High-Resolution Regional Wave Hindcast for the U.S. West Coast

September 2018

Z Yang
WC Wu

T Wang
L Castrucci

Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830
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Pacific Northwest National Laboratory
Richland, Washington 99352
Summary

This report summarizes modeling efforts for the simulation of wave climate along the U.S. West Coast using an unstructured, nested-grid modeling approach that incorporates a global-regional nested grid using WAVEWATCH III® and the high-resolution UnSWAN (Unstructured-grid Simulating Waves Nearshore) model. Wave resource and long-term wave bulk parameters were simulated and subsequently validated with wave buoy data within the model domain.

Overall, model results match observations at buoys well. The model hindcast was able to reproduce the seasonal variation of the sea state with large waves that occur in the winter and early spring months when wind forcing is strong and the calm sea state during the summer when wind forcing is weak.

The nested-grid modeling framework employed in this study provides a powerful and efficient modeling approach to accurately simulate wave climate at regional and long-term temporal scales with sufficiently fine resolutions in the nearshore region. Results can be used to inform the deployment of wave energy converters and other nearshore instrumentation/devices in nearshore regions, assist in prioritizing hotspots for near-term market opportunities and development, and provide wave resource assessment data and information to inform resource estimates for marine and hydrokinetic energy technologies.
Acknowledgments

This study was funded by the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Water Power Technologies Office under Contract DE-AC05-76RL01830 to Pacific Northwest National Laboratory.

A steering committee, chaired by Bryson Robertson, program manager at the West Coast Wave Initiative, Institute of Energy Systems, at the University of Victoria, was organized to provide external oversight for, input to and review of this model study. Steering committee members included Prof. Tuba Özkan-Haller, a wave modeling expert at Oregon State University; Dr. Arun Chawla, team lead of the WAVEWATCH III® (WWIII) model suite at the National Oceanic and Atmospheric Administration’s (NOAA’s) National Center for Environmental Prediction; Dr. Brian Polagye, a marine hydrokinetic energy expert at the Northwest National Renewable Energy Center at the University of Washington; Dr. Julie Thomas, program manager and principal investigator for the Coastal Data Information Program from University of California San Diego; Dr. Pukha Lenee-Bluhm, a wave energy expert from Columbia Power; and Mr. Sean Anderton, a manager for technical support from Ocean Renewable Power Company.
**Acronyms and Abbreviations**

CDIP  Coastal Data Information Program  
CFL  Courant–Friedrichs–Lewis  
CFSR  Climate Forecast System Reanalysis  
EPRI  Electric Power Research Institute, Inc.  
Hz  hertz  
IEC  International Electrotechnical Commission  
km  kilometer(s)  
kW/m  kilowatt(s) per meter  
m  meter(s)  
MHK  marine and hydrokinetic  
NDBC  National Data Buoy Center  
NCEP  National Centers for Environmental Prediction  
NOAA  National Oceanic and Atmospheric Administration  
NREL  National Renewable Energy Laboratory  
PE  percentage error  
R  correlation coefficient  
RMSE  root-mean-square-error  
s  second(s)  
SI  scatter index  
ST  source term  
SWAN  Simulating WAves Nearshore  
TS  Technical Specification  
UnSWAN  Unstructured-grid Simulating Waves Nearshore  
WEC  Wave Energy Converter  
WWIII  WAVEWATCH III  
yr  year(s)
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1.0 Introduction

Ocean wave has the highest energy resource among the U.S. marine and hydrokinetic (MHK) energy resources, including wave, tidal and ocean currents, ocean thermal technology, and river stream. The first U.S. nationwide wave resource assessment was conducted based on the 4 arc-minute resolution, 51-month wave hindcasts generated by the National Oceanic and Atmospheric Administration (NOAA) using nested-grid WAVEWATCHIII® model (WWIII) (EPRI, 2011; Tolman and WAVEWATCH III Development Group, 2014). The Electric Power Research Institute, Inc.‘s (EPRI’s) study showed that the U.S. West Coast has the second largest wave resource among all U.S. major coastal regions (Figure 1.1). The nationwide wave resource assessment provides a valuable first-order estimate of wave resources at a regional scale, which helps identify and prioritize hotspots for near-term market development. However, there are concerns that the shallow-water processes in the nearshore regions were not well reproduced due to the coarse-grid resolution; therefore, there is high uncertainty in resource estimates, especially in the nearshore region (Council, 2013). Most wave energy converters (WECs) are designed for deployment in nearshore areas because of low deployment and maintenance costs, as well as low risk under extreme sea states. Therefore, it is important to conduct a long-term, high-resolution wave hindcast in nearshore, shallow-water areas to improve the accuracy of hindcasts and reduce the uncertainties of previous resource assessment.

![Figure 1.1. Annual wave power density distribution in U.S. coastal regions, based on NOAA’s 4 arc-minute resolution WWIII hindcasts.](https://maps.nrel.gov/mhk-atlas)

Simulation of wave climate with fine-grid resolution at a regional scale requires extensive computational resources. The unstructured-grid modeling approach not only provides flexibility in accurately fitting the mesh boundary to the shoreline and refining the grid resolution in the area of interest, but also maintains great computational efficiency for a large model domain. In recent years, there has been significant

---

1 This image was obtained from https://maps.nrel.gov/mhk-atlas.
development in unstructured-grid third-generation wave models. For example, Unstructured-grid Simulating WАve Nearshore (UnSWAN; SWAN, 2015) has been widely used to simulate wave climates in many regions around the world (Cobell et al., 2013; Gallagher et al., 2014; Mao et al., 2016; Mediavilla and Sepulveda, 2016; Roland and Ardhuin, 2014; Wu et al., 2018; Yuk et al., 2016; Zijlema, 2010).

In this study, the WWIII and UnSWAN models were applied to simulate high-resolution wave climates along the U.S. West Coast. International Electrotechnical Commission (IEC) wave resource parameters, as well as long-term wave bulk parameters, were simulated and validated against measurements at wave buoys maintained by NOAA’s National Data Buoy Center (NDBC) and the Coastal Data Information Program (CDIP). Wave partition outputs along the nearshore region of the West Coast were generated to support wave classification development. Spatial and temporal variabilities of wave climate on the West Coast were analyzed based on the long-term model hindcast. This study demonstrates that the nested-grid modeling framework using the WWIII and UnSWAN models provides a powerful modeling approach to characterizing wave resource accurately over greater temporal and regional scales with high resolutions in the nearshore region.

2.0 Methods

A nested-grid modeling approach using structured WWIII and UnSWAN models was used in this study. Three levels of nested grids using the WWIII model were set up to simulate wave climates from global to region scales and provide open boundary conditions to the high-resolution nearshore UnSWAN model for the West Coast. The WWIII model grid configurations are listed in Table 2.1. The Level 1 grid (L1) is the global model with a resolution of 0.5 degree, about 39 km in the zonal direction at 45°N and 55.6 km in the meridional direction. Level 2 (L2) and Level 3 (L3) have grid resolutions of 6 arc-minutes and 1 arc-minute, respectively. The WWIII L3 and UnSWAN model domains are shown in Figure 2.1. Based on a wave model test bed study (Yang et al., 2017), the source term ST4 physics package (Ardhuin et al., 2010) in WWIII improved model prediction of wave power density. Therefore, the ST4 physics package was used in all WWIII model runs conducted in this study.

2.1 WWIII Model Configuration

To drive the high-resolution UnSWAN model for the West Coast, a nested-grid modeling approach was employed for this study. Three levels of structured-grid WWIII models were used, similar to other previous studies conducted in the Pacific Northwest (García-Medina et al., 2014; García-Medina et al., 2013; Wu et al., 2018; Yang et al., 2017). The L1 model is based on the NOAA National Centers for Environmental Prediction’s (NCEP’s) global WWIII model with 0.5-degree grid resolution. The L2 regional grid with a resolution of six arc-minutes was nested into the global model, and the L3 grid with a resolution of 1 arc-minute was nested into the regional L2 grid. The model domain coverage, spatial resolution, and grid size (number of grid points) for the global and the two intermediate nested grids are summarized in Table 2.1. Model output from the L3 grid provides open wave boundary conditions for the UnSWAN model (Figure 2.1).
Table 2.1. Summary of nested WWII model grids.

<table>
<thead>
<tr>
<th>Grid Name</th>
<th>Coverage</th>
<th>Resolution (long x lat)</th>
<th>Grid Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Grid L1</td>
<td>77.5°S – 77.5°N; 0 – 360°W</td>
<td>0.5° × 0.5°</td>
<td>223,920</td>
</tr>
<tr>
<td>Nested Grid L2</td>
<td>28.5° – 50.5°N; 132° – 113.5°W</td>
<td>0.1° × 0.1° (6’ × 6’)</td>
<td>12,231</td>
</tr>
<tr>
<td>Nested Grid L3</td>
<td>30.5° – 49.5°N; 128° – 115.5°W</td>
<td>1’ × 1’</td>
<td>124,046</td>
</tr>
</tbody>
</table>

Model time steps used in WWII are summarized in Table 2.2. For WWII, each model grid requires four time steps: (1) the global time step $\Delta t_g$, (2) the spatial propagation time step $\Delta t_{xy}$, (3) the intra-spectral propagation time step $\Delta t_k$, and (4) the source term time step $\Delta t_s$ (Tolman et al. 2014). The spatial propagation time step $\Delta t_{xy}$ must conform with the Courant–Friedrichs–Lewis (CFL) limit to ensure model stability.

**Table 2.2.** Model run time steps for the WWII model (L1–L3 grids).

<table>
<thead>
<tr>
<th>WWII Nested Grid</th>
<th>$\Delta t_g$ (s)</th>
<th>$\Delta t_{xy}$ (s)</th>
<th>$\Delta t_k$ (s)</th>
<th>$\Delta t_s$ (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 (global)</td>
<td>3,600</td>
<td>480</td>
<td>1,800</td>
<td>30</td>
</tr>
<tr>
<td>L2</td>
<td>600</td>
<td>240</td>
<td>300</td>
<td>15</td>
</tr>
<tr>
<td>L3</td>
<td>100</td>
<td>45</td>
<td>50</td>
<td>15</td>
</tr>
</tbody>
</table>

All WWII simulations used 29 frequency bins, 24 direction bins, a logarithmic increment factor of 1.1, a minimum frequency of 0.035 Hz, and a maximum frequency of 0.505 Hz. This spectral resolution meets the minimum requirements specified by the IEC technical specification (TS; IEC, 2015), i.e., a minimum of 25 frequency components and 24 to 48 directional components and a frequency range covering at least 0.04 to 0.5 Hz.
Figure 2.1. Model domains of U.S. West Coast. Red and blue lines represents the L2 and L3 WWIII model domains, respectively. The green line represents the high-resolution UnSWAN West Coast model domain.

Model bathymetry for all grid levels was interpolated from three NOAA bathymetry data sets: (1) the 1 arc-minute ETOPO1 Global Relief Model, (2) the 3 arc-second Coastal Relief Model, and (3) the high-resolution 1/3 arc-second tsunami bathymetry data. The 1 arc-minute ETOPO1 Global Relief Model was
used for the outer-shelf region and the deep ocean basins. The 3 arc-second Coastal Relief Model and tsunami bathymetry data for the inner-shelf region were used for the L2 and L3 model grids (Figure 2.2).

![Figure 2.2](image.png)

**Figure 2.2.** Bathymetry distribution for the WWIII models on U.S. West Coast. The white box indicates the regional L3 domain with 1 arc-minute resolution.

### 2.2 UnSWAN Model Configuration

As a fourth level, the UnSWAN model is used for the high-resolution nearshore simulation. In this study, a time step of 60 seconds was used for the UnSWAN simulations. This time step is sufficient to resolve the time variations of the computed wave field, given that the wind forcing and open boundary conditions are at hourly intervals. Sensitivity tests with smaller time steps, such as 10 and 5 seconds, showed no improvement in the predicted wave parameters. Another important parameter that affects the accuracy of model results is the maximum number of iterations of solution solver. In this study, a maximum value of 20-iteration (default value) was used in all simulations, although 95% of the solutions converged within 5-iteration. All UnSWAN model parameters in frequency and direction spaces are specified to be the same as the WWIII model parameters.

The UnSWAN model domain for the West Coast was defined by the nearshore region approximately 30 km offshore from the north end at the entrance of the Strait of Juan de Fuca to the south end between the U.S. and Mexico border (Figure 2.1). The unstructured grid consists of 435,369 nodes and 857,394 elements. The grid resolution varies from approximately 200 m along the shoreline to 350 m at the open boundary, approximately 30 km offshore. Model bathymetry was interpolated from the same bathymetric
data sets used in the WWIII model. Figure 2.3 shows the model bathymetry of the entire West Coast domain and the two map inserts show the grid distributions for the Columbia River Estuary and San Francisco Bay. While the inner continental shelf on the West Coast is generally narrow compared to the U.S. East Coast, the inner shelf on the Washington, Oregon, and northern California coasts is generally wider than that in the southern California, i.e., south of Monterey Bay. The bathymetry off the shore of the southern California coast is also much more complex; it features steep slopes, submarine canyons, and channel islands, which results in very complex wave sea states in comparison to the Pacific Northwest and northern California coasts.

Figure 2.3. Bathymetry distribution of the UnSWAN model for the U.S. West Coast. The two map inserts show the close-up model grid and bathymetry for the Columbia River Estuary and San Francisco Bay areas.
2.3 Model Forcing

In this study, the model hindcast covered the long-term period of 32 years from 1979 to 2010, which corresponds to the data availability period of the Climate Forecast System Reanalysis (CFSR), produced by NCEP. The wind forcing data (wind speeds and directions) for the wave hindcast were obtained from CFSR and interpolated onto the model grid points at hourly intervals. Comparison of CFSR wind speed with observed data at a number of NDBC buoy stations indicated that the CFSR wind speed is generally in good agreement with the observed speed and reasonably captures the diurnal and seasonal variabilities. The CFSR data meet the minimum one-hour temporal resolution requirements specified by the IEC TS (IEC, 2015) for design assessments. Figure 2.4 shows an example of global CFSR wind speed distribution on December 3, 2007.

The sea ice coverage data were downloaded from the same NCEP CFSR data set as the wind data, except that the original sea ice data were defined in the NCEP T382 Gaussian Grid that has a spatial resolution of 38 km. The sea ice data were subsequently re-projected onto the same 0.5 × 0.5 degree regular grid as the wind forcing data and implemented as daily temporal resolution. As indicated in previous studies (García-Medina et al., 2014; Yang et al., 2017), the effect of tides and currents on wave climate on the West Coast at regional scales is not important. Therefore, currents induced by tides and ocean circulations were not considered in this study.

In addition to the long-term 32-year model hindcast, a year-long simulation was conducted for the period of March 2017 to April 2018 for validation purposes, corresponding to the new shallow-water buoy measurements conducted by National Renewable Energy Laboratory (NREL). The model configuration for the year-long simulation was kept the same as those in the long-term model hindcast. Wind forcing was obtained from the second version of CFSR (CFSv2), which covers the period from 2011 to the present.

Figure 2.4. The global distribution of CFSR wind field on December 3, 2007. The extra-tropical wind storm “Great Coastal Gale” is well presented in the northeastern Pacific Ocean.
The UnSWAN model was driven by the WWIII model outputs along the UnSWAN model open boundary. Full 2D spectral boundary conditions were used at the open boundary to allow for the propagation of multimodal sea states.

Figure 2.5 shows monthly averaged significant wave height distribution around U.S. continental coastal waters and Caribbean Islands simulated using the nested-grid WWIII for July and November, respectively. Improvement in spatial resolution along the U.S. West Coast is shown clearly. In Section 3.0, Figure 3.1 also shows that significant wave height in November (winter) is much higher than that in July (summer).

![Figure 2.5](image.png)

**Figure 2.5.** Simulated monthly average significant wave height (m) with (a) WWIII for July and (b) November.

### 2.4 Measured Data for Model Validation

Model validation was conducted using measured data from wave buoys maintained by NDBC and CDIP. Two types of measured data are available from these wave buoys—directional spectral data and bulk wave parameters. In this study, buoys with either wave spectral data or bulk parameters having at least 20 years of record from 1979 to 2010 were used for model validation. A total of 28 wave buoys on the West
Coast meet these criteria (Table 2.3). A total of 23 buoys with spectral data can be used to calculate the six IEC resource parameters for model validation. Five bulk parameter buoys with long-term records (> 20 years) can be used to validate the model by comparing bulk parameters, such as significant wave height, peak period and peak direction. Note that some of the spectral buoy stations also contain long-term (>20 years) measurements of bulk parameters.

Table 2.3. Summary of wave buoys with directional spectral\(^{(a)}\) data and long-term (>20 years) bulk parameter for model validation.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Buoy</th>
<th>Longitude</th>
<th>Latitude</th>
<th>Depth (m)</th>
<th>Period Spec</th>
<th>Years Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDIP</td>
<td>46211</td>
<td>-124.244</td>
<td>46.858</td>
<td>40</td>
<td>1981 - 1983</td>
<td>1985 - 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1979 - 2004</td>
<td></td>
</tr>
<tr>
<td>NDBC</td>
<td>46005</td>
<td>-131.001</td>
<td>46.1</td>
<td>2853</td>
<td>2006 - 2008</td>
<td>2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46050</td>
<td>-124.526</td>
<td>44.656</td>
<td>137</td>
<td>1991 - 2010</td>
<td>2008 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46015</td>
<td>-124.832</td>
<td>42.764</td>
<td>420</td>
<td>2002 - 2010</td>
<td>2007 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46002</td>
<td>-130.474</td>
<td>42.589</td>
<td>3368</td>
<td>1979 - 1998</td>
<td>2000 - 2009</td>
</tr>
<tr>
<td>NDBC</td>
<td>46022</td>
<td>-124.531</td>
<td>40.72</td>
<td>391</td>
<td>1982 - 2010</td>
<td>2007 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46014</td>
<td>-123.974</td>
<td>39.235</td>
<td>256</td>
<td>1981 - 2010</td>
<td></td>
</tr>
<tr>
<td>NDBC</td>
<td>46013</td>
<td>-123.307</td>
<td>38.238</td>
<td>123</td>
<td>1981 - 2010</td>
<td>2007 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46026</td>
<td>-122.839</td>
<td>37.755</td>
<td>53</td>
<td>1982 - 2010</td>
<td>2007 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46012</td>
<td>-122.881</td>
<td>37.363</td>
<td>209</td>
<td>1980 - 2010</td>
<td>2010</td>
</tr>
<tr>
<td>CDIP</td>
<td>46236</td>
<td>-121.949</td>
<td>36.76</td>
<td>168</td>
<td>2007 - 2010</td>
<td>2007 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46028</td>
<td>-121.858</td>
<td>35.712</td>
<td>1036</td>
<td>1983 - 2010</td>
<td>2002 - 2010</td>
</tr>
<tr>
<td>CDIP</td>
<td>46215</td>
<td>-120.859</td>
<td>35.204</td>
<td>23</td>
<td>1983 - 2010</td>
<td>1996 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46023</td>
<td>-120.967</td>
<td>34.714</td>
<td>384</td>
<td>1982 - 2010</td>
<td></td>
</tr>
<tr>
<td>CDIP</td>
<td>46216</td>
<td>-119.803</td>
<td>34.333</td>
<td>183</td>
<td>2002 - 2010</td>
<td>2002 - 2010</td>
</tr>
<tr>
<td>NDBC</td>
<td>46025</td>
<td>-119.053</td>
<td>33.749</td>
<td>905</td>
<td>1982 - 2010</td>
<td>2008 - 2010</td>
</tr>
<tr>
<td>Agency</td>
<td>Buoy</td>
<td>Longitude</td>
<td>Latitude</td>
<td>Depth (m)</td>
<td>Period Param</td>
<td>Period Spec</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>-----------</td>
<td>----------</td>
<td>-----------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>CDIP</td>
<td>46224</td>
<td>-117.471</td>
<td>33.179</td>
<td>220</td>
<td>1997 - 2010</td>
<td>1997 - 2010</td>
</tr>
<tr>
<td>NREL</td>
<td>46260</td>
<td>-124.29</td>
<td>43.586</td>
<td>87</td>
<td>2017 - 2018</td>
<td>2017 - 2018</td>
</tr>
<tr>
<td>NREL</td>
<td>46261</td>
<td>-124.225</td>
<td>43.76</td>
<td>44.2</td>
<td>2017 - 2018</td>
<td>2017 - 2018</td>
</tr>
<tr>
<td>NREL</td>
<td>46263</td>
<td>-123.912</td>
<td>39.37</td>
<td>130</td>
<td>2017 - 2018</td>
<td>2017 - 2018</td>
</tr>
</tbody>
</table>

In addition to the wave data for the 1979–2010 period, measurements from three new Waverider® buoys from April 2017 to March 2018 were also used for model validation. The new buoys were deployed by NREL along the Oregon and California coasts to fill the data gaps at shallow to intermediate water depths. Locations of wave buoys for model validation are shown in Figure 2.6. The distribution of these wave buoys covers the entire West Coast, providing sufficient data sets for a thorough model validation.
3.0 Model Hindcast and Validation

The regional wave hindcast for the West Coast was conducted using the WWIII and UnSWAN models for the period of 1979–2010, as well as the period of 4/2017–3/2018. Model hindcast and validation for
the six IEC-recommended wave resource parameters derived from the model hindcast and measured spectral data are described in this section.

3.1 Simulation of IEC Resource Parameters

The six wave resource parameters recommended by IEC TS (2015) were calculated based on model results of directional wave spectra and measured wave spectral data. The six IEC parameters include omnidirectional wave power, significant wave height, energy period, spectral width, direction of maximum directionally resolved wave power, and directionality coefficient, which are defined below.

The omnidirectional wave power, $J$, is the sum of the contributions to energy flux from each of the components of the wave spectrum,

$$ J = \rho g \sum_{i,j} c_{g,i} S_{ij} \Delta f_i \Delta \theta_j \quad (1) $$

where

- $\rho$ = the density of sea water,
- $g$ = the acceleration due to gravity,
- $c_{g,i}$ = the group velocity,
- $\Delta f_i$ = the frequency bin width at each discrete frequency index $i$, and
- $\Delta \theta_i$ = the direction bin width at each discrete direction index $j$.

Directionally integrated parameters are calculated from one-dimensional (unresolved) frequency variance density using the equation

$$ S_i = \sum_j S_{ij} \Delta \theta_j \quad (2) $$

For the purpose of the present study the significant wave height is defined as the zeroth frequency of the spectral moment as

$$ H_s \sim H_{m0} = 4 \sqrt{m_0} , \quad (3) $$

where the moments of a variance spectrum are generally defined as

$$ m_n = \sum_i f_i^n S_i \Delta f_i \quad (4) $$

$H_s$ is typically paired with the energy period, $T_e$, calculated as

$$ T_e = \frac{m_{-1}}{m_0} , \quad (5) $$

to define a wave climate’s sea state. The energy period is the variance-weighted mean period of the directionally unresolved variance density spectrum. It is preferred over the peak period, because it is not sensitive to the spectral shape.

The spectral width, $\epsilon_0$
\[ \epsilon_0 = \frac{m_0m_{-2}}{m_{-1}^2 - 1}, \]  

(6)

is a measure of the spreading of energy along the wave spectrum. The directionally resolved wave power is the sum of the wave power at each direction, \( \theta \):

\[ J_\theta = \rho g \sum_{i,j} c_{a,i} S_{ij} \Delta f_i \Delta \theta_j \cos(\theta - \theta_j) \delta \]

(7)

where \( J_\theta \) is the directionally resolved wave power in direction \( \theta \). The maximum time-averaged wave power propagating in a single direction, \( J_{\theta_j} \), is the maximum value of \( J_\theta \). The corresponding direction, \( \theta_j \), is the direction of maximum directionally resolved wave power and describes the characteristic direction of the sea state.

The directionality coefficient, \( d \), is the ratio of maximum directionally resolved wave power to the omnidirectional wave power,

\[ d_\theta = \frac{J_{\theta_{\text{max}}}}{J}, \]

(8)

which is a characteristic measure of directional spreading of wave power.

Out of the six IEC parameters, only two parameters—significant wave height \( (H_s) \) and energy period \( (T_E) \)—are calculated in UnSWAN and WWIII models as default bulk parameters. Therefore, the UnSWAN and WWIII source codes were modified to calculate the other four IEC parameters \( (J, \epsilon_0, \theta_j, d_\theta) \) internally. The model source codes were also modified to include all six IEC parameters in the bulk parameter output option.

Figure 3.1 shows the two-dimensional (2D) distributions of the 32-year annual averages of six IEC parameters simulated by UnSWAN. In general, high wave power density occurs along the Washington, Oregon, and northern California coasts. Mean significant wave height and mean energy period are generally greater than 2 m and 10 s, respectively, on the Washington, Oregon, and northern California coasts. Wave power drops rapidly on the southern California coast, especially south of Santa Maria. Spatial distribution of mean spectral width varies in a small range, from 0.3 to 0.4 on the Washington, Oregon, and northern California coasts, and up to 0.5 on the southern California coast. The mean direction of maximum directionally resolved wave power typically falls in the range of 270° to 330° (from the northwest direction) along most of the West Coast, except in southern California, where wave action primarily propagates from the southwest direction (210° – 270°). The directionality coefficient on the West Coast is generally above 0.8, indicating a narrow spread of wave power. The spatial variation of the IEC parameters across-shore is clearly seen in the high-resolution model results (e.g., \( H_s, T_E \), and \( d_\theta \)), which is important for wave resource characterization related to WEC project siting.

Monthly averaged 2D distributions of the six IEC parameters based on 32 years of model results were also calculated. Horizontal 2D plots of the monthly results from January to December are provided in Appendix A. Examples of 2D distributions of the monthly averages of six IEC parameters in July and
December are shown in Figure 3.2 and Figure 3.3, respectively, in which strong seasonal variations are shown. $J$, $H_s$, $T_e$, and $d_\theta$ are much greater in winter (December) than those in the summer (July). Although not as strong as other four IEC parameters, weak seasonal variations are observed in $\varepsilon_0$ and $\theta_J$, with both being slightly greater in the summer.
Figure 3.1. Simulated 32-year annual distribution of six IEC wave resource parameters: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient.
Figure 3.2. Simulated monthly distribution of six IEC wave resource parameters in July: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient.
Figure 3.3. Simulated monthly distribution of six IEC wave resource parameters in December: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient.
3.2 Model Validation

In this study, model validation was conducted by comparing six simulated and measured IEC parameters at buoy stations. Specifically, comparisons of time history and scatter plots of the simulated and measured six IEC parameters were generated and model performance metrics were calculated to evaluate the model skills for reproducing the six IEC parameters. The following common model performance metrics used in previous studies (García-Medina et al., 2014; García-Medina et al., 2013; Wu et al., 2018; Yang et al., 2017) were adopted in this study for model validation.

The root-mean-square-error (RMSE), aka root-mean-square-deviation, is defined as

\[
RMSE = \sqrt{\frac{\sum_{i=1}^{N} (P_i - M_i)^2}{N}}
\]  \hspace{1cm} (9)

where \( N \) is the number of observations, \( M_i \) is the measured value, and \( P_i \) is the predicted value. RMSE represents the sample standard deviation of the differences between predicted values and measured values.

The percentage error (PE) is defined as

\[
PE(\%) = \frac{100}{N} \sum_{i=1}^{N} \left( \frac{P_i - M_i}{M_i} \right)
\]  \hspace{1cm} (10)

and is the average PE over the period of comparison.

The scatter index (SI) is the RMSE normalized by the average of all measured values over the value of comparison, where

\[
SI = \frac{RMSE}{M}
\]  \hspace{1cm} (11)

where the overbar indicates the mean of the measured values.

Model bias, which represents the average difference between the predicted and measured value, is defined as

\[
Bias = \frac{1}{N} \sum_{i=1}^{N} (P_i - M_i).
\]  \hspace{1cm} (12)

Percentage bias, which is defined as

\[
Bias(\%) = \frac{\sum_{i=1}^{N} P_i - \sum_{i=1}^{N} M_i}{\sum_{i=1}^{N} M_i} \cdot 100
\]  \hspace{1cm} (13)

is also commonly used to normalize bias.
The linear correlation coefficient, $R$, is defined as

$$R = \frac{\sum_{i=1}^{N}(M_i - \bar{M})(P_i - \bar{P})}{\sqrt{\left(\sum_{i=1}^{N}(M_i - \bar{M})^2\right)\left(\sum_{i=1}^{N}(P_i - \bar{P})^2\right)}}$$

(14)

and is a measure of the strength of the linear relationship between the predicted and measured values.

Comparisons of time series and scatter plots of the six IEC parameters between model results and observed data for every year at each station were generated. There are a total of 166 year-station time series and scatter plots, which are presented in Appendix B. Here only few examples at selected stations and for selected years are presented. Figure 3.4 to Figure 3.7 show time series and scatter plots of modeled results and observed data at Station 46211 in Washington, Station 46229 in Oregon, Station 46026 in northern California, and Station 46215 in southern California for the year of 2008, respectively. Overall, model results match observed data well. Both model results and observations showed similar trends in the seasonality of the six IEC parameters on the Washington, Oregon, and California coasts. Similar to the 2D distributions of the six IEC parameters (Figure 3.1), significant wave height and wave power density on the Washington and Oregon coasts (Stations 46211 and 46229) are generally greater than those on the California coast. Time series plots also show strong seasonal variability in $J$, $H_s$, and $T_e$, as indicated by the 2D plots (Figure 3.2 and Figure 3.3).

Comparisons of model-simulated and data-derived IEC parameters at the three shallow-water buoy stations (46260, 46261, and 46263) for the 4/2017–3/2018 period are shown in Figure 3.8 through Figure 3.10. Similarly, the model performed very well in reproducing the time histories of the IEC parameters at these shallow-water buoy stations, especially in capturing the extreme wave events that occurred in January 2018.
Figure 3.4. Time series (top) and scatter plots (bottom) of the six modeled and observed IEC wave resource parameters for 2008 at Buoy 46211 in Washington.
Figure 3.5. Time series (top) and scatter plots (bottom) of the six modeled and observed IEC wave resource parameters for 2008 at Buoy 46229 in Oregon.
Figure 3.6. Time series (top) and scatter plots (bottom) of the six modeled and observed IEC wave resource parameters for 2008 at Buoy 46026 in Northern California.
Figure 3.7. Time series (top) and scatter plots (bottom) of the six modeled and observed IEC wave resource parameters for 2008 at Buoy 46215 in Southern California.
Figure 3.8. Time series (top) and scatter plots (bottom) of the six modeled and observed IEC wave resource parameters from April 2017 to March 2018 at Buoy 46260 in Oregon.
Figure 3.9. Time series (top) and scatter plots (bottom) of the six modeled and observed IEC wave resource parameters from April 2017 to March 2018 at Buoy 46261 in Oregon.
Figure 3.10. Time series (top) and scatter plots (bottom) of the six modeled and observed IEC wave resource parameters from October 2017 to March 2018 at Buoy 46263 in California.

The results of the yearly averages of performance metrics (error statistics) for the six IEC resource parameters were calculated at every spectral buoy station and are provided in Appendix C. Examples of performance metrics for the six simulated IEC resource parameters at Buoys 46211, 46229, 46026, and
46215 for the year 2008 are shown in Table 3.1 through Table 3.4, respectively. The error statistics between model results and observed data at the new buoy stations at Buoys 46260, 46261, and 46263 are shown in Table 3.5 through Table 3.7.

The 32-year averages of all model performance error statistics for the six IEC resource parameters at every buoy station were calculated and are provided in Appendix D. As an example, root-mean-square-error (RMSE) and linear correlation coefficient (R), as listed in Table 3.8, are the most-commonly used model performance metrics.

Overall, error statistics between model results and observed data show good model performance in simulating the six IEC parameters. For example, the R values are above 0.9 for $J$, $H_s$, and $T_e$ at most stations and above 0.6 for $\epsilon_0$, $\theta_j$, and $d_\theta$, which are also considered well correlated considering the challenge of simulating wave direction and spectral spreading at a model spectral resolution of 15° as well as high uncertainties in the direction measurements.

**Table 3.1.** Performance metrics of the six simulated IEC resource parameters for 2008 at Buoy 46211.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>34.2</td>
<td>0.55</td>
<td>4</td>
<td>15.2</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.32</td>
<td>7.4</td>
<td>0.16</td>
<td>0.07</td>
<td>3.6</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.3</td>
<td>0.13</td>
<td>0.9</td>
<td>10.2</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.8</td>
<td>0.17</td>
<td>-0.03</td>
<td>-7.1</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.5</td>
<td>-1.2</td>
<td>0.05</td>
<td>-4</td>
<td>-1.6</td>
<td>0.80</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.9</td>
<td>0.06</td>
<td>0.02</td>
<td>2.6</td>
<td>0.72</td>
</tr>
</tbody>
</table>

**Table 3.2.** Performance metrics of the six simulated IEC resource parameters for 2008 at Buoy 46229.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>19</td>
<td>11.8</td>
<td>0.50</td>
<td>-2</td>
<td>-4.1</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>3.1</td>
<td>0.16</td>
<td>0.00</td>
<td>0.0</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.6</td>
<td>0.14</td>
<td>0.9</td>
<td>10.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-3.8</td>
<td>0.19</td>
<td>-0.02</td>
<td>-5.3</td>
<td>0.69</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.5</td>
<td>-0.9</td>
<td>0.06</td>
<td>-5</td>
<td>-1.6</td>
<td>0.85</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>1.1</td>
<td>0.08</td>
<td>0.01</td>
<td>0.8</td>
<td>0.68</td>
</tr>
</tbody>
</table>

**Table 3.3.** Performance metrics of the six simulated IEC resource parameters for 2008 at Buoy 46026.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>46.8</td>
<td>0.60</td>
<td>6</td>
<td>26.5</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>12.4</td>
<td>0.17</td>
<td>0.16</td>
<td>8.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.0</td>
<td>0.14</td>
<td>1.0</td>
<td>11.0</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.1</td>
<td>0.17</td>
<td>-0.02</td>
<td>-6.3</td>
<td>0.73</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.0</td>
<td>0.2</td>
<td>0.06</td>
<td>0</td>
<td>0.0</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>-2.2</td>
<td>0.10</td>
<td>-0.02</td>
<td>-2.9</td>
<td>0.74</td>
</tr>
</tbody>
</table>
Table 3.4. Performance metrics of the six simulated IEC resource parameters for 2008 at Buoy 46215.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J (\text{kW/m}) )</td>
<td>9</td>
<td>27.9</td>
<td>0.57</td>
<td>2</td>
<td>14.0</td>
<td>0.89</td>
</tr>
<tr>
<td>( H_s (\text{m}) )</td>
<td>0.27</td>
<td>6.5</td>
<td>0.17</td>
<td>0.05</td>
<td>3.4</td>
<td>0.90</td>
</tr>
<tr>
<td>( T_e (\text{s}) )</td>
<td>1.3</td>
<td>10.0</td>
<td>0.14</td>
<td>0.9</td>
<td>9.6</td>
<td>0.88</td>
</tr>
<tr>
<td>( \epsilon_0 (-) )</td>
<td>0.06</td>
<td>-5.4</td>
<td>0.16</td>
<td>-0.02</td>
<td>-6.0</td>
<td>0.76</td>
</tr>
<tr>
<td>( \theta (\text{degrees}) )</td>
<td>10.6</td>
<td>-0.5</td>
<td>0.04</td>
<td>-2</td>
<td>-0.6</td>
<td>0.73</td>
</tr>
<tr>
<td>( d_\theta (-) )</td>
<td>0.05</td>
<td>2.3</td>
<td>0.06</td>
<td>0.02</td>
<td>2.2</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Table 3.5. Performance metrics of the six simulated IEC resource parameters for the 4/2017–3/2018 period at Buoy 46260.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J (\text{kW/m}) )</td>
<td>16</td>
<td>44.2</td>
<td>0.62</td>
<td>6</td>
<td>24.0</td>
<td>0.94</td>
</tr>
<tr>
<td>( H_s (\text{m}) )</td>
<td>0.36</td>
<td>10.3</td>
<td>0.18</td>
<td>0.14</td>
<td>6.7</td>
<td>0.94</td>
</tr>
<tr>
<td>( T_e (\text{s}) )</td>
<td>1.3</td>
<td>12.4</td>
<td>0.14</td>
<td>1.0</td>
<td>11.5</td>
<td>0.92</td>
</tr>
<tr>
<td>( \epsilon_0 (-) )</td>
<td>0.06</td>
<td>-5.1</td>
<td>0.17</td>
<td>-0.02</td>
<td>-6.5</td>
<td>0.72</td>
</tr>
<tr>
<td>( \theta (\text{degrees}) )</td>
<td>12.1</td>
<td>-1.2</td>
<td>0.04</td>
<td>-4</td>
<td>-1.4</td>
<td>0.86</td>
</tr>
<tr>
<td>( d_\theta (-) )</td>
<td>0.06</td>
<td>4.0</td>
<td>0.06</td>
<td>0.03</td>
<td>3.8</td>
<td>0.67</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J (\text{kW/m}) )</td>
<td>18</td>
<td>46.5</td>
<td>0.71</td>
<td>7</td>
<td>26.5</td>
<td>0.93</td>
</tr>
<tr>
<td>( H_s (\text{m}) )</td>
<td>0.35</td>
<td>8.4</td>
<td>0.17</td>
<td>0.10</td>
<td>4.9</td>
<td>0.94</td>
</tr>
<tr>
<td>( T_e (\text{s}) )</td>
<td>1.3</td>
<td>12.5</td>
<td>0.15</td>
<td>1.0</td>
<td>11.6</td>
<td>0.92</td>
</tr>
<tr>
<td>( \epsilon_0 (-) )</td>
<td>0.06</td>
<td>-4.6</td>
<td>0.17</td>
<td>-0.02</td>
<td>-6.0</td>
<td>0.71</td>
</tr>
<tr>
<td>( \theta (\text{degrees}) )</td>
<td>12.3</td>
<td>-1.6</td>
<td>0.04</td>
<td>-5</td>
<td>-1.8</td>
<td>0.86</td>
</tr>
<tr>
<td>( d_\theta (-) )</td>
<td>0.06</td>
<td>4.2</td>
<td>0.06</td>
<td>0.03</td>
<td>4.0</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Table 3.7. Performance metrics of the six simulated IEC resource parameters for the 10/2017–3/2018 period at Buoy 46263.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J (\text{kW/m}) )</td>
<td>16</td>
<td>27.6</td>
<td>0.47</td>
<td>4</td>
<td>11.8</td>
<td>0.92</td>
</tr>
<tr>
<td>( H_s (\text{m}) )</td>
<td>0.38</td>
<td>6.0</td>
<td>0.17</td>
<td>0.06</td>
<td>2.7</td>
<td>0.92</td>
</tr>
<tr>
<td>( T_e (\text{s}) )</td>
<td>1.4</td>
<td>12.0</td>
<td>0.14</td>
<td>1.1</td>
<td>11.2</td>
<td>0.89</td>
</tr>
<tr>
<td>( \epsilon_0 (-) )</td>
<td>0.06</td>
<td>-8.6</td>
<td>0.19</td>
<td>-0.03</td>
<td>-9.5</td>
<td>0.71</td>
</tr>
<tr>
<td>( \theta (\text{degrees}) )</td>
<td>11.9</td>
<td>-0.6</td>
<td>0.04</td>
<td>-2</td>
<td>-0.8</td>
<td>0.82</td>
</tr>
<tr>
<td>( d_\theta (-) )</td>
<td>0.08</td>
<td>6.0</td>
<td>0.09</td>
<td>0.05</td>
<td>5.5</td>
<td>0.69</td>
</tr>
</tbody>
</table>
Finally, the percentage mean error of wave power density \((J_o/J_o - 1)\times100\)\%), as defined by EPRI (2012), was calculated based on current study results and compared to the results obtained by EPRI’s study at the validation stations selected by EPRI on the West Coast (Table 3.9). It can be seen that the percentage mean error of power density at all the selected validation stations were improved greatly compared to EPRI’s study’s results, which was based on NOAA’s 4 arc-minute resolution, 51-month hindcast. The percentage mean errors were reduced by a range from 9\% to 82\%, based on the high-resolution model hindcast.

Table 3.8. Summary of temporal averages of the root-mean-square-error and linear correlation coefficient for the six IEC wave resource parameters at buoys with spectral data.

<table>
<thead>
<tr>
<th>Buoy #</th>
<th>J (kW/m)</th>
<th>Hs (m)</th>
<th>Tc (s)</th>
<th>(\epsilon_o) (-)</th>
<th>(\theta) (degrees)</th>
<th>(d\theta) (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMSE</td>
<td>R</td>
<td>RMSE</td>
<td>R</td>
<td>RMSE</td>
<td>R</td>
</tr>
<tr>
<td>46041</td>
<td>20.94</td>
<td>0.37</td>
<td>0.96</td>
<td>1.2</td>
<td>0.89</td>
<td>0.06</td>
</tr>
<tr>
<td>46087</td>
<td>18.88</td>
<td>0.45</td>
<td>0.90</td>
<td>1.1</td>
<td>0.85</td>
<td>0.07</td>
</tr>
<tr>
<td>46063</td>
<td>14.90</td>
<td>0.37</td>
<td>0.92</td>
<td>1.3</td>
<td>0.88</td>
<td>0.06</td>
</tr>
<tr>
<td>46042</td>
<td>15.92</td>
<td>0.35</td>
<td>0.94</td>
<td>1.1</td>
<td>0.90</td>
<td>0.06</td>
</tr>
<tr>
<td>46025</td>
<td>3.86</td>
<td>0.21</td>
<td>0.88</td>
<td>1.7</td>
<td>0.76</td>
<td>0.09</td>
</tr>
<tr>
<td>46028</td>
<td>16.91</td>
<td>0.40</td>
<td>0.92</td>
<td>1.3</td>
<td>0.89</td>
<td>0.07</td>
</tr>
<tr>
<td>46015</td>
<td>20.93</td>
<td>0.40</td>
<td>0.95</td>
<td>1.4</td>
<td>0.88</td>
<td>0.08</td>
</tr>
<tr>
<td>46026</td>
<td>14.91</td>
<td>0.36</td>
<td>0.93</td>
<td>1.3</td>
<td>0.90</td>
<td>0.06</td>
</tr>
<tr>
<td>46022</td>
<td>24.91</td>
<td>0.48</td>
<td>0.92</td>
<td>1.1</td>
<td>0.89</td>
<td>0.06</td>
</tr>
<tr>
<td>46027</td>
<td>19.90</td>
<td>0.45</td>
<td>0.91</td>
<td>1.2</td>
<td>0.91</td>
<td>0.07</td>
</tr>
<tr>
<td>46050</td>
<td>17.93</td>
<td>0.37</td>
<td>0.95</td>
<td>1.3</td>
<td>0.88</td>
<td>0.07</td>
</tr>
<tr>
<td>46029</td>
<td>21.93</td>
<td>0.40</td>
<td>0.96</td>
<td>1.2</td>
<td>0.88</td>
<td>0.06</td>
</tr>
<tr>
<td>46216</td>
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<td>1.4</td>
<td>0.80</td>
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<tr>
<td>46229</td>
<td>19.93</td>
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<td>0.95</td>
<td>1.3</td>
<td>0.90</td>
<td>0.07</td>
</tr>
<tr>
<td>46213</td>
<td>17.91</td>
<td>0.40</td>
<td>0.93</td>
<td>1.0</td>
<td>0.91</td>
<td>0.06</td>
</tr>
<tr>
<td>46244</td>
<td>3.76</td>
<td>0.19</td>
<td>0.82</td>
<td>1.7</td>
<td>0.75</td>
<td>0.10</td>
</tr>
<tr>
<td>46221</td>
<td>4.73</td>
<td>0.26</td>
<td>0.77</td>
<td>1.9</td>
<td>0.69</td>
<td>0.11</td>
</tr>
<tr>
<td>46211</td>
<td>18.92</td>
<td>0.35</td>
<td>0.95</td>
<td>1.2</td>
<td>0.91</td>
<td>0.06</td>
</tr>
<tr>
<td>46236</td>
<td>10.91</td>
<td>0.32</td>
<td>0.92</td>
<td>1.4</td>
<td>0.88</td>
<td>0.08</td>
</tr>
<tr>
<td>46215</td>
<td>9.90</td>
<td>0.27</td>
<td>0.91</td>
<td>1.2</td>
<td>0.89</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 3.9. Comparison of percentage mean errors of power density at selected buoys between the current PNNL study and the EPRI study.

<table>
<thead>
<tr>
<th>Station</th>
<th>Percentage mean error (=(J_o/J_o - 1)\times100) (%)</th>
<th>Percentage Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>46041</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>46211</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>46050</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>46025</td>
<td>-9</td>
<td>-20</td>
</tr>
<tr>
<td>46022</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>46027</td>
<td>4</td>
<td>19</td>
</tr>
</tbody>
</table>
4.0 Conclusion

The use of coarse-grid-resolution models generate concerns about the accurate reproducibility of shallow-water processes in nearshore regions. Therefore, high-resolution wave hindcasts are critical to improving the accuracy of and reducing the uncertainties of wave resource assessments. This study applies an unstructured-, nested-grid modeling approach, incorporating a global-regional nested grid, using the WWIII and high-resolution UnSWAN models, to simulate wave climates along the U.S. West Coast for long-term period of 32 years. The IEC wave resource parameters were simulated and subsequently validated with wave buoy data within the model domain.

Model performance metrics, such as root-mean-square-error, percentage error, scatter index, model bias, percentage bias, and correlation coefficient, were used to evaluate the model skill for reproducing wave resource parameters, including the omnidirectional wave power ($J$), significant wave height ($H_s$), energy period ($T_e$), spectral width ($\epsilon_0$), direction ($\theta$), and directionality coefficient ($d_\theta$). Overall, the model results for the six IEC wave resource parameters match well with the measured data. UnSWAN was able to reproduce the seasonal variation of the sea state with large waves that occur in the winter and early spring months (November–March) when wind forcing is strong and the calmed sea state during the summer (June–August) when wind forcing is weak. The percentage mean error of power density at selected buoys was also compared to results presented by EPRI (EPRI 2011). Results show the percentage mean error of power density at all selected buoys was significantly improved based on high-resolution hindcast results generated in this study.

Monthly 2D distributions of IEC parameters were calculated and are provided in Appendix A. Detailed model and data comparisons of time series and scatter plots for the six IEC parameters were generated at 28 buoys for the 1979–2011 period and are presented in Appendix B. The yearly error statistics for the simulated six IEC parameters at each station are provided in Appendix C and the the 32-year averages at each station are provided in Appendix D. The high-resolution model results generated from this study can be used to inform the design and deployment of WECs in nearshore regions, assist in prioritizing hotspots for near-term market opportunities and development, and update wave resource assessment data for the U.S. Department of Energy Marine and Hydrokinetic Energy Atlas.²

² https://maps.nrel.gov/mhk-atlas
5.0 References


Appendix A – Monthly Distributions of IEC Wave Resource Parameters from 1979–2010 along the West Coast

Figure A.1. Monthly distributions of six IEC parameters in January: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.2. Monthly distributions of six IEC parameters in February: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.3. Monthly distributions of six IEC parameters in March: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.4. Monthly distributions of six IEC parameters in April: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.5. Monthly distributions of six IEC parameters in May: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.6. Monthly distributions of six IEC parameters in June: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.7. Monthly distributions of six IEC parameters in July: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.8. Monthly distributions of six IEC parameters in August: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.9. Monthly distributions of six IEC parameters in September: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.10. Monthly distributions of six IEC parameters in October: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.11. Monthly distributions of six IEC parameters in November: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Figure A.12. Monthly distributions of six IEC parameters in December: (a) omnidirectional wave power, (b) significant wave height, (c) energy period, (d) spectral width, (e) direction of maximum directionally resolved wave power, and (f) directionality coefficient along the West Coast.
Appendix B – Comparisons of Model-Simulated Six IEC Parameters with Observed Data at NDBC and CDIP Buoys

Figure B.1 through Figure B.83 are National Data Buoy Center-related plots; Figure B.84 through Figure B.166 are Coastal Data Information Program-related plots.
Figure B.1. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2010.
Figure B.2. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII simulated IEC parameters with observed data at NDBC Buoy 46029 for 2009.
Figure B.3. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2008.
Figure B.4. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2007.
Figure B.5. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2006.
Figure B.6. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2005.
Figure B.7. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2004.
Figure B.8. Comparisons of time series (top) and scatter plots (bottom) of the six WWII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2003.
Figure B.9. Comparisons of time series (top) and scatter plots (bottom) of the six WWII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2002.
Figure B.10. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2001.
Figure B.11. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 2000.
Figure B.12. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 1999.
Figure B.13. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 1998.
Figure B.14. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46029 for 1997.
Figure B.15. Comparisons of time series (top) and scatter plots (bottom) of the six WWII model-simulated IEC parameters with observed data at NDBC Buoy 46050 for 2010.
Figure B.16. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46050 for 2009.
Figure B.17. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46050 for 2008.
Figure B.18. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46027 for 2010.
Figure B.19. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46027 for 2009.
Figure B.20. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46027 for 2008.
Figure B.21. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46027 for 2007.
Figure B.22. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46027 for 2006.
Figure B.23. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46027 for 2005.
Figure B.24. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46022 for 2010.
Figure B.25. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46022 for 2009.
Figure B.26. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46022 for 2008.
Figure B.27. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46022 for 2007.
Figure B.28. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46026 for 2010.
Figure B.29. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46026 for 2009.
Figure B.30. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46026 for 2008.
Figure B.31. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46026 for 2007.
Figure B.32. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46015 for 2010.
Figure B.33. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46015 for 2009.
Figure B.34. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46015 for 2008.
Figure B.35. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46015 for 2007.
Figure B.36. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2010.
Figure B.37. Comparisons of time series (top) and scatter plots (bottom) of the six WWII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2009.
Figure B.38. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2008.
Figure B.39. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2007.
Figure B.40. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2006.
Figure B.41. Comparisons of time series (top) and scatter plots (bottom) of the six WWII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2005.
Figure B.42. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2004.
Figure B.43. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2003.
Figure B.44. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46028 for 2002.
Figure B.45. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46025 for 2010.
Figure B.46. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46025 for 2009.
Figure B.47. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46025 for 2008.
Figure B.48. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2010.
Figure B.49. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2009.
Figure B.50. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2008.
Figure B.51. Comparisons of time series (top) and scatter plots (bottom) of the six WWII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2007.
Figure B.52. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2006.
Figure B.53. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2005.
Figure B.54. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2004.
Figure B.55. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2003.
Figure B.56. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2002.
Figure B.57. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2001.
Figure B.58. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 2000.
Figure B.59. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 1999.
Figure B.60. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46042 for 1998.
Figure B.61. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46063 for 2009.
Figure B.62. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46063 for 2008.
Figure B.63. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46063 for 2007.
Figure B.64. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46063 for 2006.
Figure B.65. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46087 for 2009.
Figure B.66. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46087 for 2008.
Figure B.67. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46087 for 2007.
Figure B.68. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46087 for 2006.
Figure B.69. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46087 for 2005.
Figure B.70. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at NDBC Buoy 46087 for 2004.
Figure B.71. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2010.
Figure B.72. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2009.
Figure B.73. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2008.
Figure B.74. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2007.
Figure B.75. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2006.
Figure B.76. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2005.
Figure B.77. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2004.
Figure B.78. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2003.
Figure B.79. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2002.
Figure B.80. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2001.
Figure B.81. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 2000.
Figure B.82. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 1999.
Figure B.83. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at NDBC Buoy 46041 for 1998.
Figure B.84. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2010.
Figure B.85. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2009.
Figure B.86. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2008.
Figure B.87. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2007.
Figure B.88. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2006.
Figure B.89. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2005.
Figure B.90. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2004.
Figure B.91. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2003.
Figure B.92. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2002.
Figure B.93. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2001.
Figure B.94. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 2000.
Figure B.95. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 1999.
Figure B.96. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 1998.
Figure B.97. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 1997.
Figure B.98. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46215 for 1996.
Figure B.99. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46236 for 2010.
Figure B.100. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46236 for 2009.
Figure B.101. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46236 for 2008.
Figure B.102. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46236 for 2007.
Figure B.103. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2010.
Figure B.104. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2009.
Figure B.105. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2008.
Figure B.106. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2007.
Figure B.107. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2006.
Figure B.108. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2005.
Figure B.109. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2004.
Figure B.110. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2003.
Figure B.111. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2002.
Figure B.112. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2001.
Figure B.113. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 2000.
Figure B.114. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 1999.
Figure B.115. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 1998.
Figure B.116. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 1997.
Figure B.117. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 1996.
Figure B.118. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 1995.
Figure B.119. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 1994.
Figure B.120. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46211 for 1993.
Figure B.121. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2010.
Figure B.122. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2009.
Figure B.123. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2008.
Figure B.124. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2007.
Figure B.125. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2006.
Figure B.126. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2005.
Figure B.127. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2004.
Figure B.128. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2003.
Figure B.129. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2002.
Figure B.130. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2001.
Figure B.131. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46221 for 2000.
Figure B.132. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2010.
Figure B.133. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2009.
Figure B.134. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2008.
Figure B.135. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2007.
Figure B.136. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2006.
Figure B.137. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2005.
Figure B.138. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2004.
Figure B.139. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2003.
Figure B.140. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2002.
Figure B.141. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2001.
Figure B.142. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 2000.
Figure B.143. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 1999.
Figure B.144. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 1998.
Figure B.145. Comparisons of time series (top) and scatter plots (bottom) of UnSWAN simulated six IEC parameters with observed data at CDIP Buoy 46224 for 1997.
Figure B.146. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46213 for 2010.
Figure B.147. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46213 for 2009.
Figure B.148. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46213 for 2008.
Figure B.149. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46213 for 2007.
Figure B.150. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII simulated IEC parameters with observed data at CDIP Buoy 46213 for 2006.
Figure B.151. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46213 for 2005.
Figure B.152. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46213 for 2004.
Figure B.153. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46229 for 2010.
Figure B.154. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46229 for 2009.
Figure B.155. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46229 for 2008.
Figure B.156. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46229 for 2007.
Figure B.157. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII modeled-simulated IEC parameters with observed data at CDIP Buoy 46229 for 2006.
Figure B.158. Comparisons of time series (top) and scatter plots (bottom) of the six WIII simulated IEC parameters with observed data at CDIP Buoy 46216 for 2010.
Figure B.159. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2009.
Figure B.160. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2008.
Figure B.161. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2007.
Figure B.162. Comparisons of time series (top) and scatter plots (bottom) of the six WIIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2006.
Figure B.163. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2005.
Figure B.164. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2004.
Figure B.165. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2003.
Figure B.166. Comparisons of time series (top) and scatter plots (bottom) of the six WWIII model-simulated IEC parameters with observed data at CDIP Buoy 46216 for 2002.
Appendix C – Performance Metrics for Simulated IEC Resource Parameters

Table C.1 through Table C.84 are National Data Buoy Center-related tables; Table C.85 through Table C.166 are Coastal Data Information Program-related tables.

C.1 NDBC Tables

C.1.1 Station 46029

Table C.1. WWIII performance metrics for NDBC Station 46029 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>25</td>
<td>42.1</td>
<td>0.60</td>
<td>9</td>
<td>22.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.42</td>
<td>8.3</td>
<td>0.16</td>
<td>0.15</td>
<td>5.8</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.5</td>
<td>14.2</td>
<td>0.16</td>
<td>1.1</td>
<td>12.6</td>
<td>0.85</td>
</tr>
<tr>
<td>$\epsilon_0$ (°)</td>
<td>0.07</td>
<td>8.0</td>
<td>0.22</td>
<td>0.02</td>
<td>6.1</td>
<td>0.60</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.1</td>
<td>-1.8</td>
<td>0.08</td>
<td>-7</td>
<td>-2.6</td>
<td>0.71</td>
</tr>
<tr>
<td>$d_\theta$ (°)</td>
<td>0.10</td>
<td>-2.1</td>
<td>0.12</td>
<td>-0.03</td>
<td>-3.1</td>
<td>0.47</td>
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</table>

Table C.2. WWIII performance metrics for NDBC Station 46029 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>20</td>
<td>29.3</td>
<td>0.55</td>
<td>4</td>
<td>9.7</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.38</td>
<td>4.9</td>
<td>0.16</td>
<td>0.05</td>
<td>1.9</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>11.0</td>
<td>0.15</td>
<td>0.9</td>
<td>9.8</td>
<td>0.86</td>
</tr>
<tr>
<td>$\epsilon_0$ (°)</td>
<td>0.07</td>
<td>3.2</td>
<td>0.20</td>
<td>0.00</td>
<td>1.4</td>
<td>0.66</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.3</td>
<td>2.9</td>
<td>0.08</td>
<td>-7</td>
<td>-2.4</td>
<td>0.73</td>
</tr>
<tr>
<td>$d_\theta$ (°)</td>
<td>0.10</td>
<td>0.6</td>
<td>0.11</td>
<td>-0.01</td>
<td>-0.7</td>
<td>0.52</td>
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Table C.3. WWIII performance metrics for NDBC Station 46029 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>50.3</td>
<td>0.53</td>
<td>3</td>
<td>9.9</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>7.5</td>
<td>0.16</td>
<td>0.06</td>
<td>2.9</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.7</td>
<td>13.6</td>
<td>0.20</td>
<td>1.0</td>
<td>11.9</td>
<td>0.76</td>
</tr>
<tr>
<td>$\epsilon_0$ (°)</td>
<td>0.07</td>
<td>5.3</td>
<td>0.21</td>
<td>0.01</td>
<td>3.2</td>
<td>0.62</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.6</td>
<td>-2.5</td>
<td>0.08</td>
<td>-11</td>
<td>-3.8</td>
<td>0.70</td>
</tr>
<tr>
<td>$d_\theta$ (°)</td>
<td>0.10</td>
<td>-1.6</td>
<td>0.12</td>
<td>-0.02</td>
<td>-2.6</td>
<td>0.47</td>
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Table C.4. WWIII performance metrics for NDBC Station 46029 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>27.9</td>
<td>0.50</td>
<td>3</td>
<td>10.1</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>5.6</td>
<td>0.15</td>
<td>0.06</td>
<td>2.4</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>10.0</td>
<td>0.12</td>
<td>0.8</td>
<td>9.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-2.0</td>
<td>0.17</td>
<td>-0.01</td>
<td>-2.9</td>
<td>0.70</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>20.0</td>
<td>0.0</td>
<td>0.07</td>
<td>-2</td>
<td>-0.7</td>
<td>0.76</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>6.2</td>
<td>0.12</td>
<td>0.04</td>
<td>5.0</td>
<td>0.54</td>
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</table>

Table C.5. WWIII performance metrics for NDBC Station 46029 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>28</td>
<td>18.7</td>
<td>0.60</td>
<td>1</td>
<td>2.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>2.3</td>
<td>0.16</td>
<td>-0.02</td>
<td>-0.7</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>8.8</td>
<td>0.12</td>
<td>0.7</td>
<td>8.1</td>
<td>0.90</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.05</td>
<td>-1.4</td>
<td>0.15</td>
<td>-0.01</td>
<td>-2.4</td>
<td>0.79</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.4</td>
<td>3.0</td>
<td>0.09</td>
<td>-2</td>
<td>-0.8</td>
<td>0.71</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>2.7</td>
<td>0.11</td>
<td>0.01</td>
<td>1.4</td>
<td>0.56</td>
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</table>

Table C.6. WWIII performance metrics for NDBC Station 46029 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>28</td>
<td>24.9</td>
<td>0.44</td>
<td>7</td>
<td>11.5</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.48</td>
<td>5.2</td>
<td>0.15</td>
<td>0.08</td>
<td>2.4</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>7.4</td>
<td>0.10</td>
<td>0.7</td>
<td>6.9</td>
<td>0.89</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-8.2</td>
<td>0.17</td>
<td>-0.03</td>
<td>-9.3</td>
<td>0.71</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.0</td>
<td>4.3</td>
<td>0.09</td>
<td>7</td>
<td>2.7</td>
<td>0.73</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>7.2</td>
<td>0.12</td>
<td>0.05</td>
<td>5.8</td>
<td>0.65</td>
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Table C.7. WWIII performance metrics for NDBC Station 46029 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>14.6</td>
<td>0.48</td>
<td>0</td>
<td>-0.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>0.9</td>
<td>0.15</td>
<td>-0.04</td>
<td>-1.8</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.4</td>
<td>0.11</td>
<td>0.7</td>
<td>7.8</td>
<td>0.89</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-2.9</td>
<td>0.15</td>
<td>-0.01</td>
<td>-3.6</td>
<td>0.77</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.7</td>
<td>0.4</td>
<td>0.07</td>
<td>-1</td>
<td>-0.5</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>2.2</td>
<td>0.11</td>
<td>0.01</td>
<td>1.2</td>
<td>0.57</td>
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</table>
### Table C.8. WWIII performance metrics for NDBC Station 46029 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>20</td>
<td>19.9</td>
<td>0.49</td>
<td>2</td>
<td>5.3</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.36</td>
<td>3.6</td>
<td>0.14</td>
<td>0.03</td>
<td>1.2</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.0</td>
<td>0.11</td>
<td>0.7</td>
<td>7.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-3.7</td>
<td>0.16</td>
<td>-0.02</td>
<td>-4.4</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.3</td>
<td>-1.5</td>
<td>0.08</td>
<td>-6</td>
<td>-2.3</td>
<td>0.71</td>
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<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.09</td>
<td>5.2</td>
<td>0.11</td>
<td>0.03</td>
<td>4.0</td>
<td>0.63</td>
</tr>
</tbody>
</table>

### Table C.9. WWIII performance metrics for NDBC Station 46029 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>20</td>
<td>20.2</td>
<td>0.56</td>
<td>4</td>
<td>11.4</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>3.4</td>
<td>0.15</td>
<td>0.04</td>
<td>1.5</td>
<td>0.97</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.3</td>
<td>0.12</td>
<td>0.7</td>
<td>7.6</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-2.1</td>
<td>0.16</td>
<td>-0.01</td>
<td>-3.0</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.9</td>
<td>-2.5</td>
<td>0.08</td>
<td>-9</td>
<td>-3.3</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.10</td>
<td>3.8</td>
<td>0.12</td>
<td>0.02</td>
<td>2.5</td>
<td>0.52</td>
</tr>
</tbody>
</table>

### Table C.10. WWIII performance metrics for NDBC Station 46029 for 2001.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>20</td>
<td>20.6</td>
<td>0.49</td>
<td>2</td>
<td>5.2</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>3.7</td>
<td>0.15</td>
<td>0.03</td>
<td>1.2</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.1</td>
<td>0.11</td>
<td>0.7</td>
<td>7.2</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.05</td>
<td>-3.2</td>
<td>0.15</td>
<td>-0.01</td>
<td>-4.0</td>
<td>0.80</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.5</td>
<td>-1.8</td>
<td>0.07</td>
<td>-6</td>
<td>-2.3</td>
<td>0.73</td>
</tr>
<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.09</td>
<td>2.1</td>
<td>0.10</td>
<td>0.01</td>
<td>1.0</td>
<td>0.62</td>
</tr>
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</table>

### Table C.11. WWIII performance metrics for NDBC Station 46029 for 2000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>8.7</td>
<td>0.47</td>
<td>-1</td>
<td>-2.5</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>-0.7</td>
<td>0.15</td>
<td>-0.06</td>
<td>-2.8</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>5.6</td>
<td>0.12</td>
<td>0.4</td>
<td>4.4</td>
<td>0.84</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>0.5</td>
<td>0.18</td>
<td>0.00</td>
<td>-1.2</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>29.8</td>
<td>-0.1</td>
<td>0.11</td>
<td>-9</td>
<td>-3.1</td>
<td>0.49</td>
</tr>
<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.12</td>
<td>3.7</td>
<td>0.14</td>
<td>0.01</td>
<td>1.6</td>
<td>0.46</td>
</tr>
</tbody>
</table>
### Table C.12. WWIII performance metrics for NDBC Station 46029 for 1999.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>26</td>
<td>34.6</td>
<td>0.50</td>
<td>7</td>
<td>13.4</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.40</td>
<td>8.7</td>
<td>0.15</td>
<td>0.13</td>
<td>4.8</td>
<td>0.97</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>8.8</td>
<td>0.11</td>
<td>0.8</td>
<td>8.2</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.05</td>
<td>-4.0</td>
<td>0.15</td>
<td>-0.02</td>
<td>-5.1</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.2</td>
<td>-0.4</td>
<td>0.08</td>
<td>-3</td>
<td>-1.3</td>
<td>0.68</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>5.4</td>
<td>0.12</td>
<td>0.03</td>
<td>4.0</td>
<td>0.54</td>
</tr>
</tbody>
</table>

### Table C.13. WWIII performance metrics for NDBC Station 46029 for 1998.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>40.5</td>
<td>0.55</td>
<td>4</td>
<td>13.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>10.8</td>
<td>0.16</td>
<td>0.14</td>
<td>6.4</td>
<td>0.97</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.8</td>
<td>0.12</td>
<td>0.8</td>
<td>8.9</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>1.0</td>
<td>0.16</td>
<td>0.00</td>
<td>-0.4</td>
<td>0.77</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.4</td>
<td>-2.4</td>
<td>0.09</td>
<td>-8</td>
<td>-3.0</td>
<td>0.59</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>0.2</td>
<td>0.12</td>
<td>-0.01</td>
<td>-1.1</td>
<td>0.53</td>
</tr>
</tbody>
</table>

### Table C.14. WWIII performance metrics for NDBC Station 46029 for 1997.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>30</td>
<td>83.7</td>
<td>0.69</td>
<td>23</td>
<td>53.0</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.72</td>
<td>27.6</td>
<td>0.26</td>
<td>0.59</td>
<td>21.6</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>6.3</td>
<td>0.10</td>
<td>0.6</td>
<td>6.2</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>14.1</td>
<td>0.20</td>
<td>0.04</td>
<td>12.5</td>
<td>0.66</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>25.3</td>
<td>0.9</td>
<td>0.10</td>
<td>1</td>
<td>0.6</td>
<td>0.22</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>-1.1</td>
<td>0.09</td>
<td>-0.02</td>
<td>-1.8</td>
<td>0.60</td>
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</tbody>
</table>

### C.1.2 Station 46050

### Table C.15. WWIII performance metrics for NDBC Station 46050 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>23</td>
<td>32.8</td>
<td>0.54</td>
<td>7</td>
<td>15.9</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>4.7</td>
<td>0.16</td>
<td>0.07</td>
<td>2.8</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.5</td>
<td>14.3</td>
<td>0.16</td>
<td>1.1</td>
<td>12.5</td>
<td>0.87</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>8.4</td>
<td>0.23</td>
<td>0.02</td>
<td>6.7</td>
<td>0.54</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>27.5</td>
<td>-1.5</td>
<td>0.10</td>
<td>-7</td>
<td>-2.5</td>
<td>0.69</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>5.3</td>
<td>0.14</td>
<td>0.03</td>
<td>4.0</td>
<td>0.33</td>
</tr>
</tbody>
</table>
### Table C.16. WWIII performance metrics for NDBC Station 46050 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>29.6</td>
<td>0.49</td>
<td>3</td>
<td>10.4</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.36</td>
<td>4.8</td>
<td>0.16</td>
<td>0.04</td>
<td>1.8</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>11.4</td>
<td>0.14</td>
<td>0.9</td>
<td>10.3</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>5.3</td>
<td>0.21</td>
<td>0.01</td>
<td>3.2</td>
<td>0.63</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>26.0</td>
<td>3.8</td>
<td>-8</td>
<td>-2.9</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>7.4</td>
<td>0.15</td>
<td>0.04</td>
<td>5.6</td>
<td>0.37</td>
</tr>
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</table>

### Table C.17. WWIII performance metrics for NDBC Station 46050 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>29.8</td>
<td>0.52</td>
<td>2</td>
<td>7.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>4.9</td>
<td>0.17</td>
<td>0.03</td>
<td>1.2</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.5</td>
<td>0.14</td>
<td>0.9</td>
<td>10.2</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>8.6</td>
<td>0.23</td>
<td>0.02</td>
<td>6.6</td>
<td>0.56</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.0</td>
<td>-2.2</td>
<td>0.08</td>
<td>-8</td>
<td>-2.8</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>3.4</td>
<td>0.13</td>
<td>0.02</td>
<td>2.2</td>
<td>0.37</td>
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</table>

### C.1.3 Station 46027

### Table C.18. UnSWAN performance metrics for NDBC Station 46027 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>23</td>
<td>27.0</td>
<td>0.59</td>
<td>6</td>
<td>15.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.43</td>
<td>2.6</td>
<td>0.17</td>
<td>0.01</td>
<td>0.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>13.3</td>
<td>0.15</td>
<td>1.1</td>
<td>12.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>7.8</td>
<td>0.23</td>
<td>0.02</td>
<td>6.4</td>
<td>0.54</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>18.2</td>
<td>-1.7</td>
<td>0.06</td>
<td>-6</td>
<td>-2.2</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>0.4</td>
<td>0.12</td>
<td>0.00</td>
<td>-0.4</td>
<td>0.35</td>
</tr>
</tbody>
</table>

### Table C.19. UnSWAN performance metrics for NDBC Station 46027 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>26.4</td>
<td>0.53</td>
<td>2</td>
<td>7.8</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.43</td>
<td>3.2</td>
<td>0.20</td>
<td>-0.03</td>
<td>-1.4</td>
<td>0.89</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>10.9</td>
<td>0.14</td>
<td>0.9</td>
<td>9.9</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>4.0</td>
<td>0.21</td>
<td>0.01</td>
<td>2.4</td>
<td>0.59</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.6</td>
<td>-2.1</td>
<td>0.05</td>
<td>-7</td>
<td>-2.4</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>1.2</td>
<td>0.09</td>
<td>0.00</td>
<td>0.5</td>
<td>0.58</td>
</tr>
</tbody>
</table>
Table C.20. UnSWAN performance metrics for NDBC Station 46027 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>17.7</td>
<td>0.48</td>
<td>-1</td>
<td>-3.5</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.42</td>
<td>0.1</td>
<td>0.20</td>
<td>-0.10</td>
<td>-5.0</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>10.5</td>
<td>0.13</td>
<td>0.8</td>
<td>9.6</td>
<td>0.92</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.07</td>
<td>5.3</td>
<td>0.21</td>
<td>0.01</td>
<td>3.2</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.1</td>
<td>-2.1</td>
<td>0.05</td>
<td>-7</td>
<td>-2.4</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-0.3</td>
<td>0.10</td>
<td>-0.01</td>
<td>-1.0</td>
<td>0.46</td>
</tr>
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<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>25.0</td>
<td>0.58</td>
<td>1</td>
<td>3.2</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.42</td>
<td>2.8</td>
<td>0.21</td>
<td>-0.06</td>
<td>-2.8</td>
<td>0.89</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>10.5</td>
<td>0.13</td>
<td>0.8</td>
<td>9.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.07</td>
<td>5.9</td>
<td>0.22</td>
<td>0.01</td>
<td>3.6</td>
<td>0.54</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>14.2</td>
<td>-1.8</td>
<td>0.05</td>
<td>-6</td>
<td>-2.0</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>0.8</td>
<td>0.09</td>
<td>0.00</td>
<td>0.1</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Table C.22. UnSWAN performance metrics for NDBC Station 46027 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>22</td>
<td>9.5</td>
<td>0.58</td>
<td>0</td>
<td>-0.5</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.49</td>
<td>-3.0</td>
<td>0.20</td>
<td>-0.14</td>
<td>-5.9</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.7</td>
<td>0.13</td>
<td>0.8</td>
<td>9.0</td>
<td>0.92</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.07</td>
<td>7.0</td>
<td>0.21</td>
<td>0.02</td>
<td>5.5</td>
<td>0.64</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.8</td>
<td>-2.2</td>
<td>0.05</td>
<td>-7</td>
<td>-2.4</td>
<td>0.83</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>0.2</td>
<td>0.10</td>
<td>0.00</td>
<td>-0.5</td>
<td>0.45</td>
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Table C.23. UnSWAN performance metrics for NDBC Station 46027 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>29</td>
<td>15.4</td>
<td>0.44</td>
<td>6</td>
<td>9.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.49</td>
<td>1.6</td>
<td>0.16</td>
<td>0.01</td>
<td>0.2</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>7.7</td>
<td>0.10</td>
<td>0.8</td>
<td>7.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.04</td>
<td>-4.9</td>
<td>0.13</td>
<td>-0.02</td>
<td>-5.2</td>
<td>0.84</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.5</td>
<td>-0.4</td>
<td>0.04</td>
<td>-2</td>
<td>-0.6</td>
<td>0.89</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>2.5</td>
<td>0.07</td>
<td>0.02</td>
<td>2.0</td>
<td>0.72</td>
</tr>
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</table>
### C.1.4 Station 46022

Table C.24. UnSWAN performance metrics for NDBC Station 46022 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>47</td>
<td>43.0</td>
<td>0.67</td>
<td>24</td>
<td>34.7</td>
<td>0.88</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.66</td>
<td>11.3</td>
<td>0.20</td>
<td>0.34</td>
<td>10.1</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>10.8</td>
<td>0.14</td>
<td>1.1</td>
<td>10.2</td>
<td>0.84</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.05</td>
<td>-0.2</td>
<td>0.17</td>
<td>0.00</td>
<td>-1.4</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>25.2</td>
<td>7.0</td>
<td>0.10</td>
<td>15</td>
<td>6.1</td>
<td>0.72</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>8.0</td>
<td>0.12</td>
<td>0.06</td>
<td>7.2</td>
<td>0.46</td>
</tr>
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Table C.25. UnSWAN performance metrics for NDBC Station 46022 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>36.2</td>
<td>0.51</td>
<td>4</td>
<td>11.9</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.43</td>
<td>10.0</td>
<td>0.19</td>
<td>0.10</td>
<td>4.5</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>7.3</td>
<td>0.12</td>
<td>0.6</td>
<td>6.7</td>
<td>0.89</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.07</td>
<td>8.5</td>
<td>0.21</td>
<td>0.02</td>
<td>6.7</td>
<td>0.64</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>31.5</td>
<td>-4.1</td>
<td>0.10</td>
<td>-15</td>
<td>-4.9</td>
<td>0.78</td>
</tr>
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<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>5.1</td>
<td>0.14</td>
<td>0.03</td>
<td>3.4</td>
<td>0.55</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>43.0</td>
<td>0.56</td>
<td>5</td>
<td>16.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.42</td>
<td>13.0</td>
<td>0.19</td>
<td>0.17</td>
<td>7.5</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>7.5</td>
<td>0.11</td>
<td>0.6</td>
<td>6.8</td>
<td>0.91</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.07</td>
<td>9.6</td>
<td>0.21</td>
<td>0.02</td>
<td>7.5</td>
<td>0.64</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>29.3</td>
<td>-3.0</td>
<td>0.09</td>
<td>-11</td>
<td>-3.6</td>
<td>0.79</td>
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<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>2.4</td>
<td>0.13</td>
<td>0.01</td>
<td>0.9</td>
<td>0.55</td>
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Table C.27. UnSWAN performance metrics for NDBC Station 46022 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>39.9</td>
<td>0.59</td>
<td>4</td>
<td>12.7</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>12.1</td>
<td>0.19</td>
<td>0.14</td>
<td>6.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>0.9</td>
<td>7.0</td>
<td>0.11</td>
<td>0.6</td>
<td>6.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.07</td>
<td>10.8</td>
<td>0.21</td>
<td>0.03</td>
<td>8.6</td>
<td>0.59</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>29.2</td>
<td>-2.8</td>
<td>0.10</td>
<td>-11</td>
<td>-3.6</td>
<td>0.70</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>3.6</td>
<td>0.12</td>
<td>0.02</td>
<td>2.1</td>
<td>0.59</td>
</tr>
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### Table C.28. UnSWAN performance metrics for NDBC Station 46026 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>19</td>
<td>69.7</td>
<td>0.81</td>
<td>11</td>
<td>44.8</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.44</td>
<td>19.6</td>
<td>0.22</td>
<td>0.29</td>
<td>15.0</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>12.9</td>
<td>0.15</td>
<td>1.1</td>
<td>11.8</td>
<td>0.88</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-0.3</td>
<td>0.16</td>
<td>0.00</td>
<td>-1.4</td>
<td>0.75</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.0</td>
<td>-1.1</td>
<td>0.08</td>
<td>-4</td>
<td>-1.4</td>
<td>0.50</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>8.9</td>
<td>0.17</td>
<td>0.05</td>
<td>7.4</td>
<td>0.58</td>
</tr>
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</table>

### Table C.29. UnSWAN performance metrics for NDBC Station 46026 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>51.2</td>
<td>0.58</td>
<td>6</td>
<td>30.2</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>13.1</td>
<td>0.18</td>
<td>0.17</td>
<td>8.9</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>11.8</td>
<td>0.15</td>
<td>1.0</td>
<td>10.7</td>
<td>0.89</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-4.3</td>
<td>0.17</td>
<td>-0.02</td>
<td>-5.6</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.2</td>
<td>0.5</td>
<td>0.05</td>
<td>1</td>
<td>0.2</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>1.3</td>
<td>0.12</td>
<td>0.00</td>
<td>0.2</td>
<td>0.60</td>
</tr>
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</table>

### Table C.30. UnSWAN performance metrics for NDBC Station 46026 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>46.8</td>
<td>0.60</td>
<td>6</td>
<td>26.5</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>12.4</td>
<td>0.17</td>
<td>0.16</td>
<td>8.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.0</td>
<td>0.14</td>
<td>1.0</td>
<td>11.0</td>
<td>0.91</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-5.1</td>
<td>0.17</td>
<td>-0.02</td>
<td>-6.3</td>
<td>0.73</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.0</td>
<td>0.2</td>
<td>0.06</td>
<td>0</td>
<td>0.0</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>-2.2</td>
<td>0.10</td>
<td>-0.02</td>
<td>-2.9</td>
<td>0.74</td>
</tr>
</tbody>
</table>

### Table C.31. UnSWAN performance metrics for NDBC Station 46026 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>10</td>
<td>37.9</td>
<td>0.51</td>
<td>4</td>
<td>18.0</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>14.3</td>
<td>0.18</td>
<td>0.19</td>
<td>10.4</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.7</td>
<td>0.14</td>
<td>0.9</td>
<td>10.5</td>
<td>0.91</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-4.5</td>
<td>0.16</td>
<td>-0.02</td>
<td>-5.4</td>
<td>0.77</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.9</td>
<td>1.5</td>
<td>0.06</td>
<td>4</td>
<td>1.3</td>
<td>0.65</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>-1.0</td>
<td>0.09</td>
<td>-0.01</td>
<td>-1.4</td>
<td>0.77</td>
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</tbody>
</table>
### Station 46015

**Table C.32.** WWIII performance metrics for NDBC Station 46015 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>22</td>
<td>35.1</td>
<td>0.52</td>
<td>6</td>
<td>14.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.42</td>
<td>6.1</td>
<td>0.16</td>
<td>0.09</td>
<td>3.6</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>15.2</td>
<td>0.17</td>
<td>1.2</td>
<td>13.3</td>
<td>0.86</td>
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<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>8.3</td>
<td>0.23</td>
<td>0.02</td>
<td>6.5</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>35.8</td>
<td>-3.5</td>
<td>0.12</td>
<td>-13</td>
<td>-4.5</td>
<td>0.57</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>3.6</td>
<td>0.16</td>
<td>0.02</td>
<td>2.2</td>
<td>0.36</td>
</tr>
</tbody>
</table>

**Table C.33.** WWIII performance metrics for NDBC Station 46015 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>22</td>
<td>35.1</td>
<td>0.52</td>
<td>6</td>
<td>14.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.42</td>
<td>6.1</td>
<td>0.16</td>
<td>0.09</td>
<td>3.6</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>15.2</td>
<td>0.17</td>
<td>1.2</td>
<td>13.3</td>
<td>0.86</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>8.3</td>
<td>0.23</td>
<td>0.02</td>
<td>6.5</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>35.8</td>
<td>-3.5</td>
<td>0.12</td>
<td>-13</td>
<td>-4.5</td>
<td>0.57</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>3.6</td>
<td>0.16</td>
<td>0.02</td>
<td>2.2</td>
<td>0.36</td>
</tr>
</tbody>
</table>

**Table C.34.** WWIII performance metrics for NDBC Station 46015 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>20</td>
<td>37.7</td>
<td>0.52</td>
<td>5</td>
<td>12.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.42</td>
<td>8.5</td>
<td>0.17</td>
<td>0.10</td>
<td>4.2</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>11.3</td>
<td>0.14</td>
<td>0.9</td>
<td>10.1</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>3.2</td>
<td>0.21</td>
<td>0.00</td>
<td>0.9</td>
<td>0.62</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>27.7</td>
<td>-2.5</td>
<td>0.09</td>
<td>-9</td>
<td>-3.2</td>
<td>0.70</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.13</td>
<td>5.8</td>
<td>0.16</td>
<td>0.03</td>
<td>3.9</td>
<td>0.37</td>
</tr>
</tbody>
</table>

**Table C.35.** WWIII performance metrics for NDBC Station 46015 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>30.7</td>
<td>0.56</td>
<td>3</td>
<td>9.3</td>
<td>0.96</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>6.4</td>
<td>0.16</td>
<td>0.05</td>
<td>2.4</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.2</td>
<td>0.14</td>
<td>0.9</td>
<td>10.3</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>8.0</td>
<td>0.22</td>
<td>0.02</td>
<td>5.7</td>
<td>0.57</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>26.5</td>
<td>-3.9</td>
<td>0.09</td>
<td>-13</td>
<td>-4.4</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>3.8</td>
<td>0.15</td>
<td>0.02</td>
<td>2.3</td>
<td>0.40</td>
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</tbody>
</table>
### Station 46028

#### Table C.36. WWIII performance metrics for NDBC Station 46028 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>31.6</td>
<td>0.53</td>
<td>6</td>
<td>16.4</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>6.2</td>
<td>0.17</td>
<td>0.09</td>
<td>3.6</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>12.5</td>
<td>0.15</td>
<td>1.1</td>
<td>11.0</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>1.0</td>
<td>0.18</td>
<td>0.00</td>
<td>0.1</td>
<td>0.72</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>37.8</td>
<td>-3.1</td>
<td>0.13</td>
<td>-10</td>
<td>-3.5</td>
<td>0.25</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>1.6</td>
<td>0.16</td>
<td>0.00</td>
<td>0.5</td>
<td>0.57</td>
</tr>
</tbody>
</table>

#### Table C.37. WWIII performance metrics for NDBC Station 46028 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>23.6</td>
<td>0.45</td>
<td>1</td>
<td>5.2</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.38</td>
<td>4.2</td>
<td>0.17</td>
<td>-0.01</td>
<td>-0.4</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>10.2</td>
<td>0.14</td>
<td>0.9</td>
<td>9.0</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>0.2</td>
<td>0.18</td>
<td>0.00</td>
<td>-1.2</td>
<td>0.71</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>27.9</td>
<td>-2.8</td>
<td>0.09</td>
<td>-9</td>
<td>-3.2</td>
<td>0.62</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>7.2</td>
<td>0.16</td>
<td>0.04</td>
<td>5.5</td>
<td>0.61</td>
</tr>
</tbody>
</table>

#### Table C.38. WWIII performance metrics for NDBC Station 46028 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>23.7</td>
<td>0.52</td>
<td>2</td>
<td>6.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.40</td>
<td>3.6</td>
<td>0.17</td>
<td>-0.01</td>
<td>-0.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>11.7</td>
<td>0.15</td>
<td>1.0</td>
<td>10.5</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-1.1</td>
<td>0.17</td>
<td>-0.01</td>
<td>-2.6</td>
<td>0.71</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>34.2</td>
<td>0.6</td>
<td>0.11</td>
<td>-12</td>
<td>-3.9</td>
<td>0.44</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>3.6</td>
<td>0.15</td>
<td>0.01</td>
<td>1.7</td>
<td>0.65</td>
</tr>
</tbody>
</table>

#### Table C.39. WWIII performance metrics for NDBC Station 46028 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>17.8</td>
<td>0.45</td>
<td>1</td>
<td>3.7</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>-0.2</td>
<td>0.17</td>
<td>-0.08</td>
<td>-3.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.5</td>
<td>14.8</td>
<td>0.17</td>
<td>1.2</td>
<td>13.5</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>-2.9</td>
<td>0.21</td>
<td>-0.02</td>
<td>-4.7</td>
<td>0.58</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>28.2</td>
<td>-3.4</td>
<td>0.09</td>
<td>-12</td>
<td>-3.8</td>
<td>0.35</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>4.3</td>
<td>0.14</td>
<td>0.03</td>
<td>3.7</td>
<td>0.62</td>
</tr>
</tbody>
</table>
Table C.40. WWIII performance metrics for NDBC Station 46028 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>17.1</td>
<td>0.48</td>
<td>2</td>
<td>-7.6</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>0.8</td>
<td>0.16</td>
<td>-0.03</td>
<td>-1.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>12.0</td>
<td>0.14</td>
<td>1.0</td>
<td>10.6</td>
<td>0.90</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.07</td>
<td>-2.5</td>
<td>0.20</td>
<td>-0.01</td>
<td>-3.8</td>
<td>0.63</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>26.8</td>
<td>-2.8</td>
<td>0.09</td>
<td>-10</td>
<td>-3.2</td>
<td>0.62</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>2.7</td>
<td>0.13</td>
<td>0.02</td>
<td>2.1</td>
<td>0.68</td>
</tr>
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</table>

Table C.41. WWIII performance metrics for NDBC Station 46028 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>11</td>
<td>10.6</td>
<td>0.38</td>
<td>0</td>
<td>0.9</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>-1.3</td>
<td>0.15</td>
<td>-0.08</td>
<td>-3.4</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>11.5</td>
<td>0.14</td>
<td>1.0</td>
<td>10.0</td>
<td>0.91</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-2.8</td>
<td>0.18</td>
<td>-0.01</td>
<td>-4.2</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>29.2</td>
<td>-3.0</td>
<td>0.10</td>
<td>-10</td>
<td>-3.4</td>
<td>0.54</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>-1.6</td>
<td>0.12</td>
<td>-0.02</td>
<td>-2.2</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Table C.42. WWIII performance metrics for NDBC Station 46028 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>1.2</td>
<td>0.45</td>
<td>-2</td>
<td>-8.5</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>-4.0</td>
<td>0.17</td>
<td>-0.14</td>
<td>-6.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>6.6</td>
<td>0.12</td>
<td>0.5</td>
<td>5.3</td>
<td>0.87</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.07</td>
<td>-3.0</td>
<td>0.17</td>
<td>-0.02</td>
<td>-4.0</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>30.6</td>
<td>-3.1</td>
<td>0.10</td>
<td>-10</td>
<td>-3.4</td>
<td>0.35</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>1.0</td>
<td>0.15</td>
<td>0.00</td>
<td>0.6</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Table C.43. WWIII performance metrics for NDBC Station 46028 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>4.3</td>
<td>0.42</td>
<td>-1</td>
<td>-4.6</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>-1.8</td>
<td>0.17</td>
<td>-0.10</td>
<td>-4.2</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>5.5</td>
<td>0.11</td>
<td>0.4</td>
<td>4.2</td>
<td>0.90</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.07</td>
<td>-5.8</td>
<td>0.18</td>
<td>-0.03</td>
<td>-6.8</td>
<td>0.75</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>33.1</td>
<td>-1.6</td>
<td>0.11</td>
<td>-6</td>
<td>-1.9</td>
<td>0.51</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>3.2</td>
<td>0.16</td>
<td>0.02</td>
<td>2.1</td>
<td>0.52</td>
</tr>
</tbody>
</table>
Table C.44. WWIII performance metrics for NDBC Station 46028 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J ) (kW/m)</td>
<td>32</td>
<td>-4.0</td>
<td>0.64</td>
<td>-7</td>
<td>-13.3</td>
<td>0.92</td>
</tr>
<tr>
<td>( H_s ) (m)</td>
<td>0.49</td>
<td>-5.8</td>
<td>0.19</td>
<td>-19</td>
<td>-7.2</td>
<td>0.94</td>
</tr>
<tr>
<td>( T_e ) (s)</td>
<td>1.1</td>
<td>4.3</td>
<td>0.10</td>
<td>0.3</td>
<td>3.0</td>
<td>0.90</td>
</tr>
<tr>
<td>( \epsilon_0 ) (-)</td>
<td>0.06</td>
<td>-6.5</td>
<td>0.18</td>
<td>-0.2</td>
<td>-7.3</td>
<td>0.79</td>
</tr>
<tr>
<td>( \theta ) (degrees)</td>
<td>41.8</td>
<td>1.7</td>
<td>0.14</td>
<td>4</td>
<td>1.2</td>
<td>0.11</td>
</tr>
<tr>
<td>( d_\theta ) (-)</td>
<td>0.15</td>
<td>6.1</td>
<td>0.18</td>
<td>0.03</td>
<td>4.2</td>
<td>0.37</td>
</tr>
</tbody>
</table>

C.1.8 Station 46025

Table C.45. WWIII performance metrics for NDBC Station 46025 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J ) (kW/m)</td>
<td>4</td>
<td>14.6</td>
<td>0.54</td>
<td>0</td>
<td>-0.7</td>
<td>0.90</td>
</tr>
<tr>
<td>( H_s ) (m)</td>
<td>0.24</td>
<td>-1.5</td>
<td>0.19</td>
<td>-0.05</td>
<td>-4.0</td>
<td>0.90</td>
</tr>
<tr>
<td>( T_e ) (s)</td>
<td>1.7</td>
<td>13.5</td>
<td>0.19</td>
<td>1.1</td>
<td>12.3</td>
<td>0.78</td>
</tr>
<tr>
<td>( \epsilon_0 ) (-)</td>
<td>0.09</td>
<td>4.4</td>
<td>0.21</td>
<td>0.01</td>
<td>2.3</td>
<td>0.59</td>
</tr>
<tr>
<td>( \theta ) (degrees)</td>
<td>33.1</td>
<td>-7.4</td>
<td>0.13</td>
<td>-21</td>
<td>-8.2</td>
<td>0.55</td>
</tr>
<tr>
<td>( d_\theta ) (-)</td>
<td>0.17</td>
<td>18.6</td>
<td>0.23</td>
<td>0.11</td>
<td>15.0</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Table C.46. WWIII performance metrics for NDBC Station 46025 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J ) (kW/m)</td>
<td>3</td>
<td>9.7</td>
<td>0.51</td>
<td>0</td>
<td>-6.9</td>
<td>0.86</td>
</tr>
<tr>
<td>( H_s ) (m)</td>
<td>0.21</td>
<td>-3.1</td>
<td>0.19</td>
<td>-0.06</td>
<td>-5.9</td>
<td>0.89</td>
</tr>
<tr>
<td>( T_e ) (s)</td>
<td>1.7</td>
<td>12.7</td>
<td>0.19</td>
<td>1.0</td>
<td>11.0</td>
<td>0.75</td>
</tr>
<tr>
<td>( \epsilon_0 ) (-)</td>
<td>0.09</td>
<td>4.9</td>
<td>0.21</td>
<td>0.01</td>
<td>2.5</td>
<td>0.56</td>
</tr>
<tr>
<td>( \theta ) (degrees)</td>
<td>32.1</td>
<td>-1.9</td>
<td>0.13</td>
<td>-21</td>
<td>-8.1</td>
<td>0.38</td>
</tr>
<tr>
<td>( d_\theta ) (-)</td>
<td>0.15</td>
<td>16.8</td>
<td>0.22</td>
<td>0.10</td>
<td>13.6</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Table C.47. WWIII performance metrics for NDBC Station 46025 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J ) (kW/m)</td>
<td>2</td>
<td>21.3</td>
<td>0.49</td>
<td>0</td>
<td>8.6</td>
<td>0.81</td>
</tr>
<tr>
<td>( H_s ) (m)</td>
<td>0.20</td>
<td>1.9</td>
<td>0.19</td>
<td>0.00</td>
<td>-0.1</td>
<td>0.84</td>
</tr>
<tr>
<td>( T_e ) (s)</td>
<td>1.7</td>
<td>13.5</td>
<td>0.20</td>
<td>1.0</td>
<td>12.0</td>
<td>0.74</td>
</tr>
<tr>
<td>( \epsilon_0 ) (-)</td>
<td>0.09</td>
<td>4.6</td>
<td>0.20</td>
<td>0.01</td>
<td>2.6</td>
<td>0.50</td>
</tr>
<tr>
<td>( \theta ) (degrees)</td>
<td>33.1</td>
<td>-5.2</td>
<td>0.13</td>
<td>-20</td>
<td>-8.2</td>
<td>0.48</td>
</tr>
<tr>
<td>( d_\theta ) (-)</td>
<td>0.17</td>
<td>19.2</td>
<td>0.25</td>
<td>0.11</td>
<td>15.8</td>
<td>0.01</td>
</tr>
</tbody>
</table>
### Table C.48. WWIII performance metrics for NDBC Station 46042 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>19</td>
<td>42.6</td>
<td>0.58</td>
<td>7</td>
<td>21.8</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>10.6</td>
<td>0.18</td>
<td>0.16</td>
<td>6.9</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>12.2</td>
<td>0.15</td>
<td>1.1</td>
<td>11.1</td>
<td>0.86</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-2.0</td>
<td>0.16</td>
<td>-0.01</td>
<td>-3.4</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>30.2</td>
<td>-1.2</td>
<td>0.10</td>
<td>-5</td>
<td>-1.7</td>
<td>0.53</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.12</td>
<td>-5.1</td>
<td>0.14</td>
<td>-0.05</td>
<td>-5.8</td>
<td>0.70</td>
</tr>
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</table>

### Table C.49. WWIII performance metrics for NDBC Station 46042 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>29.3</td>
<td>0.48</td>
<td>3</td>
<td>10.8</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>6.6</td>
<td>0.16</td>
<td>0.07</td>
<td>3.1</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>10.3</td>
<td>0.13</td>
<td>0.9</td>
<td>9.3</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-3.8</td>
<td>0.17</td>
<td>-0.02</td>
<td>-5.4</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.6</td>
<td>-1.1</td>
<td>0.08</td>
<td>-4</td>
<td>-1.5</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>-3.0</td>
<td>0.11</td>
<td>-0.03</td>
<td>-3.8</td>
<td>0.74</td>
</tr>
</tbody>
</table>

### Table C.50. WWIII performance metrics for NDBC Station 46042 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>26.6</td>
<td>0.43</td>
<td>2</td>
<td>7.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>5.9</td>
<td>0.15</td>
<td>0.05</td>
<td>2.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>9.9</td>
<td>0.13</td>
<td>0.9</td>
<td>9.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-4.0</td>
<td>0.18</td>
<td>-0.02</td>
<td>-5.7</td>
<td>0.70</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.3</td>
<td>-0.3</td>
<td>0.08</td>
<td>-2</td>
<td>-0.6</td>
<td>0.75</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-3.0</td>
<td>0.12</td>
<td>-0.03</td>
<td>-3.6</td>
<td>0.76</td>
</tr>
</tbody>
</table>

### Table C.51. WWIII performance metrics for NDBC Station 46042 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>26.6</td>
<td>0.43</td>
<td>2</td>
<td>7.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>5.9</td>
<td>0.15</td>
<td>0.05</td>
<td>2.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>9.9</td>
<td>0.13</td>
<td>0.9</td>
<td>9.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-4.0</td>
<td>0.18</td>
<td>-0.02</td>
<td>-5.7</td>
<td>0.70</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.3</td>
<td>-0.3</td>
<td>0.08</td>
<td>-2</td>
<td>-0.6</td>
<td>0.75</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-3.0</td>
<td>0.12</td>
<td>-0.03</td>
<td>-3.6</td>
<td>0.76</td>
</tr>
</tbody>
</table>
Table C.52. WWIII performance metrics for NDBC Station 46042 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>26.6</td>
<td>0.43</td>
<td>2</td>
<td>7.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>5.9</td>
<td>0.15</td>
<td>0.05</td>
<td>2.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>9.9</td>
<td>0.13</td>
<td>0.9</td>
<td>9.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-4.0</td>
<td>0.18</td>
<td>-0.02</td>
<td>-5.7</td>
<td>0.70</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.3</td>
<td>-0.3</td>
<td>0.08</td>
<td>-2</td>
<td>-0.6</td>
<td>0.75</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-3.0</td>
<td>0.12</td>
<td>-0.03</td>
<td>-3.6</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Table C.53. WWIII performance metrics for NDBC Station 46042 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>23.9</td>
<td>0.45</td>
<td>3</td>
<td>11.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.31</td>
<td>5.5</td>
<td>0.14</td>
<td>0.07</td>
<td>3.2</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>9.0</td>
<td>0.12</td>
<td>0.8</td>
<td>7.9</td>
<td>0.90</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-4.7</td>
<td>0.17</td>
<td>-0.02</td>
<td>-6.2</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.0</td>
<td>0.2</td>
<td>0.08</td>
<td>-1</td>
<td>-0.4</td>
<td>0.62</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-4.0</td>
<td>0.11</td>
<td>-0.04</td>
<td>-4.5</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Table C.54. WWIII performance metrics for NDBC Station 46042 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>28.2</td>
<td>0.49</td>
<td>3</td>
<td>10.9</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.32</td>
<td>8.1</td>
<td>0.16</td>
<td>0.10</td>
<td>4.8</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>6.6</td>
<td>0.10</td>
<td>0.6</td>
<td>6.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-8.0</td>
<td>0.16</td>
<td>-0.04</td>
<td>-8.9</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.8</td>
<td>-1.0</td>
<td>0.09</td>
<td>-4</td>
<td>-1.3</td>
<td>0.62</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-0.1</td>
<td>0.12</td>
<td>-0.01</td>
<td>-0.8</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Table C.55. WWIII performance metrics for NDBC Station 46042 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>24.1</td>
<td>0.43</td>
<td>3</td>
<td>10.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.32</td>
<td>6.0</td>
<td>0.15</td>
<td>0.07</td>
<td>3.3</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>7.4</td>
<td>0.11</td>
<td>0.7</td>
<td>6.6</td>
<td>0.91</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.07</td>
<td>-10.1</td>
<td>0.18</td>
<td>-0.04</td>
<td>-10.9</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.9</td>
<td>-0.8</td>
<td>0.08</td>
<td>-3</td>
<td>-1.1</td>
<td>0.73</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>4.8</td>
<td>0.14</td>
<td>0.03</td>
<td>3.6</td>
<td>0.64</td>
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</table>
Table C.56. WWIII performance metrics for NDBC Station 46042 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>18.8</td>
<td>0.56</td>
<td>2</td>
<td>6.2</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>4.5</td>
<td>0.15</td>
<td>0.04</td>
<td>2.0</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>0.9</td>
<td>5.9</td>
<td>0.10</td>
<td>0.5</td>
<td>5.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-8.3</td>
<td>0.15</td>
<td>-0.03</td>
<td>-8.9</td>
<td>0.84</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.6</td>
<td>-2.3</td>
<td>0.08</td>
<td>-8</td>
<td>-2.5</td>
<td>0.44</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>4.8</td>
<td>0.12</td>
<td>0.03</td>
<td>4.2</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Table C.57. WWIII performance metrics for NDBC Station 46042 for 2001.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>18.7</td>
<td>0.48</td>
<td>1</td>
<td>4.0</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.36</td>
<td>4.3</td>
<td>0.15</td>
<td>0.03</td>
<td>1.3</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>0.9</td>
<td>6.3</td>
<td>0.09</td>
<td>0.5</td>
<td>5.5</td>
<td>0.93</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-8.9</td>
<td>0.15</td>
<td>-0.04</td>
<td>-9.6</td>
<td>0.84</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.9</td>
<td>-1.2</td>
<td>0.08</td>
<td>-5</td>
<td>-1.6</td>
<td>0.66</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>0.6</td>
<td>0.11</td>
<td>0.00</td>
<td>-0.2</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Table C.58. WWIII performance metrics for NDBC Station 46042 for 2000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>21.1</td>
<td>0.46</td>
<td>3</td>
<td>9.6</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>5.8</td>
<td>0.15</td>
<td>0.08</td>
<td>3.4</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>0.9</td>
<td>5.5</td>
<td>0.09</td>
<td>0.5</td>
<td>4.9</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-9.5</td>
<td>0.16</td>
<td>-0.04</td>
<td>-10.3</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>37.2</td>
<td>-1.1</td>
<td>0.13</td>
<td>-6</td>
<td>-2.0</td>
<td>0.22</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.16</td>
<td>12.4</td>
<td>0.21</td>
<td>0.07</td>
<td>10.1</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Table C.59. WWIII performance metrics for NDBC Station 46042 for 1999.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>27.8</td>
<td>0.43</td>
<td>4</td>
<td>9.5</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.38</td>
<td>7.6</td>
<td>0.16</td>
<td>0.10</td>
<td>4.0</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>6.8</td>
<td>0.10</td>
<td>0.7</td>
<td>6.1</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-12.2</td>
<td>0.19</td>
<td>-0.05</td>
<td>-12.8</td>
<td>0.79</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.9</td>
<td>0.2</td>
<td>0.08</td>
<td>-1</td>
<td>-0.3</td>
<td>0.57</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>0.1</td>
<td>0.10</td>
<td>0.00</td>
<td>-0.3</td>
<td>0.81</td>
</tr>
</tbody>
</table>
Table C.60. WWIII performance metrics for NDBC Station 46042 for 1998.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>23.1</td>
<td>0.46</td>
<td>3</td>
<td>10.3</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>6.3</td>
<td>0.15</td>
<td>0.09</td>
<td>3.9</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>6.8</td>
<td>0.10</td>
<td>0.6</td>
<td>5.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.06</td>
<td>-9.3</td>
<td>0.16</td>
<td>-0.04</td>
<td>-10.0</td>
<td>0.84</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>26.6</td>
<td>0.7</td>
<td>0.09</td>
<td>0</td>
<td>0.0</td>
<td>0.43</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-3.7</td>
<td>0.11</td>
<td>-0.03</td>
<td>-4.0</td>
<td>0.81</td>
</tr>
</tbody>
</table>

C.1.10 Station 46063

Table C.61. WWIII performance metrics for NDBC Station 46063 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>27.6</td>
<td>0.42</td>
<td>2</td>
<td>6.8</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.38</td>
<td>5.4</td>
<td>0.16</td>
<td>0.03</td>
<td>1.2</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>11.2</td>
<td>0.14</td>
<td>0.9</td>
<td>9.9</td>
<td>0.88</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.06</td>
<td>1.9</td>
<td>0.17</td>
<td>0.00</td>
<td>0.4</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>14.8</td>
<td>0.5</td>
<td>0.05</td>
<td>1</td>
<td>0.3</td>
<td>0.72</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-1.6</td>
<td>0.10</td>
<td>-0.02</td>
<td>-2.2</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Table C.62. WWIII performance metrics for NDBC Station 46063 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>29.8</td>
<td>0.48</td>
<td>3</td>
<td>10.5</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>5.7</td>
<td>0.15</td>
<td>0.06</td>
<td>2.5</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>12.9</td>
<td>0.15</td>
<td>1.0</td>
<td>11.7</td>
<td>0.89</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.06</td>
<td>-0.5</td>
<td>0.16</td>
<td>-0.01</td>
<td>-1.9</td>
<td>0.72</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>30.9</td>
<td>-1.2</td>
<td>0.10</td>
<td>-5</td>
<td>-1.8</td>
<td>0.42</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>-4.9</td>
<td>0.13</td>
<td>-0.04</td>
<td>-5.4</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Table C.63. WWIII performance metrics for NDBC Station 46063 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>11</td>
<td>24.3</td>
<td>0.40</td>
<td>3</td>
<td>9.7</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>4.4</td>
<td>0.14</td>
<td>0.04</td>
<td>1.8</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>11.1</td>
<td>0.14</td>
<td>0.9</td>
<td>10.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.06</td>
<td>0.4</td>
<td>0.18</td>
<td>0.00</td>
<td>-1.2</td>
<td>0.68</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.0</td>
<td>-1.0</td>
<td>0.05</td>
<td>-3</td>
<td>-1.1</td>
<td>0.56</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-1.9</td>
<td>0.11</td>
<td>-0.02</td>
<td>-2.2</td>
<td>0.69</td>
</tr>
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</table>
Table C.64. WWIII performance metrics for NDBC Station 46063 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>20</td>
<td>21.6</td>
<td>0.58</td>
<td>0</td>
<td>0.4</td>
<td>0.88</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.44</td>
<td>2.4</td>
<td>0.19</td>
<td>-0.03</td>
<td>-1.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>10.6</td>
<td>0.14</td>
<td>0.9</td>
<td>9.2</td>
<td>0.87</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-2.9</td>
<td>0.18</td>
<td>-0.02</td>
<td>-4.9</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.3</td>
<td>-0.6</td>
<td>0.07</td>
<td>-2</td>
<td>-0.6</td>
<td>0.51</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-1.8</td>
<td>0.11</td>
<td>-0.02</td>
<td>-2.4</td>
<td>0.70</td>
</tr>
</tbody>
</table>

C.1.11 Station 46087

Table C.65. UnSWAN performance metrics for NDBC Station 46087 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>12</td>
<td>38.8</td>
<td>0.66</td>
<td>3</td>
<td>15.0</td>
<td>0.87</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.45</td>
<td>9.6</td>
<td>0.23</td>
<td>0.08</td>
<td>4.9</td>
<td>0.89</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.0</td>
<td>0.13</td>
<td>0.7</td>
<td>8.2</td>
<td>0.82</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>3.3</td>
<td>0.22</td>
<td>0.00</td>
<td>0.4</td>
<td>0.58</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.6</td>
<td>-1.4</td>
<td>0.09</td>
<td>-7</td>
<td>-2.5</td>
<td>0.58</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.14</td>
<td>14.2</td>
<td>0.17</td>
<td>0.10</td>
<td>11.9</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Table C.66. UnSWAN performance metrics for NDBC Station 46087 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>35.0</td>
<td>0.64</td>
<td>4</td>
<td>15.1</td>
<td>0.85</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.45</td>
<td>8.8</td>
<td>0.21</td>
<td>0.11</td>
<td>5.2</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>8.2</td>
<td>0.11</td>
<td>0.7</td>
<td>7.3</td>
<td>0.87</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>0.8</td>
<td>0.22</td>
<td>-0.01</td>
<td>-1.7</td>
<td>0.55</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.4</td>
<td>2.3</td>
<td>0.09</td>
<td>2</td>
<td>0.7</td>
<td>0.55</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.13</td>
<td>13.1</td>
<td>0.16</td>
<td>0.09</td>
<td>11.1</td>
<td>0.39</td>
</tr>
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</table>

Table C.67. UnSWAN performance metrics for NDBC Station 46087 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>37.6</td>
<td>0.65</td>
<td>4</td>
<td>14.0</td>
<td>0.88</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.45</td>
<td>8.9</td>
<td>0.22</td>
<td>0.09</td>
<td>4.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>8.7</td>
<td>0.12</td>
<td>0.7</td>
<td>7.9</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>4.7</td>
<td>0.23</td>
<td>0.01</td>
<td>2.3</td>
<td>0.50</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.1</td>
<td>0.1</td>
<td>0.06</td>
<td>-1</td>
<td>-0.4</td>
<td>0.66</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>8.2</td>
<td>0.12</td>
<td>0.06</td>
<td>6.8</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Table C.68. UnSWAN performance metrics for NDBC Station 46087 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>38</td>
<td>31.9</td>
<td>0.57</td>
<td>11</td>
<td>16.8</td>
<td>0.88</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.63</td>
<td>7.5</td>
<td>0.20</td>
<td>0.19</td>
<td>5.9</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>10.4</td>
<td>0.13</td>
<td>0.9</td>
<td>8.9</td>
<td>0.80</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-3.5</td>
<td>0.24</td>
<td>-0.02</td>
<td>-6.3</td>
<td>0.46</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>27.5</td>
<td>5.5</td>
<td>0.11</td>
<td>9</td>
<td>3.6</td>
<td>0.28</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>8.2</td>
<td>0.13</td>
<td>0.06</td>
<td>6.4</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Table C.69. UnSWAN performance metrics for NDBC Station 46087 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>11</td>
<td>19.0</td>
<td>0.56</td>
<td>2</td>
<td>8.8</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>2.3</td>
<td>0.20</td>
<td>0.00</td>
<td>0.1</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>9.0</td>
<td>0.13</td>
<td>0.7</td>
<td>8.1</td>
<td>0.87</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>3.9</td>
<td>0.23</td>
<td>0.00</td>
<td>1.2</td>
<td>0.55</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>18.6</td>
<td>1.5</td>
<td>0.07</td>
<td>1</td>
<td>0.4</td>
<td>0.69</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>4.9</td>
<td>0.10</td>
<td>0.03</td>
<td>3.6</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Table C.70. UnSWAN performance metrics for NDBC Station 46087 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>11</td>
<td>20.7</td>
<td>0.54</td>
<td>0</td>
<td>1.4</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>2.8</td>
<td>0.21</td>
<td>-0.03</td>
<td>-1.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.1</td>
<td>0.11</td>
<td>0.7</td>
<td>7.4</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>5.3</td>
<td>0.21</td>
<td>0.01</td>
<td>2.7</td>
<td>0.63</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>17.3</td>
<td>0.7</td>
<td>0.07</td>
<td>0</td>
<td>0.0</td>
<td>0.59</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>4.4</td>
<td>0.10</td>
<td>0.03</td>
<td>3.1</td>
<td>0.57</td>
</tr>
</tbody>
</table>

C.1.12 Station 46041

Table C.71. WWIII performance metrics for NDBC Station 46041 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>27</td>
<td>37.1</td>
<td>0.48</td>
<td>11</td>
<td>19.2</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.43</td>
<td>7.6</td>
<td>0.15</td>
<td>0.15</td>
<td>5.3</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.1</td>
<td>0.14</td>
<td>1.0</td>
<td>10.8</td>
<td>0.87</td>
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<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>2.3</td>
<td>0.18</td>
<td>0.00</td>
<td>0.7</td>
<td>0.69</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.2</td>
<td>1.2</td>
<td>0.08</td>
<td>1</td>
<td>0.3</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>3.7</td>
<td>0.11</td>
<td>0.02</td>
<td>2.4</td>
<td>0.60</td>
</tr>
</tbody>
</table>
### Table C.72. WWIII performance metrics for NDBC Station 46041 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>33.8</td>
<td>0.46</td>
<td>2</td>
<td>7.2</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>6.3</td>
<td>0.16</td>
<td>0.04</td>
<td>1.9</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.0</td>
<td>0.15</td>
<td>1.0</td>
<td>10.8</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>3.6</td>
<td>0.20</td>
<td>0.00</td>
<td>1.4</td>
<td>0.66</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>20.7</td>
<td>2.8</td>
<td>0.08</td>
<td>-6</td>
<td>-2.1</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>2.2</td>
<td>0.11</td>
<td>0.01</td>
<td>0.9</td>
<td>0.55</td>
</tr>
</tbody>
</table>

### Table C.73. WWIII performance metrics for NDBC Station 46041 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>33.6</td>
<td>0.53</td>
<td>3</td>
<td>7.7</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.36</td>
<td>5.8</td>
<td>0.16</td>
<td>0.04</td>
<td>1.7</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.6</td>
<td>0.15</td>
<td>1.0</td>
<td>11.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>4.1</td>
<td>0.21</td>
<td>0.01</td>
<td>2.0</td>
<td>0.63</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>20.5</td>
<td>-0.7</td>
<td>0.08</td>
<td>-4</td>
<td>-1.6</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>0.4</td>
<td>0.11</td>
<td>-0.01</td>
<td>-0.8</td>
<td>0.48</td>
</tr>
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</table>

### Table C.74. WWIII performance metrics for NDBC Station 46041 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>33</td>
<td>22.4</td>
<td>0.45</td>
<td>3</td>
<td>4.0</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.48</td>
<td>3.5</td>
<td>0.15</td>
<td>0.01</td>
<td>0.3</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>7.9</td>
<td>0.10</td>
<td>0.7</td>
<td>7.1</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.05</td>
<td>-1.8</td>
<td>0.16</td>
<td>-0.01</td>
<td>-3.5</td>
<td>0.71</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.6</td>
<td>1.6</td>
<td>0.06</td>
<td>2</td>
<td>0.9</td>
<td>0.85</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>4.5</td>
<td>0.10</td>
<td>0.03</td>
<td>3.1</td>
<td>0.71</td>
</tr>
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</table>

### Table C.75. WWIII performance metrics for NDBC Station 46041 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>10</td>
<td>43.0</td>
<td>0.49</td>
<td>2</td>
<td>9.9</td>
<td>0.96</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.27</td>
<td>8.7</td>
<td>0.15</td>
<td>0.08</td>
<td>4.0</td>
<td>0.97</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>15.0</td>
<td>0.17</td>
<td>1.1</td>
<td>13.7</td>
<td>0.84</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>6.6</td>
<td>0.21</td>
<td>0.02</td>
<td>4.3</td>
<td>0.66</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.9</td>
<td>-3.8</td>
<td>0.08</td>
<td>-12</td>
<td>-4.3</td>
<td>0.72</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>-3.8</td>
<td>0.10</td>
<td>-0.04</td>
<td>-4.6</td>
<td>0.56</td>
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</table>

C.19
### Table C.76. WWIII performance metrics for NDBC Station 46041 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>22.8</td>
<td>0.51</td>
<td>3</td>
<td>10.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>4.5</td>
<td>0.15</td>
<td>0.05</td>
<td>2.3</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.6</td>
<td>0.11</td>
<td>0.7</td>
<td>7.8</td>
<td>0.93</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-4.1</td>
<td>0.17</td>
<td>-0.02</td>
<td>-4.9</td>
<td>0.71</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>18.8</td>
<td>-0.2</td>
<td>0.07</td>
<td>-2</td>
<td>-0.9</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>4.6</td>
<td>0.11</td>
<td>0.03</td>
<td>3.2</td>
<td>0.52</td>
</tr>
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</table>

### Table C.77. WWIII performance metrics for NDBC Station 46041 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>24.2</td>
<td>0.45</td>
<td>2</td>
<td>6.3</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>5.3</td>
<td>0.15</td>
<td>0.04</td>
<td>1.8</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.1</td>
<td>0.11</td>
<td>0.7</td>
<td>7.5</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.05</td>
<td>-4.2</td>
<td>0.15</td>
<td>-0.02</td>
<td>-4.9</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.3</td>
<td>-0.2</td>
<td>0.07</td>
<td>-2</td>
<td>-0.9</td>
<td>0.75</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>4.9</td>
<td>0.11</td>
<td>0.03</td>
<td>3.6</td>
<td>0.57</td>
</tr>
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</table>

### Table C.78. WWIII performance metrics for NDBC Station 46041 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>23.9</td>
<td>0.46</td>
<td>2</td>
<td>5.4</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>5.3</td>
<td>0.14</td>
<td>0.05</td>
<td>2.1</td>
<td>0.97</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.1</td>
<td>0.11</td>
<td>0.7</td>
<td>7.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.0</td>
<td>0.16</td>
<td>-0.02</td>
<td>-5.8</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.5</td>
<td>-0.9</td>
<td>0.08</td>
<td>-4</td>
<td>-1.5</td>
<td>0.60</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>4.6</td>
<td>0.11</td>
<td>0.03</td>
<td>3.5</td>
<td>0.58</td>
</tr>
</tbody>
</table>

### Table C.79. WWIII performance metrics for NDBC Station 46041 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>30</td>
<td>31.2</td>
<td>0.51</td>
<td>10</td>
<td>17.4</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.44</td>
<td>8.4</td>
<td>0.15</td>
<td>0.17</td>
<td>5.8</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>7.9</td>
<td>0.11</td>
<td>0.7</td>
<td>7.2</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-10.1</td>
<td>0.20</td>
<td>-0.04</td>
<td>-11.5</td>
<td>0.62</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.0</td>
<td>-1.7</td>
<td>0.09</td>
<td>-6</td>
<td>-2.2</td>
<td>0.39</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.20</td>
<td>24.7</td>
<td>0.28</td>
<td>0.15</td>
<td>21.0</td>
<td>-0.05</td>
</tr>
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</table>
Table C.80. WWIII performance metrics for NDBC Station 46041 for 2001.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>28.3</td>
<td>0.53</td>
<td>2</td>
<td>6.2</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>6.8</td>
<td>0.15</td>
<td>0.07</td>
<td>3.0</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.2</td>
<td>0.11</td>
<td>0.6</td>
<td>7.3</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-2.5</td>
<td>0.15</td>
<td>-0.01</td>
<td>-3.6</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>18.6</td>
<td>-2.0</td>
<td>0.07</td>
<td>-7</td>
<td>-2.5</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>3.3</td>
<td>0.10</td>
<td>0.02</td>
<td>2.0</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Table C.81. WWIII performance metrics for NDBC Station 46041 for 2000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>27.8</td>
<td>0.50</td>
<td>4</td>
<td>10.1</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>6.6</td>
<td>0.15</td>
<td>0.08</td>
<td>3.3</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>8.2</td>
<td>0.11</td>
<td>0.7</td>
<td>7.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.5</td>
<td>0.16</td>
<td>-0.02</td>
<td>-6.3</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>23.8</td>
<td>-0.2</td>
<td>0.09</td>
<td>-2</td>
<td>-0.8</td>
<td>0.36</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.11</td>
<td>7.3</td>
<td>0.13</td>
<td>0.05</td>
<td>5.9</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table C.82. WWIII performance metrics for NDBC Station 46041 for 1999.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>49.6</td>
<td>0.48</td>
<td>5</td>
<td>16.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>12.9</td>
<td>0.16</td>
<td>0.14</td>
<td>7.0</td>
<td>0.97</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.0</td>
<td>0.13</td>
<td>0.9</td>
<td>10.2</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-2.3</td>
<td>0.17</td>
<td>-0.01</td>
<td>-3.5</td>
<td>0.69</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.4</td>
<td>-2.9</td>
<td>0.07</td>
<td>-9</td>
<td>-3.3</td>
<td>0.72</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>0.9</td>
<td>0.10</td>
<td>0.00</td>
<td>-0.1</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Table C.83. WWIII performance metrics for NDBC Station 46041 for 1998.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>25</td>
<td>75.1</td>
<td>1.07</td>
<td>11</td>
<td>46.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.47</td>
<td>22.4</td>
<td>0.25</td>
<td>0.34</td>
<td>17.9</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.3</td>
<td>0.14</td>
<td>0.9</td>
<td>10.5</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>2.8</td>
<td>0.17</td>
<td>0.01</td>
<td>1.4</td>
<td>0.73</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>18.7</td>
<td>-1.3</td>
<td>0.07</td>
<td>-6</td>
<td>-2.3</td>
<td>0.65</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>0.9</td>
<td>0.12</td>
<td>0.00</td>
<td>-0.6</td>
<td>0.36</td>
</tr>
</tbody>
</table>
### C.2 CDIP Tables

#### C.2.1 Station 46215

**Table C.84.** UnSWAN performance metrics for CDIP Station 46215 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>33.5</td>
<td>0.69</td>
<td>5</td>
<td>25.2</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.32</td>
<td>7.9</td>
<td>0.19</td>
<td>0.10</td>
<td>6.0</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>12.3</td>
<td>0.15</td>
<td>1.1</td>
<td>11.7</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.2</td>
<td>0.16</td>
<td>-0.02</td>
<td>-5.6</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.8</td>
<td>-0.5</td>
<td>0.04</td>
<td>-2</td>
<td>-0.6</td>
<td>0.68</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.5</td>
<td>0.06</td>
<td>0.02</td>
<td>2.4</td>
<td>0.82</td>
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**Table C.85.** UnSWAN performance metrics for CDIP Station 46215 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>7</td>
<td>29.3</td>
<td>0.49</td>
<td>2</td>
<td>15.2</td>
<td>0.88</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.26</td>
<td>7.8</td>
<td>0.17</td>
<td>0.07</td>
<td>4.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>8.9</td>
<td>0.13</td>
<td>0.8</td>
<td>8.3</td>
<td>0.87</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.1</td>
<td>0.16</td>
<td>-0.02</td>
<td>-5.5</td>
<td>0.77</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>9.9</td>
<td>0.1</td>
<td>0.04</td>
<td>0</td>
<td>0.0</td>
<td>0.80</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.8</td>
<td>0.06</td>
<td>0.02</td>
<td>2.6</td>
<td>0.80</td>
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</table>

**Table C.86.** UnSWAN performance metrics for CDIP Station 46215 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>9</td>
<td>27.9</td>
<td>0.57</td>
<td>2</td>
<td>14.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.27</td>
<td>6.5</td>
<td>0.17</td>
<td>0.05</td>
<td>3.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>10.0</td>
<td>0.14</td>
<td>0.9</td>
<td>9.6</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.4</td>
<td>0.16</td>
<td>-0.02</td>
<td>-6.0</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.6</td>
<td>-0.5</td>
<td>0.04</td>
<td>-2</td>
<td>-0.6</td>
<td>0.73</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.3</td>
<td>0.06</td>
<td>0.02</td>
<td>2.2</td>
<td>0.77</td>
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</table>

**Table C.87.** UnSWAN performance metrics for CDIP Station 46215 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>9</td>
<td>27.4</td>
<td>0.59</td>
<td>2</td>
<td>16.1</td>
<td>0.86</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.27</td>
<td>6.2</td>
<td>0.17</td>
<td>0.06</td>
<td>3.6</td>
<td>0.89</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>9.9</td>
<td>0.14</td>
<td>0.9</td>
<td>9.5</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.3</td>
<td>0.16</td>
<td>-0.03</td>
<td>-7.0</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>9.2</td>
<td>0.7</td>
<td>0.03</td>
<td>2</td>
<td>0.6</td>
<td>0.70</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>3.7</td>
<td>0.06</td>
<td>0.03</td>
<td>3.6</td>
<td>0.82</td>
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</table>
Table C.88. UnSWAN performance metrics for CDIP Station 46215 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE (kW/m)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias (%)</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$</td>
<td>9</td>
<td>25.1</td>
<td>0.58</td>
<td>3</td>
<td>17.6</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.27</td>
<td>5.8</td>
<td>0.17</td>
<td>0.07</td>
<td>4.1</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>9.1</td>
<td>0.12</td>
<td>0.8</td>
<td>8.6</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.6</td>
<td>0.16</td>
<td>-0.03</td>
<td>-7.9</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.4</td>
<td>0.7</td>
<td>0.04</td>
<td>1</td>
<td>0.6</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>3.8</td>
<td>0.07</td>
<td>0.03</td>
<td>3.7</td>
<td>0.80</td>
</tr>
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</table>

Table C.89. UnSWAN performance metrics for CDIP Station 46215 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE (kW/m)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias (%)</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$</td>
<td>8</td>
<td>21.3</td>
<td>0.52</td>
<td>2</td>
<td>12.9</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.26</td>
<td>4.4</td>
<td>0.16</td>
<td>0.04</td>
<td>2.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>8.6</td>
<td>0.13</td>
<td>0.8</td>
<td>8.1</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.5</td>
<td>0.16</td>
<td>-0.03</td>
<td>-7.8</td>
<td>0.82</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.0</td>
<td>0.4</td>
<td>0.04</td>
<td>1</td>
<td>0.3</td>
<td>0.66</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>3.1</td>
<td>0.06</td>
<td>0.03</td>
<td>3.0</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Table C.90. UnSWAN performance metrics for CDIP Station 46215 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE (kW/m)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias (%)</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$</td>
<td>7</td>
<td>23.3</td>
<td>0.52</td>
<td>2</td>
<td>12.5</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.25</td>
<td>5.9</td>
<td>0.16</td>
<td>0.05</td>
<td>3.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>7.2</td>
<td>0.12</td>
<td>0.6</td>
<td>6.6</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.2</td>
<td>0.14</td>
<td>-0.03</td>
<td>-6.4</td>
<td>0.82</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.0</td>
<td>0.2</td>
<td>0.04</td>
<td>0</td>
<td>0.1</td>
<td>0.68</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.6</td>
<td>0.06</td>
<td>0.02</td>
<td>2.6</td>
<td>0.79</td>
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</table>

Table C.91. UnSWAN performance metrics for CDIP Station 46215 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE (kW/m)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias (%)</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$</td>
<td>7</td>
<td>28.2</td>
<td>0.50</td>
<td>2</td>
<td>16.0</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.25</td>
<td>7.8</td>
<td>0.17</td>
<td>0.08</td>
<td>5.1</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>7.3</td>
<td>0.11</td>
<td>0.6</td>
<td>6.6</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.6</td>
<td>0.15</td>
<td>-0.03</td>
<td>-7.9</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>9.5</td>
<td>0.5</td>
<td>0.04</td>
<td>1</td>
<td>0.4</td>
<td>0.80</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>3.0</td>
<td>0.07</td>
<td>0.03</td>
<td>3.0</td>
<td>0.76</td>
</tr>
</tbody>
</table>
Table C.92. UnSWAN performance metrics for CDIP Station 46215 for 2002.

<table>
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<th>Parameter</th>
<th>RMSE (%)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>10</td>
<td>24.6</td>
<td>0.62</td>
<td>2</td>
<td>15.5</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.26</td>
<td>6.4</td>
<td>0.17</td>
<td>0.07</td>
<td>4.4</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>7.1</td>
<td>0.11</td>
<td>0.6</td>
<td>6.7</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.6</td>
<td>0.15</td>
<td>-0.03</td>
<td>-7.9</td>
<td>0.85</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>9.3</td>
<td>0.3</td>
<td>0.03</td>
<td>1</td>
<td>0.2</td>
<td>0.75</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>3.5</td>
<td>0.06</td>
<td>0.03</td>
<td>3.4</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Table C.93. UnSWAN performance metrics for CDIP Station 46215 for 2001.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE (%)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>10</td>
<td>24.3</td>
<td>0.54</td>
<td>2</td>
<td>11.6</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.28</td>
<td>6.6</td>
<td>0.17</td>
<td>0.06</td>
<td>3.8</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>5.9</td>
<td>0.11</td>
<td>0.5</td>
<td>5.3</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.3</td>
<td>0.15</td>
<td>-0.03</td>
<td>-7.8</td>
<td>0.82</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.1</td>
<td>1.1</td>
<td>0.04</td>
<td>3</td>
<td>1.1</td>
<td>0.70</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.9</td>
<td>0.06</td>
<td>0.02</td>
<td>2.8</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Table C.94. UnSWAN performance metrics for CDIP Station 46215 for 2000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE (%)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>9</td>
<td>27.1</td>
<td>0.52</td>
<td>2</td>
<td>12.2</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.26</td>
<td>7.9</td>
<td>0.17</td>
<td>0.08</td>
<td>5.0</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>5.9</td>
<td>0.11</td>
<td>0.5</td>
<td>5.1</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.0</td>
<td>0.14</td>
<td>-0.03</td>
<td>-6.4</td>
<td>0.84</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.3</td>
<td>1.0</td>
<td>0.04</td>
<td>2</td>
<td>0.9</td>
<td>0.73</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>4.4</td>
<td>0.07</td>
<td>0.04</td>
<td>4.3</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Table C.95. UnSWAN performance metrics for CDIP Station 46215 for 1999.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE (%)</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>8</td>
<td>28.1</td>
<td>0.44</td>
<td>2</td>
<td>10.0</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.27</td>
<td>7.2</td>
<td>0.16</td>
<td>0.06</td>
<td>3.4</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>8.1</td>
<td>0.11</td>
<td>0.7</td>
<td>7.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.0</td>
<td>0.15</td>
<td>-0.03</td>
<td>-7.3</td>
<td>0.84</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.0</td>
<td>0.7</td>
<td>0.04</td>
<td>2</td>
<td>0.6</td>
<td>0.72</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>3.2</td>
<td>0.06</td>
<td>0.03</td>
<td>3.2</td>
<td>0.83</td>
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</tbody>
</table>

C.24
Table C.96. UnSWAN performance metrics for CDIP Station 46215 for 1998.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>19</td>
<td>32.7</td>
<td>0.74</td>
<td>6</td>
<td>23.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.36</td>
<td>9.9</td>
<td>0.19</td>
<td>0.14</td>
<td>7.5</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>7.3</td>
<td>0.12</td>
<td>0.7</td>
<td>6.8</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.9</td>
<td>0.15</td>
<td>-0.03</td>
<td>-7.4</td>
<td>0.82</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.7</td>
<td>1.9</td>
<td>0.04</td>
<td>5</td>
<td>1.8</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>5.0</td>
<td>0.07</td>
<td>0.04</td>
<td>4.9</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Table C.97. UnSWAN performance metrics for CDIP Station 46215 for 1997.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>10</td>
<td>37.8</td>
<td>0.59</td>
<td>4</td>
<td>21.5</td>
<td>0.85</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.31</td>
<td>10.2</td>
<td>0.19</td>
<td>0.12</td>
<td>7.1</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.5</td>
<td>10.5</td>
<td>0.15</td>
<td>1.0</td>
<td>9.9</td>
<td>0.85</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-8.0</td>
<td>0.16</td>
<td>-0.03</td>
<td>-8.5</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.0</td>
<td>1.0</td>
<td>0.04</td>
<td>2</td>
<td>0.9</td>
<td>0.68</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>5.3</td>
<td>0.08</td>
<td>0.04</td>
<td>5.2</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Table C.98. UnSWAN performance metrics for CDIP Station 46215 for 1996.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>5</td>
<td>25.5</td>
<td>0.41</td>
<td>1</td>
<td>10.8</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.22</td>
<td>6.4</td>
<td>0.15</td>
<td>0.05</td>
<td>3.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>7.8</td>
<td>0.12</td>
<td>0.6</td>
<td>7.1</td>
<td>0.86</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.1</td>
<td>0.15</td>
<td>-0.03</td>
<td>-7.9</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.7</td>
<td>0.3</td>
<td>0.04</td>
<td>0</td>
<td>0.2</td>
<td>0.80</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.1</td>
<td>0.06</td>
<td>0.02</td>
<td>1.9</td>
<td>0.76</td>
</tr>
</tbody>
</table>

C.2.2 Station 46236

Table C.99. UnSWAN performance metrics for CDIP Station 46236 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>37.8</td>
<td>0.73</td>
<td>5</td>
<td>26.2</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>13.6</td>
<td>0.21</td>
<td>0.20</td>
<td>11.1</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>13.3</td>
<td>0.15</td>
<td>1.1</td>
<td>12.3</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-10.7</td>
<td>0.19</td>
<td>-0.04</td>
<td>-11.8</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.2</td>
<td>1.2</td>
<td>0.04</td>
<td>3</td>
<td>1.2</td>
<td>0.67</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.04</td>
<td>1.0</td>
<td>0.04</td>
<td>0.01</td>
<td>1.0</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Table C.100. UnSWAN performance metrics for CDIP Station 46236 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>8</td>
<td>37.9</td>
<td>0.58</td>
<td>3</td>
<td>20.8</td>
<td>0.87</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.31</td>
<td>13.0</td>
<td>0.20</td>
<td>0.15</td>
<td>9.6</td>
<td>0.91</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>14.2</td>
<td>0.16</td>
<td>1.2</td>
<td>13.1</td>
<td>0.88</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.08</td>
<td>-14.5</td>
<td>0.22</td>
<td>-0.06</td>
<td>-15.6</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>9.6</td>
<td>1.4</td>
<td>0.03</td>
<td>4</td>
<td>1.3</td>
<td>0.82</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.9</td>
<td>0.05</td>
<td>0.02</td>
<td>2.8</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Table C.101. UnSWAN performance metrics for CDIP Station 46236 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>8</td>
<td>33.5</td>
<td>0.56</td>
<td>3</td>
<td>18.6</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.30</td>
<td>11.7</td>
<td>0.19</td>
<td>0.14</td>
<td>8.8</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>14.2</td>
<td>0.16</td>
<td>1.1</td>
<td>13.1</td>
<td>0.88</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.09</td>
<td>-14.6</td>
<td>0.23</td>
<td>-0.06</td>
<td>-15.9</td>
<td>0.73</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>8.9</td>
<td>0.8</td>
<td>0.03</td>
<td>2</td>
<td>0.8</td>
<td>0.78</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>1.9</td>
<td>0.05</td>
<td>0.02</td>
<td>1.8</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Table C.102. UnSWAN performance metrics for CDIP Station 46236 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>10</td>
<td>39.6</td>
<td>0.82</td>
<td>3</td>
<td>24.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.29</td>
<td>14.1</td>
<td>0.20</td>
<td>0.16</td>
<td>11.1</td>
<td>0.92</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>15.2</td>
<td>0.17</td>
<td>1.1</td>
<td>13.5</td>
<td>0.89</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.09</td>
<td>-15.3</td>
<td>0.23</td>
<td>-0.06</td>
<td>-16.6</td>
<td>0.77</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.2</td>
<td>1.5</td>
<td>0.04</td>
<td>4</td>
<td>1.4</td>
<td>0.56</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.2</td>
<td>0.05</td>
<td>0.02</td>
<td>2.0</td>
<td>0.76</td>
</tr>
</tbody>
</table>

C.2.3 Station 46211

Table C.103. UnSWAN performance metrics for CDIP Station 46211 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>21</td>
<td>41.9</td>
<td>0.57</td>
<td>8</td>
<td>22.7</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>10.0</td>
<td>0.16</td>
<td>0.15</td>
<td>6.6</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.6</td>
<td>0.14</td>
<td>1.0</td>
<td>11.4</td>
<td>0.91</td>
</tr>
<tr>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>-2.9</td>
<td>0.18</td>
<td>-0.01</td>
<td>-4.0</td>
<td>0.73</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>12.6</td>
<td>-1.0</td>
<td>0.05</td>
<td>-3</td>
<td>-1.3</td>
<td>0.86</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>1.9</td>
<td>0.05</td>
<td>0.01</td>
<td>1.6</td>
<td>0.67</td>
</tr>
</tbody>
</table>
Table C.104. UnSWAN performance metrics for CDIP Station 46211 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>37.4</td>
<td>0.55</td>
<td>4</td>
<td>15.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>8.3</td>
<td>0.17</td>
<td>0.08</td>
<td>4.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.1</td>
<td>0.14</td>
<td>0.9</td>
<td>10.1</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-6.1</td>
<td>0.20</td>
<td>-0.03</td>
<td>-7.7</td>
<td>0.72</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>12.4</td>
<td>-1.7</td>
<td>0.05</td>
<td>-5</td>
<td>-1.9</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>3.2</td>
<td>0.06</td>
<td>0.02</td>
<td>2.8</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Table C.105. UnSWAN performance metrics for CDIP Station 46211 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>34.2</td>
<td>0.55</td>
<td>4</td>
<td>15.2</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.32</td>
<td>7.4</td>
<td>0.16</td>
<td>0.07</td>
<td>3.6</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.3</td>
<td>0.13</td>
<td>0.9</td>
<td>10.2</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.8</td>
<td>0.17</td>
<td>-0.03</td>
<td>-7.1</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.5</td>
<td>-1.2</td>
<td>0.05</td>
<td>-4</td>
<td>-1.6</td>
<td>0.80</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.9</td>
<td>0.06</td>
<td>0.02</td>
<td>2.6</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Table C.106. UnSWAN performance metrics for CDIP Station 46211 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>36.5</td>
<td>0.55</td>
<td>4</td>
<td>14.0</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>8.5</td>
<td>0.16</td>
<td>0.08</td>
<td>4.0</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.0</td>
<td>0.13</td>
<td>0.9</td>
<td>9.9</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.0</td>
<td>0.17</td>
<td>-0.02</td>
<td>-6.2</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.3</td>
<td>-1.1</td>
<td>0.04</td>
<td>-3</td>
<td>-1.3</td>
<td>0.85</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.9</td>
<td>0.05</td>
<td>0.02</td>
<td>2.7</td>
<td>0.71</td>
</tr>
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</table>

Table C.107. UnSWAN performance metrics for CDIP Station 46211 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>22</td>
<td>26.7</td>
<td>0.65</td>
<td>4</td>
<td>10.3</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>5.1</td>
<td>0.16</td>
<td>0.04</td>
<td>1.8</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>10.3</td>
<td>0.13</td>
<td>0.8</td>
<td>9.4</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-4.4</td>
<td>0.16</td>
<td>-0.02</td>
<td>-5.6</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>12.0</td>
<td>-1.5</td>
<td>0.04</td>
<td>-5</td>
<td>-1.8</td>
<td>0.85</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.04</td>
<td>1.7</td>
<td>0.05</td>
<td>0.01</td>
<td>1.5</td>
<td>0.74</td>
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</table>
Table C.108. UnSWAN performance metrics for CDIP Station 46211 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>28.5</td>
<td>0.54</td>
<td>4</td>
<td>15.1</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.30</td>
<td>5.9</td>
<td>0.15</td>
<td>0.06</td>
<td>2.9</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.7</td>
<td>0.12</td>
<td>0.8</td>
<td>8.8</td>
<td>0.94</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.2</td>
<td>0.18</td>
<td>-0.03</td>
<td>-7.3</td>
<td>0.74</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.0</td>
<td>-1.1</td>
<td>0.04</td>
<td>-4</td>
<td>-1.3</td>
<td>0.86</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.1</td>
<td>0.05</td>
<td>0.02</td>
<td>1.8</td>
<td>0.72</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>11</td>
<td>20.6</td>
<td>0.41</td>
<td>2</td>
<td>6.2</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.29</td>
<td>3.1</td>
<td>0.15</td>
<td>0.00</td>
<td>0.0</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.2</td>
<td>0.12</td>
<td>0.8</td>
<td>8.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-5.5</td>
<td>0.16</td>
<td>-0.02</td>
<td>-6.7</td>
<td>0.80</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.1</td>
<td>-0.9</td>
<td>0.05</td>
<td>-4</td>
<td>-1.3</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>3.0</td>
<td>0.06</td>
<td>0.02</td>
<td>2.7</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Table C.110. UnSWAN performance metrics for CDIP Station 46211 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>25.5</td>
<td>0.57</td>
<td>2</td>
<td>6.4</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>5.0</td>
<td>0.16</td>
<td>0.03</td>
<td>1.4</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.3</td>
<td>0.12</td>
<td>0.7</td>
<td>8.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.2</td>
<td>0.17</td>
<td>-0.03</td>
<td>-7.2</td>
<td>0.81</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.8</td>
<td>-1.0</td>
<td>0.04</td>
<td>-3</td>
<td>-1.2</td>
<td>0.83</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.9</td>
<td>0.06</td>
<td>0.02</td>
<td>2.6</td>
<td>0.75</td>
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</table>

Table C.111. UnSWAN performance metrics for CDIP Station 46211 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>28.4</td>
<td>0.62</td>
<td>4</td>
<td>14.6</td>
<td>0.95</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.29</td>
<td>6.2</td>
<td>0.15</td>
<td>0.05</td>
<td>2.9</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.8</td>
<td>0.12</td>
<td>0.8</td>
<td>9.0</td>
<td>0.93</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-6.4</td>
<td>0.18</td>
<td>-0.03</td>
<td>-7.7</td>
<td>0.80</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.2</td>
<td>-1.3</td>
<td>0.05</td>
<td>-5</td>
<td>-1.7</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.3</td>
<td>0.06</td>
<td>0.02</td>
<td>2.1</td>
<td>0.71</td>
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</tbody>
</table>
### Table C.112. UnSWAN performance metrics for CDIP Station 46211 for 2001.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>32</td>
<td>33.2</td>
<td>1.00</td>
<td>3</td>
<td>7.9</td>
<td>0.73</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.57</td>
<td>5.2</td>
<td>0.27</td>
<td>0.01</td>
<td>0.7</td>
<td>0.86</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>9.7</td>
<td>0.14</td>
<td>0.7</td>
<td>8.2</td>
<td>0.86</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.07</td>
<td>-6.1</td>
<td>0.21</td>
<td>-0.03</td>
<td>-7.8</td>
<td>0.68</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.6</td>
<td>-1.0</td>
<td>0.05</td>
<td>-3</td>
<td>-1.3</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>2.4</td>
<td>0.06</td>
<td>0.02</td>
<td>2.1</td>
<td>0.62</td>
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</table>

### Table C.113. UnSWAN performance metrics for CDIP Station 46211 for 2000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>37.5</td>
<td>0.60</td>
<td>5</td>
<td>19.4</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.33</td>
<td>8.8</td>
<td>0.17</td>
<td>0.10</td>
<td>5.2</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>10.3</td>
<td>0.13</td>
<td>0.8</td>
<td>9.1</td>
<td>0.93</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.07</td>
<td>-7.2</td>
<td>0.17</td>
<td>-0.03</td>
<td>-8.5</td>
<td>0.82</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.2</td>
<td>-0.8</td>
<td>0.05</td>
<td>-3</td>
<td>-1.3</td>
<td>0.79</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>3.4</td>
<td>0.06</td>
<td>0.03</td>
<td>3.0</td>
<td>0.78</td>
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</table>

### Table C.114. UnSWAN performance metrics for CDIP Station 46211 for 1999.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>38.6</td>
<td>0.54</td>
<td>5</td>
<td>16.9</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.32</td>
<td>8.9</td>
<td>0.15</td>
<td>0.10</td>
<td>4.5</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.6</td>
<td>0.14</td>
<td>1.0</td>
<td>10.7</td>
<td>0.91</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.2</td>
<td>0.17</td>
<td>-0.03</td>
<td>-7.4</td>
<td>0.77</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.7</td>
<td>-1.0</td>
<td>0.04</td>
<td>-3</td>
<td>-1.1</td>
<td>0.83</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.7</td>
<td>0.05</td>
<td>0.02</td>
<td>2.5</td>
<td>0.71</td>
</tr>
</tbody>
</table>

### Table C.115. UnSWAN performance metrics for CDIP Station 46211 for 1998.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>28</td>
<td>39.4</td>
<td>0.71</td>
<td>10</td>
<td>26.0</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>9.7</td>
<td>0.17</td>
<td>0.15</td>
<td>6.6</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>10.9</td>
<td>0.13</td>
<td>0.9</td>
<td>10.0</td>
<td>0.92</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.06</td>
<td>-4.4</td>
<td>0.16</td>
<td>-0.02</td>
<td>-5.5</td>
<td>0.80</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.4</td>
<td>-0.7</td>
<td>0.04</td>
<td>-2</td>
<td>-0.9</td>
<td>0.83</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.5</td>
<td>0.05</td>
<td>0.02</td>
<td>2.2</td>
<td>0.75</td>
</tr>
</tbody>
</table>
### Table C.116. UnSWAN performance metrics for CDIP Station 46211 for 1997.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>22</td>
<td>43.8</td>
<td>0.64</td>
<td>9</td>
<td>25.7</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>10.7</td>
<td>0.18</td>
<td>0.16</td>
<td>7.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>11.6</td>
<td>0.15</td>
<td>1.0</td>
<td>11.0</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-3.9</td>
<td>0.16</td>
<td>-0.02</td>
<td>-4.9</td>
<td>0.80</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.0</td>
<td>-0.7</td>
<td>0.04</td>
<td>-2</td>
<td>-0.8</td>
<td>0.83</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.04</td>
<td>2.2</td>
<td>0.05</td>
<td>0.02</td>
<td>2.0</td>
<td>0.75</td>
</tr>
</tbody>
</table>

### Table C.117. UnSWAN performance metrics for CDIP Station 46211 for 1996.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>13</td>
<td>31.7</td>
<td>0.54</td>
<td>3</td>
<td>14.3</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.31</td>
<td>8.1</td>
<td>0.16</td>
<td>0.09</td>
<td>4.6</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>9.1</td>
<td>0.12</td>
<td>0.7</td>
<td>8.2</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-4.3</td>
<td>0.17</td>
<td>-0.02</td>
<td>-5.8</td>
<td>0.79</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>12.5</td>
<td>-0.9</td>
<td>0.05</td>
<td>-3</td>
<td>-1.3</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.6</td>
<td>0.06</td>
<td>0.02</td>
<td>2.3</td>
<td>0.70</td>
</tr>
</tbody>
</table>

### Table C.118. UnSWAN performance metrics for CDIP Station 46211 for 1995.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>19</td>
<td>40.9</td>
<td>0.66</td>
<td>7</td>
<td>24.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>10.3</td>
<td>0.19</td>
<td>0.14</td>
<td>7.0</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>10.4</td>
<td>0.13</td>
<td>0.9</td>
<td>9.5</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-6.3</td>
<td>0.18</td>
<td>-0.03</td>
<td>-7.6</td>
<td>0.76</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>10.8</td>
<td>-1.1</td>
<td>0.04</td>
<td>-3</td>
<td>-1.2</td>
<td>0.86</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.5</td>
<td>0.06</td>
<td>0.02</td>
<td>2.2</td>
<td>0.72</td>
</tr>
</tbody>
</table>

### Table C.119. UnSWAN performance metrics for CDIP Station 46211 for 1994.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>39.1</td>
<td>0.55</td>
<td>7</td>
<td>21.9</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>9.7</td>
<td>0.16</td>
<td>0.13</td>
<td>6.2</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>10.7</td>
<td>0.13</td>
<td>0.9</td>
<td>9.7</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-7.1</td>
<td>0.17</td>
<td>-0.03</td>
<td>-8.3</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.5</td>
<td>-0.4</td>
<td>0.04</td>
<td>-2</td>
<td>-0.6</td>
<td>0.78</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.6</td>
<td>0.05</td>
<td>0.02</td>
<td>2.4</td>
<td>0.77</td>
</tr>
</tbody>
</table>
Table C.120. UnSWAN performance metrics for CDIP Station 46211 for 1993.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>19</td>
<td>54.0</td>
<td>0.71</td>
<td>8</td>
<td>30.5</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>13.0</td>
<td>0.19</td>
<td>0.18</td>
<td>9.3</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>13.5</td>
<td>0.16</td>
<td>1.2</td>
<td>12.0</td>
<td>0.82</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>-8.2</td>
<td>0.22</td>
<td>-0.04</td>
<td>-10.4</td>
<td>0.69</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.3</td>
<td>-2.3</td>
<td>0.05</td>
<td>-7</td>
<td>-2.4</td>
<td>0.69</td>
</tr>
<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.05</td>
<td>1.8</td>
<td>0.06</td>
<td>0.01</td>
<td>1.5</td>
<td>0.68</td>
</tr>
</tbody>
</table>

C.2.4 Station 46221

Table C.121. UnSWAN performance metrics for CDIP Station 46221 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>5</td>
<td>13.2</td>
<td>0.66</td>
<td>-1</td>
<td>-7.1</td>
<td>0.81</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.28</td>
<td>-2.5</td>
<td>0.24</td>
<td>-0.07</td>
<td>-5.9</td>
<td>0.83</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.4</td>
<td>17.7</td>
<td>0.26</td>
<td>1.6</td>
<td>16.8</td>
<td>0.70</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>0.5</td>
<td>0.25</td>
<td>-0.01</td>
<td>-1.4</td>
<td>0.46</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.1</td>
<td>-6.6</td>
<td>0.09</td>
<td>-16</td>
<td>-6.7</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.09</td>
<td>6.3</td>
<td>0.11</td>
<td>0.05</td>
<td>5.7</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Table C.122. UnSWAN performance metrics for CDIP Station 46221 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>5</td>
<td>13.2</td>
<td>0.66</td>
<td>-1</td>
<td>-7.1</td>
<td>0.81</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.28</td>
<td>-2.5</td>
<td>0.24</td>
<td>-0.07</td>
<td>-5.9</td>
<td>0.83</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.4</td>
<td>17.7</td>
<td>0.26</td>
<td>1.6</td>
<td>16.8</td>
<td>0.70</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>0.5</td>
<td>0.25</td>
<td>-0.01</td>
<td>-1.4</td>
<td>0.46</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.1</td>
<td>-6.6</td>
<td>0.09</td>
<td>-16</td>
<td>-6.7</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.09</td>
<td>6.3</td>
<td>0.11</td>
<td>0.05</td>
<td>5.7</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Table C.123. UnSWAN performance metrics for CDIP Station 46221 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>10.2</td>
<td>0.63</td>
<td>0</td>
<td>-6.1</td>
<td>0.73</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.25</td>
<td>-3.1</td>
<td>0.24</td>
<td>-0.06</td>
<td>-5.8</td>
<td>0.78</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.2</td>
<td>17.5</td>
<td>0.25</td>
<td>1.5</td>
<td>16.5</td>
<td>0.70</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>-2.7</td>
<td>0.23</td>
<td>-0.02</td>
<td>-4.5</td>
<td>0.42</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.4</td>
<td>-6.8</td>
<td>0.10</td>
<td>-18</td>
<td>-7.4</td>
<td>0.61</td>
</tr>
<tr>
<td>$d_{\theta}$ (-)</td>
<td>0.10</td>
<td>6.7</td>
<td>0.12</td>
<td>0.05</td>
<td>6.0</td>
<td>0.13</td>
</tr>
</tbody>
</table>
### Table C.124. UnSWAN performance metrics for CDIP Station 46221 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>-0.7</td>
<td>0.70</td>
<td>-1</td>
<td>-16.1</td>
<td>0.74</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.27</td>
<td>-5.6</td>
<td>0.27</td>
<td>-0.09</td>
<td>-8.6</td>
<td>0.76</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.9</td>
<td>12.5</td>
<td>0.22</td>
<td>1.0</td>
<td>11.1</td>
<td>0.69</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>1.0</td>
<td>0.22</td>
<td>0.00</td>
<td>-0.7</td>
<td>0.47</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>22.3</td>
<td>-6.1</td>
<td>0.09</td>
<td>-16</td>
<td>-6.2</td>
<td>0.65</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>4.6</td>
<td>0.11</td>
<td>0.03</td>
<td>4.0</td>
<td>0.29</td>
</tr>
</tbody>
</table>

### Table C.125. UnSWAN performance metrics for CDIP Station 46221 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>1.7</td>
<td>0.66</td>
<td>-1</td>
<td>-13.5</td>
<td>0.75</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.25</td>
<td>-6.2</td>
<td>0.25</td>
<td>-0.09</td>
<td>-8.6</td>
<td>0.78</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.1</td>
<td>14.5</td>
<td>0.23</td>
<td>1.2</td>
<td>13.4</td>
<td>0.68</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>-2.2</td>
<td>0.22</td>
<td>-0.02</td>
<td>-4.2</td>
<td>0.48</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>24.0</td>
<td>-6.8</td>
<td>0.10</td>
<td>-17</td>
<td>-7.0</td>
<td>0.65</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>8.3</td>
<td>0.13</td>
<td>0.06</td>
<td>7.5</td>
<td>0.26</td>
</tr>
</tbody>
</table>

### Table C.126. UnSWAN performance metrics for CDIP Station 46221 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>0.9</td>
<td>0.66</td>
<td>-1</td>
<td>-15.0</td>
<td>0.78</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.25</td>
<td>-5.0</td>
<td>0.25</td>
<td>-0.07</td>
<td>-7.3</td>
<td>0.77</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.9</td>
<td>11.1</td>
<td>0.21</td>
<td>0.9</td>
<td>9.6</td>
<td>0.67</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>-1.7</td>
<td>0.24</td>
<td>-0.02</td>
<td>-4.1</td>
<td>0.49</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.1</td>
<td>-4.9</td>
<td>0.09</td>
<td>-12</td>
<td>-5.2</td>
<td>0.66</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>7.2</td>
<td>0.12</td>
<td>0.05</td>
<td>6.4</td>
<td>0.36</td>
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</tbody>
</table>

### Table C.127. UnSWAN performance metrics for CDIP Station 46221 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>-4.6</td>
<td>0.63</td>
<td>-1</td>
<td>-14.4</td>
<td>0.72</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.24</td>
<td>-6.4</td>
<td>0.24</td>
<td>-0.08</td>
<td>-8.0</td>
<td>0.78</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.7</td>
<td>9.2</td>
<td>0.20</td>
<td>0.7</td>
<td>8.1</td>
<td>0.66</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>0.8</td>
<td>0.21</td>
<td>0.00</td>
<td>-0.9</td>
<td>0.55</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.5</td>
<td>-4.4</td>
<td>0.09</td>
<td>-14</td>
<td>-5.7</td>
<td>0.58</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>5.7</td>
<td>0.10</td>
<td>0.04</td>
<td>5.2</td>
<td>0.40</td>
</tr>
</tbody>
</table>
Table C.128. UnSWAN performance metrics for CDIP Station 46221 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>-0.3</td>
<td>0.64</td>
<td>-1</td>
<td>-15.0</td>
<td>0.62</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.26</td>
<td>-4.6</td>
<td>0.25</td>
<td>-0.07</td>
<td>-7.0</td>
<td>0.71</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.8</td>
<td>8.4</td>
<td>0.20</td>
<td>0.7</td>
<td>7.4</td>
<td>0.64</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>1.7</td>
<td>0.23</td>
<td>0.00</td>
<td>-0.5</td>
<td>0.43</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>20.2</td>
<td>-5.4</td>
<td>0.08</td>
<td>-13</td>
<td>-5.5</td>
<td>0.71</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>6.2</td>
<td>0.11</td>
<td>0.05</td>
<td>5.7</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Table C.129. UnSWAN performance metrics for CDIP Station 46221 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>-12.0</td>
<td>0.59</td>
<td>-1</td>
<td>-21.7</td>
<td>0.87</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.23</td>
<td>-8.1</td>
<td>0.23</td>
<td>-0.10</td>
<td>-9.9</td>
<td>0.84</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>6.9</td>
<td>0.18</td>
<td>0.5</td>
<td>6.1</td>
<td>0.73</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>2.6</td>
<td>0.21</td>
<td>0.00</td>
<td>0.9</td>
<td>0.57</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>17.9</td>
<td>-4.3</td>
<td>0.07</td>
<td>-11</td>
<td>-4.4</td>
<td>0.74</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>5.3</td>
<td>0.10</td>
<td>0.04</td>
<td>4.9</td>
<td>0.41</td>
</tr>
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</table>

Table C.130. UnSWAN performance metrics for CDIP Station 46221 for 2001.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>5</td>
<td>-6.3</td>
<td>0.76</td>
<td>-1</td>
<td>-23.6</td>
<td>0.69</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.29</td>
<td>-7.2</td>
<td>0.27</td>
<td>-0.11</td>
<td>-10.6</td>
<td>0.76</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.8</td>
<td>8.7</td>
<td>0.19</td>
<td>0.7</td>
<td>7.5</td>
<td>0.71</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>-0.4</td>
<td>0.22</td>
<td>-0.01</td>
<td>-2.7</td>
<td>0.50</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>18.8</td>
<td>-4.3</td>
<td>0.08</td>
<td>-11</td>
<td>-4.5</td>
<td>0.75</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>6.8</td>
<td>0.11</td>
<td>0.05</td>
<td>6.1</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Table C.131. UnSWAN performance metrics for CDIP Station 46221 for 2000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>-1.0</td>
<td>0.65</td>
<td>-1</td>
<td>-11.2</td>
<td>0.52</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.25</td>
<td>-4.9</td>
<td>0.25</td>
<td>-0.06</td>
<td>-6.3</td>
<td>0.67</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.7</td>
<td>9.1</td>
<td>0.19</td>
<td>0.7</td>
<td>7.7</td>
<td>0.68</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>0.3</td>
<td>0.21</td>
<td>-0.01</td>
<td>-2.0</td>
<td>0.51</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.5</td>
<td>-4.9</td>
<td>0.08</td>
<td>-12</td>
<td>-5.1</td>
<td>0.69</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.09</td>
<td>6.7</td>
<td>0.11</td>
<td>0.05</td>
<td>6.1</td>
<td>0.30</td>
</tr>
</tbody>
</table>
### C.2.5 Station 46224

**Table C.132.** UnSWAN performance metrics for CDIP Station 46224 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>34.1</td>
<td>0.65</td>
<td>1</td>
<td>18.3</td>
<td>0.83</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.20</td>
<td>7.8</td>
<td>0.20</td>
<td>0.05</td>
<td>5.3</td>
<td>0.88</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.1</td>
<td>16.4</td>
<td>0.21</td>
<td>1.5</td>
<td>15.5</td>
<td>0.77</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>-9.0</td>
<td>0.23</td>
<td>-0.04</td>
<td>-10.2</td>
<td>0.57</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>17.2</td>
<td>-4.1</td>
<td>0.07</td>
<td>-10</td>
<td>-4.3</td>
<td>0.83</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>4.1</td>
<td>0.09</td>
<td>0.03</td>
<td>3.6</td>
<td>0.38</td>
</tr>
</tbody>
</table>

**Table C.133.** UnSWAN performance metrics for CDIP Station 46224 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>21.5</td>
<td>0.62</td>
<td>0</td>
<td>6.7</td>
<td>0.77</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.18</td>
<td>3.3</td>
<td>0.20</td>
<td>0.01</td>
<td>0.7</td>
<td>0.85</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.0</td>
<td>16.7</td>
<td>0.21</td>
<td>1.5</td>
<td>15.4</td>
<td>0.71</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>-10.4</td>
<td>0.24</td>
<td>-0.06</td>
<td>-12.1</td>
<td>0.50</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.2</td>
<td>-5.1</td>
<td>0.08</td>
<td>-13</td>
<td>-5.4</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>4.6</td>
<td>0.10</td>
<td>0.03</td>
<td>4.0</td>
<td>0.30</td>
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</tbody>
</table>

**Table C.134.** UnSWAN performance metrics for CDIP Station 46224 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>26.5</td>
<td>0.55</td>
<td>1</td>
<td>13.1</td>
<td>0.71</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.19</td>
<td>5.0</td>
<td>0.20</td>
<td>0.02</td>
<td>2.5</td>
<td>0.80</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.0</td>
<td>16.7</td>
<td>0.21</td>
<td>1.5</td>
<td>15.7</td>
<td>0.78</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>-8.9</td>
<td>0.22</td>
<td>-0.05</td>
<td>-10.4</td>
<td>0.51</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.3</td>
<td>-5.1</td>
<td>0.08</td>
<td>-13</td>
<td>-5.5</td>
<td>0.79</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>4.4</td>
<td>0.10</td>
<td>0.03</td>
<td>4.0</td>
<td>0.38</td>
</tr>
</tbody>
</table>

**Table C.135.** UnSWAN performance metrics for CDIP Station 46224 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>16.5</td>
<td>0.59</td>
<td>0</td>
<td>2.8</td>
<td>0.79</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.18</td>
<td>1.2</td>
<td>0.20</td>
<td>-0.01</td>
<td>-1.1</td>
<td>0.83</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>2.0</td>
<td>16.7</td>
<td>0.22</td>
<td>1.4</td>
<td>15.4</td>
<td>0.73</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.11</td>
<td>-7.7</td>
<td>0.23</td>
<td>-0.04</td>
<td>-9.3</td>
<td>0.47</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>20.2</td>
<td>-5.5</td>
<td>0.08</td>
<td>-14</td>
<td>-5.7</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>3.5</td>
<td>0.09</td>
<td>0.02</td>
<td>3.0</td>
<td>0.39</td>
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</table>
Table C.136. UnSWAN performance metrics for CDIP Station 46224 for 2006.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>14.7</td>
<td>0.61</td>
<td>0</td>
<td>5.0</td>
<td>0.73</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.18</td>
<td>1.4</td>
<td>0.20</td>
<td>0.00</td>
<td>-0.3</td>
<td>0.81</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.8</td>
<td>13.5</td>
<td>0.18</td>
<td>1.2</td>
<td>12.6</td>
<td>0.79</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>-9.4</td>
<td>0.22</td>
<td>-0.05</td>
<td>-10.6</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.0</td>
<td>-3.8</td>
<td>0.07</td>
<td>-9</td>
<td>-4.0</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>5.6</td>
<td>0.10</td>
<td>0.04</td>
<td>5.1</td>
<td>0.35</td>
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Table C.137. UnSWAN performance metrics for CDIP Station 46224 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>2</td>
<td>11.9</td>
<td>0.50</td>
<td>0</td>
<td>-1.9</td>
<td>0.80</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.18</td>
<td>1.6</td>
<td>0.20</td>
<td>-0.01</td>
<td>-0.6</td>
<td>0.82</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>10.3</td>
<td>0.16</td>
<td>0.9</td>
<td>9.3</td>
<td>0.77</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.09</td>
<td>-7.0</td>
<td>0.21</td>
<td>-0.04</td>
<td>-8.7</td>
<td>0.57</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.4</td>
<td>-3.8</td>
<td>0.07</td>
<td>-9</td>
<td>-4.0</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>3.6</td>
<td>0.09</td>
<td>0.03</td>
<td>3.2</td>
<td>0.41</td>
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</table>


<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>14.8</td>
<td>0.56</td>
<td>0</td>
<td>3.6</td>
<td>0.75</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.18</td>
<td>2.7</td>
<td>0.20</td>
<td>0.01</td>
<td>1.0</td>
<td>0.83</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>10.7</td>
<td>0.17</td>
<td>0.9</td>
<td>9.5</td>
<td>0.70</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>-8.2</td>
<td>0.21</td>
<td>-0.04</td>
<td>-9.6</td>
<td>0.56</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.9</td>
<td>-3.5</td>
<td>0.07</td>
<td>-9</td>
<td>-3.8</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>4.5</td>
<td>0.09</td>
<td>0.03</td>
<td>4.0</td>
<td>0.46</td>
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</table>

Table C.139. UnSWAN performance metrics for CDIP Station 46224 for 2003.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>20.5</td>
<td>0.55</td>
<td>0</td>
<td>7.8</td>
<td>0.67</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.20</td>
<td>5.8</td>
<td>0.22</td>
<td>0.03</td>
<td>3.6</td>
<td>0.76</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.5</td>
<td>8.8</td>
<td>0.15</td>
<td>0.8</td>
<td>7.9</td>
<td>0.72</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.09</td>
<td>-6.8</td>
<td>0.21</td>
<td>-0.04</td>
<td>-8.2</td>
<td>0.55</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.9</td>
<td>-3.0</td>
<td>0.07</td>
<td>-7</td>
<td>-3.1</td>
<td>0.77</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>4.3</td>
<td>0.09</td>
<td>0.03</td>
<td>4.0</td>
<td>0.50</td>
</tr>
</tbody>
</table>
Table C.140. UnSWAN performance metrics for CDIP Station 46224 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>2</td>
<td>10.6</td>
<td>0.50</td>
<td>0</td>
<td>0.1</td>
<td>0.82</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.16</td>
<td>2.2</td>
<td>0.18</td>
<td>0.00</td>
<td>0.5</td>
<td>0.85</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>9.1</td>
<td>0.15</td>
<td>0.8</td>
<td>8.2</td>
<td>0.78</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.09</td>
<td>-7.1</td>
<td>0.20</td>
<td>-0.04</td>
<td>-8.1</td>
<td>0.66</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.4</td>
<td>-2.3</td>
<td>0.06</td>
<td>-6</td>
<td>-2.5</td>
<td>0.81</td>
</tr>
<tr>
<td>$d\theta$ (-)</td>
<td>0.07</td>
<td>4.0</td>
<td>0.09</td>
<td>0.03</td>
<td>3.6</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Table C.141. UnSWAN performance metrics for CDIP Station 46224 for 2001.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>7.8</td>
<td>0.53</td>
<td>0</td>
<td>-5.8</td>
<td>0.71</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.19</td>
<td>0.2</td>
<td>0.20</td>
<td>-0.02</td>
<td>-2.4</td>
<td>0.80</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>9.2</td>
<td>0.16</td>
<td>0.8</td>
<td>8.0</td>
<td>0.75</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.09</td>
<td>-7.2</td>
<td>0.21</td>
<td>-0.04</td>
<td>-8.7</td>
<td>0.59</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.9</td>
<td>-2.7</td>
<td>0.07</td>
<td>-7</td>
<td>-2.9</td>
<td>0.82</td>
</tr>
<tr>
<td>$d\theta$ (-)</td>
<td>0.07</td>
<td>3.4</td>
<td>0.09</td>
<td>0.02</td>
<td>3.0</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Table C.142. UnSWAN performance metrics for CDIP Station 46224 for 2000.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>2</td>
<td>6.7</td>
<td>0.45</td>
<td>0</td>
<td>-0.5</td>
<td>0.78</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.17</td>
<td>0.1</td>
<td>0.18</td>
<td>-0.01</td>
<td>-1.1</td>
<td>0.82</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.5</td>
<td>8.8</td>
<td>0.15</td>
<td>0.8</td>
<td>7.7</td>
<td>0.72</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.09</td>
<td>-5.3</td>
<td>0.19</td>
<td>-0.03</td>
<td>-6.9</td>
<td>0.60</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.4</td>
<td>-2.9</td>
<td>0.07</td>
<td>-7</td>
<td>-3.1</td>
<td>0.81</td>
</tr>
<tr>
<td>$d\theta$ (-)</td>
<td>0.07</td>
<td>4.0</td>
<td>0.09</td>
<td>0.03</td>
<td>3.5</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Table C.143. UnSWAN performance metrics for CDIP Station 46224 for 1999.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>14.7</td>
<td>0.55</td>
<td>0</td>
<td>1.1</td>
<td>0.69</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.20</td>
<td>1.7</td>
<td>0.20</td>
<td>-0.01</td>
<td>-0.9</td>
<td>0.79</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>10.5</td>
<td>0.16</td>
<td>1.0</td>
<td>9.7</td>
<td>0.79</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.09</td>
<td>-6.4</td>
<td>0.20</td>
<td>-0.03</td>
<td>-7.6</td>
<td>0.57</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>15.7</td>
<td>-3.5</td>
<td>0.07</td>
<td>-9</td>
<td>-3.7</td>
<td>0.84</td>
</tr>
<tr>
<td>$d\theta$ (-)</td>
<td>0.07</td>
<td>3.2</td>
<td>0.09</td>
<td>0.02</td>
<td>2.8</td>
<td>0.36</td>
</tr>
</tbody>
</table>
### Table C.144. UnSWAN performance metrics for CDIP Station 46224 for 1998.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>9.0</td>
<td>0.49</td>
<td>0</td>
<td>-2.1</td>
<td>0.87</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.20</td>
<td>0.7</td>
<td>0.18</td>
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<td>-1.3</td>
<td>0.88</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>9.0</td>
<td>0.15</td>
<td>0.8</td>
<td>8.2</td>
<td>0.80</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.08</td>
<td>-4.1</td>
<td>0.17</td>
<td>-0.02</td>
<td>-5.4</td>
<td>0.65</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.9</td>
<td>-2.0</td>
<td>0.06</td>
<td>-5</td>
<td>-2.3</td>
<td>0.86</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>3.6</td>
<td>0.08</td>
<td>0.03</td>
<td>3.2</td>
<td>0.56</td>
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### Table C.145. UnSWAN performance metrics for CDIP Station 46224 for 1997.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>3</td>
<td>31.5</td>
<td>0.58</td>
<td>1</td>
<td>14.5</td>
<td>0.74</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.21</td>
<td>8.3</td>
<td>0.22</td>
<td>0.05</td>
<td>5.6</td>
<td>0.80</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.8</td>
<td>14.0</td>
<td>0.19</td>
<td>1.2</td>
<td>12.9</td>
<td>0.74</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>-10.8</td>
<td>0.23</td>
<td>-0.06</td>
<td>-12.3</td>
<td>0.55</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>14.3</td>
<td>-2.0</td>
<td>0.06</td>
<td>-5</td>
<td>-2.3</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>6.0</td>
<td>0.10</td>
<td>0.04</td>
<td>5.5</td>
<td>0.46</td>
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</table>

### C.2.6 Station 46213

### Table C.146. WWIII performance metrics for CDIP Station 46213 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>22.0</td>
<td>0.39</td>
<td>2</td>
<td>5.5</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>9.5</td>
<td>0.15</td>
<td>0.17</td>
<td>6.5</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.1</td>
<td>9.8</td>
<td>0.12</td>
<td>0.8</td>
<td>9.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.05</td>
<td>-1.3</td>
<td>0.14</td>
<td>-0.01</td>
<td>-2.3</td>
<td>0.83</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>32.5</td>
<td>-0.3</td>
<td>0.11</td>
<td>-4</td>
<td>-1.3</td>
<td>0.66</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>1.8</td>
<td>0.11</td>
<td>0.01</td>
<td>1.2</td>
<td>0.74</td>
</tr>
</tbody>
</table>

### Table C.147. WWIII performance metrics for CDIP Station 46213 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>14</td>
<td>18.7</td>
<td>0.40</td>
<td>0</td>
<td>0.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>8.3</td>
<td>0.16</td>
<td>0.11</td>
<td>4.5</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>7.3</td>
<td>0.11</td>
<td>0.6</td>
<td>6.8</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-1.6</td>
<td>0.15</td>
<td>-0.01</td>
<td>-3.0</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>20.5</td>
<td>-0.7</td>
<td>0.07</td>
<td>-4</td>
<td>-1.3</td>
<td>0.86</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>1.9</td>
<td>0.09</td>
<td>0.01</td>
<td>1.4</td>
<td>0.79</td>
</tr>
</tbody>
</table>
### Table C.148. WWIII performance metrics for CDIP Station 46213 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>21.4</td>
<td>0.48</td>
<td>0</td>
<td>0.1</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>9.0</td>
<td>0.17</td>
<td>0.12</td>
<td>4.9</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.2</td>
<td>0.11</td>
<td>0.7</td>
<td>7.5</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-1.5</td>
<td>0.16</td>
<td>-0.01</td>
<td>-3.2</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>21.3</td>
<td>-0.2</td>
<td>0.07</td>
<td>-3</td>
<td>-1.0</td>
<td>0.81</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>0.3</td>
<td>0.09</td>
<td>0.00</td>
<td>0.0</td>
<td>0.80</td>
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</table>

### Table C.149. WWIII performance metrics for Station 46213 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>23.5</td>
<td>0.48</td>
<td>1</td>
<td>2.1</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>10.4</td>
<td>0.17</td>
<td>0.14</td>
<td>5.7</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.1</td>
<td>0.11</td>
<td>0.7</td>
<td>7.7</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-3.0</td>
<td>0.15</td>
<td>-0.02</td>
<td>-4.4</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.3</td>
<td>-0.8</td>
<td>0.07</td>
<td>-3</td>
<td>-1.1</td>
<td>0.80</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>1.8</td>
<td>0.09</td>
<td>0.01</td>
<td>1.6</td>
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</table>

### Table C.150. WWIII performance metrics for Station 46213 for 2006.

<table>
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<th>RMSE</th>
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<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>18</td>
<td>23.5</td>
<td>0.48</td>
<td>1</td>
<td>2.1</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.41</td>
<td>10.4</td>
<td>0.17</td>
<td>0.14</td>
<td>5.7</td>
<td>0.94</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.0</td>
<td>8.1</td>
<td>0.11</td>
<td>0.7</td>
<td>7.7</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-3.0</td>
<td>0.15</td>
<td>-0.02</td>
<td>-4.4</td>
<td>0.78</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.3</td>
<td>-0.8</td>
<td>0.07</td>
<td>-3</td>
<td>-1.1</td>
<td>0.80</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>1.8</td>
<td>0.09</td>
<td>0.01</td>
<td>1.6</td>
<td>0.80</td>
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</table>

### Table C.151. WWIII performance metrics for Station 46213 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>14.6</td>
<td>0.45</td>
<td>1</td>
<td>1.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>7.1</td>
<td>0.16</td>
<td>0.10</td>
<td>4.2</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>0.9</td>
<td>6.4</td>
<td>0.10</td>
<td>0.6</td>
<td>5.9</td>
<td>0.93</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.05</td>
<td>-2.2</td>
<td>0.15</td>
<td>-0.01</td>
<td>-3.3</td>
<td>0.80</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.4</td>
<td>-0.2</td>
<td>0.07</td>
<td>-2</td>
<td>-0.7</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>0.9</td>
<td>0.08</td>
<td>0.01</td>
<td>0.7</td>
<td>0.83</td>
</tr>
</tbody>
</table>
### Table C.152. WWIII performance metrics for Station 46213 for 2004.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>16</td>
<td>16.6</td>
<td>0.44</td>
<td>-1</td>
<td>-2.7</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.39</td>
<td>8.4</td>
<td>0.17</td>
<td>0.09</td>
<td>3.8</td>
<td>0.93</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>0.9</td>
<td>5.7</td>
<td>0.10</td>
<td>0.5</td>
<td>5.5</td>
<td>0.90</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-1.9</td>
<td>0.15</td>
<td>-0.01</td>
<td>-3.2</td>
<td>0.80</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
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<td>-2</td>
<td>-0.8</td>
<td>0.75</td>
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<tr>
<td>$d_\theta$ (-)</td>
<td>0.08</td>
<td>1.4</td>
<td>0.10</td>
<td>0.01</td>
<td>1.1</td>
<td>0.78</td>
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</tbody>
</table>

### C.2.7 Station 46229

### Table C.153. WWIII performance metrics for Station 46229 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>20</td>
<td>17.8</td>
<td>0.43</td>
<td>1</td>
<td>3.1</td>
<td>0.94</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.40</td>
<td>5.6</td>
<td>0.15</td>
<td>0.08</td>
<td>3.1</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.8</td>
<td>0.15</td>
<td>1.0</td>
<td>11.6</td>
<td>0.89</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>0.5</td>
<td>0.19</td>
<td>0.00</td>
<td>-1.0</td>
<td>0.66</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>20.0</td>
<td>-1.0</td>
<td>0.07</td>
<td>-4</td>
<td>-1.6</td>
<td>0.79</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>0.4</td>
<td>0.09</td>
<td>0.00</td>
<td>0.1</td>
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</tbody>
</table>

### Table C.154. WWIII performance metrics for Station 46229 for 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>15</td>
<td>13.1</td>
<td>0.46</td>
<td>-1</td>
<td>-2.1</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>3.3</td>
<td>0.15</td>
<td>0.01</td>
<td>0.5</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.3</td>
<td>0.15</td>
<td>1.0</td>
<td>11.1</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-5.6</td>
<td>0.19</td>
<td>-0.03</td>
<td>-7.2</td>
<td>0.71</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>18.1</td>
<td>-1.3</td>
<td>0.06</td>
<td>-5</td>
<td>-1.8</td>
<td>0.84</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>3.3</td>
<td>0.09</td>
<td>0.02</td>
<td>2.7</td>
<td>0.70</td>
</tr>
</tbody>
</table>

### Table C.155. WWIII performance metrics for Station 46229 for 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>19</td>
<td>11.8</td>
<td>0.50</td>
<td>-2</td>
<td>-4.1</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>3.1</td>
<td>0.16</td>
<td>0.00</td>
<td>0.0</td>
<td>0.95</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>11.6</td>
<td>0.14</td>
<td>0.9</td>
<td>10.3</td>
<td>0.91</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-3.8</td>
<td>0.19</td>
<td>-0.02</td>
<td>-5.3</td>
<td>0.69</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.5</td>
<td>-0.9</td>
<td>0.06</td>
<td>-5</td>
<td>-1.6</td>
<td>0.85</td>
</tr>
<tr>
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<td>1.1</td>
<td>0.08</td>
<td>0.01</td>
<td>0.8</td>
<td>0.68</td>
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</tbody>
</table>
Table C.156. WWIII performance metrics for Station 46229 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>21</td>
<td>20.4</td>
<td>0.56</td>
<td>2</td>
<td>4.7</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.36</td>
<td>6.7</td>
<td>0.16</td>
<td>0.09</td>
<td>3.8</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>12.5</td>
<td>0.14</td>
<td>1.0</td>
<td>11.3</td>
<td>0.92</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.07</td>
<td>-6.4</td>
<td>0.19</td>
<td>-0.03</td>
<td>-7.9</td>
<td>0.69</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>16.9</td>
<td>-1.0</td>
<td>0.06</td>
<td>-4</td>
<td>-1.5</td>
<td>0.83</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.07</td>
<td>3.0</td>
<td>0.08</td>
<td>0.02</td>
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Table C.157. WWIII performance metrics for Station 46229 for 2006.

<table>
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<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>23</td>
<td>9.2</td>
<td>0.54</td>
<td>-2</td>
<td>-4.2</td>
<td>0.93</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
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<td>2.0</td>
<td>0.16</td>
<td>0.00</td>
<td>0.2</td>
<td>0.96</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>11.8</td>
<td>0.15</td>
<td>0.9</td>
<td>10.7</td>
<td>0.88</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.06</td>
<td>-3.1</td>
<td>0.18</td>
<td>-0.02</td>
<td>-4.9</td>
<td>0.77</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>19.0</td>
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<td>0.07</td>
<td>-7</td>
<td>-2.4</td>
<td>0.79</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
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<td>0.4</td>
<td>0.08</td>
<td>0.00</td>
<td>0.1</td>
<td>0.71</td>
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C.2.8 Station 46216

Table C.158. WWIII performance metrics for Station 46216 for 2010.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>6</td>
<td>-37.2</td>
<td>0.73</td>
<td>-3</td>
<td>-39.6</td>
<td>0.90</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.37</td>
<td>-24.1</td>
<td>0.31</td>
<td>-0.28</td>
<td>-24.1</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.6</td>
<td>13.4</td>
<td>0.20</td>
<td>0.9</td>
<td>11.2</td>
<td>0.77</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>7.0</td>
<td>0.23</td>
<td>0.02</td>
<td>5.6</td>
<td>0.64</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>9.9</td>
<td>1.1</td>
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<td>3</td>
<td>1.0</td>
<td>0.57</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.05</td>
<td>2.4</td>
<td>0.06</td>
<td>0.02</td>
<td>2.2</td>
<td>0.73</td>
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</table>

Table C.159. WWIII performance metrics for Station 46216 for 2009.

<table>
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<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>-38.9</td>
<td>0.75</td>
<td>-2</td>
<td>-45.2</td>
<td>0.81</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>-25.4</td>
<td>0.34</td>
<td>-0.27</td>
<td>-26.3</td>
<td>0.84</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.5</td>
<td>12.1</td>
<td>0.20</td>
<td>0.8</td>
<td>10.0</td>
<td>0.76</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>4.3</td>
<td>0.23</td>
<td>0.01</td>
<td>2.3</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>9.8</td>
<td>1.5</td>
<td>0.04</td>
<td>4</td>
<td>1.4</td>
<td>0.37</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>3.8</td>
<td>0.06</td>
<td>0.03</td>
<td>3.5</td>
<td>0.67</td>
</tr>
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</table>
### Table C.160. WWIII performance metrics for Station 46216 for 2008.

<table>
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<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>-39.8</td>
<td>0.75</td>
<td>-2</td>
<td>-43.9</td>
<td>0.91</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>-25.2</td>
<td>0.33</td>
<td>-0.28</td>
<td>-25.8</td>
<td>0.85</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>11.3</td>
<td>0.19</td>
<td>0.7</td>
<td>9.7</td>
<td>0.78</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.10</td>
<td>5.8</td>
<td>0.22</td>
<td>0.02</td>
<td>4.1</td>
<td>0.55</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>12.5</td>
<td>1.4</td>
<td>0.05</td>
<td>3</td>
<td>1.2</td>
<td>0.51</td>
</tr>
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<td>0.07</td>
<td>0.03</td>
<td>3.0</td>
<td>0.69</td>
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</table>

### Table C.161. WWIII performance metrics for Station 46216 for 2007.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>5</td>
<td>-40.9</td>
<td>0.82</td>
<td>-3</td>
<td>-44.3</td>
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</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.36</td>
<td>-25.0</td>
<td>0.33</td>
<td>-0.28</td>
<td>-25.5</td>
<td>0.81</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>6.9</td>
<td>0.15</td>
<td>0.5</td>
<td>5.8</td>
<td>0.80</td>
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<tr>
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<td>0.10</td>
<td>7.6</td>
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<td>0.02</td>
<td>5.4</td>
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<tr>
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<td>9.9</td>
<td>1.7</td>
<td>0.04</td>
<td>4</td>
<td>1.6</td>
<td>0.19</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>2.6</td>
<td>0.06</td>
<td>0.02</td>
<td>2.5</td>
<td>0.48</td>
</tr>
</tbody>
</table>

### Table C.162. WWIII performance metrics for Station 46216 for 2006.

<table>
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<tr>
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<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>-40.1</td>
<td>0.75</td>
<td>-2</td>
<td>-41.7</td>
<td>0.84</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>-25.4</td>
<td>0.33</td>
<td>-0.27</td>
<td>-25.3</td>
<td>0.85</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>10.0</td>
<td>0.17</td>
<td>0.7</td>
<td>8.3</td>
<td>0.78</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.10</td>
<td>5.7</td>
<td>0.22</td>
<td>0.02</td>
<td>3.9</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.9</td>
<td>1.8</td>
<td>0.05</td>
<td>4</td>
<td>1.6</td>
<td>0.27</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>4.5</td>
<td>0.07</td>
<td>0.04</td>
<td>4.2</td>
<td>0.65</td>
</tr>
</tbody>
</table>

### Table C.163. WWIII performance metrics for Station 46216 for 2005.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>5</td>
<td>-38.6</td>
<td>0.83</td>
<td>-3</td>
<td>-43.0</td>
<td>0.89</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.35</td>
<td>-23.8</td>
<td>0.33</td>
<td>-0.26</td>
<td>-24.5</td>
<td>0.86</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>8.1</td>
<td>0.16</td>
<td>0.5</td>
<td>6.3</td>
<td>0.84</td>
</tr>
<tr>
<td>$\varepsilon_0$ (-)</td>
<td>0.10</td>
<td>5.1</td>
<td>0.23</td>
<td>0.02</td>
<td>3.6</td>
<td>0.63</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>12.6</td>
<td>2.0</td>
<td>0.05</td>
<td>5</td>
<td>1.8</td>
<td>0.46</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
<td>0.06</td>
<td>4.0</td>
<td>0.07</td>
<td>0.03</td>
<td>3.7</td>
<td>0.73</td>
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Table C.164. WWIII performance metrics for Station 46216 for 2004.

<table>
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<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>-34.4</td>
<td>0.74</td>
<td>-2</td>
<td>-38.2</td>
<td>0.87</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.31</td>
<td>-21.5</td>
<td>0.31</td>
<td>-0.22</td>
<td>-22.0</td>
<td>0.83</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>7.4</td>
<td>0.16</td>
<td>0.5</td>
<td>6.0</td>
<td>0.83</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>2.7</td>
<td>0.21</td>
<td>0.01</td>
<td>1.5</td>
<td>0.62</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>12.9</td>
<td>2.2</td>
<td>0.05</td>
<td>5</td>
<td>2.1</td>
<td>0.54</td>
</tr>
<tr>
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<td>0.08</td>
<td>0.04</td>
<td>4.6</td>
<td>0.70</td>
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</table>

Table C.165. WWIII performance metrics for Station 46216 for 2003.

<table>
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<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>4</td>
<td>-34.3</td>
<td>0.70</td>
<td>-2</td>
<td>-39.1</td>
<td>0.86</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.32</td>
<td>-21.3</td>
<td>0.30</td>
<td>-0.23</td>
<td>-22.0</td>
<td>0.84</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.4</td>
<td>10.0</td>
<td>0.18</td>
<td>0.7</td>
<td>8.4</td>
<td>0.81</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>3.9</td>
<td>0.23</td>
<td>0.01</td>
<td>2.2</td>
<td>0.61</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>13.6</td>
<td>2.5</td>
<td>0.05</td>
<td>6</td>
<td>2.2</td>
<td>0.58</td>
</tr>
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<td>4.7</td>
<td>0.08</td>
<td>0.04</td>
<td>4.2</td>
<td>0.62</td>
</tr>
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</table>

Table C.166. WWIII performance metrics for Station 46216 for 2002.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$ (kW/m)</td>
<td>5</td>
<td>-42.7</td>
<td>0.81</td>
<td>-3</td>
<td>-42.6</td>
<td>0.92</td>
</tr>
<tr>
<td>$H_s$ (m)</td>
<td>0.34</td>
<td>-26.6</td>
<td>0.33</td>
<td>-0.27</td>
<td>-26.4</td>
<td>0.90</td>
</tr>
<tr>
<td>$T_e$ (s)</td>
<td>1.3</td>
<td>9.1</td>
<td>0.16</td>
<td>0.6</td>
<td>7.5</td>
<td>0.86</td>
</tr>
<tr>
<td>$\epsilon_0$ (-)</td>
<td>0.10</td>
<td>9.5</td>
<td>0.24</td>
<td>0.03</td>
<td>8.0</td>
<td>0.68</td>
</tr>
<tr>
<td>$\theta$ (degrees)</td>
<td>11.6</td>
<td>2.0</td>
<td>0.04</td>
<td>5</td>
<td>1.9</td>
<td>0.36</td>
</tr>
<tr>
<td>$d_\theta$ (-)</td>
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<td>3.5</td>
<td>0.07</td>
<td>0.03</td>
<td>3.1</td>
<td>0.73</td>
</tr>
</tbody>
</table>
Appendix D – Temporal Averages of Performance Metrics for Simulated IEC Resource Parameters

Table D.1 is the National Data Buoy Center-related table; Table D.2 is the Coastal Data Information Program-related table.
D.1 NDBC Table

Table D.1. WWII temporal averages of performance metrics at NDBC stations.

<table>
<thead>
<tr>
<th>Buoy #</th>
<th>Parameter</th>
<th>RMSE</th>
<th>PE (%)</th>
<th>SI</th>
<th>Bias</th>
<th>Bias (%)</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>46029</td>
<td>$J$ (kW/m)</td>
<td>21</td>
<td>31.1</td>
<td>0.53</td>
<td>5</td>
<td>11.7</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>$H_s$ (m)</td>
<td>0.40</td>
<td>6.6</td>
<td>0.16</td>
<td>0.09</td>
<td>3.3</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>$T_e$ (s)</td>
<td>1.2</td>
<td>9.2</td>
<td>0.13</td>
<td>0.8</td>
<td>8.3</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>$e_0$ (-)</td>
<td>0.06</td>
<td>0.3</td>
<td>0.17</td>
<td>0.00</td>
<td>-0.9</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>$\theta$ (degrees)</td>
<td>22.8</td>
<td>-0.1</td>
<td>0.08</td>
<td>-5</td>
<td>-1.6</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>$d_\theta$ (-)</td>
<td>0.10</td>
<td>2.5</td>
<td>0.12</td>
<td>0.01</td>
<td>1.2</td>
<td>0.55</td>
</tr>
<tr>
<td>46050</td>
<td>$J$ (kW/m)</td>
<td>17</td>
<td>30.7</td>
<td>0.51</td>
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## D.2 CDIP Table

Table D.2. UnSWAN temporal averages of performance metrics at CDIP stations.

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