



# GCAM Ecosystem: Demeter

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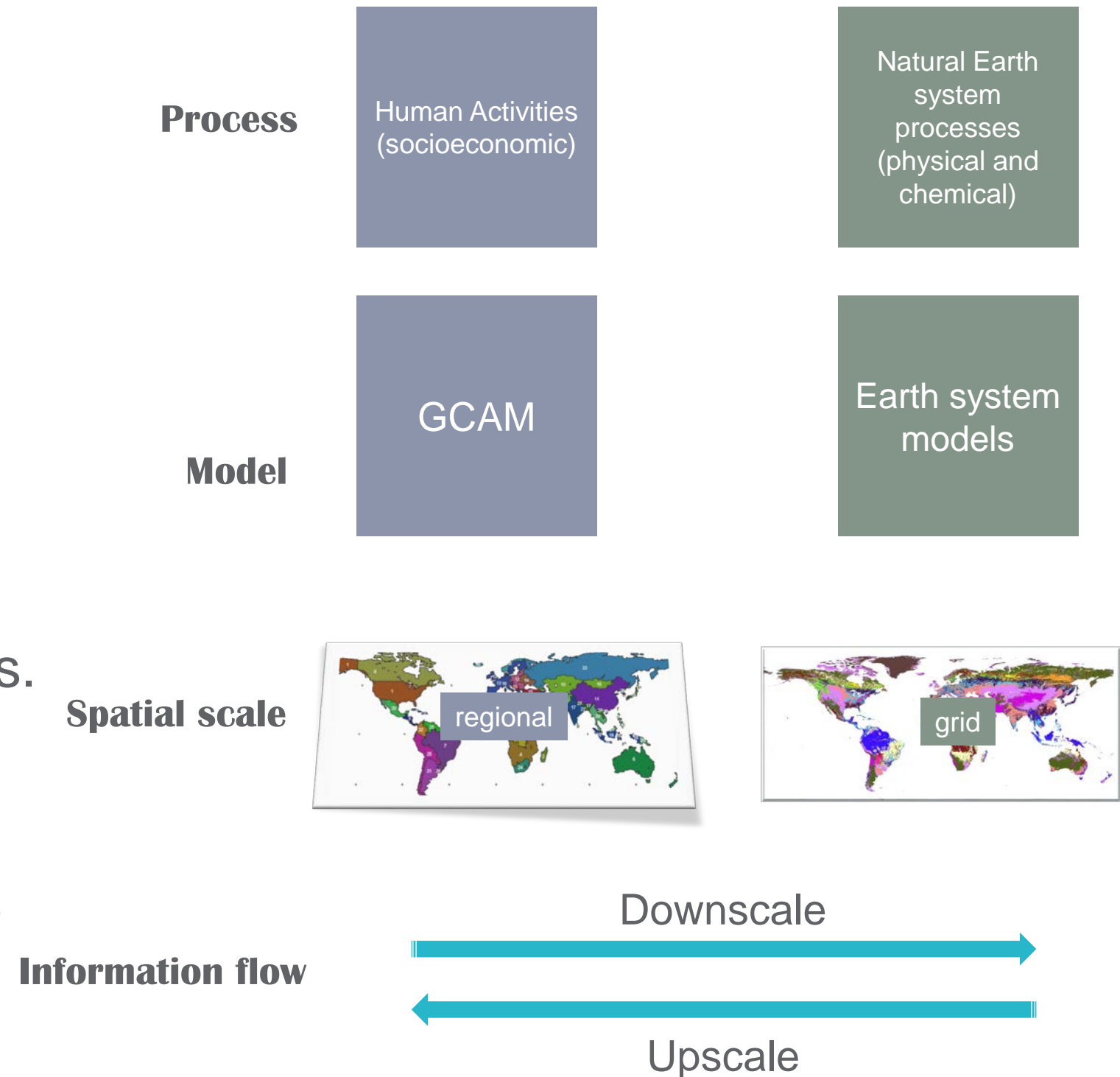




## What is Demeter

Demeter is a flexible open-source community tool for spatially disaggregation of regional land use and land cover change to the grid levels.

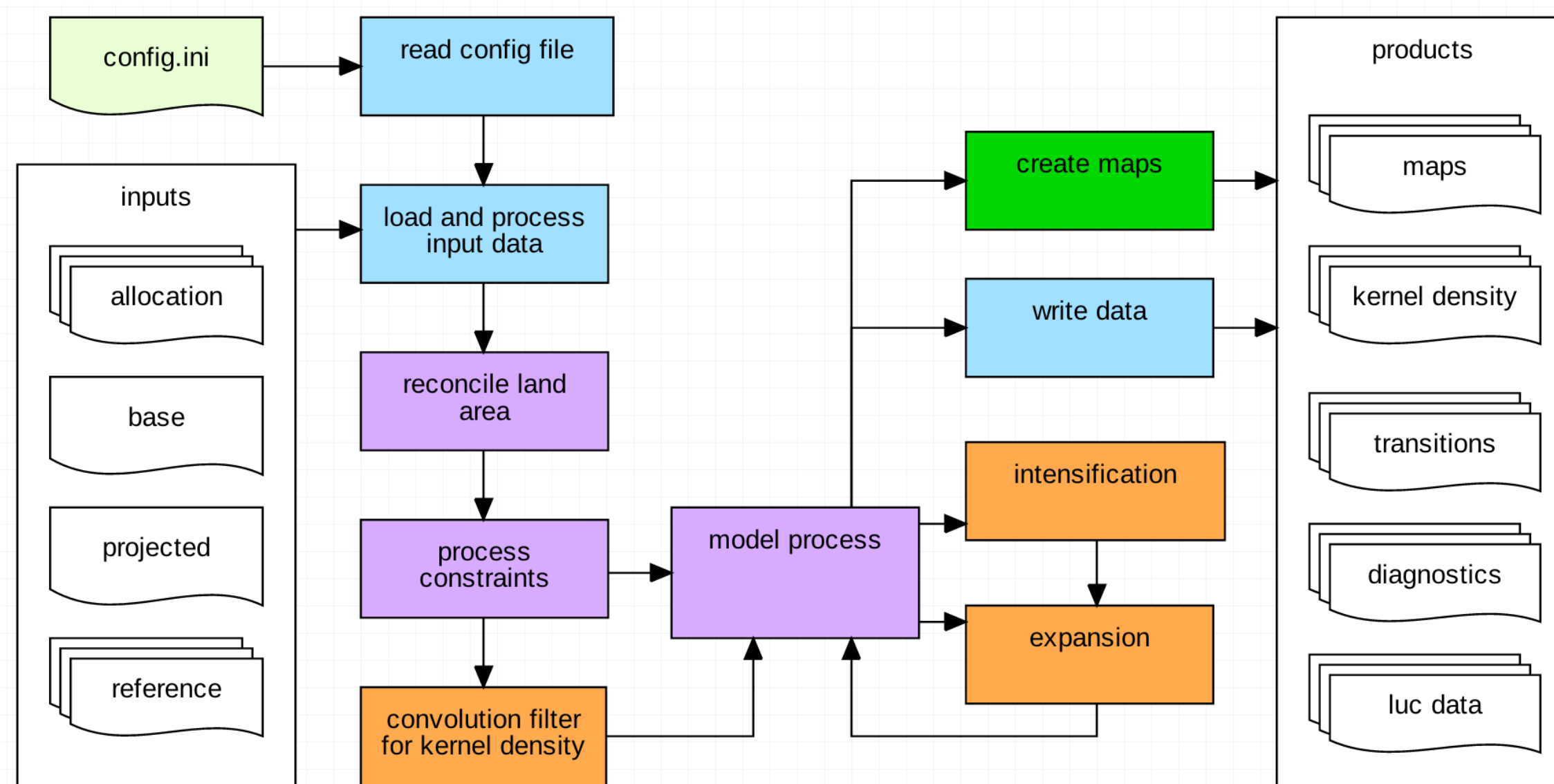
West, T. O., et al., , Environ. Res. Lett., २०१६  
 Le Page, Y. et al., Geosci. Model Dev., 9, 2016  
 Vernon, C.R., et al., *JORS*, 2018  
 Chen, M., et al., Geosci. Model Dev., 2019



## Demeter features

- Flexible
  - Base layer
  - Target spatial resolution
  - Final land cover types
  - Time period
  - Spatial constraints
  - User-defined rules
- Community tool
  - Open source
  - Extensible

## Demeter workflow





## Key Demeter parameters

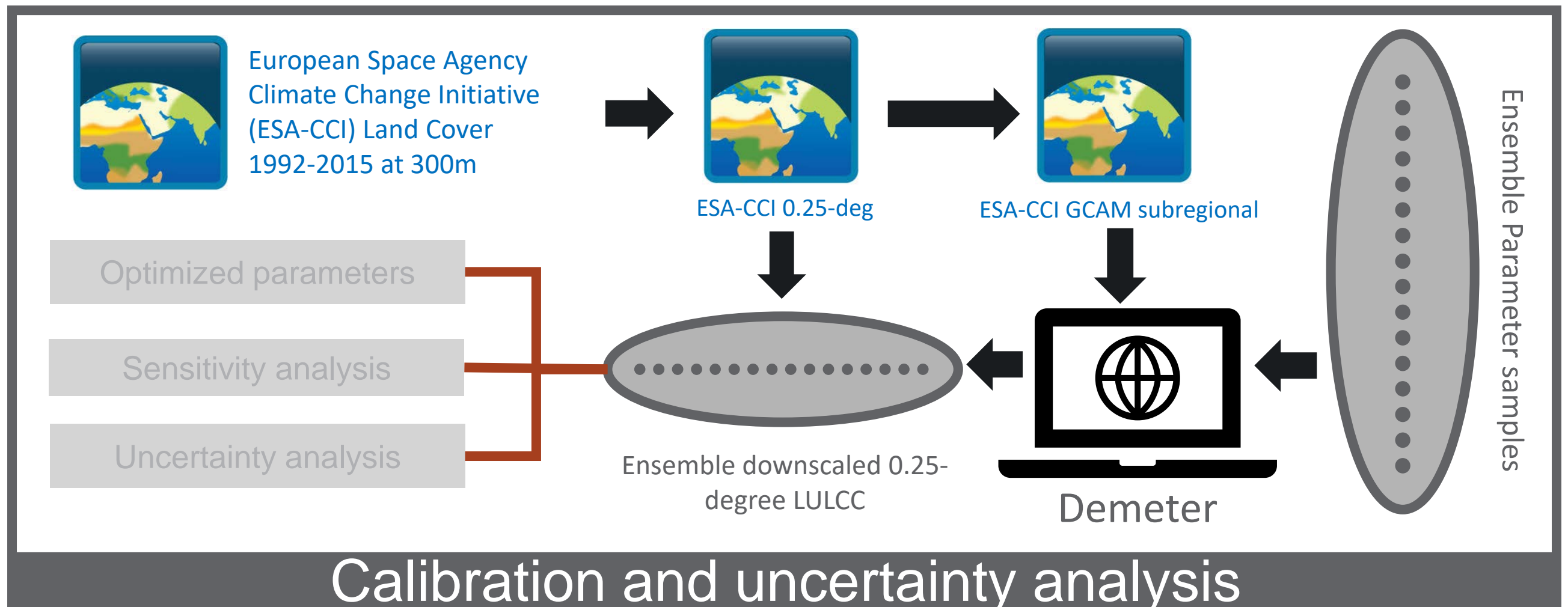
Name	Definition
$w_N$	Weight of soil nutrient availability for calculating suitability index
$w_S$	Weight of soil workability for calculating suitability index
$w_K$	Weight of kernel density for calculating suitability index
$r$	Intensification ratio
$\tau$	Selection threshold
$D$	Kernel radius

$r$  decides the ratio of land cover change for intensification

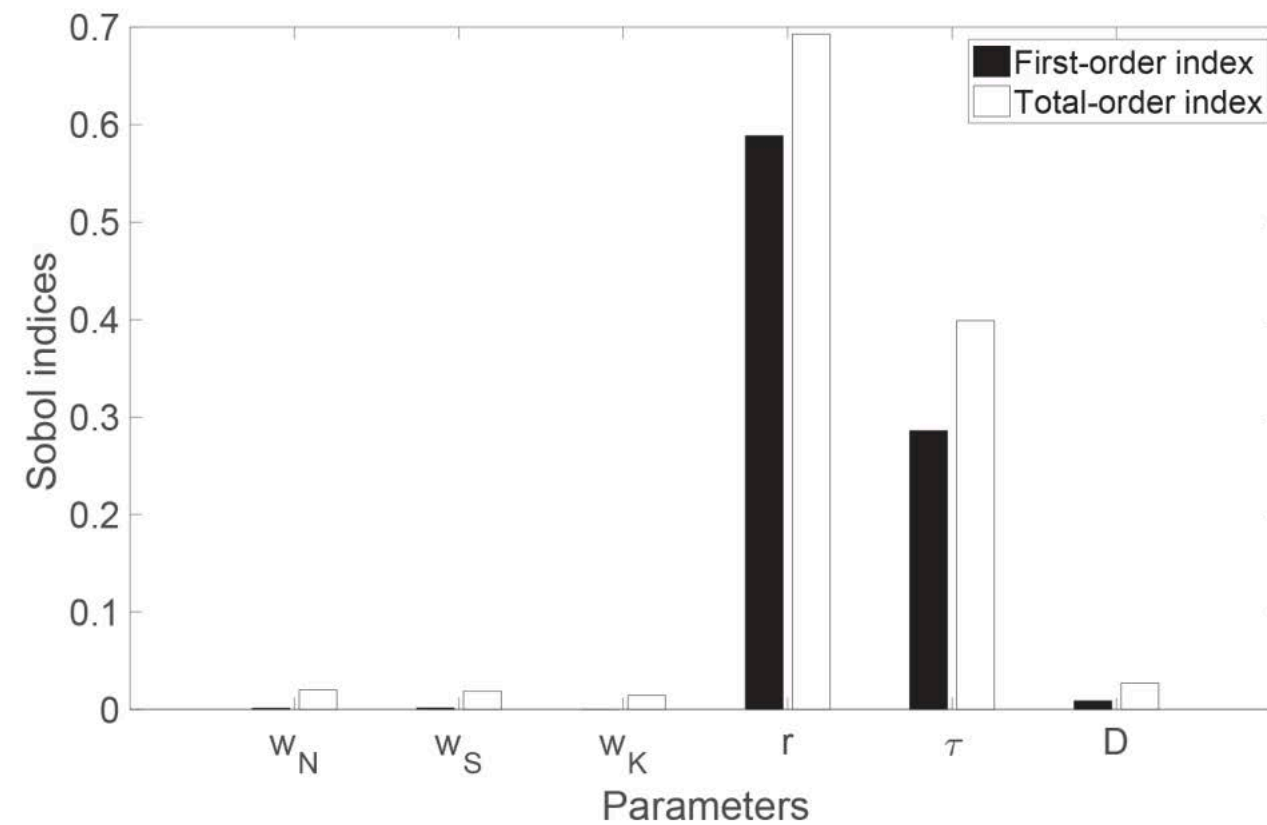
$D$ ,  $w_K$ ,  $w_S$ , and  $w_N$  determine the suitability indices (suitability for accepting area changes)

In the process of expansion, Demeter ranks candidate grid cells based on their suitability indices and selects the most suitable candidate grid cells following a user-defined threshold ( $\tau$ ) for expansion. In other words,  $\tau$  determines the number of grid cells to be selected and used for the tentative and actual conversion of land cover types.

# Calibrate Demeter for global applications at 0.25-degree resolution



## Sobol sensitivity indices for the six Demeter parameters.

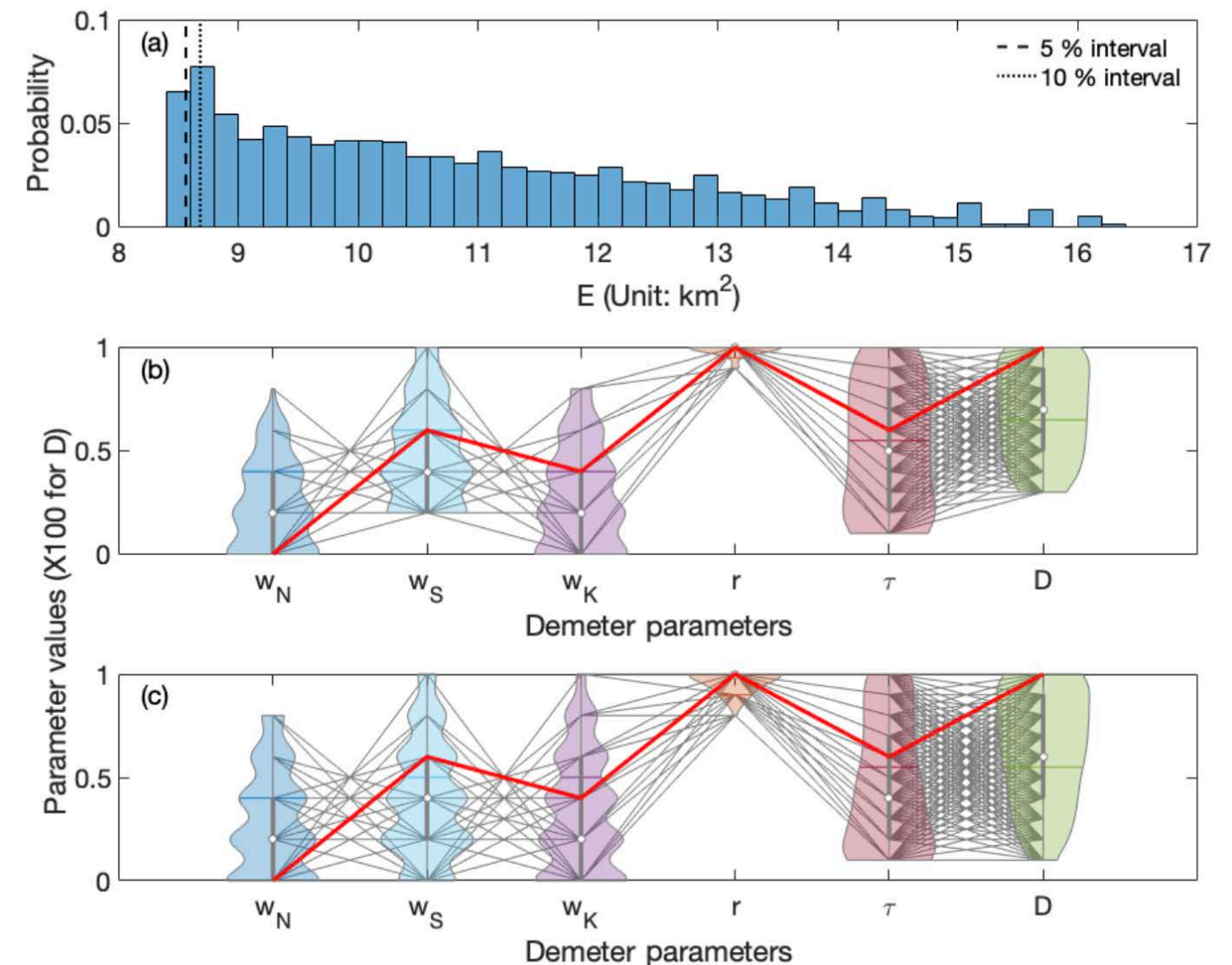


Higher indices indicate higher sensitivities



## Calibration results

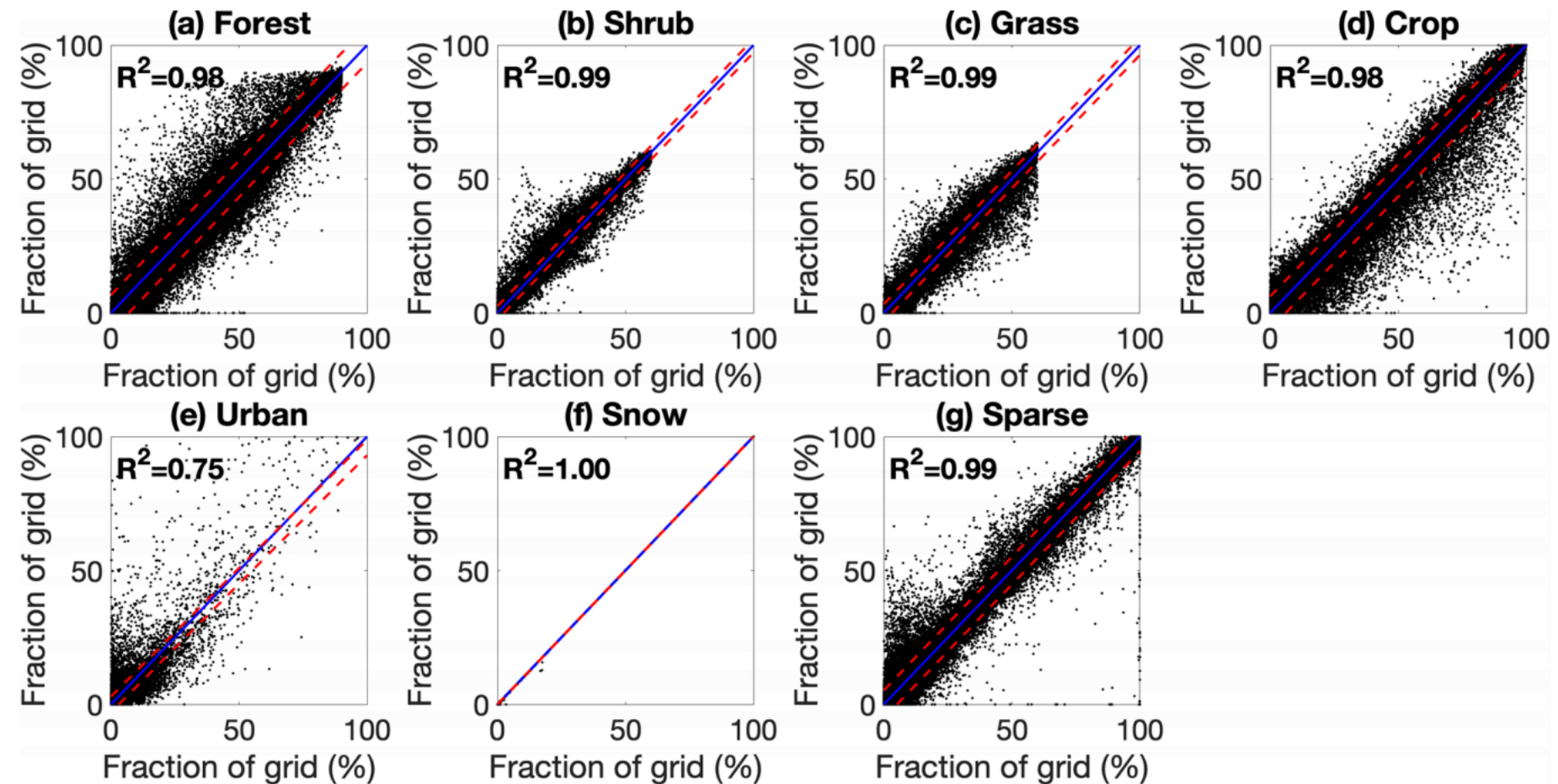
- (a) Histogram the global average discrepancies between the downscaled and observed land cover areas
- (b) The probability density of each of the acceptable 5 % parameters, as shown by the violin plots;
- (c) Same as (b) but showing the “best” 10 % parameter sets.



the red line indicates the global optimal parameter values



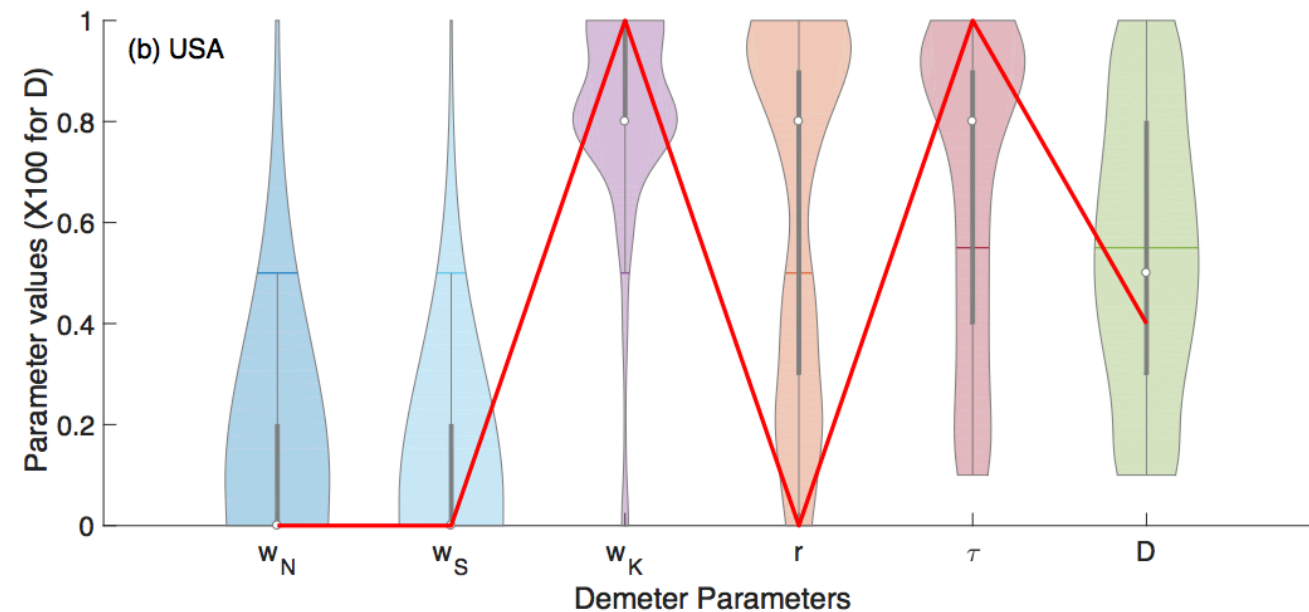
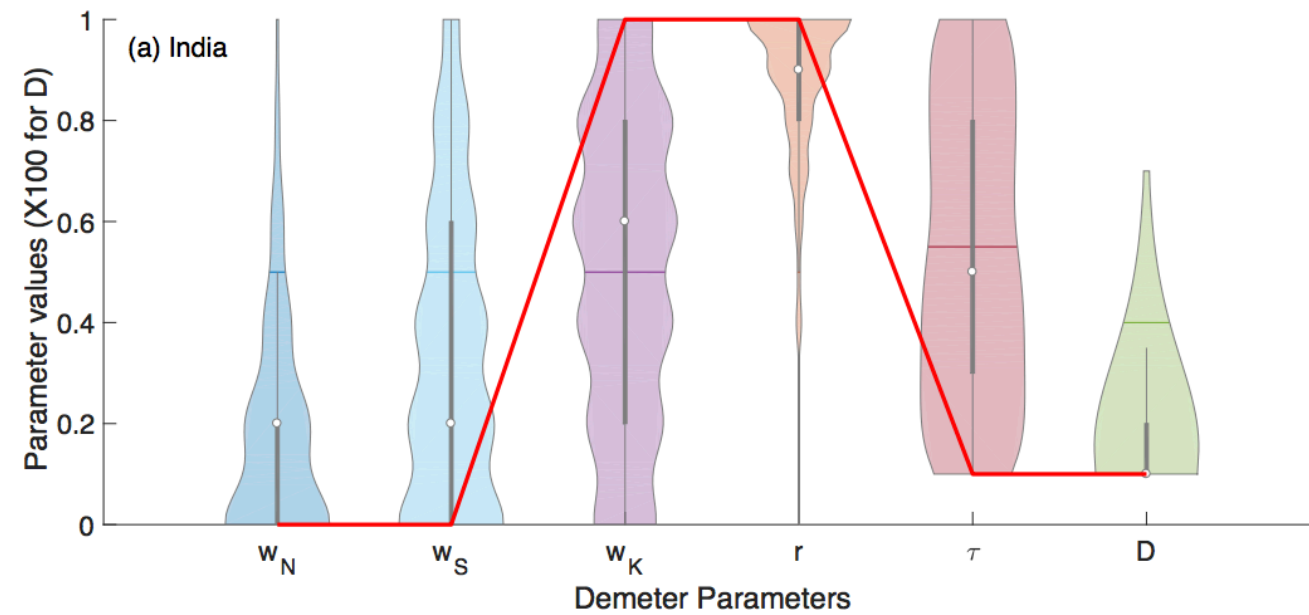
## Calibration results



Comparison between the observed and downscaled final land types with optimal parameters over the 265 852 0.25° grid cells in 2015.

## Future applications

- Different regions may have different optimal parameters
- Regional application needs further calibration





# Thank you

