

Climate Adaptation at Hazardous Waste Sites: Supporting Better Environmental Outcomes

Eric Mielbrecht - 5 November 2025 - RemPlex Summit


Largest Environmental Cleanup in the World

107 US Department of Energy sites

- 92 completed
- Complex cleanup sites

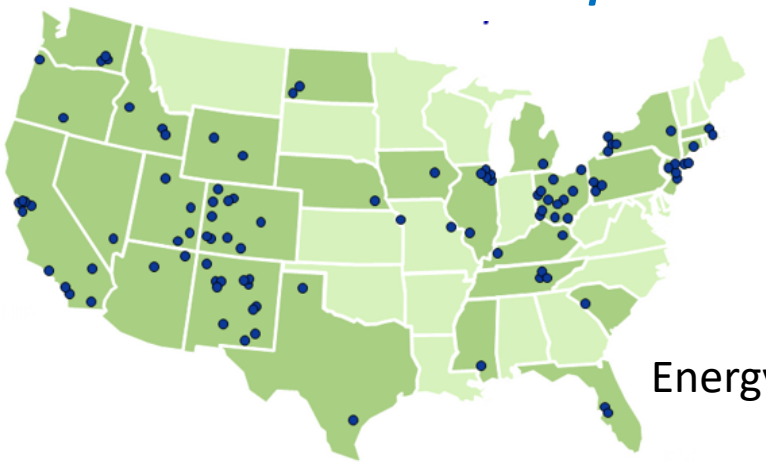
Long lifetimes

- Some DOE sites will be managed in perpetuity, with systems engineered to endure for hundreds of years

New and growing challenges

➢Climate change exacerbated wildfire, flooding, drought, heat waves, precipitation pattern changes and other extreme weather events

Historical Cleanup Sites

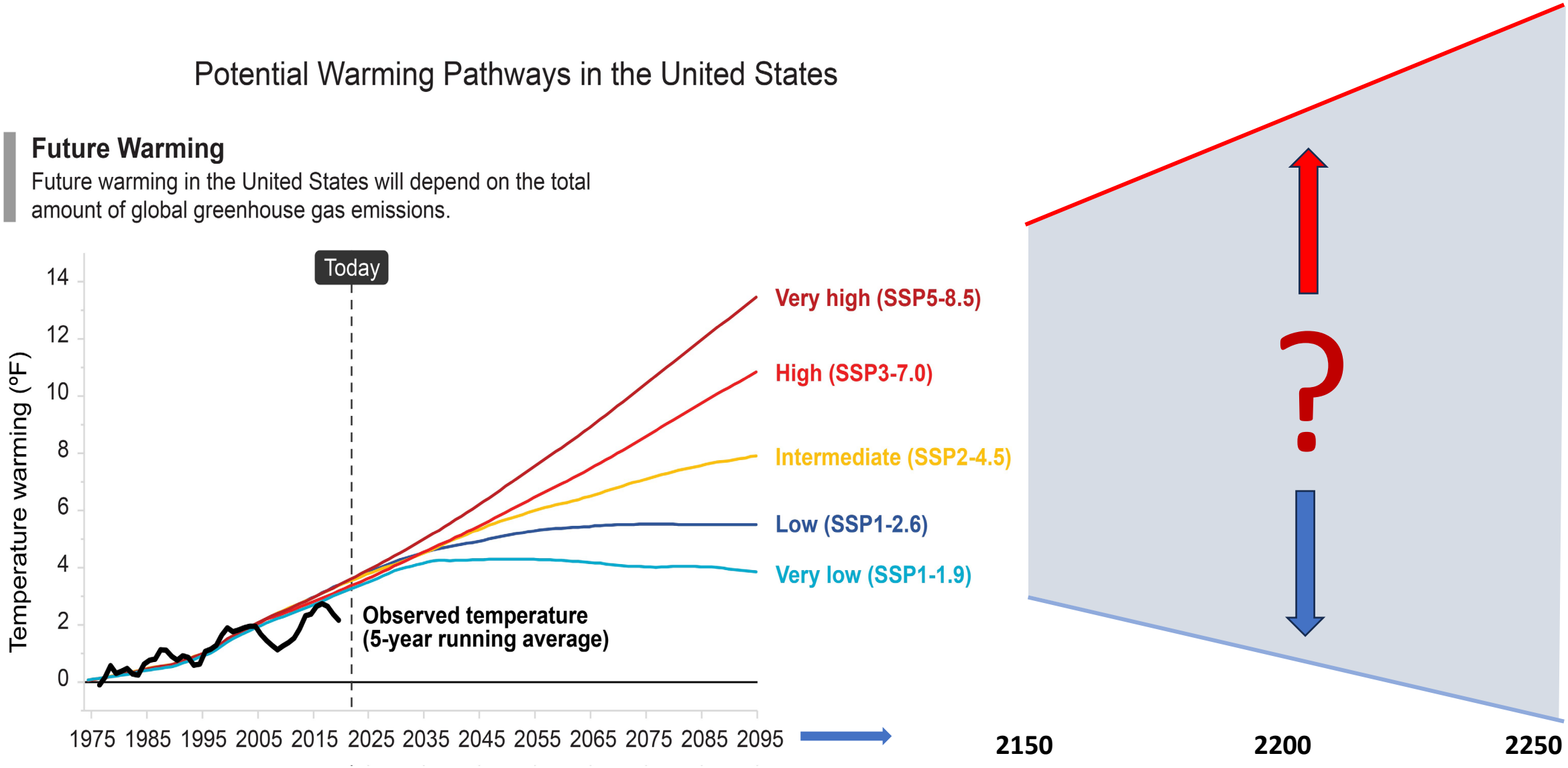


Energy.gov

Active Cleanup Sites

Energy.gov

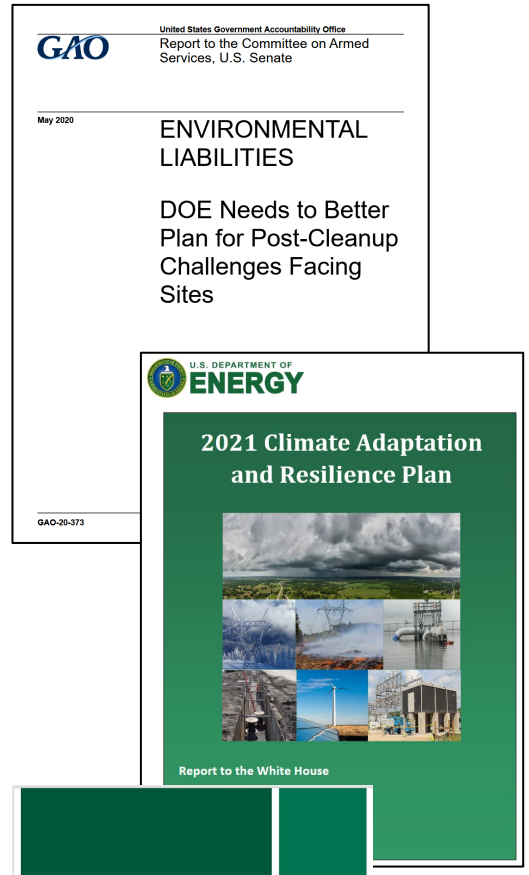
Long Lifetimes



5th National Climate Assessment

Context

- 2020 Government Accountability Office. Environmental Liabilities: DOE Needs to Better Plan for Post-Cleanup Challenges Facing Sites
- 2021 President Biden's Executive Order 14008: Tackling the Climate Crisis at Home and Abroad; Executive Order 14030: Climate Related Financial Risk
- 2021 DOE Climate Adaptation and Resilience Plan
- 2021 DOE Vulnerability Assessment and Resilience Planning Guidance
  - 2022 DOE Office of Environmental Management active sites complete initial vulnerability assessments & resilience plans.
- 2025 President Trump rescinded Executive Orders 14008 & 14030
- (State and local policies and permit requirements likely remain in place)



Guidance

Interstate Technology Regulatory Council Sustainable Resilient Remediation SRR-1. (srr-1.itrcweb.org)

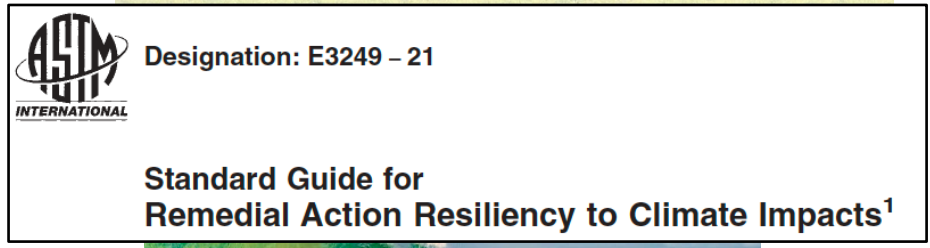
ASTM Standard Guide for Remedial Action Resiliency for Climate Impacts (ASTM E3249-21)

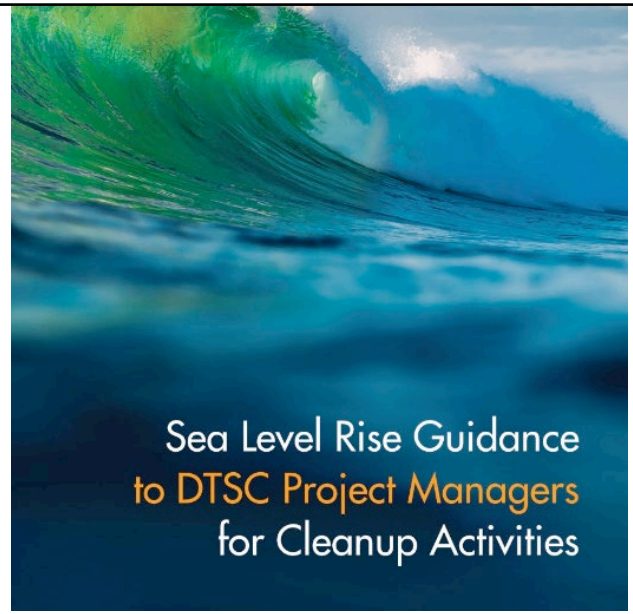
EPA Superfund Climate Resilience

- Climate Adaptation at Superfund Sites
- Climate Resilience Technical Fact Sheets

Washington: State Department of Ecology Adaptation Strategies for Resilience Cleanup Remedies.

California: Sea Level Rise Guidance for DTSC Project Managers for Cleanup Activities





Leveraging VARPs to Enhance Climate Resilience on DOE-EM Sites Project

Goal: **Enhance climate change resilience of DOE-Environmental Management sites**

- Expand on first round Vulnerability Assessment and Resilience Plans
- Pilot a learning framework for application at other DOE-EM sites
- Enhance inter-site learning and idea sharing

Disposal Cells & Remediation Activities

Timeframes - Likelihood - Consequences

Savannah River Site F & H Area Assets

- Collaborative workshop process
- System lifetimes and climate timelines
- Eliminate potential migration of contaminants from F & H Area settling basins and landfills

- Disposal cells
- Remediation activities
- Groundwater and surface water

Climate Change at Savannah River Site

- Historic severe weather events
- Climate change projections

Likelihood of increased frequency/increases of various climate parameters at SRS

	Hist-Mean	Hist-STD	RCP 4.5	RCP 8.5	Shifting 4.5	Shifting 8.5
Annual precipitation (mm/day)	3.24	0.14	3.52	3.58	Medium	High
Extreme precipitation day	2	0.74	2.48	3.17	Low	Medium
Annual avg Tmax (C)	24.79	0.31	26.63	27.5	High	High
Maximum Daily Precipitation (mm/day)	61.79	11.22	67.11	75.09	Low	Medium
Drought Index (SPEI)	-0.01	0.3	0.15	0.22	Negative	Negative
Wildfire (CFWI)	7.24		9.18	7.93	Low	Low

(CMIP v5; Representative Concentration Pathways 4.5 , 8.5; Historic 1950-2005; Projections 2006-2099)

Asset / System	Potential Vulnerability
Engineered soil and vegetation caps	Extreme precipitation Precipitation timing shifts High heat events Drought Wildfire Compounding drought/extreme precipitation
Surface and groundwater monitoring systems	Changes in groundwater dynamics Potential down-flooding of wells Inundation of monitoring equipment
Groundwater plume associated with seepage basin	Changes in groundwater dynamics

Asset / System	Potential Vulnerability
Forests on and surrounding the site	Changes in wildfire frequency and wildlife management
Phytoremediation area	Changes in surface water Temperature / Drought Evapotranspiration potential Changes in extreme precipitation
Outfalls and natural surface water areas	Erosion Extreme precipitation / stormwater management Regulatory compliance
Wetlands	Sediment disturbance
Berms, dams	Extreme precipitation

Vulnerabilities and Resilience Solutions

Asset / System	Potential Vulnerability
Engineered soil and vegetation caps	Extreme precipitation Precipitation timing shifts High heat events Drought Wildfire Compounding drought/extreme precipitation

Vulnerability of landfill caps and supporting systems

Participants had confidence that existing landfill caps were designed to or have been updated to endure the magnitude of projected changes in precipitation.

- Movable de-watering pump systems and associated response plans.
- A better understanding of surface water dynamics, including stormwater behavior.
- Planting future condition-tolerant vegetative cap cover.

Regulatory and Legal Context

Difficult to implement creative resilience actions

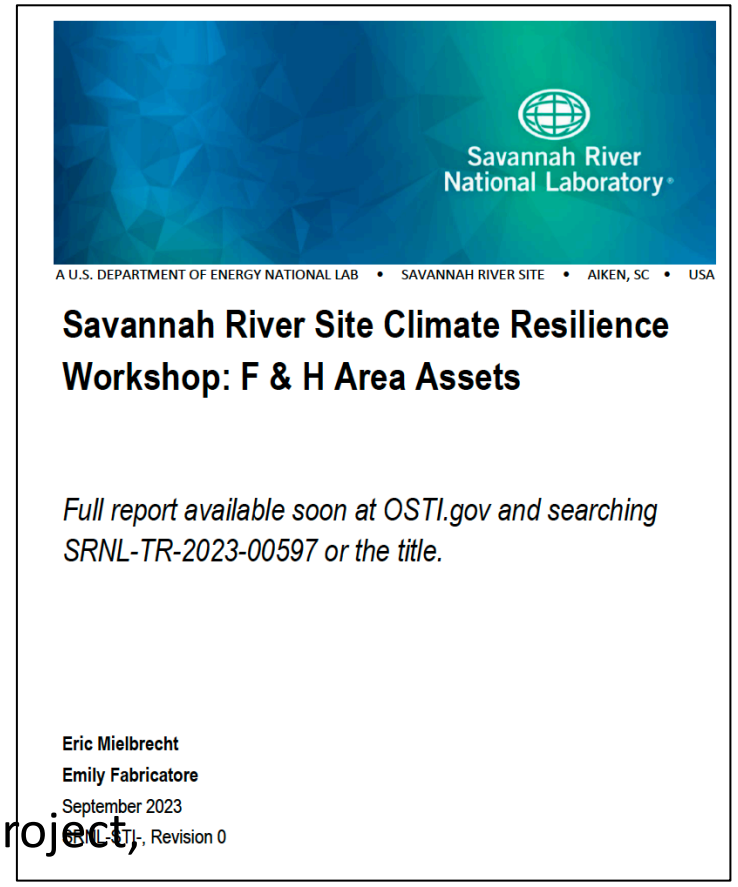
There is an opportunity for the Savannah River Site to lead research in unique and effective resilience actions.

Supporting better environmental outcomes

- Create an informed basis for new climate resilience actions that have been tested to be effective, are economically reasonable, and meet DOE's sustainability goals.
- Co-develop a regulatory context in collaboration with federal and state regulators.

Acknowledgements

Thank you to the staff of the Savannah River Site who participated in the workshop.



Project Team:

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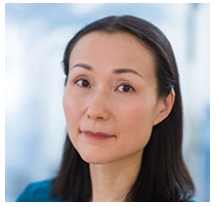
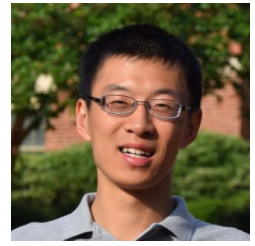
- Carol Eddy-Dilek, SRNL
- Emily Fabricatore, SRNL
- Haruko Wainwright, MIT
- Zexuan Xu, LBNL
- David Werth, SRNL (not pictured)





To learn more about this project, contact

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Climate Change

- Historic severe weather events
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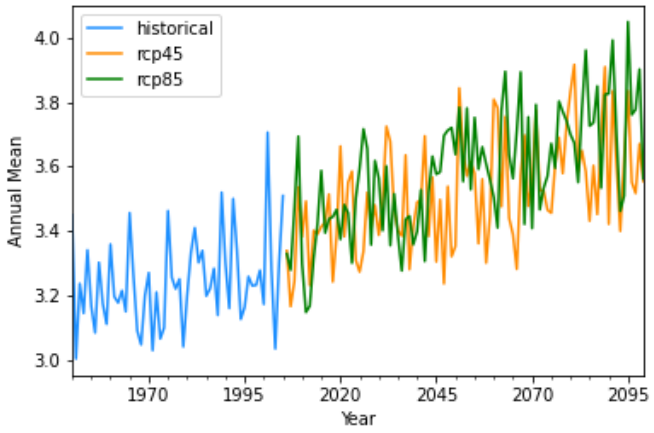
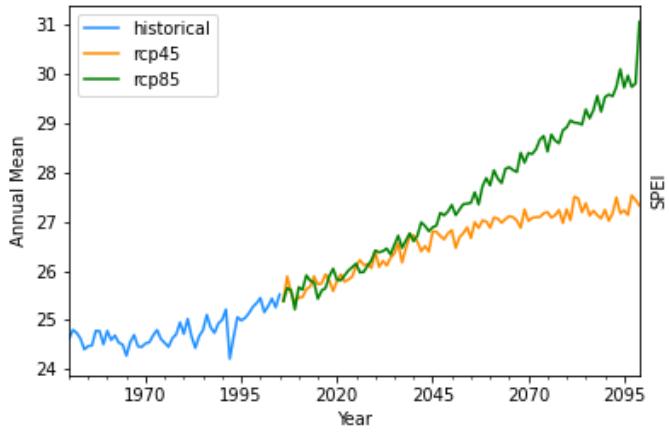
Precipitation



Temperature



Drought Index (SPEI)