Environmental Security

DOE perspectives

G. L. Geernaert
Climate and Environmental Sciences Division

DOE mission
To ensure America’s security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions

DOE activities associated with environmental security and societal threats
- Assessing vulnerabilities of energy infrastructures and societal impacts
- Risks associated with nuclear contaminants due to extreme events
- Vulnerabilities associated with nuclear materials and weapons

Infrastructure

- Infrastructure resilience
  - Existing infrastructure to extreme events
  - Energy-water interdependencies
  - Weather extremes
  - Terrorism
  - Future infrastructure
  - Design criteria utilizing climate change
  - System dynamics and network theory
- DOE’s approach emphasizes predictive science, simulation, and risk analysis
  - Weather time scales
    - Exploit WWS model outputs and partnerships
    - Data derived from, e.g., DOE, DHS, and utilities
  - Climate time-scales
    - Uses DOE in-house modeling and simulation: climate; energy and related sectors; societal sector
    - Data derived from, e.g., DOE, DHS, NGA

FAST FACTS
- Multi-lab project. Of order $20M/yr
- Part of DOE exascale computing strategy; started as branch of CESM
- Focus on extremes; SLR cryogenic; water cycle
- V1 release on track for summer 2017
- Features MPAS ocean at 10km resolution, coupled to MPAS sea-ice and land-ice.
- Atmosphere will be 25km, with CLU88 convection and full set of aerosols
- Land will include PFLTRAN, and C-N-P biogeochemistry
- Has secured ALCC, INCITE awards, as well as early access for SUMMIT and CORI

Plans beyond FY17
- Academic engagement on council and model development
- Much higher spatial resolutions to resolve extreme phenomena
- Incorporation of IAMs and IAV models (all sectors)
- Routine access to SUMMIT (ORNL); prepare for OLCF5

Accelerated Modeling For Energy

Vulnerability and risk modeling (with ESMs)

- Integrated Assessment Models (IAMs) – coarse grid; multiyear time steps; all economic and energy sectors
- Applications – climate feedbacks; agriculture; cascading impacts
- Model types: climate and earth system; deterministic/stochastic
- Use cases – water supply and sector dependencies
- Agency collaborators – USDA, EPA, USACE

- Impact, adaptation, and vulnerability (IAV) models
  - Applications – shock modeling and response; population and behavior; socioeconomics
  - Model types: hybrid – deterministic, stochastic, networks, agents, sub-agents, ...
  - Use cases – drought; migration; energy-water-land interactions, health, other sectors, behaviors
  - Agency collaborators – DHS, NGA, EPA, USDA, NSF, DARPA, (IARPA), etc.