Water-Energy Nexus

Pressures and drivers
USGCRP and DOE priorities
DOE’s WETT

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DOE
Pressures and drivers

• IPCC and NCA – science gaps
  – Projections involving water have most uncertainty
  – Models are non-convergent for water

• Stressors
  – Energy and water infrastructure interdependence
  – Shocks (e.g., blackouts) compounded when water and energy availability are both stressed to collective limits

• Utilities and planners
  – Worry most about droughts and water supply
  – Coastal zones vulnerable, esp for designing sustainable infrastructures considering future extremes

• DOE high priority “water-energy nexus”
  – Secretary of Energy formed a task team on this topic

Energy
- Petroleum 35
- Biomass 4
- Natural Gas 25
- Coal 20
- Nuclear 8
- Geothermal 0.2
- Hydro 3
- Renewable 1

Water
- Fresh Surface 265
- Saline Surface 57
- Fresh Ground 80
- Saline Ground 3

Energy reported in Quads/year. Water reported in BGD.
USGCRP

• Mandate/mission
  – Scientific research coordination: IGIM, Adapt, Obs, Health, etc.
  – Sustained assessment: NCA, GCIS
  – Adaptation
  – Communicate and educate

• New drivers
  – Inform decisions: inform risk modeling
  – President’s Climate Action Plan (PCAP)
  – Big data, tools, informatics

• Science priorities: FY2013, FY2014, FY2015, ...
  – FY2013 Integrating theme (extremes, thresholds, tipping points)
  – FY2014: coupled earth/human modeling; actionable science
  – FY2015: Drought; Arctic; Modeling (seasonal-decadal)
  – FY2016: (some combination with new drivers)

• Major science issues
  – Modeling and data infrastructure: resolution, computing, modularity, assimilation, ...
  – Multiple stressors: IA, IAV, water-energy, human component interdependence, uncertainty quantification
  – Linkage to other communities: economics, food supply, land use change, demographics, political risk analysis, conflict, etc.
Projected future changes in precipitation by 2080-2099, relative to average seasonal precipitation in 1961-1979 under the A2 emission scenario and simulated by 15 climate models. Hatched areas show areas with highest confidence in the projected change. Source: USGCRP (2009)
DOE – Water Energy Tech Team

- Systems analysis involving water-energy interdependence, climate
- Technology design scenarios, insertion, and value added
- Individual technology development
- Short term: IAV / Wx coupling – for emergency mgmt (plans)
- Longer term: System model interdependence
  - Physical earth system model for extremes (including droughts)
  - Integrated assessment (IA)
  - Impacts, adaptation, vulnerability (IAV)
- Issues receiving attention now
  - Do the right models exist to tackle the new set of problems
  - Data infrastructure: common ontologies, gridding, etc.
  - Data assimilation
  - Uncertainty quantification methodologies
  - Compatibility with risk models in the public and private sectors