

ENVIRONMENTAL SCIENCE DIVISION: CAPABILITIES IN NATURAL RESOURCE MANAGEMENT AND ENERGY POLICY

Cristina Negri, Division Director
Heidi Hartmann, Program Manager

Air Quality & Climate Modeling

Cultural Resources

Decision Support

Ecology

Economics/Ecosystem Services

Geohydrology

Geospatial Information Systems

Natural Resource Management

Remote Sensing

Soils Science

Visual Resources

EVS Website: <http://www.evs.anl.gov/>



Argonne National Laboratory



ARGONNE'S MISSION

WORLD-CLASS SCIENCE, ENGINEERING, AND USER FACILITIES DELIVER INNOVATIVE RESEARCH AND TECHNOLOGIES RELEVANT TO THE NATION'S ENERGY, ENVIRONMENT, AND ECONOMIC WELL-BEING

- \$860M operating budget
- 3,350 employees
- 1,250 scientists and engineers
- Operated by the University of Chicago for the Department of Energy
- Located on about 1,500 acres in southwest Chicago metro area

ABOUT THE ENVIRONMENTAL SCIENCE DIVISION (EVS)

- Conduct research to understand how environmental system components change as a result of energy development, application of emerging technologies, and major new federal policies and programs
- About 85 full-time and 50 part-time staff with an FY2016 budget of \$43M
- Focus on:
 - Land and renewable resources
 - Surface and subsurface hydrology
 - Coupled ecosystem processes
 - Radiation and chemical risk management
 - Environmental restoration
 - Atmospheric processes and measurement and climate research
- Provide rigorous science and engineering analyses about present and possible future state of the environment
- Operate Southern Great Plains Atmospheric Radiation Measurement (ARM) site, the world's premier climate research facility



ARGONNE HAS A LONG HISTORY OF SUPPORTING NATURAL RESOURCE MANAGEMENT AGENCIES

- Staff members with extensive experience working on land and resource management issues
- Thorough understanding of federal agency policies, programs, capabilities, technical issues, and relevant data
- Conduct basic and applied research on how natural systems behave in response to change, and how to mitigate adverse change
- Conduct science-based analyses of emerging environmental issues, with a focus on energy development
- Support formulation of policies and regulations ensuring safe, environmentally responsible, and economically sustainable energy development.



EXPERIENCE CONDUCTING INTEGRATED ASSESSMENTS TO SUPPORT ENVIRONMENTAL DECISION-MAKING & POLICY

- Broad experience preparing **National Environmental Policy Act (NEPA) analyses** to support development of new policies and programs
- **Environmental studies to support science-based decisions:** biological studies, hydrologic modeling, watershed studies, air quality modeling, climate change modeling, ecosystem services, life-cycle assessment
- **Analyses of cultural and social system issues:** assessments of impacts to cultural resources, Native American concerns, visual resources, and human dimensions
- Development and implementation of landscape-scale approaches to support **regional planning, mitigation, monitoring, and adaptive management strategies**
- Implementation of **innovative technologies and methods** for assessing environmental conditions (e.g., remote sensing technologies, geospatial analyses)
- Supporting multi-agency collaboration and stakeholder engagement through **effective information sharing and facilitated dialogue.**

Federal Agency Customers
U.S. Department of Energy
Western Area Power Administration
Bonneville Power Administration
U.S. Department of Defense
U.S. Nuclear Regulatory Commission
Environmental Protection Agency
Bureau of Ocean Energy Management
Bureau of Safety and Environmental Enforcement
Bureau of Land Management
U.S. Forest Service
Bureau of Reclamation
National Park Service
U.S. Fish and Wildlife Service
DOI Office of Indian Energy and Economic Development

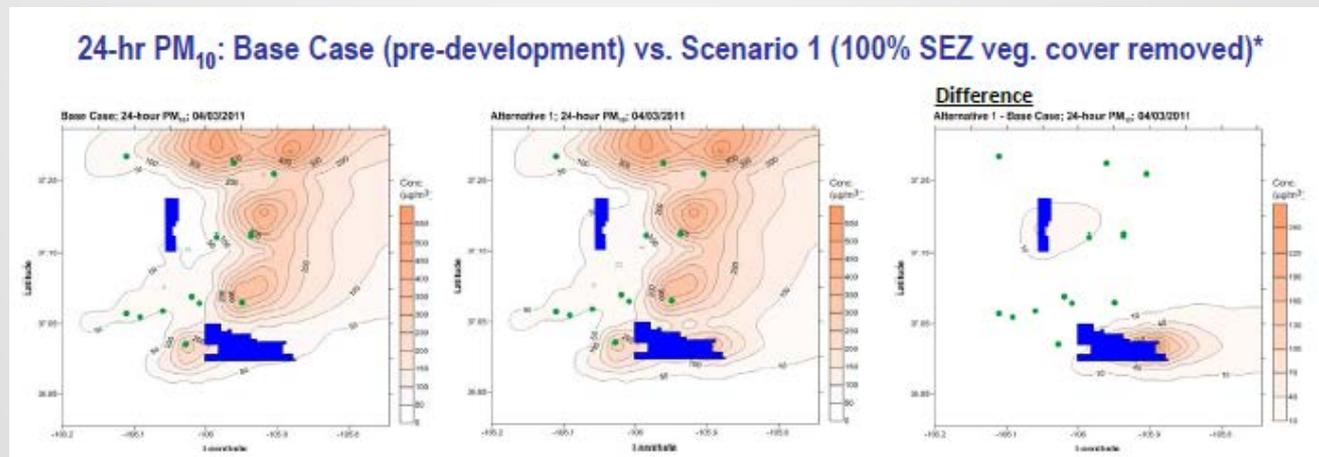


CAPABILITIES OVERVIEW

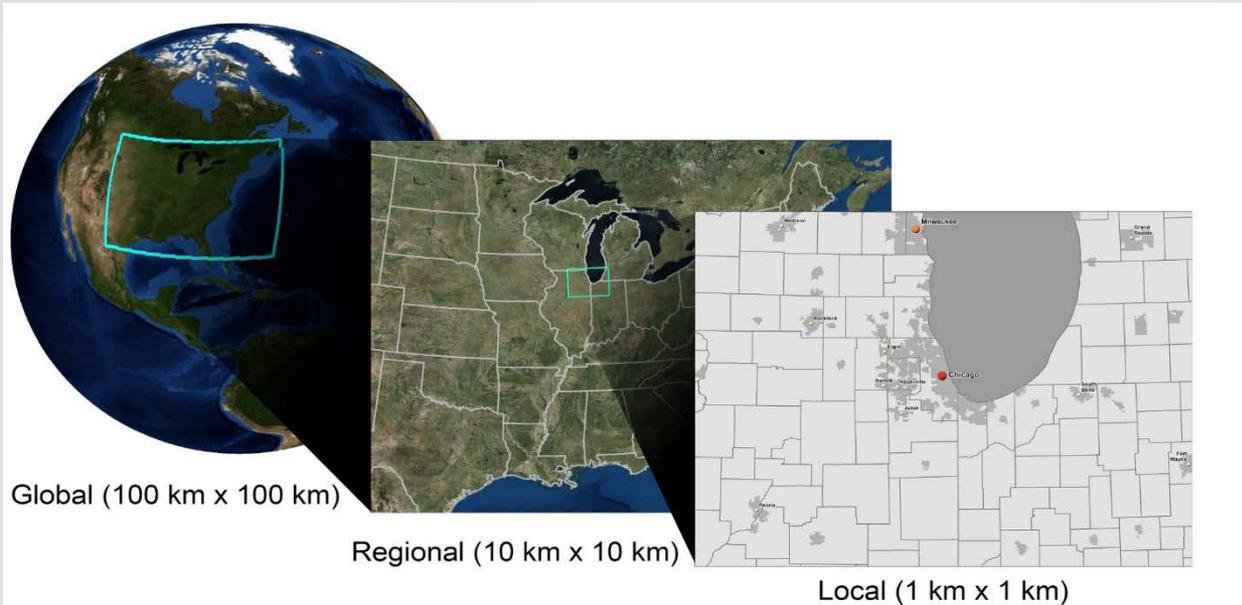


AIR QUALITY ASSESSMENT

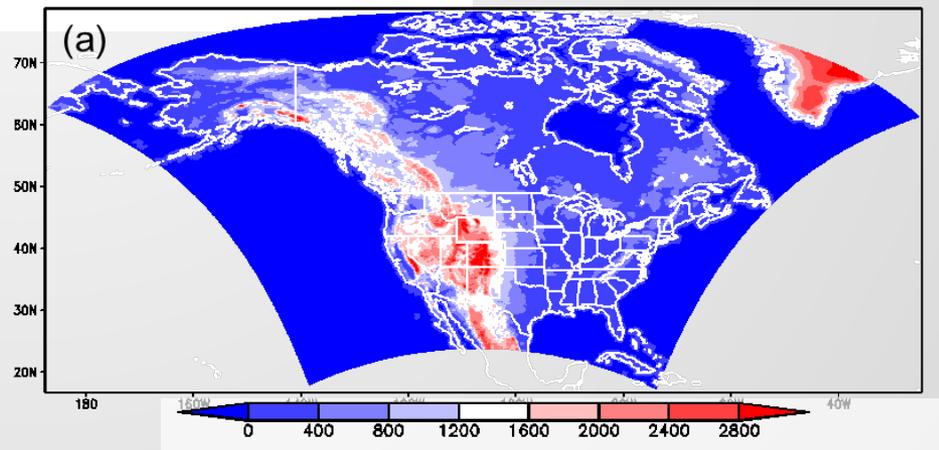
- Emission Inventory Development
 - For criteria and toxic air pollutants and greenhouse gases
 - For energy, transportation, and agriculture sectors
- Air Quality Modeling
 - Long-term, high res simulations at the regional scale
 - To aid AQ assessments of visibility, acid deposition, ozone, etc.
 - For dust, PM analysis using WRF-Chem (San Luis Valley, for BLM)
- High-Performance Computing
 - Large parallel computing systems, visualization, advanced display environments, high capacity network links



CLIMATE MODELING



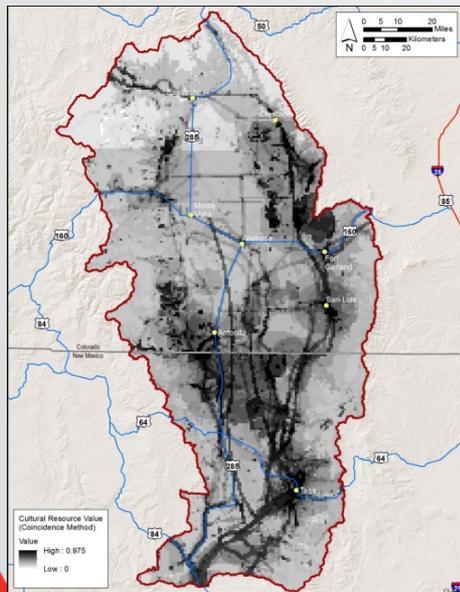
- Spatial resolution meaningful for policy and management: 12-km regional climate modeling for North America – model data publically available
- Simplified new method to estimate extremes in temp and precipitation – to support resiliency assessments and fire hazards analysis



CULTURAL HERITAGE VALUES AND RISK ASSESSMENT

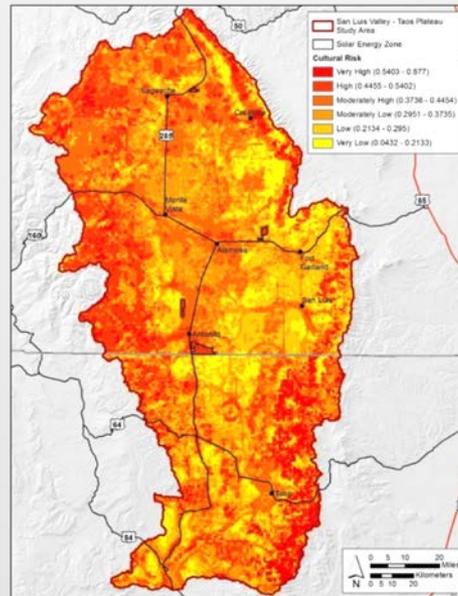
Document

- Identify areas of highest cultural heritage value



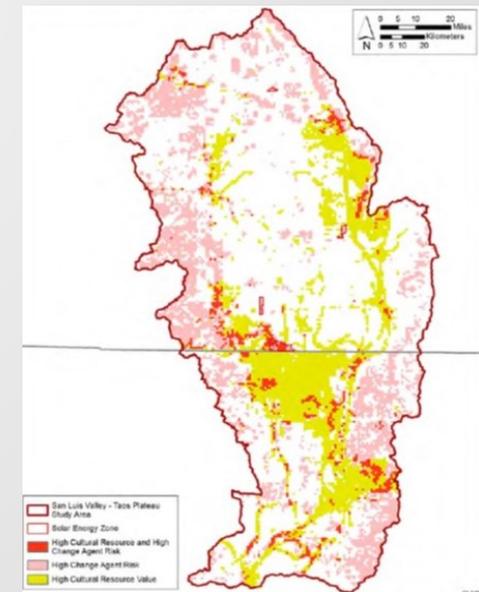
Assess

- Status and trends of resources, including vulnerability to change agents, over time



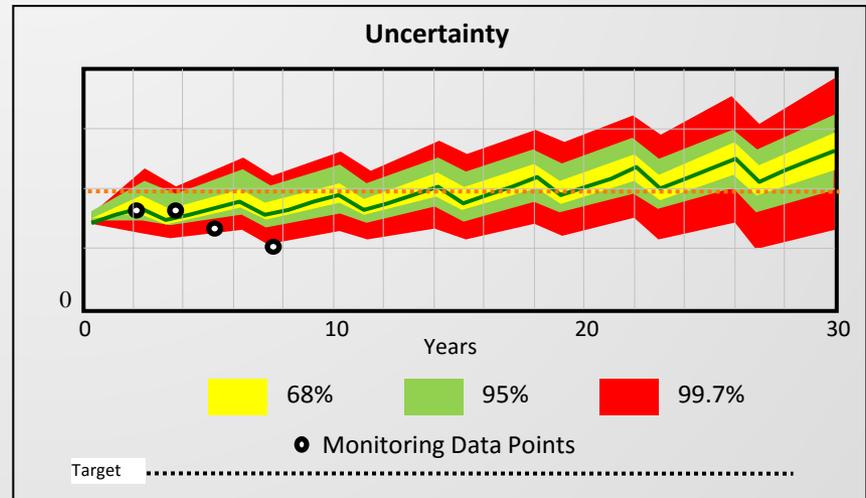
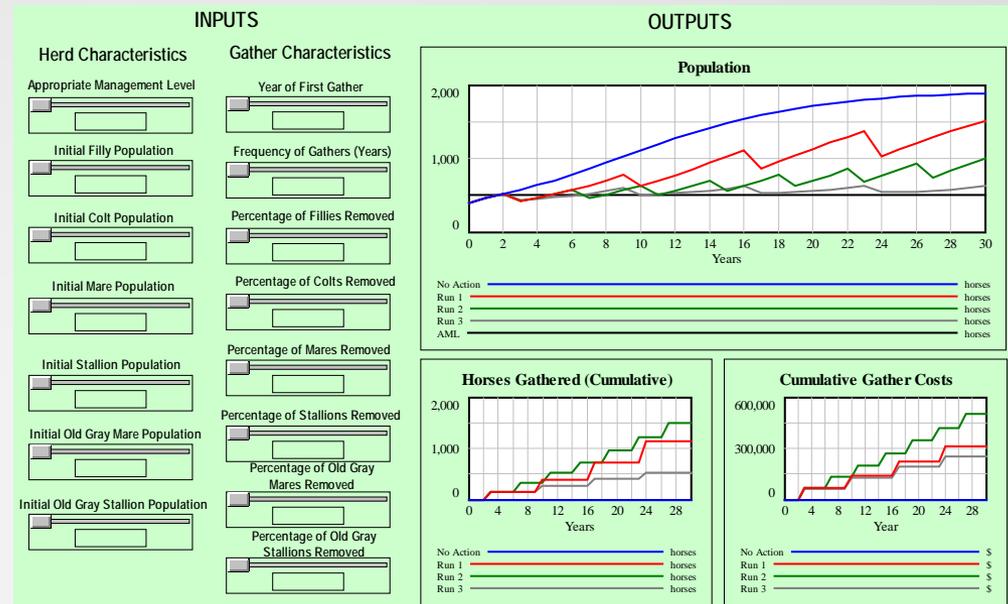
Mitigate

- Mitigation and Conservation Efforts
 - High Value - High Risk (Mitigation)
 - High Value - Low Risk (Conservation)



DECISION SUPPORT SYSTEMS

- User-friendly computer-based simulations that allow users to construct and test management alternatives and compare the projected outcomes to desired conditions
- Can handle the many complex cause and effect relationships found in coupled human and ecological systems
- Facilitate efficient and effective adaptive management



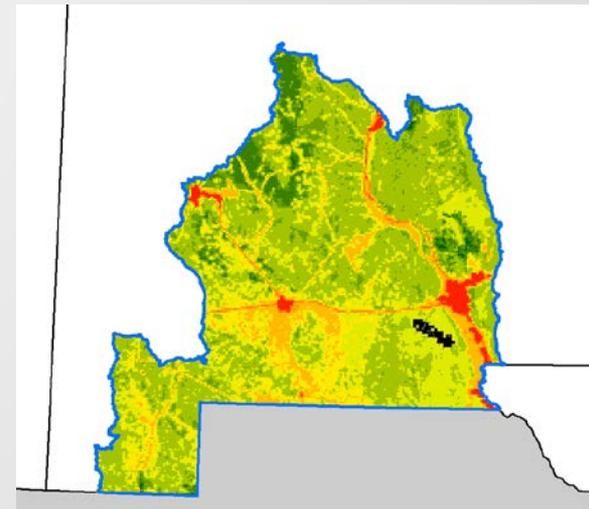
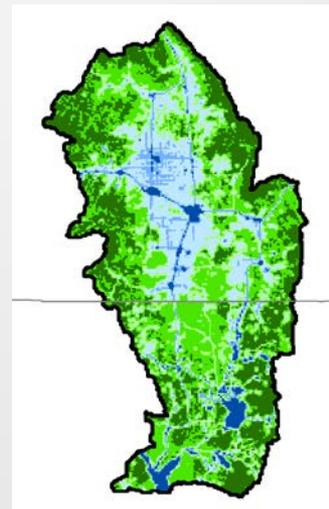
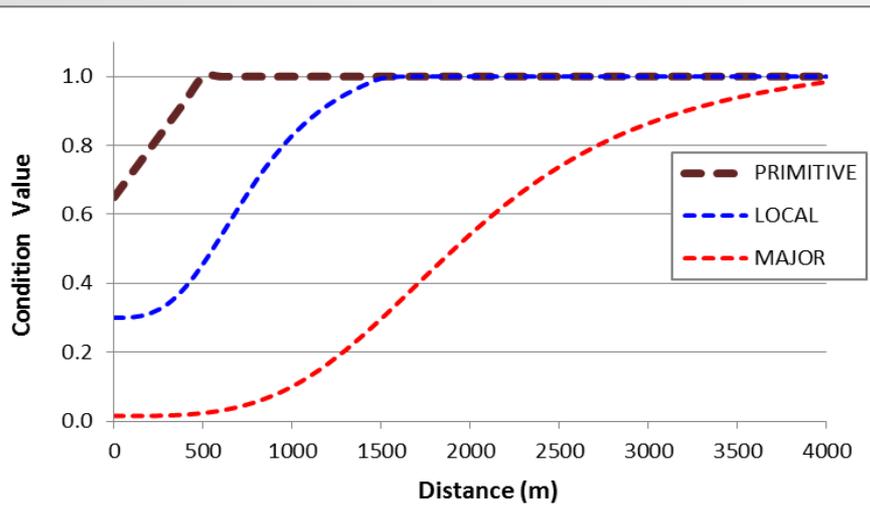
ECOLOGY: AVIAN-SOLAR INTERACTIONS

- Addressing issues associated with avian mortality at utility-scale solar facilities
- Established and facilitate multi-agency collaborative working group to advance understanding and inform future agency decisions
- Developed science coordination plan to prioritize research (2016)
- Organized technical symposium to share information about recent, ongoing, & planned research (2017)
- Conducting research into
 - Industry costs
 - Approaches to understand avian background mortality
 - Mechanisms for data collection and synthesis



ECOLOGY: LANDSCAPE-SCALE MODELING

- Development of geospatial modeling approaches for landscape assessment
 - Landscape intactness modeled using human development footprint
- Application of ecological landscape models
 - Evaluation of impacts of energy and mineral development
 - Can inform valuation of appropriate mitigation costs
 - Assists in identification and evaluation of mitigation sites and actions



ECONOMIC ANALYSIS

- Socioeconomic Impact Analysis for NEPA
 - Evaluate the local and regional socioeconomic impacts of projects based on economic indicators and measures of social activity using the IMPLAN model.
- Mitigation Costs for Large-Scale Solar Energy Development
 - Analyze compensatory mitigation requirements and costs to identify reasons for variability, and investigate whether those costs can be decreased through improved mitigation planning.

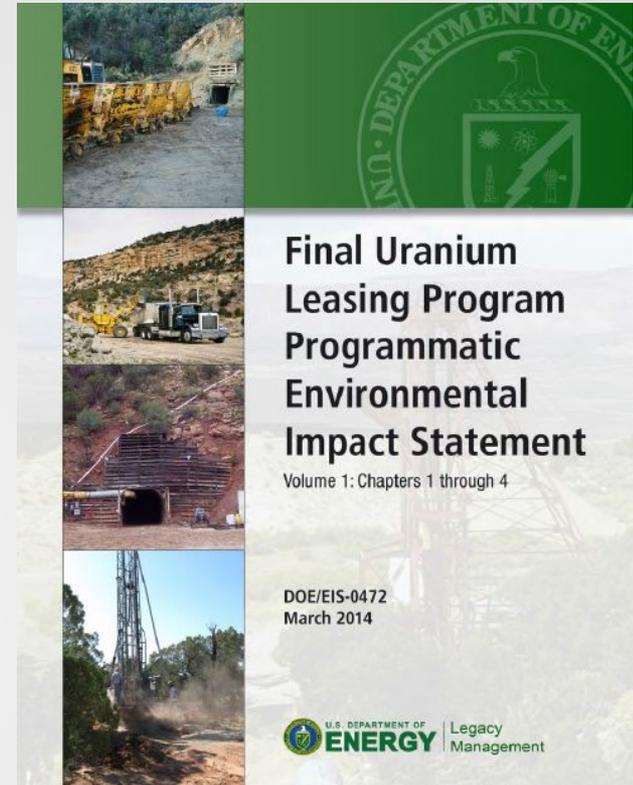
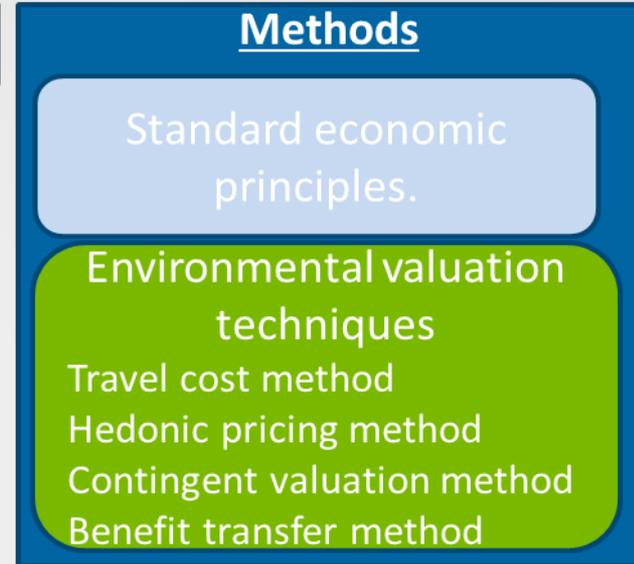
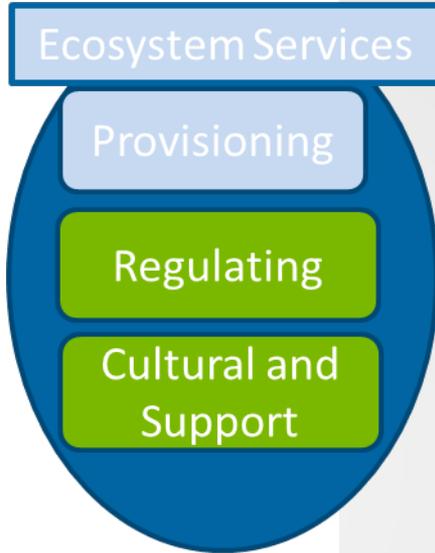
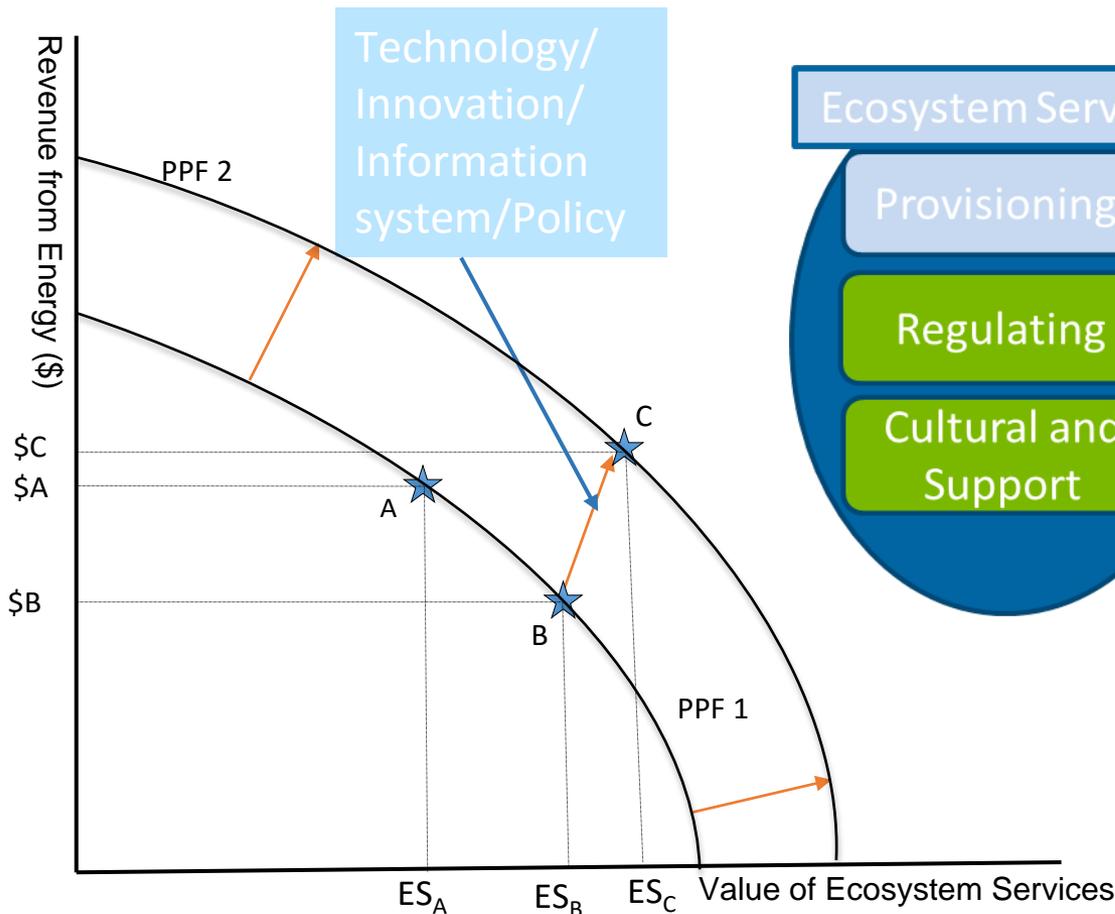


Photo Credits: DTRC/USFWS



ECOSYSTEM SERVICES: VALUATION OF ENERGY SYSTEMS



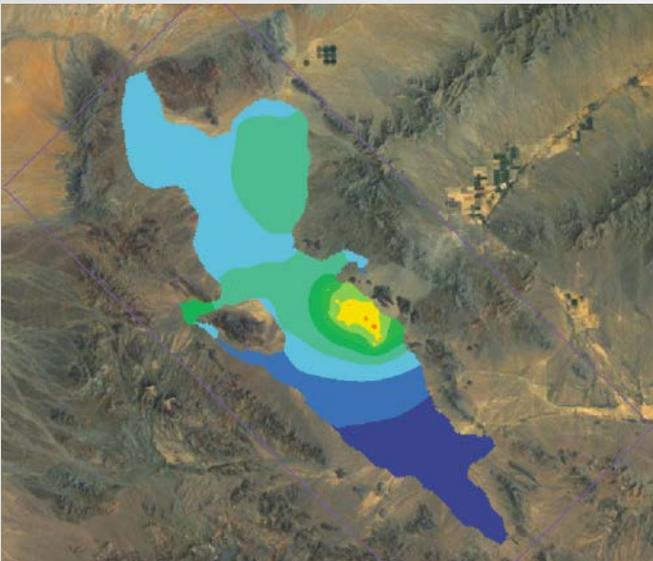
EVS PROJECTS

- Assessment of economic impact of changes in river flow on hydropower and fisheries (NASA funded)
- Integrated assessment of solar fields as pollinator habitat



GEOHYDROLOGY

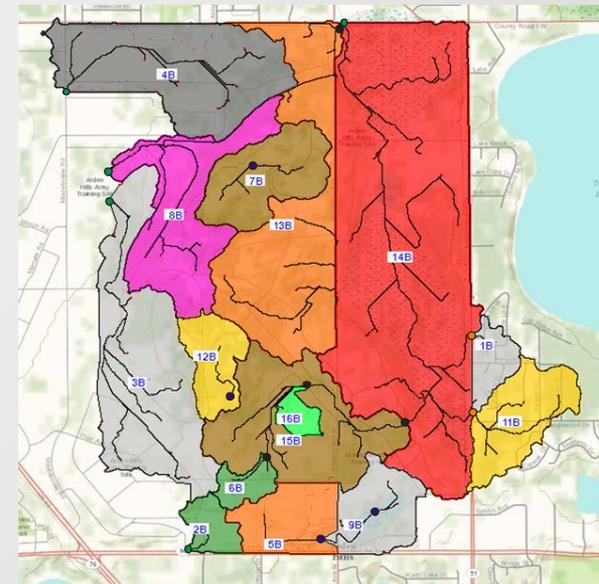
- Hydrogeological investigations
 - Modeling groundwater impacts such as drawdown from pumping, wellhead protection zone delineation, drought, trans-boundary issues
 - Subsurface characterization, 3D visualization, and groundwater/soil remediation including phytoremediation
- Stormwater Management, Flooding Analysis, Watershed Modeling



Groundwater modeling results showing drawdown due to pumping stresses



Phytoremediation site



Watershed delineation at National Guard facility



GEOSPATIAL ANALYSIS, DATA SHARING AND VIEWING

- Data compilation, consolidation, visualization, and management
- Information portals and clearinghouses
- Geospatial analysis and modeling
- Interactive geospatial data viewers supporting specific programs or data needs
- Public outreach and communication
- Online training

West-wide (Sec. 368) Energy Corridors
<http://corridoreis.anl.gov>

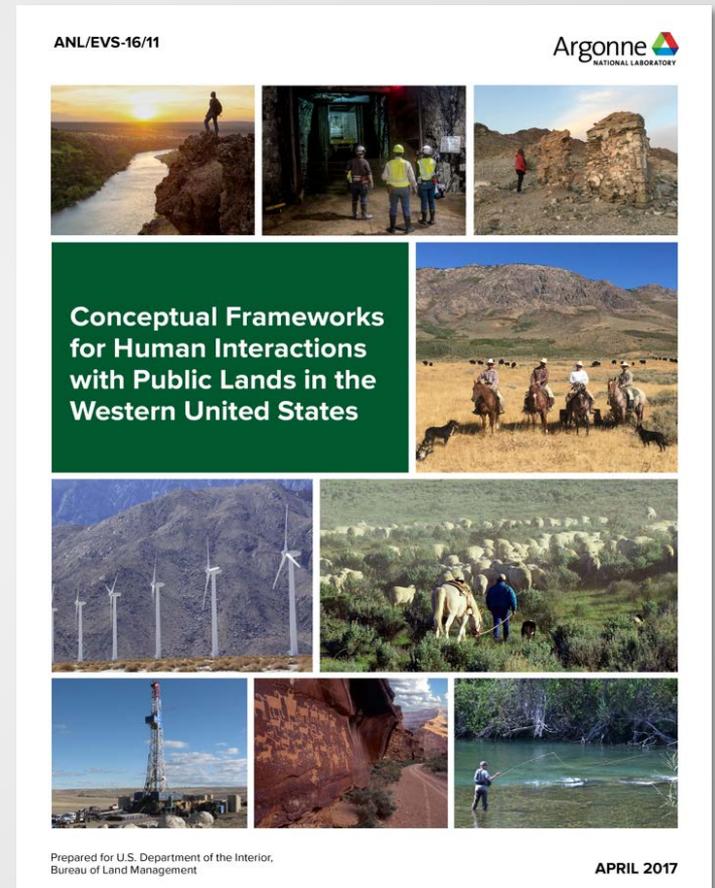
Solar Energy Environmental Mapper
<http://solarmapper.anl.gov/>

Energy Zones Mapping Tool
<https://ezmt.anl.gov/>

Tribal Energy & Environmental Information
<https://teec.indianaffairs.gov/>

NATURAL RESOURCES MANAGEMENT: HUMAN DIMENSIONS ANALYSIS

- Exploratory project for expanding consideration of human dimensions in decision-making.
- Developed typology of human interactions with public lands.
- Evaluated human needs/values frameworks for application to public lands issues.
- Developed conceptual framework for human/landscape interactions.



NATURAL RESOURCE MANAGEMENT: LONG-TERM MONITORING STRATEGIES AND IMPLEMENTATION

Overview:

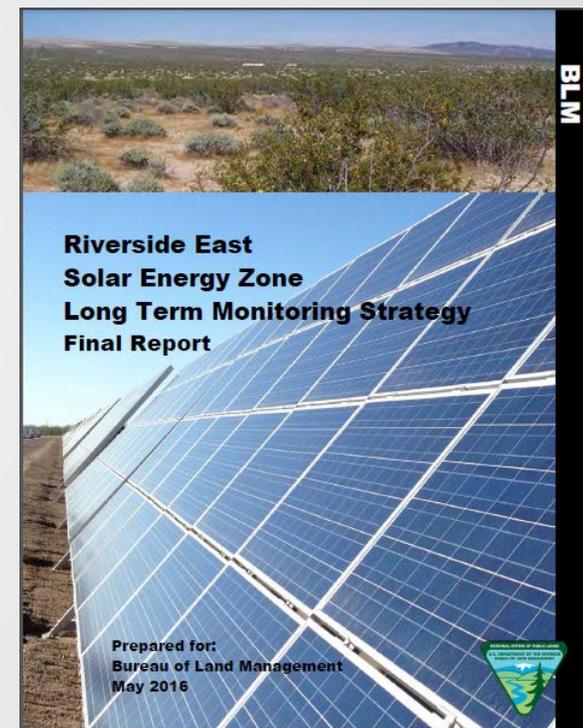
- Large scale solar is relatively new; public lands are at the forefront
- Larger footprint than typical public land development with little empirical data on impacts.
- Monitoring strategy is:
 - Regional in scale, rather than project-by project
 - Informs on status and trend of key resources and ecological processes to inform future decisions
- Transparent process with public engagement
- Lessons from this process to inform future solar monitoring strategies

Final Strategy Includes:

- Management questions, Monitoring objectives, and sampling framework

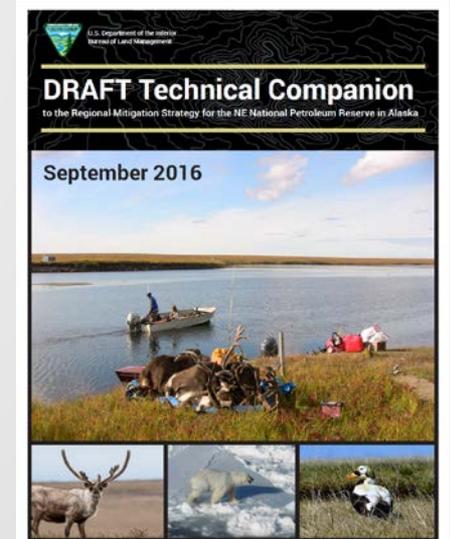
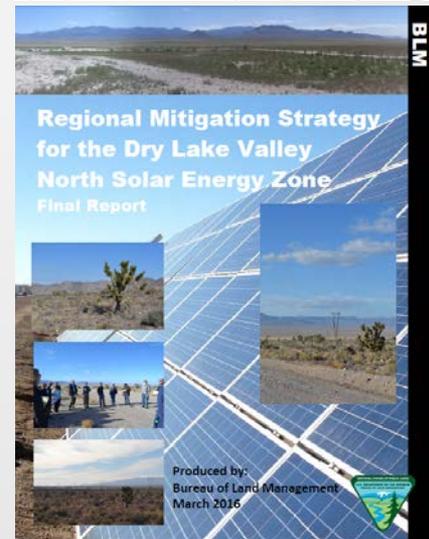
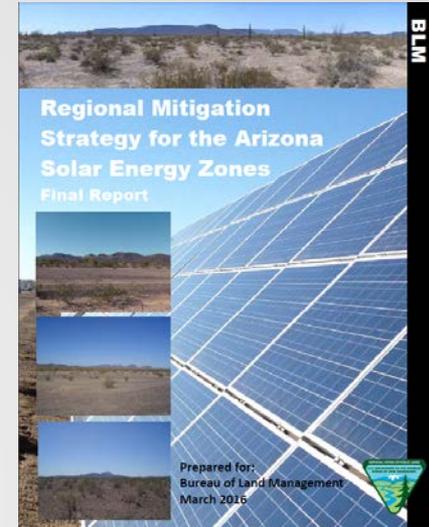
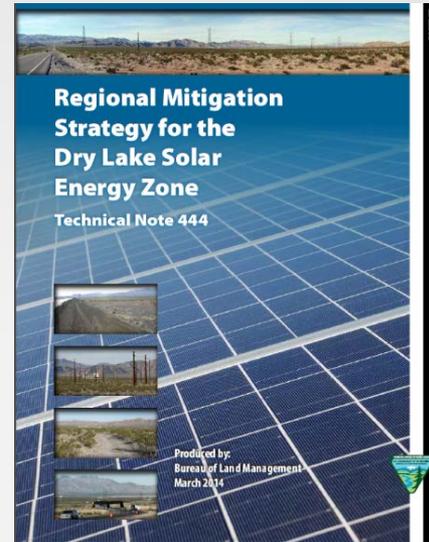
Current Status:

- New funding to consolidate, analyze and report on existing monitoring data, identify new needs, and develop remote sensing tools



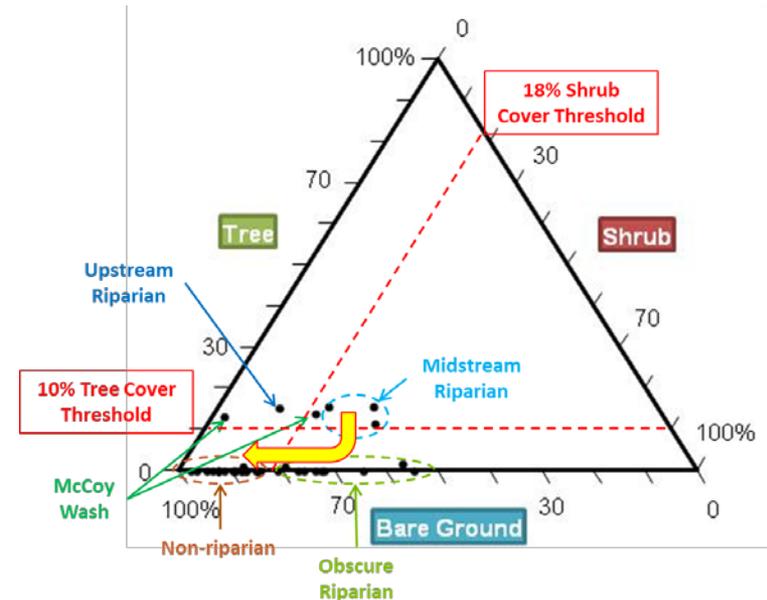
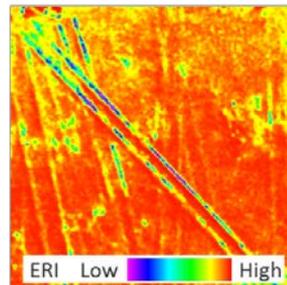
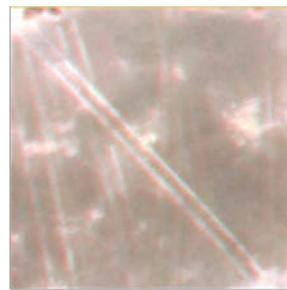
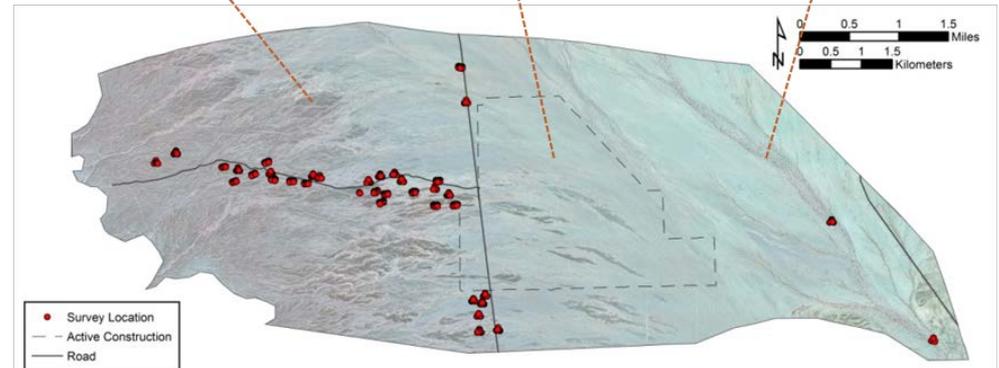
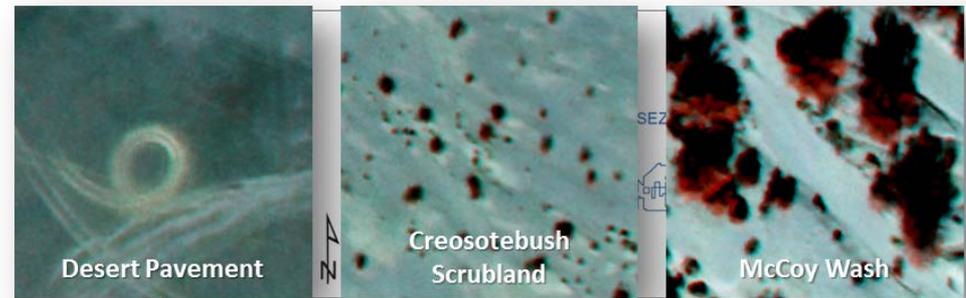
NATURAL RESOURCE MANAGEMENT: REGIONAL MITIGATION STRATEGIES

- Starting in 2012, have completed four Bureau of Land Management solar regional mitigation strategies (for solar energy zones in Arizona, Colorado, and Nevada)
- Working to complete strategies for New Mexico and Utah solar energy zones and for oil and gas development on the North Slope of Alaska



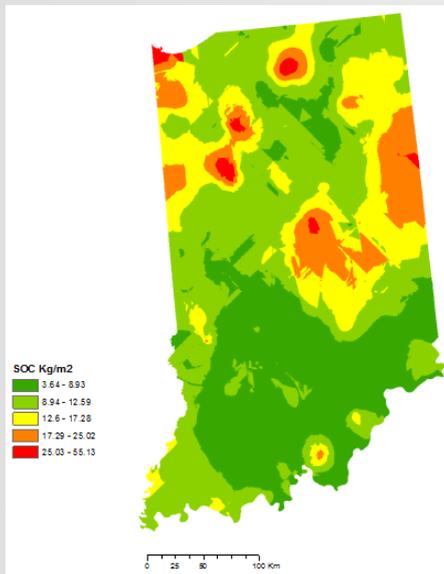
REMOTE SENSING

- Desert environment:
Conducted aerial survey and collected field data for validation of results.
- Characterized locations of desert pavement, surface stability, and vegetation alliances.
- Are investigating ways to characterize microphyll woodlands using high-res multispectral aerial imagery.
- Publication: 3 reports, 4 papers, 4 presentations.

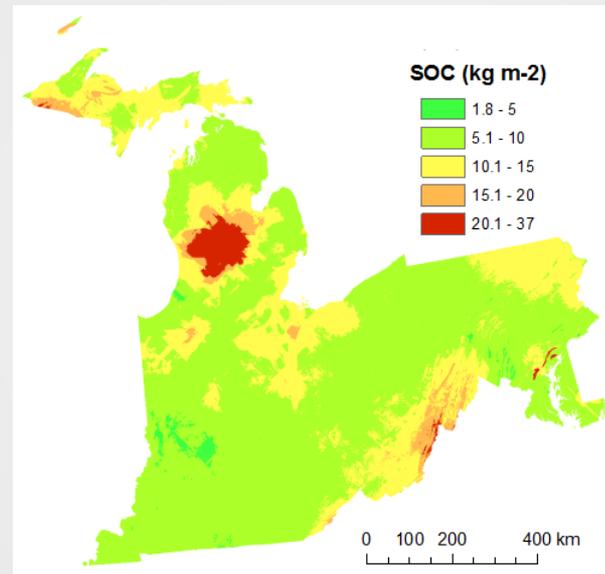


SOIL SCIENCE: CARBON SEQUESTRATION MODELING

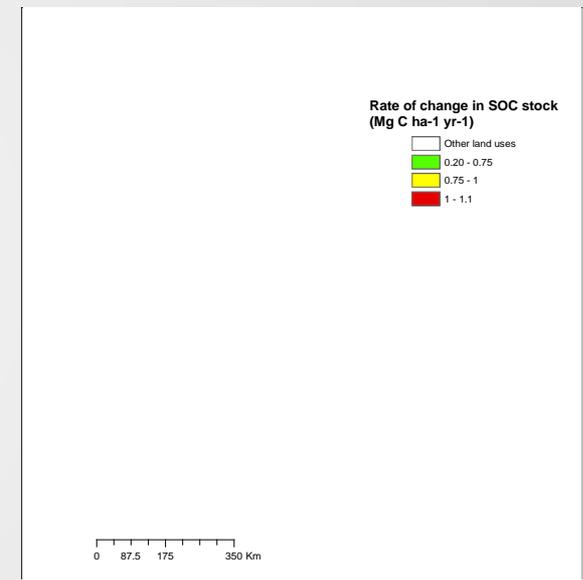
Geospatial approaches to predict spatial heterogeneity of soil organic carbon (SOC) stocks and fluxes at regional scales



(SOC stock of Indiana at 30-m spatial resolution; Mishra et al., 2009)



(SOC stock predicted using spatially adjusted GWR technique; Mishra et al., 2010)



(Predicted SOC fluxes of croplands; Mishra et al., 2012)



VISUAL RESOURCE ANALYSIS

- Visual Impact Assessment for Energy Development
- Characterization and Visibility Research
- Mitigation Development
- Inventory and Management System Design
- Guidance Development
- Field Support and Training
- Night Skies/Dark Environments



- Argonne can provide a variety of services to support initiatives related to natural resource and land management and energy policy:
 - Subject matter expertise for a variety of environmental sciences
 - Environmental analysis, monitoring and mitigation strategy efforts
 - High performance computing, data management, visualization, and geospatial analysis
 - Website design, development, and deployment
 - Internal and external stakeholder engagement



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