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’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 *regiona 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*.

<table>
<thead>
<tr>
<th>Federal Agency Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>Western Area Power Administration</td>
</tr>
<tr>
<td>Bonneville Power Administration</td>
</tr>
<tr>
<td>U.S. Department of Defense</td>
</tr>
<tr>
<td>U.S. Nuclear Regulatory Commission</td>
</tr>
<tr>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>Bureau of Ocean Energy Management</td>
</tr>
<tr>
<td>Bureau of Safety and Environmental Enforcement</td>
</tr>
<tr>
<td>Bureau of Land Management</td>
</tr>
<tr>
<td>U.S. Forest Service</td>
</tr>
<tr>
<td>Bureau of Reclamation</td>
</tr>
<tr>
<td>National Park Service</td>
</tr>
<tr>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>DOI Office of Indian Energy and Economic Development</td>
</tr>
</tbody>
</table>
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.
ECOSYSTEM SERVICES: VALUATION OF ENERGY SYSTEMS

Methods

Standard economic principles.
- Environmental valuation techniques
  - Travel cost method
  - Hedonic pricing method
  - Contingent valuation method
  - Benefit transfer method

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

Tribal Energy & Environmental Information
https://teeic.indianaffairs.gov/

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

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

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

Cristina Negri
630-252-9662
negri@anl.gov

Heidi Hartmann
630-252-6487
hnhartmann@anl.gov