Biodiversity & Ecological Forecasting Team Meeting

NASA Earth Science and Applications

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Discovering the Earth,
Delivering it Home
The NASA Earth Science Division supports basic and applied research on the Earth system and its processes.

Primary efforts are to characterize, understand, and improve predictions of the Earth system.

In parallel with research, NASA pursues innovative and practical uses of Earth science data and results to improve government, business, and civil society decision-making activities.
Operating & Planned Satellites (through 2023)
Discovering and demonstrating innovative and practical uses of Earth Science in organizations’ policy, business, and management decisions.
Applications Readiness Level (ARL)

Nine-stage metric to track the maturity of applications projects – from initial idea, through development, to the transition to operational use.

ARL as a tool:

» Communication Tool to convey expected advancement to PIs & project teams.

» Analysis Tool to assess progress of a project or state of entire project portfolio.

» Reporting Tool for performance goals.

» Diagnostic Tool to identify where projects tend to break down in development.

ARL 1-3: Discovery and Feasibility

ARL 4-6: Development, Test, and Validation

ARL 7-9: Partner Demonstration and Transition

ARL 1
ARL 2
ARL 3
ARL 4
ARL 5
ARL 6
ARL 7
ARL 8
ARL 9
Feasibility-to-Decision Support Projects – New in 2012

A two-stage approach to identify more high-reward projects with strong commitment by partner organizations. Start with multiple feasibility studies of possible applications ideas. After a year, the Program selects a subset of successful studies to pursue as in-depth applications projects.

Approach generates numerous applications ideas and focuses investments on those with high-reward potential.

Approach prioritizes partners’ “skin-in-the-game” to increase their involvement in project and commitment to adopting the project results.

<table>
<thead>
<tr>
<th>Year</th>
<th>Stage</th>
<th>Activity</th>
<th>NASA Share</th>
<th>Partner Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Feasibility</td>
<td>Prove out application potential</td>
<td>100%</td>
<td>Optional</td>
</tr>
<tr>
<td>Year 2</td>
<td>Decision Support</td>
<td>Develop application</td>
<td>~80%</td>
<td>~20%</td>
</tr>
<tr>
<td>Year 3</td>
<td>Decision Support</td>
<td>Continue development</td>
<td>~60-70%</td>
<td>~30-40%</td>
</tr>
<tr>
<td>Year 4</td>
<td>Decision Support</td>
<td>Complete application and transition</td>
<td>~30-40%</td>
<td>~60-70%</td>
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</tbody>
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Early Adopters: New with SMAP, a Soil Moisture Mission in 2014

Purpose is to conduct pre-launch applications research to accelerate use of data after launch.

Organizations with clearly-defined needs for SMAP-like data products evaluate & demonstrate the utility of SMAP data for their application and decision making.

Early Adopters:
» Use data products prior to launch (simulated data and cal/val data from field campaigns)
» Provide feedback on products and formats to increase applications value of mission
» Streamline and accelerate use of data soon after launch and check-out
» Supply own resources to do these activities

20 organizations are currently EAs from public & private-sector, domestic & foreign

** ICESat-2 starting Early Adopters in 2013 **
House Authorization

NASA Earth Science was moved under a new oversight subcommittee within the House Committee on Science, Space, and Technology.

While most of NASA is under the Subcommittee on Space, NASA Earth Science is under the Subcommittee on Environment, which also does oversight of NOAA, EPA.

Subcommittee on Environment:
Rep. Chris Stewart (R-Utah), Chair
Rep. Suzanne Bonamici (D-Oregon), Ranking Minority Member
Human Dimensions in Earth System Science: Social, Behavioral, and Economic
Integration of Natural and Social Sciences

Restructuring Federal Climate Research (NRC/BASC, 2009)
“Reorganize … to facilitate crosscutting research focused on understanding the interaction among the climate, human, and environmental systems …”

“Such a re-structuring around scientific-social issues is required to help the program become more cross disciplinary, more fully embrace the human dimensions component, and encourage an end-to-end approach (from basic science to decision support).”

Belmont Forum (ICSU Report, 2010)
“The physical-climate, climate-impact and resilience-adaptation-vulnerability research communities – which, historically, have been separate – must expand their coordination and collaboration. Funding agencies must be encouraged to establish strategic visions that draw these three communities closer together.”
Integration of Natural and Social Sciences

USGCRP Strategic Plan, 2012-2021

Numerous references to the integration of physical, chemical, biological, and social sciences;

to collaborations among researchers in natural and social sciences;

to a workforce capable of bridging the natural and social sciences.

Planet Under Pressure Meeting: State of the Planet Declaration (2012)

“The international global-change research community proposes a new contract between science and society in recognition that science must inform policy to make more wise and timely decisions …”

Proposed a major research initiative, Future Earth: research for global sustainability
Earth as a Complex Inter-related System
Elinor Ostrom, 2009 Nobel Prize

2009 Nobel Prize in Economic Sciences (shared with O. Williamson) for "her analysis of economic governance, especially the commons."

Study of common pool resources (CPR)

Work emphasizes how humans interact with ecosystems to maintain long-term sustainable resource yields. Common pool resources include many forests, fisheries, oil fields, grazing lands, and irrigation systems.

Ostrom's work has considered how societies have developed diverse institutional arrangements for managing natural resources and avoiding ecosystem collapse in many cases.

"The IHDP is now working on developing a social sciences conceptual framework, which could be easily integrated with the natural sciences frameworks to provide a deeper understanding of the principle indirect drivers, such as population demographics, inequality, world beliefs, and values among others, that might be the causal factor for the direct drivers of change, such as climate change, water and land use, etc."

"Recent studies by behavioral scientists show the use of their research in gaining a better understanding of why societies are reluctant to act even with the wealth of scientific knowledge. … Understanding these underlying values, beliefs, or fears is crucial for understanding and managing these behaviors in addressing climate change."

*Evolution of natural and social science interactions in global change research programs (PNAS, 2013)*

- H. Mooney, A. Duraiappah, A. Larigauderie

*Emphases added.*

Source: Mooney et al.  
www.pnas.org/cgi/doi/10.1073/pnas.1107484110
Terminology Transfer in Interdisciplinary Work

Economics & Policy Analysis
- Shadow Price
- Discount Rate
- Contingent Valuation
- Cobb Douglas Function
- Revealed Preference
- Marginal Utility
- Price Elasticity
- Net Present Value

Earth Science & Remote Sensing
- Spectroradiometer
- Synthetic Aperture
- Normalized Difference Vegetation Index
- Kriging
- Supervised Classification
- Passive Microwave
- Climate Envelope
- Orthorectification

Terms shared by both (though meanings may differ)
- Productivity
- Probability Density Functions
- Markov Processes
- Sensitivity Analysis
- Monte Carlo
- Lagrangian Function
Socioeconomic Impacts: A Primer

Purpose:
Inform the Earth observations community and project teams about the language, key principles, techniques, and applications of socioeconomic impact analyses.

Released March 2013
Geospatial services in the U.S. are in a high-growth phase, headed toward market maturity.

– Boston Consulting Group

Key success factors:
Government investment and policy support of geo-data collection; Clear open data policies and effective geo-infrastructure; Strong support for geospatial education, training, and innovation.

Source: BCG (2012)
Environmental Situational Awareness

Know the field, know the weather.
– Sun Tzu, *The Art of War*

- Climate Risk, Conflict Prevention
- National Security, Economic Security
- Humanitarian Assistance, Conflict Prevention
- Energy Policy
- Markets
- Resource Management
- Treaties

Environmental Intelligence

Environmental Situational Awareness

Observations
Scientific Knowledge
Modeling
Applications Knowledge

Crowd-sourcing
Hosted payloads
Mobile apps
Competitions
Social media
Citizen observations
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Questions • Discussion
Fig. 2. Conceptual diagrams of the interactions between society and nature in response to climate change impacts (53). (A) Basic model structure, (B) interactive model with some feedback, and (C) interactive model with feedbacks to populations as well as driving variables. Modified from ref. 53.
USFS adopted an ESD-developed forest carbon tool based on Landsat imagery in a comprehensive approach to carbon-storage assessments and forest management. Supports USFS implementation of E.O. [TBS].

USFS funded the expansion of the application from the pilot areas to the entire National Forest System.
United Nation’s system now using data from NASA’s Terra and Aqua satellites to identify fires and send alerts to remote areas via SMS and text messages.

USDA/NOAA-managed U.S. Drought Monitor now using NASA’s GRACE data as part of analysis in creation of weekly national and state-level maps.
NASA/USAID Capacity Building

Partnership to improve environmental management, resilience to climate change, and solve pressing development challenges

» Integrates Earth science data and models in practice of development for societal benefits

» Supports USAID’s pursuit of improved decisions on climate change and sustainable landscapes

» Expands uses and users of NASA data and identifies new applications ideas

SERVIR Applied Science Team (New 2012)

» Team of 11 Earth scientists. Each member has an individual project and is part of *ad hoc* teams to address immediate apps. or emerging needs.

“The biggest problem we have is lack of data. When someone like SERVIR-Africa comes along to help us out it is very good because we have been missing floods.”

– Simintei Kooke, Kenya Ministry of Water and Irrigation

Access to Data, Models, Online Maps, Visualizations, Decision Support Tools, Training, Needs Assessments, …