Experiences in Bridging the Gap Between Science and Decision Making at NASA's GSFC Earth Science Data and Information Services Center (GES DISC)

Steven Kempler[1], Bill Teng[2], Lawrence Friedl[3], Chris Lynnes[1], Gregory Leptoukh[1]

[1]NASA Goddard Space Flight Center, [2]NASA Goddard Space Flight Center/SESDA2, [3]NASA Headquarters

Steven.J.Kempler@nasa.gov

Abstract

- Recognizing the significance of NASA remote sensing Earth science data in monitoring and better understanding our planet's natural environment, NASA has implemented the 'Decision Support Through Earth Science Research Results' program (NASA ROSES solicitations).
- This successful program has yielded several monitoring, surveillance, and decision support systems through collaborations with benefiting organizations.
- The Goddard Space Flight Center (GSFC) Earth Sciences Data and Information Services Center (GES DISC) has participated in this program on two projects (one complete, one ongoing), and has had opportune ad hoc collaborations gaining much experience in the formulation, management, development, and implementation of decision support systems utilizing NASA Earth science data.
- In addition, GES DISC's understanding of Earth science missions and resulting data and information, including data structures, data usability and interpretation, data interoperability, and information management systems, enables the GES DISC to identify challenges that come with bringing science data to decision makers.
- The purpose of this presentation is to share GES DISC decision support system project experiences in regards to system sustainability, required data quality (versus timeliness), data provider understanding of how decisions are made, and the data receivers willingness to use new types of information to make decisions, as well as other topics. In addition, defining metrics that 'really' evaluate success will be exemplified.

NASA's 'Decision Support Through Earth Science Research Results' Program

NASA's Applied Research Program focuses on extending Earth science research results to decision making activities. Through the 'Decision Support Through Earth Science Research Results' proposal solicitation, NASA has striven to develop and demonstrate innovative and practicable applications of NASA Earth science observations and research in eight applications areas for the purpose of improving decision making activities.

- Agricultural
- Air Quality
- Climate
- Disaster Management
- Ecological Forecasting
- Public Health
- Water Resources
- Weather (Aviation)

http://nasascience.nasa.gov/earth-science/applied-sciences

Using NASA TRMM Precipitation Data for Monitoring Crop Conditions

http://dasc.gsfc.nasa.gov/agriculture/ (Funded by NASA's RREASeN CAN-02-OES-01)

The GES DISC **Agricultural Information System (AIS)** provides NASA environmental data and information to support global crop monitoring at the U. S. Department of Agriculture (USDA) Foreign Agricultural Service (FAS) and the U.N. World Food Program (WFP). The primary goal of FAS is to improve foreign market access for U.S. agricultural products. The WFP uses food monitoring to meet emergency needs and to support economic and social development.

Using NASA Soil Moisture Data in NASA/NOAA Land Surface Models to Enhance the National Weather Service River Forecast System (NWSRFS)

(Funded by NASA's ROSES 2005 -DECISIONS NNH05ZDA001N, Yao Liang, PI, currently with the Indiana University Purdue University Indianapolis)

This project focuses on improving evapotranspiration (ET) input to the NWSRFS, a sub-Decision Support System of the NWS's Advanced Weather Interactive Processing System (AWIPS). By integrating NASA's Aqua/AMSR-E and TRMM/TMI soil moisture products into land surface models that provide improved ET data seamlessly to the NWSRFS, the capability for flood and drought forecasting and disaster management is expected to be greatly enhanced. The project focuses on the Ohio River Forecast Center (RFC), for which floods and droughts are two major natural hazards that have significant impacts on the region's agriculture, industries, commercial navigation, and residential communities.

Using NASA Atmospheric Data for Air Quality Monitoring

http://disc.sci.gsfc.nasa.gov/giovanni/giovanni_air_quality_instance.shtml

The GES DISC has created the **Giovanni Air Quality Instance** for visualization and exploration of remotely-sensed and *in situ* data products related to air quality. For the continental United States, the Air Quality instance features Environmental Protection Agency AIRNow $PM_{2.5}$ data, aerosol and cloud data products from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the Terra and Aqua satellites, and aerosol products from the Ozone Monitoring Instrument (OMI) on the Aura satellite. Lat-long and correlation maps, animation, time series, scatter plots, and statistics are available through the use of Giovanni.

Bridging the Gap - Challenges

- Translating science data for decision support systems
  - Understanding the decision space to determine relevant science data inputs to decision making
  - Determining the best way to communicate science content to decision makers
  - Determining the appropriate level of detail
  - Providing data formats that can be easily understood and transparently used by the decision makers
  - Co-registering science data with applications data (often collected by boundaried region e.g., states)
- Determining the right balance: Highly validated data vs. acquisition timeliness of data.
  - How highly validated do NASA data NEED to be?
  - How will data (or images) be used?
- Maintaining resources needed to sustain the operational decision making system: New data sets, new tools, new technologies
- Meeting required spatial and temporal resolution to facilitate decision making
- Changing the decision making tools paradigm by demonstrating the benefits to decision making organizations of employing new tools and technologies
- Maintaining continuous near real time science data inputs to decision makers. (i.e.,Maintaining the timeliness of data for making decisions)
- Overcoming inertia in the decision making environment.
- Integrating new data and technologies seamlessly into an operational applications environment
- Continuity of NASA data

Bridging the Gap - Mitigations

- Keep method of data transfer flexible, to avail the project of the latest technology advances.
- Acquire deep understanding of the decision-making environment (DME) and needs (i.e., follow the consumption chain from usage scenarios back to relevant data).
- Strive for as seamless as possible an integration of project data and services into existing DME.
- As much as possible, get stakeholders to really feel they have a stake in the project. The raison d'etre for the project should come from the DME as well as the providers of project data and services.
- Plan for possible changes to the proposed collaboration; DMEs are operational and their needs could change.
- Involve the expertise of science data providers (e.g, algorithm developer), preferably as members of the collaboration.
- Plan for training in use of science data and services by DME personnel.
- Transition DME into a sustainable framework
  - Build for low maintenance costs
  - Understand upfront, with the decision making organization, how the DME will be sustained
  - Should be designed from the beginning to be integrated with the decision making organization systems
  - Document the DME, development and operations

The Use of Science Data for Decision Making

	For Science	For Decisio Making
Timeliness availability	Not urgent for s research	When needed
System Sustainabili	Part of Science Missi	Often negotiate
Data Documentati	Algorithms; prod product descript product validatic limitations	Interpretation of p for decision spa Relationship of r products to exis products
Data Requirements	Clear science go ject concep	Science data to s decision makin
Desired Dat Representati	Data for preci analysis; Image browse	Images for data c plots, and report Sometimes data statistical analy
Spatial and Temporal Da Resolution	Dependent on s research	The higher the res the better
Data Validation	Data must be o highest qualit	Data must be of highest quality, quality may be tra timeliness

Bridging the Gap - Metrics for Success

- Science data arrives on time to be utilized for decision support at a percent of the time to be specified by the decision making organization
- Science data utilization in the decision support system results in a marked improvement in prediction correctness. Before and after prediction analysis should be planned
- Science data are routinely used by a specified percent of the decision making organization's staff
- Number of references, reports, or publications that cite science data as input to decision making process
- Reuse is success: Number of new potential decision support users of NASA science data based on previous success
- Decision makers seeking to further collaborate (e.g., requesting additional useful science data products)
- Formalizing data interfaces and science data transfers due to growing dependency on the data

- Suggestions?

E-mail: Steven.J.Kempler@nasa.gov