



# *Earth Science for Decision Making: Gulf of Mexico Region*

*Principal Investigators Meeting*

*Lawrence Friedl*

*Acting Director*

*Applied Sciences Program*

*NASA Headquarters*

*8-December-2009*

*Discovering and Demonstrating Innovative and  
Practical Applications of Earth Science*



# NASA and Earth Science

## *Earth Science Division*

NASA is primarily a research and development agency.

The NASA Earth Science Division supports research on the Earth system and its processes. Primary efforts are to characterize, understand, and improve predictions of the Earth system.

In the course of performing its research, NASA collects observations and generates new scientific knowledge that can be applied to meet organizations' decision-making activities.

***Technology***

***Missions***

***Research***

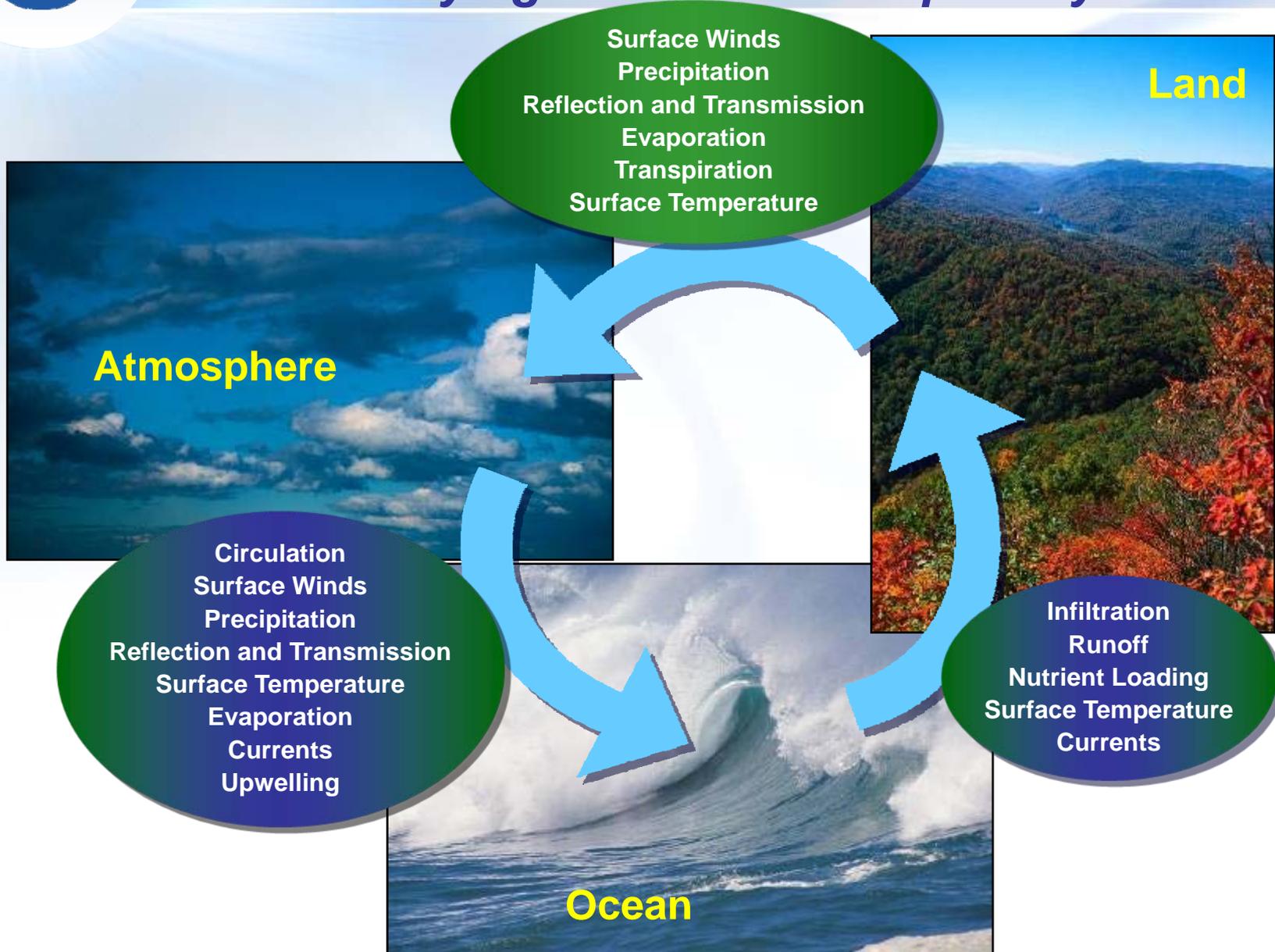
***Data Systems***

***Applications***



# NASA and Earth Science

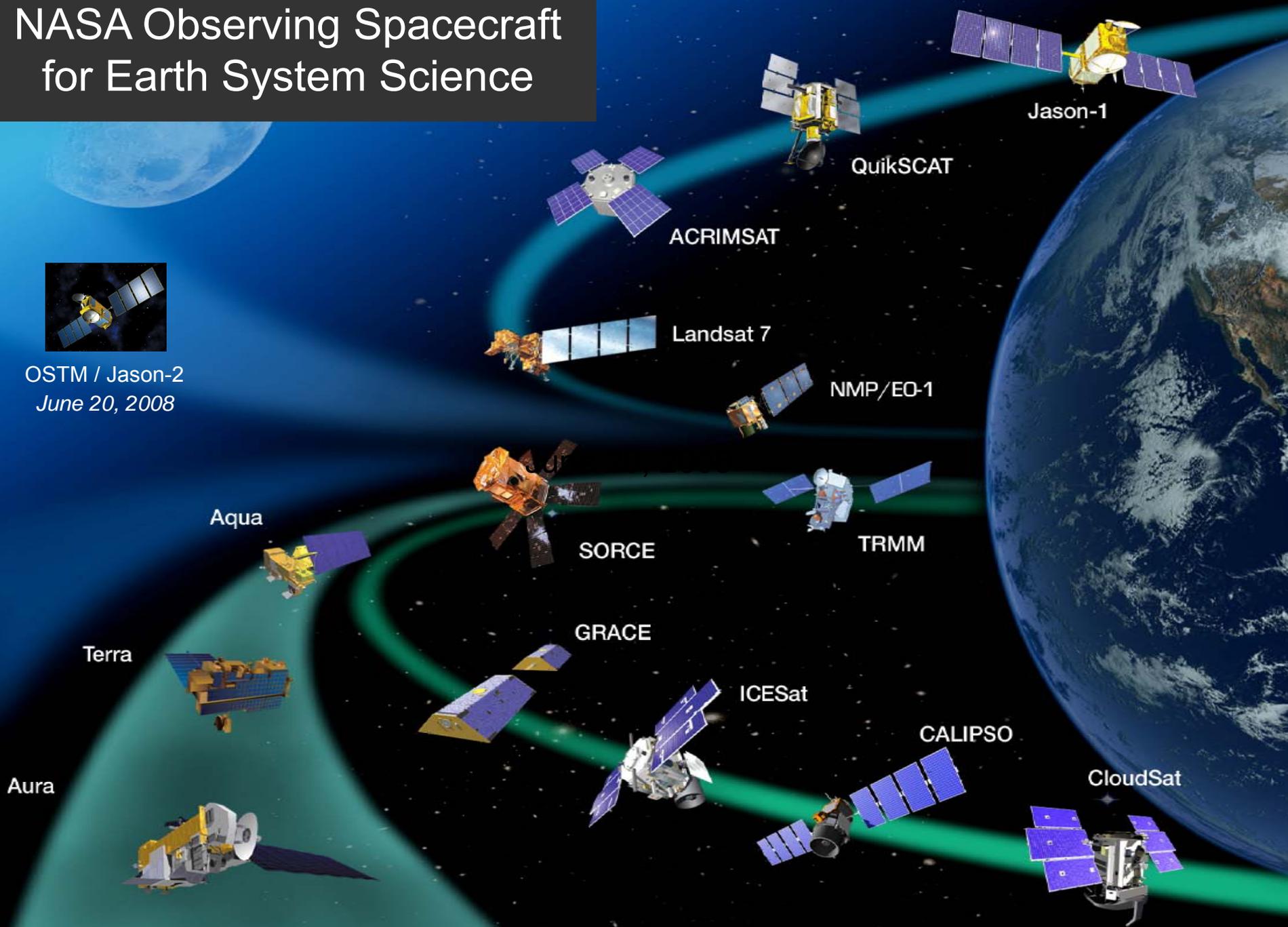
## Studying Earth as a Complex System



# NASA Observing Spacecraft for Earth System Science



OSTM / Jason-2  
June 20, 2008



Jason-1

QuikSCAT

ACRIMSAT

Landsat 7

NMP/EO-1

TRMM

Aqua

SORCE

Terra

GRACE

ICESat

Aura

CALIPSO

CloudSat



# Applied Sciences Program

## Program Strategy

### Goal 1: Enhance Applications Research

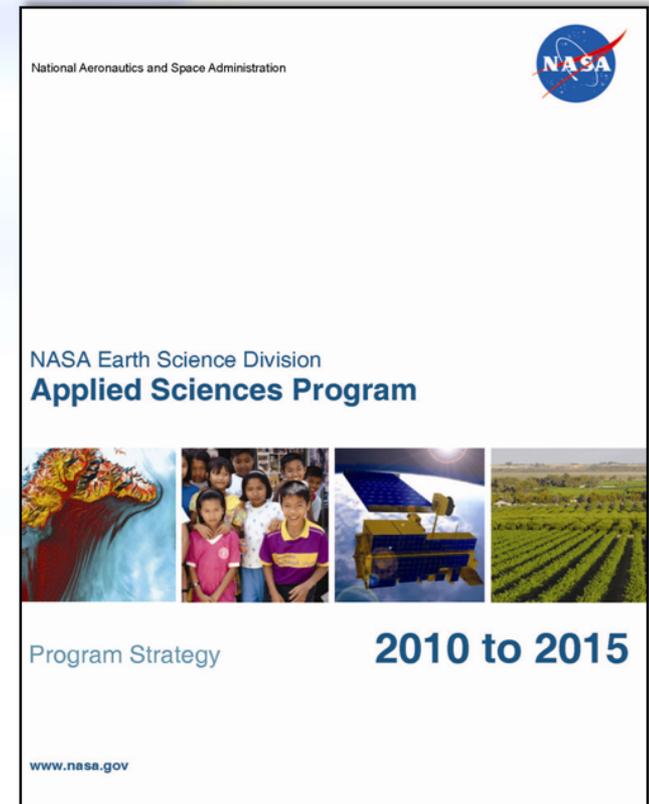
Advance the use of NASA Earth science in policy making, resource management and planning, and disaster response.

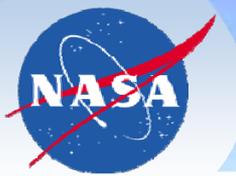
### Goal 2: Increase Collaboration

Establish a flexible program structure to meet diverse partner needs and applications objectives.

### Goal 3: Accelerate Applications

Ensure that NASA's flight missions plan for and support applications goals in conjunction with their science goals, starting with mission planning and extending through the mission life cycle.





# Applied Sciences Program

## Program Approach

*The Applied Sciences Program funds projects that enable innovative uses of NASA Earth science data in organizations' policy, business, and management decisions.*

### **Applications Areas**

The program focuses on economic, health, resource management, and other themes to support both applications knowledge and projects targeted at integrating Earth observations in specific decision-making activities.

### **Capacity Building & Initiatives**

The program sponsors specific activities to build skills and capabilities in the US and developing countries on how to access and apply environmental satellite data to benefit society.

- DEVELOP
- SERVIR
- Gulf of Mexico Initiative
- Training Modules



# Applied Sciences Program

## *Applications Areas*

*Applications to Decision Making: Eight Thematic Areas*



**Agricultural  
Efficiency**



**Air Quality**



**Climate**



**Disaster  
Management**



**Ecological  
Forecasting**



**Public Health**



**Water  
Resources**



**Weather  
(Aviation)**



# Applied Sciences Program

## *Near-term Priorities*

### **Key Topics and Directions**

- Performance Measures & Impact Evaluation
  - Project metrics to convey project & program successes
- Communicating Project Progress & Success
  - Substantive examples of accomplishments
- Applications-oriented Involvement and Support to Mission Planning and Implementation
- Transition of Successful Projects to Other Organizations
- Attention to Program Budget Obligation and Project Costing

**“A productive, directed, substantive, and competent Applied Sciences will be essential for Earth Science.”**

*– Michael Freilich, Earth Science Division Director  
8-October-2009*



# Applied Sciences Program



## Use of NASA Satellite Data Improves Ozone Level Predictions in Air Quality State Implementation Plan (SIP) Modeling

R. T. McNider and A. Pour-Biazar, University of Alabama in Huntsville

**HIGHLIGHT:** Techniques for using satellite data (MODIS, GOES) to specify photolysis\* rates were incorporated into models used by state governments to set emission limits for ozone. Baseline runs showed that adding satellite data improved the photolysis rates and changed ozone levels in the model by up to 70ppb. The changes are due to a better specification of clouds that have a major impact on photolysis rates which are a first order parameter in determining photochemical production rates in models. EPA incorporated the technique into its Community Multi-scale Air Quality (CMAQ) System and was made part of EPA's official release of the CMAQ version 4.7, released in December 2008.

**RELEVANCE:** When ozone levels exceed air quality standards, states must adopt emission reductions to lower air quality levels, based on models of the atmosphere. It may cost industry and the public billions to reduce ozone levels by 20-30 ppb. Thus, the differences in predicted ozone levels of up to 70 ppb (as identified by this project) are huge relative to reductions needed. EPA recognized that improving the photolysis rates were critical to confidence in models, which is important for industry to accept the regulations without challenge. The new satellite techniques are now available for States to use in development of State Implementation Plans (SIP), which convey to EPA the path they will take to meet air quality standards.

\*Photolysis rates: The chemical reaction rates from the splitting or decomposition of a chemical compound by means of light energy or photons.

ESD Applied Sciences Program

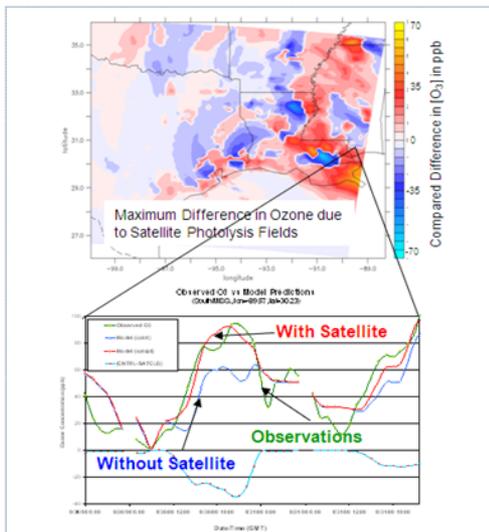


Figure 1: Top figure shows the differences in ozone between two CMAQ runs with and without use of satellite derived photolysis fields. Note the maximum differences exceed 50 ppb. Bottom figure shows time series of ozone prediction from the model vs. observations at an EPA monitoring site in South Mississippi.

Air Quality Applications

**RELEVANCE:** Load forecasts are used by utility companies to plan for purchase of gas and electricity, as well as gas storage. Utilities rely on the load forecast models so they can anticipate demand for energy, in order to dispatch natural gas and to balance load on the electric grid. Uncertainties in load forecasts can be very costly to utility companies. For gas utilities, more accurate load forecasts will reduce the costs associated with: the purchase of high-priced, short-notice "spot gas", large regulatory penalties incurred when they fail to meet demand, labor in manual relighting of thousands of customer pilot lights after a shortfall, and purchase and storage of extra "swing volume" to ensure ability to meet demand.

ESD Applied Sciences Program

## November 2009 Project Highlights

### NASA Products to Enhance Energy Utility Load Forecasting

PI: Jill Engel-Cox, Battelle Memorial Institute

Day natural gas load forecasts by up to 4.3 percentage points (PE) when NASA weather forecast models. MAPE is a forecast accuracy. Tests were for historical dates were model-based weather parameters, meters (e.g., temperature, subject at LARC. After analyzing New York and Pennsylvania, testing improved forecasts, were especially during peak winter commercial heating drives the high demand

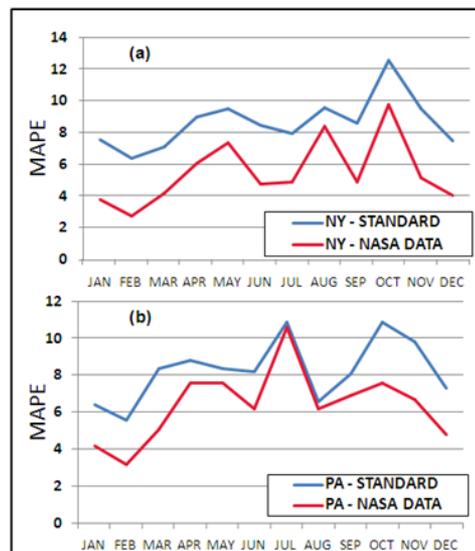


FIGURE 1: Inclusion of NASA weather forecasts (1°x1° daily avg. temp and wind speed) in gas utility load forecast models increased load forecast accuracy and reduced Mean Absolute Percent Error (MAPE) for service areas in (a) New York and (b) Pennsylvania.

Climate Applications



# Applied Sciences Program

## *Innovation and Decision Support*

**Science, technology and innovation proceed more rapidly and more cost-effectively when insights, costs and risks are shared.**

*President Obama  
National Academy of Sciences, 27-April-2009*

**We seek solutions. We don't seek – dare I say this? – just scientific papers anymore.**

*Steven Chu (now Secretary of Energy)  
San Francisco Chronicle, 22-March-2007*

**The aggressive pursuit of understanding Earth as a system – and the effective application of that knowledge for society 's benefit – will increasingly distinguish those nations that achieve and sustain prosperity and security from those that do not.**

*Preliminary Report of Earth Science Decadal Survey  
National Research Council, 2005*



**Applications Knowledge:**  
the fundamental understanding of how  
Earth science can be scaled and applied to  
serve society

**Creation of knowledge about methods and  
processes for applying Earth science**

**Capacity of institutions and organizations  
to access and apply new types of data and  
information to traditional processes and  
decision making activities**