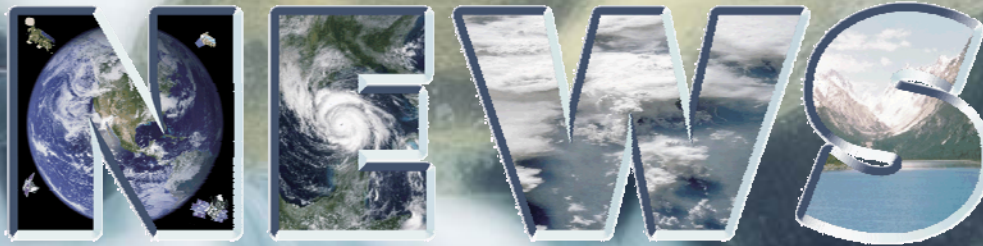# NASA ENERGY AND WATER CYCLE STUDY

NEWS

NEWS Challenge:
Document and enable improved, observationally-based, predictions of water and energy cycle consequences of Earth system variability and change.

What is integration?
• Integrating observations to establish a more complete system description
• Integrating model components to build a earth modeling system
• Integrating research results to establish end-user solutions

Data Integration: Spatial and temporal rectification to allow intercomparison and quality evaluation of disparate model and observation data;
Data-Model Integration: Physical rectification or constraint of data and its error using four dimensional data assimilation and modeling techniques.
Model Integration: Using component models to build a system model.
Solution Integration: Integrating components (research results) to develop solutions
Interpersonal Integration: Interconnection of disparate water cycle research teams.

Science Integration (NSIT model):
• Data integration
• Coordinate energy and water process modeling
• Water & energy cycle trend and variability assessments
• End-user decision support & solution network connections

State of the Water & Energy Cycle

Evaluate the research community's current ability to detect, analyze, understand and explain global water cycle change, variability, prediction and predictability.
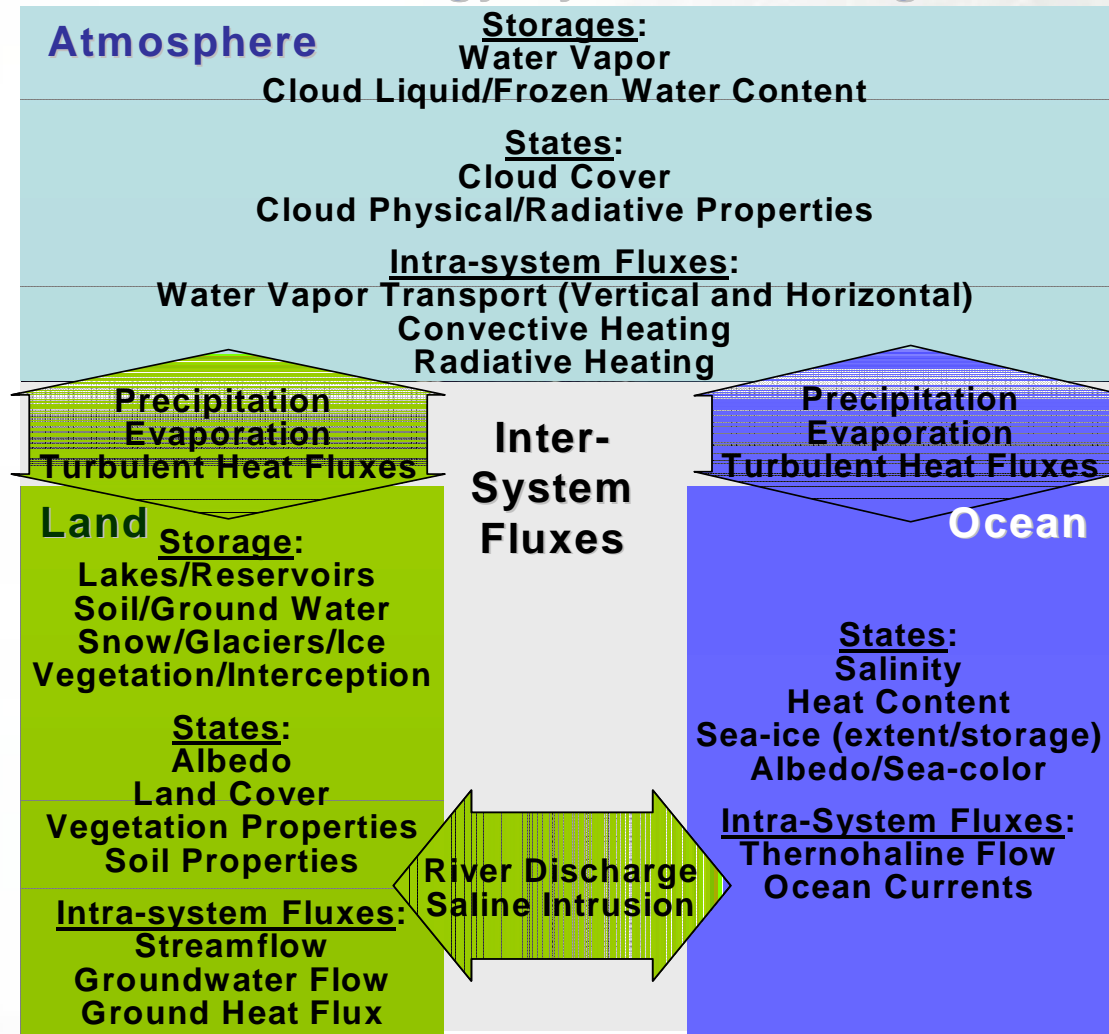
Water and Energy Cycle Data Integration

Atmosphere

Storages:
Water Vapor
Cloud Liquid/Frozen Water Content

States:
Cloud Cover
Cloud Physical/Radiative Properties

Intra-system Fluxes:
Water Vapor Transport (Vertical and Horizontal)
Convective Heating
Radiative Heating

Precipitation
Evaporation
Turbulent Heat Fluxes

Precipitation
Evaporation
Turbulent Heat Fluxes

Inter-System Fluxes

Land

Storage:
Lakes/Reservoirs
Soil/Ground Water
Snow/Glaciers/Ice
Vegetation/Interception

States:
Albedo
Land Cover
Vegetation Properties
Soil Properties

Intra-system Fluxes:
Streamflow
Groundwater Flow
Ground Heat Flux

River Discharge
Saline Intrusion

Ocean

States:
Salinity
Heat Content
Sea-ice (extent/storage)
Albedo/Sea-color

Intra-System Fluxes:
Thermohaline Flow
Ocean Currents

Figure 1: Major global water and energy cycle storages and fluxes to be included in the integration center.

NEWS Data Integration Center

The NEWS Data Integration Center (NDIC) will serve the overall NEWS team and its partners by compiling, integrating, diagnosing and disseminating water and related energy cycle observations and predictions.

Task 1: Enable the quantification of global water cycling rates, which requires global data integration for vertical water fluxes, land water storages, and lateral land water fluxes.

Task 2: WEC variability (extremes) studies.

Task 3: Diagnostic trend studies, transient variability and predictability; model validation; and initialization.

Key components of the NDIC include:
- Provide a "one stop", streamlined access to coordinated, geolocated, and integrated water & energy cycle data and visualizations from all sources.
- Identify and acquire global water and energy cycle observations and model predictions from all relevant sources, over the longest available period.
- Provide a framework for sharing IT resources for NEWS.
- Focus to serve the NEWS team, but also open for collaboration with the larger community.
- Establish the NEWS products in consistent formats and access protocols.
- Develop an integrated processing plan.
- Assess the physical consistency of products.
- Establish a data management strategy to organize and link to local and distributed data resources. Whenever possible, virtual and meta data links will be established to existing data archives, rather than explicitly downloading them.

NEWS Data Integration Center

Specifics:
- Center located at IGES/CREW, allowing for innovative security and access arrangements.
- Will use tools such as the GrADS Data Server (GDS) and OPeNDAP, interactive web services, and automated processes to provide data organization, access, subsetting and analysis services, links to distributed data, and team/public access over the internet.
- A part-time "data guru" will manage the database and assuring data continuity and user access
- A disk farm will be developed to handle the NEWS shared data resources.
- Modest computing and software resources for mining, manipulating and analyzing data holdings
- A high-bandwidth connection to the NEWS team (Internet-2).
- Procedures to limit data access to the NEWS team or allow public access will be established.
- Accounting software to keep track of data use statistics will be used to help NEWS investigators understand usefulness of their data.

The NSIT has identified the need for the NDIC, and perceives its primary value to be:
- Improved efficiency of centralized data storage.
- Value in having a common data framework.
- Value in providing provisional analysis tools.
- Providing standardized mode of interpolation (simple form in one place)