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

Why study the water & Energy cycle?

1. Water exists in all three phases in the climate system and the phase transitions are a significant factor in the regulation of the global and regional energy balances.

2. Water vapor in the atmosphere is the principal greenhouse gas and clouds at various levels and composition in the atmosphere represent both positive and negative feedback in climate system response.

3. Water is the ultimate solvent and global biogeochemical and element cycles are mediated by the dynamics of the water cycle.

4. Water is the element of the Earth system that most directly impacts and constraint human society and its well-being.

Why NEWS?

Need the collective of NASA & community information and expertise to ask (and define) the larger questions

(aka) Need the whole to be more than the sum of the parts
What are the causes of water cycle variations?
Are variations in the global and regional water cycle predictable?
How are water and nutrient cycles linked?

**NEWS Integrated Water and Energy Cycle Research Challenge:**
Document and enable improved, observationally-based, predictions of water and energy cycle consequences of Earth system variability and change.

The NEWS challenge is **global** in scale and requires the integration of NASA **system components** to make decisive progress toward the NEWS challenge in an **end-to-end program**.
The NASA Energy and Water-Cycle Study (NEWS) long-term grand challenge:

document and enable improved, observationally-based, predictions of water and energy cycle consequences of Earth system variability and change.

To make decisive advances in water and energy cycle prediction, we must:

- Develop a discipline of prediction and verification through the integration of water and energy cycle observations and models.
- Develop climate quality, globally complete observations of the key water- and energy-cycle rates and storages (e.g. assess and fill gaps).
- Provide an accurate accounting of the key reservoirs and fluxes associated with the global water and energy cycle, including their spatial and temporal variability.

NEWS is envisioned to make critical linkages (integration) between NASA research programs and satellite missions, other agencies, and international efforts (not just integrate amongst its members).
Related Missions:
+ ACRIMSAT
+ Aqua
+ Aquarius
+ ERBS
+ GPM
+ GRACE
+ ICESat
+ Jason-1
+ OSTM
+ SORCE
+ Terra
+ TOPEX-Poseidon
+ TRMM
+ Cloudsat & CALISPO
+ Decadal Survey

WEC Programs:
+ Terrestrial Hydrology
+ Precipitation Sciences
+ LCLUC
+ NEWS
+ Modeling (MAP)
+ Cloud Modeling
+ Water Management

http://science.hq.nasa.gov/earth-sun/science/water.html
**NASA Energy and Water Cycle Study Road Map**

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

**Phase 1 Deliverables:**
- Coordinated global W&E description
- Current prediction system evaluation
- Identify required improvements

**Phase 2 Deliverables:**
- Fix model problems
- New measurement approaches
- End-to-end prediction system

**Phase 3 Deliverables:**
- Dataset gaps filled and extended
- Intensive prediction system testing
- Prediction system delivery

**APPLICATION:**
- Improved water & energy cycle forecasts for use in decision support systems

**ANALYSIS & PREDICTION:**
- Understand variability
- Accurate cloud prediction
- Improve latent heating & convection models

**OBSERVATION:**
- Quantify mean state, variability, and extremes of the water & energy cycles
- Flux, transport, and storage rate quantification

Systematic observations of water and energy cycle including national and international partners

Timeline:
- 2006
- 2008
- 2010
- 2012
- 2014
- 2016
- 2018
- 2020
### Summary of Key Phase 1 Milestones

<table>
<thead>
<tr>
<th>Observations and Retrieval</th>
<th>Analysis</th>
<th>Modeling and Prediction</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Enhance global measurements of clouds and aerosols, radiation vertical profiles</td>
<td>• Reduce uncertainties in describing the global water/energy budget components</td>
<td>• Improve models of clouds, precipitation, hydrology, boundary layer and ocean mixing</td>
<td>• Identify currently available data and analysis products useful for applications</td>
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<tr>
<td>• Assess methods for quantifying snowfall and mixed precipitation</td>
<td>• Improve accuracy of precipitation and evaporation estimates</td>
<td>• Develop stand-alone ultra-high resolution cloud process and land hydrology models</td>
<td>• Conduct selective demonstrations of usefulness of current data</td>
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<tr>
<td>• Evaluate and invest in technology for observing land/water storage</td>
<td>• Develop new climate data products (e.g., latent and radiative heating profiles)</td>
<td>• Develop high resolution models for coupled clouds, radiation and hydrology</td>
<td>• Link weather &amp; climate predictions to demonstrate their use in assessments</td>
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<tr>
<td>• Evaluate global dataset adequacy and quality</td>
<td>• Quantify predictability of energy and water cycle variations (all spatial scales)</td>
<td>• Test embedded process models in general circulation models</td>
<td>• Identify observation and prediction system requirements for water management applications</td>
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<tr>
<td>• Develop improved multi-sensor multivariate geophysical retrieval methods</td>
<td>• Diagnose how multiple feedback processes affect climate responses toforcings</td>
<td>• Develop and test advanced energy and water data assimilation methods</td>
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<tr>
<td>Summary of Key Phase 2 Milestones</td>
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<tr>
<td><strong>Observations and Retrieval</strong></td>
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<tr>
<td>• Facilitate the delivery of an experimental energy and water cycle observation system to acquire comprehensive observations of cloud structure &amp; optical properties, radiation fluxes, precipitation, atmospheric circulation, aerosols, for testing CRM's, GCM's and CCM's (A-Train and other continuing observations)</td>
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<tr>
<td>• Exploit Phase 1 findings in developing advanced retrieval techniques for rain/snow, water vapor, wind etc., w/sampling density to directly determine transport, divergence terms, and soil moisture, water storage and freeze/thaw events</td>
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<td>• Identify and develop innovative remote sensing methods</td>
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<td>• Compare new remote sensing capabilities with in situ data from experimental sites and/or field campaigns</td>
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<td>• Form partnerships with operational agencies</td>
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<tr>
<td><strong>Analysis</strong></td>
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<tr>
<td>• Apply multi-variate analysis techniques in retrospective analysis of climate variability to investigate causes of natural variability and fast feedback processes, and discriminate between forced and unforced responses</td>
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<tr>
<td>• Assess climate variability (short time scales) and forcing (longer time scales)</td>
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<tr>
<td>• Assess the predictability of energy and water variations on an expanded range of space and time scales</td>
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<tr>
<td><strong>Modeling and Prediction</strong></td>
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<tr>
<td>• Develop simplified process resolving representations of precipitation and land hydrology for GCM simulations</td>
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<tr>
<td>• Evaluate conventional parametric representations of clouds, precipitation, boundary layer, land hydrology in climate models compared with weather events and observed seasonal/interannual variations</td>
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<tr>
<td>• Assess similarities and differences between model climate variability on short time scales and forced responses of models on longer time scales</td>
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<tr>
<td>• Improve representation of slow feedback processes</td>
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<tr>
<td>• Determine most informative model products for predicting water supply</td>
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<tr>
<td>• Assemble experimental end-to-end energy and water cycle prediction system from observations to data assimilation, model initialization and prediction, to assessments of hydrological consequences and decision support systems</td>
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<tr>
<td><strong>Applications</strong></td>
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<tr>
<td>• Test ability to predict consequences of extreme hydrological events</td>
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<tr>
<td>• Develop prediction skill metrics aiding decision making procedures</td>
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<tr>
<td>Summary of Key Phase 3 Milestones</td>
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<tr>
<td><strong>Observations and Retrieval</strong></td>
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<tr>
<td>• Complete assembly and deployment of a full experimental energy and water cycle observing system</td>
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<td>• Further development of a comprehensive data management and retrieval system</td>
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<tr>
<td>• Reprocess the combined record of energy and water global observations using advanced retrieval methods</td>
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<tr>
<td><strong>Analysis</strong></td>
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<tr>
<td>• Characterize the slower feedback processes that effect the energy and water cycles</td>
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<tr>
<td><strong>Modeling and Prediction</strong></td>
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<tr>
<td>• Produce a fully interactive global climate system model that characterizes the complete energy and water cycle</td>
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<tr>
<td>• Construct a comprehensive energy and water data assimilation and prediction system</td>
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<tr>
<td>• Conduct a full end-to-end test of the prediction system against the past 30 to 50 year observational record</td>
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<tr>
<td><strong>Applications</strong></td>
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<tr>
<td>• Test the accuracy of energy and water cycle prediction products for applications to water resource management.</td>
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<tr>
<td>• Demonstrate ability to predict consequences of climate change and hydrologic extremes</td>
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<tr>
<td>• Demonstrate feasibility of a global hydrologic warning system</td>
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</table>
**New Paradigm**

**NEWS** is envisioned to make critical linkages (integration) between NASA research programs and satellite missions, other agencies, and international efforts (not just integrate amongst its members).

Integration needs to move to being the foundation for NEWS, rather than an unfunded afterthought.

**NEWS** is focused around core foundation “themes”:

Themes are to be simple, with clear objectives
Instrument teams or GMAO are good examples
themes have to fit together in a value-added way
Themes should build or deliver something tangible
Theme is has leaders
Several PI-led projects will be solicited to contribute to each theme
Themes help us to connect with external partners
NEWS Working Groups

A structure has been created in the NEWS program that allows for consistency with existing NEWS activities, (aka the NEWS Implementation Plan, the NEWS integration questions, etc.), and at the same time welcomes new PIs and builds links to broader community efforts. The NEWS questions are performed by co-chair-led NEWS working groups that build off all the projects and the previous NEWS question-based groups.

The four group themes are listed below with designated co-chairs:

- **Drought & Flood Extremes** - including water and energy aspects of abrupt climate change
- **Evaporation & Latent Heating** - including both land and ocean
- **Energy & Water Cycle Climatology** - to exploit and influence evolving observing systems
- **Modeling & Water Cycle Prediction** - foster interaction with the global modeling community

The principal goal of the working groups is to propose and implement the development of papers that integrate various NEWS research within the working group topic. The working groups are expected to:

- Coordinate and integrate NEWS PI science investigations, focused on journal publications
- Liaison with relevant flight missions and NASA R&A Programs
- Implement annual assessment of progress in meeting NEWS scientific requirements
- Contribute to periodic Implementation Plan (IP) updates
- Prepare annual working group progress summaries
- Conduct regularly scheduled telecons
- Assist in planning and organization of annual Science Team meetings and sessions at national meetings (e.g. AMS, AGU)

http://www.nasa-news.org/integration/
NEWS Integration Examples

-A new surface roughness model developed by M. Bourassa of Florida State University has been combined with the Clayson/Curry surface renewal bulk turbulent flux model, a sea spray parameterization, and ocean wave data. The NEWS product better represents the observed conditions shown in hurricanes. The model is providing a 10+ year data set that can be used to evaluate coupled climate model simulations and conduct diagnostic studies to improve understanding of the water and energy cycle variability on time scales from the diurnal to the decadal.
For more information contact judith.curry@eas.gatech.edu

-Separate evaluations of the contributions by radiation, precipitation and surface sensible heat flux have revealed that the surface sensible heat flux is more important than might have been expected from the magnitude of the fluxes and that although radiation and precipitation act in concert to force the mean atmospheric circulation, they act in opposition in storms.
For more information contact wbrossow@ccnycuny.edu

-The NEWS Energy and Water Cycle Climatology project aims to synthesize a self-consistent climatology to describe the global energy and water cycles using state-of-the-art satellite information developed by NEWS scientists as well as refinements from the community-at-large. This project is now one of the four new working group projects that maintains a Google Group site and welcomes all scientists to join in the efforts to refine the global energy and water cycle.
For more information go to: http://www.nasa-news.org/integration/
NASA Earth Science Decadal Survey Missions

**Tier I**
- Climate Absolute Radiance and Refractivity Observatory (CLARREO)
- Soil Moisture Active Passive (SMAP)
- Ice, Cloud, and Land Elevation Satellite II (ICESat-II)
- Deformation, Ecosystem Structure and Dynamics of Ice (DESDynI)

**Tier II**
- Hyperspectral Infrared Imager (HYSPIRI)
- Active Sensing of CO2 Emissions (ASCENDS)
- Surface Water and Ocean Topography (SWOT)
- Geostationary Coastal and Air Pollution Events (GEO-CAPE)
- Aerosol - Cloud - Ecosystems (ACE)

**Tier III**
- Gravity Recovery and Climate Experiment - II (GRACE - II)
- LIDAR Surface Topography (LIST)
- Precipitation and All-Weather Temperature and Humidity (PATH)
- Gravity Recovery and Climate Experiment - II (GRACE - II)
- Gravity Recovery and Climate Experiment - II (GRACE - II)
- Global Atmospheric Composition Mission (GACM)
- Three-Dimensional Winds from Space Lidar (3D-Winds)
- Snow and Cold Land Processes (SCLP)
MEaSUREs Projects

Climate Variability and Change
Development of Consistent Global Long-Term Records of Atmospheric Evaporative Demand [GES DISC] (2012)
Development of Northern Hemisphere Snow and Ice Climate Data Records [NSIDC] (2006)
Globally Merged, Reconciled and Gridded Observations of Near-Surface Atmospheric and Land Surface Properties... [GES DISC] (2012)
Long-Term TOA and Constrained Surface Radiation Budget Dataset... [ASDC] (2012)

Earth Surface and Interior

Water and Energy Cycle
Development of Pre-SWOT ESDRs for Global Surface Water Storage Dynamics [PO.DAAC] (2012)
Long-Term Precipitation Dataset with Uncertainty Information [PPS] (2006)
GMAO – GISS – SPoRT – LIS

NCEP – NCAR – ESRL - GFDL
Applications Areas

Emphasis in 4 Applications Areas

Health & Air Quality
Water Resources
Disasters
Ecological Forecasting

Seek opportunities to expand to 5 additional areas

Agriculture
Climate
Weather
Energy
Oceans
## Data and Assessments

<table>
<thead>
<tr>
<th>GDAP</th>
<th>GEWEX Data and Assessment Panel (C. Kummerow; J. Schultz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSRN</td>
<td>Baseline Surface Radiation Network (E. Dutton)</td>
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<tr>
<td>CIRC</td>
<td>Continuous Intercomparison of Radiation Codes (L. Oreopoulos)</td>
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<tr>
<td>GACP</td>
<td>Global Aerosol Climatology Project (M. Mishchenko)</td>
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<tr>
<td>GPCP</td>
<td>Global Precipitation Climatology Project (R. Adler)</td>
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<tr>
<td>ISCCP</td>
<td>International Satellite Cloud Climatology Project (W. Rossow)</td>
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<tr>
<td>ITCM</td>
<td>Intercomparison of 3-D Radiation Codes (R. Cahalan)</td>
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<tr>
<td>LandFlux</td>
<td>Land Surface Fluxes (W. Rossow)</td>
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<tr>
<td>RAMI</td>
<td>Radiation transfer Model Intercomparison (J-L Wicciowski)</td>
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<tr>
<td>SeaFlux</td>
<td>Sea-Surface Fluxes (C. Clayson)</td>
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<tr>
<td>SRB</td>
<td>Surface Radiation Budget Project (P. Stackhouse)</td>
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<tr>
<td>WGDMA</td>
<td>Working Group on Data Management and Analysis (W. Rossow)</td>
</tr>
</tbody>
</table>

Assessment Working Groups:
- Aerosols (S. Christopher; J. Reid)
- Clouds (C. Stubenrauch)
- Radiation (P. Stackhouse)

## Modeling and Prediction

<table>
<thead>
<tr>
<th>GASS</th>
<th>Global Atmospheric System Study Panel (J. Petch; S. Klein)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GEWEX Atmospheric Boundary Layer Study (GABLS-3; B. Holtslag; G. Svensson)</td>
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<td>Vertical Structure and Diabatic Processes of the MJO Joint Project with the MJO Task Force using YOTC data (X. Jiang; P. Xavier)</td>
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<td>Convective and Cloud Processes During TWP-ICE: A Multi-Model Evaluation Project (A. Fridlind; J. Petch)</td>
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<td>Microphysics Project (B. Shipway)</td>
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<td>Boundary Layer Cloud Projects (A. Lock)</td>
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<td>Polar Cloud Projects (J. Pinto; H. Morrison)</td>
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<tr>
<th>GLASS</th>
<th>Global Land/Atmosphere System Study (J. Santanello; M. Best)</th>
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<tr>
<td></td>
<td>ALMA Assistance for Land-surface Modeling Activities</td>
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<td></td>
<td>GLACE-2 Global Land/Atmospheric Coupling Experiment (R. Koster)</td>
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<td>GSWP-3 Global Soil Wetness Project (T. Oki)</td>
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<td></td>
<td>LoCo Local land-atmospheric Coupling (J. Santanello)</td>
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<td>LUCID Land-Use and Climate, Identification of robust Impact (A. Pitman)</td>
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<td>PILPS Project for the Intercomparison of Land-surface Parameterization Schemes (A. Pitman)</td>
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## Hydroclimatology

<table>
<thead>
<tr>
<th>GHP</th>
<th>GEWEX Hydroclimatology Panel (D. Lettenmaier; J. Polcher)</th>
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<tbody>
<tr>
<td>AMMA</td>
<td>African Monsoon Multidisciplinary Analysis Project (T. Lebel)</td>
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<tr>
<td>BALTEX</td>
<td>Baltic Sea Experiment (H-J. Isemer)</td>
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<tr>
<td>HyMeX</td>
<td>Hydrological cycle in the Mediterranean Experiment (P. Drobinski)</td>
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<tr>
<td>LBA</td>
<td>Large-Scale Biosphere-Atmosphere Experiment in Amazonia (J. Maia)</td>
</tr>
<tr>
<td>LPB</td>
<td>La Plata Basin Project (H. Berbery)</td>
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<tr>
<td>MAHASR</td>
<td>Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative (J. Matsumoto)</td>
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<tr>
<td>MDB</td>
<td>Murray-Darling Basin Water Budget Project (J. Evans)</td>
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<tr>
<td>NEESPI</td>
<td>Northern Eurasia Earth Science Partnership Initiative (P. Groisman)</td>
</tr>
</tbody>
</table>

### Regional Hydroclimate Projects (RHPs)

- High Elevation (G. Tartari)
- Monsoon (J. Matsumoto; H. Berbery)
- Semi-arid (C. Fu)

### Data Management

- Reference Sites, River Basins (S. Williams)
- Model Output (M. Lautenschlager)
- Satellite Data (T. Koike)
- Data Integration and Dissemination (T. Koike)
- Central Data Integration (T. Koike)

### Cross-Cutting Studies

- Extremes
- Isotopes (D. Noone; K. Yoshimura)
- Aerosols (W. Lau)

### Modeling Studies

- Global Models
- Regional Models
- Inter-Continental Transferability Study (B. Rockel)
- Scale Interaction Evaluation Experiment (R. Arritt)
- Land Surface Models (M. Rockell)
- Hydrologic Applications Project (E. Wood)

### Affiliated Global Organizations

- GPCC Global Precipitation Climatology Centre (U. Schneider)
- GRDC Global Runoff Data Centre (U. Loscher)
**Vision:** Establish the scientific basis, observation, modeling and decision approaches needed to manage water security and sustainability through climate, population and environmental change uncertainties.

**Challenges:** to organize NAWP efforts
- **Adaptation:** Develop the scientific basis and tools to adapt to climate, population and environmental change.
- **Benchmarking:** Assess water dynamics, water cycle sensitivity, and evaluate/improve model skill.
- **Science informing decisions:** Develop the capacity for science-informed sustainable water management practices.

**Implementation:**
- **Quantify:** Systematically quantify North American water storages and fluxes.
- **Understand:** Analyze water cycle variations, trends and extremes; adaptation measure impacts.
- **Predict:** Improve continental precipitation, cloud and hydrology prediction.
- **Solutions:** Develop and transition new observations, models, and tools to operations.

NAWP leverages these efforts and integrates:
- **Interdisciplinary:** Atmosphere, ocean, and land
- **Government, academic, private**
- **Continental** – global to local
- **International** – 20+ North American countries

*No current effort exists to make these critical links and integration of continental-scale hydroclimatology towards water security.*

**Partnerships**
- Research
- Decision Makers
- Stakeholders
- Services & Operations

**Disciplines**
- Cryosphere
- Water
- Climate
- Atmospere
- Weather
- Ocean
- Carbon

**Solutions for America’s water security**
**Other thoughts**

- **We can pull off the integration if we are more mission oriented, with deadlines. People need to know/feel that being on this team is top priority.** Our telecom and Google group goals need to be more science specific with goals and action items.

- **A mission team is very goal oriented and has sub teams.**

- **Q: What is NEWS building? A: Prediction improvement (this is very hard to do though) We need to know what our primary deliverables are that we are promising, and the timeframe.**

- **We should pick a shorter term goal to push over the next 2 years that NEWS can plug into and make progress towards.**

- **NEWS must identify our high priority drivers.**

- **Draw ideas from NEWS-IP**
  - 1. Present ideas (overview presentation) narrowing the scope, identify or ask “what are we building?"  
  - 2. Engage participants  
  - 3. Figure out how do we get this done?
Workshop Charge

This is a NEWS science meeting, with the charge to:

• Foster in-depth science discussions, especially at the interfaces of projects and disciplines
  • Review session, break-outs, breaks, meals
  • Invited guests & links to other science programs

• Refine and plan the development of a few papers that integrate NEWS research
  • Use Google docs for group collaboration?
  • Each person should consider taking the lead for a integration paper topic

• Summarize papers and research highlights (Thursday afternoon)
  • Overview of research highlights, or integration progress
  • Include future ideas and summary of brainstorm discussions
  • Outline of paper(s) including connections, implementation plan, timelines
  • Announce plans for future working group collaborations

Next steps?
• Refinement of NEWS implementation plan
• NEWS-centered sessions at AGU/AMS
• Mid-year NEWS working group sessions or topic workshops
• Suggestions for management