Report of the NEWS Science Team Meeting
NASA Goddard Space Flight Center
1-2 May 2013

NEWS BACKGROUND

The overarching long-term challenge of NEWS remains documenting and enabling improved, observation-based predictions of the water and energy cycle consequences of Earth system variability and change. This requires assessing the variability of the global energy and water cycle on time scales ranging from seasonal to decadal, and space scales ranging from regional to continental to global, and will enable supporting the application of climate prediction capabilities for estimating the societal impact of climate variability and climate changes on water resources over a variety of spatial and temporal scales.

The scientific framework for the Water and Energy Cycle focus area was outlined in the NASA Earth Science Enterprise Strategy document, issued in October 2003. It is one of six focus areas that define the scientific content of the NASA Earth Science Program, and includes both research and technology components. The scientific priorities adopted by NEWS reflect the issues outlined in the Strategic Plan for the U.S. Climate Change Science Program (July 2003). These are:

- To understand the mechanisms and processes responsible for the maintenance and variability of the energy and water cycle, including the extent of human interaction

- To determine how feedback processes control the interactions between the global energy and water cycle and other components of the climate system, and how these feedbacks are changing over time

- To assess the key uncertainties in seasonal-to-annual and longer term predictions of energy and water cycle variables, and to outline improvements needed in global and regional models to reduce these uncertainties

- To evaluate the consequences, over a range of space and time scales, of energy and water cycle variability and change to human societies and ecosystems, and their affect on nutrient and biogeochemical cycles

- To provide a scientific basis for supporting informed decision processes in the context of changing water resource conditions and policies

When fully implemented, the NEWS research program will yield significant advances and breakthroughs in hydrological cycle climate science. Progress in achieving its objectives will be measured against its success in identifying gaps and making significant advances in:

- Promoting the development and deployment of an experimental energy and water cycle global observing system
- Assessing the global energy and water cycle through an observational record of all associated geophysical parameters
- Building a fully interactive experimental global climate model that encompasses the process-level forcings on and feedbacks within the global energy and water cycle
- Creating a global land and atmosphere data assimilation system for energy and water variables.

Second-tier NEWS research questions adopted were:

- How are global precipitation, evaporation and the cycling of water changing?
- What are the effects of clouds and surface hydrologic processes on Earth's climate?
- How are variations in local weather, precipitation and water resources related to global climate variation?
- What are the consequences of land cover and land use change for human societies and the sustainability of ecosystems?
- What are the consequences of climate change and increased human activities for coastal regions?
- How can weather forecast duration and reliability be improved?
- How can predictions of climate variability and change be improved?
- How will water cycle dynamics change in the future?

Over the past four years, the project has been working on how to refine a NEWS team approach to tackling integration. NEWS is attempting to create a structure that allows for consistency from existing NEWS activities, (i.e., conservation of scientific momentum), and at the same time welcomes new NEWS PIs and their projects. To these ends, the project created four NEWS working groups that identify integration needs and make the needed connections to partner and coordinate with water & energy cycle research and application activities going on at other organizations within NASA, nationally, and internationally. The four groups established in 2009 are:

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

The working groups are charged with coordinating and integrating NEWS PI science investigations; liaise with relevant flight missions and NASA R&A Programs; implement annual assessment of progress in meeting NEWS scientific requirements; and contribute to periodic Implementation Plan (IP) updates. A principal goal of the working groups is to promote the development of scientific papers that integrate various NEWS research within the working group topic area.

The 2013 Science Team Meeting has been structured to embrace the 18 new NEWS science investigations selected by NASA as a result of the ROSES-2011 solicitation. Once the Science Team is up and running, it is expected that the working group structure will be updated to reflect the scientific priorities of the members. It is expected, however, that the Modeling and Water Cycle Prediction Working Group will be merged within the other groups.

SUMMARIES OF NEW APPROVED PROPOSALS
(Full ROSES2011 proposal abstracts are available on the NEWS website)

Joel Norris/Observed Tropical Expansion: Impact on the Hydrological and Energy Cycles
jnorris@ucsd.edu
This project will examine the expansion of the tropics using NASA NEWS and re-ananlysis (MERRA) data for the period 1979 to present to quantify the extent of the changes in the tropics.

Ralf Bennartz/The Role of Boundary Layer Clouds in the Global Energy and Water Cycle: An Integrated Assessment Using Satellite Observations
bennartz@aos.wisc.edu
The primary objective of this work is the development of a new dataset giving cloud droplet number concentration, cloud geometrical thickness, and rain water path for stratiform boundary layer clouds using MODIS and AMSR-E data. The proposed work will also study cloud changes to anthropogenic sources of aerosol and provide retrieval uncertainty analysis.

Bill Olson/Characterizing Uncertainties in Large-Scale Atmospheric Heating Distributions Derived from TRMM Observations and Reanalysis Datasets
Bill.Olson@nasa.gov
The primary objective of this research is to estimate the uncertainty in TRMM large-scale heating estimates. The differences between TRMM and reanalysis heating estimates would be examined in terms of these uncertainties. This proposal specifically addresses just the uncertainties in latent+eddy sensible heating (Q1-QR).

Rachel Pinker/Integration of Satellite Radiative fluxes in support of Hydrological Modeling
pinker@atmos.umd.edu
This project aims to perform an in depth evaluation of current satellite (mostly NASA-sponsored) radiative flux products (shortwave (SW) and longwave (LW)) against ground observations, other products, and numerical model outputs. One of the objectives is to identify regions where satellite products disagree most, and where models have problems and could benefit from the satellite observations. The study will focus in particular on understanding scale issues of the validation process for generating informative error metrics.

Xun Jiang/Investigation of the Recycling Rate of Moisture in the Atmosphere From Observation and Model
xjiang4@mail.uh.edu
This project aims to addresses the recycling rate of moisture in the atmosphere using a number of remote sensing observational data sets to examine the precipitation recycling rate (and precipitation and atmospheric water vapor) and the suggested increase (decrease) of recycling in areas of high (low) precipitation on a decadal time .

Judith Curry/Integrated analysis of atmospheric water cycle in intense marine storms
curryja@eas.gatech.edu
The project builds on earlier work by the investigators with NEWS funding and focuses on evaporation, latent heating, and on tropical cyclones and storms in the Southern Ocean. The research will target the following two research questions: 1) What is the role of surface evaporative flux and atmospheric latent heating in the life cycle of integrated kinetic energy,

precipitation, and intensification of hurricanes? 2) How does the hydrological cycle of the high latitudes of the Southern Ocean influence the variability of Antarctic sea ice?

Joseph Santanello/Investigating the Impact of Land-PBL Coupling on the Water and Energy Cycle in NASA Model and Observation Products
Joseph.A.Santanello@nasa.gov
The focus of this project is to evaluate land-PBL coupling in several models and observational data products using diagnostics of local coupling

Dennis Lettenmaier/Assessment of the role of surface water storage in the terrestrial water budget
dennisl@u.washington.edu
This research aims to develop monthly time series of global surface water storage change at 1/4 degree resolution for the period 1950 to 2010.

Hui Su/Using NEWS Water and Energy Cycle Products to Investigate Processes that Control Cloud Feedback
hui.su@jpl.nasa.gov
The objective of this work will be to provide a comprehensive characterization of the spatial and temporal variations of clouds and related fluxes and thermodynamic and dynamic variables, with a focus on the tropical oceanic regions in the past decade. A high-level objective is to provide insight into physical processes responsible for discrepancies between models and observational data (mostly from satellite) that describe cloud feedback and energy fluxes.

Siegfried Schubert/Warm-Season Short-term Climate Extremes in the Northern Hemisphere in a Changing Climate: The Role of Stationary Rossby Waves
siegfried.d.schubert@nasa.gov
This proposal seeks to further investigate the role of stationary Rossby waves in warm-season short-term climate extremes including how that role might change in a changing climate.

Michael Bosilovich/Quantifying observation influence on regional water budgets in reanalyses
Michael.Bosilovich@nasa.gov
The initial focus of the project will be evaluating the observations assimilated in MERRA over North America, where a strong dipole structure in the vertically-integrated moisture increments during the warm season signifies a discrepancy between E-P from the model physics compared to that derived by moisture transport.

Shih-Yu Wang/Identifying extreme precipitation "hot spots" in the changing tropical-midlatitude interaction using MERRA and satellite data
simon.wang@usu.edu
This project will conduct a focused data analysis in the study of extreme precipitation threat and identify vulnerable regions in a changing climate.

Robert Brakenridge/Accelerating Changes in Arctic Ocean River Discharge Using Coupled Satellite- and Ground-based Measurements, 2002-Present
Robert.Brakenridge@Dartmouth.edu
The objective of this project is to quantify the accelerated change in Arctic Ocean river discharge using both satellite and ground based measurements since 2002. Based on the proposed work, the team also aimed to provide a website for near real time river discharge at the validated high latitude NASA AMSR-E measurement sites.**Anita Rapp/Quantifying**

the water and energy budgets of marine subsidence regions
arapp@tamu.edu
This project seeks to study the water and energy cycles in three marine subsidence regions, namely, those off the west coasts of North America, South America, and southern Africa.
Carol Anne Clayson/Characteristics of and Relationships between Surface Heat and Moisture Fluxes and Ocean-Atmosphere Variability
cclayson@whoi.edu
The objective of this project is to use long term satellite (SSM/I) and model (MERRA) data to study the temporal and spatial variability of the distributions of heat and moisture fluxes over the global oceans and to relate these distributions to associated weather parameters, such as near surface.

Robert Oglesby/Quantifying the Relative Roles of Local Versus Remote Effects on North American Summertime Drought
roglesby2@unl.edu
This focus of this project is to investigate the impact of local and remote effects on North American summer time drought especially over Central USA. Secondly, we want to understand the weakness and predicting local effects for example how evapotranspiration flux affect land-atmosphere feedback.

Seiji Kato/Investigation of Earth radiation budget variability by cloud object analysis
seiji.kato@nasa.gov
This proposed investigation focuses on understanding the variability of top-of-atmosphere (TOA) and surface radiation budget. The objective is to identify processes that affect TOA radiation budget by investigating cloud types (cloud objects) frequency of occurrence change and cloud property change within a cloud type. The result of our investigation offers a direct path to test climate models. Our investigation also sets requirements for climate models to properly model energy flows.

Patrick Taylor/Towards an Improved Understanding of the Diurnal Cycle Influence on Earth's Energy and Water Cycle Variability and Prediction
patrick.c.taylor@nasa.gov
Proposed is a set of studies designed to illuminate the controls on monthly, tropical diurnal cycle amplitude and phase and the physical mechanisms linking the diurnal cycle to E&WC variability. These studies focus around answering a simple science question: what are the consequences of misrepresenting cloud, precipitation, and radiation diurnal cycles for seasonal-to-annual E&WC prediction

WORKING GROUP CHAIR REPORTS

These reports reflect the discussions and recommendations, which will steer future working group plans for coordination and science integration.

NASA NEWS Extremes Working Group

Chair: Simon Wang (Utah State University)

Co-Chair: Bob Oglesby (University of Nebraska-Lincoln)

Members: Joe Santanello, Ming Pan, Kyle Hilburn, Siegfried, Schubert, Hailan Wang, Paul Houser, Robert Gillies

WG Summary:

The Extremes group has decided to focus on understanding severe drought in the United States. The 2012 drought may not have been **predictable** as based on current schemes employed for such purposes, but it may have been **anticipatable** due to knowledge of key precursors such as favorable (remote) SST patterns, and reduced regional soil moisture and winter snow packs. Thus, we would like to examine the extent to which the 2012 drought could be anticipated and to put recent severe droughts in perspective. This theme was determined because (1) extreme events are local and require a regional focus in the analysis; (2) the members of this group have ongoing research focusing on the central U.S.; and (3) attribution of extreme events in the U.S. is under active debate and the strength of the NEW Steam can provide further clue

Planned activity:

The strength of this extremes working group is that each group member has either done or is doing drought related analysis for the central U.S., including diagnoses of planetary- and regional-scale forcing for the Great Plains drought (Simon & Hailan), regional modeling and soil flux study in northern plains (Bob), local land–atmosphere coupling in southern Great Plains (Joe),surface climate-hydrology of extreme wet/dry in the U.S. (Ming), and intraseasonal prediction of drought (Siegfried/Hailan). Moreover, Kyle will support the low-level jet and moisture flux analysis from satellite data.

WG Theme: *COULD THE 2012 DROUGHT HAVE BEEN ANTICIPATED?*

A recent NOAA report analyzing the drought of 2012 in the central US has garnered considerable attention, both scientifically and especially in the news media. This report concluded that the drought was not inherently predictable, representing a very anomalous atmospheric circulation pattern. It is important to recognize that this 'predictability' is based on what happened in the atmosphere, and further, depends on the capabilities of the predictive schemes currently employed by NOAA. The current prediction schemes emphasize the role of the large-scale atmospheric circulation, but the extent to which the long wave patterns and subsequent short wave (synoptic) effects can be predicted iadvance remains unclear. These schemes generally lack full consideration of the local surface state, especially the effect of precursor anomalies in key elements such as soil moisture and snow pack. It is also not clear how well they account for the effects of either emerging or antecedent SST anomaly patterns. The role of the aforesaid precursors, combined with knowledge of their state, may allow some assessment of the 'likelihood' of drought that is not currently being considered. For example, by late winter of 2012 much of the central US was already experiencing dry conditions, Including reduced soil moisture, and the snowpack in the Rockies was well below normal. Sea surface temperature patterns appear to have been largely neutral. While the manifestation of the resultant drought also critically depended on the large-scale atmospheric circulation that subsequently developed, it is clear that the region was preconditioned towards being dry.

The other factor about precursors of the 2012 drought is the previous, 2011 'Texas drought.' As shown in the UNL Drought Monitor data for the contiguous U.S. (figure right),the 2011 drought remains stronger than the 2012 one in the 'exceptional' category(green line). This feature deserves attention as it might reflect the different scales in the atmospheric teleconnection pattern and the comparison of the two events might help determine the soil moisture (or lack of) impact of the 2011, intensive drought on the 2012, widespread drought. The overarching question is: How do we anticipate for 2013 – will it be a drought or non-drought year?

Working Hypothesis:

Our hypothesis is that even if one cannot predict the future atmospheric circulation patterns with much certainty for a given year, we may still be able to make some assessment of whether or not a drought may be likely to occur. We refer to this as anticipating drought. Of course, the actual drought (if any) that does subsequently occur will depend closely in magnitude and duration on the atmospheric circulation that unfolds. Indeed, precursors such as soil moisture and snowpack also become important in potentially enhancing and prolonging the drought as it occurs.

Work Plan:

To explore this concept of 'anticipating' drought further, several approaches can be taken. First, it is always important to examine previous severe droughts in the central US. Our primary focus will be on 2012, but we will also consider the droughts of the later 20th century. (We note that earlier droughts such as the 1950's or dustbowl of 1930's are problematic due to insufficient observations, especially of soil moisture and snow pack.) Second, we propose to diagnose drought factors by separating the teleconnection (large-scale) effect from the local (synoptic) weather effect, while isolating the lingering soil moisture effect from the predominant circulation anomalies. Third, it is equally important to examine how each drought 'ends,' as this determines drought duration and relates to severity – e.g., what caused the Midwest to have eased off from the 2012 drought?

Specifically, we propose to:

1. Gather all existing relevant information on soil moisture, snow pack, and SST anomalies. In some cases, especially for soil moisture, this may require adapting existing, or developing new products. Accurate information on ET fluxes is likely a key.

2. Perform targeted global and regional climate model simulations evaluating the precursors as initial conditions, and then the (simulated) subsequent evolution. Do this with precursors singly, and in combination. This requires development of a matrix of model simulations.

3. Using the information obtained from steps 1. and 2., make hindcast assessments of the likelihood of anticipating the droughts, and how long beforehand (e.g., a month, a season; a half-year) robust results might be expected from the assessments.

Finally, it is proposed that the Extreme WG produces their first progress report in the 38th Climate Diagnostics and Prediction Workshop in October 21-25, 2013 (in D.C.).

NEWS Climate Shift WG Report

Chair: Robsrt Adler
Co-Chair: Pete Robertson
Members: Adler/Gu/Huffman, Robertson, Bosilovich, Lettenmeier/Nijssen, Schubert, Su, Jiang/Yung/Li, Brackenridge/Overeen, Clayson/Roberts, Norris/Allen

The NEWS Climate Shift Working Group was formed at the NEWS Science Team meeting at Goddard (1-2 May 2013) with Bob Adler and Pete Robertson as Co-Chairs. The objective of the group will be to better understand changes in the global water cycle related to the "climate shift" which happened in approximately 1998.

Background:

During the last 25- 30 years of satellite and re-analysis information global surface warming and increases in ocean water vapor are evident, primarily in the pre-1998 period, with a leveling off of these increases in the post-1998 period. This "climate shift" is similar to an earlier inter-decadal change event in the late 1970s and has been linked to changes in ocean-atmosphere interactions linked to Pacific Decadal Variability (PDV), although other processes (AMO, aerosols, etc.) could also be involved. There is also evidence that other components of the water (and energy) cycles show a shift at approximately the 1998-2000 point. However, not all the global data sets and re-analyses agree and/or have homogeneity issues. The WG will explore this subject to better document and understand the "shift" and also understand the strengths and weaknesses of the global data sets and re-analyses to build a group consensus as to "what happened" and which data sets/re-analyses can be used with what level of confidence. This activity will also point to possible actions to improve the data sets and re-analyses for more confident research in the future.

Sample questions:

- Is the shift real?
- How consistent are the data sets and reanalyses in documenting the shift in various aspects and parameters of the large-scale water and energy cycles?
- Is there a consistency among the evidence? What data sets seem to be outliers and can we identify a physical basis for their "problem(s)" that could suggest directions for their improvement?
- To what extent is the cause of the change Pacific Decadal Variability [PDV] or AMO related?

<u>Planned activities:</u>

1) Robertson paper—Pete Robertson et al. have a draft paper, which deals with a particular aspect of the shift in terms of consistency of the global data sets and re-analyses in diagnosing the last 30 years of ocean-to-land moisture transport. This paper will directly involve a subset of the WG, but will also serve as a stepping-off point for discussion. This paper is expected to be submitted to a journal in the coming weeks.
2) Additional shift example or documentation—Members of the WG will examine their own research and other research (e.g., journal papers) that show examples of the shift (or don't) and share with the group (e.g., figures, references). We may use a drop box for this. This will serve as one departure point for discussion.
3) Regular telecons (oh no, the hated telecons!). We will try to have 1-hr telecons ~ every 6 weeks with an agenda.
4) Possible meeting at AGU in Dec. Most members of WG will be in San Fran. (with exception of CSs). Possible 5-7 pm meeting in middle of week (can we get a room with projector?) for short, informal presentations (5 min.) of pertinent results by WG members and follow-up discussion, followed by dinner paid by Jared.

Goals for next NEWS science team meeting (May 2014):

1) Publication of Robertson et al. paper and other papers of WG members that might include "shift" results.
2) Summary presentation of WG and other research to answer questions stated above. Perhaps draft of journal review article on subject.
3) Statement from WG as to strengths and weaknesses of data sets and re-analyses and suggestions to NEWS and NASA about possible actions to strengthen these information sources to reduce uncertainties and increase confidence in results.

4) NEWS Evaporation & Latent Heating WG Report

Co-Chair: Carol Anne Clayson
Co-Chair: Eric Wood
Members: Cullather/Bosilovich, Taylor, Bennartz ,Taylor, Rapp, Kato, Lipton, Pinker, Field, Liu/Curry, Peters-Lidard, Olson, Jiang, Pan, Kilic

WG Summary:
There were a number of topics that were discussed within the WG breakout session. The first is that there is still a great deal of work to be done towards understanding and characterizing the various E, P, and LH datasets, and that our group will not lose sight of this objective. The strength however of the combined group is that we can look at events or processes that cut through the capabilities and interests of individual PIs. In addition, the goal is to choose an analysis in such a way that much if not all of the analysis can be performed solely or mainly with NEWS data sets and also with MERRA results, and work together with the modeling community to not only learn something about the science, but also something about the data and the models in a way that may be useful for future model development. Several possible scientific issues that could be explored were discussed, including looking at weather extremes and how surface evap/LH/moisture convergence/divergence play a role in the evolution of such events. However, the main area of interest from the group surrounded the following strawman proposal.

Planned activity:
We would like to evaluate the latent heating transport from over a region (discussed below), for the NEWS time period of 1998 - 2007, in order to determine the following:
(1) mean seasonal flux;
(2) interannual variability;
(3) the statistical distribution of events. This would lead to an analysis of extremes or other other aspects of the distribution and how this relates to surface variability and atmospheric transport variability. An analysis of the extremes can then also be tied to specific weather events, such as atmospheric rivers or cyclonic events
(4) an analysis of trends in the transport over the time period

There was discussion at the working group about choosing the location for this type of study, which we will further discuss in our first teleconference. We may extend to two locations, as once we have the datasets in hand then it is a matter of simply choosing a different location to pull out. Our understanding of uncertainties, etc. would cut across both locations if indeed we would like to include this.

We anticipate the following sequence of events to occur:

We will be putting a google doc up for folks to read and comment on prior to our teleconference. We need to gather the group's thoughts on (a) what data sets are available; (b) what methodology we are going to use; (c) additional or alternative regions to evaluate.

Our first teleconference will go over the suggestions that have been made to that point, and I hope that we can than reach consensus on location(s) of study and methodology, as well as determining which groups are going to start the analysis of the data.

Following teleconferences will likely be held on a monthly basis. There was a great deal of discussion on this point. The feeling was that if you hold them every two weeks, they are too "commonplace" and folks will not treat them as a priority, whereas if they are

held once a month, then it becomes a much more significant deadline to spur people to work. More than about a month means folks will be getting spurred to make some progress a little too infrequently for us to finish our analysis within roughly a year+ time frame.

It should be noted that there was a significant amount of discussion that addressing this particular science problem, while limited in scope and therefore tractable within a realistic time frame, will lead to a whole host of issues and questions that will need to be explored further. We anticipate a number of questions that will be opened up by this work, so that it is certainly not a "limited-view" type of problem, but one which is central to NEWS and to the longer-term ELH group.

NEWS Cloud/Radiation WG Report
Chair: R. Bennartz
Co-Chair: A. Rapp
Members: Ralf Bennartz, Jonathan Jiang, Seiji Kato, Bill Olson, Rachel Pinker, Anita Rapp, Hui Su, Patrick C. Taylor

Target:
Synergistic investigation of energy budget in subsidence regions. Initial focus will be on Pacific off South America. Can we close energy budget in the area?

Preferred time period:
CloudSat/Caliop data period… July 2006 – June 2010

Focus area:
Low clouds/subsidence regions

Detailed Science questions:

- Diurnal cycle of clouds impact on precipitation?
- Precip diurnal cycle? Latent heating diurnal cycle?
- Diurnal cycle of cloud fraction/cloud thinning? Impact on albedo?
- Impact on surface downwelling shortwave?
- Variability with large-scale tropospheric state LTS, EIS?
- 2010/2011 El-Nino-to-La-Ninja transition…
- Energy balance model/moist physics

•SUMMARY OF MEETING CONCLUSIONS AND FUTURE ACTIONS
Over the past year, NASA has continued progress toward improving its description of the water and energy cycle, including the size and movement between its stores. Coincident use of multiple satellite and model data sources (e.g. AMSR-E, TRMM, MODIS, etc.), especially those of different but linked variables have led to improvement both in the quantification of the water and energy cycle and the uncertainty estimates of its terms, with both groundwater and total storage two newly provided variables provided by the GRACE satellite. Furthermore GRACE data has been used to provide large area estimates of the change in total water storage, with estimates of groundwater overabstraction in the Middle-East and California. of the land that by definition has to equal the sum of precipitation, evaporation, and run-off. The state of the refinement of the global water and energy balance has been derived from NASA satellite data made globally and regionally, and on annual and monthly time scales. Shorter term remote sensing data sets (EOS era~10 years) have been combined with longer term satellite records (e.g. snow covered area) and land surface model simulations to provide assessment capability to determine if, where, and how the water cycle might be changing. Progress is being made to

observe water quality over oceans, lakes and rivers as highlighted at a NASA water quality workshop and in the creation of a new NASA water quality remote sensing science team.Open ocean remote sensing capabilities to assess water properties are being tested against collected coastal and in-land water body samples to determine the feasibility and capability of remote sensing observations to determine water quality.

The NASA Energy and Water cycle Study (NEWS) has compiled the first-ever a satellite-based energy and water cycle climatology, including monthly, continental and oceanic averages of the Earth's radiation balance, as well as precipitation, evaporation and water vapor. The accompanying uncertainty evaluation adds a believability measure for application of this data and is helping to guide future satellite technology decisions and helping to improve climate model predictions using advanced diagnostics. This new integrated global water and energy assessment is being used in conjunction with NASA's Modern Era Retrospective-Analysis for Research and Applications (MERRA) reanalysis, to study and improve predictions of weather and climate variability. These integrated water and energy satellite studies have also provided insights to the mechanisms and severity of mid-western U.S. floods and droughts, which will help mitigate future damage caused by these extremes.

In 2013, NEWS initiated a new science team with innovative integration projects focused on the role of clouds in the climate system, the origins and dynamics of the 2012 midwestern drought, and the ~2002 global climate shift. These projects only have 24 months to mature, with the metric clearly being peer-reviewed literature that integrates the work of several funded NEWS projects. The current NEWS projects do not span the full range of the NEWS program goals, and are only for a short duration. Therefore, these projects have taken on subsets of the NEWS schence questions and goals – either specific aspects of global water and energy cycling processes, or a sub-global focus.

NEWS is a unique program that connects highly diverse disciplinary specalities, enabling progress towards improved water and energy cycle prediction using knowledge gained from NASA's observational program. Global water and energy cycle variability and its prediction is a highly complex and important problem; improved water and energy prediction will see huge benefits in improved agricultural and water resources planning, and preparing for the consequences of climate change. Therefore, the NEWS program must stay the course, systematically continuing towards its goals through an integration-focused research team. And future team selections should be made to bridge the gaps in the program and include a wider distribution of expertise.

• WORKSHOP PROVISIONAL AGENDA

Day - 1

08:30 – 12:00 Plenary Session
08:30 – 08:45 NASA Management Commentary (Entin)
08:45 – 09:30 NEWS Integration Challenges and Opportunities (Houser)
09:30 – 12:00 Invited Presentations - Working Group Summaries (45 min including questions):
Climatology
Modeling
Evaporation and Latent Heating
Drought and Flood Extremes
12:00 – 13:00 Lunch
13:00 – 17:00 New Investigator Research Summaries (10 min):

Norris, Bennartz, Olson, Pinker, Jiang, Curry, Santanello, Lettenmaier, Su, Schubert, Bosilovich, Wang, Brakenridge, Rapp, Clayson, Ogelsby, Kato, Taylor

Day – 2

08:30 – 9:00 Plenary Session – ~~Breakout~~ Philosophy, Expectations, Need for Partnerships
09:00 – 10:30 Individual Working Group Sessions – Discussion of Science Questions
Climatology
Modeling
Evaporation and Latent Heating
Drought and Flood Extremes
10:30 – 11:00 Plenary Session – Working Group Reports & Discussion
11:00 – 12:00 Science Question Sessions 1 – Potential Research Partnerships
12:00 – 13:00 Lunch
13:00 – 14:00 Science Question Sessions 2 – Potential Research Partnerships
14:00 – 15:00 Plenary Session – Research Partnership Reports & Discussion
15:00 – 17:00 Plenary Session – Addressing the NEWS Integration Challenges
17:00 Closing remarks and Adjourn

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