	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
Observations and Retrieval	A.1 - Implement global measurements of cloud and aerosol vertical distribution (CloudSAT and CALIPSO missions) and the retrieval of cloud optical properties, particle/drop size distribution and physical properties. Develop methods for inferring atmospheric radiative heating profiles (radiation flux divergence) combining CloudSAT, CALIPSO, and MODIS/CERES/ AMSR/AIRS/ PARASOL	L'Ecuyer	combine cloud. precipitation, atmospheric, and surface property information from multiple sensors to estimate profiles of LW and SW fluxes and heatingrates	The potential impact of anomalous cloud cover on the 2007 Arctic sea ice minimum was established using CloudSat and CALIPSO data. The results suggest that reduced cloud cover in 2007 may have significantly enhanced sea ice melt.	The results highlight the importance of considering potential atmosphere-ocean feedbacks in the highly sensitive polar regions.	Kay, J., T. L'Ecuyer, A. Gettleman, G. Stephens, and C. O'Dell, 2008: The contribution of cloud and radiation anomalies to the 2007 Arctic sea ice extent minimum, Geophys. Res. Letters 35, doi: 10.1029 /2008GL033451.	The nadir-only swath of CloudSat/CALIPSO lead to limited sampling even in polar regions. New approaches to merge CloudSat/CALIPSO with CERES/MODIS/AMSR-E/AIRS that have wider swaths, may help address this issue.
		Rossow	Analysis of diurnally-resolved land surface skin and air temperatures with surface meteorology to determine surface fluxes; analysis of multi-satellite data to estimate the extent and causes of variation of land surface inundation nevents; First attempt at a multi-year global water and energy analysis focusing first on the atmospheric energy cycle.	Compared calculated diurnal variations of surface radiative fluxes against BSRN measurements, including effects of aerosols and clouds on SW diffuse/direct ratio and surface air and skin temperatures on LW fluxes. Compared radiosonde-based cloud layer profiles with CloudSat/Calipso profiles. Compared several different infrared and microwave land surface skin temperature products. Conducted extensive studies of retrieval of land surface water, including soil moisture, inundation and river discharge based on multiple satellite measurements.	Continued improvement in the accuracy of surface radiative flux determinations. Developing complete land hydrology analysis to determine partitioning of surface water, which when combined with precipitation and evaporation will provide information about the complete land surface water cycle.		
		Wielicki, Kato	An A-train integrated aerosol, cloud, and radiation data product: Combine CALIPSO, CloudSat, MODIS and CERES data, compute atmospheric heating rate profiles with clouds and aerosol properties derived from CALIPSO, CloudSat and MODIS. Make the new merged data set available to the community.	Developed algorithms to merge CALIPSO, CloudSat, MODIS, and CERES data, computed heating rate, and produced a new merged data set. One year of merged data (from July 2006 through June 2007) are now available from Langley ASDC (http://eosweb.larc.nasa.gov/PRODOCS/ceres-news/table_ceres-news.html). Estimated modeled top-of-atmosphere and surface radiative flux (longwave) improvements by CALIPSO and CloudSat derived cloud and aerosol properties.	Heating rate profile with a high vertical resolution and better surface radiative flux. Provide data set can be used to estimate the uncertainty in surface radiation budget, aerosol and cloud radiative effect in the atmosphere, and climate process studies.		Research to combine detailed vertical cloud and aerosol profiles from CALIPSO and CloudSat with existing full swath A-train data to improve global radiative flux profile estimate, to understand the global 3-D characteristics of cloud and aerosol properties by distinct cloud-system types and large-scale environmental conditions and to lead a better characterization of global energy and water cycle.
	A.2 - Assess the feasibility of combining visible, infrared and microwave remote sensing to quantify snowfall and mixed precipitation in preparation for the GPM program, identify freezing or melting ground, detect surface melting on sea ice and ice sheets, and in general characterize cold land processes. Examine the potential uses of CloudSAT radar data to quantify snowfall, and combined TRMM and CloudSAT data to estimate mixed precipitation. In cooperation with international partners, identify further measurement requirements for advanced GPM and Cold Land Process Pathfinder missions.	Olson/Grecu	Develop physical models for the microwave scattering properties of snow and mixed-phase precipitation in support of combined radar-radiometer estimation of liquid/ice/mixed-phase precipitation in GPM. This would support algorithm development for the GPM GMI, DPR, and combined DPR-GMI sensor estimation of precipitation.	Currently have developed simple ice crystal and aggregate snow particle models and computed their microwave scattering properties. Also have developed 1D thermodynamic melting models to simulate the evolution of ice-phase precipitation particles as they fall below the freezing level. Have computed the microwave scattering properties of mixed-phase particles with simple geometries.	Particle scattering models can be linked with particle mass distribution and vertical structure models to produce physical parameterizations useful for radar-radiometer snow and mixed-phase precipitation algorithms.	Liu, J., J.A. Curry, W.B. Rossow, J. R. Key and X.Wang, 2005: Comparison of surface radiative flux data sets over the Arctic	More field observations (airborne radar, microwave radiometer, and in situ particle probe data, in conjunction with surface radar and disdrometer data) will be needed to validate snow and mixed-phase particle parameterizations. MC3E and future cold-season GPM campaigns will help fill this gap.
	A.3 - Explore potential advanced remote sensing methods for global observation such as land water storage in the form of soil moisture (possibly at several depths), inland water bodies and other important reservoirs, river discharge, and other relevant hydrologic quantities. Invest in required conceptual studies and technology development.	Rossow	Develop capability to remote sense the partitioning of land surface water into soil moisture, inundation (open water) and river discharge	Conducted extensive and numerous investigations of the new capability.	By combining visible, infrared, microwave (active and passive) satellite measurements with GRACE water mass inferences, we can determine inundation (open water) extent and volume and estimate river discharge.		More work is needed to separate soil moisture changes from small inundation fractions.
	A.4 - Evaluate the quality of global energy and water cycle datasets and identify important deficiencies or gaps. The accuracy, completeness, and physical consistency of datasets based on operational observations may be evaluated by comparing to short-term experimental satellite measurements, extensive field campaign data (e.g., GEWEX), and reference measurements from surface stations (e.g., ARM, BSRN). This quality assessment may also require technology investments to improve in situ sensors.	Lin	Quantify uncertainties in the integrated global energy data; cross-validate climate energy components using both energy and water cycle satellite observations, and analyze energy and water processes,	1. Currently available satellite data sets of radiative energy at the top of atmosphere (TOA) and surface as well as latent and sensible heat over the oceans are used to assess the global annual energy budget. The estimated annual mean atmospheric and surface heat imbalances are within the uncertainties of surface radiation and sea surface turbulent flux estimates. Significant systematic biases in the analyzed observations exist and could be as large as ~ 10 Wm-2. 2. For radiative energy, the uncertainties in satellite data sets are evaluated. The precision (or stability) of radiation measurements are higher (~1 Wm-2) than the absolute accuracy (potentially ~ 5 Wm-2) of satellite radiative energy measurements.	1. The spurious heat imbalances in the current data are much smaller than those obtained previously and debated about a decade ago. 2. Emphasized the importance of the accuracy of top-of-atmosphere net radiation for climate sensitivity estimations.	Ocean. J. Geophys. Res., 110, doi 10.1029/2004JC002381 (1-13).	1. Satellite direct measurements of land surface properties and land heat heat fluxes. 2. Lack of quantitative remote sensing techniques in estimating the relationships among satellite microwave-visible-infrared radiance measurements and vegetation properties that determine atmosphere-land surface interactions. 3. cold region processes, snowfall, ice/snow surface heat fluxes

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		Bourassa, Clayson, Jackson, Smith, and Wick	Analysis and blending of global satellite and NWP surface precipitation, temperature and humidity profilers	Comparison of nine relatively modern monthly turbulent air-sea flux products revealed substantial differences in both the heat fluxes and the forcing variables used to estimate the fluxes. The differences can be attributed to a combination of spatial and temporal sampling variations, the averaging methodology used to arrive at a monthly mean, the use of different flux algorithms, and the difficulties in estimating the forcing fields. In many regions, the differences in Tair and qair between the products clearly had a greater impact than the discrepancies in wind speed or Tskin on the derived heat fluxes. The more modern products, based on daily or better sampling were in better agreement. An analysis of the sampling found that monthly fluxes based on monthly averaged input data results in large errors in heat fluxes: >90W/m^2 in winter over western boundary currents, or 30W/m^2 in some parts or the tropics. Preliminary results find that ignoring diurnal variability accounts for roughly 10W/m^2 in the tropics. Furthermore, biases in heat flux parameterizations can account 10W/m^2 in the better parameterizations.	Biases in the oceanic latent heat fluxes are likely to be substantial, and vary as a function of location and season. Newly developed techniques for satellite retrievals will reduce the biases (through better accuracy and better sampling). Parameterization of diurnal variabilty will also reduce biases associated with the diurnal cycle.		Satellite coverage in areas of severe weather are blocked by excessive cloud cover. Statistical interpolattion is hihgly unlikely to be successful. Physically based interpolation seems to require more information about the vector wind field, which is less well sampled.
		Wood	Analyze AIRS surface retrievals for its usefulness in providing data for hydrological modeling and remote sensing	The skill of instantaneous Atmospheric Infrared Sounder (AIRS) retrieved near surface meteorology, including surface skin temperature (Ts), air temperature (Ta), specific humidity (q), and relative humidity (RH), as well as model-derived surface pressure (Psurf) and 10m wind speed (w) is evaluated using collocated National Climatic Data Center (NCDC) in situ observations (1467 stations over CONUS; 460 over Africa), off-line data from the North American Land Data Assimilation System (NLDAS), and geostationary remote sensing (RS) data from the Spinning Enhanced Visible and Infra-Red Imager (SEVIRI). Such data is needed for RS based water cycle monitoring in areas without readily available in situ data. The study is conducted over the continental U.S. and Africa for a period of more than 6 years (2002-8).	For both regions, it provides for the first time, the geographic distribution of AIRS retrieval performance. Through conditional sampling, attribution of retrieval errors to scene atmospheric and surface conditions is performed. The findings support previous assertions that performance degrades with cloud fraction and that (positive) bias enhances with altitude. In-general AIRS is biased warm and dry. In certain regions, strong AIRSNCDC correlation suggests that bias-driven errors, which can be substantial, are correctable	Raschke, E., A. Ohmura, W.B. Rossow, B.E. Carlson, Y-C. Zhang, C. Stubenrauch, M. Kottek and M. Wild, 2005: Cloud effects	
		Rodell, Beaudoing, and NEWS Water and Energy Cycle Climatology team	Develop continental and ocean-basin scale, seasonal and annual climatologies for the water and energy budgets, using best available observational products and observation-integrating models. Degree of success in closing water and energy cycles in tandem, and within error bounds based on estimated uncertainties in individual products, will indicate deficiencies and gaps in the required datasets.	Annual, continental scale water budgets close within expected error bounds. Budget residuals vary significantly across continents. Seasonal (monthly) water budgets still being evaluated. Gaps include inadequate observation and modeling of polar fluxes and fluxes over small tropical islands, which may be significant in aggregate. Previous gaps in observation based ET and runoff datasets are now being addressed by NEWS PIs (Wood and Lettenmaier).			

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		Wood	Develop large basin water and energy budgets using remote sensing, reanalysis and land surface modeling, and close the budget through a data assimilation (Constrained Ensemble Kaman Filter.)	A six year analysis has been carried out for 10 global basins, with the focus on using remote sensing products. The analysis results in differential weighting of the products depending on their uncertainty and adjustments by the filter to close of the budget indicates the extent which components are adjusted to obtain closure.	This provides the first multi-product budget time series with closure, allowing for improved estimates that can be used for diagnostic studies	on the radiation budget based on ISCCP data (1991 to 1995). Int. J. Climatology, 25, 1023-1039.	
		Dong and extreme group		The monthly precipitations derived from GPCP and TRMM observations have been compared with ARM and Oklahoma Mesonet observations over the SGP region during 1998-2007.	The good agreement between GPCP/TRMM and ARM/OK Mesonet gives us more confident to use GPCP/TRMM observations globally or other regions.		Although the agreement is very well, it is only over one location. More studies over different climatic regions, such as ARM NSA and TWP sites, are needed to further validate the GPCP and/or TRMM observations.
		Lipton	For evaporation and sensible heat fluxes from land, the primary global datasets are from numerical land surface models. The satellite data being analyzed are largely independent of what has been used in the models. The comparisons of these satellite data with the model products provide evaluations of the model-produced dataset, with respect to the consistency of the model fields with the satellite-derived parameters related to moisture in the soil and vegetation.	For evaluating model products, one valuable resource is satellite analysis of the diurnal amplitude of land surface temperature, which is strongly related to the partition between latent and sensible energy fluxes. The amplitude according to AMSR-E microwave data has been compared with what is available from MODIS infrared data.	A benefit of the microwave AMSR-E product is the far greater spatial coverage, into areas that were so persistently cloudy that the infrared MODIS product was unavailable either for the day or night measurements. The microwave data also avoid the "clear-sky bias" of the infrared land surface temperature.	Zhang, Y., W. B. Rossow, and P. W. Stackhouse, 2006: Comparison of different global information sources used in surface	
		Wood	Retrieval and evaluation of evapotranspiration (latent heat flux) over the terrestrial land surface.	To date both regional and global retrieval of the evaportranspiration fields at scales ranging from 5 km to 2-degrees, using data from the NASA EOS sensors and the ISCCP and SRB data sets. Initial analysis, evaluation and error estimates for regions and major river basins has been partially accomplished	The products are among the first long-term (multi-decadal) data sets of land evapotranspiration using the SRB and ISCCP data sets		
		Curry et al.	Evaluation and improvement of ocean surface latent heat fluxes	Of the originally proposed objectives, we have accomplished the following: · Evaluate the ocean surface fluxes and their input variables for available satellite data sets and NWP reanalyses using the assembled SEAFLUX in situ data base · Assemble a new "best" blended surface flux product · Use the blended flux data set (combining satellite and NWP products) to force regional ocean models and to evaluate the U.S. CMEP model Based upon our early results, we changed the focus of the project to address issues in Ta, qa retrievals and the evaluation and improvement of the product under high wind conditions such as hurricanes and high latitude storms.	• We have developed a new high resolution satellite SST data set that includes the diurnal cycle • We have demonstrated that an ocean surface flux product on spatial scale of 25 km and time scale of 6 hours is feasible • We have integrated and implemented a new bulk model to calculate the ocean surface latent heat flux from satellite data inputs • We have provided the first high resolution analyses of surface latent heat fluxes in hurricanes • We have had significant success in improving the satellite surface latent heat fluxes in the Southern Ocean.	radiative flux calculation: Radiative properties of the near-surface atmosphere. J. Geophys. Res., 111, D13106, doi:	Applications of the datasets are key to making scientific progress, and also essential for evaluating data set utility. We need: • Web based cyberinfrastructure to easily obtain the needed datasets in a range of projections/resolutions • A focus on key scientific objectives rather than producing datasets, ranging from climate scale (e.g. water vapor feedback, acceleration in the hydrological cycle, etc) to storm scale (e.g. understanding the coupling between energetics and water cycle in hurricanes) • Application of integrated data sets to forcing ocean models and investigating scales of ocean response to surface forcing
		Roads	Establish current uncertainty in describing global to regional atmospheric and surface water and energy budgets.	*Roads et. al. 2008) Estimated current uncertainty in describing 1986-1995 means of water and energy budget processes. Updated Roads et al. 2008 land focus with ocean and global means; focused on NEWS time periods with available data. Focused on seasonal variations and interannual monthly means.			
		Adler, Huffman, Gu, Curtis	Examine global data sets to determine water cycle changes (focusing on precipitation) on inter-annual, inter-decadal and trend time scales and relation to ENSO, volcanoes and global warming.	Global warming of surface temperature not producing increase in global precipitation, but shifts noted with increase in deep tropics, decrease in middle latitudes. ENSO produces a similar small signal in global precipitation variations with regional variations, while global volcano signal is more distinct.	Links between components of the water cycle at various time (and space) scales important to understand processes at various time scales and similarities and differences. These documented variations should serve as benchmarks for reanalysis and climate models.	10.1029/2005JD006873, (1-13).	Resources to examine climate models and their hydrological cycle in comparison with these observed results.

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
		Shie, Chiu, Adler & collaborators/users (Ardizzone, Bosilovich, Clyson, Gu, Hilburn, Huffman, B. Lin, I. Lin, Mehta, Nelkin, Olson/Mircea, Rossow/Romanski, Schlosser/Gao, Xie, and et al.)	We proposed to revive processing of, and to reprocess, the Goddard Satellite-based Surface Turbulent Fluxes (GSSTF) dataset in a project funded by the NASA MEaSUREs Program. The current daily global (1ox1o) air-sea surface fluxes GSSTF2 (Version-2) dataset (July 1987-December 2000) has been widely used since its release in 2001. A proposed new dataset (GSSTF2b) is to be produced and brought up-to-date (July 1987-December 2008) using improved input datasets such as the recently upgraded NCEP/DOE R2 sea surface skin temperature, as well as the upgraded Special Sensor Microwave Imager (SSM/I) V6 surface wind and microwave brightness temperature produced by Remote Sensing Systems (RSS). A new second dataset (GSSTF3, July 1999-Dec 2009) is also proposed, yet with a finer temporal (12-hr) and spatial (0.25°x0.25° latitude–longitude) resolution.	The production of global (1ox1o) daily (and monthly) GSSTF2b dataset (July 1987-December 2008) has lately been completed using upgraded and improved input datasets such as the SSM/I V6 product (including brightness temperature [Tb], total precipitable water [W], and wind speed [U]) and the NCEP/DOE Reanalysis-2 (R2) product (including sea surface skin temperature [SKT], 2-meter air temperature [T2m], and sea level pressure [SLP]). The input datasets previously used for producing the GSSTF2 product were the SSM/I V4 product and the NCEP Reanalysis-1 (R1) product. Moreover, a recently upgraded Cross-Calibrated Multi-Platform (CCMP) ocean surface wind vector product (Atlas et al., 2009), which is based on the same variational analysis method (VAM) applied for producing an earlier surface wind vector dataset (Atlas et al., 1996) used for determining the GSSTF2 wind stress vectors, has been used for the GSSTF2b production. These newly produced GSSTF2b turbulent fluxes, along with their counterparts from GSSTF2, were validated using available ship measurements obtained from several field experiments. It was found that GSSTF2b generally agreed better with the observations than GSSTF2 did in all three flux components – latent heat flux (LHF), sensible heat flux (SHF), and wind stress (WST). An intercomparison for the major meteorological input parameters such as wind speed, total & bottom-layer precipitable water (W & WB), and surface air & saturation specific humidity (Qa & Qs) of GSSTF2b and GSSTF2 that was conducted for both global and regional scales also showed physically consistent results. Moreover, the signals of a few ENSO episodes, e.g., the El Niño in 1997 (a stronger episode) and 2002 (a relatively weaker episode), and the La Niña in 2002, were clearly demonstrated by the globally averaged LHF of GSSTF2b. The GSSTF2b product has currently been distributed to a handful of pilot users via the PI's (Shie) ftp site:	Accurate sea surface fluxes measurements are crucial to understanding the global water and energy cycles. The oceanic evaporation that is a major component of the global oceanic fresh water flux is particularly useful to predicting oceanic circulation and transport. Remote sensing is a valuable tool for global monitoring of these flux measurements. The GSSTF algorithm has been developed and applied to remote sensing research and applications. The Earth's climate is characterized by a myriad of processes that couple the ocean, land, and atmosphere systems. The global water cycle's provision of water to terrestrial storage, reservoirs and rivers rests upon the global excess of evaporation to precipitation over the oceans. Variations in the magnitude of this ocean evaporation excess will ultimately lead to variations in the amount of freshwater that is transported (by the atmosphere) and precipitated over continental regions. The air-sea fluxes of momentum, radiation and freshwater (precipitation – evaporation) play a very essential role in a wide variety of atmospheric and oceanic problems. Information on these fluxes is crucial in understanding the interaction between the atmosphere and oceans, global energy and water cycle variability, and in improving model simulations of climate variations. These fluxes are thus required for driving ocean models and validating coupled ocean–atmosphere global models. The GSSTF product is useful for diagnosing the global water and energy cycle and hence can contribute to the goals of NASA Energy and Water Cycle Study (NEWS) and World Climate Research Program (WCRP)/Global Energy and Water Experiment (GEWEX). Model climate simulations show an enhanced hydrologic cycle, which must be corroborated with observations. The daily/monthly temporal and global (one degree spatial resolution) GSSTF2b product can be used to examine climate (e.g., seasonal and annual) variability at the scales such as ENSO (as aforementioned) and the major monsoon systems (i.e., North and South America, Asia-Australia, and West Africa). The future GSSTF3 product with a finer temporal (12-hr) and spatial (a quarter degree) resolution will be useful for studying the hurricane-ocean interaction of higher-frequency and finer-scale scenarios. Fully tested, we believe that these products can further serve as a crucial input for data assimilation of oceanic GCMs for forecasting. We have (and will) also continually distributed the newly produced GSSTF2b (and the future GSSTF3) to the SEAFLUX project, established by the WCRP/GEWEX Radiation Panel.		
		Rossow	Evaluate and improve the accuracy of surface radiative flux determinations.	Have provided extensive error analyses for the two main global surface radiative flux products and am participating in the international evaluation of more products. Have demonstrated good accuracy for determining SW diffuse/direct flux ratio and the diurnal variations of the LW fluxes.	Have shown that the limiting accuracy of surface radiative fluxes now comes from aerosols in the shortwave, not clouds, and from surface temperatures in the longwave, not clouds.		Need a better aerosol dataset to reduce surface SW flux errors below about 10 W/m^2 and better near surface air and surface skin temperatures to reduce LW flux errors below about 15 W/m^2. The latter improvement seems possible with today's datasets and is being worked on. The former improvement does not yet seem possible.

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	A.5 - Develop advanced multi-variate, non-linear, more rigorous geophysical variable retrieval methods based on physically consistent algorithms. Such development requires building new state-of-the-art radiation transfer models across the observed electromagnetic spectrum, including rigorous treatment of spectral dependence, polarization and coherent radiation. Also required are development of more effective algorithms (e.g., neural networks) that can handle non-linear relationships among a large number of variables and efficiently apply to large volume datasets such as the combined observations of the A-train, NPP and future NPOESS.	Lipton	This project is advancing neural network methods to analyze surface evaporation based on satellite measurements in the microwave, near-infrared, and thermal infrared. The neural network treats the integrated effects of moisture state and vegetation. This project applies an existing network to new datasets from Aqua, and will also focus on improving the methods by developing an iterative approach to quality control of network training data.	ftp://meso-a.gsfc.nasa.gov/pub/shieftp/fluxdata. An official distribution of GSSTR2b via NASA/DISC is expected to complete by mid-summer 2010.	The neural network provides a near-term capability to produce land surface evaporation datasets from existing sensor data, pending development of methods that are less dependent of existing model products.	Zhang, Y-C., W.B. Rossow and P. W. Stackhouse, 2007: Comparison of different global information sources used in surface	
		Rossow	Develop effective multi-source analysis methods	Have developed an efficient method for the analysis of visible, infrared and microwave (active and passive) satellite data to retrieve land surface inundation fraction. Now combining this product with altimetry and mass measurements to partition land surface water.	Developing capability to determine partitioning of land surface water into its component parts.		
	A.6 - Based on existing empirical and theoretical (model) knowledge, quantify NEWS data requirements, i.e. the nature, space/time sampling, and accuracy/precision needed for the different tasks envisioned in the program.	Olson	Develop error models that would quantify the random error (both algorithm errors and space/time sampling errors) for precipitation and latent heating estimation from passive microwave remote sensing (TMI, AMSR-E, GMI).	Currently have error models for TRMM TMI precipitation and latent heating applicable to over-ocean algorithm applications within the TRMM domain (38 S - 38 N).	TMI error modeling can provide uncertainty estimates (due to algorithm errors and space/time sampling) for precipitation and latent heating. This modeling can serve as a template for Aqua AMSR-E and GPM GMI radiometer precipitation estimates.		Need to generalize error models to regions outside the TRMM domain (38 S - 38 N), and over land regions. Error models need to be generalized to other microwave sensors: AMSR-E, SSMIS, GPM GMI, etc.
		Rossow	Evaluated global energy and water cycle and compared results with existing climate models.	Have shown that event the older data products have enough skill to show problems with the models -- the largest difficulty concerns the amount and type of information routinely saved from model runs, which produces more uncertainty than in the datasets.			Need land surface turbulent energy and water flux products with similar accuracy to that available for the ocean surface and surface radiation. Need better information about the profiles of latent and radiative heating of the atmosphere.
	A.7 - Downscaling of GPCP 2.5o-monthly precipitation product to 0.25o & sub-daily scale using recently developed satellite-based high resolution precipitation products (HRPP).	Sorooshian, Hsu, Gao, and Imam	The downscaling approach gives bias adjustment of satellite-based rainfall estimation at sub-daily scale using GPCP monthly rainfall estimation. The study shows it is effective in downscaling of low spatial and temporal GPCP rainfall estimation to sub-daily rainfall from recently developed HRPP.	Multiple years (2000~current) bias adjusted PERSIANN estimation is generated for hydrologic analysis.	GPCP adjusted PERSIANN rainfall at 0.25o-daily scale is evaluated using NCEP gauge adjusted radar rainfall data. Case studies demonstrated the bias adjusted PERSIANN rainfall is effective.	radiative flux calculation: Radiative properties of the surface. J. Geophys. Res., 112, D01102, doi: 10.1029/2005JD007008, (1-20).	
	A8 - Improvement of fine time scale satellite precipitation estimation using geostationary and low orbital satellite information	Sorooshian, Hsu, Gao, Imam, Amitai	(1) Test and evaluate using multispectral image from GOES-R channels in rain area delineation. (2) Develop rainfall retrieval algorithm that makes use of cloud motion vectors from frequent GEO-IR cloud-top images, the textural and brightness temperature features of GEO satellite, cloud modeling and instantaneous passive microwave rainfall estimation.	A comparative validation against ground radar rainfall measurements of 1- and 3-h of proposed accumulated rainfall outputs is evaluated. The proposed rainfall estimates consistently outperform accumulated 3-h microwave (MW)-only rainfall estimates.	Case studies demonstrate that the algorithm provides the potential to synergize available satellite data to generate useful precipitation measurements at an hourly scale		
	A9. - Evaluation high resolution precipitation products (HRPP)	Arkin, Sorooshian, Hsu	The PEHRPP program of the International Precipitation Working Group (IPWG) brings together a series of activities for the evaluation of satellite-based precipitation estimates at high spatial and temporal resolution. This program helps to characterize the errors of current operational high resolution precipitation products at various spatial-temporal scale and climatic regimes.	A workshop is held at the World Meteorological Organization (WMO) headquarters in Geneva, Switzerland from December 3-5, 2007. Results of HRPP were presented at the workshop.		Romanou, A., B. Liepert, G. Schmidt, W. Rossow and Y-C. Zhang, 2007: 20th century reduction in surface solar irradiance in	

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		Fetzer	Create merged water substance data sets from the A-Train, including AMSR-E, AIRS and MLS water vapor and cloud top properties from MODIS, AIRS and CloudSat/CALIPSO.	Delivered combined A-Train data sets to CREW server at 1-degree and 3-hour resolution. Merged and reconciled water vapor from AIRS, AMSR-E and MLS has proved very feasible, as demonstrated in Fetzer et al. (2006; 2008) and Liang et al. ('Characterization of A-Train water vapor sensitivity through integration of averaging kernels and retrievals', in preparation). Our NEWS data sets include information about temperature, total precipitable water vapor, and height-resolved water vapor from the surface into the mesosphere. The AMSR-E and AIRS records extend from May 2002 to the present, and the MLS records covers July 2004 to presents. Cloud properties are also in the delivered data set, though reconciling them is more difficult (see 'Perceived Gaps').	An eight-year record of water vapor reservoirs is available for NEWS and other analyses. Creating a merged record has provided insights into all the individual instruments' data sets contained in it. We now understand the observational properties of these instruments far better than at the beginning of the project. This improves our interpretation of the resulting merged data sets.		Merging cloud properties from different sensors remains a challenge. Reconciling cloud liquid water from MODIS and AMSR-E is described in Torre Juárez (2009). Retrieved clouds from AIRS and MODIS are radiatively consistent (Kahn et al., 2007). However, there are many caveats in combining retrieved cloud top properties from AIRS and MODIS (Nasiri et al., 'Comparisons of collection 5 MODIS and version 5 AIRS cloud top pressure, cloud fraction, and effective brightness temperature', in preparation). Height-resolved water vapor flux using AIRS water vapor and MERRA winds is promising, showing consistency with TRMM rainfall and estimated ocean evaporation (Wong et al., Atmospheric water vapor and heat budgets associated with the intra-seasonal oscillation of Indian monsoon rainfall, in preparation).
Analysis	B.1 - Using existing datasets, assemble a complete description of global energy and water cycle to within 15%, based on budget closure considerations, including variability and changes. In cooperation with other agencies and international partners, review existing analysis procedures and implement consistent reprocessed analyses of essential long-term global datasets. Also needed are consistent time series of atmospheric state and circulation data, derived from operational analyses of basic meteorological observations or the reanalysis of archives. In cooperation with NWP centers, seek improvements in the accuracy of divergent wind field analyses.					simulations and observations. Geophys. Res. Lett., 34, L05713, doi: 10.1029/2006GL028356, (1-5).	
		Adler, Huffman, Gu, Curtis	Determine how the characteristics of global precipitation are changing in terms of means,m variations and extremes and integrate this information into energy/water cycle studies	Determination of climatological rain and bias error using multiple products for water cycle closure. Estimate of bias error for global precipitation; Rainfall comparison with MERRA initiated. means, inter-annual variations, daily distributions, extremes, temperature/.rain relationships	Early results indicate recent ocean means high in tropics, low in mid-latitudes, generally better that other reanalysis. ENSO pattern and magnitudes good but trends problematic.		
		Hilburn, Wentz	Use inter-calibrated and validated passive microwave satellite observations of wind speed and water vapor to estimate water vapor transport	The "Passive Microwave Water Cycle" Dataset (http://www.remss.com/)	The dataset provides evaporation, precipitation, water vapor, water vapor transport and divergence over the ocean from consistently processed satellite data. Our work brought water cycle consistency constraints into the discussion of evaluating multi-decadal trends in satellite data.	Zhang, Y-C., W.B. Rossow, C.N. Long and E.G. Dutton, 2010: Exploiting diurnal variations to evaluate the ISCCP-FD flux	Only two techniques (from Kyle Hilburn and Tim Liu) have been developed in NEWS for determining water vapor transport from satellite data. These techniques have characteristic differences over both the open ocean and near coastlines. Accurate estimates of water vapor transport from satellite data over the ocean are a minor but important gap, especially for regional water balance studies. Also, water vapor transport estimates will likely receive more attention with the start of the GPM mission as we resolve discrepancies between the annual mean and seasonal cycles of precipitation over the northern and southern hemisphere extratropics.

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
		W. Timothy Liu	Study water and energy balances over ocean and the influence on terrestrial water cycle	(1) We have successfully derived water transport integrated over the depth of the atmosphere from spacebased observations, the divergence of which is the fresh water flux between the ocean and the atmosphere (evaporation-precipitation). We validated our classical method of estimating surface evaporation through dedicated field experiment. See publication 1, 6, and 8.; (2) The mean value of ocean surface water flux is found to agree with those from MERRA model provided by NEWS. The historic value given in the textbook of Budyko published 36 years ago is found to be 20% too high. (see our presentation in 2009 Columbia meeting); (3) The annual variation of the flux with the climatological river discharge from continent subtracted agrees with ocean mass loss measured by GRACE both in amplitude and in phase. It also implies there is 20% uncertainty in the time variable river discharge; (4) Through Green's theorem, the continental water balance over South America was examined. The mean flux is 4% higher than Budyko's value. The atmospheric water influx minus river discharge agrees with the mass change in phase and amplitude of the annual cycle, with 13% uncertainties. (Publication 3); (5) The moisture transport we derived has been used in the study of MJO with Duane Waliser (Publication 9), in South Great Plain rainfall extremes with Xiquan Dong. We are applying the data to resolve the Sahel Precipitation Jump Paradox (Publication 10), and the oceanic source of East Asian rainfall at various time-scales. We have examined the anchoring effect of local mountains on monsoon rain (Publication 4); (6) Study how change of river discharges from Amazon and Yangtze Rivers affect the ocean (Publications 2 & 7); and (7) We have revealed the penetrating effect of mid-latitude ocean fronts on the water and radiative balances near the Tropopause, way above the atmospheric boundary layer (Publication 5).	By successfully developed methodologies to estimate two major components of the water cycle; atmospheric moisture transport and surface water exchange over global oceans from spacebased observations (the latter through two separate approaches), we, for the first time, provide adequate temporal and spatial coverage for measurements of these two major parameters. The agreement with water conservation principles (closure), with GRACE data, in the long term mean and seasonal cycle lends credibility to the spacebased measurements and put quantitative uncertainty of continental and polar discharge of water to the ocean to within 20%. Ocean closure could be translated to continental closure through the Green's theorem. South America, being almost entirely enclosed by open ocean and has the largest water change signal, gives the best result with only a few percents of uncertainty in the long term mean and slightly above 10% uncertainty in the monthly variation. The unique utility of moisture transport integrated over the depth of the atmosphere is clearly demonstrated in studying the Sahel precipitation jump paradox and the Southern Great Plain extremes, where the surface moisture transport has significant seasonal difference from the transport aloft. Although our major goal in NEWS study is to examine ocean's role in continental water balance, we also have worked with other investigators to reveal the effect of the change of two major rivers discharges on ocean current, salinity, and biological productivities. The spacebased surface water and energy fluxes we produce also contribute to the computation of the ocean meridional heat and water flux, which is the major factors that governs Earth's moderate climate and is a major national and international research endeavor. The coupling of the small and slow processes of the ocean to the transient and large-scale processes of the atmosphere, particularly in the extratropical latitudes, has been controversial. The atmospheric lapse rate is believed to be too weak to generate deep convection to transfer the effect of oceanic processes high enough in the atmosphere to be effective on the coupling. Past studies did not show the effect of local sea surface temperature changes beyond the boundary layer particularly in long time scales. Through satellite temperature and rain profiles, and cloud top radiative parameters, we revealed that the signatures of sea surface temperature and surface stress in mid-latitude ocean fronts penetrate way above the atmospheric boundary layer. The results of our investigations contributes to and benefitted from other NASA Earth Science programs: Precipitation Measuring Mission (TRMM and GPM), Ocean Vector Wind Science Team (QuikSCAT), Ocean Surface Topography Science Team (JASON), Ocean Surface Salinity Science Team (Aquarius), Sea Surface Temperature Science Team (AMSR-E and MODIS), Atlantic Meridional Overturning Current (AMOC) Science Team, and is at cross-cutting front of the international CLIVAR and GEWEX Programs. There are potential and plan to link with Carbon Cycle studies and the related space missions.		
		Rodell, Beaudoing, and the NEWS W&E Cycle Climatology team	Develop continental and ocean basin scale, seasonal and annual climatologies for the water and energy budgets, using best available observational products and observation-integrating models. Makes use of datasets developed by NEWS PIs as well as other data sources (e.g., Dai and Trenberth's runoff data).			calculations and Radiative-Flux-Analysis-Processed Surface Observations from BSRN, ARM and SURFRAD. J. Geophys. Res.,	Ice sheet monitoring and modeling; Direct human impacts on the water cycle via water management, irrigation, groundwater extraction, etc.; A climate modeling expert to liaison with that community, provide expertise on interpreting and downscalling their predictions, and provide guidance on how to make our results most useful to climatologists.

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
		Smith and Mehta	The Mediterranean Sea is a noted atmospheric moisture source basin in that it almost continuously exhibits positive evaporation minus precipitation (E - P) properties throughout the four seasons and from one year to the next. It is well-documented, however, that during various phases of North Atlantic Oscillation (NAO) the atmospheric moisture source properties of the basin vary significantly due to changes in P. In this context, the main objective of this project is to document, analyze, and understand moisture source property over Mediterranean Basin (MB) on day-to-day, monthly, seasonal, and interannual time scales using a combination of satellite-derived products and atmospheric reanalysis products.	1) Using existing NEWS data sets for E (Goddard Sea Surface Turbulent Flux – GSSTF2b) and P (Global Precipitation Climatology Project – GPCP), E-P has been calculated over the MB for years 1988-2007. While mean 20-year mean E-P is positive over the MB, maximum E-P is noted over the eastern MB. Significant interannual variability of the E, P, and E-P is noted over both eastern and western Mediterranean domains, where the P and E-P behaviors are qualitatively different over the western Mediterranean domain than from that over the eastern Mediterranean. Over the Eastern Mediterranean, the seasonal cycles of the E, P, and E-P are quite regular with autumn-winter maxima and summer minima. Over the western Mediterranean domain, on the other hand, the P shows substantial variability with intermittent bimodal pattern which results in irregular seasonal behavior of E-P during the analysis period. In summary, the net moisture available from the MB is spatially and temporally variable to the extent that warrants in-depth analysis of dynamical/physical processes over the MB. For this purpose, Modern Era Retrospective-analysis for Research and Applications (MERRA) atmospheric reanalysis data are being currently analyzed. 2) An algorithm to detect and document heavy to extreme rainfall events over the MB is developed based on Tropical Rainfall Measuring Mission merged product 3B42 and is being currently tested.	Because the MB is a key source of moisture for the atmosphere in general and rain systems over the MB act as major source of latent heating in this subtropical-midlatitude transitional region, it is important to diagnose and understand water cycle characteristics over this region and its contribution to the global water cycle. Moreover, It is projected by climate change models that the water cycle over the MB is altered under various climate change scenarios. It is also well-known that precipitation over the MB exhibits interannual to decadal time variability during various phases of NAO. Therefore, it is important to diagnose and understand variability of E, P, and E-P over the MB based on observational and reanalysis products so that the possible climate change influence can be understood/confirmed/projected better.		
		Rossow	Determine Lorenz energy cycle using global energy and water cycle products.	Completed analysis of the Generation of Available Potential Energy based on global energy and water data products and evaluated major sources of error.	Identified key attributes of the data products required to obtain accurate assessment of the Lorenz energy cycle.		
	B.2 - Improve the accuracy of precipitation and evaporation estimates over land and ice, and complete the datasets over continents, sea ice and ice sheets, through combined analysis of multiple satellite and surface measurements. The required additional inputs include surface skin temperature and soil wetness/melting indicators (combined infrared and microwave observations), near-surface humidity (atmospheric sounder suites), ocean surface wind velocity (active and passive microwave sensors), land-ice surface wind inferred from conventional weather observations and assimilation analysis. Merge the flux products with water storage information derived from	Rodell and Beaudoing	Integrate best available data within multiple, sophisticated land surface models in order to estimate ET and other fluxes. Intercompare ET estimates from multiple land surface model simulations and assess uncertainty in the estimates based on model spread and evaluation with ground based data.		Standard deviation of ET from multiple simulations is generally as large or larger than difference between modeled and observed ET, thus providing a convenient yet conservative way to estimate uncertainty.	(in press).	Lin: cold region processes are still the major gap for water and energy cycle.

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		Lipton	1) Land surface models have the potential to take proper account of the strengths and limitations of the remote sensing products. In comparing satellite analysis products with model products, we focus on the identification of discrepancies between satellite and model data, with the aim of determining areas for improvement in the models or in their use of data. 2) Evaporation estimates are generated from a neural network trained with satellite and model data. In this mode, the neural network essentially brings model-generated evaporation estimates into closer agreement with the satellite measurements in areas where the model fields are inconsistent with the satellite data.		1) Improvements to the assimilation of satellite data in models will reduce the uncertainties of the evaporation estimates produced by assimilation systems. 2) Neural network provides interim evaporation estimate improvements while data assimilation approaches are being improved.		Incomplete knowledge of the contributions of various soil and vegetation parameters to the time-dependent land surface moisture and evaporation-related signals seen in analyses of microwave and infrared data.
		Adler, Huffman, Gu, Curtis	Determine how the characteristics of global precipitation are changing in terms of means, variations and extremes and integrate this information into energy/water cycle studies	New GPCP V2.1 monthly and V1.1 daily products released: Main changes over land due to new gauge analysis. Trend pattern similar, tropical ocean positive trend reduced	There is higher confidence in the data sets due to the improved gauge analysis used over land and the longer period used to calibrate the OPI, used in the pre-SSMI era.		
	B.3 - Improve the accuracy of precipitation and evaporation estimates over land and ice, and complete the datasets over continents, sea ice and ice sheets, through combined analysis of multiple satellite and surface measurements. The required additional inputs include surface skin temperature and soil wetness/melting indicators (combined infrared and microwave observations), near-surface humidity (atmospheric sounder suites), ocean surface wind velocity (active and passive microwave sensors), land-ice surface wind inferred from conventional weather observations and assimilation analysis. Merge the flux products with water storage information derived from	Lipton		3 The annual variation of the flux with the climatological river discharge from continent subtracted agrees with ocean mass loss measured by GRACE both in amplitude and in phase. It also implies there is 20% uncertainty in the time variable river discharge.		Land Surface Properties -- Water	
		Dong, Zib, Kennedy, Xi	Investigation of the 2006 and 2007 flood extreme events at the US SGP using an integrative analysis of observations (ARM ground-based; WSR-88D radar, Oklahoma Mesonet, GPCP and TRMM satellite observations, and NCEP reasnalysis).	The atmospheric State, cloud fraction, surface radiation and precipitation derived from MERRA and NARR (and NCEP global reanalysis) have been compared with DOE ARM SGP and NSA observations during a 10-yr period.	The results derived from MERRA agree with ARM observations much better than those derived from NARR (and NCEP). This is the first time, to date, to quantitatively estimate the uncertainties of three reanalyses using ARM ground-based observations.		
		Rossow	To support estimates of land surface evaporation, compare and develop improved retrievals of land surface air temperatures and humidities as well as land surface skin temperatures.	Completed comparisons of available products; now working on improved retrieval and analysis approach.			
	B.4 - Develop new climate data products, based on combined analyses of operational and experimental satellite measurements, and in situ reference measurements from surface networks such as the Baseline Surface Radiation Network, ARM-CART or similar facilities. In particular, investigate and exploit methods for inferring latent and radiative heating profiles (radiation and heat flux divergence) from vertical profile measurements by TRMM, CloudSAT, and CALIPSO, supplemented by A-train, POESS/NPOESS and METOP data. These results may be extended to longer periods using statistical models of cloud vertical structure related to different cloud systems observed by operational polar-orbiting and geostationary environmental satellites.	L'Ecuyer, Olson	Develop and evaluate new vertically-resolved atmospheric radiative heating rate products from TRMM and Aqua observations.		The vertically-resolved diabatic heating (Q1) product that has emerged from the integration of our radiative heating estimates and the Olson latent heating estimates represent the first satellite-driven estimates of their kind. Since Q1(z) plays and integral role in atmospheric processes on the scales ranging from those of individual storms to the large-scale circulation, this product will fill important gaps in our understanding of the role of clouds and precipitation in the climate system. Furthermore, it is anticipated that these products will provide valuable constraints on the performance of predictive models as NEWS transitions into phase II.	Prigent, C., F. Aires, W.B. Rossow and A. Robock, 2005: Sensitivity of satellite microwave and infrared observations to soil	The product is currently limited to the region from 38 S to 38 N limiting our ability to study processes on the truly global scale and precluding analysis of global energy balance. This should be resolved by applying an analogous technique to Aqua observations. Significantly more effort needs to be put into using these datasets to evaluate numerical models and there is a need to go beyond evaluation to explore new ways of using these observations to directly constrain model physics and improve predicability.

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
		McFarlane	Develop optimal estimation retrieval which provide error bars on cloud properties. Process multiple years at ARM tropical and mid-latitude sites.	New combined radar/lidar retrieval developed. Cloud properties and radiative heating rates calculated for multiple years at ARM TWP sites (available from PI by request; will be put in NEWS archive after final evaluation). Currently performing inter-comparisons with other retrievals (Delanoe, Protat, Deng) to estimate uncertainties in retrieved properties and effect of uncertainties on calculated heating rates/fluxes. Several conference presentations on this work; paper currently in preparation. Also examining methods of clustering/classification to link vertical structure classes from ARM data to geostationary satellite data so that 3D structure of clouds/heating rates can be predicted. Paper linking vertical structures to satellite data in preparation.	Dataset can be used to examine diurnal variation of cloud properties/heating rates to understand what A-Train sensors are not sampling; can also be used for detailed comparisons to A-Train and TRMM datasets to determine uncertainties. Combination of ARM vertical structure with geostationary satellite data will provide 3D view of clouds/heating rates.		Initial comparisons with TRMM retrievals performed for a short period; need to revisit TRMM comparisons and perform comparisons with CloudSat now that multi-year datasets exist for all products. Analysis of diurnal cycle in cloud properties/heating rates to understand variability missed by 2/day sampling of A-Train.
		Rossow & Papa	Developed land surface inundation fraction product. Now working on determination of water volumes to estimate river discharge.	Have extended the product to cover a 16-yr period; there are noticeable trends in the extent of coastal wetlands that correspond to regions of significant population growth. Using this product to estimate methane emissions improves agreement with observed methane concerntrations.			
	B.5 - Characterize weather-scale and longer-term variations in the global energy and water cycle using available global datasets, investigate possible trends, teleconnections and potential causal relationships and quantify the predictability of energy and water cycle variations on spatial scales, from weather systems to global, and time-averaging periods. This work will yield critical new insights into the performance, strengths, and limitations of individual data sets.	Deng	Dynamical control of the Pacific storm track on the occurrence of winter hydrological extremes over the western United States	4 Through Green's theorem, the continental water balance over South America was examined. The mean flux is 4% higher than Budyko's value. The atmospheric water influx minus river discharge agrees with the mass change in phase and amplitude of the annual cycle, with 13% uncertainties. (Publication 3)	The Pacific storm track and the weather disturbances associated with it determine much of the subseasonal to interdecadal variability in the winter hydrological cycle of the western North America, largely due to their close coupling with tropical (ENSO, MJO etc) and extratropical (PDO, AO, NPO etc) modes of low-frequency variability. Understanding the physical processes causing storm track variability across different timescales would therefore help identify origins of current models' deficiencies in terms of representing and predicting variability in the hydrological extremes over the western North America, and ultimate contribute to future model development and the establishment of a more accurate prediction system for hydrological applications. This project directly contributes to B.5 and has important linkages to C.5, D.2 and D.3	moisture at a global scale. I: Relationship of satellite observations to in situ soil moisture measurements. J. Geophys. Res., 110, doi	Expertise in regional/global modeling/data assimilation is needed in order to convert new knowledge of dynamical mechanisms into prediction capability.
		Dong and extreme group		The onsets of the SGP droughts and floods were triggered by persistent large-scale flow anomalies. For example, the 2005-2006 winter precipitation deficit over the SGP is clearly linked to significantly suppressed cyclonic activity over the southwestern US, which shows robust relationship with the western Pacific teleconnection pattern. The interannual timescales, the SGP hydrological extremes are clearly linked to the anomalous moisture transport from the Gulf Mexico.	The analysis method can be used to study the drought and flood events over other climatic regions in our future study.		
		Rodell, Famiglietti, and Chambers	Investigation of trends in terrestrial water storage based on GRACE data		Some apparent TWS trends are related to climate change (e.g., Greenland and Antarctic ice sheet melt), others are related to groundwater mining (e.g., northern India and central California), and others simply reflect natural variability (e.g., the drought in the southeast U.S. which ended in 2009).	10.1029/2004JD005087 (1-15).	
		Olson/Gu	Investigate energetics of intraseasonal phenomena (e.g. MJO) in the Tropics, using information from TRMM Q1 (diabatic heating) product and Aqua AIRS temperature data.	Performed first cut analysis of eddy available potential energy generation in composite MJO using 6 years of TRMM Q1 and AIRS temperature data. Also analyzed global equatorial cycle of Q1 in the MJO.	Provides a reference for evaluating model reanalyses of MJO energetics. Analysis method is potentially useful for investigating other intraseasonal modes of atmospheric variability. The MJO, in particular, impacts rainfall variability in the Tropics and also midlatitudes, but is difficult to simulate the MJO correctly with state-of-the-art GCM's.		

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
		Schubert	Carry out C20C simulations as well as idealized SST experiments to assess impact of the different ocean basins, soil moisture feedbacks, and vegetation on drought. Off-line LSM simulations to assess drought conditions.	Improved understanding of potential predictability of droughts in U.S. Great Plains, quantified impacts of the different ocean basins on U.S. drought. Assessed robustness of soil moisture anomalies in land surface models. Completed the climate model runs, and undertook comparison of the model results. Made initial assessment of the model dependence of response including 2006 and 2007 for Integration project #2.		Aires, F., C. Prigent and W.B. Rossow, 2005: Sensitivity of satellite microwave and infrared observations to soil moisture at a global	
		Adler, Huffman, Gu, Curtis	Investigate ENSO impacts on precipitation distributions, including extremes using GPCP and TRMM data.	Over the tropics, which appear to control the global signal, the spatial extent of extreme monthly rain rates, both dry and wet, increases over the ocean for El Niño and La Niña events. For land, the relationship is shown to be somewhat different, with an increase in frequency of dry extremes offset by a decrease in wet extremes during El Niño. During La Niña an increase in frequency of wet extremes and no change in dry extremes is observed over land.	Indicates complexity of relations between ENSO and precipitation extremes.		
		Schmidt/Worden/Nc	Investigate tropical variability using model and satellite based constraints on water isotopes	Improved understanding of the AURA/TES water vapour isotope retrievals and their dependence on cloud cover and surface temperature. First comparisons between state-of-the-art isotope-enabled GCMs and the TES isotope fields.	The isotope products are orthogonal to other measures of water fluxes and so will be useful in constraining water vapour budgets when the satellite products can be fully integrated into a modelling framework. Improvements in the characterisation of the retrievals are essential to integrating the model and observational data.	scale. II: Global statistical relationships. J. Geophys. Res., 110, doi 10.1029/2004JD005094, (1-14).	
	B.6 - Develop advanced non-linear, multi-variate diagnosis/analysis techniques to investigate how multiple feedback processes affect the climate response to various forcings.	Lin	Quantify uncertainties in the integrated global energy data; cross-validate climate energy components using both energy and water cycle satellite observations, and analyze energy and water processes.	5 The moisture transport we derived has been used in the study of MJO with Duane Waliser (Publication 9), in South Great Plain rainfall extremes with Xiquan Dong. We are applying the data to resolve the Sahel Precipitation Jump Paradox (Publication 10), and the oceanic source of East Asian rainfall at various time-scales.	With accurate long-term measurements of TOA radiation, the analysis method suggested may provide a great potential in the estimations of the climate sensitivity.		The absolute accuracy of TOA net radiation (or ocean heat storage) measurements needs to be significantly improved.
		Dong and extreme group		Two positive feedback processes have been identified in this study. They reinforced an existing drought or flood event, i.e., making dry areas dryer and wet areas wetter. During the extreme dry period, more incoming solar radiation was absorbed by the ground, which was resulted from less clouds, LWP, precipitation, and thinner Cu cloud thickness. With less precipitation, more absorbed incoming solar radiation was used to increase the surface temperature, which makes the atmosphere drier and provides a physical basis for interpreting the observed the tendency of a drought to “feed upon itself”. During the extreme wet period, more precipitation is strongly associated with increased PWV, CF, Cu cloud thickness, and cloud LWP. The increased PWV adds more moisture for the subsequent precipitation event and enhances the severity of the widespread flood.		Papa, F., C. Prigent, F. Durand and W.B. Rossow, 2006: Wetland dynamics using a suite of satellite observations: A case study of	These two positive feedbacks processess are derived from observations. MOdeling effort is certainly needed.
		Rossow	Continue to expand neural network-based analysis approach. Have developed rigorous theoretical approach to this type of analysis that anchors it on the physics of radiative transfer models.				

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
Modeling and Prediction	C.1 - Pursue improvements in current parameterizations of cloud and precipitation processes, land surface hydrology, and vertical transport in the atmospheric boundary layer and oceanic mixed layer. This work could be carried out using a range of models, from process-scale to regional and global, and from NWP models to fully coupled climate models, as well as additional observations. The outcome of this effort would be tested by comparing model outputs to observation-based global energy and water cycle datasets, notably surface radiation, heat, and water fluxes, and atmospheric transport data. The same non-linear, multi-variate analysis methods, developed for application to observations, can be applied to model representations to assess how well dynamical relationships and extreme events are captured.	Peters-Lidard, Tao, Chern, S. Kumar, A. Kumar, Mohr, Shen, Shi, Zeng	Develop and evaluate a new Goddard multiscale modeling system with unified physics to study the water and energy cycles from local to regional and global scale.	1. Ice nuclei (IN), a class of aerosols, are introduced into the Goddard cloud-resolving model (CRM) to address their indirect effects on water and energy cycles. 2. CRM simulations, which are driven by the large-scale forcing over various experimental sites (e.g., ARM-SGP, TWP-ICE, and TOGA-COARE), are carried out to study the effects of increased IN on clouds and radiation. 3. The interface between the NASA MERRA and Goddard CRM has been finished, which provides a framework to further study the effect of changed land surface on water and energy cycles. 4. The interface between GCE and the Land Information System (LIS) was completed and tested against SGP-ARM observations.	The CRM simulations over different geographic regions revealed that IN can significantly change water and energy cycles. The simulations also revealed that the indirect effect of increased IN on radiative forcing can explain the geographic and seasonal pattern of the observed warming. This study strongly suggests that land surface can significantly impact water and energy cycles via IN. Simulations with the interactive LSMs through LIS compared much better to the observed magnitude and timing of precipitation vs. control simulations with prescribed surface fluxes.		The interface between LIS and the Goddard CRM needs to be improved to incorporate the coupling between land surface and clouds via IN. The finished interface between the Goddard CRM and NASA MERRA can provide a framework to further study the regional effect of land surface on water and energy cycles, especially via IN.
		Peters-Lidard and Santanello	The study of Land-Atmosphere Coupling and its impact on Water and Energy Cycles	Comprehensive diagnostics of Local L-A Coupling (LoCo) for models and observations developed with the coupled LIS-WRF model containing multiple PBL and LSMs.	Combining regional-scale simulations with process level diagnostics, the full nature and sensitivity of the L-A coupling can be quantified in terms of the governing process that can be measured. In turn, deficiencies in the PBL or LSM components of the coupled system can be pinpointed and improved in a coupled mode (as opposed to offline as was typcially done in the past). As part of the GEWEX-GLASS effort, these experiments and LIS-WRF testbed have provided the backbone for LoCo studies and ongoing collaborations in the int'l community.	application and evaluation for the Indian subcontinent. Geophys. Res. Lett., 33, doi: 10.1029 /2006GL025767, (1-4).	The effect of L-A coupling on efforts to assimilate NASA observations (including land) into water and energy cycle prediction systems is a critical next step.
		Peters-Lidard and Santanello	Diagnose the L-A coupling for Dry/Wet Extremes in the SGP	L-A coupling diagnostics applied to LIS-WRF experiments for 2006-7 period in the SGP and including MERRA data and integrated datasets developed by Dong et al. for NEWS. The process-chain and feedbacks inherent in LoCo have been clearly defined and comprise the full set of sensitivities that translate soil mositure variability into clouds and precip variability.	Extended simulations during dry and wet summer periods allow for compositing of results and diagnostics describe the bulk behavior of LSM, PBL, and their coupling during extreme conditions.		The impact of land data assimilation (e.g. soil moisture) on the coupled system during extreme events.
		Leung	Combine data analysis and modeling to determine the potential impacts of air pollution on water resources.	Developed a more computationally efficient spectral bin microphysics (SBM) scheme for simulating aerosol effects on clouds and precipitation.		Prigent, C., F. Aires and W.B. Rossow, 2006: Land surface microwave emissivities over the globe for a decade. Bull. Amer. Meteor.	
		Leung		Compared a spectral bin microphysics and a bulk microphysics scheme for simulating aerosol effects on clouds and precipitation and quantified/evaluated differences in model simulations.			
		Leung		Implemented the spectral bin and bulk microphysics schemes in a community atmospheric model (WRF).		Soc., 87, 1573-1584.	
		Betts	Evaluating the coupling of land-surface, boundary-layer, cloud and radiative processes in MERRA.				
		Betts	Evaluate the coupling of land-surface, boundary-layer, cloud & radiative processes in MERRA, by analyzing output from MERRA on daily and seasonal timescales & compare with data, RA40 and ERA-Interim	Focus was MERRA 2004 & ERA-interim 1989-2000		Papa, F., C. Prigent, W.B. Rossow, B. Legresy and F. Remy, 2006: Inundated wetland dynamics over Boreal regions from remote	

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
	C.2 - Develop stand-alone, ultra-high resolution cloud process models that can resolve energy-containing scales of cloud systems dynamics, and explicitly represent cloud condensation processes (grid-scale microphysics), cloud water and ice, cloud particle size and properties. Likewise, develop stand-alone ultra-high resolution models of land surface hydrology and coupling with the atmosphere, for model computation of energy and water fluxes, soil moisture, and runoff. Assess the value of combining both types of models into a single integrated representation of coupled cloud, radiation, and surface hydrology. The outcome of this effort would be evaluated against detailed measurements from experimental sites (e.g. ARM-CART, TOGA-COARE, CEOP Reference stations) and ad hoc field experiments.	Peters-Lidard, Tao, Chern, S. Kumar, A. Kumar, Mohr, Shen, Shi, Zeng	Examine impacts of various spatial/temporal scales of land surface physics on boundary layer evolution, and quantify the interactive soil-vegetation-precipitation processes and feedbacks and their influence on preferential convective initiation and precipitation processes.	Goddard multiscale modeling system, that includes a cloud-resolving model (Goddard GCE), a mesoscale model (WRF), a multiscale modeling framework (MMF) and a global high-resolution mesoscale model, has been successfully coupled with Goddard unified physics (microphysics, radiation, and LIS) to study the water and energy cycles from process-scale to global scale. The system has been successfully applied to study longterm climate (such as AMIP type climate simulations and climate change simulations), inter-annual variability (such as El Nino and La Nina simulations), inter-seasonal and seasonal variability (such as Madden-Julian Oscillation, Monsoons, Africa Easterly waves, drought and flood, tropical cyclones), short-term weather events, diurnal cycle studies and individual cloud systems. Model results have been validated against global energy and water cycle datasets, NASA satellite measurements (TRMM, GPM, MODIS, CERES, MLS, and CloudSat etc.) and special field campaigns datasets. The system has been successfully coupled with the Goddard Satellite Data Simulation Unit (SDSU), the radiances and radar/lidar reflectivities/attenuation can be directly extracted from the high-resolution model output and compare directly with satellite measurements. This approach could be a new pathway for using NASA satellite data for improving our knowledge of the physical processes and leads to new improvements in model physics. In addition, the four-dimensional high resolution model outputs have been provided via cloud library data portal for the whole community.	The representation of cloud systems and their interactions with radiation and land surface processes is always the major uncertainty in climate modeling and prediction. The Goddard multiscale modeling system provides a unique tool to represent the cloud systems and their interactions in their natural temporal and spatial scales. The system not only allows explicit representation of model physics but also allows different scale systems to coexist and interact with each other. The high resolution global mesoscale model has demonstrated its capability to simulate MJO, tropical cyclones, Africa easterly waves. The MMF has been shown to substantially reduce common systematic errors in climate models and improve the simulations of MJO, ITCZ, and diurnal cycle. The WRF model has been successfully apply to study extreme weather events. Overall, the multiscale modeling system has increased our understanding of physical processes that constitute the main components of the hydrological cycle and lead to improvements of model physics. Any improvements of model physical process (microphysics, radiation, turbulence and surface processes) have been tested first in the process scale and then propagate to regional and global scale.		Shortcomings in the representation of model physics (cloud microphysics, radiation, turbulence, and surface processes) are still the major uncertainties in modeling and prediction. Combined different satellite measurements, in-situ observations will prove better constrains for model parameters and lead to better physical schemes. Any new scheme need to be well tested in a multiscale modeling system to assess their performance from process scale to regional and global scale.
		Dong, Wu		The extreme precipitation events over the SGP region have been simulated by WRF (ARW) model and compared with the merged ARM cloud radar and NEXRAD observations, and ARM and OK mesonet precipitations. observations.	The cloud and precipitation parameterizations of WRF can be improved through this study. 2) In the mean time, the model simulations can help us to retrieve the cloud and precipitation microphysical properties because the observation represents an integrated factor of clouds and precipitation.	sensing: The use of Topex-Poseidon dual-frequency radar altimeter observations. Int. J. Remote Sensing, 27, 4847-4866,	
		Denning	Constrain phenology model parameters with QA screened MODIS FPAR+LAI by use of EnKF data assimilation.	Built EnKF-based Data Assimilation & phenology model			
		Denning		Successfully predicted LAI, FPAR at local-scale		doi:080/01431160600675887.	
		Denning		Integrated prognostic model into SiB3 and CLM3.5			
		Denning		Global phenology parameters and Global + North American Phenology Reanalysis		Prigent, C., F. Papa, F. Aires, W.B. Rossow and E. Matthews, 2007: Global inundation dynamics inferred from multiple satellite	
	C.3 - Test the above process representations as embedded modules in general circulation models (GCM) capable of producing deterministic predictions of weather events and/or realistic simulations of weather-scale variability. Assess the performance of process-resolving models embedded in GCM computations (one-way coupling) against the same data as above.	L'Ecuyer, Olson, Waliser			Shortcomings in the ability of various reanalysis products to represent the magnitude of diabatic heating variations associated with the MJO point to potential weaknesses in embedded cloud and precipitation process models. Most notably, the modeled partitioning of stratiform and convective rainfall does not capture the observed MJO signature.		Most GCM output datasets do not contain sufficient information to evaluate vertical profiles of diabatic heating yet this analysis can provide valuable moist physics in these models.
	C.4 - Develop and test next generation energy and water data assimilation systems that can ingest relevant atmospheric and hydrologic measurements and determine initial values for regional to global model predictions of variations or change in the global precipitation and hydrologic regimes.	Rodell, Beaudoing, and Zaitchik	Intercomparison among operational model analysis, remotely sensed evaporation and land surface model estimates		Snow cover assimilated with minimal impact on the water balance. Irrigation is shown to have significant affect on the water budget, accounting for a 4% increase in ET averaged over the continental U.S. Large variability in accuracy of runoff estimates among land surface models and over different river basins.	observations, 1993-2000. J. Geophys. Res., 112, D12107, doi: 1029/2006JD007847, (1-13).	

	Summary of Key Phase-1 NEWS Milestones	Investigator	Proposed	Accomplished	Signifcance	Publication & links	Perceived Gaps
		Lipton	Assimilation system products are compared with and satellite data related to surface moisture fluxes. Identify systematic discrepancies that are conceptually or statistically related to hydrologic processes (that is, where satellite measurements are sensitive to the processes and appear to indicate the process is not being well modeled).		Findings identify issues for possible further investigation and potential improvement of assimilation systems.		Land surface assimilation systems make significant use of remotely sensed data, but need targeted enhancements to make full use of the information in microwave and infrared measurements
	C.5 - Conduct quantitative evaluations of differences among global model predictions of the energy and water cycle over seasonal to decadal time scales, and investigate the causes for such differences.	Bosilovich, Robertson and Chen	Evaluations of NASA's Global Water and Energy cycle data		Provides the first look at limits on the new MERRA and Interim water and energy cycle data, and shows where each still need further model development to be more consistent with observations.	Papa, F., C. Prigent and W.B. Rossow, 2007: Ob' river inundations from satellite observations: A relationship with winter snow	More details are needed at finer scales (e.g. continental), for example that ability of reanalyses to reproduce variability and extreme events, rather than just the climate
		Bosilovich, Mocko	Uncertainty of water and energy budget data in Analyses		Shows that the result of global atmsopheric data assimilation (analyses) model component uncertainties can be characterized and quantified in a super-ensemble framework (not unlike what is done with IPCC forecasts). The difference is that the members of the ensemble all use much the same observational data for assimilation, and so all are constrained to the actual weather. So that, the resulting data, and even the physics fileds (those not in the control vector) also have stronger comparison to available observations. The implication for global water and energy budget climatology is that any single reanalysis may be insufficient, but much may be gained by evaluating an ensemble of reanalyses.		Limited to the 2 years of CEOP Phase 1 (2003-2004). With the recent release of so many new reanalyses in the recent years, combined with previous existing reanalyses could show that an ensemble of reanalyses may provide a more consistent representation of present day climate than any single reanalysis.
		Wood	Intercomparison among operational model analysis, remotely sensed evaporation and land surface model estimates	A detailed analysis for the GEWEX CEOP period has been carried out that includes three ET remote sensing retrieved data sets, seven operational models archived as part of the CEOP activities and one-off-line land surface models. Comparisons have been done at local, basin and global scales.	Significant differences have been observed in some of the operational models which can be attributed to deficiencies in the model parameterizations.	parameters and river runoff. J. Geo	The analysis is limited by the CEOP operational archive. The use of the TIGGE archive would allow for a longer analysis period.
		Soden	The ability of climate models to reproduce observed variations and linkages between the atmospheric water & energy cycles at large time and space scales. Approach used: Compared satellite-observed and model-simulated changes in water vapor, cloud, precipitation, etc.	Yr. 4 AND 5 of project focused on model-to-satellite methodology for directly comparing model-simulated and satellite observer microwave Tb. See publications			

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		Lettenmaier	Intercomparison among satellite data, reanalysis products and land surface model simulations with in situ measurements. Examine the consistency of dominant temporal and spatial variability of these surface radiative fluxes at the regional scale and their significant trends in observed data.	We analyzed surface downward shortwave and longwave radiation and albedo from the (1) ERA-40, (2) ERA-Interim, (3) ISCCP, and (4)VIC model for the period from 1984 to 2006. In addition, diurnal and mean seasonal cycles were compared with in situ measurements. At the regional scale, the consistency of dominant spatial, temporal and latitudinal variability of these surface radiative fluxes across different datasets was examined. Also, for a small number of GEBA stations with records spanning the period from the 1950s and 1960s to post-2000, we analyzed long-term trends in surface downward shortwave radiation.	Surface radiative fluxes are a key driver of the land surface hydrological cycle, but because in situ measurements are sparse, relatively little attention has been focused on their space-time variations. This work has done a comprehensive analysis on surface radiative fluxes over the pan-Arctic.	Papa, F., A. Guntner, F. Frappart, C. Prigent and W.B. Rossow, 2008: Variations of surface water extent and water storage in large	
	C.6 - Establish performance metrics for energy and water cycle predictions taking into account the limits of predictability of atmospheric and hydrologic variables over a range of space- and time-scales, from regional to global, and from weather time-scale to climate change.	Bosilovich, Robertson and Chen	Evaluating NASA's Water and Energy Cycle data		This work showed very clearly that the MERRA system development had achieved global precipitation values of higher quality than the existing reanalyses at that time. Specifically the tropical precipitation has much higher skill in the MERRA system. Also, both observations and models were shown to be general lower qualtiy in South American and Africa.		Only considered precipitation, but Taylor diagrams can show different variables on the same chart, so that for any one system, multiple variables could be showed characterizing the full range of the water and energy budget. However, the method relies on having acceptable baseline reference data, and hence, much of the other development going on within NEWS.
		Chen, Bosilovich	Evaluating NASA's Water and Energy Cycle data		Although it is hard to distinguish the quality of the reanalyses in the spatiotemporal domain, in the LW-SW JFD domain, it is shown that MERRA and EC-interim are closer to the retrievals than other reanalyses. This means that the JFD analysis method is an effective metric to measure the performance of model in the water and energy cycle. The atmospheric state related bias information revealed with LW-SW JFD analysis method will be very useful for model modification.	river basins: A comparison of different global data sources, Geophys. Res. Lett., 35, L11401, doi: 10.1029/2008GL033857 (1-5).	the JFD method should but has not been applied on the GCM simulation results (IPCC AR4, AR5). This method is very good for evaluating the GCM result, because it is based in the domain of the atmospheric state rather than the spatiotemporal domain.
		Peters-Lidard and Santanello	The study of Land-Atmosphere Coupling and its impact on Water and Energy Cycles	Comprehensive diagnostics of Local L-A Coupling (LoCo) for models and observations developed with the coupled LIS-WRF model containing multiple PBL and LSMs.	The full heat and moisture budgets in the PBL can be quantified and evaluated in terms of their sensitivity to PBL and LSM parameterizations at regional scales.		A single metric of L-A coupling remains elusive due to the complex behavior of the system at the process-scale. Also the implications of local/regional coupling versus global/climate scales remain undefined.
Applications	D.1 - Identify currently available data and analysis products that are useful for applications.	Dong and extreme group		DOE ARM ground-based observed clouds, radiation, and precipitation. GPCP, TRMM and OK mesonet precipitation and water vapor. MERRA and NARR reanalysis datasets.		Papa, F., C. Prigent and W.B. Rossow, 2008: Monitoring flood and discharge variations in the large Siberian rivers from a	
		Lipton	Analyze microwave, thermal infrared, and near-infrared satellite data analysis products in comparision with data from land surface models. A hindrance to the use of the new products for applications is the lack of sufficient comparison with other datasets and modeling and analysis to clarify the interpretation of the products.	Some of the innovative microwave/infrared satellite data analysis products (such as measures of microwave penetration depth and surface change detection) have been demonstrated to have information that is complementary to previous products, with respect to water in soil and vegetation.	The comparisons we are doing with model data are expected to advance our understanding of the new products and their applicability to agriculture and resource management, such as drought assessment.		
		Leung		Performed WRF simulations to assess the impacts of air pollution on precipitation in squall line, supercel, and orographic cases		multi-satellite technique. Surv. Geophys., doi: 10.1007/s10712-008-9036-0, (1-21).	
		Leung		Performed WRF-Cherm simulations to assess the impacts of soot on snow on water resources in mountain regions			
	D.2 - Link weather and climate predictions to the demonstration of some representative consequence; notably consequences of extreme events. Evaluate the extent to which the information provided by current models and data is sufficient for such applications.	Dong and extreme group		Through an integrative analysis of observed extremes, we attempt to answer the four scientific questions: 1) Are HY06 and HY representative of significant drought and flood? 2) To what extent are the severities of flood and drought affected by the feedbacks associated with cloud and radiation anomalies? 3) To what extent do the large-scale dynamics play a role in controlling the SGP extremes? 4) How are the SGP hydrological extremes linked with the moisture transport from the Gulf of Mexico and the cyclonic activity?	The study has showed a great team effort to investigate the precipitation events over the SGP region. This study also sets up a model for the extreme group or NEWS team to follow on other extreme events over other climatic regions.	Frappart, F., F. Papa, J.S. Famiglietti, C. Prigent, W.B. Rossow and F. Seyler, 2008: Interannual variations of river water storage	When we study the extreme events, it is better to combine the observations with model simulations.

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		Dong, Zib, Xi		In this study, we examine the record high summer sea-ice extent in 1996 and record low in 2007, and investigate the impact of atmospheric state, CF, and surface radiative fluxes on these two record sea-ice extents using both MERRA and NCEP II reanalyses. The record low sea-ice extent in 2007 is associated with increased surface temperature, CF, and LW-down flux, decreased SW-down flux, positive temperature anomalies. The record low sea-ice extent in 2007 is accompanied by strong, anomalous southerly flow across the Western Arctic and East Siberian Sea enhancing poleward heat transport into the area. In contrast, negative anomalies in temperature, CF, and LW-down flux are observed over the Area Of Focus during the summer of 1996 where the record high sea-ice extent appeared. Northerly wind anomalies are also present across East Siberian Sea during the summer of 1996, which may help transporting sea-ice southward towards the Siberian coastline.	Analyzing long-term variations of the various parameters influencing sea-ice extent may provide valuable information and shed light on predicting the yearly sea-ice minima in the future.		
	D3. - Identify observation and prediction system requirements for water management applications.					from a multiple satellite approach: A case study for the Rio Negro river basin. J. Geophys. Res., 113, D21104, doi:	
	D4. - Merge multiple satellite precipitation estimates for basin scale hydrologic applications.	Sorooshian, Hsu, Gao, Imam	merging several satellite-based precipitation analyses for basin scale hydrologic applications were explored. Case studies include both data rich and ungauged basins in US and Africa.	Several ways to integrate several precipitation data sources to drive runoff base on default parameters of SAC-SMA model were evaluated. Because each algorithm is unique in rain estimation from its unique sensors, retrieval process, and spatial and temporal coverage, one product may perform better in different regions and seasons. The best combination including the correction of bias and weighted combination were explored. Markov Chain Monte Carlo (MCMC) method is used for parameter estimation and uncertainty analysis of combined rainfall estimation	Satellite-based precipitation analysis can be biased which may cause over- or under-estimation of flood forecasting in the catchment scale. Effective integration of multiple satellite products can give better rainfall estimation and give improved hydrologic simulation of ungauged basins		
						10.1029/2007JD009438 (1-12).	
						Ringeval, B., N. de Noblet--Ducoudré, P. Ciais, P. Bousquet, C. Prigent, F. Papa, and W. B. Rossow, 2010: An attempt to quantify the impact of changes in wetland extent on methane emissions on the seasonal and interannual time scales, Global Biogeochem. Cycles, 24, GB2003, doi:10.1029/2008GB003354.	
						Papa, F., C. Prigent, F. Aires, C. Jimenez, W.B. Rossow, and E. Matthews (2010), Interannual variability of surface water extent at global scale, 1993-2004, J. Geophys. Res., doi:10.1029 /2009JD012674 (in press).	
						Papa, F., F. Durand, W.B. Rossow, A. Rahman, and S. Bala, 2010: Seasonal and interannual variations of the Ganges-Brahmaputra River discharge, 1993-2008 from satellite altimeters. J. Geophys. Res., (submitted).	

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						Durand, F., F. Papa, A. Rahman, and S. Bala, 2010: Impact of Ganges-Brahmaputra interannual discharge variations on Bay of Bengal salinity. J. Earth Syst. Sci., (submitted).	
						Adam, L., P. Döll, C. Prigent, and F. Papa, 2010: Global-scale analysis of satellite-derived time series of naturally inundated areas as a basis for floodplain modeling. Advances in geosciences, (submitted).	
						SeaFlux	
						Romanou, A., W.B. Rossow and S-H. Chou, 2006: Decorrelation scales of high resolution turbulent fluxes at the ocean surface and	
						a method to fill in gaps in satellite data products. J. Climate, 19, 3378-3393, doi: 10.1175 /JCLI3773.1.	
						Stramler, K., A.D. Del Genio and W.B. Rossow, 2010: Synoptically driven Arctic winter states. J. Climate, (submitted).	
						LandFlux	
						Jim'nez, C., C. Prigent, B. Mueller, S.I. Seneviratne, M.F. McCabe, E.F. Wood, W.B. Rossow, G. Balsamo, A.K. Betts, P.A.	
						Dirmeyer, J.B. Fisher, M. Jung, M. Kanamitsu, R.H. Reichle, M. Reichstein, M. Rodell, J. Sheffield, K. Tu and K. Wang, 2010:	
						Global inter-comparison of 12 land surface heat flux estimates. J. Geophys. Res., (submitted).	