Evaluation of NASA's Global Water Cycle Data: Interannual Variability, Inter-decadal Changes and Trends

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Uncertainty in observations and models used to characterize the global water and energy cycle, especially in interannual variability, must be addressed and improved for continued progress in understanding climate variability and change. While models can produce low frequency variability, their validation is difficult and spatially dependent. Observations are often spatially and temporally inconsistent, and may have significant uncertainties associated with their algorithms and input data streams. NEWS is expected to support individual model and observational data set development and investigations. *This proposed project will integrate existing, long-term global data sets, new NASA data sets, and global models to define modes of variability (inter-annual to decadal) in the global water and energy cycles.*

We will address issues in the global water and energy cycle structured around the NEWS strategic elements: *Observations*, the key to evaluating the real processes, but are limited by a multitude of uncertainties; *Understanding*, integrate many sources of observations with model and analyses to "unscramble" multiple modes of variability; and *Models*, while the primary way to predict climate change, models must represent current climate and interannual variability.

In this project, we will address several scientific issues regarding the climate variability and connections to water and energy cycles. Among these are evaluations of surface energy fluxes, top-of-atmosphere radiative fluxes, and their concomitant modes of variability. We will investigate the interannual variability in observations and models to better understand the interrelationships of different observations and their uncertainties and limitations. We expect to contribute to improvements in subsequent versions of the data by working with algorithm and model developers. EOS data products will provide independent validation and intercomparisons with existing long-term merged products, and perhaps extension of the climate record. *The expected outcome of this research is: 1) improved knowledge of water/energy cycle variations on inter-annual to decadal scales based on observed signals deemed to have high confidence; 2) validation of NASA's state-of-the-art model simulations and reanalysis climate variations and therefore better understanding of the underlying processes; 3) insights into limitations in specific global data sets and pathways for them to be improved through re-processing.* Our long-term goal is to reduce the uncertainty in detecting low frequency variability in the observations leading to a better understanding of global changes of the water cycle.

Relevancy. The main objectives of this project are to integrate many remotely sensed data products (historical and modern) as well as numerical model output, in order to address key climate variability and change questions related to NASA Earth science, and also to improve the understanding and limitations of the observed data and model products. In this way, the project is directly relevant to the Product-driven NEWS activities, and will contribute greatly to the NEWS strategic and grand challenge objectives. This project fills several critical needs in Phase I of the NEWS implementation, and we expect to collaborate closely with the NEWS integration team.