

Variability of Rain Drop Size Distributions and Implications for Remote-Sensing of Rainfall

Sponsor: Louisiana Space Consortium (LaSPACE)--NASA Space Program

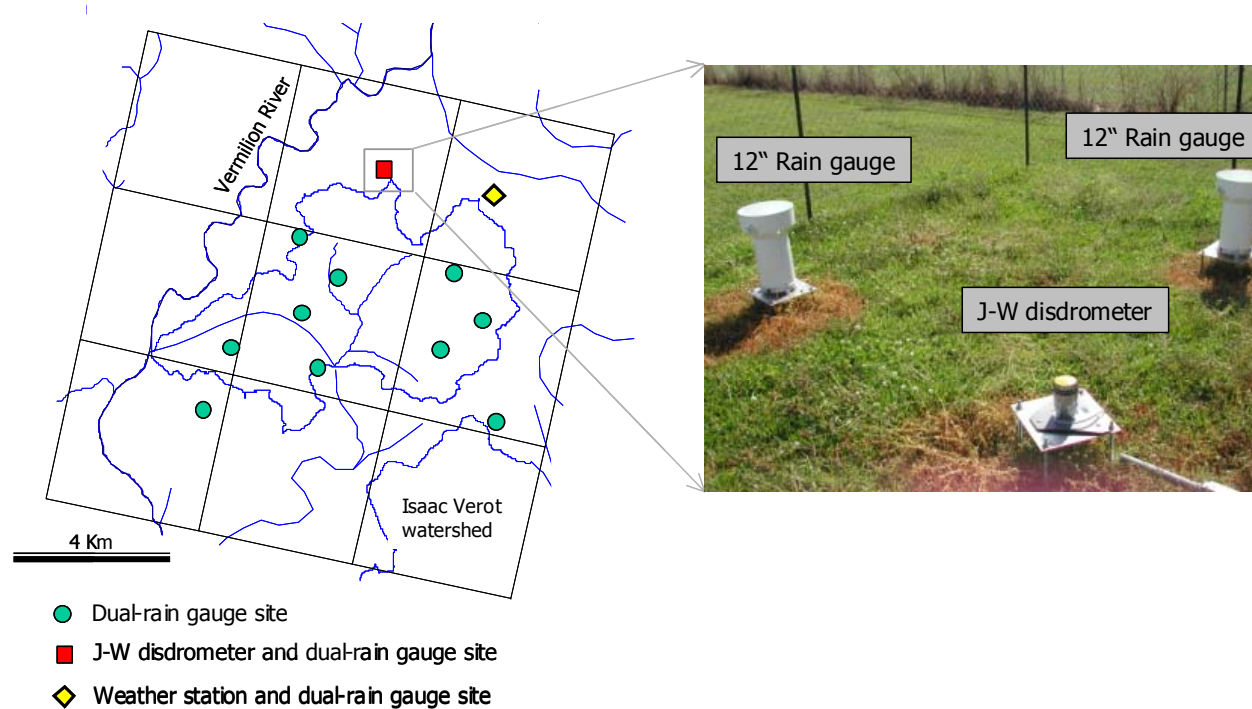
Brief Description:

The Earth atmosphere gets three-fourths of its heat energy from the latent heat released by precipitation. Therefore, information about precipitation is critical to understanding the global hydrologic balance and the complex interactions among the different components of the hydrologic cycle. For example, rainfall information is important in the tropics where large-scale patterns of rainfall affect the entire global circulation as manifested in climatic events such as El Niño-Southern Oscillation (ENSO). Knowledge about rainfall amounts, distributions, and mechanisms will allow researchers to predict severe weather with high accuracy, to refine flood-warning systems, and to predict availability of freshwater resources that are critical for agricultural and other human activities. Unfortunately, rainfall is one of the most difficult atmospheric variables to measure due to its stochastic nature and significant spatial and temporal variability. Therefore, the National Aeronautics and Space Administration (NASA) has identified measuring global precipitation as a major component in studying of the Earth's physical and biological systems. Examples of recent NASA's satellite missions that focus on remote sensing of precipitation include the Tropical Rainfall Measuring Mission (TRMM, 1997), the Earth Observing System EOS Aqua satellite, 2002, and the anticipated Global Precipitation Mission (GPM). In addition to satellite-based rainfall observations, ground weather radar systems can also provide rainfall measurements with relatively high temporal and spatial resolutions. Satellite and radar technologies for measuring rainfall provide several advantages over traditional surface rain gauges. Such advantages include regional and global coverage, and improved spatial and temporal sampling resolutions. However, due to the inherent indirectness of satellite and radar observables (cloud top reflectance and thermal radiance in satellite, and reflectivity factor in radar), estimation algorithms are often developed and used to retrieve rainfall quantities from the remotely sensed variables. Information on rainfall drop size distribution (DSD) has significant importance not only for the design of space-borne radar, but also for the development of rainfall estimation algorithms. DSD measurements are usually obtained using a device called disdrometer. This device collects data on the size of falling raindrops and constructs drop size distribution relations (i.e., number of drops for different drop size classes).

This project focuses on characterization of rainfall drop size distribution (DSD) and its spatial and temporal variability. DSD information is used to design space-borne radar systems, and to develop remote sensing rainfall estimation algorithms used in recent and future NASA satellite missions (e.g., TRMM and GPM). Such algorithms are used to provide reliable quantification of rainfall amounts and distributions that are essential for studies on the earth's atmosphere and the global hydrologic cycle. The proposed data collection and analyses will be beneficial to the mission of NASA's Earth Science enterprise by improving the measurement of global precipitation using remote-sensing techniques.

Tasks:

The tasks proposed in this project aim to: (1) Collect and analyze DSD and rainfall rate measurements using state-of-the-art instruments, (2) Characterize the variability and uncertainty in DSD measurements, (3) Compute rainfall parameters used for the design of space-borne precipitation radar, and (4) Gain a better understanding of how the DSD variability can impact the accuracy of remote sensing rainfall estimates.



Location of the disdrometer and the dense rain gauge network in the Isaac Verot experimental watershed in south Louisiana

The activities of this study will be implemented over a period of one year with close collaboration with Dr. Ali Tokay from the NASA's Laboratory of Atmosphere at the Goddard Space Flight Center (GSFC).