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Multi-spectral remotely sensed precipitation estimation

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It is widely recognized that distribution and quantity of the hydrologic variables, particularly precipitation, are the key parameters in hydrologic operations for improving real time precipitation forecasting, severe weather monitoring, water resources management, flood forecasting, and many other hydrologic applications. However, accurate high spatial and temporal resolution precipitation (both rainfall and snowfall) estimation is still a challenging problem. Despite the fact that rainfall intensity can be captured through different ground and remote observation sources, such as: gauge, radar, and satellite, there is still no observation source or a technique that can provide the true amount and realistic spatial distribution of precipitation. Reliable direct rainfall measurements can be obtained, only, from rain gauge stations but at point scale, where ground-based radar system can provide indirect areal rainfall estimates with limited spatial coverage. Although, satellite is the only possible source of collecting information with no spatial limitation, precipitation estimates from satellite imagery have greater uncertainties associated with the observing instrument as well as the relationship between rainfall and observations. Application of remote sensing data for precipitation estimation is a challenging research area, particularly for the remote and mountainous regions, where there is usually heavier precipitation and ground-based gauge and radar networks cannot cover.

Using combination of satellite-based multi-spectral observations that can provide information from various cloud properties can also improve precipitation estimates. In this presentation, improvement of remotely sensed rainfall and snowfall estimates from combination of satellite-based infrared (IR) and microwave (MW) channels will be discussed. Distribution and intensity of both rainfall and snowfall are enhanced using cloud-top IR from geostationary operational environmental satellite (GOES) in conjunction with multi frequency microwave data from advanced microwave sound-

ing units (AMSU). Preliminary investigation indicates that the higher frequency microwave (89 GHz and 150 GHz) is more correlated with precipitation (both rainfall and snowfall). Ground surface and meteorological information, such as topography, temperature, relative humidity, and wind speed and direction, are also used in conjunction with remote sensing data to enhance snowfall detection and estimation. Spatial resolution and intensity of IR-based rainfall retrievals for thunderstorms are improved by combining cloud-to-ground lightning CGL from NLDN with high-resolution cloud-top brightness temperature (IR-T_b) from geostationary satellites. Preliminary results for a short time (a three hour) thunderstorm demonstrate that using lightning in addition to cloud T_b increases the accuracy of rainfall estimate (e.g., cc= 0.7).