Application of satellite data to tropical climate modeling and prediction

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Prediction is a powerful motivation for developing models and observing systems. However, application of satellite remote sensing to climate modeling and prediction is still in its infancy, largely due to the limitation of data record being too short. In recent decades, there has been an array of satellite missions developed for ocean and atmosphere applications, including AVHRR, SSM/I, ERS1/2, TOPEX-Poseidon-Jason, QuikSCAT/SeaWind, TRMM, SeaWIFS, ISCCP, among others. From multi-sensor measurements of these missions, products of SST, surface wind, sea level height, precipitation, cloud cover and ocean color can be derived. With blended datasets now becoming 10-20 years long and growing, their application to low-frequency ocean and climate studies has started to show great potential. We should evaluate the impact of these data on a large range of time-scales and in a quantitative manner. More importantly, we should explore the usability of these high-quality, high-resolution observations to real-time climate prediction.

Here we focus on the tropics for two reasons: first, there are large intraseasonal-to-decadal fluctuations in the tropics which have strong influences on regional and global climate; and second, satellite observations are likely to have a major impact here because they are very useful for measuring the essential elements of the tropical ocean-atmosphere coupled system. In this presentation, we review the brief history of multi-sensor satellite data application to tropical climate modeling and prediction, with particular attention to ENSO-related studies. We demonstrate that satellite-derived SST, SSH, and wind data have strong positive impacts on ENSO simulation and prediction, because of the important roles of these variables in the "dynamic coupling" of the system. We also emphasize that satellite-derived surface fluxes, such as precipitation and solar radiation, are useful for diagnosing and simulating the "thermodynamic coupling" in the ENSO cycle. In order to take full advantage of multi-sensor satellite data, we need to follow a consistent and systematic approach.