Paper ID: 28549
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EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Applications and Economic Benefits (5)

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EMERGING CAPABILITIES IN SATELLITE OBSERVATIONS OF THE ATMOSPHERE THAT WILL DECREASE UNCERTAINTY IN QUANTIFYING GLOBAL WARMING

Abstract

Measuring Earth energy budget at a global scale is practical only by global measurements from satellites. The inability to measure fundamental quantities required for disentangling the effects of meteorology and anthropogenic aerosol emissions on cloud properties is a major contributor to the long stagnation in our ability to reduce the uncertainty in the anthropogenic impact on future global warming. Until now, satellites have been incapable of measuring neither the updraft speed of the air that forms the clouds, nor the concentrations of aerosols that are capable of forming cloud drops. These are the missing fundamental quantities. An emerging new capability to measure both updraft speeds and aerosols that can nucleate cloud drops can provide a clear vision to the future, which hopefully will lead to informed decision making. Retrieving both cloud base updraft and cloud condensation nuclei (CCN) is becoming possible with the advent of the SUOMI/NPP sun synchronous (13:30 overpass time) polar orbiting satellite which was launched in late 2011. Suomi/NPP has the VIIRS Imager that has a resolution of 375 m in the visible, near and thermal IR wavebands. This is a breakthrough resolution because it allows resolving the properties of small boundary layer clouds, including cloud base height and drop concentrations. This allows estimatiing cloud base updrafts indirectly by measuring the energy components that are propelling the air vertical motions. Early results show the feasibility of measuring both updrafts and CCN. Measuring the vertical motions of of cloud tops will become possible by the CLoud Observation for Updraft Detection (CLOUD) Constellation, which is being considered by a team that includes NASA based on the design of the author of this abstract. This will be obtained by mapping the time evolution of the topography of cloud tops by photogrammetric methods that will be applied to multi-angle overlapping high resolution satellite images. The CLOUD constellation is designed to orbit Earth in formation the already existing satellite series (JPSS) that will be used to retrieve cloud drop concentrations and radiative properties. Having coincident observations of cloud composition and dynamic structure will provide the fundamental quantities that we have been missing until now for quantifying the anthropogenic climate forcing. This represents the beginning of a revolution in the way that we will use satellites for weather and climate applications, from predicting weather at a scale of several hours to predicting possible climate changes at scales of decades and beyond.