CLIMATE DATA RECORDS OF GEOPHYSICAL VARIABLES FROM SPACECRAFT RADIOMETRY

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By providing global data sets that potentially span decadal time scales, well-calibrated radiometers on earth-observation satellites are one possible source of Climate Data Records (CDRs). To be of useful length, the CDRs have to be derived from measurements over the lifetimes of several radiometer generations, and this implies there are differences in radiometer design and performance characteristics that have to be taken into account. Over the length of a time series of measurements from a single radiometer, the error characteristics of the data might change, perhaps caused by instrument degradation, or the nature of the measurement itself might change such as a diurnally varying signal being sampled at a different time of day as the equator crossing time of an orbit drifts with age. Thus, to generate meaningful CDRs it is not sufficient that the spacecraft instruments be well-characterized and well calibrated, although these are necessary conditions, but also that a mechanism be employed that provides independent verification of the accuracies of the satellite-derived geophysical variables over the duration of the multiple-missions. One such approach is to compare the satellite-derived geophysical variables with coincident and collocated measurements of the same variables from radiometers on aircraft or surface based platforms. In the case of sea-surface temperature (SST) this method has been adopted to validate the satellite retrievals from both infrared and microwave radiometers. A number of groups have deployed self-calibrating infrared radiometers on ships to provide long-term radiometric measurements of the SST to determine the error characteristics of the satellite retrievals. By periodically bringing these ship-based radiometers together for calibration against a transfer standard instrument or source, traceable to a National SI standard, the requirements for generating satellite-derived CDRs of SST can be met.

The SST is a geophysical variable that exhibits variability over a wide range of spatial and temporal scales. The amplitudes of which can be several degrees over time scales of hours to seasons to interannual intervals, whereas the trend of increasing SST that is believed would be an indicator of global warming is 0.2K per decade or less. This heating would not be uniformly distributed throughout the world's oceans. Thus the sought-after climate change signal is a small trend that would have to be identified against a background of much larger variability. The SST itself responds to changes in a number of forcing functions, primarily the diurnal and season cycles of insolation, winds mixing that redistributes heat in the vertical, and advection by ocean currents that redistribute the heat laterally. To compound the difficulty of deriving and interpreting CDRs, the uncertainties in the satellite retrievals have components that are correlated with these same geophysical forcing. Thus, it is imperative that our understanding of the dependences of the residual errors in the satellite retrievals on other geophysical variables be clear and well established.

This presentation will include a discussion of the required characteristics of a CDR of SST, along with the endeavors adopted over the past several years to provide such a time series of well-characterized SST fields with a defensible tractability to SI standards.