An Improved Microwave Satellite Data Set for Hydrological and Meteorological Applications

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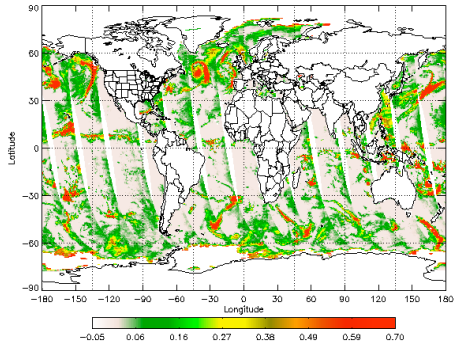
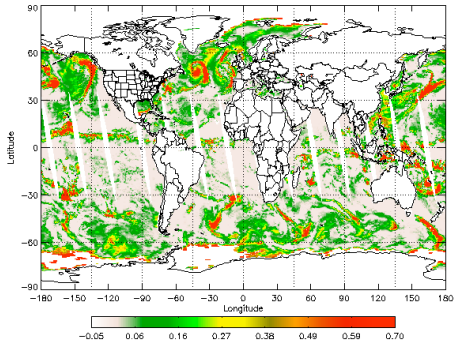
Introduction

More than one decade of observations from the Advanced Microwave Sounding Unit (AMSU) onboard the polar-orbiting satellites NOAA-15 to -19, and EU Meteorological Operational satellite program-A (MetOp-A) provide global information on water vapor, cloud, precipitation, etc. After the addressing of the asymmetric cross-scan bias of the AMSU-A window channels, and inter-calibration among the same sensor onboard the different NOAA and EUMETSAT satellites, the quality of the data set has been improved for both fundamental and thematic climate data record (CDR). Specifically, the improved total precipitable water (TPW) product is vital in several application aspects, such as detecting atmospheric rivers, which is closely related to extreme precipitation.

Cloud Liquid Water before Scan Bias Correction



Cloud Liquid Water after Scan Bias Correction

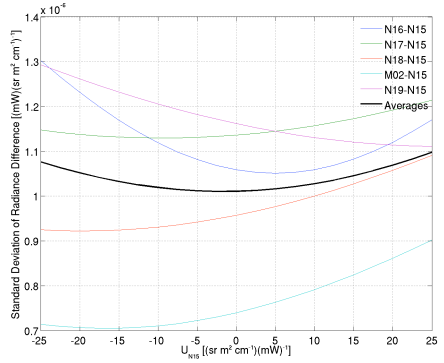


Inter-Calibration Sequential Adjusting Process

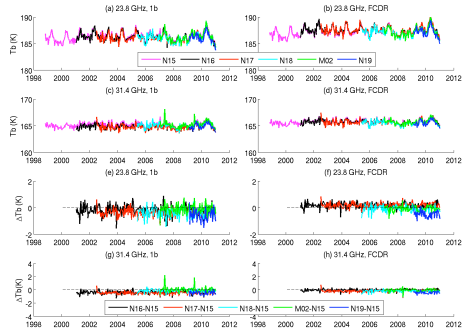
1. Generate intermediate simultaneous nadir overpass (SNO) data set with 142 variables for each SNO events
2. Calculate SNO coefficients (α, β, a_0, a_1)
3. Set $\delta R_{N15} = 0$, and μ_{N15}, calculate δR_k, μ_k, k = 1 to 5
4. Generate level-1c radiances for all six satellites using recalibration coefficients
5. Compute tropical ocean mean time series of ΔTb for available overlaps between pairs
6. Change the value of μ_{N15} and repeat steps 3, 4, and 5
7. Stop when summation of root mean square of ΔTb is minimum

(Credit to Zou C.-Z. and Wang W, 2011, JGR, 116)

Iterative Search for μ_{N15} of 23.8 GHz Channel



Impact of Inter-Calibration on Time Series

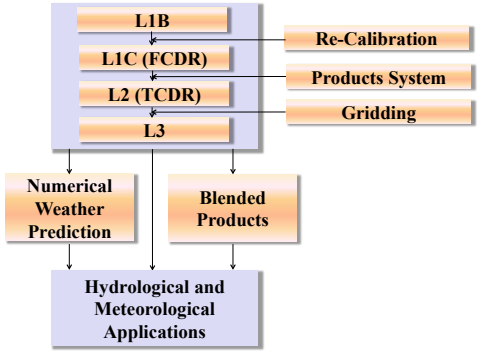


AMSU Hydrological Products

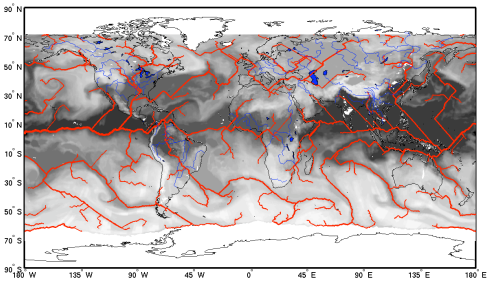
Products	Main Channels (GHz) Used in MSPPS*
Rain Rate	23.8, 31.4, 50.3, 89, 150/157, 183.3±1, ±3, ±7/190.3
Ice Water Path	23.8, 31.4, 89, 150/157
Total Precipitable Water	23.8, 31.4
Cloud Liquid Water	23.8, 31.4
Snow Cover	23.8, 31.4, 89
Snow Water Equivalent	23.8, 31.4, 89
Sea Ice	23.8, 31.4, 50.3

* Short for Microwave Surface and Precipitation Products System. In Microwave Integrated Retrieval System (MIRS), all AMSU AMSU-A, -B/ Microwave Humidity Sounder (MHS) channels are used in product retrievals

AMSU Production Chain



Atmospheric River Extracted from TPW



Atmospheric river (in red) extracted from blended TPW (in gray) of Jul 22, 2013, with surface river (in blue) as reference.