

Passive Microwave Radiometer constellation for Sea Surface Temperature

Prepared by CEOS Sea Surface Temperature Virtual Constellation (SST-VC)

Presented to CGMS-44 WGIII/6 by A. O'Carroll & K. Casey

Coordination Group for
Meteorological Satellites

SST-VC, WP/III/6, 7th June 2016



Overview

Use of Passive Microwave Radiometers (PMW) for SST retrievals is an essential component of global constellation of SST sensors.

Provides temperature of ocean under clouds, not possible from infrared sensors, albeit with poorer spatial resolution.

Particularly important in high-latitude regions and in areas of extensive and persistent cloud cover or in case of a large volcanic event.

Currently there are risks and gaps identified in constellation, therefore continuity and redundancy of PMW for SST is sought.

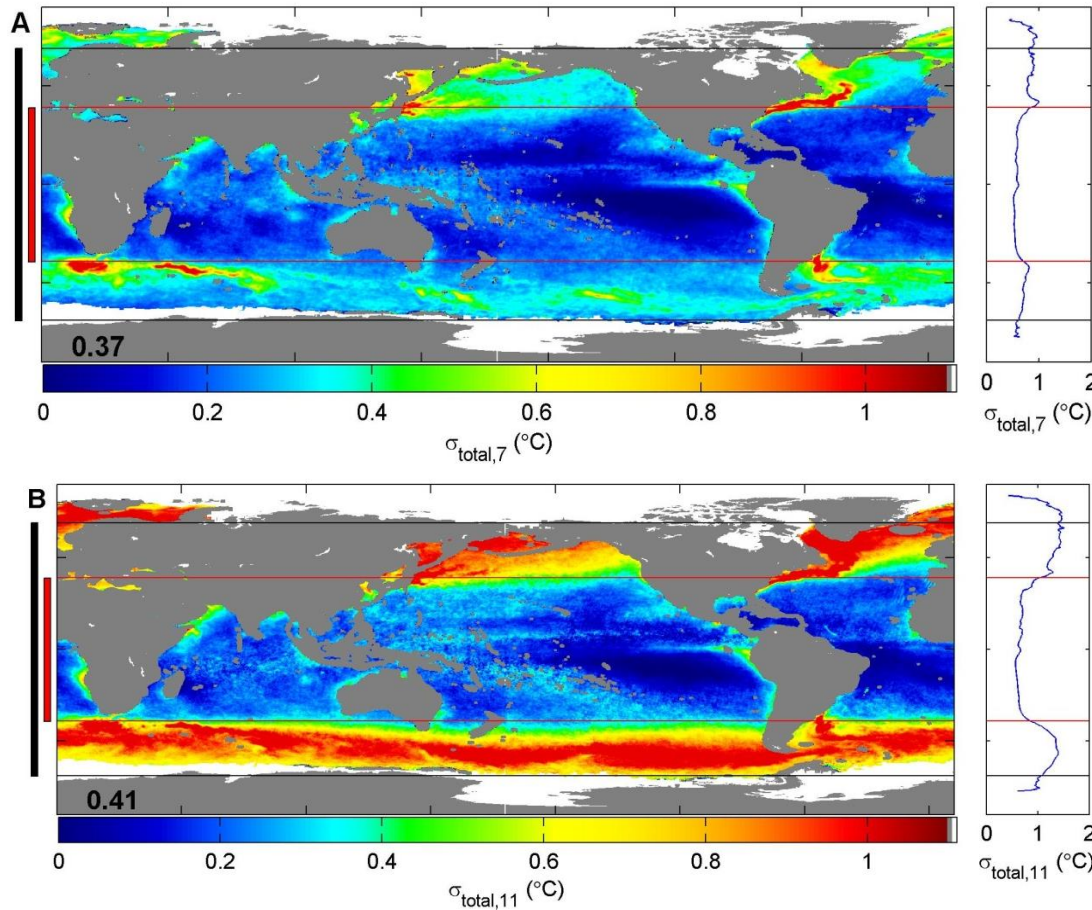
Presented to CEOS SIT-31 in April 2016.

Follows on from presentation to CGMS-42 in 2014.

Passive Microwave Radiometer constellation for SST

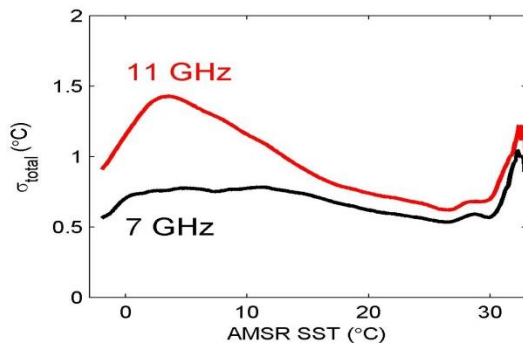
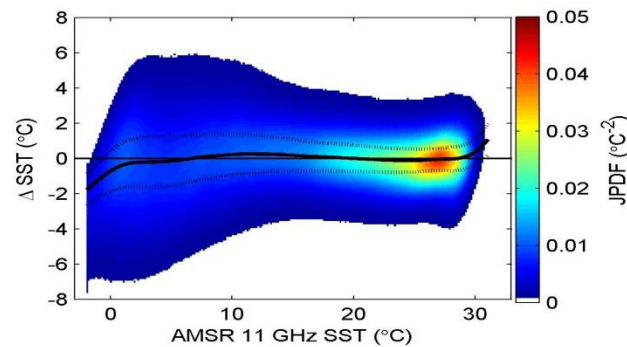
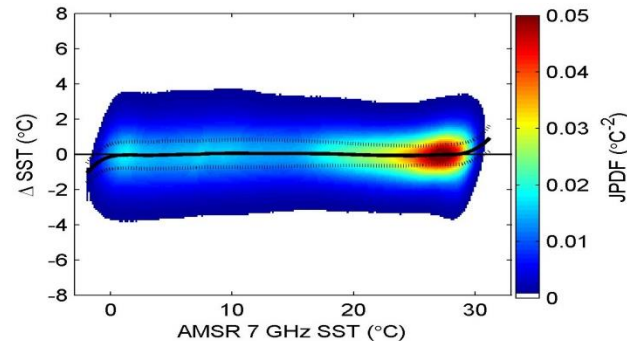


The benefit to SST retrievals using $\sim 7\text{GHz}$ and $\sim 11\text{GHz}$ channels



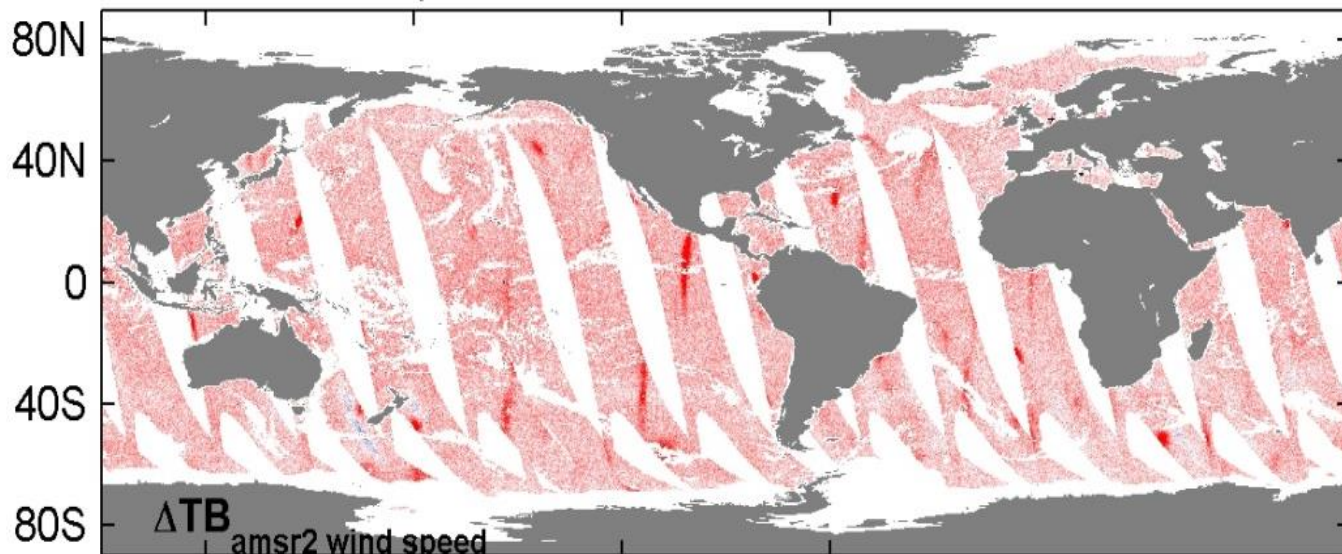
- Standard deviation of differences between AMSR-E and Reynolds SST for top (7GHz AMSR-E SST) and bottom (11GHz AMSR-E SST).
- Map using 11GHz demonstrates significant errors above 40 degree latitude for both hemispheres, due to decreased sensitivity to colder SST at 11 GHz.
- Importance of 6-7GHz channel at high-latitudes.
- From Gentemann et al. (2010).

Importance of 6-7GHz for SST



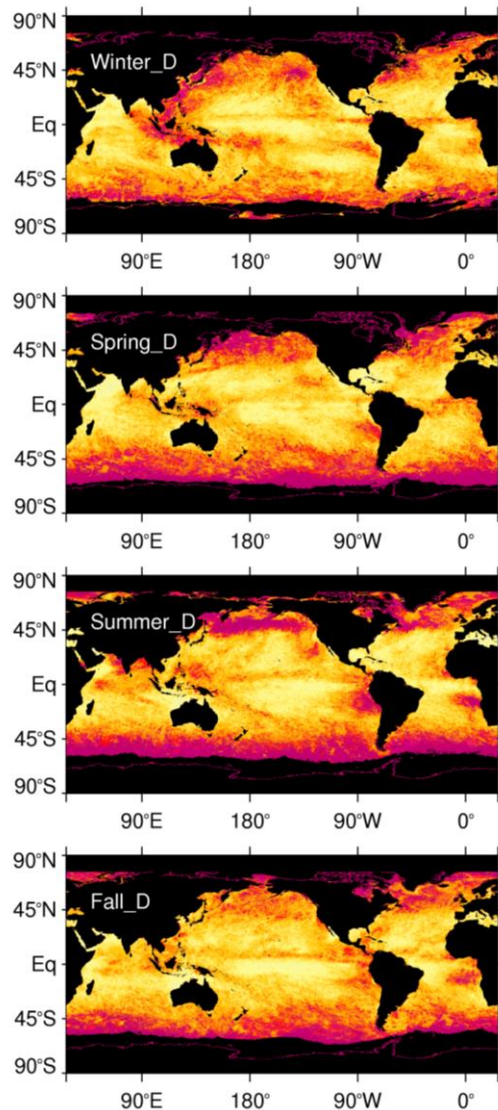
- AMSR-E minus Reynolds SST as a function of 7 GHz SST (top) and 11 GHz SST (bottom).
- Increased differences between the two retrievals at cooler temperatures.
- 7 GHz SST retrieval gives much more stable differences for all temperatures.
- From Gentemann et al. (2010).

Radio Frequency Interference

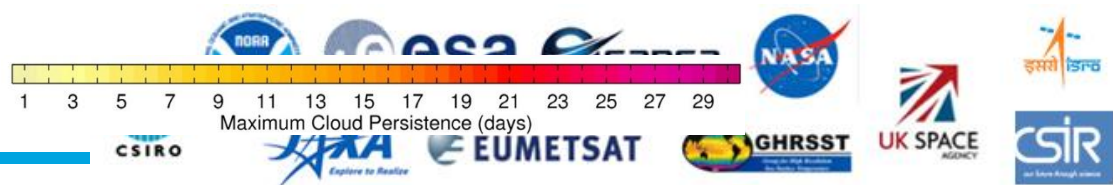


- Double difference of brightness temperature minus radiative transfer model simulated brightness temperatures, $TB_{6.9-RTM6.9} - (TB_{7.3-RTM7.3})$, showing the many vertical red streaks where satellite-satellite RFI is affecting SST retrievals.
- Presently the only method for removing these contaminated SST retrievals depends on having both 6.9GHz and 7.3GHz channels (from Gentemann et al (2015)).

Cloud cover limitations on infrared SST



- Maximum cloud persistence (days) from MODIS v6 daytime cloud mask data (seasons relate to Northern Hemisphere; D indicates daytime part of each orbit).
- Highlights regions where infrared SST retrievals are prevented due to persistent cloud cover.
- Regions where 11GHz are not accurate and infrared not possible due to cloud are highly correlated.
- Emphasizes need for 6-7GHz channel.
- From Lui and Minnett (2016).



Summary

- Uncertain future for PMW SSTs, especially at high latitudes where the PMW SSTs provide valuable through-cloud data in the region where the climate is changing most rapidly.
- The current outlook means there is a high risk of a gap, particularly for SSTs using the ~7GHz channel.
- The GHR SST science team meeting will be in Qingdao in June 2017 and should facilitate closer collaboration with China on the HY-2 and FY-3 series towards PMW SST capabilities. There is a need to work together on lower level data to ensure sensors are well calibrated and to tie in to existing records.
- The operational availability of PMW data from HY-2 and in the future from Meteor is of interest.

Key issues of relevance to CGMS:

- Progress has been made regarding 'reference' dual-view SST data (Sentinel-3 SLSTR); geostationary SST over full Indian Ocean; increased participation of agencies with SST capability to GHRSSST and the SST-VC.
- There is a risk to the current and continued PMW constellation for SST and a need for a redundant capability of PMW with ~ 7 GHz. These concerns are now heightened with no confirmed continuity of plans for AMSR-2 available.
- Operational availability of PMW data from HY-2 and in the future from Meteor.

To be considered by CGMS:

- Coordination and assistance to ensure the continuation of the existing capability of PMW for SST.
- Coordination and assistance to ensure the redundancy of PMW for SST.
- Assistance with access to current and future operational PMW data streams.

