Precipitable Water retrieval over Antarctica from Satellite Microwave Humidity sounders

Georg Heygster*(1), Christian Melsheimer(1), Arantxa Triana Gomes (1), Gunnar Spreen (1),
Monia Negusini(2), Boyan H. Petkov(3) and Claudio Tomasi (3)
(1) University of Bremen, Germany, www.iup.uni-bremen.de
(2) Institute of Radio Astronomy – INAF, Bologna, Italy www.ira.inaf.it
(3) Institute of Atmospheric Sciences and Climate - CNR, Bologna, Italy www.isac.cnr.it

1. Extended Abstract

Atmospheric water vapor is an important constituent of the global hydrological cycle; it transports humidity and heat and it is the most important greenhouse gas. While over open ocean total precipitable water vapor (PW) is routinely surveyed with satellite microwave imagers like SSMI(S) and AMSR-E/2, large-scale observations over land ice and sea ice are much more difficult because of the high and highly varying surface emissivity. However, a procedure has been suggested exploiting the data of the satellite humidity sounders SSM/T2, AMSU-B and MHS aboard the DMSP, Aqua and Metop satellites or satellite series, respectively. The basic idea is to use three channels of neighbouring frequencies. The surface contribution in the observed brightness temperatures is excluded by considering the ratio of brightness temperature differences. The resulting quotient is closely related to the atmospheric opacity from which in turn the PW can be inferred. The original version [1] used the three dual-band channels centred around the water vapor absorption line near 183 GHz (183 ± 3, ± 5, and ± 7 GHz) plus the 150 GHz channels in two different 3-channel combinations for the ranges 0 to 1.5 kg/m^2 and 1 to 7 kg/m^2, resp.. Later, the procedure has been adapted to the microwave humidity sounders AMSU-B and MHS with channels at 183 ± 1, ± 3, and ± 7 GHz [2]. Moreover, the method has been extended to also use the 89 GHz channel by introducing knowledge about the emissivity of Arctic sea ice. This allows for a retrieval up to 14 kg/m^2. Results for Antarctica based on the original algorithm will be presented, including at least one year (2007) of new data. In coastal Antarctic areas, Global Positioning System (GPS) and radiosounding (RS) stations are available and their long time series of observations can be used to retrieve PW. To ensure the utmost accuracy of the results homogeneous, consistent and up-to-date processing strategies for these data-sets were adopted and the content and variations of the PW were obtained at some Antarctic sites (Negusini et al 2016). The resulting time series can be used as a comparison and validation of the satellite data, that could contribute to a better understanding of the global climate balance.

2. References

1. Miao, J., K. Kunzi, G. Heygster, T. A. Lachlan-Cope, J. Turner, 2001: Atmospheric water vapor over Antarctica derived from SSM/T2 data. *J. Geophys. Res.*, 106, D10 (May 27), 10187--10203.

2. C. Melsheimer, G. Heygster 2008: Improved retrieval of total water vapor over polar regions from AMSU-B microwave radiometer data. *IEEE Trans. Geosci. Remote Sens.* 46(8), p.2307-2322, doi:10.1109/TGRS.2008.918013.

3. Negusini M, Petkov BH, Sarti P, and Tomasi C. 2016. Ground based water vapor retrieval in Antarctica: an assessment. *IEEE Trans. Geosci. Remote Sens. (TGRS)* 54 (5), p. 2935-2948, doi:10.1109/TGRS.2015.2509059.