Title: Temperature and water vapor mixing ratio profiles retrieved from the OU/NSSL CLAMPS MWR
Location: Orange Site for Perdigao
Lat/Lon: 39.714 degN, -7.736 degE
Instrument: OU / NSSL CLAMPS HATPROv4 microwave radiometer (RPG)

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Contact: Dave Turner, NOAA (dave.turner@noaa.gov)

--- Background

The downwelling radiance observed by multi-channel microwave radiometers (MWRs) contains information on the vertical profile of water vapor mixing ratio and ambient temperature above the instrument. The AERIoe thermodynamic profile retrieval algorithm (Turner and Loehnert 2014; Turner and Blumberg 2019) was modified to retrieve these profiles from MMWR observations directly (i.e., without the need for input infrared spectrometer data such as from the AERI instrument). The thermodynamic profiles can be used to characterize the evolution of the planetary boundary layer and liquid water bearing layer clouds.

This dataset was collected by the above instrument during the Perdigao field campaign (Fernando et al. 2019). The retrieval was run at 10-minute resolution, and uses both zen ith and off-zenith observations.

This is a physical-iterative retrieval method. The retrieval of thermodynamic profiles from spectral microwave radiance observations is an ill-posed problem, and thus constraints need to be included in the retrieval algorithm to provide physically plausible results. Here, we use a climatology of radiosonde profiles made at Lisbon during the spring and summer as our prior information in an optimal estimation framework. As the method uses an optimal estimation framework, a full error covariance matrix of each solution is included in the output file. The 1-sigma uncertainty of each retrieved variable, which is derived from the error covariance matrix, is included for each scientific field and is named "sigma_X", where "X" is the name of the scientific field (e.g., 'temperature'). Additional observations were used to help constrain the retrieval: in particular, surface in-situ measurements of temperature and humidity were included in the retrieval, as well as temporally interpolated radiosonde data launched at the "Orange Site" during Perdigao; however, the uncertainty in the interpolated radiosonde data was inflated and these sonde data were only used for altitudes above 4 km where there is little information content in the MWR signal.

There is an overall "qc_flag" field that is set when a retrieval should not be trusted. However, the logic that sets this flag didn't work correctly, and it should not be used. Instead, consider all retrievals that have a value for "converged_flag" greater than 0 and less than 9 as valid. If you have any questions, contact Dave Turner.

--- Version information

This is Release_2_9 of the AERIoe algorithm. The retrievals were performed by Dave Turner (NOAA; dave.turner@noaa.gov). Any questions about the retrieved quantities should be directed to him.

--- Details on the MWR

The MWR used at this site is a HATPRO v4 system developed by Radiometer Physics GmbH (Rose et al. 2005). This instrument is part of the CLAMPS-1 facility, which is described in Wagner et al. (2019). The instrument was calibrated using liquid nitrogen before the field campaign. A small spectral bias was determined during post-analysis, and removed before the retrieval was performed. The instrument contact is Petra Klein (pkklein@ou.edu). Papers that use these data should acknowledge both Dr. Klein and Dr. Turner.

--- References

Fernando, H.J., and 48 coauthors (including D.D. Turner), 2018: The Perdigao: Peering into microscale details of mountain winds. Bull. Amer. Meteor. Soc., accepted.

Rose, T., S. Crewell, U. Loehnert, and C. Simmer, 2005: A network suitable microwave radiometer for operational monitoring of the cloudy atmosphere. Atmos. Res., 75, 183-200, doi:10.1016/j.atmosres.2004.12.005.

Turner, D.D., and U. Loehnert, 2014: Information content and uncertainties in thermodynamic profiles and liquid cloud properties retrieved from the ground-based Atmospheric Emitted Radiance Interferometer (AERI). J. Appl. Meteor. Clim., 53, 752-771, doi:10.1175/JAMC-D-13-0126.1.

Turner, D.D., and W.G. Blumberg, 2018: Improvements to the AERIoe thermodynamic profile retrieval algorithm. IEEE J. Selected Topics Appl. Earth Obs. Remote Sens., accepted, doi:10.1109/JSTARS.2018.2874968.

Wagner, T.J., P.M. Klein, and D.D. Turner, 2019: A new generation of ground-based mobile platforms for active and passive profiling of the boundary layer. Bull. Amer. Meteor. Soc., 100, 137-153, doi:10.1175/BAMS-D-17-0165.1.

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