Title: CLAMPS2 TROPoe Retrievals
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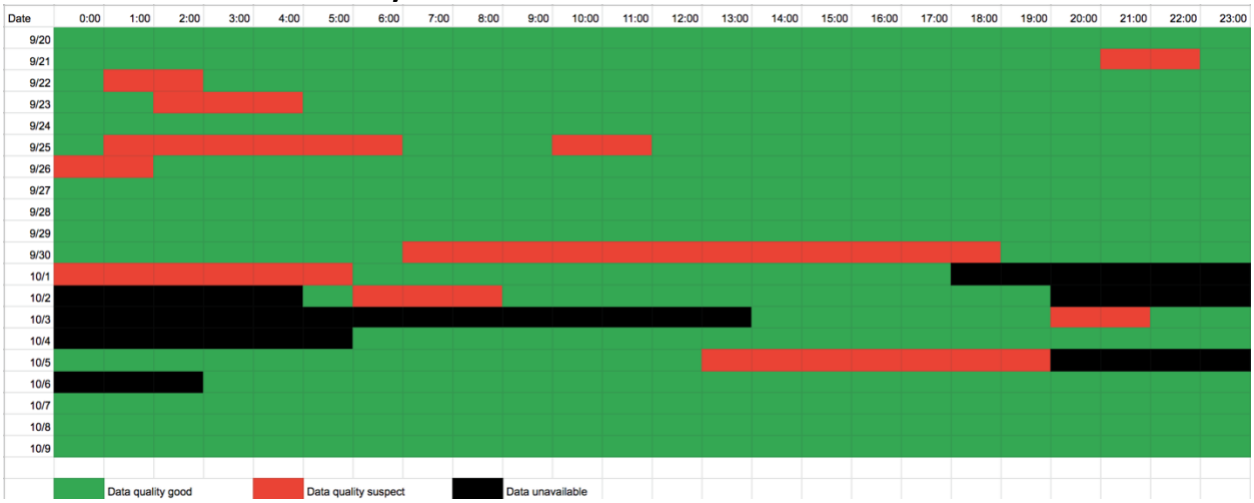
1.0 Dataset Overview

These files contain 24 hour periods of retrieved thermodynamic profiles derived from observations collected by the CLAMPS2 microwave radiometer (MWR). The TROPoe algorithm is a python based equivalent to the AERIoe algorithm (see Turner and Blumberg 2019). These data were collected during the CHEESEHEAD project. Only MWR-only versions of the retrieval are available for CLAMPS2.

1.1 Date range: 19 September – 10 October 2019
1.2 Location: Prentice Airport Site; 45.54 N, 90.28 W, 475 m elevation
1.3 Estimated data availability



2.0 Instrument Description

The CLAMPS2 platform includes an ABB-AERI and Radiometrics MP-3000A MWR. **The CLAMPS2 AERI experienced damage in transit to the site and did not operate for this campaign.** The MWR and AERI make spectrally resolved radiance observations that can be inverted to provide profiles of temperature and water vapor. In order to provide a profile, these instruments make observations along absorption features that have a range of transmission as a function of wavelength (i.e., selecting channels that have different optical depths). Furthermore, these instruments make observations in spectral regions that have absorption by water vapor and another gas (in the microwave an oxygen absorption band is used, in the infrared a carbon dioxide band is observed). The dry gas is assumed to be well mixed and the concentration known; thus inverting the equation for downwelling radiance provides the temperature profile. The retrieval algorithm (TROPoe) is then able to retrieve the water vapor concentration from spectral radiance observations made in spectral region with variable water vapor optical depths since the temperature profile is known. The spectral regions used by both of these instruments

to profile water vapor and temperature are as follows: AERI temperature-612-713 cm^{-1}, AERI water vapor-538-588 cm^{-1} and 1250-1350 cm^{-1}, MWR temperature-52-28 GHz, and MWR water vapor-22-31 GHz.

3.0 Data collection and processing:

In all instances of the TROPoe retrieval, a climatology based on soundings from Chanhassen, MN was used as the prior. RAP model profiles were used as an additional observation above 4km. The retrieved profiles are available every 10 minutes.

4.0 Data format:

Data are provided in netcdf format. The typical naming convention is clamps*tropoe*C2.c1.YYYYMMDD.HHmmss.cdf, following closely to ARM file naming convention. Values in place of * are internal markers for version and platforms included in the retrieval. The files have time and height dimensions.

Variables provided (only listing selected basic variables, many more provided):

Name	Dimension	Unit
base_time	Single value	Seconds (since 00 UTC 1 Jan 1970)
time_offset	Time	Second (since base_time)
hour	Time	Hours since 00UTC this day
height	Height	km AGL
temperature	Time, Height	C, temperature
waterVapor	Time, Height	g/kg, water vapor mixing ratio
theta	Time, Height	K, potential temperature
Rh	Time, Height	%, relative humidity
dewpt	Time, Height	C, dew point temperature
thetae	Time, Height	K, equivalent potential temperature
sigma_*	Time, Height	m MSL, altitude above mean sea level

Bolded variables are the main retrieved profiles from which other variables are derived. The sigma_* variables provide the 1-sigma uncertainty of that variable (available for main retrieved profile variables).

5.0 Data Remarks

The vertical resolution of the retrieved profiles decreases with altitude in both the MWR and AERI retrievals; this is due to the broadening of the weighting function as a function of height. Thus, there are relatively few independent pieces of information (IPI) in the profile (4-8 for the AERI, 2-4 for the MWR). However, the temporal resolution of the retrieved profiles from the AERI and MWR is high, and thus the evolution of the atmosphere, even with lower vertical resolution, can still be well characterized. It should be noted that the majority of the information on the temperature and humidity structure in the AERI and MWR observations is in the lowest 2-3 km; very little information exists above these levels in the observations due to the very broad weighting functions at those altitudes.

The two instruments also have a significantly different sensitivity to clouds. The optical depth of a cloud is much smaller in the microwave than in the infrared, and thus the retrieved temperature and humidity profiles from the MWR are much less sensitive to the presence of the cloud; this is not the case in the infrared where the emission from the cloud greatly hampers the ability to retrieve profiles from the AERI. Cloud base height is an essential input into the AERI retrieval algorithm in cloudy conditions; this can be easily determined from the Doppler lidar measurements. This complementary nature, the higher vertical resolution by the AERI in clear sky scenes but the "all weather" (with the exception of moderate to heavy precipitation) capability of the microwave profiler, is why we have included both systems in this facility.

6.0 References

Turner, D.D. and W.G. Blumberg, 2019: Improvements to the AERIoe thermodynamic profile retrieval algorithm. IEEE Selected Topics Appl. Earth Obs. Remote Sens., 12, 1339-1354