Title: CLAMPS2 TROPoe Retrievals
Authors: Tyler Bell, OU-CIWRO/NSSL, tyler.bell@noaa.gov; Elizabeth Smith, NOAA/OAR/NSSL, elizabeth.smith@noaa.gov, Joshua Gebauer OU-CIWRO/NSSL, joshua.gebauer@noaa.gov; Lydia Bunting, OU-CIWRO/NSSL
Data content questions can be directed to any author OR to the contacts listed at apps.nssl.noaa.gov/CLAMPS

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 equivalent to the AERIoe algorithm (see Turner and Loehnert, 2014; Turner and Blumberg 2019). These data were collected during the PERiLS project. MWR only data is available.
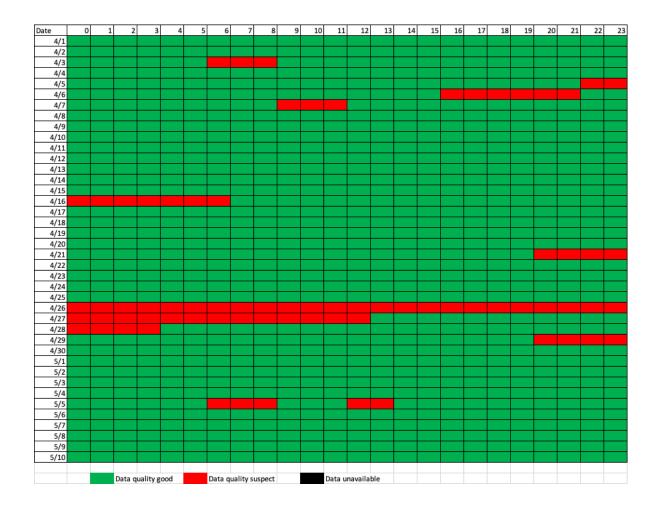
1.1 Date range: 7 February – 10 May 2023
1.2 Location: Lake Village, AR; 33.33 N, 91.28 W, 33 m elevation
1.3 Estimated data availability

MWR-only retrievals

Date | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23

Dates: 4/1, 4/2, 4/3, 4/4, 4/5, 4/6, 4/7, 4/8, 4/9, 4/10, 4/11, 4/12, 4/13, 4/14, 4/15, 4/16, 4/17, 4/18, 4/19, 4/20, 4/21, 4/22, 4/23, 4/24, 4/25, 4/26, 4/27, 4/28, 4/29, 4/30, 5/1, 5/2, 5/3, 5/4, 5/5, 5/6, 5/7, 5/8, 5/9, 5/10

Legend: Data quality good | Data quality suspect | Data unavailable

2.0 Instrument Description

The CLAMPS2 platform includes an ABB-AERI and RPG HATPRO MWR. The AERI consists of a Fourier transform interferometer, scene scanning-optics, IR detector, calibration blackbodies, and instrument control hardware. The exact system design and extensive theory of operation can be found in Knuteson et al. (2004). On a clear sky day it is capable of measuring IR radiances throughout the depth of the atmosphere with a wavenumber resolution 1 cm^{-1} and temporal resolution of ~20 seconds. The AERI has an absolute accuracy of < 1% of the ambient blackbody radiance and has typical noise < 0.2 mW (m^2 sr cm^{-1})$^{-1}$. The instrument is not able to collect observations in precipitation and when precipitation is detected a mechanical hatch is closed to protect the instrument. The radiances collected by the AERI contain information that can be used to obtain profiles of temperature, water vapor and trace gases as well as basic cloud properties. A MWR is a microwave receiver that measure the emission of microwave radiation from the atmosphere. The RPG HATPRO MWR observes microwave brightness temperatures in seven channels in the 22-31 GHz band and seven channels in the 51-58 GHz band. Information on the water vapor and integrated quantities of liquid water is in the 22-31 GHz band and temperature profile information is in the 51-58 GHz band.

3.0 Data collection and processing:

A climatology from soundings was used as the prior for the TROPoe retrievals. Recentering of this prior based on a surface water vapor measurement was performed for each retrieved profile. Zenith observations from all MWR channels are included in both sets of retrievals. Temperature and water vapor observations from a surface station and RAP analysis temperature and water vapor profiles above 4 km are also used in the retrievals. Cloud-based height information from a Doppler lidar was included for retrievals that occurred after 15Z on 24 June 2022. 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 the MWR 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 (2-4 for the MWR). However, the temporal resolution of the retrieved profiles from the 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 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.

6.0 References

Knuteson, R. O. and Coauthors, 2004: Atmospheric Emitted Radiance Interferometer. Part I: Instrument Design. *J. Atmos Oceanic Tech.*, **21**, 1763-1776.

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, 2019: Improvements to the AERIoe thermodynamic profile retrieval algorithm. *IEEE Selected Topics Appl. Earth Obs. Remote Sens*., **12,** 1339-1354, doi:10.1109/JSTARS.2018.2874968.