





Microwave Temperature Profiler Observations during MPEX

Julie Haggerty, Chris Davis, Dave Ahijevych, Kelly
MPEX Workshop
19 November 2013



Microwave Temperature Profiler (MTP)

MJ Mahoney, Jet Propulsion Laboratory, California Institute of Technology
Richard Denning, Jet Propulsion Laboratory, California Institute of Technology



Description


The Jet Propulsion Laboratory (JPL) MTP instrument is a passive, microwave radiometer that measures the brightness temperature of the atmosphere due to the natural thermal emission from oxygen molecules. Measurements at three different frequencies near 60 GHz are made at 10 elevation angles from near-zenith to near-nadir, during a 15-second scan cycle. Measured brightness temperatures are converted to air temperature versus altitude by using a modified statistical retrieval procedure developed especially for the airborne application. This quasi-Bayesian procedure selects between many sets of retrieval coefficients to determine which set of expected brightness temperatures best matches the measured brightness temperatures. This set of retrieval coefficients is then used to retrieve a temperature profile.

Scientific Objectives

Measure Temperature Profiles: These provide meteorological context by identifying the tropopause height for other in situ or remote trace gas, hydrometeor or aerosol measurements. This is important during GloPac because oceanic regions like the Pacific Ocean are radiosonde sparse.

Plot Temperature Curtains: Color-coding temperature profiles and plotting them as a curtain along the Global Hawk's flight track will identify stratospheric intrusions and other atmospheric temperature structures. This facilitates interpretation of other measurements during GloPac.

Plot Isentropes: If a temperature profile is converted to a potential temperature profile scan by scan, the altitude of specific potential temperature surfaces (called isentropes) can be identified and plotted. Isentropes are the streamlines on which air parcels flow, so they allow atmospheric dynamics to be studied, such as convectively-excited gravity waves or larger scale synoptic waves.

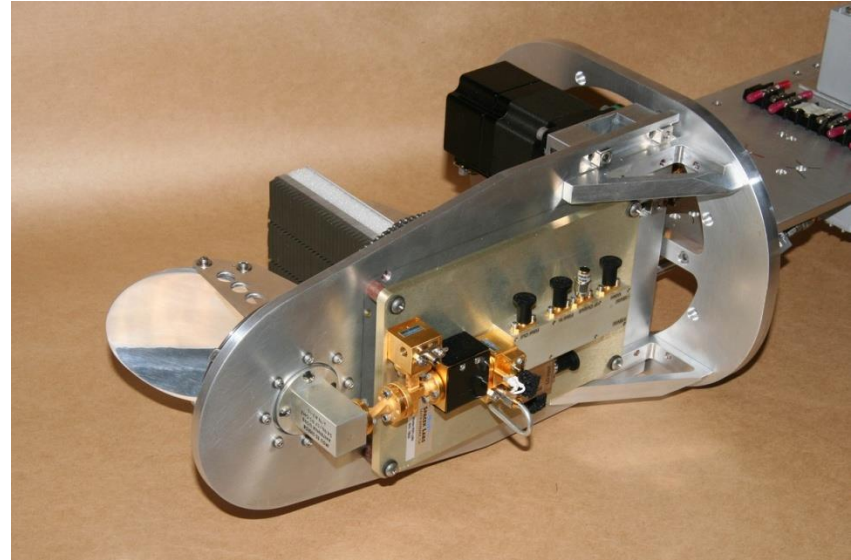


GloPac 2009

Microwave Temperature Profiler

Sensor Overview

- Airborne passive microwave sounding device
- Measures emission at 3 frequencies in the oxygen absorption (55 GHz) complex
- Scans from near-nadir to near-zenith, sampling at specified elevation angles
- Internal calibration system uses heated blackbody target and in situ temperature measurement
- Measurement uncertainty $\sim 0.2\text{K}$



- Penetration depths depend on frequency and altitude ($\sim 0.5 - 4$ km at 10 km flight level)
- Surface emission detected at low altitudes

MTP

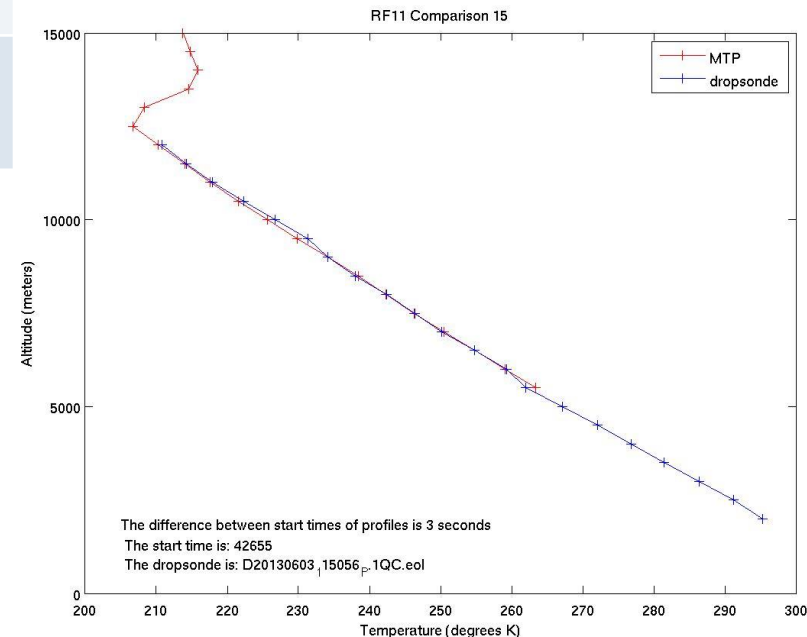
Temperature Profile Retrievals

- Statistical retrieval method constrained with a priori information from proximate radiosondes
- Profiles available at 17 sec intervals (~4 km horizontal spacing)
- Vertical resolution ~150 m within 1 km of aircraft, increases to ~1 km at >6 km away
- Profiles usually extend to $\pm 6-8$ km from flight level



MTP vs. Dropsonde Temperature Profiles

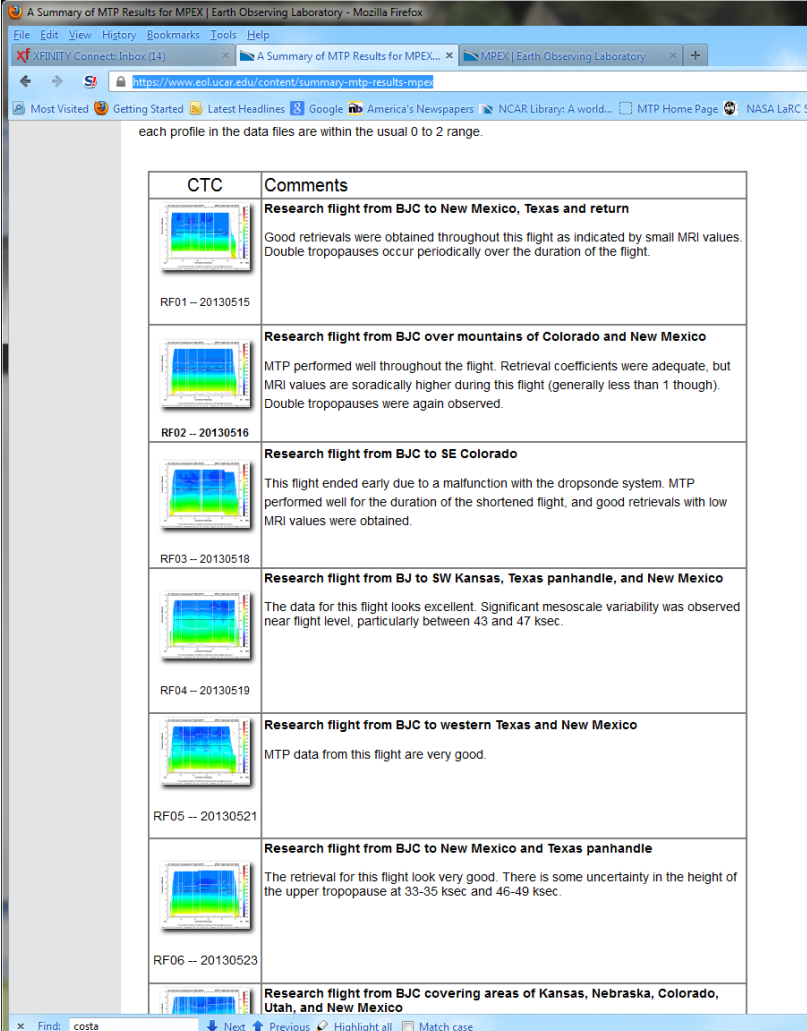
	MTP	Dropsonde
Measurement method	remote	in situ
Accuracy	0.2-1.5 K	0.2K
Horizontal spacing in MPEX	4 km	~100 km
Vertical resolution	150 m – 1 km	6 m
Vertical extent	± 6km from flight level	Flight level to surface



MPEX Data Summary








- MTP functioned well on all 15 flights
- Retrievals quality is generally good
- Lower quality retrievals with larger uncertainties obtained during periods of extreme spatial variation (e.g., fronts, mountainous areas)
- Double tropopauses frequently observed
- Comparison with dropsonde and upsonde temperature profiles in progress
- Data summarized at:

<https://www.eol.ucar.edu/content/summary-mtp-results-mpex>



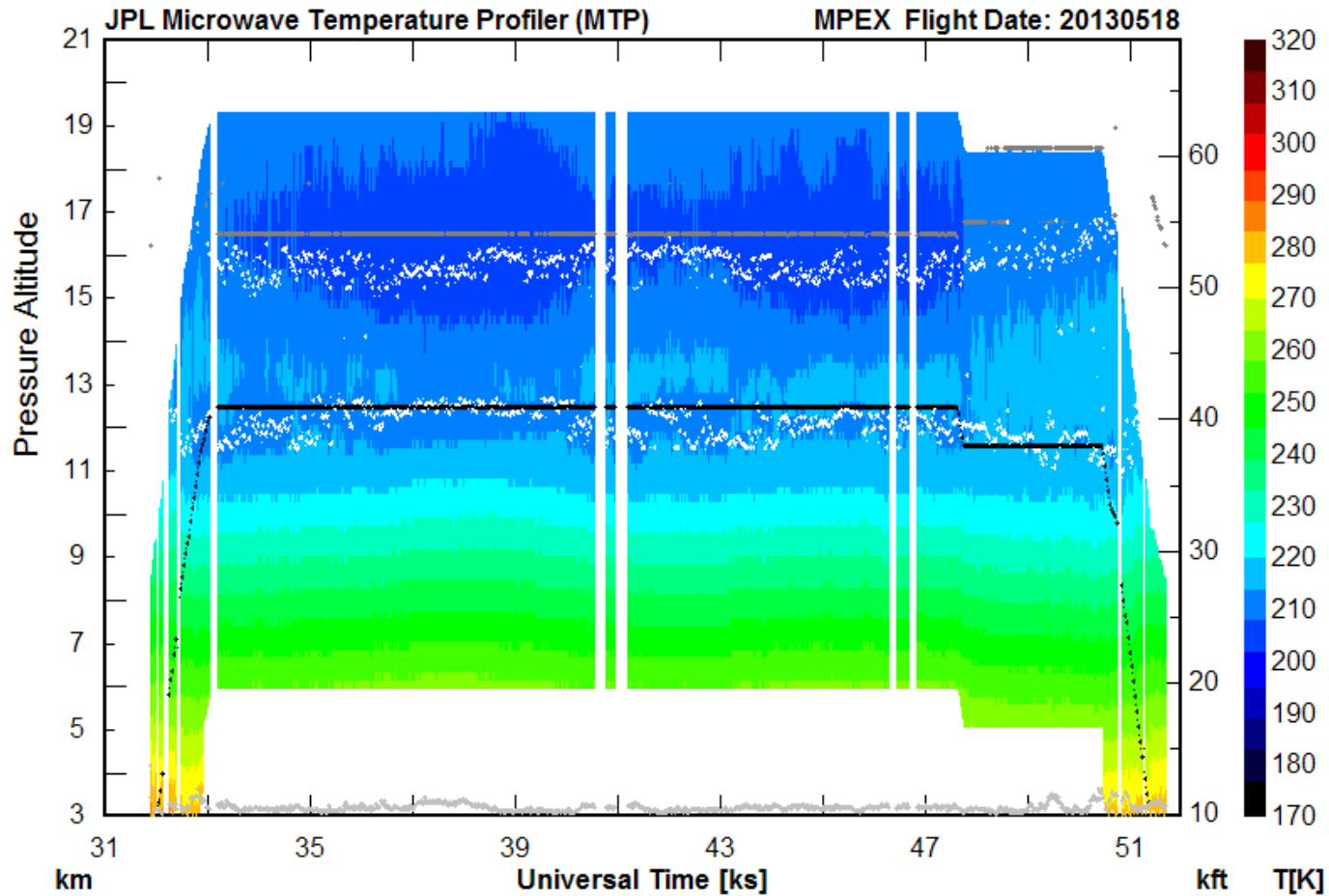
A Summary of MTP Results for MPEX | Earth Observing Laboratory - Mozilla Firefox

each profile in the data files are within the usual 0 to 2 range.

CTC	Comments
 RF01 -- 20130515	Research flight from BJC to New Mexico, Texas and return Good retrievals were obtained throughout this flight as indicated by small MRI values. Double tropopauses occur periodically over the duration of the flight.
 RF02 -- 20130516	Research flight from BJC over mountains of Colorado and New Mexico MTP performed well throughout the flight. Retrieval coefficients were adequate, but MRI values are sporadically higher during this flight (generally less than 1 though). Double tropopauses were again observed.
 RF03 -- 20130518	Research flight from BJC to SE Colorado This flight ended early due to a malfunction with the dropsonde system. MTP performed well for the duration of the shortened flight, and good retrievals with low MRI values were obtained.
 RF04 -- 20130519	Research flight from BJ to SW Kansas, Texas panhandle, and New Mexico The data for this flight looks excellent. Significant mesoscale variability was observed near flight level, particularly between 43 and 47 ksec.
 RF05 -- 20130521	Research flight from BJC to western Texas and New Mexico MTP data from this flight are very good.
 RF06 -- 20130523	Research flight from BJC to New Mexico and Texas panhandle The retrieval for this flight look very good. There is some uncertainty in the height of the upper tropopause at 33-35 ksec and 46-49 ksec.
 RF07 -- 20130523	Research flight from BJC covering areas of Kansas, Nebraska, Colorado, Utah, and New Mexico

Find: costa Next Previous Highlight all Match case

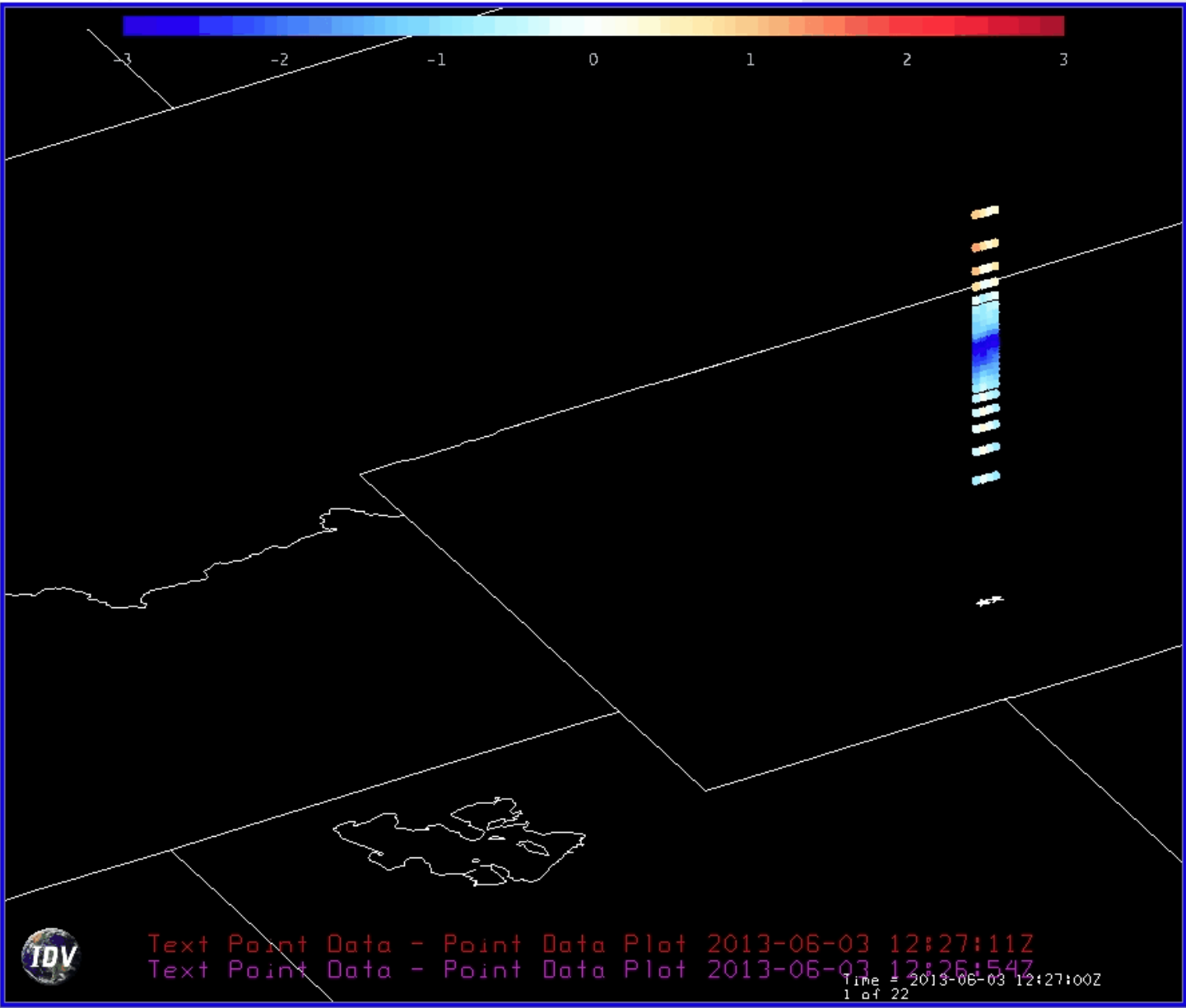
Questions?





View Projections

2013-06-03 12:27:00Z



Legend

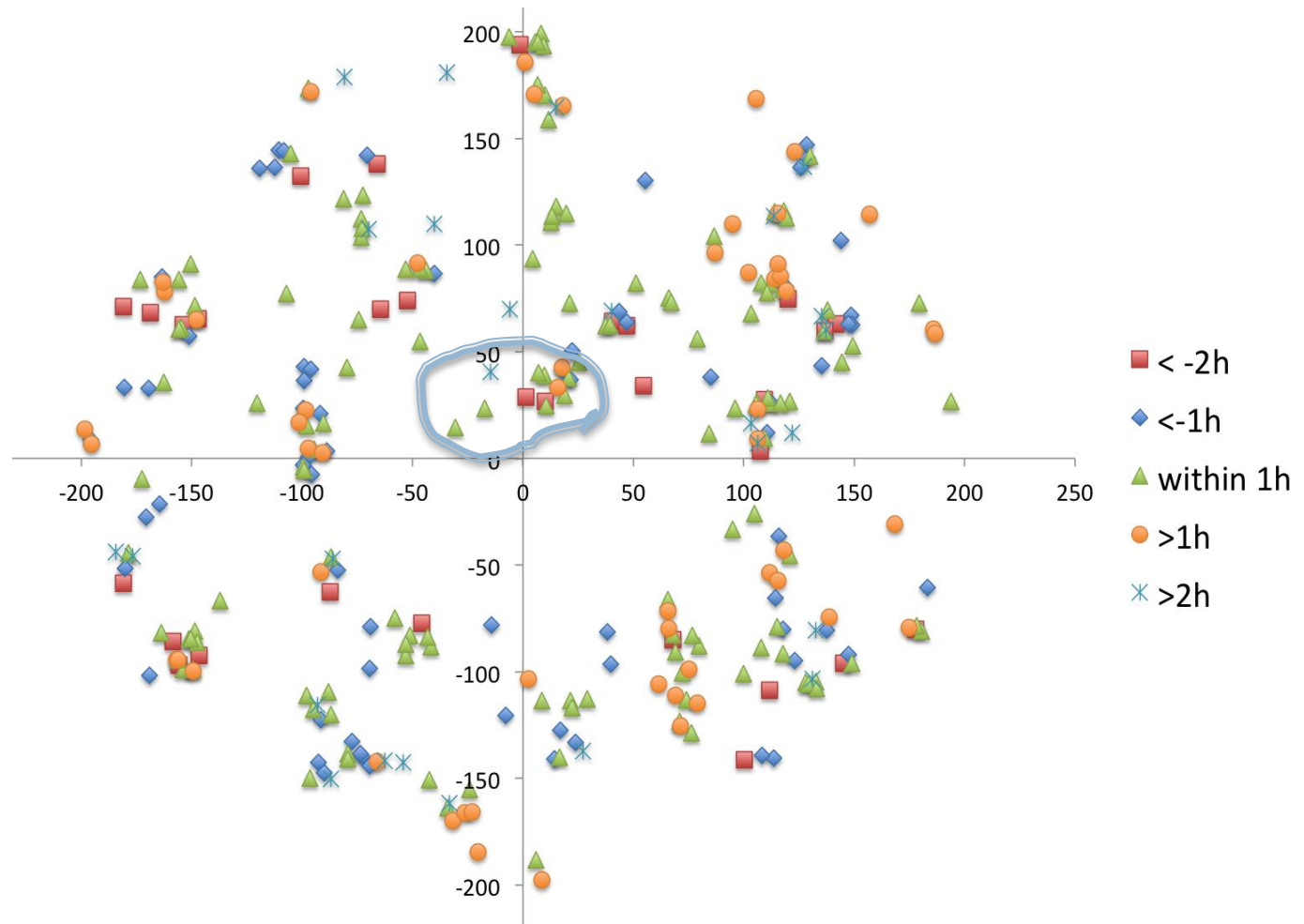
- Maps
- [Default Background Maps](#)
- Hi-Res US
- Point Data
- [Text Point Data - Point...](#)
- Layout model:PREDICT cloud drift
- [Text Point Data - Point...](#)
- Layout model:temperature curtain
- dTEMP_MTP:
-
- 3 3
- [Text Point Data - Point...](#)
- Layout model:temperature curtain
- dTEMP_MTP:
-
- 3 3



Text Point Data - Point Data Plot 2013-06-03 12:27:11Z
 Text Point Data - Point Data Plot 2013-06-03 12:26:54Z
 Time = 2013-06-03 12:27:00Z
 1 of 22



Rawinsonde positions relative to dropsonde

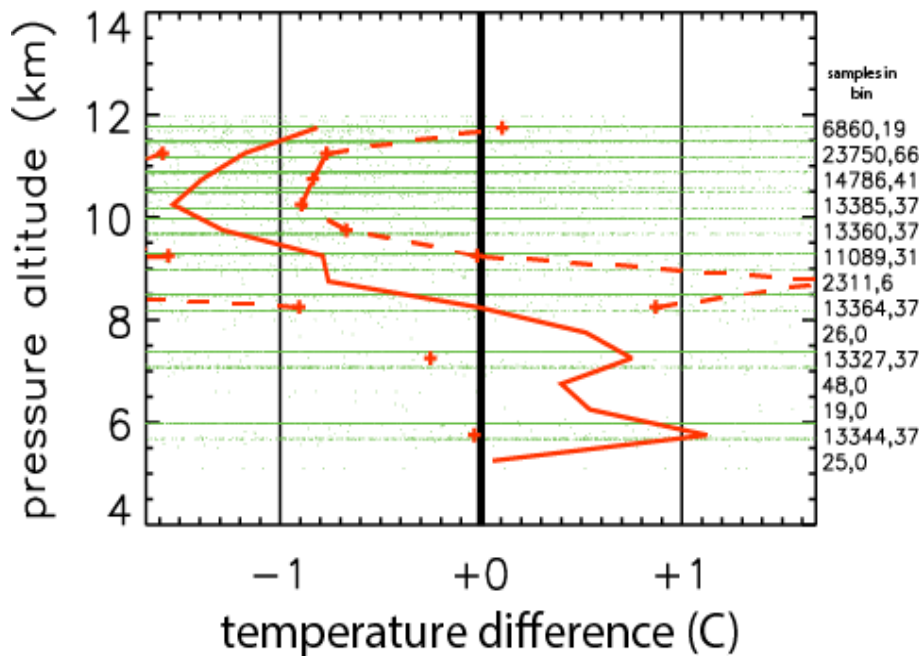


Cluster to the north probably results from

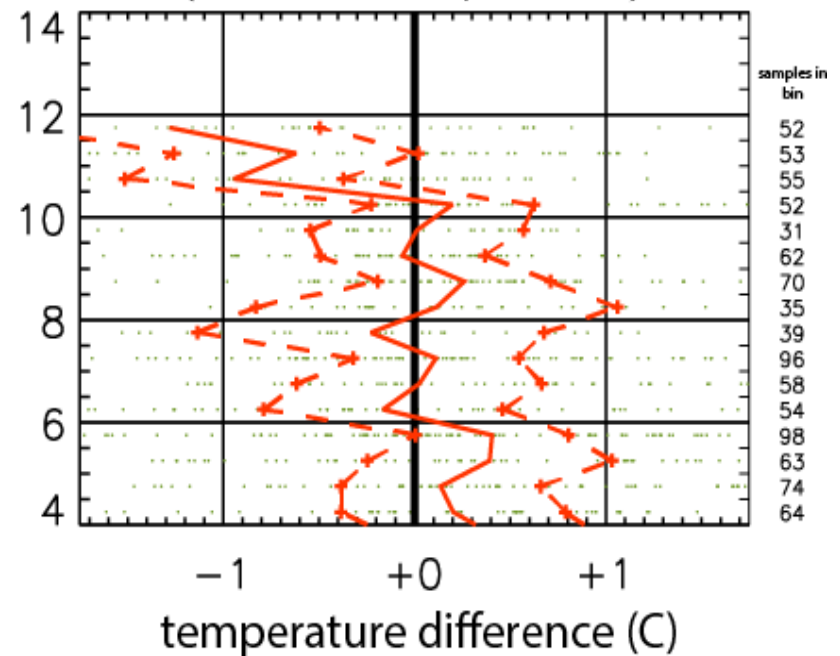
- 1) proximity of drop points to Albuquerque, Grand Junction and Dodge City,
- 2) those stations are slightly north of the drop points, and
- 3) were flying near those points (especially DDC and ABQ) near 12 UTC.

Measured Temperature Difference between MTP, dropsonde, and upsondes

MTP - dropsonde

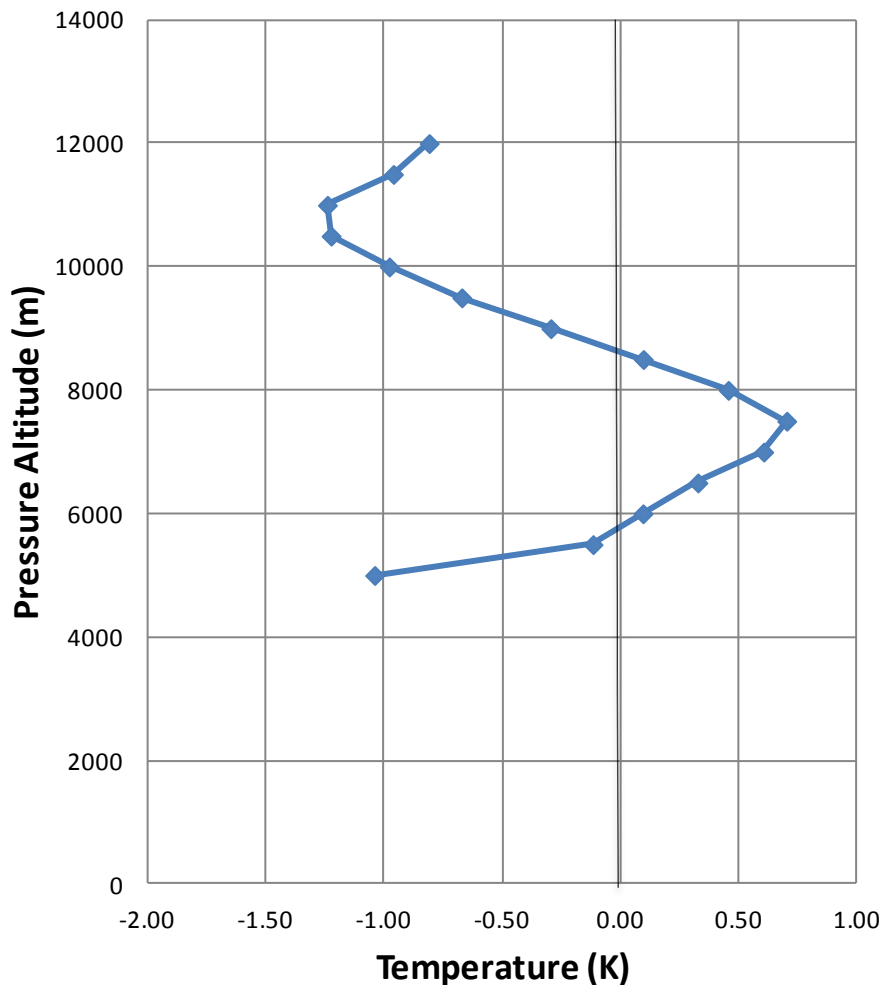


upsonde - dropsonde
(within 90 min, 150 km)



MTP-Dropsonde Mean Difference

(Fast-fall dropsondes removed, 359 comparisons)



MTP-Dropsonde Mean Difference

(Fast-falls removed, longitude west of 104° degrees removed, 167 comparisons)

