

MMS Observations of the Eastern Pacific TTL during ATTREX-2011

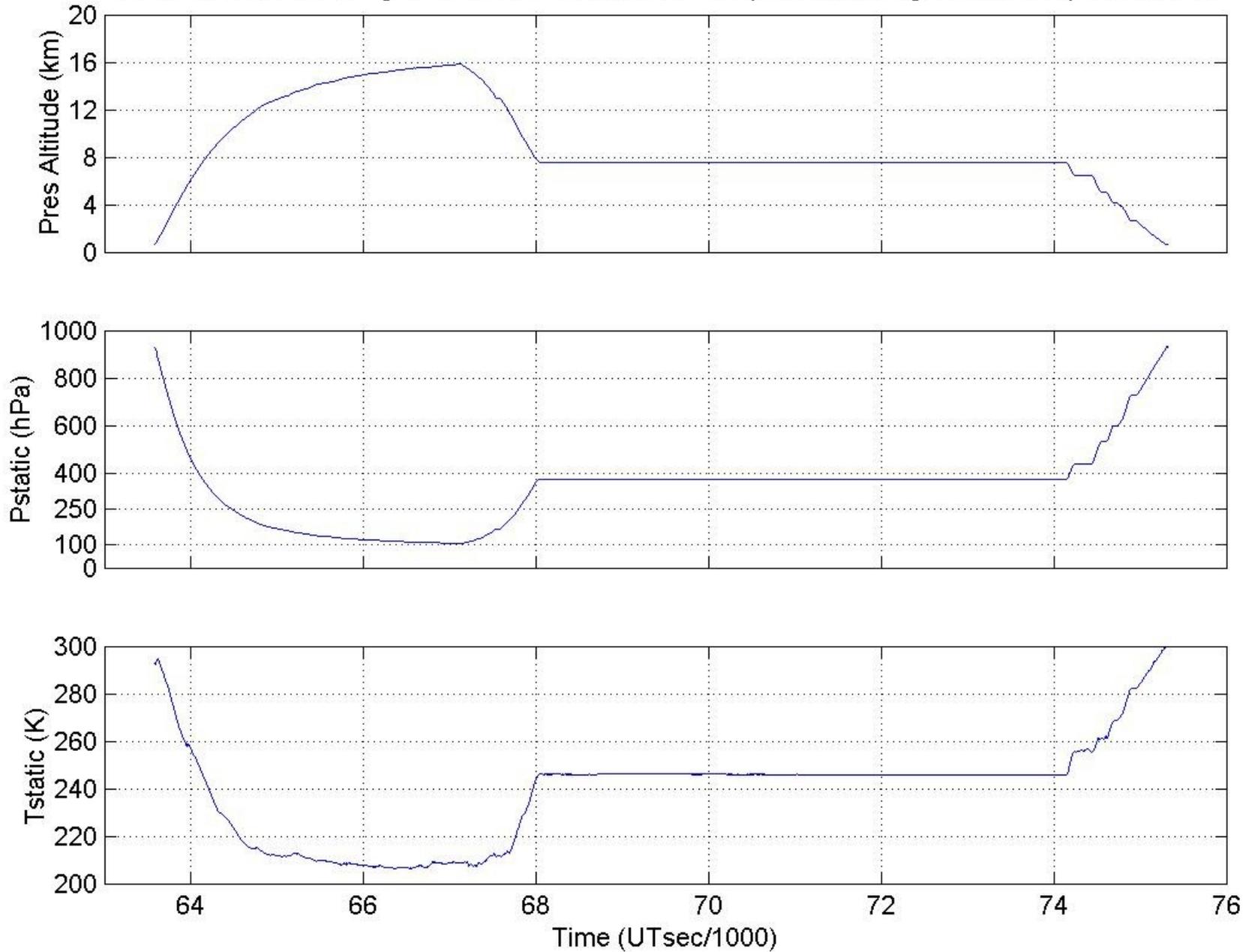
J. Dean-Day¹, T.P. Bui² and C. Chang¹

ATTREX Science Team Meeting
Boulder, CO
June 11-12, 2012

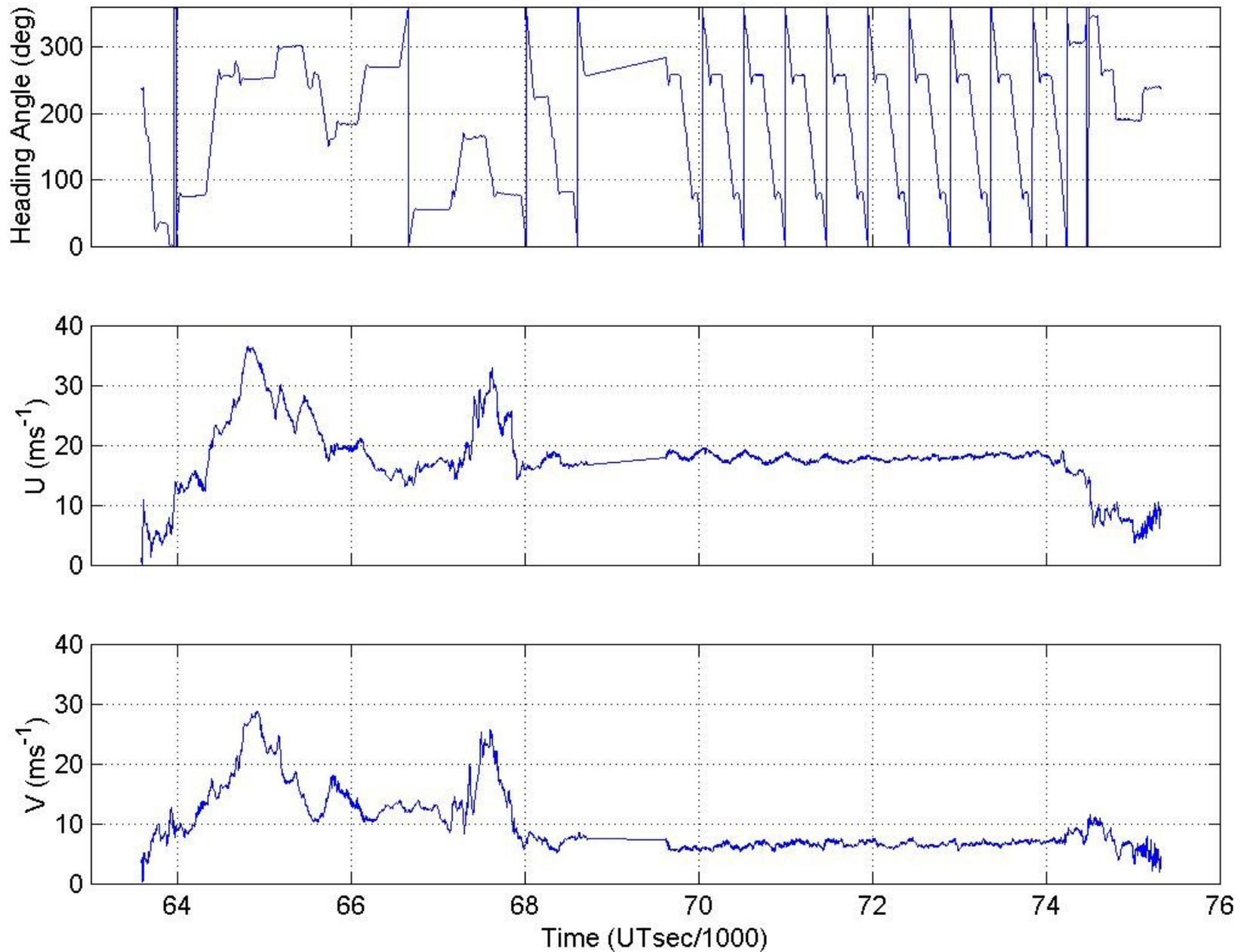
¹Bay Area Environmental Research Institute, Sonoma, CA

²NASA Ames Research Center, Moffett Field, CA

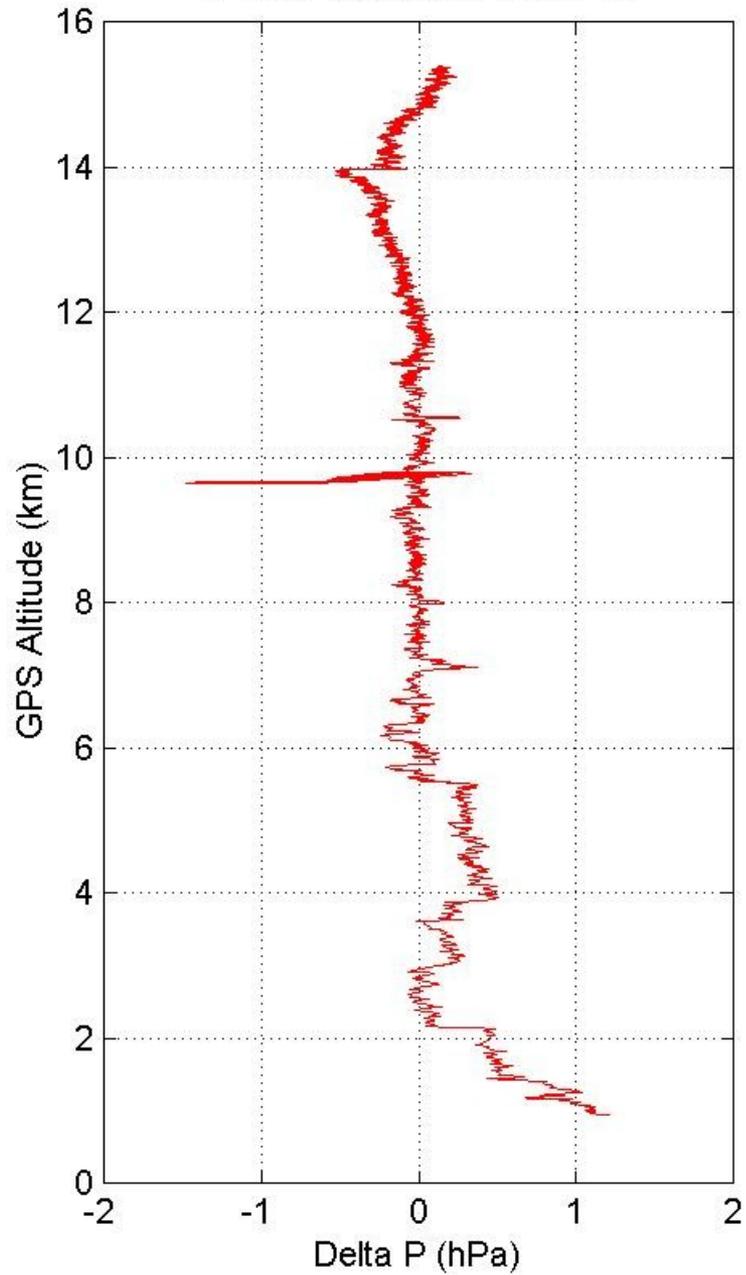
20111024 ATTREX Flight #2; MMS Pressure and Temperature during fuel burnoff prior to RTB



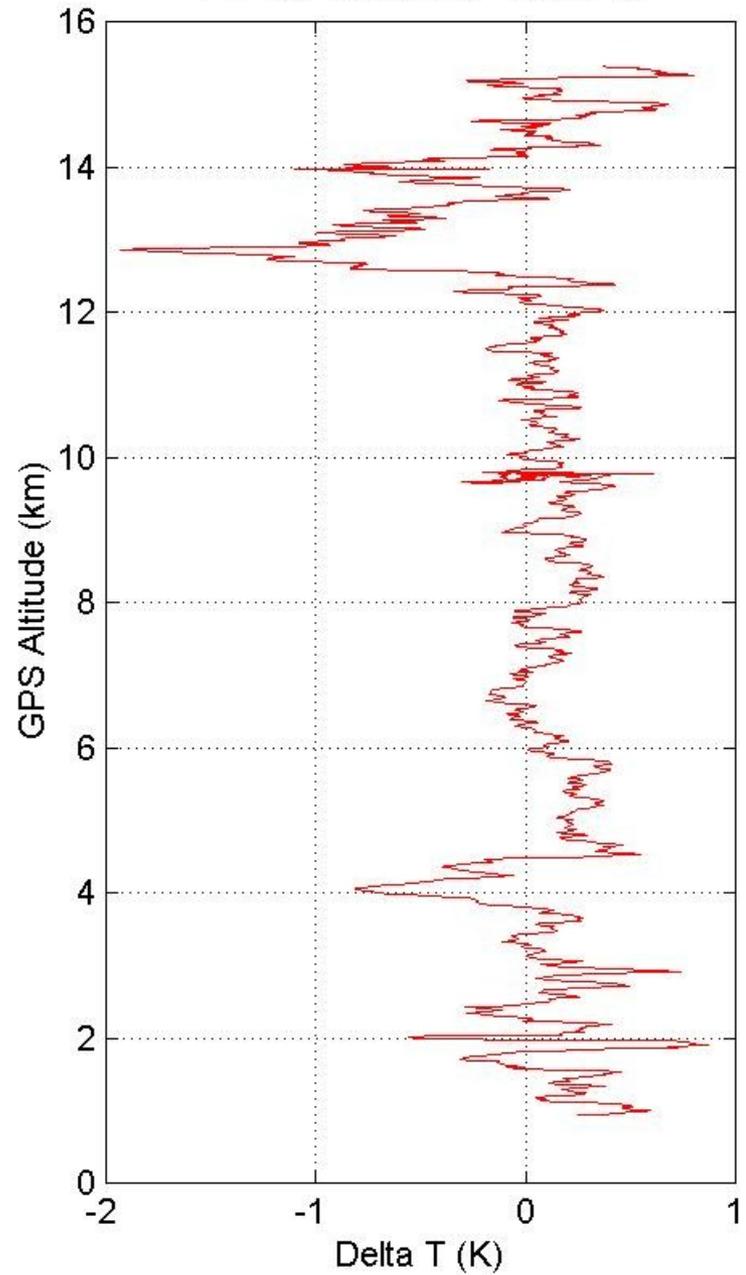
20111024 ATTREX Flight #2; MMS Horizontal Winds during fuel burnoff prior to RTB



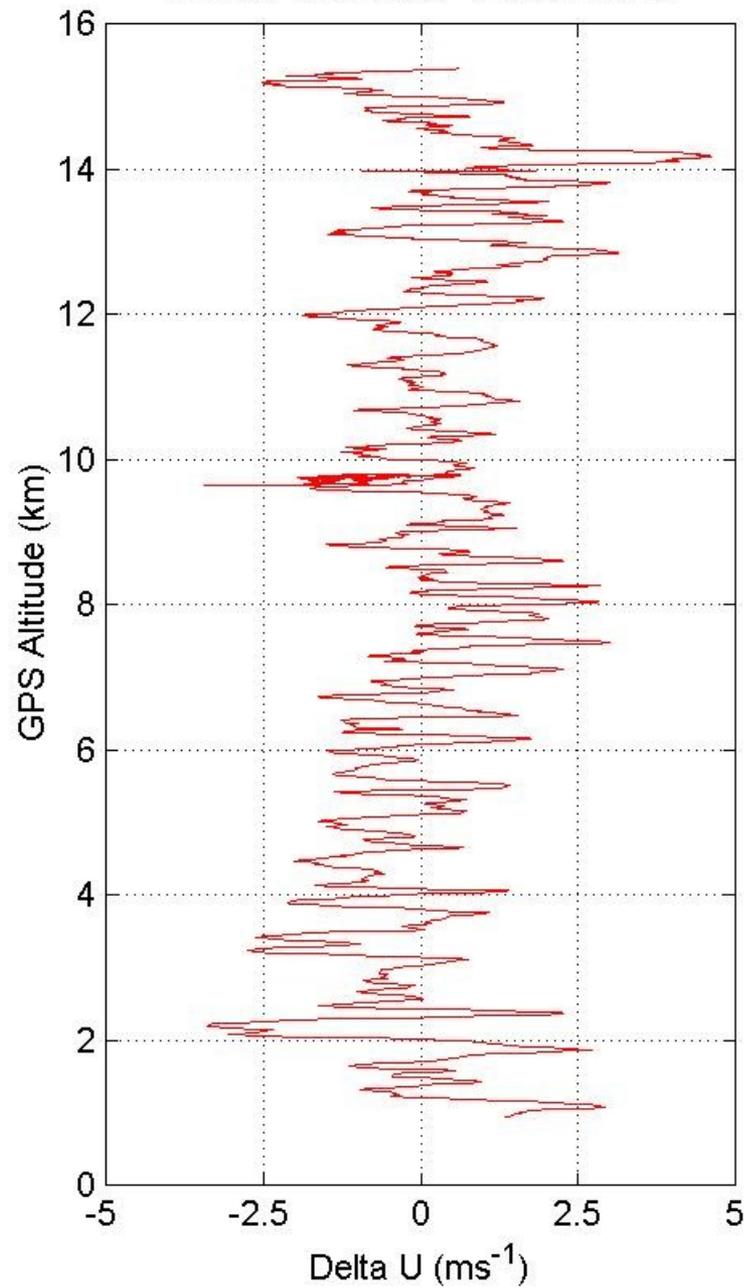
111109 18Z MMS - EDW Ps



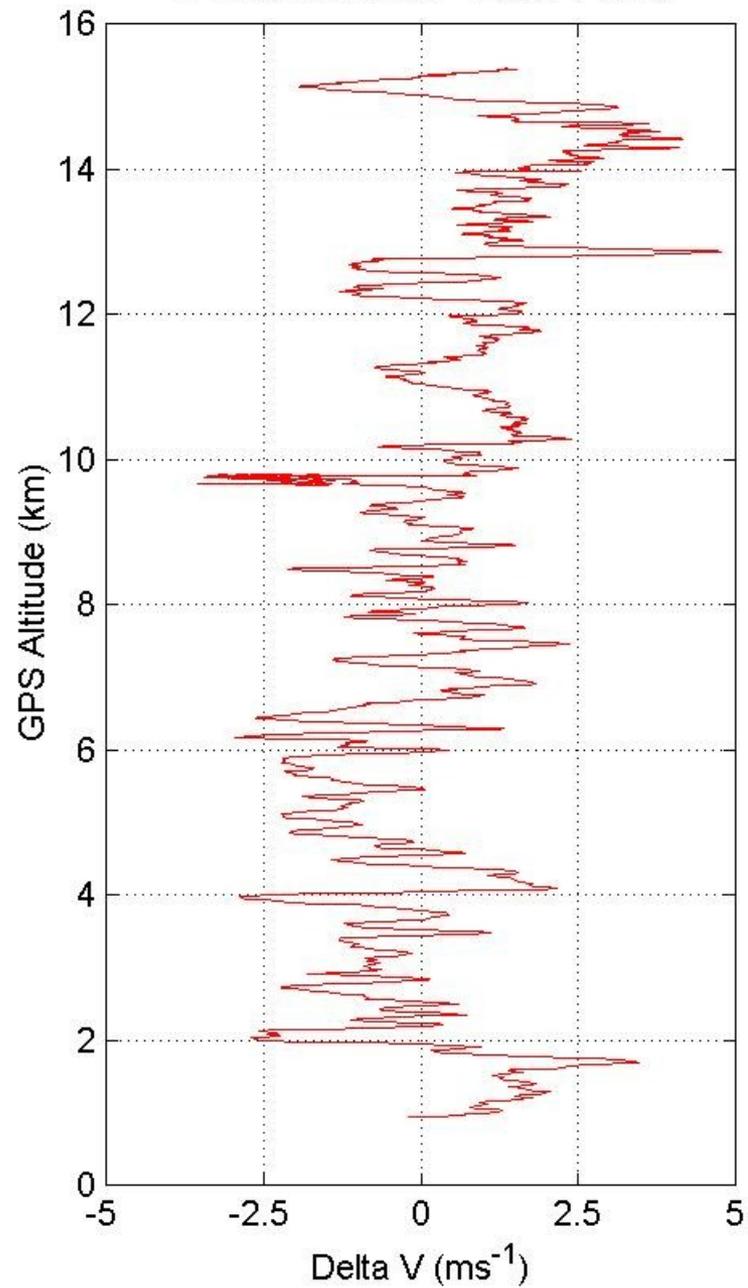
111109 18Z MMS - EDW Ts



111109 18Z MMS - EDW U wind



111109 18Z MMS - EDW V wind



MMS Wind Data Reduction Methods for ATTREX-2011

1. Litton 100-G Inertial Navigation System (S/N 1032) has a bad GPS module

111020, 111024, 111028:

Litton 100-G attitude (pitch/roll/heading) was combined with C-MIGITS-III velocity ($V_x/V_y/V_z$) and position (latitude/longitude).

Exception: On 111028 after 124000 UTsec, Litton unit lost alignment.

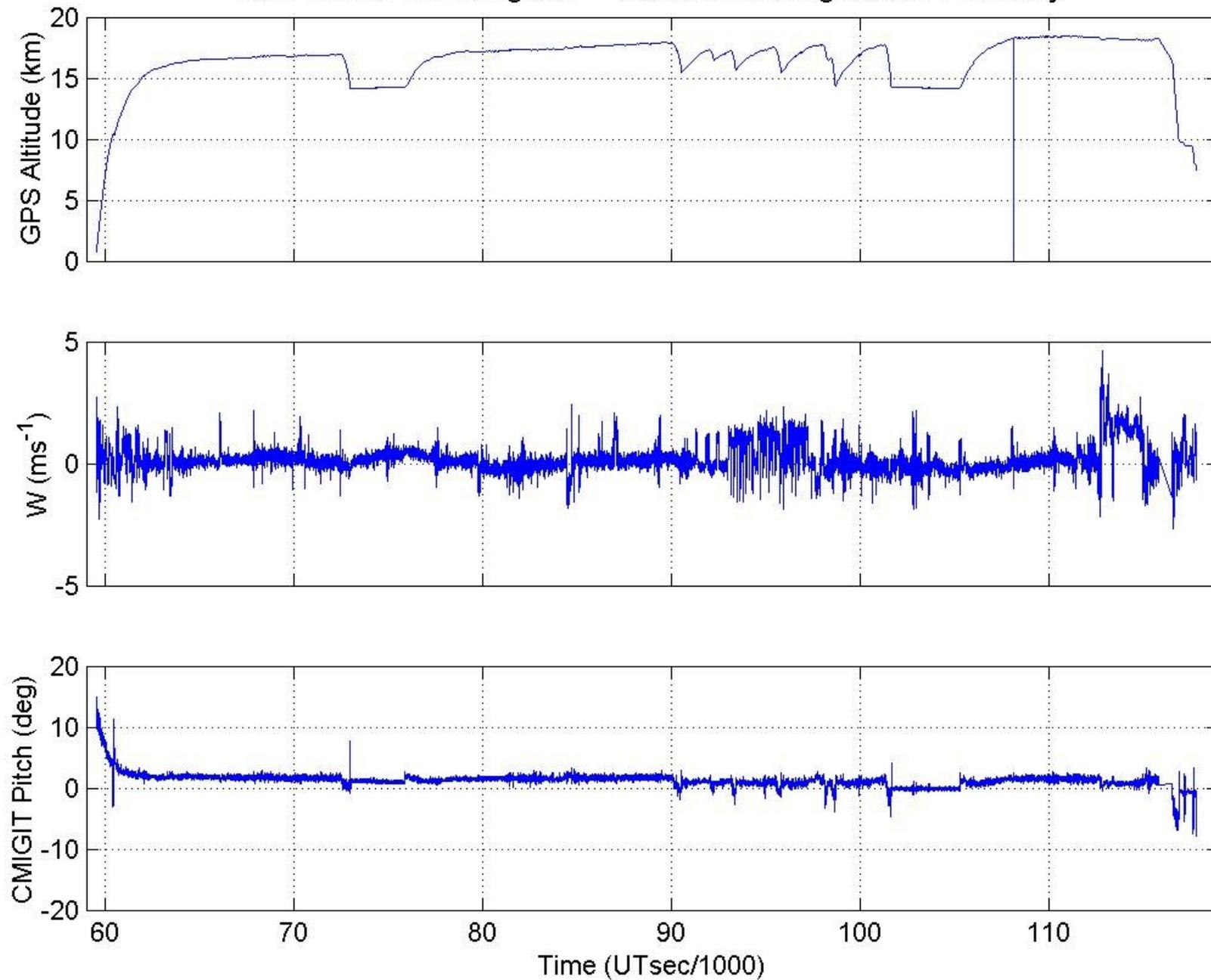
2. Last Two Flights: Litton 100-G was removed from the airplane

111105, 111109:

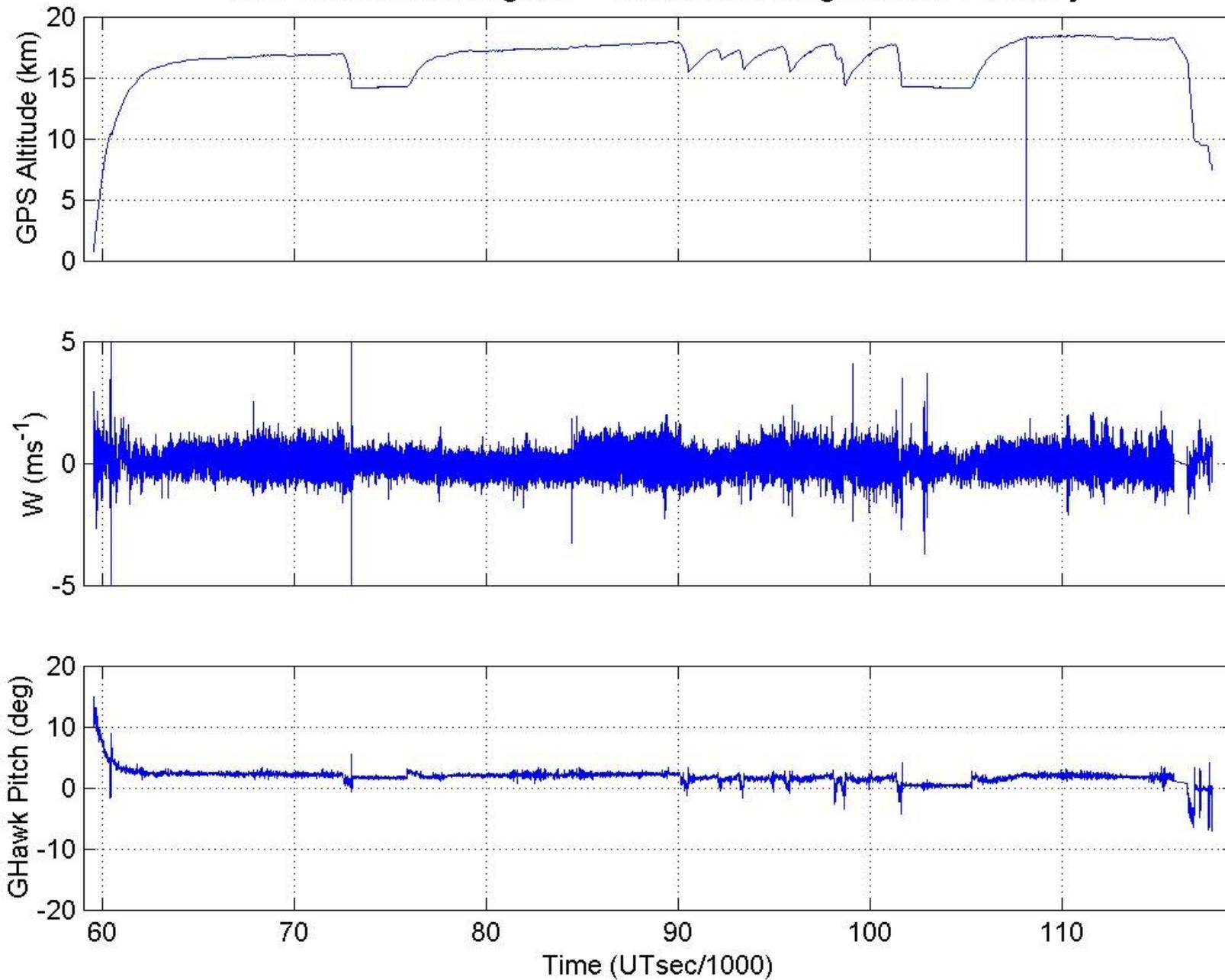
Select GHawk INS variables were grab-sampled @ 1 Hz (NASDAT); combined with C-MIGITS data. [GHawk data suffered amplitude loss]

- a) GHawk pitch & roll low-passed @ 0.14 Hz and combined with high-passed CMIGITS pitch & roll.
- b) GHawk V_z was low-passed @ 0.14 Hz, no high-pass necessary.
- c) GHawk heading was smoothed (1 second running average)
- d) All GHawk variables were time shifted to account for latency (1.0 ± 0.1 seconds)

20111105 ATTREX Flight #4 -- Vertical Wind using CMIGIT Pitch Only



20111105 ATTREX Flight #4 -- Vertical Wind using NASDAT Pitch Only



b) Horizontal Winds

Horizontal winds were unavailable or were less accurate during select times, as follows:

<u>Date</u>	<u>Time</u>	<u>Status</u>	<u>Reason or Symptom</u>
111028:	>124000 UTsec	Unavailable	No CMIGIT Heading No Litton 100-G Heading
111105:	112750-113450 UTsec	Impaired	No CMIGIT Ground Speed <i>Used RACAL ground speeds</i>
111109:	97640-97920 UTsec 99470-99600 UTsec 105000-105350 UTsec 106100-106600 UTsec 118620-119200 UTsec 125650-126100 UTsec 135220-135500 UTsec >146700 UTsec	Impaired	No CMIGIT Ground Speed <i>Used RACAL ground speeds</i>
	146700-146900 UTsec 148150-148200 UTsec >148300 UTsec	Unavailable	No CMIGIT Ground Speed Poor RACAL ground speeds

Total Lost or Impaired Data:

111028:	~4.4 hours
111105:	~0.2 hours
111109:	~1.2 hours

c) *Vertical Winds*

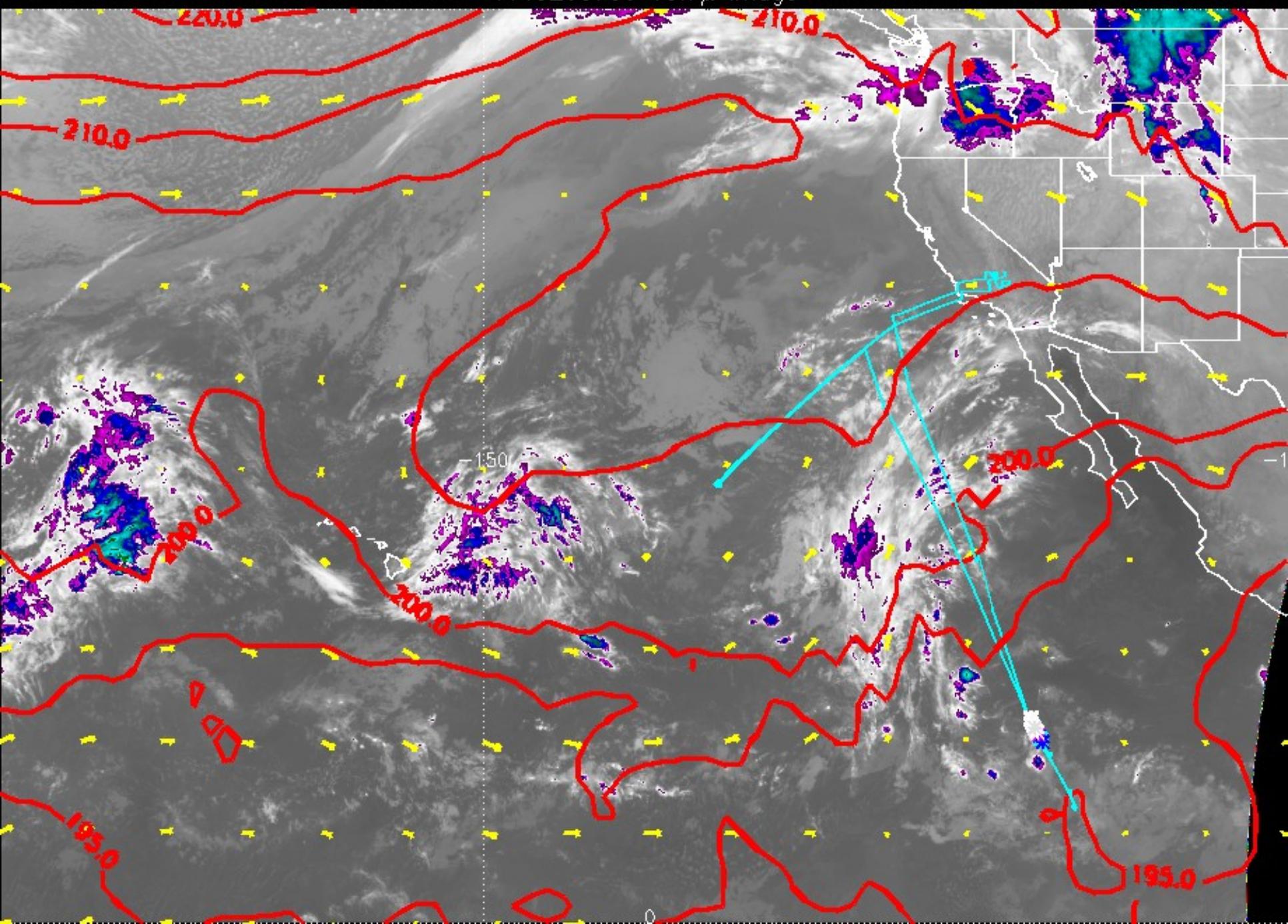
Vertical winds were unavailable during select times, as follows:

<u>Date</u>	<u>Time</u>	<u>Status</u>	<u>Reason or Symptom</u>
111020:	69800-70200 UTsec	Unavailable	No CMIGIT Vz No Zdot (from Litton 100-G)
111028:	>124000 UTsec	Unavailable	No CMIGIT Vz No Zdot (from Litton 100-G)
111105:	>112700 UTsec	Unavailable	No CMIGIT Pitch available to merge with GHawk Pitch
111109:	99400-101000 UTsec 105000-105400 UTsec 106100-106800 UTsec 118500-119200 UTsec 125300-126300 UTsec >146700 UTsec	Unavailable	No CMIGIT Pitch available to merge with GHawk Pitch

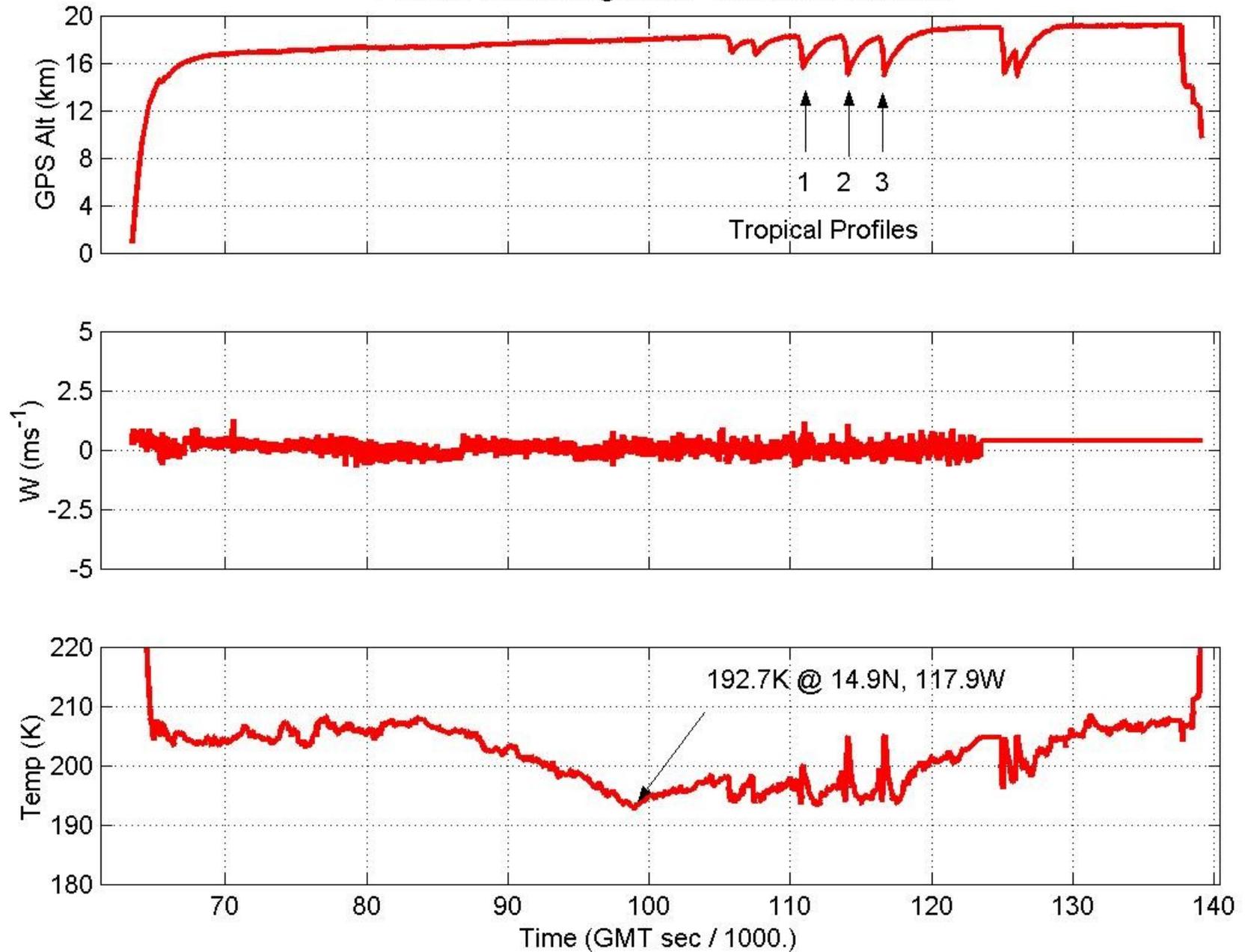
Total Lost or Impaired Data:

111020:	~0.1 hours
111028:	~4.4 hours
111105:	~1.7 hours
111109:	~1.9 hours

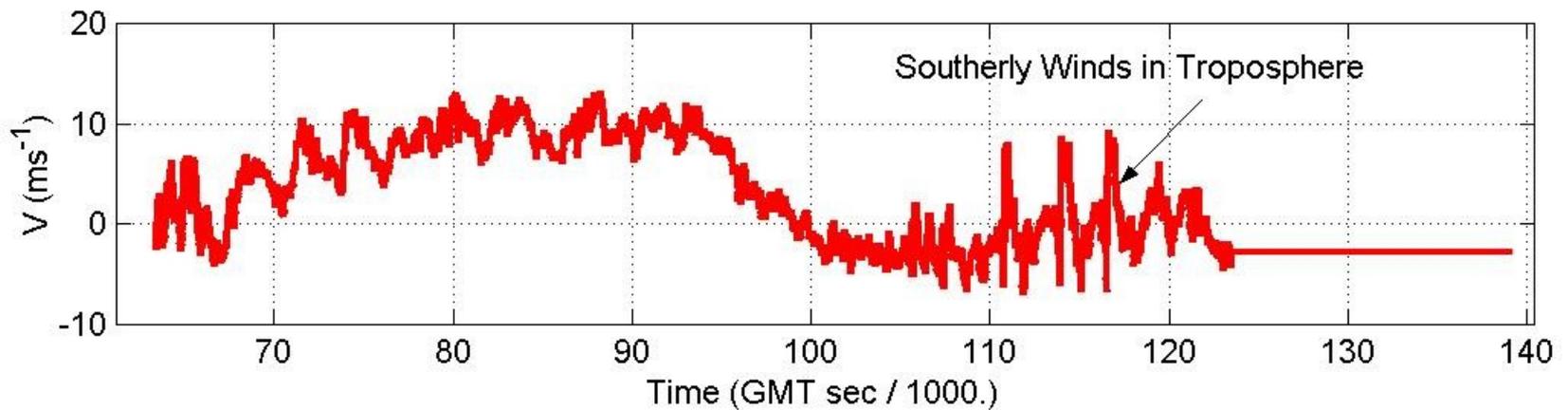
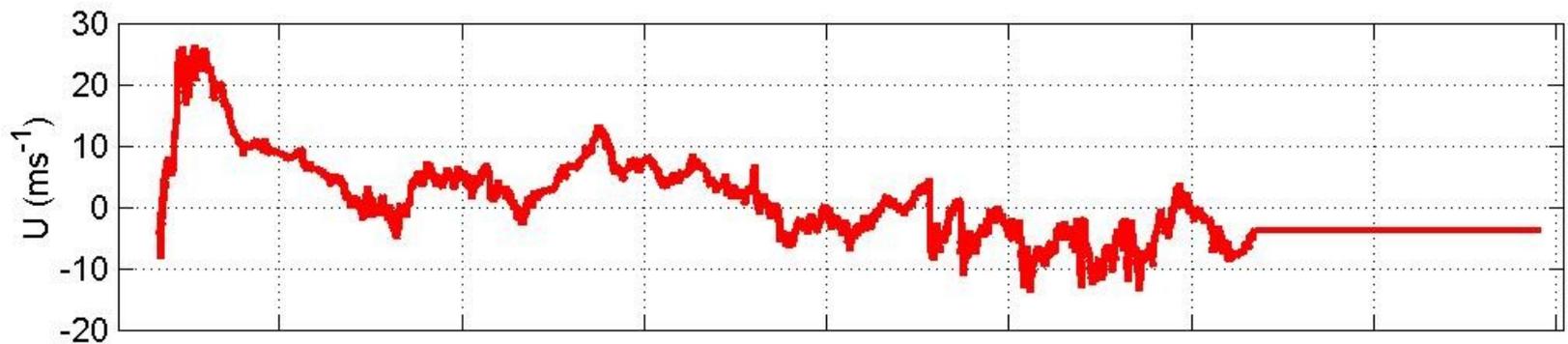
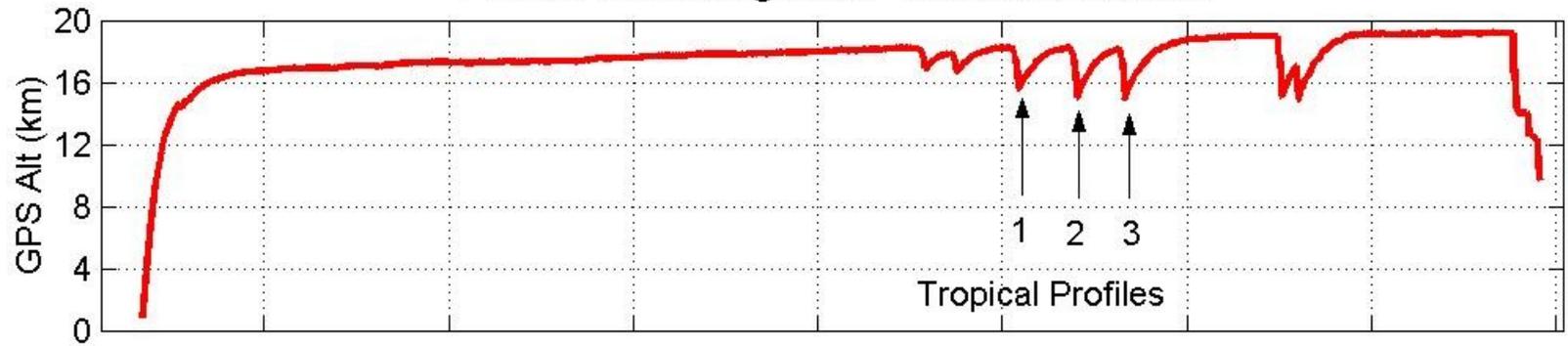
1110290730 10.7 μ image



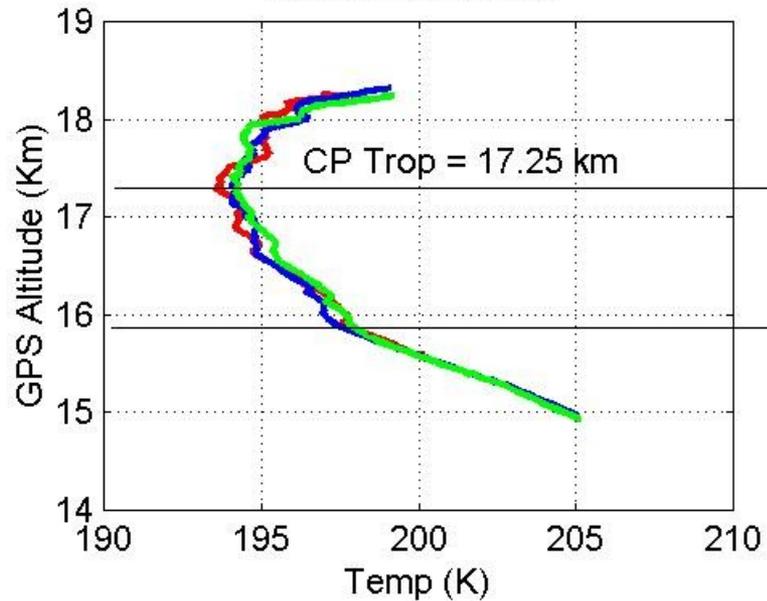
111028 ATTREX flight #03 -- Revised MMS Data



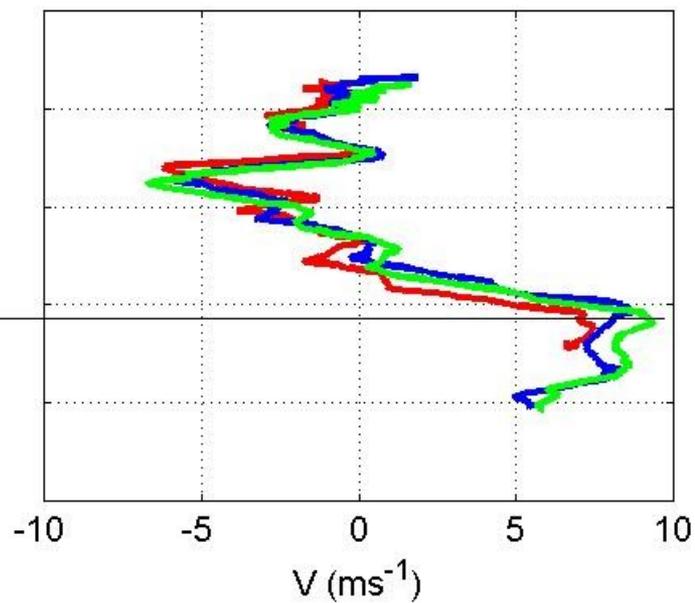
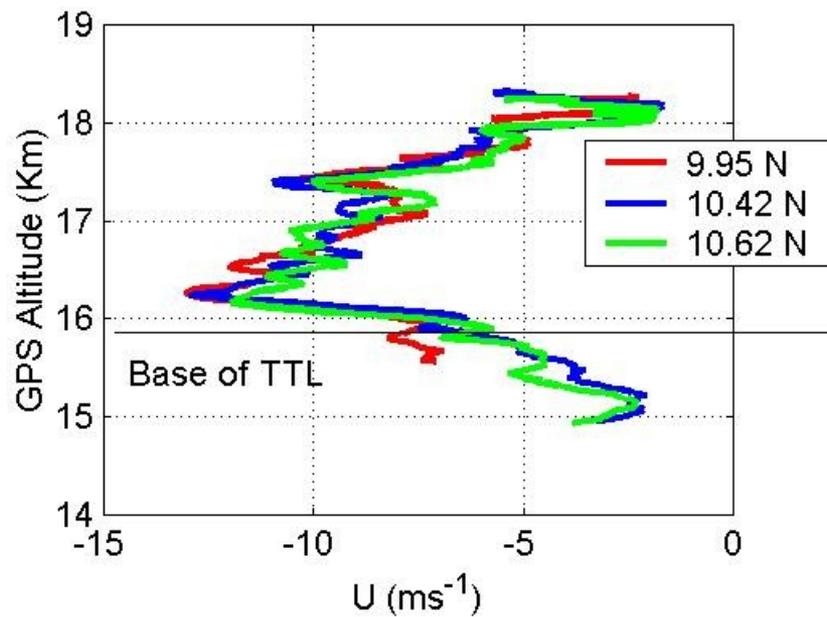
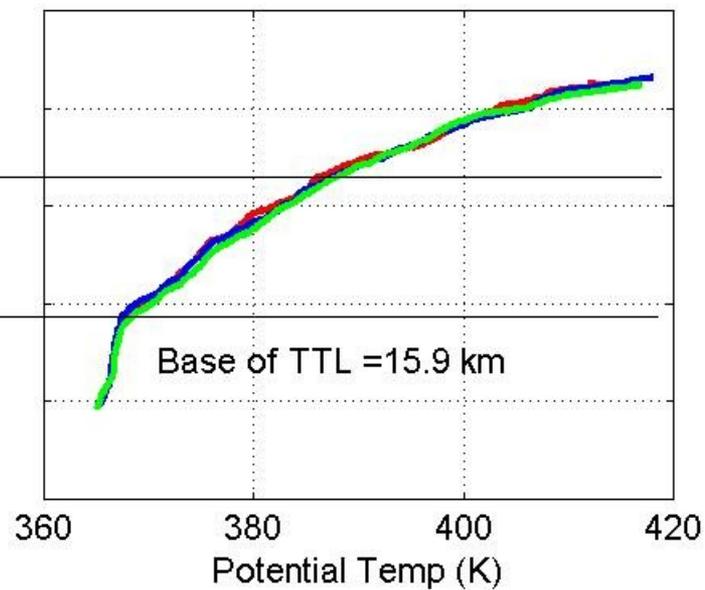
111028 ATTREX flight #03 -- Revised MMS Data

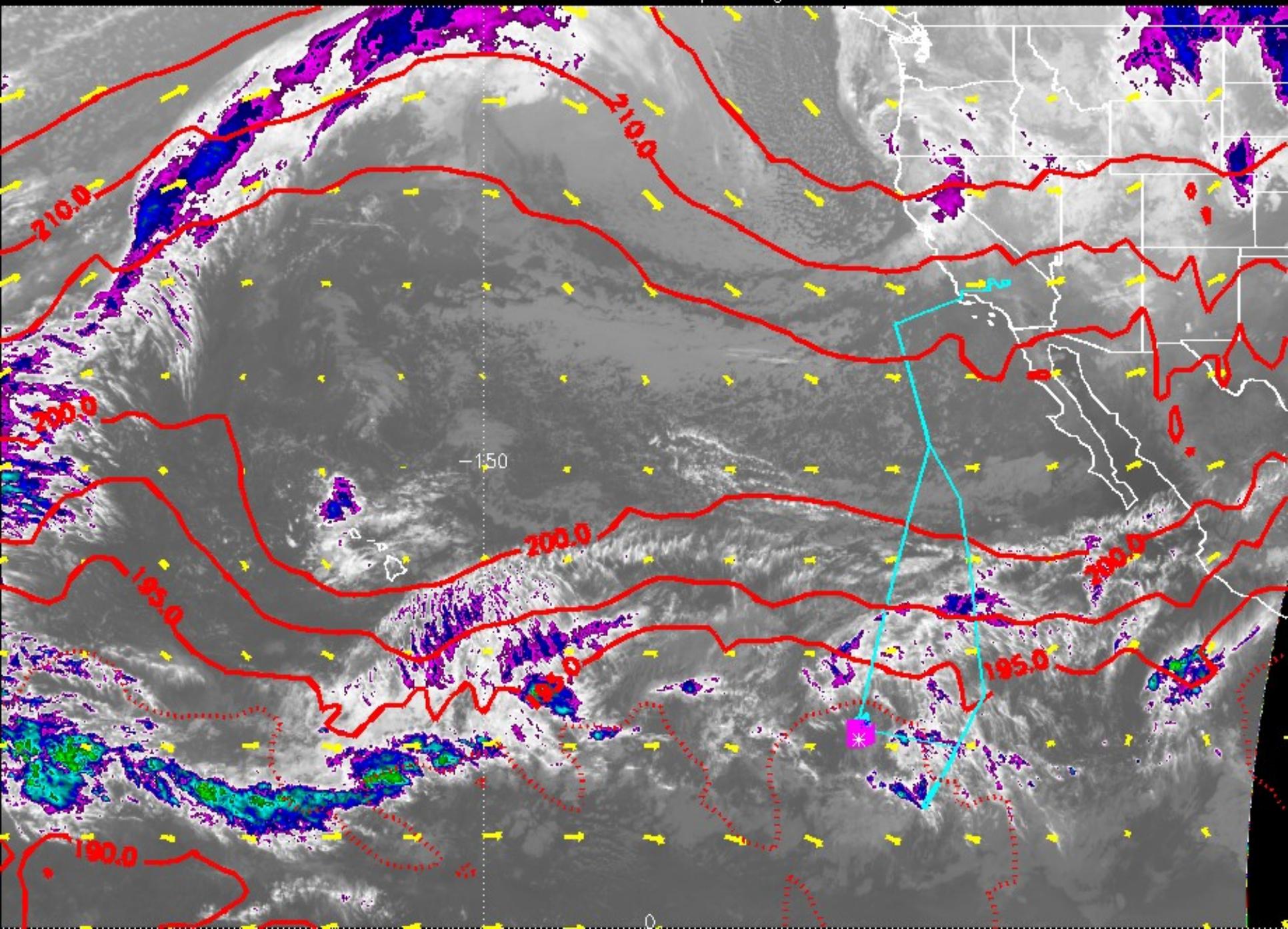


Global Hawk MMS

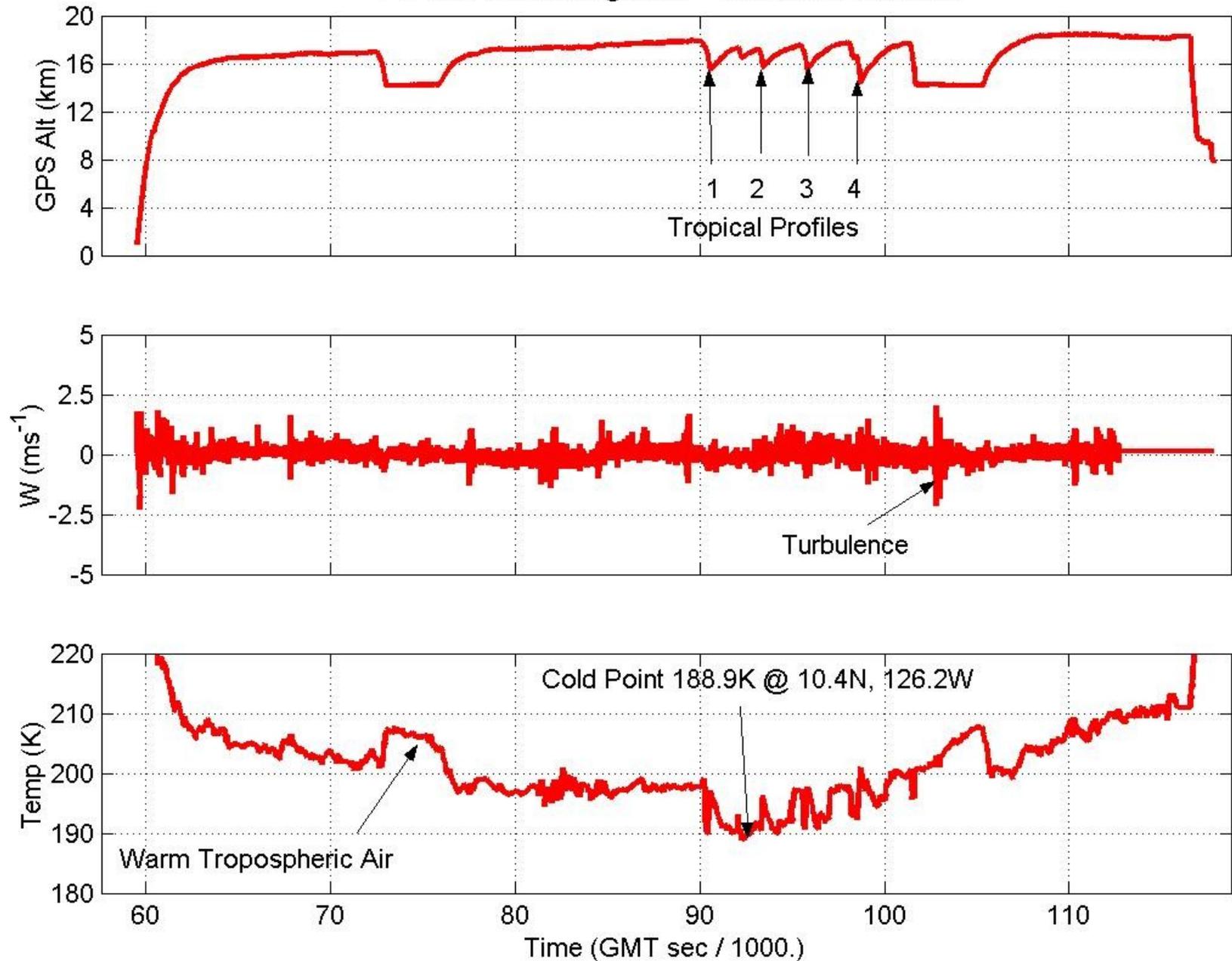


20111028 Descent Profiles

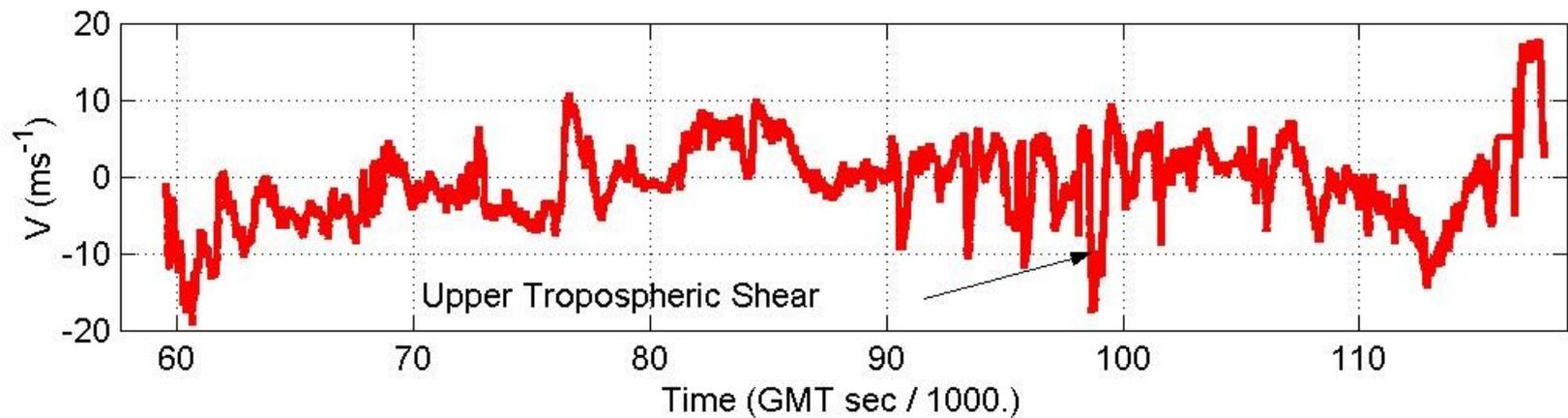
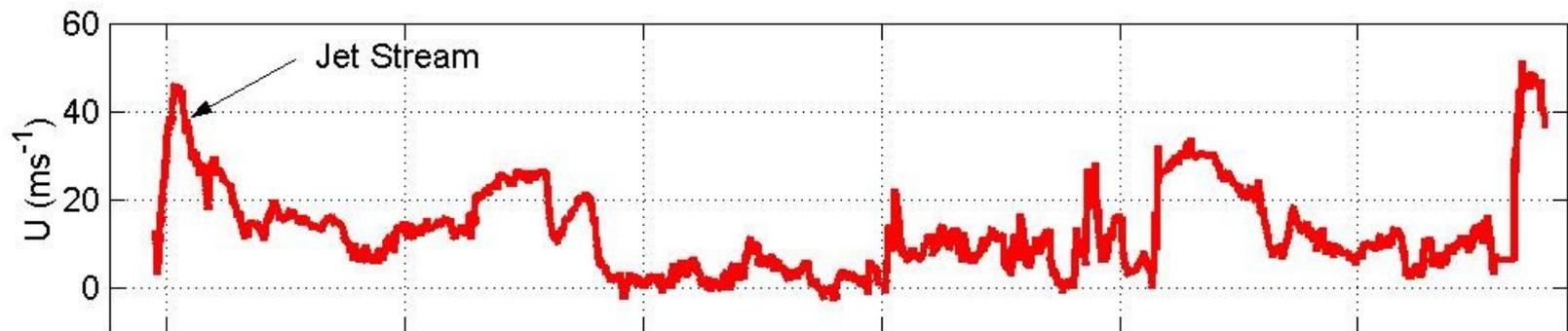
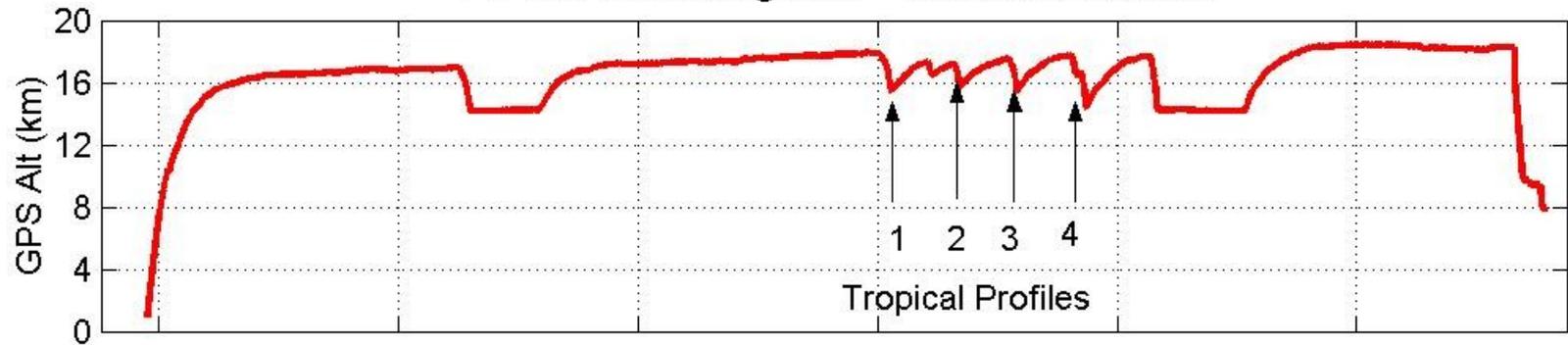




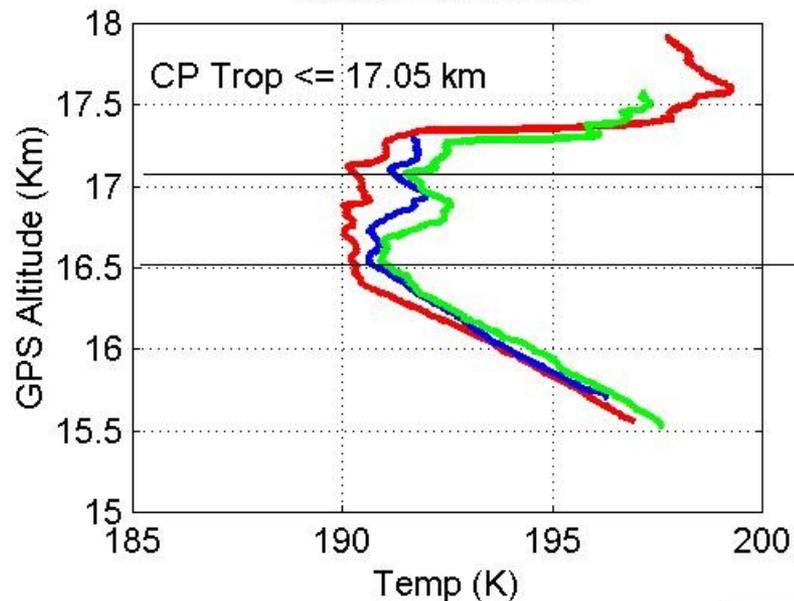
111105 ATTREX flight #04 -- Revised MMS Data



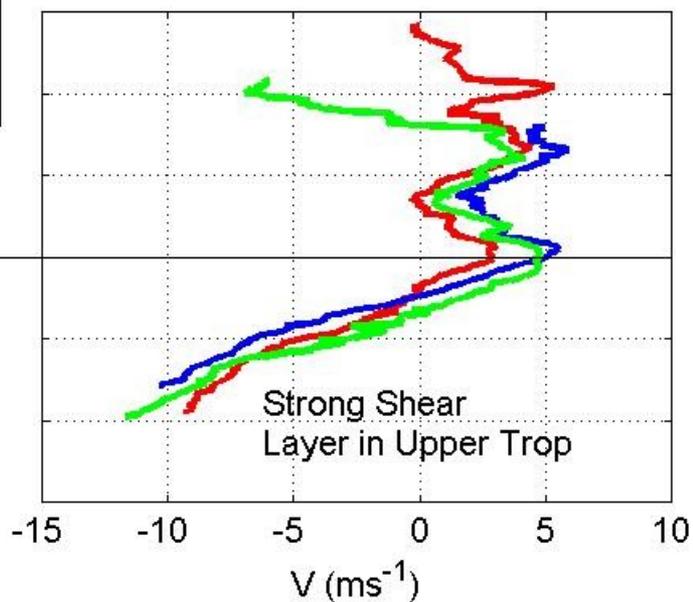
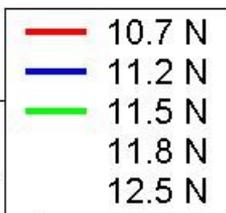
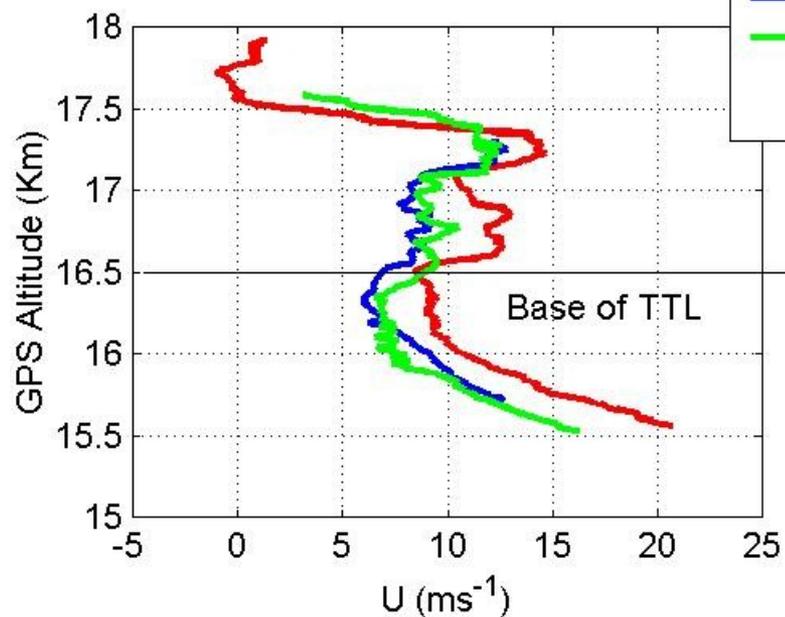
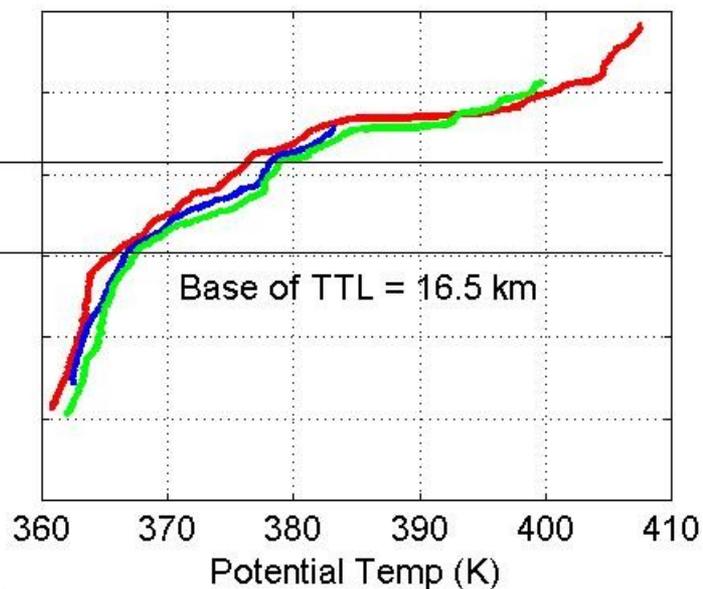
111105 ATTREX flight #04 -- Revised MMS Data



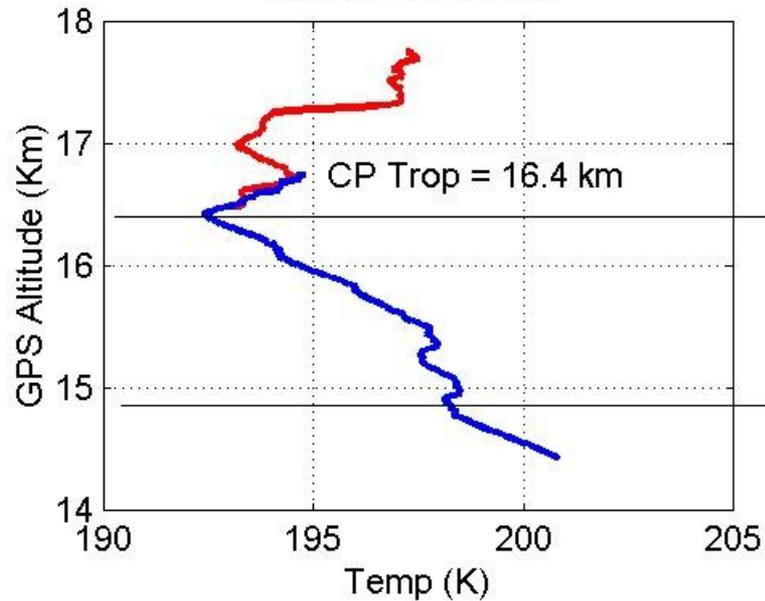
Global Hawk MMS



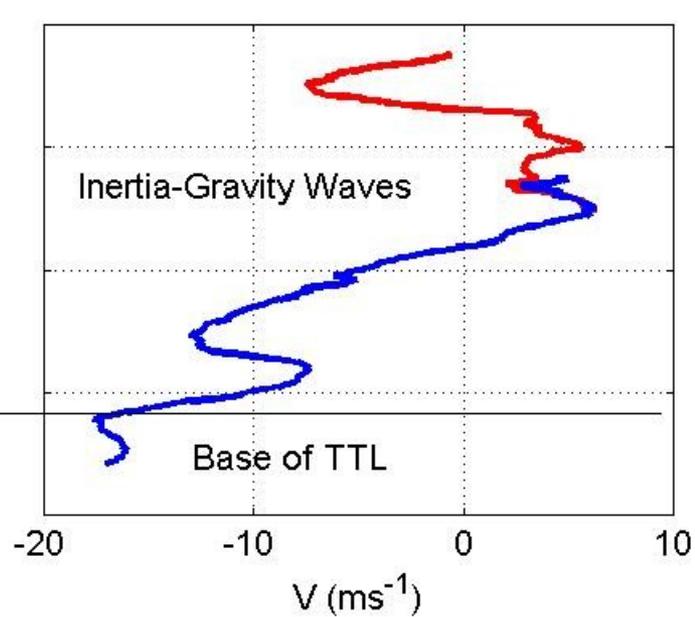
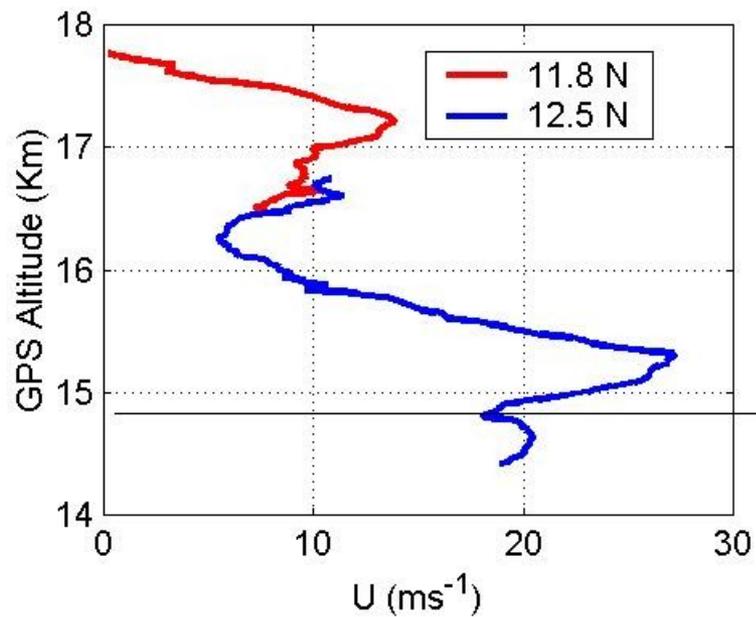
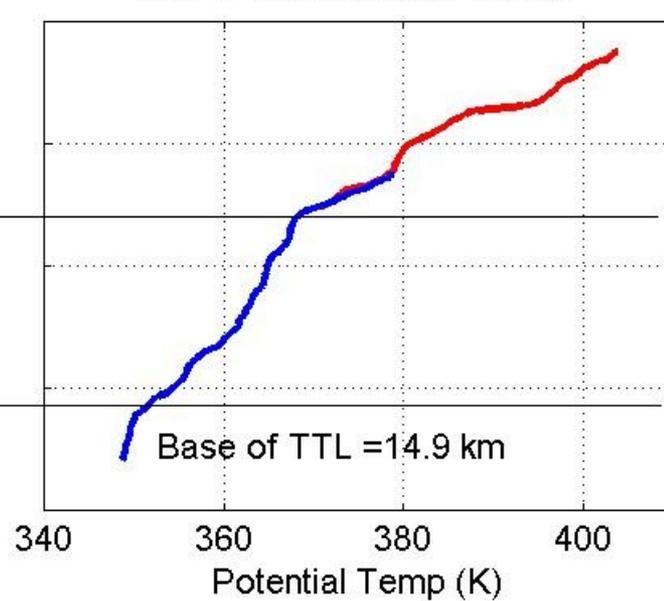
20111105 Descent Profiles

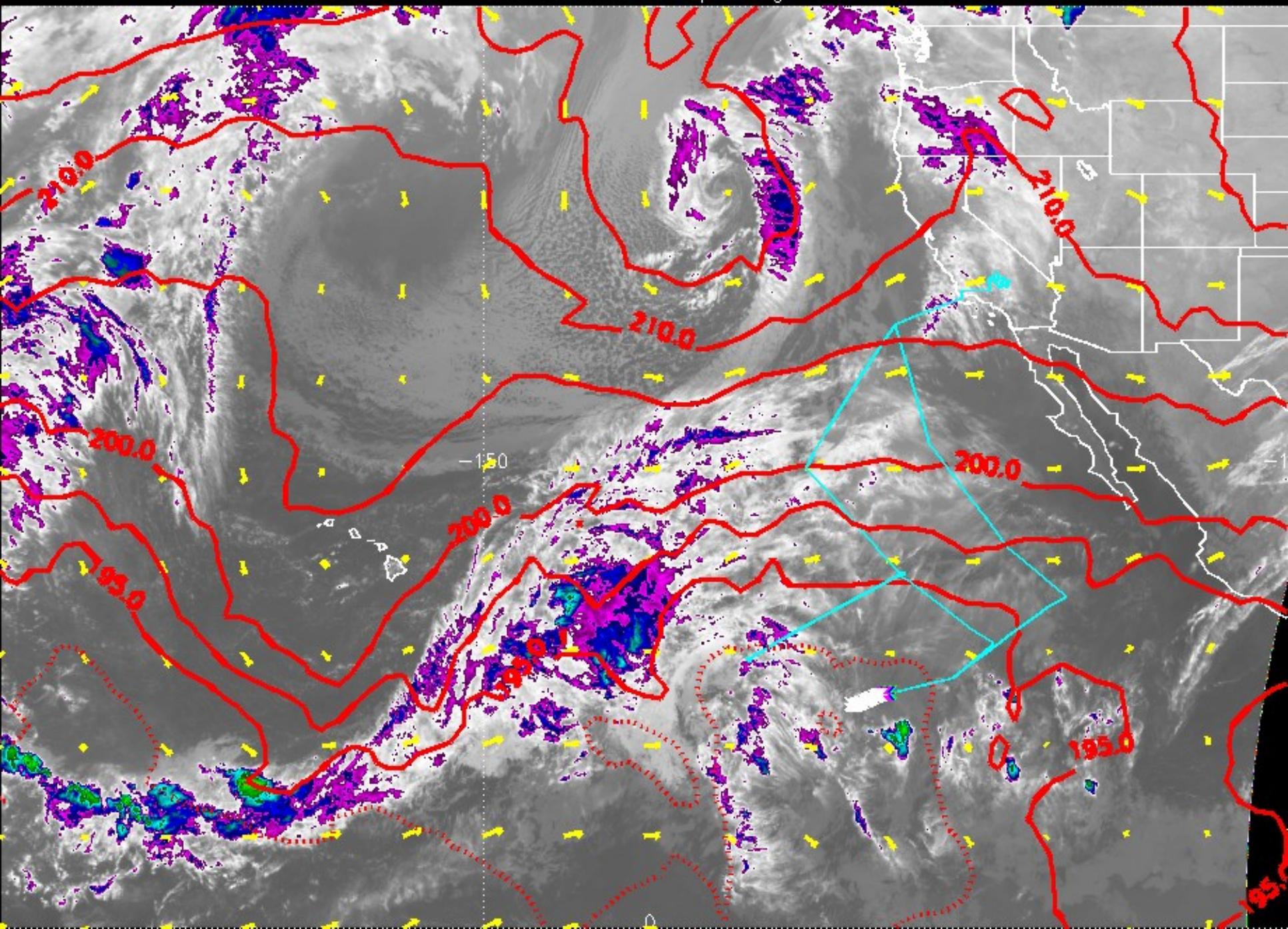


Global Hawk MMS

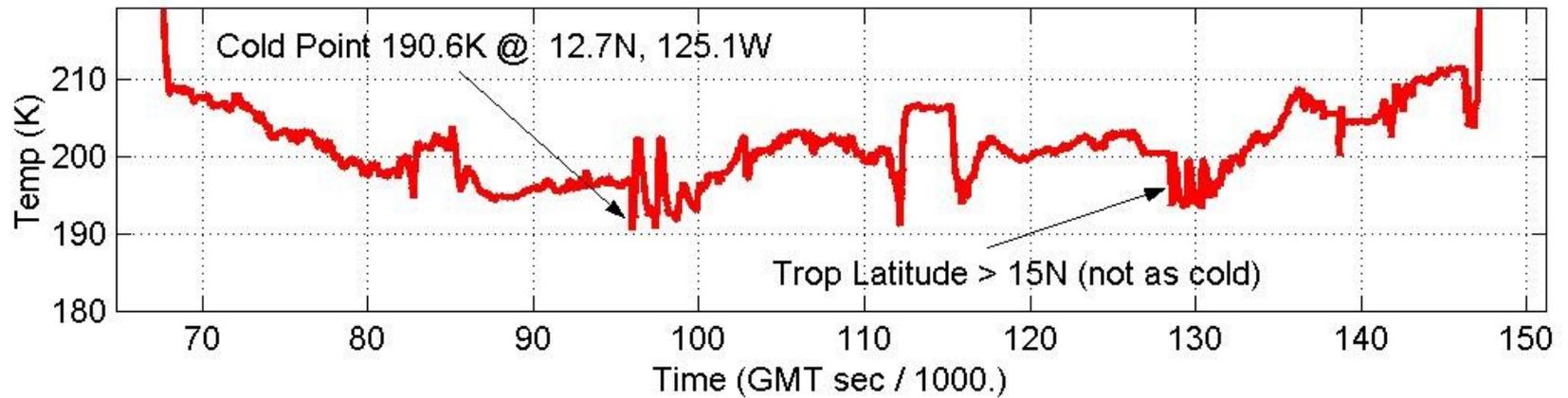
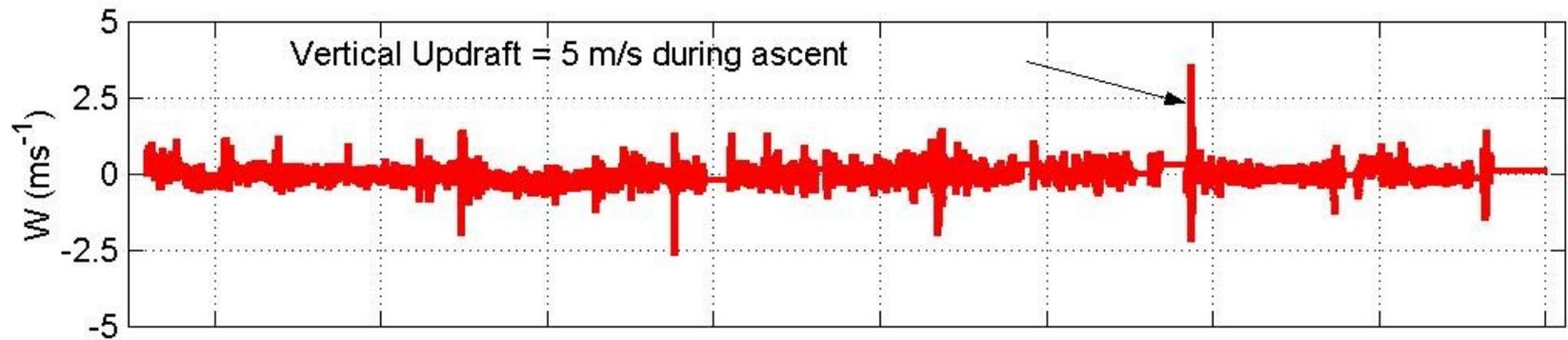
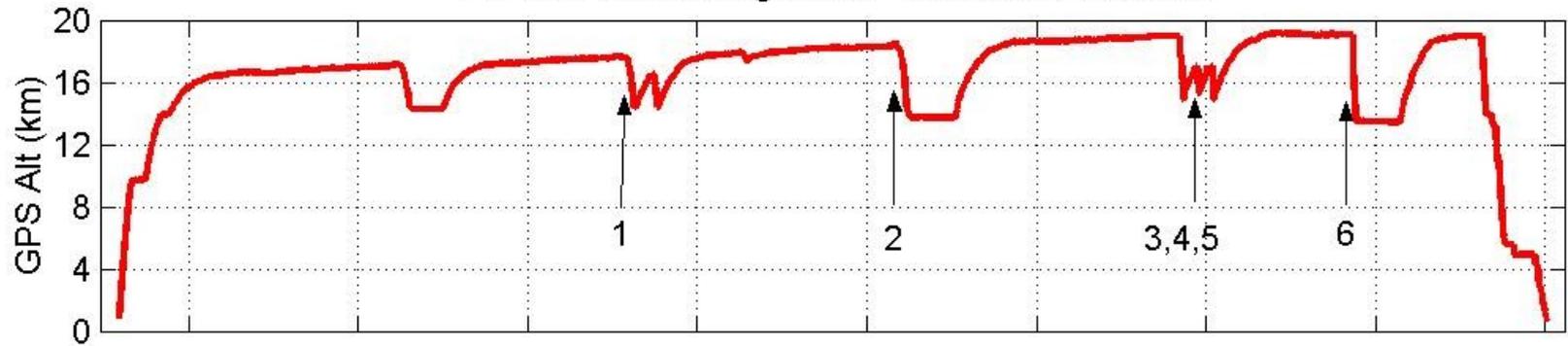


20111105 Descent Profiles

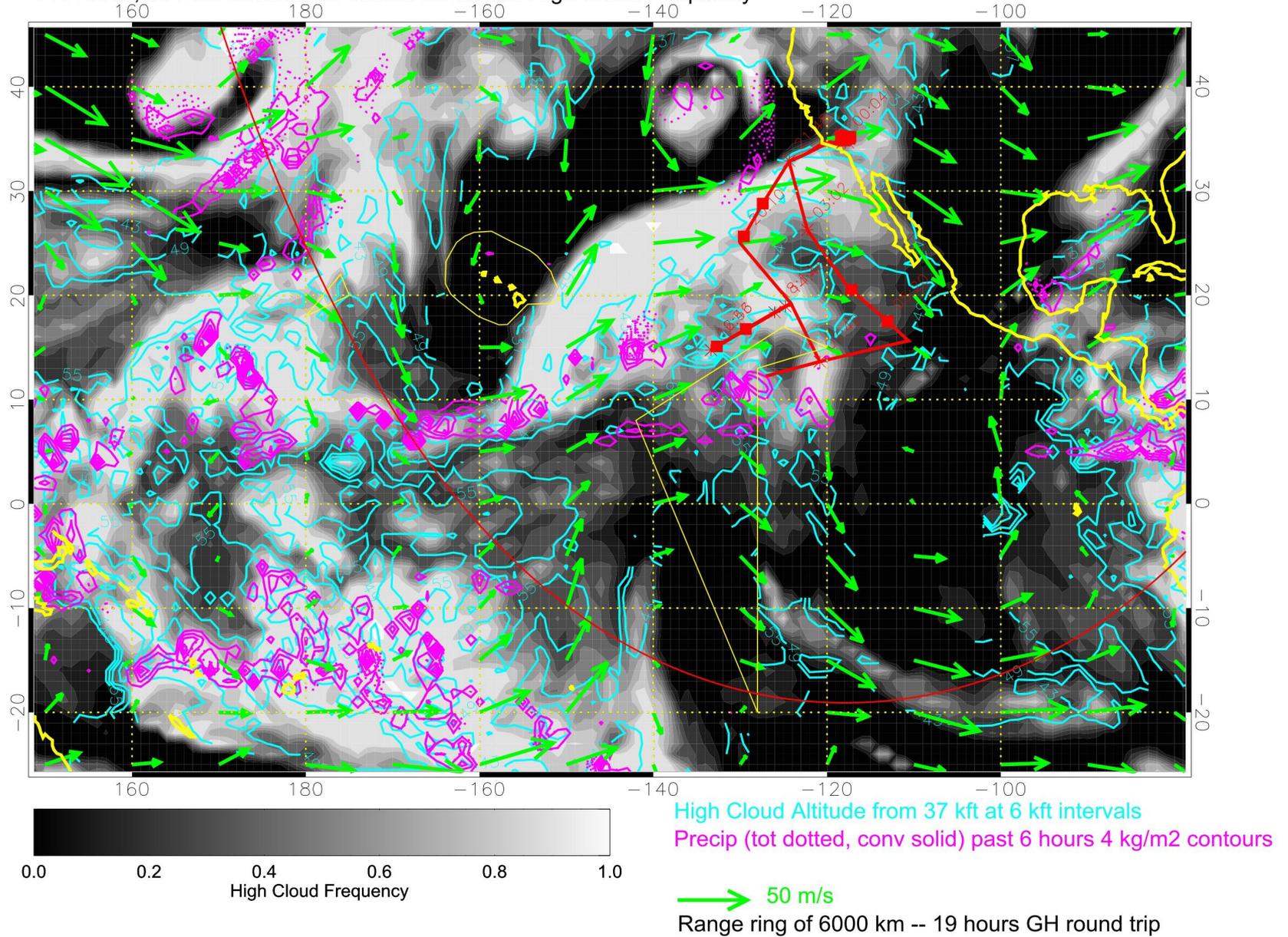


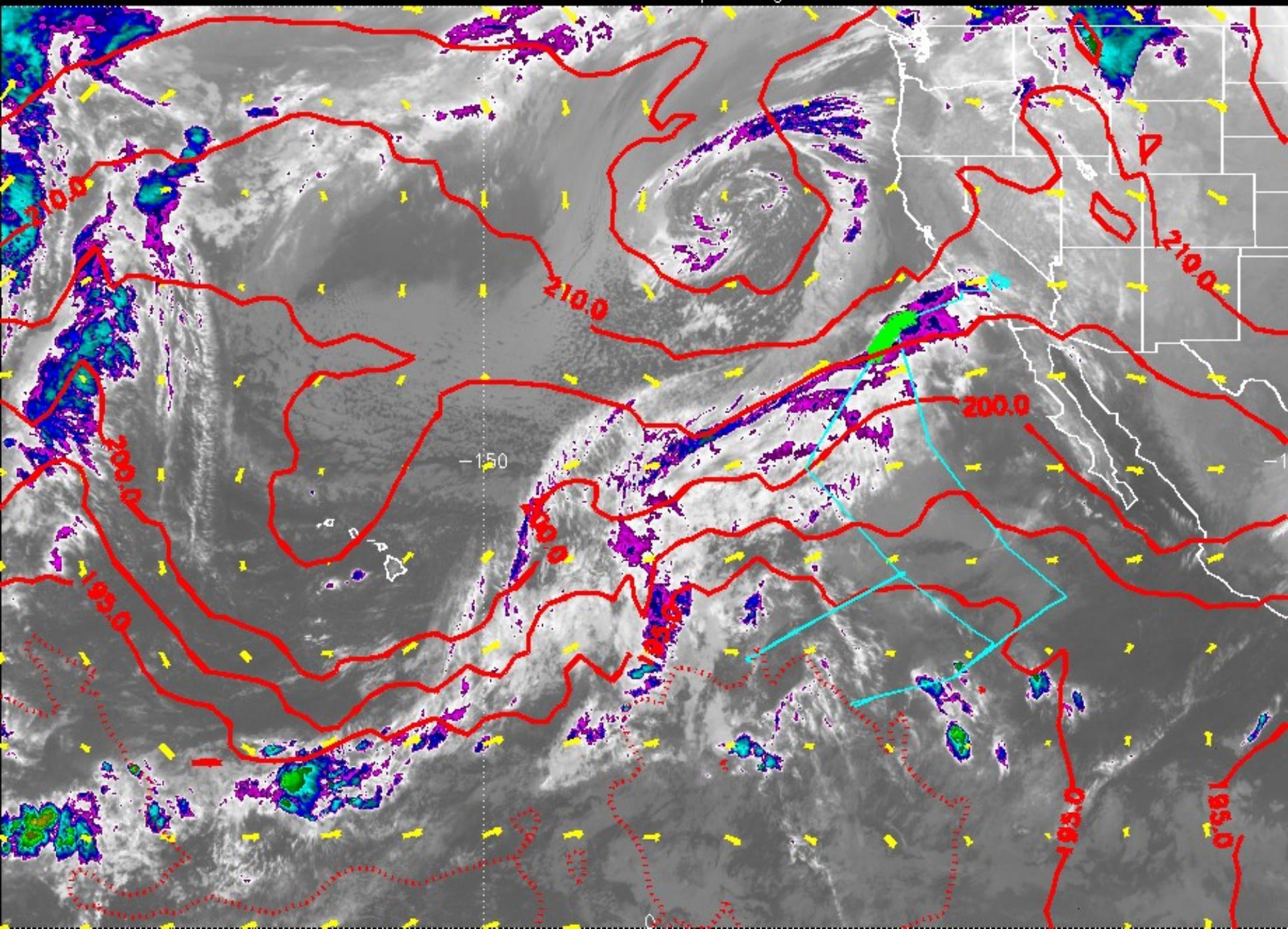


111109 ATTREX flight #05 -- Revised MMS Data

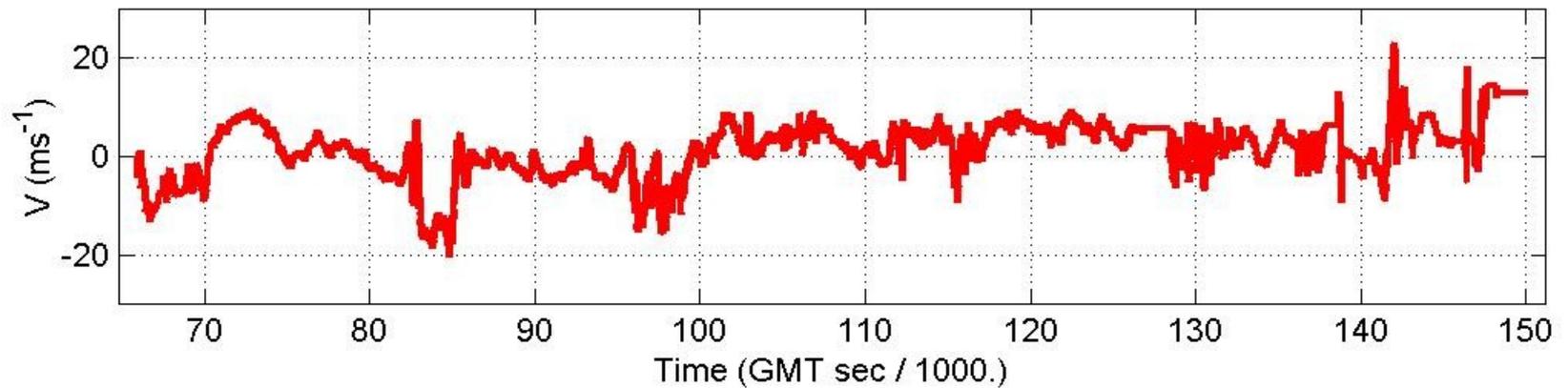
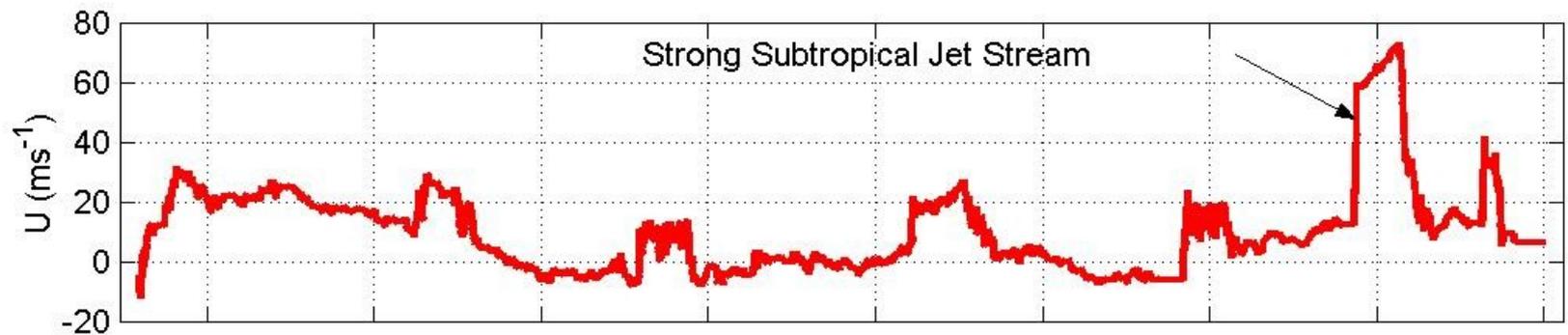
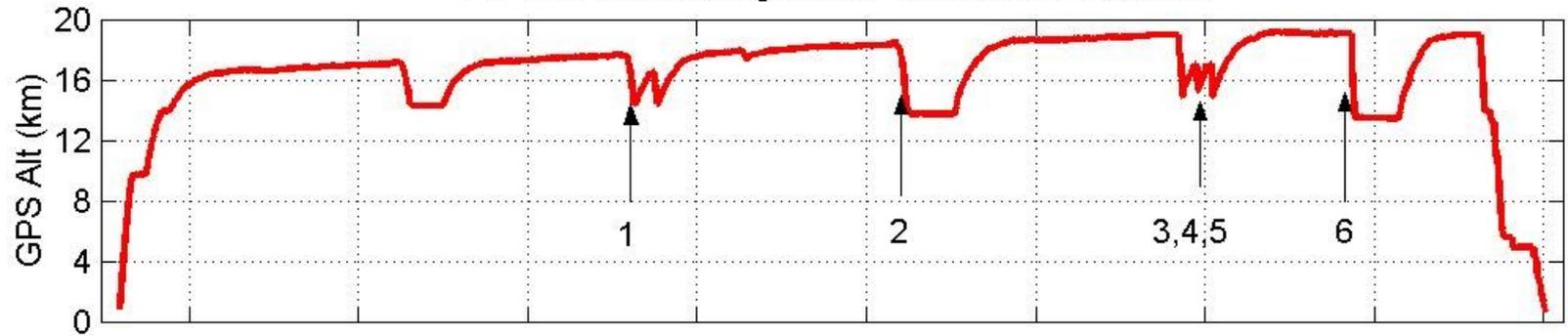


11111018, 30 hour forecast for 150mb winds and High Cloud Frequency

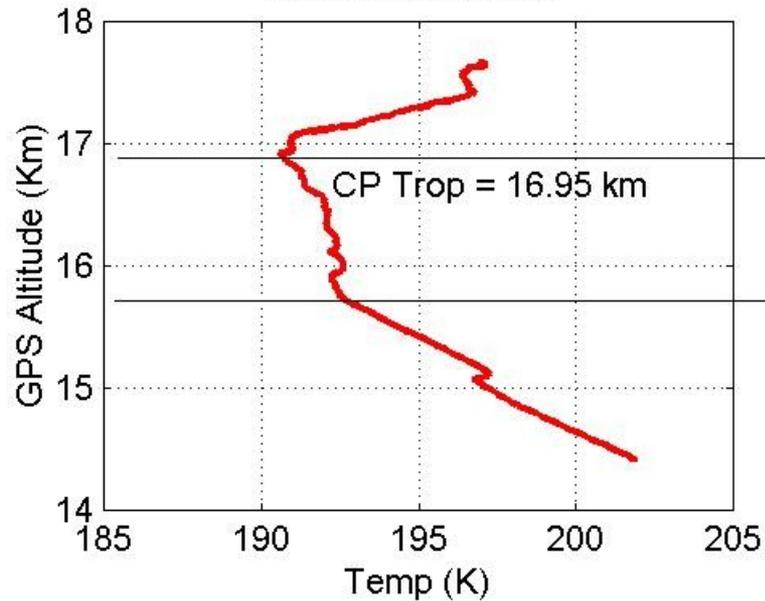




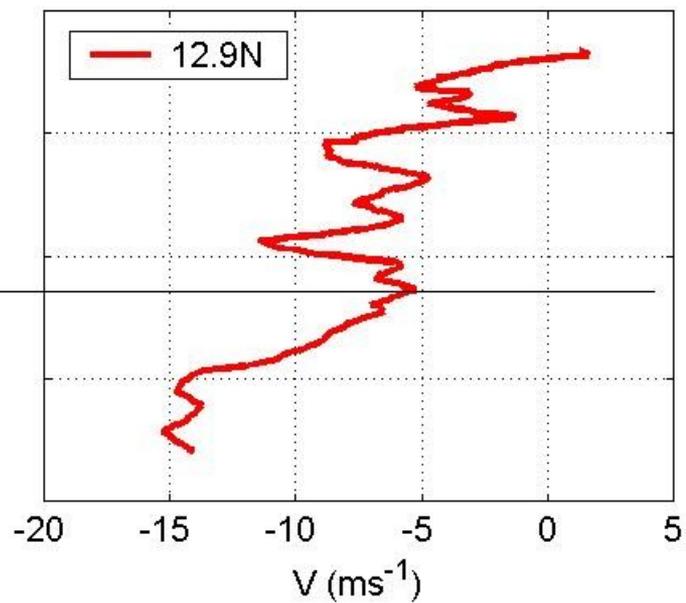
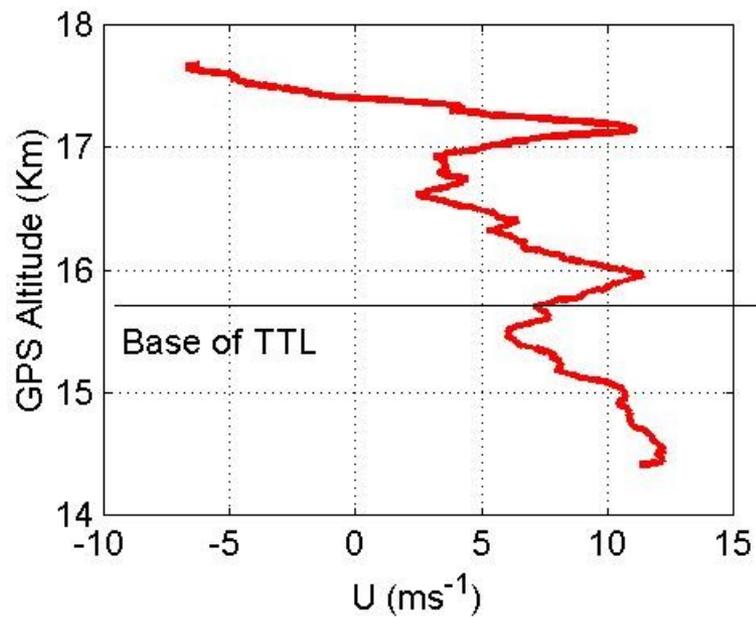
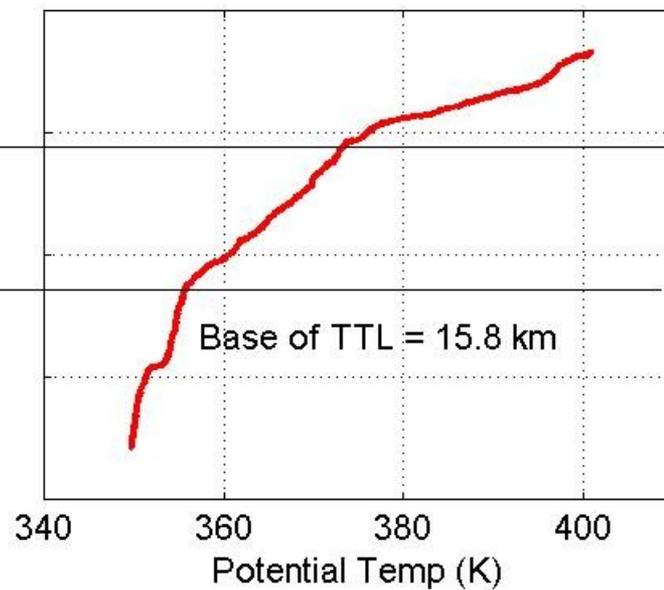
111109 ATTREX flight #05 -- Revised MMS Data



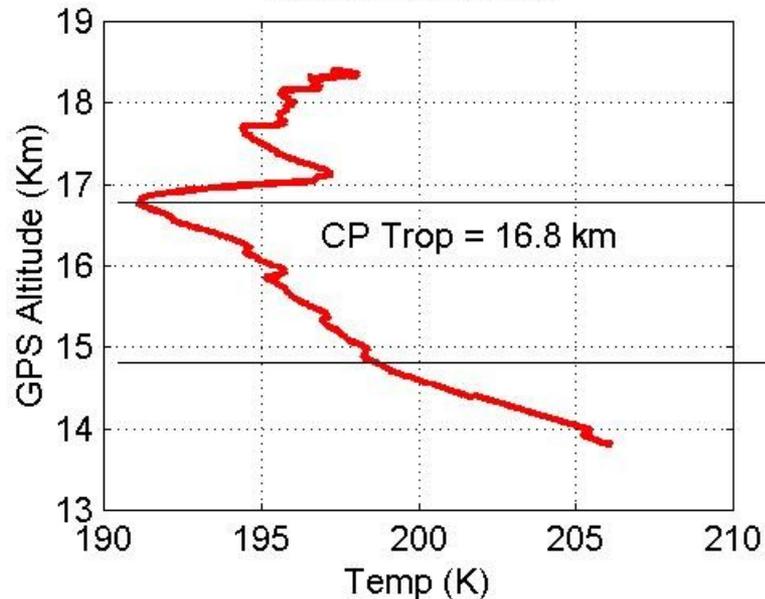
Global Hawk MMS



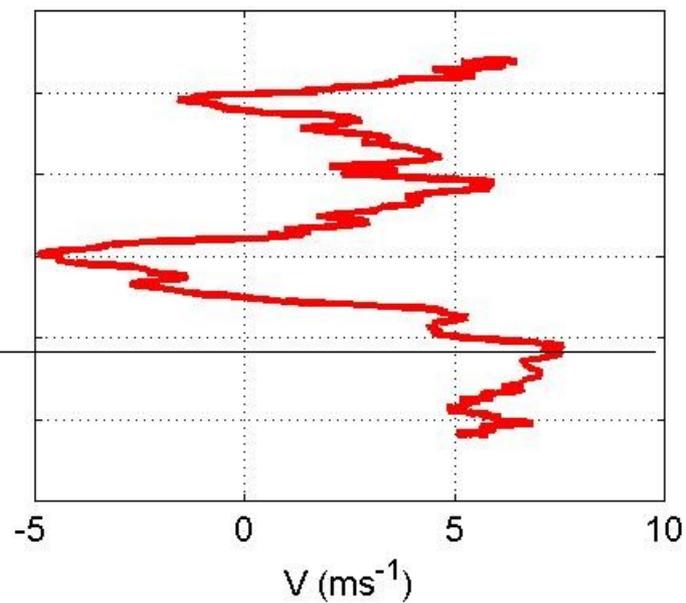
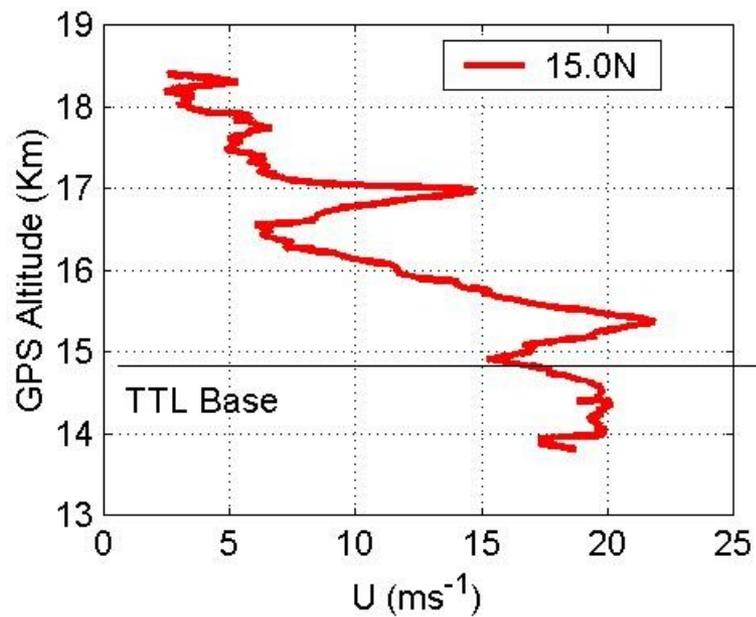
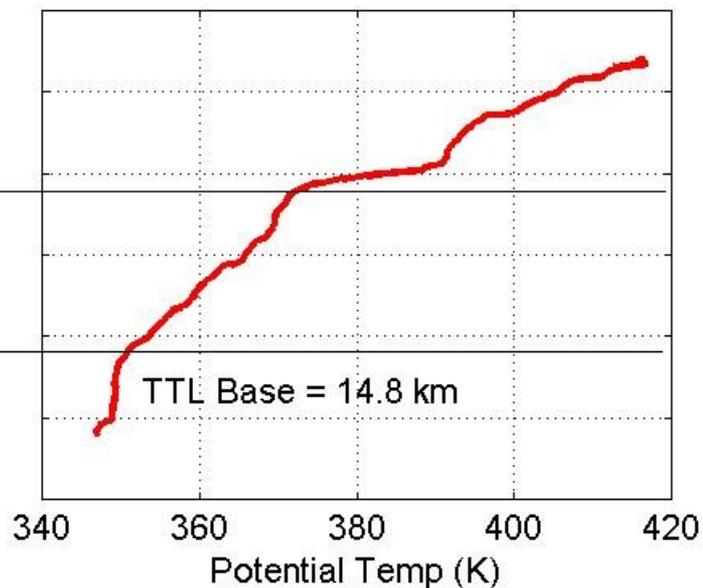
20111109 Descent Profiles



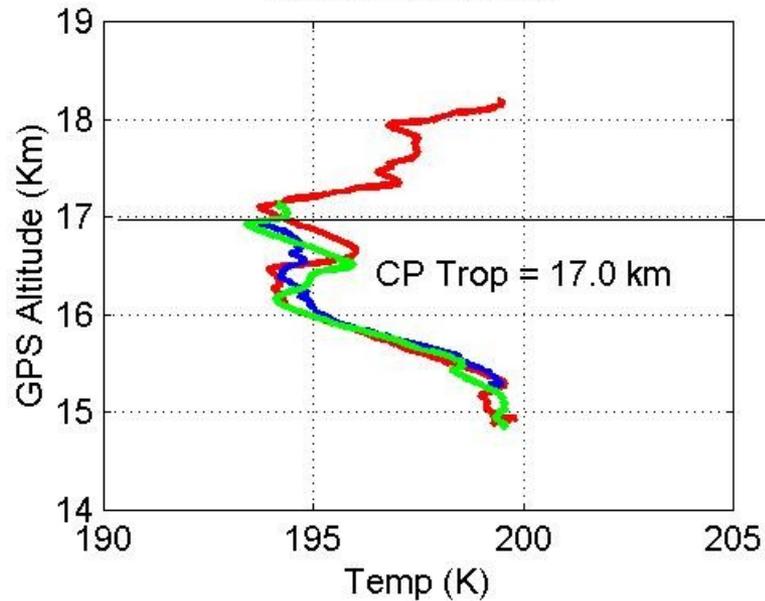
Global Hawk MMS



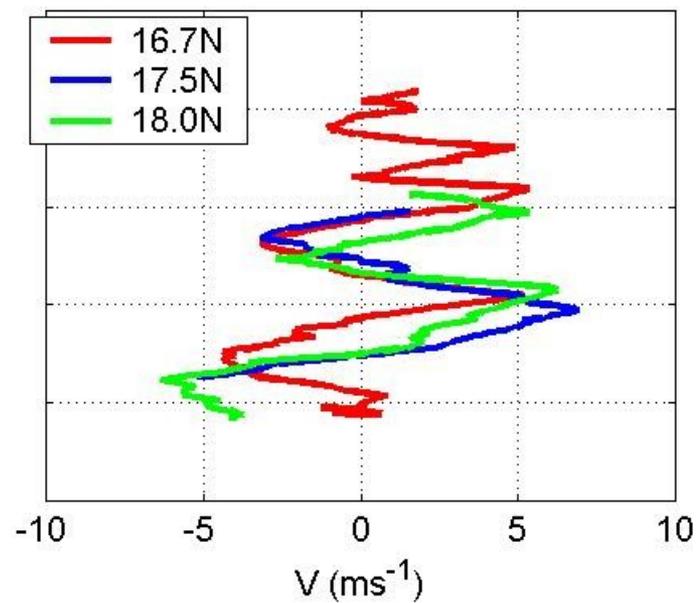
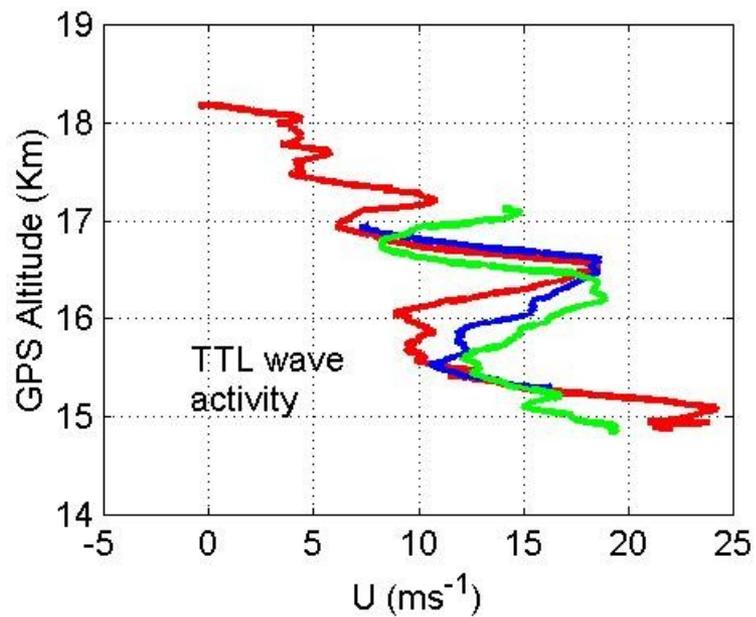
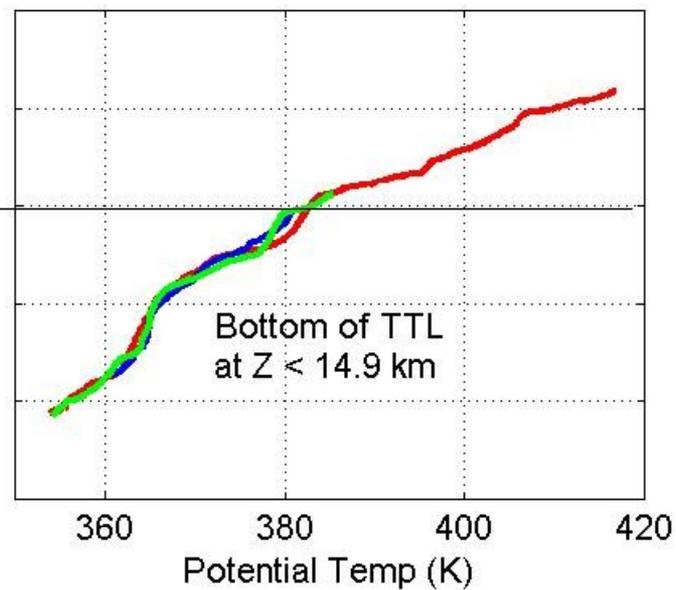
20111109 Descent Profiles



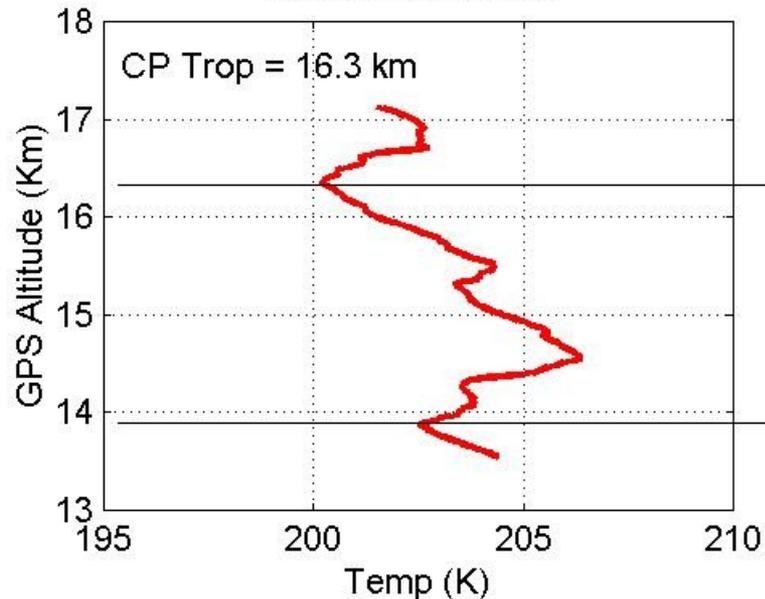
Global Hawk MMS



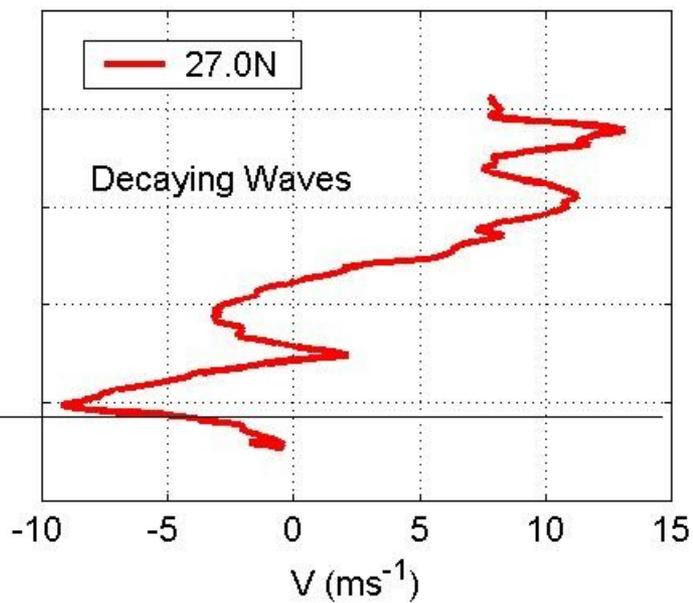
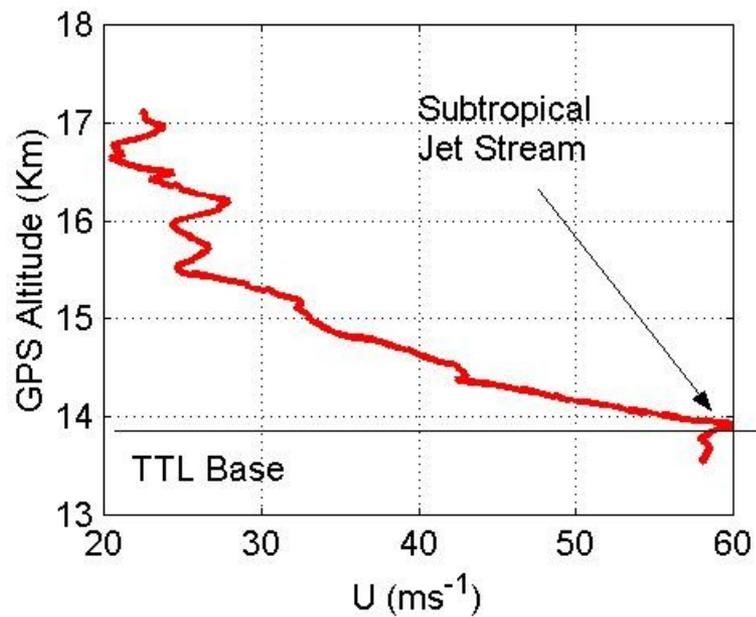
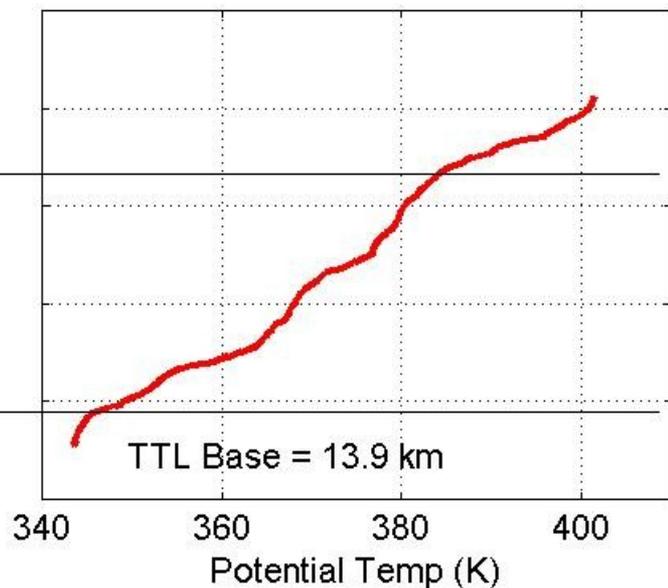
20111109 Descent Profiles



Global Hawk MMS



20111109 Descent Profiles



Tropical Tropopause Layer Observations in the Eastern Pacific
(between 10° and 27° N)

Lower Boundary (defined as discontinuity in lapse rate):

13.9 – 16.5 km; higher altitudes toward the equator)

Upper Boundary (cold point tropopause)

16.3 – 17.2 km (90 – 100 hPa)

Aged anvil cirrus was observed as high as 16.8 km (111109, descent #2)

Tropopause Temperatures:

189 – 194 K (in situ observations can be 2 – 3K colder than NCEP forecast)

Subtropical Jet Stream (on 111109 only):

Northern Transit, near 30° N.

Peak wind of 73 ms⁻¹ at 13.5 km (160 hPa level, just below lower boundary)

Southern Transit: GHawk flew considerably further south, missed jet max

Mesoscale Waves and Wind Shear Layers:

Often observed, with reproducible signatures within the TTL wind and temperature fields when temporal/spatial separations are minimized