

MMS on the NASA Global Hawk: Initial Results from the Global Hawk Pacific Mission (GloPac)

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Airborne Tropical Tropopause Experiment (ATTREX)

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Meteorological Measurement System: Precision and Accuracy Metrics

Variable	Typical Value	Precision	Accuracy
Static Pressure (p)	60 hPa	± 0.01 hPa	± 0.3 hPa
Static Temperature (T)	190 K	± 0.01 K	± 0.3 K
Horizontal Wind (u, v)	30 ms ⁻¹	± 0.1 ms ⁻¹	± 1 ms ⁻¹
Vertical Wind (w)	< 1 ms ⁻¹	± 0.1 ms ⁻¹	± 0.3 ms ⁻¹

Other Meteorological Parameters Available at 20 Hz:

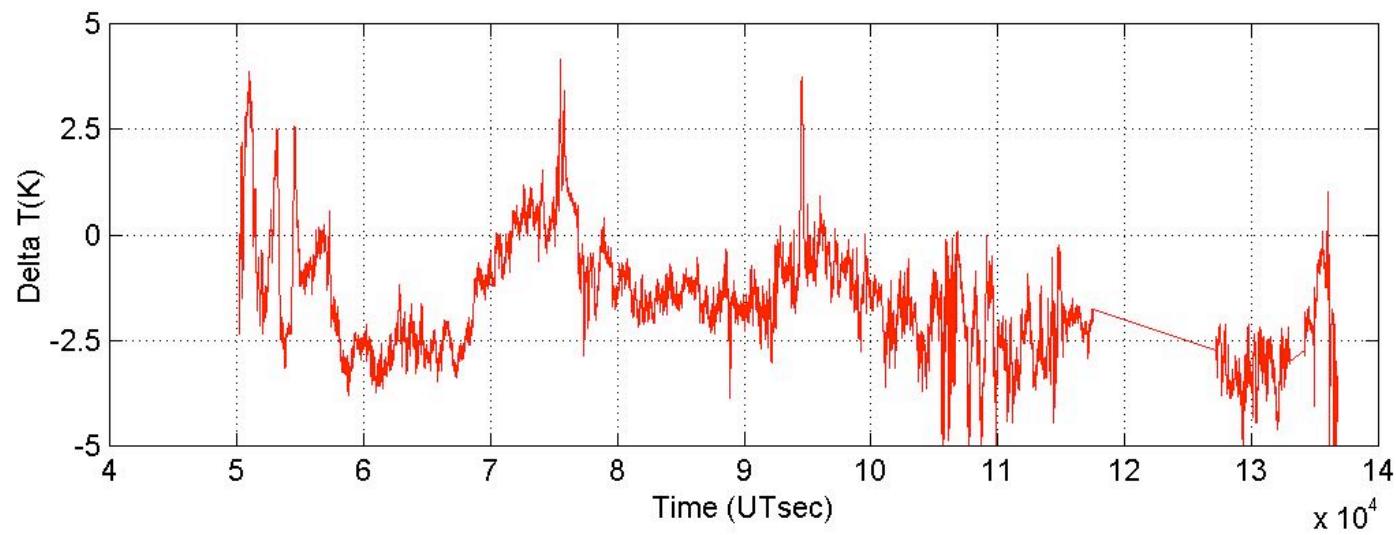
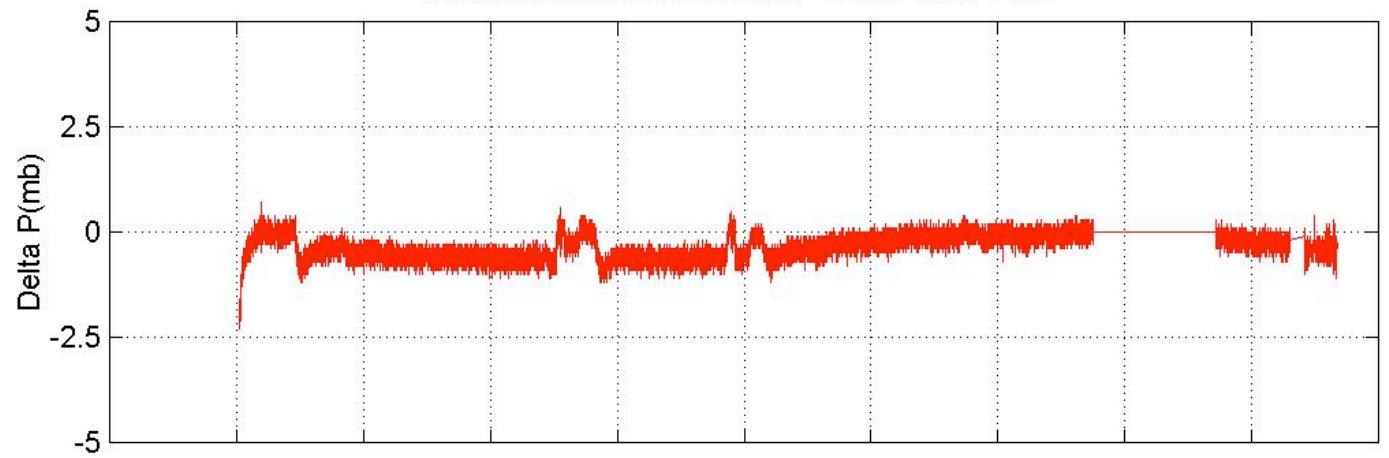
Potential Temperature (θ), True Air Speed, Turbulence Intensity (I), GPS Position, Velocity, and Acceleration; Pitch, Roll, and Heading; Angle of Attack, Angle of Sideslip (Yaw); Dynamic and Total Pressures, Total Temperature

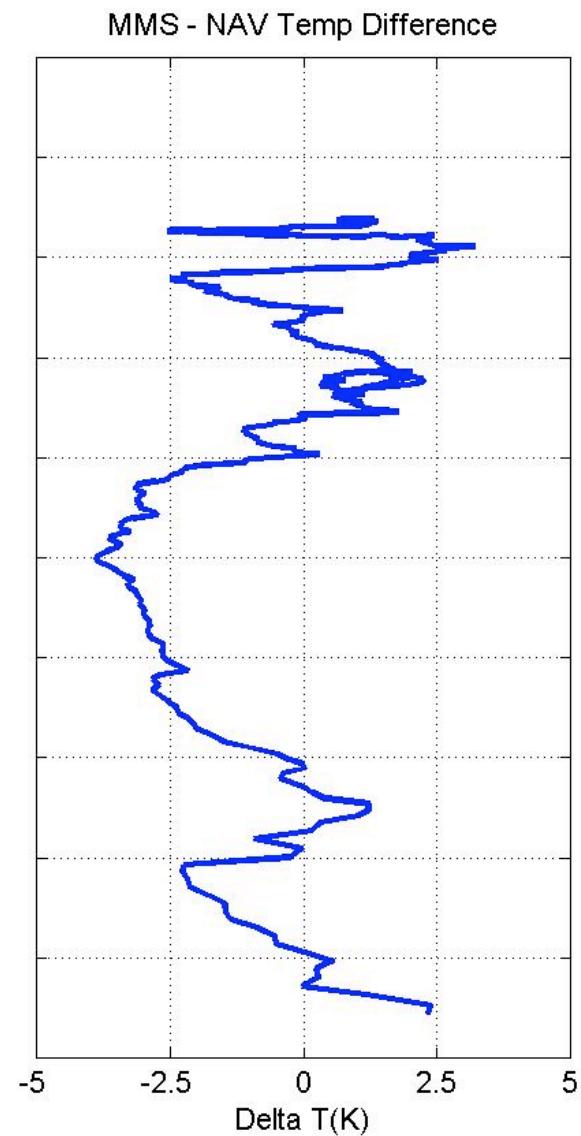
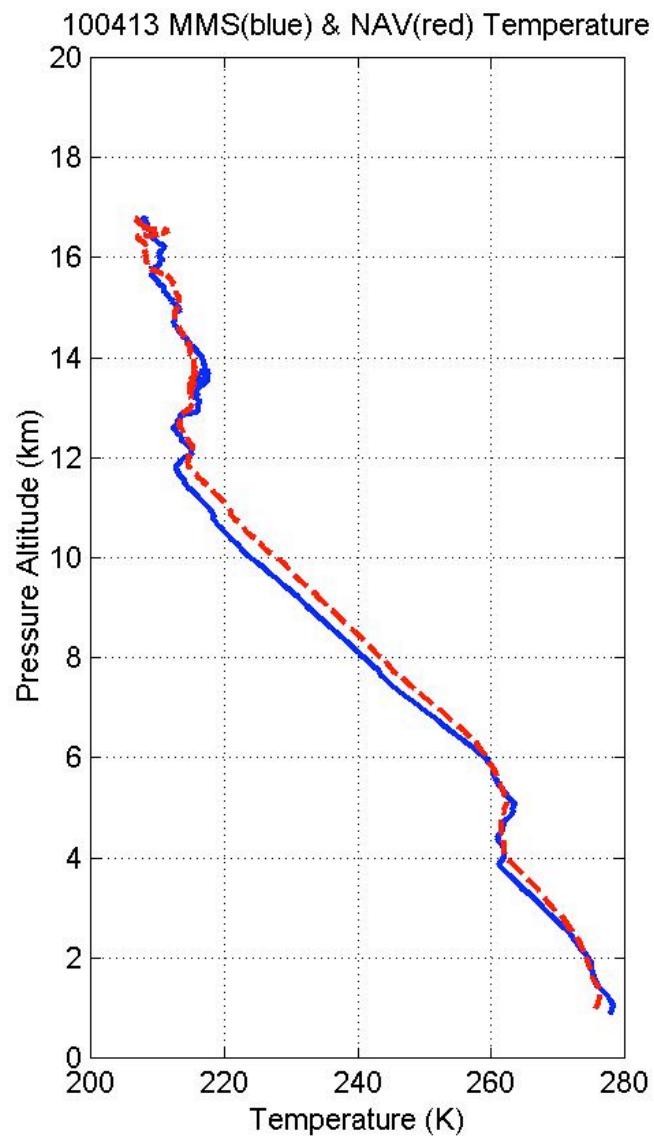
MMS Calibration / Quality Control & Verification Process

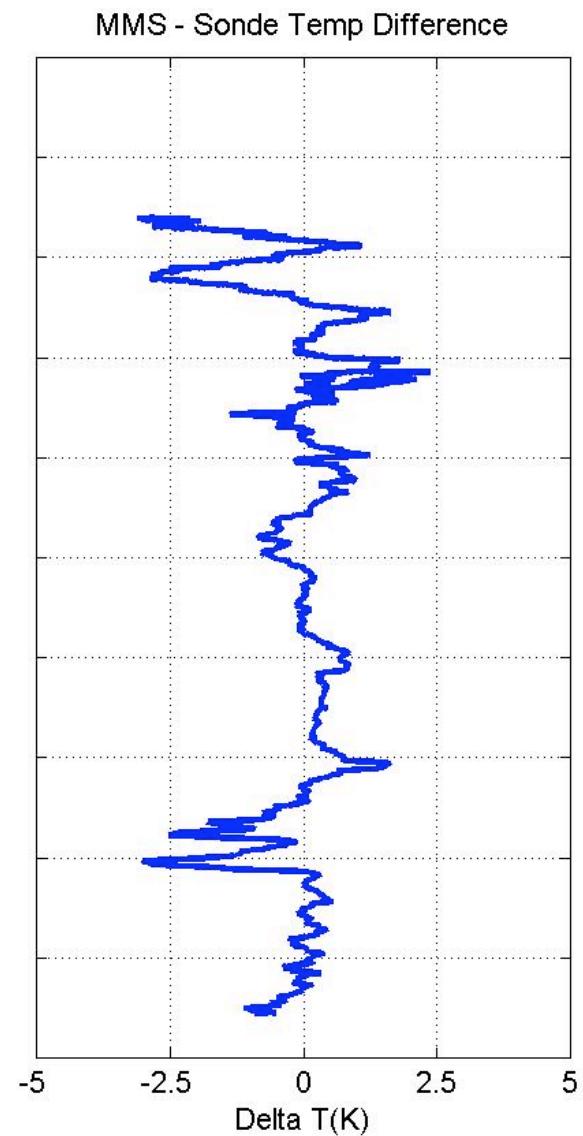
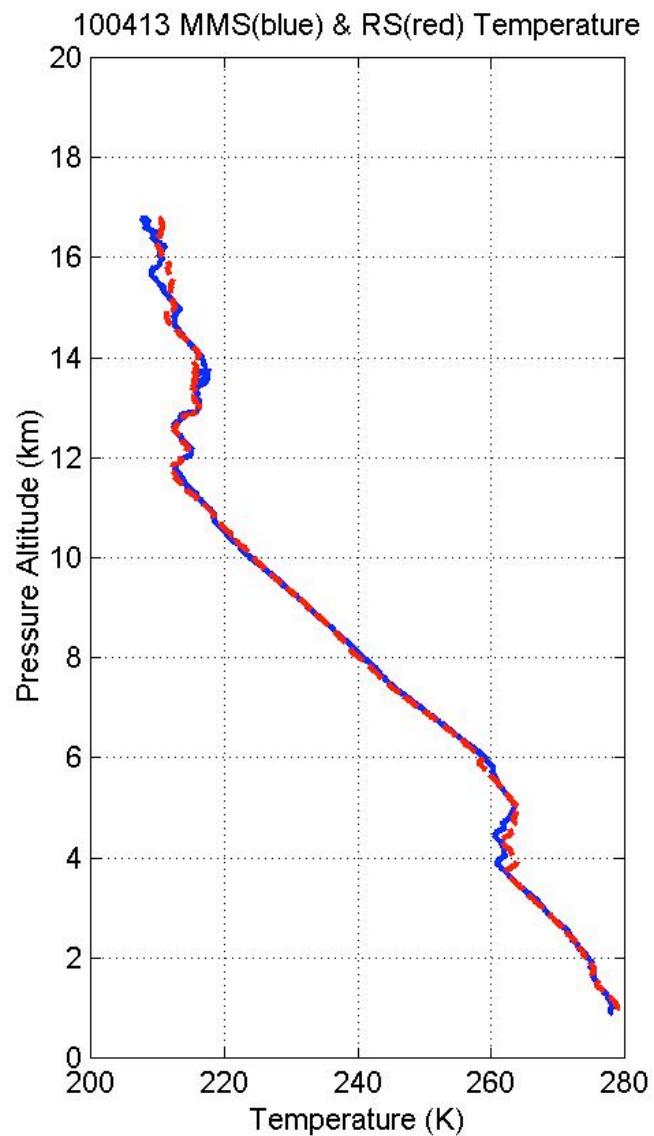
- Individual Sensor Calibrations (re-certification to NIST standards)
- Sensor Dynamic Response Tests
- Dynamic Characterization of Inertial Navigation System
- In-Flight Aerodynamic Calibration (aircraft pitch, yaw, turning maneuvers)
- Comparison with Radiosondes (close proximity with space & time) and other measurements as available (aircraft navigation system)

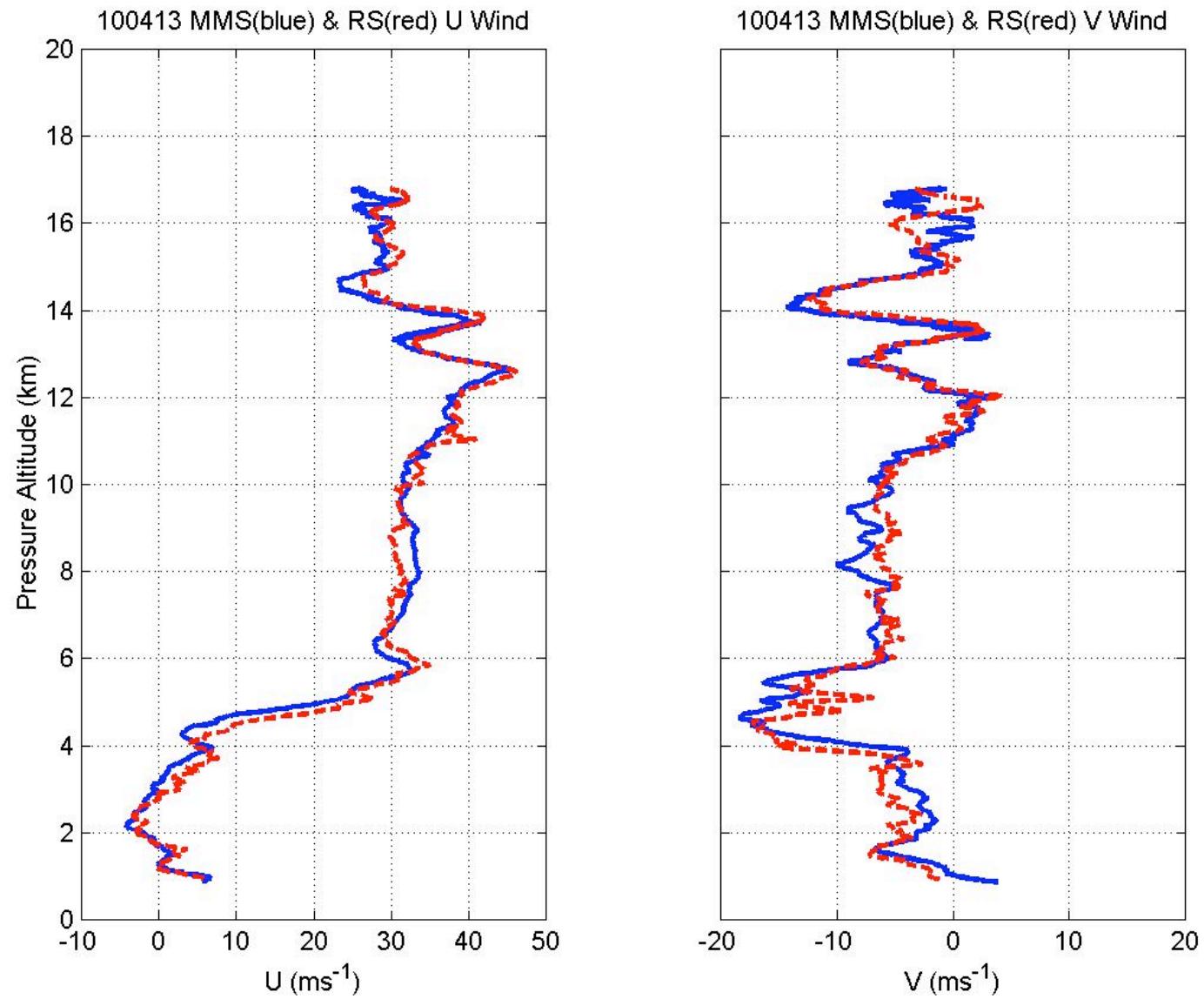
Preliminary MMS data for GloPac was submitted in April 2010

Global Hawk 20100413: IWG - MMS Delta P & T









MMS – EDW Radiosonde Comparison Statistics

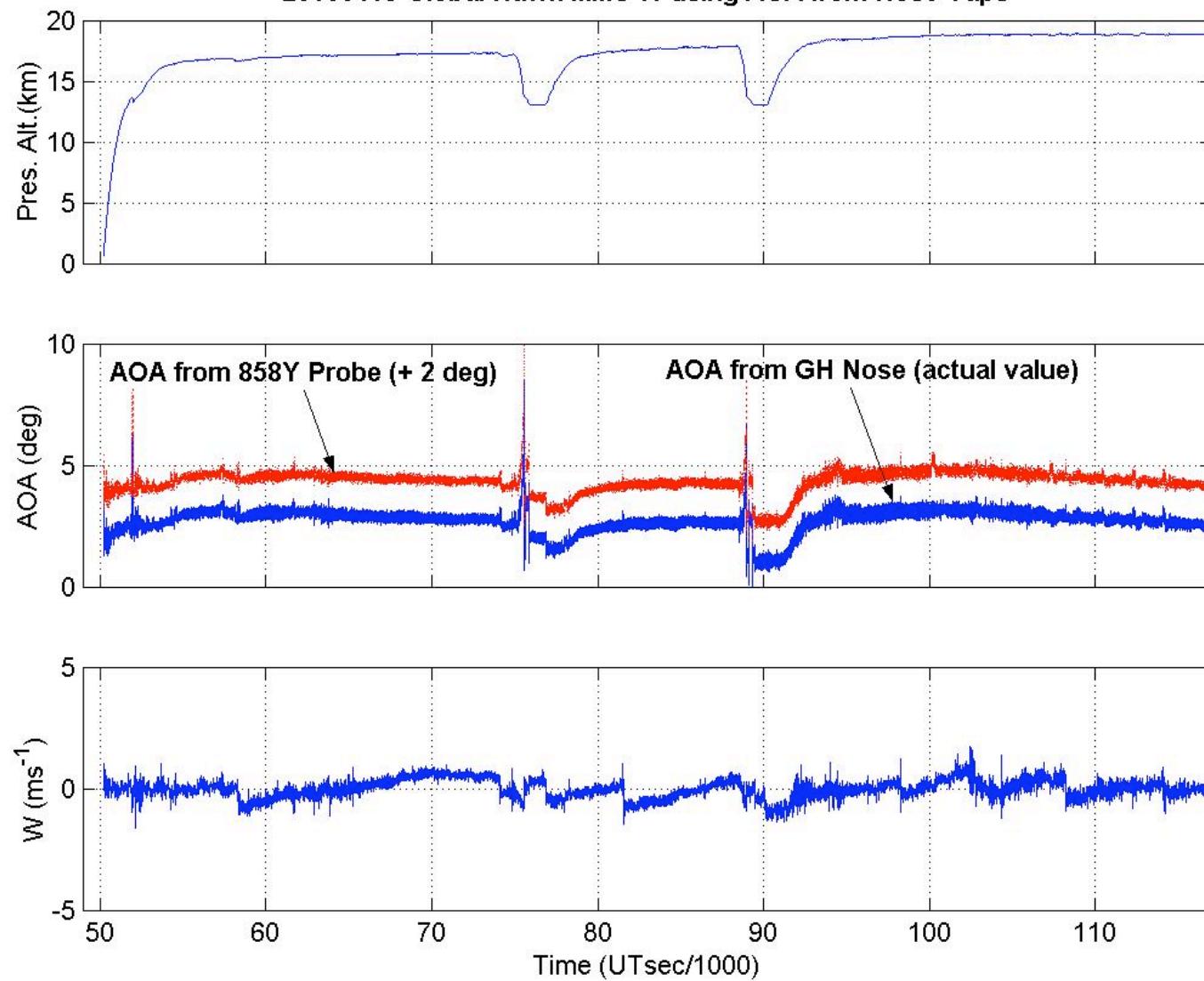
- Comparisons were made using GH ascent data on 4/2, 4/7, 4/13 & 4/23
- Pressure values were used as the independent variable (not altitude)
- Mesoscale variability was not accounted for (or removed)

<u>Variable</u>	<u>MMS – EDW difference</u>	<u># Samples</u>
T	-0.42 ± 0.61 K	4
u	-1.35 ± 1.48 ms $^{-1}$	3
v	-0.68 ± 2.07 ms $^{-1}$	3
$ \vec{V}_H $	1.51 ± 2.54 ms $^{-1}$	

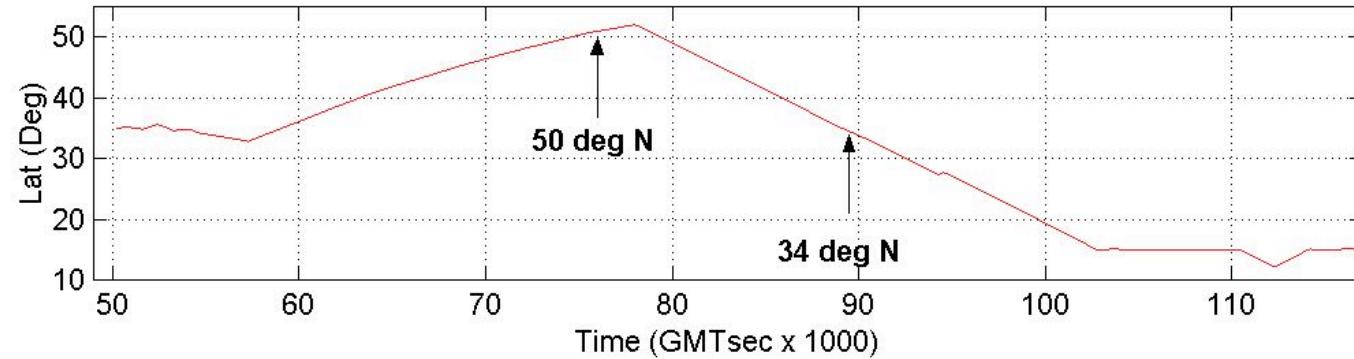
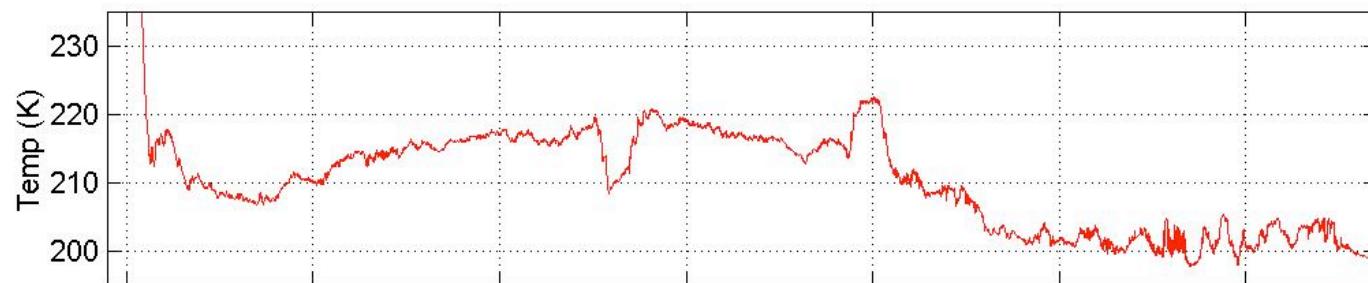
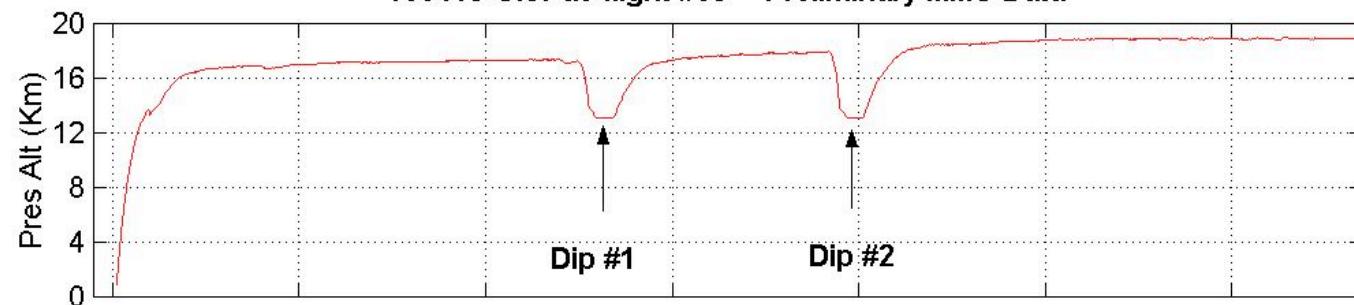
MMS on Global Hawk for GLOPAC

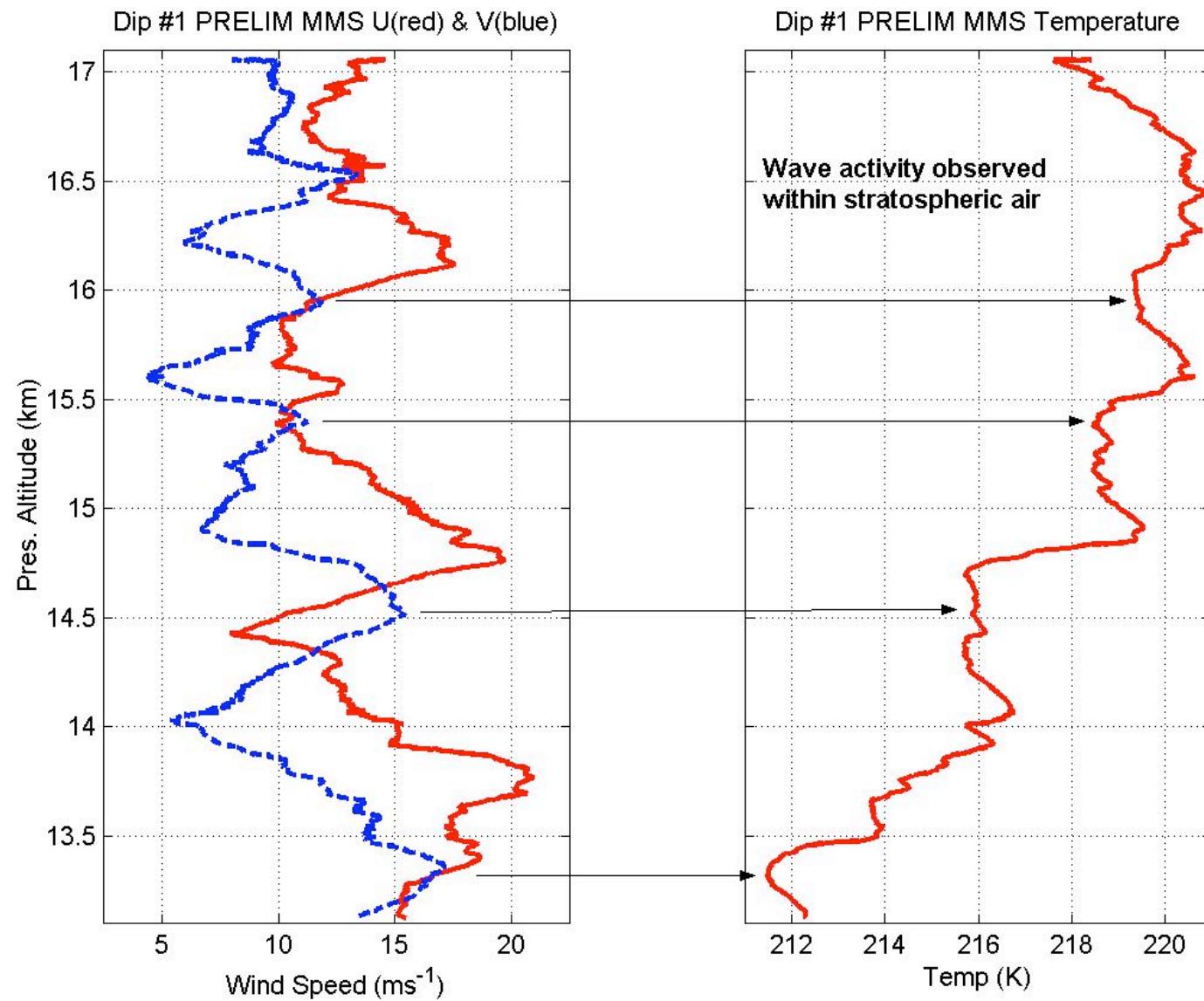


20100413 Global Hawk MMS W using AOA from Nose Taps

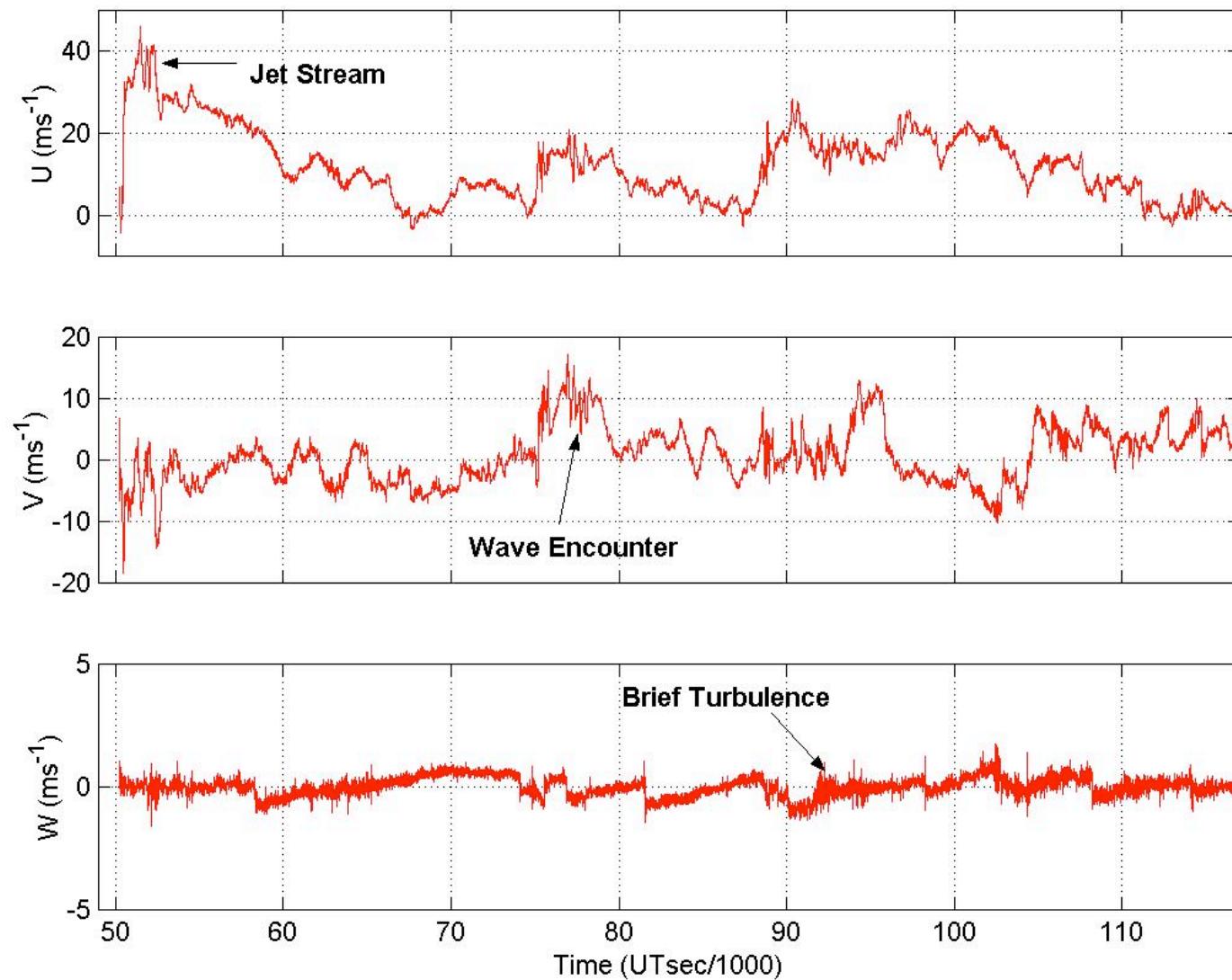


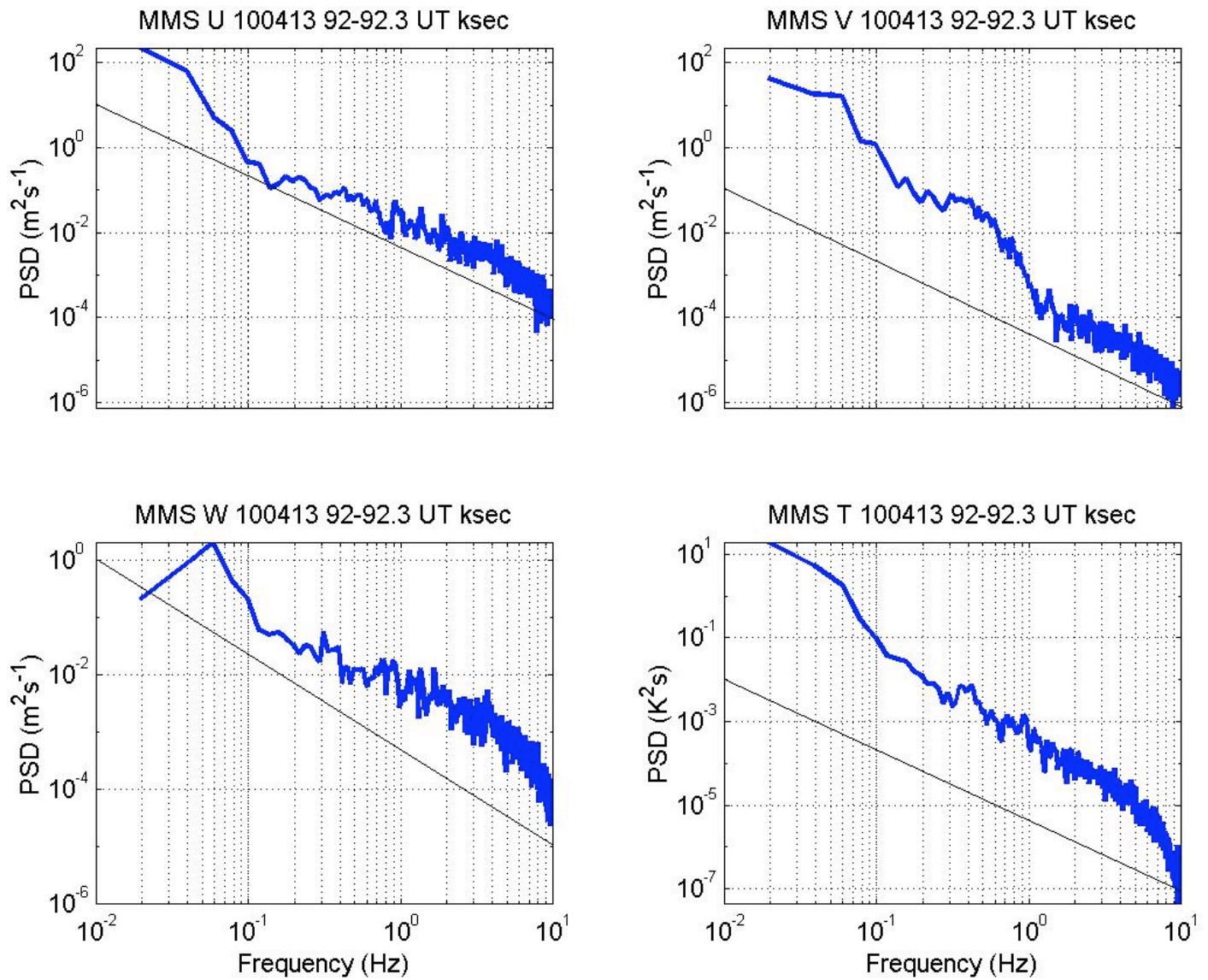
100413 GloPac flight #03 -- Preliminary MMS Data





20100413 Global Hawk MMS Winds





LOOKING FORWARD: MMS CONCERNS FOR ATTREX

- **Install dedicated GPS antenna in Zone 7**
(GPS correction critical for INU accuracy)
- **Payload power availability during descent**
(UPS capacity to maintain INU alignment)
- **Maintain aerodynamically clean air flow ahead of our static pressure ports**
- **More reliable data link**
- **Fly Litton LN-100G INS?** (subject to constraints)
- **Improved pitch maneuvers** (what algorithm yields the required motion?)
- **MMS Calibration for GloPac is incomplete** (Further work on p , w , etc.)