TAMMS Data Status Post Mission

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How do you compute the 3-D winds????

The ambient wind speed components are computed as the difference between two vectors:

- Velocity of the aircraft with respect to the Earth (inertial)

- Velocity of the air with respect to the aircraft (differential pressures & static P&T)

Important Notes:

- These tend to be an order of magnitude higher than the resulting air speed (either horizontal or vertical)

- True Airspeed (U_a) is a function of the Mach Number and the total air temperature

- Mach Number is a function of static and impact pressure and is subject to how well the static pressure is calibrated

So at its most basic level its just geometry ...

For **straight** and **level** legs, the 3D winds can be approximated as

$$u = U_p - U_a * \sin(\psi + \beta) \qquad \text{EW horizontal wind}$$

$$v = V_p - U_a * \cos(\psi + \beta) \qquad \text{NS horizontal wind}$$

$$w = W_p - U_a * \sin(\theta - \alpha) \qquad \text{vertical wind}$$

Temperature sensor (used to determine ambient air temperature and aircraft speed)

Pressure transducers to provide static and dynamic pressure with minimal impact of flow distortion around the aircraft

5-hole pressure port system to provide
- **Angle of Attack** – difference between the centerline of the aircraft and the on coming wind direction
- **Sideslip Angle** – difference between aircraft heading and track angle
- Reference pressure

INTERNAL COMPONENTS:
- A real-time data system from UEI is used
- An Applanix 610 is used for the Inertial data (better accuracy and precision especially for Vertical Platform velocities)
- The data is collected and an IWG1 data string is broadcast to the other computers in the aircraft and to the ground.
- A time server provides a common time base
- Data is downlinked to the ground to check instrument health during flight.

Real time Data System

New Data System
- Manufactured by UEI (ueidaq.com)
- Linux Based
- Real-time
- Rugged 50g shock, 3 g vibration
- Small (4" x 4" x 4")
- Runs at powerup
- 24-bit 16 channel analog card (with separate timers on each channel)
- 8 channel ARINC-429 card (all receive) with independent timestamps for each incoming sample
- More than 60 data streams are individually sampled at > 100 Hz

- Entire setup takes up about ½ of a single bay rack

- Other components include:
    - Analog / ARINC-429 breakout box
    - 5 channel Ethernet switch
    - Applanix 610
    - UPS

- Data is broadcast over Ethernet to be monitored remotely

Full vertical winds Equation (from Lenschow, 1986)

$$w = W_p - U_a/D * (t1c - \tan(beta) * t2c - \tan(alpha) * t3c) + L * t4c$$

Measurements Needed (and source)   *** Data Recorded at at least 100 Hz ***

- W_p = Aircraft vertical velocity   *(from Applanix)*
- U_a = True Airspeed   *(fn Pressure and Temperature)*
- Alpha & Beta   *(AOA and sideslip differential pressures)*
- $D = \sqrt{1 + \tan^2(alpha) + \tan^2(beta)}$ *(differential pressures)*
- $T1c = \sin(Pitch)$ *(from Applanix)*
- $T2c = \cos(Pitch) * \sin(Roll)$ *(from Applanix)*
- $T3c = \cos(Pitch) * \cos(Roll)$ *(from Applanix)*
- $T4c = dPitch * \sin(Pitch)$ *(from Applanix)*

L = separation distance (m)   *(pressure port to transducer)*

Current Data Summary and Archive Status

Summary of Measurements
- First year data collected with a PC-based LabWindows system
- Post year-1 we switched the real time data system
- System was responsible for our data collection as well as the KT-19 (surface IR temp) and for collecting and broadcasting an IWG1 file to the other computers on the Falcon and on the ground
- Minimal data loss due to acquisition issues (part of flight early with the RT system there was a hiccup)
- Primary issues leading to data loss was icing messing with the TAT or dP ports

Where are we as of today…
- Data for all 3 campaigns are in the archive and are final
- I have gone back and made the files consistent from year to year for simplicity
- Two data files are in the archive
    - 1-s Summary Files: Aircraft position and attitude, Pressure, Temperature,, and horizontal winds
    - 20-hz Winds Files: Aircraft position and attitude, 3-D winds, pressure, temperature and surface temp
- *Note*: for moisture data, use DLH not dew point (hence why its not in my archive files)
- Data is in ICARTT format, so text
- Winds are filtered to remove non-SL data. Undoubtably some made it but most are out. There are artifacts introduced for non-SL wind data and caution needs to be used. If you want to use it email me and we can discuss ….
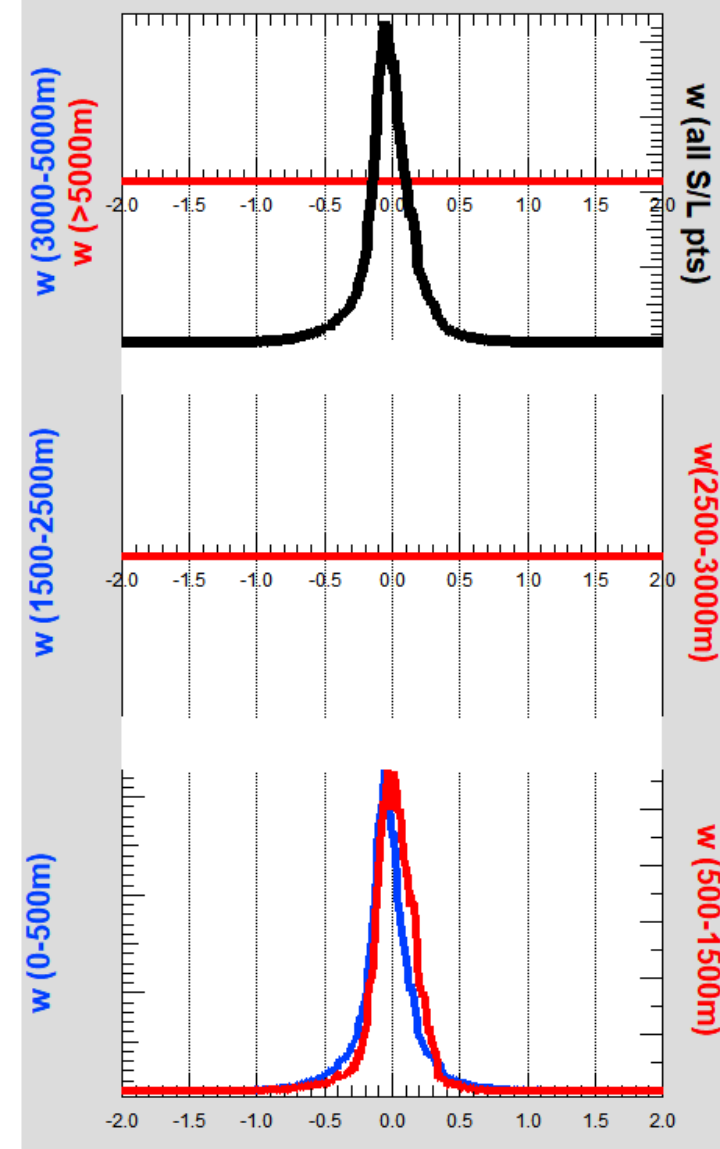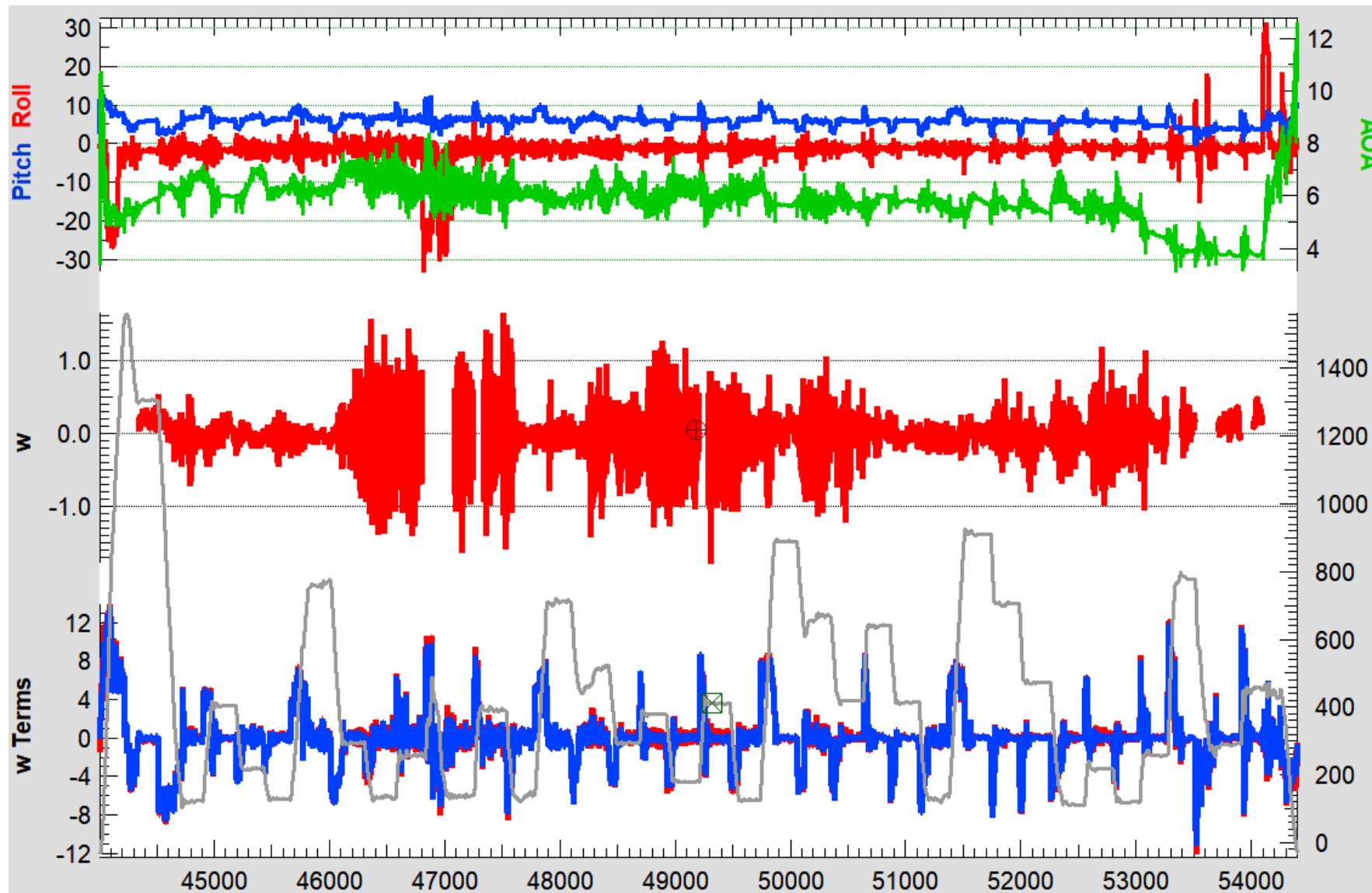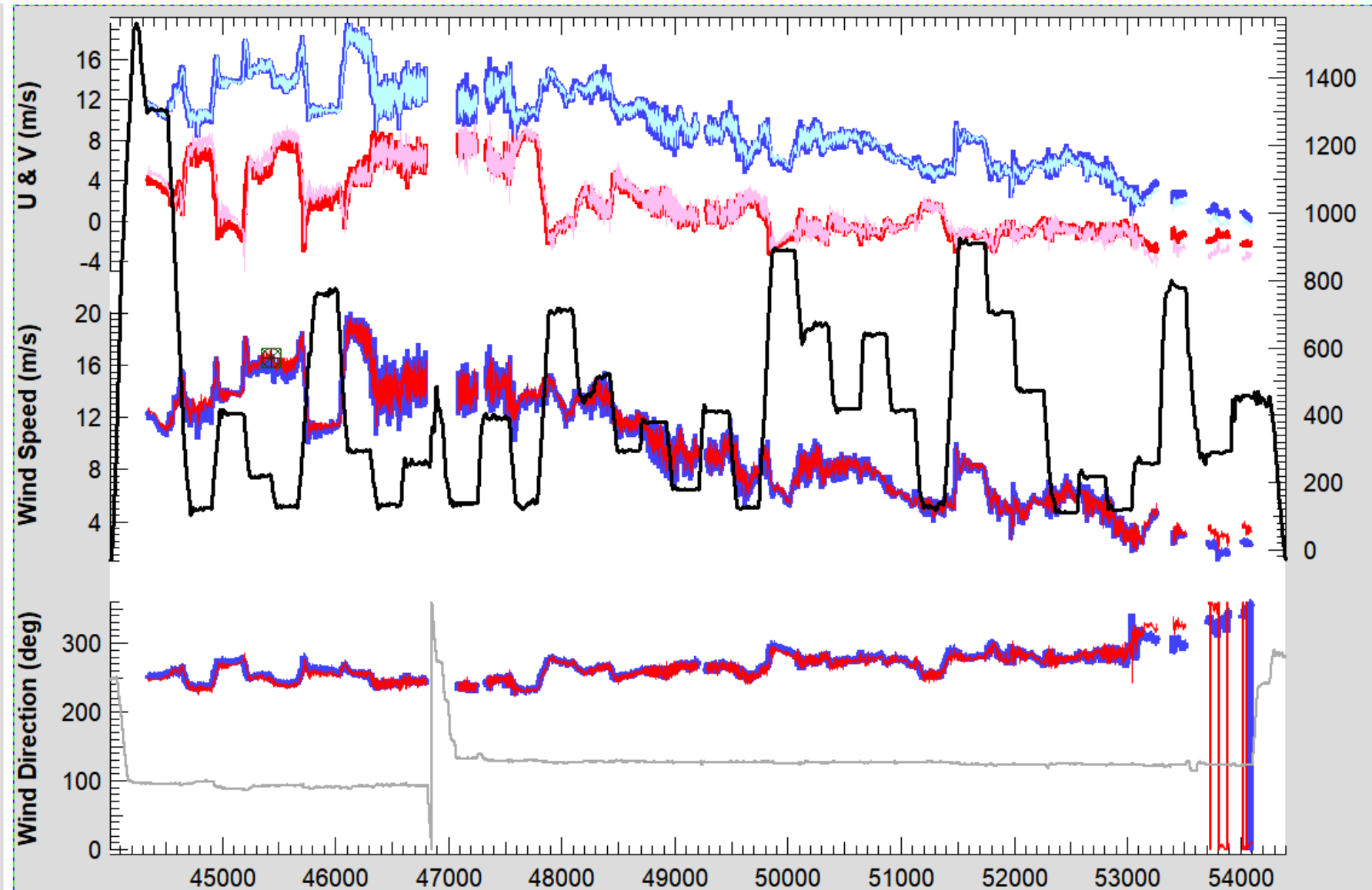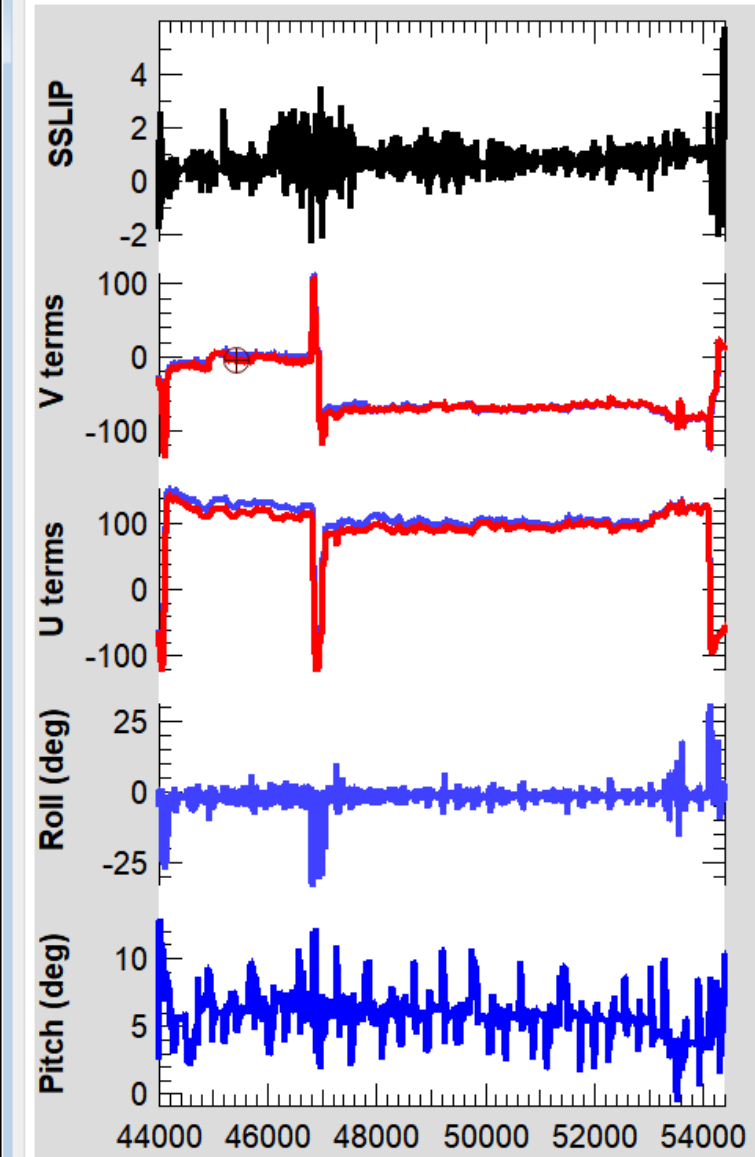
Papers

JGR Atmospheres

Research Article   🔒 Full Access

Aircraft Observations of Turbulence in Cloudy and Cloud-Free Boundary Layers Over the Western North Atlantic Ocean From ACTIVATE and Implications for the Earth System Model Evaluation and Development

Michael A. Brunke ✉ Lauren Cutler, Rodrigo Delgado Urzua, Andrea F. Corral, Ewan Crosbie, Johnathan Hair, Chris Hostetler, Simon Kirschler, Vincent Larson, Xiang-Yu Li … See all authors ⌄

And Posters …

The Validation of Airborne High Spectral Resolution Lidar 2 (HSRL-2) Retrievals for the Estimation of Ocean Surface Wind Speeds

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