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A/C 6002 Flight 153 Weather Station Data Analysis Summary

May 23, 2011

Task Summary

- **Primary data of interest is wind speed and wind direction to the best fidelity available**
- **Two sources of data**
  - **Laptop Data: Received by laptop from Wx Station**
  - **TM Data: Received by A/C from Wx Station and TM'ed to Trailer**
  - **Both A/C and Laptop receive same TM transmission from Wx Station (NOT TO BE CONFUSED WITH TM TX TO TRAILER)**
- **The goal was to time-correlate the two sources**
  - **The Laptop data time source had previously been synced to UTC and then incremented based on PC clock**

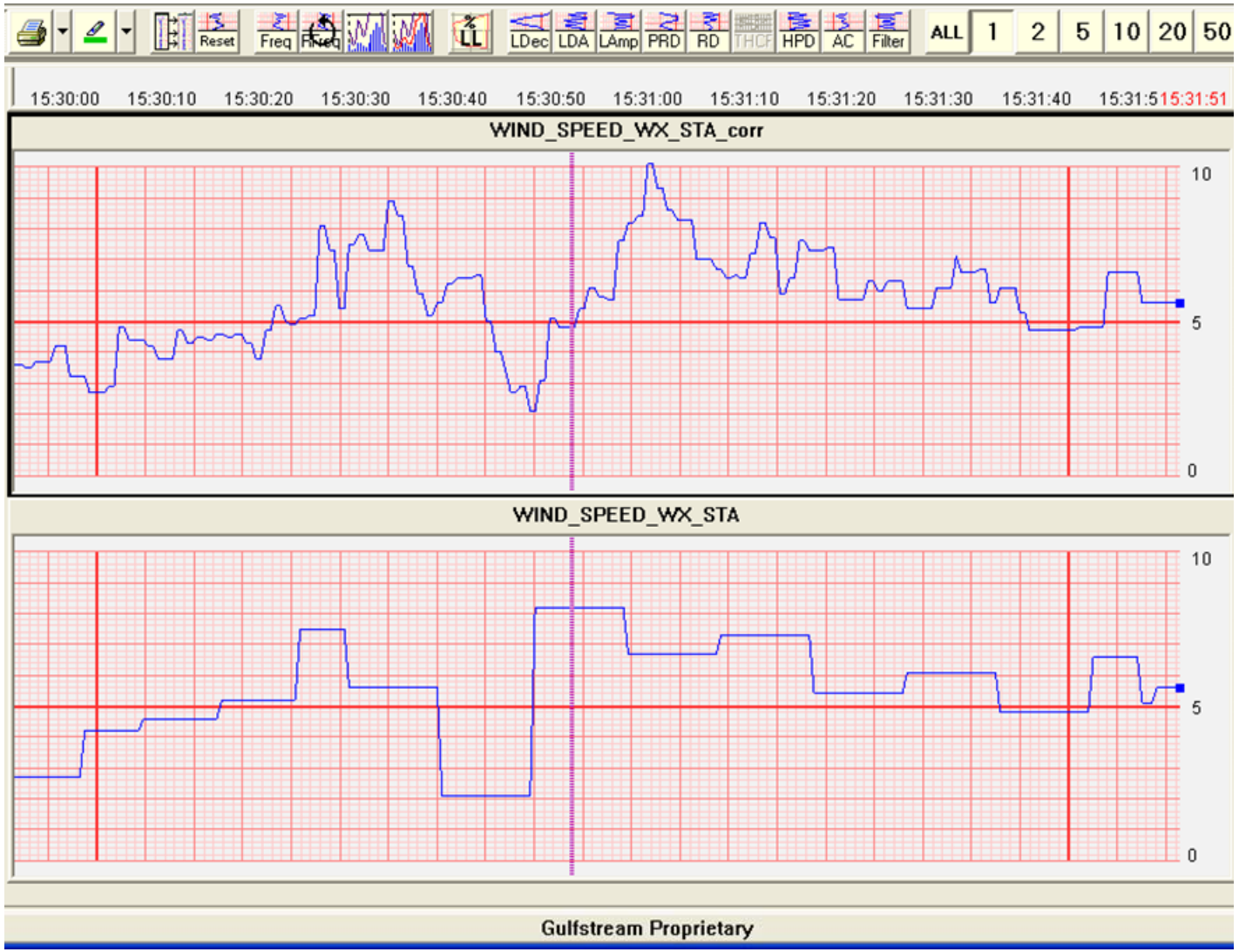
First Hurdle – Bad TM Data

- **Upon initial overlay and review, anomalies were observed**
  - **TM Wx Station Data did not appear to be updating as frequently as it should**
  - **Sample rate should be 1sps but even during the "active" periods data would only refresh every 5-10sec.**
- **Further review isolated IADS built-in functions as the culprit**
- **New parameters were created for the TM Data Wx Parameters using different functions and problem was resolved**
  - **See following chart for comparison of results**

TM Data Corrected Parameters

Corrected Parameter using different functions

Original Parameters as recorded to TM Data



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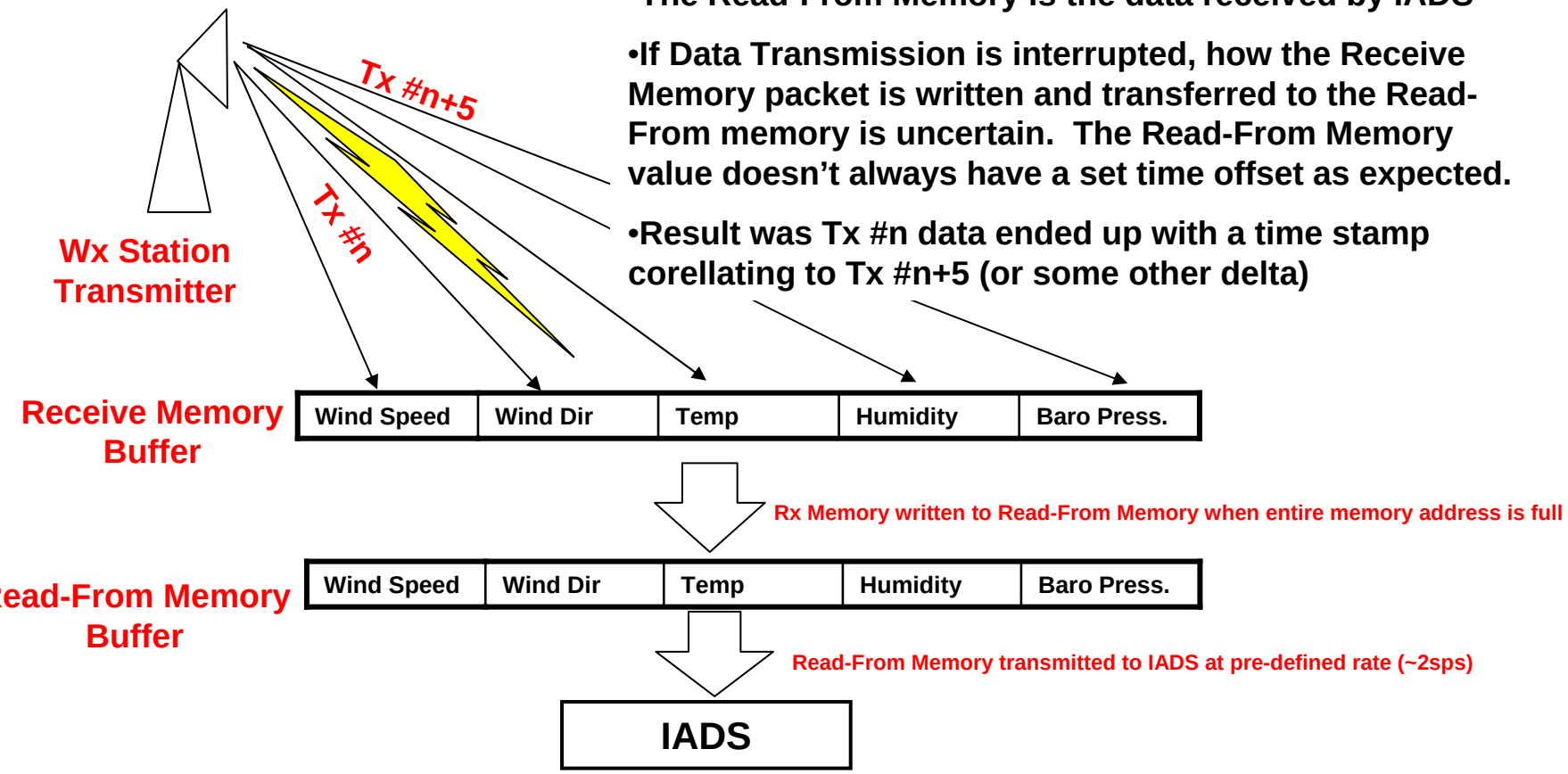
Second Hurdle – Determining Time Offset

- **Initial comparisons of the Wx Station wind data and Corrected TM Data wind data showed inconsistent time offset depending on point used for comparison**
  - **Offsets during active update periods 7-8sec**
  - **Offsets during intermittent update periods highly variable – 12-15sec, some more, some less**
- **Wx Station Data as received on A/C is serial bus data that is double-buffered**
  - **How that process handles interruptions is uncertain**
- **TAKEAWAY: Time correlation point has to be for a time when the TM Data was updating at ~1sps to ensure correct correlation.**
  - **Yielded more consistent time offsets as expected**

Double-Buffered Data

- Receive Memory is filled sub-packet by sub-packet in order (left to right for simplicity)
- Once Receive Memory Data packet is full, it is written to the Read-From Memory
- The Read-From Memory is the data received by IADS
- If Data Transmission is interrupted, how the Receive Memory packet is written and transferred to the Read-From memory is uncertain. The Read-From Memory value doesn't always have a set time offset as expected.
- Result was Tx #n data ended up with a time stamp corellating to Tx #n+5 (or some other delta)

Double Buffer Setup



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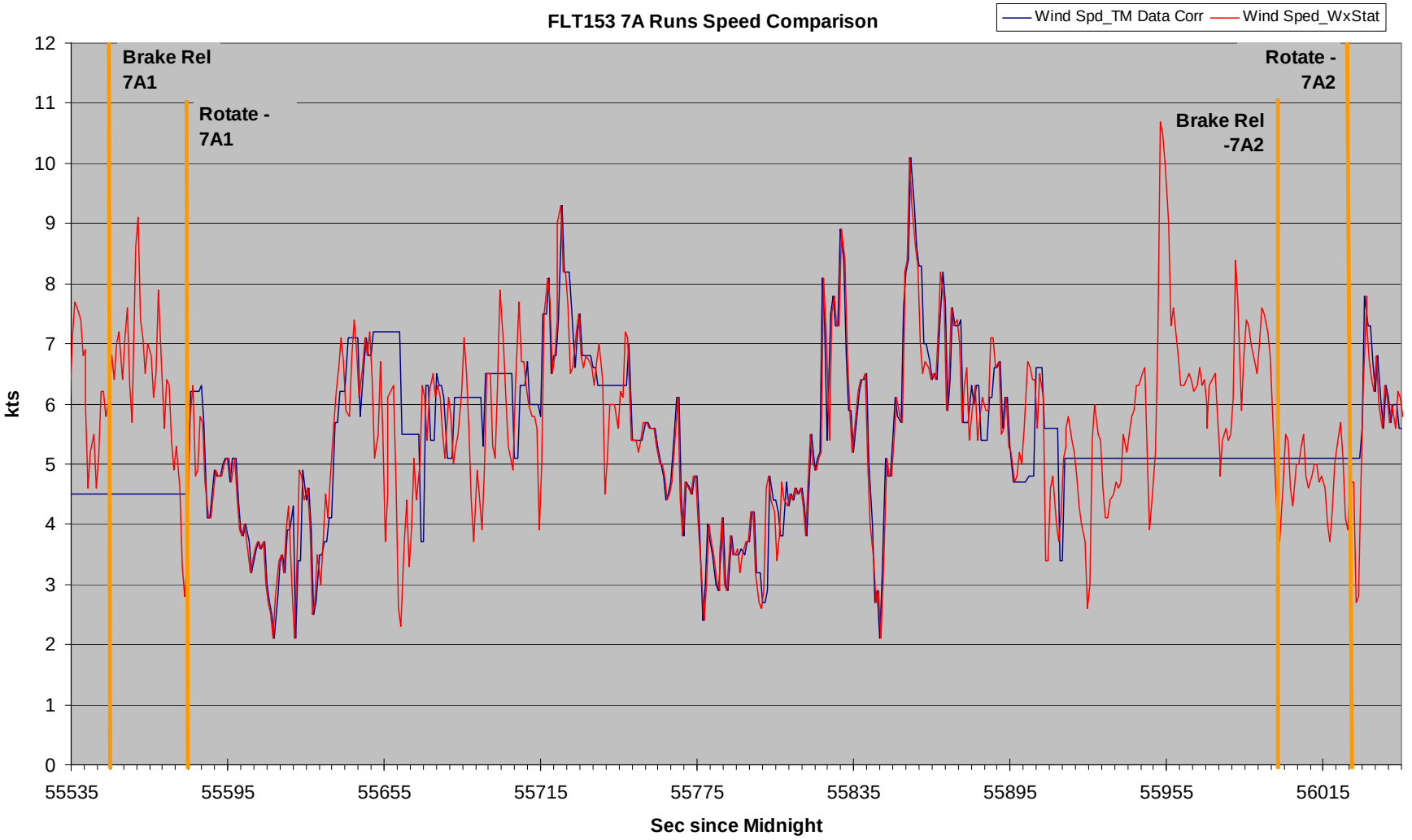
Determining Time Offset

- The corrected data was exported from IADS (at 1sps) to Excel and compared to the Wx Station data
- Comparisons were performed to match wind speed and direction exactly for a given sample
- Time offset was determined to be 7.5sec
  - IADS Time = Wx Station Time + 7.5sec
  - Due to sample rate of data, accuracy of time offset +/- 0.5sec
- The offset Wx Station data was overlaid in Excel with the corrected TM Data with good correlation
  - Comparison Plot of Wind Speed Overlay on Following Chart

Time Offset Correlation Comparison



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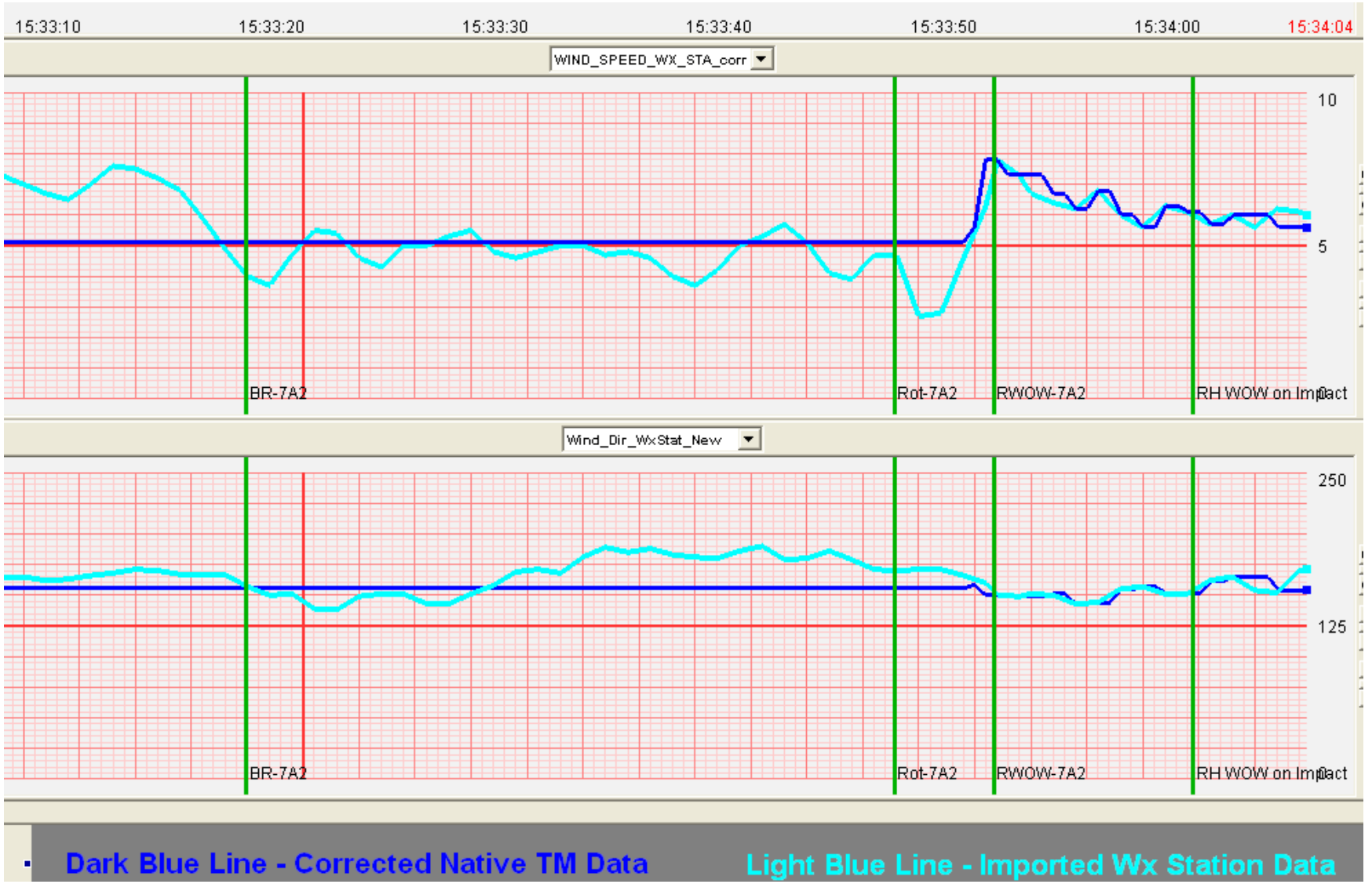
Parameter Summary

Parameter Name	Parameter Description
WIND_SPEED_WX_STA	Wind Speed as recorded in IADS from TM Data - kts
WIND_SPEED_DIR_STA	Wind Direction as recorded in IADS from TM Data – Magnetic Direction
WIND_SPEED_WX_STA_corr	Wind Speed corrected in IADS from TM Data (new data arguments) – kts
WIND_DIR_WX_STA_corr	Wind Direction corrected in IADS from TM Data (new data arguments)– Magnetic Direction
Wind_Speed_WxStat_New	**Wind Speed recorded by Wx Station Laptop synced to TM Data IADS time – kts**
Wind_Dir_WxStat_New	**Wind Direction recorded by Wx Station Laptop synced to TM Data IADS time – Magnetic Direction**

IADS Data Overlay



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Wx Station Data Accuracy

- **Based on method used for correlation, time accuracy +/- 0.5sec**
- **Wx Station Data Accuracy**
  - **Wind Speed: +/- 1.1 mph (0.96 kts) or 5%**
  - **Wind Direction: +/- 5 deg @ Wind Speed > 5 mph (4.3 kts)**
  - **Temperature: +/- 0.27 deg F**
  - **Humidity: +/- 1%**
  - **Baro Pressure: +/- 1.5 mbar**

Wx Station Location

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FLT153 Run 7A1 Wind Component

Crosswind: + from Right ; Headwind: + on Nose

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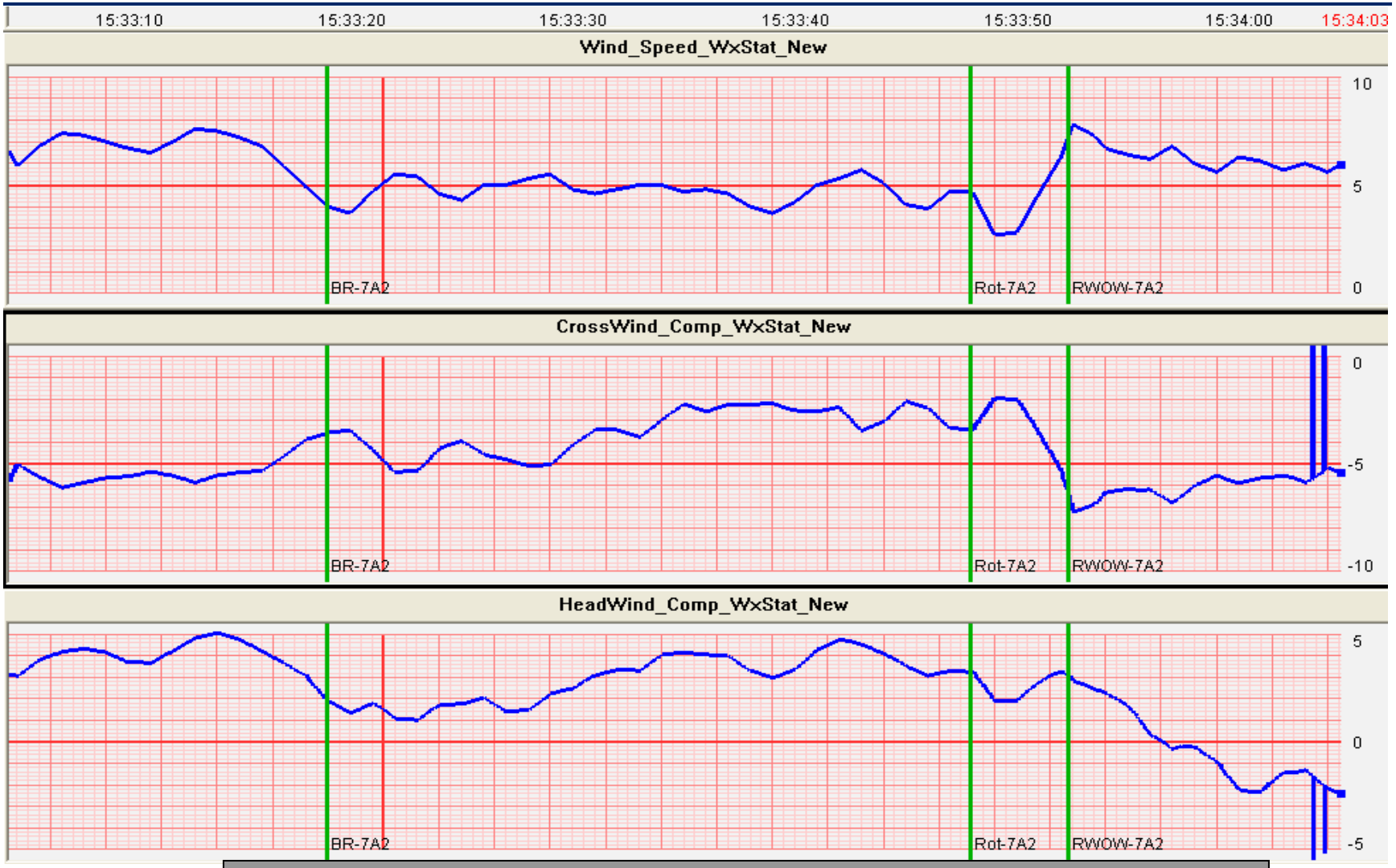
FLT153 Run 7A2 Wind Component



Crosswind: + from Right ; Headwind: + on Nose

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