Observed Altimetry System Error (ASE)
B744-10 Aircraft

John Warburton
FAA ANG-E61

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Federal Aviation Administration

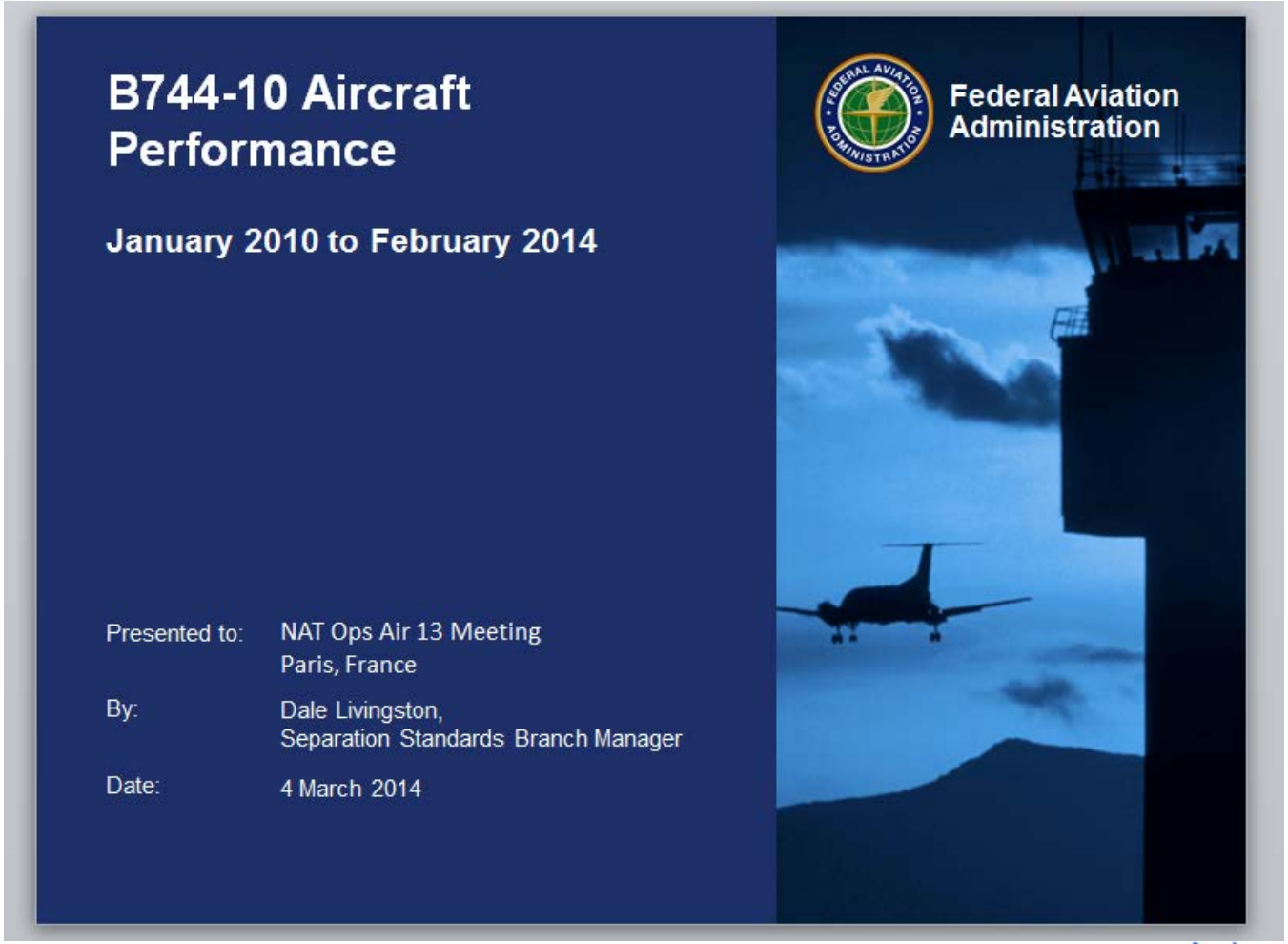
Issue for Discussion

- Previously presented Altimetry System Error (ASE) results for B744-10 aircraft identified a potential issue with the number of non-compliant points and overall Measuring Group bias
- Data from the previous presentation was re-processed, and a new data set was generated
  - New data was created using the past methodology
- An apparent increase in the monitoring group bias is being observed

Additional Information

- Similar data continues to be observed by and reported to ANG-E61 by other RMAs
  - Data available from Automatic Dependent Surveillance-Broadcast (ADS-B) ASE processing was used to confirm Aircraft Geometric Height Measurement Element (AGHME) ASE
- Boeing issued a Special Attention Service Bulletin, 747-34-3010, in 2013 giving instructions to test the altimetry system, including pitot-static probes, air data computers, and pressure transducers

Previously Presented Result



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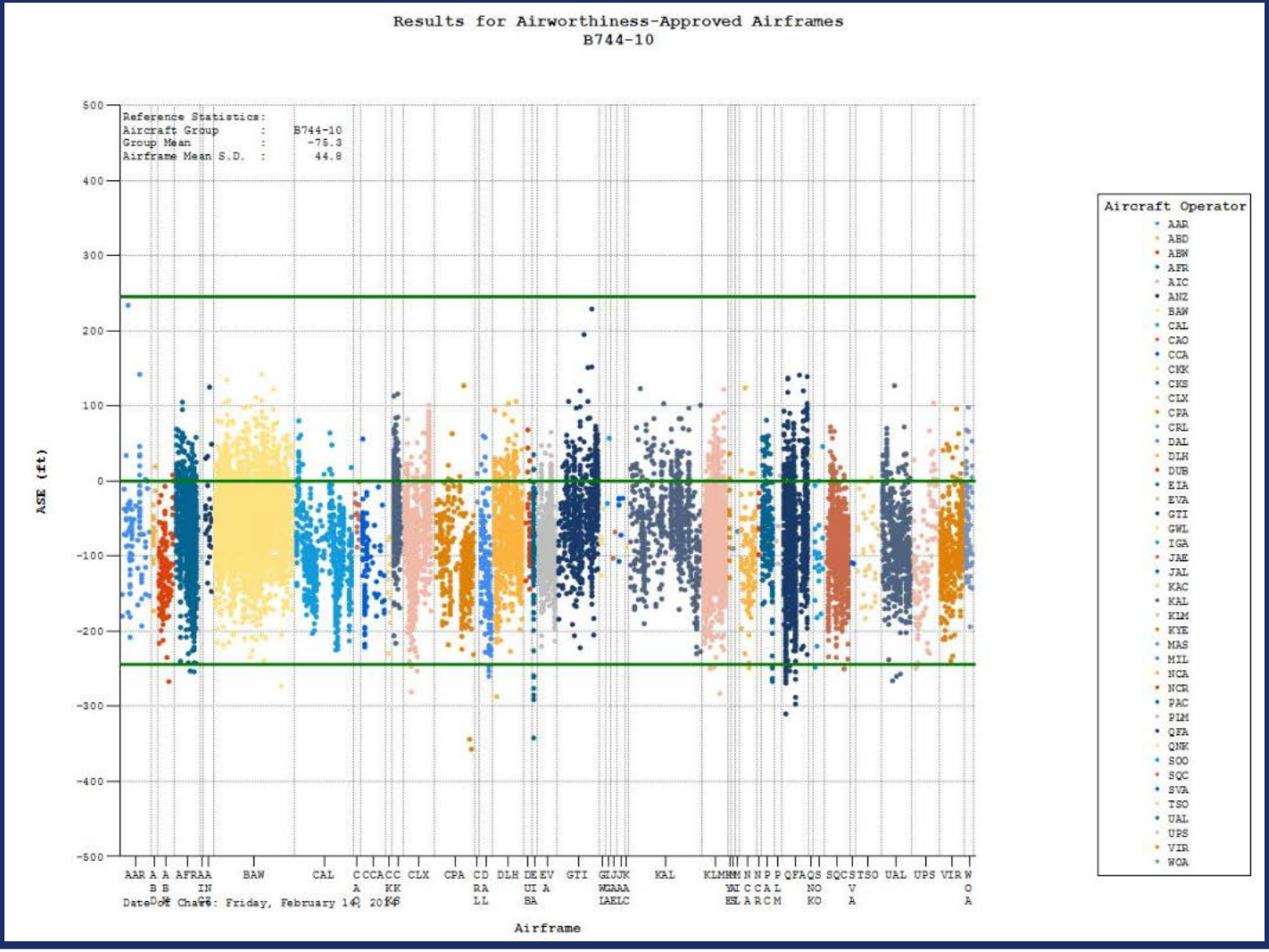
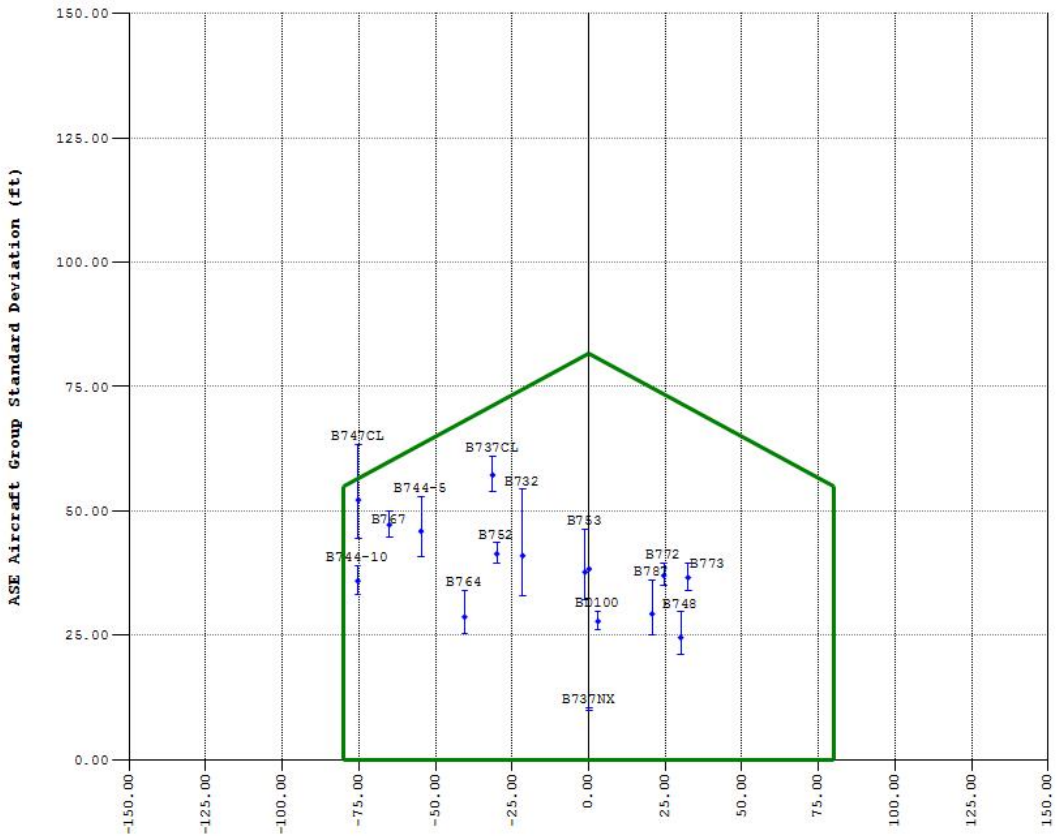
Airframe Observations



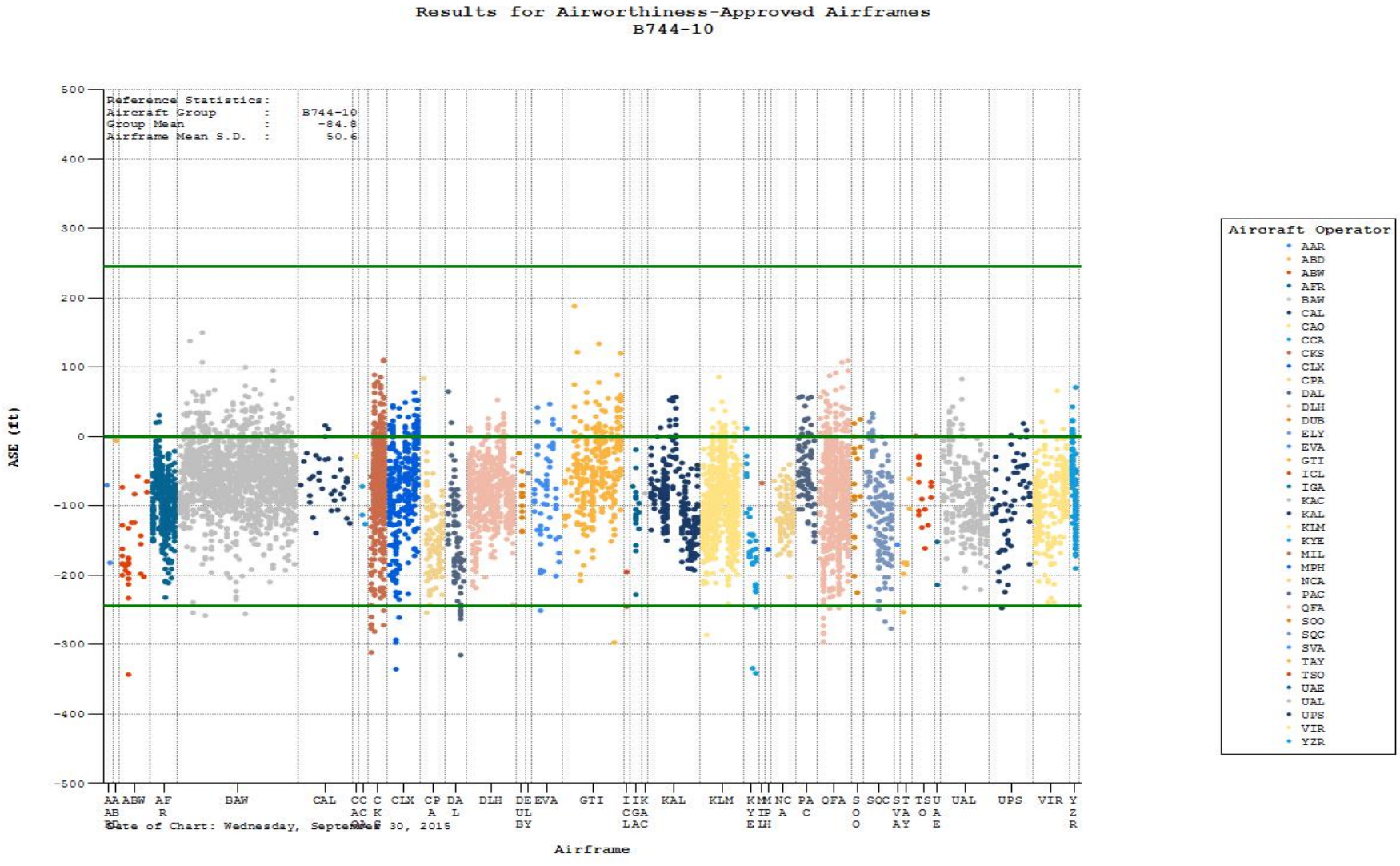
Group Mean & Standard Deviation



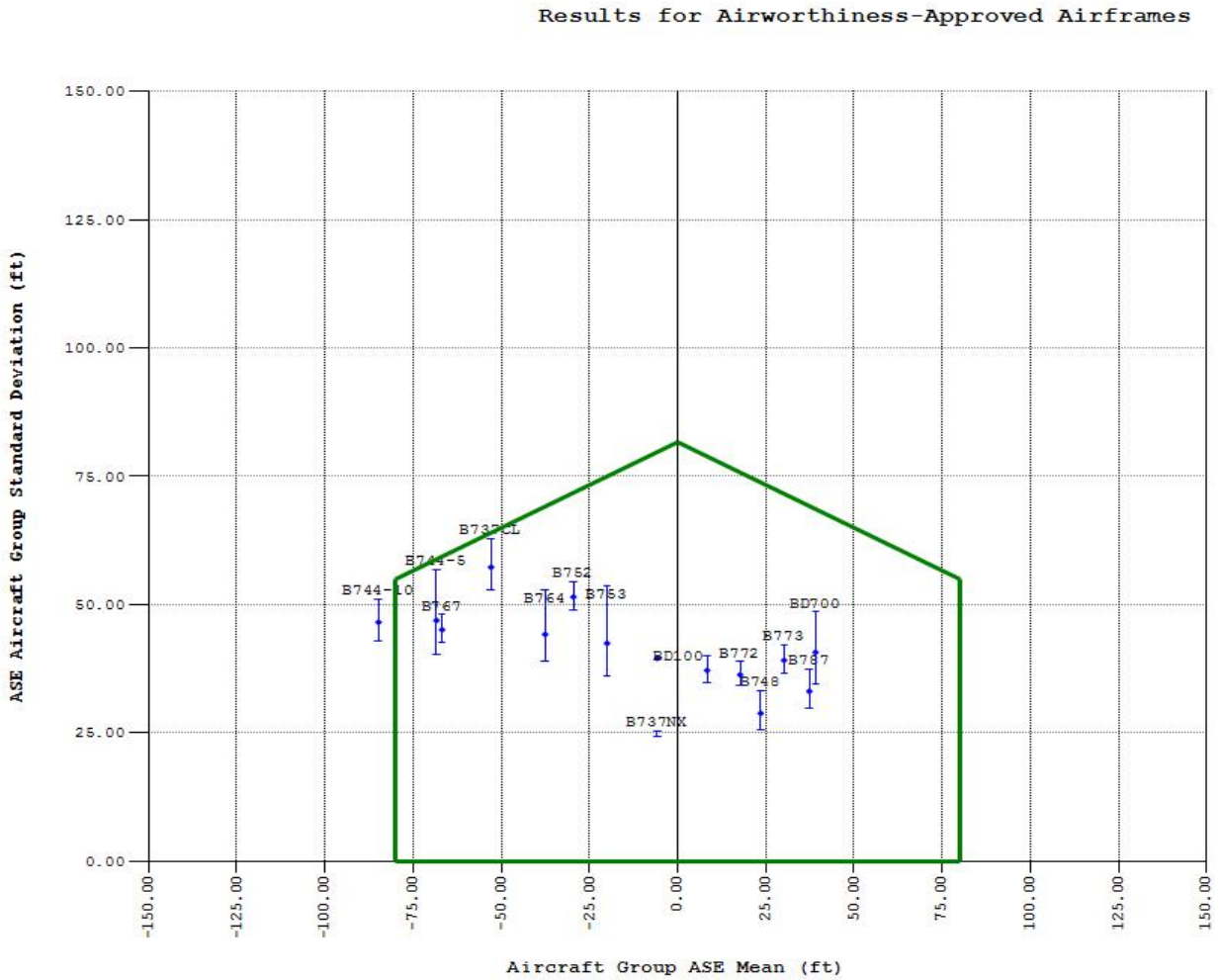
Aircraft Groups Monitore	
B732	40
B737CL	480
B737NX	1924
B744-10	395
B744-5	123
B747CL	58
B748	50
B752	768
B753	59
B764	53
B767	603
B772	444
B773	317
B787	51
BD100	389

Note: ASE variance estimate reduced by assumed measurement variance of (46.8 ft²)
Date of Chart: Friday, February 14, 2014

Recent Results



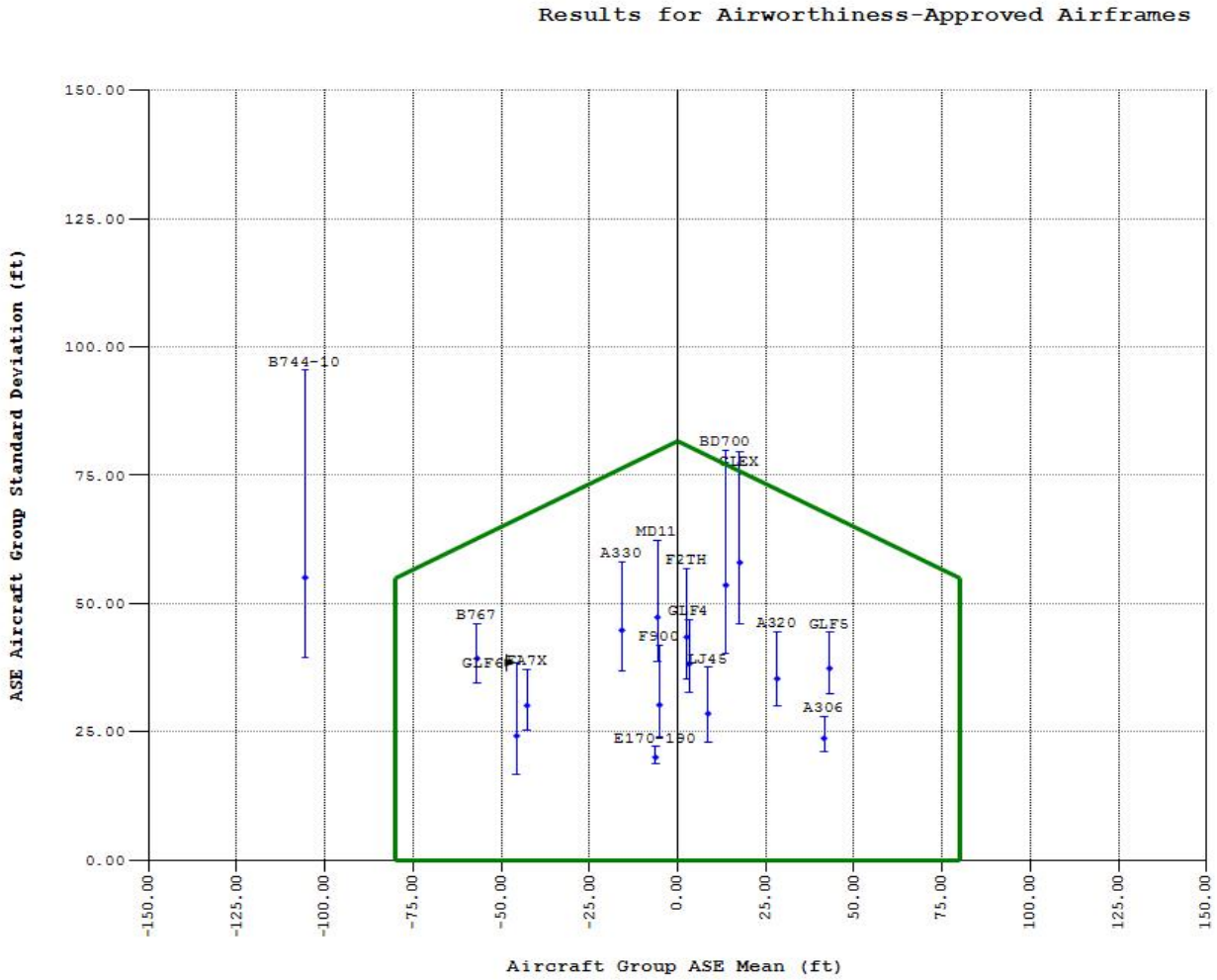
ASE Group Chart
AGHME Data



Aircraft Groups Monitore	
B737CL	235
B737NX	1860
B744-10	279
B744-5	66
B748	83
B752	602
B753	37
B764	37
B767	496
B772	415
B773	385
B787	138
BD100	385
BD700	101

Note: ASE variance estimate reduced by assumed measurement variance of (42.6 ft²)
Date of Chart: Wednesday, January 06, 2016

ASE Group Chart
ADS-B Data



Aircraft Groups	Monitore
A306	52
A320	41
A330	39
B744-10	13
B767	94
BD700	19
E170-190	79
F2TH	41
F900	26
FA7X	46
GLEX	28
GLF4	52
GLF5	85
GLF6	15
LJ45	38
MD11	38

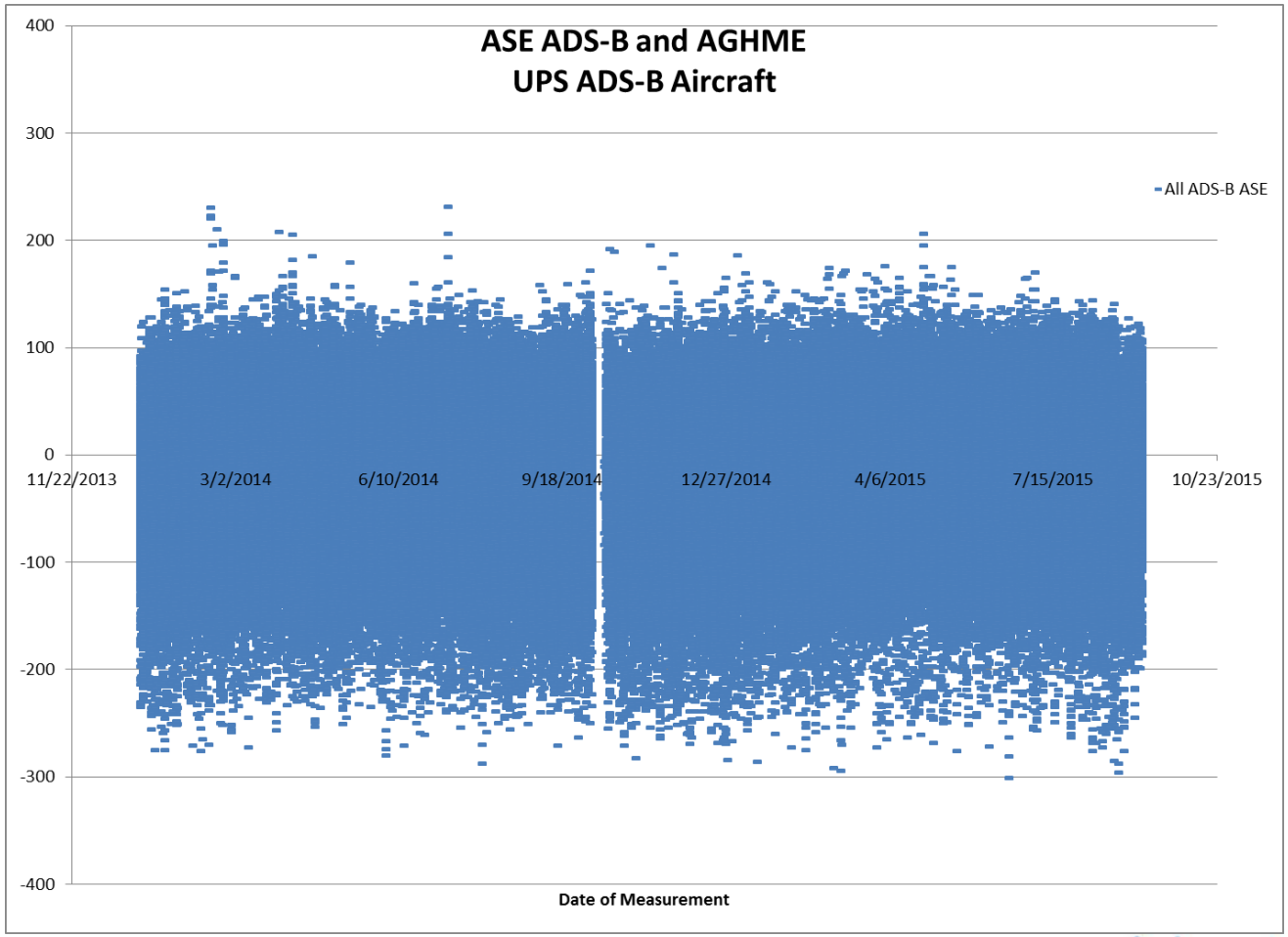
Note: ASE variance estimate reduced by assumed measurement variance of (12.6 ft²)
Date of Chart: Tuesday, October 06, 2015

Measurement Comparisons

- The following charts show the ensemble of ASE measurements observed in the UPS ADS-B equipped fleet
- Single Aircraft Monitoring Group measurements are plotted on top of the ensemble to provide a comparison of that group with the population
- AGHME and ADS-B ASE measurements are plotted for each Monitoring Group

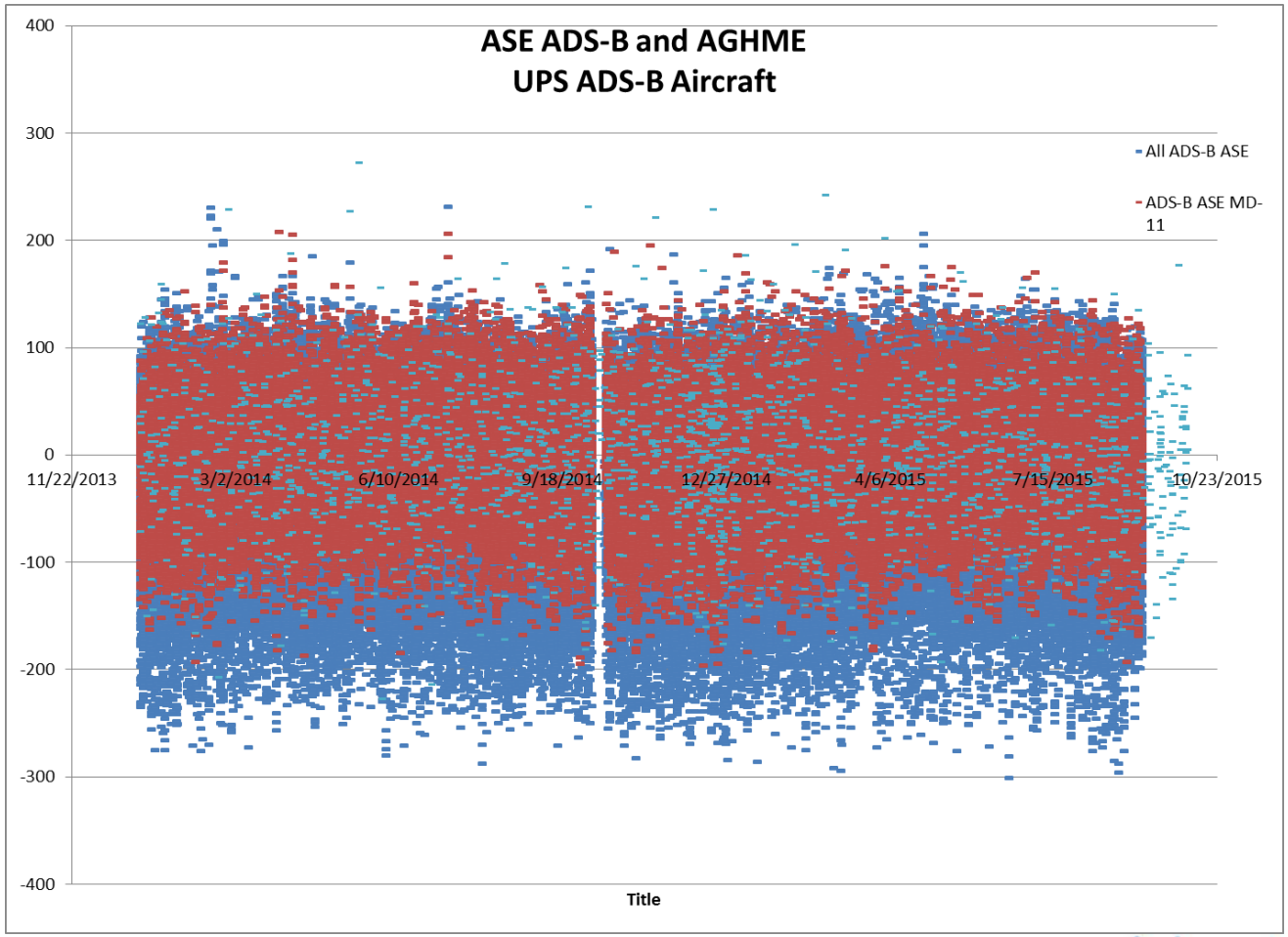
Population of ADS-B ASE Measurements

Overall bias of approximately -75ft.



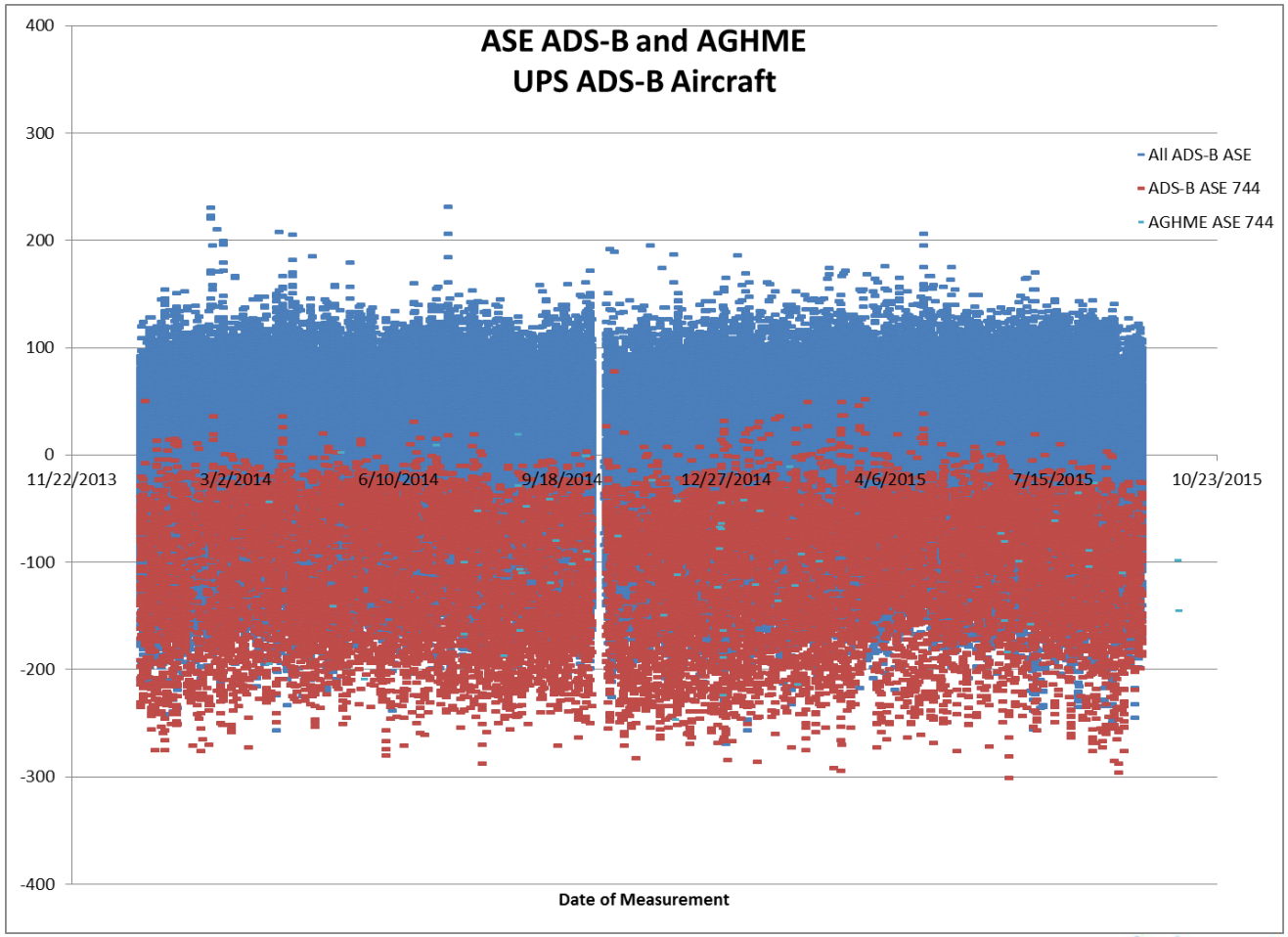
MD-11 ASE

MD-11 bias of approximately 0ft.



B744

B744 bias of approximately -100ft.



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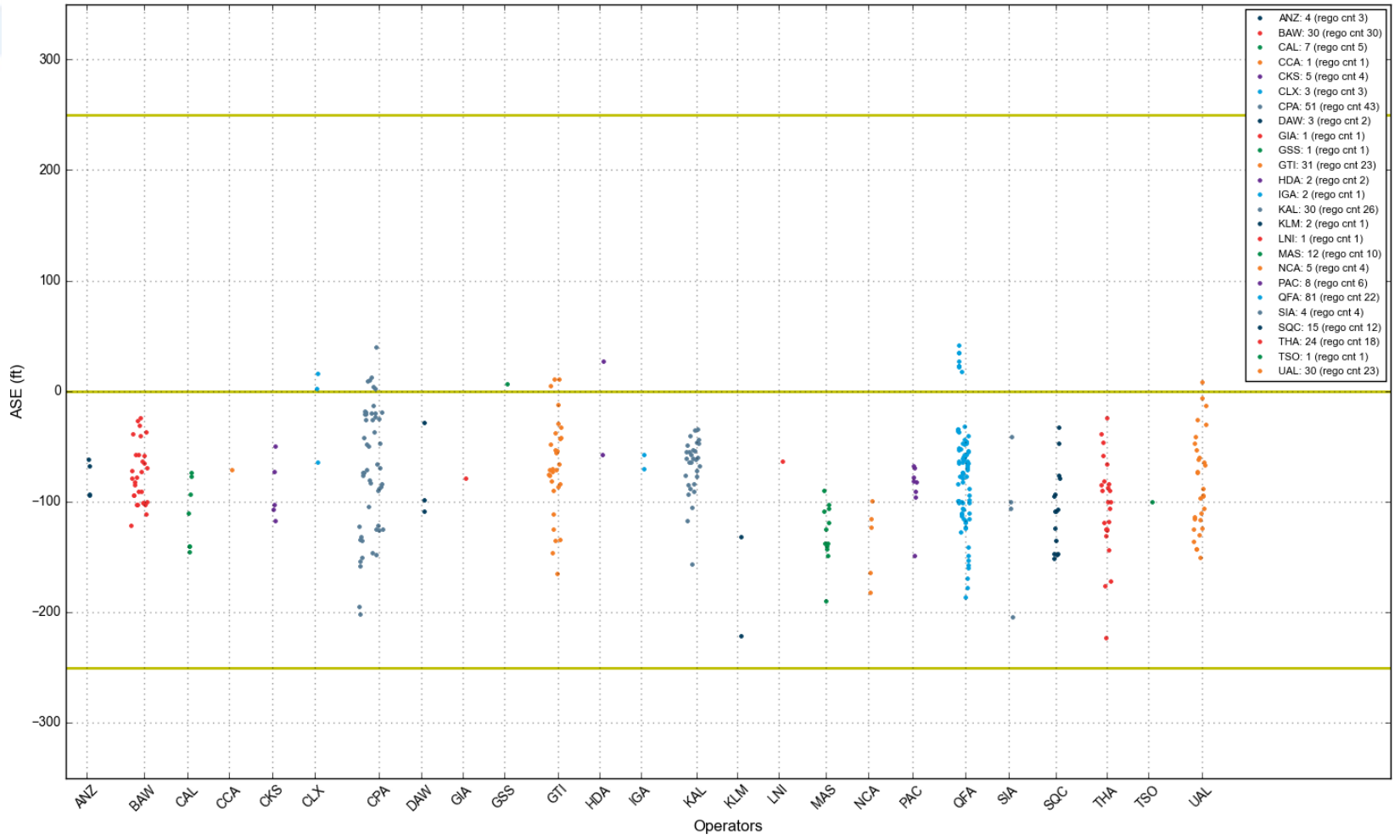
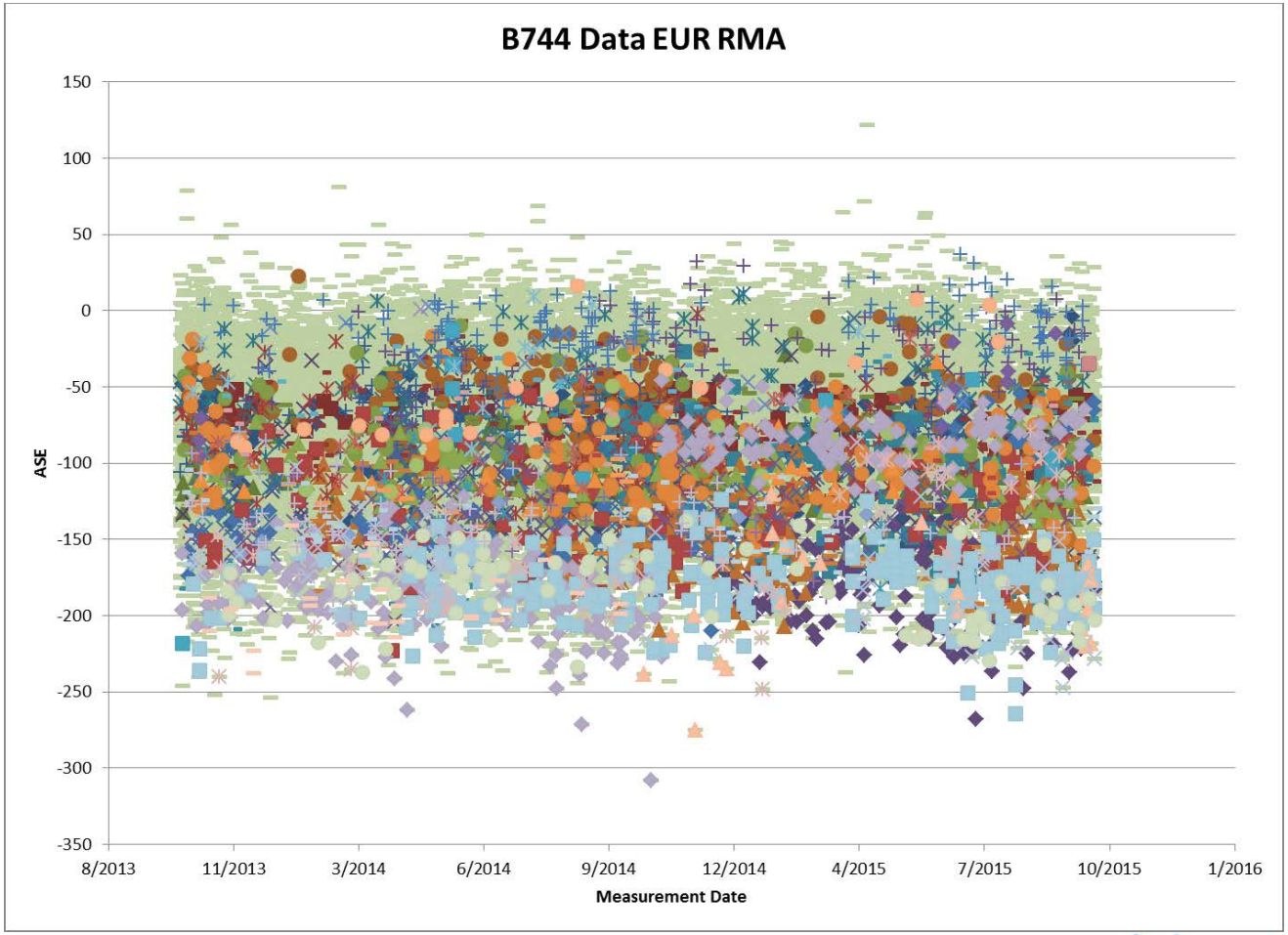
ODAS v2 - Permetior
12-Oct-2015

Results for AAMA Airworthiness-Approved Airframes B747
Mean: -80.82
S.D.: 47.23



EUROCONTROL ASE Measurements

B744 bias of approximately -100ft.



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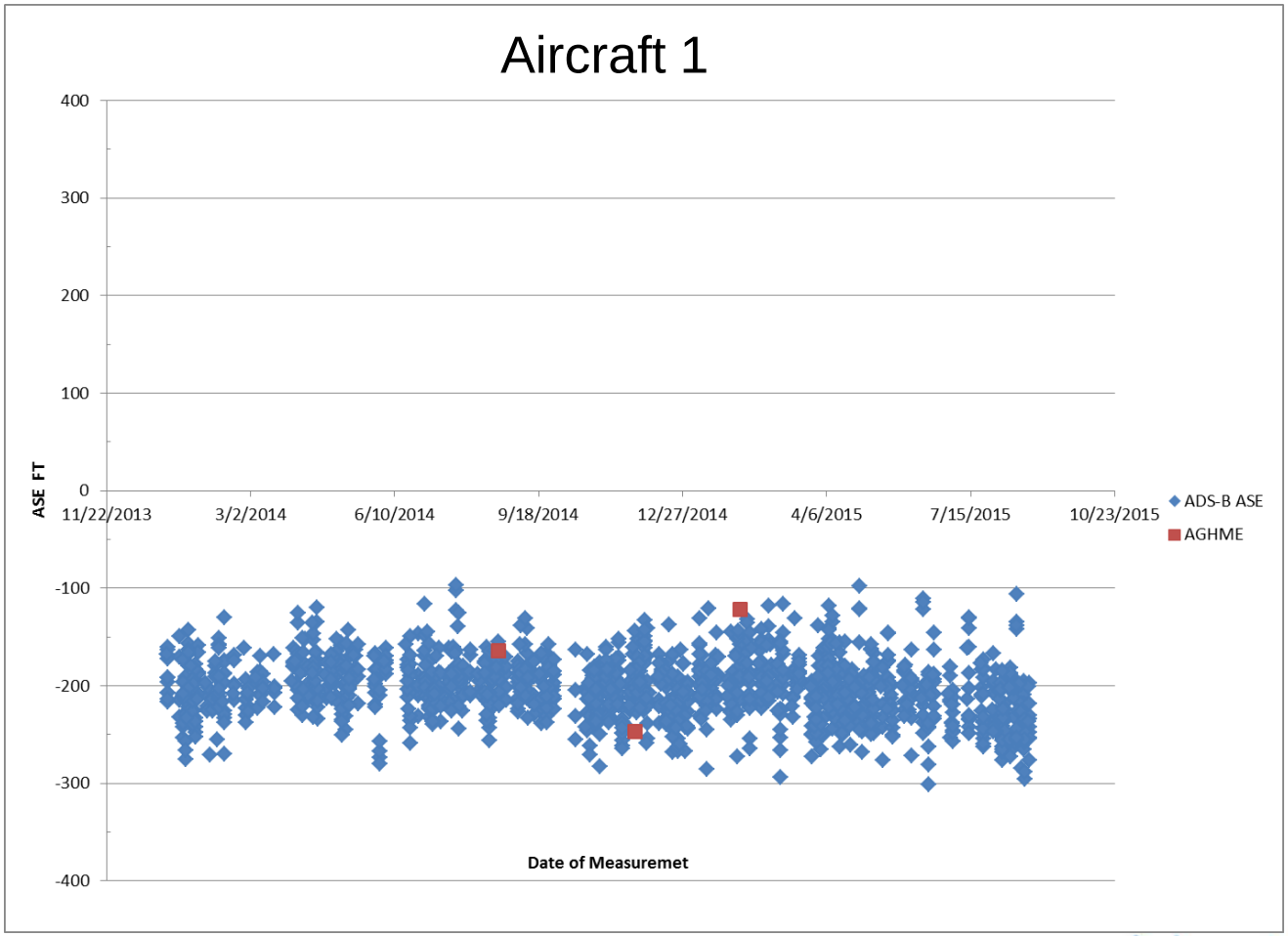
FAA Work Plan

- ANG-E61 provided a set of set ASE-Rs to FAA Flight Standards, AFS-470 for coordination with manufacturers in January 2016
- Track ASE changes during corrective actions
- Share corrective actions in the effort to develop a resource for aiding future large ASE remedies
- One of the subject B744 was removed from service
  - No repair data available, however the aircraft has been identified with the reported error

B744 AGHME and ADS-B ASE



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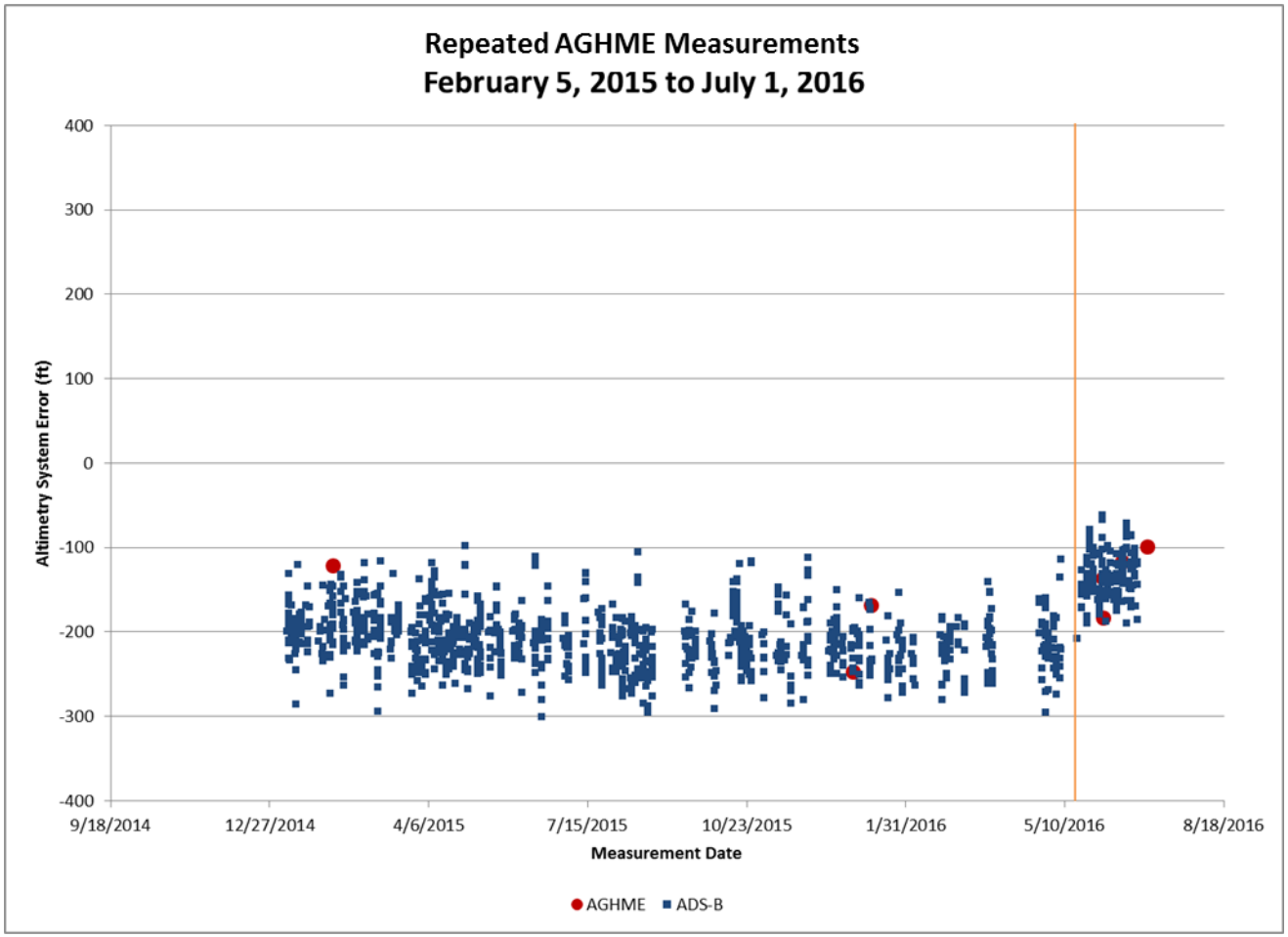
B744 AGHME and ADS-B ASE



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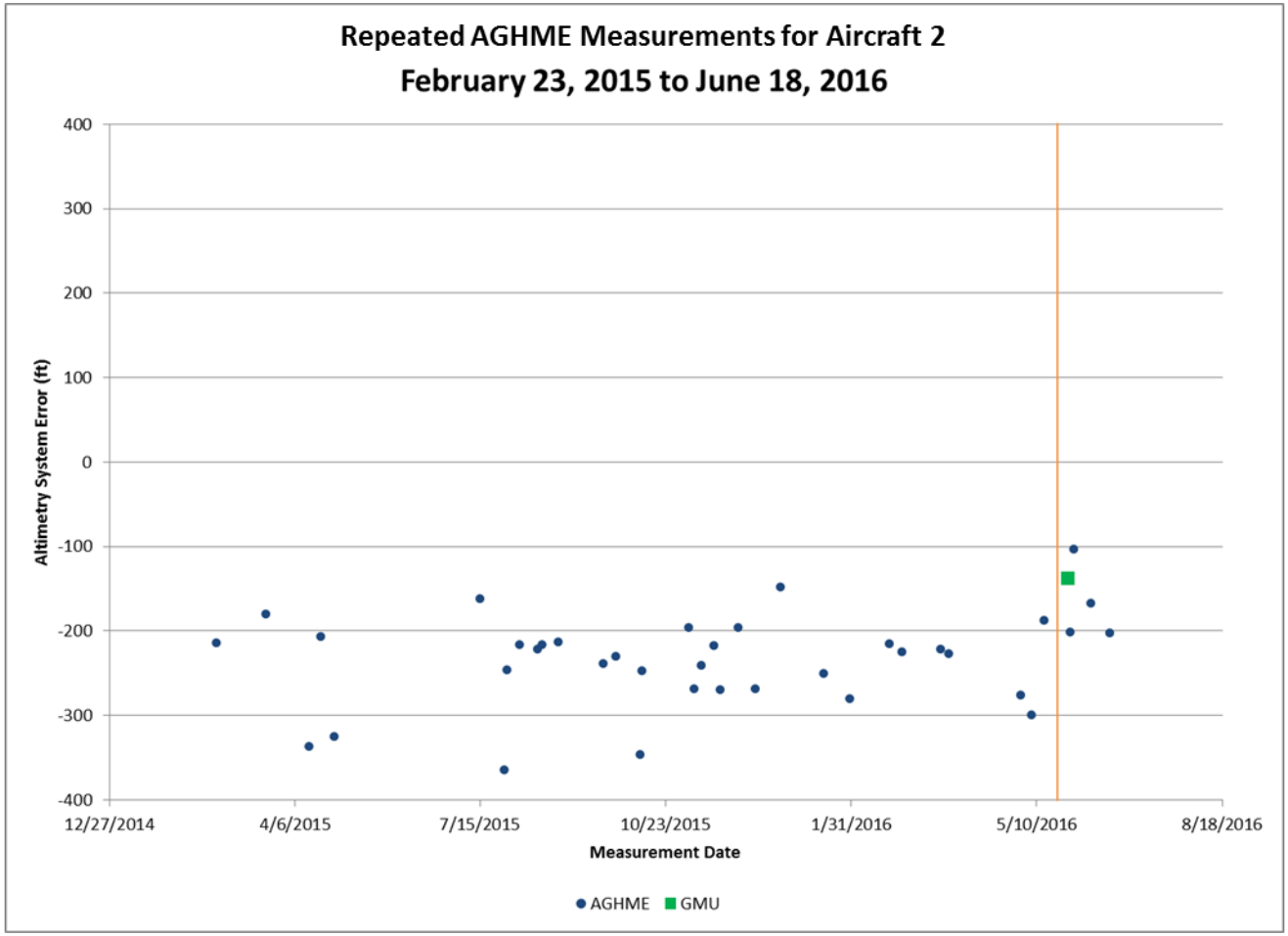
Aircraft 1 Actions Taken

- 5/19/2016 – 5/20/2016: Accomplished ADC accuracy test per AMM 34-12-00-735-020, para. S (Fig. 502 altitude points) on both L and R systems, with R ADC out-of-tolerance (reading high at all test points). It is worthy to note that R ADC originally installed on 5/09/2008 with approximately 36,500 flt hrs. R ADC, S/N 32578786 was replaced and both systems re-tested and found to be within tolerances. Tested both.

- ATC transponders per 34-53-00-735-465 with all altitudes tested (30,000 to 42,000 at 1,000 ft increments) satisfactory. Accomplished pitot static probe inspections per 34-11-01-601, task 206-001 with no noted defects. Accomplished satisfactory altitude alert operational check

B744 AHGME AC2



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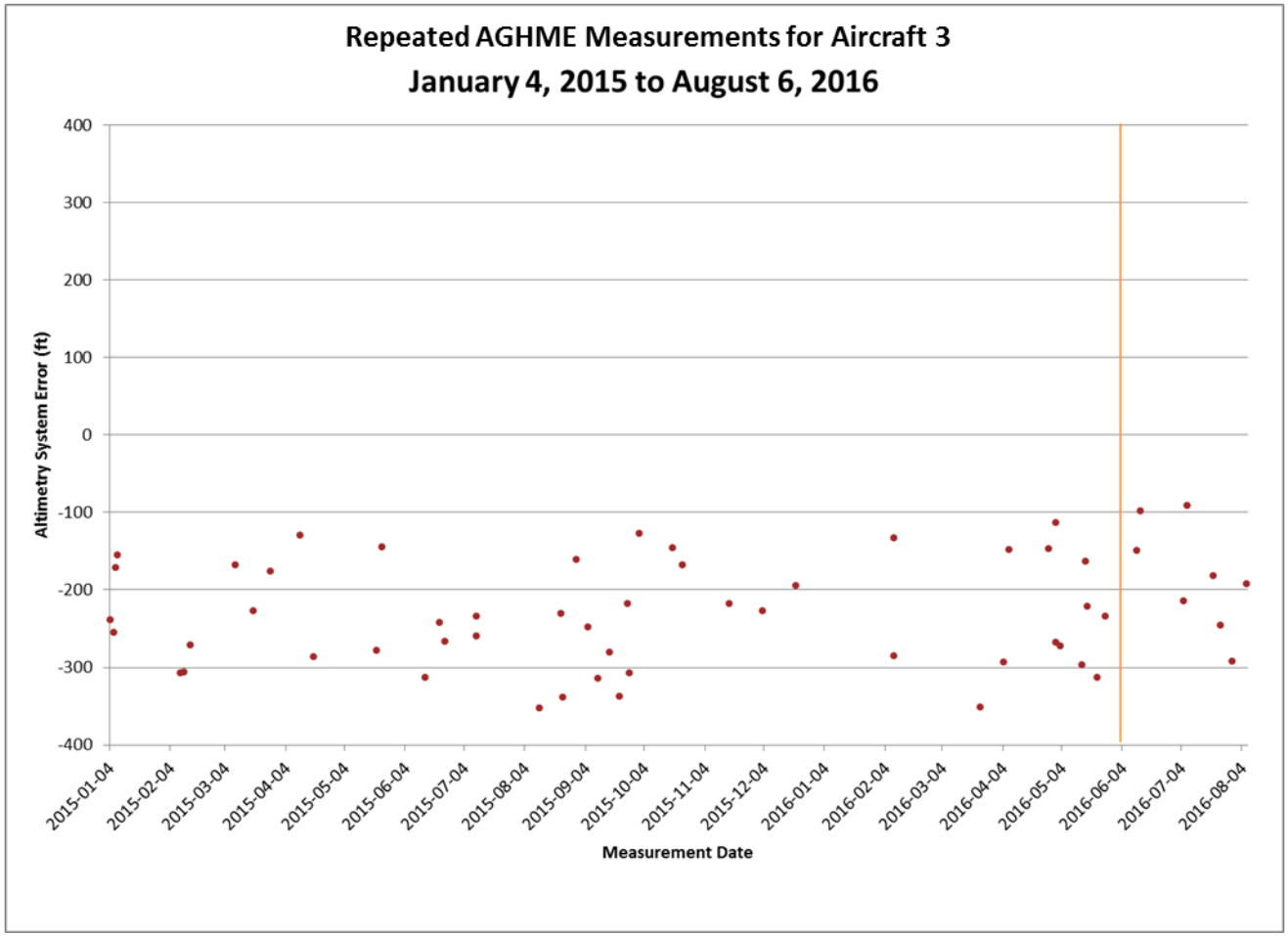
Aircraft 2 Corrective Action

- Operator reported they R&R'd all three ADCs, checked everything else but have indications they may still be trending low. – Need to review HM data.
- Resolution insufficient to date although the improvement was noted

B744 AHGME AC3



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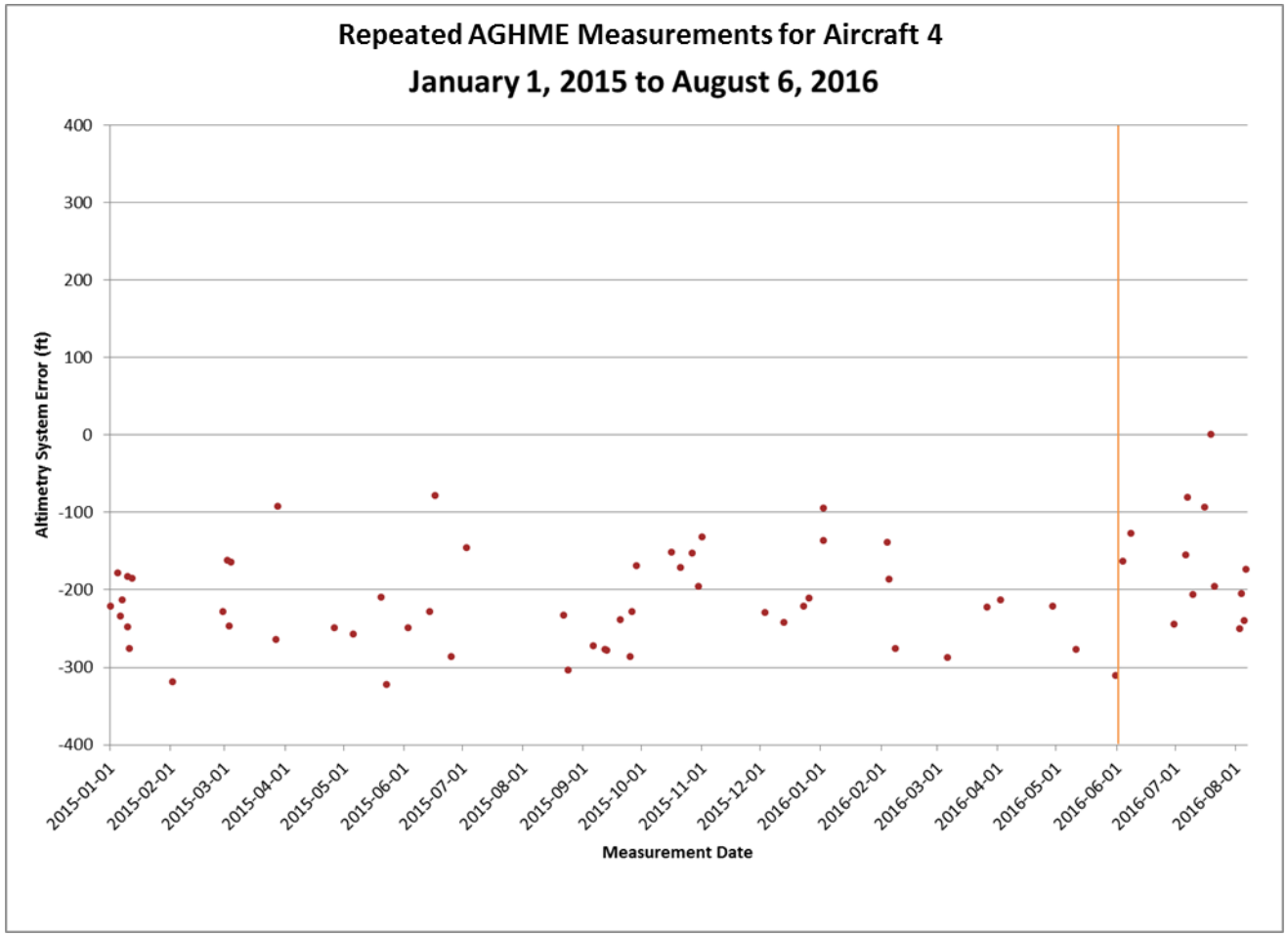
Aircraft 3 Corrective Action

- Boeing Service Bulletin 747-34-3020 - Navigation - Air Data System - Altimetry System Test. The Test revealed that the altimetry system was out of tolerance, with all Air Data Computers (ADC) exceeding a static error of 0.6mb. All 3 ADCs were replaced and the altimetry system tested satisfactorily after this.

- All other company 747-400 aircraft will have the Boeing Service Bulletin 747-34-3020 performed on them within the next 6 months. Aircraft Maintenance Schedule Amendment to repeat the check at every 747-400 aircraft C check (every 24months).

- Resolution Insufficient

B744 AGHME AC4



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Aircraft 4 Corrective Action

- 747-FTD-34-12004 Altimetry System Error due to Latent Transducer / Pitot-Static Probe Degradation
- Operator actioned Boeing Service Bulletin 747-34-3020 - Navigation - Air Data System - Altimetry System Test. The Test revealed that the altimetry system was out of tolerance, with all Air Data Computers (ADC) exceeding a static error of 0.6mb, and that the Pitot struts were damaged beyond limits.
- All 3 ADCs and 2 Pitot probes were replaced and the altimetry system tested satisfactorily after this.

- Resolution Insufficient

Summary

- ASE results presented for B744-10, including AGHME data from 2011-2015 and ADS-B data from 2014-2015, show a large and increasing bias in this monitoring group
  - Group Bias 2011-14: 76ft; Group Bias 2014-15: 84ft
- Large ASE was observed in measurements from multiple operators of aircraft in this group
  - Altimetry System Error-Reports (ASE-R) were issued and resolutions are being tracked
- Only one of the cases has been resolved