Experimental System of ADS-B Height Monitoring in Japan

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Background

- In Japan, JASMA (Japan Airspace Safety Monitoring Agency) is conducting Aircraft Height Keeping Performance Monitoring as an RMA.

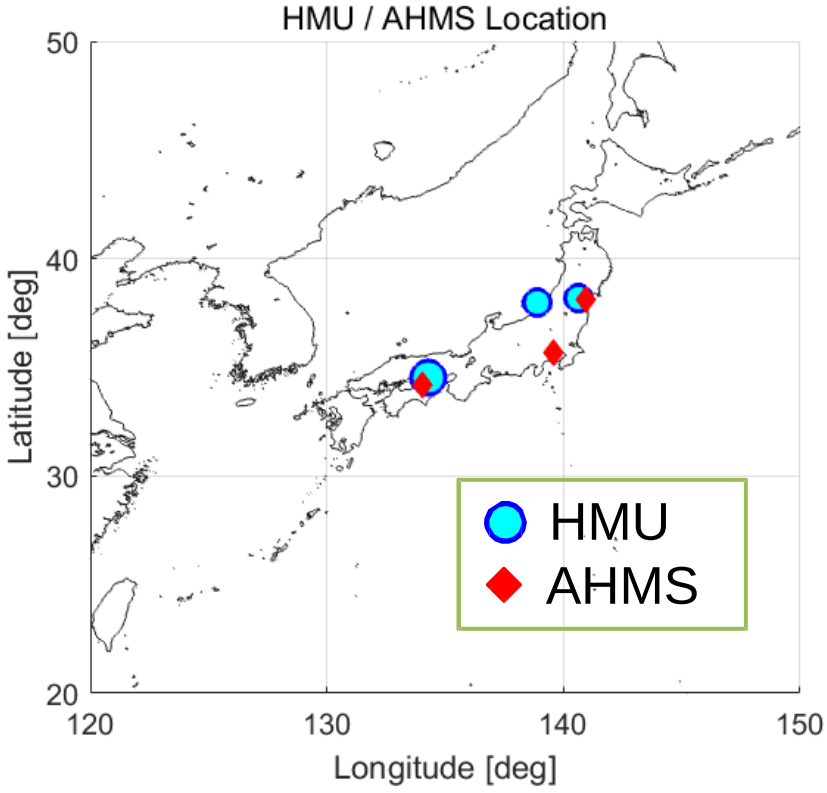
- 3 **HMU**'s (Height Monitoring Unit) are in operation.
  - Setouchi (R~40NM), Niigata (R~30NM), Sendai (R~30NM)

- Each HMU measures aircraft geometric height with 5 ground stations. (**MLAT (Multi-Lateration)** technique; as AGHME)

- On the other hand, ADS-B Height Monitoring System (**AHMS**) uses GPS geometric height information contained in ADS-B messages from aircraft.

AHMS Experimental System in Japan

- ENRI is conducting research on AHMS performance in Japan.
- 3 ADS-B receiver stations are installed as an experimental system.
  - Takamatsu (Setouchi), Chofu (Tokyo), Iwanuma (Sendai)



ADS-B receiver station

Major Error Sources for ASE calculation

According to ICAO WG reports (RMACG, SASP), there are several error sources for ASE calculation.

"Large-scale Study of the Use of Automatic Dependent Surveillance-Broadcast Data for Monitoring Aircraft Altimetry System Error", Separation and Airspace Safety Panel (SASP) Meeting Of The Working Group Of The Whole (WG/WHL)/19-WP/16, Montreal, Canada, 23 May to 3 June, 2011.

(1) Incorrect Height Datum of GPS Height

HAE (Height Above Ellipsoid) or HAG (Height Above Geoid)

No information for discrimination is contained in ADS-B messages!

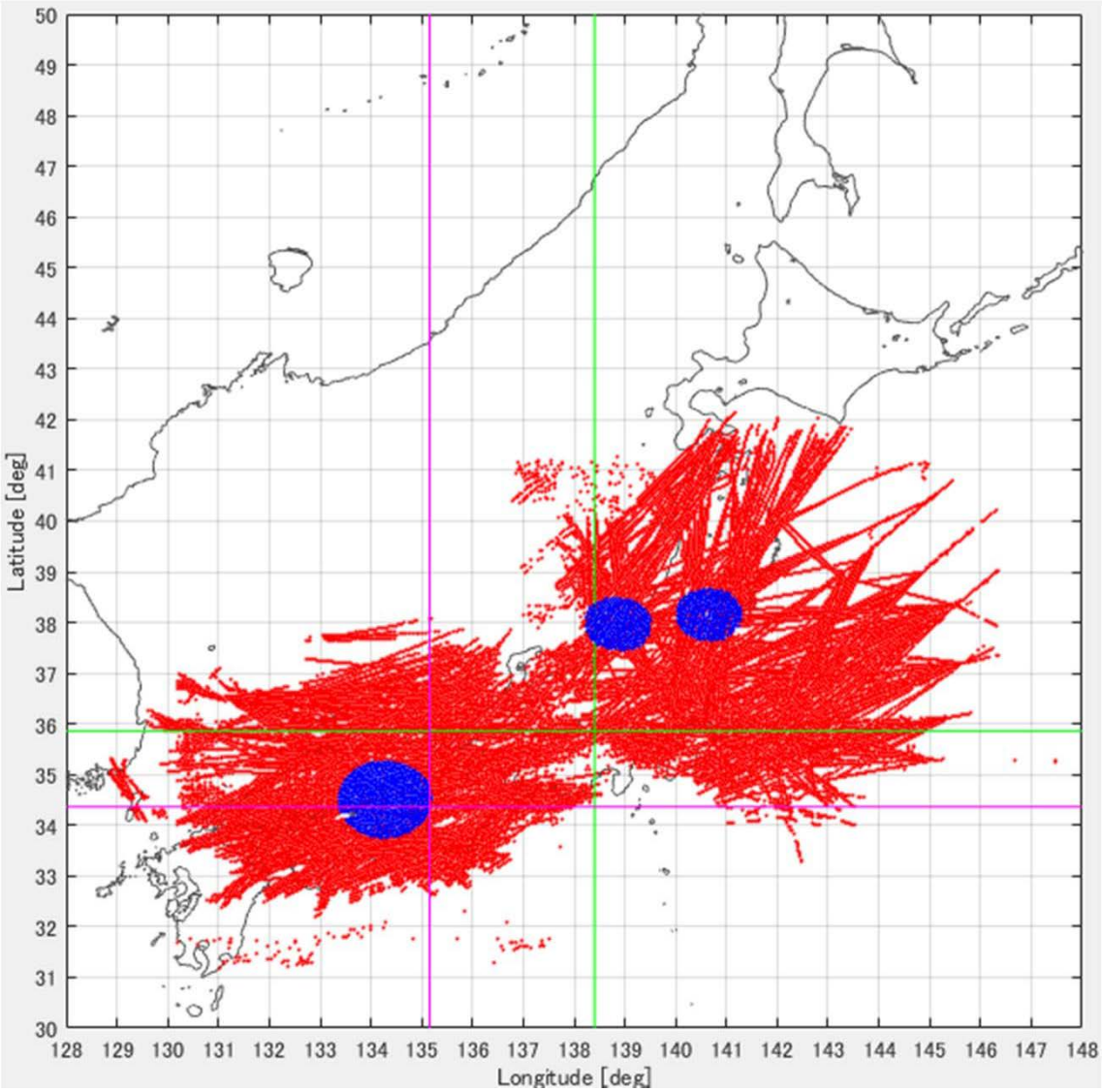
(2) Meteorological Data Error

Numerical data used to convert Barometric Altitude to Geometric Height

(3) Quantization Error

Barometric Altitude and GPS Height in ADS-B messages are broadcast in 25 ft quantization

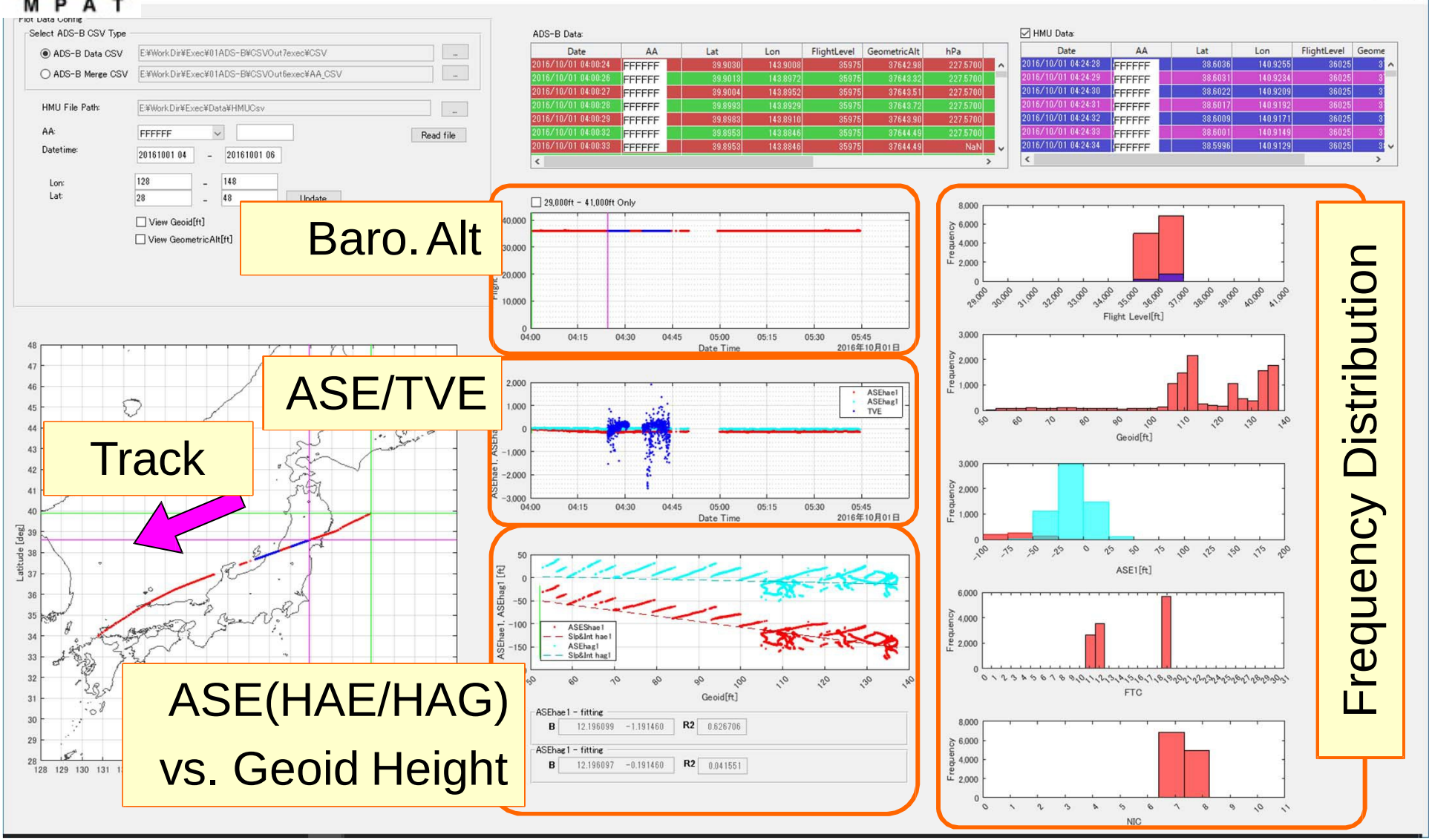
Experimental System – Coverage -



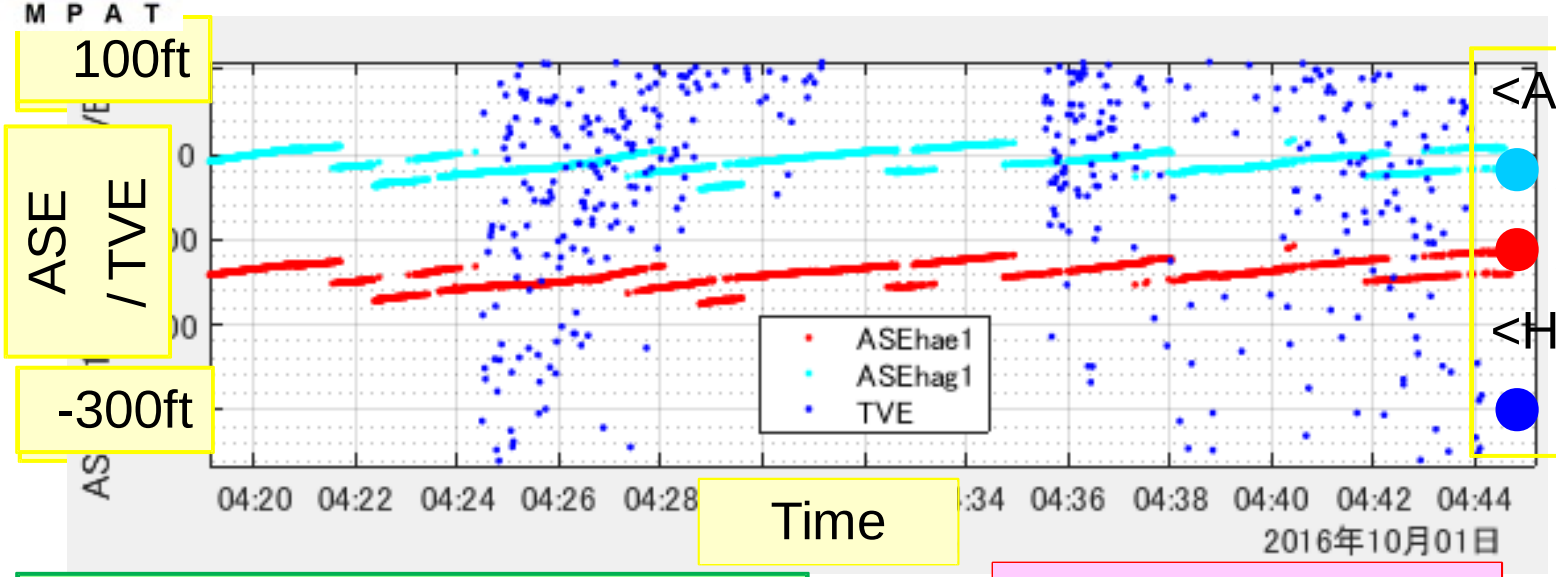
Aircraft Track Plot
(for 1 day)

- AHMS (ADS-B)
- HMU (MLAT)

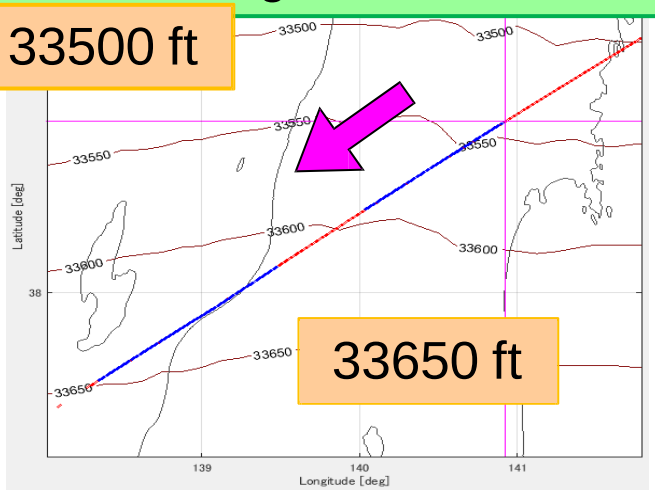
Analysis Tool



Preliminary Results – an airframe – (1)



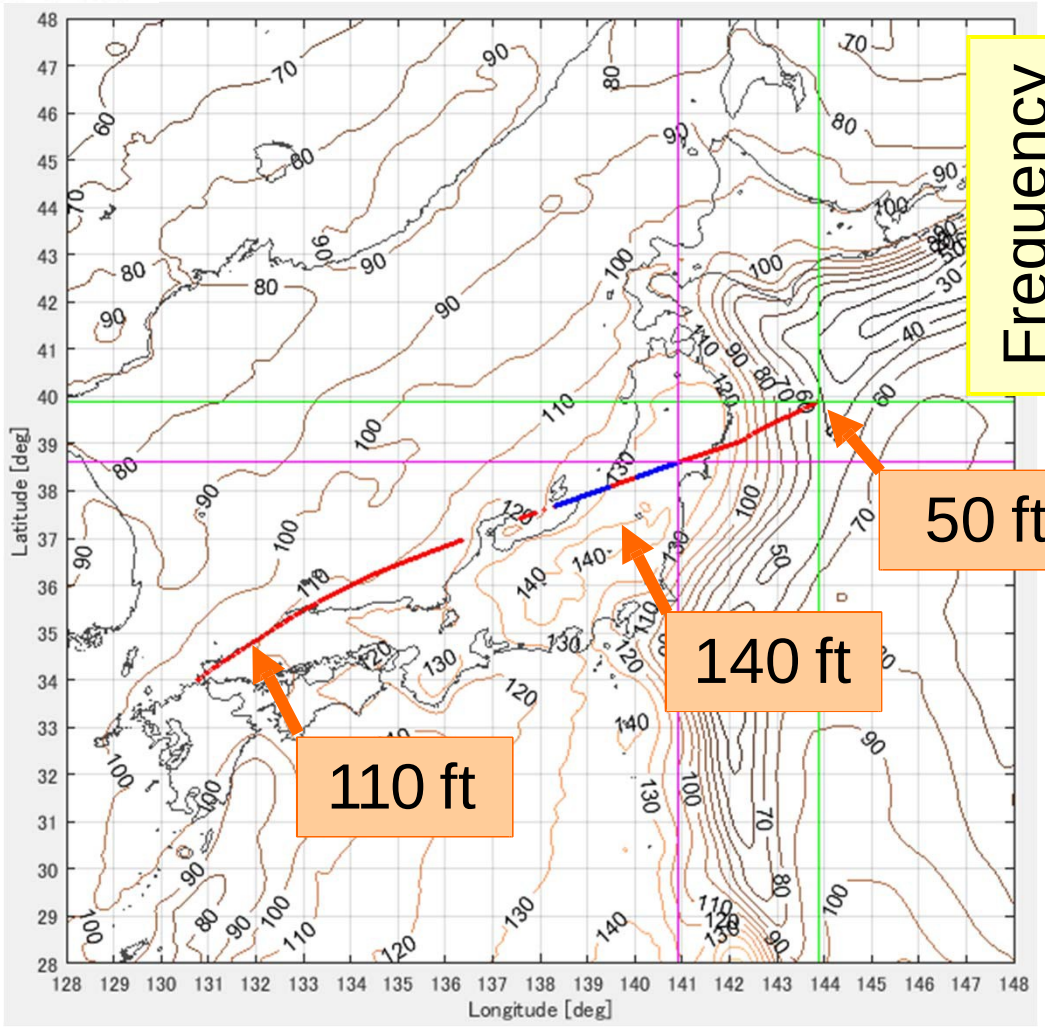
Geometric Height in Meteorological Data@FL360

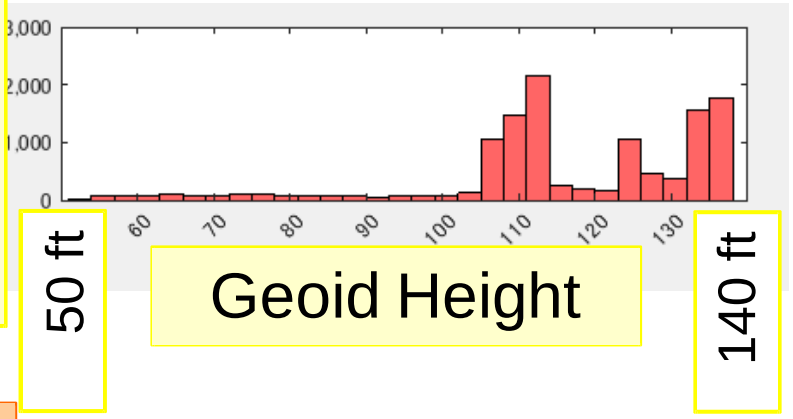


ASEσ = 17 [ft]

- Std. Dev. ASEσ of AHMS is smaller than that of HMU (MLAT)
- Quantization Error is recognized

Preliminary Results – an airframe – (2)

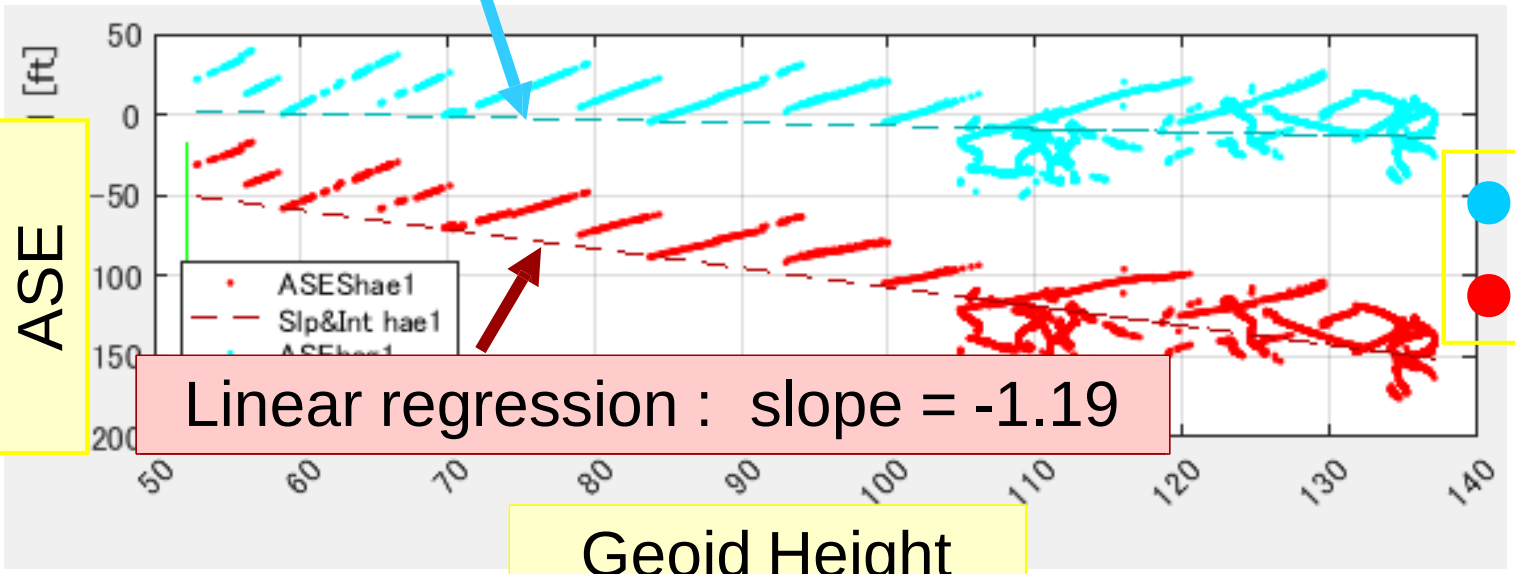




ADS-B data are obtained of this airframe flying in the range of 50 - 140 [ft] of Geoid height.

Preliminary Results – an airframe – (3)

Linear regression : slope = -0.19



Linear regression : slope = -1.19

ASE value is assumed to be stable.

GPS Height of this airframe is determined as HAG

ASE value of this airframe (averaged) = -10 ft.

Summary

ENRI is developing AHMS Experimental System

- ADS-B receiver station are installed for research.

Items undertaken

- **Modification of ASE calculation**
  - Interpolation of Meteorological data
  - Conversion from Geo-Potential height to Geometric height
- **Statistical Analysis of Many Aircraft**
  - Sortation by Aircraft Group (e.g. B772, B744-5, A320, etc)
- **Detection of Non-compliant Aircraft (ASE > 245 ft)**

  … considering the ASE distribution due to measurement error