

System Certification and Implementation - Japan

Susumu Saito

Electronic Navigation Research Institute

*National Institute of Maritime, Port and Aviation Technology,
Japan*

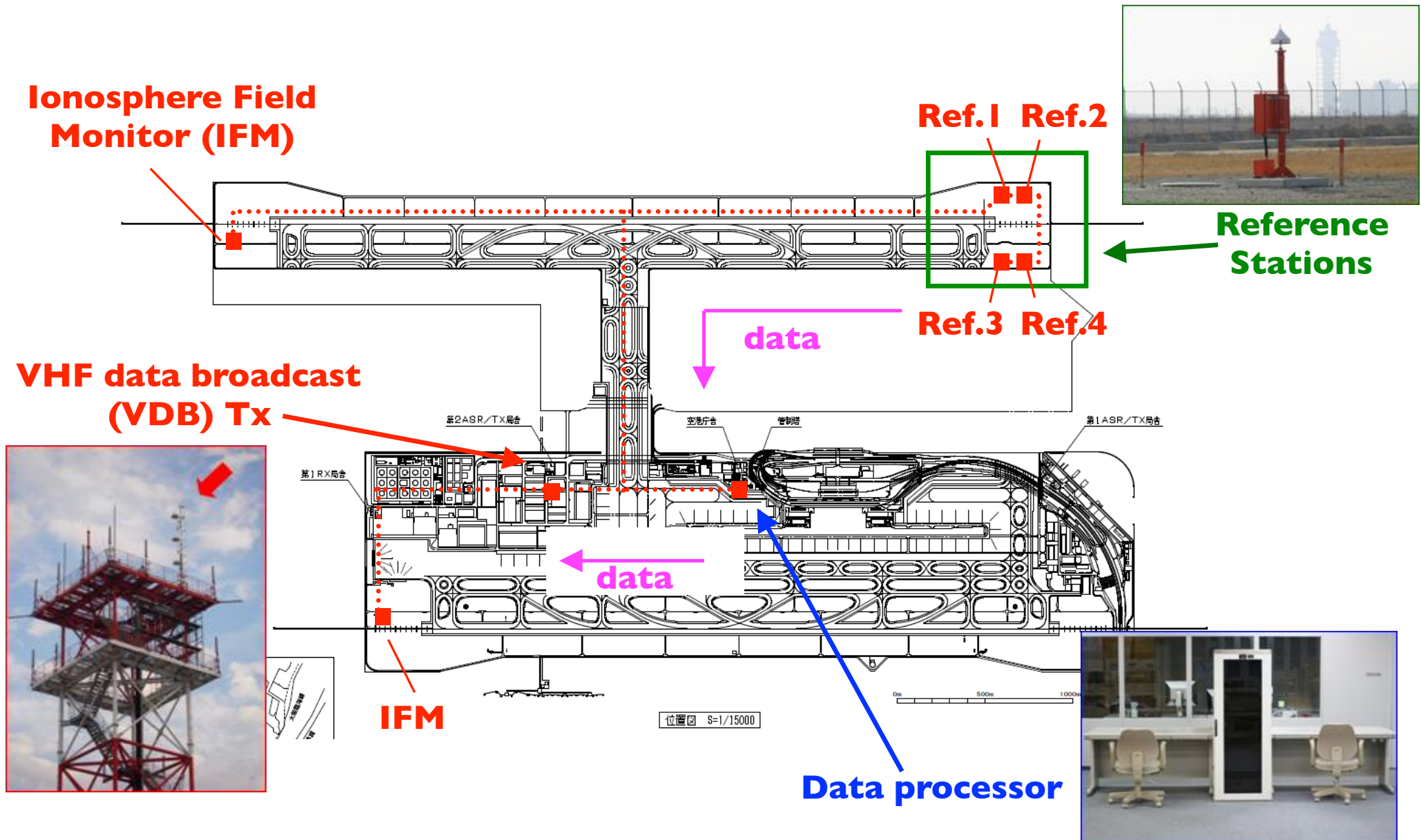
(E-mail: susaito@mpat.go.jp)

- * Ongoing GBAS/SBAS implementation in Japan
- * Study of certification of GBAS
 - Prototype development and implementation
- * Ionospheric threat characterization for GBAS
 - Common ionosphere threat model for GBAS in APAC region
 - Improvement of the ionospheric threat model
- * Certification of GBAS for Tokyo Haneda
 - Framework
 - Safety verification processes

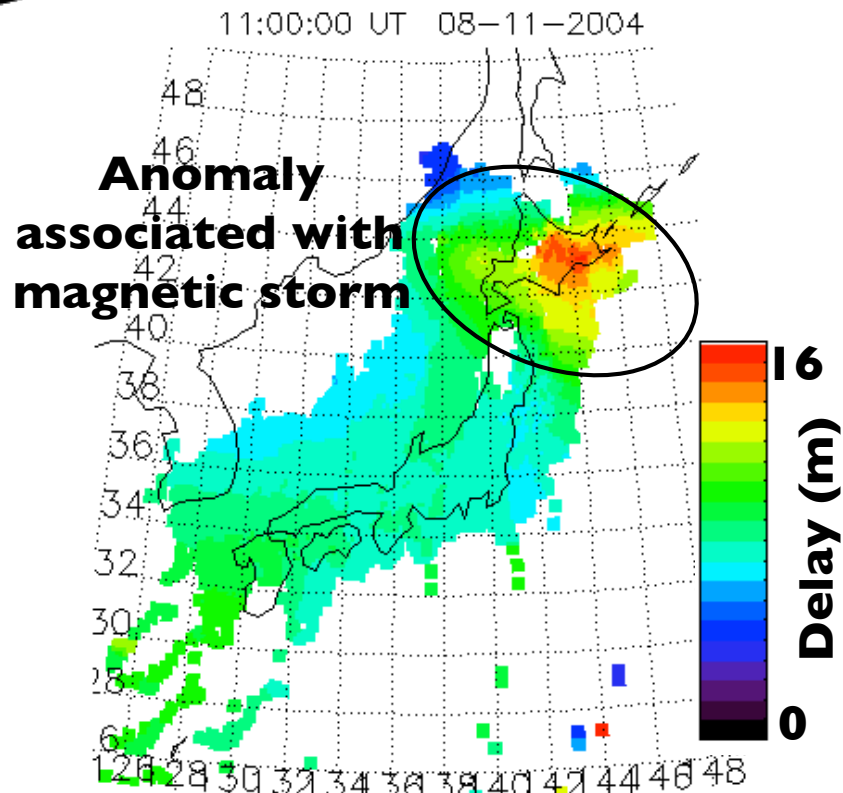
- * MSAS upgrade from V1 to V2
 - GEO change from MTSAT-2 to QZS-3
 - MCS upgrade
 - GMS upgrade
 - QZSS System Service (QSS) implements MSAS V2.
 - ◆ Certification of MSAS V2 is going on.
- * GBAS implementation at Tokyo-Haneda
 - GBAS implementation program started in 2016
 - NEC Corp. was awarded the contract.
 - ◆ Certification of NEC GBAS is going on.
 - ✓ Certification related activities are presented in the following slides.

- * Objectives
 - Study safety design and verification processes for GBAS by developing a “near-operational” prototype
- * Contents
 - Develop a prototype with integrity monitors compliant with ICAO Annex 10.
 - Safety design and assessment for hardware, software including integrity monitors, and siting of equipments
 - Flight trials with experimental and operational aircraft
- * Participants
 - ENRI: Project lead, responsible for all (system design, safety assessment, flight trials)
 - NEC: Manufacturer
 - ✓ JCAB participates in the project as an observer.

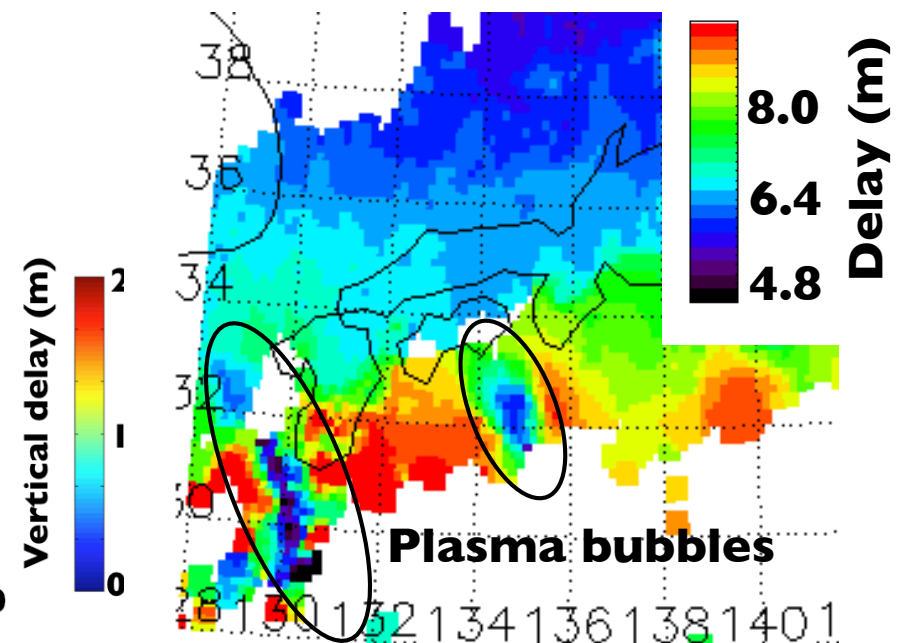
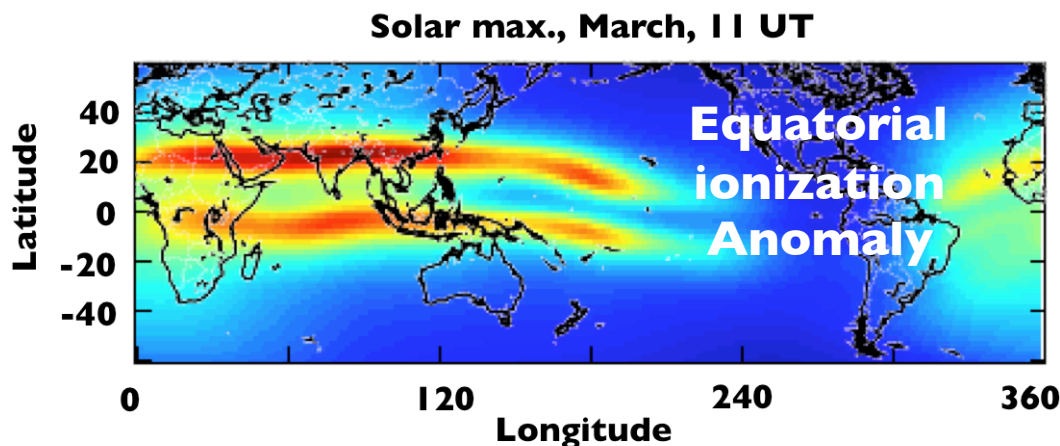
GBAS Prototype Development - Osaka-Kansai



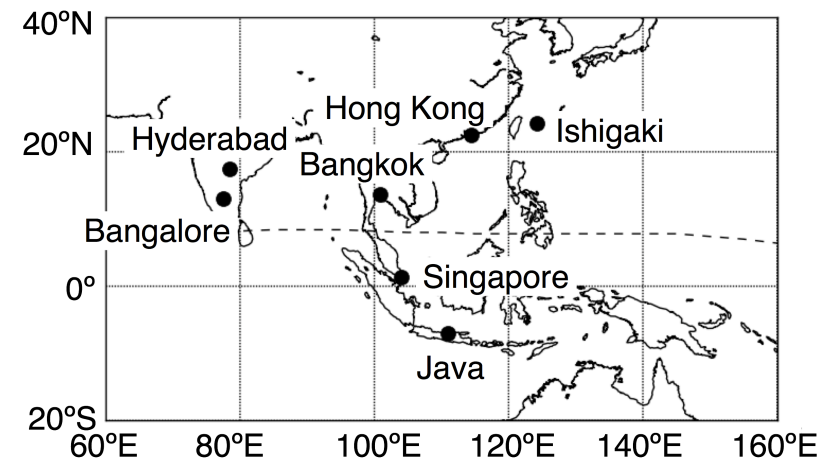
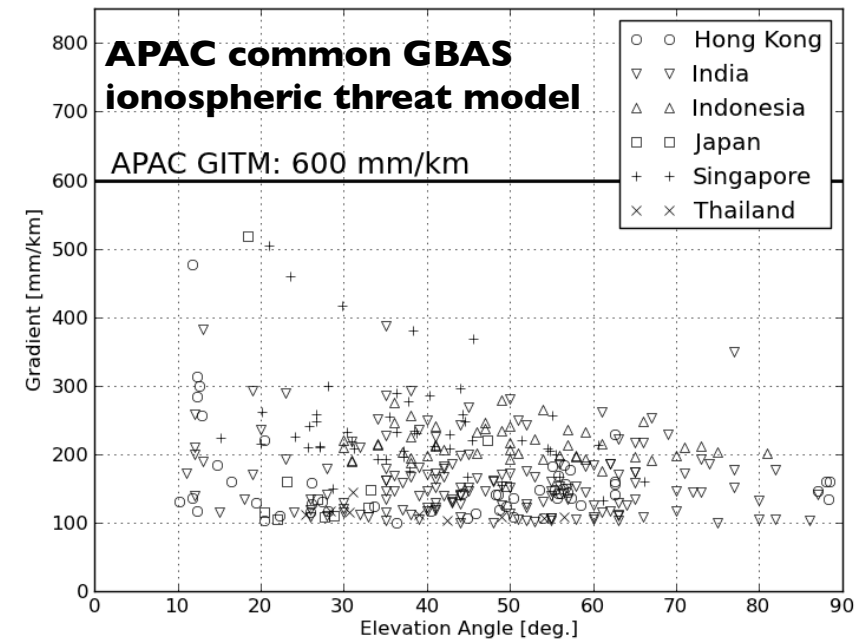
Ionosphere Threat Mitigation - Ionospheric conditions in Japan



- * Japan is located at mid- to low magnetic latitude region ($\sim 15-41^\circ$ in magnetic latitude).
- Subject to both mid-latitude type and low latitude type ionospheric anomalies

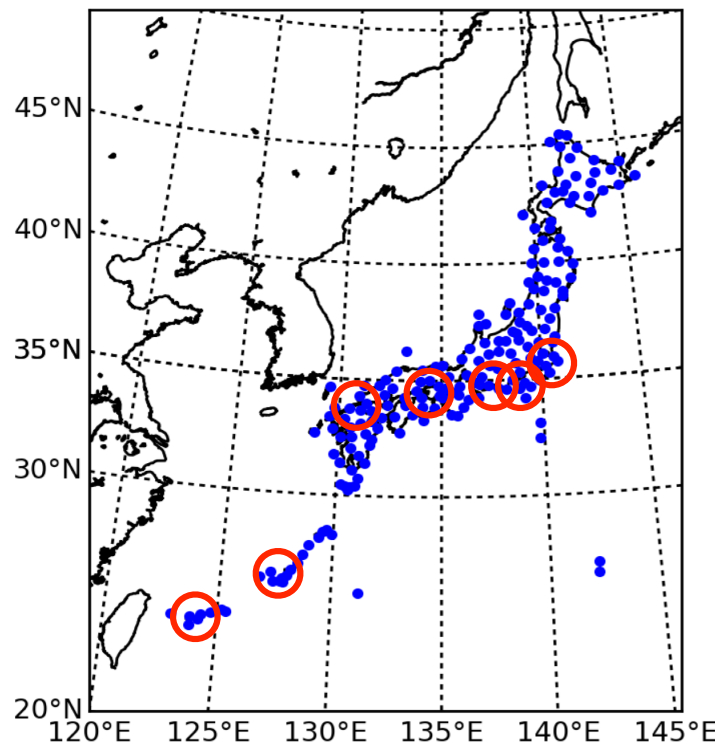


- * Assessment of ionospheric anomalies characteristic to the low magnetic latitude is essential.
 - Data collection and sharing in the same region is effective.
- ➔ APANPIRG CNS-SG decided to establish Ionospheric Studies Task Force (ISTF)
 - APAC common GBAS ionospheric threat model was established by ISTF.
 - Japan contributed to ISTF activities through ENRI.

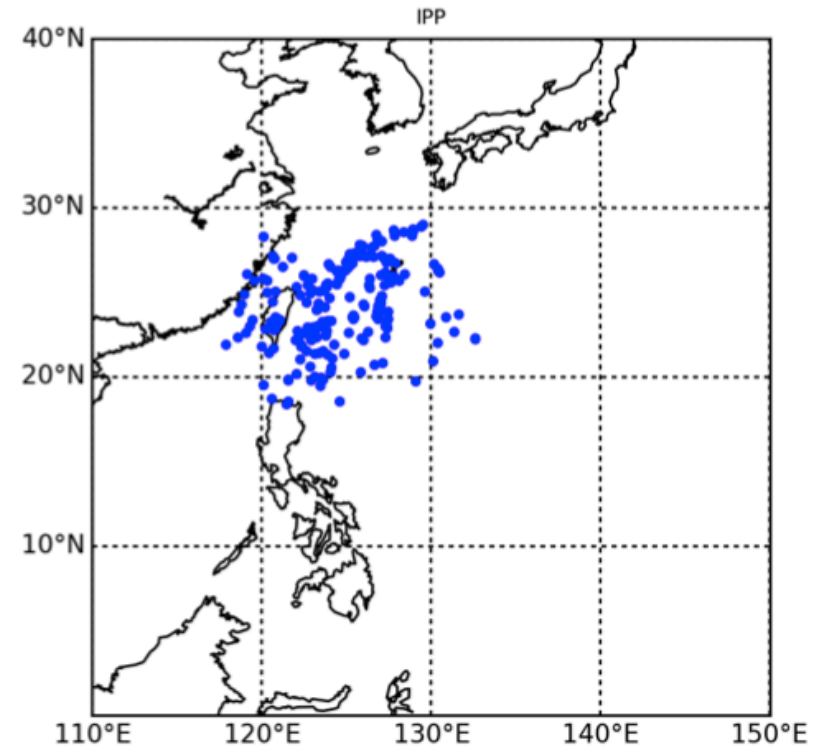


Data collection for ISTF
[Saito et al., GPS Solutions, 2018]

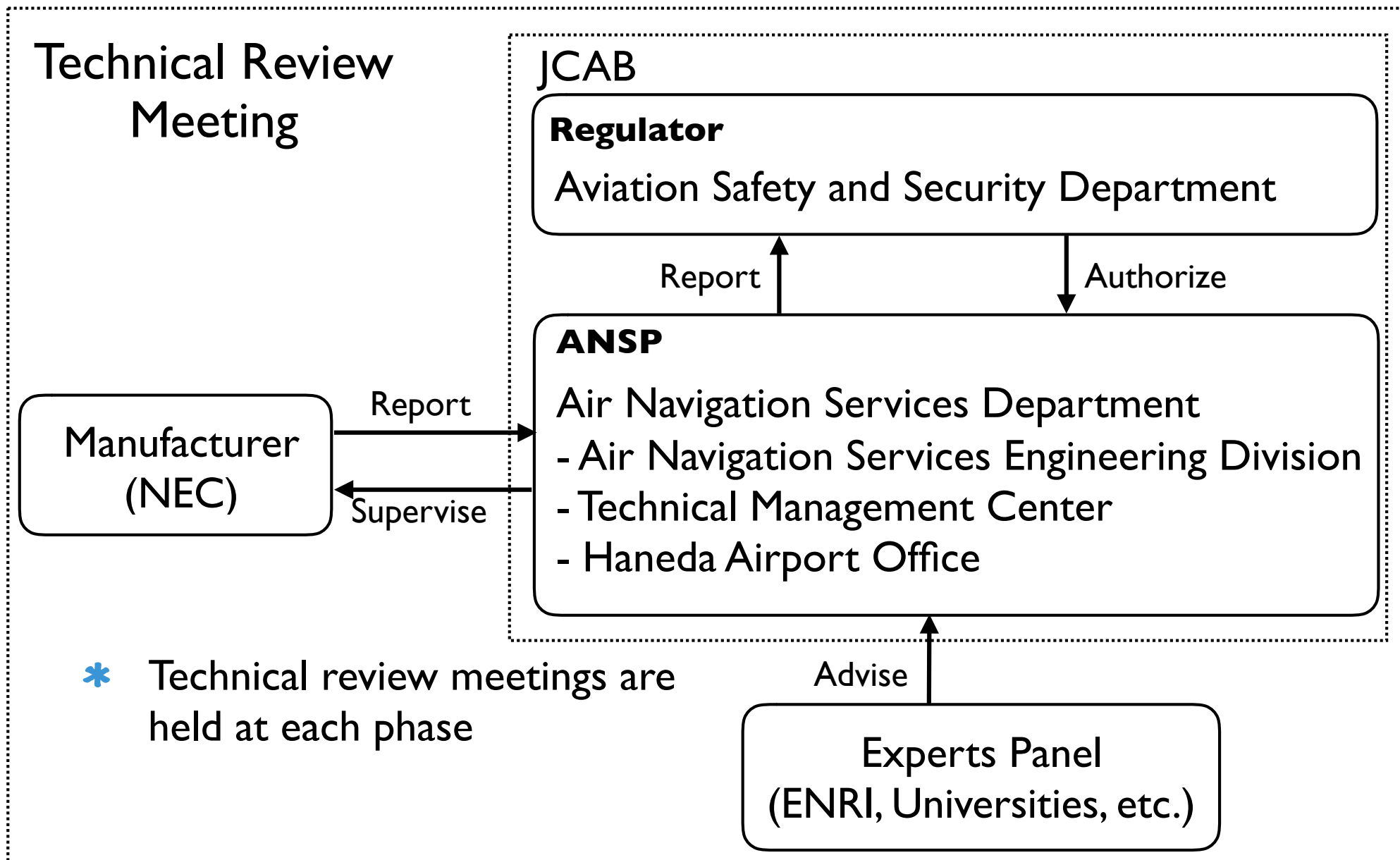
- * APAC common GBAS ionospheric threat model is the basis of the ionospheric threat model for Tokyo-Haneda.
 - It is severer than that in the mid-latitude (such as CONUS model)
 - Adaptation of the ionospheric threat model for Tokyo-Haneda by historical data analysis by ENRI is going on.



Clusters of GEONET stations for ionospheric gradient analysis



Ionospheric gradients > 100 mm/km (2014-2017)





Certification of GBAS for Tokyo-Haneda - Safety Verification Processes (I)



- * System safety verification plan
 - From preliminary design phase to operation
 - Prepared by the manufacturer and authorized by JCAB
- * Preliminary design review (Sep. 2016 - Sep. 2017)
 - Functional hazard assessment
 - Fault mode and effect analysis
 - Fault mode and effect summary
 - Common cause analysis
 - Fault tree analysis
 - System safety assessment
 - Algorithm description documents
 - ✓ Analysis based on theory, simulations, and data collected in the past in similar conditions.
- * Critical design review (Aug. 2017 - Nov. 2018)
 - Technical review at a critical level
 - Review of modifications made after the preliminary phase



Certification of GBAS for Tokyo-Haneda - Safety Verification Processes (2)



- * Manufacturing verification (Completed Mar. 2019)
 - Safety evaluation report
 - Algorithm description document (ADD)
 - Additional report on modification after the critical design phase
- * Parameter verification (June 2019 -)
 - Based on safety practice manual and parameter verification manual (Prepared by the manufacturer and accepted by JCAB)
 - Analyze data collected onsite to verify the determined parameters
 - Report results with the final version of ADDs.
- * Pre-operation validation (In preparation)
 - Continuous data collection for 1.5 years (planned)
 - Demonstration of performance (accuracy, integrity, continuity, and availability)
- * Flight inspection (In preparation)
 - Flight inspection center is preparing for flight inspection of GBAS.
 - Practices in collaboration with ENRI's prototypes