Supporting European Aviation

EUROCONTROL

RVSM and the EUR RMA

Andrew Lewis
NMD/INF/CNS
6th October 2022

FOUNDING MEMBER OF sesar JOINT UNDERTAKING

NETWORK MANAGER

EUR RMA

- The EUR Regional Monitoring Agency (EUR RMA) was established by EUROCONTROL in 2003, at the request of the ICAO European Air Navigation Planning Group (EANPG now superseded by EASPG).
- The establishment of an RMA was required to ensure compliance with amendments to ICAO Annex 11.
- These amendments were implemented in response to aircraft altimetry system issues identified during the RVSM implementation programme.
- Principally, monitoring programmes are required to assess aircraft Altimetry System Error (ASE)

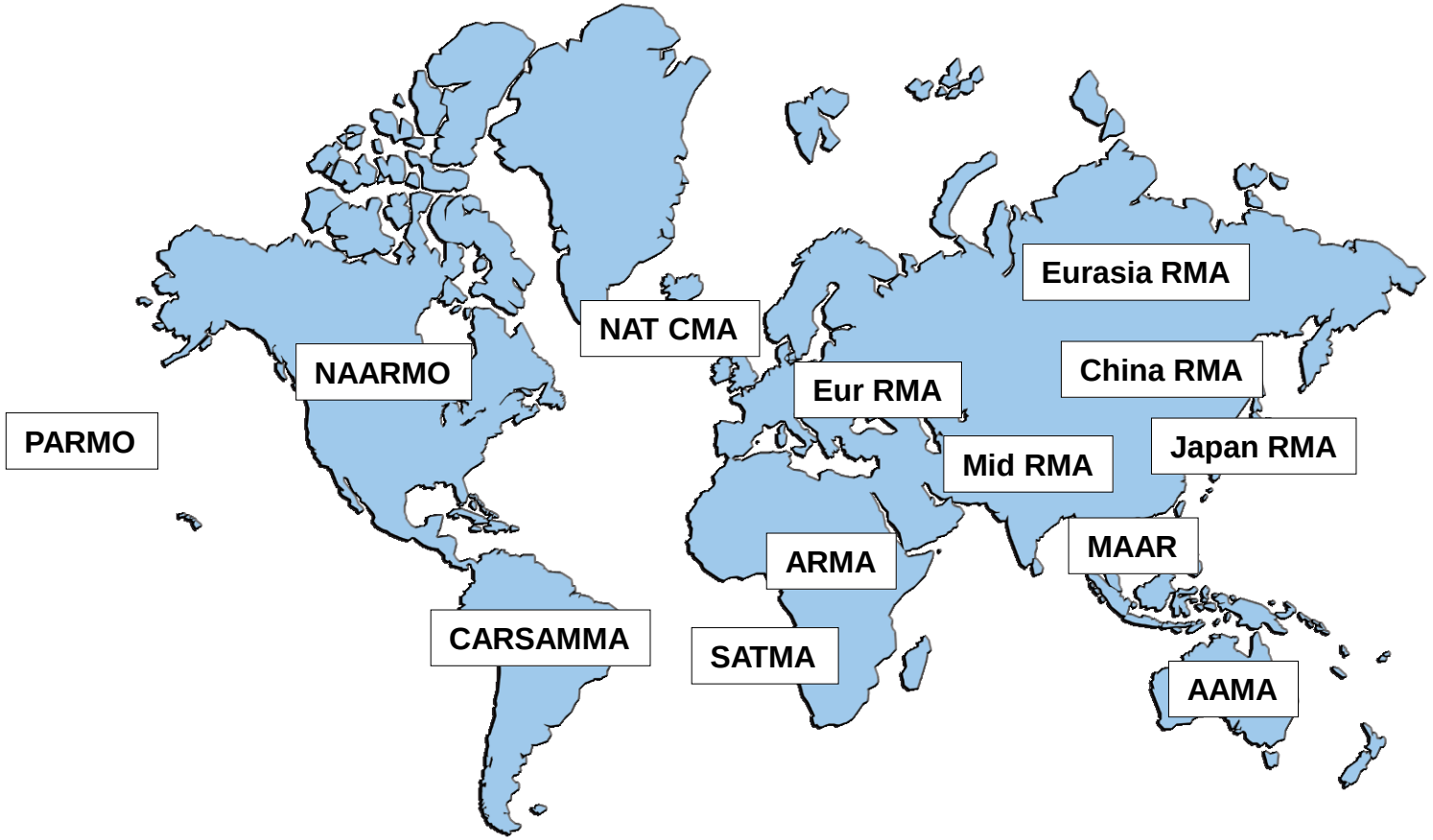
EUR RVSM Region

Amsterdam FIR	Alger UIR	Ankara FIR	Barcelona UIR	Beograd UIR	Berlin UIR
Bratislava FIR	Brindisi UIR	Brussels UIR	Bucuresti FIR	Budapest FIR	Canarias UIR
Casablanca FIR	Chisinau FIR	France UIR	Hannover UIR	Hellas UIR	Istanbul FIR
Kaliningrad FIR	Kharkiv FIR	Kobenhavn FIR	Kyiv FIR	Lisboa FIR	Ljubljana FIR
London UIR	L'viv FIR	Madrid UIR	Malta UIR	Milano UIR	Minsk UIR
Nicosia FIR	Norway UIR	Odesa FIR	Praha FIR	Riga UIR	Rhein UIR
Roma UIR	Rovaniemi UIR	Sarajevo UIR	Scottish UIR	Shannon UIR	Simferopol FIR
Skopje FIR	Sofia FIR	Sweden UIR	Switzerland UIR	Tallinn UIR	Tampere UIR
Tel Aviv FIR	Tirana FIR	Tunis UIR	Varna FIR	Vilnius UIR	Warszawa FIR
Wien FIR	Zagreb FIR				

EUR RVSM States

Albania	Algeria	Andorra	Armenia	Austria	Azerbaijan	Belarus
Belgium	Bosnia & Herz'a	Bulgaria	Croatia	Cyprus	Czechia	Denmark
Estonia	Finland	France	Georgia	Germany	Gibraltar	Greece
Guernsey	Hungary	Isle of Man	Israel	Italy	Jersey	Latvia
Lithuania	Luxembourg	Rep of Moldova	Malta	N Macedonia	Monaco	Montenegro
Morocco	Netherlands	Poland	Romania	San Marino	Serbia	Slovakia
Slovenia	Spain	Sweden	Switzerland	Tunisia	Turkey	Ukraine
UK						

RMAs World-Wide



Principle Roles of the EUR RMA

- Verify the RVSM approval status of aircraft flying 1,000 ft. vertical separation minimum in RVSM airspace.

- Conduct RVSM airspace safety assessments, including statistical collision risk estimations to determine compliance with pre-determined Targets Level of Safety (TLS).

- Monitor aircraft height keeping performance with emphasis on aircraft ASE.

RVSM Approval

- Three elements of an RVSM approval.
  - Design, Construction, Configuration and Equipment (Airworthiness)
  - Continued airworthiness procedures (Maintenance)
  - Flight crew procedures (Training)

- Airworthiness approval normally linked to aircraft certification (TC, STC, SB, etc.)
  - Normally valid for life of the airframe unless it is modified.

- Maintenance and training are operator specific.

- State Authorities must verify all elements are verified prior to issuing an RVSM approval.

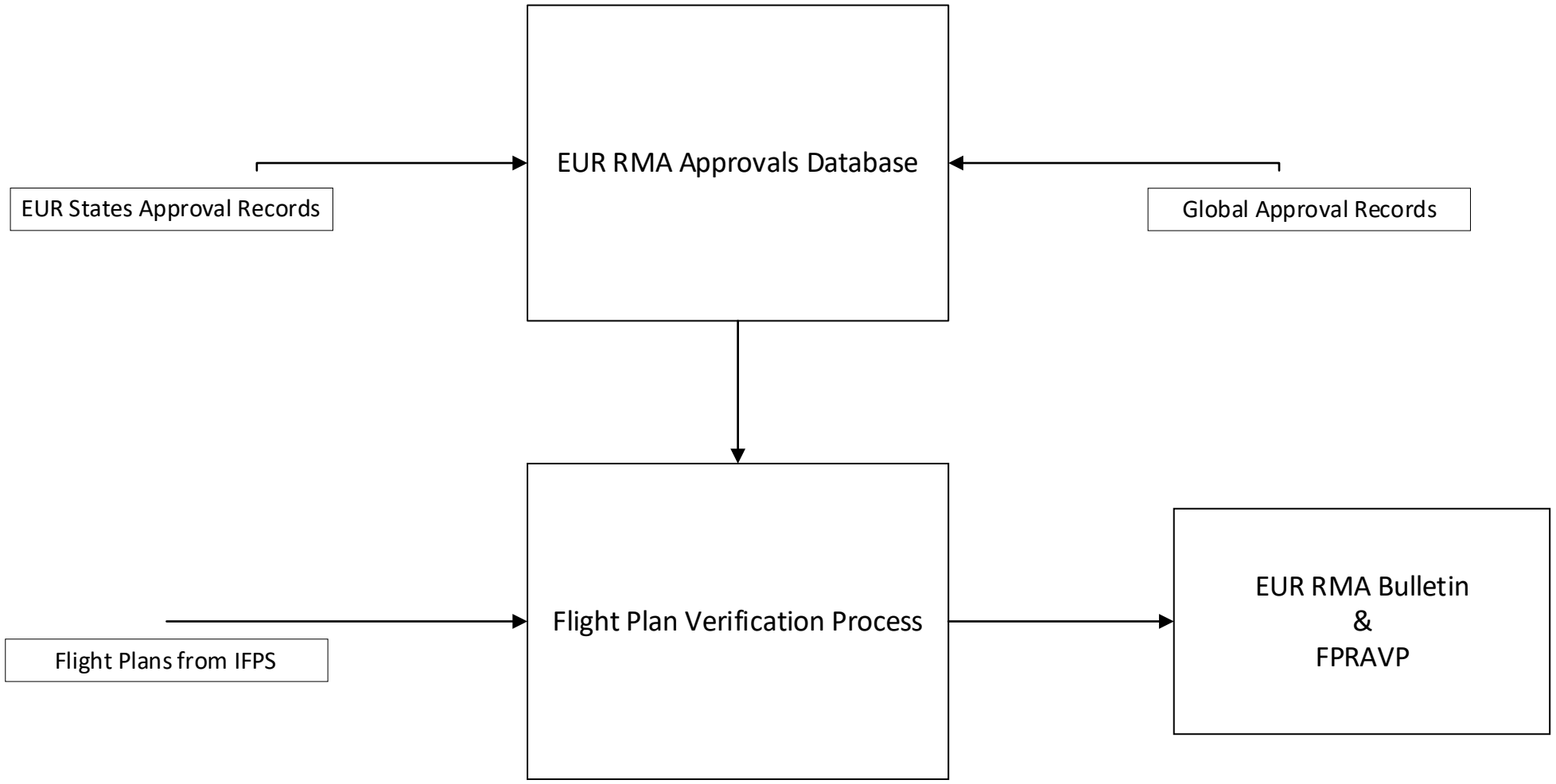
RVSM Approval Authority

- ICAO Annex 6 Part I – Commercial Aircraft
  - State of Operator
- ICAO Annex 6 Part II – International General Aircraft
  - State of Registry
- EU Regulation 965/2012 – Non Commercial Complex Aircraft
  - State of Operator
- ICAO article bis 83
  - Bi-State agreement for the transfer of approval (and other) responsibilities

RVSM Approval Verification

- An RVSM approval is mandatory for all civil aircraft operating in RVSM airspace.
- An RVSM approval is not transferrable between operators.
- EUR RMA conducts audits of flight plans to verify operator/aircraft RVSM approval status.
- State Authorities are notified of aircraft which may be operating without RVSM approval.
- Non-approved aircraft are listed on the EUR RMA Bulletin and further action may be taken by States in whose airspace these aircraft operate in.

RVSM Approval Management and Verification



Flight Plan RVSM Approval Verification Process

- The FPRAVP is implemented in the EUROCONTROL IFPS system.
- The initial flight plan submission for any aircraft listed on the EUR RMA Bulletin of Non-RVSM approved aircraft, will be rejected by the IFPS.
- The FPRAVP is currently implemented for German RVSM airspace only but is expected to be extended to other parts of the IFPS zone in 2023.
- Operators may still submit manual flight plans (via telephone) giving verbal confirmation of RVSM approval. However, operators should ensure that they are entitled to declare RVSM approval prior to doing so.

PBCS Approvals

- PBCS approval (RCP 240 and RSP 180) currently required for NAT and PAC.
- EUR RMA manages PBCS approvals for EUR States. Provided to NAT CMA.
- Non-approved and non-compliant aircraft identified and reported by NAT/PAC ANSPs.
- EUR RMA receives reports from NAT CMA and forwards to EUR States.
- EUR RMA does not exercise any oversight or reporting responsibilities for PBCS approval or technical compliance.

Operator Ongoing Height Monitoring Requirements

- Operators are required to have a minimum of two airframes, of each RVSM type operated, monitored every two years or 1,000 flight hours. ICAO Annex 6 Parts I & II.

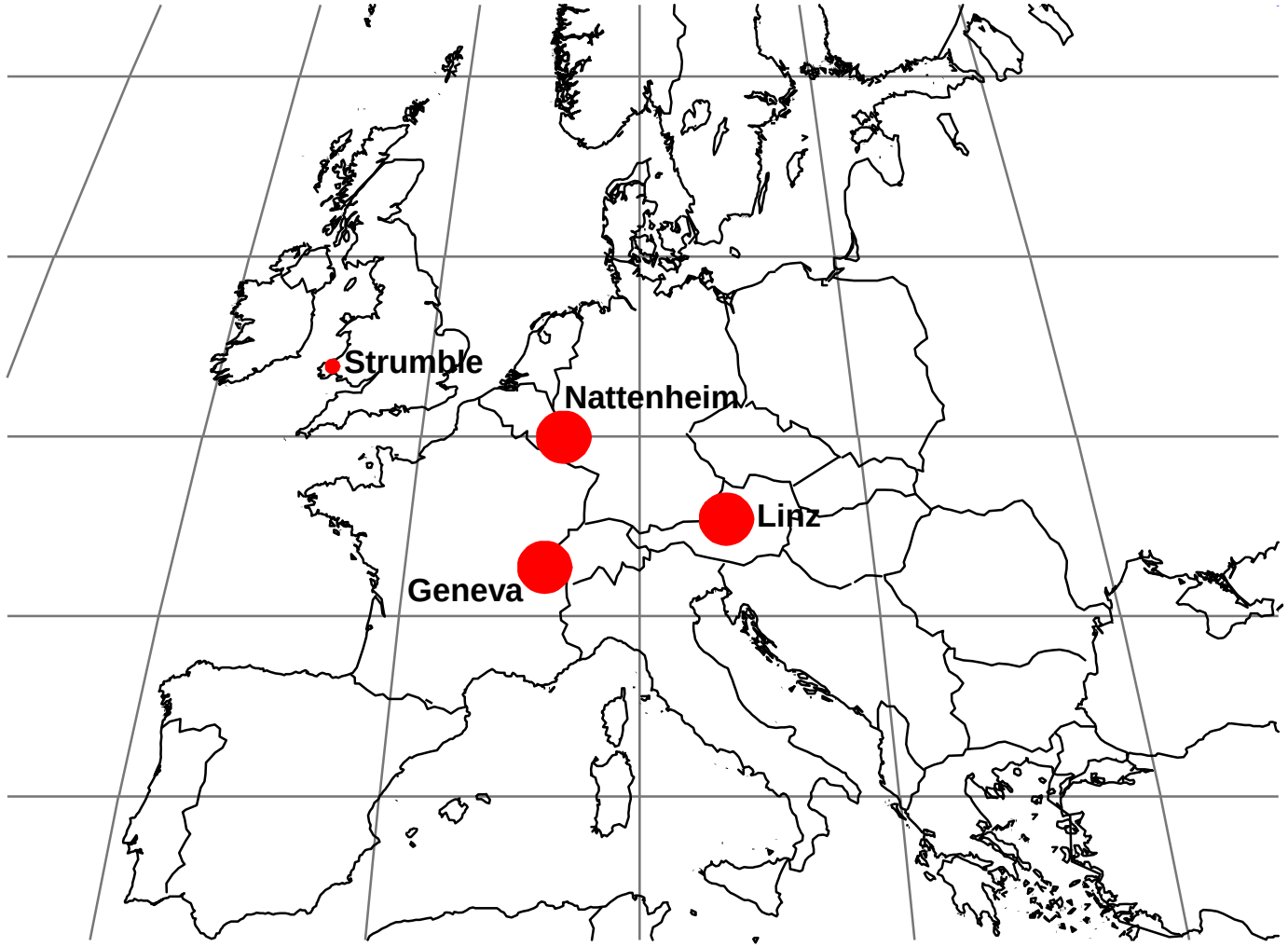
- This ensures that the continued airworthiness procedures implemented by all operators are verified on a continuous basis and ensures continued compliance with height keeping performance requirements.

- Monitoring all operators ensures that a representative sample of all aircraft is included in the annual statistical collision risk assessment.

- The EUR RMA conducts an annual check for operator compliance with the two year requirement limit for all aircraft which have been in service for a minimum of two years.

- Results of non-compliant operators are forwarded to State Authorities for coordination with operators. Operators may demonstrate compliance to their authorities if they have not flown 1,000 flight hours since their last monitoring or entering service.

EUROCONTROL HMU Infrastructure



Future Plans

- EUROCONTROL is implementing an aircraft height monitoring programme using aircraft determined geometric height data embedded in ADS-B transmission messages.
- This will extend the monitoring coverage through most of Europe and enable all suitably ADS-B equipped aircraft to be monitored without having to overfly an HMU.
- For a minimum of 5 years ADS-B monitoring will be used to complement HMU.
- It is likely that at least 1 HMU will be required to continue in service beyond this time.

Operator Monitoring

- Although the options for height monitoring in Europe are currently limited to HMU, operators can be monitored in any other RVSM region.
- Suitably (ADS-B version 2) equipped aircraft can be monitored in the USA and SE Asia.
- All RMAs share monitoring data and results from other regions are taken into account, prior to an operator being assessed as not compliant with the 2 year monitoring requirement.
- The EUR RMA does not conduct independent quality checks of monitoring results provided by other RMAs.

Altimetry System Error

Causes

- Static Source Errors (SSE), or errors in measurement of ambient air pressure.
- Leaks in the hydraulic pressure system.
- Errors in analogue to digital conversion of air pressure.
- Operation of aircraft outside of the approved flight envelope.
- Operation of aircraft outside of the approved flight configuration.
- Incorrect application of SSE Corrections (SSEC).

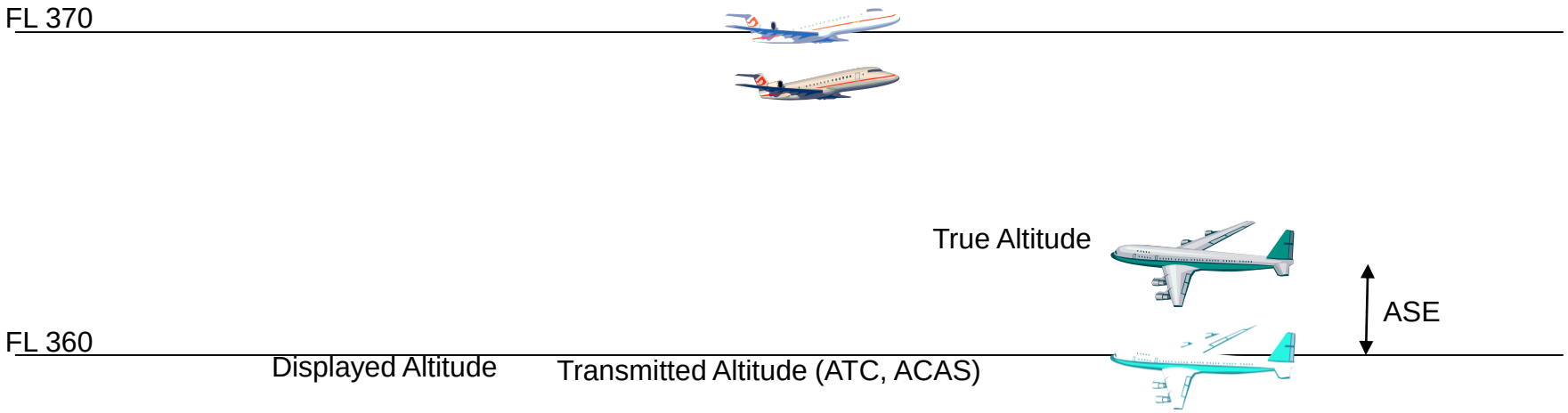
SSE Correction

- SSE profile identified at design stage and appropriate corrections made in the aircraft avionics system.

RVSM Aircraft Height Keeping Performance Requirements

- Reducing vertical separation minimum between aircraft inherently increases the risk of a mid-air collision.
- Minimum Aircraft Systems Performance Specifications (MASPS) were developed, which required aircraft to comply with stringent aircraft height keeping performance requirements.
- One vital aspect of the MASPS was the limitation of Altimetry System Error (ASE) and the specification of maximum thresholds of ASE, with which aircraft design and continued performance was required to comply.
- A critical part of any RVSM monitoring programme is the ability to monitor aircraft height keeping performance (particularly ASE).

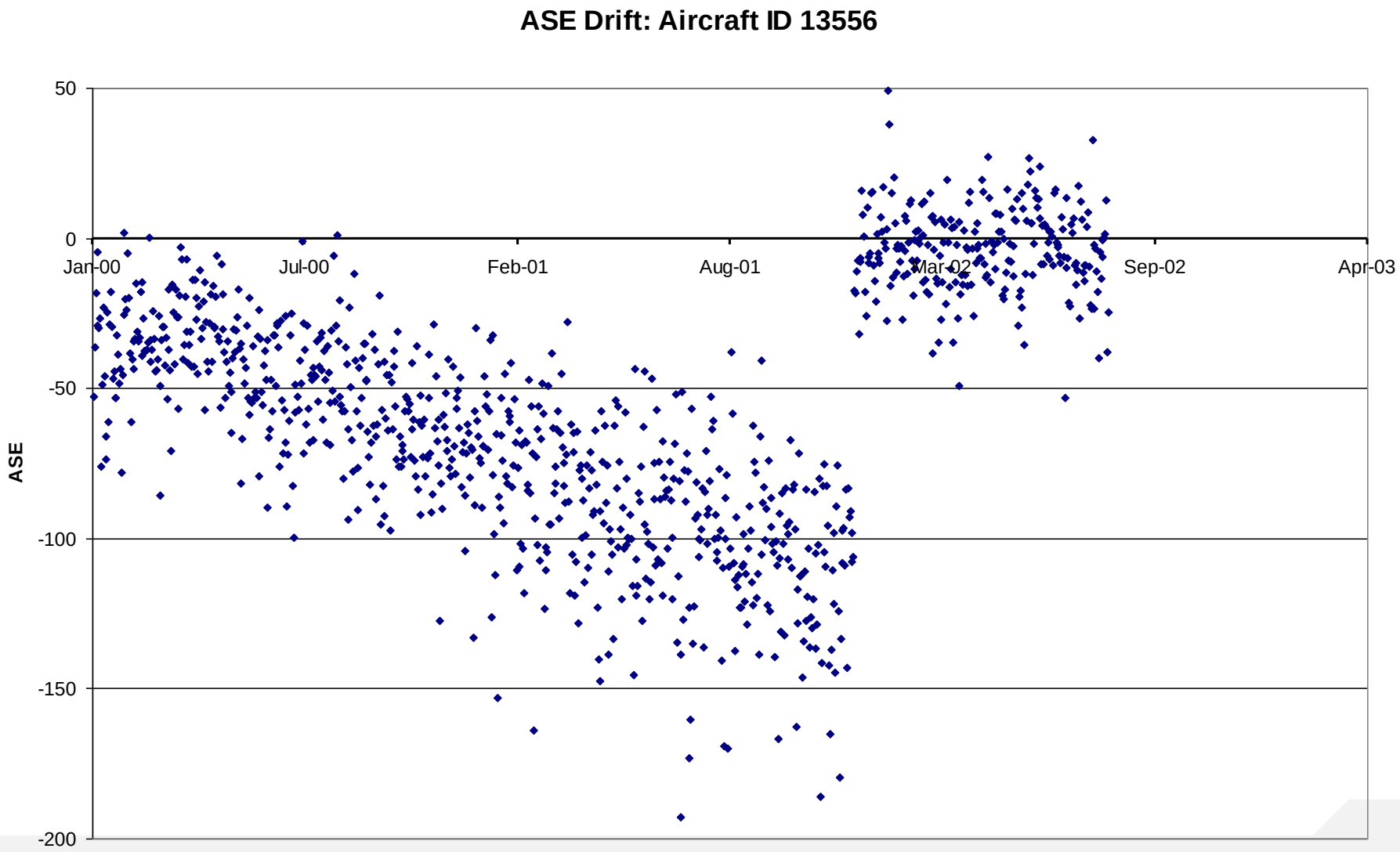
Altimetry System Error



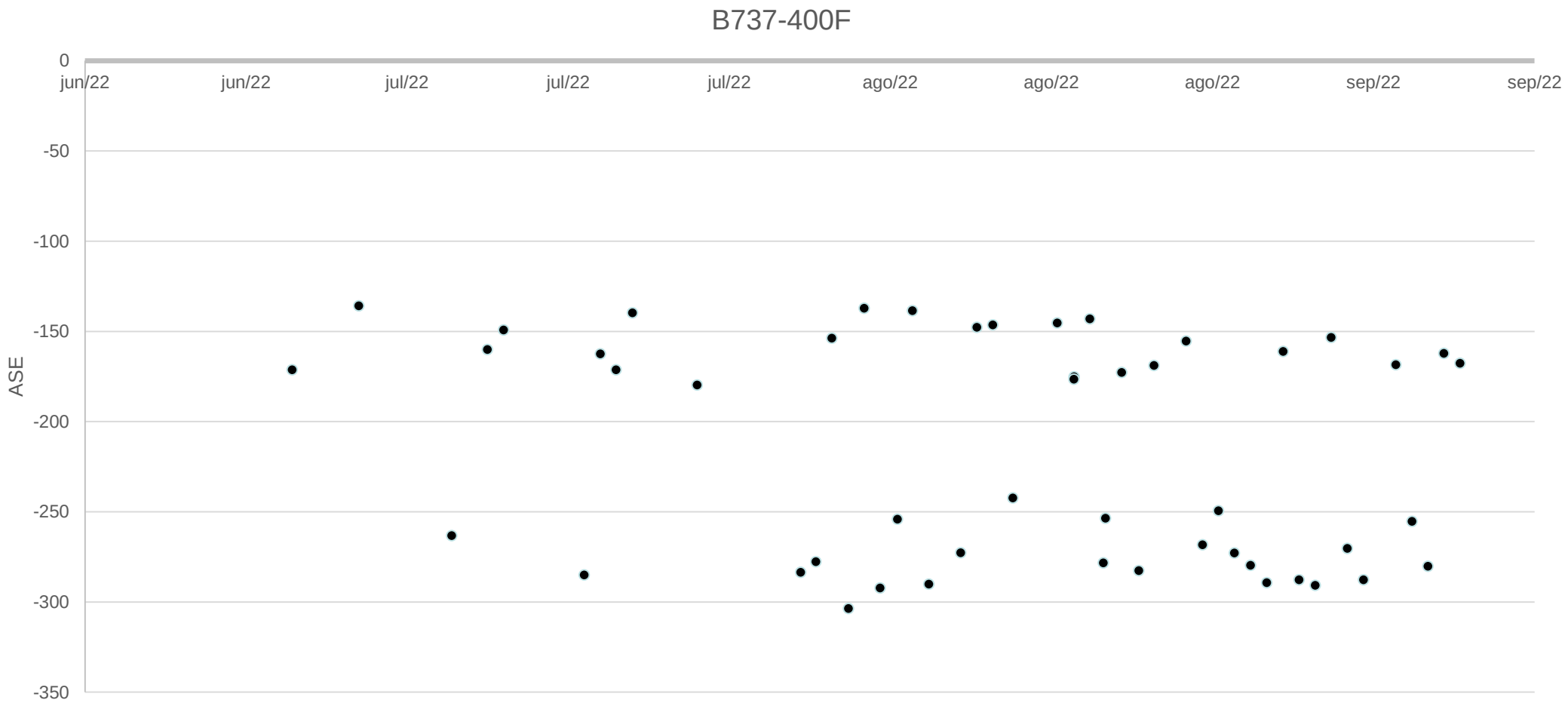
EUR RMA ASE Processes

- Monthly review of all aircraft with a minimum of one ASE estimate which is > ±180 ft. (Classified as aberrant performance).
- Aberrant aircraft with deteriorating trends or consistently large ASE (> ±200 ft.) subject to reporting to approval authority.
- All aircraft with minimum of one non-compliant ASE estimation (> ±275 ft.) subject to mandatory investigation report.
- States are responsible for initiating ASE investigations with operators.
- EUR RMA can provide assistance directly with the operator if requested by State Authority.
- Investigations closed following feedback on fault identification and remedial actions, preferably with post investigation height monitoring.

ASE Analysis



ASE – Latest Investigation

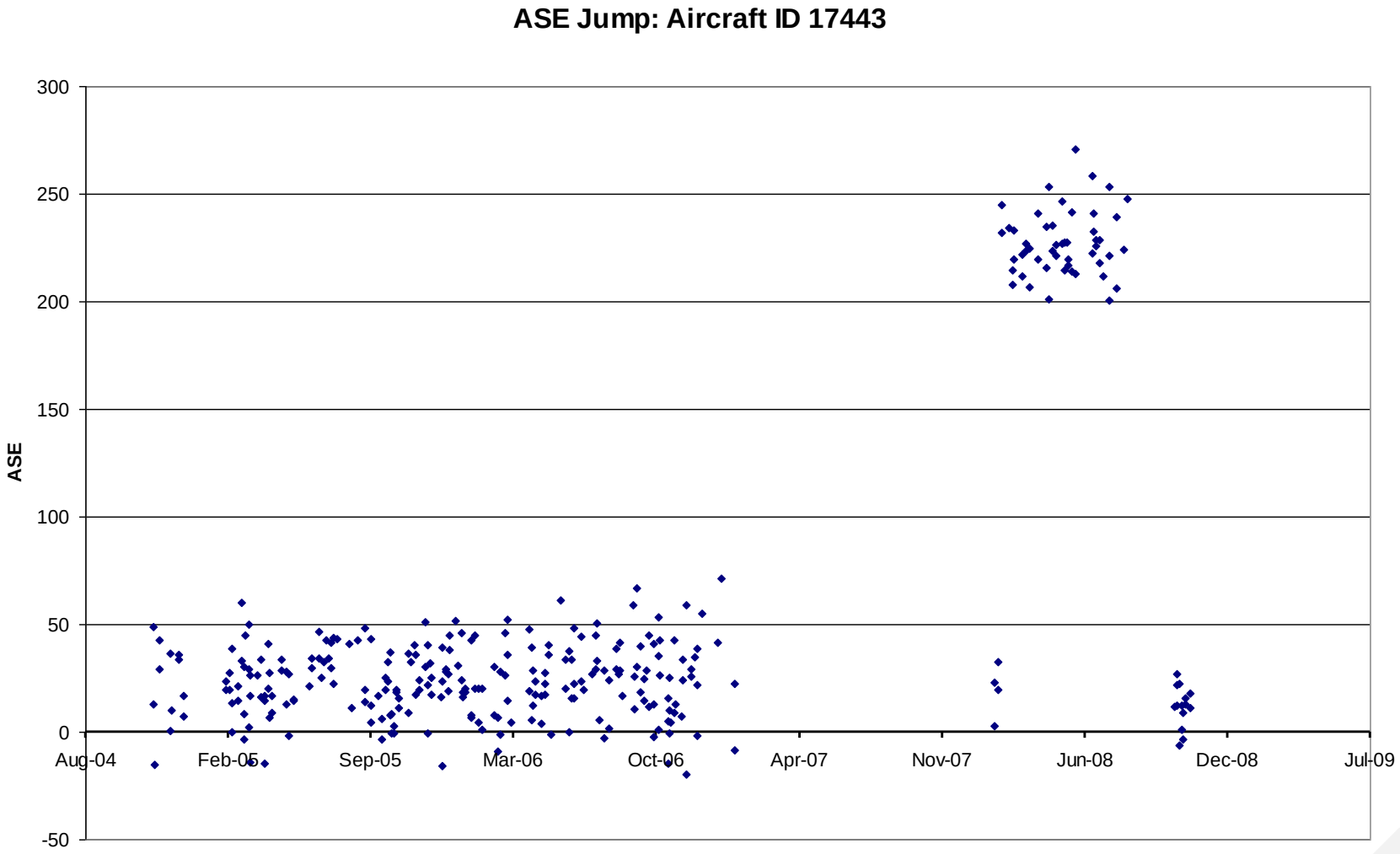


Changes to SSE (Contributions to ASE)

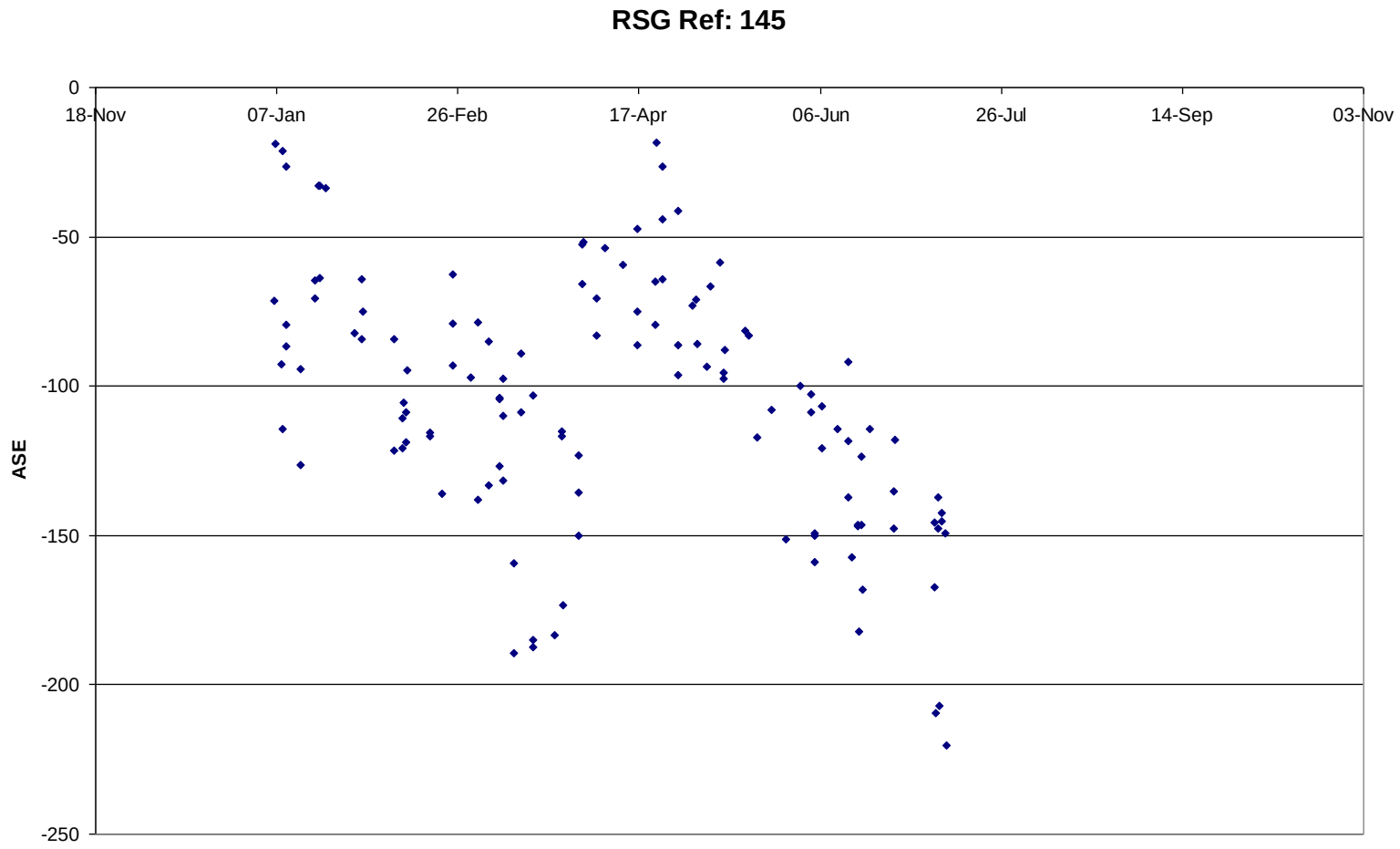
- Aircraft modifications involving changes to the external configuration of an airframe for which new SSEC values are not calculated.

- Contamination or corrosion in the vicinity of the air pressure sensors.

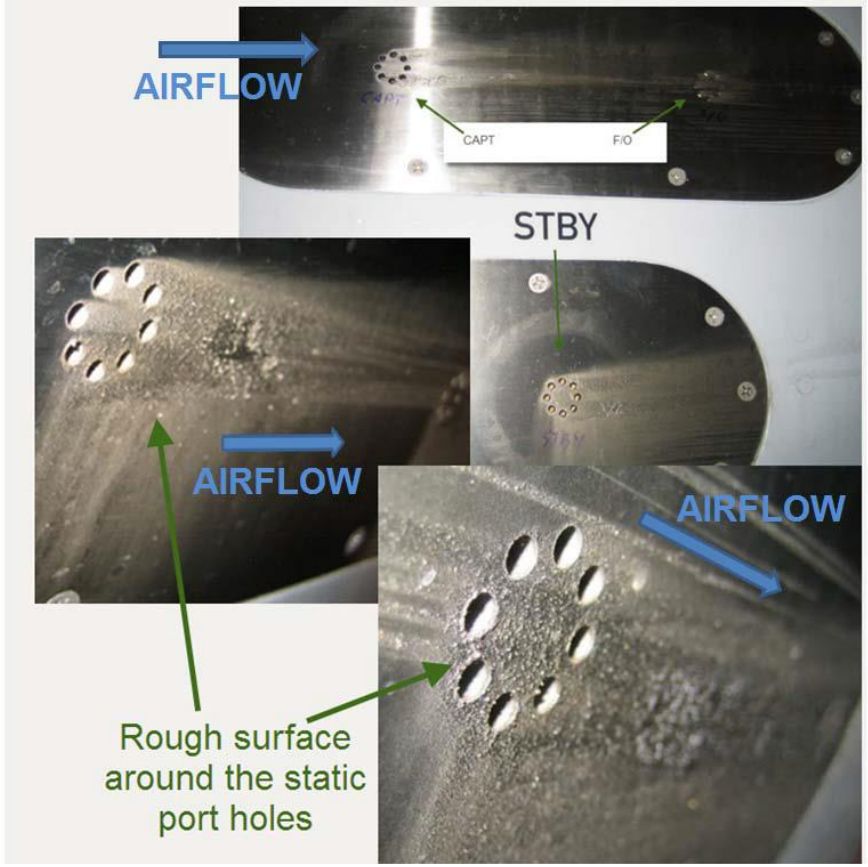
ASE Analysis



Early A380 ASE Profiles



The Cause of A380 ASE Drift



Airbus A380

EUR RMA Achievements

- Approximately 20 million height monitoring results since 2003.
- Approximately 6000 individual aberrant and non-compliant aircraft ASE profiles assessed.
- 250+ individual aircraft investigated for aberrant and non-compliant ASE values.
- Multiple aircraft design issues identified and quantified (B767, F70, P180, SB20, A380, etc.).

Additional Information

- Web site: https://www.eurocontrol.int/service/european-regional-monitoring-agency
- General Contact: eurrma.Support@eurocontrol.int
- ASE Workshop scheduled for 5TH to 7TH September 2023 at EUROCONTROL HQ Brussels

- ICAO Document 9574 – Operation of RVSM
- ICAO Document 9937 – Operation of an RMA
- EUR Document 034 - Guidance material for Safety Monitoring in European RVSM Airspace

End of Presentation