

Presented by

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ATM Airworthiness & Regulation  
EAA



# Volcanic Ash Perspectives Airbus Status

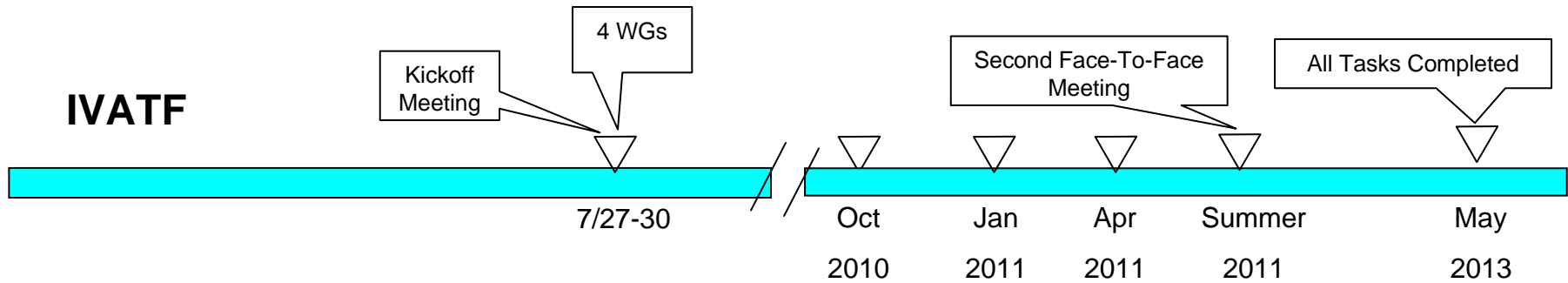
*September, 2010*  
*Joelle Monso*

# Introduction

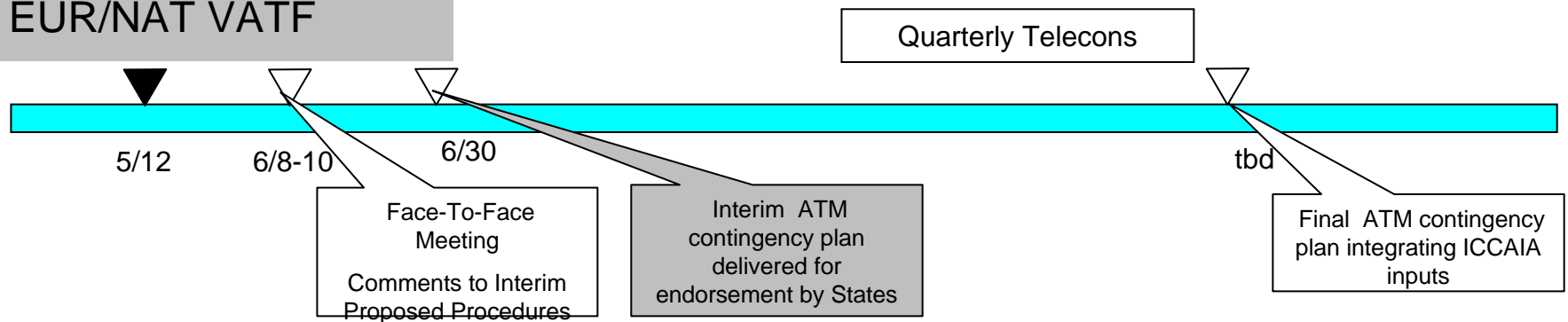
- *Interim Decisions*
  - *CAA UK*
  - *EU/NAT VATF*
  - *EASA*
  - *Airbus Volcanic Ash Advice*
- *Way forward: Airbus work plan*
  - *Contribution to ICCAIA mid-term plan to set up appropriate procedures to ensure safe operations around VA events through IVATF (ICAO)*
  - *Leading European Research Project to address atmospheric threat issues (including Onboard VA detection system)*

# Interim Decisions

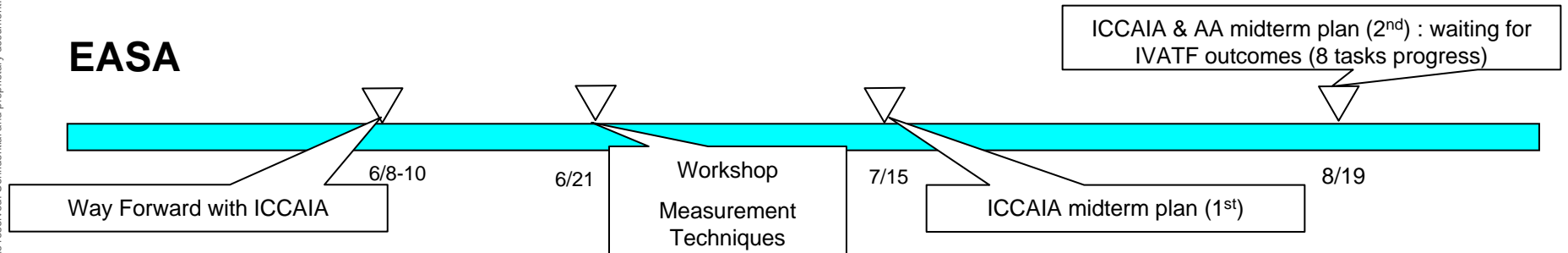
## IVATF



## EUR/NAT VATF



## EASA



# ICAO- EU Contingency plan: Reason for Change

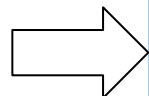
- **Remove the notion of « 0 » ash concentration for clear area**
- **Introduce new terminology to provide flexibility for States own policy**

## Post-mod:

- ✓ **Pre-mod:** no agreed value on ash concentration which constitutes a hazard to jet aircraft engines. So, it was interpreted by States as potential hazard above « 0 » contamination level, with extensive airspace closure.
- ✓ **Post-mod:** Definition of danger area and introduction of the notion of restricted area in EUR region only (not NAT) to cope with all existing Systems.
- **ICAO recognized that all modeled ash concentrations are subject to uncertainty relative to errors in the estimation of the eruption strength.**
  - ▶ Danger area : defined around the volcanic source ( 120 Nm or 60 Nm buffer, forecast independent) declared by NOTAM.
  - ▶ Contaminated area: from eruption: +0 & +6h will be declared only by SIGMET , then further every 6h declared by both SIGMET & NOTAM.
- **Clearances** should not normally be issued through danger area. Furthermore, States are not prevented from establishing Restricted or Prohibited Areas over the sovereign of the state, if considered necessary by the State concerned



# EU/NAT Contingency plan: Amendment



Key Element is

Introduction of concentration thresholds  
to depict areas of ash concentration  
as Low, Medium, High

Predicted (not clearly said)

## Terminology

**Area of Low Contamination:** An airspace of defined dimensions where volcanic ash may be encountered at concentrations equal to or less than  $2 \times 10^{-3} \text{ g/m}^3$ .

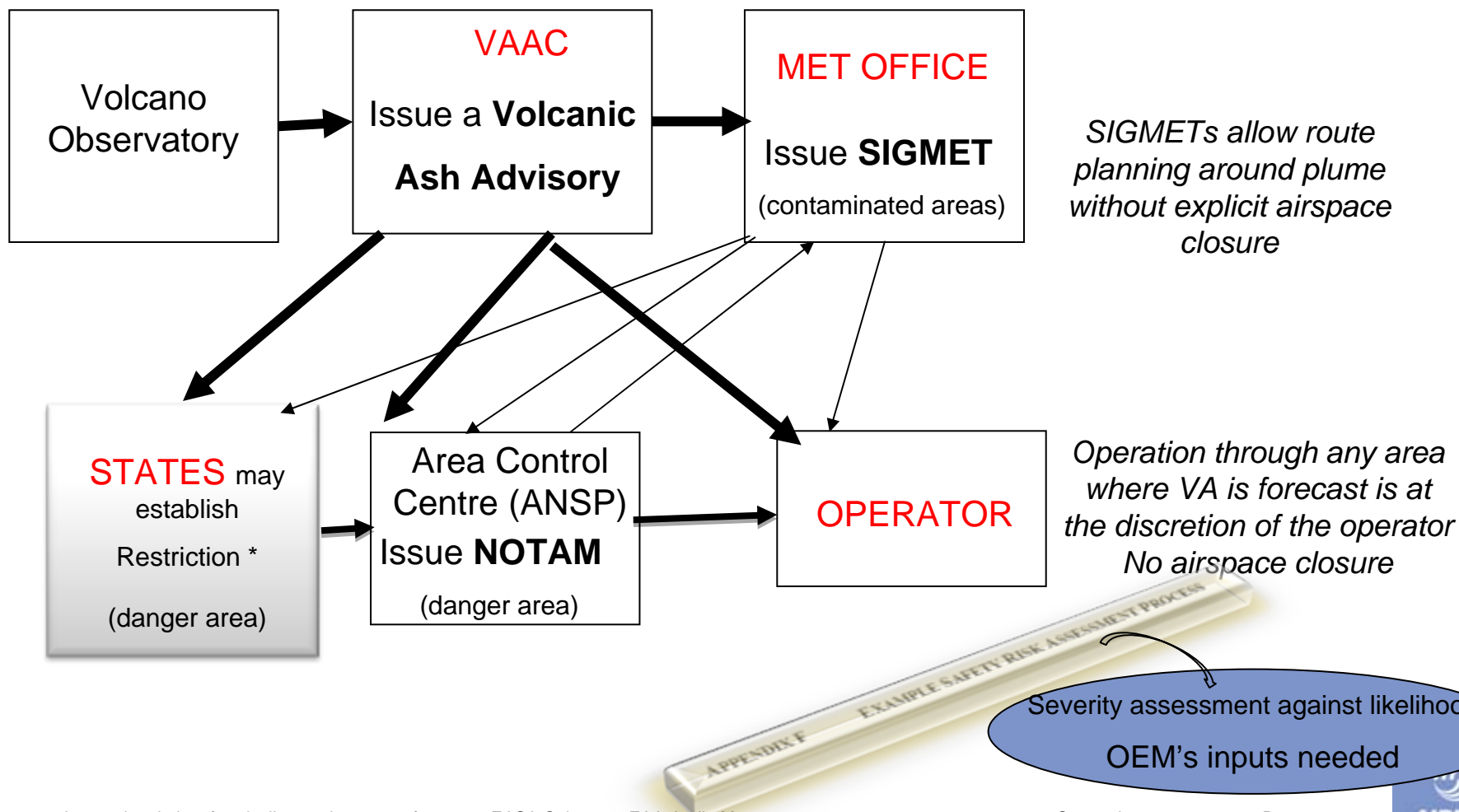
**Area of Medium Contamination:** An airspace of defined dimensions where volcanic ash may be encountered at concentrations greater than  $2 \times 10^{-3} \text{ g/m}^3$ , but less than  $4 \times 10^{-3} \text{ g/m}^3$ .

**Area of High Contamination:** An airspace of defined dimensions where volcanic ash may be encountered at concentrations equal to or greater than  $4 \times 10^{-3} \text{ g/m}^3$ , or areas of contaminated airspace where no ash concentration guidance is available.



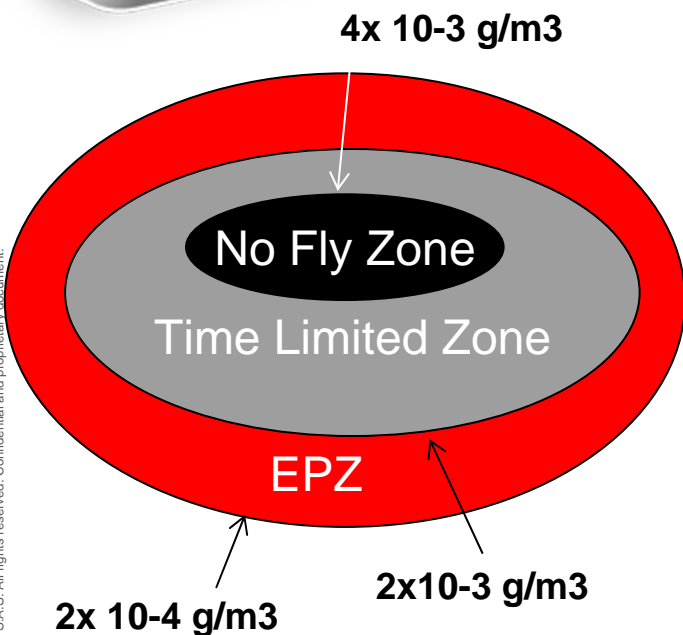
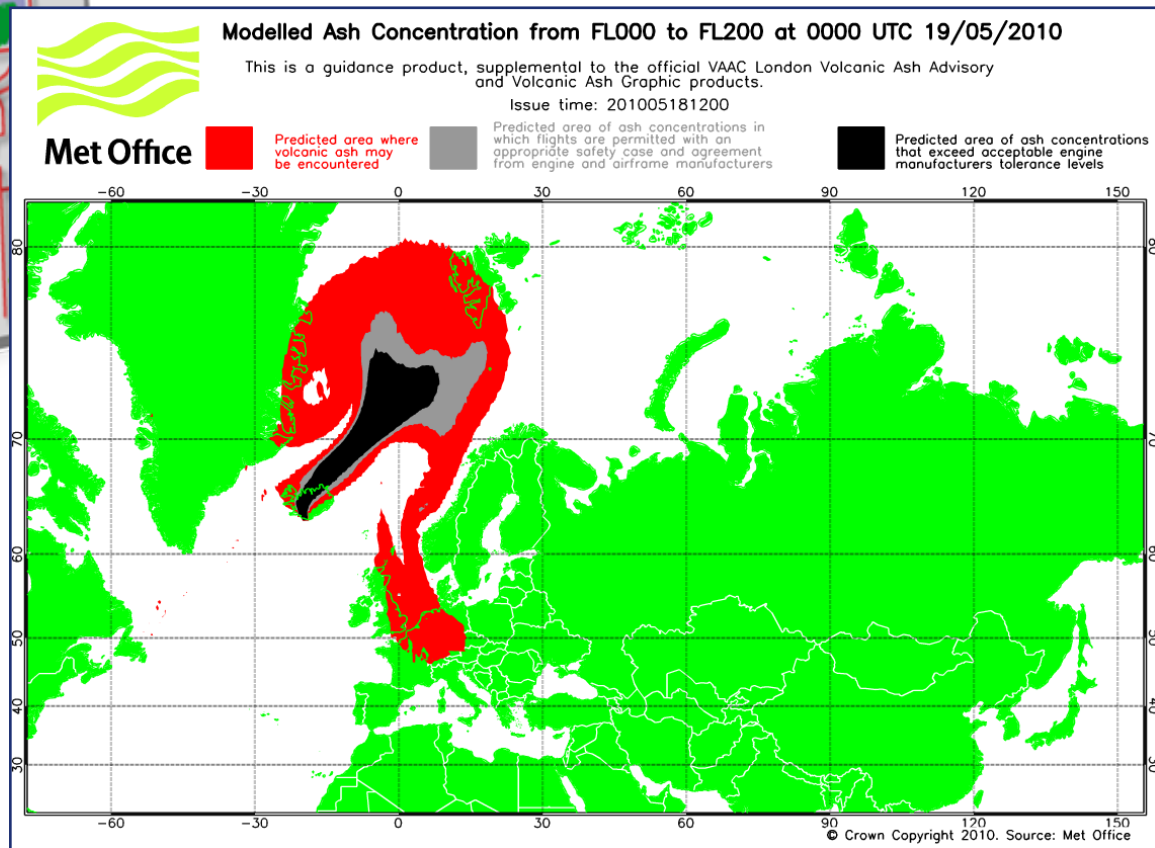
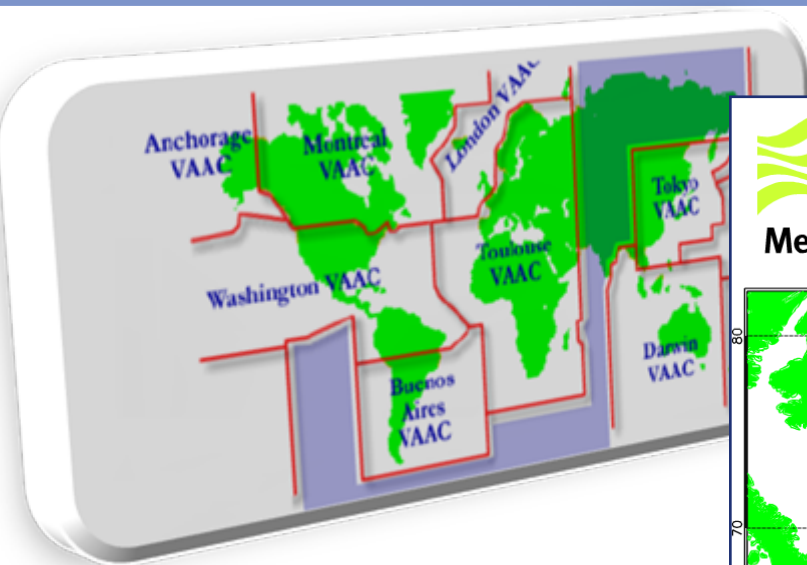
# Volcanic Ash Alerting Process

## ICAO Volcanic Ash contingency Plans for EUR & NAT (Interim Contingency Plan)



# VAAC / MET Office - Ash concentration charts

## 17th May – Interim Decisions



CAA –UK & UK MET Office → NFZ (Black), TLZ (Grey), EPZ (Red) and Normal zone (White)

EASA → NFZ (black), EPZ a (Grey), EPZ b (Red), Normal Zone (White)

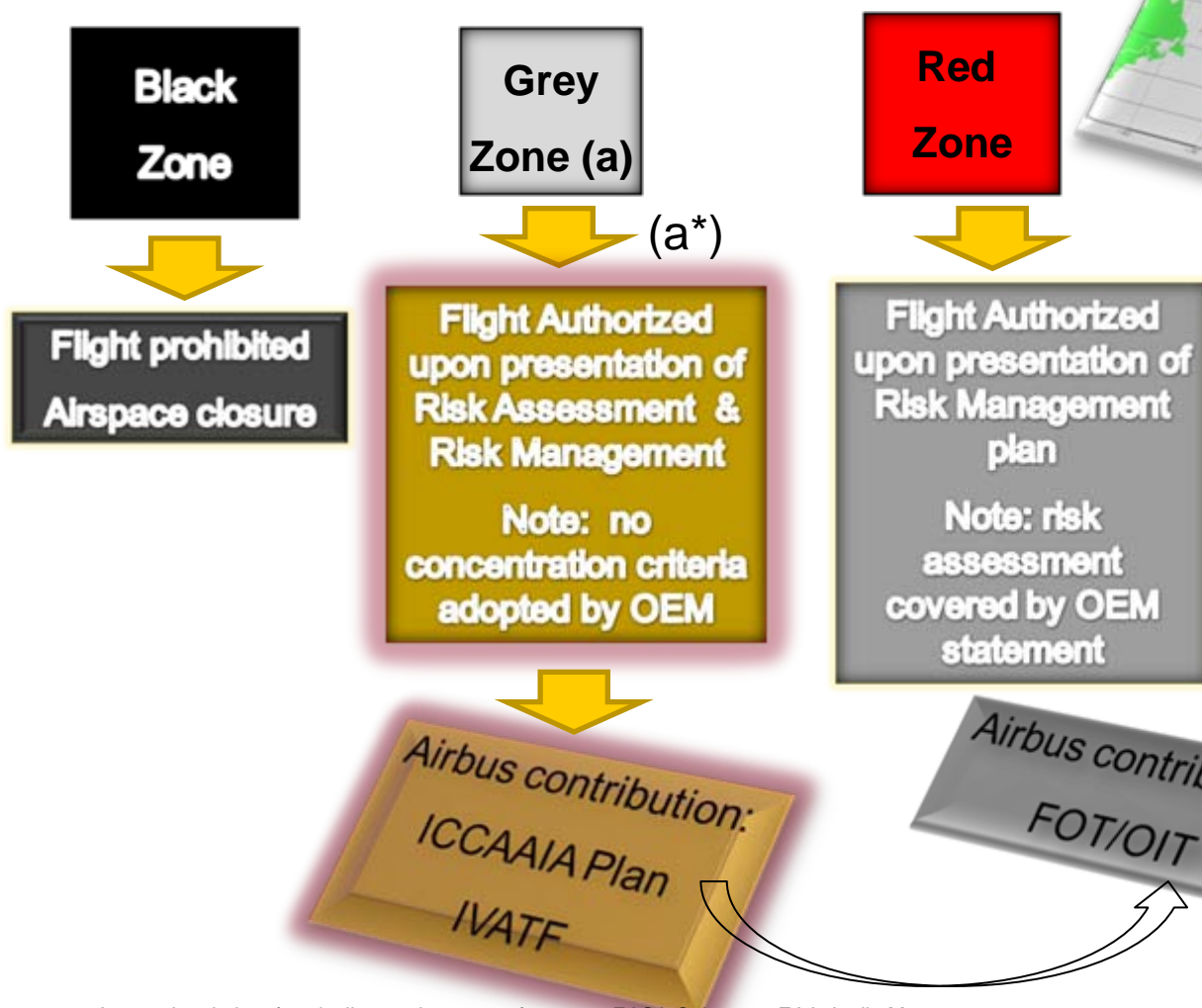
ICAO (EU/NAT): Danger area, Restricted area, Prohibited area:

New: low, medium and high (forecast of concentration) for restricted area



# Volcanic Ash Risk Assessment – Interim decision

The notion of danger area as seen by EASA:



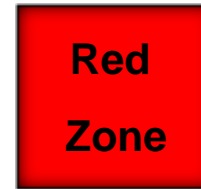
**MET Office charts**

(\*) : Grey zone- option a or b.

Option b= re-classification in Red (EPZb) following clearance flights

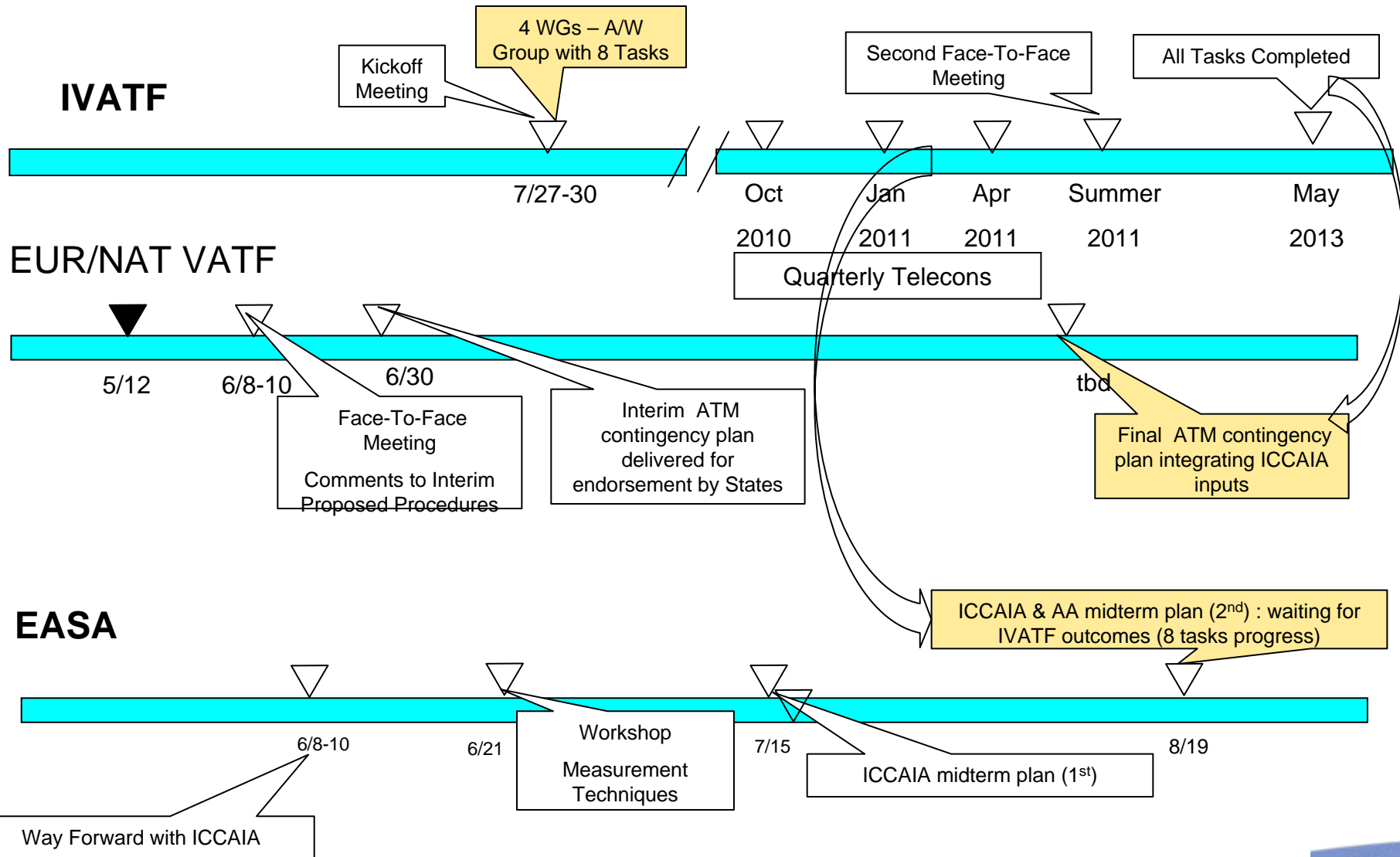


# Interim Decision – Flying in EPZ (Red Area)



- Risk Assessment was based on:
  - Engine Manufacturers and aircraft OEM experience, assessments and tests,
  - Contributions from operators through tests in predicted EPZ,
- The following has been worked-out:
  - There is no additional requirements from the OEMs, for flying in EPZ
  - Sampling programmes were set up to check the absence of cumulative effects by repetitive inspection of selected A/C systems and Engines Components.
    - By the Engine Manufacturers with representative operators to
      - Check HPC via borescope –airfoil erosion/accumulation of debris
      - HPT/LPT via borescope-accumulation of debris on blade/nozzles/plugged cooling holes
      - MCD and scavenge screens and
      - Trend Monitoring review
    - By AIRBUS with AFR( A320 family), BAW (A320 family), DLH (A320 family), MON (A330 and A300-600), EIN (A320 family) to check Fuel, Cabin Air, Bleed and Airdata systems
      - Exposure to ash has to be assessed by post processing DFDR data and UK met Office published ash concentration charts to correlate routing with predicted ash contamination
      - Interim Report has shown no findings, final report not completed yet (correlation not established for all sampled flights)

# Mid & Long Term Schedule



# ICAO IVATF Work Plan / Airbus Participation

- 4 IVATF working groups: Airbus can participate to the AIR & ATM groups, and can support the Sciences & IAVW groups if needed:
  - ▶ **Airworthiness Group**: « Airworthiness considerations / Risk Assessment & Guidance Material », Airbus participation through ICCAIA.
  - ▶ **ATM Group**: available for participation,
  - ▶ **Sciences Group**: available for activities interdependence with Airworthiness group.
  - ▶ **IAVW Coordination group** (IAVWOPSG): we do not see need for Airbus participation.

# IVATF Tasks – Key Items

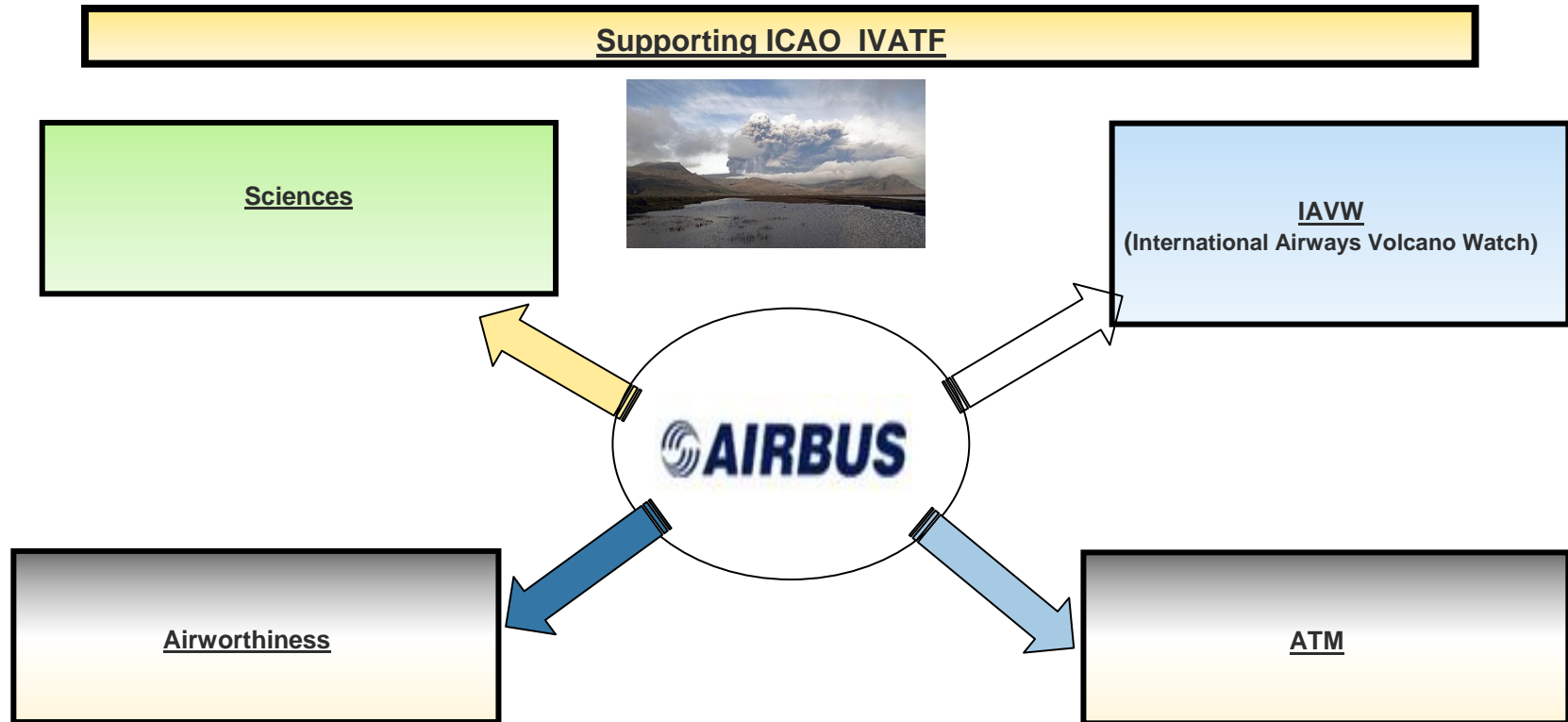
- **Airworthiness Group:** « Airworthiness Considerations & Guidance Material for Risk Assessment »
  - ▶ Assessment of Product Susceptibility (Engines /Airframe/ Equipment....)
  - ▶ Establish Acceptable Operational Criteria
  - ▶ Validate or Amend threshold values (EU/NAT Contingency Plan) - Actual versus Forecast concept. Note: Industry position promotes operation in avoidance of « Visible Ash » (« Visible Ash » criteria is to be defined)
  - ▶ GM for Authorities and Operators establishing process to perform operational safety analysis and safety management.

# Initial OEM Philosophy for Operations in Vicinity of Volcanic Ash in Europe

## **Waiting for IVATF outcome, current Airbus position is still valid :**

- Engines are the leading indicator of ash ingestion; airframe also important but 2<sup>nd</sup> to engines
- Extensive operations in predicted ash concentrations have yielded nil or negligible findings
- The UK MET model appears to be conservative for Eyjafjallajökull based on flight test sampling and operator experience in the UK and European airspace.
- Flight in predicted densities **higher than  $2 \times 10^{-3} \text{ g/m}^3$**  may be undertaken at operator discretion provided **flight into visible\* ash clouds is avoided.** \* *Visible based on satellite or eyeball observations.* Operators need to monitor position of the visible\* ash cloud and forecast movement to allow night/IFR operations.
- Maximum use of in-flight pilot reports (PIREPs) encouraged to aid in the dissemination of information about suspected ash locations and vertical extent.

# Airbus Perspectives for Volcanic Ash



# Airbus Perspectives for Volcanic Ash: CSA-SA

Leading European Research Project: FP 7th



**ATMOSPHERIC THREAT**



Rolls-Royce



**AIRBUS**



**SAFRAN**  
Snecma

IAVW



Scientific Support



**THALES**

Airworthiness  
(Authorities, States, ICAO)

Development of Safety standards



Manufacturers

(Development of Measurement & Detection Instruments)



OR





# Framework Programme for EU funded project

## FP7th – R&T on Unusual Atmospheric Conditions WBS – Airbus is Project Leader with Strategic Supervision of global project

 **AIRBUS**

### Where is it safe ?

Competence of **MET Services** and FIR Authorities

- **detection and observation**
- **precise predictions**
- **improve communication broadcasting**

Ice Particles  
Dust, Sand,  
Hail....



**ATMOSPHERIC  
THREAT**

### What is Safe ?

**Manufacturer's Competence**

- Key Factors for Operation & Airworthiness considerations
- **Develop instruments and equipment**

### Grant it's safe

Competence of **AAs and GOVs, ICAO**

- **establish safety standards**
- **establish approved procedures and guidelines**

### Operate Safely !

- **Guidelines for operational decision- making**

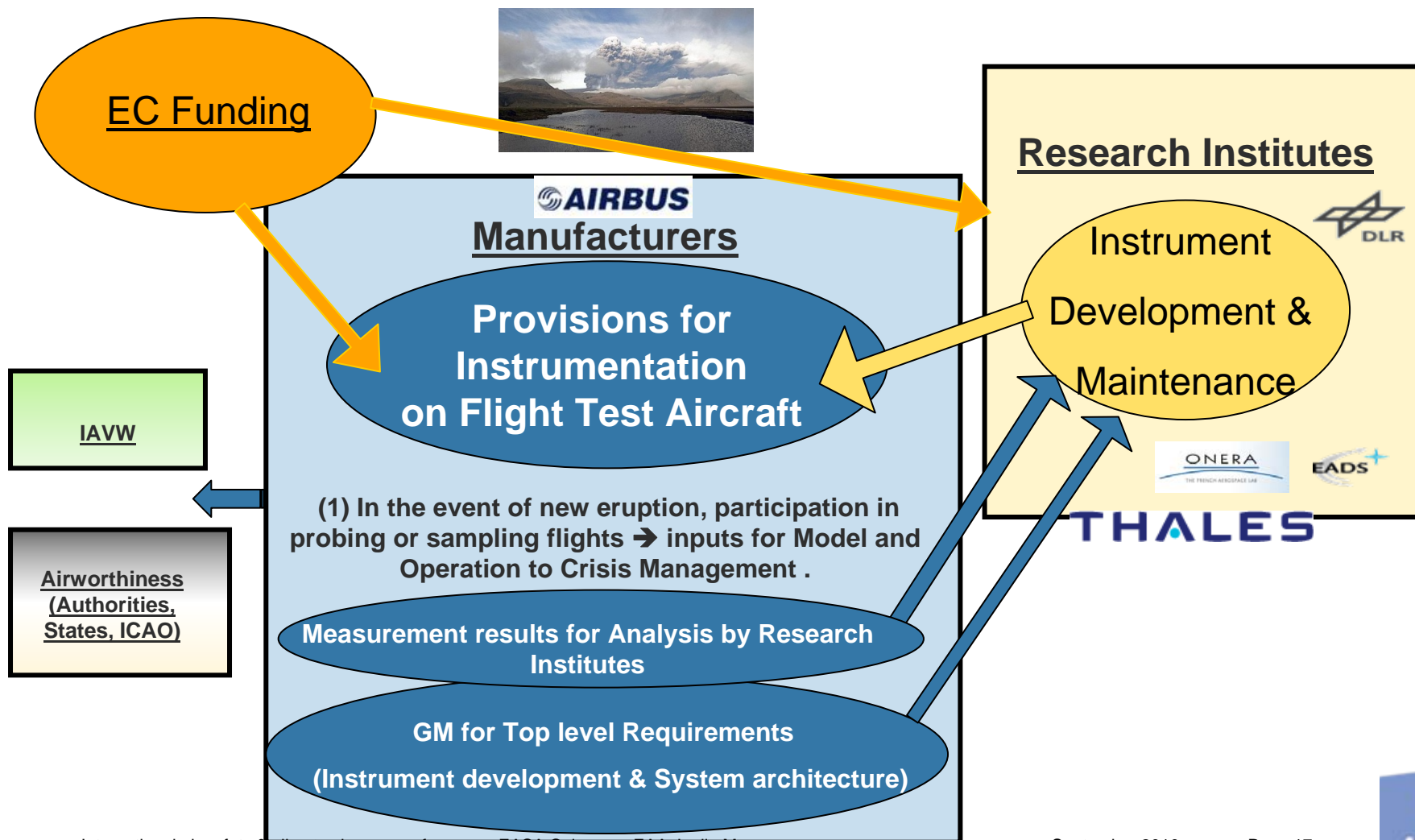
**European Partners**

# Airbus Perspectives for Volcanic Ash

European Research Project FP 7th – Strategic Supervision



## Development of Measurement (1) & Detection (2) Instruments for Volcanic Ash



# Airbus -How will work be accomplished?

Airbus focus: Work through ICAO International Task force  
& EU Research Projects (R&T)

International Aviation Industry Groups	
International Aviation Industry Group	Airbus Focal
ICCAIA	Claude Schmitt
ICAO IVATF	Manfred Birnfeld, Stephane Flori, Joelle Monso
EU&EC / EASA	Yves Regis / Anne Jany / Joelle Monso
FP 7 <sup>th</sup> – R&T	Fabien Dezitter

# Airbus Perspectives: Conclusion

Our understanding is that all main activities shall be coordinated with the aims of ICAO IVATF



## Key message:

**Concentration values 2 or 4 mg/m<sup>3</sup> in a context of overestimation of concentration (peak values) should not lead us to consider that these values are still acceptable for operation in a continuum.**

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# *Back-Up Slides*

# CSA-SA on Unusual Atmospheric Conditions

## Core Team

- European Partners that constitute the **Core Team**

### Airframers



### Engines Manufacturers



### System Suppliers



### Meteo Office



### Research Institutes



EASA

and



EUROCONTROL



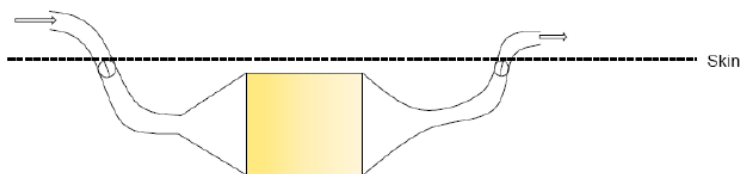
# (1) Measurement: Particle Collecting Device

## AIRBUS provisioning Installation of Instruments

### Particle collection device

- Airflow duct system through cabin
- Additional pressure valves to seal cabin
- Inflight changeable filter box (avoiding contamination)
- Large and small particles filter
- Analysis in ground laboratory

=> Determine exactly what aerosols the cloud consists of



Gas Analysis Device should  
analyse

Air composition

• Particle Collecting Device to  
measure exposure detection to  
trigger maintenance action

• It should filter the air captured  
outside of the aircraft, air quantity  
measured by a flow meter

(capture and store particles > 1um)

## AIRBUS provisioning Installation of Instruments

### DIRECT SAMPLING of GAS and LIQUIDS

- Measure concentration of volcanic gases

- HCl
- HNO<sub>3</sub>
- H<sub>2</sub>SO<sub>4</sub>
- SO<sub>2</sub>

### CHALLENGE FOR ALL DIRECT SAMPLING:

- Real time display on board of concentrations
- Calibration
- Interpretation of measurement results

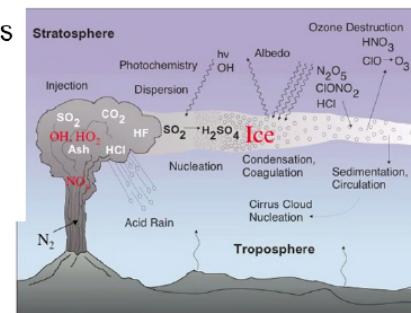
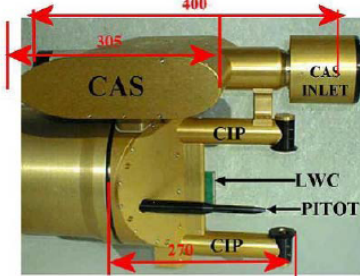


Figure showing volcanic cloud chemical species, radiative and chemical processes that have atmospheric relevance. (modified from A Robock, with items in red added).

# (1) Measurement: Particle Counting Probe

## AIRBUS provisioning Installation of Instruments

### CAPS – Cloud Aerosol and Precipitation Spectrometer

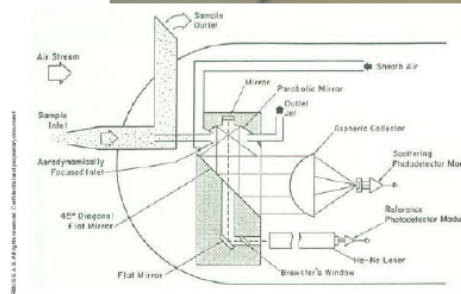


- CAS: aerosols 0.5-50 $\mu$ m
- CIP: larger particles 25-1550 $\mu$ m
- Airspeed, Altitude, Temperature, liquid water content, relative humidity
- Size: 1200\*400\*300, 20kg
- Speed range: 10-300m/s

In board data analysis: 20s delay between measurement and display of ash concentration measurement

## AIRBUS provisioning Installation of Instruments

### PCASP – Passive Cavity Aerosol Spectrometer Probe



- Aerosols 0.1-3 $\mu$ m
- Dynamic pressure, temperature, flow of sample and sheath air
- Size: 1020\*180, 18.2kg
- Speed range: 0-250m/s

## (2) Detection: Ash Cloud Detection System

Should allow detecting ash plume position and give directly concentration ahead of aircraft flight direction

(laser + telescope on lateral window)

### ■ AIRBUS provisioning Installation of Instruments

LIDAR (DLR) or similar



- Analyzing of laser backscatter signatures
- Classification and detection of aerosol concentration at 5 - 7km range
- Needs in situ measurement for calibration
- Installation in cabin observing through specially glassed window
- Forward projection with mirror in 3D window

# Airbus Probing Flights

## ■ COOPERATION REQUIRED

- Airbus has competence in operation of test aircraft in challenging environment
  - Flight Test Instrumentation and Engineering Expertise
    - Engine Survey and Real Time Analysis during flight
    - System Survey, real time analysis, reconfiguration
    - Expert Decision Making during flight
  - Aircraft operate under Flight Test Airworthiness Control
    - Aircraft configuration monitored by Flight Test special instructions
    - Crew and maintenance staff can adapt to operational environment
    - Risk assessment made by Management and Flight Crew
- Atmospheric research activity is not necessarily within Airbus competences
  - Instrument ownership should be with research organisation, but held available in case of need
  - maintenance of Instruments to be assured by appropriate Lab's
  - Scientific on-site support necessary for Interpretation of measurements
    - full time availability of experts ( shared betw. Institutes ? )
    - scientists on board during sampling ?

