Contingency Planning in Civil Aviation

Volcanic Ash Cloud

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Air Navigation

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Presentation Plan

- Expect the Unexpected
- Contingency Planning legal framework
- How does it work in practice?
- Eyjafjalla 2010
- Lessons learned and improvements (Grimsvotn 2011)
- The future

Aviation

- Aviation: important mode of transport (4% of the world's economy)
- Aviation: the safest mode of transport
- Aviation: the most internationalized mode of transport
- ICAO = Organisation of States = international aviation law
- National Aviation Authorities = decision makers over national sovereign airspace
- EASA = European Aviation Safety Agency / EC = Commission

Expect the Unexpected

- Aviation Safety: managing the risks
- Aviation Security: preventing unlawful acts, limiting their effects
- Contingency Planning: devise a plan what to do in case of an abnormal situation (disruption, major crisis)

Contingency Planning legal framework

- SARPS = Standards and Recommended Practices
- PANS = Procedures for Air Navigation Services
- Regional Air Navigation Plans
- SARPS Implementations
- ICAO Annex 2 – Rules of the Air (applies without exception over the high seas)
- ICAO Annex 6 – Operations of Aircraft

Contingency Planning legal framework (2)

- ICAO Annex 11 – ATS Air Traffic Services
- ICAO Annex 14 – Aerodromes
- ICAO Doc9137 Airport Services Manual Part 7 Emergency Planning
- ICAO Annex 17 – Security – Unlawful Acts
- ICAO PANS ATM Doc4444 – complimentary to the SARPS
- ICAO Doc9859 SMM – Safety Management Manual

Emergency Response Planning (ERP)

- SSP State Safety Programme
- Part of SSP = requires ATS providers to implement SMS
- Annex 6 = flight operators and approved MROs to develop ERP = Emergency Response Plans
- How to recognize an emergency situation?
- How to orderly move from normal ops to emergency ops
- Who do you coordinate with?

Emergency Response Planning (ERP)

- ERP = checklist of actions following an accident; who is responsible for each action

- Governing policies
- Organizations
- Crisis management centre
- Records
- Accident site
- News media
- Formal investigation
- Post-occurrence checklists
- Training; exercises
- Coordination (part of SMS)

European Safety legal framework

- EASA = European Aviation Safety Agency
- EC 216/2008 EU EASA Basic Regulation
- EC 996/2010 European net of Investigation Boards, Emergency Response Planning
- EASA findings -> EC enforcement body
- Challenge: National Aviation Authorities – ICAO – EASA - FABs
- US model: FAA

Contingency = Service continuity, Emergency Response

Outage

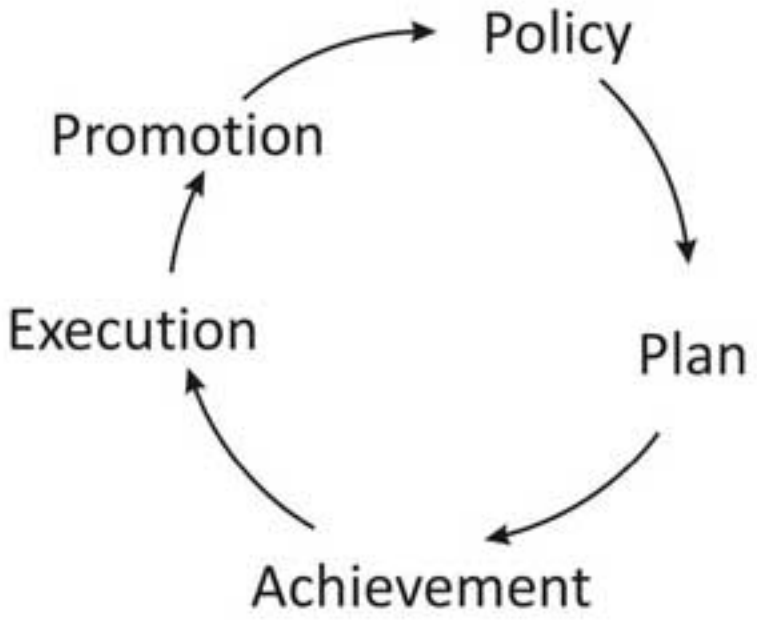
Normal OPS	Emergency Situation	Service Continuity	Recovery	Normal OPS

Degraded Mode

- Hours: Safety driven
- Days or Weeks: Business driven

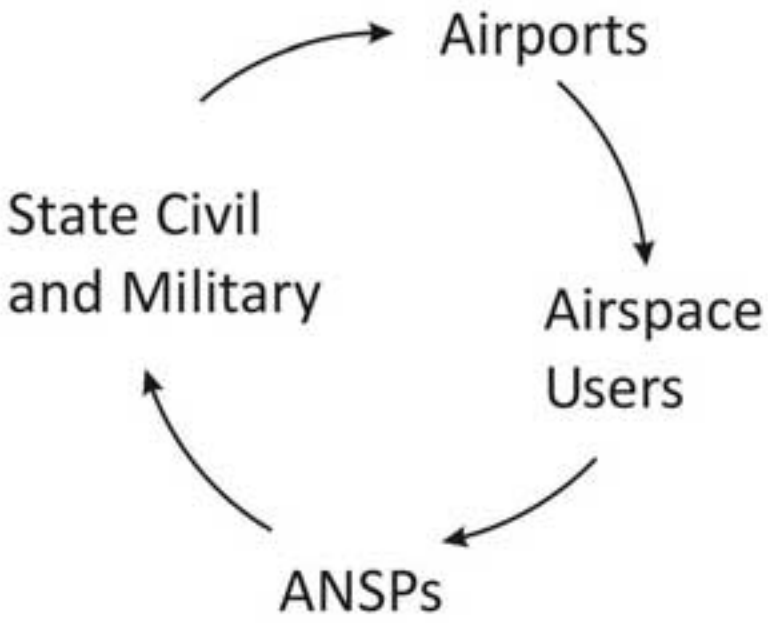
Planning Methodology

SMS Cycle



Planning Methodology

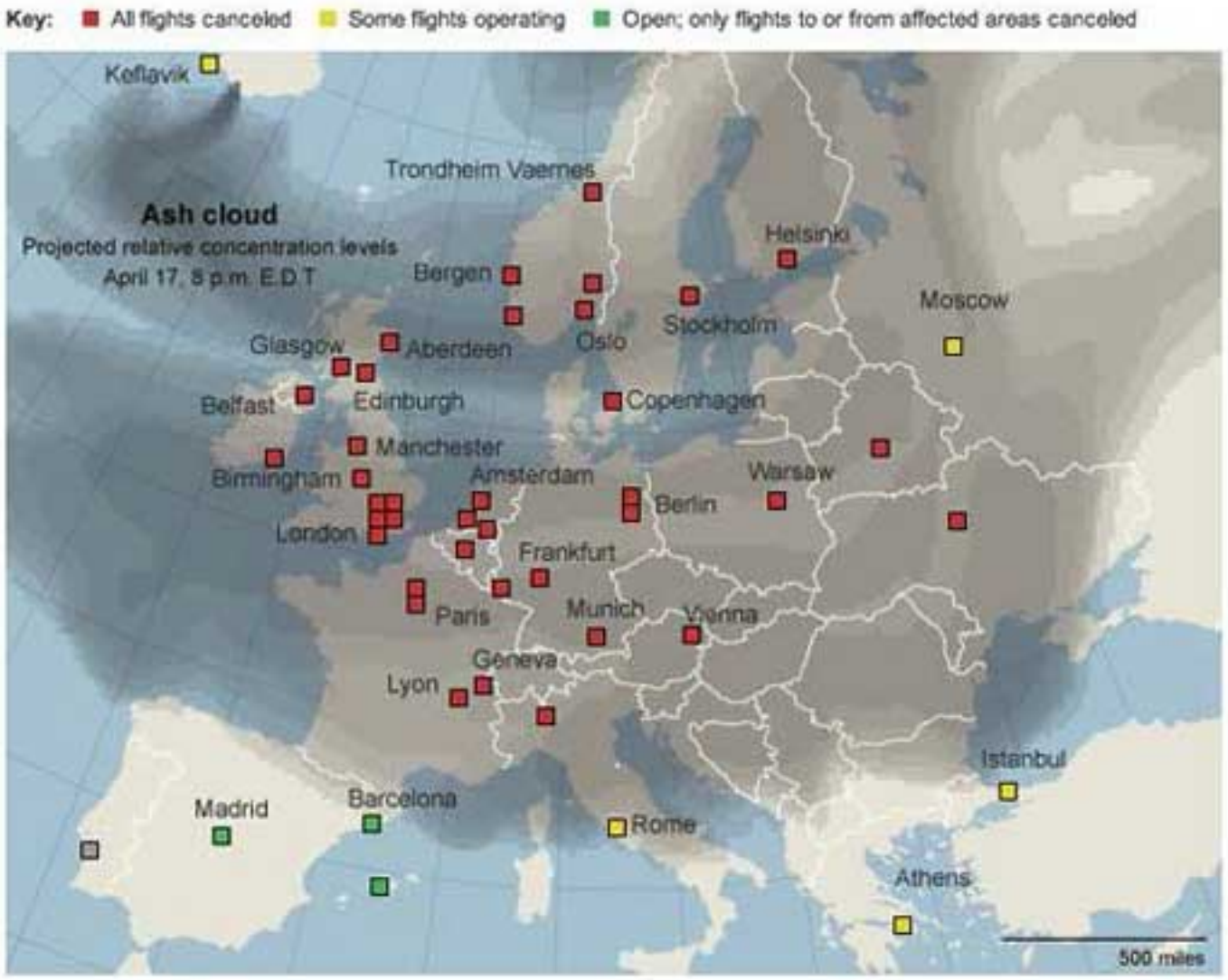
Stakeholders' Cycle



EACCC

- EACCC = European Aviation Crisis Coordination Cell (EACCC) est. by EU Transport Ministers on 11 May 2010 with the help of EUROCONTROL
- responsible for alerting the aviation community to an impending crisis and
- for proposing, coordinating and implementing the measures required to deal with it
- key function: keep all aviation stakeholders informed about the crisis, including the decisions that have been taken and the progress of the measures to deal with it

Eyjafjalla Crisis 2010



Facts of Eyjafjalla 2010 Crisis

- €2 bn. Losses
- 90% of flights banned for no real reason
- Contingency plan was inadequate, too many different approaches
- EUROCONTROL NOP Portal = ad hoc central coordinator
- Communication shortages
- Irrelevant maps published, emotional response
- Pilot reports = irrelevant

Facts of Eyjafjalla 2010 Crisis (2)

- Starting with Eyjafjalla 2010 the threat of "Volcanic Ash Cloud" was de-facto replaced by "Volcanic Ash and Dust Contamination"
- This was made possible by increasing sensitivity of remote sensing technology, and by increasing computing power of forecasting computers
- The threat occurrence trigger level was lowered
- Since then, except for Etna eruptions 2011, all other eruptions were treated with this increased sensitivity

Facts of Eyjafjalla 2010 Crisis (3)

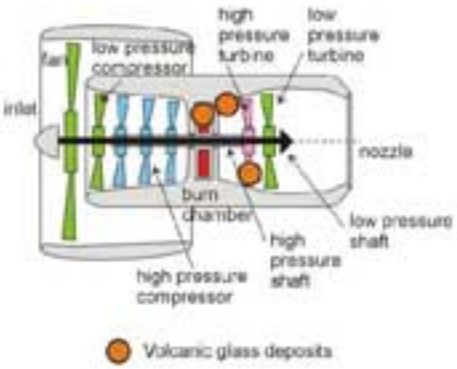
- New coverage of threat is global:
- Pinatubo 1991 – Global (on today's standards)
- Eyjafjalla 2010 – North Atlantic, Europe including Scandinavia, Mediterrean Sea, Russia
- Puyehue 2011 – Argentina, Australia, New Zealand
- Katla (expected) – Northern Hemisphere

What can go wrong in a VA encounter

Parts / Occupants	Cause	Effect	Response
Turbine engines	fuel injection and combustor deposits of melted ash (glassy coatings)	surge, shut-down, difficult restart in flight	idle thrust, evasive maneuver
Turbine engines	clogging the turbine cooling vents	overheating	idle thrust, evasive maneuver
Pitot-static	clogging the sensors	unreliable air speed indications	attitude-based flying, indicated air speed deducted from ground speed and wind velocity
Turbine engines	abrasion with hard particles	wear of fan, compressor, turbine, transmission	idle thrust, evasive maneuver
Pneumatic controls	clogging the vents	failure	evasive maneuver
Windshield, body, wings, empennage	cracks, abrasion with hard particles	wear, opaqueness	evasive maneuver
Avionics, on-board instruments	clogging air-cooling vents, electrostatic discharges	overheating, malfunction	evasive maneuver
Human occupants	breathing contaminated air, eye cornea contact with ash/dust particles	respiratory problems, eye damage	nose breathing, replace contact lenses with eyeglasses
Turbine engines, body and instruments metallic parts	acidity, exposure to associated SO_2 and sulfurous acid	corrosion (in time)	maintenance check and replacement

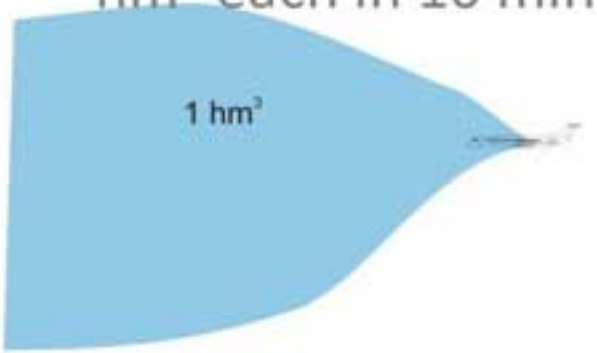
Vulnerability ~ Air Breathing Flow

Air Breathing Order of Magnitude	Description	Affected Hardware or Liveware
1,000 m^3/s	High flow non-filtered air breathing	turbine engines
100 m^3/s	Directly exposed to airflow	windshield, empennage, body and wing
0.01 m^3/s	Low flow non-filtered air breathing	human occupants, Pitot-static sensors, computers, electrical engines and other air-cooled parts
Irrelevant	Air breathing through filters	piston engines, air-cooled parts with air filters



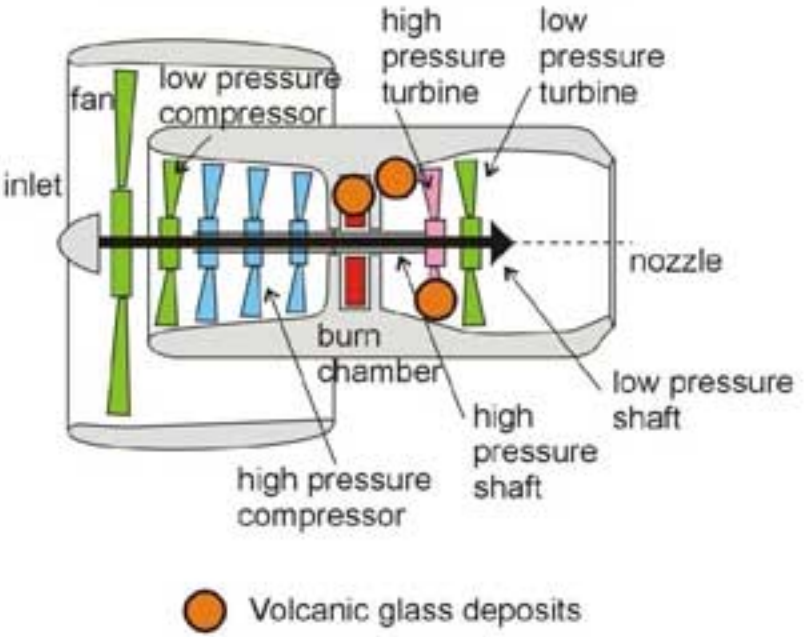
Vulnerability is Critical for Turbofan Engines

Turbofan engines are huge vacuum cleaners, sucking an average of 1,000,000 m^3 = 1 hm^3 each in 10 minutes of flight



One kilogram of deposits is enough to cause turbine overheating and even engine failure (restarting is possible though outside the contaminated area)

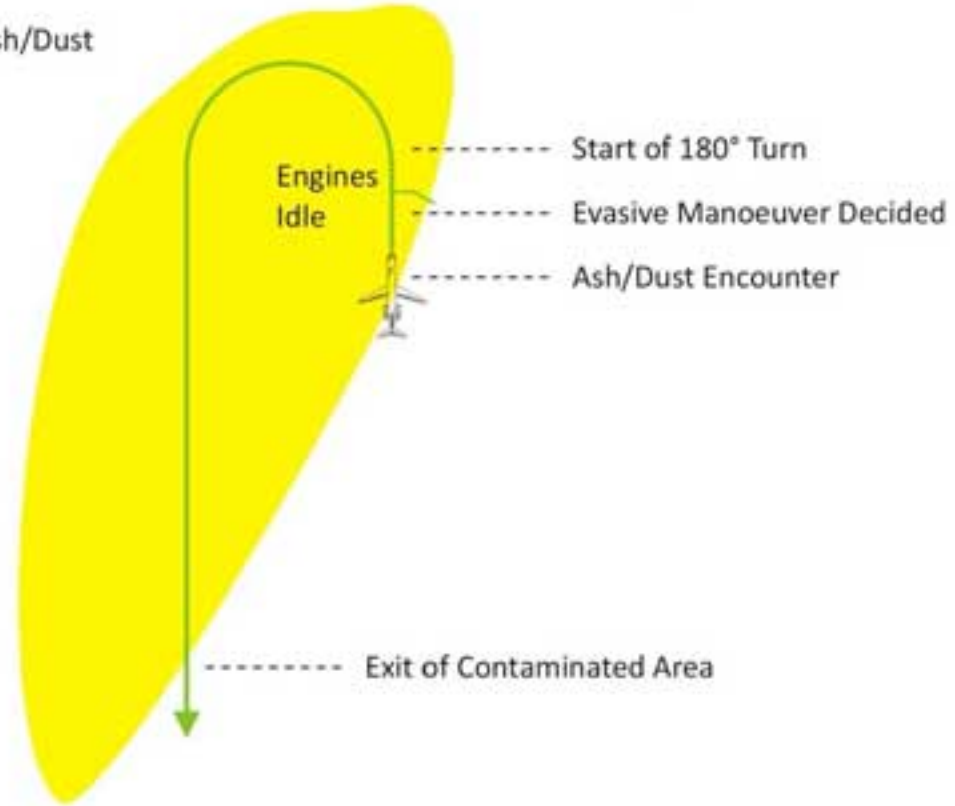
The Silica particles in the core flow will be deposited as glass in the combustion chamber and on the



Scale of phenomenon = 1 Cubic hectometre

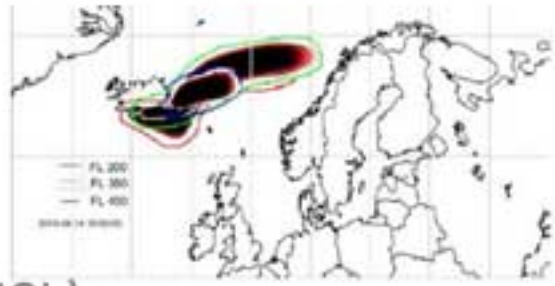
Characteristic time scope = 10 minutes of flight = exposure of an average turbine engine to 1,000,000 m^3 = 1 hm^3 of air

10 minutes is the maximum exposure of an aircraft engaged in an evasive manoeuver after an unanticipated volcanic ash encounter



Future Eruption First Reaction Checklist

- ✓ Location of the eruption / time: LAT, LONG, HHMMz, DDMMYY



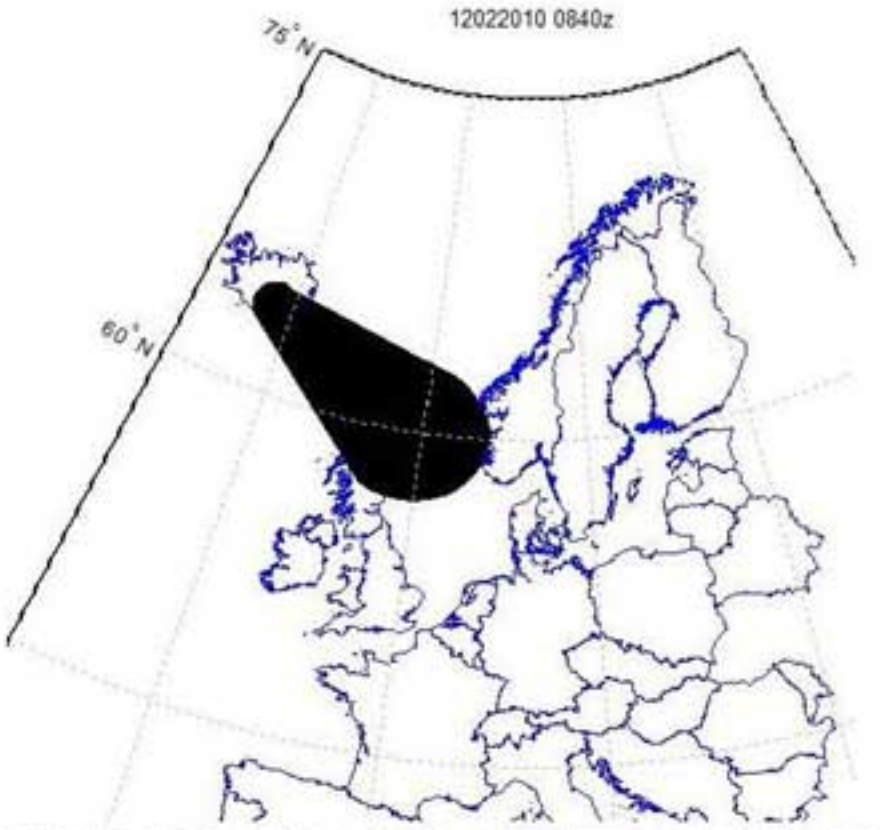
{repeat until eruption ends}

- ✓ How tall is the eruption column? ECH (m AMSL)
- ✓ Download wind profile in the area (e.g. from NOAA): WD/WV
- ✓ Calculate how far will the volcanic ash cloud go: VA_{MAX}
- ✓ Draw a contour with VA_{MAX} as major axis on the map: DA

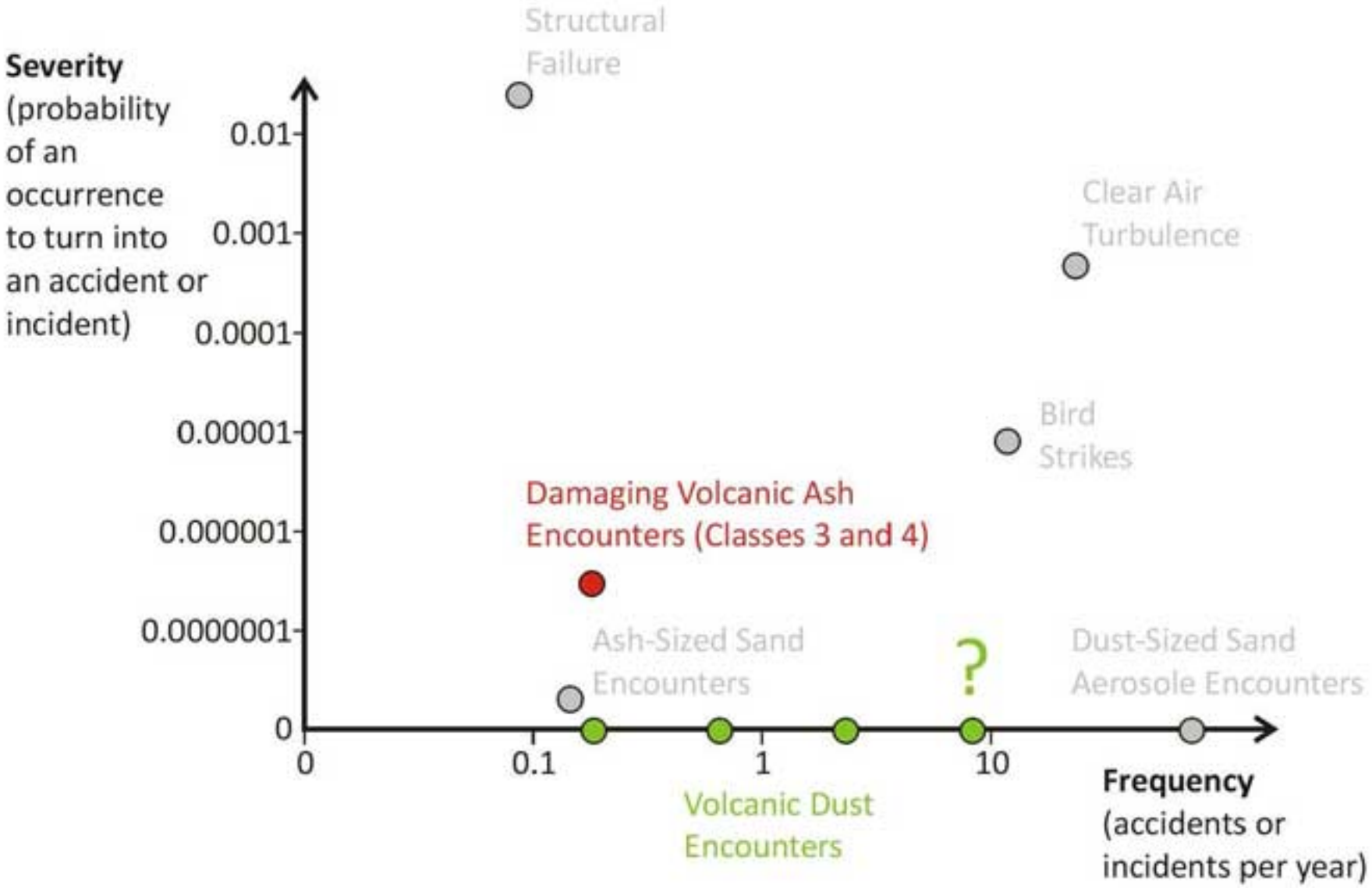
Ash4D

Volcanic Ash Danger Area

Shape: defined by the variability of wind direction and amplitude of wind velocity



Severity vs. Frequency Safety Risk



Improvements: ICAO EUR/NAT VATF

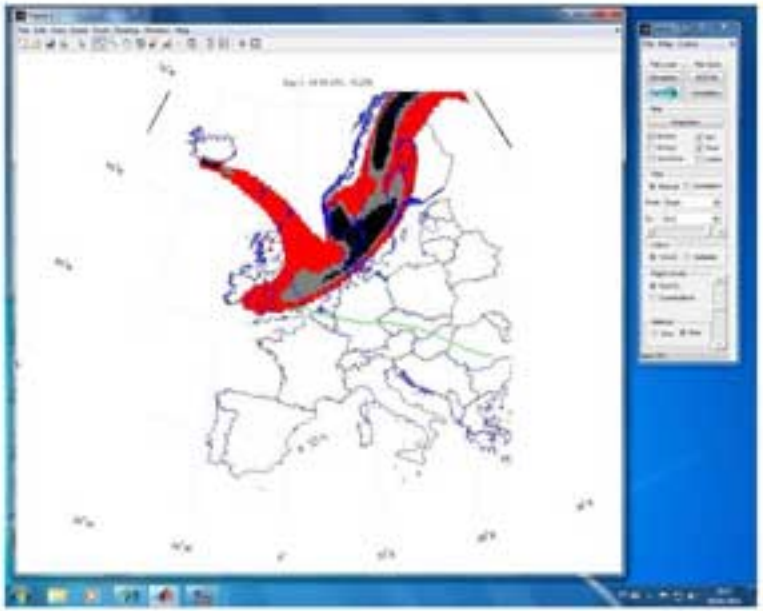
- A new contingency plan
- Realistic simulations needed (exercises)
- EUROCONTROL exercise before Grimsvotn eruption

Grimsvotn Eruption

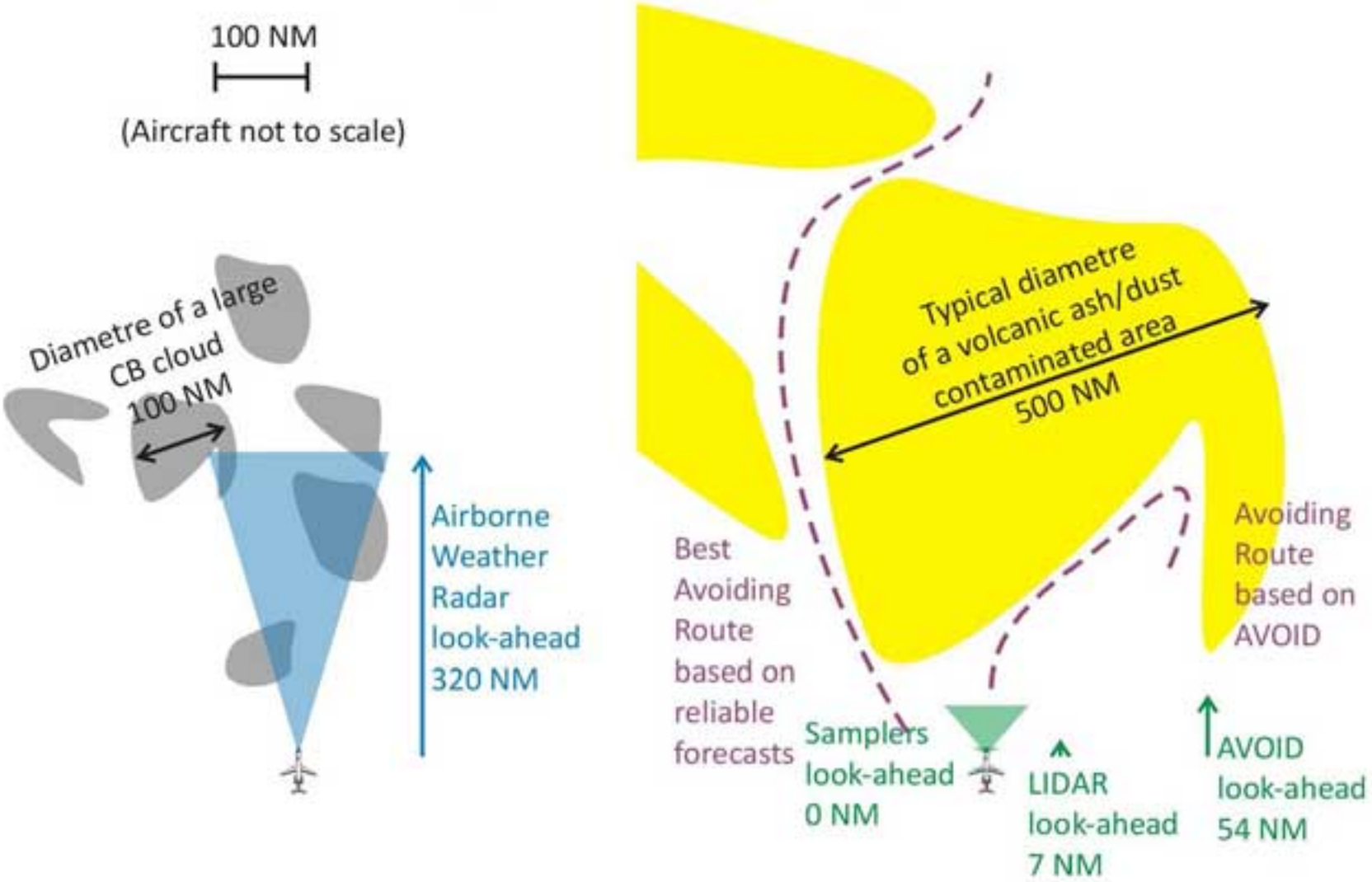
- Double the potential disruption of Eyjafjalla
- No unnecessary banning of flights
- Communication adequate
- Less emotional excursions
- More relevant maps published

The Future

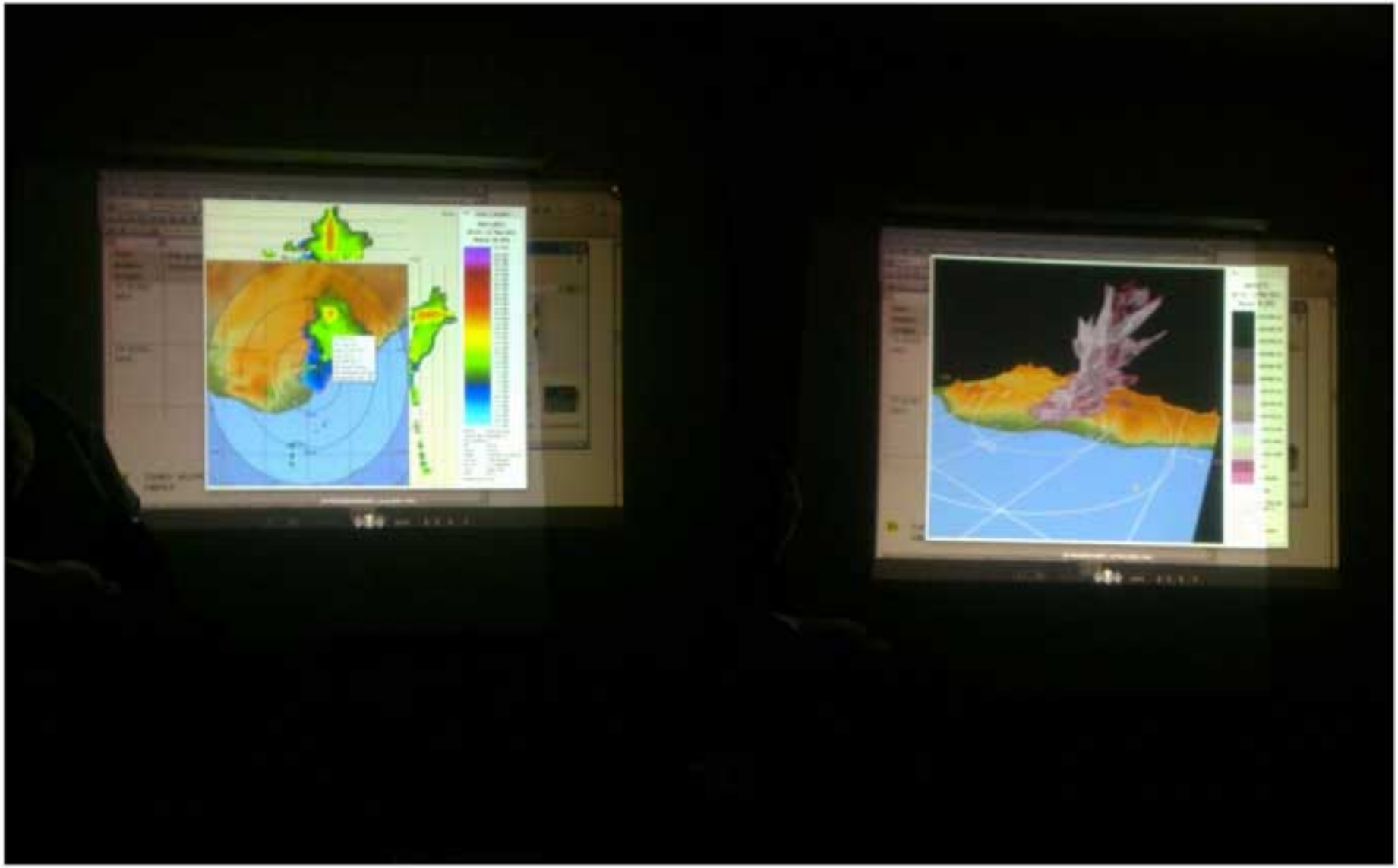
Alert system for any given airspace from the moment of a new eruption: Ash4D Software // EVITA



Future sensors are shortsighted and the scale of the phenomenon is larger

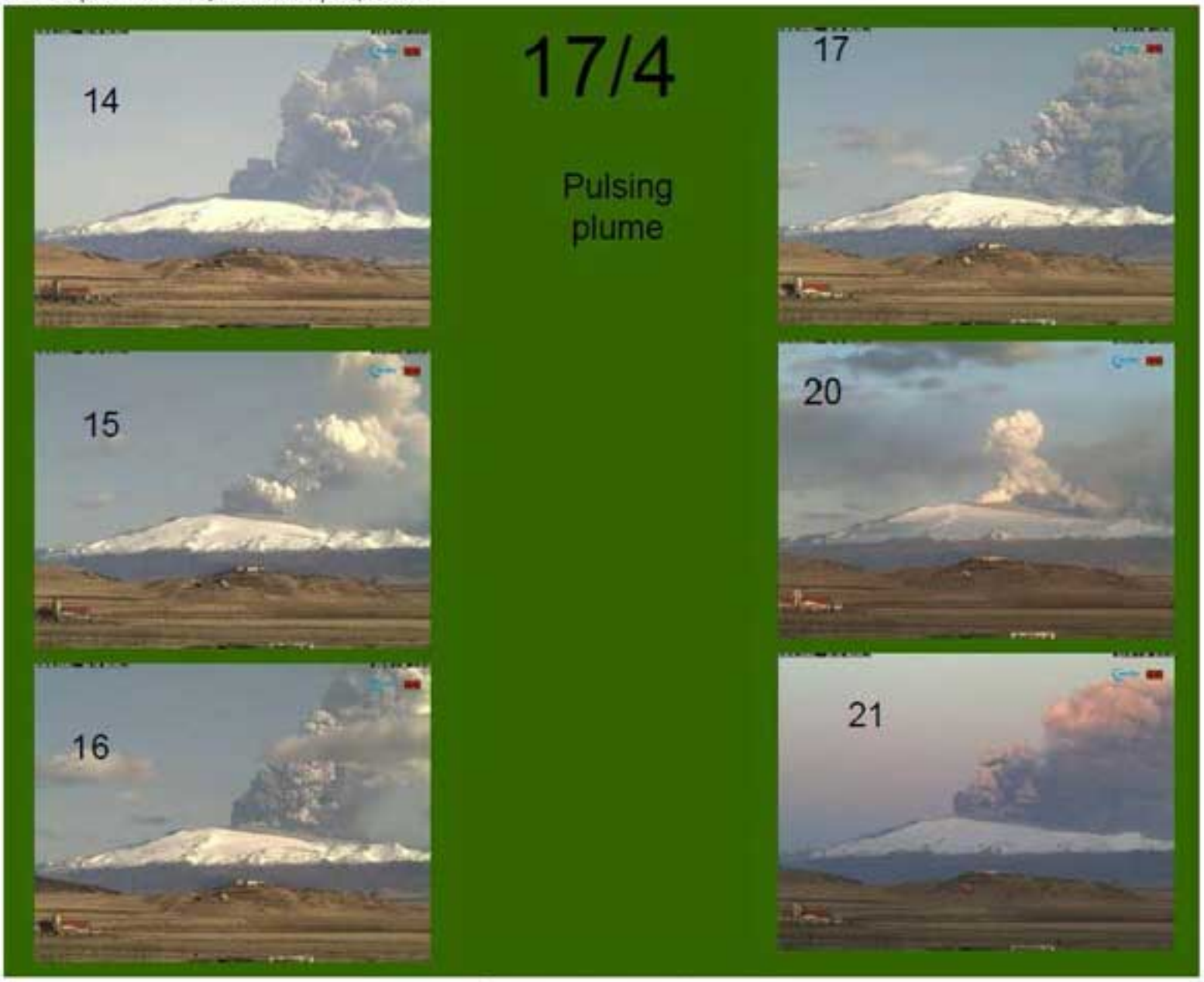


Future sensors are optical devices vulnerable to IMC



Source of the photo: own database

Source: Ármann Höskuldsson, et al, "The Eyjafjallajökull eruption 2010, course of events, intensity and magnitude", Atlantic Conference on Eyjafjallajökull and Aviation 15-16 September 2010, Keflavik Airport, Iceland



Thank you!