



ICAO

INTERNATIONAL CIVIL AVIATION ORGANIZATION

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Workshop on the provision of
information on volcanic eruptions
and ash clouds

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Developing Effective SIGMETs and Advisories

ICAO WACAF Office

By the Secretariat

Outline

1. Introduction
2. Phenomena requiring SIGMET issuance
3. Importance of SIGMET
4. Impacts of SIGMET
5. Key Challenges in the provision of SIGMET Information
6. What To Do to Assist Pilots With Timely and Quality SIGMET Information
7. Conclusion



- **SIGMETs** (Significant Meteorological Information) and **advisories** play a **crucial role in the safety and efficiency** of aviation operations by **alerting users to hazardous weather conditions** affecting flight operations.
- The **challenges** associated with SIGMET provision primarily relate to **timely dissemination, forecast accuracy**, and **ensuring consistent interpretations** among different meteorological watch offices (MWOs).
- **Coordination** among meteorological stakeholders, as well as **differences in operational practices an/or assessment** of the same hazardous weather situation, are also **key aspects of the challenges** to be addressed..

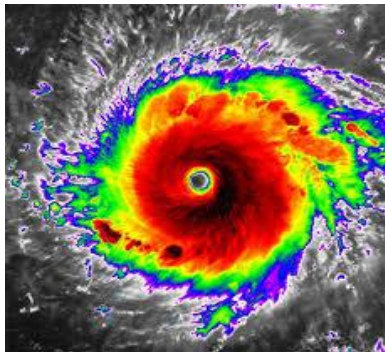
Phenomena requiring SIGMET issuance

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A3, Chap.7, App. 6 refer



TS



TC



SEV TURB



SEV ICE



MTW



HVY DS



HVY SS



VA



RDOACT CLD

Importance of SIGMET for users



- **Operational Safety:** Warn flight crews and air traffic controllers of hazardous meteorological phenomena such as thunderstorms, turbulence, volcanic ash, tropical cyclones, and icing.
- **Flight Planning and Rerouting:** Assist in strategic and tactical decision-making for rerouting and delaying flights.
- **Regulatory Compliance:** Fulfill ICAO Annex 3 and WMO standards for aeronautical meteorological service provision.
- SIGMETs play a critical role in **ensuring safety, minimizing environmental impact, and enhancing efficiency** in aviation operations.

Safety Impact of SIGMETs



■ Prevention of Weather-Related Incidents

- **Timely Hazard Awareness:** SIGMETs alert crews to hazardous weather (e.g., turbulence, ash, icing) in real time, allowing preventive action.
- **Situational Awareness:** Help pilots and ATC anticipate and avoid dangerous weather, reducing unintentional encounters.

■ Support for Tactical Decision-Making

- **Route Adjustments:** Enable crews to safely change altitude, speed, or route to avoid weather impacts.
- **Diversion Planning:** Facilitate timely and safer diversion decisions when conditions deteriorate.

■ Protection Against Specific Hazards

- **Turbulence:** Minimizes injury risks.
- **Icing:** Prevents performance and control issues.
- **Volcanic Ash:** Avoids engine and system damage.
- **Tropical Systems:** Supports avoidance of storms, wind shear, and lightning.

■ Regulatory and Safety Compliance

- **Meet ICAO Annex 3 requirements** and support Safety Management Systems (SMS) as essential tools for weather risk mitigation.

Efficiency Impact of SIGMETs



Positive Impacts

■ Improved Strategic Planning

- *Timely SIGMETs support better flight dispatch decisions, route planning, and airspace flow management, contributing to reduced airborne delays and holding times.*

■ Reduced Air Traffic Controller Workload

- *Reliable SIGMETs help ATC to anticipate traffic flow issues and implement efficient rerouting proactively, instead of reacting to in-flight weather deviations.*

■ Enhanced Predictability for Airlines

- *Airlines benefit from more predictable operations and on-time performance when SIGMETs are accurate and timely, reducing disruption costs.*

Negative Impacts

■ Potential for Increased Congestion in Non-SIGMET Areas

- *If large airspace regions are under SIGMETs, rerouted traffic can congest adjacent sectors or FIRs, leading to inefficiencies in those areas.*

■ Airspace Capacity Reduction

- *FIRs affected by SIGMETs may experience reduced capacity, requiring flow restrictions that slow operations and increase ground or airborne holding*

Environmental Impact of SIGMETs



Positive Impacts

- **Reduced Emergency Fuel Dumping or Diversions**

Timely SIGMETs help aircraft avoid hazardous weather, reducing the need for emergency actions like fuel dumping or diversions.

- **Lower Emissions from Efficient Rerouting**

Accurate SIGMETs support optimized flight paths, minimizing holding, altitude changes, and associated CO₂ emissions.

Negative or Trade-Off Impacts

- **Increased Fuel Burn from Longer Routes**

Rerouting around SIGMET areas can lead to longer flights and higher emissions, especially if the SIGMET is too broad or inaccurate.

- **Environmental Cost of Over-forecasting**

Non-concise and vague SIGMETs can lead to unnecessary rerouting, thereby increasing the cumulative environmental impact.

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- The diagram illustrates the flow of Volcanic Ash Advisory (VAA) and SIGMET information between various entities. The entities and their interactions are as follows:
- Volcano Observatories** (Red box) send **VONA** (red arrow) to the **Area Control Center ACC** and **SIGMET** (red arrow) to the **Met Watch Office MWO**.
 - Area Control Center ACC** (Dark grey box) send **VAA** (blue arrow) to the **Volcanic Ash Advisory Center VAAC** and **SIGMET** (grey arrow) to **Adjacent AACs**.
 - Volcanic Ash Advisory Center VAAC** (Blue box) send **VAA** (blue arrow) to the **Area Control Center ACC** and **SIGMET** (grey arrow) to **Other VAACs**.
 - Met Watch Office MWO** (Blue box) send **SIGMET** (grey arrow) to **Other VAACs** and **Adjacent MWOs**.
 - Other VAACs** (Blue box) send **SIGMET** (grey arrow) to **Aircrew Briefing**.
 - Aircrew Briefing** (Light blue box) send **SIGMET** (grey arrow) to **Other VAACs**.
 - Adjacent MWOs** (Blue box) send **SIGMET** (grey arrow) to **Other VAACs**.
- The diagram also shows an aircraft icon at the top, indicating the context of the information flow.

Challenge – Regulatory Framework

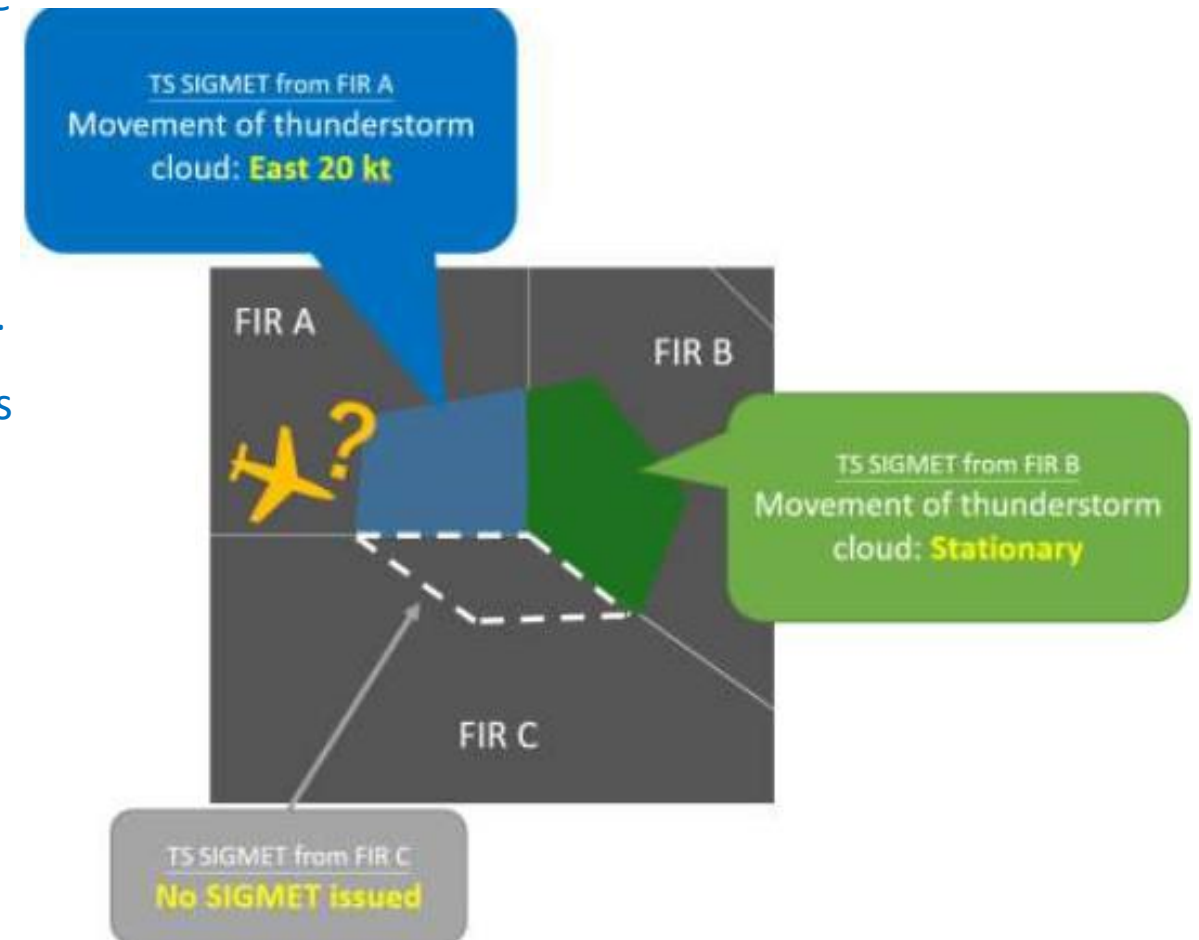
- **State has not include in their regulation, the ICAO related SARPs regarding the provision of SIGMET Information to users.**
- **No operational guidance provided to the MET Service Provider for the implementation of SIGMET requirements (AFI SIGMET Regional Guide refers).**
- **No mechanism in place to oversee the implementation of SIGMET related requirements.**



Challenge – Lack of Coordination

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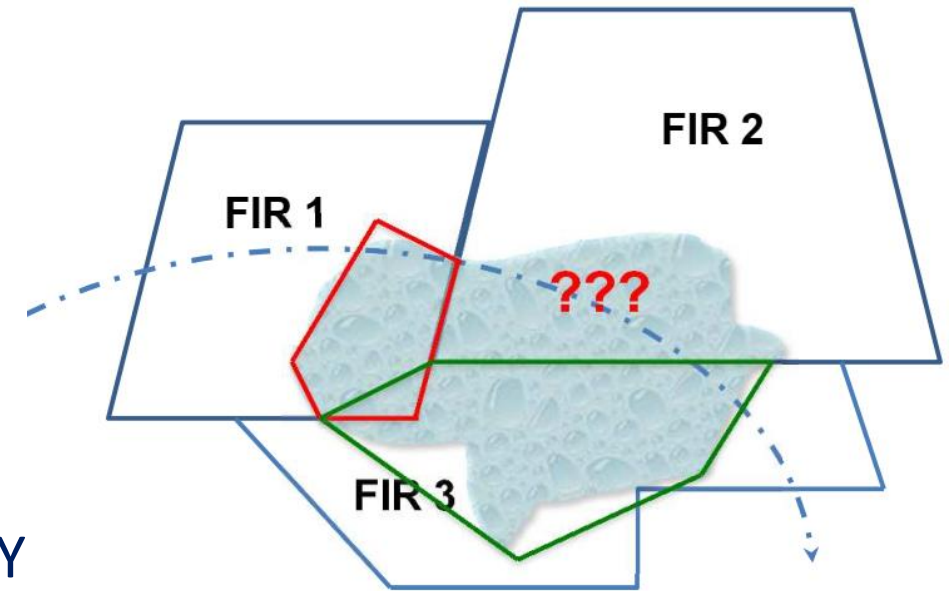
- **SIGMET Responsibility:** Each forecaster is responsible for issuing SIGMETs within their own Flight Information Region (FIR).
- **Cross-FIR Weather Hazards:** When significant weather phenomena (e.g., thunderstorms) extend across multiple FIRs, coordination becomes essential.
- **Potential Inconsistencies:** Pilots may receive SIGMETs that are not fully aligned at FIR boundaries.
- **Differences** may arise due to varying operational procedures or meteorological assessments by forecasters in adjacent FIRs.
- **Operational Impact:** These inconsistencies can lead to confusion or mixed responses by flight crews and air traffic management, potentially affecting safety and efficiency.



Challenges – Lack of information on en-route hazardous weather

1) Three (3) **separate** SIGMET messages should be issued.

- Lack of information would cause;
 - **Unexpected encounter** to hazardous weather (SAFETY RISK)
 - **Inefficient flight route** (EFFICIENCY RISK)

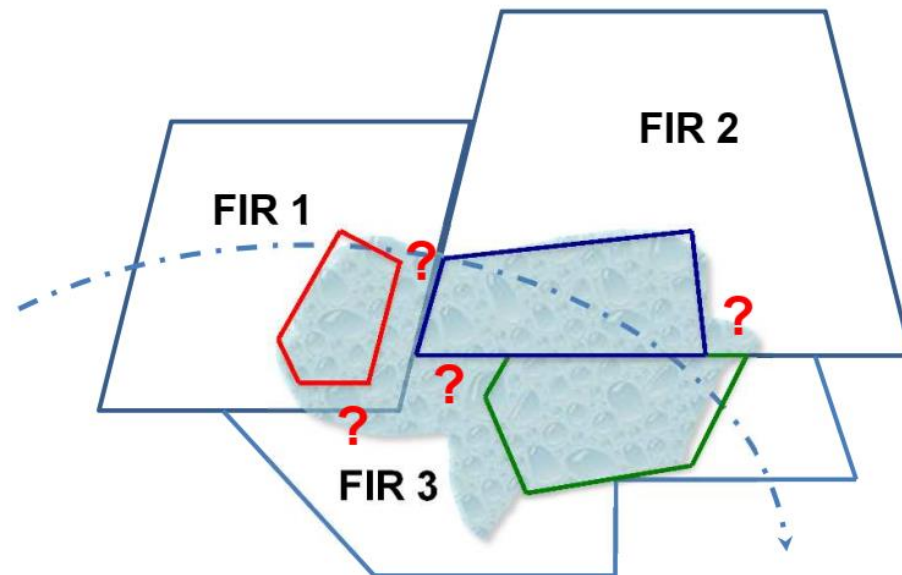


2) Lack of SIGMET **should be addressed**

Challenges – Inconsistency

Inconsistency of SIGMETs across the FIRs

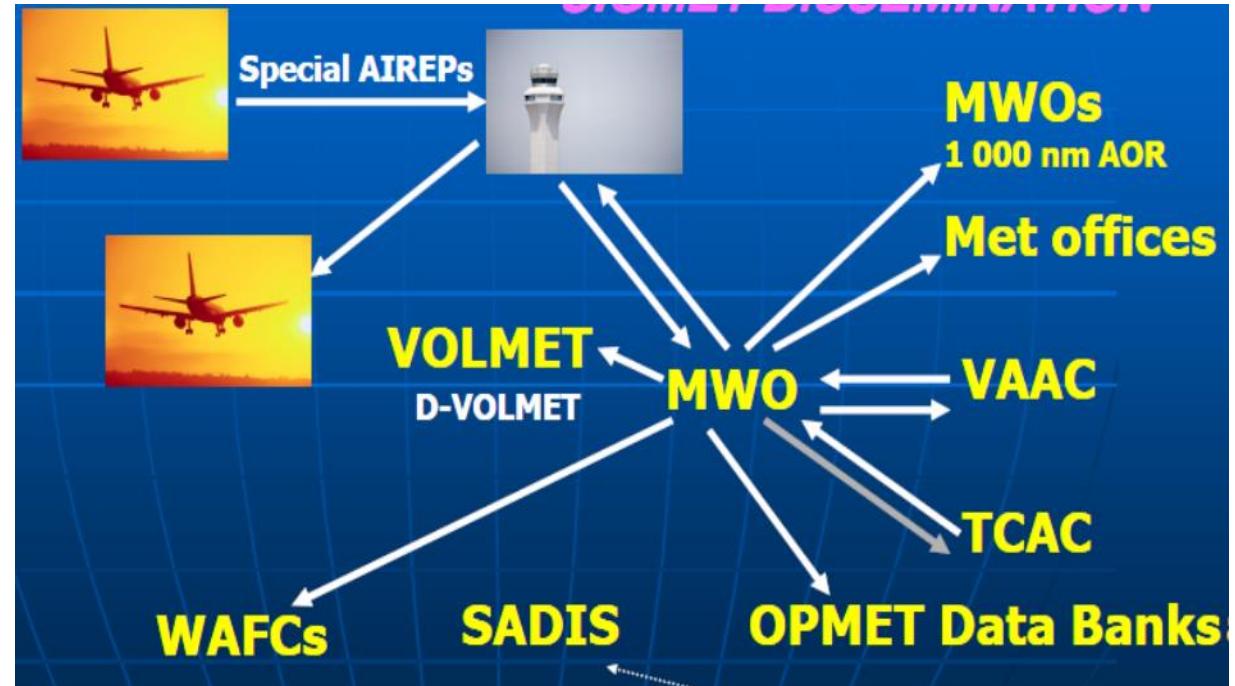
- 1) There (3) **separate** SIGMET messages should be issued;
- 2) **Gaps and discontinuity** of SIGMETs between FIR boundaries are another risk
- 3) **Coordination among MWOs** for “seamless” cross-border SIGMET information is strongly required (**Annex 3 refers**)



Challenges – Timely dissemination of SIGMETs

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- **SIGMET Dissemination (A3, App. 6, Std 1.2.1):** SIGMETs shall be sent to MWOs, other Met Offices, WAFCs, and VAACs, as per regional agreements. Volcanic ash SIGMETs must also be sent to VAACs.
- **OPMET Centres (A3, App. 6, Std 1.2.2):** SIGMETs shall be distributed to international OPMET databanks designated under regional agreements, for the operation of aeronautical fixed service Internet-based services.
- **Data Formats (A3, App. 6, Std 1.1.6):** As of 5 November 2020, SIGMETs shall be issued in IWXXM format, in addition to the traditional TAC format.



Note.— The technical specifications for IWXXM are contained in the Manual on Codes (WMO-No. 306), Volume I.3, Part D — Representation Derived from Data Models. Guidance on the implementation of IWXXM is provided in the Manual on the Digital Exchange of Aeronautical Meteorological Information (Doc 10003).

Developing Effective SIGMETs and Advisories

**What To Do to Assist
Pilots With Timely and
Quality SIGMET
Information ?**



- **Establishment of MET Service Provider (A3, Chap.3, 3.4 et 3.5) :** Act for establishing the Air navigation service provider **with the responsibility of providing MET services**
- **Regulate the provision of SIGMET Information:** Inclusion in the national MET regulations of ICAO related SARPs regarding the provision of SIGMET Information.
- **Capacity for ensuring application of SIGMET-related requirements:**
 - Develop **adequate tools** for inspecting the provision of SIGMET information to users; and
 - **Train MET Inspectors** on the inspection of the provision of SIGMET information.
- **Follow-up on the resolution of SIGMET related deficiencies :**
 - Ensure there is a **Directive for the resolution by the MET Service Provider(s)** of findings identified during the surveillance activities of SIGMET provision.

Operational framework (1/2)

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- **Approved organizational structure** of the MET Service Provider.
- **Appropriate Infrastructure and facilities** : Implementation of Infrastructures, facilities and systems for the preparation and provision of VA SIGMET information to users.
- **Operational instructions for SIGMET issuance** : Approved operational instructions/procedures for the provision of SIGMET services (PANS-MET (Doc 10157) and AFI Regional SIGMET Guide refer).
- **Coordination mechanism:**
 - **Agreements** with ATS Units, neighbouring MWOs/AMOs, VAACs.
 - Implementation of **Volcanic Ash Contingency Plan**.
 - **Coordination** with Volcanic Ash Advisory Centres (VAACs), Tropical Cyclone Advisory Centres (TCACs), and neighboring MWOs **when phenomena cross FIR boundaries** etc.

- **Capability for Monitoring and updating SIGMET:**
 - **Continuous monitoring** using radar, satellite, METARs, AMDAR, and model outputs, etc.
 - Use of **automated detection tools** and **nowcasting systems**.
- **Capability for dissemination:**
 - **Immediate dissemination** through AFTN, SADIS, AMHS, etc.
 - Ensure **accessibility to end-users in real-time**.
- **Capacity Building and Continuous Improvement**
 - **Training programmes/plans** and **mechanism for developing and maintaining** competencies of forecasters
 - Participation in the **VA SIGMET Tests**
 - Participation in the **Volcanic Ash Exercise**
 - **Quality Management Systems (QMS):** Integrate SIGMET performance monitoring (e.g., accuracy, timeliness indicators)
 - **Collect and analyze feedback from pilots and ATC** to refine practices, and to **anticipate the identification and the mitigation** of SIGMET related risks.



Conclusion

- Developing effective SIGMETs and advisories is fundamental to **safe and efficient** air navigation.
- It requires an **appropriate regulatory and operational frameworks** for the provision of SIGMET Information in compliance with ICAO related SARPs.
- Enhancing the quality of SIGMET information relies on **effective quality assurance measures** and the **continuous development and maintenance of competencies** of forecasters and other involved technical personnel.



Thank You!