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THE 15TH ASIA-OCEANIA METEOROLOGICAL SATELLITE USERS' CONFERENCE (AOMSUC-15)
2025 FENGYUN SATELLITE USER CONFERENCE (2025 FYSUC)

Risk map for volcanic ash monitoring: Case study of Mount Lewotobi Laki-laki, Indonesia

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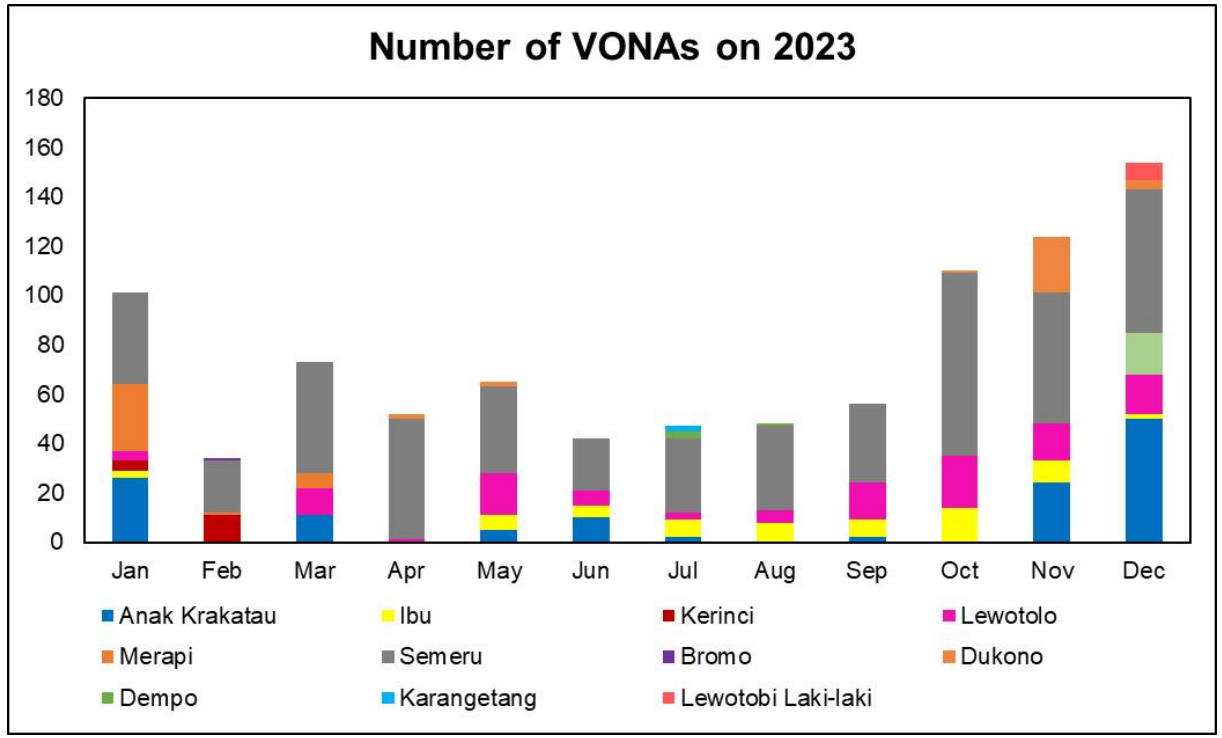


Volcanic Activity and Hazards in Indonesia

- Indonesia is highly susceptible to volcanic ash threats due to its numerous active volcanoes and high population density.
- Ash clouds from eruptions can persist in the atmosphere for hours or days, posing risks to aircraft.

Mt. Lewotobi Laki-laki Eruption and Impact

- In December 2023, Mt. Lewotobi Laki-laki erupted, closing Maumere Airport due to volcanic ash.
- Ash plumes from volcanoes can affect aviation if they reach Maumere Airport.

Objectives

- Analyze the impact of Mt. Lewotobi Laki-laki's eruption on flight operations at Maumere Airport.
- Create a risk map for volcanic ash monitoring using wind patterns, satellite imagery, and surface wind profiles.

VA trajectory and dispersion analyzed using Hysplit model and Himawari-8 satellite data

- VA trajectory was modeled using the Hysplit model and GFS datasets.
- VA dispersion utilized Himawari-8 satellite data and the three-band volcanic ash product (TVAP) for IR bands of 3.7 μm, 10.8 μm, 12.0 μm.

TVAP = 60 + 10 (12.0 μm – 10.8 μm) + 3 (3.7 μm – 10.8 μm)

Historical eruption data (1990-2023) and wind conditions (2014-2023) plotted to assess risk

- Investigated ash movement trends from 1990 to 2023 using Hysplit trajectory.
- Plotted windrose of surface winds at Maumere Airport (2014–2023) to figure out possible seasonal variations in wind condition.
- Analyzed monthly wind and rainfall data (1991–2020) for flight levels (FL050, FL100, FL140, FL240, FL300, FL340, FL390, FL450).

Rainfall (mm)	Wind direction	Wind speed (knots)	Criteria
> 500	wind is not towards the airport	0 – 10	**No risk**
300 – 500	possible wind towards the airport	10 – 20	**Low**
100 – 300	possible wind towards the airport	20 – 50	**Medium**
0 – 100	wind goes straight to the airport	> 50	High

Eruption of Mt. Lewotobi Laki-laki and its Impact on Aviation

Communication and Updates

- Beginning with the eruption of Mt. Lewotobi Laki-laki on December 23, 2023.
- PVMBG updates volcanic activity daily with color-coded levels.
- Observations of ash particles using paper test and meteorological conditions shared with AirNav Unit Maumere.

Impact on Aviation Operations

- Tem

Table. The VONA of Mt. Lewotobi Laki-laki

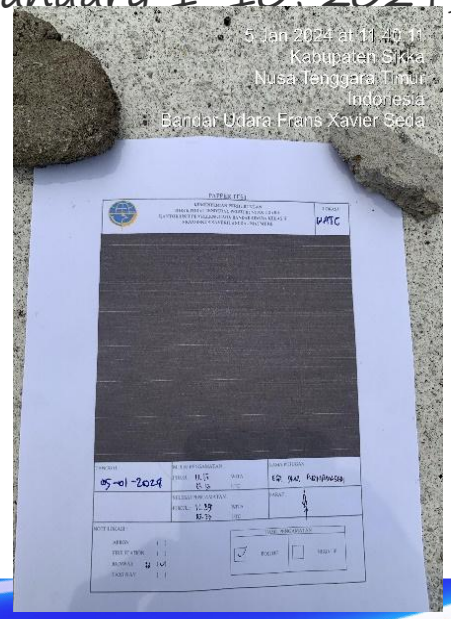
Date	Issued (UTC)	Volcanic Activity Summary	Volcanic Cloud Information
23-12-2023	10:25	Eruption at 10:25 UTC	Ash-cloud is not observed
27-12-2023	18:53	Eruption with volcanic ash cloud at 18:53 UTC	Ash cloud moving to northwest. Volcanic ash is observed to be white to gray. The intensity of volcanic ash is observed to be thick.
01-01-2024	20:54	Eruption with volcanic ash cloud at 20:54 UTC	Ash cloud moving from southwest to west. Volcanic ash is observed to be gray to brown. The intensity of volcanic ash is observed from medium to thick.
05-01-2024	21:03	Eruption with volcanic ash cloud at 21:03 UTC	Ash cloud moving from southwest to west. Volcanic ash is observed to be white to gray. The intensity of volcanic ash is observed from medium to thick.

Source: https://magma.esdm.go.id/vona

Table. METAR from Maumere Meteorological Station

Time	METAR
010900Z	34005KT 8000 VA FEW017 31/26 Q1009 TEMPO TL1000 VA=
030830Z	34004KT 5000 VA BKN015CB 31/27 Q1008 TEMPO TL1000 VA RMK CB TO E=
051200Z	16003KT 6000 VA SCT016 29/26 Q1012 TEMPO TL1300 VA=
070600Z	35005KT 5000 VA FEW016 33/26 Q1008 TEMPO TL0700 VA=
090530Z	34005KT 6000 -RA FEW015CB SCT018 29/27 Q1007 TEMPO TL0600 -RA RMK CB TO E AND W=

January 1-10, 2024, via NOTAM



AirNav Indonesia

PERUM LPPNPI
INTERNATIONAL NOTAM OFFICE
Gedung 611 Air Traffic Services
Bandara Soekarno – Hatta
Telepon : 021-55910631
Fax : 021 – 55910659
Email : nof.indonesia@gmail.com

NOTAM

Nomor NOTAM	:	C0017/24 NOTAMN
Lokasi	:	WATC - MAUMERE
Perihal	:	AERODROME CLOSED
Ringkasan Isi NOTAM	:	BANDAR UDARA FRANSISKUS XAVERIUS SEDA

Text NOTAM

C0017/24 NOTAMN
Q) WAAF/QFALC/IV/NBO/A/000/999/0838S12214E005
A) WATC
B) 2401022355
C) 2401030900EST
E) AD CLSD DUE TO LEWOTOBI VOLCANIC ASH)

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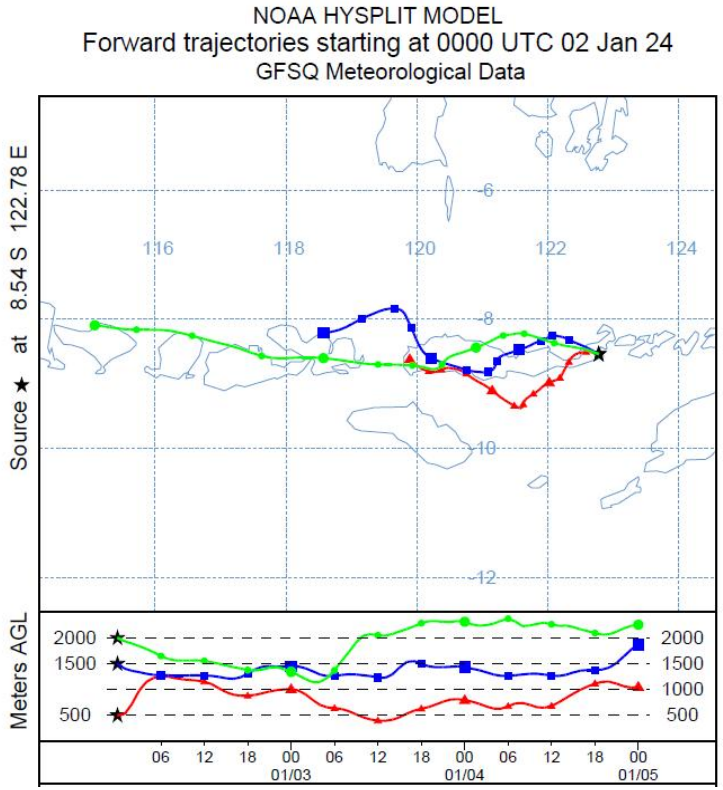
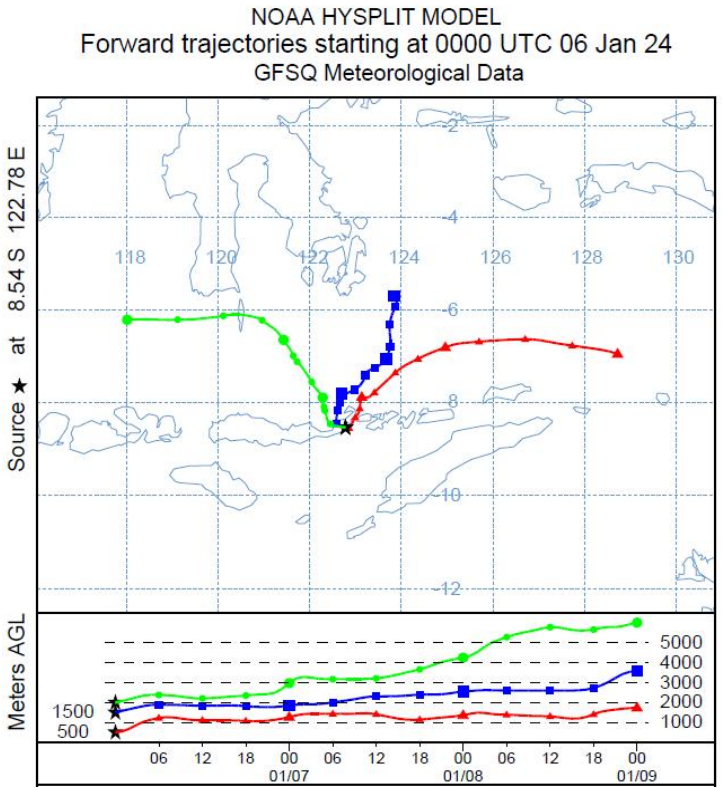
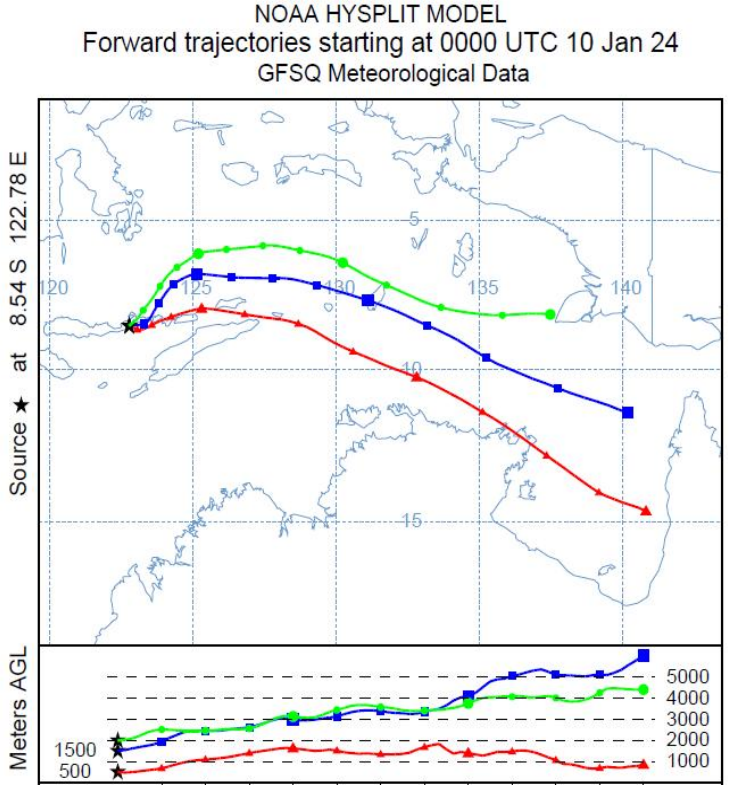
Ash Transport and Dispersion Models for Aviation



Ash moved southwest to northwest from January 1-4, 2024, potentially affecting Maumere Airport

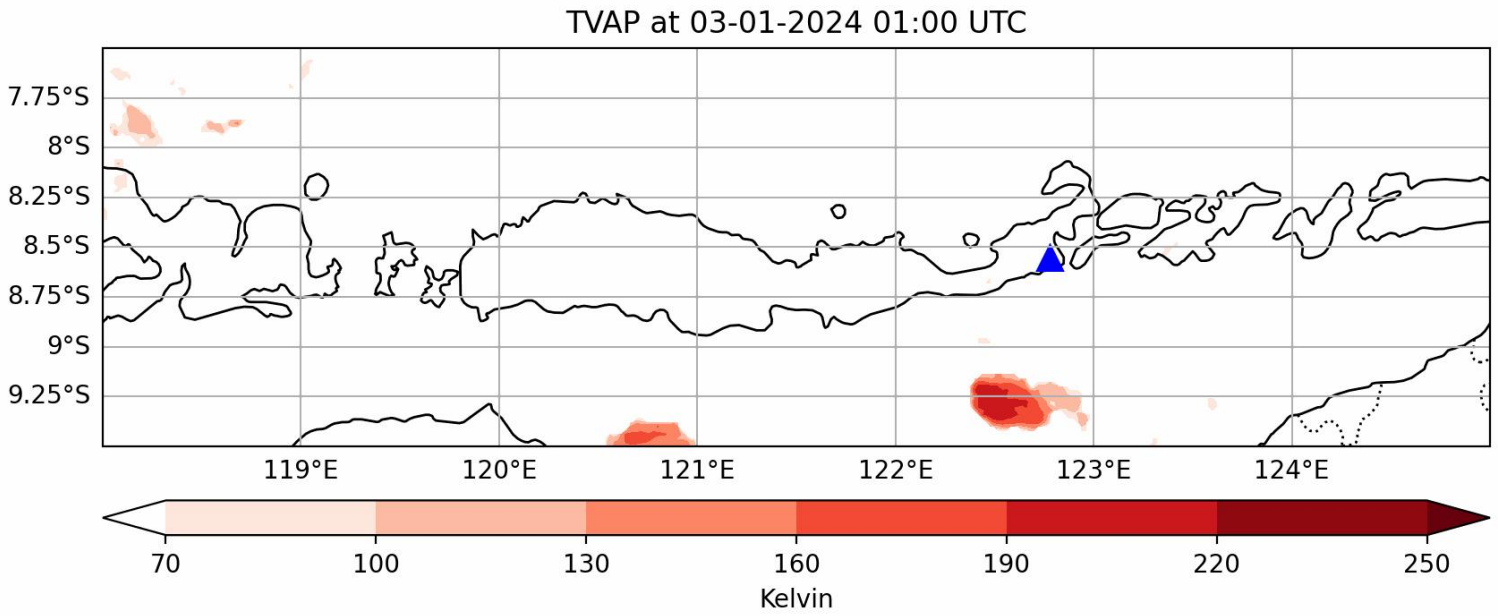


January 5-7, 2024, ash moved towards the Flores Sea, reducing impact on Maumere Airport



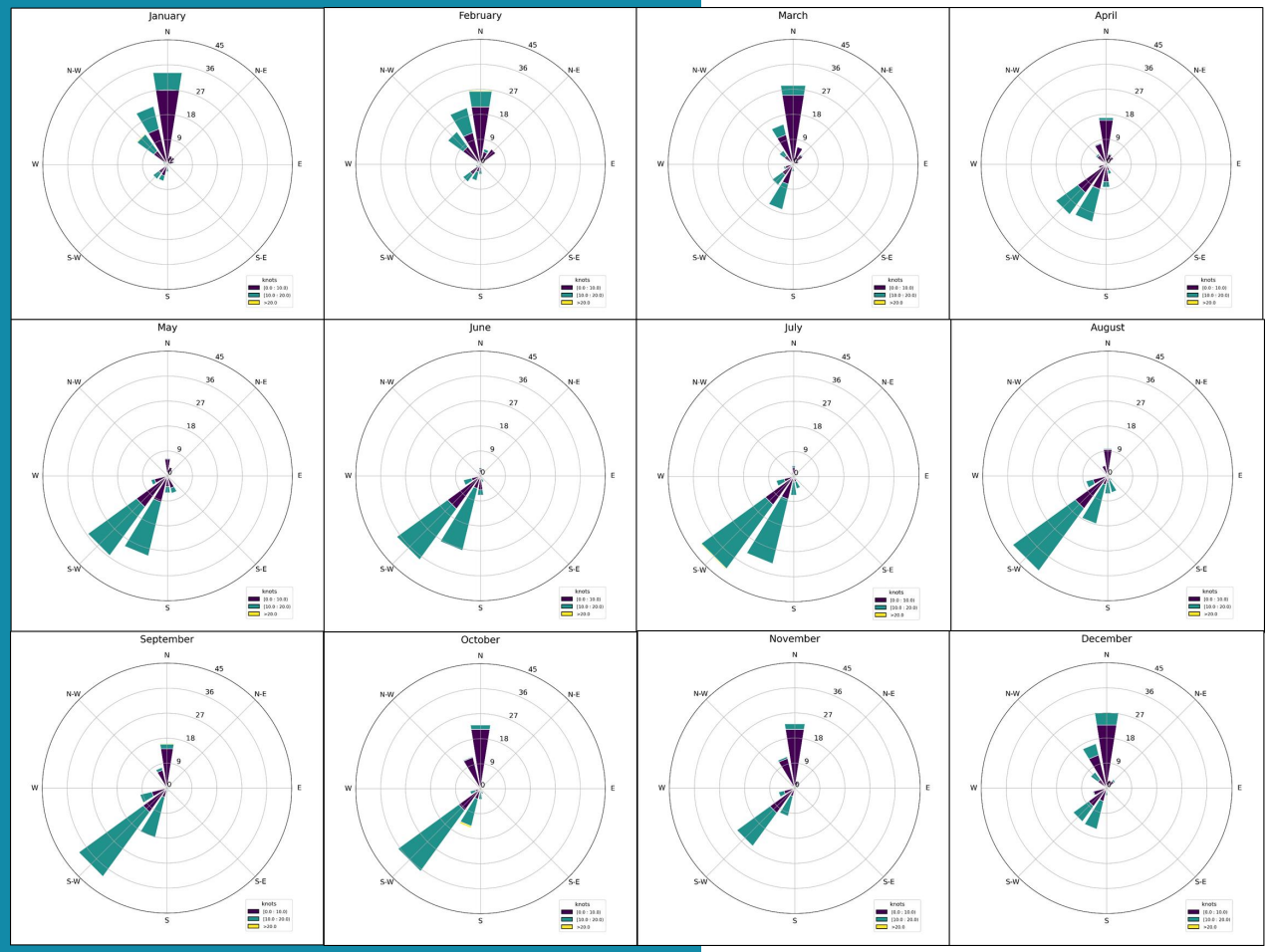
From January 8-10, 2024, ash cloud moved east, showing minimal risk to Maumere Airport

Ash Transport and Dispersion Models for Aviation



- VA propagation depends on wind conditions, moving southwest and west from Mt. Lewotobi Laki-laki
- TVAP method may overestimate ash in some areas due to high clouds.
- Distinguishing ash from thin cirrus clouds is challenging in certain conditions.
- IR data can still observe ash plumes despite unknown surface emissivity.

Climatic Condition at Maumere Airport



Wind Pattern

- Wind analysis at Maumere Airport shows monsoon-influenced patterns.
- November to April: Northwest to Northeast winds at 2-10 knots.
- May to October: South to Southwest winds at 5-20 knots, with strong winds (8-30 knots) from June to August.
- **High risk of VA impacts on Maumere Airport from May to October**

Rainfall Pattern

- High rainfall during December-February (300-500 mm, up to 700 mm in the western area).
- March-May as first transition season sees 100-300 mm of rainfall.
- Dry season (June-August) has less than 100 mm.
- September-November as second transition season sees 100-200 mm of rainfall.
- **High VA risk during dry and second transition seasons.**

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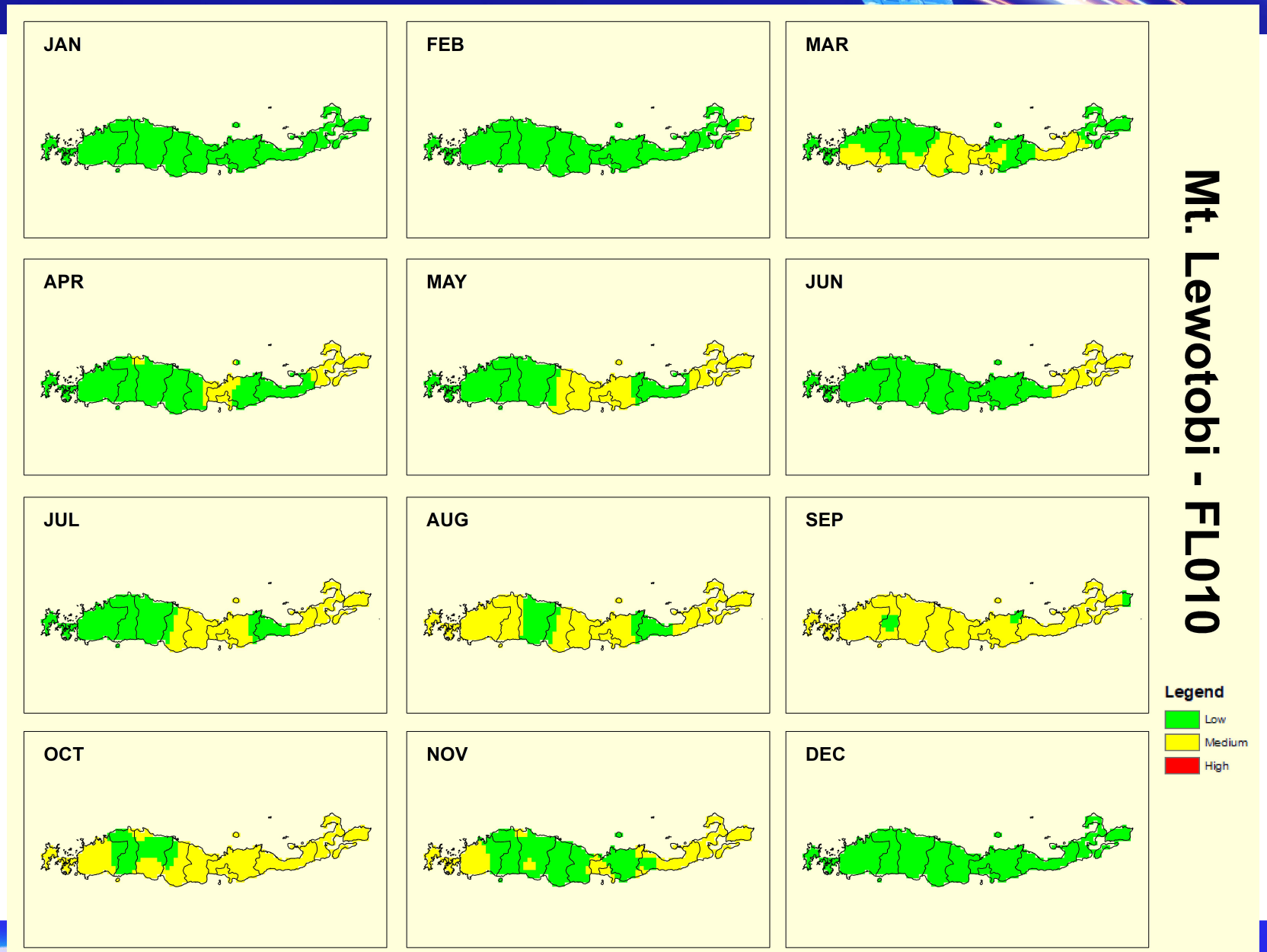
Ash Distribution Risk Hazard

Medium volcanic hazard
risk
on Flores Island
from July to October



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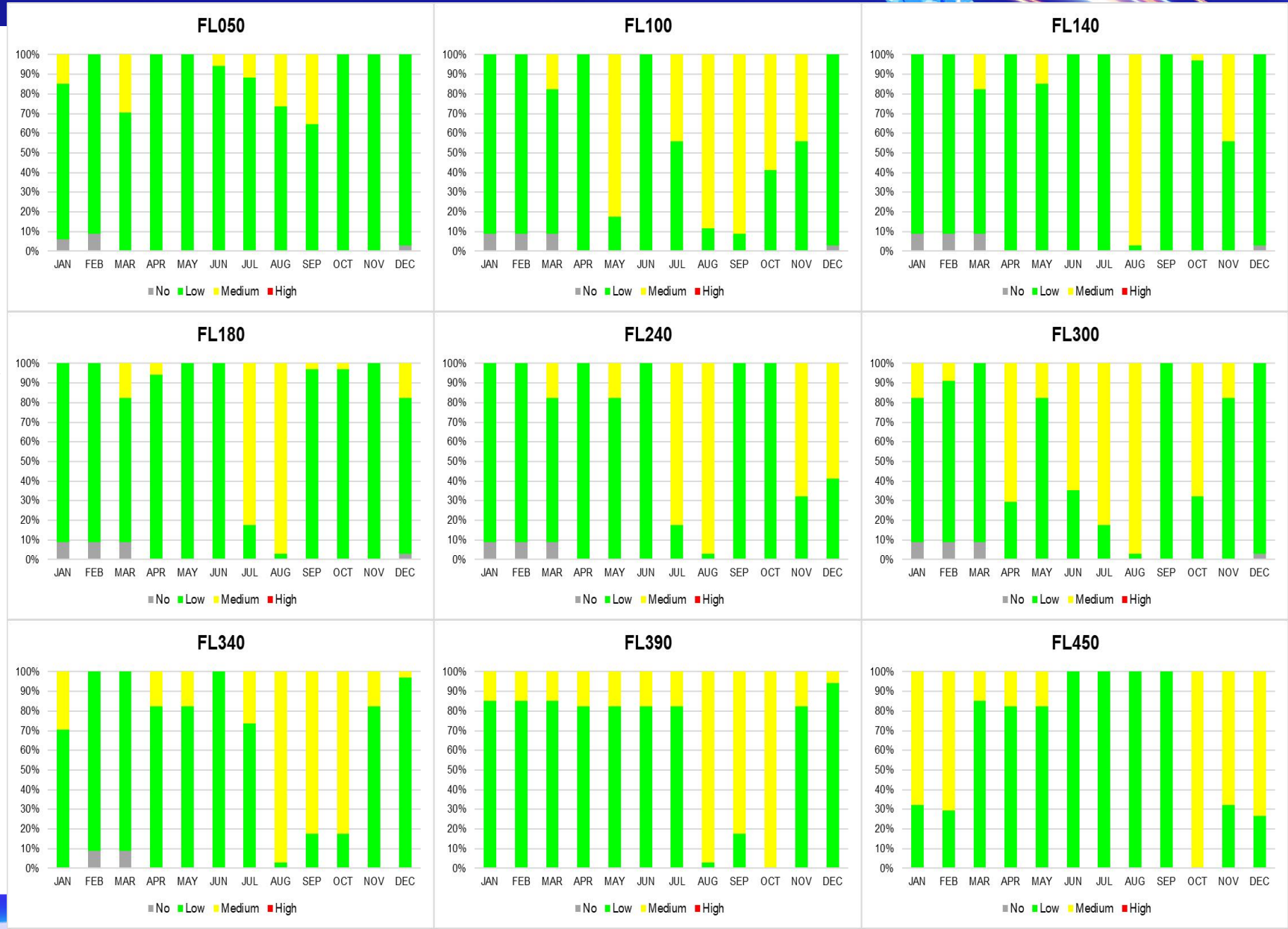
Ash Distribution Risk Hazard

Maumere Airport faces medium risk of ash at multiple flight levels (FL100, FL180, FL240, FL300, FL340, FL390)



Mitigation and Preparedness Strategies

- Ash distribution depends on wind, particle size, and density; quantification requires considering uncertainties.
- Effective hazard mitigation requires detailed planning and coordination among volcanologists, pilots, air traffic controllers, airport personnel, and meteorologists.
- Preparedness involves formulating operational plans, decision-making protocols for airport closures, and managing ash-contaminated airspace.

Conclusion

- Moderate volcanic hazards risk from July to October on Flores Island.
- Effective coordination and communication among relevant stakeholders are crucial for detecting volcanic ash and ensuring aviation safety.