Monitoring volcanoes of the world with IMS infrasound network: evaluation of the reliability of a new detection algorithm

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INTRODUCTION

The detection and notification of ongoing volcanic eruptions are crucial for supporting the Volcanic Ash Advisory Centres, particularly in areas where local monitoring systems are absent at active Volcanoes. Long-range infrasound monitoring might provide useful information.

METHODS/DATA

A global scale Early Warning (EW) system, based on Infrasound Parameter (IP), is applied to 16 IMS infrasound array to detect volcanic explosive eruptions, between 2010 and 2019, where multiple eruptions with different VEI occurred.

START

RESULTS

The notifications of the algorithm are compared to the bulletin reports of the Global Volcanism Program (GVP). The EW system demonstrates its ability to not only detect major events (VEI≥3), but also reliably identify small persistent eruptions.
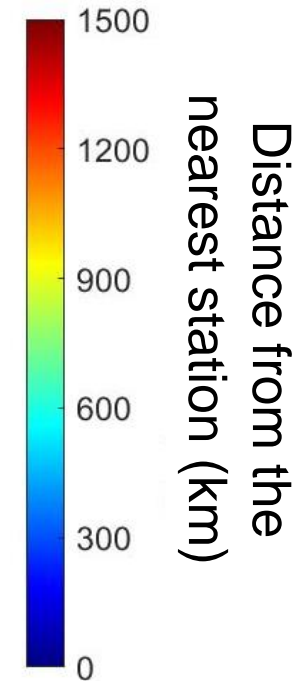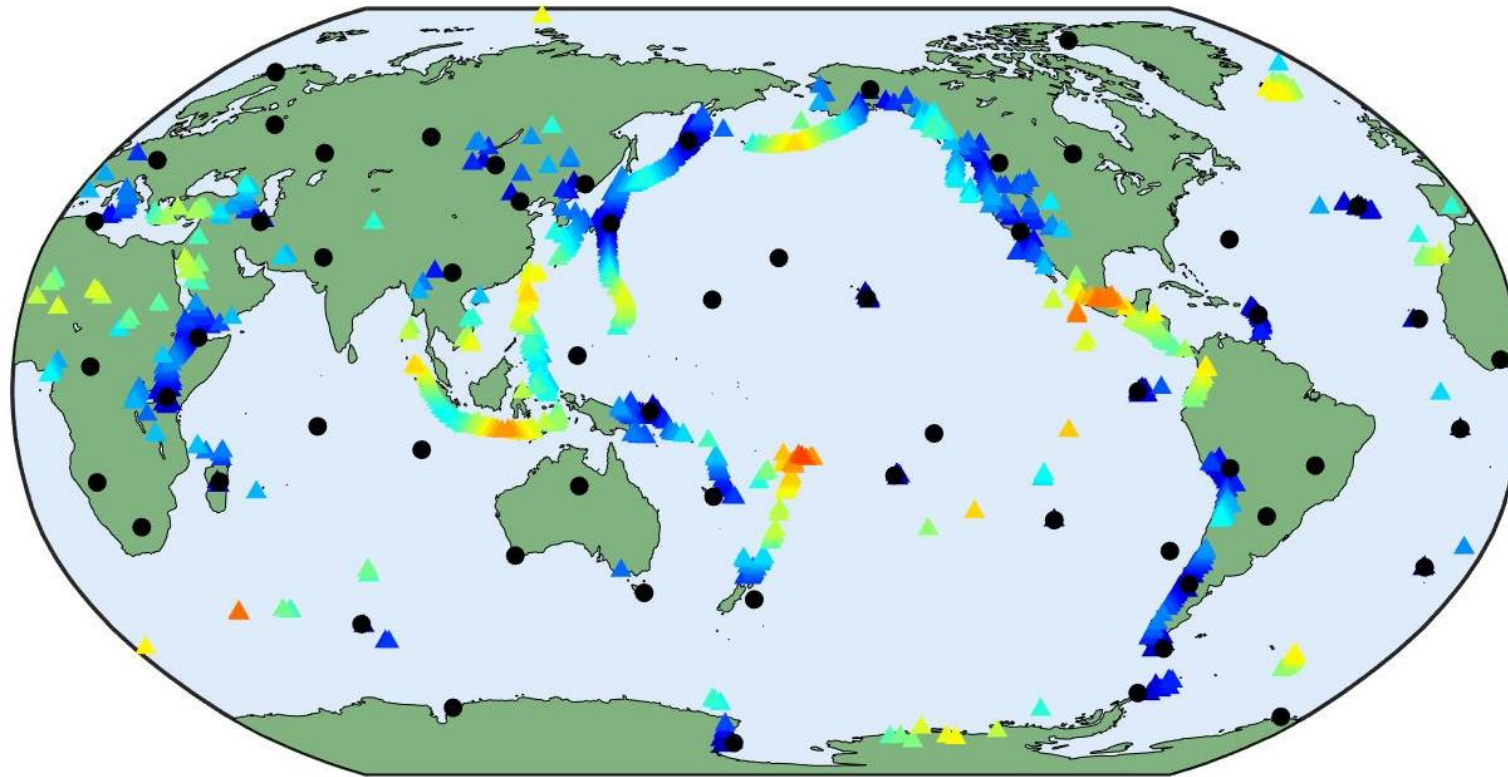
CONCLUSION

The algorithm's false alert rate has been assessed, and it is generally low for most volcanoes. Unresolved ambiguity remains due to short spacing among volcanoes with respect to the array and the unfavourable propagation conditions.

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~**1500 active volcanoes** on Earth
~**68** erupt every year
5-6 eruptions per year with a **VEI ≥ 3**

Eruptions with a **VEI ≥ 3** can inject ash at elevation of **5-15 km** and thus potentially affect air traffic

INTRODUCTION

OBJECTIVES

METHODS/DATA

RESULTS

CONCLUSION

Distance from the nearest station (km)

Permanent and extensive monitoring is limited to few countries.
Many volcanoes worldwide are **poorly monitored**

Objectives: Find out the eruptive volcanic signals
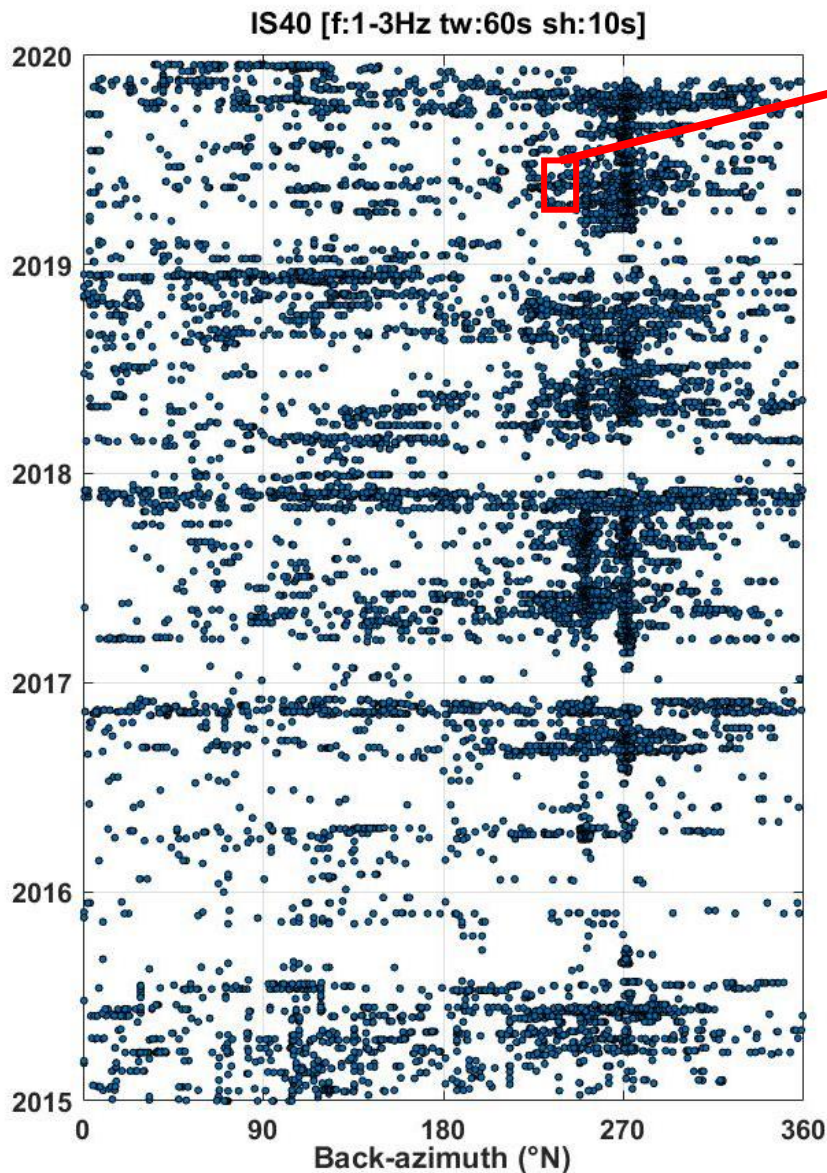with an early warning system and estimate the false alerts

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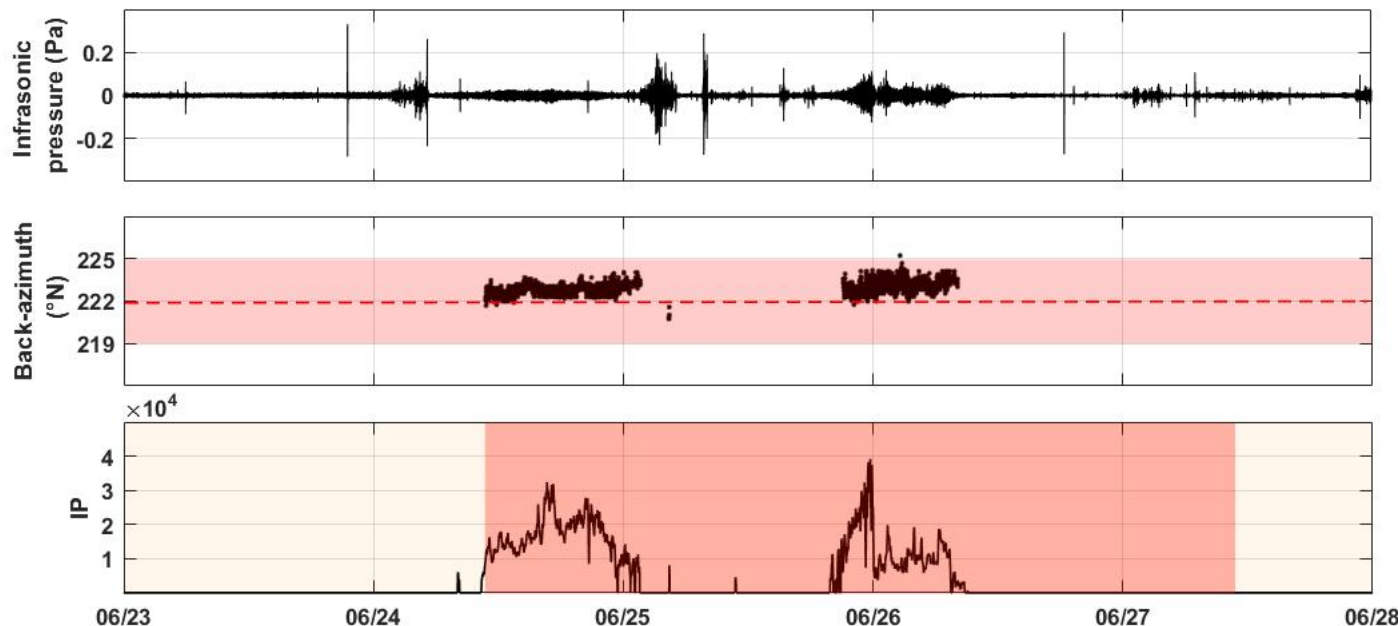DST
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Ulawun Eruption

Only ~2% of detections correspond to the eruption… and the others?

Long-range Volcano Infrasound Early Warning

$$IP = N_{det} \times Ps$$

N_{det}=Persistency of the signal
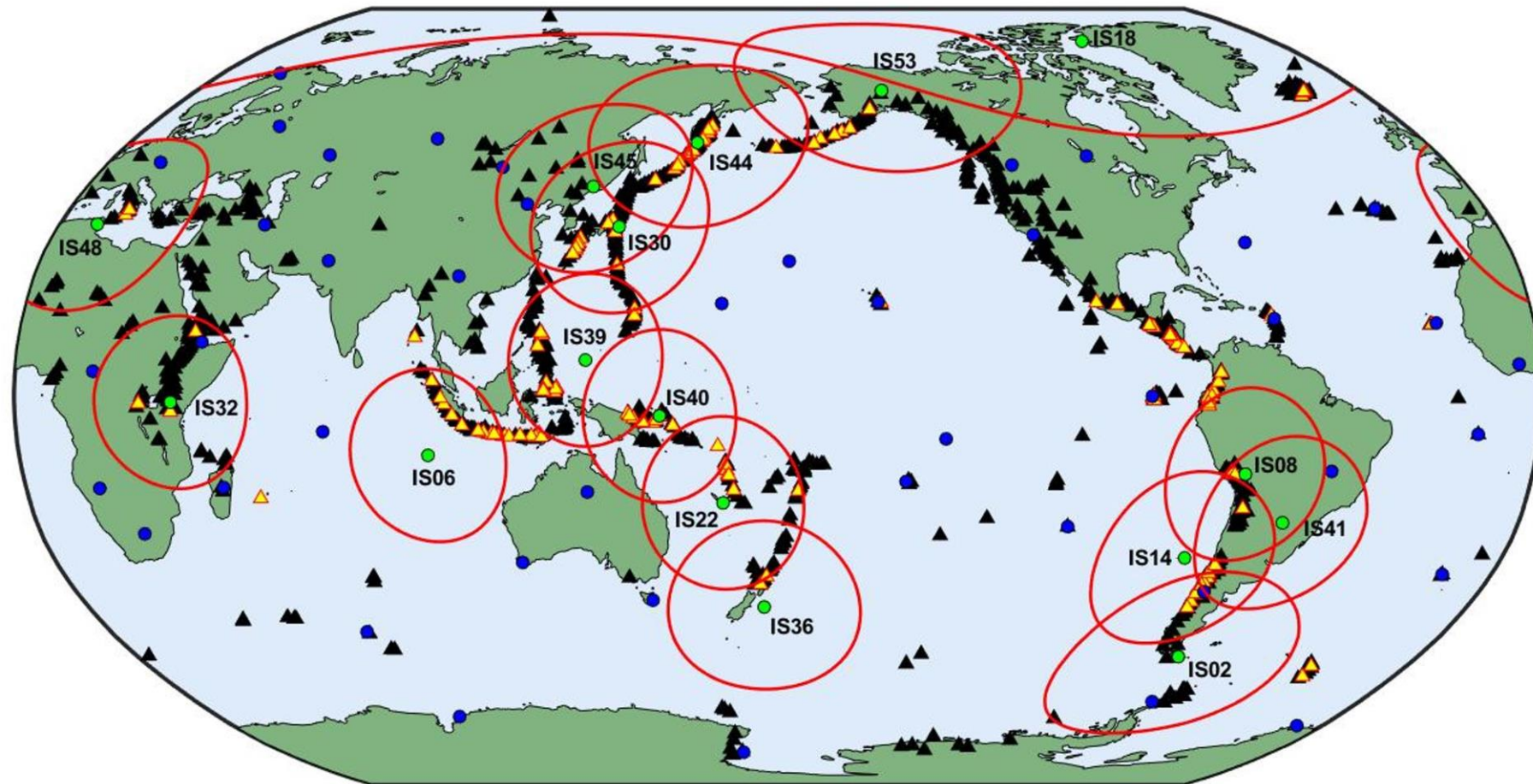Ps=infrasound pressure at the source

IS40 [f:1-3Hz tw:60s sh:10s]

IP>100 → EW 24h → 🔴 Real Volcanic alert

🟡 False alert

INTRODUCTION

OBJECTIVES

METHODS/DATA

RESULTS

CONCLUSION

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Methods/data: Selected IMS stations to detect eruptive activity with the long-range EW infrasound detection algorithm

- Period of interest **2010-2019**
- **16** analysed **IMS** stations

- The targets are those volcanoes which fall within **2000 km** from an IMS station

IMS station	# VOLC <2000 km	# Active VOLC
I02AR	58	11
I06AU	64	11
I08BO	73	6
I14CL	117	13
I18DK	33	3
I22FR	15	8
I30JP	143	16
I32KE	109	4
I36NZ	15	2
I39PW	92	14
I40PG	50	10
I41PY	101	11
I44RU	195	17
I45RU	147	17
I48TN	29	2
I53US	85	6
TOT	1326	151

△ Active volcano   ● IMS analysed stations
▲ Non-active volcano   ● IMS stations
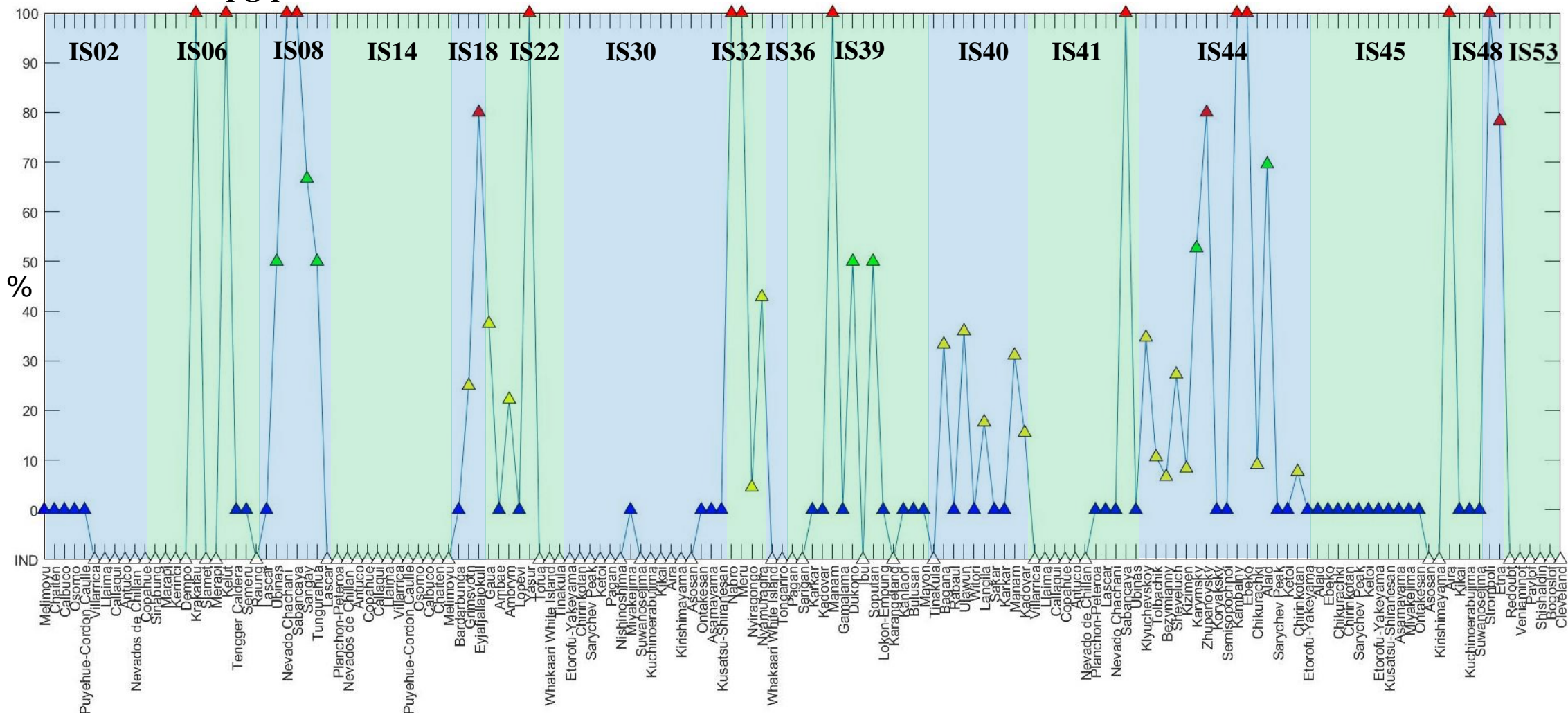
INTRODUCTION

OBJECTIVES

METHODS/DATA

RESULTS

CONCLUSION

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Results: Reliability on the notifications provided by the algorithm

$$R_{rel} = \frac{N_{ra}}{N_{TOT}} \times 100$$

N_{ra} is # of alerts that corresponds a volcanic eruption.
N_{TOT} is # of alerts that the system delivers for the selected volcano.

P5.2-478

Conclusion: Some considerations on the EW algorithm and the first attempt to estimate the number of false alerts

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Reliability Ratio R_{rel} (%)	Number of volcanoes
75-100	16
50-75	7
0-50	17
0	50
IND	61
TOT	151

For volcanoes with R_{rel} ≤50 %, the algorithm provides a low rate of false alerts → **0.5 false alerts per year** for **42** volcanoes.

Considering volcanoes with a R_{rel} ≥50 % and IND and low false alerts rate, **the number of potentially monitorable volcanoes** is **126**.
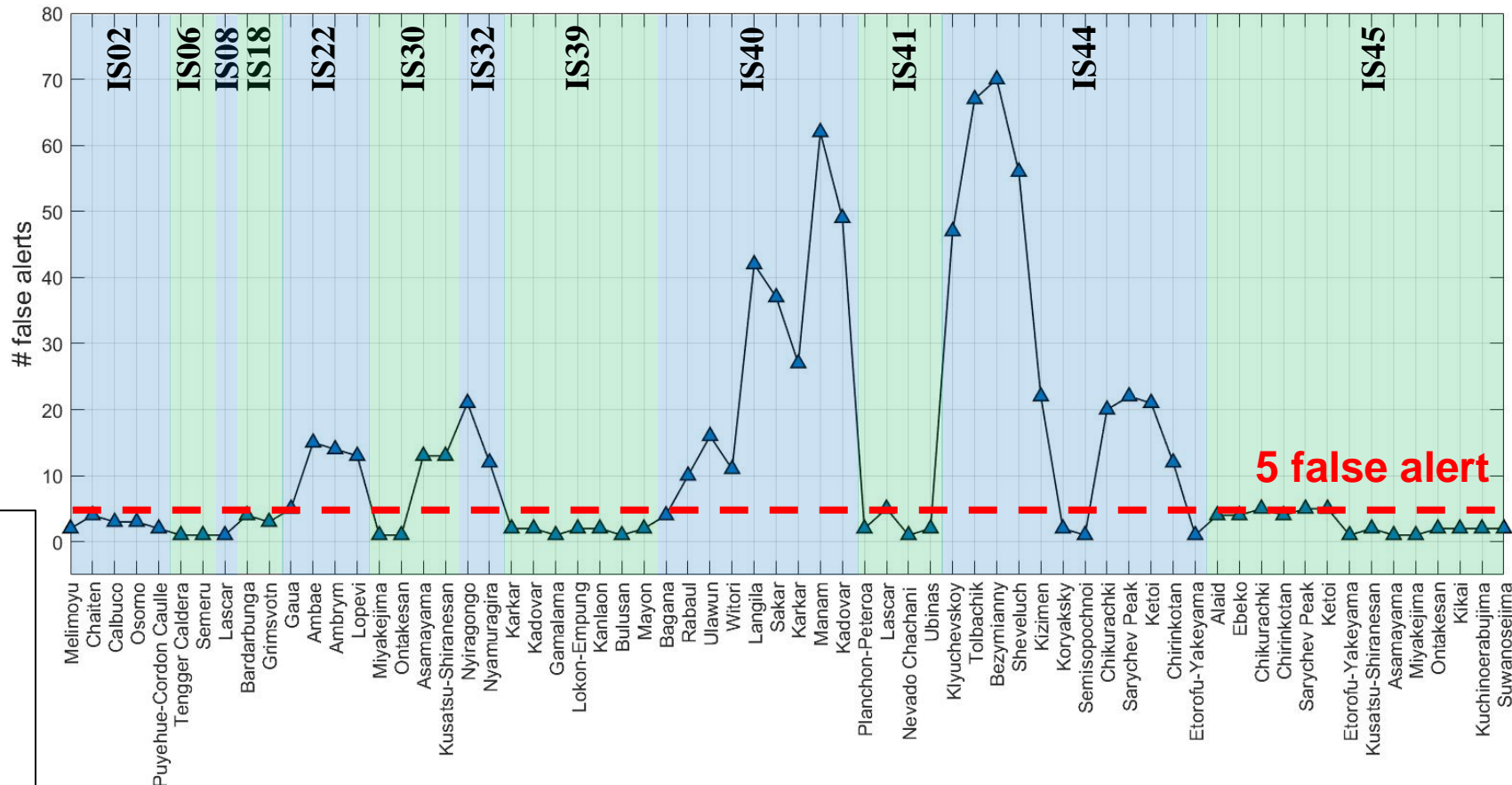
Future steps:
- Expected Azimuth deviation correction.
- Validation with MIROVA.

INTRODUCTION
OBJECTIVES
METHODS/DATA
RESULTS
CONCLUSION