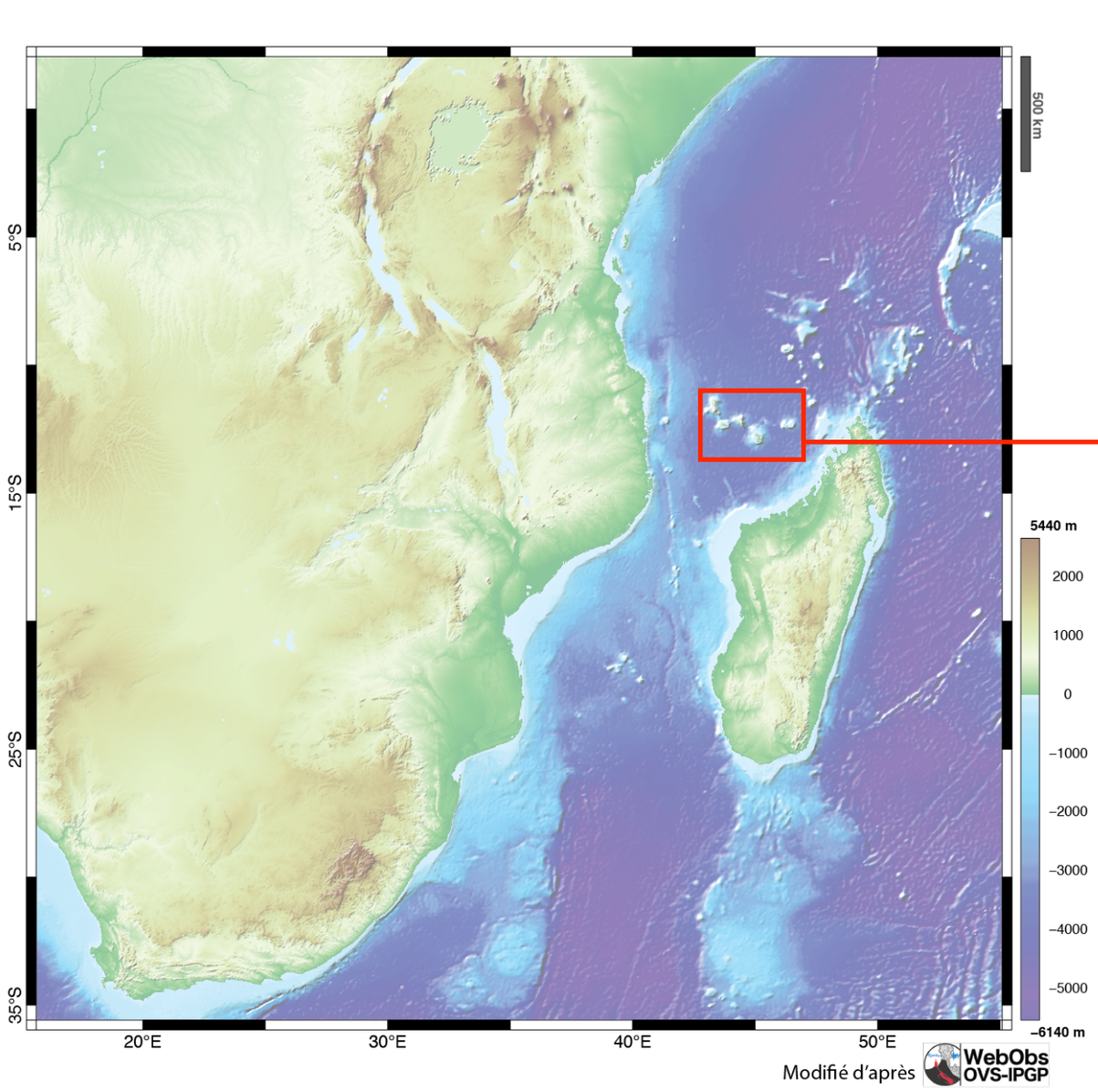
# Machine learning appliqué à l'analyse de la sismicité de l'éruption à Mayotte

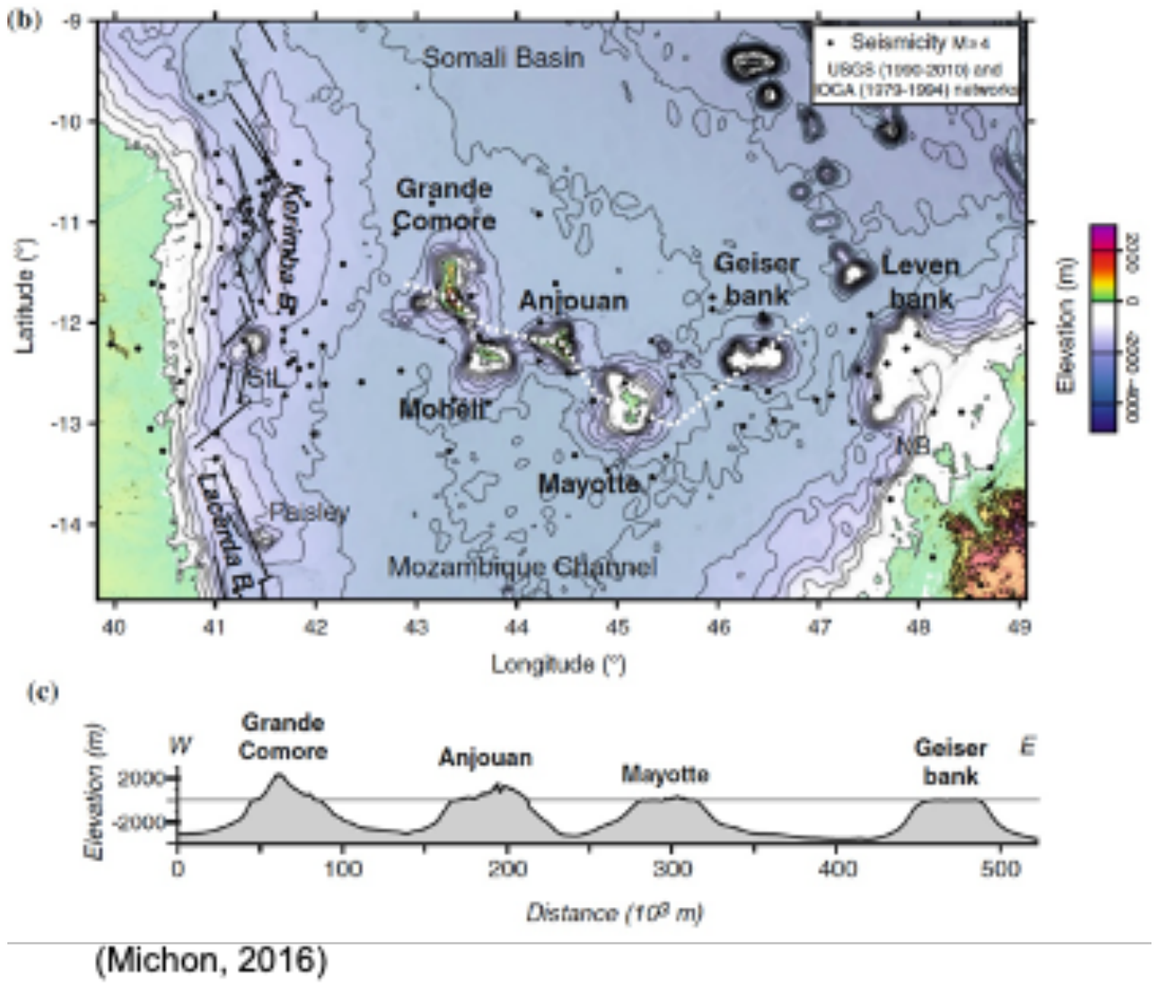

## Lise Retailleau

Avec J.-M. Saurel, V. Ferrazzini, C. Satriano, T. Mittal, A. Peltier, J.-C. Komorowski, A. Lavayssière, W. Zhu, G. C. Beroza…
and the REVOSIMA

# Mayotte Island and the Comoros archipelago




Modifié d'après WebObs OVS-IPGP



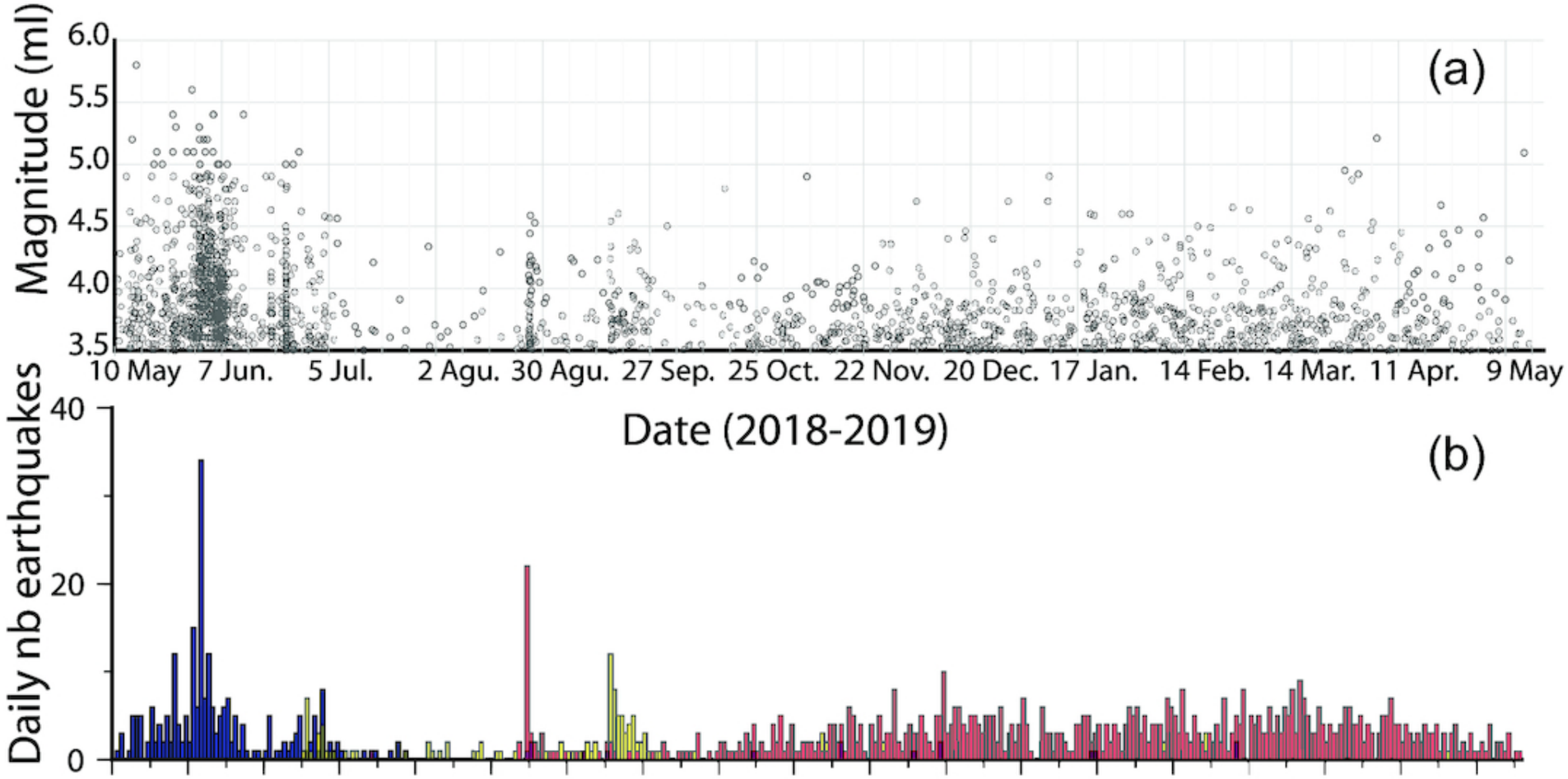

(Michon, 2016)

- Moderately active seismically
- Volcanic activity in Karthala

# The Mayotte seismicity crisis

- The Seismic crisis started in **May 2018.** (Cesca et al, 2020, Lemoine et al, 2020) culminating with a **5.9** earthquake

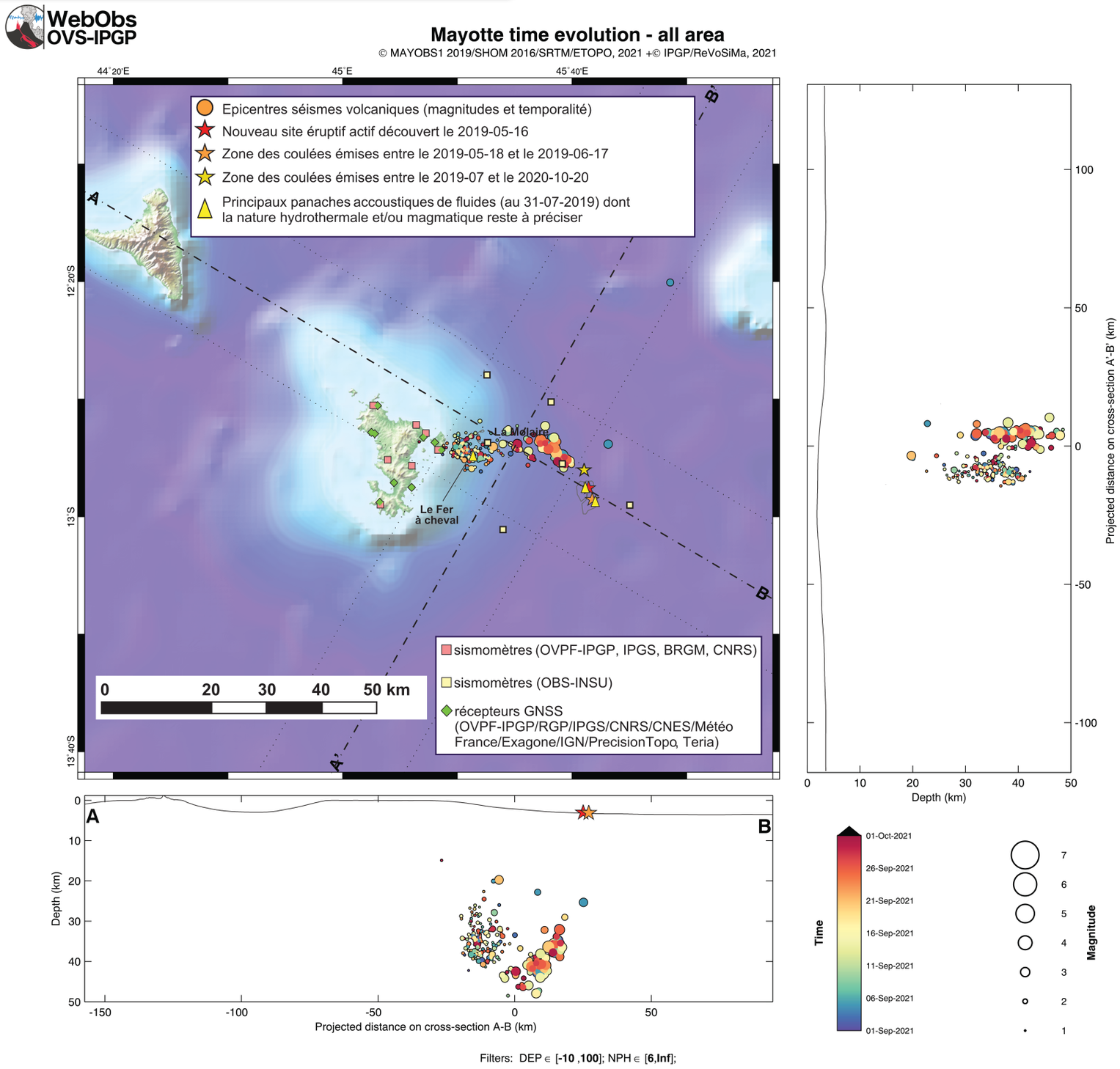
- New offshore volcanic edifice discovered in May 2019 (Feuillet et al, 2021)




**Lemoine et al 2020**

# Analysis of the crisis with its seismicity

## Monthly seismicity




Filters: DEP ∈ [**-10** ,**100**]; NPH ∈ [**6**,**Inf**];

From: **01-Sep-2021 00:00**
To:**01-Oct-2021 00:00**

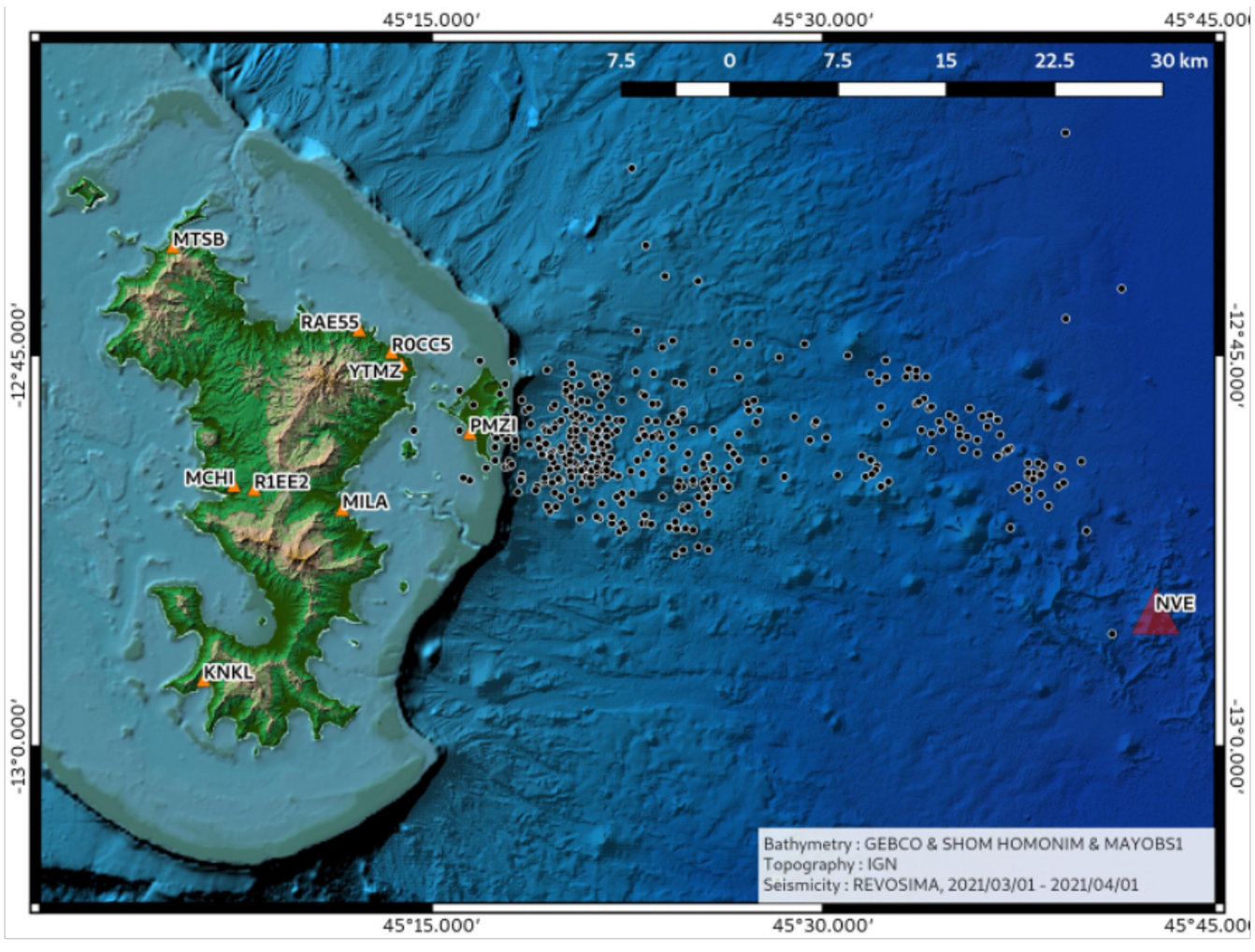
Total events =**224**
Magnitude: min **0.3** - max **3.5**
Types:
**VT Mayotte** (224),

PROC.HYPOMAYOTTE / MayotteTime_ - sysop@pitondescalumets - 04-Oct-2021 06:15:57 +0 - hypomap.m (2021-01-01) / WebObs project (Beauducel et al., 2001-2021)

# The Mayotte seismicity crisis

- Real-time monitoring challenges :
  - Small land-based network (8 stations) ;
  - Earthquakes are outside of the network and only on one side.

- Need to automatically pick **P and S** phases

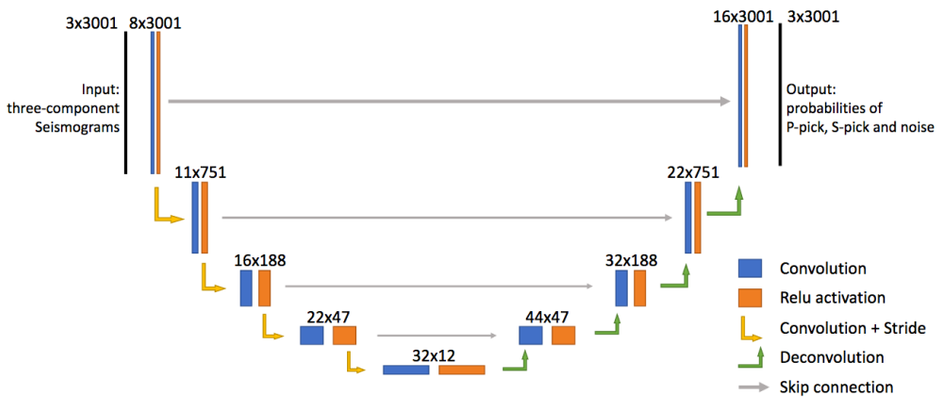


# Use of PhaseNet for automatic picks

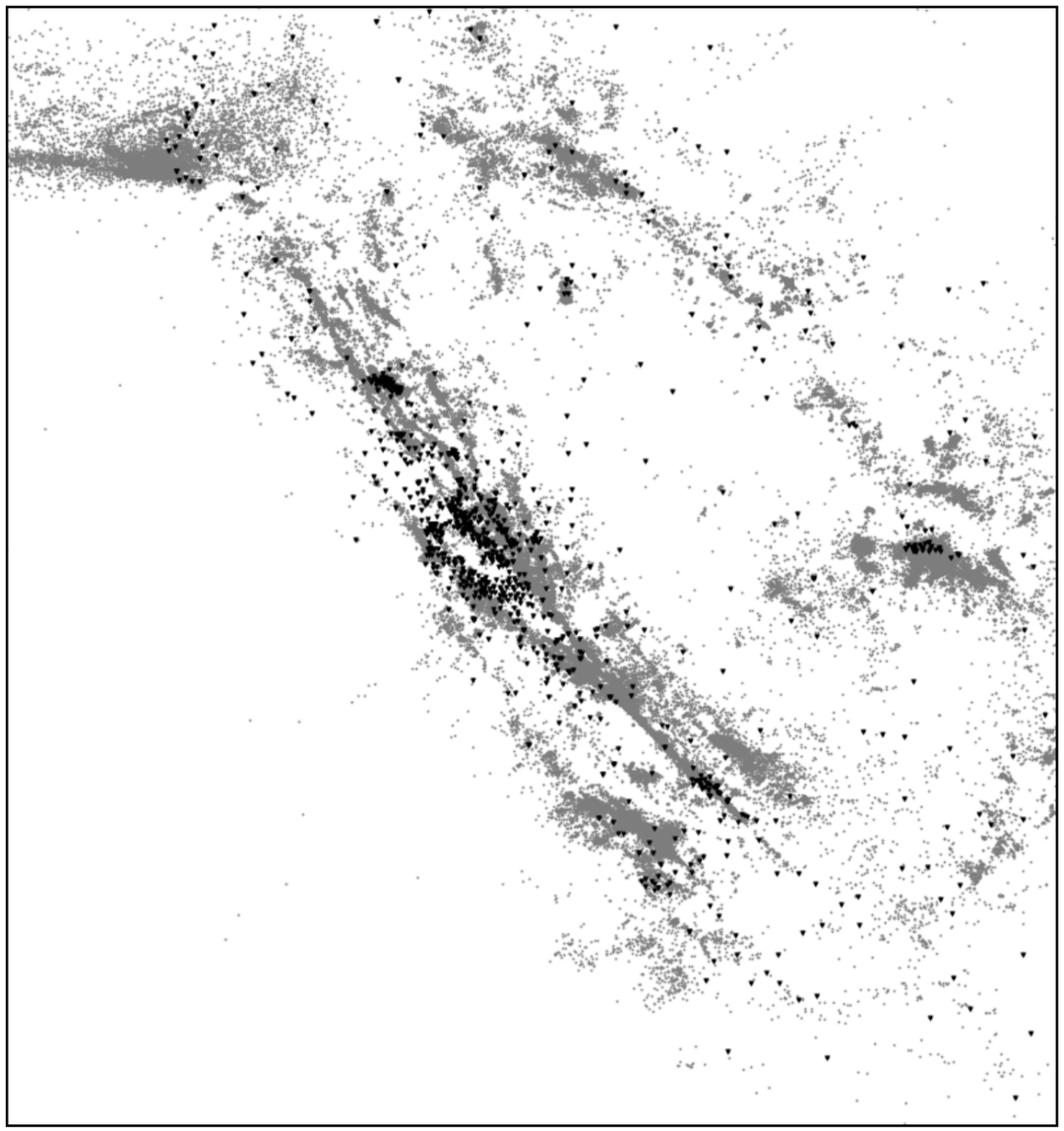
**Automatic detection with Machine Learning**

## PhaseNet

Neural network based method
Trained on data in California




**Zhu and Beroza 2018**



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## Automatic detection with Machine Learning

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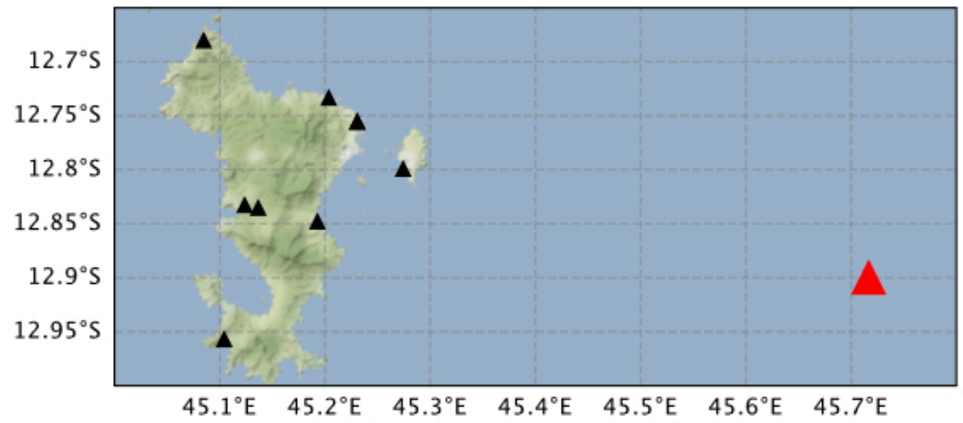
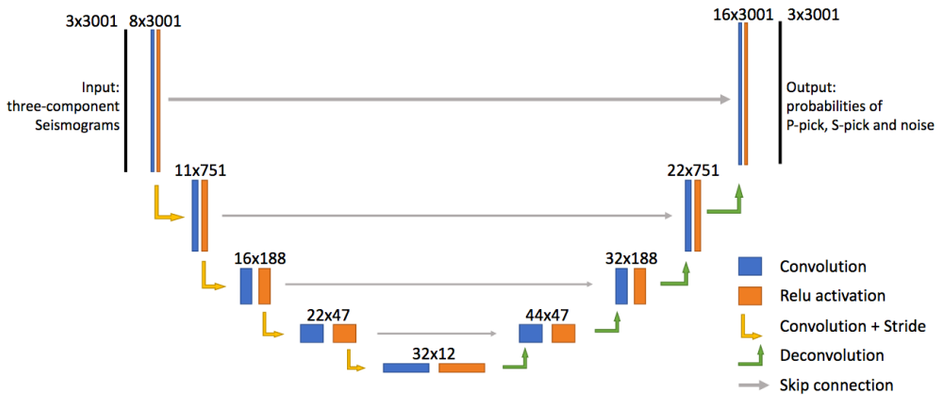
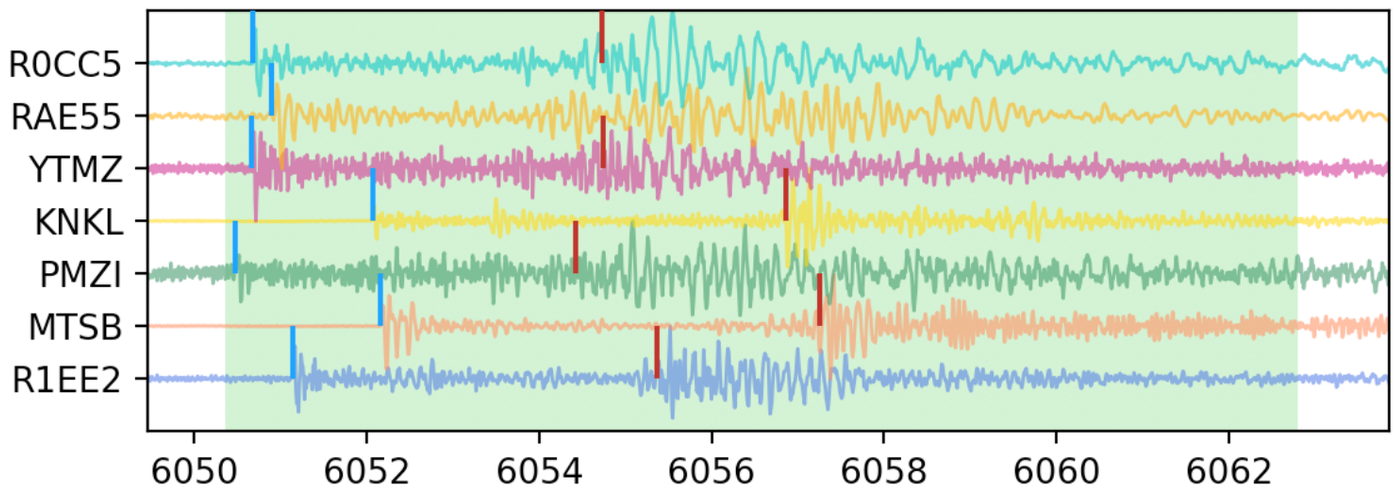



**P and S picks**



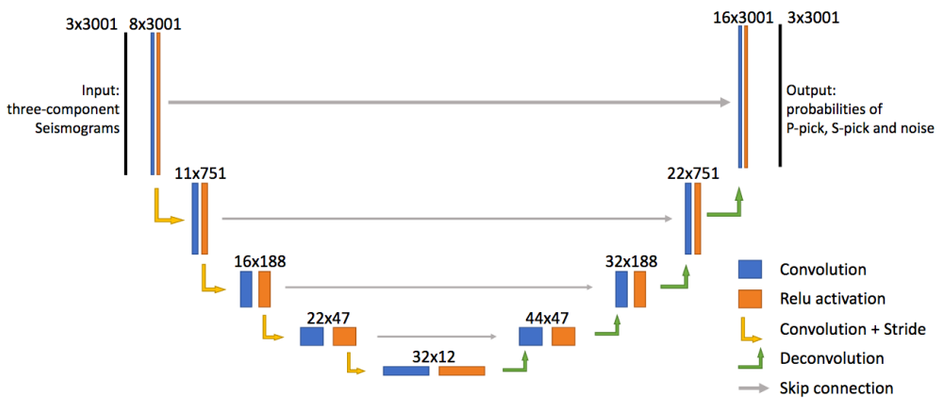

**Zhu and Beroza 2018**

# Use of PhaseNet for automatic picks

**Automatic detection with Machine Learning**

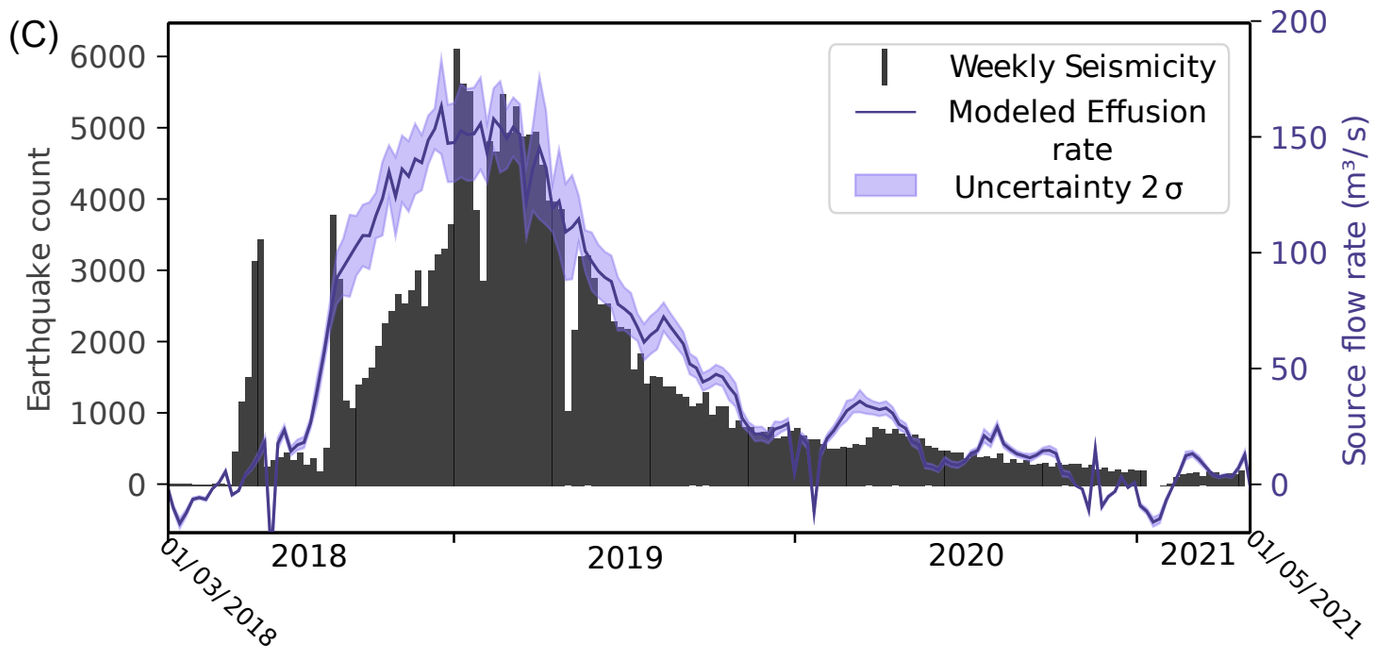
**Continuous analysis of the seismicity**

PhaseNet




**Zhu and Beroza 2018**

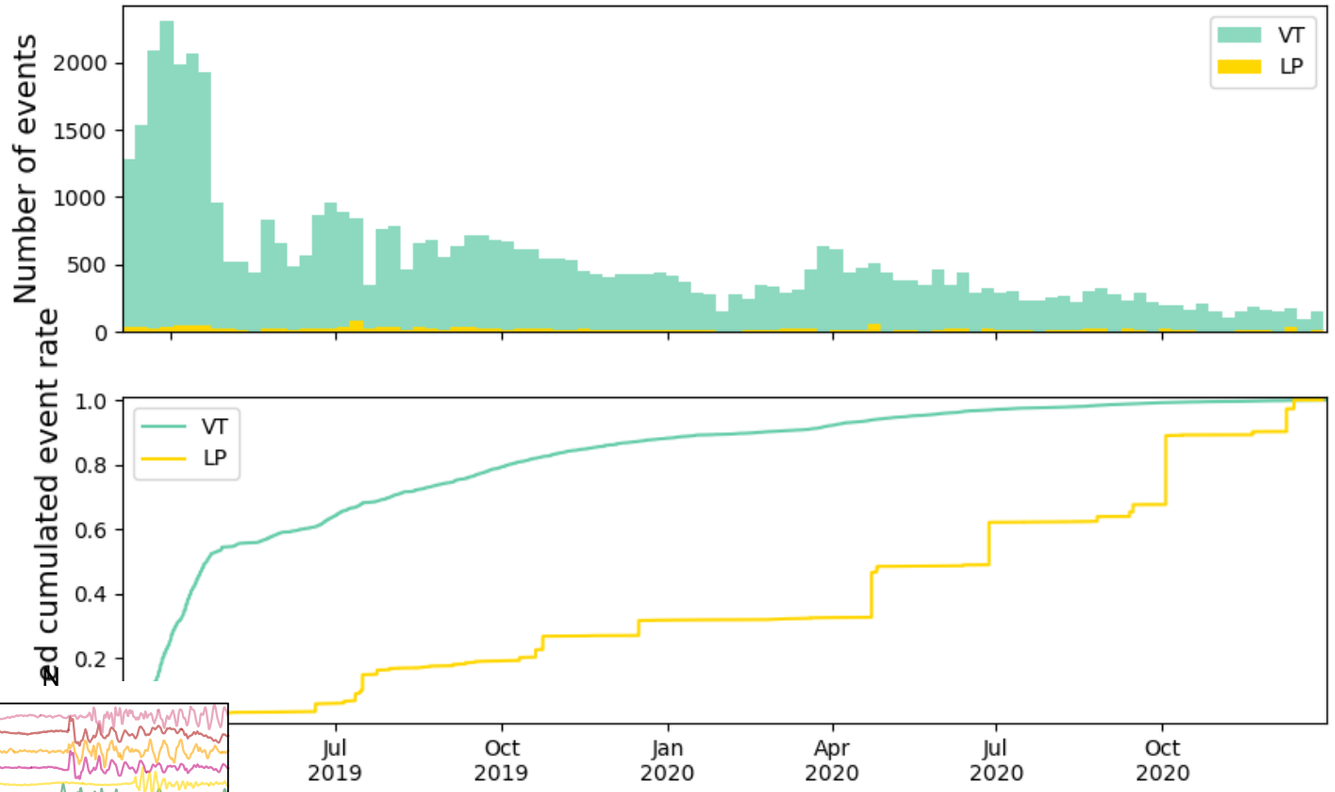
**Automatic detection on YTMZ**



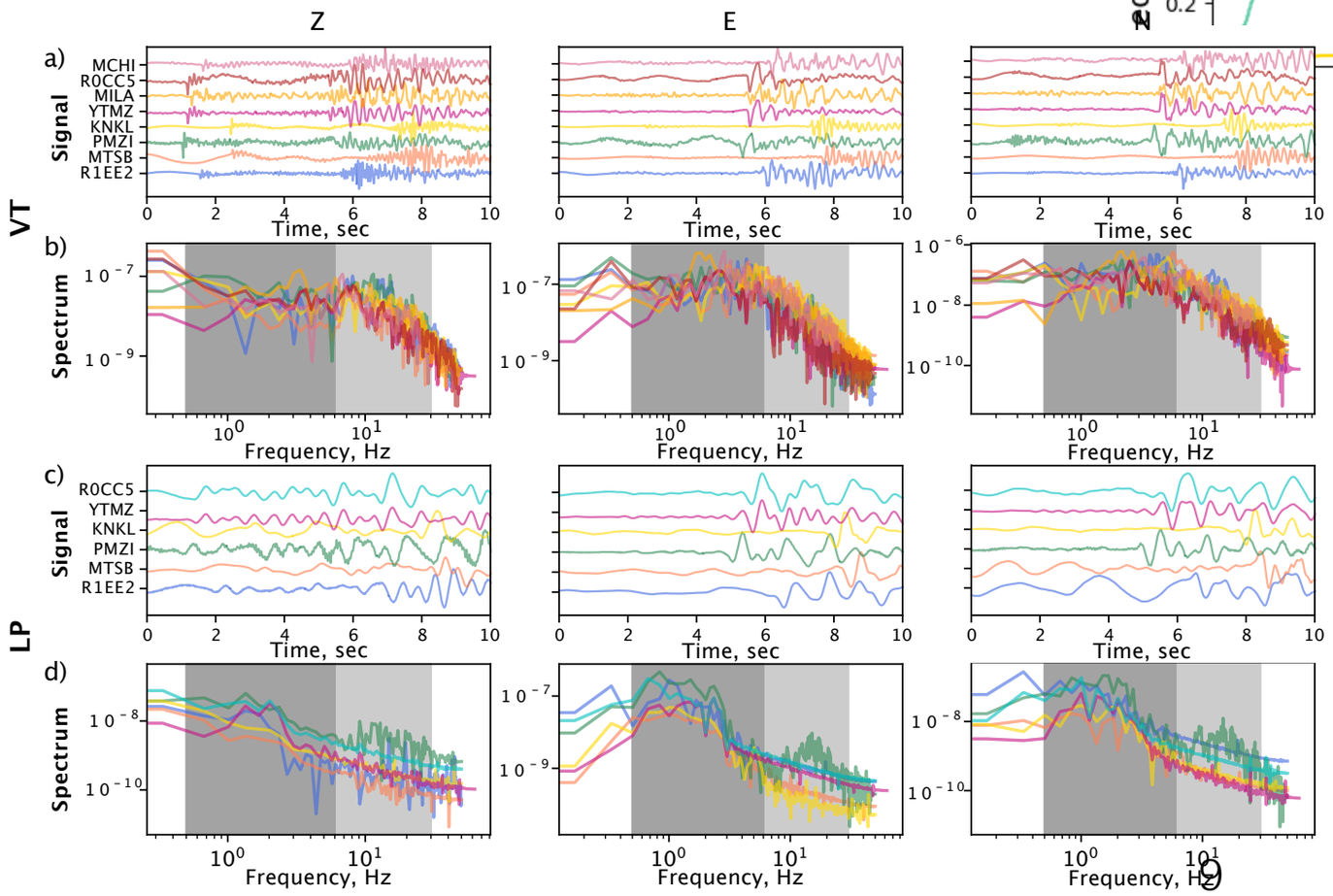

**Mittal et al., in review**

# Automatic detection from March 2019 to February 2021

## Detection of 50000 events




## Separation between VT/LP events



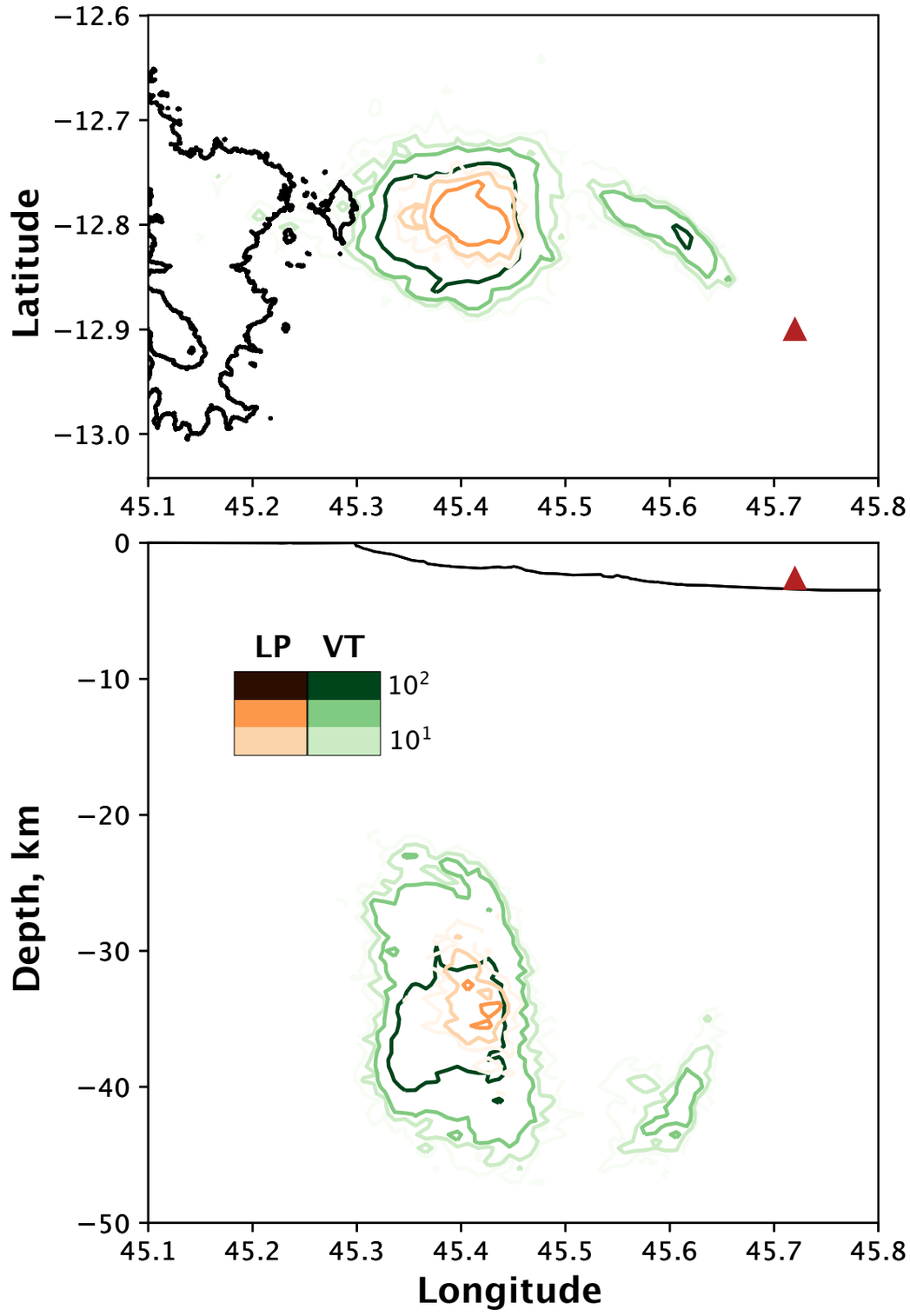

Retailleau et al. , in prep

# Automatic detection from March 2019 to February 2021

**Detection of 50000 events**

**Separation between VT/LP events**

**NonLinLoc (Lomax et al., 2009)**
**+ Lavayssière et al., in review**




**Retailleau et al. , in prep**

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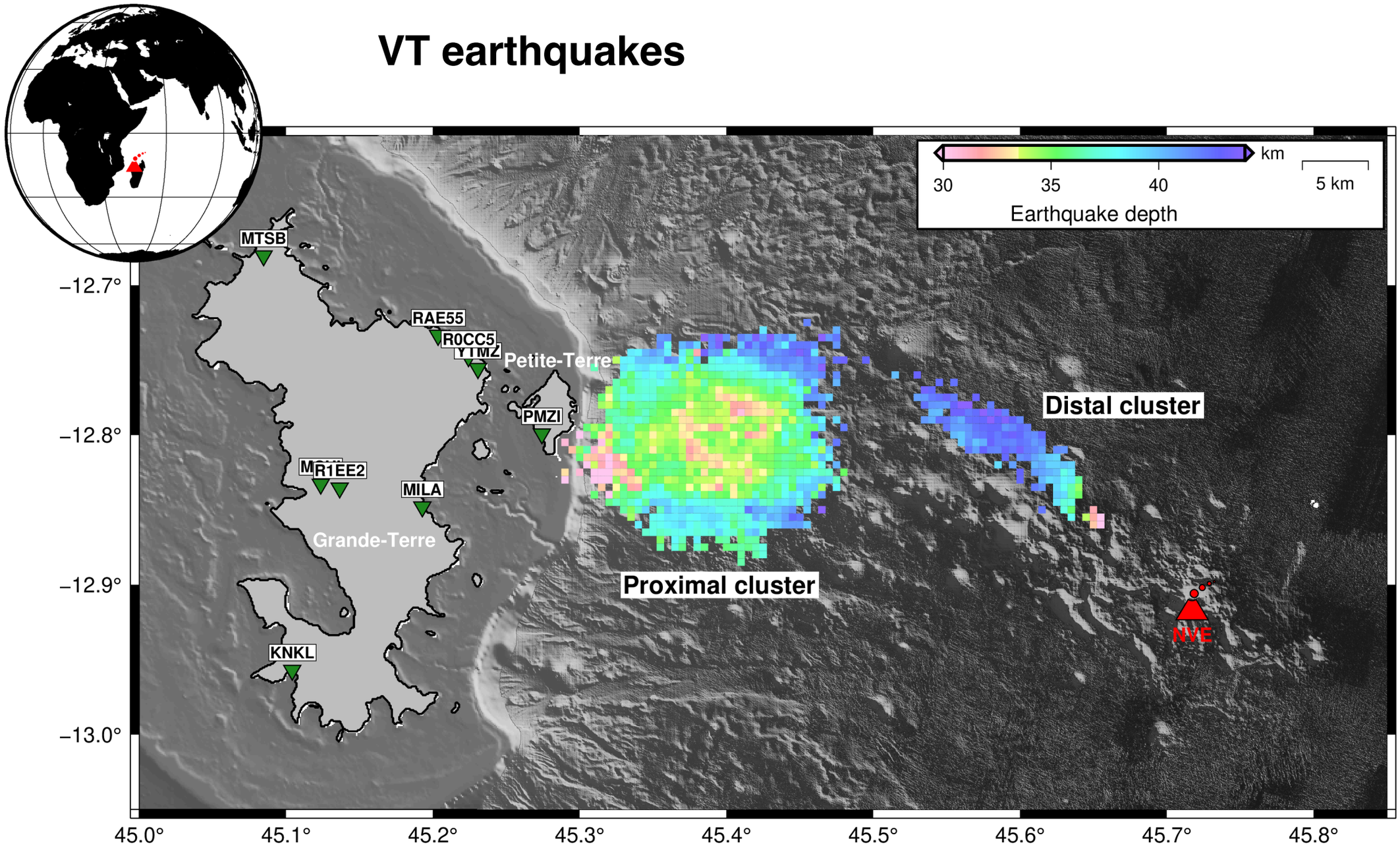
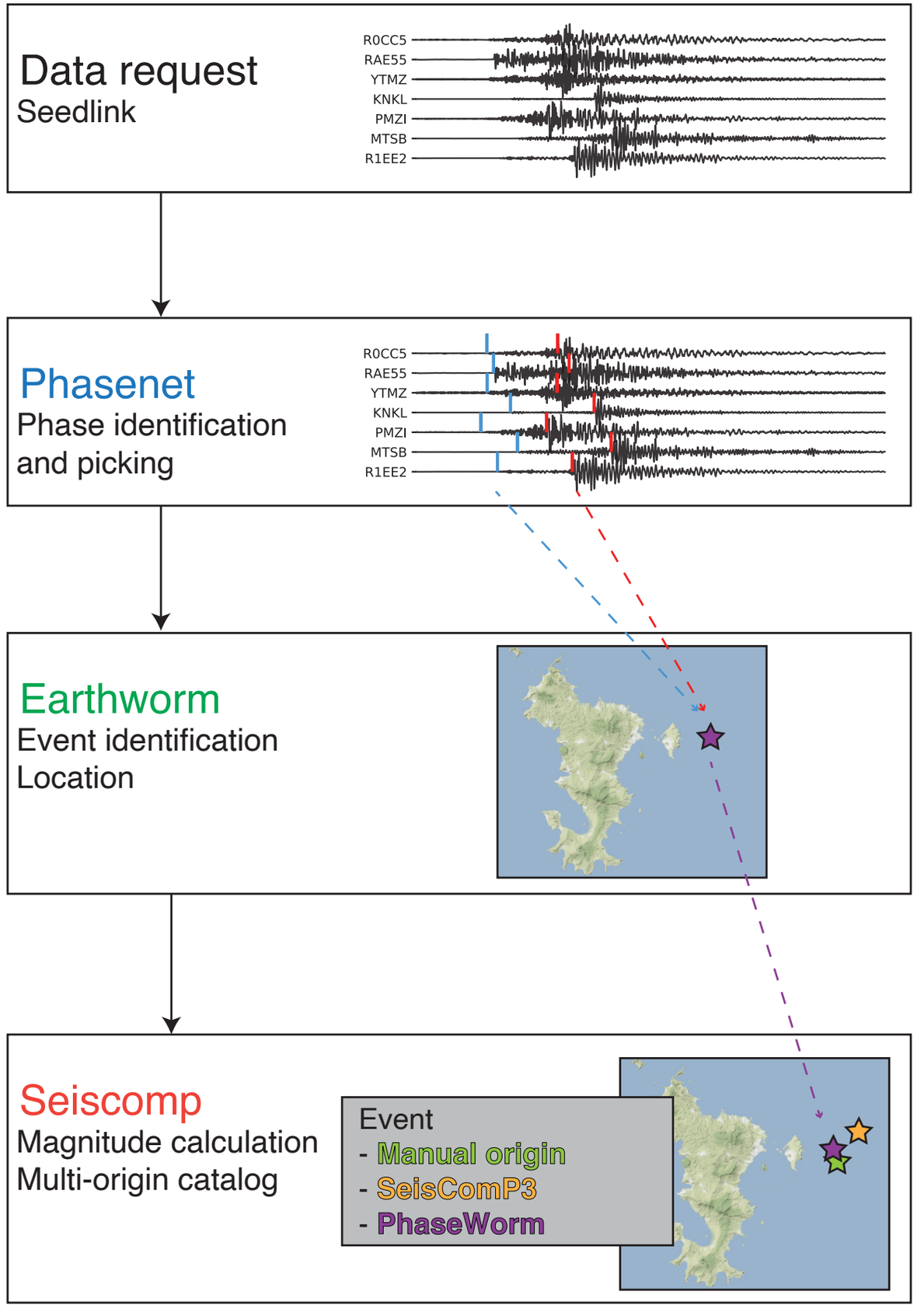
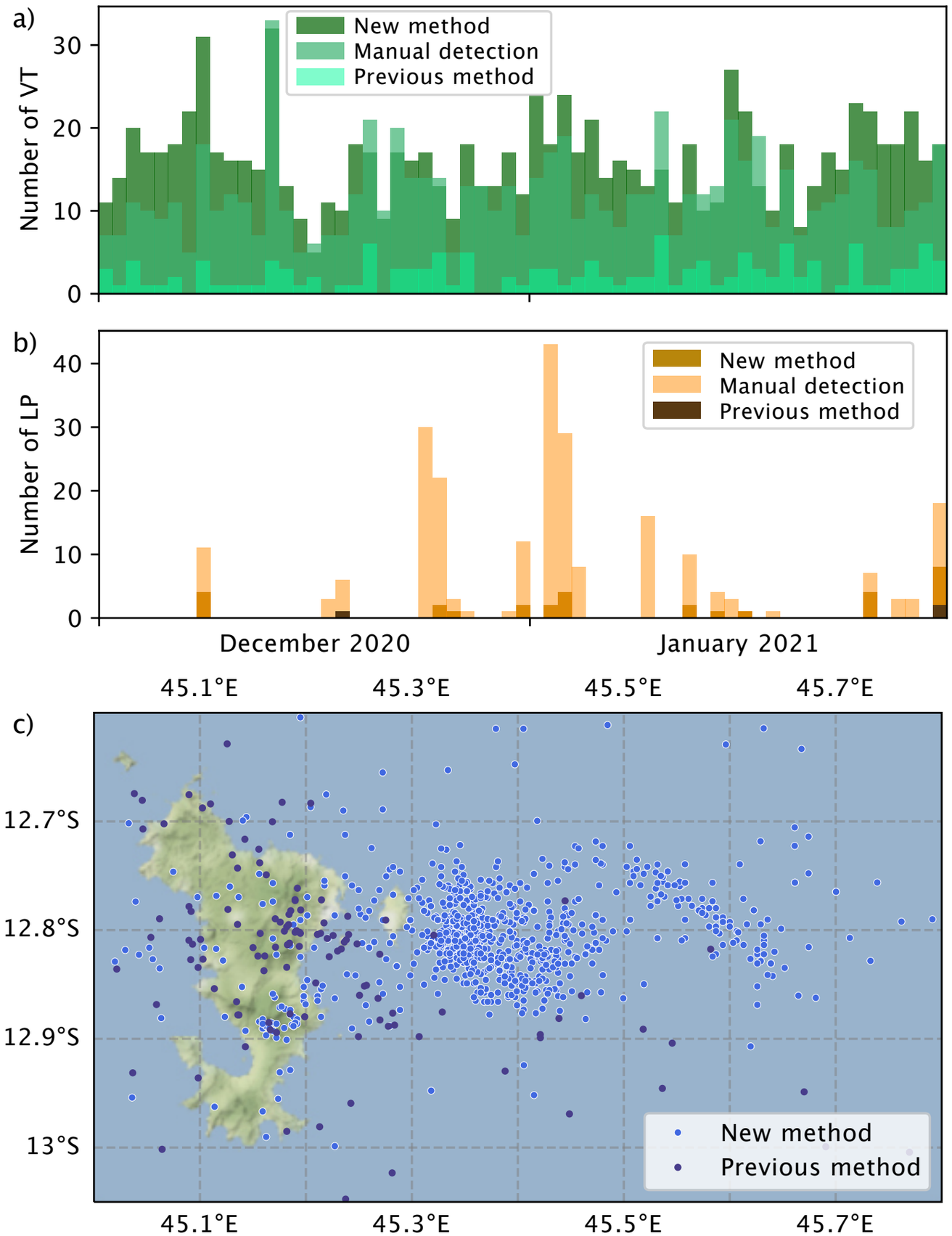


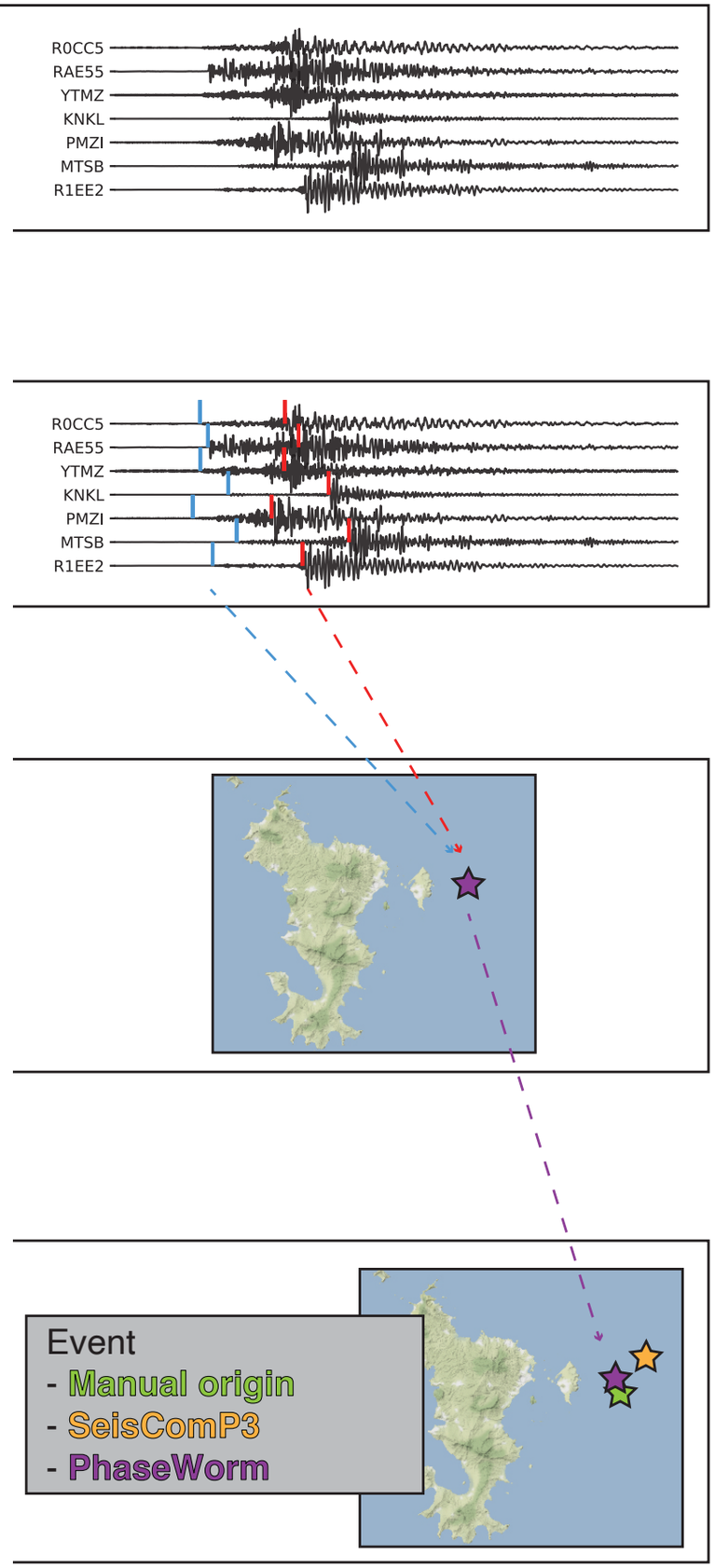

## Poster of Aude Lavayssière

# Real-time monitoring




**Retailleau et al., in review**



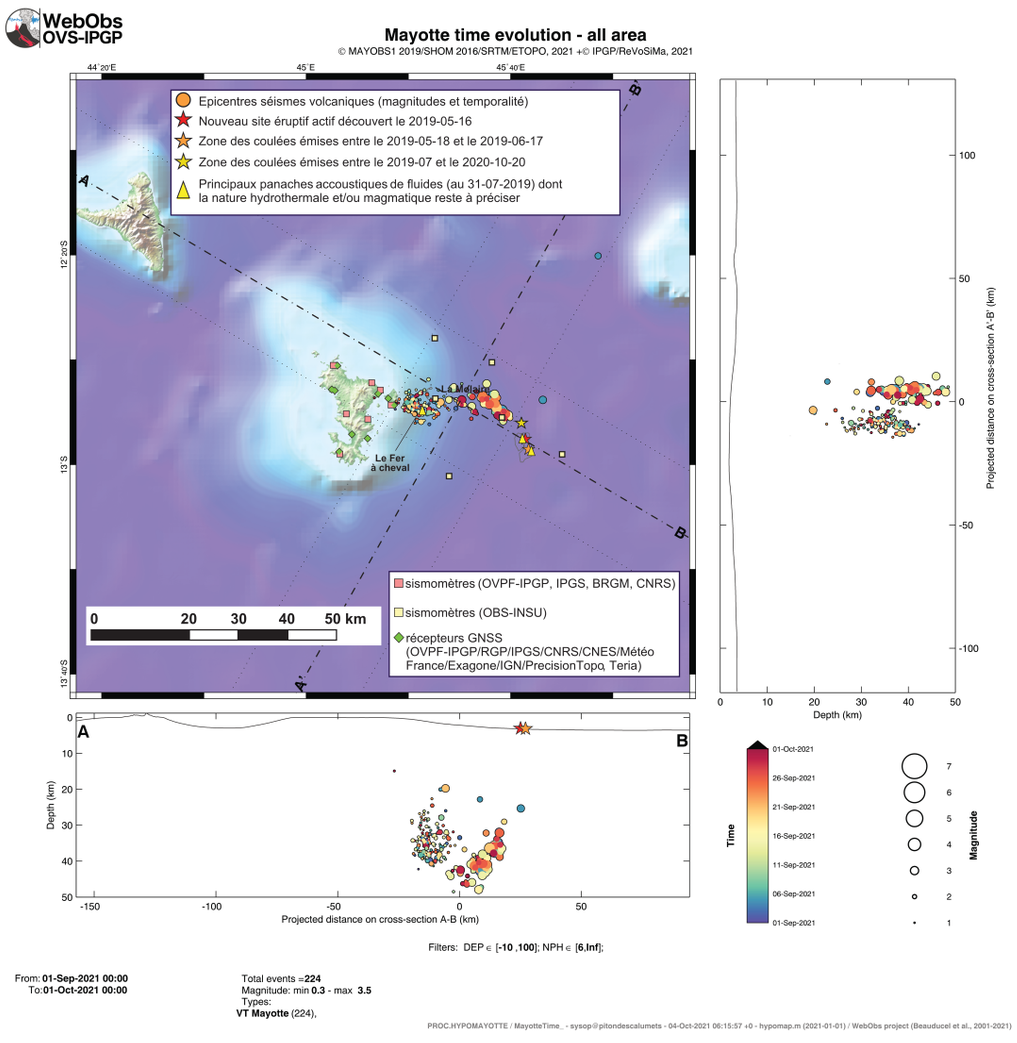



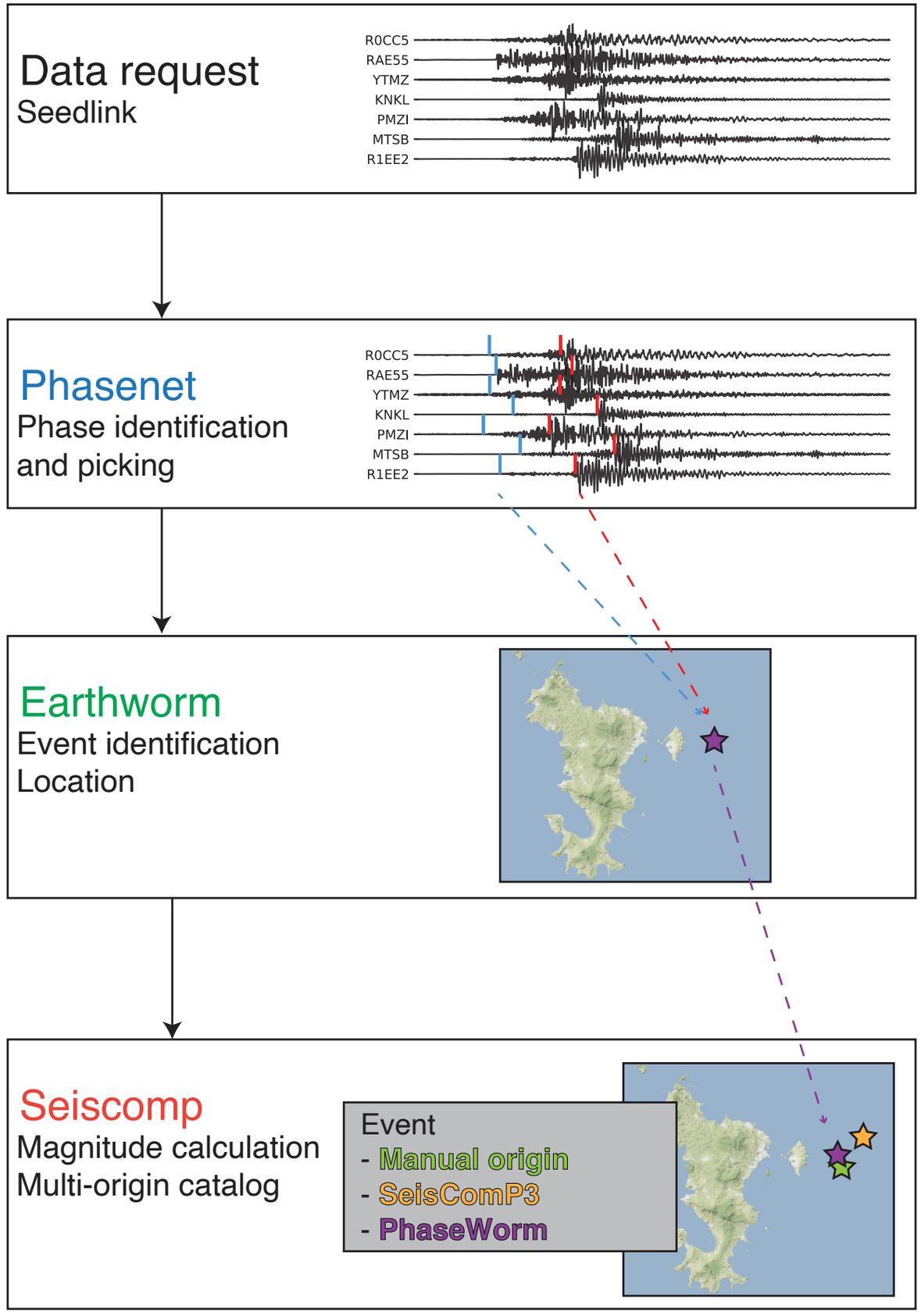



**Retailleau et al., in review**

# Real-time monitoring

- Running since March 2021
- Now also in Martinique




**Retailleau et al., in review**

# Summary

- Seismic crisis in May 2018
- Followed with subsidence and east displacement
- Start of eruption estimated late June early July

**Analysis of the seismicity through automatic detection**

- **Detection of numerous events and addition of LP earthquakes analysis**
- **Real-time detection of the seismicity since March 2021**