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► **To cite this version:**

Ludmila Provost, Andrea Antonucci, Andrea Rovida, Oona Scotti. Reducing differences in earthquake activity rate estimates across borders in Europe. 5èmes Rencontres Scientifiques et Techniques Résif, Nov 2021, Obernai (67210), France. hal-03482598

**HAL Id: hal-03482598**

**<https://hal.science/hal-03482598>**

Submitted on 16 Dec 2021

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# REDUCING DIFFERENCES IN EARTHQUAKE ACTIVITY RATE ESTIMATES ACROSS BORDERS IN EUROPE

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## Introduction

Computing activity rates may differ when using different catalogues, especially along border regions. This is the case at the France/Italy border, in the Alps area where three catalogues are available : FCAT [1], CPTI [2] and SHARE [3] catalogues. In this area, activity rates are mainly based on historical earthquakes.

Possible origins for differences

- macroseismic data used
- data used to calibrate the methodologies
- Methodology used

We investigate here the influence of using different methodologies to estimate magnitude for historical earthquakes on activity rates

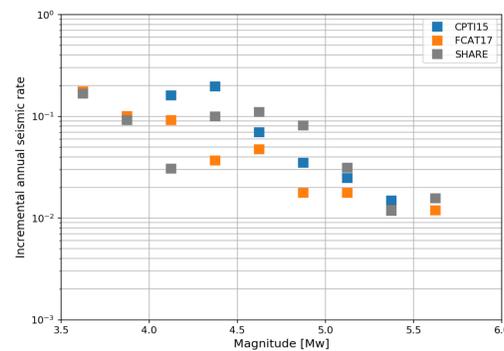


Figure 1. Activity rates for SHARE, CPTI15 and FCAT catalogues at the France/Italy border.

## Methods and Materials

We calibrate Boxer [4] and QUake-MD [5] methodologies on the same data, i.e. same macroseismic intensity data points and same calibration event parameter (Magnitude/depth). Both methodologies are applied to the same macroseismic data at the France/Italy border (blue-violet polygon on Fig.2) to obtain a Boxer and a QUake-MD catalogue.

Completeness times (CT) are computed with Albarello et al 2001 algorithm [6]. The more recent CT between the two catalogues is used for each magnitude bin to compute activity rates.

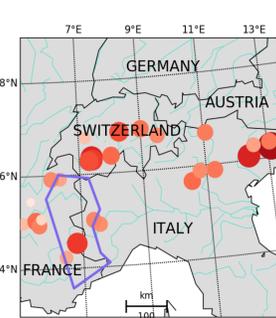


Figure 2. Calibration dataset (28 earthquakes) and area used to compute activity rates (blue-violet polygon).

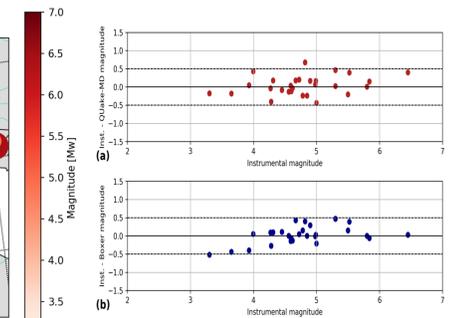


Figure 3. QUake-MD (a) and Boxer (b) magnitude residual on the calibration database.

## Results

Activity rates for both Boxer and QUake-MD catalogues are similar. Some differences are observed at higher magnitudes and are within the activity rates uncertainties [7]. The differences observed between Boxer and QUake-MD catalogues are significantly smaller than the differences observed between CPTI15, FCAT and the SHARE catalogues.

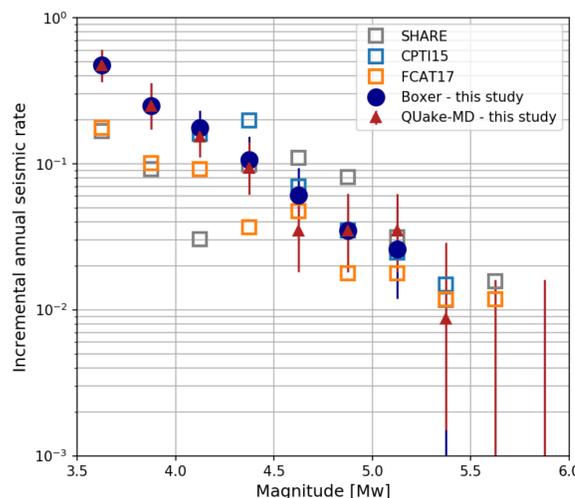


Figure 4. Activity rates for SHARE, CPTI15, FCAT catalogues and our study Alps-Boxer and QUake-MD catalogues at the France/Italy border.

## Discussion

The two methodologies differ in their approach : QUake-MD estimates depth as well as magnitude whereas depth is implicitly taken into account in Boxer through the epicentral intensity. If both methodologies offer the same performance in terms of magnitude estimates, a systematic difference that correlates with the depth estimates in the QUake-MD inversion scheme is found.

The differences between Boxer and QUake-MD catalogues are expected to be low as long the study area is large enough to have a sufficient number of earthquakes in a balanced depth range to compute robust activity rates.

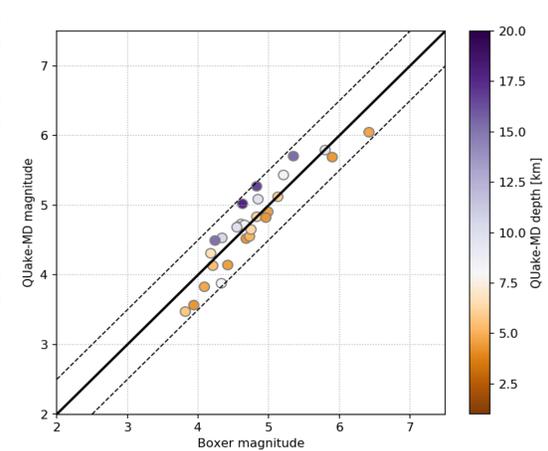


Figure 5. Boxer magnitude compared to QUake-MD magnitude for the calibration dataset. Color is linked to QUake-MD depth

## Conclusions

Our results show that differences in earthquake activity rates across borders in Europe can be reduced as long as we share the same macroseismic data and the same datasets to calibrate our respective methodologies to estimate historical earthquake magnitudes. However, differences between methodologies may in some cases induce systematic differences in activity rates: using different methodologies may be a way to capture these epistemic uncertainties affecting activity rate estimates.

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## Acknowledgements

We would like to thanks Francesco Visini for lending us the codes to compute completeness times and activity rates.