

Abstract

Rapid gravitational mass movements, such as landslides, rockfalls, or avalanches are repeatedly recognized during routine seismic monitoring at national earthquake observatories. Yet, utilizing the tools of seismology for fast detection and characterization of mass movements is still uncommon.

Here we present a set of past landslide and rockfall events in Austria and neighboring countries, which were well recorded by several permanent seismic stations. We aim at identifying seismically observable parameters of the mass movements, where additional geological and geographical data is available.

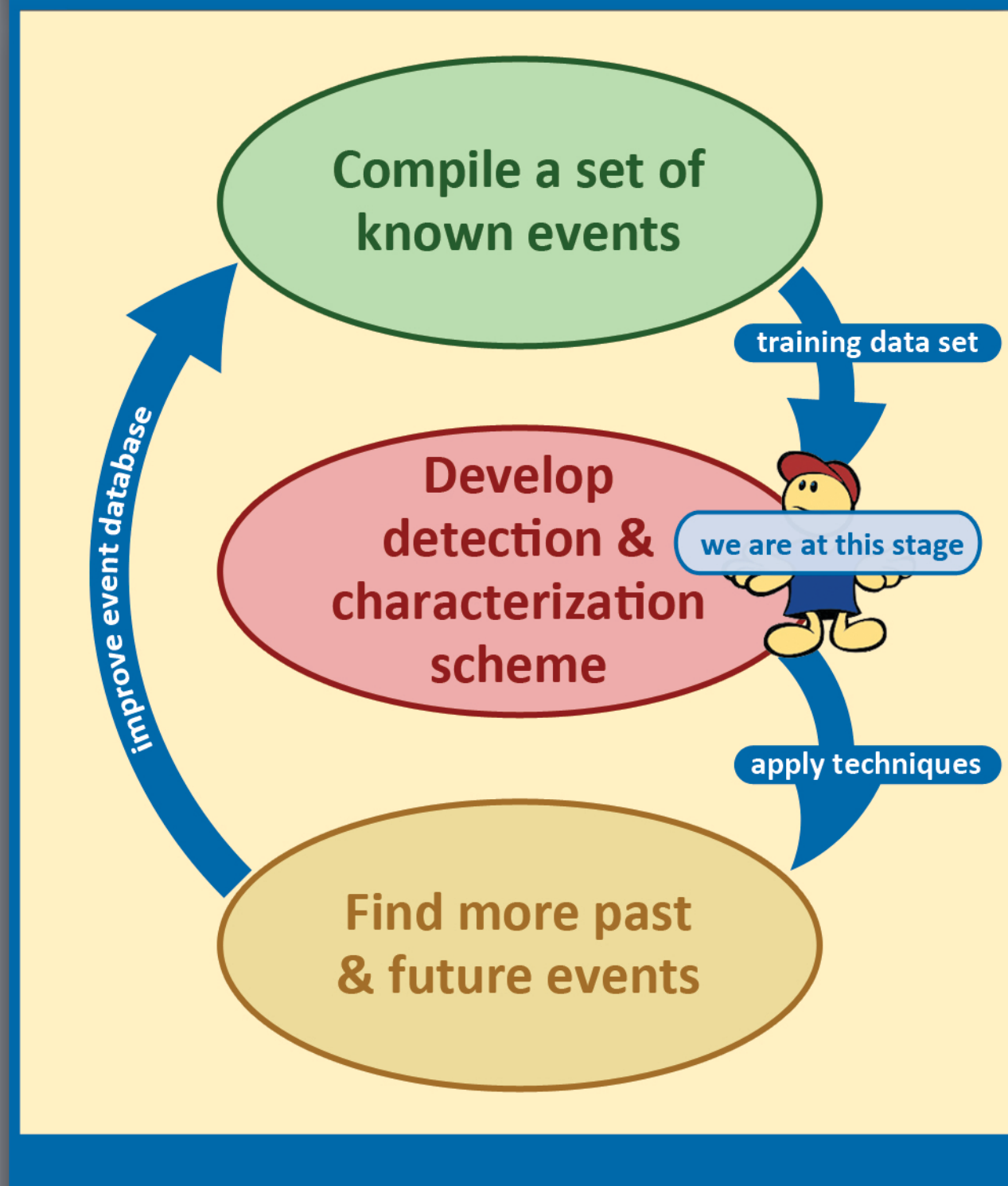
Seismology recently gained attention for the assessment of gravitational mass movements because it can potentially provide continuous realtime detection and approximate localization of events. However, the applicability on country scale needs to be tested and the seismological determination of precise location and of event parameters is challenging.

Quick facts

12 rockfalls in Austria
between 2007 - 2015

identified by **ZAMG**
during **earthquake monitoring**
(Zentralanstalt für Meteorologie und Geodynamik)

Workflow

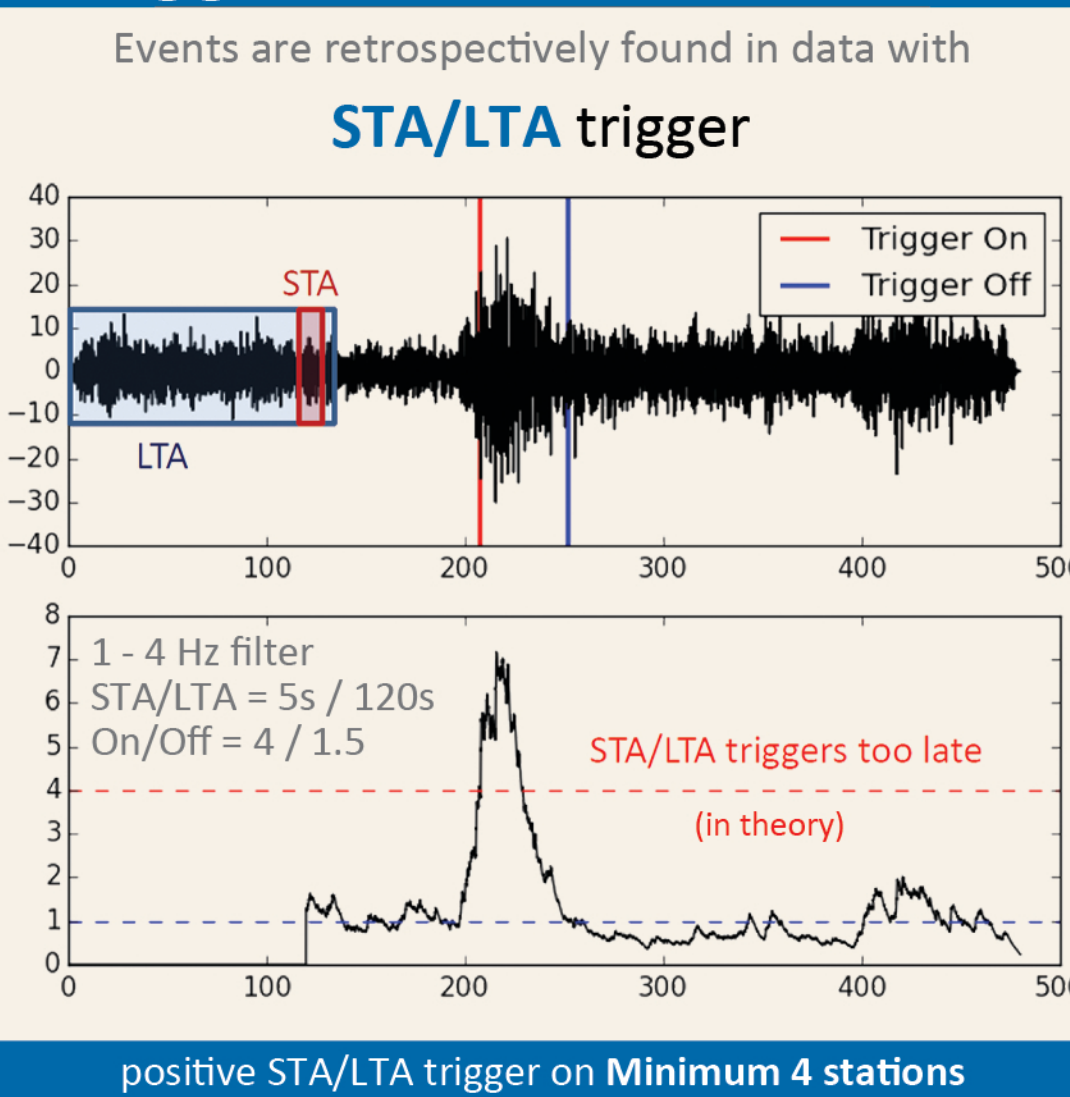


References

Hibert, C., Mangeney, A., Grandjean, G., Baillard, C., Rivet, D., Shapiro, N. M., Satriano, C., Maggi, A., Boissier, P., Ferrazzini, V. and Crawford, W. (2014), Automated identification, location, and volume estimation of rockfalls at Piton de la Fournaise volcano, JGR: Earth Surface, 119, 2014

Can we detect them automatically?

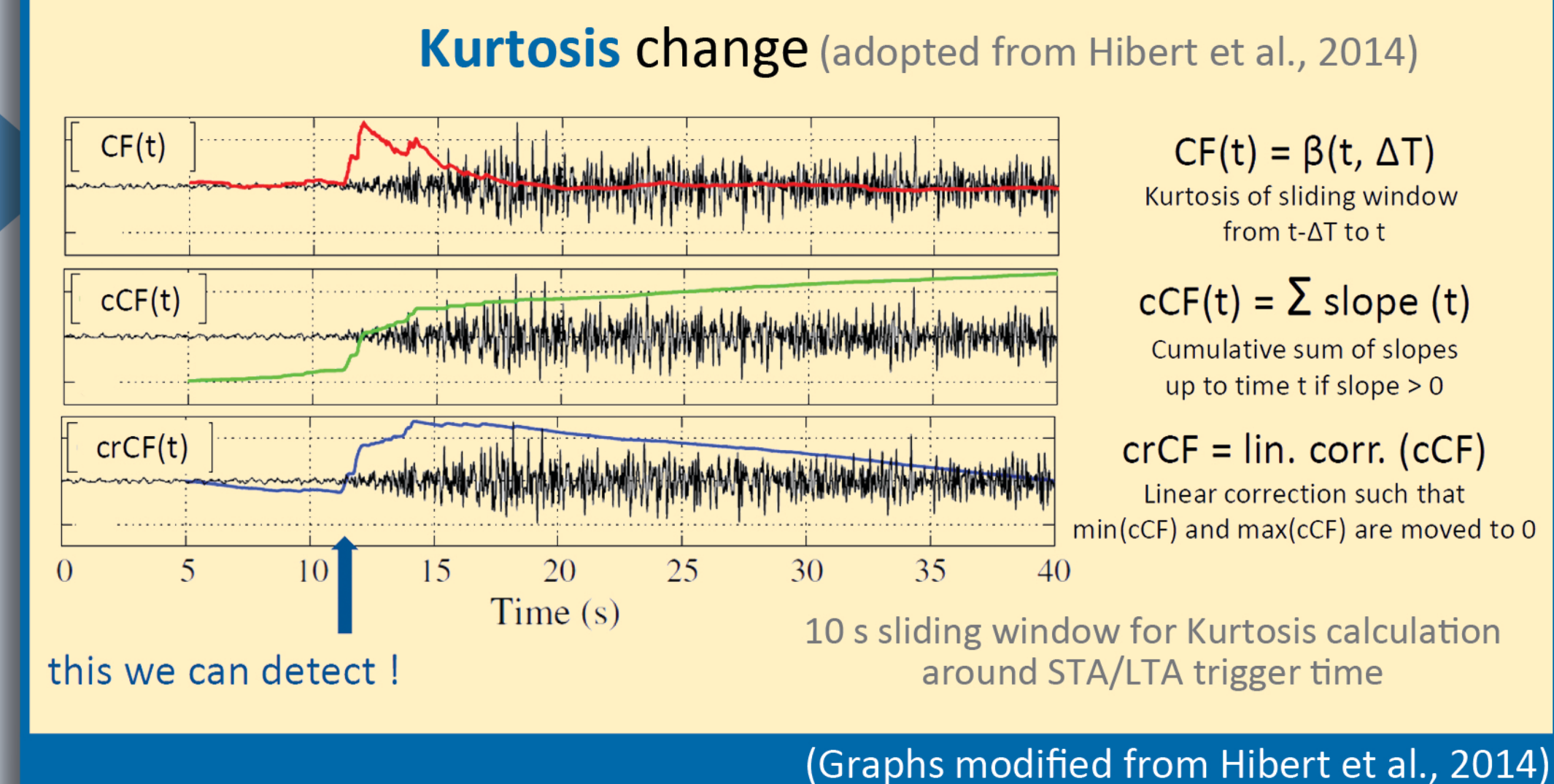
Trigger routine



How to pick correct onset?

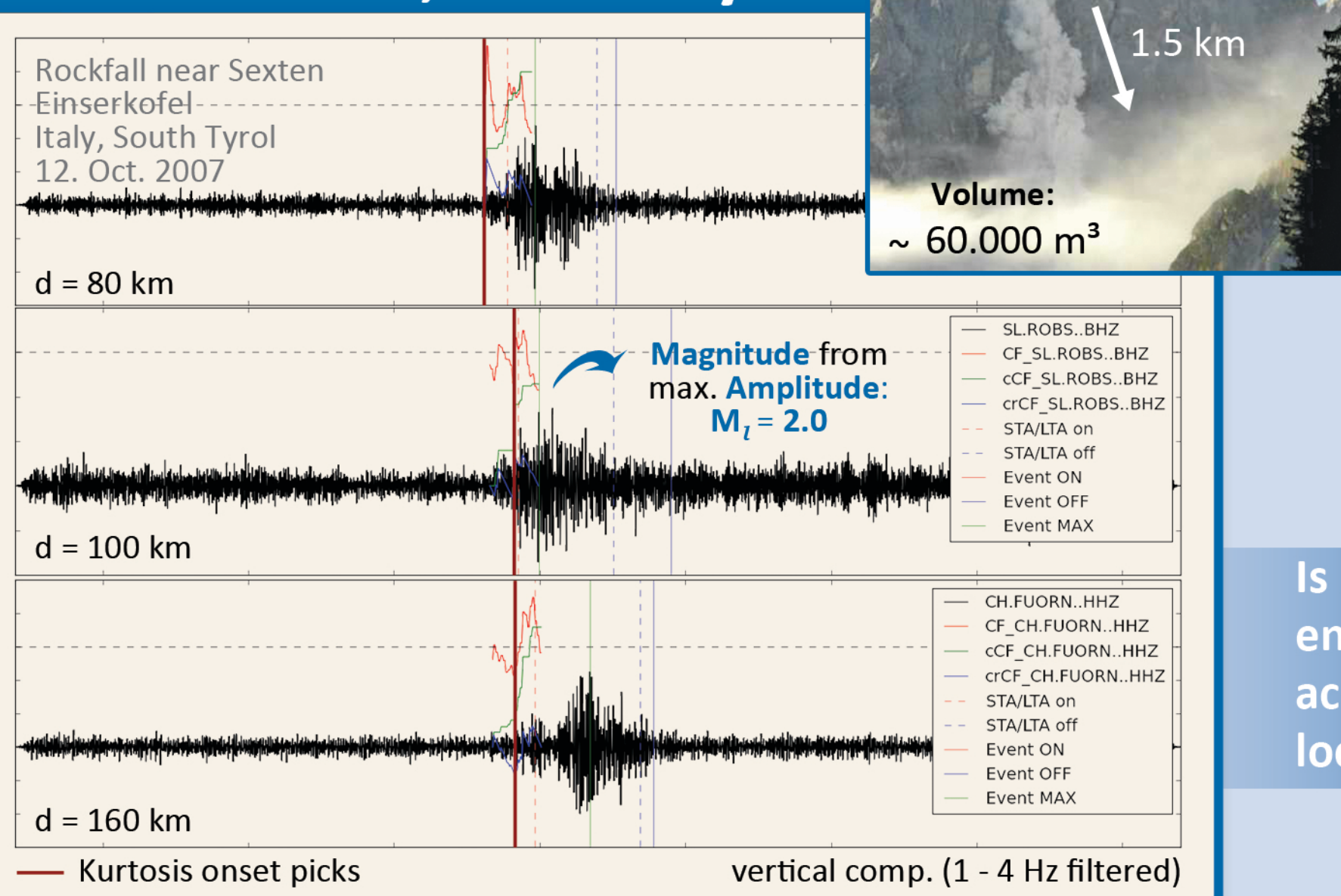
Onset determination

Since STA/LTA triggers too late for emergent signals, we determine signal onset from



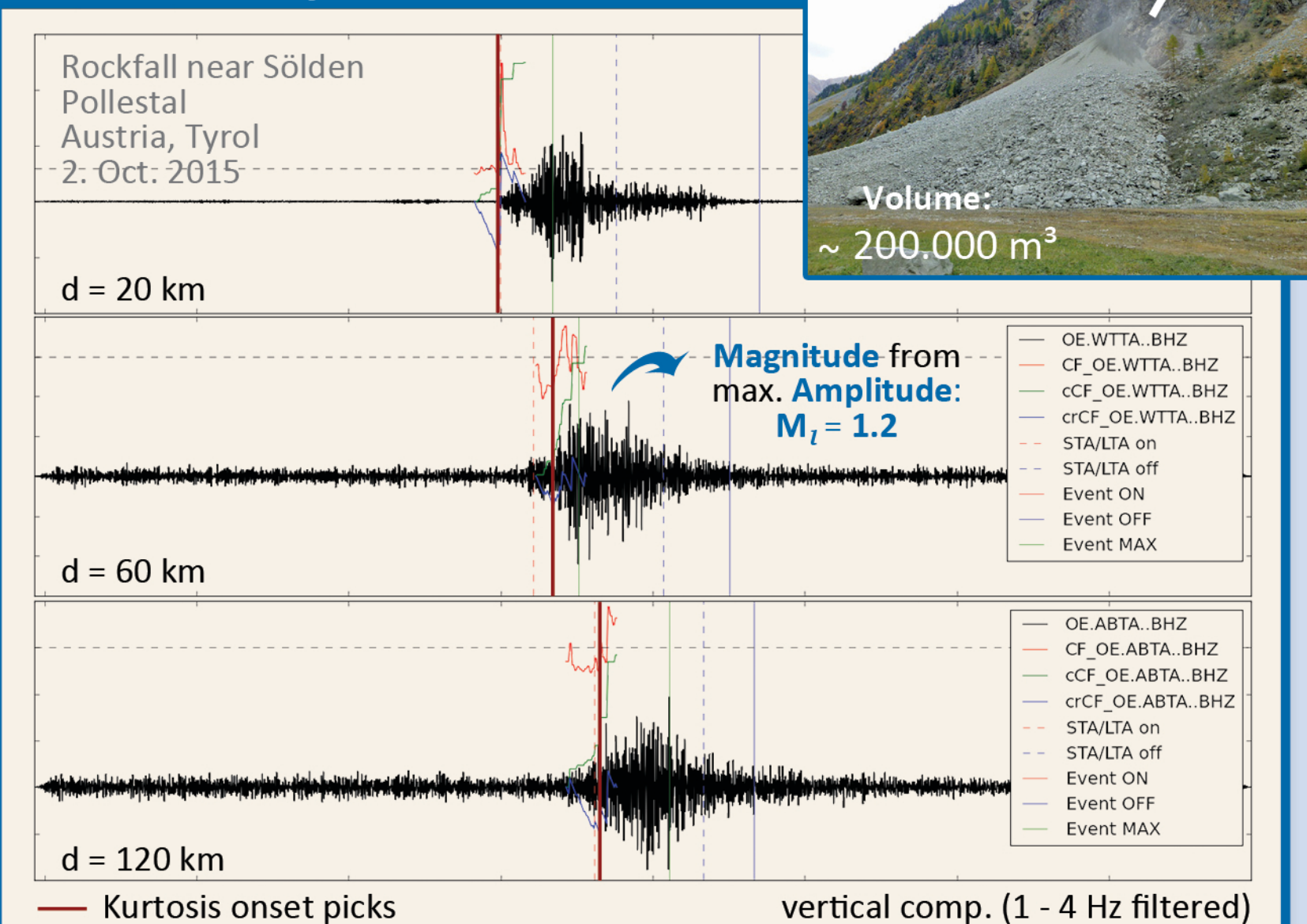
How well does it work?

Einserkofel, South Tyrol



How well does it work?

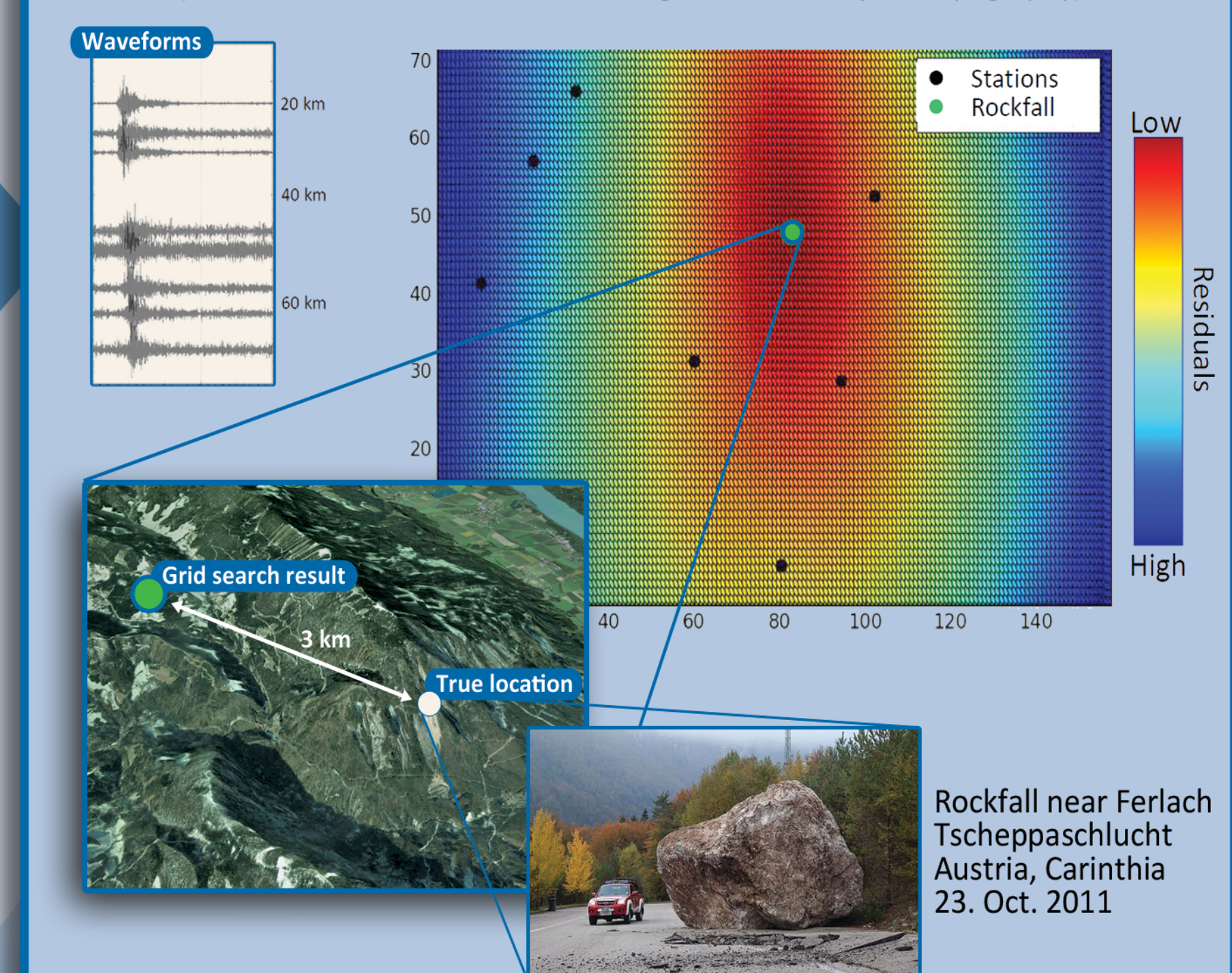
Sölden, Austria



Is it precise enough for accurate location?

Location

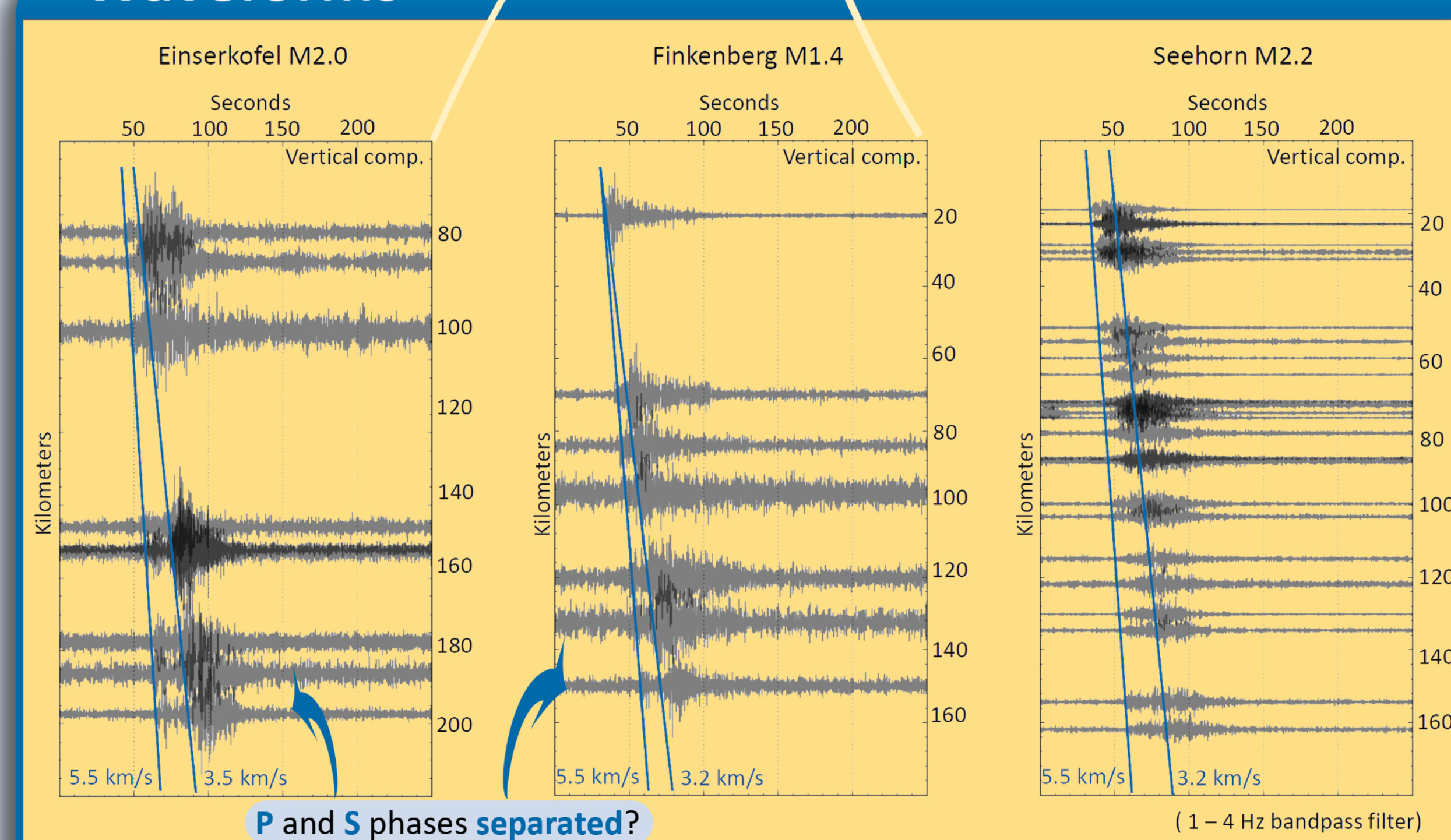
For **close stations** (< 100 km), we can locate the event with a **grid search** (minimize travel time residuals, homogeneous velocity, no topography)



Conclusions (at this stage)

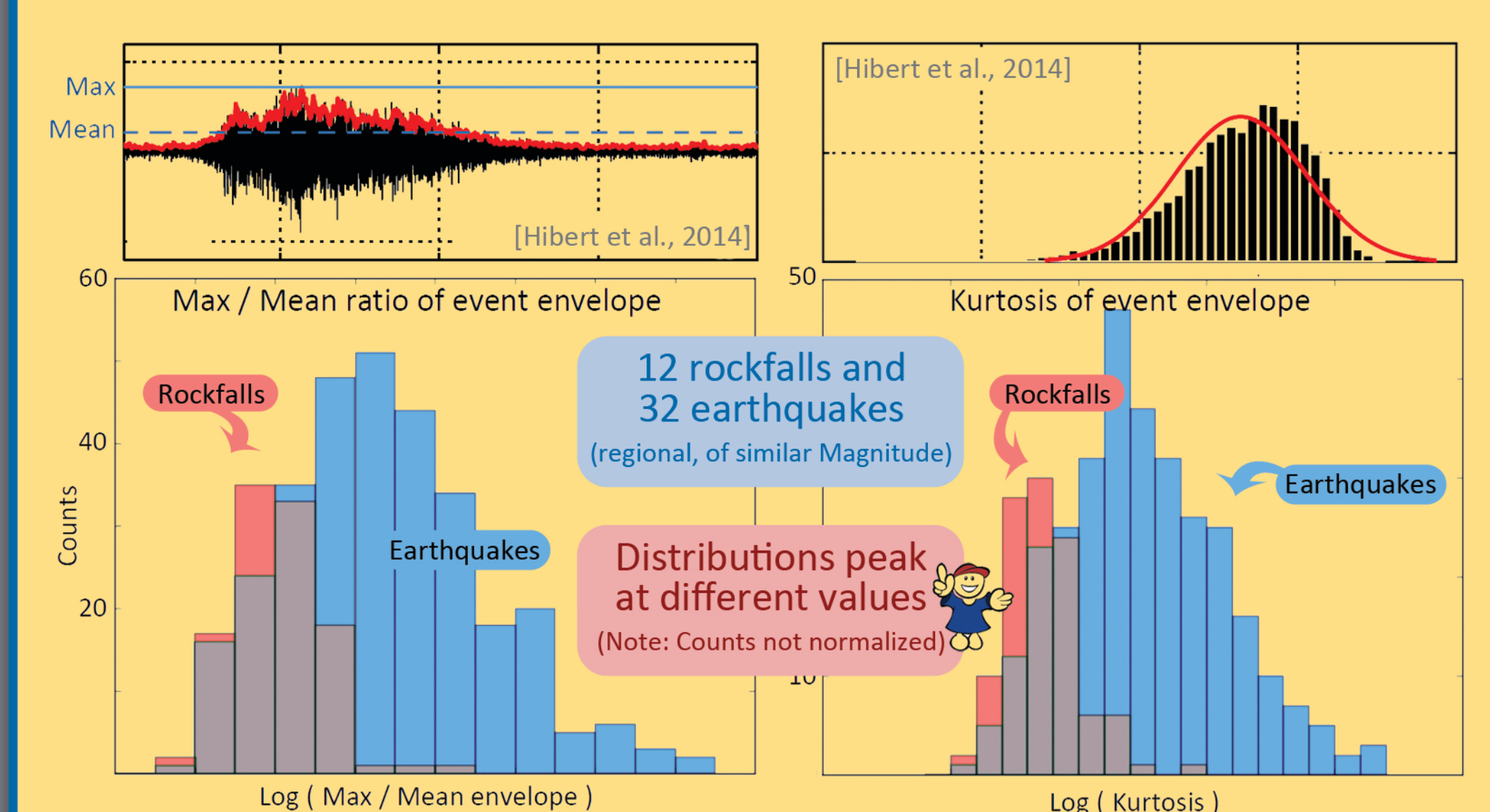
- Detection of larger rockfalls on regional scale is possible (even with comparably insensitive STA/LTA triggers)
- Kurtosis based picking still requires adjustments (not precise enough for automatic location at this stage)
- Seismic Magnitude (M_L) does not relate to rock Volume (this was already observed in other studies)
- Distant stations (> 100 km) can help to separate phases (and can thus improve the event location; only for larger rockfalls)

Waveforms



Discrimination from regional seismicity

To automatically **discriminate rockfalls from earthquakes** we explore the use of several techniques that were successfully applied in a volcano setting (Hibert et al., 2014)



Combination of several parameters may allow to **distinguish gravitational mass movements** from regional earthquakes