Robustness of κ_0 measurement: insight from a site in the low-to-moderate seismicity context of southeastern France

Presented by

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Perron et al. (2017) "Robustness of kappa (κ) measurement in low-to-moderate seismicity areas: insight from a site-specific study in Provence, France". *Bull. Seimol. Soc. Am.* **107**, 2272–2292. doi:10.1785/0120160374

Now at

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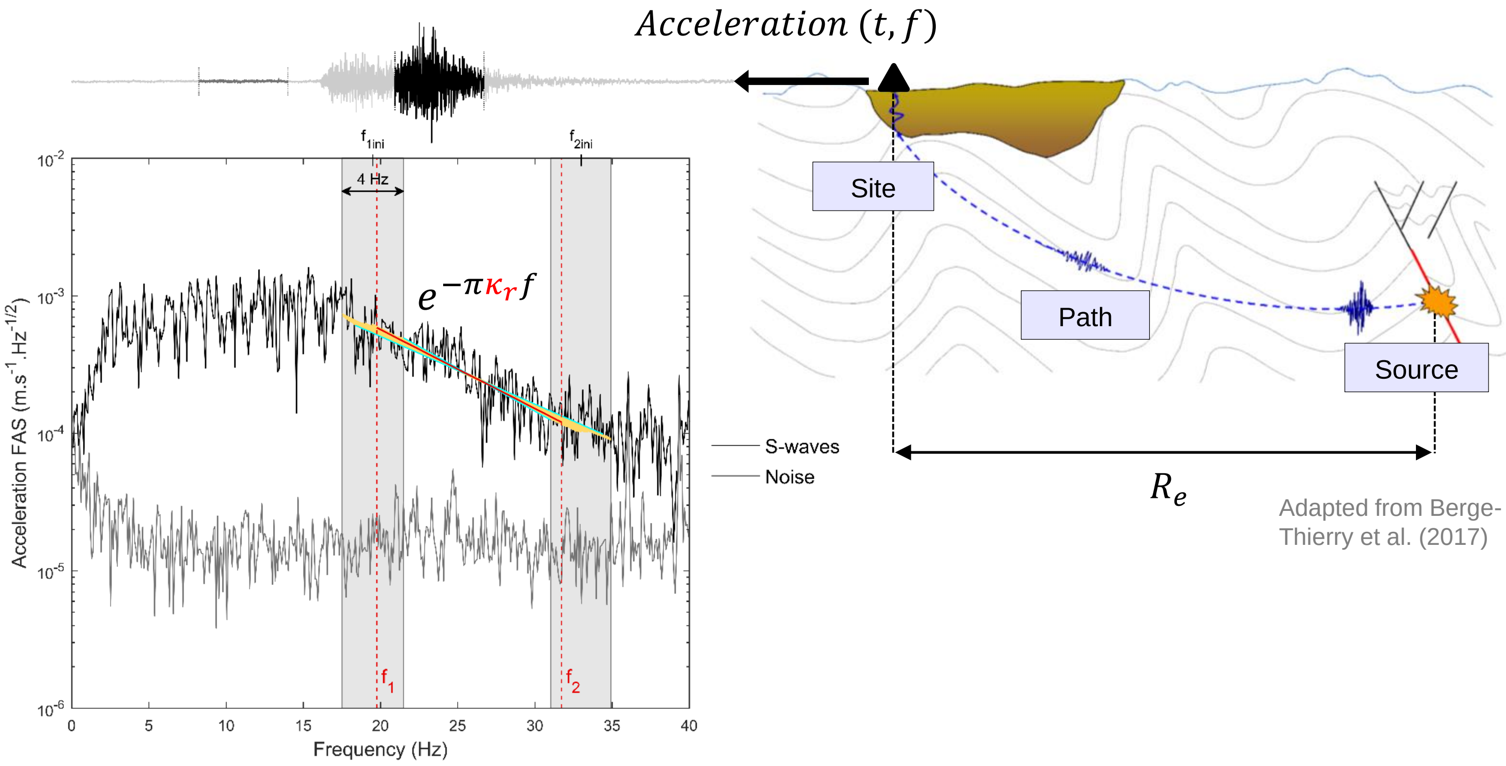
Individual κ_r

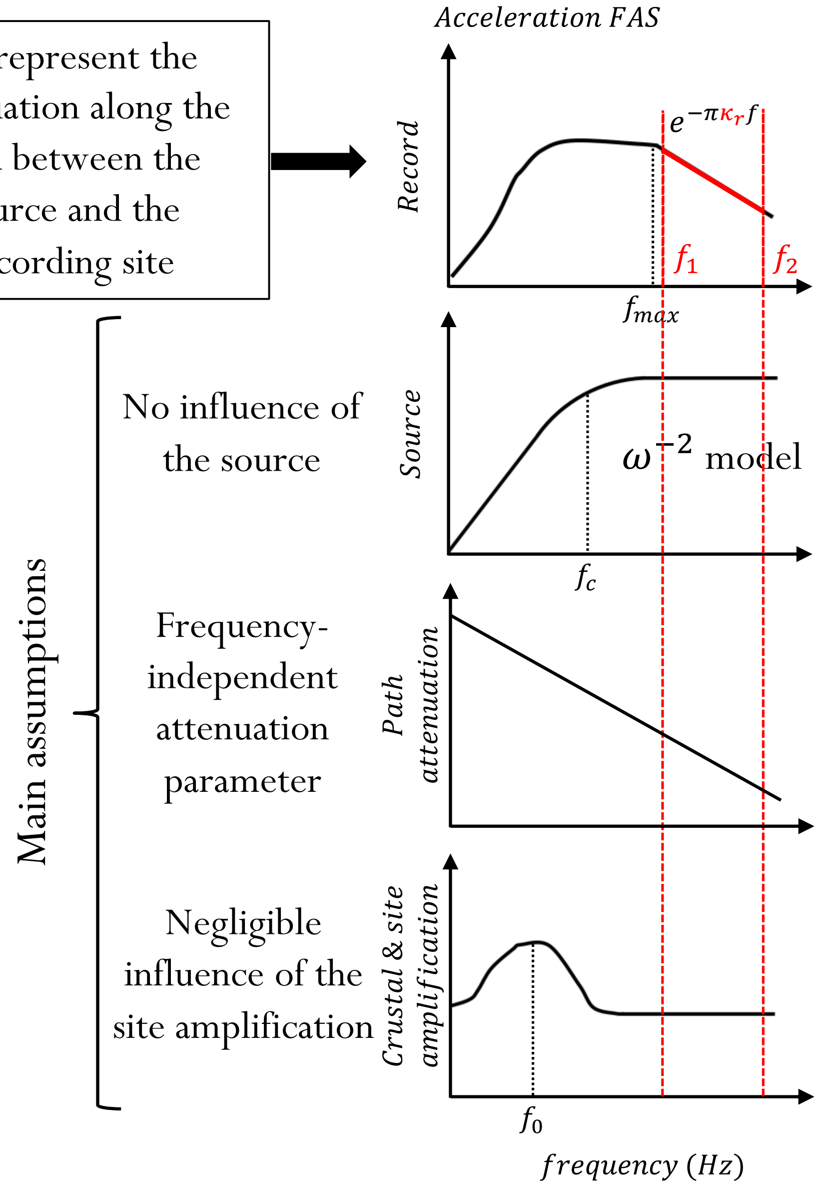
For a given earthquake located at epicentral distance R_e, κ_r is define by the relation:

$$A(f) = A_0 e^{-\pi \kappa_r f}, \qquad f_1 < f < f_2$$



Adapted from Berge-Thierry et al. (2017)

κ_r represent the attenuation along the path between the source and the recording site

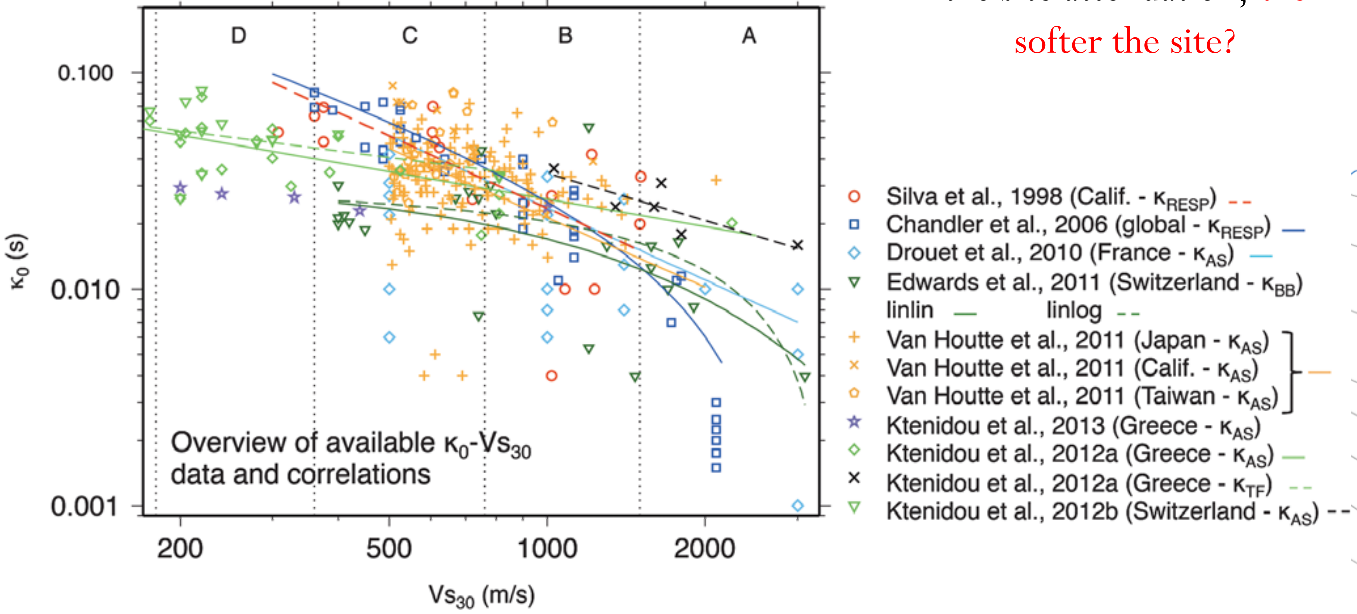


The site component κ_0

κ_0 correspond to the site component of κ_r such as:

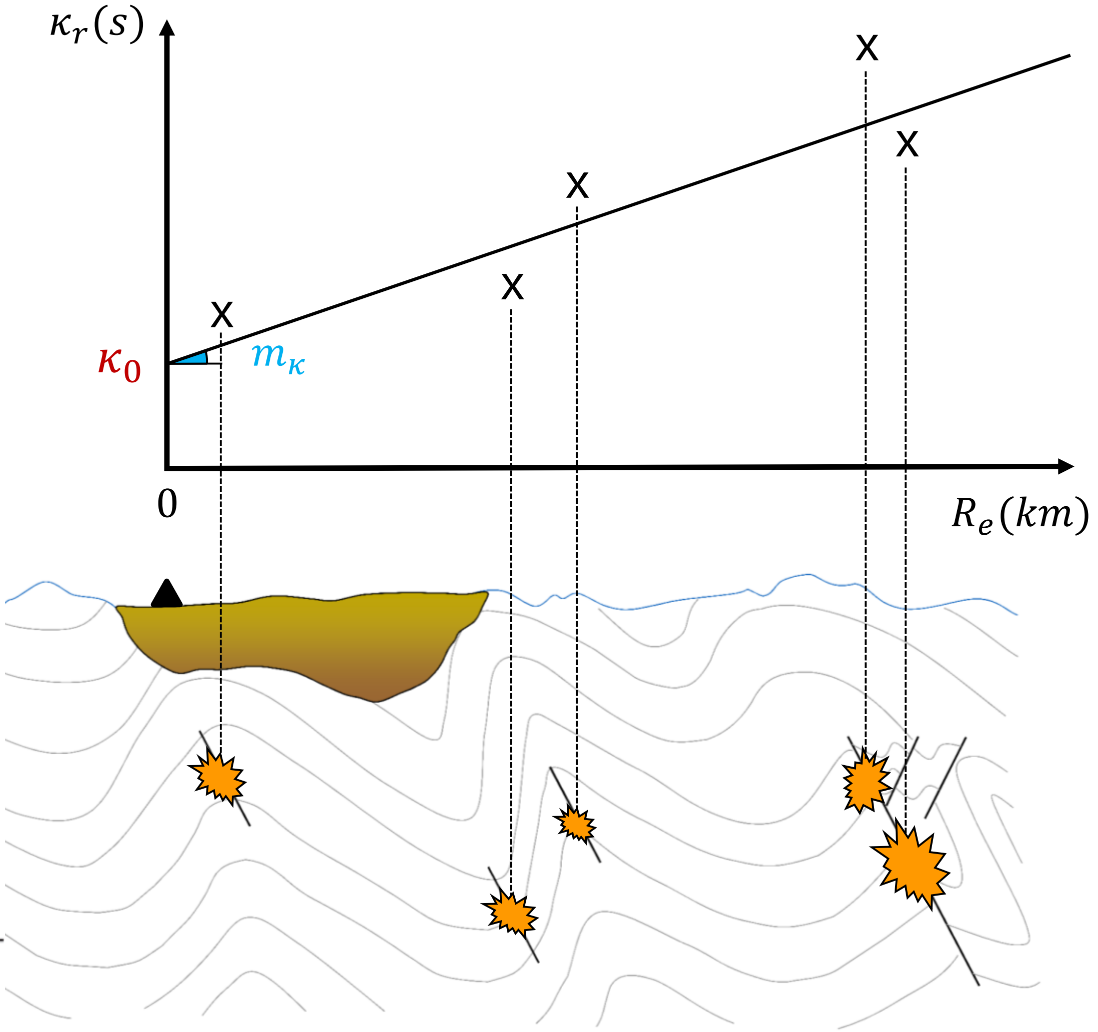
$$\kappa_r(R_e) = \kappa_0 + m_\kappa \cdot R_e$$

Correlation between V_{S30} and κ_0?



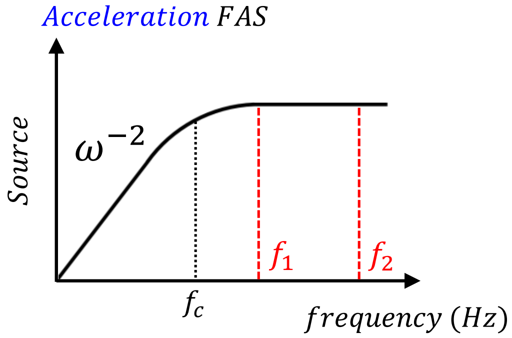
Source : Ktenidou et al. (2014)

The higher κ_0, the higher the site attenuation, the softer the site?

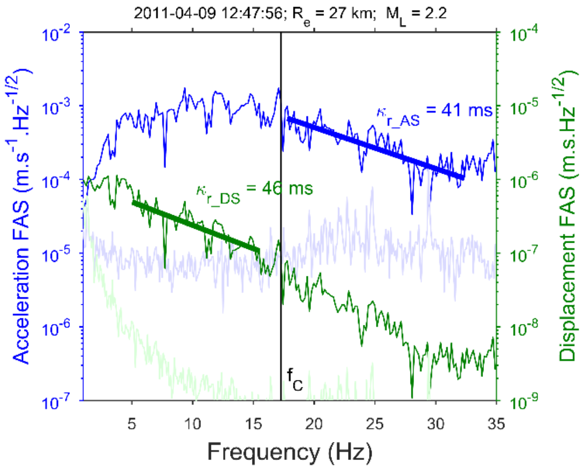


Approaches to measure κ_r

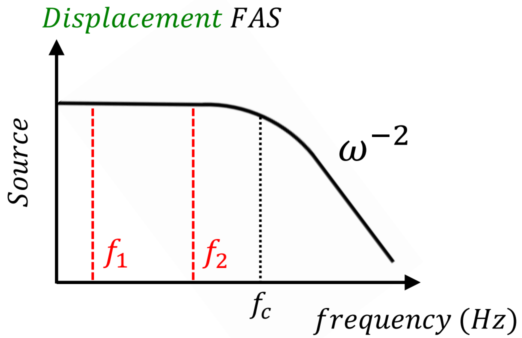
κ_{AS} : Anderson and Hough (1984)



- High frequency measurement $> f_c$
- $M_L > 3$



κ_{DS} : Biasi and Smith (2001)

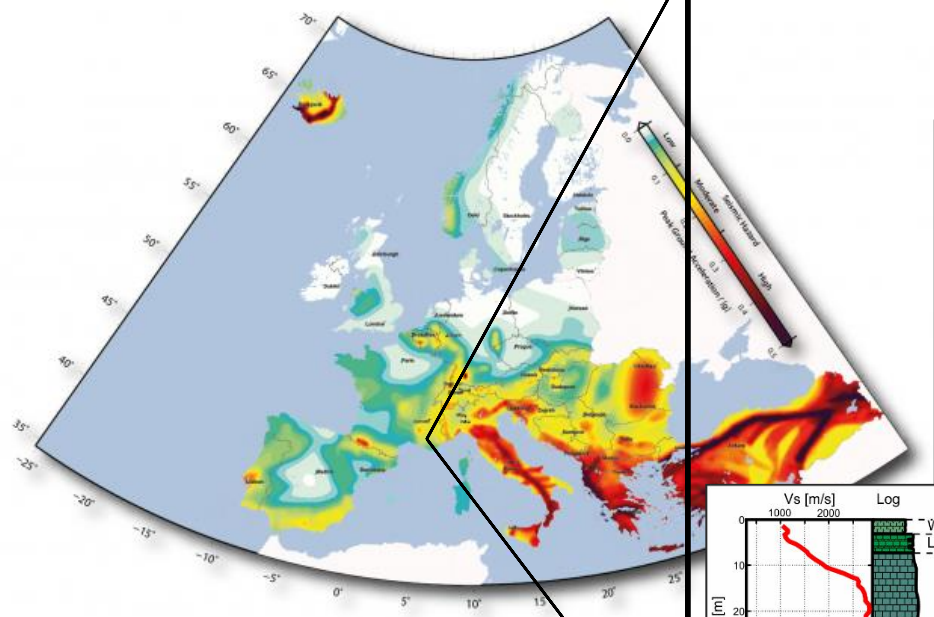


- Low frequency measurement $< f_c$
- $M_L < 1,5$

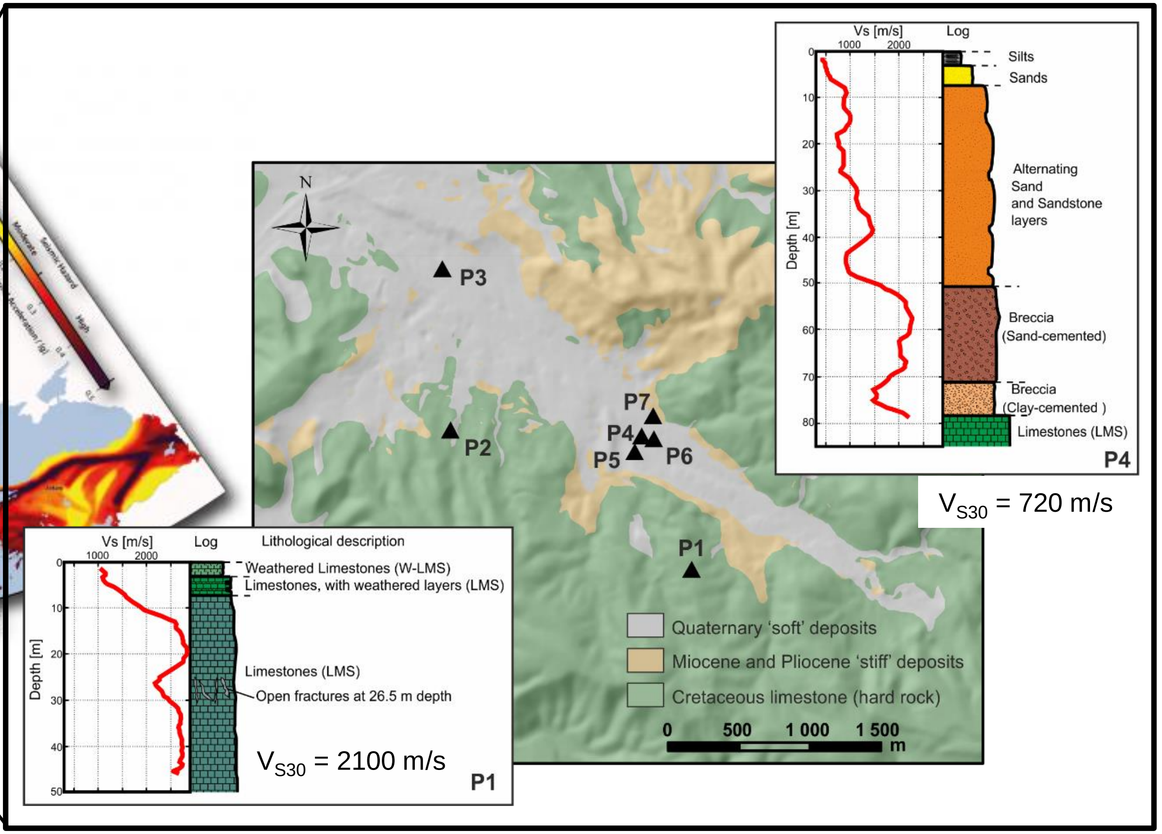
- Use of κ_0:
  - Ground Motion Prediction Equations (GMPEs)
  - Stochastic modeling
  - Host-to-target adjustments
  - etc.

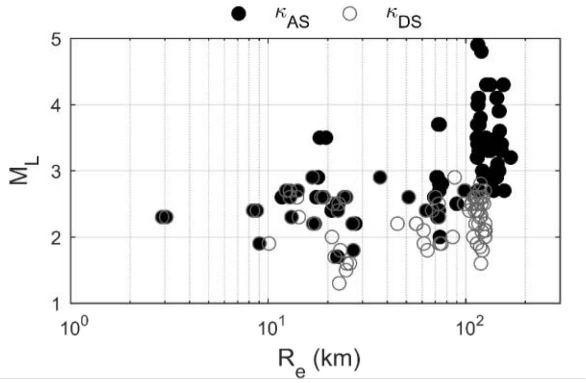
The study site

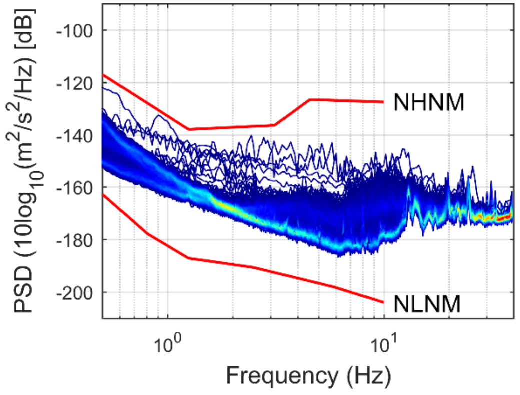
- Seismicity: low-to-moderate
- Recording period: $2^{1/2}$ years
- Instruments: 7 velocimeters et 2 accelerometers
- About 70 earthquakes usable for κ_r measurements

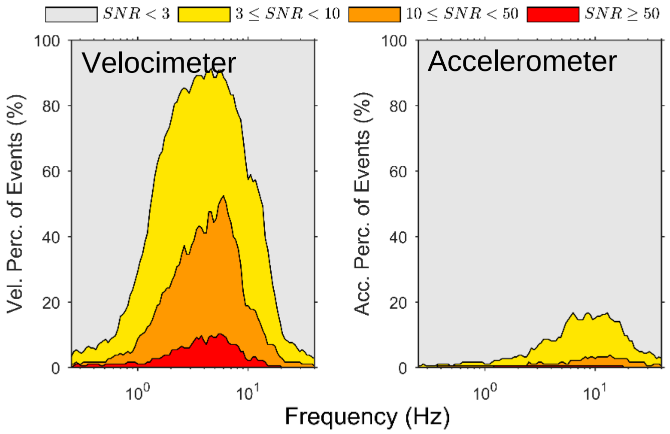


Source : Woessner et al. (2015)





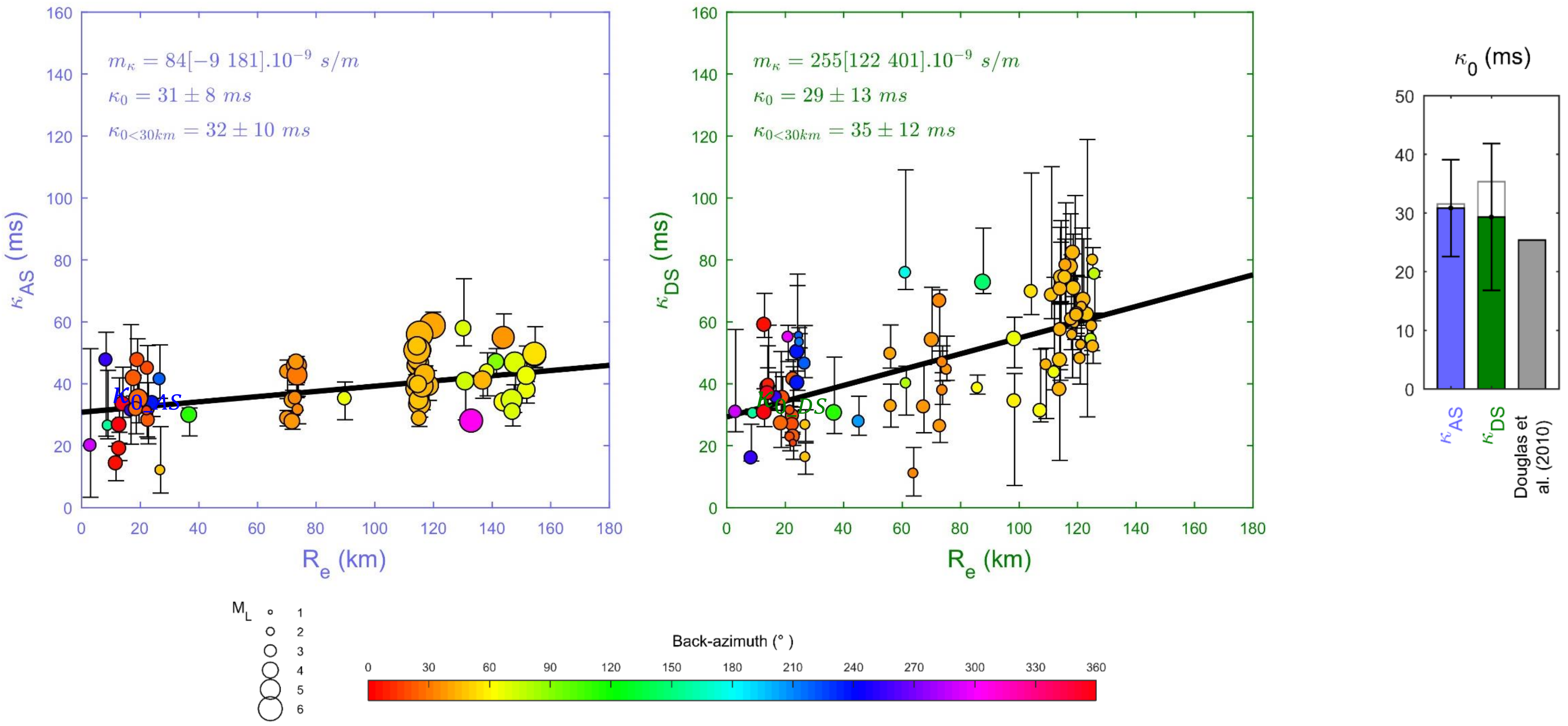




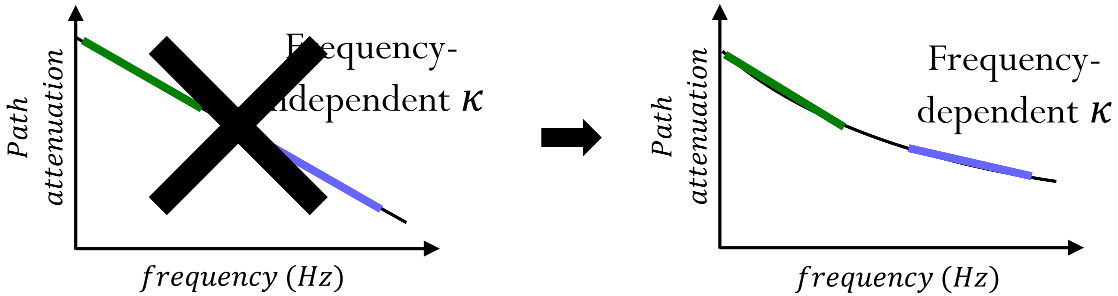
Comparison between κ_{AS} and κ_{DS}

κ_{AS} : Anderson and Hough (1984)

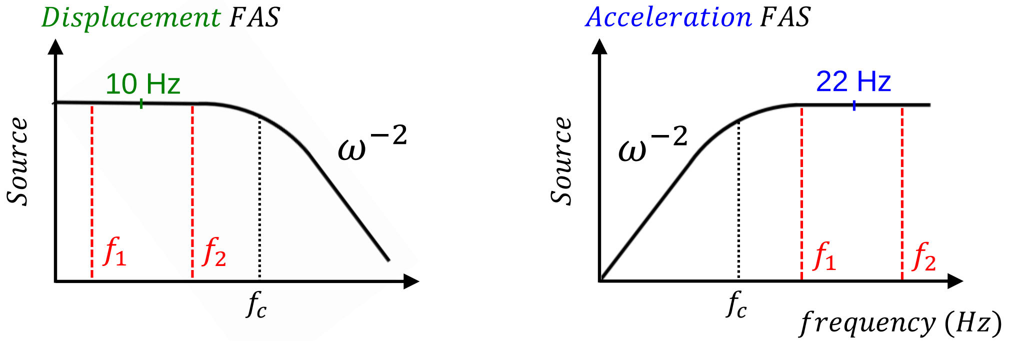
κ_{DS} : Biasi and Smith (2001)

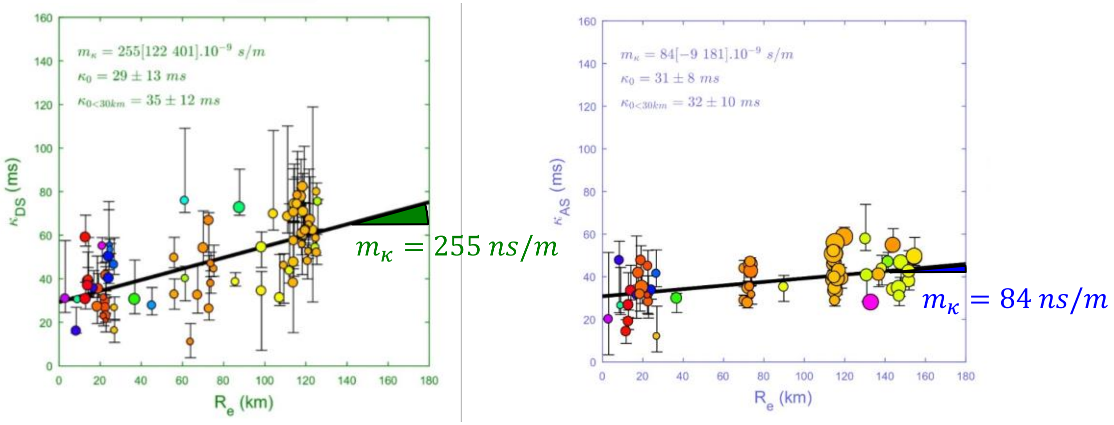


Frequency-dependence assumption



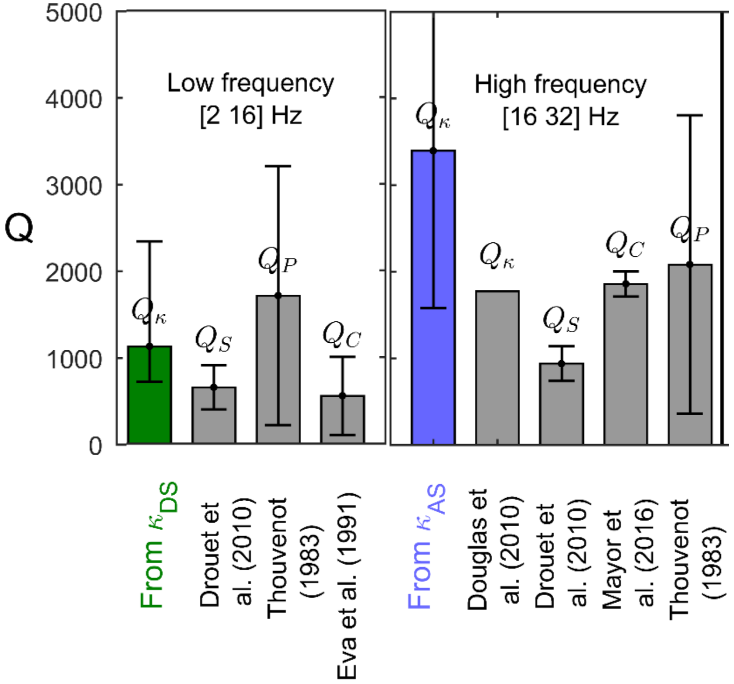
- The frequency dependence can explain a parts of the discrepancy between m_{κ_AS} and m_{κ_DS}
- No quantifiable effect between κ_{0_AS} and κ_{0_DS}



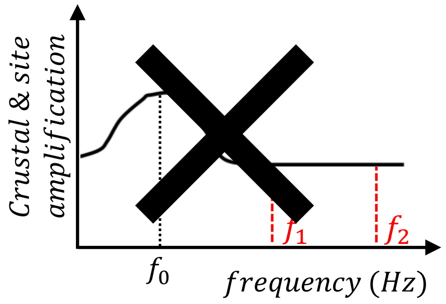


The m_κ slope can be translated in crustal quality factor Q_κ through:

$$Q_\kappa = \frac{1}{V_S\, m_\kappa}$$

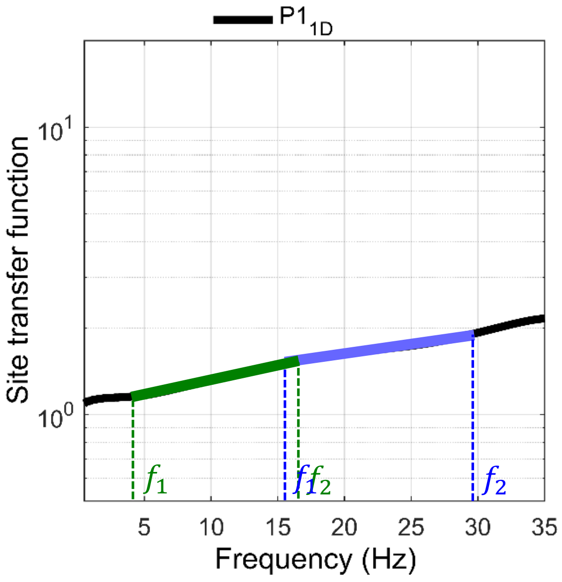


Negligible amplification influence assumption

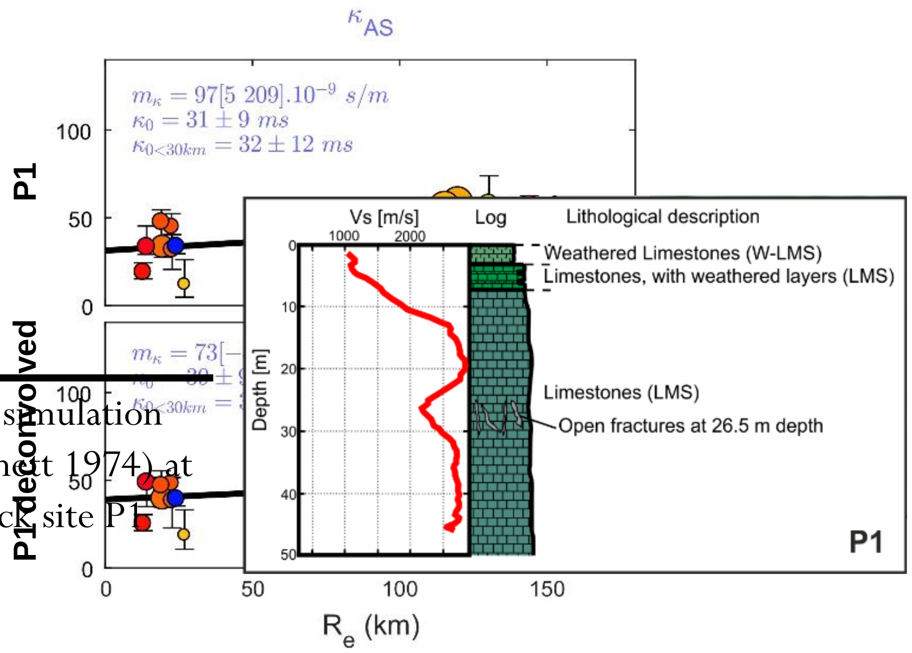


- Non-negligible influence on κ_0 at rock sites
- Very probable and unpredictable influence on κ_0 at soil sites

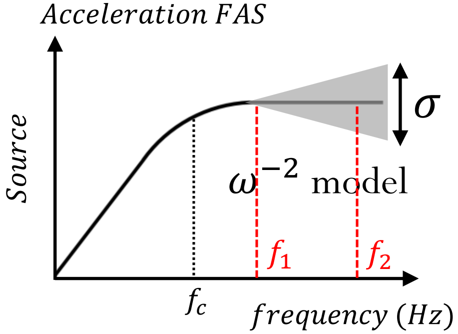
Crustal and site amplification



1D simulation (Kennett 1974) at rock site P1

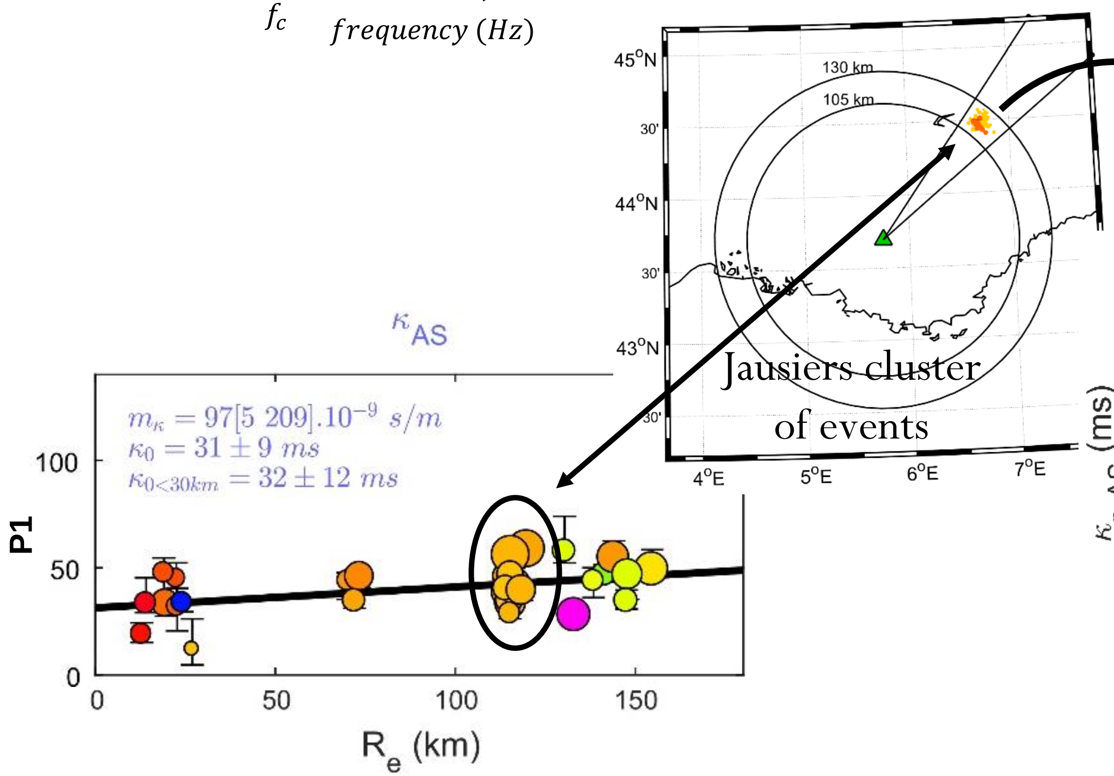


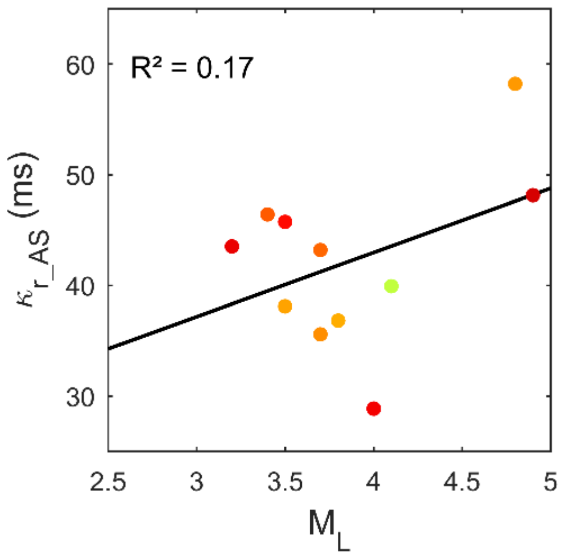
Negligible source influence assumption



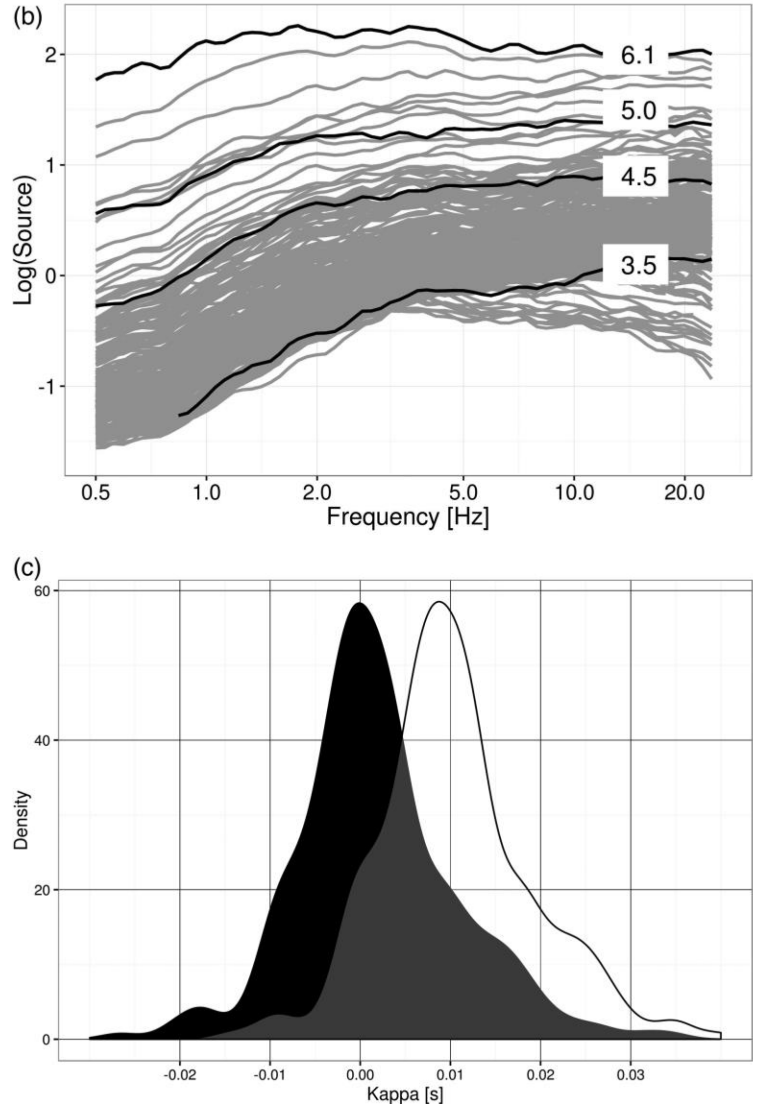
- κ_0 uncertainty controlled by the source term
- No quantifiable influence of the source on the average κ_0

- Same site (P1)
- Fixed frequency range $[f_1\ f_2]$
- Very similar path





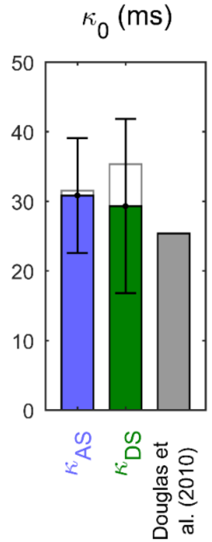
231 inverted Fourier source spectra from the L'Aquila sequence



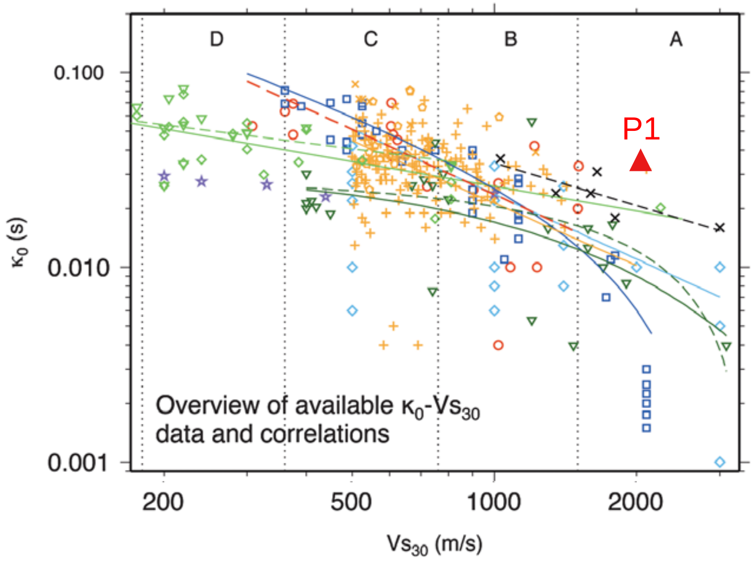
Source : Bindi et al. (2017)

Conclusions

- Consistent results between κ_{0_AS} and κ_{0_DS} at rock site, and in agreement with the literature



- For low-to-moderate seismicity areas, the κ_{DS} approach is a promising alternative to the very uncertain V_{S30}-κ_0 correlations



- Very probable frequency-dependence of κ
- Noticeable influence of the amplification on the average values of κ_0, even for rock sites
- Despite κ_0 is a site parameter, the uncertainty associated to its measurement is clearly and strongly dominated by the source term

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▌Negligible amplification influence assumption