

Imaging azimuthal anisotropy in the alpine crust from ambient noise beamforming

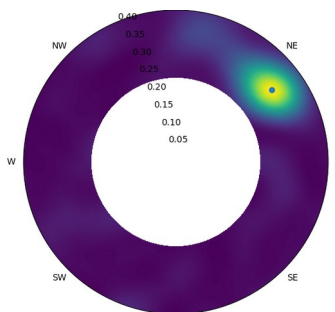
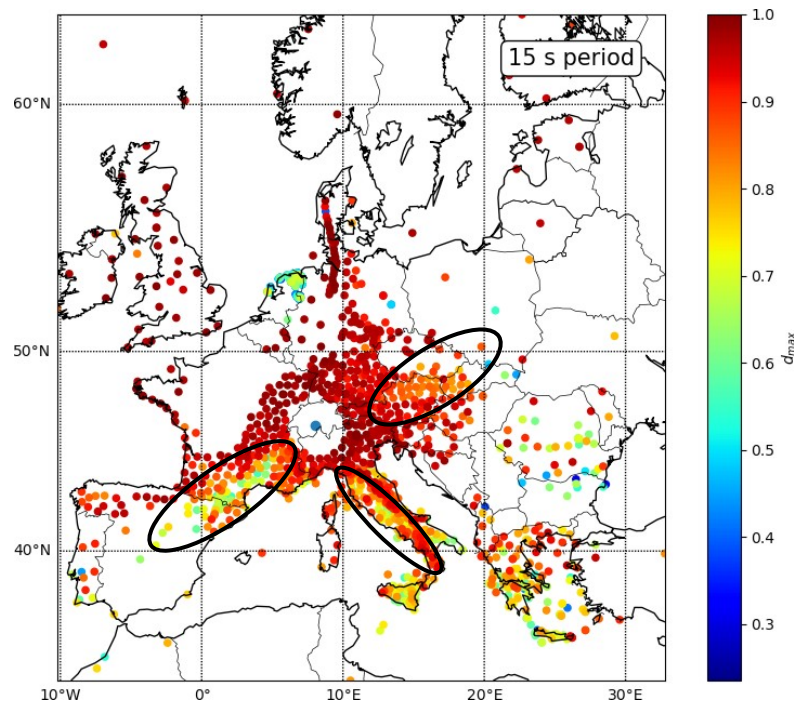
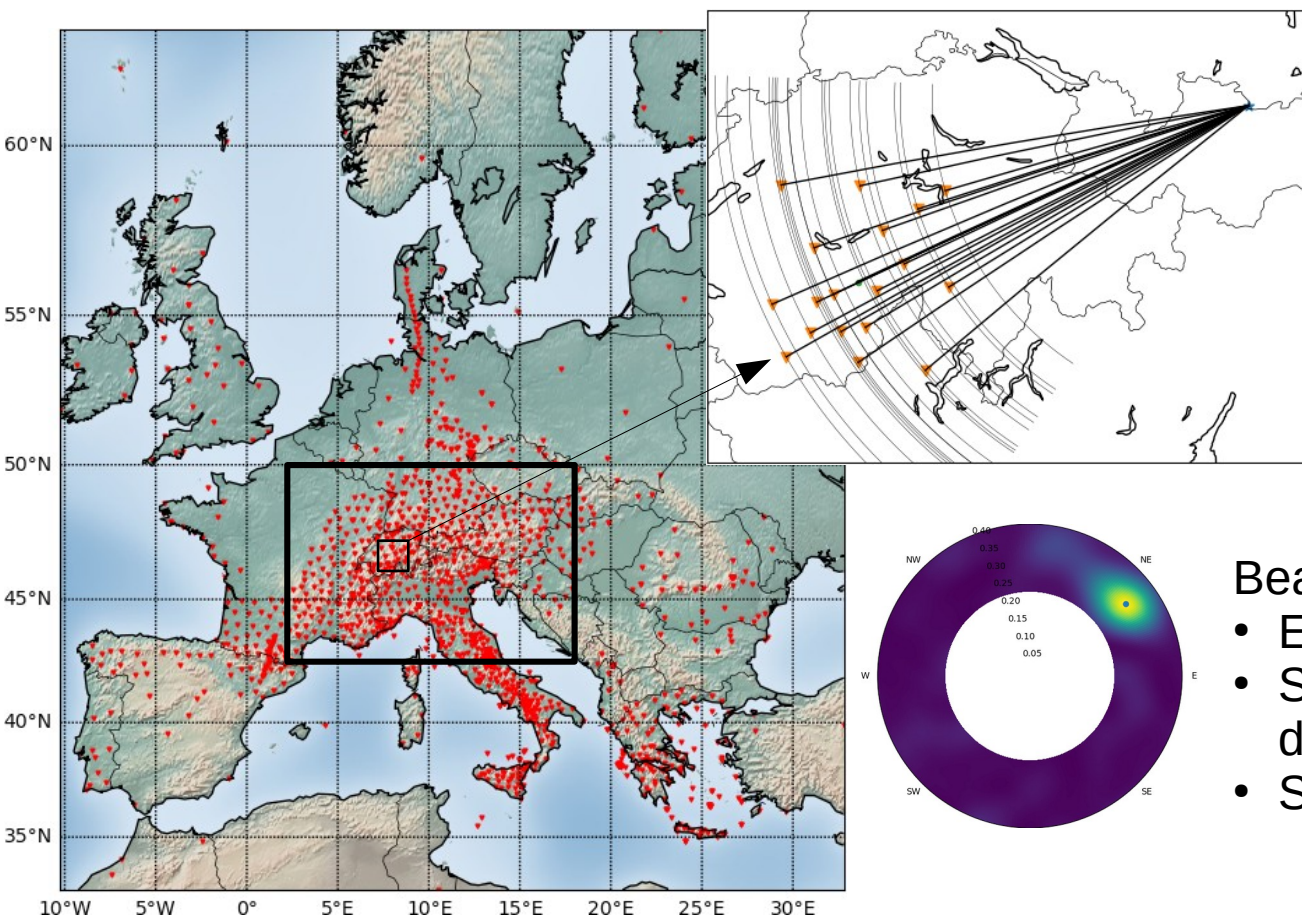
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Data and methods



Beamforming for each sub-network:

- Each station is used as a virtual source
- Sources with low beam quality downweighted in further analysis
- Sub-network size increases with period

Data and methods 2

Advantages of beamforming:

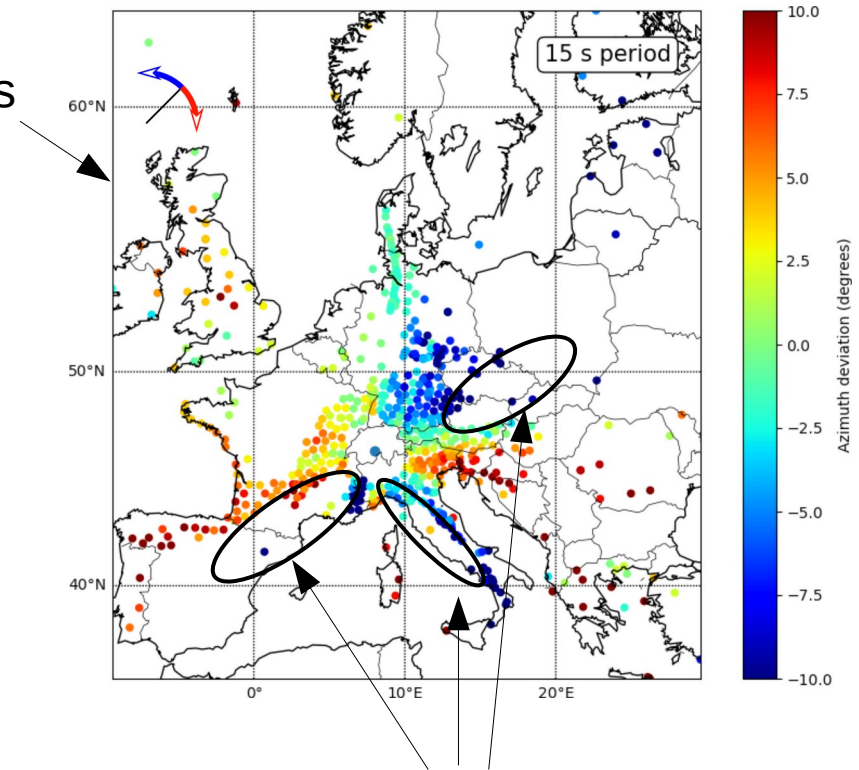
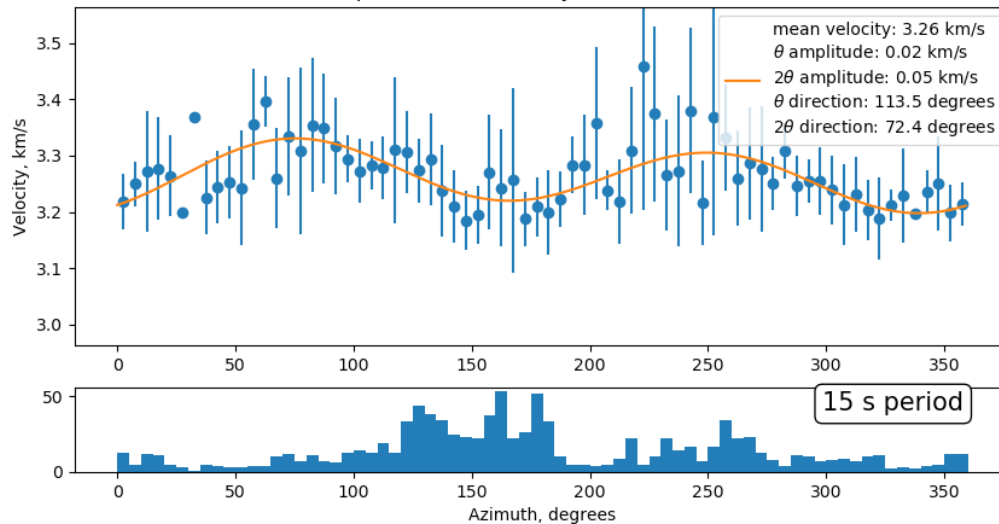
- Explicit control on stations used
- Account for great circle deviations over 10 degrees
- Quantify measurement quality

Estimation of azimuthal anisotropy:

Fit all data points to

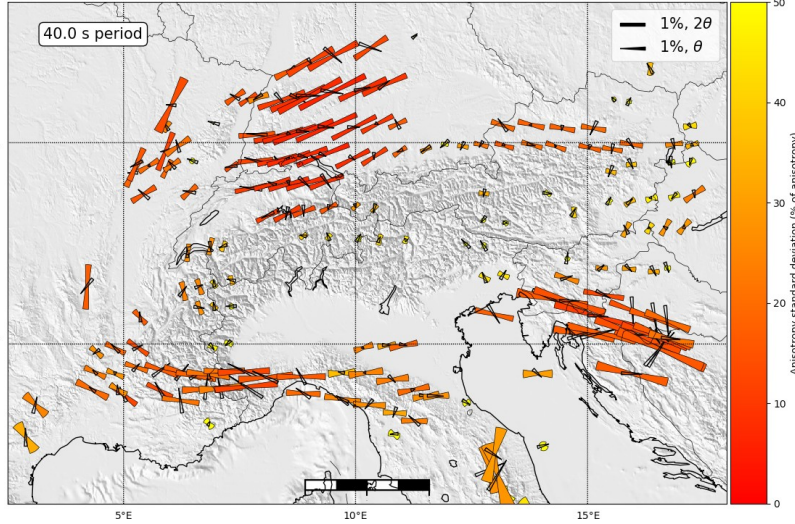
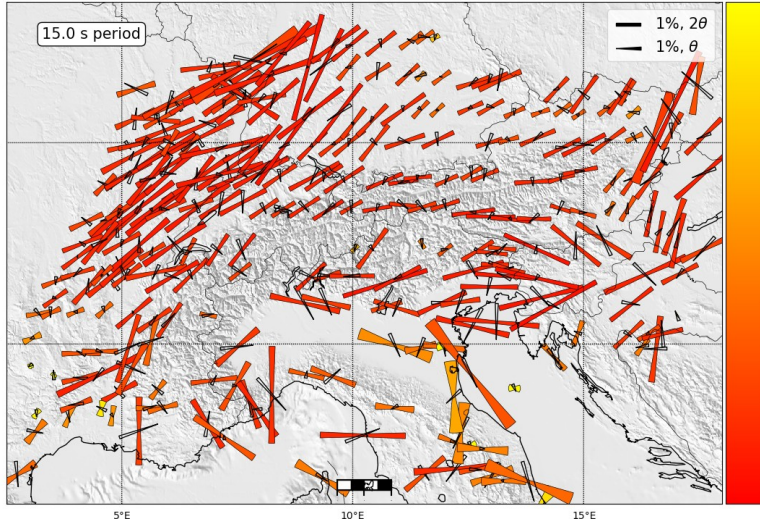
$$v_0 + A_1 \cos(\theta - \phi_1) + A_2 \cos(2(\theta - \phi_2))$$

Example of fit for the array around 48.0N, 11.0E



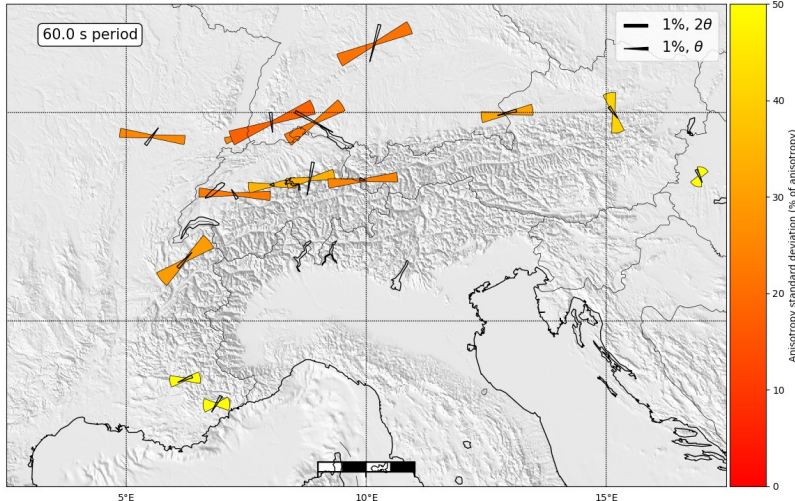
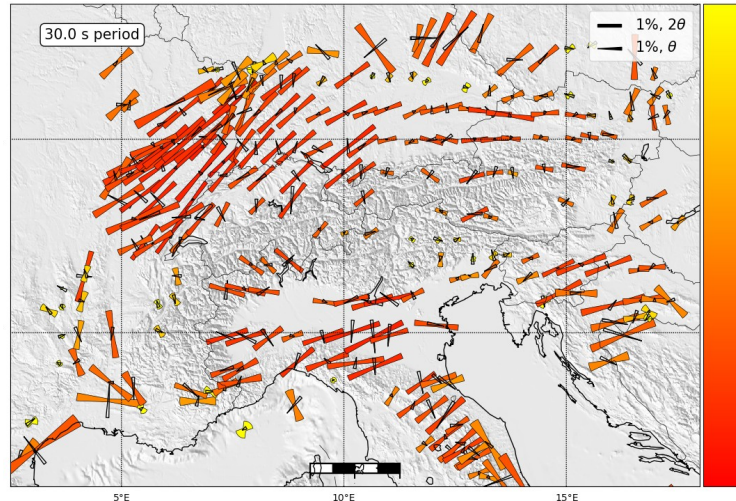
Low measurement quality corresponds to strong wavefront deformations

Results



Anisotropy decreases with period up to 40 s
Increases at longer period

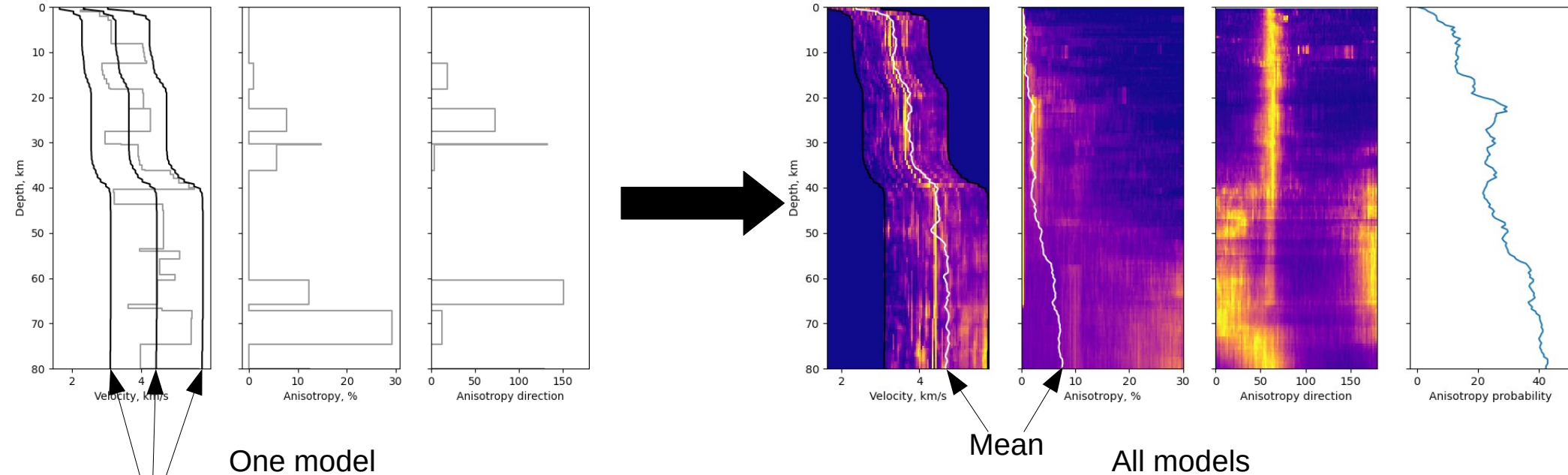
Anisotropy generally parallel to the alpine chain



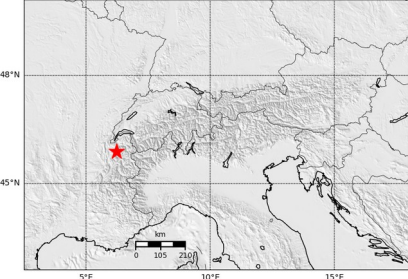
Weaker anisotropy in the alpine chain

Broadly similar to SKS results

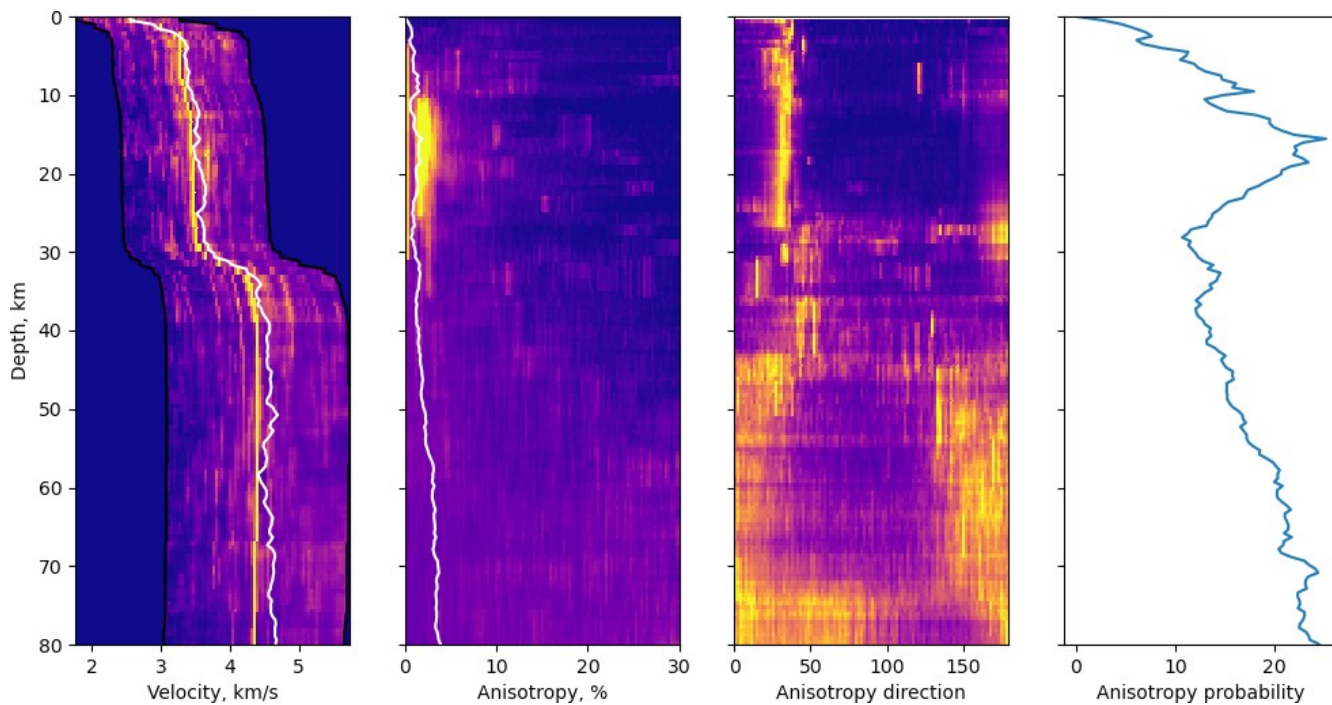
Depth inversion



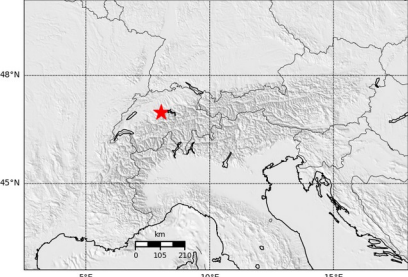
- Bayesian transdimensional inversion with Mcmc
- Isotropic velocities and reference model from Lu *et al.* (2020)
- 12 period bands 5 s wide from 10 s to 75 s
- Stronger uncertainties at longer periods



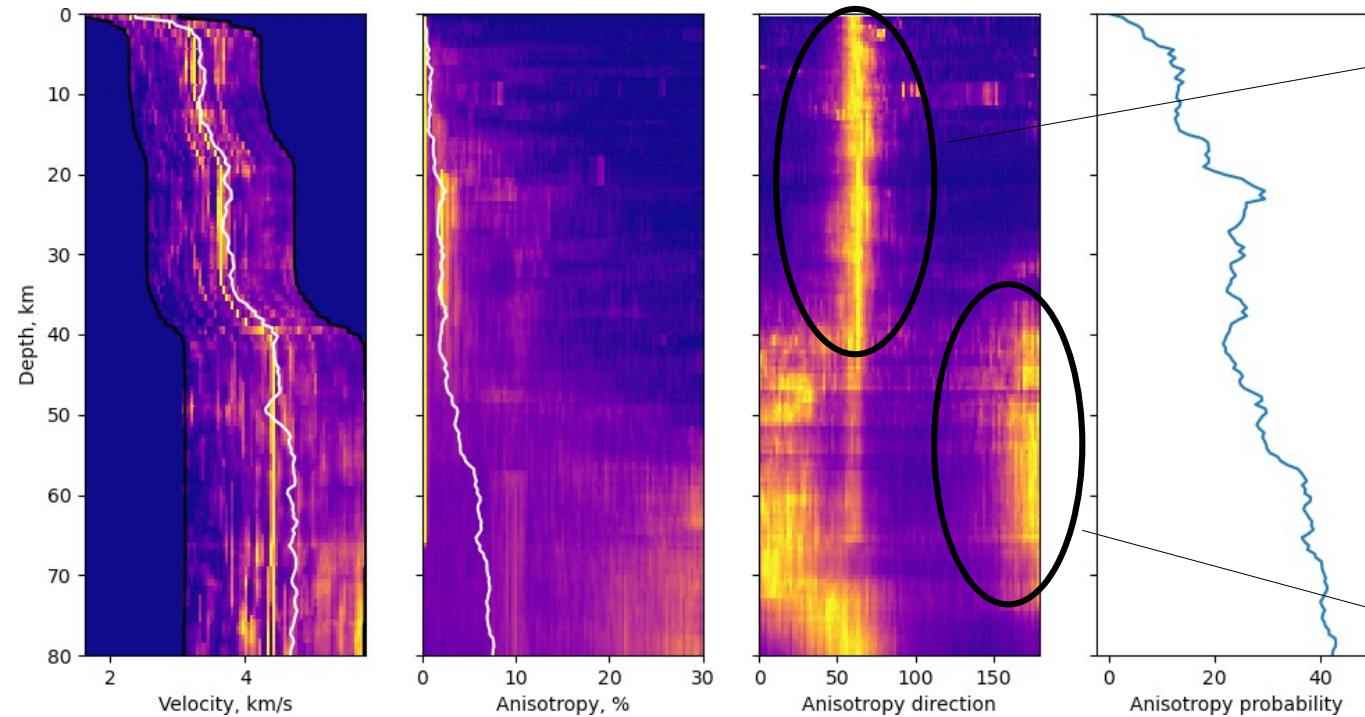
Western Alps



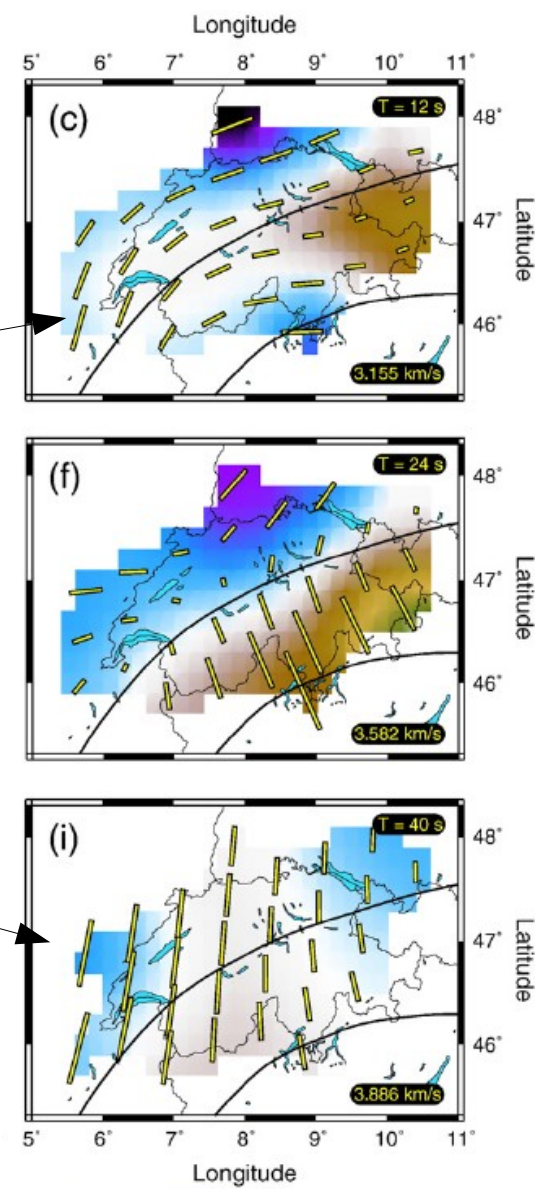
Roughly oriented parallel to the Alps
Change in direction between 30 and 50 km depth
Relatively weak anisotropy at depth

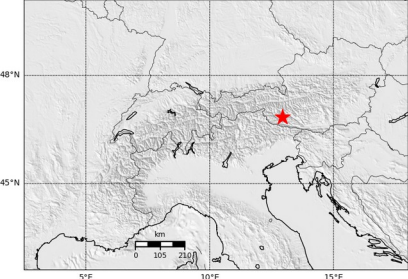


Swiss Alps

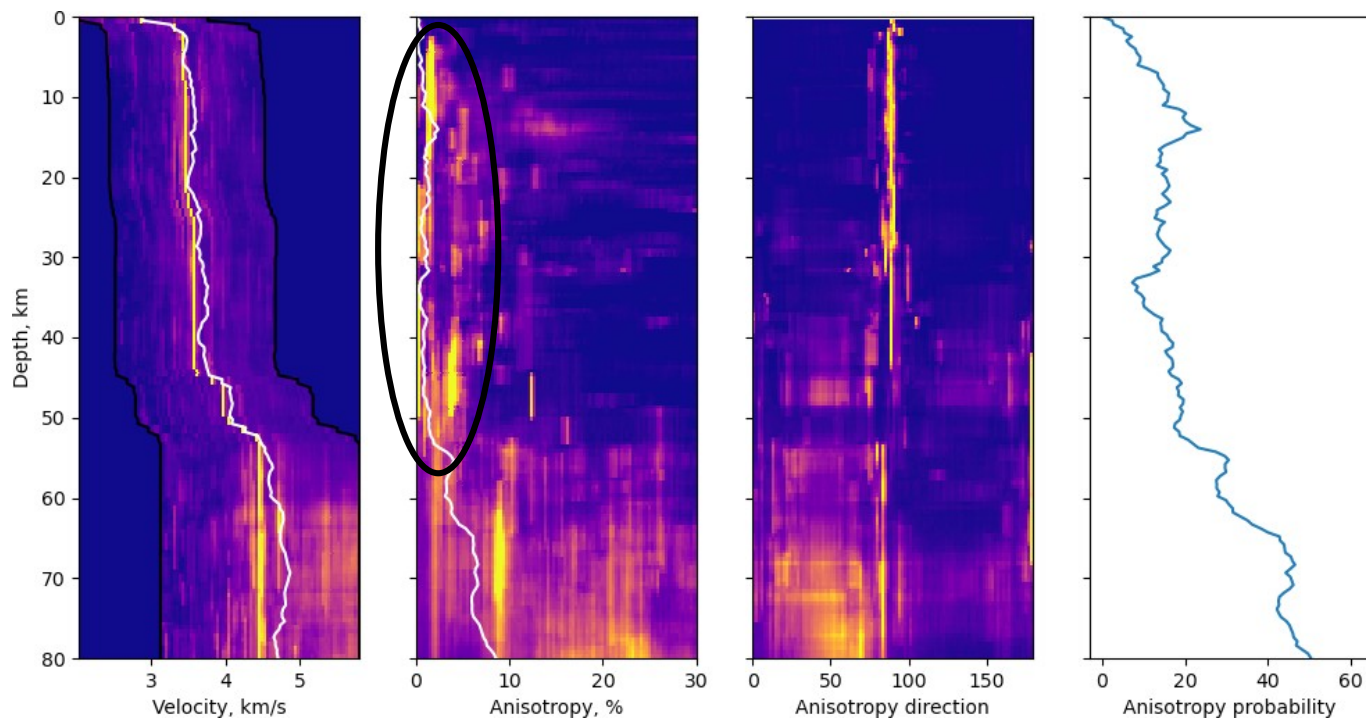


Roughly oriented parallel to the Alps
 Change in direction around 40 km depth
 Directions compatible with Fry *et al.* (2011) but at greater depths

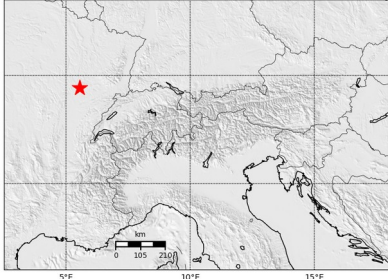




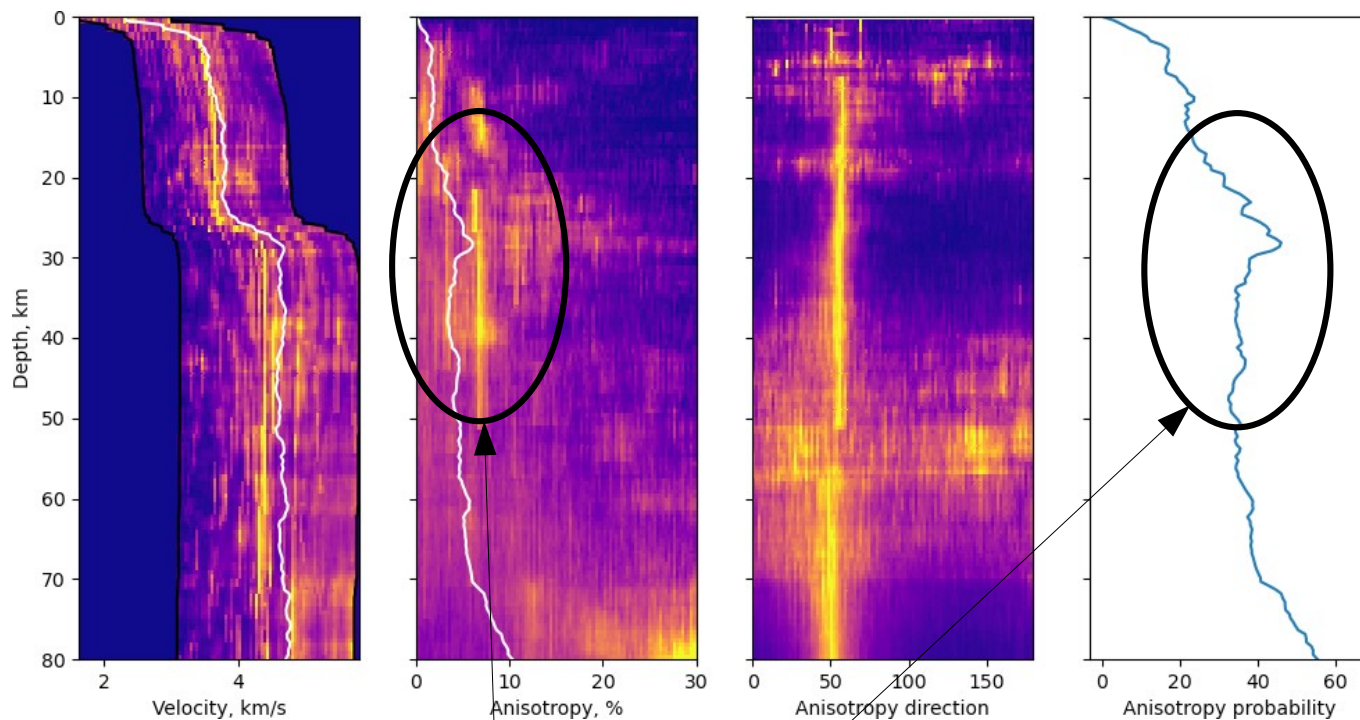
Eastern Alps



Weak anisotropy in the crust
Roughly oriented parallel to the Alps



North-west of the Alps



Strong anisotropy in the crust
Constant direction over the whole depth range

Conclusions

- Generally weaker anisotropy in the alpine chain
- In the western Alps, change of anisotropy direction at around 40 km depth
- North-west of the Alps, strong anisotropy between 20 and 50 km depth
- Weaker anisotropy at 40 s period not reflected in the inversion