SPIN ESR 1.1: Harnessing wavefield gradients: theory, experiment, applications

Local Seismic Anisotropy from 6C Observations

Le Tang[1]

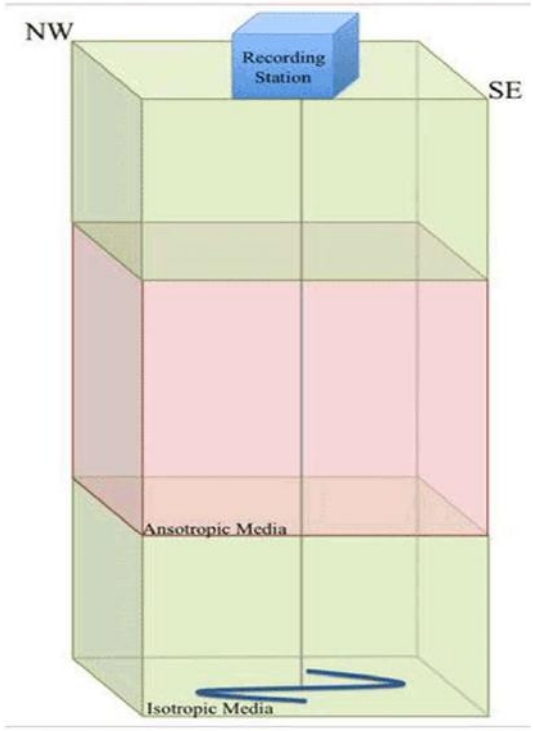
Supervisor: Heiner Igel[1] & Jean-Paul Montagner[2]

[1]Department of Earth and Environmental Sciences, LMU
[2]Institut de Physique du Globe de Paris (IPGP), Université de Paris
SPIN 3rd workshop, 27.03.2023, Scotland

MOTIVATION

Azimuthal Anisotropy

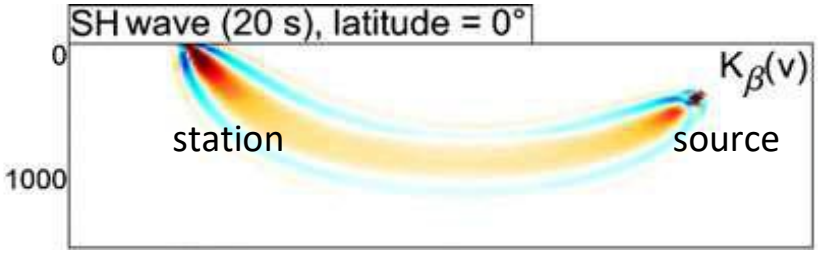
(2) Shear wave splitting (e.g. SKS) (or Polarization analysis)



https://en.wikipedia.org/wiki/Shear_wave_splitting

(1) Time-dependent (or time + waveform, FWI) tomography

Translational displacement



Bernauer et al., 2012

(3) good lateral resolution + good depth resolution ???

Translation/Rotation=f(v)

Bernauer et al., 2012 (isotropic media)

THEORY

weakly anisotropic media (surface wave)

$$\frac{\boldsymbol{A}}{\boldsymbol{\Omega}}(\omega,\psi) = v(\omega,\psi) = v_0 + R_1(\omega) + R_2(\omega)cos2\psi + R_3(\omega)sin2\psi + R_4(\omega)cos4\psi + R_5(\omega)sin4\psi$$

Tang et al., 2023, under review

Smith & Dahlen, 1973

A: $translational\ acceleration$

Ω: $rotation$

ω: $circular\ frequency$

ψ: $azimuth$

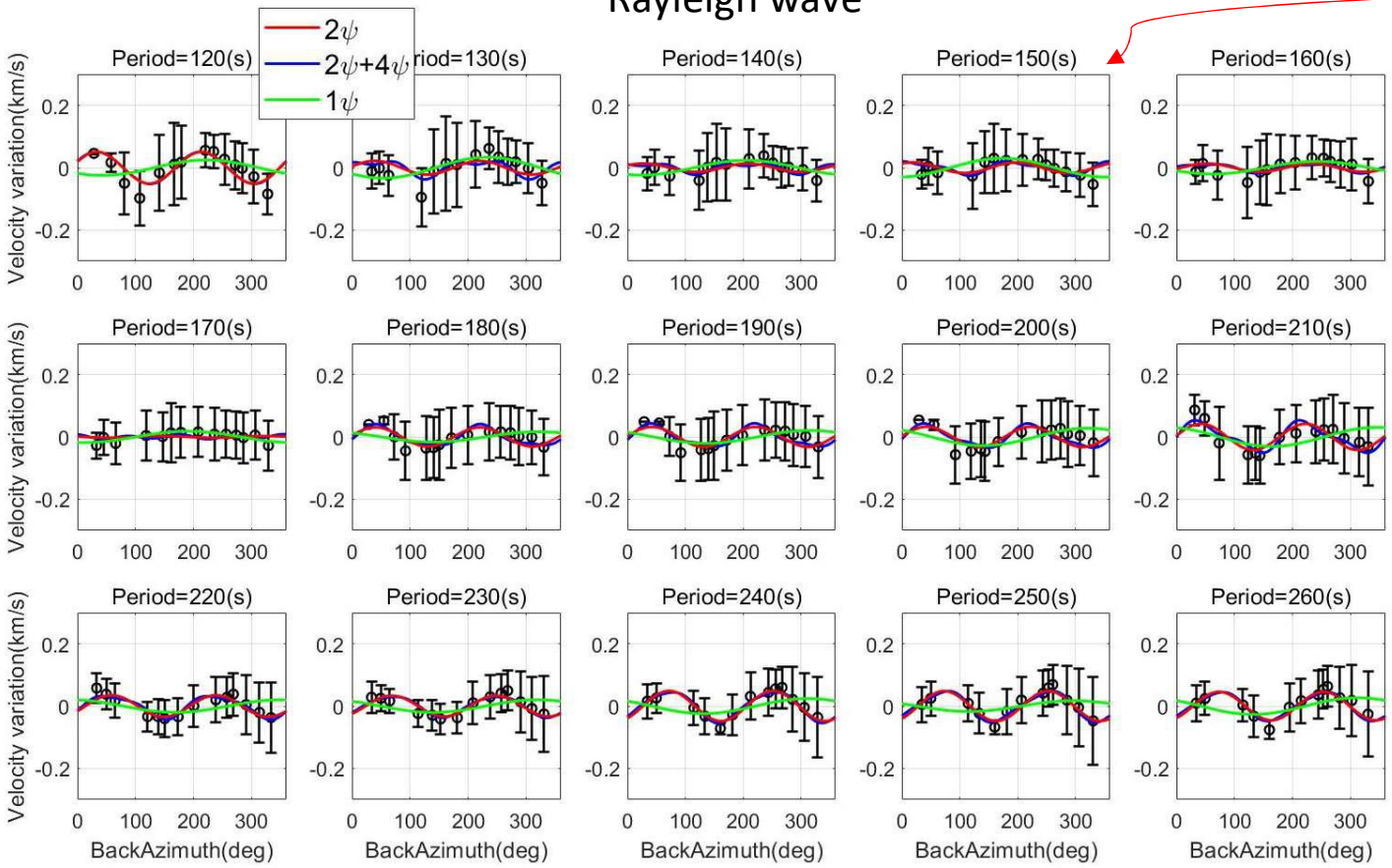
$R_i(\omega)$: $depth\ integration\ function$

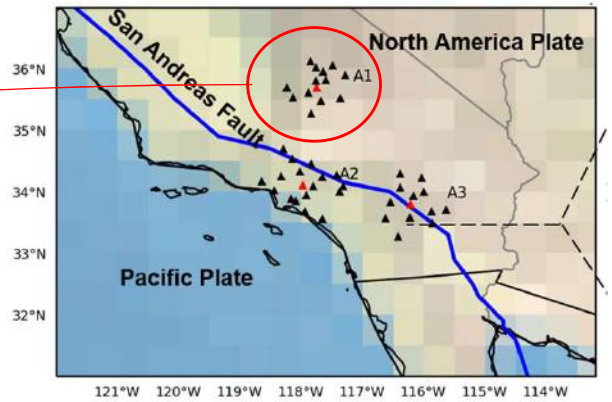
OBSERVATION

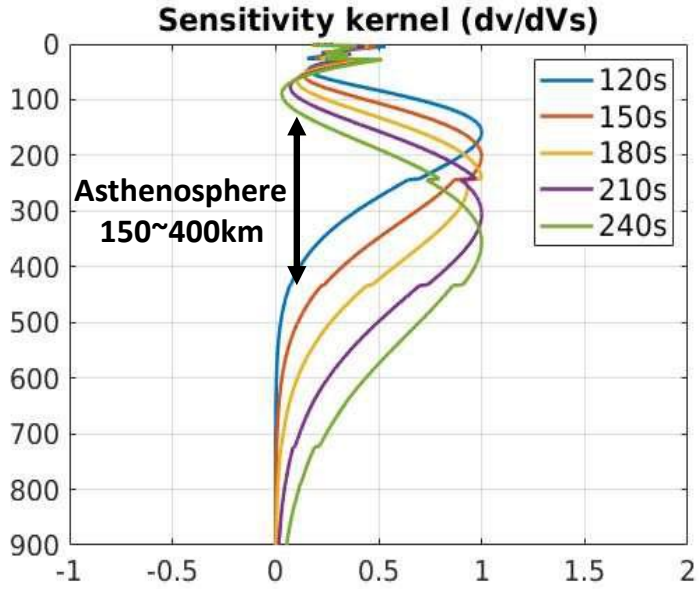
ADR (array derived rotation:~20km-120km)
(~100 events>M6.5, STS2 stations)

LAB depth in this area: 70~100km

Rayleigh wave







Tang et al., 2023, in preparation

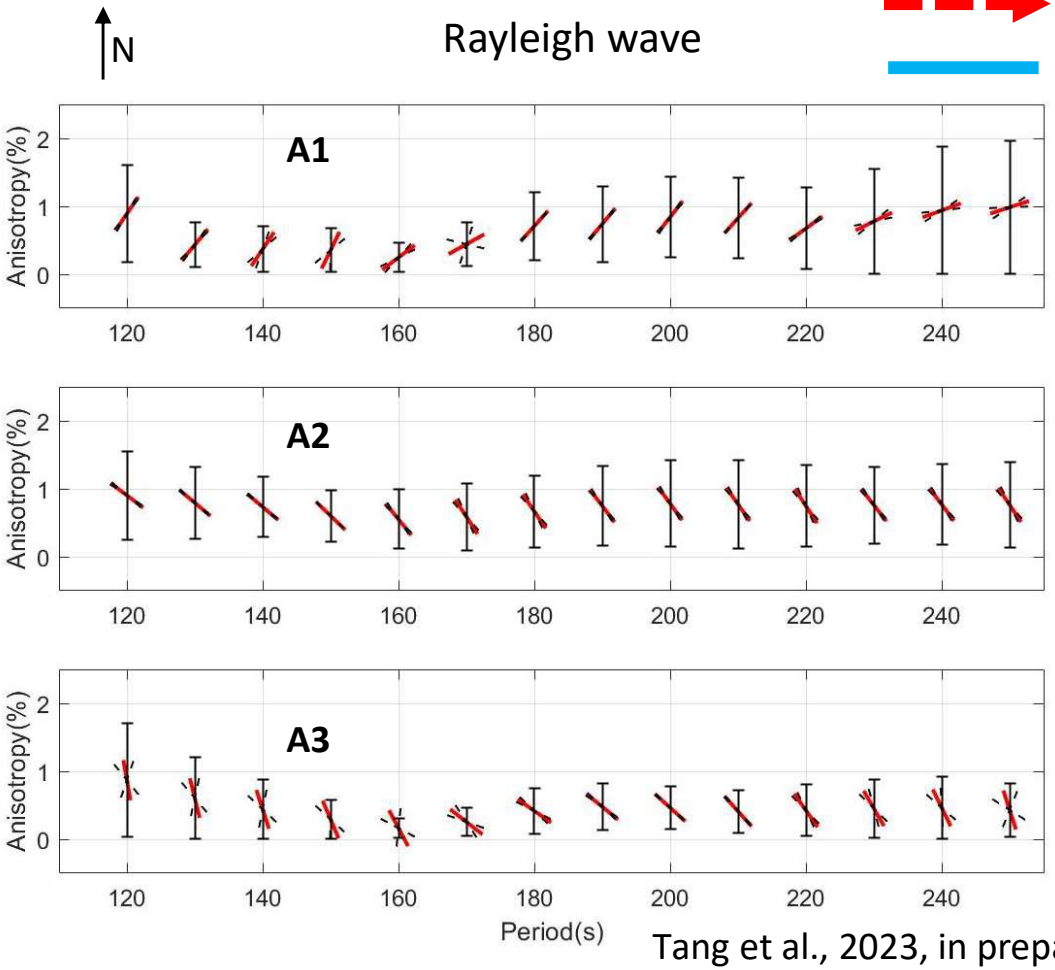
OBSERVATION

Fast direction obtained by joint inversion (surface waveform + SKS)

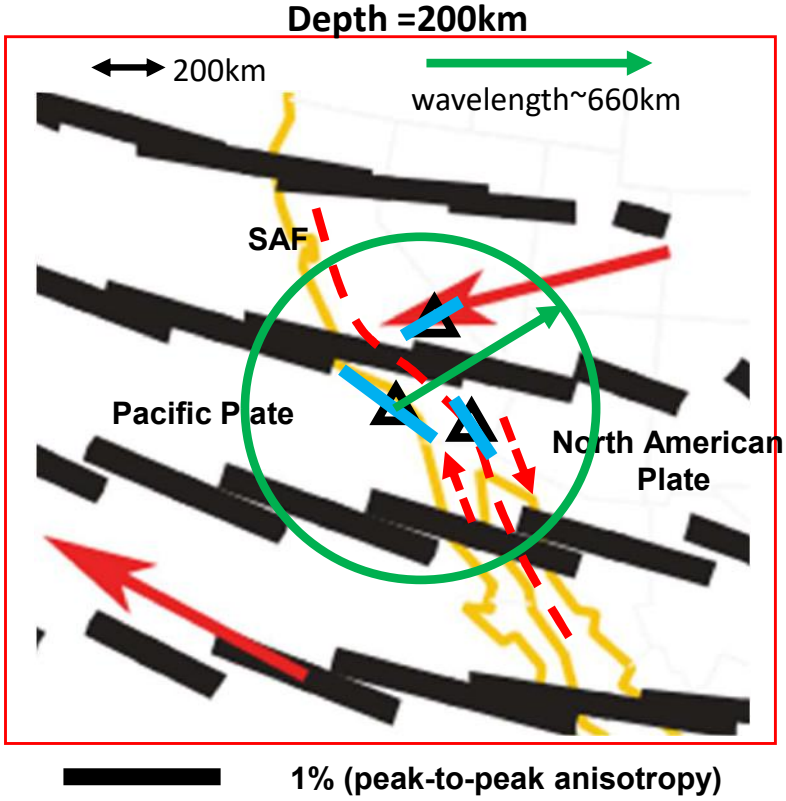
Direction of **absolute plate motion** (APM)

Direction of relative plate motion. **San Andreas Fault** (SAF)

6C result: Fast direction of Rayleigh wave (140-160s: ~200km)



Tang et al., 2023, in preparation



modified from Marone and Romanowicz, 2007,Nature

CONCLUSION

1. **A new method** for studying azimuthal anisotropy (high lateral resolution << wavelength).
2. **Improve the observation of rotation** to decrease the uncertainty (or error).
3. **Ambient noise data**.(should be possible …)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 955515 – SPIN ITN (www.spin-itn.eu)