Numerical simulation of hum excitation in an ocean with bathymetry

Rolf Häfner[1], Rudolf Widmer-Schnidrig[1,2]

[1]Institut for Geophysics; University of Stuttgart
[2]Black Forest Obervatory (BFO)

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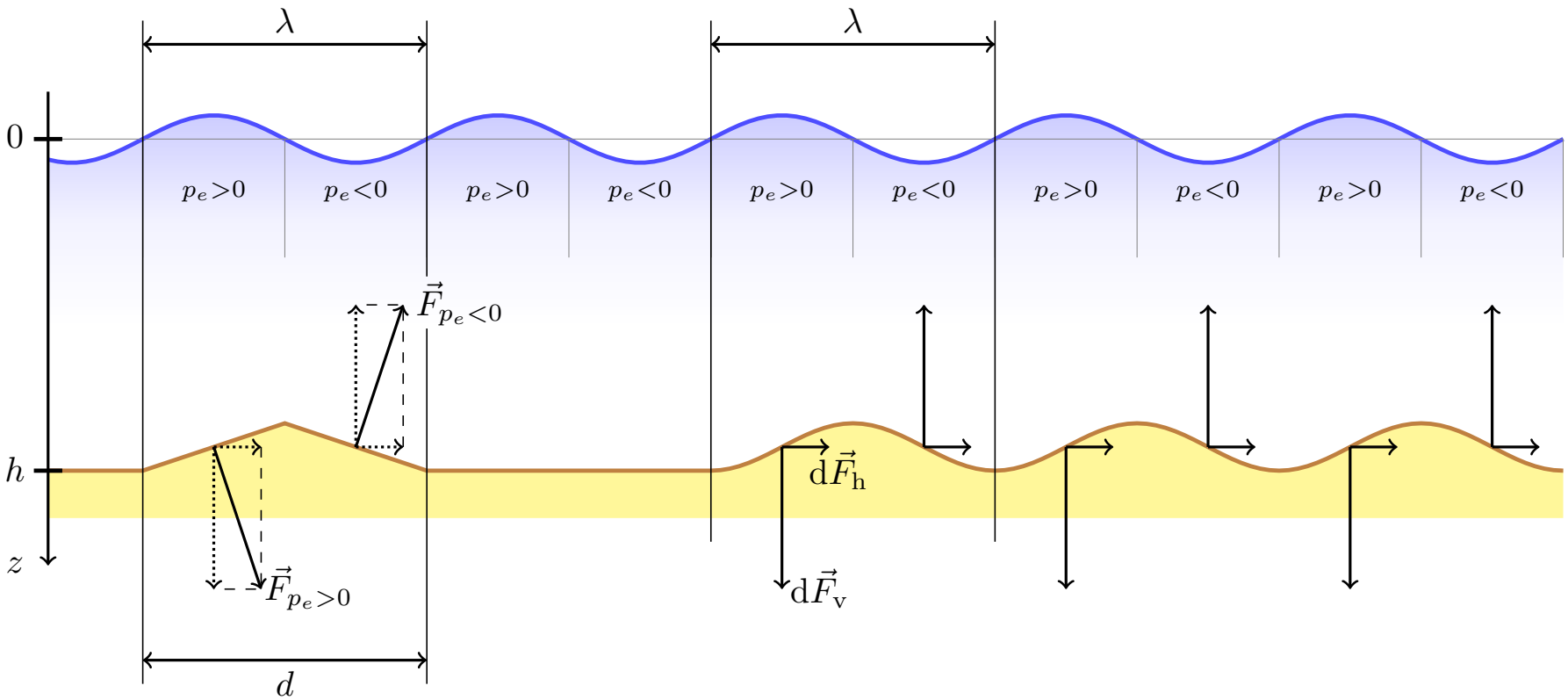
Hum Day

Open problems

- Can normal forces on submarine slopes explain both the observed vertical and horizontal Hum?
- What is the ratio of excitet Rayleigh and Love wave energy?

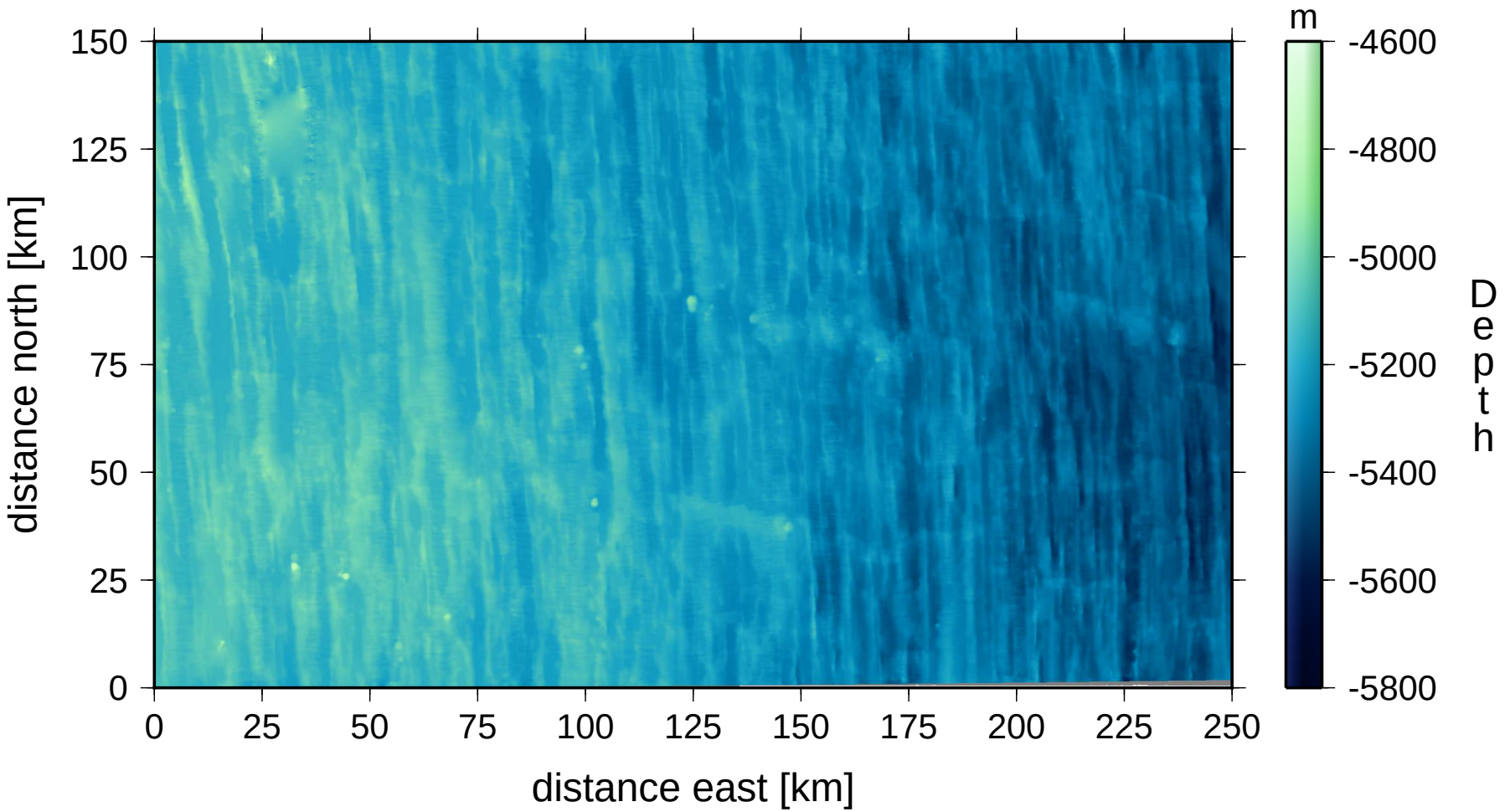
Model

We expand the excitation mechanism suggested by Fukao, Nishida and Kobayashi (2010; GRL) from distributet seamounts to periodic bathymetry.



Is there periodic bathymetry?

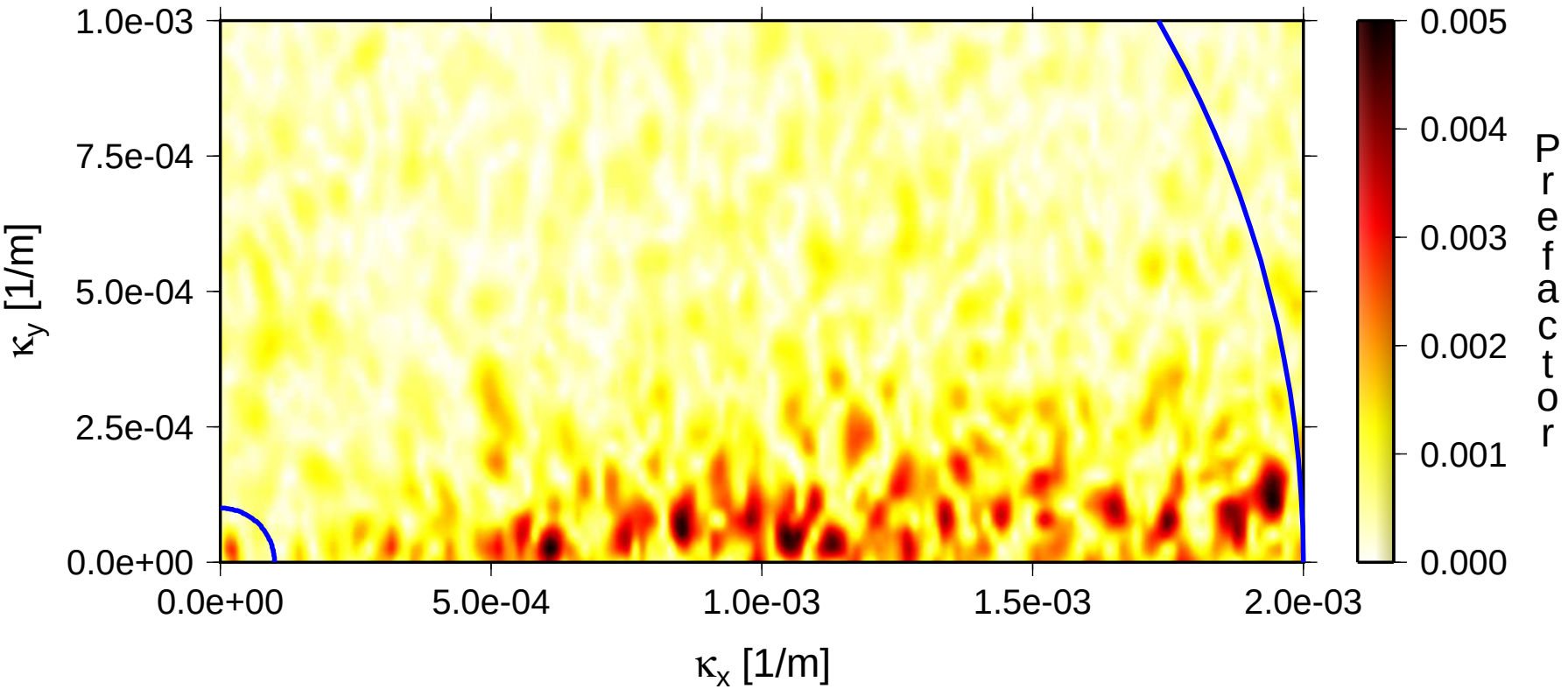
Is the assumption of periodic bathymetry realistic?



bathymetry near 19°30'N152°30'W

Is there periodic bathymetry?

The fourier transform shows periodic structure

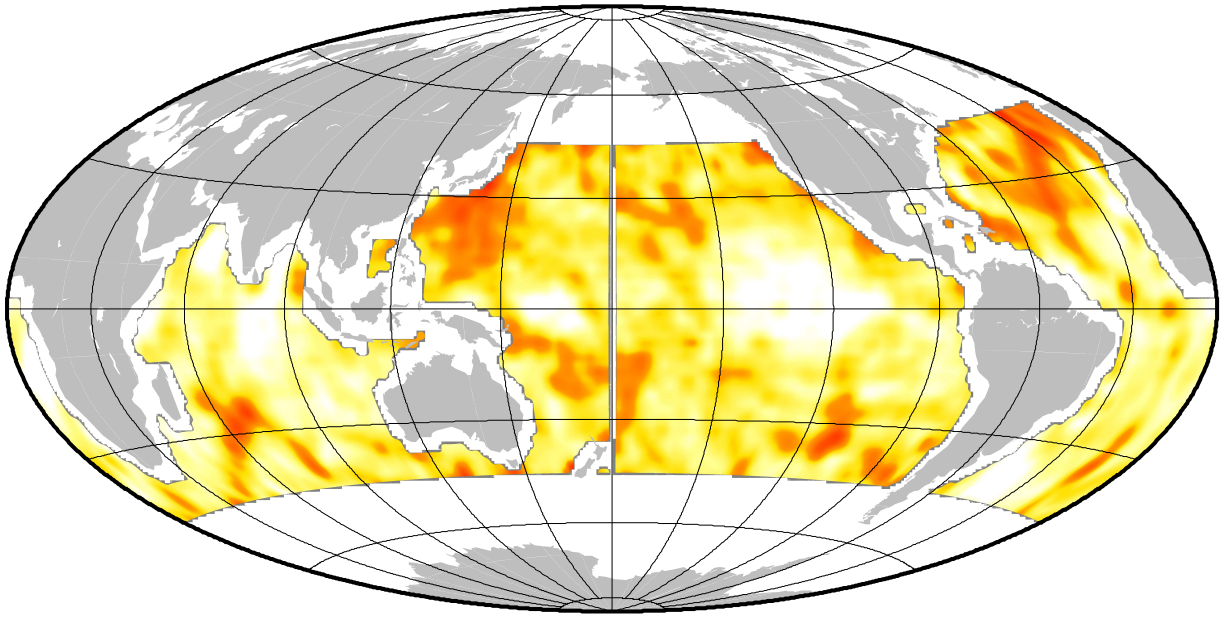


circular arcs at $k_1 = 1 \cdot 10^{-4}\mathrm{m}^{-1}, \lambda_1 \approx 62\mathrm{km}$ and $k_2 = 2 \cdot 10^{-3}\mathrm{m}^{-1}, \lambda_2 \approx 3\mathrm{km}$

Is resonant excitation efficient?

The resulting excitation ...

- is highly dependant on matching wave vectors $\vec{k}$ of the bathymetrie and the infragravity wave field.
- may be integrated over large areas.



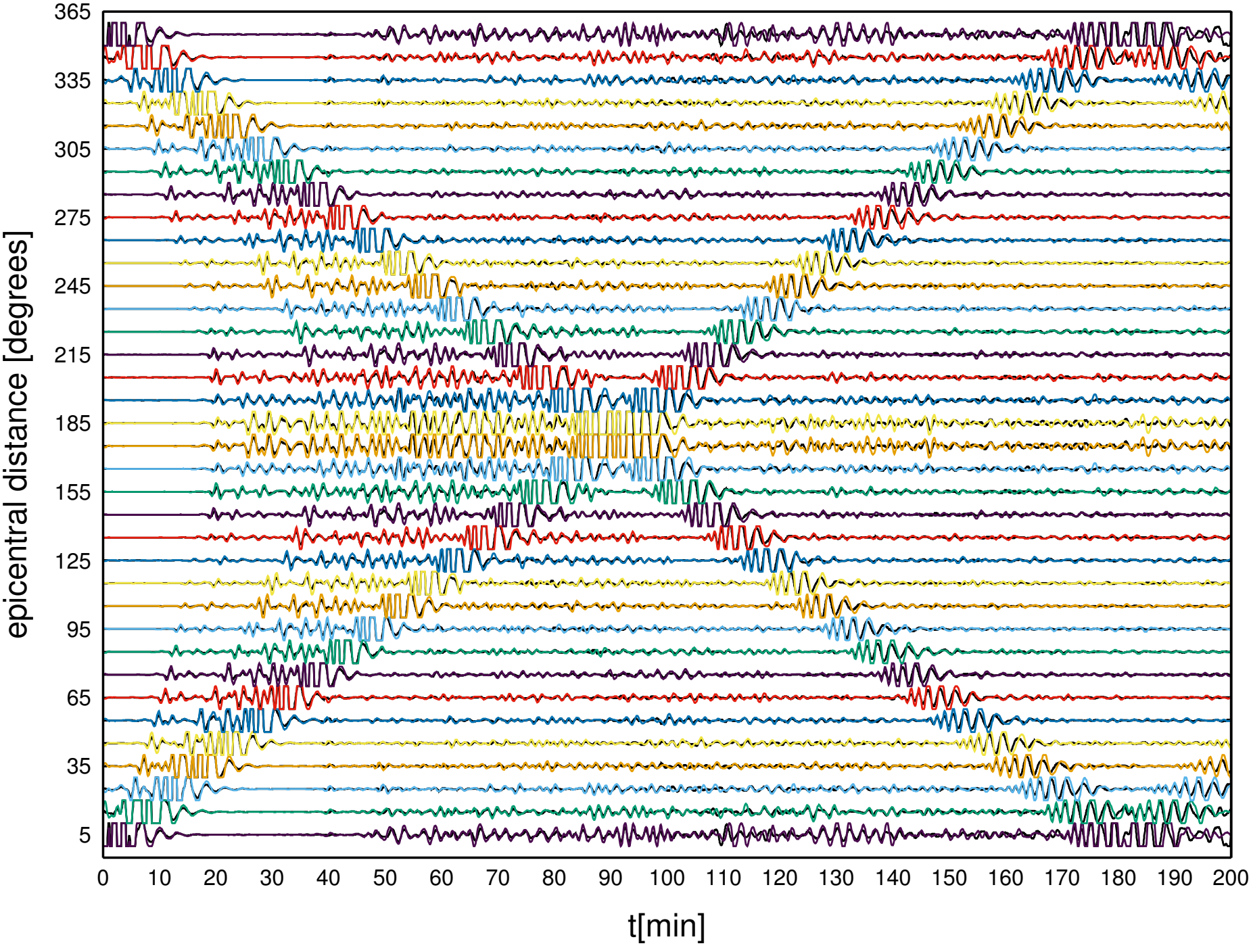
Our Software

To investigate these problems we need software to calculate synthetics

- for spatially and temporally extended sources.
- of ressure fields on real and synthetic bathymetries.
- for extended time windows.

Our Software ...

- is an in-house development in Python:
  - easy import and export of different data formats for seismic or bathymetric data (obspy, netcdf, etc.)
  - efficient numeric by the use of numpy/scipy
- uses mode summation:
  - efficient at low frequencies
  - allows for pre-selection of mode type
- uses a grid of time dependant point forces a source.


epicentral distance [degrees]
365
335
305
275
245
215
185
155
125
95
65
35
5
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
t[min]

Performance

Type	f_{max}	modes	time
1 Source, 2048 samples:			
Full waveform	30 mHz	9787	9.3s
Surface Waves	30 mHz	590	0.8s
Full waveform	10 mHz	1165	1.3s
Surface Waves	10 mHz	184	0.016s
1000 Sources, 8192 samples:			
Full waveform	10 mHz	$1.1 \cdot 10^6$	54min

Current status

- We have a robust and easy to expand toolbox for the calculation of synthetics
- The numeric efficiency is sufficient.
- We can easily import different sources of seismic, hydrophone and bathymetric data.

Next steps

- Comparison of synthetic and analytic results for idealized simple bathymetries and pressure fields.
- Creation of a more realistic pressure field models based on hydrophone data.

Thank you for your attention!