# Radiometer characterization (and other things)

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# Idea for verifying radiometer

- Find a time or a frequency or something where we *know* there are R-waves
- Run the radiometer r-wave code on that time

# Possible examples

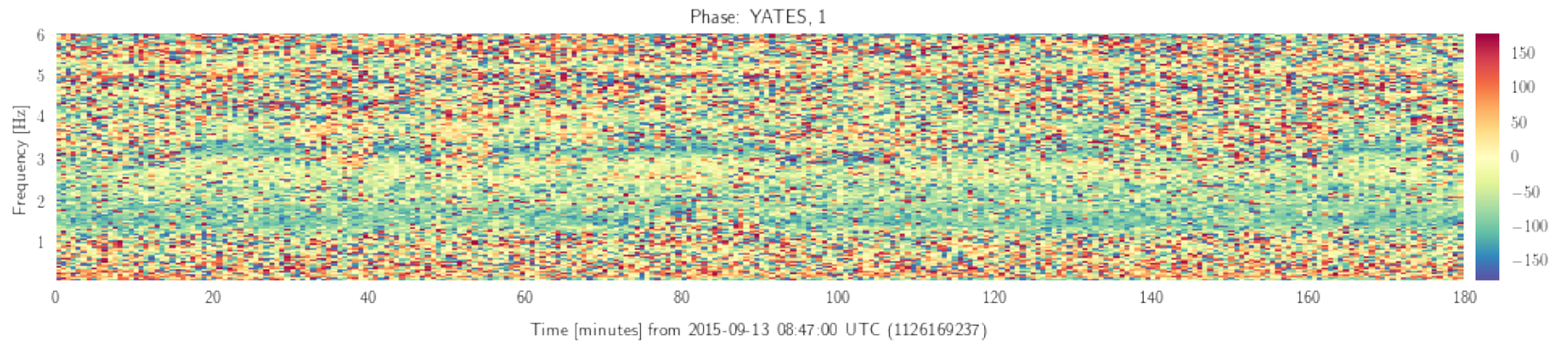
1. After an EQ
2. After a mine-blast
3. Some persistent source
4. Microseism

# Persistent source example

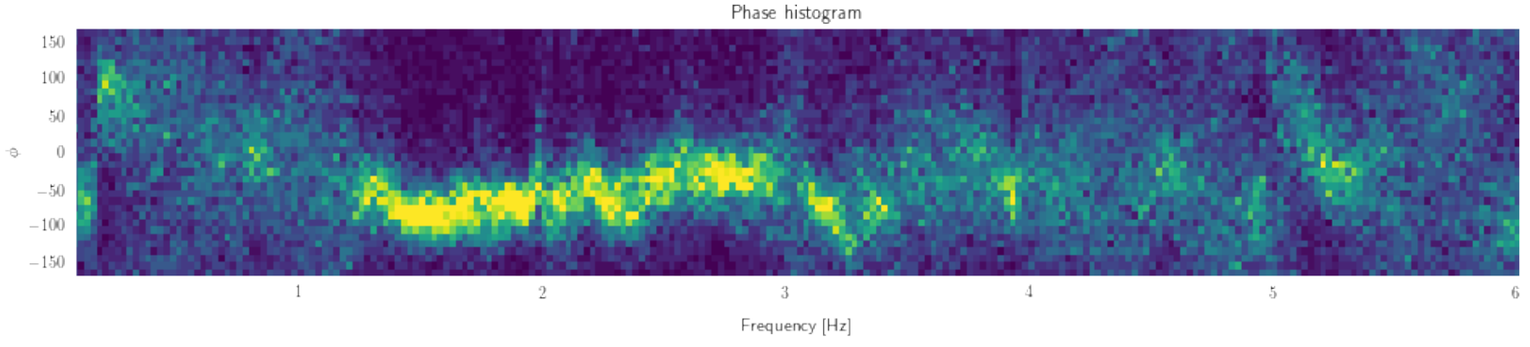
- Top: Phase difference between vertical and east channel

- Bottom: Histogram over time segments

- NOTE: This source isn't really seen in the North channel at all




confusing information so I've covered up these plots

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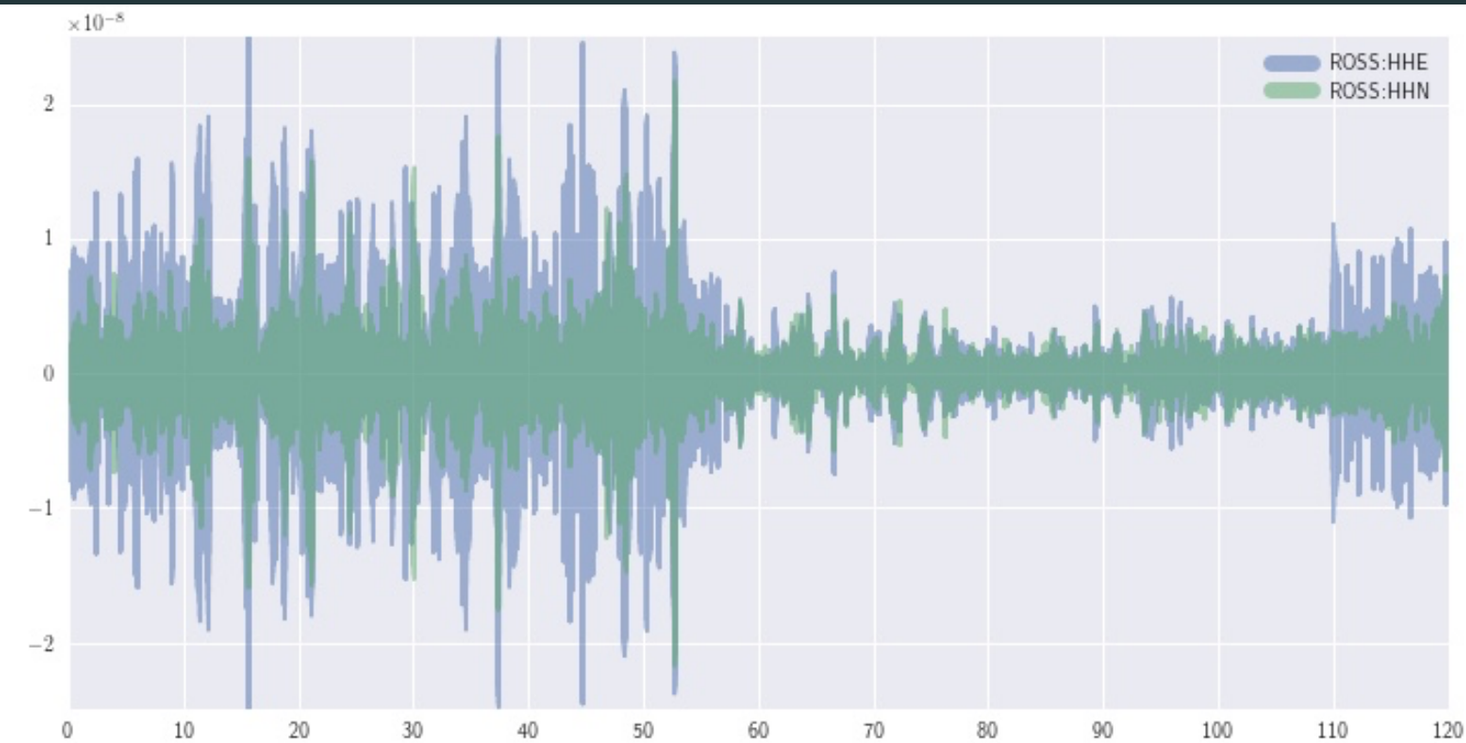
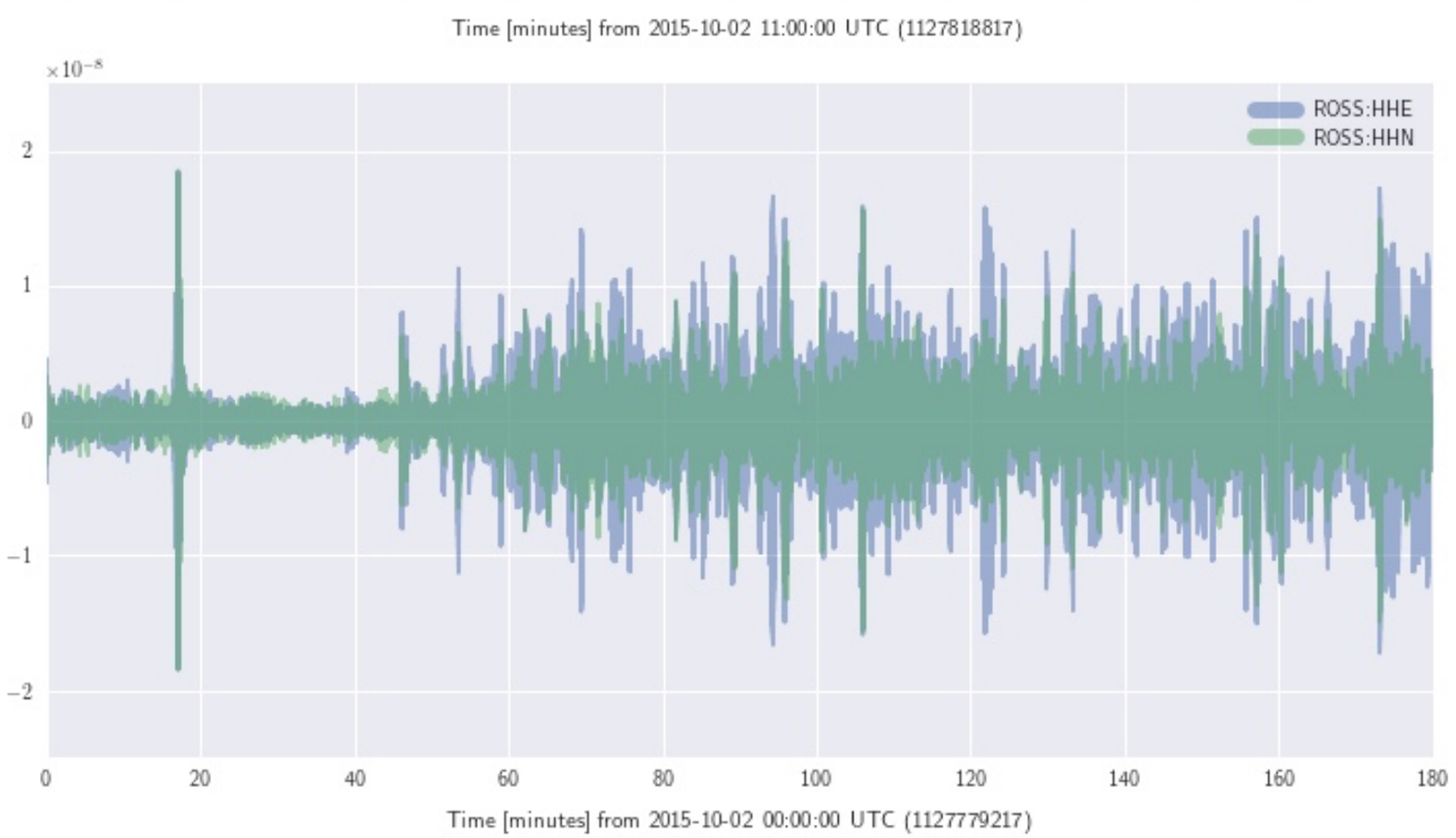
# This source turns on and off?

- Band-pass filter from 1.4 - 1.6 Hz, look at time series




- See it turn off at 00:00 - 00:30 and 12:00 - 12:30 UTC *every day* for some reason

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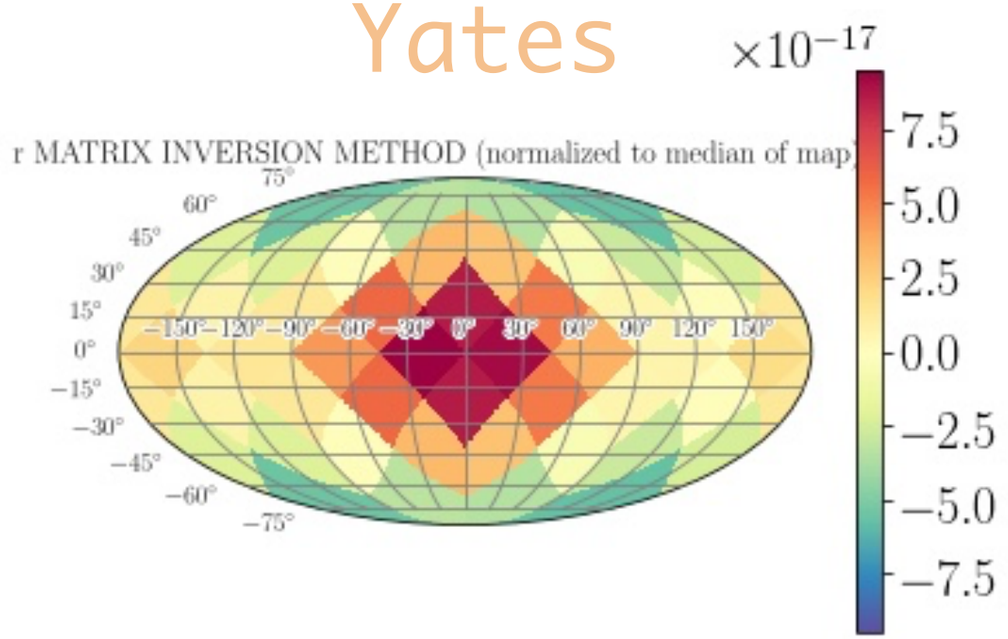
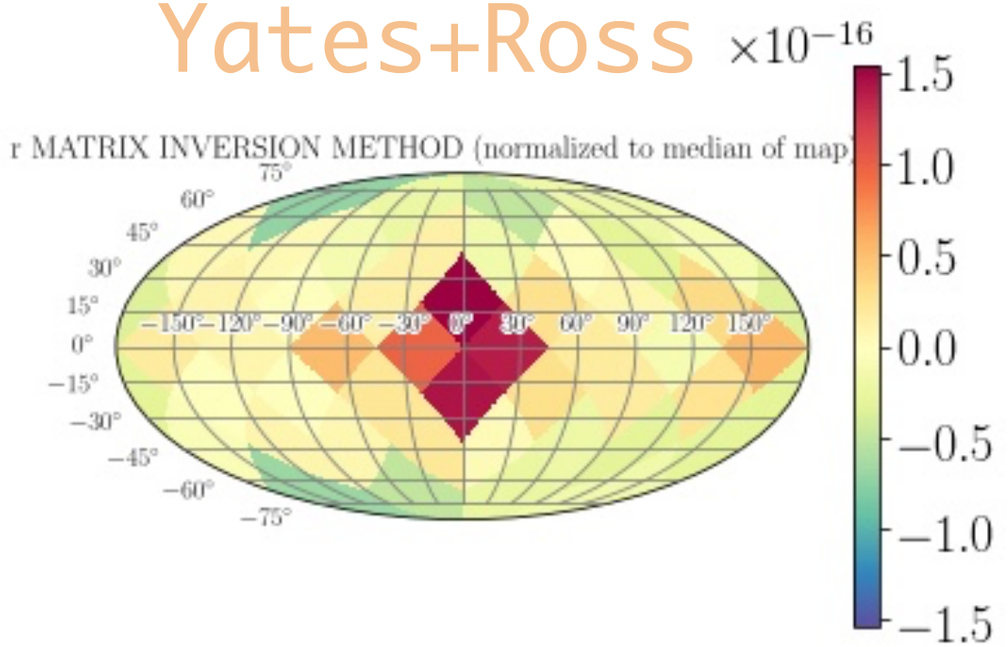
# Can we recover this source when it's on?

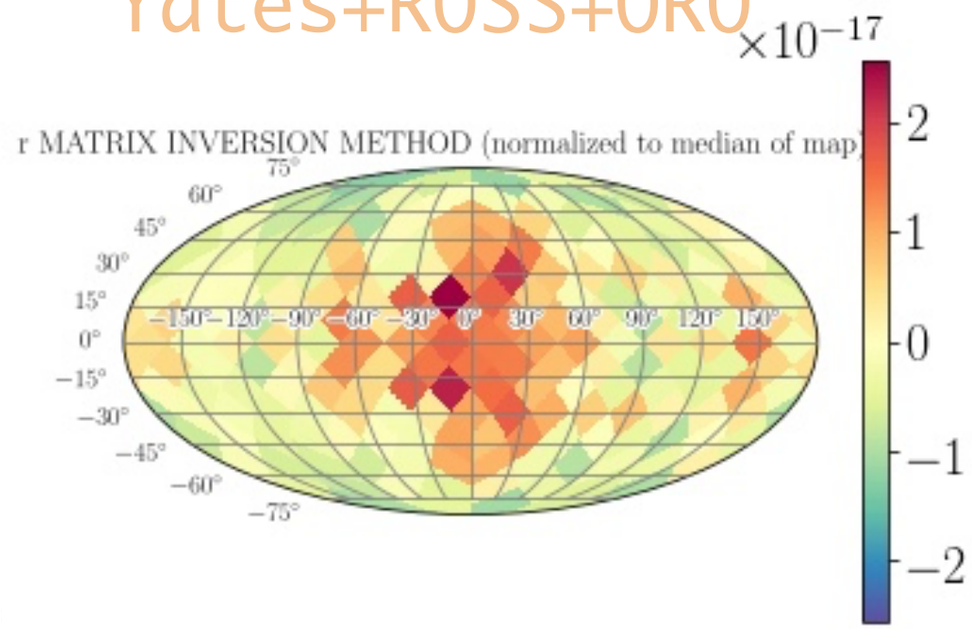
Yates



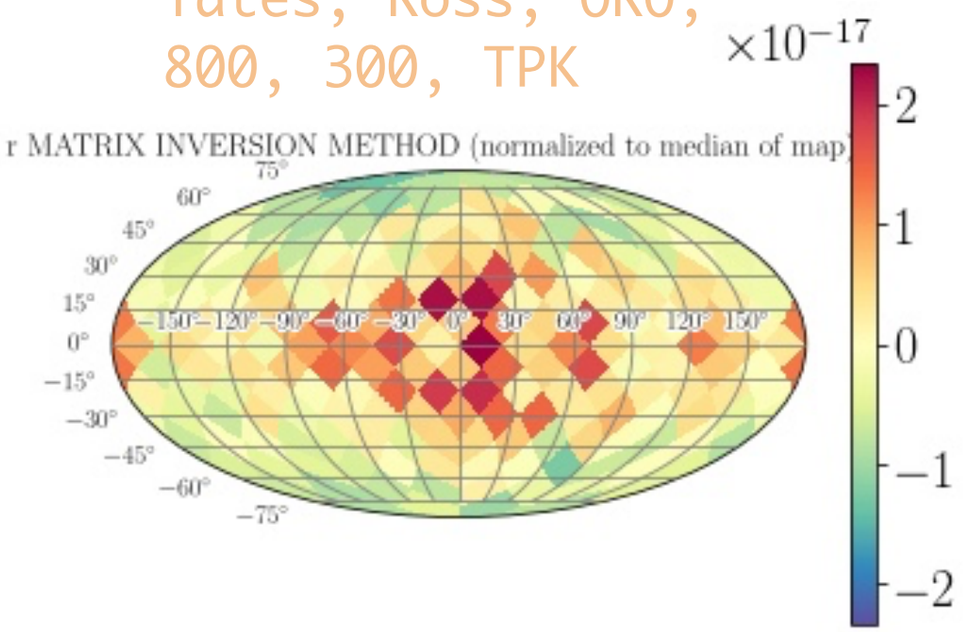

Yates+Ross




Yates+ROSS+ORO




Yates, Ross, ORO,
800, 300, TPK

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# Does the size of the recovery make sense?

- All recoveries done using Daniel's velocity estimates for r-waves

- $2x10^{-17}$ (in power) -> $4.4x10^{-9}$ in amplitude.

  - That's about right if you look at time series from two slides ago.

# Other notes about this study

- The source isn't seen in all channels
  - not seen in DEAD, SHL, and some of the stations at depth.
    - Adding stations at depth does not help radiometer recovery (potentially due to mismatch in eigenfunction?)
- It's unclear to me whether this source is local or distant. See next slide

# Verifying this recovery

- Radiometer has two aspects to its recovery if we just use surface stations:
  - Timing information
  - Polarization information (i.e. longudinal + vertical for Rayleigh waves)
- We can asses polarization information by using single stations in the radiometer recovery (see slide 6 top left for example).
- We can asses timing information using a separate analysis that *just* uses timing on the same data.

# Time delay between separated channels

- Plot phase between stations vs. projected distance in eastern direction. The slope is $1 / (v\sin\theta)$
- $v\sin\theta = 3396.22 \pm 429.55$ m/s
- So…we can also figure out what the direction is this way if we assume we know the velocity a priori!
- Used YATES, ROSS, ORO, TPK, 800, 300 for analysis.

# Time delay direction measurement

$$\phi = \frac{2\pi f d}{v}$$

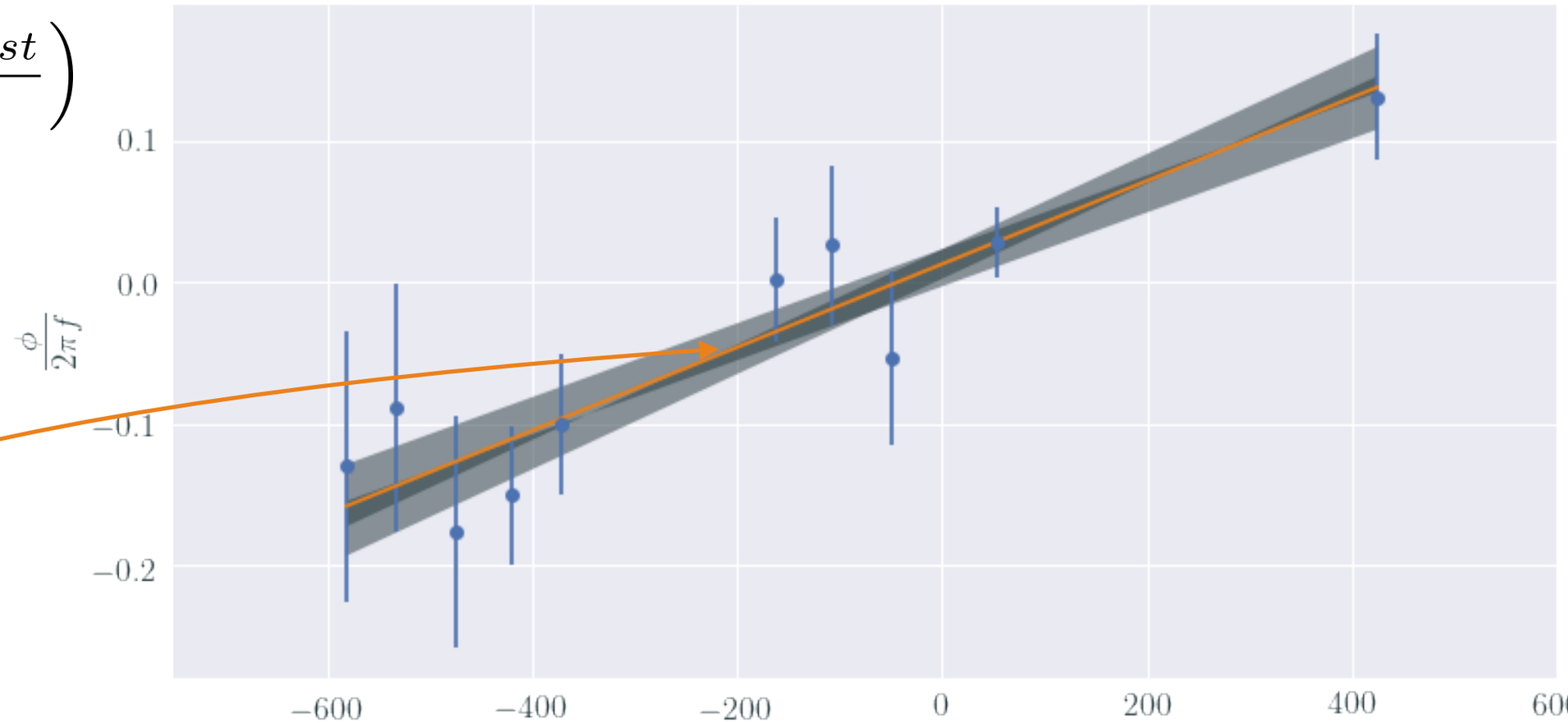
$$v = 2636 \pm 300 \text{ m/s}$$

- Using Michael's r-wave velocity measurements.

$$v_{east} = v \sin\theta$$

$$\theta = \arcsin\left(\frac{v_{east}}{v}\right)$$

$$\theta = 51^\circ \pm 12^\circ$$




$$v_{east} = 3396.22 \pm 429.55 \text{ m/s}$$

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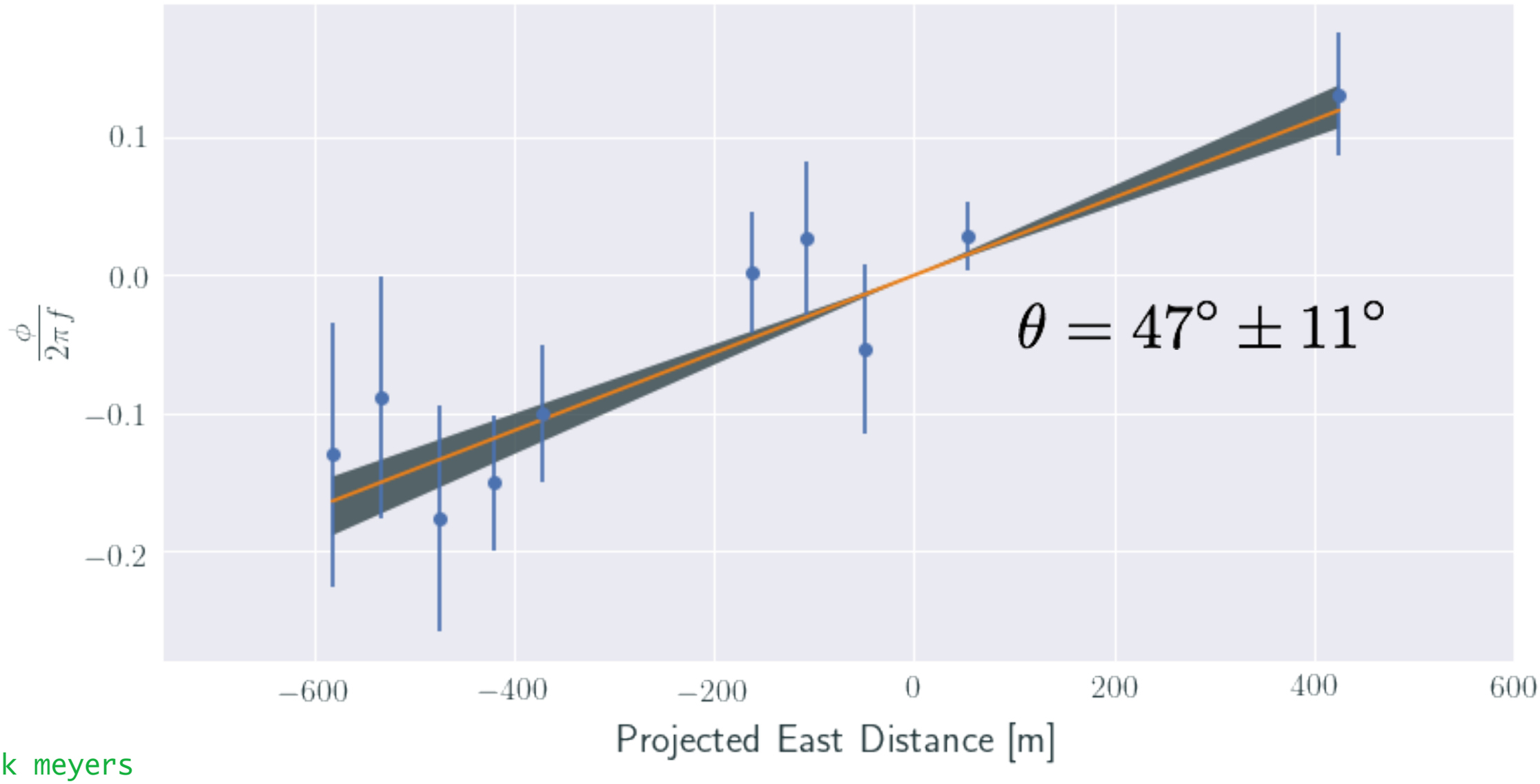
# Comments

- This is not *directly* comparable to radiometer yet (it only uses East channels, for example)…but it’s getting there.

# Extras – fix intercept

- Fit while fixing that phase is zero at zero distance:



# Extras – recovery comparison