

# X-band radar breakout

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UNIVERSITY OF MIAMI  
ROSENSTIEL SCHOOL of  
MARINE, ATMOSPHERIC  
& EARTH SCIENCE



# X-band radar discussion topics

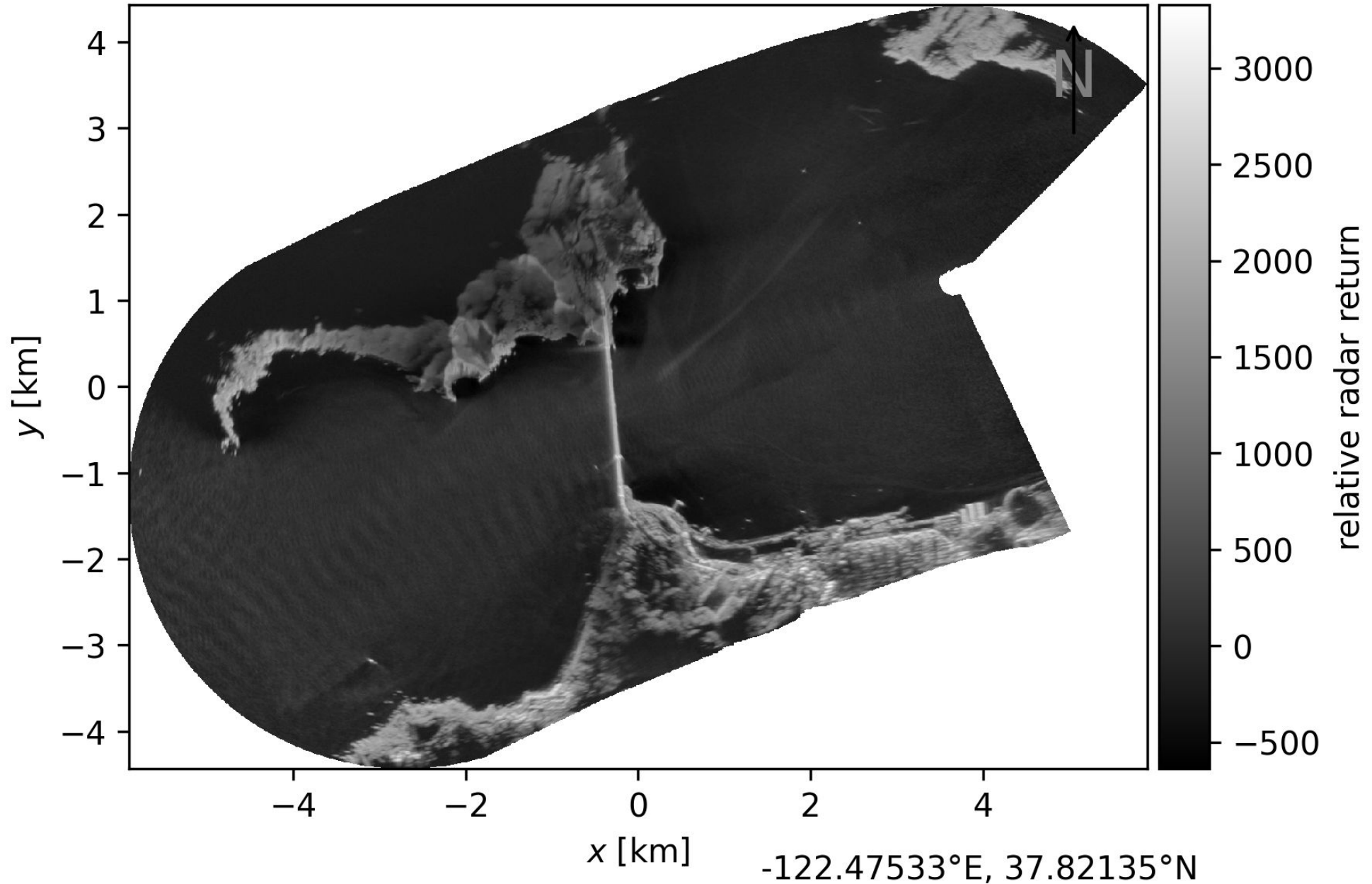
- Add radar products to cruise data set and R2R catalog.
  - Which products should be included?
    - Near-surface current and sea ice drift maps: ~100 MB/day,
    - Wave spectra and parameters: ~1 GB/day,
    - Mean sea surface roughness images: ~5 GB/day.
- What solutions exist for storing, transferring, and archiving radar raw data (or other shipborne big data sets)?
- Identify long-term archive for radar raw data with R2R.
  - What is the status of discussions with NCEI?
    - Radar raw data: 200-300 GB/day or 55-65 TB/year.
- Extend radar support to more radar-equipped research vessels.
  - Interested in enhancing your shipboard X-band radar's capabilities?
    - Email me ([blund@cstars.miami.edu](mailto:blund@cstars.miami.edu)).

# X-band radar best practices

- Record GPS and accurate heading data at high temporal resolution (>1 Hz) via serial feed.
- Enable regular radar calibrations by recording radar raw data while departing from and returning to port.
- Synchronize the radar acquisition server with the ship's time server.

SR 2021-06-11 00:10:04 - 00:39:27 UTC  
azimuth = 0.000°, range = 0.000 m, time = 0.000 s

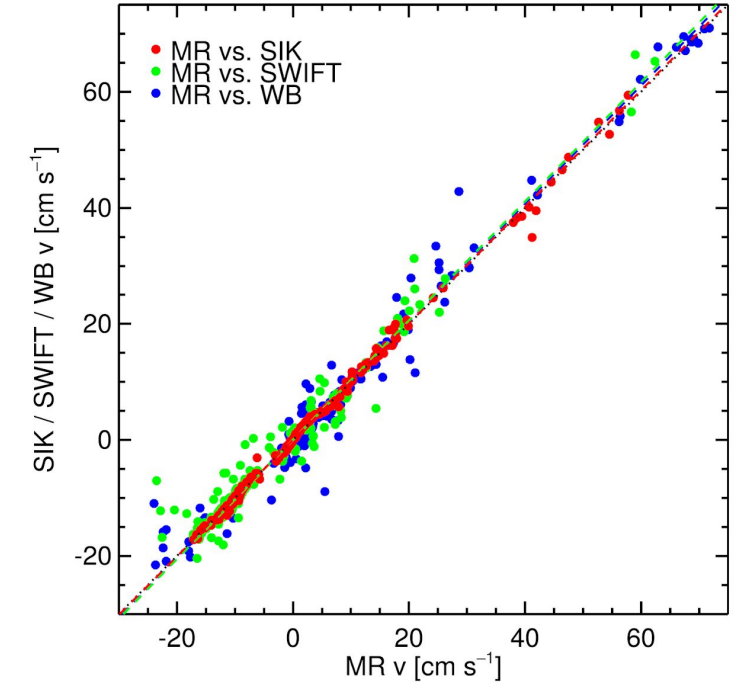
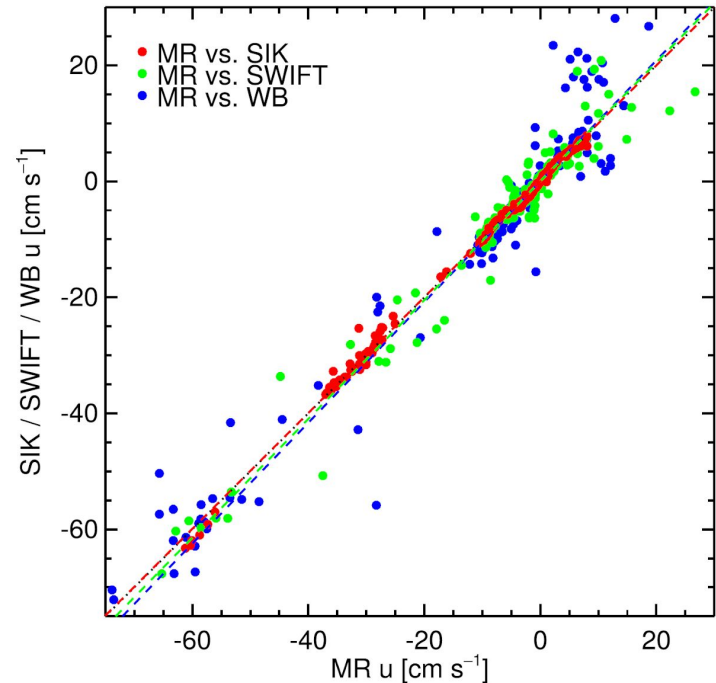
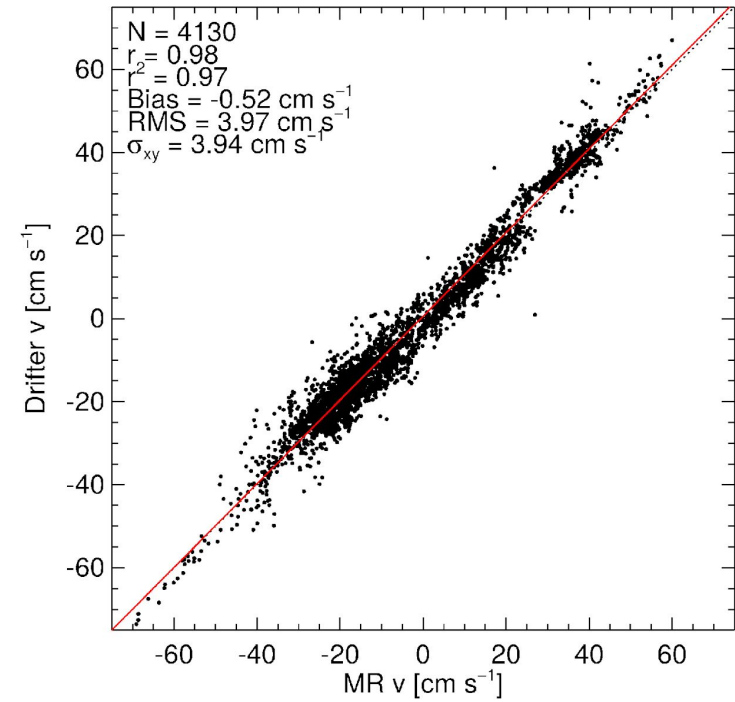
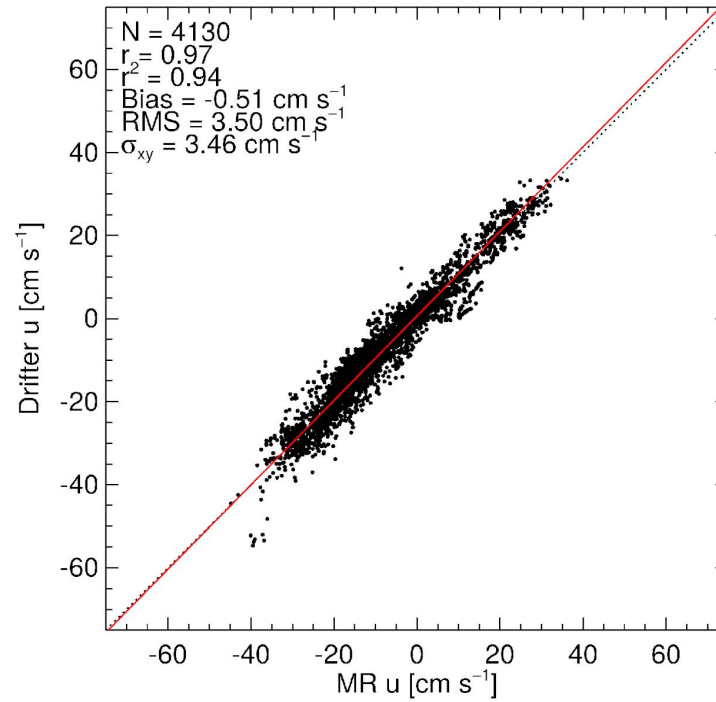
By marrying the radar raw data with high resolution and accurate GPS and heading data, and regularly calibrating the radar, we ensure that the radar backscatter measurements are correctly georeferenced, and that ship motion is entirely removed.



Scatter plots comparing radar-derived near-surface current (top) and sea ice drift (bottom) measurements with reference drift measurements.

Both current and sea ice drift measurements have an accuracy better than 4 cm/s (and repeatability better than 2 cm/s).

Low-resolution and low-accuracy navigation data or failure to calibrate the radar will result in mapping errors, compromising the radar products' quality.



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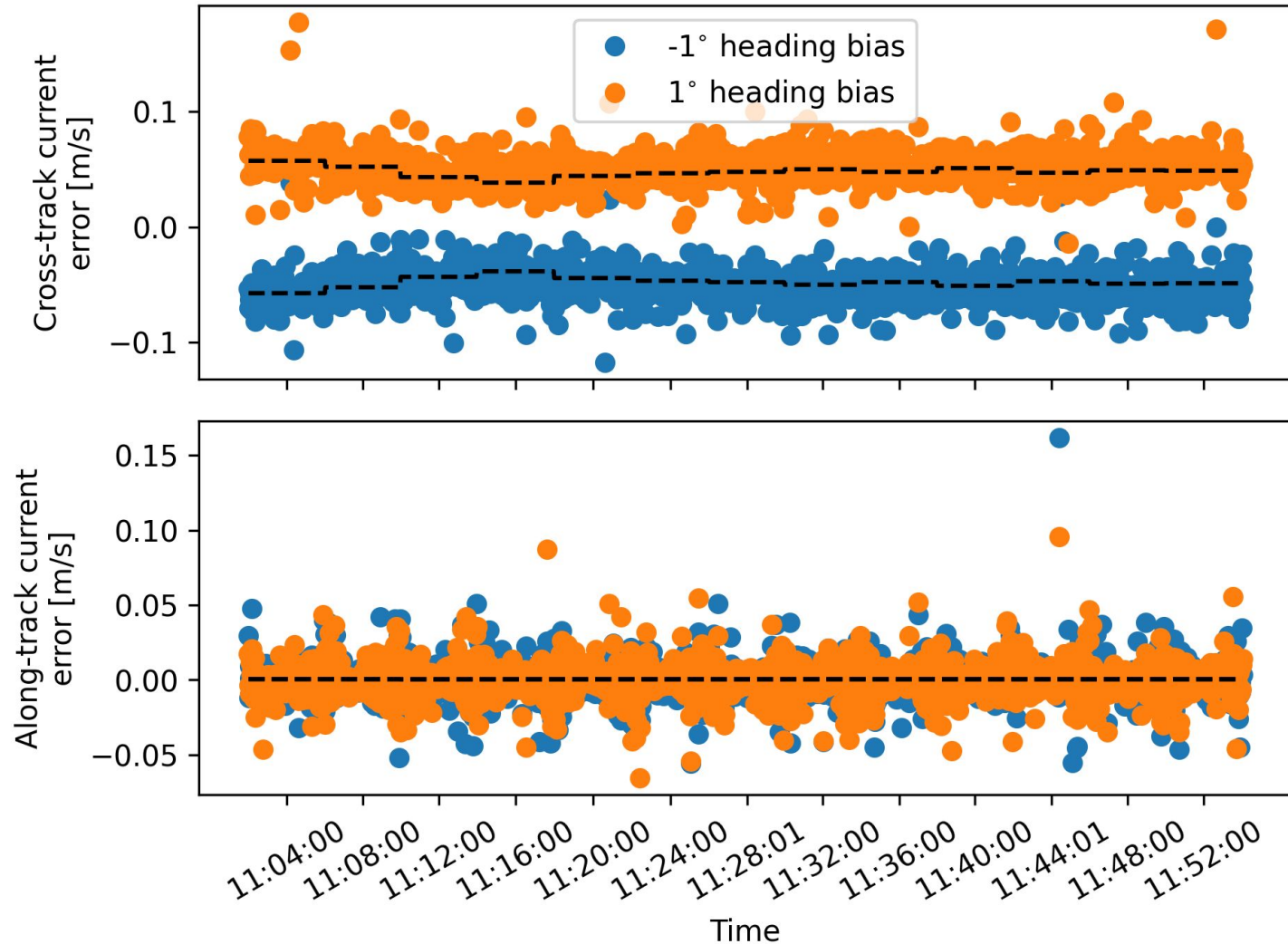
# Current errors as function of heading bias

Cross- and along-track current errors for a 1-hour R/V Sally Ride data set with a transit speed of 2-3 m/s and heading biases of  $-1^\circ$  and  $1^\circ$ .

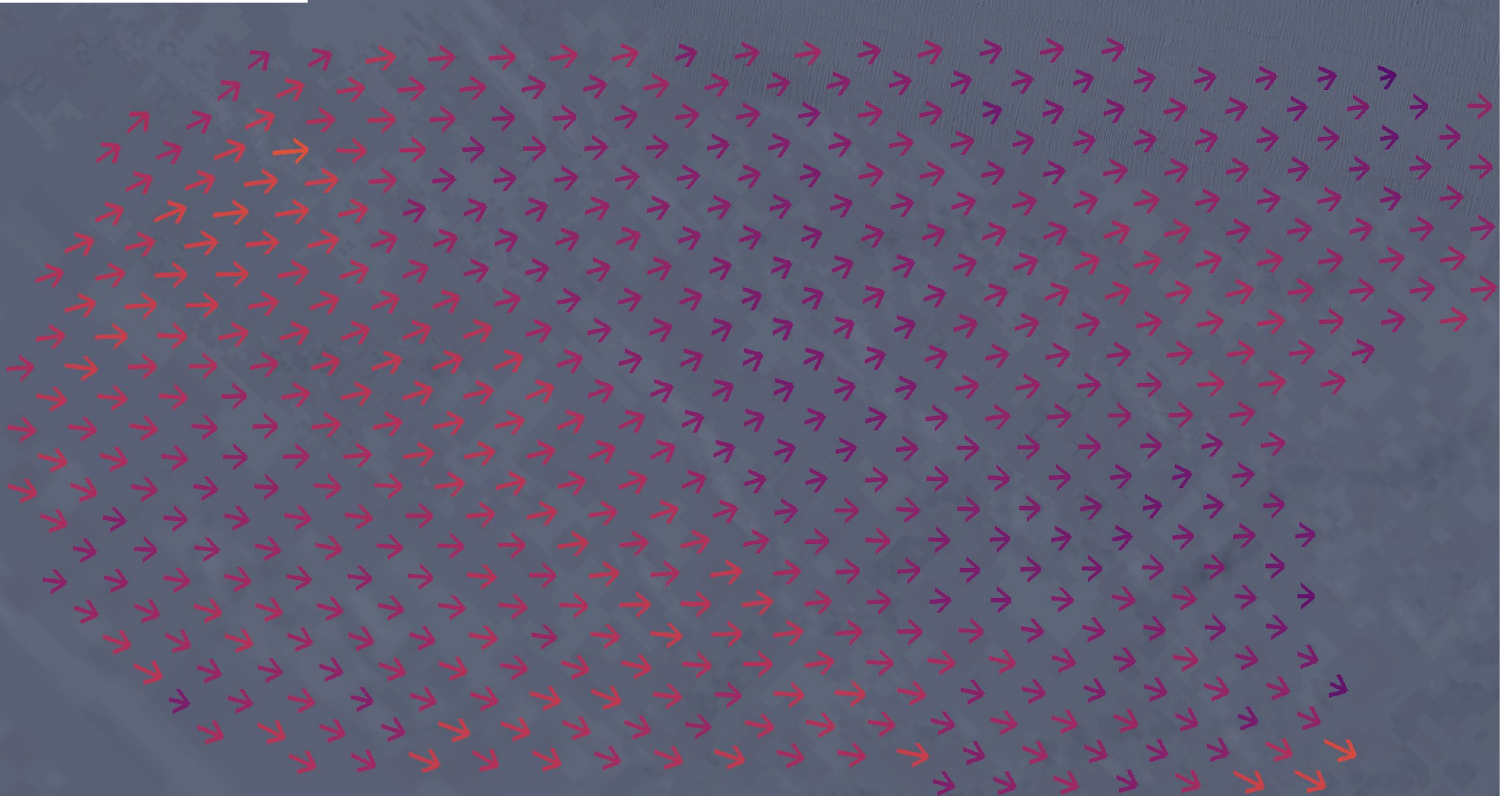
A small bias in the radar image heading can lead to a large cross-track current error ( $U_{\perp, err}$ ), proportional to the ship speed ( $U_{ship}$ ) and the sine of the heading bias ( $\theta$ ), and a small along-track error ( $U_{\parallel, err}$ ):

$$U_{\perp, err} = U_{ship} * \sin(\theta),$$

$$U_{\parallel, err} = U_{ship} * (1 - \cos(\theta)).$$



Azimuth bias = -1 deg



Google Earth

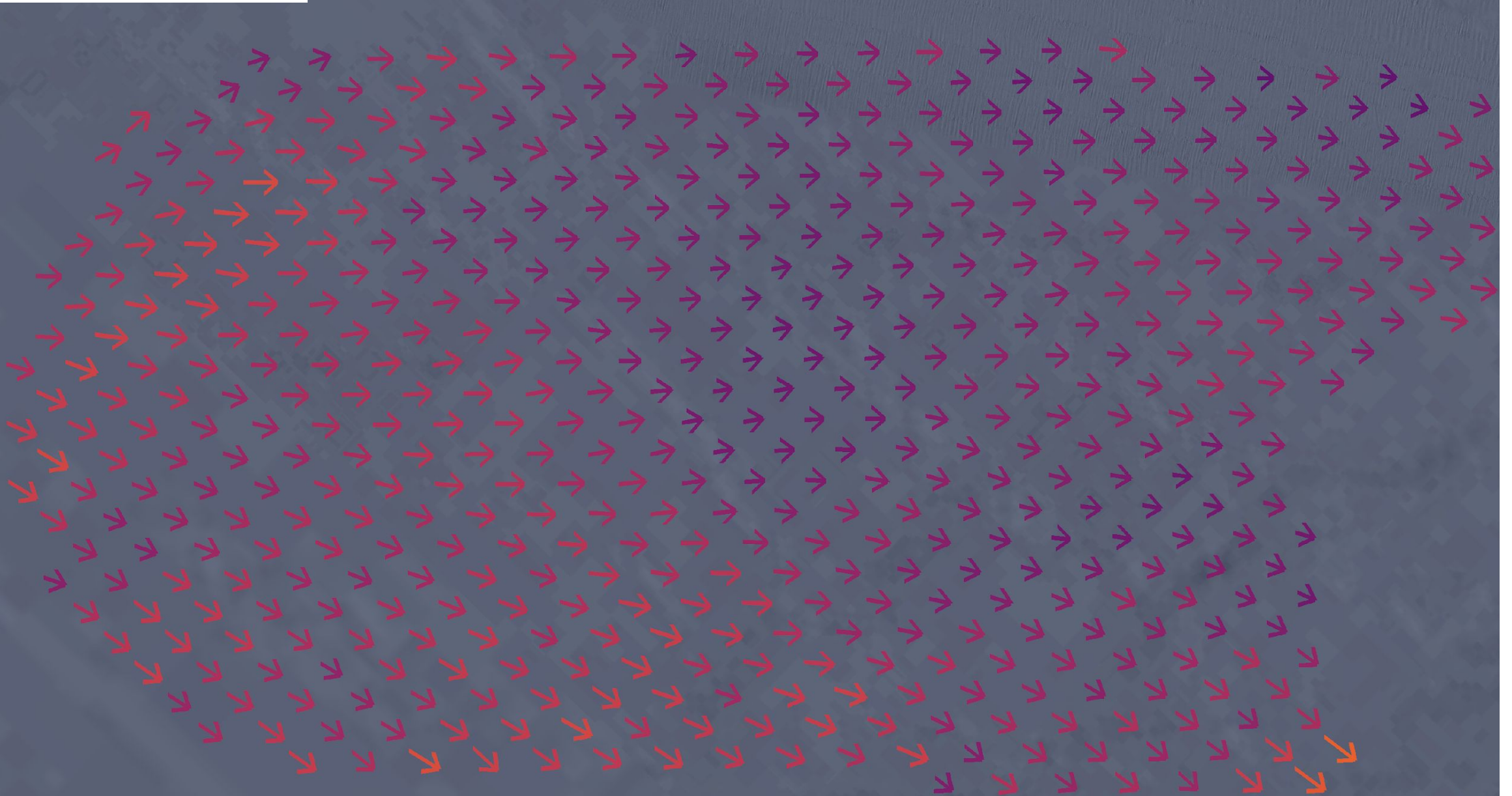
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Data CSUVB SFML, CA OPC



2 km



Azimuth bias = 0 deg



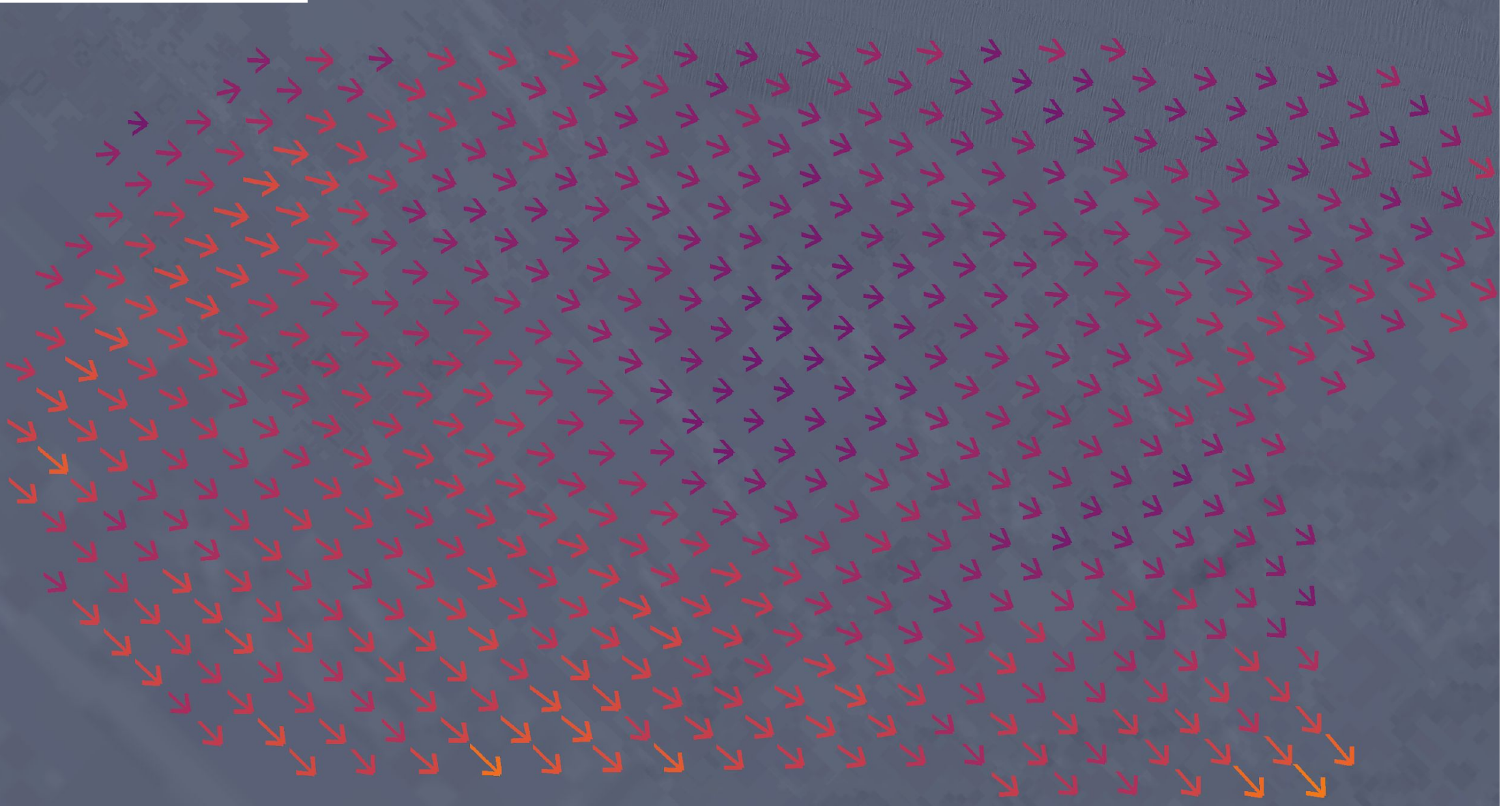
Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Data CSUVB SFML, CA OPC



2 km

Azimuth bias = 1 deg



Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Data CSUVB SFML, CA OPC

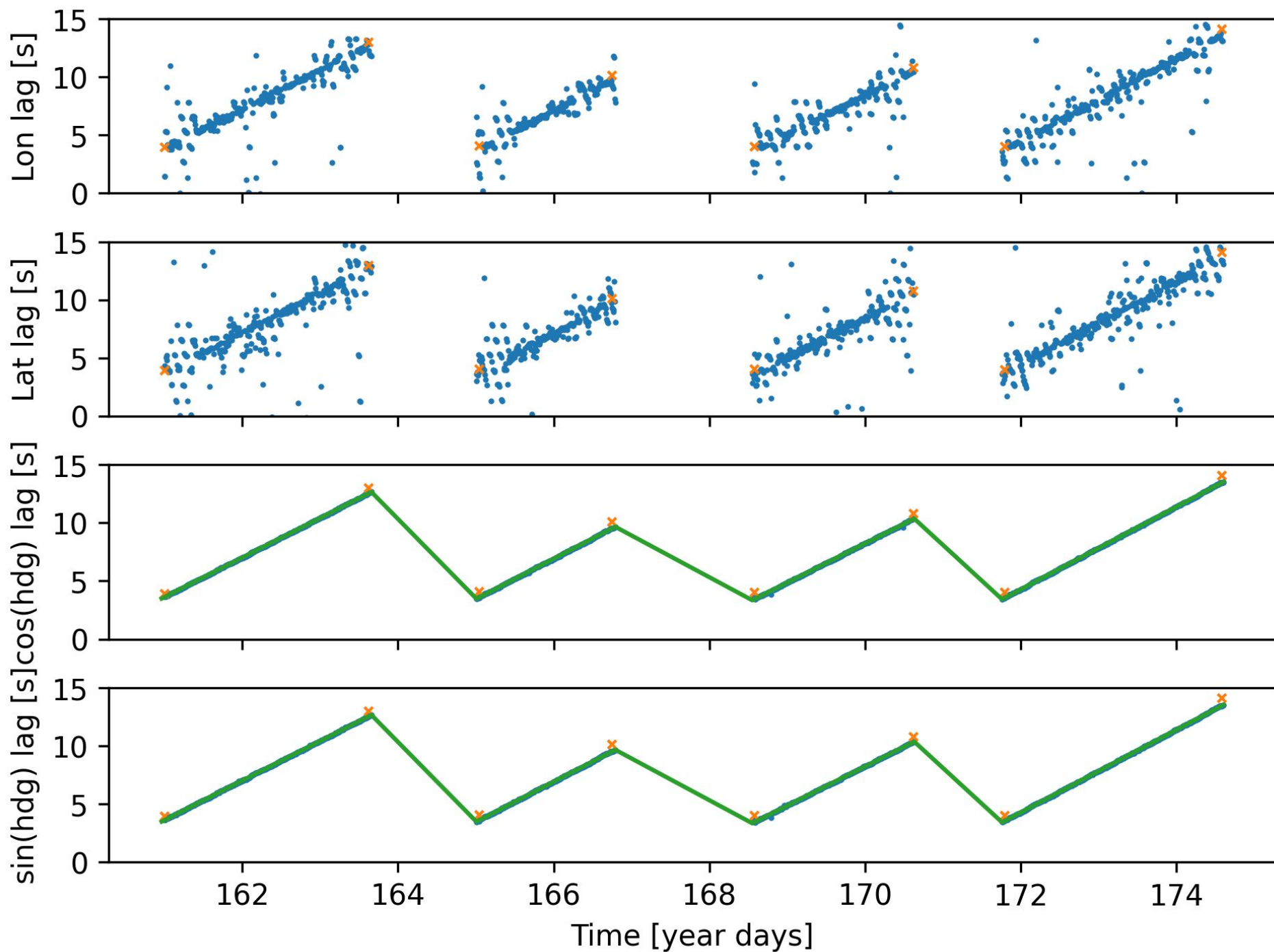


2 km

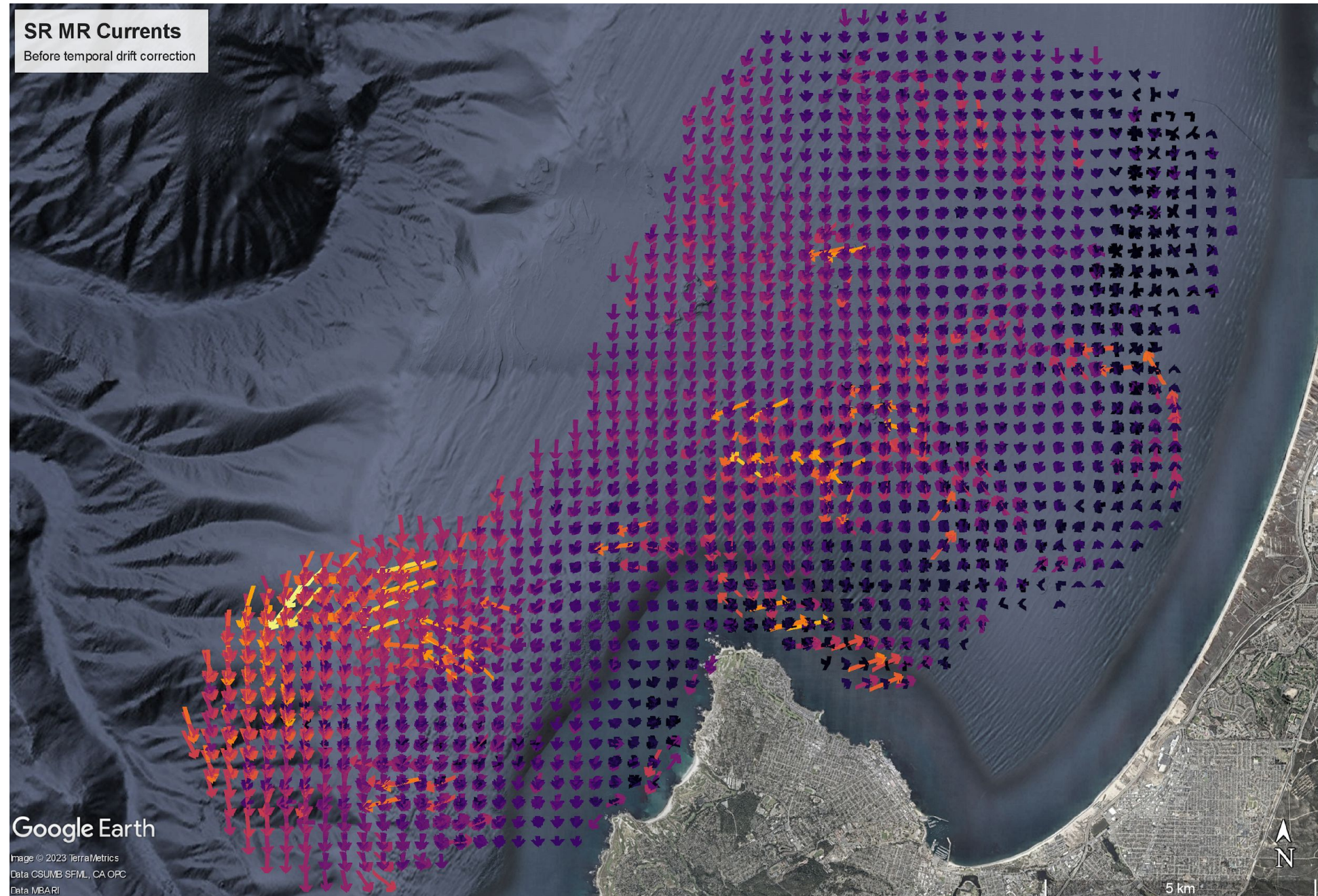
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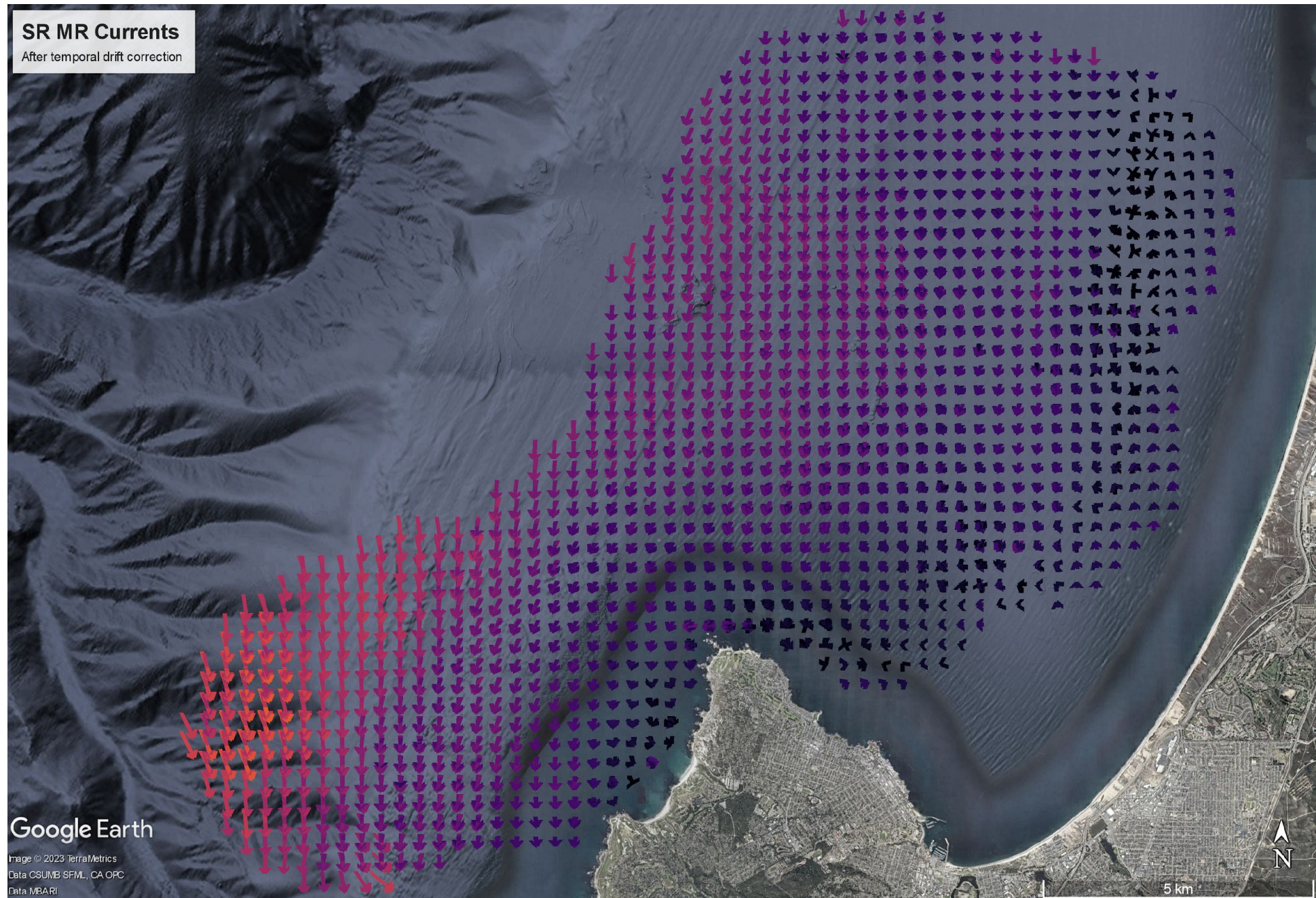
Cross-correlation between the low-resolution R/V Sally Ride position and heading data from the WaMoS POL files and the ship's navigation log files revealed a significant drift in the WaMoS time stamps. (The same issue is present on R/V Roger Revelle, not shown.)



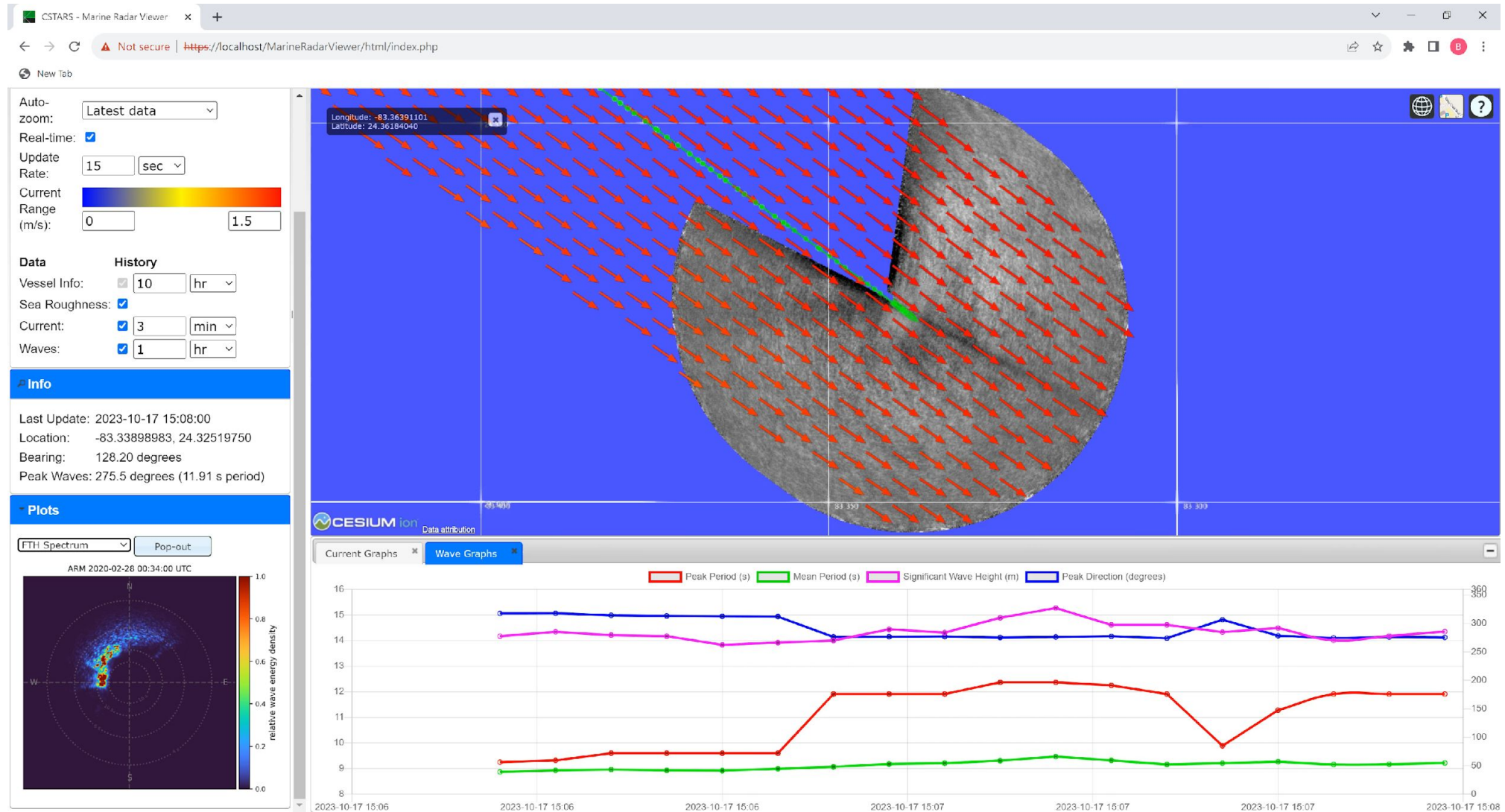
R/V Sally Ride in  
Monterey Bay:  
Radar-derived  
near-surface  
current map  
**before** time drift  
correction.



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# CSTARS X-band radar web viewer demo



# References

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