

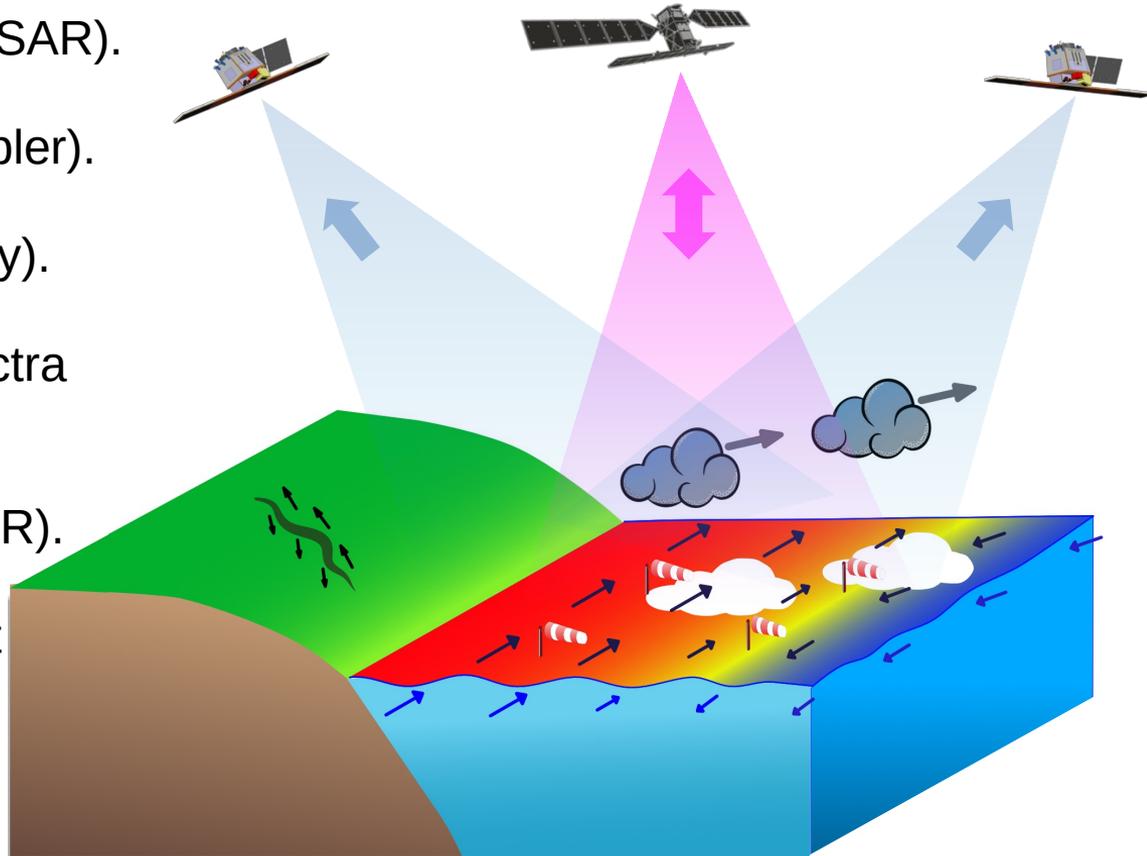
# Ocean wave spectra in tropical cyclones with the Earth Explorer 10 candidate Harmony

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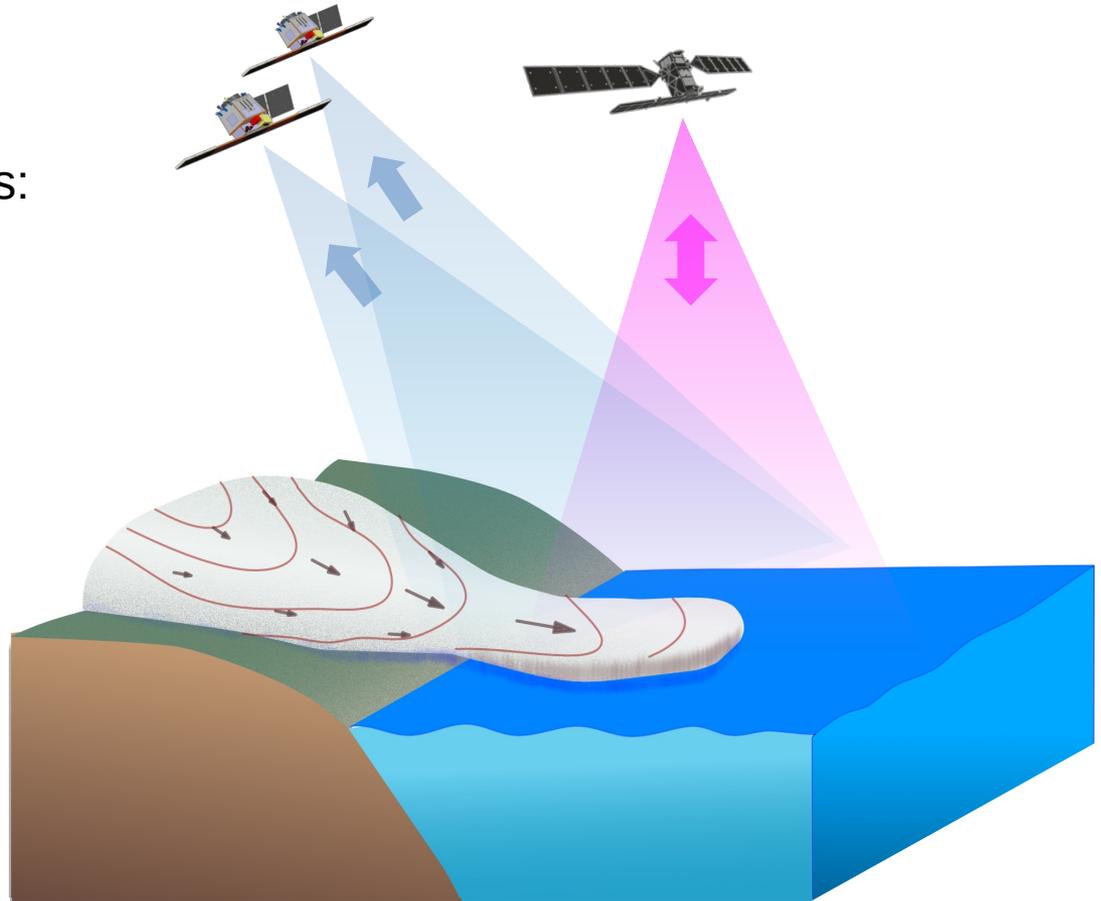
# Harmony observation concept: Stereo phase

- 3D surface deformation (dInSAR).
- Ocean surface motion (Doppler).
- Surface winds (scatterometry).
- Improved surface wave spectra (NRCS modulation).
- Sea surface temperature (TIR).
- Cloud-top motion and height (TIR time-lapse/parallax).

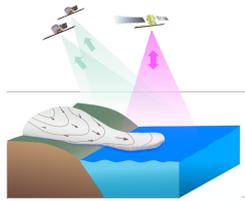


# Harmony observation concept: XTI phase

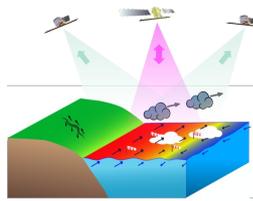
- 3D surface deformation.
- Surface elevation time-series:
  - Glaciers
  - Permafrost
  - Icebergs
  - Volcanoes
- Ocean topography.



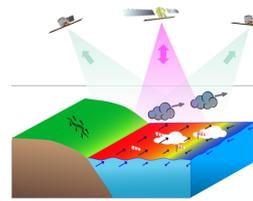
# Mission Timeline



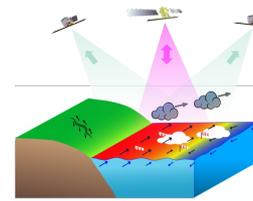
Y1



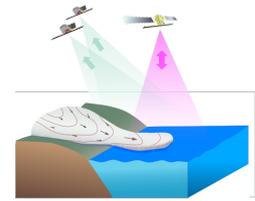
Y2



Y3



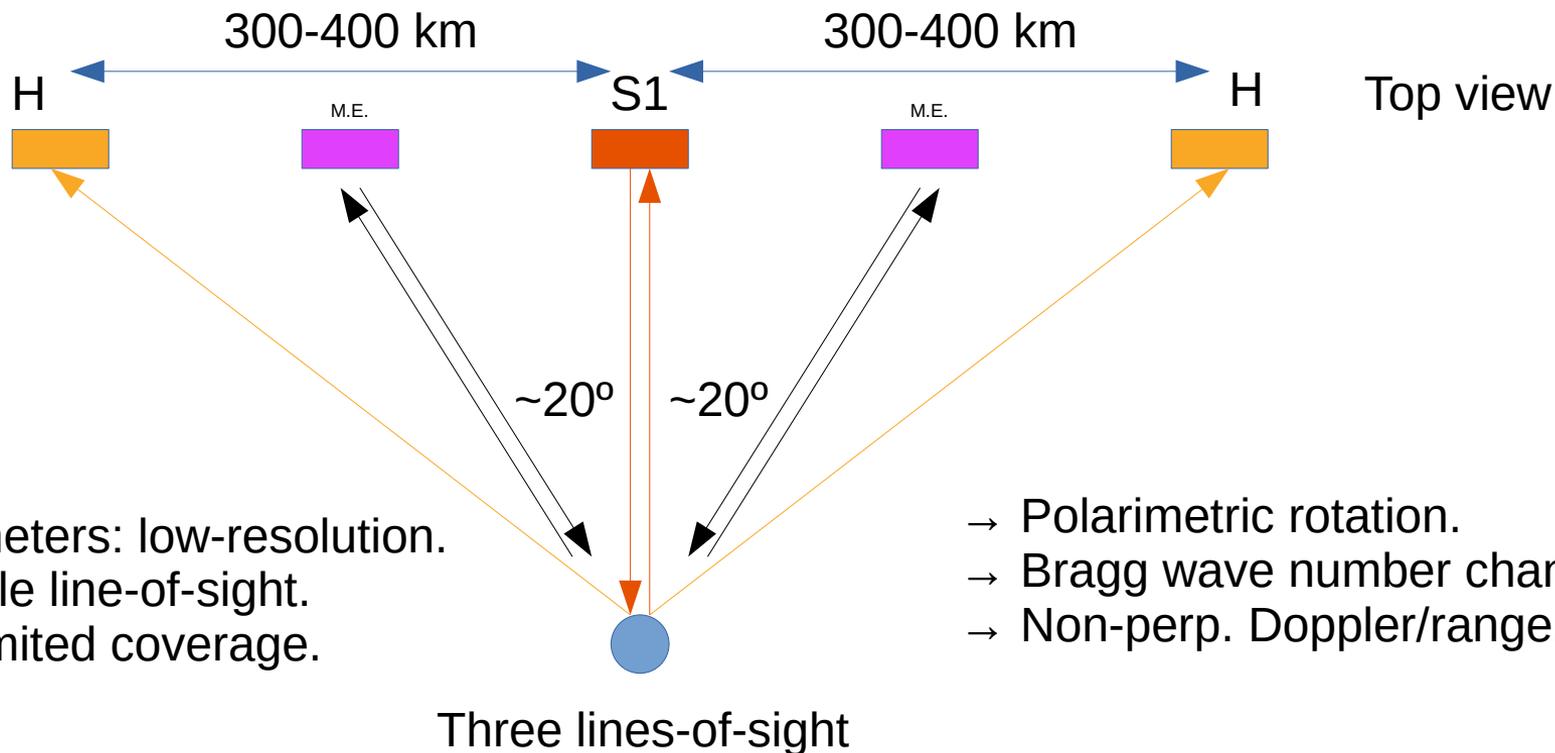
Y4



Y5

Ice Volume change				Ice Volume change
Glacier dynamics				Glacier dynamics
	3-D Ice surface motion			
	Air-sea interactions			
Exp. Ocean topography	<b>Atmosphere-ocean-extemes (Tropical Cyclones, Polar lows, etc)</b>			Exp. Ocean topography
	Upper ocean dynamics			
	Tectonic Strain			
Vol. change (volcanoes)				Vol. change (volcanoes)
Iceberg volume	Sea-ice instantaneous motion/deformation			Iceberg motion

# Monostatic 'equivalent'

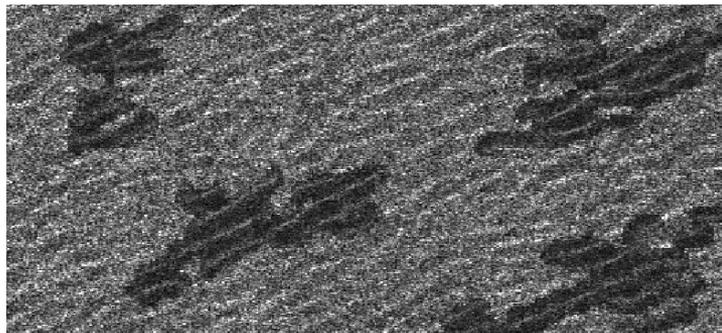


- Scatterometers: low-resolution.
- SAR: single line-of-sight.
- Planes: limited coverage.

- Polarimetric rotation.
- Bragg wave number change.
- Non-perp. Doppler/range.

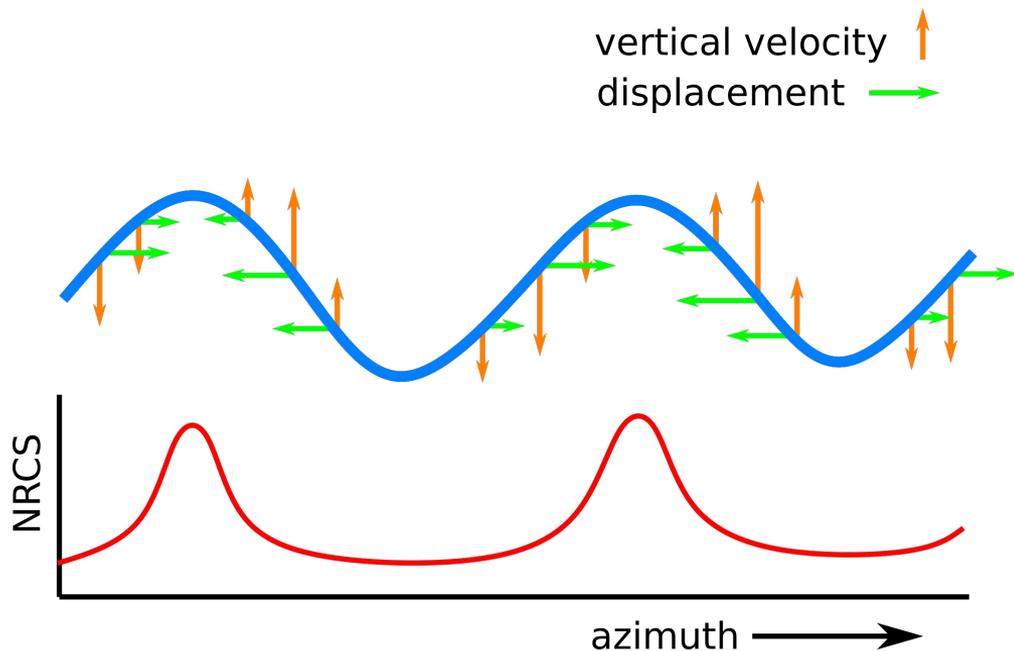
# SAR distortions

- RAR modulation:
  - Surface tilt.
  - Hydrodynamics.
  - Range bunching.

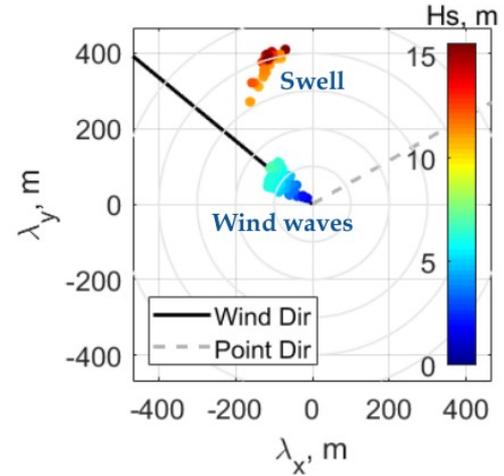
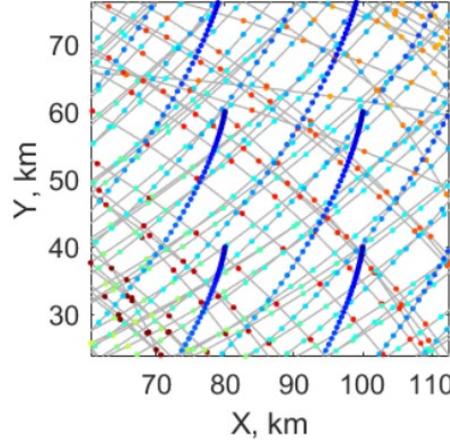
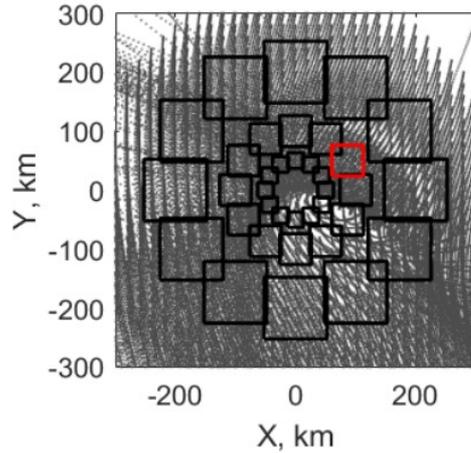


Gunson and Lehner, 2001

- SAR distortion:
  - Velocity bunching.
  - Azimuthal cut-off.



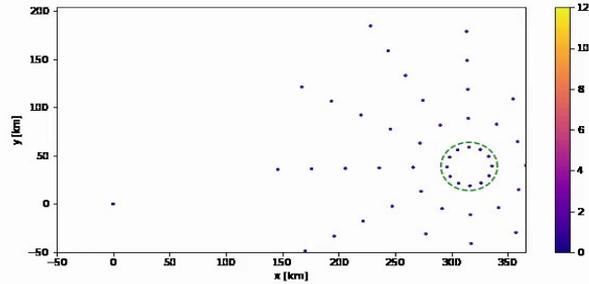
# Tropical cyclone wave modeling



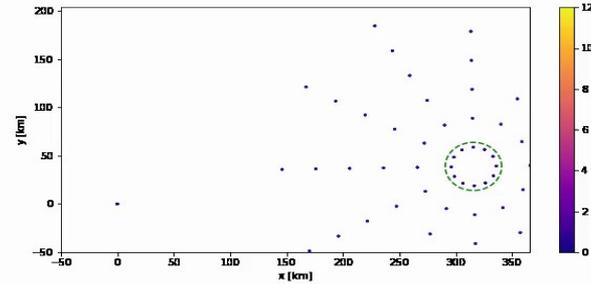
- Kudryavtsev et al. (2021a/b).
- Numerically grow wave trains in a wind field.
- ‘Wave spectra’ estimated in the red box.

# Tropical cyclone waves

→ Inflow angle: 20 deg



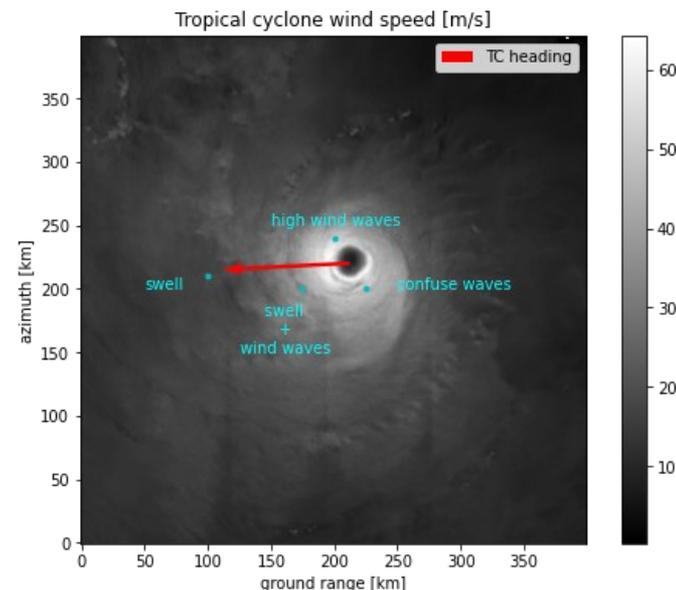
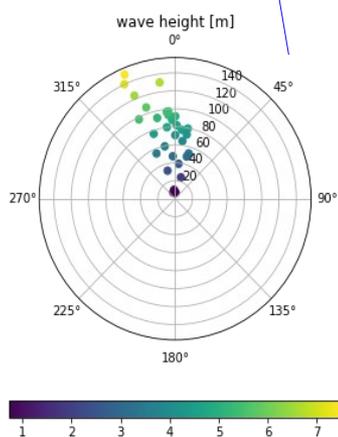
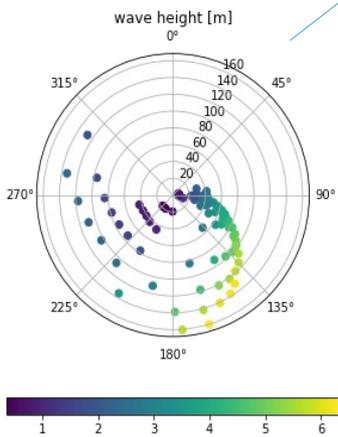
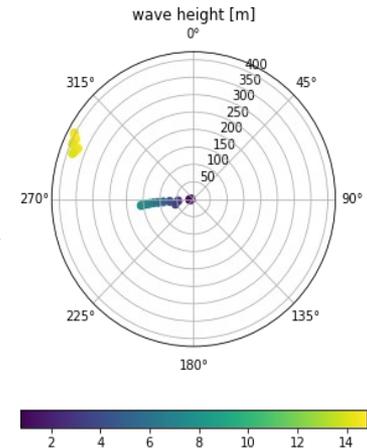
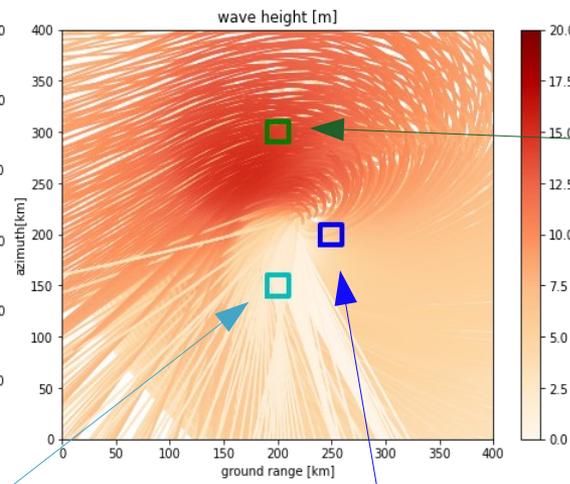
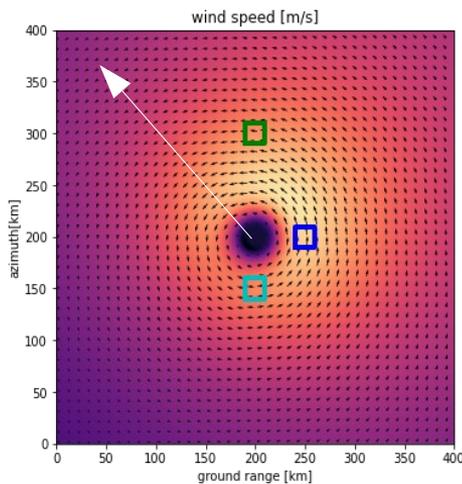
→ Inflow angle: 5 deg



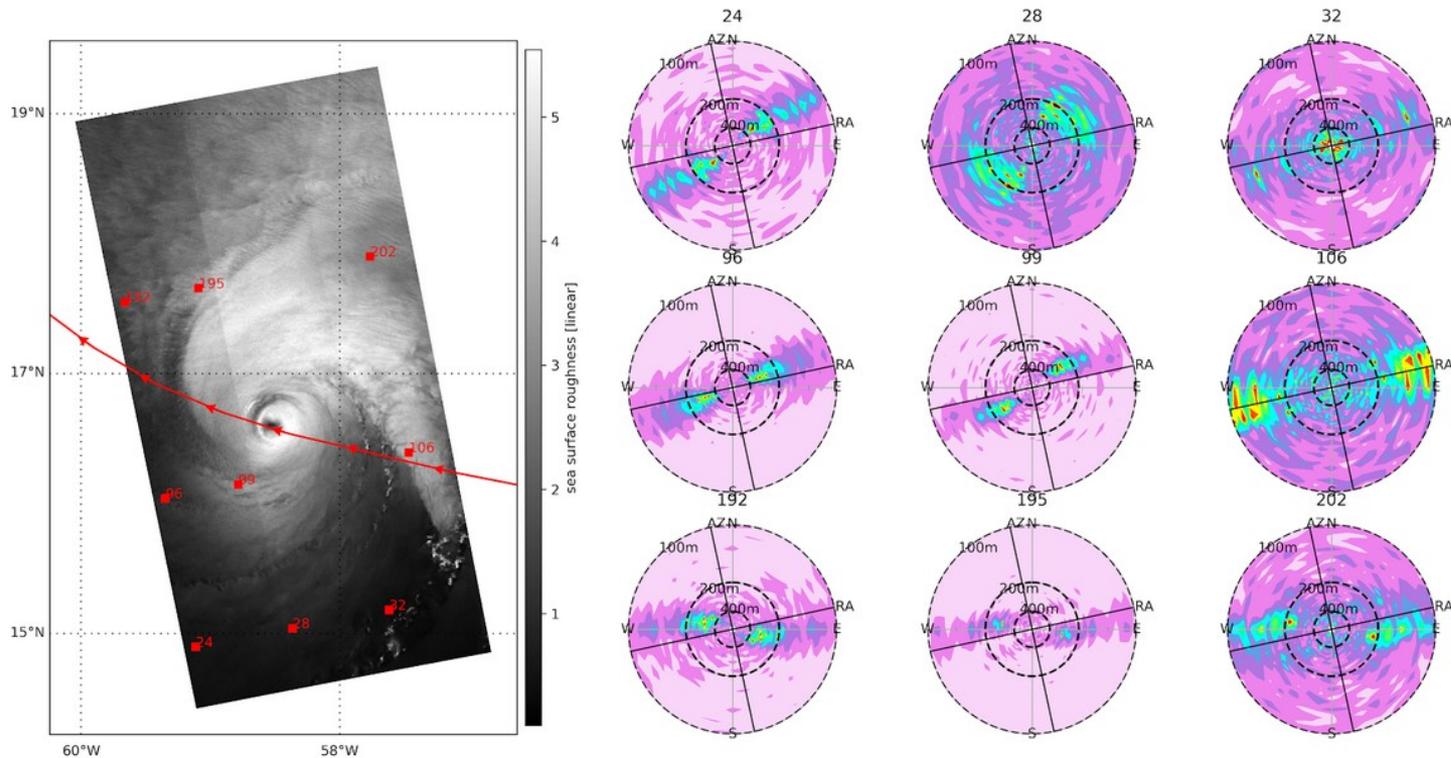
Significant wave height [m]

**Wave spectra contain information about the wind field.**

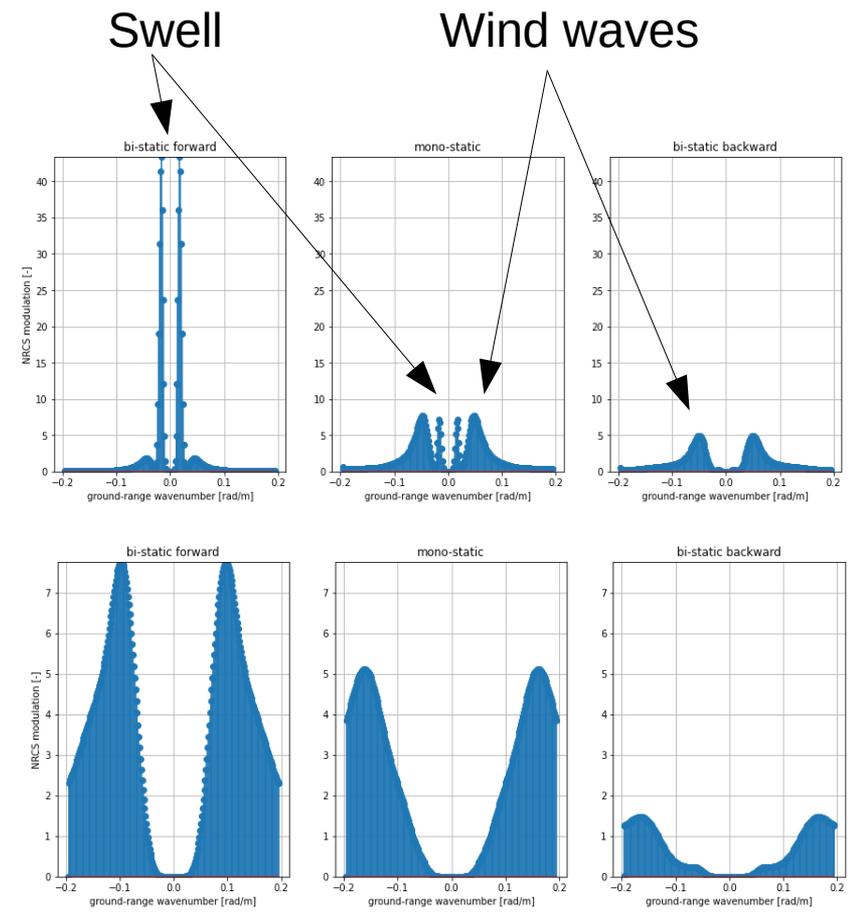
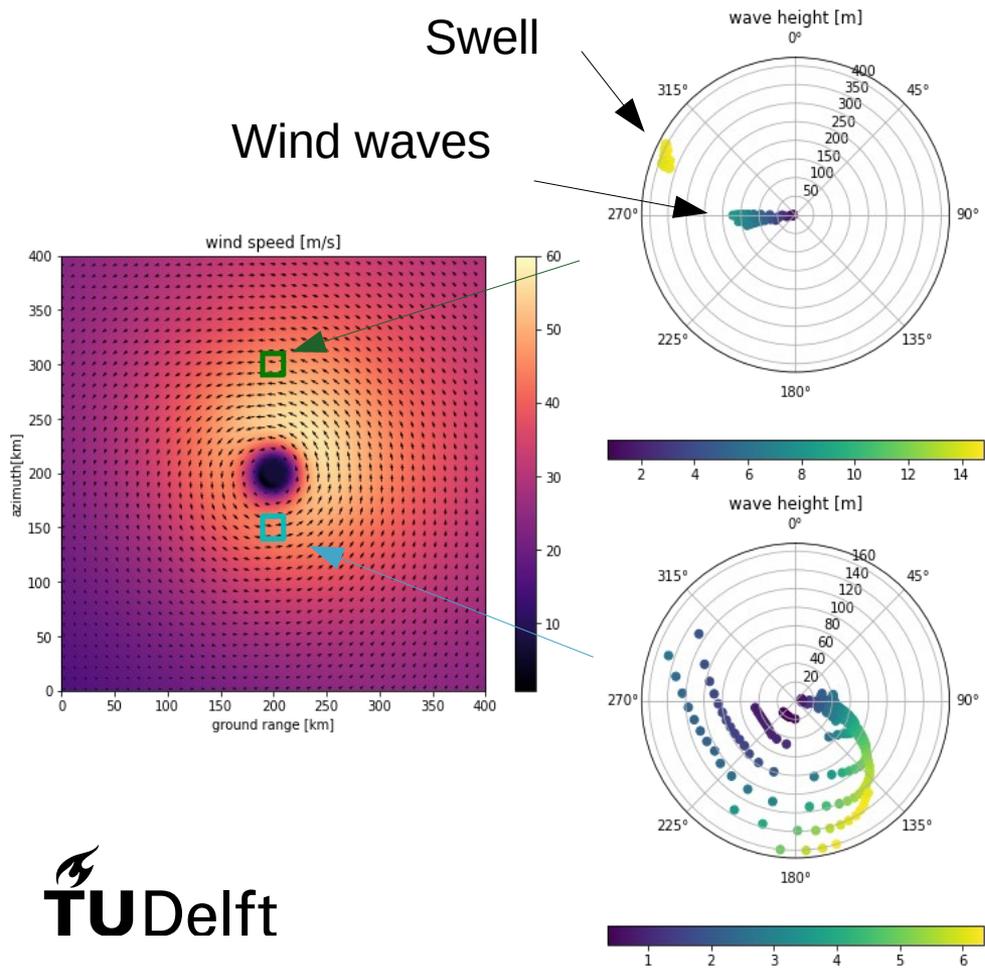
# Tropical cyclone wave modeling



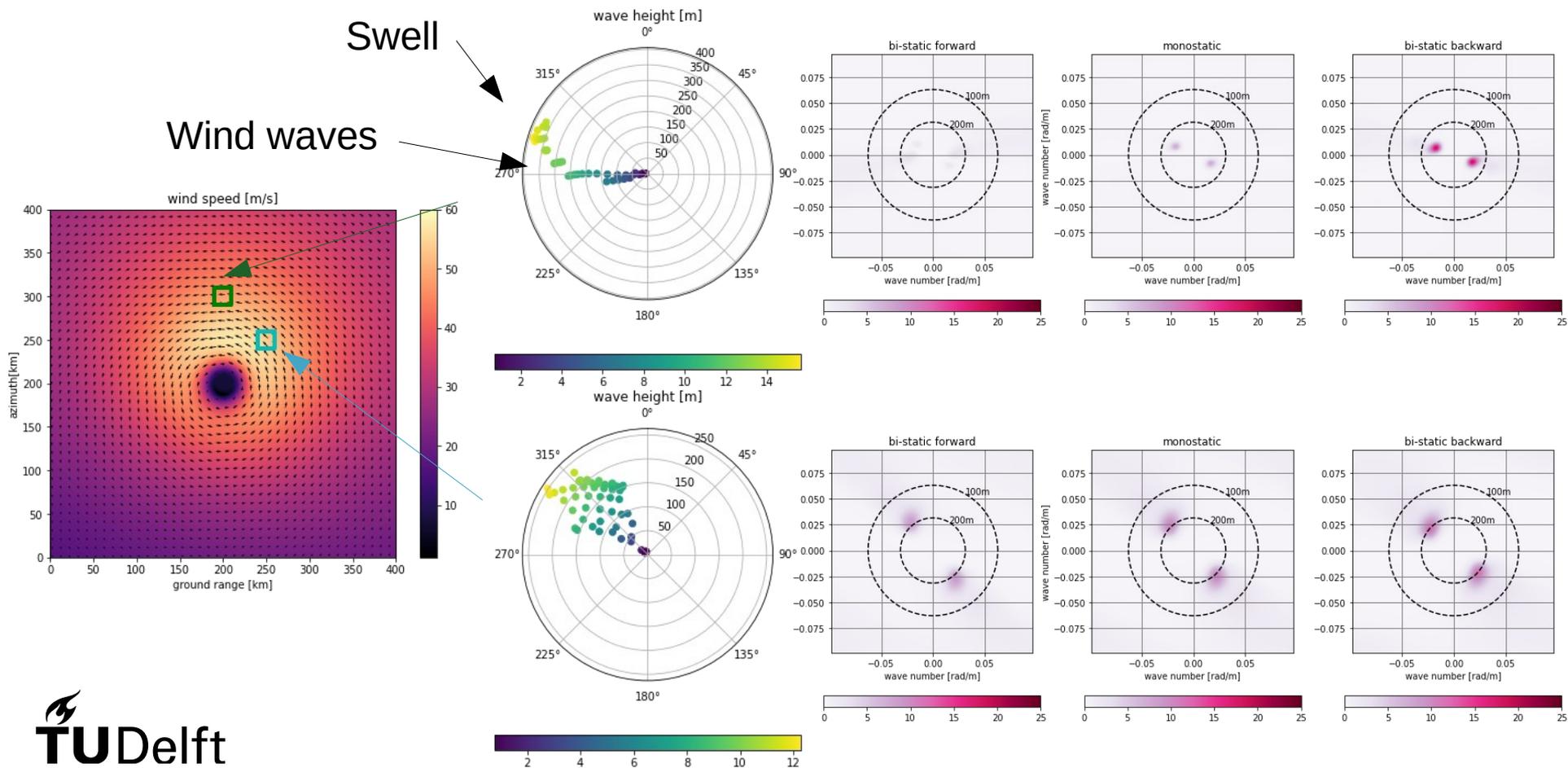
# SAR observations



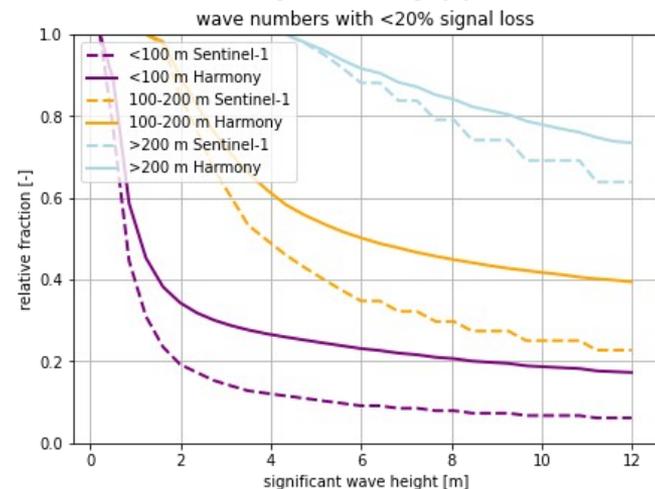
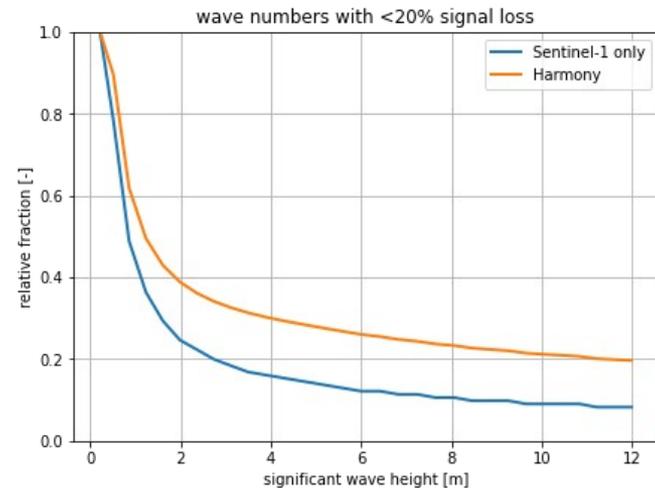
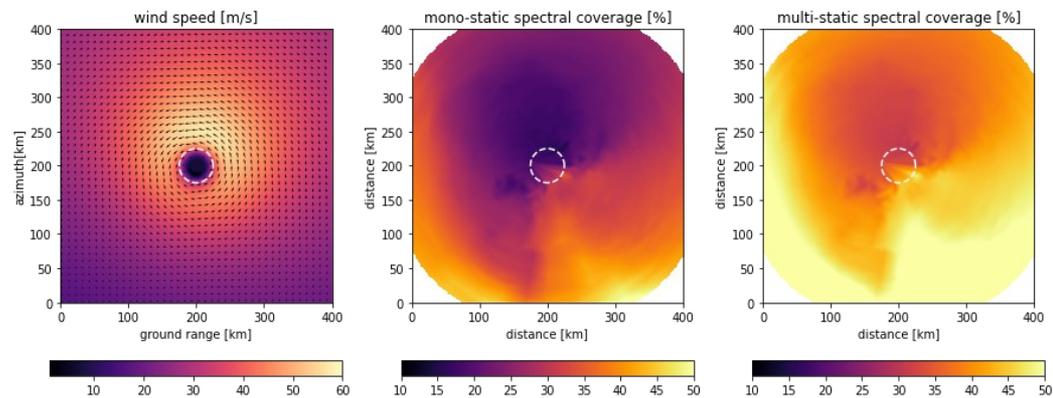
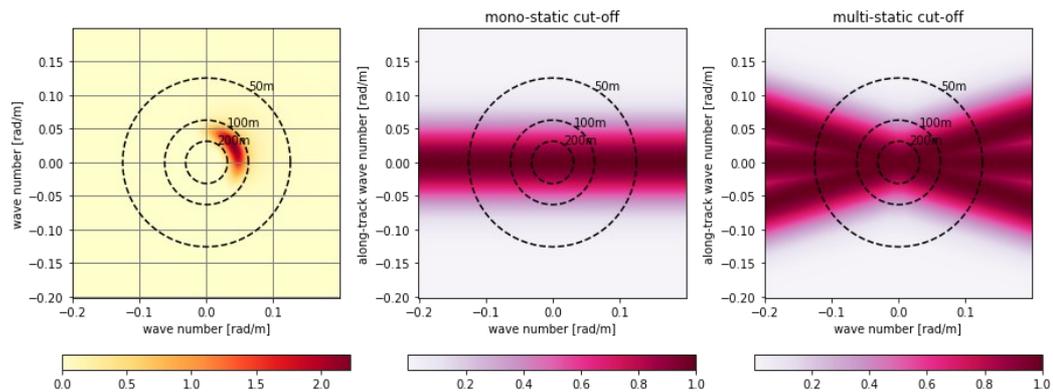
# RAR wave spectra



# SAR wave spectra



# SAR spectral coverage



# Summary

- Harmony's multi-target mission:
  - Ocean and air-sea interactions (currents, waves, wind, clouds).
  - Cryosphere (sea ice, land ice, icebergs).
  - Solid Earth (strain, volcanoes).
- Tropical cyclones:
  - Harmony has three lines-of-sight:
    - High-resolution Doppler.
    - High-resolution backscatter.
  - Harmony's SAR spectra:
    - Improved spectral coverage.
    - Improved constraints on wave spectra.

