Observations conditions and principle for ocean current front backscatter modulation

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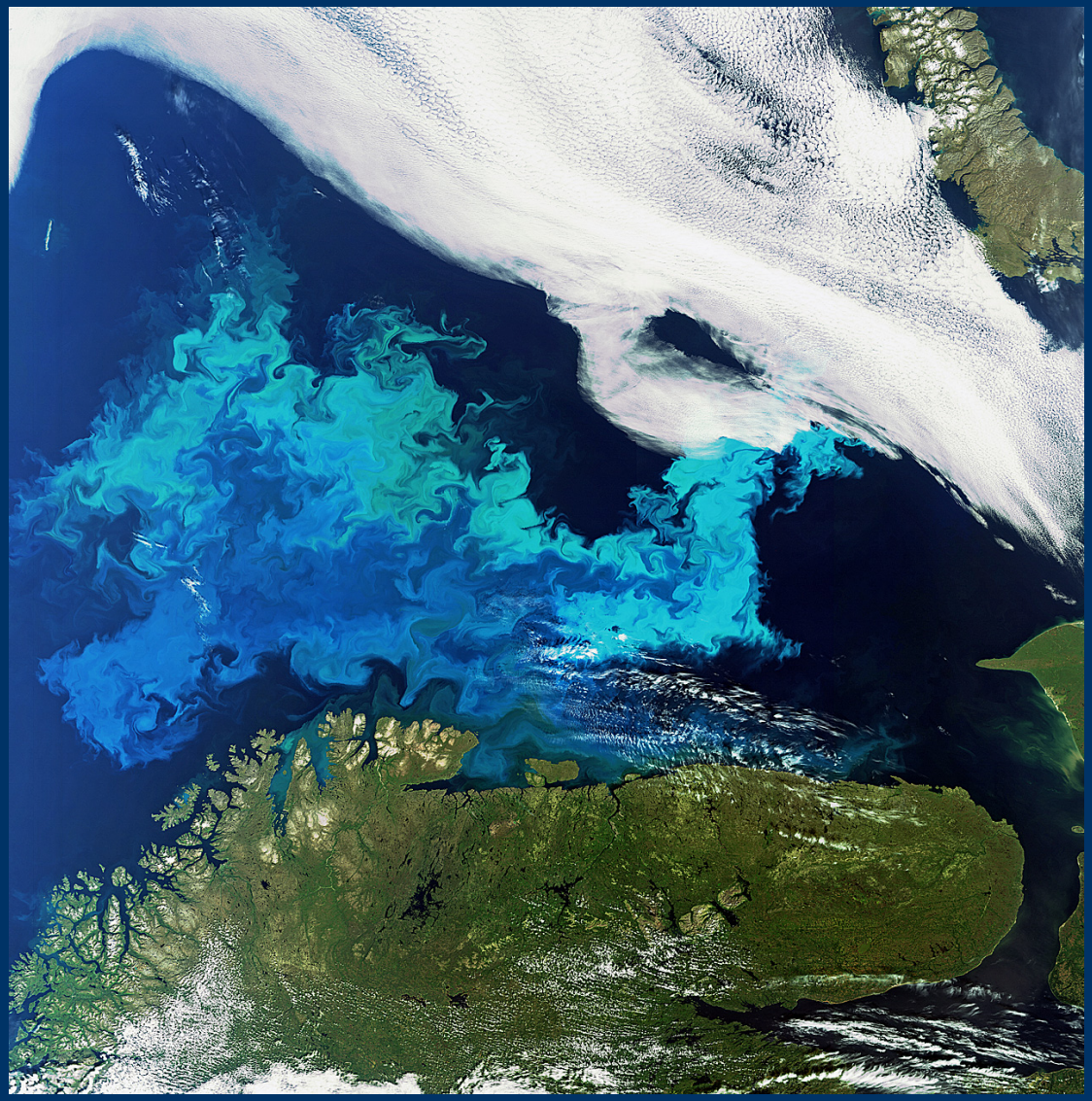
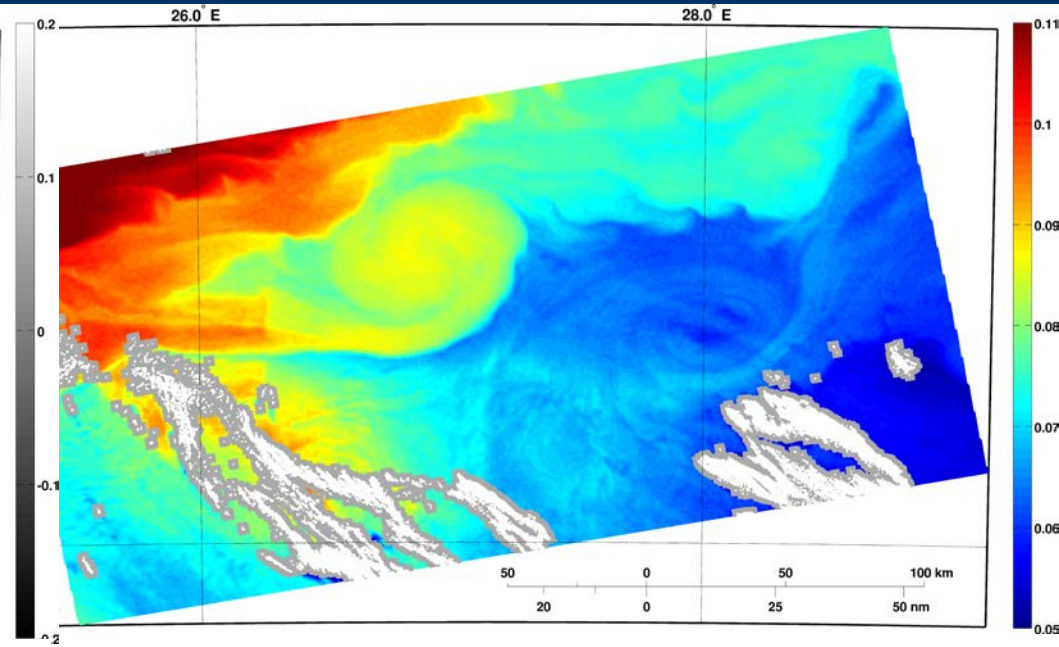
Understand 3D dynamics

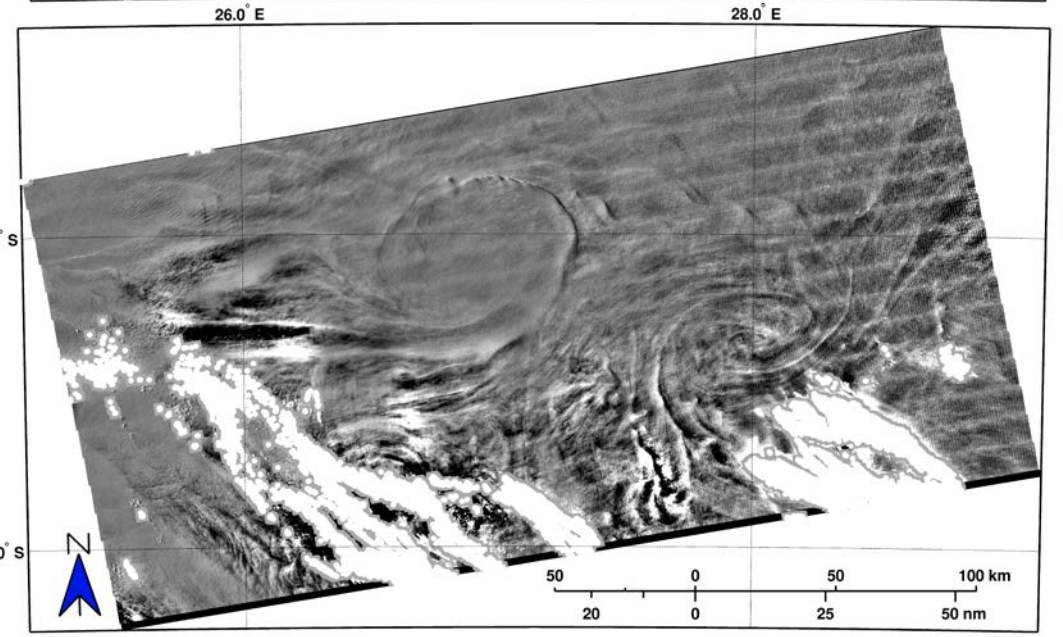


Barents sea – Cape Nordkinn

- vertical transport
- Roughness - a surface parameter of convergence / divergence zone (vertical velocities)
  - Understand roughness (wind, current, …)
  - Quantify 3D motion of upper oceanic layers

Synergies...





$$\boldsymbol{V} = \boldsymbol{U} + \bar{\boldsymbol{u}} + \tilde{\boldsymbol{u}}$$

The divergence of the total flow, $\nabla \cdot \boldsymbol{V}$

is governed by the secondary ageostrophic flow $\tilde{\boldsymbol{u}}$

and reads $\nabla \cdot \boldsymbol{V} = -f^{-1}\bar{u}_j \dfrac{\partial}{\partial x_j}\Omega_z$

where

$$\Omega_z = \partial U_1 / \partial x_2 - \partial U_2 / \partial x_1 \equiv \Delta\psi$$

is the vorticity of the QG currents

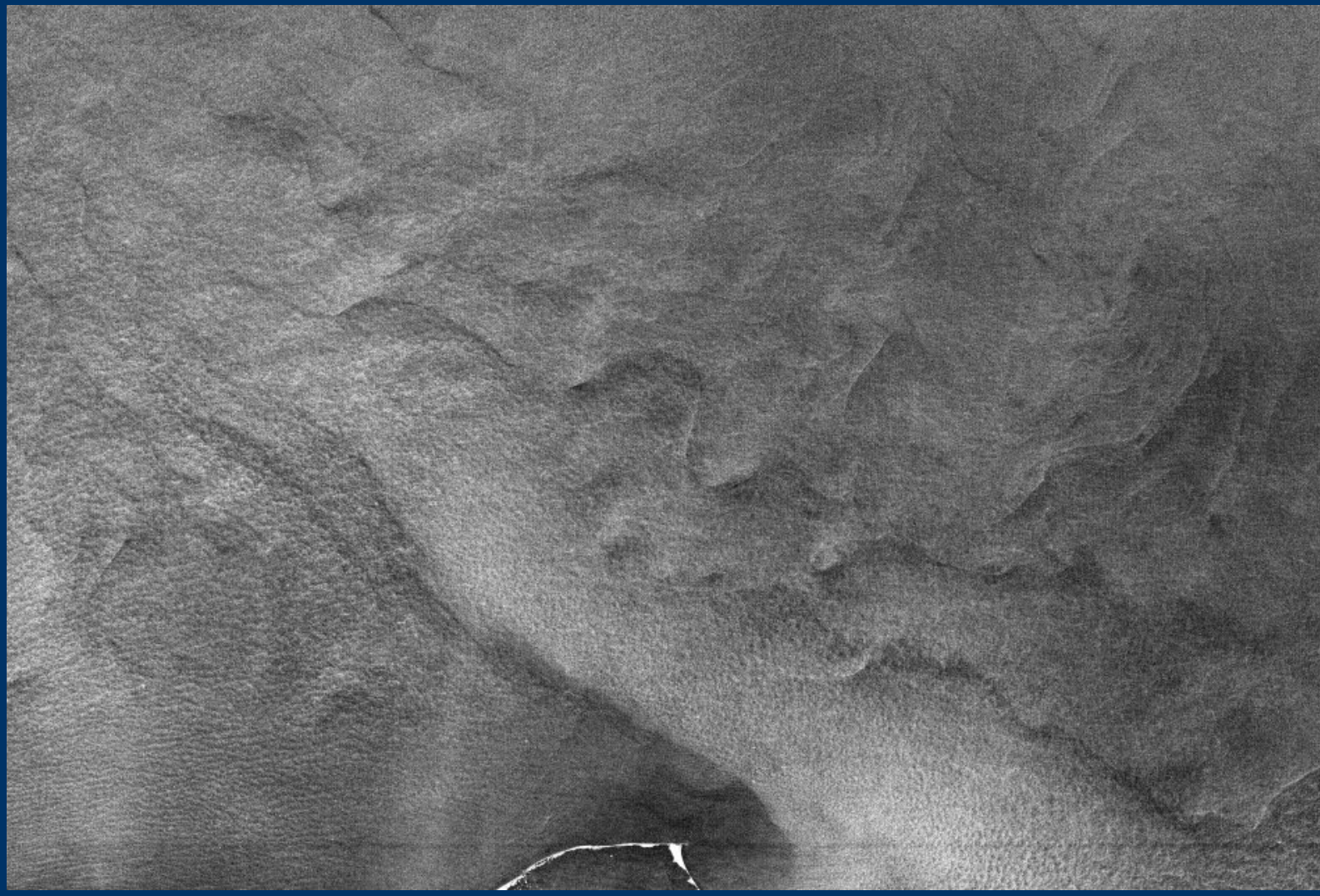
Roughness ...

… as a major revealing parameters of meso and submesocale variability

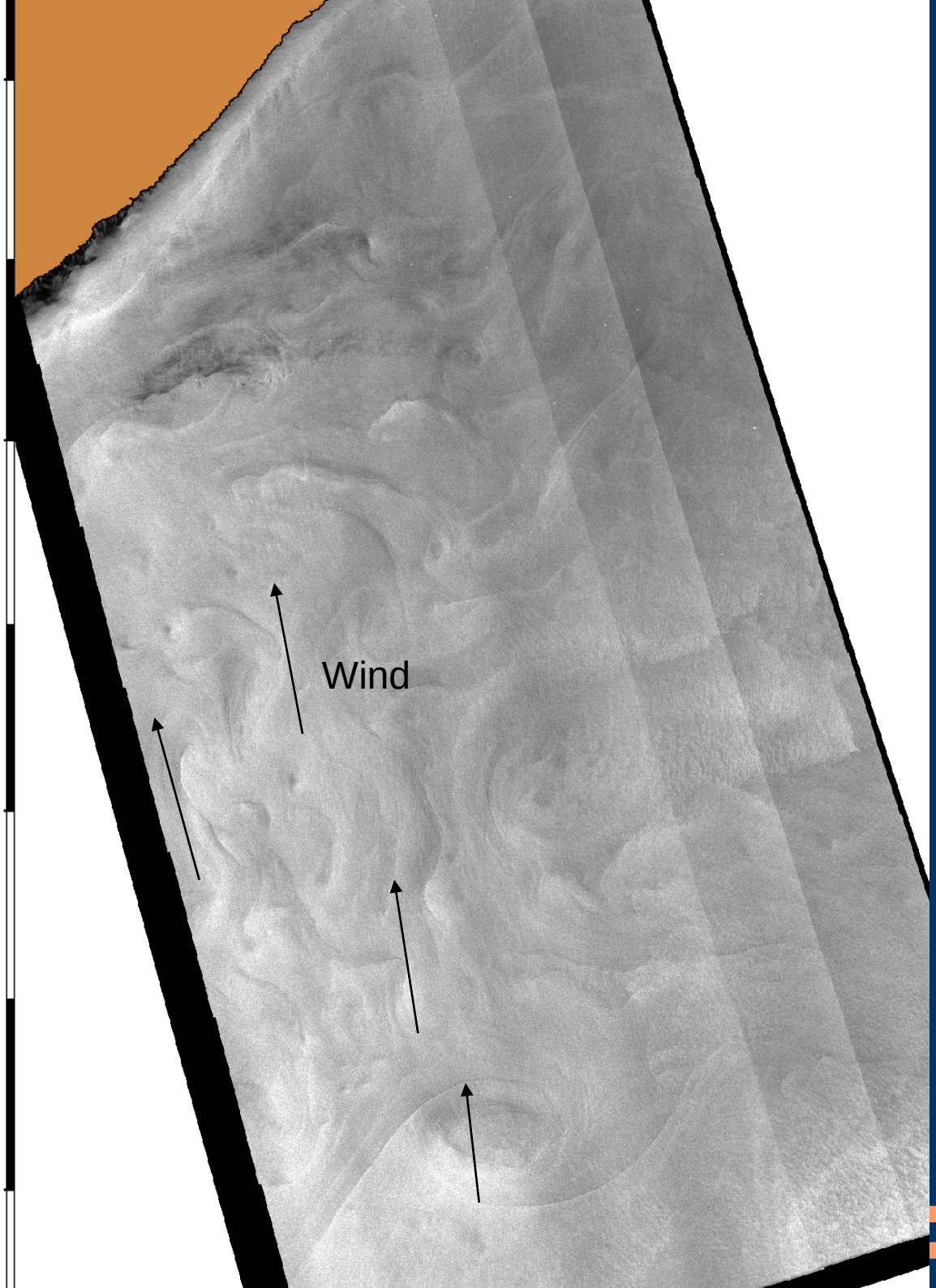
- Convergence / divergence zone
- Currents and winds

- Zone of interest : strong currents
  - Agulhas
  - Gulf stream
  - ...

Typical ASAR roughness with Mesoscale signature



Southern hemisphere



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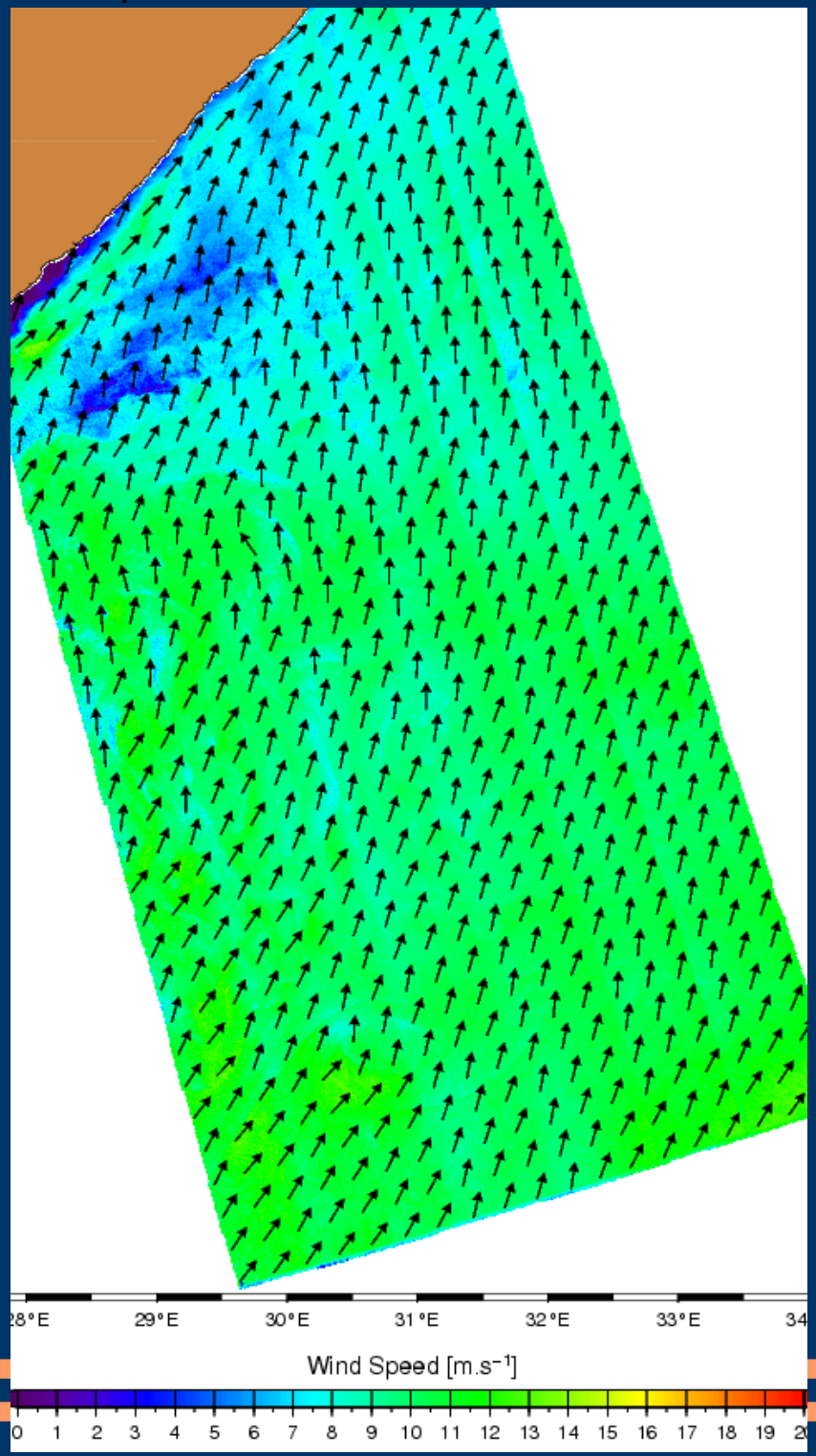
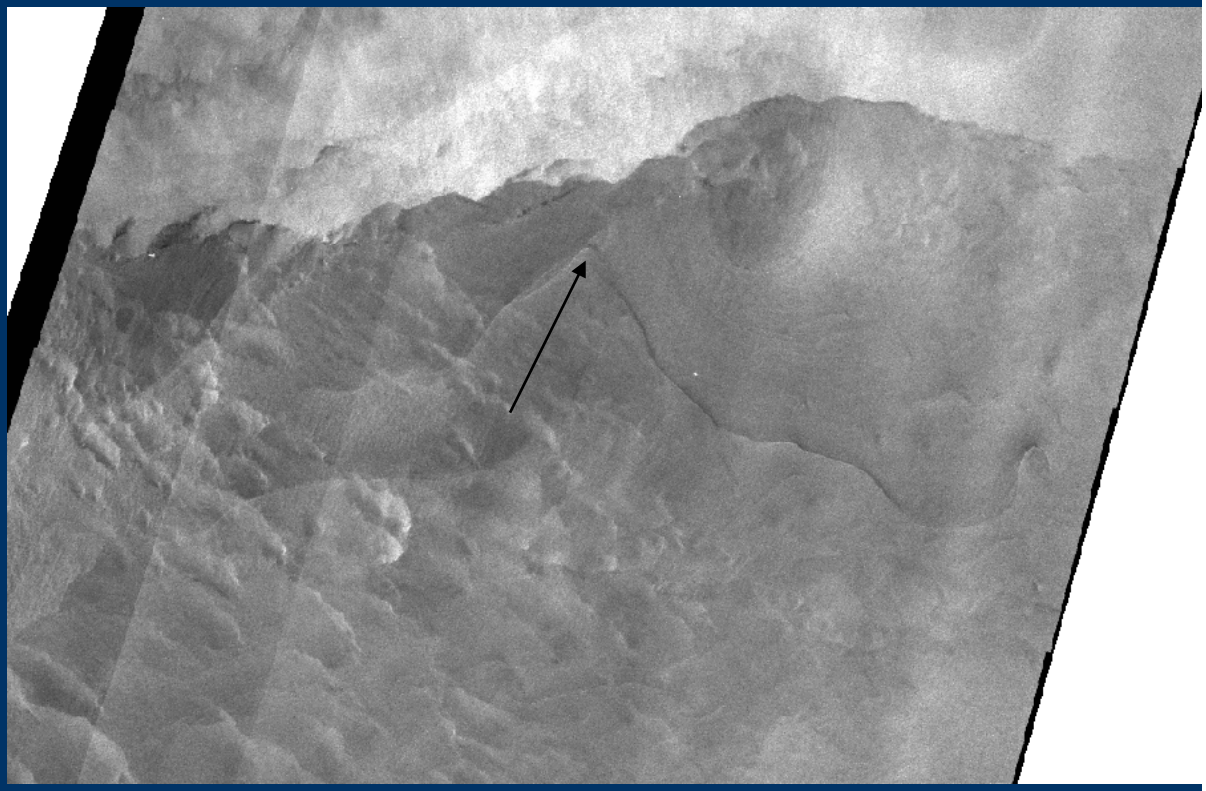
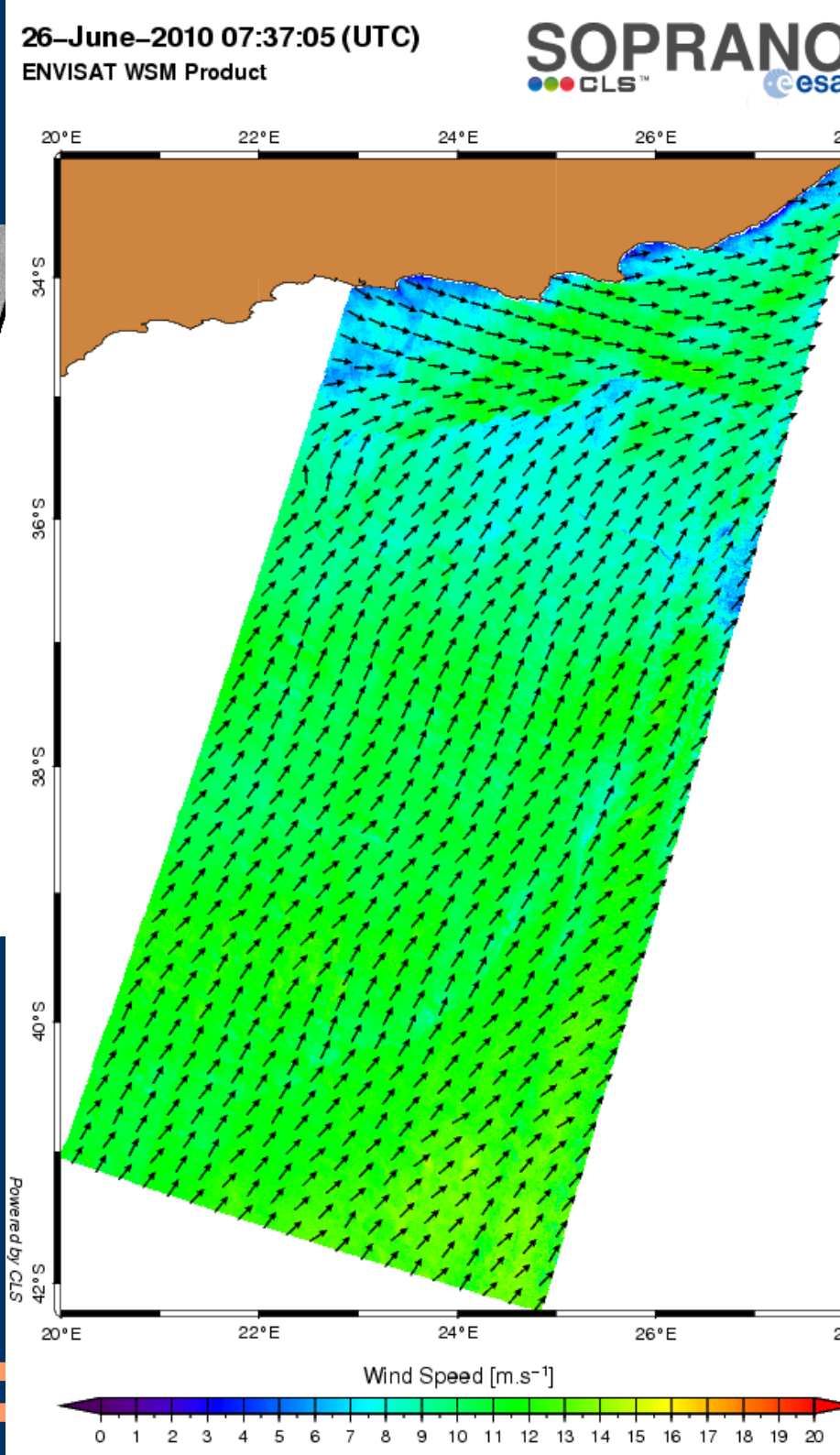
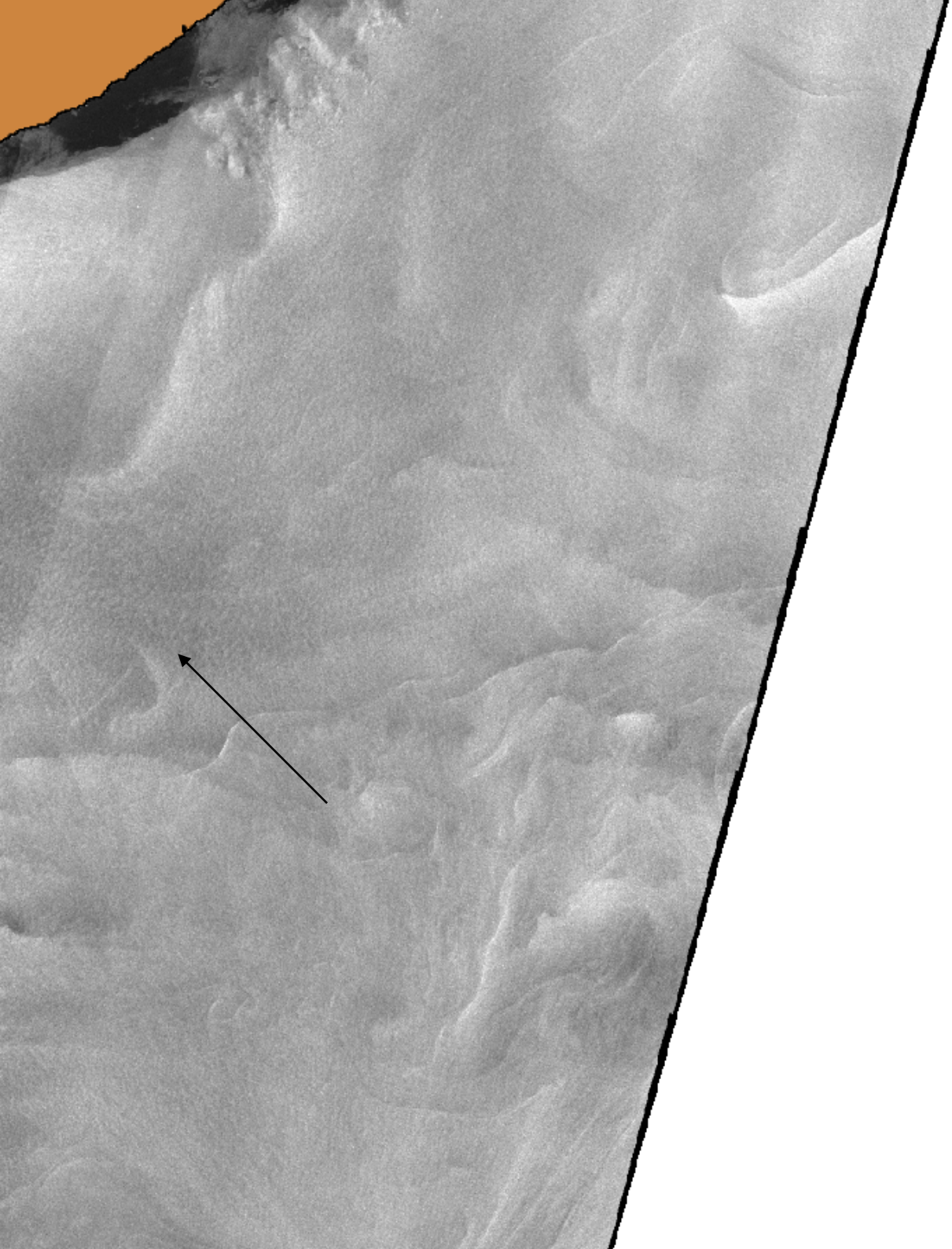
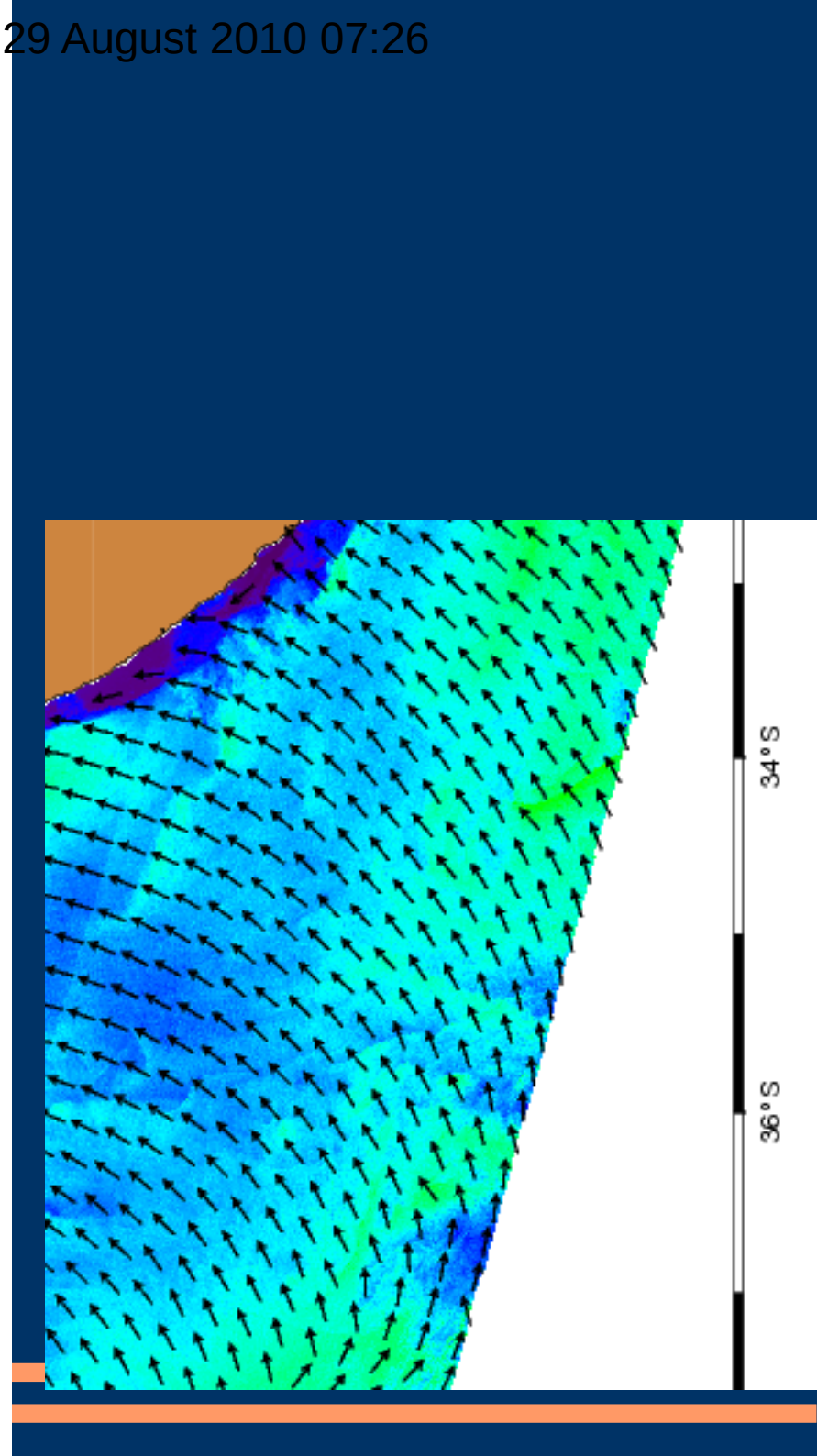




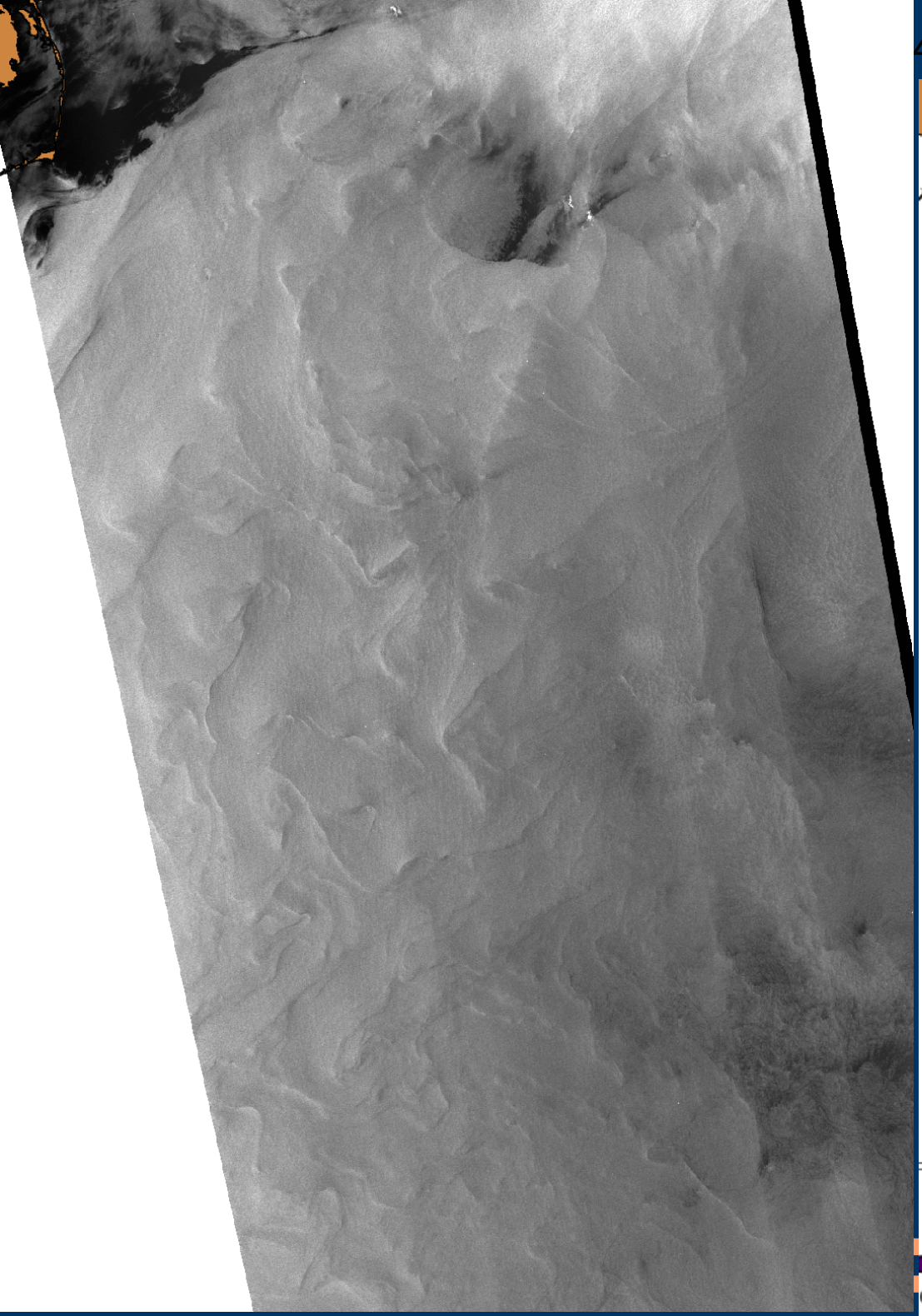

26–June–2010 07:37:05 (UTC)
ENVISAT WSM Product
SOPRANO
CLS
esa
20°E
22°E
24°E
26°E
34°S
36°S
38°S
40°S
42°S
Powered by CLS
Wind Speed [m.s⁻¹]
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

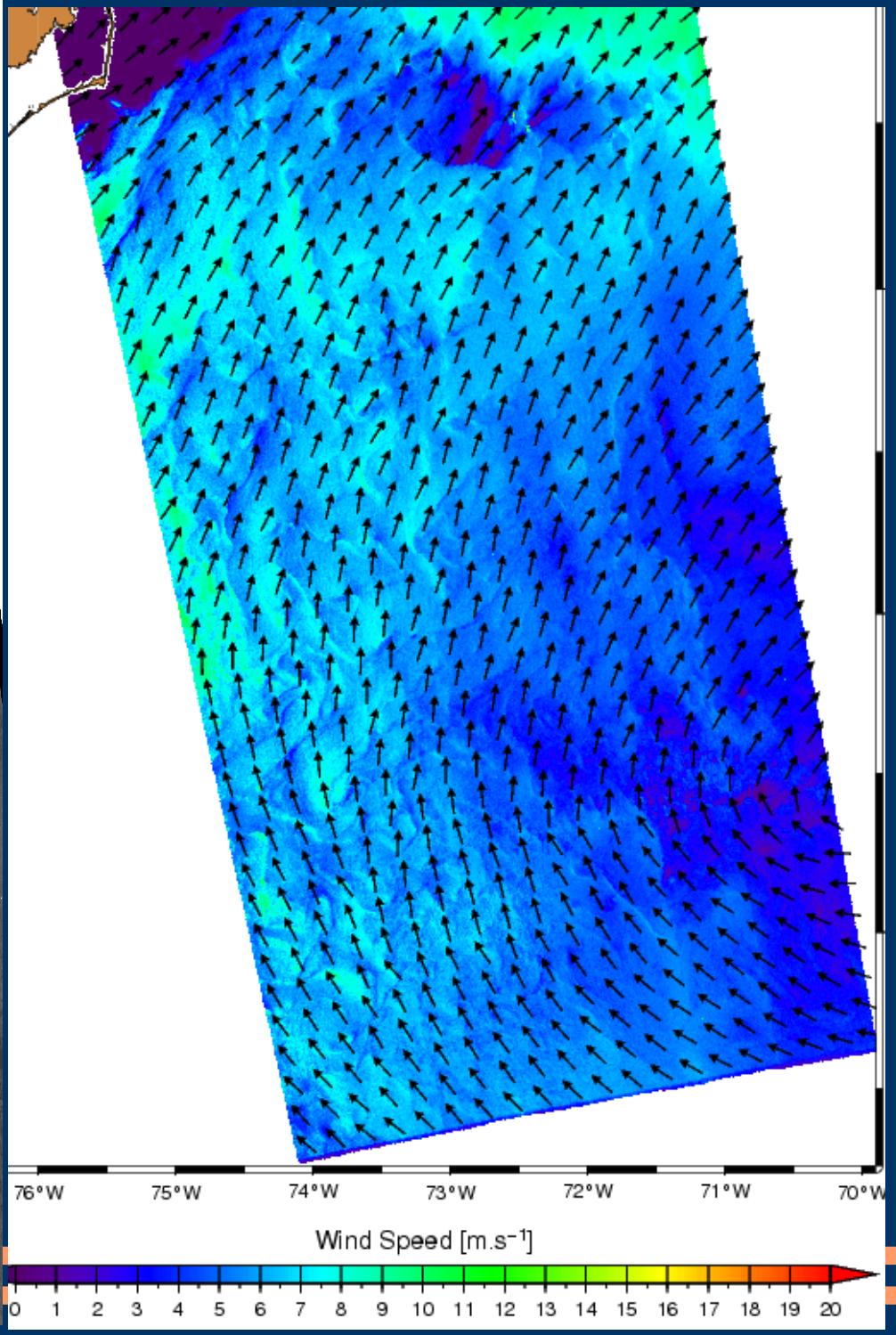
29 August 2010 07:26





Northern hemisphere

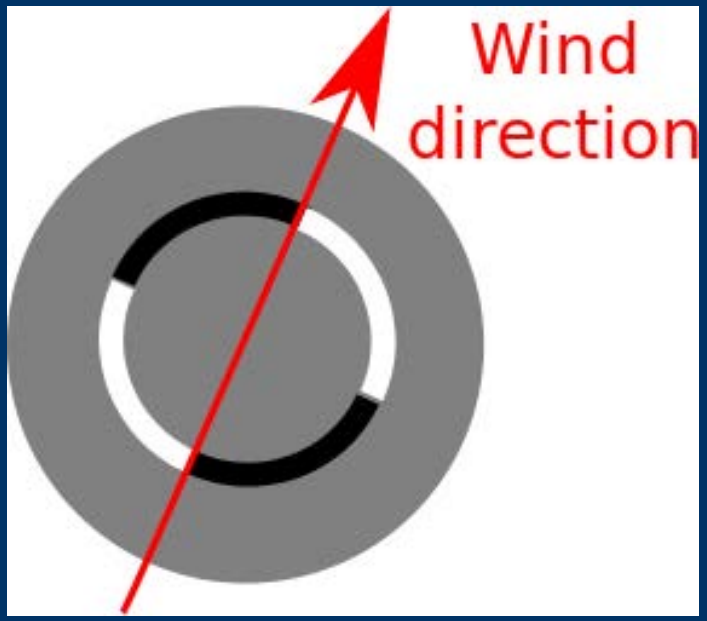



76°W
75°W
74°W
73°W
72°W
71°W
70°W
Wind Speed [m.s⁻¹]
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

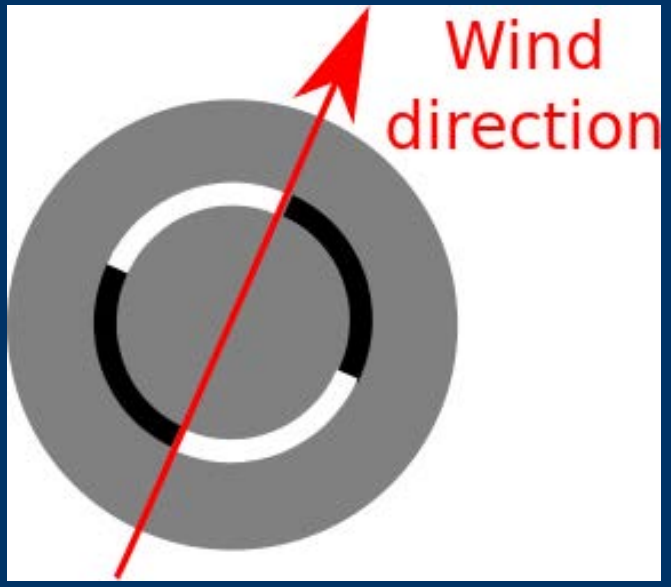
First qualitative Observation of Meso & submesoscale convergence and divergence frontal zone

Observation of enhancement or reduction of roughness contrast depending on relative angle between wind and front directions.

(with apparent independance of SST gradient and current shear)



Northern hemisphere

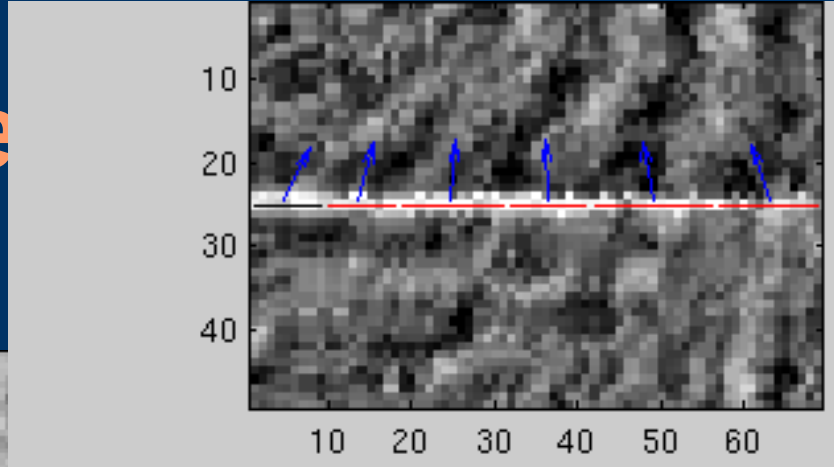


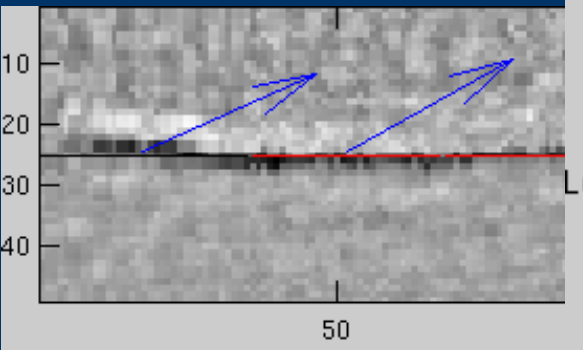
Southern hemisphere

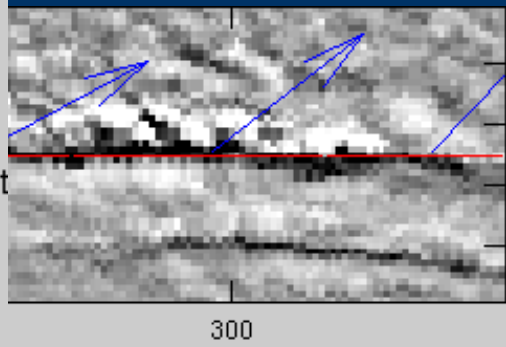
Statistical overview

- Statistical estimation of global wind effect on convergence/divergence zone
- Methodology
  - Manual / automatic front selection
  - Contrast adjustement for front positioning
  - Front classification (direction / wind, curvature)
  - Mean wind estimation over a front (ECMWF model, ..)
  - Satistical representation

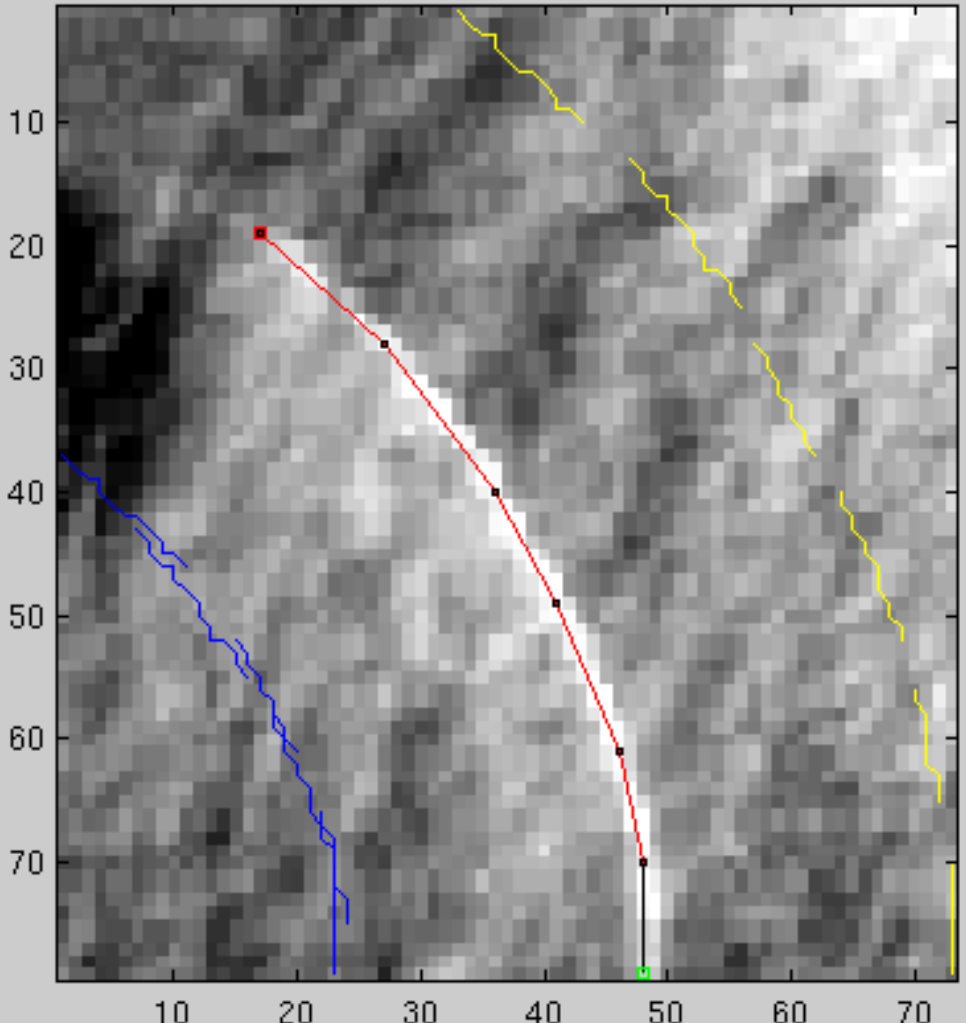
Front se is tool



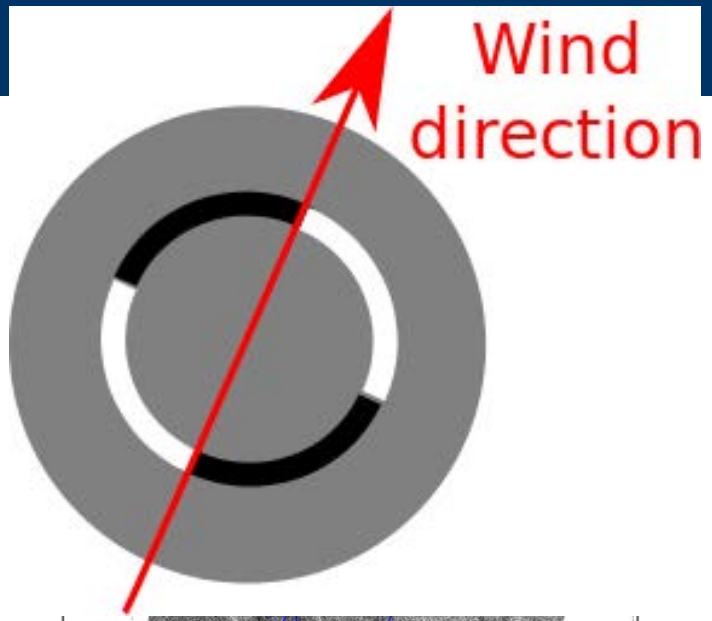


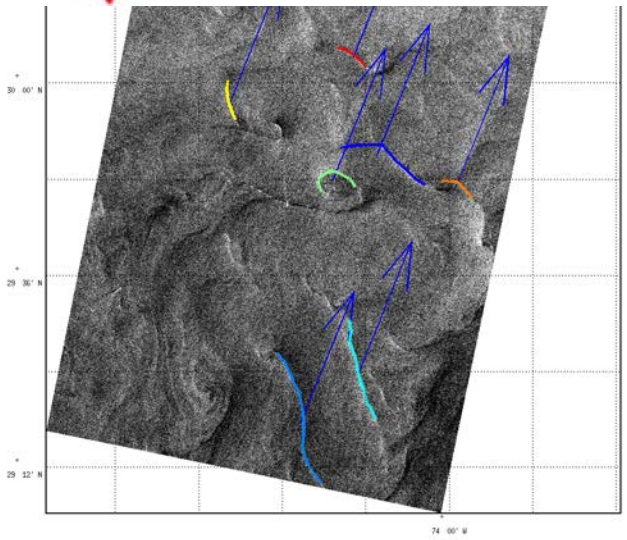


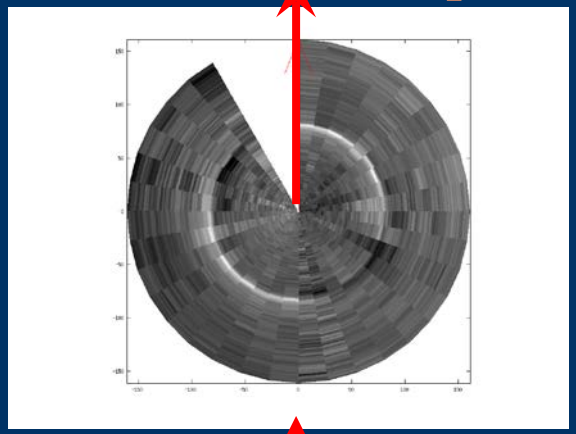
Left clic : move point / Middle clic : add point / Right clic : remove point

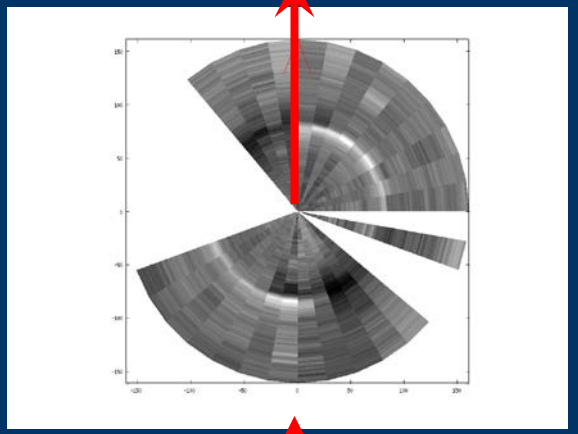


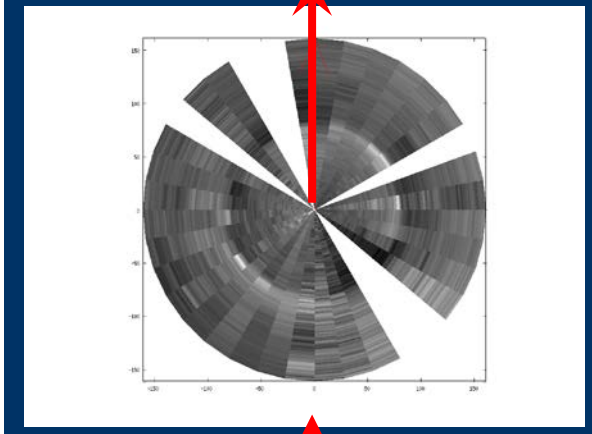
ASAR Northern Hemisphere

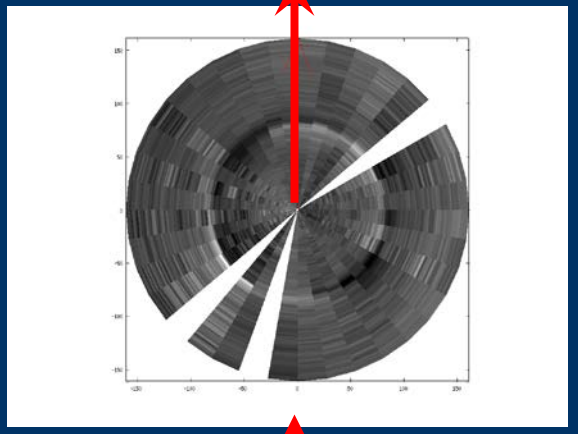


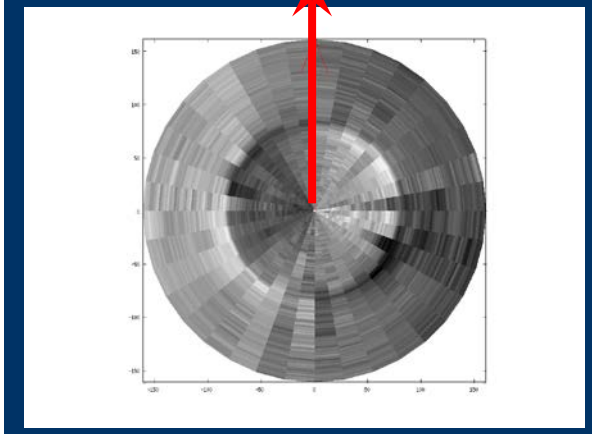


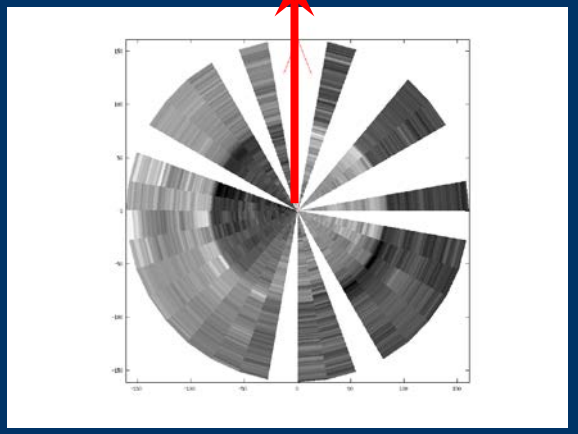




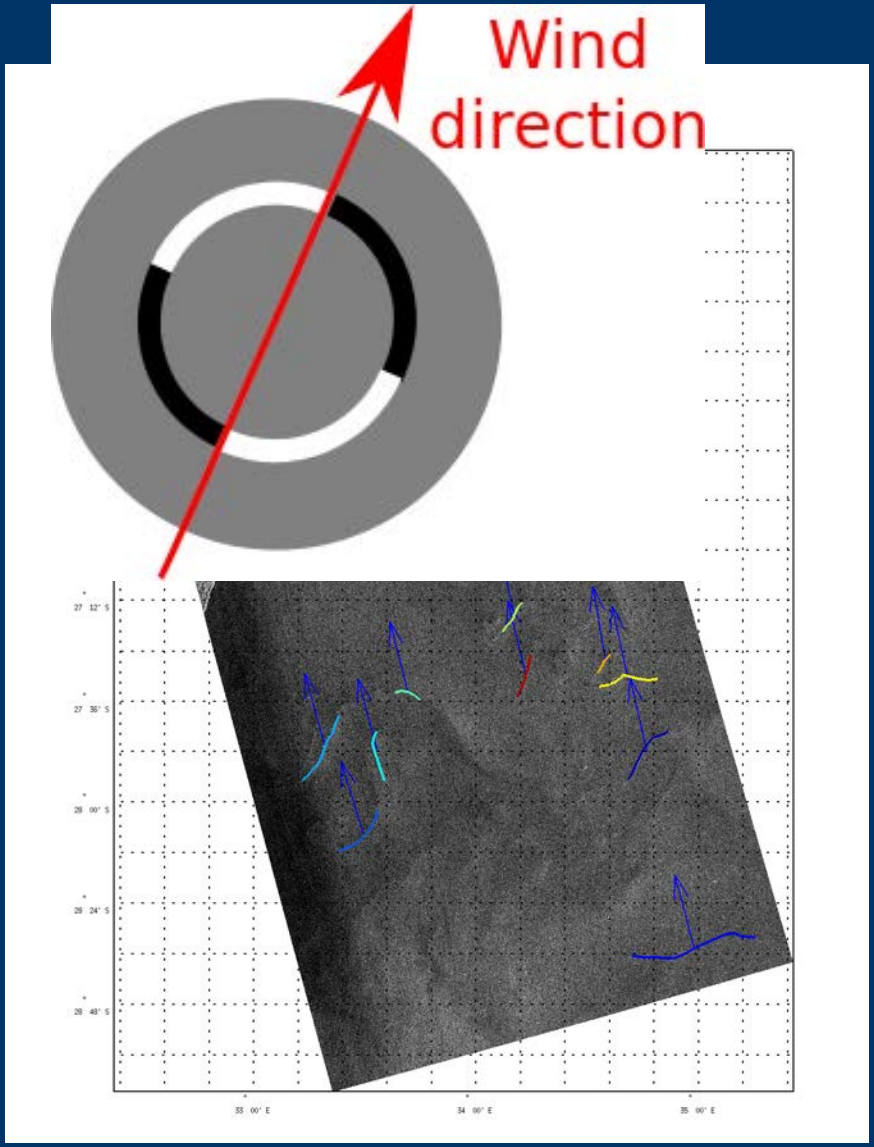


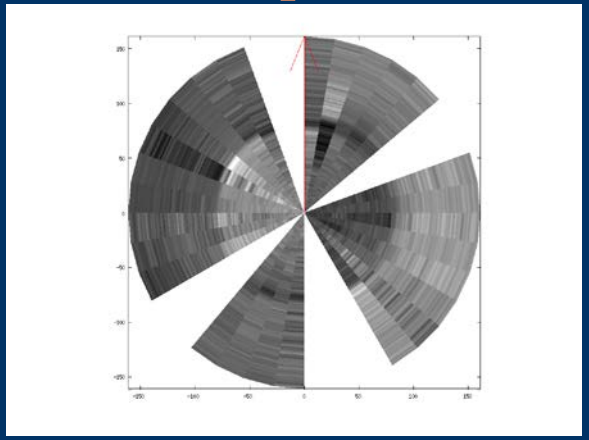


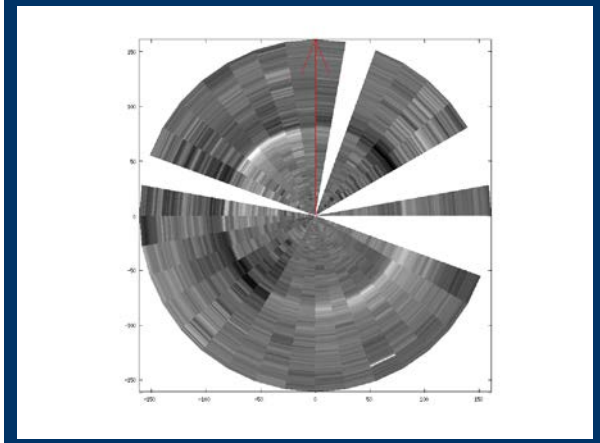


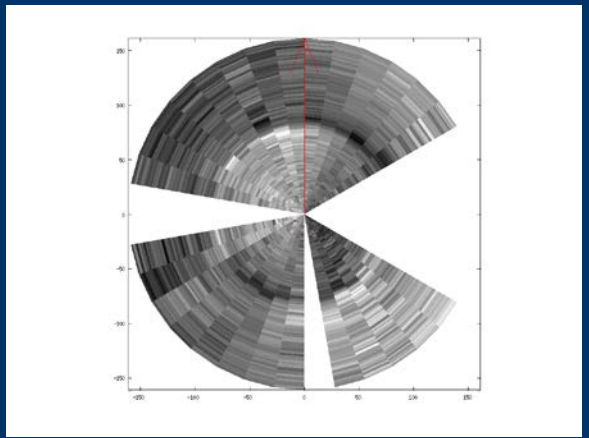


ASAR Southern Hemisphere









Roughness in MERIS images

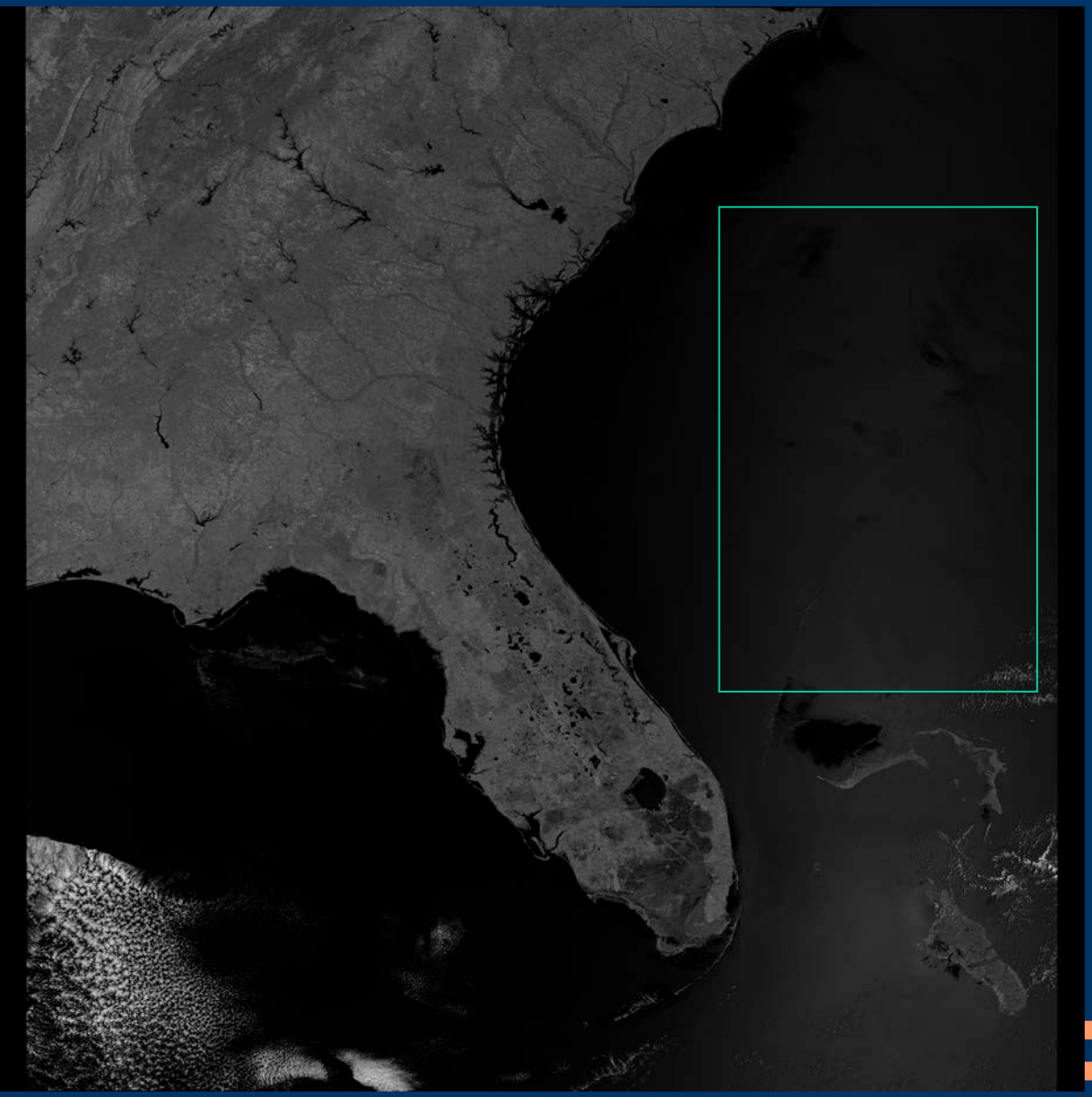
$$B = \frac{\rho E_s}{4 \cos\theta_v \cos^4\beta} P(Z_x, Z_y)$$

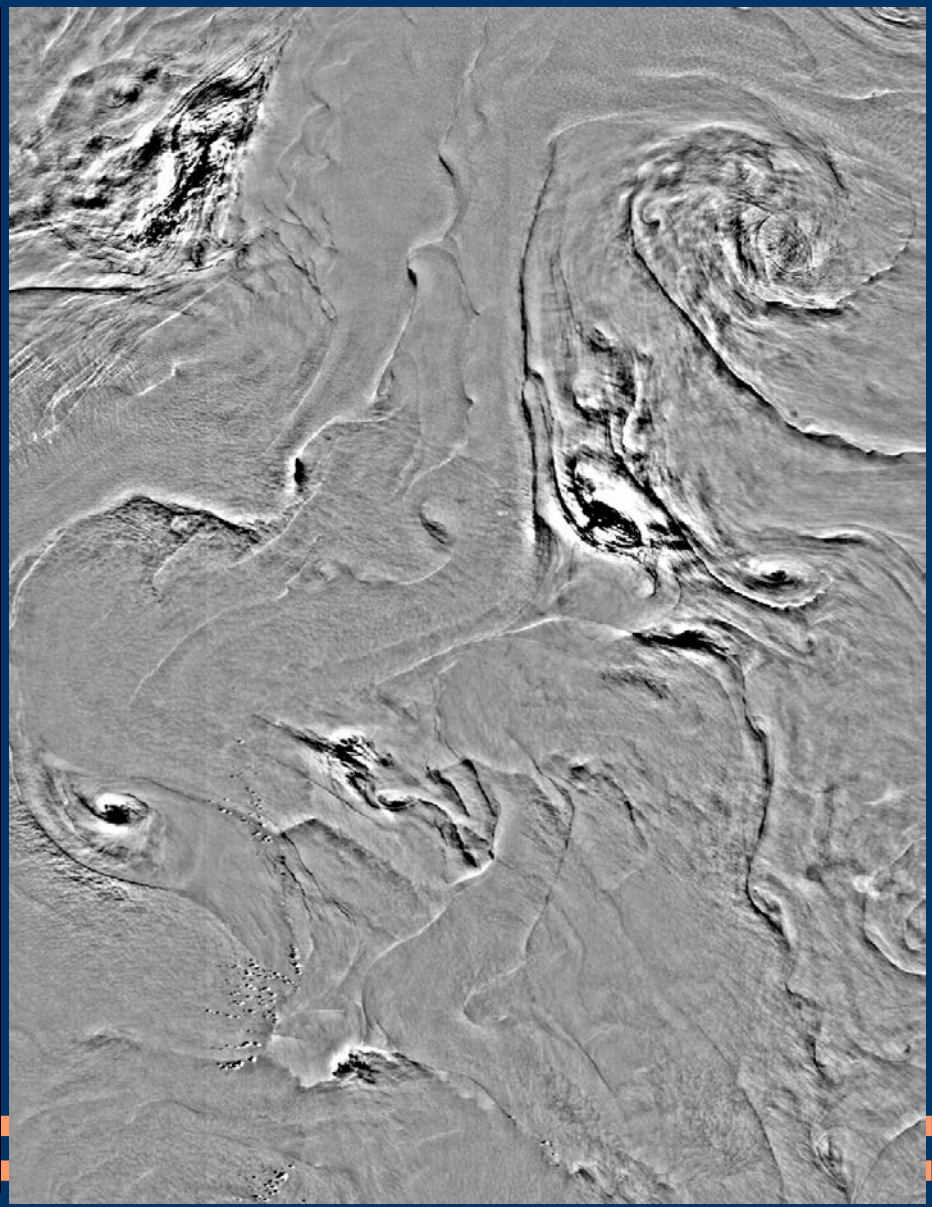
- Red channel on sea surfaces depends on roughness.

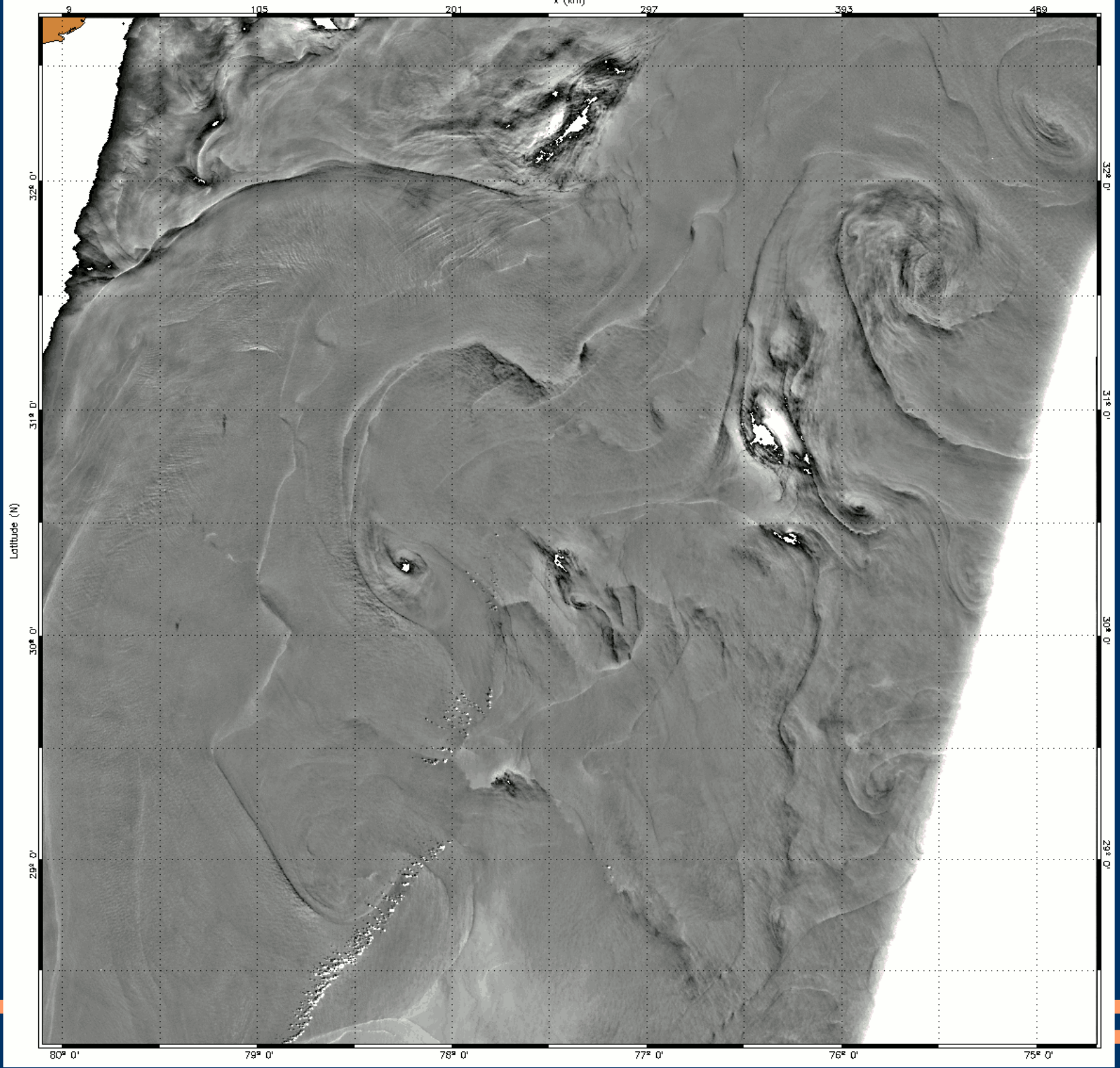
Interest zone⟶ Glint area

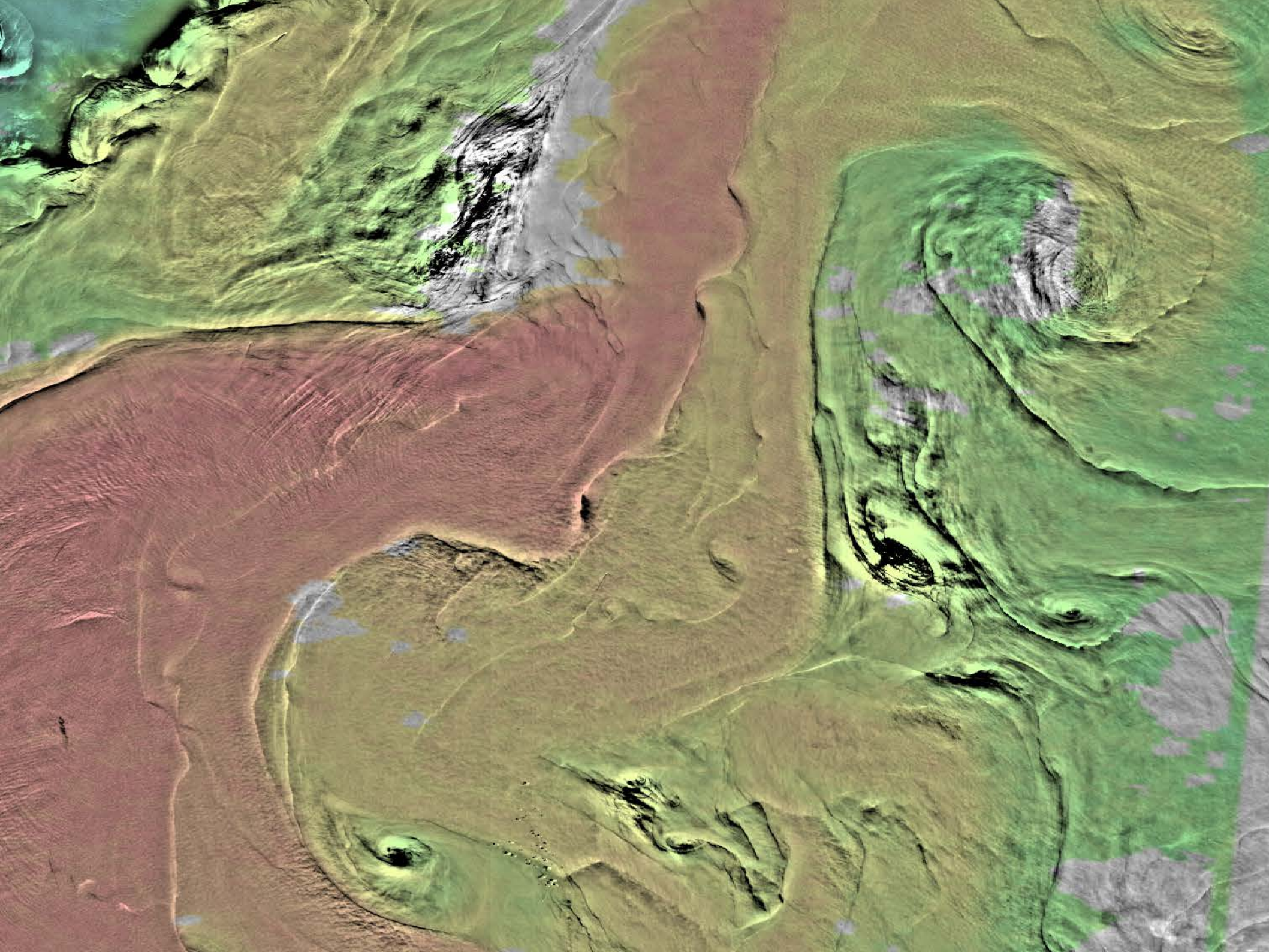
- Large scale backgroud (sun glitter width)
- Small scale details (contrast)

Optical image -MERIS-
Sun glint area in Near Red channel

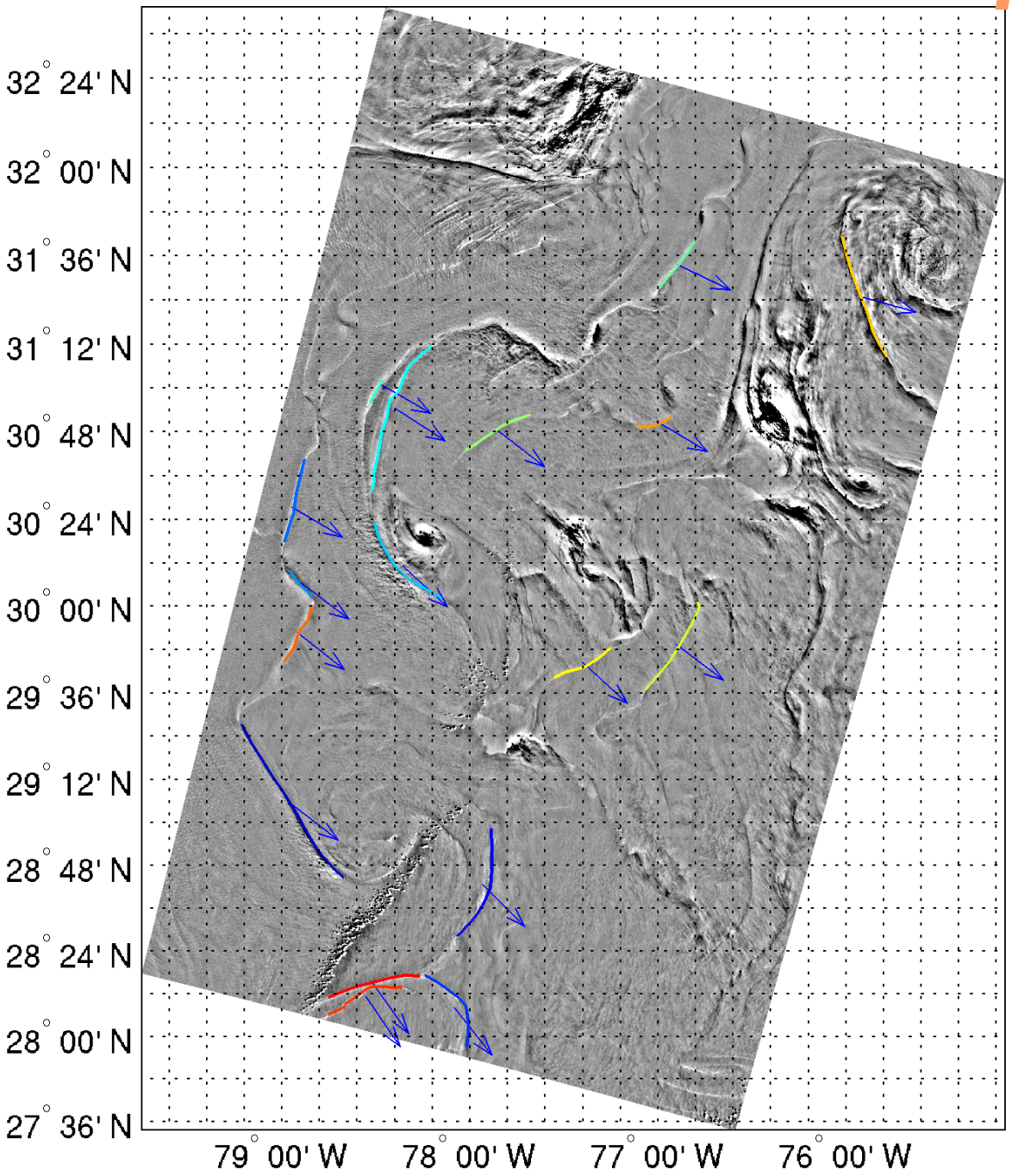


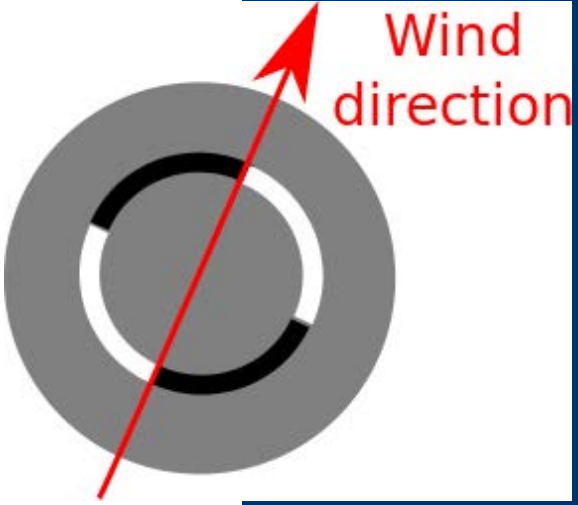


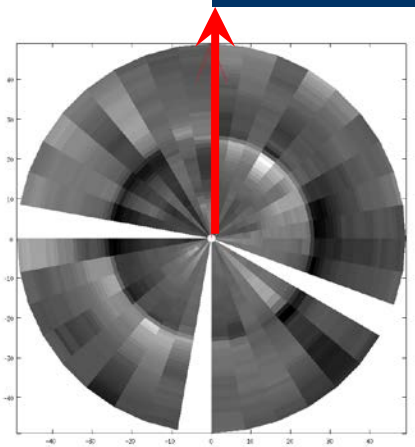

x (km)
9
105
201
297
393
489
Latitude (N)
32° 0'
31° 0'
30° 0'
29° 0'
80° 0'
79° 0'
78° 0'
77° 0'
76° 0'
75° 0'

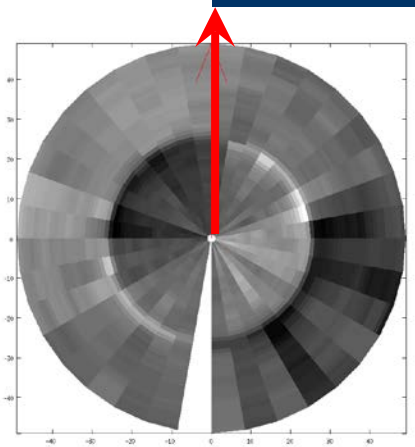


MERIS Northern hemisphere









Conclusion & Perspectives

- Front roughness variation is clearly wind dependent (mostly on direction relative to observation azimuth angle)
- Observed in ASAR surface roughness mostly at low incidence (20 to 30 deg) and wind direction near the azimuth direction.
- Observed in MERIS derived roughness mostly in wind direction near the range direction.
- Quantitative analysis in terms of sst gradient strength and associated ageostrophic circulation interaction with Eckman current needs to be checked.

Thank you