

# The Effect of the Agulhas Current on SAR Derived Wind Fields

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# Presentation Outline

Research Objectives

Introduction to SAR

Previous Research

Research Approach

Results

Summary and Conclusions



# Research Objectives

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# Primary Research Questions

1. What is effect does the Agulhas Current have on the overlying wind patterns and regimes? Namely:
  - a. The relative effect of speed and direction of wind regimes in relation to current flow
  - b. The geophysical modification of true wind speed over the current from SST influences
2. What is the effect of initial wind speed intensity on the overall change in wind speed over the current.
3. Can a quantifiable rule be derived which explains the different effects?



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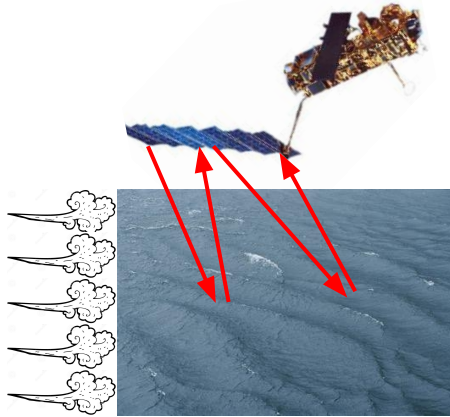
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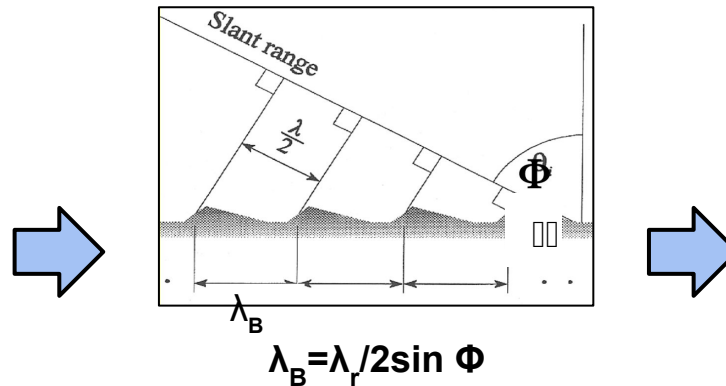


# ASAR Basics: From Waves to Wind Speeds

Active Radar

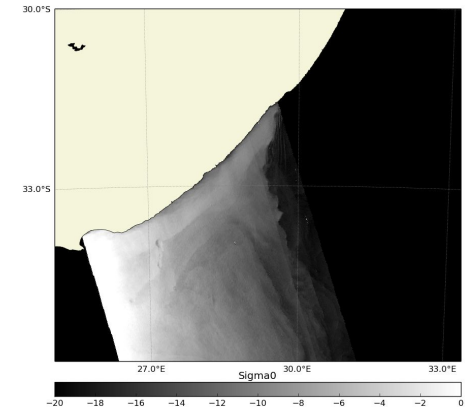


Bragg Scattering

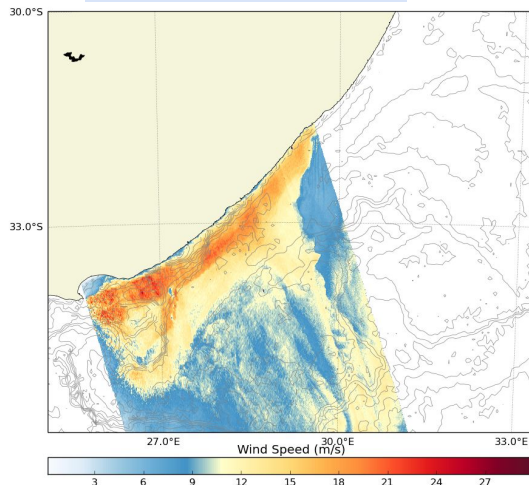


$\lambda_B$  = Bragg wavelength,  $\lambda_r$  = Radar wavelength,  
 $\Phi$  = Incidence angle

NRCS ( $\sigma^\circ$ )



Finished Product



Relative Wind Speed

Geophysical Model Functions (eg: CMOD5.n)

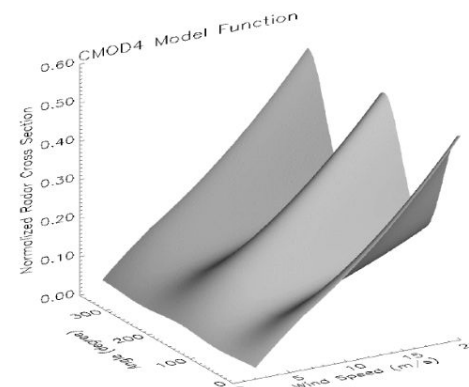


Figure 13.1. The CMOD4 geophysical model function relating wind speed and direction with respect to the radar to normalized radar cross section. For this case, the radar nadir incident angle is 25°.

$$\sigma_0 = CMOD(c, v, \phi, \theta) = B0(c_0, v, \theta) [1 + B1(c_1, v, \theta) \cos(\phi) + B2(c_2, v, \theta) \cos(2\phi)]^p$$



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# Influence of Current Signatures on Satellite Wind Data

- Past research has shown evidence of influence of large scale ocean currents in satellite wind measurements.

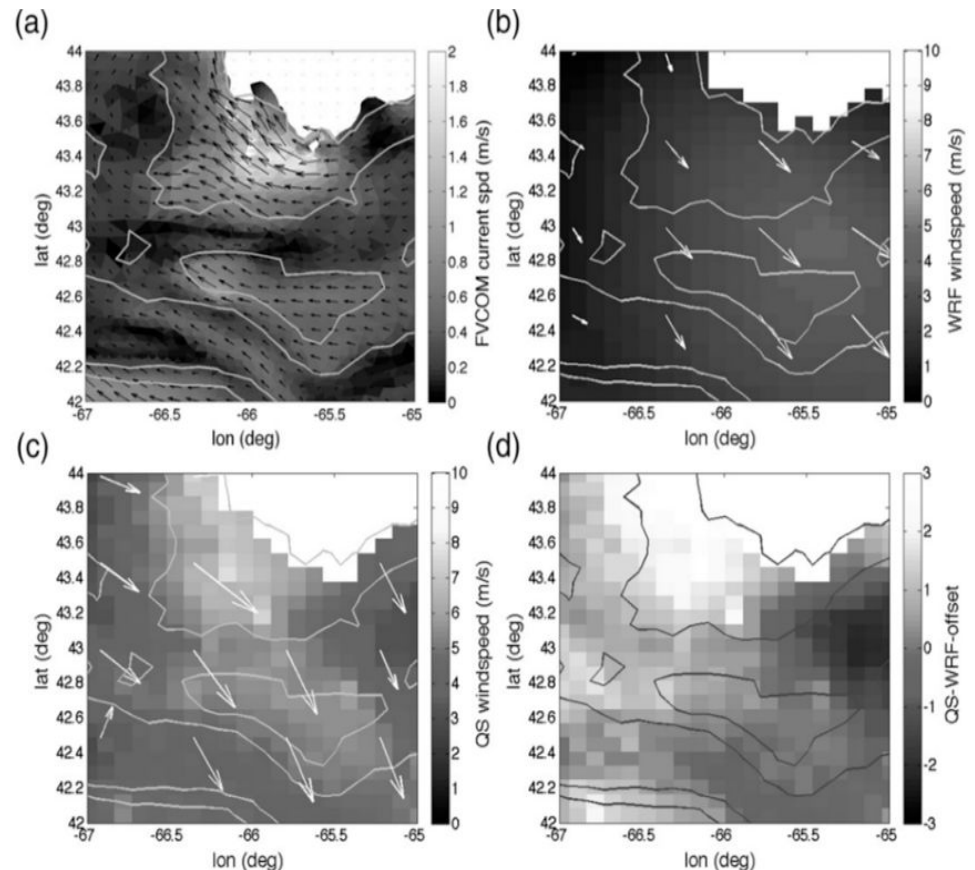
**QuikSCAT** and **ASCAT** compared to **WRF** model and in situ data

**Near 1 to 1** correlation between satellite derived wind speeds and ocean velocities.

**10%-20%** difference for current relative wind speeds

**However:**

**No research using high-res SAR on intense boundary currents**



Plagge et al. 2012





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# Data

**Number of Swaths:** 987

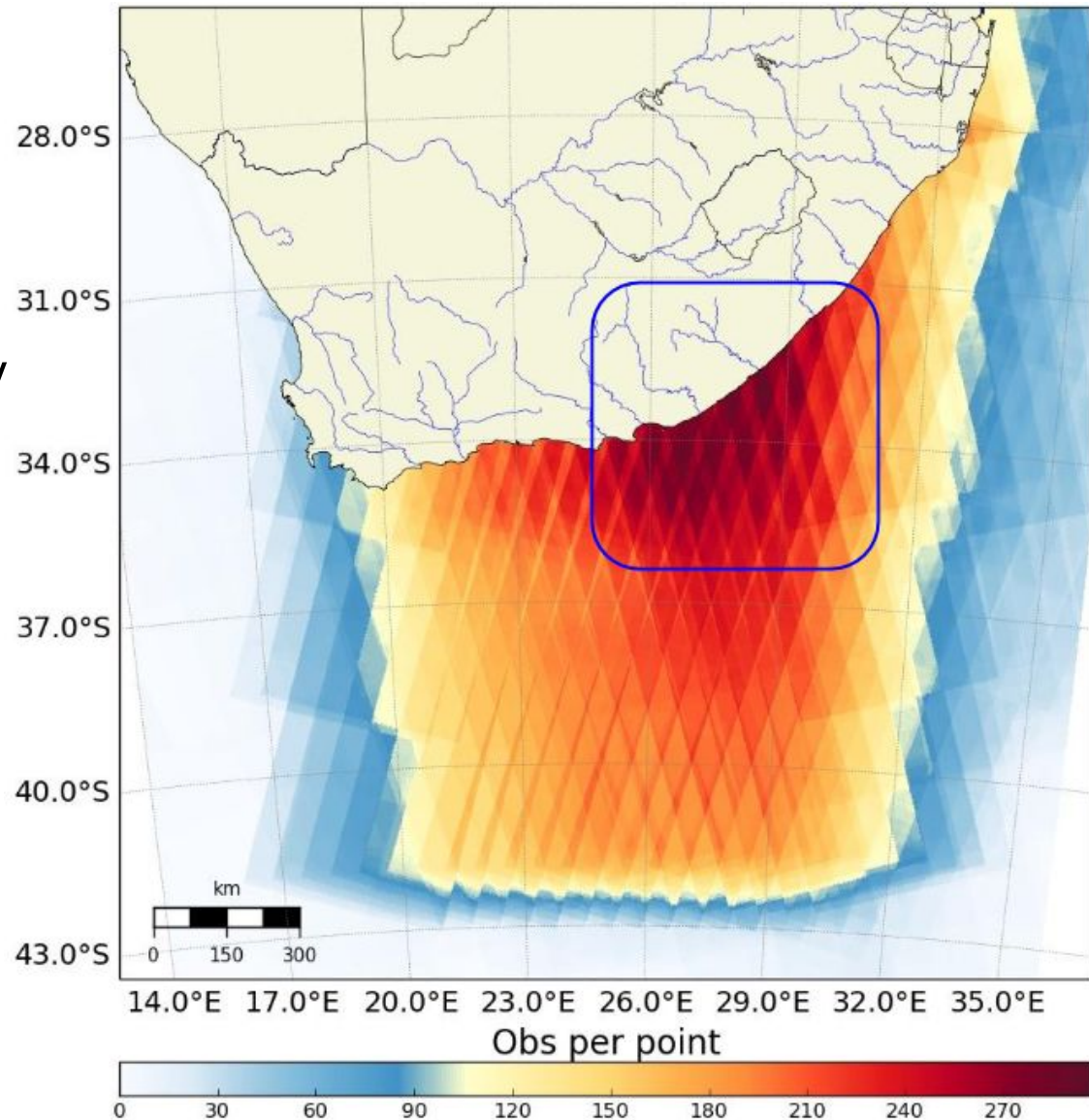
**Time Period:** 2007-2012

**Sample Rate:** 1 Orbit per day  
approx. 3-5 day repeat  
measurement cycle

**Max Data Density:** 297

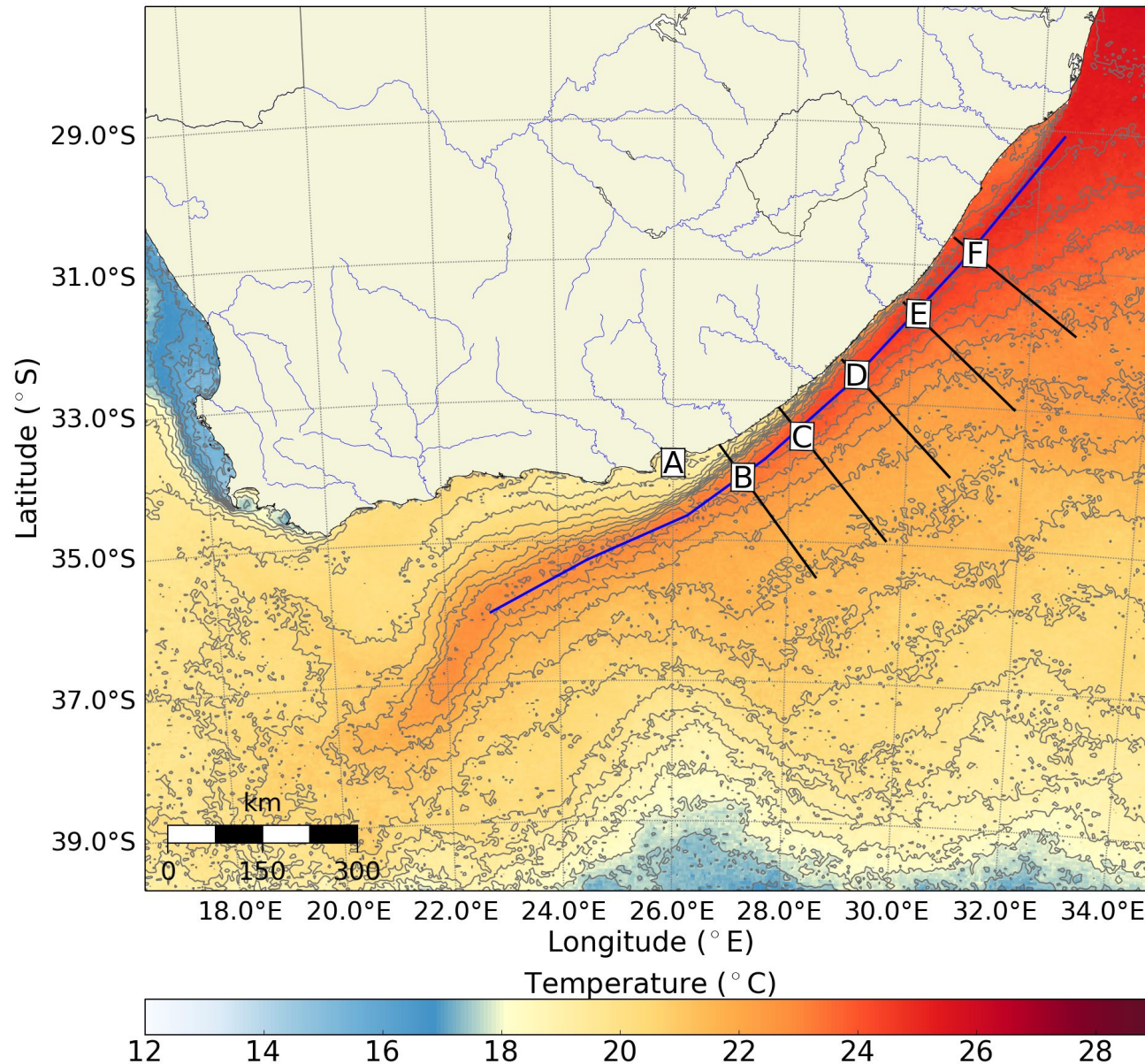
**Swath Width:** ~400km (Wide  
Swath)

**Resolution:** 150m x 150m  
(Re-Gridded to 1km x 1km)

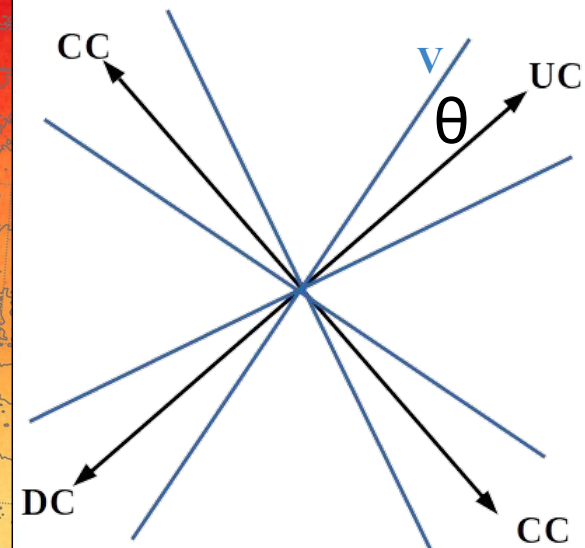




# Research Approach: Locations of interest



## Grouping of wind Regimes



$$UC = V \cos \theta$$

- Vector Component
- Wind regime direction grouping
- Angle of deviation from regime component



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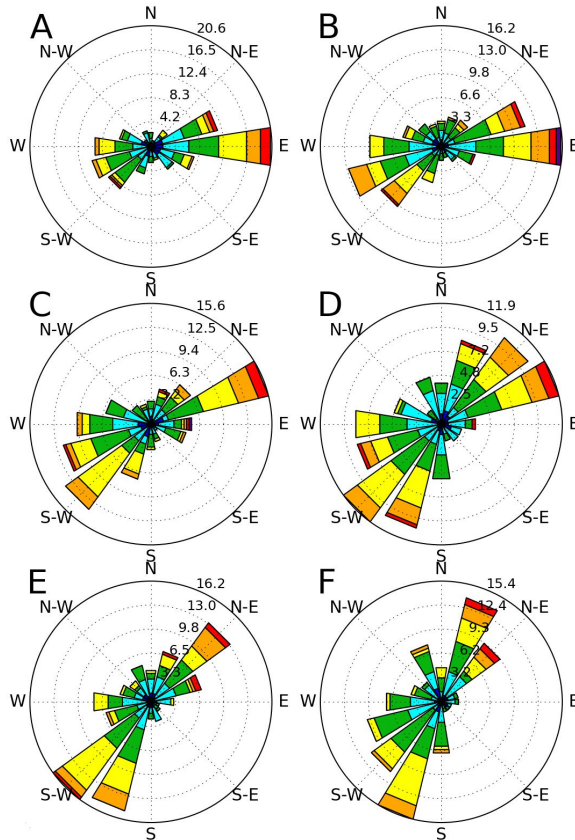
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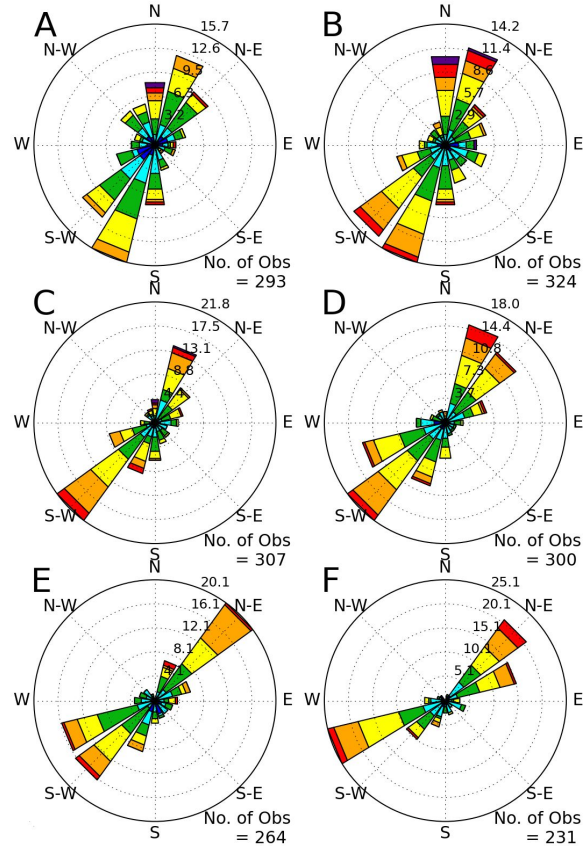
# Wind Roses (Envisat ASAR vs CFSv2 and Metop/ASCAT)

Metop/ASCAT(1) vs CFSv2 (2) and ASAR (3) derived wind speed and direction frequency

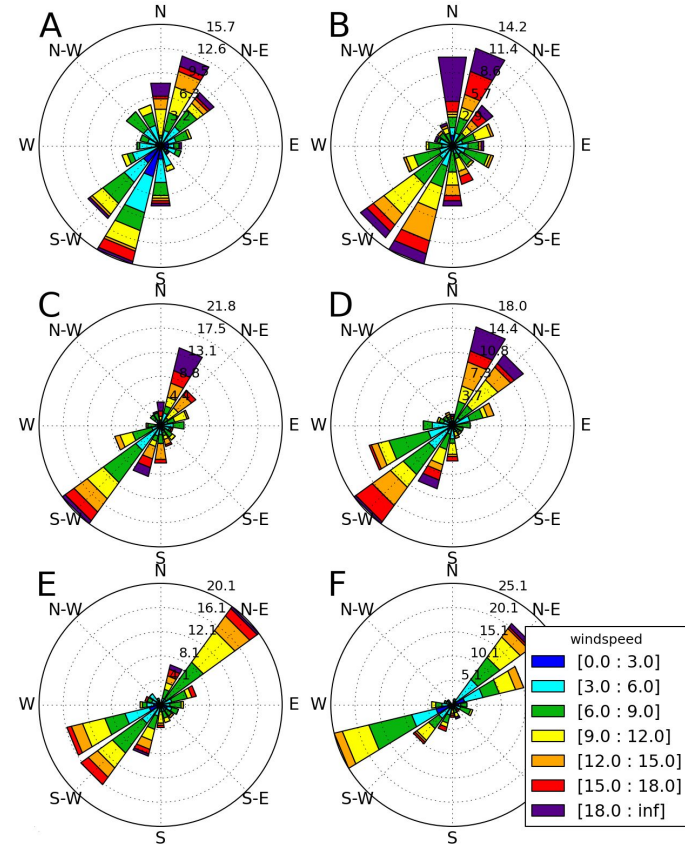
ASCAT Derived Wind Roses for 2007 to 2012



CFS Derived Wind Roses for 2007 to 2012



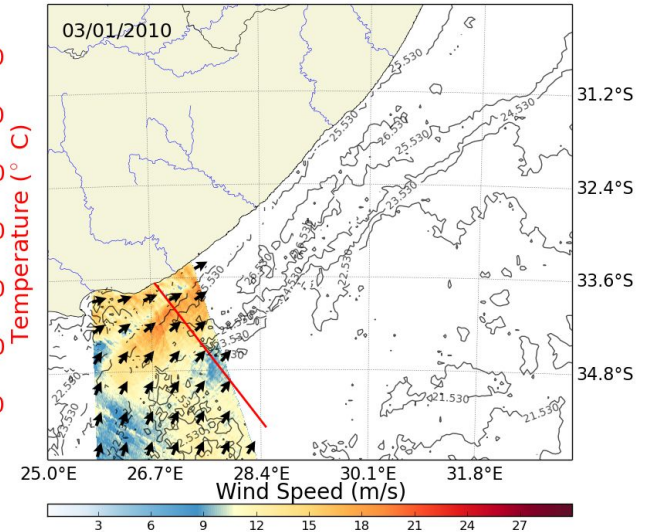
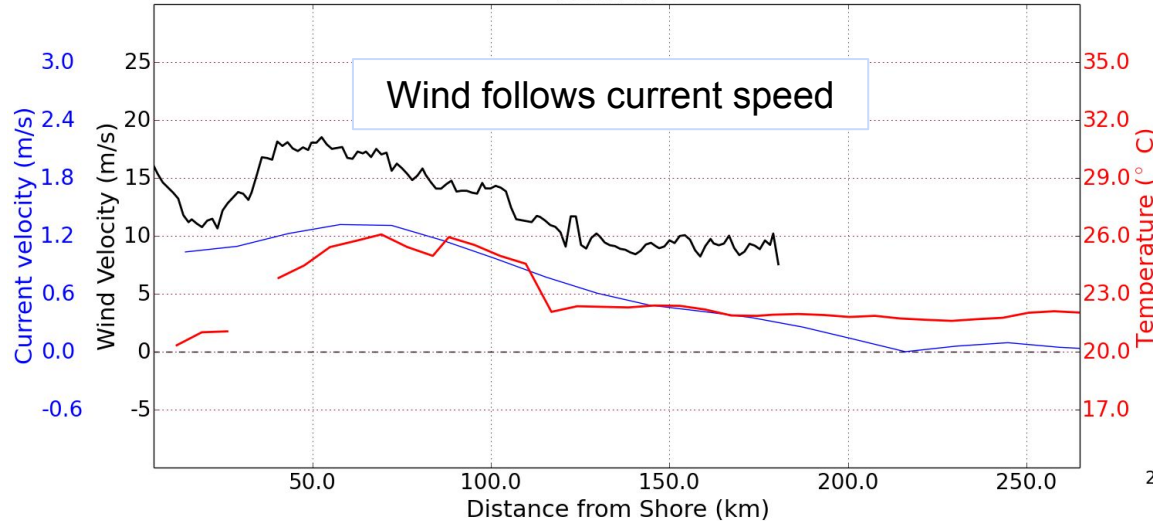
ASAR Derived Wind Roses for 2007 to 2012



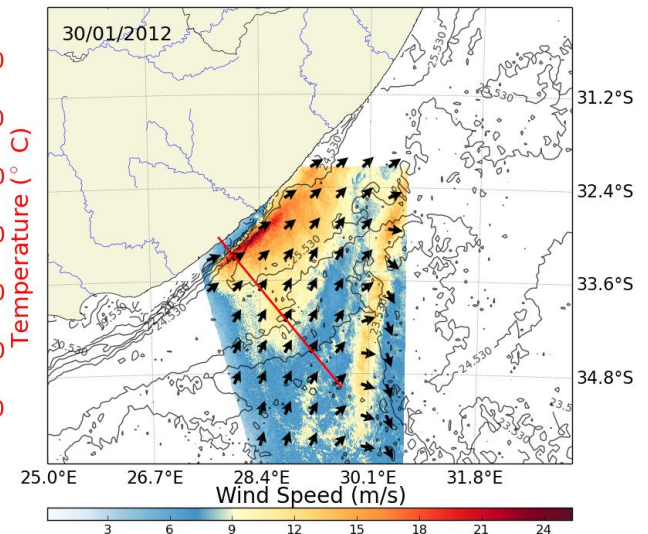
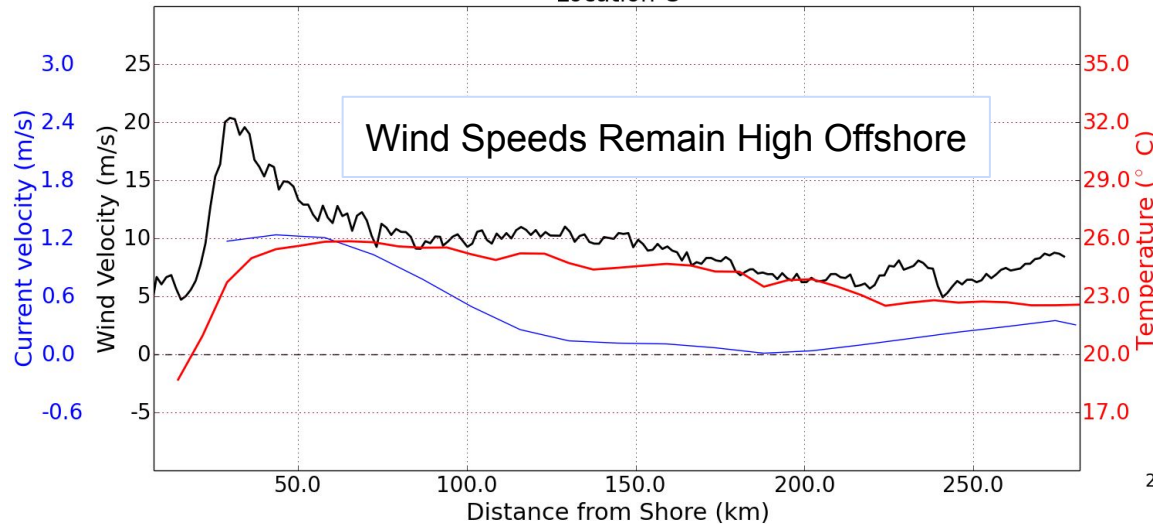
Winds are aligned with the current  
General increase in intensity in BOTH Upcurrent and Downcurrent scenarios

# Case Studies Show Multiple Influences

Location B

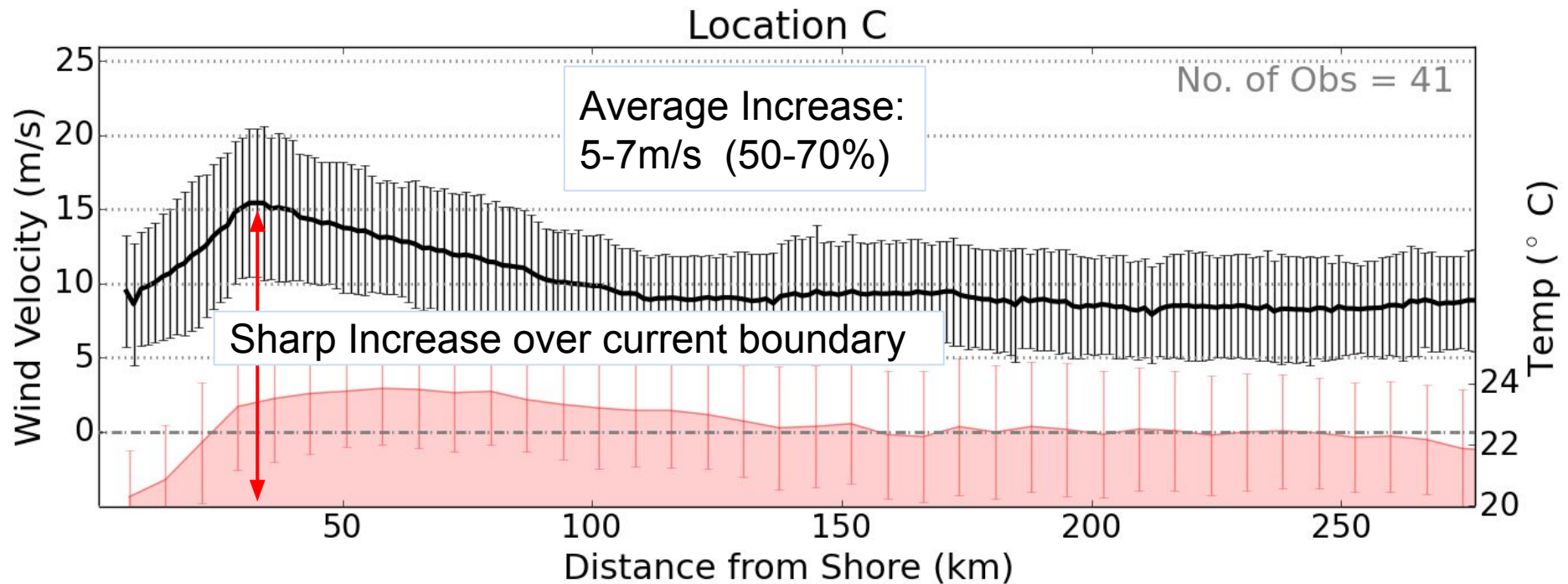


Location C





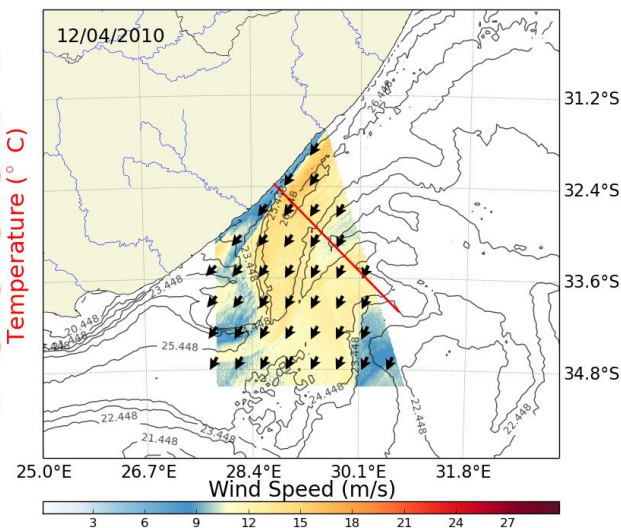
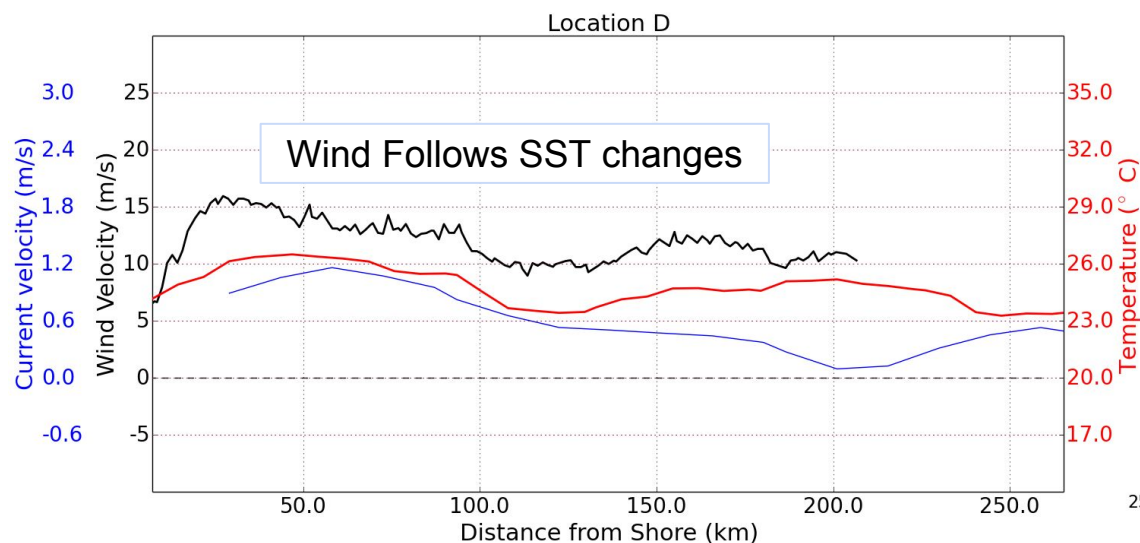
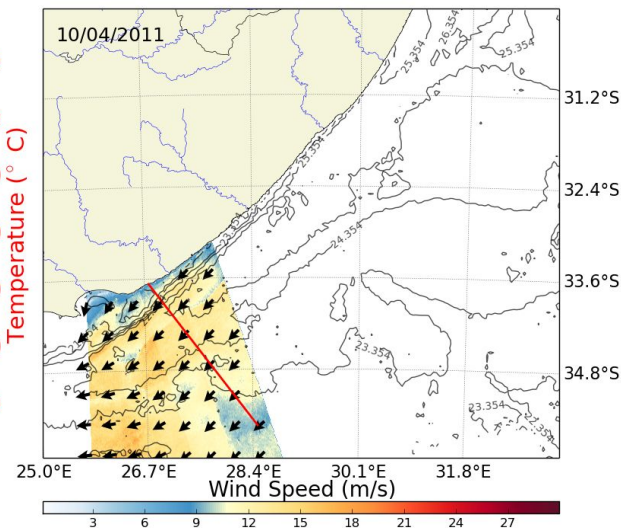
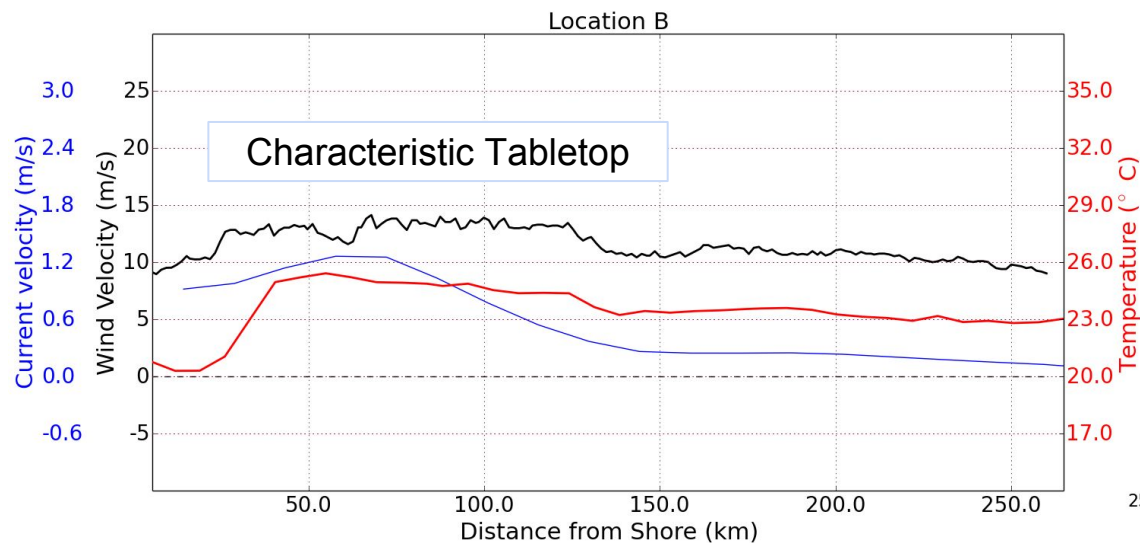
# Mean Upcurrent Relative Effect



**Possible Causes of Abnormal Increase in Wind Speed:**

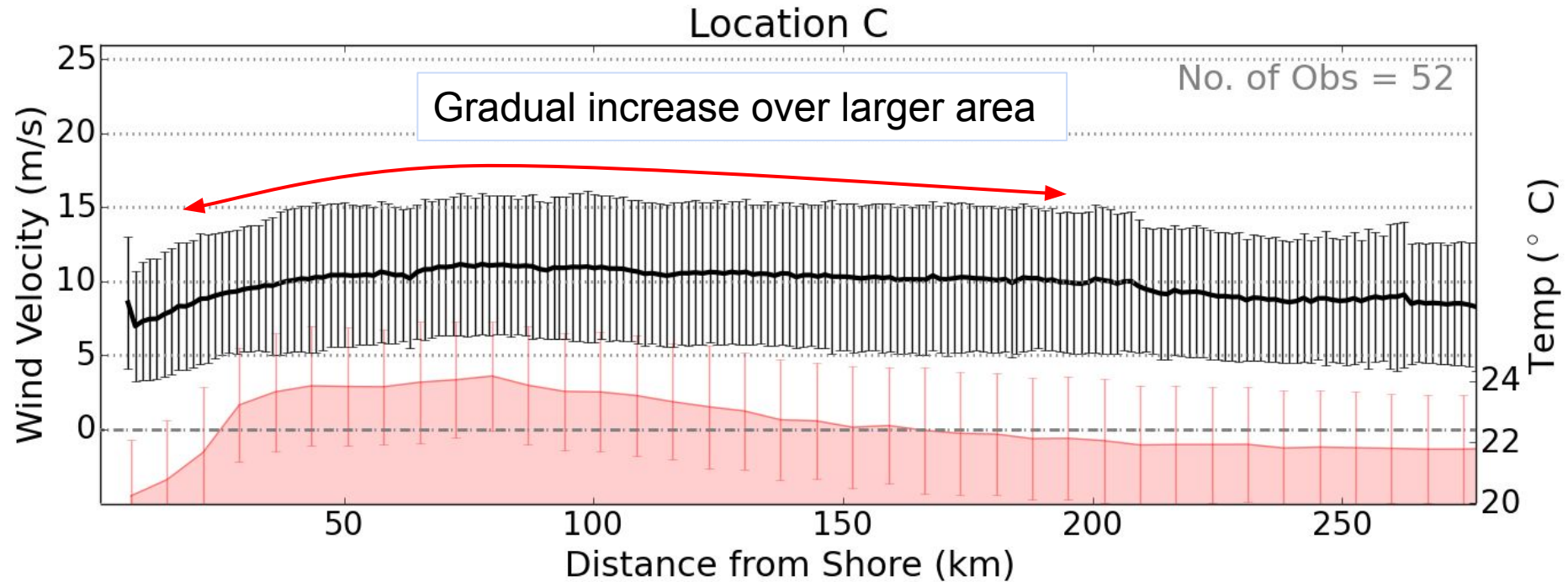
Intensity of current; Compounding influence of SST;

# Downcurrent More Affected by SSTs





# Mean Downcurrent Effect



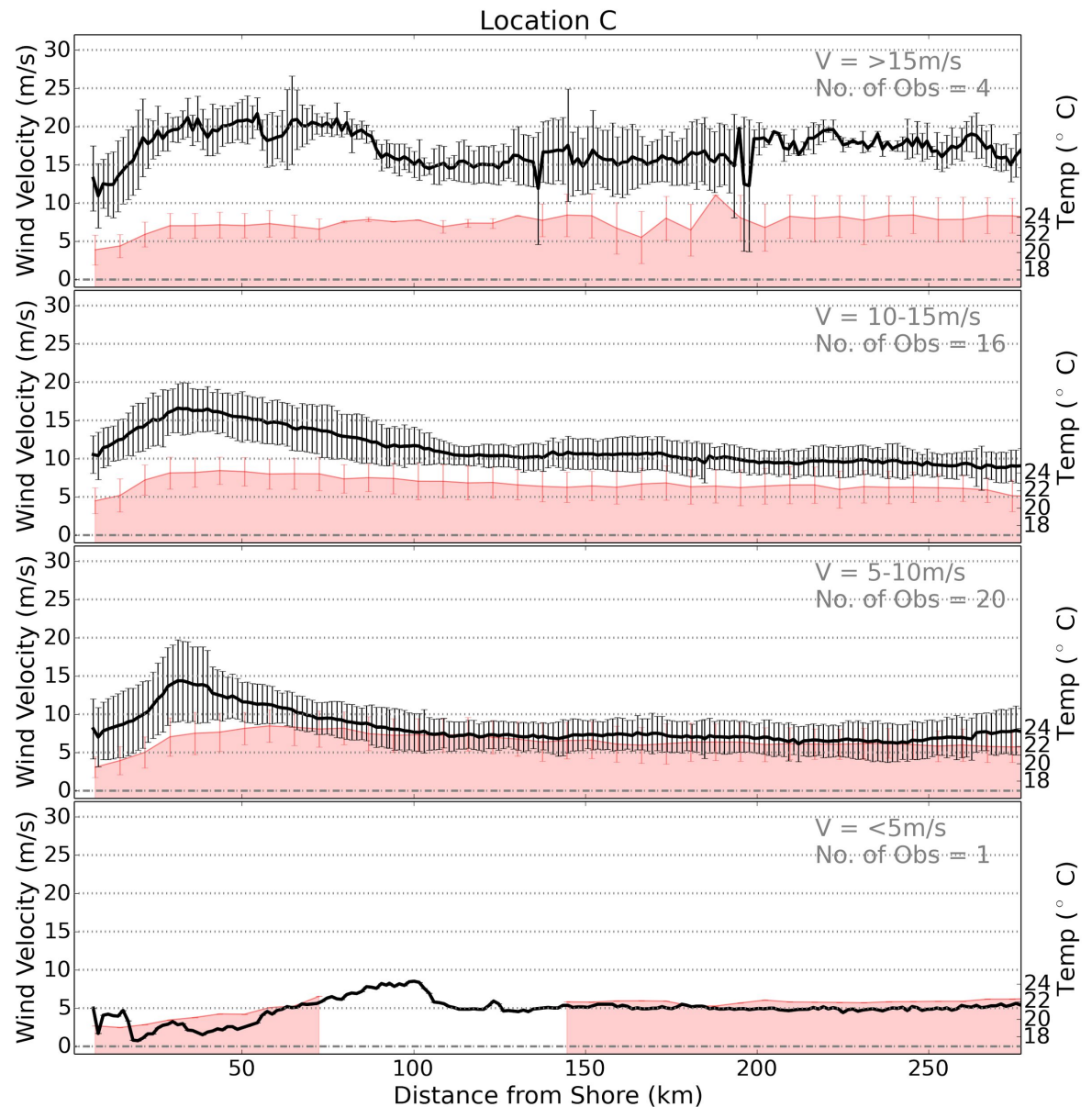
## Conclusion:

Increase in downwind speeds indicates additional, external influencing factors on surface roughness signature (Rouault., 1999)

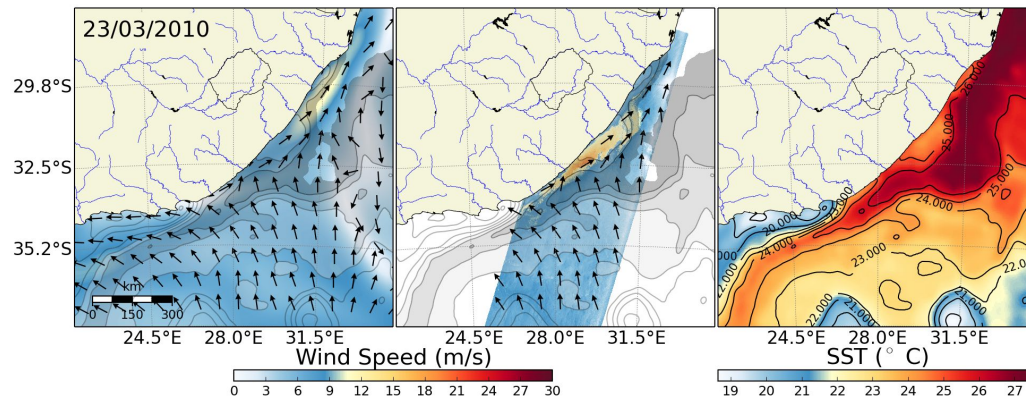
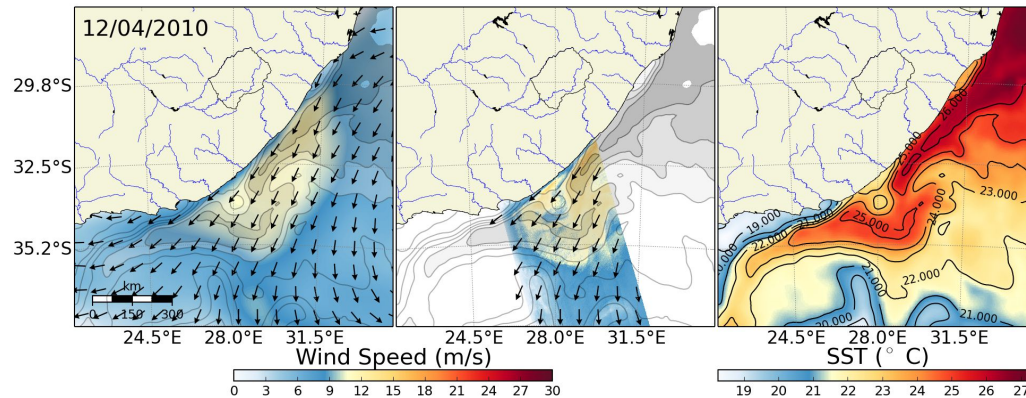
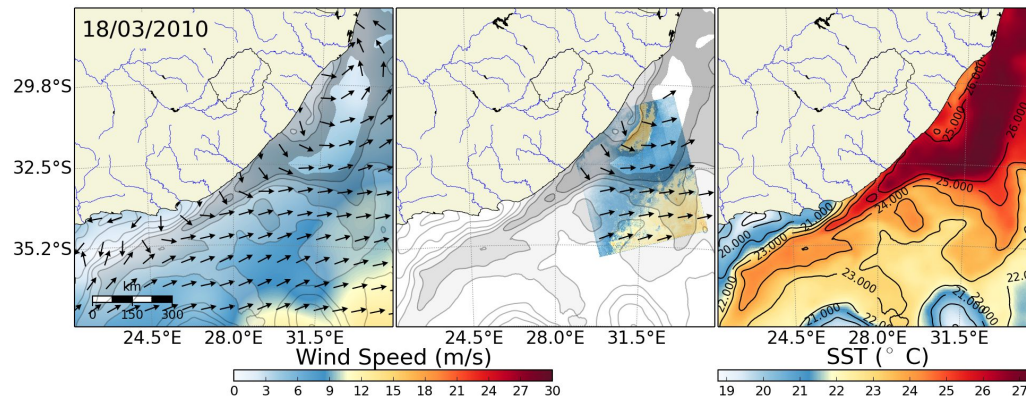
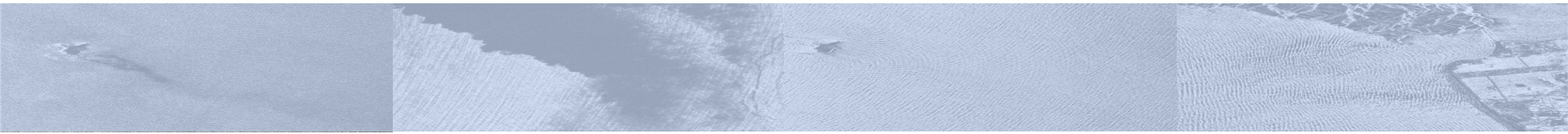
# Influence of Variation in Wind Intensity

Greatest indication of increase is between 5m/s and 15m/s

CMOD5.n is only valid for moderate wind speeds







Complex Mesoscale features  
evident in wind speed data.

Unexplained changes in wind  
speed

**Conclusion:**

Other unexplained geophysical  
and roughness modifying forcings  
influence derived wind speed



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# Summary and Conclusions

1. High-res SAR better resolves wind over small scale, intense features
2. Upcurrent regime most affected by relative effect (Mean increase ~50-70%)
3. Downcurrent regime shows increase in wind speed (~40-50%)
4. Wind speeds between 5-15m/s most affected
5. Evidence of external, geophysical influence for all regimes which result in difficulties in deriving quantifiable rule.

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