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Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

Temporal and spatial variability of Wind Intensifications assessed from scatterometers

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and

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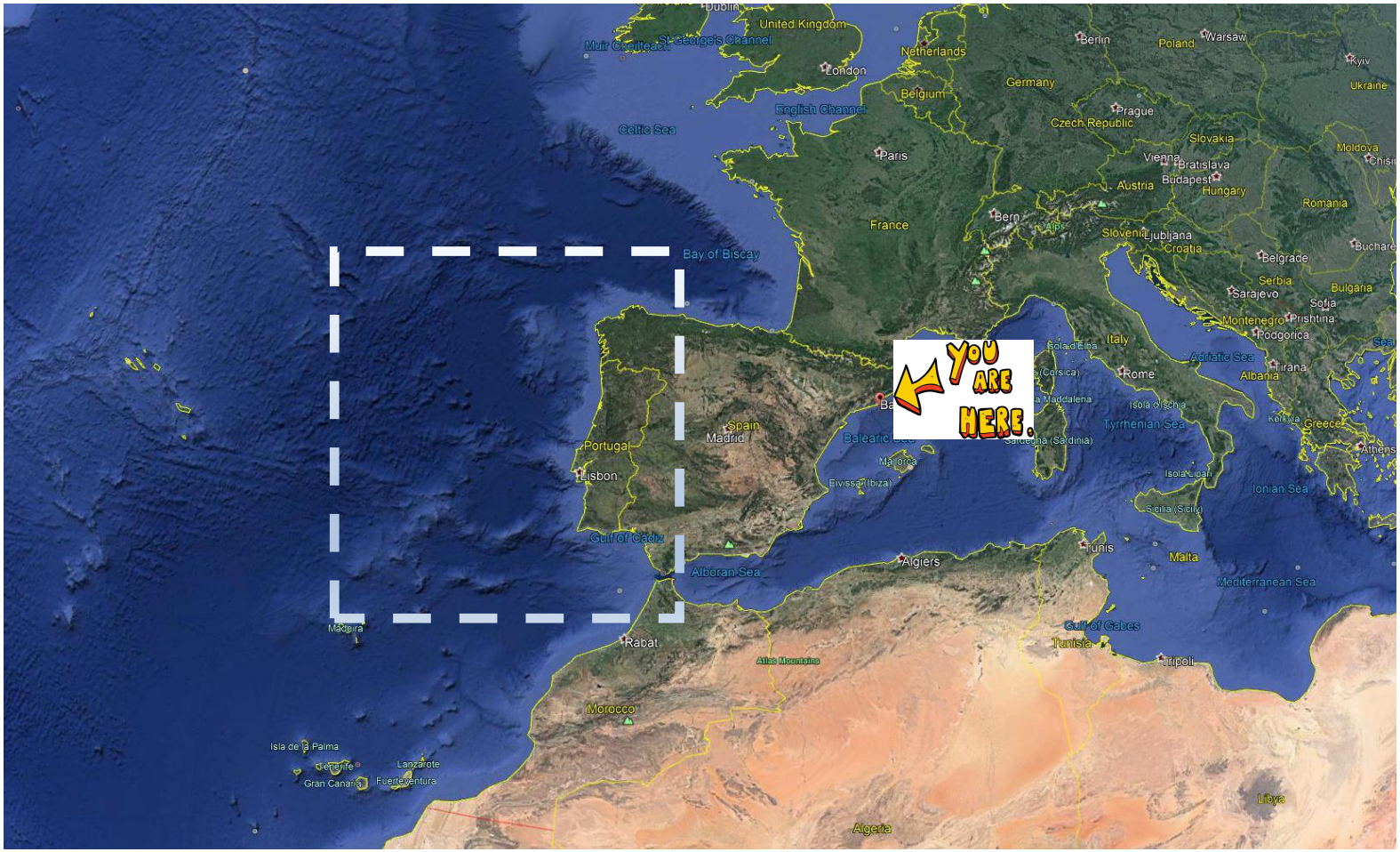
Thanks to:
Ad Stoffelen

outline

- What are wind intensifications?
- Motivation
- Spatial variability - ASCAT-6.25
- A glance on temporal variability - ASCAT and RapidScat
- Conclusions

Wind Intensifications?



Wind intensifications?

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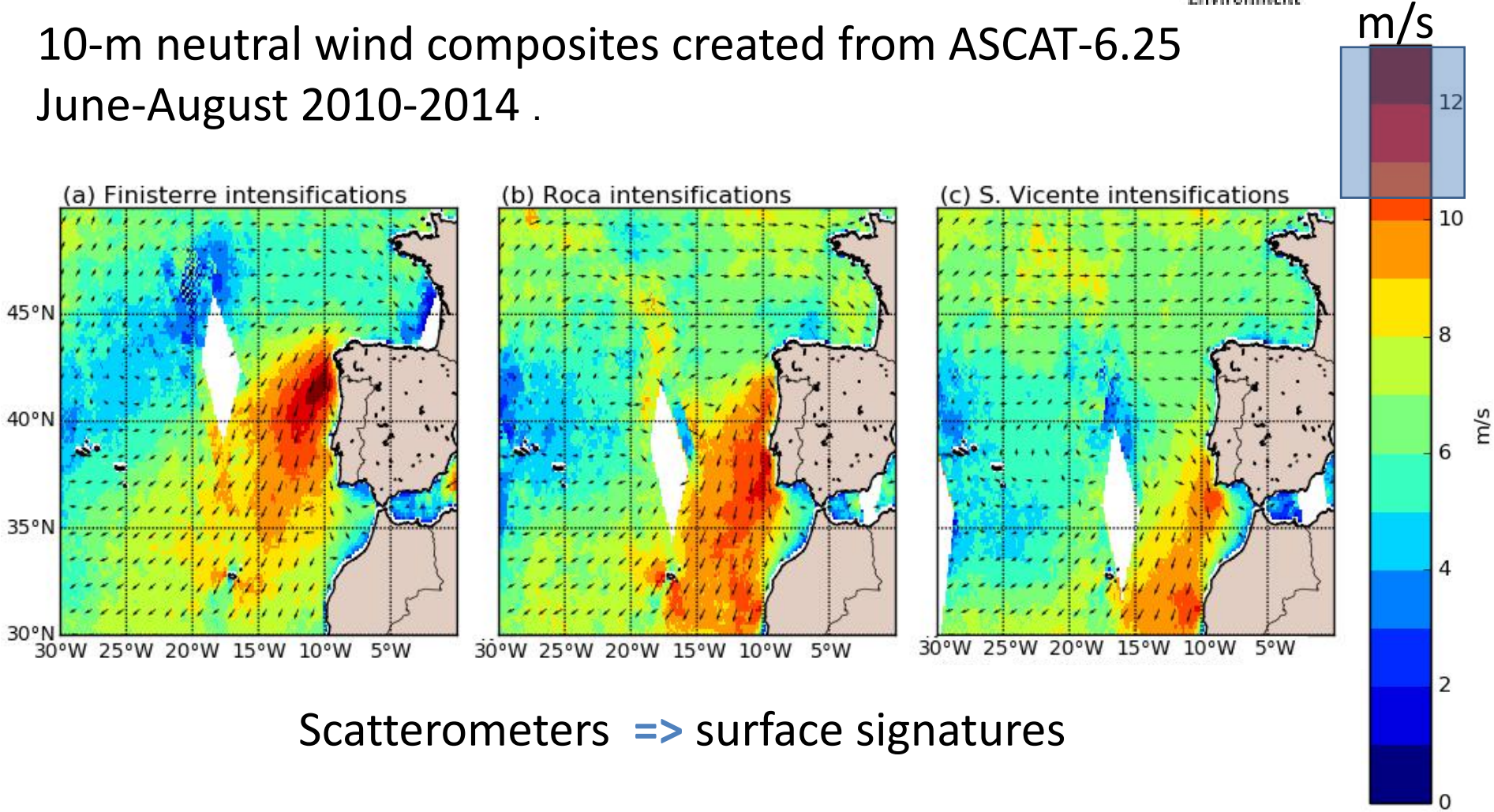
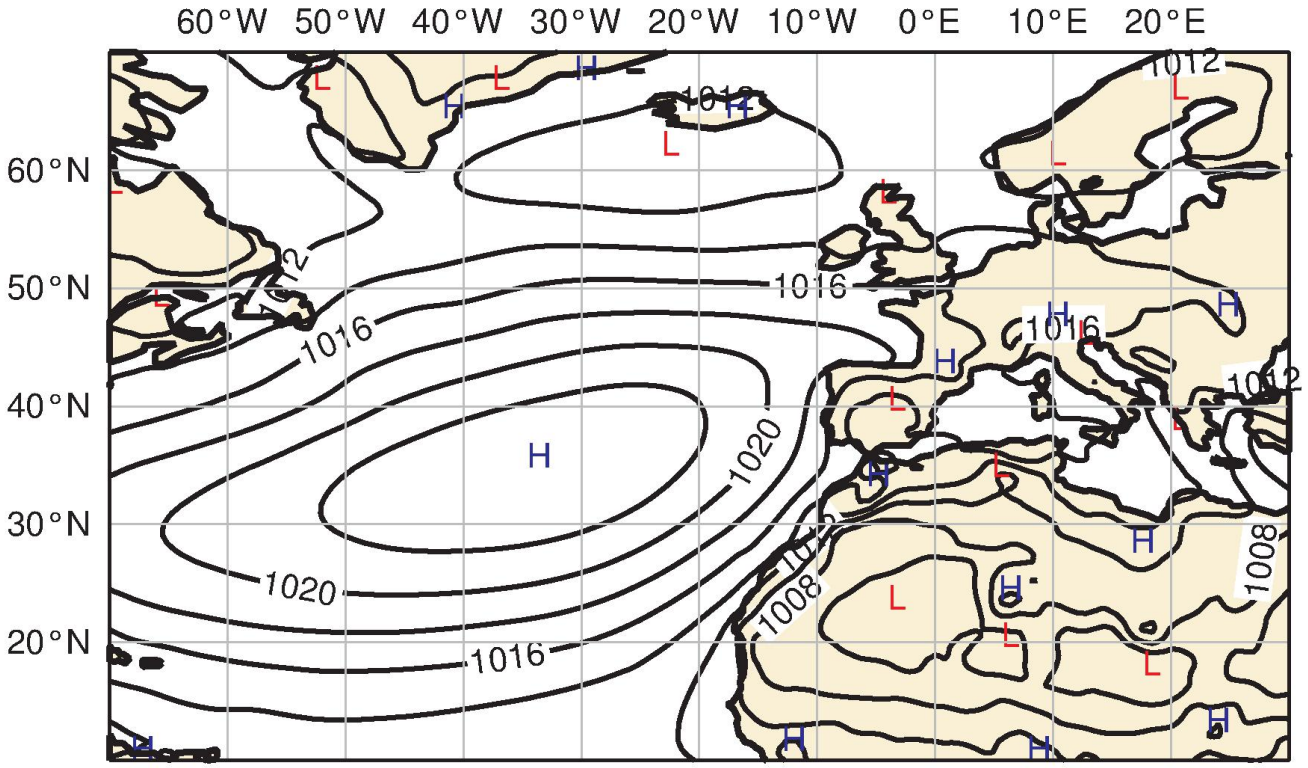
10-m neutral wind composites created from ASCAT-6.25 June-August 2010-2014 .



Scatterometers => surface signatures

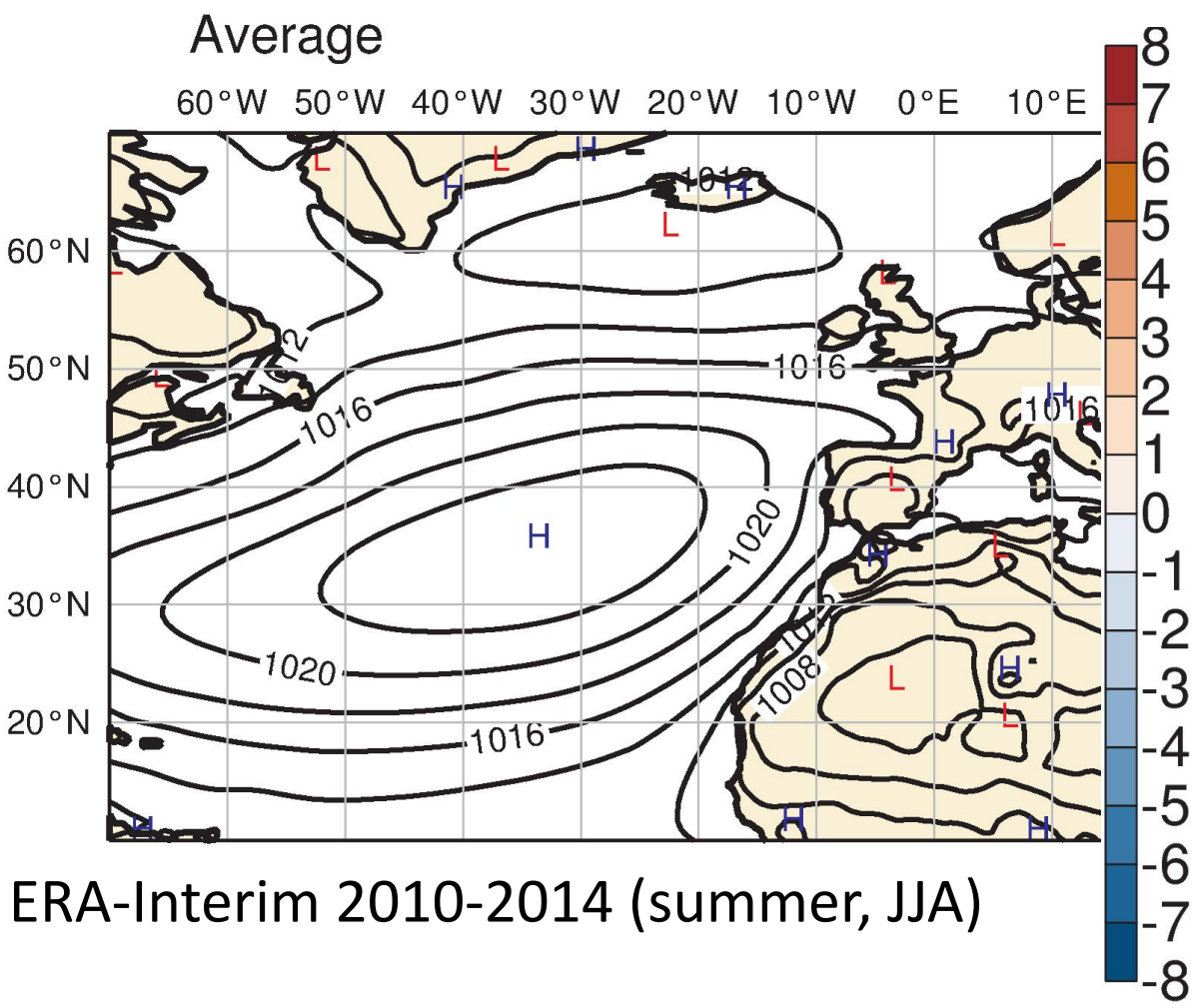
Wind Intensifications?

Average mean sea-level pressure (hPa)



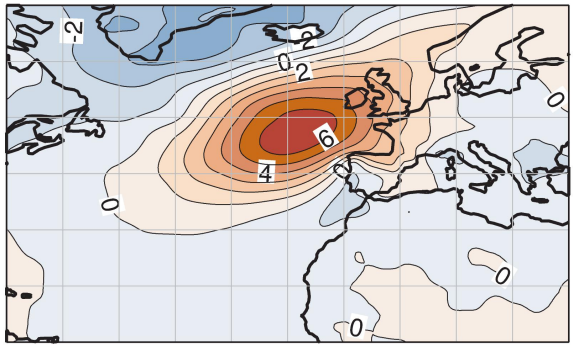
ERA-Interim 2010-2014 (summer, JJA)

Wind Intensificatic

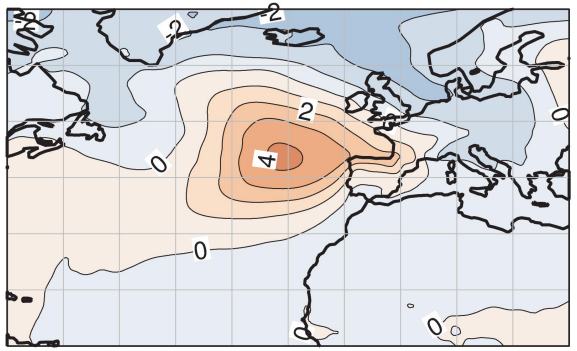


ERA-Interim 2010-2014 (summer, JJA)

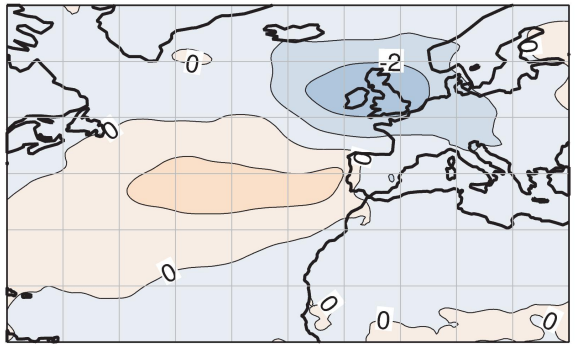
(c) Finisterre - Average



(e) Roca - Average

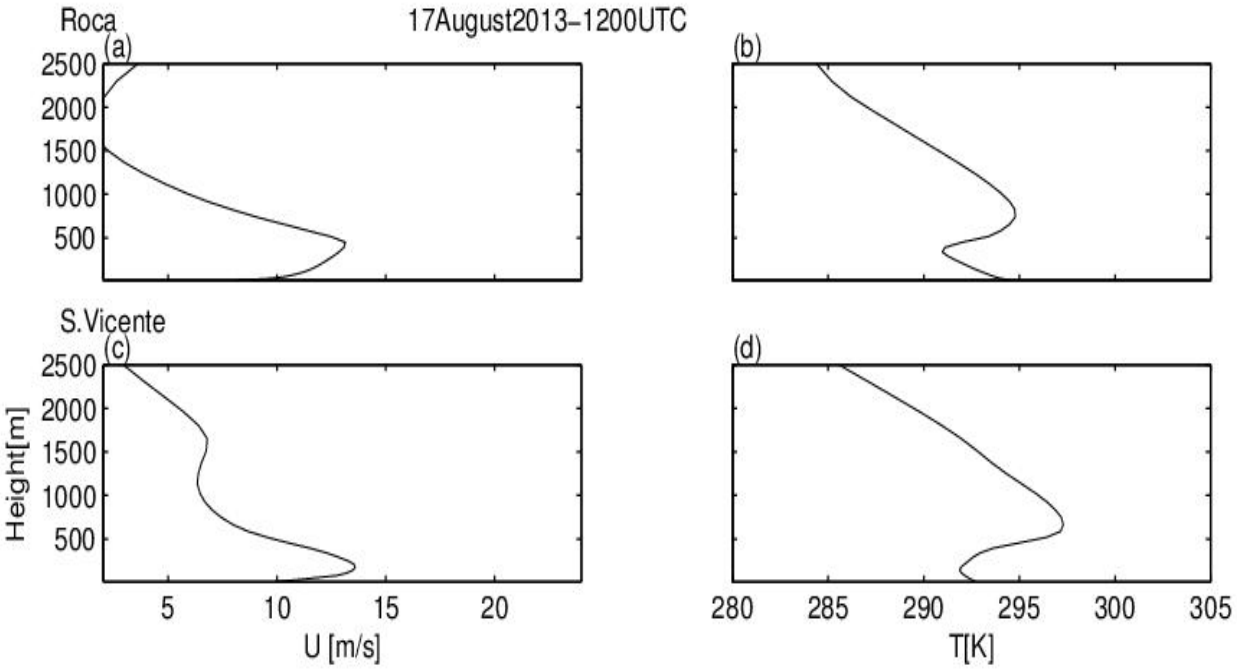


(g) S. Vicente - Average

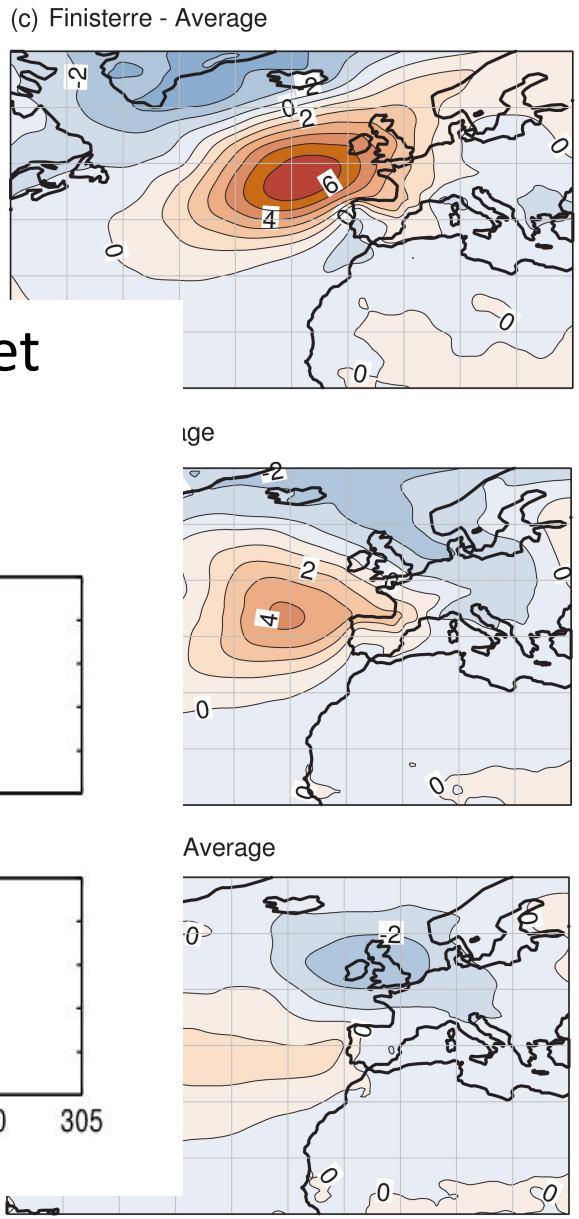


Wind Intensificati

At the lower troposphere a Low-level coastal jet (LLCJ) is frequently produced.



IFS



ERA-Interim 2010-2014 (summer, JJA)

What are expansion fans?

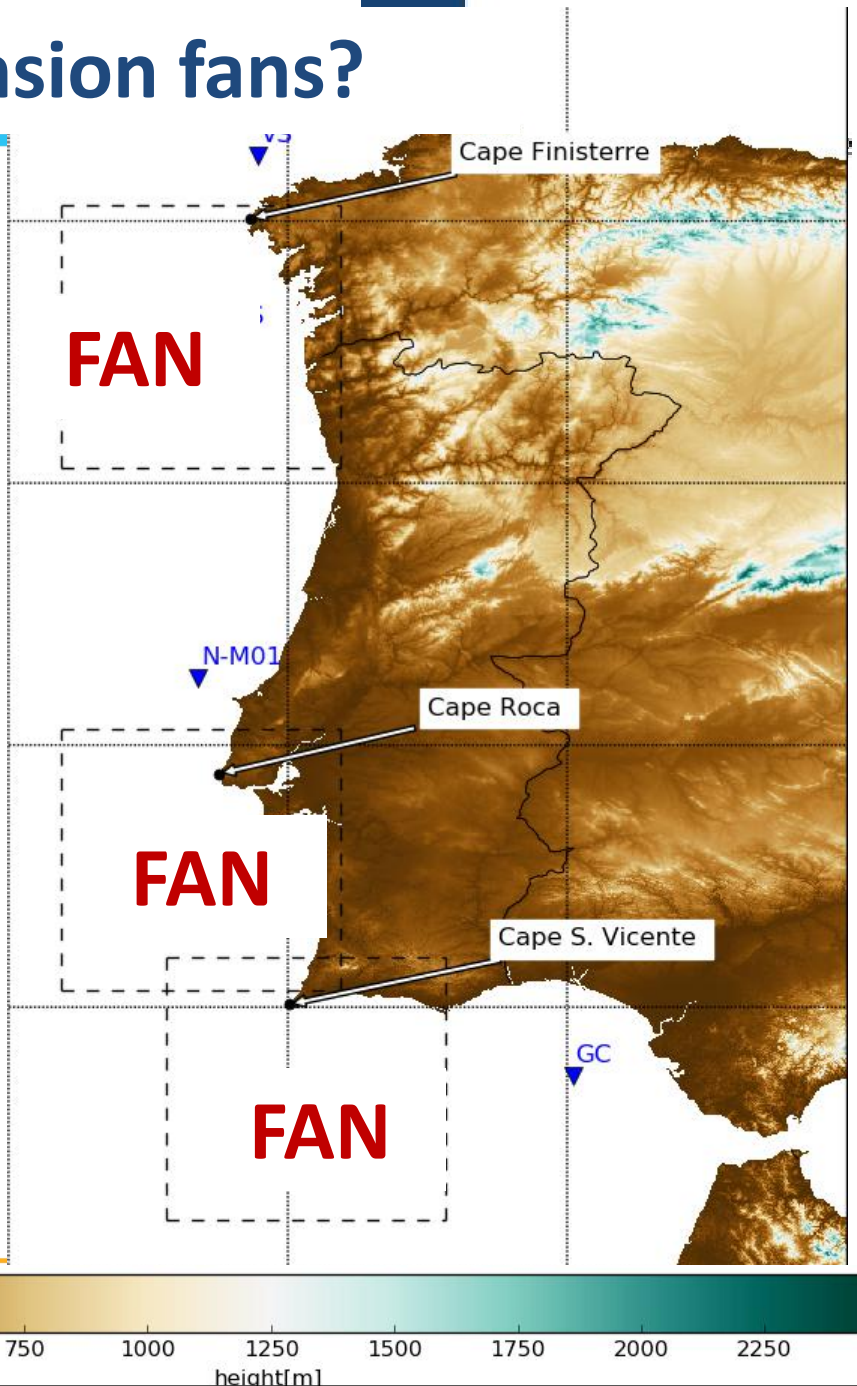
Hydraulic Conceptual Model

$$Fr = \frac{Vmean}{\sqrt{gH\dfrac{\theta_u - \theta}{\theta}}}$$

Fr≥1, Supercritical

or

0.5 ≤Fr <1, Transcritical



Motivation

1. LLCJs and fans have impact on coastal dynamics, marine ecosystems and weather conditions:

- Occur in wind-driven coastal upwelling regions => **impact on marine ecosystems.**
- Are related to vertical **wind speed shear** and low-level wind divergence and convergence (**fog**) => **hazard to aviation operations**.

2. Although the synoptic conditions are well known, **several questions remain open.**

What is the temporal and spatial variability of LLCJ/fans?

Data

Data used in this study are:

- ASCAT-6.25 data JJA 2010 - 2014 (grid size 6.25 km);
- RapidScat data for the JJA 2015 and 2016 (grid size 25 km);
- ASCAT-coastal data JJA 2015 and 2016 (grid size 12.5 km);

Surface signature of LLCJs and fans (~500 m) referred as :

Wind intensifications

Why use scatterometers?

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1. Provide a **synoptic view** with **mesoscale detail**.

Swath 2 X 500 km

Effective resolution: **ASCAT-coastal, 28 km**

Vogelzang et al. [2017]

ASCAT-6.25, 17 km

2. Provide **observations** in regions **where there are no observations**.

3. If we consider **ASCAT** ovw products, 2 (x2) passes over the study area at about the same time but at **distinct times of the diurnal cycle**.

4. **RapidScat** non-synchronous orbit (prograde 51.6º inclination) "almost 2 summers" of wind observations at times of the day never before observed by satellite.

5. **Accuracy of these instruments** - errors in scatterometer wind components, on NWP scales **~1m/s**, Vogelzang et al. [2011]

Results - spatial variability

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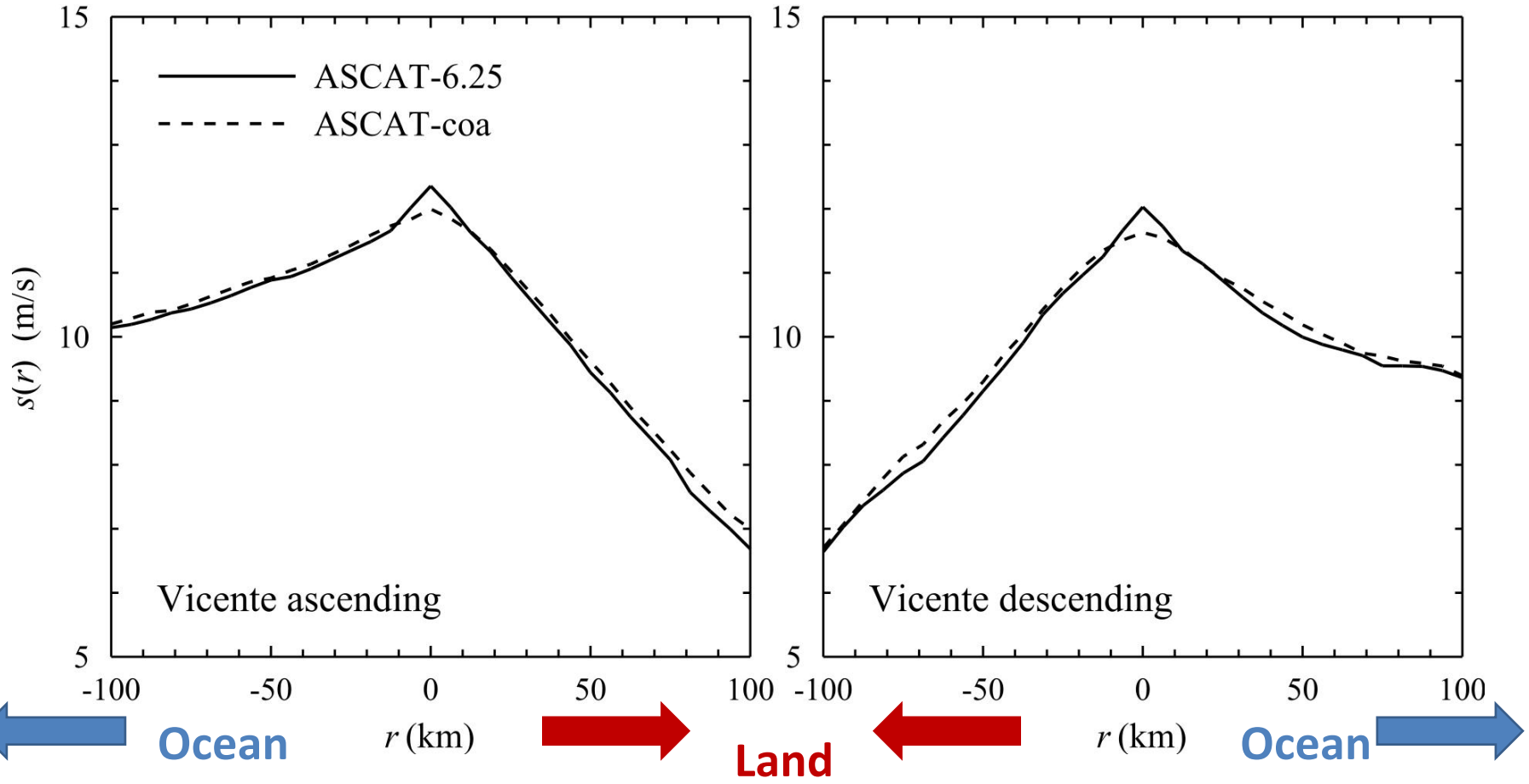
(Recap: ASCAT-coastal, 28 km and ASCAT-6.25, 17 km)



Average wind through the wind speed maximum

Results - Spatial variability

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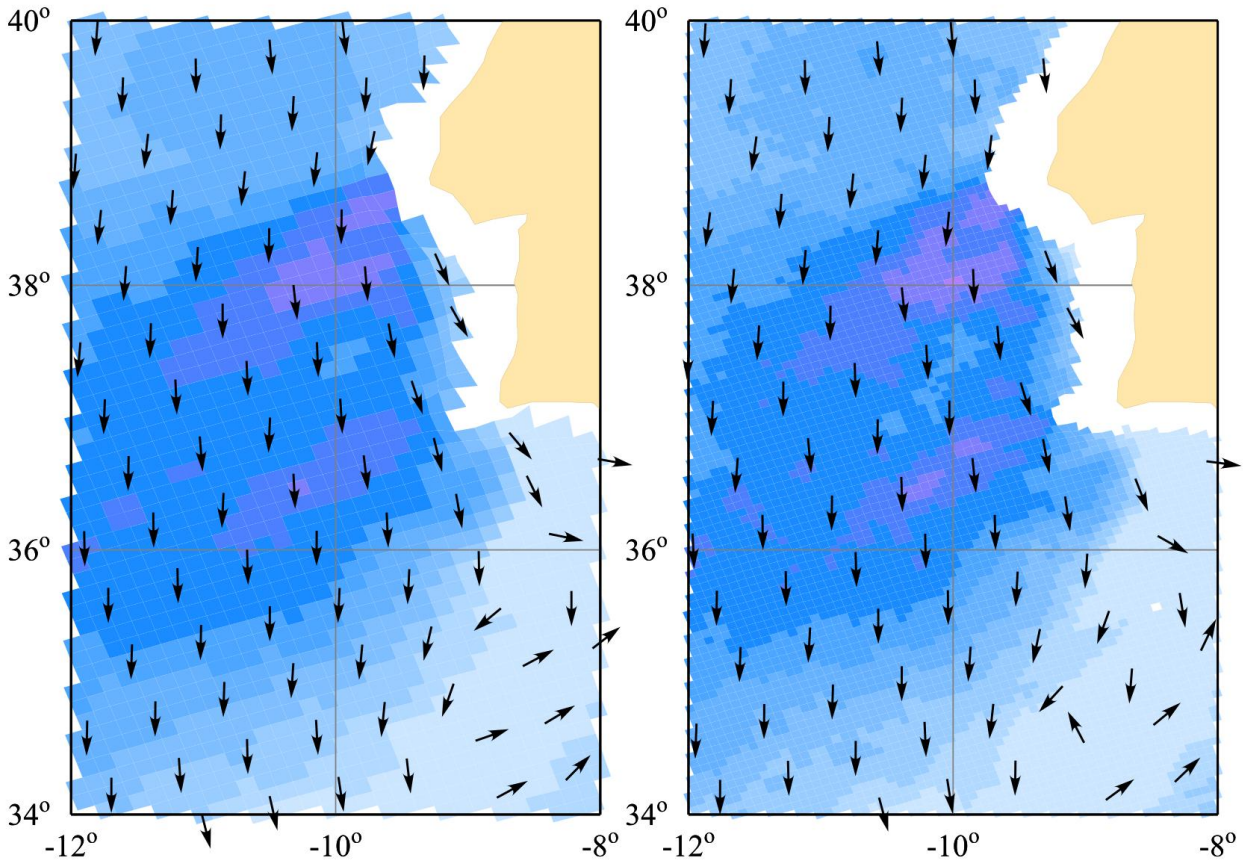
ASCAT-coastal

ASCAT-6.25

Metopb-ascending



Wind arrows thinned to one arrow every 50 km.

Intensification event at S. Vicente and Roca 28-06-2015

Results - temporal variability

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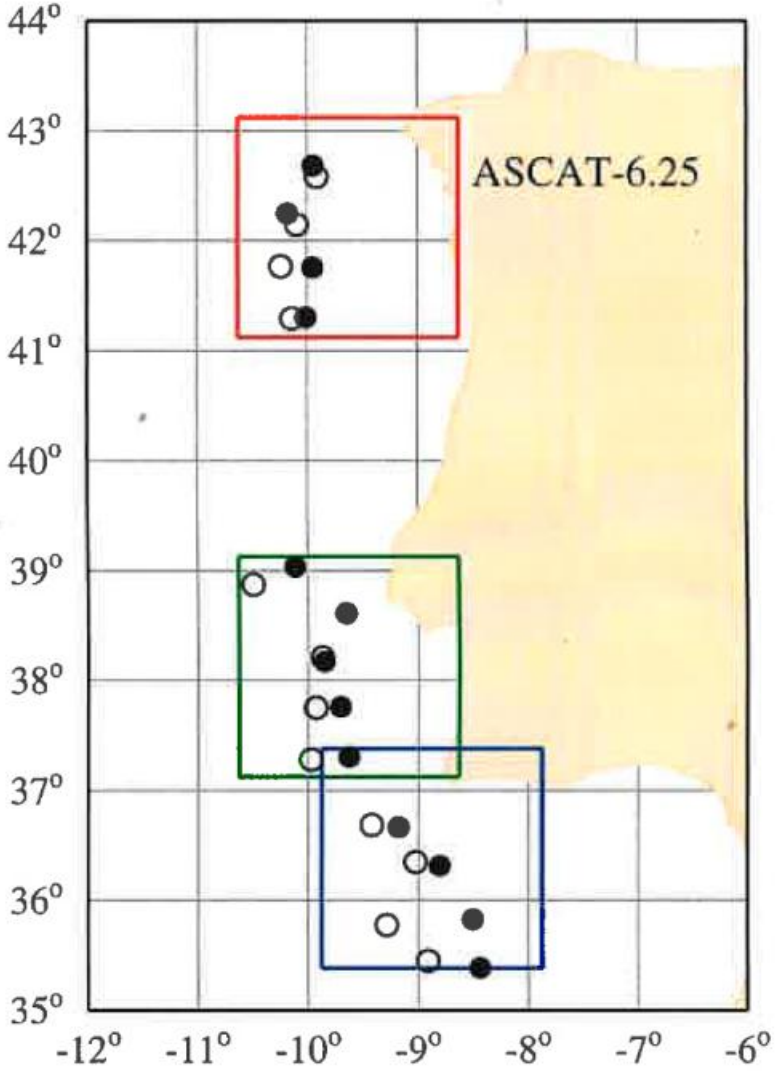
ASCAT-6.25 (JJA 2010-2014) - Average wind max locations



- ○ Morning ~ 0900 -1000 UTC
- ● Evenning ~ 2100 - 2200 UTC

Northern regime

Southern regime

Results - temporal variability

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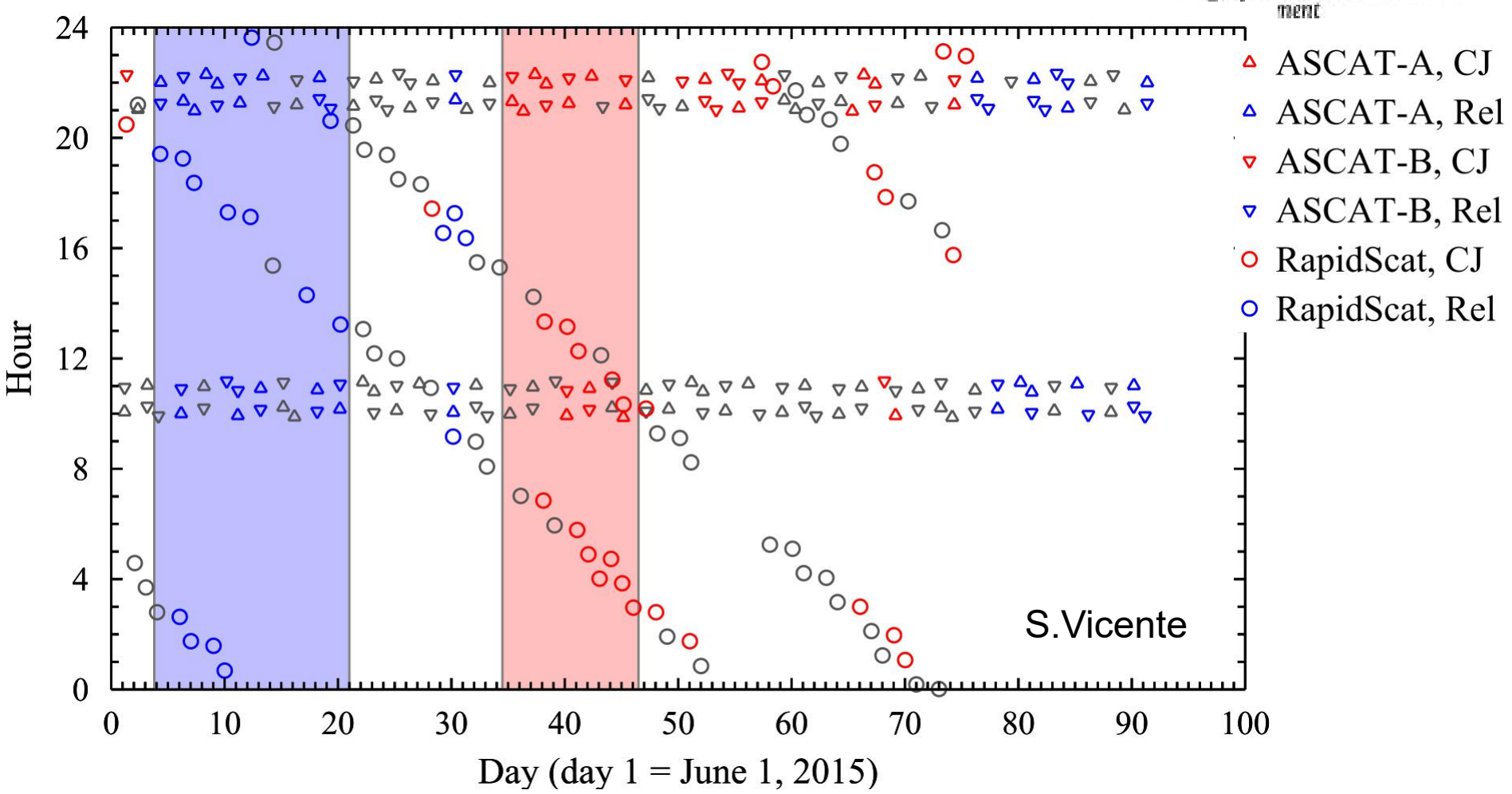

wind intensifications last for entire days

Conclusions

- **ASCAT-6.25 winds show** the dimensions and spatial characteristics of the **wind intensifications in detail**.
- **ASCAT-6.25 AM** and **PM revealed** a **southern sector** of the **coast** where the **wind intensification maxima moves towards the coast** as a **delayed response** to the daily **baroclinic maximum** in **mid afternoon**.
- **RapidScat mission** enabled us to have a first picture of the wind diurnal cycle during 2 summers, confirming that **wind intensifications** are **multi days events**, clearly **distinct from the sea breeze circulation**.

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THANK YOU!

Backup

Results - frequency

wind intensification events

Intensification Event location	ASCAT-6.25 (2010-2014)
Finisterre	15%
Roca	14%
S. Vicente	26%

Sensitivity tests to the stability function parametrization

Using parametrizations of the stability function to convert wind buoy measurements at 3/4 m to the surface is a more correct approach. However, considering more measured parameters, also introduces more errors. No clear advantage is shown when comparing with neutral conditions.

A simple method can be the better one

	u (ms^{-1})						v (ms^{-1})					
	ASCAT-6.25			ASCAT-coastal			ASCAT-6.25			ASCAT-coastal		
	LKB Ψ=0 KNMI	**LKB Ψ**	Ψ- Beljaars ECMWF	LKB Ψ=0 KNMI	**LKB Ψ**	Ψ- Beljaars ECMW	LKB Ψ=0 KNMI	**LKB Ψ**	Ψ- Beljaars ECMWF	LKB Ψ=0 KNMI	**LKB Ψ**	Ψ- Beljaars ECMWF
bias	0.04	**0.07**	0.12	0.04	**0.07**	0.12	0.10	**0.04**	-0.20	0.10	**0.04**	-0.20
σ	1.68	**1.68**	1.79	1.65	**1.67**	1.78	1.60	**1.57**	1.70	1.57	**1.53**	1.67

In line with conclusions of Sundu et al. (2013)

Methods

- Criteria to define events in LLCJ conditions (Monteiro et al. 2016) QuikSCAT 2000-2009

Event	Centre latitude (degrees)	Centre longitude (degrees)	≧ Wind speed threshold (m/s)
Finisterre	42.12	-9.625	10.5
Roca	38.125	-9.625	10.8
Vicente	36.38	-8.875	10.1

Results - LLCJ- temporal variability

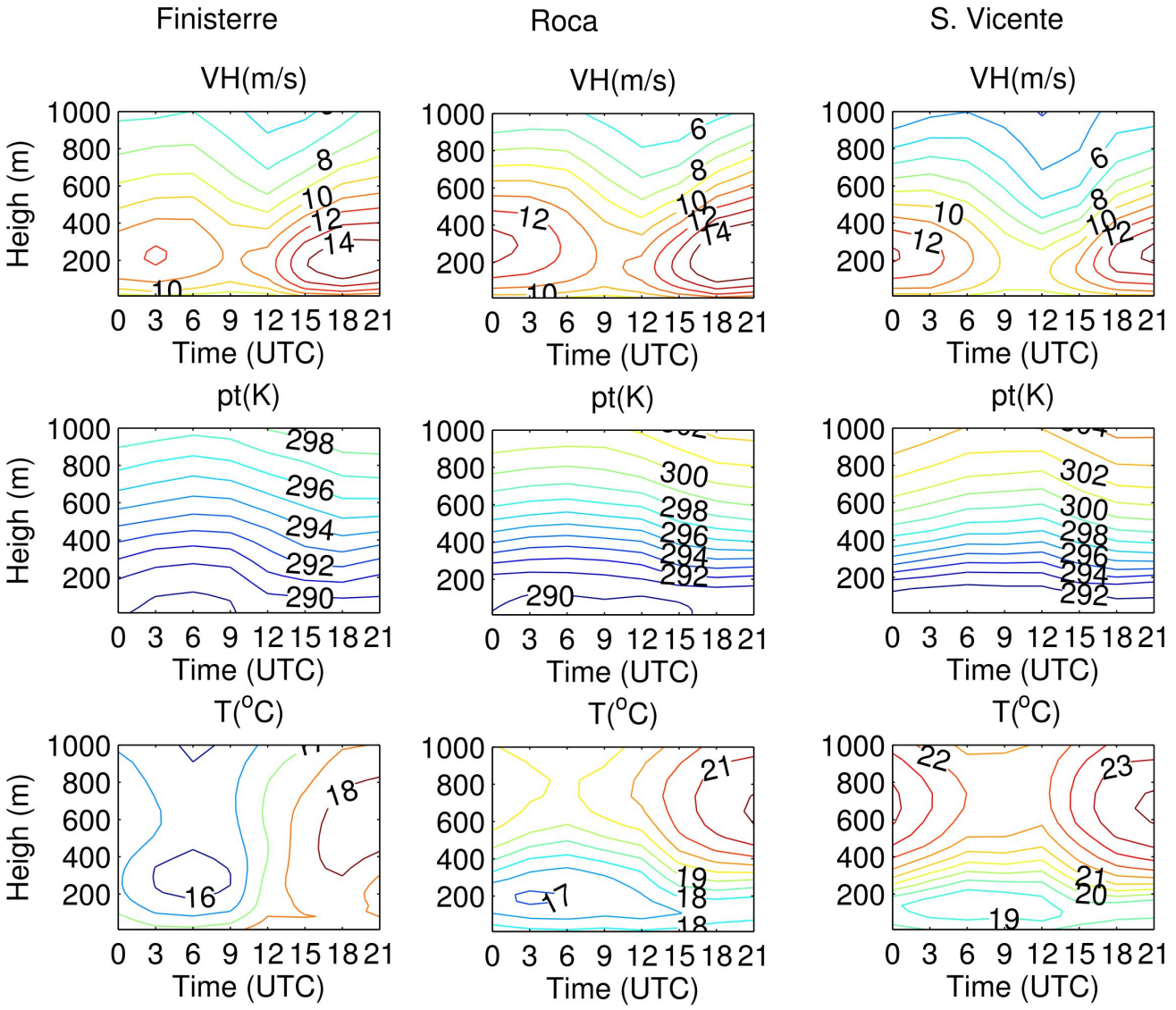
ECMWF/IFS for

wind intensification

events selected

from ASCAT-6.25

JJA 2010 to 2014



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