

Offshore Wind Resource Estimation in Mediterranean Area Using SAR Images

Calaudi, Rosamaria; Arena, Felice; Badger, Merete; Sempreviva, Anna Maria

Publication date:
2013

Citation for published version (APA):

Calaudi, R., Arena, F., Badger, M., & Sempreviva, A. M. (2013). *Offshore Wind Resource Estimation in Mediterranean Area Using SAR Images*. Poster session presented at ESA Living Planet Symposium, Edinburgh, United Kingdom.

[Link to publication in CBS Research Portal](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

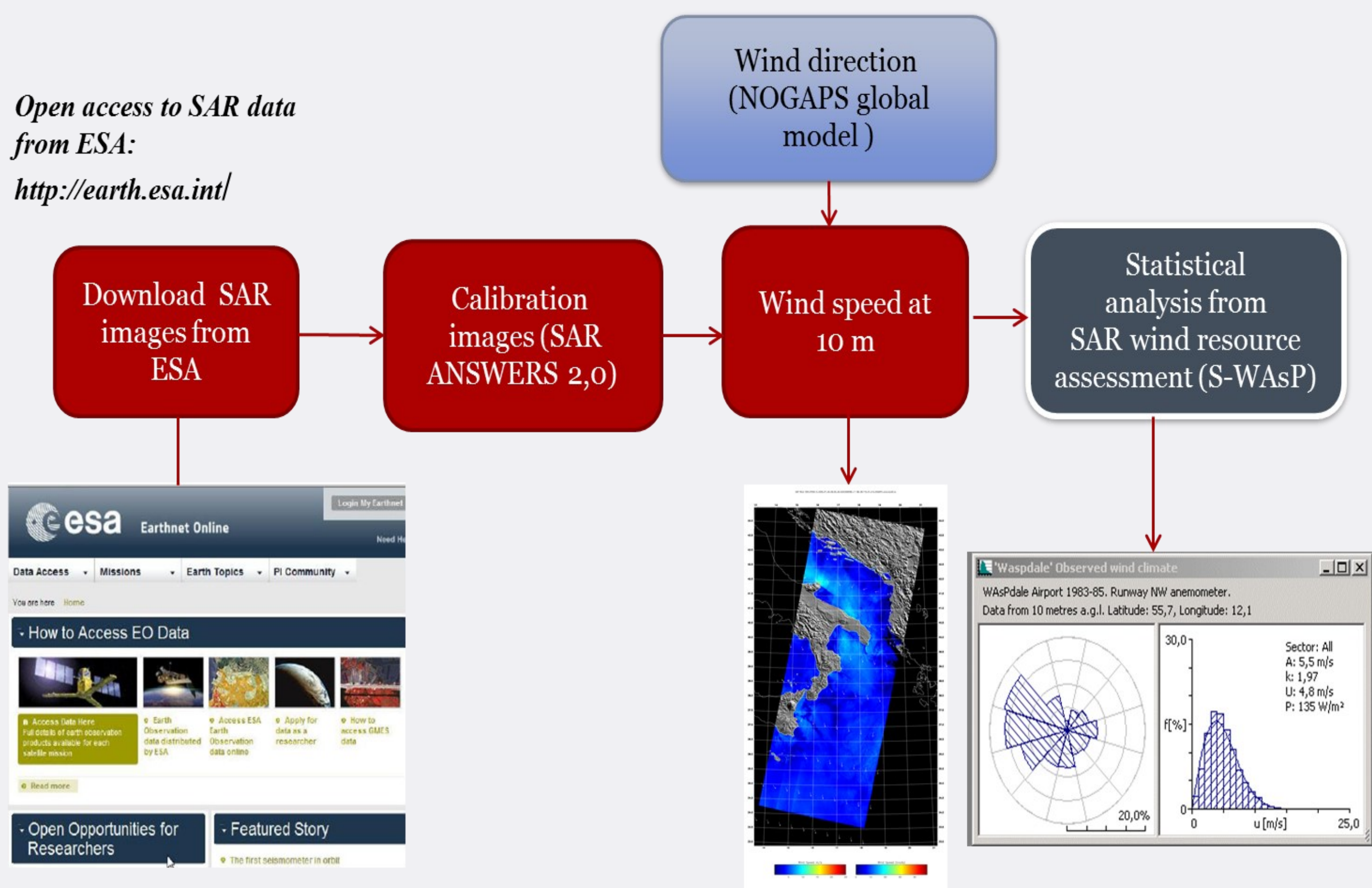
If you believe that this document breaches copyright please contact us (research.lib@cbs.dk) providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 04. Jul. 2025

Abstract

Satellite observations of the ocean surface from Synthetic Aperture Radars (SAR) provide information about the spatial wind variability over large areas. This is of special interest in the Mediterranean, where spatial wind information is only provided by sparse buoys, often with long periods of missing data. Here, we focus on evaluating the use of SAR for offshore wind mapping. Preliminary results from the analysis of SAR-based ocean winds in Mediterranean areas show interesting large scale wind flow features consistent with results from previous studies using numerical models and space borne wind data i.e. scatterometers with lower resolution.

Methodology



We use data from ENVISAT satellite by the European Space Agency (ESA) - ESA Project n° ID 11849 – Principal Investigator: R. Calaudi -. In ScanSAR mode, the ASAR sensor is capable of scanning in a 400 km wide swath with a spatial resolution of 100 m.

Wind speed in the Mediterranean from March 2002 to April 2012 is retrieved at high resolution using the Johns Hopkins University, Applied Physics Laboratory (JHU/APL) software APL/NOAA SAR Wind Retrieval System (ANSWRS version 2.0).

The algorithm is initialized using wind directions determined by the Navy Operational Global Atmospheric Prediction System (NOGAPS) models interpolated in time and space to match the satellite data. NOGAPS data are available at 6-hour intervals mapped to a 1° latitude/longitude grid and the wind vectors from the lowest model level around 10 m above the are used.

The statistical analysis of SAR wind map, for a total of 3269 scenes, is performed with the Satellite –Wind Atlas Analysis and Application Program (S-WAsP) tool developed by Risø DTU. S-WAsP is a software for wind resource estimation based on SAR data.

Wind climatology and a case study

Observations. Three hourly wind data were available for the Lampedusa and Ustica Islands from the Italian Meteorological Service; hourly measurements at a 10m mast, located at the coastline, in the coastal town of Crotona were provided by the marine network of sensors of ISPRA (Institute for Environmental Protection and Research).

Figure 1 shows: The location of the observations; The resulting maps of mean wind speed in the Mediterranean and around the Calabria region, a long, narrow and mountainous peninsula in South Italy, where breezes and mountains play a major role for the local climate causing opposite wind variability at either side of the coast; and the comparisons between observations and SAR winds.

In the Mediterranean map, we note the channeling effect due to orographic features i.e. Sicily Channel, le Bocche di Bonifacio between Corsica and Sardinia; and in the Calabria map we note the high wind speed (in yellow) likely associated to the effect of the only valley that connects the Tyrrhenian Sea to the Ionian Sea. The pattern might represent both the channeling created either by the sea breeze or by the synoptic flow.

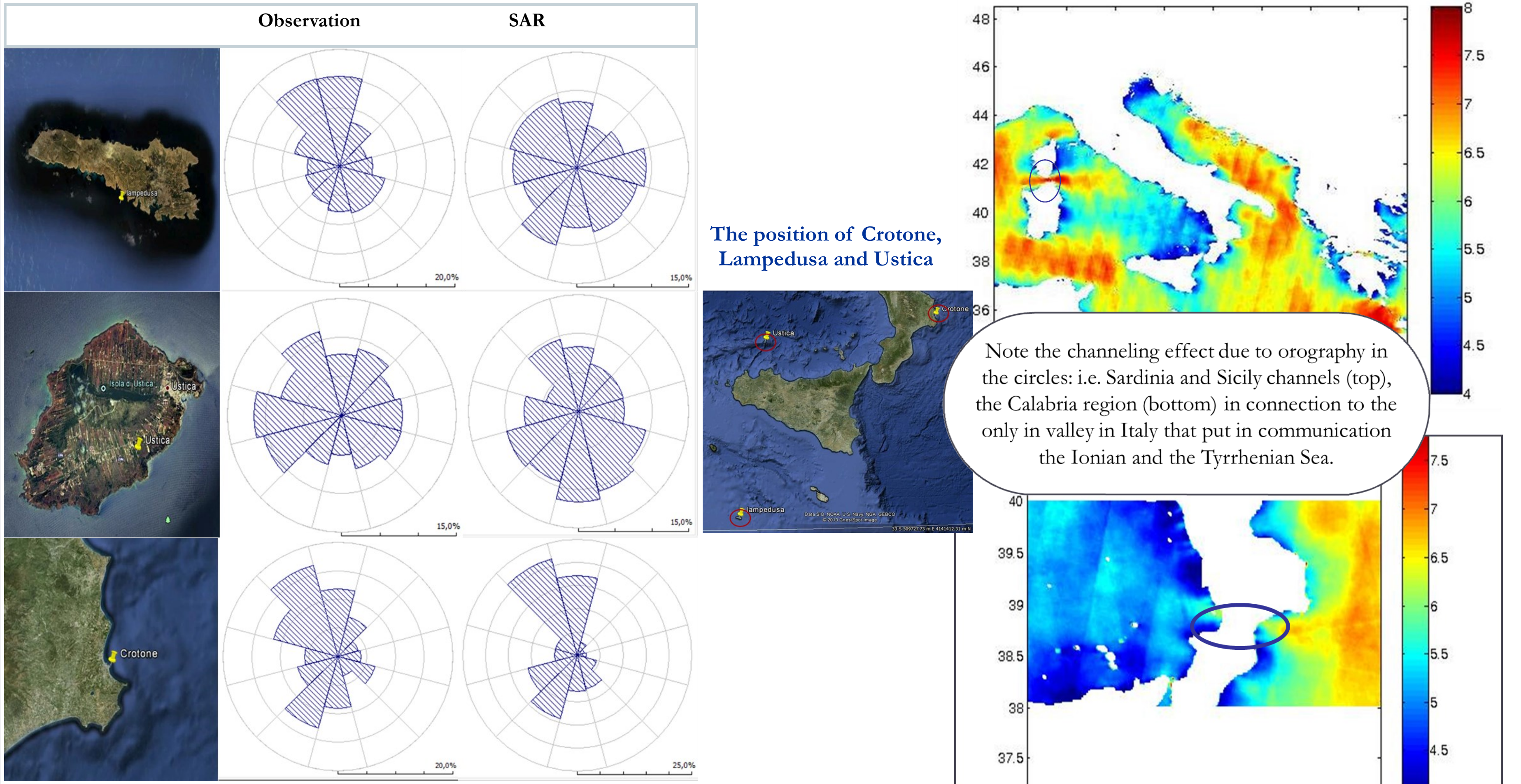
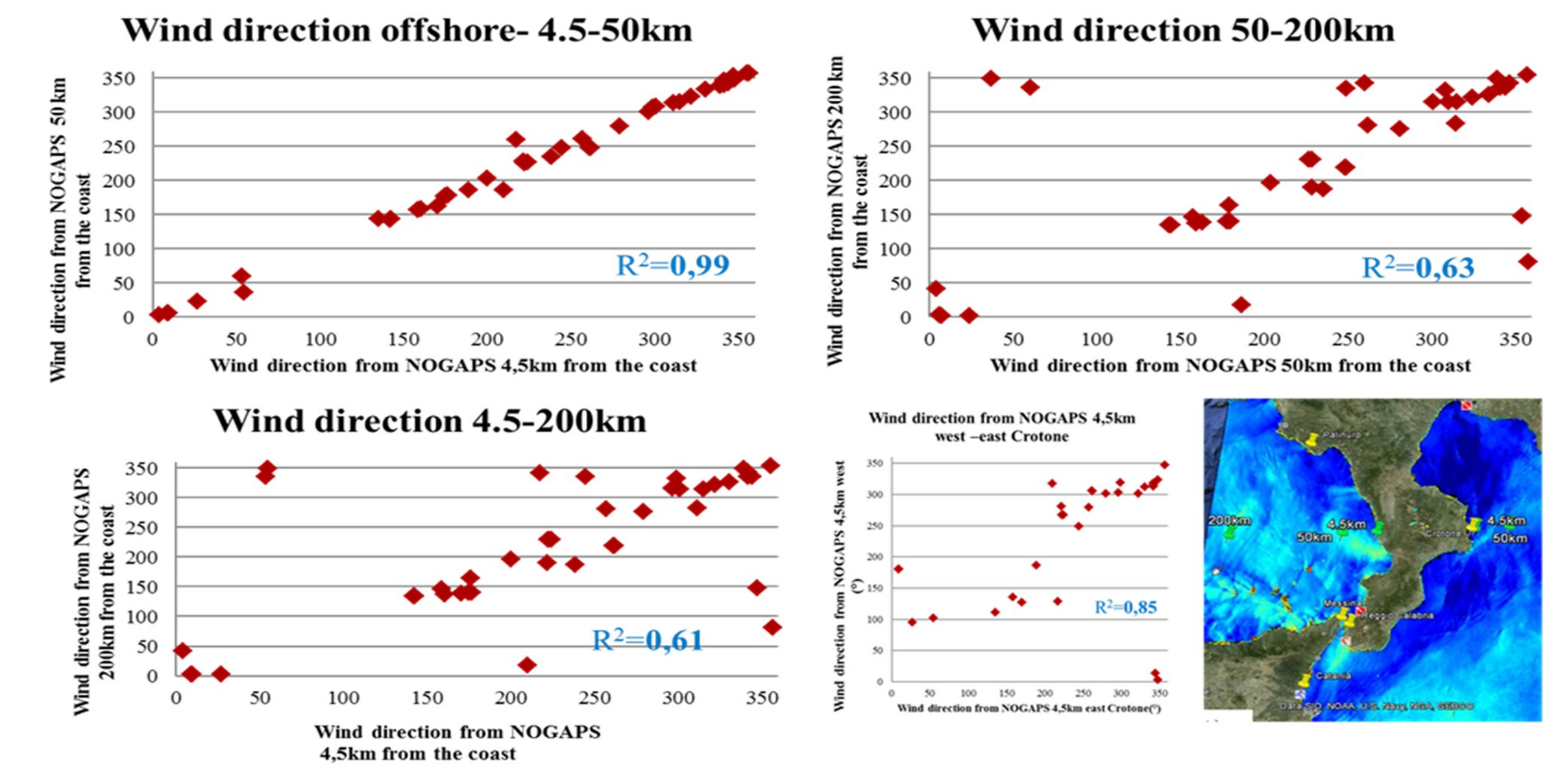


Figure 1 Wind Climatology: (Left) Comparison of the wind roses from SAR and observations at Lampedusa (top) and Ustica (middle) islands and the coastal site of Crotona in Calabria. (Right). Wind maps of the Mediterranean (top) and around Calabria (bottom) at 10 m. a.s.l.

Case study - Crotona 2009

Comparison of the wind direction input from NOGAPS

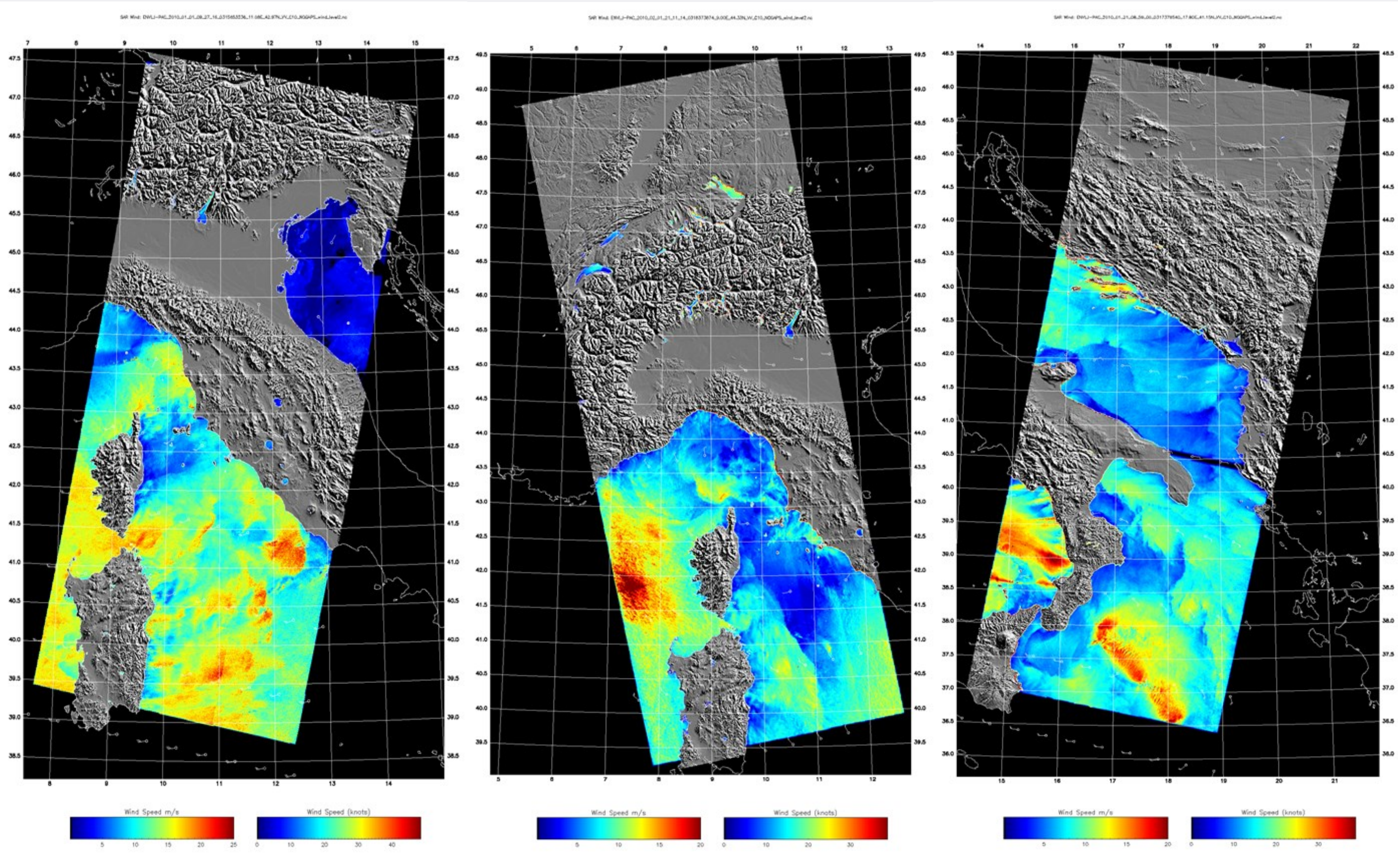


NOGAPS DIRECTIONS AROUND NARROW PENINSULAS.

To investigate the suitability of wind directions from the NOGAPS model around peninsulas narrower than the model spatial resolution, we focus on the Calabria region and use a subset of 44 satellite images in year 2009 covering the area. We selected points of the SAR images at distances of 4.5, 50 and 200 km at the two opposite sides of peninsulas (Figure 2). Figure 3 illustrates that the correlation coefficient of NOGAPS wind directions at different distances varies from $R^2=0.61$ to $R^2=0.99$ depending on the distance. The high correlation $R^2=0.99$ between 4.5 and 50 km, indicate that the points fall in the same grid mesh, confirming the limit of the NOGAPS horizontal resolution. Another example is on the NOGAPS wind direction correlations at either side of the Calabria region at two points chosen 4.5 km offshore. The coefficient of correlation between NOGAPS data wind direction of two opposite sides of peninsulas, is $R^2=0.85$. Also in this case, the high correlation confirms the limit of the NOGAPS horizontal resolution in presence of peninsulas narrower than the model grid resolution. Opposite winds during sea breeze days are not caught. Therefore, in such cases, models with higher spatial resolution would probably be more appropriated and future work will address this issue.

Conclusions.

We presented preliminary results from the analysis of SAR-based ocean winds in Mediterranean area at a spatial resolution of 500m, suitable for estimating the coastal wind climatology. Here, we showed the wind climatology for the Mediterranean obtained using wind data retrieved for the whole ENVISAT mission. The resulting wind maps show reliable flow patterns induced by the orography i.e. flow channeling i.e. in the Sardinia channel and in connection to the only in Valley in Italy that put in communication the Ionian and the Tyrrhenian Sea. The SAR methodology is certainly useful as a guide to indicate prospective coastal areas where to carry on detailed measurements. Work is in progress to study the accuracy of the ANSWRS 2.0 - SAR wind retrieval system, using as input the RAMS mesoscale model at 10 km resolution instead of the NOGAPS model, since NOGAPS is not able to catch i.e. the different seas breeze direction development at either sides of a peninsula narrower than its spatial resolution.



Acknowledgments. Rosamaria Calaudi acknowledges fundings from the European Commission, European Social Fund (FSE) for her staying at DTU, and from ESA Education for the sponsorship to attend the ESA Living Planet Symposium 2013.