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WIND CLIMATOLOGY IN SOUTH ITALY BY COMPARING SATELLITE DATA AND GROUND BASE STATIONS AND A CORRELATION WITH NAO (NORTH ATLANTIC OSCILLATION) INDEX

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Abstract: This study addresses preliminary results about the seasonal wind variability, especially during the winter season, in South Italy. Wind climate for the coastal waters off South Italy was estimated based on images of the Advanced Synthetic Aperture Radar (ASAR) onboard the ENVISAT satellite during the period from March 2002 to April 2012.

Keywords: remote sensing, SAR, NAO, coastal erosion.

1. INTRODUCTION

This study addresses preliminary results about the seasonal wind variability, especially during the winter season, in South Italy. Wind climate for the coastal waters off South Italy was estimated based on images of the Advanced Synthetic Aperture Radar (ASAR) onboard the ENVISAT satellite during the period from March 2002 to April 2012. The high spatial resolution of the gridded SAR data is particularly relevant to study near shore coastal sites, where most part of human activities are located. Climatological indices were analyzed for chosen sites: the monthly, annual and seasonal wind indices were calculated at each site from SAR. Estimating wind indices minimizes biases and makes it possible to compare the year-to-year variability or the seasonal cycle as observed by the different data sets, also when two time series have a different wind speed range.The North Atlantic Oscillation (NAO) index correlates the pressure fields over the North Atlantic and those over the central Atlantic represented by the difference of the values of the detected pressure on a particular area of the Azores with that of a certain area of Iceland. If the NAO index is negative, <= 0.5 more frequent actions blockers in Atlantic are resulting split meridian polar jet in the Mediterranean area. January and the first half of February 2012 witnessed exceptionally long period of unusually severe weather over the eastern and central Europe. Finally a case study of strong event of January 6, 2012 is presented. The purpose of this work is to document and examine a particular strong event in January 2012 over the South Italy, where we employed the synergy of the SAR data, NAO index and Weather Research and Forecast (WRF) model simulations. This work was partially supported by the projects PON01_2651 SIGIEC - "Integrated Management System for Coastal Erosion". SAR satellite data are provided by the European Space Agency (ESA Project n° ID 11849- Principal Investigator Rosamaria Calaudi)

2. WIND CLIMATOLOGY FROM SAR

2.1 WIND INDEX FROM SAR– SOUTH ITALY

The study area is the Southern Italy with particular attention to events related to the erosion sites Bagnara, Monasterace, Alimini.

We studied on a local scale, climate indices based upon database of satellite ENVISAT mission. The data cover a period of seven years (2005-2012). These indices are calculated on data in the offshore environment around a distance of 4.5 km from the coast.

A brief description of the indices used in this work is given: IA-Annual Index-: ratio of average wind speed(ms-1) that year and average wind speed (ms-1) calculated on the entire period for a chosen place.

Im - Monthly Index-: ratio of the mean wind speed(ms-1) for the month concerned and average wind speed (ms-1) calculated in the reference to a chosen place.

Is -Seasonal Index-: ratio of average wind speed (ms-1) for the month concerned and average wind speed (ms-1) calculated in the season of reference for each year to a chosen place.

<Uy> - Annual Average wind speed (ms-1)-: average wind speed in that year to a chosen place. <Um> -Monthly Average wind speed (ms-1)-: average wind speed in the month and the year considered for a chosen place.

Analysing the indices calculated for the three locations in Southern Italy is clear that data relating to Alimini have been a growing trend over the years, so the idea was to investigate further in this location with the choice of a case study, registered as an event of extreme type.

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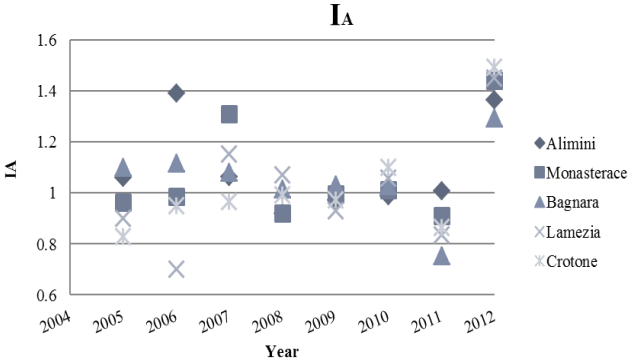

Figure 1. Annual Index, IA, for chosen places in South Italy from database of SAR

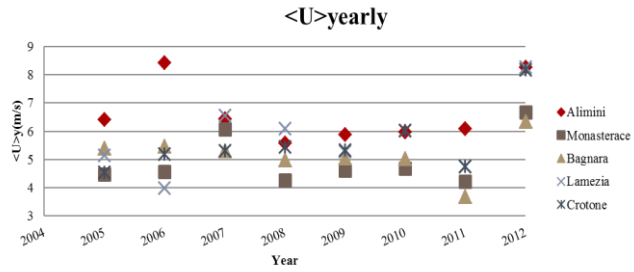

Figure 2. Annual Average wind speed (m s-1), Uy, for chosen places from database of SAR.

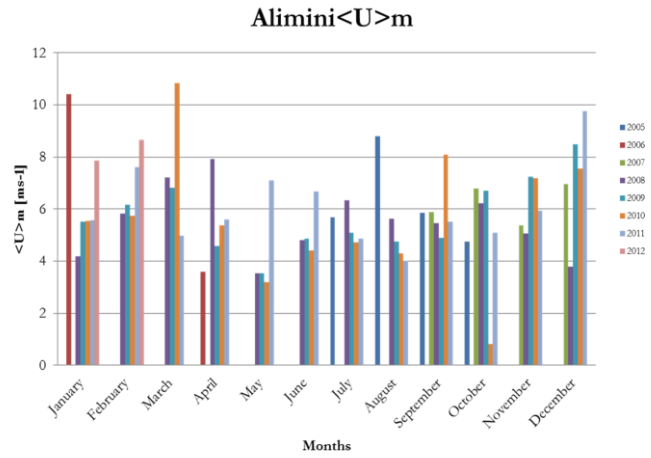

Figure 3. Monthly Average wind speed (m s-1), Um, for chosen place of Alimini in South Italy from database of SAR.

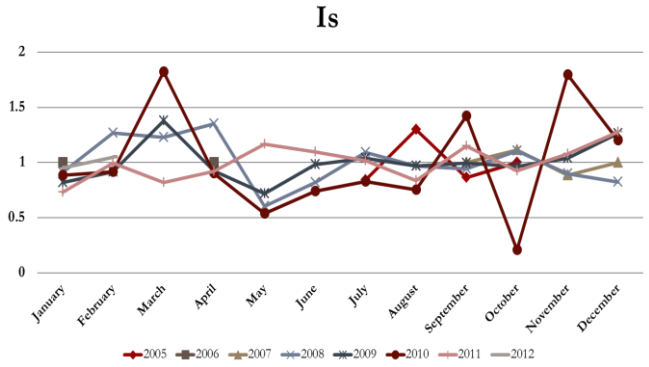

Figure 4. Seasonal Index, Is, for chosen place of Alimini in South Italy from database of SAR.

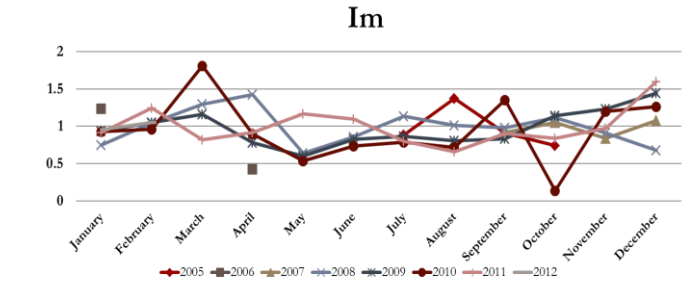

Figure 5. Monthly Index, Im, for chosen place of Alimini in South Italy from database of SAR.

2.2 CIRCULATION PATTERN AND TELECONNECTION

The NAO (Hurrell and van Loon, 1997) is a large-scale variation of atmospheric Azores High and the Icelandic Low and is most pronounced in winter.

During a positive phase of the NAO, both the Icelandic Low and Azores High are well developed, and difference between them. During this case study, an Atlantic Ridge configuration with NAO index and SCAN index is in a positive phase.

This positive mode (SCAND.NAO MOI index) leads to a distinct Mediterranean cyclogenesis and widespread above-average precipitation in the Mediterranean area with maxima in the central and south region around Italy (Xoplaki, 2002).

The low pressure is concentrated in the east of central Italy.

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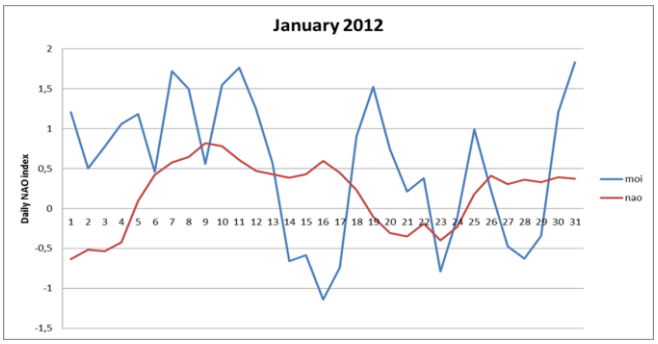

Figure 6. January 2012: Daily Nao and MOI teleconnection index.

3. STATISTICAL ANALYSIS OF SEASONAL AND DIURNAL VARIATION IN LAMEZIA TERME

3.1 CASE STUDY: SOUTH ITALY-ALIMINI STRONG EVENT JANUARY 06, 2012

A detailed knowledge of teleconnections is indeed a very useful and effective theoretical basis for weather forecasting and climatology and thus to forecast extreme events that are often the trigger factors and contributing cause of coastal erosion, flooding, Landslide etc.

To check the condition of Atlantic ridge provided NAO index and the consequential occurrence of extreme events, we have been put together for this case study, the synergies of using satellite images of the SAR, the simulation model by weather conditions in both synoptic regional scale and further validation by experimental measurements.

It seems clear that the measurements of wind from SAR, from model WRF and from mast with domain of Calabria and Puglia are in good agreement both on the prevailing wind direction and the wind speed (see Table 1).

Measurements	U [m s-1]	WD [°]
SAR	18.4	350
Mast	17.4	326
WRF	17.5	350

Table 1. Comparison for Wind speed U[ms-1] and Wind direction WD[°] between measurements from Satellite, mast and model. Point of measurement Alimini.

4. CONCLUSIONS

The purpose of this work was to study wind variability, especially during the winter season, in South Italy. To that end we employed the synergy of the SAR data, NAO index and Weather Research and Forecast (WRF) model simulations. The set of information allows us to make some further assumptions about how the large-scale oscillations affect the cyclones that occur in the regions of Southern Italy, particularly in Calabria and Puglia. Furthermore the high correlations found between the values of these indices with extreme events that result in coastal erosion rather than landslides, can be useful indicators to prevent and manage situations where you experience these phenomena.

In particular, the case study, represented a typical strong event which characterize usually the winter season in South Italy. The day was characterized by a perturbation that moved during the day from NW to SE. From the wind maps it is clearly seen as the wind patterns are oriented, for the entire day, from N along the Adriatic coast of Puglia (Alimini) and N-NW along Calabria.

As the Table 1 shows, the wind speed, was up to 17 ms^{-1} measurements, MAST and WRF. The field analysis baric surface demonstrates the existence of a minimum of pressure on the Croatian coast in progressive shift towards Greece.

To confirm the move of the perturbation from NW to SE winds anti -clockwise around the lowest baric, affecting the southern regions with northerly direction. This baric configuration is typical in situations with strong and cold winds from the Balkans that impact on the coasts of South Italy.

This methodology, which put together measurement from Satellite, mast and model, could be useful to study the strong events which that often are cause of erosional effect. Work are in progress to examine other case studies related to extreme events similar to the case study shown here in order to improve the methodology presented.

In all the measurements used and also the NAO index configuration confirms the strong event we observe particularly good correlation between SAR.

Acknowledgments

SAR satellite data are provided by the European Space Agency (ESA Project n° ID 11849 – Principal Investigator: R. Calaudi). This work was partially supported by the projects PON01_2651 SIGIEC - “Integrated Management System for Coastal Erosion”.

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