SPECIAL VERIFICATION APPLICATION: OPERATIONAL WIND VERIFICATION OVER NORTH ADRIATIC SEA

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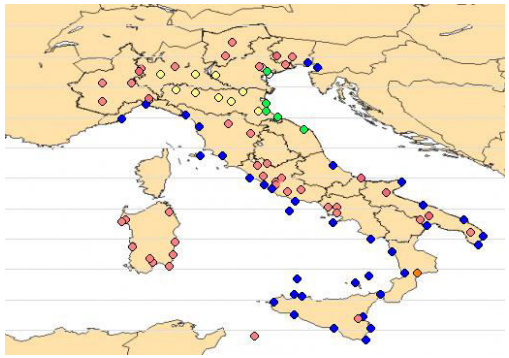
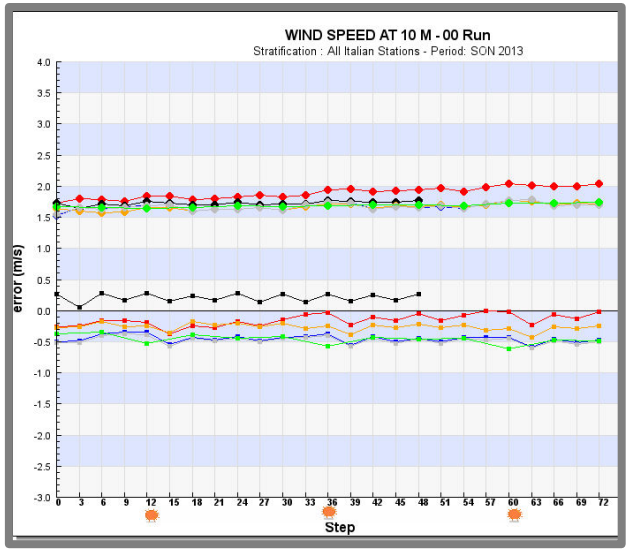
16th COSMO General Meeting
8-11 September 2014, Eretria (Greece)

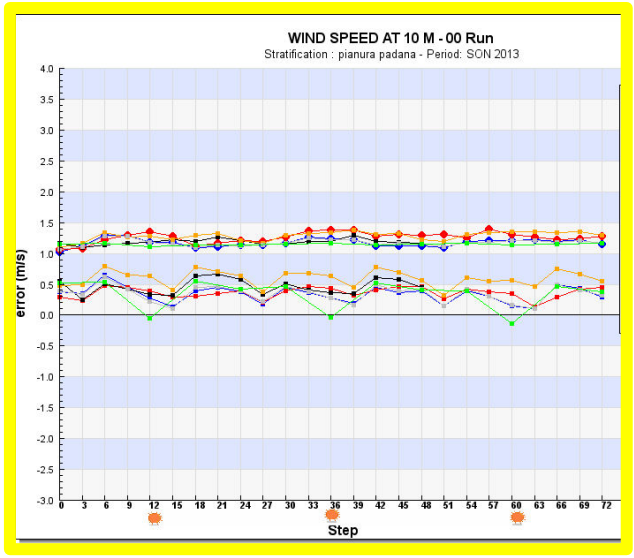
Outline

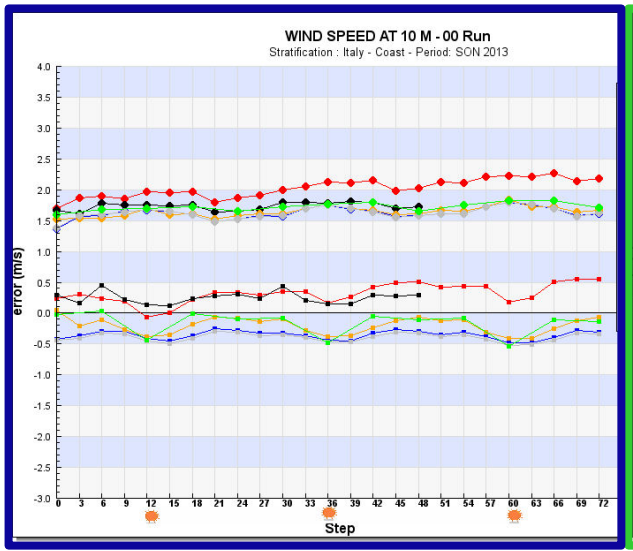
- Some preliminary results of a work that has been done for a end-user of numerical forecast of wind field are presented
- Standard verifications techniques are used, but they are not sufficient to satisfy the request of the user for a better use of models forecasts
- Different ways of depict wind speed and direction are investigated, some results are presented as examples of the properties that can be deduced from the plots

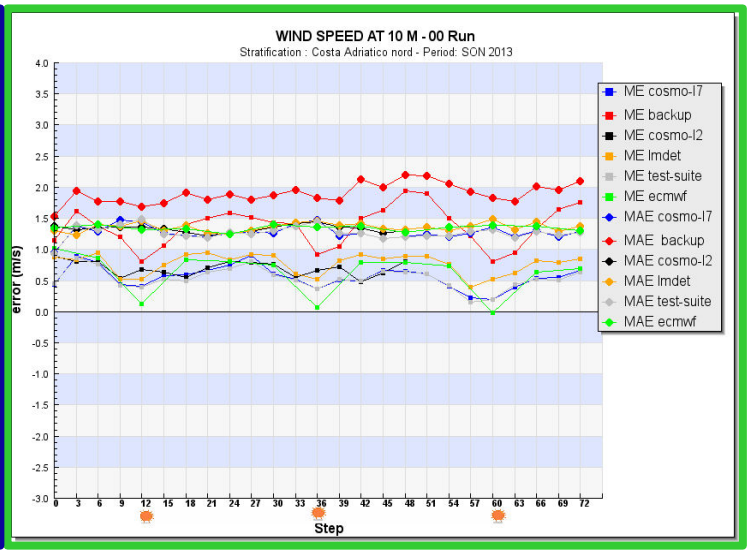
10 m wind speed verification over Italy





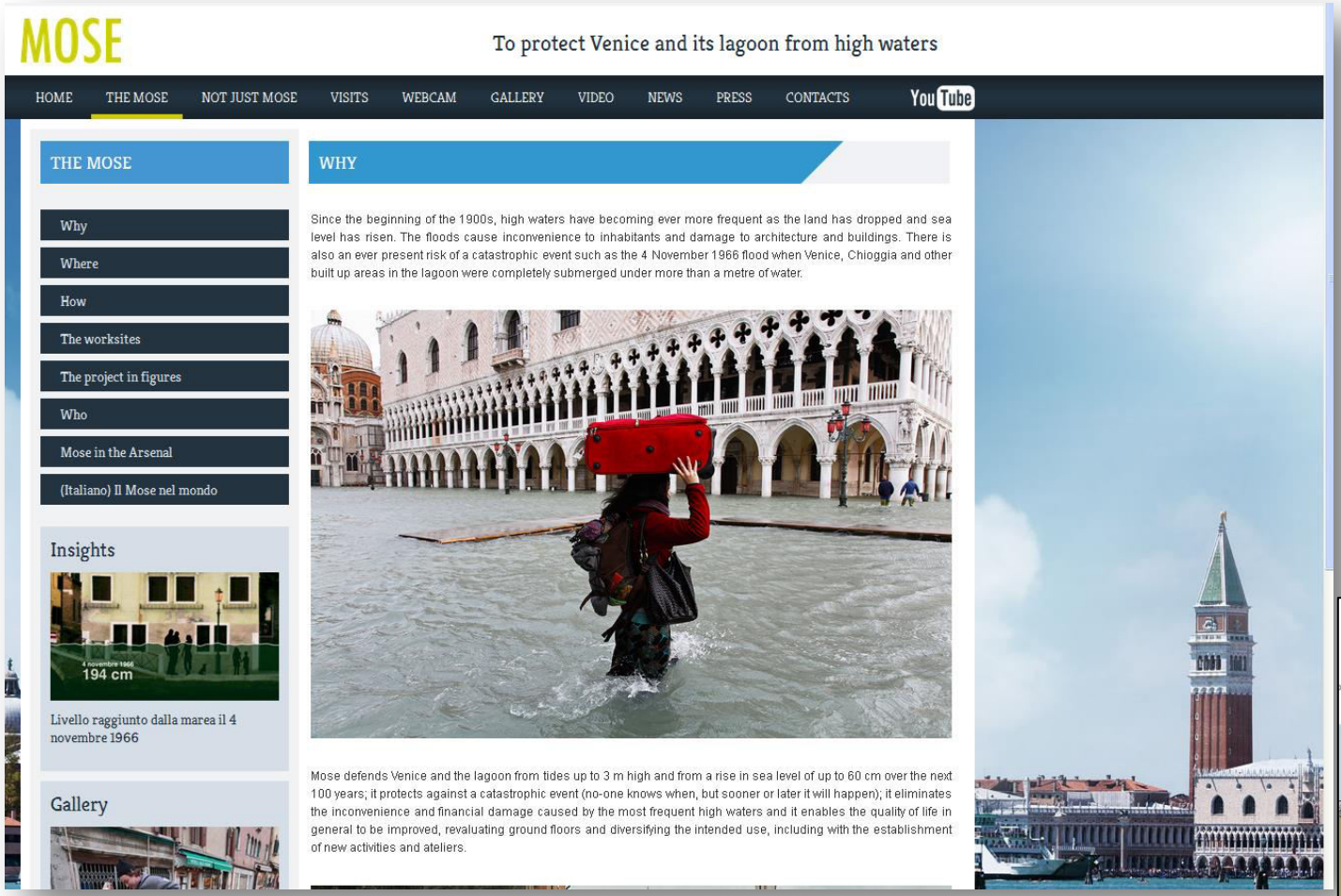


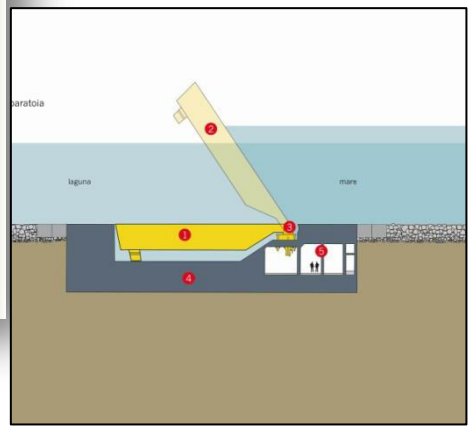




But for most practical application these information are not enough!

One of the applications: meteorological support for MOSE





Observational Dataset

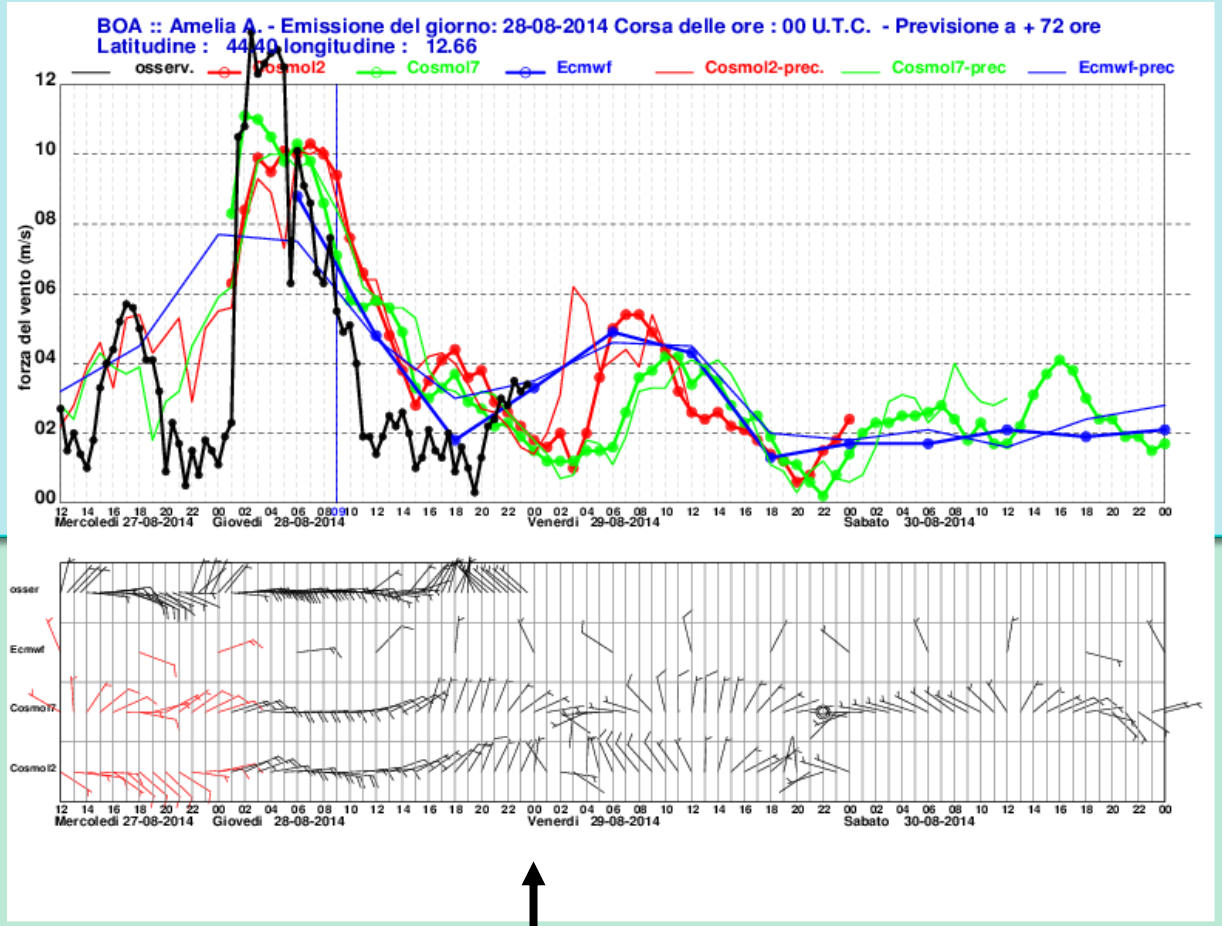
A	44.40,12.66	amelia
B	44.39,12.34	angelina
C	44.52,12.51	anita
D	44.08,13.78	barbara
E	44.47,12.27	piomboni
F	45.31,12.35	arsenale
G	45.23,12.30	chioggia
H	45.38,12.30	malamocco
I	45.31,12.50	torre cnr

- **HOURLY WIND SPEED AND DIRECTION**
- **PERIOD: 1 JANUARY 2014 – 31 MAY 2014**

Example of product for MOSE meteorologiacal support

Wind speed

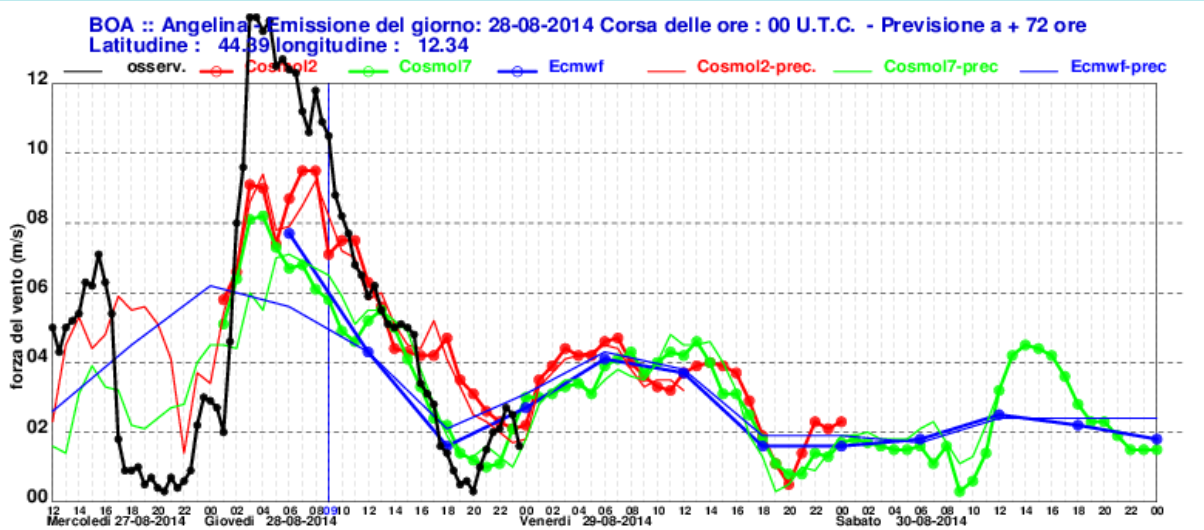
Wind barbs



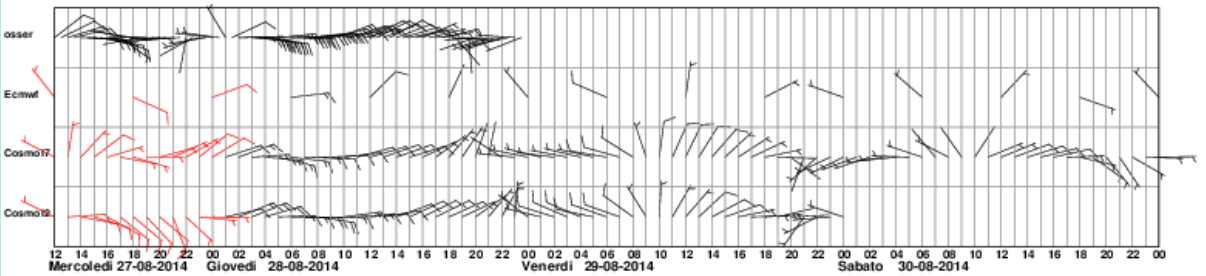
Each hour the observation is updated for a near-real time comparison

Example of product for MOSE meteorologiacal support

Wind speed



Wind barbs



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Example of product for MOSE meteorologiacal support

Wind speed

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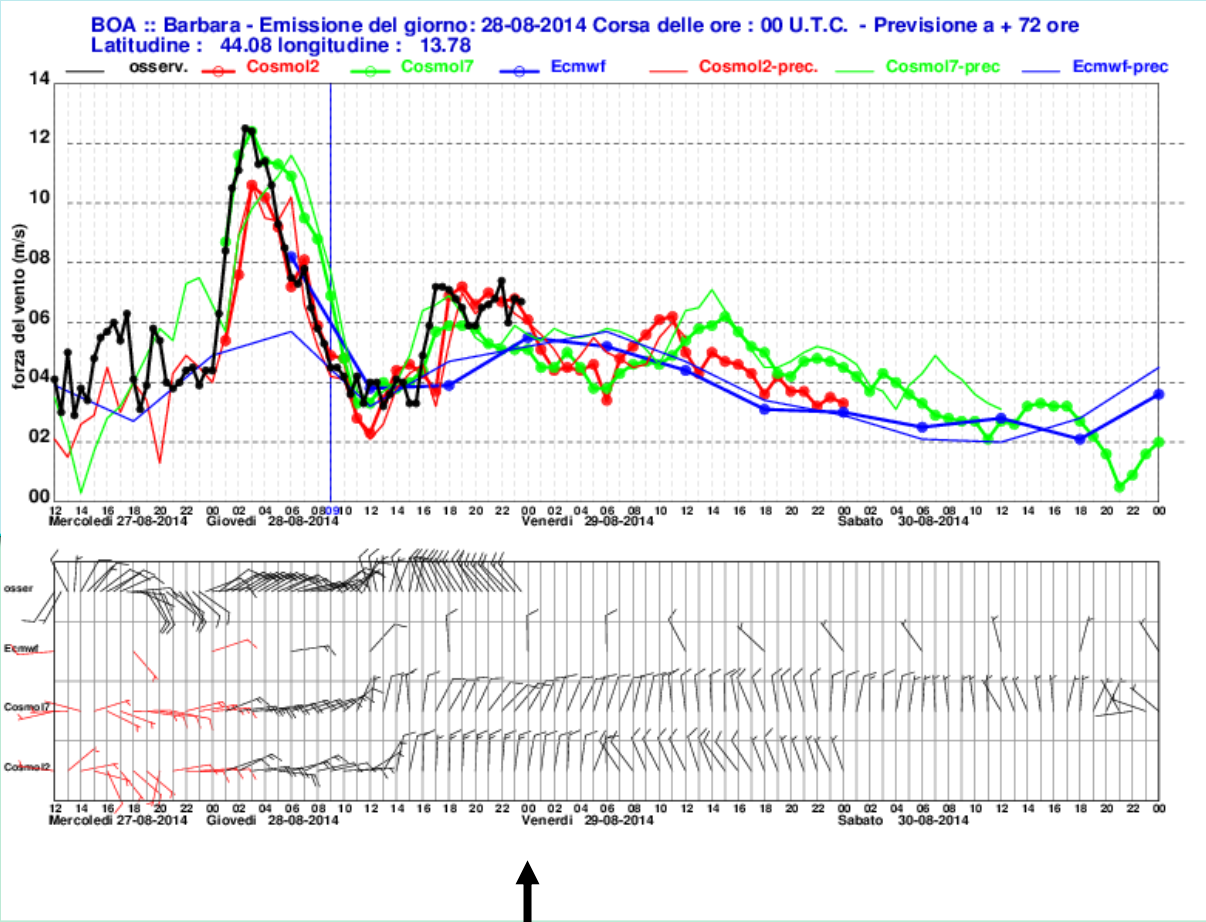
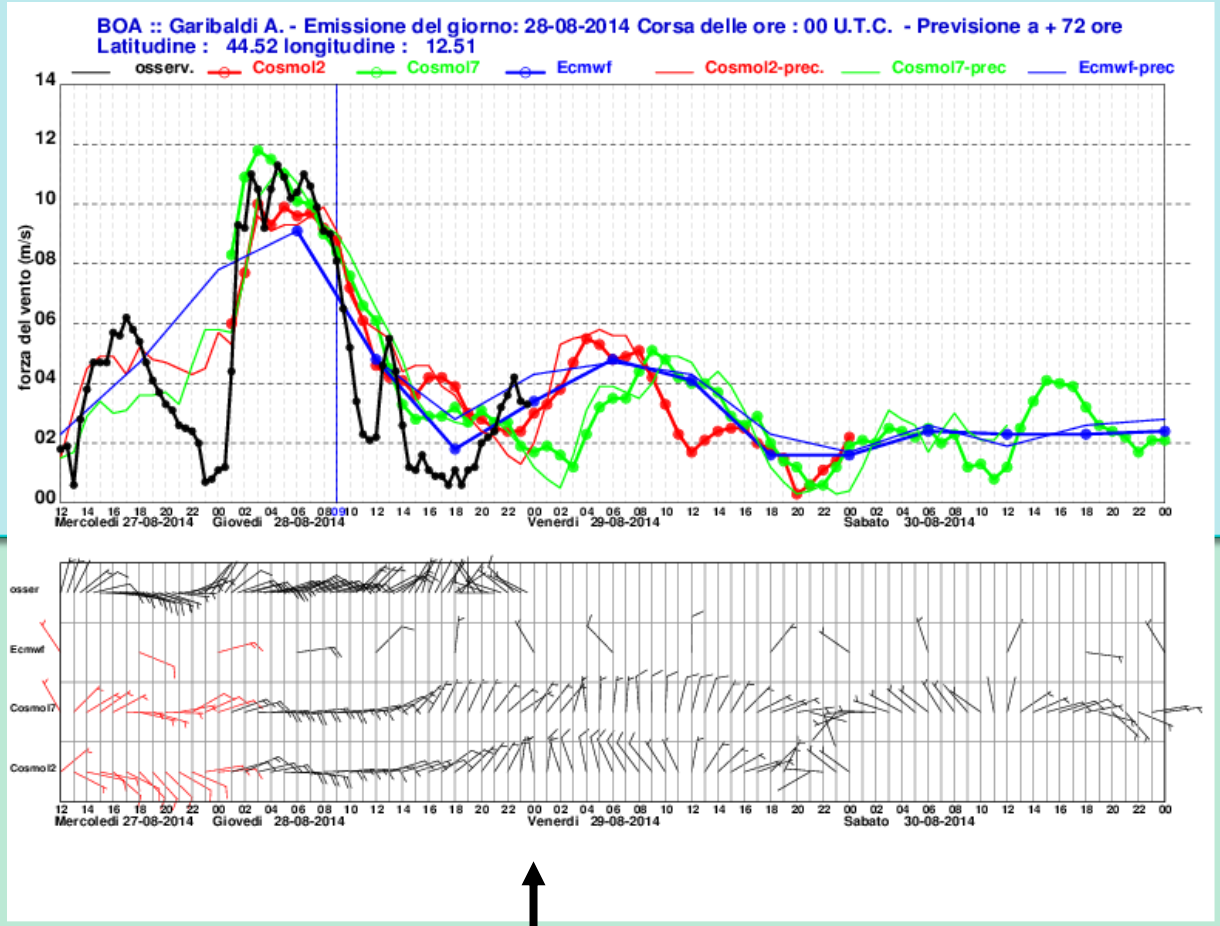


Each hour the observation is updated for a near-real time comparison

Example of product for MOSE meteorologiacal support

Wind speed

Wind barbs

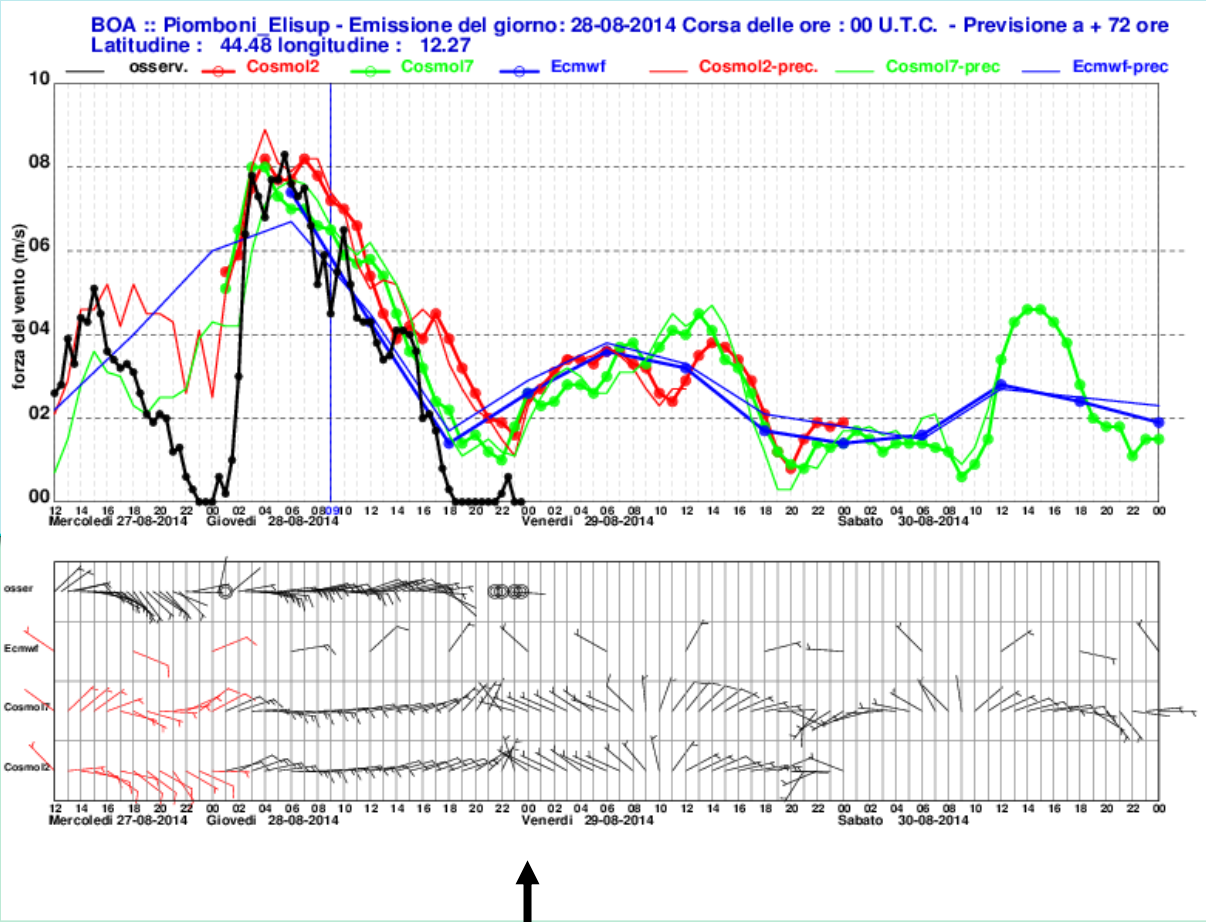


Each hour the observation is updated for a near-real time comparison

Example of product for MOSE meteorologiacal support

Wind speed

Wind barbs

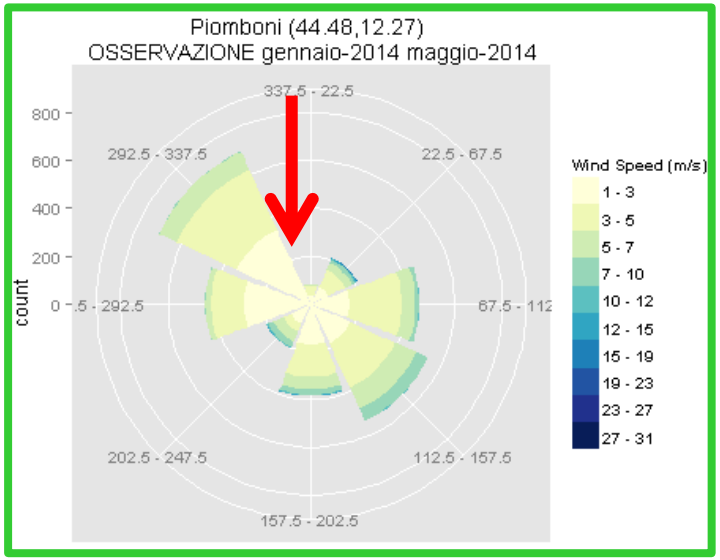


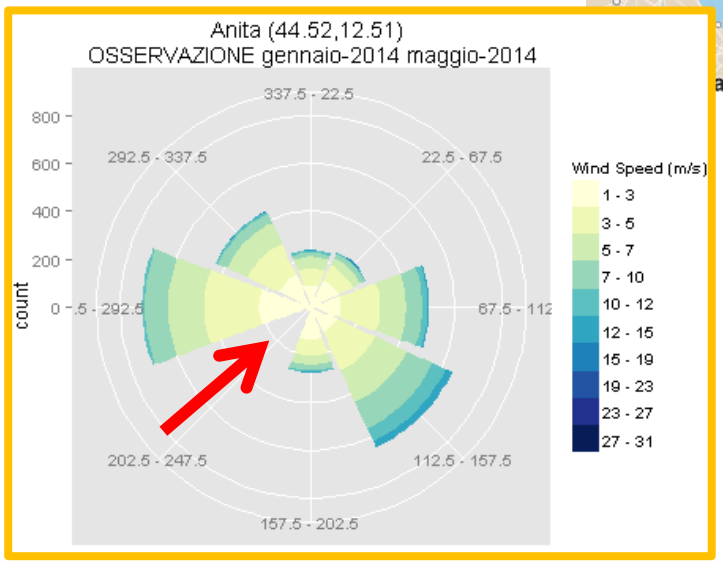
Each hour the observation is updated for a near-real time comparison

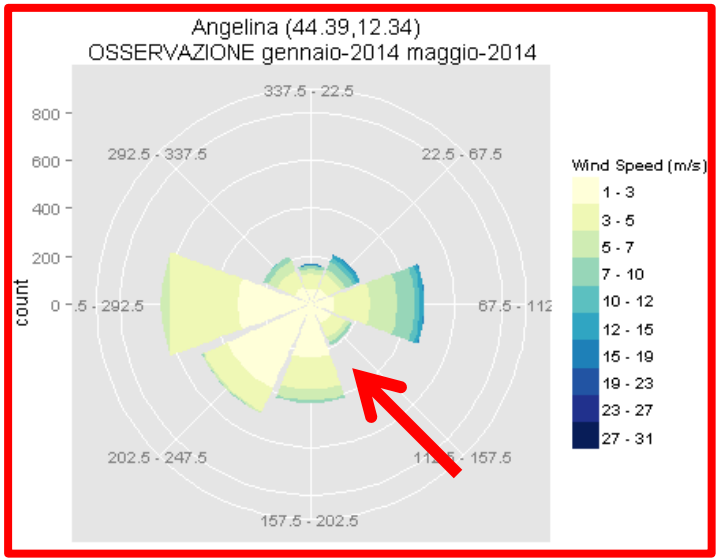
How to verify this type of product on a periodical basis?

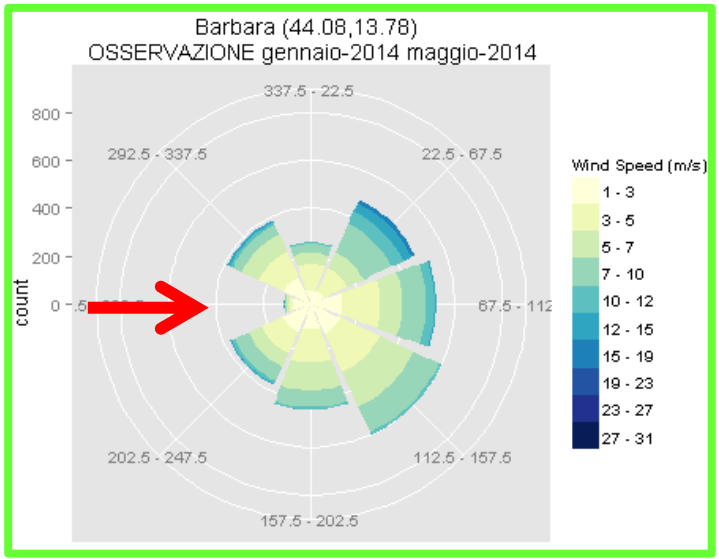
- For wind direction, wind roses are plotted for each location
- For wind speed, ME,MAE and RMSE are evaluated for each location
- The most useful thing to do should be investigate the ability of the model to reproduce wind changes:
  - But since wind variations can be related both to large scale forcing and local behavior such as breeze, a sort of climatological study has been performed in order to have an idea of the ability of models to depict diurnally and topographically forced circulations
    - For the moment wind changes have not been taken into account, but are my favorite topics for future works!

Wind Direction verification:
Rose wind for “offshore platforms”





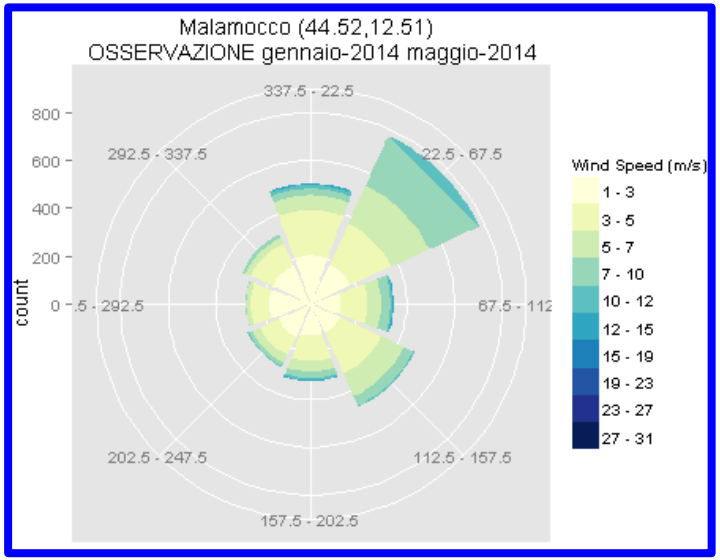


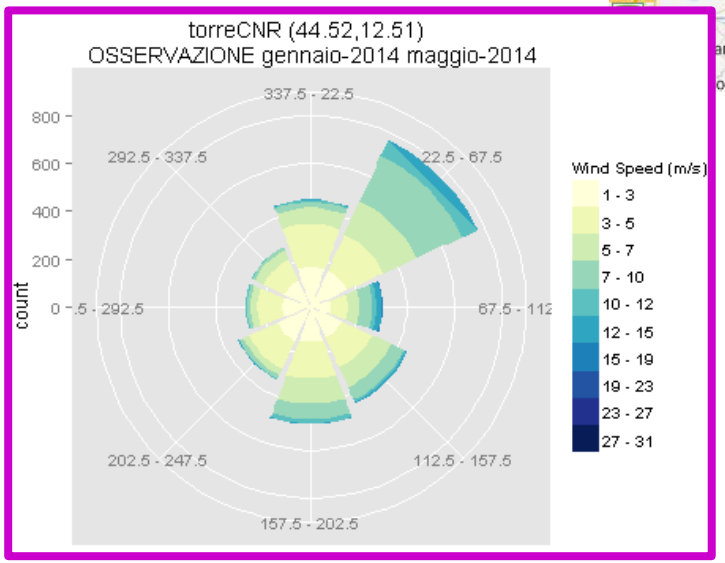


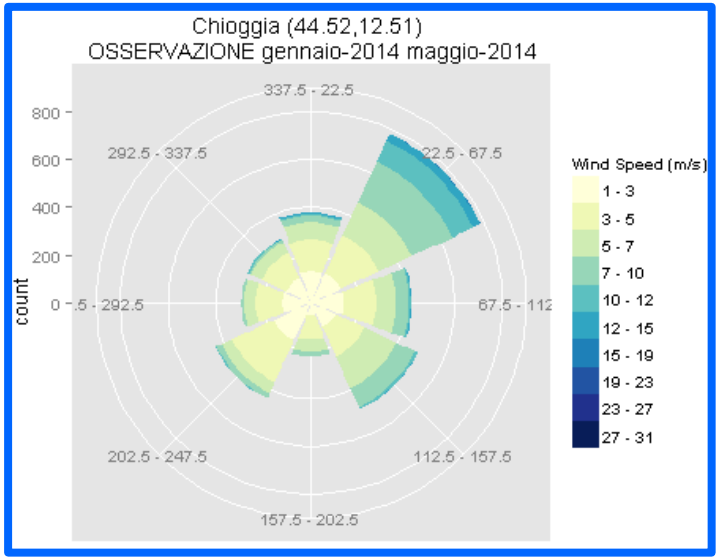
- **Some directions seem to be artificially blocked**
- **Anemometers height are not known , for forecasts we used 10m wind**

→ care in results interpretation

Wind Direction verification: Rose wind for MOSE stations







Anemometer height

Malamocco → 15 m

Chioggia → 8 m

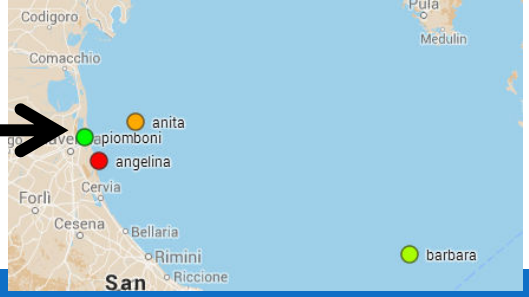
Torre CNR → 8 m

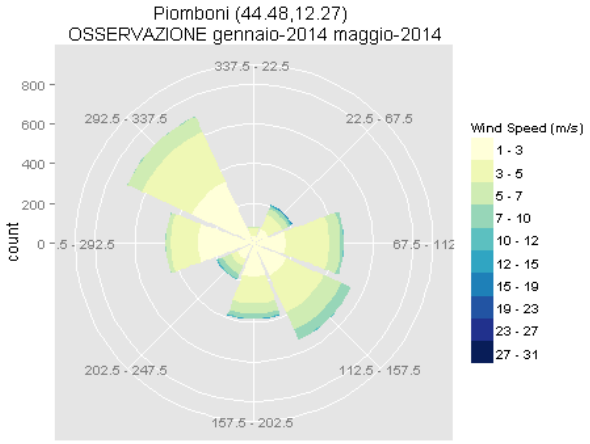
For forecasts we used 10 m wind

Data are provided by "Venezia Nuova" consortium

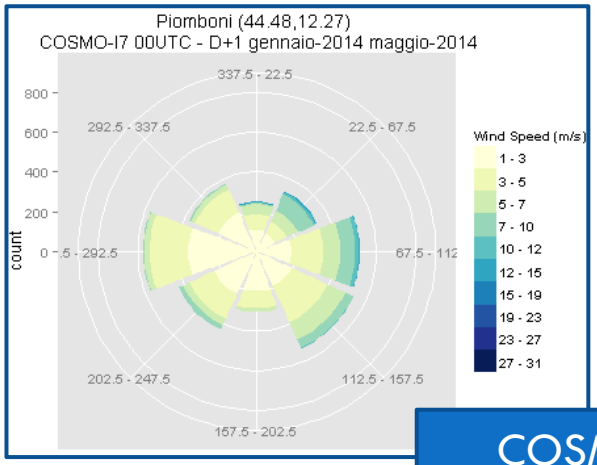
“Piomboni”

On the coast





day 1



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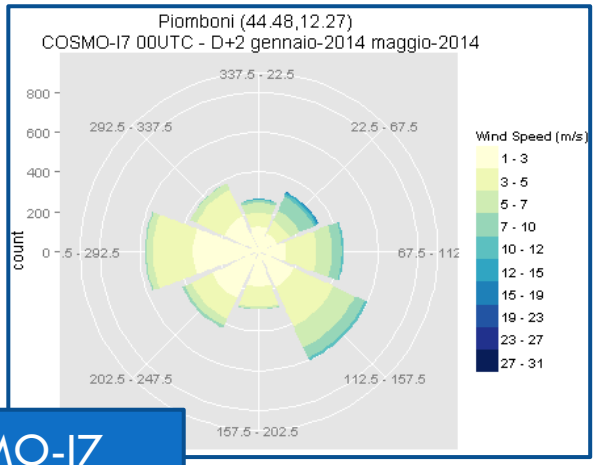
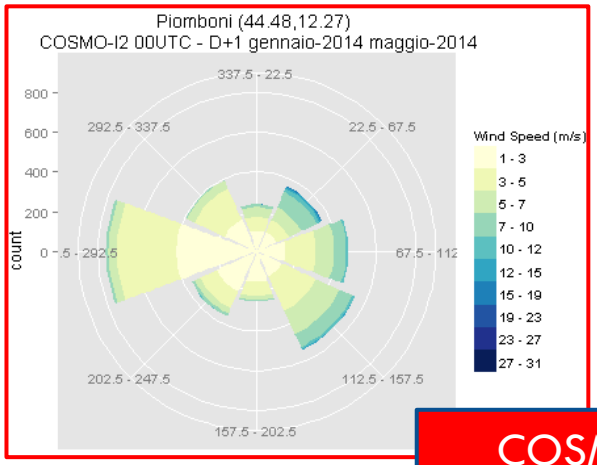
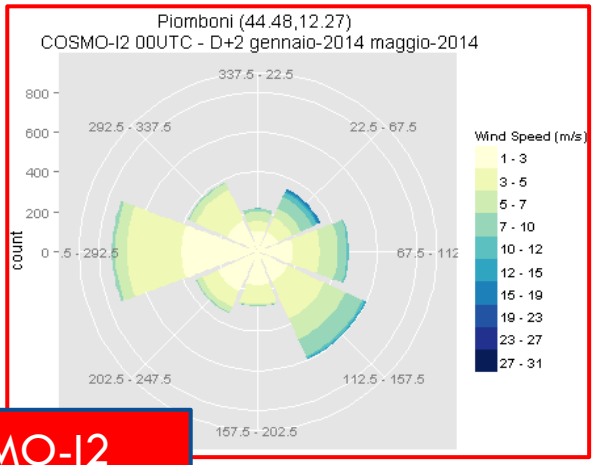


COSMO-I7



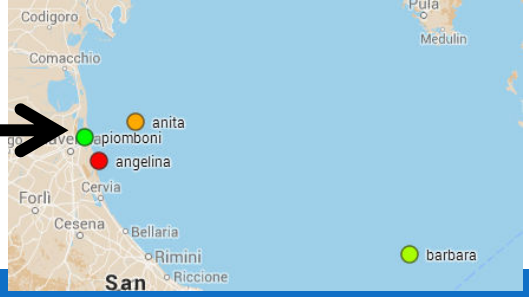


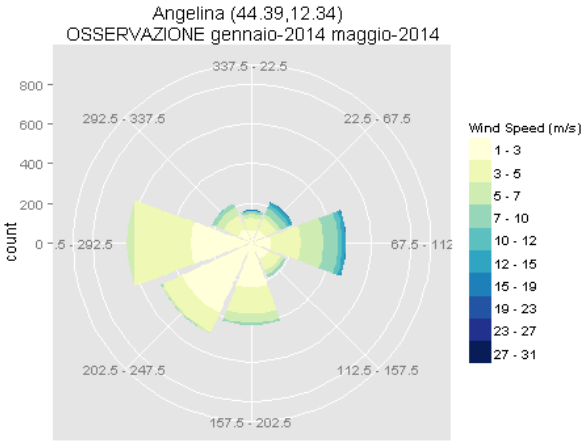
COSMO-I2

- Models prefer W respect to NW
- Overestimation of E and NE both as intensity and frequency (obs problem?)
- SE well described
- COSMO-I2 differs from I7 in W frequency

“Angelina”

Near to the coast





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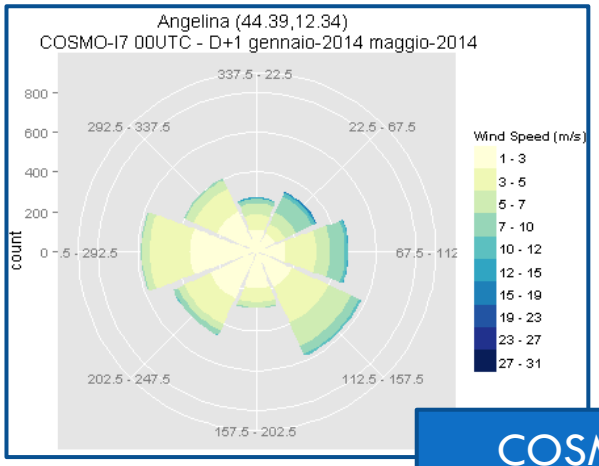
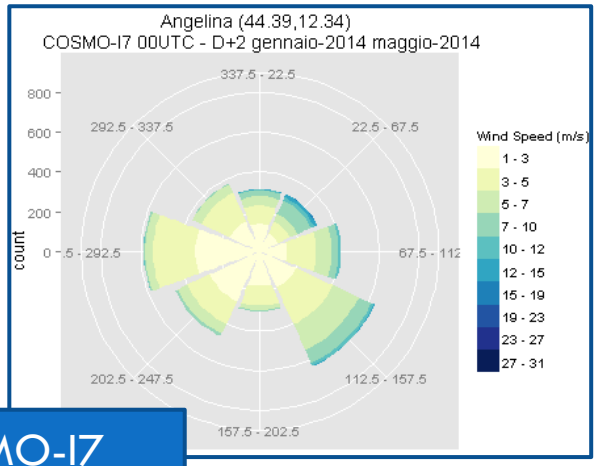
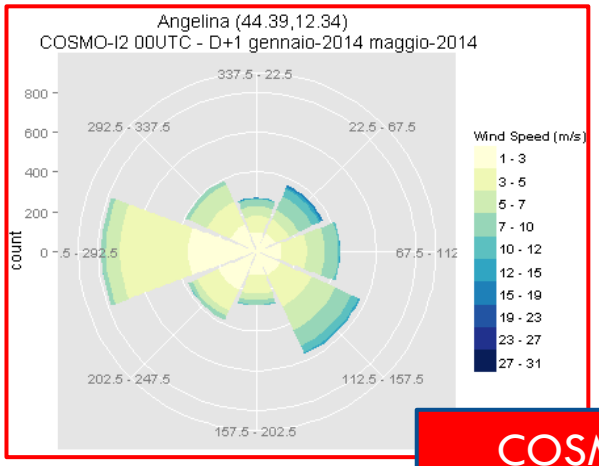


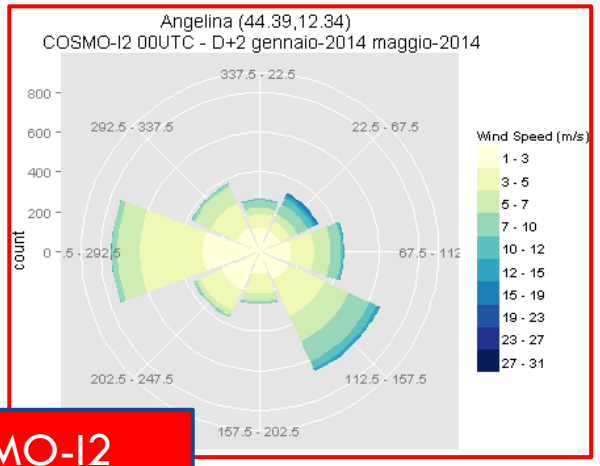
day2



COSMO-I7

- SE obs problem!
- N & NE overestimation
- E well described as frequency but speed lightly underestimated
- C-I2 > C-I7 for W

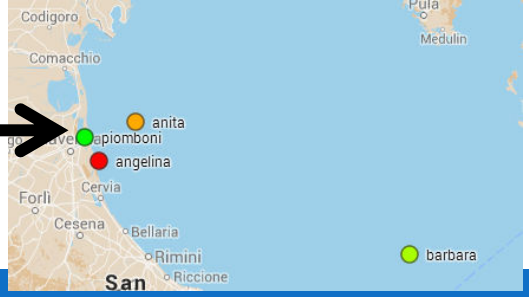


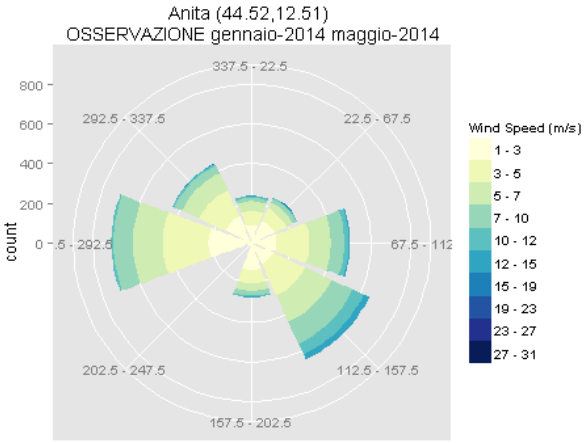


COSMO-I2

“Anita”

Off-shore 25 Km from the coast





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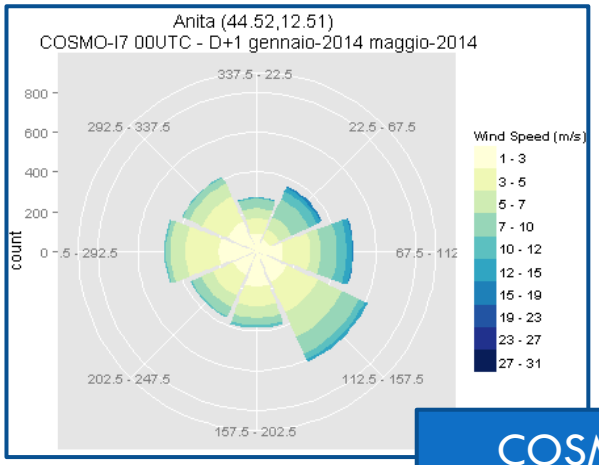

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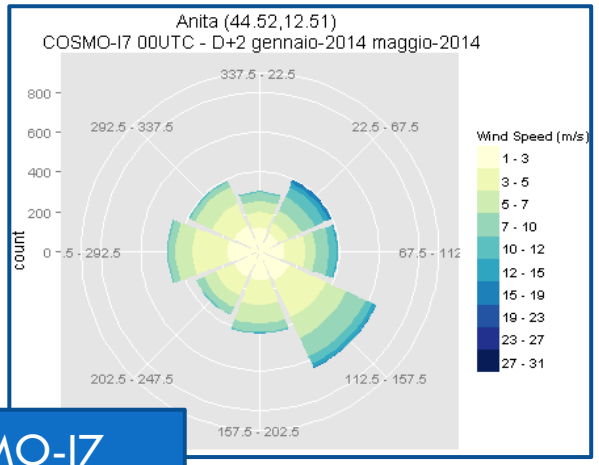
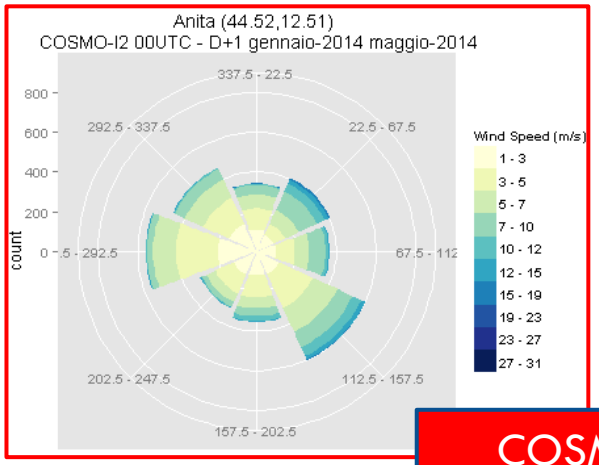
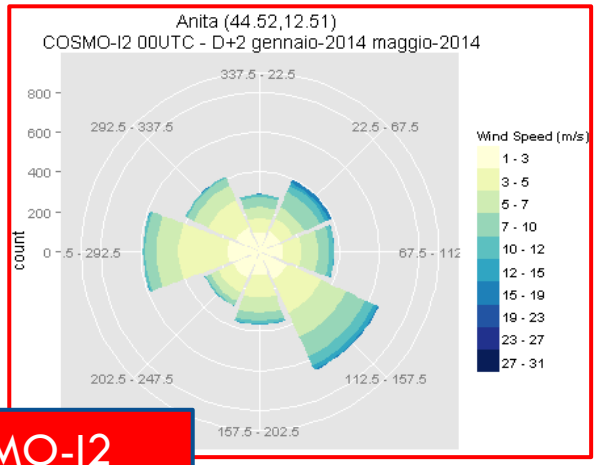


COSMO-I7

- W is underestimated, CI2 slightly better than CI7
- Good in SE
- NE & S overestimated

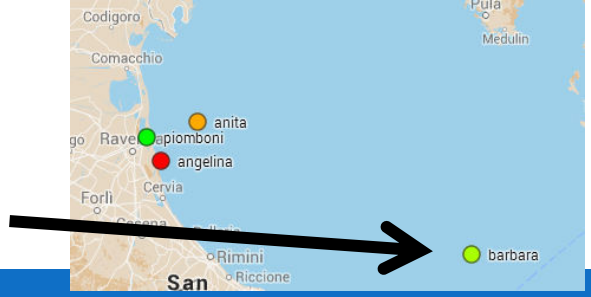


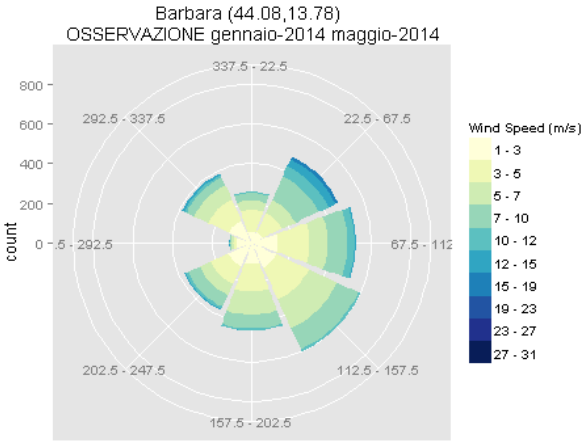


COSMO-I2

“Barbara”

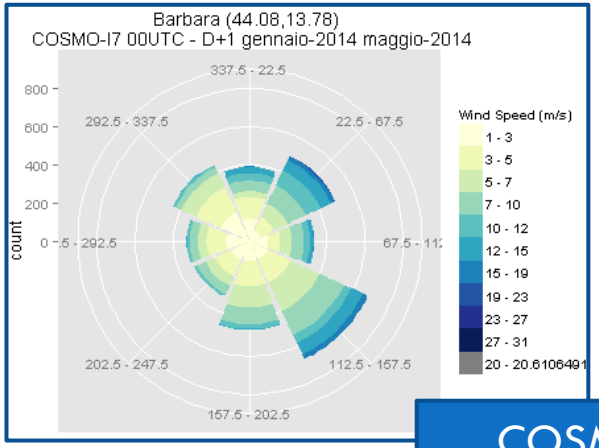
Off shore 150 Km from the coast

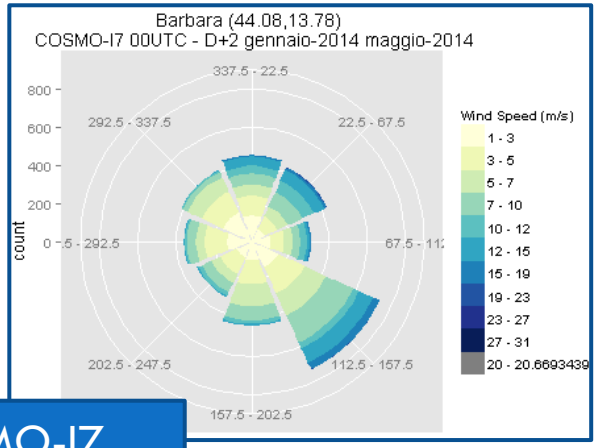




day 1

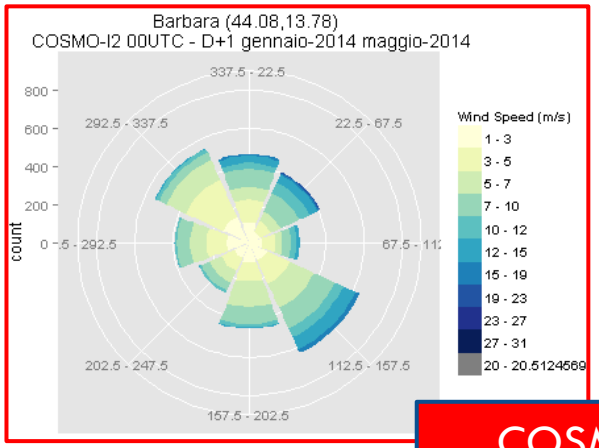
day2

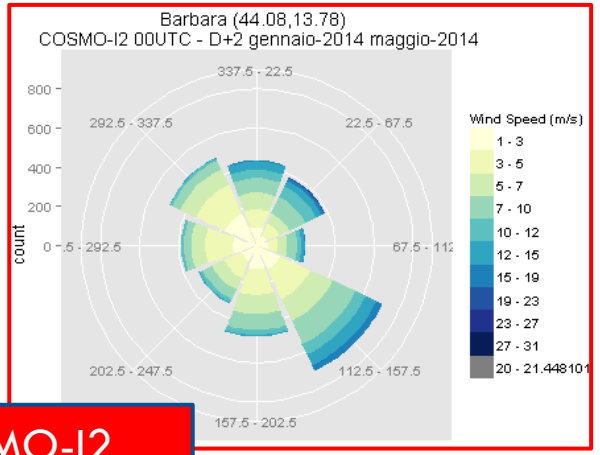




COSMO-I7

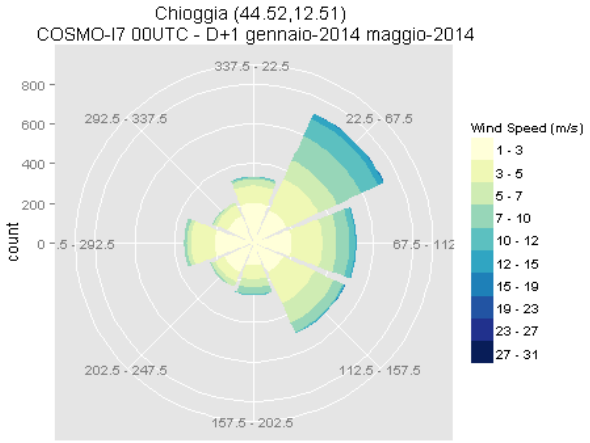
- NE well reproduced
- models prefer SE to E
- Wind speed overestimated





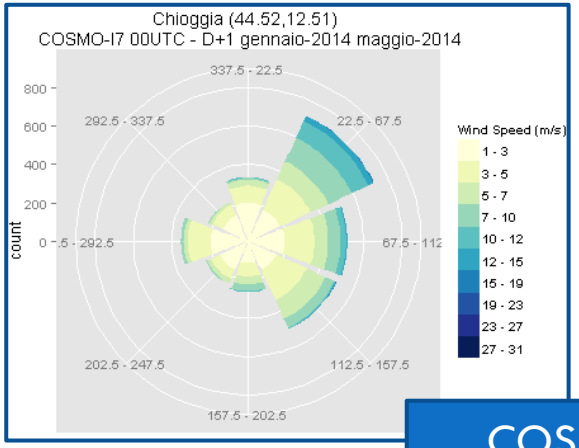
COSMO-I2

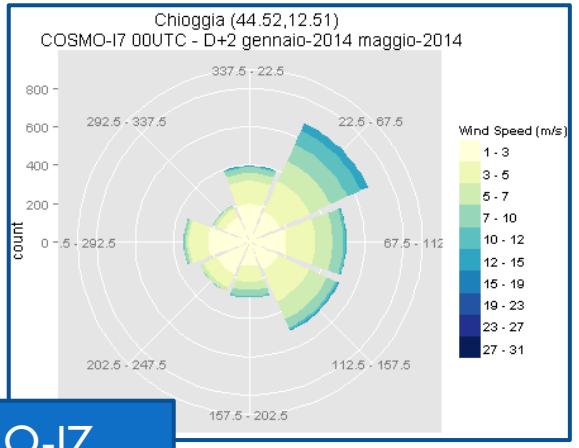
“Chioggia”



day 1

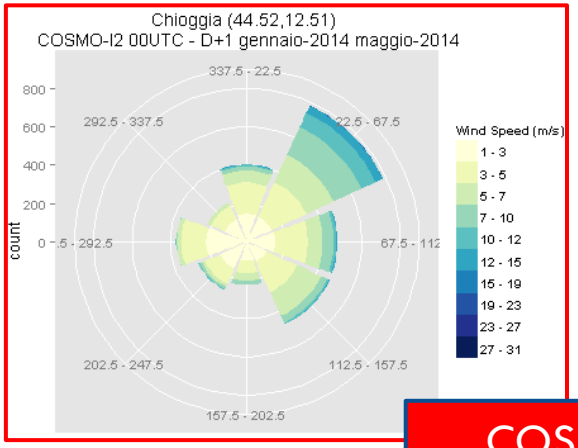
day2

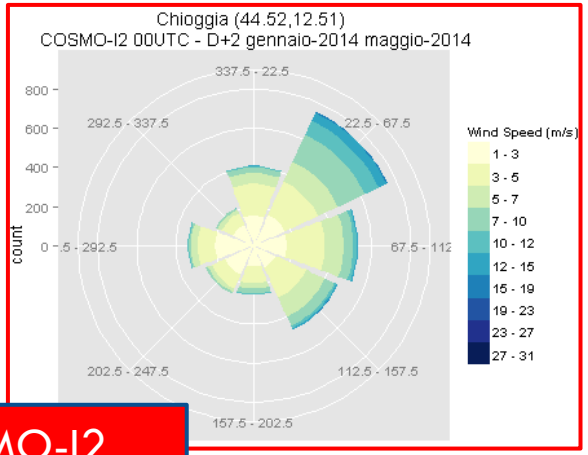




COSMO-I7

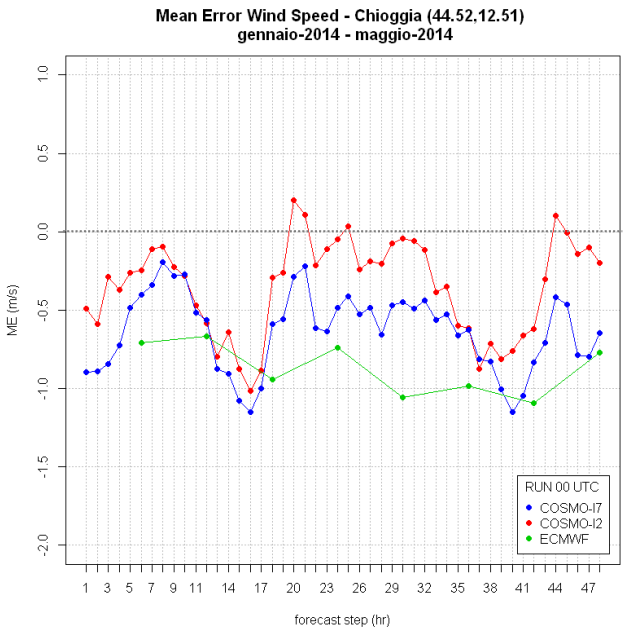
- very good representation of wind field



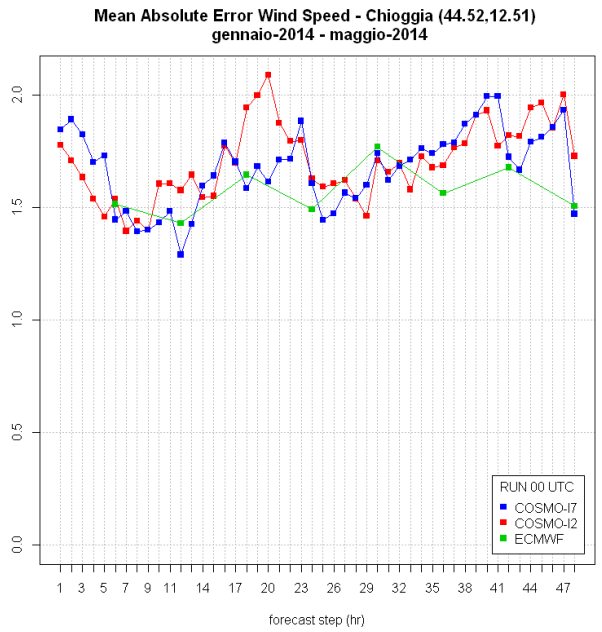


COSMO-I2

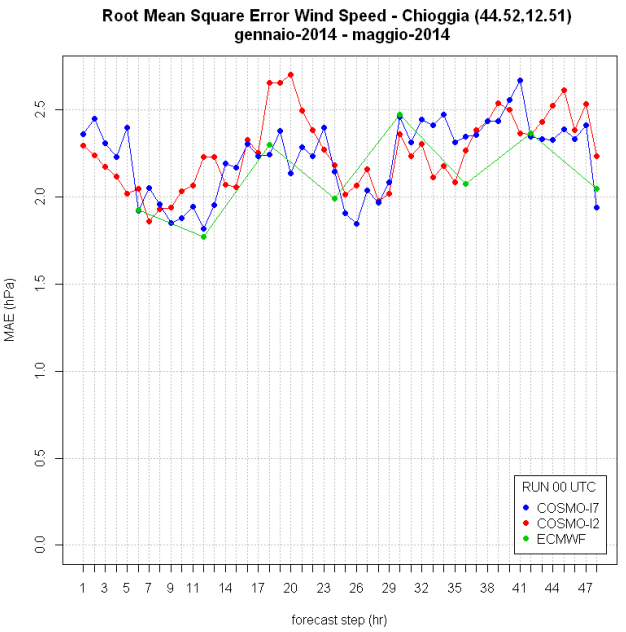
Chioggia: wind speed errors



ME

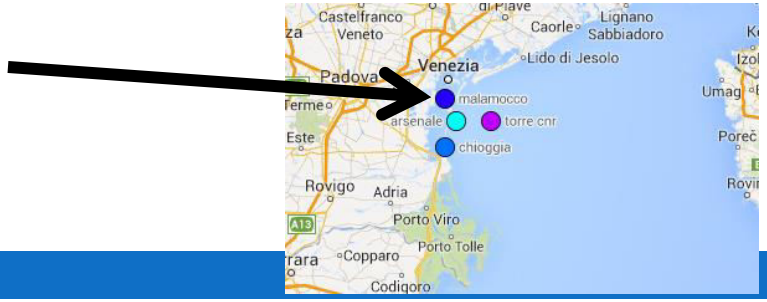


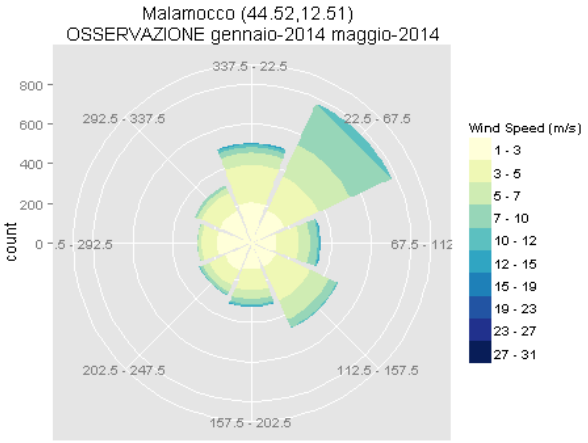
MAE



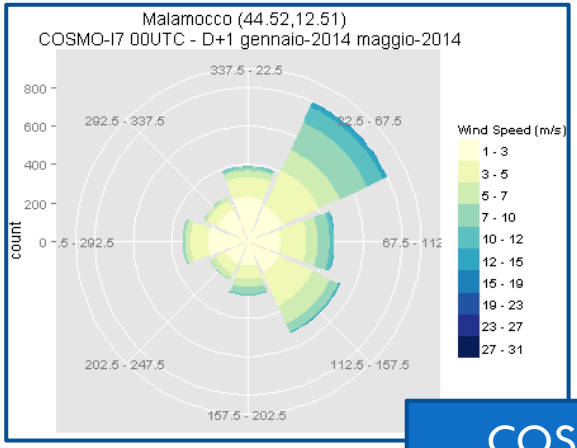
RMSE

“Malamocco”

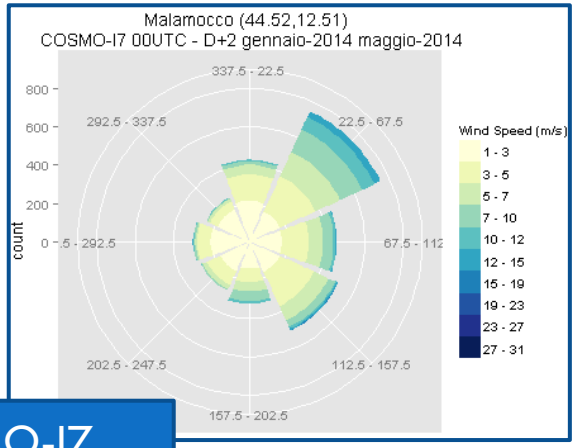




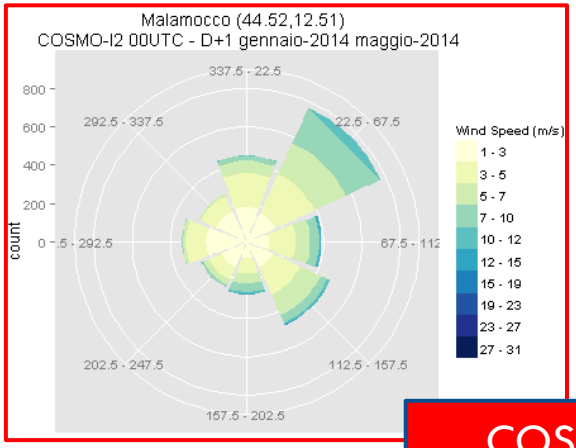
day 1

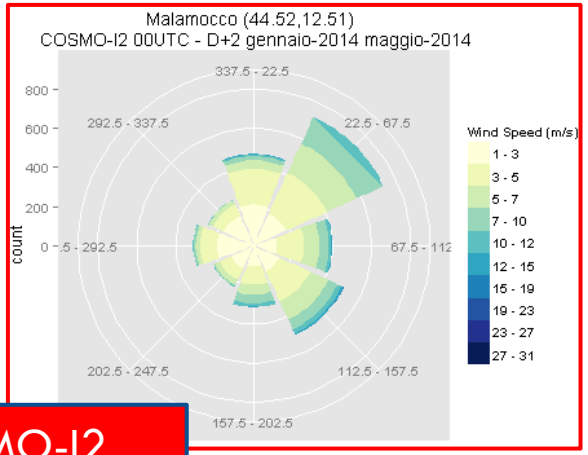


day2



COSMO-I7

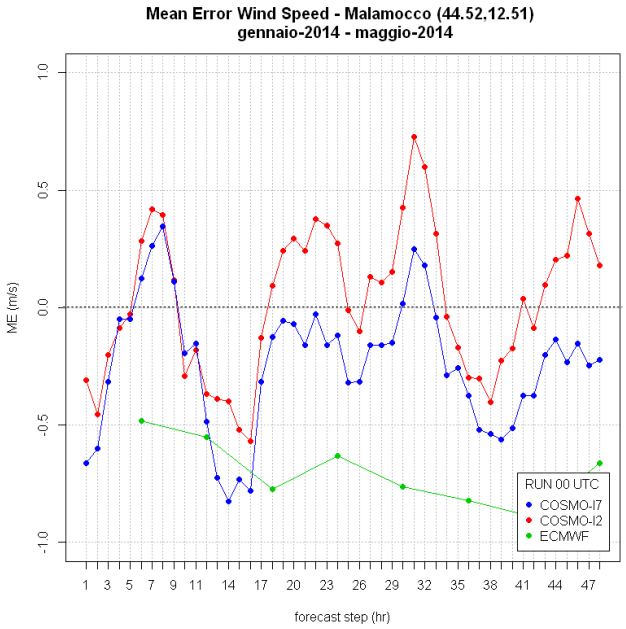




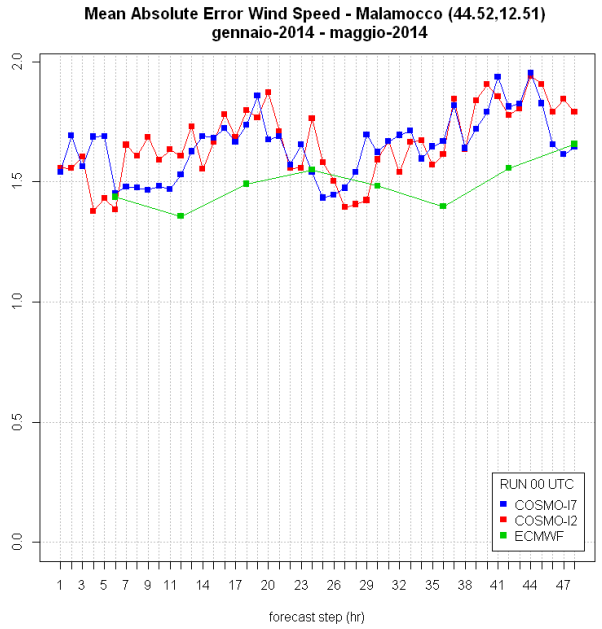
COSMO-I2

- very good representation of wind direction frequency
- CI7 tends to overestimate wind speed in particular from NE

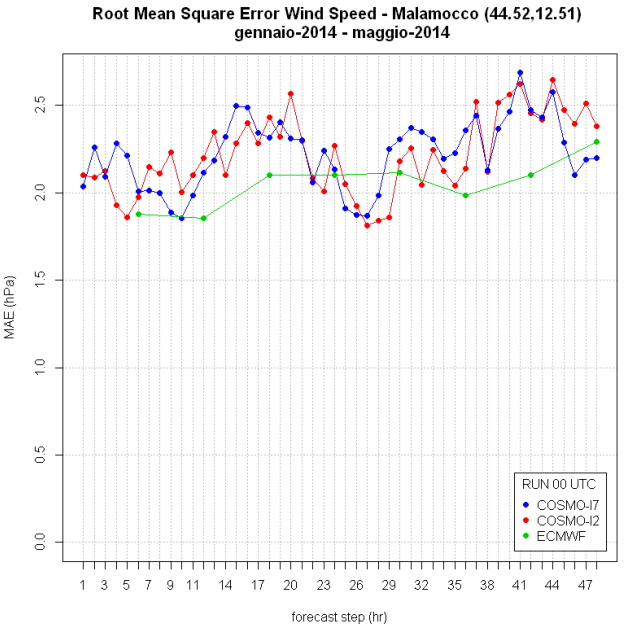
Malamocco: wind speed errors



ME



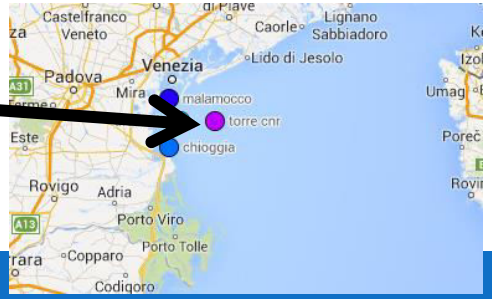
MAE

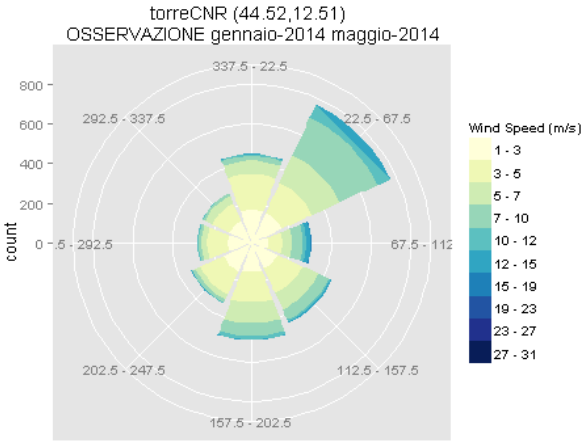


RMSE

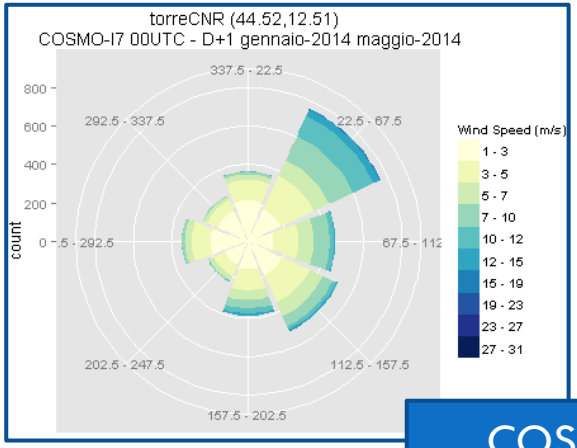
On average the overestimation of wind speed of COSMO-I7 does not appear…

“Torre CNR”

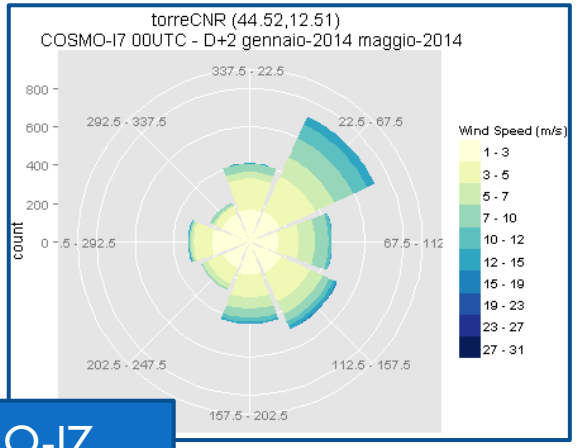




day 1

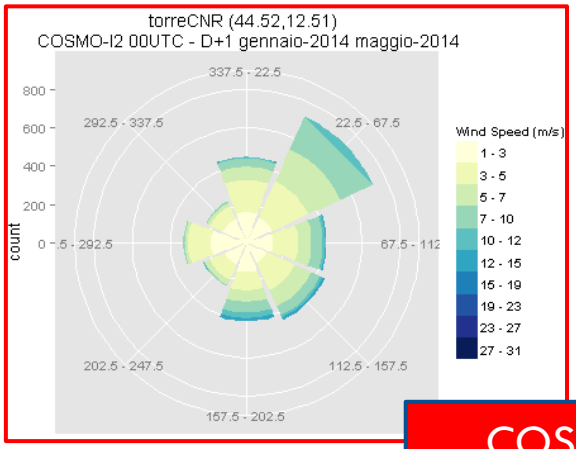


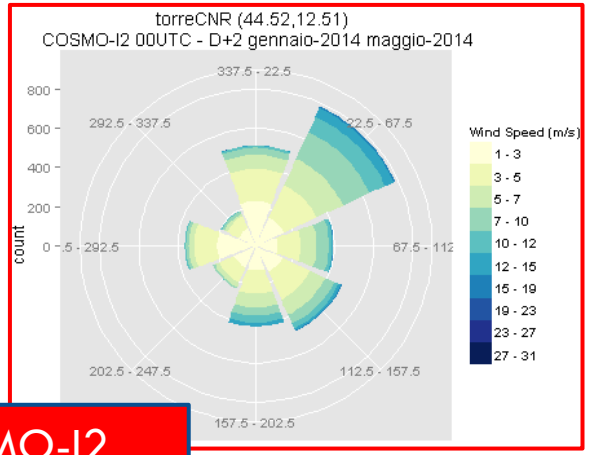
day2



COSMO-I7

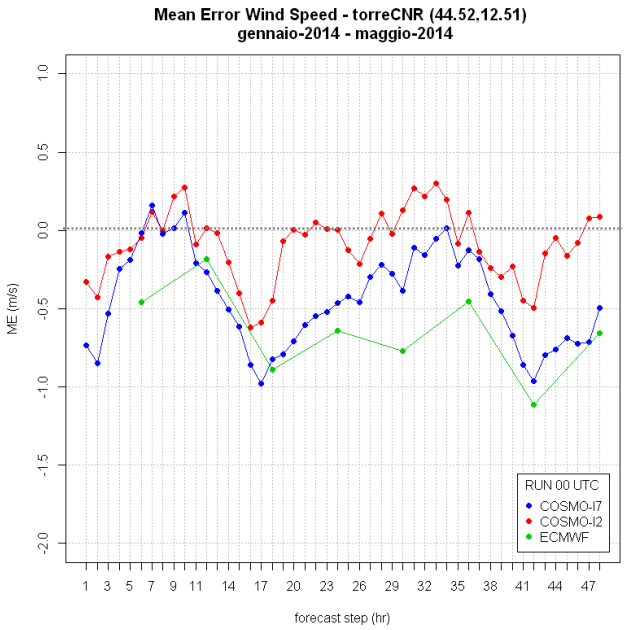
- NE good as total frequency but CI7 tends to overestimate wind speed, CI2 underestimates
- frequency of E overestimated

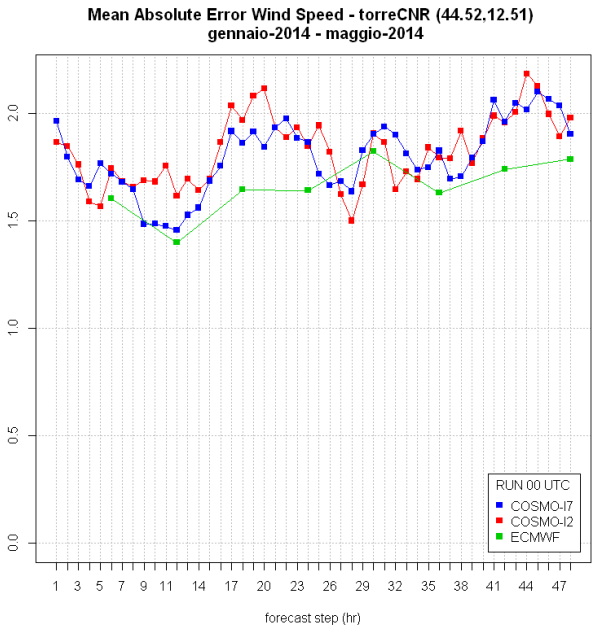


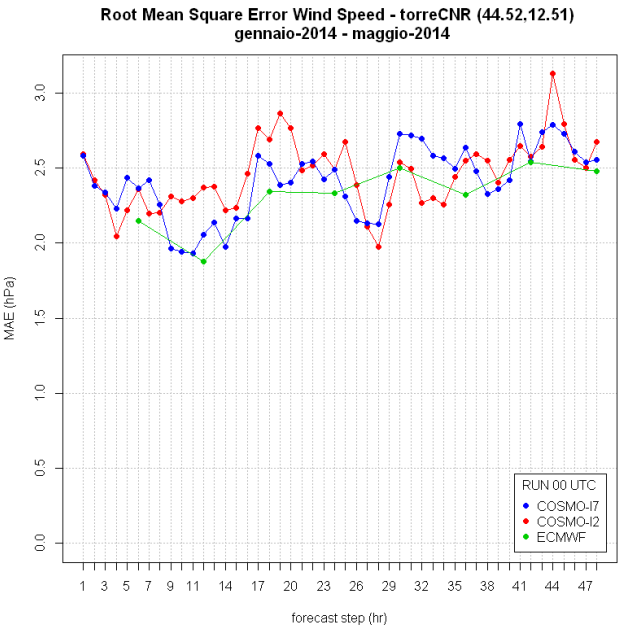


COSMO-I2

TorreCNR: wind speed errors







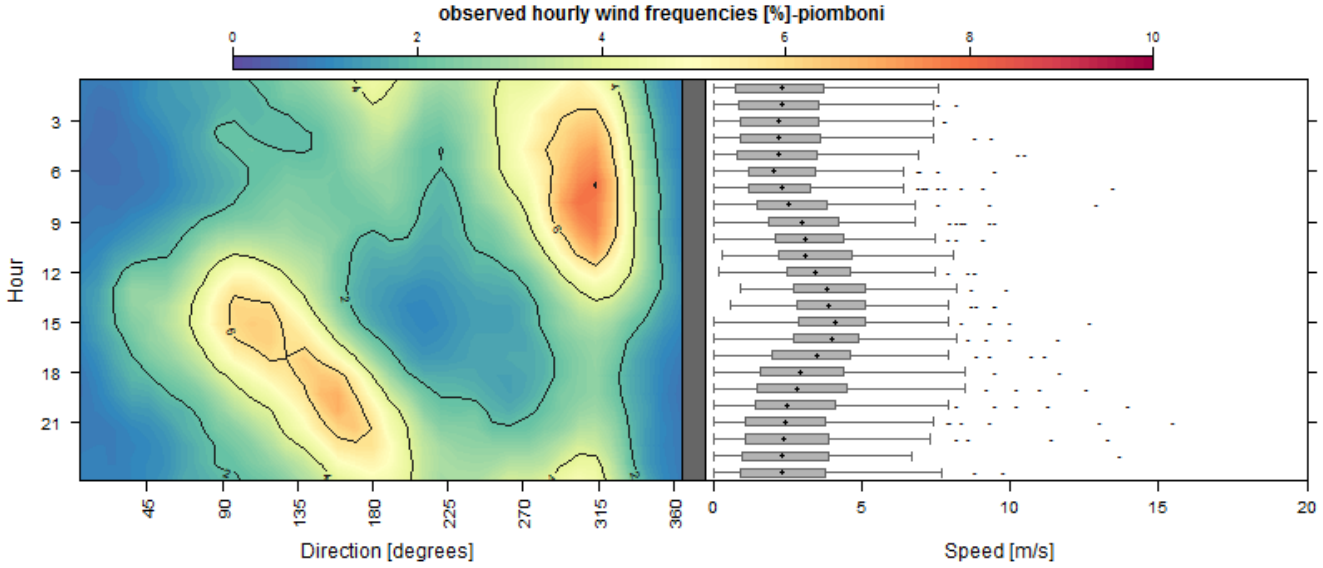
ME MAE RMSE

Also in this case on average the NE overestimation does not appear, maybe a stratification for direction should be necessary…but the number of plot will grow as the information to give to the end-user…

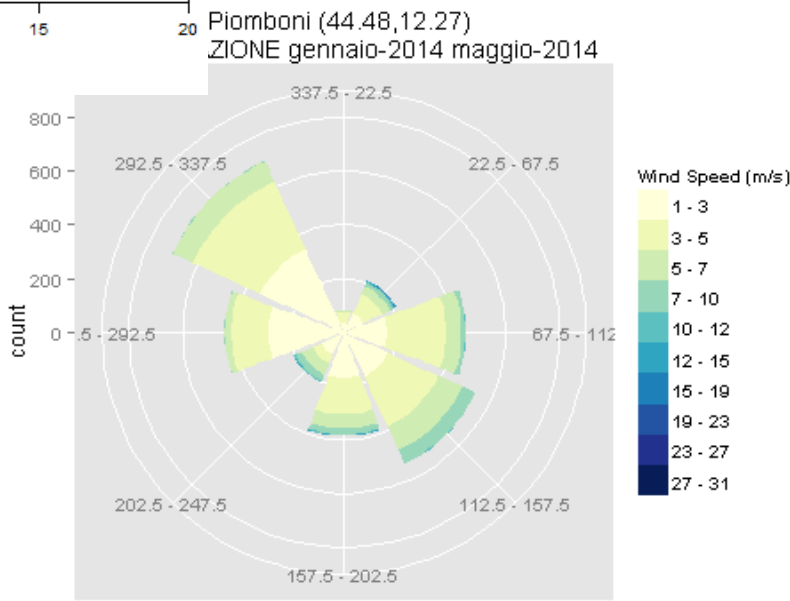
Visualizing diurnal wind climatology

- Getting information on diurnal climate dynamics is especially important in regions of complex terrain or for coastal locations, where diurnally reversing wind flow patterns are a major climatic feature
- R package from "metvurst repository" (https://github.com/tim-salabim/metvurst)
  - It is intended to provide a compact overview of the wind field climatology at a location and plots wind direction and speed as a function of the hour of day.
    - direction is plotted as frequencies of occurrences
    - speed is represented by a box plot

Visualizing diurnal wind climatology



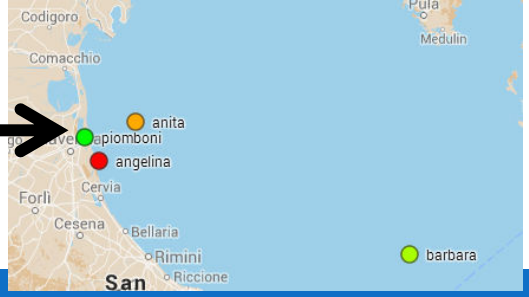
NE E SE S SW W NW N



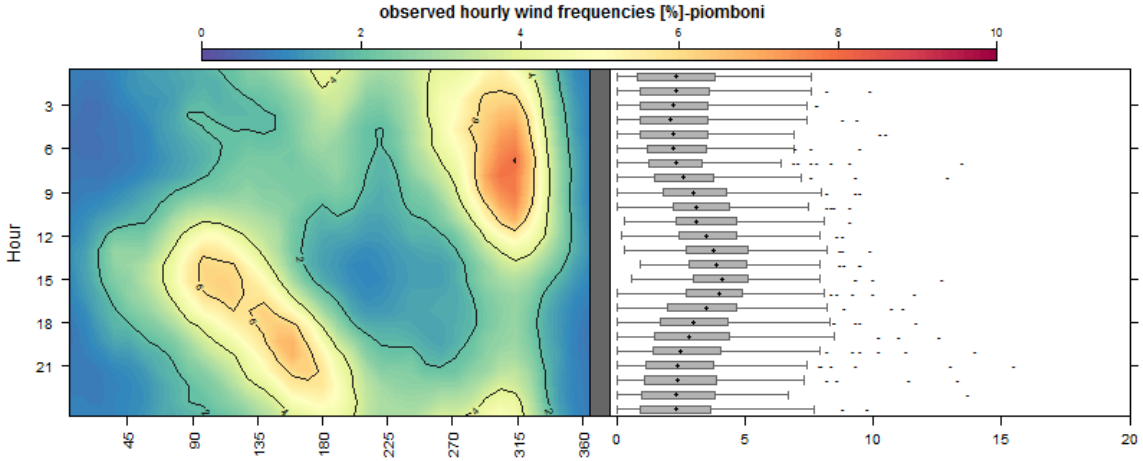
In the next graphs some examples of these plots are presented to illustrate some of the properties that can be deduced from this type of plot. Results are not complete to define the quality of the models

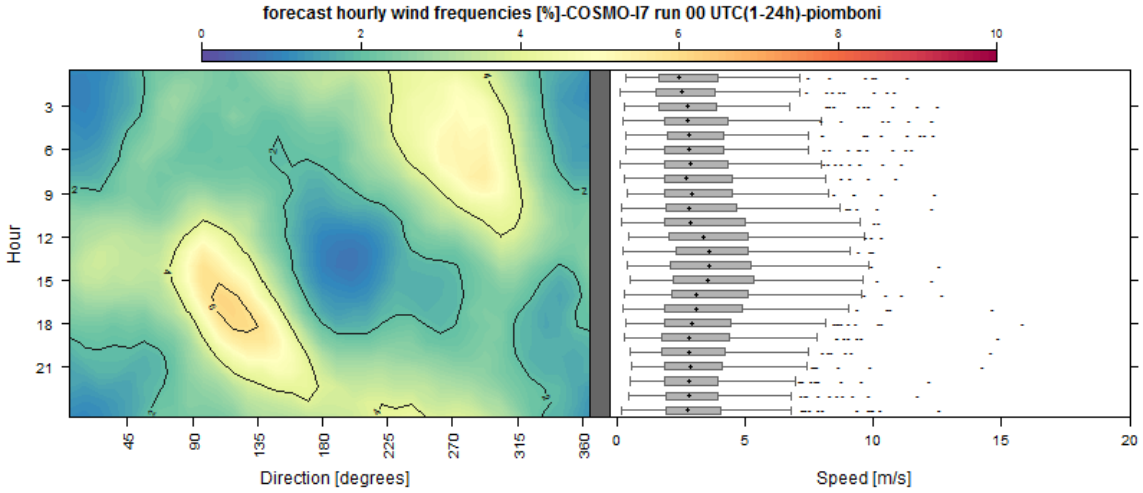
“Piomboni”

On the coast



observation





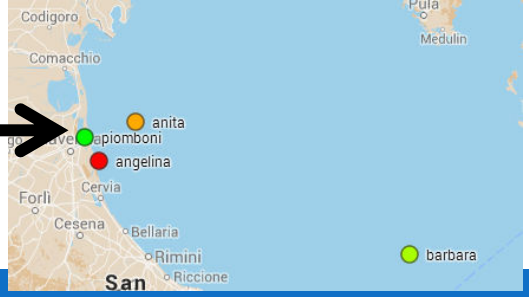
Direction are quite well reproduced, a part from NW that is less frequent in forecast

Differences in diurnal cycle of intensity

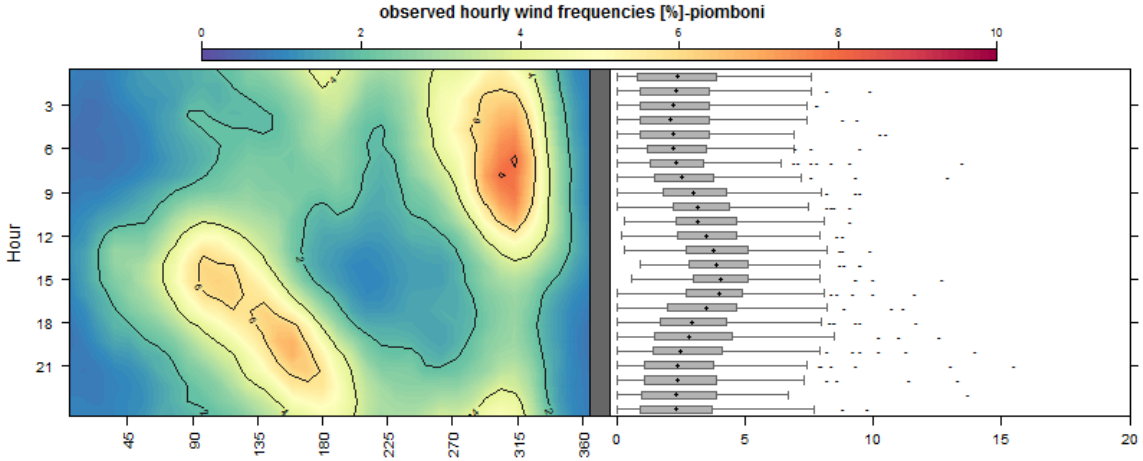
COSMO-I7 day 1

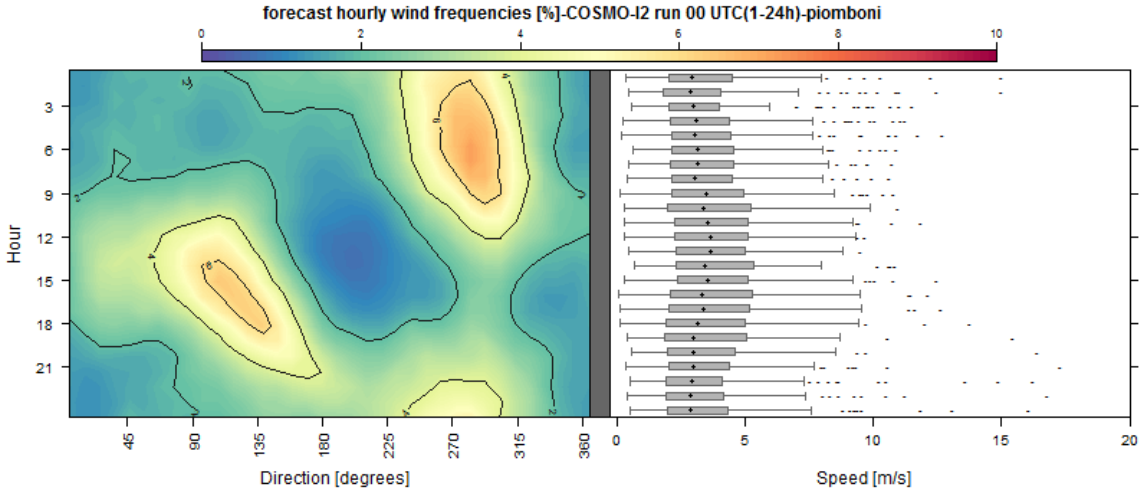
“Piomboni”

On the coast



observation





Cosmo-I2 describe better the NW direction but with overestimation of intensity

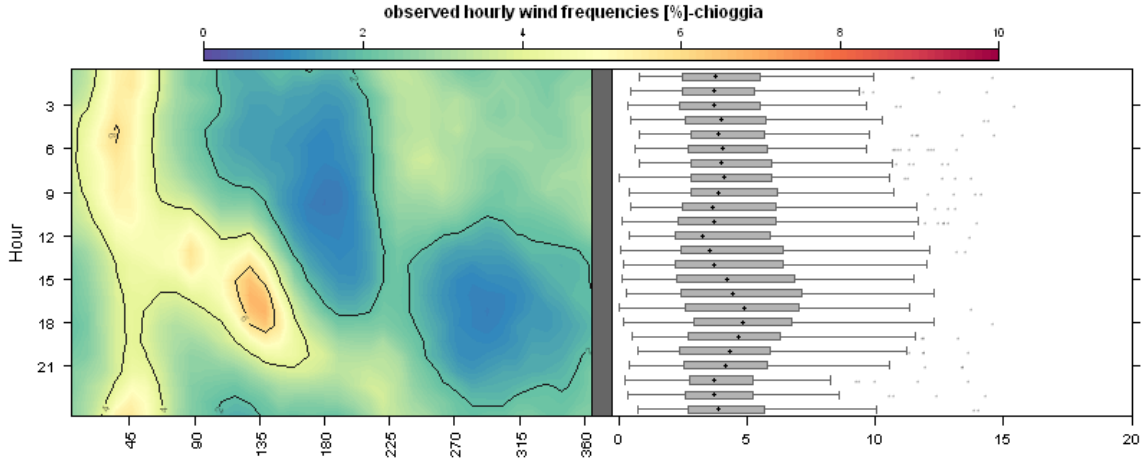
Diurnal cycle in wind speed not very pronounced

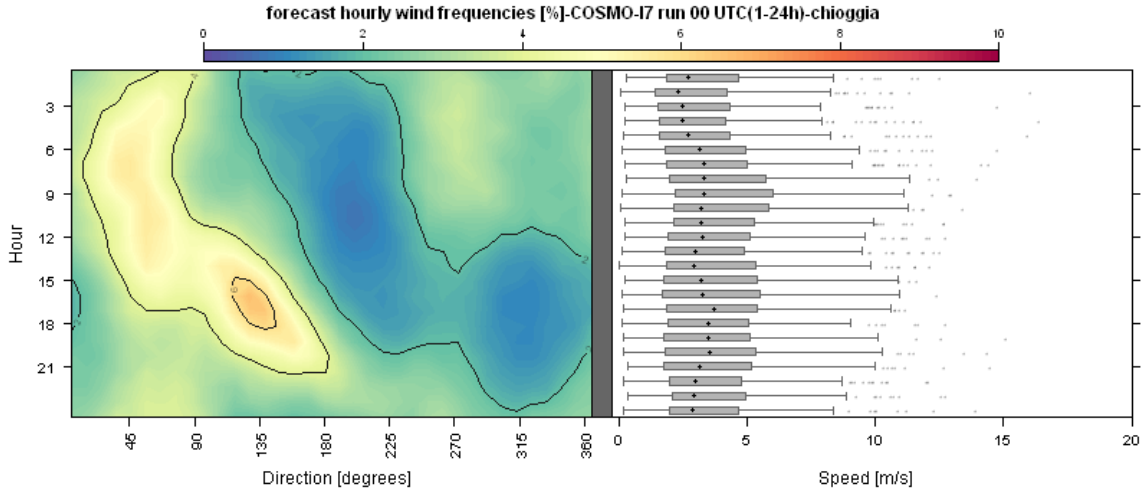
Outliers in the evening hours are comparable

COSMO-I2 day 1

"Chioggia"

observation



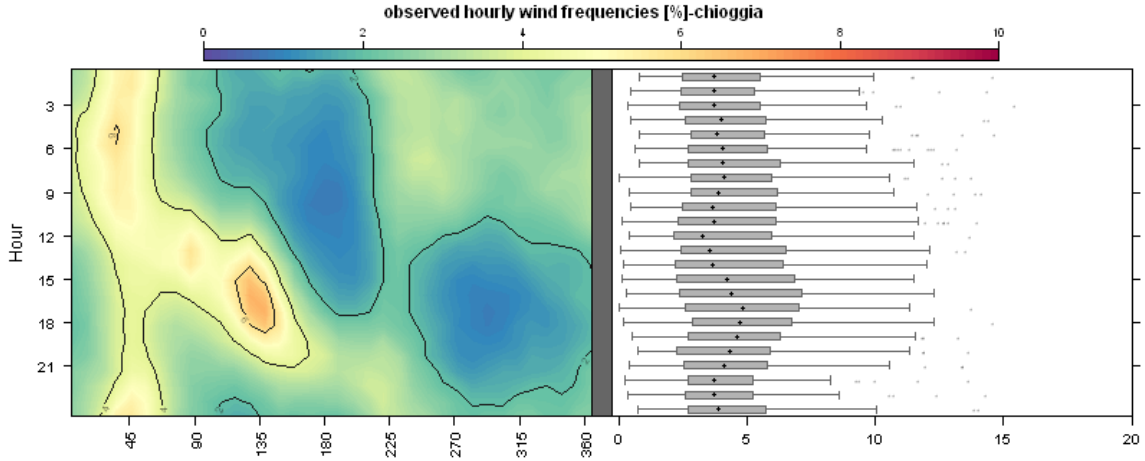


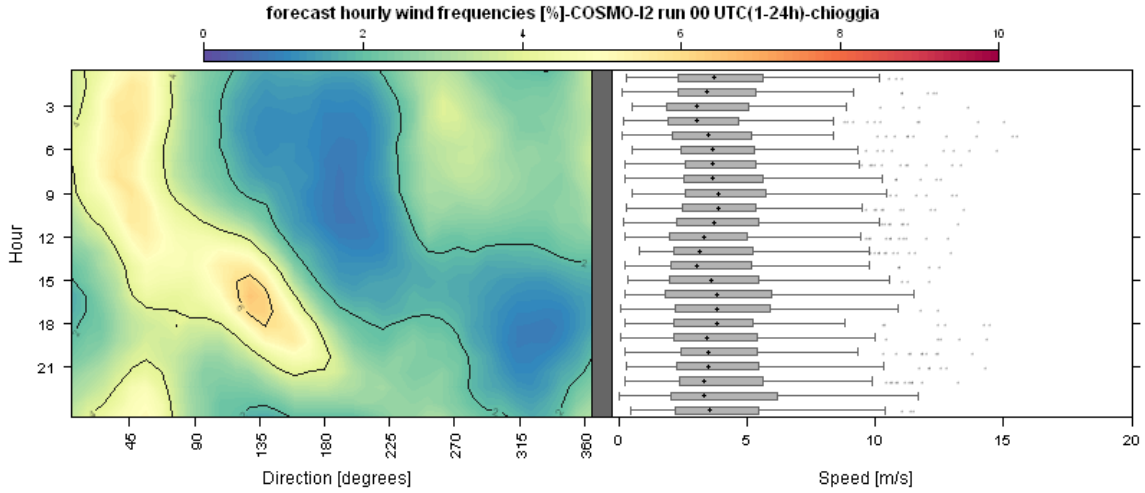
Wind speed is underestimated and diurnal cycle not very evident

COSMO-I7 day 1

"Chioggia"

observation

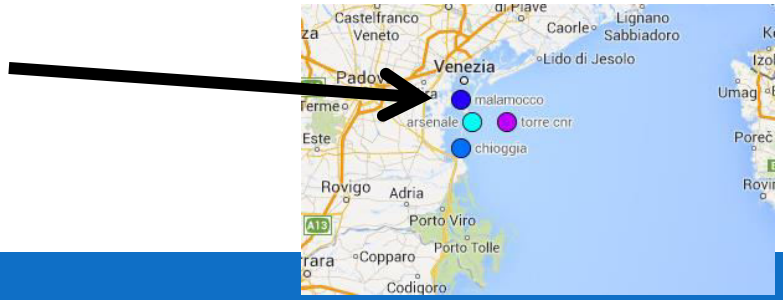




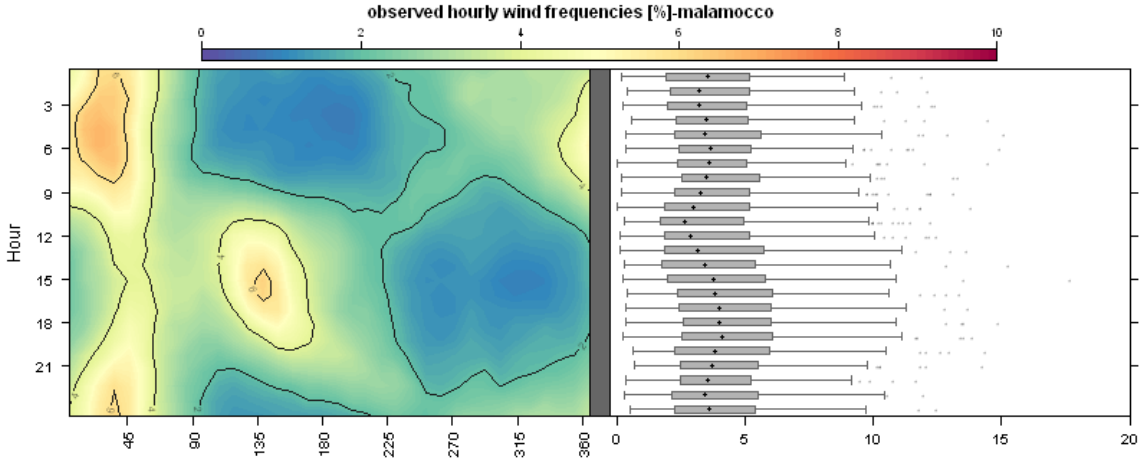
Better representation of direction but diurnal cycle not well reproduce, even if slightly better than CI7

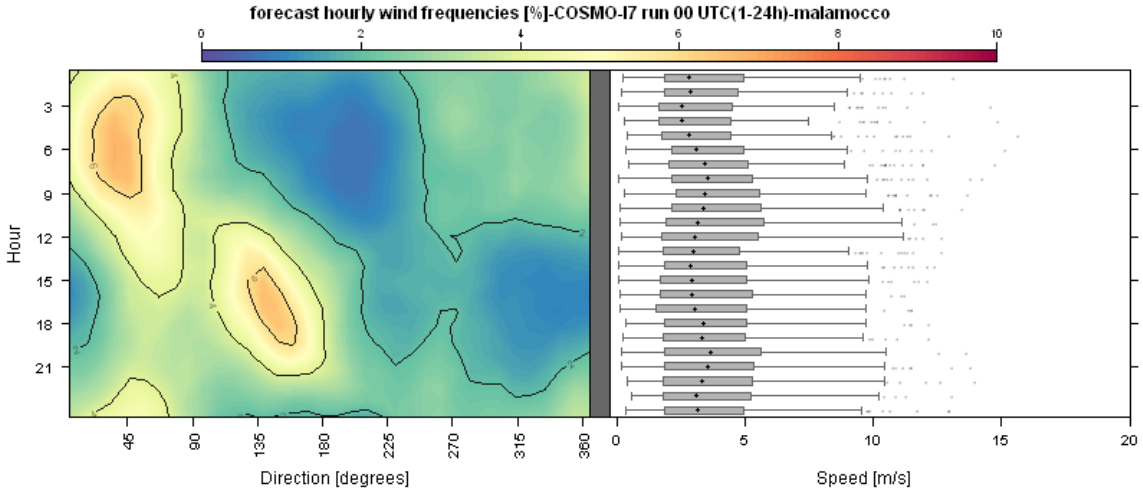
COSMO-I2 day 1

"Malamocco"



observation

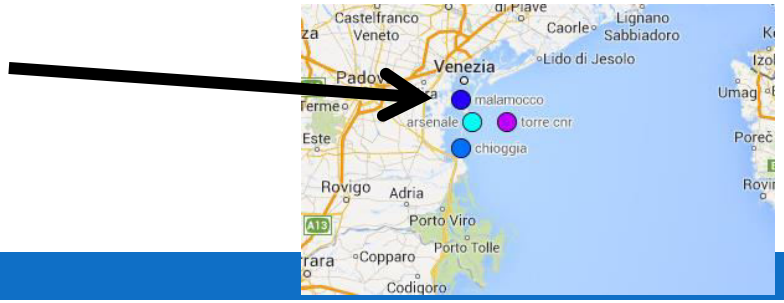




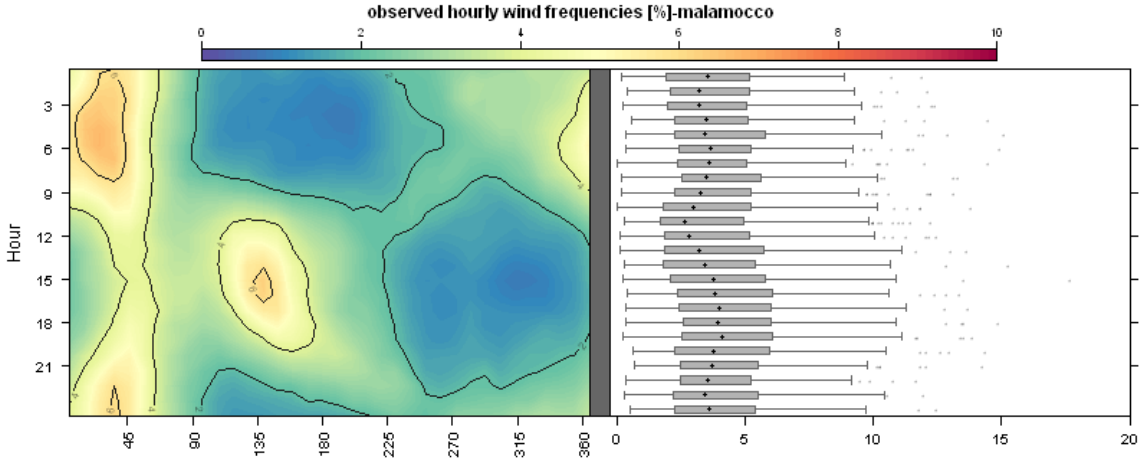
The direction are not so bad, but diurnal cycle is different

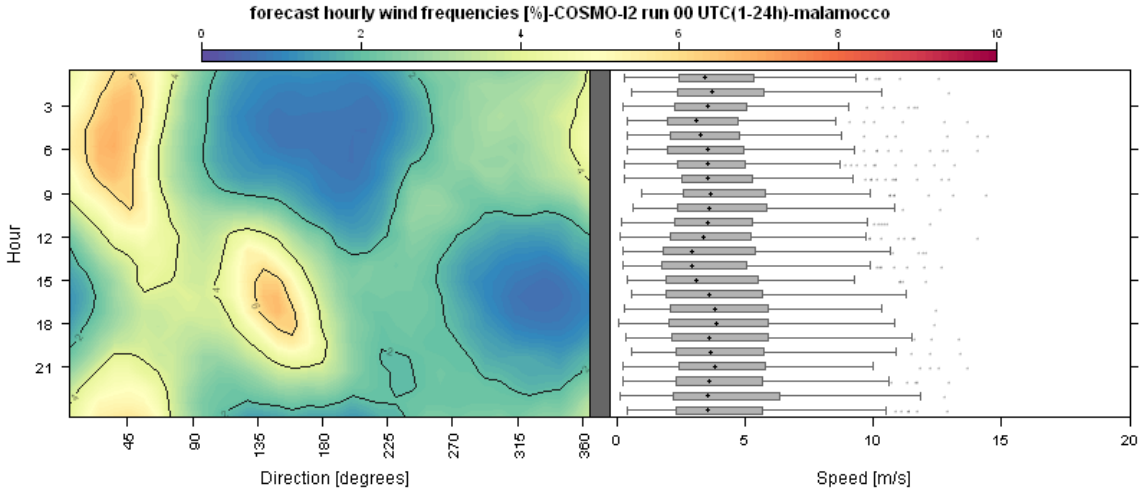
COSMO-I7 day 1

"Malamocco"



observation

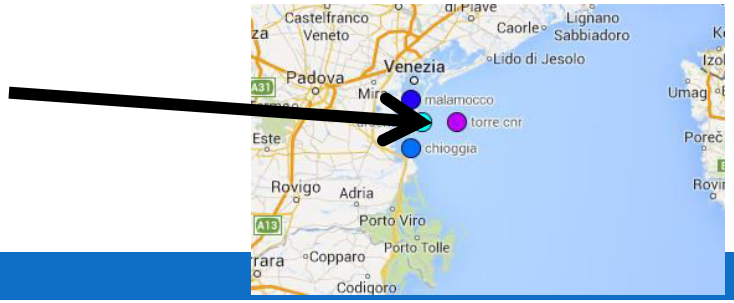




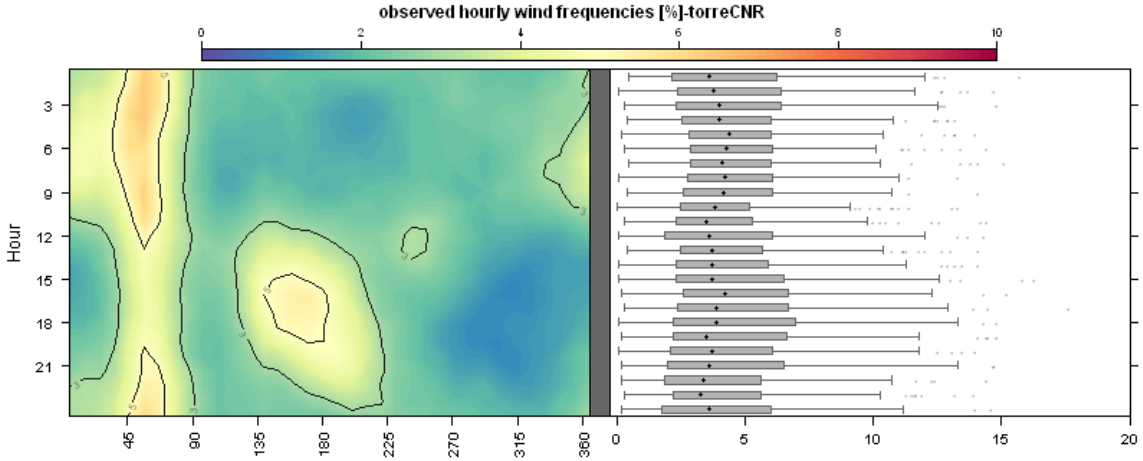
Good for direction, Even the diurnal cycle seems a bit better but the hour of the minimum is different (about 12 UTC for obs, 15 UTC for model)

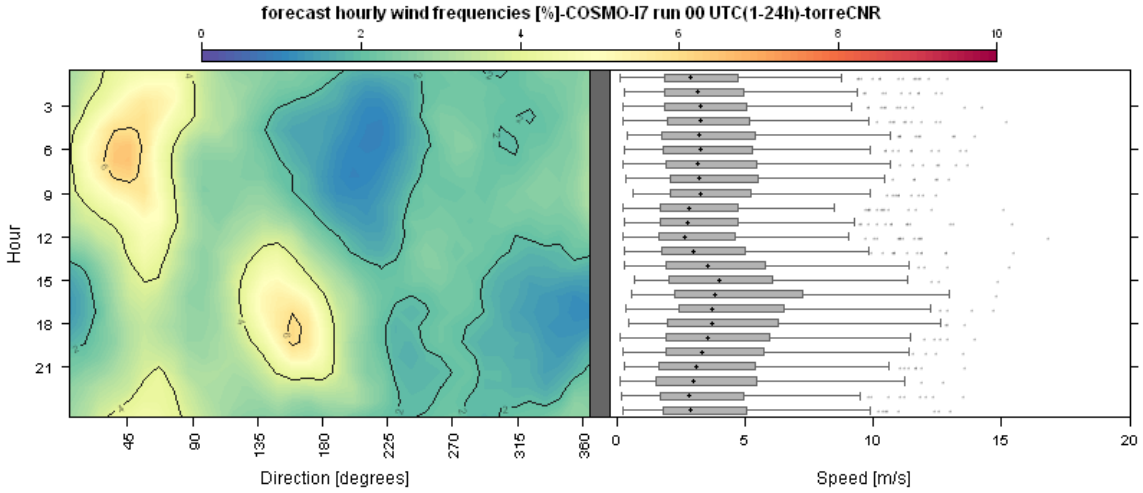
COSMO-I2 day 1

"Torre CNR"



observation



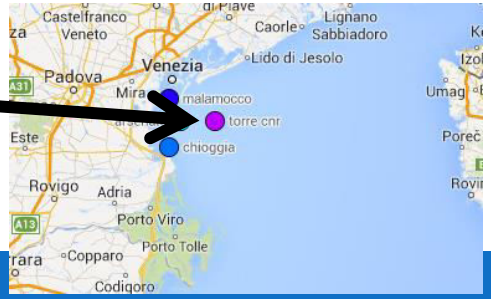


Directions are different

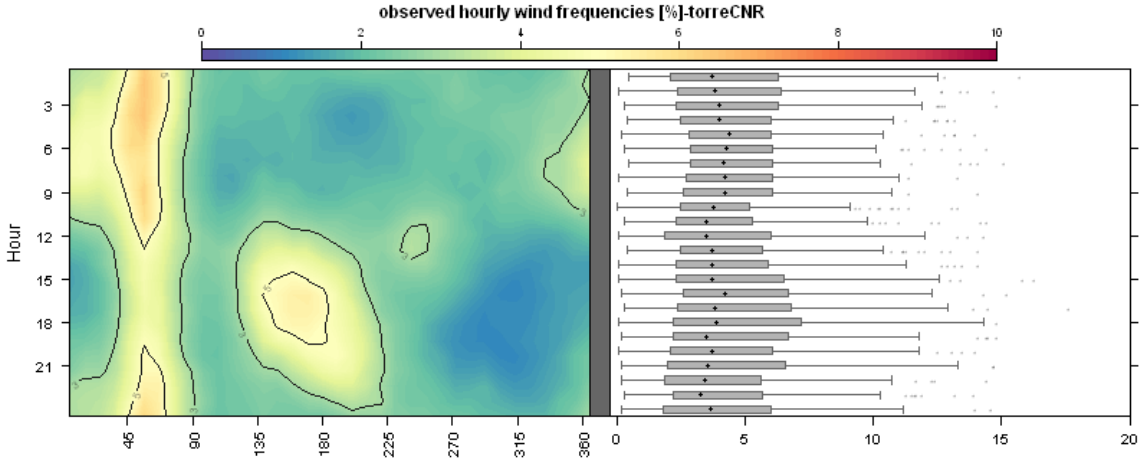
Diurnal cycle seems better than in other locations

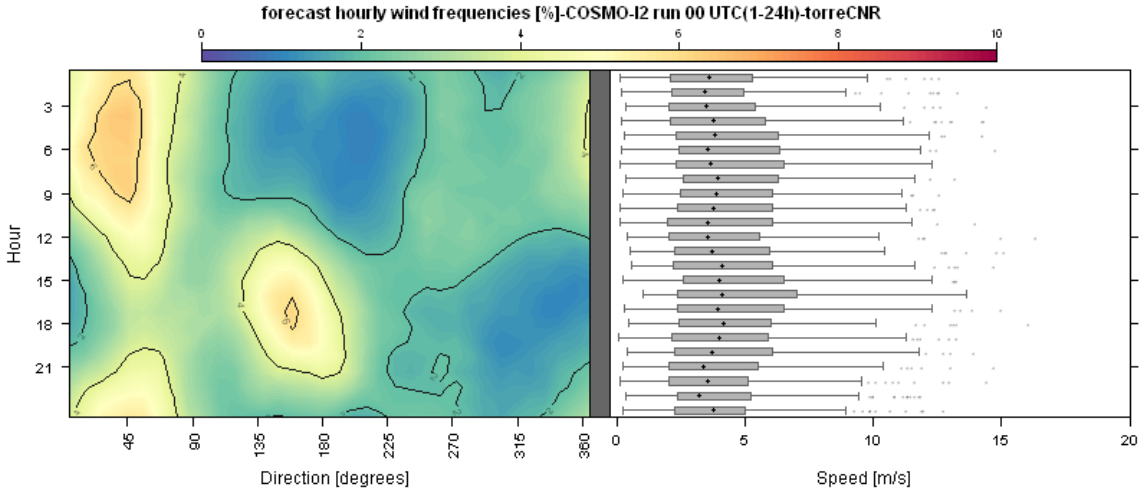
COSMO-I7 day 1

"Torre CNR"



observation





Oversestimation of speed in the morning, better in the afternoon

COSMO-I2 day 1

Conclusion and ideas to continue the work

- This is a preliminary study, to learn something from the results more work is need to separate season, select more reliable stations
- For example, using “windcontour-plot type”
  - Plot 2m temperature together with direction for breeze onset investigation
  - Plot wind speed errors (ME /MAE) together with direction
- Study significant wind changes between two time steps, not related to diurnal variations


THANKS