A user-oriented verification methodology for wind forecast

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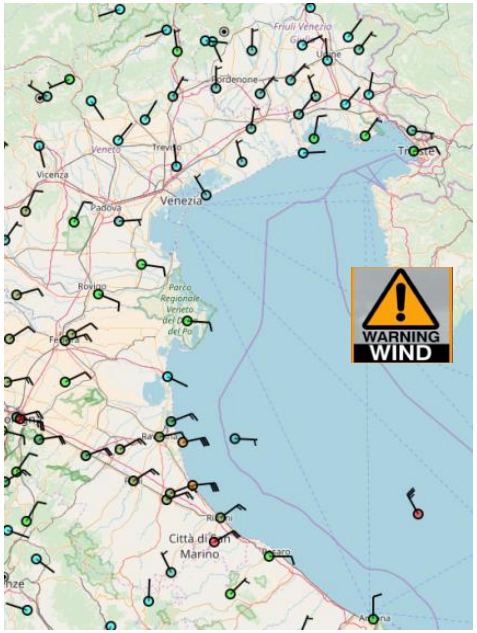
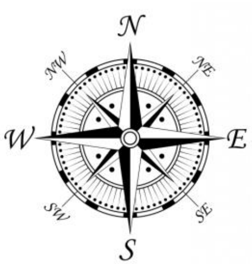
One of the main uses of wind forecast is to issue warnings when wind speed exceeds some threshold.
For example, strong easterly winds can determine the possible occurrence of sea storms over the Italian coast of the Adriatic Sea, but also less intense winds can cause problems to the touristic activity on the beach.
Therefore verification should answer questions such as:



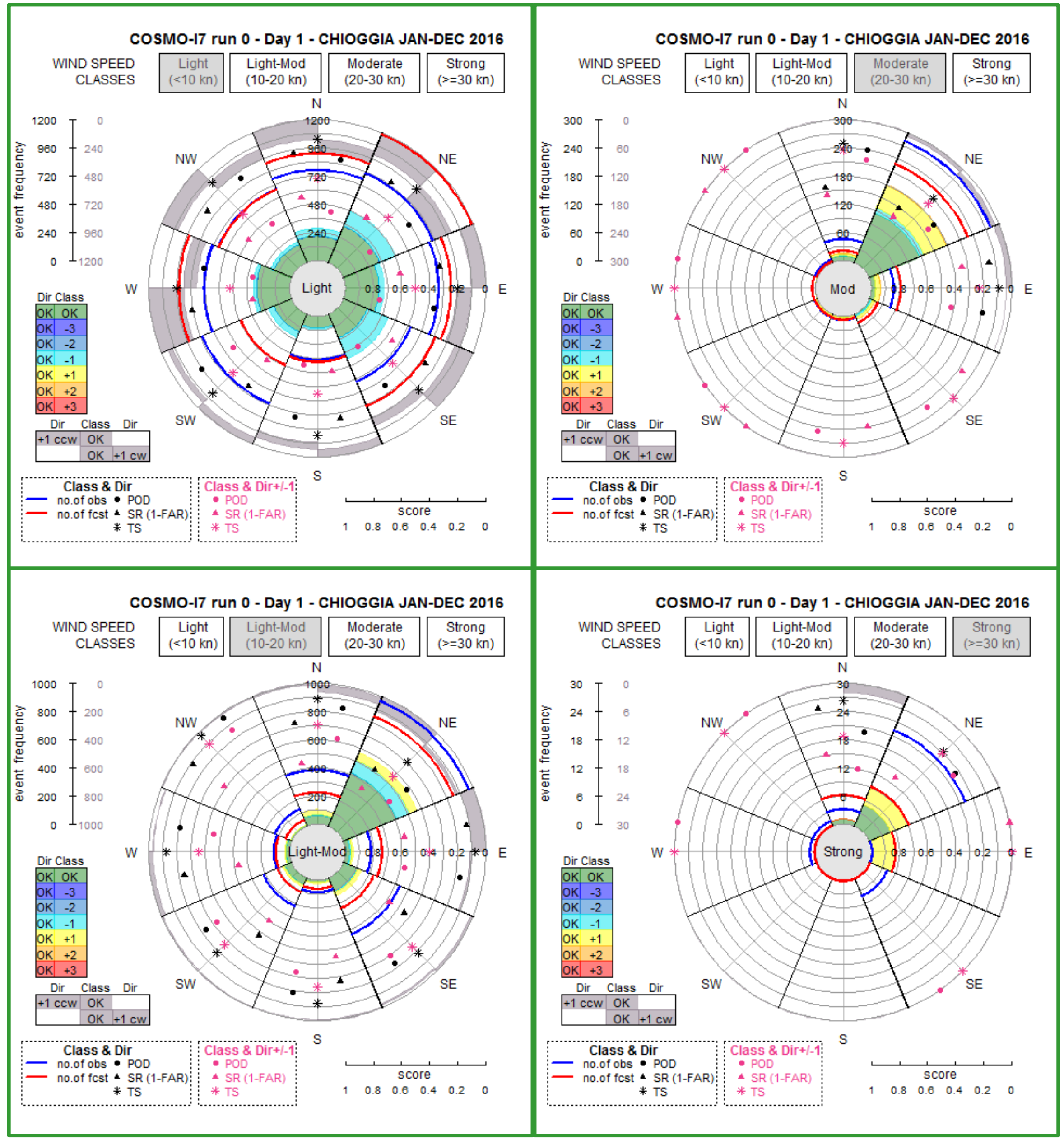
- Is the model able to predict critical winds?
- How many false alarms or misses?
- Does the model have the same performance in all directions?
- Is the direction correctly forecast?
- Does the direction error depend on wind speed?

How to take into account wind speed and direction and summarize the results in a plot ?



The “Performace – Rose”

A novel diagram in which scores and type of errors of wind forecast are summarized according to directions



For each station, 10m-wind observations (hourly or 3/6-hourly or other time aggregations) and corresponding data predicted by model are categorized in octants for wind direction and in classes for wind speed.

Light: ws<10 knots

Light-Moderate:

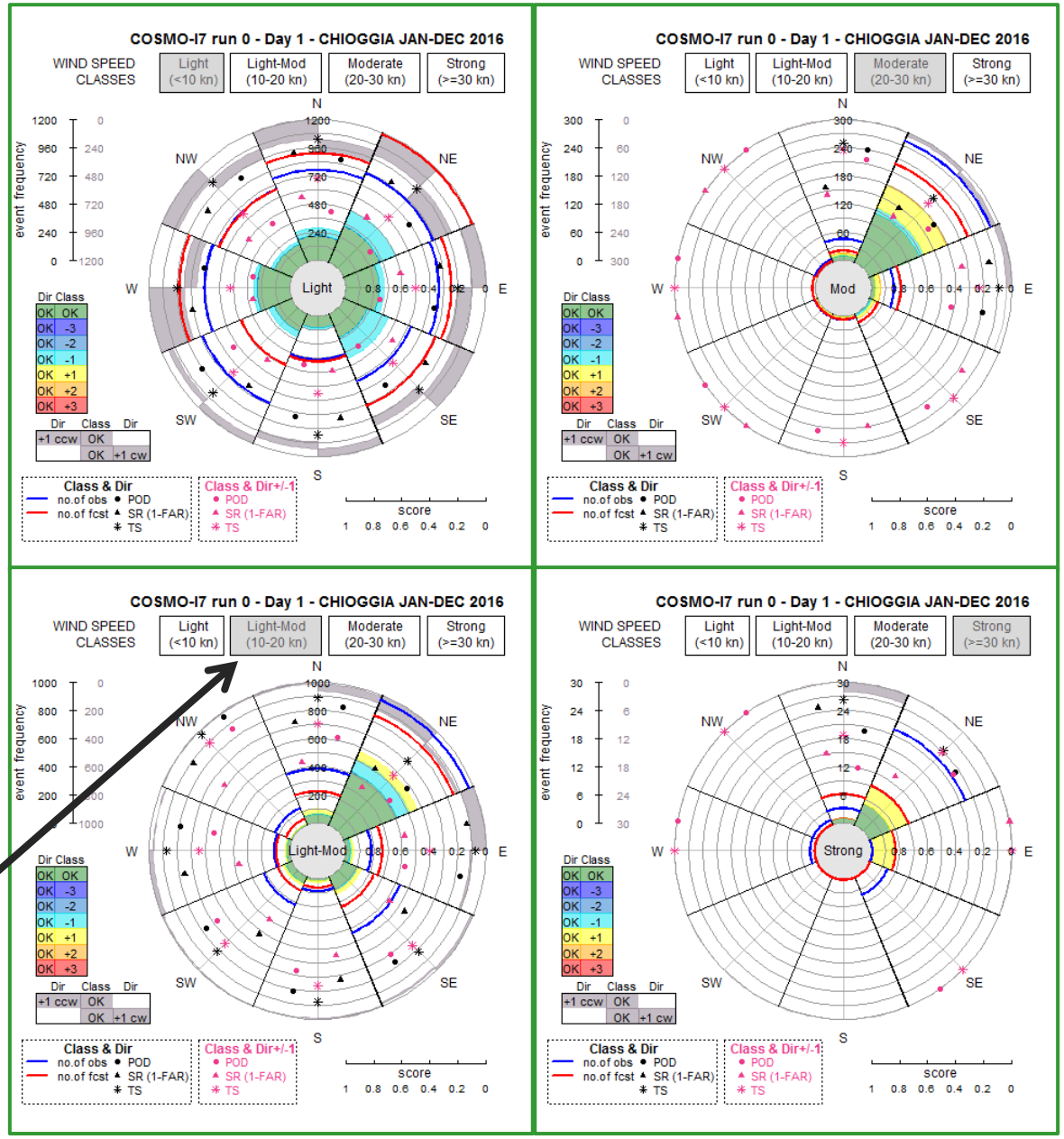
10≤ ws < 20 Knots

Moderate:

20≤ ws < 30 Knots

Strong: ≥30 Knots

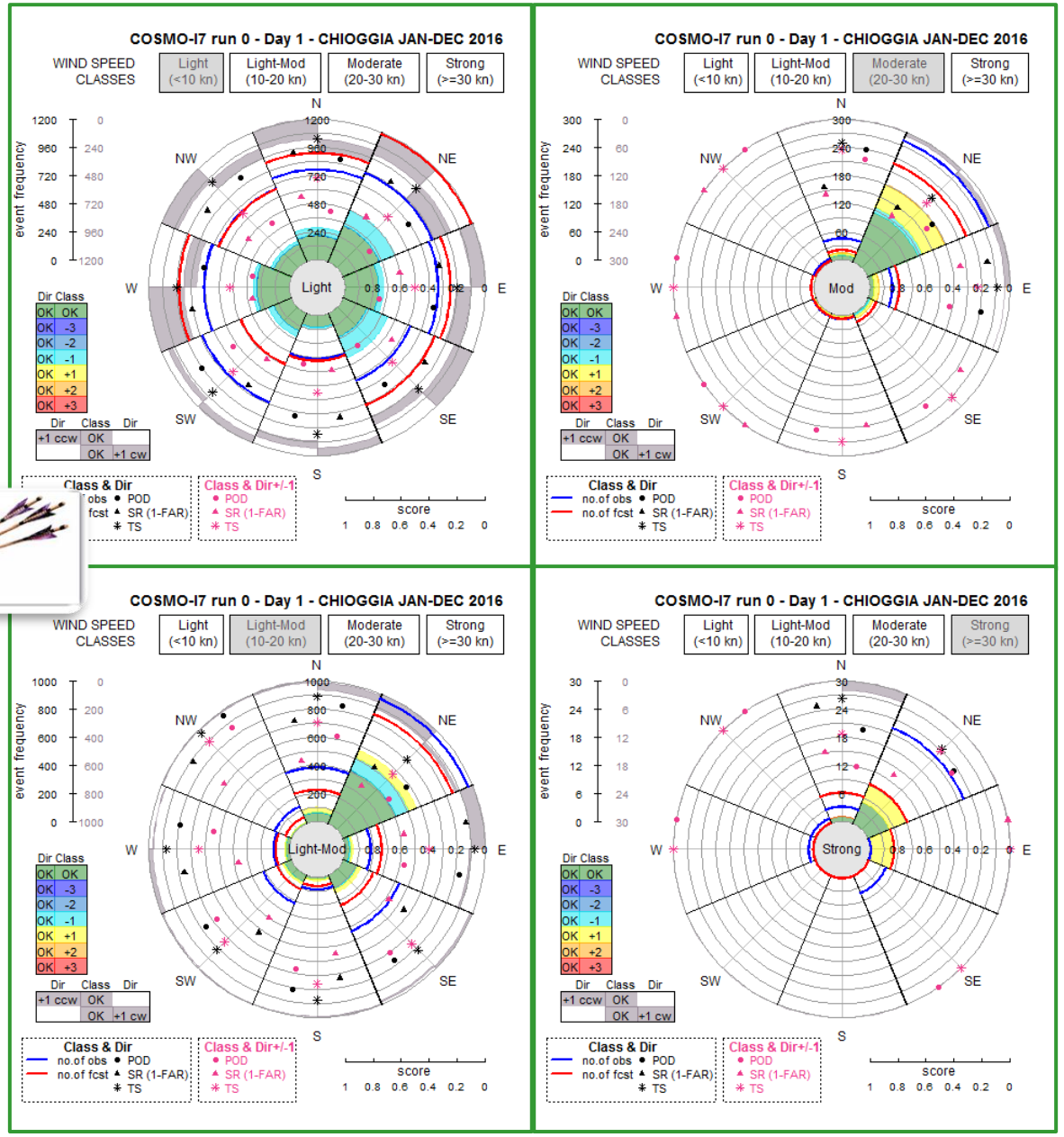
For each class a separate plot is done



Verification scores are plotted as symbols:

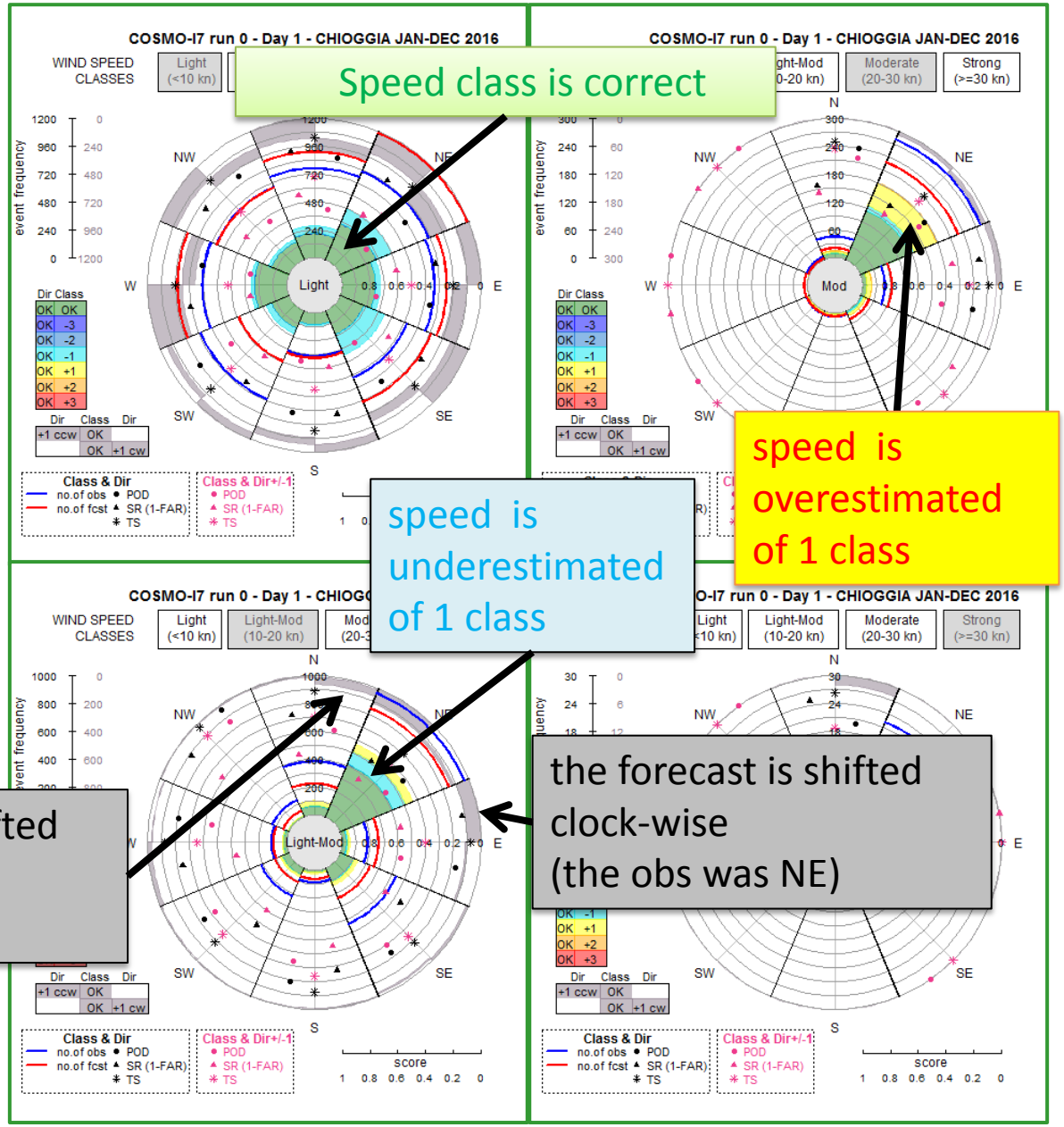
- The colors represent the two types of event
  - **Black:** Correct speed class and direction
  - **Purle:** Correct speed but with a tolerance in direction (1 octants)
- Perfect score 1 is in the innermost ring
- Red line represents the number of forecast in the specific class
- Blue line represent the number of observations in the specific class

Scores improve in the case of tolerance in direction, especially for light wind



Colored sectors represents how model predicts the reference speed class in each direction, <u>being the direction correct</u>

The gray half-sectors represent the number of forecast in each direction that are “nearly” correct in direction, <u>being the intensity correct</u>



Verification of hourly 10-m wind predicted by COSMO-I7 00 UTC run for the station "Chioggia" near Venice. The statistics refer to 1 year (JAN-DEC 2016) of hourly data from 1 to 24 h of forecast (DAY 1) and corresponding observations.

Underestimation of the intensity ,with correct direction predicted, is more evident for "Light" and "Light-moderate" classes (see cyan sectors).

In case of "Moderate" winds predicted the number of cases of underestimation is very small, while the number of overestimated events is significant (see yellow sectors).

This information is important for the forecasters as they can be confident about the low risk of missing critical events.

Unfortunately the performance-rose relative to "Strong" wind shows that the scores relative to this type of event are very low. In addition to cases of overestimations, the most frequent error is the complete missing of the event (predicted in lower wind classes with very different direction and therefore not visible in the performance-roses).