Probability of precipitation type and Most probable precipitation type

New ECMWF products

Estibaliz Gascon, Tim Hewson

Forecast Department

ECMWF

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Why these new probabilistic products?

- Difficulties of accurate forecasting of precipitation type in winter at ground level, specially mixed (freezing rain).
- **Freezing rain** is particularly hazardous due to its ice-loading effects on power wires and because it can make travel extremely dangerous. But also heavy snowfalls.
- The uncertainty of mixed phases forecasting can be partially reduce using ensemble forecast.
- We also used a technique with precipitation rate variable to classify dry from precipitating in order to try to enforce a zero frequency bias for each precipitation types: reduce misses and false alarms.

50 perturbed forecast +1 control forecast IFS (ECMWF)

- 0-144h (3-hourly)
- 0.2° x 0.2° lat/lon
- Twice a day: 00 and 12 UTC

Instantaneous variables

Types (6):

- Rain
- Sleet
- Snow
- Wet Snow
- Freezing rain
- Ice pellets

Precipitation type variable

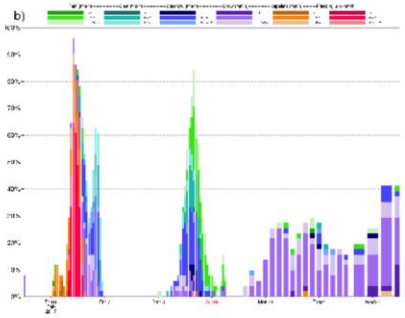
Precipitation rate variable

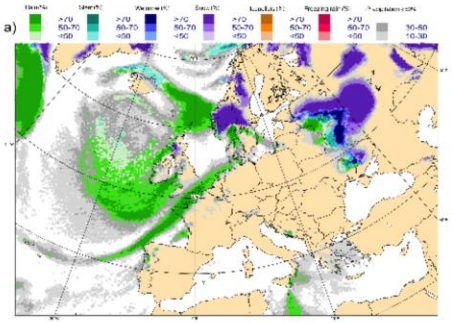
Categories (3):

- Low intensity (min-0.2 mm/h)
- Medium intensity (0.2-1mm/h)
- Hight intensity (>1 mm/h)

6 precip. types
x 3 precip. rate categories
= 18 grib files

PROBABILITY OF PRECIPITATION TYPE

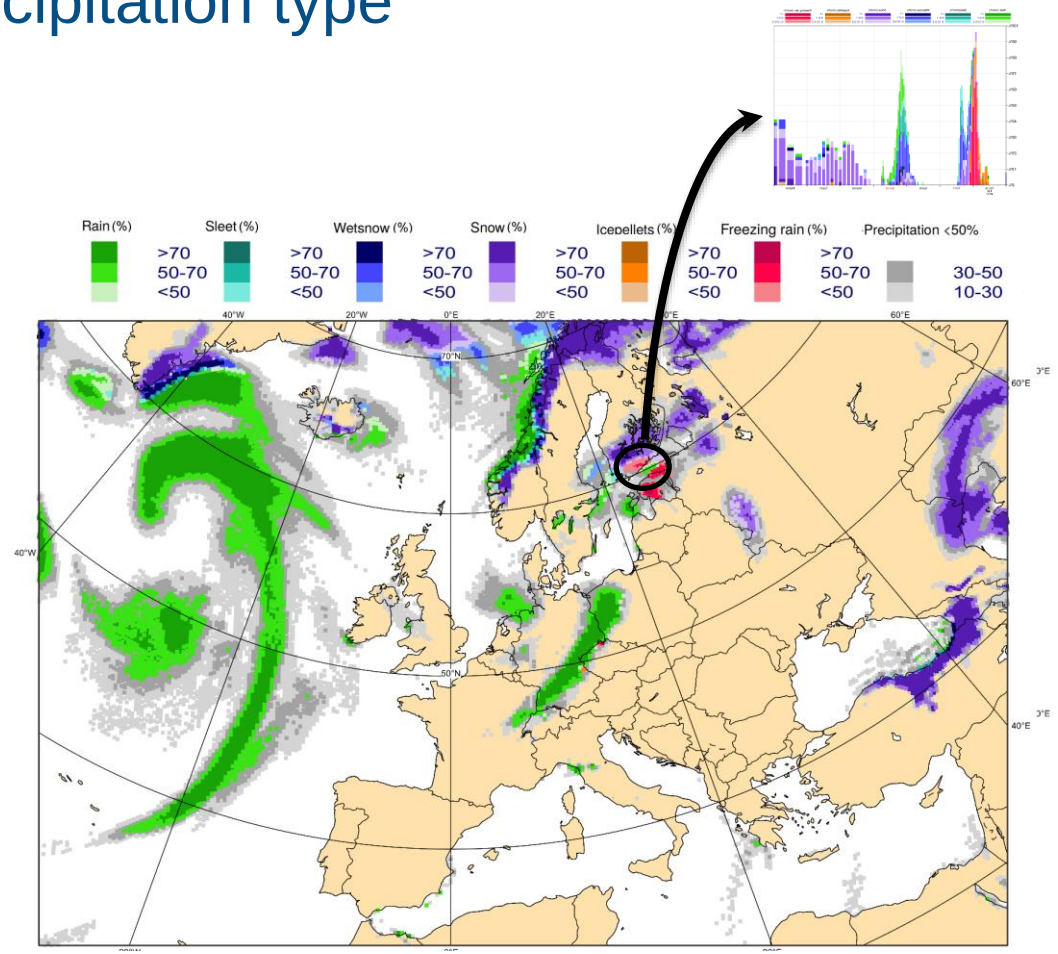




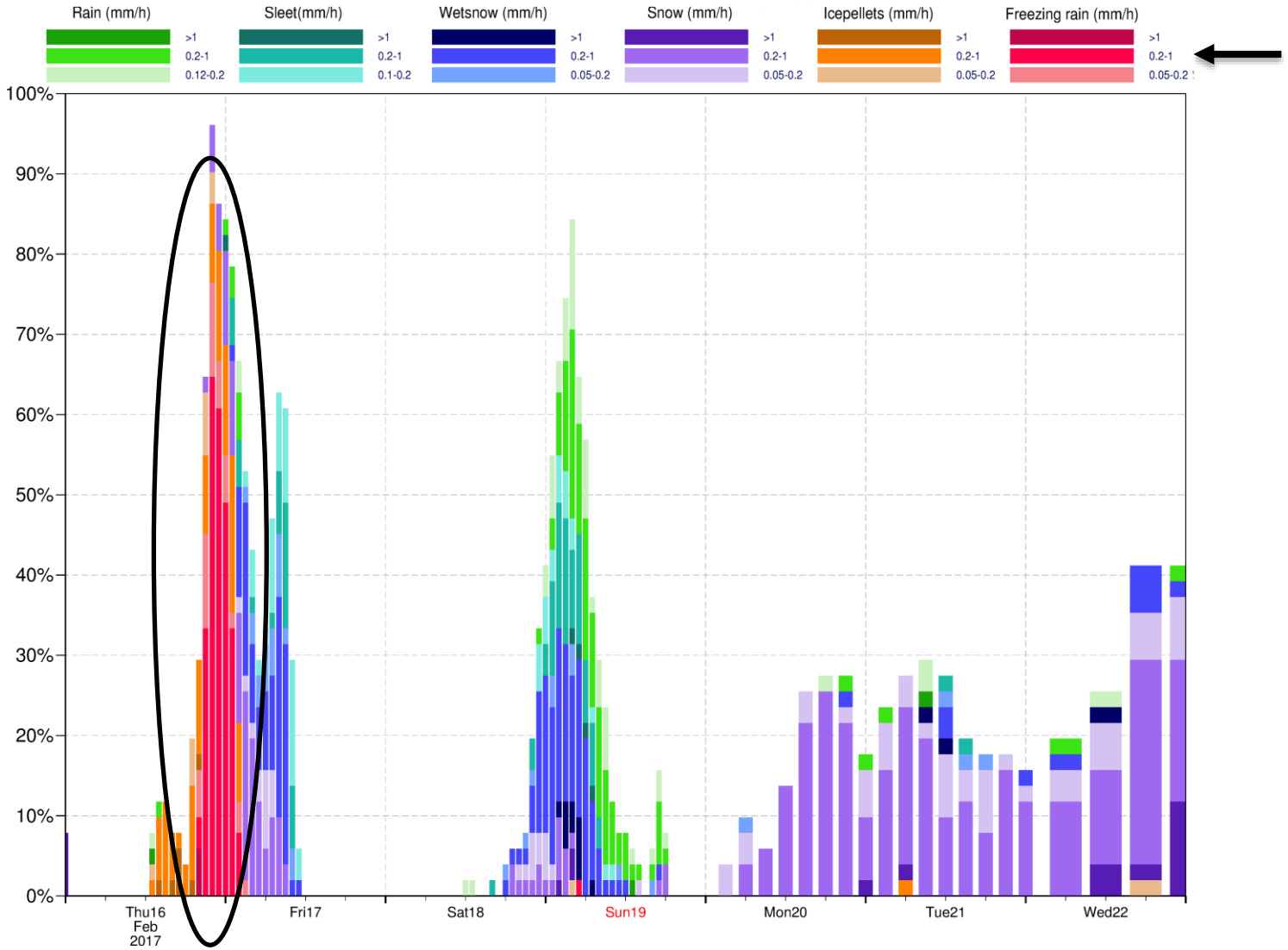
MOST PROBABLE PRECIPITATION TYPE

Most probable precipitation type

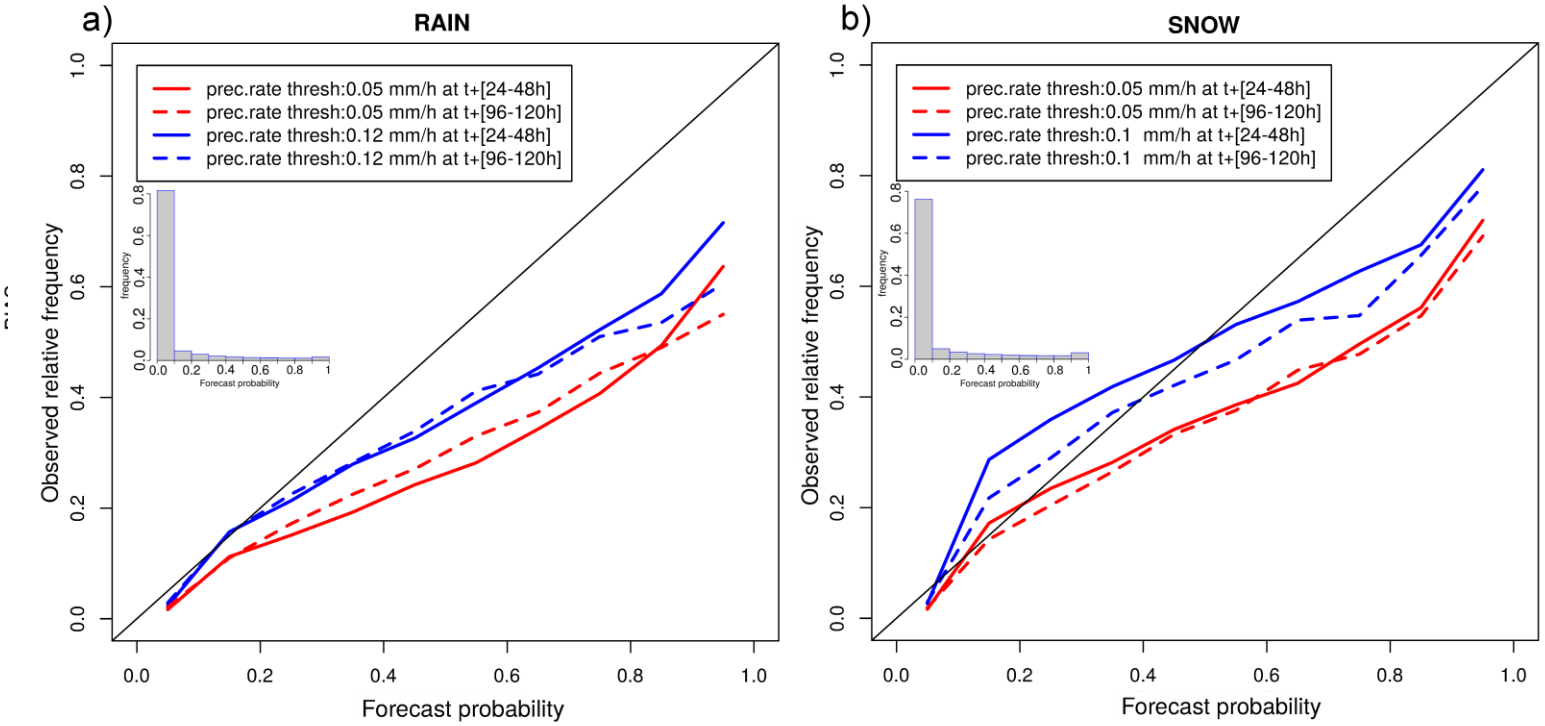
- What precipitation type is **most probable**, wherever the probability of some precipitation is **>50%.**
- Shading darkness (but not grey) is further used to denote the most probable precipitation type in three **probability ranges**: up to **50%**, **50-70%** and **>70%.**
- **Grey shading** denotes two more categories, for when the probability of any type of precipitation is **10-30%** or **30-50%**.



Probability of precipitation type



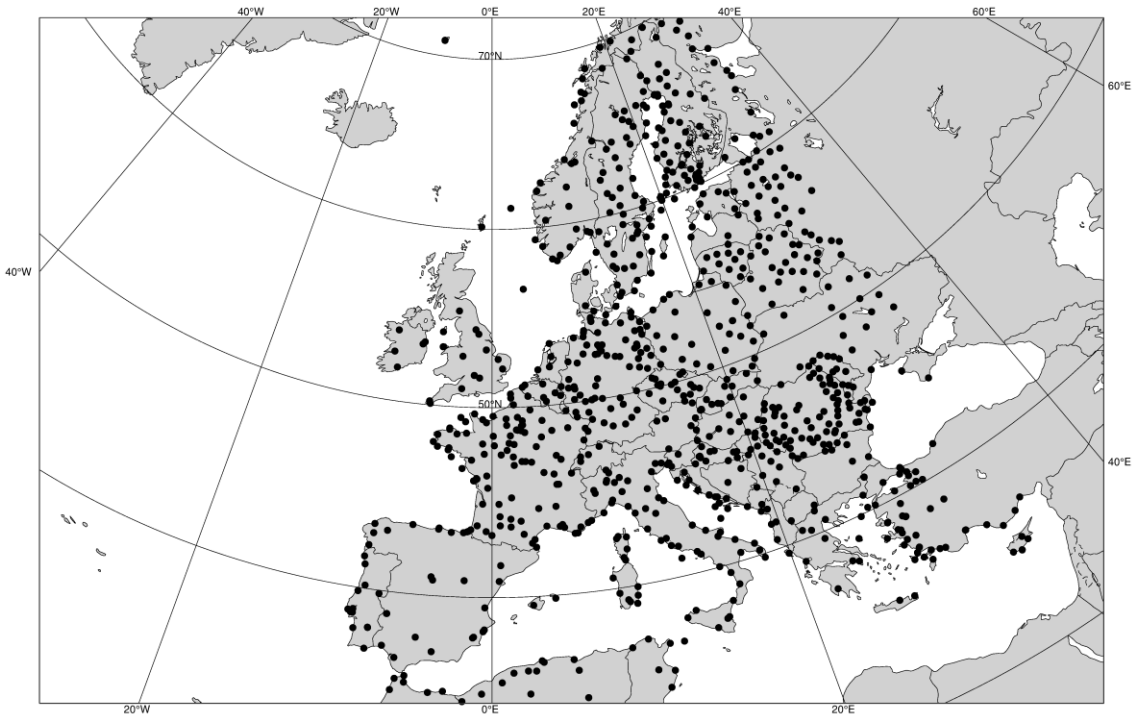
Reducing systematic bias with the precipitation rate



- To define **Rmin** for each ptype.
- Enforce **bias = 1** to make the total frequency of occurrence of each ptype, within forecasts, over all the observation sites, equal the observed frequency of those sites.
- ENS tends to be over-confident with high probabilities. For snow a net under-prediction bias manifests itself at low probabilities.

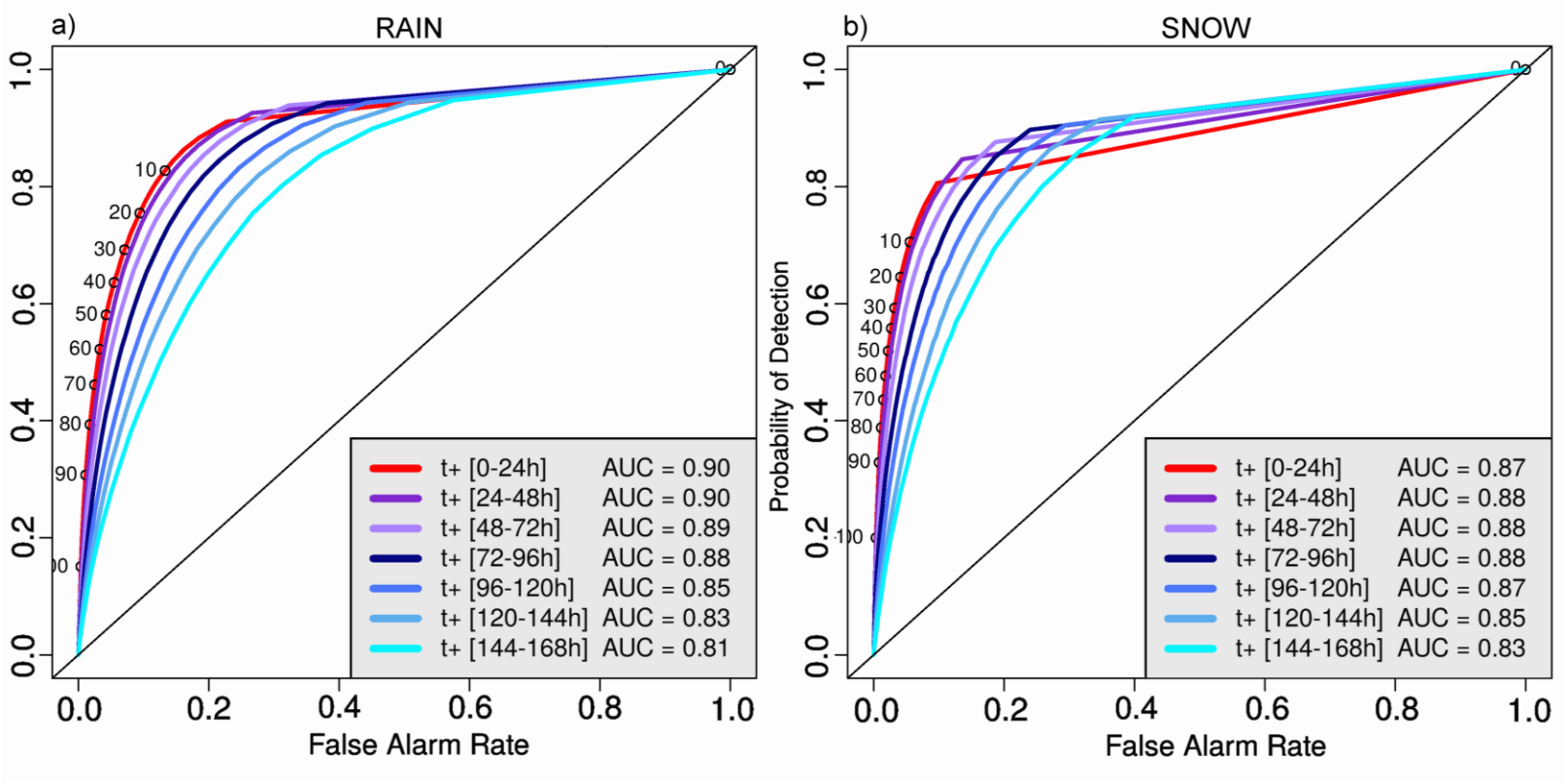
VERIFICATION

Manual SYNOP stations available

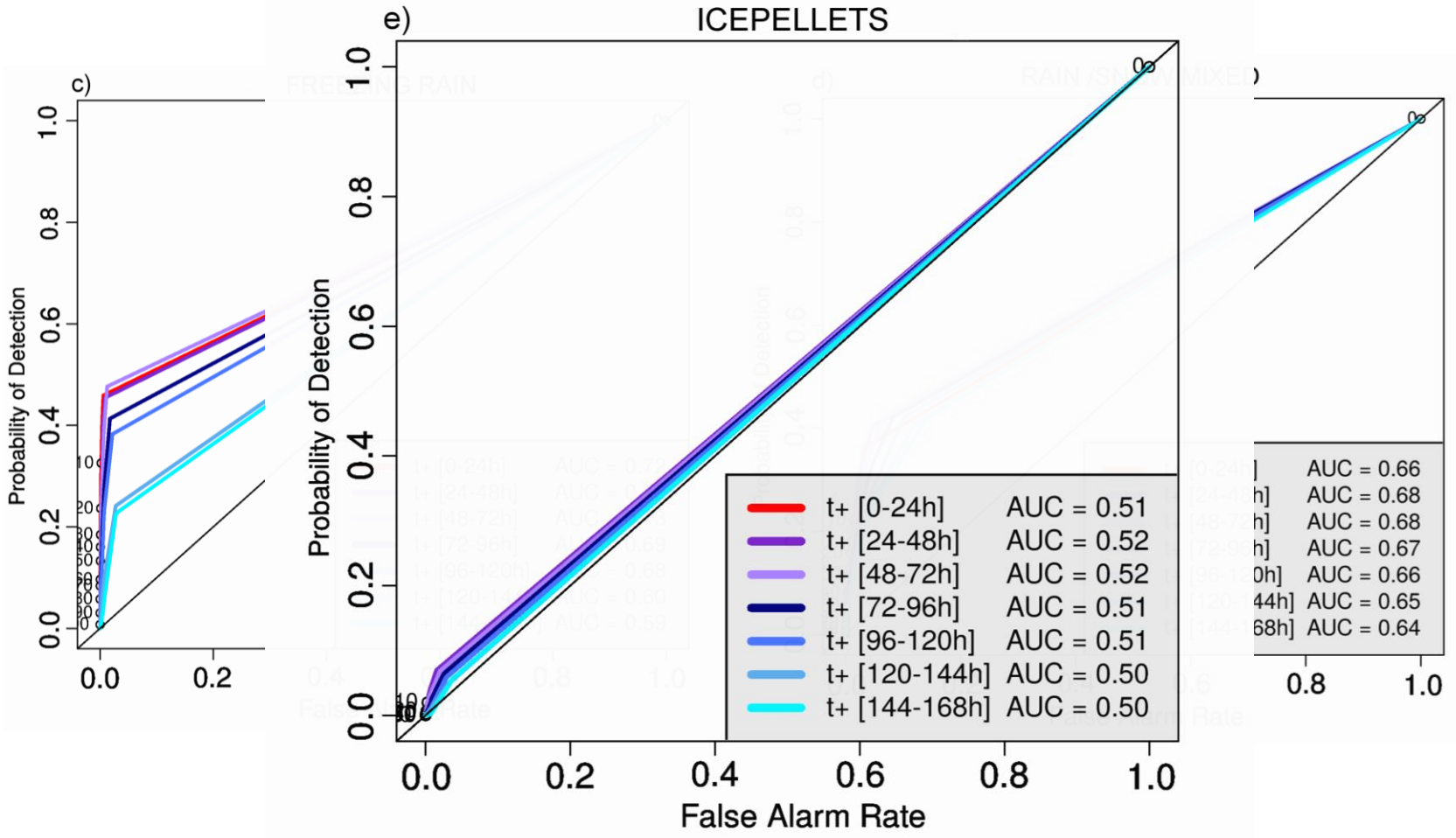


- The verification has been developed using **3-hourly** observations of present weather from manual **SYNOP** in **Europe** in 4 months winter period in 2016-2017.
- SYNOP stations with a 150 m altitude difference with the closest ENS point were removed from the verification.

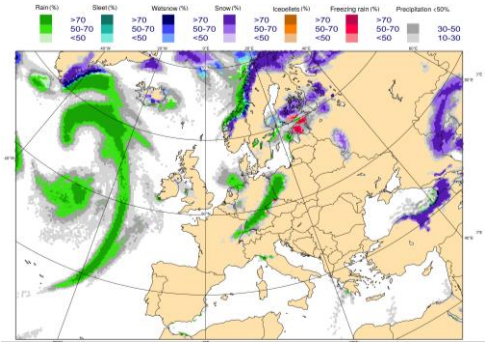
VERIFICATION: ROC curves of probabilities

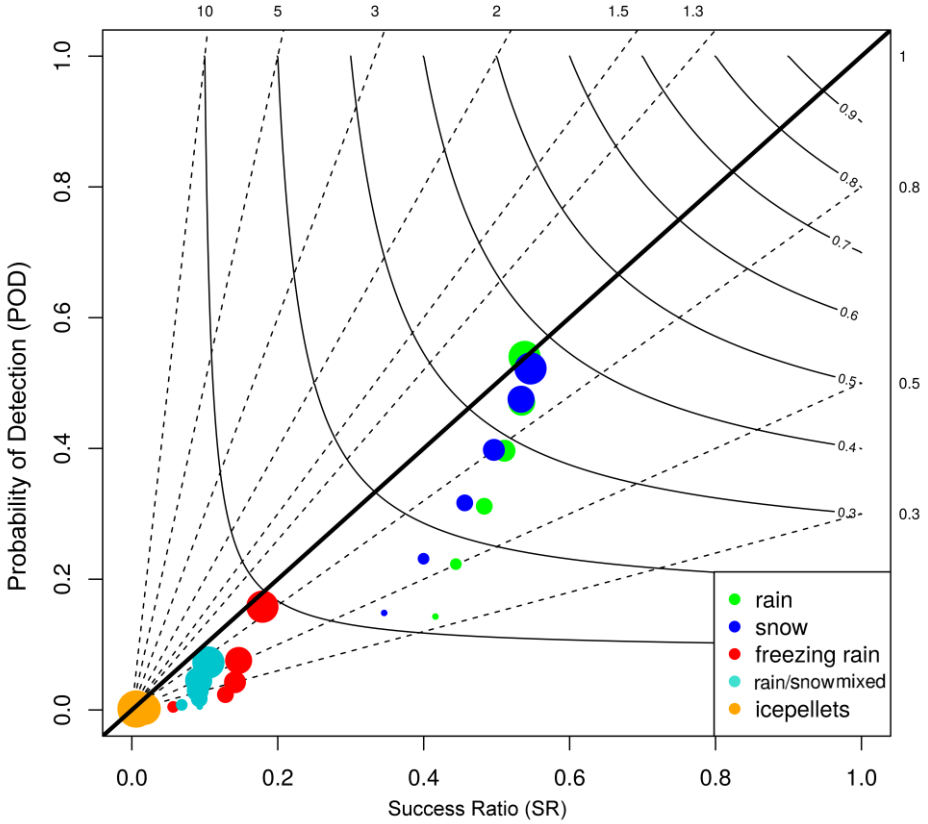


VERIFICATION: ROC curves of probabilities

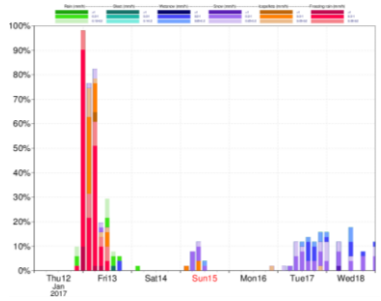


VERIFICATION: Most probable precipitation type

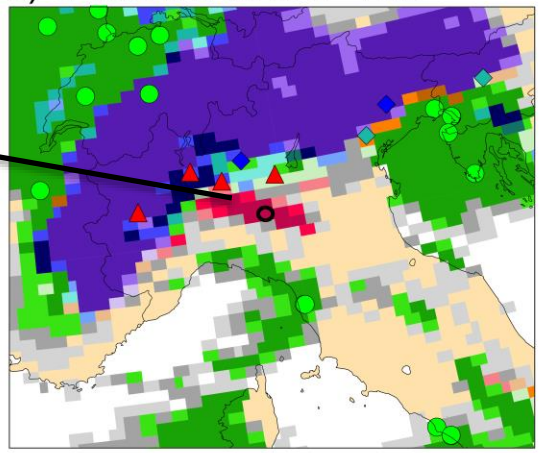




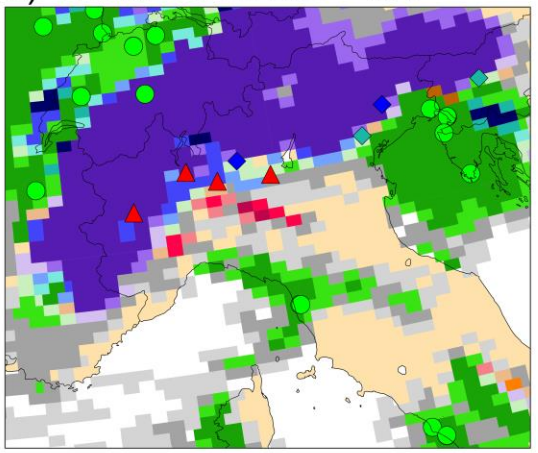
CASE STUDY: freezing rain in Italy



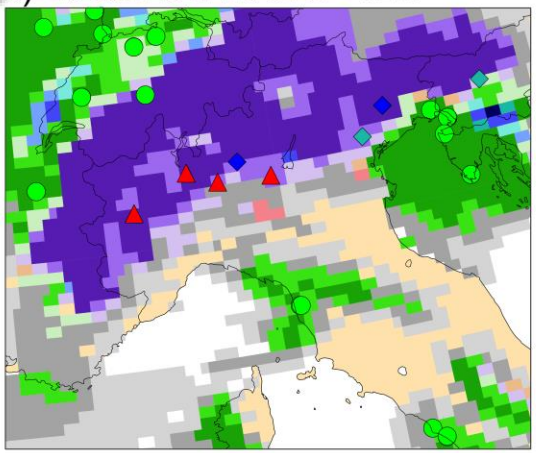
a) 12 Jan 2017 00 UTC + 24 h



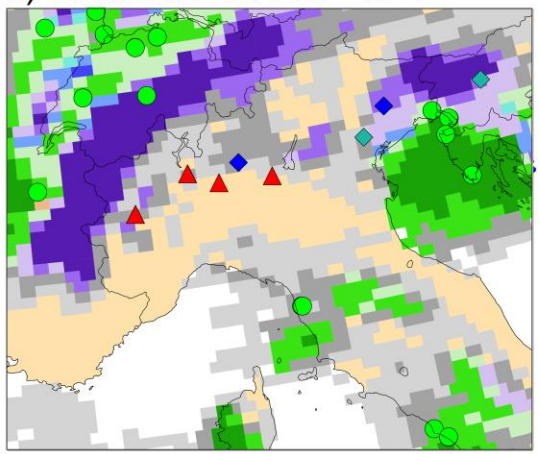
b) 11 Jan 2017 00 UTC + 48 h

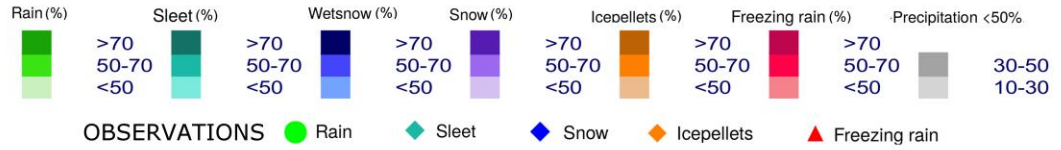


c) 10 Jan 2017 00 UTC + 72 h

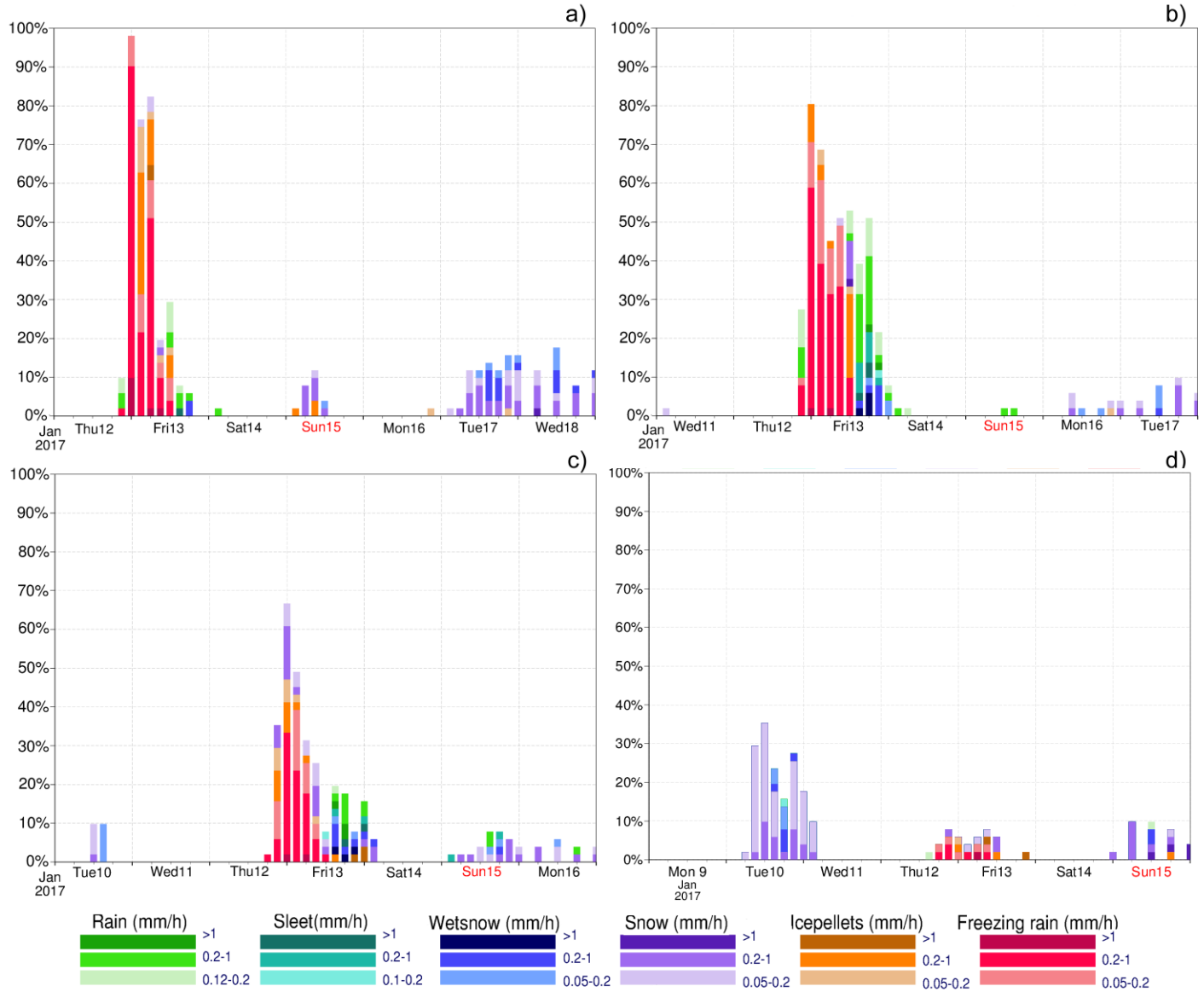


d) 09 Jan 2017 00 UTC + 96 h





CASE STUDY: freezing rain in Italy



TIPS to use the products

- A new **colour palette** was added in **ecCharts** to the **HRES** precipitation type field to match the Most probable precipitation type palette.
- Take into account the **height of the ENS in your meteogram location** (in the title of precipitation type meteogram), because the observation height can be very different, specially in mountainous areas.
- In the **meteogram, the bars are stacked** in such a way that the nominally **most hazardous** type (freezing rain in the high intensity category) is shown at **the bottom**, and the least hazardous (low intensity rain) at the top.
- Whenever the **lightest shade**, of a given colour (except grey) appears on **the map**, the user immediately knows that more than one precipitation type has been predicted at that time, which can serve as **an initial alarm bell for "uncertainty"**

CONCLUSIONS

- **Two new ECMWF** products have been performed, the probability of precipitation type and the most probable precipitation type. The second provides a first guess of the precipitation type while the first one analyse all the probabilities in a specific location and help to make better decisions about a particular event.
- Different **precipitation rates thresholds** have been applied to each precipitation type enforce bias=1.
- Both products are very skilful in forecasting **rain** and **snow** but it is only moderately skilful for **freezing rain** and **sleet** and unskilful for icepellets.
- The advantage of use **ENS forecast** is that it consistently produces a better spread of its (FAR, POD) pairs. This provides information for a wider range of FAR scores and thus may be useful for users with different levels of false alarm tolerance.

THAN YOU VERY MUCH

FOR YOUR ATTENTION!

estibaliz.gascon@ecmwf.int

For further reading:

- Gascón, E., T. Hewson, and T. Haiden, 2018: Improving Predictions of Precipitation Type at the Surface: Description and Verification of Two New Products from the ECMWF Ensemble. Wea. Forecasting, 33, 89–108

- ECMWF 2017-2018 winter Newsletter article: “New products for precipitation type probabilities”