Extreme Forecast Index Maps

These maps highlight areas where the EPS forecast is very different from the model average climate. This EPS climate has been derived from three years of constant resolution EPS (1997-1999), taking every month all D+5 and D+10 EPS daily forecast (including the control) and the analysis at resolution TL159. This results in samples populated by around 10,000 events for each calendar month. Every percentile of the resulting distribution (plus the extremes 1/1000th) has been archived for parameters T_{2m}, ff_{10m}, and precipitation accumulated over 24h, 120h and 240h respectively.

The Extreme Forecast Index is a measure of the distance between the full EPS probability distribution and the EPS climate distribution. It has been designed as an extension of the Continuous Ranked Probability Score (CRPS, e.g http://w3user:9999/~mom/memos/EPS_scores.ps.gz). In mathematical words:

$$CRPS = \int_{-\infty}^{+\infty} [\, p_{EPS}(x < \alpha) - p_{C\lim}(x < \alpha)]^2 \, d\alpha \qquad \textbf{(Equation 1)}$$

where α is the forecast parameter, p_{EPSs} and p_{clim} the probability distributions from the EPS forecast and the climate respectively. (Fig)
As defined in (Equation 1, the CRPS scales like the parameter α. It can easily be rescaled as a non-dimensional index by using a forecast-climate probability diagram where the x-axis is the climate distribution and the y-axis is the EPS forecast (Fig)

$$CRPS_2 = \int_{0}^{1} [\, p_{EPS}(x < \alpha(p)) - p]^2 \, dp \qquad \textbf{(Equation 2)}$$

For a deterministic forecast, , p_{EPS}=0 below the forecast value, 1 above. It can be shown easily that if this forecast value is exactly the median of the climate (p=0.5), then CRPS2=1/12; if the forecast value is a breaking-record value (p=0 or p=1), then CRPS2=1/3. Therefore we will introduce the Extreme Forecast Index as 3 times the CRPS2 as defined in (Equation 2: it will vary between 0 to 100%. 0 is for a forecast that reproduces the EPS climate distribution exactly, 100% is for a purely deterministic forecast where all EPS members forecast breaking-record values (in practice, values occurring in less than 0.1% of the monthly EPS climate fields). The interest is usually for fields *exceeding* rather than lying below the climate values (strong winds, large amounts of precipitation). Therefore the Extreme Forecast Index is shaded on the maps only when it is large (in excess of 50%) and when the EPS Forecast Probability Function is right-sided compared to the climate. This is based on a positive value of the following quantity:

$$CRPB = \int_{0}^{1} [\, p_{EPS}(x < \alpha(p)) - p] \, dp \qquad \textbf{(Equation 3)}$$

which again is an index lying between –0.5 and +0.5 telling of the bias of the forecast distribution with respect to the climate. For T2m, both extremely warm and cold events are highlighted with a different shading convention. However because the 3 years climate is oviously limited to sample the SST climate (these are prescribed in the forecast), a land-sea mask has been applied to only highlight extreme events over land.

Finally, care should be taken when interpreting the results that the information is mainly with respect to the past 3 years of running the EPS. Preliminary results have shown that some isolated points over the coast line are often highlighted that are probably associated to recent changes of the land-sea mask. Also recent model changes are likely to affect the model climate: (new fractional precipitation scheme, new postprocessing of 10m-wind).

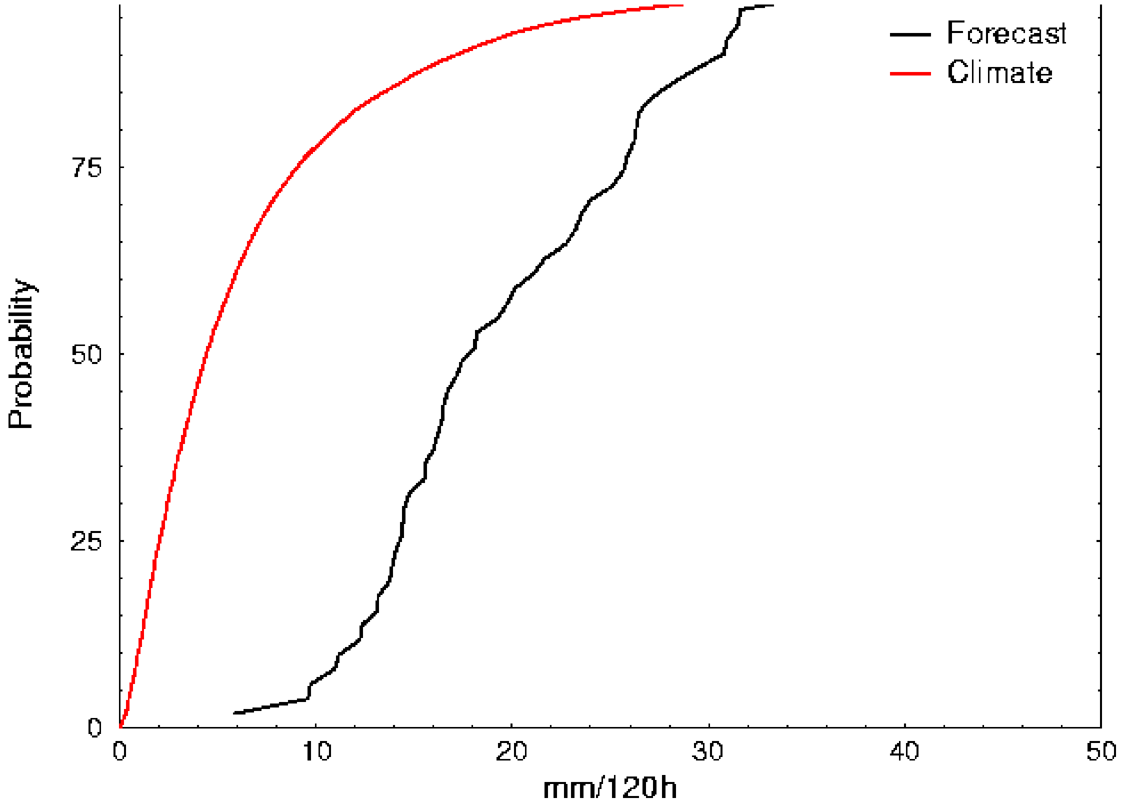

Figure 1: Forecast and Climate probability distributions (Base 15/2/2000, precipitation accumulated between 48 and 168h steps)

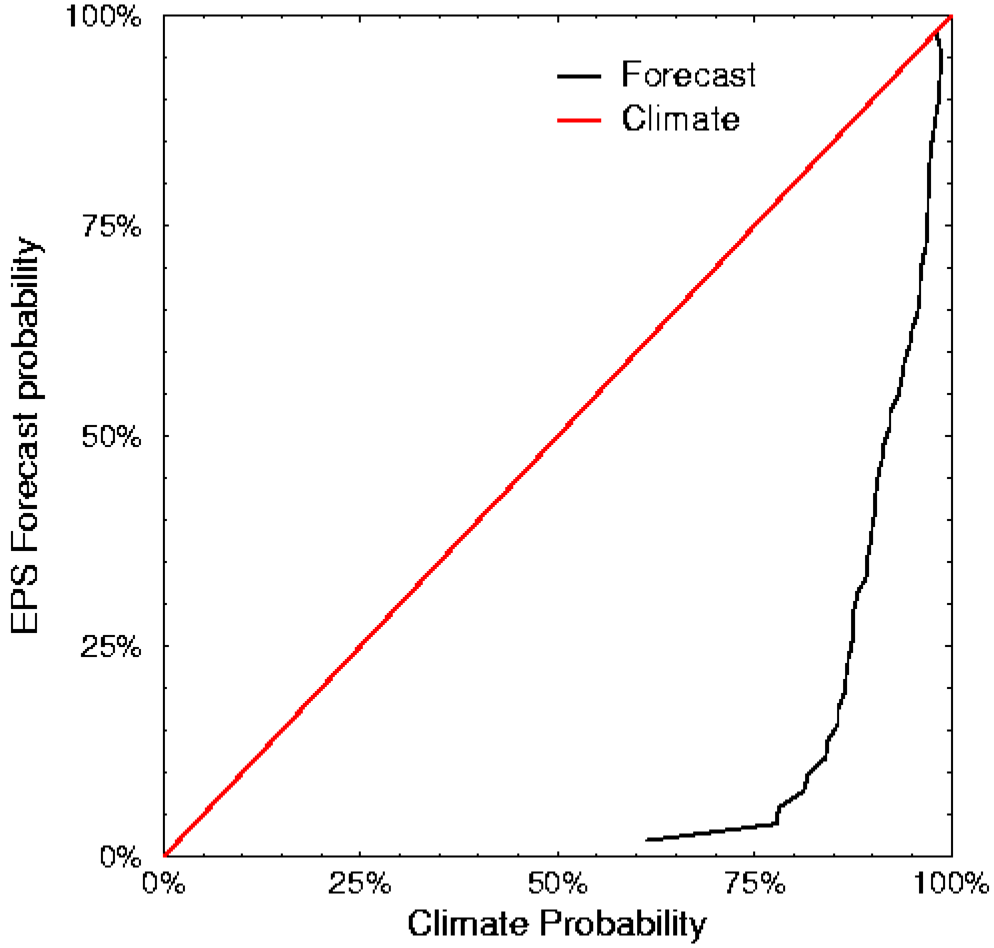

Figure 2: Forecast vs Climate Probability diagram (same data as in Figure 1). Corresponding EFI is 71.9% (CRPB is +0.402)