Operational Implementation of Ensemble-Based « dynamical » Uncertainty Circles around Tropical Cyclone Track Forecasts

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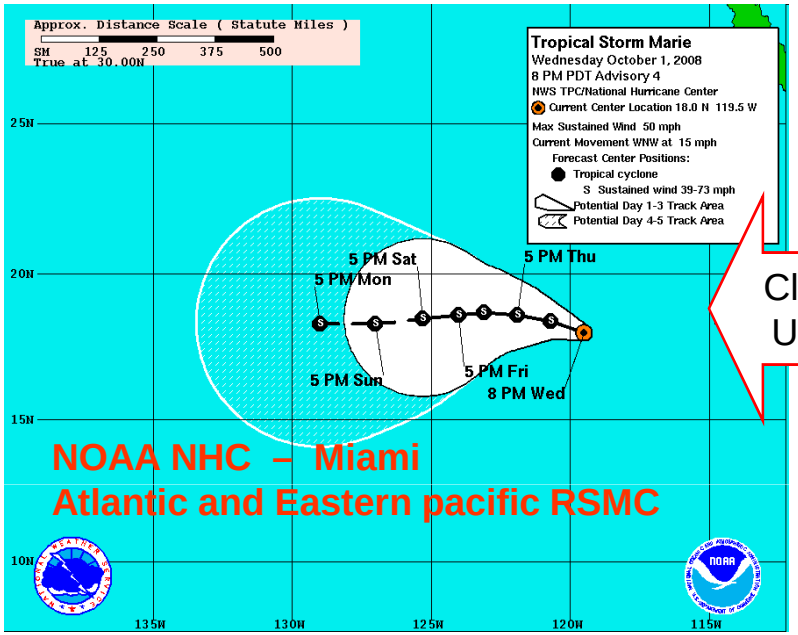
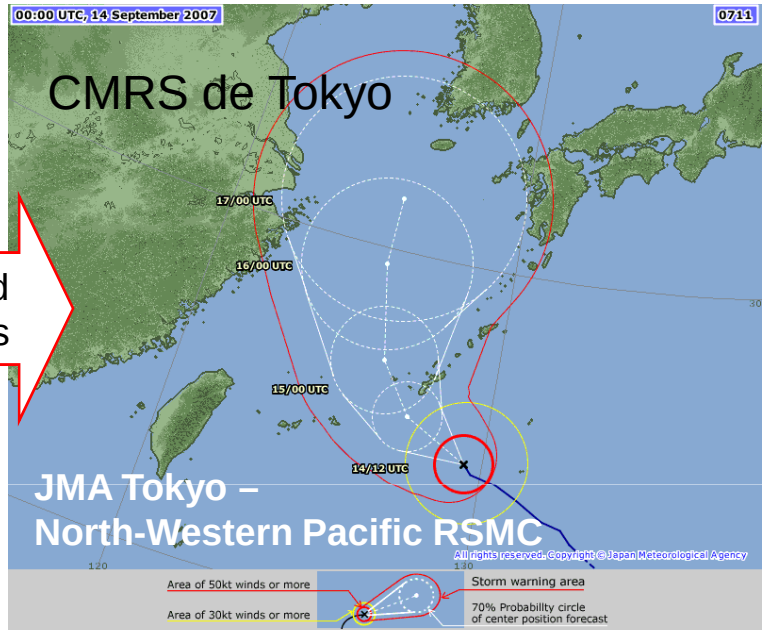
Outlines

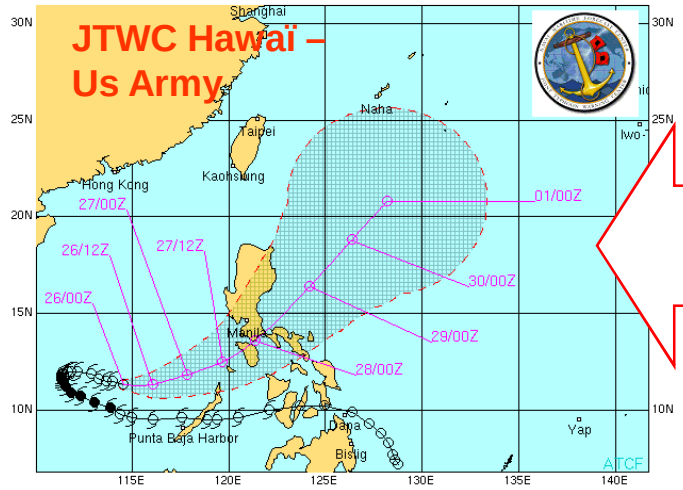
- Several uncertainty cones around official track forecast in the world.
- Why and how computing ensemble-based uncertainty cone ?
- Is an ensemble-based uncertainty cone able to describe the RSMC forecast error (probabilistic verifications) ?
- Operational Issues.

Uncertainty Cones



Climatology-Based Uncertainty Cones





Hybrid Uncertainty Cone (Climatology + Forecast Winds extension)

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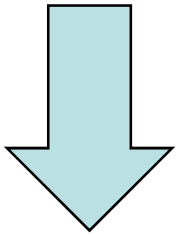
Ensemble based uncertainty cones

Motivation

- The uncertainty from ensemble prediction could help to produce a case-dependent cone. - Yamaguchi et al (2009)

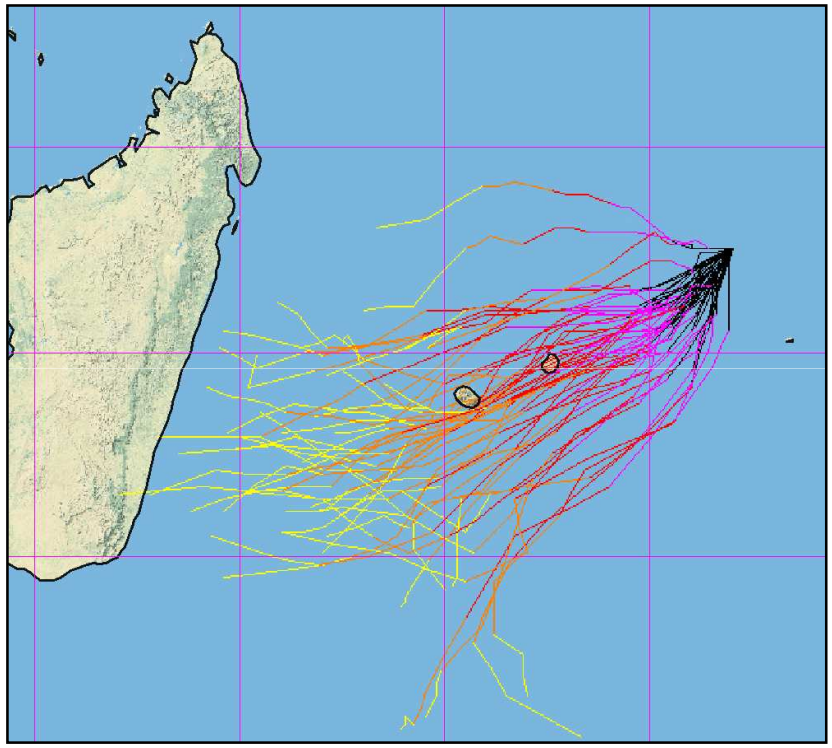
- Uncertainty cones are useful to convey an uncertainty information of the forecast error of the ensemble Mean - Majumbar and Finocchio (2010) .

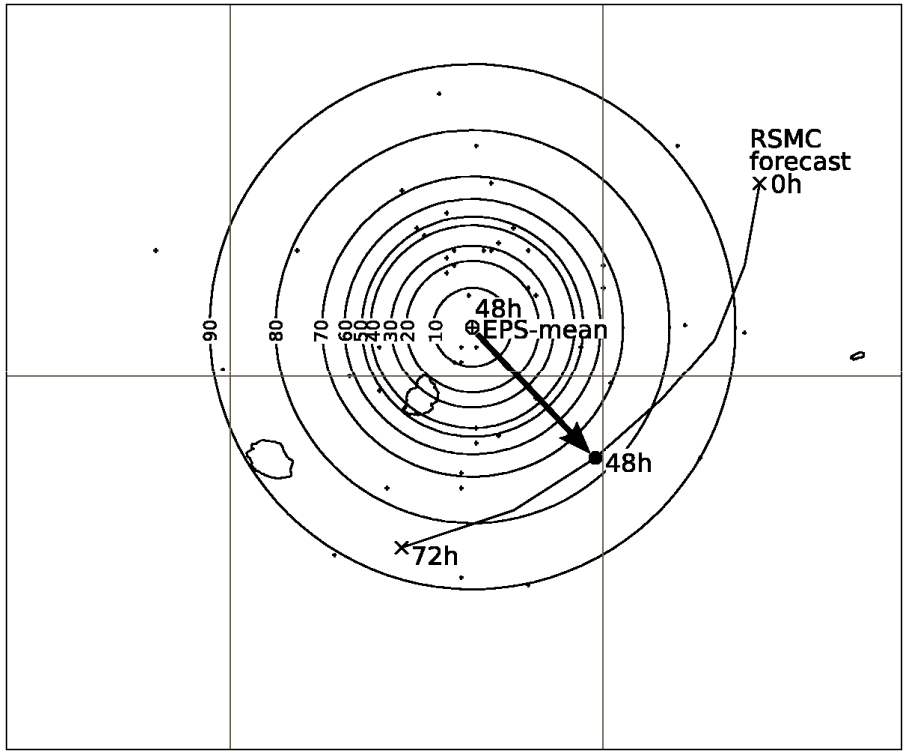


Do the ensemble-based uncertainty circles better describe the uncertainty of the RSMC Forecast (instead of ensemble mean) than climatological circles ?

Ensemble-based probabilistic forecast of Tropical Cyclone positions

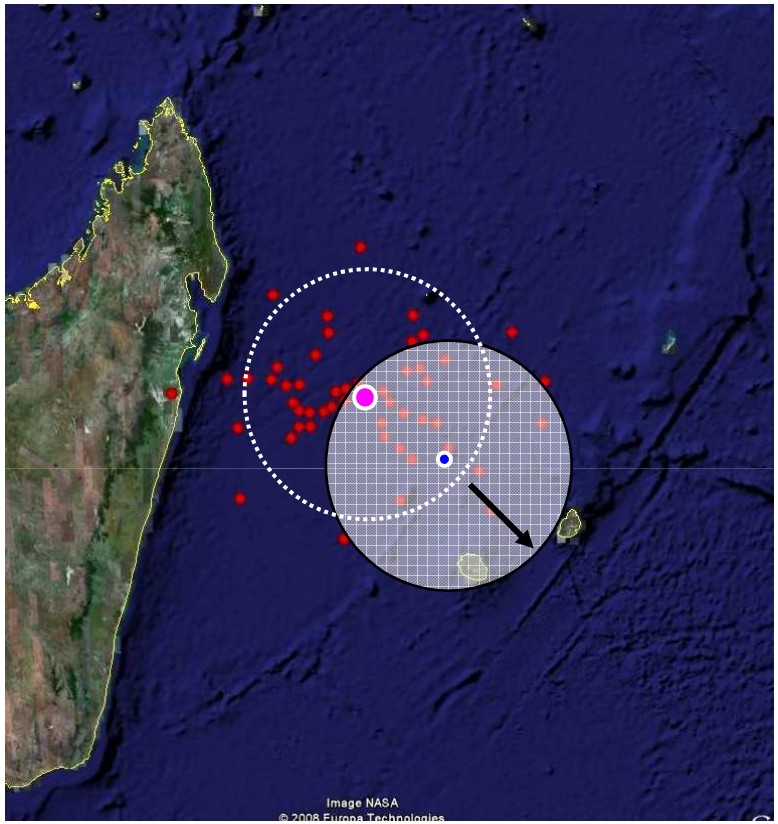
Method of construction:





The circle of probability x% is centred on the ensemble mean and contains x% of the members. Then it is translated to the RSMC forecast position.

Exemple : Constrution of a 75% uncertainty circle for 48h lead time



Ensemble members in red
Ensemble mean in pink
RSMC forecast position in blue

Forecast probability is 75 %
→ Circle centred on ensemble mean position build than 75 % (38/51) of the members are inside.

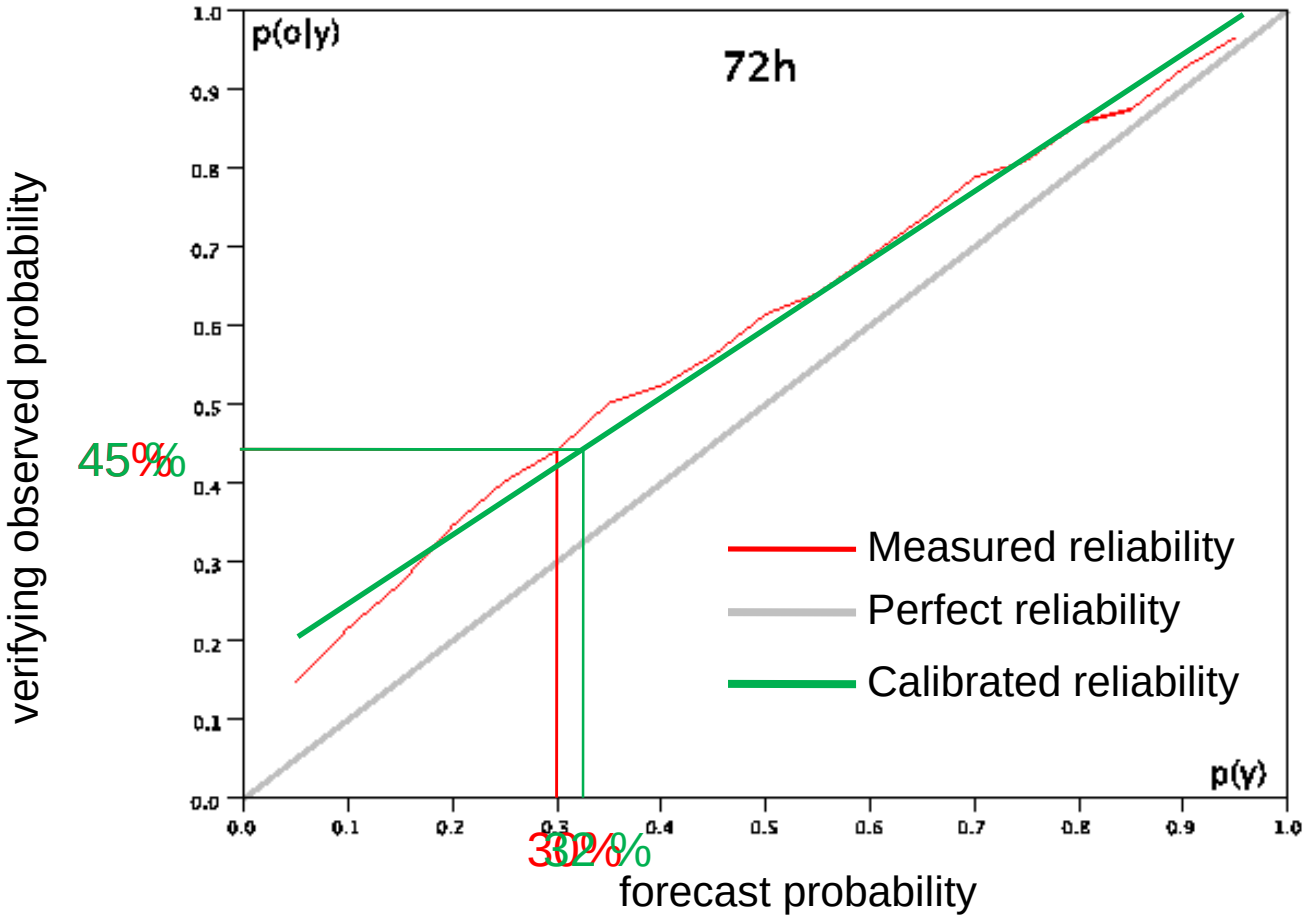
Then the circle is tranlated on the RSMC forecast position at the same lead time

Probabilistic forecast of TC positions

- Data sample : 2 recent cyclone seasons 2007/2008 & 2008/2009
  - 225 RSMC forecast tracks until 72-h lead time.
  - Forecasted TC positions by the EPS members from ECMWF.
  - Observed TC positions are from the official RSMC BestTrack.

Probabilistic forecast of TC positions

- Reliability and calibration



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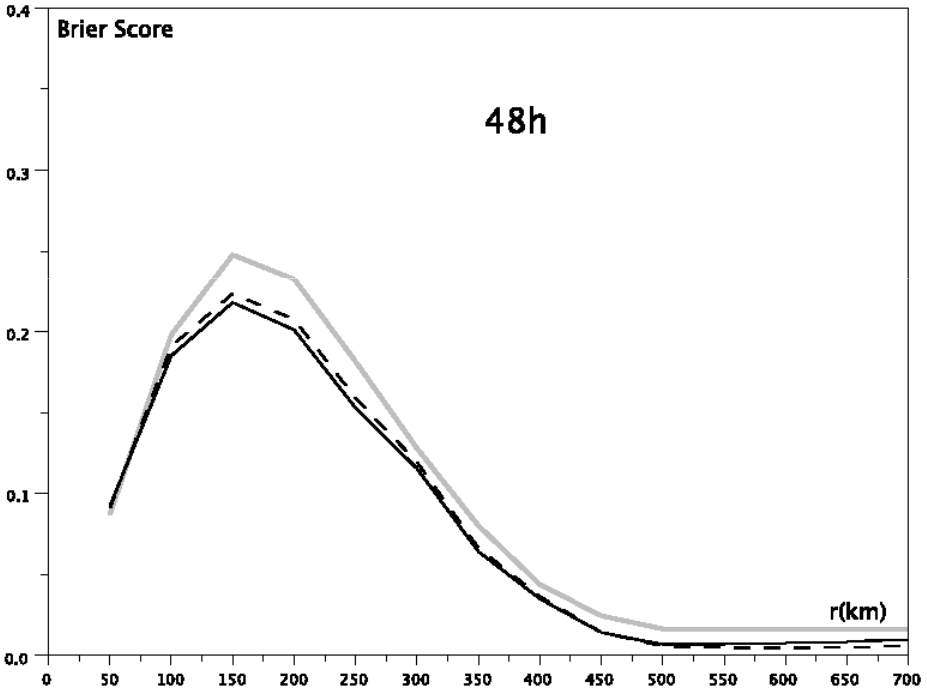
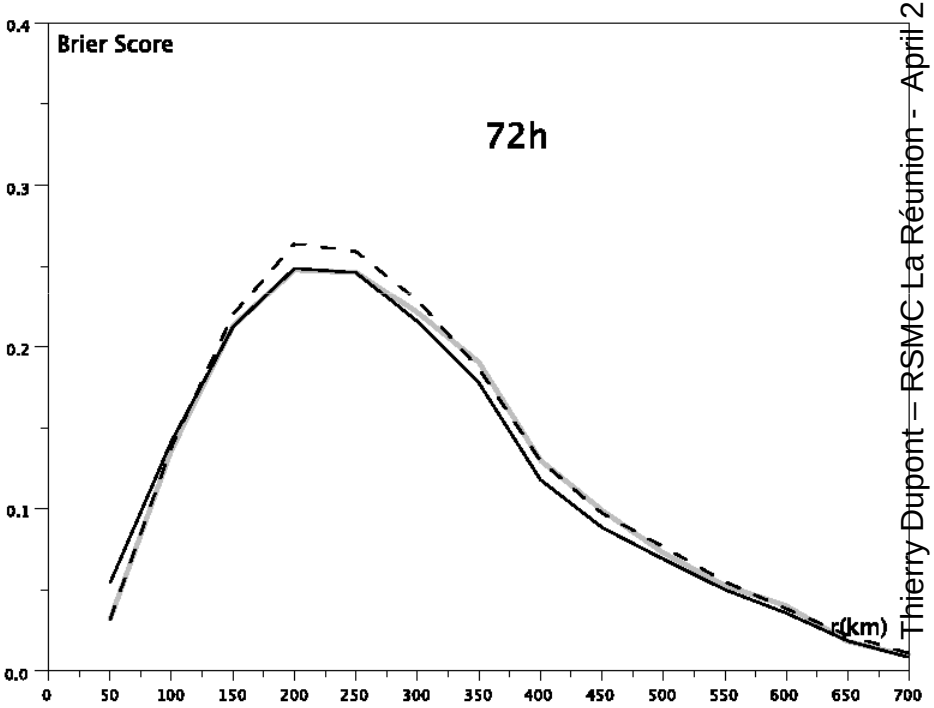
Probabilistic forecast of TC positions

Verification : Probabilistic scores, to be compared with the climatology





Climatological error

Circle without calibration

Calibrated circle

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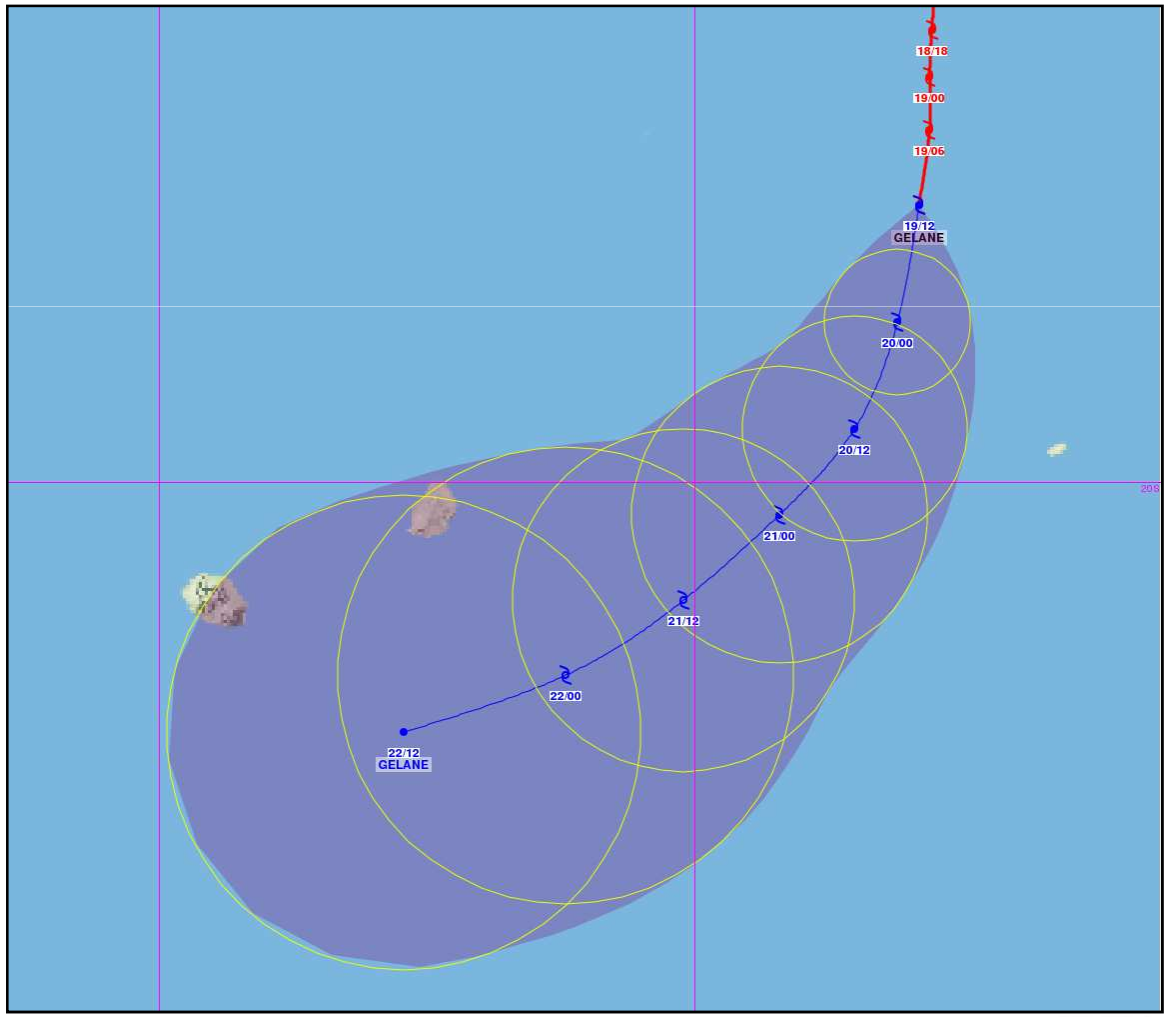
Construction of the cone

- Circles obtained for the calibrated probability 75%

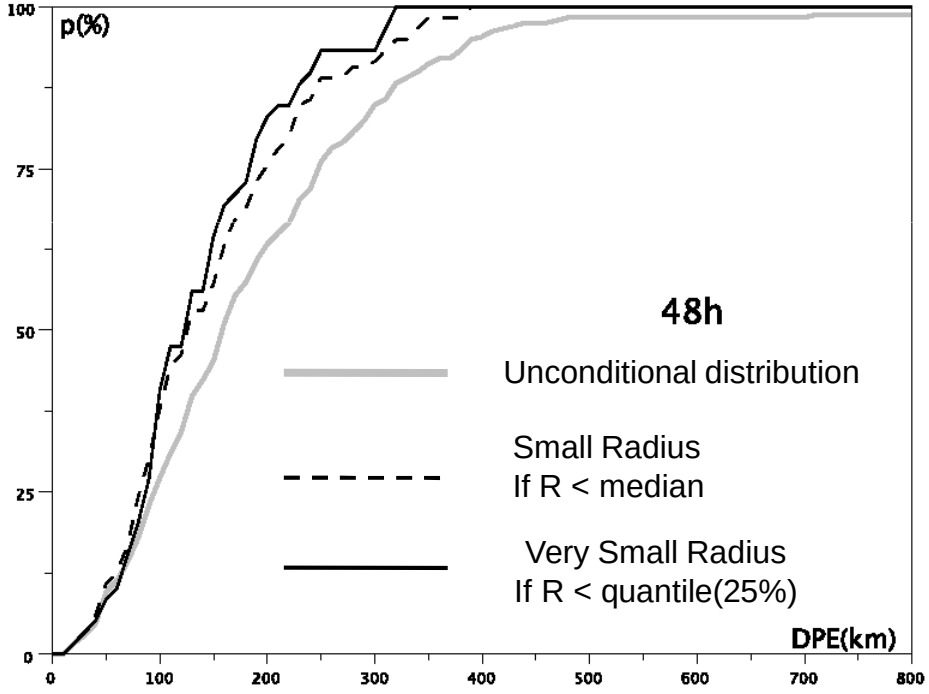


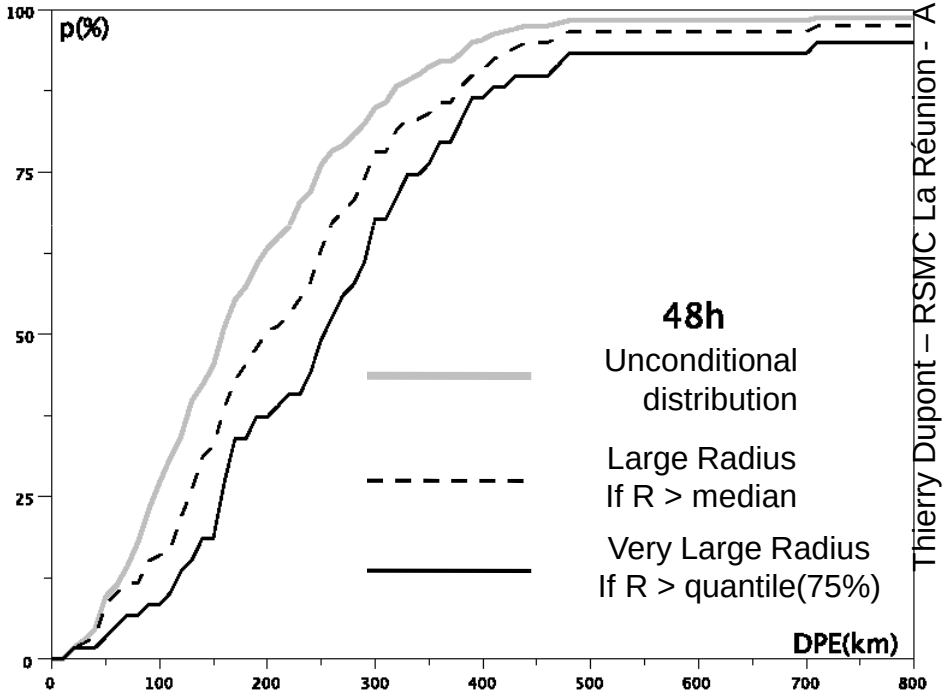
does the size of the cone indicate the amplitude of error?

Verification of the capacity of the cone to detect small and large RSMC forecast errors

Conditional distributions

- The distribution of position error depends on whether the radius R of the uncertainty circle is small or large:





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Verification of the capacity of the cone to detect small and large RSMC forecast errors

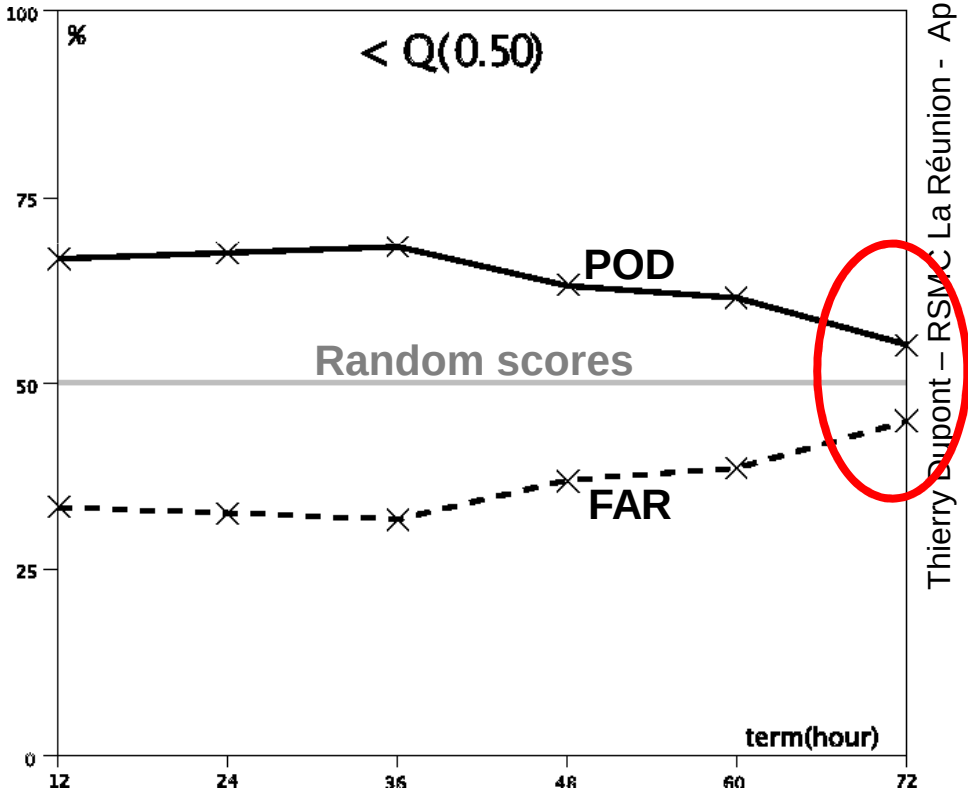
Capacity to discriminate between small and large errors:

- Error < median :

36h	Predicted radius < Q(0.5)	Predicted radius ≥ Q(0.5)
Error < Q(0.5)	34%	16%
Error ≥ Q(0.5)	16%	34%

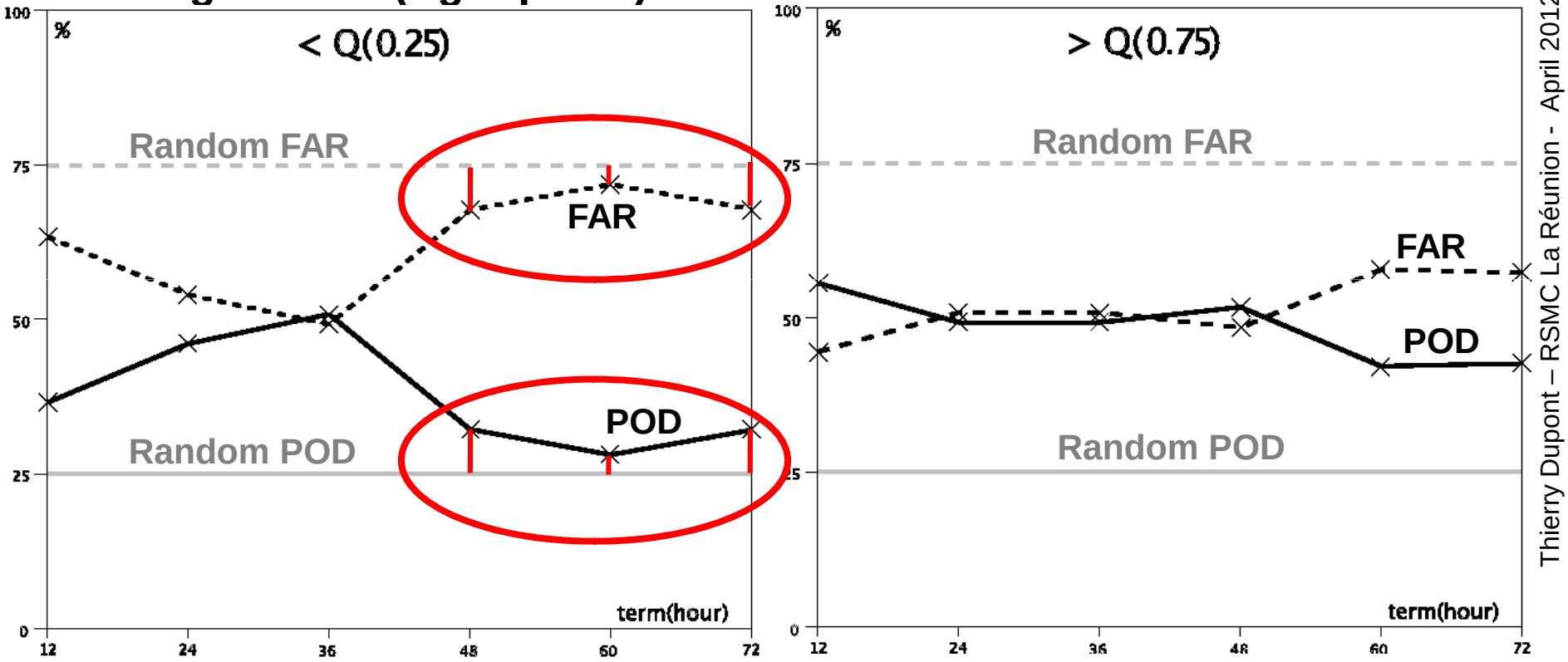
POD : probability of detection [erreur < Q(0.5)]

FAR : false-alarm rate [erreur < Q(0.5)]



Verification of the capacity of the cone to detect small and large RSMC forecast error

Capacity to discriminate between very small (left panel) and very large errors (right panel):



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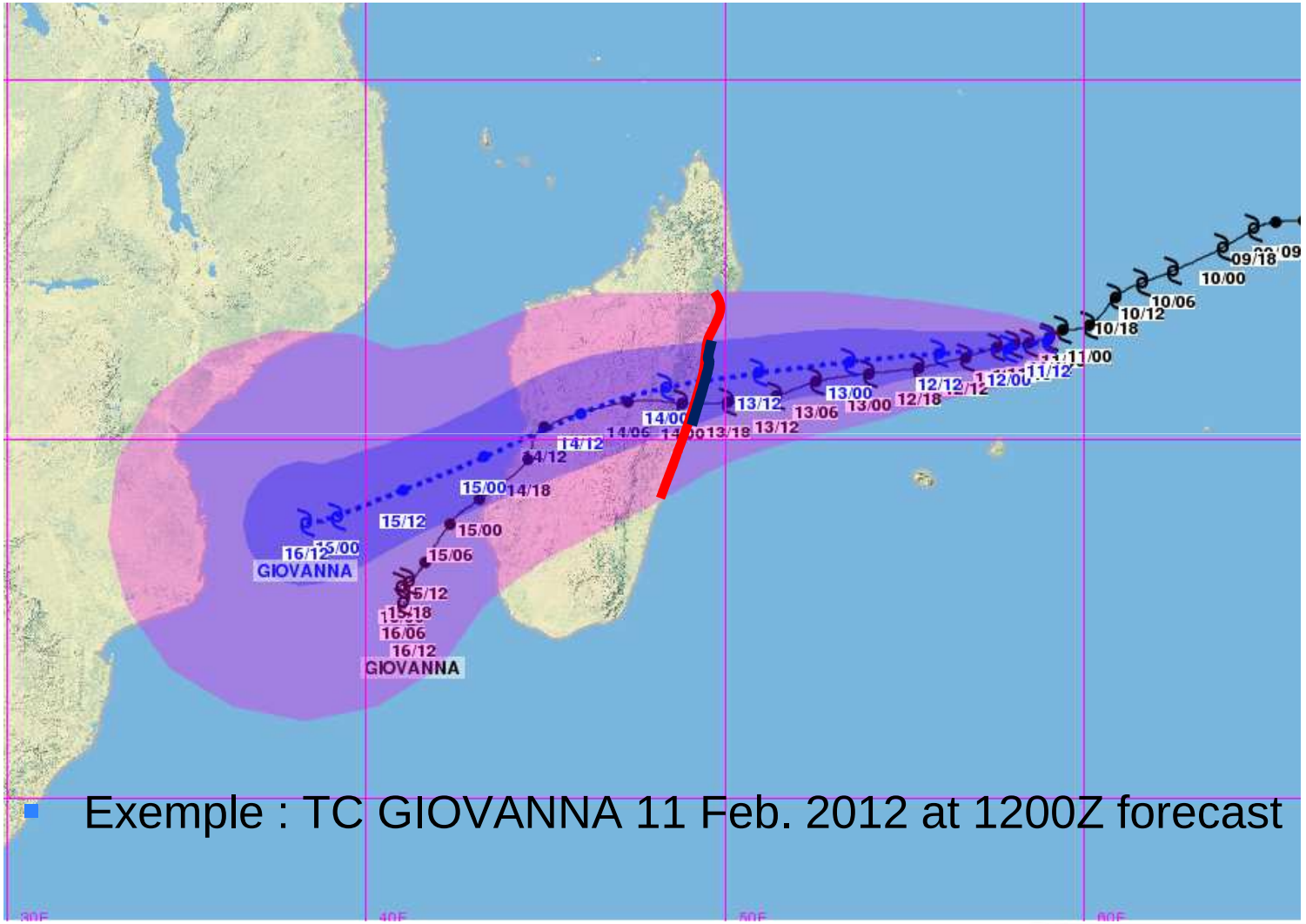
Operationnal Issues (1)

- Operational implementation since the beginning of the current 2011/2012 cyclone season.
- New calibration to take into account the delay in operationnal availability of EPS forecasts (12h at 00TU and 12TU, 18h at 06TU and 18TU)
- Extension of the uncertainty cones until 5-days lead time.
- Final expertise depends on the duty TC Forecaster

Operationnal Issues (2)

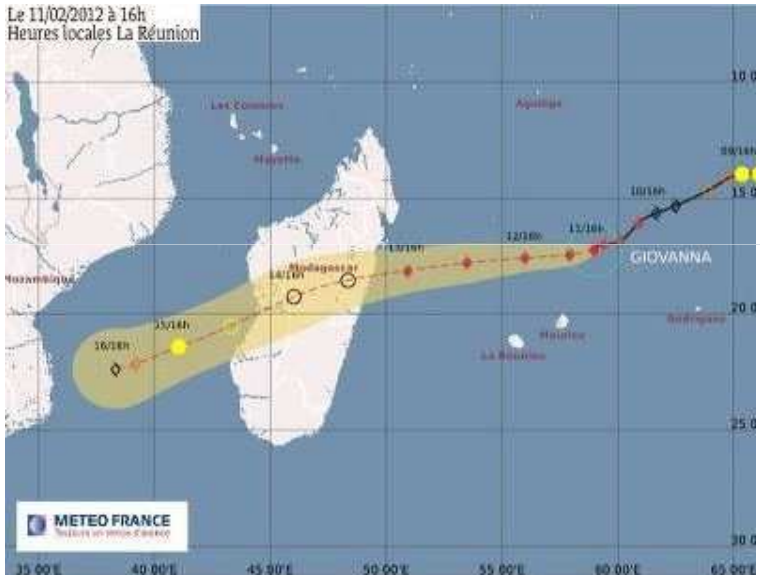


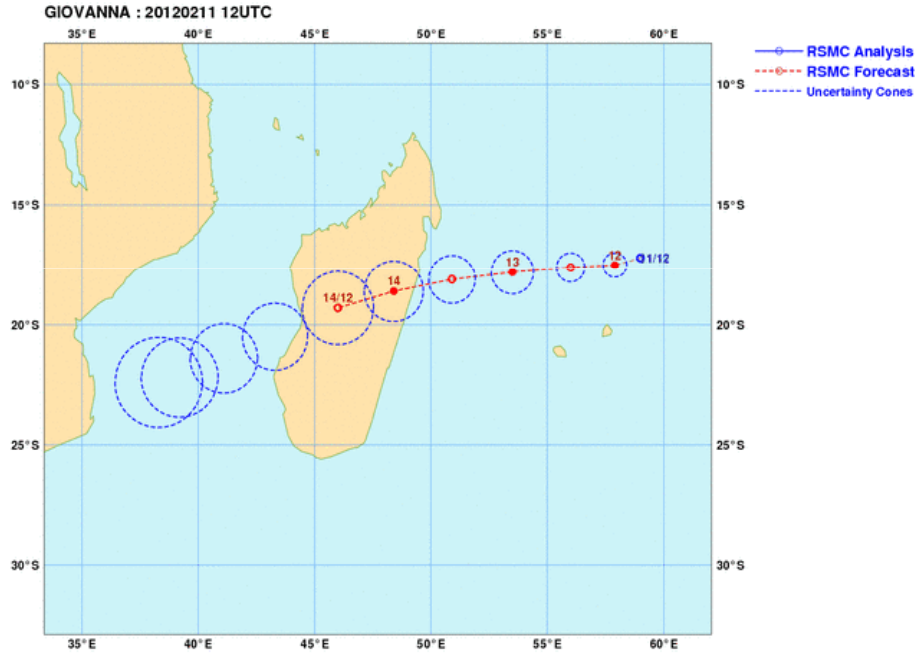
- Exemple : TC GIOVANNA 11 Feb. 2012 at 1200Z forecast

Thierry Dupont – RSMC La Réunion - April 2012

Operationnal Issues (3)

- Final Graphical Products for TC GIOVANNA 11 Feb. 2012 at 1200Z forecast





Public Website of RSMC La réunion

Southern Africa SWFDP Website (Restricted Acces)

For further informations , please refer to
Dupont, T., M. Plu, P. Caroff, and G. Faure, 2011:
Verification of ensemble-based uncertainty circles
around tropical cyclone track forecasts.
Wea. Forecasting, 26, 664–676.

Merci de votre attention.
Thanks for your attention

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