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METEO FRANCE

Correction tool of an automated weather forecast database for severe events

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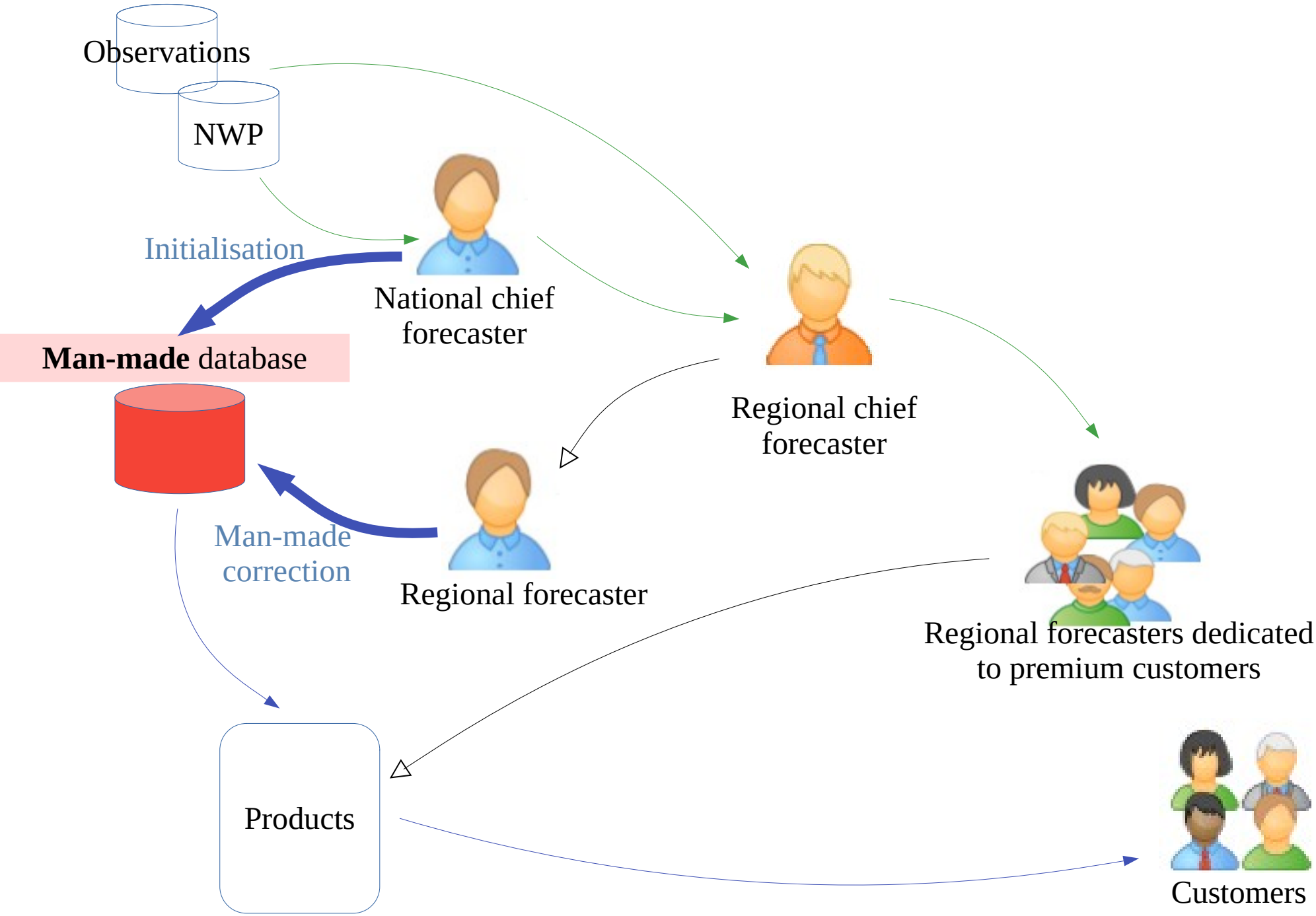
Introduction

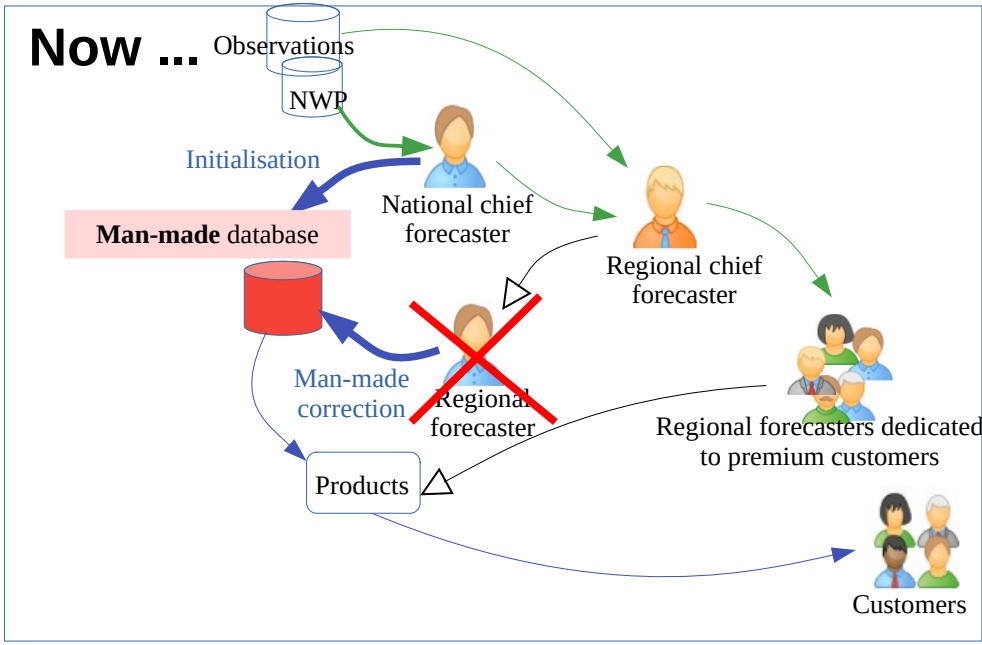
- **Météo-France has started developing an automated weather forecast database** because of :
  - the availability of huge and increasing amount of data
  - the decreasing man-power

- Towards automation. Is there still a room for human control on the forecast gridded fields ?

Now ...


Observations
NWP
Initialisation
National chief forecaster
Regional chief forecaster
Man-made database
Man-made correction
Regional forecaster
Regional forecasters dedicated to premium customers
Products
Customers

After 2023 ...



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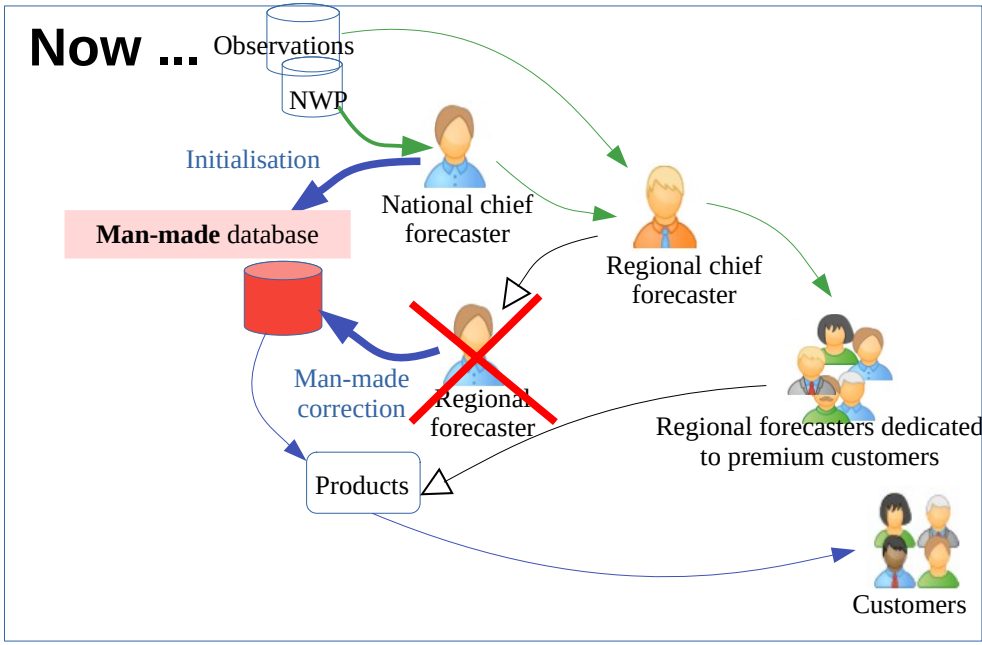

Observations

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Automated database

Correction tool

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AUTOMATED DATABASE

- It will serve the general public (website, commercial products) across the globe and over all lead times from day 0 to 14 (with priority for France for day 0 to 3).

- Outputs :
  - forecast probabilistic data
  - preferred values in deterministic form

4 runs (for day 0 and day 1 forecasts) :
- 0100 UTC
- 0700 UTC
- 1200 UTC
- 1900 UTC

AUTOMATED DATABASE

- **Combination of several numerical model outputs (example for run 07 UTC)**
  - **Deterministic models**
    - Global : ARPEGE (0.1°,3 runs), HRES (0.125°, 1 runs)
    - Limited area : AROME (0.01°, 3 runs), AROME-HRES (0.01°, 1 runs)
  - **Ensemble systems :**
    - Global : PEARP (0.1°, 35 mbs, 1 runs), ENS (0.25°, 50 mbs, 1 runs)
    - Limited area : PE-AROME (0.025°, 16 mbs, 2 runs)

Total : 126 model outputs

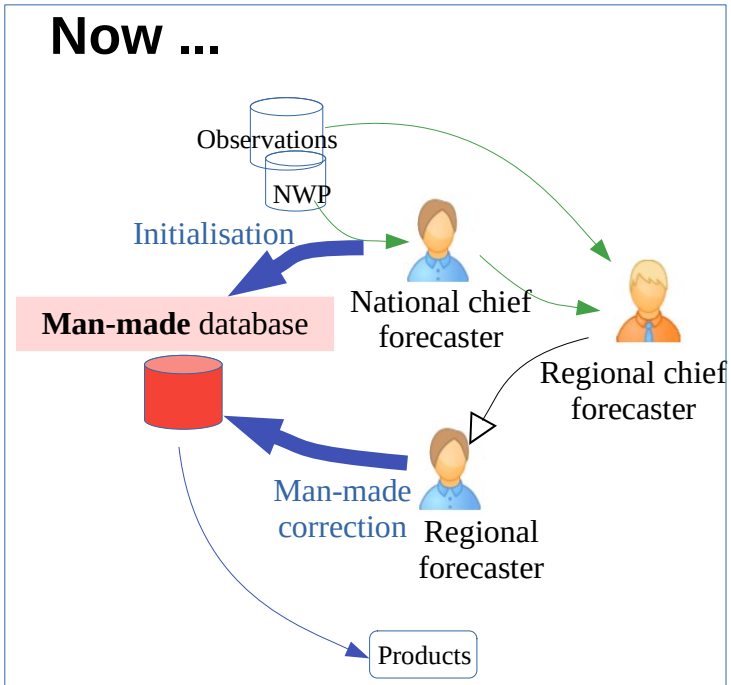
The different model outputs

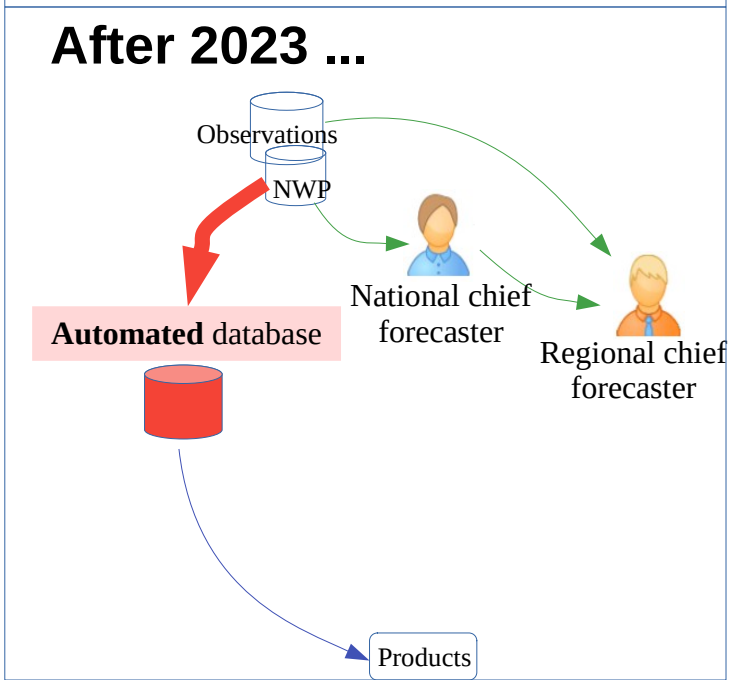
day-1	ARPEGE	at 12 UTC
day-1	ARPEGE	at 18 UTC
day 0	ARPEGE	court
day-1	HRES	at 12 UTC
day-1	AROME	at 06 UTC
day-1	AROME	at 12 UTC
day-1	AROME	at 18 UTC
day-1	AROME-HRES	at 12 UTC
day-1	PEARP	at 18 UTC
day-1	ENS	at 12 UTC
day-1	PE-AROME	at 15 UTC
day-1	PE-AROME	at 21 UTC

CORRECTION TOOL

- **Why do we need a correction tool ?**
  - To avoid unconsistencies with the expert scenario built by the forecasters when an extreme event is expected

- **For which weather parameters is it applied ?**
  - Wind gust
  - Rainfall
  - Snow accumulation
  - Thunderstorm





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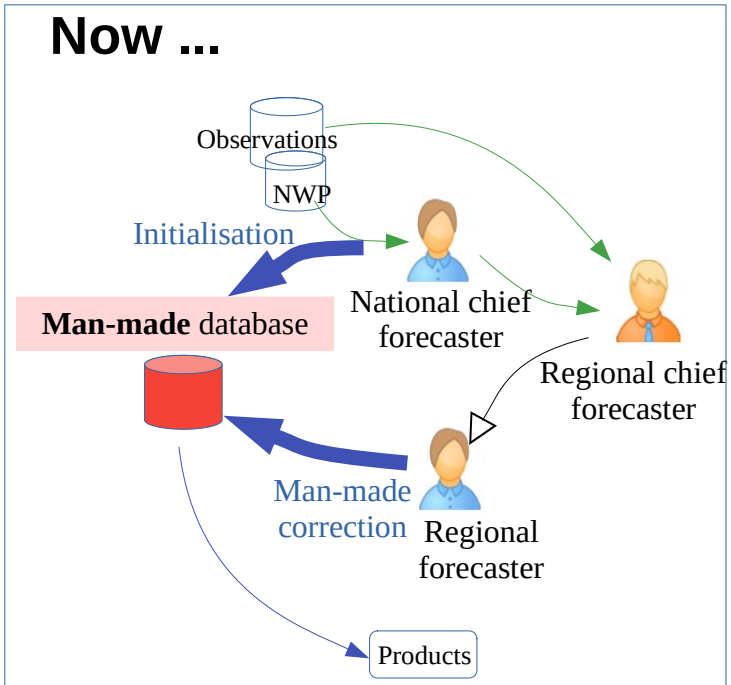
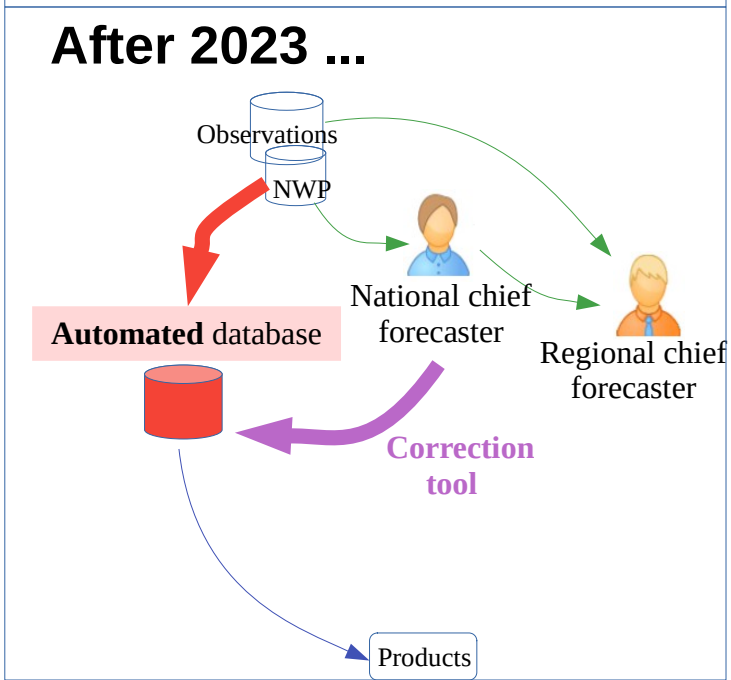




METHODOLOGY

1. **The correction tool is triggered when :**
   - Warning >= « dark » yellow
   - the automated database does not follow the expert scenario

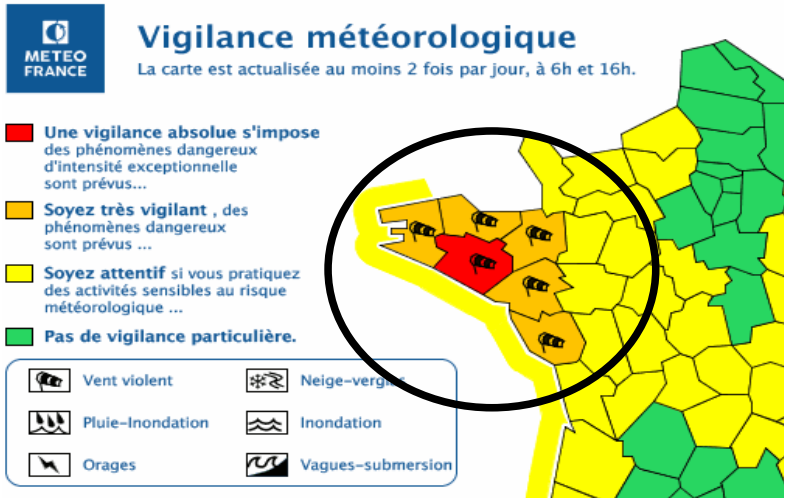
2. **Search for the closest model outputs to the expert scenario among the NWP offer**

3. **The automated database is replaced by one of the closest model outputs**

TRIGGERING OF THE CORRECTION TOOL

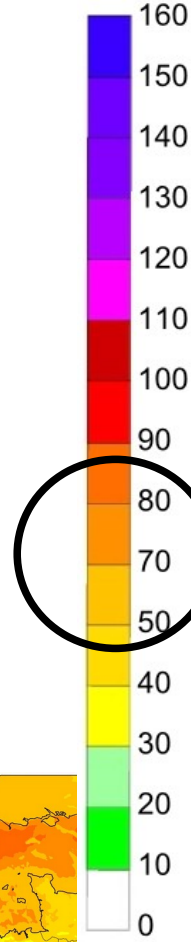
- **Example :** Alex storm on the 1st and 2nd of October 2020

Wind warning

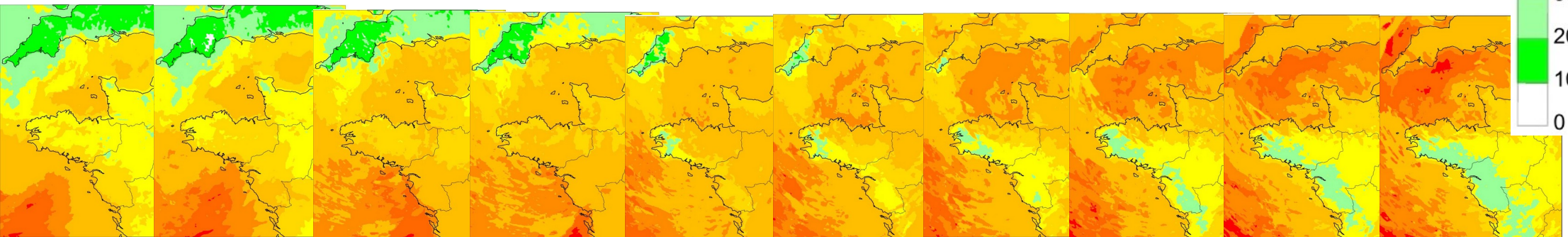


Expert scenario valid between oct. 1st at 20UTC - oct. 2nd at 8UTC.

Wind gust (km/h)



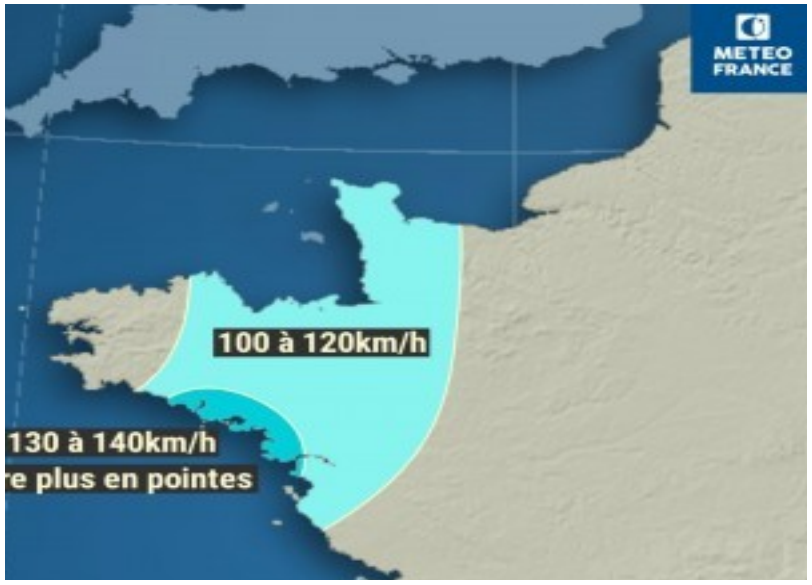
Automated database forecasts, initialized on Oct. 1st at 00 UTC
Valid for oct 1st at 20 UTC up to oct. 2nd at 08 UTC



SEARCH FOR THE CLOSEST MODEL OUTPUT ?

- Search among the 126 model outputs + the automated database
- Calculation of a distance between each model output and the expert scenario
- The distance calculation depends on several caracteristics :

Expert scenario valid between oct. 1st at 20UTC - oct. 2nd at 08UTC.

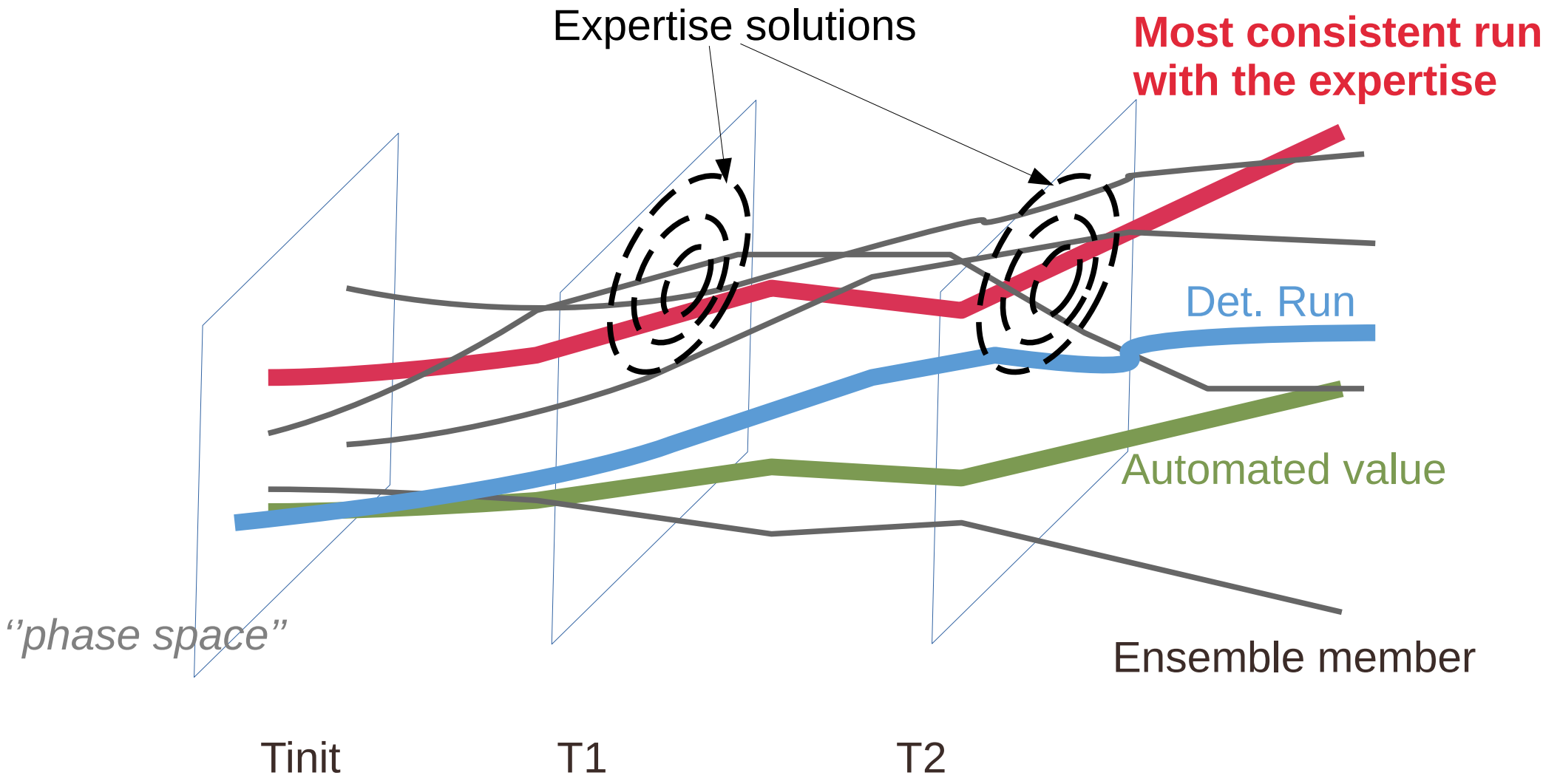


Caracteristics provided by the chief forecaster:

- **Parameter** : wind gust
- **Time period :**
  oct. 1st at 20UTC - oct. 2nd at 8UTC
- **Impact areas :**
  - Area 1 : 130 up to 140 km/h
  - Area 2 : 100 and 120 km/h
- **Different priority ranks for each zone** provided by the forecasters :
  - Area 1 : weight = 1
  - Area 2 : weight = 0.5

➡ D_total = 1 x D_Area1 + 0.5 x D_Area2

SEARCH FOR THE CLOSEST MODEL OUTPUT ?



CLASSIFICATION RESULTS

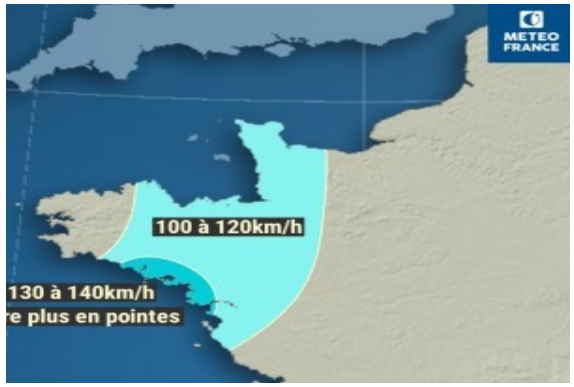
CLASSIFICATION	MODEL OUTPUTS
1	PEARP member 0, run day 0 at 00 UTC
2	ENS member 44, run day -1 at 12 UTC
3	PEARP member 26, run day 0 at 00 UTC
4	ENS member 49, run day -1 at 12 UTC
5	ENS member 39, run day -1 at 12 UTC
…	
13	ARPEGE run day 0 at 00UTC
...	
102	AUTOMATIC DATABASE run day 0 at 07 UTC
...	
123	PEARP member 23, run day 0 at 00 UTC
124	PEAROME member 16, run day 0 at 03 UTC
125	PEARP member 25, run day 0 at 00 UTC
126	PEARP member 27, run day 0 at 00 UTC
127	PEAROME member 3, run day -1 at 21 UTC

distance

Closest det. model

CLASSIFICATION RESULTS

Expert scenario valid between oct. 1st at 20UTC - oct. 2nd at 08UTC.



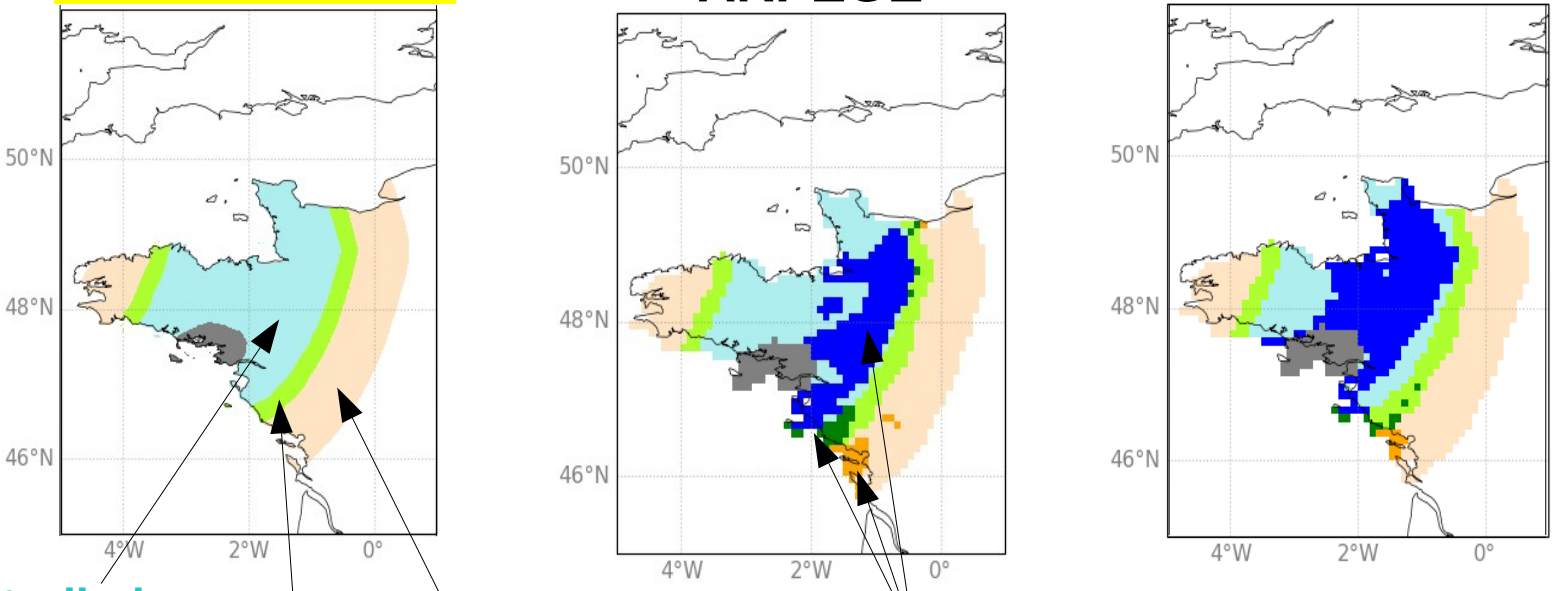
Automated database
before correction

Closest det. model

ARPEGE

Closest Model output

PEARP member 0



Studied area

Tolerance area

Intolerance area

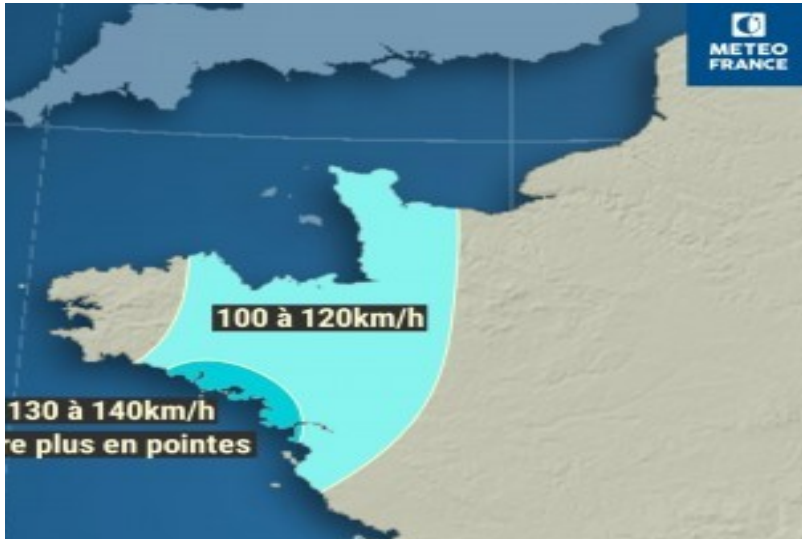
Agreement btw the expertise and the model output

LAST STEP OF THE CORRECTION TOOL

- The national chief forecaster will choose or not to replace the automated database with either :
    1. The closest model output
    2. The closest deterministic model

- Correction done :
    - For each forecast range of the studied time period
    - Within the studied area only

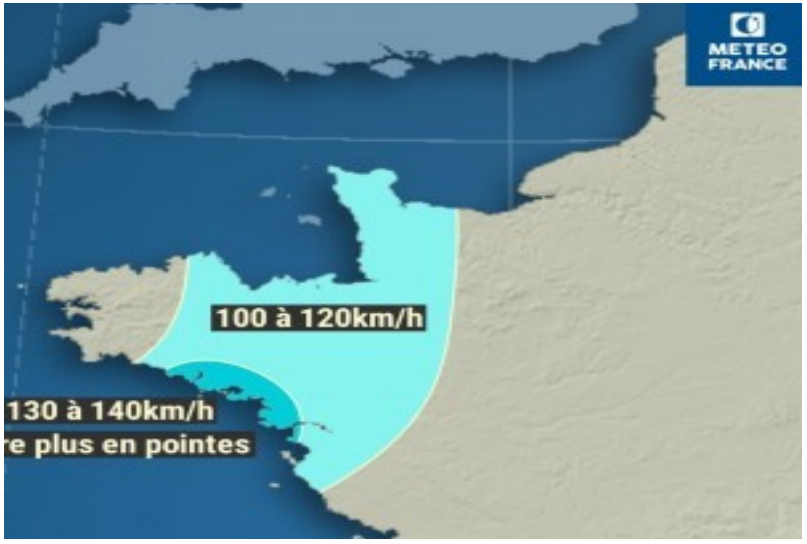
Expert scenario valid between
oct. 1st at 20UTC - oct. 2nd at 08UTC.



LAST STEP OF THE CORRECTION TOOL

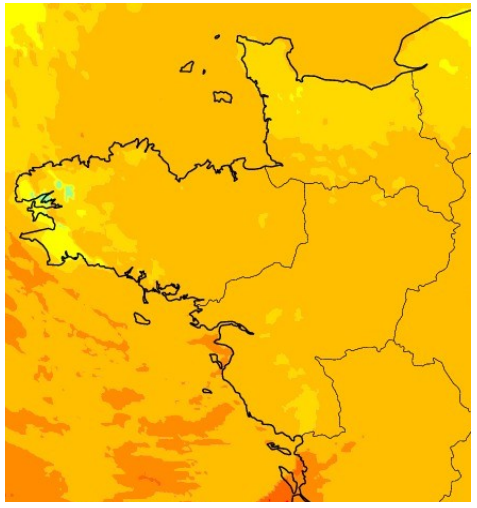
Forecast valid time : Oct 2nd at 01 UTC

Expert scenario valid between oct. 1st at 20UTC - oct. 2nd at 08UTC.

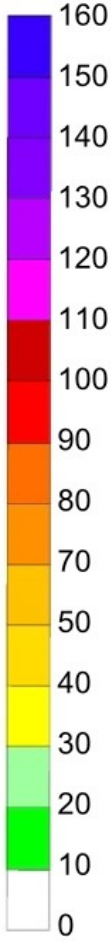


Raw Automated Database (102/127)

Run : 2020/10/01 **07UTC +18h**

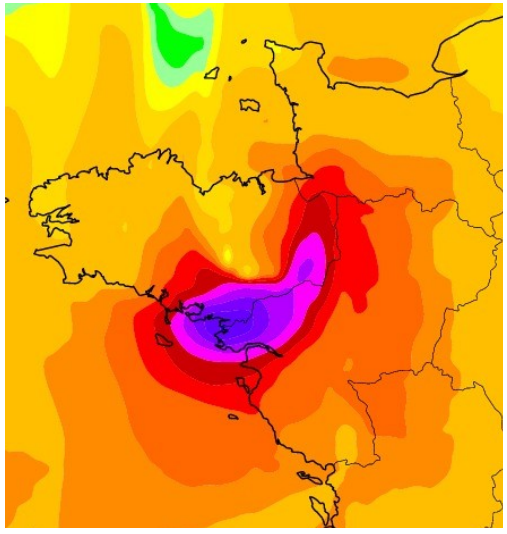


Wind gust (km/h)



PEARP member 0 (1/127)

Run : 2020/10/01 **00UTC +25**h



ARPEGE (13/127)

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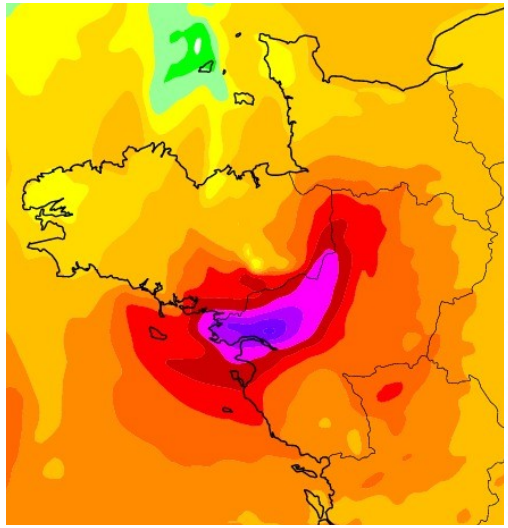

LAST STEP OF THE CORRECTION TOOL

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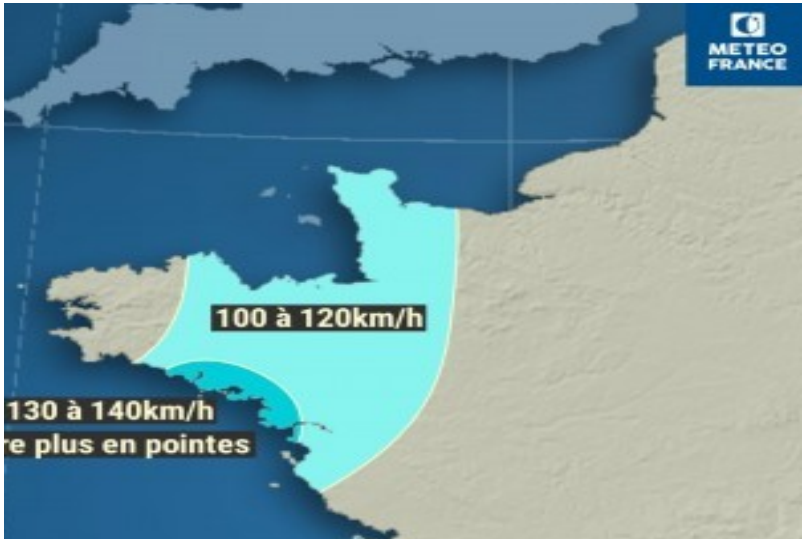

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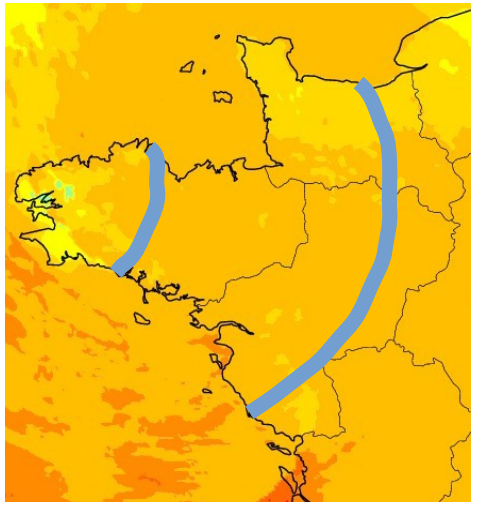

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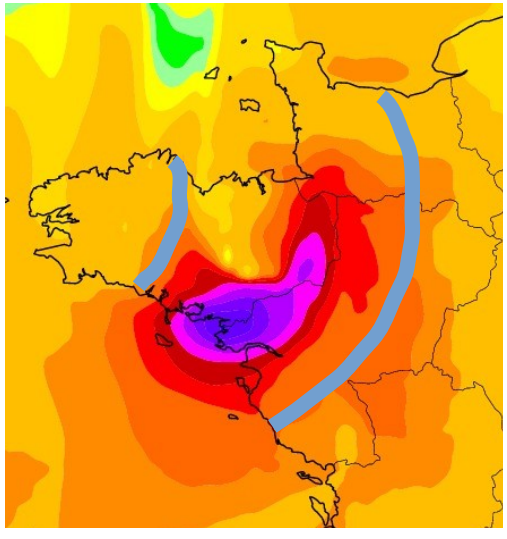

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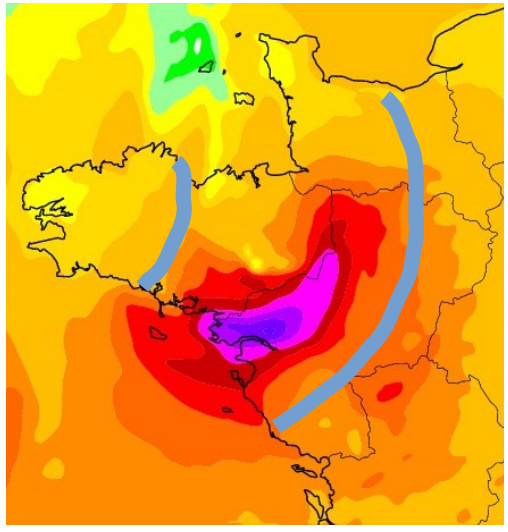
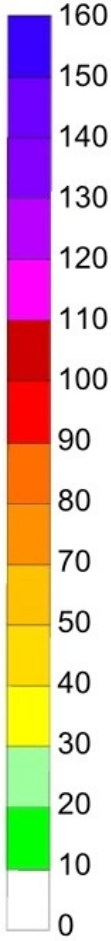


Wind gust (km/h)



CONCLUSION

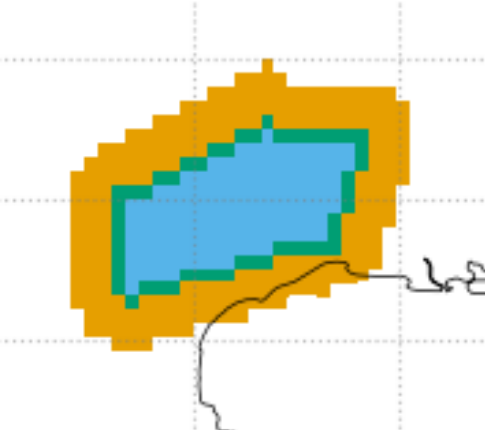
- In this presentation, we have showed the correction tool methodology for short term forecast (up to day 1).
- It is an ongoing project ; expected to be operational for 2023
- It will only concern the production for the general public (website, commercial products, etc.). Forecasters will remain in charge of warning based on their expertise.

PERPECTIVES

- We are planning to develop a methodology to correct :
  - Forecasts at day 2/ day 3
  - Middle-range forecasts
  - Tropical cyclone track

EXTRA SLIDES

Calcul de la distance d'une CONTRAINTE



2. Pour chaque contrainte, identification des points OK/NOK sur chaque polygone
    1. Si paramètre non cumulé (rafales): identification des points de grille qui respectent l'enjeu demandé sur au moins une des échéances de l'événement
    2. Si paramètre cumulé, travail sur un seul grib
3. Calcul du pourcentage d'accord et de désaccord :
    1. Accord = pourcentage points OK sur le polygone étudié
       + 0,25*(pourcentage points OK sur le polygone flou)
        1. Si Accord > 1, Accord = 1
        2. Au final, 0 < Accord < 1
    2. Désaccord = pourcentage points OK sur le polygone d'intolérance
        1. Au final, 0 < Desaccord < 1
4. Pour des contraintes sur RELIEFS ou COTES, les pourcentages d'accord et de désaccord sont calculés sur ces masques particuliers
5.

Calcul de la distance d'une CONTRAINTE

Contrainte SEUIL

1. y = 1 - (Accord - 0,8*Désaccord)
2. Recalibrage de y sur [0,1] : distance_contrainte = y/1,8
    1. Si concordance parfaite (accord = 1), 0 < distance_contrainte < 0,45
    2. Si aucun accord (accord = 0), 0,56 < distance_contrainte < 1
    3. Si accord à 50 %, 0,28 < distance_contrainte < 0,72

2. Contrainte LOC
    1. Optimum centré sur des seuils OK sur 5% du domaine
    2. En cours de changement