ALADIN assimilation experiments, seasoned B matrices and 10m winds

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Outline of the talk

1. 10m wind observations on earth

- generalities
- station selection
- non-gaussian station pdf rejection
- bias correction

2. Experiments with 2 different B statistics compared to the operational ones.

Current status of Surface Layer (SL) obervations inside ALADIN France 3dvar

- Surface pressure are used
- 10m wind are used over sea, not very much at 10m in fact !
- T2m and Hu2m assimilated inside ALADIN-FRANCE since summer 2005
- Strong impact in the lower troposphere, humidity, improvement of precipitation scores.
- Correction of humidity increments due to SEVIRI data.
- Requires «good» surface analysis
- Analysis increment does not spread too much inside boundary layer.
- Produces small scales increments, but filtered by DFI

Surface Layer wind assimilation

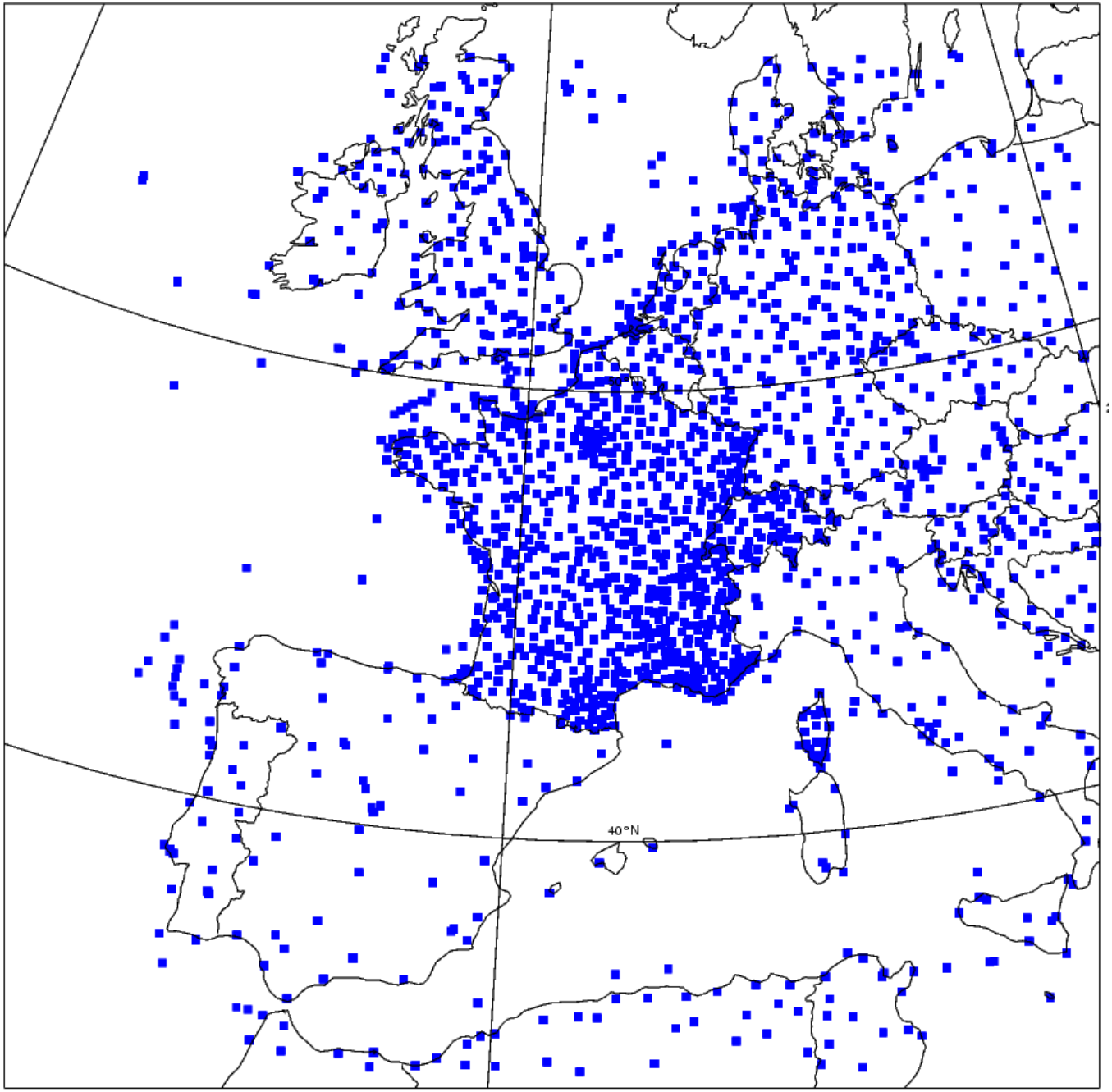
- Misrepresentation in models because of orography and physiography
- Some measurments represent local phenomena
- Last model level is above 10m (~17m)=>use of SL relationships

=> necessity of coherence check to blacklist unwanted stations

Wind observations

- Between 1200 and 1600 wind observations for the domain ALADIN-FRANCE, depending on the hour
- Wind measurments at 10m over land
- Observations from ship, wind height measurment > 10m
- High density of observations over France, comming from our «RADOME» network

wind measurment stations



Surface Layer wind observation operator

Similarity relationship is used inside SL :

$$\frac{\partial u}{\partial z} = \frac{u_*}{\kappa (z + z_0)} \Phi_D \left(\frac{z + z_0}{L} \right)$$

With Φ_D a function depending on the stability and on L (Monin-Obukhov length)

Allows to obtain u(z=10m) from last level wind speed

direct computation done in ACNTCLS, tangeant linear in ACNTCLSTL and adjoint in ACNTCLSAD

10m wind rejection

- Wind speed is checked for 10m winds
- No test on wind direction

=>That allows bad wind direction to be taken into account inside the system

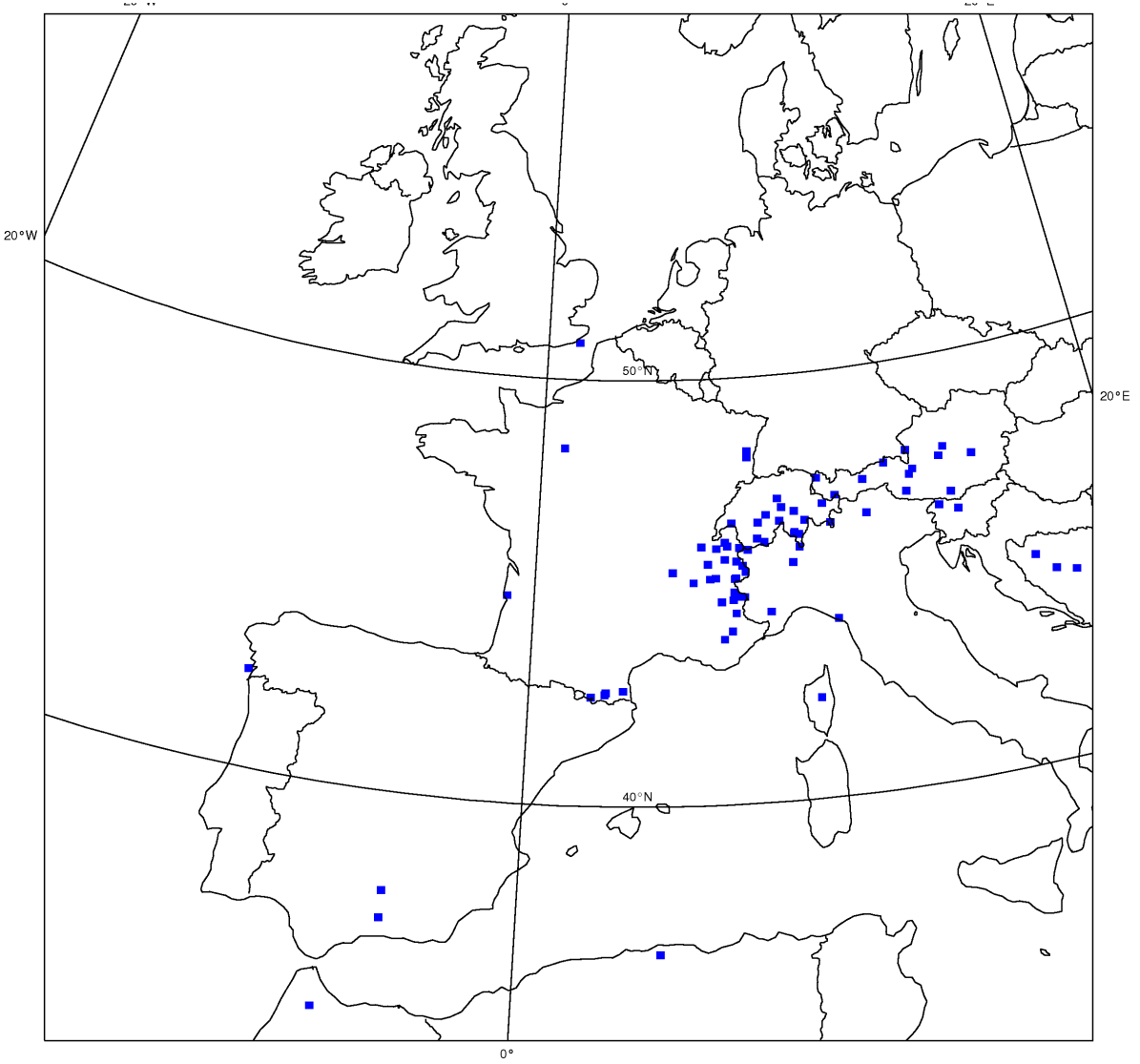
- We can guess that wind direction differences is to be found systematically with some station (because of orography)

=>Necessity to blacklist stations with wind direction differences

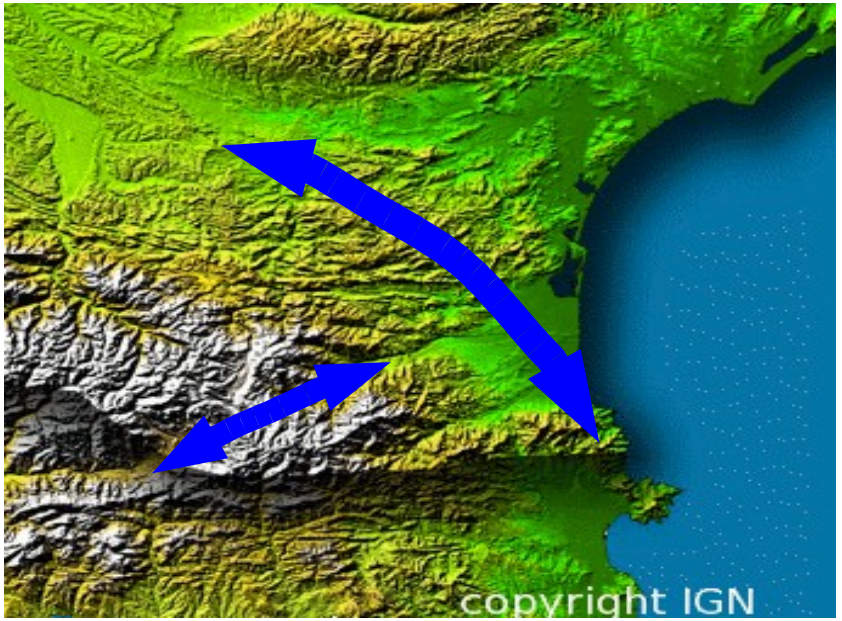
Station selection

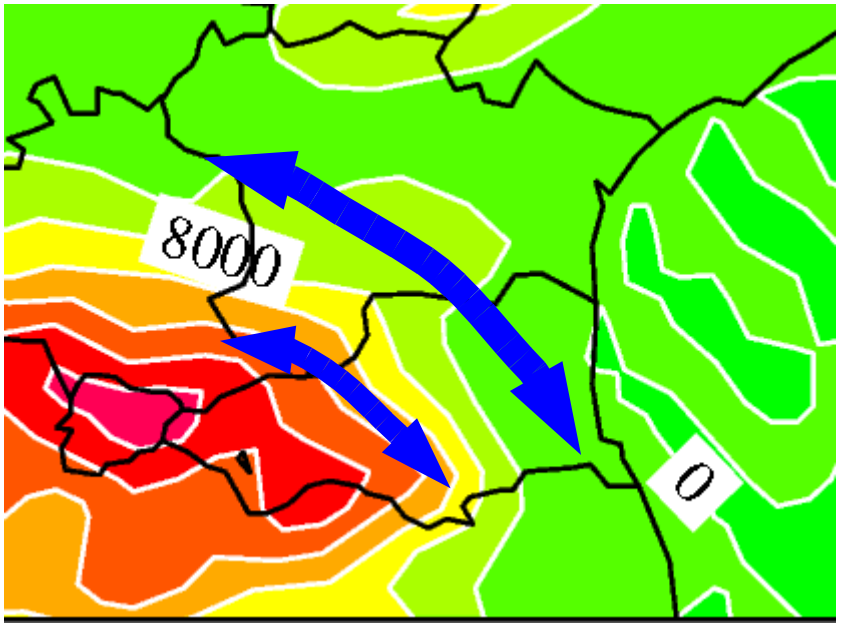
- We used a monitoring on ALADIN-FRANCE over 4 month data (september 2006 december 2006)
- Stations retained are those for which correlation coefficient between model and observation is > 0.3 both for u and v component
- 101 stations were blacklisted on that criteria, most of them in montainous areas.
- That allowed us to also blacklist some ship data, it appears that these observations are not of very good quality.

Blacklist for 10m WINDS



Orography difference



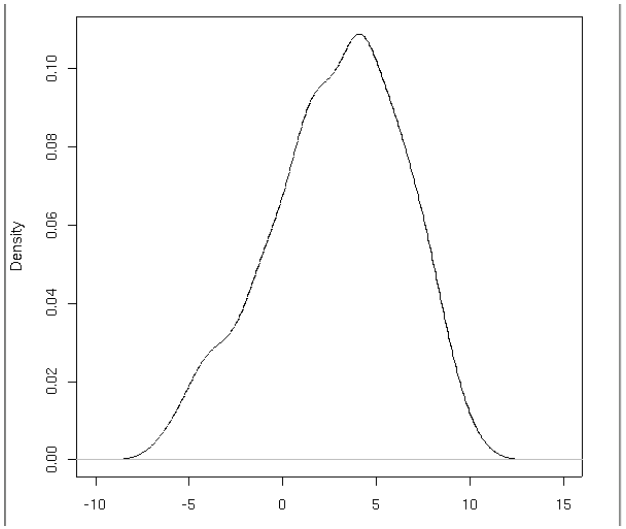


ALADIN orography leads to 90° difference in that valley.

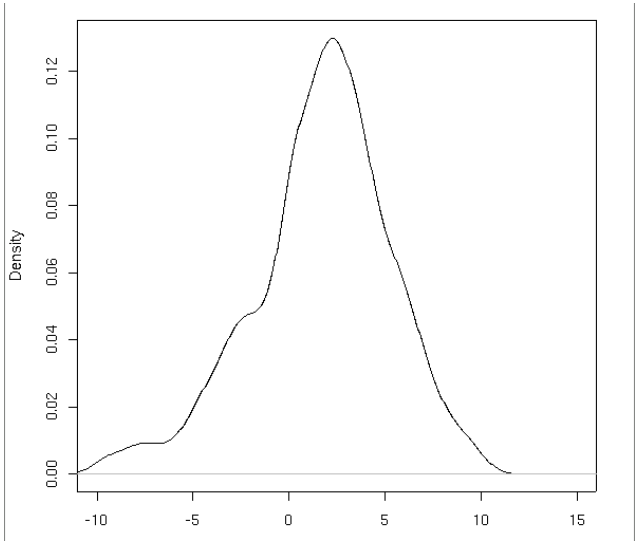
PDF for observation and model equivalent

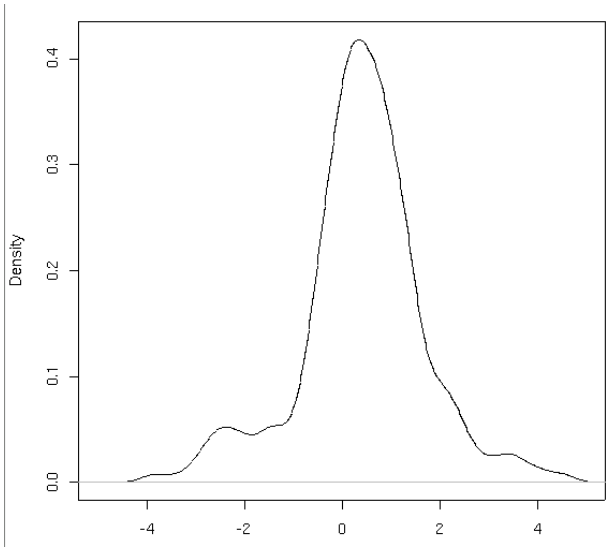
Model

Observation

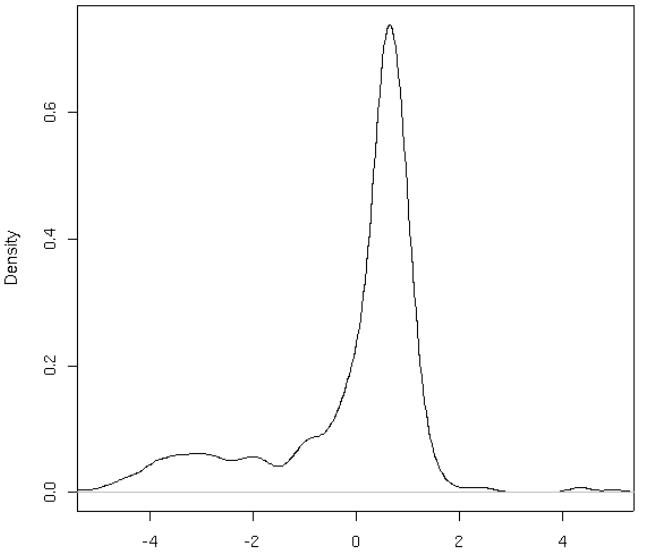


Good station

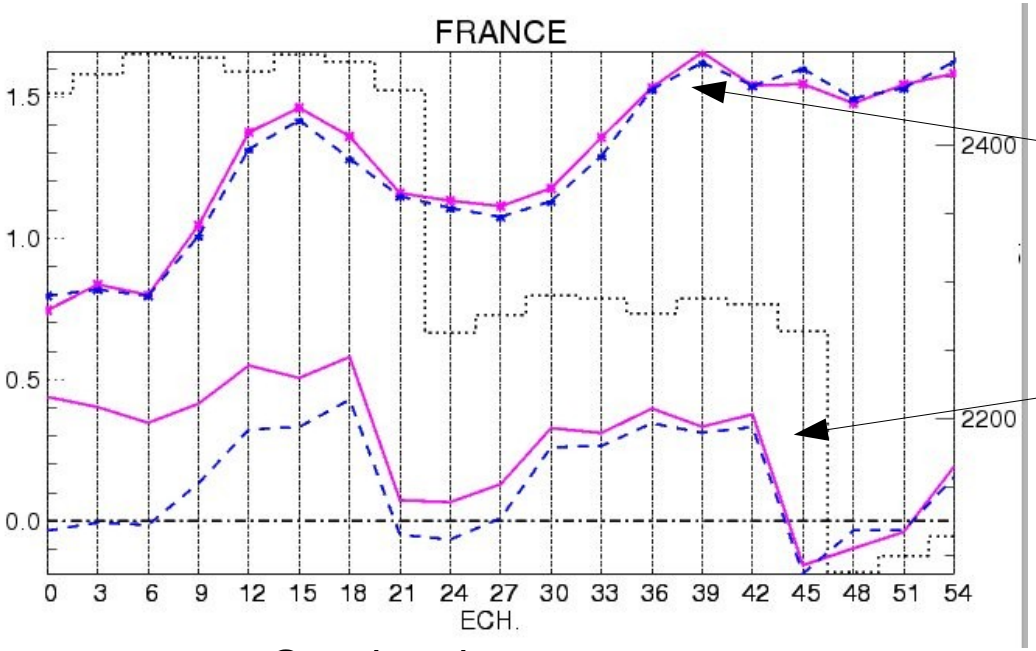




Bad station



Results : reference experiement

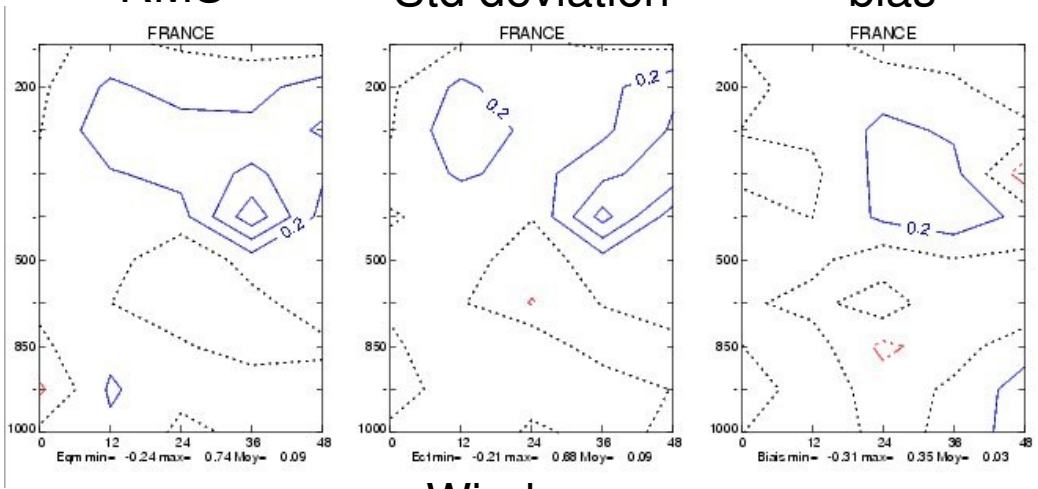


RMS

bias

Sea-level pressure score

RMS Std deviation bias



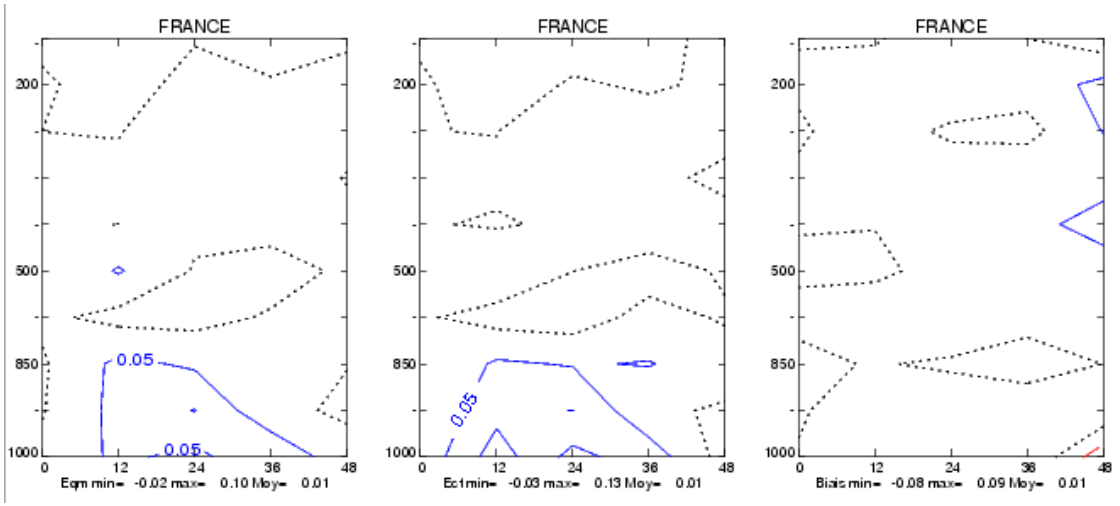
Wind score

- Good scores, especially in term of sea-level pressure, tropospheric wind and tropospheric humidity

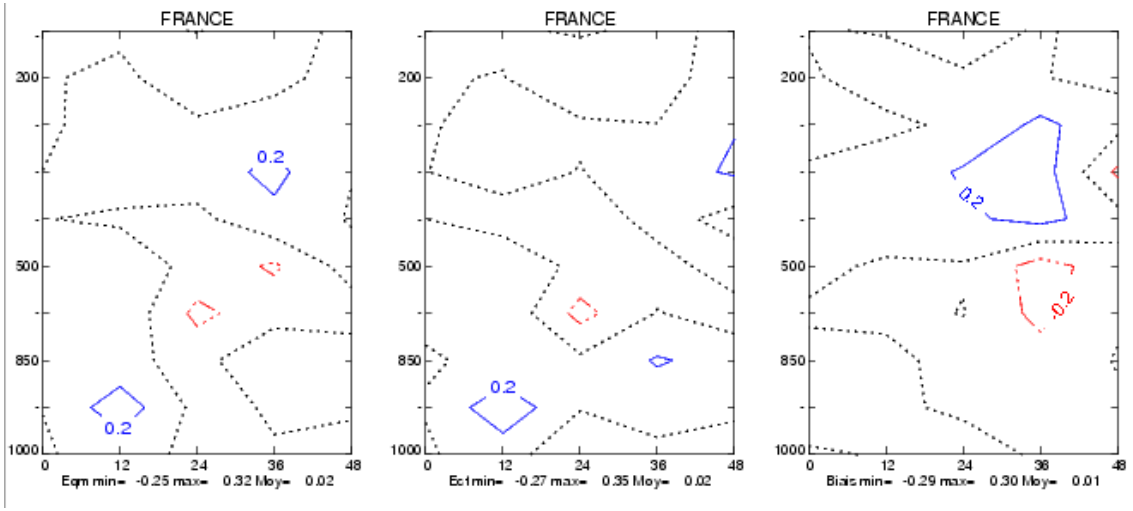
Results : elimination of stations

Neutral compared to SYNOP observations
Slightly positive compared to TEMP

RMS | Std deviation | bias



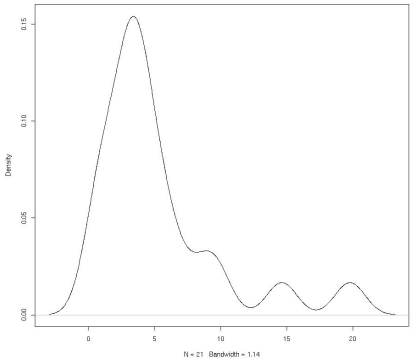
Temperature



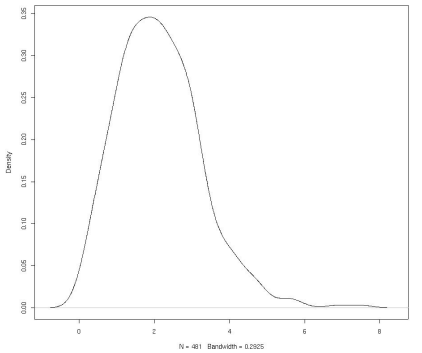
Wind force

Test of gaussian PDF

- Test with elimination of 600 stations, that present the less gaussian aspect for innovation
- Test based on good amount of population inside the 3 thresholds : σ, 2σ, 3σ
- That test is quite soft : one should eliminate the station very far from gaussian PDF



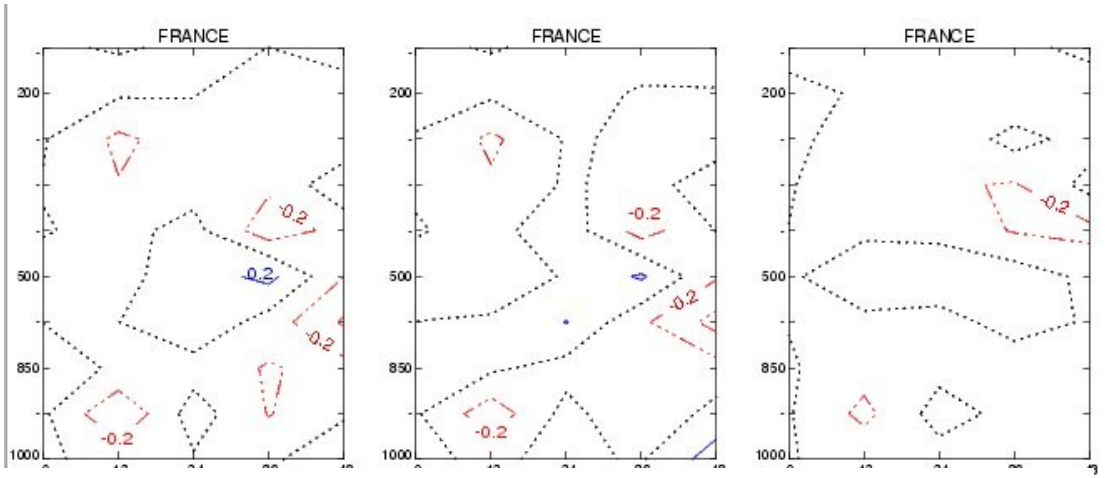
Bad station (PDF too far from gaussian profile)



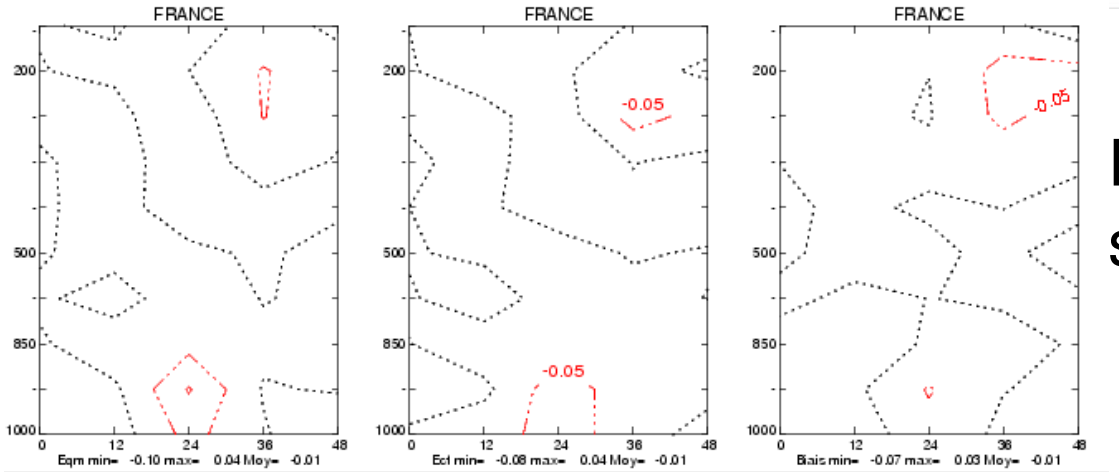
Good station

Test of Gaussian PDF

RMS Std deviation bias



Degradation of wind scores compared to TEMP

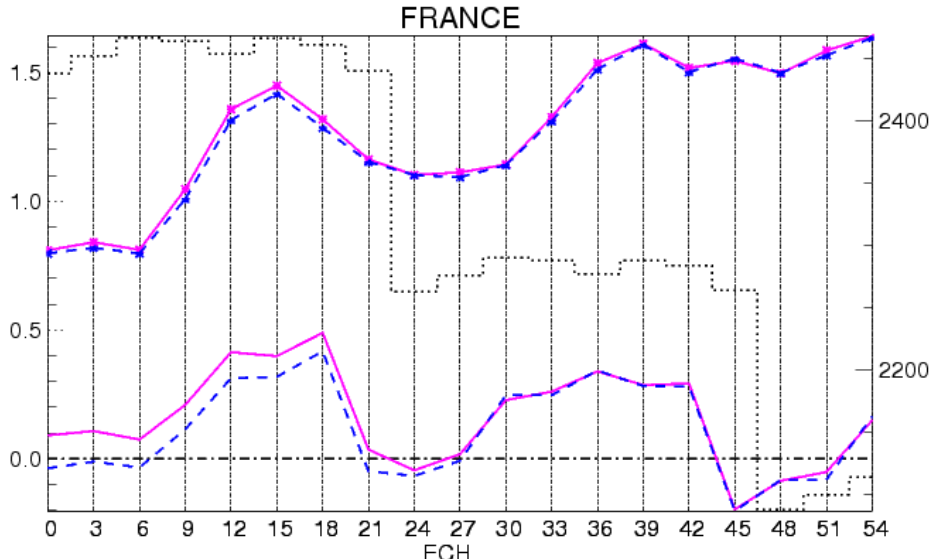


Degradation of temperature scores compared to TEMP

Very neutral, except for wind and temperature/TEMP : slight degradation.

10m Wind bias correction

•For wind force > 2 m/s a bias correction is applied for each station
•Bias is computed over the period September 2006-> december 2006
•Simple constant bias correction on u and v
•Slight degradation over the test period, Pmer bias is increadsed
=> the Pmer bias of ALADIN can be corrected with the use of 10m observations, if we want to make bias correction on those stations, we have to make things a bit more subtly !



10m winds analysis

- Reference experiment shows good improvement especially on sea level perssure and tropospheric wind.
- Station selection improves scores compared to TEMP data.
- Removal of stations with non-gaussian PDF does not lead to better results
- Strategy for bias correcion ?

Tests on new B matrix

- These new B matrices are computed with the ensemble technique
- One perturbated (observations are pertubated) 3dvar, followed bye a forecast.
- 2 period of 15 days :
  - 1-15 february 2005 (anticyclonic conditions) => winter JB
  - 3-17 september 2006 (convectives events) => summer JB

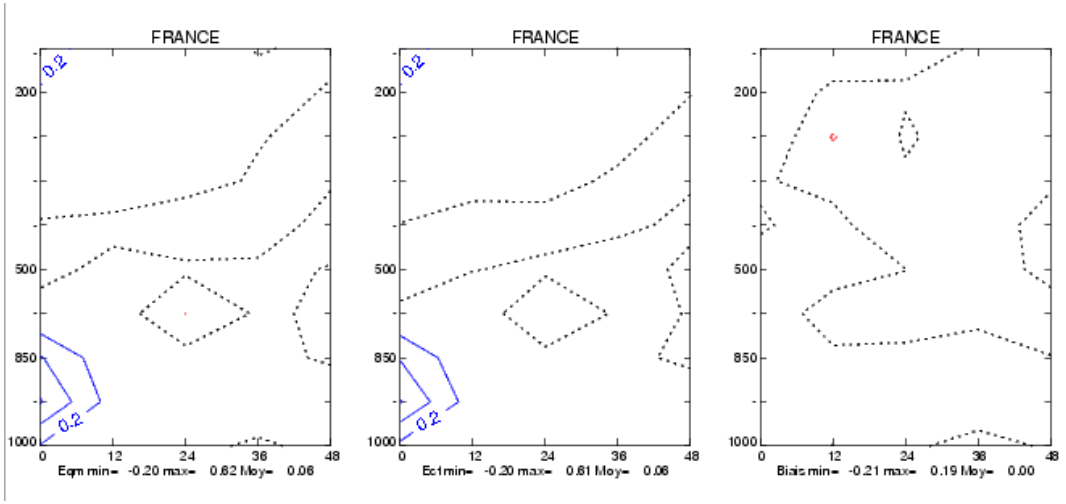
New experiments

- we tested 2 different experiments :
- one with the winter B on the period 1-15 february 2006
- one with the summer B on the period 1-15 august 2006
- we expect a better score compared to the operational run

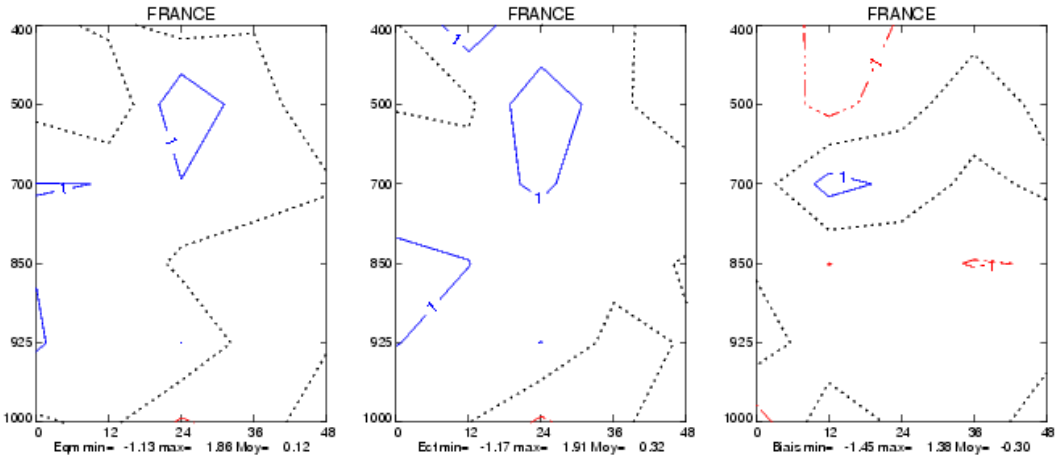
Experiment 1 : winter period with the winter B matrix

Slightly positive scores compared to TEMP for wind force and humidity, neutral elsewhere.

RMS Std deviation bias



Wind score

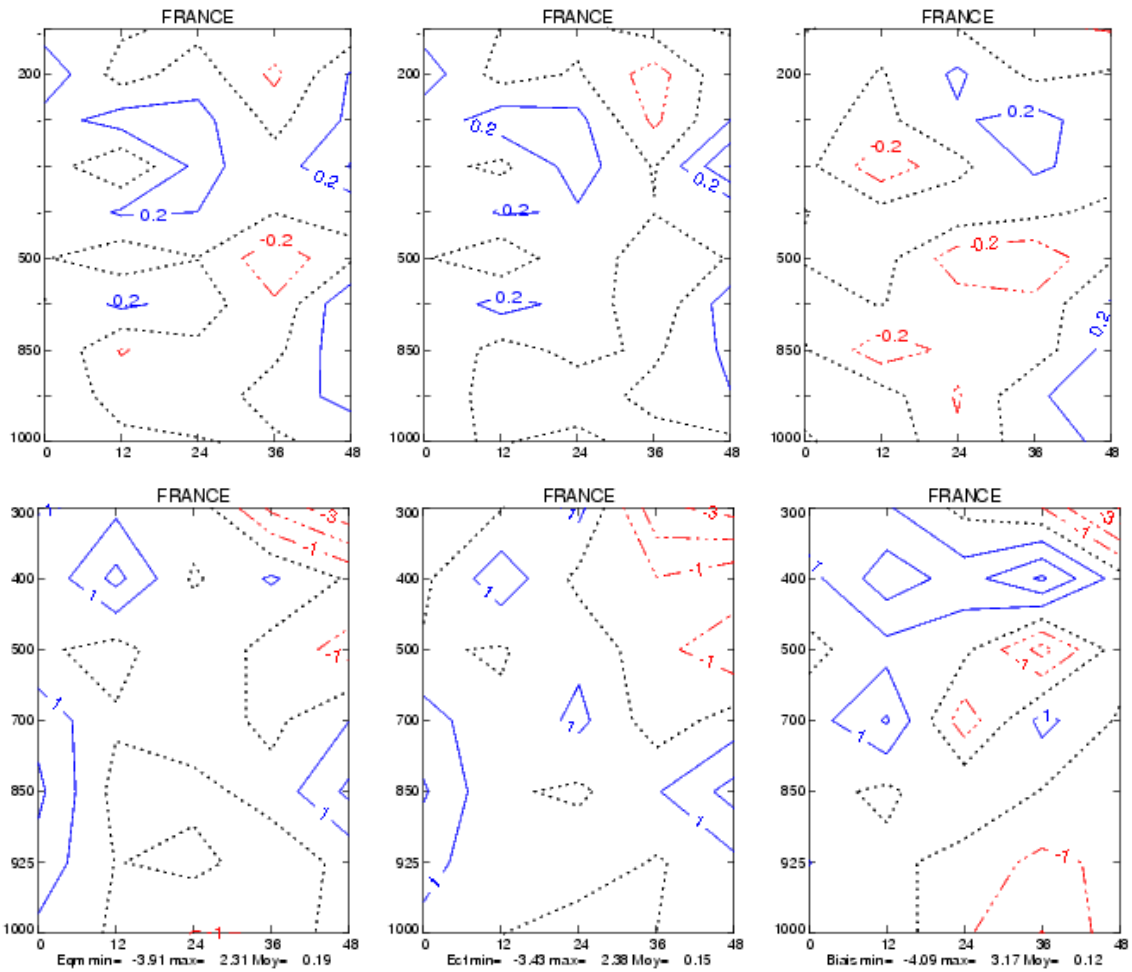


Humidity score

Experiment 2 summer period with the summer B matrix

Slightly positive scores compared to TEMP for wind force and humidity, neutral elsewhere

RMS Std deviation bias



Wind

Humidity

Winter and summer B matrix use

Each B matrix used on the same year period leads to slightly positive results.
=> operational average B matrix is quite robust, that is a quite good result,
How can we implement an every-day B matrix with those 2 matrices ? Is a linear combination possible ?

Thank you for your attention !