

**Institut National de la Météorologie**

## **Use of global EDA perturbations in a LAM 3DEnVar scheme**

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# OUTLINE

1. Why using global EDA perturbations in a LAM 3DEnVar scheme ?
2. AROME-France 3DEnVar with global EDA perturbations Configuration
3. Results & Scores
4. AROME-Tunisie 3DEnVar with global EDA perturbations Configuration
5. Summary & Perspectives

# 1. Why using global EDA perturbations in a LAM 3DEnVar scheme ?

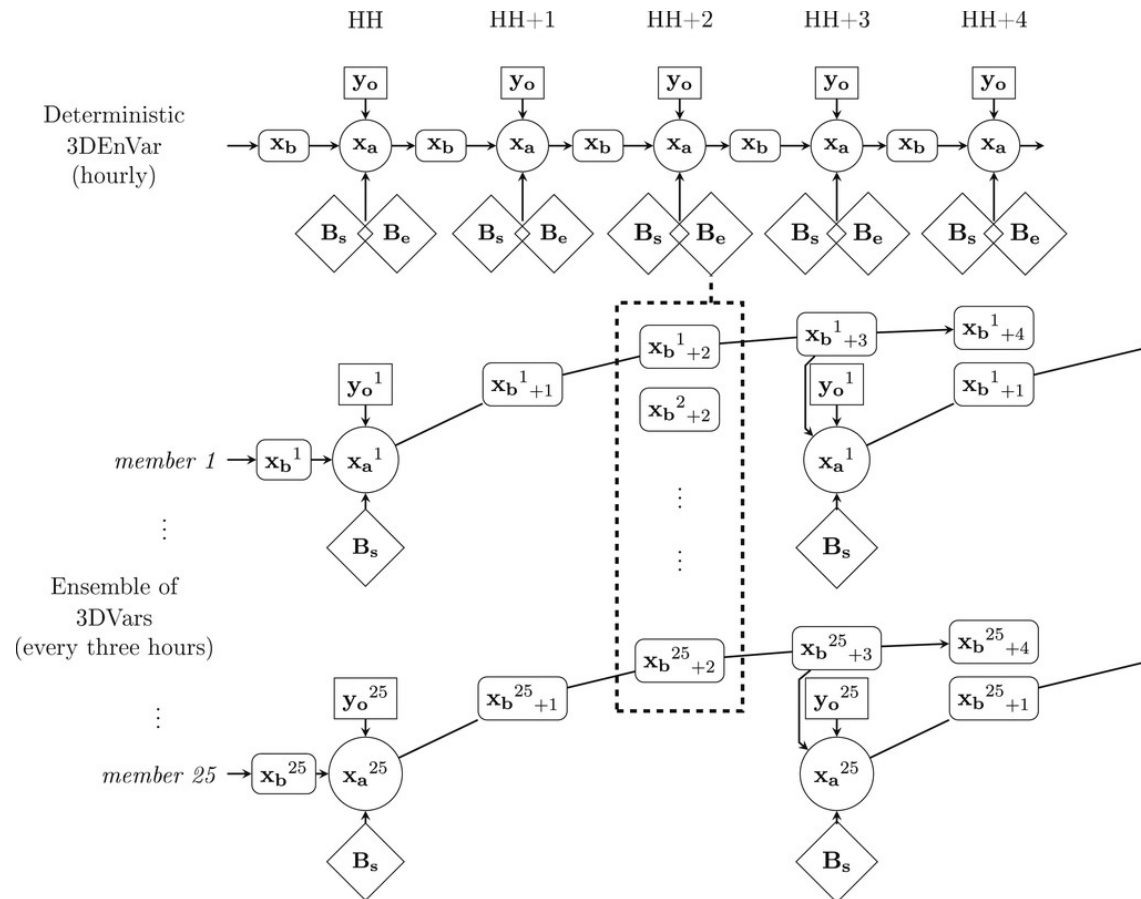
## +3DEnVar vs 3DVar

- 3DEnVar has proven itself when compared to 3DVar system
- 3DEnVar with LAM Perturbations => LAM Ensemble
- Many countries are interested in implementing a 3DEnVar scheme but the numerical cost is a big challenge

=>Reducing the Numerical cost:

Investigate the impact of taking the perturbation from global EDA as input for a LAM 3DEnvar

# 4. AROME-France 3DEnVar with global EDA perturbations Configuration



## 3DEnvar system

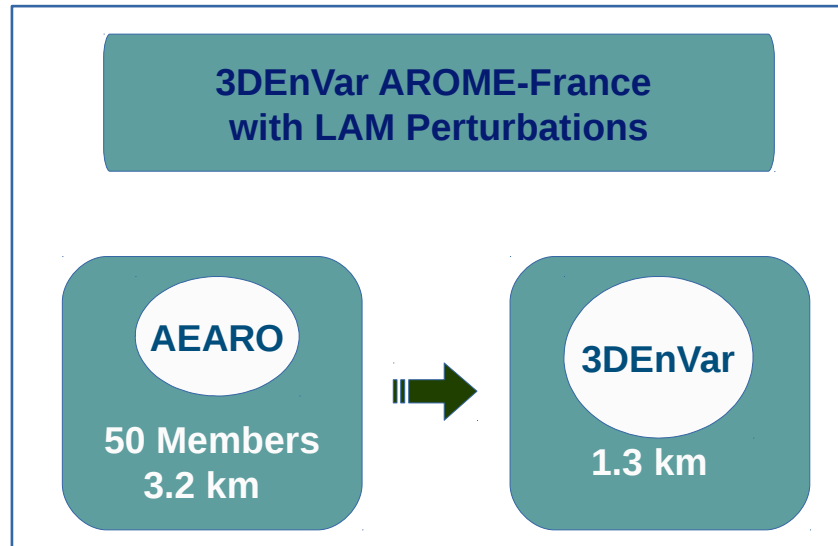
Article 2021:

A Square-Root, Dual-Resolution 3DEnVar for the AROME Model: Formulation and Evaluation on a Summertime Convective Period  
Yann Michel and Pierre Brousseau

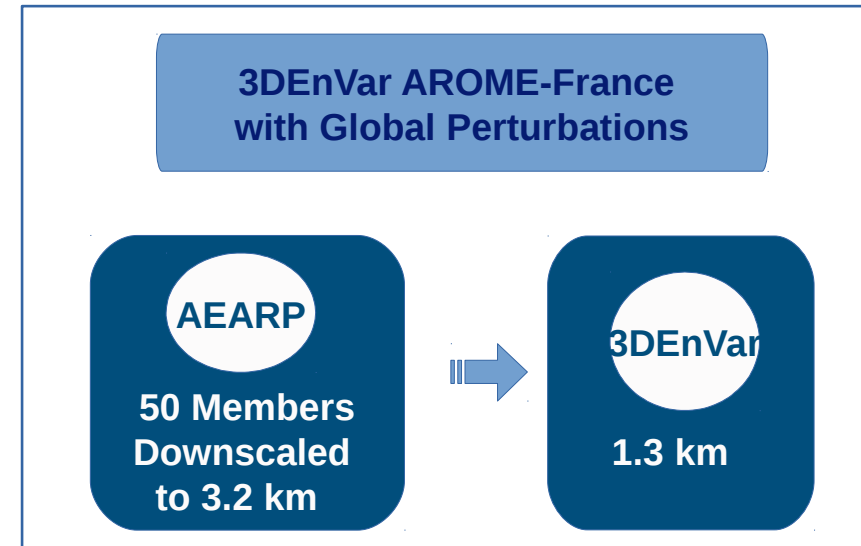
**! Current systems:**  
AEARO 50 Members

## 4. AROME-France 3DEnVar with global EDA perturbations Configuration

- Experiments and Reference based on cycle48 with OOPS



Vs.



### 3. Results & Scores

#### - Methodology :

- Comparaison of :AROME 3Dvar, 3DEnVar with LAM Perturbations and 3DEnVar with Global Perturbations
- diagnose ensemble correlations (LAM vs Global)
- statistics of observation-background and observation-analysis
- diagnose the evolution of sigma-b

#### - Verification period :

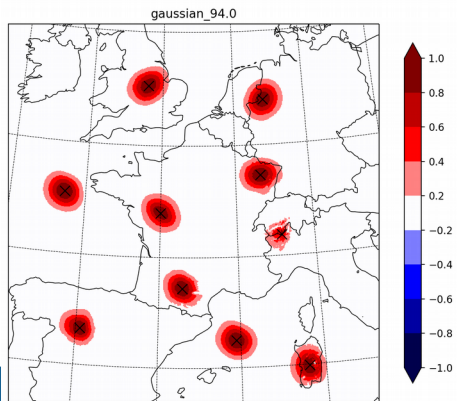
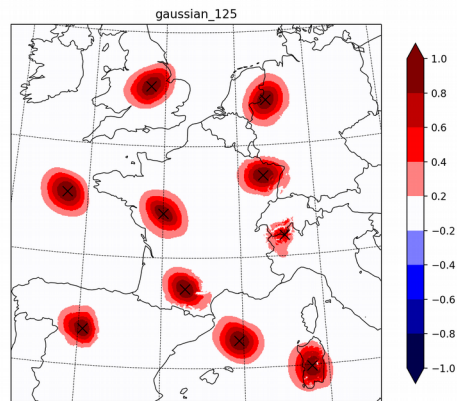
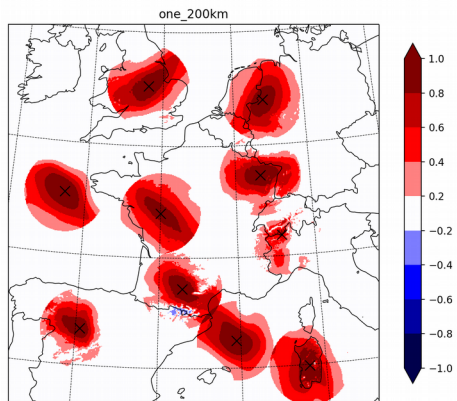
10/08/2022 to 08/09/2022

=> to cover a situation of strong convective gust not very well forecast in Corsica on 08/18/2022 (missed “red alert” situation)

# 3. Results & Scores : Correlation Diagnostics

## AEARP Ensemble downscaled to 3.2

S040TEMPERATURE : Correlation for 2022081100  
Temrs are 3.0 and 3.0.  
Members : 50

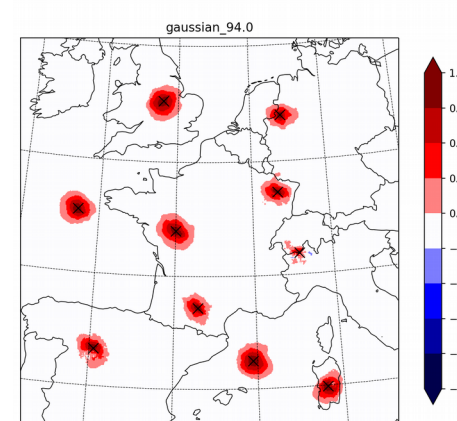
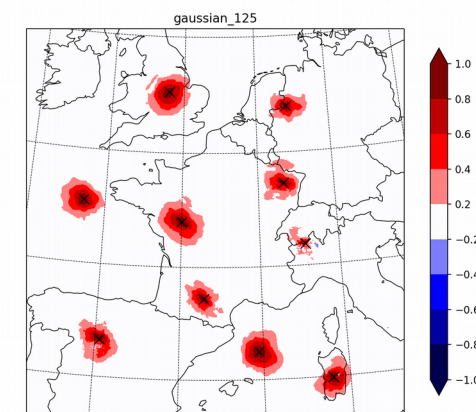
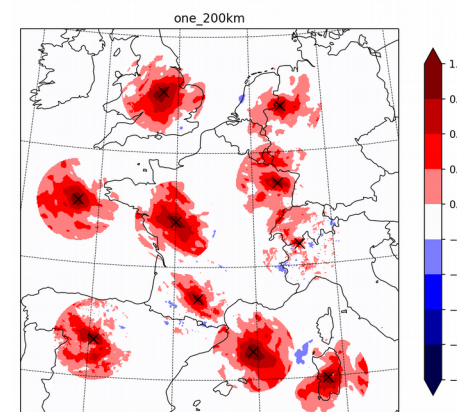


Temperature at Level 40:

- Correlations from global perturbations are more homogeneous and isotropic
- Less differences with the localization

## AEARO Ensemble

S040TEMPERATURE : Correlation for 2022081100  
Temrs are 3.0 and 3.0.  
Members : 50

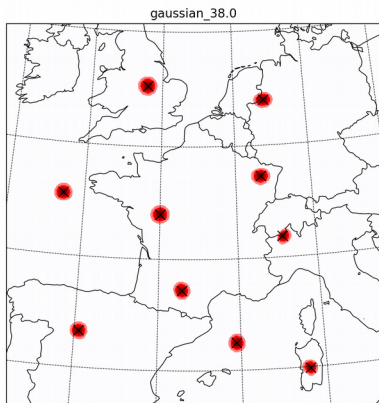
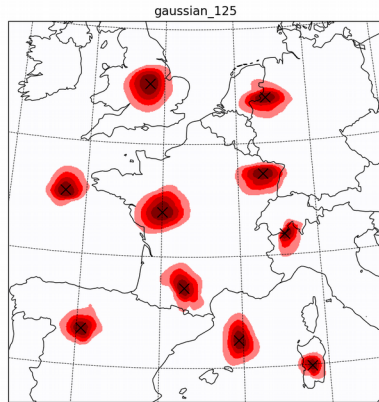
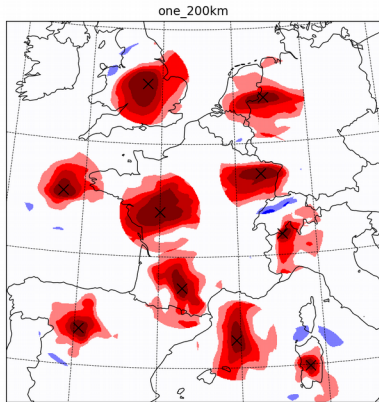


**!** Thanks to Vincent CHABOT for the DECor (Diagnose Ensemble Correlation) Tool

# 3. Results & Scores : Correlation Diagnostics

## AEARP Ensemble downscaled to 3.2

S080HUMI.SPECIFI : Correlation for 2022081100  
Temrs are 3.0 and 3.0.  
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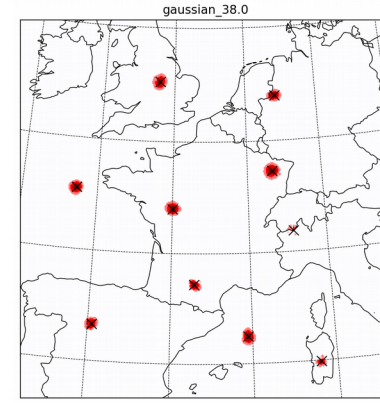
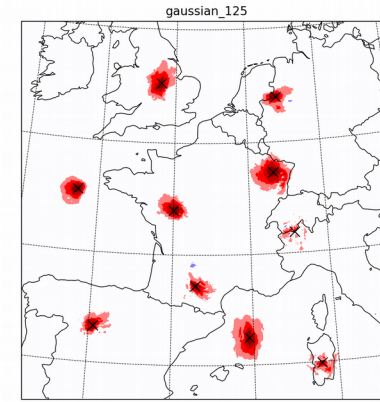
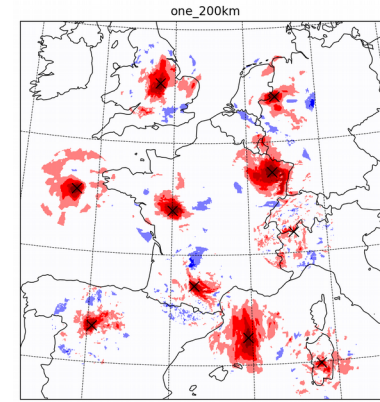


Specific Humidity at Level 80:

- Less differences in the lower levels

## AEARO Ensemble

S080HUMI.SPECIFI : Correlation for 2022081100  
Temrs are 3.0 and 3.0.  
Members : 50



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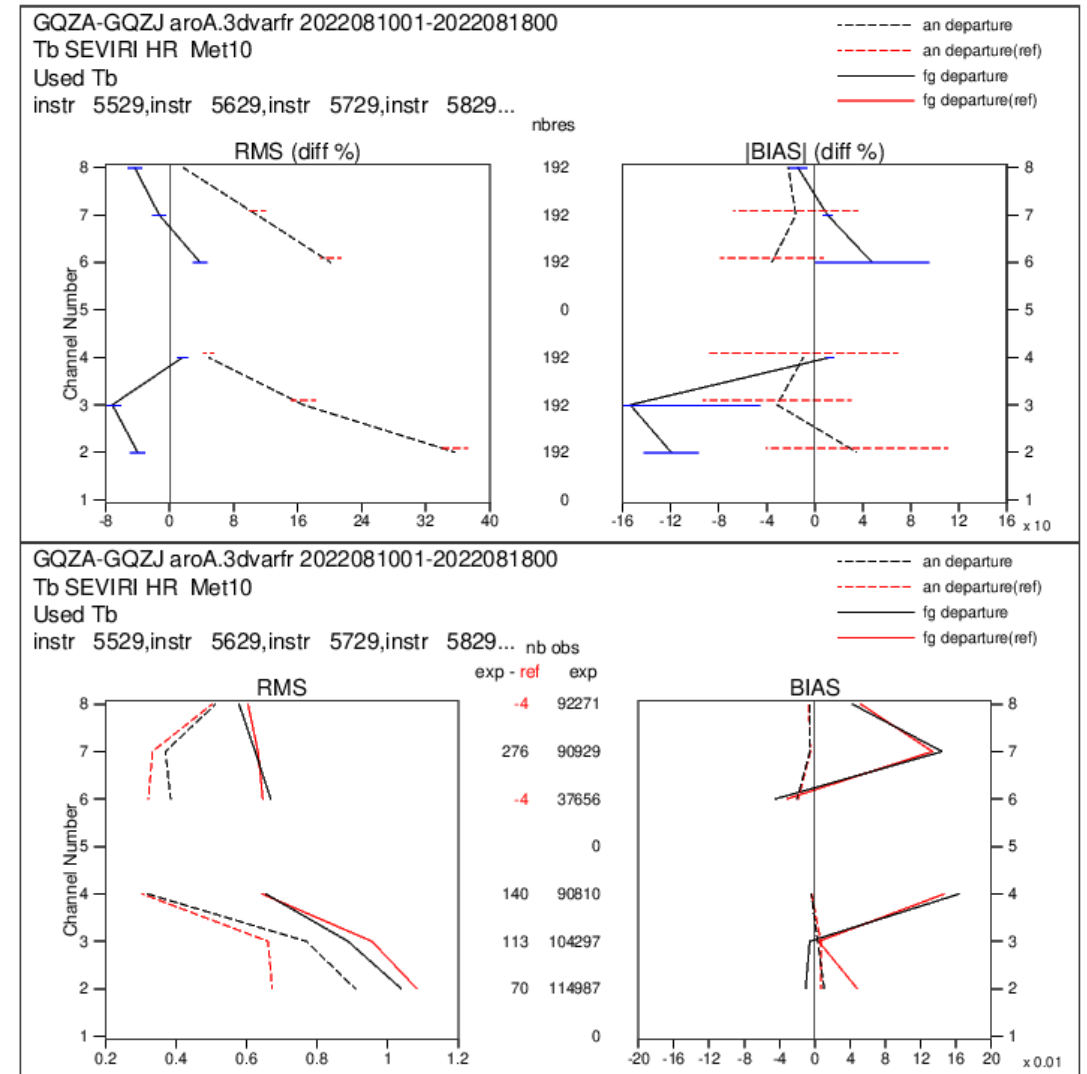
### 3. Results & Scores : OBSTAT

Experiment: 3DEnvar with global EDA perturbations  
 Reference: 3Dvar

-Obs-Analysis are **smaller** with 3DEnvar with global EDA perturbations

=> apply an inflation to increase the spread of the downscaled global EDA ensemble

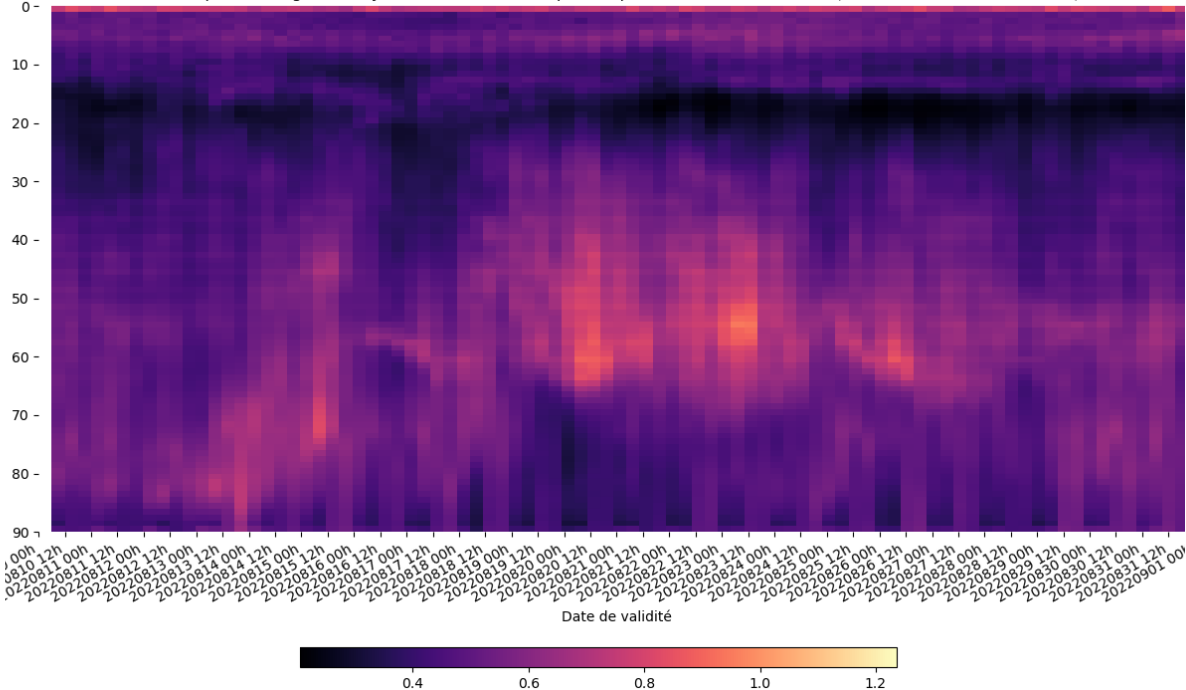
=> investigate the evolution of sigma-b of the downscaled global EDA ensemble



### 3. Results & Scores : Sigma-b diagnostics

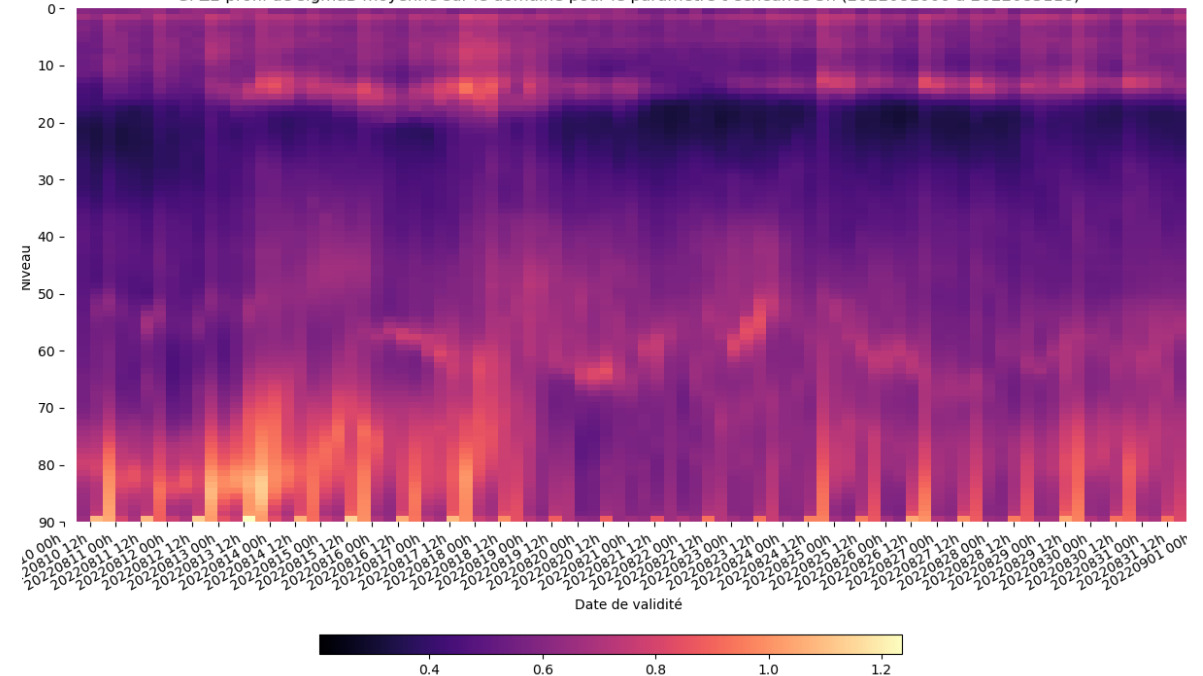
#### 3DEnvar with Global Perturbations

GRAA profil de sigmaB moyenné sur le domaine pour le paramètre t échéance 3h (2022081000 à 2022083118)



#### 3DEnvar with LAM Perturbations

GPZ2 profil de sigmaB moyenné sur le domaine pour le paramètre t échéance 3h (2022081000 à 2022083118)



Temperature Sigma-b vertical profile

- Diurnal convective cycle with 3DEnvar with LAM Perturbations (higher sigmab at 18H) not present in the global EDA perturbations

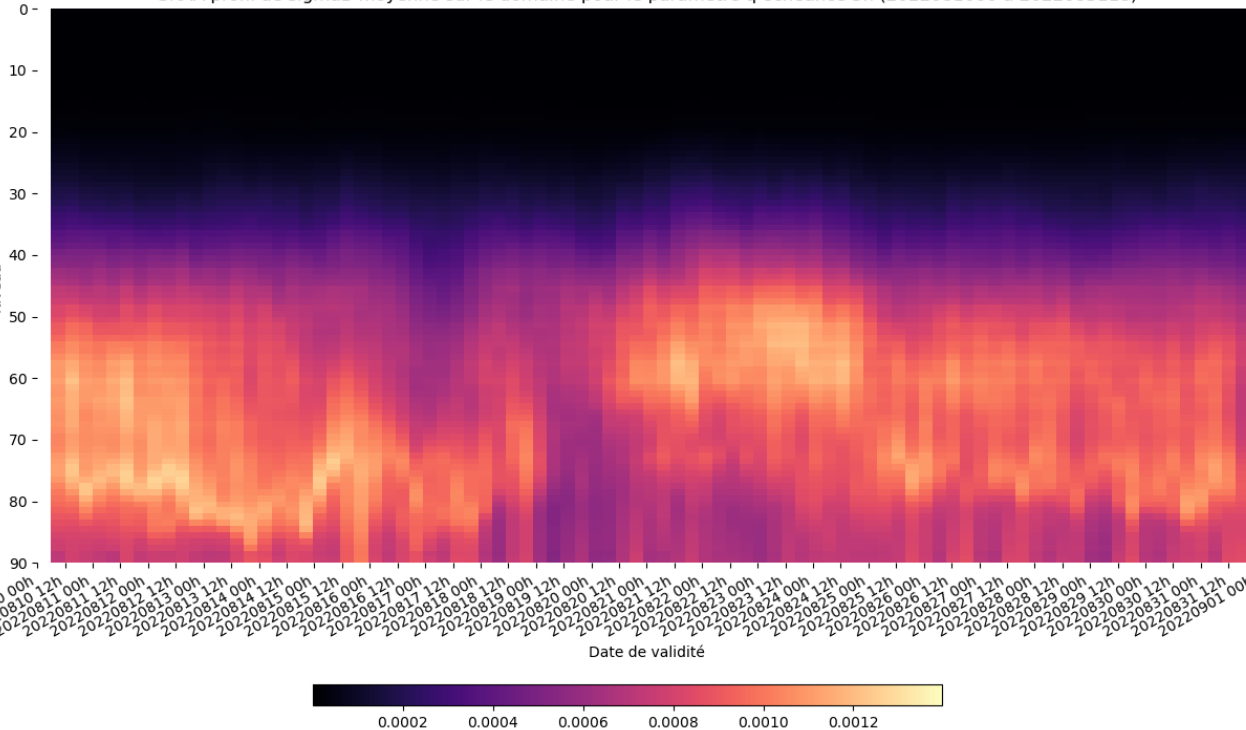
? Apply inflation factor equal to 2 ?

! Thanks to Valérie VOGT for the scripts.

### 3. Results & Scores : Sigma-b diagnostics

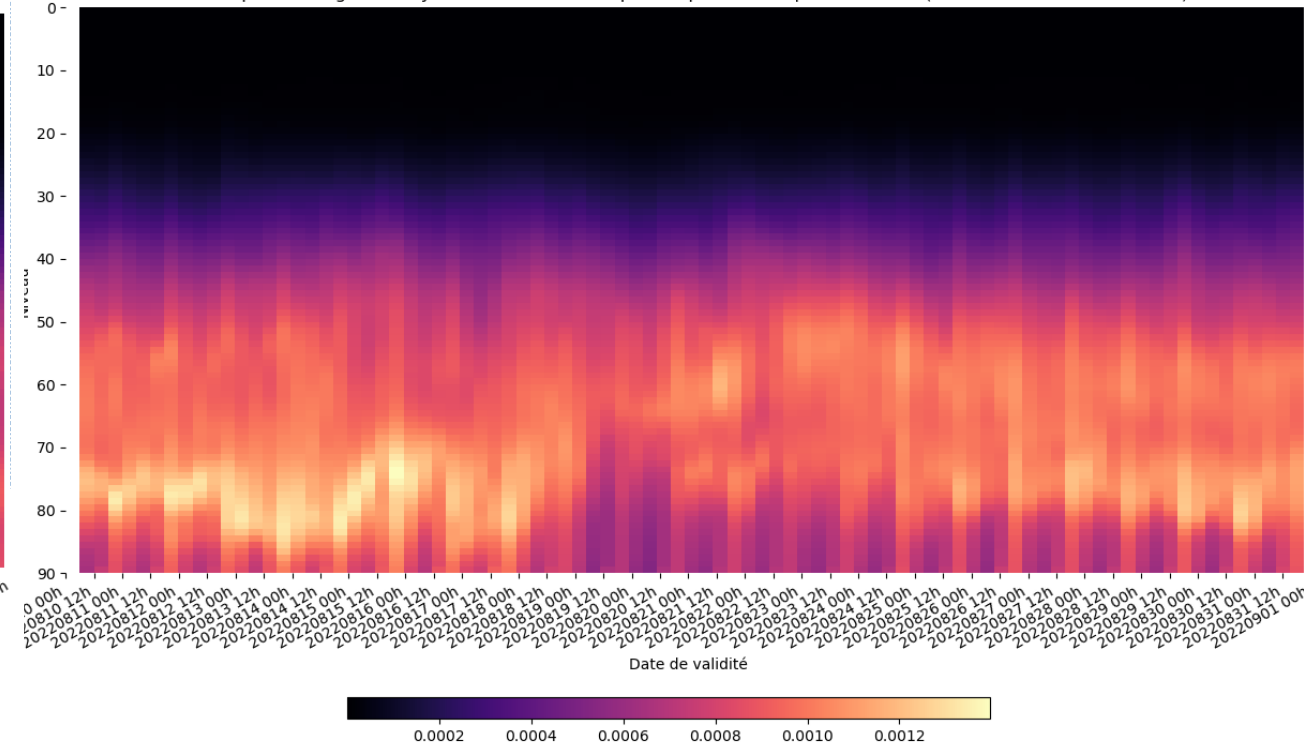
#### 3DEnvar with Global Perturbations

GRAA profil de sigmaB moyenné sur le domaine pour le paramètre q échéance 3h (2022081000 à 2022083118)



#### 3DEnvar with LAM Perturbations

GPZ2 profil de sigmaB moyenné sur le domaine pour le paramètre q échéance 3h (2022081000 à 2022083118)

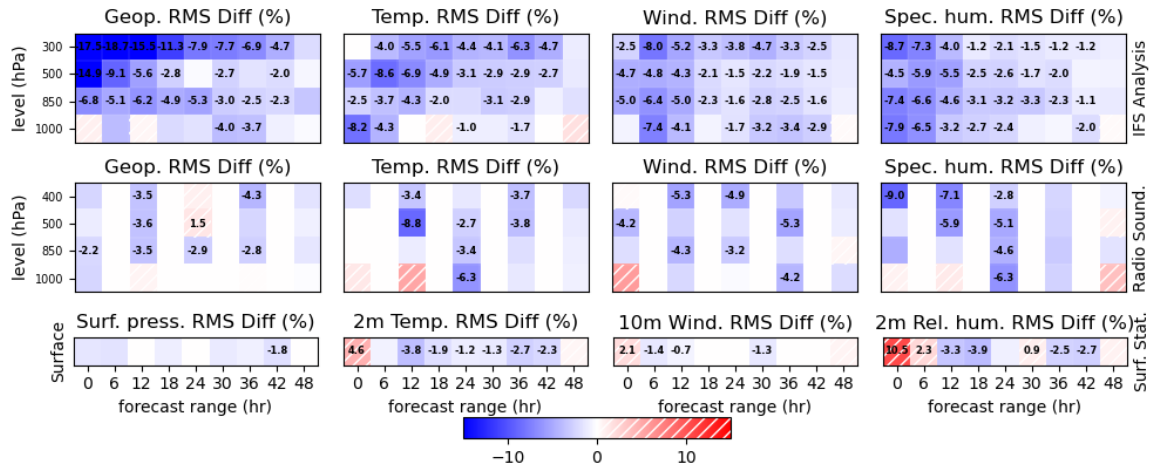


Specific Humidity Sigma-b vertical profile  
same amplitude => we can not apply the same inflation for all the variables !

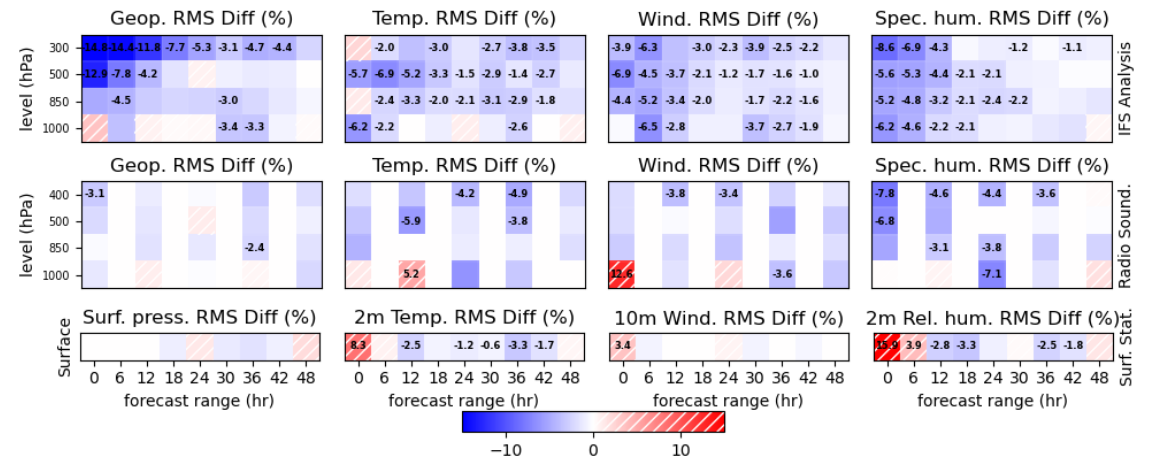
! Thanks to Valérie VOGT for the scripts.

# 3. Results & Scores : Scores

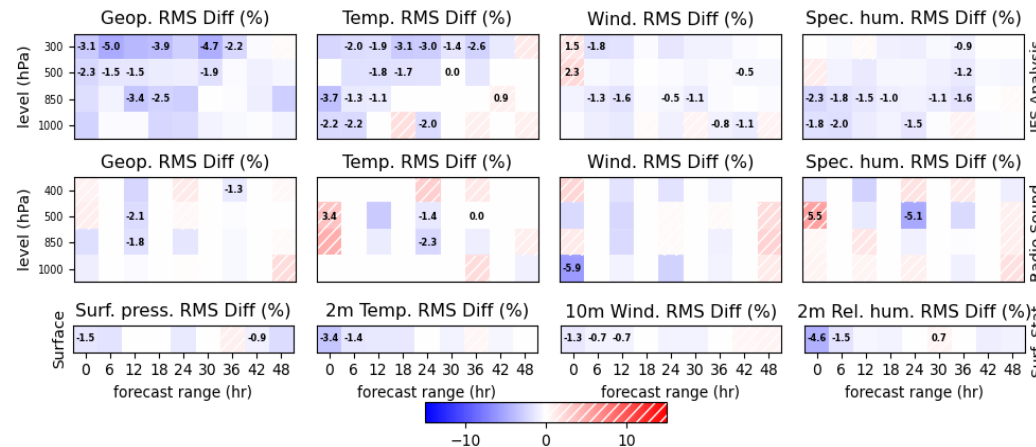
## 3DEnvar with LAM Perturbations Vs 3DVar



## 3DEnvar with Global Perturbations Vs 3DVar



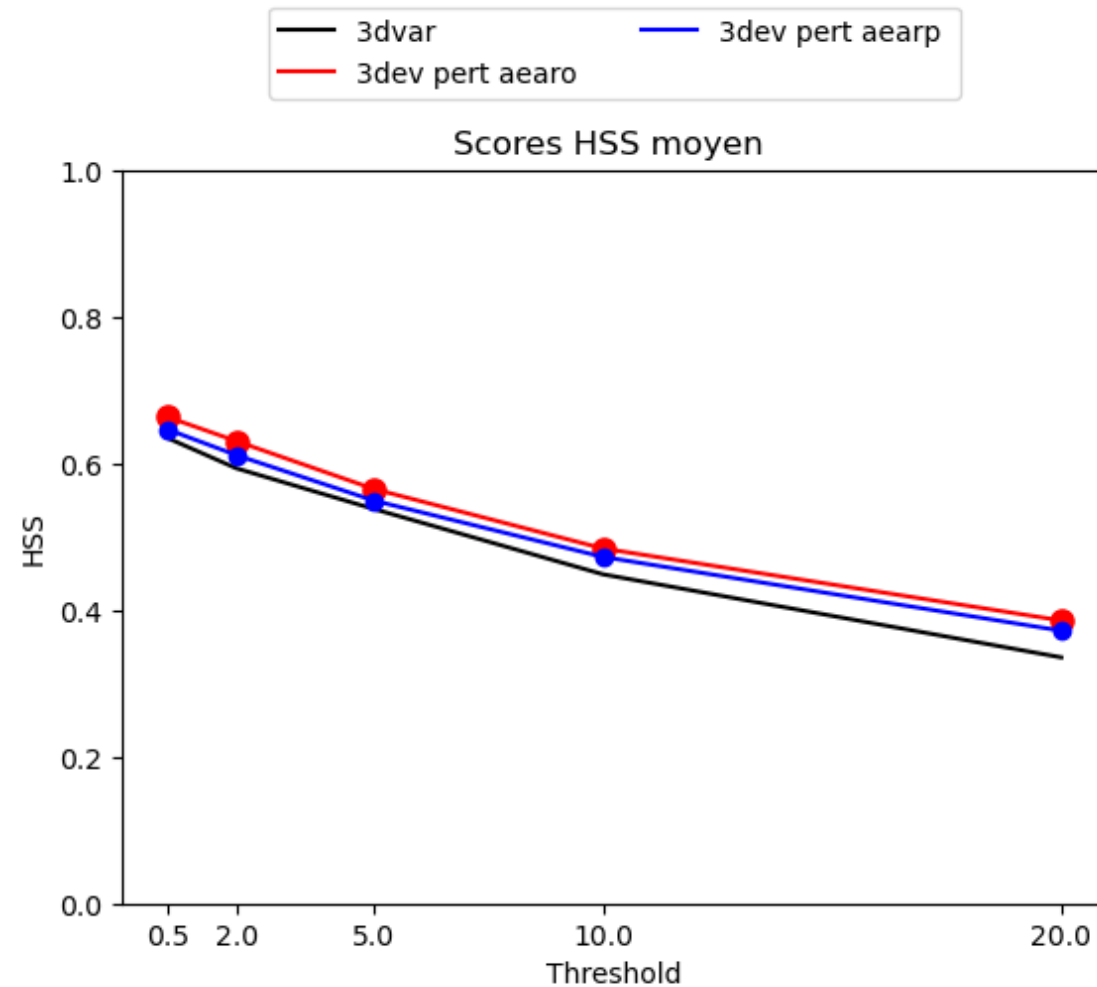
## 3DEnvar with LAM Perturbations Vs 3DEnvar with Global Perturbations



- 3DEnVar with Global Perturbations is a good alternative for a 3DEnVar with LAM Perturbations

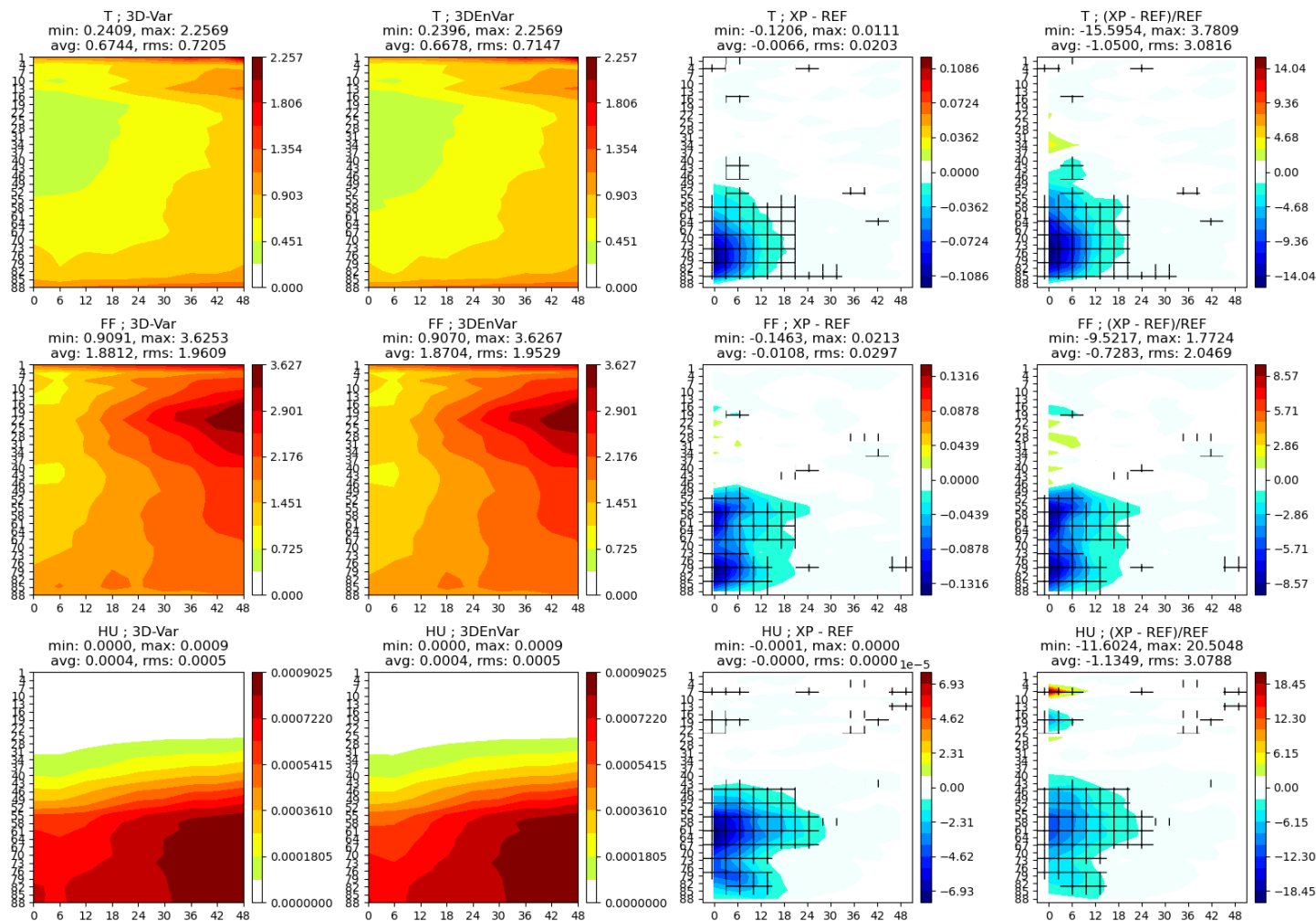
### 3. Results & Scores : Scores

- 24H accumulated Rain HSS average score over the verification period
- 3DENVAR with Global Perturbations is better than 3DVAR
- 3DENVAR with Global Perturbations is a good alternative for a 3DENVAR with LAM Perturbations



# 4. AROME-Tunisie 3DEnVar with global EDA perturbations : first results

Comparaison des EQM framng



- Scores of T, FF and Q compared the arpege analysis every six hours over 20 days

- Improvement in 3DEnVar with global perturbations compared to 3DVar in a good part of the troposphere until 24 hour which reaches 10% in relative difference

! Thanks to Maud MARTET for the scripts and the scores.

## 5. Summary & Perspective

### +Summary:

- 3DEnVar with Global Perturbations is better than 3Dvar
- 3DEnVar with Global Perturbations is a good alternative for a 3DEnVar with LAM Perturbations

### + Perspectives:

- 3DEnVar with Scale Dependent Localization
- Applying different inflation factors for the control variables

Thanks for your attention !

Questions?

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