Institut National de la Météorologie

DAsKIT Working Days

AROME-Tunisie 3Dvar system :

B matrix computation & diagnostics

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PNT / DRDM / INM

Outline

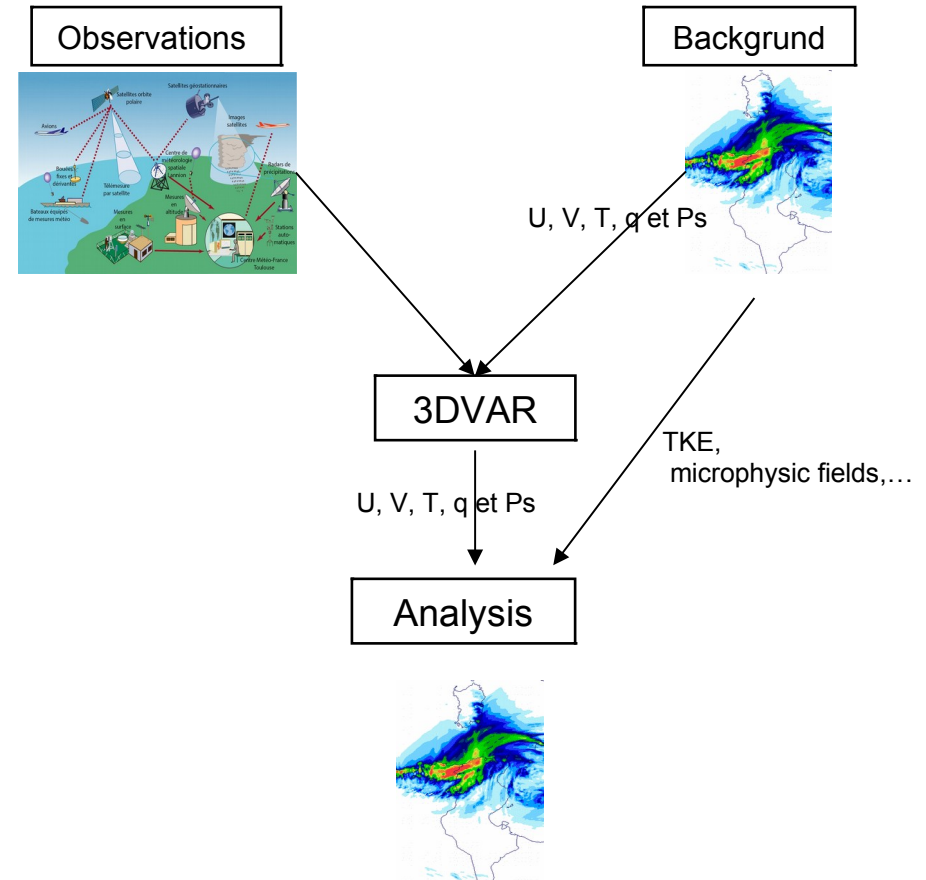## ALADIN-Tunisie DA Configuration

- 3DVAR scheme
- 6H cycling
- OPLACE observations
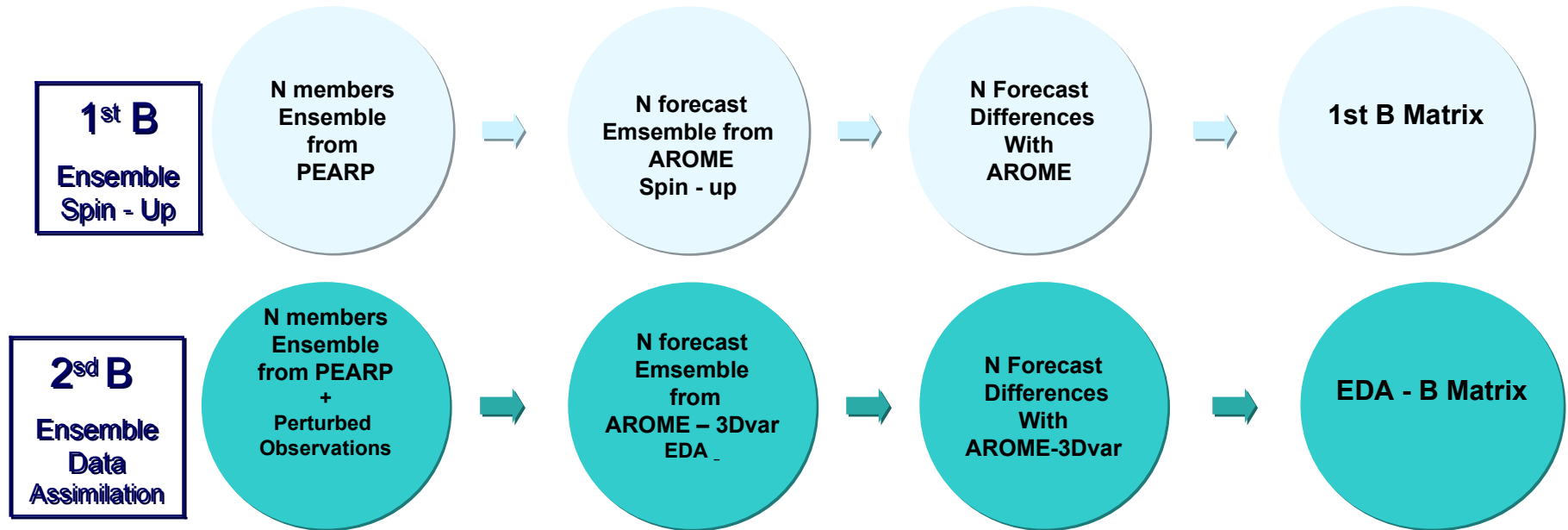- Local: Synop, Amdar

AROME-Tunisie DA Configuration

Tested on Meteo-France

- 3DVAR scheme
- 3H cycling
- Synop, Temp, Amdar, Buoy
- Satellite: Seviri, AMSU-A, AMSU-B, IASI

Data Assimilation Scheme

Observations

Backgrund

U, V, T, q et Ps

3DVAR

TKE, microphysic fields,…

U, V, T, q et Ps

Analysis

1st B — Ensemble Spin - Up

N members Ensemble from PEARP → N forecast Emsemble from AROME Spin - up → N Forecast Differences With AROME → 1st B Matrix

2sd B — Ensemble Data Assimilation

N members Ensemble from PEARP + Perturbed Observations → N forecast Emsemble from AROME – 3Dvar EDA → N Forecast Differences With AROME-3Dvar → EDA - B Matrix

Perturbed SST with C931

Perturbed SST

- OSTIA files

- As the Sea ~ 1/6 of Tunisian domain -> fixed perturbation

! Perturbed SST for the LACE domain with C931 over 2 periods winter+summer 2016 : work done during the LACE stay on Prague 2018 (files and scripts available on MF servers)

▪B matrices are the average of 3 B matrices calculated over 3 periods: winter (rainy season) , summer (Hot & humid) and Fall (convective systems) ➔ take on consideration all the Regimes that influence Tunisian Weather

▪ In order to have a positive definite B matrix , we must have the number N of differences equal to or greater than the number of vertical levels of the model (60 for Arome 2.5 km et 90 for Arome 1.3 km) :

Winter-Time 07-16 February:

   6 members ensemble * 10 days at 00H ➔ **60**

Fall-Time ''Off season'' 25 September – 04 October 2015:

   6 members ensemble * 10 days at 00H ➔ **60**

Summer-Time 16-20 August 2016:

   6 members ensemble * 5 days * 2 runs 00H & 12H (to integrate convective phenomena) ➔ **60**

▪Same periods for B matrix - EDA and B matrix Spin-up ➔ compare the matrices

What kind of diagnostics ?

▪**Standard deviations and variance spectra** :

- Horizontal variance spectra of background error

- Vertical profile of background error standard deviation

▪**Auto-correlation** : Vertical Profile of vertical correlations

▪ **Cross – correlation** :

- Vertical profile of spectral averages of percentages of explained error variances

- Horizontal scale of spectral averages of percentages of explained error variances

? **What kind of information can we take from such diagnostics ?**

Vertical profile of background error standard deviation 1
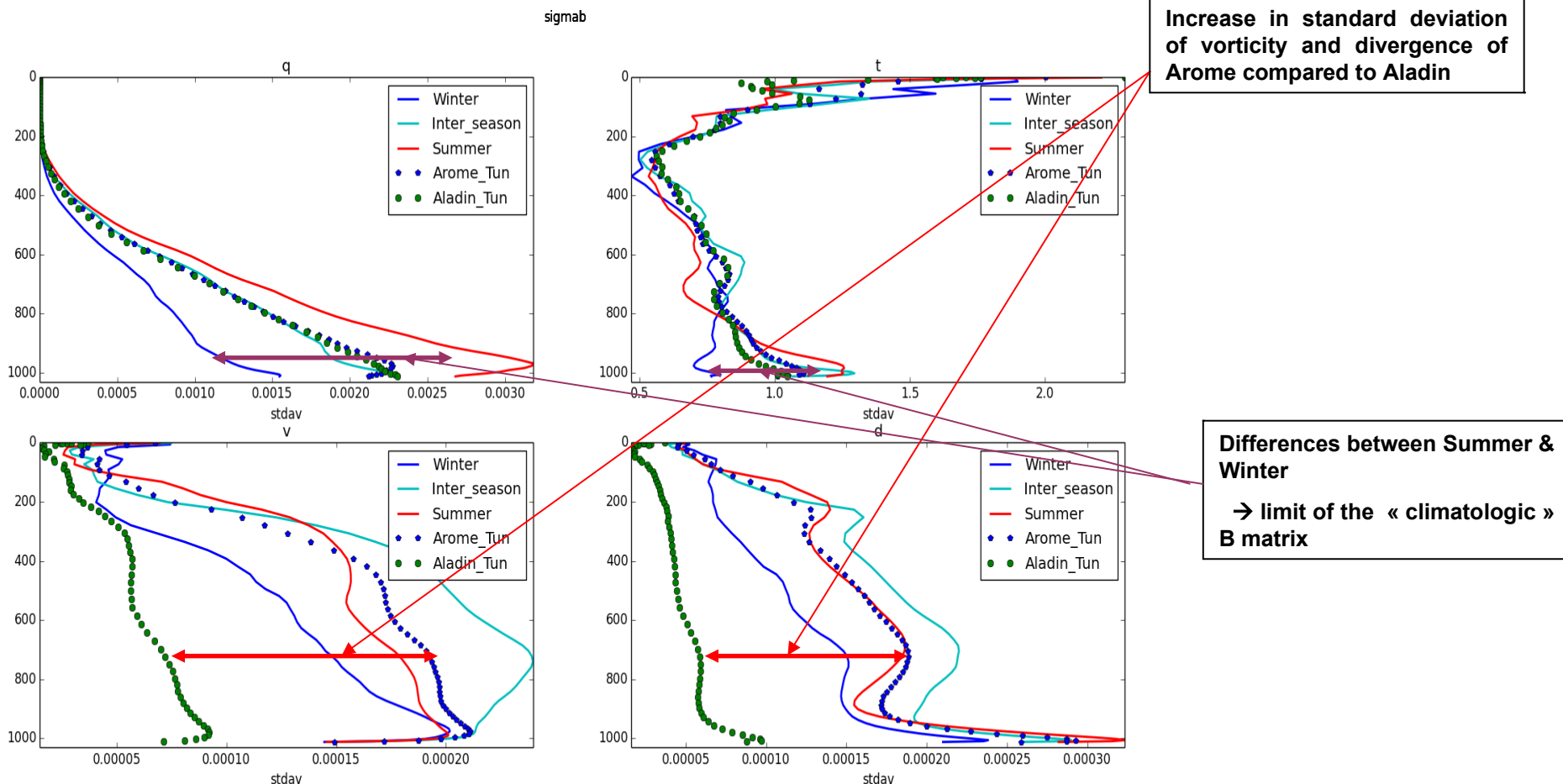
Vertical profile of the standard deviation of specific humidity (q), temperature (t), vorticity (v) and divergence (d) for AROME-TUNISIE during winter (blue line), inter-season (cyan line) and summer (red line) periods; AROME–Tunisie (mean of the 3 periods) (blue dot) and ALADIN-TUNISIE (green dot).

Increase in standard deviation of vorticity and divergence of Arome compared to Aladin

Differences between Summer & Winter

→ limit of the « climatologic » B matrix

Vertical profile of background error standard deviation 2

Increase in standard deviation of vorticity and divergence of Arome EDA versus Arome Spin up

Vertical profile of the standard deviation of specific humidity (q), temperature (t), vorticity (v) and divergence (d) for AROME-TUNISIE Spinup; AROME–Tunisie EDA and ALADIN-TUNISIE (green dot).

Horizontal variance spectra of background error 1
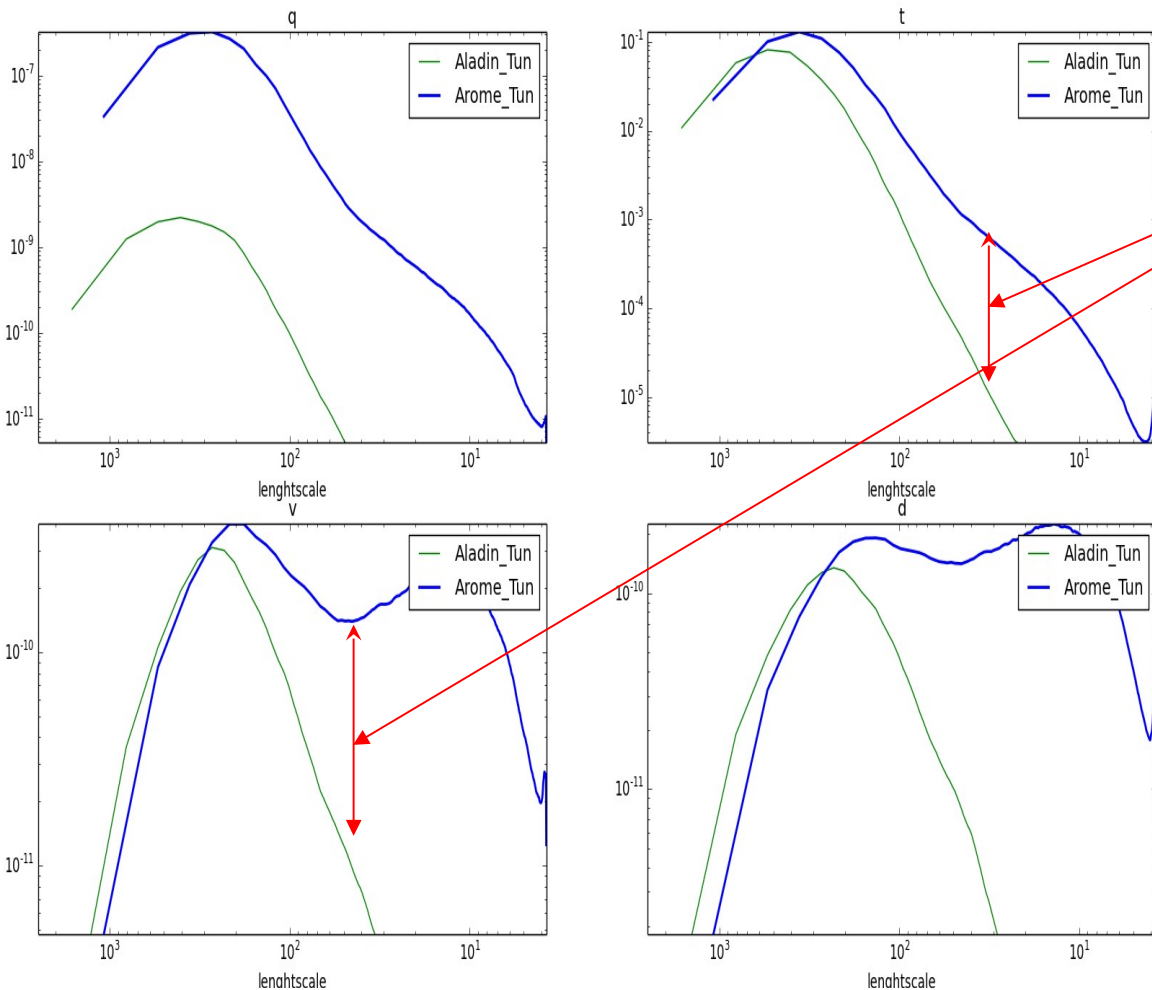
Difference between Arome and Aladin for short wavelengths as Arome represents better small scale structures

Arome DA will put less weight on background fields than Aladin

→ **For the same innovation, Arome increment will have larger amplitude then Aladin**

Horizontal variance spectra at 800 hPa of specific humidity (q) temperature (t), vorticity (v) and divergence (d) for AROME–Tunisie (blue) and ALADIN-TUNISIE (green)

Horizontal variance spectra of background error 2
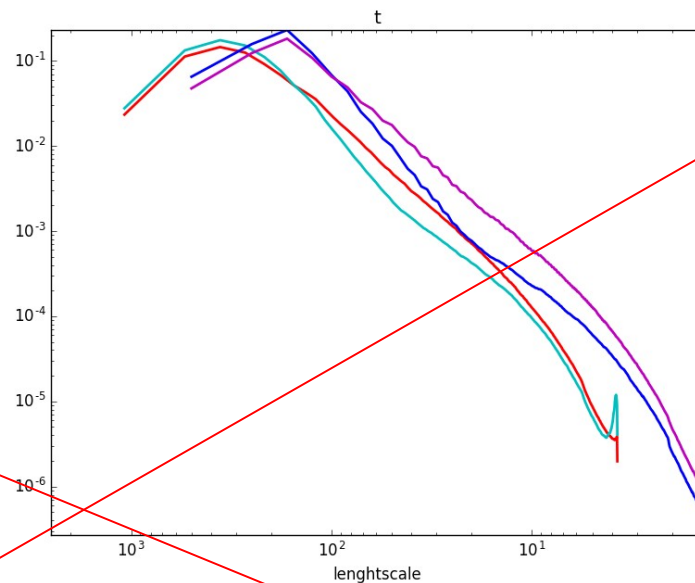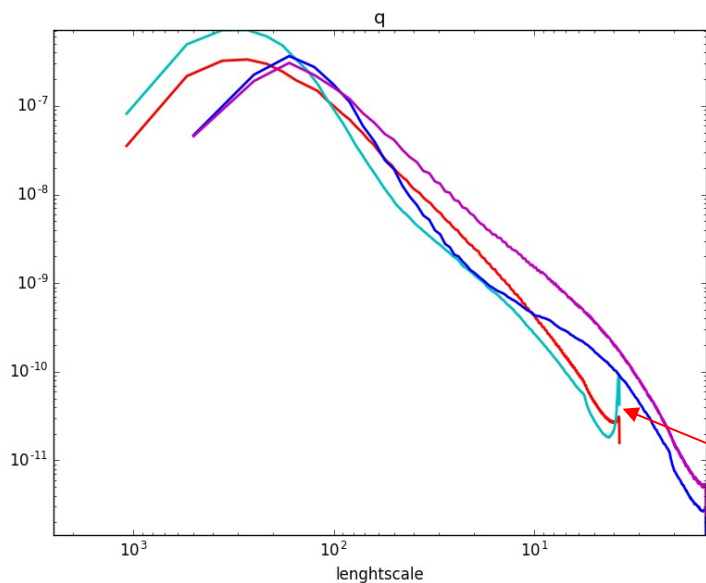
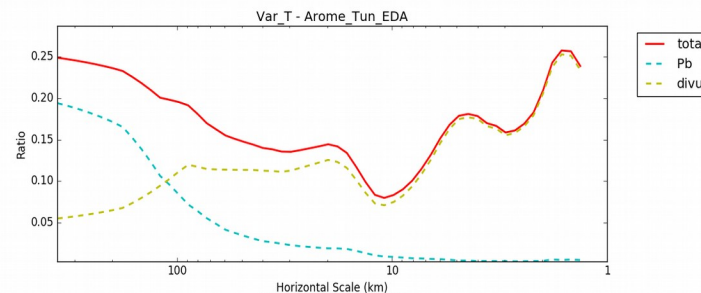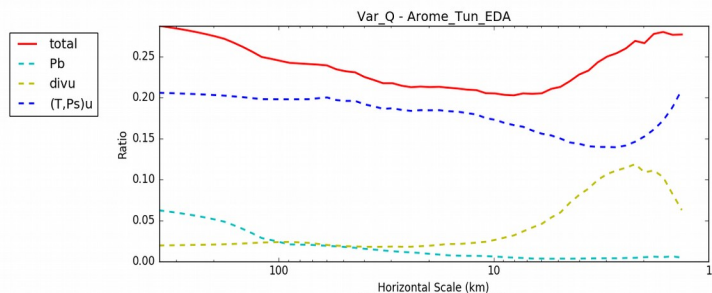**Arome EDA horizontal variance are bigger than Arome Spin up for short wavelengths**

Evolving of small scale background perturbations due to EDA Cycling Effect
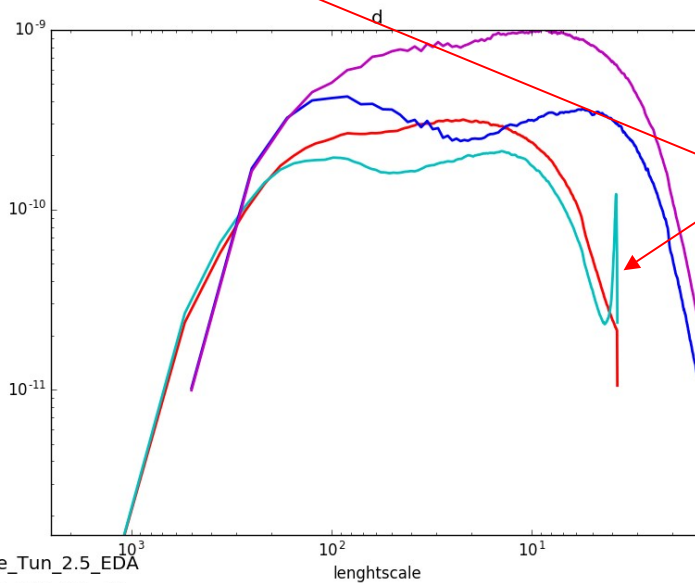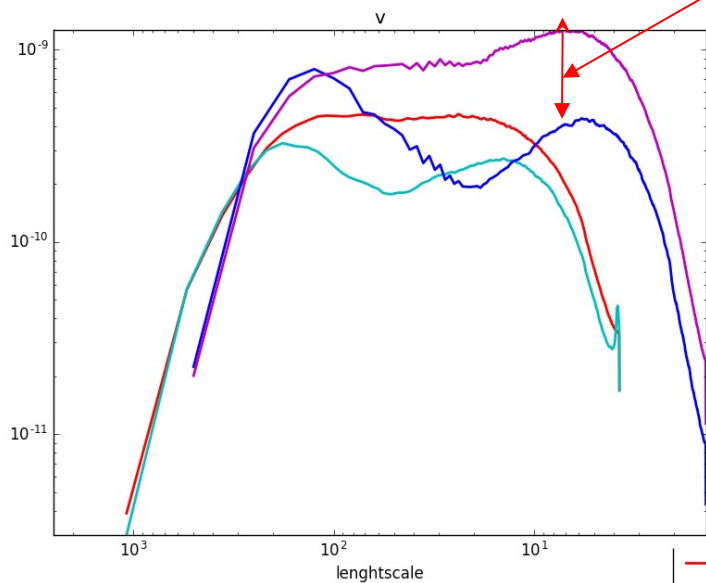
Noise with B matrix Spin-up

-> reduced due to DA cycling with EDA B matrix

Arome_Tun_2.5_EDA
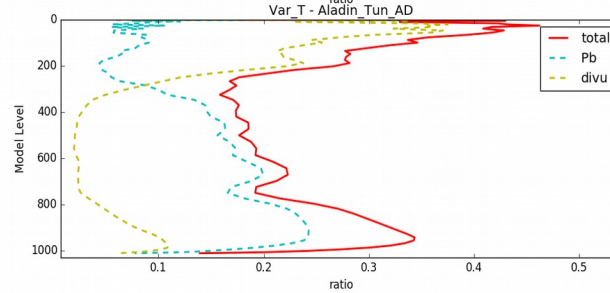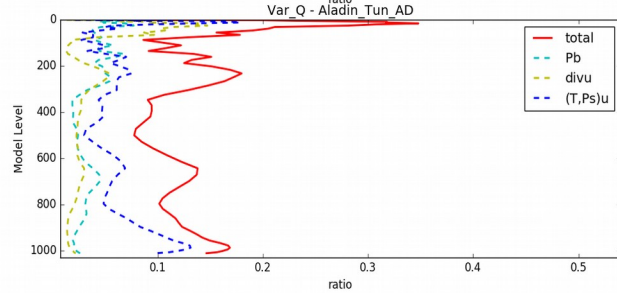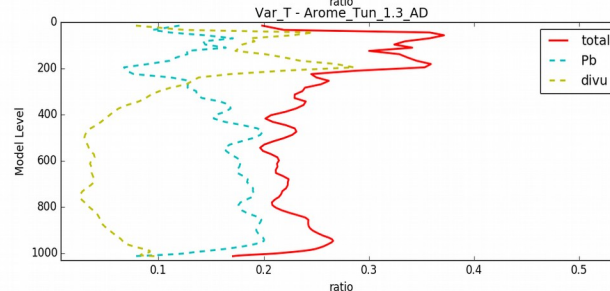Arome_Tun_2.5_AD
Arome_Tun_1.3_AD
Arome_Tun_1.3_EDA
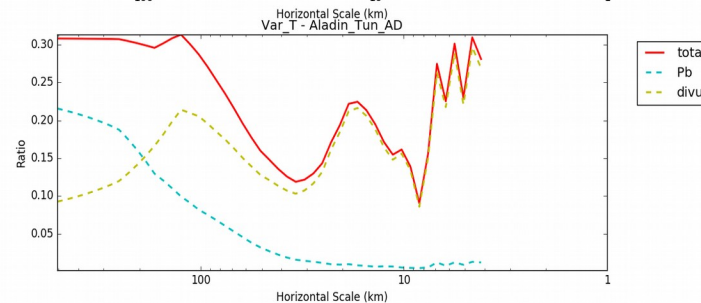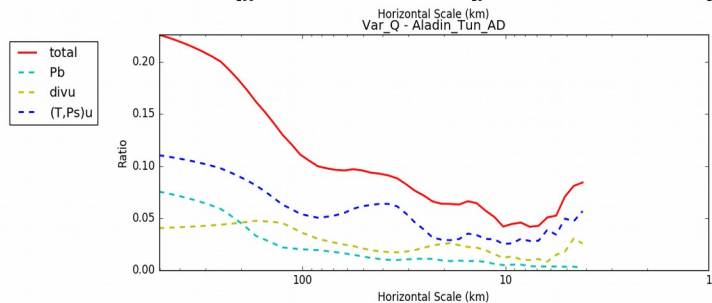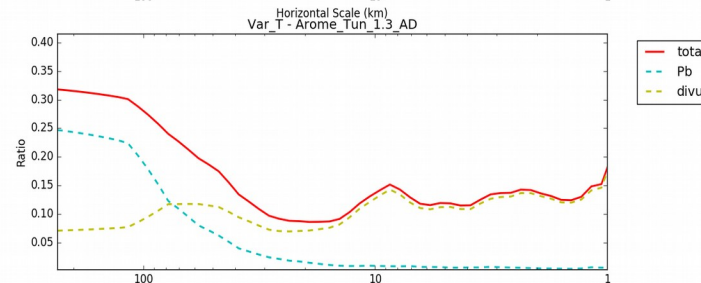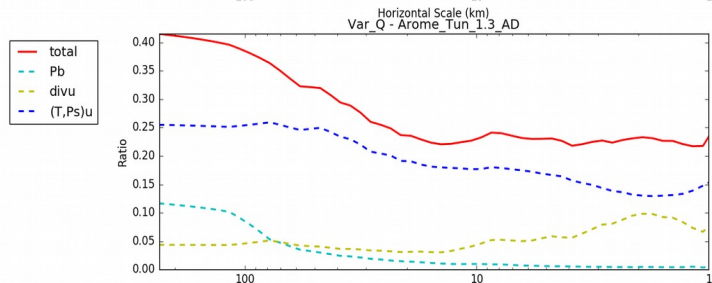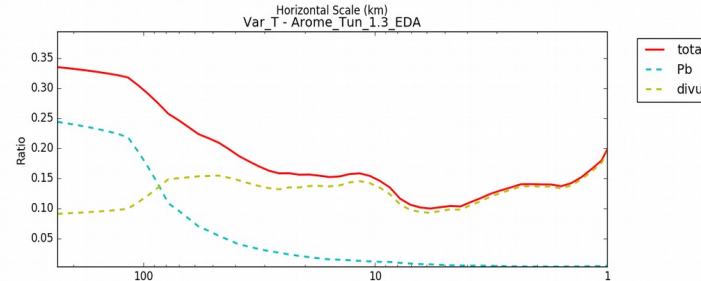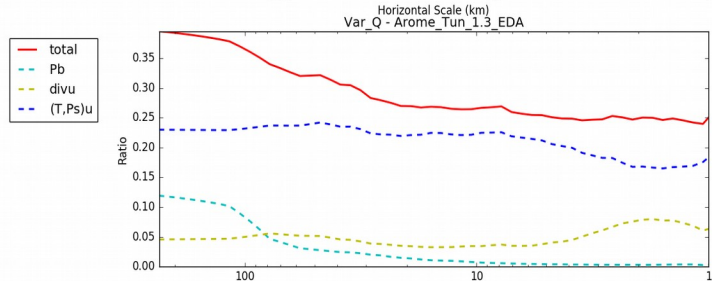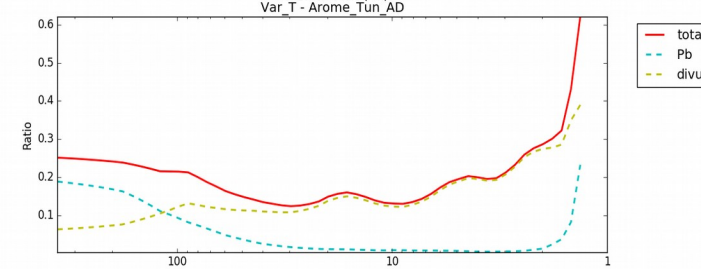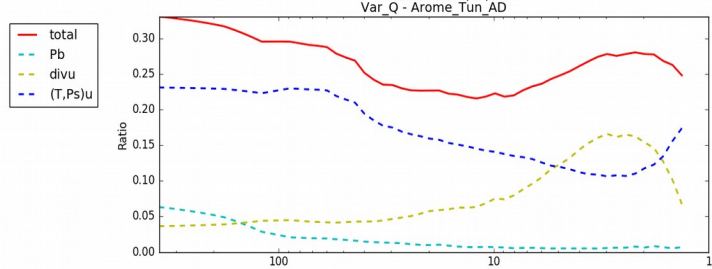
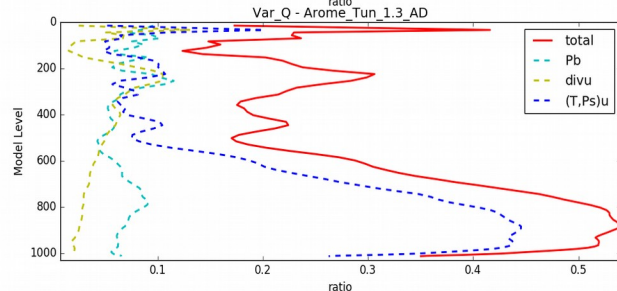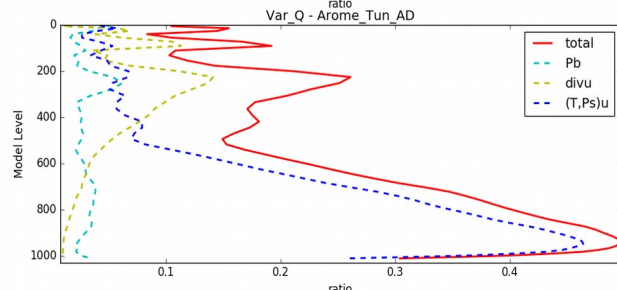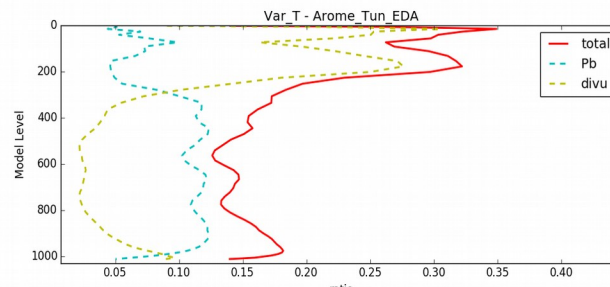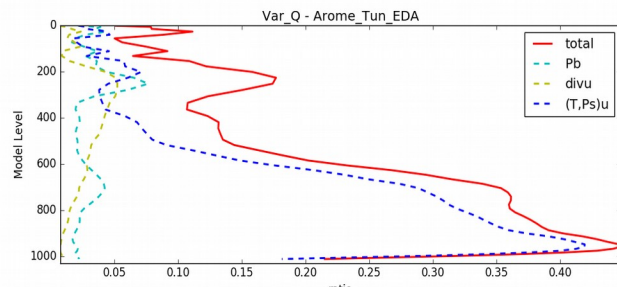**Explained Variance:**

Horizontal scale

Pb unbalanced
Geopotentiel

Divu unbalanced
Divergence

T unbalanced
Temperature
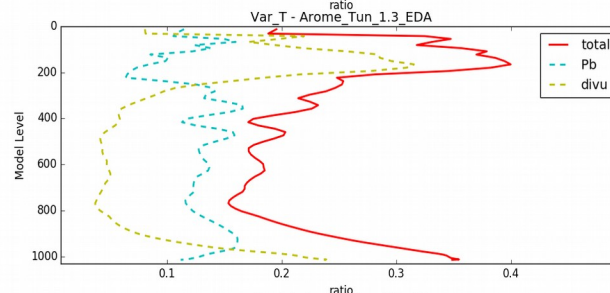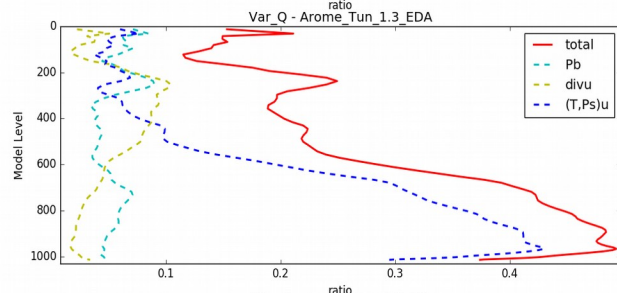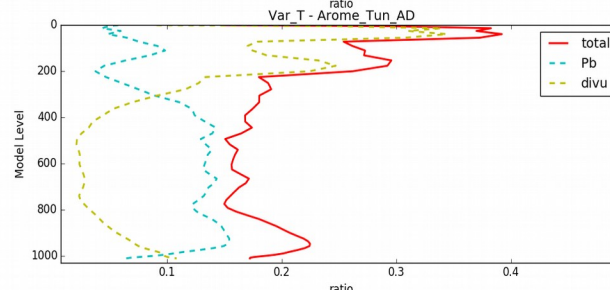
Explained Variance:

Vertical profile

Pb unbalanced Geopotentiel

Divu unbalanced Divergence

T unbalanced Temperature

- Despite the computational cost, B matrix with EDA is worth pursuing

- Jk blending to overcome the "sparseness" of observation on Tunisian domain : Work on progress

- Next Challenge: Observations

 Work on our Local Data Base Observation for DA

Thank you ☺

Question ?

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