ALADIN Data Assimilation basic kit Working Days

Institut National de la Météorologie

DA experiences and plans in Tunisia

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Models Installed on the HP Server

	ALADIN	AROME	HARMONIE
Model version	CY38t1_bf.03	CY38t1op2	CY38t1_bf.03
Spatial Resolution	7.5 km	2.5 km	2.5 km
Vertical Levels	70	60	65
Boundaries	ARPEGE 10km	ARPEGE 10km	ALADIN 7.5km
Time step	450s	45 s	45 s

HP proliant Server	
Processors	4 CPUs (6,42GHZ), 40 cores, 80 threads
RAM	256Go
Hard disk	16 To
Operating system	Redhat Linux 6.5

Which data

Locally : 25 synop station, 2 TEMP, 1 wind profiler

RADAR project

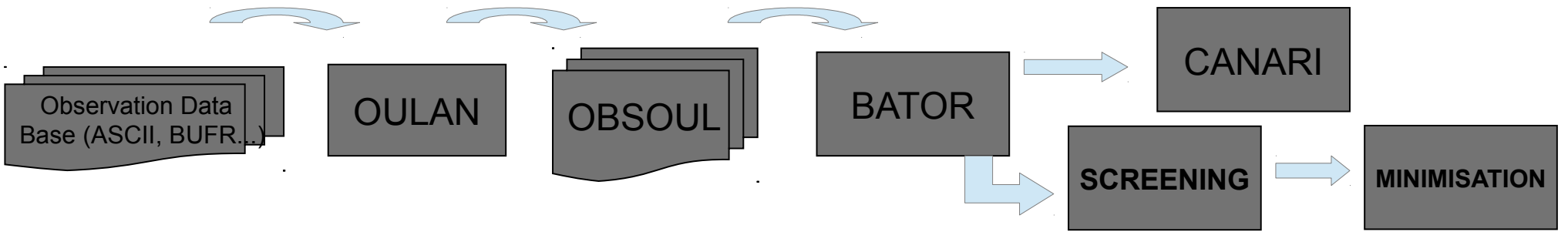
OPLACE data

- Observations for CANARI

  SYNOP and TEMP

- Observations for 3DVAR

  SYNOP / Aircraft / AMV / TEMP / Wind Profiler / Satellite ATOVS / Satellite SEVIRI



Canari and Minimisation chain

- Obsprep - odb – canari
- Obsprep – odb – screening – minimisation

Obsprep : prepares all needed observations for 3DVAR Atmospheric analysis.

Odb : Builds ODB (program BATOR) by subbases and merges the sub-bases at the end to one common ECMA database. The database is dumped at the end with MANADALAY.

Screening : Performs observational SCREENING and take first guess from CANARI analysis.

Minimisation : Performs 3DVAR analysis and take first guess from CANARI analysis.

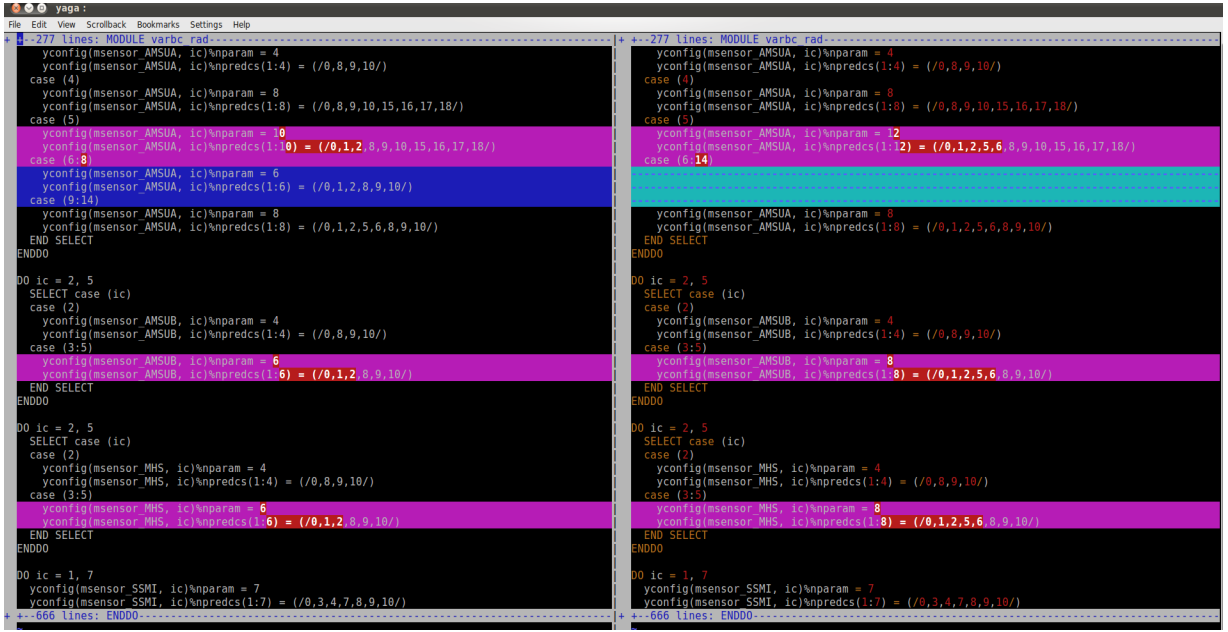
Screening & Minimisation

- **When I run screening with ARPEGE VARBC file I get the following error :**
  - ABORT! 1 VarBC_setup (load_table): Increase JPMXNPRED.
- it occurs in the following chain :
  - #4 0x20D640F in __sdl_mod_MOD_sdl_srlabort at sdl_mod.F90:100
  - #5 0x20F1DF9 in abor1_ at abor1.F90:38
  - #6 0x4E3746 in __varbc_setup_MOD_load_table at varbc_setup.F90:1606
  - #7 0x4EDBC2 in __varbc_setup_MOD_setup_traj at varbc_setup.F90:283
  - #8 0x4402D8 in cnt1_ at cnt1.F90:105
  - #9 0x40AEC3 in cnt0_ at cnt0.F90:171
  - #10 0x408721 in MAIN__ at master.F90:85
- **And when I run it in cold-start mode (LVARBC=FALSE) ; it seems that the model diverge, I get NAN for T and Q**
  - Is it enough to put LVARBC = FALSE to launch screening and minimzation in cold start mode or there are other changes to make ?

Screening & Minimisation

- Must have same set of predictors in the model through module/varbc_rad.F90. Otherwise, the global VarBC coefficient are not reasonable for the VarBC scheme. In this case, there is probably different setting of predictors for some MHS/AMSU-B and AMSU-A channels. The next image shows the modification (in varbc_rad.F90) that are necessary to set. Default (right) and modified file (left).

Secondly, in the VarBC file there is parameter Numpreds defining the maximal number of predictors in the VarBC scheme. This number is cycle dependent. So it is numpreds=27 for (cy38t1),
however, numpreds=31 in Arpege (cy41t1). In order to use the Arpege VarBC file as warmstart, it is enough
to rewrite this numpreds=31 to numpreds=27 in the Arpege VarBC file. This is also the solution for the abort:
ABORT! 1 VarBC_setup (load_table): Increase JPMXNPRED.



Screening & Minimisation

- VarBC_setup (data_stats): Get data counts and obs errors
- VarBC_RAD (get_min): Parameter mismatch!
- groupkey=4 3 5
- nparam=10
- yconfig(isensor,ichannl)%nparam=12
- ABOR1 CALLED
- VarBC_RAD (get_min): Number of parameters does not match.

COPE: Continuous Observation Processing Environment

is set up as a collaboration between ECMWF, Meteo-France, HIRLAM and ALADIN/LACE. It was proposed because the current observation processing chain including quality control which could be found in several places (e.g. pre-processing, external pre-screening, screening within assimilation...) is not optimal. The COPE framework will replace the packages OULAN / BATOR (and BUFR2ODB at ECMWF), to improve the pre-processing of observations for use in NWP.

The current design of the pre-processing chain for synop observations :

SYNOP TAC/BUFR	**”decoding”**	**local database (BUFR/NETCDF...)**	**OULAN**	**OBSOUL ASCII**	**BATOR**	**ODB-1**

COPE: Data flow for synop observations

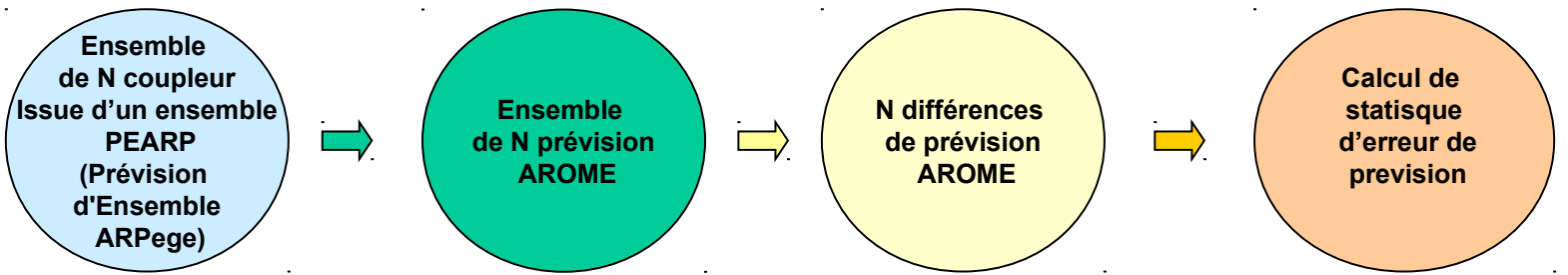
SYNOP BUFR format	**B2O (bufr2ODB)**	**ODB-2**	**COPE FILTERS**	**ODB-2** (filtered)	**odb2_to_odb1**	**ODB-1**

COPE: Continuous Observation Processing Environment

- BATOR is definitely more mature and MF/ALADIN/HIRLAM are familiar with how it works. COPE is less mature and, it was identified that the final step writing ODB suitable for data assimilation can be problematic. The main benefits of COPE are relation to its construction and flexibility. For example, filtering and QC are easily applied to observations.
- to what point the COPE framework will be efficient and/or beneficial for LAM applications in comparison with BATOR, especially with respect to it’s maintenance and the maintenance of its related software.

Background error covariance matrix:

- Determines how the observations modify the guess to produce the analysis.
- The computation was done with the ensemble methode : using an ensemble of forecasts in dynamique adaptation to estimate the error covariances of forecasts.



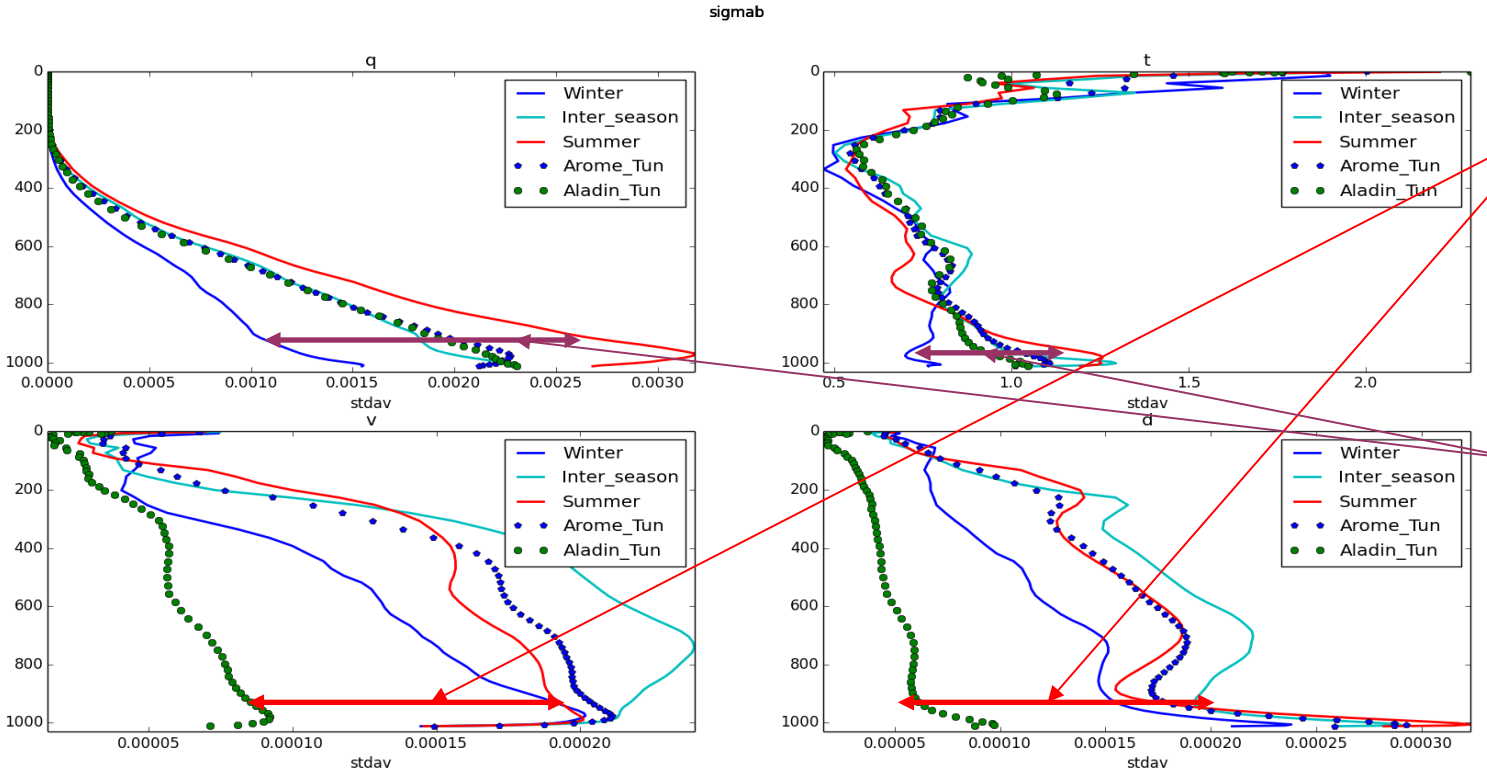
- The AROME B-matrix is the average of B-matrixes calculated over 3 periodes: winter, summer et interseason
- For the B-matrix to be positive definite, the number N of differences should be equal to or greater than the number of vertical levels of the model 60:

winter periode : an ensemble of 6 members * 10 days → 60

interseason periode : an ensemble of 6 members * 10 days → 60

summer periode : an ensemble of 6 members * 5 days * 2 networks 0h et 12h (to take more into account the convective phenomena) → 60

4. The configuration AROME-3DVAR: Statistics of the Background error covariance matrix



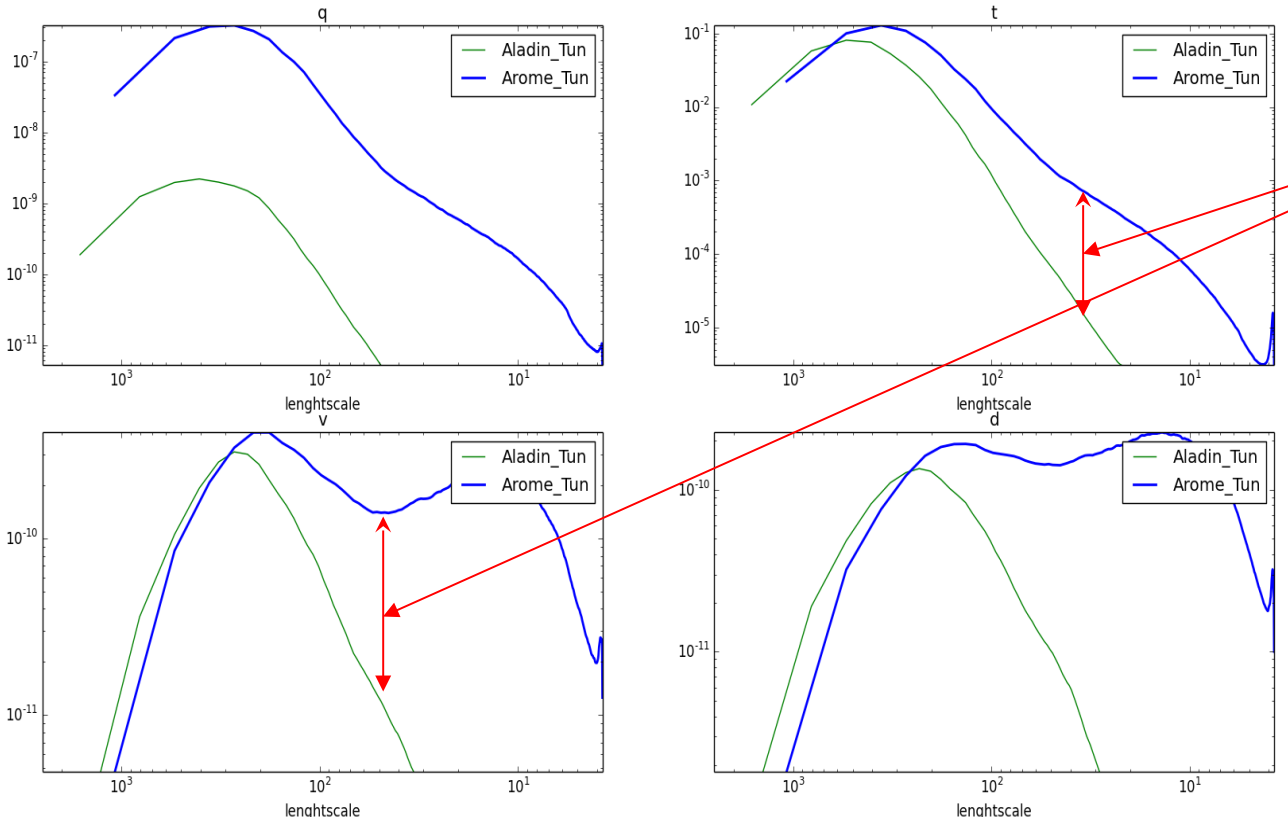
Increase in standard deviation of guess errors for vorticity and the divergence of Arome compared to Aladin

Differences in the statistics according to the calculation period

==> Limit of B-matrix "climatological"

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).

The configuration AROME-3DVAR : Statistics of the Background error covariance matrix



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)

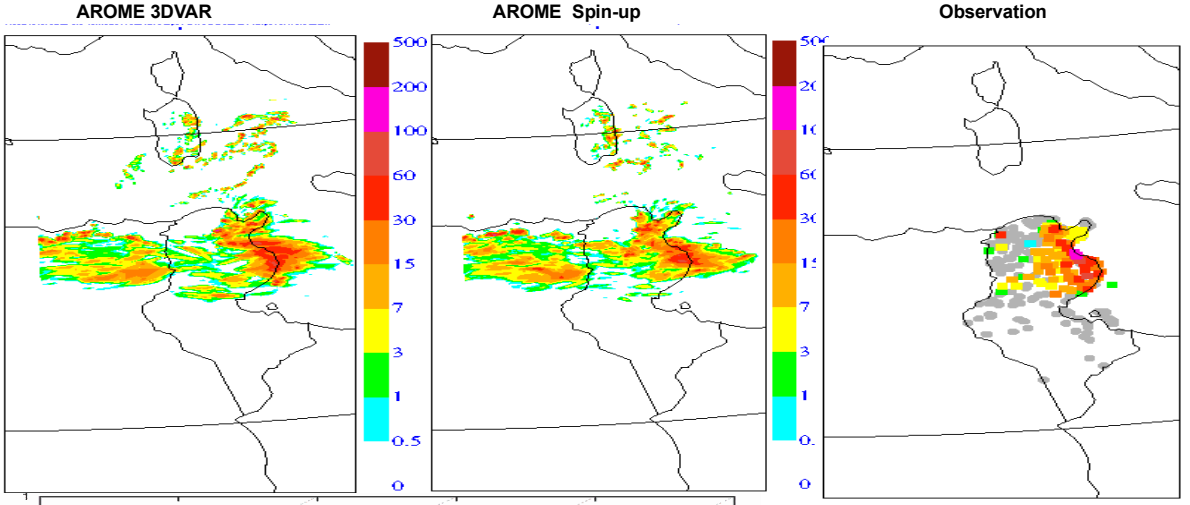
Increased gaps between Arome and Aladin for smaller wave lengths as Arome better represents small-scale phenomena

In assimilation, the Arome guess will have less weight and will be more modified than Aladin

- **For the same innovation (observation - guess), Arome's increment (analysis-guess) will be larger**

Flood event of 23 september 2016

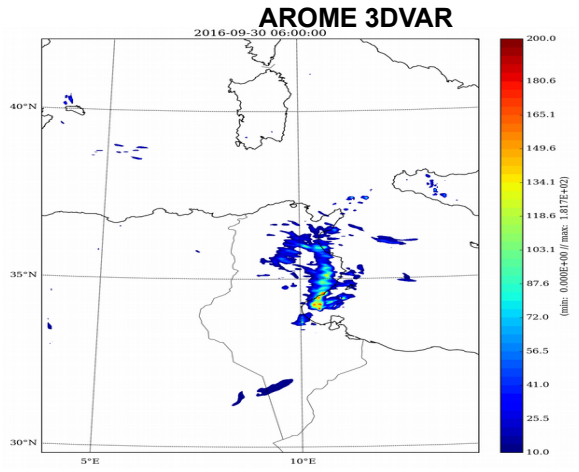
On the 23th of September 2016, a flood event occurred on the Tunisian eastern cost caused by an intense **convective system**. This case study shows the data assimilation impact on the forecast of the precipitations. Although both AROME-3DVAR and AROME Spin-up mode configurations predicted well the situation, AROME-3DVAR gave more accurate forecasts for the precipitation amount and the convective cell localization. As it is shown in these figures, AROME-3DVAR (red line) improved the detection rate and reduced the false alarm rate for all the thresholds compared to AROME on spin-up mode (green line).

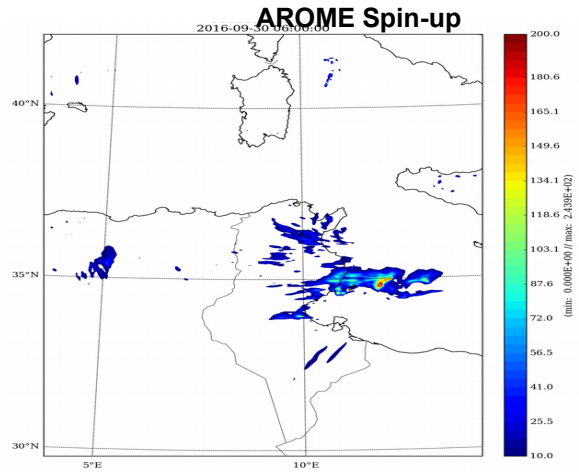


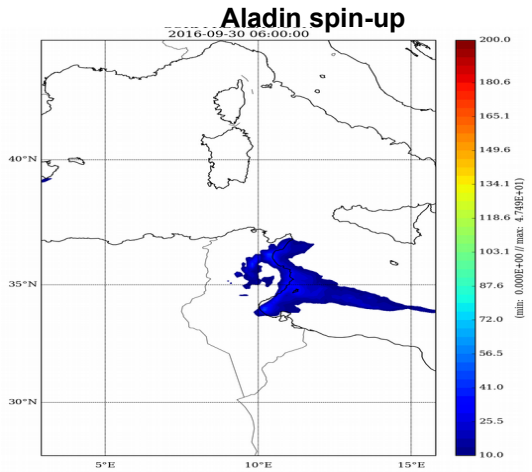
▪ **AROME-TUNISIE 2.5 km 3DVAR Results during the 23th of September 2016 Flood event**

by Wafa Khalfaoui

Apport de AROME-3DVAR dans des situations convectives; Inondations de Septembre 2016



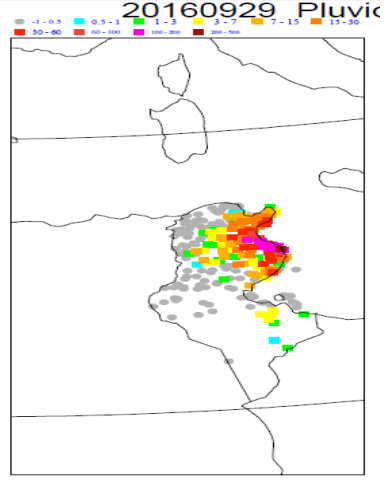




Case of 29 Septembre 2016

Better estimation of the localisation and the intensity:

- more than 200 mm near Mahdia
- Better estimation of the localisation and of the intensity for Arome 3DVAR compared to the dynamique adaptation.
- While Aladin missed the situation, Arome has well predicted the torrential rains of September 29.



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Thank you for your attention