Stay report

Updating and validation of Arome_dust

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Contents

Introduction

Early versions of Arome code and Aladin contained a complete scheme of atmospheric desert dust cycle were validated during the thesis work of Kocha (2011) and Mokhtari (2012), respectively. These two versions, now called Arome_dust and Aladin_dust, were used in conjunction with Meso-NH during the Fennec measure campaign. During this campaign, desert dust products simulated by Arome_dust and Aladin_dust were confronted to real-time observations (Chaboureau and al. 2016).

The first validated version of Arome_dust was based on the cycle 33. Since this cycle, no validation or assessment has been made on recent cycles of Arome_dust. Furthermore, developments and significant improvements are introduced into source codes, new coding standards, new databases, new surface and micro physical schemes... etc. Certainly, these elements affect the desert dust cycle. So an update of this version is necessary.

Unlike Arome_dust, Aladin_dust versions were regularly updated since its initial version based on cycle 36. A first update of the Aladin_dust version was performed on cycle 36 and used during the CHAMRMEX campaign (Mallet and al. 2016). An evaluation to cycle 38 has been carried out and validated during the exercises of Working Group on Numerical Experimentation (WGNE) (http://meioambiente.cptec.inpe.br/wgne-aerosols/), then, the same version has been implemented in the supercomputer at the Algeria Met Office (ONM). This version became operational since May 2014. An important new diagnostic field was introduced in this version which is visibility. Therefore, this version is often consulted by forecasters for drawing up aeronautical bulletins, including the regional meteorological departments in southern Algeria.

A final validation of this version took place in June 2016 just after the update of Aladin-Algeria from cycle 38 to 40. Although these updates are not introduced in GCO official cycles for other Aladin partners so they can benefit.

For all these reasons, this stay was programmed, its purposes are:
- Phasing Arome_dust and Aladin_dust version on cycle 43
- Evaluating and upgrading Arome_dust version (cycle 40) with Aladin_dust

This report is organized as follows: we'll present in Chapter 1 the various changes made to the code to upgrade the Aladin_dust and Arome_dust versions. Chapter 2 is devoted to the description of namelist's changes in order to activate desert dust modules in Arome_dust. Then, we'll describe in the third chapter the experiments carried out. in chapter 4, we'll present all the results obtained for each simulation. We’ll finish this report by a conclusion.

1. Phasing

We'll describe in this chapter the various changes made in the source code to activate dust modules in Arome and Aladin. The basic cycle used is cy43t1_main.

1.1. Phasing of Aladin_dust version

The main modified subroutines are:

1) – arpifs/phys_dmn/mf_phys.F90

- Passive scalars and diagnostics pass to arguments in aplpar.F90 as gfl PGFL variables instead of local variables:

ZEXT → PGFL(1,1,YEXT(1)%MP)

ZEZDIAG → PGFL(1,1,YEZDIAG(1)%MP)

2) - arpifs/phys_dmn/aplpar.F90

- Activating the wet deposition in aplpar.F900

!#include "aro_wetdep.h" ==> #include "aro_wetdep.h"

- Intermediate calculation and initialization of input variables needed for subroutines aro_mnhdust.F90 and aro_wet_dep.F90 without levels's inversion. This allows a homogeneous pre-treatment of desert dust with Arome_dust (subroutine apl_arome.F90).

3) - arpifs/phys_dmn/suphmse.F90

- Activating the aroini_frommpa.F90 and aroini_wet_dep.F90 routines : these subroutines allow to settle the various parameters related to desert dust.

!#include "aroini_frommpa.h"

!#include "aroini_wet_dep.h"

#include "aroini_frommpa.h"

#include "aroini_wet_dep.h"

- Call the aroini_frommpa.F90 and aroini_wet_dep.F90 subroutines.

IF (LMDUST.AND.(NGFL_EXT/=0).AND.LRDEPOS) THEN

CALL AROINI_WET_DEP

ENDIF

CALL AROINI_FROMMPA

4) - arpifs/setup/su0phys.F90

- Adding the logical variable LMDUST

5) - arpifs/nameliste/namarphy.h

- Adding the logical variable LMDUST

6) - mpa/micro/externals/aroini_frommpa.F90

- Initialization of the variable NSV_MSE

7) - mpa/chem/externals/aro_mnhdust.F90

- Preliminary calculation: inversing levels by calling the inv_levels.F90 subroutine.

8) - mpa/chem/externals/aro_wetdep.F90

- Preliminary calculation: inversing levels by calling the inv_levels.F90 subroutine.

9)- mpa/chem/internals/inv_levels.F90

- New subroutine added to the source code to invert levels and move from Meso-NH environment to Aladin/Arome environment and vice versa with addition of two more levels for Meso-NH.

10) - mpa/chem/externals/aro_rainaero.F90

- Calling the inv_levels.F90 routine to invert levels.

11) - mpa/chem/internals/aer_wet_dep_kmt_warm.F90

- Back to original version of the code aer_wet_dep_kmt_warm.F90.

The cycle 43, containing all modifications made to activate dust modules, is availble in :
/home/gmap/mrpe/mokhtari/pack/cy43t1_main.01.dst.IMPI500IFC1500.2y.pack

2. Activating dust modules in Arome

In the case of no-restart, the activation of dust modules at the forecast step in Arome (e001 configuration) is done by activating a set of keys in the namelist block NAMARPHY, especially LRDUST and LRDEPOS as follows:

```
&NAMARPHY
LMPA=.TRUE.,
LMICRO=.TRUE.,
LTURB=.TRUE.,
LMSE=.TRUE.,
LKFBCONV=.FALSE.,
LKFBD=.FALSE.,
LKFBS=.FALSE.,
LMFSHAL=.TRUE.,
LRDEPOS=.TRUE.,
LRDUST=.TRUE.,
/
```

Variables related to desert dust are declared in the nameliste block NAMGFL. In Arome, 9 GFL variables type are introduced for passive scalar variables and 7 for diagnostics:

```
&NAMGFL
NGFL_EXT=9,
NGFL_EZDIAG=7,
YEZDIAG_NL(1)%CNAME='ZN_DST',
YEZDIAG_NL(2)%CNAME='ZM_DST',
YEZDIAG_NL(3)%CNAME='ZRG_DST',
YEZDIAG_NL(4)%CNAME='ZRGM_DST',
YEZDIAG_NL(5)%CNAME='SSA_DST',
YEZDIAG_NL(6)%CNAME='ASY_DST',
YEZDIAG_NL(7)%CNAME='AOD_DST',
YEXT_NL(1)%LGP=.TRUE.,
```

```
YEXT_NL(2)%LGP=.TRUE.,
YEXT_NL(3)%LGP=.TRUE.,
YEXT_NL(4)%LGP=.TRUE.,
YEXT_NL(5)%LGP=.TRUE.,
YEXT_NL(6)%LGP=.TRUE.,
YEXT_NL(7)%LGP=.TRUE.,
YEXT_NL(8)%LGP=.TRUE.,
YEXT_NL(9)%LGP=.TRUE.,
YEXT_NL(1)%LT1=.TRUE.,
YEXT_NL(2)%LT1=.TRUE.,
YEXT_NL(3)%LT1=.TRUE.,
YEXT_NL(4)%LT1=.TRUE.,
YEXT_NL(5)%LT1=.TRUE.,
YEXT_NL(6)%LT1=.TRUE.,
YEXT_NL(7)%LT1=.TRUE.,
YEXT_NL(8)%LT1=.TRUE.,
YEXT_NL(9)%LT1=.TRUE.,
YEXT_NL(1)%LADV=.TRUE.,
YEXT_NL(2)%LADV=.TRUE.,
YEXT_NL(3)%LADV=.TRUE.,
YEXT_NL(4)%LADV=.TRUE.,
YEXT_NL(5)%LADV=.TRUE.,
YEXT_NL(6)%LADV=.TRUE.,
YEXT_NL(7)%LADV=.TRUE.,
YEXT_NL(8)%LADV=.TRUE.,
YEXT_NL(9)%LADV=.TRUE.,
YEXT_NL(1)%LQM=.TRUE.,
YEXT_NL(2)%LQM=.TRUE.,
YEXT_NL(3)%LQM=.TRUE.,
YEXT_NL(4)%LQM=.TRUE.,
YEXT_NL(5)%LQM=.TRUE.,
YEXT_NL(6)%LQM=.TRUE.,
YEXT_NL(7)%LQM=.TRUE.,
YEXT_NL(8)%LQM=.TRUE.,
YEXT_NL(9)%LQM=.TRUE.,
YEXT_NL(1)%LQM=.TRUE.,
YEXT_NL(2)%LQM=.TRUE.,
YEXT_NL(3)%LQM=.TRUE.,
YEXT_NL(4)%LQM=.TRUE.,
YEXT_NL(5)%LQM=.TRUE.,
YEXT_NL(6)%LQM=.TRUE.,
YEXT_NL(7)%LQM=.TRUE.,
YEXT_NL(8)%LQM=.TRUE.,
YEXT_NL(9)%LQM=.TRUE.,
YEXT_NL(1)%LREQOUT=.TRUE.,
YEXT_NL(2)%LREQOUT=.TRUE.,
YEXT_NL(3)%LREQOUT=.TRUE.,
YEXT_NL(4)%LREQOUT=.TRUE.,
YEXT_NL(5)%LREQOUT=.TRUE.,
YEXT_NL(6)%LREQOUT=.TRUE.,
YEXT_NL(7)%LREQOUT=.TRUE.,
YEXT_NL(8)%LREQOUT=.TRUE.,
YEXT_NL(9)%LREQOUT=.TRUE.,
YEXT_NL(1)%LGPINGP= .TRUE.,
YEXT_NL(2)%LGPINGP= .TRUE.,
YEXT_NL(3)%LGPINGP= .TRUE.,
YEXT_NL(4)%LGPINGP= .TRUE.,
YEXT_NL(5)%LGPINGP= .TRUE.,
YEXT_NL(6)%LGPINGP= .TRUE.,
YEXT_NL(7)%LGPINGP= .TRUE.,
YEXT_NL(8)%LGPINGP= .TRUE.,
YEXT_NL(9)%LGPINGP= .TRUE.,
/
```

The sandblasting scheme is activated in SURFEX via two nameliste blocks: NAM_DUST and NAM_SURF_DST. The CVERMOD key is used to activate the DEAD revised version (Mokhtari et al. 2012) in SURFEX.

```
&NAM_DUST
LDUST = .TRUE.,
LRGFIX_DST= .TRUE.,
LVARSIG = .FALSE.,
LSEDIMDUST = .TRUE.,
LDEPOS_DST = .TRUE.,
NMODE_DST=3,
/
&NAM_SURF_DST
CEMISPARAM_DST='AMMA',
CVERMOD='CMDVER',
/
```

For the case of restart, a pre-processing step should be done in order to add dust fields in the first coupler file. The fields to be initialized are selected in the nameliste NAML:

```
&NAML
NBC=9,
LOPC(1)=.TRUE.,
CDPREFM(1)='S',
NBNIV(1)=60,
CDSUFM(1)='DSTM31',
LOPC(2)=.TRUE.,
CDPREFM(4)='S',
NBNIV(2)=60,
CDSUFM(2)='DSTM32'
LOPC(3)=.TRUE.,
CDPREFM(3)='S',
NBNIV(3)=60,
CDSUFM(3)='DSTM33',
LOPC(4)=.TRUE.,
CDPREFM(4)='S',
NBNIV(4)=60,
CDSUFM(4)='DEDSTM31C',
LOPC(5)=.TRUE.,
CDPREFM(5)='S',
NBNIV(5)=60,
CDSUFM(5)='DEDSTM32C',
LOPC(6)=.TRUE.,
CDPREFM(6)='S',
NBNIV(6)=60,
CDSUFM(6)='DEDSTM33C',
LOPC(7)=.TRUE.,
CDPREFM(7)='S',
NBNIV(7)=60,
CDSUFM(6)='DEDSTM31R',
LOPC(8)=.TRUE.,
CDPREFM(8)='S',
NBNIV(8)=60,
CDSUFM(8)='DEDSTM32R',
LOPC(9)=.TRUE.,
CDPREFM(9)='S',
NBNIV(9)=60,
CDSUFM(9)='DEDSTM33R',
/
```

Dust fields are extracted in Fullpos step by adding a set of variables to the namelist blocks NAMAFN, NAMFPC and NAMGFL.

```
&NAMAFN
TFP_EXT(1)%CLNAME='AOD_DST',
TFP_EXT(1)%IBITS=16,
TFP_EXT(2)%CLNAME='ZN_DST',
TFP_EXT(2)%IBITS=16,
TFP_EXT(3)%CLNAME='SSA_DST',
TFP_EXT(3)%IBITS=16,
TFP_EXT(4)%CLNAME='ZM_DST',
TFP_EXT(4)%IBITS=16,
TFP_EXT(5)%CLNAME='ASY_DST',
TFP_EXT(5)%IBITS=16,
&NAMFPC
CFP3DF(1)='AOD_DST',
CFP3DF(2)='ZN_DST',
CFP3DF(3)='SSA_DST',
CFP3DF(4)='ZM_DST',
CFP3DF(5)='ASY_DST',
&NAMGFL
NGFL_EXT=5,
YEXT_NL(1)%LGP=.TRUE.,
YEXT_NL(1)%LREQOUT=.TRUE.,
YEXT_NL(1)%LGPINGP= .TRUE.,
YEXT_NL(1)%NREQIN=1,
YEXT_NL(1)%CNAME='AOD_DST',
YEXT_NL(2)%LGP=.TRUE.,
YEXT_NL(2)%LREQOUT=.TRUE.,
YEXT_NL(2)%LGPINGP= .TRUE.,
YEXT_NL(2)%NREQIN=1,
YEXT_NL(2)%CNAME='ZN_DST',
YEXT_NL(3)%LGP=.TRUE.,
YEXT_NL(3)%LREQOUT=.TRUE.,
YEXT_NL(3)%LGPINGP= .TRUE.,
YEXT_NL(3)%NREQIN=1,
YEXT_NL(3)%CNAME='SSA_DST',
YEXT_NL(4)%LGP=.TRUE.,
YEXT_NL(4)%LREQOUT=.TRUE.,
YEXT_NL(4)%LGPINGP= .TRUE.,
YEXT_NL(4)%NREQIN=1,
YEXT_NL(4)%CNAME='ZM_DST',
YEXT_NL(5)%LGP=.TRUE.,
YEXT_NL(5)%LREQOUT=.TRUE.,
YEXT_NL(5)%LGPINGP= .TRUE.,
YEXT_NL(5)%NREQIN=1,
YEXT_NL(5)%CNAME='ASY_DST',
/
```

3. Description of experiments

After upgrading the Arome_dust with Aladin_dust version operational at the ONM (ALGERIA), we conducted a validation and evaluation study of this version. Several simulations were performed in order to show the desert dust predictability with a convective scale model and then highlight the radiative impact of dust aerosol.

To do this, three experiments were performed. The first two simulations were performed using two different dust emission schemes: DEAD original and DEAD revised (Mokhtari et al. 2012).

The third simulation was performed with Arome version with no-dust. This simulation is used as a control simulation to evaluate the radiative impact of desert dust.

Experiment 1 :

The aim of this experiment is to validate the original version of DEAD. This version is enabled in the default code.

Experiment 2 :

The second experiment used to validate the modified version of DEAD. This version is activated in code by setting the key CVERMOD = CMDVER.

Experiment 3 :

The control simulation is performed with Arome by disabling dust modules. To do this, we put LRDUST and LRDEPOS keys to FALSE. At the surface (SURFEX), dust modules are disabled by removing the NAM_DUST and NAM_SURF_DST blocks in the namelist namel-prev-surfex.

The domain of integration is centred over Algeria and contains 1024 x 972 points and 60 vertical levels. The horizontal resolution is 3 km (Fig. 1).

The simulations were started on August 9th 2016, to avoid the phenomenon of spin-up and enable the initialization of dust for targeted days.

All experiments were launched on 192 processors.

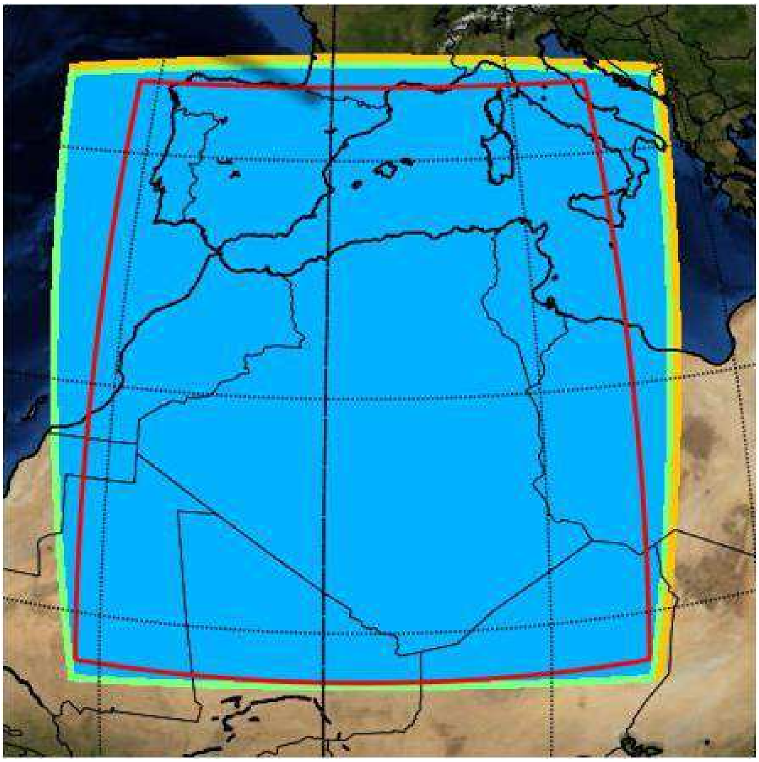

Fig. 1: Domain integration of Arome_dust

4. Results and discussion:

4.1. Case study : August 10th and 11th, 2016 situation

4.1.1. Situation analysis

The choice of this situation was done based on the METAR (METeorological Aerodrome Repport) draw by several stations in southern Algeria, namely Biskra, Touggourt, Adrar and Bechar, Ouargla, H Messaoud B B Mokhtar.

11/08/2016 (12h):
Bechar : METAR DAOR 111200Z 09012KT 3000 DU FEW033 37/15 Q1016=
Touggourt : METAR DAUK 111200Z 36010KT 3000 HZ BKN040 SCT100 31/13 Q1017=
B.B.Mokhtar : METAR DATM 111200Z 24020KT 7000 DRSA FEW046TCU SCT100 35/20 Q1015=
Ouargla : METAR DAUU 111200Z 04022KT 3000 DRSA FEW033TCU SCT040 34/12 Q1015=
El Oued : METAR DAUO 111200Z 03014KT 6000 BKN033 35/18 Q1018=
SPECI DAUO 111310Z 06018KT 4000 DRSA BKN033 35/17 Q1018=
Adrar : METAR DAUA 111200Z 32008KT 6000 FEW046 SCT133 42/03 Q1012=
H. Massaoud : METAR DAUH 111200Z 34022KT 4000 DRSA BKN040 36/13 Q1016=

10/08/2016 (12h):
Bechar : METAR DAOR 101200Z 25014KT 9999 SCT033 SCT100 39/09 Q1016=
Touggourt : METAR DAUK 101200Z 16014KT 9999 FEW040 40/10 Q1013=
B.B.Mokhtar : METAR DATM 101200Z 36006KT CAVOK 37/19 Q1014=
Ouargla : METAR DAUU 101200Z 15018KT 9999 FEW046 41/04 Q1012=
El Oued : METAR COR DAUO 101200Z 20010KT 9999 FEW040 40/10 Q1012=
Adrar : METAR DAUA 101200Z 18020KT 6000 DRSA NSC 43/// Q1011=
H. Massaoud : METAR DAUH 101200Z 16011KT CAVOK 41/12 Q1014=

The days of August 10th and 11th were characterized by a progressive development of convective activity from the Algerian Sahara to the highlands. This activity was accompanied by a significant episode of sand uprising across the Algerian Sahara (Fig. 2), in particular the Western Sahara and the extreme south.

Figure 2 shows satellite images MODIS / AQUA taken at 12: 40 GMT for the days of August 10th and 11th. We remark in satellite images the spatial extent of dust plumes from Bechar, Adrar, Timimoun, to Tamanrasset.

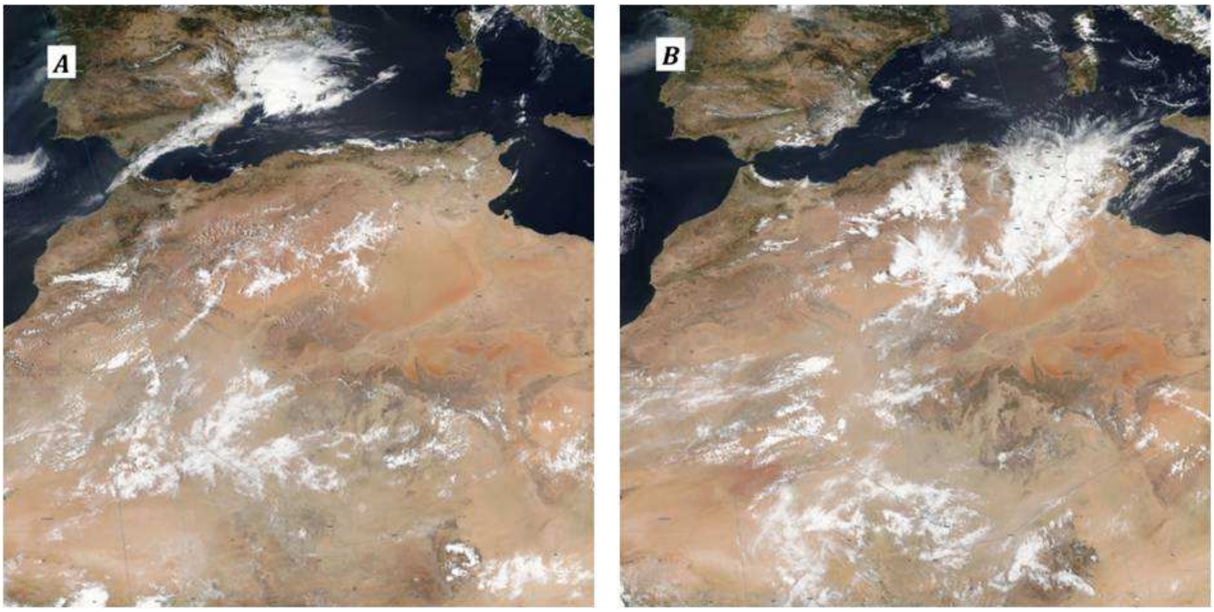

Fig. 2: Satellite Images MODIS / AQUA taken at 12:40 utc (A: 10-08-2016, B: 11-08-2016).

The Aerosol Optical Depth AOD (Fig. 3) recorded during the days of August 10th and 11th, exceeding 1 in several locations in southern Algeria. These high values were confirmed by the data of AOD (AERONET) measured at Tamanrasset station (Fig. 4). Indeed, the analysis of the AOD's daily variation during the month of August shows that the episodes of 10th and 11th were marked by relatively high AOD values. In this region, these high values are due to high concentrations of desert dust.

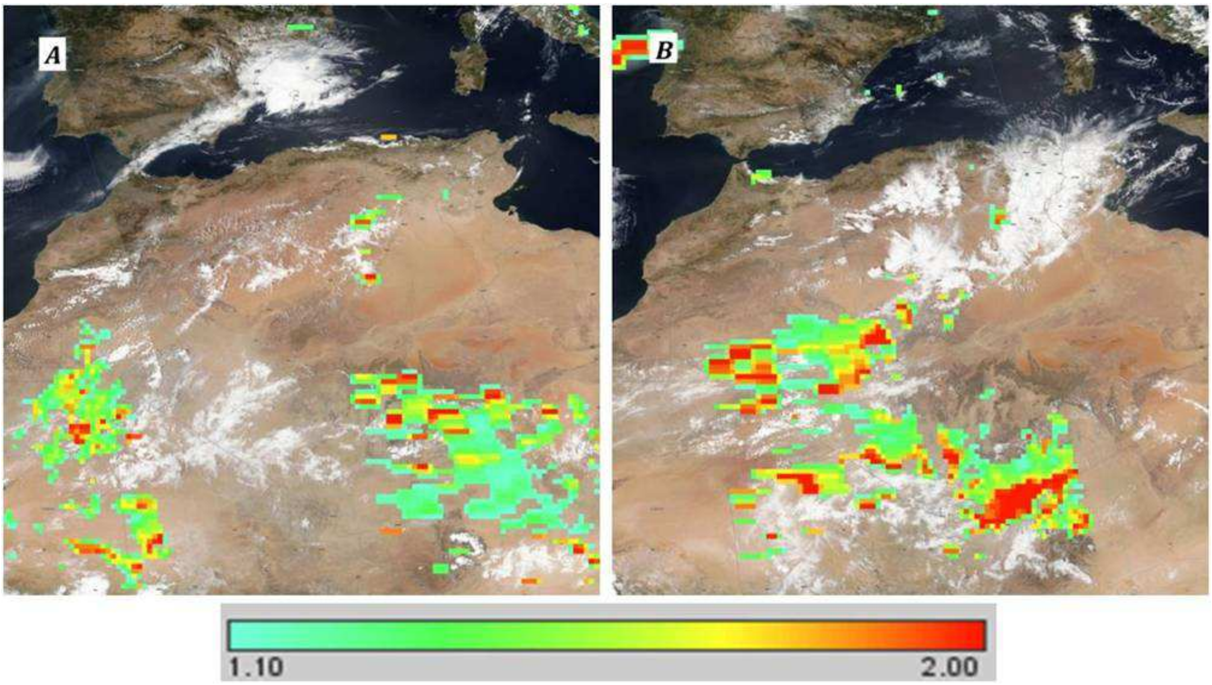

Fig. 3: The Aerosol Optical Depth obtained by the combination of satellite images MODIS / AQUA taken at 12:40 utc with the corrected reflectance Suomi NPP / VIIRS (A: 10-08-2016 B: 11-08-2016).

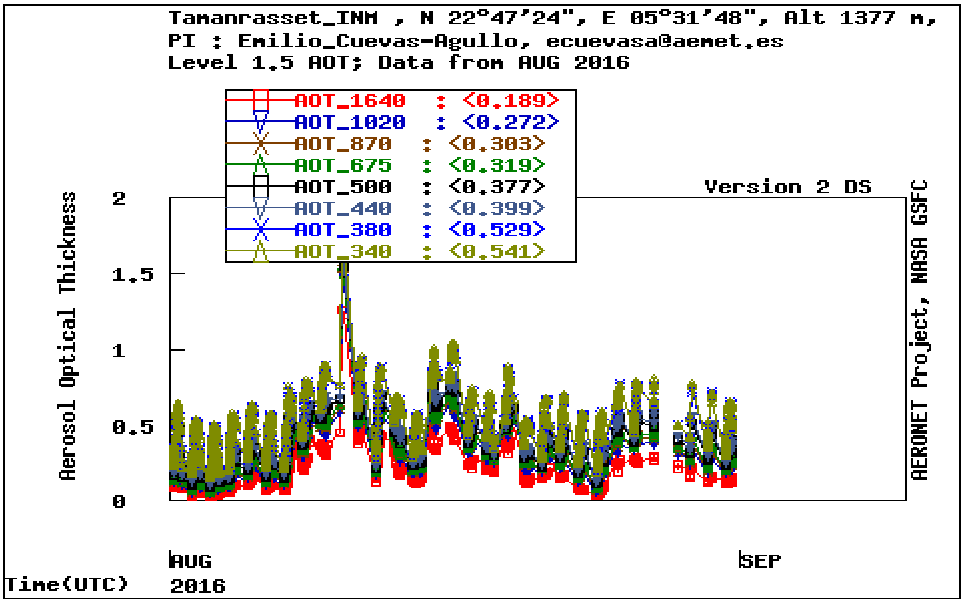

Fig. 4: The AOD daily average recorded during the month of August 2016 in Tamanrasset station (Source: http://aeronet.gsfc.nasa.gov/).

4.1.2. Simulation of the 10, 11 August situation:

The situation of August 10th and 11th simulated by the Arome_dust model using both versions of the sandblasting scheme: original DEAD and revised DEAD. The results shown in this study concern the surface concentrations of desert dust and aerosol optical depth predicted by each version.

a) Experiment 1: original DEAD

Figure 5 shows the surface dust concentrations predicted by Arome_dust on August 10th and 11th. From the perspective of spatial distribution, we note the desert dust uprising forecasts is well simulated by Arome_dust, especially the axis of Laghouat, El-Oued, Touggourt to Bechar. The concentrations obtained through Arome exceed 7 mg.m^{-3}. Also the uprisings observed on the Adrar region and the extreme south of Algeria (Guezzam) were well predicted by the model.

However, the AOD simulated by the model are underestimated compared to the observations (do not exceed 1), especially on August 10th. However, in terms of spatial distribution, the simulated AOD on August 11th are in agreement with the observations, but remains low. This is probably due to the default in initialization (may be one day of run is insufficient to initialize and reproduce satisfactory dust concentration in the atmosphere). It is also interesting to note that the predicted AOD in Tamanrasset are too far from reality. This is due to the nature of this region and its texture. Indeed, the Tamanrasset region is excluded from the source areas, while in reality it contains important dust deposit areas surrounding mountains including the Hoggar and Tassili, which can be subsequently reactivated by the wind.

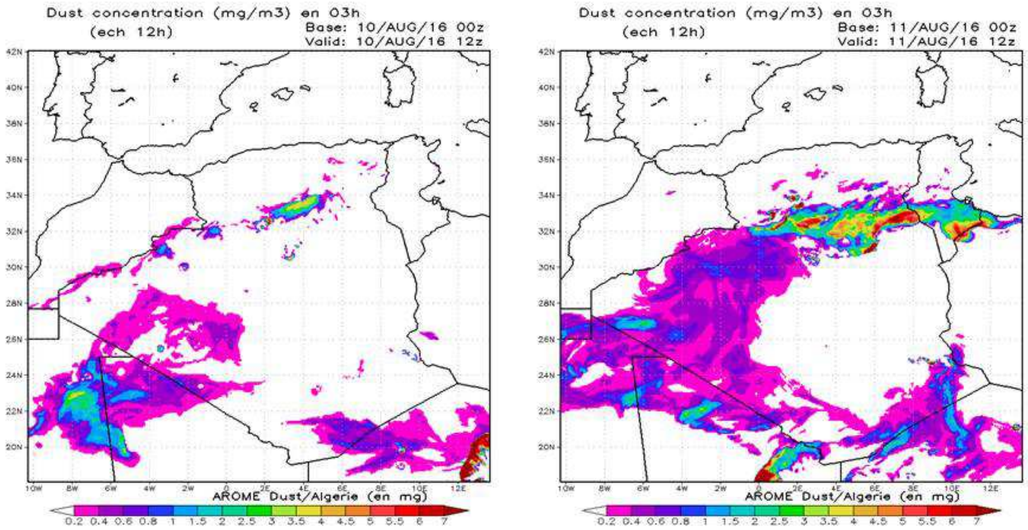

Fig. 5: Concentrations of desert dust simulated by Arome_dust (DEAD original version) on August 10th and 11th 2016 at 12: 00 GMT.

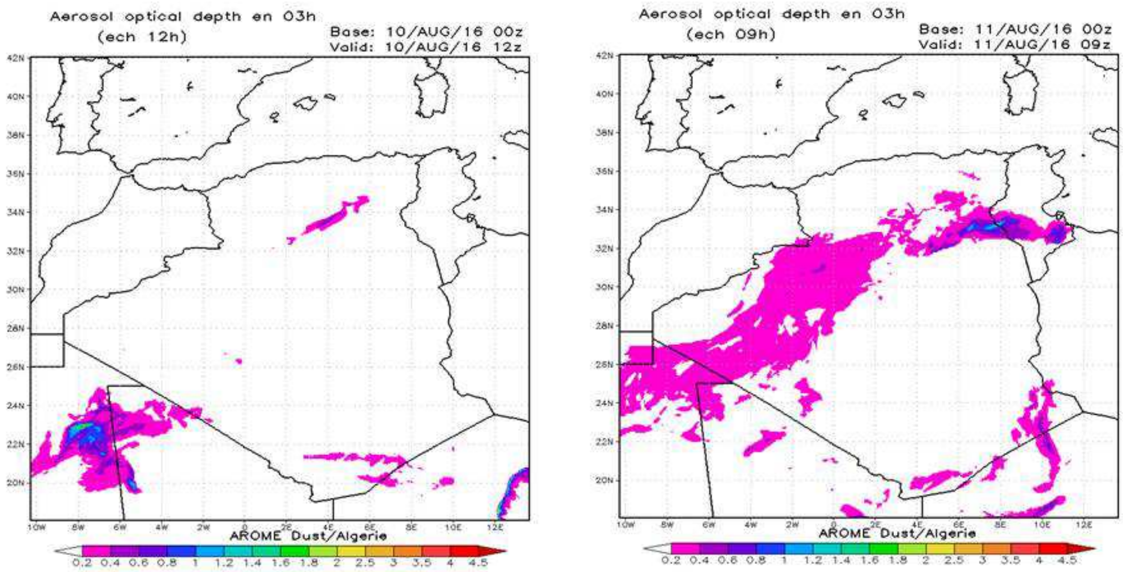

Fig. 6: AOD simulated by Arome_dust (DEAD original version) on August 10th and 11th 2016 at 12: 00 GMT.

b) Experiment 2 : revised DEAD

The results obtained by the revised version of DEAD are virtually the same pace for the spatial distribution, except the Adrar region where the revised version behaved well with observations compared to the original version on August 10th. The difference between the two versions lies in the intensity of predicted concentrations, which is clearly noted during the day of 11th. The results of the original version of DEAD seem a bit exaggerated compared to the actual situation (Fig. 2).

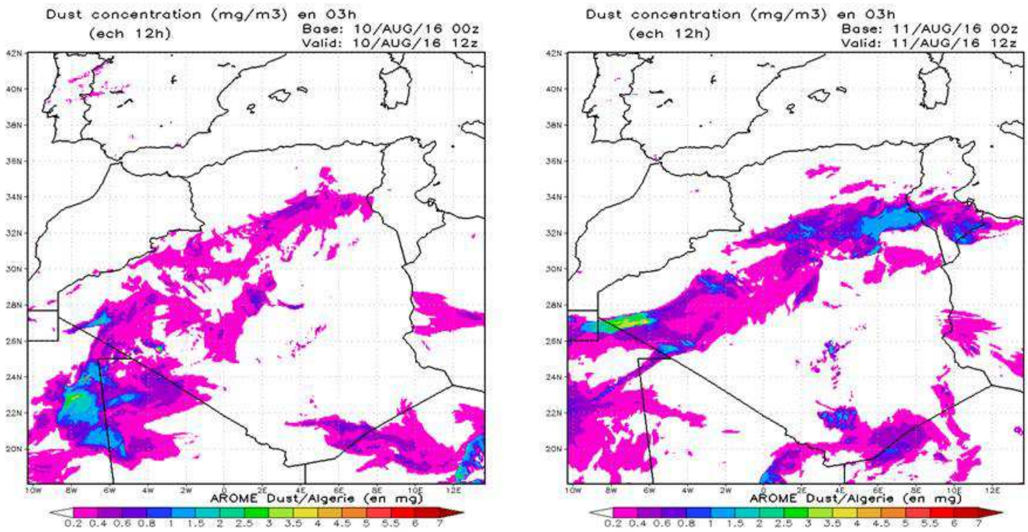

Fig. 7: Concentrations of desert dust simulated by Arome_dust (DEAD revised version) on August 10th and 11th 2016 at 12: 00 GMT.

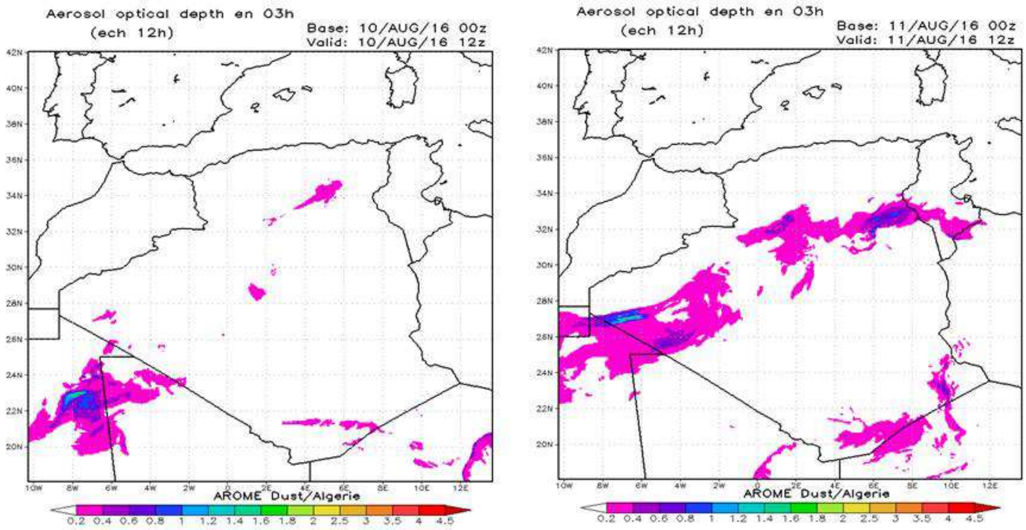

Fig. 8: AOD simulated by Arome_dust (DEAD revised version) on August 10th and 11th 2016 at 12: 00 GMT.

4.2. Radiative effect

The analysis of the temperature difference between Arome_CTL and Arome_dust (DEAD revised version), reveals that the presence of desert dust reduces significantly the temperature at 2 meters (Fig. 9), which is clearly seen on August 11th where we notice differences of 0.1 to 2 °C in the dust uprisings areas.

The net solar radiation at the surface is also reduced during sand uprising episodes (Fig. 10), with a deficit up to 150 W / m 2. The same results are obtained for the case of the DEAD revised version.

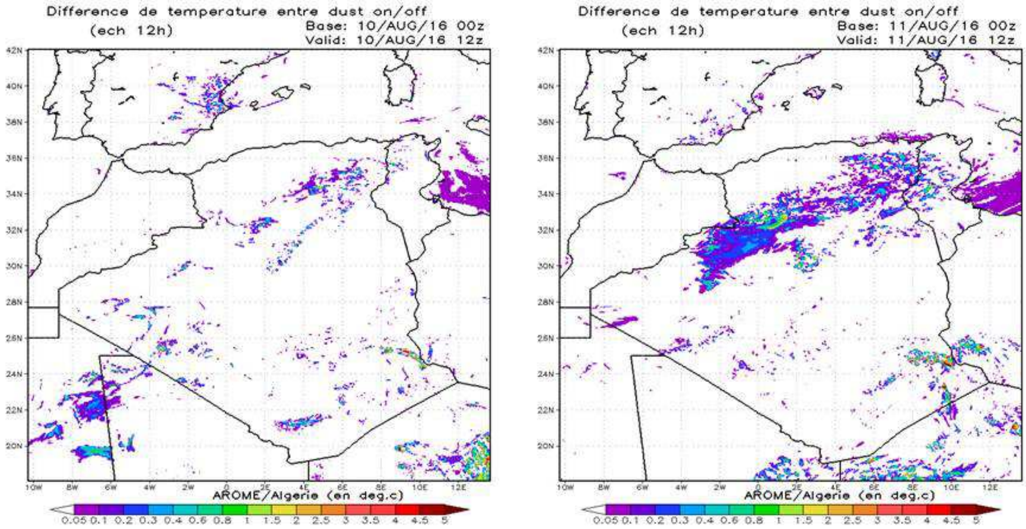

Fig. 9: Temperature differences at 2m between Arome_CTL and Arome_dust (DEAD original version) on August 10th and 11th 2016 at 12: 00 GMT.

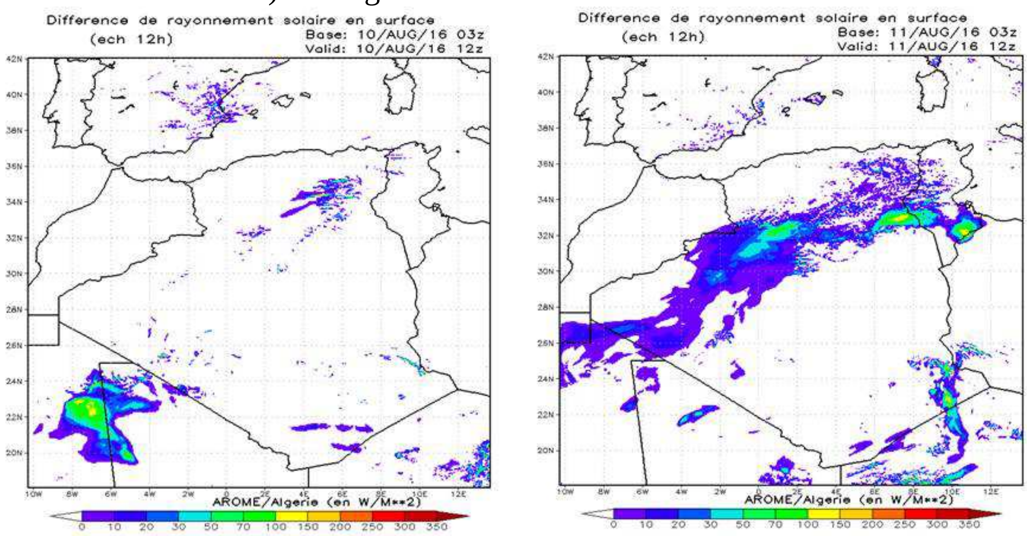

Fig. 10: Net solar radiation differences between Arome_CTL and Arome_dust (DEAD original version) on August 10th and 11th 2016 at 12: 00 GMT.

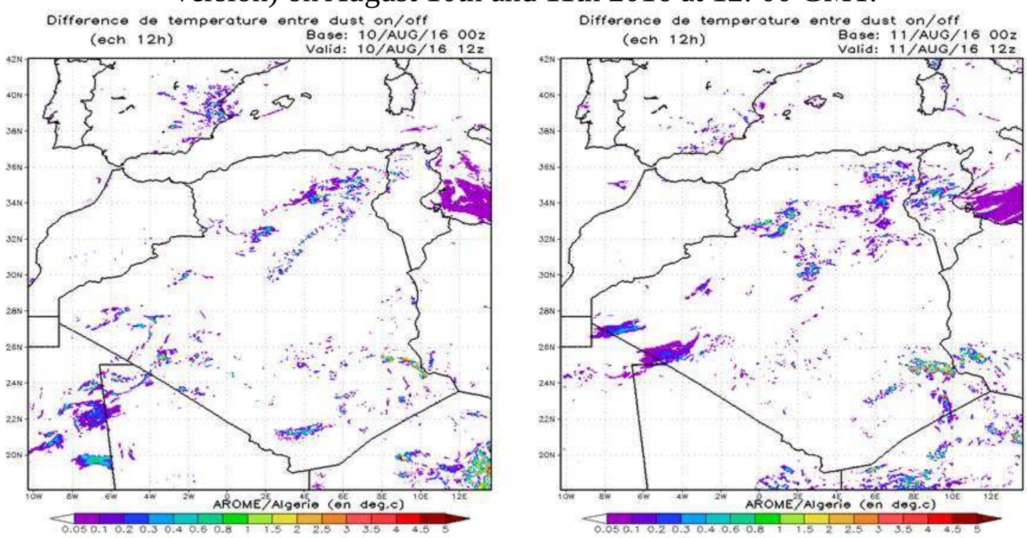

Fig. 11: Temperature differences at 2m between Arome_CTL and Arome_dust (DEAD revised version) on August 10th and 11th 2016 at 12: 00 GMT.

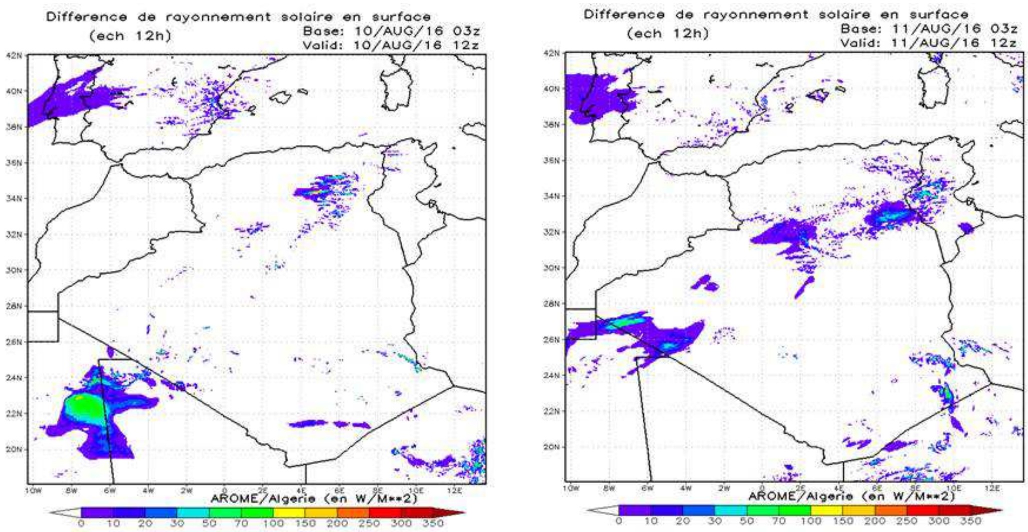

Fig. 12: Net solar radiation differences between Arome_CTL and Arome_dust (DEAD revised version) on August 10th and 11th 2016 at 12: 00 GMT.

4.3. Aladin_dust simulations

To highlight the effect of the resolution and the contribution of the physical scheme at convective scale of the model's predictability, we have shown below the concentrations of dust and AOD simulated by Aladin_dust (8km of resolution). It is clearly visible that the model Aladin_dust missed the forecast for the studied days (August 10th and 11th). As already mentioned in previous sections, our situation was characterized by the presence of convective activity over many parts of the Sahara. It is remarkable by the presence of cloud clusters in the southern Algeria (Fig. 2). Also, it is possible that the failure of the model is due to spin-up. Perhaps, such a resolution, it took several days to run to better reproduce the fields of dust in the atmosphere.

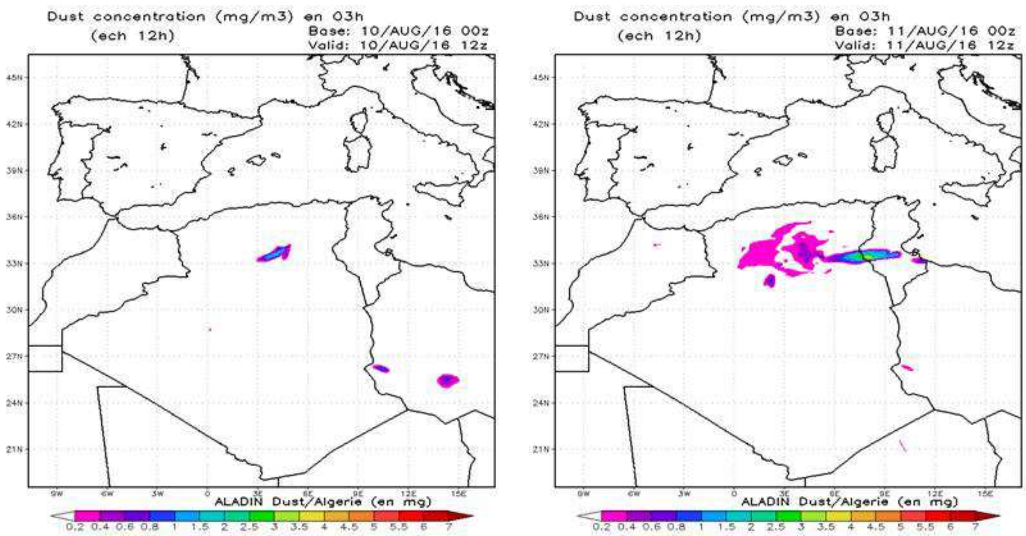

Fig. 13: Concentrations of desert dust simulated by Aladin_dust on August 10th and 11th 2016 at 12: 00 GMT.

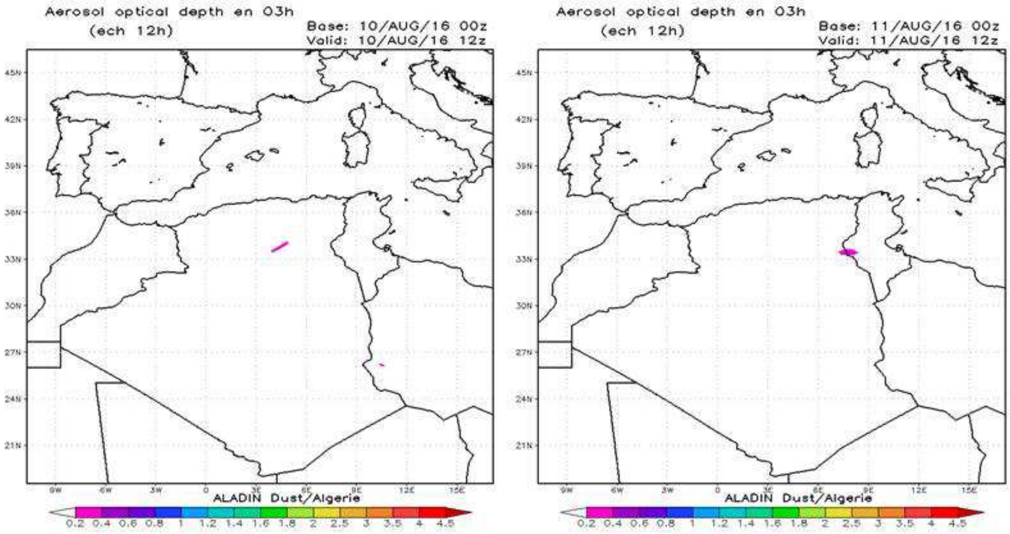

Fig. 14: AOD simulated by Aladin_dust on August 10th and 11th 2016 at 12: 00 GMT.

4.4. Computational cost of the Arome_dust version

The computational costs of Arome_dust version made for each simulation are given in Table 1. The analysis of this table shows that:

- The activation of dust modules in Arome_dust cycle 40 costs about 60 minutes for a 24 hours run compared to the Arome control version (no dust), it be a ratio of 37%.
- Arome_dust modified version (DEAD revised version) costs about 3 minutes over for a 24 hours run compared to the DEAD original version.
- Arome_dust cycle 43 allowed us to benefit about 10 minutes in computational costs for a 24 hours run compared to the Arome_dust cycle 40.

Table 1: Computational costs of Arome_dust version

Model	Characteristics	cycle	Experiments	Run	Memory	Computational cost
Arome_dust	**Grid** 1024 x 972	Cy 40	DEAD Orig	24 h	30284496 kb	9760.03 sec
			DEAD Revi		30255004 kb	9951.42 sec
	Levels : 60	Cy 40	CTL		27472044 kb	6129,48 sec
	NPROC= 8 x 24	Cy 43	DEAD Revi		38955272 kb	9125.29 sec
			DEAD Orig		38937460 kb	9110.51 sec

Conclusion and perspectives

An upgrade of Arome_dust with Aladin_dust was successfully made on the basis of the cycle 40. This version was validated for the situation of August 10th and 11th 2016. Results presented in this report are very satisfactory since the model was able to reproduce the spatial distribution of dust plumes observed in these days, with the exception of the Tamanrasset region. In terms of intensity, Arome_dust underestimates the AOD compared to AERONET and MODIS observations. This is probably due to the initialization effect. In fact, one day of the run is insufficient to satisfactorily reproduce the distribution of dust concentration in the atmosphere.

The inter-comparison of Arome_dust result with those of Aladin_dust, showed that the first one (Arome_dust) with its high resolution (3km) and microphysical scheme, reproduced much better the studied situation.

We also made a phasing of Aladin_dust and Arome_dust versions to the cycle 43. From the perspective of debugging, these versions have been validated and are available on the path "/home/gmap/mrpe/mokhtari/pack/cy43t1_main.01.dst. IMPI500IFC1500.2y.pack ". Scripts and namelistes are available in "/home/gmap/mrpe/mokhtari/SAVE".

On the side of performance and Computational costs, activating dust modules in Arome consumes over 37% of the calculation time (compared to the controle version). The transition from cycle 40 to cycle 43 allowed a gain of more than 10 minutes in computational costs for a 24 hours run.

In order to consolidate our conclusions on the contribution of model resolution on the quality of forecasts, a detailed study of deep convection situation in southern Algeria will be done in the near future with version 43. This study will could make a subject of an article to be published in the Aladin-Hirlam newsletter.

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