

PHASING REPORT

PARTICIPATION IN THE VALIDATION OF PRE_CY38

by Mohamed Zied SASSI

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Météo-France, Toulouse

This report is a summary of my stay with the COOPE team, from October 3rd to November 11th 2011 in Météo-France, Toulouse. So first of all, I would like to thank all the team, for the nice welcome, and the precious indications that helped me so much during my participation and will help me for sure for my future challenges.

This six weeks stay was my first personal participation in a validation effort, witch concerned the pre_cy38. During this period, I used to participate within three main tasks :

- Cleaning of some norm violations ;
- Validation of 923 configuration with pre_cy38;
- Test of an optimization pack for the CANARI code.

1) Norm violation cleaning:

This task was accomplished by using the norm violation diagnostics and the coding norms Manuel of Ryad El Khatib, "Coding standards for ARPEGE/IFS/ALADIN". It concerned the 14 following routines:

```
/arp/dfi/corgfl.F90  
/arp/dfi/copgfl.F90  
/arp/op_obs/hjo.F90  
/arp/var/amv_read_oberror.F90  
/arp/var/evjcdfi.F90  
/arp/var/sujb.F90  
/arp/var/sujbwavgen.F90  
/arp/var/symtransin.F90  
/arp/var/jbchvari.F90  
/arp/var/jbchvariad.F90  
/arp/var/jbchvar.F90  
/arp/var/jbchvarad.F90  
/arp/var/pregprh.F90  
/arp/var/suskf.F90
```

The main norm violation encountered in this task consisted on variable naming rules.

After cleaning these routines, a test was accomplished with Mitraillette to verify the neutrality of the cleaning. The numerical comparison showed that the cleaning has no impact over the results.

Finally, I inserted these cleaned routines in my clearcase branch "sassi_CY37T1_sas" and then they were introduced into the sixth version of the cy37t1.r3b (cy37t1_r3b.06).

2) Validation of 923 configuration with the pre_cy38:

The 923 configuration is applied to create the climatological files, necessary for ALADIN model runs. It interpolates information from global to limited area fields.

To validate this configuration with the pre_cy38, many tests over ALADIN domains were done.

First of all, an update of the namelists was needed, and consisted on the add of the following fields:

```
&NAERAD
  LSRTM=.FALSE.
/
&NAMSKF
/
&NAMVV0
/
&NAMWAVELETJB
/
```

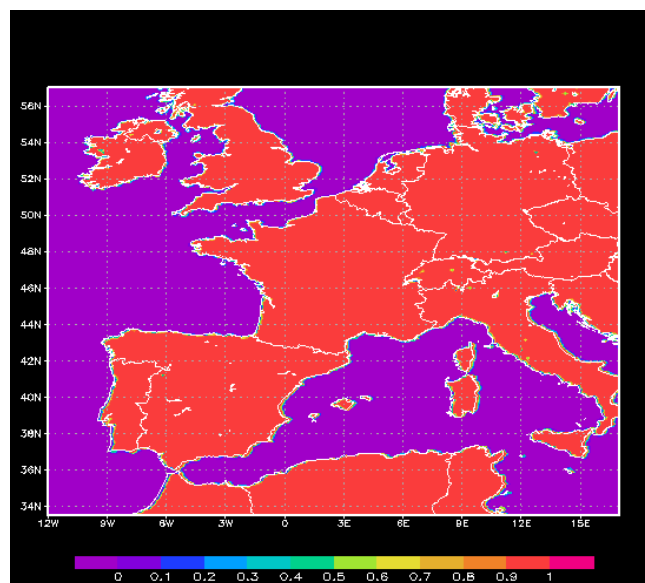
Then, I used to run the 923 configuration over each domain respecting it's geographical characteristics. To produce the final output files, the 923 configuration proceeds through the five following steps, witch write the needed data fields:

STEP 1: This step defines the orography parameters:

- Land-See mask;
- Standard Deviation;
- Anisotropy of sub-scale orography;
- Angle between the direction of orography and the x-axis;
- Surf;
- Land Fraction;
- Urbanization Fraction;
- Dynamical roughness length times g.

STEP1 fields norms (Run of pre_cy38):

EBICLI NORMS :	C+/MAX	C+/AVE	C+/MIN	E/MAX	E/MIN
SURFIND.TERREMER :	0.100000000000000E+01	0.122671232701408E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFET.GEOPOTENT :	0.684907189350467E+04	0.627731026164022E+02	0.000000000000000E+00	0.347195558290741E+04	0.000000000000000E+00
SURFVAR.GEOP.ANI :	0.100000000000000E+01	0.924540715016718E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFVAR.GEOP.DIR :	0.157079632679490E+01	-.465595628742619E-02	-.157079225453921E+01	0.157079632679490E+01	-.156874790369201E+01
SURFZ0REL.FOIS.G :	0.218127575801310E+03	0.286848554145401E+00	0.980664999999999E-02	0.143737639611063E+03	0.980665000000000E-02
SURFPROP.TERRE :	0.100000000000000E+01	0.120683261484263E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFPROP.URBANIS :	0.560000000000000E+00	0.123649221831766E-04	0.000000000000000E+00	0.000000000000000E+00	0.000000000000000E+00
SURFZ0.FOIS.G :	0.218127575801310E+03	0.286848554145401E+00	0.980664999999999E-02	0.143737639611063E+03	0.980665000000000E-02



Picture1: Land-See mask over ALADIN France domain (zoomed)

STEP 2: This step defines the surface, soil and vegetation characteristics:

- Land-Sea Mask;
- Index of vegetation;
- Albedo;
- Emissivity;
- Maximum Soil Depth;
- Proportion of clay;
- Proportion of sand;
- Maximum proportion of vegetation;
- Soil Depth;
- Urbanization Fraction;
- Proportion of vegetation.

STEP2 Output fields (Run of pre_cy38):

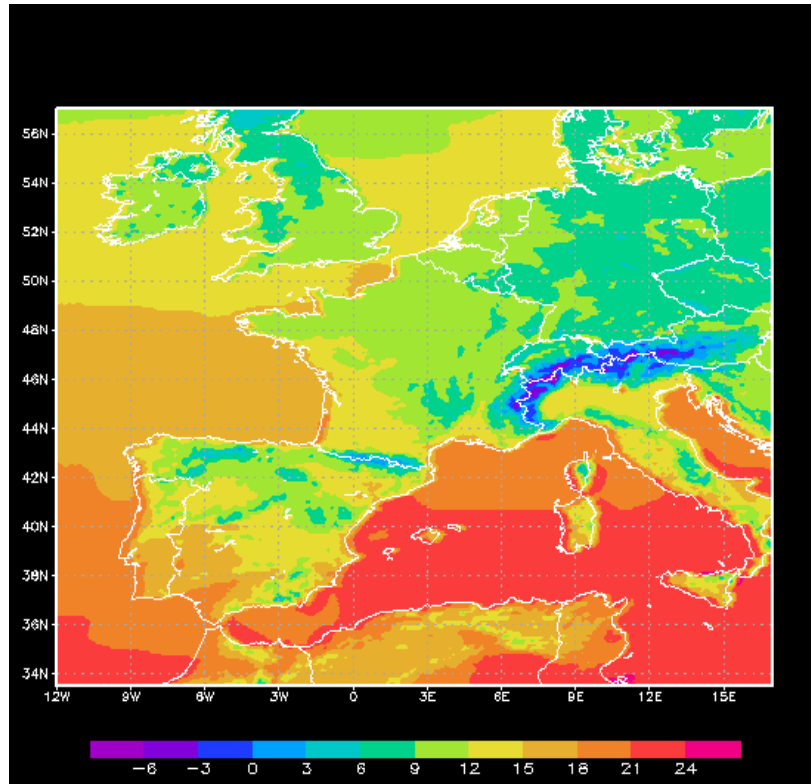
EBICLI NORMS :	MAX	AVE	MIN		
SURFIND.TERREMER :	0.100000000000000E+01	0.118343209876543E+00	0.000000000000000E+00		
SURFIND.VEG.DOMI :	0.400000000000000E+01	0.123997777777778E+01	0.100000000000000E+01		
EBICLI NORMS :	C+I/MAX	C+I/AVE	C+I/MIN	E/MAX	E/MIN
SURFALBEDO.SOLNU :	0.380159295043359E+00	0.788312853517984E-01	0.510800911230392E-01	0.223634443286483E+00	0.663593187616417E-01
SURFEMISSIVITE :	0.973354789325736E+00	0.959211538636942E+00	0.950500000000000E+00	0.960071795848431E+00	0.948510289897305E+00
SURFEPAL.SOL.MAX :	0.800000000000000E+01	0.735660905746066E+01	0.100000000000000E+00	0.800000000000000E+01	0.100000000000000E+00
SURFPROP.ARGILE :	0.580000000000000E+02	0.720537035127670E+01	0.300000000000000E+01	0.560084325396825E+02	0.300000000000000E+01
SURFPROP.SABLE :	0.920000000000000E+02	0.110382209026045E+02	0.600000000000000E+01	0.824041644638806E+02	0.600000000000000E+01
SURFPROP.VEG.MAX :	0.990000000001740E+00	0.484273087485319E-01	0.000000000000000E+00	0.563810515089840E+00	0.000000000000000E+00
SURFEPALIS.SOL :	0.800000000000000E+01	0.731157881334983E+01	0.100000000000000E+00	0.800000000000000E+01	0.100000000000000E+00
SURFPROP.URBANIS :	0.555856924206326E+00	0.100678878636411E-04	0.000000000000000E+00	0.000000000000000E+00	0.000000000000000E+00
SURFALBEDO :	0.380159295043359E+00	0.788312853517984E-01	0.510800911230392E-01	0.223634443286483E+00	0.663593187616417E-01
SURFPROP.VEGETAT :	0.990000000001740E+00	0.484273087485319E-01	0.000000000000000E+00	0.563810515089840E+00	0.000000000000000E+00
SURFALBEDO.COMPL :	0.380159295043359E+00	0.788312853517984E-01	0.510800911230392E-01	0.223634443286483E+00	0.663593187616417E-01

STEP 3: This step modifies the albedo and emissivity and defines the monthly climatological values, the climatological fields are:

- Land-Sea Mask;
- Ground surface temperature;
- Deep soil temperature;
- Maximum surface water content;
- Maximum deep soil water content;
- Surface snow amount;
- Relaxation values for deep temperature;
- Relaxation values for deep soil moisture;
- Emissivity (monthly and modified over sea only);
- Albedo (monthly and modified over sea only);
- Dynamical roughness length times g.

STEP3 Output fields (Run of pre_cy38):

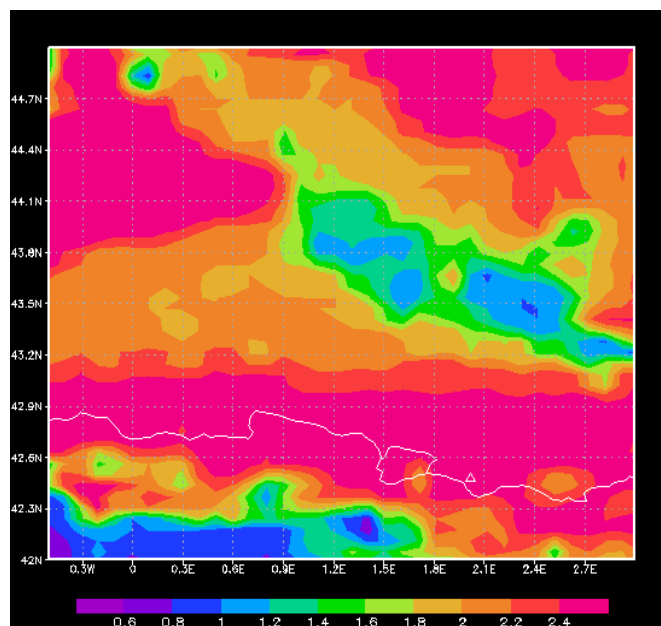
EBICLI NORMS :	MAX	AVE	MIN		
SURFIND.TERREMER :	0.100000000000000E+01	0.118343209876543E+00	0.000000000000000E+00		
EBICLI NORMS :	C+I/MAX	C+I/AVE	C+I/MIN	E/MAX	E/MIN
SURFTEMPERATURE :	0.306544788197455E+03	0.298695273499736E+03	0.27011142605239E+03	0.301671816752920E+03	0.285333755517282E+03
PROFTEMPERATURE :	0.306544788197455E+03	0.298674869972558E+03	0.270005170166240E+03	0.301671816752920E+03	0.285272772524075E+03
SURFPROP.RMAX.EA :	0.100000000000000E+01	0.958921174912070E+00	0.539723898850742E+00	0.100000000000000E+01	0.300527768693522E+00
PROFPROP.RMAX.EA :	0.100000000000000E+01	0.957500511487007E+00	0.551344918749782E+00	0.100000000000000E+01	0.319655850513127E+00
SURFRESERV.NEIGE :	0.122239776437089E+02	0.874986634956575E-04	0.000000000000000E+00	0.000000000000000E+00	0.000000000000000E+00
RELATEMPERATURE :	0.306544788197455E+03	0.298674869972558E+03	0.270005170166240E+03	0.301668760247545E+03	0.285272772524075E+03
RELAPROP.RMAX.EA :	0.100000000000000E+01	0.957500511487007E+00	0.551344918749782E+00	0.100000000000000E+01	0.319655850513127E+00
SURFALBEDO :	0.380159295043359E+00	0.788312853504023E-01	0.510800911230392E-01	0.223634439136532E+00	0.663593092527036E-01
SURFEMISSIVITE :	0.973354789325736E+00	0.959211538635718E+00	0.950499999746199E+00	0.960071795858098E+00	0.948510291117447E+00
SURFZ0.FOIS.G :	0.218127575801310E+03	0.286538076020533E+00	0.980664999999999E-02	0.143737639611063E+03	0.980665000000000E-02



Picture2: Surface temperature over ALADIN France domain (zoomed)

STEP 4: This step defines and modifies the vegetation and surface characteristics (monthly):

- Land-See Mask;
- Proportion of vegetation;
- Dynamical roughness length times g;
- Albedo;
- Leaf area index;
- Stomatal minimal resistance;
- Thermal roughness length times g;



Picture3: Leaf Area Index over ALADIN France domain (zoomed over Midi-Pyrénées)

STEP4 Output fields (Run of pre_cy38):

EBICLI NORMS :	MAX	AVE	MIN			
SURFIND.TERREMER :	0.100000000000000E+01	0.118343209876543E+00	0.000000000000000E+00			
EBICLI NORMS :	C+I/MAX	C+I/AVE	C+I/MIN	E/MAX	E/MIN	
SURFPROP.VEGETAT :	0.990000000001740E+00	0.480041586000398E-01	0.000000000000000E+00	0.563810499502509E+00	0.000000000000000E+00	
SURFZ0.FOIS.G :	0.218129802342274E+03	0.440321763889520E+00	0.980665000000000E-02	0.143736479685183E+03	0.980665000000000E-02	
SURFALBEDO :	0.305674937083873E+00	0.813628487584313E-01	0.599999906139376E-01	0.215131904668230E+00	0.699999904339476E-01	
SURFIND.FOLIAIRE :	0.600000000000558E+01	0.158514001906398E+00	0.000000000000000E+00	0.223384549588222E+01	0.000000000000000E+00	
SURFRESI.STO.MIN :	0.500000000000000E+04	0.439791466181764E+04	0.39999999166633E+02	0.500000000000000E+04	0.100000000000000E+01	
SURFGZ0.THERM :	0.392266588399957E+01	0.281359174857522E-01	0.980665000000000E-03	0.268929446861791E+00	0.980665000000000E-02	
SURFZ0VEG.FOIS.G :	0.392266588399957E+02	0.195322613299229E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00	
SURFALBEDO.VEG :	0.200000000017160E+00	0.680649246888528E-01	0.500000000000000E-01	0.304203869048559E+00	0.500000000000000E-01	

STEP 5: This step modifies some fields over land by high resolution datasets.

- Land-See Mask;
- Ground surface temperature;
- Deep soil temperature;
- Maximum surface water content;
- Maximum deep soil water content;
- Surface snow amount;
- Relaxation values for deep temperature;
- Relaxation values for deep soil moisture;
- Ozone;
- Aerosols.

STEP5 Output fields (Run of pre_cy38):

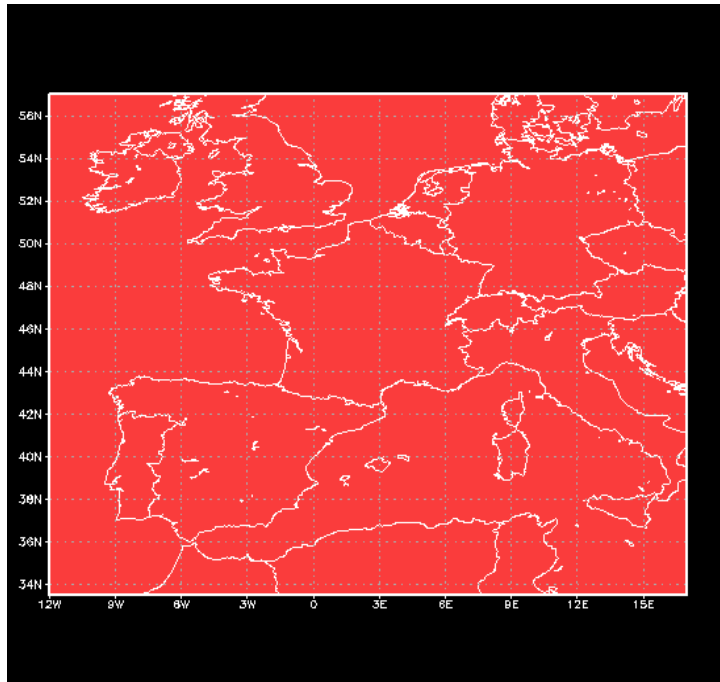
EBICLI NORMS :	MAX	AVE	MIN			
SURFIND.TERREMER :	0.100000000000000E+01	0.118343209876543E+00	0.000000000000000E+00			
EBICLI NORMS :	C+I/MAX	C+I/AVE	C+I/MIN	E/MAX	E/MIN	
SURFTEMPERATURE :	0.306544788197455E+03	0.299166936848883E+03	0.271795983280277E+03	0.303628976685915E+03	0.286677617781663E+03	
PROFTEMPERATURE :	0.306544788197455E+03	0.299166936847529E+03	0.271795983280277E+03	0.303628976930541E+03	0.286677617676231E+03	
SURFPROP.RMAX.EA :	0.100000000000000E+01	0.943329860752313E+00	0.188375799534293E+00	0.100000000000000E+01	0.164180550761541E+00	
PROFPROP.RMAX.EA :	0.100000000000000E+01	0.943329860752313E+00	0.188375799534293E+00	0.100000000000000E+01	0.164180550761541E+00	
SURFRESERV.NEIGE :	0.000000000000000E+00	0.000000000000000E+00	0.000000000000000E+00	0.000000000000000E+00	0.000000000000000E+00	
RELATEMPERATURE :	0.306544788197455E+03	0.299166936847529E+03	0.271795983280277E+03	0.303628976930542E+03	0.286677617676231E+03	
RELAPROP.RMAX.EA :	0.100000000000000E+01	0.943329860752313E+00	0.188375799534293E+00	0.100000000000000E+01	0.164180550761541E+00	
SURFA.OF.OZONE :	0.772814908462729E-01	0.740338119749010E-01	0.696646702561999E-01	0.769999820325682E-01	0.697627214947356E-01	
SURFB.OF.OZONE :	0.316600000000000E+04	0.316600000000000E+04	0.316600000000000E+04	0.316600000000000E+04	0.316599999999999E+04	
SURFC.OF.OZONE :	0.307186749731540E+01	0.304954126182029E+01	0.302813721048760E+01	0.306916959434756E+01	0.303064030587705E+01	
SURFAEROS.SEA :	0.102894569573979E-01	0.705488251663559E-02	0.143932640394030E-02	0.997571598913468E-02	0.174703904562813E-02	
SURFAEROS.LAND :	0.865685366197608E-01	0.309654325412891E-01	0.153977459097744E-01	0.857847291813556E-01	0.158260283754196E-01	
SURFAEROS.SOOT :	0.932204134715708E-02	0.987900861842921E-03	0.359581983942288E-03	0.902772895292279E-02	0.368766324656466E-03	
SURFAEROS.DESERT :	0.322292646507339E-01	0.120630992902057E-01	0.248449438068024E-02	0.320369984446410E-01	0.292194229316632E-02	

The validation of the 923 configuration was accomplished with the cy37t1.r3b.v05 version, in comparison with the operational cycle and the cycle cy37T1.bf02. and consisted on comparing the results of the pre cy_38 runs with the reference files. So we need to get identical climatological files to ensure that the new version of the code does not alter the output results.

As an example, we can consider the running of 923 configuration over France domain, for the climatological file of October 2011.

To compare the output results, it's possible to use fields norms or to make difference graphics.

For example, the next picture describes the difference between the surface temperature field, calculated with the operational cycle and with the pre_cy38:



Picture4: Difference in Surface temperature over ALADIN France domain (zoomed)
(Comparison between climatological files of operational run and pre_cy38 run)

The unique color in this picture represents the constant field of value 0. It proves that the results obtained with the run of operational cycle and of the pre_cy38 are identical.

A second test was taken with runs of pre_cy38 and cy37T1.bf2, the numerical comparison between the output files shows identical fields norms as presented on the following example of the STEP 1 of 923 configuration run over ALADIN France domain:

- Run with cy37t1.r3b.v05:

EBICLI NORMS :	C+I/MAX	C+I/AVE	C+I/MIN	E/MAX	E/MIN
SURFIND.TERREMER:	0.100000000000000E+01	0.461112469518441E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFET.GEOPOTENT:	0.850210245172057E+04	0.343379341122884E+03	0.000000000000000E+00	0.488082638520113E+04	0.000000000000000E+00
SURFVAR.GEOP.ANI:	0.100000000000000E+01	0.726462444317144E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFVAR.GEOP.DIR:	0.184556133910375E+01	-1.05429861179964E-01	-1.71136209553067E+01	0.157078397701826E+01	-1.56893323784465E+01
SURFZ0REL.FOIS.G:	0.320290727168152E+03	0.441961160752371E+01	0.980665000000000E-02	0.215935414600210E+03	0.980665000000000E-02
SURFPROP.TERRE:	0.100000000000000E+01	0.461720866237997E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFPROP.URBANIS:	0.100000000000000E+01	0.417181224020460E-02	0.000000000000000E+00	0.422279887218045E+00	0.000000000000000E+00
SURFZ0.FOIS.G:	0.320290727168152E+03	0.441961160752371E+01	0.980665000000000E-02	0.215935414600210E+03	0.980665000000000E-02

- Run with cy37t1.bf2:

EBICLI NORMS :	C+I/MAX	C+I/AVE	C+I/MIN	E/MAX	E/MIN
SURFIND.TERREMER:	0.100000000000000E+01	0.461112469518441E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFET.GEOPOTENT:	0.850210245172057E+04	0.343379341122884E+03	0.000000000000000E+00	0.488082638520113E+04	0.000000000000000E+00
SURFVAR.GEOP.ANI:	0.100000000000000E+01	0.726462444317144E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFVAR.GEOP.DIR:	0.184556133910375E+01	-1.05429861179964E-01	-1.71136209553067E+01	0.157078397701826E+01	-1.56893323784465E+01
SURFZ0REL.FOIS.G:	0.320290727168152E+03	0.441961160752371E+01	0.980665000000000E-02	0.215935414600210E+03	0.980665000000000E-02
SURFPROP.TERRE:	0.100000000000000E+01	0.461720866237997E+00	0.000000000000000E+00	0.100000000000000E+01	0.000000000000000E+00
SURFPROP.URBANIS:	0.100000000000000E+01	0.417181224020460E-02	0.000000000000000E+00	0.422279887218045E+00	0.000000000000000E+00
SURFZ0.FOIS.G:	0.320290727168152E+03	0.441961160752371E+01	0.980665000000000E-02	0.215935414600210E+03	0.980665000000000E-02

During this validation, similar runs as France domain took place over the following domains:

- FRANCE 7.5 , FRANX01;
- REUNION, MASCA01, MASCA025;
- POLYNESIE, POLY01, POLY025;
- CALEDONIE, CALED01, CALED025;
- ANTIGUY, ANGUY01, ANGUY025.

The run tests over these domains showed a similar results between the pre_cy38 runs and the operational cycle runs.

3) Validation of an optimization pack for the CANARI code:

The CANARI code is an initialization tool used for ARPEGE, to produce initial atmospheric state in different altitudes. This code uses the optimum interpolation method, which is based on the Best Linear Unbiased Estimation, such the following equation:

$$X^A = X^G + BH^T(HBH^T + R)^{-1}(Y - HX^G)$$

with

- X^A : analyzed state vector
- X^G : background state vector
- Y : observation vector
- H : observation operator (model space to observation space)
- B : background error covariance matrix
- R : observation error covariance matrix
- K : gain matrix

This task consisted on using an optimization pack developed by Ryad El Khatib in order to increase the performance of the run performance of CANARI code.

STEP 1: It consists on eight routines pack, which I merged in clearcase, and tested onto ALADIN and ARPEGE.

The considered routines are:

- arp/canari/camera.F90
- arp/canari/canada.F90
- arp/canari/casgqa.F90
- arp/canari/casgra.F90
- arp/canari/casgva.F90
- arp/canari/caspia.F90
- arp/canari/cassva.F90
- arp/canari/catrma.F90

The ALADIN tests in the same conditions with and without the new routines, showed that these new routines help to decrease time consumption for CANARI code, and at the same time, don't alter the results of the code:

Initial Run:

Resource	Elapse Time	Total CPU Time	Max mem / job
Allocated	5400 s	5280 s	68300 MB
Used	1046 s	948 s	4691 MB
Ratio	19,00%	17,00%	6,00%
Remaining	4354 s	4332 s	63609 MB

Second Run (with modified routines):

Resource	Elapse Time	Total CPU Time	Max mem / job
Allocated	5400 s	5280 s	68300 MB
Used	464 s	416 s	5651 MB
Ratio	8,00%	7,00%	8,00%
Remaining	4936 s	4864 s	62649 MB

The verification of spectral norms shows that these routines have no impact on the numerical results, an example of comparison is the following:

Initial Run:

```
SPECTRAL NORMS - LOG(PREHYDS) 0.115091800157502E+02
LEV  VORTICITY      DIVERGENCE      TEMPERATURE      HUMIDITY      KINETIC ENERGY
AVE 0.516243416734392E-04 0.405094523371067E-04 0.246644025010463E+03 0.151770426512446E-02 0.140230384976385E+03
```

Second Run (with modified routines):

```
SPECTRAL NORMS - LOG(PREHYDS) 0.115091800157502E+02
LEV  VORTICITY      DIVERGENCE      TEMPERATURE      HUMIDITY      KINETIC ENERGY
AVE 0.516243416734392E-04 0.405094523371067E-04 0.246644025010463E+03 0.151770426512446E-02 0.140230384976385E+03
```

These tests were run with the cy37T1.bf2 and with pre_cy38 code and in consideration of mono and multi processors.

– ARPEGE: The new routines had the same effect as with ALADIN in decreasing time use but this test showed an impact over the numerical fields in output files.

STEP 2: It consisted on a pack of 30 routines witch I merged in clearcase. This new routines define new variables such as “LIOLEVG” witch allows a few vertical levels tests with ALADIN. The list of routines is the following:

```
arp/utility/openfa.F90
arp/dia/wrmlppa.F90
arp/dia/wrspeca.F90
arp/module/yomct0.F90
arp/module/yomct1.F90
arp/module/yomdim.F90
arp/module/yomop.F90
arp/namelist/namct0.h
arp/namelist/namct1.h
arp/namelist/namdim.h
arp/phys_ec/sugwd.F90
arp/setup/su1yom.F90
arp/setup/suallo.F90
arp/setup/sucfu.F90
arp/setup/suct0.F90
arp/setup/sudim1.F90
arp/setup/sudim2.F90
arp/setup/sugridspa.F90
arp/setup/sugridua.F90
arp/setup/sumpini.F90
arp/setup/suoph.F90
arp/setup/suspeca.F90
arp/setup/suvert.F90
arp/setup/suxfu.F90
arp/utility/deallo.F90
ald/utility/cchien.F90
```

The analyses with this pack are not yet done because of compilation errors in routines `suct0.F90`, `sumpini.F90` and `su1yom.F90` as follows:

f90: error(110): i.suct0.F90, line 160: Extra text follows the end of statement.

f90: error(110): i.sumpini.F90, line 188: Extra text follows the end of statement.

f90: error(524): i.sumpini.F90, line 285: Format specifier variable "nam_distributed_vectors" in READ statement is never assigned by format label.

f90: error(439): i.sumpini.F90, line 285: Name "nam_distributed_vectors" must be typed explicitly.

f90: error(682): i.su1yom.F90, line 200: Characteristics of argument are inconsistent with dummy argument "pblh" of explicit interface.

At the end of this report I want to thank one more time all the team with whom I worked during my stay and with whose advice and explanations helped me improve my knowledge about ARPEGE and ALADIN models.

These knowledges that I inquired during this phasing event will help me for sure for my future challenges.