SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year

2015

Project Title:

Assessment of the AROME NWP model at sub-kilometre horizontal resolution over highly orographic terrain (Arome-500)

Computer Project Account:

spfrmary

Principal Investigator(s):

Alexandre MARY

Affiliation:

Météo-France

Name of ECMWF scientist(s) collaborating to the project
(if applicable)

Yann Seity
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Claude Fischer
Marie-Dominique Leroux
David Barbary
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Rachel Honnert

Start date of the project:

Jan 1st, 2015

Expected end date:

Dec 31st, 2016

Computer resources allocated/used for the current year and the previous one

(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)			14,450,000	1433334.67
Data storage capacity	(Gbytes)			30,000	0

Summary of project objectives

(10 lines max)

This special project aims at addressing by experimental means the properties of AROME for a typical resolution of 500m in mountainous regions both over inland France and over tropical islands (La Réunion or Tahiti). A specific attention will be paid to the four following issues: a) locally steeper slopes; b) 3D effects at surface level; c) adaptation of turbulence schemes at sub-kilometre scale; d) triggering of convection.

Summary of problems encountered (if any)

(20 lines max)

Building a prototype experiment running on the ECMWF HPC from Météo-France's OLIVE web interface was performed without any major difficulty.

However, we faced more serious problems when trying to use the I/O server developed within the IFS/Arpege code from this interface, which would save around 50% of SBU for an AROME forecast. This fairly blocking point caused a delay in the use of the special project resources, and work continues for trying to improve this situation. This is the main hint that prevented a larger use of the allocated resources in the first 6 months of this project.

Although this problem is not solved, a first set of simulations has been run, with – not surprisingly – much larger SBU consumption than should be.

Summary of results of the current year (from July of previous year to June of current year)

The implementation of the orography-radiation interaction scheme in AROME/SURFEX has been developed by the end of 2014, with final modifications and validations done until April 2015 on CY41T1.

Compilation of the AROME model code (containing this scheme) in its version CY41T1_op1 has been succeeded on CCA, soon after availability of this cycle, at the beginning of May 2015.

For the time being, the following experiments have been run:

- AROME-France forecast at 1,3km resolution, on 2 dates of February and April 2015, with different options in the orography-radiation ("ORORAD") scheme, i.e. correction of short-wave and/or long-wave surface fluxes due to:
    a) the Sky-View Factor (fraction of sky not occulted by surrounding mountains);
    b) the incidence angle of direct solar radiation with regards to solar zenith/azimuth and local slope and aspect;
    c) the possible occultation of direct solar radiation by surrounding mountains with regards to solar zenith/azimuth.

  The results of these parameterizations, of which an illustration is shown below, are under evaluation.

  These experiments represent a total 1,4MSBU.

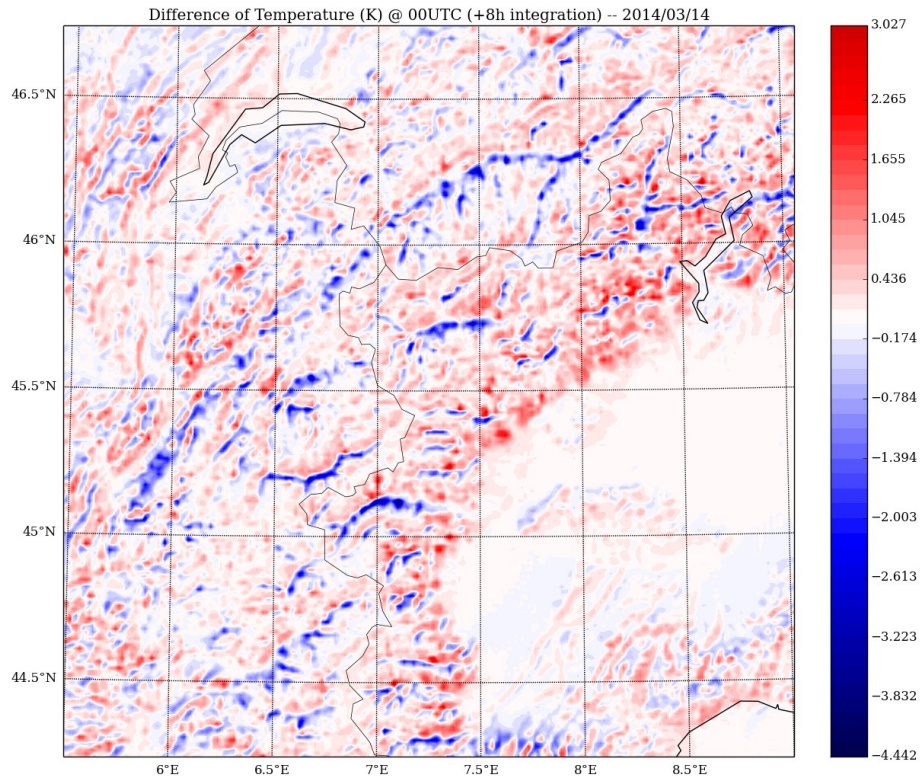

Illustration 1: Temperature difference at lowest model level using slope angle parameterization, over the Alps, at 08UTC (8h integration). One can clearly see larger solar heating in Eastern slopes and smaller heating down in valleys or on Western slopes.

- Several versions of the turbulence scheme implemented in the French AROME non-hydrostatic model are tested with different numerical simulations and for a small domain over the Alps.
  These simulations intend to investigate the quality of turbulence schemes at horizontal resolutions of the order of 500 m or finer, namely within the so-called “grey zone” of turbulence.
  These experiments (currently being ported to CCA) correspond to the following modifications:
  a) a reduction of turbulent fluxes with a factor depending on the resolution of the model (Boutle et al. 2014, Honnert et al. 2011);
  b) a reduction of turbulent fluxes by releasing some of the usual hypotheses assumed to be valid at meso-scale;
  c) a resolution-dependant correction of the diagnostic of convective mass-flux at the surface;
  d) variations about c) with different normalizations of the mass flux by using different measurements of heights of PBL and cloud.

  Details about the parameterizations and the results of these experiments will be given in a future Special Project report.

Cited references:

Boutle, I. A., J. E. J. Eyre, et A. P. Lock, 2014, Seamless stratocumulus simulation across the turbulent grey zone, Mon. Wea. Rev., 142, 1655–1668, 2014.
Honnert, R., V. Masson, et F. Couvreux, 2011, A diagnostic for evaluating the representation of turbulence in atmospheric models at the kilometric scale., J. Atmos. Sci., 68, 3112–3131, 2011.

List of publications/reports from the project with complete references

Summary of plans for the continuation of the project

(10 lines max)

2nd semester, 2015:

- Thorough sensitivity tests of the orography-radiation scheme with different resolutions (500m, 1,3km, 2,5km). Evaluation against observations, in terms of 2m-temperature and 10m-wind.
- Extended simulations of AROME 500m over Tahiti island. Evaluation in terms of rain scores, convection triggering and local effects.
- Exploitation of the results of turbulence parameterizations experiments.