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: Sensitivity of decadal forecast to atmospheric resolution and physics

Computer Project Account: spfrguer

Principal Investigator(s): Jean-François Guérémy

Affiliation: CNRM-GAME/GMGEC

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

Start date of the project: 01 January 2013

Expected end date: 31 December 2015

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)	14500000	16122929	15000000	0
Data storage capacity	(Gbytes)	30000	30000 (on frtodcli)	30000	0

Summary of project objectives

(10 lines max)

The main objective of the project is to investigate the sensitivity of decadal predictability to atmospheric resolution and physics. Two earlier projects dealing with decadal forecasts (i.e., CMIP5 and EPIDOM) made use of our present model CNRM-CM5 with different atmospheric spatial resolutions, Tl127l31 for the former and Tl63l62 together with Tl63l91 (including for the latter. In the present project, we will use a more recent version of the CNRM-CM model including a new atmospheric physical package (non orographic gravity wave drag, turbulence, convection and microphysics). Moreover, different atmospheric spatial resolutions will be considered in the course of the project, all including the stratosphere to take advantage of our simulated QBO, starting from Tl159l91 and going to Tl255l91.

Summary of problems encountered (if any)

(20 lines max)

Going from IBM to Cray HPC, we have experienced a drop of computing resources. Our coupled model is working with 3 components (atmosphere, ocean and coupler), each of them taking necessarily one node on the Cray HPC, which is not the case on the previous IBM and the MF Bull. Going from T159l91 to Tl255l91 (see the following summary of the current year) represents a resource increase of 2.6; we decided to divide by 2 the number of years in the range of the hindcasts; but finally we carried out only 6 start years among the 11, with the available resources of the past year.

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

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

As mentioned in the summary of plans from our last report, during the second part of the second year we performed a second set of decadal hindcasts using CNRM-CM5+ with a resolution of Tl255l91, running on the Cray cca of ECMWF. The plan was to consider the same 11 start dates from 1980 to 2005 every 3 or 2 years (1980, 1983, 1985, ...), as the first set performed with tl159l91. The hindcasts start from the first of November of the previous year. Each decadal hindcasts is an ensemble of 10 members over a range of 5 years (in order to divide by 2 the calculation, considering an computation increase of 2.6 due to the change of resolution). But due to a shortage of computing resources, only the first 6 start dates have been performed (see “problems encountred”). The initial conditions is coming from a coupled simulation nudged toward NEMOVAR in the ocean and toward the rotational dynamics of ERA-Interim in the stratosphere only, in order to get the best initial condition possible for both ENSO and QBO.

As a reminder (see previous reports), CNRM-CM5+ is an upgraded version of CNRM-CM5 (Voldoire et al., 2012), using cycle 37t1 of ARPERGE-IFS (and NEMO 1° as in CNRM-CM5) and a new atmospheric physical package: turbulence (Cuxart et al., 2000), microphysics (Lopez, 2002), convection (Guérémy, 2011 and Piriou, 2012, personal communication for the prognostic convective microphysics following Lopez, 2002) and a new non orographic gravity wave drag parameterization (Lott, 2012).

Figure 1 shows the Z500 plumes for 1983 and 1990 start dates for both resolutions Tl159 and Tl255. CNRM-CM5+ presents a quasi null drift, whereas CNRM-CM5 was producing a negative drift corresponding to decrease of 0.6K of the temperature at 2m. In the CNRM-CM5+ version (still in evolution , see next) used for the Tl255 hindcasts, a negative bias of 10 to 15 meters is present for the Z500 field.

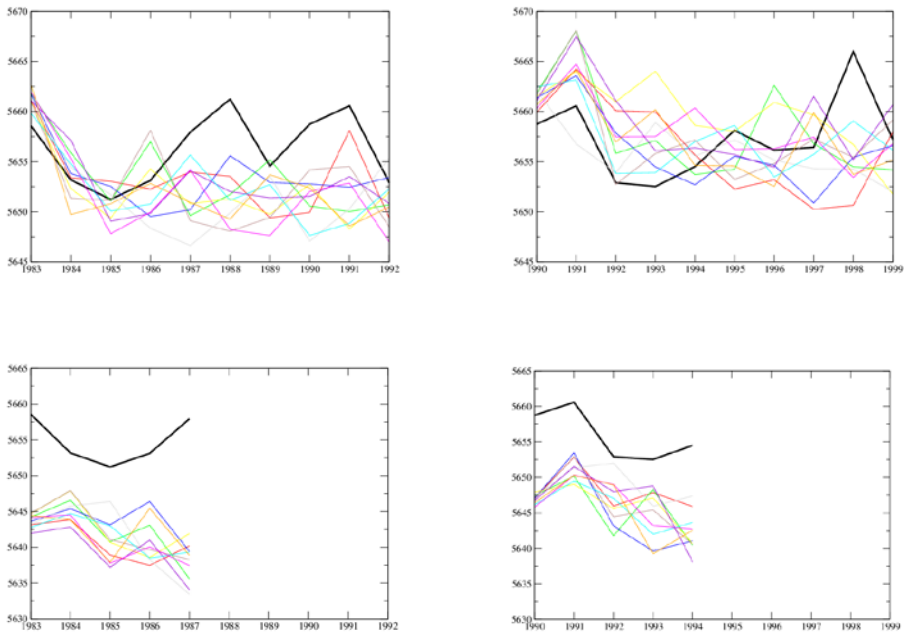

Fig. 1. Z500 plumes for 1983 and 1990 start dates, Tl159 top row and Tl255 bottom row (ERA-Interim in black, members in colour).

The spatial maps of temporal correlation (computed over the 6 start dates) for the temperature at 2m averaged over the years 2 to 5 are shown in Fig. 2. Both resolutions Tl159 (left) and Tl255 (right) are depicted. Overall, the regions of good skill are common in both experiments (and also in other experiments, see previous report), that is the equatorial Indian Ocean together with the equatorial western Pacific, the northern Atlantic Ocean and USA, southern Europe, eastern Asia for the continental regions. Going deeper into regional differences, it is worth to notice that the skill obtained by Tl255 is better than the one of Tl159 over the tropical Pacific and over the Tropical Atlantic in a lesser extent.

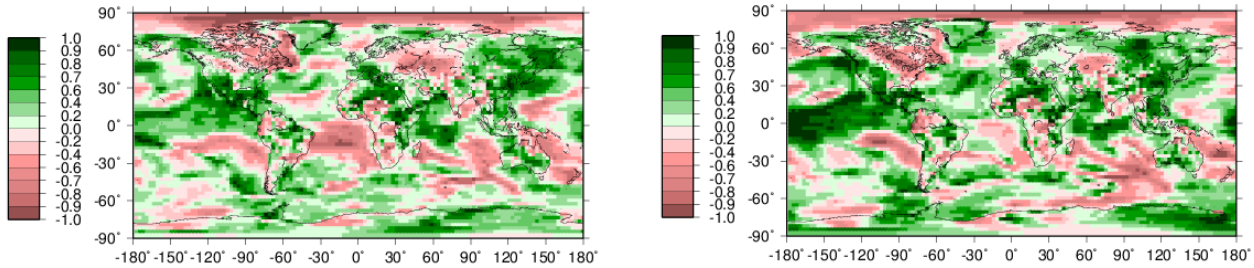

Fig. 2. T2m correlation for the years 2-5 over 6 start dates: Tl159 left and Tl255 right.

During the first part of the third year, the main part of the activity has been devoted to significant improvements, correction and re-tuning of CNRM-CM5+ (both in its atmospheric and soil components), getting at final a beta version of CNRM-CM6 (called pre-CNRM-CM6) which will be used for the upcoming simulations of CMIP6.

List of publications/reports from the project with complete references

Summary of plans for the continuation of the project

(10 lines max)

In the second part of the third year, we intend to perform a third set of decadal hindcasts using pre-CNRM-CM6 with a resolution of Tl255l91. The plan is to consider the same 11 start dates from 1980 to 2005 every 3 or 2 years (1980, 1983, 1985, ...), as the first set performed with tl159l91, but with a 5 year range. We hope to take advantage of OASIS3-MCT which enables to save one node in the coupled system, considering the present architecture of the Cray HPC. The hindcasts will start from the first of November of the previous year. Each decadal hindcasts will be an ensemble of 10 members over a range of 5 years. The initial conditions will come from a coupled simulation nudged toward NEMOVAR in the ocean and toward the rotational dynamics of ERA-Interim in the stratosphere, as for the previous experiments.