REQUEST FOR A SPECIAL PROJECT 2013–2015

MEMBER STATE: ....France...

Principal Investigator[1]: ...Dr Virginie Marécal..............

Affiliation: ....CNRM/GAME Météo-France............................

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Other researchers: L. Grellier (PhD Student on HEVA project)
P. Hamer (Post-doc on SHIVA project)

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Project Title:

Modelling the impact on atmospheric chemistry of very short-lived species and volcanic emissions of halogens

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** _FRHALO	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2011	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2013-2015: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2015.)	**2013**	**2014**	**2015**
High Performance Computing Facility (units)	450,000		
Data storage capacity (total archive volume) (gigabytes)	150		

Electronic copy of the form sent on (please specify date):

Le Directeur général adjoint

....

Olivier GUPTA

[1] The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

Principal Investigator: ... Dr Virginie Marécal ....

Project Title: Modelling the impact on atmospheric chemistry of very short-lived species and volcanic emissions of halogens

[redacted]

It is expected that Special Projects requesting large amounts of computing resources (500,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

1. INTRODUCTION

Dr Virginie Marécal, who is the coordinator of this request for special projects, is a CNRS permanent researcher. She moved to CNRM/GAME (Météo-France) since Sept. 2010. She has worked for the last 10 years and she is still working on the modelling of air composition using the limited-area coupled meteorological-chemistry C-CATT-BRAMS model. This model is optimized for parallel computers and run operationally at CPTEC/INPE (Brazil) for air quality predictions over South America. The C-CATT-BRAMS was firstly implemented on the NEC Météo-France computer but its performances on this scalar computer are very poor and cannot be improved without major code modifications (as discussed with NEC user support). This is why the C-CATT-BRAMS was implemented on ECMWF IBM parallel computer on which it gives good performances. For these tests, we used SBUs that were attributed to Météo-France. These SBUs were not planned to be used for C-CATT-BRAMS simulations since it was not anticipated that the model will not work properly on Météo-France NEC computer. The present request will allow to continue the C-CATT-BRAMS simulations planned in the SHIVA and HEVA scientific projects (see below) in which CNRM/GAME is involved for the period 2012-2014. Request form for a special project were submitted and we obtained SBUs for 2011 (late request) and 2012. The extended abstract provided here is the same as in the previous request forms with updates.

2. SCIENTIFIC CONTEXT

Halogen reactive species from any source (anthropogenic or natural) are of particular interest for atmospheric chemistry. Their role on stratospheric ozone depletion is well established since the 1980's. Reactive halogen sources were assumed so far to be long-lived natural and anthropogenic organic substances (mostly CFCs) (Wamsley et al. 1998). But recent studies have shown that additional sources (~30%) should be considered to explain bromine measurements in the stratosphere (Pfeilsticker et al. 2000, Salawitch et al. 2005, Dorf et al., 2008). These sources may come from Very Short-Lived Substances (VSLS) or volcanoes as stated in the World Meteorological Organization Scientific assessment of ozone depletion conducted in 2010 (WMO 2011). Observations show that atmospheric halogen loading is now decreasing and will carry on declining over half a century (Montzka et al., 2003; WMO 2011), reflecting the control of CFC emissions by the Montreal Protocol and its Amendments. As a result, the contribution of VSLSs and volcanic halogens to the total halogen loading and hence to stratospheric ozone depletion is bound to become relatively more important in the future. In the troposphere, it was shown recently that halogen reactive species have an implication in the oxidation power of the troposphere (von Glasow et al. 2004, Lary 2005, Yang et al. 2005). The contribution of volcanoes to the reactive halogen compound content at the global scale is identified to be one of the objectives to be reached in the future (von Glasow et al., 2009; HitT project of IGAC (International Global Atmospheric Chemistry)).

The CNRM/GAME (Centre National de Recherches Météorologiques/Groupe d'étude de l'Atmoshère Meteorologique) is involved in two projects addressing these issues. The first one is the SHIVA European project devoted to the study of halogen VSLSs. The second one is on volcanic emissions (HEVA) and was funded by INSU/CNRS (Institut National des Sciences de l'Univers/ Centre National de la Recherche Scientifique) until 2012. A follow-up proposal was submitted to

ANR (Agence Nationale pour la Recherche). It also currently benefits from funds (regional + Météo-France) for L. Grellier's PhD. These projects will provide important results on the role of halogen VSLS and volcanic (emissions, transport and chemistry processes) on tropospheric air composition at local and regional scales. These processes will then be included in MOCAGE and C-IFS models in the frame of the MACC-II project lead by ECMWF.

2. SCIENTIFIC PLAN

2.1 SHIVA European Project

The FP7 European project SHIVA (Stratospheric ozone: Halogen Impacts in a varying Atmosphere http://shiva.iup.uni-heidelberg.de/) is coordinated by the University of Heidelberg and funded for 3 years and one year extension until June 2013.

The main objectives of the project are to quantify natural emissions (mainly from oceans) of halogen VSLS and to study their impact on stratospheric ozone. The CNRM-GAME objective in the project is to perform local and regional process studies (chemistry and transport) of the evolution of VSLS in the troposphere and in the lower stratosphere based on a modelling approach. This work is done in link with field campaign measurements gathered in Nov./Dec. 2011 in Malaysia and Chemistry-Transport Model (CTM) studies in collaboration with Dr M. Chipperfield (Univ. Leeds, UK). More precisely, the C-CATT-BRAMS (Freitas et al. 2009) is used to simulate several case studies of the field campaign in convective environments using a chemistry scheme (89 gaseous species) including tropospheric chemistry (RACM scheme, Stockwell et al. 1997) and chemistry for $CHBr_3$ and CH_2Br_2 (Hossaini et al. 2010) which are the most abundant halogen VSLS. We use the grid nesting capability of the model in order to make process studies at the local scale and comparisons at the regional scale with global CTM results for validation purposes. The model developments to include halogen VSLS chemistry in the C-CATT-BRAMS are done. A publication on the results obtained with this new scheme in an idealised framework is currently under revision (Atmos. Chem. Phys.).

In practice, Dr V. Marécal is in charge of C-CATT-BRAMS modelling work which is done in collaboration with Pr M. Pirre (Laboratoire de Physique et Chimie de l'Environnement et de l'Espace, Orléans, France). A 16-month post-doc (Dr P. Hamer) works at CNRM/GAME on the C-CATT-BRAMS modelling under V. Marécal's supervision since Nov. 2011.

2.2 HEVA project

The HEVA (Halogen Emissions from Volcanoes and their impact on Atmospheric chemistry) project is coordinated by V. Marécal (CNRM/GAME) and was funded by INSU/CNRS for 3 years until 2012. A proposal for additional funds (4 years) to continue the project was submitted to ANR (Agence Nationale pour la Recherche) in Jan. 2012. The ANR decision will be known by June. It currently benefits from funds (region + Météo-France) for L. Grellier's PhD.

The objectives of HEVA are to produce the first geographical inventory of halogen emissions by volcanoes and to study their impact on tropospheric chemistry and, potentially, on the ozone budget in the stratosphere including its feedback on climate. It is based on a pluri-disciplinary consortium associating specialists in volcanology and in atmospheric chemistry. Detailed studies at the local and regional scales in volcanology and atmospheric chemistry are done for three volcanoes at different latitudes during periods for which emission fluxes and air composition of plumes close to and/or far from the crater are available: Etna (Italy), Eyjafjallajökull (Iceland) and Ambrym (Vanuatu). These local studies will be used for extrapolation at the global scale.

In this project the CNRM/GAME is in charge of the atmospheric chemistry modelling studies at the local and regional scales based on the C-CATT-BRAMS model. This model is used to study the chemical evolution of the volcanic halogen emissions in the atmosphere for the three selected volcanoes/events. The results will be compared to those obtained by the global CTM MOCAGE (Josse et al. 2004, Bousserez et al. 2007) used operationally at CNRM/GAME. Grid-nested simulations will be run for comparisons with MOCAGE.

Halogen species emitted by volcanoes are mainly in the form of inorganic hydrogen halides HCl, HBr, HI (Oppenheimer et al, 1998). Due to their high water solubility it was assumed that they were rapidly removed by precipitation and had only local effects. However, high levels of reactive halogen BrO (Bobrowski et al., 2003, Oppenheimer et al. 2006) were observed recently in volcanic plumes. 0D-model studies (e.g. Roberts et al. 2009) have shown that they are rapidly generated from HBr, HCl and Br emissions by heterogeneous reactions on sulphate aerosols also emitted by volcanoes. A plume chemistry module was implemented in both MOCAGE and C-CATT-BRAMS model and is currently tested. The chemistry scheme used in C-CATT-BRAMS includes RACM scheme (Stockwell et al. 1997) and inorganic halogen chemistry (88 species in total).

In practice, Dr V. Marécal is in charge of the C-CATT-BRAMS modelling work which is done in collaboration with Dr B. Josse (CNRM/GAME) and Pr M. Pirre and Dr L. Jourdain (Laboratoire de Physique et Chimie de l'Environnement et de l'Espace, Orléans, France). A post-graduate student (L. Grellier) currently works on the C-CATT-BRAMS modelling of the Eyjafjallajökull's eruptions in the frame of her thesis started in October 2011.

3. SIMULATIONS PLANNED AND COMPUTING RESOURCES NEEDED

Since detailed studies at the local and regional scales are required in SHIVA and HEVA the simulations planned in both projects include up two to three nested grids with typically 130x130x45 grid points, ~90 gaseous species. Simulations will be run for 4 to 7 days. A reference simulation without the VSLS (resp. volcanic emissions) is required to study the impact of VSLS (resp. volcanic emissions). For SHIVA at least two case studies from the field campaign will be simulated. Sensitivity tests on the VSLS chemistry scheme which is still not fully explored will be done. For HEVA, simulations for Etna and Eyjafjallajökull will be run at CNRM/GAME, those for Ambrym being done at LPC2E. Major sources of uncertainty in HEVA are the quantification of the halogen emissions from volcanoes and the chemistry within the plume. Therefore sensitivity tests on these two aspects will be done.

The C-CATT-BRAMS model is a code developed and optimized for both operational and research applications that can be run on massively parallel computers (MPI). It is used operationally at CPTEC (http://meioambiente.cptec.inpe.br, Brazil) for air quality forecasts. It is based on the BRAMS meteorological model (Brazilian Regional Atmospheric Modeling System, Freitas et al. 2009) which can be run with horizontal resolutions spanning from a few meters to several hundreds kilometres. It is mainly coded in Fortran 90. For parallelism the model divides the geographical domain in sub-domains with a master node configuration.

The C-CATT-BRAMS model has been implemented on ECMWF IBM Power 6 computer. The reference simulation for HEVA project without volcanic emissions was run with 2 nested grids (130x80x44 grid points for the coarse grid and 192x142x44 grid points for the fine grid) over two days. It required 6770 SBU per 24 hours of simulation on 2 nodes of 64 processes.

For the whole SHIVA project from 2011 to 2013, it is planned to run a reference simulation without VSLS, a simulation with VSLS and 6 sensitivity tests on the chemistry scheme and emissions. Each simulation uses 3 nested grids over 4 days and is estimated ~40 KSBU. It is anticipated to make simulations for two case studies. The total of these simulations leads to 640 KSBU.

For the whole HEVA project from 2012 to 2015, it is planned to run for Etna and for Eyjafjallajökull a reference simulation without volcanic emissions, 8 simulations with minimum and maximum estimates of volcanic emissions of HBr, HCl and SO_2 and with different assumptions in the plume chemistry. Each simulation use 3 nested grids over 7 days for Etna and 5 days for Eyjafjallajökull and is estimated ~70 KSBU for Etna and ~50 KSBU for Eyjafjallajökull. The total of these simulations leads to 1080 KSBU.

The planned repartition for each year is :
2011: 320 KSBU
2012: 800 KSBU
2013: 450 KSBU
2014: 150 KSBU (in a new proposal for a special project)
We obtained the requested KSBU for 2011 and 2012. **We request here 450 KSBU for 2013.**

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REQUEST FOR A SPECIAL PROJECT 2013–2014

MEMBER STATE: FRANCE

Principal Investigator[2]: François BOUTTIER

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Project Title: Continental winter weather prediction with the AROME ensemble prediction system

If this is a continuation of an existing project, please state the computer project account assigned previously.	SPFRBOUT__________
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2012
Would you accept support for 1 year only, if necessary?	YES / ~~NO~~

Computer resources required for 2013-2015: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2014.)	**2013**	**2014**	**2015**
High Performance Computing Facility (units)	5,000,000	6,000,000	0
Data storage capacity (total archive volume) (gigabytes)	4,000Gb	4,000Gb	0

*An electronic copy of this form **must be sent** via e-mail to:* *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date):

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Continue overleaf

Le Directeur général adjoint

Olivier GUPTA

2 The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

Principal Investigator: François Bouttier

Project Title: Continental winter weather prediction with the AROME ensemble prediction system

Extended abstract

It is expected that Special Projects requesting large amounts of computing resources (500,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

Description for project "Continental winter weather prediction with the AROME ensemble prediction system"

1) Introduction.

The basis of this proposal is to improve the value of ensemble prediction systems in winter weather situations. Two main tasks are planned. One is the evaluation and tuning of a limited-area ensemble prediction system based on the AROME model at an horizontal resolution of about 2km. The domain and test periods will focus on significant wintertime weather events such as low clouds, fog, frost, snowfall, and high winds over Central Europe. The other task is the development and testing, for preoperational purposes, of forecast improvements by expanding the representation of model errors , of initial conditions errors, and of perturbations to lateral boundary boundary conditions (LBCs). It is planned to focus on boundary layer physics, because low-level errors are often significant for wintertime weather prediction over land.
Examples of scientific questions to address are: the role of the radiative properties of land surfaces and low clouds, ensemble perturbation techniques for sheets of low clouds and fog, the usefulness of perturbing various land surface fields, identifying an appropriate stochastic perturbation scheme for the stable planetary boundary layer. The longer-term objective is the development of perturbation strategies for locally influenced phenomena in high-resolution operational ensembles, to be used in conjunction with the larger-scale LBC perturbations provided by global ensembles such as ECMWF's EPS.

2) Developing high-resolution ensembles for Central Europe

Until now, high-resolution short-range ensemble predictions over Central Europe have been studied using horizontal resolutions of the order of 10km. In the Aladin/Hirlam consortium, (quasi-)operational ensembles have typically used the HIRLAM, ALADIN or ALARO models. They have demonstrated that some added value can be produced (compared to direct exploitation of EPS output) thanks to the higher model resolution, which improves probabilistic forecasts of low-level wind, gusts, temperature, humidity and precipitation (Wang 2011, Theis et al 2009, Clark et al 2011, Horányi et al. 2011). As demonstrated in Météo-France (Vié et al, 2010), even better forecasts can be obtained using the AROME model at kilometric resolutions and with smaller domains, in both deterministic and ensemble prediction runs. The higher resolution delivers clear benefits for the ensemble prediction of thunderstorms and high precipitation, because the largest convective clouds (and their uncertainty) can be explicitly simulated, as documented in the literature. There has been less work on winter weather events, but it is believed that substantial added value will stem in these cases from:

a more realistic depiction of mountain range and valleys, particularly with respect to foehn effects and the trapping of cold air and low clouds in the valleys and foothills, which can lead to extreme local variability (and, often, uncertainty) of temperature, sunshine, wind and precipitation;

- a better representation of land surface effects, for instance humidity sources from lakes and large rivers, which can strongly influence wintertime weather in such areas, with consequences on local forecasts for cities, airports and motorways; uncertainties on snow cover may play a role, too;
- a more explicit representation of the formation, advection and dissipation of fog and low clouds, which have an indirect effect on the prediction of temperature and the occurrence of frost;
- the detailed representation of cloud microphysics and of the vertical PBL structure is likely to help in the prediction of the precipitation phase (snow vs liquid rain), which is very important for human activities.

A baseline version of the AROME ensemble prediction system has been developed at Météo-France, which comprises LBC coupling to a global ensemble (PEARP), perturbations of initial conditions using an AROME ensemble data assimilation (EDA, brousseau et al 2011), and a representation of atmospheric model errors using a limited area version of ECMWF's SPPT scheme (stochastic perturbations of physics tendencies, Palmer et al 2009). This system has good probabilistic scores over France in the warm season, particularly with respect to Mediterranean rain events, synoptically forced weather, and thunderstorms. It is proposed to investigate its performance for the lesser known wintertime conditions that occur in Central Europe, using a relocated version of the AROME-2.5km model as prepared by the Hungarian Meteorological Service. A dedicated set of AROME ensemble predictions will be run and evaluated over several weeks. Probabilistic scores will be investigated using verification against observations (national synops and raingauges, aircraft reports, radars, satellite cloud products). It will be interesting to compare the AROME ensemble performance against lower-resolution LAM ensembles (with more members) and the EPS over the same area.

Some ensemble characteristics can be adjusted if the necessary computing power is available, e.g. the strength, correlations and nature of the tendencies perturbed by the SPPT scheme; the variance of perturbations applied to observations and surface fields in the EDA; the criteria used to cluster the PEARP forecasts when preparing the LBCs. A small number of impact experiment will be carried out to determine if the peculiarities of wintertime weather warrant the development of situation-specific perturbation strategies, particularly in terms of obtaining the correct ensemble spread for key weather parameters.

3) Representing low-level model error

Most existing ensemble prediction systems lack spread in low-level output parameters. Multiphysics approaches are known to improve spread, although it is not very satisfactory that they tend to produce ensembles whose member-to-member differences are dominated by systematic biases. Stochastic physics approaches can help with the representation of mesoscale model errors (Berner et al 2011). It is known from the NWP physical parametrisation community that NWP models have issues representing surface fluxes, the structure of stable boundary layers, and capping inversions. Ideally, the related model uncertainties should be represented as dedicated perturbations in ensemble prediction systems. It is planned to develop them in high-resolution, small-domain ensembles such as AROME ensembles, because most of their forecast uncertainties at upper levels will already be handled by the LBC perturbations by larger-scale ensembles. In this project, it is proposed to focus on the perturbation of processes that are likely to be relevant for wintertime NWP:

- the radiative balance at the surface, by perturbing the albedo and the radiative properties of the surface and clouds,
- the surface energy budget, by perturbing the mixing length, soil moisture and temperature, and the snow cover,
- the formation/dissipation of fog and low clouds, by perturbing the low-level humidity and cloud/ice water content, possibly using object displacement methods,
- the rain/snow transition, by perturbing the PBL temperature, and the relevant microphysical processes.

There may not be enough human resources to develop perturbation strategies for all these processes within the project, nevertheless the intention is to, at least, evaluate to what extent existing perturbation techniques (such as EDA perturbations of the soil and snow assimilation systems) need improvement in order to provide a satisfactory ensemble reliability in high-impact winter weather. Some simple 2D model tendency perturbations can be tested using the existing SPPT software.
The work will be carried out in coordination with the HIRLAM/ALADIN community. It will use the IFS software.

Technical requirements
The estimate for the computer resources is conservative, and based on the 2011 experience of running AROME-France ensemble prediction tests using Météo-France resources on C1A and ECFS. It is planned to test each set of modifications by running (typically) 15-21 days of 12-member AROME ensemble forecasts at 24-h range. This is the minimum experiment length required to reliably identify the average impact of modifications. About ten sets of impact experiments need to be run each year in order to achieve the scientific objectives. A substantial part of the experimentation will be run using a smaller domain than AROME-France, centred over Hungary.

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REQUEST FOR A SPECIAL PROJECT 2013–2015

MEMBER STATE: France

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E-mail: jean-francois.gueremy@meteo.fr

Other researchers: ....

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Project Title:

Sensitivity of decadal forecast to atmospheric resolution and physics

If this is a continuation of an existing project, please state the computer project account assigned previously.		
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2013	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2013-2015: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2015.)	**2013**	**2014**	**2015**
High Performance Computing Facility (units)	14,5 10**6	14,5 10**6	15 10**6
Data storage capacity (total archive volume) (gigabytes)	40,000	30,000	30,000

An electronic copy of this form via e-mail to [redacted]

Electronic copy of the form sent on (please specify date):

Le Directeur général adjoint

Olivier GUPTA

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[3] The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

Principal Investigator: Jean-François Guérémy

Project Title: Sensitivity of decadal forecast to atmospheric resolution and physics

[redacted]

It is expected that Special Projects requesting large amounts of computing resources (500,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

Scientific proposal:
(plus gueremy_dec_forecasts.pdf, as attached file)

The climate group of CNRM-GAME (CNRM-GAME/GMGEC) has conducted many climate simulations using its own coupled global climate model (CGCM) over the last 15 years. These simulations cover scales ranging from seasonal forecasts up to climate change projections, including more recently decadal forecasts. For the purpose of CMIP5, a new version of the CGCM has been released, called CNRM-CM5 (Voldoire et al., 2012). CNRM-CM5 has been used to perform both the CMIP5 climate change projections together with the CMIP5 decadal forecasts. Moreover, this version will be used for the upcoming EUROSIP CNRM System 4.
Decadal forecast activity is more recent at CNRM. It started in the frame of the EU ENSEMBLES project in 2008. Last year, the CERFACS has carried out the CMIP5 decadal forecasts using the CNRM-CM5 model. At CNRM, I have been involved since the beginning of last year in a French research project (called EPIDOM) devoted to decadal forecast (Guérémy and Laanaia, 2012; see the attached file). My own activity at CNRM/GMGEC is shared between climate prediction research, notably with a participation to EU projects such as DEMETER (Guérémy et al, 2005) or MERSEA, and convective parameterization research (Guérémy, 2012).
The present proposal aims to take advantage of all these recent elements of context. The main goal will be the investigation of the sensitivity of decadal forecast to atmospheric resolution and physics. This particular topic has been partly addressed in the frame of EPIDOM. Indeed, using CNRM_CM5 (including a new parameterization of non-orographic gravity wave drag) with a coarser horizontal resolution (Tl63 instead of Tl127, the former being cheaper), ensembles of 10 member decadal forecasts have been performed considering 5 starting dates (1981 to 2001, every 5 years) in the frame of a twin experiment using a low top (LT, 62 vertical levels) in one hand and a high top (HT, 91 levels, identical in the troposphere but including the stratosphere) in the other hand. It is shown that the inclusion of the stratosphere provide significant differences between the anomalies of LT and HT in few places all around the globe (larger differences for the years 2-5 versus 6-9). At the same time, HT is providing light improvement in terms of scores particularly for years 6-9 and notably over mid-latitude and polar regions of both hemisphere.
Following this twin experiment, in the frame of the present proposal (for the first year), we would like to carry out another twin experiment including the stratosphere (91 levels), but using the CMIP5 horizontal resolution (Tl127). The first experiment would use the CMIP5 physics, while the second would use a more recent prognostic physics including a prognostic TKE turbulence scheme (Cuxart et al., 2000), a prognostic resolved microphysics (Lopez, 2002) and a CAPE relaxation convection scheme (Guérémy, 2011 and Piriou, 2012, personal communication for the prognostic convective microphysics following Lopez, 2002). The plan would be to consider 10 departure dates (the CMIP5 ones from 1960 to 2005, every 5 years) over 10 years with 8 members. With such an experimental design, it will be possible to compare the results to those obtained in the frame of

CMIP5 (Tl127l31) and EPIDOM (Tl63l91) beyond the only sensitivity test to the physics. Thus, both sensitivity of decadal forecasts to physics and resolution will be investigated.
During the second year, we propose to perform the same type of decadal forecast experiment (10 starting dates * 10 years * 8 members) only using the new physics but considering a larger horizontal geometry (Tl179 instead of Tl127). Such a larger geometry implies a factor 2 in terms of computing resources.
During the third year, we propose to perform another decadal forecast experiment (10 starting dates * 10 years * 8 members) only using the new physics but considering additional improvements, notably the inclusion of prognostic scheme for the aerosols.

Technical characteristics:

CNRM-CM5 includes ARPEGE-Climat as atmospheric component , NEMO v3 from IPSL (1°, 42 levels + GELATO ice model from CNRM) as oceanic component and OASIS v3 from CERFACS (coupler).
In order to perform a decadal experiment (10 starting dates * 10 years * 8 members) using the Tl127l91 geometry for ARPEGE-Climat, 7.25 10**6 units are needed. Therefore, 14.5 10**6 units are needed for the first year, together with data storage volume of 40 To.
The same experiment using the Tl179l91 geometry for ARPEGE-Climat requires the double in terms of computing resources. Therefore, 14.5 10**6 units are needed for the second and third year, together with data storage volume of 30 To.

References:

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