A propos du centre ou de la direction fonctionnelle
Grenoble Rhône-Alpes Research Center groups together a few less than 800 people in 35 research teams and 9 research support departments.
Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Contexte et atouts du poste
Team Presentation: the general scope of the AIRSEA project-team (http://team.inria.fr/airsea/) is to develop mathematical and computational methods for the modeling of oceanic and atmospheric flows. The used mathematical tools involve both deterministic and statistical approaches. The domains of applications range from climate modeling to the prediction of extreme events. This post-doctorate will take place in the framework of the European contract C3S ERGO that aims at developing the next generation of seasonal forecast system. Strong interactions are expected with its members in particular with the European Centre for Medium Range Weather Forecast (ECMWF) in Reading (UK).
Context
For its ocean analysis (ORA), ECMWF uses NEMOVAR, an incremental variational data assimilation system, which solve the variational data assimilation optimization problem by successive quadratic approximations. The quadratic optimizations are called inner-loops, while the updates of the non-linear trajectory and subsequent inner loops are called outer iterations. Such scheme allows for further simplifications in the inner problem either to deal with non-differentiabilities or for reducing the computing cost. For example one can solve inner problems at a coarser resolution than that of the non-linear model. Note that the convergence of inner optimization problems is still ensured, but it may affect the convergence of the outer problem if the approximation is too strong. In this case experience shows that very few outer iterations may still be beneficiary before the algorithm starts to diverge. This is actually likely to be an issue in case of incremental 3D-Var and 5 days assimilation window. A possible way to reduce, if not solve, this issue is to increase gradually the inner resolution as outer iterations goes on, leading to the multi-incremental algorithm. Alternatively to ensure convergence, as advocated by Debreu et al (2015), one could use proper multi-grid methods where the approximation made when solving the problem at coarser resolution is accounted for (Briggs et al 2000).

In NEMOVAR, multi-grid could also be used to solve the implicit diffusor operator that is used to model correlations within. Solving the diffusion at coarse resolution is likely to be a good approximation for simulating long decorrelation length scales and for the localization kernel in. As for multi-incremental, a key point of this work package is to check the validity of such approximation, in particular in the vicinity of coastlines, and propose trade-off strategies if it proves unsatisfactory.

Mission confiée
Assignments:
Developing multi-grid capabilities for ocean models with structured grid is not straightforward. Indeed, due to ocean complex boundaries the transfer problem (from one resolution to another and back) is ill-posed and ad-hoc solutions has to be found, depending on the application. This is further complicated by the fact that ORA makes use of NEMO’s global tripolar ORCA grid family. A stronger difficulty could come from the fact that coarser grids have been significantly reworked to cope with the poor resolution. As a consequence higher and lower resolution grids may not match and data locality cannot be ensured in an MMP context, leading to potential significant increase in communication overhead.
In a multi-incremental context such overhead is not an issue since transfer only happen twice per outer iteration. In a multi-grid context however transfer happens several times (2 or 4) per inner iteration, efficiency of said transfer becoming crucial. In this case it is probably better to generate coarse grids by subsampling the nominal grid, leading to simpler and faster transfer operator.
In a multi-incremental 4D-Var context, subsampled grids are unlikely to be well adapted to run tangent and adjoint models that would be needed, so both approaches have to be implemented if one want to leave this option opened for future applications.

Principales activités
The post doctorate candidate will have to help with the implementation and the validation of such...
grid transfer operators, as well as conducting numerical experiments to assess the performance of
the proposed schemes, both in term of quality and numerical cost.

**Compétences**

**Essential:**
- strong interest in applied mathematics and a taste for computer sciences.
- Basic knowledge in numerical analysis and optimisation.
- Programming skills in Fortran.

**Desired:**
- Experience with a numerical oceanic models and
data assimilation

Applicants must have a PhD in Applied mathematics, or, if not, in atmospheric/oceanic sciences with good background in numerical analysis.

**Avantages**

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

**Rémunération**

2 653 euros