

<Title>

NorESM code analysis and optimization

Project plan

< The purpose of the project plan is to identify, define and delimit the project's commitment. >

< WHO IS INVOLVED IN THE PROJECT >

1. Project organization

Requester

Name: Ilona Riipinen
Title/position: Assoc. Professor
Affiliation: Department of Applied Environmental Science,
Stockholms University
Phone:
E-mail: ilona.riipinen@itm.su.se

Project responsible for requester (if different from requester)

Name: Juan-Camilo Acosta
Title/position: PhD student
Affiliation: Department of Applied Environmental Science,
Stockholms University
Phone:
E-mail: juan-camilo.acosta@itm.su.se

Project responsible for SNIC

Name: Chandan Basu
Title/position: Application expert
Affiliation: NSC, SNIC
Phone:
E-mail: basu@nsc.liu.se

< For other project members, please specify role and contact details. >

Project member

Name: Hamish Struthers
Title/position: Application expert
Affiliation: NSC, SNIC
Phone:
E-mail: struthers@nsc.liu.se

Project manager

Name: Torben Rasmussen
Title/position: Application expert
Affiliation: NSC, SNIC
Phone: 013281494
E-mail: torbenr@nsc.liu.se

2. SNIC project name

< Name of an associated SNIC resource allocation project, if applicable (e.g. SNIC 2014/X-YYY). >

SNIC 2014/1-155 and SNIC 2014/8-18

< MOTIVATION FOR GETTING THIS PROJECT SUPPORT >

3. Expected enabling benefit

< Generally provided by the requester. Formulate the expected enabling benefit. That is, the benefit the project will contribute to associated research activities on short and/or long term. How will this further enable research activities for the requester and others? >

Short-term benefit:

- Better understand the bottlenecks of our code and learn about performance optimization potentials.
- Set of recommendations regarding focus points for code optimization changes.

Long-term benefit:

A speedup of this code will enable researchers to perform more and/or longer simulations within a range of scientific projects. A necessary first step in optimizing the model is a profiling study of the code.

4. Impact of the research that the project is associated with

< Generally provided by the requester. Why is this enabling important? For example, describe how important the software/data is for your current and future research activity and for other national and international research activities. >

NorESM (Norwegian Earth System Model) is a fully coupled global climate model consisting of components for the atmosphere (CAM4-Oslo), land (CLM4-CN), sea ice (CICE4) and ocean (MICOM). This model is increasingly being used as part of Swedish research projects studying:

- The role of natural and anthropogenic aerosol emissions on the Earth's radiative balance.
- Sensitivity of Arctic climate to remote (ie. mid- and low-latitude) changes in emissions of short lived climate forcing agents.
- The implications for atmospheric composition and climate of different air quality and climate policy options (through e.g. emission reductions).

In order to ensure that NorESM is run efficiently on SNIC resources we need the profiling and optimization work indicated above. Global

climate simulations, particularly the fully coupled version of NorESM what includes interactive atmospheric chemistry (MOZART chemistry) are very computationally intensive and so it is important to try to gain the best performance possible out of the code. This will enable more and/or enable longer simulations to be run and completion times to be reduced - freeing time for scientific analysis of the output.

5. Why is SNIC assistance needed?

The NorESM code needs to be analyzed by an applications expert to find possible improvements in the current implementation. As atmospheric scientists we lack the know-how to perform a state-of-the-art analysis, which is required for code optimization.

< WHAT ARE WE HANDS-ON GOING TO DO IN THE PROJECT? AND HOW? >

6. Project objective

< Describe briefly the background and formulate the project objective, i.e. what is it intended that the project should do to achieve the expected enabling benefit? How are you going to deliver the requested enabling? >

The project aims to understand the performance of the NorESM code, which is a global Earth system model.

We will:

- Review the MPI pe mapping of the different sub-models (atmosphere, land, sea ice and ocean) currently used for model simulations.
- Analyze the NorESM code to identify code sections and routines to be further evaluated for performance optimization. We will do this by running suitable test cases through analysis tools such as Scalasca and VTune.
- Propose a set of recommendations for code optimization changes based on the performance analysis.

Deliverables:

| Delivery no. | Description | Schedule |
|--------------|--|---------------|
| 1 | Presentation of code profiling analysis. | October 2014 |
| 2 | Report detailing recommendations for source code revisions for model runtime optimization. | November 2014 |

7. Work plan and resource estimate

< Specify the required staff resources in PM and the time frame for the project. >

The project will be conducted during 2014-H2.
NSC will spend up to 1 PM within this project.
Person months will mostly be carried by the 'National Användarstöd' project.

We will use the SNIC 2014/1-155 and SNIC 2014/8-18 resource allocations on Triolith (50000 and 450000 core h/m respectively) as the compute resource for the project. However, a short-term resource allocation on Triolith will be requested from SNAC, if it is required to satisfactorily perform the code analysis and test simulations.

Start date: Early September 2014

End date: 2014-12-31

Defined milestones (MS) and decision points (DP):

< Describe important review points in the form of milestones and decision points. >

| Milestone/Decision point | Description | Date |
|--------------------------|--|---------------|
| DP1 | Project plan approved | August 2014 |
| MS1 | Code profiling done | October 2014 |
| MS2 | Presentation of profiling analysis. | October 2014 |
| MS3 | Report detailing profiling results and recommendations. Discussion of potential follow-on project on implementation of recommendations. | November 2014 |

Responsibilities:

< Describe the responsibilities of the various project members and stakeholders. Who is responsible for what? And who decides what? >

- Requester will provide access to the NorESM code. Contact for this is Juan.

- Requester will provide assistance for SNIC to understand the code. Contact for this is Juan.
- Requester will provide test cases for the code profiling. Contacts for this are Juan.
- NSC/SNIC will review model configuration (MPI pe mapping for sub-models). Contact for this is Chandan and Hamish.
- NSC/SNIC will perform the code profiling and prepare a report of proposed code changes. Contact for this is Chandan.
- All project members will discuss what code changes may be relevant for implementation. Chandan will organize a face-2-face meeting to go through the project report on recommended code changes for optimization.

Communication and dialogue:

< Describe how the project members will keep each other updated throughout the project. Describe how results, decisions, project changes, etc. will be discussed and communicated. >

- E-mail contact to set up access to the code and provide test cases for the code profiling.
- E-mail contact as necessary throughout the project.
- Face-2-face meeting to review analysis results. This could be incorporated as part of the annual NorESM workshop, October 23-24, Stockholm.
- Face-2-face meeting to present project report, discuss future implementation of recommendations and close the project.

Confidentiality requirements:

N/A

8. Approval

< The signatures of all parties confirm the validity of the project plan. The SNIC office can overrule this approval or require adjustments to the project plan, such as the amount of PMs that can be spent in the project. >

I agree to the objective, scope, and responsibilities described in this project plan:

Requester

For SNIC

Date:

Date:

Ilona Riipinen

Patrick Norman

Project responsible for SNIC

Date:

Chandan Basu
