

*Optimization of a lagrangian cloud parcel model
for use in the global climate model ECHAM6.1-
HAM2.2*

Project plan

1. Project organization

Requester

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Project responsible for requester (if different from requester)

Name:
Title/position:
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Project responsible for SNIC

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Project member

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Project manager

Name: Torben Rasmussen
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2. SNIC project name

LiU-2015-00617

3. Expected enabling benefit

The code in question to be optimized is a lagrangian adiabatic cloud parcel model, developed by D. Partridge (Stockholm University). This code has been embedded into the global climate model ECHAM6.1-HAM2.2 in such a way that the embedded version is identical to an offline test version. Currently the embedded code dominates the run time of the climate model, thus any speedup to the offline code will lead to large speed gains for the global climate model.

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.
- Faster version of code that includes optimizations that can be quickly implemented, if such were found from profiling of code.

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; and implementation of any very simple changes to the code revealed from the profiling that will lead to speedup.
- Potential for larger code changes, such as OpenMP parallelisation can be decided.

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

The planned research pathway involves running the global climate model ECHAM6.1-HAM2.2 with an embedded cloud parcel model in replacement of the standard parameterisation of droplet activation. This new framework, from herein referred to as ECHAM6.1-HAM2.2-PARCEL, represents a state-of-the-art process description of droplet activation in climate models, and is the first of such to be developed.

In order to ensure that the global climate model ECHAM6.1-HAM2.2-PARCEL is run efficiently on SNIC resources we need the profiling and optimization work indicated above. Speedup of the offline version of the code will enable more and/or enable longer simulations of the global climate model to be run and completion times to be reduced – freeing time for scientific analysis of the output.

5. Why is SNIC assistance needed?

The cloud parcel model 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.

6. Project objective

The project aims to understand and improve the performance of an adiabatic cloud parcel model.

We will:

- Do detailed profiling of the cloud parcel model code
- Analyze the cloud parcel model 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 VTune.
- Propose a set of recommendations for code changes based on the performance analysis.
- Make code changes identified to be very fast to implement based on the profiling results.
- Evaluate whether openmp parallelisation should be feasible and how much work that would entail.

Deliverables:

Delivery no.	Description	Schedule
1	Presentation of code profiling analysis.	April, 2015
2	Report detailing recommendations for source code revisions for model runtime optimization.	May, 2015

7. Work plan and resource estimate

The project will be conducted during 2015-H1.

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: 2015-04-01

End date: 2015-05-31

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

Milestone/ Decision point	Description	Date
DP1	Project plan approved	March, 2015
MS1	Code profiling done	April, 2015
MS2	Presentation of profiling analysis.	April, 2015
MS3	Report detailing profiling results and recommendations. Discussion of potential follow-on project on implementation of recommendations.	May, 2015

Responsibilities:

- Requester will provide access to the cloud parcel model code. Contact for this is Dan Partridge, Stockholm University.
- Requester will provide assistance for SNIC to understand the code. Contact for this is Dan Partridge, Stockholm University.
- Requester will provide test cases for the code profiling. Contacts for this are Dan Partridge, Stockholm University.
- NSC/SNIC will review model configuration. 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.
- NSC/SNIC will implement minor code changes that will lead to speedup time-permitting. Contact for this is Chandan.

Communication and dialogue:

- 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.
- Face-2-face meeting to present project report, discuss future implementation of recommendations and close the project.

Confidentiality requirements:

N/A

8. Approval

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

Requester

Date: _____

Dan Partridge

For SNIC

Date: _____

Patrick Norman

Project responsible for SNIC

Date: _____

Chandan Basu