

# 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** .....2018.....

**Project Title:** Simulating the climate in Last Millennium using EC-Earth  
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**Computer Project Account:** ..... spdkyang .....

**Principal Investigator(s):** ...Shuting Yang .....

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**Affiliation:** ...Danish Meteorological Institute.....

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

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**Start date of the project:** .....Jan. 1, 2017 .....

**Expected end date:** .....Dec. 31, 2018 .....

**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
<b>High Performance Computing Facility</b>	(units)	2250000	35174	2250000	0
<b>Data storage capacity</b>	(Gbytes)	2000		2000	0

## **Summary of project objectives**

(10 lines max)

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The aim of the project is to develop the transient climate in the last millennium (850-1849 CE) using climate model EC-Earth in response to mainly natural forcing (i.e., solar variations, volcanic aerosols, orbital parameters and the atmospheric concentration of well mixed greenhouse gases) as well as to a less extent the land use/land cover changes. The experiment will contribute to the CMIP6 endorsed Paleoclimate Modeling intercomparison Project phase 4 (PMIP4), as well as to be used to study the characteristics and mechanisms of decadal to centennial climate variability.

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## **Summary of problems encountered** (if any)

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The release of the fully tuned EC-Earth3, which is to be used for EC-Earth consortium's CMIP6 contributions, is further delayed. Since we intend to perform the Last Millennium (LM) climate simulation using the same model as CMIP6 (at low resolution T159) in order to ensure meaningful comparing the resulting climate with the present and pre-industrial climates simulated by the (eventual) CMIP6 model, we have not been able to start the production simulations. The EC-Earth consortium is currently working extensively to fine tune the model, and expects to freeze the model for CMIP6 (i.e., EC-Earth3.3) in the coming month. The actual LM experiments will therefore commence in the autumn once the EC-Earth3.3 is released.

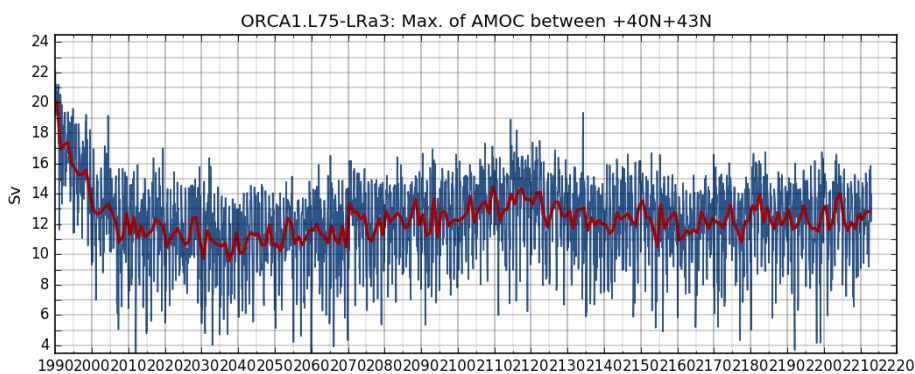
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## **Summary of results of the current year** (from July of previous year to June of current year)

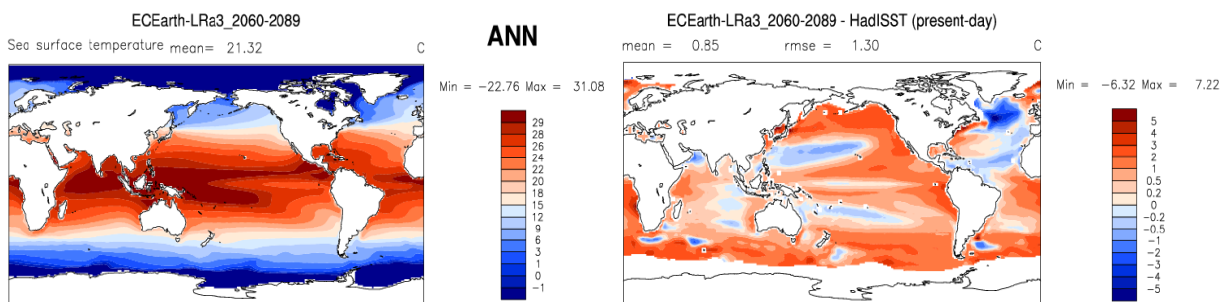
This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

While we are waiting for the release of EC-Earth3.3, we had worked on the configuration of the low resolution model, EC-Earth3-LR, on cca using the intermediate model version EC-Earth3.2, with the expectation that the setup for EC-Earth3.3 is fairly close to that of EC-Earth3.2. We also carried out a “pseudo spin-up” run of 120 years under the present day condition with this low resolution model version (performed on DMI’s HPC). This pseudo spin-up will foster an ocean state close to equilibrium which can then be served as the initial state for the production model version in order to shorting the spinning up time when EC-Earth3.3 (and so that EC-Earth3-LR) is released.

The figure below illustrates the evolution of the Atlantic Meridional Overturning Circulation (AMOC) in the 120 year simulation. After an initial rapid slow down, the AMOC gradually stabilizes at around 13 Sv with (small) interannual variations. The level of the AMOC strength is relative low comparing to the observed state but still acceptable (the AMOC at the most recent working version of the EC-Earth3 is somewhat stronger than this version, not shown).



The simulated SSTs toward the end of the 100 year are shown below as a 30-year average (left) and its difference with the HadISST average (right). In comparison with the HadISST data set, the SSTs demonstrate a similar pattern as the observation but somewhat too warm in most of the mid-latitude and eastern part of the ocean, except over North Atlantic where the SSTs are generally too cold. The global averaged bias is small and about 0.85°C. We are therefore confident that the final version of EC-Earth3-LR will simulate recent climate reasonably well.



## List of publications/reports from the project with complete references

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None. ....  
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**Summary of plans for the continuation of the project**

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The EC-Earth consortium will formally release the EC-Earth3.3 model in the coming month. We will then finalize the EC-Earth3-LR. Starting from the end of the above 120 year run, a long spin-up under the preindustrial condition will be performed to establish an unforced, reasonably stable climate as the initial state for the LM simulation. We expect to perform the spin-up run in the autumn 2018 and the LM experiment toward the end of 2018.  
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