LATE REQUEST FOR A SPECIAL PROJECT 2015–2017

MEMBER STATE: Germany

Principal Investigator[1]:   Prof. Dr. Alexander Knohl

Affiliation: Department of Bioclimatology

Address: University of Göttingen

          Büsgenweg 2

          37077 Göttingen

E-mail: aknohl@uni-goettingen.de

Other researchers: Andre Ringeler (aringel@gwdg.de)

Project Title: Modeling local and regional climate in Sumatra/Indonesia with WRF-CLM taking account to tropical land-use transformations

Would you accept support for 1 year only, if necessary?	YES X	NO ☐

Computer resources required for 2015-2017: (The project duration is limited to a maximum of 3 years, agreed at the beginning of the project. For late requests the project will start in the current year.)	**2015**	**2016**	**2017**
High Performance Computing Facility (units)	150 000		
Data storage capacity (total archive volume) (gigabytes)	15 000		

*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):   22.12.2014

Continue overleaf

---

[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.

This form is available at:
http://www.ecmwf.int/about/computer_access_registration/forms/

Principal Investigator:
Alexander Knohl

Project title:
Modeling local and regional climate in Sumatra/Indonesia with WRF-CLM taking account to tropical land-use transformations

Allocation period: 1.1.2015 - 31.12.2015

Project abstract

Land transformation from natural to managed ecosystems such as oil palm and rubber plantations might result in changes of greenhouse gas fluxes (CO_2 and CH_4) and of local and regional climate due to land-atmosphere feedbacks after changed surface properties. The land-atmosphere feedbacks are non-linear and additionally complicated by climate change. To gain knowledge of the still unknown ecological and climatological impacts of transformation of rainforest into oil palm and rubber plantations in Indonesia this project will implement the regional modelling and land surface modelling approaches to study the interactions between different landuse types and the atmosphere und to upscale the energy, water, carbon and nitrogen fluxes to regional level. The latest evaluated version of the regional climate model WRF (V3.5) coupled to the Community Land Model CLM4 will be used driven with ERA-Interim data to assess the ongoing and past landuse changes. The multiple nesting will be used to downscale the data to the required high local resolution. The models will be parameterised and validated using the existing local and regional observations data. Then climate projections (SRES, PCP) modelled by General Circulation Model (from MPI or ECMWF) will be dynamically downscaled and the land transformation interactions will be studied under the conditions of changing climate. The effects of spatial and temporal variability on ecological functions will be quantified. With this we will improve the sustainability of land use in lowland tropical regions. The project is an important part of CRC 990 EFForTS and will also contribute to CORDEX SE-Asia.

Project overview

The main goal of the proposed project is to investigate the atmospheric effects of land use changes in transformation systems in tropical lowlands in Sumatra. The following processes need to be addressed to achieve the main goal: to assess the impact of land transformations (tropical lowland rainforest to rubber plantation and oil palm plantation) on feedbacks to regional climate via surface albedo, surface roughness and water exchange. Understanding these processes and feedbacks will provide insights how land transformations contribute to changes in regional radiative forcing and thus provide constrains for developing sustainable land use strategies to balance ecological and economic needs. Therefore, the following tasks are required:

Range of planned work from the scientific view:

Investigating land use effect and vegetation feedback to climate forcing

The Community Land Model (CLM) will be adapted regionally. Land surface properties of the transformation systems (albedo, roughness, leaf area index (LAI), soil profiles, etc) will be parameterized based on pre-existing data from: own new measurements over oil palm plantations and (b) other FLUXNET flux towers in SE Asia, and (c) remote sensing data (e.g. MODIS albedo, LAI, biomass) as well as land cover map and regionalization products. The model will use data on current land-use as the initial input. The measured responses of the transformation systems (oil palm)

at local level to the variability of "present" climate, published data and analysis of remote sensing information will be used to parameterize the Community Land Model. The coupled WRF-CLM model will be run under "present conditions" (1995 – 2000) and under projected climate with different land use scenarios to evaluate the types and magnitudes of climatic influence on ecosystems and their feedbacks to climate forcing as well as land use change effects on regional climate.

Mathematical and/or computational aspects

In order to reach the scientific goals and to provide the data requested by other subprojects a sufficient model representation of mesoscale atmospheric processes is required by adequately accounting for remote forcing. Thus, consecutive dynamical downscaling steps will be performed using a non-hydrostatic regional climate model. The first coarser resolution nesting level will cover the entire region of Sumatra, to sufficiently consider El Niño Southern Oscillation forcing and modulation of Sumatra climate, whilst the final nesting level is assumed to provide an operational high resolution grid-refinement down to the order of 1 x 1 km, confined to the investigation. To access climatological aspects, natural variability and potential landuse change impacts, the processed data sets need to span a sufficient time period. In the first year the project aims to downscale at least the ERA-Interim data from 1995 up to 2000 for two different landuse scenarios.
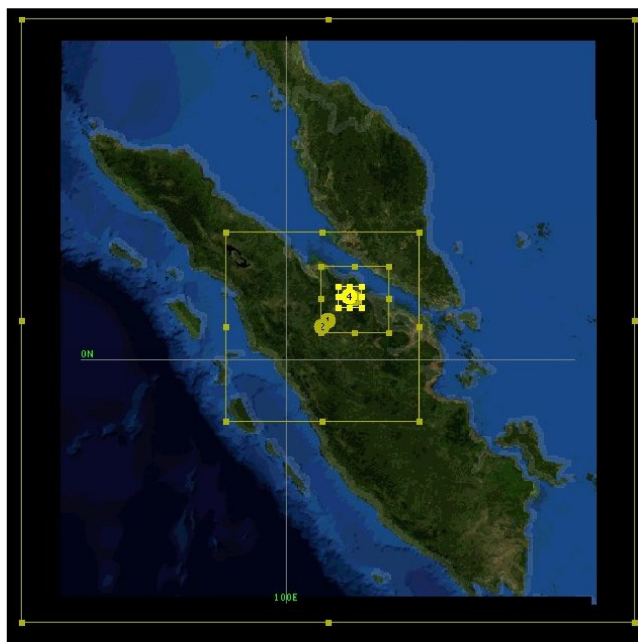

Fig. 2 Domain Setup

Algorithmic/mathematical/numerical methods and solution procedures

The nested regional climate simulations are done with the Weather Research & Forecasting Model (WRF), which is driven by various global data sets. The WRF model part is driven every 6 hours by initial data from the global data set. In order to be able to carry out several 5 year simulations during the project time it is necessary to run yearly simulations with many different initial dates in parallel.