REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING SPECIAL PROJECT

MEMBER STATE: Germany

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Samuel Zipper (visting scientist from McGill University, Montreal, Canada)

Project title: Integrated simulations of the terrestrial system over the European CORDEX domain

Project account: **SP DE KOLL**

Additional computer resources requested for	**2017**
High Performance Computing Facility (units)	3.000.000
Data storage capacity (total) (Gbytes)	

Continue overleaf

[1] The Principal Investigator is the contact person for this Special Project

Technical reasons and scientific justifications why additional resources are needed

This is a technical report to request additional resources for the accounting period 2017. The objective of this special project is to perform high-resolution fully coupled aquifer-to-atmosphere simulations over the European CORDEX domain. The simulations are performed with the integrated Terrestrial Systems Modeling Platform, TerrSysMP, consisting of the three-dimensional surface-subsurface model ParFlow, the Community Land Model CLM3.5 and the numerical weather prediction model COSMO of the German Weather Service (Gasper et al., 2014; Shrestha et al., 2014). The simulation results are used to investigate feedbacks of groundwater and soil moisture dynamics with climate variables such as air temperature and precipitation at continental scales.

Additional compute time is requested to perform a sensitivity analysis of model results to the land use/land cover (LULC) dataset. This work builds on previous work conducted as part of Jessica Keune's PhD thesis, which focused on coupled aquifer-to-atmosphere water and energy feedbacks during extreme heat and drought. However, those simulations used a single LULC dataset, and we are proposing to extend our analysis of the 2003 European drought and heat wave via a partial factorial experiment varying LULC (2x scenarios) and vegetation characteristics (3x scenarios) to interrogate the effects of anthropogenic LULC change on drought and extreme heat. This requires a total of 6 fully-coupled, year-long simulations. To date, 4 of these simulations have been completed, with 2 remaining simulations. Table 1 summarizes the (minimum) compute time for a one-year water management simulation. Additional compute time is needed for post-processing, archiving and analysis.

This study is critical to evaluating the impact of human modifications to the land surface on extreme heat and drought. Previous work by Stefanon et al. (2014a) suggested that agriculture may have played a role in reducing early-summer temperatures in 2003, but exacerbated late summer extreme heat due to drought-induced crop failure compared to deeper-rooted natural vegetation. However, this study focused only on Central France. There is some evidence that historical LULC change within Europe has led to a warmer and drier summer climate (Heck et al., 2001) and changes in the occurrence of extreme near-surface air temperature (Anav et al., 2010); however, other research indicates that anthropogenic land use is contributing to cooler summer temperatures (Zampieri and Lionello, 2011), or that effects if LULC change on heat can be significant in spring but negligible in summer (Ma et al., 2016). Therefore, both the direction and magnitude of human LULC change impacts on the European climate remain highly uncertain. Moreover, none of these studies represented groundwater dynamics in a process-based manner, and therefore implicitly neglected groundwater-land surface-atmosphere feedbacks which TerrSysMP is designed to simulate.

Table 1. Compute time needed for a single water management simulation with increased time steps for the hydrologic compartments (3 minutes for ParFlow and CLM, 1 minute for COSMO) and a 3-minutes coupling frequency, using a total of 14 nodes, i.e. 504 tasks with 12*12 tasks for ParFlow, 16*16 tasks for COSMO and 6*6 tasks for CLM3.5.

Simulation Period	**Average / Total Wall Clock Time**	**Average / Total SBU**
1 month	45135s (13h)	101.922
1 year	541622s (155h)	1.223.067

Additional resources are mainly needed because previously requested compute time was underestimated. Due to a recently-discovered issue related to the coupling frequency between different components of TerrSysMP, two simulations had to be rerun, thus leaving insufficient compute time for the final two scenarios. Therefore, we request an additional 3.000.000 SBU for the accounting period 2017 to run the final two simulations.

References

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