Project: **1345** Project title: **Modelling dust emissions from agricultural sources** Principal investigator: **Matthias Faust** Report period: **2022-11-01 to 2023-10-31**

Introduction

Dust plays a pivotal role in the Earth's climate system, making it a significant subject of research. While Europe is not typically considered a dust source in global climate models, agricultural areas, such as croplands, are known to be frequent emitters of dust. This project, conducted on the HLRE-4 supercomputer, aimed to investigate European agricultural dust sources using the COSMO-MUSCAT model. The project involved simulating potential dust emission episodes over the past two decades.

Model Setup

The project introduced COSMO-MUSCAT to the HLRE-4 computing environment. The installation and operation of COSMO-MUSCAT on HLRE-4 were successfully accomplished. The model system was found to scale effectively on the supercomputer. However, the model's setup took longer than anticipated, causing a delay in using the allocated resources during the first quarter of the allocation period.

The second quarter was spent preparing for the main simulation. For preprocessing, the project relied on the "int2lm" tool to interpolate ERA5 reanalysis data as input for the COSMO-MUSCAT model system. Unfortunately, severe technical issues with "int2lm" led to further delays.

Challenges and Considerations

In preparation for a long-term study, the project found that preprocessing required more resources than initially requested. They were also challenged by external input data for our simulations, especially satellite-based vegetation data, which are essential for our model approach. This data was found to be unreliable for cases before 2014 due to longer periods of missing data in autumn and winter episodes. To ensure the project's quality standards. further investigations into strategies for handling the varying quality of the vegetation dataset are necessary. Alternatively, we may explore other data sources in the future.

Adapting Strategy

The challenges led to a change in strategy during the third quarter of the allocation period. To ensure responsible usage of the granted resources, the project decided to change its approach. We chose to focus on simulating the full year of 2019, a year of particular interest due to drought conditions in central Europe. Furthermore, 2019 included a significant dust storm in Poland. The simulations related to the Poland dust storm will be used in an upcoming publication. The simulation of the full year 2019 provided valuable insights into dust emissions from croplands in Europe and their temporal and geographical distribution.

Conclusion

The research project on the HLRE-4 supercomputer with the COSMO-MUSCAT model provides valuable insights into dust emissions from European agricultural sources. Despite initial technical challenges and delays, the project successfully harnessed the supercomputer's capabilities for extensive simulations. The decision to adopt the strategy

during the third quarter allowed for the comprehensive study of the intriguing dust emissions in the pivotal year of 2019. As the project progresses, it promises to advance our understanding of the complex dynamics of dust emissions in Europe and contribute to the body of knowledge in this field.