i_SSS
integrated Support System for Sustainability

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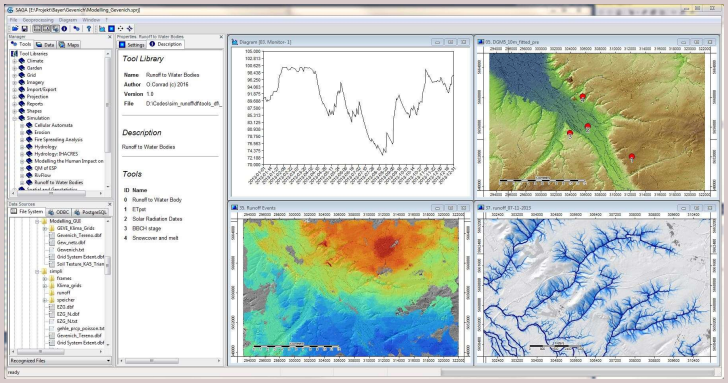
Background

- Decision support system to optimise cultivation of agricultural crop land
  - Increase crop yield
  - Minimise damage to the environment
- Determine site characteristics through a combination of on-site measurements and remote sensing
  - Take measurements at selected fields to cover manifold circumstances
  - Testsites i.a. in Brasil, France and Germany
- Consider weather-forecast to minimise risk of impairing crop yield and nearby ecosystems due to runoff, erosion and mass transport
- Develop HPC infrastructure to store and process huge amount of data to create realtime decision system in the end
- Make use of existing geographic information system SAGA
- Cooperation between Universität Hamburg and Bayer CropScience AG
- Duration of project: 2016-04-01 / 2021-03-31

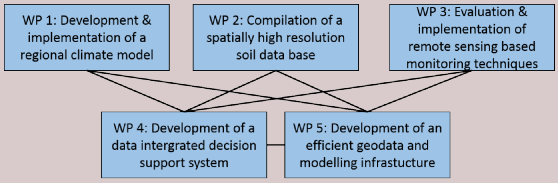
SAGA

- System for Automated Geoscientific Analyses [1]
- Written in C++
- Free and open-source
- Basis for decision support system
- Modular structure simplifies integration of new tools
  - Over 650 tools already integrated
  - New tools for the decision support system will be integrated
- Parallelisation with OpenMP



Digital Farming

- Soil and weather are important location factors for crop yield and productivity
- Decision support system assists the farmer to minimise an economic loss through in situ and ex situ impairments
  - Recommendation of plant protection (dosage, mixture, time, etc.)
  - Change direction of plough furrow
  - Change field border (rearrange hedges, plant vegetation, etc.)
- SAGA tools describe geological and ecological processes
  - Global and local input data with high resolution
  - Amount of data makes HPC essential

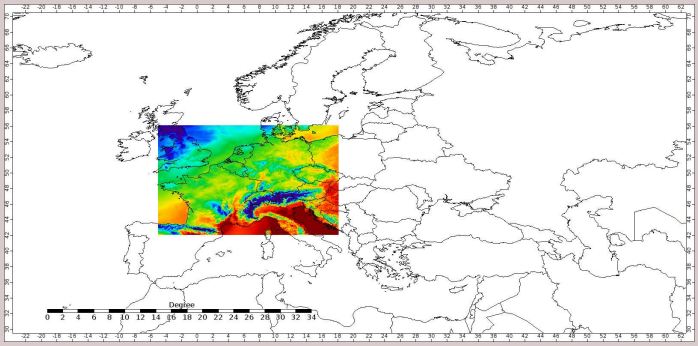


Future Work

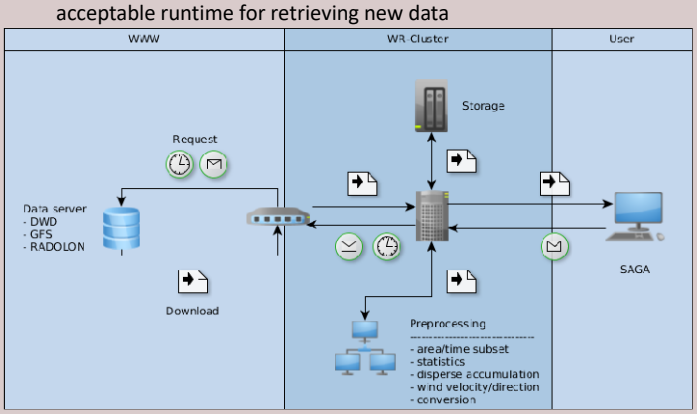
- Adapt SAGA to be executed on distributed hardware
  - Evaluate potential of source-to-source translation to automatically replace OpenMP with MPI-3 RMA
- Optimise SAGA tools to utilise HPC hardware
- Evaluate and add additional data-sources
- Comparison of GFS and ICON concerning the reliability of forecasts
  - Improve quality of data through combination of various input sources

Developed Infrastructure

- Download and store ICON [2] weather-data requested from DWD
- Reduce size of forecast data through preprocessing
  - Remove unnecessary variables from timesteps before download
  - Currently about 1.5 TB for one year of daily 24h-forecasts of Europe
    - Over 9000 timesteps
    - Amount of needed timesteps and variables will increase eventually during the development of additional tools
  - During the initial phase of development the input data of Europe can be cropped onto an area of interest, which reduces the input size by roughly 90%



- Additional data-sources to evaluate quality of ICON forecast or to complement it
  - Amongst others GFS [3] and RADOLAN [4]
- Additional preprocessing methods to adapt data before loaded into SAGA
- Python-program to manage and simplify the download and preprocessing of new data
  - Collection of scripts to automatise different workflows
  - Evaluate different approaches and libraries to optimise performance
  - Parallelise download and preprocessing on HPC cluster for ensuring an acceptable runtime for retrieving new data



- Install and run SAGA on HPC cluster
  - Available command line interface allows automatised tool execution
  - Future expansion by MPI would allow tools to distribute computing

References

[1] CONRAD, O., et al. System for automated geoscientific analyses (SAGA) v. 2.1. 4. Geoscientific Model Development, 2015, 8. Jg., Nr. 7, S. 1991-2007.
[2] ICON, https://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html
[3] GFS, https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/global-forcast-system-gfs
[4] RADOLAN, http://www.dwd.de/DE/leistungen/radolan/radolan.html

Acknowledgements

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