Project: **677**

Project title: **Evaluierung der Atmosphärenchemie in MECO(n)**

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In 2019 three major code developments for the MECO(n) modelling system have been performed.

1) The MESSy submodel OASIS3MCT was finalised and the coupling of COSMO-CLM to the community land model (LBM-CLM) established.
2) The MESSy infrastructure submodel TENDENCY, which enables detailed tendency analyses for all prognostic variables for many processes has been implemented into the COSMO-CLM model and in a second step a COSMO-CLM/MESSy version additionally containing the fog microphysics of the model PAFOG has been developed.
3) The ICON/MESSy development was pushed forward and most MESSy diagnostic submodels have been implemented up to now**.**

1) The *OASIS3-MCT* software is frequently used within European Earth System Models to externally couple earth compartment models. Among others, couplings with the atmospheric component models ECHAM or COSMO exist. On the other hand, these two atmospheric models are also equipped with the MESSy interface. In order to take advantage of the already existing couplings of atmospheric models to other earth compartment models and to combine these with the flexibility usually available within the MESSy interface, a MESSy submodel OASIS3MCT has been build enabling the external coupling between compartment models equipped or not equipped with the MESSy infrastructure. The first application for the modelling system containing both *OASIS3-MCT* coupling capabilities and the MESSy interface was the coupling of the atmospheric compartment model COSMO-CLM to the land surface model LBM-CLM. As a first step results have been compared between the well established COSMO-CLM^2 of Davin et al. (2016, ETH) on which this development is based and the newly developed coupling using the MESSy interface.

   Figure 1 shows that both system yield very similar results.

   For 2020 we now will be able to proceed with the full evaluation of the coupled system COSMO-CLM/MESSy-*OASIS3-MCT*-LBM-CLM.

2) Figure 2 shows an example of an analyses with the TENDENCY submodel. Here the tendency profiles for different processes changing temperature, water vapor and cloud water at a specific station are depicted. TENDENCY also proved very helpful to test the consistency of results after tuning or introduction of new developments (e.g. the new fog microphysics).

   In 2020 this setup will be used to analyse the mechanism leading to fog formation in the model COSMO-CLM/MESSy for Namibia. Especially, TENDENCY will be used to further analyse the contribution of single processes (e.g. condensation or sedimentation) to fog formation/ dissipation.

3) One of the most challenging parts of the ICON/MESSy development is the existence of “patches” or (sub-)domains in the model. The concurrent existence of the same variables on different patches has not been part of the MESSy code so far and all components of MESSy need to be adapted to this feature.

   As a first step now the diagnostic submodels dealing with the further analyses of other variables (channel objects) have been adapted to ICON in a way, that all diagnostic submodels are able to calculate different diagnostics on different patches. For this the meaning of the namelist entries has been enhanced. Making additional parsing of strings inevitably, but also rendering it possible to keep the “old” namelist style for the other MESSy basemodels (e.g. ECHAM5 and COSMO-CLM). The implementation of all process submodels required for gas phase chemistry simulations is planned for 2020.

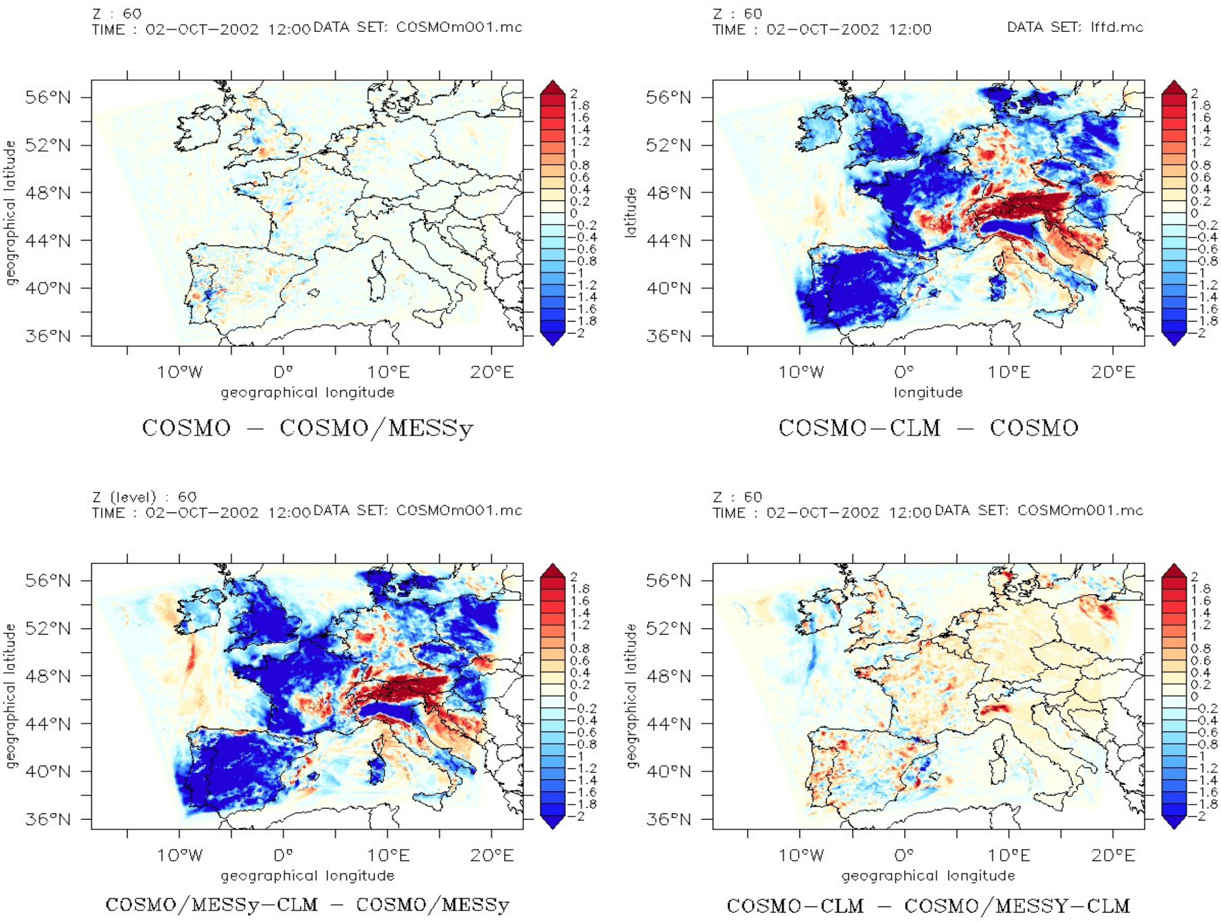

Figure 1: Temperature differences between different COSMO setups: upper left: difference between COSMO and COSMO/MESSy; upper right: difference between COSMO coupled with LBM-CLM and COSMO with standard TERRA surface model; lower left: difference between COSMO/MESSy coupled to LBM-CLM and COSMO/MESSy using TERRA and lower right: the difference between COSMO coupled to LBM-CLM and COSMO/MESSy coupled to LBM-CLM.

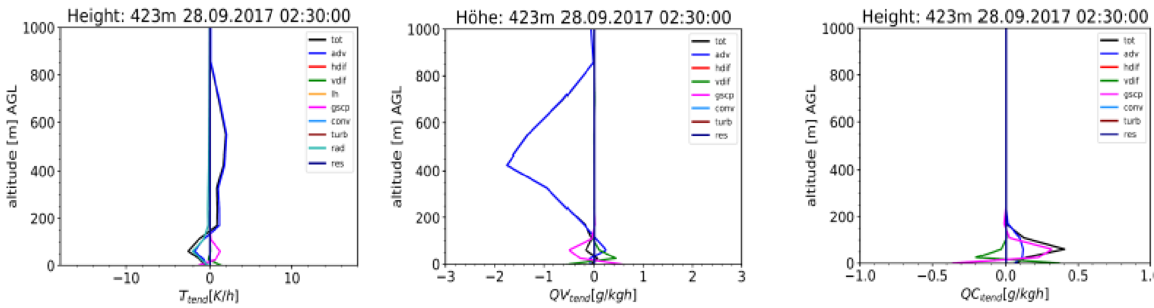

Figure 2: Vertical temperature, water vapour and cloud water tendency profiles at **Gobabeb (**14.5° E 23.56° S).