Project: **974**

Project title: **HD(CP)2-II S5 (Cloud and Convective Organization)**

Project lead**: Dr. Rieke Heinze (MPI-M)**

Report period: **2016-01-01 to 2016-12-31**

The HD(CP)^2 (High definition clouds and precipitation for advancing climate prediction) is a framework project funded by BMBF. The subproject S5 of phase II is about cloud and convective organization.

Key activities and achievements in 2016:

- ICON-NARVAL simulations (Fig.1): Convection resolving simulations with ICON over the tropical Atlantic accompanying the NARVAL-II campaign were successfully completed. Over 60 days were simulated within the period of the observational campaigns NARVAL-I (Dec 2013) and NARVAL-II (Aug 2016). These synoptic realistic simulations feature emergent phenomena in unprecedented detail, ranging from cold-pools of small cumuli, interacting squall lines of deep convection to hurricanes evolving from breaking easterly waves.
    - The simulations were performed in cooperation of with the HErZ group (Daniel Klocke (DWD) and Cathy Hohenegger (MPI-M). By combining resources from DWD, the full granted computing time in bm0974 was not consumed.
- The results of the ICON NARVAL simulations are further used as input data to large-eddy simulations with ICON-LEM over the tropical Atlantic within the HD(CP)2 – M project.
- Great progress was made by applying satellite foreword operators to the model data and segmenting the cloud field in individual identities. A wide range of cloud statistics were derived which are currently evaluated in terms of convective aggregation.
- Improved understanding how radiation drives convective organization (Fig.2): The new method to compute 3D radiative transfer, developed in HD(CP)^2 phase I, was applied. By disentangling the various feedbacks and mechanisms, related to radiative heating, the influence on the cloud field evolution was studied.

Used resources:

- The work storage was a limiting factor as the produced data amounts exceeded the initial expectations.
- Despite the great scientific advancement, a fair amount of computing resources left unused, which was primarily given by the maternity leave of Rieke Heinze and Matthias Brueck starting only after June.

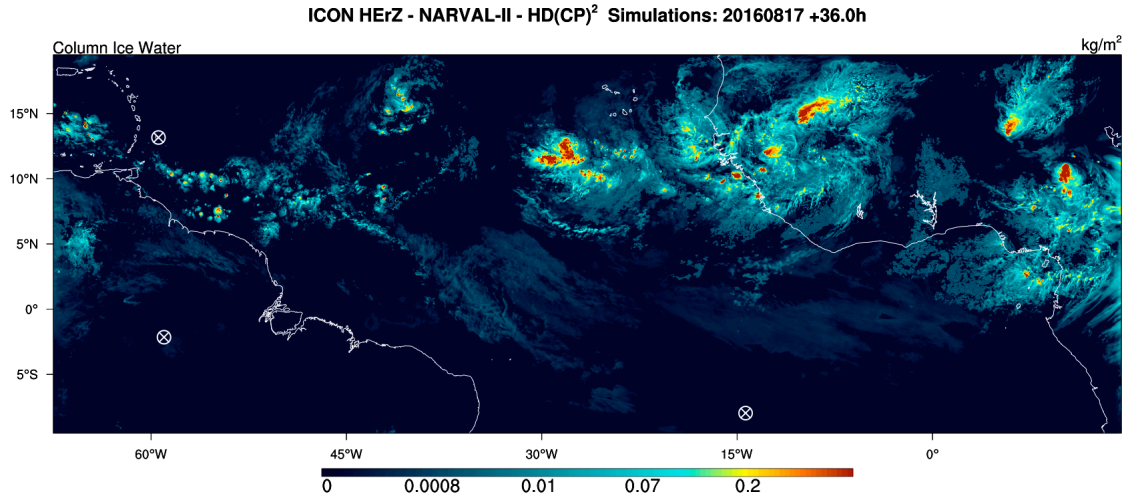

Fig.1: Convection resolving ICON simulations over the tropical Atlantic: high values of column

integrated ice water indicate region of deep convection. Note the wide range of horizontal scales of aggregation (Matthias Brueck, MPI-M)

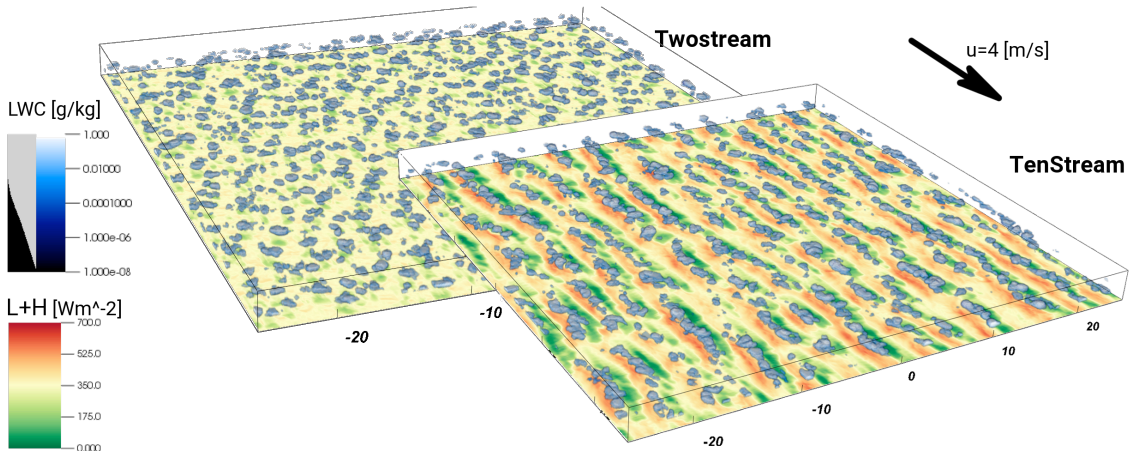

Fig. 2: Shallow Cumulus cloud simulations with UCLA-LES driven with 1D radiative transfer (Twostream, top panel) and 3D radiative transfer (TenStream, bottom). Shown are surface fluxes (sensible and latent heat, L+H) and cloud liquid water content(LWC). The position of the sun in the case of 3D radiative transfer organizes the convection in cloud streets. (Fabian Jakub, LMU)

Publications

Heinze, R., A. Dipankar, C. C. Henken, C. Moseley, O. Sourdeval, S. Trömel, X. Xie, P. Adamidis, F. Ament, H. Baars, C. Barthlott, A. Behrendt, U. Blahak, S. Bley, S. Brdar, **M. Brueck,** S. Crewell, H. Deneke, P. Di Girolamo, R. Evaristo, J. Fischer, C. Frank, P. Friederichs, T. Göcke, K. Gorges, L. Hande, M. Hanke, A. Hansen, H.-C. Hege, C. Hoose, T. Jahns, N. Kalthoff, D. Klocke, S. Kneifel, P Knippertz, A. Kuhn, T. van Laar, A. Macke, V. Maurer, B. Mayer, C. I. Meyer, S. K. Muppa, R. A. J. Neggers, E. Orlandi, F. Pantillon, B. Pospichal, N. Röber, L. Scheck, A. Seifert, P. Seifert**, F. Senf**, P. Siligam, C. Simmer, S. Steinke, B. Stevens, K. Wapler, M. Weniger, V. Wulfmeyer, G. Zängl, D. Zhang, and J. Quaas (2016): Large-eddy simulations over Germany using ICON: A comprehensive evaluation. Quart. J. Roy. Meteor. Soc. (accepted)