Project: 834 Project title: HD(CP)² Module M (Modelling) Project lead: Bjorn Stevens Report period: 1.1.2014 - 30.09.2015

<u>M1</u>:

The main target of module M1 in HD(CP)2 Phase 1 was to develop the HD(CP)2 ICON model and finally deliver the proof of concept, that the code is able to perform the "HD(CP)2 – Phase 1 - Status Simulation" with satisfying performance and comparable quality to other LES models like PALM or UCLA – LES.

In 2014 the tasks / bottlenecks to overcome had been

- Setting up HD(CP)2 ICON model in regional mode with 3 grid nested in LES resolution
- Removing all global field from the ICON code by introducing parallel domain decomposition and distributed arrays to enable massive parallelism (up to 100.000 cores) and massive performance speedup
- Performing the "HD(CP)2 Prototype Simulation (HPS)"

In 2015 core tasks were

- Including the physical implementation of the 2 moment microphysics
- Performing 20 "golden days" of the HOPE campaign
- Delivering model data, which can be compared to the observations of Module O.

In 2014, the total amount of CPU time on Blizzard consumed for M1 activities were small - compared to the required budget: only 0.15 mio CPUh were used. Because of necessary code refactoring due to technical reasons (memory scaling problems), the main scaling work was done at JuQueen at FZJ in Jülich.

In 2015, scaling tests and code development took 0.2 mio CPUh (until Sept. 2015) at Blizzard. From July 2015 on Mistral was available. Tasks done on Mistral:

- Massive physical tuning and technical performance optimization was necessary
- Simulation of the first days of HOPE (24 h of the 4-nested grid version of the HD(CP)2 model requires ca. 1.9 mio CPUh incl. I/O), incl. tuning and testing

This consumed the total amount of 18 mio CPUh (750.000 node h) on Mistral (until Sept. 2015) **M2**:

The main target of module M2 in HD(CP)2 Phase 1 was

- Delivering LES benchmark simulations with PALM and UCLA LES for the "HD(CP)2 Prototype - Simulation (HPS)" and "HD(CP)2 – Phase 1 - Status Simulation" mentioned above to be compared to HD(CP)2 ICON model. (2014)
- Performing sensitivity experiments with ice microphysics for the HPS setup with UCLA LES (2015, Blizzard & Mistral)
- Performing an additional HD(CP)2 ICON experiment using the HPS setup of the model (2015, Blizzard & Mistral)

In 2014, the total amount of Blizzard CPU time consumed for these activities were 2 mio CPUh, which was roughly what was requested in the computing time applications of that year.

In 2015 M2 used 1.2 mio CPUh (until Sept. 2015) on Blizzard and 400.000 CPUh on Mistral. **M7**:

One main target of M7 is to investigate the influence of solar radiation on cloud development thus a new parameterization for radiation was developed and tested and then tuned for optimized performance.

In 2015 the total amount of 800.000 CPUh of Blizzard CPU time was used and 1.2 mio CPUh on Mistral.