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Progress in the development of ATHAM-Fluidity: A new high-resolution atmospheric model for simulating localised extreme weather events

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Within the framework of the EU FP7-PEARL (Preparing for Extreme And Rare events in coastaL regions) project, a new high-resolution non hydrostatic atmospheric model is currently developed: ATHAM-Fluidity. Unlike many existing atmospheric models, ATHAM-Fluidity's dynamical core is based on a mixed finite-element discretisation designed to operate on unstructured and adaptive meshes, for an optimized use of computational power. The model is designed to simulate extreme weather conditions at local scales (on the order of 50x50 km2) and will ultimately help better understand and assess the impacts of heavy precipitation events in coastal areas. As such, ATHAM-Fluidity will constitute an important component of a suite of multi-physics models, including for example storm surge and flood modelling systems, whose role will particularly consist in producing high-resolution precipitation maps in areas of interest. A series of case studies identified within PEARL (for example Greve, Denmark, an area particularly vulnerable to floods and storm surges) will be further investigated using ATHAM-Fluidity and this integrated modelling framework.

In order to successfully achieve its tasks, ATHAM-Fluidity must be equipped with a series of physical parameterisations to capture the formation and evolution of clouds and heavy precipitation. After a careful evaluation of ATHAM-Fluidity under dry atmospheric conditions [Savre et al., submitted to MWR 2015] for which the performances of the dynamical core and mesh adaptivity algorithm have been assessed, the model has recently been extended to handle moist atmospheric conditions and clouds. These new developments include the implementation of ATHAM's active tracer concept to account for atmospheric moisture and hydrometeors, as well as a warm two-moment bulk microphysics scheme to parameterise the formation and evolution of liquid clouds and precipitation. In addition, a turbulence diffusion closure, specifically designed for Large Eddy Simulations of the atmospheric boundary layer, has also been implemented.

Results obtained using the enhanced ATHAM-Fluidity model on selected idealised test cases will be presented. In particular, the ability of ATHAM-Fluidity to capture the development of an idealised supercell storm as well as the evolution of a turbulent atmospheric boundary layer will be demonstrated.