Explicit microphysics for (non-hydrostatic) HIRLAM

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Motivation

- Non-hydrostatic (NH) adiabatic kernel for HIRLAM developed at the UT during last decade.
- Existing cloud schemes not optimized for 1-3km scale (does not mean they do a bad job, EMHI 3.3km domain) - no good companion for NH model for moist processes.
- Combine a more detailed microphysics with NH HIRLAM for explicit representation of deep convection.
- Prerequistic, the microphysics should be computationally cheap yet detailed enough.

Microphysics

- Bulk microphysics scheme Based on Schultz 1995 and updates.
- Five categories for moist variables
  - cloud ice (pristine crystals)
  - snow
  - precipitating ice (hail, graupel, sleet)
  - rain
  - cloud water, existing before saturation
- Bulk scheme - no computation of size distributions (just concentrations), parameterizations assume larger particles for larger concentrations.
- CCN concentration not used (YET)
- about 16? microphysical processes included.

Dynamics

- SISL scheme for advection
- Advection like for passive scalars + physical tendencies from microphysics.
- Vertical fall speed estimated by the microphysics module, simple function of concentration, density and temperature. This speed is combined with the SISL trajectory calculation.
- SISL is not mass conserving in HIRLAM for longer time scales.

Implementation

- First, try to get working in hydrostatic model, current stage ;(
- HIRLAM 3D model, no 2D, 1D not really meant for 1-3km scale.
- Testing is a bit tricky, computational cost and more complicated analysis of results.
- Model seems to be stable and gives reasonable results with hydrostatic dynamics.

Evaluation

PC cluster(s) and HIRLAM do not cooperate well - limited number of tests so far. Difficulties due to 3D (computer screen is 2D). Few modelled cases show similarities with reference HIRLAM: strong convection and high-precipitation amount strong snowfall last november large scale precipitation 1 week ago. No detailed comparison with observations or other models.

Examples

Siia pilt 0308 summeeritud sademetest koos põhilise infoga.

Some conclusions

Modelled meteorological situations look reasonable and developed model is stable and fast. Developing and testing a 3D model can take be more time-consuming than initially expected. Evaluation of fine details in a 3D model is complicated.