

Working group on clouds and testbed

Discussion on cloud cover verification and fog-issues:

Do we have the same problem about clouds in HARMONIE, AROME ?

- **Javier Calvo (JC):** Spatial verification of low clouds

SAL analysis of low clouds has been performed at AEMET based on the EUMETSAT NWC SAF low cloud type.

Results: HARMONIE 38h1.2 *overestimates* the low clouds over the Iberian peninsula and the Mediterranean, but *underestimates* the low clouds in the sea to the north of the peninsula.

Action : MF (EB,YS) will send AROME operational grib file (CC, T2m, rh2M, Q2m, SHF, LHF) to compare with AEMET-HARMONIE 38h1.2. AEMET (JC) is encourage to continue the validation and comparison between AROME-MF and HARMONIE.

- **Balazs Szintai (BS), Viktoria Homonnai:** In Hungary we have the same experience as MF, so low clouds are underestimated, especially during winter.

Case study with increased autoconversion function (AUTIS=.TRUE.). The case study also includes Karl Ivar Ivarson (KII)'s OCND2 ICE3 update.

Results:

Warm case: OCND2 improves the forecast over Hungary, where the reference simulation has too low low cloud cover, although the low cloud cover is still too low with OCND2. AUTIS has no significant effect.

Cold case: AUTIS gives a better forecast in this case. OCND2 + AUTIS gives the best results for cloud cover, U10m and to some extend T2m.

ST: Perhaps this is because the cloudy boundary layer is more decoupled from the upper atmosphere.

- **Bent Hansen Sass (BHS):** Over-prediction of low clouds and fog.

Case from 10-11 April 2015: Forecast start : 23 UTC 9 April , cold model generated fog (not observed) was seen in Öresund region south and east of Copenhagen on 10 April in the morning. 2m temperature became low 2°C-4° C in the sea fog. The fog dissolved during the afternoon of 10 April. Interestingly, in the longer forecast range, 11. April late afternoon, this operational run with HARMONIE cycle 38 forecasted thunderstorm in northern Jutland correctly.

On March 10 2015, HARMONIE had false low clouds that HIRLAM did not have. Both of the HARMONIE runs (cycle 38h1.2 and 38h1.2) produced too high cloud amounts for this case.

On average, for the first three months of 2015, a positive bias of almost 1.5 octas is seen from HARMONIE.

The precipitation release from shallow clouds is too low.

Discussion:

EB: Have you tried to run with the MF AROME settings? In this the cloud scheme and the mass flux scheme is different.

ACTION (BHS, EB, YS) : EB and YS will send the MF-Arome namelist

WdR: For the North sea fog case (see Aladin/Hirlam newsletter no. 2 and 3) no substantial difference is found when using EDKF i.o. EDMF.

WdR: Erroneous fog over sea seems to have two major sources: 1. Too moist air from land is advected above sea where it gives rise to difficult to dissolve erroneous fog fields. 2. Initialisation problem: too high humidity values, again above sea difficult to dissolve under stable conditions.

- **Karl-Ivar Ivarsson:** Over-prediction of low clouds and fog - perhaps due to too much latent heat flux from the surface most clearly seen in spring ? Patrick Samuelson experienced similar behaviour with the “new snow “scheme in HIRLAM in the beginning. We can probably learn something from that ?

- **ACTION :** what about KNMI and MF 2D map comparison on the common area ? Some years ago KNMI automatically send their Harmonie gribfiles to an anonymous ftp server so Meteo France could evaluate them (from KNMI Jan Barkmeijer and from MF Yann Seity was involved in this). KNMI can restart the scripts: **but who will look at it and do the comparison?** . Is it still really interesting ? Probably yes in addition to the Cabauw testbed. WdR and EB will try to find MF and KNMI contact point ?

KNMI test-bed/ACTRIS2 campaign:

- **Lisa Bengtsson:** evaluation of cloud ice, cloud water of AROME and ALARO in the next ACTRIS2 project (former cloud-net).

Validations against CloudNet radars have been performed. The RADAR data were interpolated to the vertical levels of the model. This has been studied with HARMONIE for both OCND2 = .FALSE. and OCND2 = .TRUE. With OCND2 a reduction in cloud ice is seen.

ACTION (LB,EB, ALARO ?) : LB will compare also the observed temperature profile and the ARPEGE output especially ql, qi for the 5 stations. Topic: separation between liquid and ice function of T

- **Wim de Rooy:** status/plans, projects/experiments, can we use the testbed to answer some of the above discussion?

Action around testbed and Cabauw:

Step0: EB and WdR will merge both version of MUSC. (forcing part)

to be able to use exactly the same namelist and input file.

Step1: (WdR, LB, EB, YS, ALARO ??)

1D comparison from 3D output RACMO, HARMONIE, ARPEGE, ALARO (?) with the NetCdf format (Knmi Parameterization Testbed), access to the website ?(*It is not clear to me what is meant with "access to the website". Anyhow, prefabricated plots are available. It is enough and already very useful*)

Step2: 1D experiment forced by RACMO and ARPEGE(?) by different users with the same model version. (LB, WdR, EB, ALARO ??etc ...)

People interested in evaluating their modification in the testbed should build their modification on **the** testbed set up (the sources codes will be send to the contributor). When send back including the modification, a parallel run can be started in the testbed.

Action: Jeanette Ovnlee (JO) and Laura Rontu : We should have a workshop or a web-meeting in about half a years time on this. (November ?)

Cloud-radiation-aerosol interactions :

- **Karl-Ivar Ivarsson:** The best diameter spectrum for ice/snow/graupel (if there is any) Possible use of this in radiation?

The relations of precipitation ice crystals number concentrations to the mixing ratio are important parametrizations.

The ice nucleus concentration is independent of the mixing ratio.

For snow the number concentration increases geometrically with decreasing mixing ratio.

Cloud ice reaching the ground should be turned into precipitation.

There is too much graupel in the model at the moment. Perhaps small graupel crystals should be transformed to snow in the model.

Actions: Karl-Ivar (KI) Tests started with converting cloud ice to precipitation. Small effect seen so far. Tests with reducing of graupel in case of small mixing ratios of graupel in combination of high supersaturation with respect to ice have also started. So far, the changes works as expected, but much longer tests are needed. Tests with different siize distubutions of solid water will continue.

- **Laura Rontu:** Sodankylä clouds.

HARMONIE with three different radiation schemes (IFS, ACRANEB-2 & Hlradia) was compared with Sodankylä measurements. Sodankylä spring 2014 was mostly cloudy, with snowfall events. In harmonie cy38h1.2-based simulations, the vertically integrated cloud liquid condensate was an order of magnitude larger than that of cloud ice. Snow and graupel were mostly present in model when snowfall was observed, not in non-precipitating clouds. Open questions for further study:

Are there non-precipitating ice crystals in the clouds in the nature? The present parametrizations of radiation transfer in clouds are based on their existence and rely on assumptions on their size and shape via equivalent radia.

How to define the optical properties of large (falling) ice crystals, snow flakes, graupel? Are there such large crystals in non-precipitating clouds? How important are the optical properties of precipitating solid and liquid particles compared to those of in-cloud ice crystals and liquid droplets?

Is it possible to develop a unified way to define the optical properties of precipitating and non-precipitating cloud particles, based on their assumed size distribution, which is also used by the schemes treating cloud and precipitation microphysics? What can be learned from parametrizations of radiative transfer in fresh snow laying on ground?

- **Kristian Pagh Nielsen:** Cloud microphysics calculations are performed completely separately within the radiation scheme(s). How can this be harmonised with the remaining physics.
- **Action** (Jason Williams & radiation team): Introduction of CCN's 2D-field (over land and ocean for the usage of liquid and ice cloud effective/equivalent radius definition, further for cloud microphysics parametrizations.
- **Action (LR):** To plan and find people for a longer term study of "Parametrization of radiative properties of precipitating particles in HARMONIE", or even wider: "Unified parametrization of radiative properties of aerosol and hydrometeor particles in HARMONIE NWP and climate system". There is a need for this, existing expertise in HIRLAM and nearby for collaboration (e.g. at FMI Petri Räisänen, Timo Nousiainen, Roberta Pirazzini), even a possibly to benefit from knowledge about radiation transfer in snow laying on ground or blown by wind.

Other items:

- **Karl-Ivar Ivarsson:** Some details about the sedimentation of cloud ice

Action: (KI): The number concentration of ice used for sedimentation differs from that of the rest of ice microphysics. Tests with harmonizing those have started, with mixed results. Easier to harmonized with radiation (see Kristians point above) if equal also here.

Optimization of the code used in the OCND2-option (esat-tables etc) Should it be used more generally in the code .e.g in turbulence? It is important to remember that both cloud ice and cloud water can precipitate even without becoming snow and rain.

Action: KI: Test with tables for optimations are planned later in spring. (starting with the turbulence scheme.)