Atmos. Chem. Phys. Discuss., 10, C10692–C10697, 2010
www.atmos-chem-phys-discuss.net/10/C10692/2010/

Atmospheric Chemistry and Physics Discussions

ACPD
10, C10692–C10697, 2010

Interactive Comment

Interactive comment on "Investigating the sensitivity of high-resolution mesoscale models to microphysical parameters by the use of polarimetric radar observations" *by* R. Ferretti et al.

R. Ferretti et al.

rossella.ferretti@aquila.infn.it

Received and published: 3 December 2010

Anonymous Referee #2

Received and published: 21 October 2010 Review: "Investigating the sensitivity of high-resolution mesoscale models to microphysics parameters by the use of polarimetric observations". Authors: Ferretti et al.

»>We appreciate the frank comments of the reviewer, but we do not agree with his/her analysis and believe that most of the proposed arguments are not correct. Indeed, the criticism of the reviewer is, in many cases, fairly obscure and not well explained (so that we might have misinterpreted some of them). On the other hand, we prefer to leave the "kiss of death" to the fiction world (see Hathaway, 1947 or Schroeder, 1995): the science community does not need such an embarrassing metaphor.»>

Summary comments: This manuscript describes sensitivity of model results to graupel / hail parameters much as was done in a thee-ice-category model, much as was done by Gilmore et al. 2004 (Mon. Wea. Rev, AMS). Two mesoscale models were used for the sensitivity tests using 1 km horizontal resolution.

Comparisons with polarimetric observations are made, which is very difficult for graupel (Straka et al. 2000, J. Appl. Meteor. 2000), are made. Marzano et al. (2008, IEEE), a co-author of the paper under review, shows this for C-band radar while Straka et al. (2000) shows this for S-band radar. Graupel and hail are essentially indistinguishable for sizes of 5-10mm, which are sizes probably most accountable for graupel and hail (certainly much graupel may be a few mm smaller, such as 2-4 mm.) Even the paper by Marzano et al. (2008) uses a classification based on graupel / small hail as a category. My recommendation is that there is not enough new or adequately presented material for publication in a highly referenced journal.

»> Perhaps, the referee could not stand to read the whole paper, but actually a hydrometeor category analysis is performed and a discussion about the clustering of the available radar-based categories is illustrated. In order to facilitate the comparison between radar observations and NWP models, the 10 radar-derived hydrometeor classes are grouped to three main categories: snow (green, in the paper figures) which accounts for dry snow and ice; graupel (red in the paper figures) which accounts for hail, graupel and small hail; rain (blue in the paper figures) which accounts for light drizzle, and light, moderate and heavy rain. The comparison with the NWP model-based products is straightforward if this radar-based class clustering is preliminarily carried

ACPD

10, C10692–C10697, 2010

Interactive Comment

out.»»

Major Comments: Why are two 'high-resolution' mesoscale models really needed for these types of studies? Richard Feynman would not joke about how unscientific this is-it is akin to 'cargocult science'. How do the authors separate differences owing to differences in the models other than the microphysics? For this reason, little to the author's knowledge, Table 1 becomes one kiss-of-death for this paper.

»> We are sorry we did not clearly stated it, but the reason for using two different NWP models was just to investigate the response of different mesoscale models to the same changes in the precipitating high-density hydrometeor (named "graupel") parameters. We have added a sentence to clarify this point in the revised introduction. The results show that a sensitivity analysis of microphsyics parameterization may be strongly dependent on the NWP model once ensured that the "best" NWP model configuration (with respect to available measurements) is chosen as a reference configuration. Surely we are not joking, Mr. Feyman! »>

The authors should have started off with the use one model, and a model with one adequate microphysics scheme to examine graupel and hail if the authors want to study graupel and hail. Certainly, previous models for almost 25 years (e.g, Ziegler 1985, J. Atmos. Sci.; Ferrier 1994, J. Atmos. Sci.; Meyers et al. 1997, Atmos. Res.; Milbrandt and Yau 2005, J. Atmos. Sci.) have shown how important it is to split graupel and hail categories to adequately assess their growth parameters. »> Indeed, the employed NWP models, MM5 and COSMO which may be considered state-of-the art mesoscale models (note that WRF model set is an evolution of MM5) do not foresee the use of an explicit microphysics for hail, grouping graupel and hail into one precipitating high-density (about 0.4 g/cmˆ3) ice category. »>

In addition, all of the previously mentioned models incorporated two moments, with the latter incorporating three moments to capture a supposedly adequate shape parameter for the gamma distribution used to represent the size distribution function of particles.

ACPD

10, C10692–C10697, 2010

Interestingly, kiss-of-death number two for this paper is that the two models used use different members of gamma-size distribution functions.

»> For what concerns NWP models and the incorporation of two or three moments microphysical scheme, as we stated in the introduction, the purpose of this paper is to investigate the response of microphysics scheme mostly used for NWP, which are generally one-moment bulk parameterization, neither two or three moments. The reason is that few a priori information is available for two or three moment schemes (e.g., the "shape" parameter of the particle size distribution is mostly arbitrary for ice categories) so that the uncertainties may become fairly large.»>

Verisimilitude at its best is very unlikely to produce adequate simulations, hind-cast predictions at the convective scale with 1km resolution for all practical purposes (see papers by George Bryan formerly of Penn State University and now NCAR on importance of resolution), especially for comparison with observations, such as polarimetric ones of graupel and / or hail. Also, what defines a correctly simulated hail fields as opposed to an incorrectly simulated graupel fields? If valid recommendations from this paper were to be made in this paper then the authors should have done a comprehensive parameter space study with idealized soundings in my honest opinion. Certainly some observations are useful for 'comparison' but 'validation'. Where are the error computations of the models (why models I still don't know), of the microphysics? Is this done in the section on 'spectral analysis of hydrometeor spatial fields '. I don't think we know enough about polarimetric signature and modeling microphysics of storms, so they can't be computed at this stage in history of observational and modeling technology. Perhaps the kiss-of-death number three for the paper.

»> With respect to the NWP spatial resolution, in their important paper Bryan et al. (2003) performed simulations of a squall line at resolution of 1km, 500 m, 250 m and 125 m. They assessed that, although a simulation performed at 1km grid spacing is able to capture the basic cumulus structure, it is not sufficient to completely resolve intra-cloud motion. Moreover, their simulations suggested that convection may be of

ACPD
10, C10692–C10697, 2010

Interactive Comment

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

the scale of 1-2 km in some specific conditions, weakening the accepted rule of 1km as a high enough resolution for convective storms. They assessed a strong correlation between vertical velocity and grid resolution: vertical velocity and rain increase with higher resolution. In addition, they determined that for a LES (Large Eddy Simulations) study of the convection the ratio between the dimensions of the convective cell and the model grid spacing may be approximately 100. Based on what Bryan et al., assessed, we should investigate microphysics at 100m which is good for LES, but it is impossible for NWP. It may be that in the near future the new generation of high resolution NWPs will work at such high spatial resolution. Until that time we have to face the real NWP, most of them are running between 3km and 1km resolution. This is why we decided to investigate the response of two well known NWPs at 1km. Finally, a lot of studies on modelling microphysics at 1km or even 3km can be found in literature; one of the most recent being Luo et al., (2010) which using WRF-ARW at 3km analyzed the impact of cloud microphysics parameterizations (Morrison, Thompson and Lin) on a mesoscale convective storms. The authors also established that an overestimation of the intercept parameter N0r would result in an underestimation of the mass-weighted rain fall speed.»>

I don't understand the usefulness or methodology of the short section on spectral analysis of hydrometeor spatial fields and cannot comment further without further information or references.

»> The purpose of the spectral analysis was to objectively compare the models results. But we agree is somehow confusing therefore we decide to cut this part.»>

The final conclusion that polarimeric data should be used to study the vertical structure of storms and not rain at the ground is not the real final conclusion in my opinion. Geeze, we live at the ground. I would have though knowing rainfall amounts accurately would have been an essential component of accurately modeling preciptation, especially in NWP. The real conclusion in my opinion is that graupel and hail need to be predicted as independent variables. Or conversely, the real conclusion is that this

ACPD
10, C10692–C10697, 2010

Interactive Comment

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

type of study should not use two different models, each with a different microphysics package than the other.

»> The referee stated: ‘Geeze, we live at the ground. I would have though knowing rainfall amounts accurately would have been an essential component of accurately modeling precipitation, especially in NWP’. We believe that Feyman would turn in his grave because of this statement! We are convinced that atmospheric research is aimed at investigating and understanding processes in the atmosphere. It is not sufficient to end up with the right result, but it is also important to understand why. Moreover, it is important to establish if one result is obtained for the wrong reason because improvements may be obtained only if a process is known.»>

»> Reference Luo Y., Y. Wang, Wang H., Zheng Y, and H. Morrison: Modeling convective-stratiform precipitation processes on ei-Yu front with Weather Research and Forecasting model: comparison with observations and sensitivity to cloud microphysics parameterizations. J.Geophys. Res. 115, 1-23, 2010.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 20461, 2010.

ACPD

10, C10692–C10697, 2010

Interactive Comment