

Interactive comment on “Spin-up Characteristics with Three Types of Initial Fields and the Restart Effects on the Forecast Accuracy in GRAPES Global Forecast System” by Zhanshan Ma et al.

Anonymous Referee #1

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Overview:

This paper examines the impact of initial conditions on the spin-up process in the GRAPES_GFS model, with results showing that the external FNL analysis is inferior to the model’s internal analysis and that the removal of hydrometeor information during the cycling process has a deleterious effect and necessitates further spin-up time. These conclusions are convincingly examined from numerous angles, although the findings are somewhat as expected. Because of that, the paper would benefit from a bit more explanation of the motivation of the work (e.g., did the FNL used to be used prior to the 4DVAR upgrade? Why is it that the hydrometeor data is wiped out during the

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cycling process, and is changing that currently under consideration?). There are also a few spots in the analysis, particularly of the tendencies, where there appear to be a few errors in labeling/incongruencies with the cited figures or sections that are unclear. A few of the figures could also stand to be a bit clearer in their labeling and font size. Finally, while the paper’s writing is fairly good, there remain widespread instances of misused articles and awkward words and phrases that sometimes obscure the clarity of what is trying to be conveyed, some of which are noted in the technical corrections below. That said, the motivation of the work is sound and the analysis appears to be solid, so pending the specific comments listed below I believe the manuscript should be published.

Specific Comments:

Line 25: Changing “variation amplitudes” to “variations in amplitude...” may be clearer here.

Lines 81, 144: By “resolution”, do the authors actually mean the “grid spacing”?

Lines 95-102: If I am understanding correctly, the operational model includes 3 hours of “built in” spin-up time so that forecasters looking at a launched forecast don’t have to discard the first few hours of the model run. If that is the case, why is it that the hydrometeor variables are discarded? Is it due to limitations of disk space during the restart? Because this seems like something that would predictably introduce problems and negate the benefits of spinning the model up earlier (which the results of the paper confirm), I think it would be helpful for the authors to provide a bit of history about why this is currently done.

Line 129: Consider removing “weather process” here, as I think the sentence reads more clearly without it.

Lines 134-135: The sentence beginning “In the second experiment” is quite unclear to me. What “results” are being talked about here? How is an “initial field” used?

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The following sentence is clearer in terms of what is actually being done, so consider rephrasing or removing.

Line 187: What is meant by the “co-action of cloud and convections” here? Is this co-action shown in the figure?

Lines 195-196 and elsewhere: Does “physical process” here refer to the line labeled PHY in Fig. 2, or all ‘physical processes’ in the model (versus dynamic)? Make sure this is clear throughout the text. The text also states that the biggest difference between F00 and G21 is caused by the convection scheme, but it appears to me that the PHY line is also significantly different between the two.

Section 3.1.2 overall: Related to the previous comment, it would be helpful if the authors state more explicitly how each of the tendencies in Figs 2, 3, etc are defined. ‘RAD’ and ‘PBL’ are somewhat straightforward, but the authors should state clearly where the CLOUD, CONV, and PHY tendencies are coming from and how they all differ.

Line 211: Please add reference to Figure 3 here.

Line 212: Again, related to comments 7 and 8, the authors state that it is due to “Cloud and convection processes”, but Fig. 2a,d seems to show the biggest changes due to CLOUD and PHY rather than CONV (black line). Please clarify.

Line 222: It appears to me that the DYN and particularly the PHY line in Fig. 3g show much smaller adjustments than the middle and upper levels, not larger. Please clarify.

Line 223: Re: “dehumidifying and heating of the atmosphere”, doesn’t Fig. 3g show an overall cooling of the atmosphere (negative TT for the ALL line), corresponding to a generally positive overall WVT in 2g?

Line 237: It appears to me that the adjustments in G00 are almost half those in G21 at all levels (at least for the first few integrations) and not what I would characterize as “close to or slightly smaller”.

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Line 248: Please define how the total hydrometeor content is defined (even if it is just cloud + ice + rain + snow + hail, etc.).

Lines 258-259: Is that how the equilibrium state is being defined overall, or is the description given here (24 hours vs. 6 hours below 850 hPa) only for this case? It seems more accurate to state that the equilibrium state is defined as when the difference with respect to the 24-hour integration is minimal, implicitly assuming that equilibrium will have been reached by 24 hours. Also, please quantify what “is insignificant” means here. Is it just being used subjectively?

Lines 251-267: Can the authors add some discussion of the equilibrium “overshoot” in F00 at upper levels? This was one of the more noteworthy things I noticed about this figure.

Line 292: Should “initial time” really be 21Z (i.e., in G21)?

Lines 308-309: These findings are definitely in agreement with past studies about the importance of an accurate initial moisture field, at least on the storm-scale. It may benefit the paper and further emphasize the authors’ point to add some references to other papers discussing the importance of accurate moisture DA, e.g.:

Weygandt, S. S., A. Shapiro, and K. K. Droegemeier, 2002: Retrieval of model initial fields from single-Doppler observations of a supercell thunderstorm. Part II: Thermodynamic retrieval and numerical prediction

Ge, G., J. Gao, and M. Xue, 2013: Impacts of assimilating measurements of different state variables with a simulated supercell storm and three-dimensional variational method.

Line 329: Do the authors mean the G21 run instead of observations? If not, what observations are being referenced here?

Line 352: This sentence is unclear to me as I don’t understand what is meant by “same forecasts”, although I assume the authors are stating that the conclusions for

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both Lekima and Krosa are the same and therefore only Lekima will be presented. Please clarify.

Line 355: Can “CCWV” and “TCIW” be made consistent with the axis labels in Fig. 9, of vice versa?

Figures 1, 2, 3: Tick labels are small and hard to read. Please enlarge.

Figure 4: Legend text is too small to read.

Figures 1, 2, 3, 4: Please add titles to each subplot of what run, height, time, etc. are being shown in each panel. It is confusing having Figure 1 vary by run in each row, Figure 2 vary by run in each column, etc.

Figure 7a: Are the legend labels switched here? As per the discussion, shouldn't g21_cwp be higher than g00_cwp?

Technical Corrections:

Line 32, 37, elsewhere: Change “Besides” to “In addition”

Line 43: Change “reasonability” to “representativeness”

Line 53: “model” → “modeling”

Line 56: “could” → “can”

Line 91: “widely-used” → “widely used”

Line 115: “difference” → “differencing”

Line 128: Should “1.2” be “2.2” here?

Line 143: “outputted” → “output”

Line 145: “operational solution” → “the operational setup”

Line 182: “in the” → “due to”

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Lines 185-186: “this level” → “these levels”

Line 187, 198, 202, 208, elsewhere: “convections” → “convection”

Line 244: Remove “analysis”

Line 251: “no matter the” → “regardless of whether the”

Line 273: “lead time” → “forecast time”

Line 277: “at time 1 hour after” → “at 1 hour into”

Line 302: “can reflect” → “reflects”

Line 303: Remove “relatively”

Line 305: “It” → “This”

Line 312: “in the operation” → “operationally”

Line 313: “less THC” → “decreased THC”

Line 314: Remove “situation”

Line 315, 351: “typhoon track” → “track”; “landed on” → “made landfall in”

Line 327: “cloud” → “clouds”

Line 334: “moments” → “times”

Line 335: “two” → “four”

Line 351: “continued to develop on ocean” → “remained offshore”; remove “from off-shore areas”

Line 360: “strengthening” → “increase”

Line 368: “get” → “gets”; remove “of them”

Line 371: “an alternation of” → “alternating”

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Line 374, 381: "While" → "In contrast,"

Line 382: Should "G20" here be "G21"?

Line 388: Should "Lichma" be Lekima?

Line 398: "All the three different experiments" → "All three experiments"

Line 407: "unobvious" → "not obvious"

Line 418: "analysis" → "analysis of"

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-177>, 2020.