HAFS Coordination Meeting Minutes/Chat log
Feb 3, 2021 (2-3 pm ET)

Participants List

EMC (HAFSv0.2A baseline configuration - Chunxi Zhang; The impact of the scale-aware SAS scheme on the HAFS-ESG grid experiment - JungHoon Shin)

HAFSv0.2A baseline configuration

- 3 km regional ESG grid and CMEPS based ocean coupling with the bilinear regridding method
- The physics testing plan includes shallow convection only for the scale-aware SAS scheme, given the shallow convection is important esp. for the shallow convection of the ocean.
    - Hybrid EDMF PBL scheme is modified at FIU and TKE-EDMF PBL is scheme modified at HRD.
    - Tuning of EEPS PBL scheme to see it's impacts.
    - Thomson MP shows positive impact but it has instability issues so use small time steps.
- EEPS scheme improved track and intensity forecast for day 3 and day 4 and has modest maximum wind speed bias.
- EEPS scheme has better wind speed-pressure relationship for weaker storms

Impact of scale-aware SAS scheme on HAFS-ESG grid experiment

- SAS scheme improved track and intensity forecast significantly (HAFSv0.1S exp.)
- Test cases on Dorian (57 cycles) and Humburto (27 cycles)
- Dorian: Smaller spread of storm track with SAS scheme; intensity has varying wind speed
- Humburto: with SAS scheme, track and intensity forecast aligned well with the best track
- While the SAS scheme produced a strong storm, however the small scale convection in the upper lat ocean appears.

AOML (HAFS PBL Physics Testing and Evaluation at NOAA AOML - Andy Hazelton)

- Four different PBL schemes were considered- EDMF-GFS, EDMF-TKE, modified EDMF-GFS, modified EDMF-TKE.
- While default schemes are too diffusive, modified schemes have reduced diffusivity.
- Modified EDMF-TKE scheme is closest to the observations in terms of inflow angle
- Reducing diffusivity produces wind peak closer to best track
- Using LES data to improve GFS-EDMF scheme.
- All changes will be evaluated by comparing with NOAA-P3 data.

GFDL (GFDL T-SHiELD Near Real-Time System - Morris Bender)

- Most HAFS models did well compared to the Operational HWRF
- T-Shield has the lowest intensity error, HAFS-B tends to have positive intensity bias (possibly lack of ocean coupling) while HAFS-A has large negative bias.
- HAFS-B has the lowest track error, T-shield has the highest positive east-west track error, HAFS-A has the negative E-W bias.
- Distribution of spatial error and bias for all four models (HAFS-A, HAFS-B, HWRF and T-shield) shows subtropical region has east bias.
- Evaluation of recent convection tests with T20H T-Shield 2019 and 2020 Atlantic seasons showed little impact of SAS on track forecast while some improvements on intensity skills with SAS turned on.
- Evaluation of deep and shallow convection for the 2020 Atlantic season with T-shield showed reduced track error with SAS on, reduced east-west bias with both SAS and shallow convection turned off.

Q. Is bias coming from shallow convection?
Not sure, when shallow convection is turned off, it makes the storm weak. HAFS is also having the same problem.

Frank: SAS issues need to be diagnosed, need to see what the vertical profile looks like with SAS turned on, map out the mass flux profile from model to model to find a clue for this issue.

FIU (Updates on Improvement of HAFS Turbulent Mixing Schemes and Understanding of the Pathway to Rapid Intensification - Ping Zhu)

- Tested stability BVF correction in HAFS-B, tested BVF correction and a new TKE scheme in HAFS-A.
- Tested 21 storms (TC, Cat 1-2 and Cat 3-5) in 2018-2020 seasons in the Atlantic basin using HAFS-A. Results show BVF has the lowest track and intensity error.
- In the test case of hurricane Michael simulated by HAFS-B, it failed to reach the observed peak intensity. The storm structure supports that the eye is governed by symmetry dynamics.
- The static stability correction in the eyewall by including the effects of liquid- and ice-phase hydrometeors improves HSFS skill in predicting TC track and intensity, in particular, for RI storms.
- Eyewall convection must exceed a critical level to generate sufficiently large inward transport of absolute vorticity to overcome friction dissipation and other deceleration processes.
- A robust interaction between the resolved and parameterized SGS processes, the latter plays an important role in initiating the WISHE-like positive feedback leading to RI.

Chat log

Jason Sippel - NOAA Federal 2:00 PM
forecasting snow sucks worse than forecasting hurricanes

Andrew Hazelton - NOAA Affiliate 2:07 PM
Can you remind me what the EEPS scheme is?

Xiaomin Chen - NOAA Affiliate 2:11 PM
@Chunxi Could you explain more about what is the selected physics package consisted of in this year?

Frank Marks - NOAA Federal 2:15 PM
What does the SA SAS do to the environment that makes the track better or worse?

Sundararaman Gopalakrishnan - NOAA Federal 2:17 PM
How strong was the storm when it spuriously turned?

chunxi zhang - NOAA Affiliate 2:17 PM
E-epsilon (EEPS) scheme is a TKE-based scheme with TKE and TKE dissipation rate (epsilon) as prognostic variables

Sundararaman Gopalakrishnan - NOAA Federal 2:18 PM
Chunxi - Do we have E-e scheme in HAFS? Or is this a new inclusion?

Evan Kalina - NOAA Affiliate 2:19 PM
Chunxi: Do you use the mp tendency limiter with Thompson? If so, do you still see the instability you mentioned?

chunxi zhang - NOAA Affiliate 2:20 PM
This year's physics suite for baseline runs is still based on GFSv15, with modification to 1) the GFS surface layer scheme 2) the GFS Hybrid-EDMF scheme.

JungHoon Shin - NOAA Affiliate 2:21 PM
@Frank, Good question. I need to look more details about it. But when I looked the results, it seems that short wave trough near the Florida was deeper in the SAS experiment.

JungHoon Shin - NOAA Affiliate 2:22 PM
And there was more organized convection near the trough in the SAS experiment. I guess this may have some impacts on the trough

Frank Marks - NOAA Federal 2:23 PM
@JungHoon was it parameterized or resolved convection?

Xiaomin Chen - NOAA Affiliate 2:25 PM
@Chunxi Thanks!

JungHoon Shin - NOAA Affiliate 2:26 PM
I believe it is parameterized convection.

Frank Marks - NOAA Federal 2:26 PM
@Andy does the tke scheme allow for advection of tke? If so how would that compare to Ping’s modification?

chunxi zhang - NOAA Affiliate 2:26 PM

We believe that the saSAS scheme improved the subtropical high and mid-latitude systems (we haven't done any systematic diagnosis no it though). As a result, it improved the track forecast, especially after day 2. Without the shallow convection, the vertical mixing for shallow convection is not strong enough for sure.

Andrew Hazelton - NOAA Affiliate 2:27 PM
@Frank I think it can be a tracer, yes. Ping's TKE scheme is just 1-D, I believe.

Frank Marks - NOAA Federal 2:27 PM
@Chunxi how does it do that. What is changed in the environment due to sas?

JungHoon Shin - NOAA Affiliate 2:28 PM
@Gopal,it seems that you are asking about Dorian. To ask your question, for Dorian experiment with SAS, the strongest storms were about 165-177 knots, 5-10 knots stronger than observation.

Jun Zhang - NOAA Affiliate 2:28 PM
@Gopal, thanks for the comments. Besides obs, the LES data Xiaomin is working on will be very useful for further improvement as we discussed with him.

Andy covers part of that.

chunxi zhang - NOAA Affiliate 2:30 PM
@Sundararaman Gopalakrishnan The EEPS is in HAFS but not in official repository.

Jun Zhang - NOAA Affiliate 2:31 PM
@JungHoon, have you tested the performance of scale-aware SAS for multiple TC cases? Was the track error reduced?

chunxi zhang - NOAA Affiliate 2:32 PM
@Evan, yes I used it. With dt_atmos = 60s, I got two failed runs out of around 126 runs. At that time, I didn't use ESG grid.

JungHoon Shin - NOAA Affiliate 2:33 PM
@Jun, I tested two 2019 cases at this point of time. I haven't calculated the track error yet. But I will calculate the error.

Andrew Hazelton - NOAA Affiliate 2:34 PM
@Chunxi, is there an EEPS CCPP suite available somewhere?

Evan Kalina - NOAA Affiliate 2:34 PM
Chunxi: OK. Could be worth checking with Curtis et al. to see what values of dt_atmos, k_split, n_split, and the limiter they are using for their 3-km runs over the CONUS.

But they are using the ESG grid, so that is one difference.

Jun Zhang - NOAA Affiliate 2:35 PM
Thanks @JungHong. It looks the scale-aware SAS performed better than the other scheme based on your slides. It will be nice to do a track error verification.

chunxi zhang - NOAA Affiliate 2:36 PM
@Frank, the SAS scheme change the environment through subsidence warming. With the current scale-awareness method, I believe the warming effects are large due to the large mass flux generated by the SAS scheme.

Sundararaman Gopalakrishnan - NOAA Federal 2:36 PM
JungHoon Shin Thanks.. I wanted to know if the storm was too week/or already dissipated the time the runs started producing the wrong tracks?

Zhan Zhang - NOAA Federal 2:39 PM
@sikchya will you upload today's slides?

JungHoon Shin - NOAA Affiliate 2:39 PM
@Gopal, the case that made odd sharp left turn was not weak. Min SLP was below 960-970 hPa. So it has moderate intensity.

Frank Marks - NOAA Federal 2:40 PM
@Chunxi thanks. So the convection was parameterized. How is the increased mass flux distributed in the vertical? Is it shallow, mid or high-level. i.e., driven by shallow or deeper convection? It would be really nice to show the mean profile of the mass flux or maybe a distribution of the mass flux in the vertical.

Curtis Alexander - NOAA Federal 2:40 PM
@Evan @Chunxi: CONUS 3-km runs have been using dt_atmos=40s, ksplit=4, nsplit=5 OR dt_atmos_36s, ksplit=2, nsplit=5

chunxi zhang - NOAA Affiliate 2:42 PM
@Evan, thanks, I will talk to Curtis

Evan Kalina - NOAA Affiliate 2:42 PM
@Chunxi see his reply above

Curtis Alexander - NOAA Federal 2:43 PM
We have disabled use of any ttend limiter

Xiaomin Chen - NOAA Affiliate 2:48 PM
@Morris Does this suggest the scale-aware parameterization of the MF is problematic?

You 2:49 PM
@Zhan, all presentations will be distributed to the HAFS group

Frank Marks - NOAA Federal 2:49 PM
@Xiaomin I think it depends on how the SAS scheme distributes the MF in the vertical.

chunxi zhang - NOAA Affiliate 2:49 PM
@Frank, The mass flux is first defined at cloud base and the value of the mass flux at cloud base is provided by the closure. The closure is where the current scale-awareness used. From cloud base to cloud top, the mass flux is modified by entrainment/detrainment. Typically, the entrainment decreasse with height, and detrainment reaches the maximum at cloud top. The trigger function, closure and entrainment/detrainment are different between deep and shallow convection.

Zhan Zhang - NOAA Federal 2:50 PM
@Sikchya Thanks!

Andrew Hazelton - NOAA Affiliate 2:51 PM
@Chunxi and @Frank, I do wonder if entrainment is playing a role here. I remember reading that the entrainment parameter is tuned up in the recent version of SA-SAS and is more active in dry environments, such as the edge of the subtropical ridge

Frank Marks - NOAA Federal 2:51 PM
And that is dependent on the enthalpy profile the model passes to the SAS scheme. So it could be dependent on how well the model gets the mean enthalpy profile in the region where the issues arise. If it is too dry in mid levels you will likely have more shallow convection and vice versa. So not only fo we need the vertical distribution of MF, but also the vertical profile of enthalpy.

Morris Bender - NOAA Federal 2:51 PM
I still am puzzled what was so unique in 2020.

chunxi zhang - NOAA Affiliate 2:52 PM
@Curtis, thanks!

Morris Bender - NOAA Federal 2:54 PM
Andy would you mind having Gus make a similar plot of the 500 hPa for HAFB compared to the Analysis.

Or we can ask Alex to do it, maybe that is quickest

Frank Marks - NOAA Federal 2:54 PM
@Chunxi That is why the vertical enthalpy structure is critical as it will control the entrainment/detrainment.

Xiaomin Chen - NOAA Affiliate 2:54 PM
@Frank I agree. @Chunxi I wonder if the entrainment rate has a scale-aware adjustment from 13-km tp 3 km resolution.

Andrew Hazelton - NOAA Affiliate 2:54 PM
@Morris I have a z500 bias plot for HAFS-B I can send you

chunxi zhang - NOAA Affiliate 2:54 PM
@Frank, agreed. we do need to check the environmental enthalpy profile

Andrew Hazelton - NOAA Affiliate 2:55 PM
If Alex wants to do something similar to your analysis though I am happy to share our data

I think that would be useful

Curtis Alexander - NOAA Federal 2:56 PM
@Chunxi: Absolutely. Yeah, we think dt_atmos=60s is rather large for 3-km scale "fast-physics" like microphysics and we have instability there without using a limiter (that we want to avoid).

Morris Bender - NOAA Federal 2:56 PM
Xiaomin that is a good question, I forget details of the scale aware now

Jun Zhang - NOAA Affiliate 2:57 PM
@Ping, nice work!

chunxi zhang - NOAA Affiliate 2:57 PM
@Xiaomin. the current scale-awareness method only applies to the closure, then rescale the mass flux vertically.

Xiaomin Chen - NOAA Affiliate 2:58 PM
@Chunxi Got it. Thanks

Morris Bender - NOAA Federal 2:58 PM
that is what I thought

Morris Bender - NOAA Federal 2:59 PM
details of the SAS scheme was written up some years ago, not sure how much it has changed.

Xiaomin Chen - NOAA Affiliate 2:59 PM
@Ping Do you just make the revision in the eyewall? Or it is applicable to the rainband as well

Frank Marks - NOAA Federal 3:00 PM
@Chunxi and @Morris that makes me wonder if the 3-km vs 10 km horizontal vertical enthalpy structure is changes in a proportional manner to the way SAS expects.

Andrew Hazelton - NOAA Affiliate 3:00 PM
@Jun we noticed that in Dorian as well. It's consistent with the intensification due to inner core CBs that Rob's 2013 paper and my 2017 paper showed

With the modifications you get more convection inside the RMW

Frank Marks - NOAA Federal 3:01 PM
i.e., coarser res has weaker gradients

Jun Zhang - NOAA Affiliate 3:01 PM
@Andy, thanks. It is nice to see this feature happens in other cases.