Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2019-4-RC1, 2019

Ocean Science
Discussions

Interactive comment on "The impact of a new high-resolution ocean model on the Met Office North-West European Shelf forecasting system" *by* Marina Tonani et al.

Anonymous Referee #1

Received and published: 22 February 2019

General comments

The paper "The impact of a new high-resolution ocean model on the Met Office North-West European Shelf forecasting system" presents in a really useful and interesting way the main components of the high resolution regional ocean forecasting system and the validation protocol and results. Main novelties and innovative works in this study concern the high resolution of this regional forecasting system including data assimilation of the main available observations. As mentioned by the authors, it seems difficult to exhibit really significant improvements link to the higher resolution especially because the validation protocol is based on standard comparison between model and

observations even if authors used specific high resolution observations based on gliders or HF radars. Nevertheless the study present an exhaustive comparison to available observations (assimilated or not) and validation diagnostics for most of the physical variables, these information are really useful for users of these operational forecast products and for developers of ocean forecasting system. I recommend the publication of this paper if the following minor revisions are taking into account in the final version.

1. Introduction

1. It could be useful to have a schematic view of the operational schedule of the system. The figure 2 with more information for example

2. Could you provide more precise information on the number of observations assimilated in the system thanks to the chosen assimilation cycles?

3. You mentioned the on going development of physic-biogeochemistry coupled system and the operational constrain. It's not the topic of the paper, but I suggest there is too much or not enough information for readers. Could you add few words about the time constrain and what kind of development is expected to reach the goal.

2. System Development

2.1 Core model Description

1. One specificity of the model configuration is the vertical coordinate system based on z*-σ. There is no justification in the description paragraph concerning the number of vertical levels which is the same than in the lower resolution system. Is there theoretical or experimental justification to reduce the rmax coefficient to 0.1 in this high resolution configuration and what is the expected impact (except the numerical stability)?

2. You impose a minimum of 10m depth on the bathymetry (this characteristic is also mentioned in the conclusion as a limitation), could you justify this choice, is only due to model stability?

3. How do you justify such difference (2 orders of magnitude) between the diffusion coefficient on tracer and advection?

2.1.1 Boundary and surface forcing

1. Could you add in the table 2 information concerning the difference of solar flux penetration in the two configurations and information on the tidal forcing at lateral boundaries

2.2 Assimilation method

Some information are missing in the description: 1. How is implemented the IAU method?

2. What is the SLA bias correction?

3. How do you use the 2 correlation length scale in the in the assimilation scheme? Do you perform 2 analysis?

4. In table 4, what are the differences between the 2 in situ data sources. How do you manage observation available in the two data bases?

5. In table 4, there is no information on the mean dynamic topography used to assimilate the SLA.

6. There is no information on methodology applied to assimilate the SLA in the model including tides.

2.3 Operational production

1. How is computed the QC error threshold for the observations?

2. You provide output fields on a standard vertical grid, how do you provide the information at the surface (0m) ? Is there a specific extrapolation to the surface?

3. Additional information concerning computing resources for this operational system could be useful (number of CPU, computer characteristics . . .)

4. More information could be added on figure 2 as for example, the observations, the atmospheric forcing, the restart and the assimilation and forecast sequence

4 Validation

4.1 Tides

1. M2 is the dominant tidal signal and probably the most important in an operational system for applications, user needs . . . One unexpected result increasing the resolution is perhaps the degradation of the mean M2 solution. It will be important in this section to discuss this point and highlight origin of this degradation.

4.2 Sea Surface Height

The section concerning SSH, as it is, is not really useful and could be removed. But as the SSH is assimilated in the system it's important to quantify impact of these observations. I suggest to add few diagnostics in comparison to SSH as for example :

Statistic/comparison with altimetry in open ocean where observation are assimilated. Along track comparison could be performed. It's important to understand in the paper why the SLA is assimilated in the system

Spatial power spectra to quantify spatial resolution of the system

Variability or eddy kinetic energy

4.3 Sea Surface Temperature

Temporal variability from seasonal cycle to high frequency is validated comparing model output to satellite observations and in situ time series. As expected there are few differences between the two models, main difference between the models being the horizontal resolution, even if the authors exhibit interesting higher frequency processes in the high resolution system. Even if it is not feasible with the observations why any spatial power spectra (or other diagnostics) has been performed to quantify

differences between the 2 models?

4.4 Water Column

On figure 10 larger bias and larger differences between AMM15 and AMM7 is located at 1000m depth. Is it linked to Mediterranean water? How do you explain this difference if the two configurations have the same constrains at the boundary and assimilates the same observations?

4.4.2 Moorings in German Bight

Few more information or hypothesis will be useful to explain some descriptions. - “The high frequency is better reproduced”. Do you compute the correlation between the 2 time series? It’s not so clear on figure 11

- “at the bottom AMM15 is more accurate”. Why? Is it link to the bathymetry or link to vertical projection of increments?

- Table 8 : what is the depth of the bottom at each Buoy position?

- Figure 9 : why there is no model information in October? Add the correlation on the figure

4.4.3 Glider transects

Could you precise if the glider observations are assimilated or not in the system

4.4.4 Mixed layer depth

I suggest adding the mixed layer depth for AMM15 and AMM7 on figure 15 for example.

4.5 Currents

The comparison with HF radar observations is very useful and seems to be more relevant to compare high and low resolution model outputs. I suggest adding the statistics (mean, rms, correlation on amplitude and direction) which seems to be encouraging for the high resolution model as it is explain in the text but without the figures.

Figure 17 is nice to exhibit differences between the 2 models. It could be even better to add map with high resolution observations on the same area. Is there any SLA, SST or ocean color map that can be used to compare front and meso scale structures?

5 Conclusions and future developments

Something is missing in the conclusion, even if it is not obvious to validate and quantify improvement link to the higher resolution a discussion on expected improvements and link with user needs on this domain will be useful.

Typo, figures or format correction

1. Section Boundary and Surface Forcing should be 2.2 and then 2.3 Assimilation method, 2.4 operational system

2. Table 4 is cited before table 3.

3. Conclusion l 7 spatial/temporal

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