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Discussions

Interactive comment on "Towards a new BOLAM-MOLOCH suite for the SIMM forecasting system: implementation of an optimised configuration for the HyMeX Special Observation Periods" *by* S. Mariani et al.

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The comments provided by the two Referees are extremely accurate and precious. On the basis of such comments the authors are preparing an amended version of the paper, as described in detail below.

1) Aim of the paper

The aim of the paper is to provide an evaluation of the meteorological and marine mod-

eling chains deployed and/or implemented in HyMeX and to use the so-obtained results to support the designing of an updated version of the SIMM forecasting system. We will state this point clearly in the amended paper, both in the abstract and in the main text. The idea is to carry on the evaluation of the new MET chain on a case-study basis focusing on two particular heavy precipitation events monitored and forecast during the HyMeX Intense Operation Periods 16 and 18 (IOP16 and IOP18). The meteorological conditions associated to these events were also responsible of two exceptional/severe tide events in the Venice Lagoon ("acqua alta"), and they have been selected for this reason. In fact, one of the national tasks of ISPRA is to monitor and forecast hydrological and hydrographic parameters over the Venice Lagoon. Consequently, in view of the operational implementation of the updated version of SIMM, it becomes particular relevant to assess for these particular case studies the performance of the different meteorological and marine configurations used during HyMeX. This has been done by evaluating the MET chains in terms of QPF quality over the north-eastern Italy, and the marine chain in terms of prediction accuracy of the Venice tide peak forecast (at Punta della Salute tide-gauge). In addition, due to the unbalance in the submitted paper between the marine part and the meteorological part, and following the Referees' suggestion, it has been decided to include into the study the assessment of the marine chain in predicting the tide levels and peaks observed at Burano, Chioggia Vigo, Malamocco (Faro Rocchetta) and Torson di Sotto, as well as at the open-sea CNR platform (Fig. 1).

No other "acqua alta" events occurred during SOP-1 - the following exceptional storm surge event took place in Venice on 11 November 2012, a week later the end of the campaign.

Accordingly with the Referee #2, we will provide our QPF verification study with more strength by including scatter diagrams and PDFs of observed/predicted rainfall aggregated n x n grid cells (see point #3). Similarly, as anticipated, additional results from SHYFEM simulations of the two case studies driven by the operational and new MET chain will be discussed (see point #4). These studies will complete the existing material giving more robustness to the discussion.

The assessment of the performance of the new wave modeling component of SIMM (namely Mc-WAF), including those referred to the two HyMeX campaigns, has been presented in a distinct paper, recently published (Casaioli et al., Adv. Sci. Res., 2014). This choice was due to the complexity of Mc-WAF that spans from the Mediterranean to local coastal scales, and uses for its initialization the meteorological fields provided by both the currently operational MET chain (0.1° BOLAM) and the hi-res MET chain implemented for HyMeX (0.07° BOLAM + 0.0225° MOLOCH). The results of this verification study are briefly summarized in the amended paper for sake of completeness.

2) System description

On the basis of the Referees' comments, we recognize that the description of the different operational/pre-operational model configurations within the SIMM forecasting system can be confusing, and more important it introduces in the reader some confusion about the aim of the paper.

As suggested, we will reduce the part concerning the old system and re-organize the part concerning the operational and the HyMeX systems by introducing also a couple of tables with the main settings (Initial and boundary conditions, grid spacing, domain size, lead time, spin-up, parameterization schemes, etc.) of the different configurations. In the amended paper, the former Figure 1 will be also replaced with two new figures (see Figs. 2 and 3) to better describe the components of these new model chains, namely the one operational and the updated version obtained as a result of the HyMeX activity.

Summarizing:

- The present operational chain includes a low-resolution meteorological segment (the 0.3° BOLAM-father, and a 0.1° BOLAM-son) with a 96-h lead time, which provides

meteorological fields used to initialize two (rather new) marine modeling segments, one for forecasting sea-state conditions over the Mediterranean Sea and several regional areas (Mc-WAF), and one for predicting Venice "acqua alta" tide events (SHYFEM) – see Fig. 2.

- There is also a "legacy" marine model chain (WAM + POM + VL_FEM) but, since it is not the subject of this study, we recognize that mentioning it confuses the reader with unnecessary information. This part will be removed and only cited using references to previous works (e.g., Speranza et al., 2004, 2007) – not shown.

- Then, we have a hi-res BOLAM+MOLOCH meteorological segment that was implement and tested during the HyMeX SOP campaigns; the paper aims at evaluating this new meteorological model segment on the basis of the HyMeX outcomes. This point will be clarified in the revised text.

- We also agree to mention in the paper our future plans for the system upgrade: the BOLAM-MOLOCH configuration, which currently runs with a shortened lead time (60h) and with a reduced MOLOCH domain (only Northern and Central Italy), will be fully operationally deployed in chain with Mc-WAF and SHYFEM – see Fig. 3. This will require the extension of the lead time to 96h and the use of a larger MOLOCH domain to include the whole Italian territory and conterminous seas.

3) Meteorological forecast verification

We agree that the paper quality can be increased by including some more quantitative comparison between observations and QPFs. However, instead of comparing these quantities "on individual rain gauge basis", as suggested by Referee#2, we deem necessary to deal, as fairly as possible, with the different scales represented by the forecast fields (several grid steps) and the rain gauge observations (a much smaller scale). So, in order to provide scatter diagrams and PDFs of observed/predicted rainfall, we rather prefer to compare aggregated/upscaled raingauges and gridded forecasts over n x n grid cells (varying the number n of grid cells), rather than compare observations with gridded forecasts interpolated from the grid cells to the raingauge locations. Some considerations on differences on spatial structures among the forecast fields (using the Fourier spectral analysis) will be also included.

Concerning categorical scores (such as BIAS, ETS, HK, POD, FAR, EDI and SEDI), we are carrying on a specific verification study over an extensive time window covering the two HyMeX SOP campaigns, from September 2012 to March 2013. This study, planned for the HyMeX special issue on QJRMS, inter-compares not only the ISPRA meteorological models but also some of the other meteorological models deployed by the HyMeX partners (the GFS-driven BOLAM and MOLOCH versions by ISAC-CNR; the WRF by CETEMPS; the AROME-WMED by Météo France, etc.), using as observational dataset the rainfall measurements collected during HyMeX from several European networks. A preliminary outlook of this study was the subject of the talk done during the 2013 HyMeX WS in Cassis: Th3.6 Performance of the BOLAM-MOLOCH forecasting chains implemented for the HyMeX SOP campaigns: a QPF verification study using a wide rainfall measurement dataset by Mariani et al.. We deem not appropriate to include, even in part, this material in the present paper that is targeted to the two abovementioned case studies. The performance of SIMM, both in the operational configuration and in the updated configuration, over those events is indeed quite relevant in view of the ISPRA operational tasks.

The questions about the contribution of different factors (initialization, domain size, resolution among others) to the different performance of the BOLAM and MOLOCH models may be issued in two ways: on a long term statistical sensitivity study (this has been done in a previous paper, Casaioli et al., Meteorol. Appl., 2013) or via a thorough inspection of the case studies (including specifically-designed sensitivity tests, e.g. modulating orography). Concerning the former approach, in the submitted paper was present the Figure 4 as a synthesis of the Casaioli et al. results, which reported in the categorical performance diagram several categorical scores calculated over a six-month time period for the 0.07° BOLAM, for the 0.1° BOLAM and for one of the

alternative configurations of BOLAM tested within the sensitivity study. This figure will be however removed according to suggestions from Referee#2. The latter approach goes way over the scope of this paper, and it is currently the subject of another work by Davolio et al. that will be presented at the upcoming HyMeX workshop in La Valletta.

As mentioned by Referee#2, several observation sources are available for the HyMeX campaigns, including MSG WV images on the synoptic scale and many locally-deployed instruments (radars, wind and thermal profilers, radiosoundings among others) on the local (meso-beta) scale. Information provided by these sensors and instruments may be more appropriate for a thorough study on the nature of the BOLAM forecast error during IOP18. This is what we are carrying on, as described at the end of point #4. The preliminary results were shown in Cassis (PS2.19 The impact of different NWP forecasting systems on acqua alta forecasts: Two IOP case studies over the NEI target site by Casaioli et al.). We deem sufficient for the scope of the present paper the discussion about the QPF performance, since QPF is usually considered as a general indicator of the quality of NWP model outputs. However, we are ready to include in the amended version also additional comparison on, for instance, MSG water vapor against model pseudo-water vapor images or PV fields.

Beside explain these issues in the amended paper, we will address the issue of our planned system improvement strategy, which mainly will look for improvements by tuning model domain extension and horizontal resolution (by the way, as reported by Referee#1, we recognize that, more than “optimization”, it is preferable to talk about “improvement”, also in the paper title).

4) Sea (tide) forecast verification

We agree with the need to show more results, in primis verification of SHYFEM initialized with the hi-res "HyMeX" BOLAM (the HyMeX MOLOCH domain is too small to drive SHYFEM). Anyway, in order to include such results, we deem mandatory to include the co-authors of this study (ISPRA colleagues) among the author list. These results will provide more balance to the paper. As anticipated, we will also include tide verification over more observation points over the Venice lagoon as well as at the open-sea CNR platform.

Summarizing:

- For IOP16 (most predictable case) there is a little gain in forecast skill when the HyMex BOLAM is used to drive SHYFEM in place of the lo-res BOLAM.

- For IOP18, the correspondent gain is still appreciable, but the peak prediction skill is lower than in the other case. The remarkable point is that both the model forecast are very sensitive both to initial conditions and to BOLAM configuration. Namely, forecasts initialized 36h before the peak are fairly good (with error of the opposite sign when using the two BOLAMs), whereas forecasts initialized 60 h in advance are by far less skillful (even worse than ones initialized 84h in advance) with a comparatively worse performance when using hi-res BOLAM. To discuss and explain these results is clearly way over the scope of this paper, since it requires a deep study of the involved weather system (which we suspect to be a very ill-predictable Mediterranean cyclone). As reported before, we plan to write another work specifically on this issue.

5) Paper balance and conclusions

We deem that, through the aforementioned improvements to the paper, we may easily achieve the task of both having a balanced paper and to provide more definite conclusions, provided that old and new material is adequately discussed and interpreted. We agree also that the used rainfall data should be provided with an adequate description; that we should try to limit the use of acronyms to the strictly necessary; that a general re-ordering of the material and a clearer introduction (in particular about the aim of the paper and the motivation of our approach) may make more understandable the task of both our prediction system and this study (including contextualization of our work). The suggestions provided by the Referee#2 on figures (which figure needs to improved, which one needs to be removed, etc.) will be taken into account in the

amended version.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 649, 2014.

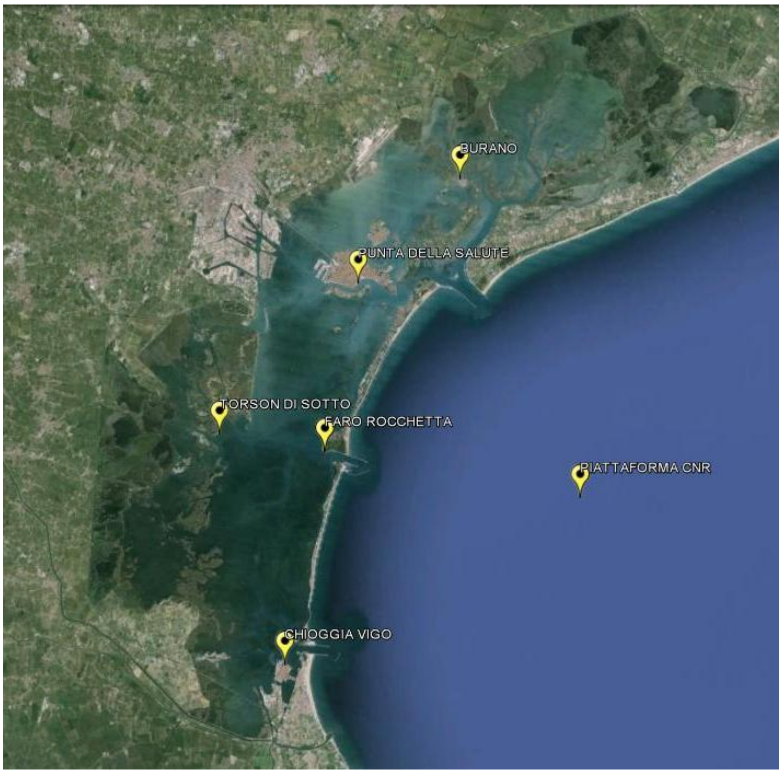

Fig. 1. Overview of the tide-gauges available over the Venice Lagoon and at the CNR platform used for the SHYFEM verification.

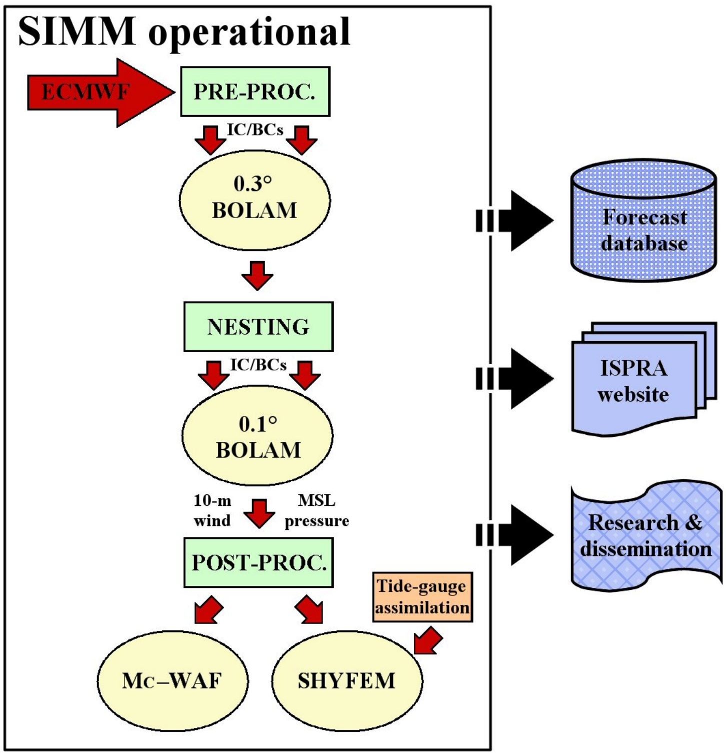

Fig. 2. The operational SIMM model sequence.

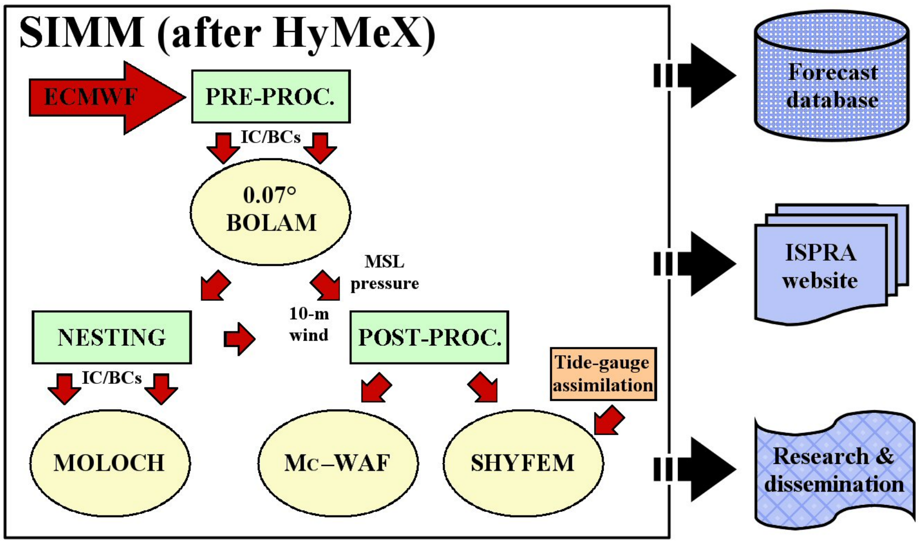

Fig. 3. The updated SIMM model sequence, obtained as a result of the HyMeX campaign.