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## **Comment on nhess-2020-409**

Anonymous Referee #2

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Referee comment on "Performance of the Adriatic early warning system during the multi-meteotsunami event of 11–19 May 2020: an assessment using energy banners" by Iva Tojčić et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2020-409-RC2>, 2021

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Performance of the Adriatic early warning system during the multi- meteotsunami event of 11-19 May 2020: an assessment using energy banners

Iva Tojčić, Cléa Denamiel, Ivica Vilibić

### General comments

The present paper deals with the forecasting of meteotsunamis in some parts of the Croatian Coast, one of the world areas where this kind of phenomena acquire relevant magnitude. Forecasting of meteotsunamis (that is, large sea level oscillations in a range of periods similar to the tsunami periods, triggered by small scale meteorological disturbances) is an operational and scientific challenge, due to the complexity of the phenomenon and the small scale of the meteorological perturbations directly triggering the meteotsunamis. The Croatian scientists have implemented a meteotsunami forecasting/warning system (CMeEWS) constituted by a numerical model prediction suite (including atmospheric and oceanic modules), an observational meteorological and oceanic system and a stochastic surrogate model.

The particular objective of this paper is to check the behaviour of CMeEWS during a recent large period of meteotsunamis in some of the Croatian ports (11 to 19 May, 2020). As a result, the authors are not optimistic with regard to the deterministic forecasts directly obtained from the numerical model suite and they rely more in the probabilistic forecasts obtained from the stochastic model. The authors highlight the introduction of a verification method, based on the examination of the energy banners associated to the displacement of meteorological small scale perturbations, as one of the main results of their work.

In fact, one of the general concerns of this referee with regard to this paper is that the authors seem not to be very clear in their objectives and results. An effort to review the text in this sense could improve the paper.

This is an aspect of a more general problem of this paper: it is quite complicated in its drawing, what makes a little difficult to read it. A general review of the drawing is convenient.

The high degree of uncertainty in the deterministic forecasting of some small scale meteorological disturbances, particularly those related with the triggering of meteotsunamis, is a well-known fact, although there are cases in which particular disturbances of this kind can be reasonably well forecasted is rare (Renault et al, 2011).

To reduce or to narrow down the uncertainty of the deterministic forecast, CMeEWS includes a stochastic model based on the polynomial chaos expansion method. The stochastic model provides probabilistic forecasts that the authors consider more useful than the direct deterministic forecasts. The model used in CMeEWS is a way, but not the only way to narrow down the uncertainties through probabilistic forecasts: Vich and Romero (2020: <https://doi.org/10.1007/s11069-020-04041-5>) or Mourre et al (2020: <https://doi.org/10.1007/s11069-020-03908-x>)

#### Particular comments

- Regarding Section 2, although this paper is not the presentation of the CMeEWS (this was made in previous papers), this system is also described here, although not with enough clarity. It seems to me that the authors describe a numerical prediction model

suite, which is a part of the CMeEWS and that contains a basic module, named COASTWST, and a meteotsunami module. I understand that the meteotsunami module includes the known atmospheric model WRF, running at a resolution of 1-1.5 km, and providing air pressure data, every minute, to a marine module (ADCIRC), which resolutions is variable, reaching up to 100 m in the most sensible zones. Is that correct? Other key details are not explained. Particularly, which are the models that constitute the basic module COASTWST? Which are their characteristics? How they feed WRF, as part of the meteotsunami module?

- Section 2.3, line 126, I don't understand what "fail to reproduce or underestimate" means.

- Lines 127-128, please, clarify the sentence

- Line 135, how the parameters of the atmospheric perturbation are obtained from WRF? automatically? subjectively?

- Section 3, figure 2: this figure is not clear. It is difficult to see the lines with clarity. Perhaps it would be better to remove the colours. On the other hand, perhaps adding wind in the 850 hPa panels would help to the meteorological large scale frame. Another suggestion: perhaps including a vertical atmospheric profile would also help.

- Section 4, figures 3, 4, 5. What are the abscises in every box? Are they time? Following lines 214-215 it seems that they are time and, particularly, twelve hours around the time of interest: is it correct? If so, the times are not indicated. How have the places been selected? Is "composite" referred to spectral analyses over 30 minutes sampling? Running, continuous overlapping or discrete sampling?

- Lines 204-206, no a threshold for air pressure change is mentioned. Is it 20 Pa/4 min, as indicated by Denamiel et al (209b)? Please, review drawing

- Line 206, "are greater than" (??) à "is greater than"

- Line 216, "intense air pressure" is an incomplete or not understandable expression

- Lines 217-220: the authors indicate the System renounces to indicate a timing for the phenomenon. It is pity don't include indication about the timing: it would be a potential added value to the daily warnings

- Section 5, line 281, is it spatial variance (in an area) at a fixed time or time variance (during 3 hours) at fixed grid points? It seems the second. Please, review

- Line 283, it seems that the points of largest variance define energy banners or transects. Are these transects determined objectively or subjectively, transect by transect?

- Lines 293-294, I don't understand well the definition of "transect sampling criteria", is it a magnitude obtained multiplying air pressure variance and marine response? Please explain a little more

- Figures 6 to 10 and the corresponding figure captions. Some questions: How the speed of propagation of the pressure disturbances is determined? In the down panels of these figures it seems that the abscises are distances along the transect, but no scale is indicated. No all the possible transects are explicitly considered in these figures; in the supplement, figures 2 to 15 are more exhaustive. It is not clear how the transects are chosen for figures 6 to 10. The reference to the figures of the supplement in the captions of figures 6 to 10 is more confusing than clarifying. In my opinion, all the captions, from figure 6 to 10 have to be written more clearly. Some particular details:

- Figure 7: With regard to the transect that is highlighted, it is not easy to understand why the transect sampling criteria –second panel in the figure- give so large values, when there are not conditions for a Proudman resonance –last panel-.

- Figure 8: The caption mentions two transects, but only one is indicated (on the contrary, in figure 6 the caption only mentions one transect, but the first panel seems to show two transects).

- Figure 9: Only one transect is indicated in the first panel, but it seems to me that there are two parallel partial transects, one of them vanishing soon, the other appearing late

- Lines 381-383: Difficult to understand; please, clarify