The paper aims to introduce high resolution ocean models used in operational coastal forecasting applications, describing the spatial scales, and key processes addressed by high-resolution coastal and regional models.

Some numerical modeling techniques essential for capturing such small-scale coastal dynamics (including parameterization of turbulence and mixing effects, the modelling of tidal dynamics or the accounting of variable freshwater river contributions) are highlighted. Being also discussed the role of some monitoring tools (especially ADCPs, HF Radar, or the coming SWOT coastal altimetry), that linked to data assimilation techniques and through OSEs and OSSEs can help to improve prediction accuracy in the coastal zone.

A list of ocean models commonly used for coastal and regional modelling is provided, together with some insights into the fine resolution nesting techniques and the use of unstructured-grid models to simulate the coastal zone.

By addressing these topics, the paper effectively achieves its main goal, introducing the status of high-resolution ocean forecasting services aimed to solve coastal dynamics, as mentioned in the paper title.

Some specific points that can be addressed in more detail by the authors in the updated manuscript:

- Links with emerging AI-based solutions. In the abstract it is said: “This work underscores the potential of advancing coastal forecasting systems through interdisciplinary innovation, paving the way for enhanced scientific understanding and practical applications” and in the conclusion is stated: “applying artificial intelligence to optimize model parameterization, grid design, and predictive analyses will unlock new capabilities for simulating small-scale processes like sediment transport and ecosystem responses.” However, in the paper sections, there is no reference to any AI application. Can the authors include in the manuscript some information about the links between the new AI-based solutions and coastal modelling? The inclusion of some information on AI applications (and references to related literature or to on-going initiatives) will enhance the proposed review, and will certainly increase its interest to more potential readers.

- **Section 3.3. Fine resolution nested models, downscaling and upscaling.** This section, on finer resolution nested models, downscaling and upscaling techniques, would need some refinement.

After the initial paragraph explaining coastal downscaling through one-way nesting, the authors describe an example of increasing resolution in a regional system (not clearly referred; see next point). Then a paragraph on 2-way nesting coupling, describing an example (not sufficiently referred), and a final paragraph on the AGRIF tool from NEMO.

I see ok the proposed section organization, but I would ask the authors to keep the same level of review detail(/references) of the first paragraph along the whole section. For instance, some more examples can be included/referred for the 2-way nesting part.

I would also ask the authors to add in this section some information about multi-model intercomparison exercises (this section downscaling/upscaling may be the place to mention this working line that combines the use of global, basin, regional and coastal models).

Some pieces of information about multi-model intercomparison exercises that I would recommend the authors to include in this section can be in the line:

> The organization of these multi-model studies is identified by the coastal modelling community as a need. Firstly, to tackle common assessments of the wide range of overlapping (global/basin/regional and local) models that are available for users in some costal zones. Secondly, these multi-model validation exercises, comparing the performance of global/regional "core" model forecasts (i.e. from services such as the Copernicus Marine one) and coastal model solutions, nested into the formers, are useful to identify the potential added value (and the limitations) of performed coastal downscaling with respect to the "parent" core operational solutions, in which high-resolution coastal models are nested.
>
> In that sense, these multi-model intercomparison exercises are key elements for many initiatives, such as the **HE FOCCUS** (Forecasting and Observing the Open-to-Coastal Ocean for Copernicus Users) Project, that have in their core the enhancing of existing coastal downscaling capabilities, developing innovative coastal forecasting products based on a seamless numerical forecasting from regional models of the Copernicus Marine Service covering the EU regional seas, to Member States coastal forecasting systems (authors can add here any other pertinent reference from literature).
>
> Furthermore, and from an end-user perspective, multi-model study cases focused on extreme event simulations, such as the one performed by **Sotillo et al. (2021)** focused on the record-breaking Western Mediterranean Storm Gloria, allow to identify strengths and limitations of model solutions delivered by operational forecast services available in zones affected by extreme events; for instance, in the referred study case, 5 model systems were considered (including systems both from the Copernicus Marine

service -with usages of the Global and the regional Mediterranean and Atlantic IBI solutions- and 2 coastal services nested into the regional solutions). This kind of multi-model study cases certainly help to enhance product quality assessments (in this Gloria Storm case, making extensive use of the local HF radar capabilities), increasing the knowledge about the model systems in operations, and outlining future model service upgrades (both in the regional and coastal services) aimed at achieving a better coastal forecasting of extreme events.

Considering the present organization of section 3 in the manuscript, I would suggest the authors adding this reflection about multi-model studies after Line 229 statement. Anyway, please, feel free to elaborate on it, including more references to different multi-model intercomparison exercises (there are several examples in the literature for different zones).

Sotillo MG, Mourre B, Mestres M, Lorente P, Aznar R, García-León M, Liste M, Santana A, Espino M and Álvarez E (2021) Evaluation of the Operational CMEMS and Coastal Downstream Ocean Forecasting Services During the Storm Gloria (January 2020). *Front. Mar. Sci.* 8:644525. doi: 10.3389/fmars.2021.644525

- **In 231.** Enhancing the horizontal resolution of the North Sea operational model from 7 to 1.5 kilometers has shown improvements in off-shelf regions, but biases persist over the shelf area, indicating the need for further enhancements in surface forcing, vertical mixing, and light attenuation.
  Here when saying "North Sea operational model" are the authors referring to the Copernicus Marine NWS-MFC forecasting model system? If so, and the increase of resolution mentioned is the one documented in **Tonani et. al. (2019),** please, refer properly to such work (reference below). If not, please specify which system and resolution increase is here being mentioned.
  Tonani, M., Sykes, P., King, R. R., McConnell, N., Péquignet, A.-C., O'Dea, E., Graham, J. A., Polton, J., and Siddorn, J.: The impact of a new high-resolution ocean model on the Met Office North-West European Shelf forecasting system, Ocean Sci., 15, 1133–1158, https://doi.org/10.5194/os-15-1133-2019, 2019.

- **In 257.** Fine spatial resolution in unstructured-grid models allows for the resolution of secondary (transversal) circulation in estuaries and straits **(Ilicak et al. 2021),** thereby improving mixing and enhancing the representation of long-channel changes in stratification, as demonstrated by Haid et al.
  The Ilicak et al. 2021 paper nicely illustrates how a high-resolution unstructured grid model is used to enhance the simulation of circulation across the Turkish Strait System that communicate both Mediterranean and Black Seas.

Ilicak, M., Federico, I., Barletta, I., Mutlu, S., Karan, H., Ciliberti, S. A., Clementi, E., Coppini, G., & Pinardi, N. (2021). Modeling of the Turkish Strait System Using a High Resolution Unstructured Grid Ocean Circulation Model. *Journal of Marine Science and Engineering*, *9*(7), 769. https://doi.org/10.3390/jmse9070769

- **In 266.** Data assimilation in coastal regions presents challenges due to the presence of multiple scales and competing forcings from open boundaries, rivers, and the atmosphere, which are often imperfectly known (Moore and Martin, 2019).
  In this point, I would suggest adding specific mention to tides as one of the main challenges for data assimilation. There are many references in the literature to the (absence of) data assimilation in tidal coastal zones. One statement like the following one can be added to the manuscript: **Data assimilation is particularly challenging in tidal environments (especially for meso- and macro-tidal environments; and not so in micro-tidal coastal zones).** -included selected update references…-

- Some parts of the manuscript lack citation. This is especially so, for instance in section 2. Unlikely, some other sections of the manuscript provide much more level of references to previous works than Section 2. Below, some options for balancing this different level of citation, including some pertinent reference to address the following points can be:

**In 82.** High-resolution services in the coastal ocean operate at various spatial scales depending on the specific applications and objectives (**Sotillo, 2022**).

This Special Issue (Sotillo, 2022) entitled "ocean modelling in support of operational ocean and coastal services", compiles 11 recent papers on operational coastal services based on high-resolution models. Its citation here can certainly provide readers with insights about scales, objectives and applications, as stated in this sentence with no reference.

Sotillo, M. G. (2022). Ocean Modelling in Support of Operational Ocean and Coastal Services. *Journal of Marine Science and Engineering*, *10*(10), 1482. https://doi.org/10.3390/jmse10101482

**In 135.** Accounting for high-resolution atmospheric forcing into coastal models is essential for accurately capturing local meteorological dynamics, including wind patterns, temperature gradients, and precipitation rates. Such detailed atmospheric data drive fundamental processes like heat and momentum fluxes

**(García-León et al. 2022),** profoundly influencing coastal hydrodynamics, sediment transport, and ecosystem response.

The proposed García-León et al. work demonstrates that the usage of a new high-resolution atmospheric forcing, together with the update of bulk formulae to compute surface fluxes, have positive impacts across different high-resolution model systems for ports.

García-León, M., Sotillo, M. G., Mestres, M., Espino, M., & Fanjul, E. Á. (2022). Improving Operational Ocean Models for the Spanish Port Authorities: Assessment of the SAMOA Coastal Forecasting Service Upgrades. *Journal of Marine Science and Engineering*, *10*(2), 149. https://doi.org/10.3390/jmse10020149.

This is one example, among many others in the literature (authors should fell free to add more), that can support such statement on atmospheric forcing. I would recommend the authors look for some more references to complete this aspect related to the improvement of the atmospheric forcing in coastal high-resolution modeling. Indeed, it would be interesting if in a review paper like this, it is mentioned that atmospheric forcing can be seen today unfortunately as a common limitation for high-resolution coastal modelling. Especially, when coastal modelers are aiming and working on (as stated at the end of this section 2; in 158):

"Simulations at grid resolutions that would sufficiently resolve the coastal sub mesoscale would require horizontal grid resolutions of approximately 1-10 meters in estuaries and 0.1-1 kilometer in coastal shelf domains. However, achieving such high resolutions poses significant computational challenges and resource demands".

But coastal modelers typically can rely only on atmospheric forcing data from national/regional operational services, which have resolutions of around 2-5 km resolution, often being this the best available option (or even lower resolution data when no other alternatives are available). Authors may also link this point on atmospheric forcing limitations with on-going AI initiatives to improve coastal winds.

**In 149.** The interactions between tidal forcing, river flow and estuarine geometry result in intricate and variable periodic patterns (as shown in **Campuzano et al. 2022 for the Western Iberian Buoyant Plume and in Sotillo et al. 2021 for the whole European Atlantic façade**).

Campuzano et al. and Sotillo et al. works (on the simulation of the Western Iberian Buoyant Plume formed by the contribution of several rivers, and the sensitivity of IBI model to different river forcing data) can provide some illustration of the intricate and variable patterns resulting between river flows, estuarine geometries; and all in regions with marked tidal influence.

Campuzano, F., Santos, F., Simionesei, L., Oliveira, A. R., Olmedo, E., Turiel, A., Fernandes, R., Brito, D., Alba, M., Novellino, A., & Neves, R. (2022). Framework for Improving Land Boundary Conditions in Ocean Regional Products. *Journal of Marine Science and Engineering*, *10*(7), 852. https://doi.org/10.3390/jmse10070852

Sotillo, M. G., Campuzano, F., Guihou, K., Lorente, P., Olmedo, E., Matulka, A., Santos, F., Amo-Baladrón, M. A., & Novellino, A. (2021). River Freshwater Contribution in Operational Ocean Models along the European Atlantic Façade: Impact of a New River Discharge Forcing Data on the CMEMS IBI Regional Model Solution. *Journal of Marine Science and Engineering*, *9*(4), 401. https://doi.org/10.3390/jmse9040401

- Some other references that may enhance the proposed introductory/review scope of the paper may be the following ones:

**In 197**. The use of HFR networks has become an essential element of coastal ocean observing systems, contributing to high-level coastal services (Stanev et al., 2016; Rubio et al., 2017; **Reyes et al., 2022**)

I would suggest including this more recent review work of Reyes et al. on existing HFR data multidisciplinary science-based applications in the Mediterranean Sea, primarily focused on meeting end-user and science-driven requirements, addressing regional challenges in maritime safety, extreme hazards and environmental transport processes.

Reyes, E., Aguiar, E., Bendoni, M., Berta, M., Brandini, C., Cáceres-Euse, A., Capodici, F., Cardin, V., Cianelli, D., Ciraolo, G., Corgnati, L., Dadić, V., Doronzo, B., Drago, A., Dumas, D., Falco, P., Fattorini, M., Fernandes, M. J., Gauci, A., Gómez, R., Griffa, A., Guérin, C.-A., Hernández-Carrasco, I., Hernández-Lasheras, J., Ličer, M., Lorente, P., Magaldi, M. G., Mantovani, C., Mihanović, H., Molcard, A., Mourre, B., Révelard, A., Reyes-Suárez, C., Saviano, S., Sciascia, R., Taddei, S., Tintoré, J., Toledo, Y., Uttieri, M., Vilibić, I., Zambianchi, E., and Orfila, A.: Coastal high-frequency radars in the Mediterranean – Part 2: Applications in support of science priorities and societal needs, Ocean Sci., 18, 797–837, https://doi.org/10.5194/os-18-797-2022, 2022.

- Minor (typo) Points.

In 15 typo: “introduce key”

In 17 typo: “for the”