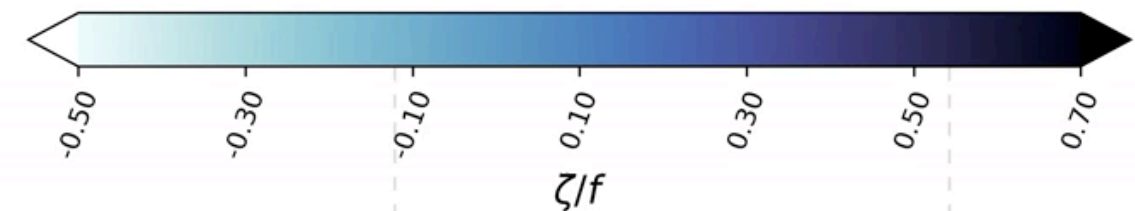
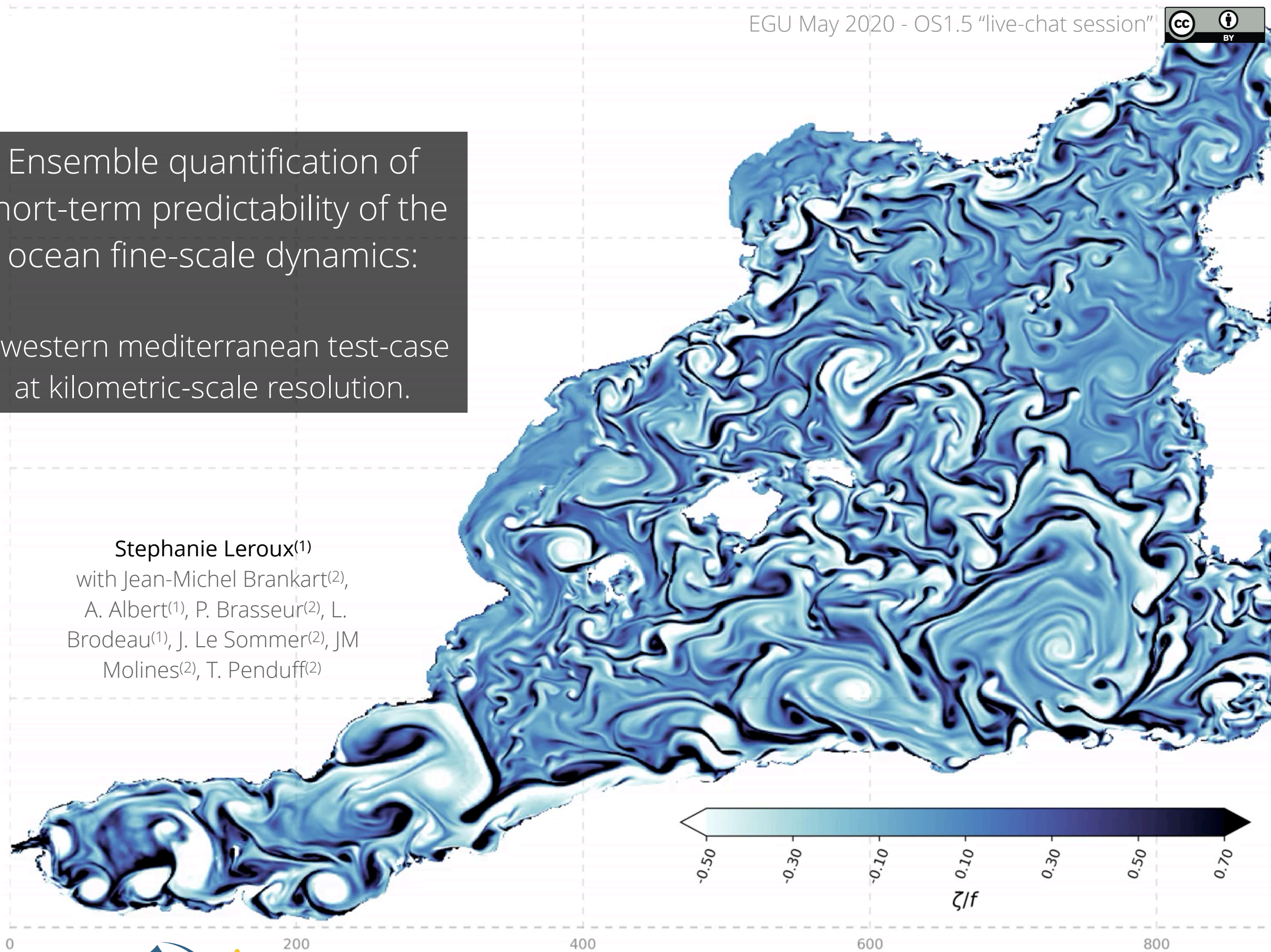


Ensemble quantification of short-term predictability of the ocean fine-scale dynamics:

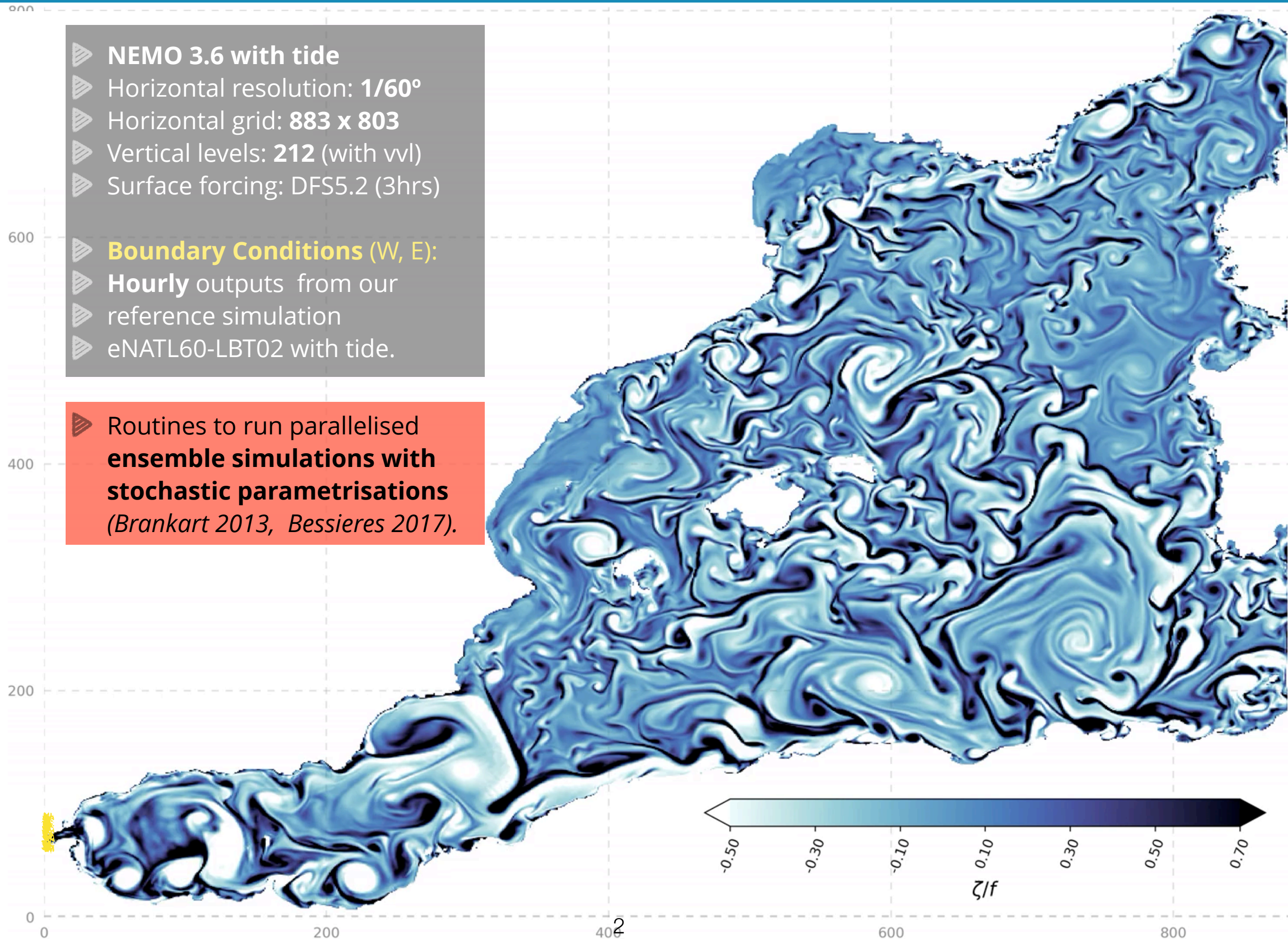
A western mediterranean test-case at kilometric-scale resolution.

Stephanie Leroux⁽¹⁾

with Jean-Michel Brankart⁽²⁾,
A. Albert⁽¹⁾, P. Brasseur⁽²⁾, L.
Brodeau⁽¹⁾, J. Le Sommer⁽²⁾, JM
Molines⁽²⁾, T. Penduff⁽²⁾



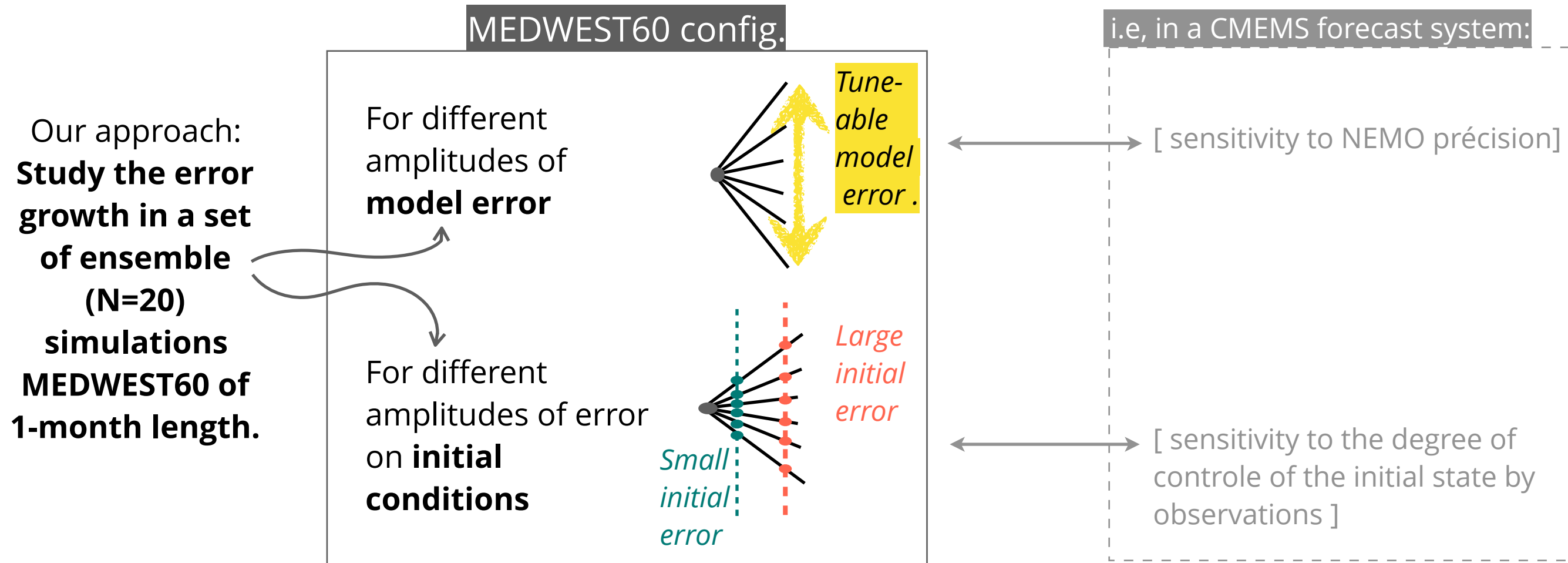
1. MEDWEST60: a set of regional ensemble simulations at kilometric scale



2. A test-case to study predictability of the fine-scale ocean dynamics

“Predictability” in an operational context = Forecast accuracy required for a given CMEMS application.

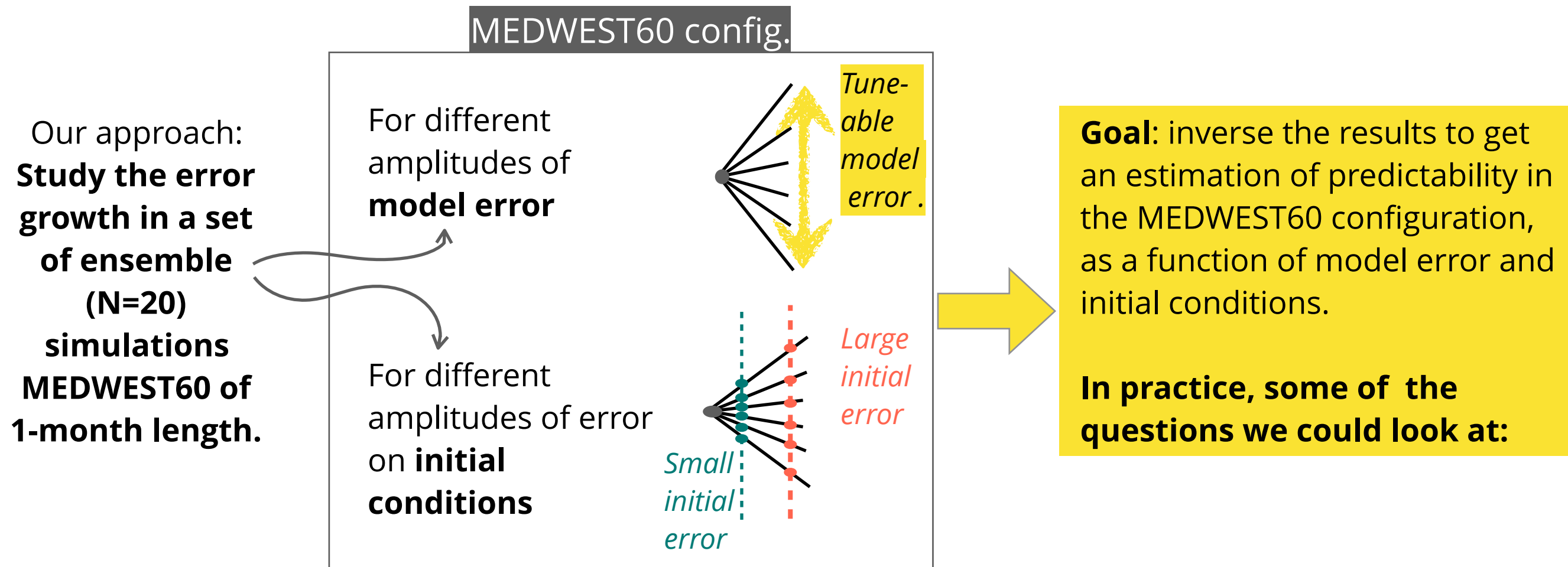
In an operational system, the forecast is limited by errors from both initial conditions and from the model.



2. A test-case to study predictability of the fine-scale ocean dynamics

“Predictability” in an operational context = Forecast accuracy required for a given CMEMS application.

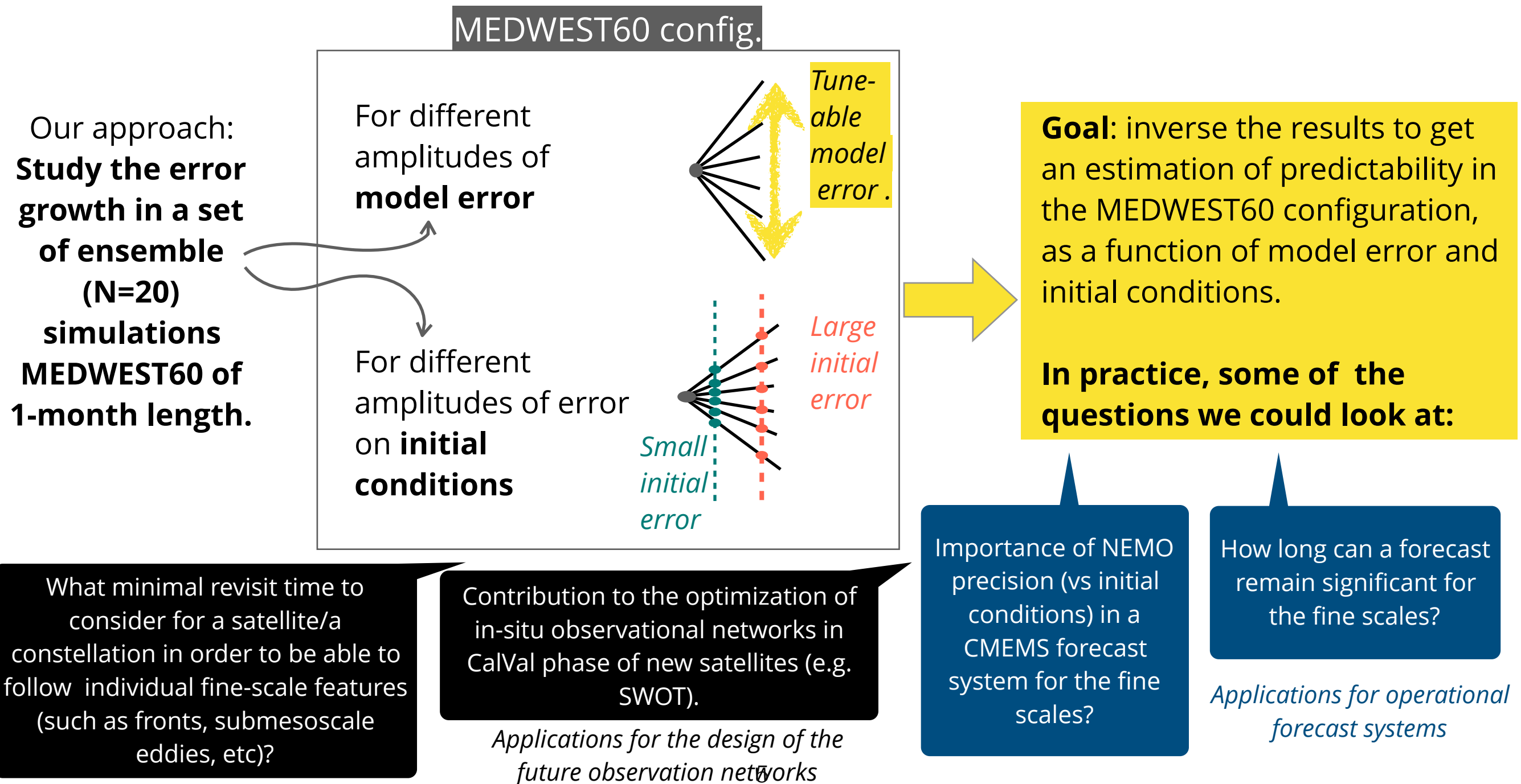
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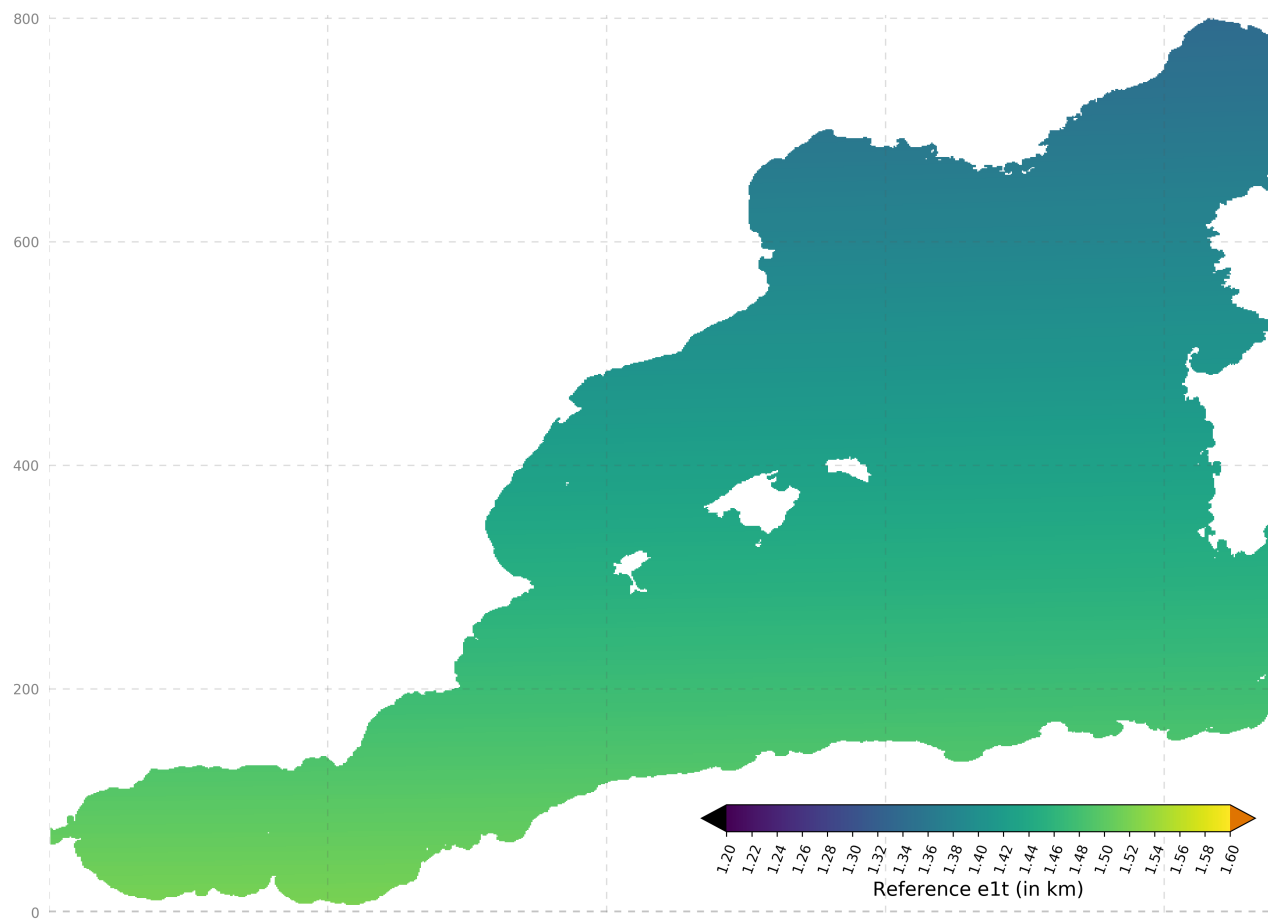
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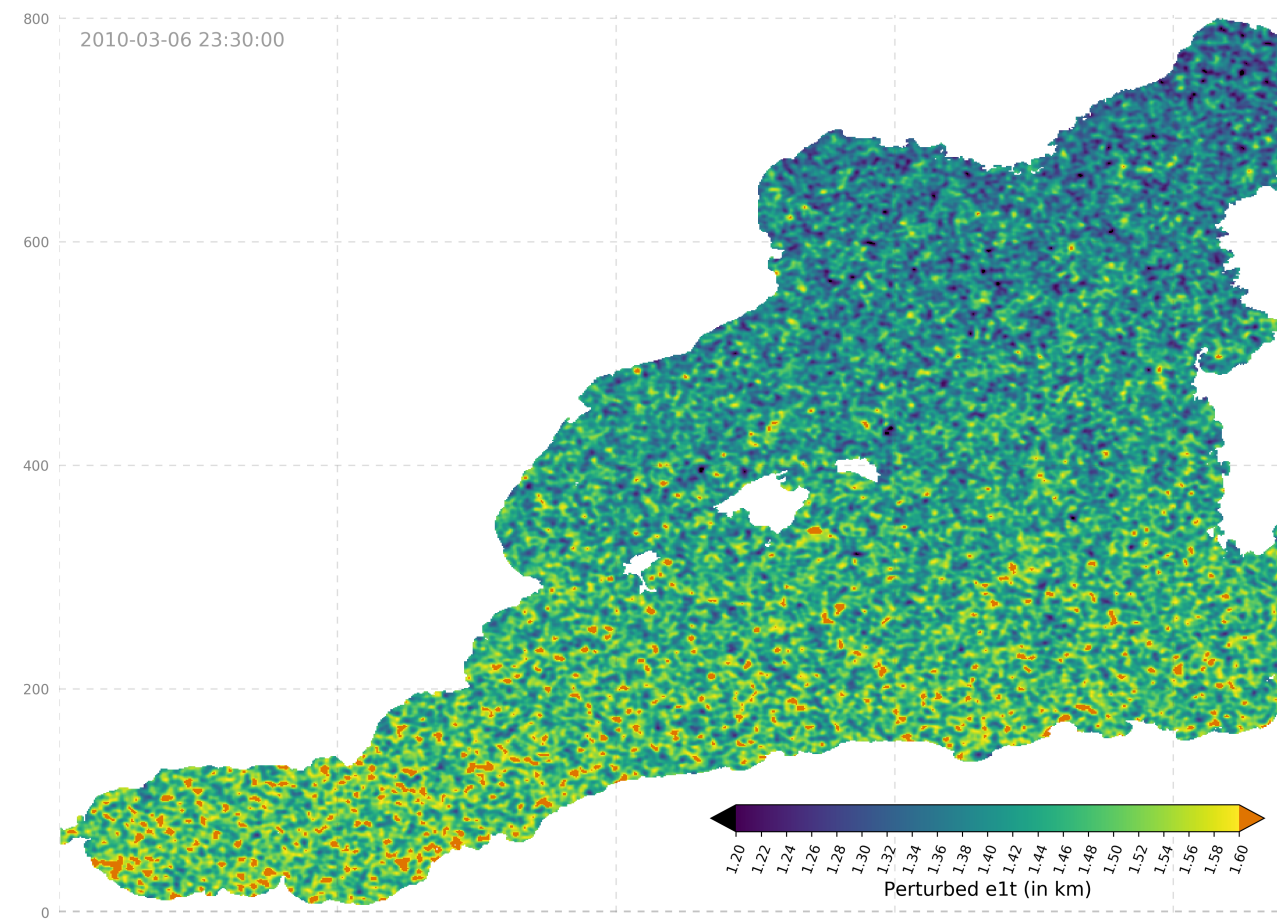
3. In practice - how we generate a “tunable model error”:

- Starting from a common restart file, the 20 members of each ensemble experiment are generated with a **stochastic perturbation applied on the model horizontal metrics (e1,e2 in NEMO) at each time-step.**
- e1,e2 are used to compute the derivatives in NEMO, so perturbing those metrics **can be seen as a way to take into account the uncertainty on the exact position of the oceanic structures.**
- In practice, this stochastic perturbation is implemented using the stochastic module in NEMO by Brankart (2013). The perturbation expresses a random order-2 auto-regressive process, of which we can set:
 - the **amplitude (here std of 1% or 5%),**
 - the **time correlation (here set to 1 day),**
 - some spatial smoothing (laplacian filter, here set to 10 grid points).

(a) The unperturbed model horizontal metrics (e1)



(b) Example of perturbed model horizontal metrics (e1) (sto_std=5%)

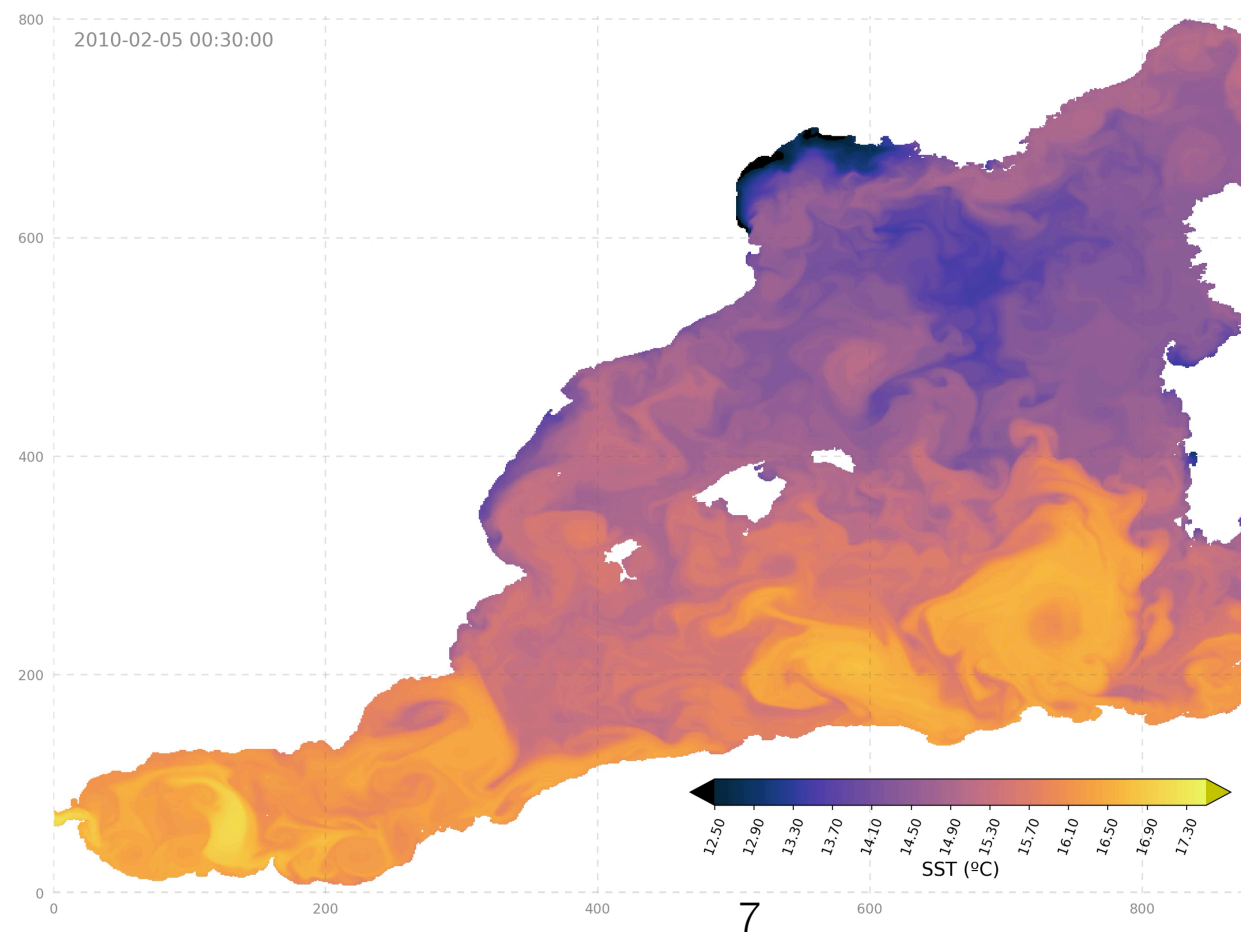


4. In practice - the 3 ensemble experiments we have produced so far:

We have produced 3 ensemble experiments so far:

- **ENS1**: e1,e2 stochastically perturbed with a Std=1% (start date in February 2010), run for 2 months,
- **ENS2**: e1,e2 stochastically perturbed with a Std=5% (start date in February 2010), run for 1 month,
- **ENS3**: e1,e2 stochastically perturbed with a Std=1% (start date in August 2010), run for 1 month.

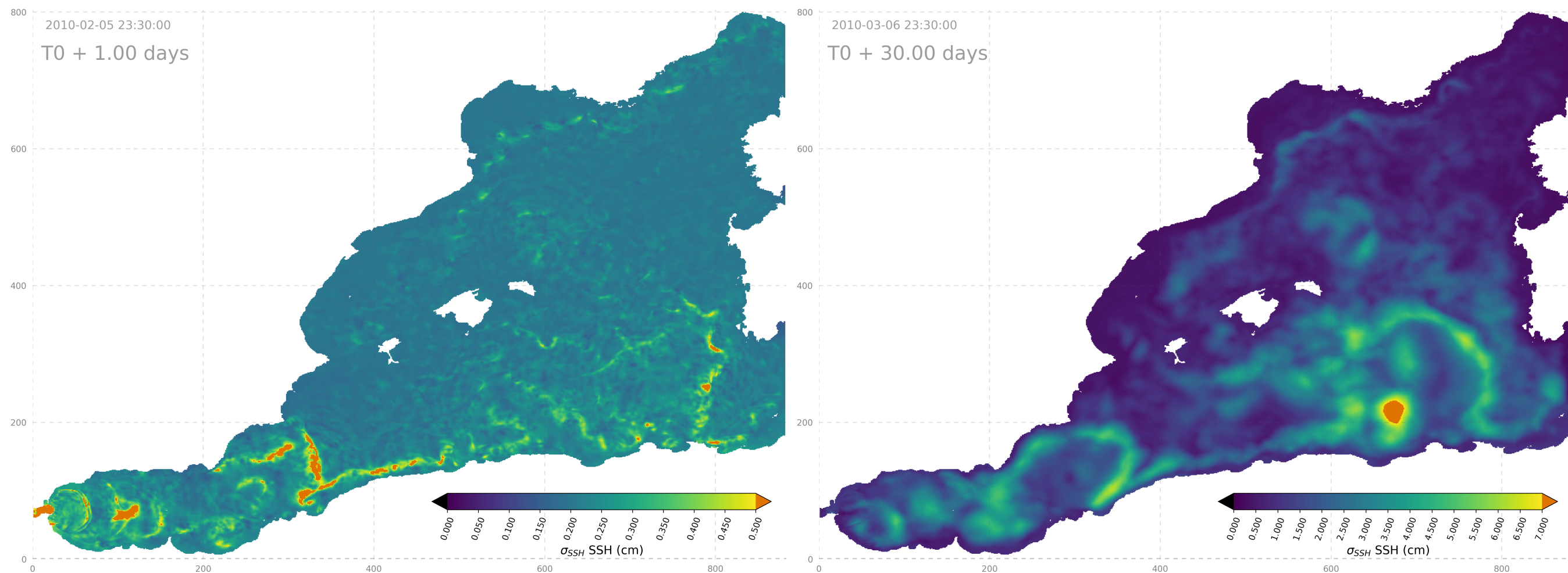
2-D and 3-D outputs were saved at hourly frequency.



5. (Very) preliminary results

This is on-going work, and due to the Covid-19 and quarantine context, we finished just a few days ago to produce the first set of ensemble experiments and we can only show here a few (very!) preliminary diagnostics from those experiments.

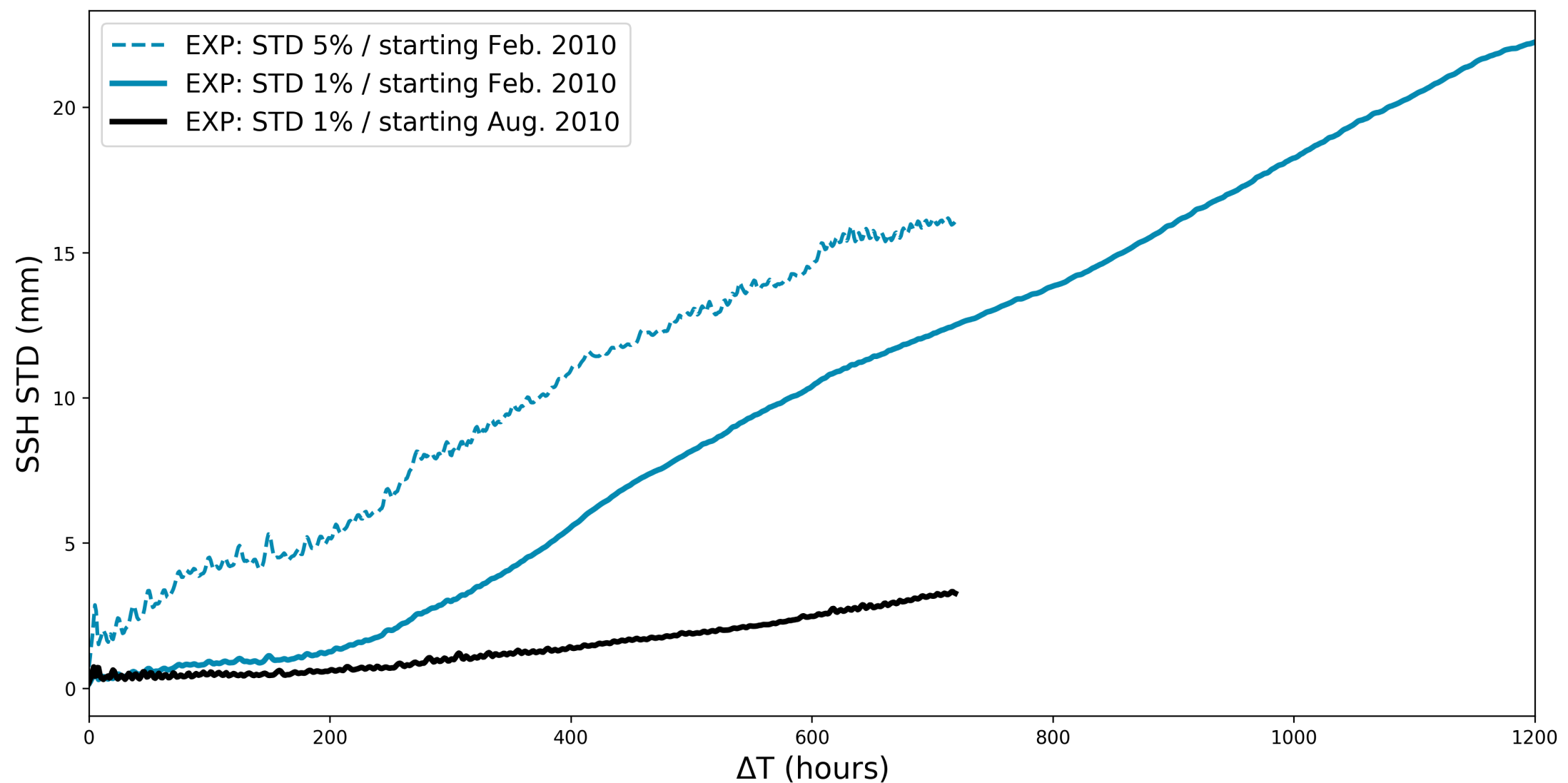
Fig1: Ensemble-STD of the hourly SSH after 1 day (left) and 30 days (right) in the ensemble experiment ENS2 (where e1,e2 stochastically perturbed with a std_sto=5%)



5. (Very) preliminary results

This is on-going work, and due to the Covid-19 and quarantine context, we finished just a few days ago to produce the first set of ensemble experiments and we can only show here a few (very!) preliminary diagnostics from those experiments.

Fig2: Time-evolution of the ensemble-STD of hourly SSH, spatially-averaged over the entire MEDWEST domain from the 3 ensemble experiments where e1,e2 stochastically perturbed with a std_sto of 1%, 5% and starting at 2 different dates (in winter and summer)



5. (Very) preliminary results

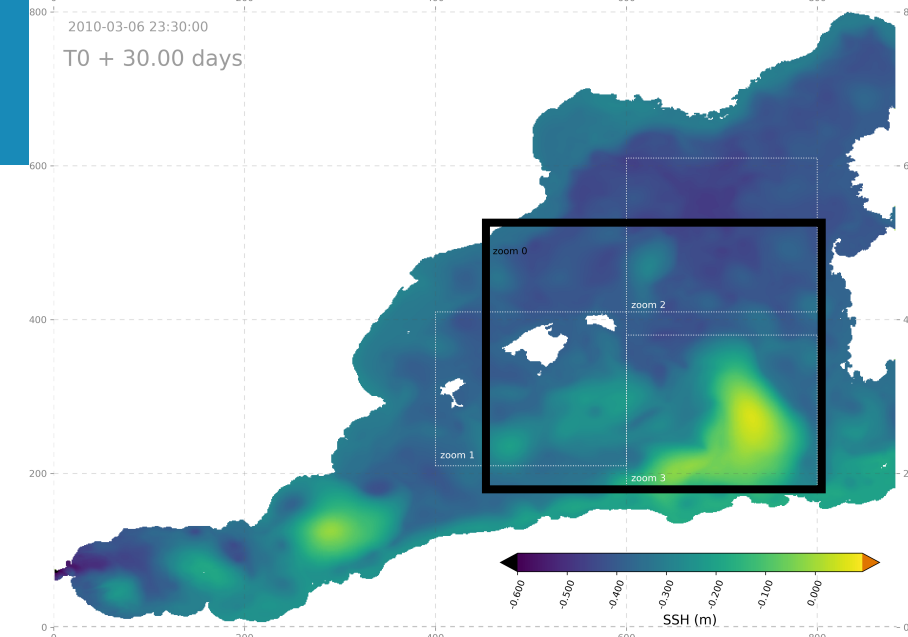
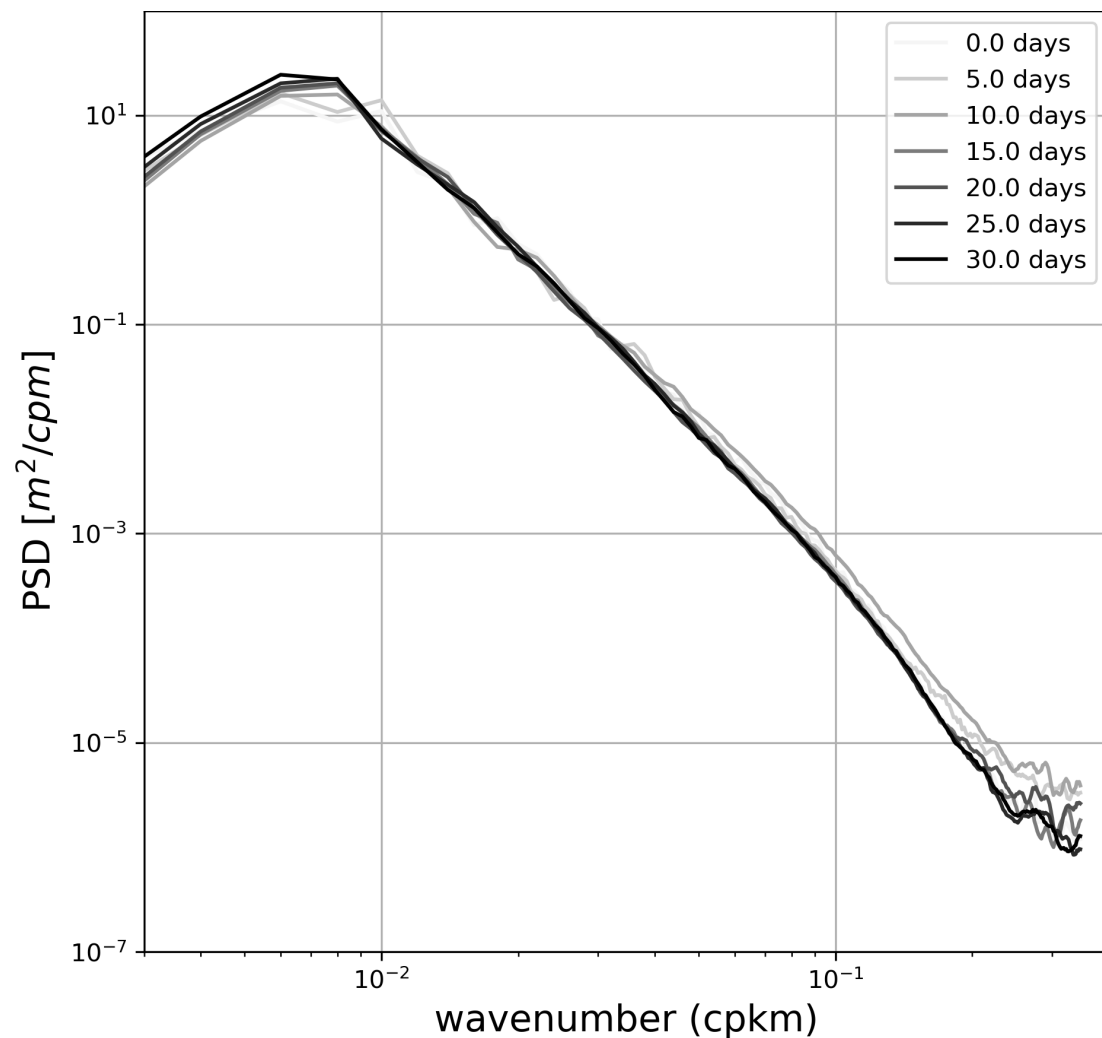
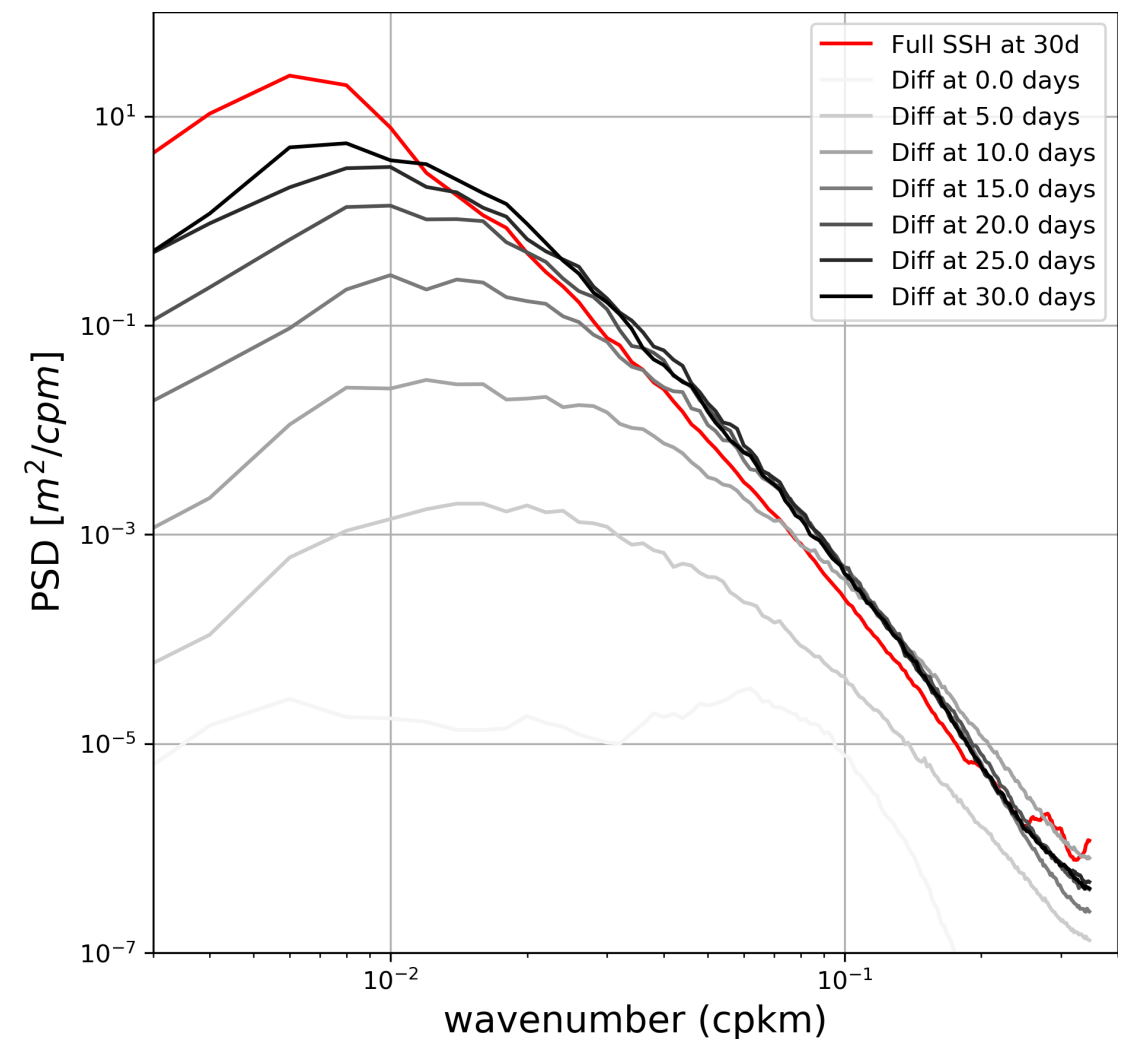


Fig3: Time-evolution of the **spatial Power Spectral Density (PSD)** in a 350x350 grid point subdomain (cf map), averaged over the 20 members in the ensemble experiment ENS1 (e1,e2 sto_std = 1%), for:

(a) the SSH full field



(b) the difference in the SSH field between member #1 and each other member



Questions? Comments?

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