Relative dispersion and relative diffusivities of model-runs in the North Sea

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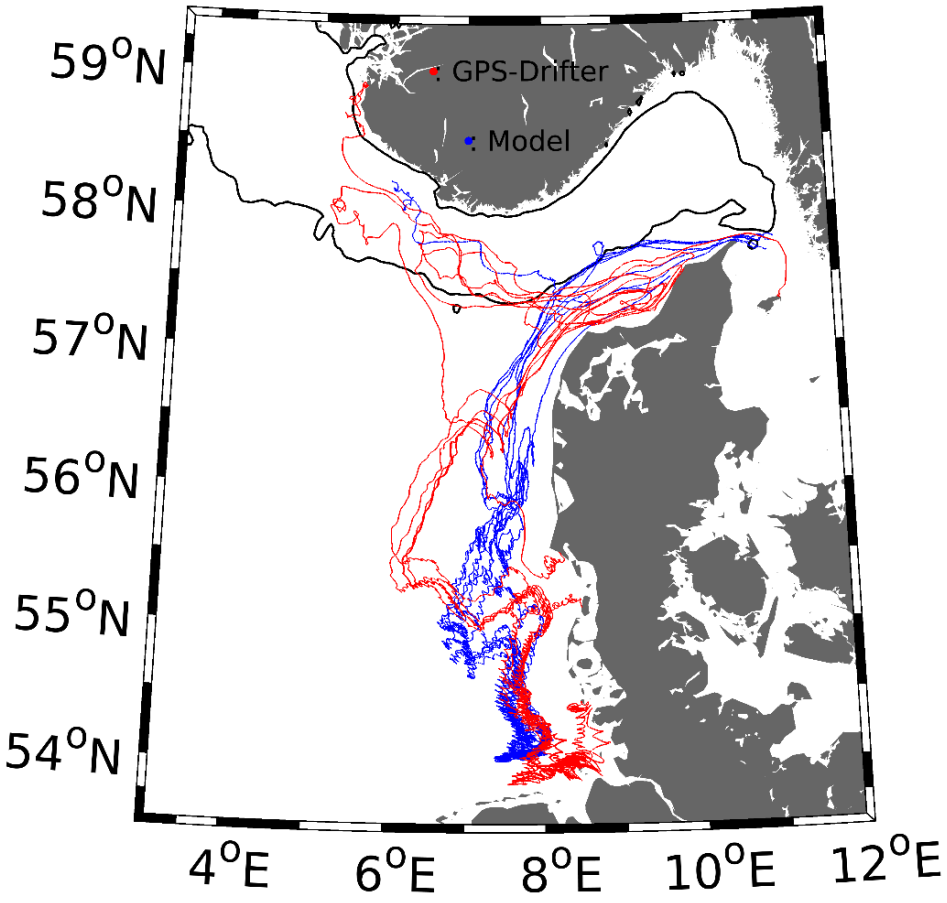
Research area



North Sea - German Bight- Trajectories of the model-runs compare to GPS Drifter observations

Methods

- **GCOAST-NEMO** model setup is the **NEMO** version 3.6 coupled with wave model **WAM**

- **OpenDrift**: open-source offline **Lagrangian model**

Objectives: Investigate relative dispersion and relative diffusivities of model-runs in the North Sea for the period Oct-Dec 2018 and Jan 2019

Relative dispersion

$$D^2 = \frac{1}{N}\sum_{i,j}[x_i(t) - x_j(t)]^2 + [y_i(t) - y_j(t)]^2$$

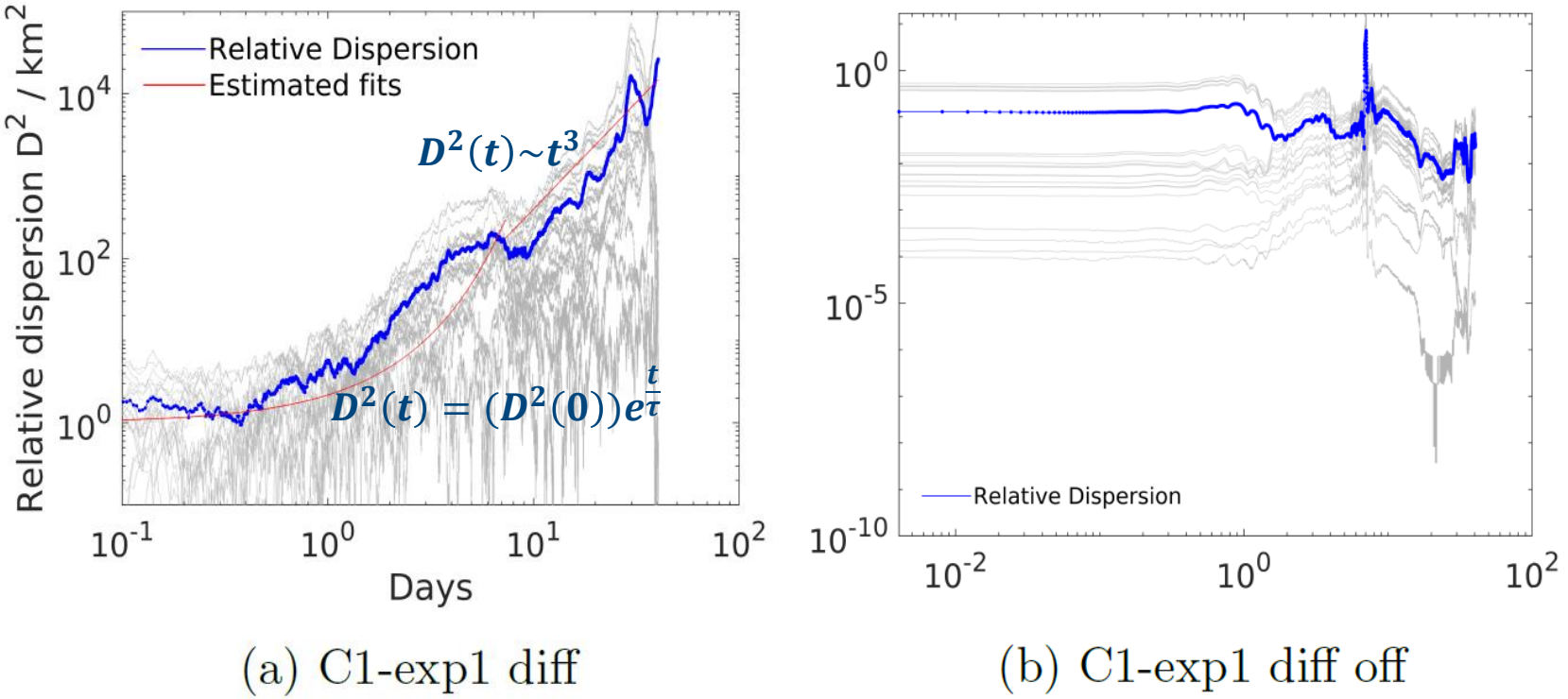
- Mixing of passive tracers in a turbulent flow field
- i and j refer to each model-run of a pair in the cluster of N model-runs pairs
- **Exponential growth**:

$$D^2(t) = (D^2(0))e^{\frac{t}{\tau}}$$

- **The Richardson regime**:

$$D^2(t) \sim t^3$$

- Fig 1b): numerical uncertainties



(a) C1-exp1 diff (b) C1-exp1 diff off

Figure 1

Relative diffusivity

- Rate of change of relative dispersion
- Describes the mixing properties of the flow field as a function of the length scales
- Depends on the pair separation D:

$$\mathbf{K} = \frac{\mathbf{1}\boldsymbol{d}}{\mathbf{4}\boldsymbol{dt}}[\boldsymbol{D}^{\mathbf{2}}(\boldsymbol{t})]$$

- The diffusivity (K) grows according to a $D^{\frac{4}{3}}$ power-law
- Local dispersion regime

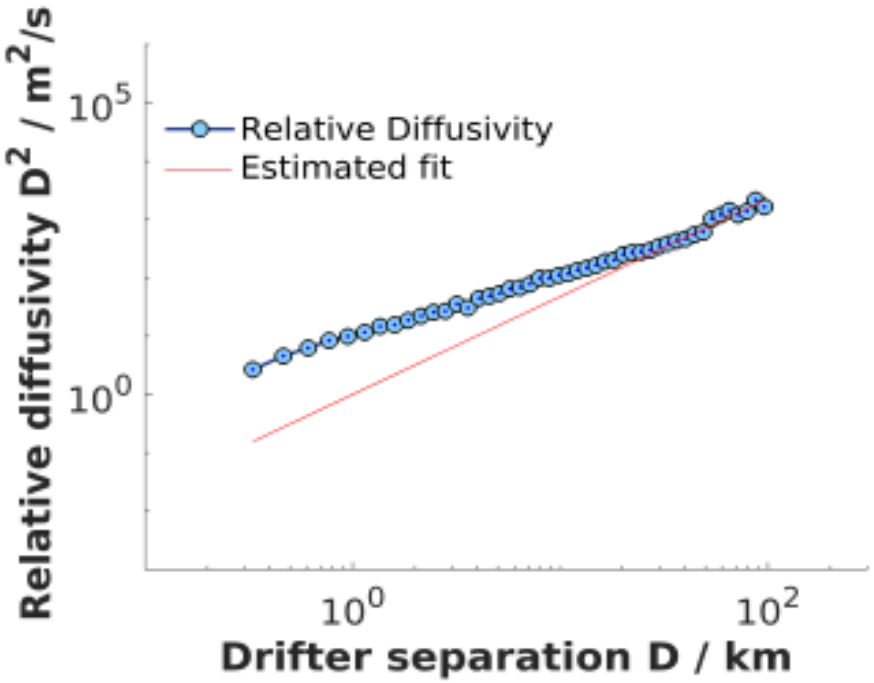


Figure 2: C1-exp1 diff

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Summary

1. The added parameters (i.e, Stokes-Coriolis forcing, Sea state-dependent momentum flux, Sea state-dependent energy flux, and wave-induced mixing) to the ocean model improved the relative dispersion and relative diffusivity
2. The random distribution for the diffusion used in OpenDrift works well and it is likewise needed
3. The results obtained in this study were compared with observations and are in good agreement

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Thank you!

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