frontiers

Supplementary Material

1 STATISTICAL ESTIMATES

The quantitative measure of the consistency of two data sets, theoretical and observational, can be estimated by the correlation coefficient r:

$$r = \frac{\sum_{i=1}^{n}(P_i - \overline{P})\sum_{1}^{n}(O_i - \overline{O})}{\sqrt{\sum_{i=1}^{n}(P_i - \overline{P})^2 \sum_{i=1}^{n}(O_i - \overline{O})^2}}.$$

In our case P is the model predicted displacement of isotherms from their equilibrium depth, O is the observed displacement recorded in-situ. The overbar denotes averaging over n readings.

Another quantitative parameter that can quantify the model performance is the index d of the agreement between observations and model preduictions introduced by Willmott (1981, 1982)

$$d = 1 - \frac{\sum_{i=1}^{n}(P_i - O_i)^2}{\sum_{i=1}^{n}(\left|P_i - \overline{P}\right| + \left|O_i - \overline{O}\right|)^2},$$

This parameters shows a measure to what extent the model output is error free. The coefficient d can vary from 0 (complete disagreement between predicted and observed values) to 1 (perfect coincidence).

2 COMPARISON OF IN-SITU AND MODEL DATA

Figures S1 (stations 32 and 34) and Figure S2 (station 35 and 36) present one-minute model sampling and instant profiles of horizontal velocities at one particular moment of time for comparison with LADCP data in Figure 2 (main text).

3 THE LAGRANGIAN MODEL

The procedure of particle's trajectory calculations was presented in Stashchuk et al. (2018). Here we follow their method. The initial position of every particle was at a some grid point $\vec{x_0}(x_0, y_0, z_0)$. Here the velocity field vector $\vec{U}(u_0, v_0, w_0)$ is known from the model output. In Δt time the particle moves to the position with coordinates $\vec{x}(x, y, z)$

$$\vec{x} = \vec{x}_0 + \vec{U} \cdot \Delta t, \tag{S1}$$

which is inside a grid cell of the model, Figure S3. A new position of the particle does not necessarily coincide with nodal points of the grid, and thus, its velocity $\vec{U}(u, v, w)$ is unknown and calculated using a trilinear interpolation method. All steps of this procedure are presented below:

I A vector $\vec{x_d}(x_d, y_d, z_d)$ is defined:

$$x_d = \frac{x - x_0}{x_1 - x_0}, \quad y_d = \frac{y - y_0}{y_1 - y_0}, \quad z_d = \frac{z - z_0}{z_1 - z_0}. \tag{S2}$$

Here $\vec{\vec{x}}_0$ and $\vec{\vec{x}}_1$ are the coordinates of the grid nodes.

The velocities at the grid corners should be found, Figure S3:

$$
\begin{aligned}
\vec{\vec{U}}_{00} &= \vec{\vec{U}}_{000}(1-x_d) + \vec{\vec{U}}_{100}x_d, \\
\vec{\vec{U}}_{01} &= \vec{\vec{U}}_{001}(1-x_d) + \vec{\vec{U}}_{101}x_d, \\
\vec{\vec{U}}_{10} &= \vec{\vec{U}}_{010}(1-x_d) + \vec{\vec{U}}_{110}x_d, \\
\vec{\vec{U}}_{11} &= \vec{\vec{U}}_{011}(1-x_d) + \vec{\vec{U}}_{111}x_d.
\end{aligned}
\tag{S3}
$$

II The definition of the velocity at the ends of the vertical line that crosses the particle, Figure S3:

$$
\begin{aligned}
\vec{\vec{U}}_{0} &= \vec{\vec{U}}_{00}(1-y_d) + \vec{\vec{U}}_{10}y_d, \\
\vec{\vec{U}}_{1} &= \vec{\vec{U}}_{01}(1-y_d) + \vec{\vec{U}}_{11}y_d.
\end{aligned}
\tag{S4}
$$

III Finally, the calculation of velocity at the position of the particle

$$
\vec{\vec{U}} = (\vec{\vec{U}}_0(1-z_d) - \vec{\vec{U}}_1)z_d. \tag{S5}
$$

Procedure (S2)-(S5) allows calculation of a new position of the particle and its velocity every five minutes using the model output. The described algorithm is repeated again and again until the whole 50 -day particle trajectory is calculated.

REFERENCES

Stashchuk, N., Vlasenko, V., and Howell, K. L. (2018). Modelling tidally induced larval dispersal over Anton Dohrn Seamount. *Ocean Dyn.* 68, 1515–1526. doi:10.1007/s10236-018-1206-0

Willmott (1981). On the validation of models. *Phys. Geogr.* 2, 184–194

Willmott (1982). On the climatic optimization of the tilt and azimuth of flat-plane solar c ollectors. *Solar Energy.* 28, 205–216

3.1 Figures

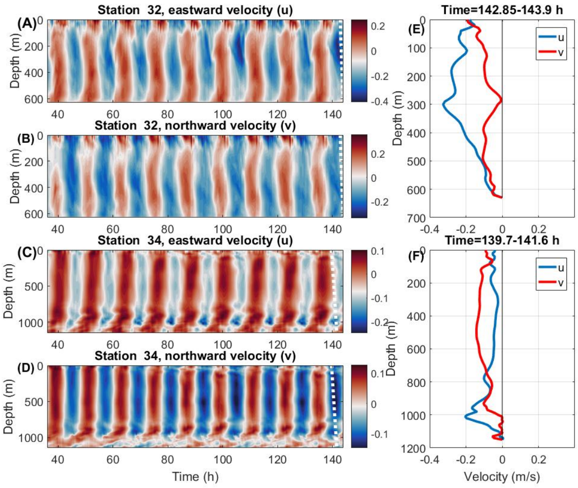

Figure S1. Model predicted time series of the eastward (A), (C) and northward (B), (D) velocities for stations 32 and 34. (E) Vertical profiles of the velocity components for station 32 after 142.9 hours of the model time (shown by the white dashed line in panels (A) and (B)). (F) Vertical profiles of the velocity components for station 34 after 139.7 hours of the model time (shown by the white dashed line in panels (C) and (D)

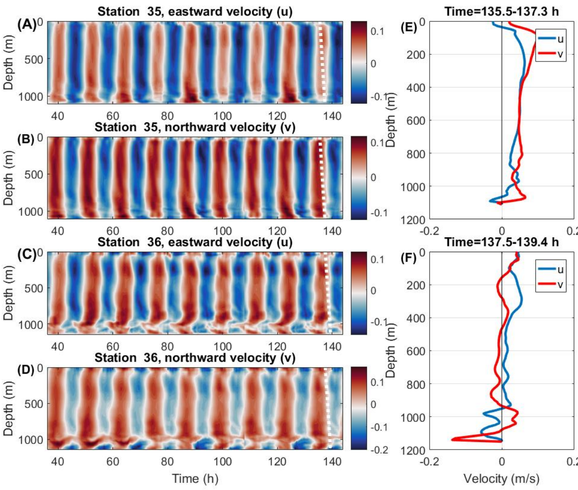

Figure S2. Model predicted time series of the eastward (A), (C) and northward (B), (D) velocities for stations 35 and 36. (E) Vertical profiles of the velocity components for station 35 after 135.5 hours of the model time (shown by the white dashed line in panels (A) and (B)). (F) Vertical profiles of the velocity components for station 36 after 137.5 hours of the model time (shown by the white dashed line in panels (C) and (D)

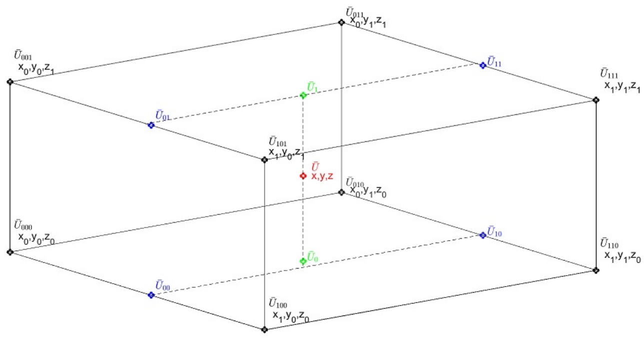

Figure S3. Scheme of trilinear interpolation. From Stashchuk et al. (2018).This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/)