Comparison of drifter observations and model trajectories in the Baltic Sea

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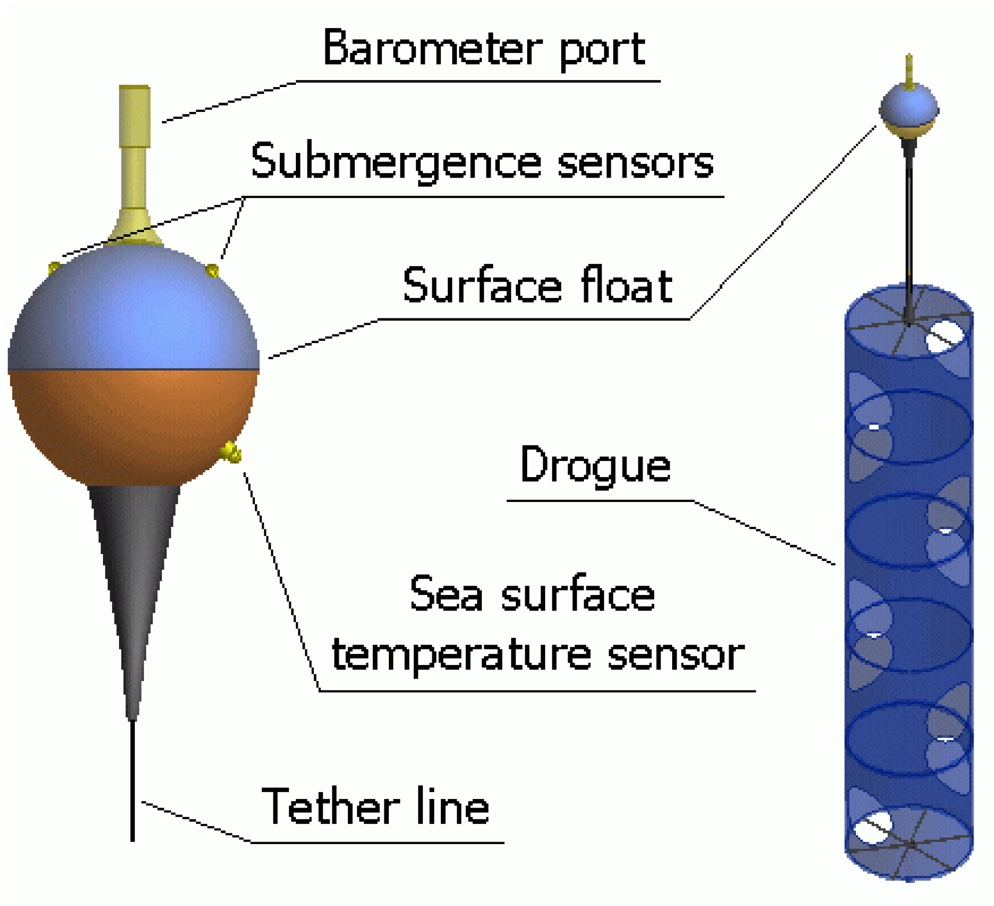

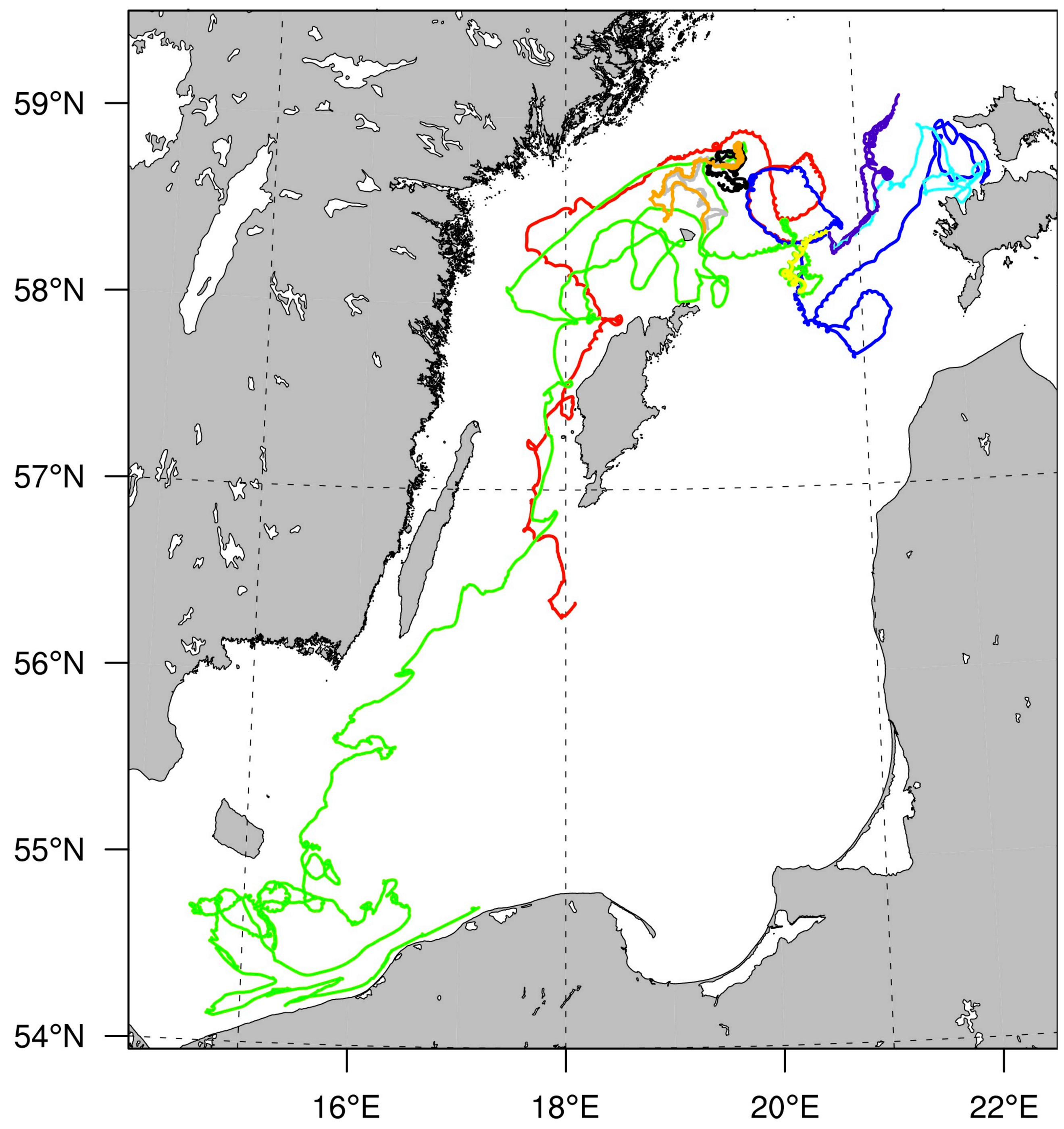

Figure 1: Tracks of the ten surface drifters deployed in the Baltic Sea 2010 and 2011. Filled dots mark every 256 hours. For the theoretical calculations, 36 model trajectories are started from each filled dot each model year.

Pairs and triplets of SVP-B surface drifters have been deployed in the Baltic Sea during the summers of 2010 and 2011. A wide range of Lagrangian statistics have been computed using the positions of the surface drifters. These have been compared to statistics from trajectories simulated using the Lagrangian trajectory code TRACMASS (Döös, 1995; Blanke & Raynaud, 1999) and the RCO model (Meier & Faxén, 2002).

Good agreement is found for Lagrangian properties such as the Lagrangian integral time scale (Rupolo, 2007). Velocity is found to be underestimated by the model, both in strength and variability. Spread is found to be severely underestimated by the model, but also to be very dependent on the initial separation and the grid box size. Döös *et al.* (2011) found that better agreement is obtained when the horizontal resolution of the model is increased.

$$D_A^m(t) \equiv \sqrt{\sum_{i=1}^{2} \left[x_i^m(t) - x_i^m(0)\right]^2},$$

where x_i^m is position of trajectory m and i is dimension.

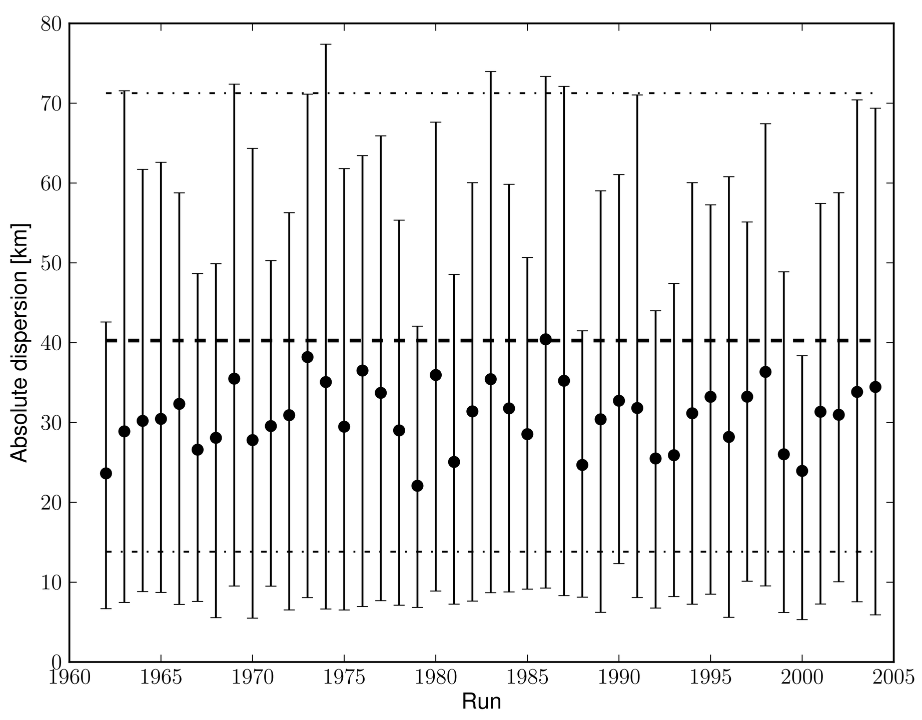

Figure 2: Average absolute dispersion for drifters (horizontal dashed line) and model trajectories for each year. Error bars and dash-dotted lines show 10th and 90th percentiles. The absolute dispersion seems to be underestimated by the model.

$$T_{L,x} = \int_0^\infty R_x(\tau)\, d\tau.$$

where $R_x(\tau)$ is the auto-correlation of the velocity in x-direction.

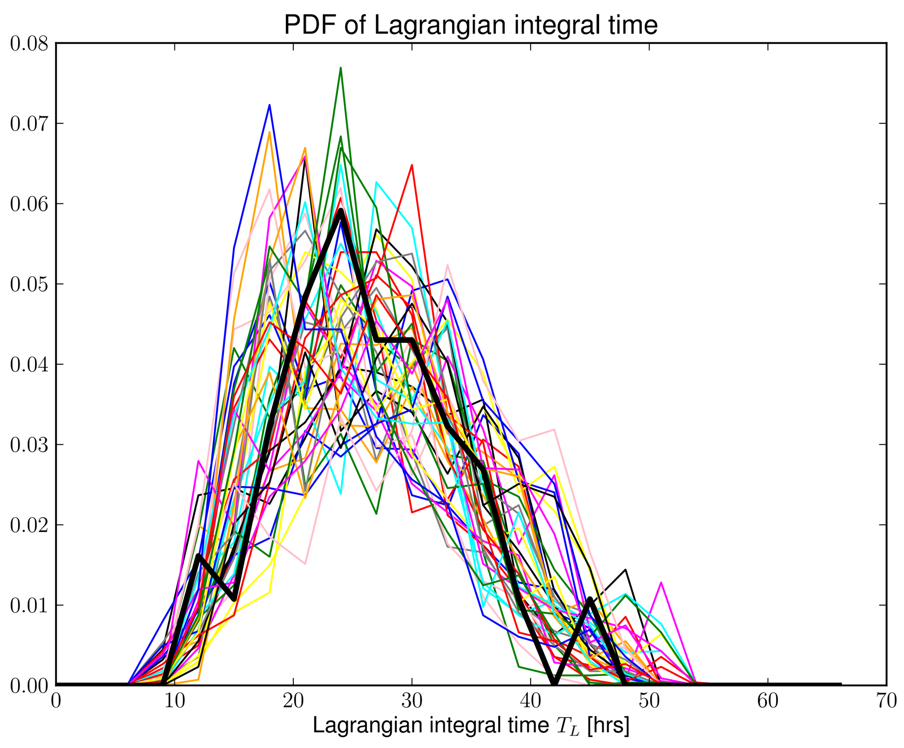

Figure 3: Lagrangian integral time scale calculated for drifters and model trajectories each year. A 14-hour running mean was applied to the drifters in order to filter out inertial oscillations not resolved by the model.

$$D_R^p(t) \equiv \sqrt{\sum_{i=1}^{2} [x_i^q(t) - x_i^r(t)]^2},$$

where x_i^q is the position of the trajectory q in the pair p.

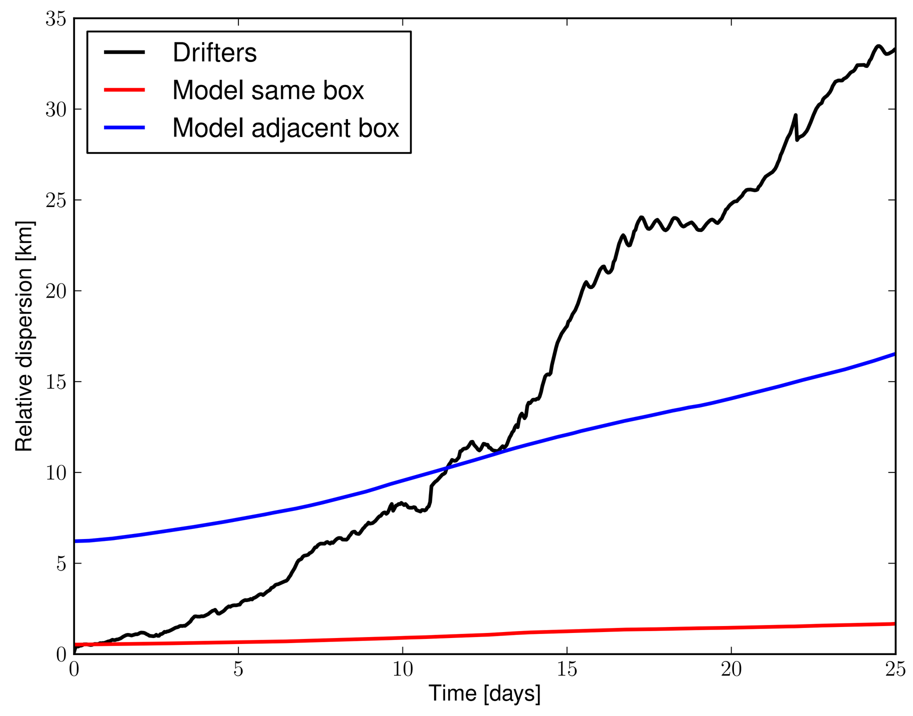

Figure 4: Mean relative dispersion for drifters (black), model-simulated trajectories starting in the same grid box (red) and in adjacent grid boxes (blue). The relative dispersion is underestimated by the model, but also very dependent on the model resolution.

References:

Blanke B. & Raynaud S. 1997. Kinematics of the Pacific Equatorial Undercurrent: An Eulerian and Lagrangian approach from GCM results, *J. Phys. Oceanogr.* 27, 1038–1053

Döös K. 1995. Inter-ocean exchange of water masses. *J. Geophys. Res.* 100 (C7), 13499–13514

Döös K., Rupolo V. & Brodeau, L. 2011. Dispersion of surface drifters and model-simulated trajectories. *Ocean Modelling* 39, 301–310.

Meier H.E.M. & Faxén T. 2002. Performance Analysis of a Multiprocessor Coupled Ice-Ocean Model for the Baltic Sea. *J. Atmosphere and Ocean Tech.* 19., 114–124.

Rupolo V. 2007. A Lagrangian-Based Approach for Determining Trajectories Taxonomy and Turbulence Regimes. *J. Phys. Oceanogr.* 37, 1584–1609.