



Supplement of

Surface horizontal kinetic energy sensitivity to numerical parameters in tidal-resolving North and Equatorial Atlantic simulations

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Section S1 Introduction

This supplementary material contains : Section S2: an additional figure documenting the spatial distribution of trajectory segments for all drifter datasets; Section S3: a table of absolute SKE values integrated across all datasets and frequency bands; and Section S4 : an analysis of the impact of drifter sampling density on the spectral estimates.

5 Section S2 Figure of spatial distribution of trajectory segments for all drifter datasets

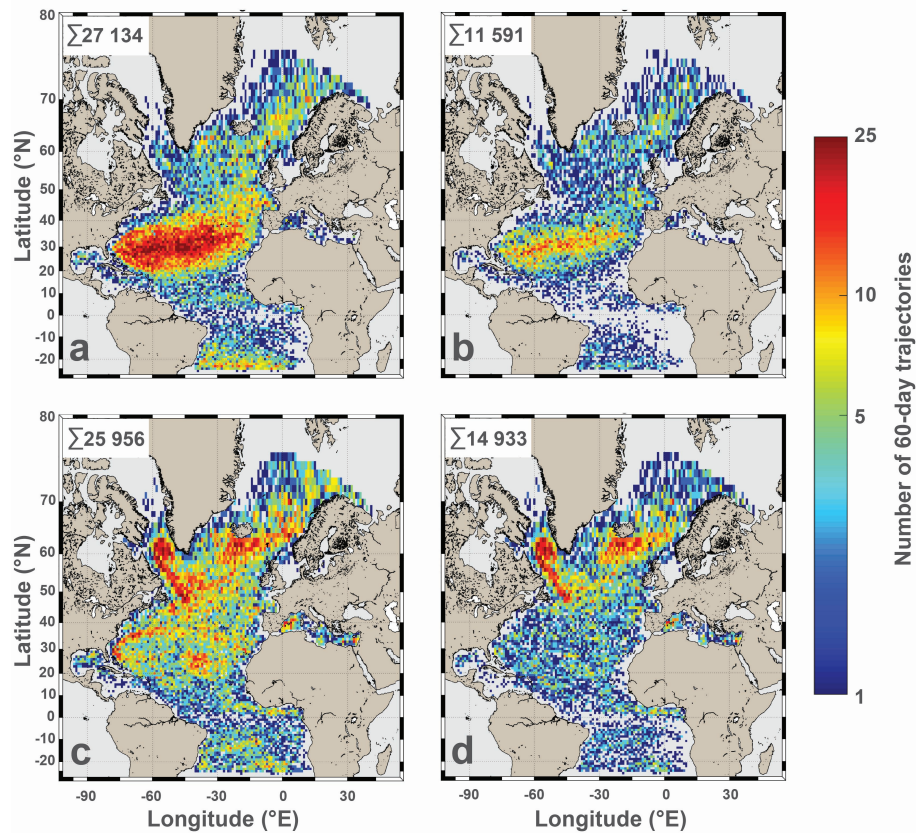


Figure S1. Number of 60-day trajectories in $1^\circ \times 1^\circ$ bin for, respectively, undrogued and drogued surface drifters in top and bottom row. The first column of each correspond to all available drifters and second one for drifters equipped with GPS only. The total number of segments is given in the top left of each panel.

Section S3 Table of absolute SHKE values integrated across all datasets and frequency bands

Table S1. Surface horizontal kinetic energy (SHKE; $10^{-3} m^2 s^{-2}$) averaged over the NEATL domain for the seven HYCOM experiments, the OceanParcels (OP) experiments, and surface drifters. Two datasets are considered, one that includes GPS-tracked drifters only and one with all drifters (both Argos and GPS positioning systems). Presented below are the total SHKE, and SHKE integrated over low-frequency (> -0.5 cpd and < 0.5 cpd); diurnal frequency ($\pm[0.9, 1.1]$ cpd); semidiurnal frequency ($\pm[1.9, 2.1]$ cpd); and near-inertial frequency ($\pm[0.9, 1.1]f$ cpd poleward of $\pm 5^\circ$ latitude). Each cell shows SHKEd/SHKEs where SHKEd and SHKEs represent SHKE values computed in waters deeper and shallower than $500 m$, respectively. SHKEs are not provided for Lagrangian fields (i.e., OP and drifters) due to the low density of observations in these regions (Figure 1 in the main text and Figure S1).

Experiment	Total	Low freq	Diurnal	Semidiurnal	Near-Inertial
NEATL12-T	96.8/134.1	88.8/61.2	1.3/2.0	1.8/64.4	5.9/27.2
NEATL12-M ₂	98.1/126.3	90.7/61.5	1.1/0.6	1.6/60.1	5.8/25.5
NEATL12-T-HVR	107.0/151.1	98.4/69.1	1.4/2.1	1.9/72.4	6.4/27.7
NEATL50-T	127.2/144.5	117.3/71.8	1.3/2.2	2.6/62.7	5.3/26.0
NEATL50-T-WD	124.8/140.8	116.4/70.9	1.2/2.1	1.9/60.3	5.1/25.2
NEATL50-T-HB	118.0/136.3	107.9/61.3	1.3/2.0	3.0/65.5	5.3/25.2
NEATL50-T-HB-HF	125.1/143.0	108.5/64.1	3.0/3.2	3.2/65.2	9.5/27.6
OP Seed $1/2^\circ$	122.6/—	107.7/—	3.1/—	2.1/—	9.3/—
OP Seed drifters	122.7/—	102.1/—	3.3/—	2.1/—	9.9/—
Undrogued drifters	137.8/—	103.7/—	2.8/—	1.7/—	8.1/—
Undrogued drifters GPS	146.3/—	94.1/—	3.1/—	1.8/—	8.4/—
Drogued drifters	99.8/—	77.8/—	1.9/—	1.7/—	6.8/—
Drogued drifters GPS	101.7/—	74.5/—	1.8/—	1.9/—	7.3/—

Section S4 Impact of drifter sampling

In Section 4 of the main manuscript, OP Seed Drifters is compared to undrogued drifters to minimize sampling biases. Here, we quantify the impact of sampling density by comparing OP Seed $1/2^\circ$ (244,632 offshore segments out of 264,361 in total, uniformly seeded on a $1/2^\circ \times 1/2^\circ$ grid) to OP Seed Drifters (23,579 offshore segments out of 24,302 in total, matching the observed drifter distribution), a factor of approximately 10 difference in the number of segments.

The comparison of the zonally averaged PSD between OP Seed $1/2^\circ$ and OP Seed Drifters (Figure ??a-c) reveals no distinct spectral differences, apart from a frequency-independent positive bias in energy for the uniformly seeded experiment. The exception is around $30^\circ N$, where both experiments show nearly equal energies (ratio near 0.5), consistent with the high concentration of undrogued surface drifters in the North Atlantic Gyre at that latitude (Figure S1). Quantitatively, as shown in Table 2 in the main manuscript and Table S1, sampling density has a small impact on total, semidiurnal and diurnal SHKE averaged over the domain, though a slightly larger effect is found in the near-inertial and high-frequency reservoirs. Regionally (Figure S2d-o), no systematic spatial pattern emerges, with the notable exception of the North Atlantic Gyre where the denser sampling yields nearly equal energies. Overall, the differences remain small and spatially incoherent, suggesting that the sampling distribution of undrogued drifters provides a sufficient representation of the domain-averaged SHKE.

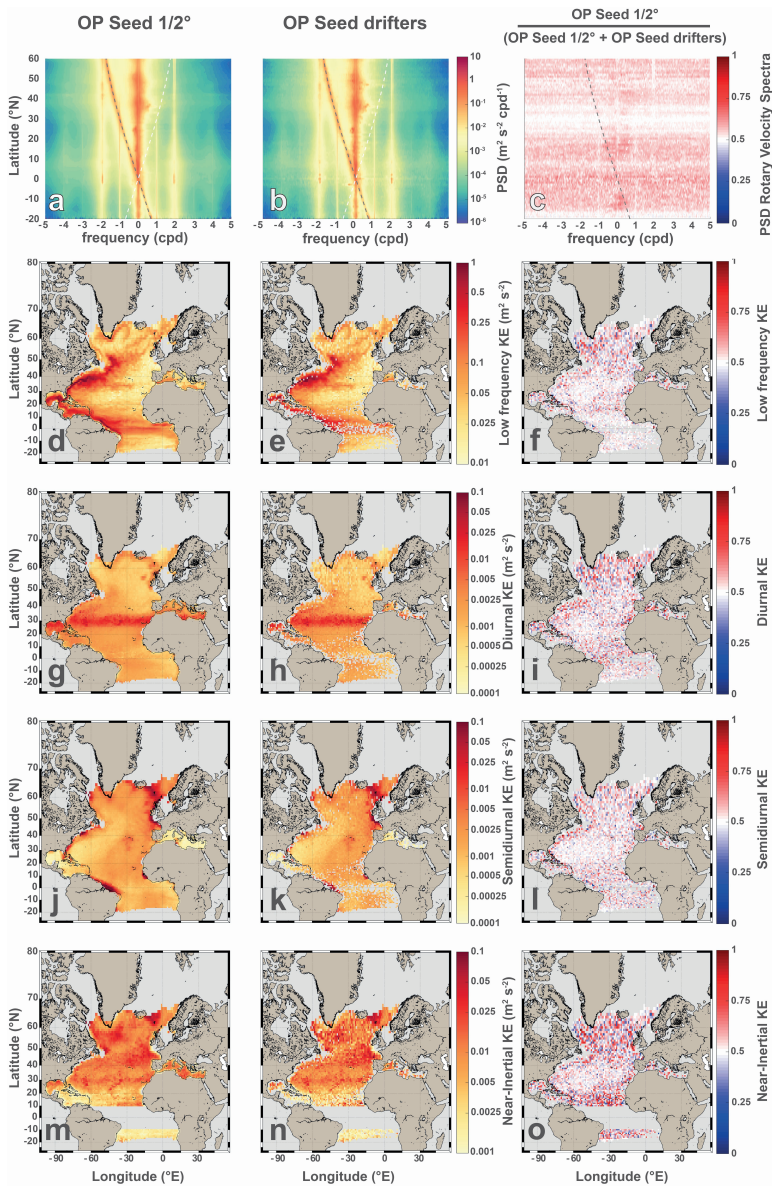


Figure S2. Comparison of OP Seed $1/2^\circ$ (first column) and OP Seed Drifters (second column), with a normalized ratio obtained by dividing the first column by the sum of the first and second columns (third column); a ratio of $1/2$ indicates equal energies. The first row (a to c) shows the zonally averaged rotary spectra in 1° latitude bins computed over the offshore domain (waters deeper than 500 m) in the NEATL domain; note the decimal logarithmic color scale for panels a and b. The subsequent rows show maps of surface horizontal kinetic energy (SHKE) components over the NEATL domain: low-frequency (> -0.5 cpd and < 0.5 cpd; second row, d to f); diurnal ($\pm[0.9, 1.1]$ cpd; third row, g to i); semidiurnal ($\pm[1.9, 2.1]$ cpd; fourth row, j to l); and near-inertial ($\pm[0.9, 1.1]f$ cpd out of the band of latitude $\pm 5^\circ$ around the equator; fifth row, m to o). Note the decimal logarithmic color scale for all map panels.