# Supporting Information 1 for "The interplay between animal location accuracy and the decorrelation length scale of environmental variables when investigating environmental selection in marine organisms"

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## A Supplementary figures

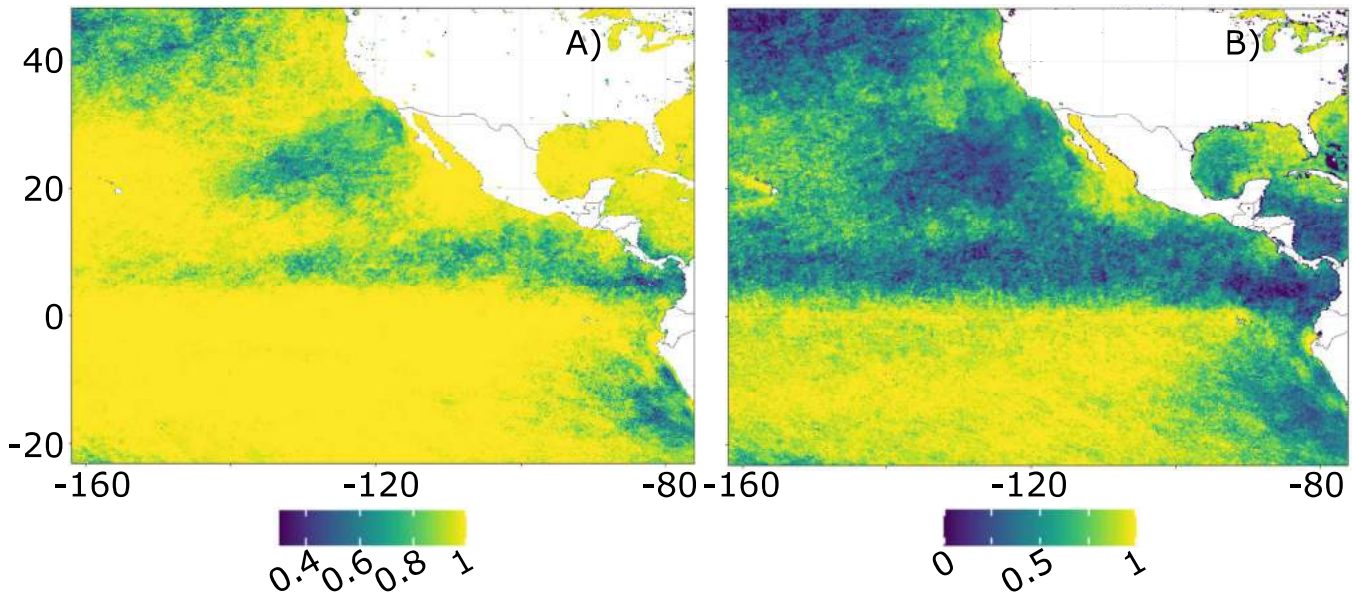


Figure S1: Fraction of the 80-day period with data for SST (A) and chlorophyll-a concentration (B) after 8-day averaging. As FTLE is a model output, the data coverage is perfect and thus not plotted here.

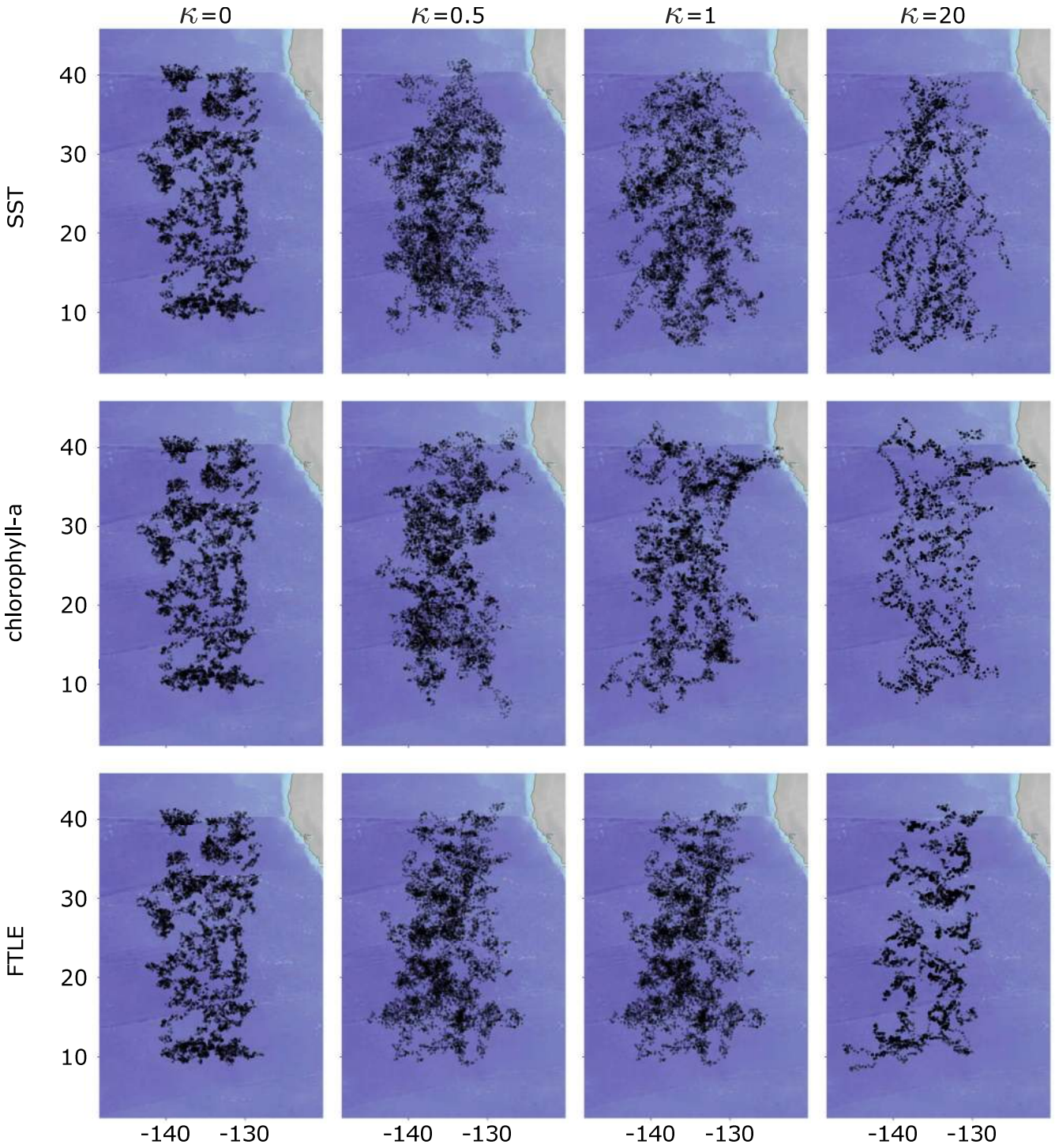


Figure S2: Synthetic tracks of animals selecting for different environmental variables (rows) and with different selection strengths (columns). There are 100 different 80-day tracks per panel. As the case $\kappa = 0$ corresponds to no environmental selection, the same set of tracks was used for all three environmental variables.

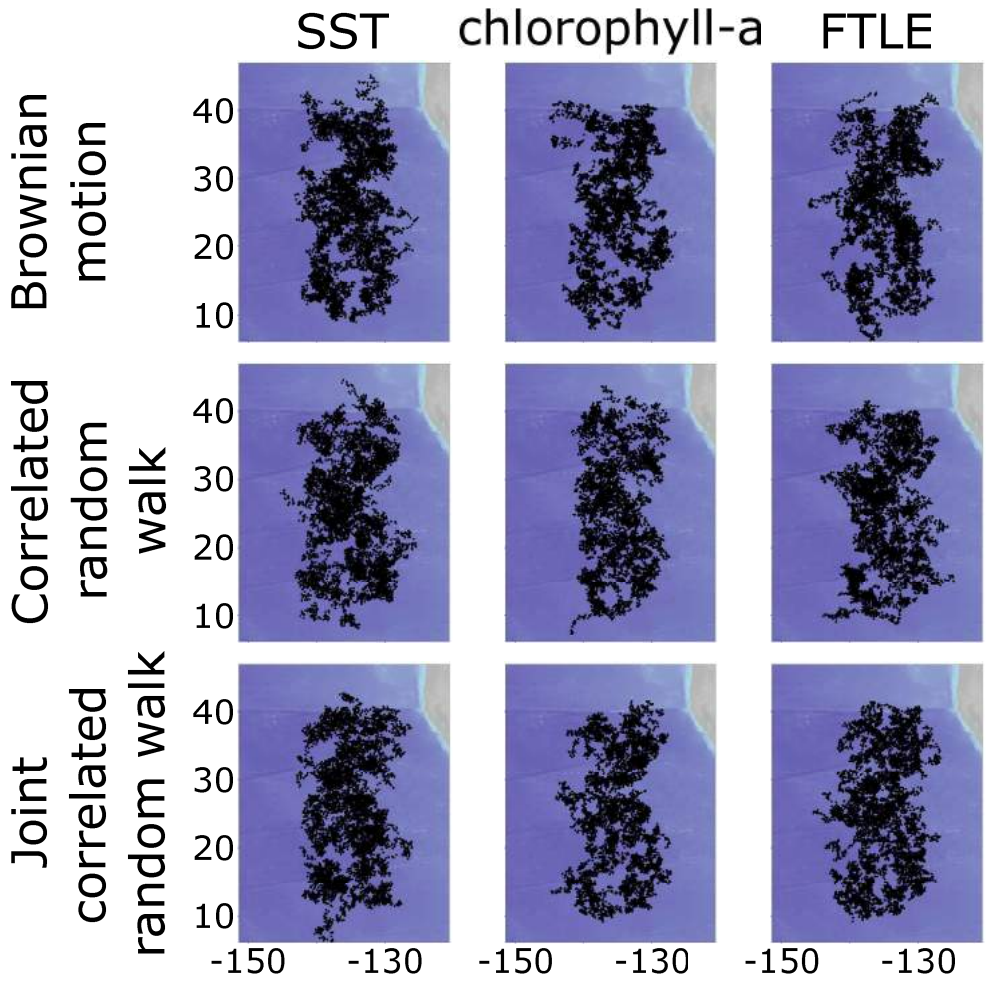


Figure S3: Pseudo-absence tracks for all three null models, based on the synthetic tracks for each of the three different environmental variables selected, with selection strength $\kappa = 1$. Pseudo-absence tracks based on tracks with different selection strengths are qualitatively similar and thus not pictured here.

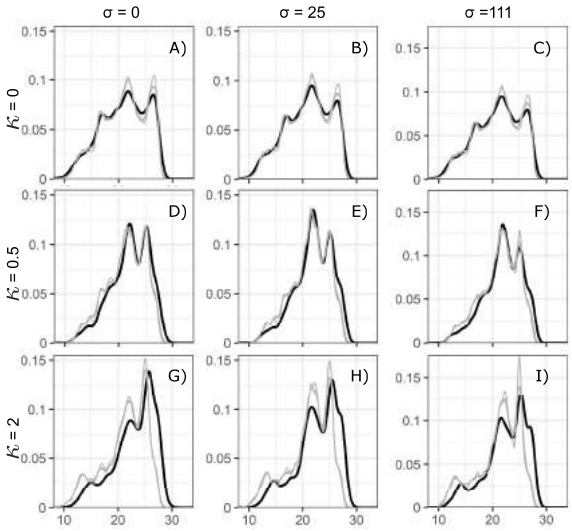


Figure S4: Density distribution of SST (in $°C$) at synthetic presence (black) and pseudo-absence (grey) points, for presence tracks not biased towards high SST (A, B, C), weakly biased towards high SST (D, E, F), and for presence tracks moderately biased towards high SST (G, H, I). The first column (A, D, G) corresponds to locations known with perfect accuracy, the second column (B, E, H) to locations known with moderate accuracy (standard error of 25 km), and the third column (C, F, I) to locations known with weak accuracy (standard error of 111 km). Note the different vertical axes of the third column.

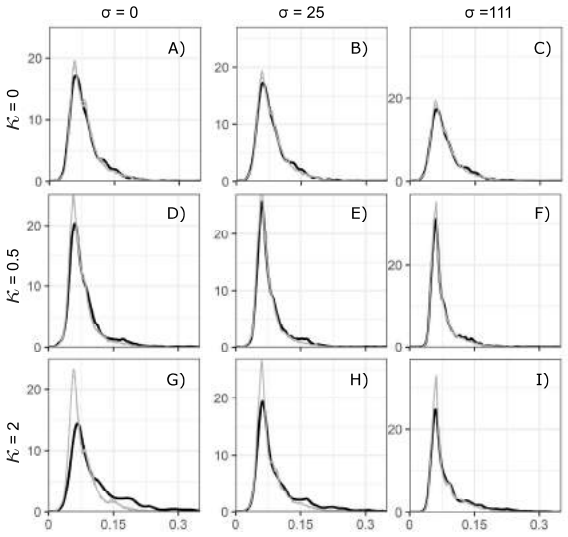


Figure S5: Density distribution of chlorophyll-a concentration (in $mg\ m^{-3}$) at synthetic presence (black) and pseudo-absence (grey) points, for presence tracks not biased towards high chlorophyll-a (A, B, C), weakly biased towards high chlorophyll-a (D, E, F), and for presence tracks moderately biased towards high chlorophyll-a (G, H, I). The first column (A, D, G) corresponds to locations known with perfect accuracy, the second column (B, E, H) to locations known with moderate accuracy (standard error of 25 km), and the third column (C, F, I) to locations known with weak accuracy (standard error of 111 km). Note the different vertical axes of the three columns.

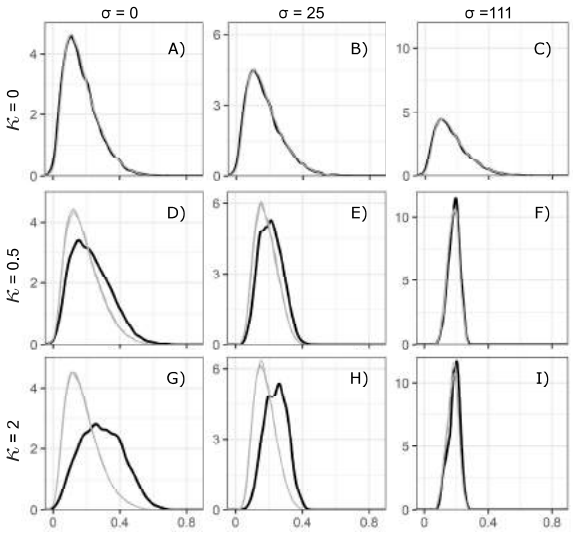


Figure S6: Density distribution of FTLE (in $day^{-1}$) at synthetic presence (black) and pseudo-absence (grey) points, for presence tracks not biased towards high FTLE (A, B, C), weakly biased towards high FTLE (D, E, F), and for presence tracks moderately biased towards high FTLE (G, H, I). The first column (A, D, G) corresponds to locations known with perfect accuracy, the second column (B, E, H) to locations known with moderate accuracy (standard error of 25 km), and the third column (C, F, I) to locations known with weak accuracy (standard error of 111 km). Note the different vertical axes of the three columns.

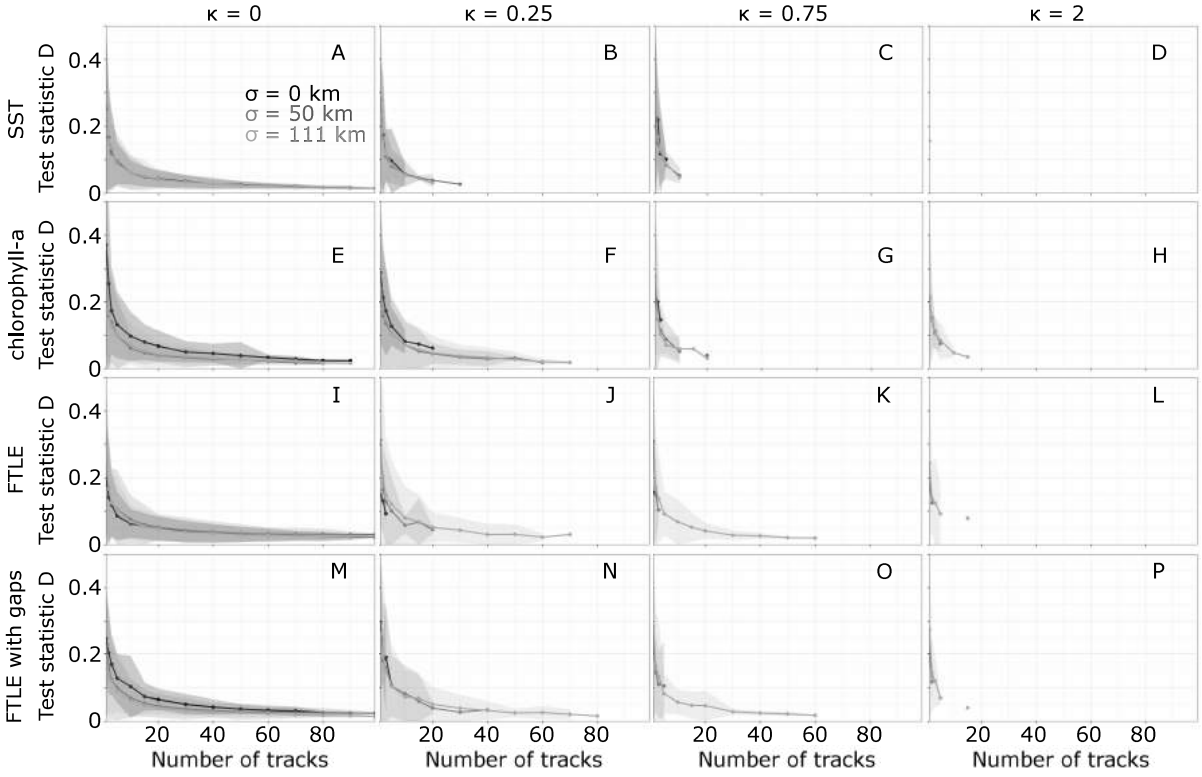


Figure S7: Test statistic $D$ for selection for lower values of SST (A, B, C, D), chlorophyll-a (E, F, G, H), FTLE (I, J, K, L), and FTLE with the same data gaps as chlorophyll-a (M, N, O, P) at different selection strengths (in columns) and for three different accuracies of geolocation estimates (shades of grey). Only test statistics from tests with $p < 0.05$ are included. Shaded areas around each line indicate the bootstrapped 95% confidence intervals.

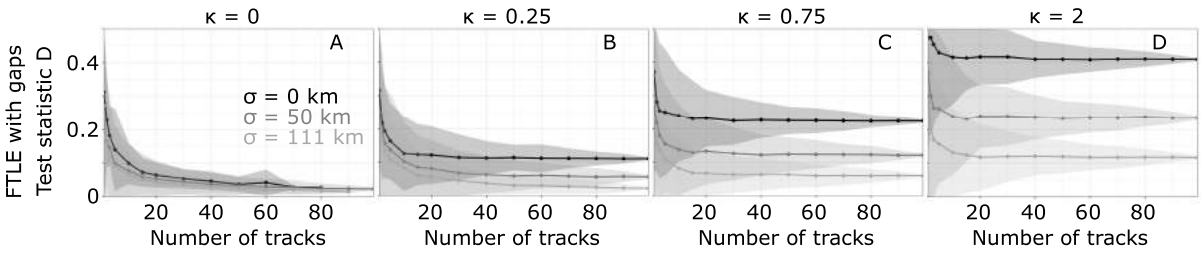


Figure S8: Test statistic $D$ for selection for higher values of FTLE with the same data gaps as chlorophyll-a (A, B, C, D) at different selection strengths (in columns) and for three different accuracies of geolocation estimates (shades of grey). Only test statistics from tests with $p < 0.05$ are included. Shaded areas around each line indicate the bootstrapped 95% confidence intervals.

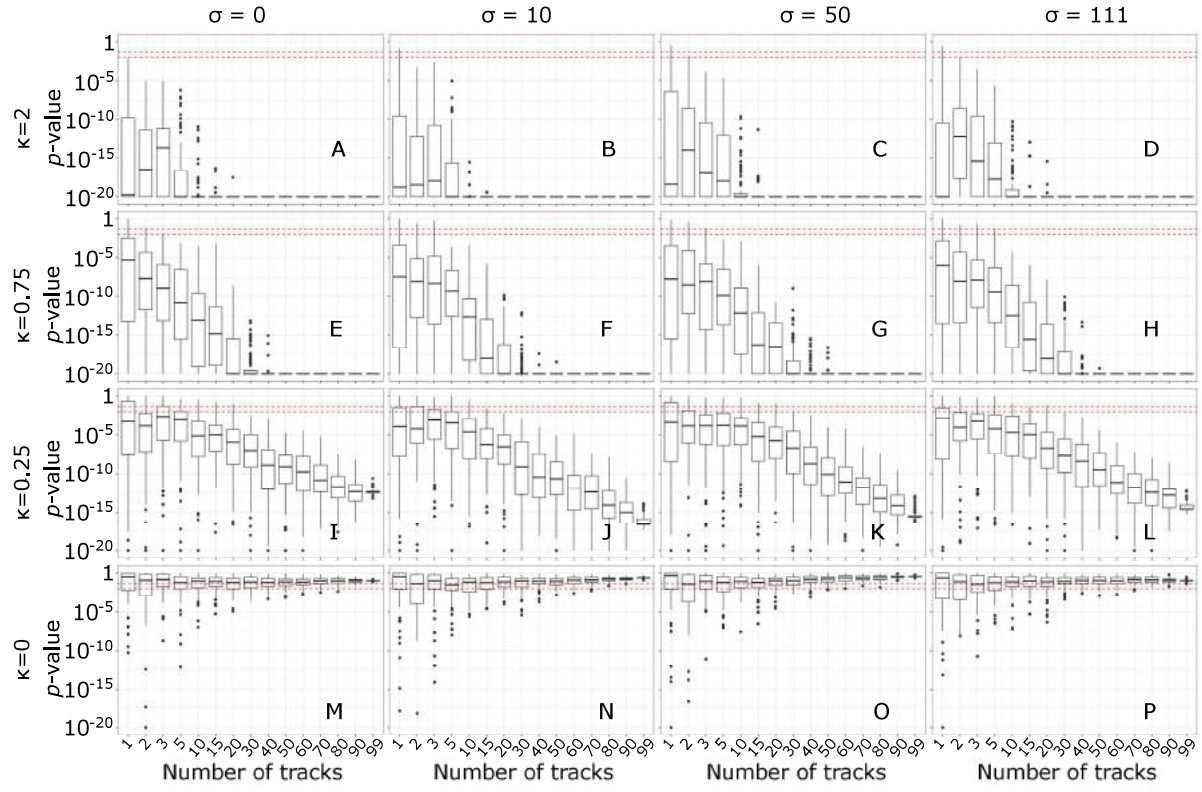


Figure S9: Box plots of the distribution of $p$-values of tests testing selection for higher values of SST as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

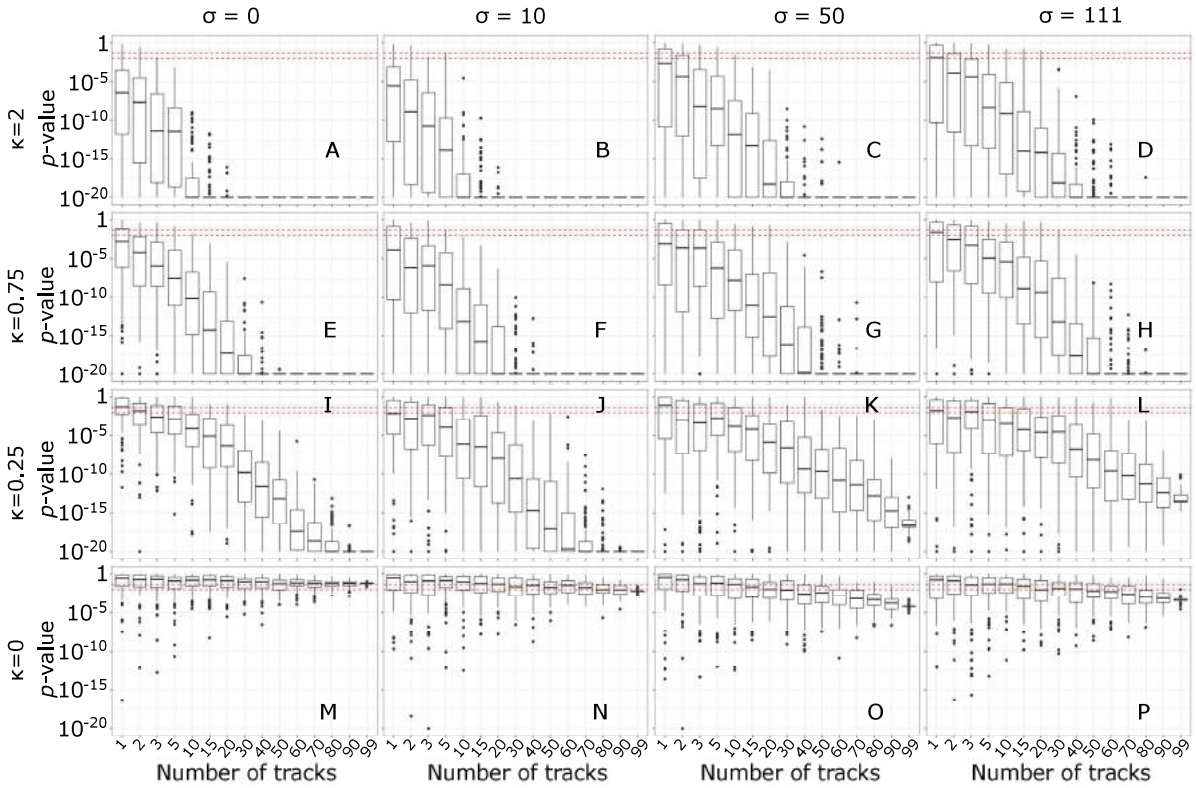


Figure S10: Box plots of the distribution of $p$-values of tests testing selection for higher values of chlorophyll-a concentration as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

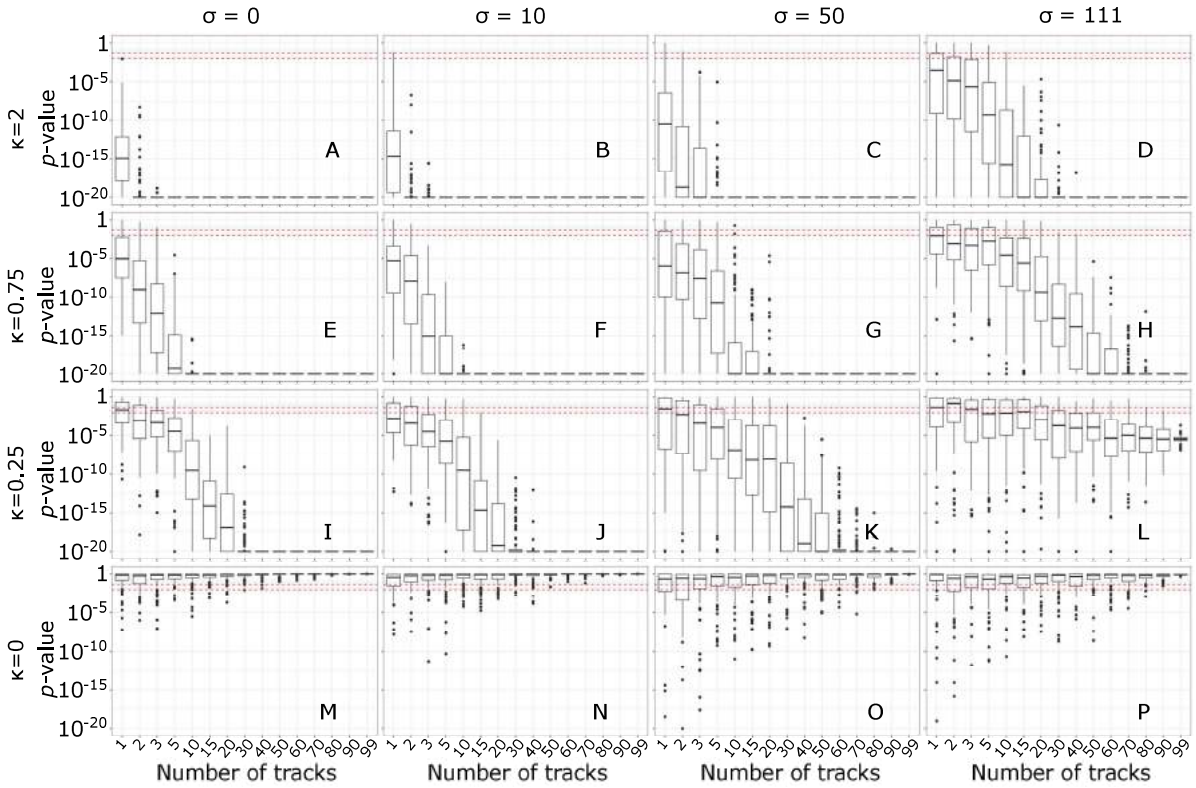


Figure S11: Box plots of the distribution of $p$-values of tests testing selection for higher values of FTLE as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

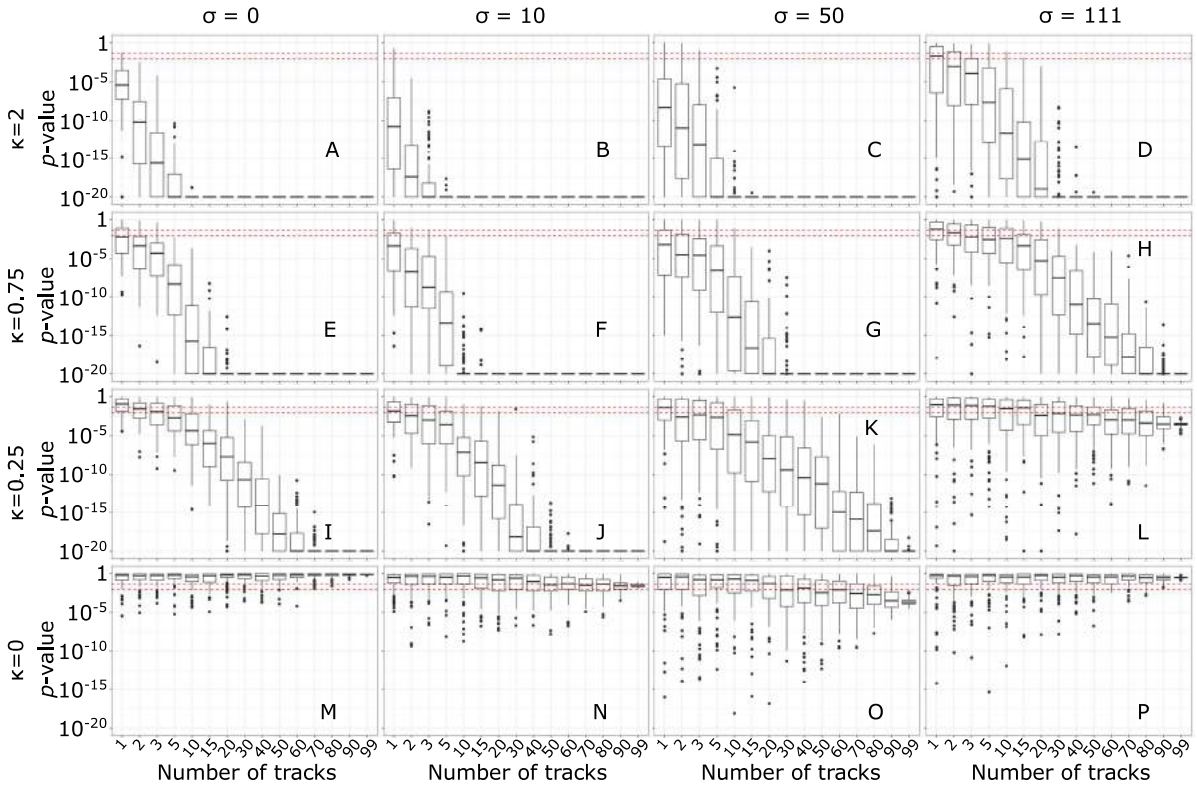


Figure S12: Box plots of the distribution of $p$-values of tests testing selection for higher values of FTLE (with the same data gaps as chlorophyll-a) as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

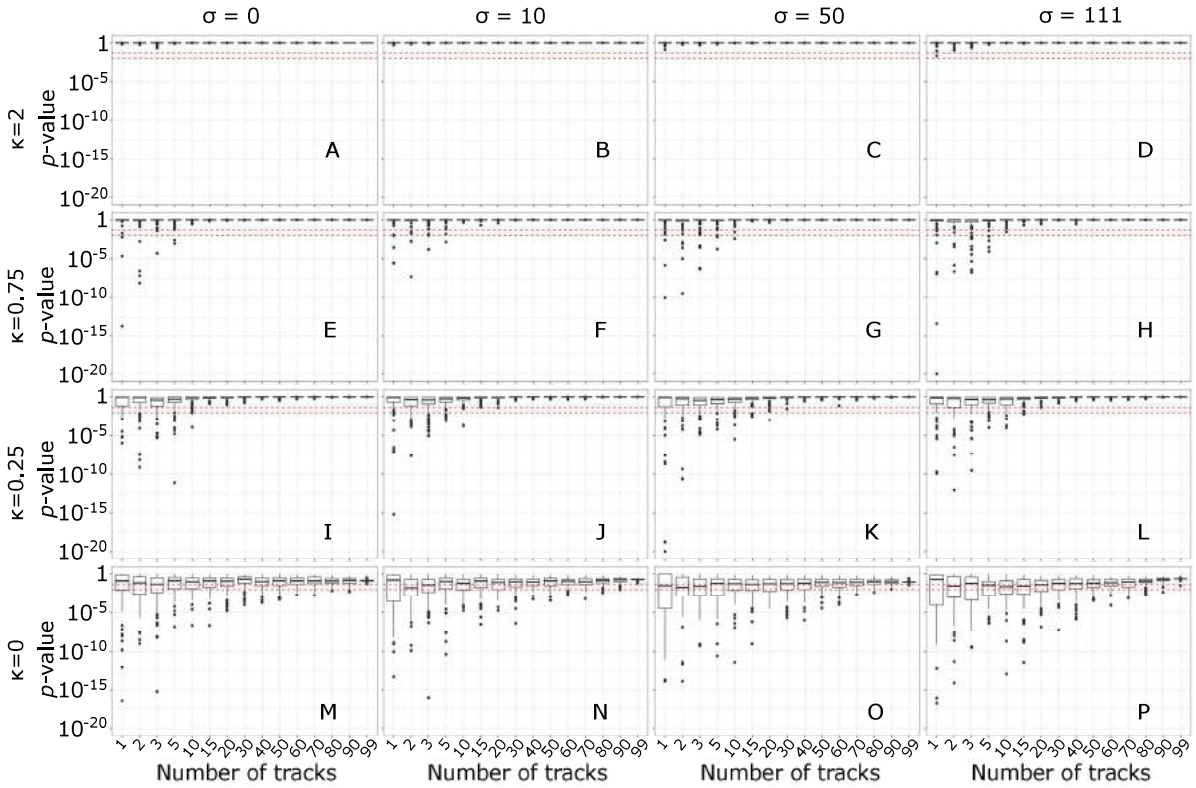


Figure S13: Box plots of the distribution of $p$-values of tests testing selection for lower values of SST as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

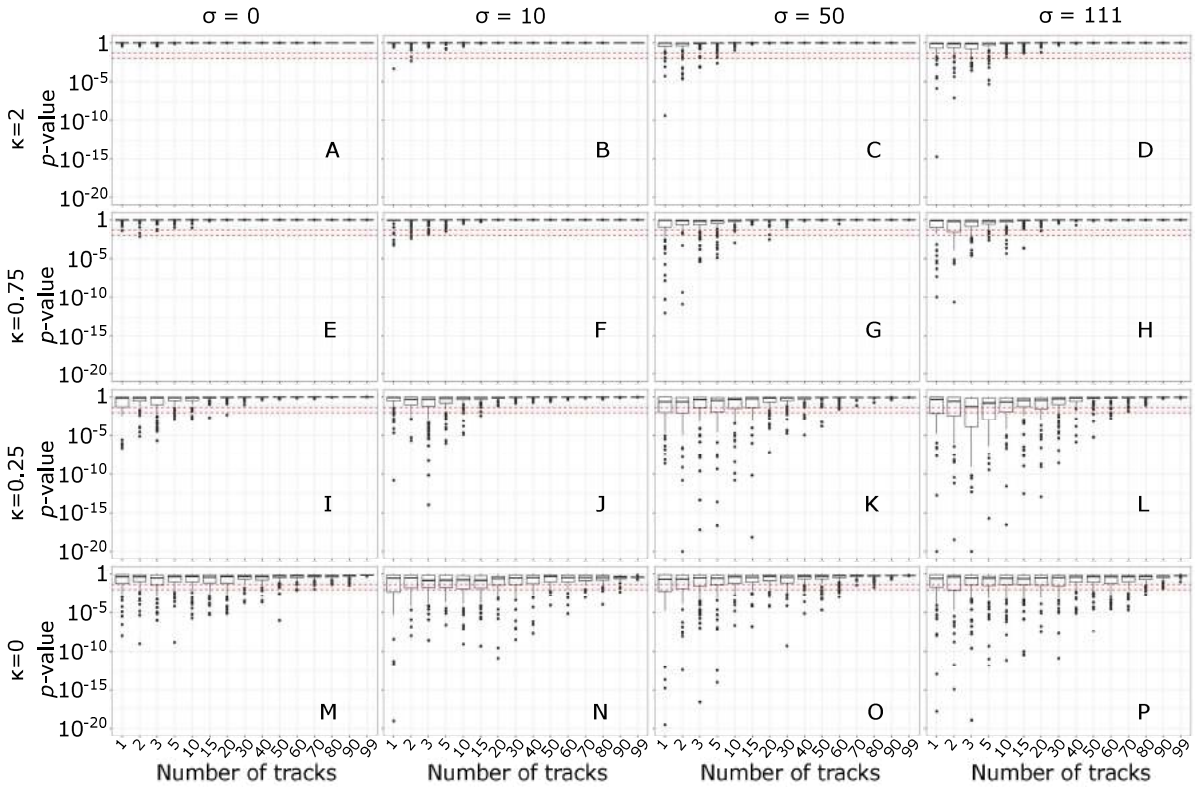


Figure S14: Box plots of the distribution of $p$-values of tests testing selection for lower values of chlorophyll-a concentration as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

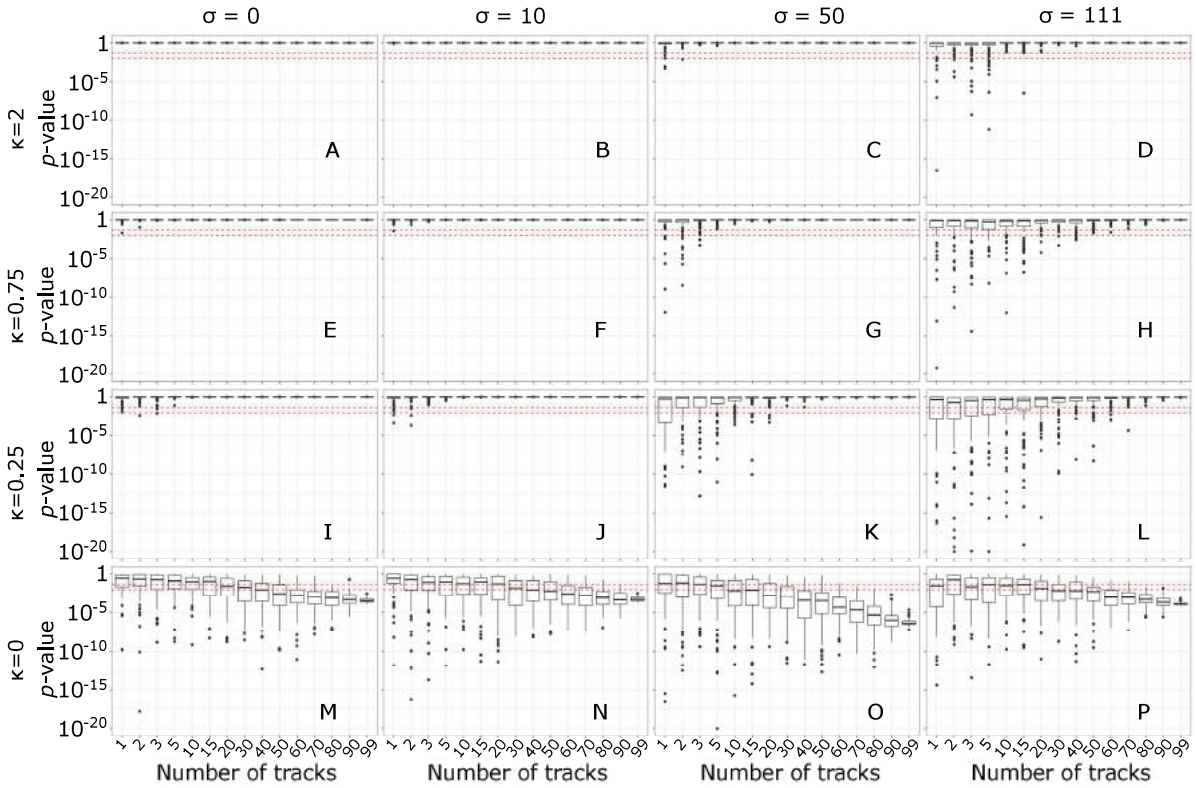


Figure S15: Box plots of the distribution of $p$-values of tests testing selection for lower values of FTLE as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

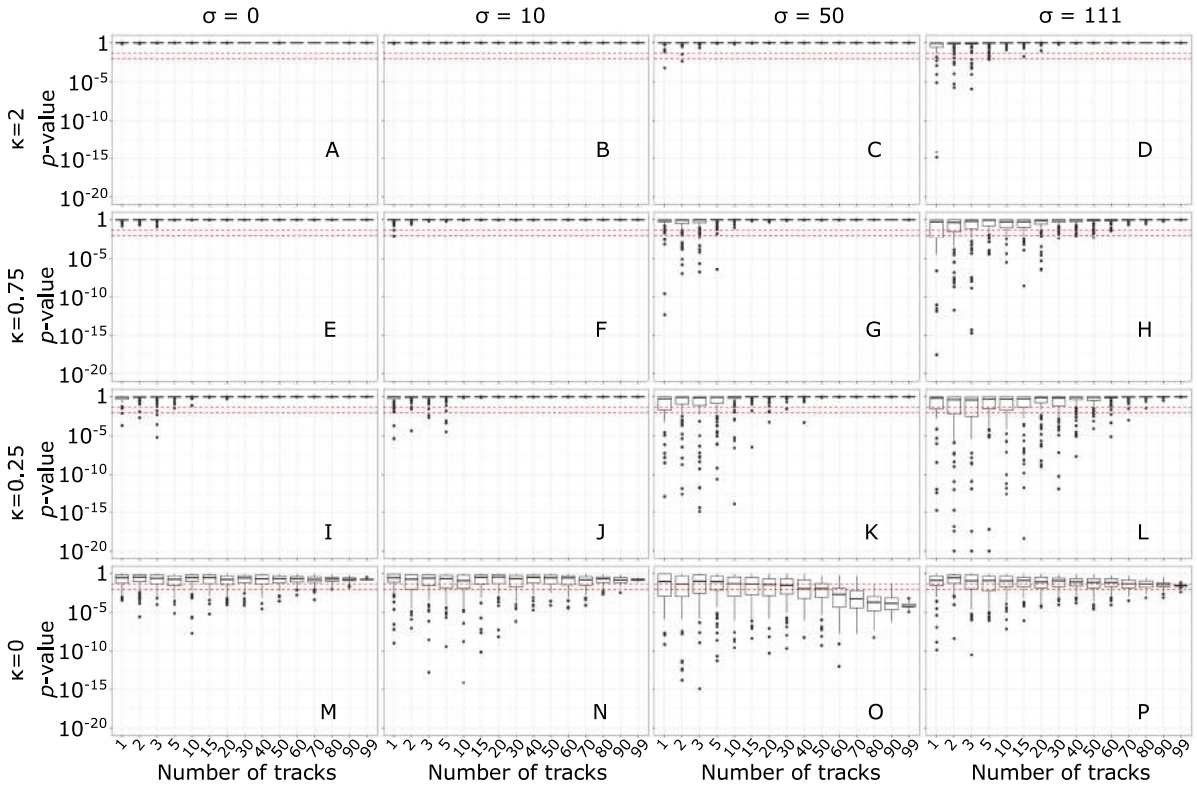


Figure S16: Box plots of the distribution of $p$-values of tests testing selection for lower values of FTLE (with the same data gaps as chlorophyll-a) as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). The two dotted red lines indicate $p = 0.05$ and $p = 0.01$, and $p$-values lower than $10^{-20}$ are plotted as $10^{-20}$. Results shown for all null models aggregated only.

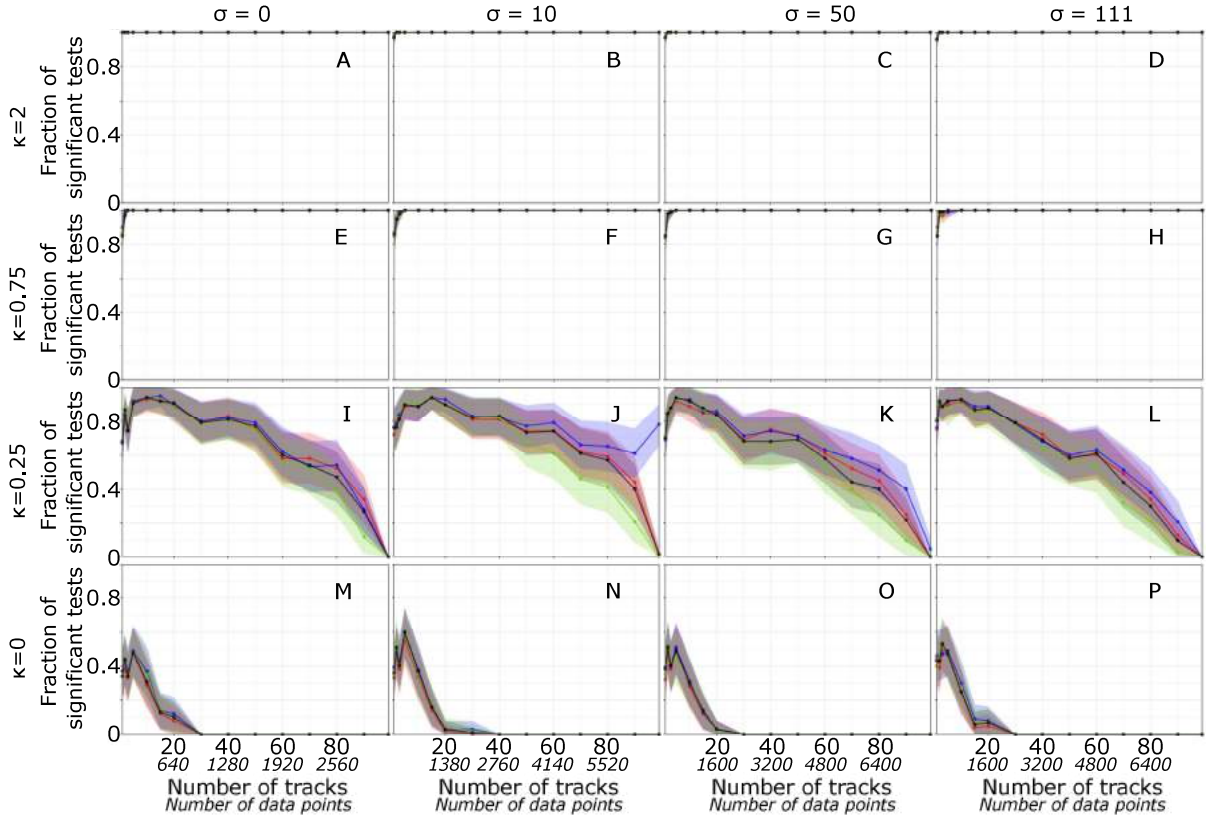


Figure S17: Fraction of test results showing effective selection for higher values of SST as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

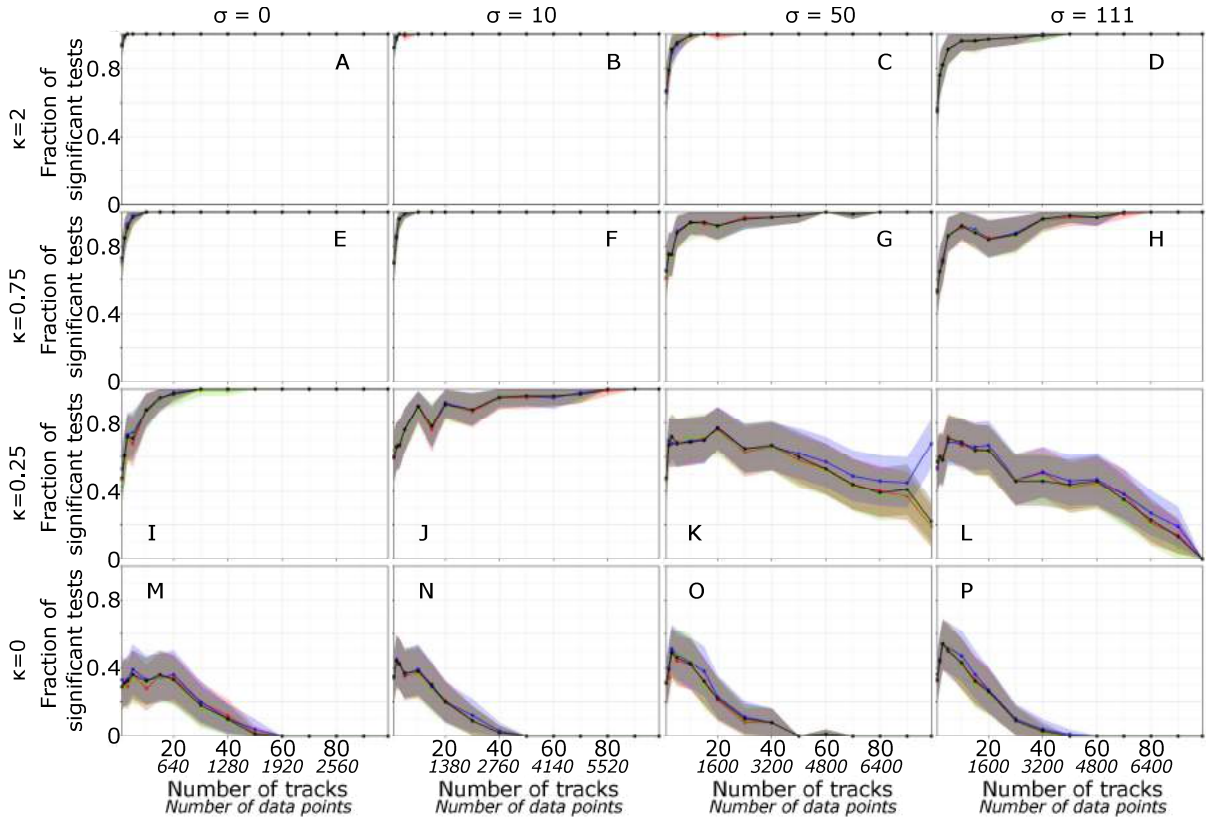


Figure S18: Fraction of test results showing effective selection for higher values of chlorophyll-a concentration as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

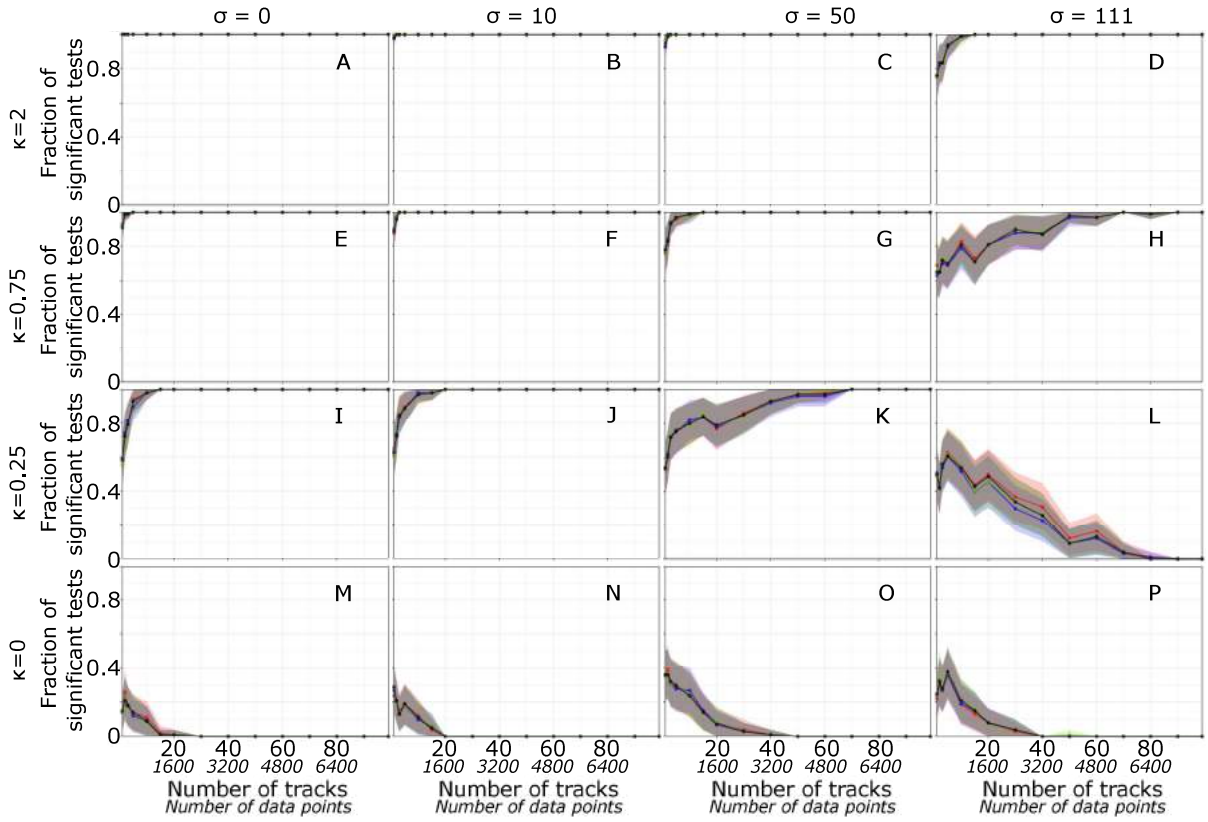


Figure S19: Fraction of test results showing effective selection for higher values of FTLE as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

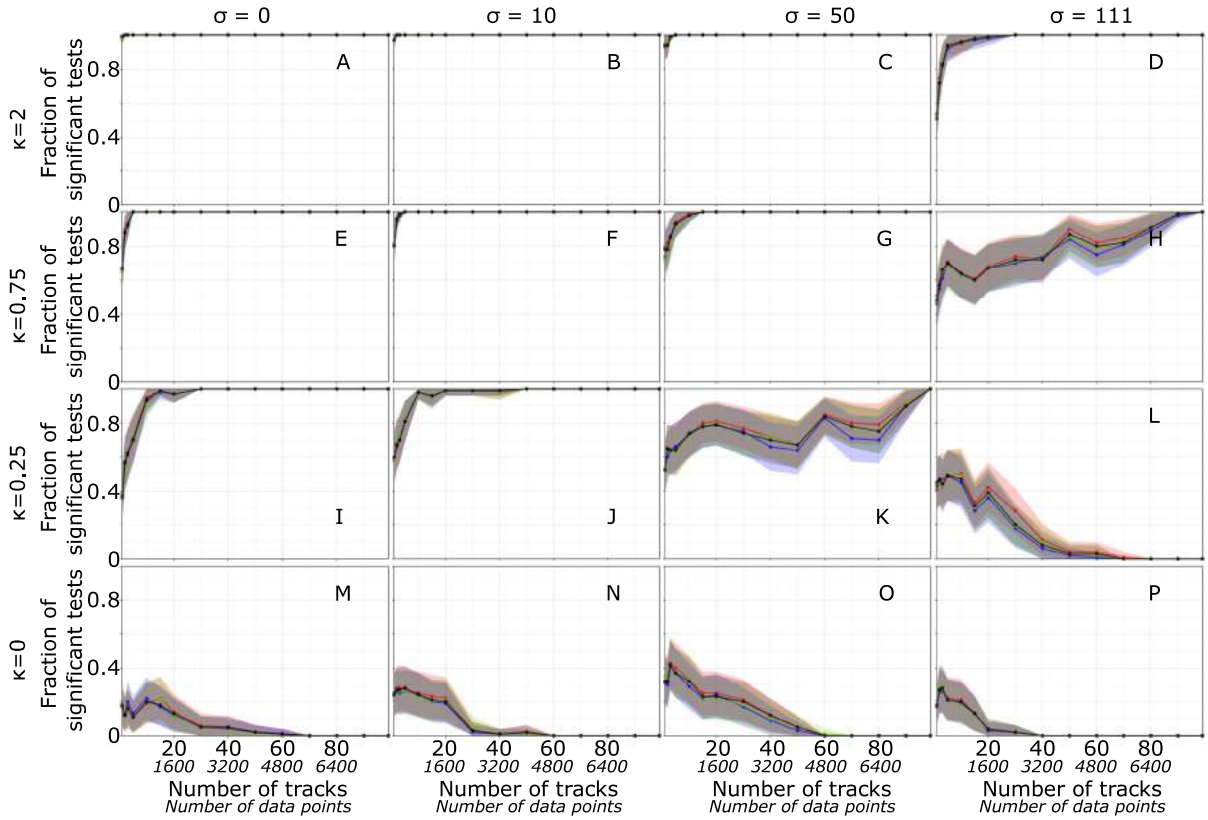


Figure S20: Fraction of test results showing effective selection for higher values of FTLE (with the same data gaps as chlorophyll-a) as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

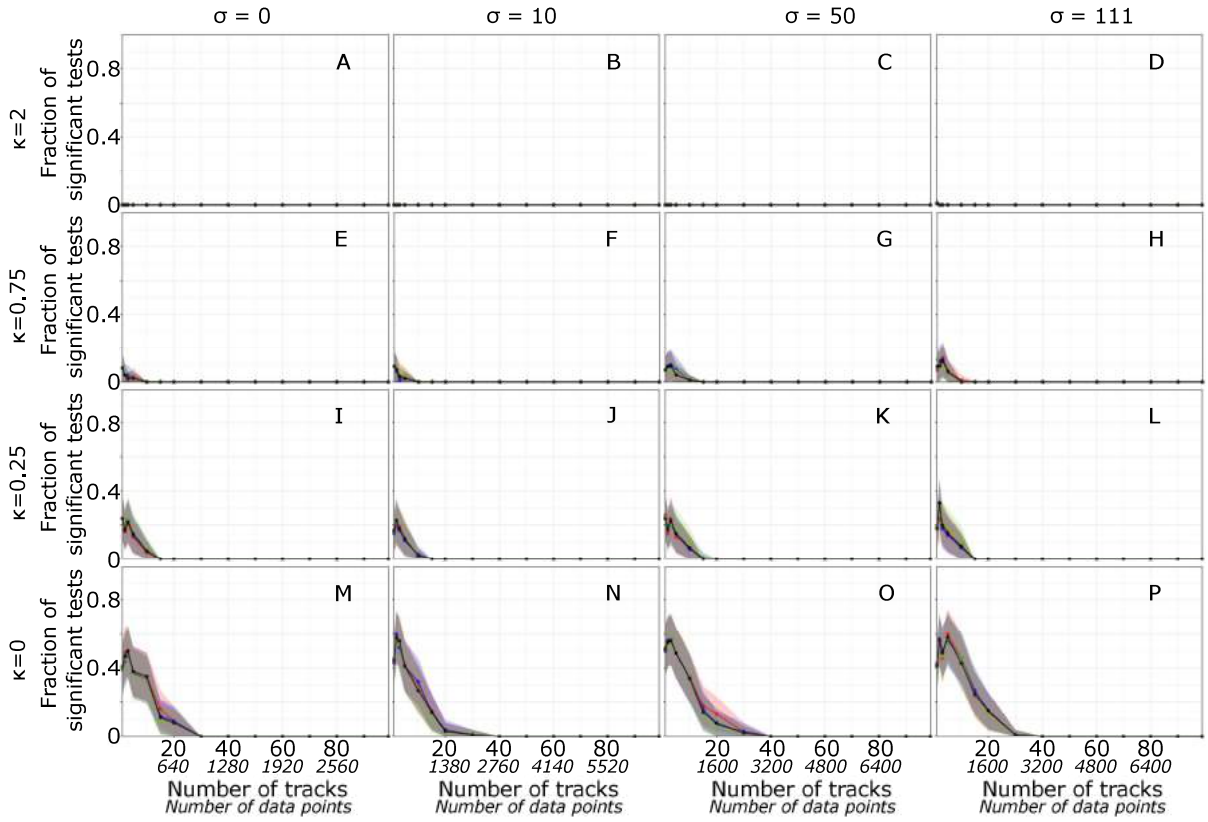


Figure S21: Fraction of test results showing effective selection for lower values of SST as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

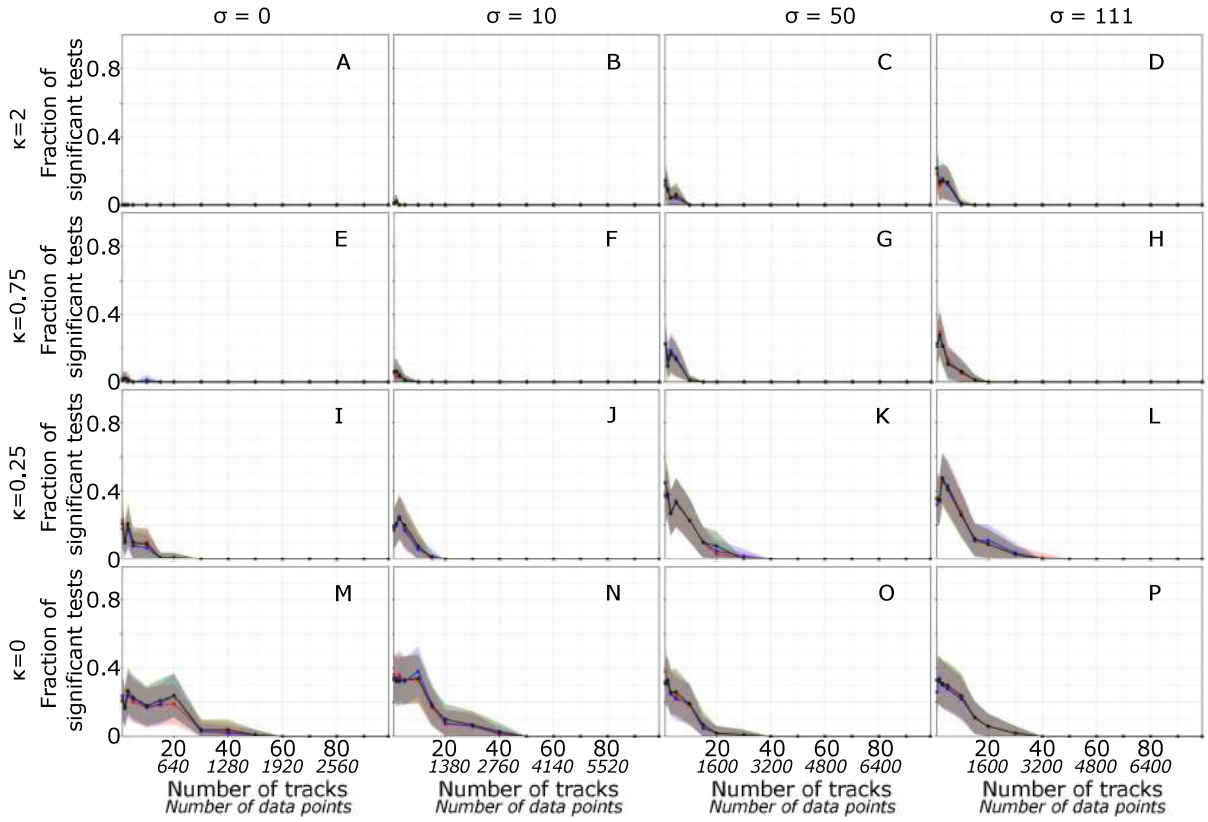


Figure S22: Fraction of test results showing effective selection for lower values of chlorophyll-a concentration as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

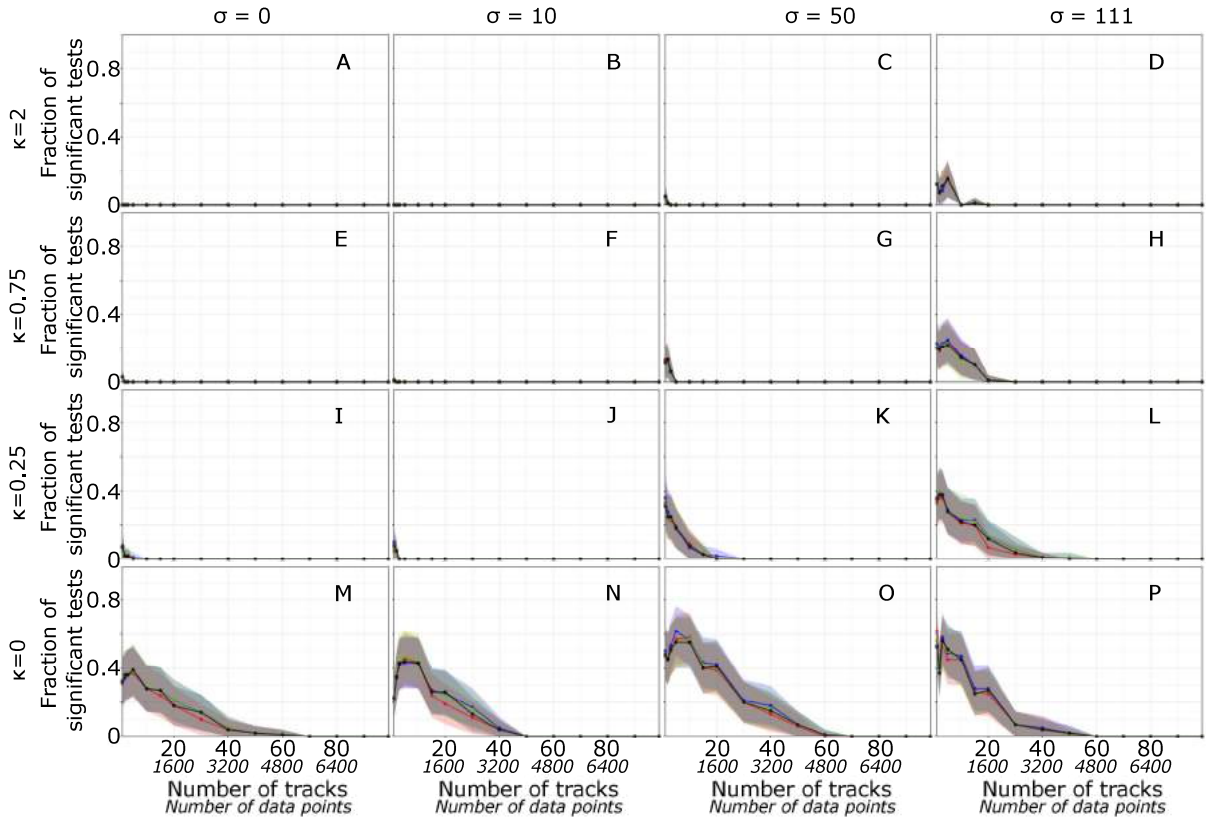


Figure S23: Fraction of test results showing effective selection for lower values of FTLE as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

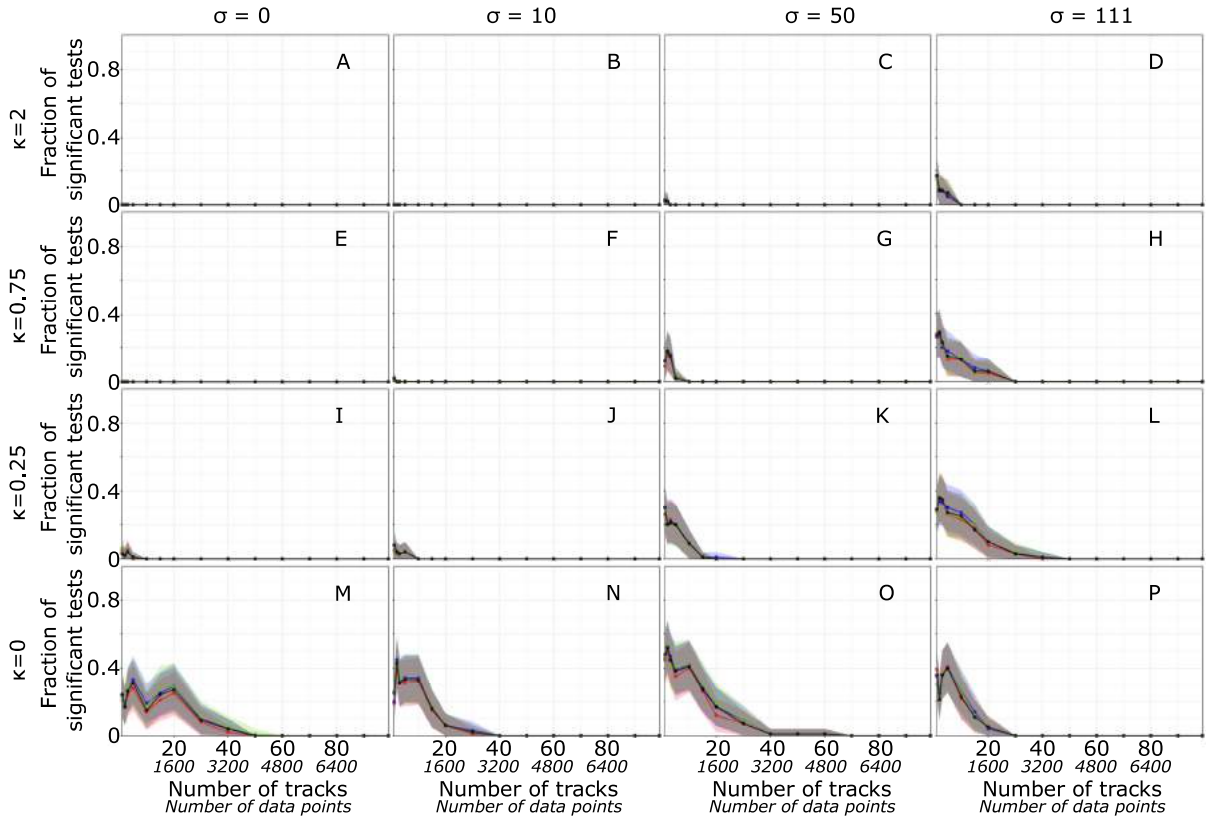


Figure S24: Fraction of test results showing effective selection for lower values of FTLE (with the same data gaps as chlorophyll-a) as a function of the number of tracks considered for different values of $\kappa$ (rows) and $\sigma$ (columns). Shaded areas around each line indicate the bootstrapped 95% confidence intervals. Black lines show results for all null models aggregated, red lines results from Brownian walks only, Blue lines from Correlated random walks only, and green lines from Joint correlated random walks only.

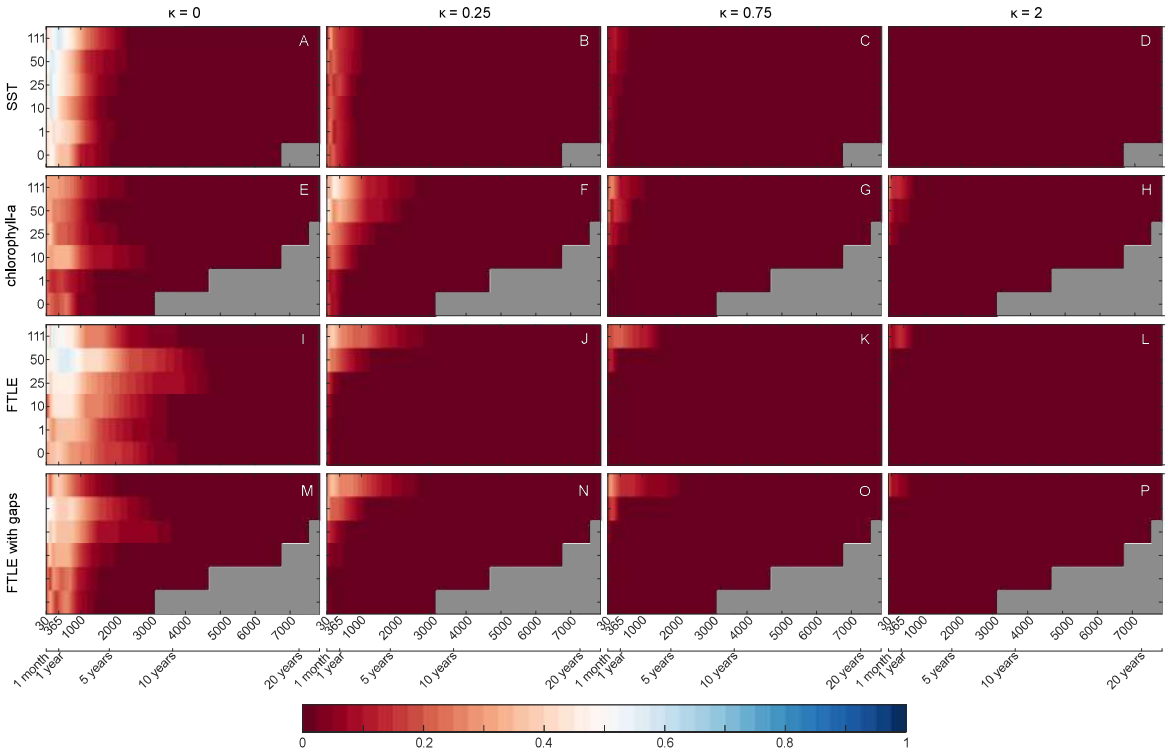


Figure S25: Fraction of test showing effective selection for lower values of SST (A, B, C, D), chlorophyll-a (E, F, G, H), FTLE (I, J, K, L), and FTLE with the same data gaps as chlorophyll-a (M, N, O, P) at different selection strengths (in columns), geolocation accuracy (rows of the panels) and sample sizes (columns of the panels). Sample sizes are plotted as sample size with environmental data (in both number of data points and its corresponding time span), hence the grey patches in panels A-H and M-P.

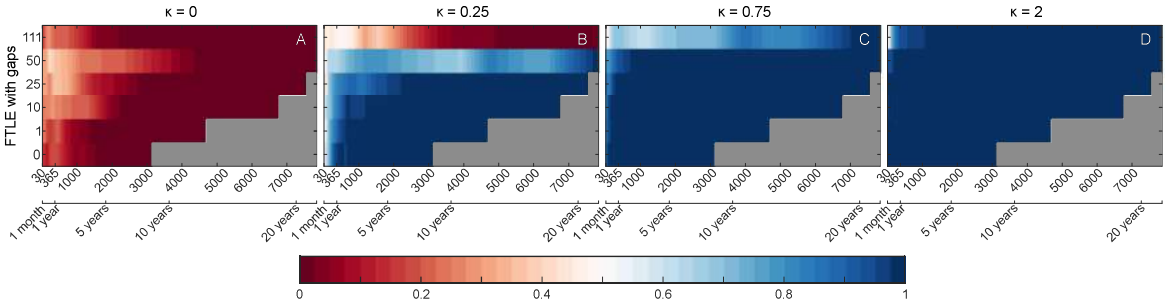


Figure S26: Fraction of test showing effective selection for higher values of FTLE with the same data gaps as chlorophyll-a (A, B, C, D) at different selection strengths (in columns), geolocation accuracy (rows of the panels) and sample sizes (columns of the panels). Sample sizes are plotted as sample size with environmental data (in both number of data points and its corresponding time span), hence the grey patches.