Figure S1. Ensemble dispersion relative to current speed: verification of Equation 4 averaged over the entire year 2021 for each grid point at the surface (a), at 30 m (b), at 100 m (c) and at 200 m (d). The black line indicates the ideal relation expressed in Eq. 4 of the manuscript.
Standard deviation $\sigma_{2021}$ from 2021 reanalysis, temperature

(a) JFMA, 0 m

(b) JASO, 0 m

(c) JFMA, 20 m

(d) JASO, 20 m

(e) JFMA, 30 m

(f) JASO, 30 m

(g) JFMA, 50 m

(h) JASO, 50 m
Figure S2. Seasonal standard deviation for potential temperature $T$ at different depth levels for the year 2021: at the surface (a), at 20 m depth (c), at 30 m(e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer. Please note the different units used at different depths.
Standard deviation $\sigma_{2021}$ from 2021 reanalysis, current speed

(a) JFMA, 0 m
(b) JASO, 0 m
(c) JFMA, 20 m
(d) JASO, 20 m
(e) JFMA, 30 m
(f) JASO, 30 m
(g) JFMA, 50 m
(h) JASO, 50 m
Figure S3. Seasonal standard deviation for current velocity $v$ at different depth levels for the year 2021: at the surface (a), at 20 m depth (c), at 30 m (e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer. Please note the different units used at different depths.
S2 Internal variability

Ensemble spread $\sigma_i$, temperature

(a) JFMA, 0 m

(b) JASO, 0 m

(c) JFMA, 20 m

(d) JASO, 20 m

(e) JFMA, 50 m

(f) JASO, 50 m

(g) JFMA, 100 m

(h) JASO, 100 m
Figure S4. Seasonal average of the ensemble spread for potential temperature $T$ at different depth levels for the year 2021: at the surface (a), at 20 m depth (c), at 50 m depth (e), at 100 m depth (g), at 200 m depth (i), at 500 m depth (k) and at 1000 m depth (m) for winter and similarly in (b), (d), (f), (h), (j) and (n) for summer. Please note the different units used at different depths.
Ensemble spread $\sigma$, current speed

(a) JFMA, 0 m

(b) JASO, 0 m

(c) JFMA, 20 m

(d) JASO, 20 m

(e) JFMA, 50 m

(f) JASO, 50 m

(g) JFMA, 100 m

(h) JASO, 100 m
Figure S5. Seasonal average of the ensemble spread for current speed $v$ at different depth levels for the year 2021: at the surface (a), at 20 m depth (c), at 50 m depth (e), at 100 m depth (g), at 200 m depth (i), at 500 m depth (k) and at 1000 m depth (m) for winter and similarly in (b), (d), (f), (h), (j) and (n) for summer. Please note the different units used at different depths.
Figure S6. Vertical profile of the seasonally and spatially averaged ensemble spread for potential temperature (a) and current speed (b). Red represents summer, whereas blue is winter.

Figure S7. Average interannual spread $\sigma_R$ at the surface in the Mediterranean Sea computed with the reanalyses from the period 1987 - 2021. $\sigma_R$ is computed as the spread of an ensemble composed of the current speed field of each year from 1987 to 2021. The dots indicate the locations that were chosen for the analysis: Western Mediterranean Sea (WMed), Balearic Islands (Balea), Gulf of Lion (GoL), Tyrrhenian Sea (Tyrr), Adriatic Sea (Adr), Ionian Sea (Ion), Cretan Sea (Cre) and Eastern Mediterranean Sea (EMed).
Figure S8. Seasonally averaged vertical profile of the ensemble spread $\sigma_I$ (red) for potential temperature and of the vertical temperature gradient $-\nabla T_z$ (blue) in summer at WMed (a), Balea (b), GoL (c), Tyrr (d), Adr (e), Ion (f), Cre (g) and EMed (h).
Figure S9. Seasonally averaged vertical profile of the ensemble spread $\sigma_I$ (red) for potential temperature and of the vertical temperature gradient $-\nabla T_z$ (blue) in winter at WMed (a), Balea (b), GoL (c), Tyrr (d), Adr (e), Ion (f), Cre (g) and EMed (h).
S4 Noise-to-signal ratio
Figure S10. Seasonal average of the noise to signal ratio for potential temperature $T$ at different depth levels for the year 2021: at the surface (a), at 20 m depth (c), at 30 m depth (e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer.
**Figure S11.** Seasonal average of the noise to signal ratio for current speed $v$ at different depth levels for the year 2021: at the surface (a), at 20 m depth (c), at 30 m depth (e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer.
Ensemble spread $\sigma_u$ temperature

(a) JFMA, 0 m

(b) JASO, 0 m

(c) JFMA, 20 m

(d) JASO, 20 m

(e) JFMA, 30 m

(f) JASO, 30 m

(g) JFMA, 50 m

(h) JASO, 50 m
Figure S12. Seasonal average of the ensemble spread for potential temperature $T$ at different depth levels for the year 2020: at the surface (a), at 20 m depth (c), at 30 m (e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer. Please note the different units used at different depths.
Figure S13. Seasonal average of the ensemble spread for current speed $v$ at different depth levels for the year 2020: at the surface (a), at 20 m depth (c), at 30 m (e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer. Please note the different units used at different depths.
Figure S14. Seasonal average of the noise to signal ratio for potential temperature $T$ at different depth levels for the year 2020: at the surface (a), at 20 m depth (c), at 30 m depth (e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer.
Figure S15. Seasonal average of the noise to signal ratio for current speed $v$ at different depth levels for the year 2020: at the surface (a), at 20 m depth (c), at 30 m depth (e), at 50 m depth (g), at 100 m depth (i), at 200 m depth (k), at 500 m depth (m) and at 1000 m depth (o) for winter and similarly in (b), (d), (f), (h), (j), (n) and (p) for summer.