viscosity $A_v = 0.5$ cm^2 s^{-1} and diffusivity $K_v = 0.1$ cm^2 s^{-1}. Convective adjustment is utilized when the water column is statically unstable, with a vertical viscosity A_v^{cvct} and diffusivity K_v^{cvct} both equal to 50 cm^2 s^{-1}. At the open boundaries (Lermusiaux, 1997), Orlanski radiation (ORI/ORE) conditions (Orlanski, 1976) were preferred for all variables. Across coastlines, the normal flow and tracer flux are set to zero. Along coastlines, the tangential flow is slowed down at the coast, using a Rayleigh friction of relaxation time $\tau_c = 7200$ s and Gaussian decay horizontal-scale of one grid point, $L_c = 9$ km. This condition is a ''damped free-slip''. At the bottom, a dynamic stress balance is applied to the momentum equations, with a drag coefficient $C_d = 2.5 \times 10^{-3}$. An additional Rayleigh bottom friction is employed to control possible numerical error growth in the barotropic transport and parameterize a simple bottom boundary layer for momentum. Its parameters are a relaxation time τ_b of 3600 s and Gaussian decay vertical-scale H_b of two bottom levels, with $H_b \leq 50$ m. Although atmospheric forcings were used in operations, during the period considered here, they are not the main source of variability. For simplicity, the wind-stress and surface buoyancy flux are thus set to zero; the internal dynamics is the main interest.

2.3. Field initial conditions

The gridded fields are initialized by objective analysis (OA) and PE adjustment, using the data gathered up to Sept. 15 (Fig. 4a). For better stability and accuracy of the initial fields, the salinities of the AXBTs are estimated. In the Strait of Sicily, this is challenging because there is no clear T/S relationship and the T/S distribution varies in all dimensions (x, y, z, t). All of the procedures investigated employed the available CTD data (Fig. 4a) as a pool of reference T/S profiles. The method selected (e.g., Lermusiaux, 1997) computes the salinity of a given AXBT using a weighted average of the reference salinities. The weights in the average increase with the similarity between the location, profile shape, depth and temperature range of the AXBT data and reference T data. Constraints based on the reference T/S diagram are also imposed. The resulting 926 T/S profiles are first gridded on flat levels using a two-scale horizontal OA. The first stage maps the large-scales (subbasin-scale) tracer fields, the second adds the mesoscale correction to the subbasinscale estimates. The associated error correlation is the second derivative of an isotropic Gaussian. It has been commonly used in the Mediterranean (e.g., Robinson and Malanotte-Rizzoli, 1993). The measurement error covariance matrices are assumed diagonal, with constant non-dimensional variance. Table 2 summarizes the main parameters.

A first-guess at the initial flow conditions is computed assuming geostrophic balance, with a level of no motion at 180 m. The nonlinear momentum equations are then integrated from this first-guess, keeping the objectively analyzed temperature and salinity fixed. This integration is usually continued until the mean kinetic energy stabilizes around a plateau, without rapid changes. This procedure is called an *adjustment PE integration* and the resulting initial fields are said *PE-adjusted*. The adjustments at play are, in order of importance: (i) the generation of the deviation between the inviscid, linear, depth-integrated PE flow and the first-guess, depth-integrated flow in geostrophic balance from a flat level of no motion, here at 180 m. This process is a joint