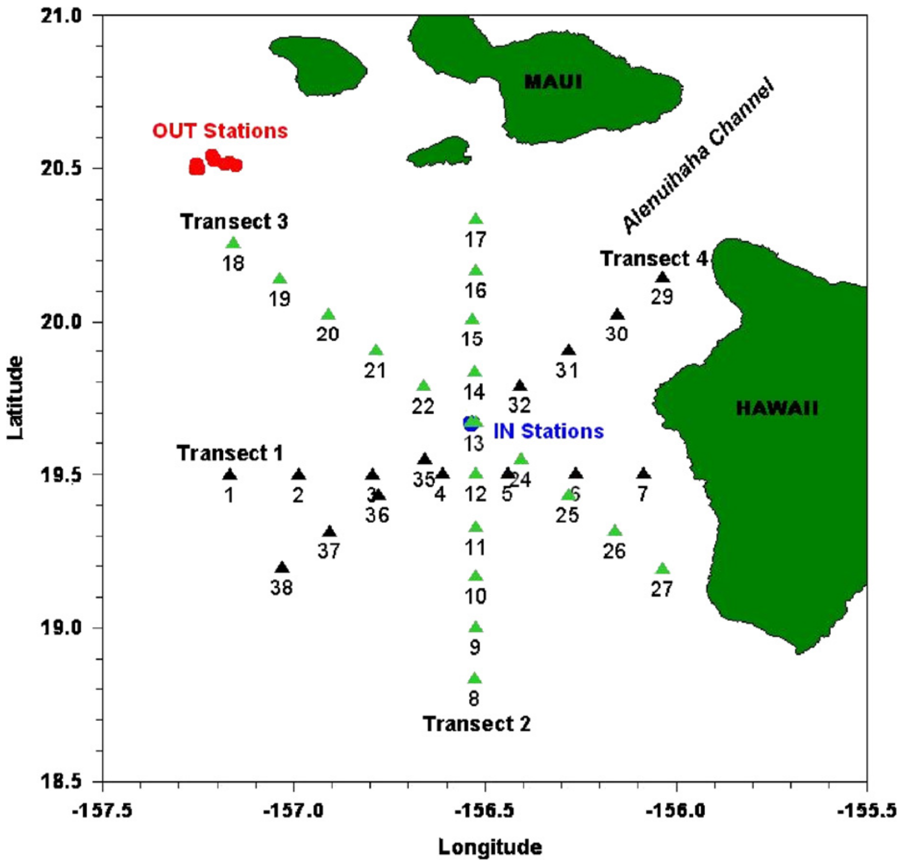

Fig. 1. The sequence of eddy survey stations during E-Flux I (November 6–11, 2004) indicated by the STAR-stations 1–38 (Casts 10–48). A total of four line-transects were made and sampling stations were located at intervals of ca. 20 km. Green triangles represent Transects 2 and 3 described in detail. Red and blue circles represent OUT- and IN-stations, respectively.

collected from 9 of the total 18 eddy OUT-stations (selection criteria explained in Section 3.1) and z is depth.

The ship's ADCP data are reported as 10-m vertically binned eastward (u in cm s^{-1}) and northward (v in cm s^{-1}) components. Accurately resolving the geometric center of an eddy is critical. Following a procedure outlined in Nencioli et al. (2008), a 20- by 20-point grid was defined around the area of minimum ADCP velocities of each transect line. ADCP velocities were then decomposed into tangential and radial components relative to each point of the grid at each depth. The estimate of the eddy center was defined at each depth as the grid point for which the average value of tangential velocity was maximum. This method proved to be extremely reliable as the geometric centers along each transect could be determined quantitatively at respective depths. Analysis of *Noah* data suggests that none of the line survey transects went exactly through the center. For the purposes of studying currents associated with the eddy, the horizontal current components were decomposed into radial velocities (V_r) and tangential (or azimuthal) velocities (V_θ) using a cylindrical coordinate system whose origin was at the best estimated position of *Noah's* center at each depth. Angular velocity (V_θ) was then calculated as V_ω divided by the radial distance, r (km), from the calculated center of the eddy (where $V_\theta \approx 0$).Important dynamical properties such as the extent to which a mesoscale eddy rotates as a solid body and potential for lateral exchange of water between the inner and outer regions to occur can be inferred from the analysis of its potential vorticity field. The orders of magnitude of the various terms, which comprise the equation for potential vorticity in a cylindrical coordinate system (Pedlosky, 1979), were estimated using the ADCP data obtained during the observations of *Noah*. For our case, the equation for potential vorticity (ζ) can be reduced, to a first-order approximation according to the following equation (Olson, 1980; Joyce et al., 1981):

$$\zeta = \frac{\partial \rho}{\partial z}\left(\frac{V_\theta}{r} + \frac{\partial V_\theta}{\partial r} + f\right) \tag{2}$$

where $\partial\rho/\partial z$ is the vertical gradient of density, r is the radial distance from the center and f is the Coriolis parameter as given by $f = 2\Omega \sin\phi$ where Ω is the Earth's rotation rate and ϕ is latitude. Detailed explanations of the calculations utilized here to compute vertical and horizontal velocity shear (using partial differential equations) and the first-order approximation of the potential vorticity following Olson (1980) and Simpson et al. (1984) are described extensively in Nencioli et al. (2008).

3. Observational field results

Truly synoptic observations of dynamic, evolving mesoscale eddy features using ships and satellites are not possible. However, the 5-day horizontal and vertical mapping campaign conducted during E-Flux I (Fig. 1) appears to have been successful, in part because *Noah* remained in virtually the same location during our survey. The following results utilize the temperature, salinity, density, velocity, and biological–biogeochemical measurements from Transects 2 and 3 (Fig. 1). These two transects, although not perpendicular to each other, were selected based on the fact that they both cross Cyclone *Noah* relatively close to its best-estimated geometric center. These transects were also conducted