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A combined laboratory and analytical study of flow through the Faroe Bank Channel

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Field data have been used to specify the velocity and density field conditions in an idealized, distorted laboratory model in which the spatial and temporal development of a turbulent, dense source flow has been studied parametrically in terms of the source Rossby (Ro0) and Froude numbers (Fr0) respectively. Measurements show that the flow (i) maintains geostrophic balance within the topographically-varying channel and (ii) adjusts on the Ekman time scale to changing flow conditions. The outflow structure is shown to consist of a dominant axial (i.e along channel) component, with a significant transverse (i.e side slope) secondary circulation driven by Ekman drainage and topographic divergence processes. Density field measurements show mixing occurring between the turbulent outflow and the overlying water mass and buoyancy anomaly data are derived to quantify the spatial variations of mixing processes along and across the channel. An analytical model based on Ekman dynamics is developed for flow in the channel and the predictions of the dimensions of the outflow in terms of the external flow and topographic parameters are shown to accord well with the laboratory data.