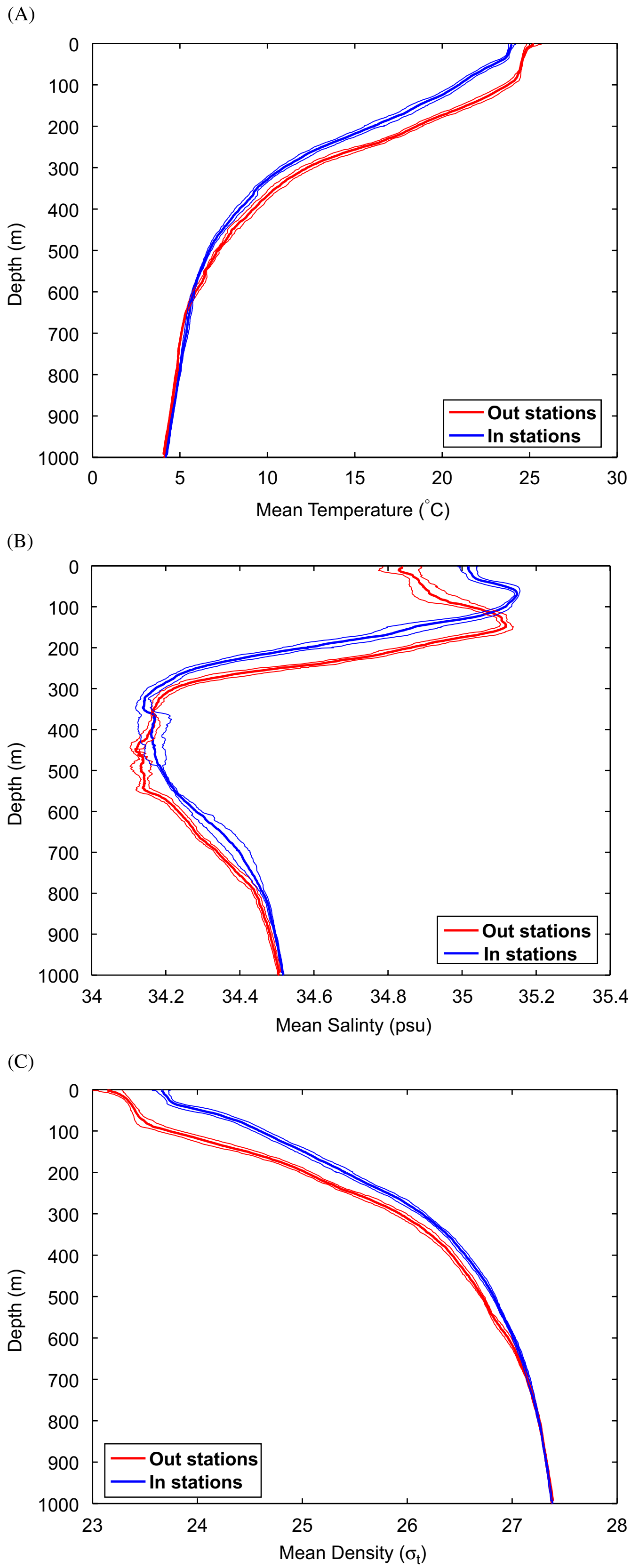

Fig. 4. Mean vertical profiles of temperature, salinity and density for *Opal*'s core region (IN_{avg}) and the far-field (OUT_{avg}). The lines at the sides of each profile indicate the 1 standard deviation interval.

profiles. The dotted lines at the sides of each profile in Fig. 4 indicate the 1 standard deviation interval associated with the averaged property at each depth. Clearly standard deviations for all the properties from both IN_{avg} and OUT_{avg} are minimal.

Comparisons of the mean profiles of temperature, density and salinity shown in Fig. 4 are consistent with the presentation of data in Figs. 2 and 3. Specifically, the eddy-induced uplift is reflected in an upward displacement of the seasonal thermocline, deep salinity maximum and base of the surface mixed layer by about 80–100 m at the center of the eddy; and the magnitude of upward displacement decreases with depth. Despite the decreasing uplift with depth, vertical profiles in Fig. 4 clearly reveal that the influence of *Opal* extended to depths of about 600–700 m.

Important information concerning the water masses characterizing Cyclone *Opal* can be inferred from classic *T*–*S* relations as shown in Fig. 5. Fig. 5 shows *T*–*S* diagrams (A) for the 26 OUT-stations, (B) for the 42 selected IN-stations, and (C) for all of the transect stations, including center casts. The S-shaped *T*–*S* curve shown in Fig. 5A is typical for the Hawaiian oceanic region and is established by the presence of five distinct water masses. These are in order from greatest depth to the surface: the North Pacific Bottom Waters (NPBW), characterized by moderate salinity (>34.5) and low temperature (<4 °C); the North Pacific Deep Waters (NPDW), characterized by moderate-to-low salinity (34.5 down to 34.2) but still relatively cold waters (4–6 °C); the North Pacific Intermediate Waters (NPIW), characterized by low salinity (<34.2) and relatively higher temperature (6–12 °C); the Subtropical Subsurface Waters (SSW) characterized by high salinity >34.5) and much warmer temperatures (~20 °C); and the shallowest near-surface waters characterized by high temperatures (~25 °C) and lower salinity being largely influenced by precipitation (Wyrtki and Kilonsky, 1984). Salinity, rather than temperature, is clearly the variable that can be used most successfully to identify the different water masses of the region. For this reason the depths at which these masses occur can be easily determined from the OUT_{avg} vertical plot of salinity in Fig. 4B. The NPDW water masses extend from below 1000 m up to depths between 700 and 800 m, and the NPIW water masses are confined between 300 and 600 m depths. The SSW water masses are found between 100 and 200 m depths, and the near surface waters are limited to the upper 20 m of the water column. The NPBW water masses are much deeper than 1000 m and therefore are not shown in the plot.

The *T*–*S* diagram data shown for the IN-stations in Fig. 5B are practically identical to the *T*–*S* diagram data for the OUT-stations. This indicates that only moderate entrainment occurred at the center of the eddy, and therefore the observed shoaling of isotherms, isohalines and isopycnals toward the center is likely almost entirely determined by an eddy-induced vertical movement of water. It is because of this upwelling that at *Opal*'s center the SSW water masses that usually occur only at depths deeper than 100 m are brought to the surface, and thus establish the saline, cold core typical of the Hawaiian cyclonic eddies. Fig. 5C shows slightly different features compared to those of the previous two diagrams. The *T*–*S* curves in the diagram that are still identical to the ones evident in Fig. 5A and B are from the transect casts sampled at *Opal*'s center, and confirm the conclusions from the analysis of the previous *T*–*S* diagrams. However, there are also many curves characterized by much less saline SWWs even though NPIWs and near surface waters show quite typical temperature and salinity values. These data are from the peripheral transect casts. The much less pronounced deep salinity maximum found outside the core region of the eddy most likely indicates an enhancement of lateral or vertical mixing, or a possible entrainment of different water masses within the depth levels occupied by the SSWs. The absence of a pronounced deep