depiction of this process is schematicized for a first baroclinic mode cyclonic, cold core eddy in Figure 8a.

Mesoscale eddies are now known to be ubiquitous oceanographic features (see BTM time series in Figures 5 and 6 and altimetry data set shown in Figure 7).

Several recent studies have suggested that mesoscale eddies may play major roles in supplying new nutrients to the upper ocean (i.e., importantly, the euphotic layer), and thus enhance primary production and carbon export in otherwise nutrient-deficient systems as well as shift phytoplankton community structure (e.g. McGillicuddy, et al. 1998; Oschlies and Garcon, 1998; McNeil et al., 1999; Letelier et al. 2000; Dickey et al., 2001; McGillicuddy, 2001; Conte et al., 2002; see recent reviews by McGillicuddy, 2001; Dickey and Falkowski, 2002; Lewis 2002). One depiction of this process is schematicized for a first baroclinic mode cyclonic, cold core eddy in Figure 8a.

Interestingly, current estimates suggest a broad range of 10 to 50% of global new primary production to be due to eddy-induced nutrient fluxes (e.g., McGillicuddy et al. 1998, Oschlies and Garcon 1998; Siegel et al, 1999; Letelier et al. 2000). Clearly, lack of sufficient relevant data sets has inhibited our ability to understand and quantify the biogeochemical significance of eddies leading to the ongoing controversies (e.g., Oschlies and Garcon, 1998; McGillicuddy et al., 1998).

Mesoscale features have been observed with remote sensing tools including sea surface temperature and color sensors such as the Sea-viewing Wide Field-of-view Sensor, SeaWiFS (e.g., Yoder et al., 2001; McGillicuddy, 2001); however not all eddies are shown with these methods and cloud obscuration remains problematic for developing continuous time series of features. Also, analyses of satellite altimetry data sets in conjunction with biogeochemical models have suggested the importance of first baroclinic mode cyclonic eddies (surface depression at center of the eddy) for input of nutrients into the euphotic layer and the enhancement of primary productivity and thus carbon flux to depth (McGillicuddy et al., 1998; Siegel et al., 1999).

Other types of eddies and mesoscale features (see Figure 8b) have been shown to exhibit high nutrient injection events and elevated primary productivity as well, thus confounding relatively simple models of new production and nitrate fluxes based on altimetry data. Further, the evolution of eddies (spin-up or formation versus spin-down and decay phases; Figure 8b) must be important as well because of the vertical motion of the thermocline and nutricline into or out of the euphotic layer (e.g., Flierl and McGillicuddy, 2002).