# Roles for the ocean mesoscale on the supply of mass and tracers to the Northern Hemisphere subtropical gyres

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Lateral transport at the boundaries of the subtropical gyres plays a crucial role in providing the nutrients that fuel primary productivity, the heat that helps restratify the surface mixed layer, and the dissolved inorganic carbon (DIC) that influences air-sea carbon exchange. Mesoscale eddies are hypothesized to be an important component of these lateral transports; however, previous studies have not explicitly quantified the role played by these eddies. Here, we quantitatively assess the physical mechanisms that control the transport of heat, nutrients and carbon across the North Pacific and North Atlantic subtropical gyre boundaries using the eddy-rich ocean component of a climate model (GFDL's CM2.6) coupled to an idealized biogeochemical model (mini-BLING).

Our results suggest that lateral cross-subtropical gyre boundary transport supplies a substantial amount of heat, DIC, and nutrients, mainly across Gulf Stream and Kuroshio. Mass, heat, and DIC supply is mainly driven by the mean circulation, while mesoscale eddies oppose the mean, removing mass, heat and DIC from the gyres. Nutrient transport differs markedly from the other tracers, as nutrients are principally supplied to both subtropical gyres by mesoscale eddies. These lateral transports of heat, DIC, and nutrients all play a significant role in their respective subtropical gyre budget in both basins: Mean lateral transport supplies almost all DIC and heat into the subtropical gyres, with 37% (32%) of DIC and 21% (24%) of heat being removed from the North Pacific (North Atlantic) subtropical gyre by the eddy component of the lateral transport on an annual mean basis. The eddy lateral transport of heat is, on average, the same order of magnitude as the air-sea fluxes, implying its important role in subtropical ocean climate. Likewise, the lateral nutrient supply, combining the roles of both mean and eddy components, provides 77% of total nutrient supply in North Pacific and 86% in North Atlantic, which is approximately 1.5 times larger than a previous estimate by a coarse resolution model.

 