The ocean is rich with small-scale fronts, eddies, and filaments with horizontal length scales of approximately 0.1 - 10 km, in what is termed the ocean submesoscale. It is widely recognized that submesoscale processes play a fundamental role in both the dynamics and biogeochemistry of the upper-ocean, yet our best projections suggest that we will not have sufficient computational power to directly resolve these scales in coupled climate models until near the end of the century. There is therefore a pressing need for understanding how submesoscale variability alters the large-scale circulation, and in this talk I will discuss two recently identified pathways through which submesoscale processes can affect the ocean's meridional overturning circulation. The first pathway is a consequence of submesoscale frontal dynamics in the turbulent surface boundary layer, which I show tend to reduce the formation rate of ocean mode waters. A high-resolution simulation of the North Atlantic confirms these submesoscale processes modify the large-scale interior properties of the subtropical mode water, and hence the gyre-scale circulation and the upper-limb of the Atlantic overturning circulation. The second pathway I identify involves submesoscale instabilities in the bottom boundary layer, a newly recognized aspect of ocean circulation that has the potential to transform our understanding of many aspects of the dynamics and biogeochemistry of the bottom boundary layer. In the deep ocean, these submesoscale instabilities over topography influence how dense waters are made lighter and brought back towards the surface, suggesting a new conceptual model for the closure of the abyssal overturning circulation. I will conclude my talk with a brief discussion of the exciting prospects for studying submesoscale processes over the coming decade, where a convergence of high-resolution turbulence resolving, and large-scale realistic, modeling techniques will enable a more complete understanding of the role of the submesoscale in the broader climate system.

Monday  April 29th, 2019  12:00p.m. POST 723
*The speaker is a candidate for a faculty position in the Department of Oceanography.