Cloud cover over the Gulf Stream in winter: observational evidence for atmospheric response to changes in upper ocean heat content

Julie Ann Koehlinger (jkoehl@uw.edu) [1], LuAnne Thompson[1], and Michelle Serino[1,2]

Observational analyses have shown that changes in AMOC are tightly linked to changes in meridional heat transport. Likewise, in the mean, meridional heat transport convergence is balanced by surface heat flux. Previous work has shown that this relationship holds interannually in the Gulf Stream region, where heat content variations are primarily driven by heat transport convergence, and that in turn, surface heat fluxes are controlled by heat content variations. The seasonal cycle of sea surface temperature, surface wind convergence and precipitation has also been shown to be linked to cloud cover in the region with mid-level cloud fraction linked to surface wind-convergence driven by SST (sea surface temperature) gradients.

Here, we investigate the relationship between year-to-year changes in cloud fraction with surface fluxes and with heat content variations in the Gulf Stream region. We do this using AVISO SSH (sea surface height) as a proxy for upper ocean heat content, turbulent heat fluxes from OAFlux (Objectively analyzed air-sea fluxes), and ISCCP (International Satellite Cloud Climatology Project) derived cloud fraction. We find that in January and February, mid-level cloud fraction anomalies are tightly coupled to surface heat fluxes anomalies. In addition, we find that SSH leads mid-level cloud fraction in December and January by as much as 6 months. This study shows direct evidence for an atmospheric response to heat content changes in the Gulf Stream region and that the changes in the atmosphere can be predicted several seasons in advance.

[1]University of Washington School of Oceanography, [2]Millersville University of Pennsylvania