EGU2020-22220, updated on 23 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-22220
EGU General Assembly 2020

Characteristics of Cold Air Outbreaks and associated Polar Mesoscale Cyclones in the North-Atlantic region

Annick Terpstra[1,2], Ian Renfrew[2], and Denis Sergeev[3]
[1]University of Bergen, Geophysical Institute, Bergen, Norway (annick.terpstra@uib.no)
[2]University of East Anglia, School of Environmental Sciences, Norwich, United Kingdom
[3]University of Exeter, College of Engineering, Mathematics and Physical Sciences , Exeter, United Kingdom

Geographically confined, equatorward excursions of cold air masses into ice-free regions account for the majority of oceanic heat loss in key regions for deepwater formation in the North Atlantic. These cold-air outbreaks (CAO) are frequently accompanied by the development of severe mesoscale weather features, such as intense low-level jets and polar lows. Exchange of heat, moisture and momentum between the ocean and atmosphere in response to mesoscale features, either directly, or indirectly via modulating the longevity and intensity of the cold air mass modulates the wind-driven oceanic gyres. Yet, it remains unclear how often mesoscale cyclones accompany cold-air outbreaks, and how mesoscale features modify the air-sea interactions.

Focusing on two key regions, the Labrador Sea and the Greenland/Norwegian Sea, we outline the temporal evolution of CAO events and associated mesoscale cyclogenesis. We apply objective detection to both CAO events and mesoscale cyclones and introduce an alternative metric to characterize the cold air mass. Despite the nearly 20 degrees difference in latitude, CAOs over both regions exhibit rather similar evolution, surface fluxes, and thermodynamic structure. The large scale configuration during CAO onset comprises a very cold upper level through over the CAO region and a surface cyclone downstream. As the CAO matures the cold air mass extends towards the south-east, accompanied by enhanced surface fluxes and destabilization of the CAO airmass. About 2/3 of the CAO events are accompanied by mesoscale cyclogenesis, with the majority of mesoscale cyclones originating inside the cold air masses. Neither the duration nor the maturity of the CAO event is relevant for the initiation of mesoscale cyclogenesis. Genesis conditions for mesoscale cyclogenesis during CAOs over the Labrador Sea are moister and exhibit stronger surface fluxes compared to their Norwegian Sea counterparts.