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Atmospheric Inversion Strength over Polar Oceans in Winter Regulated by Sea Ice

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Low-level temperature inversions are a common feature of the wintertime troposphere in the Arctic and Antarctic. Inversion strength plays an important role in regulating atmospheric processes including air pollution, ozone destruction, cloud formation, and negative longwave feedback mechanisms that shape polar climate response to anthropogenic forcing. The Atmospheric Infrared Sounder (AIRS) instrument provides reliable measures of spatial patterns in mean wintertime inversion strength when compared with available radiosonde observations and reanalysis products. Here, we examine the influence of sea ice concentration on inversion strength in the Arctic and Antarctic. Correlation of inversion strength with mean annual sea ice concentration, likely a surrogate for the effective thermal conductivity of the wintertime ice pack, yields strong, linear relationships in the Arctic (r=0.88) and Antarctic (r=0.86). We find a substantially greater (stronger) linear relationship between sea ice concentration and surface air temperature than with temperature at 850 hPa, lending credence to the idea that sea ice controls inversion strength through modulation of surface heat fluxes. As such, declines in sea ice in either hemisphere may imply weaker mean inversions in the future. Comparison of mean inversion strength in AIRS and global climate models (GCMs) suggests that many GCMs poorly characterize mean inversion strength at high latitudes.