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The role of anthropogenic forcing on the recent increase in Antarctic sea ice extent

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The time series of Antarctic sea ice extent computed with an improved Bootstrap algorithm indicates that the increasing annual trend is significant at less than the 5% level. The trend is dominated by the changes in the autumn and in the Ross Sea sector. There has been a trend towards enhanced cyclonic atmospheric circulation over the Amundsen-Bellingshausen Sea resulting in greater northerly flow down the Antarctic Peninsula and stronger southerly flow off the Ross Ice Shelf. These changes are apparent in the ECMWF reanalysis fields and in the ensemble mean of the IPCC Assessment Report 4 climate models, when integrated through the late Twentieth Century with increasing greenhouse gases and depletion of stratospheric ozone. These changes are statistically significant when compared to pre-industrial control runs, demonstrating that the sea ice has increased as a result of anthropogenic activity. Experiments with an atmosphere-only climate model indicate that depletion of stratospheric ozone has contributed most to the circulation changes.