The changing Antarctic sea-ice environment

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The stark contrast between widespread decrease in Arctic sea ice versus the small but significant increase in Antarctic sea ice poses many questions about Antarctic sea ice and climate change in the Southern Hemisphere. Understanding Antarctic sea ice and its response to (and role in modulating) climate change and variability are further challenged by the fact that most models simulate a decrease in Antarctic sea ice coverage, not increase as observed. The poleward intensification of westerly winds over the satellite era is thought to be one factor contributing to the positive Antarctic sea ice trend, but models that successfully capture this change show that it leads to sea ice decreases, not increases. So what are we missing here and how can we improve this situation?

Here, we discuss what we currently know (and don't know) about Antarctic sea ice and its response to climate change and variability, e.g., the regional/seasonal differences in wind-driven versus thermal-driven sea ice changes (and feedbacks); regional/seasonal connections to large-scale climate variability; the role of snow and freshwater changes in affecting air-ice-ocean interactions and ice mass balance.

A crucial prerequisite to improving our understanding of Antarctic sea ice, and how and why it is changing or varying, is the need for integrated data sets, e.g., in situ multi-platform time series observations that capture air-sea-ice interactions from before the autumn freeze/advance to after the spring melt/retreat. Until recently, however, such coordinated observations have been difficult, if not impossible, to obtain. Fortunately, important new technologies and techniques are fast emerging, and recent process studies are providing exciting new results and insights into the complexity of the Antarctic sea ice environment.