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Response of the global ocean to Greenland and Antarctic ice melting

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The transient response of the global ocean circulation to enhanced freshwater forcing associated with melting of the Greenland and Antarctic ice sheets is being investigated. Increased freshwater runoff from Greenland results in a basin-wide response of the North Atlantic on timescales of a few years, communicated via boundary waves, equatorial Kelvin waves, and westward propagating Rossby waves. In addition, modified air-sea interaction plays a fundamental role in setting up the basin-scale response of the Atlantic circulation in its subpolar and subtropical gyres. In particular, the modified ocean dynamics and thermodynamics lead to a depression in the central North and South Atlantic that would not be expected from linear wave dynamics. Moreover, the heat content increases on basin and global scales in response to anomalous freshwater forcing from Greenland, suggesting that the ocean's response to enhanced freshwater forcing would be a coupled problem. Other parts of the world ocean experience a much slower adjustment in response to Greenland freshwater forcing, communicated via planetary waves, but also involving advective/diffusive processes, especially in the Southern Ocean. Over the 50 years considered here, most of the sea level increase associated with freshwater input from Greenland remains in the Atlantic Ocean. In contrast, ice melting around Antarctica has a much reduced effect on the global ocean. In both cases, none of the basins came to a stationary state during the 50-year experiment.