the Arctic[2]. Earlier time series[1,2] of salinity variability in the Nordic Seas appeared to be in phase with variability in the subpolar gyre, supporting a direct Arctic source of fresh water for both regions. However, the salinity record presented by Glessmer *et al.* shows a five-year delay between salinity fluctuations in the subpolar gyre and corresponding changes in the Nordic Seas. If a significant contribution of Arctic water to the subpolar gyre is confirmed by future analyses, then Arctic water may, after all, be the source of Nordic Sea freshening, but indirectly, through mixing and water mass transformation in the North Atlantic subpolar gyre.

Glessmer *et al.*[3] have demonstrated that the Atlantic inflow is the primary source of salinity anomalies in the Nordic Seas from 1965 to 1995. We now need to see whether this relationship also holds for the past 15 years, when the North Atlantic Oscillation was on average more neutral, the Northern Hemisphere was warming, and the accelerated melting of the Greenland and Canadian Arctic ice sheets added up to 500 $km^3\ yr^{-1}$ of fresh water to the Arctic and North Atlantic oceans. ❐

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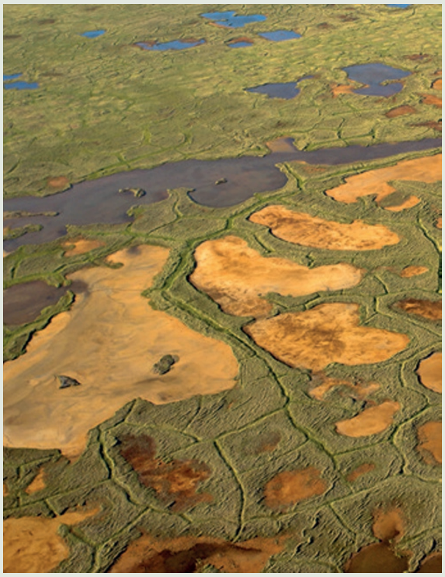
BIOGEOCHEMISTRY

Carbon sinks and sinking tundra

Alaska's Barrow Peninsula is characterized by irregular distributions of meadows, aquatic features and ice-wedge polygon formations within a mosaic of lakes, drained lake basins and surrounding tundra. Carbon fluxes vary across these different geomorphological features, and the geomorphology itself can change rapidly in response to climate. As a result, assessing the net carbon balance of these permafrost landscapes — which hold about half the world's soil organic carbon — and its sensitivity to future change is a challenge.

To evaluate current and future regional carbon budgets while accounting for the geomorphological heterogeneity, Mark Lara and colleagues created a map of the Barrow Peninsula, classifying the landscape according to ten categories on a 30 × 30 m grid (*Glob. Change Biol.* http://doi.org/wdc; 2014). Specifically, they identified meadows, drained slopes, ponds, lakes, rivers, ice-wedge polygons with high, flat or low centres, interconnected low centre polygons, and troughs along the edges of polygons using remote sensing data from the QuickBird and Landsat-7 satellites. Using observations of growing-season fluxes of methane and CO_2 measured across the range of geomorphological features, they then estimated the regional carbon balance.

Whether a feature was wet or dry was an important factor in both CO_2 uptake and methane emissions. More methane was emitted from geomorphological features such as ponds, meadows, low centre polygons and troughs, where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wetter conditions provide the low-oxygen environment required for methane production. But many of these same features also had the highest levels of CO_2 removal from the atmosphere, with more carbon being incorporated into biomass and soils. An exception was low centre polygons, which were the only geomorphological feature to have a net loss of CO_2 to the atmosphere. The age of basins where lakes of meltwater had drained away — a common feature in the Arctic landscape — was also important: older basins emitted less methane, but also took up less CO_2 from the atmosphere than younger basins. Integrating across all the geomorphological variation, uptake of CO_2 outstripped emissions of methane, making the peninsula a net carbon greenhouse-gas sink.

Geomorphic change can happen relatively quickly in Arctic landscapes. In the youngest drained lake basins, new vegetation, ice wedges and polygon morphology establish themselves naturally on a decadal time scale, whereas the geomorphology of older drained basins, which can be thousands of years old, changes much more slowly. At the same time, Arctic warming has contributed to a rapid increase in the number of thermokarst pits and troughs, which are depressions in the soil that are formed when the ice wedges surrounding polygons melt and subside. The formation of thermokarst pits and troughs increases the area of saturated soils where methane is produced, but it also transforms low centre polygons to high centre polygons, which have higher rates of CO_2 uptake and lower rates of methane emissions. On balance, these geomorphological changes magnify the net greenhouse-gas sink in the Barrow Peninsula, and represent a negative feedback to the changing climate.

Taking into account the importance of geomorphology for carbon fluxes noted by Mark Lara and colleagues, it may be important to consider the evolution of the landscape alongside the direct effects of changes in climate in order to understand the response of Arctic soil carbon to global warming.

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