



## Soil map digs under the tundra

Philippe Ciais

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## BOOKS &amp; ARTS

## Soil map digs under the tundra

An ambitious atlas that charts the composition of frozen northern soils highlights their contribution to climate change, finds **Philippe Ciais**.

**Soil Atlas of the Northern Circumpolar Region**

Edited by A. Jones, V. Stolbovoy, C. Tarnocai, G. Broll, O. Spaargaren and L. Montanarella

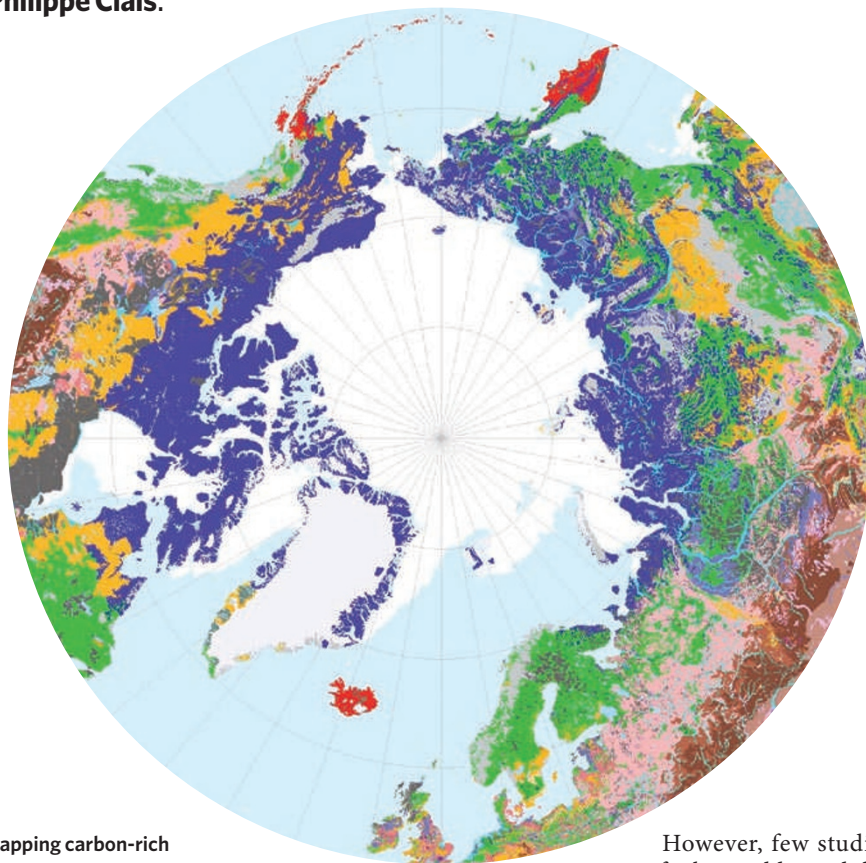
European Commission, Office for Official Publications of the European Communities: 2010. 144 pp. €25

In an era when we can access maps of anywhere in the world on our mobile phones, the skin of our planet seems to have lost its mystery. But the European Commission's *Soil Atlas of the Northern Circumpolar Region* is worthy of attention. The fragile soils of northern latitudes, especially the Arctic, hold the key to the future of Earth's climate.

Soil sampling requires extensive fieldwork. The *Soil Atlas* combines data from thousands of pits, dug across the circumpolar region by researchers from different countries each summer for more than 50 years. Experts from Canada, Russia, the United States and northern Europe came together to share these data to mark the International Polar Year in 2007–09 by raising public awareness of northern soils. The Joint Research Centre of the European Commission shows vision by publishing the results so lavishly.

In the past two decades, the northern circumpolar region has experienced faster warming than elsewhere in the world, a trend that climate models predict will continue. How soils respond to this thawing will decide whether the area will be a source or sink of carbon. In warmer future conditions, northern plants would grow better and sequester atmospheric carbon. But carbon would also be lost to the atmosphere through increased microbial decomposition. The land biota exerts further feedback on climate through its albedo and energy exchange, and through methane emissions by the wetlands that carpet flood plains. Unfortunately, we do not know how all these effects will combine.

The high northern latitudes are also of geopolitical and economic interest because of their huge stores of oil, natural gas and gas hydrate. These resources are likely to be exploited for energy as the polar ice retreats. The price could be high, in terms of both damage to the local environments and threats to global climate through increased carbon dioxide emissions.



**Mapping carbon-rich northern soils will help track their response to future warming.**

The *Soil Atlas* opens with a reminder that 90% of Alaskan soils, 60% of Russian soils and 50% of Canadian soils are frozen. The presence of ice greatly affects the characteristics of soil, with frost mixing the layers into chaotic patterns. These structures remain after warming — the testimony of former ice ages is still recognizable in thawed soils. The formation of ice wedges, frost cracking and frost heave also affect the physical properties, hydrology and biogeochemical cycles of northern soils.

Freezing conditions below the surface prevent roots from going deep, affecting plant growth. The frigid temperatures also preserve dead roots, which form carbon-rich deposits over time, such as in the Yedoma loess soils of northeastern Siberia. These contain organic matter up to 50 metres deep, intermixed with giant ice wedges. Altogether, frozen soils contain more than twice the mass of carbon in the atmosphere, and the release of even a fraction of this could amplify global warming.

However, few studies so far have addressed this problem quantitatively. The book highlights the potential danger but does not address how soil mapping should be improved to monitor it.

The atlas overcomes the contentious issue of how to classify soils objectively by adopting an international standard: the World Reference Base for Soil Resources, produced by the Food Administration Organization of the United Nations. The result is the first unified presentation of the circumpolar landscape. A drawback is the bias caused by reclassification. The arbitrary lumping together of different nationally defined soil categories means that whereas the map of soil types in some regions of Siberia looks extremely detailed, large areas of northern Canada are all mapped in the same colour, labelled cryosol. Readers could conclude that Canadian soils are more uniform or less densely sampled than in Siberia, which is not the case.

The book does not include information about sampling dates and locations, or the interpolation technique used to make maps

from field observations. Such explanations would have increased the volume's scientific impact. This omission reflects some reticence of Arctic countries to divulge detailed geo-referenced data about their soils and forestry to their neighbours. Now that climate researchers are, quite rightly, under pressure to be transparent about their source data and models, inventory agencies in each country should follow suit. It is a step in the right direction that

the *Soil Atlas* maps are openly accessible online (see [go.nature.com/TaMdZR](http://go.nature.com/TaMdZR)).

Knowledge of the northern soils could benefit many disciplines, from studies of landscape formation to meteorology, climatology, ecology, biogeochemistry and hydrology. To allow further analyses, these data will need to be translated into a form that is amenable to computer modelling — for instance, tabulated soil depths, hydraulic properties, conductivity,

and carbon and nutrient content. This can be done if researchers combine their efforts, so let's hope that the collaborative spirit of the International Polar Year lives on. ■

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## On markets and collective mood

**Mood Matters: From Rising Skirt Lengths to the Collapse of World Powers**

by John L. Casti

Springer: 2010. 210 pp. \$27.50

Elections, markets and judicial systems rest on the presumption that people make conscious, logical choices based on stable preferences. Journals are packed with evidence to the contrary. Among the variables recently suggested to affect important decisions are rain, hunger, sexual arousal and the colour of ink used to express one's views.

With reason dethroned as the ruling explanation for people's conduct, the search is on for another framework in which human behaviour can be modelled. In *Mood Matters*, complexity mathematician John Casti argues that collective psychology is the place to look. The irrationality that matters — leading to financial panics, terrorist acts and political lurches — is not within individuals but among them, he says. Moreover, Casti believes that major social changes are signalled by fluctuations in markets. Reflecting the collective mood, financial data are reservoirs of social information that can be tapped to predict crises.

*Mood Matters* is a brief for the field of socioeconomics, a term coined by stock-market analyst Robert R. Prechter in the 1980s. It describes a nascent discipline that, Casti says, will explain and predict social change using reliable laws of human nature. Its instrument is stock-market indices, records of the prices of precious metals and the like. Because they have been recorded in detail for more than a century, financial markets are arguably one of the best measures of the attitudes of populations. The data are "clean", Casti notes, and there are abundant tools for analysing them.

Casti follows Prechter in arguing that social mood — defined as a group's collective belief about the future — is the main driver of wars, political upheavals, terrorist campaigns, changes

in fashion and economic booms and busts. Since 1700, he writes, major wars have tended to follow drops in stock prices. He discerns two types of collective mood: pessimistic and optimistic. Each mood moves through society in two phases so that nations, regions and even the whole world travel on an endless oscillation of mass emotion. Optimism, experienced first as hope then hubris, is followed by pessimism, felt as fear then despair, over many timescales. Returning to optimism once more, the cycle repeats.

What causes social moods to form? Quoting Prechter, Casti offers only the thin notion that all people have an "impulse to herd in contexts of uncertainty". This will not satisfy social scientists. Similarly hazy is the book's definition of the group that shares this mass emotion. Casti assigns a single mood at a given time to a particular collective, whether that is the population of a city, country or even the world. But each of us belongs to more than one social group, so how can we have one belief about the

future? How do individual beliefs contribute to the shared mood? How are variations over time to be reckoned with? All questions for the future, Casti says.

With so many key concepts left undefined, *Mood Matters* offers only trends and examples — horror movies are popular after stock prices have fallen, and incumbent politicians are not. This is not the "plausible chain of connection" that Casti hopes will make a scientific law distinct from a mere correlation. Similarly baseless are the inferences he draws between precise numbers and vague social concepts — for instance, between the Dow Jones Industrial Average and pessimism.

Casti is right to ask how we should move to a post-rational model of human nature, but he does not make the case that market data trends are the road to insight. There is no short cut around the lab through the stock-market tables. ■

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Collective psychology might be mirrored in the social information contained in financial market indices.