Around the world

J. Phys. Oceanogr. **37,** 2550–2562 (2007)

Averaged along parallels to the equator, the world oceans circulate from pole to pole in two giant vertically stacked loops, finds a new study. The upper circulation cell extends to about 2,000 m in depth and connects waters sinking in the northern subpolar regions to water rising in the Southern Ocean. The second loop snuggles up underneath, with water sinking to the bottom around Antarctica and rising on its way north along the ocean basins' rough sea floor.

Rick Lumpkin of the National Oceanic and Atmospheric Administration, Miami, and Kevin Speer of Florida State University used an inverse ocean model — that is, a model that finds the best-fitting circulation pattern given our incomplete knowledge of ocean flows and the exchange between ocean and atmosphere. They fed the model with global data on wind as well as heat exchange with the atmosphere, and with the ocean flow data from the World Ocean Circulation Experiment, obtained between 1985 and 1996.

The two-cell global circulation pattern that the model returns differs between the Atlantic and the Indo-Pacific oceans: the upper cell is much more prominent in the Atlantic Ocean.

Northern Asian forests

Earth Planet. Sci. Lett. **264,** 284–298 (2007)

Earth's climate both influences and is influenced by vegetation. It is therefore important to understand past variations in vegetation cover. A recent study finds that the density of trees in forests during peak conditions of the last Ice Age — the Last Glacial Maximum — was moderately lower than in today's forests.

Pavel Tarasov from Free University, Germany and colleagues used an extensive compilation of data on modern and fossil pollen collected from various locations in northern Asia in order to reconstruct the tree density during the Last Glacial Maximum. They first calculated modern tree density using remotely sensed as well as pollen data. The relatively robust agreement between estimates from the two methods and the quantitative relationship between them meant that fossil pollen data could be used to estimate the tree density in northern Asia around the Last Glacial Maximum. The results indicate that areas that are forested at present were much more open with lower vegetation density at that time.

These findings support moderately low tree cover density, but not a substantial reduction or complete absence of trees in northern Asia during the peak of the last Ice Age, as had been suggested earlier.

Stretching the crust

MAREK SILARSKI

Geology **35,** 1135–1138 (2007)

The Pannonian Basin is a marked topographic low in central Europe, surrounded on all sides by mountain ranges. Basin formation was thought to have been initiated by stretching of one plate as the neighbouring plate progressively sank (subducted) into the mantle. A recent study proposes instead that simultaneous stretching and contraction, triggered by the collapse of previously over-thickened crust, and consequent sinking of the underlying mantle layer can explain the region's unusual topography.

Gregory Houseman and Lykke Gemmer of the University of Leeds, UK, used a numerical model to simulate the deformation of a lithospheric block with an unusually thick crust in one region. Collapse of the thick part of the crust induces sinking of the underlying dense lithospheric mantle. The crust immediately above is dragged along and buckles up to form a peripheral mountain range. As the warmer and more buoyant mantle comes up, the crust encircled by the mountains is stretched and becomes thinner. In the Pannonian Basin region, the differential stretching of crust and mantle layers is better predicted by these suggested processes than by the subduction explanation.

Deep earthquakes occurring beneath the southeast Carpathian Mountains may delineate the still-sinking lithospheric mantle.

Earth's hotter twin

Nature **450,** 629–632 (2007)

Venus and Earth are almost equal in mass and radius and appear to have evolved from very similar beginnings, yet the surface climate on both planets is very different. However, first results from the Venus Express mission that reached the planet in April 2006 suggest that despite their dissimilar surface temperatures, Earth and Venus have a lot in common.

Håkan Svedhem at the European Space Agency, Nordwijk, Netherlands, and his colleagues give an overview of a suite of papers analysing the data from the first year of the Venus Express mission that launched from Kazakhstan in November 2005. They report that, like Earth, Venus has a longitudinal atmospheric overturning circulation — the Hadley circulation. Because of the planet's slow rotation, the venusian overturning extends substantially further poleward than on Earth, to ~60° of latitude, where it transits abruptly into the polar circulation — a vortex-type structure with a double eye.

In addition, the mission revealed a lightning rate on Venus that is about half of that on Earth, constituting a substantial energy input into the lower atmosphere, with potential implications for atmospheric chemistry.

Snowball Earth prevented?

Nature **450,** 813–818 (2007)

A drawdown of oxygen into the ocean in rapidly cooling conditions could have led to the release of carbon dioxide to the atmosphere, allowing the Earth to steer clear of the tipping point into a 'snowball Earth', according to a new modelling study. This feedback loop could have acted as a buffer to control extreme temperature variations before the Cambrian explosion of life.

W. Richard Peltier from the University of Toronto and colleagues present a combined model of the carbon cycle and physical climate during the Neoproterozoic era, which suggests that a complete snowball state might not have occurred. The 'snowball Earth' theory proposes that for some time during the Neoproterozoic era (around 700 million years ago), the planet was entirely covered by ice. In the new model, more atmospheric oxygen is absorbed into the ocean as surface temperatures drop, which in turn mobilizes dissolved organic carbon for release into the atmosphere as carbon dioxide. The rise in atmospheric carbon dioxide levels causes warming of the Earth's surface, which counters the initial cooling effect.

During the Neoproterozoic era, conditions on Earth were clearly extreme. But the new model suggests that although the climate was unusual, the carbon cycle was even more out of kilter compared with the 635 million years that followed.