Geophysical Research Letters

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Highlights of this issue

Geophysical Research Letters, 28 November 2004

Simulating Jupiter and Saturn's cloud patterns

Researchers have successfully recreated in laboratory experiments the unusual patterns seen in cloud bands circling Jupiter and Saturn. **Read et al. [L22701]** suggest that normal planetary rotation creates periodic organized systems of clouds in the planets' turbulent atmospheres that leads to the discolorations seen around the two giants and may explain similar features observed in Earth's oceans. Such banded features and winds have long been observed in telescopic images of the two planets, but their origin has not been conclusively determined. The researchers expanded on previous numerical and theoretical studies by conducting experiments with a 14-meter diameter turntable, on which they generated and maintained zonal jets under simulated rotational conditions. They then studied the patterns over extended periods as the jets evolved and changed in response to experimental variables. The authors confirmed the conditions needed to create and sustain the regional atmospheric patterns and indicate that the new information could allow them to better estimate the circulation patterns in the future.

Atmospheric chemistry's enhanced effect on organic aerosols

Chemical processes in the atmosphere may remove nearly as much organic carbon from the troposphere as rain, which was previously considered the major mechanism for eliminating the pollutant particles. **Molina et al. [L22104]** report that organic aerosols, which are abundant in the troposphere and as an aerosol can affect cloud formation and climate, can be quickly broken down after a chemical reaction with ubiquitous hydroxide compounds. The authors show that particles containing compounds such as paraffin wax are readily volatized by these and subsequent reactions, whereas inorganic particles are better able to resist the breakdown. The researchers' laboratory experiments also show the removal rate for organic particles and indicate that other compounds such as soot may experience a similar reaction in the presence of hydroxyl radicals. Their results may necessitate the revision of global circulation and atmospheric transport models to account for the changes in the lifespan of pollutant aerosols in the environment.

Explaining ozone reductions in California pine forests

A previously unmeasured type of very reactive particles in California's pine forests may be responsible for enhancing ozone uptake in the forests and affecting the tropospheric chemical composition. **Goldstein et al. [L22106]** report that thinning of the forests, which dramatically enhanced natural hydrocarbon emissions from the trees, also stimulated ozone uptake within the forest canopy. They suggest that the observation proves that the unmeasured natural emissions, called biogenic volatile organic compounds, released from pine needles and bark similarly to commonly measured emissions, are so reactive that they are lost via ozone oxidation before they can escape the forest canopy. The authors suggest that the volatile organic compounds may be the dominant cause of ozone deposition in pine forests and should be included in climate models. Such inclusions would affect emission inventories and estimates for ozone and atmospheric chemistry on local, regional and global scales.

Time to improve GPS accuracy

Correcting for a time lag built into current Global Positioning System satellites can significantly enhance the accuracy of highly detailed GPS observations that are increasingly used to study Earth systems. **Choi et al. [L22608]** report that existing satellite techniques often slightly misjudge the location of ground changes like seismic activity, ice sheet flow and volcanic deformation because researchers used the wrong time delay in the GPS satellites. The authors show that the orbit period varies for each satellite and often differs considerably from what scientists have assumed since the GPS constellation was begun in the late 1970s. The researchers, for example, examined a GPS dataset from the well-observed 2003 San Simeon earthquake and found that high-precision (1 Hertz) GPS data needed to be corrected by nine seconds. They suggest that the improved processing technique would greatly reduce current error rates and make it possible to more accurately measure dynamic ground motion across the globe.

Cover. *A favored theory for the origin of banded zonal jets, like those seen in the atmospheres of the outer planets and narrow jets recently discovered in the terrestrial oceans, has been tested experimentally in the world's largest rotating tank. The theory is based on anisotropic self-organization in geostrophic turbulence in the presence of a planetary vorticity gradient. A geostrophically turbulent flow developed from small-scale, salt-driven convection, forced by spraying denser water onto the surface of a fluid layer. The streak-line photograph at the top captures a snapshot of large eddies and zonal jets that emerged from the convective cells, organized by the system rotation and the "planetary beta effect" produced by sloping bottom topography (straight lines are radial features at the bottom of the tank). The adjacent radius-time (Hövmüller) diagram shows contours of the zonal mean velocity, which show persistent zonal jets that alternate in sign with radius, indicating that this mechanism works in 3-D in a real fluid.* See Read et al. [L22701].