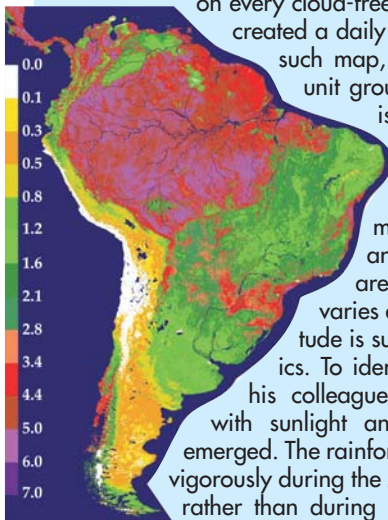
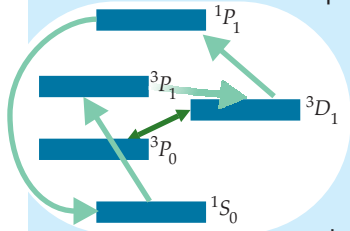


Amazonian rainforest regulates its own rain. Since 1999 the MODIS (Moderate Resolution Imaging Spectroradiometer) instrument aboard NASA's *Terra* spacecraft has looked down on every cloud-free spot on Earth's surface and created a daily map of the vegetation. One such map, of the green-leaf area per unit ground area in South America, is shown here. Boston University's Ranga Myneni and his colleagues have analyzed five years of MODIS maps of the Amazon basin and found that the total leaf area of the rainforest's trees varies annually by 25%. The amplitude is surprisingly large for the tropics. To identify its source, Myneni and his colleagues correlated the leaf area with sunlight and rainfall. More surprises emerged. The rainforest's leaf area expands most vigorously during the Amazon's sunny, dry season rather than during its cloudy, wet season. The growth spurt starts just before the sunny weather, as if the leaves anticipate the change in season. Then, when the leaf canopy is at its lushest, the rainy season starts, as if triggered by the water vapor and other gases that the leaves emit. Myneni believes the deep roots of the rainforest trees render the trees insensitive to the timing of the abundant rainfall. Decoupled from rainfall, the trees respond instead to variations in sunlight. (R. B. Myneni et al., *Proc. Natl. Acad. Sci. USA*, in press.) —CD



Trapping radium atoms. Some paths toward unifying nature's fundamental forces invoke sources of *CP* violation. Those same sources may shift the charge distribution of nuclei to give them a tiny but potentially measurable electric dipole moment (see PHYSICS TODAY, June 2003, page 33). Physicists are already looking for nuclear EDMs in trapped atoms. Heavy atoms work best. Their relativistic outer electrons incompletely screen the nuclear charge from an external electric field, exposing the putative EDM. If the nucleus has spin, the EDM will respond to parallel and antiparallel electric fields in a detectably different way. Because of its high atomic number and nuclear spin, the radium-225 nucleus is already a promising EDM candidate. Its octopole shape, which boosts any EDM 100-fold, makes it an even better one. Unfortunately, radium is hard to cool and trap because it lacks a strong atomic transition for removing kinetic energy. Even so, Jeffrey Guest of Argonne National Laboratory and his colleagues have recently trapped ^{225}Ra (and ^{226}Ra). Their scheme works as follows. Laser light at 714 nm drives the $^1\text{S}_0 \rightarrow ^3\text{P}_1$ transition. Instead of obligingly dropping back to $^1\text{S}_0$ for another round of cooling, the atoms occasionally de-excite to the $^3\text{D}_1$ state. That detour is not disastrous. Light from a second laser, at 1429 nm, drives the $^3\text{D}_1 \rightarrow ^1\text{P}_1$ transition. From $^1\text{P}_1$, atoms promptly de-excite to the



$^1\text{S}_0$ ground state by emitting a 483-nm photon. The scheme worked far better than the Argonne researchers expected. At first they worried that too many atoms would make a $^3\text{D}_1 \rightarrow ^3\text{P}_0$ transition and miss out on excitation to $^1\text{P}_1$. That leak was plugged by a surprising source: Room-temperature blackbody photons from the glass walls of the trap chamber repopulate the $^3\text{D}_1$ state. For perhaps the first time, ambient photons have helped, not hindered, a cold-atom experiment. (J. R. Guest et al., *Phys. Rev. Lett.* **98**, 093001, 2007.) —CD

Slowed light handed off. Eight years ago Lene Hau and colleagues at Harvard University demonstrated the ability to slow a light pulse in a gas of atoms to 17 m/s. Quantum interference effects among the atoms, the light pulse, and a second, coupling light beam slow and spatially compress the light pulse as it enters the atom cloud; the pulse's amplitude and phase information get coherently imprinted on the atoms. A few years later, the team showed that if the coupling beam is turned off, the light pulse is actually halted, but its imprint on the atoms remains. If the coupling beam is turned back on, the original light pulse could be reconstituted and sent on its way. Now Hau's group has added an extra layer to the story: passing the encoded light-pulse information from one atom cloud to another. She and her colleagues begin by halting and extinguishing a light pulse in a Bose-Einstein condensate of sodium atoms. The amplitude and phase of the light pulse become imprinted on a pulse of atoms that is ejected from the condensate in the same direction as the incident light pulse. As seen going from left to right in this shadow image, the "messenger" pulse travels to a second sodium BEC some 160 microns away, from which the signal is revived as a light pulse. This feat, say the researchers, may find application in quantum information processing and controllable optical delay lines. (N. S. Ginsberg, S. R. Garner, L. V. Hau, *Nature* **445**, 623, 2007.) —PFS



The quantum Hall effect warms up. Observing the quantum Hall effect (QHE) in a two-dimensional electron system requires exquisite care and ultralow temperatures, typically below the boiling point of liquid helium. Graphene, a one-atom-thick sheet of carbon atoms tightly packed in a honeycomb lattice, is a remarkable exception. By fashioning graphene into an FET and using the gate voltage to adjust the charge-carrier density in a fixed magnetic field of 29 T, Andre Geim (University of Manchester, UK), Philip Kim (Columbia University), and their colleagues noticed QHE signatures emerge even at room temperature. Graphene's band structure accounts for the observation: Its electrons behave like massless, relativistic fermions (see PHYSICS TODAY, January 2006, page 21). In the presence of a magnetic field, the allowed electron energies split into discrete Landau levels. In graphene, unlike other, "nonrelativistic" QHE materials, the gap between the ground state and first excited level exceeds the thermal energy at room temperature by an order of magnitude for a magnetic field of 45 T. Researchers currently harvest their graphene by simply peeling off monolayer flakes from bulk graphite. With more careful preparation to reduce defects, the authors expect that QHE-based resistance standards using graphene in magnetic fields as low as 5 T may soon be developed. (K. S. Novoselov et al., *Science* **315**, 1379, 2007.) —RMW ■