their colleagues realized that the metal edges of each antenna would bend the horizontal electric field of any normal-incidence photons by 90° and thereby satisfy the QCL selection rule. The photons become loosely trapped between the metal cladding layers and are amplified as they interact with the subbands in the quantum wells. The antenna structures likewise bend outgoing photons' field by 90°, which recovers their horizontal polarization.

The new device's geometry and large cross section offer further advantages. With 17 antennas packed together and receiving the same reflected light from an output polarizer, the laser is easy to lock into a single-cavity mode whose shape, polarization, and spectral properties can be controlled through the design of the metasurface and external cavity. What's more, the beam power is scalable. So far, Williams and his team have generated beams of a few milliwatts—a respectable output. To increase the output power, they could lithographically add more antennas.

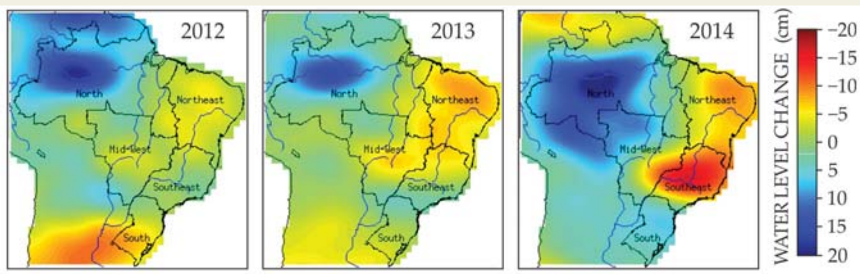
"We've shown the VECSEL configuration yields good power with a great beam," Williams says. "Our goal is to demonstrate that it yields great power in a great beam."

Mark Wilson

Reference

1. L. Xu et al., *Appl. Phys. Lett.* **107**, 221105 (2015).

WEIGHING BRAZIL'S DROUGHT FROM SPACE



The drought that has been afflicting southeastern Brazil for three years has become the country's worst since the 1920s. Water is rationed in São Paolo and other cities. Crop yields are plummeting. If the drought does not break, energy rationing could follow, as Brazil's hydropower stations struggle to operate. To gain a continent-scale overview of the disaster, Augusto Getirana of NASA's Goddard Space Flight Center turned to data from the Gravity Recovery and Climate Experiment (GRACE). The two GRACE spacecraft circle Earth in a low-altitude polar orbit, one trailing the other by 220 km. Whenever the lead craft flies over, say, a mountain, it feels a slightly increased gravitational tug, which temporarily pulls it farther away from the trailing craft. Measured interferometrically, such fluctuations in separation—positive and negative—are translated into a time-dependent map of Earth's gravity. On seasonal time scales, the fluctuations arise largely from changes in the disposition of the planet's liquid and frozen water. When Getirana looked at GRACE maps of Brazil, he could see the seasonal changes in the total amount of water above and below ground. As the figure shows, by 2014 a severe drought had stricken the southeast. Because droughts arise from planet-scale shifts in climate, Getirana's study suggests that gravitational data could help tie those shifts to local shifts in ground and surface water. (A. C. V. Getirana, *J. Hydrometeor.*, in press.) —CD

and temperature, used a microphone to measure the sound at a regularly spaced array of points in the green region. The experimental positions of the pressure maxima and nodal lines agreed well with optimization results, especially when factoring in microphone positioning errors and background noise. But the measurements highlighted the need for the calculations to account for damping, frequency and environmental variations, and manufacturing tolerance. (R. E. Christiansen, O. Sigmund, E. Fernandez-Grande, *J. Acoust. Soc. Am.* **138**, 3470, 2015.) —RJF

SWIMMING SPHERES

The gliding motion of jellyfish, eels, and other sea creatures is not just captivating to watch in an aquarium. Understanding the mechanics of swimming can, for example, help life scientists explicate biological functions and engineers design tiny robots for targeted drug delivery. Now, Daphne Klotsa of the University of North Carolina at Chapel Hill and colleagues from the University of Nottingham in the UK have carried out a detailed observational and simulation study of an extraordinarily simple type of artificial swimmer: two spheres attached by a spring and placed in a saltwater bath. The researchers caused the bath to vibrate vertically, both to provide energy that the swimmer could convert into translational motion and to allow for control of the streaming Reynolds number—loosely speaking, the ratio of inertial to viscous forces acting on the swimmer. For low Reynolds number, the experimental team observed oscillations of the spheres, but no center-of-mass motion. When they raised the Reynolds number, however, by increasing the vibration frequency or amplitude, the simple swimmer began to move through the saltwater as it oscillated. The simulation cross section illustrated here shows the essential mechanism at play when the spherical components (filled circles) are of unequal size and density. Arrows give the direction of the liquid flow averaged over the spheres' oscillation cycle. The crosses indicate vortex rings surrounding the spheres. At low Reynolds number (left), the flows around the two oscillating spheres are similar and the swimmer is stationary. High Reynolds number (right) breaks that symmetry of flow; indeed, a forceful jet of water emerges from below the smaller, denser sphere, propelling the swimmer upward. (D. Klotsa et al., *Phys. Rev. Lett.* **115**, 248102, 2015.) —SKB PT