assumptions. Until now, it was not clear that one could fully determine Earth's structure using only wave travel times.

But that is what Vasy and his team's proof shows — and the geophysical problem was a key motivation for solving the conjecture. Their assumption, which differed from Michel's, was that the curved space, or manifold, is structured with concentric layers. This allowed them to construct a solution in stages. "You go layer by layer, like peeling an onion," says Uhlmann. For practical applications, this means that researchers will not only know that there is a unique solution to the problem; they will also have a procedure to calculate that solution explicitly.

The three mathematicians circulated their 50-page paper among a small pool of experts and then posted it in the arXiv repository. Depending on the feedback they get, the authors hope to submit it to a journal in the coming weeks.

FROM THEORY TO REALITY

But applying the theory to real geophysical data will not happen immediately, says Maarten de Hoop, a computational seismologist at Rice University in Houston, Texas. One difficulty is that the theory assumes that there is information at every point. In reality, however, data are collected only at relatively sparse locations.

The theory could lead to a better understanding of known features, such as the mantle plumes underneath Iceland or Hawaii, and, perhaps, to the discovery of new ones, adds de Hoop.

As with every meaty mathematical result, it will take time to get to grips with the proof and vet it thoroughly, says Gabriel Paternain, a mathematician at the University of Cambridge, UK. Experts are taking the claim seriously, in part because it builds on a technical step from a linear form of the problem that the community has accepted as a breakthrough[4], adds UCL mathematician Yaroslav Kurylev. So far, says Paternain, the impression is "excellent". ■

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SMART-BOX.PT

Technicians install sensors for the Perdigão wind-mapping project.

ATMOSPHERIC SCIENCE

Huge wind-flow study spins up

International team in Portugal seeks to improve models of wind patterns over rugged terrain.

BY ALEXANDRA WITZE

Machines have invaded a windswept rural valley in eastern Portugal. Squat white containers stare at the hillsides, sweeping lasers across the eucalyptus-studded slopes, and towers bristling with scientific instruments soar 100 metres into the air.

Their international team of minders will spend the next five months measuring nearly everything it can about the wind that blows through the site. An unprecedented arsenal of meteorological equipment will study speed, direction and other characteristics for the world's most detailed wind-mapping project. The aim is to illuminate fundamental properties of wind flow over complex terrain, to help researchers improve atmospheric computer models and enable engineers to decide where to put wind turbines to get the most energy from them.

The results of the project, called Perdigão, should also improve models of how air pollution sinks into valleys and help drones and aircraft to navigate gusty mountain terrain.

"This will be utterly transformative in both understanding the physics of the atmosphere and also how to optimally use wind energy," says Sara Pryor, an atmospheric scientist at Cornell University in Ithaca, New York, who works on the project. "It's brilliant."

By testing wind-flow models against the detailed data from Perdigão, researchers will be able to apply their findings in other locations. "Lessons learned will translate into improved atmospheric models for the entire wind-energy community," says Sonia Wharton, a meteorologist at the Lawrence Livermore National Laboratory in Livermore, California.

Europe gets 11% of its total energy from wind. But just a 10% shift in wind speed can change the amount of energy produced by up to 30%, says Jakob Mann, a wind-energy researcher at the Technical University of Denmark near Copenhagen. And losses are greatest in hilly or forested regions. Mann leads the €14-million (US$14.9-million) New European Wind Atlas project, a collection of wind-mapping studies and experiments of which the project in Portugal is the largest.

A pilot experiment by the Perdigão team in 2015 found turbulence downwind of one ridge that affected wind patterns on the next — the sort of detail that can improve models of atmospheric flow, says José Laginha Palma, a wind-energy specialist at the University of Porto in Portugal and head of the project.

Such models have typically relied on measurements from a simpler field experiment based on and around a hill in Askervein, UK, in the 1980s. "We're going to update and replace data going back 30 years," says Palma.

Portugal has a well-developed wind industry, and the Perdigão ridges already host one turbine. Winds at the site generally sweep across and down two steep ridges at around 8 metres per second — but they can blow at up to 40 metres per second. One recent burst blew the door off a temporary office trailer on one of the ridges. Knowing where such gusts occur can help turbine engineers take advantage of the steady winds while avoiding damage by the biggest gusts, says Rebecca Barthelmie, a wind engineer at Cornell who is working at the site.

Much of the scientific equipment is already up and running, and researchers will install the rest throughout February. The set-up includes 54 masts outfitted with instruments to measure wind speed, direction, temperature, humidity and other factors, both along and perpendicular to the ridges, 20 times per second. And 22 instruments will study small-scale wind flow in three dimensions using the laser-based technique lidar.

Many studies have looked at wind patterns on the scale of 1 kilometre, but the Perdigão experiment is the first to push large-scale wind mapping down to resolutions of 100–500 metres, says Harindra Fernando, a fluid-dynamics engineer at the University of Notre Dame in Indiana.

He is co-leader of the US researchers working at Perdigão, who are funded with $3.4 million from the National Science Foundation. "What we are trying to do is portable to anywhere in the world," he says. ■

PUBLISHING

Funders call for bio-preprints hub

Biomedical scientists argue for centralized server.

BY EWEN CALLAWAY

Life scientists keen to share their findings online before peer review are spoilt for choice. Whereas physicists gravitate to one repository — the 'preprint' server arXiv — life sciences has a fast-growing roster of venues for preprints. There's the biology-focused bioRχiv, and a biology section on arXiv too. But other sites have sprung up in the past year, or soon will, and these, too, provide opportunities for life sciences: ChemRxiv for chemistry; psyArXiv for psychology; even AgriXiv for agricultural sciences and paleorXiv for palaeontology.

Now, a coalition of biomedical funders and scientists is throwing its weight behind a 'one-stop shop' for all life-sciences preprints — a move that its backers argue should clarify any confusion and make it easier to mine the preprint literature for insights.

On 13 February, ASAPbio, a grass-roots group of biologists that advocates for preprints, issued a funding call to build a central preprint site. The US National Institutes of Health (NIH), the Wellcome Trust and several other leading funders also announced their support for the concept.

"The landscape could become fragmented very quickly," says Robert Kiley, head of digital services at the London-based Wellcome Trust. "We want to find a way of ensuring that, although this content is distributed far and wide, there's a central place that brings it all together."

The details of the service are inchoate: its scope will depend on specific scientific fields and their funders, says Jessica Polka, the director of ASAPbio. But as well as aggregating content from other biology-focused preprint sites, ASAPbio wants the site to mesh with arXiv and with ChemRxiv, which the American Chemical Society in Washington DC plans to launch soon.

ALL YOUR PREPRINTS HERE

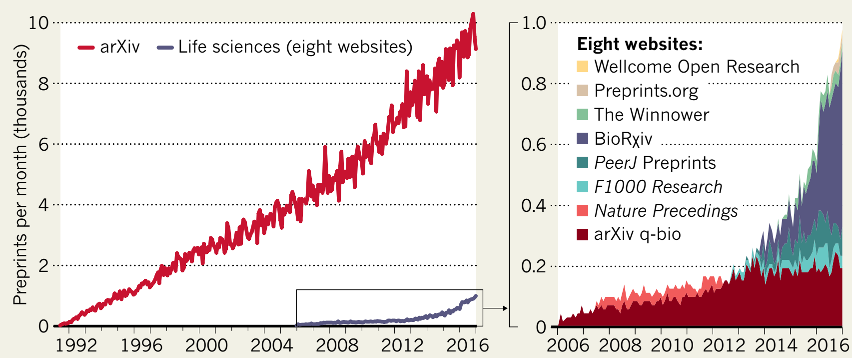
Proponents hope that a central site will lure biologists to embrace preprints as wholeheartedly as physical scientists have. Physics manuscripts routinely appear at arXiv.org months before publication in peer-reviewed journals, as researchers race to release their findings online before their rivals. And preprints are now accepted currency in determining priority for a discovery, as well as in winning grants and jobs. ArXiv handles more than 100,000 manuscripts each year in physics, mathematics and computer science, whereas the largest life-sciences preprint server, bioRχiv, posted around 5,000 manuscripts in 2016 (see 'Preprints on the rise').

"One of the lessons of arXiv is that users prefer 'one-stop shopping'," says Paul Ginsparg, a theoretical physicist at Cornell University in Ithaca, New York, who founded the site in 1991.

A central preprint service could also help scientists use automated software to mine the literature for insights, says Ron Vale, a cell biologist at the University of California, San Francisco, and a founder of ASAPbio. At the moment, researchers who want to mine ▶

PREPRINTS ON THE RISE

Life scientists are increasingly posting preprints online, although the much older arXiv server attracts ten times as many preprints, mostly in physics, computer science and mathematics.



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