

# THIS WEEK

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## The wisdom of clouds

*The European Open Science Cloud is a laudable plan to make publicly funded data freely available. It must be pushed forward, not allowed to stagnate.*

The European Commission has its critics, but no one can doubt it has ambitious plans. For example, by the year 2020, the commission says, all European researchers will be able to log in to an enormous virtual repository that will eventually provide access to the collective data from all publicly funded research. This European Open Science Cloud would be a safe, cheap and reliable way to store and access data, and getting to it would be as easy as signing into a Netflix account. It would also be a massive boon — encouraging interdisciplinary research and data reuse, reducing duplication and promoting reproducibility. Sounds more like a dream than a plan? Some scientists think so. Few even know the project exists.

Given the enormous value of such a system to researchers, their obliviousness is a sign that some of the people tasked with bringing the vision to life do not yet believe it will happen. And even those with faith don't know exactly what it would look like or how it would come about.

The vagueness is no great surprise. Rather than construct a single physical data repository, the commission wants to bring together and build on existing research data centres, both public and private. It would connect these using a single interface with common software and protocols. This is an efficient use of resources, but also a logistical and coordination nightmare.

Much of the commission's work so far has gone into understanding why researchers do not already routinely share data, focusing on existing incentives and the need for expertise. It thinks, rightly, that the cloud is the way to push the underlying culture of science towards data sharing. But now, getting the project going is crucial.

To that end, the commission gathered data experts from Europe's major laboratories, science funders and government representatives in Brussels on 12 June. The grand — if somewhat staged — aim of the event was to get all parties to endorse the project. But, revealingly, many attendees saw the project unfolding in a range of different ways. These conflicting views will have to be aligned somehow by the end of the year, when the commission intends to publish a formal plan.

Outstanding issues include the big one: how to pay. Major data repositories and shared cloud-computing facilities already exist, but some will need to grow. All will need to be made interoperable and connected by a high-bandwidth network. The commission has said that it expects to pay €2 billion (US\$2.2 billion) of an overall €6.7 billion — the rest of which it hopes will come from national funders and private sources using “innovative” business models.

One group that was little represented at the invitation-only event was commercial companies. These will be essential to bringing together under one virtual roof the many petabytes ( $10^{15}$  bytes) of data that European institutions generate each month.

Meanwhile, there are more subtle challenges that will take time and money to solve. The envisioned software tools to search, browse and access data do not yet exist. And if the cloud is to become more

than somewhere that research data go to die, the data must come annotated and formatted in such a way that other scientists can make sense of them.

Currently, the commission's dream is so big and shapeless that many involved can't see a path to achieving it. German and Dutch ministers warned last month that it risked getting bogged down in detail and funding disputes. Wary of failing to capitalize on the existing will to complete the project, they called for support for an initiative already under way in their countries. This aims to kick-start the wider science cloud by getting existing data infrastructures to agree on protocols that make at least some of their data findable, accessible, interoperable and reusable (FAIR).

**“The dream is so big and shapeless that many involved can't see a path to achieving it.”**

The project — called GO FAIR — intends to develop a template for linking up new partners, including cross-border collaborators, within a year.

Other European countries should not fear getting behind this initiative, or other pilot schemes that have grown organically in recent years. As long as communication lines remain open, finding out what works and what doesn't, and taking some responsibility for tackling the huge range of questions, can only be valuable. It could also provide the necessary momentum. Although such an ambitious plan might never have emerged without European leadership, the size of the project has brought inertia. And like a PhD student faced with the looming task of writing up a thesis, those involved may find the project almost too daunting to start. Getting a range of players to agree to the cloud as a goal was a crucial first stage. But progress is now more likely to come from pulling their heads down from the clouds and getting stuck in. ■

## Disaster alert

*The US government must keep its west coast safe.*

On a winter night three centuries ago, so a Native American legend tells, the Pacific Northwest of the United States and Canada was rocked by a ferocious clash between supernatural creatures. The Thunderbird and the Whale battled for hours. Thunderbird went to grab Whale in his talons, but Whale got away. The ground shook and the ocean rose to flood the coast.

Modern science caught up with these tales a few decades ago. When several nuclear power plants were proposed for the region, the US Nuclear Regulatory Commission investigated the likelihood

of a large earthquake striking the Pacific Northwest. The result was a shock. A series of geological studies revealed that enormous earthquakes and tsunamis had repeatedly ravaged the coast, most recently in January 1700.

Although earthquake risk in the region — known as Cascadia — is well known, what to do about it is still undecided. With a few exceptions, politicians have been slow to embrace emergency preparedness. Local governments are only just starting to get ready for the consequences of a catastrophic tsunami, such as moving schools out of inundation zones.

Some of the most forward-looking work is the result of private money. The co-founder of technology company Intel, Gordon Moore, lives on Hawaii's coast and is well aware of the threat of tsunamis. His foundation supports natural-disaster preparedness along the US west coast. This includes funding an April workshop that explored options to install monitoring instruments on the sea floor off Cascadia, some of them developed by a Seattle inventor and philanthropist with a keen interest in disaster mitigation (see page 466).

The Gordon and Betty Moore Foundation also supported the early development of ShakeAlert, an earthquake early-warning system led by the US Geological Survey (USGS), that is currently being tested along the US west coast. It relies on a network of seismometers on land. When the ShakeAlert instruments detect an earthquake, they send immediate warnings, which arrive before the tremors cause damage. The plan is that the seconds to several minutes of notice can allow trains to slow to a halt, surgeons to pull their scalpels out of patients and children to climb beneath desks.

The foundation's funding made sense when ShakeAlert was getting under way — private money is appropriate to jump-start experimental projects. But it is time for the federal government to commit.

Although the USGS has overseen ShakeAlert from the start, President Donald Trump has proposed cutting federal support for the system next fiscal year. The amount is US\$8.2 million — a puny sum for investing in such a seismically active region. The consequences of not being prepared are expensive: the Federal Emergency Management Agency has estimated that the seismic risk in California, Oregon and Washington could lead to average yearly losses of \$4.1 billion.

**“It is up to members of Congress to reverse this proposed cut and fully fund ShakeAlert.”**

To ensure the safety of US citizens is the most basic responsibility of the federal government. ShakeAlert is at a crucial time in its development: it has just enough momentum behind it to turn it into a reality. Organizers hope to have real-time alerts flowing to the public next year. The existing federal funds are a tiny investment with enormous public-safety benefits.

It is a challenge of disaster risk management to get anyone to care about an event that may or may not happen during a politician's tenure. But other nations have done it. Japan's much-vaunted earthquake early-warning system has had minor glitches, but overall has been tremendously successful in saving lives. Mexico's government has installed seismometer networks for real-time alerts throughout Mexico City. Romania has a similar system for a nuclear research facility.

Fortunately for the United States, Trump can only propose a budget. It is up to members of Congress to reverse this proposed cut and fully fund ShakeAlert. All the bluster coming out of Washington can't hold a candle to the next epic battle of Thunderbird and Whale. ■

## Mercury rising

*Future generations will fear, rather than fend for, the environment.*

Scott Pruitt achieved something of a political first last week. The controversial head of the US Environmental Protection Agency (EPA) was grilled by the officials who control his budget and told that he had asked for too little cash. In fact, the officials insisted, they were determined to give his agency more than he had requested.

“I can assure you, you're going to be the first EPA administrator that's come before this committee in eight years that actually gets more money than they asked for,” said Oklahoma congressman Tom Cole, a member of the US House of Representatives Committee on Appropriations who, as a Republican, is nominally on the same side as Pruitt. In a gruelling session, Pruitt was left in no doubt of what the committee members thought of proposals from Donald Trump's administration to slash both the spending and the remit of the EPA.

“I'll get straight to it. The fiscal year 2018 budget request for EPA is a disaster,” said Nita Lowey, a Democratic representative for New York who sits on the committee. The intended cuts of US\$2.4 billion to the agency budget, she said, would “surely impact EPA's ability to fulfil its critical mission of protecting the air we breathe and the water we drink”.

Not so, Pruitt stated. With less money and fewer staff, the agency would do a better job and be able to focus more on its core mission. What's more, President Trump's high-profile exit from the Paris agreement on climate change, he has promised, does not undermine US leadership on and engagement with the problem.

Meanwhile on planet Earth the heat is rising. Britain was hit by a heatwave at the weekend that forecasters say could last for weeks, and

temperatures in California are predicted to reach record levels in a few days' time. The world is cooking and we should anticipate more of the same.

From extreme rainfall to rising sea levels, global warming is expected to wreak havoc on human lives. Sometimes, the most straightforward impact — the warming itself — is overlooked. Yet heat kills. The body, after all, has evolved to work in a fairly narrow temperature range. Our sweat-based cooling mechanism is crude; beyond a certain combination of high temperature and humidity, it fails. To be outside and exposed to such an environment for any length of time soon becomes a death sentence.

And that environment is spreading. A death zone is creeping over the surface of Earth, gaining a little more ground each year. As an analysis published this week in *Nature Climate Change* shows, since 1980, these temporary hells on Earth have opened up hundreds of times to take life (C. Mora *et al.* *Nature Clim. Change* <http://dx.doi.org/10.1038/nclimate3322>; 2017). At present, roughly one-third of the world's population lives for about three weeks a year under such conditions. If greenhouse-gas emissions continue to rise unchecked, that figure could climb, exposing almost three-quarters of the population by the end of the century.

The analysis also reveals that even aggressive reductions in emissions will lead the number of deadly heatwaves to soar in the coming decades. Cities including London, New York, Tokyo and Sydney have all seen citizens die from the effects of excessive heat. By 2100, people in the tropics could be living in these death zones for entire summers. It's true that warmer winters will save lives further north. And those living in urban environments may find ways to adapt to the new norm of extreme heat. But, if the researchers are correct, the politics of Pruitt and those who try to hold him to account will seem quaint and anachronistic to our grandchildren. For they will live in a world in which most will see the environment less as something to protect, and more as something to protect themselves and their families from. ■