through or connect data sets. Intelligent searches often rely on whatever descriptive metadata researchers have attached to the data. The metadata are read by an application programming interface (API), a set of commands that computer programmes use to interact with data stores and pull information from them. Not all data repositories use APIs; those that do not may not be the best places to store or release information, because it could be hard for anyone to find.

Sites that are dedicated to hosting particular types of data, such as DNA sequences, usually tell submitters what format is appropriate. They may require data to be entered using an online form or following specific instructions. By contrast, generalist sites — such as institutional repositories, data journals or ventures similar to figshare.com — may have looser requirements. This has the potential to result in a blizzard of different formats and descriptive tags, which could make discovering and reusing data more difficult, so researchers should pay close attention to the norms in their fields.

Decisions about metadata standards should be made early in a research project, says Michener. DataONE has provided a primer on best practices, as has a tool called DataUp, run through the University of California Curation Center in Oakland to help researchers to create data packages that are good enough to put online. Other aspects of data-sharing to consider early on include the information's sensitivity and whether some parts must be stripped out to avoid, for example, identifying human study participants or the locations of endangered species. Researchers also need to be clear about whether they will allow their data sets to be used for any purpose, or whether they would like to limit reuse to, for example, non-commercial applications. One widely understood way of documenting reuse rights is by giving the data one of several different Creative Commons licences.

> ***"At the end of the day, science is a social process. You will never get there hiding yourself and your work."***

Ultimately, says Michener, early-career researchers need to pay attention to new and developing ways to share data, and to the standardized formats that are emerging to make data easier to search and discover. Those who do not, he says, should rethink why they are doing research. "I think we are just now reconnecting with what science is all about — not just creating new knowledge, but also sharing the information and data that underpins those discoveries." ■

Richard Van Noorden *is a senior reporter at* Nature.

TURNING POINT
Kevin Gurney

Sustainability scientist Kevin Gurney has been studying climate change for 27 years. He has worked in academia, public policy, non-governmental organizations (NGOs) and think tanks, and is currently at Arizona State University in Tempe. He describes how he navigates the science–policy divide.

What convinced you to do a graduate degree?
As an undergraduate, I worked at the Lawrence Berkeley National Laboratory in California, taking spectroscopic measures of greenhouse gases. Working with wonderful mentors who were excited about the science was infectious. Later I did a master's in atmospheric science at the Massachusetts Institute of Technology in Cambridge and my focus shifted to chemistry and chlorofluorocarbons (CFCs) — greenhouse gases that also deplete Earth's ozone layer, and so have science and policy implications.

How did you become active in policy?
Regulation was ramping up to stop production of fully fluorinated CFCs, and industry was looking for alternatives. In 1986, I found that compounds called HCFCs, which contained less chlorine and thus caused less ozone depletion, still had the heat-trapping properties of CFCs. The policy implications were huge and there was so much misinformation. I was thinking, people need to know about this. I got more involved with policy at that point.

Why not go on immediately to pursue a PhD?
I wanted to work on the political implications first. In 1992, I started working with the Institute for Energy and Environmental Research in Takoma Park, Maryland. We sued the US Environmental Protection Agency to get it to regulate HCFCs, and we spread the word that HCFCs were not as environmentally friendly as manufacturers claimed. I also got involved in discussions on the Montreal Protocol, the treaty to regulate ozone-depleting chemicals. I realized how ineffectively science and policy interacted. I got a master's in public policy at the University of California, Berkeley, then a PhD in ecology at Colorado State University in Fort Collins. These days it is easier to get an interdisciplinary degree, but I tell my students that some degrees lack a rigorous science foundation. There is no substitute for a solid mathematics and physics background — it gives you credibility.

How did you move from CFCs to carbon?
I attended the negotiations in London and Copenhagen to amend the Montreal Protocol, laying out a plan to manage CFC phase-out. Once the treaty was set, I began to see that rising carbon dioxide levels were an interesting problem. I maintained a personal network of contacts in NGOs, and many organizations were shifting to carbon dioxide and climate research for exactly the same reasons I was — it was quickly gaining traction. NGOs, including the US branch of the conservation group WWF in Washington DC, paid for me to go to Kyoto Protocol negotiations, and I worked pro bono as a science consultant. I told the NGOs I was not going to give anyone just a line they wanted to hear. My PhD adviser let me take vacation to attend negotiations every four months.

What is climate-change negotiation like?
It is the most intense, pressure-filled world you can imagine. I was very involved with language in the Kyoto Protocol about the missing carbon sink — the carbon dioxide absorbed on land, which is not fully understood — and how to account for it. I learned a lot about law during my policy degree, which made me effective in crossing the divide between policy and science. You don't have to dumb down; you have to learn how legislators and policy-makers view science.

You won a Faculty Early Career Development award from the US National Science Foundation in 2009. How are you using it?
I'm doing a risky thing and getting involved with citizen science to use Google Earth to identify power plants (see *Nature* http://doi.org/nb3; 2013). Normally I would be too worried that it would fail to use funding dollars. But we have thousands of people involved and are adding hundreds of power plants to an emissions database that is part of NASA's pilot carbon-monitoring system. It is of interest to climate scientists, social scientists and policy-makers. ■

INTERVIEW BY VIRGINIA GEWIN