Open and Reproducible research: the new frontier

Dasapta Erwin Irawan & Willem Vervoort

4 January 2018

Open data and reproducible research

Summary

- Data and **open** data
- The issue with verifiable research
- Open and reproducible research
- Challenges

Data and **open** data (1)

How many of you have?

- Data from old research on a floppy disk, zip disk, usb stick, mobile harddrive: *I am going to publish that one day!*.
- Data on your harddrive from your PhD student, but you have no idea how she/he organised it
- received data from a colleague and spend hours reformatting it to your needs
- asked data from a colleague, who said yes, but then could not find the data
- spend hours filling in forms and e-mailing with another institution to access data (climatology!!)

Data and **open** data (2)

Have you ever experienced any of the following?

I have got this great idea,

- but I cannot access the data
- but I can't find a simple example of how to do the analysis correctly
- but my model won't run without this specific data

or. . . .I read this great paper,

- but I think the analysis is wrong.
- but I can't work out how exactly they this analysis
- but I think I know how to take the next step if I could use the data

Data and **open** data (3)

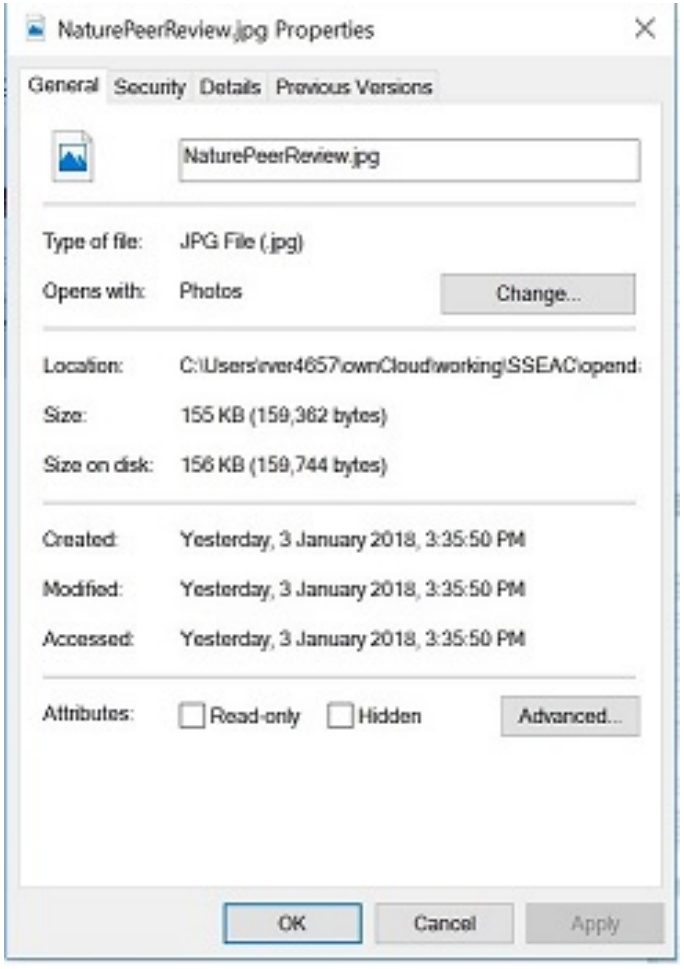
or. . . I am using this piece of software,

- but I don't understand how the algorithm exactly works
- but I would like to change it slightly to work better for my research
- but I can't access the code without a hefty fee

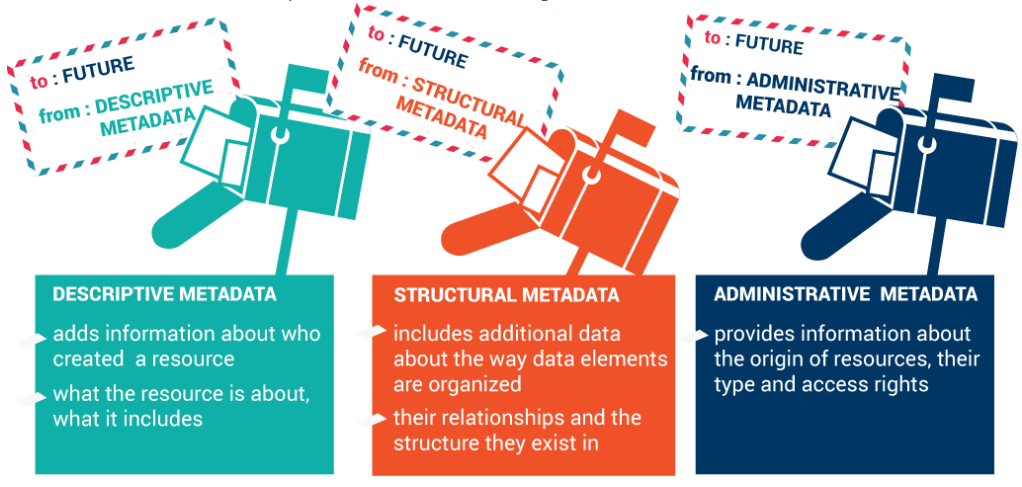
Data and **open** data (4)

- Data can be anything, it can be words, numbers, pictures, even bits of code or algorithms
- Most data is currently difficult to access
  - individuals computers
  - protected
  - not well described
- **Open data** is not only easily accessible, but is also well described
  - it has all the meta data to describe the *provenance* and the *characteristics*
- Examples are data from the IPCC and NOAA
- We will look at this in more detail later

Meta data



https://ontotext.com/knowledgehub/fundamentals/metadata-fundamental/



Vocabulary and data dictionary

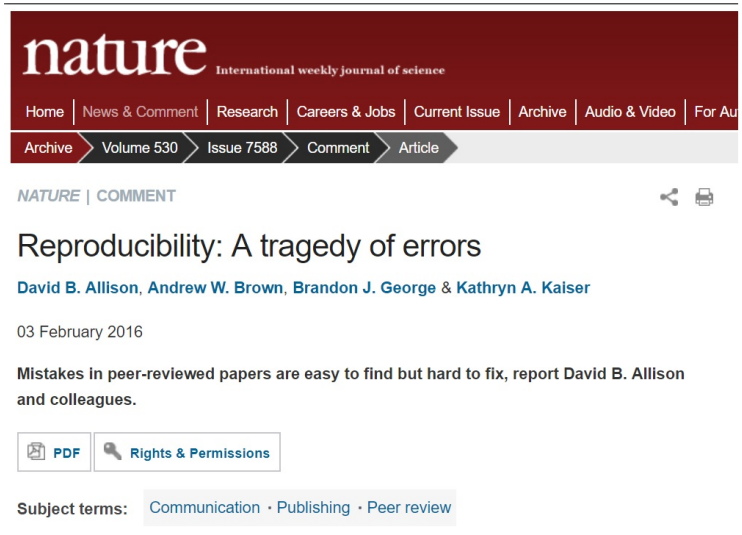
- The keywords for your metadata should originate from a **vocabulary** or an **ontology**
  - Ontology: set of controlled terms for keywords with a hierarchy: example FOR codes
  - A good ontology would have related terms, Wikipedia is an example of a system that uses an ontology
  - A vocabulary is a more simple list of keywords, for example, most journals require you to choose from specific keywords when you submit a paper

Vocabulary and data dictionary

- Data dictionary is simpler:
  - decribes columns in a data sheet
  - describes layout of code structure
  - describes files and folders
- example data dictionary: Readme file in example project

The issue with verifiable research

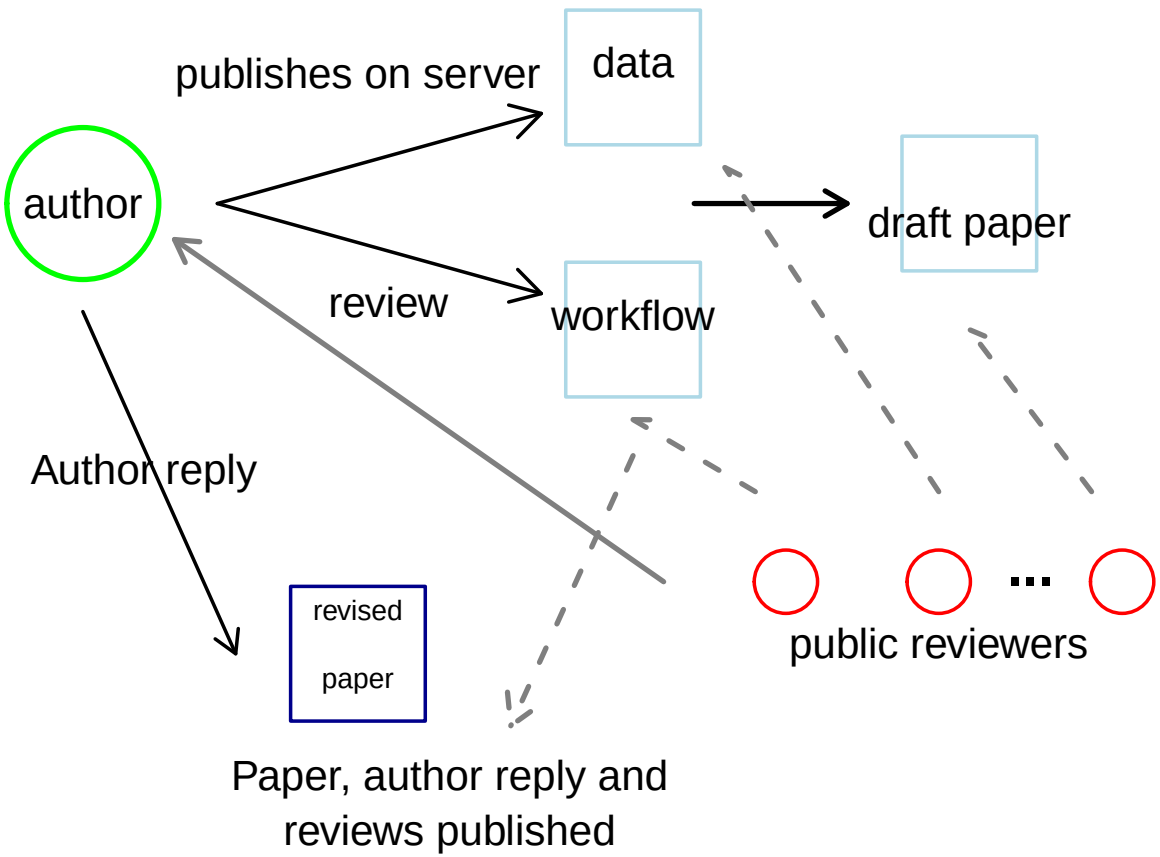
- The current process is peer review
- Requires knowledgeable reviewers
- System has been questioned recently, can it be fair and can it be maintained?
  - Fairness to different languages (non English)
  - Cost of traditional publishing
  - Hidden cost of reviewer's labour
- open and reproducible research might be a solution



An ideal description of open, reproducible, peer reviewed research

What would ideal open, reproducible research look like?

- all data and analyses should be open and accessible



The roadblocks to open data and reproducible research

Why is this not happening?

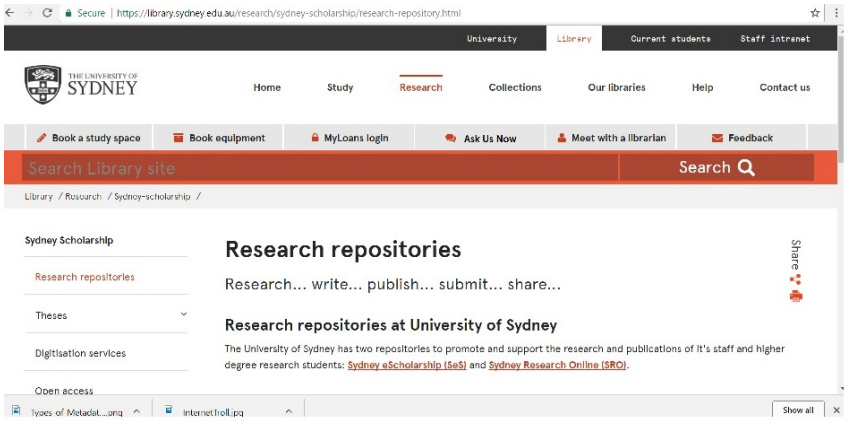
- Skill and ability to publish open data and workflows (researcher)
  - meta data
  - workflow documentation
- Provision of infrastructure (institution)
- IP and ownership claiming
- unbiased reviews and internet trolls

Three major components to reproducible data and research

- Open and accessible data
- For *raw* data: fully documented metadata (what the data actually is, and how it was generated or measured)
- For *derived* data: fully described and documented workflow (*provenance*, how the data was manipulated)

New skills that we need to make it happen

- How do we regularly and consistently describe metadata with our data
- How do we easily publish data and preprints (How does our institution manage this)
- Understanding how we can protect IP: licencing and digital identifiers
- Getting recognition and support from our institutions for open data publications



How this workshop fits in

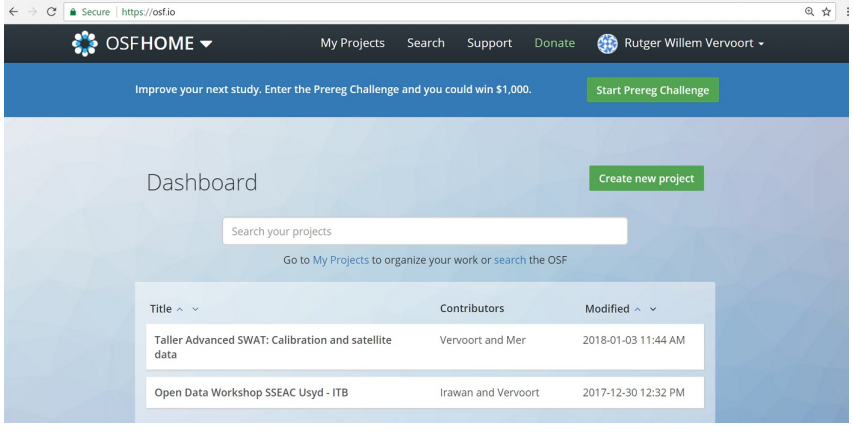
Over the next 4 days, we will teach you about:

- data, and how to write good metadata
- netcdf and why this might be useful
- workflows and how to record a workflow using Rmarkdown
- code and how to manage code via github
- how to get recognition, DOI and licences

What is already out there?

There is already a lot out there! (althought not everything is free)

- Data journals, for example Data in Brief and Data, and there is a growing list
- Data repositories, for example PANGEA, but here is a long list
  - The University of Sydney also runs its own data repository
- Journals to publish workflows, for example MethodsX
- Full open science repositories, such as Zenodo and OSF



Class activity (15 minutes)

- Discuss in groups:
  - How you have shared data in the past?
  - What are the main ways how you currently store and *curate* data. How easy would it be for someone else to access your data?
  - What actions do you have to take to share data.
  - How easily have you accessed someone else's data?
- As a group report back to summarise