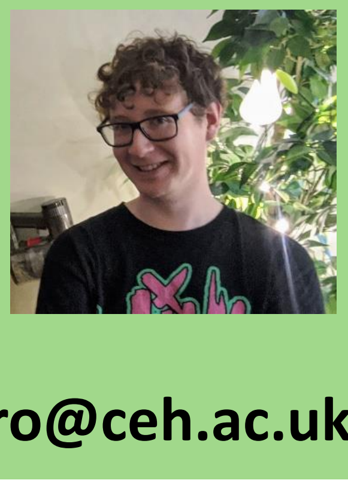
UK Centre for Ecology & Hydrology

Object Storage:
How chunky would you like your data?



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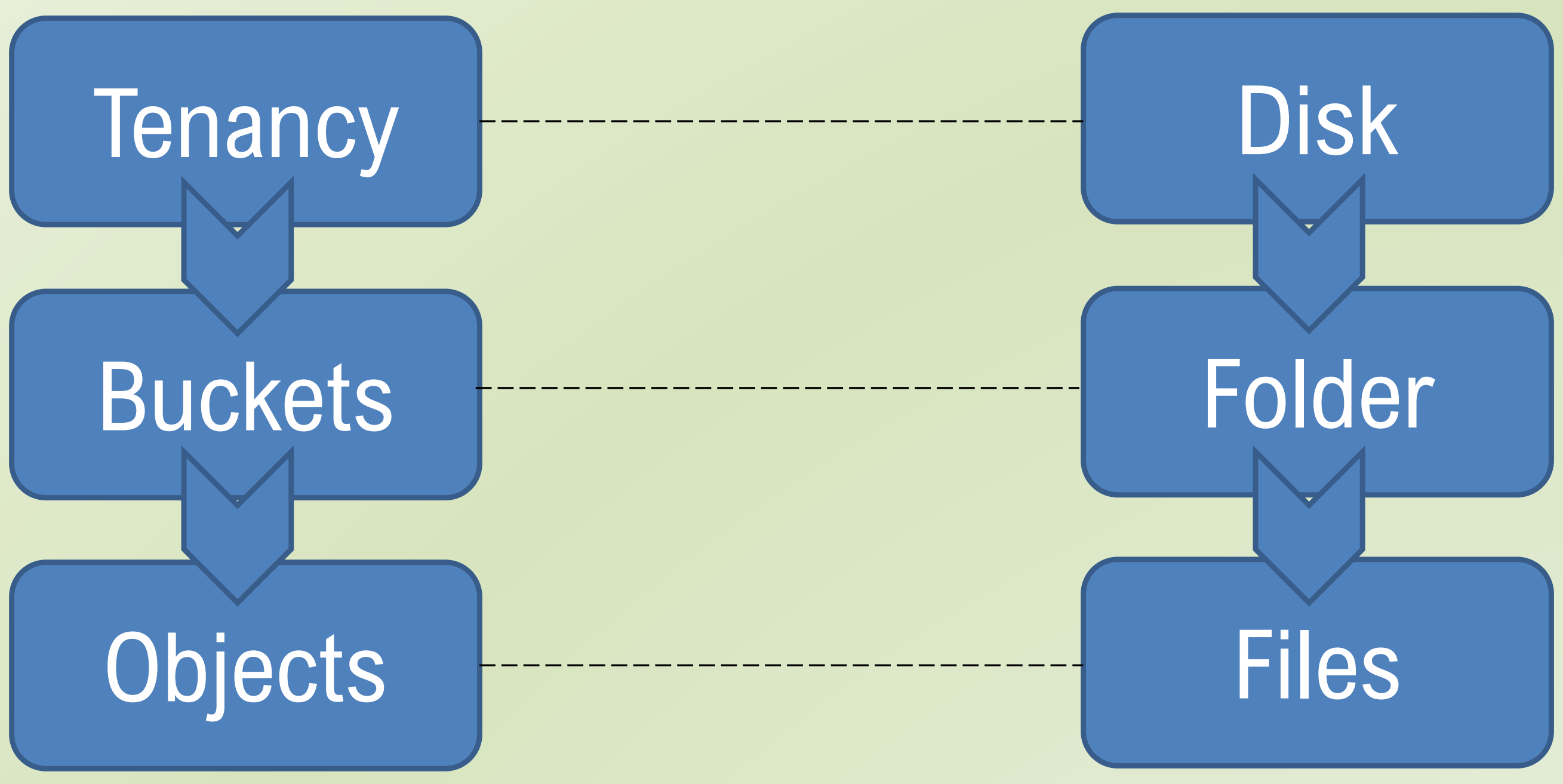
What is Object Storage?

- A new type of data storage on the cloud
- Unlike traditional file-systems: not hierarchical and accessed over HTTP
- A ‘tenancy’ (disk) contains ‘buckets’ (folders) which contain ‘objects’ (files/chunks of files)



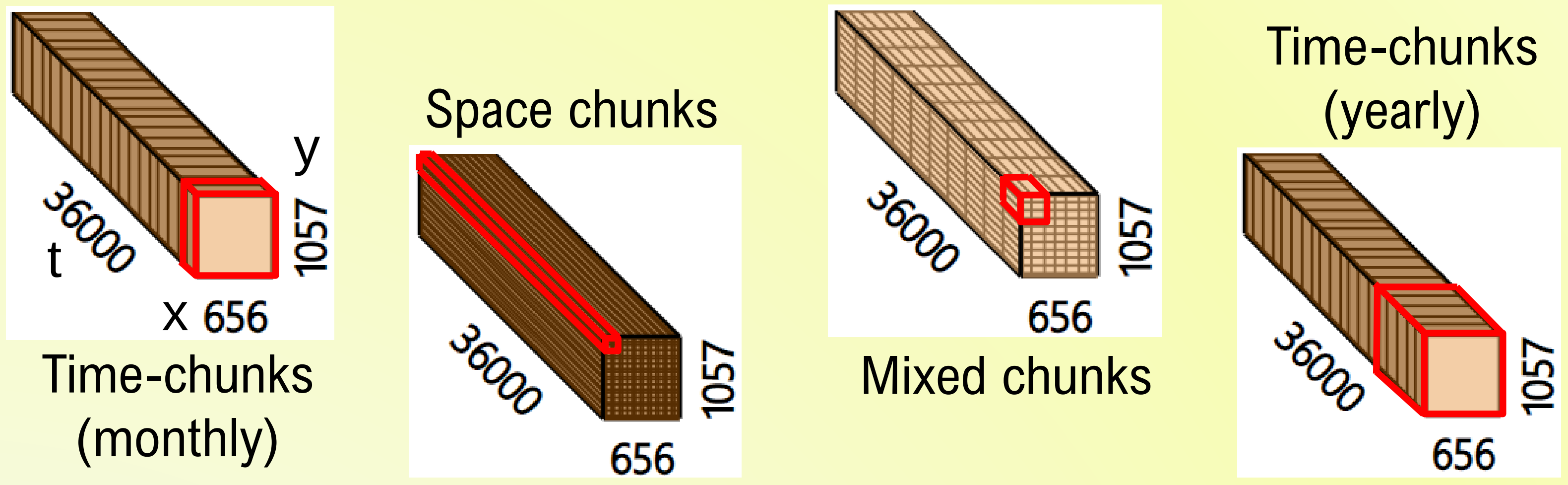
Why is it needed?

- Far cheaper per byte than disk
- Faster and better support of parallel processing
- Important for the next generation of multi-petabyte datasets, models and digital twins
- Easier for sharing externally

What did we do and why?

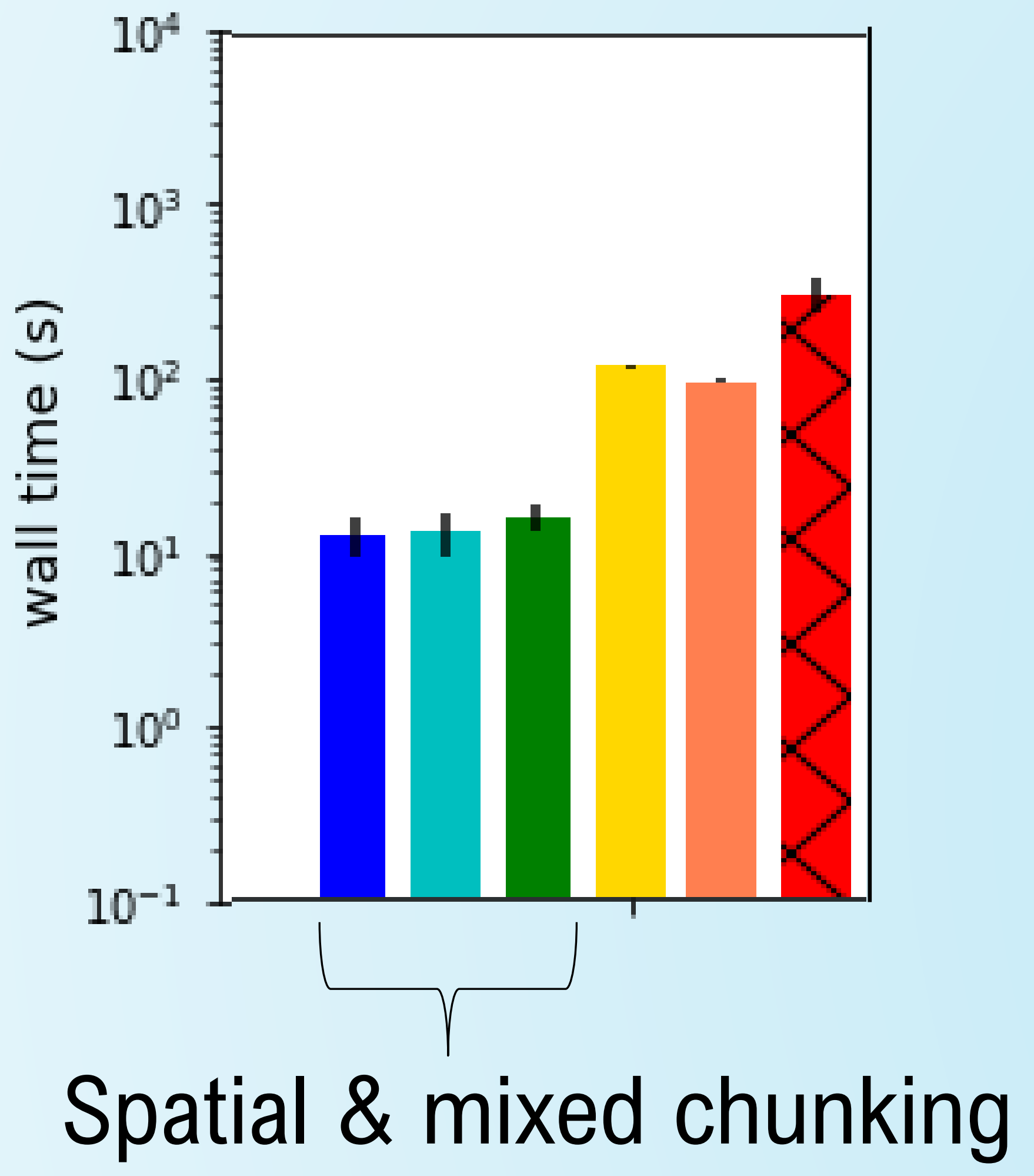
- With object storage you can only download one whole object at a time
- This is very inefficient for large datasets
- Instead you can divide the ‘objects’ into ‘chunks’ of each file using the **zarr** file format

But how best to do this?
What dimensions to chunk?
What size to make the chunks?



- How you chunk and the type of data analysis you are doing strongly affects the performance of the object store
- We attempted to quantify this and provide demonstration notebooks for accessing and analysing datasets on object storage

Grid-box analysis at each timestep



🟦 10km spatial chunking (14MB)

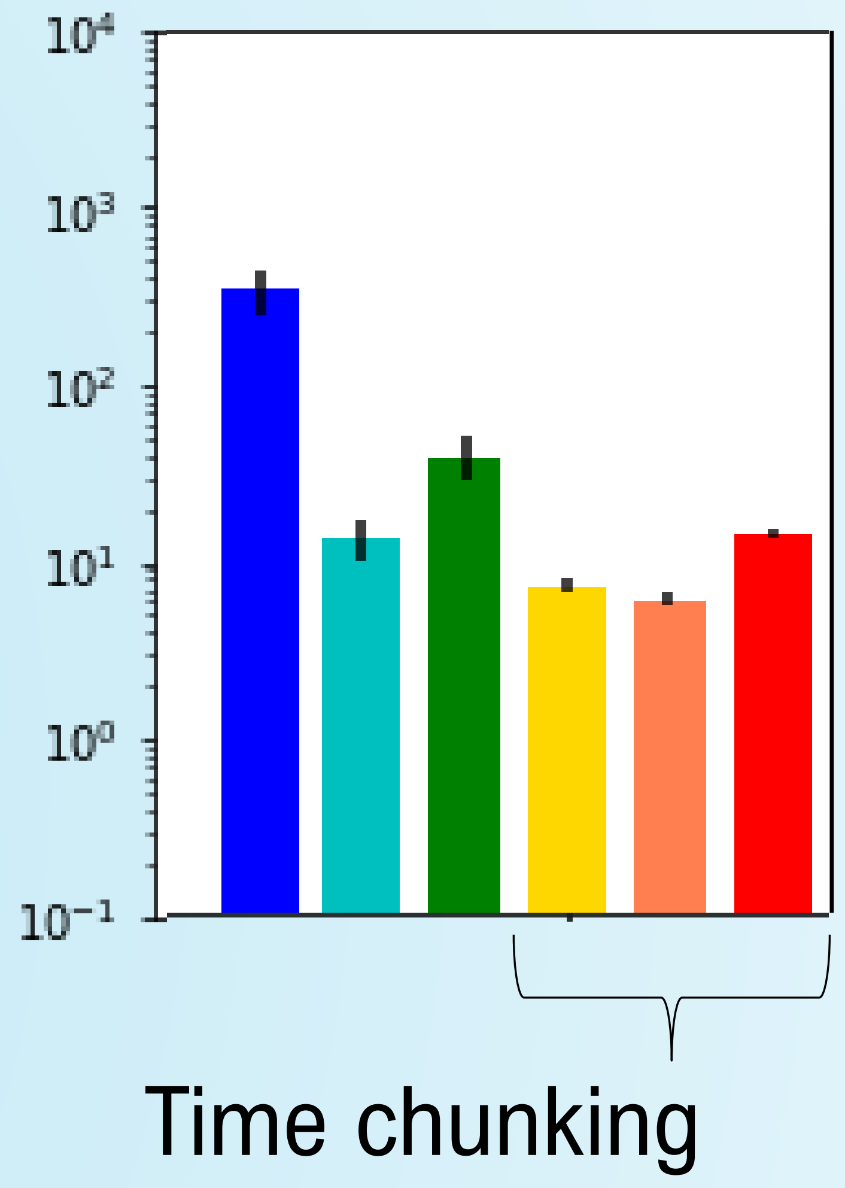
■ 100km spatial & yearly (14MB)

🟩 100km spatial & 10yr (140MB)

Key message: At least a 10× slow-down in performance with ‘bad’ chunking

- Chunking can be ‘bad’ with an analysis:
  - At every timestep (left) on data **heavily chunked in time** OR
  - At every grid-point (right) with data **heavily chunked in space**
- Because reading the whole matrix for just one grid-point of interest is inefficient!
- Chunk byte-size also impacts: Many small chunks mean large overheads; **few large chunks** mean unnecessary data load. Network bandwidth also plays a role.
- **Mixed chunking** reduces the impacts: All analyses have ~equal but average speed

Time-period analysis at each grid-point



🟧 Seasonal chunking (240MB)

🟥 Yearly chunking (930MB)

🟨 Monthly chunking (79MB)

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