UKRI Science and Technology Facilities Council

UKRI Natural Environment Research Council

Air Quality Data at CEDA

Martin Juckes

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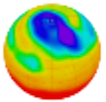


Centre for Environmental Data Analysis

SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

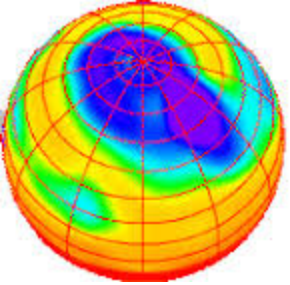
JASMIN

National Centre for Atmospheric Science

NATURAL ENVIRONMENT RESEARCH COUNCIL

National Centre for Earth Observation

NATURAL ENVIRONMENT RESEARCH COUNCIL



Outline of Talk

- Introducing CEDA: Who we are
- Data
- Services and Standards

CEDA overview

- Centre for Environmental Data Analysis
- Mission: to provide data and information services for environmental science
- 31 staff
- CEDA Archive and JASMIN

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

What we do

CEDA Archive

Centre for Environmental Data Analysis
SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

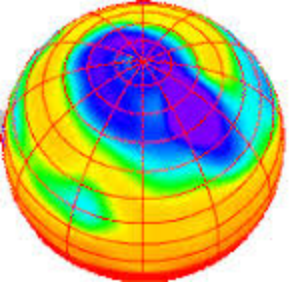
CEDA Archive

- Search the Data Catalogue

  Input search term...

- Download data
- Deposit data

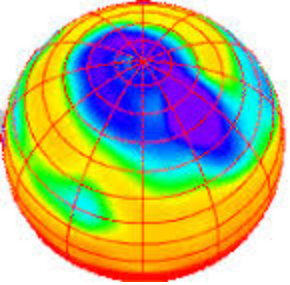
JASMIN



Air Quality Data

CEDA holds a vast range of air quality datasets. Some examples are described below.

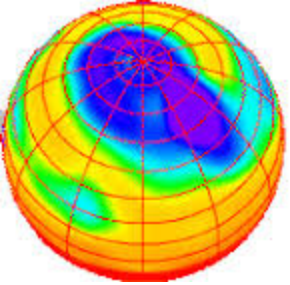
- Facility for Airborne Atmospheric Measurements - FAAM
- Atmosphere Measurements Facility - AMF
- ESA Climate Change Initiative
- Coupled Model Intercomparison Project 6 (CMIP6)



Facility for Airborne Atmospheric Measurements

The FAAM BAe-146-301 has been in service since 2005, carrying an extensive payload of instruments.

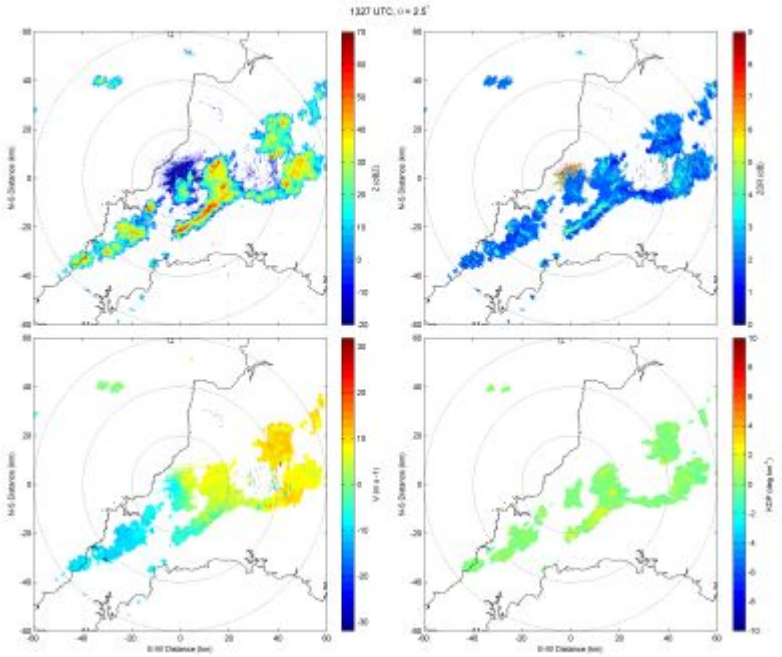
Measurements from hundreds of flights are held in the CEDA archive.

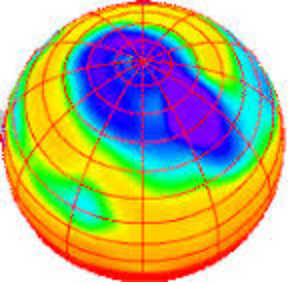


Atmospheric Measurement Facility - AMF

The AMF operates and supports a wide range of surface and airborne instruments;

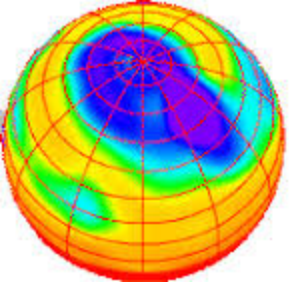
Data is archived at CEDA, using standard file names and data formats to make the data more accessible to users.





AMF Observatories

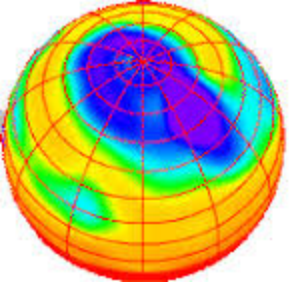
- Cape Verde Atmospheric Observatory, N. Atlantic (CVAO);
- Weybourne Atmospheric Observatory, Norfolk (WAO);
- BT Tower, London;
- Cardington, Bedfordshire;
- CFARR Chilbolton Observatory, Hampshire;
- MSTRF Capel Dewi Observatory, near Aberystwyth.



Weybourne

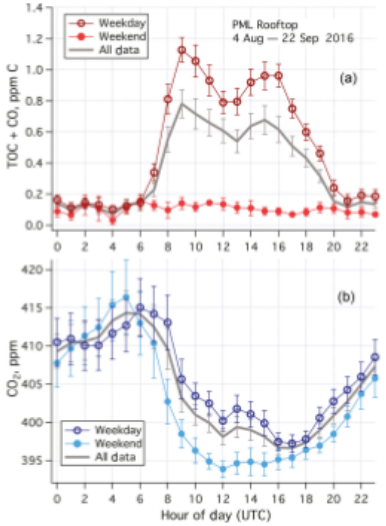
Composition & Pressure;
Observed at 1 minute intervals;
Norfolk coast;
2002-present;
BADC CSV/NASA Ames.

NCAS
atmospheric measurement facility
amf
excellence in measurement

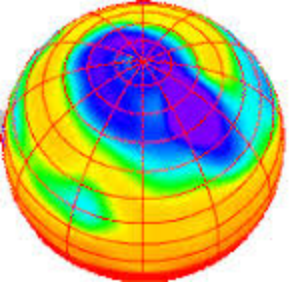


Penlee Point, PML

Composition & Meteorology;
Observed at 5 minute intervals;
South coast of England;
2014-2018.
BADC CSV/NASA Ames.



Yang, M. and Fleming, Z. L.: Estimation of atmospheric total organic carbon (TOC) – paving the path towards carbon budget closure, Atmos. Chem. Phys., 19, 459–471, https://doi.org/10.5194/acp-19-459-2019, 2019.



ESA CCI Aerosol

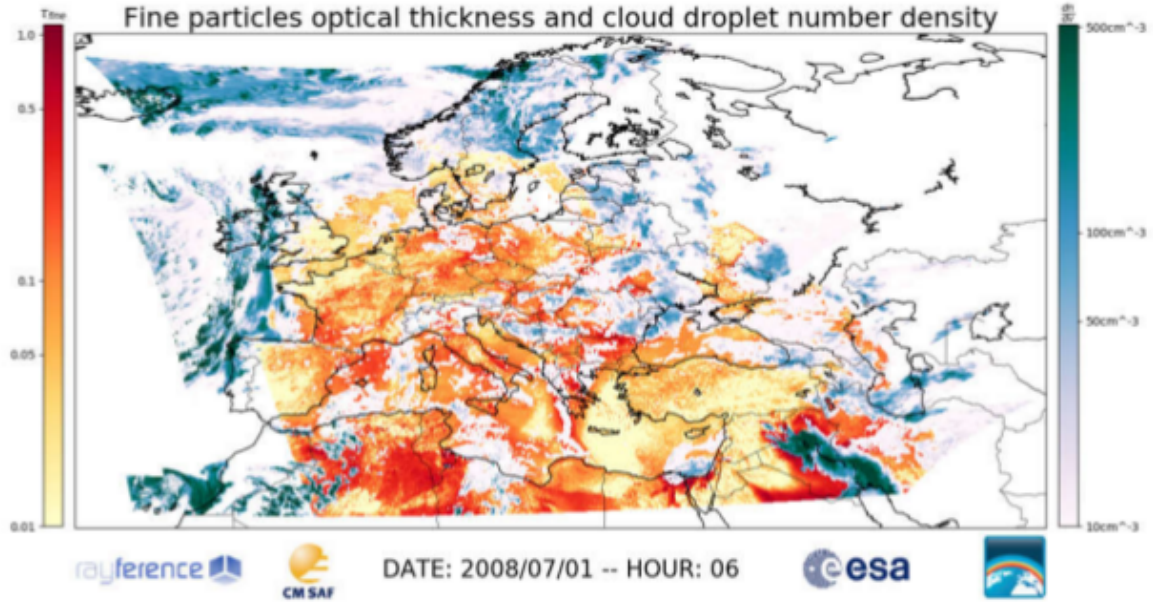


Figure 23: Combined demonstration product of SEVIRI Fine mode AOD (red colour bar) and cloud droplet number density (courtesy of CM SAF) for 1st July 2008 at 6 AM.

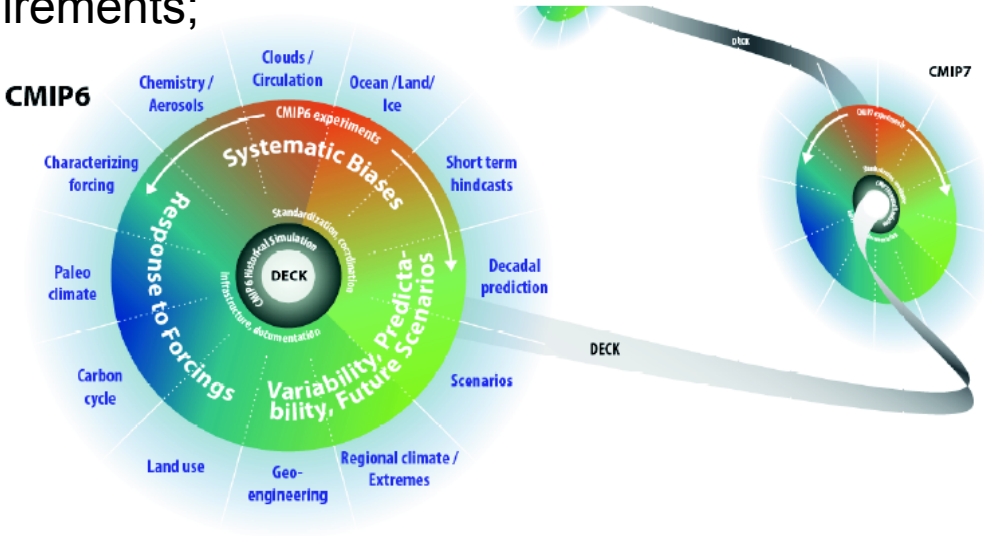
CEDA hosts many large datasets from the European Space Agency, including long-term climate records provided through the ESA Climate Change Initiative.

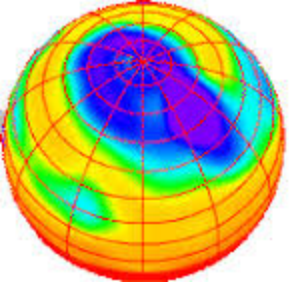
Within the Aerosol project, there are many air quality variable, such as the **Fine Mode Aerosol Optical Depth** shown here.

Climate Model Data

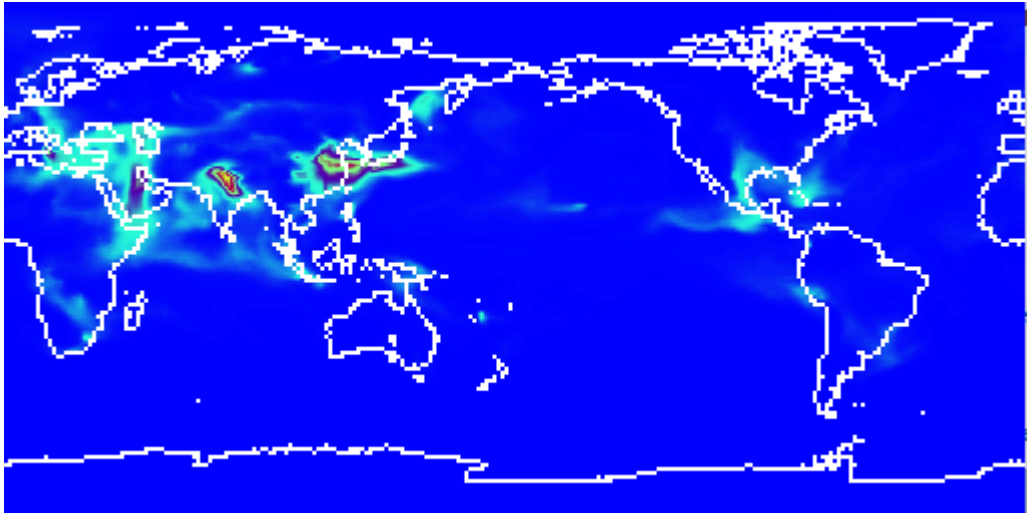
CEDA will publish the UK contribution to the World Climate Research Programme Coupled Model Intercomparison Project #6 (CMIP6). CEDA is supporting preparations for CMIP6 through:

1) contributions to the development of the archive software;
2) documentation of experimental requirements;
3) consolidated data requirements.





Model data at CEDA: AerChemMIP

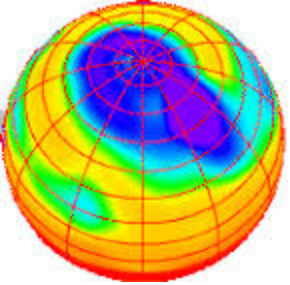


Atmospheric Load of Sulphate Dry Aerosol from the MIROC6 model contribution to the CMIP6 archive.

CEDA is hosting data from the Coupled Model Intercomparison Project Phase 6 (CMIP6), produced by all major climate modelling centres.

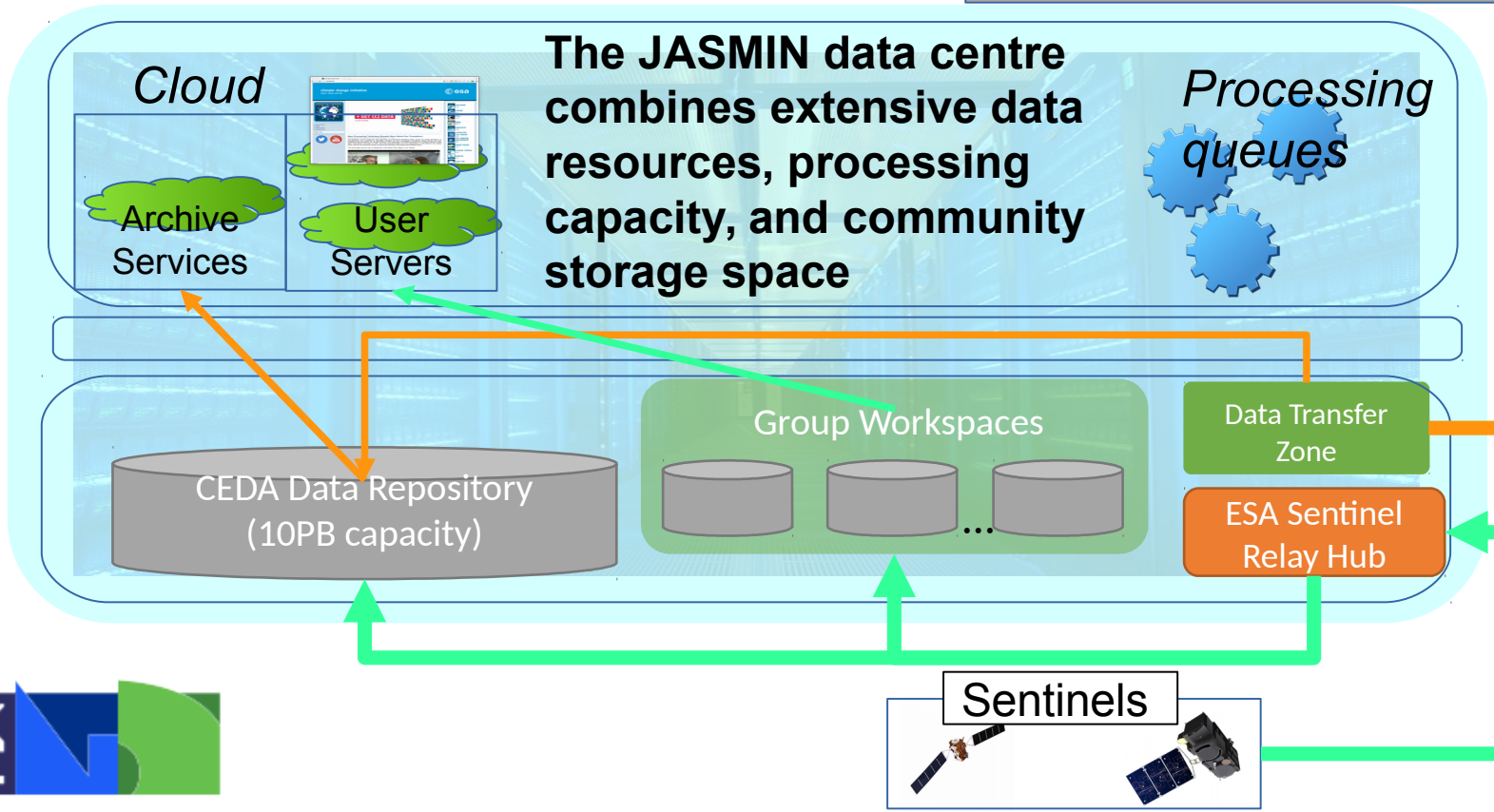
The experiments include many which are designed to explore the feedbacks between climate and air quality.

This includes data from the Aerosol Chemistry Model Intercomparison Project (AerChemMIP).



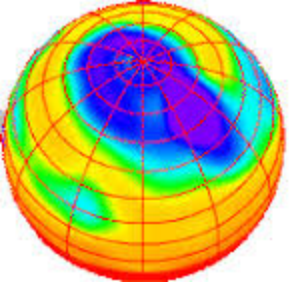
CEDA Services

A JASMIN overview

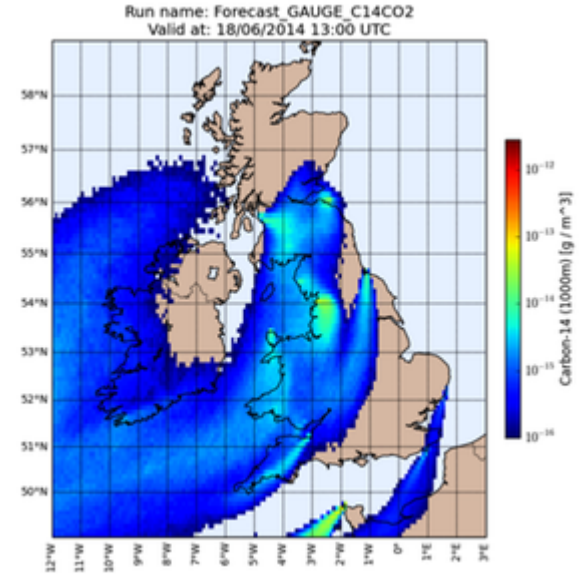


JASMIN Operations

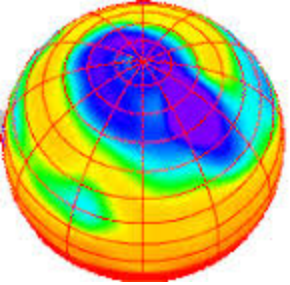
- The JASMIN high-performance analysis system is operated and maintained by the Scientific Computing Department (SCD) at STFC;
- A cloud computing infrastructure is installed on JASMIN to provide flexible resource management;
- The CEDA archive and associated services are hosted on JASMIN;
- CEDA administers and supports direct access to computing and collaborative data stores for users, through Research Council support.



Modeling at CEDA: NAME



The Met Office's Numerical Atmospheric-dispersion Modelling Environment (NAME) is installed on JASMIN and can exploit CEDA's archive of meteorological data and the processing capacity of the LOTUS batch system in JASMIN.



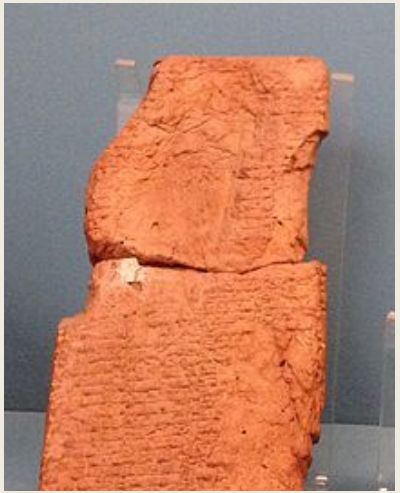
Standards

Legal standards started appearing more than 4000 years ago.
The standards allow decisions to be made consistently and reliable.

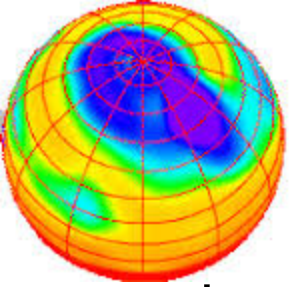
Today, we use many data standards to ensure that data is recorded and stored reliably.

Recommended global attributes
title, *institution*, *comment*, *source*, *history*, *references*

Part of the CEDA guidance on metadata, 2019.



Code of Ur-Nammu -- the oldest surviving legal code (after the Sumerian King Ur-Nammu, c. 2100 BC).



NERC EDS

The NERC Environmental Data Service is aggregating (or integrating?) the 5 NERC Environmental Data Centres to provide a harmonised entry point and enhance accessibility of NERC resources outside the research community.

UKRI

CEH Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS 1835 British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Centre for Environmental Data Analysis
SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

BODC British Oceanographic Data Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

DAFNI

Providing a platform to improve decision making for national infrastructure in the UK and worldwide

DAFNI (Data & Analytics for National Infrastructure Research) is set to become the UK's next generation platform to support infrastructure decisions: planning, investment, design and operation. DAFNI will provide the intelligence needed to revolutionise the quality, efficiency, resilience and sustainability of infrastructure systems.

The DAFNI data centre is being developed and run by the Scientific Computing Department at STFC. CEDA is working with the DAFNI team to exploit synergies.

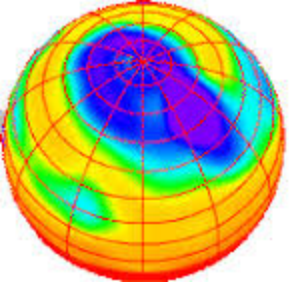
www.dafni.ac.uk

EPSRC Engineering and Physical Sciences Research Council

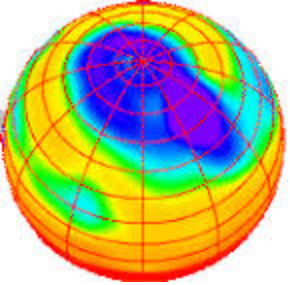
Science & Technology Facilities Council

UK Research and Innovation

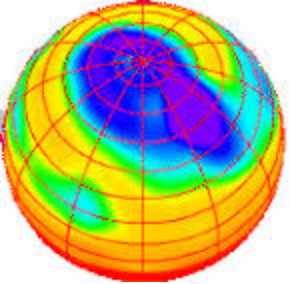
UKCRIC



Questions?



CEDA Collaborations



Working with others

Dept. for Environment and Rural Affairs - DEFRA

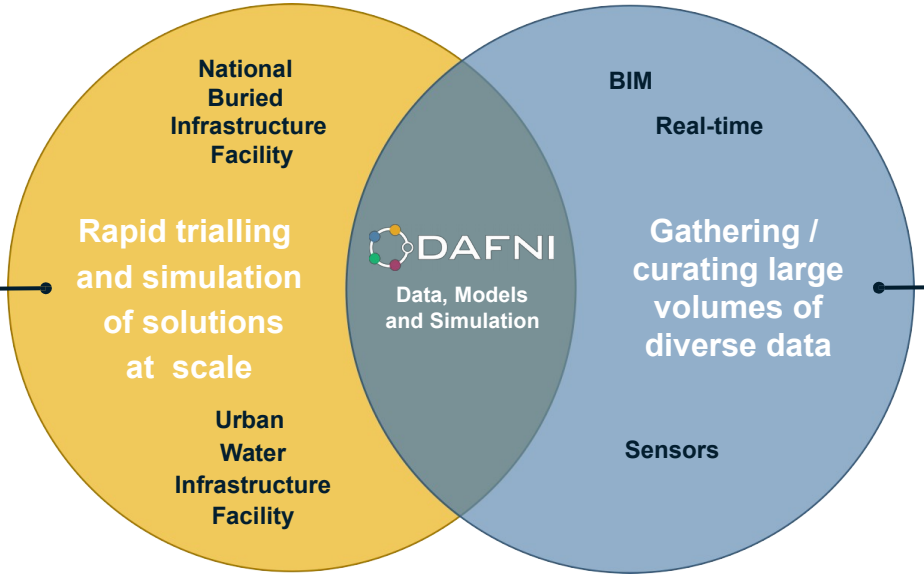
- DEFRA coordinates a wide range of Air Quality activities to support work on **Policy Advice** (what if?) and **Compliance Monitoring** (what is ..?);
- CEDA is currently contributing to a strategic review of Air Quality Monitoring -- the objective is to increase accessibility of DEFRA data;

Data & Analytics Facility for National Infrastructure - DAFNI

- The DAFNI project is run by the Scientific Computing Department at STFC. DAFNI is creating a modeling environment for models of National Infrastructure, including pollution sources such as transport and electricity generation.

DAFNI role in the UKCRIC (£126.6 million investment)

National Infrastructure Labs



Urban Observatories

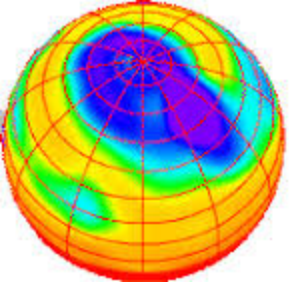
www.dafni.ac.uk

EPSRC Engineering and Physical Sciences Research Council

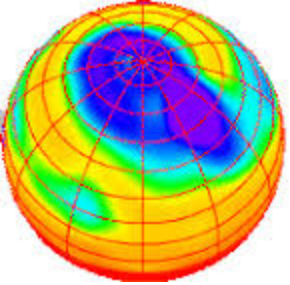
Science & Technology Facilities Council

UK Research and Innovation

UKCRIC



Your Data



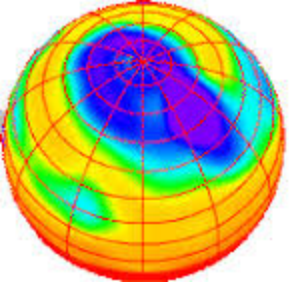
Data Standards: Basics

What?
- **title**: a short description of the data held in a file;
- data variable (described later);

Who?
- **institution**: the name of the institution, e.g. University and department;
- ***contact***: name of the individual responsible; using, for example, an Orcid identifier will ensure that this contact information still works 10 years from now;

Why?
- **comment**: describe in the objectives of the work;

How?
- **source**: describe the software or instrument used to produce the data;
- **history**: describe the key steps of the procedure;
- **references**: link to relevant published documents (DOI if possible);



Data Standards: Time and Space

When?

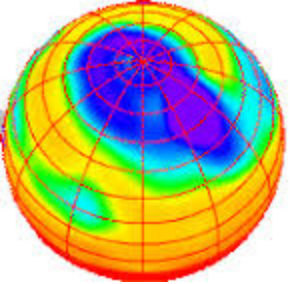
- **time**: a time dimension should specify the time at which the data was collected or, for model data, th time that is being simulated;

Where?

- Spatial coordinates can be given as latitudes and longitudes or as a map projection;

```
double time(time);
        time:standard_name=”time”;
        time:units=”days since 1990-01-01 00:00:00”;
        time:calendar=”standard”;
        time:long_name=”Time of Measurement”;
```

```
double lat(lat);
        time:standard_name=”latitude”;
        time:units=”degrees_north”;
        time:long_name=”Latitude”;
```

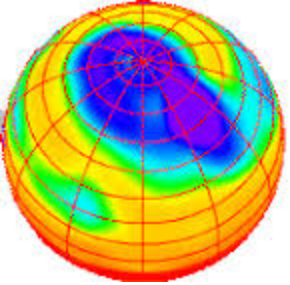


Data Standards: the Data

The data variable can be identified precisely by a Climate and Forecast (CF) Convention Standard Name.

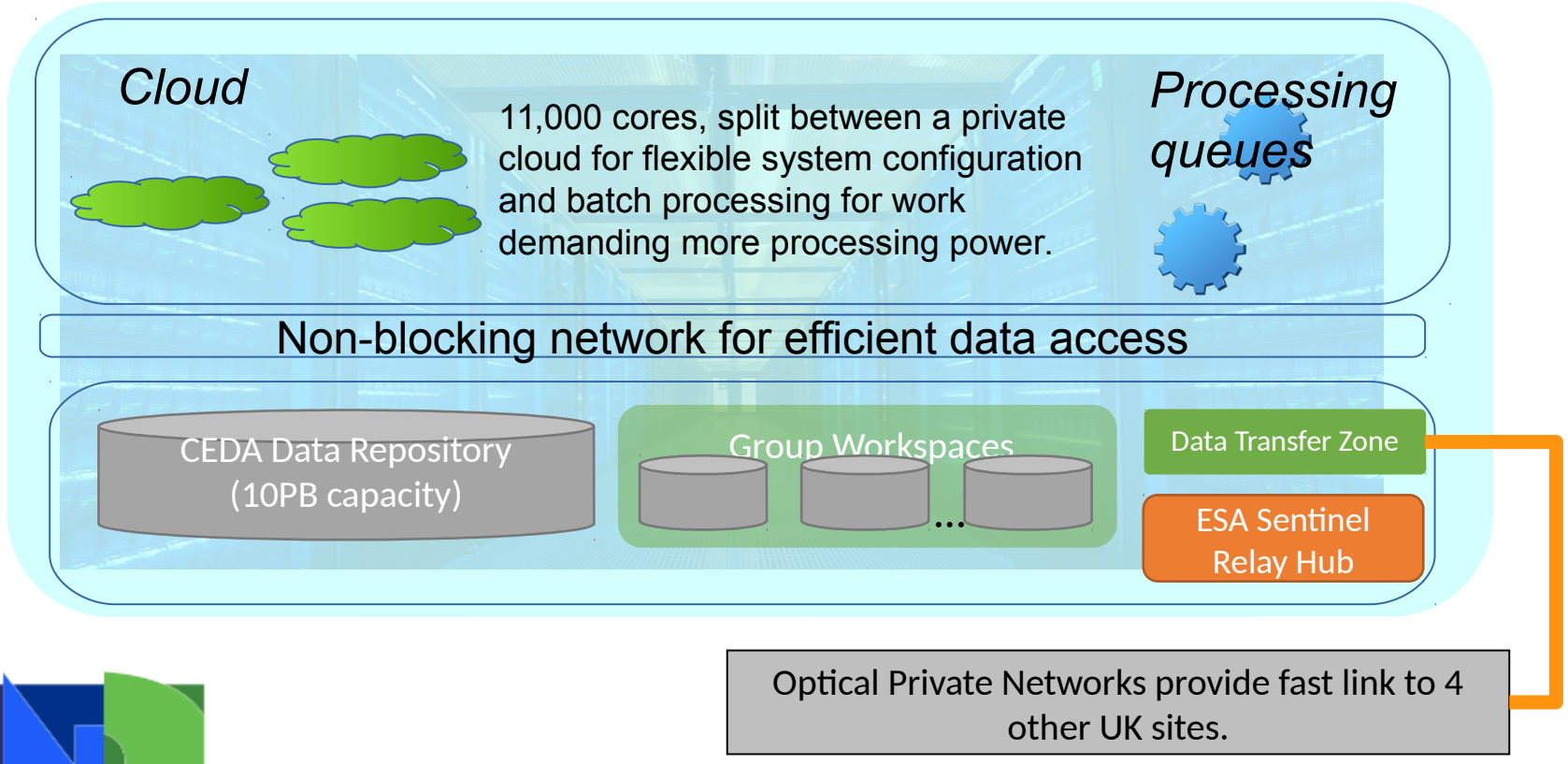
This convention, and the standard names it contains, are maintained by the global research community, with institutions in the UK, Germany, and USA contributing to the core effort of moderating discussions and maintaining documents.

```
dimensions:
        time = 20;
        lat = 180;
        lon = 180;
variables:
   float pr(time,lat,lon);
        pr:standard_name=”precipitation_flux”;
        pr:units=”kg m-2 s-1”;
        pr:long_name=”Precipitation”;
```

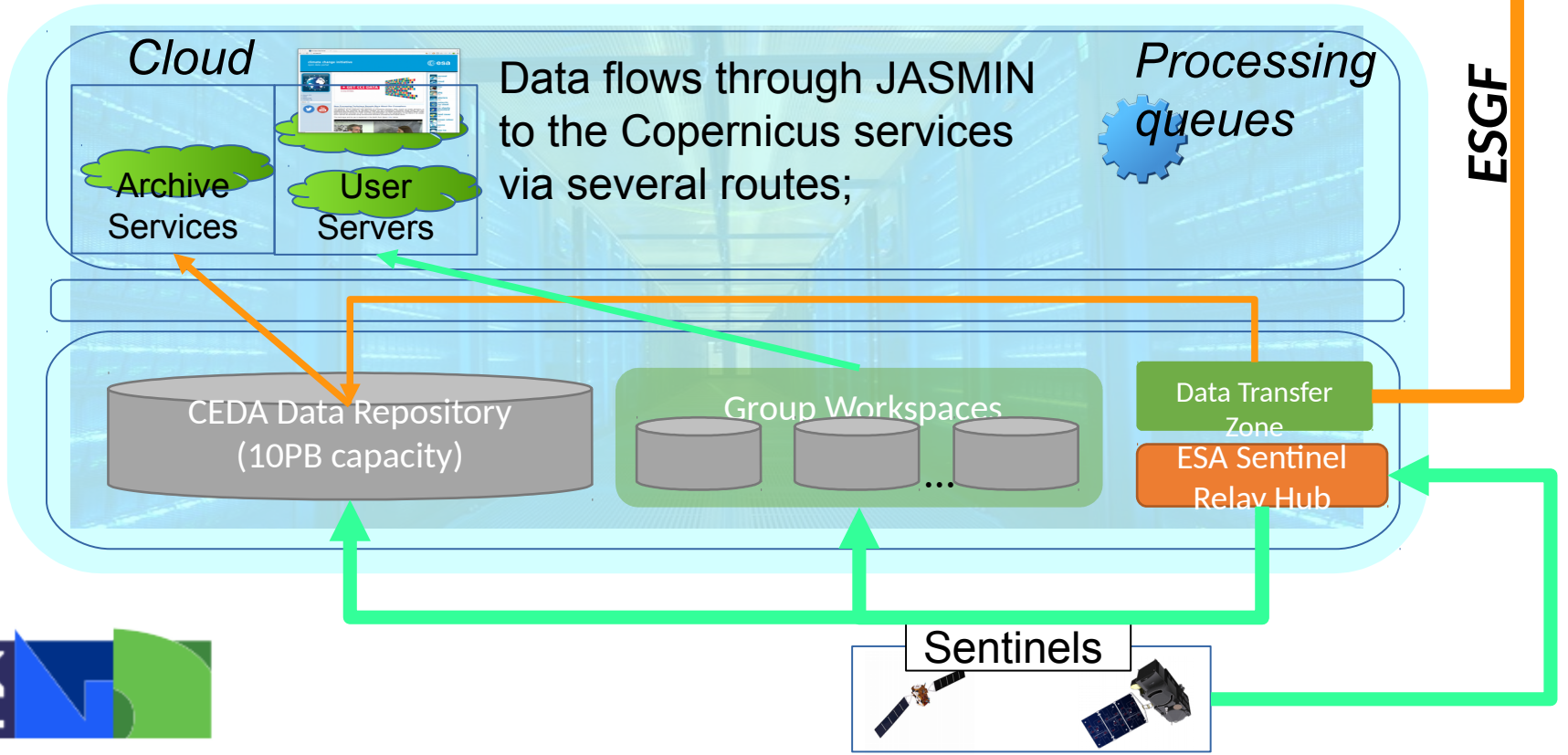


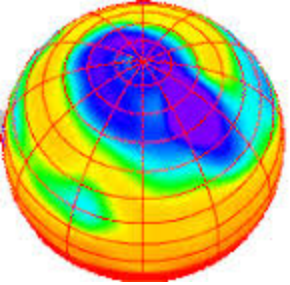
NCAS Programme at CEDA

A JASMIN overview [1]



A JASMIN overview [2]

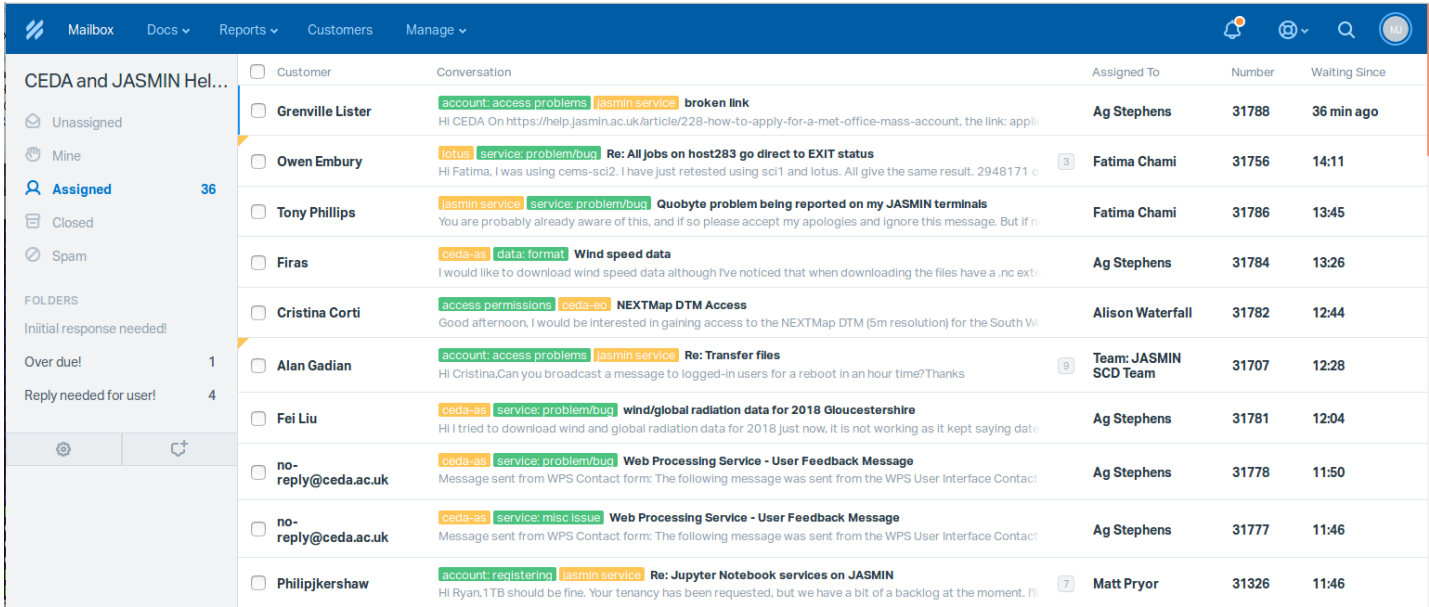




Service Delivery: User Support

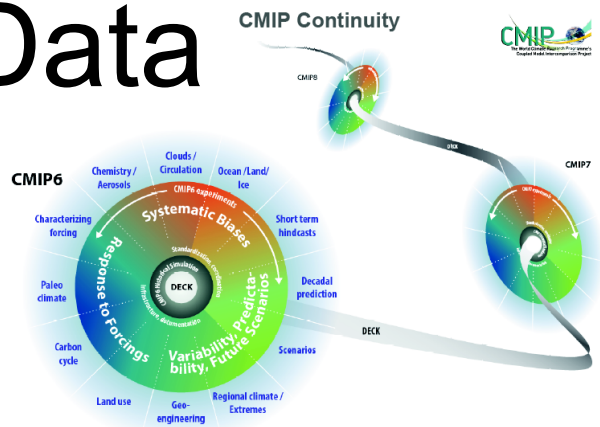
Helpdesk: 65 queries per week (CEDA);

Triaging: queries are handled in the HelpScout support platform; the helpdesk team check outstanding queries regularly;



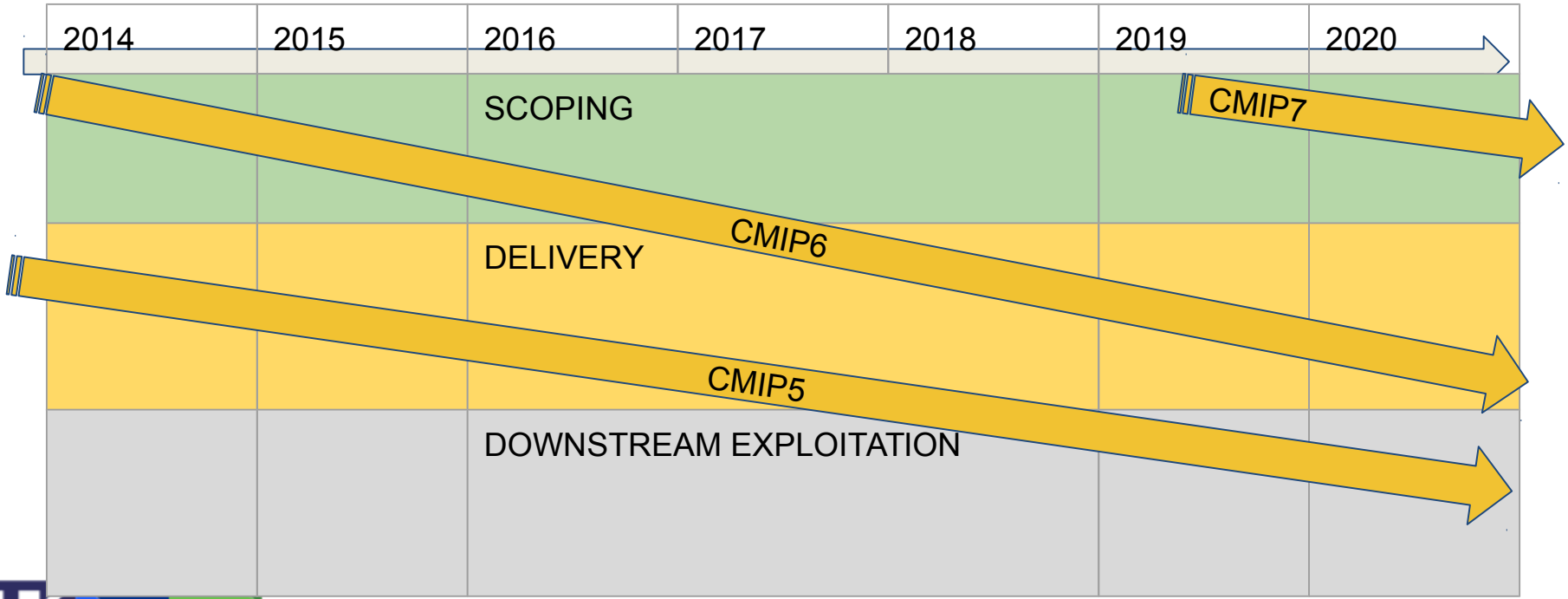
Climate Model Data

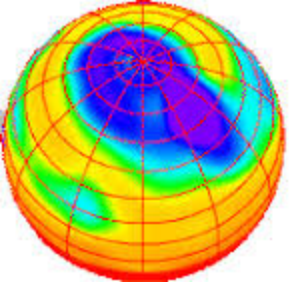
- CEDA supports the global collaborative effort and specific UK requirements.
- Activities range from contributions to global and European strategy development to delivery of information through the Intergovernmental Panel on Climate Change (IPCC) and Climate Services.



Hardware	Operations	Community
• Business case • Procurement • Installation and operation	• Publishing UK simulations • Transferring data to the UK • Data access services • Helpdesk Ongoing CMIP5: • Providing data to Climate Service (C3S)	• Governance bodies • Experiment specifications • Data requirements • Software development • Operations support • Data standards for the IPCC • Support for IPCC authors

CEDA and CMIP6





Activities: standards

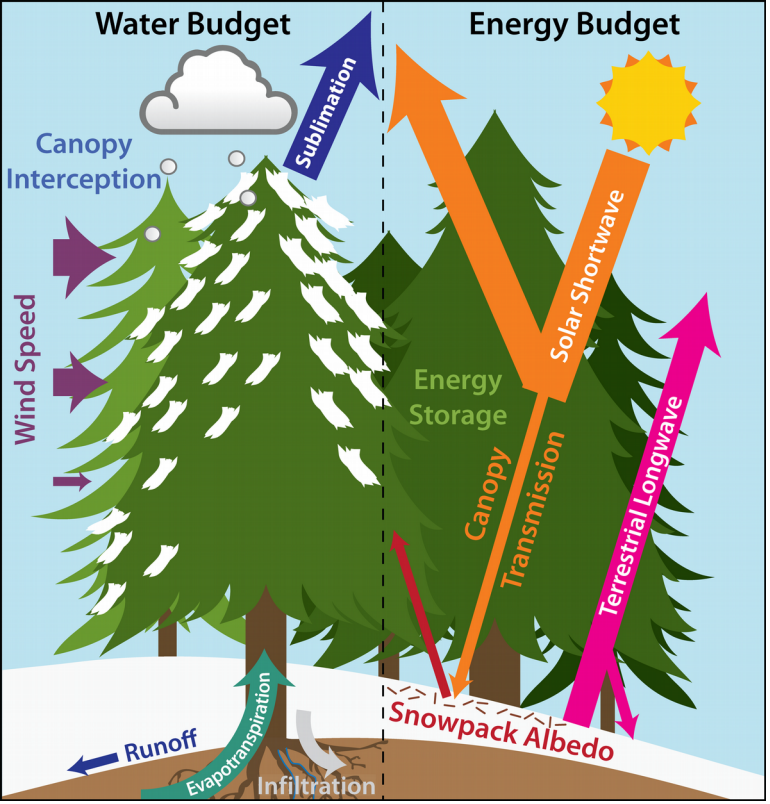
Data and data service standards ensure re-usable data and underpin scalable services. For example:

Atmospheric

- Climate and Forecast Conventions (CF) for netCDF;
- CMIP standards for data, experiments and models;

Data Services

- UK Gemini (INSPIRE) for catalogue exports;
- OGC standards for web services.

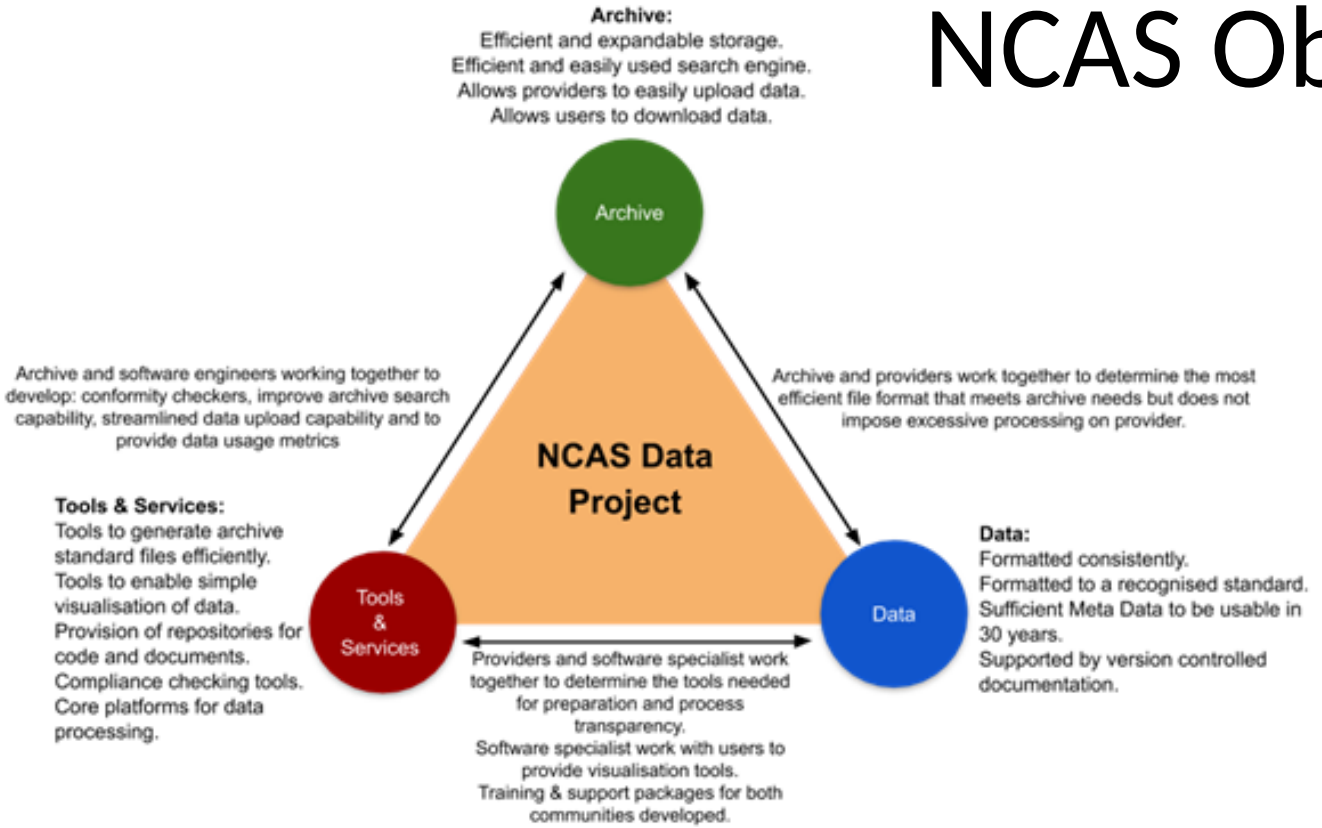


Eric Small, Uni. Colorado

Data Standards .. Example 1

Some of the climate models which will be used for the Coupled Model Intercomparison Project 6 (CMIP6) will resolve tree canopies in more detail than before.
The standards have been updated to provide clear terms for the interception and storage of snow by the canopy, and also for the reflection of solar radiation by the canopy.

Data Standards: Example 2: NCAS Obs Data



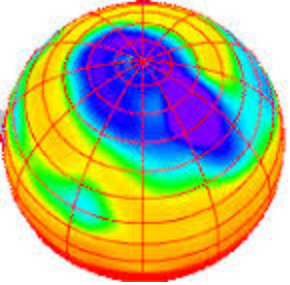
Community Roles and Engagement

Supporting Data Standards

- For EO climate data through ESA Climate Change Initiative;
- For climate model projections through the CMIP data request and the Climate and Forecast Convention;

Engaging with the global community

CEDA staff participate in working groups of the the World Climate Research Programme (WCRP) and the Committee on Earth Observation Satellites (CEOS), participate in the Earth System Grid Federation, manage part of the Intergovernmental Panel on Climate Change (IPCC) Data Distribution Centre.



Questions?