Science & Technology Facilities Council | UK Research and Innovation | NERC SCIENCE OF THE ENVIRONMENT

NCAS, CMS, CEDA and JASMIN: AN OVERVIEW

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

“National capability”

Computational Modelling Service
CMS

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

Facility for Airborne Atmospheric Measurements
FAAM

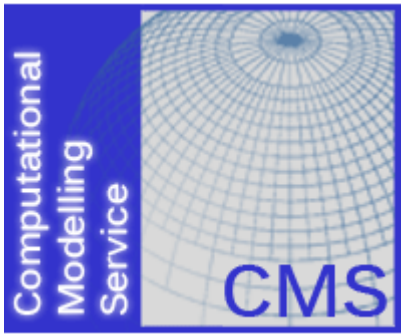
Met Office

Facilities and Services

NCAS
atmospheric measurement facility
amf
excellence in measurement

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

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

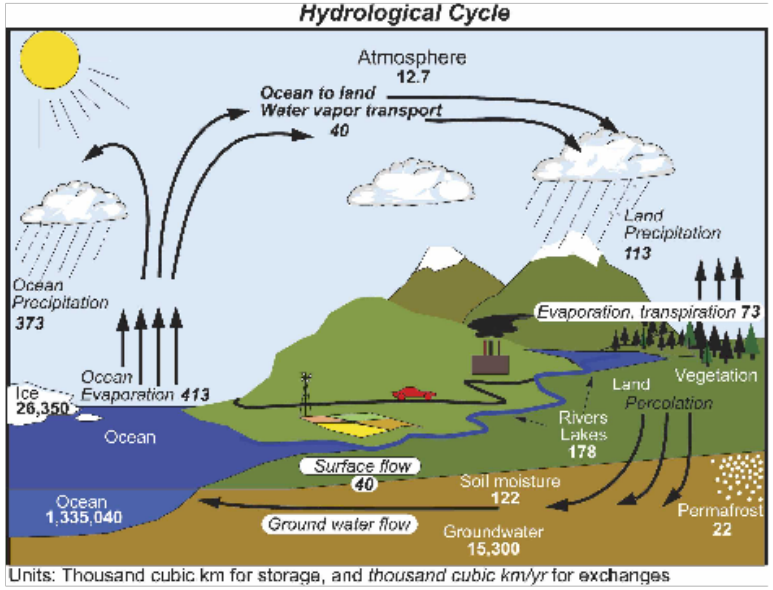


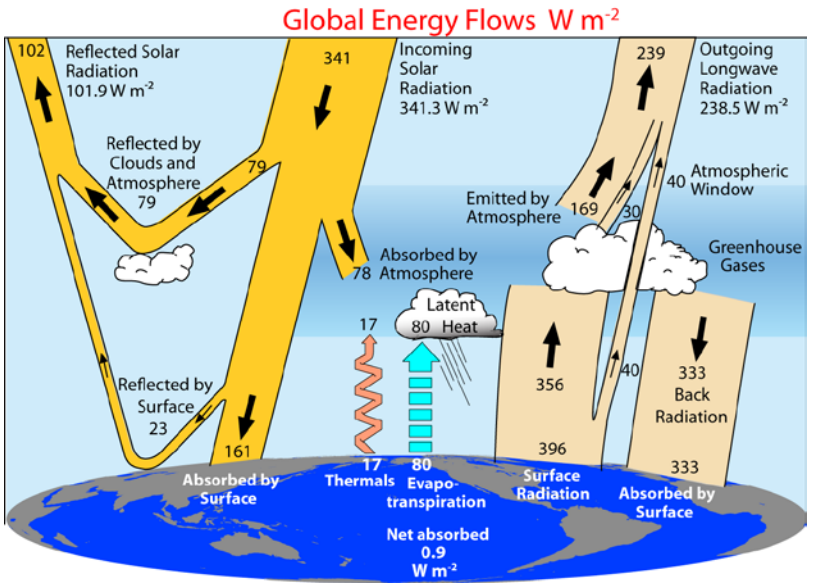
NCAS Computational Modelling Services (CMS)

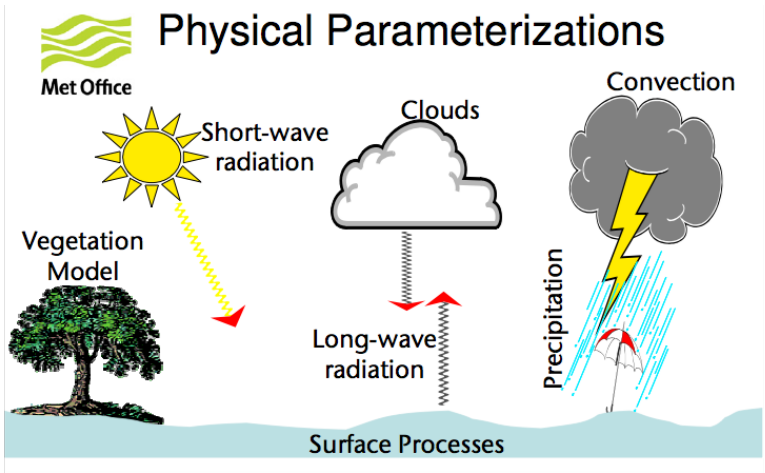
NCAS Computational Modelling Services (CMS)

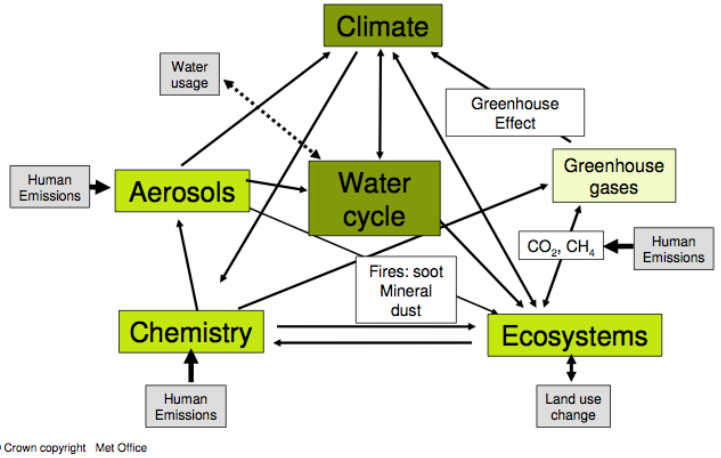
- CMS staff undertake NCAS activities in support of computational science (particularly High Performance Computing (HPC) and numerical modelling)
- Provide underpinning infrastructure for the UK academic atmospheric and polar science community to support climate, weather, and earth-system research.
- Provide training for scientists:
  - NCAS Introduction to Scientific Computing course
  - NCAS Introduction to Unified Model course
  - NCAS CF Python tools course

Climate Modelling





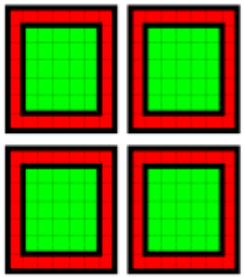


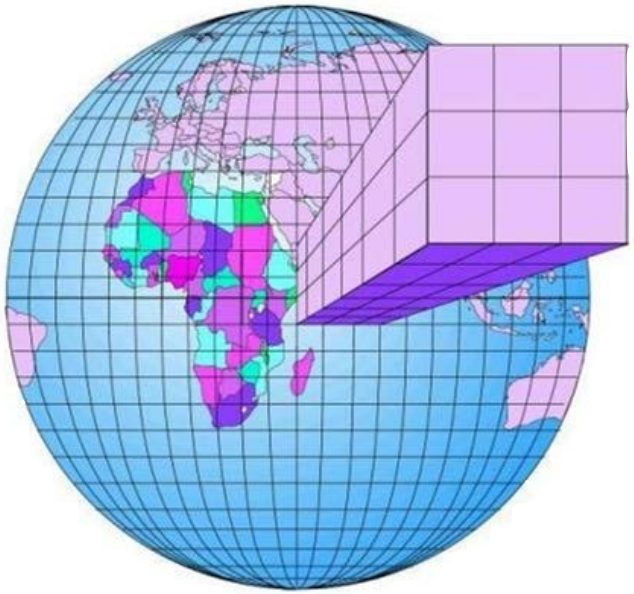


(Trenberth et al, 2007,2009)

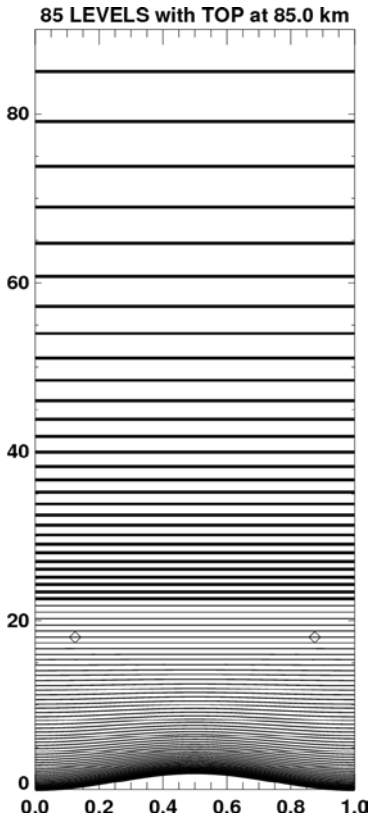
PARALLEL Implementation

- Regular, Static, Lat-Long Decomposition
- Mixed mode MPI/OpenMP
- Asynchronous I/O servers
- Communications on demand for advection
- Multiple halo sizes





Horizontal resolution



Land surface

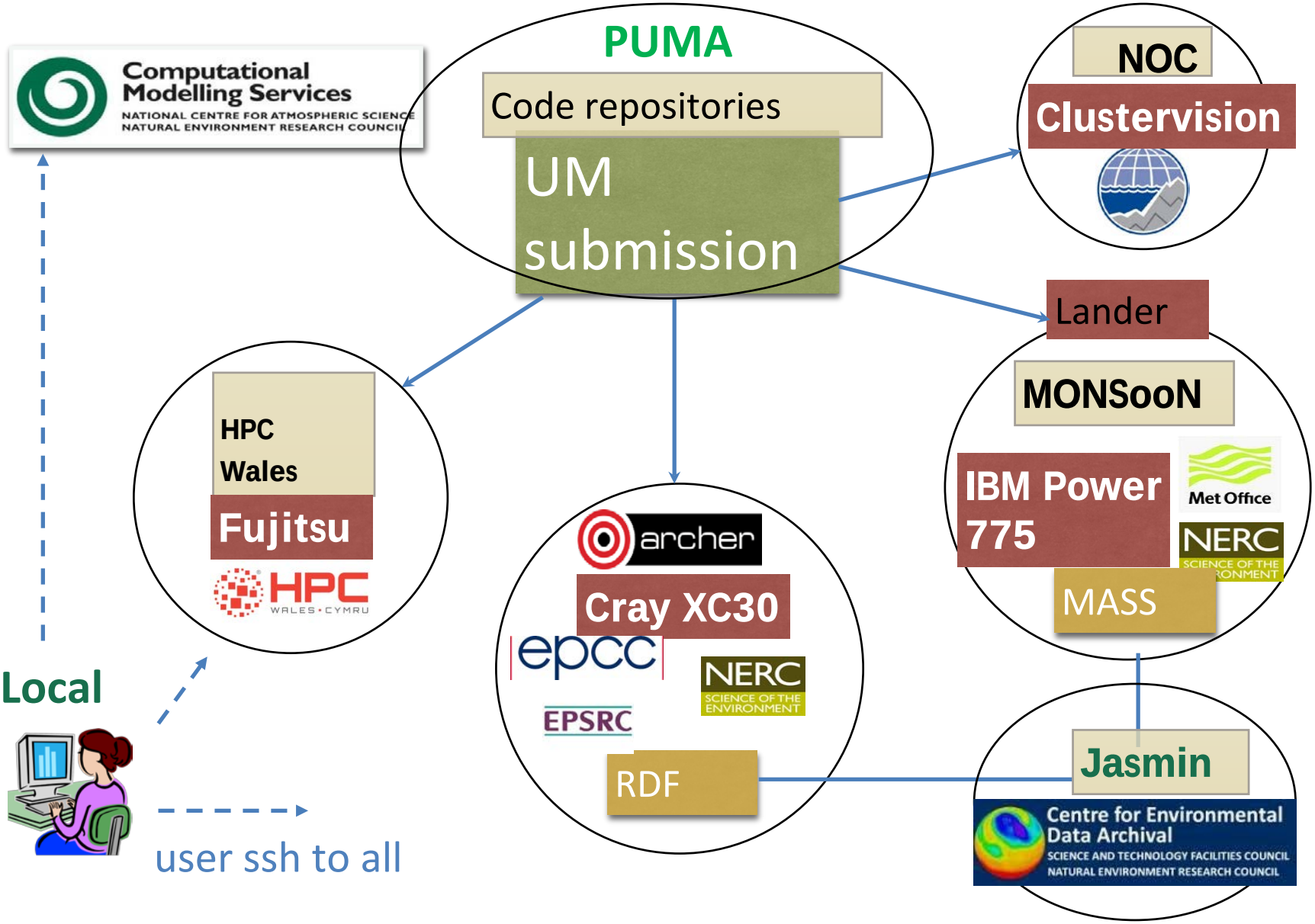
Vertical resolution

Global Models

N96	N144	N216	N320	N512	N768	N1024	N2048
(192 x 145)	(288 x 217)	(432 x 325)	(640 x 481)	(1024 x 769)	(1536 x 1152)	(2048 x 1536)	(4096 x 3073)
~135 km	~90 km	~60 km	~40 km	~25 km	~17 km	~12 km	~6 km

	NWP	Climate
Run length	10 day operational forecast, 15 day ensemble forecast	Months (seasonal) Years, decades, centuries+
Global resolution	Testing: N320 (40 km) with 15 min ts Operational: N768 (17 km) with 7.5 min ts	Low resolution: N96 (135 km) with 20 min ts High resolution: N512 (25 km) with 15 min ts
Dynamics	Non-bit reproducible	Bit-reproducible

NCAS supported MACHINES



Centre for Environmental Data Analysis

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NERC Data Centres

NERC supports five data centres covering a range of discipline areas:

- British Oceanographic Data Centre (Marine)
- Centre for Environmental Data Analysis Archive (Atmospheric and Earth Observation)
- Environmental Information Data Centre (Terrestrial and freshwater)
- National Geoscience Data Centre (Geoscience)
- Polar Data Centre (Polar and cryosphere)

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Data Centres

The Centre for Environmental Data Analysis is responsible for the running of the following data centres:

CEDA Archive

The CEDA Archive operated the atmospheric and earth observation data centre functions on behalf of NERC for the UK atmospheric science and earth observation communities. It covers climate, composition, observations and NWP data as well as various earth observation datasets, including airborne and satellite data and imagery. Prior to November 2016 these functions were operated by CEDA under the titles of the British Atmospheric Data Centre (BADC) and the NERC Earth Observation Data Centre (NEODC).

UKSSDC

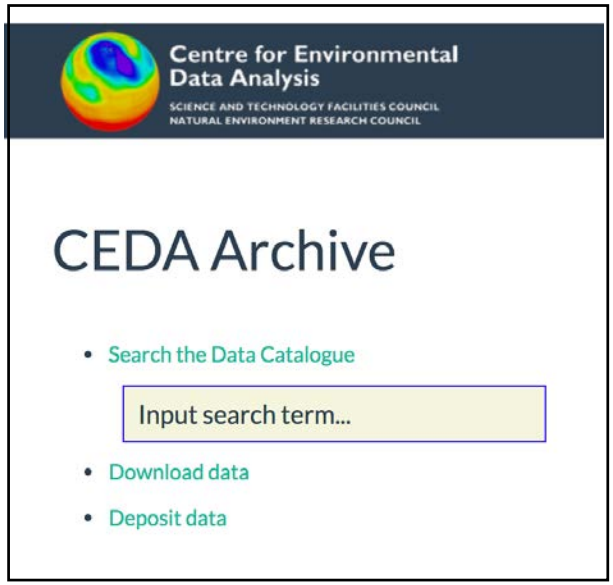
The UK Solar System Data Centre (UKSSDC), co-funded by STFC and NERC, curates and provides access to archives of data from the upper atmosphere, ionosphere and Earth's solar environment.

IPCC Data Distribution Centre

The Intergovernmental Panel on Climate Change (IPCC) DDC provides climate, socio-economic and environmental data, both from the past and also in scenarios projected into the future. Technical guidelines on the selection and use of different types of data and scenarios in research and assessment are also provided.

www.ceda.ac.uk

CEDA Archive (November 2018)

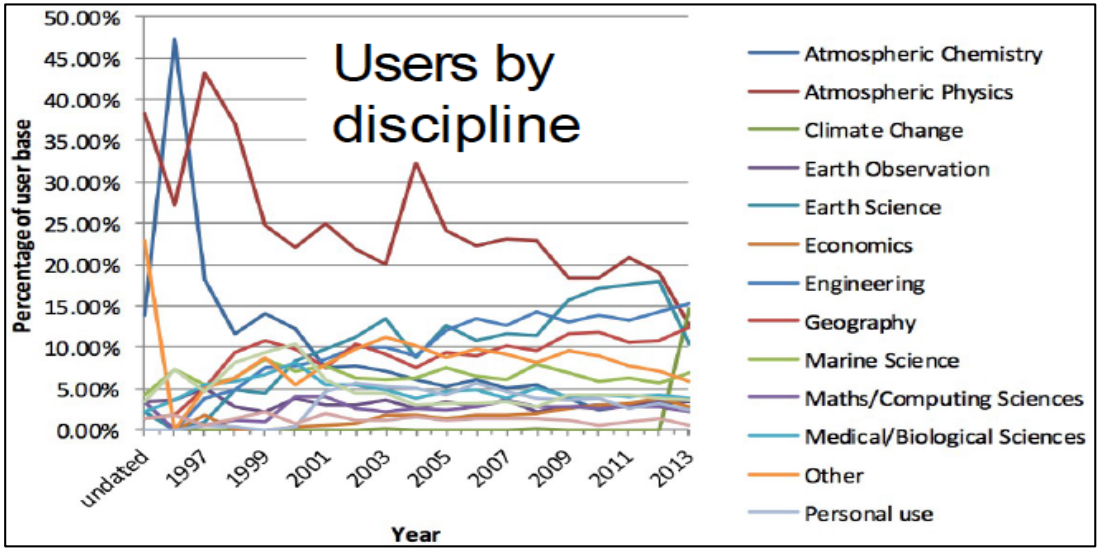


Data Type	Data Volume (Petabytes)
Earth Observation	6.7
Atmospheric Science	2.1
Total	8.8 PB

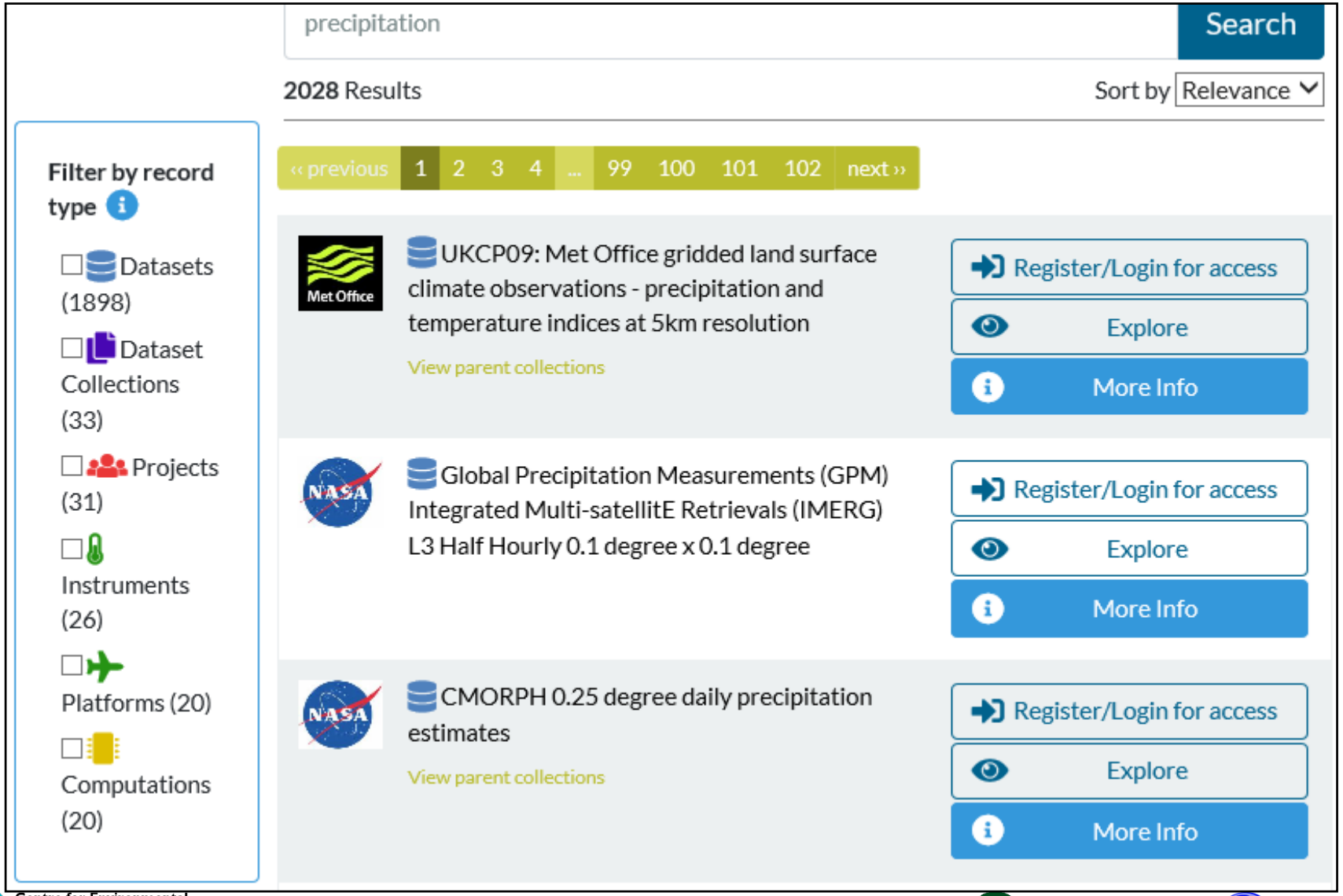
~ 529 datasets collections, ~5273 datasets

~ 181 million files

> 50,000 registered users



http://catalogue.ceda.ac.uk



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What is the role of CEDA?

- **Preserve the science record** (for data produced by NERC funded research).
- **Facilitate data use** (for any data that compliments NERC research in Atmospheric sci or Earth Observation (EO)).
- **Support data standards** (for international science community), e.g. ESA Climate Change Initiative; CMIP (Climate Model Intercomparison Project) data request; Climate-Forecast (CF) metadata convention.
- **Engage with global community.** CEDA staff participate in:
  - World Climate Research Programme (WCRP);
  - Committee on Earth Observation Satellites (CEOS);
  - Earth System Grid Federation (ESGF);
  - Intergovernmental Panel on Climate Change (IPCC) Data Distribution Centre.

CEDA Projects

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Projects

EUFAR

The European Facility for Airborne Research (EUFAR) aims at coordinating the operations of the European fleet of instrumented aircraft in the field of environmental research in the atmospheric, marine, terrestrial and Earth sciences.

More information here: http://www.ceda.ac.uk/projects-details/

UK Climate Projections User Interface

CEDA developed, maintains and manages the UK Climate Projections User Interface and Data Services (UKCP09 UI) on behalf of the Environment Agency. The UI supports a large user community (over 7,500) and provides access to datasets, customised image products and an off-line Weather Generator model.

More information here: http://www.ceda.ac.uk/projects-details/

NERC Data Catalogue Service

CEDA is responsible fo
behind NERC's Data Catalogue Service (DCS), harve
catalogues from NERCs designated data centres and
one data discovery service.

Lots more

ESPAS - Near-Earth Space Data Infrastructure for e-Science

The ESPAS project aims to provide e-infrastructure necessary to support the access to observations, modelling and prediction of the Near-Earth Space environment – which includes the plasma and energetic particle environments that surround our planet and the neutral atmosphere above 60 km. These environments are an important target for future research in areas such as space weather and Sun-climate studies.

CEDA's role in this project is to lead the interoperability work package and to deploy and host the final infrastructure.

More information here: http://www.ceda.ac.uk/projects-details/

Marine Environment Data and Information Network (MEDIN)

MEDIN is a partnership of UK organisations committed to improving access to marine data with partners from both the public and private sector. CEDA is responsible for running the web-server behind the MEDIN data discovery portal.

More information here: http://www.ceda.ac.uk/projects-details/

JASMIN Overview

The JASMIN facility is a "super-data-cluster" which delivers infrastructure for data analysis.

It is a hybrid between super-computer and data-centre which provides a globally unique computational environment.

To address "one of NERC's most strategically important challenges: the improvement of predictive environmental science." Prof. Duncan Wingham, NERC Chief Exec.

JASMIN is a world leading, unique hybrid of:

- **44PB** high performance storage by end of 2018
- High-performance computing (>**11000 cores**)
- Large scale near line tape storage
- Custom sophisticated network architecture
- Innovative cloud hosting capabilities

Hosted by STFC
Scientific Computing Department

"Computing Expertise across length scales from processes within atoms to environmental modelling"

- Applications development and support,
- Compute and data facilities and services
- Research and Training
- Numerical Analysis

Data Services

- STFC: Facility Archives (ISIS, Diamond)
- LHC: UK Hub (Tier 1 archive)
- BBSRC: Institutes data archive
- MRC: Data Support Service
- NERC: CEDA backup and JASMIN elastic tape

High Performance Computing

- Emerald GPU cluster for Oxford, UCL, Southampton, Bristol.
- SCARF HPC for RAL
- Hartree: Blue Joule bluegene HPC
- Hartree: Blue Wonder idataplex HPC
- JASMIN: NERC super data cluster

Close working partnership with industry

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National Centre for Earth Observation
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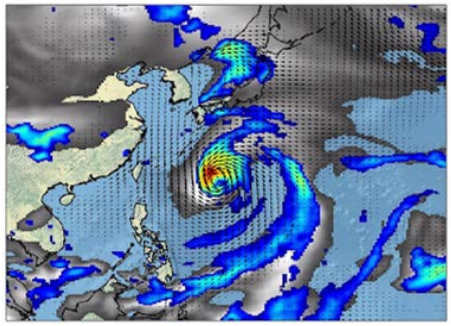
Processing big data: the issues

- Parallel processing in the Environmental Sciences has historically focussed on running highly-parallelised models.
- Data analysis was typically run sequentially because:
  - It was a smaller problem
  - It didn't have parallel resources available
  - The software/scientists were not equipped to work in parallel
- The generation of enormous datasets (e.g. UPSCALE – around 300Tb) means that:
  - Processing big data **requires** a parallel approach
  - Fortunately, platforms, tools, and programmers are becoming better equipped

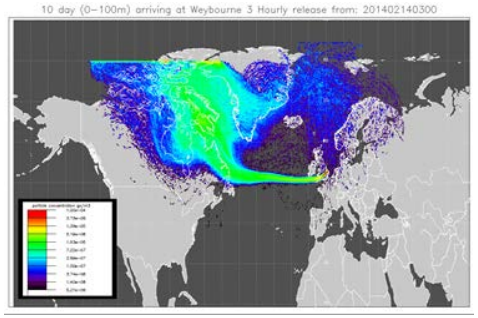
>170 Science projects on JASMIN to date

HRCM



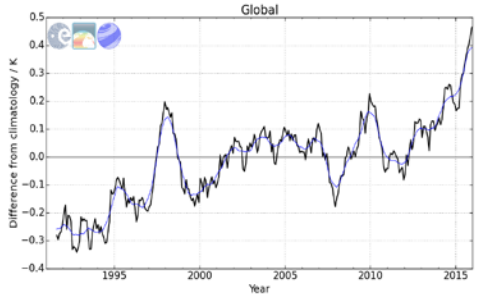
- NCAS & Met Office
- Hi-res climate simulations
- Tracking tropical cyclones
- Processing time down from **3 months to 1 day**

NAME



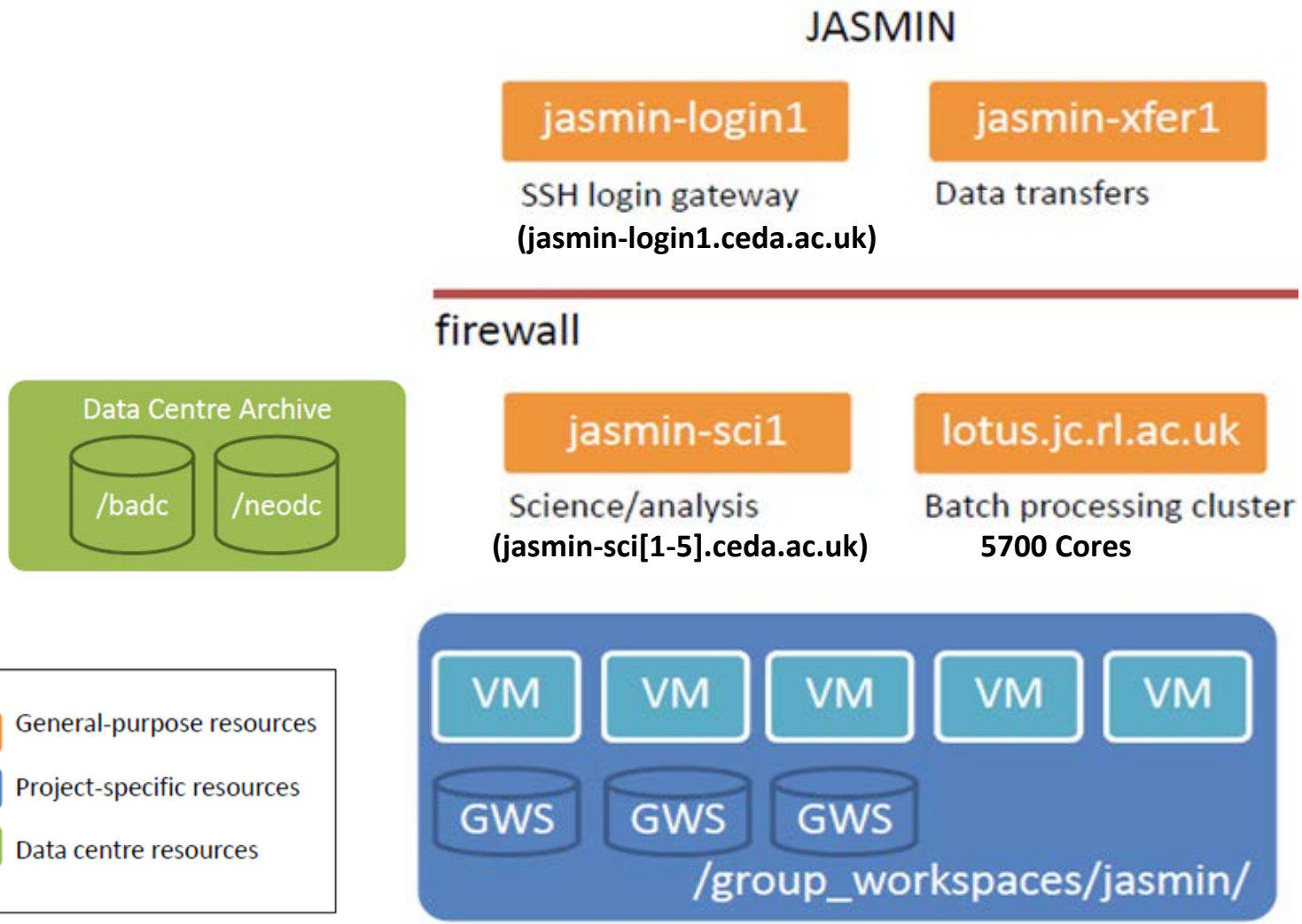
- Met Office Atmos Dispersion model
- Shared with community
- Input data: **>40TB**
- Single deployment of model + data

ESA SST-CCI

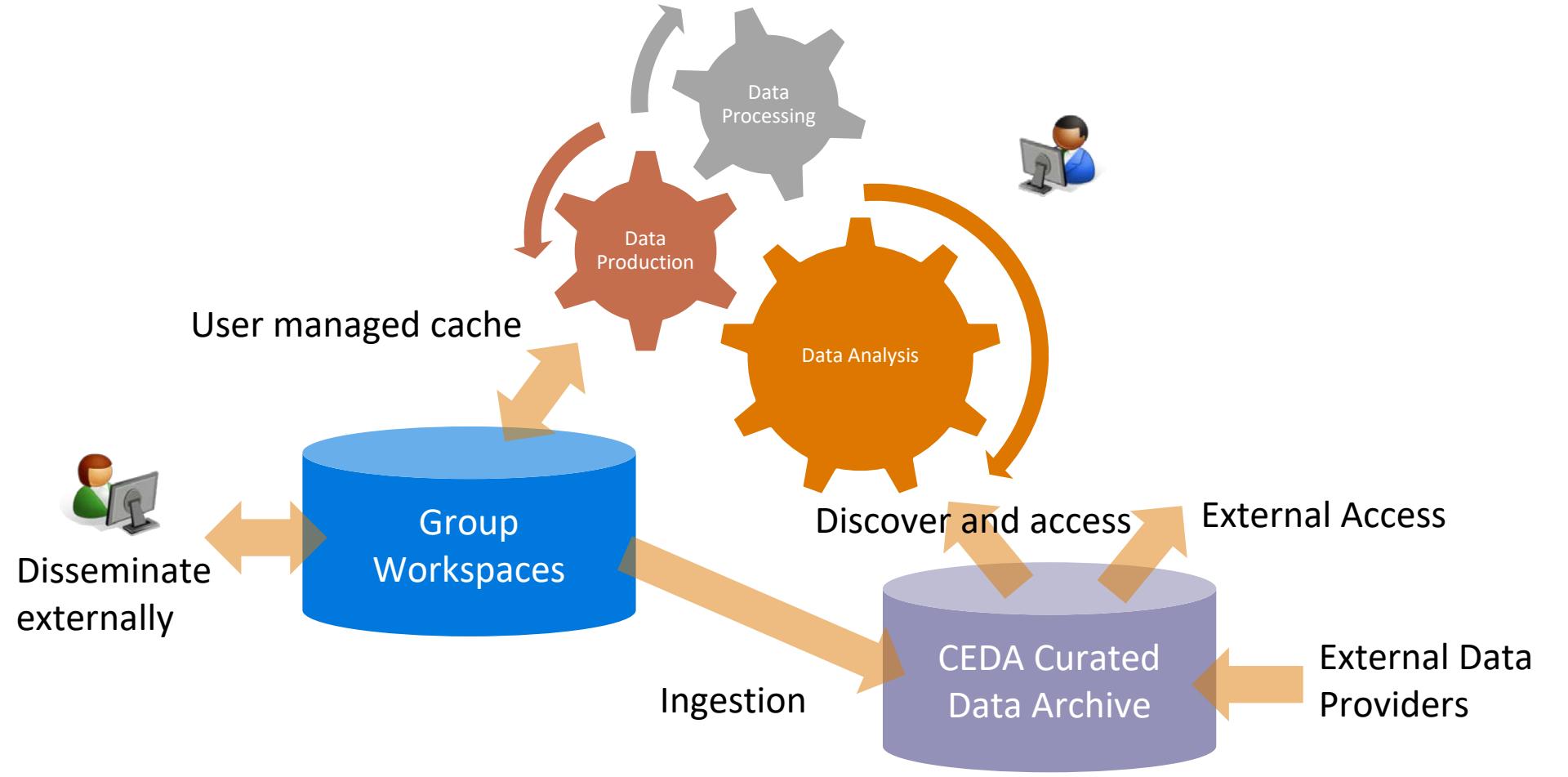


- Reading University
- Generating Sea Surface Temperature data
- **Inputs: 180TB** EO products
- Outputs: **50TB for CEDA Archive**

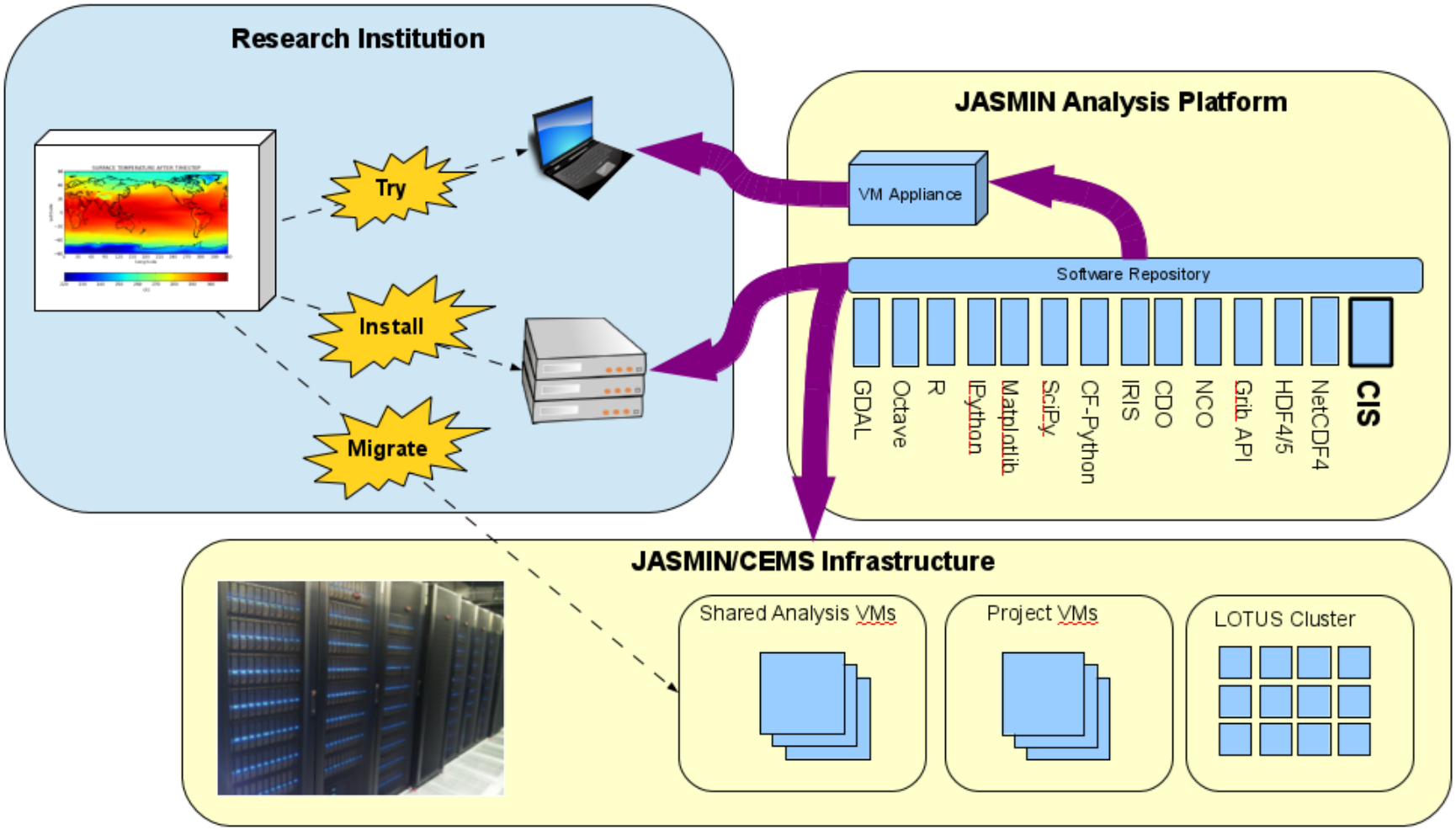
Scientific computing on JASMIN



JASMIN brings computational power close to the data



The “JASMIN Analysis Platform”: a re-usable, re-deployable bundle of common tools



Further Information

- NCAS website: **ncas.ac.uk**
- CMS website: **cms.ncas.ac.uk**
- CEDA website: **ceda.ac.uk**
- JASMIN online help: **help.jasmin.ac.uk**
- JAP: **help.jasmin.ac.uk/article/271-jap**