Introduction to computing resources

Computer User Training Course 2017

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User Support

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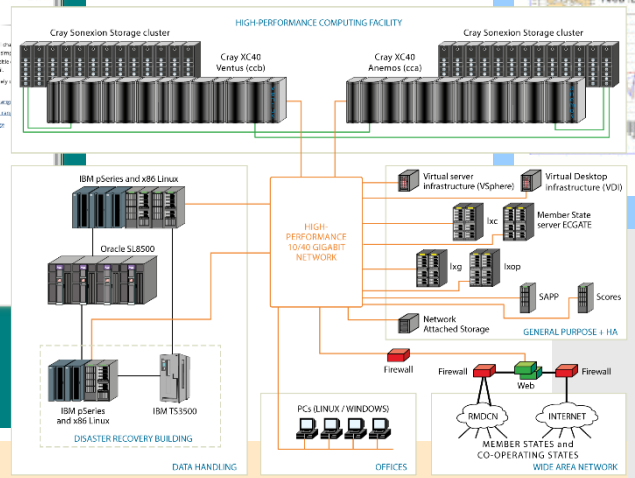
ECMWF

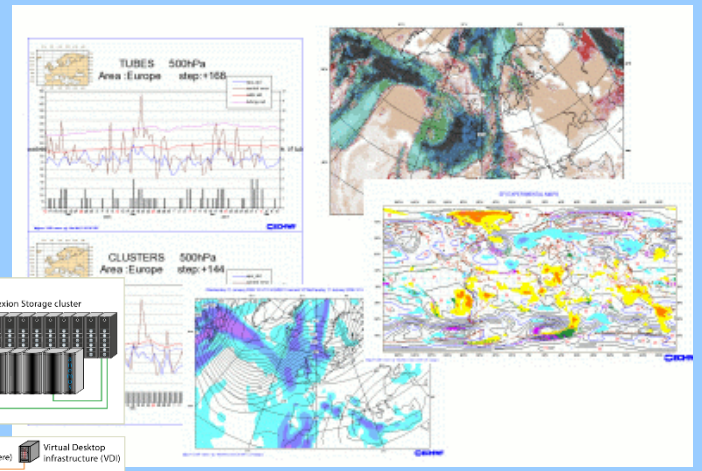
Overview

Web services (ECaccess,ecCharts,APPS,..)

Computer facilities



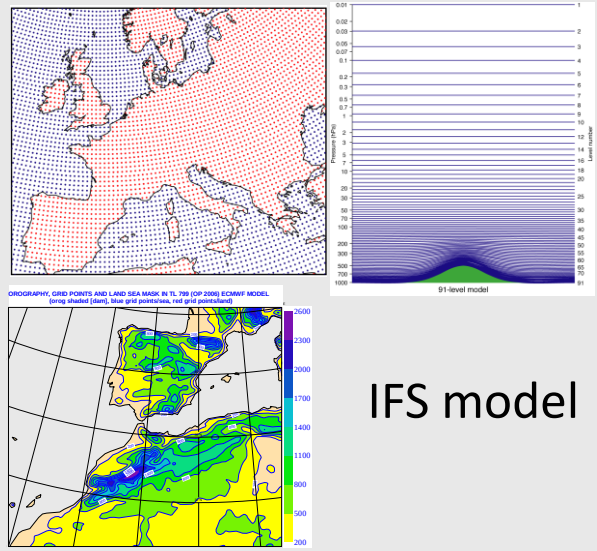
Meteorological software & libraries



mars, ecCodes, Metview, Magics, ecFlow etc.

Service Desk { *Fault reporting, Service queries*

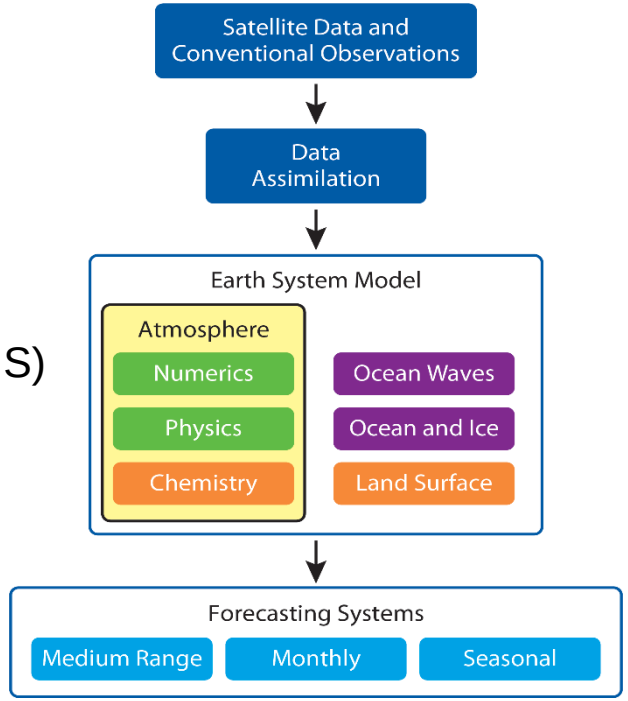
User Support { *Advice on the use of ECMWF computers*



IFS model

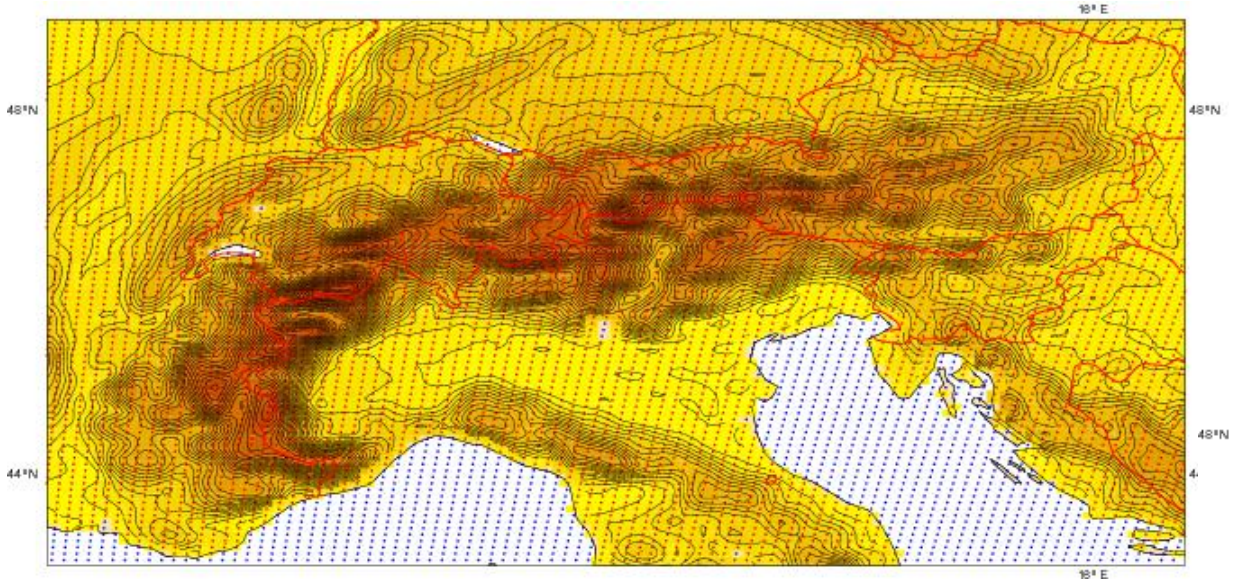
ECMWF operational forecasting system

- High resolution forecast and analysis (HRES)
  - ~9 km and 137 levels (T_{CO}1279 L137) to 10 days at 00 and 12 UTC (BC run to T+90 at 06 and 18 UTC)
- Ensemble forecast (ENS) – 51 members
  - ~18 km and 91 levels (T_{CO}639 L91) to 15 days at 00 and 12 UTC (BC run to T+144 at 06 and 18UTC)
  - With ocean coupling from initial time
  - Monday / Thursday 00 UTC extended to 46 days at ~36 km (Monthly Forecast)
- Ocean waves
  - WAM-HRES: ~14 km to 10 days at 00 and 12 UTC (coupled with HRES)
  - HRES-SAW: Stand Alone Wave model : at ~11 km to 10 days at 00 and 12 UTC
  - WAM-ENS: 51 members: at ~28 km to 15 days at 00 and 12 UTC (coupled with ENS)
- Seasonal forecast – 51 members
  - ~80 km and 91 levels (T_L255 L91), once per month to 7 months ahead
  - sub-set of 15 members is run for 13 months every quarter (30 years of hindcasts)



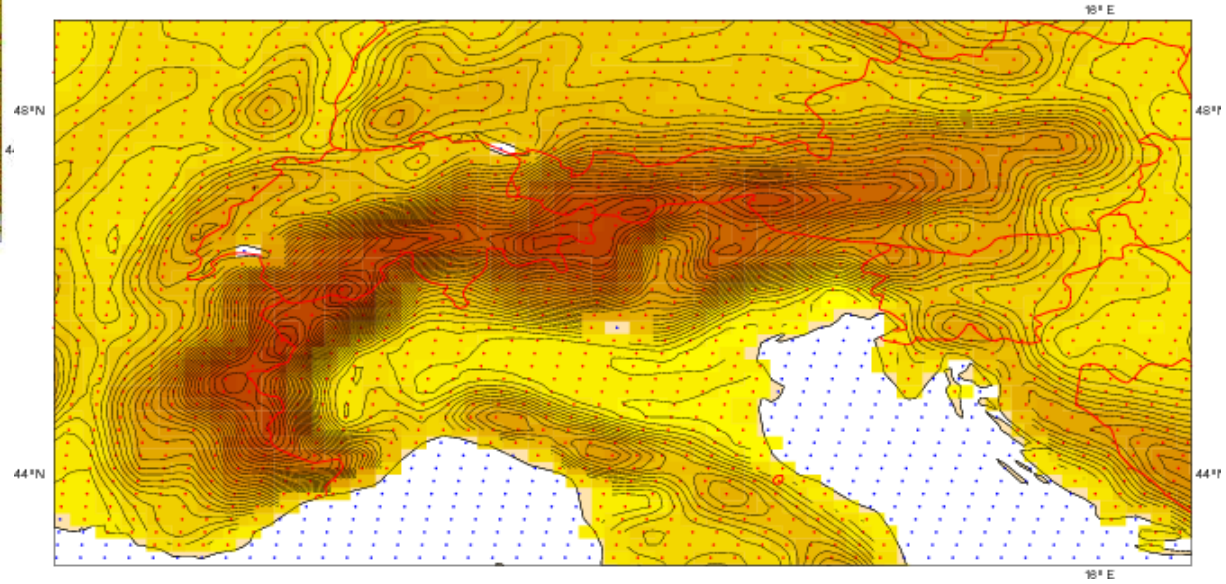
Land-sea mask and orography

HRES: O1280 (~9 km)



137 x 6,599,680 = 904,156,160 grid points

ENS Days 1-15: O640 (~18km)

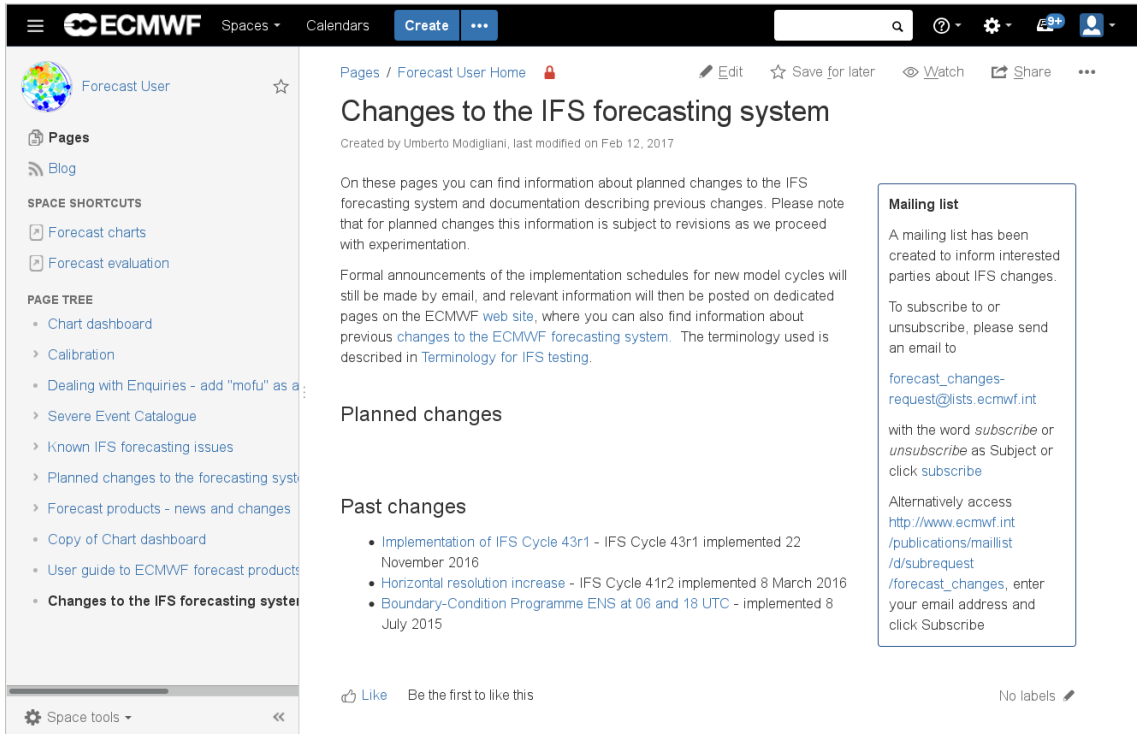


91 x 1,661,440 = 151,191,040 grid points

Operational upgrades for 2017

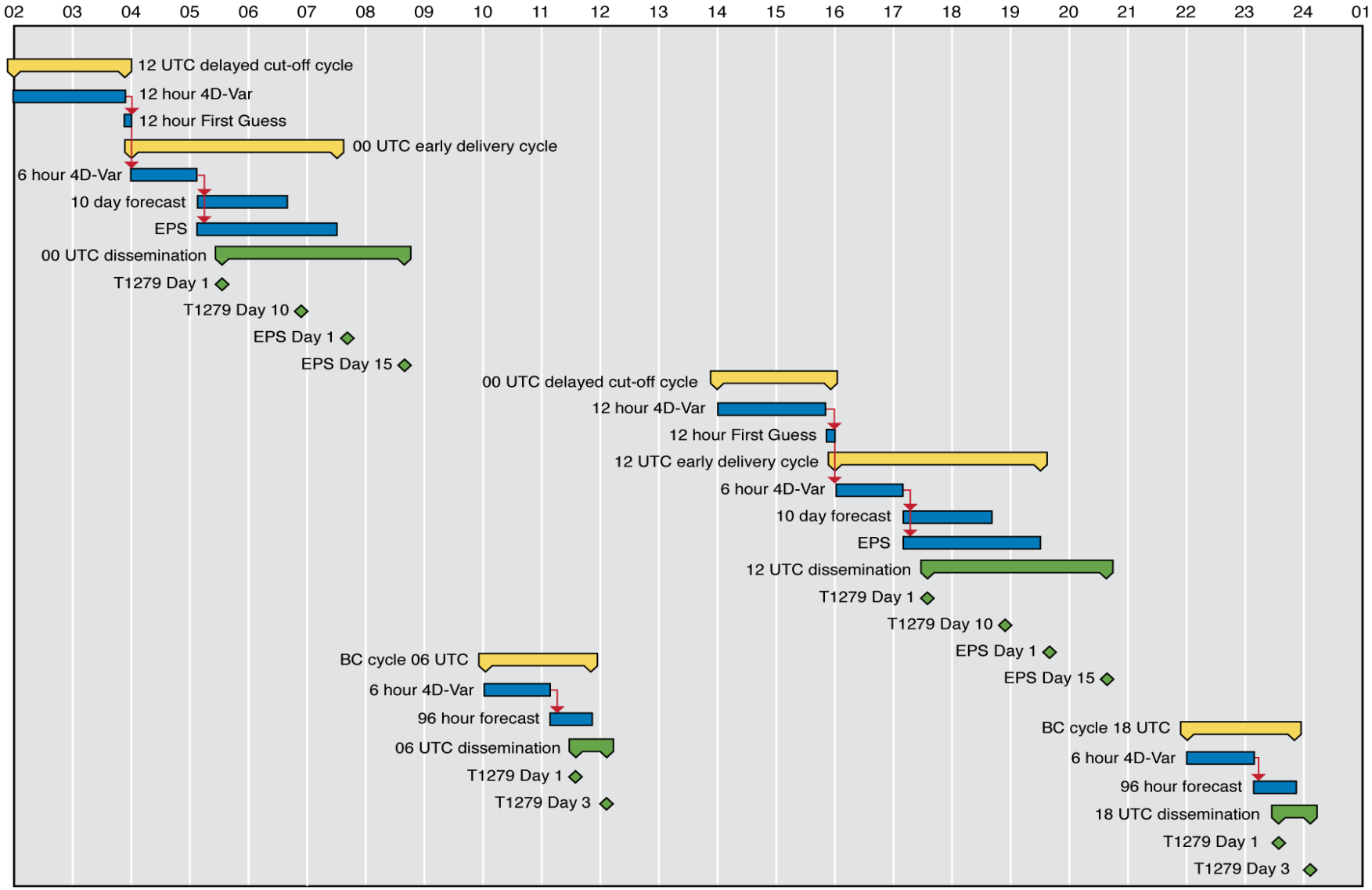
- 7 March 2017: Earlier dissemination of ENS and WAM ENS
  - Products will be disseminated 40 minutes earlier starting at 07:00 / 19:00 for 00 / 12 UTC cycles
  - Applies also to the ENS BC products at 06 and 18 UTC.

- June 2017: Implementation of System 5
  - New seasonal forecast system
  - Horizontal resolution increased to ~36 km with 91 vertical levels ($T_{CO}319$ / O320 / L91)
  - Increased ocean resolution

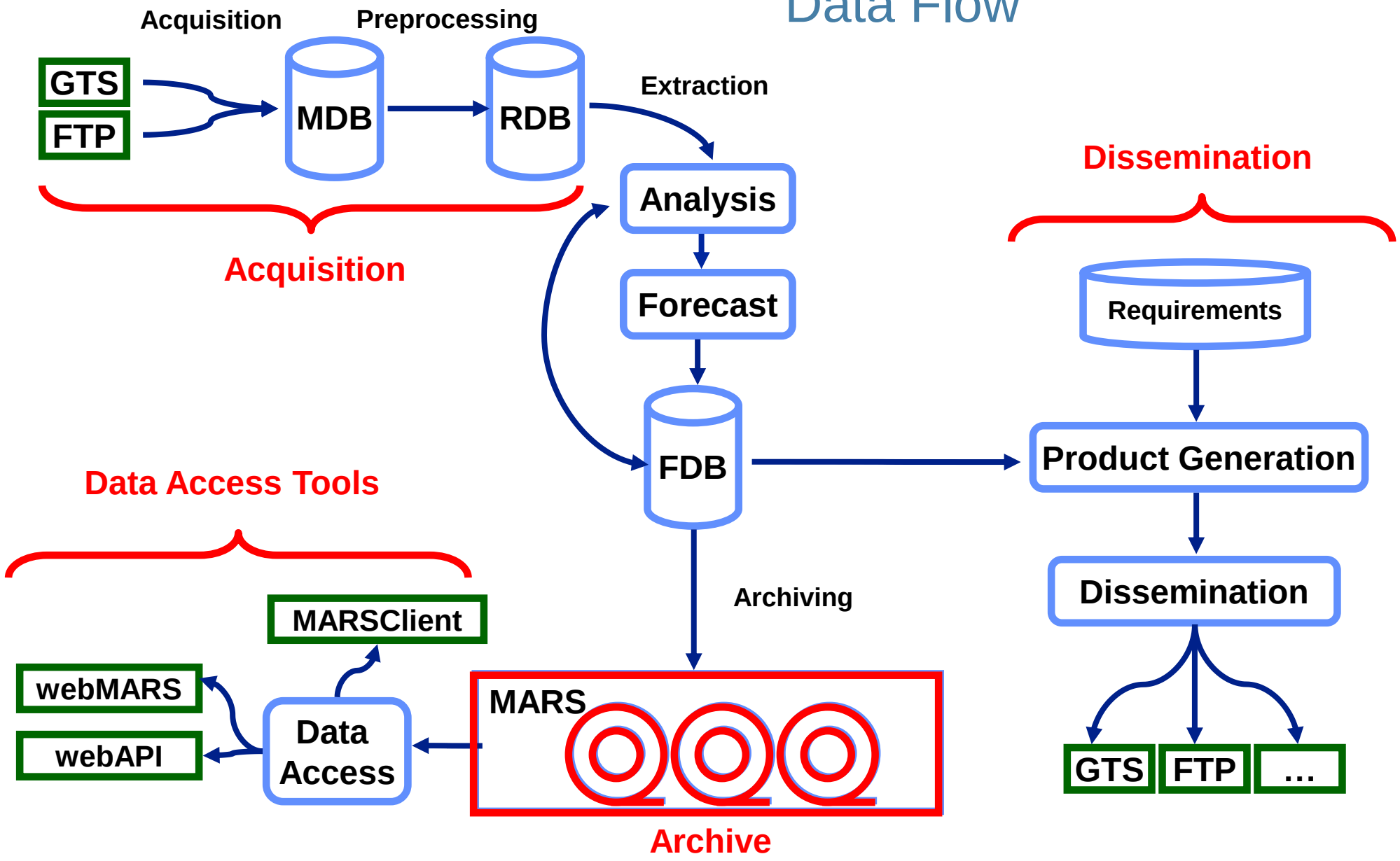


https://software.ecmwf.int/wiki/display/FCST/Changes+to+the+IFS+forecasting+system

The main operational suites on ECMWF's HPCF



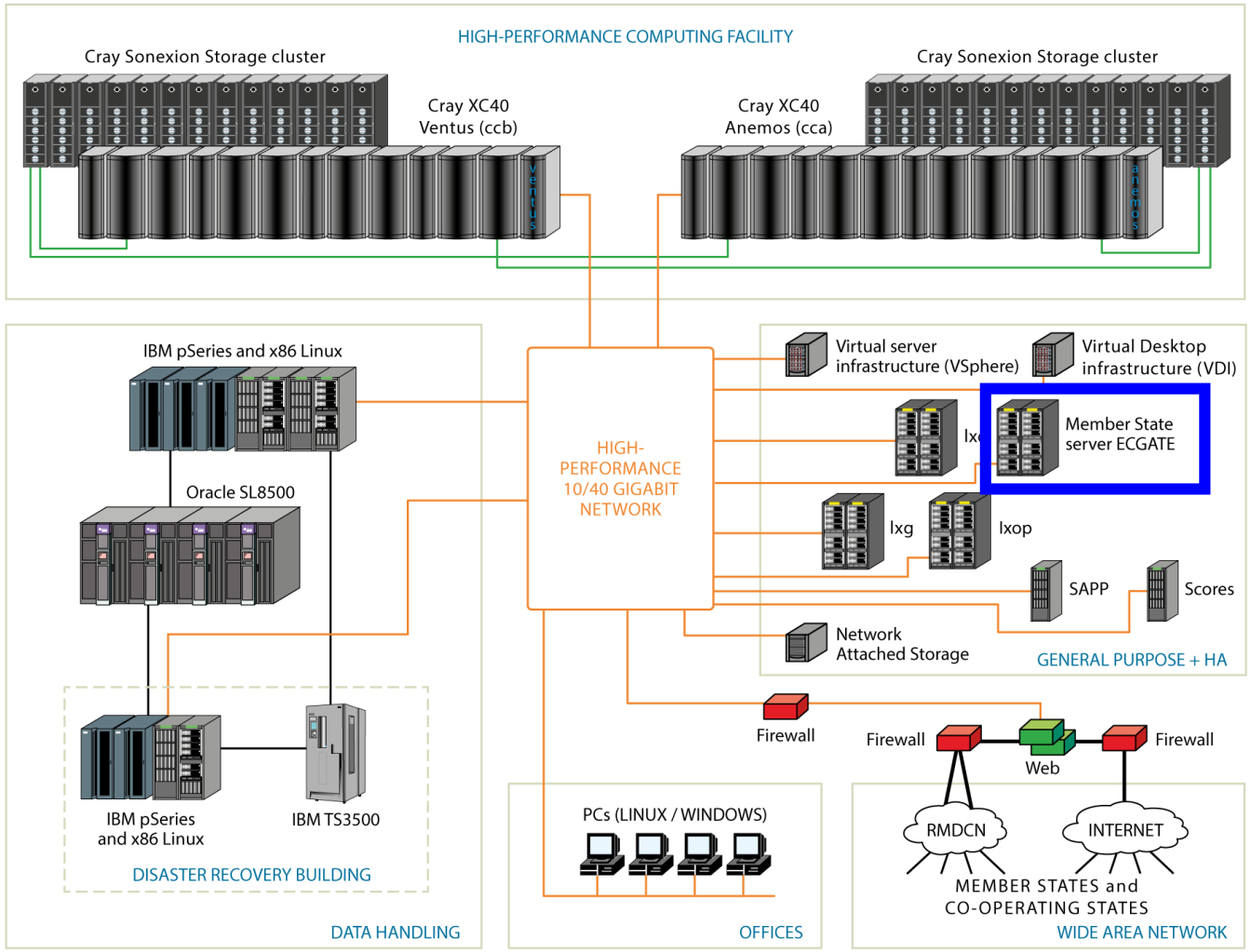
Data Flow


Acquisition
Preprocessing
GTS
FTP
MDB
RDB
Extraction
Analysis
Forecast
FDB
Acquisition
Dissemination
Requirements
Product Generation
Dissemination
GTS
FTP
...
Data Access Tools
MARSClient
webMARS
webAPI
Data Access
Archiving
MARS
Archive

Computing Services

Linux cluster – ecgate

Web documentation: www.ecmwf.int/en/computing/our-facilities/ecgate



ecgate – configuration

- 12 compute nodes each with
  - 2 Intel Xeon processors (Sandy Bridge-EP): 16 core at 2.7 GHz
  - Hyper threading provides 32 virtual CPUs per node
  - 128 GB memory
  - 2 x 900 GB SAS HDD
- One (+one as backup) node used as a "login" node
- RedHat Enterprise Linux Server 6.8
- 6 I/O server nodes
  - Provides ~275 TB raw disk space (~200 TB of usable space)
  - All file systems are GPFS (General Parallel File Systems)
  - File systems use RAID 5 for speed and resilience
- Available to ~3000 users at more than 350 institutions

ecgate – purpose

Batch submission
- **SLURM**
- **ECaccess Tools**

Program development

Visualisation
- **Metview**
- **Magics**

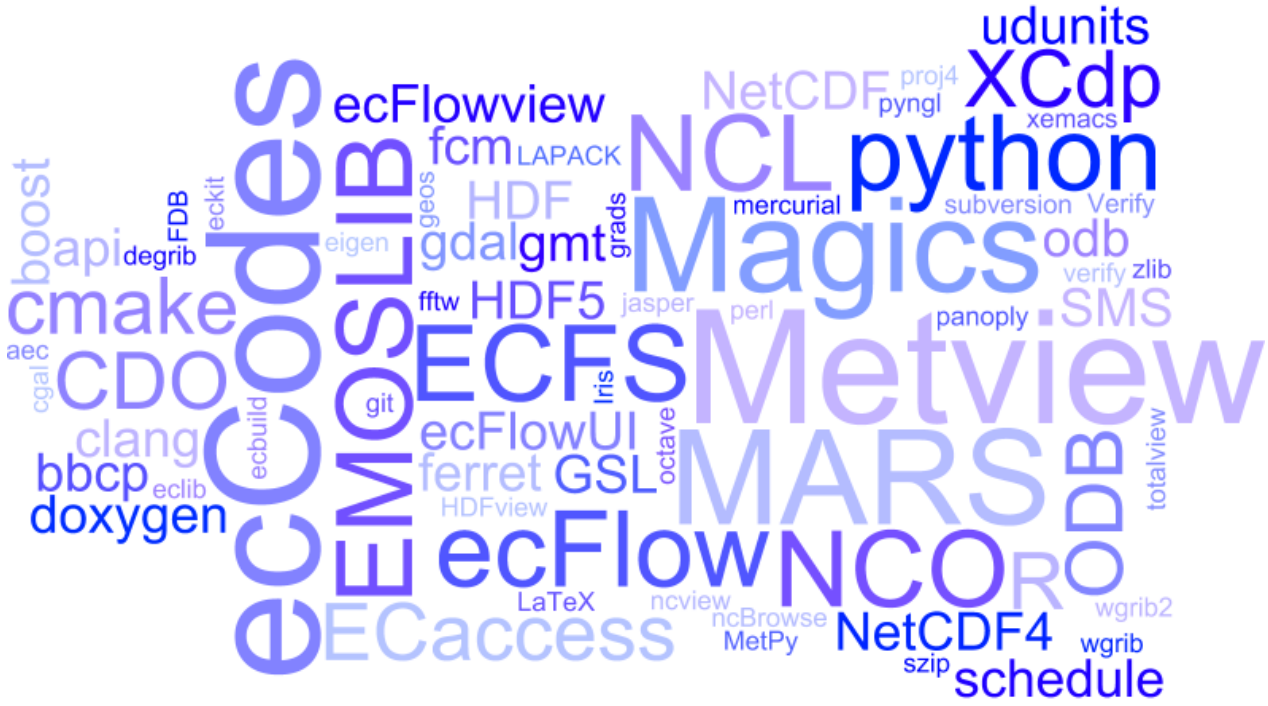
Time-critical applications
- **Option 1**
- **Option 2**

Data transfer
- **ftp / sftp**
- **ectrans**

Access to archives
- **MARS**
- **ECFS**

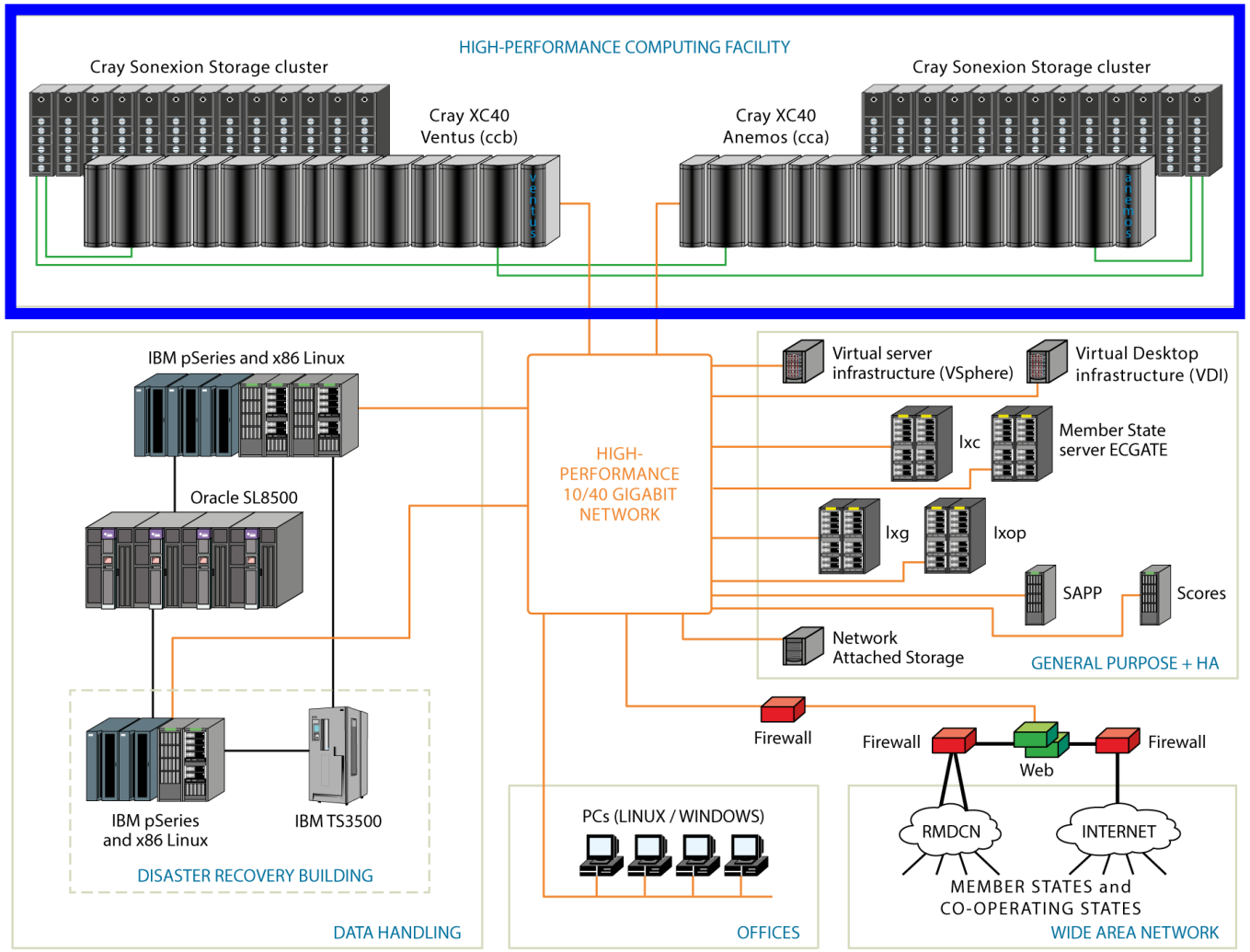
ecgate – software environment

- General ECMWF software and libraries:
  - ECLIB, EMOSLIB, ecCodes, odb_api
- Archives: MARS and ECFS
- Data formats:
  - NetCDF, NetCDF4, HDF, HDF5
- Graphics
  - ECMWF: Metview, Magics
  - External data analysis and visualisation tools
    - ncview, view_hdf. panoply, GrADS
    - CDO, NCO, R, NCL, gnuplot
- Debugging: Totalview, gdb
- Suite scheduling and monitoring: ecFlow, ecFlowview / ecFlowUI



HPCF

Web documentation: www.ecmwf.int/en/computing/our-facilities/supercomputer



HPCF – Cray XC40

- Operational at ECMWF since 19 September 2014
- Phase 2: ~3600 nodes / 130,000 compute cores per cluster
- ~8.5 petaflops peak and ~320 teraflops sustained performance
- Numbers 23 and 24 in the November 2016 Top 500 Supercomputers list
- Contract with Cray extended to 30 September 2020

Cray HPCF Phase 1 vs Phase 2 – a quick comparison

	Phase 1	Phase 2
Sustained Performance (teraflops)	200	**320**
Peak performance (teraflops)	3,593	**~8,500**
Processor technology	Intel Ivy Bridge	**Intel Broadwell**
Parallel application nodes (per cluster)	3,400	**3,513**
Pre-/Post-processing nodes (per cluster)	104	104
Cores per node / CPUs per node	24 / 48	**36 / 72**
Total compute cores (per cluster)	84,096	**130,212**
Memory per node (GiB)	64 (1866 MHz DDR3)	**128 (2400 MHz DDR4)**
External login nodes	2 x Ivy Bridge	2 x Ivy Bridge, **1 x Haswell**
Clock frequency (GHz)	2.7	**2.1**
Storage capacity (petabytes)	15	**20**
Floating Point Instruction set	AVX	**AVX2**
Default compiler	Cray 8.2.7	**Cray 8.4.x**

HPFC – purpose

Batch submission
- **PBSpro**
- **ECaccess Tools**

Time-critical applications
- **Option 1**
- **Option 2**
- **Option 3**

Access to archives
- **MARS**
- **ECFS**

Data transfer
- **ftp / sftp**
- **ectrans**

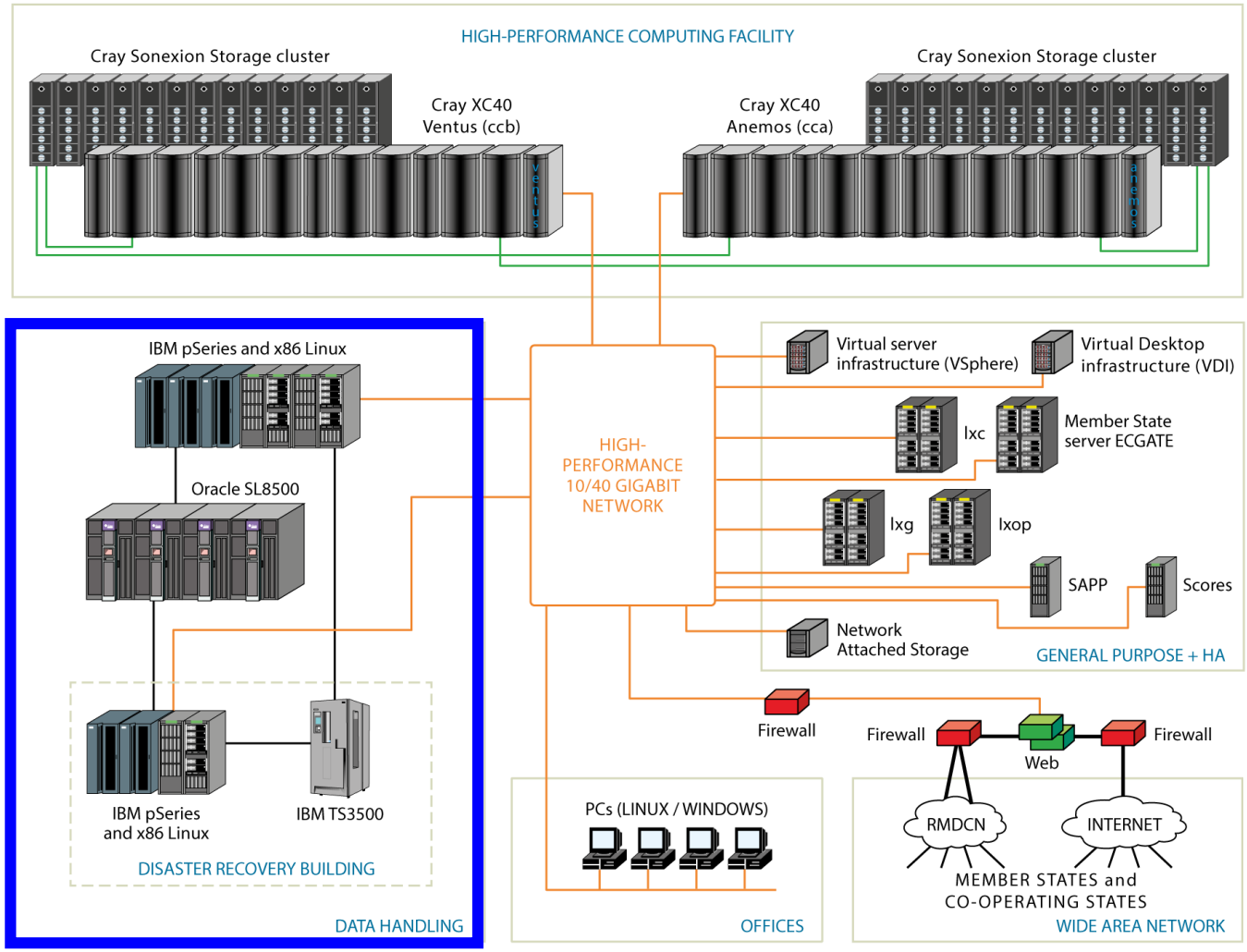
Running meteorological models
- **Member State models**
- **ECMWF's IFS**

HPCF – software environment

- General ECMWF software and libraries: ECLIB, EMOSLIB, ecCodes
- Archives: MARS, ECFS
- Data formats, tools and libraries
  - NetCDF, NetCDF4, HDF, HDF5
  - NCO, CDO
- Debugging
  - Allinea DDT
- Numerical libraries
  - LIBSCI (Cray), GSL, FFTW

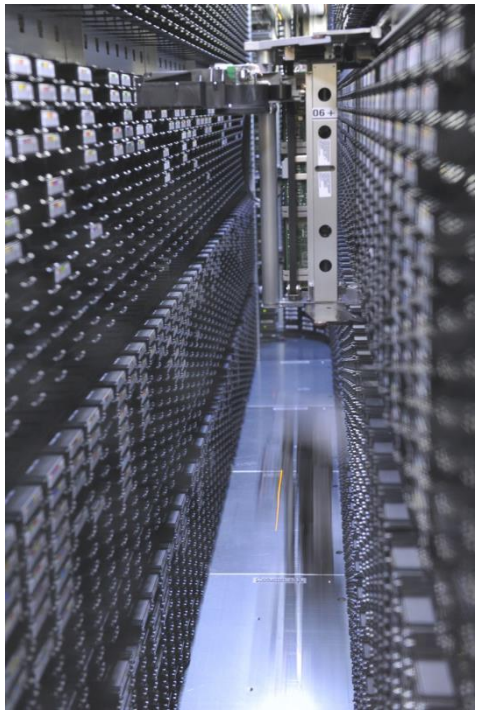
Data Handling System (DHS)

Web documentation: www.ecmwf.int/en/computing/our-facilities/data-handling-system



DHS – configuration

- DHS Hardware
  - Intel-based Linux servers
  - Some IBM p575/p620 servers
  - 4 Oracle SL8500 automated tape libraries



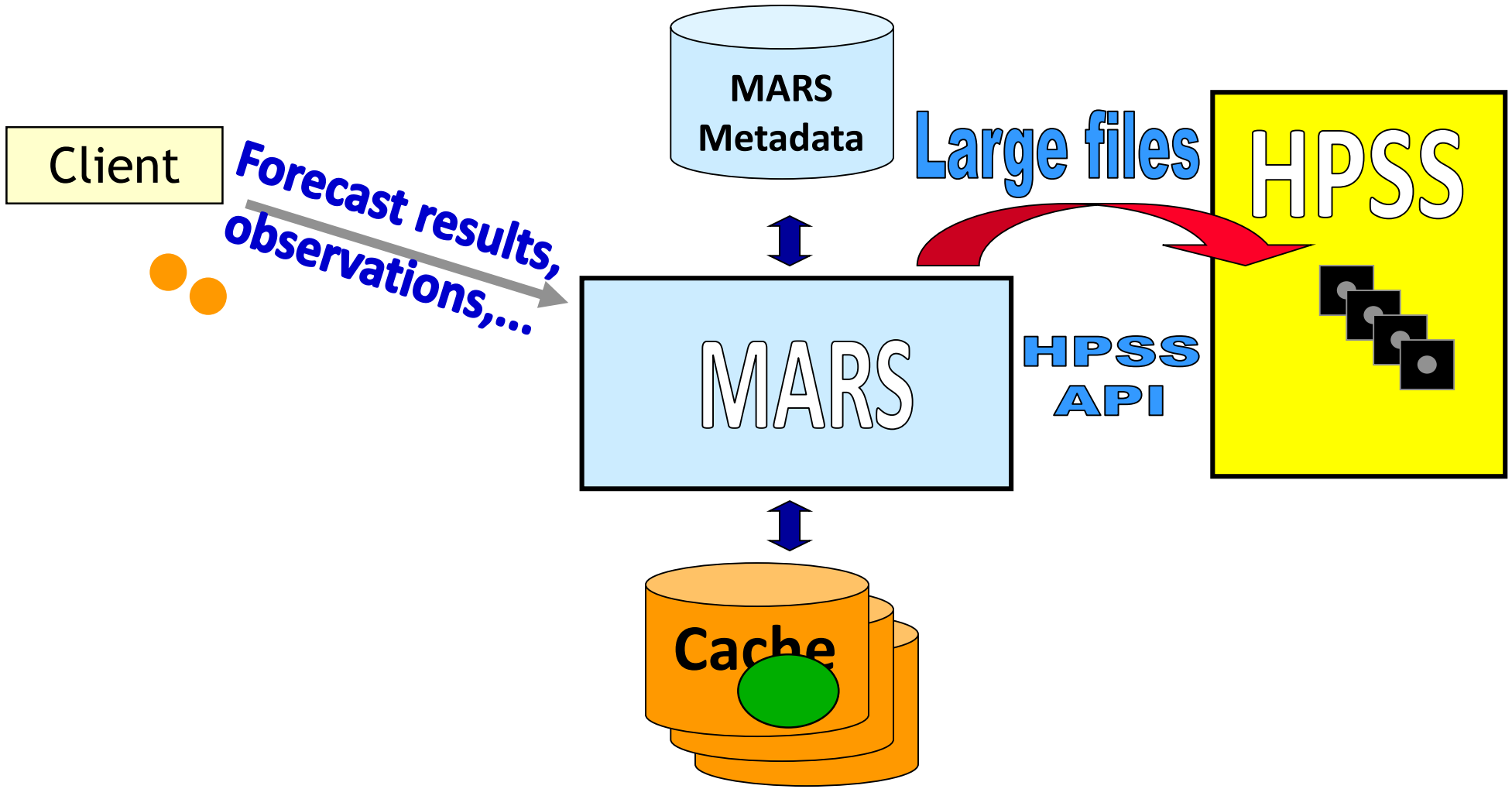
- DHS Software
  - Based on HPSS (High-Performance Storage System)

- Comprises two archives
  - MARS – Meteorological archive
  - ECFS – User archive

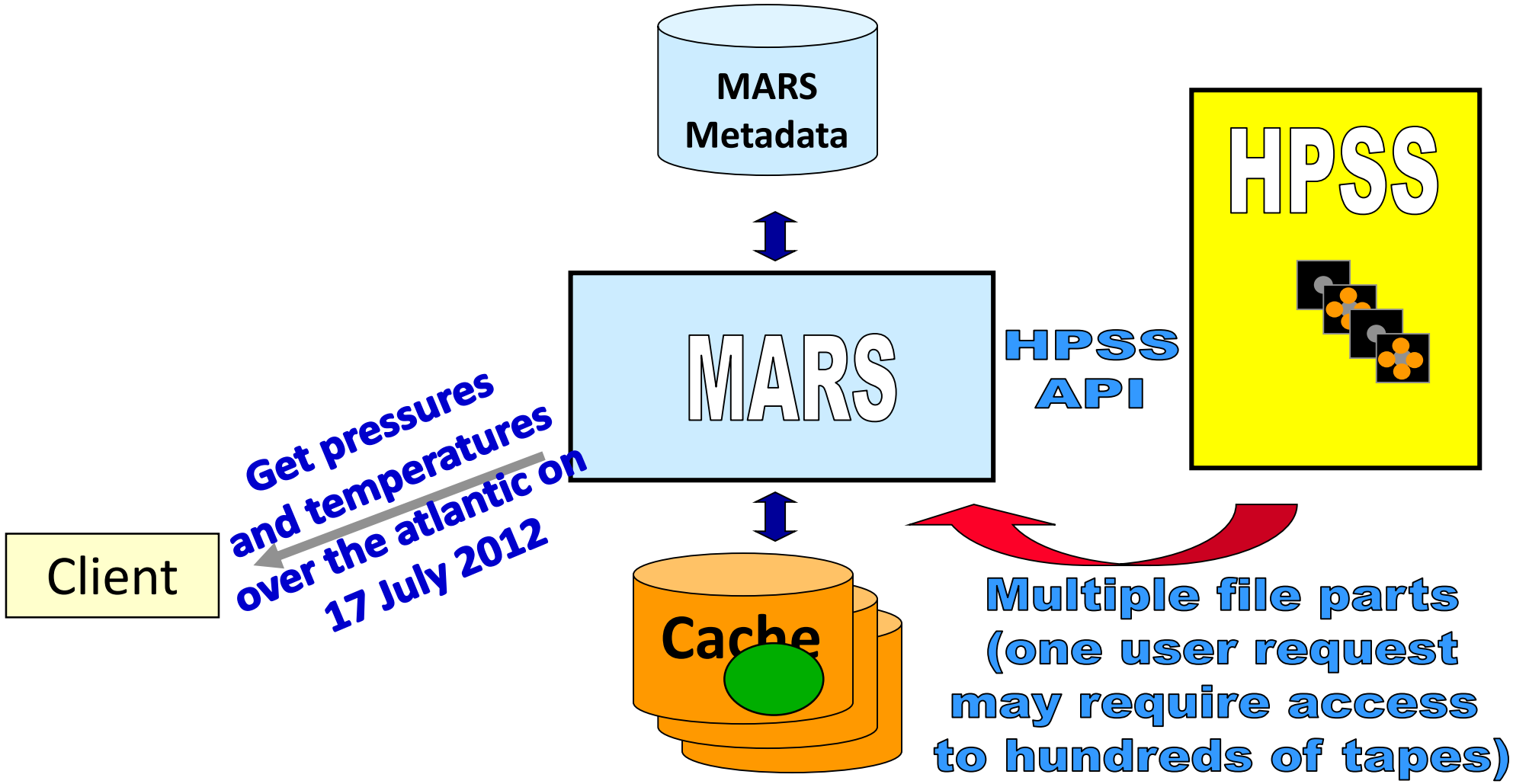
DHS Services

- MARS – Meteorological Archive and Retrieval System
  - Data is accessed via a meteorological meta-language interface
  - Bulk of the data, few files (but holding billions of fields in total)
  - Relies upon excellent tape drive performance when retrieving lots of small parcels of data from tape
- ECFS – ECMWF File System
  - HSM-like (Hierarchical Storage Management) service for “ad-hoc” files that are not suitable for storing in MARS
  - Data is accessed via an rcp-like interface
  - Millions of files, many very small
- HPSS
  - Both MARS and ECFS rely on HPSS as the underlying data management system that is used to store the data
  - Users do not have direct access to HPSS, only via MARS and ECFS

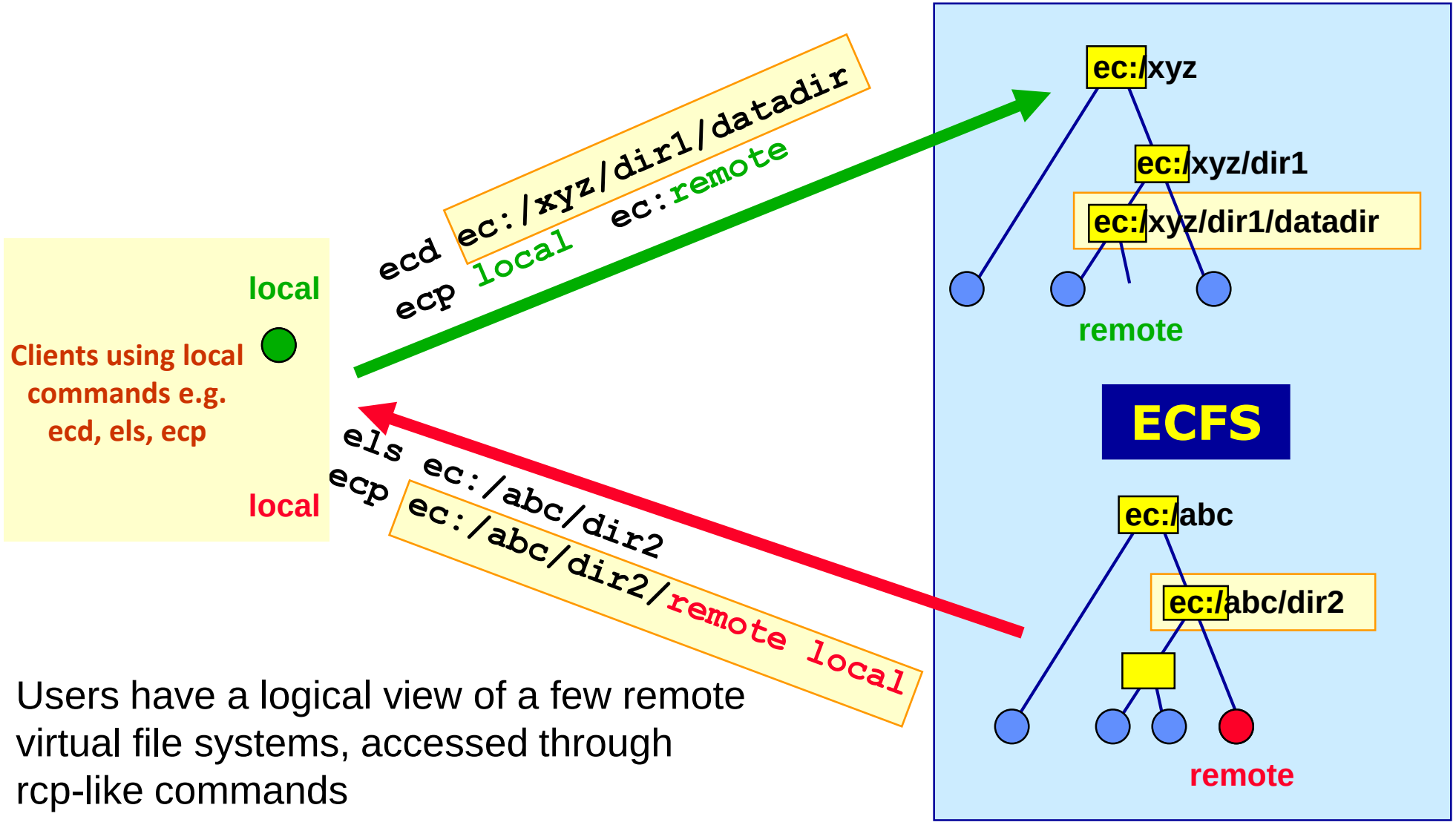
MARS archiving



MARS retrieval



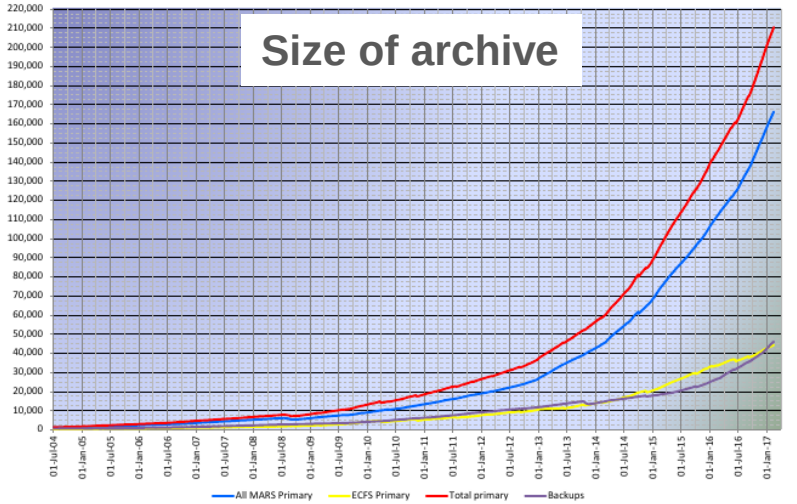
ECFS – the user's view



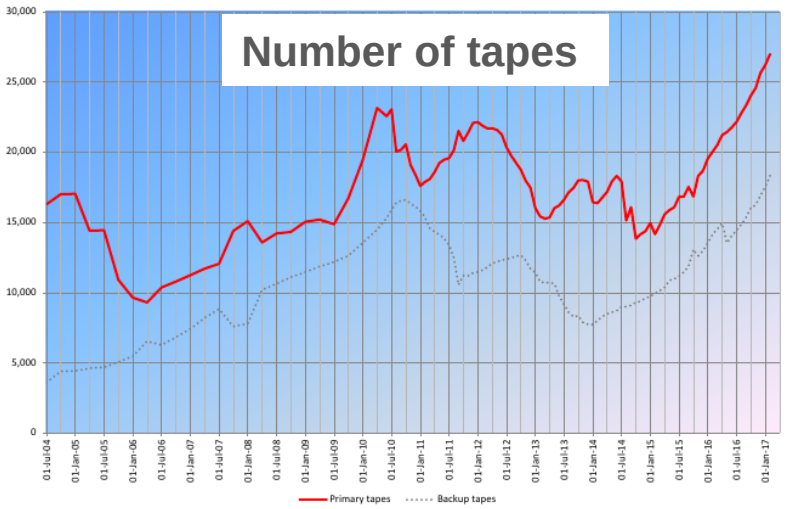
Users have a logical view of a few remote virtual file systems, accessed through rcp-like commands

The ECMWF Archive – statistics

- The DHS provides access to ~210 PB of primary data
- An additional ~46 PB of backup copies of part of the primary data are stored in the DRS
- In a typical day the archive grows by ~233 TB
- ~15,500 tape mounts on average per day
  - On some days this can peak at around 25,000
- MARS data:
  - ~6% of the files
  - ~80% of the data volume
- ECFS data:
  - ~94% of the files
  - ~20% of the data volume



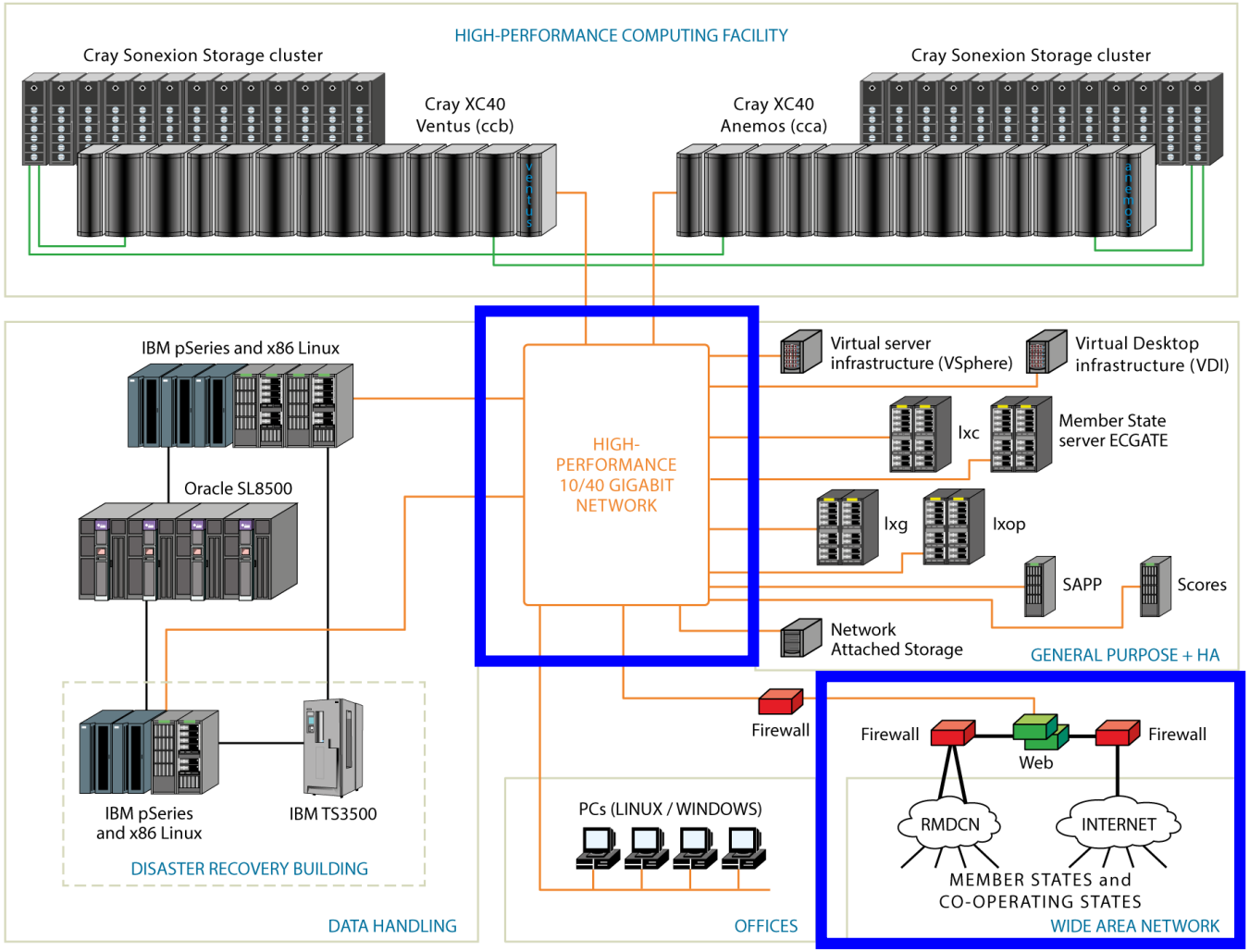
220 PB



30,000

Networks

Web documentation: www.ecmwf.int/en/computing/our-facilities/networks
www.ecmwf.int/en/computing/our-facilities/rmdcn



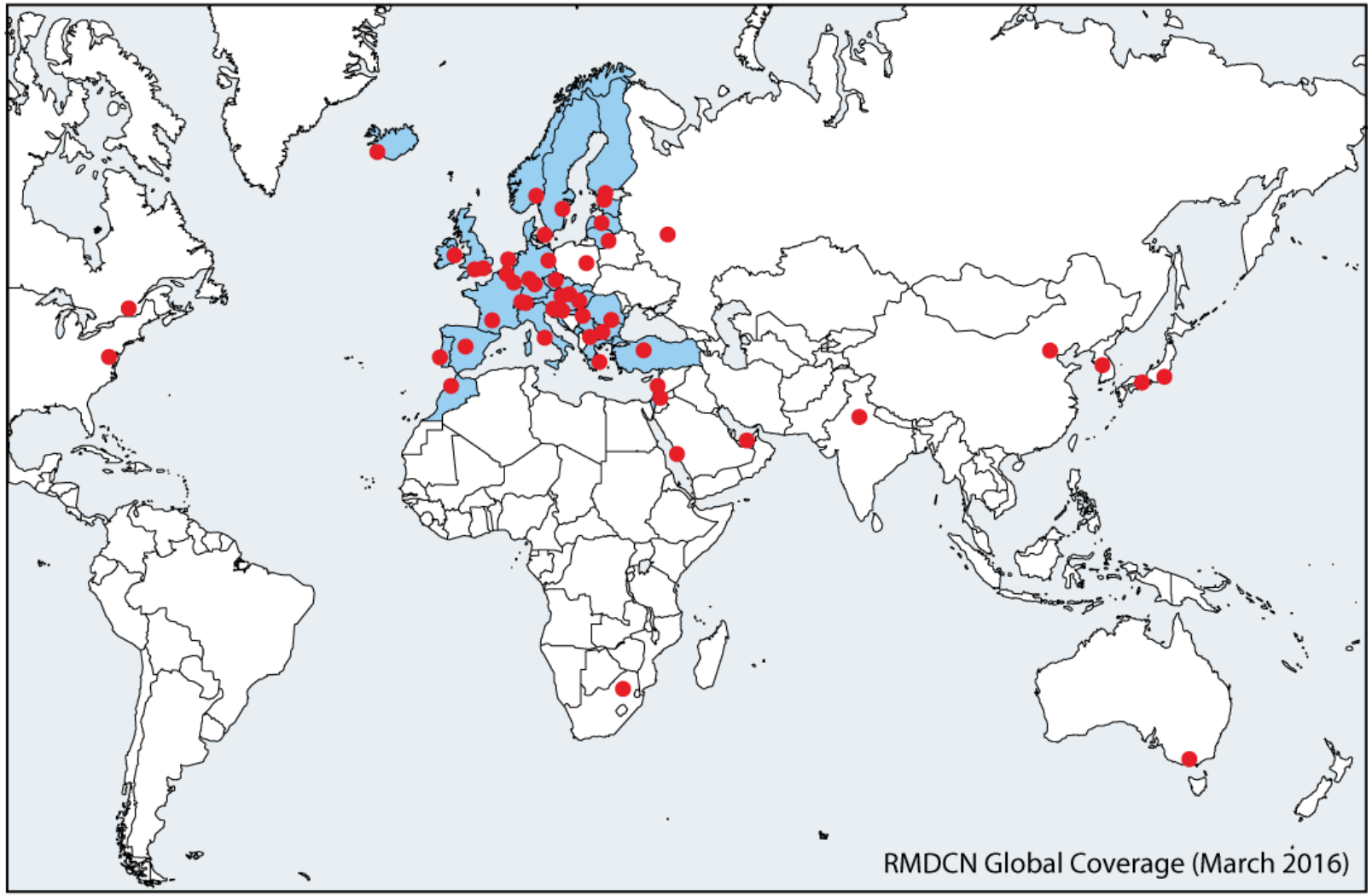
Networks

- Internal (LAN)
  - High Performance Network: 40 Gbps
  - Office Network: 10 Gbps

- External (WAN)
  - Internet
    - Dual 15 Gbps connection to SuperJANET, the UK Education and Research Network

  - RMDCN (Regional Meteorological Data Communications Network):
    - Secured VPN provided through MPSL (Multi Protocol Label Switching)

RMDCN Connections



- 53 sites currently connected (March 2016)

Access to ECMWF resources

All interactive login access to ECMWF requires security token authentication

Interactive access via Internet link

ssh –X –l <UID> ecaccess.ecmwf.int

or with NX from NoMachine (the desktop Virtualization Company)

Through your Web browser at http://ecaccess.ecmwf.int/ (or local gateway)

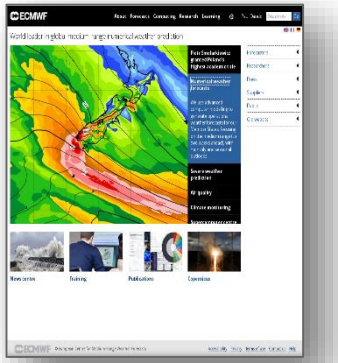
Or by installing nxclient on your local machine

The same token, or a password or a certificate can be used to access the ECMWF website

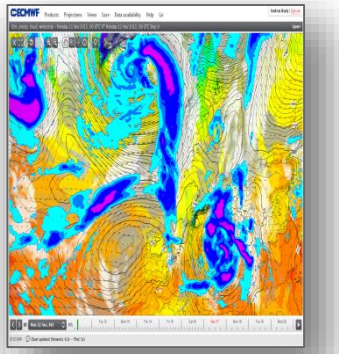
Web Services
www.ecmwf.int

Web services – overview

- Five key service areas:



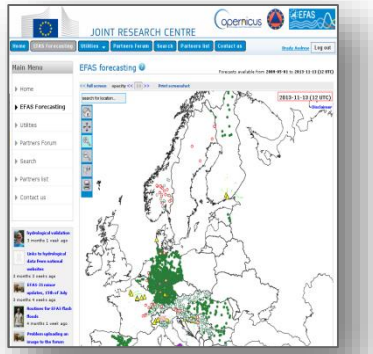
www
Everyone



ecCharts
Forecasters

Data
Web data users

Software
Everyone



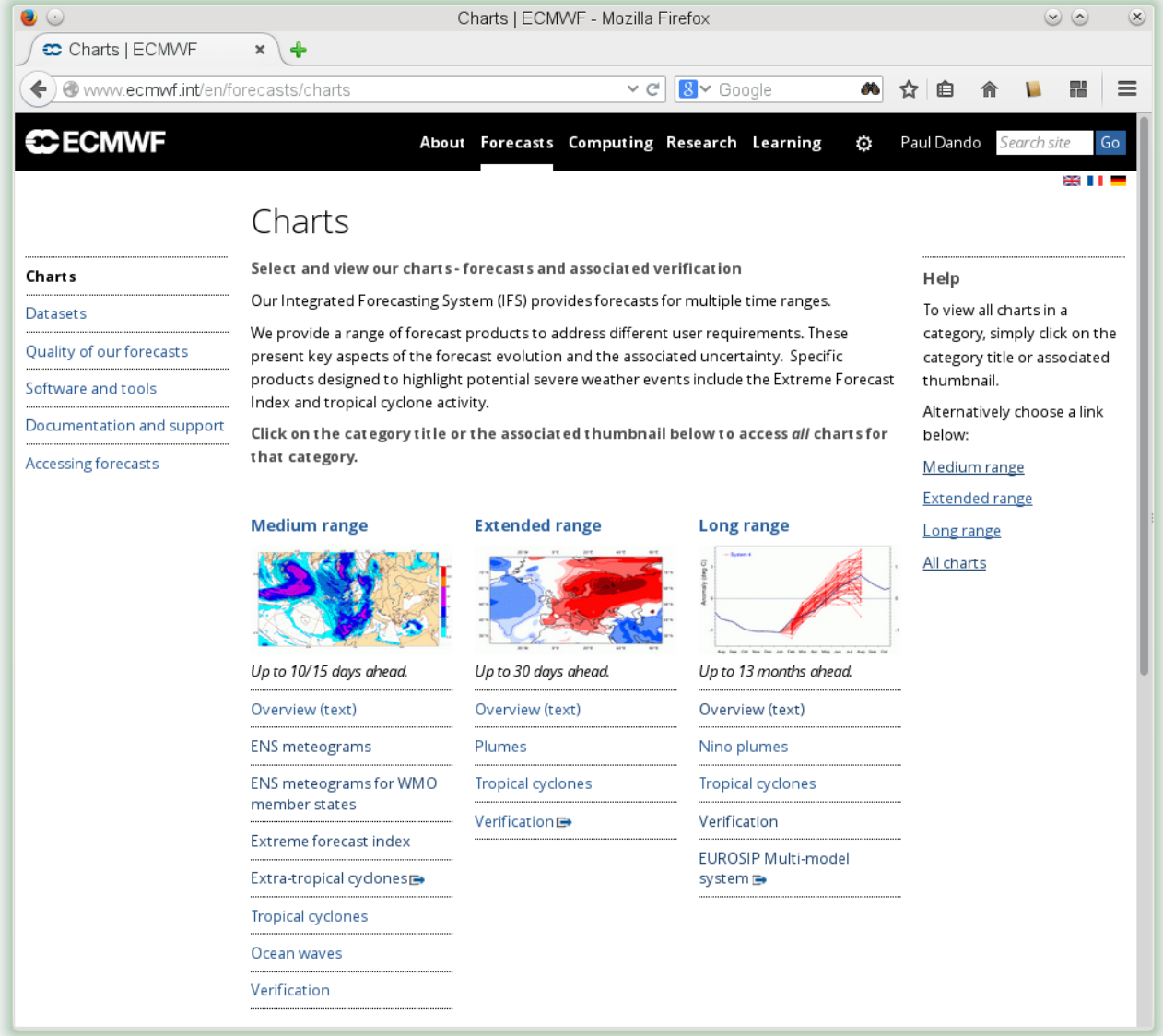
EFAS
EFAS Partners

Web services - www.ecmwf.int/en/forecasts/charts

Charts accessible depend on the user

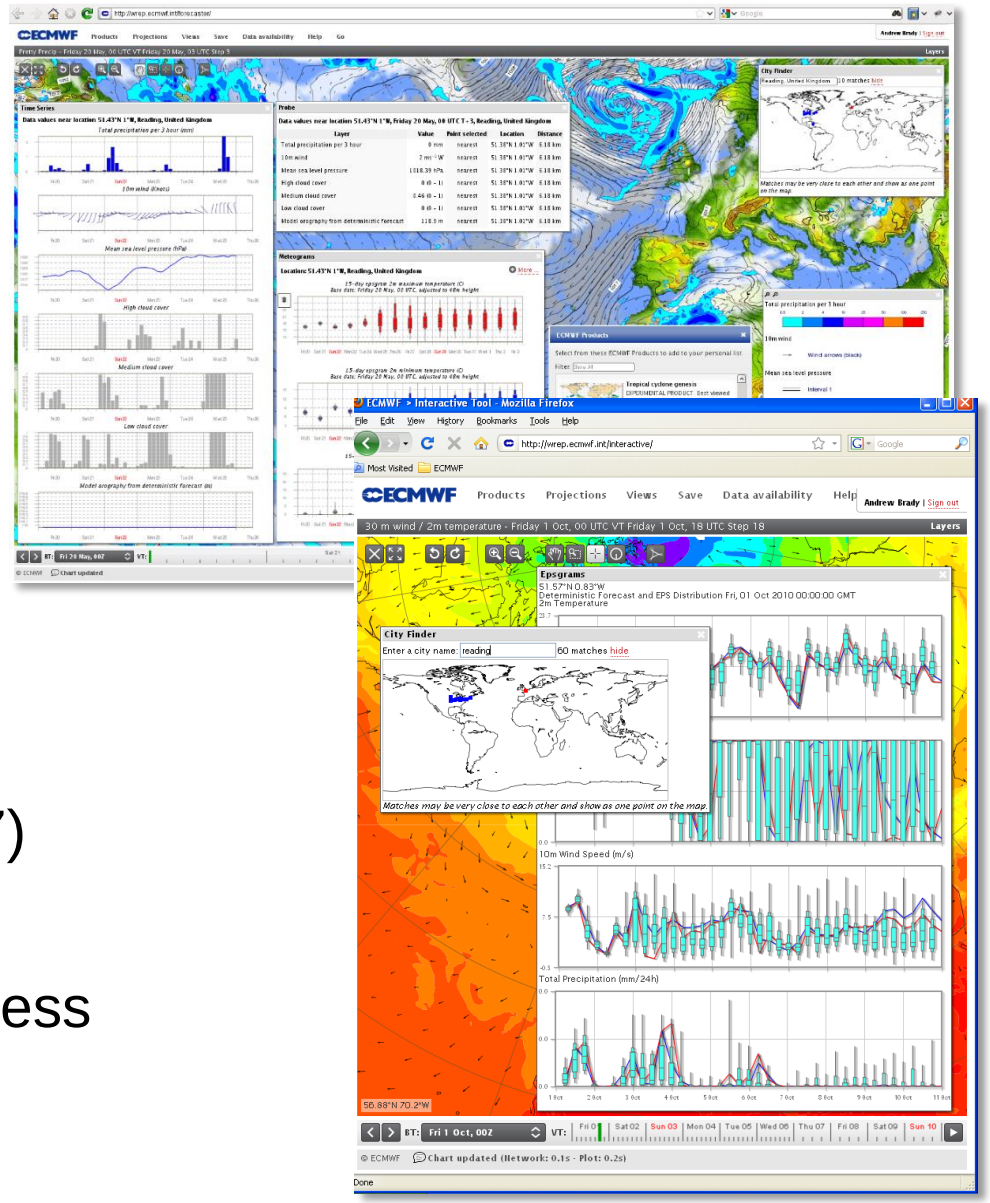
Users need to log in to access charts that are not publicly accessible

All users that register from a NMS of a MS or CS get access to the full set of charts



Web services – ecCharts: http://eccharts.ecmwf.int/

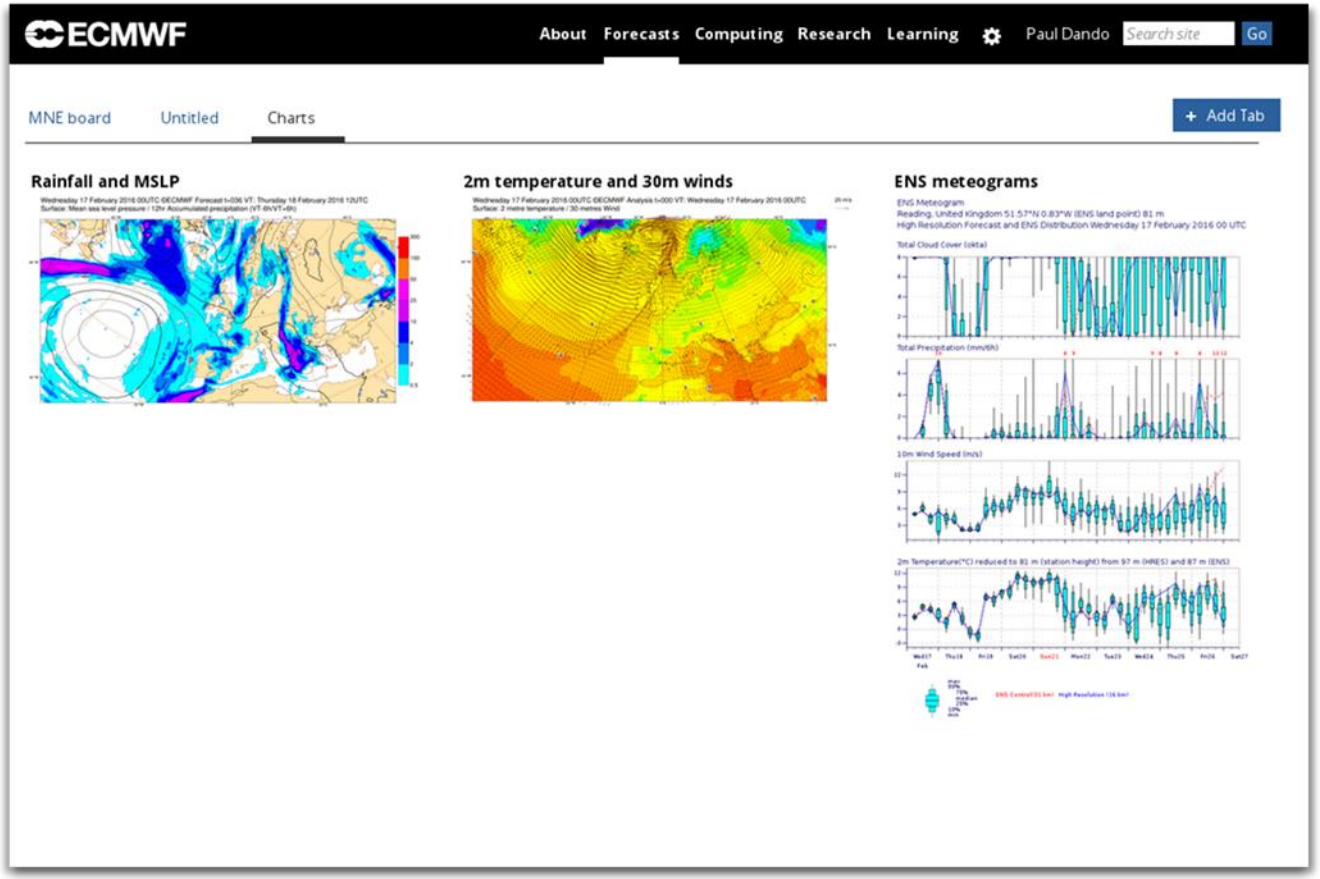
- Highly interactive (products created on-demand)
  - Interactivity (zoom-pan)
  - Layer customisation (e.g. thresholds)
  - Charts with bespoke layers
  - Optional styles for layers
  - Animation of charts
  - HRES, ENS, WAM products
  - Standard and bespoke ENSgrams
  - Extreme Forecast Indices (EFI)
  - Point probing to explore data
- Highly available and operationally supported (24x7)
- Use of agreed dissemination schedule
- OGC WMS standards for machine-to-machine access
- Access approved by Comp Reps



Web chart dashboard

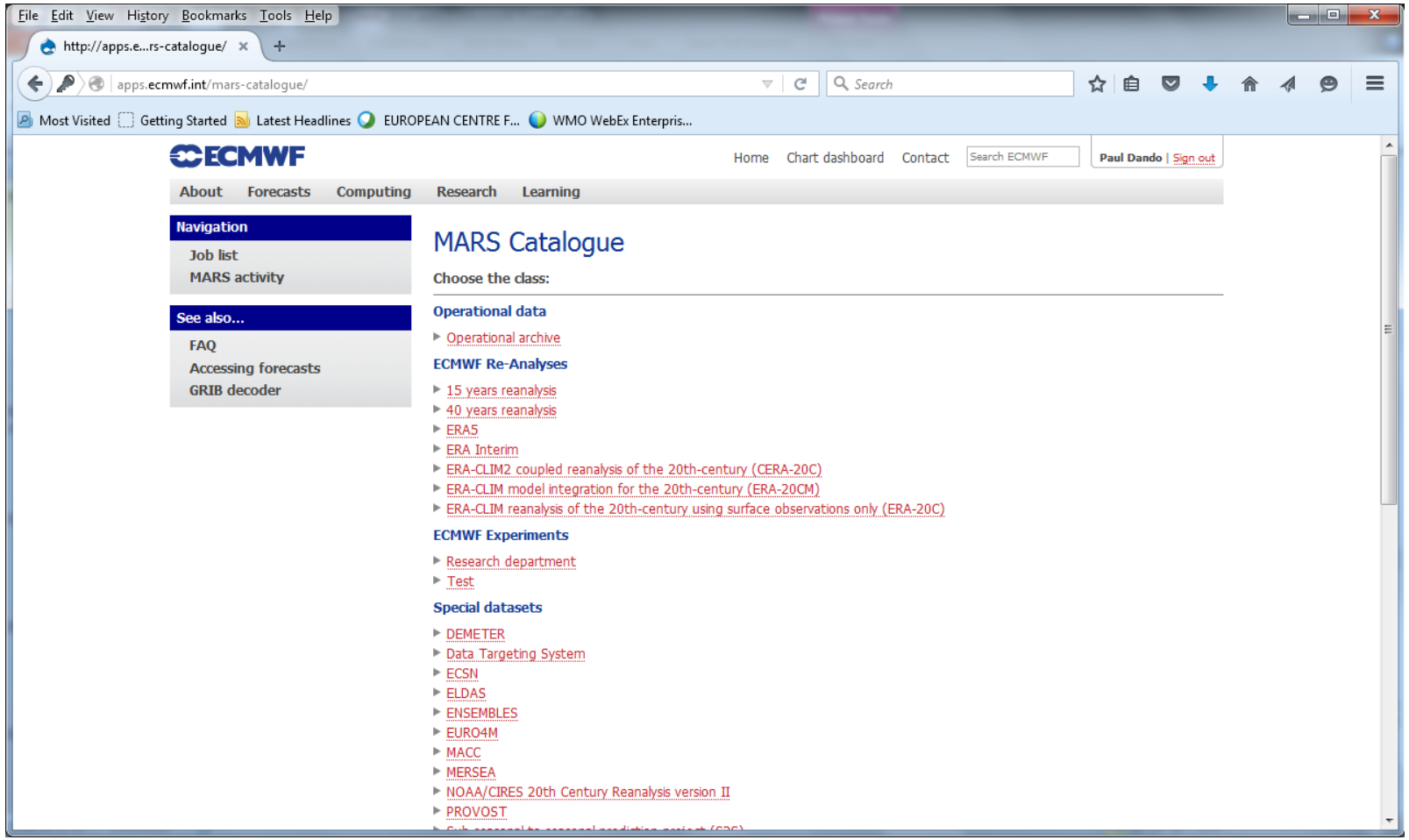
- Documentation: https://software.ecmwf.int/wiki/display/FCST/Chart+dashboard

- Place to organise regularly accessed charts
- Shared with the ecCharts dashboard



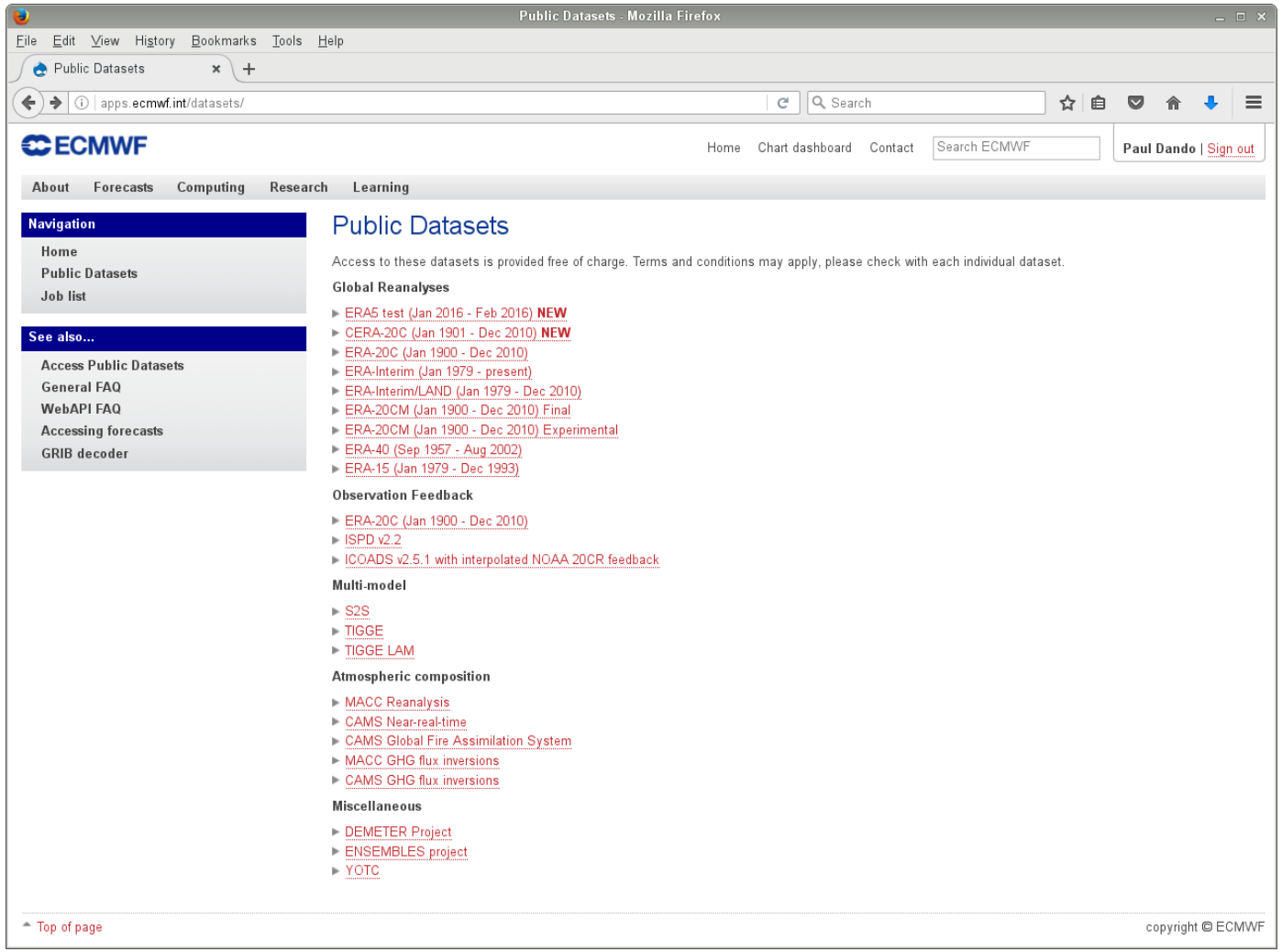
Web Services – MARS http://apps.ecmwf.int/services/mars/catalogue/

- Web based interface to MARS
- Available to registered users only
- Retrievals (GRIB and NetCDF)
- Batch access with WebAPI (Python)



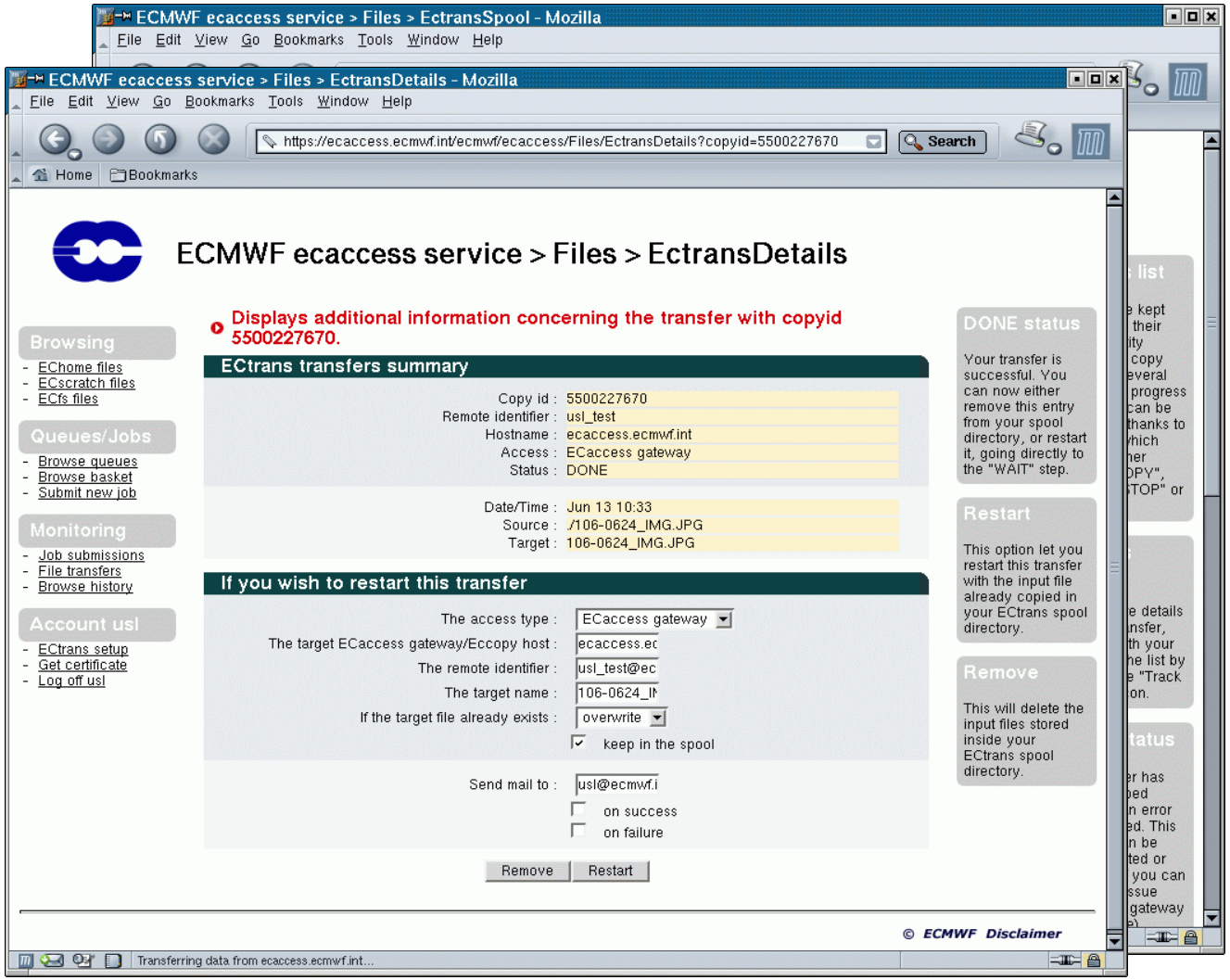
Data Server – http://apps.ecmwf.int/datasets/

- Public (non-commercial) distribution of data
  - Self-registration
- Batch access with WebAPI (Python, Perl, Java, Ruby)
- GRIB or NetCDF
- ERA-Interim, ERA5 TIGGE, S2S, CAMS etc



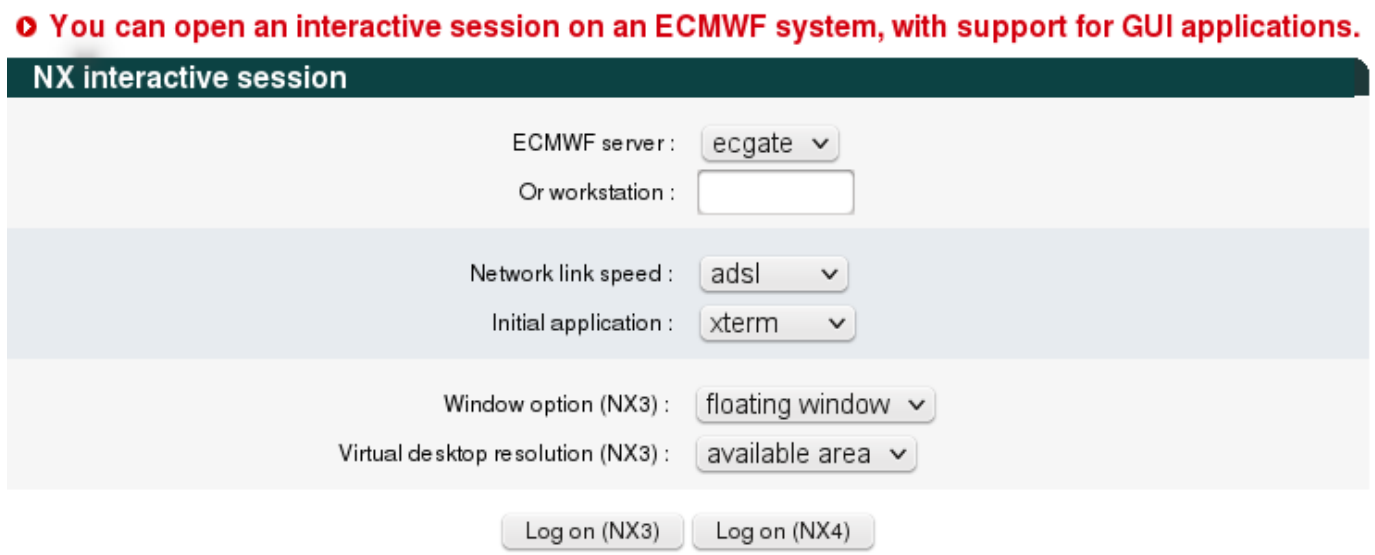
Web Services – http://ecaccess.ecmwf.int

- Interface to browsing, transfers, editing, submission of files to ECMWF
- Online help
- Security token needed



NX – web access – http://ecaccess.ecmwf.int/

- You can access NX through your Web browser



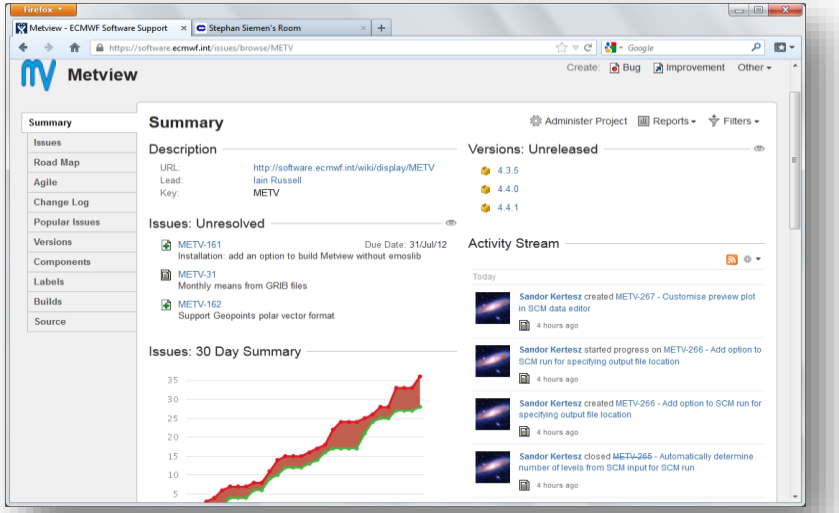
- You can select the:
  - Host (ecgate / cca)
  - Internet connection speed

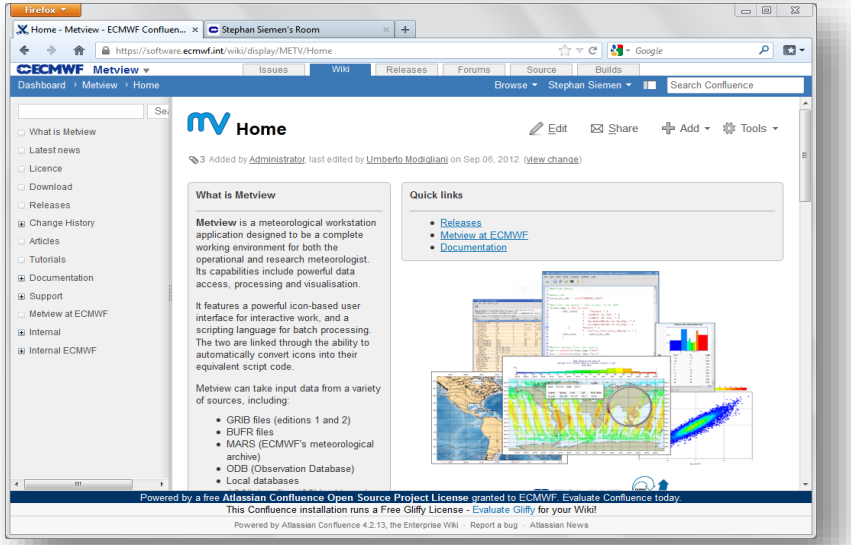
Login requires a token

Software Support – http://software.ecmwf.int/

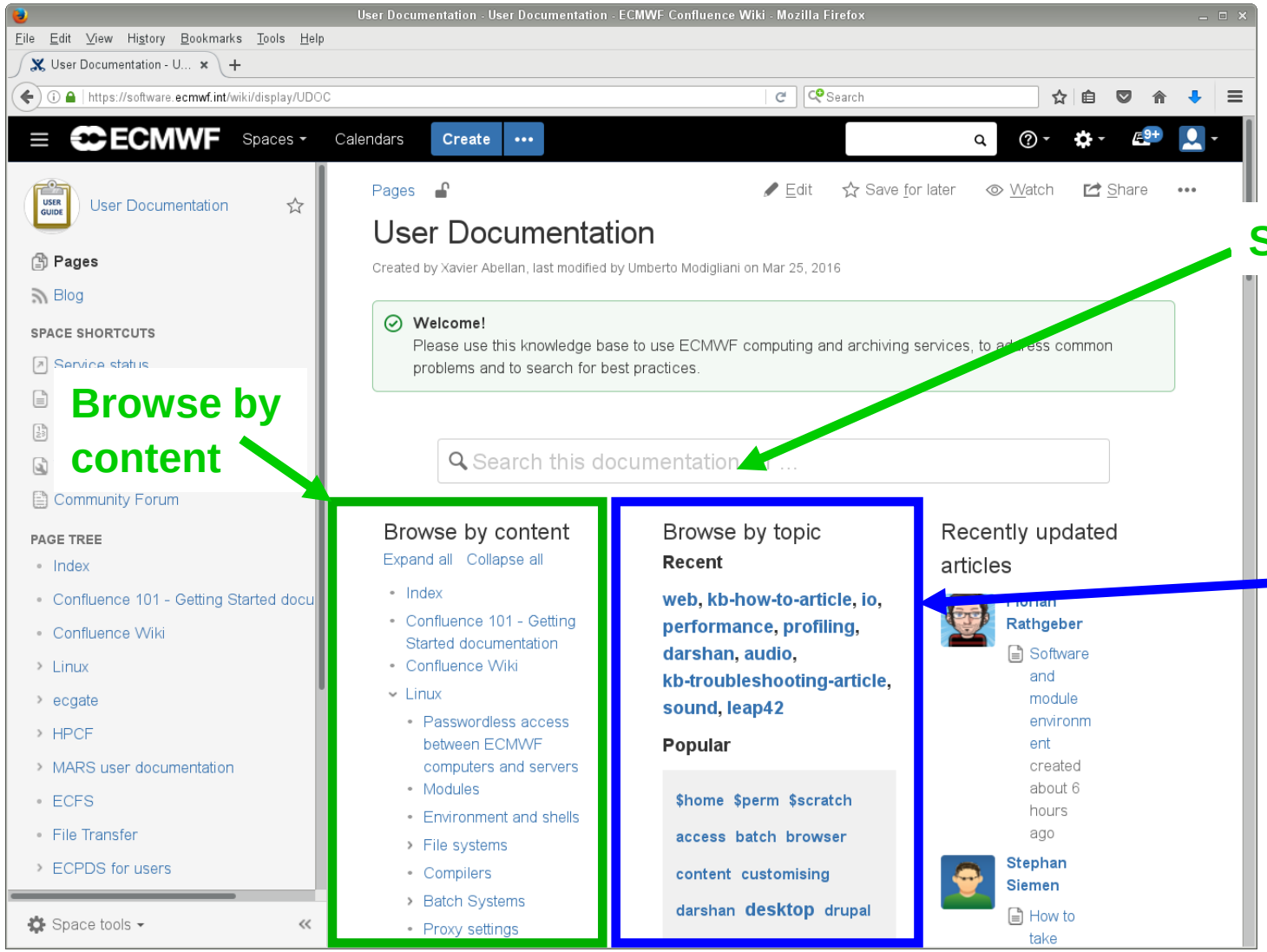
- Support for external users
  - Keep track of issues in a central place
  - Spread knowledge throughout the Centre

- Based on Atlassian Suite
  - JIRA (issues)
  - Confluence (documentation wiki)
  - Bamboo (Builds)





Web Documentation – https://software.ecmwf.int/wiki/display/UDOC/User+Documentation

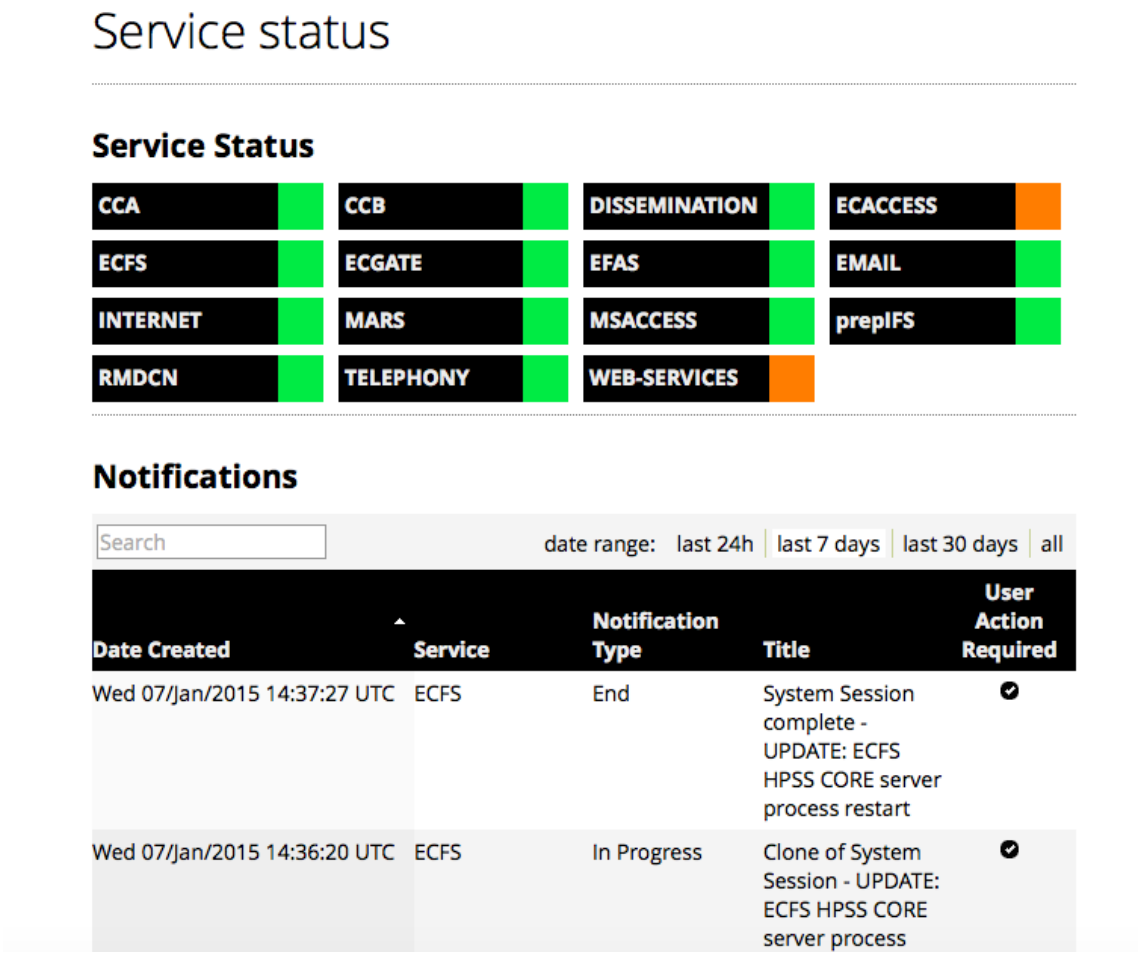


Web Services – documents and documentation

- Official documents (restricted access)
  www.ecmwf.int/en/about/who-we-are/governance
- ECMWF publications
  www.ecmwf.int/en/research/publications
- Research at ECMWF
  www.ecmwf.int/en/research
- Computing Services
  www.ecmwf.int/en/computing
- And much more …

Operational status

http://www.ecmwf.int/en/service-status



Service status

Service Status

CCA	CCB	DISSEMINATION	ECACCESS
ECFS	ECGATE	EFAS	EMAIL
INTERNET	MARS	MSACCESS	prepIFS
RMDCN	TELEPHONY	WEB-SERVICES	

Notifications

Search — date range: last 24h | last 7 days | last 30 days | all

Date Created	Service	Notification Type	Title	User Action Required
Wed 07/Jan/2015 14:37:27 UTC	ECFS	End	System Session complete - UPDATE: ECFS HPSS CORE server process restart	✓
Wed 07/Jan/2015 14:36:20 UTC	ECFS	In Progress	Clone of System Session - UPDATE: ECFS HPSS CORE server process	✓

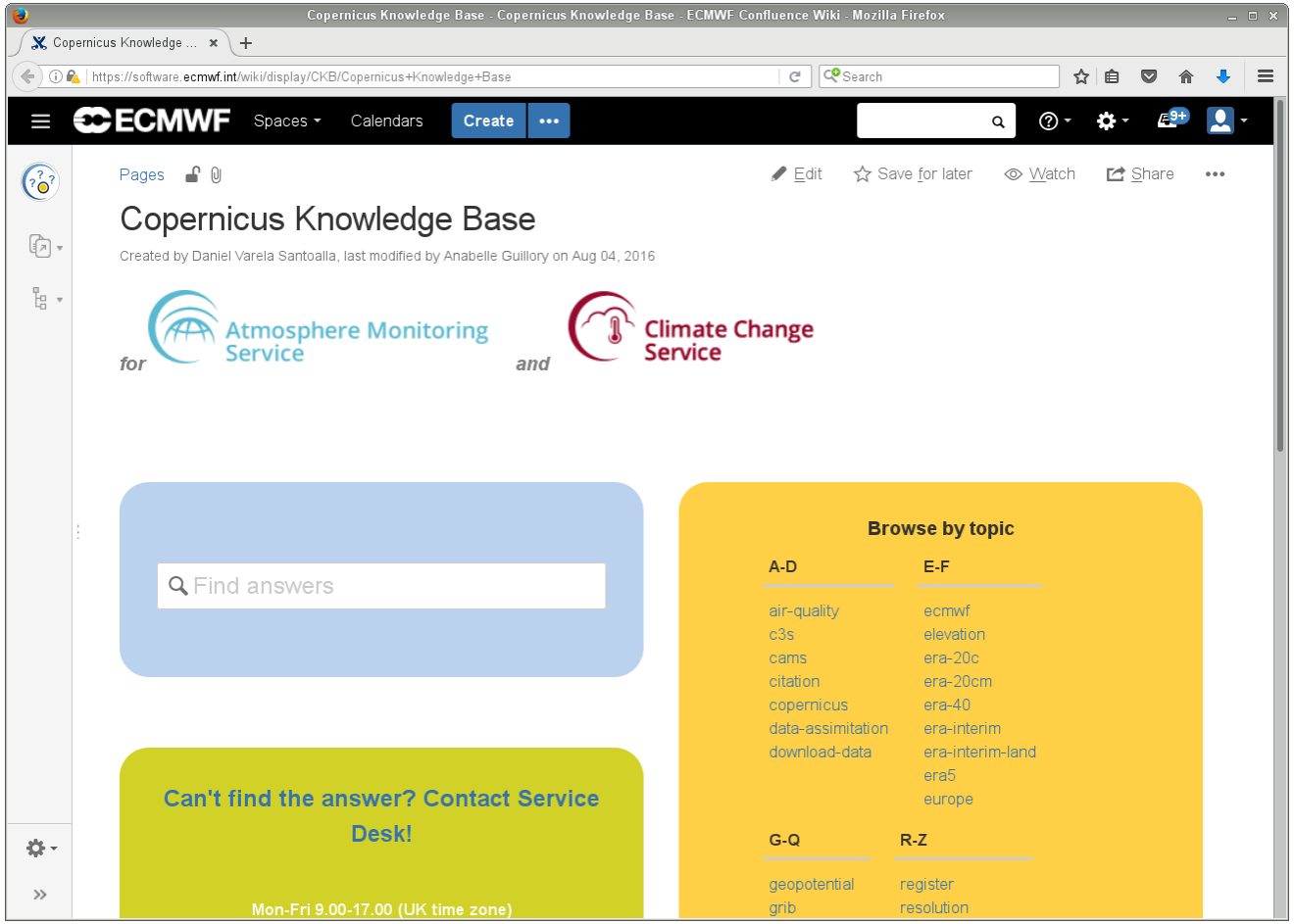
- Email sent only if user action is required
- For announcements of upcoming system sessions see also /etc/motd on ecgate

ECMWF Help & Support – who to contact?

Reason to contact	Who	Availability	How
Urgent Dissemination problems, issues with model output	Service Desk	24h/7d	Email: servicedesk@ecmwf.int Tel: +44 118 9499 303
Generic fault reporting, general service queries etc.	Service Desk	24h/7d	
Specific advice or user query	User Support	8h/5d	Email: advisory@ecmwf.int Tel: +44 118 9499 000 (switchboard)
Changes in dissemination requirements	Dissemination administrators	8h/5d	Email: diss_admin@ecmwf.int
Requests for ECMWF software, report problems and bugs	Software Support	8h/5d	Email: software.support@ecmwf.int
Copernicus support (including queries about re-analysis data)	Copernicus User Support	8h/5d	Email: copernicus-support@ecmwf.int
Specific graphics queries	Development Section	8h/5d	Email: metview@ecmwf.int magics@ecmwf.int

Copernicus user service desk

- Single Point Of Contact for all user enquiries related to CAMS and C3S products and activities
  - data access, availability, documentation, events, etc
- Web portal for submitting queries
  - Committed to respond within 8 working hours
  - Aim at resolving issues within 5 working days.
- Copernicus Knowledge Base
  - Collection of information and FAQs for “self help”
  - Useful not just for CAMS and C3S !



https://software.ecmwf.int/wiki/display/CKB/Copernicus+Knowledge+Base

Questions?