Present state and future of computing at ECMWF

Dr. Martin Palkovič, Director of Computing
ECMWF current computing facilities
ECMWF current computing facilities

HIGH-PERFORMANCE COMPUTING FACILITY

Cray Sonexion Storage cluster

Cray XC40 Ventus (ccb)

Cray XC40 Anemos (cca)

External
(Member States)
25%

Production forecasts
25%

ECMWF
Research
50%

Virtual server
infrastructure (VSPHERE)

Virtual Desktop
infrastructure (VDI)

Member State
server ECGATE

SAPP

Scores

Network
Attached Storage

Firewall

Firewall

Firewall

PCs (LINUX / WINDOWS)

OFFICES

INTERNET

MEMBER STATES and
CO-OPERATING STATES

WIDE AREA NETWORK

IBM pSeries and x86 Linux

IBM TS3500

Oracle SL8500

IBM pSeries and x86 Linux

DISASTER RECOVERY BUILDING

DATA HANDLING

EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS
ECMWF’s production workflow

Data acquisition

Forecast run

Product generation

Dissemination

Web services

Archive

Data Handling System

60M+ data used every day

RMDCN

Internet

Internet

Archive
Evolution of archive and HPC sustained performance
The ECMWF data archive

- Data archival and retrieval system for all ECMWF data
  - 310 PB primary data
    - This data is stored on cartridges and disks
    - If this data was printed, there would be enough books to reach the moon 8 times
- Large meteorological archive
  - Direct access from Member States
  - Available to research community worldwide
- User access via ECMWF developed applications
  - MARS – Meteorological Archival and Retrieval System
    - Access via “meteorological terms”, e.g. fields
  - ECFS – ECMWF Common File System
    - File based access for non-meteorological data
- Every day the archive grows more than 250 TB
Preparing for the move – 2+2 new IBM US4500 tape libraries and 2 second-hand Oracle SL8500 tape libraries from CERN
Data dissemination volumes

- Monthly Volume of Data Transmitted: 857TB (~28.6TB/day)
- Exponential Increase trend for Internet
RMDCN basic package evolution
10-year challenge

10x more observational data per day

2000x more model data per time step

25x more forecast product data per day in critical path

30x more data sent to customers per day in critical path

100x more data archived per day

Data acquisition

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Product generation

Dissemination

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Archive

Data Handling System

10x more observational data per day

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ECMWF new data centre in the Tecnopolo di Bologna

Former tobacco factory built in 1949 and closed in 1998
Data centre design
Data centre layout
How it will look
Bologna target functional design

**TELECOM**
- **INTERNET**
- **RMDCN**
- **LEASED LINES**
- **SATELLITES**
- **EXTERNAL CLOUD**

**M C L O U D**
- **ACQUISITION**
- **PREPROCESSING**
- **EXTERNAL DISSEMINATION**
- **QUALITY CONTROL & VERIFICATION**
- **GRAPHICAL DISSEMINATION**
- **CORPORATE SERVICES**
- **VIRTUAL DESKTOP**
- **ACCESS SERVICES**
- **WEB SERVICES**
- **ORCHESTRATION SERVICE**

**E U R O P E A N WEATHER CLOUD**
- **SAAS (FUTURE)**
- **PAAS (FUTURE)**
- **IAAS**

**H P C**
- **HIGH PERF. BATCH**
- **GENERAL PURPOSE BATCH**
- **INTERACTIVE**
- **FDB**
- **HIGH SPEED PARALLEL STORAGE**
- **POSTPROCESSING**
- **QUALITY CONTROL & VERIFICATION**
- **INTERNAL DISSEMINATION**
- **FORECASTING SYSTEM**

**D H S**
- **ECFS**
- **MARS**
- **LONG TERM ARCHIVE**

**NETWORKING**
- **MONITORING**
- **ONLINE STORAGE**
- **IDENTITY & ACCESS MANAGEMENT**

**ECMWF Bologna Architecture**
**DATE**
23 July 2018

**Tier 1.1** = Critical Path
**Tier 1.2** = Immediate Call Out
**Tier 2** = Restart Next Sociable Hour
**Tier 3** = Restart Next Working Day
ECMWF outputs are constantly increasing and a gap already exists.

Compelling use cases across the EMI.
European Weather Cloud timeline

• Beginning January 2019: pilot phase starts
• End February 2019: Working Groups are assembled
• Until mid-March 2019: initial collection of use cases
• May 2019: first tests on prototype pilot infrastructure at ECMWF
• Mid-September 2019: pilot infrastructure at EUMETSAT and ECMWF opens
• From beginning January 2020: process to add one or two additional “members” in the federated infrastructure
• Until summer 2020: evaluate and gather feedback from use cases and consolidate requirements & specification documentation
• Autumn 2020: present proposal for operational European Weather Cloud infrastructure to relevant Committees then Councils of ECMWF and EUMETSAT
vCPUs : 784 (2x48+5X64+6X72)
RAM   : 8076 GB
Storage: 432 TB (11 systems X 24 HDDX1.7TB)

Current deployment : 1 controller nodes
8 Compute nodes
Dynamic digital twin of our planet

Past

Present

Future
Exaflops Computing and Exabytes Data required

High-Res Global Earth-system view and simulations; large datasets (internet of things, new EO satellites, ...)
Summary

The ECMWF infrastructure in Shinfield Park, Reading is reaching its age

Brand new ECMWF infrastructure in Tecnopolo di Bologna opens new opportunities

New infrastructure, new HPC, new tape archive create also a challenge

Cloud computing and AI as important components for the future next to the HPC