

ECMWF: Adapting a successful European endeavour infrastructure to future needs

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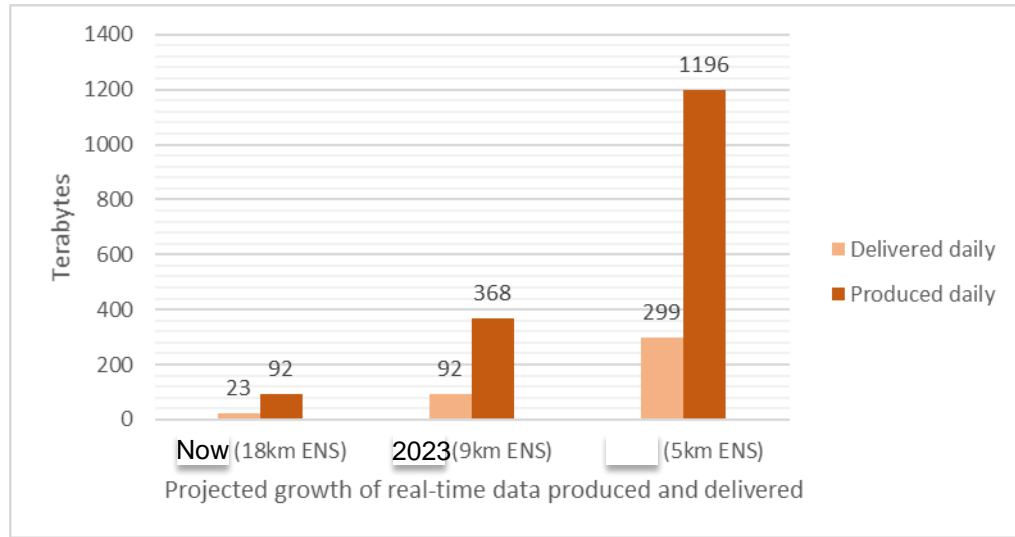
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Overview and motivations

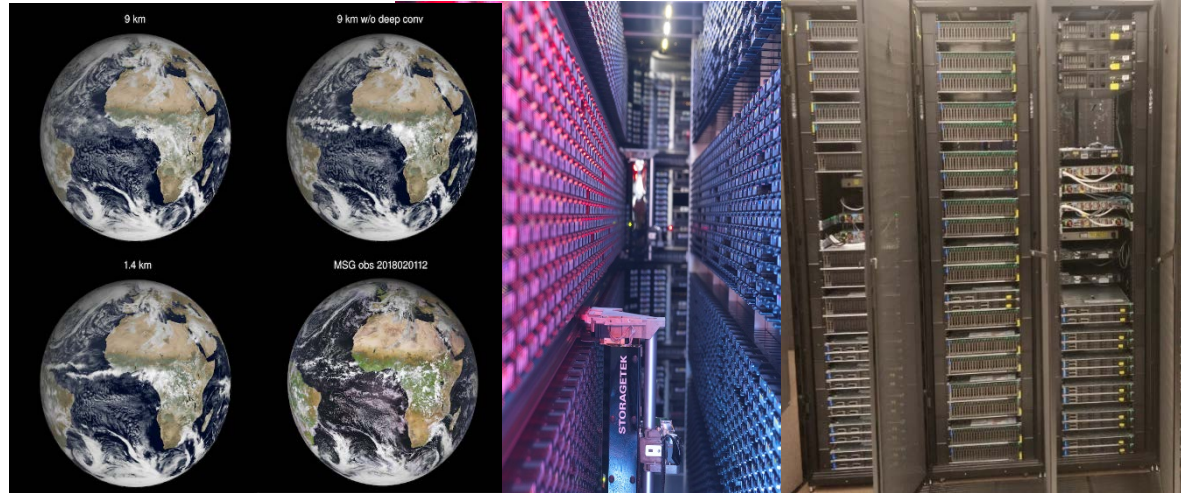
- Dealing with increasing size of ECMWF data products and
 - Creating the European Weather Cloud service to provide a facility to process these products and
 - Supporting enhanced application flexibility
- Upgrading ECMWF supercomputer facilities in new Bologna Data Centre and
 - Adding a new GPU partition
 - Adapting IFS to GPUs and accelerators – Hybrid2024
- An infrastructure also capable of
 - Supporting complex projects: SEE-MHEWS-A
 - Supporting Member States in case of emergencies

Dealing with increasing size of ECMWF data products



- “To make available to the Member States, in the most appropriate form, the results provided” by global forecast models, research experiments and the archive (ECMWF Convention)
 - Cloud technology to support the data access and exploitation
- To integrate service provision elements (ECMWF, EUMETSAT, Member States and Copernicus Services)
- To increase the socio-economic benefit of weather forecast data
- To exploit opportunities and address challenges linked to open policies and market changes

Creating the European Weather Cloud service



“The European Weather Cloud aims to be the cloud-based collaboration platform for meteorological application development and operations in Europe and enables the digital transformation of the European Meteorological Infrastructure. The European Weather Cloud is dedicated to support the National Hydro-meteorological Services of the Member States of both ECMWF and EUMETSAT in fulfilling their official duties to protect life and property from impending meteorological hazards.”

"a community cloud"

Who is it for?

Member and Cooperating States

Research & Development

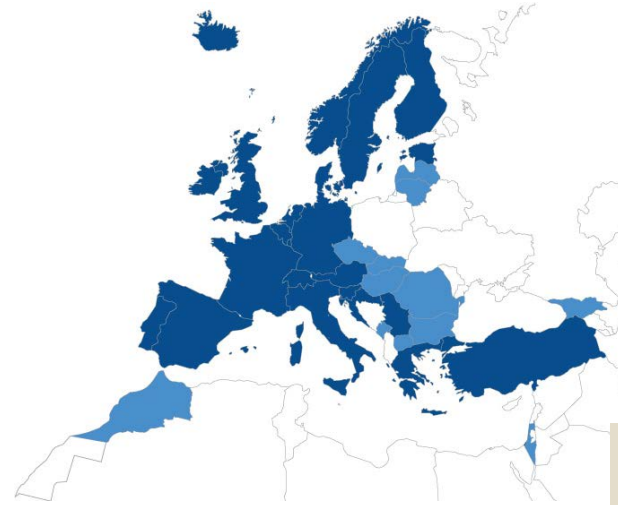
ECMWF Special projects
EUMETSAT thematic annual R&D calls

EMI Partners (e.g. EUMETNET)

Internal use

Support training, hackathons
Partners
Contractor interaction / projects

ECMWF



EUMETSAT



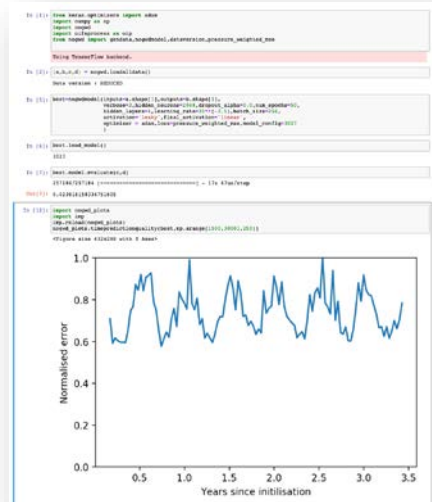
What is it used for?

icon-pre
pre-processing of input data from DWD's operational database and other sources.
- single instance, IO intensive

icon-lam
self-contained, MPI-parallel executable of the ICON limited area model. Ready-to-use for small and medium size setups.
- "virtual cluster" of multiple instances, CPU+network intensive

icon-post
post-processing and basic visualization of limited area ICON runs.
- single instance, IO intensive

DWD use case on offering notebooks to train and develop the ICON model on the European Weather Cloud



Oxford University offering Jupyter notebook environments for Machine Learning on weather & climate data sets

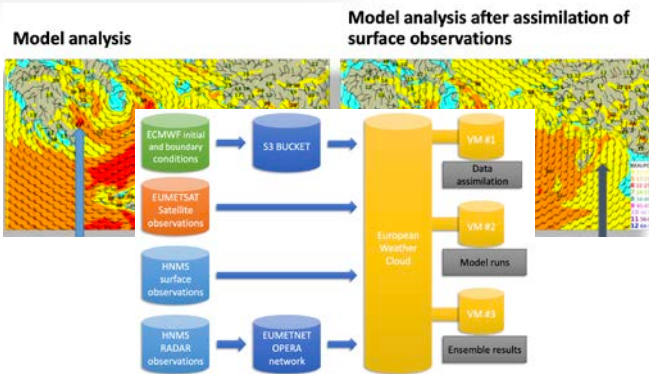


Forecast and climatology of cloud cover for Energy and Spatial sectors
Météo-France

Hosted on both ECMWF and EUMETSAT

The screenshot shows the KNMI Climate Explorer web interface. It includes a search bar, a 'Starting point' section with a 'Welcome, anonymous user' message, and a 'GIS global temperature mean' chart showing a correlation coefficient of r = 0.942. The interface is in German.

KNMI Climate Explorer running on the European Weather Cloud



HNMS uses ECMWF forecast as boundary condition for model and assimilation trials

The screenshot shows the DWD Geoportal web interface. It features a search bar, a 'Typ' dropdown menu, and a 'Max. Abdeckung' (Maximum Coverage) section with radio buttons for 'Deutschland (112)', 'Europa (3)', and 'Global (5)'. There are several map tiles displayed, including 'COSMO-Q2', 'ICON-EU', and 'ICON'. The interface is in German.

OGC web map services integrating maps in DWD's Geoportal

European Weather Cloud benefits to users, data providers and federees

Users:

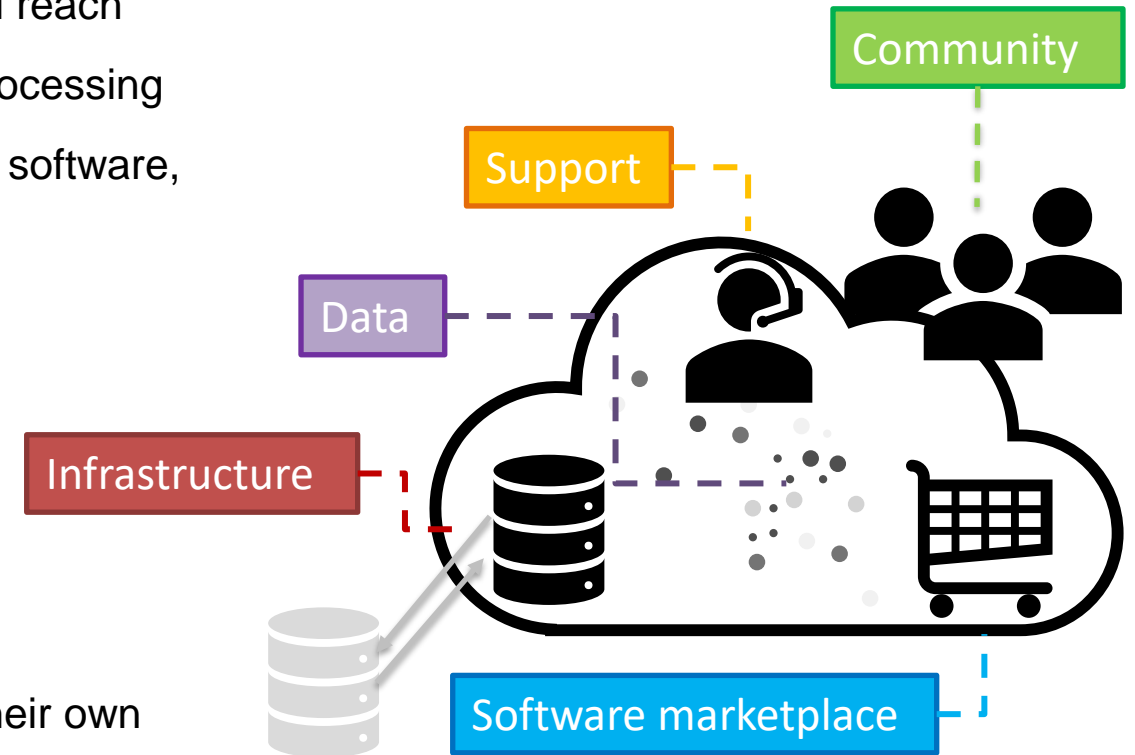
- Access to resources that may be outside their normal reach
- Rich and fast data availability, with data locality for processing
- Community support: knowledge, discussion platform, software, infrastructure setups...

Data providers

- Easier to provide data
- Greater use of their datasets
- Easier combination with other datasets

Federees

- Data federation may make it easier to bring data to their own cloud-federated systems
- Ready collaboration environment
- Opening themselves to a wider range of users

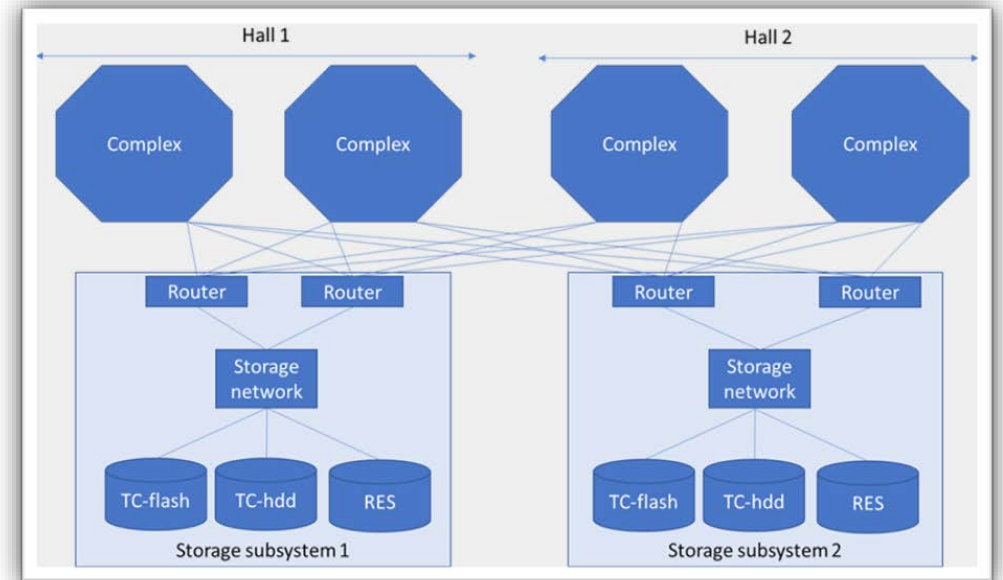


ECMWF new data centre in Bologna



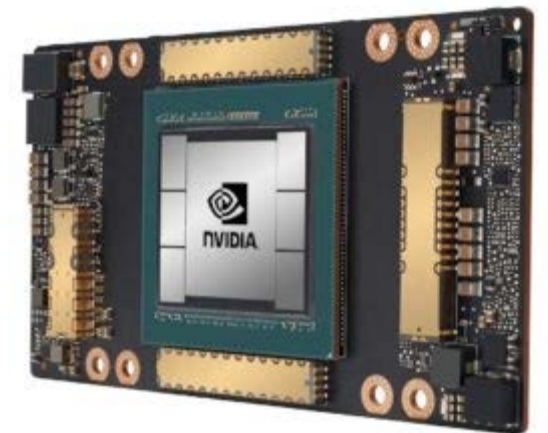
A reliable and multi-purpose HPC configuration

- Atos BullSequana XH2000
- 25% of HPC is available to 23 Member States for their work including time critical suites, back ups of their operation, research and special projects
- 4 Complexes (for redundancy)
 - Each Complex consists of two clusters:
 - Parallel work cluster:
 - 1920 nodes for parallel compute
 - General Purpose work cluster
 - 112 nodes for general purpose use (more memory, local SSD)
- A total of over one million CPU cores



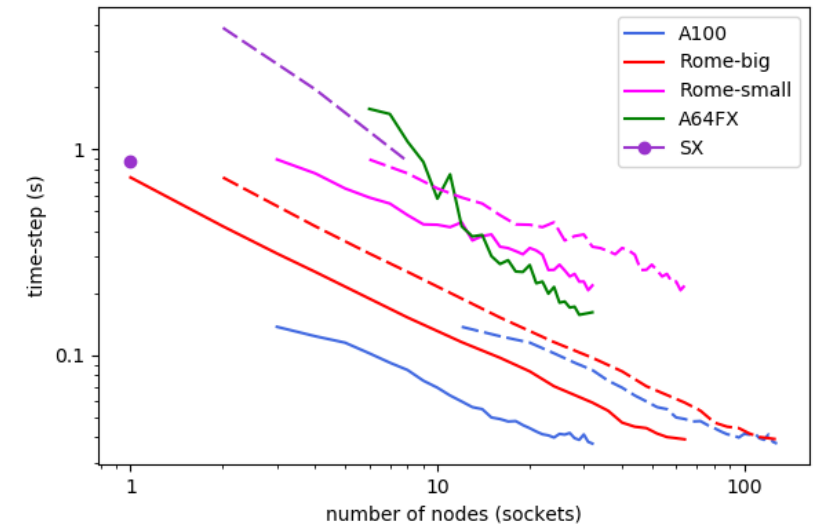
Adding a GPU partition

- To support ECMWF efforts for IFS to make effective use of this technology
- To support AI/ML developments
- 18 GPU blades integrated into one GPIL cluster.
- Each blade is configured with
 - 2 x AMD Rome 7742
 - 512GB DDR4 3200
 - Nvidia Redstone board with 4 x A100-40
 - 72 GPUs
 - 2 x HDR200 InfiniBand connections

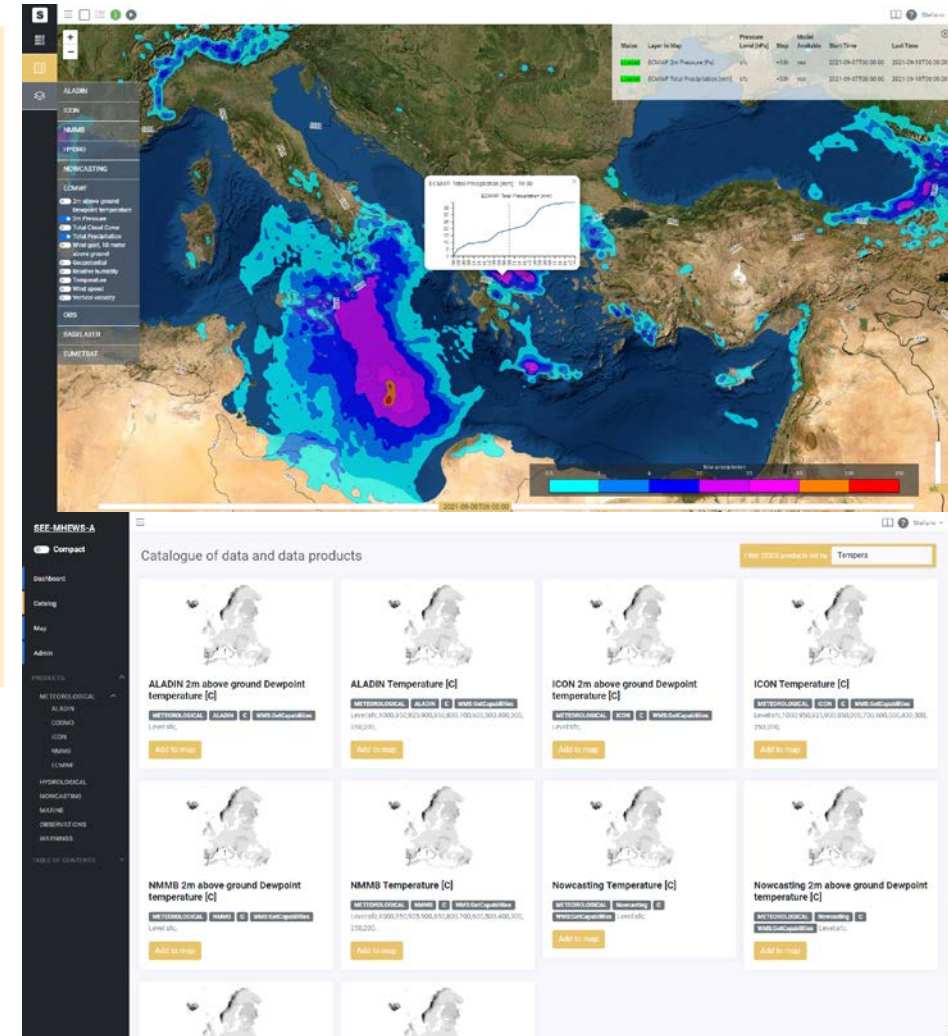
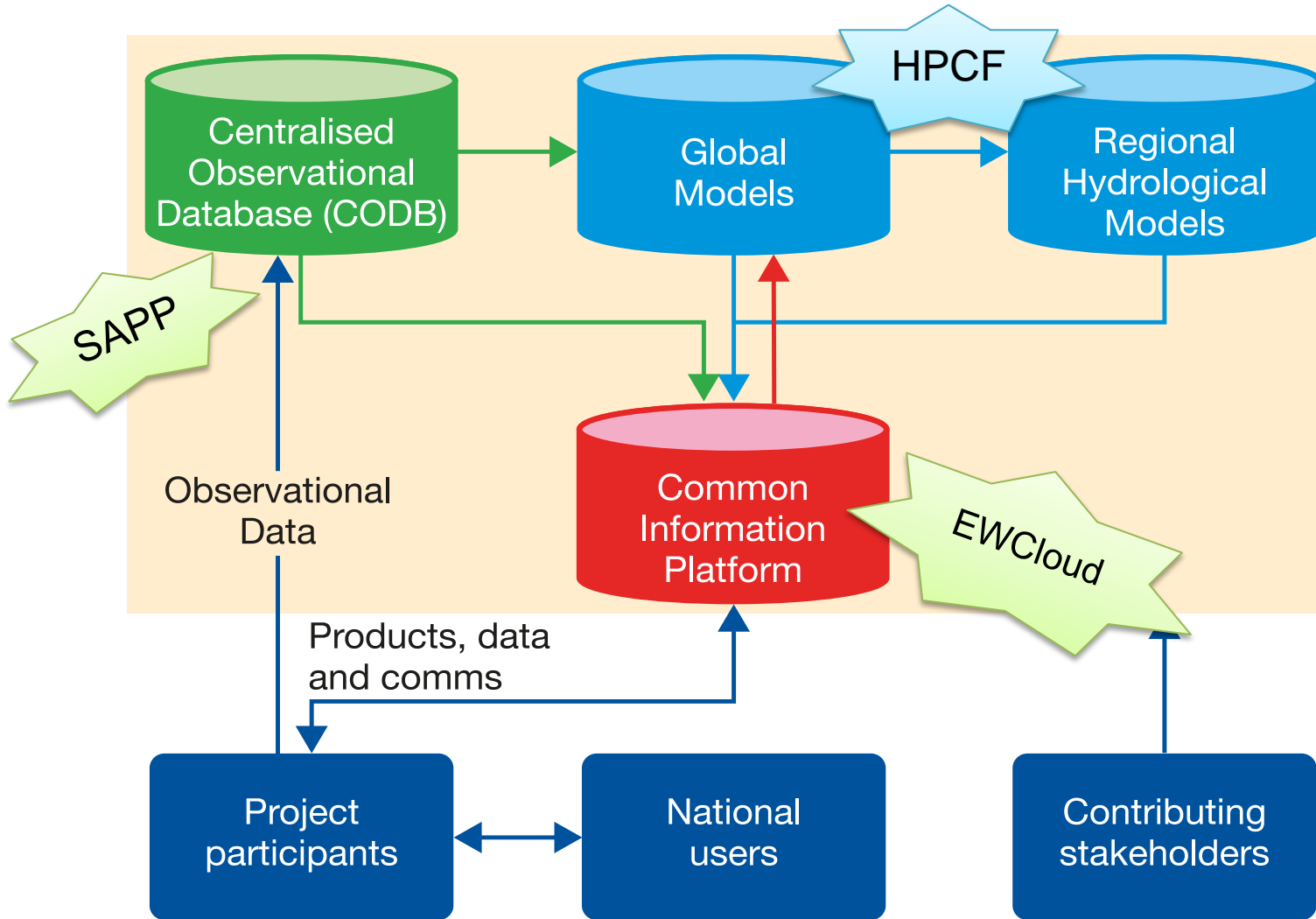


Adapting IFS to GPUs and accelerators – Hybrid2024

- Sustainable GPU and accelerator adaption of IFS forecasts
- Develop “GPU-readiness” and hybrid CPU-GPU modes for IFS
- Close synergy with Destination Earth, Atos CoE and various European projects
- Refactoring IFS for GPU offload without sacrificing CPU performance



An infrastructure supporting complex projects: SEE-MHEWS-A



An infrastructure supporting Member States in case of emergencies

- On 22 March, a 5.3 magnitude earthquake hit Zagreb
- DHMZ headquarters were severely damaged
- Offered to help run their production at ECMWF in 2 fronts:
 - European Weather Cloud
 - IT infrastructure and various servers
 - HPCF
 - NWP runs and post-processing.
- See presentation by Branka IVANČAN-PICEK later today



Conclusions

- ECMWF has continued to adapt its multi-purpose heterogeneous IT infrastructure to support ECMWF's mission and facilitate the effective use of its products and services
- Started providing cloud-based services by creating together with EUMETSAT the European Weather Cloud
- Continued to evolve its HPC infrastructure by adding a GPU partition to support IFS adaptation to this accelerator technology and AI/ML developments
- ECMWF multi-purpose IT infrastructure can also support complex Member State projects and be relied on in case of emergencies