Advancing Global NWP through collaboration
Solving Big Data challenges as a community

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European co-operation at its best: pooling resources
European Centre for Medium-range Weather Forecasts

- Independent intergovernmental organisation established in 1975
  - 22 Member States + 12 Cooperation States
  - Headquarter in Reading, UK + Bologna, Italy
  - 350+ staff

- 24/7 operational services + research
  - Operating weather forecast models
  - Data services delivering TBs of output data to users in real time worldwide
  - Operate archive of observations and model data (> 300 PB)
  - HPC centre with two supercomputer clusters
ECMWF’s role is to address the critical and most difficult research problems in global medium-range NWP that no one country could tackle on its own.
GLOBAL COLLABORATION
There are many ways to enable collaborations
Not just only data …

• Establish standards for the community
  – ECMWF works closely with WMO & OGC

• Events - Training / Workshops / Hackathons
  – Share how best to use our forecasts
  – ECMWF hosts and participates in many face-to-face events
  – Important to establish contact and understand each needs
  – Gather feedback and learn from each other

• Software
  – ECMWF offers many software packages for the community
  – Open source and Open Development on GitHub
ECMWF Earth System Model
A model is only as good as its assimilated observations.

Observations from across the globe help to improve forecast quality!

either real-time for assimilation or delayed for verification;
support initiatives such as WMO SOFF
ECMWF Earth System Model...variety of ranges

Medium-range

Monthly-range

Long-range

- Weekly anomaly
  - 2m temperature over Europe (3-10 Dec)

- Medium-range
- Monthly-range
- Long-range
  - Nino 3.4 SST anomaly plume – 1 November 2017
ECMWF Earth System Model...Environmental prediction

Atmosphere Monitoring

Flood forecasting

Climate Change

Fire forecasting
ECMWF ENSEMBLE PREDICTION

Initial conditions

Ensemble members illustrating the possible scenarios

Distribution of ensemble members

Confidence level of predicted forecasts

Low  |  High

3D view of model predictions

Flat view of model predictions
Example of open datasets

- Multi-model real-time (TIGGE)
- Sub-seasonal to seasonal (S2S)
- Atmospheric composition (Copernicus Atmosphere Monitoring Service - CAMS) [https://atmosphere.copernicus.eu](https://atmosphere.copernicus.eu)
- Reanalysis ERA5 (Copernicus Climate Change Service – C3S) [https://climate.copernicus.eu](https://climate.copernicus.eu)
- Global Floods: GloFAS (Copernicus Emergency Monitoring Service – CEMS) [http://www.globalfloods.eu](http://www.globalfloods.eu)
The every evolving reanalysis datasets
Great asset for Machine Learning

ERA5 back extension:
1950-1978, to be available 2020 Q2

✓ restore climate quality for stratospheric temperature
✓ Use more appropriate background correlation lengths
✓ Need: until availability of COSMIC GNNS-RO 2006

ERA5 land: available in the CDS from 2001
1981-2000 later this year; 2020: back to 1950
9km Land downscaling from ERA5
ECMWF provides support to WMO countries

Assisting the World Meteorological Organization (WMO) is one of ECMWF’s founding objectives and holds an important place in the Centre’s current ten-year Strategy to 2025.

This partnership ranges from:

• providing essential data to WMO Members free of charge (WMO essential and additional data)
• supporting training for capacity building
• supporting fellowships
• supporting projects to improve severe weather forecasting in developing countries like WMO Severe Weather Forecasting Demonstration Project (SWFDP). In this project we provide access to our global HRES and ENS products
A lot of valuable data ... and an increasing number of users ... but how can users build services using this valuable data? ... without massive investment!
Global Streamflow Forecast

Paradigm shift: from data provision to service provision for the hydrological community

- No need for individual infrastructure
- Easy access to streamflow forecasts
- Use of information according to local prioritised needs
- Leverage existing hydro-met expertise to focus on decision-making tools
A change we also can see overall at ECMWF …
Provide tools to work with meteorological data

- En/Decoders for GRIB / BUFR / ODB
- Tools for real-time & archive data access
- Post-processing of data - interpolation & visualisation
- Tools to describe workflows in Python
Allowing the community to contribute - GitHub

- Users can contribute fixes and new features themselves
  - Run Continuous Integration (CI) testing
  - Enforce the signing of code contribution agreement
  - To have dialogue with developers at ECMWF
Reduce the need for data downloads

eCCharts – our windows to our forecast

- Allows users to browse and view over 250 model parameters and time series products
- The Web Map Service (WMS) allows the easy integration in own GIS systems
- New web APIs let users retrieve subsets / time series / cross sections instead of downloading raw NWP data
Bringing processing to the data
The Copernicus Climate Data Store (CDS)

• New portal to find / download and work with Copernicus climate change data

• Many data sets too large for users to work locally → therefore it offers server side processing

• High-level descriptive Python interface
  – Allow non-domain users to build apps

• Try it out yourself:
  https://cds.climate.copernicus.eu
Next step: The European Weather Cloud

- The vast data volumes created by new forecast models and satellites forces us to radical change how we work

- With partners in our community we build a federation of private clouds to enable easier and faster access by hosting the processing close to the data
Use cases for the European Weather Cloud
Showcasing new abilities for our users

OGC Web services on full ECMWF forecasts without need of data transfer to DWD

SEES: Synergy of ECMWF and EUMETSAT Services
Display simultaneously EUMETSAT OSI SAF and ECMWF forecasts

Historical Dataset ML Model Training / Blending
Large amounts of historical forecast data

First WMS service
In preparation to start January 2020
Coming in 2020

Participants: Switzerland, United Kingdom, France, Germany, Netherlands, Finland, Sweden, Norway, Austria, Denmark, ECMWF and EUMETSAT
Thank you for your attention

The strength of a common goal