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ECMWF is one of 127 Participating Organisations, which, together with the 105 member nations and the European Union, form the Group on Earth Observations. The GEO community's ambition is to pool Earth observation resources world-wide to enable informed decision-making across multiple Societal Benefit Areas and Sustainable Development Goals.

ECMWF contributes to GEO in the fields of research in ensemble forecasting through its activities in TIGGE, TIGGE LAM and S2S, and in environmental information services through its involvement in the EU Copernicus programme, and in particular its Climate Change, Atmosphere Monitoring and Emergency Services.

EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

ADVANCING RESEARCH IN ENSEMBLE FORECASTING

ECMWF's computing facilities are amongst the largest worldwide for high-performance computing and data archiving dedicated to meteorology. This enables the Centre to provide the scientific community with access to long records of global observations and model-generated analysis and forecast data that enable research to be carried out worldwide to increase knowledge and improve modelling of the Earth system.

ECMWF's data archive includes TIGGE, TIGGE-LAM and S2S that form part of the weather contribution to the Global Earth Observation System-of-Systems (GEOSS) and are accessible through the GEOSS Common Infrastructure (GCI).

TIGGE – global ensemble forecast data

The International Grand Global Ensemble (TIGGE) dataset consists of twelve years of multi-model ensemble forecast data from 10 global NWP centres, starting in October 2006 to present time. The total volume of the database is 2.8 PiB, for 6.6 billion fields, and it receives requests from about 200 users every month that extract approximately 10 TBytes of data. TIGGE has become a focal point for a range of research projects, including research on ensemble forecasting, predictability and the development of products to improve the prediction of severe weather.

TIGGE-LAM for regional ensemble forecasts

TIGGE-LAM is an extension of TIGGE archive to include weather forecasts from limited-area model ensembles. It has been developed as part of the EU-funded GEOWOW project to improve Earth observation data discovery, accessibility and exploitability. These forecasts are produced on grids with horizontal resolution between 12 and 2 km and provide detailed information for the short range, up to a few days ahead. Output from eight limited area models is being ingested in the TIGGE-LAM archive daily. TIGGE-LAM enables users to compare models and improve the methodologies for the generation and application of regional ensemble forecasts. It will also provide valuable insight for the development of global ensembles as the resolution of these forecasts is planned to increase significantly in the coming years.

Sub-seasonal to seasonal weather forecasts (S2S)

ECMWF provides forecast data out to 2 months ahead and is also an archiving centre of the S2S database, that includes near real-time forecasts (3-week delay) and also re-forecasts from 11 operational centres. These data are important to improve our understanding and the representation of physical processes in Earth system Models. The database will be used to assess the potential societal benefits of using sub-seasonal to seasonal forecasts in a wide range of applications, such as agriculture.

CONTRIBUTING TO ENVIRONMENTAL INFORMATION SERVICES

The development of global weather models, such as ECMWF's IFS, into more complete Earth system models has created the opportunity to analyse and predict many other aspects of the natural environment than purely the weather. **Copernicus** is the EU's flagship programme on monitoring the Earth's environment using satellite, in-situ and modelling information. It aims to deliver reliable, validated information services in six areas: land, marine and atmosphere monitoring, emergency management, security, and climate change. ECMWF is implementing the **Climate Change** and the **Atmosphere Monitoring Services** and contributes to the Emergency Management Service by operating the computational centre for the Global Flood Awareness System (GloFAS) and the Global Wildfire Information System (GWIS), along with conducting research in these areas.

Monitoring the atmosphere

At the Earth's surface, aerosols, ozone and other reactive gases determine the quality of the air around us, affecting human health, life expectancy, and ecosystems. Ozone distributions in the stratosphere influence the amount of ultraviolet radiation reaching the surface. Greenhouse gases, aerosols, and chemical species have been introduced into the ECMWF model to enable the forecasting of atmospheric composition. Research in these areas is leading to increased knowledge and improved analysis and forecasting skill.

Understanding climate change

Research at ECMWF focuses on the development of consistent reanalyses of the coupled climate system, including the atmosphere, the land surface, the ocean, sea ice, and the carbon cycle. Reanalysis datasets available from ECMWF cover the past 100 years of weather. These provide a comprehensive assessment of the state of the climate in the recent past up to the present. In addition ECMWF carries out research and produces seasonal predictions of phenomena such as El Niño; this timescale is at the critical interface between weather and climate prediction.

Informing water management

Through the Global Flood Awareness System (GloFAS), ECMWF delivers global flood guidance up to 30 days in advance, and makes them available free of charge without any usage restriction. To support GloFAS, ECMWF is carrying out inter-disciplinary research on meteorology and hydrology to help flood forecasting to be improved. In addition, ECMWF also supports AIP8-GEOSS Water Services and GEOGLOWS, which encourage and help government data providers and research centres to publish water resource time series data. These include observed and modelled variables such as stream flow, stream depth, precipitation, soil moisture, runoff, water quality, and others. These data are important to our understanding of the frequency, variability, and consequences of extreme weather events (storms, floods, and drought).
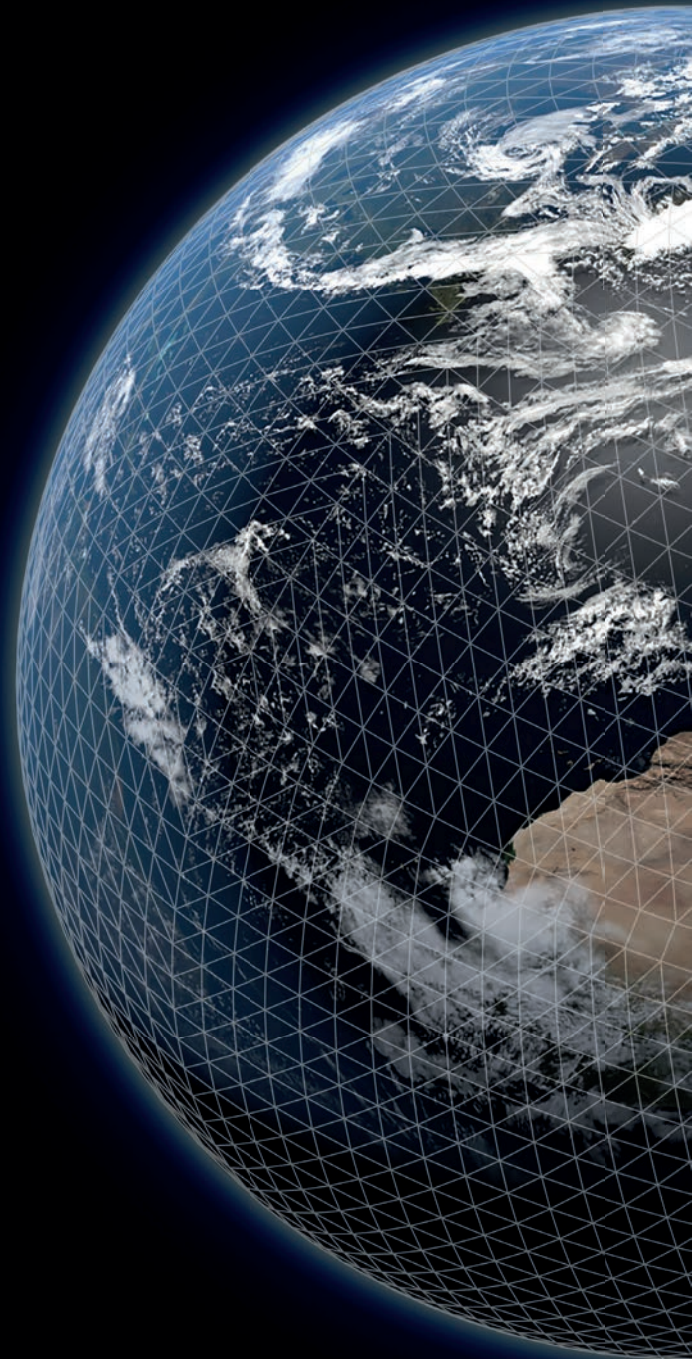
ECMWF is an intergovernmental organisation supported by 34 Member and Co-operating States. It carries out research in numerical weather prediction to develop, produce and disseminate global weather forecast information. ECMWF has partnerships and co-operation agreements with many organisations around the world, such as the WMO, space agencies, research institutes, and weather centres. Its research involves the science underpinning modelling of the Earth system and its forecasts rely on Earth observations.

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