Using ECMWF's Forecasts (UEF2022)

Report of Contributions

https://events.ecmwf.int/e/UEF2022

Contribution ID: **1** Type: **Oral presentation**

Model output to weather forecasts: the need to address the known unknowns

Wednesday, 8 June 2022 14:00 (20 minutes)

Advances in numerical weather prediction mean that model output is more accurate, and with an increasing array of variables and ensembles. It is good to discuss how best to chart this model output to be easily digestible to a wide cross section of forecasters and users.

It is also important to ask what is missing from the model output - the *known unknowns* –and how to communicate these uncertainties.
Using case studies from the energy sector, we will explore how the operational forecaster can add value, including through flow-dependent evaluation of forecasts. These will show how knowledgeable forecasters add value, and enable users to make better real world decisions.

Time allowing, we will look at how NWP might try to encapsulate some of this forecaster knowledge … tho this speaker believes operational forecasters will continue to add value for some decades.

Primary author: FINNEY, Isla (Lake Street Consulting Ltd)

Presenter: FINNEY, Isla (Lake Street Consulting Ltd)

Session Classification: User Engagement and Feedback

Track Classification: UEF2022

Contribution ID: **2** Type: **Oral presentation**

Forecasting Large Hail using Logistic Models and the ECMWF Ensemble Prediction System

Friday, 10 June 2022 09:30 (20 minutes)

An Additive logistic Regression model for large hail was developed based on convective parameters from ERA5 reanalysis, severe weather reports from the European Severe Weather Database (ESWD), and lightning observations from the Met Office Arrival Time Difference network (ATDnet). This model was shown to accurately reproduce the spatial distribution and the seasonal cycle of observed hail events in Europe.
To explore the value of this approach to medium-range forecasting, a similar statistical model was developed using four predictor parameters retrieved from the ECMWF Ensemble Prediction System (EPS) reforecasts: Mixed Layer CAPE, Deep Layer Shear, Mixed Layer Mixing Ratio, and the Wet Bulb Zero Height. Probabilistic large hail predictions were created for all available 11-member ensemble forecasts (2008 to 2019), for lead times from 12 to 228 hours.
First, we evaluated the model's predictive skill depending on the forecast lead time using the Area Under the ROC Curve (AUC) as a validation score. For forecasts up to two to three days, the model highlights a very high predictive skill (AUC ≥ 0.95). However, it remains skillful even for extended forecasts (AUC=0.86 at 180 hours lead time) showing that it can identify regions with hail potential well in advance. Second, we compared the forecast spatial probabilities at various lead times with observed hail occurrence focusing on a few recent hail outbreaks. Finally, the skill of our four-dimensional model was compared with that of composite parameters such as the Significant Hail Parameter (SHP) and the product of CAPE and Deep Layer Shear (CAPESHEAR). The logistic model outperformed CAPESHEAR at all lead times. Compared to SHP, the model exhibited a higher skill especially at short lead times (up to 36 h). These results show that our approach can improve hail forecasting metrics especially when compared to those based on CAPE-SHEAR approaches only.

Primary authors: BATTAGLIOLI, Francesco (European Severe Storms Laboratory); Dr TSONEVSKY, Ivan (European Center for Medium Range Weather Forecasting (ECWMF)); GROENEMEIJER, Pieter (European Severe Storms Laboratory)

Presenter: BATTAGLIOLI, Francesco (European Severe Storms Laboratory)

Session Classification: Severe Weather Forecasting

Track Classification: UEF2022

Contribution ID: **3** Type: **Oral presentation**

The Météo-France surveillance automated system for meteorological data

Wednesday, 8 June 2022 11:40 (20 minutes)

Météo-France is facing a decreasing man-power dedicated to weather forecasting whereas in the meantime more and more weather data become available to the forecasters. Therefore, in the last couple of years, several products and technologies have been developed to quickly visualize those data. One of those technologies is a automated surveillance system that warns forecasters of a possible severe weather event. This surveillance system consists in scanning all the available French numerical weather model outputs then sending a popup when a significant number of grid points over a domain pre-defined by the forecasters of a particular model reaches a threshold. The main meteorological parameters that are watched are wind gust, rainfall, snowfall, temperature (for heatwaves). This surveillance system will also be used to produce specific weather services for diverse customers and in the correction process of the Météo-France's automated forecast database. Finally, an ongoing project consists in developing a similar surveillance system but for the observations.

Primary author: BOISSERIE, Marie (Météo-France)

Co-authors: Dr MAYNARD, Karine (Météo-France); Dr BARBIER, Jessica (Météo-France); Dr ARBOGAST, Philippe (Météo-France)

Presenter: BOISSERIE, Marie (Météo-France)

Session Classification: Theme: Technology to display and process meteorological data

Track Classification: UEF2022

Contribution ID: **4** Type: **Poster presentation**

The Météo-France products for visualising ensemble forecasts

Météo-France is facing a decreasing man-power dedicated to weather forecasting whereas in the meantime more and more weather data become available to the forecasters. Therefore, in the last couple of years, several products have been developed to quickly visualize the ensemble forecasts. We have developed bubble and bar charts that are used to detect signals in forecast ensembles but also to classify this event among a climatology of remarkable past weather events (such as heat-wave, severe storms, intense precipitation events). A product showing the signal of each ensemble members at different runs gathered in a single chart is also well appreciated by our forecasters. Because Extreme Forecast Index (EFI) is also an interesting tool to visualize ensembles, we have developed our own EFI for wind and rainfall using Météo-France global and limited-area models. Those EFI are produced without the use of a French reanalyze. Finally, APIC (Avertissement pluies Intenses à l'échelle des communes) is an automatic warning service that indicates in real time the exceptional nature of the precipitation in progress over a commune.

Primary authors: TRAJAN, Alexandre (Météo-France); BOISSERIE, Marie

Presenter: BOISSERIE, Marie

Track Classification: UEF2022

Contribution ID: **5** Type: **Oral presentation**

Creative Use of Colour to Satisfy Different User Needs

Wednesday, 8 June 2022 10:20 (30 minutes)

Meteorological data, commonly visualised in map format, has to satisfy wide-ranging user needs. For example, the needs of the forecasting community and business-critical users tend to be very different to the needs of more passive user categories, such as the public. And in turn user requirements depend also on the variable(s) being displayed. One way to address this complexity, and achieve customer satisfaction, is via creative, carefully tailored use of colour - this may seem like a trivial undertaking but it is not. Questions that need to be posed to design appropriate visualisation strategies include, but are not limited to: Does the user need to quickly identify values? Should the variables in question have an intuitive connection to colour (e.g. blue for cold)? Are different variables being overlayed or juxtaposed? Do we want to highlight hazardous conditions? Many times a compromise has to be found between competing requirements in these and other categories. This talk will provide examples of good and bad practice, including common pitfalls related for example to "visual non-linearity"of RGB settings, and provide pointers to how to best tailor a colour scheme for a target audience. We will also touch on strategies for colour-blindness, and also on how colour should not be used to overstate minimally significant results. We will also stress that, although time consuming, trial and error testing using inputs from multiple meteorological scenarios is the way to achieve visual presentations that will stand the test of time.

Primary author: Mr HEWSON, Tim (ECMWF)

Presenter: Mr HEWSON, Tim (ECMWF)

Session Classification: Theme: Presenting and visualising meteorological data

Track Classification: UEF2022

Contribution ID: **7** Type: **Oral presentation**

Met.3D: Interactive 3D visualization for rapid exploration of atmospheric ensemble simulation data

Thursday, 9 June 2022 14:00 (1 hour)

Met.3D (https://met3d.wavestoweather.de) is an open-source research software aiming at making novel interactive 3D and ensemble visualization techniques accessible to the atmospheric community. Since its first public release in 2015, Met.3D has been used in multiple visualization research projects targeted at atmospheric science applications, and has evolved into a feature-rich visual analysis tool facilitating rapid exploration of atmospheric simulation data. The software is based on the concept of "building a bridge"between "traditional"2D visual analysis techniques and interactive 3D techniques powered by modern graphics hardware. It allows users to analyse data using combinations of feature-based displays (e.g., atmospheric fronts and jet streams), "traditional"2D maps and cross-sections, meteorological diagrams, ensemble displays, and 3D visualization including direct volume rendering, isosurfaces and trajectories, all combined in an interactive 3D context. Met.3D is designed to natively support ECMWF ensemble forecast data, and in collaboration with the ECMWF visualization team an interface between ECMWF's Metview software and Met.3D has been implemented. This workshop will introduce participants to Met.3D. We will demonstrate how to explore ECMWF forecast data interactively and in 3D, and provide information about how Met.3D can be used in research as well as operational settings.

Primary author: RAUTENHAUS, Marc (Universität Hamburg)

Co-authors: BECKERT, Andreas; HEWSON, Tim (ECMWF); RUSSELL, Iain (ECMWF)

Presenter: RAUTENHAUS, Marc (Universität Hamburg)

Session Classification: Theme: Technology to display and process meteorological data - 3D and Virtual Reality

Track Classification: UEF2022

Contribution ID: **8** Type: **Oral presentation**

Interactive data visualisation and pre-processing with ECMWF's Metview software

Wednesday, 8 June 2022 12:00 (20 minutes)

Effective visualisations can take a lot of time and experimentation to get right. Having an interactive environment in which to try out different aspects such as colour schemes can drastically reduce the time required. An interactive environment is also a great way to dynamically explore data, look for features and compare different datasets. On top of this, it can be essential to pre-process data before visualising it, whether to compute more useful parameters from those you have, to compare data from different sources, or simply to reduce data volumes. This presentation will show how ECMWF's meteorological workstation software, Metview, can address these issues and even write Python code for you!

Primary author: Mr RUSSELL, Iain (ECMWF)

Co-authors: Dr MACIEL, Pedro (ECMWF); Mr KERTESZ, Sandor

Presenter: Mr RUSSELL, Iain (ECMWF)

Session Classification: Theme: Technology to display and process meteorological data

Track Classification: UEF2022

Contribution ID: **9** Type: **Poster presentation**

Reproducing the open weather forecast charts using Python and Jupyter notebooks

As of recently, ECMWF started the move towards serving data to users beyond operational forecasters in Member states and commercial customers for a charge, by adopting an open data policy which will be implemented in phases from 2020 to 2025. The first phase included opening hundreds of web forecast charts and making archived data available under a Creative Commons (CC BY 4.0) open licence in 2020. The next step was in January 2022 when the production of open subset of real time medium range forecast began.

This phased move towards free and open also data represents a big step towards a more reproducible open science. However this can not be achieved by only opening the real time data. The users need to be able to find and easily use the data and integrate it into their own research work or application workflows. Reliable access to the data is achieved by making it available both through ECMWF https service and via the Microsoft Azure cloud, where the archived data is kept as well.

In order for the data to be more FAIR (Findable, Accessible, Interoperable and Reusable), additional development work is being done. This work includes the design of an API to easily download the data, and the development of open source Python libraries to process and visualise it. To present these new tools and help users understand how to retrieve and process ECMWF data, a set of Jupyter notebooks was created, each of them reproducing one open weather forecast chart from the downloading the data to the visualisation.

This poster will focus on development of Jupyter notebooks for reproducing the open charts, but will also give a short overview of which open data and software are available.

Primary author: VUCKOVIC, Milana (ECMWF)

Co-author: Ms LAMY-THEPAUT, Sylvie (ECMWF)

Presenter: VUCKOVIC, Milana (ECMWF)

Track Classification: UEF2022

Contribution ID: **10** Type: **Oral presentation**

Reproducible visuals of meteorological data in scientific publications

The importance of visuals in scientific publications has increased in recent years. Not only because nowadays, but we also tend to advertise scientific papers on platforms such as Twitter or Linkedin, where it is always helpful to add a compelling visual to accompany any text. Journals are also increasingly requesting a higher quality in paper graphics. In articles in the meteorological field, the production of map plots of meteorological fields is essential. Several Python libraries exist to produce and customise a wide range of map plots. However, the quality of map plots from more niche software like Metview can be higher and more preferable. Metview is a workstation application aimed at both the operational and research meteorologist. Its capabilities include meteorological data access, processing and visualization. It features a rich library of Python functions and classes and a powerful user interface for interactive work. The problem with using such software is that it might not be easy for everyone to reproduce the map plots either because people might not have the software installed or because they are unfamiliar with its language. To facilitate the reproducibility of code created in Metview-Python, we need to share the code itself, but we also need to share the environment with which we run the code. Platforms like MyBinder.org allow sharing code efficiently and running it on a web browser, so local installations might not be required. This talk will show how Metview has been recently adapted to tools like Zenodo, Jupyter notebooks, and Binder to help scientists share their science complying with the highest standards in workflows and publications reproducibility.

Primary author: PILLOSU, Fatima (ECMWF)

Co-author: Mr RUSSELL, Iain (ECMWF)

Presenters: PILLOSU, Fatima (ECMWF); Mr RUSSELL, Iain (ECMWF)

Session Classification: Theme: Presenting and visualising meteorological data

Track Classification: UEF2022

Contribution ID: **11** Type: **Oral presentation**

Establish an Enhanced Climate Change resilience over Lake Kivu basin

Thursday, 9 June 2022 12:40 (20 minutes)

Aim of the project: Enhance Climate Change Impacts, Mitigation and Adaptation

Area: Lake Kivu basin region

Objectives:
• Create an intervention plan
• Hold stakeholder workshops
• Provide specific recommendations for conservation action
Areas of intervention: The project implementation will include the community empowerment, education and outreach and land and forest restoration

Primary author: UWIZEYE, Amos (Meteo Rwanda)

Presenter: UWIZEYE, Amos (Meteo Rwanda)

Session Classification: Using Copernicus and climate data

Track Classification: UEF2022

Contribution ID: **12** Type: **Oral presentation**

Doing more with what we have: adding narrative and skill to NWP output through automated event-precursor analysis

Wednesday, 8 June 2022 12:20 (20 minutes)

Advances in numerical weather prediction regularly produce more skilful and far-ranging predictions of the atmospheric state –but at the cost of increased complexity. As resolution becomes finer and ensemble sizes grow, it becomes ever-more difficult to track why a forecast system predicts a certain outcome: despite their basis in theory, our NWP systems often end up being treated simply as black-box models. Here, we report on the development of a new tool that aims to simplify the process of cracking open the black box, by automatically tracing the chains of large-scale precursors that lead to increased risk of a particular extreme weather event.

The potential for such a tool to add value to existing NWP output is twofold. Firstly, by automatically identifying the causal factors –wave-breakings, extratropical transitions, etc. –leading to a weather event, interpretability is reintroduced to the forecast. Understanding the narrative of a weather event, in a way reminiscent of the use of storylines in climate projections, makes it easier to weight contradictory or 'jumpy'forecasts, and to identify where known model biases may be impacting the prediction. Secondly, there is the promise of quantitative improvements in forecast skill, through process-oriented bias correction. Where remote drivers alter the probability of a weather event via teleconnections, models may capture the driver but not successfully propagate its influence, leading to an absence of an event in the forecast. By spotting and flagging the presence of such a driver in the NWP output, a valuable long-range warning could nonetheless be provided.

We demonstrate this tool with a motivational example from European extreme rainfall. Still in a prototype phase, we particularly aim to elicit feedback and insight from end-users into what functionality and visualisation methods would be of most value to them, in order to maximise the downstream impact of the project.

Primary author: DORRINGTON, Joshua (Karlsruher Institute of Technology)

Co-authors: GRAMS, Christian M. (IMK-TRO, Karlsruhe Institute of Technology (KIT)); VITART, Frederic (ECMWF); MAGNUSSON, Linus (ECMWF); GRAZZINI, Federico (LMU Muenchen/ARPAE-SIMC); FERRANTI, Laura (ECMWF)

Presenter: DORRINGTON, Joshua (Karlsruher Institute of Technology)

Session Classification: Theme: Technology to display and process meteorological data

Track Classification: UEF2022

Contribution ID: **13** Type: **Poster presentation**

Interactive detection and visual analysis of 3-D fronts in ECMWF forecasts

Atmospheric fronts are a widely used conceptual model in weather forecasting, most encountered as two-dimensional (2-D) front lines, e.g., on surface analysis charts. The three-dimensional (3-D) dynamical structure of fronts is commonly sketched in 3-D illustrations of idealized weather systems in atmospheric science textbooks. Only recently the feasibility of objective detection and visual analysis of "real"3-D frontal structures within numerical weather prediction data has been proposed, and such approaches are not yet widely known in the atmospheric community. In our work, we investigate the benefit of objective 3-D front analysis for research and forecasting. Our technique builds on a recent gradient-based detection approach, combined with modern 3-D interactive visual analysis techniques, all integrated into the open-source meteorological visualization framework Met.3D. In our presentation, we show case studies of extratropical cyclones and their frontal dynamics. Examples include joint interactive visual analysis of 3-D fronts and warm conveyor belt trajectories, and development of the 3-D frontal structure of the characteristic stages of a Shapiro-Keyser cyclone. We also demonstrate the benefit of our technique for comparative analysis of frontal dynamics in different model simulations provided by the ECMWF, e.g., of different resolution. We argue that the presented approach has large potential to be beneficial for complex studies of atmospheric dynamics and for operational weather forecasting.

Primary authors: BECKERT, Andreas (Universität Hamburg); OERTEL, Annika (Karlsruhe Institute of Technology); CRAIG, George (Meteorological Institute, LMU Munich); EISENSTEIN, Lea (Karlsruhe Institute of Technology); RAUTENHAUS, Marc (Universität Hamburg); HEWSON, Tim (ECMWF)

Presenter: BECKERT, Andreas (Universität Hamburg)

Track Classification: UEF2022

Contribution ID: **14** Type: **Poster presentation**

Weather regimes, weather types and their relation to local scale phenomena

How the ECMWF Weather Regimes Probabilities chart can support meteorologist in Lombardy to provide more accurate forecast? My thesis paper tries to answer this question. After reproducing the four weather regimes over the Euro-Atlantic area (NAO+, NAO-, BLO, AR), the daily series of occurrence of the regimes 1950-2019 was constructed. The analysis of the series made it possible to derive statistical information on the regimes: trend, variability, persistence.
As Lombardy covers a very small area compared to the Euro-Atlantic one where the regimes are defined, the same time frame was also studied in terms of weather types over the Euro-Mediterranean area.
The comparison between the two schemes showed how each pattern over the Euro-Atlantic area affects the distribution of weather types over the Euro-Mediterranean area.
Therefore, some events of interest from the point of view of operational meteorology were analyzed in terms of weather regimes and weather types. In particular, the following were chosen: the PM10 drop recorded in winter 2010, the heat waves in July 2015, the heavy rainfall in November 2014, the drought of 2017, the fires in spring 2017 and the foehn episodes in January 2019. This analysis revealed several connections between synoptic scale patterns and observed local events. The data collected support the hypothesis that both weather types and weather regimes can be used to characterize local scale phenomena and suggest that the issue can be investigated further. A systematic investigation would make it possible to consolidate the hypotheses made in this first exploratory phase and make the ECMWF Weather Regimes Probabilities chart a tool for forecasting practice.

Primary author: LEGNANI, Laura (Università degli Studi di Milano)

Co-author: Dr MINARDI, Gian Paolo (ARPA Lombardia)

Presenter: LEGNANI, Laura (Università degli Studi di Milano)

Track Classification: UEF2022

Contribution ID: **15** Type: **Oral presentation**

Flood Forecasting at Google - Flood Warning System and Research

Wednesday, 8 June 2022 12:40 (20 minutes)

Floods cause between thousands and tens of thousands fatalities, affect hundreds of millions of people, and cost tens of billions of dollars every year. Google's Flood Forecasting Initiative aims to provide actionable flood warnings to local agencies, NGOs, and the public, especially in those regions where little to no other warning systems are available. Starting 4 years ago with a small pilot area in India, our models now cover large parts of India and Bangladesh and with a population of over 220 million people. The system consists of machine learning based models for water level prediction and inundation modeling. The outputs of these models are coupled with an alert dissemination system to reach end users through different channels such as Google Search and Google Maps.
In this talk, we will provide an overview of our current system. Additionally, we will present new research results from our efforts to scale our system to many more locations globally. These include (a) changes in the model architecture, (b) a shift of focus from localized models, towards more generic models that can potentially be applied everywhere globally, and (c) the use of different forcing products, including ERA5 and ECMWF forecasts.

Primary author: SHALEV, Guy (Google)

Presenter: SHALEV, Guy (Google)

Session Classification: Theme: Technology to display and process meteorological data

Track Classification: UEF2022

Contribution ID: **16** Type: **Oral presentation**

Predicting PM2.5 concentration across India using multisource earth observation data and machine learning

Thursday, 9 June 2022 12:20 (20 minutes)

According to the World Health Organisation, 3.7 million people around the world died in 2012 as a result of outdoor air pollution. In India, according to the Central Pollution Control Board (CPCB) in India, 43.5% of children have reduced lung function and breathing problems. Air pollution is a major environmental health problem that affects people in developed and developing countries alike. With millions of people dying prematurely every year as a direct result of poor air quality, it has never been more important to monitor the air we breathe.
Various approaches have been proposed to model PM 2.5 (particulate matter with an aerodynamic diameter less than 2.5 microns) in the recent decade, with satellite-derived aerosol optical depth, land-use variables, and several meteorological variables as major predictor variables. The goal of this study is to develop and compare an ensemble-based regression machine learning model and predictor variables to estimate daily PM 2.5 across contiguous India at a resolution of 1km * 1km. By combining data from multiple sources including MODIS (NASA), Sentinel5P (ESA), meteorology, and landcover information from ECMWF Copernicus services, the prediction model has been trained to predict the PM 2.5 concentrations.
Findings from our models show that it does a significantly great job in predicting PM 2.5 daily, monthly, and annual concentrations at an unprecedented spatial resolution and accuracy across pan India. A Cross-validation (CV) using more than 300 ground monitors both spatially and temporally shows high and stable accuracy with a coefficient of determination of 0.85, a root-mean-square error of 15.57 ug m-3, and a mean prediction error of 9.77 ug m-3. This shows good agreement between CV predictions and observations. The model implements variable importance to examine the effects of each predictor on the target PM 2.5 concentration estimation. In general, our model is robust, and the estimates are in line with regular ground validation. It may thus also be useful for applications in related air pollution studies, especially those focused on urban areas.

Primary authors: Mr KOCHHAR, Ishaan (Blue Sky Analytics); AHMED, Saheel (Blue Sky Analytics); Mr PURWAR, Kshitij (Chief Technology Officer)

Presenters: Mr KOCHHAR, Ishaan (Blue Sky Analytics); AHMED, Saheel (Blue Sky Analytics)

Session Classification: Using Copernicus and climate data

Track Classification: UEF2022

Contribution ID: **17** Type: **Oral presentation**

Dynamic data Visualization for Climate Data

Thursday, 9 June 2022 09:30 (20 minutes)

I am the Founder & CTO at Blue Sky Analytics, a climate-tech startup empowering the world' s decision-makers with accurate, real-time, and standardized climate data. Using AI models, we crunch terabytes of raw satellite data to deliver environmental and climate intelligence like forest fire risk, drought risk, GHG emissions from power plants, air-quality monitoring, and more.
To holistically understand and leverage these terabytes of data we need a visualization platform that allows users to get insights at their fingertips and is compatible with all types of devices. That' s where SpaceTime comes into the picture - a multi-data set mapper which visualizes datasets in a spatial and temporal context. The main purpose of SpaceTime is to host all kinds of datasets like temporal & spatial.
It is powered by two types of data sources I.e. vector and raster files. And comes with different data layers ranging from point, circle, symbols, cluster, polygons etc. The biggest advantage is that we can visualise the data using different colour scales like - min-max, quantize, quantize-nice & quantile and with the capability to customize colour palettes of your choice. In addition to that, it is easily compatible with mobile, desktop, and tablets on mobile networks and also accessible to colour blind people. Any dataset which has latitude, longitude (or a shape boundary) & timestamp can be visualised easily with a simple config JSON file.
SpaceTime allows us to pass different components like - boundary level, parameters, duration, data type, data selection type, data mode, etc.
Using all the amazing features we have already visualised many of our in-house datasets ranging from GHG emissions (dynamic point), water quality (raster), lake detection (polygon), air quality parameters like PM 2.5 (point & raster-based) etc.

Primary author: PURWAR, Kshitij (Blue Sky Analytics)

Presenter: PURWAR, Kshitij (Blue Sky Analytics)

Session Classification: Theme: Climate data visualisation and communication

Track Classification: UEF2022

Contribution ID: **18** Type: **Oral presentation**

Resonance Space VR - Translating Climate Data Into An Interactive Bigdata Sculpture

Thursday, 9 June 2022 15:20 (20 minutes)

Title: Resonance Space VR - Translating Climate Data Into An Interactive Bigdata Sculpture

Authors:

- Alexander Peterhänsel, Media Artist, Professor for Digital Media, Brandenburg University of Applied Sciences
- Daniel Tirelli, Geophysicist, JRC
- Jutta Thielen del-Pozo, Meteorologist, JRC
- Thomas Petroliagkis, Meteorologist, JRC

Presenter:

- Alexander Peterhänsel, Media Artist, Professor for Digital Media, Brandenburg University of Applied Sciences
- (TBC) Daniel Tirelli, Geophysicist, JRC

Resonance Space VR is an interactive VR installation **based on ECMWF meteorological data**. The installation is planned to be exhibited at UEF2022.

The media art piece is the result of the scientific-artistic residency program (2019-2020) at the Joint Research Centre of the European Commission (JRC). The art piece has previously been exhibited at the BOZAR in Brussels as well as the JRC in Ispra.

This talk will:

- describe the media art piece, which represents the translation of a scientific hypothesis into an immersive VR-experience;
- discuss the interdisciplinary approach to its conception, highlighting the collaboration of scientists with artists;
- explain the usage of ECMWF meteorological data;
- discuss results, learnings and potentials of experimental approaches to the visualisation of meteorological data.

Primary author: PETERHAENSEL, Alexander (Brandenburg University of Applied Sciences)

Presenter: PETERHAENSEL, Alexander (Brandenburg University of Applied Sciences)

Session Classification: Theme: Technology to display and process meteorological data - 3D and Virtual Reality

Track Classification: UEF2022

Contribution ID: **19** Type: **Oral presentation**

Toward a petascale data hackathon for exploring the 1-km IFS nature run

Wednesday, 8 June 2022 14:20 (20 minutes)

During 2020-2021, the European Center for Medium-Range Weather Forecasts (ECMWF) and the Oak Ridge National Laboratory (ORNL) received an award from the U.S. Department of Energy to simulate and develop a baseline for weather and climate simulations at 1-km resolution, using the Summit supercomputer, hosted at the Oak Ridge Leadership Computing Facility (OLCF). The ECMWF hydrostatic Integrated Forecasting System (IFS), with explicit deep convection on an average grid spacing of 1.4 km, was used to perform the simulations in two phases, as a set of two nature runs (NR) for the periods corresponding to 2018 November to 2019 February (four months) and August - October in 2019 (three months). The simulations revealed unprecedented detail of the earth's atmosphere. These baseline simulations will provide further guidance toward future model developments and satellite mission planning. The project won the 2020 *HPCwire Readers Choice Award* for Best Use of HPC in Physical Sciences.

The simulation output amounts to over 500 TB in total volume, much of it stored as compressed and bit-packed grib files. After the spectral and grid point conversion the volume inflates to over 2 PB. Once our seminal manuscript was published, we received a few inquiries regarding access to the data. All of the interested research teams lacked the necessary infrastructure and/or bandwidth to download and manage the large volume of data. So, we are facilitating direct access to the data and computational resources via a data hackathon, jointly sponsored by the OLCF and the ECMWF.

A formal announcement for the event will solicit proposals from teams that are interested in relevant research topics, such as extreme weather events, including hurricanes and severe storms. At 1-km resolution, many of the smaller scale processes are resolved, such as most of the gravity wave spectrum. Hence, this dataset provides a unique opportunity to not only smaller scale processes but also to inform the development of their parameterization in order to improve numerical weather and climate prediction. We are also emphasizing and encouraging the development of AI and ML applications for surrogate models, emulators for data assimilation systems, satellite retrievals of earth observations, etc. Visualization of the global 1-km simulations are also of special interest for science investigations as well as for outreach activities to inform and educate.

Initially the model output was saved every 3 hours, with the anticipation that we could rerun short periods as necessary with higher temporal frequency output for specific science cases. Both model level data at all 137 levels and pressure level fields at 31 levels have been archived, along with key single level fields. Since then with feedback from the community, we identified a set of special cases, including a tropical cyclone and three severe weather episodes. We used checkpoint files to restart these simulations for the special cases but with data output every 15 minutes. The high temporal frequency output has added an additional 500 TB of grid point data. Observing System Simulation Experiments (OSSEs) can be performed for designing, configuring and evaluating future satellite instruments for prediction of severe weather events.

We are currently in the process of finalizing the plans for the data hackathon, scheduled to launch on 1 June 2022. The announcement of opportunity, soliciting proposals, will be disseminated in early May 2022. The selection of projects will be completed toward the end of May. The hackathon will be for a duration of 6 months. The teams will have access to Andes at OLCF, a Linux cluster with 704 nodes, each with 256 GB memory per node. For machine learning and AI workloads, we will also facilitate access to Ascent, a stand-alone 18-node system with an architecture similar to Summit. The users can also deploy jupyter notebook instances for interactive analytics. The approved users and teams will be able to get familiar with the OLCF systems and the data via tutorial and training sessions. Mentors will be available to provide support related to the systems and

the data collection. We have already engaged several external stakeholders with diverse research interests. During our presentation, we will discuss our experiences and the lessons learned from planning and preparation for the hackathon, the nature of various science investigations, and the roadmap for the event.

Primary authors: ANANTHARAJ, Valentine (Oak Ridge National Laboratory); WEDI, Nils (ECMWF); POLICHTCHOUK, Inna; DUEBEN, Peter (ECMWF); PARETE-KOON, Suzanne (Oak Ridge National Laboratory); PAPATHEODORE, Thomas (Oak Ridge National Laboratory)

Presenter: ANANTHARAJ, Valentine (Oak Ridge National Laboratory)

Session Classification: User Engagement and Feedback

Track Classification: UEF2022

Contribution ID: **20** Type: **not specified**

Arrival, registration and coffee

Tuesday, 7 June 2022 13:00 (1 hour)

Contribution ID: **21** Type: **Oral presentation**

Welcome

Tuesday, 7 June 2022 14:00 (5 minutes)

Presenter: PAPPENBERGER, Florian (ECMWF)

Contribution ID: **22** Type: **Oral presentation**

Housekeeping

Tuesday, 7 June 2022 14:05 (5 minutes)

Presenter: HEMINGWAY, Becky (ECMWF)

Contribution ID: **23** Type: **not specified**

Poster session and drinks reception

Tuesday, 7 June 2022 16:50 (1h 40m)

Contribution ID: **24** Type: **not specified**

Arrival

Wednesday, 8 June 2022 09:00 (30 minutes)

Contribution ID: **26** Type: **not specified**

User Voice Corner

Wednesday, 8 June 2022 15:30 (1h 40m)

Presenter: HEWSON, Tim (ECMWF)

Contribution ID: **27** Type: **not specified**

UEF2022 Dinner

Wednesday, 8 June 2022 18:30 (2h 30m)

Contribution ID: **28** Type: **not specified**

Arrival

Thursday, 9 June 2022 09:00 (30 minutes)

Contribution ID: **29** Type: **not specified**

Interactive Visualisation Session

Thursday, 9 June 2022 16:00 (1 hour)

Contribution ID: **30** Type: **not specified**

Arrival

Friday, 10 June 2022 09:00 (30 minutes)

Contribution ID: **31** Type: **not specified**

Speakers' Corner

Friday, 10 June 2022 11:20 (1 hour)

Presenters: SAHIN, Cihan (ECMWF); MAGNUSSON, Linus (ECMWF); HEWSON, Tim (ECMWF)

Contribution ID: **32** Type: **Oral presentation**

Concluding Remarks and Close

Friday, 10 June 2022 12:20 (10 minutes)

Presenter: RABIER, Florence (ECMWF)

Contribution ID: **33** Type: **Oral presentation**

Plans for SEAS6 and outcomes of a User Consultation

Wednesday, 8 June 2022 14:40 (20 minutes)

ECMWF plans to introduce the next major upgrade of its seasonal forecasting system, SEAS6, in 2024. Increased computing resources will allow us to improve the range and structure of the forecasts and supporting re-forecasts. This can be done in various ways - increased ensemble sizes, more frequent issuing of forecasts, longer forecast ranges for ENSO outlooks, and an increased range of years for reforecasts. Since computational resources are limited, choices must be made as to the balance between these different enhancements. The costs of different options are known, some being relatively cheap and others very expensive. ECMWF can also estimate the benefits of different choices in terms of reduced sampling errors and increased precision in forecast pdfs. However, our decisions should also take account of the usefulness of the various options. To gain information on this we have run a User Consultation to understand the views and priorities of users and potential users of ECMWF seasonal forecasts. This talk will present the plans and options for SEAS6, and results from the User Consultation.

Primary author: STOCKDALE, Tim (ECMWF)

Presenter: STOCKDALE, Tim (ECMWF)

Session Classification: User Engagement and Feedback

Track Classification: UEF2022

Contribution ID: **34** Type: **Oral presentation**

Invited presentation: Effective data visualisation for decision making and making an impact

Thursday, 9 June 2022 09:50 (40 minutes)

Presenter: KAYE, Neil (Met Office)

Session Classification: Theme: Climate data visualisation and communication

Contribution ID: **43** Type: **Oral presentation**

”Visualising Meteorological Data” - Introducing the theme

Tuesday, 7 June 2022 16:00 (10 minutes)

Presenter: HEMINGWAY, Becky (ECMWF)

Session Classification: Updates from ECMWF

Contribution ID: **50** Type: **Oral presentation**

News on ECMWF's forecast performance

Wednesday, 8 June 2022 09:30 (25 minutes)

An overview is given about recent developments in forecast performance of ECMWF's operational forecasting system. Time scales from medium through extended range to seasonal are considered and forecast skill improvements due to recent model upgrades are highlighted. Comparisons with other centres are made, and ECMWF's lead in upper-air and surface forecasts is scrutinized. In addition to standard surface verification against in-situ observations, results on the use of gridded observational datasets for precipitation and radiation fluxes are shown. Evaluations of tropical cyclone and ocean wave forecast skill, as well as the Extreme Forecast Index (EFI) conclude the presentation.

Primary author: HAIDEN, Thomas (ECMWF)

Presenter: HAIDEN, Thomas (ECMWF)

Session Classification: Updates from ECMWF

Track Classification: UEF2022

Contribution ID: **51** Type: **Oral presentation**

European State of the Climate Report: a success story to communicate climate data effectively

Thursday, 9 June 2022 12:00 (20 minutes)

The annual European State of the Climate report represents an occasion to make the most of the climate data produced by the Copernicus Climate Change Service (C3S) and its partners. Both for research and operational purposes, the report covers several essential climate variables (ECVs) and climate indicators to analyse their evolution over time and assess climate variability and change. In order to communicate the findings in a more effectively manner and to encourage audience's uptake, the team behind the elaboration of the report has produced visualisations and infographics that have contributed to the success of this flagship C3S'product.

Primary authors: VAMBORG, Freja (ECMWF); LOPEZ, Nuria (ECMWF)

Presenters: VAMBORG, Freja (ECMWF); LOPEZ, Nuria (ECMWF)

Session Classification: Theme: Climate data visualisation and communication

Track Classification: UEF2022

Contribution ID: **52** Type: **Oral presentation**

ECMWF research progress and plans

Tuesday, 7 June 2022 15:05 (25 minutes)

ECMWF carries out a wide-ranging research programme, and this presentation will describe some of the key current foci. Ultimately the goal of the research is to lead to better forecasts, and the talk will include a brief recap of the two operational upgrades introduced over the last year, and a description of the plans for new cycles to exploit the new HPC in Bologna.

Primary author: BROWN, Andy (ECMWF)

Presenter: BROWN, Andy (ECMWF)

Session Classification: Updates from ECMWF

Track Classification: UEF2022

Contribution ID: **53** Type: **Oral presentation**

Invited presentation: Visualising climate change

Tuesday, 7 June 2022 16:10 (40 minutes)

I will discuss: (i) recent popular visualisations of climate data aimed at broad public audiences, and (ii) various issues in how we present weather and climate data in scientific graphics.

Primary author: HAWKINS, Ed (National Centre for Atmospheric Science, University of Reading)

Presenter: HAWKINS, Ed (National Centre for Atmospheric Science, University of Reading)

Session Classification: Updates from ECMWF

Track Classification: UEF2022

Contribution ID: **54** Type: **Oral presentation**

ECMWF product development

Tuesday, 7 June 2022 14:10 (25 minutes)

The presentation will review forecast product development activities at ECMWF over the past year, in response to user requests and feedback.

The Integrated Forecasting System (IFS) upgrade to Cycle 47r3 in October 2021 included a major upgrade to the moist physics of the model, resulting in more realistic precipitation characteristics. With Cycle 47r3, we introduced several new products, such as new improved convective available potential energy (CAPE) output developed in close collaboration with the European Severe Storms Laboratory and a clear-air turbulence product developed with the German Aerospace Center (DLR). Improved visibility and wind gust forecast products were also introduced.

In autumn 2021, we added more than 50 new products and increased the number of available forecast steps in the OpenCharts catalogue. We also introduced a new feature called ChartSet that allows users to see their selections side by side and change time steps or areas in one click for the entire set of selected products. In January 2022, a wide range of ECMWF's forecast data across the globe became openly available. A set of Jupyter notebooks is available to help users access the data and reproduce the plots from our open forecast charts.

Primary author: RICHARDSON, David (ECMWF)

Presenter: RICHARDSON, David (ECMWF)

Session Classification: Updates from ECMWF

Track Classification: UEF2022

Contribution ID: **55** Type: **Oral presentation**

Optional seminar: The Open Data Pathway

Wednesday, 8 June 2022 17:10 (20 minutes)

Open data has been recognised as one of the main tools to maximise the socio-economic benefits of investments in data production, and forms a key part of the ECMWF Strategy between now and 2030. ECMWF products and weather data in general contribute to a broad range of activities by service providers, and their use enables and enhances the protection of life and property by National Weather Services. In order to realise the full potential of open policies, data need to be easily accessible and available.

This presentation highlights the roadmap for the transition to open data, including a summary of recent changes to data policy and data access methods, as well as the proposed changes in the coming years, such as new and updated open datasets, as well as reductions in the cost of data. The challenges associated with the transition are also presented.

Primary authors: PIDDUCK, Emma (ECMWF); PARODI, Ilaria (ECMWF); KUILMAN, Maartje (ECMWF); YANG, Xiaobo

Presenter: PIDDUCK, Emma (ECMWF)

Track Classification: UEF2022

Contribution ID: **58** Type: **Oral presentation**

New visualisation of forecast system diagnostics

Wednesday, 8 June 2022 09:55 (25 minutes)

Many diagnostics of the ECMWF analysis and forecast systems are created using the Diagnostics Toolbox. These are now available to users - to help understand previous seasons and to evaluate new IFS cycles. Work is also progressing on the visualisation of tropical waves and the MJO. Examples of all these diagnostics will be presented, with a view to gauging interest and obtaining feedback.

Primary authors: RODWELL, Mark (ECMWF); EMERTON, Rebecca

Presenter: RODWELL, Mark (ECMWF)

Session Classification: Updates from ECMWF

Track Classification: UEF2022

Contribution ID: **59** Type: **Oral presentation**

ECMWF - Forecasting for the future

Tuesday, 7 June 2022 14:35 (30 minutes)

ECMWF's mission for 2021-2030 is to "Deliver global medium-range numerical weather predictions and monitoring of the Earth system to our Member States". Underpinning this are the values: Collaboration, Integrity, and Passion.
This presentation highlights how work being doing at ECMWF are in line with these. Our integrity and passion have resulted in new model updates and continued leading forecast performance. Our plans for continued model improvement cycles will be outlined. Collaboration on numerous activities will take ECMWF into the future and benefit our member and cooperating states as well as the meteorological community. These projects include Bologna Our New Datacentre (BOND), our new facility in Bonn, the European Weather Cloud, Destination Earth, Machine Learning and Copernicus. All these will be discussed as to how they contribute to ECMWF's 2021-2030 mission.

Primary author: Prof. PAPPENBERGER, Florian (ECMWF)

Presenter: Prof. PAPPENBERGER, Florian (ECMWF)

Session Classification: Updates from ECMWF

Track Classification: UEF2022

Contribution ID: **60** Type: **Oral presentation**

The Copernicus Climate Data Store

Thursday, 9 June 2022 11:40 (20 minutes)

The Climate Data Store (CDS) is the Copernicus climate change service (C3S) solution to global data delivery and visualisation. Driven by the principles of simplicity and consistency, the CDS provides free access to over 100 datasets for a global interdisciplinary and intersectoral audience of over 100,000 users. Furthermore, the CDS offers online processing facilities and a suite of over 30 applications which provide a simple-to-use interface to the complex datasets and generate new knowledge from the data.

We present the design principles and system architecture of the CDS and demonstrate the ease of access to the wealth of data available through the CDS and the simplicity of visualising the data using the online processing facilities. Additionally, we provide insight on the lessons learnt which informed our view for future developments to meet the growing needs of a growing user community.

Primary author: COMYN-PLATT, Edward (ECMWF)

Presenter: VARNDELL, James (ECMWF)

Session Classification: Theme: Climate data visualisation and communication

Track Classification: UEF2022

Contribution ID: **61** Type: **Oral presentation**

Invited presentation: Visualizing data for impact: a participatory journey from data to storytelling

Thursday, 9 June 2022 10:30 (40 minutes)

A participatory approach is the foundation for building design solutions that empower citizens, policymakers, experts and non-experts to make informed decisions. Angela Morelli, information designer, co-founder and CEO of InfoDesignLab, will guide us through the journey of co-designing data visualizations that present information in effective ways in order to capture the imagination of an audience.

Primary author: MORELLI, Angela (Info Design Lab)

Presenter: MORELLI, Angela (Info Design Lab)

Session Classification: Theme: Climate data visualisation and communication

Track Classification: UEF2022

Contribution ID: **62** Type: **Oral presentation**

Invited presentation: Storm Naming and Conveying Risk

Friday, 10 June 2022 10:10 (40 minutes)

This talk will comes from the heart and mind of a forecaster who has worked for over 35 years trying to predict changeable and sometimes volatile weather coming in from the Atlantic and relaying forecasts and warnings to the public and emergency services. Evelyn will take us from her early days when the forecast for tomorrow was hugely uncertain and data came in painfully slowly on a roller type machine on electrostatic paper ⋯.imagine there was no internet kids⋯ .through to the current sophisticated Ensemble high resolution local models and Monthly forecasts using ECMWF Global.
Evelyn is now Head of Forecasting at Met Éireann and chairs the EUMETNET Task Team on Storm Naming. She will explain the raison d'être for Storm Naming and the current state of play across Europe with all NMS's now participating from Norway to Greece to Portugal. Iceland is unique as there just aren't enough letters in the alphabet to name all the winter storms!
A question to the modelers: how do you convey actionable advice when you are very uncertain yourself about what could happen? Adopting the precautionary principle is another term for 'the boy who cried wolf'and is not acceptable to society. A small chance of a high impact event is easier to describe five days ahead than tomorrow and heres where the human forecasters step up as the trusted and authoritative voice of the wonderful meteorological community via, inter alia, TV, Radio, Podcasts, Web, App and Social Media.

Primary author: CUSACK, Evelyn (Met Éireann)

Presenter: CUSACK, Evelyn (Met Éireann)

Session Classification: Theme: Communicating forecast data

Track Classification: UEF2022

Contribution ID: **64** Type: **Oral presentation**

The National Weather Service Whole Story Uncertainty and Probabilities Viewer

Thursday, 9 June 2022 15:00 (20 minutes)

A 2006 report by the National Research Council entitled "Completing the Forecast"concluded that uncertainty is a fundamental characteristic of weather prediction, and no forecast is complete without a description of its uncertainty. The Whole Story Uncertainty and Probabilities (WSUP) Viewer is a cloud-based user interface for displaying forecast data not able to be transmitted to the NWS Weather Forecast Offices due to volume. Model data unavailable to NWS field forecasters include the majority of the probabilistic quantitative precipitation forecast grids as well as snow and ice exceedance probability grids. Given the potential for large impacts to life and property, probabilities concerning these forecast elements can be valuable to forecast offices in providing impact-based decision support services. In addition to conveying probabilistic information, the NWS viewer displays model components at select point locations. By seeing individual model component data, forecasters can better understand how our National Blend of Models (NBM) arrived at its guidance forecast.

Primary authors: Mr RUTH, David (NOAA); STROM, Dana (NOAA)

Presenters: Mr RUTH, David (NOAA); STROM, Dana (NOAA)

Session Classification: Theme: Technology to display and process meteorological data - 3D and Virtual Reality

Track Classification: UEF2022

Contribution ID: **65** Type: **Oral presentation**

Earth Observation Data and Social Media

Friday, 10 June 2022 09:50 (20 minutes)

Social media platforms offer a way to engage with a wide range of people from across all sectors of society. As such they can be an effective way to share the relevance of Earth Observation data (and derived products and services) to everyday life and beyond.

However, using social media platforms effectively can require styles of communication that are not overly familiar to scientists and those working in the technical aspects of the sector. Beyond that, different platforms also work in different ways, and the most effective communication styles for each also vary.

In this presentation we'll explore some examples of how information and imagery from Earth Observation and related products and services have been shared on different social media platforms to engage with diverse audiences. We'll look at how different social media accounts present themselves, with a particular focus on what the 'passionate individual'can do to use these platforms in their work.

Primary author: EVERS-KING, Hayley (EUMETSAT)

Presenter: EVERS-KING, Hayley (EUMETSAT)

Session Classification: Theme: Communicating forecast data

Track Classification: UEF2022