WAVES TO WEATHER

WWRP WORLD WEATHER RESEARCH PROGRAMME

WORLD METEOROLOGICAL ORGANIZATION

Conference on Predictability and Multi-Scale Prediction of High Impact Weather

Program
(last update: Oct. 04th 2017)

Monday 9th October 2017

09:00-12:00	*Registration + lunch buffet*
12:00-12:10	Welcome and general information (A. Laurian)
12:10-12:20	Presentation of HIWeather (J. Keller)
12:20-12:50	Overview of Waves to Weather (W2W) (G. Craig - Keynote)

<u>Session on multi-scale prediction systems</u> (chair: Jenny Sun)

12:50-13:20	The new hourly 4D-Var system for the Met Office operational convective-scale UKV model (B. Macpherson - Keynote)
13:20-13:35	An extended tropical cyclone prediction system for Australia (P. Steinle)
13:35-13:50	Balanced data assimilation strategies (G. Hastermann)
13:50-14:05	Strategies for multi-scale data assimilation using a 3DVAR system (Juanzhen Sun)
14:05-14:20	Approaches to convective scale data assimilation (T. Janjic-Pfander)
14:20-14:35	What observations do we need for convective-scale data assimilation? (M. Weissmann)
14:35-16:00	Poster session + *coffee break*
16:00-16:30	SINFONY - Development of a new seamless prediction system for very short range convective-scale forecasting at DWD (U. Blahak - Keynote)

16:30-16:45 Assimilation of visible satellite images for improved prediction of high impact weather (L. Scheck)
16:45-17:00 Impact of Orography on Predictability of Deep Convection in an Idealized Ensemble Data Assimilation Testbed (K. Bachmann)
17:00-17:15 From Surface to Atmosphere: Ocean-Wave-Atmosphere interactions in a fully coupled environmental prediction model (J. Fallmann)
17:15-17:30 Discussion (buffer)
17:30-18:30 Discussion on reproducibility of scientific results (chairs: S. Rasp, S. Lerch and G. Fragkoulidis; introductory talk 20' + discussion 40')

19:00- *Ice breaker*

Tuesday 10th October 2017

Session on scale interactions and error growth (chair: G. Craig)

09:00-09:30 Improving Stochastic Parametrization Schemes using High-resolution Model Simulations (H. Christensen - Keynote)
09:30-09:45 Error growth from the micro- to the synoptic scales governed by the geostrophic adjustment process (L. Bierdel)
09:45-10:00 Role of initial and model errors in uncertainty of weather forecasts (T.-Y. Leung)

10:00-10:15 The impact of convection in the West African monsoon region on global weather forecasts: explicit vs. parameterized convection simulations using the ICON model (G. Pante)
10:15-10:30 Quantifying the added value of convection-permitting climate simulations in complex terrain: a systematic evaluation of WRF over the Himalayas (R. Karki)

10:30-11:00 *Coffee break*

11:00-11:15 Tropical transition of hurricane Chris (2012) over the North Atlantic Ocean: a multi-scale investigation of predictability (M. Maier-Gerber)
11:15-11:30 Dynamics and predictability of Medicanes in the ECMWF ensemble forecast system (E. Di Muzio)
11:30-11:45 Identification of Rossby Wave packets using Local Finite Amplitude Wave Activity (P. Ghinassi)
11:45-12:00 Atlantic-European weather regimes: physical processes governing their life cycles and applications (C. Grams)
12:00-12:15 Multi-scale sensitivity and predictability of high-impact extratropical cyclones (J. Doyle)
12:15-12:30 Dynamics of forecast errors in a quantitative PV framework (M. Baumgart)
12:30-12:45 Discussion (buffer)

12:45-14:00 *Lunch buffet*

14:00-14:30 HIWeather: Predicting & Warning Weather-Related Hazards (B. Golding - Keynote)

Session on probabilistic forecasting and statistical post-processing methods (chair: P. Steinle)

14:30-15:00 Statistical post-processing of ensemble weather forecasts (T. Gneiting - Keynote)
15:00-15:15 An operational global system for forecasting point rainfall and flash flood risk (T. Hewson)
15:15-15:30 Analog based post-processing of navigation-related hydrological ensemble forecasts (S. Hemri)
15:30-15:45 Automated flood potential advisories based on vertically integrated atmospheric moisture fluxes (I. Mahlstein)
15:45-16:00 Predictability of precipitation over tropical northern Africa using TIGGE, statistical postprocessing and statistical forecasting methods (P. Vogel)

16:00-16:30 *Coffee break*

16:30-16:45 Taking into account hydrodynamic parameters and initial soil moisture uncertainties in an ensemble-based flash-flood forecasting system (B. Vincendon)
16:45-17:00 Representation of mechanical lifting by subgrid-scale orography using stochastic perturbations (M. Hirt)
17:00-17:15 Forecast variability of the blocking system over Russia in summer 2010 (L.-A. Quandt)
17:15-17:30 Predictability of frontal waves and cyclones as a function of scale and intensity (J. Methven)
17:30-17:45 Forecaster's Dilemma: extreme events and forecast evaluation (S. Lerch)
17:45-18:00 Quantifying the skill in probabilistic forecasts for the sea breeze deriving from large-scale variables (C. Cafaro)
18:00-18:45 Discussion (buffer)

19:00- *Conference dinner at the Hotel Goldene Sonne*

Wednesday 11th October 2017

Session on extreme weather events (chair: P. Knippertz)

09:00-09:30 Multi-scale predictability of severe weather from a diagnostic perspective (L. Magnusson - Keynote)
09:30-09:45 Role of Rossby wave packets for Northern Hemisphere heat waves (G. Fragkoulidis)
09:45-10:00 Dynamics and predictability of the 2016 late summer heat waves over Europe (P. Zschenderlein)
10:00-10:15 The extratropical transition of Typhoon Sinlaku (2008): challenges in modelling and mechanisms determining structural changes (H. Lentink)

10:15-10:30 A perspective on forecasting cyclonic storms from ECMWF's meteorological analysts (T. Hewson)

10:30-11:00 *Coffee break*

11:00-11:15 Predictability of wind gusts in winter storms over central Europe (F. Pantillon)
11:15-11:30 Secondary cyclogenesis along an occluded front leading to damaging wind gusts: windstorm Kyrill (P. Ludwig)
11:30-11:45 Modeling of severe convective system from the 21 August 2007 with the COSMO model (K. Wojcik Damian)
11:45-12:15 Improving high impact weather and climate prediction for societal resilience in Subtropical South America: Proyecto RELAMPAGO-CACTI (J. Ruiz - Keynote)
12:15-12:30 Discussion (buffer)

12:30-13:30 *Lunch buffet*

Session on high impact weather in urban areas (chair: P. Knippertz)

13:30-14:00 From urban meteorology, climate and environment research to integrated city services (S. Grimmond - Keynote)
14:00-14:15 SURF: Understanding and predicting urban convection and haze (X. Liang)
14:15-14:30 Urban-rural temperature differences in Lagos metropolis using geospatial techniques and insitu observation (O. Vincent)
14:30-14:45 Characterization of rainfall events and correlation with reported disasters: a case in Cali, Colombia (C. Canon-Barriga)

14:45-15:30 *Coffee break*

15:30-15:45 High-resolution forecasts and radar observations of the 7 June 2016 Hamburg tornado (P. Hoffmann)
15:45-16:00 Discussion (buffer)
16:00-17:00 Discussion on link to urban and environmental prediction (chair: S. Grimmond)
17:00- Further discussions and networking

Thursday 12th October 2017

Session on cloud and PBL processes (chair: P. Steinle)

09:00-09:30 Sub-kilometer Challenges in Convective Boundary-layer Modeling (J. Dudhia - Keynote)
09:30-09:45 Variability and clustering of mid-latitude summertime convection (S. Rasp)
09:45-10:00 Impact of idealized soil moisture heterogeneity on deep convection (F. Baur)
10:00-10:15 Sensitivity of clouds and precipitation to surface inhomogeneities under different synoptic conditions over Germany (L. Schneider)

10:15-10:30	Physically based stochastic perturbations in the boundary layer to represent precipitation and streamflow forecast uncertainty with WRF-Hydro (J. Arnault)
10:30-10:45	Predictability of ice clouds (P. Spichtinger)
10:45-11:15	Discussion (buffer)
11:15-11:45	*Coffee break*
11:45-12:45	Discussion on HIW areas requiring further efforts (chairs: G. Craig and J. Sun; introductory talk and discussion on overview/review paper(s))
12:45-14:00	*Lunch buffet*
14:00	*End of the conference*

Keynote presentations

George C. Craig *Monday 9th, 12:20-12:50*
(Meteorological institute, Ludwig-Maximilians University, Munich Germany)

Title: Overview of Wavec to Weather (W2W)

Abstract:
Waves to Weather (W2W) is a Collaborative Research Center, funded by the German Research Foundation to investigate the limits of predictability and contribute to the scientific foundation of improved forecasting of high impact weather. With over 20 principal investigators and a potential duration of 12 years, W2W represents a major commitment of resources within Germany and an opportunity to contribute strongly to the international community, especially to the HIWeather program of the WWRP. This presentation will give a brief outline of the W2W initiative, present some key scientific results from the first two years, and highlight the potential for cooperation with researchers worldwide.

Bruce Macpherson *Monday 9th, 12:50-13:20*
(Met Office, UK)

Title: The new hourly 4D-Var system for the Met Office operational convective-scale UKV model

Abstract:
In July 2017, the Met Office implemented a new hourly 4D-Variational data assimilation system for its convective-scale UKV model, replacing the previous 3-hourly 3D-Variational system. We will discuss the motivations, challenges, compromises and practical solutions which were required to achieve a single affordable system which can adequately address ‘nowcasting’ and ‘next day’ forecast timescales. We will also outline plans to improve the coupling of this deterministic system with our convective-scale ensemble forecasting system.

Ulrich Blahak *Monday 9th, 16:00-16:30*
(Deutscher Wetterdienst, Germany)

Title: SINFONY - Development of a new seamless prediction system for very short range convective-scale forecasting at DWD

Co-authors: Roland Potthast, Kathrin Wapler, Axel Seifert, Alberto De Lozar, Elisabeth Bauernschubert, Christian Welzbacher, Robert Feger, Lisa Neef, Liselotte Bach, Martin Rempel, Michael Hoff, Markus Junk

Abstract:
At DWD a new internal project has been set up to develop its future seamless ensemble prediction system for storm-scale forecasting from observation time up to +6h/+12h forecasts. The focus is on severe summertime convective events with their associated hazards (heavy precipitation, hail, wind gusts, etc.).

Up to now, for the first 1-2h this relies mostly on observation-based nowcasting products, whereas convection-allowing ensemble NWP (COSMO-DE-EPS) is only able to reach/outperform the quality of nowcasting at later times. New NWP forecasts are started only every 3 h and after a rather long cut-off time to wait for incoming observational data.
Moreover, nowcasting and ensemble NWP are treated as two separate and independent methods, and there are few common products available for the forecasters.

The goal of the new project is to narrow down these gaps, on the one hand by enhancements to both nowcasting and NWP separately and on the other hand by mutual information exchange and combination, to further enhance the quality of both. High-resolution observational data (radar, satellite, lightning, GPS-derived moisture, etc.) will be exploited. We consider in particular:
- Nowcasting ensembles, ensembles of "objects", also informed by uncertainties from NWP
- Life cycle in nowcasting, informed by radar, lightning and satellite data and by informations from ensemble-NWP
- Rapid Update Cycle (RUC) ensemble NWP: 1-km-scale, LETKF, hourly update, ~40 members, advanced model physics (2-moment microphysics including hail, 3D-turbulence)
- LETKF assimilation in ensemble NWP in observation space of:
    - 3D-radar-data (native observations as well as nowcast "objects")
    - Meteosat SEVIRI IR and VIS satellite data
    - Lightning flash densities using the Lightning Potential Index as a forward operator
- New products combining nowcasting and NWP ensemble information in a probabilistic way for our forecasters

This project has been started in early 2017 and the presentation will give an overview on the plans and present results of first case studies.

Hannah Christensen *Tuesday 10th, 09:00-09:30*
(NCAR, USA)

Title: Improving Stochastic Parametrization Schemes using High-resolution Model Simulations

Abstract:
Stochastic parametrization schemes are used in NWP to represent uncertainty in the forecast due to unresolved processes. Whereas traditional deterministic parametrization assumes the existence of a scale separation between the resolved and unresolved scales, stochastic schemes acknowledge that in reality this scale separation does not exist. Instead the sub-grid scales are represented as a combination of a predictable deterministic component and an unpredictable stochastic component. Within this framework, memory and spatial correlations can be included, explicitly representing the impact of sub-grid processes on scales above the

truncation scale, and thereby the transfer of errors from sub-grid to larger scales.

In this presentation I will give some background on the use of stochastic parameterizations in NWP, and the variety of approaches that have been proposed. I will discuss the use of high-resolution model simulations to learn about the form these stochastic schemes should take in order to skilfully represent unresolved variability. This methodology can also be used to motivate improvements to existing stochastic schemes, and I will finish by proposing one such improvement. This is shown to benefit forecast skill for a set of cases in which the synoptic initial conditions were more likely to result in a European 'forecast bust'.

Brian Golding *Tuesday 10th, 14:00-14:30*
(Met Office, UK)

Title: HIWeather: Predicting & Warning Weather-Related Hazards (B. Golding)

Abstract:
The introduction of km-scale convection-permitting Numerical Weather Prediction models has produced a step change in weather forecast guidance. However, current results give only glimpses of what ought to be achievable. With focused efforts by meteorologists in partnership with other physical and social scientists, this breakthrough can produce a revolution in weather-related hazard warnings, saving millions of lives, worldwide. The World Meteorological Organisation's High Impact Weather project (HIWeather) has identified challenges in the forecasting and warning production and delivery chain, which it aims to facilitate research into. Concentrating on short duration hazards, the project's five research pillars address weather processes, hazard modelling, impact modelling, warning communication and evaluation. In my talk, I shall give an overview of HIWeather, its achievements and its plans, focusing on challenges in km-scale prediction in the context of the requirements of decision makers.

Tilmann Gneiting *Tuesday 10th, 14:30-15:00*
(Heidelberg Institute for Theoretical Studies, Germany)

Title: Statistical post-processing of ensemble weather forecasts

Abstract:
Ensemble prediction systems typically are biased and uncalibrated, and so they benefit from statistical post-processing. I will review state-of-the-art approaches for doing this, such as Bayesian model averaging (BMA) and ensemble model output statistics (EMOS) or heterogeneous regression. A major challenges lies in the modeling of physically realistic inter-variable, spatial, and temporal dependence structures in postprocessed forecast fields, for which ensemble copula coupling (ECC) and the Schaake shuffle are attractive options.

Linus Magnusson *Wednesday 11th, 09:00-09:30*
(European Centre for Medium-range Weather Forecasts, UK)

Title: Multi-scale predictability of severe weather from a diagnostic perspective

Abstract:
Predicting high-impact weather events is a crucial task for forecasting centres and is clearly a multi-scale issue. On the subseasonal time-scale, the aim is to predict flow-regimes that have higher likelihood of extreme events. In the medium-range the challenge is to predict the timing, position and duration of the event. However, for some types of extreme weather it is still difficult for current models to capture the intensity even at the shortest scales.
As extreme events by nature are rare, and each case is unique, a statistical evaluation is not straightforward. It is therefore necessary to identify key features for the development of the extreme events that are possible to verify and to identify where also less extreme cases will be useful.
In the presentation I will give examples of high-impact events to demonstrate the challenges in sub-seasonal, medium-range and short-range predictions and what type of signals are expected. I will give example of evaluation and diagnostics that can be undertaken to better understand the predictability and limitations of the capability.

Juan Jose Ruiz *Wednesday 11th, 11:45-12:15*
(Centro de Investigaciones del Mar y la Atmosfera, Buenos Aires, Argentina and Univ. of Buenos Aires, Argentina)

Title: Improving high impact weather and climate prediction for societal resilience in Subtropical South America: Proyecto RELAMPAGO-CACTI

Co-authors: Stephen W Nesbitt (Univ. of Illinois at Urbana Champaign, USA), Paola Veronica Salio (Centro de Investigaciones del Mar y la Atmosfera, Buenos Aires, Argentina and Univ. of Buenos Aires, Atmospheric and Oceanic Sciences, Argentina), Adam Varble (Univ. of Utah, USA), Robert Jeffrey Trapp (Univ. of Illinois at Urbana Champaign, USA), Rita R Roberts (NCAR, USA), Francina Dominguez (Univ. of Illinois at Urbana Champaign, USA), Luiz Machado (INPE National Institute for Space Research, Sao Jose dos Campos, Brazil), and Celeste Saulo (Servicio Meteorológico Nacional, Buenos Aires, Argentina)

Abstract:
Subtropical South America is host to many types of weather and climate hazards. The convective systems that initiate near and apart from the complex terrain of the Andes and Sierras de Córdoba are by many measures the most intense in the world, producing hazards such as damaging winds, hail, tornadoes, extreme and unusual lightning behavior, and flash and riverine flooding. These systems are modulated by interannual, intraseasonal, and synoptic drivers, however multi-scale models suffer from extreme biases in low level temperature and humidity due to their poor representation of organized convection and representation of convection near complex terrain, which hampers predictive skill of relevant processes across all timescales.

To address these cross-cutting issues, we have proposed a large, multi-agency international field campaign called RELAMPAGO-CACTI, which will address key gaps in physical process understanding in the production of convective storms in this region. RELAMPAGO (Remote sensing of Electrification, Lightning, And Mesoscale/microscale Processes with Adaptive Ground Observations) will be a 24-month hydrological meteorological field campaign, with an intensive observing period 1 Nov – 15 Dec 2018 in the near the Sierras de Córdoba (SDC), the Andes foothills near Mendoza, and the region near São Borja, Brazil. A complementary funded 7-month U.S. Department of Energy field campaign called Clouds, Aerosols, and Complex Terrain Interactions (CACTI), which will focus on detailed observations of cloud and aerosol lifecycle near the SDC while an intensive observing period featuring aircraft observations will match RELAMPAGO's. While collecting the observations will enhance knowledge of the processes acting to modulate extremes in the region, a coordinated modeling effort will aim to evaluate coupled weather, climate, and hydrologic models using RELAMPAGO-CACTI observations. In addition, partnerships with the Servicio Meteorológico Nacional (SMN) of Argentina and Brazil's Centro de Previsão de Tempo e Estudos Climáticos (CPTEC), as well as related international and local societal impacts projects such as the World Meteorological Organization's High-Impact Weather project will enable improved end-to-end impacts predictions in this vulnerable region.

Sue Grimmond *Wednesday 11th, 13:30-14:00*
(University of Reading, UK)

Title: From urban meteorology, climate and environment research to integrated city services

Co-authors: A. Baklanov, V. Bouchet, Luisa Molina; Gufran Beig; Heinke Schluenzen, Jhoon Kim, Pablo Saide, Jianguo Tan, Ranjeet Sokhi, Paulo Saldiva, D. Terblanche, X. Tang

Abstract:
Accelerating urban population growth, especially in developing countries, has become a driving force of human development. Crowded cities are centers of creativity and economic progress, but polluted air, flooding and other climate impacts mean urban environments also face significant weather, climate and environment-related challenges. Increasingly dense, complex and interdependent urban systems make cities vulnerable: a single extreme event can lead to a widespread breakdown of a city's infrastructure often through domino effects. Many organizations, including the World Meteorological Organization (WMO), recognize that rapid urbanization necessitates new types of services which make the best use of science and technology. Such Integrated Urban Weather, Environment and Climate Services should assist cities in facing hazards such as storm surges, flooding, heat waves, and air pollution episodes, especially in changing climates. The aim is to develop urban services that meet the special needs of cities through a combination of dense observation networks, high-resolution forecasts, and multi-hazard early warning systems, and long-term urban climate projections and modeling for urban planning for sustainable and resilient cities. A number of recent international studies have been initiated to explore these issues. This presentation will provide a brief overview of recent research programs and activities in urban hydrometeorology, climate and air pollution; describe the novel concept of urban integrated weather, climate and environment related services; and highlights research needs for their realization.

Jimy Dudhia
(NCAR, Boulder, USA)

Thursday 12th, 09:00-09:30

Title: Sub-kilometer Challenges in Convective Boundary-layer Modeling

Abstract:
The primary scales of transport in the convective boundary layer are below the grid scale of typical NWP models and have to be parameterized. However, even at 1 km grid sizes, some differences emerge in how different treatments of the sub-grid scale affect grid-scale structures that may be important for the forecast. This talk will outline how PBL parameterizations of various types handle being run at higher resolutions down to sub-kilometer scales, and will infer from LES simulations what a more correct behavior should be. Schemes are now being proposed to work more correctly across this so-called grey zone between the parameterization of, and resolving, the primary eddies.

Poster session

Monday 9th, 14:35-16:00

The posters will be displayed during the whole conference.

Session on multi-scale prediction systems

- An additive scheme for treating model error in ensemble Kalman filter (T. Janjic-Pfander)
- Ensemble-Type Kalman Filter Algorithm conserving Mass, Total Energy and Enstrophy (Y. Zeng)

Session on scale interactions and error growth

- Mesoscale dynamical regimes in the midlatitudes (G. C. Craig)
- Amplification of the Downstream Wave Train during Extratropical Transition: Sensitivity Studies (J. Keller)
- Storm structure, tropopause evolution, and associated predictability during the extratropical transition of Karl (2016) (M. Riemer)
- Development of a predictability index for heavy precipitation (F. Grazzini)
- The downstream impact of dropsonde and extra radiosonde observations conducted during the NAWDEX field campaign in 2016 (M. Schindler)
- The North Atlantic Waveguide and Downstream Impact Experiment (NAWDEX) (A. Schäfler)

Session on probabilistic forecasting and statistical post-processing methods

- On the multiday time evolution of ensemble variance: Case studies with the COSMO-E ensemble (C. Klasa)
- Early warning products for severe weather events derived from operational medium-range ensemble forecasts (M. Matsueda)
- High Impact Weather Prediction over Central and West Africa using WRF-Var Model: A case study (P. Moudi Igri)
- Predicting the Probability of Lightning Occurrence with Generalized Additive Models (T. Simon)
- Observation impact in a six-week high impact weather period (T. Necker)

Session on extreme weather events

- Simulating impacts of extreme climate events on urban infrastructure and energy demand over the West Africa Sahel (A. L. Bonkaney)
- Changes in summer wind and convective precipitation over the UK and Europe from a regional weather simulation: a case study (A. Gadian)
- High Resolution Numerical Modeling of a distinct Extreme Weather Event “Cold Surges” over South China (A. Kumar)
- Synoptic Analysis and Hindcast of an Intense Bow Echo in Western Europe: The 9 June 2014 Storm (L. Mathias)
- Evaluation of moisture sources for the Central European summer flood of May/June 2013 based on regional climate model simulations (J. Pinto)
- Formation of a sting-jet during "Christian" (P. Arbogast)
- Identification of tropical-extratropical interactions and extreme precipitation events in the Middle East based on potential vorticity and moisture transport (A.J. de Vries)

- High Impact Weather forced by Ex-Sanchez (NAWDEX IOP11) (C. Keil)

Session on cloud and PBL processes

- Parameter estimation for an improved representation of clouds (Y. Ruckstuhl)
- Assimilation of cloud-affected radiances in deep convection: a case study (J. Schröttle)
- Aerosol cloud interaction in deep convective clouds over the Indian peninsula using Spectral (bin) Microphysics (G. Urankar)

Others

- Waves to Weather – a collaborative research center with a decadal trajectory of DFG-funding (H. Volkert)