HIWeather

WWRP
World Weather Research Programme

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Dear Colleagues,

After several years of co-leading the Communication Task Team, I am excited to be taking on the role of co-chair of HIWeather with Brian Golding. I'd like to thank David Johnston, who has stepped down as co-chair, for his valuable contribution and guidance to HIWeather since the programme was initiated.

As a social scientist in New Zealand, I conduct research on behavioural response to warnings and how to communicate forecasts and warnings more effectively. I research impact-based severe weather warning systems, as well as conducting research on forecasts for geohazards. I am fortunate to be in a position to then directly apply the results to improve our forecasts. Recently I became co-located with an emergency management team and have been learning about how they use our forecasts, and generally more about their context and decision-making. By strengthening this relationship between scientists and practitioners, I know that our forecasts and science advice information will improve further.

Building relationships to strengthen communication is a key part of the book we have been working on for HIWeather. The writing is progressing nicely, and I'm looking forward to seeing the final versions of the chapters coming together. I encourage you to read more about the book, the citizen science project, and the value chain project in this newsletter and in previous editions. I love it how these activities and HIWeather in general bring together such a diverse array of people from across so many disciplines, to build relationships, awareness and understanding of each other's areas of expertise. I'm looking forward to learning more about other groups within the WMO and seeing how we can build our connections and develop pathways to implementation. By doing this, I hope that our research is useful, usable and used, and can contribute towards reducing the risk of high impact weather.

Best Wishes

Sally Potter

Co-Chair

CONTENTS

Citizen Science project:
Submissions for the special issue of the Australasian Journal of Disaster and Trauma Studies are now due. Submission details are available at: http://trauma.massey.ac.nz/.
The survey of citizen science projects is open at
https://massey.au1.qualtrics.com/jfe/form/SV_aaWCTHai8RFzBqI. Please add details of your project.

Warning Value Chain project:
We are developing an inventory of existing examples of where the value chain has been applied, based on a systematic review of academic and grey literature and workshops. If you know of relevant reports in peer reviewed journals or in the grey literature, please could you forward them to the project office at hiwico@cma.gov.cn

HIWeather Endorsement:
The Steering Group (SG) of the High Impact Weather (HIWeather) Project provides endorsement for projects, programs and initiatives that plan to contribute to the goals of HIWeather as outlined in the HIWeather Implementation Plan. Projects seeking endorsement through HIWeather may either be funded or in the process of seeking funding. (More information: http://hiweather.net/Lists/16.html)

Twitter users:
We would like to invite those who use Twitter to communicate about HIWeather relevant topics to use the hashtag #hiweather.

- **FESSTVal Hybrid Summer School**: 17 May – 7 August 2021, Lindenberg, Germany and online. Website http://fesstval.de/concept. Applications closed.

- **CMOS 55th Congress,** 31 May – 11 June, online Website: https://congress.cmos.ca/. Abstract submission closed. Registration open.

- **RMetS Annual Science Conference:** 22 June, 6 July & 21 September, online Website: https://www.rmets.org/event/asc2021. Abstract submission closed. Registration open.

- **IACS/IAMAS/IAPSO assembly:** 19-23 July, online Website: https://cryosphericsciences.org/vaco-21/ Free registration open.

- **AOGS Annual Meeting**: 1-6 August 2021, online. Website: https://www.asiaoceania.org/aogs2021/ Abstract submission closed. Early registration until 18 May.

- **AOGS-EGU Joint Conference NatHazards2021**: 20-22 September 2021, online. Abstract deadline: 1 June, 2021 Registration deadline: 10 August 2021 Website: http://nathazards.org/

- **AMS 30th Conference on Severe Local Storms**: 18-22 October 2021, Santa Fe, NM. Abstract Deadline: 14 June, 2021. Registration open August. Website: https://www.ametsoc.org/30th-conference-on-severe-local-storms1/

- **AGU Fall Meeting**: 13-17 December 2021, New Orleans, New Orleans LA, United States and online. Abstract Deadline: 4 August. Website: https://fallmeeting.agu.org/

HIWEATHER CITIZEN SCIENCE PROJECT

Citizen science is a broad term that encompasses various types of projects where the public (citizens) work with agencies and academic researchers to undertake scientific research. Citizen science has its beginnings in the physical sciences but has expanded to other areas, including natural hazard research. The motivations, design, and outputs of citizen science projects vary widely. Some projects are highly participatory, where the citizens are involved in the project design, data collection, and analysis. In others, citizens only provide data to projects designed and coordinated solely by the science agencies. Both ends of this spectrum are useful for creating new scientific outputs and enhancing citizen involvement in science. With many new and ongoing citizen projects planned or underway within the High Impact Weather community, this project is designed to share information and provide tools to help groups and agencies develop new activities.

PLANNED ACTIVITIES FOR 2021

DEMONSTRATION PROJECTS

The survey from 2020 provided insights of many citizen science projects currently happening in the HIWeather space. Not all citizen science projects have formal websites or have been officially published. Some projects may not necessarily have the chance to share their research outputs and their innovative methods. This activity aims to provide a platform for citizen science projects to be showcased through HIWeather supported web platforms. Starting mid-year, HIWeather web platforms will showcase citizen science projects regularly. Projects will be scoped out by the team highlighting innovative citizen science initiatives. An open call for groups to submit content, as part of a grand challenge, may also be administered. The demonstration projects will be part of an inventory collection featured in the HIWeather website.

From the HIWeather 2020 Workshop, several participants have expressed their interest to hear from the citizens of citizen science. Part of this demonstration projects activity will look at ways to also highlight citizen's contributions and stories. An aspect that can be included will be features on citizens and their experiences in participating in projects through compilation of stories that can be published online as written or video features.

PUBLICATION OF GUIDANCE NOTE

We plan to publish the guidance note by the end of 2021.

PUBLICATION OF JOURNAL SPECIAL ISSUE

We plan to publish the special issue by the end of 2021.

WEBINARS AND WORKSHOPS

HIWeather Citizen Science Working Group will maintain the partnership with YESS-Community to deliver webinars or workshops. The group will continue to explore a range of workshops/ conferences/ training opportunities through 2021 on citizen science, aimed at sharing practice, creating new networks for knowledge sharing and collaboration.

RELATED LINKS

Concept note of the webinar series with YESS Community on 'Exploring the role of citizen science in weather, climate, and related projects. https://www.yess-community.org/yesscomm_wp/wp-content/uploads/2020/11/YESSHIW-webinar-series.pdf

Compilation of the video recordings of the five sessions of the webinar series with YESS Community on 'Exploring the role of citizen science in weather, climate, and related projects. https://www.yess-community.org/yess-hiweather-webinar-series/

Compilation of the video recording of the 'Successful Citizen Science' presentations during the 2020 HIWeather Workshop. https://drive.google.com/drive/folders/1EoumyYGRCHFxW5cSp483krWR7xmw0dk5?usp=sharing

HIWEATHER VALUE CHAIN PROJECT

Effective warnings of weather-related hazards result from the successful interaction of many people and organisations, each contributing their specific capability and knowledge of the weather and associated hazards, impacts, communication, decision making processes, and ultimately community benefit. The information value chain provides a framework for characterising the production, communication, and use of warnings in terms of its processes, inputs and outputs, relationships, contributions, and operational contexts of stakeholders. Measuring and evaluating the effectiveness of information added and exchanged along the warning chain can help to identify where improvements could significantly contribute to reduced economical and societal losses from natural disasters. This project aims to

- review value chain practices used to describe and understand weather, warning and climate services
- assess and provide guidance on how to effectively apply value chains in a weather warning context involving multiple users and partnerships, and
- generate an easily accessible means for scientists and practitioners involved in researching, designing, and evaluating weather-related warning systems to review relevant previous experience and assess their efficacy using value chain approaches.
- analyse the warning chain data to understand, revise and extend best practice in warning processes.

The project will focus on warning chains for the hazards identified in the HIWeather Implementation Plan: urban flood, wildfire, localised extreme wind, disruptive winter weather, and urban heat waves and air pollution.

Analysing the end-to-end warning chain requires a multi-disciplinary research project that integrates physical and social sciences with practitioner perspectives. Leading researchers in the WWRP HIWeather project and Societal and Economic Research Applications (SERA) working group bring relevant expertise on state-of-the-art weather and hazard prediction, warning communication, and economic analysis. External partners from the academic, emergency management and private sectors provide additional richness of knowledge and experience needed to successfully achieve the aims.

Subject to obtaining the required funding, the project is working to the following timescales:
- Glossary of value chain and warning chain terminology in a hydrometeorological context: end 2021
- High-level value chain framework tool for decision makers: end 2022
- Guidance and tools for more specific and context-appropriate usage of value chain approaches: end 2022
- Initial catalogue of HIW events: end 2022
- A living database of hazardous weather events with rich information covering (as much as possible) the components of the forecast and warning value chain. Full release: end 2024
- Analysis and advice on best practice warning value chains (from simple to complex) analysed from the database. Publication: end 2024
- Exchange and integration of practical experiences (NMHSs and partners) and weather-related natural, social, and interdisciplinary science (research community): through workshops in 2021 and 2023.
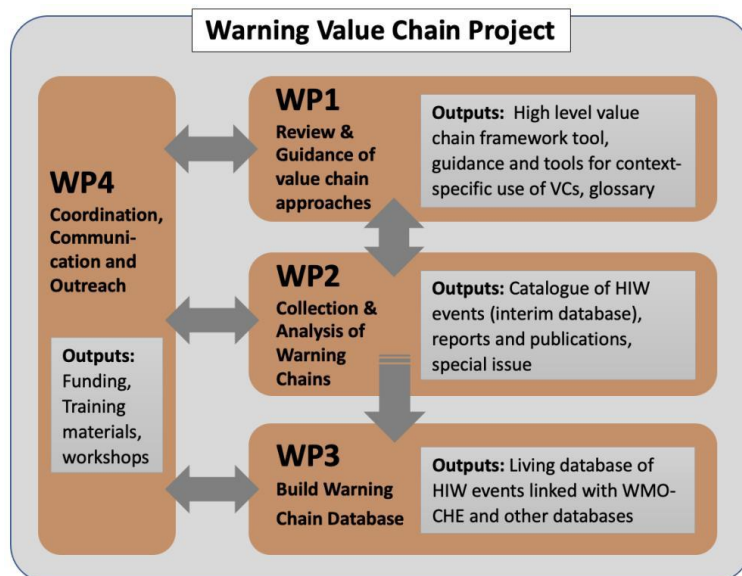
HIWEATHER BOOK: "TOWARDS THE PERFECT WARNING"

HIWeather is working with Springer publishers to bring out a book that summarises current and emerging good practice in the production and communication of weather-related warnings. Titled "Towards the perfect warning: bridging disciplinary gaps through partnership and communication", the book aims to take a whole-system approach, emphasising the essential role of partnership in delivering the information needed for the user to make critical decisions. The book is aimed primarily at emergency management professionals, including those in weather services and related environmental protection bodies who contribute to the production of warnings. It will also provide a valuable pedagogical resource for those studying or training in disaster risk reduction. The structure of the book is built around the five "valleys of death" in the HIWeather warning chain concept (see Zhang et al, 2019, Increasing the value of weather-related warnings, Science bulletin, 64, 647-649 *http://hiweather.net/Uploads/ue/file/20190723/1563869466819765.pdf*). The book consists of:

1   Introduction

2   Early warning systems & their role in disaster risk reduction

3   From warning to decision/action - a partnership of communicators and decision-makers – turning a message into a protective action

4   From impact forecast to warning - a partnership of scientists and communicators - turning information into an actionable message

5   From hazard to impact - a partnership of physical and social scientists – observing and modelling impacts that result from weather-related hazards

6   From weather to hazard – a partnership of physical scientists in connected disciplines – observing and modelling weather-related hazards

7   Bridging the fifth valley – a partnership of observation scientists with forecasters – observing and modelling the weather

8   End-to-end partnerships – linking the whole chain together to reduce the impact of weather-related hazards

The writing of each chapter is being led by a coordinating author, and there are currently 47 contributing authors. A complete draft of the book is currently being reviewed prior to submission in June.

PROCESSES & PREDICTABILITY

P&P	NAWDEX (North Atlantic Waveguide and Downstream Impacts Experiment)
	Multi-scale, multi-leadtime predictability of high-impact weather
	RELAMPAGO-CACTI (Remote sensing of Electrification, Lightning, And Meso-scale/micro-scale Processes with Adaptive Ground Observations - Cloud Aerosols and Complex Terrain Interactions)
	SCMREX (Southern China Monsoon Rainfall Experiment)
	FESSTVaL (Field Experiment on submesoscale spatio-temporal variability in Lindenberg)
	PRECIP (Prediction of Rainfall Extremes Campaign in the Pacific)

NAWDEX (NORTH ATLANTIC WAVEGUIDE AND DOWNSTREAM IMPACTS EXPERIMENT)

Lead: Andreas Schäfler

About 45 participants from the USA, Canada, the UK, Switzerland, France, Norway, the Netherlands and Germany took part in the 4th NAWDEX workshop from 8-9 March 2021 online. The latest results using the NAWDEX observational database were presented and next steps beyond NAWDEX were discussed. Read more about this workshop here: *https://www.wavestoweather.de/meetings/nawdex-workshop_2021*).

MULTI-SCALE, MULTI-LEAD TIME PREDICTABILITY OF HIGH-IMPACT WEATHER

Leads: Shira Raveh-Rubin, Linus Magnusson, Michael Riemer

Objectives: Assess the predictability of different ingredients to HIW events as a function of lead time and identify the physical processes that limit predictability (see *Di Muzio et al, 2019* for tropical-cyclone-like Mediterranean cyclones). In collaboration with the Multiscale Forecasting theme, assess the role of assimilating high-resolution data to capture the mesoscale dynamics and improve short-term prediction. Starting with high-impact weather related to dry intrusions (*Catto and Ravel-Rubin, 2019*; *Ravel-Rubin and Catto, 2019*), develop general recommendations how to assess this insight for other types of high-impact weather.

Linus Magnusson finalized his report: ECMWF Severe Event Catalogue for Evaluation of Multi-scale Prediction of Extreme Weather, which can be found here: *https://www.ecmwf.int/en/elibrary/19230-ecmwf-severe-event-catalogue-evaluation-multi-scale-prediction-extreme-weather*

In the spring issue of ECMWF Newsletter, an article about the February storms in north-western Europe highlighted new forecast products for extreme weather on various time scales: *https://www.ecmwf.int/en/newsletter/163/news/forecasting-februarys-wet-and-stormy-weather-parts-europe*, and the upcoming ECMWF newsletter will feature an article on the record-breaking snowfall in Spain in January. In addition, predictability issues with the severe cold spell in North America this February are reported here: *https://confluence.ecmwf.int/display/FCST/202102+-+Cold+spell+-+US*.

This activity is now mainly directed towards the Value Chain project (see above).

RELAMPAGO-CACTI

Remote sensing of Electrification, Lightning, And Meso-scale/micro-scale Processes with Adaptive Ground Observations - Cloud Aerosols and Complex Terrain Interactions

RELAMPAGO was funded by the US National Science Foundation to observe convective storms that produce high impact weather in the lee of the Andes in Argentina. It also involves contributions from NASA, NOAA, Argentina (MINyCT), Brazil (CNPq and FAPESP), Chile (CONICYT), universities across the region, Argentina's national meteorological service (SMN) and Brazil's space agency (INPE). Observations during the main observing period, Nov-Dec 2018, successfully captured many storms. See press report at: *https://www.abc.net.au/news/2019-01-23/weather-scientists-find-one-of-worlds-largest-hail-stones/10735666*

SCMREX (SOUTHERN CHINA MONSOON RAINFALL EXPERIMENT)

Lead: Yali Luo

Despite some impacts of the COVID-19, the 2020 field campaign of the Southern China Monsoon Rainfall Experiment (SCMREX) was successfully carried out, with the IOP running continuously from 1 May to 30 June, 2020. The most recent research progresses of SCMREX were reported at the virtual meeting of WMO/WWRP Working Group on Tropical Meteorological Research (WGTMR) on 14 July 2020. It was planned that during the Third Phase of SCMREX (2021-2024), field campaigns, physical mechanism studies and NWP studies will continue with the improved observing capability and adjusted research focuses. The physical mechanism studies will make more efforts to unravel the interactions of aerosol-convection-precipitation and the independent/interactive influences of complicated surface (i.e., cities, topography, and water), and also to examine the research results in a broader context by comparing with other regions. The NWP studies will further the polarization radar data assimilation, improving model physics schemes, and developing perturbation methods for ensemble forecast at the convection-permitting resolutions.

FESSTVAL (FIELD EXPERIMENT ON SUBMESOSCALE SPATIO-TEMPORAL VARIABILITY IN LINDENBERG)

Lead: Linda Schlemmer

FESSTVaL has been initiated by the Hans-Ertel-Center for Weather Research and was planned to take place in the summer months of the year 2020 at the Meteorological Observatory Lindenberg - Richard-Aßmann-Observatorium (MOL-RAO) of the German Weatherservice (DWD) near Berlin. To identify the sources of sub-mesoscale variability, the measurement campaign focuses on three main aspects: atmospheric boundary layer structures, cold pools, and gusts of wind. In order to capture phenomena at the submesoscale (500 m – 5 km), a hierarchical measurement strategy will be realized. This includes wind profiling stations with several coordinated Doppler Lidars, two mobile thermodynamic profilers, more than 100 stations with near-surface measurements, more than 20 automatic weather stations, an X-Band radar, and a number of energy balance stations. This equipment is supplemented by the extensive ground-based remote sensing array at the MOL-RAO. Complementing to this, the added value of a citizen-science measurement network is investigated during the campaign with "Internet-of-things" based technology and low-cost sensors build and maintained by citizens. The FESSTVaL measurements will be complemented by high-resolution large-eddy simulations (ICON-LES).

From May 17th to July 31st 2021 measurements will be carried out at the MOL-RAO in Lindenberg and in the vicinity. The intensive measurement period (IOP) runs from June 7th to July 2nd. The associated summer school has a special format: small groups of students will take part on site, while a series of lectures will take place throughout the period. Progress can be followed at blog and daily quick looks, about the current events. Every Monday at 5 p.m. there is a lecture that deals with a variety of topics from the research area. This is open to anyone interested. See http://fesstval.de/en/

PRECIP

Lead: Rob Rogers

The U.S. NSF has recently funded a project entitled **Prediction of Rainfall Extremes Campaign in the Pacific (PRECIP)**, led by Michael Bell and Kristen Rasmussen (Colorado State University), which seeks to improve the fundamental understanding and predictability of the processes that produce extreme precipitation through an ingredients-based physical framework. Research observations will be collected during four event types that meet a global definition of 'extreme' rainfall across the spectrum of rainfall intensity and duration: (1) deep convective cores, (2) wide convective cores, (3) broad stratiform regions, and (4) tropical cyclones (TCs; termed "typhoons" in the West Pacific).

PRECIP will be conducted in collaboration with the Taiwan-area Atmospheric and Hydrological Observation and Prediction Experiment (TAHOPE) and Japanese Tropical cyclones-Pacific Asian Research Campaign for Improvement of Intensity estimations/forecasts (T-PARCII). Ground-based assets involved in data collection include dual-frequency/dual-polarization radar, disdrometers, and profilers, while airborne assets include the Taiwanese Dotstar and Japanese G-II aircraft. The NOAA P-3 aircraft will not be available for airborne missions in support of this campaign next year. Due to COVID concerns, The field phase is delayed to 25 May-10 August 2022.

See https://www.eol.ucar.edu/field_projects/precip

MULTI-SCALE HAZARD FORECASTING

MSF	MOUNTAOM (RDP alongside the 2022 Winter Olympic Games in Beijing)
	Review the current state of nowcasting & forecasting high impact weather
	Intercomparison of km-scale DA & nowcast/forecast systems
	SURF (Study of Urban Rainfall and fog/haze)
	ICE-POP2018 (RDP/FDP alongside the Pyeongchang Winter Olympic Games in South Korea)
	UK Environmental Prediction (UKEP) project

MOUNTAOM (RDP ALONGSIDE THE 2022 WINTER OLYMPIC GAMES IN BEIJING)

China will host the 2022 Winter Olympic Games in the mountains to the northwest of Beijing. A research activity is underway in the Chinese Meteorological Administration to develop capability in forecasting the relevant weather parameters in this area. The project has six research themes. Annual field programmes have been conducted in preparation, the first of which was held in winter 2017. LES modelling experiments are being conducted with nested grids from 1km down to 37m. The project has an International Advisory Committee, the chair of which is Prof Joe Fernando.

REVIEW THE CURRENT STATE OF NOWCASTING & FORECASTING HIGH IMPACT WEATHER

Lead: Sharan Majumdar

A review of the current state of high impact weather nowcasting/forecasting with an emphasis on flood and high wind warnings has been published by BAMS, see
https://journals.ametsoc.org/view/journals/bams/aop/bamsD200111/bamsD200111.xml

INTERCOMPARISON OF KM-SCALE DA & NOWCAST/FORECAST SYSTEMS

Lead: Jenny Sun

Objectives: Demonstrate state-of-the-art of km-scale DA & nowcast/NWP systems for HIW warning with an emphasis on floods & high winds.

Discussion continue with DAOS on how best to achieve this objective.

SURF (STUDY OF URBAN RAINFALL AND FOG/HAZE)

Lead: Miao Shiguang (CMA/IUM). Linked to HIWeather through GURME and the MSF task team

The Institute of Urban Meteorology is carrying out the SURF field experiment to study urban pollution and extreme precipitation in Beijing.

ICE-POP2018 (RDP/FDP ALONGSIDE THE PYEONGCHANG WINTER OLYMPIC GAMES IN SOUTH KOREA)

Led by KMA and linked to HIWeather through the WGNMR and MSF task team the IOP period is complete. See the science plan at https://gpm.nasa.gov/sites/default/files/document_files/08%20ICEPOP2018_plan.pdf

UK ENVIRONMENTAL PREDICTION (UKEP) PROJECT

Lead: Huw Lewis

The UK Environmental Prediction initiative is a national collaboration led by the Met Office, *Centre for Ecology & Hydrology*, *National Oceanography Centre* and *Plymouth Marine Laboratory*. It develops and evaluates the UK's first fully coupled regional prediction system at kilometre scale, encompassing atmosphere, ocean, wave, land surface, and biogeochemistry model components and their interactions. The aim of the initiative is to enable multi-disciplinary research on Earth system processes at high resolution and to improve future operational applications. One of the exciting aspects of working with coupled systems, is the need to join together and share different perspectives and expertise from across weather and climate, marine and hydrological science disciplines. For further information on the UK Environmental Prediction collaboration, contact huw.lewis@metoffice.gov.uk or visit
https://www.metoffice.gov.uk/research/approach/collaboration/ukenvironmentalprediction

HUMAN IMPACTS, VULNERABILITY & RISK

HIVR	Formal (statistical) impact model intercomparison
	Impact data collection
	Review & classification of impact modelling

FORMAL (STATISTICAL) IMPACT MODEL INTERCOMPARISON

Lead: Martin Goeber

Develop Masters student module to examine simple and physically-based impact models

IMPACT DATA COLLECTION

Leads: Joanne Robbins and Rainer Kaltenberger

A review paper is being prepared on how met services collect and use impact data.

REVIEW & CLASSIFICATION OF IMPACT MODELLING

Leads: Brian Mills & HIVR task team

An outline has been agreed and writing of the chapter on disruptive winter weather is well advanced. It is anticipated that the hazard-specific chapters may be published separately as they are completed.

COMMUNICATION

COMM	Unconventional data sources for impact modelling, evaluation & communication
	Review of approaches to communicating high impact weather
	Training Materials
	Review of the role of trust, salience and beliefs on people's responses to weather warnings
	Communicating uncertainty
	Post-event case studies
	Communication platform
	HIGHWAY (Lake Victoria Basin Nowcasting project)
	GCRF African Science for Weather Information and Forecasting Techniques (GCRF African SWIFT)

UNCONVENTIONAL DATA SOURCES FOR IMPACT MODELLING, EVALUATION & COMMUNICATION

Leads: Sara Harrison and Amber Silver

An unconventional data research network has been formed. Several activities are underway to investigate tools for gathering social media data from the public, and on the use of weather warnings by the public using data from social media. Activities include:

- Twitter data analysis: Hywel Williams (U. Exeter, UK)

- Use and interpretation of warnings on social media by the public: Amber Silver (U. at Albany, US), Shannon Panchuk (BoM, Australia)

- Citizen science: Lisa McLaren (JCDR, New Zealand)

- Role of conventional and unconventional (e.g., social media, crowdsourcing) data for impact models & warnings: Sara Harrison, Sally Potter (New Zealand). Sara has published a paper on Volunteered Geographic Information for severe weather early warning: http://trauma.massey.ac.nz/issues/2020-1/AJDTS_24_1_Harrison.pdf

- Thomas Kox and colleagues have a citizen science project in Munich on weather impacts and weather observations with school children. Review of approaches to communicating high impact weather.

Lead: Andrea Taylor, Communication task team

A special issue of the *International Journal of Disaster Risk Reduction* under the title, "Communicating High Impact Weather: Improving warnings and decision-making processes" is available at *https://www.sciencedirect.com/journal/international-journal-of-disaster-risk-reduction/vol/30/part/PA*

A UCAR COMET training module on communicating impact-based warnings is available at *https://www.meted.ucar.edu/training_module.php?id=1597#.XqDuVP8za71*.

A NOAA training module on communicating risk: the impact-based forecast and warning services approach: is available at *https://www.meted.ucar.edu/training_module.php?id=1597#.XyxmEyhKhaQ*

We are continuing to collate existing training materials for weather communication. Links can be shared with Andrea Taylor (*a.l.taylor@leeds.ac.uk*).

COMMUNICATING UNCERTAINTY

Lead: Sally Potter

The aim of this project is to review and publish the implications of uncertainty in weather forecasts and warnings across the whole spectrum of HIWeather. A discussion of uncertainty was held in the webinar on 26 October.

A publication on communicating model uncertainty, associated with HIWeather, has been published: *https://www.sciencedirect.com/science/article/pii/S2212420918306630?via%3Dihub*

Collated essays on uncertainty from an AMS special session have been shared by Julie Demuth: *https://items.ssrc.org/category/chancing-the-storm/*

INFLUENCE OF TRUST, SALIENCE AND BELIEFS ON WARNING RESPONSE

Lead: Amisha Mehta, Communication Task Team

A research study is underway to examine how participants trust weather forecasts and agency warnings in the context of flood events. This work is part of a program funded by the Bushfire and Natural Hazards Cooperative Research Centre and co-designed with Victoria State Emergency Services and the Australian Government Bureau of Meteorology. Anyone interested in being part of this activity is encouraged to contact Amisha at *a.mehta@qut.edu.au*.

HIGHWAY (LAKE VICTORIA BASIN NOWCASTING PROJECT)

Link: Andrea Taylor

The "HIGH impact Weather lAke sYstem" project was part of the UKAid WISER programme. HIGHWAY implemented co-designed and sustainable early warning systems in the Lake Victoria area. Reports on the development and implementation of forecasting and warning systems by the project are at *https://www.metoffice.gov.uk/about-us/what/working-with-other-organisations/international/projects/wiser/highway*. In 2019 HIGHWAY supported a field campaign over the Lake Victoria Basin, coordinated by NCAR. Results of this campaign are available at *http://catalog.eol.ucar.edu/highway*. A paper has been submitted to BAMS.

GCRF AFRICAN SCIENCE FOR WEATHER INFORMATION AND FORECASTING TECHNIQUES (AFRICAN SWIFT)

Link: Andrea Taylor (Communication TT)

A 4-year Global Challenges Research Fund (GCRF) project to improve African hourly to seasonal forecasting capabilities, funding 80 scientists in 5 UK and 10 African institutions, with WMO as an advisory member.

Weather forecasts are advancing Nigeria's fight for food security

African SWIFT scientists at NiMet are developing custom forecast products for the agricultural sector, equipping 56,000 farmers with the information they need to feed the country's growing population each year.

Meningitis outbreaks mitigated by sub-seasonal forecasts in sub-Saharan Africa

African SWIFT scientists are using sub-seasonal forecasts to predict the location and scale of impending meningitis outbreaks. The early-warning system gives up to two weeks warning of conditions that could trigger a meningitis outbreak, allowing health agencies more time to activate emergency response plans.

European satellite data key to African nowcasting

A new African SWIFT briefing note outlines nowcasting achievements in Africa, a vision for future opportunities, and the critical role of European organisations like EUMETSAT and the WMO.

EVALUATION	

	Warning response
	Global Hazard Map
	Probabilistic forecasting and evaluation of tropical cyclones
EVAL	Fire weather evaluation
	Societal and Economic Research Applications (SERA) Workshop
	Verification Challenge
	Method(s) to measure avoided losses due to improved warnings

WARNING RESPONSE

Lead: Anna Scolobig

Dr. Philippe Weyrich was awarded the ETH Zurich 2020 Medal for his PhD Thesis, "To act or not to act: Warning communication and decision-making in response to weather-related hazard" advised by Professor Anthony Patt and Dr. Anna Scolobig. The Thesis received this prestigious award because it presents: "a multi-faceted investigation of how severe weather warnings should be communicated in order to save live and reduce economic damage". Philippe's work has been inspired by interactions with HIW colleagues (Task Teams "User oriented Evaluation", "Vulnerability" and "Communication"). The PhD Thesis is open access and available at:

Weyrich, P., 2020. To act or not to act: Warning communication and decision-making in response to weather-related hazards. Doctoral thesis, ETH Zurich, Diss. ETH No. 26533 *https://www.researchcollection.ethz.ch/handle/20.500.11850/404058*

GLOBAL HAZARD MAP

Leads : Helen Titley and Joanne Robbins

The Global Hazard Map (GHM) summarises the risk of high-impact weather across the globe over the coming week using forecasts from the Met Office and ECMWF global ensembles. It includes forecast layers for tropical cyclones (strike probability and tracks), 24-hour precipitation accumulation, maximum wind gust in a 24-hour period, 24-hour snowfall accumulation, as well as severe heat waves and cold waves. We are working with the University of Exeter to investigate if social media data could be used to evaluate the ability of GHM to identify events which cause community impacts.

PROBABILISTIC FORECASTING AND EVALUATION OF TROPICAL CYCLONES FLOODING

Leads: Helen Titley

Ensemble forecasting of tropical cyclones (TCs) is vital in capturing the situation-dependent uncertainty in the track and intensity forecasts for existing storms, and in providing probabilistic information about tropical cyclone genesis, but there is huge potential to increase the pull through of ensemble-based uncertainty and probabilistic data in to operational TC forecasts and warnings.

A new study is underway to investigate ensemble-based predictability of flooding in TCs using the Global Flood Awareness System (GloFAS).

Helen Titley is the HIWeather representative on the new Tropical Cyclone-Probabilistic Forecast Products (TC-PFP) Pilot Project. TC-PFP is a WMO Seamless Global Data-processing and Forecasting System (S/GDPFS) Pilot Project aiming to coordinate across RSMCs and other forecast centers to identify best practice guidance for probabilistic tropical cyclone forecasts. The project team are currently planning a WMO-sponsored workshop in early summer 2021 for operational TC forecast centres and NWP centres to discuss physical science, social science, and resources aspects of TC-PFPs.

FIRE WEATHER EVALUATION

Lead: Amanda Anderson

This NCAR project evaluated coupled fire-weather modelling, and wrapped up in June 2020. Recent work explored the forecast sensitivity to fuel moisture, terrain and ignition location, and spotting capability in the model.   The assessment also explored how the sensitivity information can be conveyed to the user.

SOCIETAL AND ECONOMIC RESEARCH APPLICATIONS (SERA) WORKSHOP

Lead: Martin Goeber

This workshop will be held in Offenbach, Germany in 2021, hosted by DWD's Hans Ertel Centre. It will have SERA themes similar to the NCAR's earlier WAS*IS (Weather and Society*Integrated Studies) workshops. The format will include a tutorial for students from weather services, etc., followed by a scientific conference.

VERIFICATION CHALLENGE

Leads: Beth Ebert

A second competition for evaluation metrics using non-traditional observations (e.g. sensor networks, social media, citizen science, impact data, etc.) is being run by the Joint Working Group on Forecast Verification Research (JWGFVR). The contest is aimed to encourage the development and demonstration of verification approaches targeted to use new and non-traditional observations. New verification metrics and visualisations are encouraged.

The challenge is open to individuals and teams. The deadline for entries has been extended to 31 May 2021. The winner will receive an all-expense paid attendance and keynote talk at 8th International Verification Methods Workshop to be held in 2022. The challenge supports the WWRP's HIWeather, Sub-seasonal to Seasonal Prediction (S2S), and Polar Prediction (PPP) projects.

METHOD(S) TO MEASURE AVOIDED LOSSES DUE TO IMPROVED WARNINGS

Leads: Masa Haraguchi and Michael Kunz

This study will write a review paper that categorizes methods to estimate avoided losses. It will focus on heatwave and tropical cyclones, connecting to loss data from disaster reports from the World Bank.

US CONTRIBUTIONS

Dr. John Cortinas has been our senior contact point in NOAA. We congratulate Dr. Dorothy Koch on her appointment as director of OAR and look forward to working with her as she takes on this role. Dr Jennifer Sprague-Hilderbrand is a member of the HIWeather Advisory Group.

The US has a wide range of relevant work underway including the Hydrometeorology Testbed (HMT), focusing on rainfall and flood forecasting, and the Hazardous Weather Testbed, focusing on tornado, wind and hail forecasting. CAPS is running 3-km CONUS-domain cycled EnKF data assimilation, including radar data, for selected periods and discussing coupling with hydrology/river stream models for HMT. The National Weather Service FACETS project *(http://www.nssl.noaa.gov/projects/facets/)* is closely aligned with several aspects of HIWeather.

UK CONTRIBUTIONS

Relevant areas of work include unconventional data sources, km-scale data assimilation and ensemble prediction, km-scale coupled modelling, hazard impact modelling and risk communication. The Met Office recently completed implementation of its new hourly lagged convection-permitting ensemble. Trial results showed a substantial gain in performance (*https://www.metoffice.gov.uk/research/news/2019/mogreps-uk-hourly-cycling-updates*). Impacts work is largely carried out in the Natural Hazard Partnership (http://www.naturalhazardspartnership.org.uk/). NERC/UKAid fund four research projects through the Science for Humanitarian Emergencies And Resilience (SHEAR) programme focusing on co-production of knowledge using a multi-disciplinary and problem-centred approach in sub-Saharan Africa and south Asia (http://www.nerc.ac.uk/research/funded/programmes/shear/). See also SWIFT and HIGHWAY, above. The UKRI Global Challenges Research Fund Urban Disaster Risk Hub, which is endorsed by HIWeather, is working in Kathmandu, Nairobi, Istanbul and Quito (*https://www.de.ed.ac.uk/project/gcrf-urban-disaster-risk-hub)* to develop resilient urban development plans.

GERMAN CONTRIBUTIONS

W2W (Waves to Weather) is a Collaborative Research Center delivering the underpinning science needed to identify the limits of predictability in different weather situations so as to pave the way towards a new generation of weather forecasting systems. See http://w2w.meteo.physik.uni-muenchen.de/. The research programme is listed under the headings of Upscale Error Growth, Cloud-Scale Uncertainties and Predictability of local Weather. The second 4-year phase has started July 2019. Results of the project are available in a QJRMS and an AMS journal special collection and on the W2W website (*https://www.wavestoweather.de/*).

Waves to Weather scientists are participating in ASKOS, an international field campaign on the Cape Verde islands in summer 2021 (*http://askos.space.noaa.gr*). This project is built around planned calibration/validation aircraft measurements conducted during the same period. Due to the Corona pandemic, the campaign will take place at best with reduced program. Cape Verde during boreal summer is ideal for a study of tropical wave phenomena. The midlevel African easterly jet allows for the formation of synoptic-scale African easterly waves (AEWs) that typically reach their maximum intensity close to the coast of West Africa. AEWs interact with convection and its mesoscale organization through modifications in humidity, temperature and vertical wind shear, and often serve as initial disturbances for tropical cyclogenesis. In addition, the tropical atmosphere sustains different types of planetary waves that frequently interact with the monsoon and AEWs. To support our research in this area, we plan frequent radiosonde ascents from Cape Verde to complement the measurements from space and aircraft.

WEXICOM **(**Weather warnings: from EXtreme event Information to COMunication and action) is an interdisciplinary collaborative research project aimed at facilitating transparent and effective communication of risks and uncertainties for individual user groups. See *http://www.geo.fu-berlin.de/en/met/wexicom/index.html*.

AUSTRALIAN CONTRIBUTIONS

An Australian HIWeather community was established at the annual Australian Meteorological and Oceanographic Society (AMOS) meeting. The goal is to foster collaboration within Australia of physical and

social scientists, forecasters, and users of forecasts of high impact weather. Anyone who is interested can contact *HIWeather@bom.gov.au* to join this community.

The Bureau of Meteorology and Geoscience Australia are conducting a small project on **impact prediction**, currently looking at impacts of wind on infrastructure. Partners include forecasters and State Emergency Services. High resolution ensemble NWP is coupled to a wind damage function to derive probabilistic spatial maps of damage severity, using East Coast Lows as demonstration events.

Future Warning Services (FWS) framework: In February 2018 the Australian Fire and Emergency Services Authority Council (AFAC) Warning Group commissioned social research to build a sound evidence base for a national three-level warning framework for all hazards, following which the Australian Bureau of Meteorology has embarked on a three-year Public Services Transformation to improve the impact and value of our services. A copy of the PST business case can be obtained from *public-services@bom.gov.au*. The Future Warning Framework outlines four key goals:

Goal 1. Adopt Australia's Total Warning System

Goal 2. Issue Best Practice Warnings

Goal 3. Implement Scaled Three Level Warnings

Goal 4. Develop Impact-based Warnings

The 'Reducing Illness and Lives Lost from Heatwaves' (RILLH) is a multi-agency collaboration between the Australian Bureau of Meteorology (BOM), Australian Bureau of Statistics (ABS), Department of Health (DOH), and Geoscience Australia (GA). The RILLH is a data-integration partnership project and asks three questions; 'who is most at risk?', 'where are they?', and 'how can services to vulnerable groups be improved through heat-health warnings and targeted interventions?'. This project seeks to answer these questions by mapping vulnerability against Excess Heat Factor (EHF), the scale used to define heatwave intensity by the Bureau of Meteorology and many Australian States and Territories. The project is building a national 'map' of heat health vulnerability. It is anticipated that the methodology can be applied to other natural hazards as well. The results will support emergency response and planning in the immediate term and will inform and shape spatially target intervention strategies including impact forecast warning systems, social registries and community outreach, social media targeting, and urban planning. For more information contact Shannon Panchuk (*shannon.panchuk@bom.gov.au*)

NEW ZEALAND CONTRIBUTIONS

Within New Zealand, Resilience to Nature's Challenges (*https://resiliencechallenge.nz/*), is a five-year Government-funded research programme that started mid-2019. The Weather & Wildfire theme, co-led by Richard Turner (NIWA) and Sally Potter (GNS Science), aims to improve our understanding of extreme weather and wildfire impacts on communities and infrastructure, and co-design mitigation solutions (including improving impact-based warnings) with key stakeholders. We are using three scenarios – an ex-tropical cyclone, severe winter storm, and wildfire on a rural-urban interface. The programme has been aligned to support the goals of the WMO HIWeather programme. The Weather & Wildfire theme is linked to other themes within the programme, that will also contribute to HIWeather, notably the Resilience in Practice Model, co-led by Julia Becker (Massey University) and the Urban theme co-led by David Johnston (Massey University).

ARGENTINE CONTRIBUTIONS

The Alert.AR project finished in May 2018, having delivered a new warning system. A Health & Heatwave Early Warning System (*https://www.smn.gob.ar/smn_alertas/olas_de_calor*) was inaugurated in 2019 as a result of a joint research between the National Ministry of Health and the National Meteorological Service of Argentina. The warning system is based on mortality data and climatological information from the last 40 years for 57 cities of Argentina. A WMO regional workshop on Impact-Based Forecasting & Warning is being hosted in September.

SMN is developing a new Early Warning Service in partnership with emergency managers and citizens. A training day/workshop with all the provincial directors of emergency agencies and their technical teams will be held in June to inform them about how the new EWS will work well in advance of its launch. An event in July in conjunction with the National Secretariat of Science and Technology will include a workshop with all

technical scientific bodies that "depend" on the information of warnings and forecasts to issue other types of warnings, announcements or bulletins so they will be able to adjust their own systems. (Julia Chasco, SMN)

Joint initiative towards a International Fujita scale to assess tornado and wind damage (with European Severe Storms Lab) is still growing. Recently, there was a poster presentation at EMS Annual Meeting in Copenhagen, 9-13.9.2019. Information and first IF-scale draft document (v 0.1) can be found at *https://www.essl.org/cms/international-fujita-scale/*, there is also an internal forum for experts to discuss case studies and further refinements, experts who are working in this field are welcome to join our initiative. Next face-to-face meeting of the IF-Scale steering committee is planned along with the ESSL Tornado and Windstorm Damage Assessment Workshop in August 2020 in Wr. Neustadt, Austria. *https://www.essl.org/cms/upcoming-events/workshop-damage-assessment/*. Spread the message!

The EUMETNET EMMA/Meteoalarm PM carried out a survey on implementation of impact-oriented warnings among Meteoalarm members in Europe in August 2018 – May 2019. 79 questions covered topics from warning format, production process of warnings, dissemination of warnings, verification of warnings, warning strategy, crowdsourcing and cross-border collaboration 32/37 of European NMHSs replied, making it a valuable dataset for potential initiatives on the regional / global scale in the field of IoW. Results were presented at the EMS Annual Meeting in Copenhagen, 9-13.9.2019. Publication is planned for 2020.

European Weather Observer –ZAMG and ESSL are in contact with a number of European NMHSs to work on and refine a pan-European, standardized set of human-assessed (hydro, meteo, geo) crowdsourcing reporting parameters and enable exchange through a standardized API. In 2018 a first set of reporting parameters was defined. Our proposal is, that European NMHSs act as national data hubs for weather- and impact observations enabling exchange of data between NMHS level and European level. A consortium of participating NMHSs is formed and a standardized API between all partners will enable real time data exchange using the MQTT protocol. NMHSs are invited to provide API to subnational collaborators (e.g. spotter groups, emergency authorities). The API can be easily implemented in existing web pages and apps, e.g. *https://wettermelden.at* .

Recently, four projects lead by researchers from Chinese Academy of Meteorological Sciences (CAMS) have been approved as *National Key Technology Research and Development Plan*:

1) "Development of High Resolution Data Assimilation Techniques and East Asia Atmospheric Reanalysis Datasets" (Xudong LIANG). The aim is for a 3km reanalysis for East Asia.

2) "*Research on Thunderstorm Electrification-discharge Processes and Lightning Effects*" (Weitao LYU). Observational and theoretical approaches to understanding lighting using AI approaches to develop a lightning forecasting and warning platform.

3) "*Aerosol-Convective Cloud Interaction Mechanism and Its Model Application Demonstration over Beijing-Tianjin-Hebei Region*" (Jianping GUO *https://www.researchgate.net/profile/Jianping_Guo6*). Improving 24-hour precipitation scores in the Beijing-Tianjing-Hebei region using improved mixed-phase parametrization scheme with aerosol effects.

4) "*Development of Seamless Weather-Climate Model Dynamic Core on Unstructured Grid*" (Jian LI). More accurate dynamical core suitable for future supercomputing architectures.

A five-year Project, "*Key Dynamic and Thermodynamic Processes and Prediction for the Evolution of Typhoon Intensity and Structure*" of the Ministry of Science and Technology, led by Prof. Zhemin Tan from Nanjing University aims to deliver 3-7 day typhoon track, intensity and structure forecasts, see: *http://meso.nju.edu.cn/web/typhoon/*.

SMART 2022

The small-scale intensive observation experiments are under way in the two Olympic mountain areas. A short-term forecasting system has been developed with multi-source data fusion, adaptive downscaling, and machine learning, which can provide 100-meter resolution and 10-minute update of 0-24-hour weather forecast under complex terrain for Beijing Winter Olympics. The 24-240-hour weather forecasting methods for the games is developed based on the Chinese numerical weather prediction model GRAPES. The seamless forecast methods for 0-240 hours of key points of Winter Olympics has also been developed combining machine learning, other methods and forecasters' experience based on the above grid-point forecasts. Special meteorological service methods for Winter Olympics, such as automatic processing of graph and text, traffic meteorology and helicopter rescue, have been formed. Some of the achievements will be applied to meteorological services of the upcoming Winter Olympics test series

NAWDIC (NORTH ATLANTIC WAVEGUIDE, DRY INTRUSION, AND DOWNSTREAM IMPACT CAMPAIGN)

An International field campaign focusing on mid-latitude dynamics with the aim to provide required observations for understanding the tropopause structure and downstream high impact weather (HIW) in the eastern North Atlantic winter. NAWDIC will build directly on insights of the North Atlantic Wave guide and Downstream impact EXperiment (NAWDEX; Schäfler et al. 2018) and is scheduled to take place in the winter of 2024 or 2025. For more information about NAWDIC, please visit
https://internal.wavestoweather.de/campaign/projects/nawdic/wiki

The 4th NAWDEX workshop took place online from 8-9 March 2021. About 45 participants from the USA, Canada, the UK, Switzerland, France, Norway, the Netherlands and Germany participated.
In two oral and two poster sessions the latest results using the unique NAWDEX observational data set were presented. Oral presentations focused on recent work by young scientists. The diverse program covered topics from WCB studies, tropopause-based uncertainty characterization to instrument-driven analyses. From our W2W group, Konstantin Krüger, Annika Oertel and Andreas Schäfler (presenting Matthias Schindlers work) gave presentations. Andreas Schäfler gave an overview talk about the results that were obtained in the last 4.5 years and summarized the related publications.
In a fruitful plenary discussion, steps beyond NAWDEX have been discussed. Lively exchanges at poster sessions, as well as lively informal discussions were made possible by the online platform QiqoChat. In the social event on 8 March photos taken during NAWDEX at Iceland were shown.

PICS: TOWARDS INTEGRATED NOWCASTING OF FLASH FLOOD IMPACTS

PICS is making rapid progress in all aspects of the flash flood impact prediction chain. For instance, the first flooded-area simulations were produced for each of the 15 events studied in the project. For this purpose, a hydrological model was adjusted on an event-by-event basis using all available flow observations. The FLOODOS model (https://osur.univ-rennes1.fr/eros/index.php/floodos/) was then used to simulate the flooded areas.
Also, work has begun to develop a damage model specific to flash floods, estimating the areas affected and the resulting losses for insured properties. This work is based on inputs provided by the partners of the PICS project: aforementioned flooded areas, radar-raingauge rainfall observations, and 1 km^2 resolution grids of net rainfall and streamflow simulated with the SMASH model (https://hess.copernicus.org/articles/24/5519/2020/).
More information can be found on the project website: https://pics.ifsttar.fr/en/.

COSMO-AWARE

Within AWARE project, COSMO participants experiment a number of forecast methods and evaluation approaches that are linked to high impact weather HIW. During March 2021, a teleconference took place and the advances of the Task work were presented. Presentations can be found in http://www.cosmo-model.org/view/repository/wg5/ meetings. An overview of available observation sources for convective events was prepared that can serve as a basis to further analyze and evaluate intense precipitation events. It considers, in particular, non-standard and proxy sources of data. With respect to verification methods,

lightning forecasts evaluation has been undertaken over alpine areas in order to find a suitable configuration of thresholds and upscaling treatment to enhance the predictability. The intermediate results show that for a threshold of ≥ 1 flash/ 100 km2/h over 6 hours scores are better by using a grid with less resolution. Object-oriented approaches are followed for the evaluation of the upscaled lightning structures. AWARE project continuation with a focus on ensemble forecasts of HIW is currently discussed while the decision will be made during COSMO consortium annual meeting in September 2021.

OTHER RELATED ACTIVITIES

GHHIN (GLOBAL HEAT HEALTH INFORMATION NETWORK).

A professional network of academics, government representative at all levels, professional organizations, international organizations, donor organizations, private sector and non-governmental organizations eager to share and engage in issues around heat and health. See *http://www.ghhin.org/*

VORTEX-SE (VERIFICATION OF THE ORIGINS OF ROTATION IN TORNADOES EXPERIMENT – SOUTHEAST)

A research program to understand how environmental factors characteristic of the southeastern United States affect the formation, intensity, structure, and path of tornadoes and to determine the best methods for communicating forecast uncertainty related to these events. See *http://www.nssl.noaa.gov/projects/vortexse/*

I-REACT

EU Horizon2020 project on Improving Resilience to Emergencies through Advanced Cyber Technologies (I-REACT), involving 20 partners, will integrate existing systems to facilitate early planning of weather-related disaster risk reduction activities. I-REACT will co-operate with the European Flood Awareness System (EFAS), European Forest Fire Information System (EFFIS), European Global Navigation Satellite System (E-GNSS), Copernicus, etc. See *http://www.i-react.eu/*

ANYWHERE

An EU Innovation action designed to bridge the gap between R&D in forecasting and warning high impact weather and climate so as to enhance response by emergency managers and first responders across Europe *http://www.anywhere-h2020.eu/*. The project catalogue contains forecasting algorithms for hazards and their impacts, many developed in previous EU actions. *http://anywhere-h2020.eu/catalogue/*

ARISTOTL-EHNSP

Aristotle will deliver multi-hazard capability to the EU Emergency Response Coordination Centre (ERCC), which is responsible for the coordination of human aid upon request of the government of a country affected by natural (and other) hazards. It offers a scalable scientific network including new hazard related services and a pool of experts in the field of Hydro-Meteorology and Geophysics that can support ERCC in crisis situations worldwide. See *http://aristotle.ingv.it/*

EUROPEAN DISASTER RISK MANAGEMENT KNOWLEDGE CENTRE

The centre works at the science-policy interface to help EU Member States respond to emergencies; prevent and reduce the impact of disasters. See *http://drmkc.jrc.ec.europa.eu/.* The Risk Data Hub at https://drmkc.jrc.ec.europa.eu/risk-data-hub/#/ may be of particular interest to HIWeather researchers.

S2S (SUB-SEASONAL-TO-SEASONAL PREDICTION)

Latest news is available at http://www.s2sprediction.net/static/news

PPP (POLAR PREDICTION PROJECT)

Latest news is available at http://www.polarprediction.net/news.html

TIGGE (THORPEX INTERACTIVE GRAND GLOBAL ENSEMBLE) AND TIGGE-LAM (-LIMITED AREA MODEL)

The TIGGE dataset (*https://www.ecmwf.int/en/research/projects/tigge*) is one of the major achievements of THORPEX. It now contains over 10 years of global data. On a smaller scale, the TIGGE-LAM dataset provides 5 years of multi-model ensemble data at mesoscale resolution for limited areas. These datasets have been used to investigate a variety of atmospheric processes and there is scope for more use in the context of HIWeather. Opportunities may be driven by analysis of weather phenomena or weather variable thresholds associated with high impact. Within the S2S project, activities related to specific weather phenomena are brought together at *http://s2sprediction.net/* under topic wiki pages. There may be opportunities to do something similar for phenomena relevant to HIWeather. If you are interested, please contact John Methven at Reading University.

CODATA: THE COMMITTEE ON DATA OF ICSU

CODATA promotes global collaboration to improve the availability and usability of data on the principle that data produced by research and susceptible to be used for research should be as open as possible and as closed as necessary. CODATA works to advance interoperability and usability of such data: research data should be intelligently open or FAIR. The group is working particularly in three important global challenges in **infectious disease, sustainable cities,** and **disaster risk reduction**: *www.codata.org/task-groups/linked-open-data-for-global-disaster-risk-research*

THE YOUNG EARTH SYSTEM SCIENTISTS (YESS) COMMUNITY

The YESS Community is an international multidisciplinary Early Career Researcher (ECR) network with more than 1000 members from over 80 countries. It brings together early career scientists, from both natural and social sciences, working in a field of Earth system science. It is a bottom-up initiative run by its members. YESS works closely with WWRP, GAW and WCRP to get ECRs involved and to provide them with a collective voice. YESS invites interested HIWeather master students, Ph.D. students and postdocs (within 5 years after their last degree) to join and engage in the community. See *www.yess-community.org* and follow YESS on Facebook: *www.facebook.com/yesscommunity*, Twitter: *twitter.com/YESSCommunity* or LinkedIn: *www.linkedin.com/company/yess-community*.

JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH

Open access journal dedicated to human and mediated communication issues associated with crises, risks, and emergencies. It has an international editorial board and invites manuscripts of a philosophical, theoretical, methodological, critical, applied, pedagogical or empirical nature. It includes community or regionally based events and risks, such as hurricanes, floods, wildfires, infectious disease outbreaks or similar threats. See *www.jicrcr.com*.

Co-chairs:
Brian Golding, UK, brian.golding@metoffice.gov.uk
Sally Potter, New Zealand s.potter@gns.cri.nz

ICO: Qinghong Zhang, Huiyi Fan, China, hiwico@cma.gov.cn

Processes & Predictability (P&P) theme
Lead: Michael Riemer, Germany, mriemer@uni-mainz.de

Members: John Knox, Peter Knippertz, Andreas Schäfler, Juan Fang, Shira Rabeh-Ruvin, Linus Magnusson, Deanna Hence, Yali Luo, Linda Schlemmer, Robert Rogers

Multi-Scale coupled Forecasting (MSF) theme
Lead: Jenny Sun, USA, sunj@ucar.edu

Members: Olivier Caumont, Paul Joe, Peter Steinle, Sharan Majumdar, Jianjie Wang, Jim Dudhia, Krushna Chandra Gouda, Nusrat Yussouf, Yi Wang, Glen Romine

Human Impacts, Vulnerability & Risk (HIVR) theme
Lead: Brian Mills, Canada, bmills@uwaterloo.ca

Members: Joanne Robbins, Michael Kunz, Isabelle Ruin, Melanie Gall, Sara Harrison, Craig Arthur, Linda Anderson-Berry, Urbano Fra. Paleo, Harald Richter, Danielle Nagele

Communication theme
Co-leads: Andrea Taylor, UK, a.l.taylor@leeds.ac.uk & Thomas Kox, Germany, t.kox@lmu.de

Members: Sara Harrison, Brenda Mackie, Julie Demuth, Amber Silver, Bob Goldhammer, Philippe Weyrich, Emily Campbell, Amisha Mehta, Faye Wyatt, Rutger Dankers, Gina Eosco, Marion Tan

Evaluation theme
Lead: Beth Ebert, Australia, beth.ebert@bom.gov.au

Members: Amanda Anderson, Barb Brown, Julia Chasco, Martin Goeber, Masa Haraguchi, Rainer Kaltenberger, Chiara Marsigli, Marion Mittermaier, Anna Scolobig, Helen Titley

Link to SURF project: Xudong Liang, liangxd@cma.gov.cn

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Representatives of WGNE (Working Group on Numerical Experimentation under WCRP)
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Jian Sun, China, jian.sun.cma@gmail.com

Representatives of RISK-KAN
Kai Kornhuber, USA, kk3397@columbia.edu
Colin Raymond, USA, cr2630@columbia.edu

HIWeather book: "Towards the Perfect Warning"

Editor: Brian Golding

Coordinators: Robert Šakić Trogrlić, Anna Scolobig, Cheryl Lafaye Anderson, Joanne Robbins, Brian Golding, Paul Joe

Co-authors: Colin McQuistan, Marc van den Homberg, Brian Golding, Mirianna Budimir, Alison Sneddon, Sally Potter, Thomas Kox, Rainer Kaltenberger, Philippe Weyrich, Julia Chasco, Nadine Fleischhut, Douglas Hilderbrand, Jane Rovins, David M. Johnston, Will Lang, Brian Mills, Rainer Kaltenberger, Thomas Pagano, Ross Middleham, Rutger Dankers, Isabelle Ruin, John Nairn, Jenny Sun, Michael Riemer, Beth Ebert, Helen Titley, Nusrat Yussouf, Huw Lewis, Graeme Boyce, Mika Peace, Steve Goodman, Krushna Gouda, Peter Li, James LaDue, Jim Wilson, Jeanette Onvlee, Pei Chong, Robert Rogers, George Isaac, Volker Wulfmeyer, Kim Elmore

Value Chain project:
Lead: Beth Ebert

Members: *Adriaan Perrels, Juan Sarmiento, Carla Mooney, Brian Golding, Bob Goldhammer, Julie Demuth, Brian Mills, Melanie Gall, Jeff Lazo, Helen Titley, Chiara Marsigli, Anna Scoobig, Sharanya Majumdar, Yi Wang, Nusrat Yussouf, Krushna Gouda, Linus Magnusson, Robert Rogers, Rebecca Morss*

Citizen Science project:
Lead: Marion Tan

Members: *Anna Scolobig, Brian Mills, Emily Campbell, Sara Harrison, Harald Kempf, Lisa McLaren, Lauren Vinnell, Andrea Taylor, Chris David, Deanna Hence, Helen Titley, Jennifer Sprague-Hilderbrand, Michael Riemer, Qinghong Zhang, Rainer Kaltenberger, Jenny Sun, Sarah Dance, Ajit Tyagi, Julia Becker, Benjamin Payne, David Johnston, Alicia Cui, Brian Golding*

ADVISORY BOARD

John Rees, British Geological Survey, UK, representing Funding Agencies

Jan Polcher, Laboratoire de Meteorologie Dynamique of Centre National de la Recherche Scientifique, France, representing Climate Science

Jennifer Sprague-Hilderbrand, National Oceanic and Atmospheric Administration, USA, representing Users

Virginia Murray, Public Health England and UNDRR, UK, representing the UN family

MANAGEMENT

FUNDING

A Trust Fund can support HIWeather conference attendance by delegates from developing countries. New contributions are needed to develop and facilitate the work of the project.

INTERNATIONAL COORDINATION OFFICE (ICO)

The ICO is hosted by Chinese Academy of Meteorological Sciences, and responsible for the organisation of Steering Group, Advisory Board and Task Team teleconferences and maintenance of HIWeather web site: *http://hiweather.net/Index*

SECRETARIAT

Estelle de Coning and David Hoffmann provide the link to the World Weather Research Programme.

COMMUNICATION

The HIWeather web site can be reached at *http://hiweather.net/Index*. It contains the Implementation Plan, Steering Group and Task team membership and HIWeather presentations. It is available for task teams to post meetings and progress.

A communications web platform for the project is live at *http://hiweathercomms.net/*. A HIWeather twitter account is available to follow at *https://twitter.com/WMO_HIWeather*.

MEETINGS

The Steering Group meets quarterly, usually by teleconference. The last physical annual SG meeting was held on 14-16 October 2019 in Geneva, with attendance of WWRD, Co-chairs, Task team leaders, and ICO. Task teams meet by teleconference at intervals to suit their work. The Advisory Board aims to meet at least once a year by teleconference.

RELEVANT PUBLICATIONS

This list contains recent publications selected by the editor as being relevant to the work of HIWeather, including most publications by members of the HIWeather task teams. It is inevitably incomplete and is meant to serve as a help to research rather than as a record. Please see the HIWeather website at http://hiweather.net/Lists/23.html for a list of publications by HIWeather members.

Adhikari, B. R. 2021. LIGHTNING FATALITIES AND INJURIES IN NEPAL. WCAS 449–458. https://doi.org/10.1175/WCAS-D-20-0106.1

Ali, T., Petra Topaz Buergelt, Douglas Paton, James Arnold Smith, Elaine Lawurrpa Maypilama, Dorothy Yu_girr, Stephen Dhamarrandji and Rosemary Gundjarranbuy 2021. Facilitating Sustainable Disaster Risk Reduction in Indigenous Communities: Reviving Indigenous Worldviews, Knowledge and Practices through Two-Way Partnering. Int. J. Environ. Res. Public Health, 18, 855. https://doi.org/10.3390/ijerph18030855

Bannister, T., Elizabeth E. Ebert, Ted Williams, Philip Douglas, Alan Wain, Maree Carroll, Jeremy Silver, Ed Newbigin, Edwin R. Lampugnani, Nicole Hughes, Clare Looker, Vanora Mulvenna, Danny Csutoros, Penelope J. Jones, Janet M. Davies, Cenk Suphioglu, Paul J. Beggs, Kathryn M. Emmerson, Alfredo Huete, and Ha Nguyen, 2021. A PILOT FORECASTING SYSTEM FOR EPIDEMIC THUNDERSTORM ASTHMA IN SOUTHEASTERN AUSTRALIA. BAMS E399–E420. https://doi.org/10.1175/BAMS-D-19-0140.1

Buschow, S. and Petra Friederichs 2021. SAD: Verifying the scale, anisotropy and direction of precipitation forecasts Q J R Meteorol Soc. 147:1150–1169 DOI: 10.1002/qj.3964

Cafaro, C., Beth J. Woodhams, Thorwald H. M. Stein, Cathryn E. Birch, Stuart Webster, Caroline L. Bain, Andrew Hartley, Samantha Clarke, Samantha Ferrett and Peter Hill. 2021, DO CONVECTION-PERMITTING ENSEMBLES LEAD TO MORE SKILLFUL SHORT-RANGE PROBABILISTIC RAINFALL FORECASTS OVER TROPICAL EAST AFRICA? WAF 697–716. https://doi.org/10.1175/WAF-D-20-0172.1

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