CONSORTIUM FOR SMALL SCALE MODELING

PP-AWARE: Appraisal of "Challenging WeAther" FoREcasts

WG5 &WG4 (collaboration with WG7)

PLs: Flora Gofa and Anastasia Bundel

Duration: Sept 2019 – Aug 2021

Status of Tasks 1 & 2

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PP AWARE

Project Start Date: 09.2019
Project Lead : Gofa - Bundel

	TASK	LEAD	START	END	% DONE	FTEs	Tot Mon	SON 2019 Sep	Oct	Nov	DJF 2020 Dec	Jan	Feb	MAM 2020 Mar	Apr	May	JJA 2020 Jun	Jul	Aug
1	Challenges in observing CW/HIW (WG5 and WG4 related)			-	37%	0.30													
1.1.1	Overview of CW/HIW observational data sources characteristics: IMGW-PIB	Mazur	09/2019	02/2020	0.80	0.10	6		0.05			0.03							
1.1.2	Overview of CW/HIW observational data sources characteristics: RHM	Bundel	10/2019	04/2020	0.02	0.05	7		0.01			0.01							
1.2	Approaches to introduce observation uncertainty	Bundel	10/2019	04/2020	0.20	0.05	7					0.01							
1.3	review of non conventional observations and their use in verification)	Marsigli	03/2019	08/2020	0.00	0.10	6												
2	Overview of appropriate verification measures for HIW (WG5 related)				57%	0.90													
2.1	Survey for assessment of proper verification of phenomena	Mazur, Linkowska	10/2019	05/2020	0.29	0.35	7		0.05			0.05							
2.2	Role of SEEPS and EDI-SEDI for the evaluation of extreme precipitation	Boucouvala, Gofa	11/2019	08/2020	0.64	0.25	9			0.06		0.1							
2.3	EVT approach- Fitting precipitation object characteristics to different distributions	Muraviev	09/2019	08/2020	0.83	0.30	12		0.15			0.1							
3	Verification applications (focus on spatial methods) to HIW *(WG5 and WG7)*			-	13%	1.40													
3.1	Verification of forecasts of intense convective phenomena and visibility range	Mazur, Linkowska	09/2019	08/2021	0.04	0.50	24		0.02										
3.2	Lightning potential index (LPI) in mountain regions	Cattani	09/2019	08/2021	0.00	0.10	24												
3.3	CRA (Contiguous rain area) and FSS analysis on intense precipitation	Bundel	09/2019	08/2020	0.00	0.30	12												
3.4	DIST methodology tuned on high-threshold events for flash floods forecast evaluatio	Tesini	09/2019	08/2020	0.75	0.10	12		0.05			0.025							
3.5	LPI verification and correlation of convective events with microphysical and thermody	Gofa,Boucouvala	10/2019	08/2020	0.23	0.30	11					0.07							
3.6	comparative verification of NWC and NWP results using spatial verification methods (	Hoff	09/2019	08/2021	0.20	0.10	24					0.02							
4	Overview of forecast methods, representation and user-oriented products (WG4)			-	22%	1.25													
4.1	Postprocessing vs. direct model output for HIW	Tatarinovich,Bundel	09/2019	08/2021	0.20	0.50	24		0.05			0.05							
4.2	Improving existing post-processing methods	Mazur,Duniec	09/2019	08/2021	0.32	0.25	24		0.03			0.05							
4.3	QPF evaluation approaches	Tesini	09/2019	02/2020	0.90	0.10	6		0.05			0.04							
4.4.1	Representing and communicating HIW forecast for decision making - RHM	Bundel	01/2020	08/2021	0.10	0.10	20					0.01							
4.4.2	Representing and communicating HIW forecast for decision making - NMA	Balacescu	06/2020	08/2021	0.00	0.10	15												
4.5	Product generation and calibration of convection-permitting ensemble	Marsigli	09/2019	08/2020	0.00	0.20	12												

Task 1. Challenges in observing CW/HIW (WG5 and WG4 related)

Question: How well high-impact weather is represented in the observations, including biases and random errors, and their sensitivity to observation density?

HIW phenomena studied: visibility range (fog), thunderstorms (w. lightning), intense precipitation, extreme temperatures and winds.

- This task is basic for the understanding of the nature of phenomena studied within the project.
- The task will consider which observations are necessary to verify HIW forecasts, as well as issues related to observation sparseness, quality, and thresholds.
- Work effort will be given to identify the dependence of HIW prediction improvements on dense observations, to identify observation requirements for monitoring the selected hazards and/or for assessing forecast accuracy and quantify the role of observation uncertainty. The study on observation uncertainty was initiated within the INSPECT project (COSMO technical report 37, chapters 4.1.3 and chapter 5).
- *The outcome of this task is the description of available HIW observations (including non-standard ones) and their characteristics.*

Task 1. Challenges in observing CW/HIW (WG5 and WG4 related)

Question: How well high-impact weather is represented in the observations, including biases and random errors, and their sensitivity to observation density?

Task 1.1 Overview of CW/HIW observational data sources characteristics

Grant a good description of HIW phenomena, an adequate source of observational data should be provided. This is of high importance especially in connection with task 3 (verification) and 4 (overview and improvement of existing forecast methods.

IMGW subtask 1.1.1

Work steps:

Assessment of usefulness of particular observational data sources, keeping in mind the criteria of validity, long period of observation, “white-listed” quality, accessibility, etc. Recommendations of the usage.

Deliverables

Report with <u>particular attention paid to the recommendations</u>, mainly in terms of easy access to data.

<u>**Contributors**</u>

Task 1.1: Andrzej Mazur, FTE 0.1, Start 09.2019 – End 02.2020

Task 1. Challenges in observing CW/HIW (WG5 and WG4 related)

Question: How well high-impact weather is represented in the observations, including biases and random errors, and their sensitivity to observation density?

RHM subtask 1.1.1

Work steps:

Description of methods to diagnose areas of thunderstorm activity

Estimates of accuracy of lightning detection networks, worldwide and at the national levels, including the radar and satellite data

Deliverables

Intercomparison of diagnostic methods for thunderstorm activity, including accuracy estimates based on selected test cases.

Contributors

Anastasia Bundel, FTE 0.05, Start 10.2019 – End 02.2020

Task 1. Challenges in observing CW/HIW (WG5 and WG4 related)

Question: How well high-impact weather is represented in the observations, including biases and random errors, and their sensitivity to observation density?

Task 1.2 (RHM)

Approaches to introduce observation uncertainty

Analysis of observation uncertainty contribution to verification scores.

Quantification of observation uncertainty is important for forecasting all the hydrometeorological variables. For HIW events, which are often the rare ones, it is of extreme importance.

Work steps:

Analysis of literature about the methods to introduce observation uncertainty for the HIW phenomena of intense precipitation, extreme temperatures and winds.

Analysis of available datasets

Tests with the new scores accounting for observation uncertainty

Deliverables:

Report on existing methods to introduce observation uncertainty and an overview of novel verification scores accounting for observation uncertainty (e.g., CRPS adapted for observation ensemble).

Contributors

Task 1.2: Anastasia Bundel, FTE 0.05, Start 10.2019 – End 04.2020

Task 1. Challenges in observing CW/HIW (WG5 and WG4 related)

Question: How well high-impact weather is represented in the observations, including biases and random errors, and their sensitivity to observation density?

Task 1.3 (DWD)

Review of non conventional observations and their use in verification)

Work steps:

Deliverables:

Summary of the WMO-WG report that CM co-authored.

Contributors

Task 1.3: Chiara Marsigli, FTE 0.1, Start 03.2020 – End 08.2020

Task 2. Overview of appropriate verification measures for HIW (WG5 related)

Question: How well high-impact weather forecast quality is represented with commonly used verification measures? What is the most appropriate verification approach?

HIW phenomena studied: intense precipitation, thunderstorm (lightning activity, visibility range (fog).

The verification of many HIW events requires metrics that remain useful for rare events. Their main characteristics: are that must be less dependent on the base rate (climatology of the event), the dependency on spatial and temporal scales and sampling of observational data should be minimized and the dependency on the verification grid should be minimized. Hits and false alarms should be taken into account.

As no single score exists that addresses all these properties, the response of commonly used scores on HIW for these properties will be studied through this Task on selected test cases.

Scores behavior for the evaluation of both the deterministic and ensemble forecasts of HIW (SEDI, EDS, EDI, SEEPS, CRPS) will be addressed. Global scores tuned over extreme events will be also tested.

Proper scoring rules for extremes, downscaling of precipitation extremes will be studied.

Task 2. Overview of appropriate verification measures for HIW (WG5 related)

Question: How well high-impact weather forecast quality is represented with commonly used verification measures? What is the most appropriate verification approach?

Task 2.1 (IMGW-PIB)

Survey for assessment of proper verification of phenomena – continuous vs. discrete verification (occurrence vs. specific values).

This task should provide arguments for choosing a particular method that should be used to verify HIW phenomena. Continuous phenomena are easier to describe, and a mathematical apparatus for this purpose is huge and wide and easily accessible, however, it may be tempted to check whether other methods could be used in the verification (see task 3).

Work steps:

Brief research (case studies) to assess applicability of particular method(s);

When (if) possible, comparison and judgment whether continuous or discrete methods may/should be applied.

Overall final recommendations

Deliverables:

Report on the consequent steps of work, possibly papers in peer-reviewed journals and suggestions/recommendations of methods to be selected.

Contributors

Task 2.1 (0.35FTEs): Andrzej Mazur, Joanna Linkowska, *Start 10.2019 – End 05.2020.*

Task 2. Overview of appropriate verification measures for HIW (WG5 related)

Question: How well high-impact weather forecast quality is represented with commonly used verification measures? What is the most appropriate verification approach?

Task 2.2 (HNMS) Role of SEEPS and EDI-SEDI for the evaluation of extreme precipi forecasts

Work Steps:

Analyze the variation in precipitation climatology for various geographical regions and seasons around Greece

Selection of intense precipitation events and application of the SEEPS and EDI scores for COSMO4, COSMO1, ICON-GR and ECMWF forecasts for different stations.

Determine what perspectives these scores provide, if any, on precipitation forecast when climatology of stations is taken into consideration.

Deliverables:

Report on the description of the method that is followed for the evaluation of precipitation forecasts over Greece.

Statistical results based on chosen case studies followed by conclusions/recommendations on using the methods.

Contributors

Task 2.2 (0.25FTEs): Dimitra Boucouvala, Flora Gofa, *Start 12.2019 – End 08.2020.*

Task 2. Overview of appropriate verification measures for HIW (WG5 related)

Question: How well high-impact weather forecast quality is represented with commonly used verification measures? What is the most appropriate verification approach?

Task 2.3 (RHM) Extreme Value Theory (EVT) approach- Fitting precipitation object characteristics to different distributions:

Work Steps:

Statistical analysis of precipitation object characteristics based on the radar data for Central Russia for warm and cold seasons.

Work with R Extremes library, fevd function (fitting extreme value distributions to data, plotting histograms, parameter estimation, probability densities, qq-plots, return periods, and other functionality). Fitting distributions of large object sizes (and probably, intensities) using fevd, qq-plots and pdf for observations of warm and cold periods.

Comparison of parameters of extreme value distributions of precipitation object characteristics during warm and cold season.

Preliminary research idea: to interpret parameters of Pareto distribution for forecasts and observations as systematic errors and to formulate recommendations for forecasters

Deliverables:

Histograms of statistical parameters of precipitation objects, comparative analysis of extreme value distribution parameters for precipitation objects during the warm and cold period. Proposals for forecast improvement using the information obtained.

Contributors

Task 2.3 (0.3FTEs): RHM: Anatoly Muraviev, Start 09.2019 – End 08.2020.

PP-AWARE

Project Duration: Sep 2019-Aug 2021 (2 years)

Project Participants

ARPAE-SIMC: Maria Stefania Tesini
DWD: Chiara Marsigli, Michael Hoff
HNMS: Flora Gofa, Dimitra Boucouvala
IMGW-PIB: Andrzej Mazur, Joanna Linkowska, Grzegorz Duniec,
MeteoSwiss: Daniel Cattani
NMA: Tudor Balacescu
RHM: Anastasia Bundel, Ekaterina Tatarinovich, Anatoly Muraviev

Next Steps

End of May (?) VideoConf on Tasks 3 & 4
Preparation of deliverable reports
PPAWARE meeting during GM Sept2020 (??)
Decision for participation on **HIWEATHER/WMO** and preparation of application

HIWeather

Benefits of Endorsement

Endorsement will:

- Increase the visibility of research activities (e.g., listing on website),
- Provide an international framework for your research which can help to leverage support and funding,
- Contribute to improving the coordination between different HIWeather-related activities,
- Enhance networking and communication.

A project may be endorsed by HIWeather if:

- It contributes to HIWeather goals as outlined in the HIWeather Implementation Plan.
- You provide a summary of the planned activities of the project, which will be made public through the HIWeather website (http://hiweather.net) and newsletters.
- You identify a contact point who will report progress in the project for inclusion in HIWeather reports and newsletters and on the HIWeather website.
- Your project website and published papers acknowledge the link with HIWeather.

HIWeather

When a project is endorsed by HIWeather:

- It can receive a letter of support, if required.
- Its aims will be visible to a wide, international community through listing on the HIWeather website and sharing with the HIWeather community.
- Its progress will be posted on the HIWeather website and included in the quarterly HIWeather newsletter, currently sent to over 200 recipients, worldwide, and advertised widely through social media.
- It will be referenced in the HIWeather annual report.
- It will be positioned in the HIWeather international framework of activities contributing to improved early warnings of weather-related hazards, possibly helping it gain support and funding.
- The contact point will have access to the HIWeather community, through invitations to HIWeather workshops and personal contact with an assigned member of the HIWeather Steering Group, providing enhanced networking and communication with related activities and the possibility of building new collaborations.