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 3 & 4

Status of Task 3 & 4

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 thermod	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 3: Verification applications (with a focus on spatial methods) to HIW

Question: Can spatial verification methods contribute to the proper evaluation of HIW phenomena and in what way?

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

This task will make use of the analysis and outcomes of Task 2. It is also connected with and continued from PP-INSPECT and MesoVICT projects on the spatial methods.

Task 3.6 Work on the comparative verification of NWC and NWP results using spatial verification methods as part of the SINFONY project at DWD.

Deliverables

Reports on development of the work

Applications of described methods to a chosen case study period in May/ June 2016

Presentation of results

Contributors

Subtask 3.6: DWD: Michael Hoff, FTE 0.1 Start 09.2019 – End 02.2021

Task 3: Verification applications (with a focus on spatial methods) to HIW

Question: Can spatial verification methods contribute to the proper evaluation of HIW phenomena and in what way?

Task 3.4 DIST methodology tuned on high-threshold events for flash floods forecast evaluation

Work steps:

For each catchment area, several parameters of the distribution of both the observed and forecast values will be computed.

Verification using a categorical approach, using a set of indices.

Verification of average values of precipitation over catchment areas will be used to investigate the ability of models in reproducing different amounts of precipitation.

Deliverables:

Reports on verification results using model with different resolution for different period of time.

Contributors

Subtask 3.4: ARPAE: Maria Stefania Tesini, FTE 0.1 Start 09.2019 – End 09.2020

Task 3: Verification applications (with a focus on spatial methods) to HIW

Question: Can spatial verification methods contribute to the proper evaluation of HIW phenomena and in what way?

Task 3.5: LPI verification and correlation of convective events with microphysical and thermodynamical indices.

Work steps:

Selection of intense precipitation events preferably for various weather regimes.
Analysis of lightning activity as derived by HNMS network and comparison with LPI
Construction of gridded observation datasets based on HNMS lightning network
Application of spatial methods techniques on lightning forecasts derived from models with different resolution mainly focused on structural characteristics
Analysis of lightning distribution characteristics in comparison with precipitation and other thermodynamic indices in order to determine what is the preferable tool for forecast of highly convective events.

Deliverables:

Application of the methodology and results on selected case studies. Conclusions based on the performed analysis

Contributors

Subtask 3.5: Flora Gofa, FTE0.15, Dimitra Boucouvala, FTE 0.15, Start 10.2019 – End 08.2020

Task 3: Verification applications (with a focus on spatial methods) to HIW

Question: Can spatial verification methods contribute to the proper evaluation of HIW phenomena and in what way?

Task 3.3. CRA (Contiguous rain area) and FSS analysis on intense precipitation

Work steps:

Preparation of idealized cases for testing.

Bug-fixing in craer R SpatialVx function (partially based on idealized cases).

CRA and FSS analysis on MesoVICT cases (more cases will be considered compared to INSPECT work)

Running CRA and FSS on summer and winter periods for the Central Russia COSMO-Ru and radar fields.

Possibly, the work in step 4 will be performed for reflectivity fields directly.

Deliverables

CRA scores and the FSS analysis for intense precipitation and (possibly) reflectivities.

<u>Contributors</u>

RHM: Anastasia Bundel, FTE 0.3, Start 09.2019 – End 08.2020

Task 3: Verification applications (with a focus on spatial methods) to HIW

Question: Can spatial verification methods contribute to the proper evaluation of HIW phenomena and in what way?

Task 3.1 Verification of forecasts of intense convective phenomena (thunderstorms w. lightning)

This subtask should supply with the extended knowledge of quality of HIW phenomena' forecasts, in connection with selected spatial verification methods (this study should supplement task 2, subtask 2.1 – see above – by the application of spatial methods) and from the point of view of parameterization/forecasts methods (task 4, see below).

Work Steps:

Verification of HIW phenomena using spatial methods (eg. SAL- the structure (S), amplitude (A) and location (L)) vs. archived data.

Verification of operational forecasts with current data (observations)

Recommendations

Deliverables:

Report on the verification approach and results for thunderstorms intensity forecasts with the use of predefined methods, recommendations and considerations.

Contributors

IMGW-PIB: Joanna Linkowska, FTE 0.3, Andrzej Mazur, FTE 0.2 Start 09.2019 – End 08.2021

Task 3: Verification applications (with a focus on spatial methods) to HIW

Question: Can spatial verification methods contribute to the proper evaluation of HIW phenomena and in what way?

DELAYED

Task 3.2 Lightning potential index (LPI) in mountain regions

Strong convection, storms are potentially phenomena that can cause significant damages, which could be prevented by accurate weather forecasts. The outcome of this subtask should be the estimation of quality of the local LPI (Lightning potential index) forecasts received by MeteoSwiss end users. LPI will be integrated into the COSMO operational chain at MeteoSwiss and will be used to supply several products (See Task 4.3.1.)

Work steps:

Integration in the operational chain of COSMO-1, and COSMO-e

Tests of the flash conversion rate LPI to flash numbers

Case studies, and verification

Comparison with the IFS products for end users

Deliverables

Reports on the quality of LPI forecasts at MeteoSwiss

<u>Contributors</u>

MCH: Daniel Cattani, FTE 0.1 Start 09.2019 – End 08.2021

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.

Task 4: Overview of forecast methods, representation and user-oriented products linked to HIW (WG4 related)

Question: How well is HIW is represented in postprocessing? What are the pros/cons of DMO vs. PostPro with respect to HIW phenomena predictions? What is the current predictive skill, and the user's interpretation of forecast value in high-impact weather situations (observed and/or forecast)?

HIW phenomena studied: fog/visibility, convection related CW (thunderstorms, lightning, hail, squalls, showers, tornadoes, super-cell storms, flash floods, Wind hazard forecasting, wind metrics that relate to impacts)

The task will provide an overview of direct model output and postprocessing methods: describe the state of the art in predicting HIW; identify processes that lead to high impacts; make recommendations for targeted work to address weaknesses in understanding and predicting them. This task also touches on the question of decision-making based on CW/HIW forecasts.
The output of this task is improvement in providing COSMO users with forecast/warnings of the most important HIW events

Task 4.1. Postprocessing vs. direct model output for HIW, RHM

Deliverables

- An overview of existing DMO methods for fog/visibility forecasts
- An overview of existing postprocessing methods for fog/visibility forecasts
- An overview of most widespread postprocessing methods for forecasting CW events related to convective processes (thunderstorms, lightning, hail, squalls, showers)
- Comparison of the scores of post-processing techniques, direct model output, and human forecasts for HIW events, where possible
- Recommendations to the COSMO community as to the best choice of the forecast method of the events considered in this subtask

Contributors

- E.Tatarinovich, FTE 0.3 **ONGOING** **-> Presentation**
- A.Bundel, FTE 0.2 **STARTED BUT DELAYED**

Start 09.2019 – End 08.2021

Task 4.2 Improving existing post-processing methods, IMGW-PIB

-> Presentation

Deliverables

- Partial reports on the quality of various forecasts methods, advantages and disadvantages; conclusions (recommendations) of hind-cast evaluation, esp. of ANN vs. MLR and ALSR; recommendations for future and operational use
- Report on the verification results of **visibility range??** and thunderstorms intensity with the use of predefined methods; possibly paper in peer-reviewed journal, recommendations and considerations

Contributors

- Andrzej Mazur, FTE 0.15, Grzegorz Duniec, FTE 0.1, Start 09.2019 – End 08.2021 **ONGOING**

It is proposed to stop this task within PP AWARE and move it to new PP MILEPOST as soon as it is accepted with shifting the rest of FTEs to MILEPOST

Intermediate rerport in AWARE?

Task 4.3 QPF evaluation approaches, ARPAE-SIMC

-> Presentation

The evaluation of the amount of precipitation over catchment areas is one of the most important use of the QPF at ARPAE for hydrological purpose and for the issuing of Civil Protection alert for possible floods. To meet the needs end-users, such as hydrologists or forecaster, we have developed some tools that provide mean, maximum and some other percentiles values of the precipitation field over the catchment areas of the Emilia-Romagna region. Exceeding predefined thresholds can give useful indications for situations of intense precipitation possibly leading to floods.

Deliverables

- An overview of all the products provided to the end-user (forecaster or hydrologist)

Contributors

- ARPAE-SIMC, Maria Stefania Tesini, FTE 0.1, Start 09.2019 – End 12.2020 **ONGOING**

Task 4.4. Representing and communicating HIW forecast for decision making -> Presentation

- This subtask will describe approaches to representing and communicating HIW forecasts/warnings for a wide range of users (the kind of users depends on the country/institution) with examples (maps, test messages, symbols). It will compare data transfer channels to communicate HIW forecasts: internet sites, sms lists, e-mail, radio, mobile apps vs. “common” transfers.

Deliverables

- Overview of approaches to communicating high impact weather to different categories of users
- Feedback from users
- Examples of representing HIW forecasts

Contributors

- RHM, Anastasia Bundel, FTE 0.1, Start 01.2020 – End 08.2021 **ONGOING**

  It is proposed to include Inna Rozinkina: a document is being prepared: “**How to provide high-res NWP for adverse weather forecasting**
- NMA, Tudor Balacescu, FTE 0.1, Start 06.2020 – End 09.2021 **DELAYED**

Task 4.5 Product generation and calibration of convection-permitting ensemble, DWD

- The work consists in generating products from a seamless ensemble for the prediction of convective events. To pursue this aim, upscaling of the fields and calibration of the model output will be investigated. Among the project objectives, the proposed subtask deals with the predictability of high impact weather (thunderstorms) and with the generation of products for their prediction, which can be effectively used by the forecasters.

Contributors

- DWD, Chiara Marsigli, FTE 0.2, Start 09.2019 – End 09.2020 **POSTPONED OR CANCELLED**

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

Preparation of deliverable reports
PPAWARE meeting during GM Sept2020 (??)
Submission of **HIWEATHER/WMO** application