PP-AWARE: Appraisal of "Challenging WeAther" FoREcasts

Joint Project Proposal: ***WG5 &WG4 (collaboration with WG7)***

The goal of the PP is to provide COSMO Community with an overview of forecast methods and forecast evaluation approaches that are linked to high impact weather (not necessarily considered extreme to all users).

Key forecast quality and verification aspects to consider in this project include:

- How well high-impact weather is represented in the observations, including biases and random errors, and their sensitivity to observation density.
- How well high-impact weather is represented in models, including systematic and stochastic errors, and their sensitivity to model resolution.
- How well high-impact weather is represented in postprocessing.
- The predictability, current predictive skill, and the user's interpretation of forecast value in high-impact weather situations (observed and/or forecast).

Motivation

• In COSMO consortium, there have been several studies partially related to CW aspects. However, **up to now there haven't been a project explicitly focusing on evaluation and development of HIW forecasts**

• Necessity to tackle scientific problems, **which step beyond the concerns of a single strategic area and a Working Group**

• Challenging weather (CW) or high impact weather (HIW), are events the local society is not routinely experiencing: **extreme in amplitude** (intense winds, or heavy convective precipitation), **rare** (lie in a tail of climatological distribution for a particular location) or high impact by being **prolonged 'regimes'** (droughts, heat-waves or cold-spells), while others can be considered **challenging if society is particularly vulnerable** (e.g. impact of fog on transportation).

Changes in PP plan since January 2019 SMC:

- **PP content was again discussed during ICCARUS in WG5-WG4 meeting**
- **Participants provided written detailed feedback: phenomena to study, motivation with respect to project objectives, description of work in steps, deliverables)**
- **Elimination of conflicts in subtask work**
- **Some SubTasks were deleted or connected**

Proposed Tasks

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.

Task 1.1 Overview of CW/HIW observational data sources characteristics Review of available sources, estimation methodologies, and associated error.

Andrzej Mazur, IMGW-PIB, Anastasia Bundel, RHM

Task 1.2. Approaches to introduce observation uncertainty

Analysis of observation uncertainty contribution to verification scores focused on HIW forecasts

Anastasia Bundel, RHM.

Total Resources Task1: 0.2FTEs

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).

Task 2.1 Survey for assessment of proper verification of phenomena – continuous vs. discrete verification (occurrence vs. specific values). Andrzej Mazur, Joanna Linkowska, IMGW-PIB

Task 2.2 Role of SEEPS and EDI-SEDI for the evaluation of extreme precipitation forecasts

Flora Gofa, Dimitra Boucouvala, HNMS

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

Total Resources Task2: 0.9 FTEs

Task 3: Verification applications (with a focus on spatial methods) to HIW (WG5 and WG7 related). This task will make use of the findings of Task 2 and is connected with and continued from PP-INSPECT and MesoVICT projectsFeature-based analysis of intense precipitation patterns. Spatial methods on a probabilistic approach

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).

Task 3.1 Verification of forecasts of intense convective phenomena (thunderstorms w. lightning) and visibility range (fog). Joanna Linkowska, IMGW-PIB

Task 3.2 Lightning potential index (LPI) in mountain regions. Daniel Cattani, MCH

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

Anastasia Bundel, RHM

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

Maria Stefania Tesini, Arpae-SIMC

Task 3.5 LPI verification and correlation of convective events with microphysical and thermodynamical indices. Dimitra Boucouvala, F. Gofa, HNMS

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.

Michael Hoff, DWD

Total Resources Task3: 1.4FTEs

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, flash floods)

Task 4.1 Postprocessing vs. direct model output (DMO) for HIW. E.Tatarinovich, A. Boundel, RHM

Task 4.2 Improving existing forecast methods. Andrzej Mazur, Grzegorz Duniec, IMGW-PIB

Task 4.3 QPF evaluation approaches. Maria Stefania Tesini, Arpae-SIMC

Task 4.4 Representing and communicating HIW forecast for decision making

Anastasia Bundel, RHM and Tudor Balacescu, NMA

Task 4.5 Product generation and calibration of convection-permitting ensemble

Chiara Marsigli, DWD

Total Resources Task4: 1.25FTEs

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

Total Resources: 4.15 FTEs

RHM: 1.5FTEs, IMGW-PIB: 1.2FTEs, HNMS: 0.75FTEs, DWD: 0.3FTEs, ArpaE-SIMC: 0.2FTEs, MCH: 0.1FTEs, NMA: 0.1FTEs