PNOWWA Summary

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The **major scientific result** of PNOWWA is the development of a new method for nowcasting snowfall based on extrapolation of movement analysed in consequent radar images, assessing the uncertainties of snowfall nowcasting related to growth and decay using the scale analysis and ensamble nowcasting technologies.

PNOWWA has demonstrated the benefits of very short-term (0-3h nowcast) probabilistic winter weather forecasts, which are based on identification and extrapolation of the movement of weather radar echoes with 15min time resolution. The PNOWWA project has shown the improved predictability of changes in snowfall intensity caused by underlying terrain, such as mountains and lakes or sea. This was performed through **two research demonstrations** that were conducted both offline and online at Operative User Environment (OUE) sites at the airports of Innsbruck and Helsinki.

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An extensive **user consultation survey** was performed. It involved Austria, Denmark, Finland, Germany, Norway and Switzerland. Various airport types were considered, like big hubs, small airports and even alpine airports with weekend traffic peaks due to winter charter flights.

Based on the survey, majority of stakeholders see most potential for probabilistic weather forecasts to help render decisions objectively, and secondly by using them in decision support when cost-loss ratios are known. A general **positive and open attitude toward probabilistic forecasting** and its benefits by respondents was evident.

For most of the stakeholders this survey served as an informational and educational activity.

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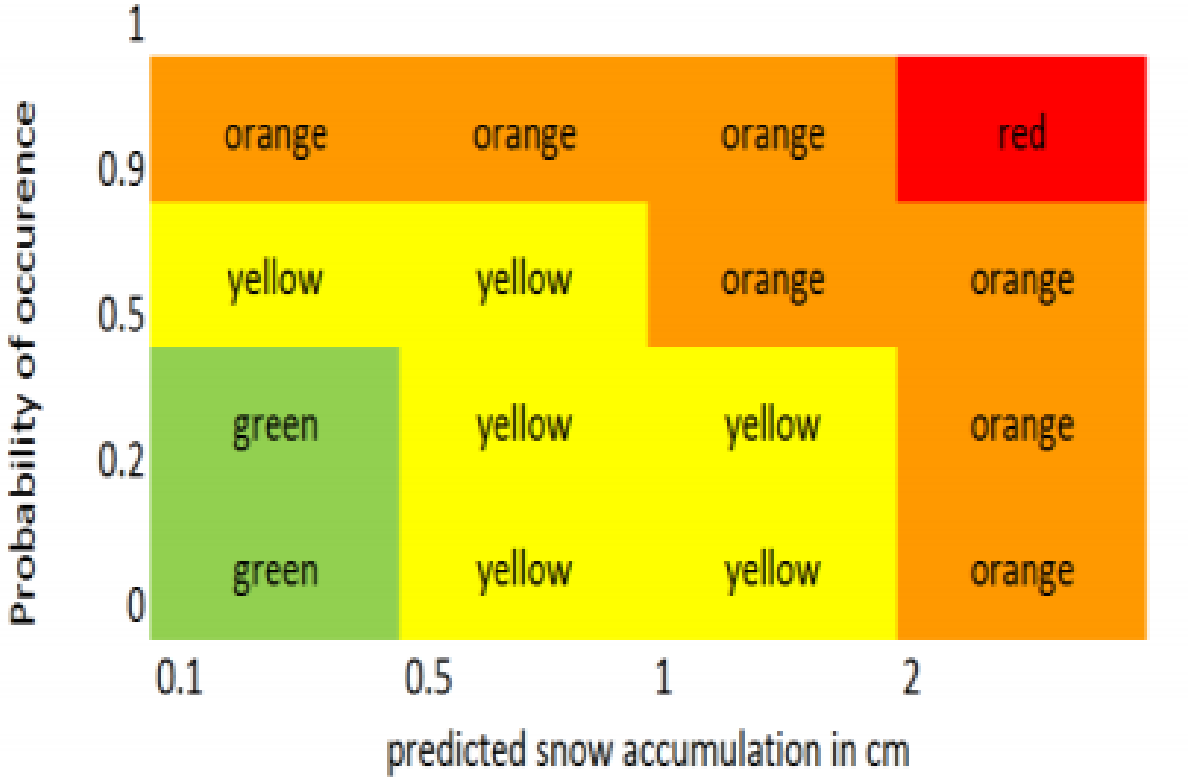
Based on the maturity analysis performed for contribution of PNOWWA project to Enabler METEO- 04d, it can be concluded that the METEO-04d has reached the maturity represented by Technology readiness Level 1 (**TRL 1 INTERMEDIATE**). During the PNOWWA development process, needs to update the Enabler METEO-04d were found and update of the METEO-04d were suggested.

The methodologies that were developed utilizing probabilistic radar-based nowcasting and tested in actual operational ATM environment need to be brought up to higher TRL levels. The **first next step** on this should be an applied research project to bring the PNOWWA methods up to **TRL 2**.

Impact based matrix for LOWW runway clearance



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Recommendations for future R&D activities (Next steps)

- Getting the current PNOWWA method of 0-3 hours winter weather nowcast into TRL2
- Extending the PNOWWA forecasting system up to 48 hours
- Adding new parameters (cloud ceiling, reduced visibility due to fog) through data fusion into the PNOWWA method to improve the forecasting scheme
- Adding information from adjusted road weather models and existing TAF, METAR parameter information into the PNOWWA method

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Outline of a possible PNOWWA-related future research activity

Specific challenge: Winter weather has major short-term (0 to 3 hours) impacts on the aviation and airport efficiency, and it affects all levels of aviation from airplane landings to the airport (e.g. runways) maintenance. The methodology to predict probabilistically the winter weather conditions during the next few (0-3) hours has been developed, and this allows for the development of decision making tools, processes and precise winter weather nowcasting prediction models. The current methodology calls for an extension to predict probabilistically the winter weather conditions beyond the first few hours, e.g. for the period of the next two days. The whole methodology needs to be tested by a specific real-time research demonstration with product visualization tools for the decision-making systems having tight interaction with ATM stakeholders.

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Scope: Research work may investigate the improvement of the short-term nowcast models (0 to 3 hours) by involving additional winter weather related parameters into the probabilistic nowcasting methodology through data fusion. Also specific local micro-weather models could be utilized by merging the model results with the nowcasts.

Extending the prediction to cover the next two days would require to include numerical weather prediction through ensemble prediction system (EPS) and to blend the EPS results seamlessly with the nowcasting results of the first few hours.

Expected impact: This research will enhance the understanding of the specific ATM stakeholder user needs and generate suggestions and prototypes of winter weather services and tools to be developed for the operational use in ATM field.

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Thank you very much for your attention!

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