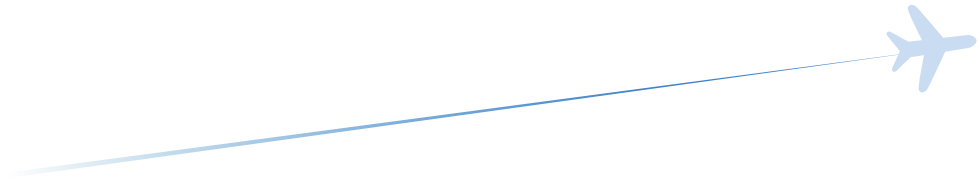

Survey of User Opinions of Demonstrated Product

D4.3 - SUODP

PNOWWA

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PNOWWA

PROBABILISTIC NOWCASTING OF WINTER WEATHER FOR AIRPORTS

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Abstract

After PNOWWA winter 2017 demonstration campaign, user feedback was collected and demonstrates the principal applicability and reliability of probabilistic winter short term forecasting. Further stakeholder training in using impact based probabilistic forecasts is necessary and the benefit of the use is strongly dependent from proper calibration of probability thresholds.

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Abbreviations

ATM	Air Traffic Management
APOC	Airport Operation Centre
EFHK	Helsinki International Airport
EFRO	Rovaniemi International Airport
LOWI	Innsbruck International Airport
LOWW	Vienna International Airport
MET	Aeronautical Meteorological Service
PNOWWA	Probabilistic Nowcasting of Winter Weather for Airports

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Executive Summary

This deliverable document contains documentation regarding the PNOWWA survey of user opinions of demonstrated PNOWWA project product. According to the survey The PNOWWA demonstration product showed principal applicability and reliability of the short term winter forecast quality during demonstration campaign 2017. Stakeholders saw the potential and benefit of probabilistic weather forecast to help render decision more objective at a glance. But further user training and information is necessary.

1. Introduction

Probabilistic winter weather forecasts for airports have been introduced in a workshop and different meetings with main stakeholders, such as ATM, runway maintenance, de-icining and airliners at airports (see PNOWWA deliverables 'D4.1 PNOWWA Survey of user Needs' and 'D4.2 PNOWWA User needs for Demonstration'). Additional, surveys and individual contacts defined user needs and adequate impact based thresholds. Subsequent, an online PNOWWA product demonstrator at 4 airports were provided during recent winter (February/March 2017), which was updated every 15 minutes.

The demonstration phase should deliver user feedback about applicability and benefit of the concept of probabilistic short term forecasting (up to 3 hours) for airport operation during adverse winter weather. Selected user groups are ATM, runway maintenance and de-icing. For verifying the quality of the PNOWWA product two topographic different regions within Europa are selected, Austria with alpine character and Finland with flat areas but strong influence of Baltic sea at Helsinki airport and stronger winter conditions far north at Rovaniemi airport. Additional small airports (Rovaniemi, or Innsbruck - which is dominated by winter charter traffic) are compared to large hub based airports (Vienna, Helsinki).

In next chapter, user feedback and opinion is summarized on a country basis. The information has been collected to prove the concept of probabilistic winter weather nowcasting and to improve and verify the quality and handling of the product (see also PNOWWA deliverable 'D6.1 – Report of simulation campaign' for first modification of the product during demonstration phase).

2. Questionnaires for user feedback / opinion

The feedback of first PNOWWA 2017 scientific demo is summarized for Austria and Finland.

2.1 Summary – Austria

The summary of the feedback of first scientific demonstration of PNOWWA 2017 from LOWW and LOWI (see Table 1) are based on 6 individual representatives from APOC, runway maintenance, ATM and MET (Austro Control, Innsbruck airport and Vienna airport).

Remark: Due to warm winter, no snow fall events occurred during demonstration campaign in Austria.

Table 1: The summary of the feedback of first scientific demonstration of PNOWWA 2017 from LOWW and LOWI.

Questions	**User Opinion**
Did you use the product? How often?	LOWW, LOWI: no snowfall during demonstration phase LOWI: reduced visibility due to fog not indicated in PNOWWA product LOWI: snow shower from north after the demonstration phase showed short lead times
What was your general opinion for service?	undefined more user training and experience necessary Proper definition of probability-impact thresholds necessary for using in decision support systems – very sensitive (LOWW runway maintenance)
Your specific opinions about	
1. Layout of product?	OK (auto update and time-step included)
2. Relevance of thresholds used?	LOWI: OK, but ceiling would be necessary parameter for ATM LOWW: OK, but different colour coding for

	probability values (APOC, MET)
3. Accuracy of snow accumulation?	not verified
4. Correctness of snow type dry/wet?	not verified
5. Correctness of the timing of snow periods	not verified
6. How easy/difficult it was understand what the probability means in forecast?	MET is used to work with probabilities APOC, ATM not used to work with probabilities (further user training necessary, proper impact based thresholds has to be defined/calibrated for a decision support system)
7. How easy/difficult it was understand how you can use the probability information in decisions making of your own work?	difficult LOWW runway maintenance used 2 forecasts and set wrong impact based thresholds of probability of snow fall which caused an increase of used chemicals in winter 2016/2017 safety first decisions
What kind of proposals you have for further develop the product so, that it will gives more value for you?	APOC + ATM: training in November MET: use of exceedance of probabilities
Are you interested in PNOWWA probability forecast product for historic events (high impact winter weather at your airport – recent winter or past)?	LOWW 8/9.Feb 2017
Are you interested in participating next year's winter demonstration for your airport?	yes

2.2 Summary – Finland

Summary of user opinions from EFHK and EFRO (see Table 2) are based on 9 individual contacts to users from Finnair, Swisport and Finavia.

Table 2: Summary of user opinions from EFHK and EFRO.

Questions	User Opinion
Did you use the product? How often?	At EFRO users used the products, that were familiar to them, demo product was not really used. At EFHK Finnair used 2-3 times occasionally, other users couldn't tell how many times it was used.
What was your general opinion for service?	It would have been more interesting product early winter, demo was a bit too late. Will be useful for estimation of the capacity and need of de-icing. Similar product should be available to all airports.
Your specific opinions about	
1. Layout of product?	Colouring could be coded by some other way. That should be planned together.
2. Relevance of thresholds used?	Ok.
3. Accuracy of snow accumulation?	no opinions
4. Correctness of snow type dry/wet?	no opinions
5. Correctness of the timing of snow periods	no opinions
6. How easy/difficult it was understand what the probability means in forecast?	Principally it is clear.
7. How easy/difficult it was understand how you can use the probability information in decisions making of your own work?	In runway maintenance they have a good ability to user probability information.
What kind of proposals you have for further develop the product so, that it will gives more	More information about the product needed before next winter. Exceedance probabilities are

value for you?	more useful.
Are you interested in PNOWWA probability forecast product for historic events (high impact winter weather at your airport – recent winter or past)?	Not discussed.
Are you interested in participating next year's winter demonstration for your airport?	Yes

2.3 General aspects of user opinions

In this chapter, user opinions are summarized for Austria and Finland with respect to pre-demonstration information from stakeholders at European airports (see PNOWWA deliverables 'D4.1 PNOWWA Survey of user Needs' and 'D4.2 PNOWWA User needs for Demonstration') and user feedback during the first demonstration phase ('D6.1 PNOWWA Report of simulation campaign'). User comments are highlighted, assessed by the project team, to be most relevant for probabilistic nowcasting of winter weather.

2.3.1 Applicability and reliability of the product:

The online demonstration went in operation with beginning of February 2017 and produced nowcasts in 15 minute intervals. After first feedback of bad forecast quality of the product, correction in radar motion vectors was applied and resulted in feedback of reliable good quality for Finland. Additional feedback was given for one case of good discrimination between wet and dry snow. Freezing rain didn't occur during the demonstration campaign 1. Additional first tests showed reliable results, because the product didn't show rapid changes from time step to time step, which was a concern of stakeholders at the beginning of the project. All collected case studies for winter 2016/2017 have been verified (see PNOWWA webinar presentation "*Snow nowcasts with extrapolative methods. Case studies and lessons learned.*" by E. Saltikoff, S. Pulkkinen and M.Hagen.) and showed good results of snowy and dry periods using probabilities of 50% for snow. Selected case studies will be public for further analyses.

Previous feedback shows, that the product was analysed and used by stakeholders. Additional requests from users, such as a comprehensive seamless forecast product which should be available to all airports, including visibility reduction due to fog, including ceiling information during snowfall, extension of the lead time and individual colour coding supports the fact, that the product might be very useful for airport operation during adverse winter weather.

2.3.2 Use of probability and calibration:

Probabilistic forecasting is nowadays used in meteorology to quantify uncertainty. In contrast with deterministic forecasting, the natural intrinsic variability of weather and the uncertainty in the observations and in the forecast process itself are considered. Probabilistic information in the demonstrator is created by generating an ensemble of nowcasts. Analysed case studies demonstrate the intrinsic uncertainty of weather, which show the decrease of probability with increasing lead time. Then the user must choose proper probability thresholds, which gives them the correct balance

of alert and false alarms for specific applications. Hence, an objective quantity of uncertainty results, which means increasing risk of wrong decision with lower likelihood. Therefore, results from user survey show, a majority of stakeholders see most potential for probabilistic weather forecasts to help render decisions more objective. E.g. in LOWW probability forecast have been introduced during last years and impact based matrix was defined with runway maintenance (see D4.2: 'PNOWWA User needs for Demonstration'). Also at EFHK, the user opinion reflects most potential for this user group. By the other hand, using to low thresholds of probability (to be on the safe side) during last winter 2016/2017 in LOWW, caused a theoretical increase of chemical cost for the airport in contrast to previous years. In individual contacts, user stated the risk of incidents, when low likelihood of adverse winter weather might be neglected. The calibration of probability might be addressed in follow-up projects, because the thresholds for defined parameters and pre-defined snow heights should be based on statistics over several years, taking into account all the complex interaction between different stakeholders, air traffic and adverse winter weather. Economic key performance indicators can be established, but safety aspect and a holistic aeronautical approach has to be considered. At the end, probability forecasts lead to advantages on an average basis, potentially not on a single event. In this context, e.g. Oslo airport stated possible use of probabilistic forecasts depending from traffic load and EFHK user opinion reflect the ability for the estimation of capacities and the need for de-icing for all airports.

Another user opinion was the change from most probable class to exceedance of probability. This reflects, that stakeholder searching for potential in use of this probability information and the rise of awareness. Next demonstrator for winter 2017/2018 is prepared for this change. Second demonstration phase (not included in project plan) offers the possibility for additional adverse winter conditions at airports and subsequent additional feedback from users. As requested in the user opinions, the demonstrator will start with beginning of the winter period to collect more cases of different aspects (e.g. different weather pattern, different airports: large/small/topographic influences, different air traffic). Additional we try to get closer in contact with users during adverse weather episodes and we will introduce exceeding probability in next winter demonstrator, as more training was requested in the user opinion.

3. Conclusions

The PNOWWA demonstration product showed principal applicability and reliability of the short term winter forecast quality during demonstration campaign 2017. Stakeholders saw the potential and benefit of probabilistic weather forecast to help render decision more objective at a glance. But further user training and information is necessary and the product should available from beginning of winter period. The definition or calibration of the proper thresholds of probability for each class is essential, when different user preparation depends on event, likelihood, and air traffic. Additional those actions are overlaid by safety priority in aviation and the complex interaction between different airport operations. E.g. in LOWW the use of very low probabilities for low snow fall heights caused high consumption of chemicals for runway maintenance for ordinary snow events. This point out the need for proper adjustment of used probabilistic classes and the gathered feedback of individual colour coding of the product.

A change from most probable class to exceedance of probability was discussed with users, which might be more useful because of the stronger effect of highlighting of adverse winter weather in the PNOWWA product. Most probable class showed the mean of an ensemble, while the exceedance of probability will show the percentage of ensemble for all different classes, even lower probability values for severe events.

Stakeholder requested additional information of cloud ceiling, longer lead time and to include all weather elements such as e.g. fog in an entire decision support system, but those points are beyond the PNOWWA product which is designed for short term nowcasting of winter weather using weather radar data only.

References

1. PNOWWA deliverable D4.1: 'PNOWWA Survey of user Needs', 2017
2. PNOWWA deliverable D4.2: 'PNOWWA User needs for Demonstration', 2017
3. PNOWWA deliverable D6.1: ' Report of simulation campaign', 2017
4. 'Snow nowcasts with extrapolative methods. Case studies and lessons learned. ' E. Saltikoff, S. Pulkkinen and M.Hagen, PNOWWA webinar 4.10.2017.