Documented Datasets with Description and Info Page

D6.2 – DDDIP

PNOWWA

Grant:	**699221**
Call:	**H2020-SESAR-2015-1**
Topic:	**Sesar-04-2015**
Consortium coordinator:	**Finnish Meteorological Institute**
Edition date:	**[11 October 2017]**
Edition:	**[00.01.00]**

Founding Members

EUROPEAN UNION EUROCONTROL

SESAR JOINT UNDERTAKING

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Document History

Edition	Date	Status	Author	Justification
00.01.00	11.10.2017	First release	Elena Saltikoff Harri Haukka	

PNOWWA

PROBABILISTIC NOWCASTING OF WINTER WEATHER FOR AIRPORTS

This document is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 699221 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document describes two datasets of probability forecasts for winter weather at airports. The snow fall events occurred during the first PNOWWA demonstration campaign in winter 2017 in Helsinki and Innsbruck. The datasets made available at the PNOWWA website.

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Abbreviations

ATM	Air Traffic Management
dBZ	Radar Reflectivity
EFHK	Helsinki-Vantaa airport
LOWI	Innsbruck airport
P1	First data column
P2	Second data column …
PNOWWA	Probabilistic Nowcasting of Winter Weather for Airports
T	Temperature
Td	Dewpoint
UTC	Universal Time Coordinated

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Executive Summary

This deliverable document contains documentation regarding the two datasets of PNOWWA probability forecasts for snow. These datasets (in raw format) are available in PNOWWA website (http://pnowwa.fmi.fi) intranet section. This deliverable consists of this description and info document and the datasets located in the PNOWWA webserver.

Two datasets of PNOWWA probability forecasts for snow that are made available:

- Nowcasts for Helsinki-Vantaa airport EFHK
- Nowcasts for Innsbruck Airport LOWI

Both datasets cover month of February 2017.

Direct links to the datasets are:

- EFHK: http://fmispace.fmi.fi/fileadmin/PNOWWA/EFHK_Feb2017.tar.gz
- LOWI http://fmispace.fmi.fi/fileadmin/PNOWWA/LOWI_Feb2017.tar.gz

In Appendix there are short examples regarding the raw data files for both EFHK and LOWI that were used in preparation of this deliverable.

1 Introduction and Potential Use

PNOWWA - Probabilistic Nowcasting of Winter Weather for Airports – is a research project developing methods to support the Air Traffic Management (ATM) challenged by winter weather. In winter 2017, PNOWWA organized a real-time demonstration campaign providing to selected end-users very short-term (0-3h nowcast) probabilistic winter weather forecasts in 15min time resolution based on extrapolation of the movement of weather radar echoes.

This deliverable documents two datasets saved during the campaign, which are made available in the PNOWWA Website: one for Helsinki-Vantaa airport in Finland, one for Innsbruck Airport in Austria. Helsinki-Vantaa is located 30 km from the sea, Innsbruck is surrounded by mountains. There are 2886 comparable forecasts of different lengths and intensities for each location. In total, the dataset consists of 450 000 probability forecasts.

By providing the datasets openly, PNOWWA wants to encourage students and fellow researchers to play with the data, compare it to other data sources and to get familiar with the concept of probability forecasting.

The dataset also works as sample for any potential end users, who want to either assess the usefulness of such forecasts in their applications, or to get familiar with the data format.

2 Data Structure

The data is saved in .txt files, each containing 13 lines for 13 forecast lengths. Separator is semicolon ";".

The filename type is Year month date submission time _ airport _rainprob_PNOWWA.txt

For example `201702010000_LOWI_rainprob_PNOWWA.txt`

`The probability forecasts are generated at 1st Feb. 2017 00:00UTC for Innsbruck Intl. airport.`

In the file, each forecast line consists of valid time, and two sets of 4 probabilities: first set using thresholds agreed for dry snow, second set for wet snow. (In PNOWWA production process, selection of which forecast to use was made only at the later phase of production chain, hence both sets are always calculated).In case or rain, the thresholds of wet snow should be used. .

- The thresholds for dry snow are 15.5 dBZ, 24.5 dBZ, 29 dBZ.
- The thresholds for wet snow are 19.5 dBZ, 23.5 dBZ, 29 dBZ.

The same probability tables can be interpreted to probabilities for certain classes of other parameters (snow depth, visibility, de-icing weather type), when the thresholds are converted using table 1. When temperature is below -1 C and dewpoint below -0C, the lower part oof the table should be used, otherwise the upper part. . E.g. dry snow accumulation forecast between 5 and 10 mm within 15 minutes results from extrapolated radar reflectivity between 24.5 and 29 dBZ accompanied by surface temperatures below 0 °C and dewpoints below -1 °C.

Table 1: Conversion table for radar reflectivity dBZ into snow fall intensities and corresponding visibility for wet and dry snow depending from temperature (T) and dew point (Td) from surface observations and numerical model data.

Class Wet snow (M0<T<=3 and Td<=0); T and Td defined from combination of METAR and HIRLAM model output.

snow accumulation (mm) / 15 min	water equivalent mm/h	Visibility class (m)	De-icing weather type	dBZ
>5	>=4	<=600	3	>29.0
2-5	1.6-4	600-1500	3	23.5-29.0
1-2	0.8-1.6	1500-3000	2	19.5-23.5
<1	<0.8	>3000	0	<19.5

Class Dry snow (T<=M0 and Td<=-1); T and Td defined from combination of METAR and HIRLAM model output.

snow accumulation (mm) / 15 min	water equivalent mm/h	Visibility class (m)	De-icing weather type	dBZ
>10	>=4	<=600	3	>29.0
5-10	2-4	600-1500	3	24.5-29.0
1-5	0.4-2	1500-3000	2	15.5-24.5
<1	<0.4	>3000	0	<15.5

Example:

```
2017-02-01 01:15:00;0.87;0.12;0.01;0.00;0.96;0.03;0.01;0.00
```

Forecast is valid 01:15 UTC on 1st February 2017.
Probability for intensity below 15.5 dBZ is 0.87.
Probability for intensity between 15.5 and 24.5 dBZ is 0.12.
Probability for intensity between 24.5 and 29 dBZ is 0.01.
Probability for intensity above 29 dBZ is 0.00.

Probability for intensity below 19.5 dBZ is 0.96.
Probability for intensity between 19.5 and 23.5 dBZ is 0.03.
Probability for intensity between 23.5 and 29 dBZ is 0.01.
Probability for intensity above 29 dBZ is 0.00.

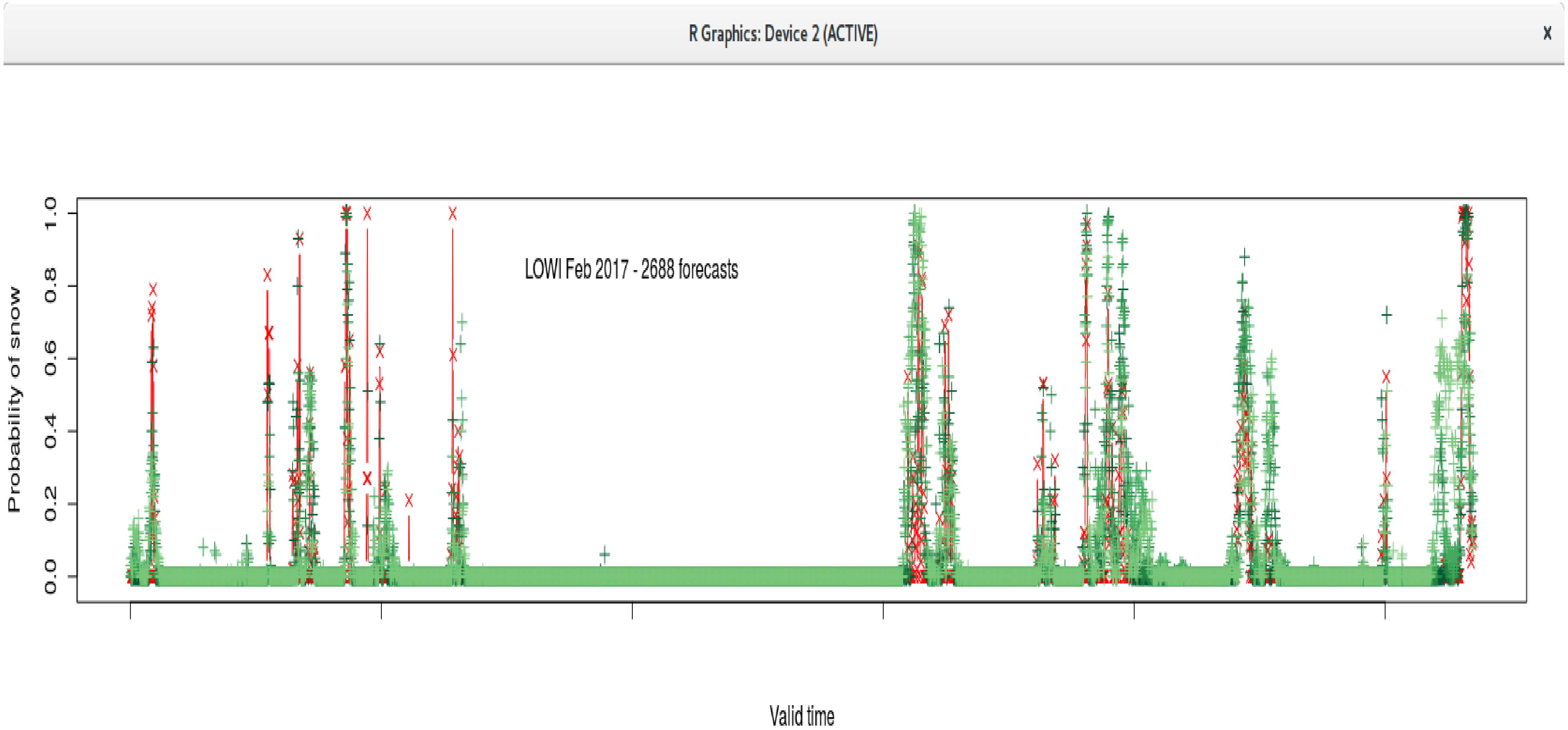
Missing data is indicated with -1.00.

3 Examples of Visualisation

Following examples of visualization demonstrate the use of PNOWWA data and helps to check proper data import in your own application or programs.

Note that each file contains forecasts issued at the same time. If you want to collect forecasts which are valid at the same time (as in our sample visualizations), you need to build a simple table.

3.1 Time series of entire month (February 2017)



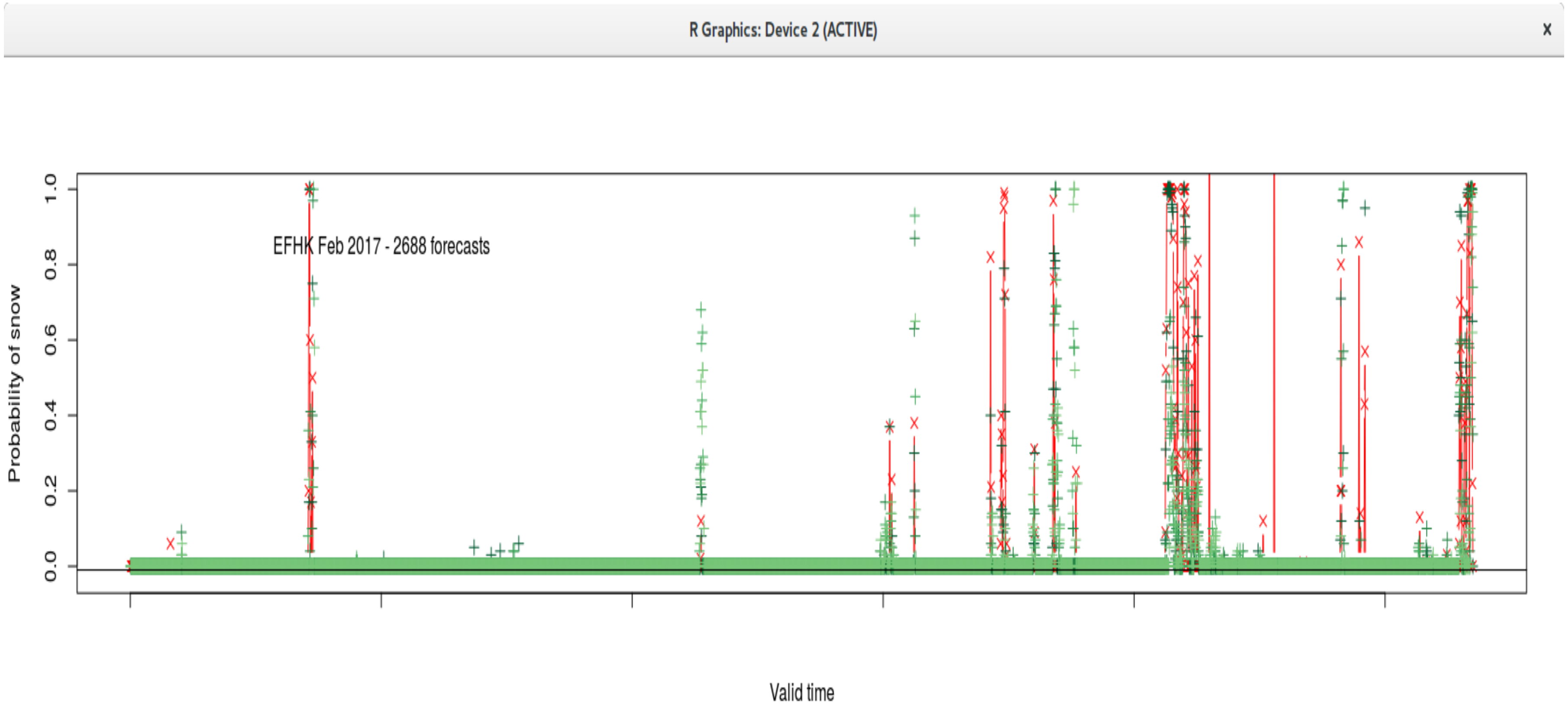


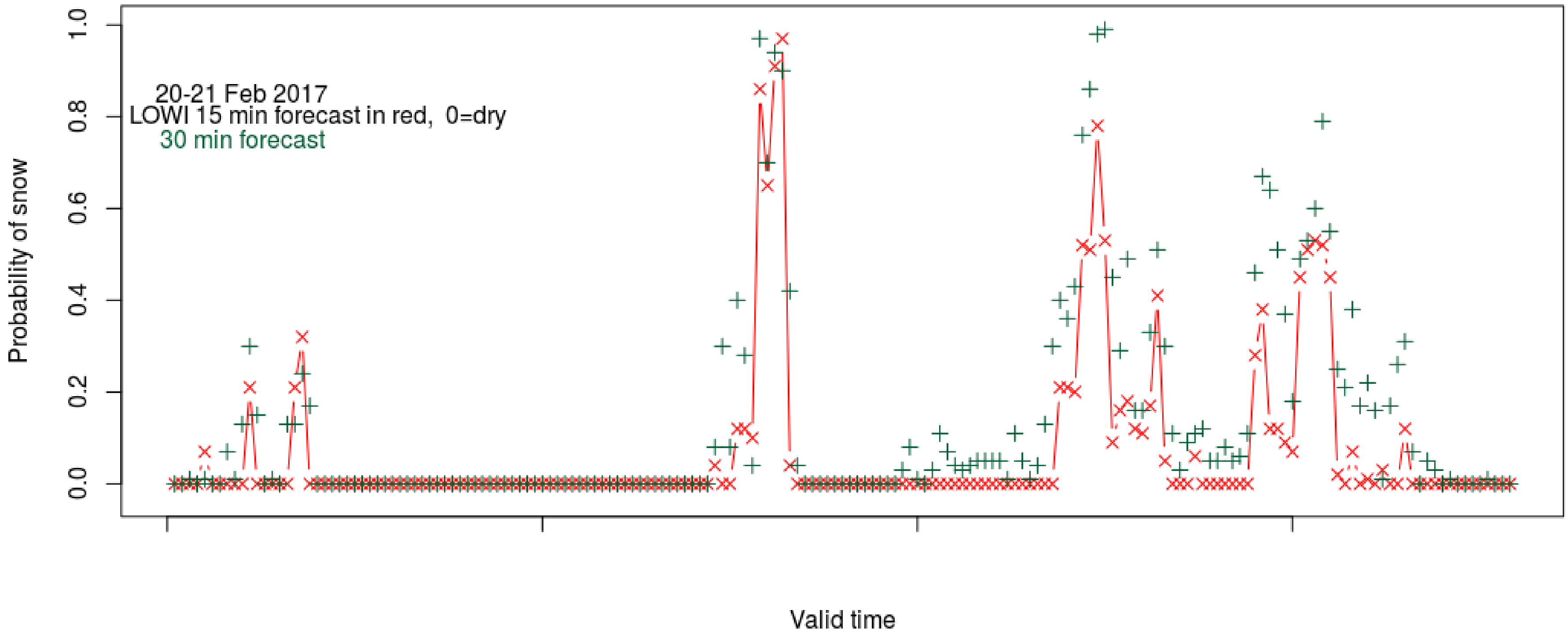
Fig. 1 Time series of forecasted probability in LOWI (upper panel) and EFHK (lower panel) for radar reflectivity larger than 15.5dBZ . Red colour represents observation (see text for further explanation, while green shows forecast probabilities (dark green…30 min forecast, light green … 120 min).

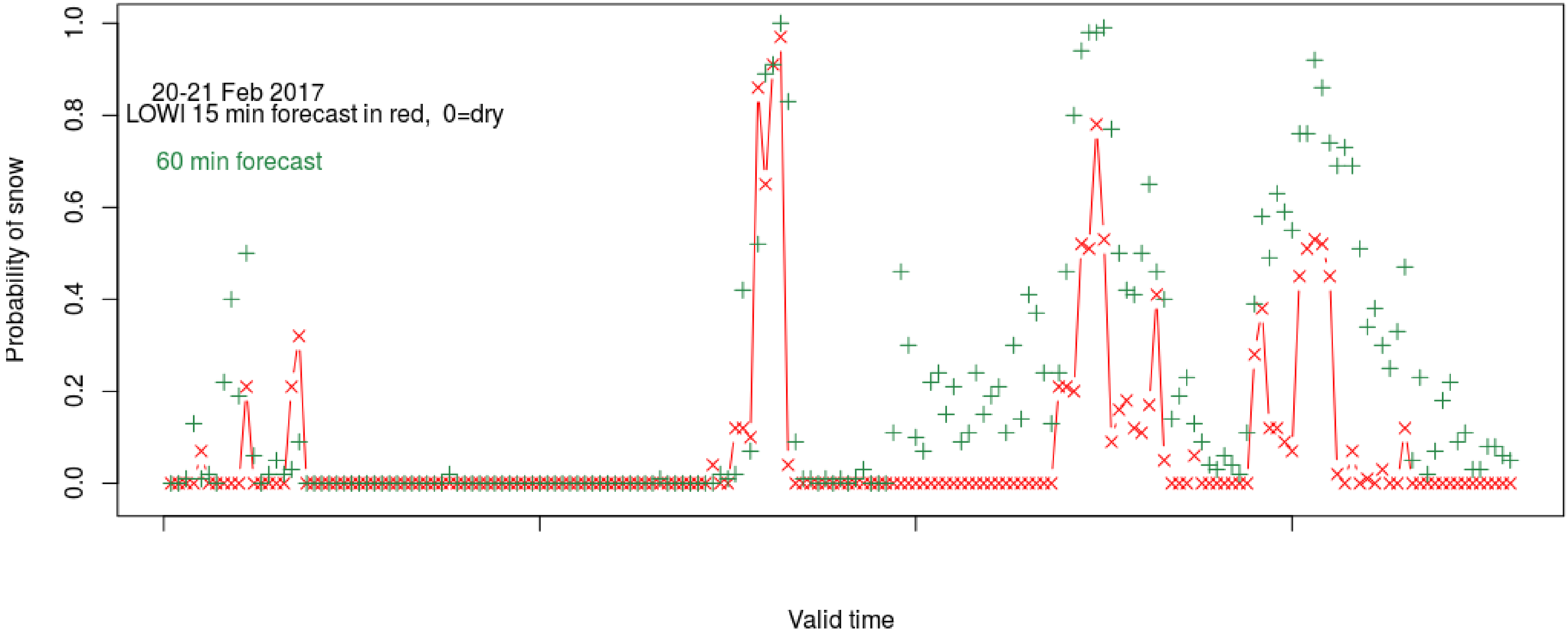
Time series of forecasted probability of the lowest intensity threshold (15.5 dBZ) in LOWI and EFHK are shown in fig 1. Each point in X-axis represents one 15 minute period, starting 1 February 03:00 UTC and ending 28 February 22:45 UTC. (This is to ensure same number of forecasts of all lengths). Red line and crosses show the 15-minute nowcast, which is used as the observation, against which the other forecasts are verified. The green shades from dark to light represent forecasts of different lengths: 30 min, 60 min, 90 min and 120 min.

The 15-minute nowcast is used as "observation", because it represents the portion of radar pixels near the airport which had snowfall over the threshold intensity at the validating radar image. It often shows values near 0 (dry) or 1 (snow). I case of "probability of 0.5" we can thing that probably it was snowing part of the 15-minute period.

Plotting time series is advisable to check that data reading routines are OK. The displayed parameter is 1-P1, ie, when first column in the dataset (P1) is Probability for intensity below 15.5 dBZ, then (1-P1) is Probability for intensity at least 15.5 dBZ.

3.2 Details of a 2-day case.





20-21 Feb 2017
LOWI 15 min forecast in red, 0=dry
60 min forecast
Probability of snow
0.0
0.2
0.4
0.6
0.8
1.0
Valid time

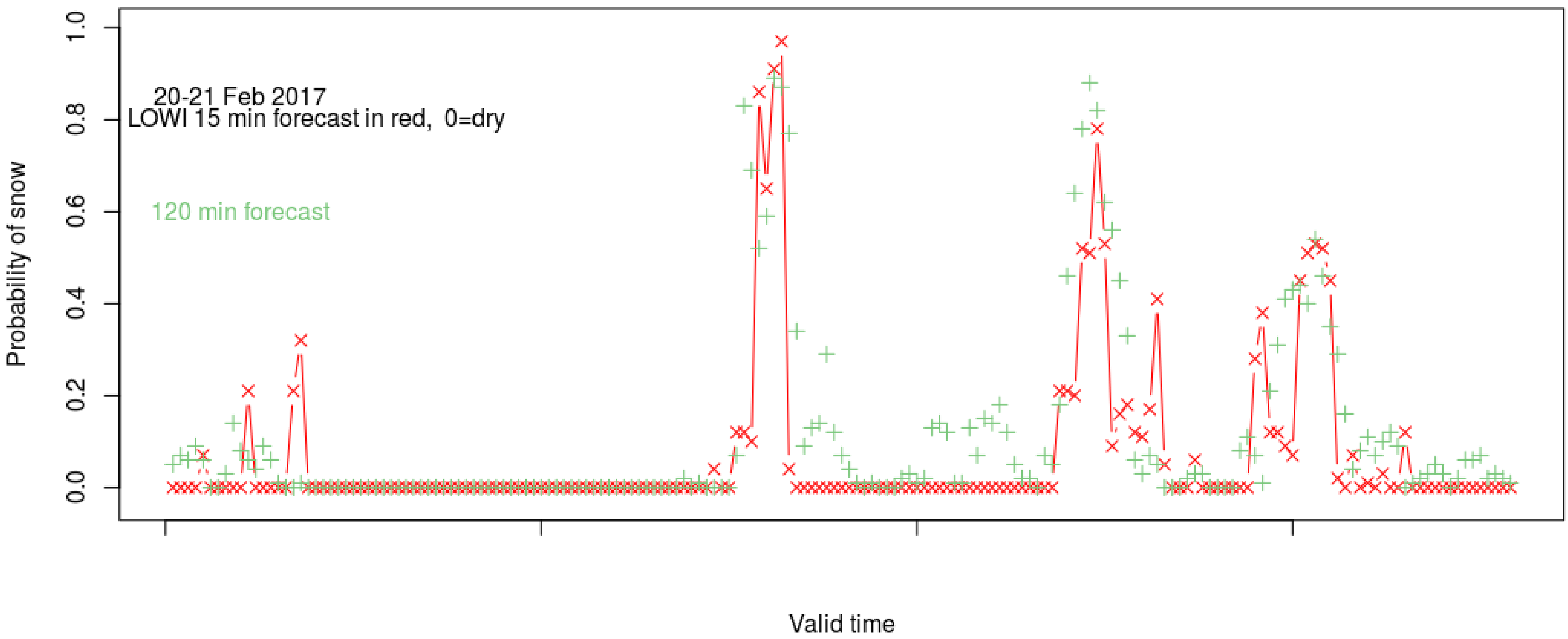


Fig. 2. Time series of forecasted probability in LOWI 21-22 February 2017. Red line and marks are 15 minutes nowcasts, green marks show 30 min (top), 60 min (middle) and 120 min (lowest panel) nowcasts.

Focusing the display to a few interesting days (Fig 2.), we can see that the long dry period was forecasted correctly even in the longer forecasts, and so were the most of the snowfalls. The 120 minutes forecast missed one snowfall event in the beginning of this case, and the number of false alarms grew on the second half of the time series.

Appendix: Examples of the Raw Data

Raw data example for EHFK (201702010000_EFHK_rainprob_PNOWWA.txt):

```
2017-02-01 00:15:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 00:30:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 00:45:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 01:00:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 01:15:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 01:30:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 01:45:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 02:00:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 02:15:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 02:30:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 02:45:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 03:00:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 03:15:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
```

Raw data example for LOWI (201702010000_LOWI_rainprob_PNOWWA.txt):

```
2017-02-01 00:15:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 00:30:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 00:45:00;1.00;0.00;0.00;0.00;1.00;0.00;0.00;0.00
2017-02-01 01:00:00;0.93;0.07;0.00;0.00;0.98;0.02;0.00;0.00
2017-02-01 01:15:00;0.87;0.12;0.01;0.00;0.96;0.03;0.01;0.00
2017-02-01 01:30:00;0.85;0.15;0.01;0.00;0.92;0.07;0.01;0.00
2017-02-01 01:45:00;0.93;0.07;0.00;0.00;0.98;0.02;0.00;0.00
2017-02-01 02:00:00;0.76;0.24;0.00;0.00;0.84;0.14;0.02;0.00
2017-02-01 02:15:00;0.70;0.30;0.00;0.00;0.85;0.14;0.00;0.00
2017-02-01 02:30:00;0.80;0.18;0.02;0.00;0.90;0.07;0.03;0.00
2017-02-01 02:45:00;0.88;0.12;0.01;0.00;0.93;0.05;0.02;0.00
2017-02-01 03:00:00;0.87;0.12;0.02;0.00;0.94;0.03;0.03;0.00
2017-02-01 03:15:00;0.88;0.10;0.02;0.00;0.93;0.04;0.03;0.00
```