Geosci. Instrum. Method. Data Syst. Discuss., 5, C276–C283, 2016
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Geoscientific Instrumentation Methods and Data Systems Discussions

# *Interactive comment on* "Weather model verification using Sodankylä mast measurements" *by* M. Kangas et al.

**M. Kangas et al.**

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Received and published: 11 March 2016

Thank you for your valuable comments and suggestions. Please find our response below.

Q: We regret that there is no example or illustration in this paper to prove the benefits of near-real time comparison for NWP model verification and for monitoring observations.

A: The on-line verification system itself acts, as said in the article, as a kind of alarm bell, alerting model developers that there is something in the model that would necessitate a further study, so it is hard to provide any specific and well-documented illustration of its benefit. When asked, we were told by one researcher that he had used Sodankylä data and plots several times to understand various modelling aspects,



but mostly on talks, with no references. From our own experience, e.g. the near-real time plots did quite early on hint to some spring-time problems in HIRLAM, which were then corrected through model development. The data collected this way can, however, be also used in larger model studies. We have added a mention about this with a reference:

Introduction: Data collected this way can also be used directly in model performance studies (Atlaskin and Kangas, 2006).

References: Atlaskin, E. and Kangas M., Sodankylä data utilization for HIRLAM verification and 1D model studies. The first joint HIRLAM All Staff Meeting and ALADIN Workshop, Sofia, Bulgaria, 15-18 May 2006. Hirlam Newsletter No. 51, October 2006, 10 pp. Available at http://hirlam.org/.

as well as another reference of a more extensive use of Sodankylä measurements:

Coustau, M., Martin, E., Soci, C., Bazile, E. and Besson, F. Evaluation of the MESCAN system in particular for snow (using the SURFEX off-line simulation driven by MESCAN). EURO4M Project, report D.2.11, March 2014.

Q: It could have been also interesting to illustrate how the statistical comparison helps to interpret the errors physically

A: An example of statistical plots (Figure 3) with short discussion added at the end of Chapter 3.2.

Q: Section 4 presents a very brief evaluation of an Harmonie-Arome model configuration (2.5km and 65 vertical levels) with 3 different radiation schemes (IFSRAD, ACRANEB2,HLRADIA). It would be interesting to describe the vertical resolution near the ground and the interpolation algorithm to diagnose screen level variables. The simulated radiative fluxes compare reasonably well with observations. It is found that there is a systematic cold bias on T2m which is not due to radiation fluxes. It is mentioned (not shown) that there is no bias on surface temperature. We regret that the study

of this T2m bias is not deepen. It would be for instance very interesting to evaluate the temperature biases at 3, 8, 18, 32m to investigate if the problem is rather in the interpolation method to diagnose T2m or in the physical parameterizations (turbulence scheme most probably).

A: Thank you for this comment, we agree in principle. According to the request by Reviewer 1, we have added a figure of LWUP to represent surface temperature. Deeper evaluation of T2m would indeed be interesting and even necessary. We could use all available mast measurements on temperature and the turbulent fluxes as well as soil and snow temperature measurements, closing the surface energy balance, and include a systematic discussion of the assumptions used when diagnosing T2m from the predicted surface and lowest model level temperatures. However, an exhaustive study falls beyond the scope of the present study where our aim is, with some examples, to present the possibilities Sodankylä measurements offer.

Q: Page 586 line 16 : the period is 15 January – 15 May 2014, but later the period is shorter from 15 January to 15 March 2014, which is not really a spring period as written several times in the paper.

A: We agree, and have corrected the dates and usage of the word "spring" to be consistent throughout the manuscript.

Q: Page 588 line 2 : the reference system is not described.

A: The reference system is mentioned at p. 586 lines 7-9 (original manuscript). We have modified this to: ...HARMONIE-AROME forecast system, based on the reference cycle 38h1.2 (http://hirlam.org/index.php/hirlam-programme-53/general-model-description/mesoscale-harmonie),...

At p. 587, lines 3-5 (original manuscript) modified to: All three schemes were tested within the framework of AROME physical parametrizations by running three series of experiments using a dedicated version (harmonie-38h1.radiation) of HARMONIE-



AROME over a domain covering Finland.

Further, we modified p.587 lines .10-18 (original manuscript) to

Model–observation comparison in early spring 2014

Most of the winter days before mid-March 2014 were cloudy in Sodankylä. Most observed and predicted clouds were essentially non-precipitating. The non-precipitating clouds predicted by HARMONIE-AROME consisted mainly of (supercooled) liquid droplets while the ice crystal content was small. Some amount of (precipitating) snow and graupel was practically always present in the simulated clouds and some liquid/ice condensate at the lowest model level was often predicted. This is due to a recent change in cloud microphysics treatment in the HARMONIE reference system (Karl-Ivar Ivarsson, personal communication, 2015).

and again at p.588 line 2 (original manuscript) ... deviated from the reference system where a fraction of the snow and graupel particles to ... deviated from the default HARMONIE (cycle 38h1.2) settings, according to which a fraction of the snow and graupel particles We hope this clarifies our point: our experiments were based on the reference system of HARMONIE cycle 38h1.2. The reference system contained modifications to the microphysics, suggested by Karl-Ivar Ivarsson. We took them, but did not allow precipitating particles to influence radiation fluxes, which is different from the default. In addition, we introduced two new radiation schemes, as described in section 4.1.

Please also note the supplement to this comment:
http://www.geosci-instrum-method-data-syst-discuss.net/5/C276/2016/gid-5-C276-2016-supplement.pdf

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Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 5, 577, 2015.

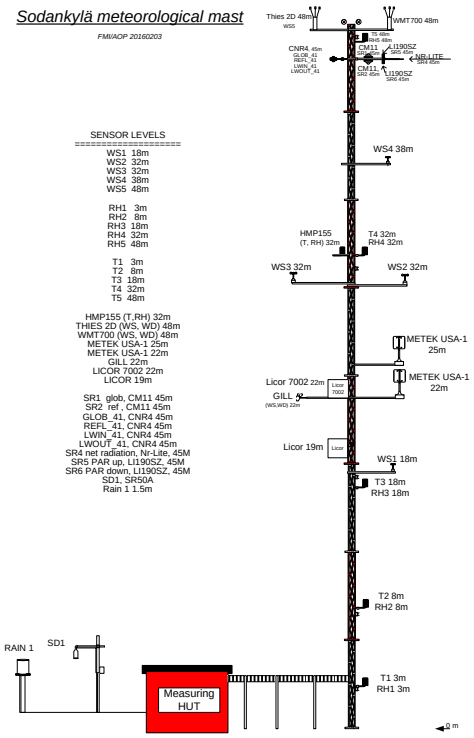
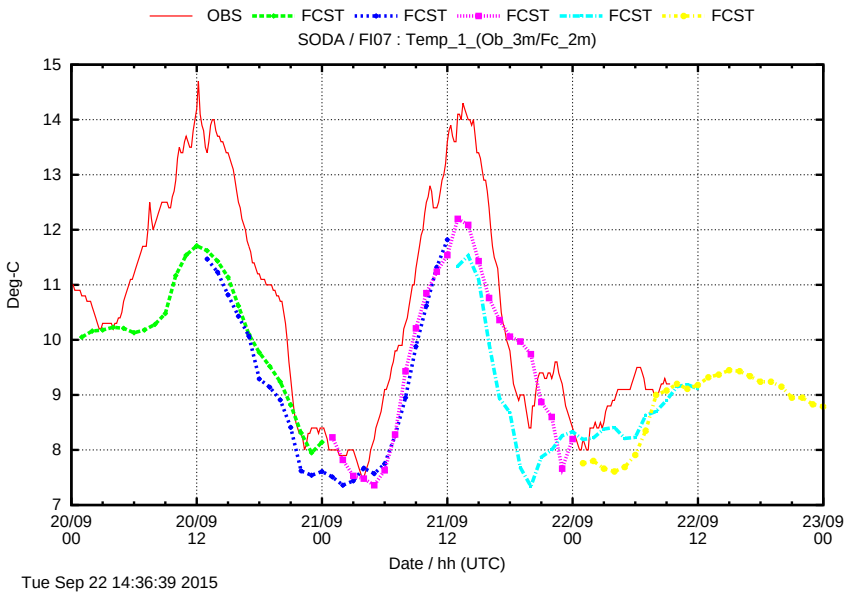

Sodankylä meteorological mast
FMI/AOP 20160203
SENSOR LEVELS
WS1 18m
WS2 32m
WS3 32m
WS4 38m
WS5 48m
RH1 3m
RH2 8m
RH3 18m
RH4 32m
RH5 48m
T1 3m
T2 8m
T3 18m
T4 32m
T5 48m
HMP155 (T,RH) 32m
THIES 2D (WS, WD) 48m
WMT700 (WS, WD) 48m
METEK USA-1 25m
METEK USA-1 22m
GILL 22m
LICOR 7002 22m
LICOR 19m
SR1 glob, CM11 45m
SR2 ref , CM11 45m
GLOB_41, CNR4 45m
REFL_41, CNR4 45m
LWIN_41, CNR4 45m
LWOUT_41, CNR4 45m
SR4 net radiation, Nr-Lite, 45M
SR5 PAR up, LI190SZ, 45M
SR6 PAR down, LI190SZ, 45M
SD1, SR50A
Rain 1 1.5m
Thies 2D 48m
WMT700 48m
CNR4 45m
CM11
LI190SZ
NR-LITE
WS4 38m
HMP155
(T, RH) 32m
T4 32m
RH4 32m
WS3 32m
WS2 32m
METEK USA-1
25m
METEK USA-1
22m
Licor 7002 22m
GILL
Licor 19m
WS1 18m
T3 18m
RH3 18m
T2 8m
RH2 8m
RAIN 1
SD1
Measuring
HUT
T1 3m
RH1 3m
0 m

**Fig. 1.**




OBS
FCST
FCST
FCST
FCST
FCST
SODA / FI07 : Temp_1_(Ob_3m/Fc_2m)
Deg-C
15
14
13
12
11
10
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Date / hh (UTC)
Tue Sep 22 14:36:39 2015

**Fig. 2.**

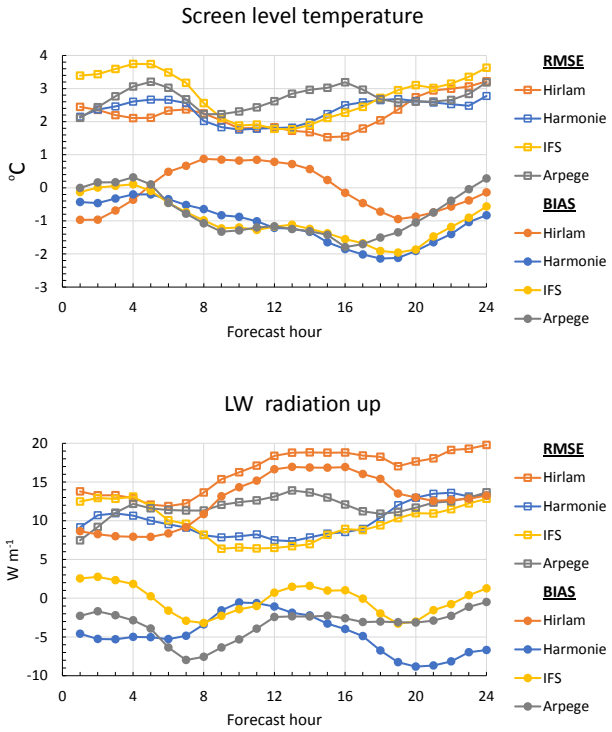
Screen level temperature
°C
Forecast hour
RMSE
Hirlam
Harmonie
IFS
Arpege
BIAS
Hirlam
Harmonie
IFS
Arpege
LW radiation up
W m-1
Forecast hour
RMSE
Hirlam
Harmonie
IFS
Arpege
BIAS
Hirlam
Harmonie
IFS
Arpege

**Fig. 3.**



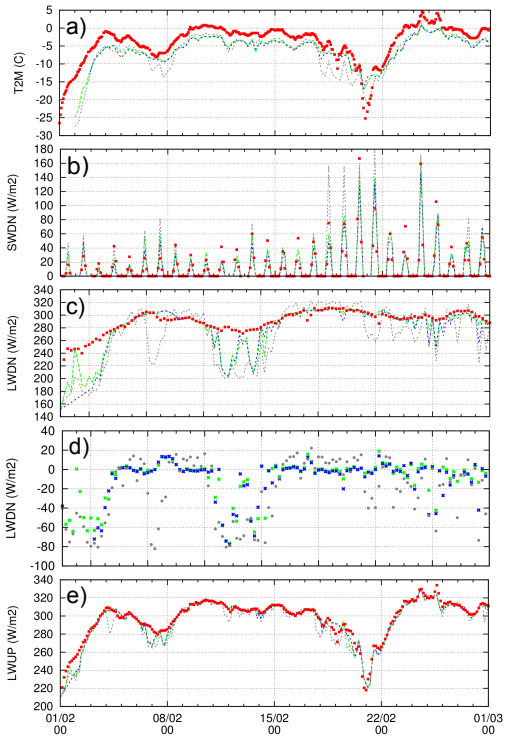
a)
T2M (C)
b)
SWDN (W/m2)
c)
LWDN (W/m2)
d)
LWDN (W/m2)
e)
LWUP (W/m2)
01/02 00
08/02 00
15/02 00
22/02 00
01/03 00

**Fig. 4.**