The Cryosphere

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Supplement of

Spatial variability in snow precipitation and accumulation in COSMO–WRF simulations and radar estimations over complex terrain

Franziska Gerber et al.

Correspondence to: Franziska Gerber (gerberf@slf.ch)

S1. Model levels

Table S.1 gives the first 21 model levels all four model domains (d01–d04).

Table S.1. First 21 model levels for all four model domains (d01–d04).

Level	d01 m	d02 m	d03 m	d04 m
1	24.1	23.1	22.6	3.1
2	83.0	79.7	77.6	9.4
3	163.4	156.9	152.7	18.8
4	265.7	255.4	248.1	31.4
5	394.5	379.1	368.0	44.0
6	558.2	536.2	519.9	56.6
7	758.7	728.0	705.4	94.5
8	944.0	904.9	848.5	158.0
9	1098.5	1051.7	933.9	221.9
10	1255.8	1200.7	1020.1	286.2
11	1416.0	1352.0	1107.1	351.0
12	1657.3	1578.9	1237.5	416.2
13	1979.9	1881.7	1411.3	481.6
14	2305.8	2187.1	1585.9	547.8
15	2635.0	2495.1	1761.4	614.3
16	2967.6	2805.8	1937.8	681.2
17	3303.8	3119.3	2115.2	748.6
18	3643.7	3435.7	2293.7	811.9
19	3987.4	3755.2	2473.2	871.2
20	4335.0	4078.0	2653.9	930.8
21	4686.8	4404.4	2835.6	990.7

The header "Domains" spans columns d01–d04.

S2. Variability at the local domain

Figure S.1 shows the domain-wide statistics of the local domain, for which data has a resolution of 300 m (Figure 1 in the main text). Variograms analogously to Figure 6 and Figure 7 in the main text are presented for the local domain. Trends removed from the data to produce the variograms in Figure S.2 are given in Table S.2. For Figure S.3 no trends are removed to retain the effect of large-scale precipitation processes. Thus, small as well as intermediate scale patterns may be hidden by the domain-wide trends.

Table S.2. Large-scale linear trends of entirely-filtered radar and WRF precipitation patterns on the local domain (300 m horizontal grid spacing, Figure 1 in the main text). *Orientation* gives the direction of the slope and *Intensity* the strength of inclination. $0°$ would indicate a slope pointing toward the East. WRF snow precipitation is from simulations with weak terrain smoothing (Sect. 2.1 in the main text).

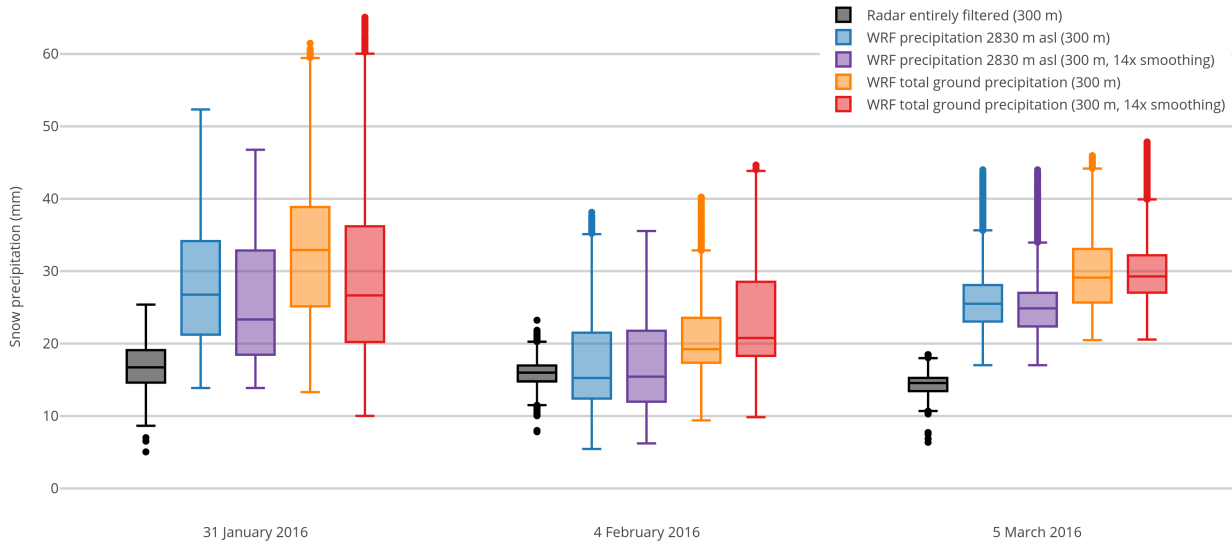|	31 January 2016 Orientation	Intensity	4 February 2016 Orientation	Intensity	5 March 2016 Orientation	Intensity
Radar entirely filtered	68.5°	0.14	150.5°	0.03	-135.4°	0.04
WRF precip. at 2830 m asl	22.6°	0.26	5.8°	0.24	-79.6°	0.19
WRF total ground precip.	30.6°	0.32	24.2°	0.24	-67.6°	0.21

Figure S.1. Domain-wide 24 h precipitation statistics for the local domain (300 m horizontal grid spacing, Figure 1 in the main text) for the three precipitation events on 31 January 2016, 4 February 2016 and 5 March 2016. Gray colors show entirely-filtered radar precipitation. WRF precipitation at 2830 m above sea level (m asl) for simulations with weak terrain smoothing (Sect. 2.1 in the main text) and strong terrain smoothing are given in blue and violet, respectively. Orange (red) shows boxplots of WRF total ground precipitation for weak (strong) terrain smoothing. Radar precipitation and WRF precipitation at 2830 m asl are masked (as shown in Figure 4 in the main text).
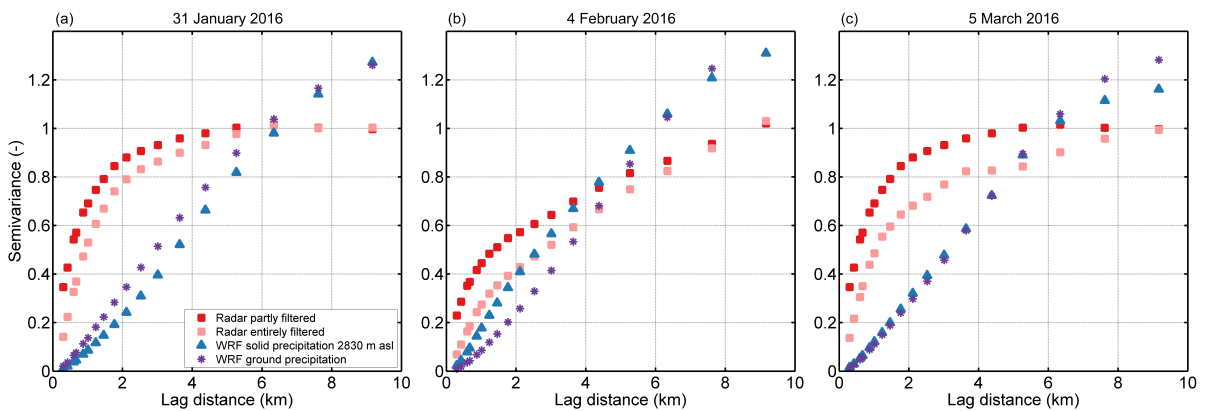

Figure S.2. Normalized variograms of detrended snow precipitation for the precipitation events on a) 31 January 2016, b) 4 February 2016 and c) 5 March 2016 for the local domain (300 m horizontal grid spacing, Figure 1 in the main text). Variograms are given for partly-filtered (red) and entirely-filtered (orange) radar snow precipitation, WRF snow precipitation at 2830 m above sea level (m asl, blue) and WRF total ground precipitation (violet). WRF precipitation is from simulations with weak terrain smoothing (Sect. 2.1 in the main text). All precipitation fields are masked.
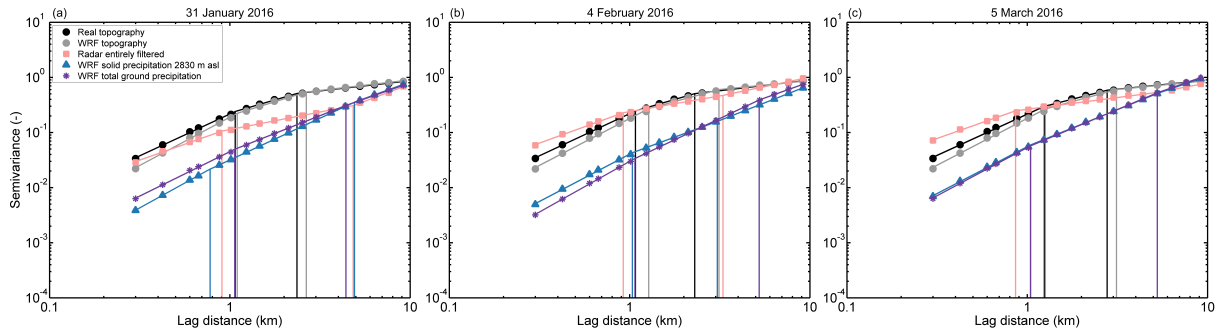
Figure S.3. Normalized variograms of the snow precipitation events on a) 31 January 2016, b) 4 February 2016 and c) 5 March 2016 for the local domain (300 m horizontal grid spacing, Figure 1 in the main text). Variograms are given for entirely-filtered radar snow precipitation (orange), WRF snow precipitation at 2830 m above sea level (m asl, blue) and WRF total ground precipitation (violet). Additionally, variograms are given for real topography (based on dhm25 © 2018 swisstopo (5740 000 000), black) and WRF topography (gray). WRF topography and precipitation are from simulations with weak terrain smoothing (Sect. 2.1 in the main text). All precipitation fields are masked.