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From D95 to Explicit Snow scheme -
experiences from offline and first NWP experiments

SURFEX Users workshop, Toulouse, 27 February 2017

Mariken Homleid and Aspelien

Introduction

Snow status in HARMONIE-AROME

- Default options in current cycle (40h1.1 with SURFEX 7.3)
  - 1-layer snow scheme (CSNOW=D95)
  - Snow analysis by Optimum Interpolation using snow depth observations
- Performance with respect to snow
  - Realistic snow amounts (SWE) in regions with representative observations
  - Problematic surface temperatures in cold season...several reasons for that...

Experiments with Explicit Snow scheme (CSNOW=3-L)

- Offline experiments with several versions, options, time periode and stations
  - to evaluate the performance with respect to snow accumulation and melting
  - Offline runs are not very useful for evaluating the effect on surface temperatures....

- First NWP experiments with cycle 40h1.1 and SURFEX7.3
  - ISBA Force Restore
  - No surface assimilation

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Experiments with Explicit Snow scheme (CSNOW=3-L)

- **Offline experiments** with SURFEX7.3 and SURFEX8.0
  - CSNOW=D95/3-L, CISBA=3-L/DIF, LISBA_CANOPY=T/F, NPATCH=1/2
  - Wnter 2014/2015 on 30 Norwegian and Swedish stations

- **First NWP experiments** with cycle 40h1.1 and SURFEX7.3
  - REF: CSNOW=D95, CISBA=3-L, LISBA_CANOPY=T, NPATCH=1
  - EXP: CSNOW=3-L, CISBA=3-L, LISBA_CANOPY=T, NPATCH=1

SURFEX offline experiments at 30 stations

	1 patch SURFEX 7.3	1 patch SURFEX 8.0	2 patches SURFEX 7.3	2 patches SURFEX 8.0
"Operational": CISBA=3-L CSNOW=D95	C7.3	C		P
CISBA=3-L CSNOW=3-L	D7.3	D	Q7.3	Q
CISBA=DIF CSNOW=3-L	E7.3	E		R

On the following slides are

- some conclusions based on all offline experiments
- illustrated by examples from experiment C,D and Q at 5 stations

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Evaluation of snow accumulation and melting

D95 snow scheme

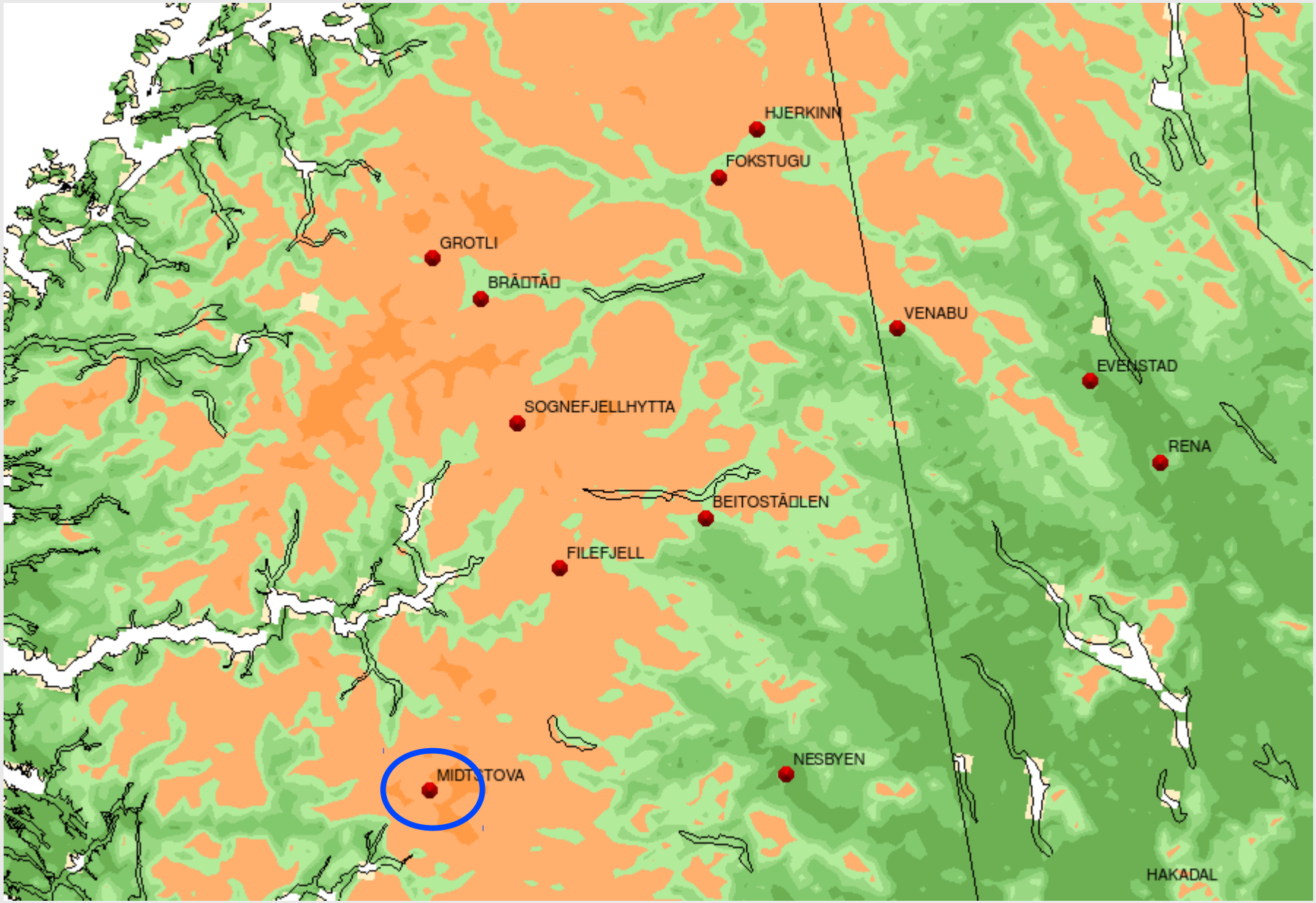
- realistic accumulation and melting, but generally slightly too much snow and too late melting
- similar performance with SURFEX 7.3 and SURFEX 8.0
- similar performance with 1 and 2 patches

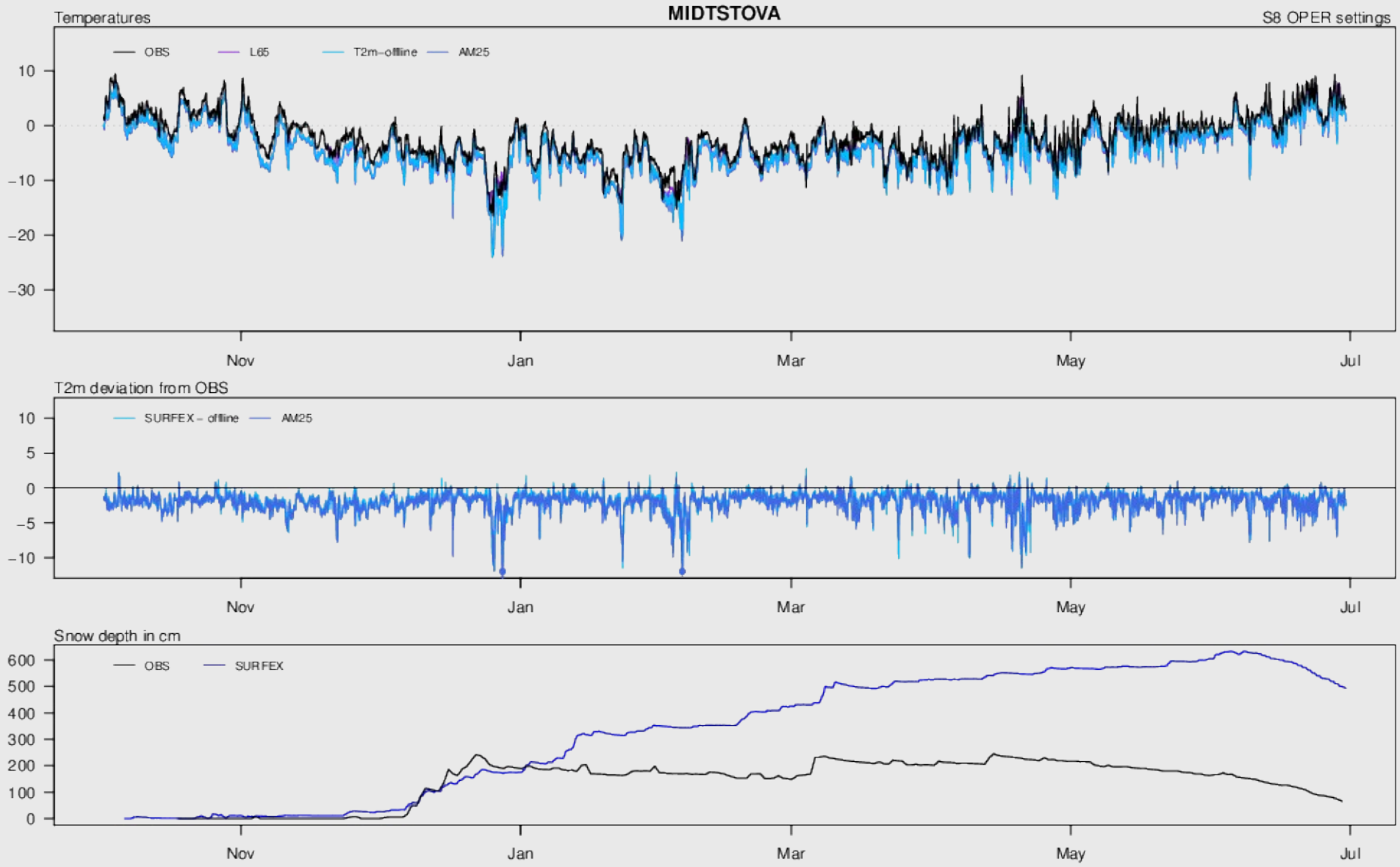
Explicit Snow scheme

- 1 patch
  - realistic snow accumulation, but too rapid melting at most stations (except stations with fraction of forest (P2) close to 0)
  - similar performance with SURFEX 7.3 and SURFEX 8.0

- 2 patches
  - realistic snow accumulation/melting, generally less than with D95 and too little at some stations (e.g. Hakadal, Bjørnholt)
  - slightly less snow with SURFEX 8.0 than SURFEX 7.3

Midtstova frac(open land)=1 frac(forest)=0





D95: overestimation of snow, underestimation of temperature

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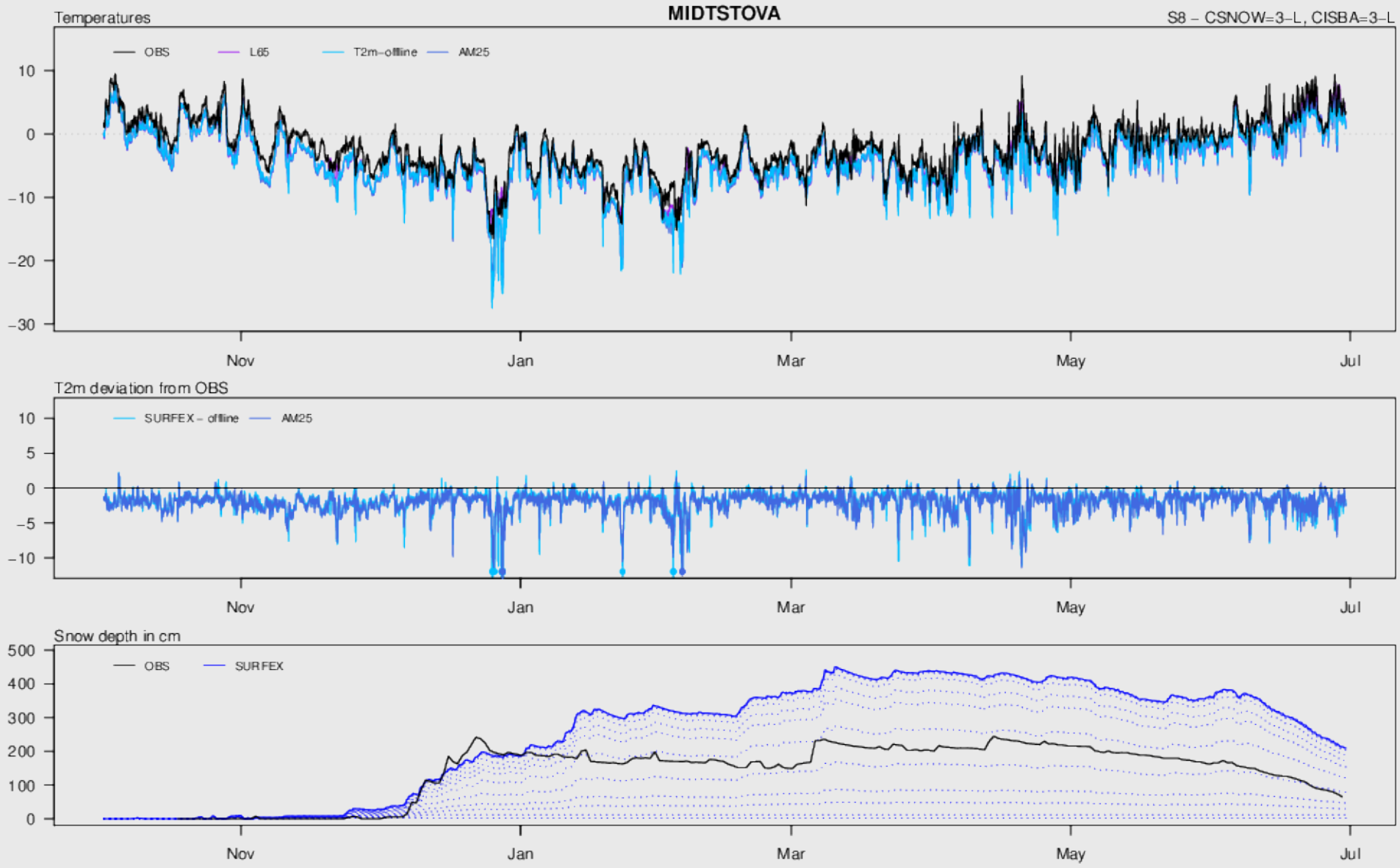

CSNOW=3-L, NPATCH=1: too much snow, too cold

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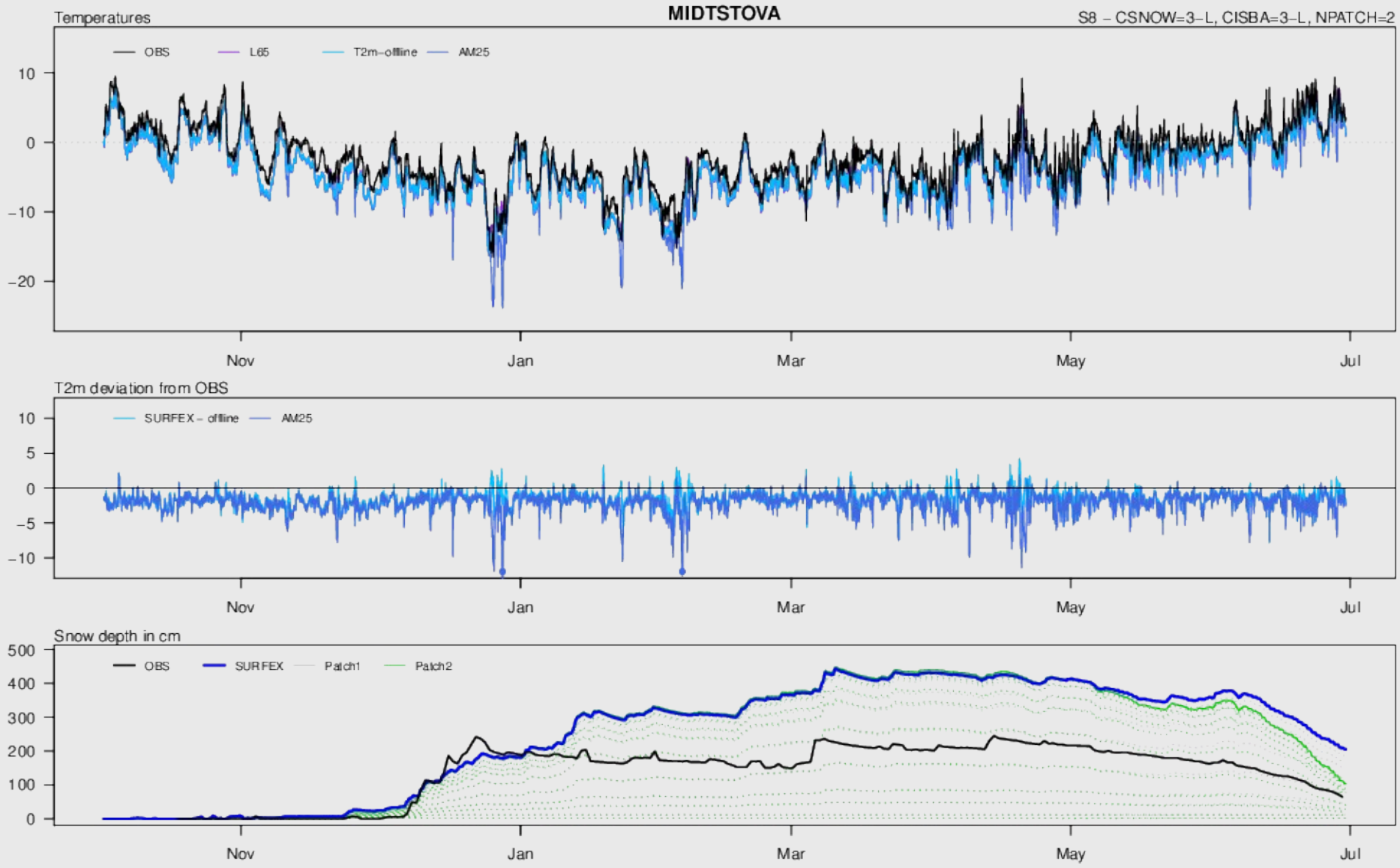

CSNOW=3-L, NPATCH=2: too much snow, too cold

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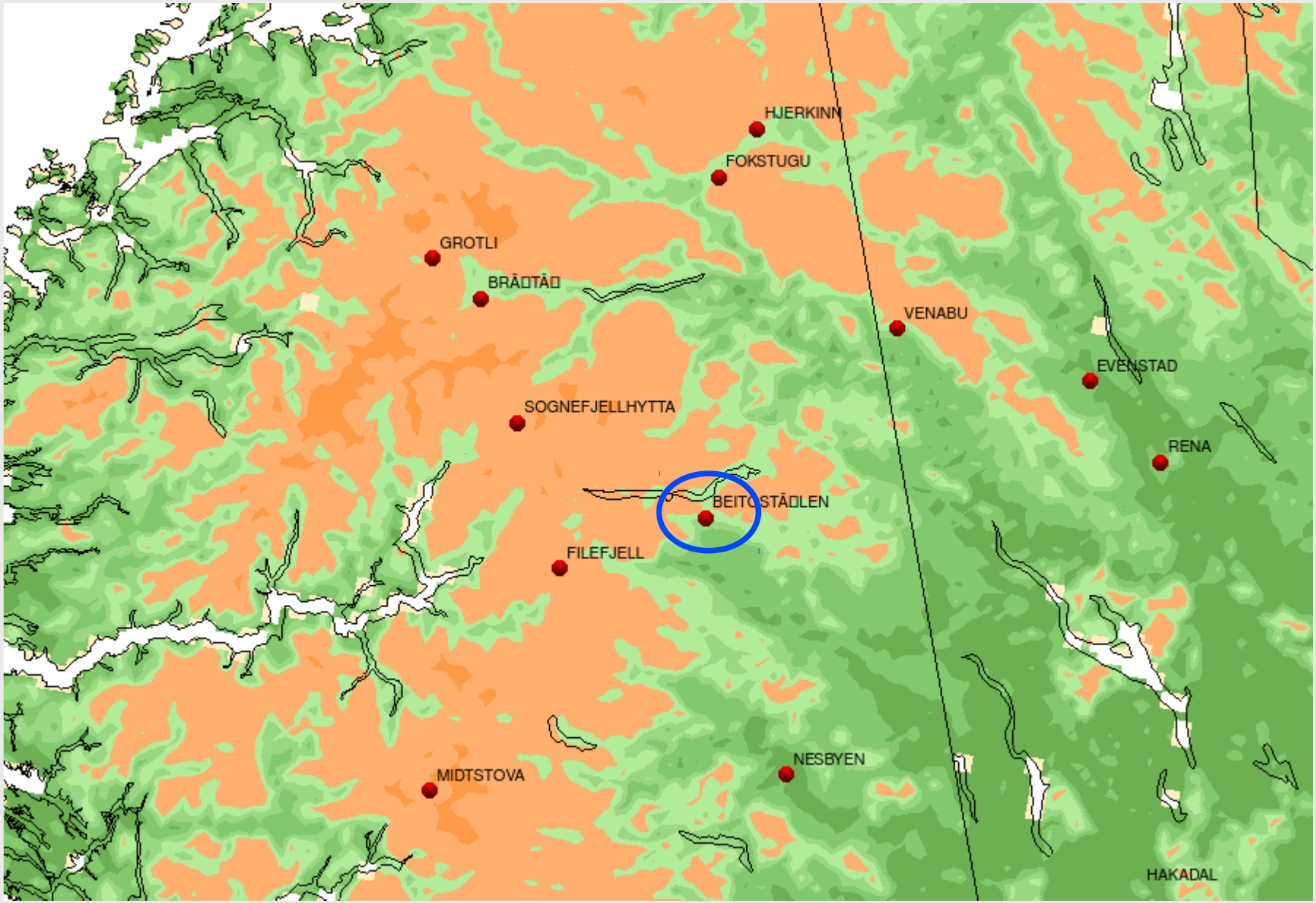
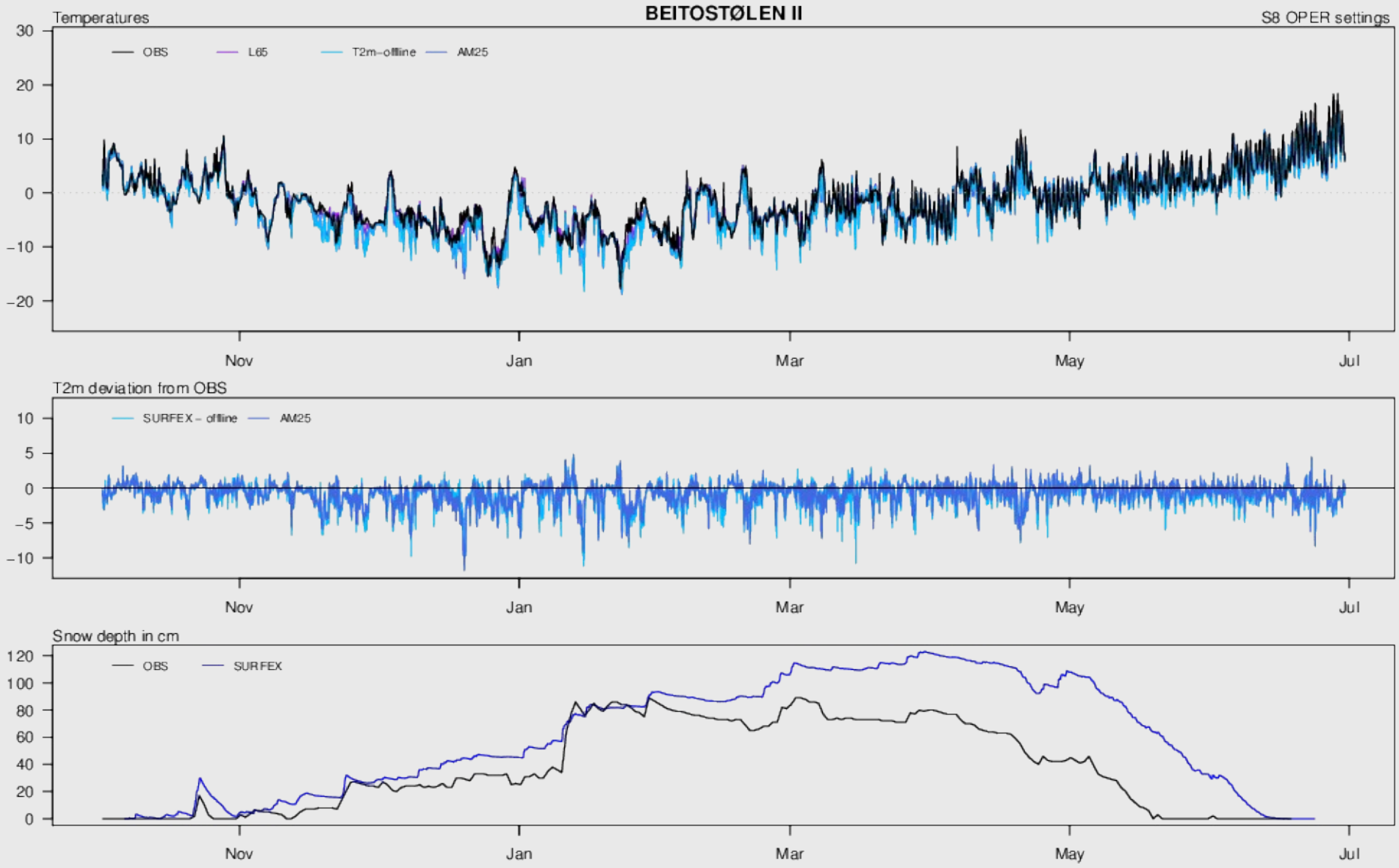
Beitostølen frac(open land)=0.7 frac(forest)=0.3





D95: realistic snow accumulation, too slow melting

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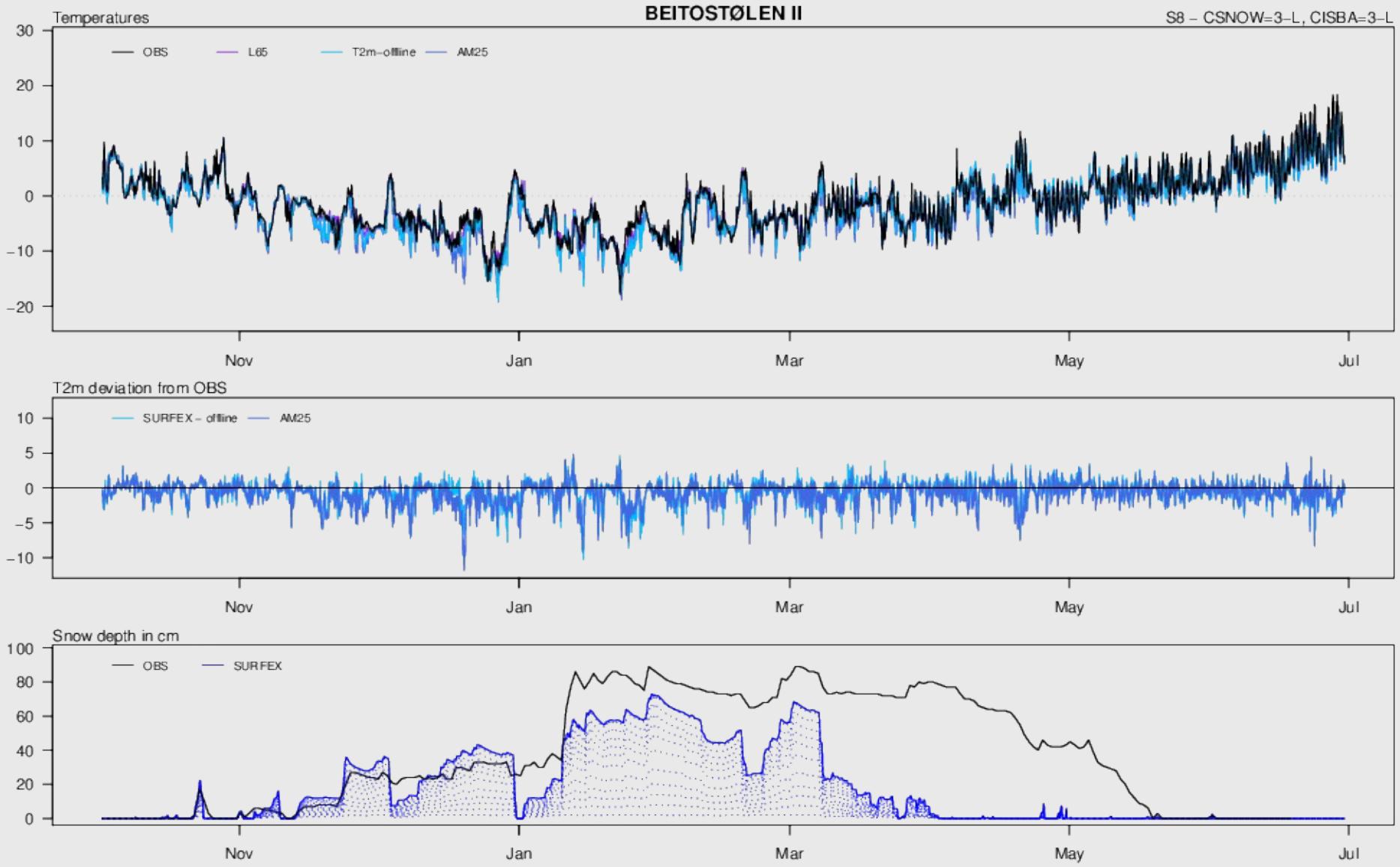
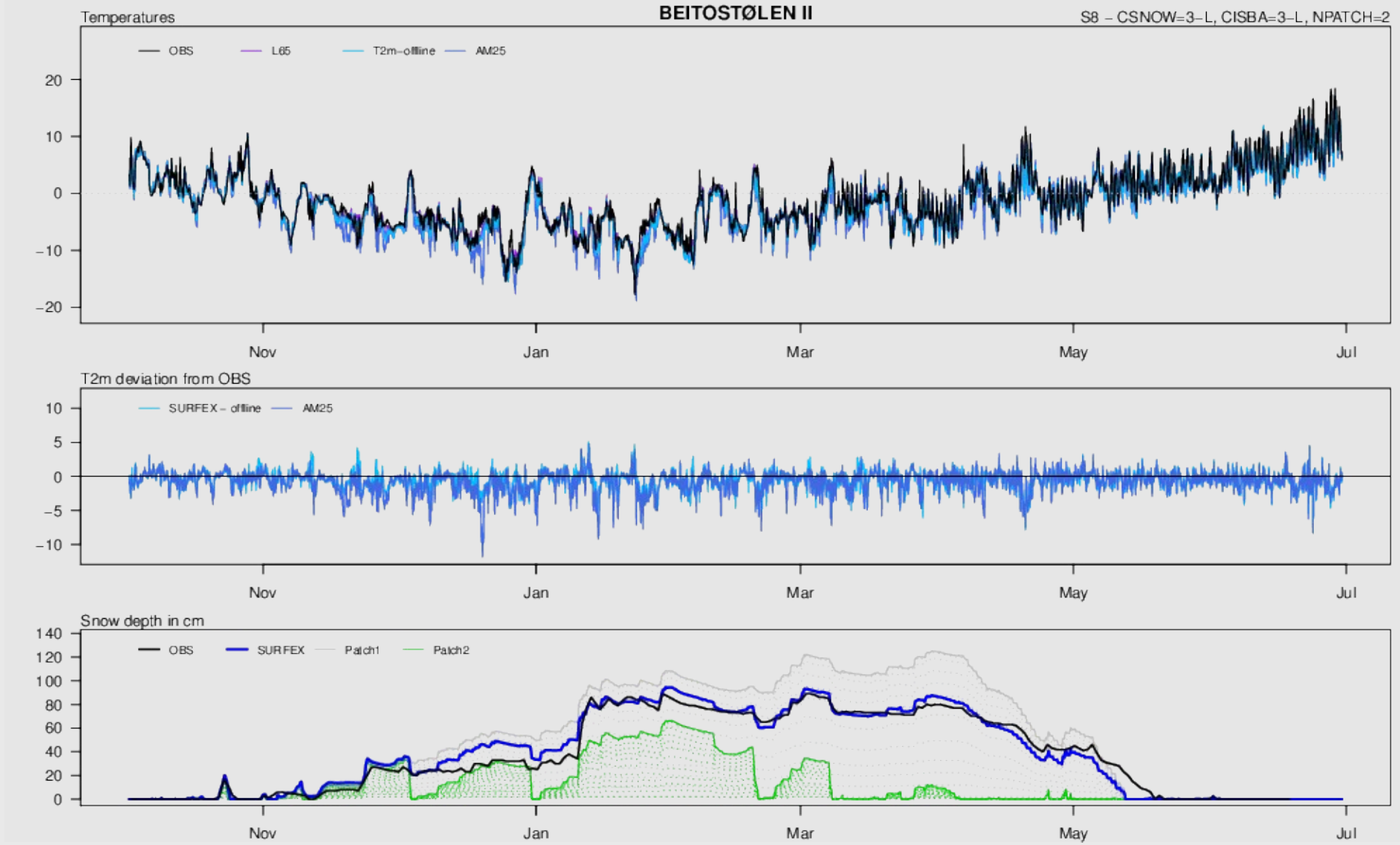
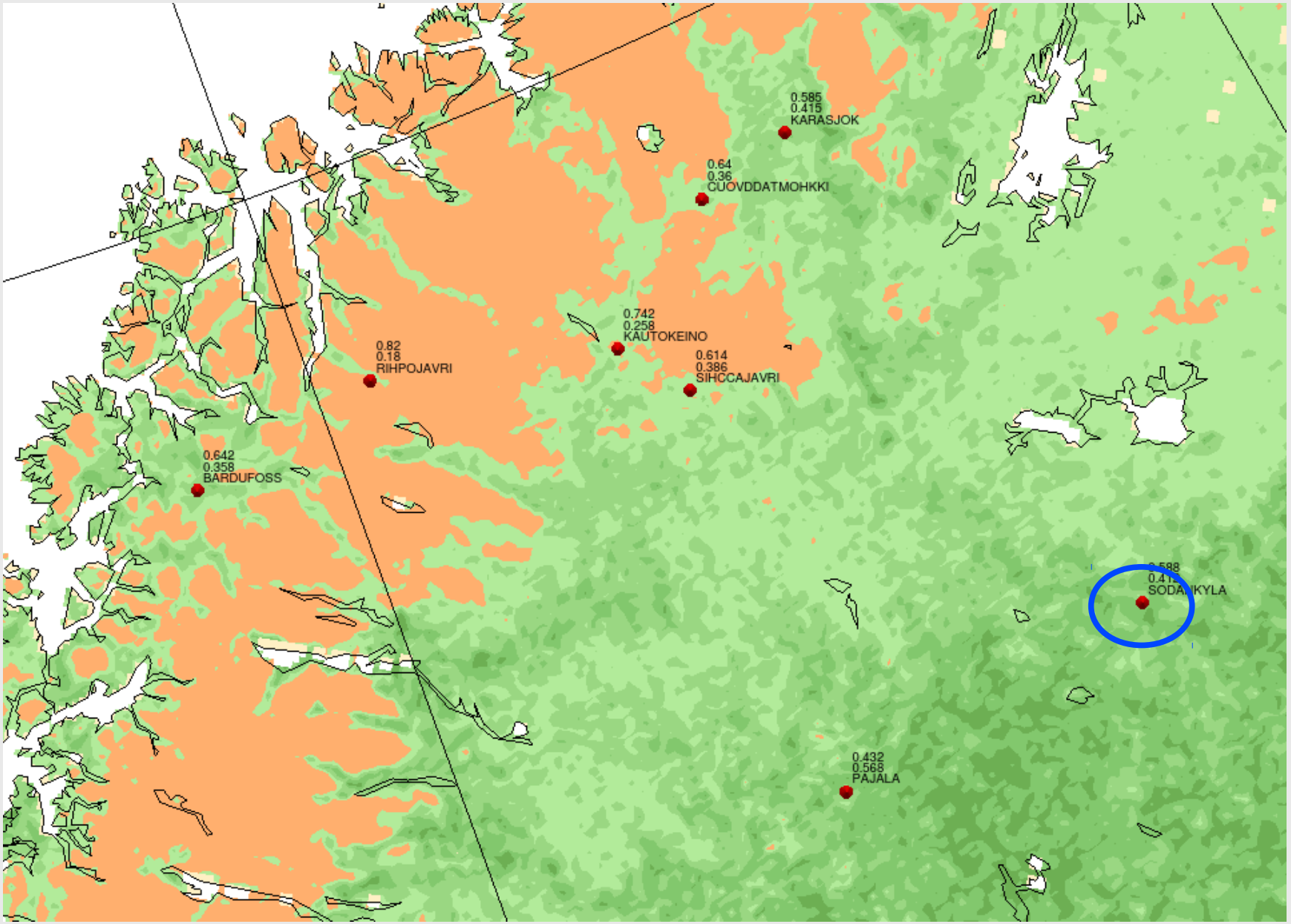


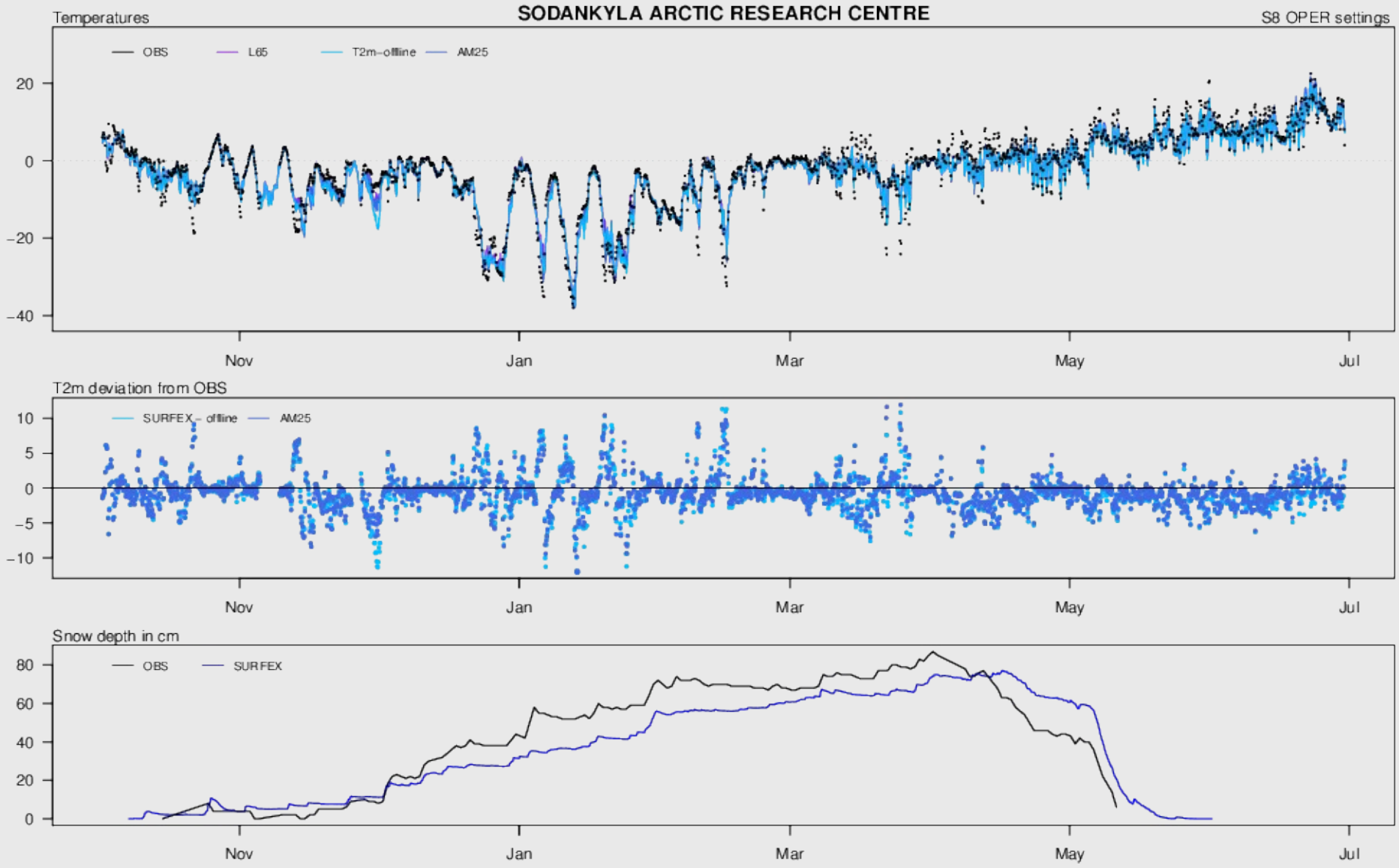
CSNOW=3-L, NPATCH=1: realistic snow accumulation, BUT too rapid melting



CSNOW=3-L, NPATCH=2: realistic snow accumulation and melting

Sodankylä frac(open land)=0.6 frac(forest)=0.4





D95: realistic snow accumulation and melting

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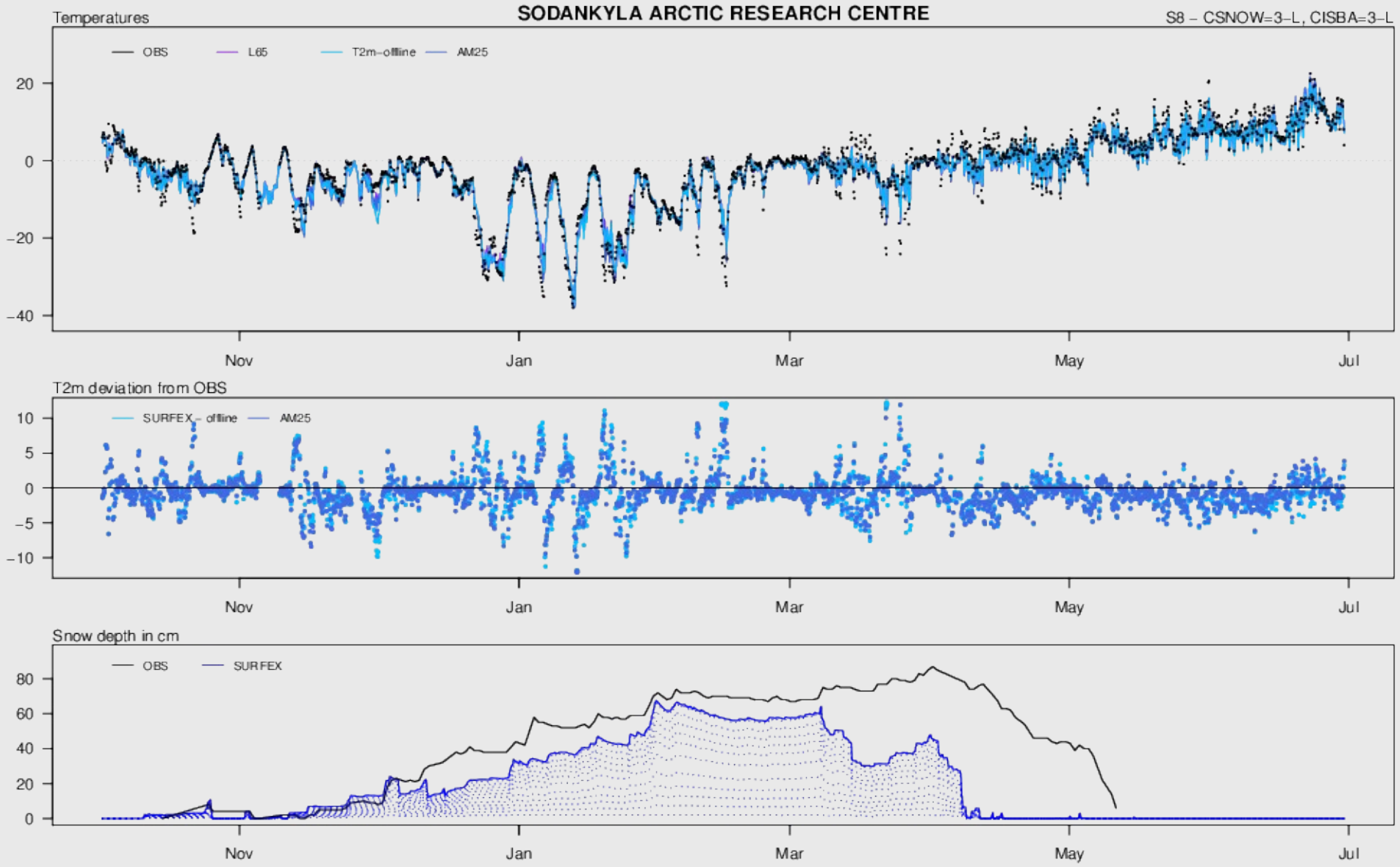

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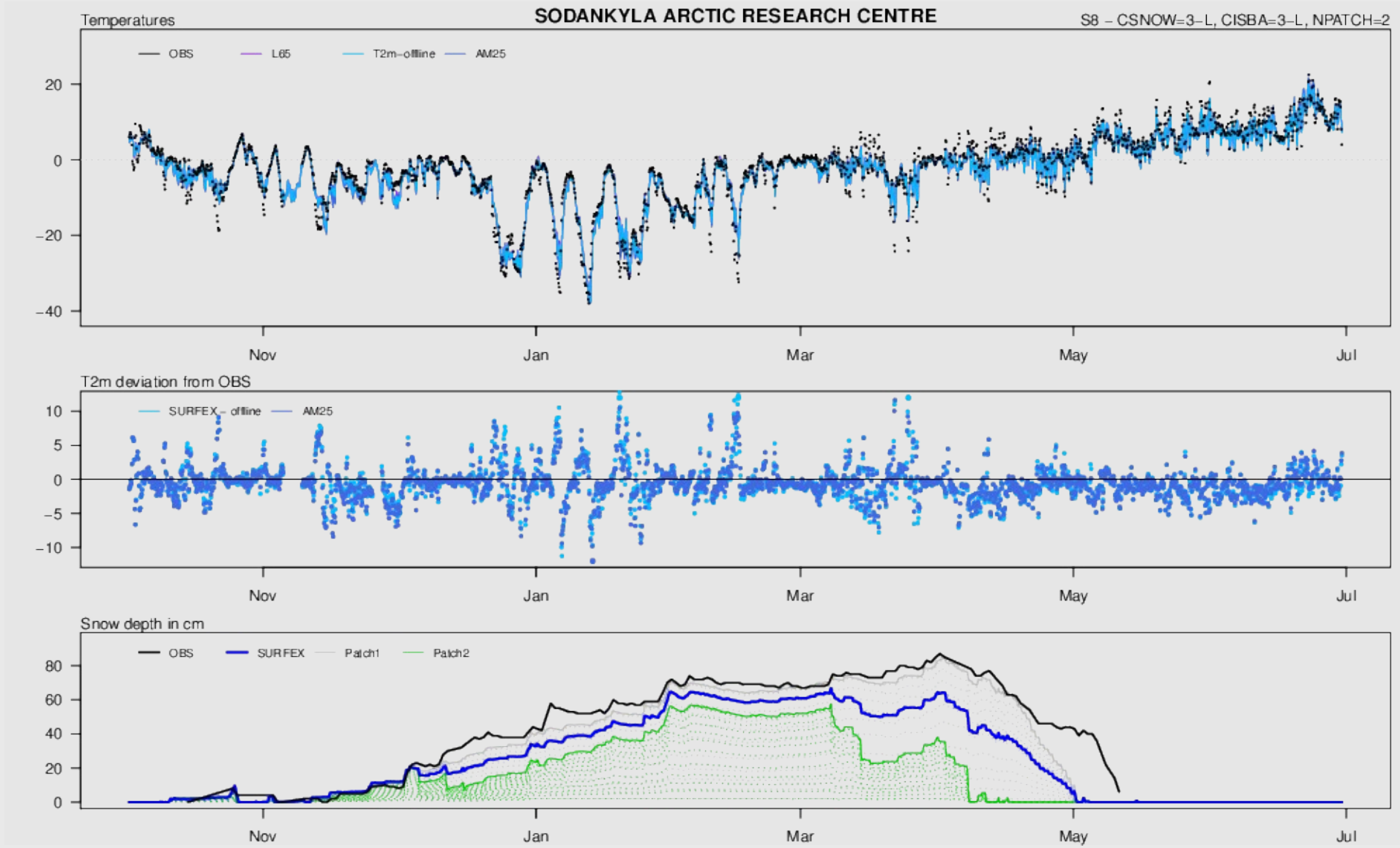
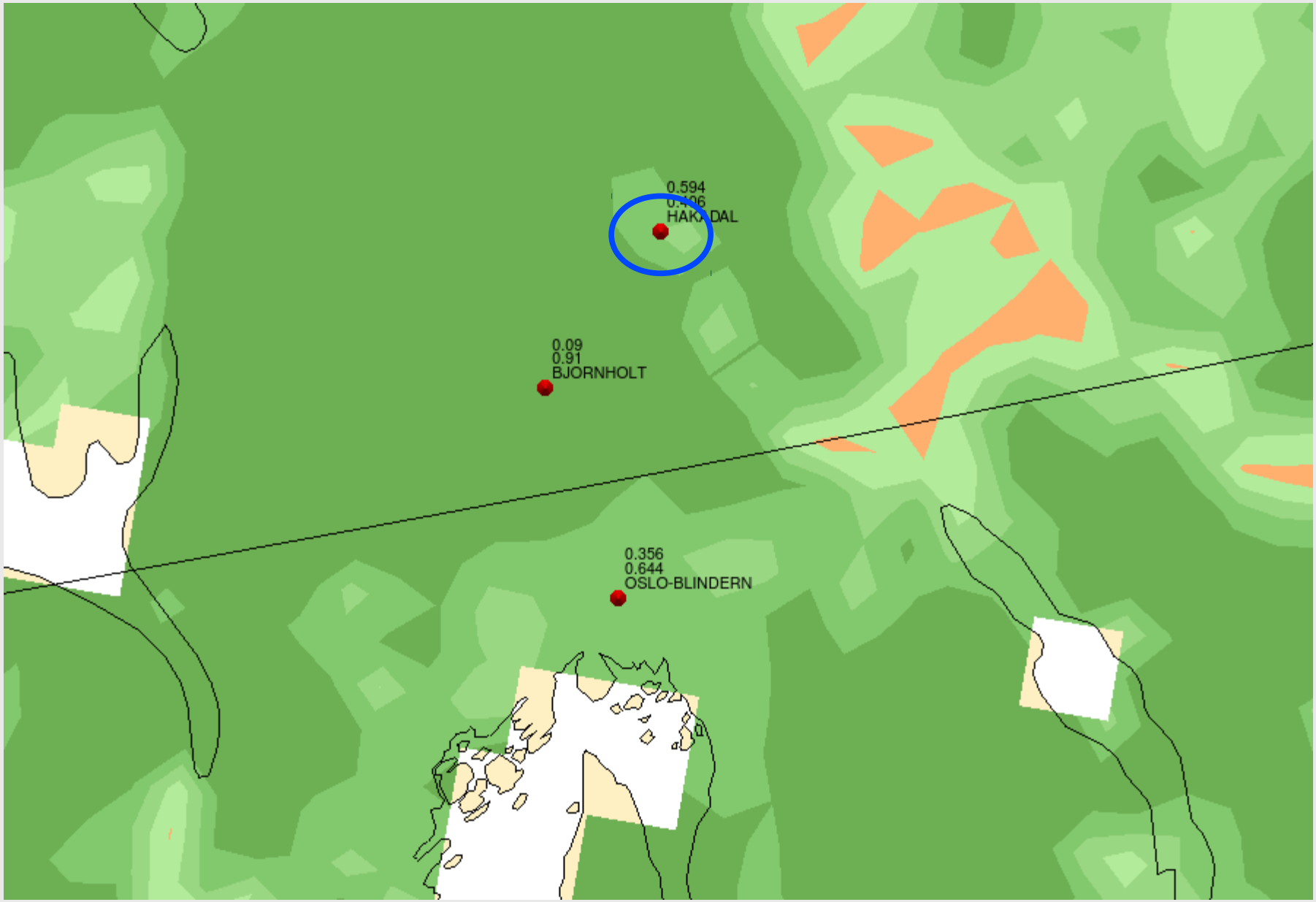
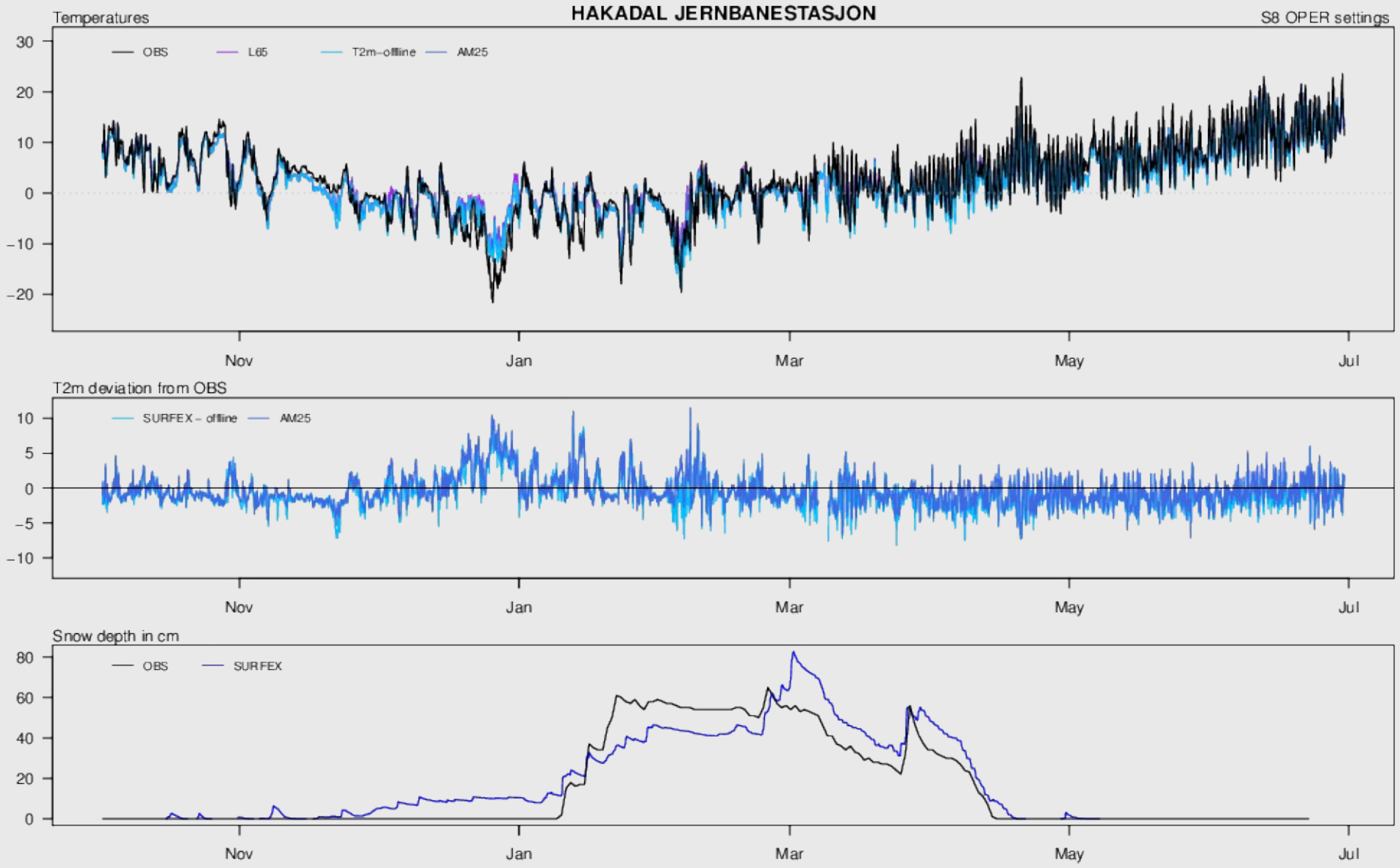


CSNOW=3-L, NPATCH=2: realistic snow, better than with NPATCH=1

Hakadal frac(open land)=0.6 frac(forest)=0.4





D95: realistic snow accumulation and melting

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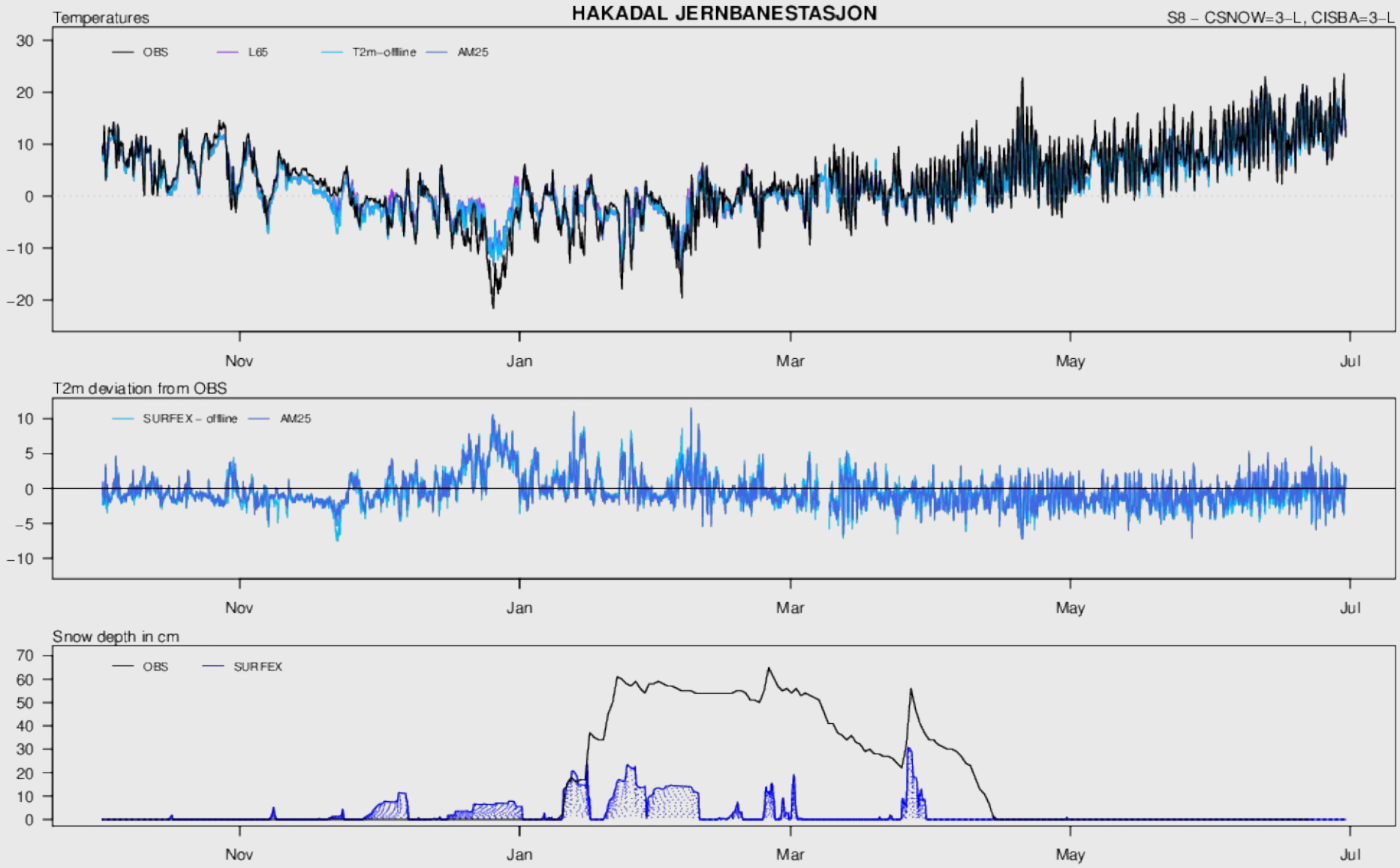
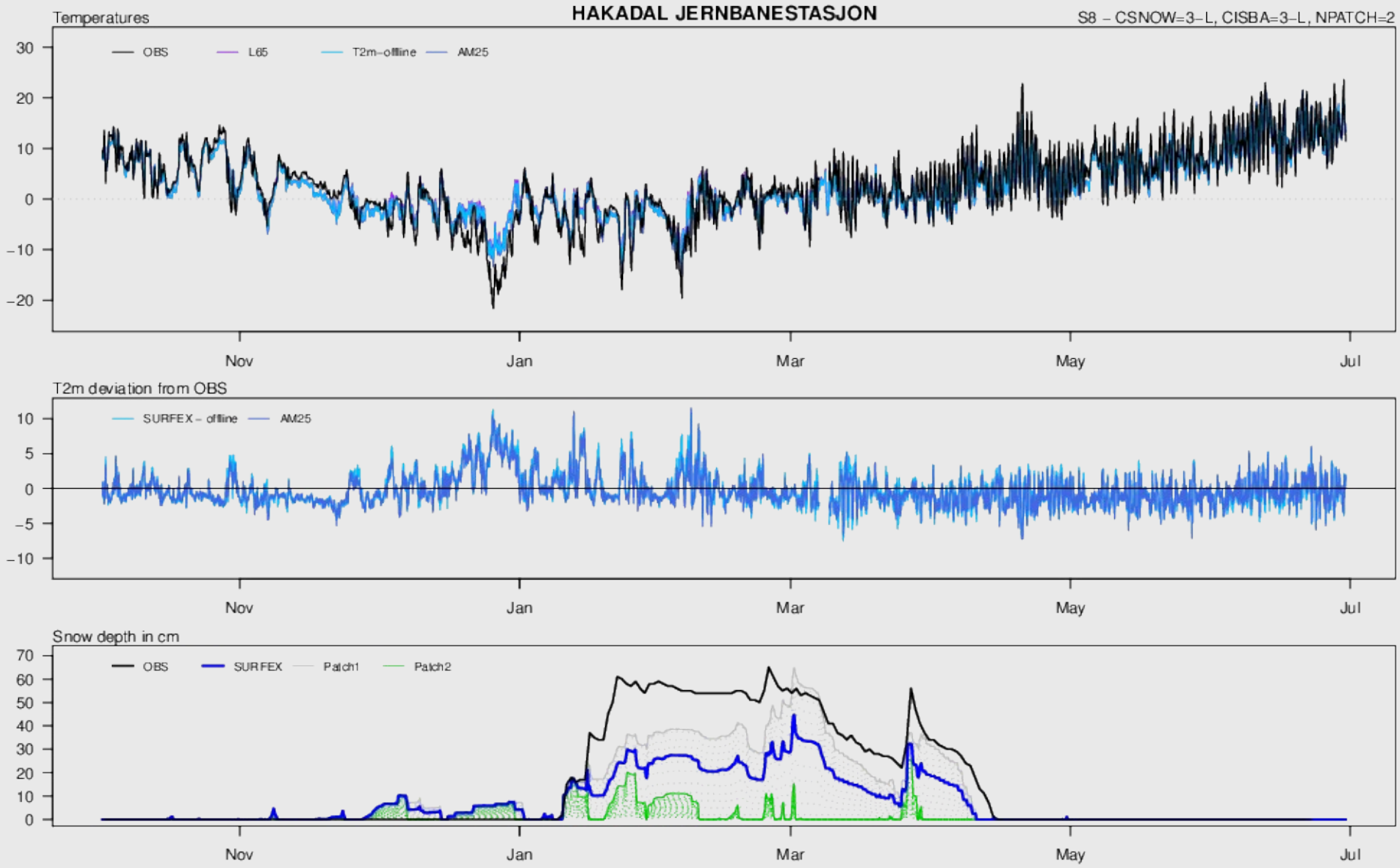
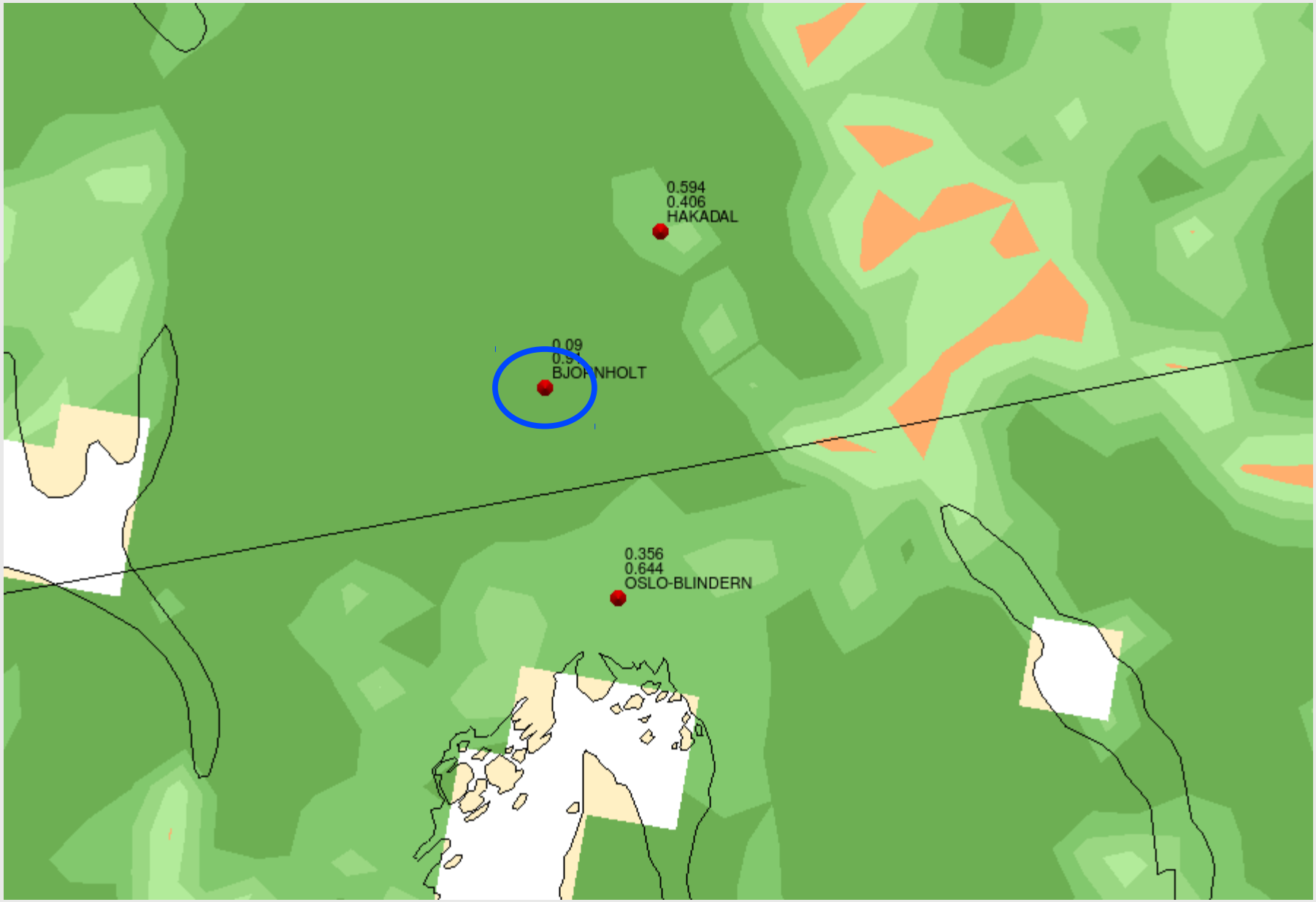


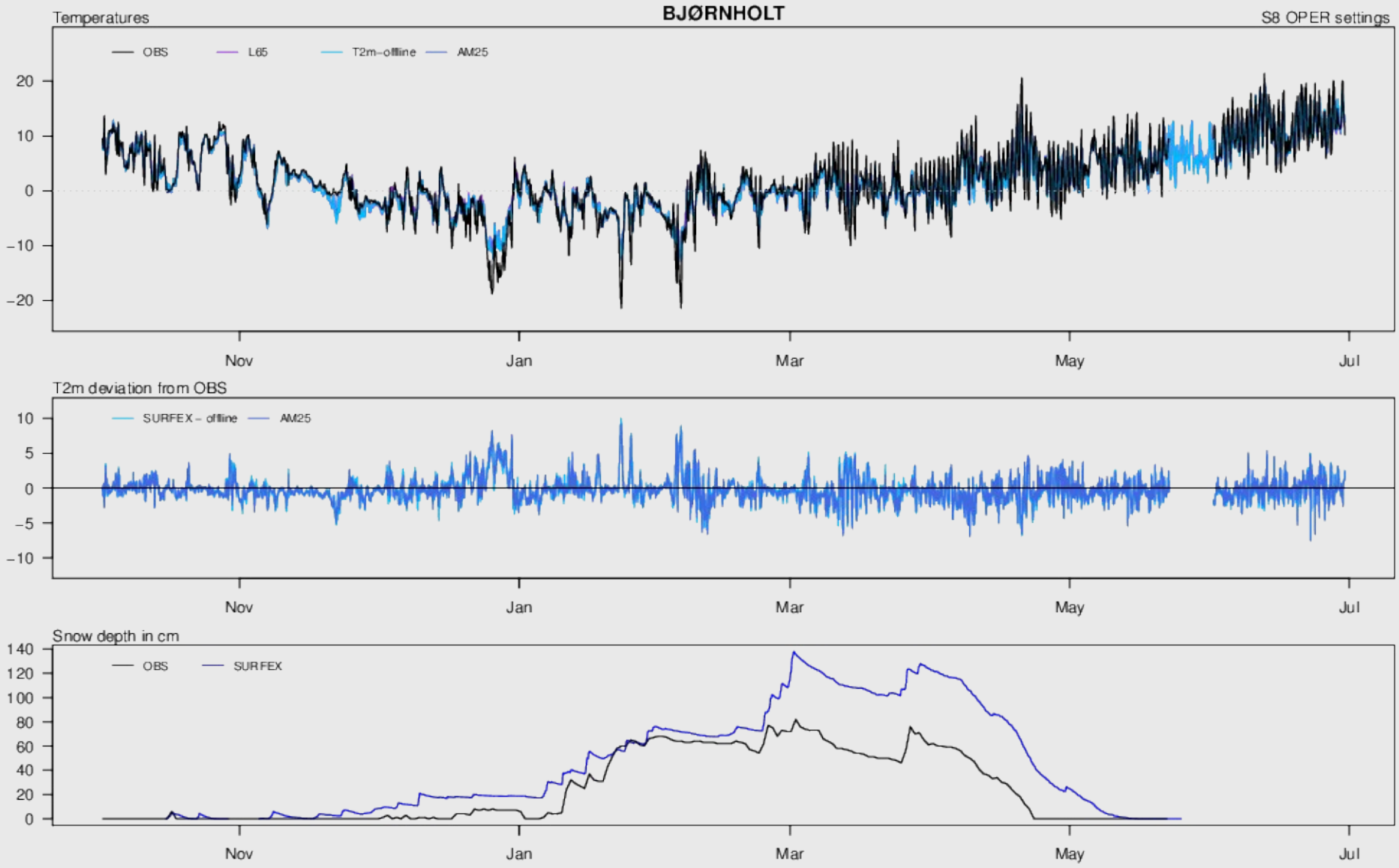
CSNOW=3-L, NPATCH=1: maybe realistic snow accumulation, BUT too rapid melting



CSNOW=3-L, NPATCH=2: better than with NPATCH=1

Bjørnholt frac(open land)=0.1 frac(forest)=0.9





D95: realistic snow accumulation, too slow melting

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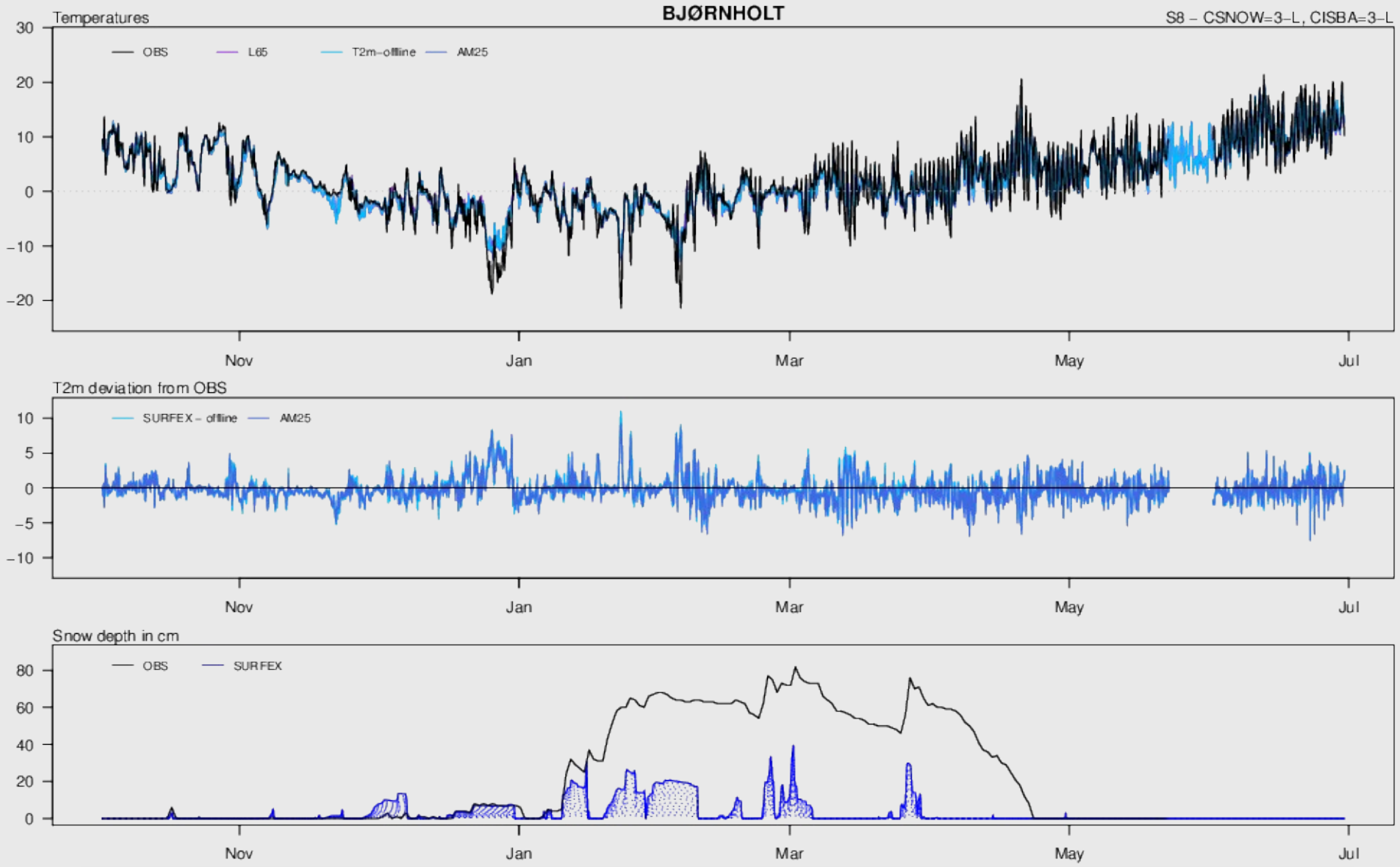
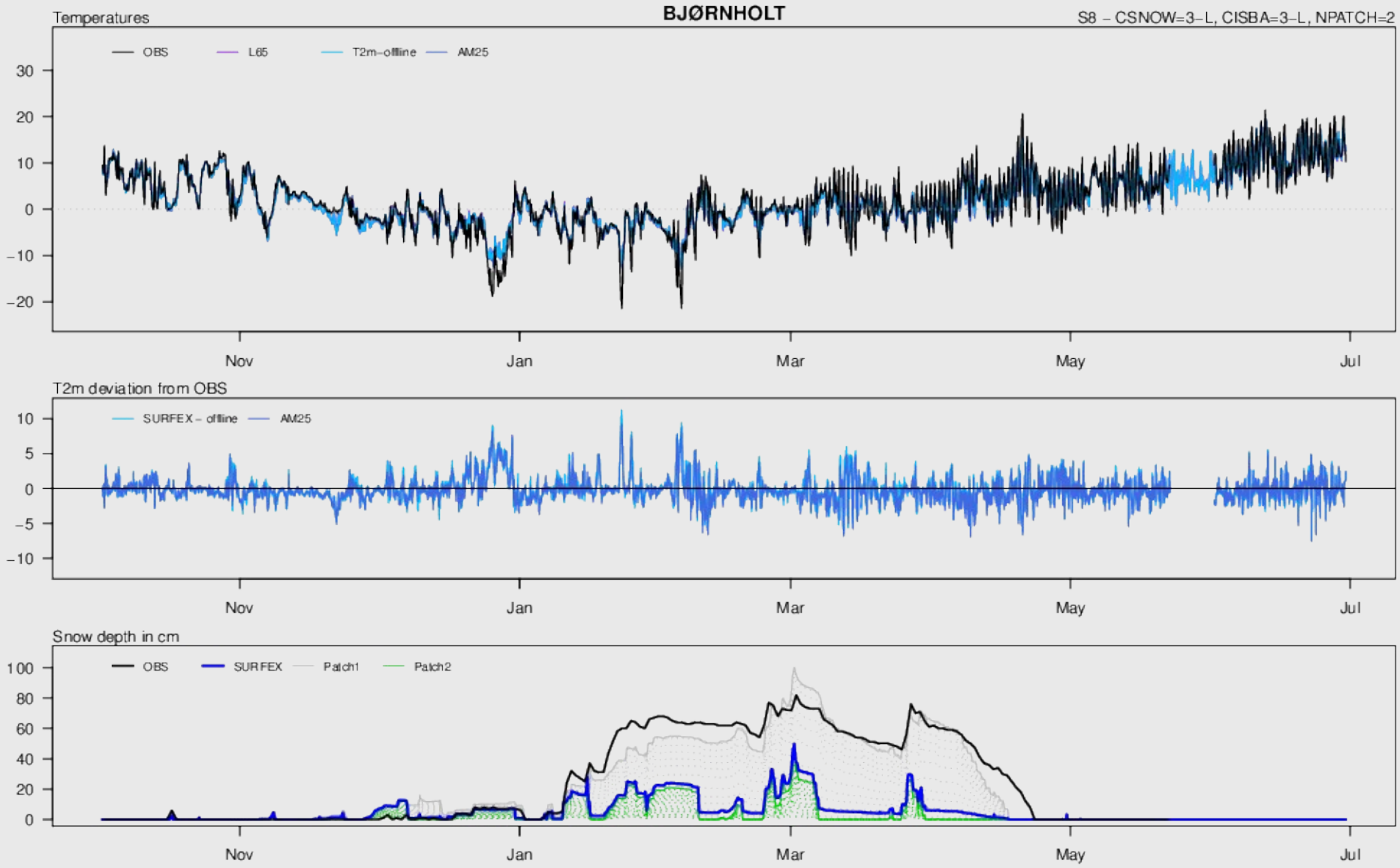


CSNOW=3-L, NPATCH=1: maybe realistic snow accumulation, BUT too rapid melting



CSNOW=3-L, NPATCH=2: underestimation, but better than with NPATCH=1,
snow amount on patch1 is close to observed

First NWP experiments with Explicit Snow sheme in HARMONIE-AROME

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Experiments with cycle 40h1.1 and SURFEX7.3

- Time period: 1. December – 15. December 2016
- No surface assimilation
- ISBA Force-Restore, Surface Boundary Layer scheme
- REF: CSNOW=D95
- EXP: CSNOW=3-L

Experiences so far

- Crash when initialisating with SWE from ECMWF boundary grib files
  - Due to very low surface temperatures in a few grid points with no snow surrounded by initial maximum snow amount (XSWEMAX=500 kg/m²)
  - «walk arround» by reducing XSWEMAX to 30 kg/m²
- Too rapid melting as seen also in offline experiments

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Thank you!!