



Meteorologisk
institutt

Regional Snow Modeling in Norway with SURFEX/Crocus

Hanneke Luijting, Dagrun Vikhamar Schuler, Thomas Skaugen



Meteorologisk
institutt

Why?

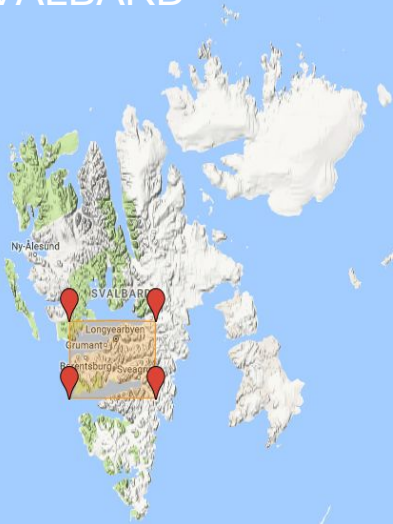
- Snow makes up 30% of annual precipitation in Norway
- Important for
 - Hydropower production planning
 - Forecasting of floods and avalanches
 - Winter sport activities
 - Construction safety
 - Traffic flow at airports, roads and railways
 - Weather and climate system



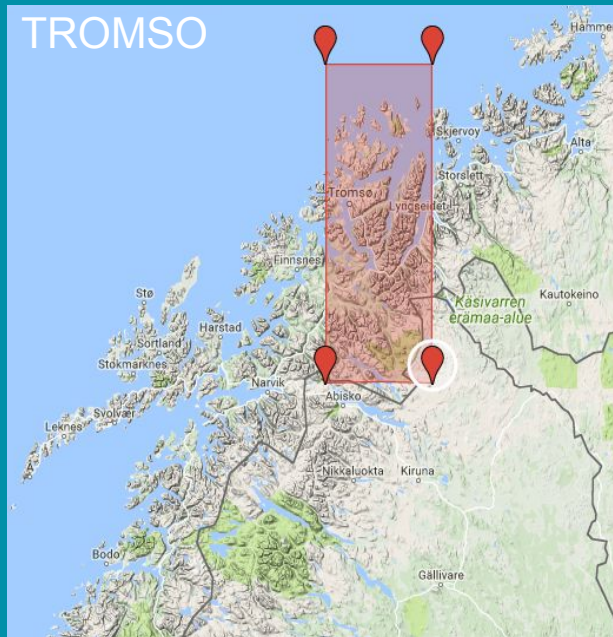
Meteorologisk
institutt

Domains

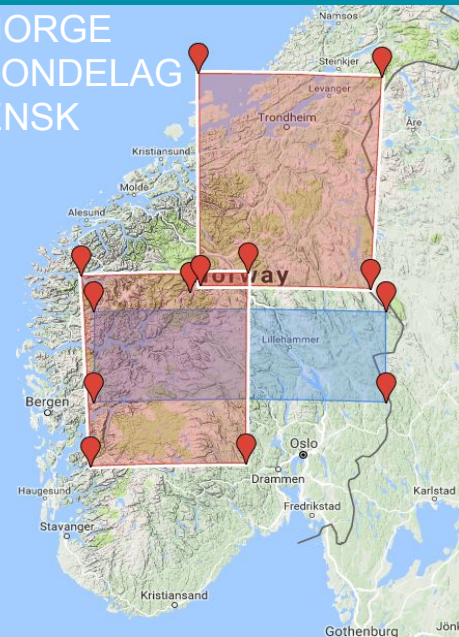
SVALBARD



TROMSO



SNORGE TRONDELAG RENSK

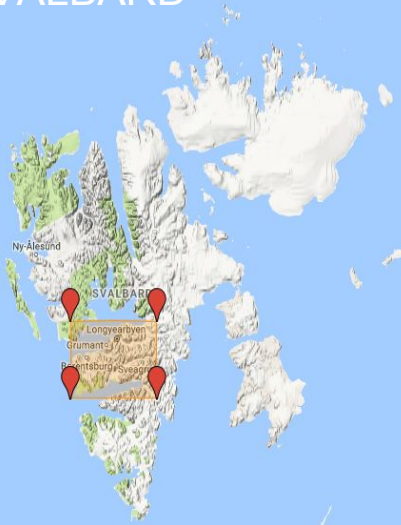




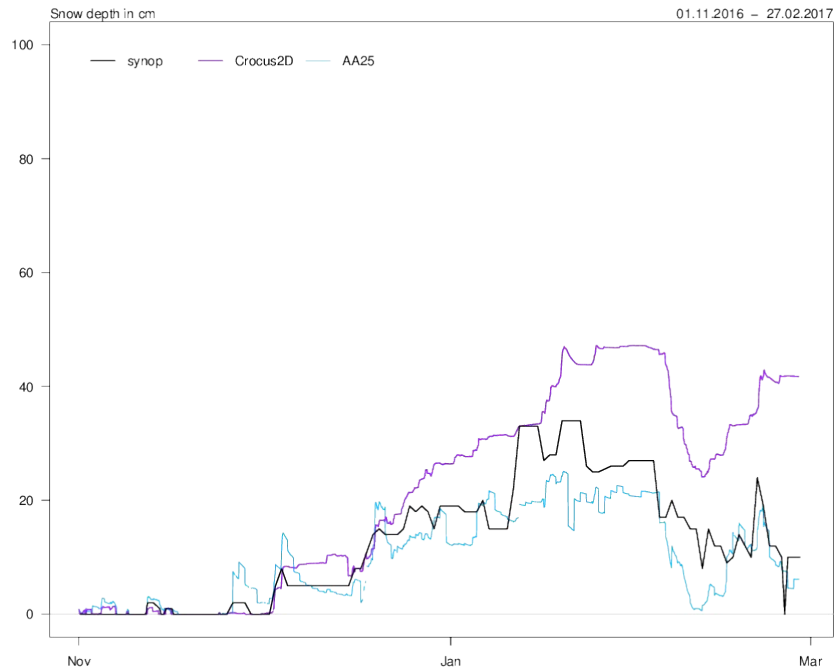
Meteorologisk
institutt

Domains

SVALBARD



SVALBARD LUFTHAVN

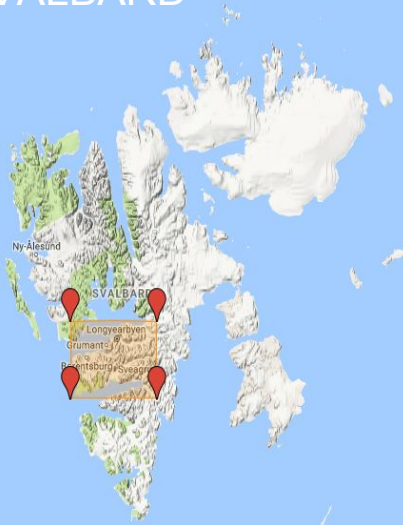




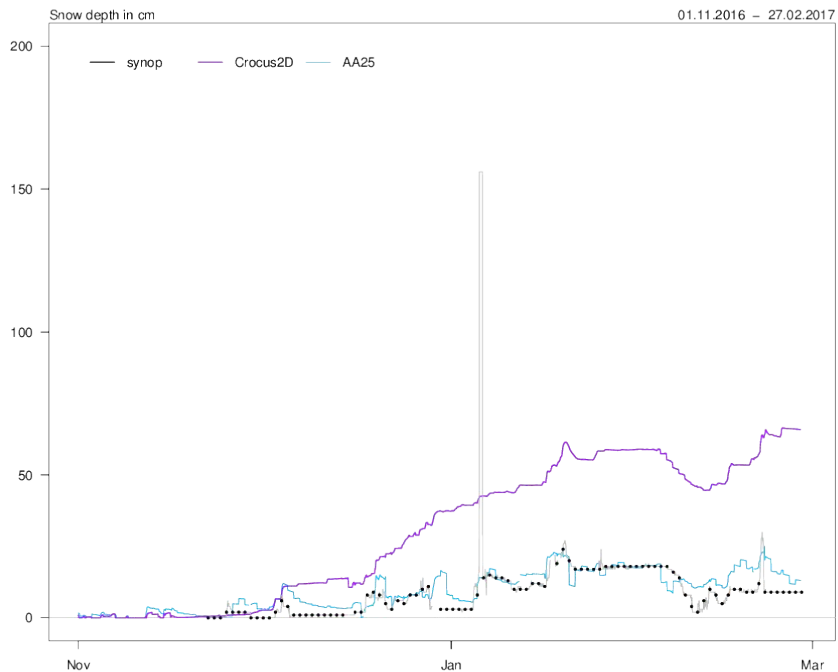
Meteorologisk
institutt

Domains

SVALBARD



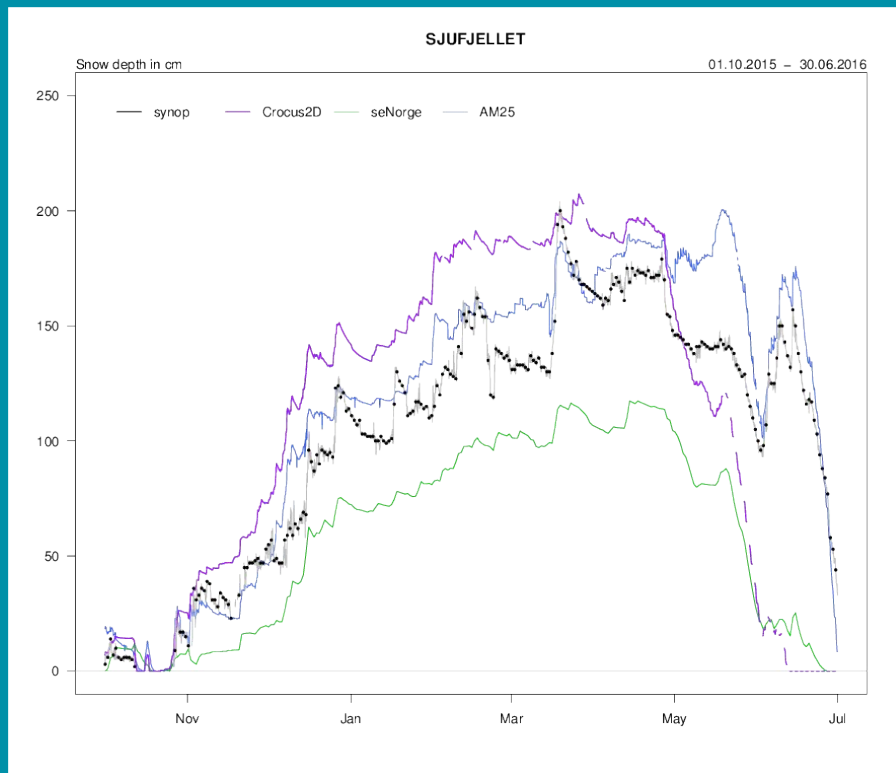
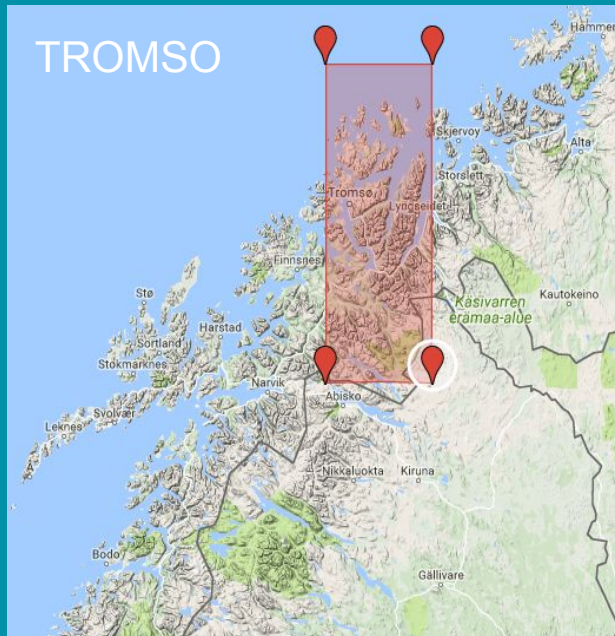
ADVENTDALEN





Domains

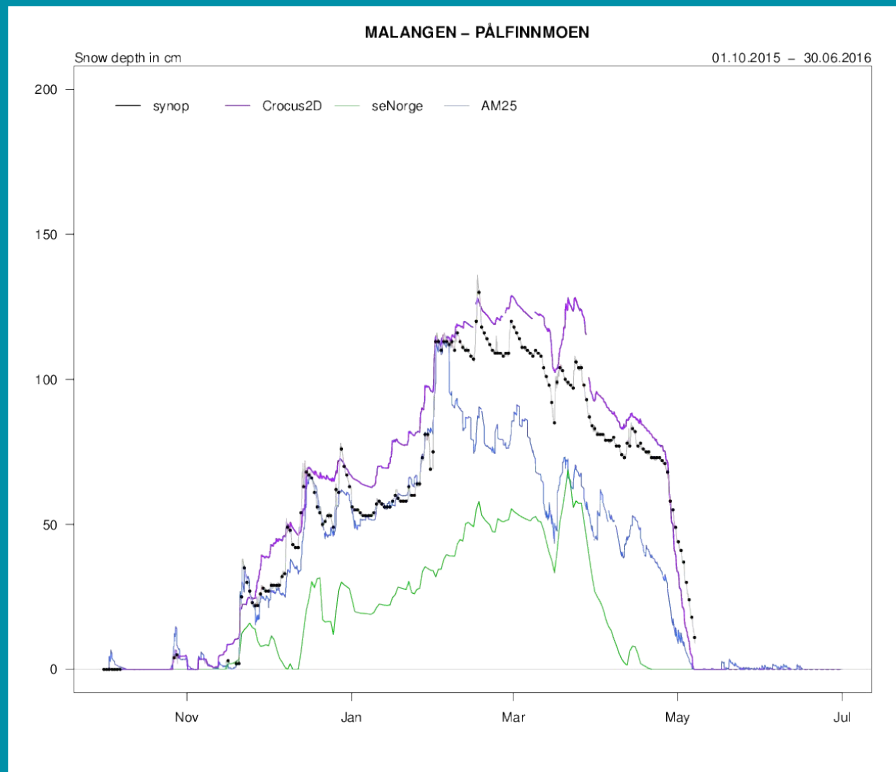
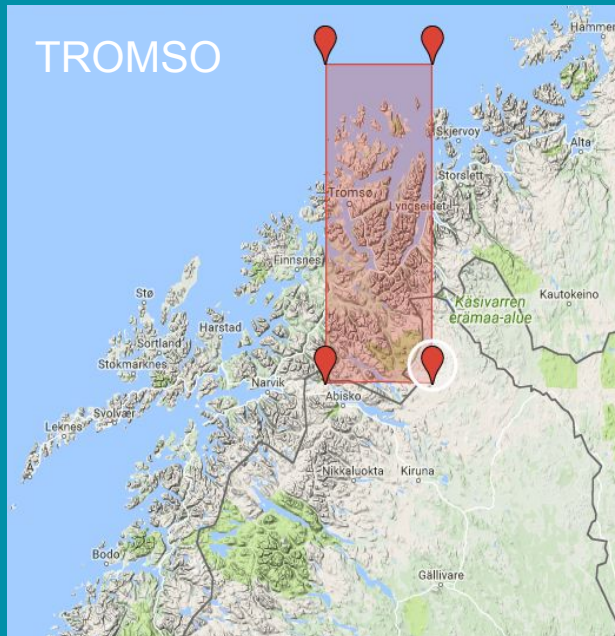
Meteorologisk
institutt





Domains

Meteorologisk
institutt

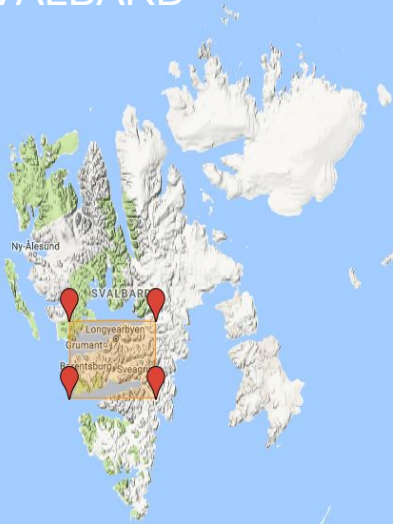




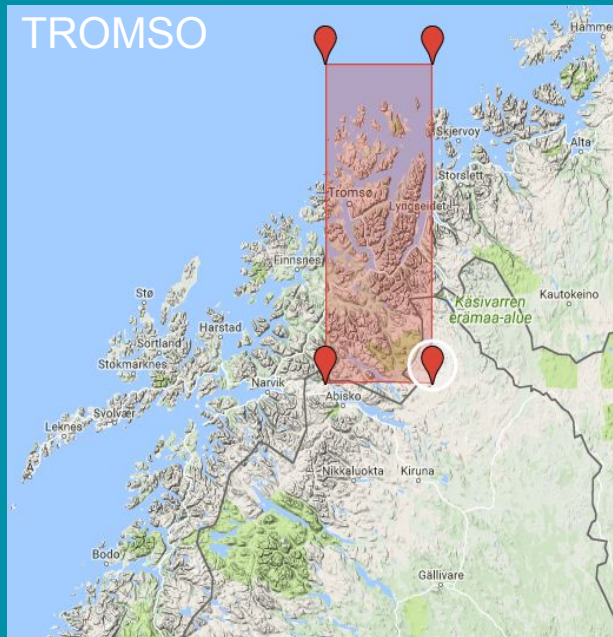
Meteorologisk
institutt

Domains

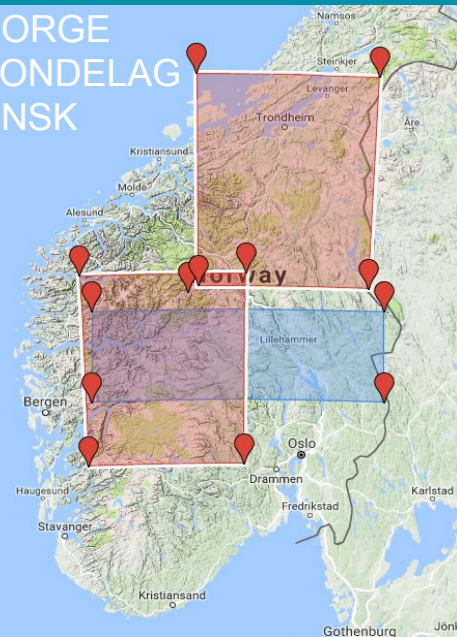
SVALBARD

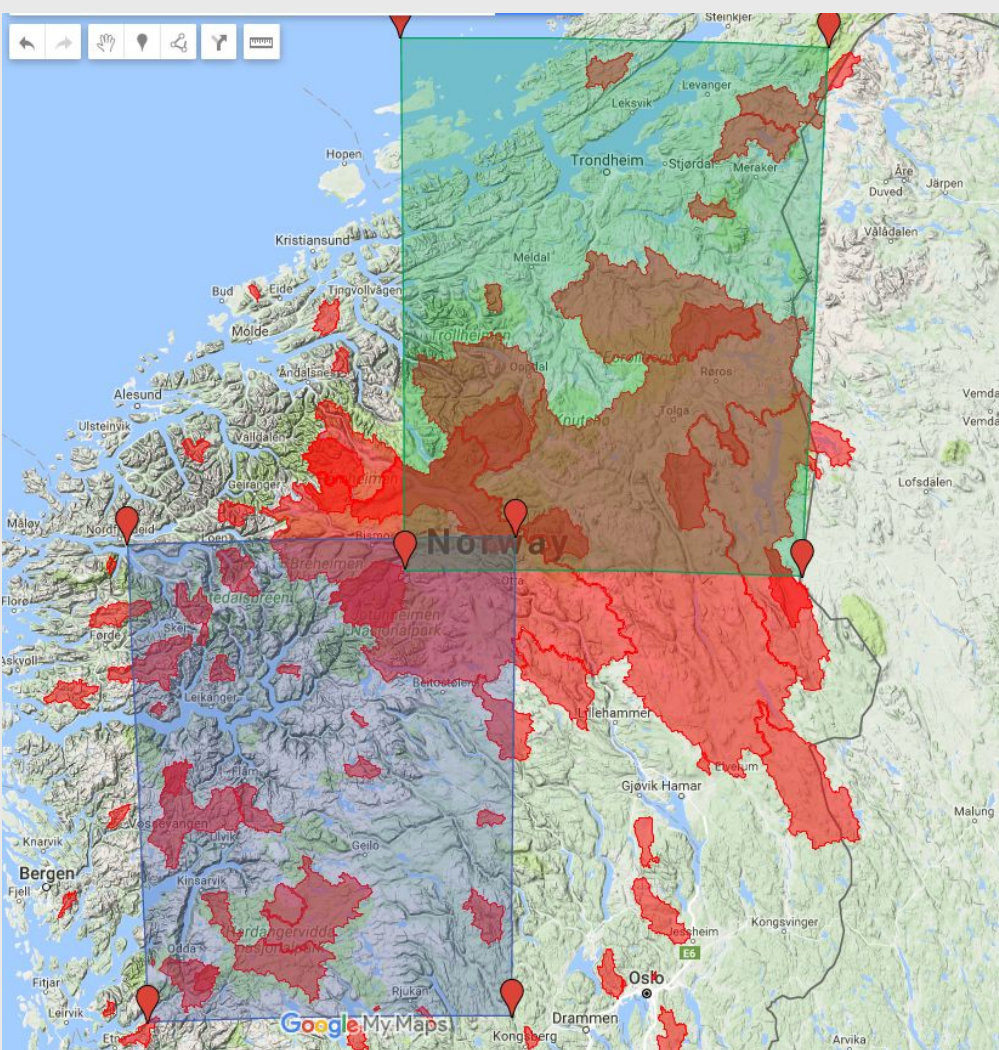


TROMSO



SNORGE TRONDELAG RENSK





SNOWHOW

- Better SNOW models for natural hazards and HydropOWER applications
- Led by NVE (The Norwegian Water Resources and Energy Directorate)
- Two domains, chosen to cover catchment areas
- 5 models
- Two years/winters:
Sep 2014 - Sep 2016



Meteorologisk
institutt

SURFEX: input

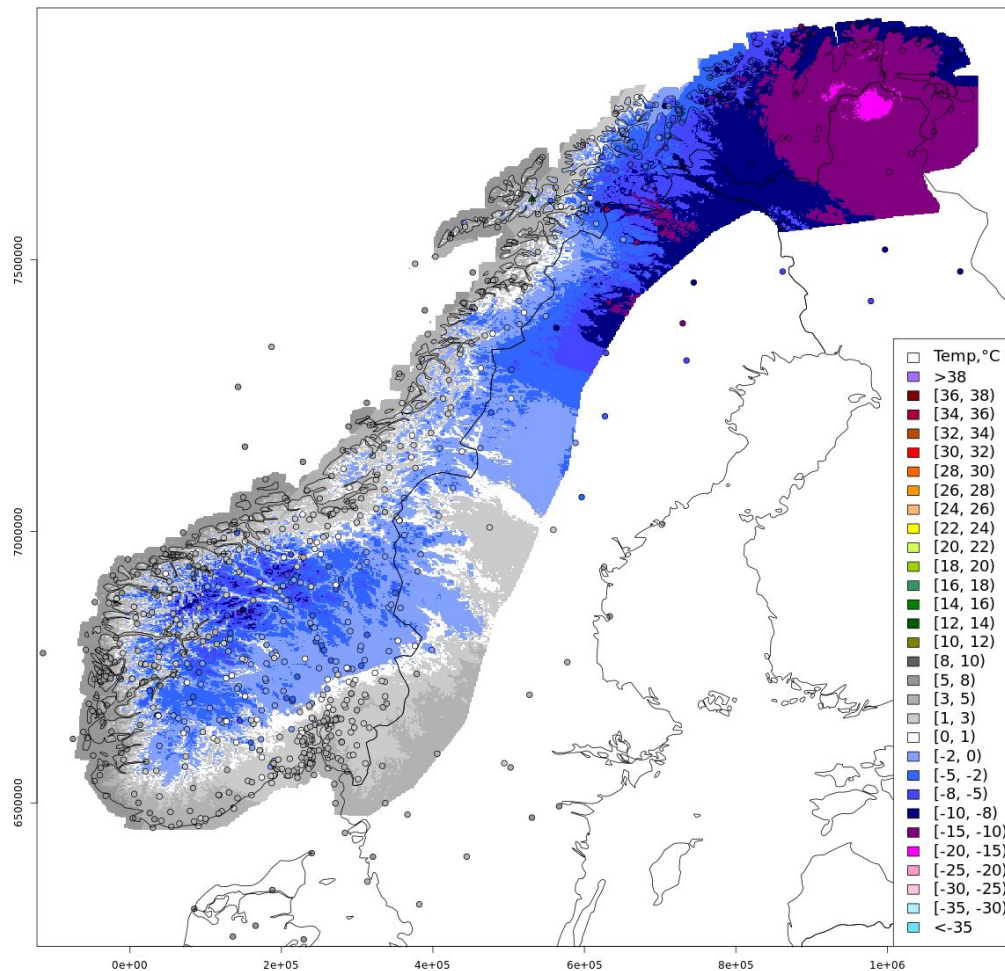
Variable	Unit	Description
ZS	m	Surface orography
LON	deg	longitude
LAT	deg	latitude
TA	K	air temperature
QA	Kg/Kg	air specific humidity
WIND	m/s	wind speed
DIR SW	W/m2	downward direct shortwave radiation
SCA SW	W/m2	downward diffuse shortwave radiation
LW	W/m2	downward longwave radiation
PS	Pa	surface pressure
RAIN	Kg/m2/s	rainfall rate
SNOW	Kg/m2/s	snowfall rate
CO2	NB	CO2 concentration
DIR	deg	wind direction

**Gridded hourly
observations,
1 km resolution**

*Everything else from
HARMONIE-AROME
MetCoOp (2.5 km)*



Meteorologisk
institutt

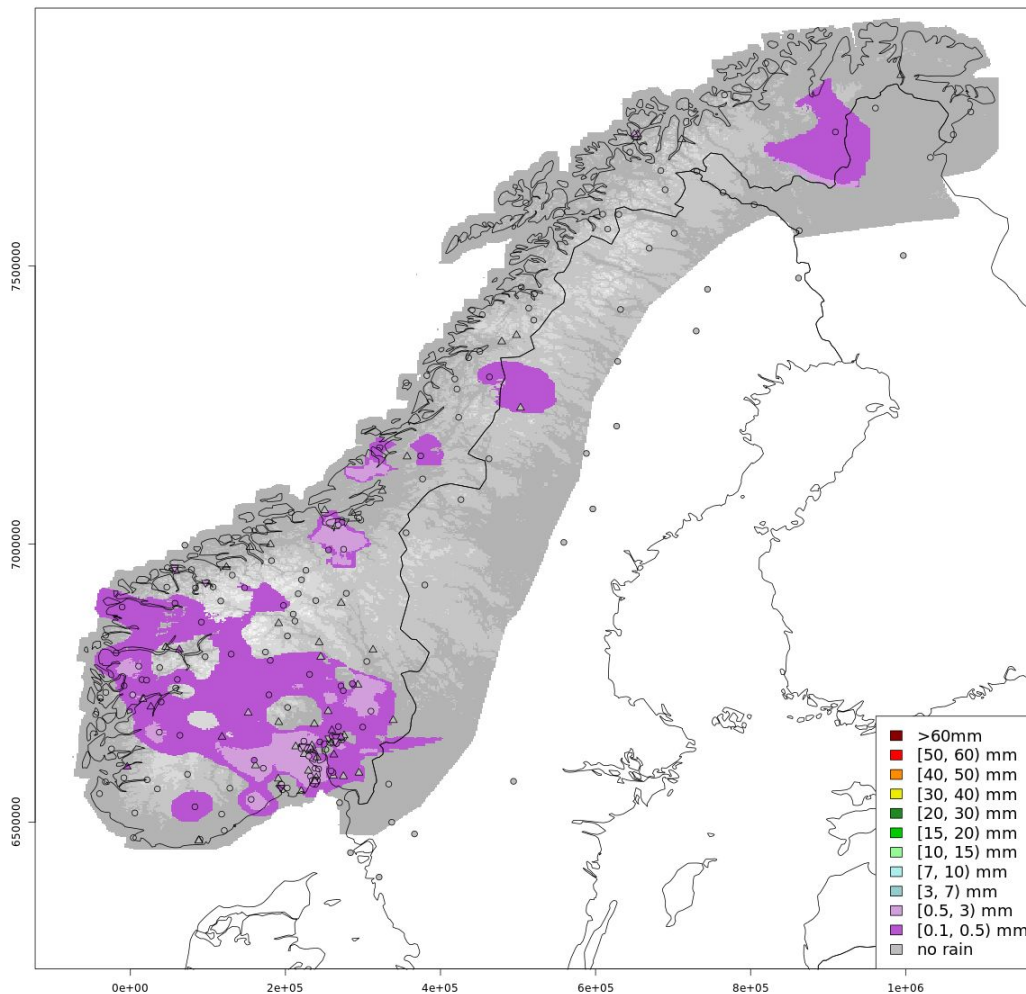


Hourly Temperature

2016.01.23.04 PREC1h hourly accumulated precipitation [UTC]



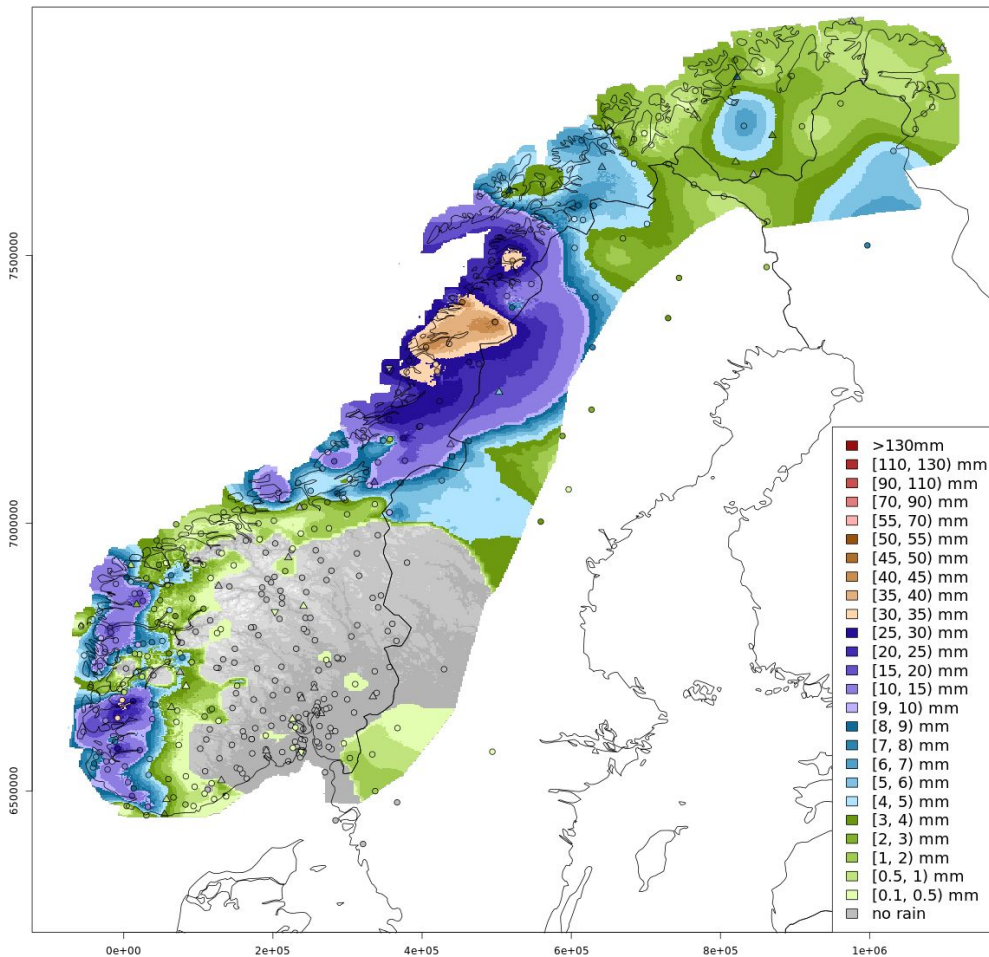
Meteorologisk
institutt



Snow when $T < 0.5^{\circ}\text{C}$,
Rain when $T > 0.5^{\circ}\text{C}$

Hourly Precipitation

2016.09.07 PREC1d daily accumulated precipitation [UTC]



Snow when $T < 0.5^{\circ}\text{C}$,
Rain when $T > 0.5^{\circ}\text{C}$

Daily Precipitation

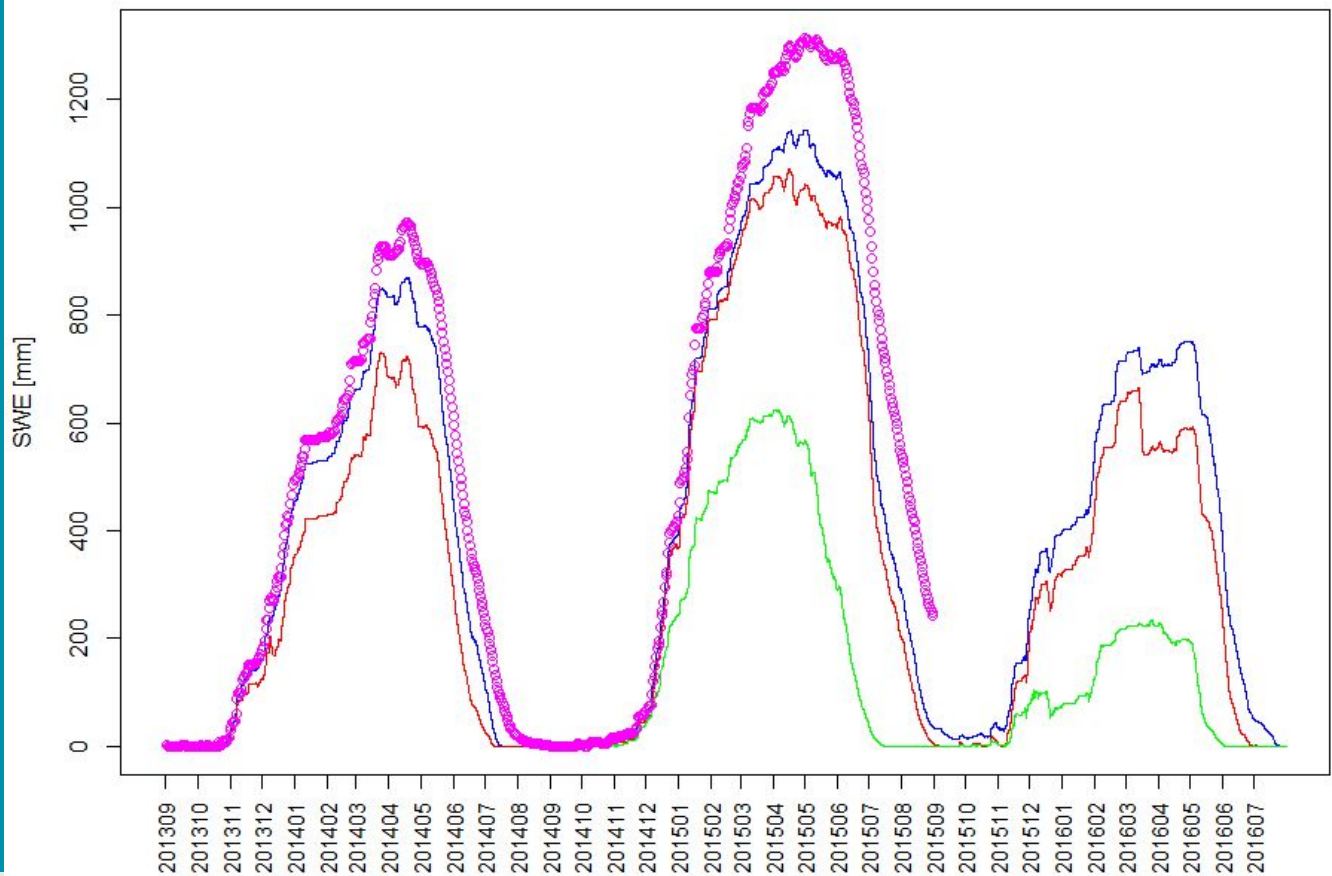


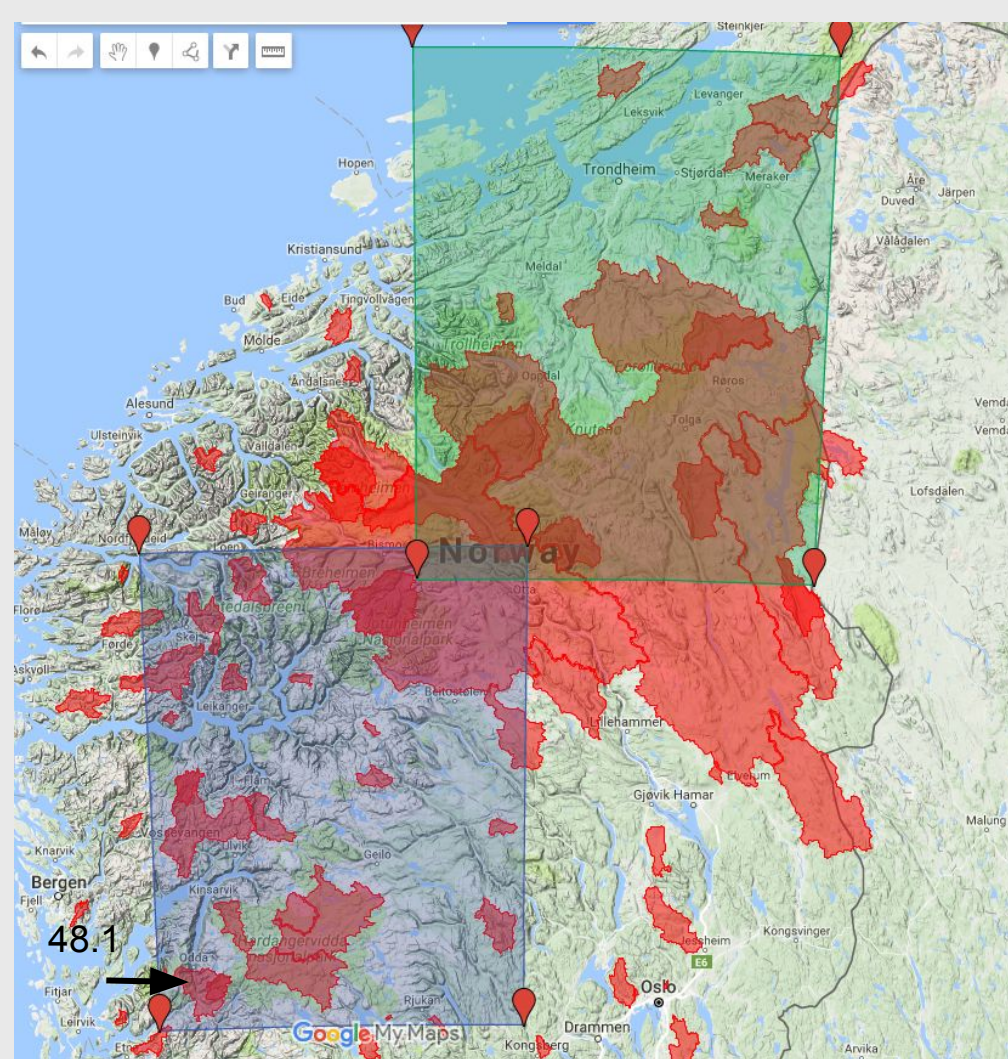
Meteorologisk
institutt



Meteorologisk
institutt

SWE(mm) 48.1 Elevation zone= 0 ._eb(Blue),_calCX(red), Crocus (green),SeNorge3h (pink)



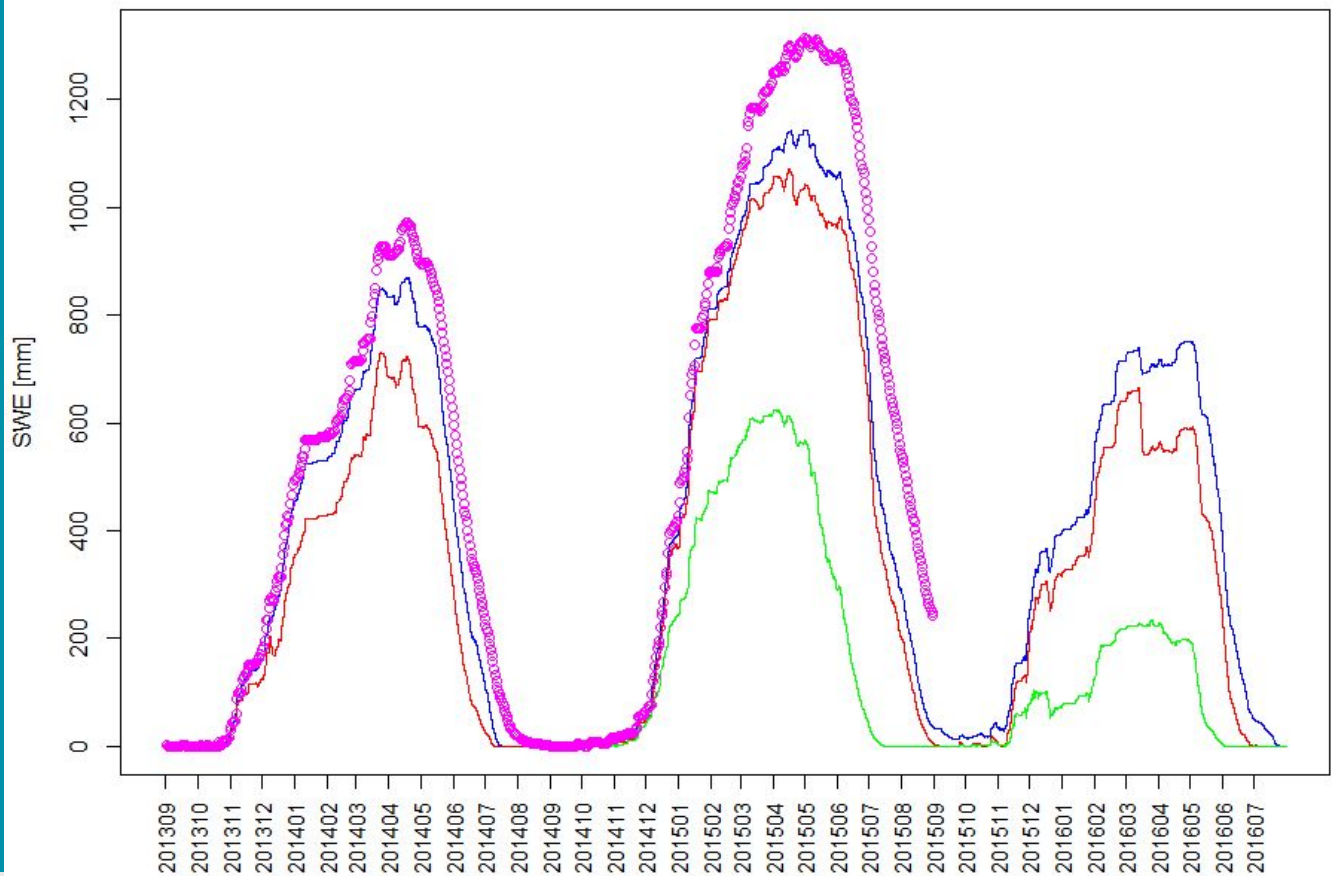


- Averaged per catchment area
- 4 models:
 - SURFEX/Crocus (7.3)
 - DDD (Distance Distribution Dynamics)
 - DDD-EB
 - SeNorge

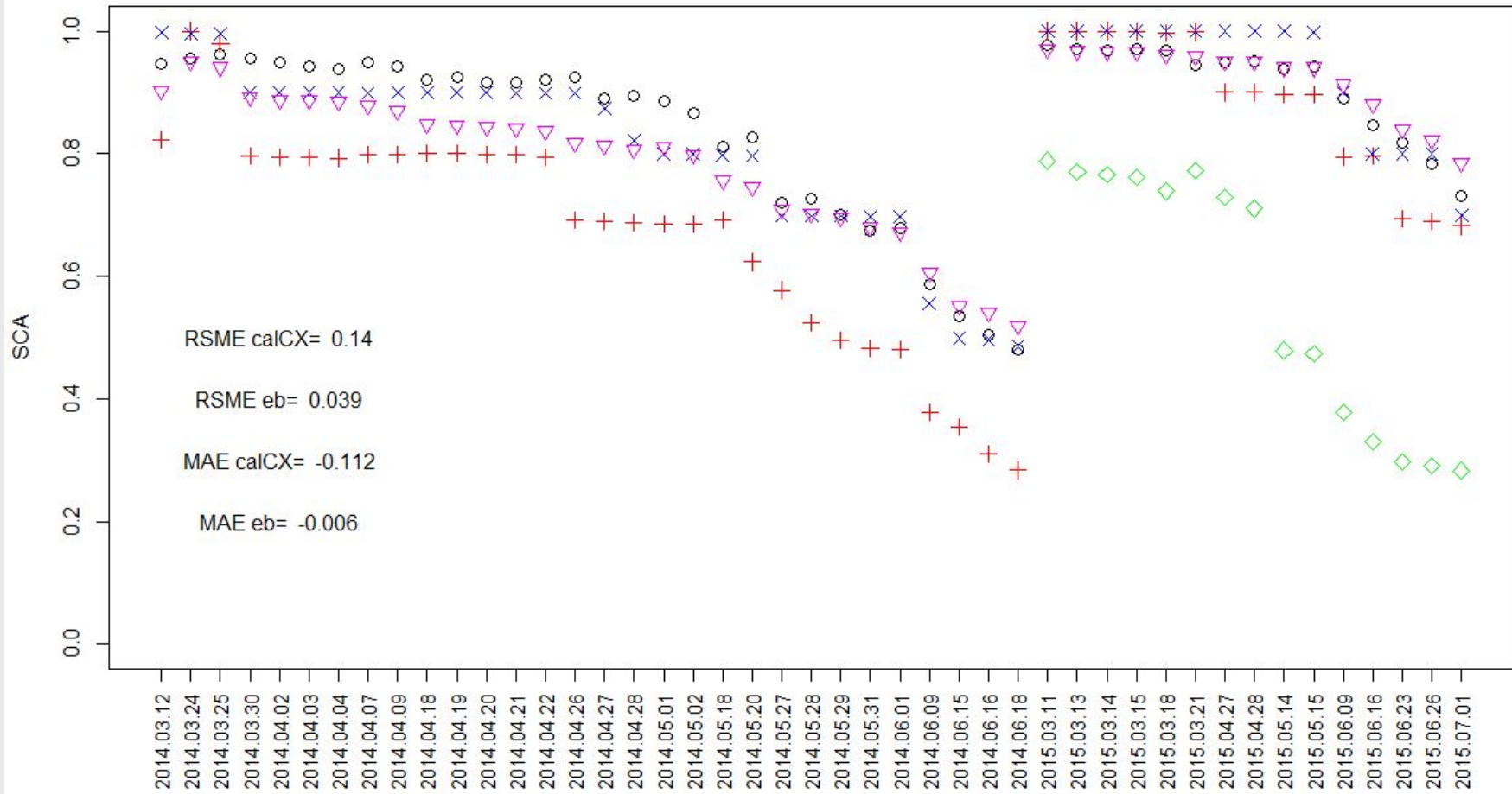


Meteorologisk
institutt

SWE(mm) 48.1 Elevation zone= 0 ._eb(Blue),_calCX(red), Crocus (green),SeNorge3h (pink)

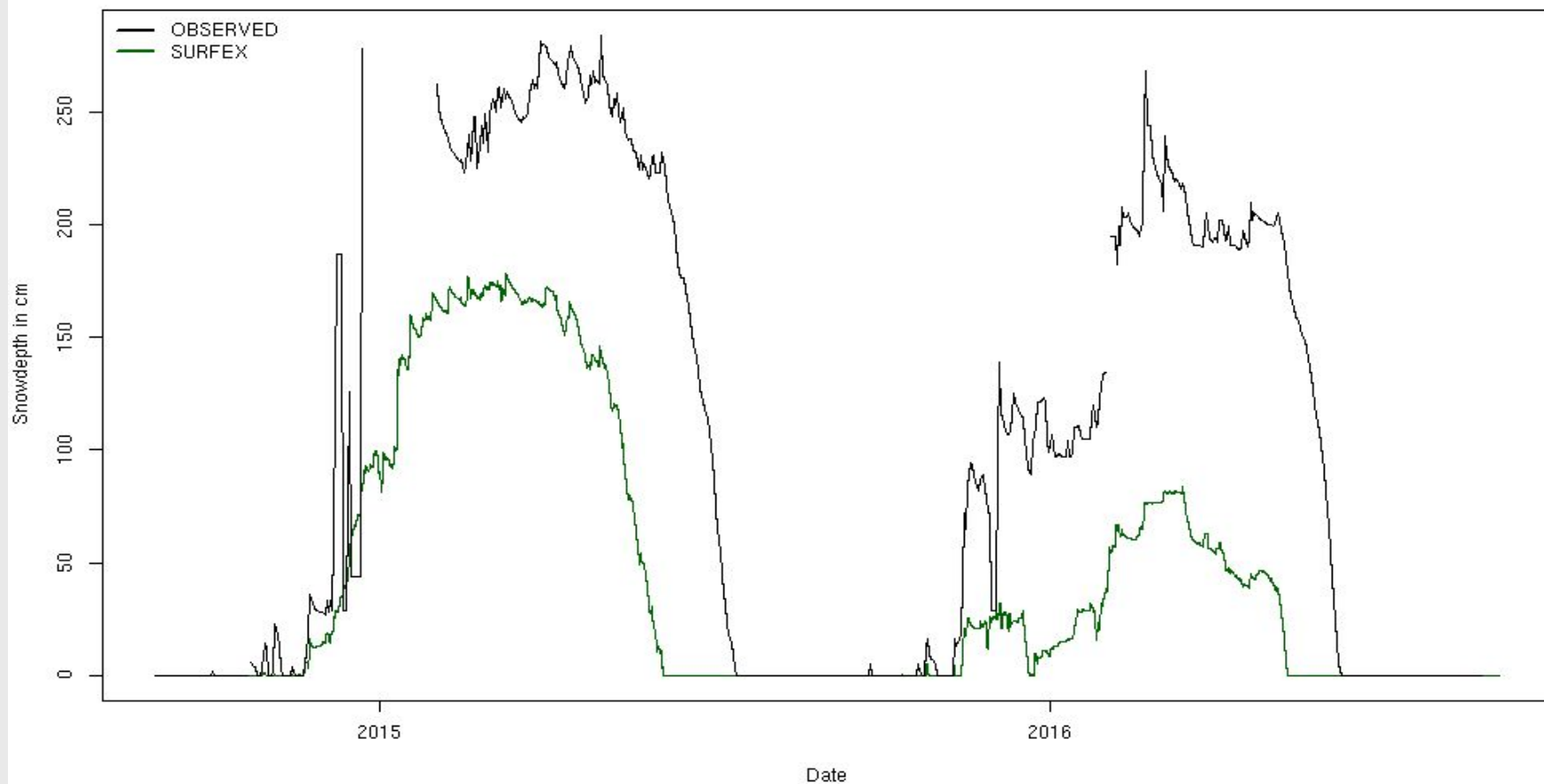


SCA comp. 48.1 Elevation zone= 0 . MODIS(Black)_eb(blue)_calCX(red), Crocus(green), SeNorge 3h(magenta)



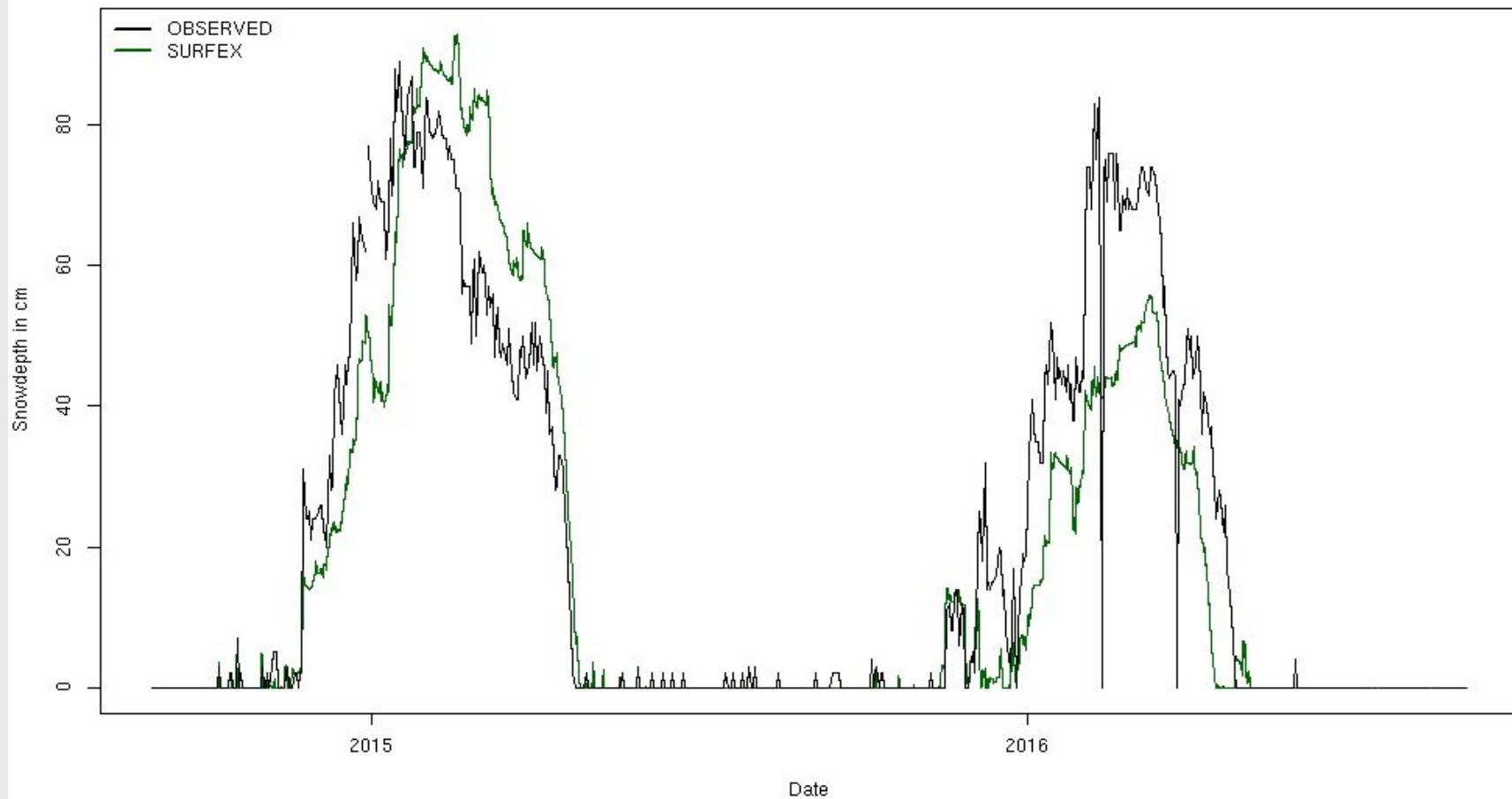
Snowdepth at RØLDALSFJELLET

1010 m



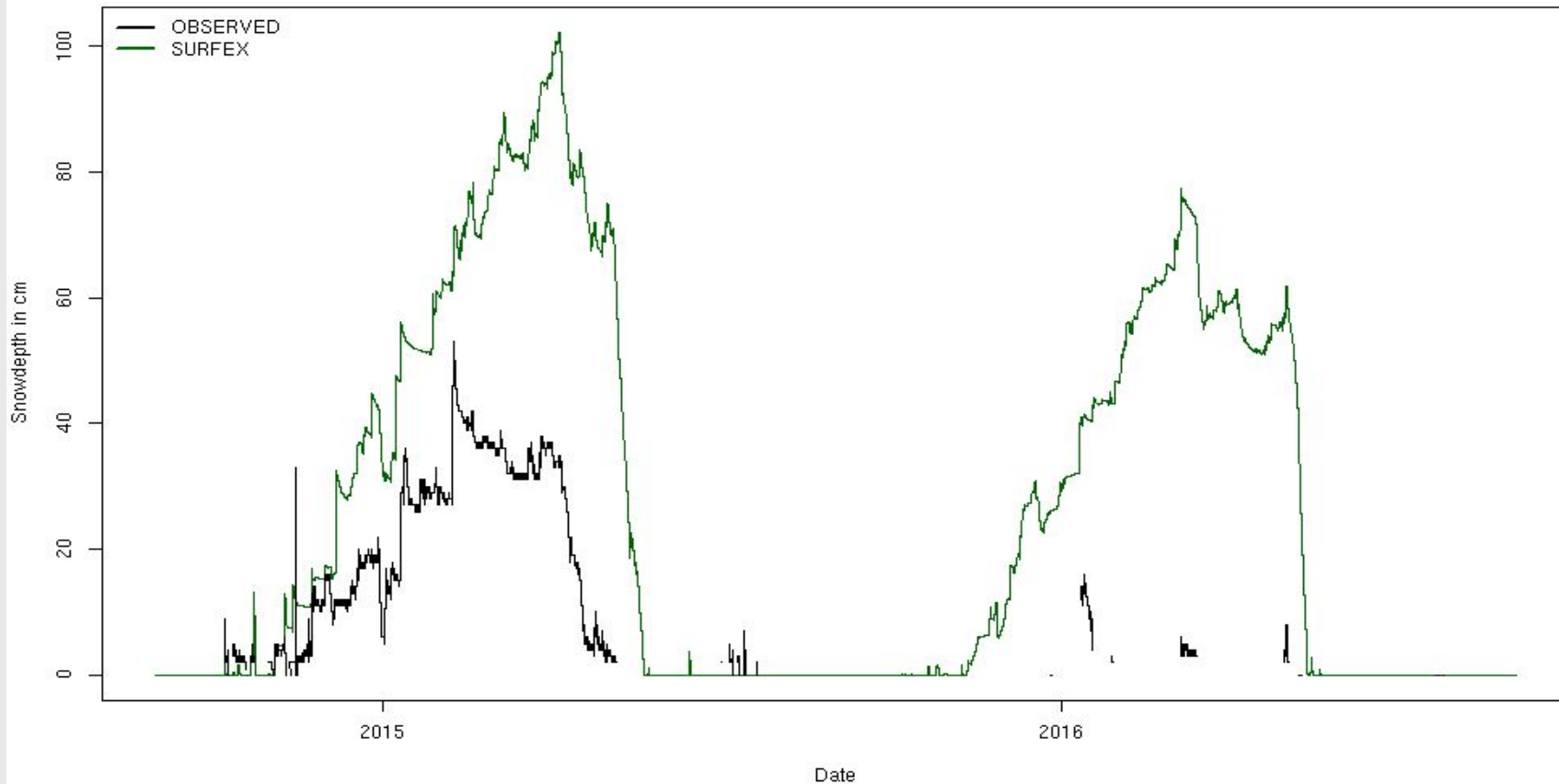
Snowdepth at MØSSTRAND II

977 m



Snowdepth at HJERKINN II

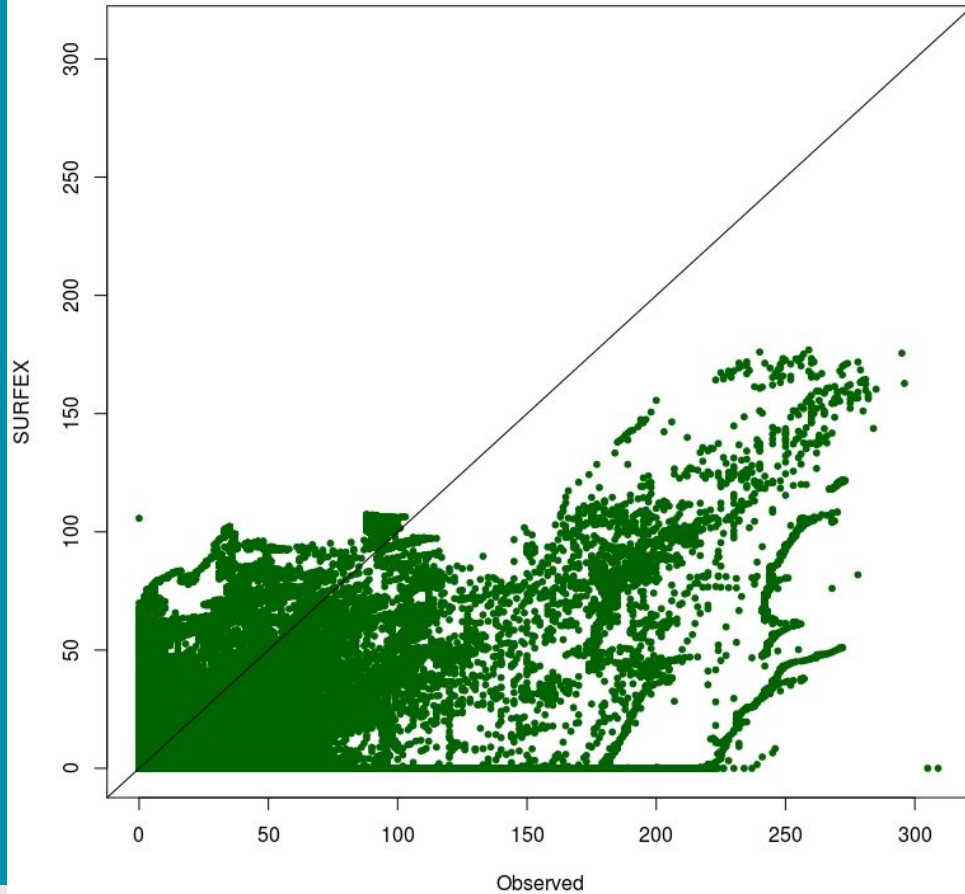
1012 m





Meteorologisk
institutt

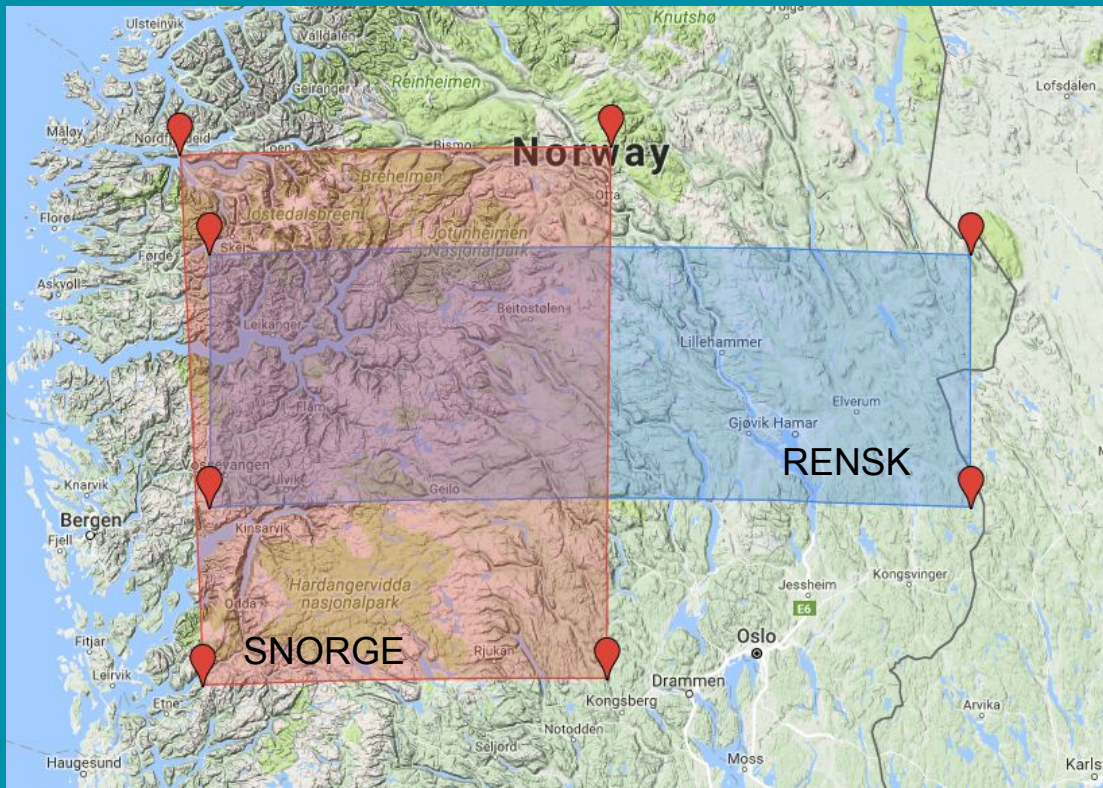
Snowdepth (cm) for Sep 2014 - Sep 2016





Meteorologisk
institutt

Overlap



Difference:

RENSK:

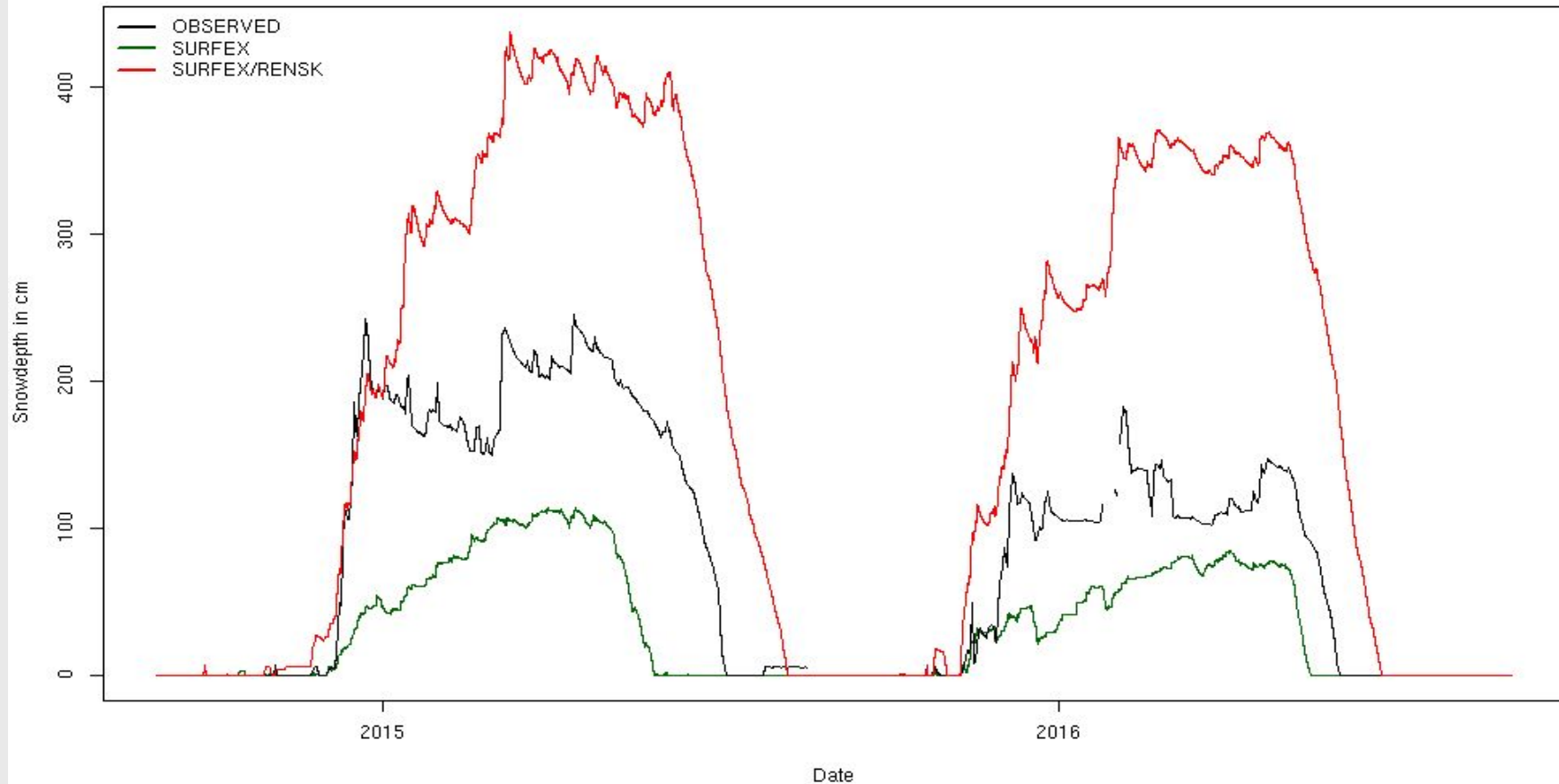
model data from
HARMONIE
AROME
MetCoOp

SNORGE:

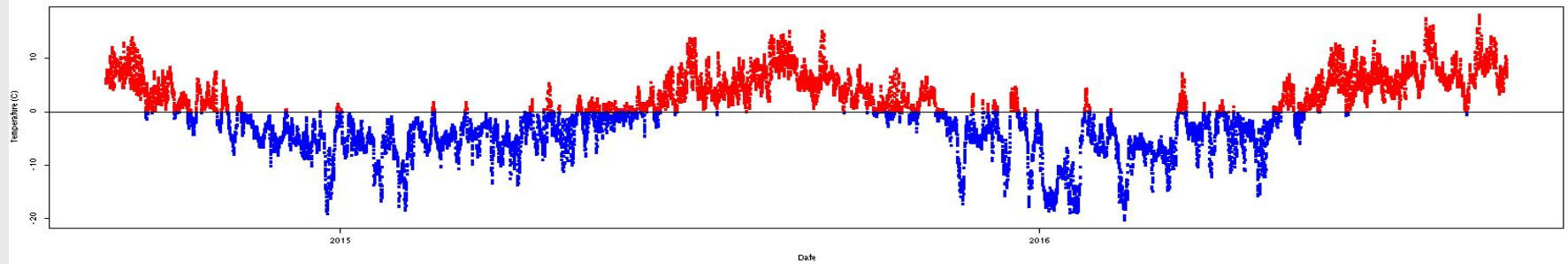
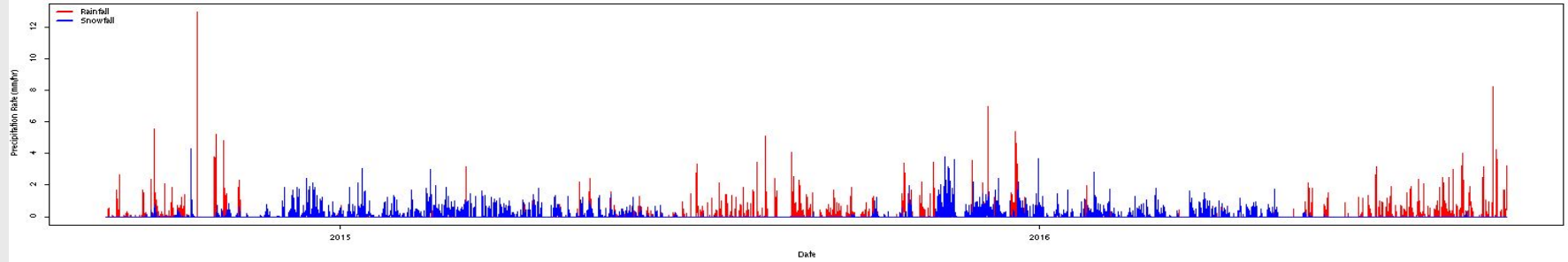
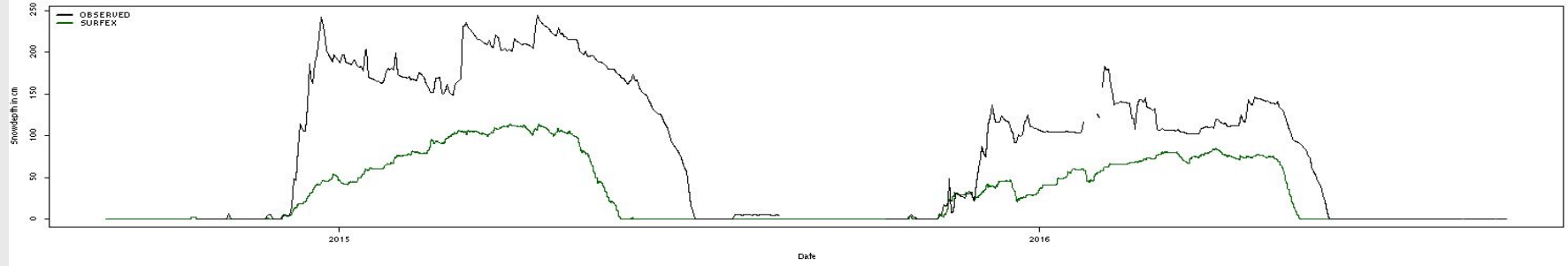
Gridded
observations of
temperature and
precipitation

Snowdepth at MIDTSTOVA

1162 m

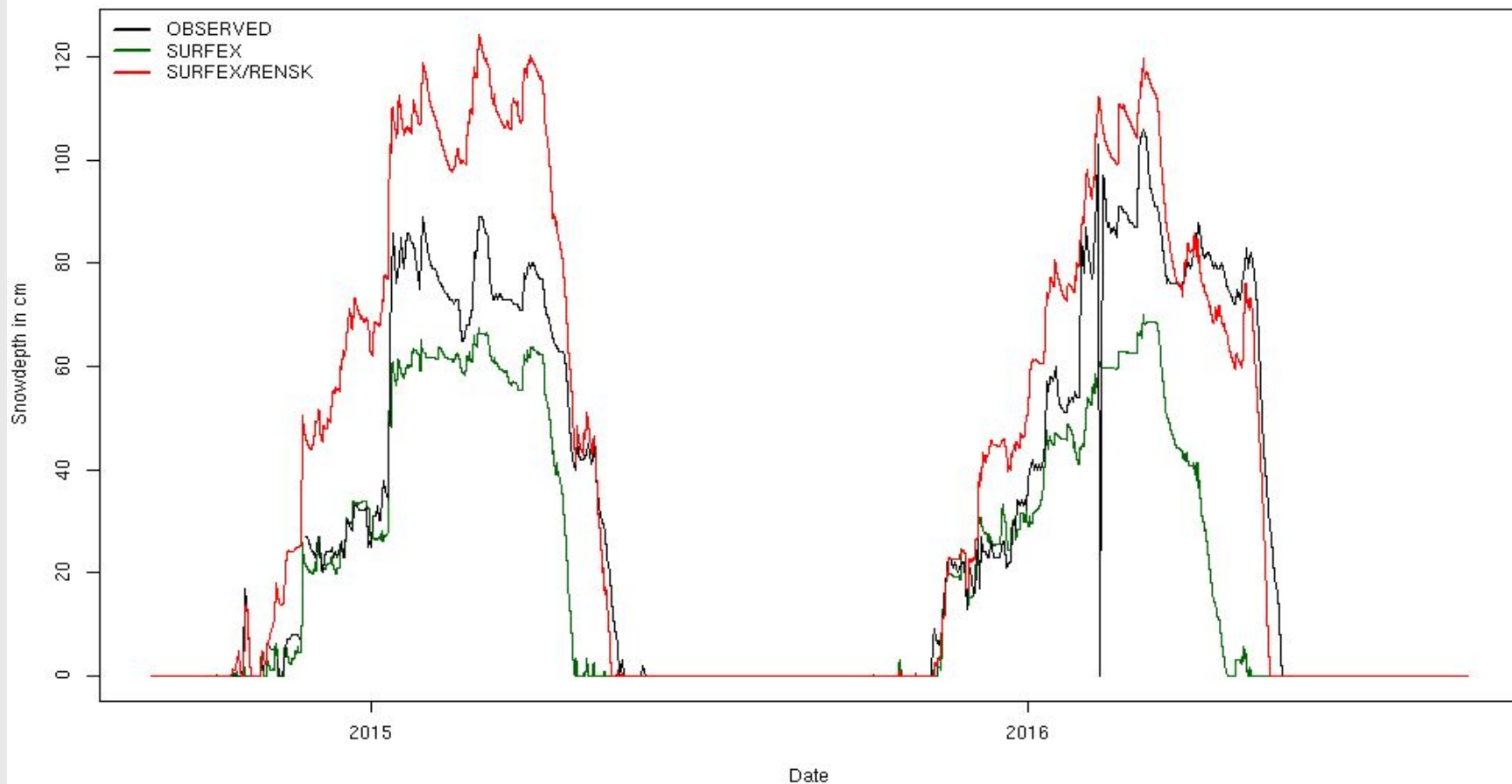


Snowdepth at MIDTSTOVA

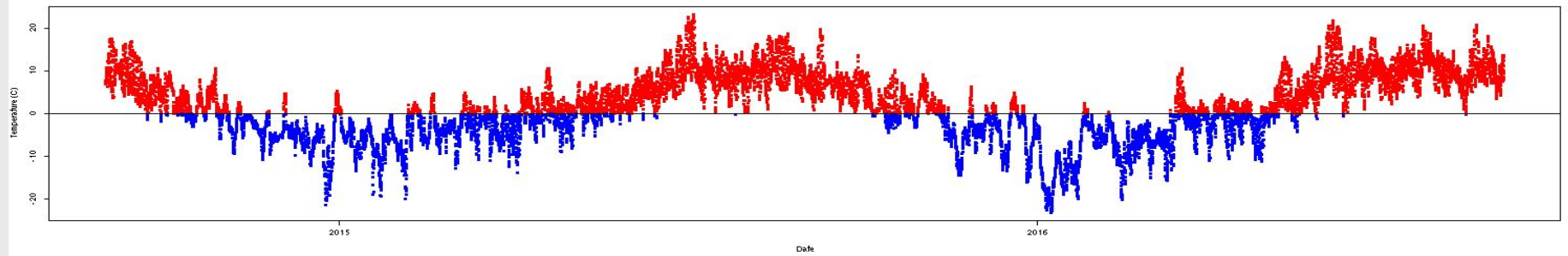
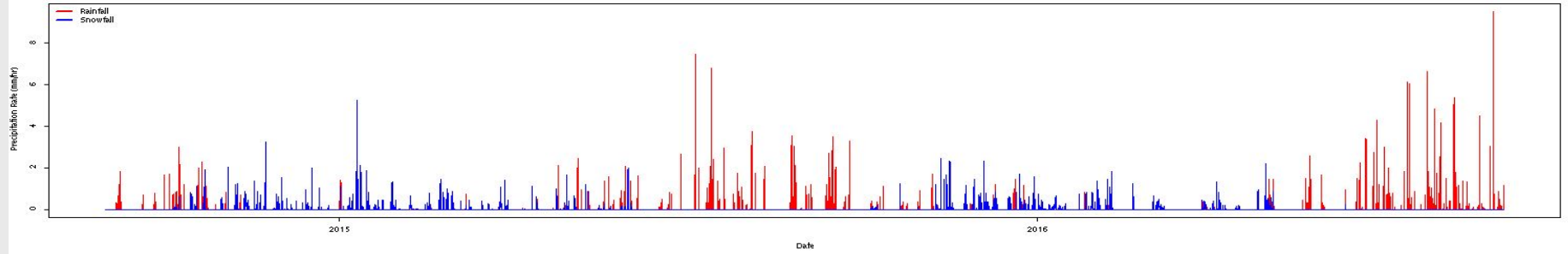
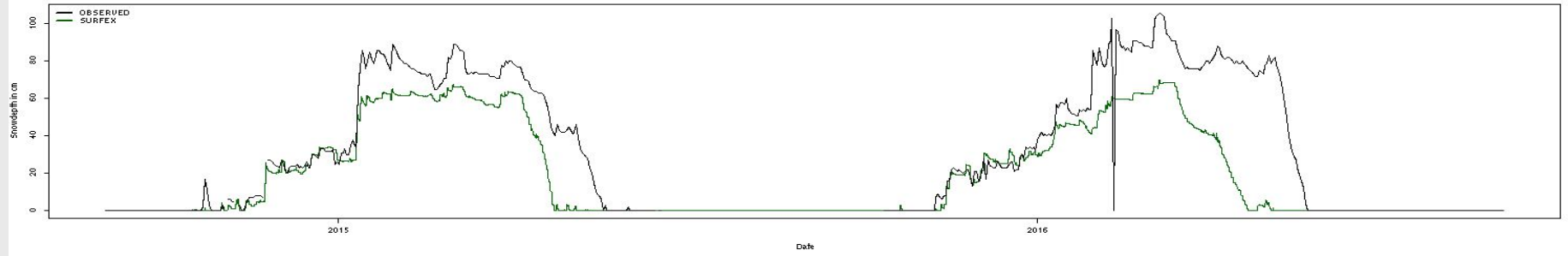


Snowdepth at BEITOSTØLEN II

965 m



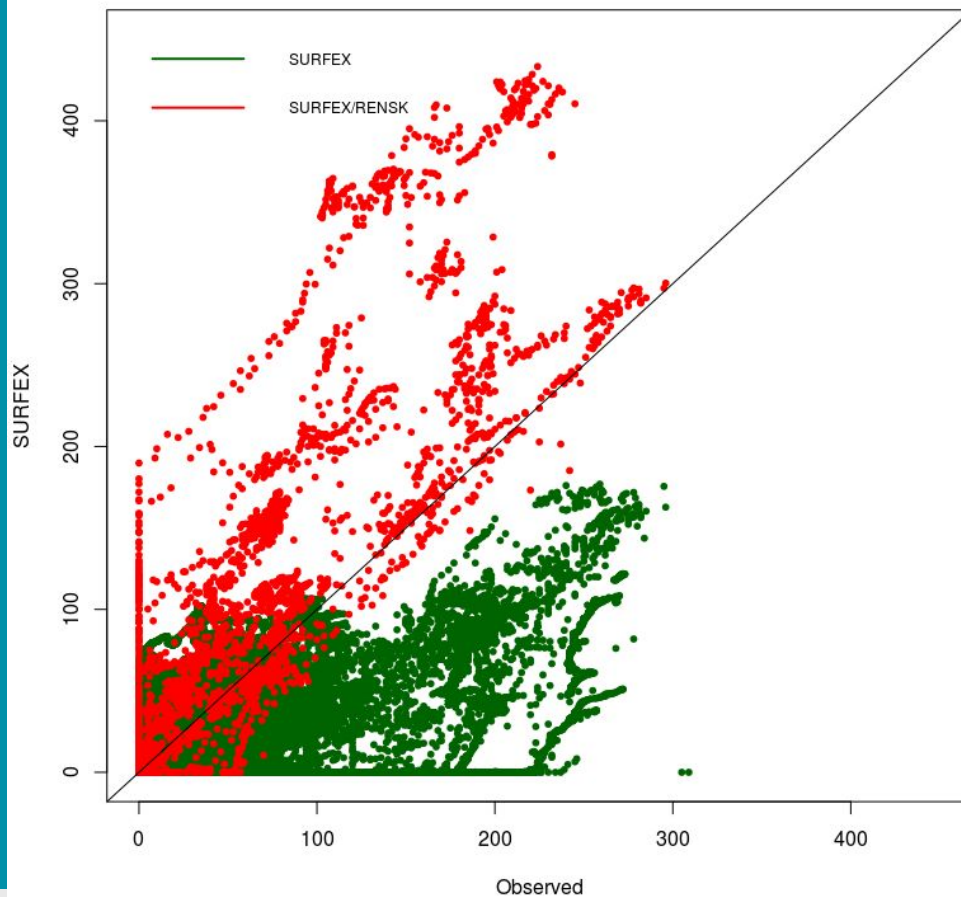
Snowdepth at BEITOSTØLEN II





Meteorologisk
institutt

Snowdepth (cm) for Sep 2014 - Sep 2016



Thank you!

