EGU General Assembly 2020
Sharing Geoscience Online

Estimation of snow water equivalent in a mountain range by using a dynamic regression approach

Antonio-Juan Collados-Lara[1], David Pulido-Velazquez[1], Eulogio Pardo-Igúzquiza[2], Esteban Alonso-González[3], and Juan Ignacio López-Moreno[3]

[1]Instituto Geológico y Minero de España, Urb. Alcázar del Genil, 4. Edificio Zulema Bajo, 18006, Granada (Spain). e-mails: aj.collados@igme.es; d.pulido@igme.es

[2]Instituto Geológico y Minero de España, Ríos Rosas, 23, 28003 Madrid (Spain). e-mail: e.pardo@igme.es

[3]Instituto Pirenaico de Ecología, Consejo Superior de Investigaciones Científicas (CSIC), 50059 Zaragoza (Spain). e-mails: e.alonso@ipe.csic.es; nlopez@ipe.csic.es

EGU2020-13112: Estimation of snow water equivalent in a mountain range by using a dynamic regression approach

EGU General Assembly 2020
Sharing Geoscience Online

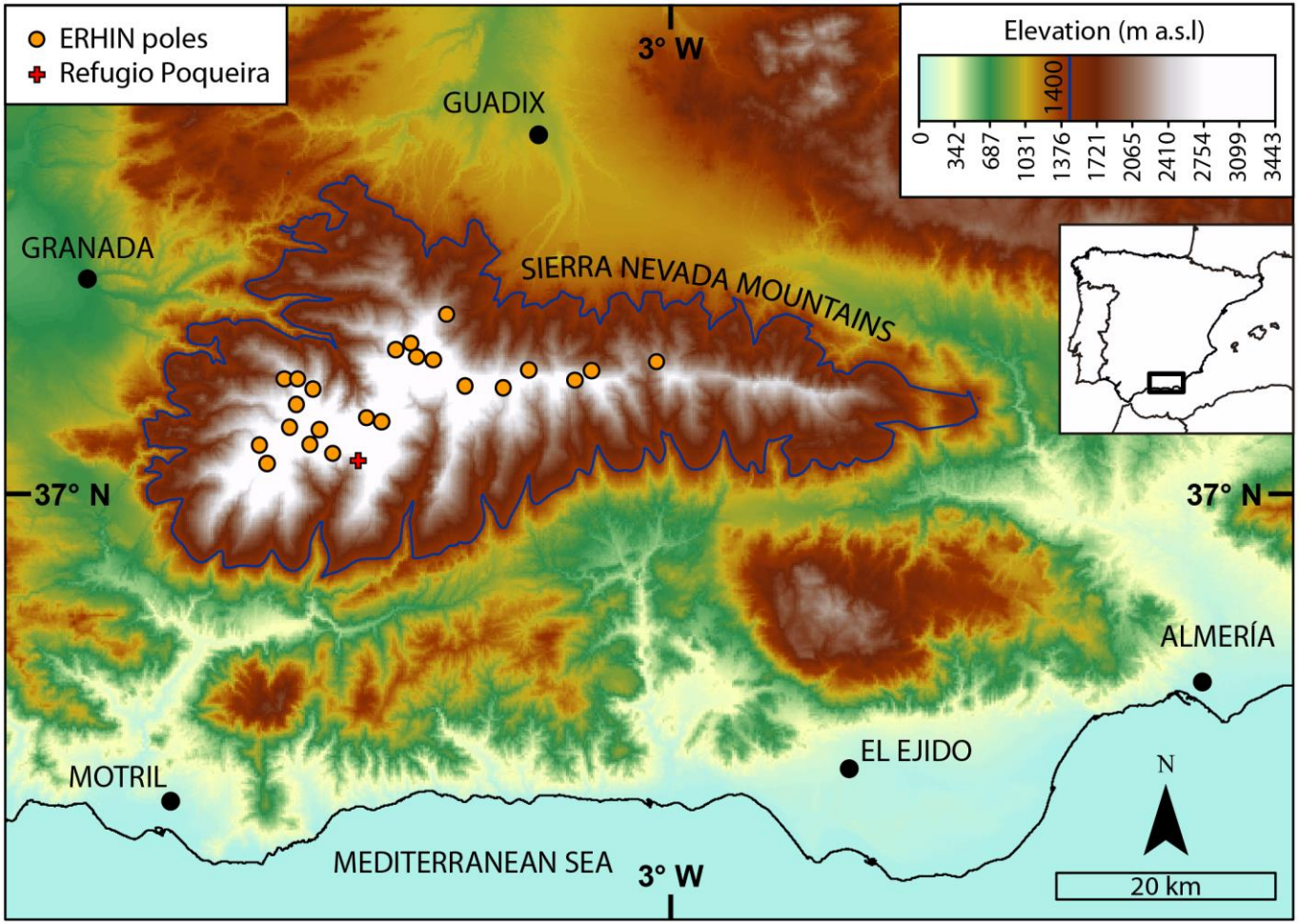
Case study

Sierra Nevada Mountain Range (Spain)

Data

Snow depth:

- 23 snow poles (ERHIN)
- Refugio Poqueira (Pimentel et al. 2017)
- SCA from MODIS
- Snow density (Alonso-González et al 2018)
- Precipitation and temperature (Spain02 v04 project)
- Elevation (DEM 5m)

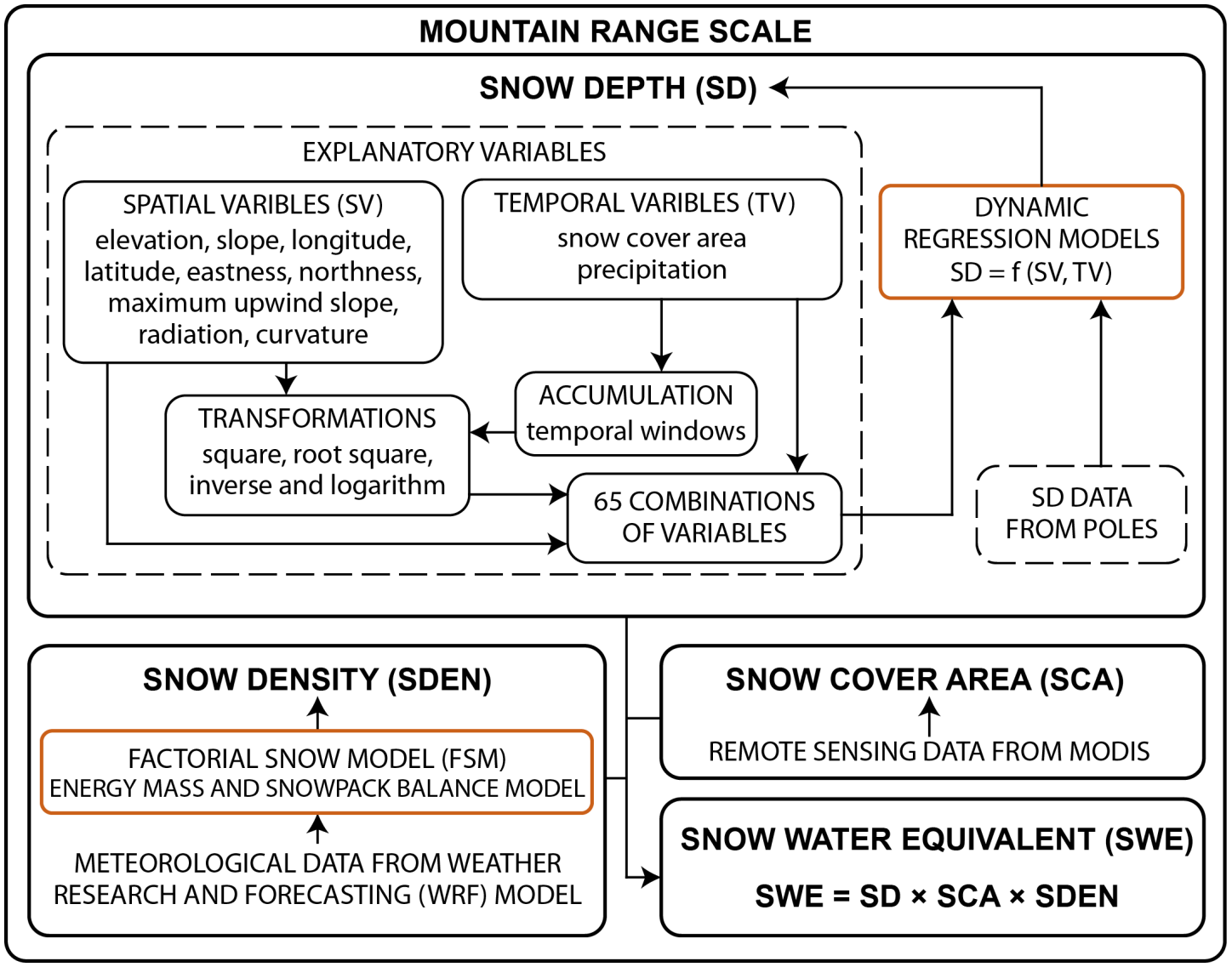


Objectives

General method that can be applied at mountain range scale to estimate daily spatial distribution of SWE (specially indicated when limited snow information is available)

EGU General Assembly 2020
Sharing Geoscience Online

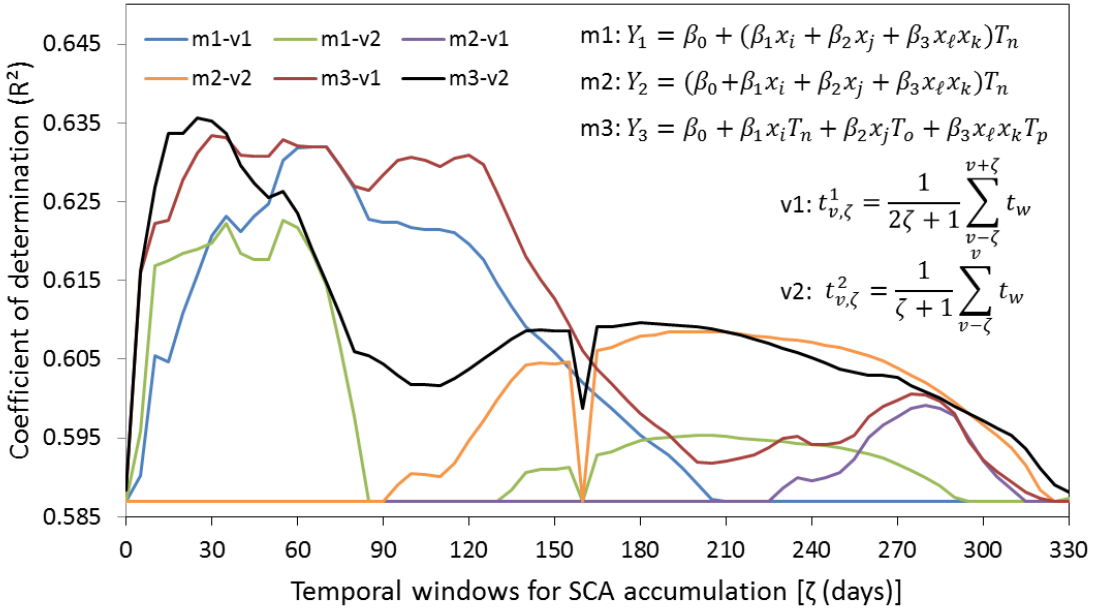
Methodology

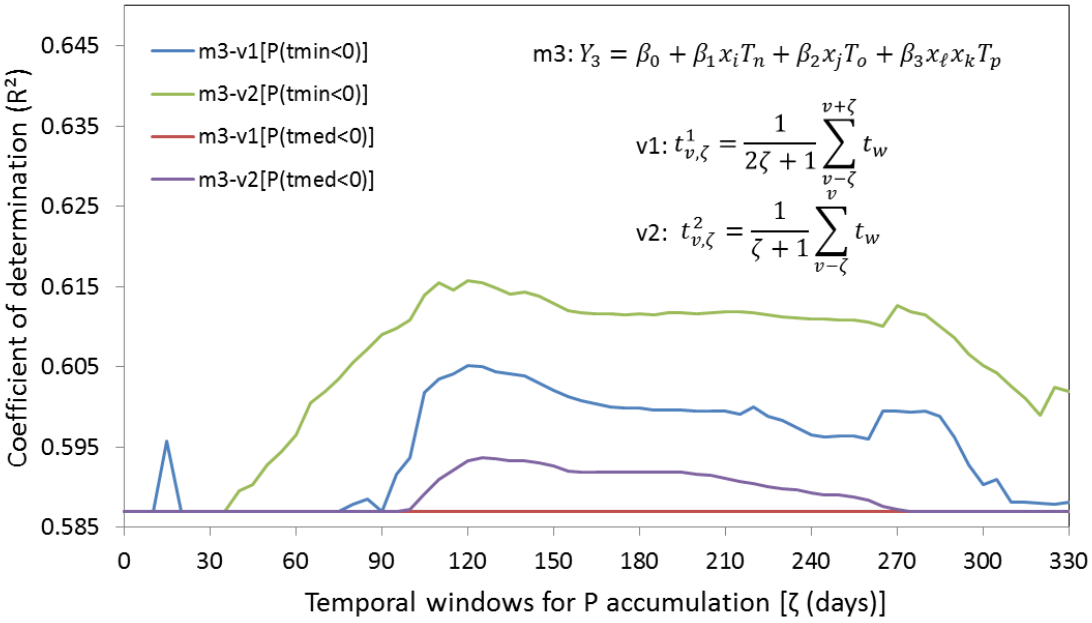


EGU General Assembly 2020
Sharing Geoscience Online

Results

Regression models





EGU General Assembly 2020
Sharing Geoscience Online

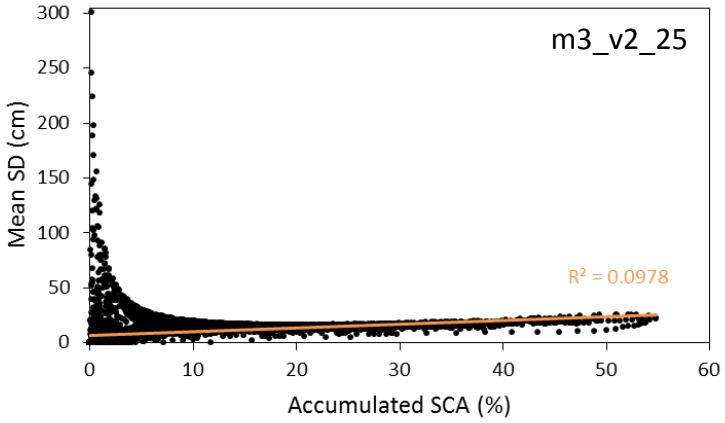
Results

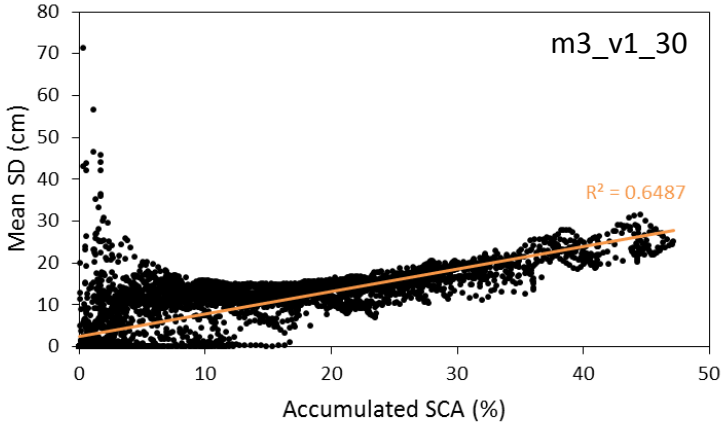
Regression models

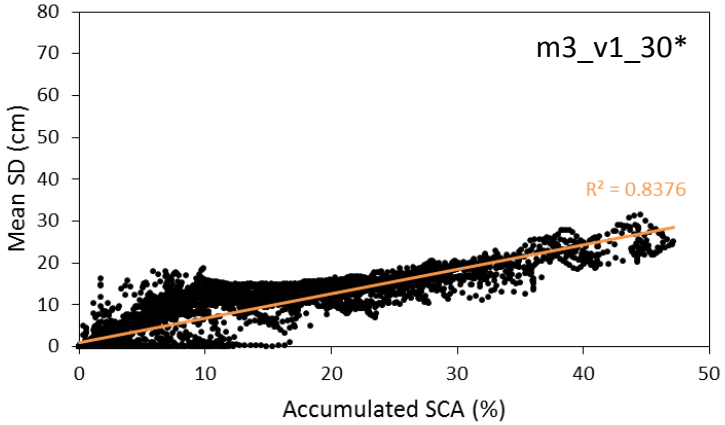
$$m3\_v2\_25 \rightarrow SD = \beta_0 + \beta_1 \frac{ELEV}{SCA} + \beta_2 \frac{ELEV^2}{SCA} + \beta_3 SLOP^2 \sqrt{CURV};\ t^2_{v,\zeta};\ \zeta = 25$$

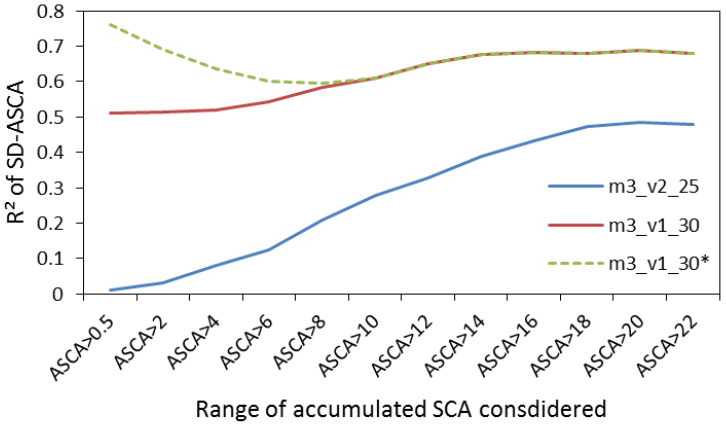
$$m3\_v1\_30 \rightarrow SD = \beta_0 + \beta_1 \frac{ELEV}{SCA} + \beta_2 \frac{ELEV^2}{SCA} + \beta_3 SLOP^2 \sqrt{CURV};\ t^1_{v,\zeta};\ \zeta = 30$$

$$m3\_v1\_30 *\!\!\rightarrow m3\_v1\_30 \text{ if } ASCA > 10 \text{ and } SD = \beta_0 + \beta_1 ELEV + \beta_2 SLOP^2 + \beta_3 MUWS^2 CURV \text{ if } ASCA \leq 10$$





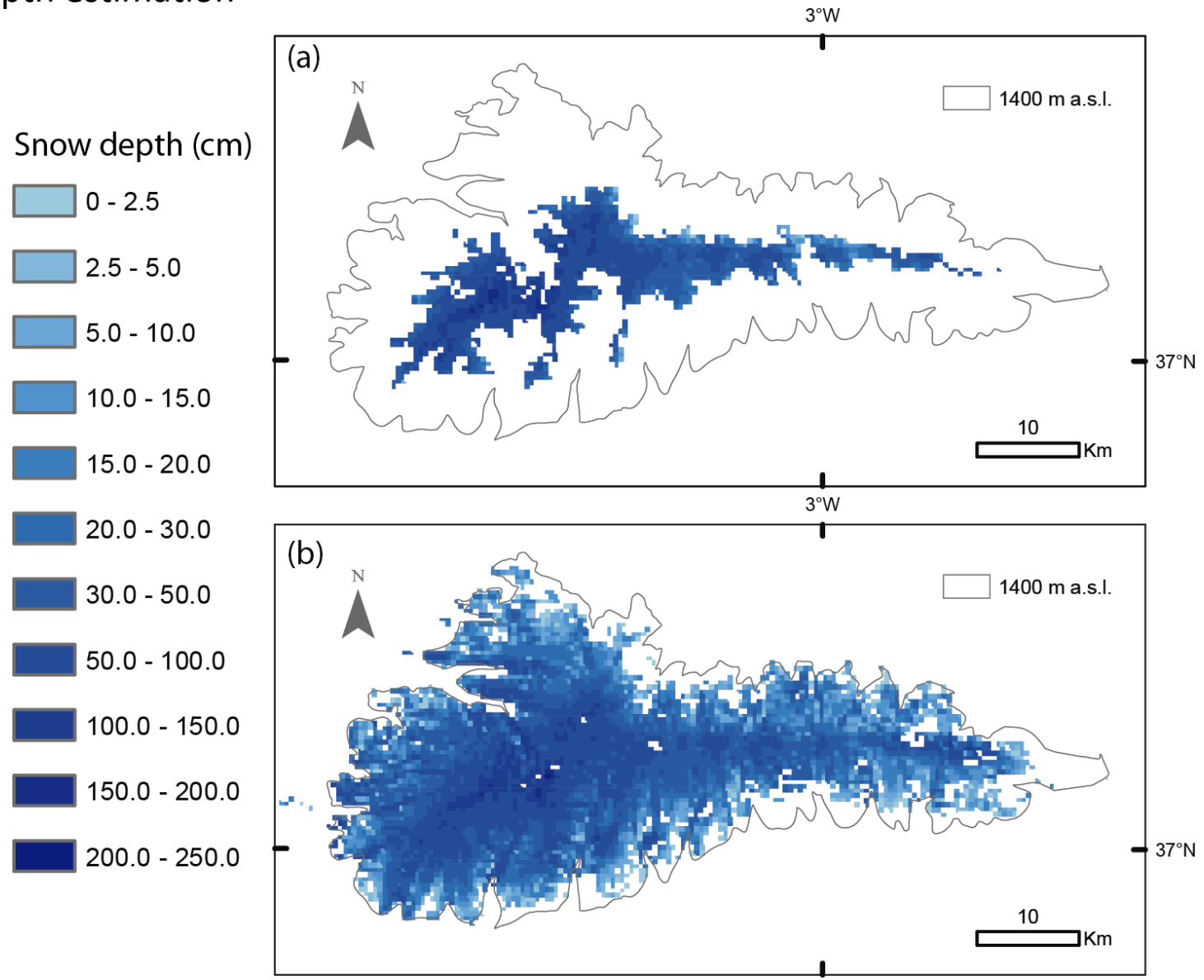




EGU General Assembly 2020
Sharing Geoscience Online

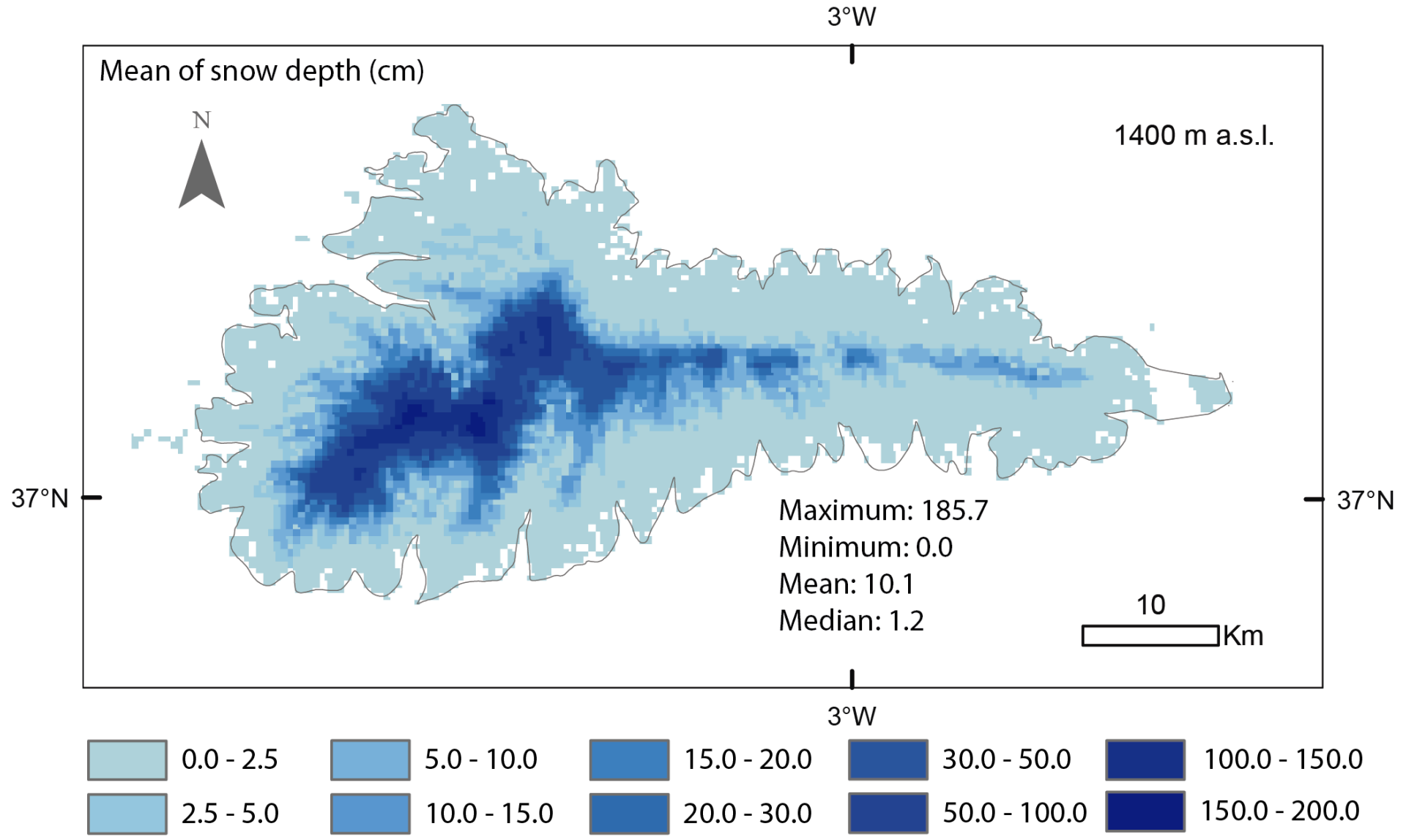
Results Snow depth estimation

(a) 2005–02–02
(b) 2008–12–16



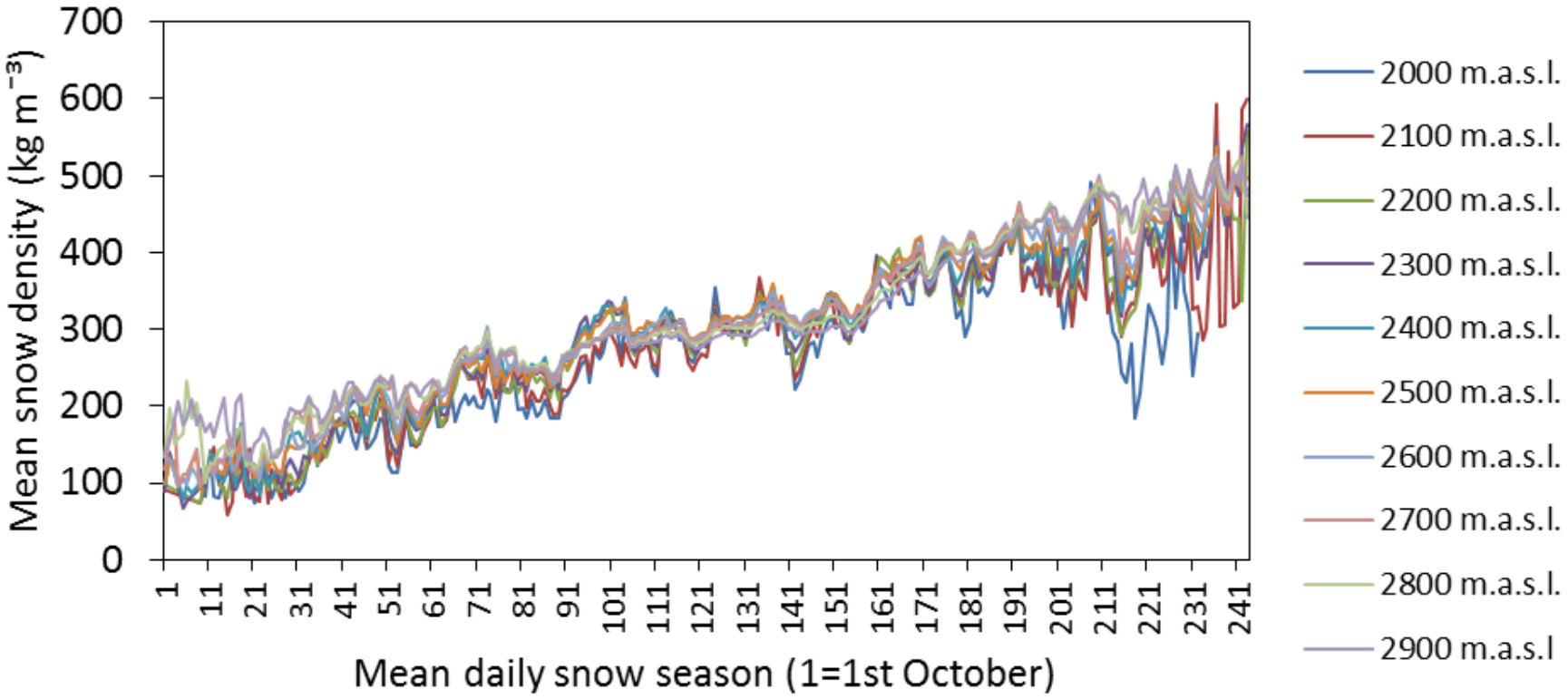
EGU General Assembly 2020
Sharing Geoscience Online

Results Snow depth estimation



EGU General Assembly 2020
Sharing Geoscience Online

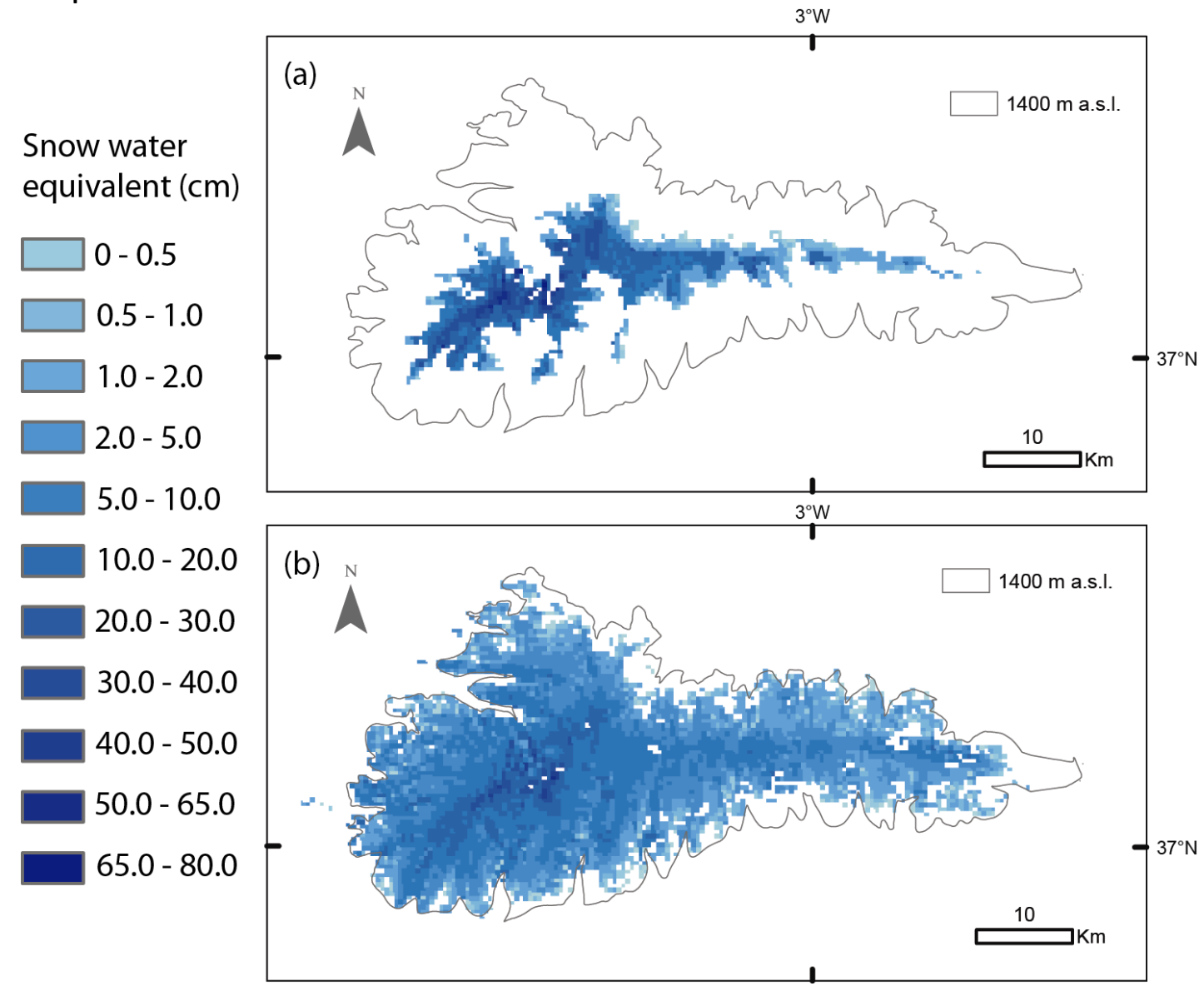
Results Mean Snow density in the mountain range



EGU General Assembly 2020
Sharing Geoscience Online

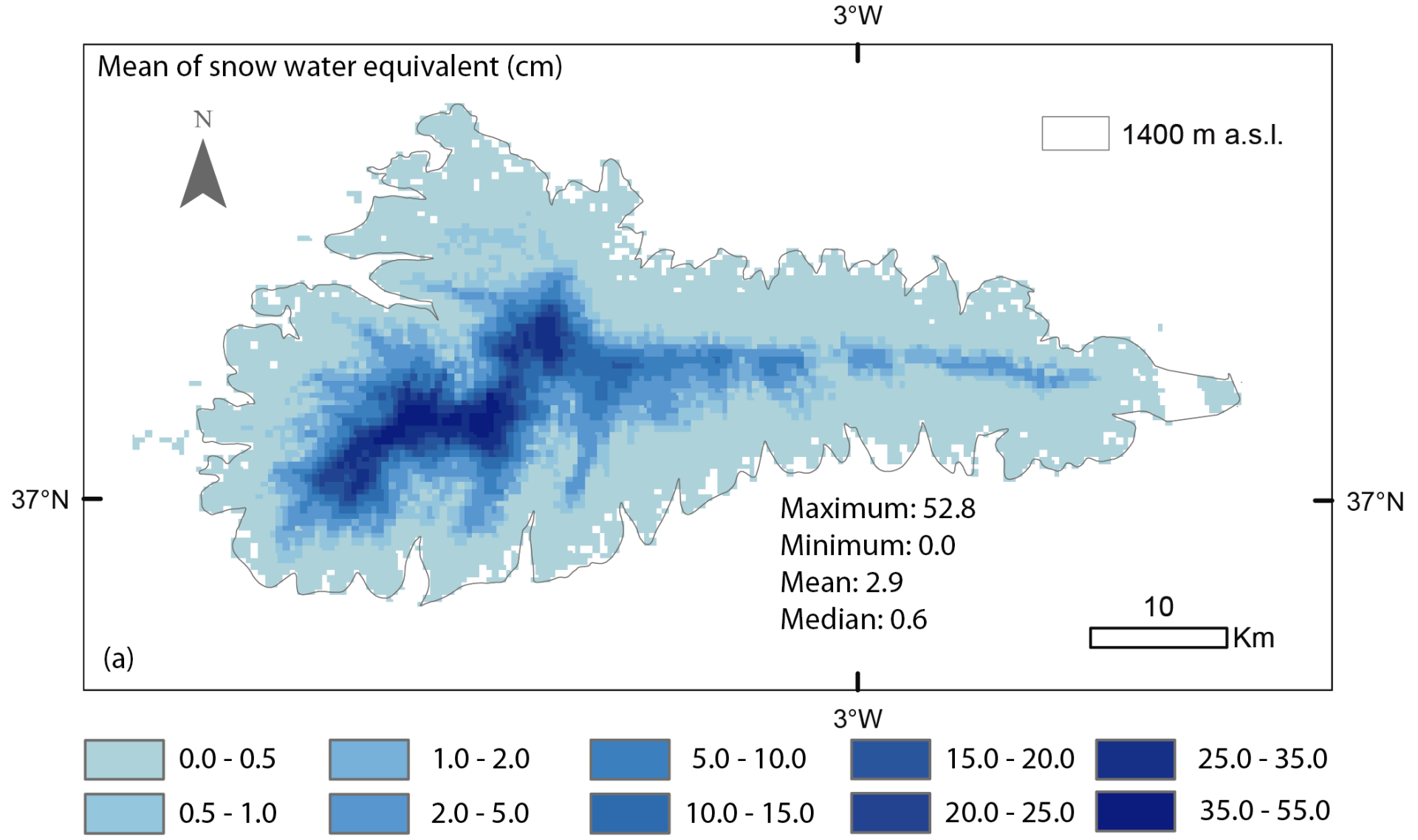
Results Snow water equivalent estimation

(a) 2005–02–02
(b) 2008–12–16



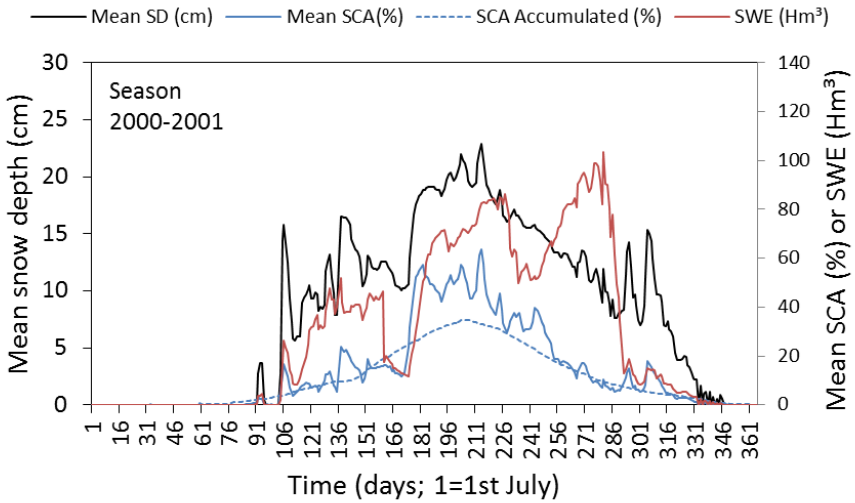
EGU General Assembly 2020
Sharing Geoscience Online

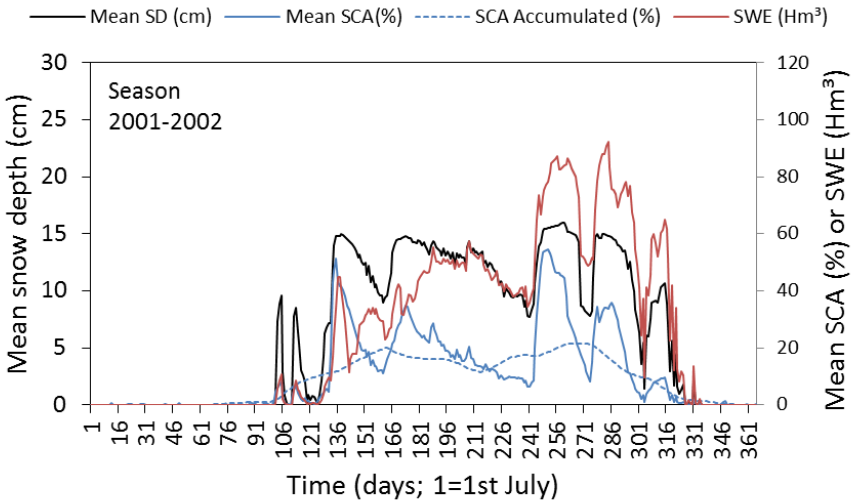
Results Snow water equivalent estimation

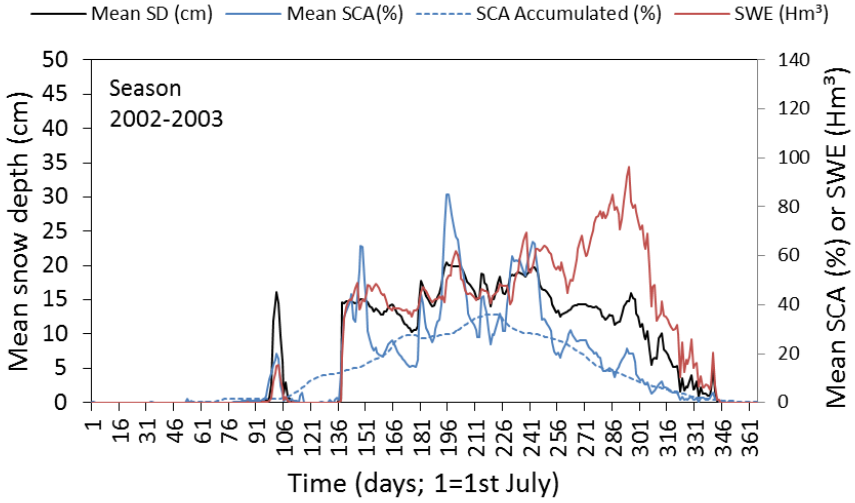


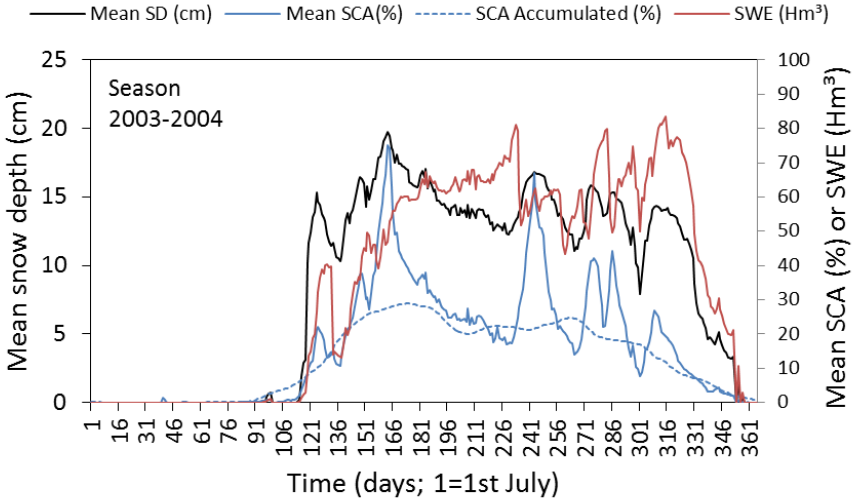
EGU General Assembly 2020
Sharing Geoscience Online

Results Daily series of mean SD, SWE and SCA for the mountain range



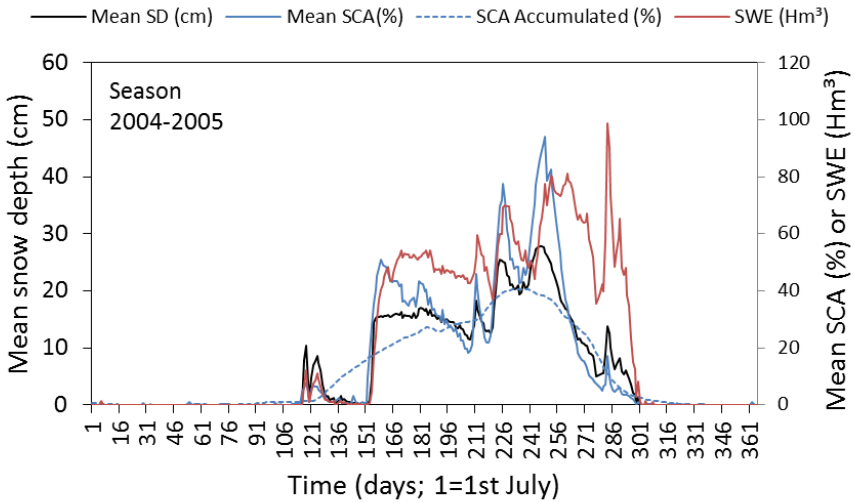


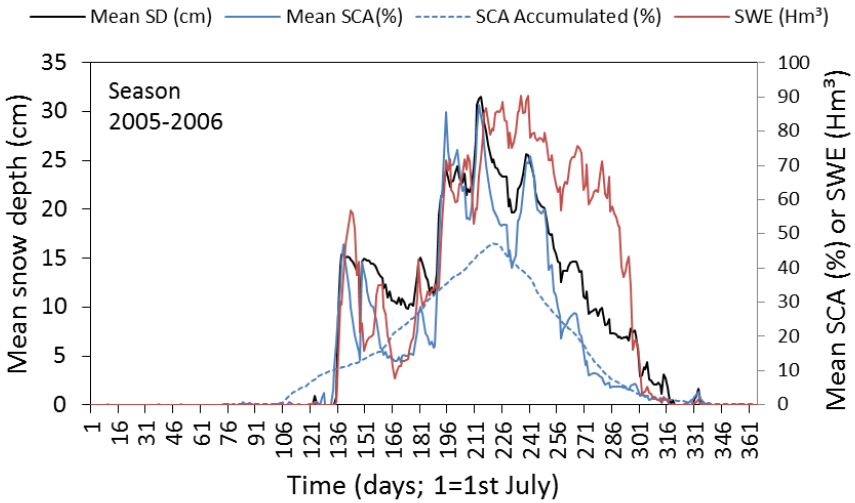


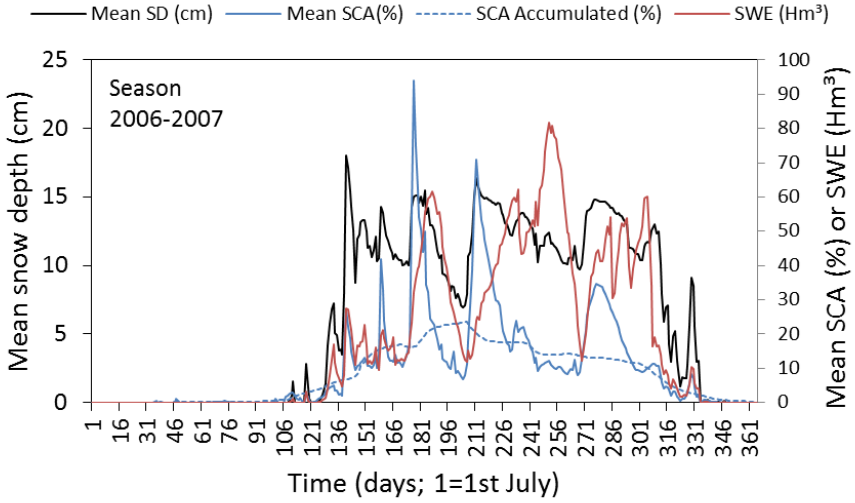


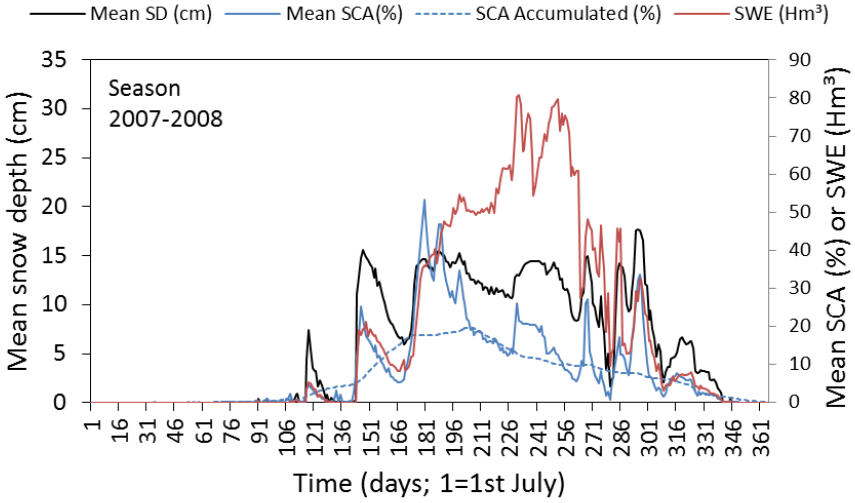
EGU General Assembly 2020
Sharing Geoscience Online

Results Daily series of mean SD, SWE and SCA for the mountain range

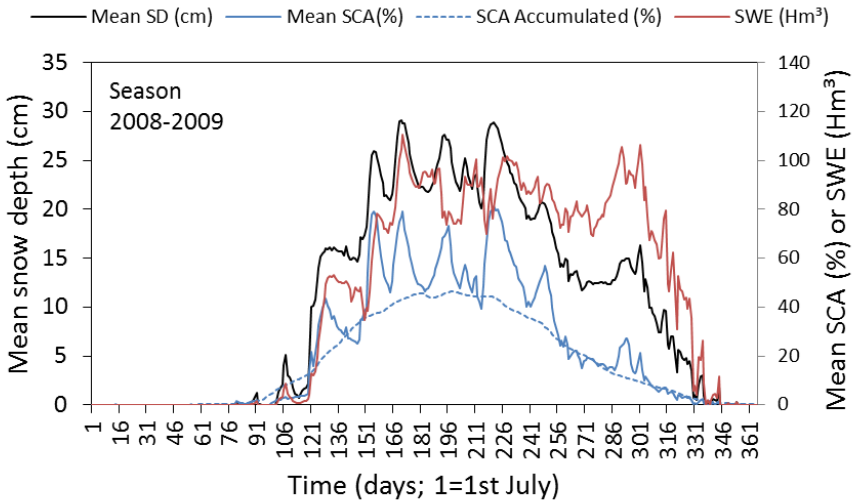


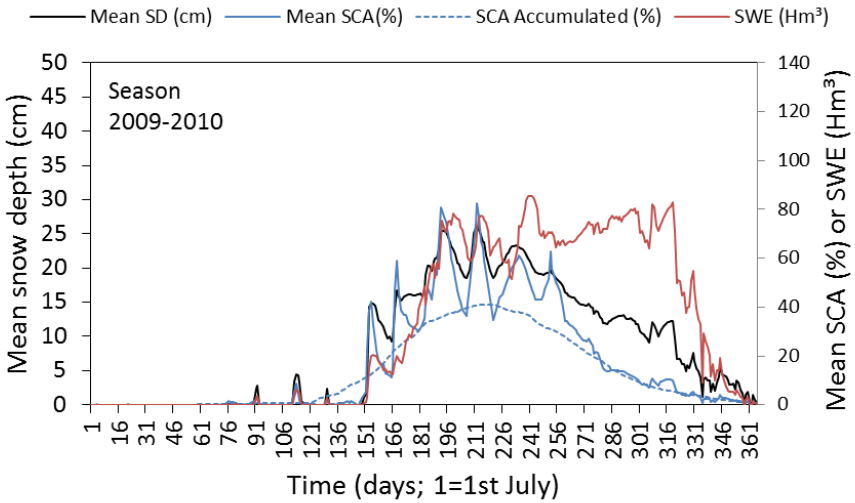


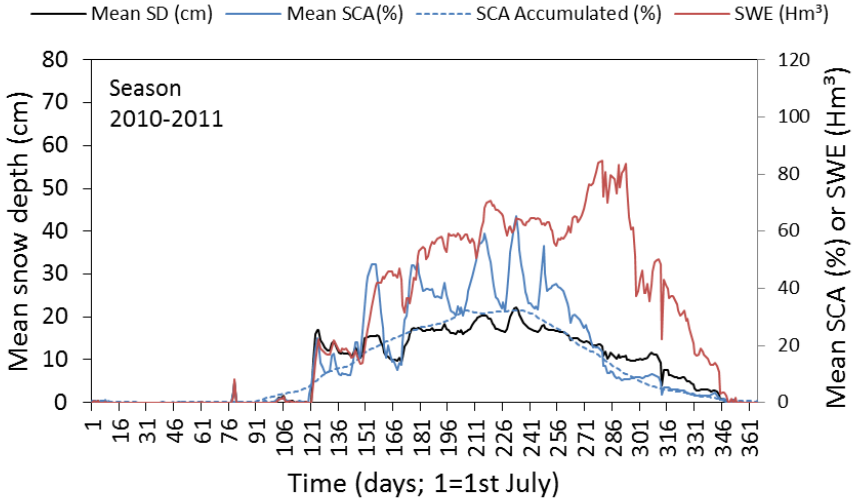


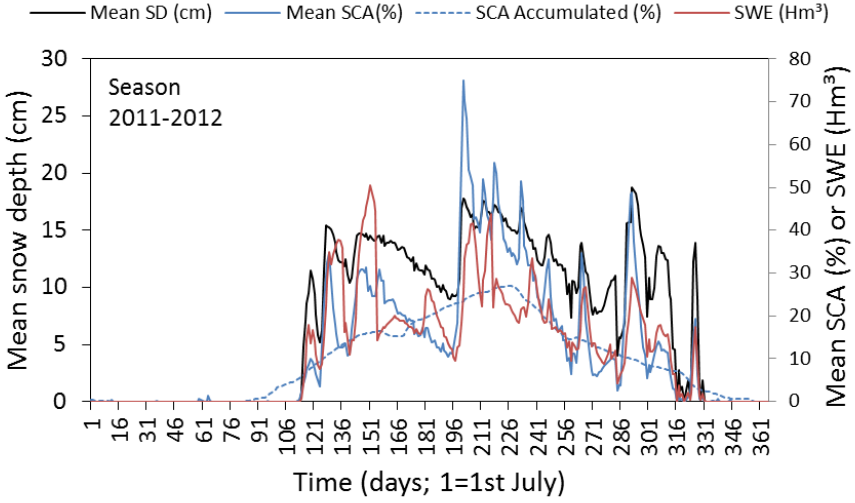


Results Daily series of mean SD, SWE and SCA for the mountain range

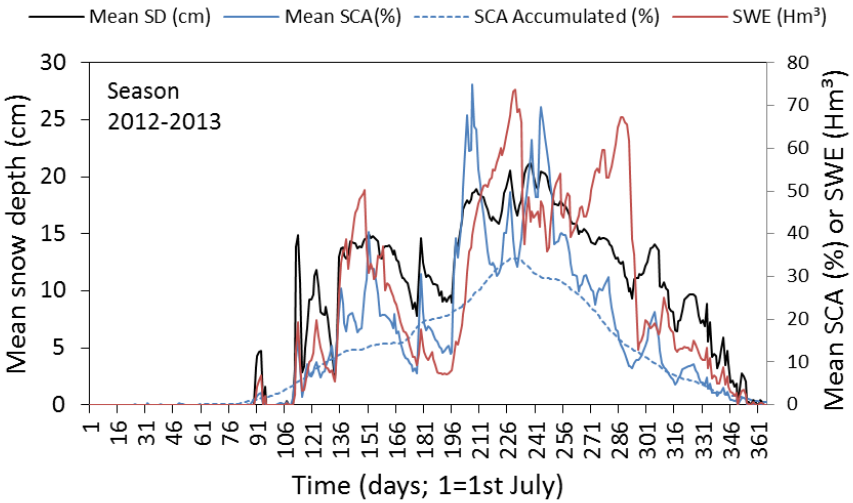


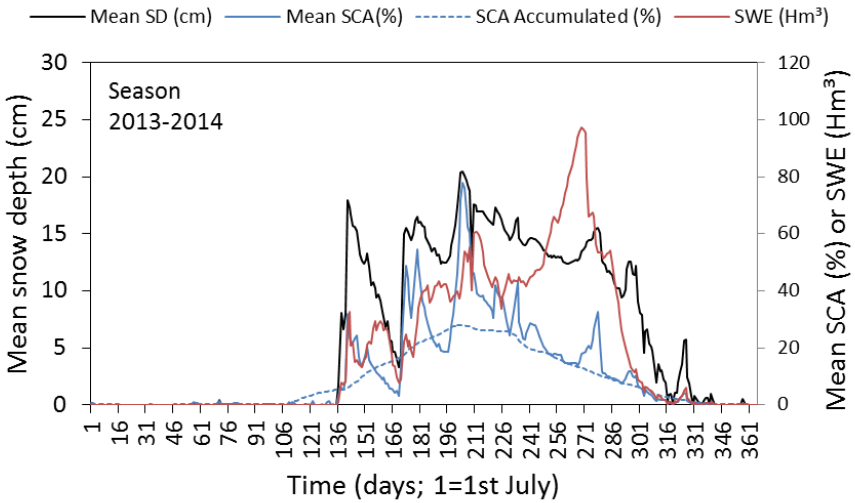






Results Daily series of mean SD, SWE and SCA for the mountain range





EGU General Assembly 2020
Sharing Geoscience Online

Summary

General method to estimate spatially distributed daily fields of SD and SWE in a mountain range

It is applicable to any mountain range

It is useful in cases with limited snow information

In Sierra Nevada we estimated daily spatially distributed (460-m resolution) SD and SWE.

Previous works estimated SD and SWE for the whole mountain range of Sierra Nevada but the spatial and temporal resolution were limited

The mean total SWE accumulated in a snow season in the period 2000-2014 is around 330 Hm^3 and the maximum around to 480 Hm^3

The snow of the Sierra Nevada mountain range plays a significant role in the water resources of the region