MINISTERIUM
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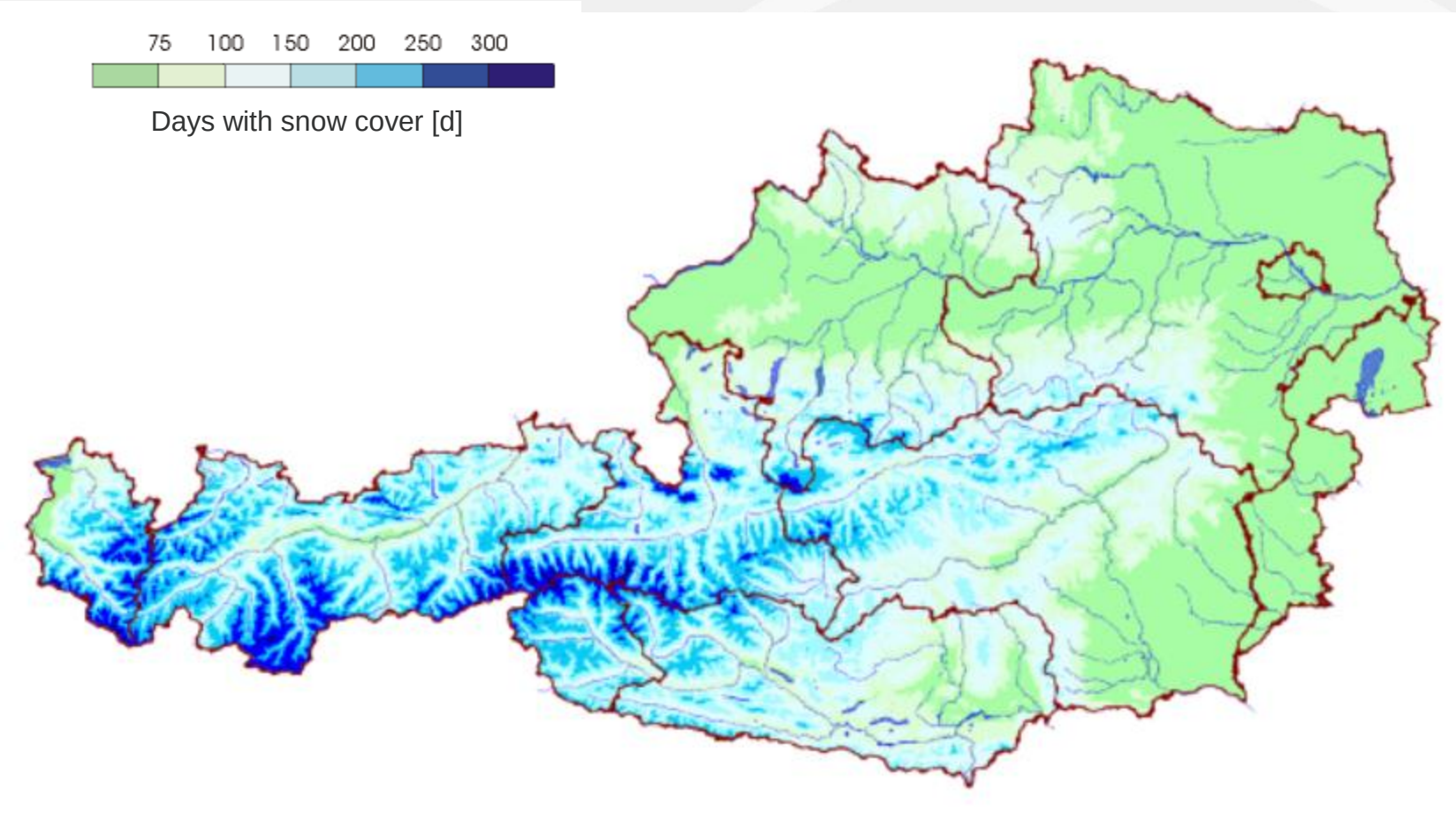
ÖSTERREICH

HBLFA RAUMBERG - GUMPENSTEIN
LANDWIRTSCHAFT

A method of quantifying precipitation and evaporation in winter under climate change conditions

„Lysimeterforschung – Möglichkeiten und Grenzen“
17. Gumpensteiner Lysimetertagung 09.-10. Mai 2017
HBFLA Raumberg-Gumpenstein

Motivation



Source: Auer et al. 2001

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Motivation

Snow as a factor in the water balance

Precipitation in terms of snow:

Depending on the region, a significant share of the total annual precipitation

Evaporation/Sublimation of snow:

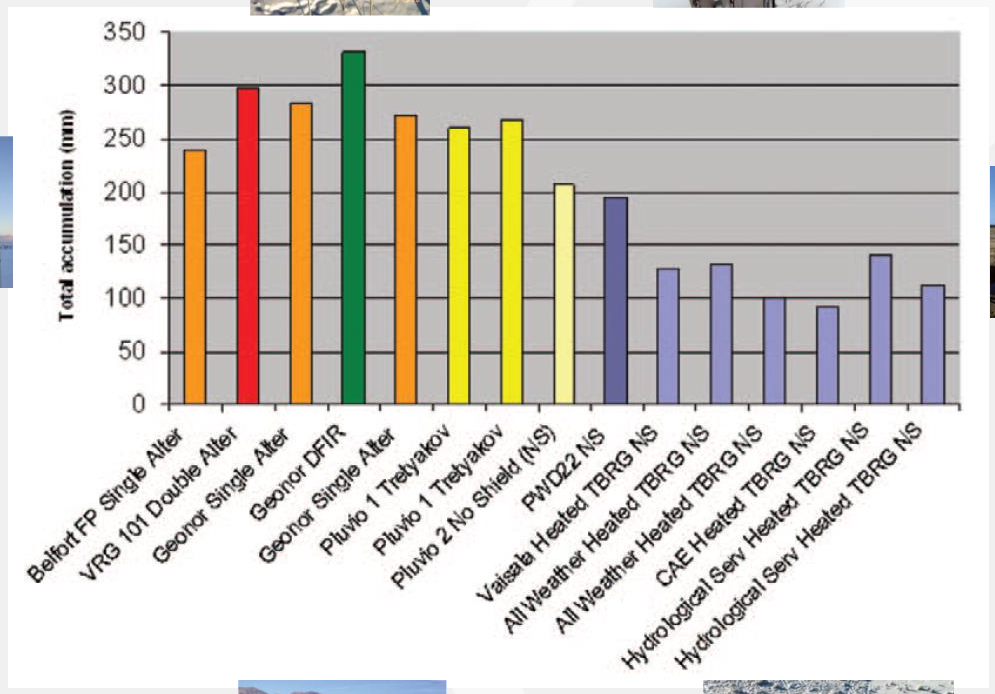
Precipitation fraction lost by evaporation and sublimation for drainage

Snow water reservoir:

Snow is temporary storage of winter precipitation (filling ground water storage / water supply for growth period)

Motivation

How Well Are We Measuring Snow: The NOAA/FAA/NCAR Winter Precipitation Test Bed



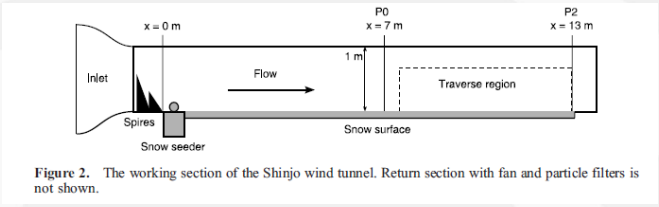
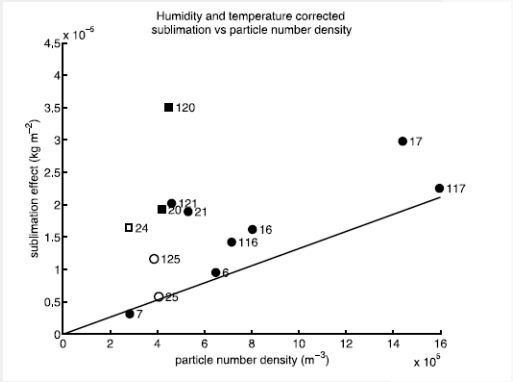


Figure 2. The working section of the Shinjo wind tunnel. Return section with fan and particle filters is not shown.

Source: Wever et al. 2009



Source: Rasmussen et al. 2012

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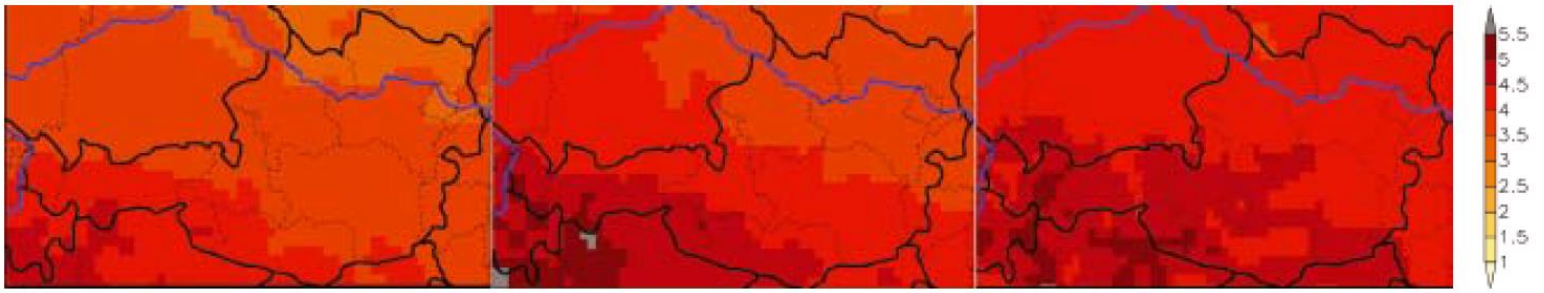
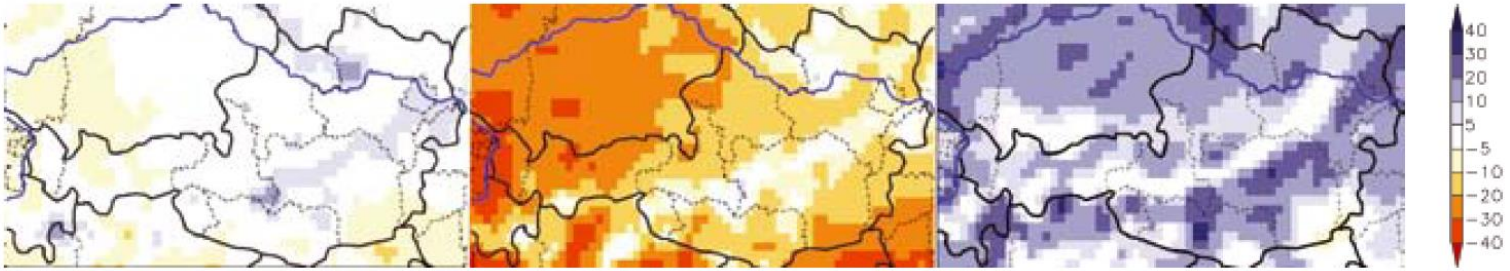
Climate change - Water balance



Change of temperatures for the period 2071–2100

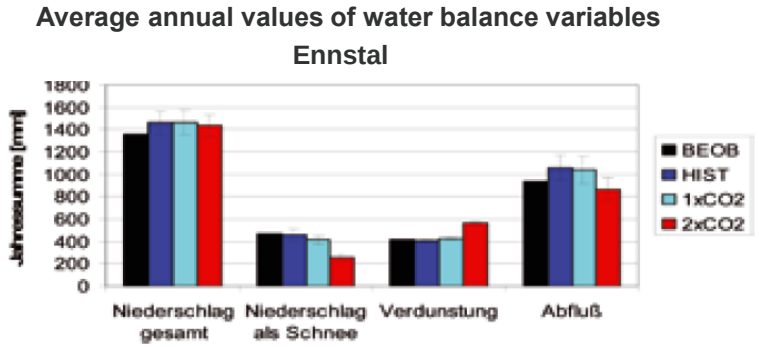
a) year b) summer c) winter



Percentage change in precipitation for the period 2071–2100

a) year b) summer c) winter

Source: UBA, 2008



Source: Nachtnebel und Fuchs, 2001

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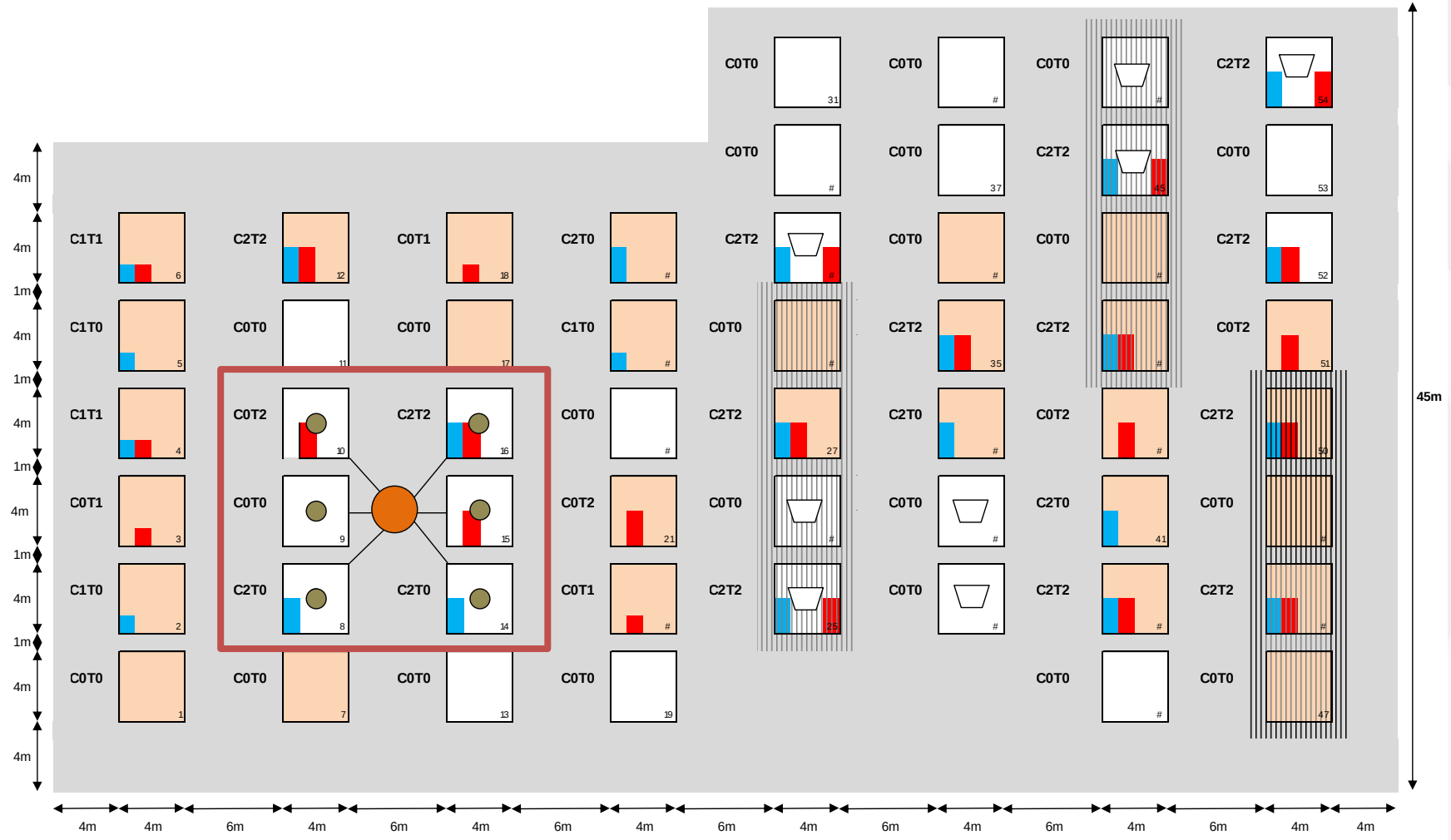
Experimental concept for the simulation of global warming in grassland



single plot size	4m x 4m
Lysimeter surface	1m²
diameter fumigation ring	2,20 m
tretment area	3.80 m²
harvest area	1 m²

service chamber for lysimeters

monolith lysimeter

rainout shelter

NEE-frames

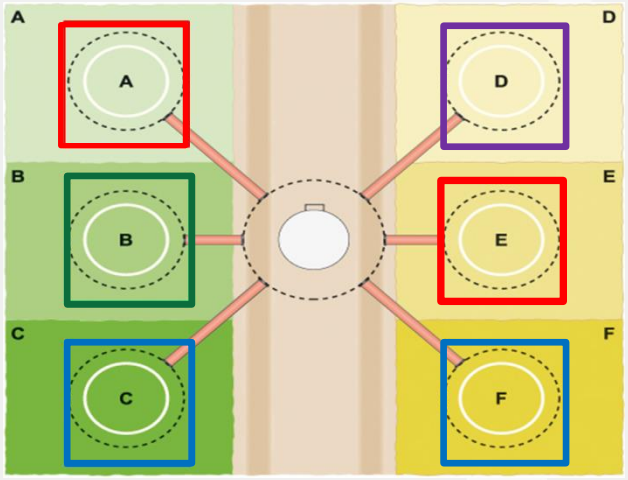
mesocosmos 12 per plot

C1 C2 fumigation rings

T1 T2 infrared heater

treatments

Lysi-T-FACE



Treatments on the lysimeters:

A+E: C0T2

B: C0T0

C+F : C2C0

D: C2T2

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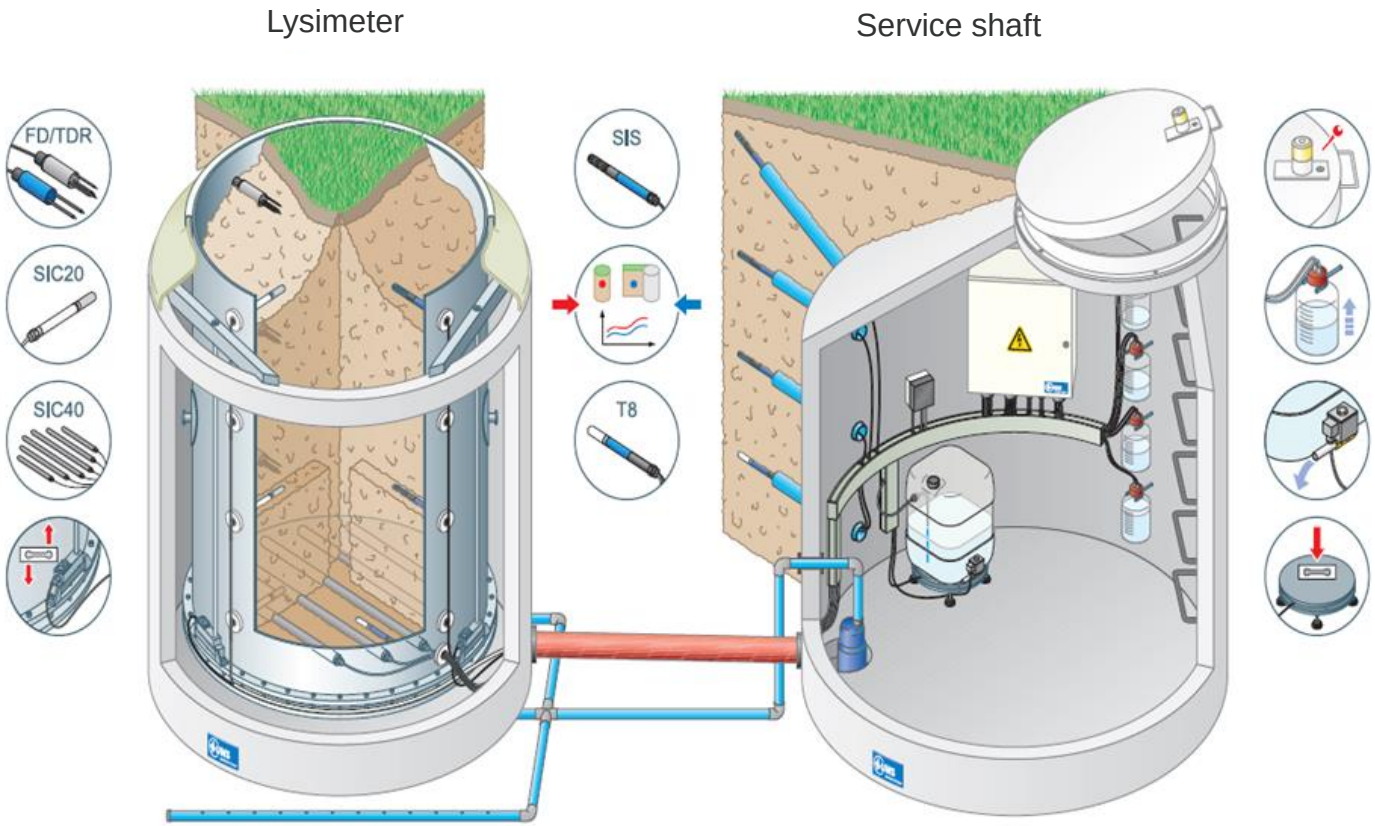
Lysimeter



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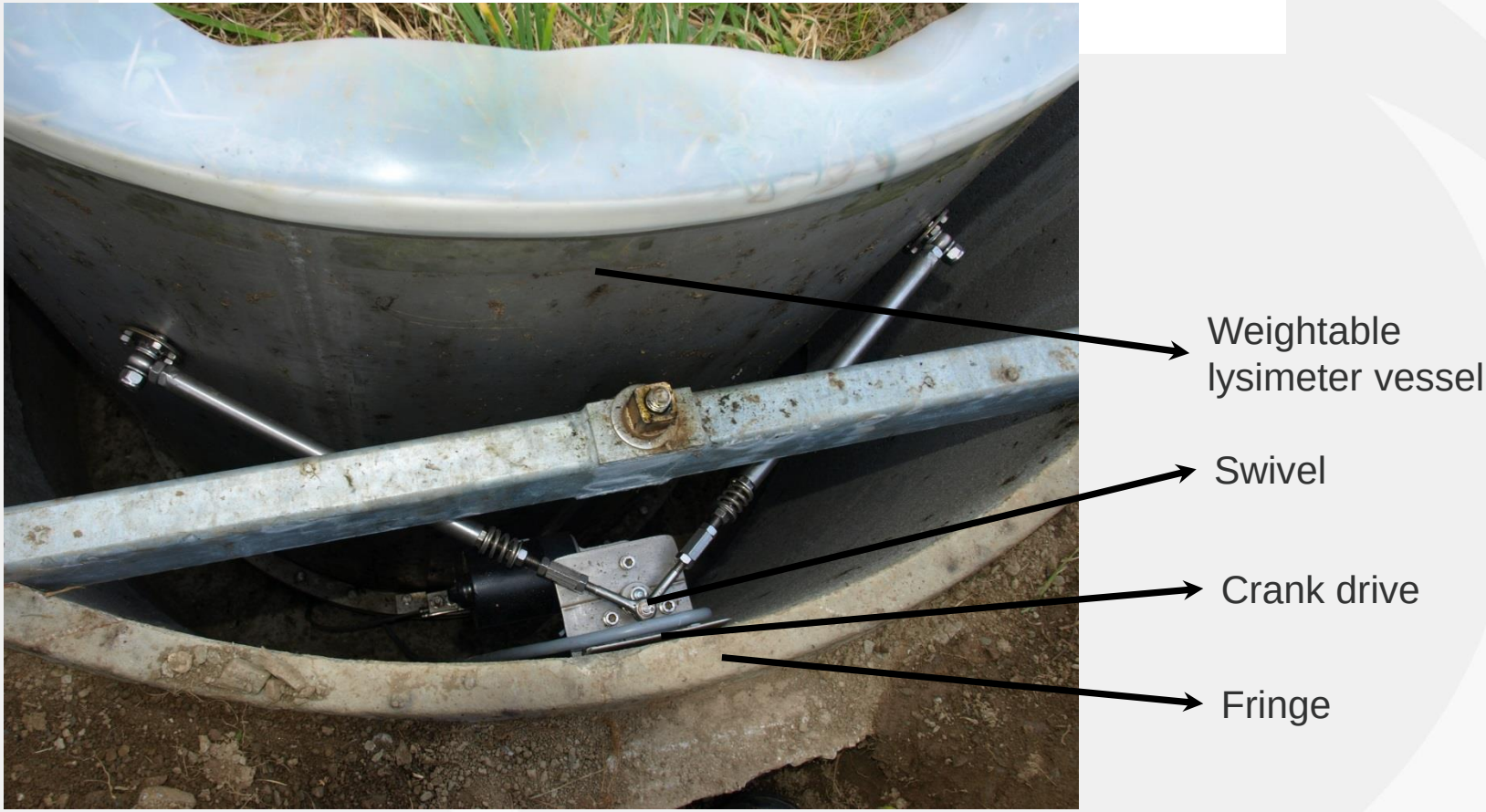
Mechanical seperation of snow load



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Mechanical seperation of snow load

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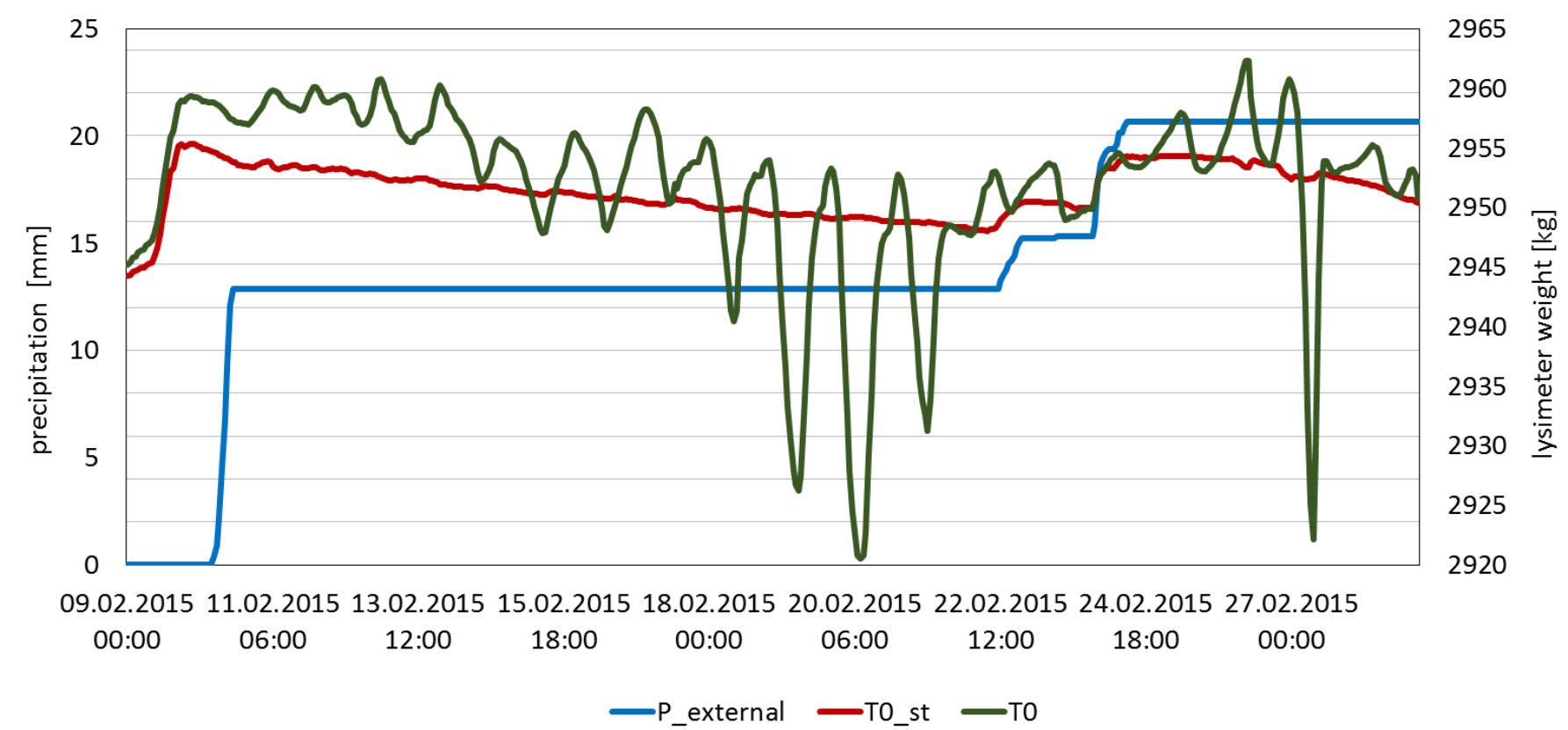
Results

Weight fluctuations

Snow water storage change

Weight fluctuations



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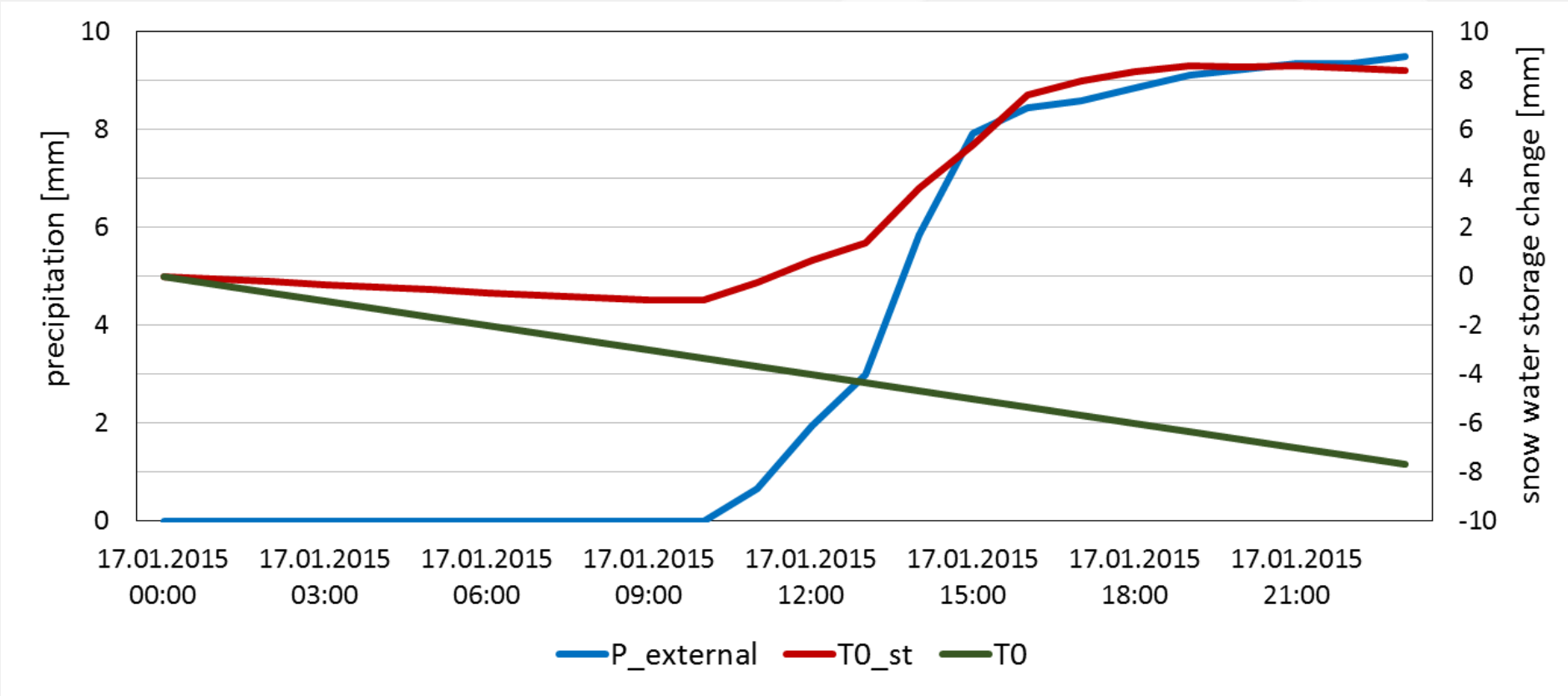
Snow accumulation



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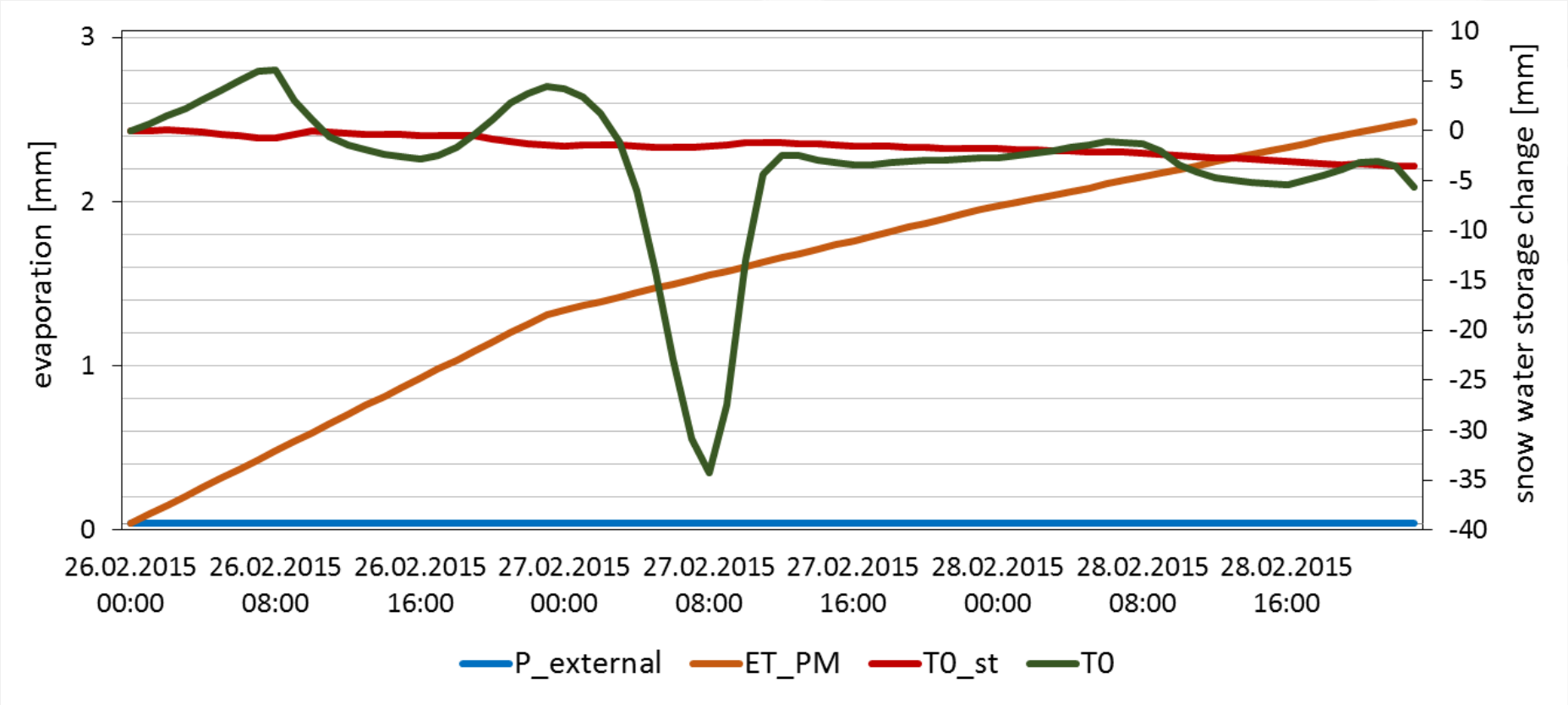
Snow evaporation



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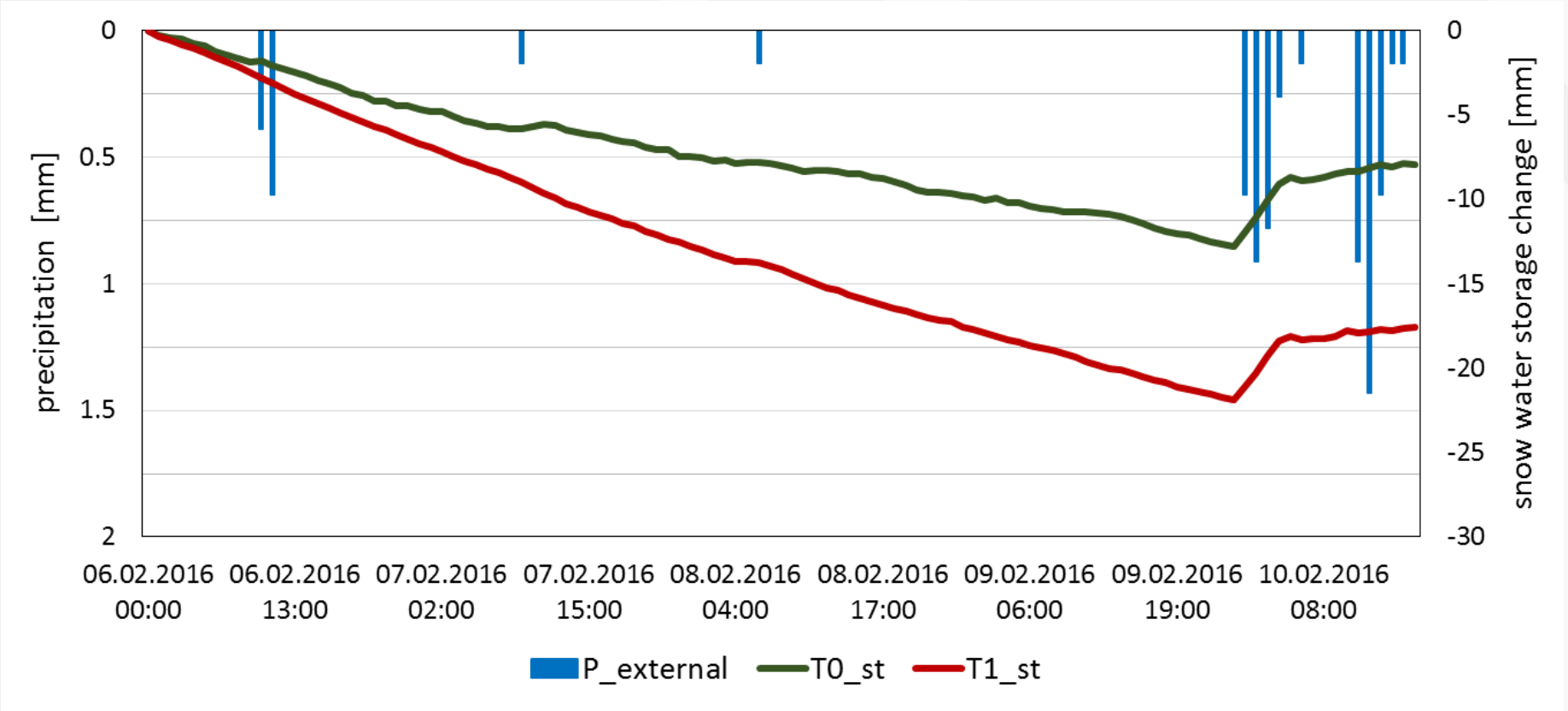
Snow accumulation/evaporation under increased temperature



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Summary and conclusions

In the test period:

- **the occurring weight fluctuations caused by the snow load on the lysimeter could be largely reduced**
- **the snow water storage changes by snow accumulation and evaporation could be obtained reproducible**
- **the effect of heating on evaporation could be quantified**

A comprehensive assessment of

→ the effects and

→ the suitability

of the snow separation system under different conditions and snow levels requires a multi-year observation over all lysimeters

Thank you for your attention!

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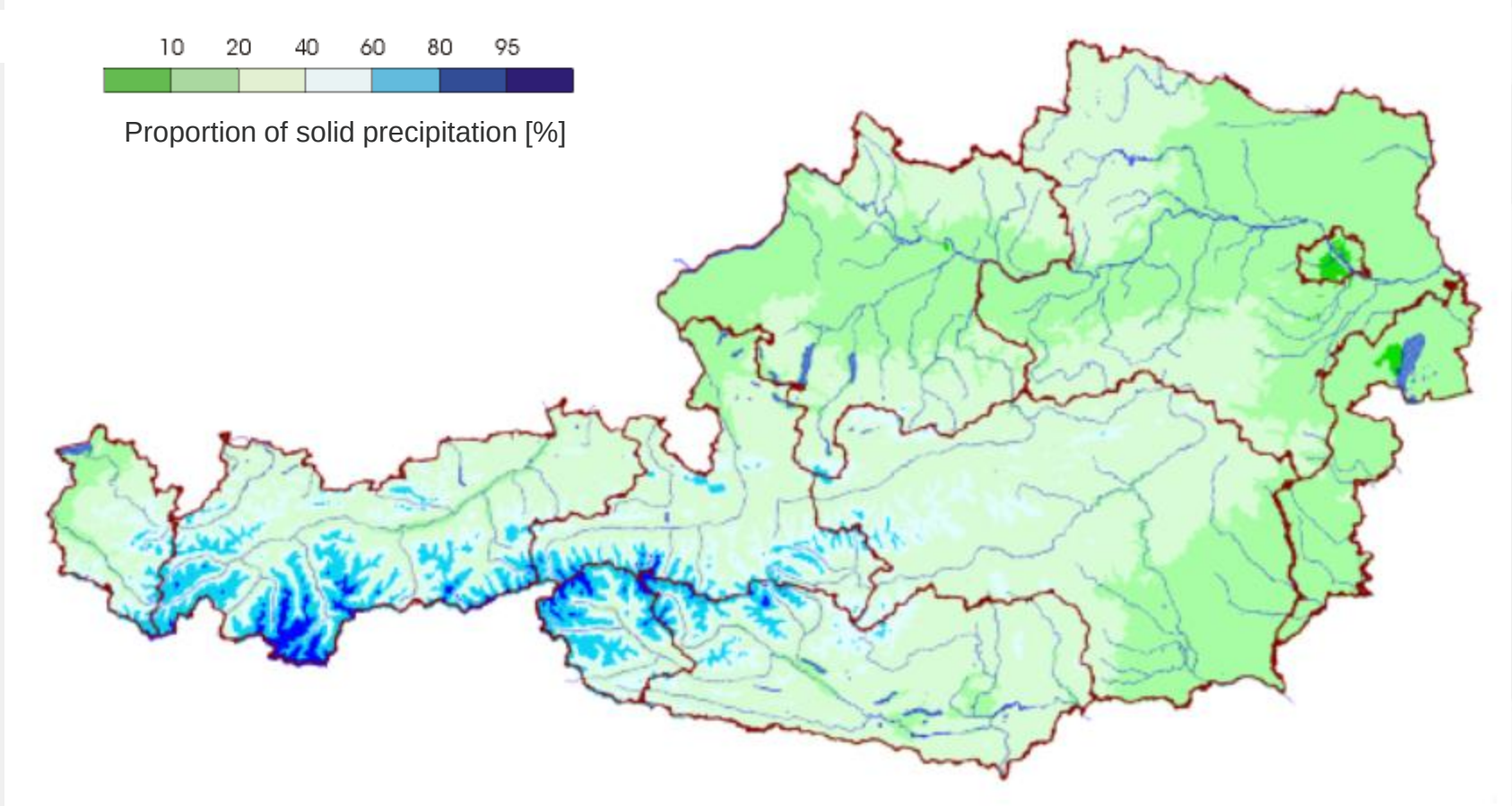

Source: Auer et al. 2001

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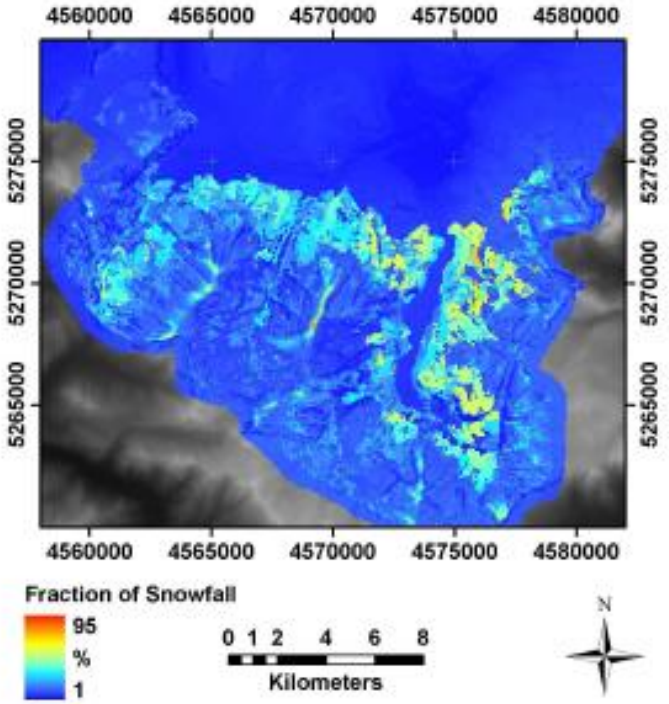

Fig. 15. Fraction of modelled total winterly snow sublimation losses of total winterly snowfall precipitation in the National Park area (2003/2004).

Source: Strasser et al. 2008

Table 2. Contributions relative to total snowfall and scale-dependent significance of the winter water balance components as modelled with AMUNDSEN for the Berchtesgaden National Park domain for 2003/2004. The additional amount of snowmelt is caused by rain-on-snow.

Water balance component	Seasonal amount (mm)	Relative contribution (%)	Local significance	Regional significance
Snowfall	+651.1	+100.0	high	high
Ground resublimation	+15.8	+2.4	moderate	small
Ground sublimation	−44.9	−6.9	moderate	small
Canopy sublimation	−84.9	−13.0	moderate	moderate
Sublimation from turbulent suspension	−26.5	−4.1	high	small
Snowmelt	−693.1	−106.5	high	high