UNIVERSITÄT BERN

04.02.2014 EARSeL LISSIG Workshop Bern
Session: Snow and Climate

A snow cover climatology for the European Alps derived from AVHRR data

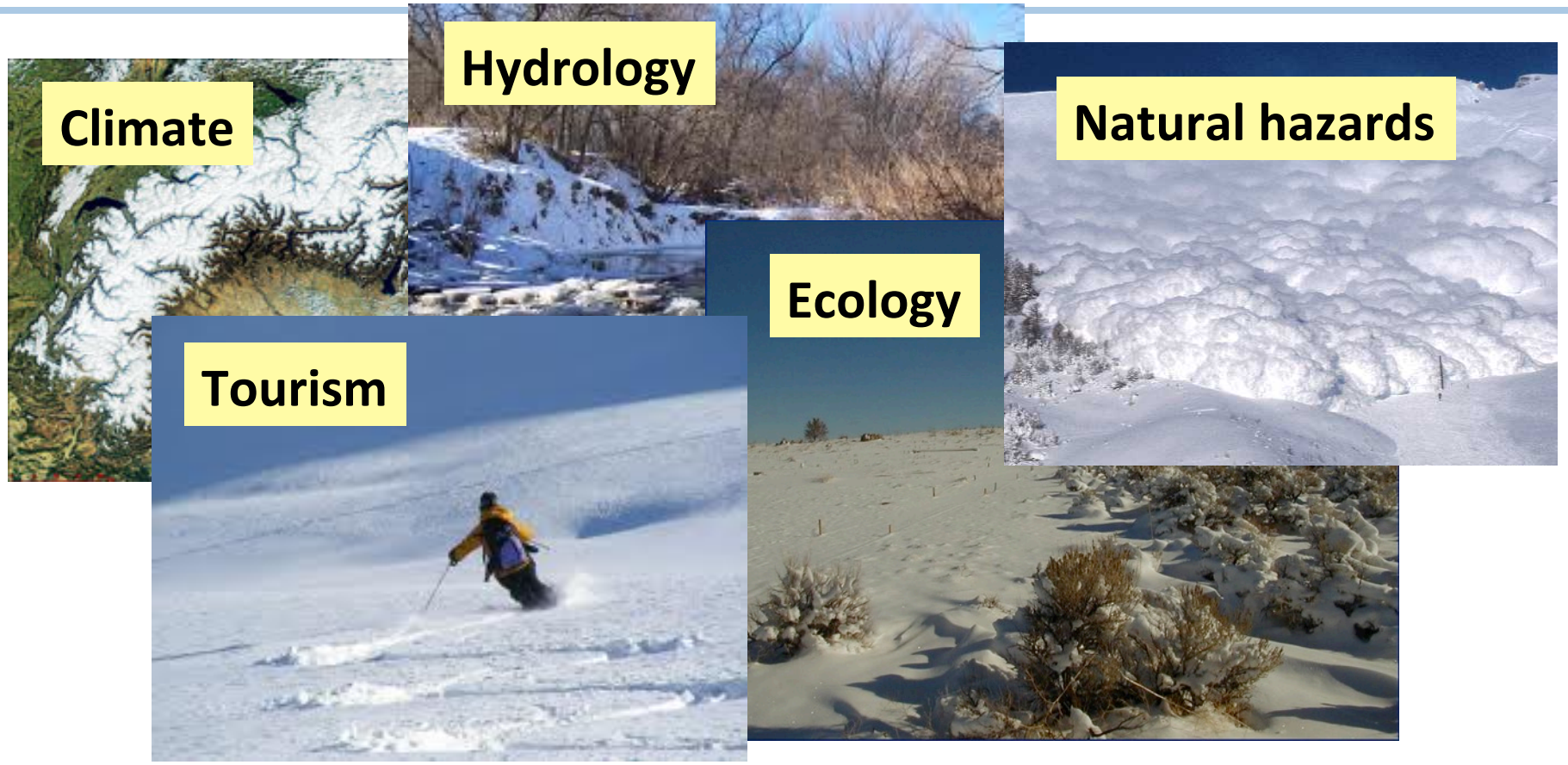
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2 WSL Institute for Snow and Avalanche Research SLF, Davos

GLOBSNOW esa

GCOS terrestrial ECV snow cover

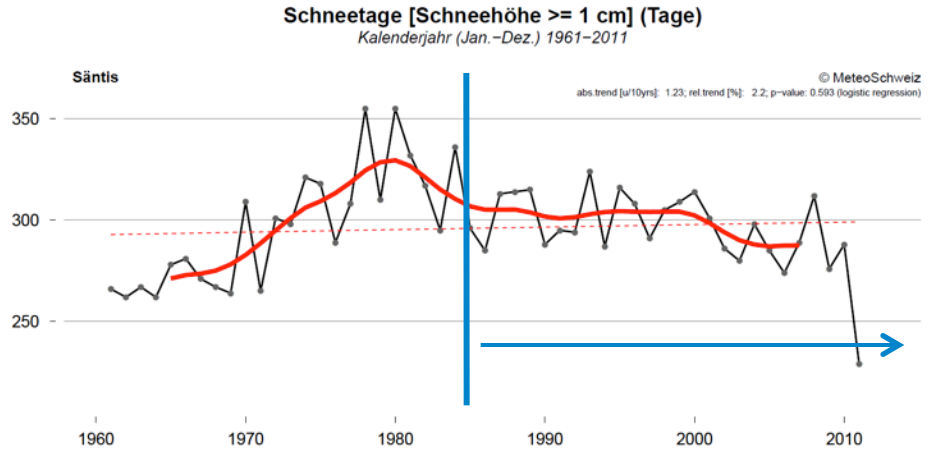


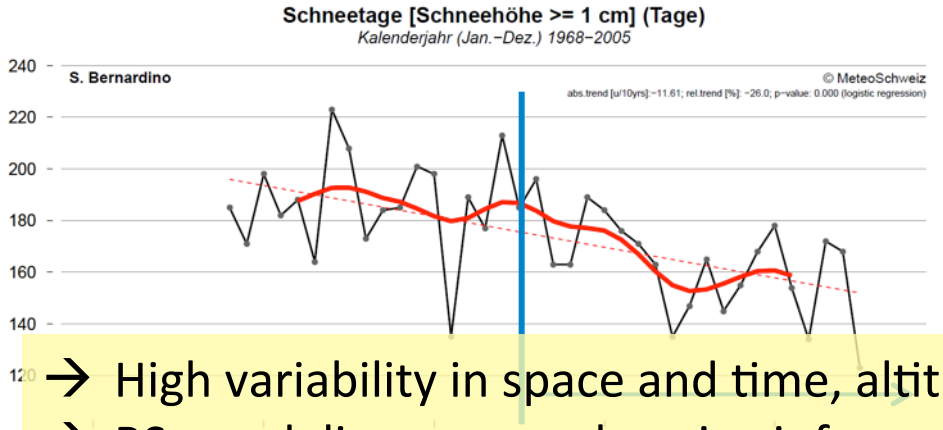
→ Snow cover extent is a **sentinel for climate change**
→ Need for systematic snow monitoring
→ ***"Snow monitoring critically depends upon satellite-based Earth Observation"***

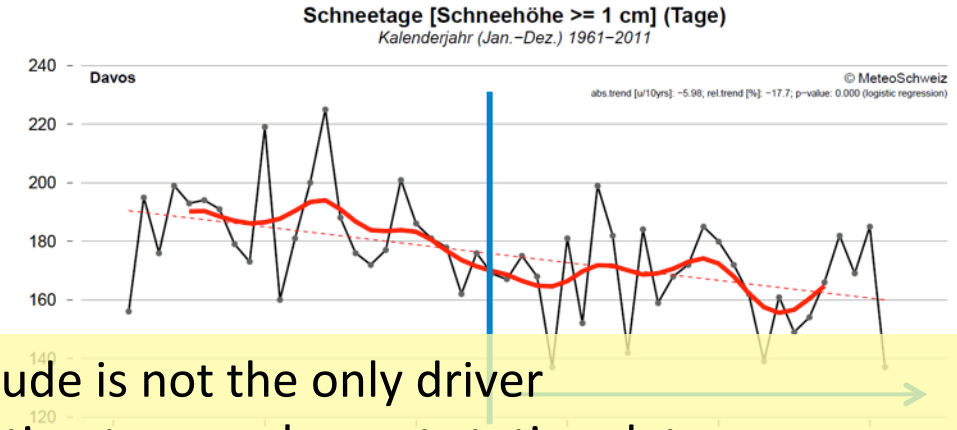
Snow and climate:
Days with snow > 1cm Switzerland (1961-2011)

- Säntis (2.502m amsl)
- San Bernadino (2.469m amsl)
- Davos (1.594m amsl)

(Source: MeteoSwiss)







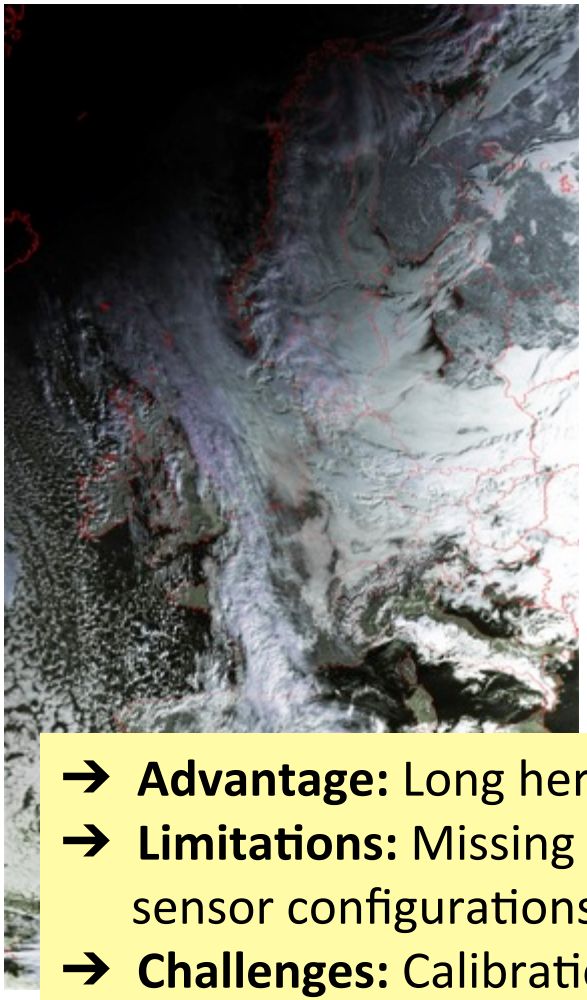
→ High variability in space and time, altitude is not the only driver

→ RS can deliver comprehensive information to complement station data

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The AVHRR platform

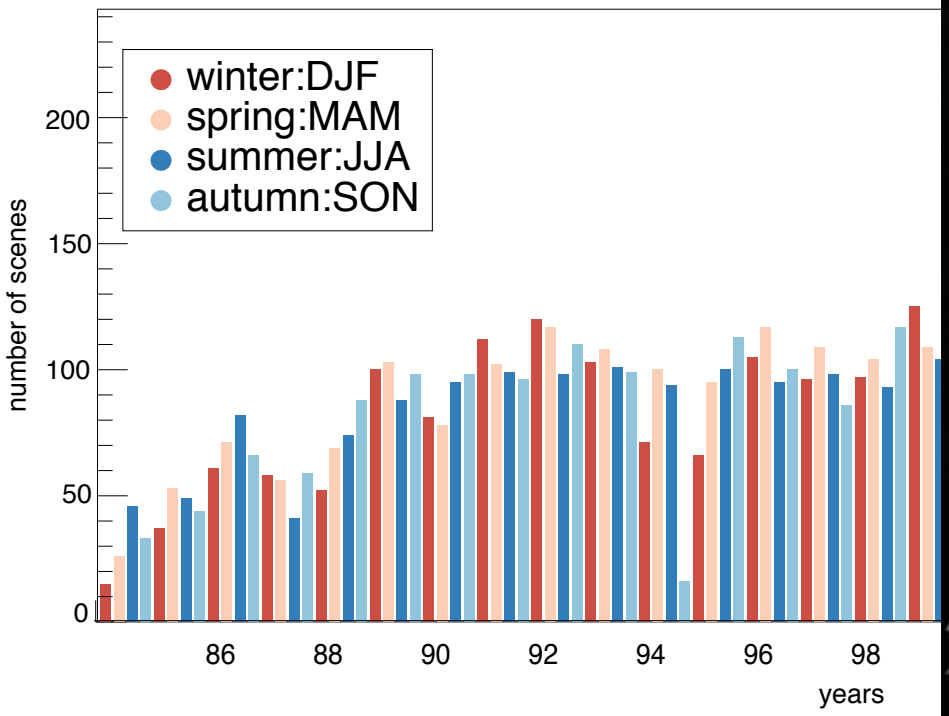




satellite	NOAA-series (6-19) & METOP-A
spatial resolution	1 km (at nadir)
temporal resolution	1 day
spectral resolution	5 channels
lifetime	1981 - date
end of mission	ca. 2022
archives	regional (e.g. University of Bern)

- ➔ **Advantage:** Long heritage
- ➔ **Limitations:** Missing on-board calibration, 5 channels, orbital drift, differing sensor configurations…
- ➔ **Challenges:** Calibration, Geocoding, cloud masking, consistency

The UB data set: archive and coverage



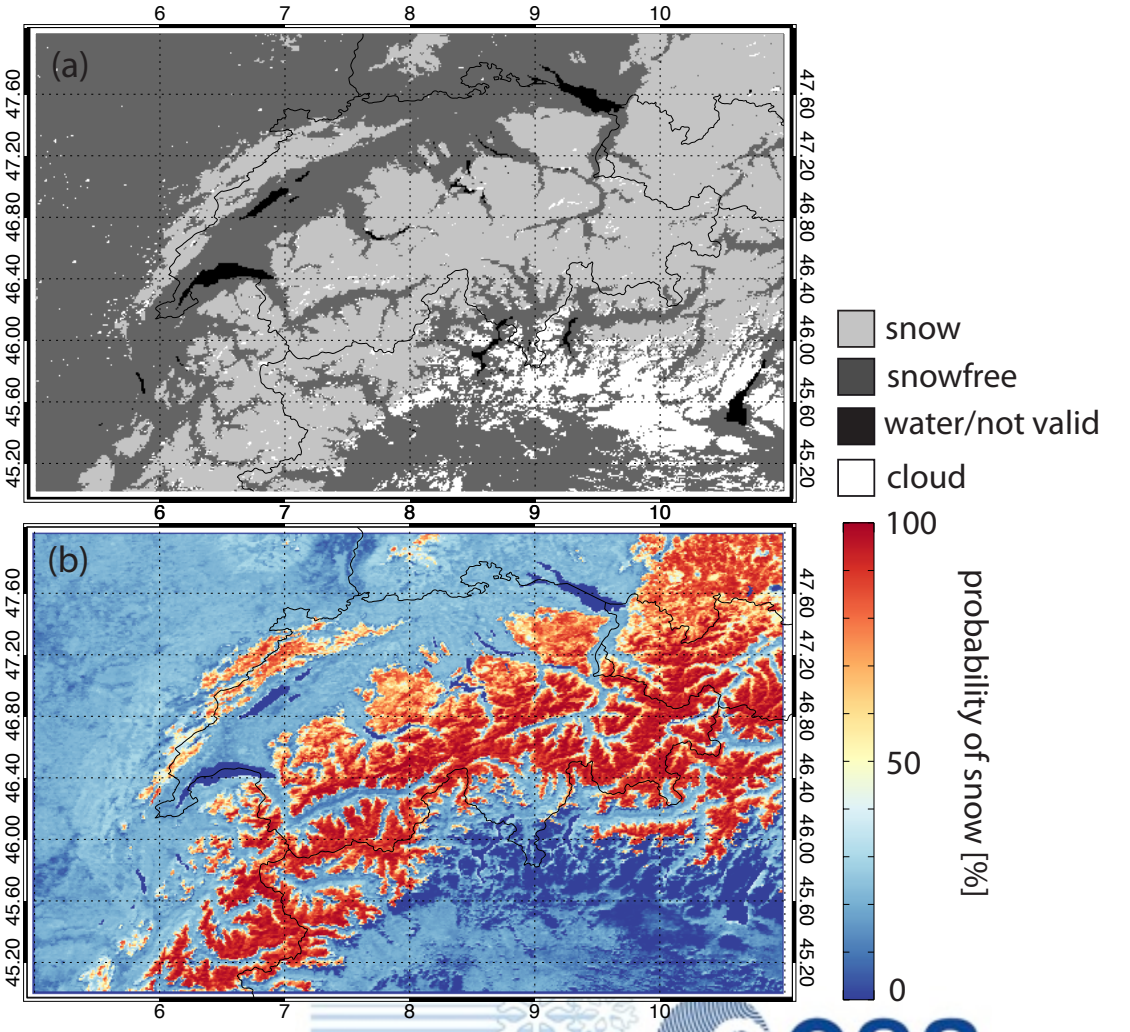


➔ Archive consists of > 110’000 data sets

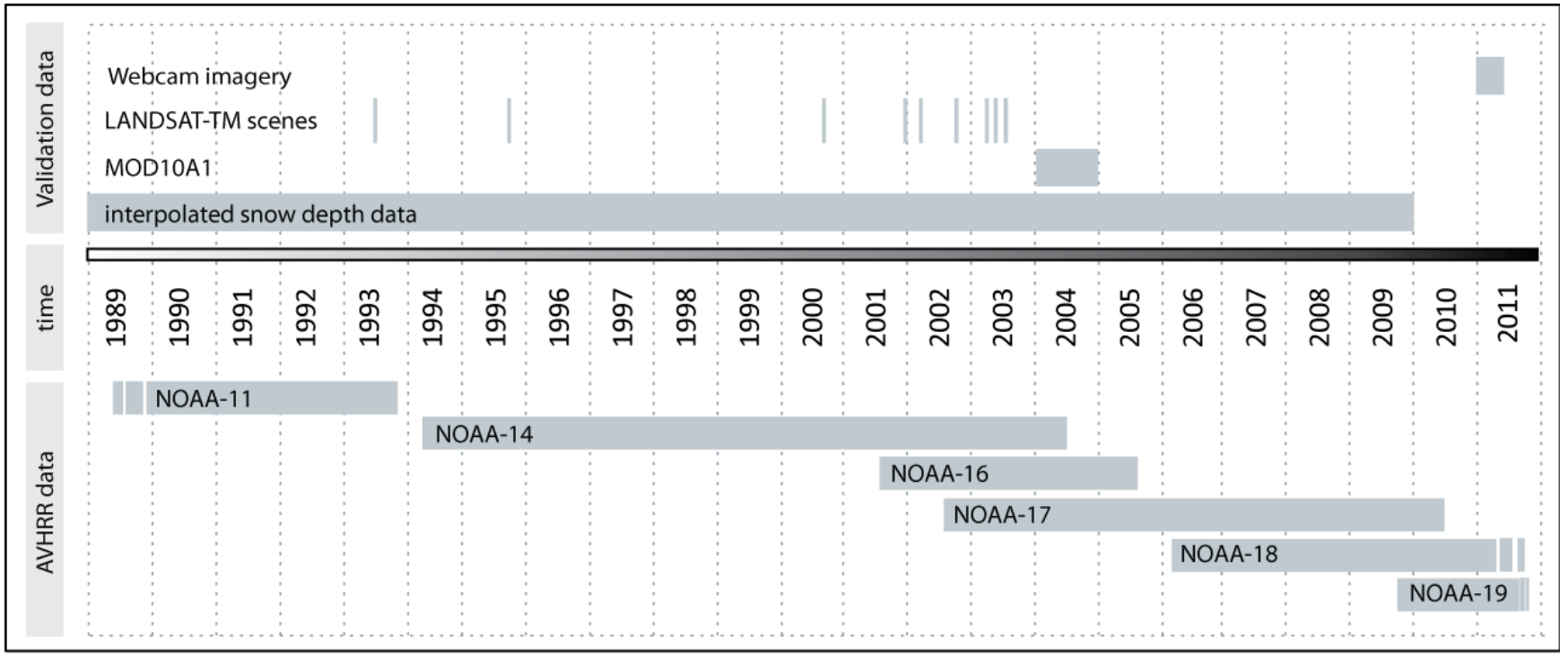
➔ Sources: RSGB, Uni Berlin, DLR, SAA/CLASS, ESA (data mining ongoing)

ECV snow extent: processing and validation

- Capitalizes on the spectral properties of snow in the **visible and the near infrared spectrum**
- Applicable to **any kind of AVHRR** generation
- **Probability indication of snow occurence** for each pixel
- Extensively **validated** and tested for **long-term consistency (inter-sensor)**

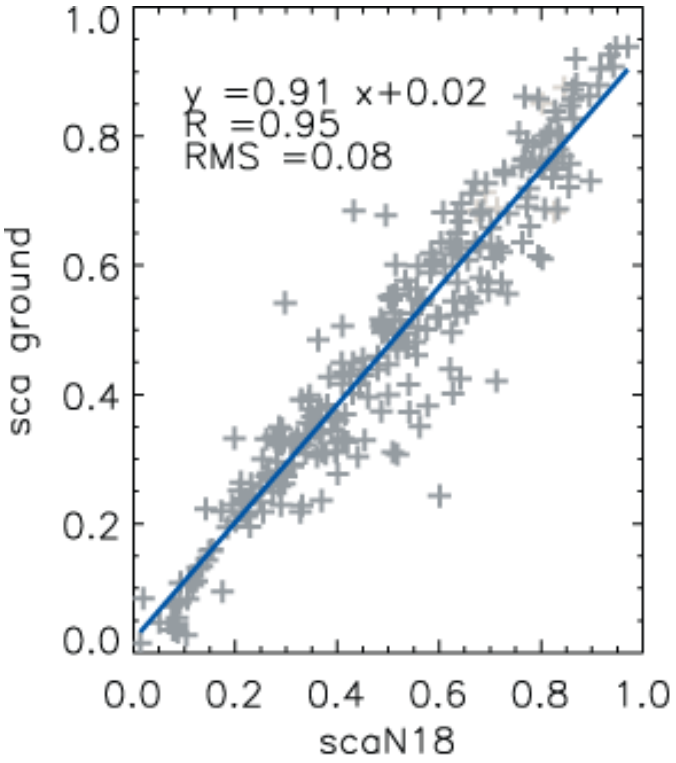


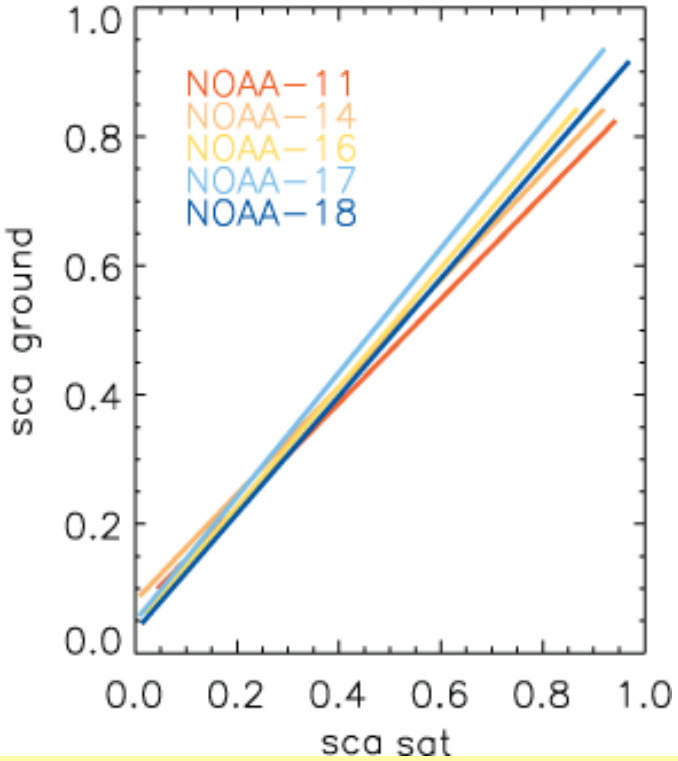
ECV snow extent: Validation and accuracy



→ Extensive validation against different reference data sources
→ Overall accuracy around 90% POD (depending on landcover, complexity of topography and cloud coverage)

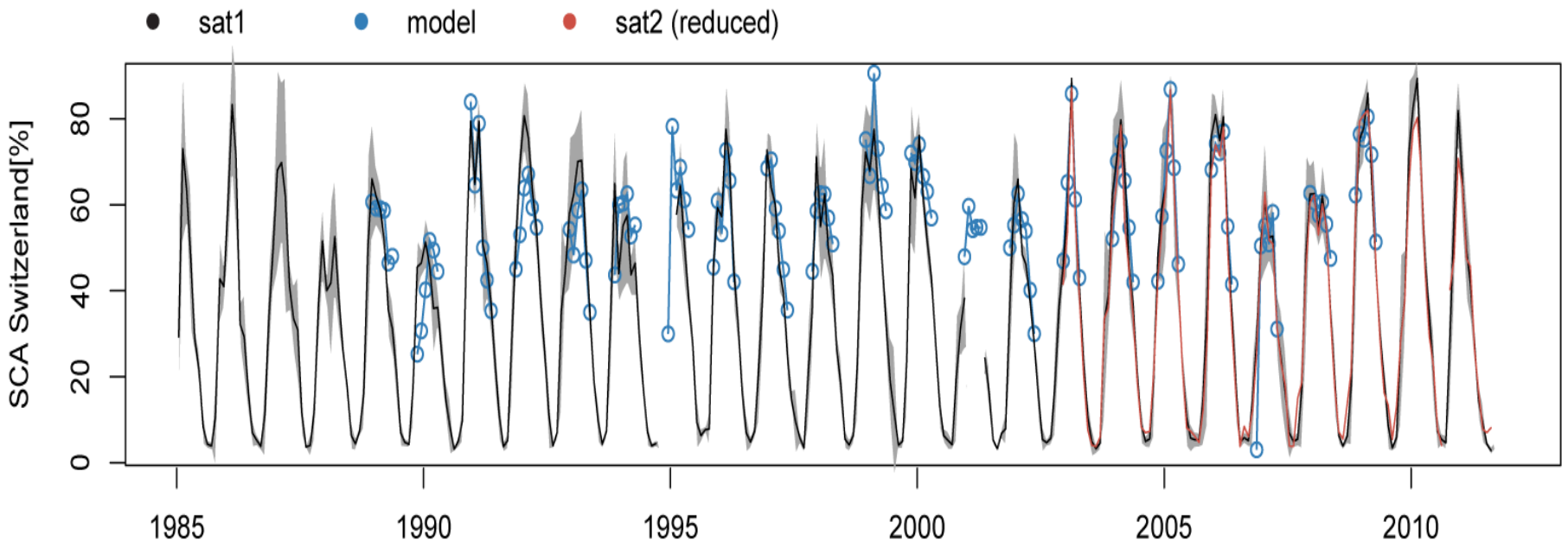
ECV snow extent: Long-term consistency





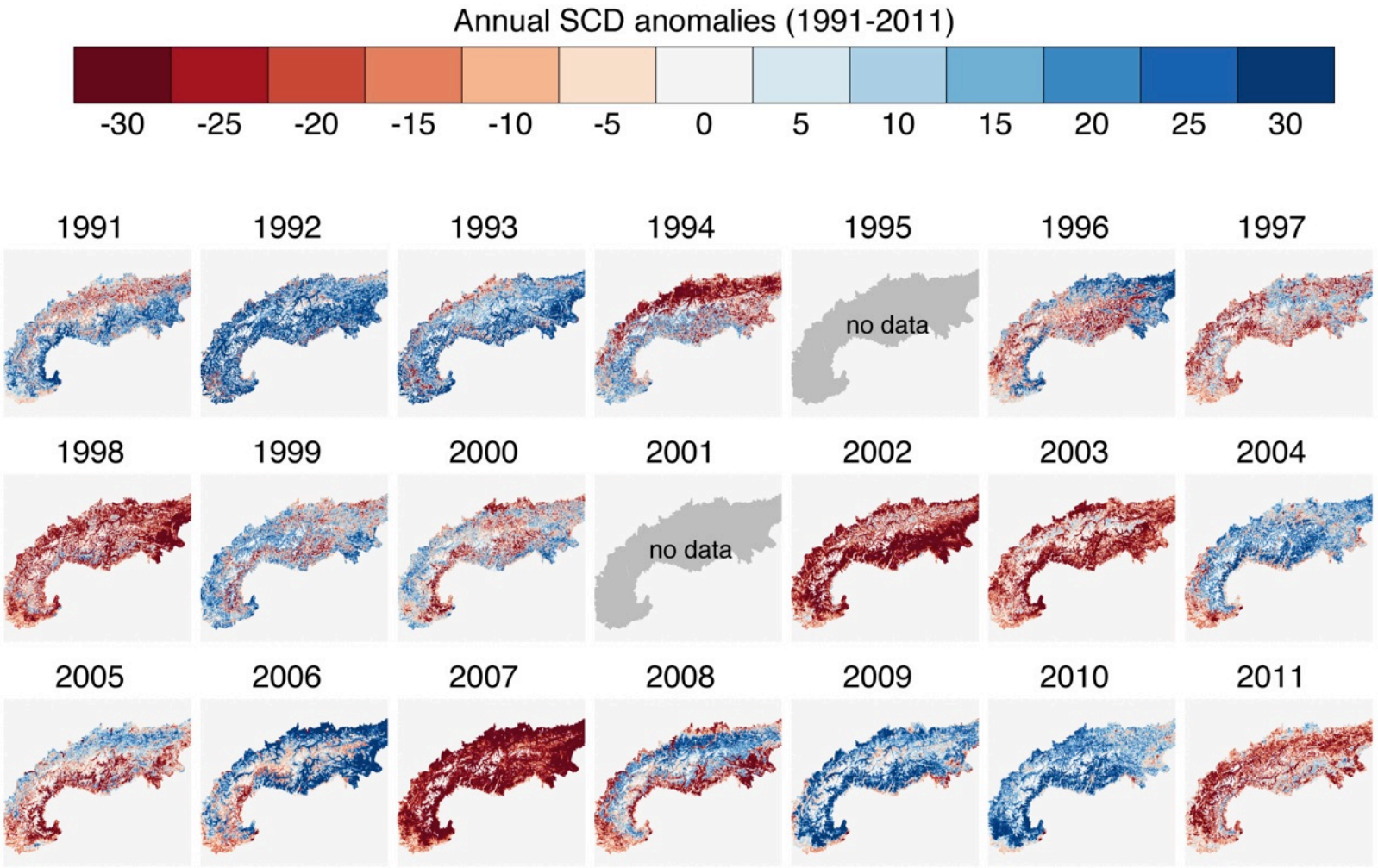
→ Assessed from comparison to temproally stable gridded snow data
→ Assessed from overlapping periods between sensors

ECV snow extent: Time series SCA

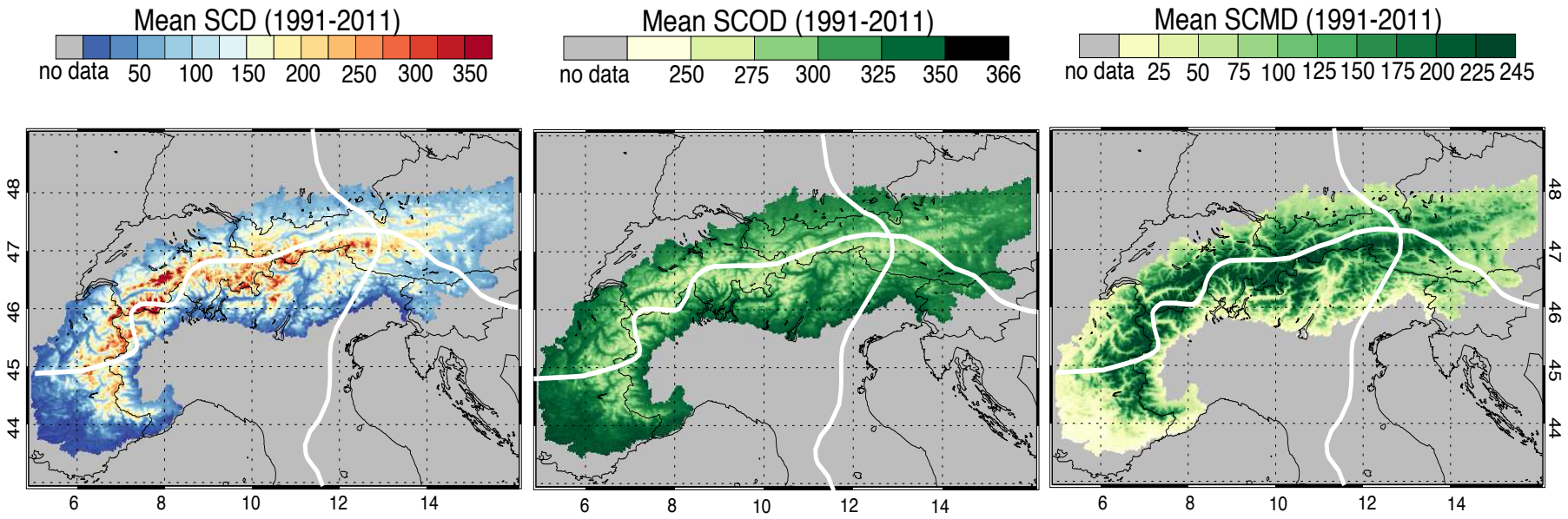


→ high agreement between satellite data and ground-based SCA
→ No artificial trend introduced by irregular data availability

ECV snow extent: Time series European Alps



ECV snow extent: Available composite products



→ Pixelwise snow information (annual or interannual) at 1km
→ Temporal ***and*** spatial representation of snow parameters
→ Values can be calculated application-dependent



Take home message

- **AVHRR Data archive at University of Bern** (1985-2014) is available for ECV snow
- **ESA's backfilling initiative** is acknowledged to **complete AVHRR data archive** and fill existing gaps
- We can offer a **well validated and consistent ECV snow data set for European Alps**
- **Application-dependent parameters and products** can be delivered (for climatology, phenology, hydrology, etc.)
- Future plans include the expansion&validation of the **applications to whole Europe**

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Thank you for your attention!

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http://www.globsnow.info/index.php?page=Products

Hüsler, F., Jonas, T., Riffler, M., Musial, J. P., and Wunderle, S.: A satellite-based snow cover climatology (1985–2011) for the European Alps derived from AVHRR data, The Cryosphere, 8, 73-90, doi:10.5194/tc-8-73-2014, 2014.

Hüsler, F., Jonas, T., Albrecht, S., and Wunderle, S.: Validation of a modified snow cover retrieval algorithm from historical 1-km AVHRR data over the European Alps. Remote Sensing of Environment, 121, 1, pp. 497--515, doi: 10.1016/j.rse.2012.02.018, 2012.

GLOBSNOW esa