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Evaluation of snow cover properties in ERA5 with several satellite-based datasets in Northern Hemisphere in spring 1982-2018

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Introduction

Snow cover affects…

- surface albedo
- human activities
- hydrological cycle

Snow cover is changing

- Mostly negative trends, but large spatial and seasonal variability exists

Reanalysis and satellite data provide snow cover estimates at continental scale

Data and methods

ERA5

- ECMWF atmospheric reanalysis
- Spatial resolution 30 km
- **SWE, albedo,** and **SCE**
- SCE calculated using SWE and snow density

Satellite-based datasets

SWE

- Non-mountainous regions: **SnowCCI v2**
- Mountainous regions: mean of **MERRA-2, Brown and Crocus v7**

SCE

- Rutgers
- JAXA JASMES

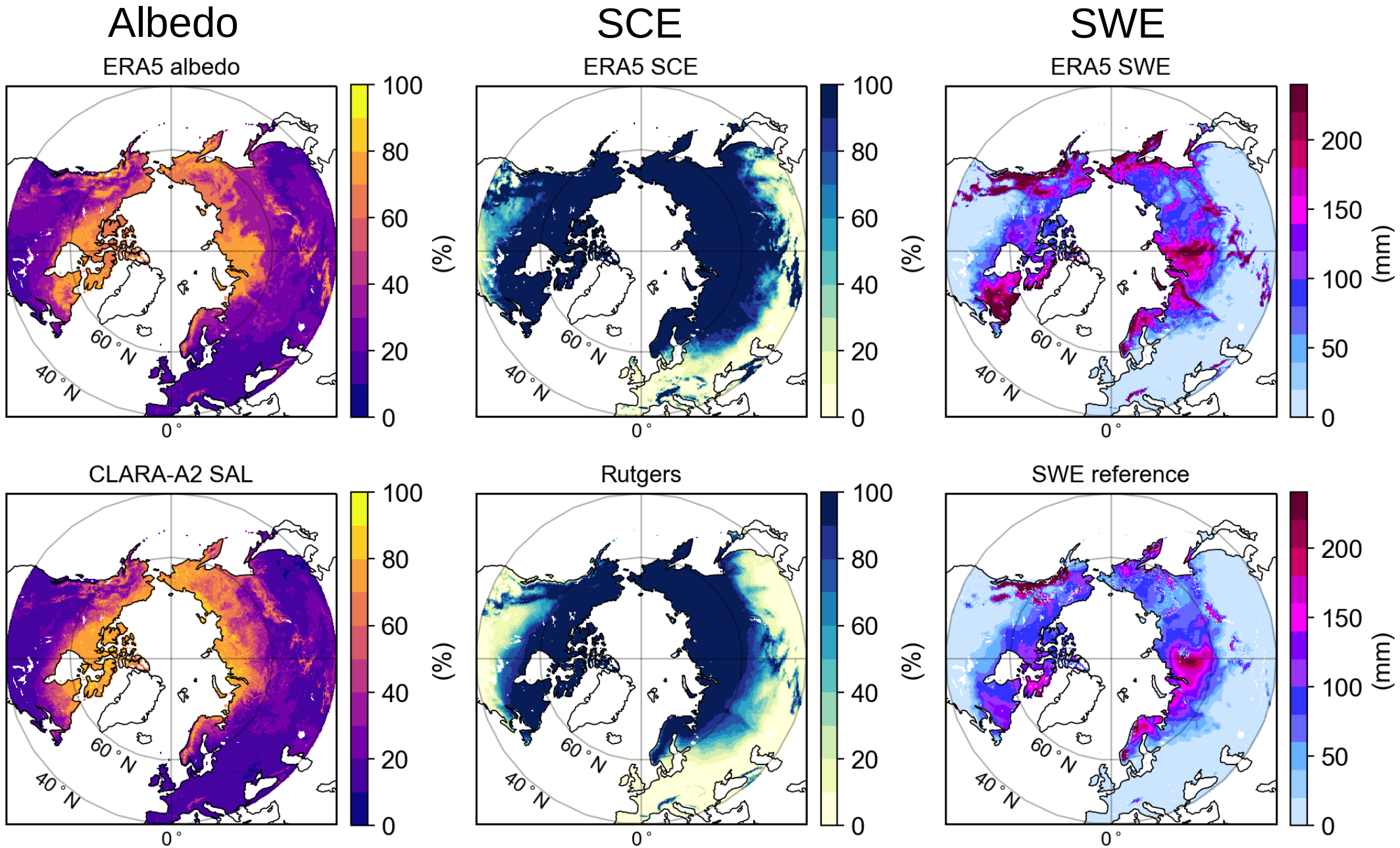
Surface albedo

- CLARA-A2 SAL
- MODIS black-sky albedo (MCD43D51)

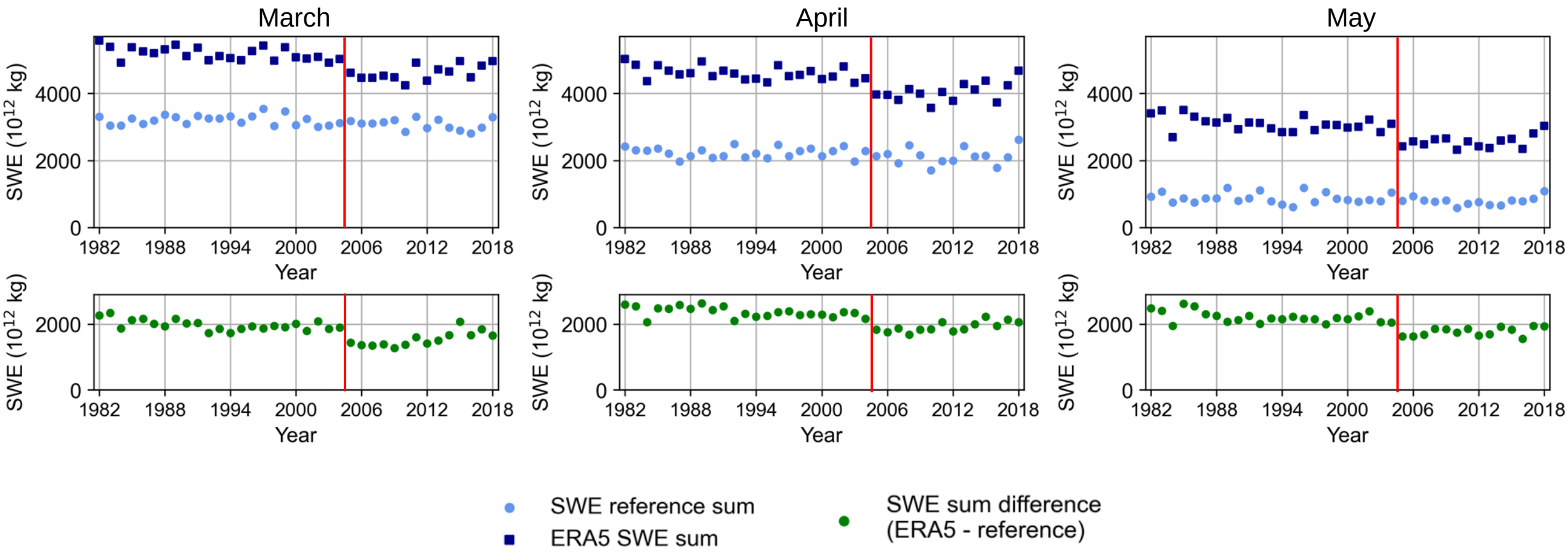
- **Study area**: land areas north of 40 °N
- **Study period**: spring (March-May) 1982-2018 and 2000-2018
- 25 km equal-area projection
- Comparison grid cell by grid cell
- Trends calculated using Theil-Sen method

Results

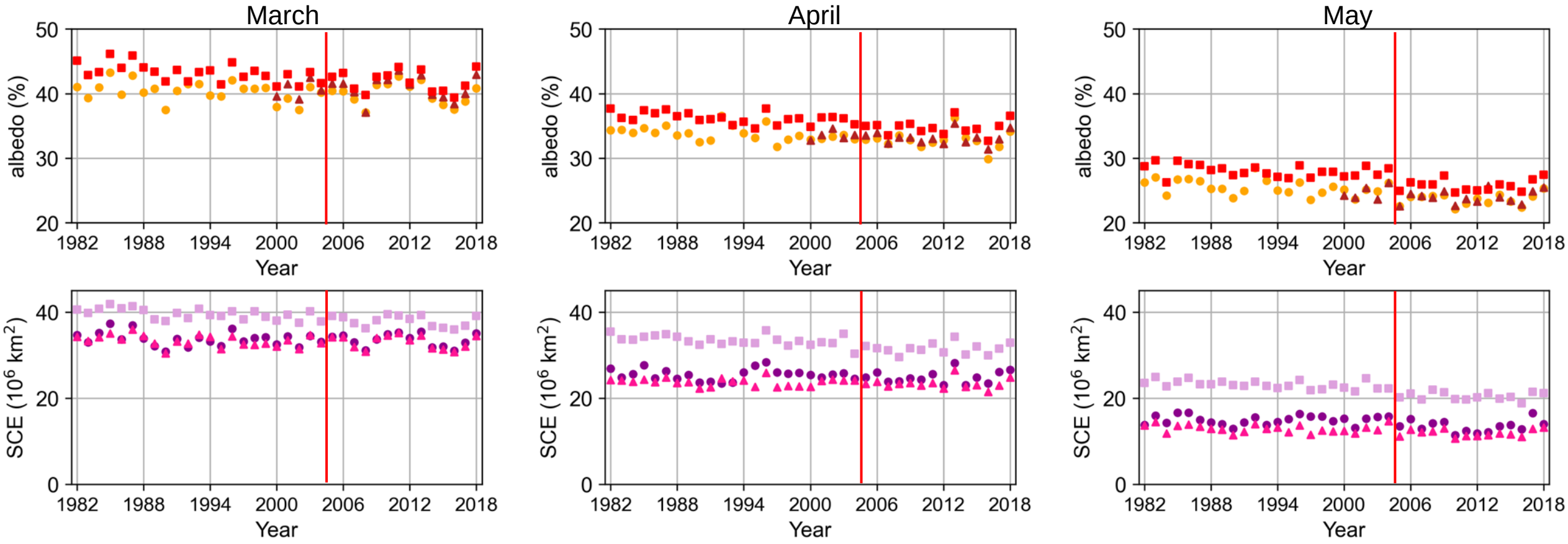
Mean values in April 1982-2018



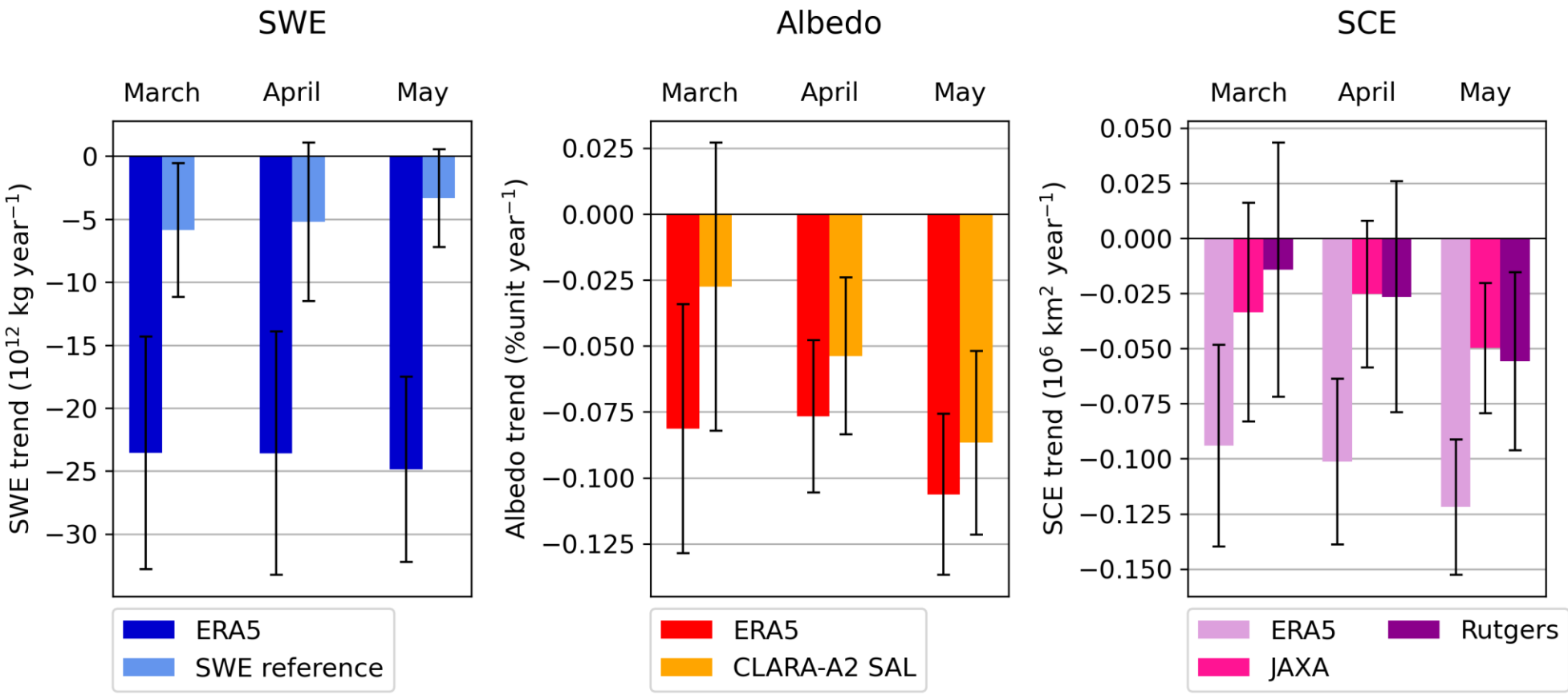
ERA5 overestimates SWE



ERA5 overestimates SCE, but not albedo



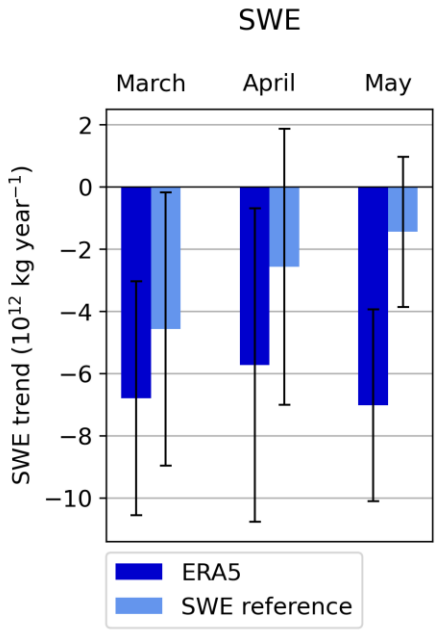
Trends in 1982-2018 show large variability



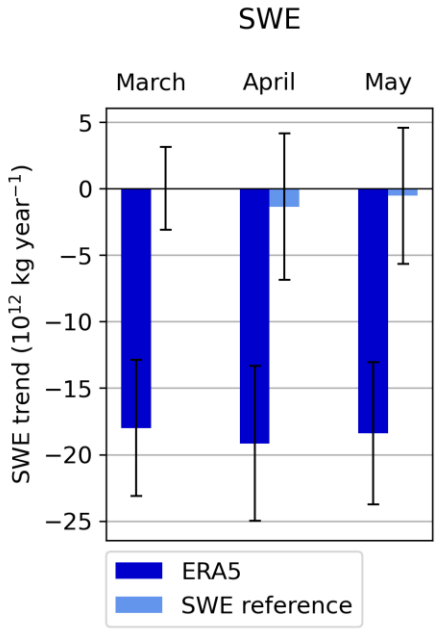
error bars = 95% confidence intervals

The trends are different in North America and Eurasia

North America



Eurasia

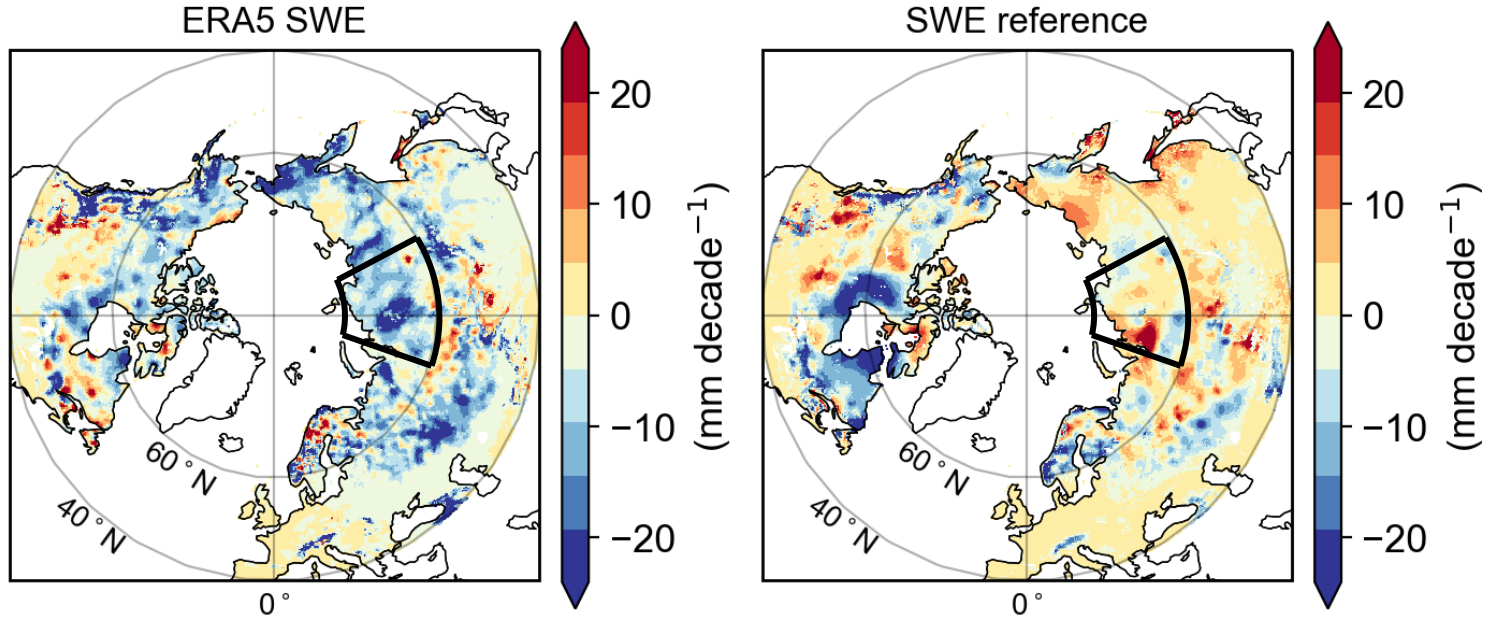


error bars = 95% confidence intervals

Large variability exists between the datasets

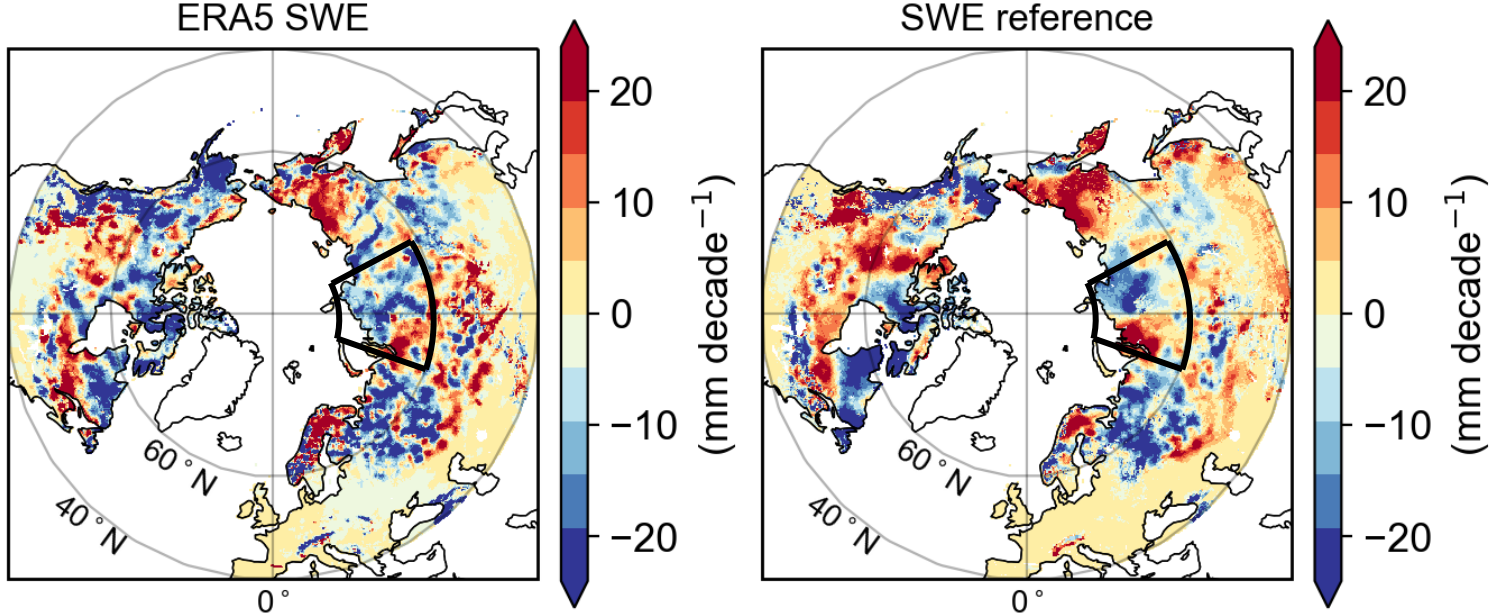
1982-2018

SWE trend in March



The datasets are more consistent with each other

2000-2018



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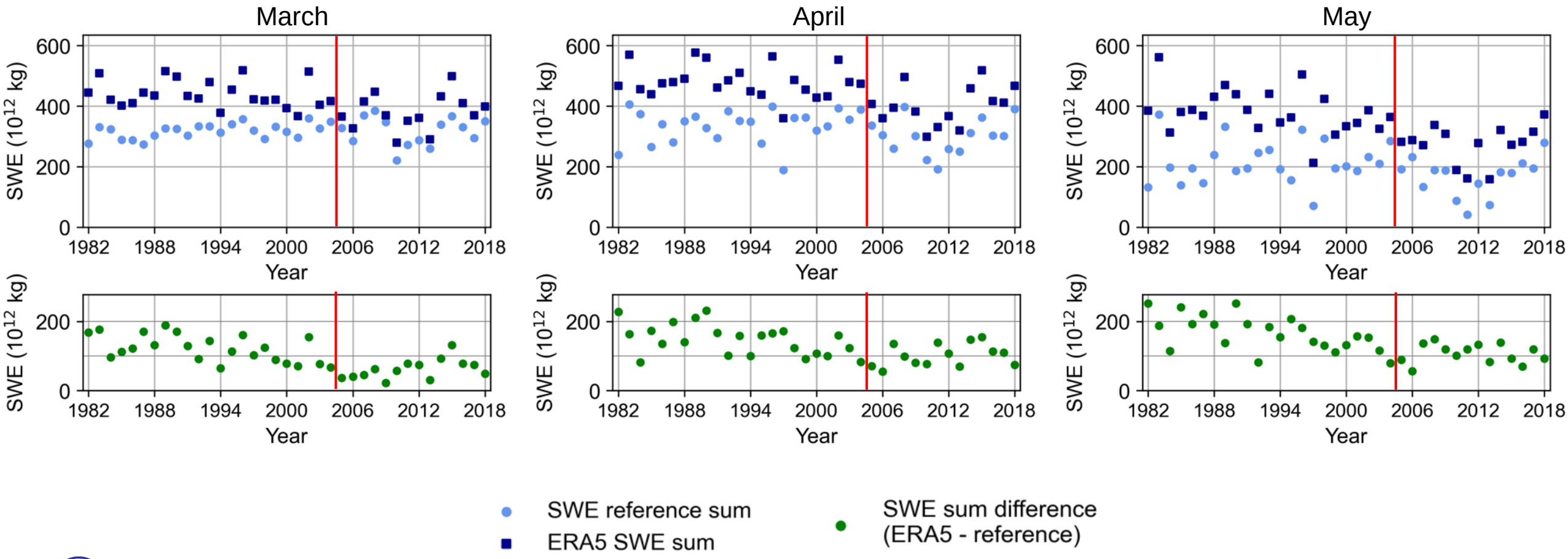
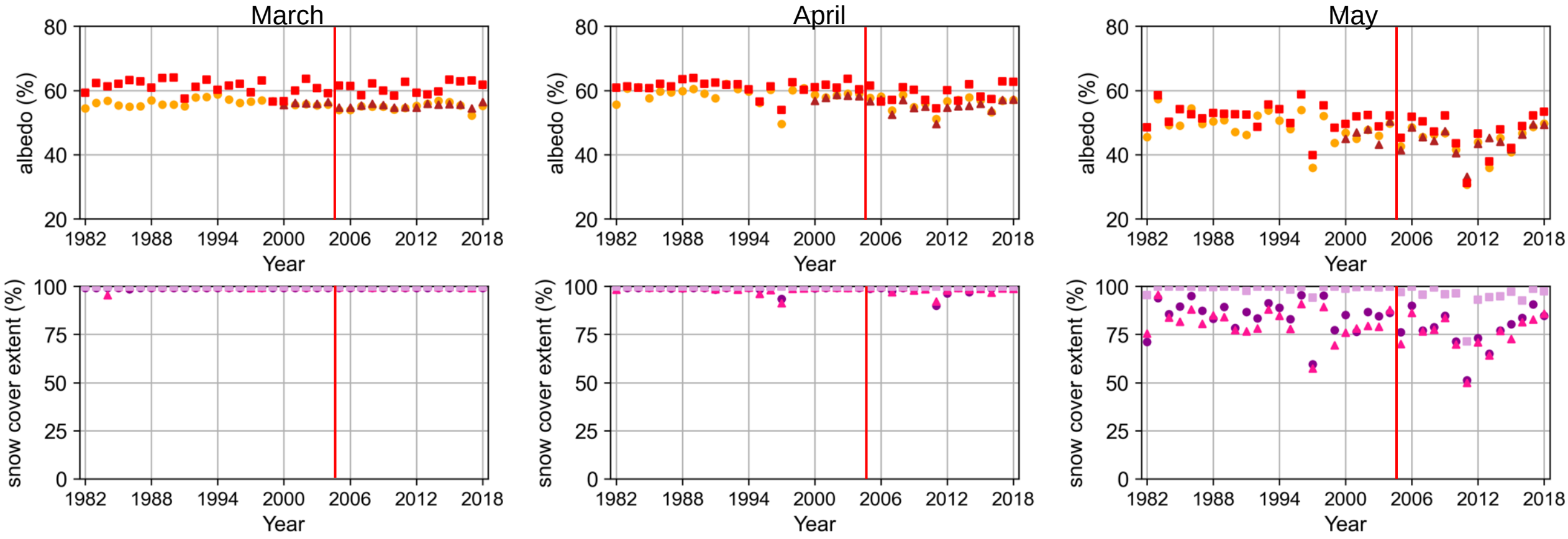
The difference in SWE decreases after 2004



The difference in SCE and albedo remains the same during the study period



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Conclusions

- ERA5 overestimates SWE and SCE, whereas albedo is more consistent with satellite-based datasets
- Trends vary considerably
  - ERA5 shows mostly statistically significant negative trends
  - Satellite-based datasets show negative SWE trend in March, and negative trend in SCE and albedo in late spring
- ERA5 is more consistent with satellite-based datasets from year 2004 onwards, when IMS (Interactive Multisensor Snow and Ice Mapping System) is added

Thank you!

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