

Extension of CCI sea ice climate time series with historical satellite data

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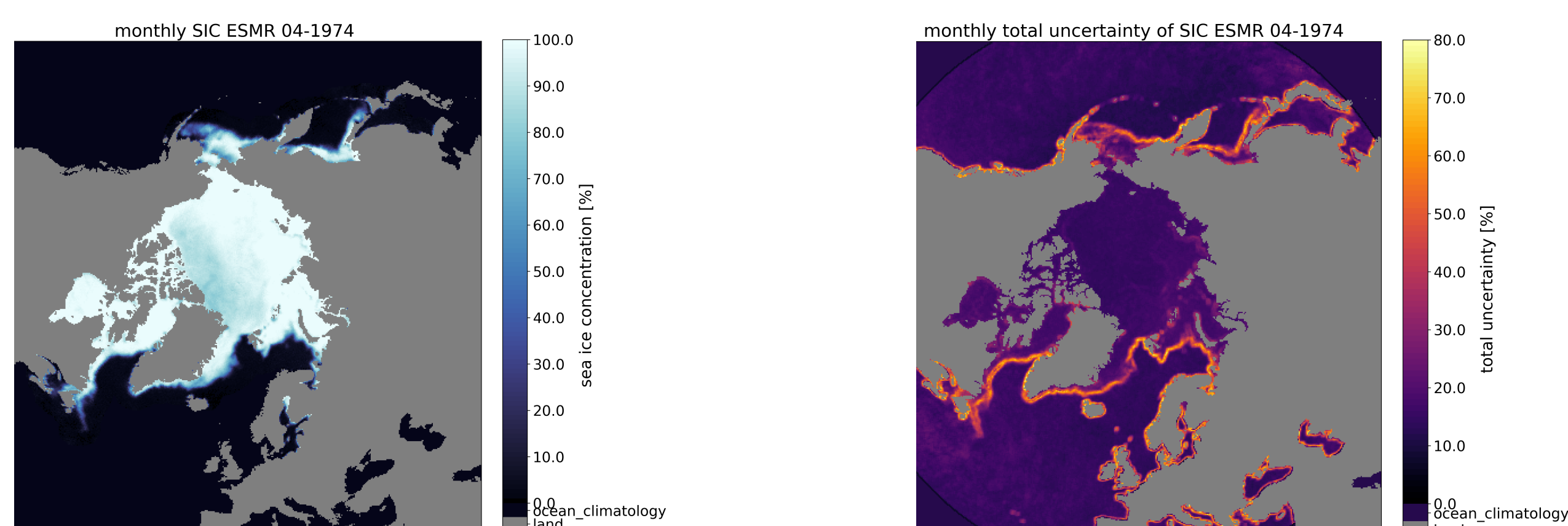
Introduction

The effects of global climate change are amplified in the arctic, making arctic sea ice an important climate indicator. Current sea ice climate data records (CDRs), based on satellite data, are beginning in the late 1970's. However, there are also satellite missions from the early and mid 1970s which can be used for mapping sea ice and for extending the current CDRs. One example is the data of the Electrically Scanning Microwave Radiometer (ESMR) on board the NIMBUS 5 satellite, which was operating between 1972 and 1977. As part of the ESA CCI+ sea ice project a new sea ice concentration (SIC) data set was created from the ESMR L1 data and is presented here.

Sea Ice Concentration & Uncertainty

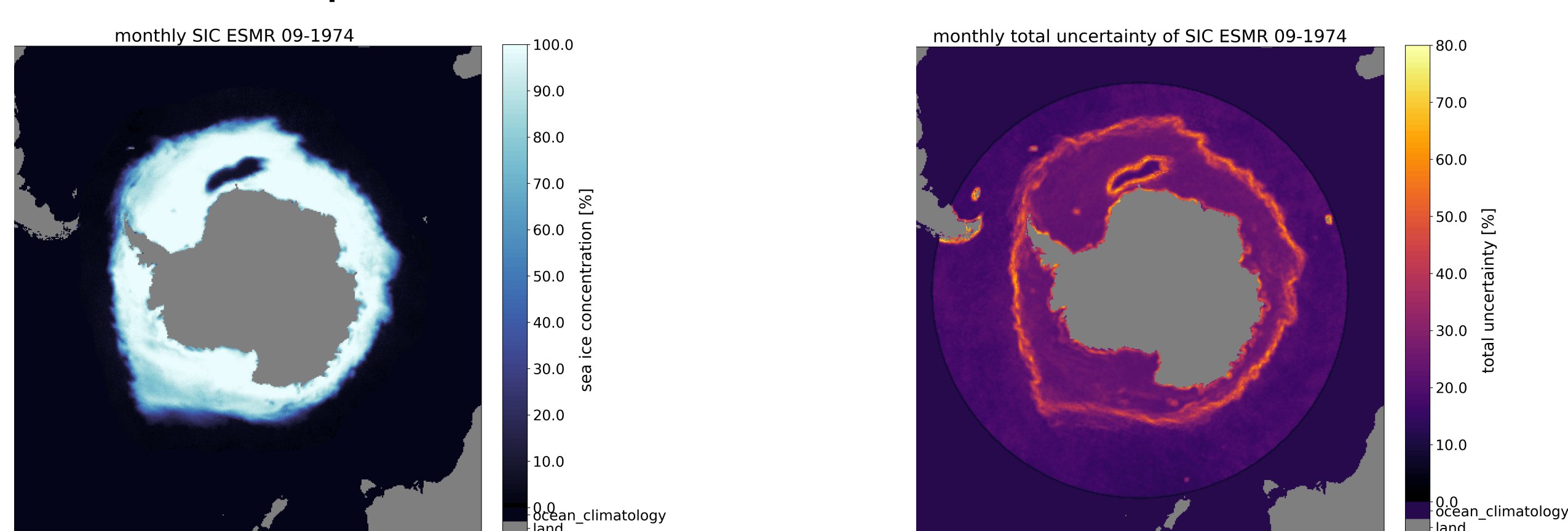
The data shows interesting sea ice features during the years 1972-1977. Two such features, which were much larger and more frequent in the 1970s than today are:

Odden ice tongue extending eastward from the East Greenland Current:



Monthly mean SIC for for April 1974, Northern Hemisphere, Monthly mean uncertainty for April 1974, Northern Hemisphere

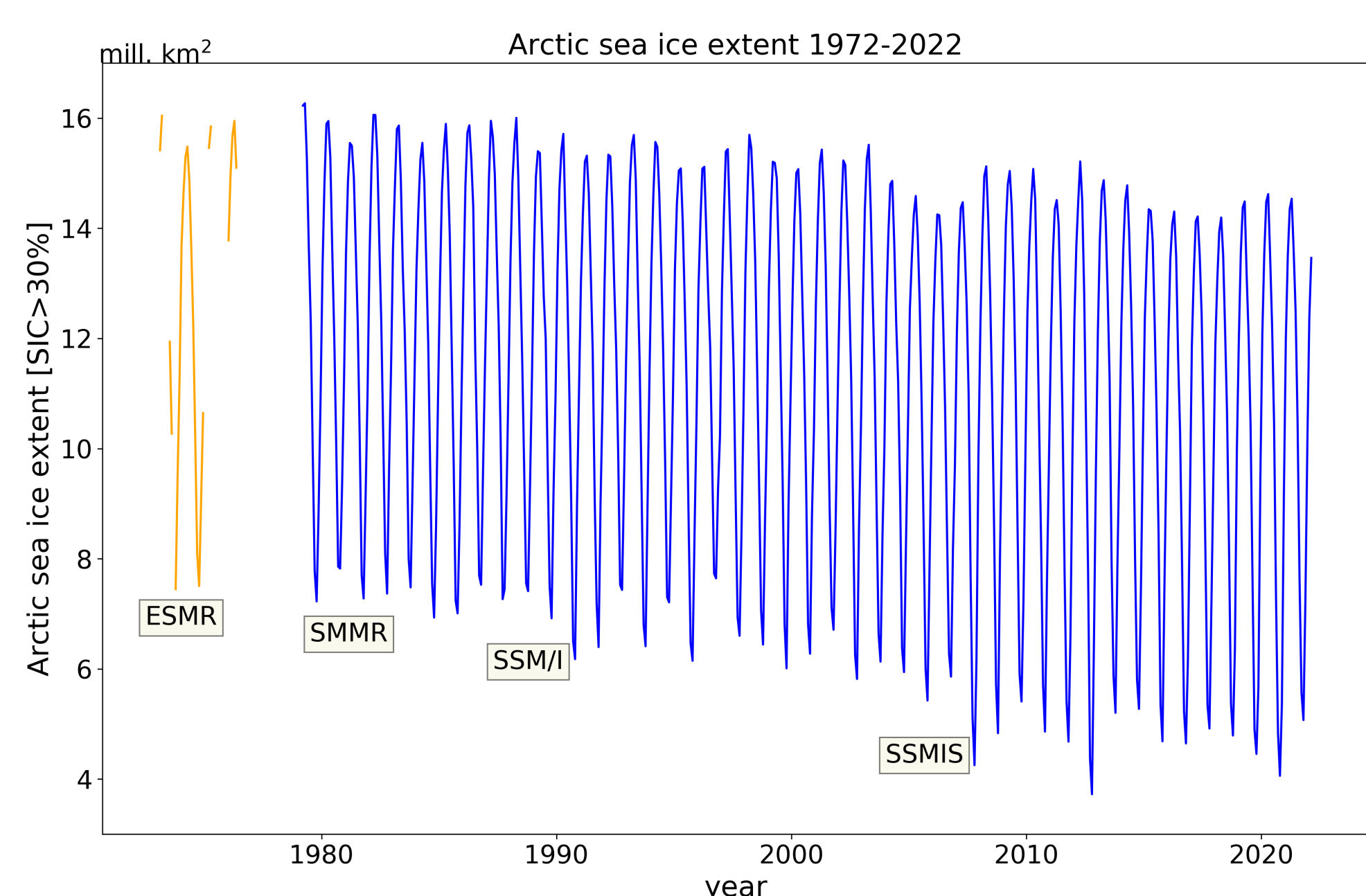
Maud Rise Polynya, open water area enclosed by sea ice, on the Southern Hemisphere:



Monthly mean SIC for September 1974, Southern Hemisphere, Monthly mean uncertainty for September 1974, Southern Hemisphere

Monthly Sea Ice Extent

From the SIC monthly mean sea ice extents (SIE) have been calculated. Only months with a coverage of 99 % have been included from the ESMR data set (orange line), while the OSI-430 & OSI-450 (blue line) shows the monthly means for 1979-2022.



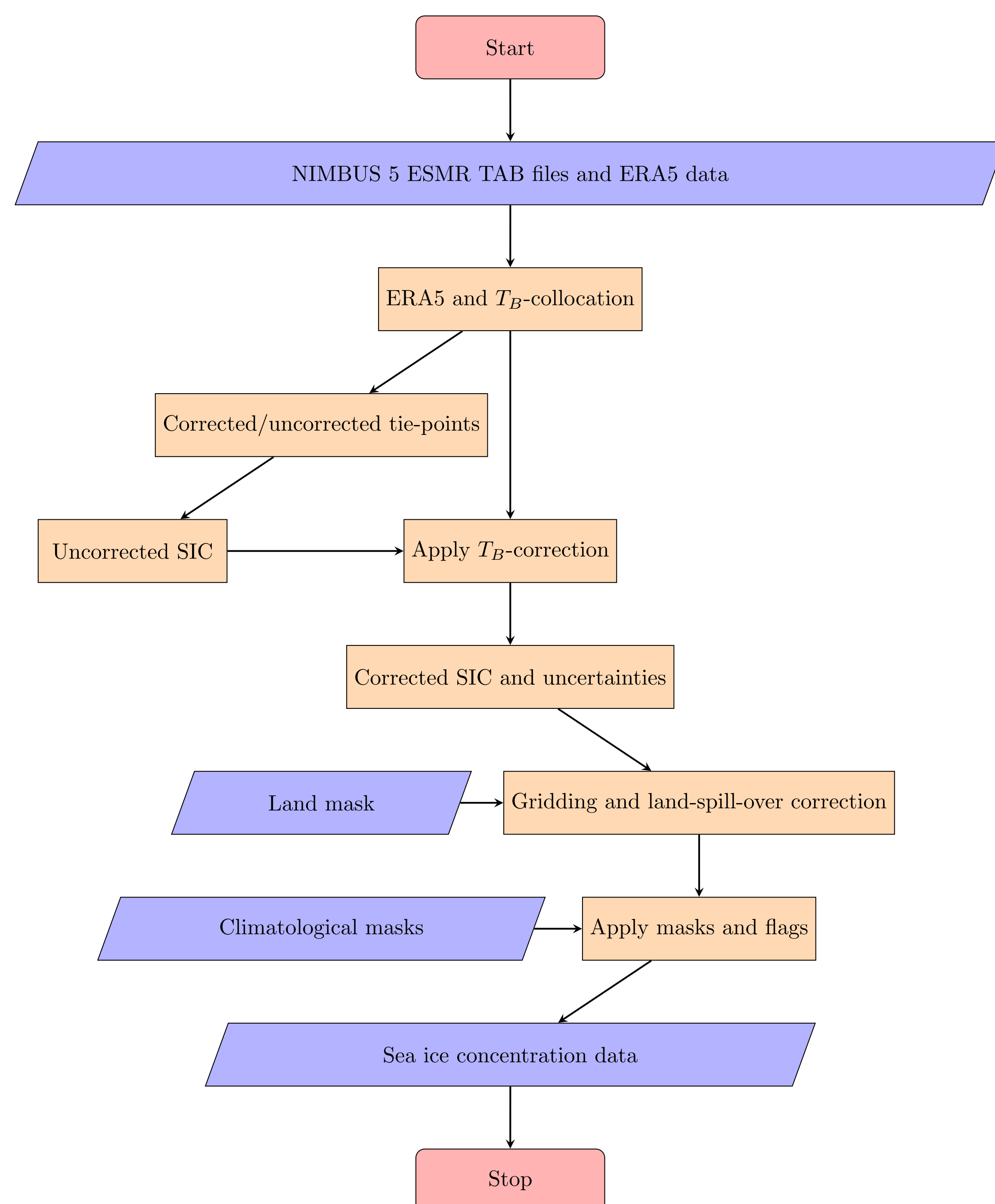
Monthly mean sea ice extent from CCI ESMR (orange line) and OSI-SAFs products (blue line) for the Northern Hemisphere in Mill.km². [Adapted from DaMS Vejret]

Processing

ESMR data key features:

- Single channel across-track scanning at 19.35 GHz.
- Observations at 78 different incidence angles from nadir to about 63°.
- December 1972 - May 1977.
- Global coverage, where polar regions are covered every $\frac{1}{2}$ day.

Processing:



ESMR data-processing flowchart [from the CCI+ ESMR SIC PUG]

- Dynamical tie-points.
- TB correction with Radiative Transfer Model (RTM).
- Uncertainty estimates.

Future Research

- Further work on ESMR re-calibrations, noise reduction etc.
- Improvement of SIC retrieval & estimation of sea ice type.
- Investigating other microwave data of the 1970s for comparison and filling gaps.
- Climate data record stability and inter-comparison with data from other sources.

Data & References

[ESMR CCI+] The CCI+ NIMBUS 5 ESMR SIC dataset is available on ESA's data portal, <http://dx.doi.org/10.5285/34a15b96f1134d9e95b9e486d74e49cf> [publication in preparation]

[GES DISC] NASA Goddard Earth Sciences Data and Information Services Center, Dataset ESMR/Nimbus-5 Level 1 Calibrated Brightness Temperature V001 (ESMRN5L1), https://disc.gsfc.nasa.gov/datasets/ESMRN5L1_001/summary

[DaMS Vejret] Vejret, the membership journal of the danish meteorological society (DaMS), (Volume 174), <https://www.dams.dk/vejret>