National Snow and Ice Data Center
ADVANCING KNOWLEDGE OF EARTH'S FROZEN REGIONS

NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration Version 6 Updates

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1 Summary

The *NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration* (Meier et al. 2026a) was updated to Version 6 in January 2026. This data set provides a Climate Data Record (CDR) of sea ice concentration (SIC) from passive microwave data beginning with the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) in October 1978 and continuing with the DMSP F08, F11, and F13 Special Sensor Microwave Imager (SSM/I) and the DMSP F17 Special Sensor Microwave Imager/Sounder (SSMIS), and the JAXA GCOM-W1 Advanced Microwave Scanning Radiometer 2 (AMSR2) to present. This document describes the changes that were made to create Version 6. In addition, the near-real-time (NRT) counterpart to the SIC CDR, the *Near-Real-Time NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration* (Meier et al., 2026b), which is processed with the same code but with NRT input data, was updated to Version 4. The changes noted in this document also pertain to that data set.

The goal with the Version 6 SIC CDR product (Meier et al., 2026a) was to add AMSR2 as an input source of brightness temperatures to the CDR time series. Because the DMSP satellites are aging and there are no planned follow-on SSMIS instruments, the need arose to switch to a new instrument for the input data, and AMSR2 was chosen for this. Since the AMSR2 instrument has different sensor characteristics than SSMIS, such as higher resolution and different channel frequencies (Table 1), we used AMSR2 brightness temperature data from another NSIDC data set that had already been intercalibrated with SSMIS. See Section 3, Matching AMSR2 SIC to SSMIS SIC, for details. For a complete list of the differences between AMSR2 and SSMIS see Table 1 and Table 2 in the C-ATBD (Windnagel et al., 2026).

Table 1. Description of difference between AMSR2 and SSMIS sensors

	AMSR2	**SSMIS**
Gridded Sensor Resolution (km)	12.5	25
Channel Frequencies (GHz)	18.7	19.4
	23.8	22.2
	36.5	37.0

2 Overview of Changes

The following is a list of changes made to CDR V6:

1. Added AMSR2 as the input brightness temperature source beginning 1 January 2025. Sea ice concentration fields derived from these data are in the cdr_seaice_conc variable.
2. Removed the AMSR2 prototype sea ice concentration (prototype_am2 group) that was part of CDR V5.
3. Fixed a bug in Version 5 code that allowed sea ice concentration values less than 10% to be considered during land spillover corrections. Land spillover corrections apply “neighborhood” operations that, for any given grid cell, consider adjacent grid cells when deciding if a correction should be applied. This means that cells

that had values greater than the 10% threshold were also affected in the final output, because they were near the cells with <10% concentration. This has been corrected in the code that processes Version 6 data, with the result that there is a slight increase in ice extent in V6. See Section 4 Difference Between CDR V5 and CDR V6 for further information.

4. Updated Python code to use latest versions of core libraries such as NumPy and Xarray. This change caused small rounding differences in the data due to modifications (often improvements) in how these libraries interact with floating point data. For instance, in one example, a grid cell in V6 is calculated as 0.10090834. In V5, the value for the same grid cell is 0.099999994. Because that is less than 10%, it is removed by the 10% threshold. In V6, this cell is not removed by the 10% threshold, so V6 shows slightly more ice than V5. See Section 4 Difference Between CDR V5 and CDR V6 for further information.

3 Matching AMSR2 SIC to SSMIS SIC

To obtain AMSR2 SIC matched to SSMIS SIC, we start by using an input AMSR2 brightness temperature product from NSIDC that had initial matching done between the AMSR2 and SSMIS sensors. This data set, called *AMSR2 Daily Polar Gridded Brightness Temperatures, Version 2* (Stewart et al., 2025), is made using resampled AMSR2 brightness temperature fields that closely match the sensor resolutions of the legacy brightness temperatures from the SSMIS sensor. These resampled AMSR2 brightness temperatures are then gridded onto the same 25 km polar stereo grids used for SSMIS and subsequently processed to produce SIC fields.

However, this matched AMSR2 data set of resulting sea ice concentration grids still yielded a small bias in hemispheric sea ice extent between SSMIS and AMSR2. To remove this bias, we used a technique in which a varying ice/water concentration threshold is applied to the AMSR2 SIC fields. We derived this method from Seki et al. (2024) where we compare an overlap period of AMSR2 and SSMIS SIC data for 2023 and 2024. See the C-ATBD (Windnagel et al., 2026) for details on how we applied the Seki method. Figure 1 and Figure 2 show the resulting sea ice extent for this two-year period calculated from gridded CDR-code-produced AMSR-2 and SSMIS sea ice concentration fields. The two agree quite well, and differences are within the uncertainty range of the data. Note: While CDR V6 processing was used to obtain AMSR2-derived SIC fields for comparison with SSMIS derived fields, AMSR2-derived SIC fields are not available in the published V6 product until 1 January 2025.

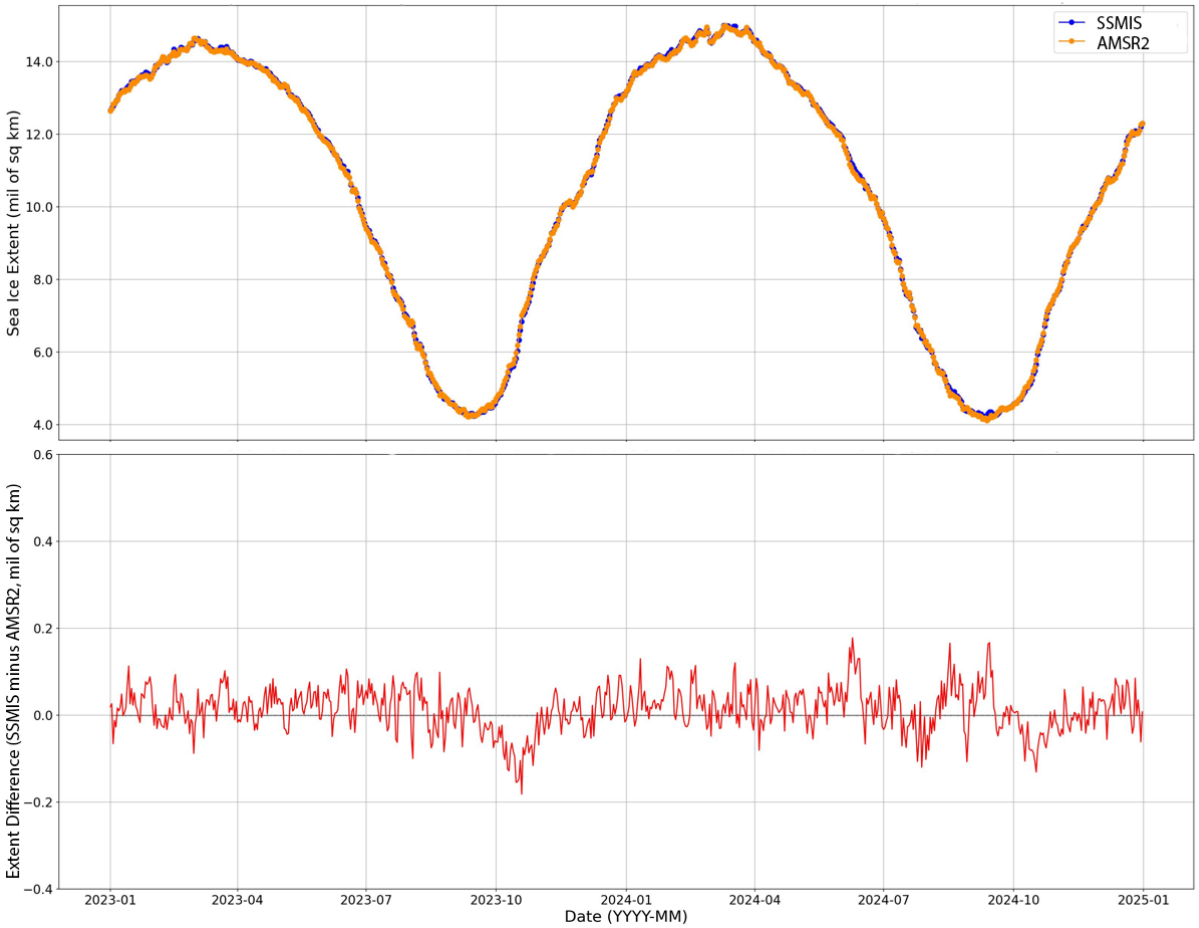

Figure 1. SSMIS- and AMSR2-derived sea ice extent for 2023 through 2024 for the Northern Hemisphere with Seki ice concentration adjustment applied to AMSR2 data. SSMIS extent (blue) and AMSR2 extent (orange) for 2023 and 2024 (top), and the difference between SSMIS and AMSR2 extent (bottom).

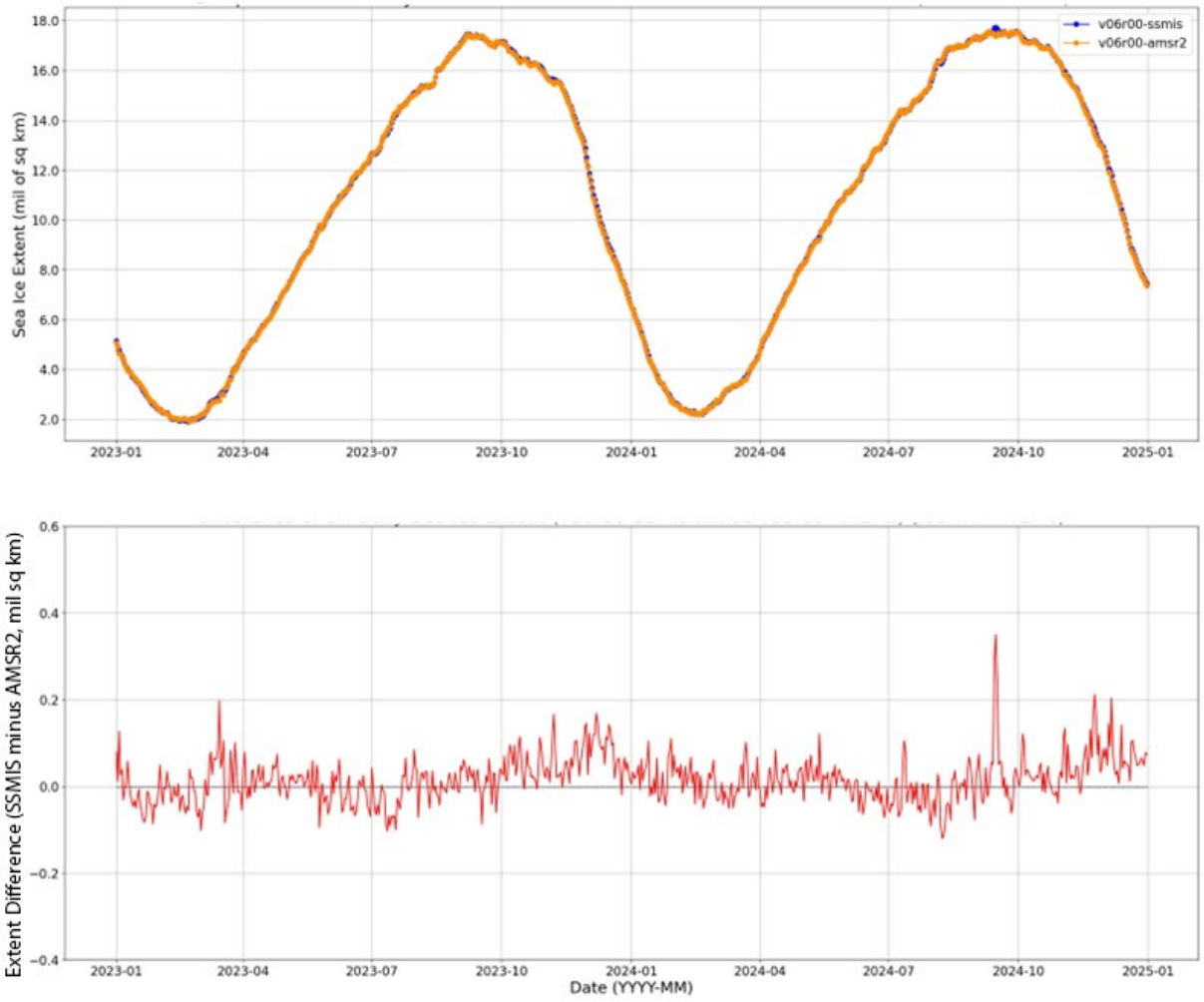

Figure 2. SSMIS- and AMSR2-derived ice extent for 2023 through 2024 for the Southern Hemisphere with Seki ice concentration adjustment applied to AMSR2 data. SSMIS extent (blue) and AMSR2 extent (orange) for 2023 and 2024 (top), and the difference between SSMIS and AMSR2 extent (bottom).

Figure 3 shows a representative comparison of sea ice from the SIC CDR V6 using SSMIS and AMSR2, along with a visible composite MODIS image. Even after being resampled to the SSMIS resolution, the 25 km gridded AMSR2 concentration field appears to depict the ice cover slightly better than SSMIS, especially near the bottom of the images along the coast of Greenland where SSMIS shows ice but AMSR2 and MODIS do not. However, this is only one point in time of these data, so it is not conclusive. Note that the AMSR2 data in the V6 product begins 1 January 2025, and the image for Figure 3 was processed specifically for this comparison.

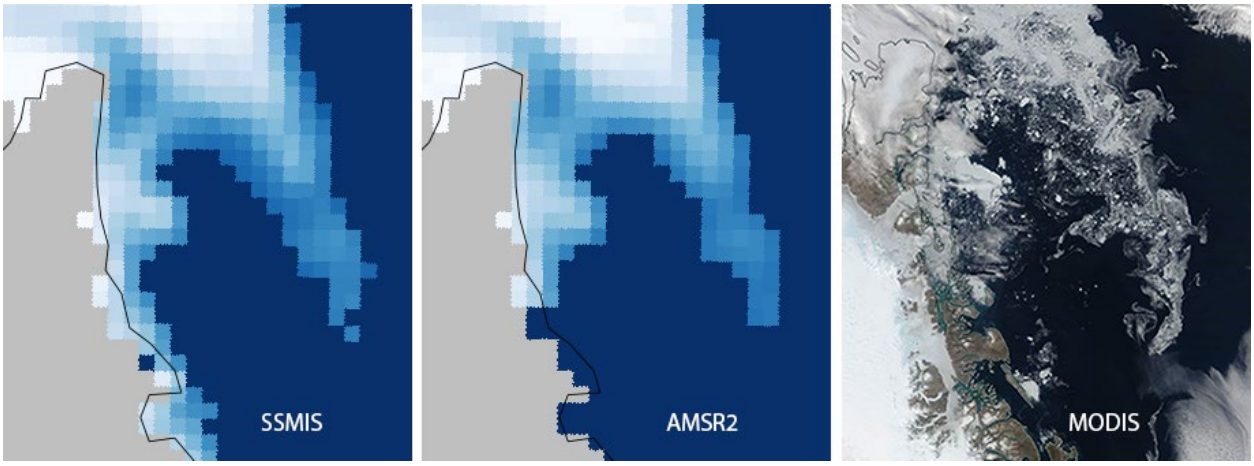

Figure 3. Comparison of SIC from 25 km SSMIS CDR (left), 25 km AMSR2 CDR (middle), and 500 m true-color MODIS image (right) for 30 July 2021 off the northeast coast of Greenland.

4 Extent Difference Between CDR V5 and CDR V6

For the time series from October 1978 through December 2024, where SMMR, SSM/I, and SSMIS are used as input in both Version 5 and Version 6, there are minimal extent differences between the two versions. This section only covers those differences. For differences between SSMIS and AMSR 2, see Section 3 Matching AMSR2 SIC to SSMIS SIC.

4.1 Northern Hemisphere

Table 2 provides statistics of the differences between Version 5 and Version 6 for the Northern Hemisphere. The maximum differences are quite small and well within the error of the data. Figure 4 (top) shows a comparison of the sea ice extent time series from CDR V5 and CDR V6 from 1978 through 2024 for the Arctic. The values are so close that V6 (in blue) is not visible underneath the V5 (in orange). To quantify the variation, Figure 4 (bottom) shows the differences between the two (CDR V6 minus CDR V5). The smallest differences (less than .01) are due to rounding differences from updating Python libraries. The larger differences (greater than .01), mostly seen in the SMMR period (1978 – 1987), are due to fixing the bug in the land spillover correction.

Table 2. Northern Hemisphere extent difference statistics (CDR V6 minus CDR V5) for full time series and for SSM/I and SSMIS only. Statistics are derived from a sample size of N = 16870 days spanning 25 Oct. 1978 – 31 Dec. 2024 for full time series and for N = 13690 days spanning 10 Jul. 1987 – 31 Dec. 2024 for the SSM/I-SMMIS series.

Statistic	NH Extent (Mil sq km)	NH Extent without SMMR (Mil sq km)
Mean extent difference	0.00066	0.0000423
Standard deviation	0.0022	0.00086
Maximum extent difference	0.022	0.022
Minimum extent difference	-0.020	-0.020

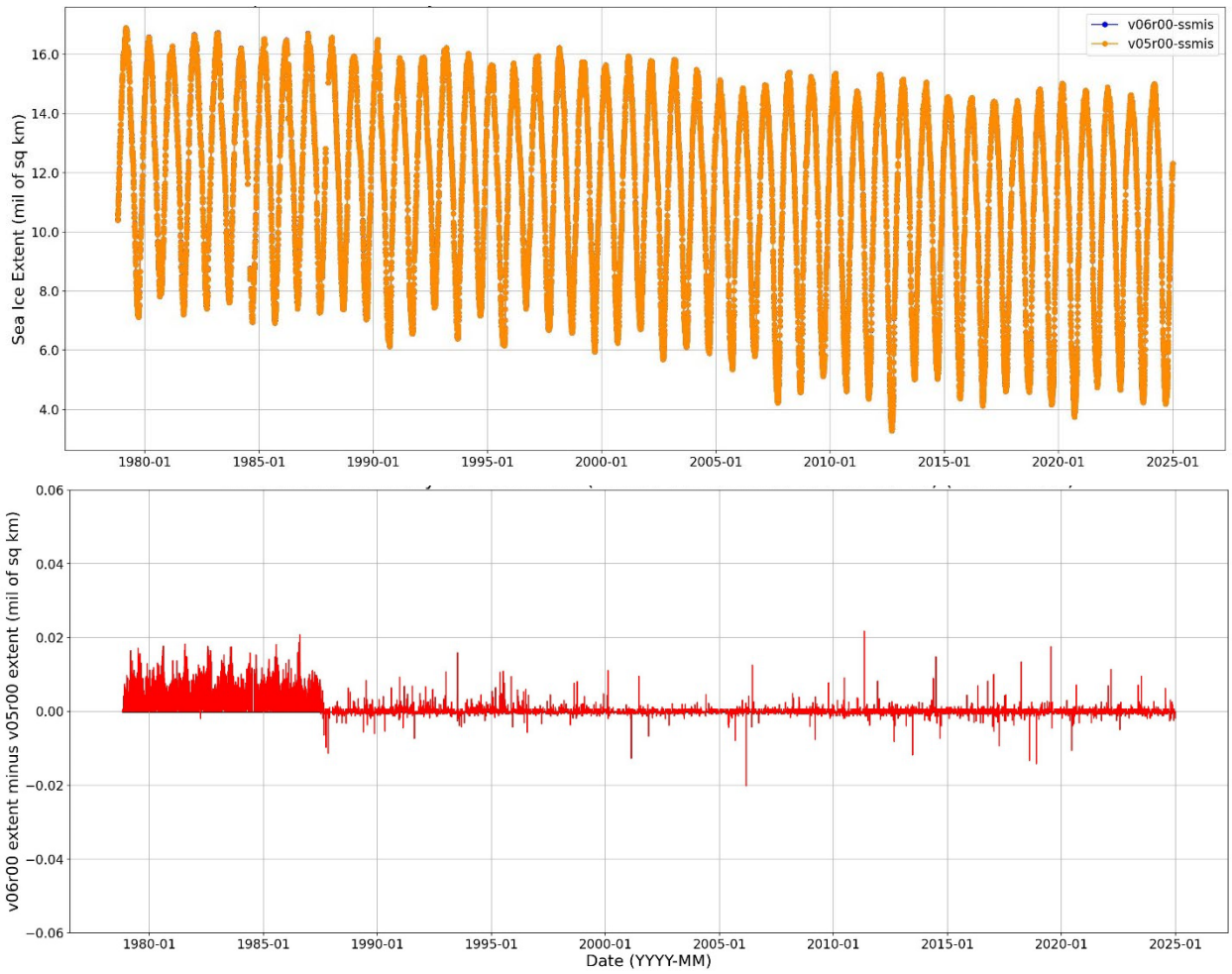

Figure 4. Northern Hemisphere sea ice extent for V6 (blue) and V5 (orange) (top) and the difference (V6– V5) bottom.

4.2 Southern Hemisphere

Table 3 provides statistics of the differences between Version 5 and Version 6 for the Southern Hemisphere. The maximum differences are quite small and well within the uncertainty range of the data. Figure 5 (top) shows a comparison of the sea ice extent time series from CDR V5 and CDR V6 from 1978 through 2024 for the Antarctic. The values are so close that V6 (in blue) is not visible underneath the V5 (in orange). To quantify the variation, Figure 5 (bottom) shows the differences between the two (CDR V6 minus CDR V5). The smaller differences (less than .01) are due to rounding differences from updating Python libraries. The larger differences (greater than .01), mostly seen in the SMMR period (1978 – 1987), are due to fixing the bug in the land spillover correction.

Table 3. Southern Hemisphere extent difference statistics (CDR V6 minus CDR V5 for full time series and for SSM/I and SSMIS only. Statistics are derived from a sample size of N = 16870 days spanning 25 Oct. 1978 – 31 Dec. 2024 for full time series and for N = 13690 days spanning 10 Jul. 1987 – 31 Dec. 2024 for the SSM/I-SMMIS series.

Statistic	SH Extent (Mil sq km)	SH Extent without SMMR (Mil sq km)
Mean extent difference	0.0010	0.000073
Standard deviation	0.0033	0.0010
Maximum extent difference	0.078	0.078
Minimum extent difference	-0.0024	-0.0024

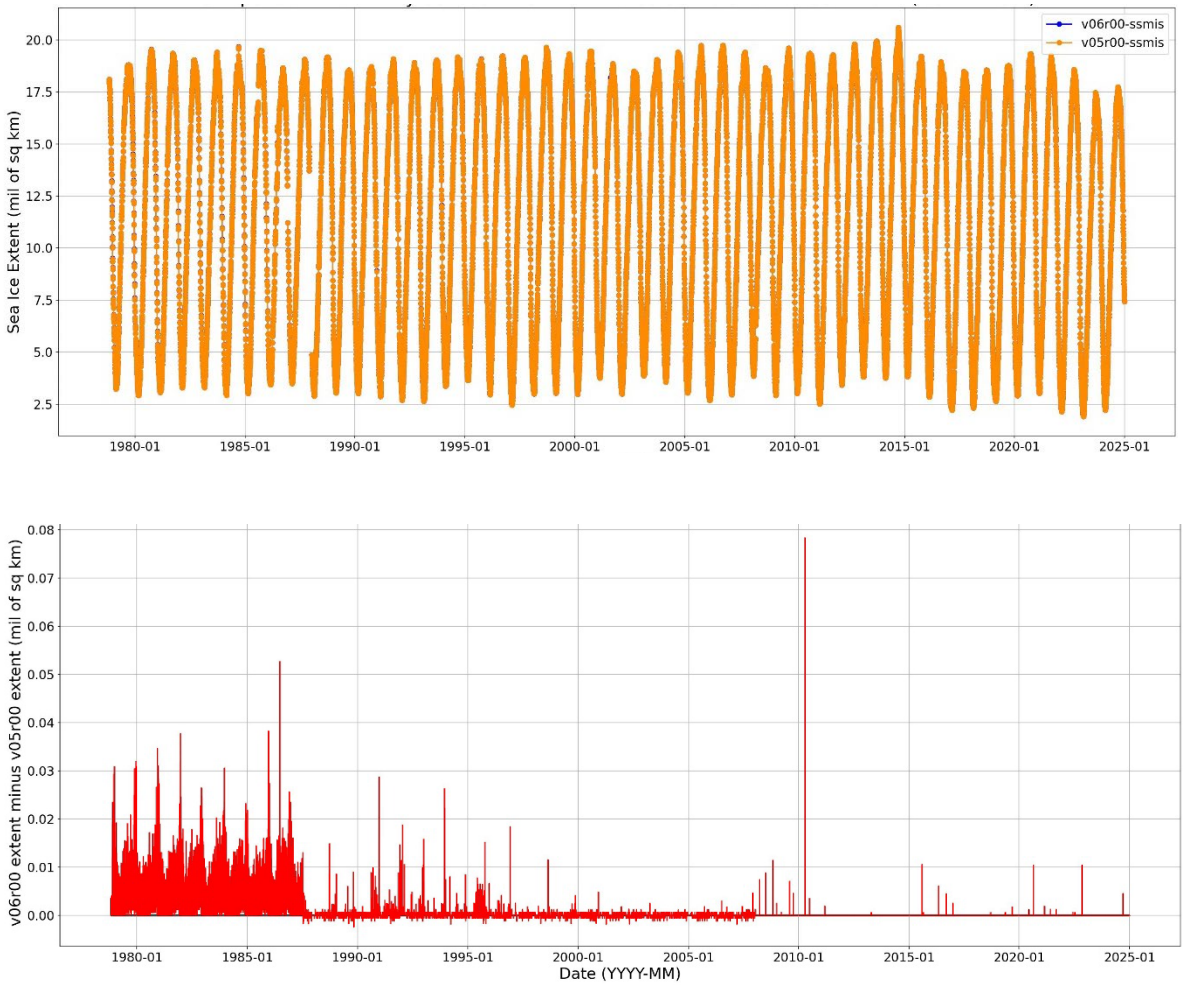

Figure 5. Southern Hemisphere SSMIS sea ice extent from SSMIS for V6 (blue) and V5 (orange) (top) and the difference (V6 SSMIS – V5 SSMIS) bottom.

5 References

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