Seasonal features of Snow Cover Extent variations in Eurasia in the annual cycle and their changes over the decades

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Being a crucial part of the climatic system, the snow cover extent (SCE) is sensitive to the ongoing warming. The observed increased variability of the SCE in the recent decades is manifested in intensification of extreme weather events compared to previous years. In this paper, we analyze the interseasonal and interannual variability of SCE and the features of its changes over the last four decades using the satellite data and the results of the numerical simulations of the SCE in Eurasia with the models of the CMIP6 project (https://esgf-node.llnl.gov/projects/cmip6).

Figure 1 presents phase portraits for the SCE in the Northern Hemisphere based on monthly average satellite data for the two sub-periods: 1979-1999 and 2000-2020. The corresponding averaged phase portraits for 20-year periods of 1980-1999 and 2000-2019 are marked in bald. According to the satellite data for the analyzed 40-year period, the average annual snow cover extent in the Northern Hemisphere is about 25 million km^2. The maximum area of snow cover in the NH in the annual course is about 50 million km^2, the minimum is less than 3 million km^2.

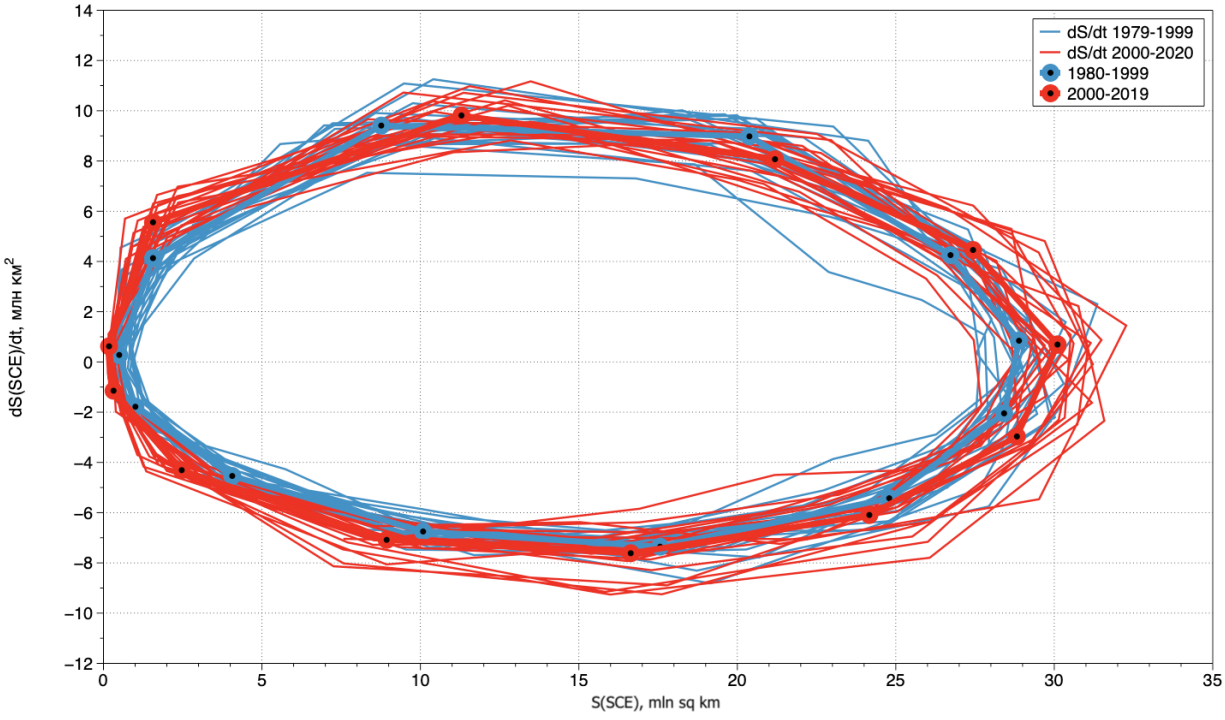

Figure 1 Phase portraits for snow cover extent in Eurasia based on satellite monthly average data for two sub-periods: 1979-1999 (blue color) and 2000-2020 (Red color). The corresponding monthly averaged phase portraits for 20-year periods of 1980-1999 and 2000-2019 are marked in bald.

The greatest variability of the snow cover area is manifested in the coldest months with the greatest extent of the snow cover. For the summer months, the variability of the snow cover area is noticeably less, while the tendency for a decrease in the snow cover area with general warming in recent decades is more pronounced for them than for the winter months.

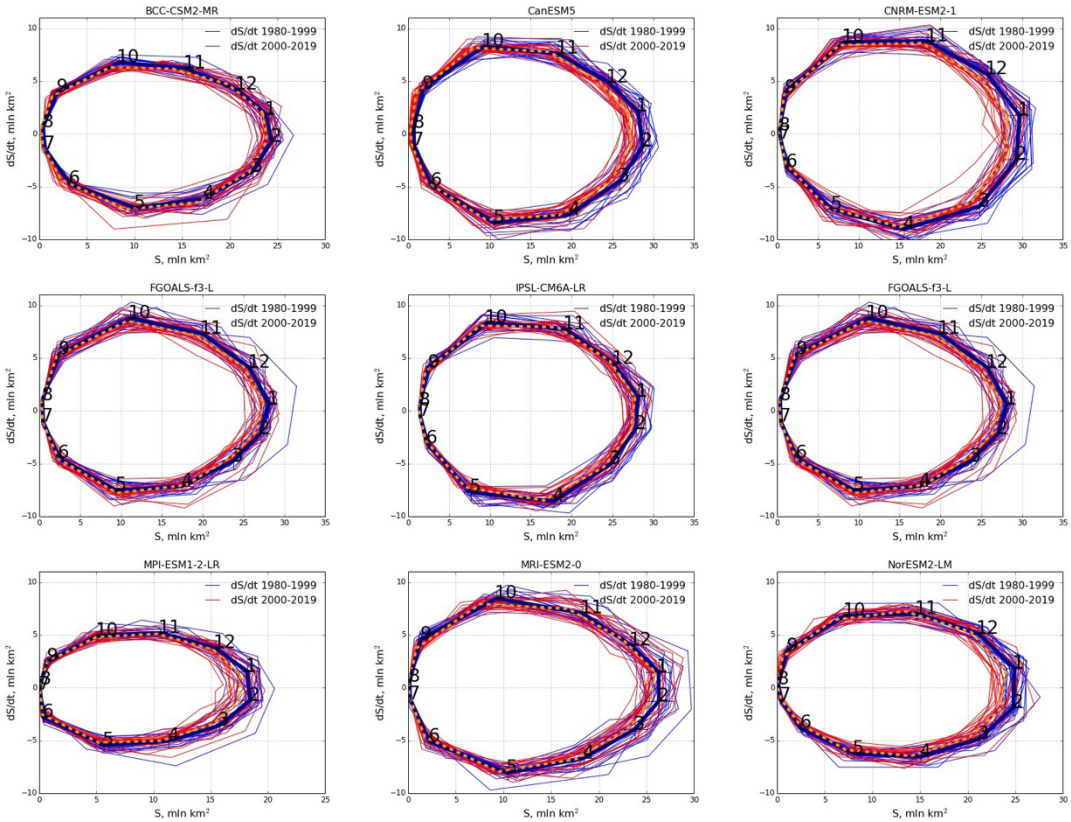

Figure 2 Phase portraits for snow cover extent in Eurasia based on the results of models simulations monthly averaged data for two sub-periods: 1980-1999 (blue color) and 2000-2019 (Red color). The numbers represent the months from January to December (1-12 respectively). S = S(SCE).

Figure 2 presents the phase portraits for the results of numerical simulations of the snow cover extent by the models of CMIP6 project for the same time periods. It is seen that the SCE variability in the winter months is also significantly greater than that in the summer months. While some of the models reproduce the results of satellite data analysis well, others tend to underestimate the variability for the most recent time period.

The increase of SCE in the autumn months during warming can be explained by an increase in the transport of water vapor in the atmosphere with snowfall over the continents due to a decrease in the area of sea ice in the Arctic Ocean. It is significant that for the modern climate of recent decades, in particular for Eurasia, it is in October that a transition to negative surface temperatures and the formation of snow cover starts.

Features of snow cover changes can be associated not only with long-term trends in climate change and modes of interdecadal and intradecadal climatic variability, which manifest themselves differently in different regions, but also with the features of the analyzed data and its homogeneity, including CDR satellite observation data. In particular, the need to correct the CDR data until 2005 was noted in several papers.

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References

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