



## Final Sudden Stratospheric Warmings and the memory of the stratosphere

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Sudden Stratospheric Warming (SSW) is the most spectacular dynamic event occurring in the middle atmosphere. It can lead to a warming of the winter polar stratosphere by a few tens of K in one to two weeks and a reversal of the stratospheric circulation from wintertime prevailing westerly winds to easterly winds similar to summer conditions. This strong modification of the stratospheric circulation has consequences for several applications, including the modification of the stratospheric infrasound guide. Depending on the date of the SSW, the westerly circulation can be re-established if the SSW occurs in mid-winter or the summer easterly circulation can be definitively established if the SSW occurs in late winter. In the latter case it is called Final Warming (FW). Each year, it is possible to define the date of the FW as the date of the final inversion of the zonal wind at 60°N - 10 hPa . If the FW is associated with a strong peak of planetary wave activity and a rapid increase in polar temperature, it is classified as dynamic FW. If the transition to the easterly wind is smooth without planetary wave activity, the FW is classified as radiative.

The analysis of the ERA5 database, which has recently been extended to 1950 (71 years of data), allowed a statistical analysis of the evolution of the stratosphere in winter. The main conclusions of this study will be presented :

- the state of the polar vortex in a given month is anticorrelated with its state 2 to 3 months earlier. The beginning of winter is anticorrelated with mid-winter and mid-winter is anticorrelated with the end of winter;
- dynamic FWs occur early in the season (March - early April) and are associated with a strong positive polar temperature anomaly, while radiative FWs occur later (late April - early May) without a polar temperature anomaly;
- the summer stratosphere (polar temperature and zonal wind) keeps the memory of its state in April-May at the time of FW at least until July .

These results could help to improve medium-range weather forecasts in the Northern Hemisphere due to the strong dynamic coupling between the troposphere and stratosphere during SSW events.