



## Winter stratosphere-troposphere system and precipitation over Europe

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Data from the ERA40 database is used to analyse the anomalous behaviour of the Northern Hemisphere winter stratosphere-troposphere system and its relationship with surface climate in Europe. The study is based on an index of monthly precipitation over Europe. This index (*pcp\_idx*) is the standardized expansion coefficient of precipitation of the first SVD mode between 1000-hPa geopotential in the Northern Hemisphere and precipitation over Europe, for the boreal winter months (December, January and February) in the period 1957-99. The first SVD mode accounts for the 45% of the squared covariance of the two fields, and the 38% of the total variance of precipitation over Europe. Positive values of *pcp\_idx* are associated both with increased synoptic eddy activity and westerly winds in the North Atlantic (around 60°N). This finding is consistent with an enhanced (decreased) number of cyclones crossing northern (southern) Europe.

We have found that the stratospheric polar night jet appears significantly weakened (strengthened) not only during a month with positive (negative) precipitation anomalies over southern and central Europe, but also in the preceding three weeks. Vertical propagating planetary waves seem to play an important role in these results. An analysis of the index of refraction and Eliassen-Palm cross-sections suggests that the lower stratosphere at mid-high latitudes is more (less) likely to permit propagation of planetary waves from the troposphere into the stratosphere, where they tend to decelerate (accelerate) the mean flow, both prior to and during a winter month with negative (positive) anomalous precipitation over southern and central Europe.

To gain a better understanding of the predictive power of these relationships, we narrow down on the 1995-96 winter, when precipitation over southern Europe had high positive anomalies. This winter, a negative NAO phase in the Atlantic coexisted with a Niña event in the equatorial Pacific. The boreal anomalous residual circulation resembles that obtained in certain works for the impact of Niña events in the stratosphere, suggesting that this phenomenon could have had an impact on the stratospheric circulation over Northern Hemisphere in the 1995-96 winter.