EGU21-16522
https://doi.org/10.5194/egusphere-egu21-16522
EGU General Assembly 2021

Statistical associations of teleconnection indices and space weather with spring weather pattern in the Eastern Baltic region

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The studies of associations between solar inputs and climate are mostly designed for winter or cold period; whereas the knowledge about these associations during spring on a day-to-day time scale are very scarce. Therefore, the aim of this study is to detect the response of spring air temperature (T), relative humidity (RH), and atmospheric pressure (ATP) to variation in teleconnection indices and space weather variables on the day-to-day timescale during the period of 1998–2017 in six cities of Eastern part of the Baltic region. We created a multivariate linear regression model for weather variables including month, the linear and seasonal trend, different teleconnection patterns, El Niño–Southern Oscillation (ENSO), the Quasi-biennial Oscillation (QBO) phase, the presence of Sudden Stratospheric Warming (SSW), and space weather variables.

The multivariate models for the mean daily weather variables showed a positive association between T and the daily Arctic oscillation (AO), monthly Scandinavian pattern (SCA) indices, solar proton events (SPEs) with a lag of 1-9 days, and solar wind dynamic pressure (P) with a lag of 1-2 days and negative association between T and East Atlantic/West Russia (EA/WR) index. The linear and seasonal trends, the presence of SSW during March, and changes in AO, EA/WR, and SCA indices explained about 73% of the variation in mean daily T in the investigated region in spring. The presence of the daily mean proton flux of > 10 MeV and energy over 10 pfu with a lag of 1-9 days and higher P with a lag of 1-2 days were also related to higher mean T. The mean RH positively correlated with a long-term and short-term variation in galactic cosmic rays (GCR) and solar wind speed (SWS) with a lag of 0-6 days and negatively correlated with EAWR and NINO3.4 indices. The seasonal variation, the presence of SSW during March, the QBO phase, and the changes in the EA/WRI and ENSO explained over 38% of variation in the daily mean RH in spring.

The mean ATP was negatively associated with both long-term and short-term changes in GCR and positively associated with the North Atlantic oscillation (NAO), EA/WR, and SCA indices, B_y component of interplanetary magnetic field with a lag of 2 days, P, days of Stream Interaction Regions (SIRs), and SWS with a lag of 4-6 days. These space weather variables had stronger effect on spring ATP in the eastern part of the Baltic region as compared to stratospheric events and teleconnection patterns. Results of the present study show the significant short-term effects of SSW, SPEs, SIRs, and solar wind variables on spring weather pattern in the Eastern part of the Baltic region.