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Solar irradiance and energetic particle impacts on the atmosphere: Status and development.

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The interest to the solar influence on climate was enhanced by its potential importance for the climate change on seasonal and regional scales, widely discussed possibility of the grand solar minimum emergence and progress in the understanding of the energetic particle precipitation. Several papers describing the simulations and observations of the ozone layer and atmospheric response to solar irradiance and particle output variability have been recently published. The results demonstrate consensus of the obtained atmospheric effects in the middle-to-upper stratosphere, while the scatter in tropospheric response is substantial. The reasons of this disagreement could be related to the applied scenarios for the solar forcing agents and different treatment of the sun-related effects in climate models. It is well known that the simulation of the climate response to solar variability requires well defined set of forcing agents, properly designed modules to transform direct solar effects to internal model variables and model ability to reproduce entire chain of the physical processes responsible for the propagation of the initial effects in time and space. Many of these aspects have been under active evaluation leading to better understanding of the atmospheric response to solar variability and more accurate projections of solar impact on future climate. In this talk I will review the recent progress reached in several directions including the refinement of the solar irradiance variability, importance of middle range energy electrons, treatment of the auroral electrons, galactic cosmic rays and extreme solar proton events, accuracy of the heating and photolysis rates calculation codes as well as the representation of top-down mechanism of solar impact propagation. I will also discuss potential implications of these developments on future climate and ozone layer projections.