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[*Abstract*]

Influence of solar activity in the middle atmosphere

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Abstract: Variations in solar activities are evident through solar cycles.These cycles can occur on millennial, centennial, and decadal timescales, although solar activity also changes on yearly (seasonal), monthly, and daily scales. Milutin Milanković, in his well-known cycles, described the millennial-scale changes in the Sun–Earth relationship and laid the foundations of mathematical climatology. Valentina Zharkova proposed that the centennial solar cycle may result from the interference of two magnetic waves with similar but not identical frequencies. According to her findings, the Sun has entered a modern Grand Solar Minimum, which is expected to lead to a significant reduction in the solar magnetic field. This article focuses on decadal solar activity, specifically the 11-year solar cycle. Changes in this cycle affect temperature and atmospheric circulation, thereby influencing the conditions for the propagation and reflection of gravity waves (GWs) in the Earth's middle atmosphere. These effects are most pronounced in the stratosphere, where variations in solar UV radiation can increase temperatures by up to 3 K and alter ozone concentration by approximately 2%. Additionally, during extreme solar minima, the lower thermosphere becomes relatively cold, with temperatures around 500 K. In contrast, during periods of high solar activity,

temperatures in the thermosphere can reach up to 2000 K. In this study, we examined the characteristics and propagation of gravity waves under these varying conditions.

Keywords: solar activity, stratosphere, thermosphere, gravity waves

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