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Semidiurnal solar tide differences between fall and spring transition times in the Northern Hemisphere

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In the framework of the DYNAMITE project, here we present our analysis of the behavior of the semidiurnal solar tide (S2) during the fall and spring transition times in the Northern Hemisphere. The tides have been retrieved from wind measurements provided by three meteor radars: Andenes (69°N), Juliusruh (54°N) and CMOR (42°N). During the autumn, S2 is characterized by a sudden and pronounced decrease occurring every year and at all height levels. The spring transition also shows a decrease of S2, but that progressively extends from lower to higher altitudes during an interval of ∼15 to 40 days. To assess the contributions of different semidiurnal tidal components, we have examined a 20-year free run simulation by the Hamburg Model of the Neutral and Ionized Atmosphere (HAMMONIA). We see that the differences exhibited by the S2 tide at middle and high latitudes of the Northern Hemisphere between equinox times are mainly due to distinct behaviors of the migrating semidiurnal and the non-migrating westward propagating wave number 1 tidal components (SW2 and SW1, respectively). Specifically, during the fall both, SW2 and SW1 decrease, while during the spring time SW2 decreases but SW1 remains approximately constant or slightly decreases. The decrease shown by SW1 during the fall occurs later than that of SW2 and S2, which indicates that the behavior of S2 is mainly driven by the migrating component. Nonetheless, the influence of SW1 is necessary to explain the behavior of S2 during the spring. Contributions by other semidiurnal tidal components are small to negligible. At the same time the decrease in amplitude occurs, a clear change in the phase of SW2 during the early fall (during the fall in the observed S2) can be seen. This change in the phase might be indicating a displacement of the source of the semidiurnal solar tide, i.e. ozone transport; but it may be also indicating non-linear interactions. In fact, our meteor radar wind measurements show considerable gravity wave activity during the autumn, which suggests that the abovementioned behavior of S2 may be partly due to non-linear interaction with gravity waves.