Lower Thermosphere Sporadic Ni (TSNi) layers and correlation with Lower Thermosphere Sporadic Na (TSNa)

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We report the first observations of lower thermosphere sporadic Ni (TSNi) layers, based on the lidar data at Yanqing Station (40.41° N, 116.01° E). There were 29 TSNi layers from April 2019 to April 2020 and from July 2020 to June 2021, and 11 TSNi layers exhibited peak densities higher than those of the main Ni layers. All TSNi layers only were observed from May to September and high-density TSNi layers mainly occurred in May and June. Moreover, a TSNi layer with maximum density 818 cm^{-3} was detected on 17 May 2021. 19 TSNi layers were detected in May and June, of which 14 TSNi layers were associated with Es. In May and June, TSNi layers and TSNa layers concurrently appeared at similar heights. And the spatial-temporal correlation coefficient of TSNi and TSNa density variations was close to 1, indicating that TSNi and TSNa layers had similar morphological structure and density variations and both had a very good correlation. The TSNi peak density was comparable to TSNa peak density and the Ni and Na atoms generated by neutralization of Ni^{+} and Na^{+} in Es were also comparable. These showed that Es neutralization played an important role in the formation of TSNi and TSNa layers.