高分解能Ca^+ライダーによって観測されたスポラディックE層の微細構造
Vertical fine structure and time evolution of plasma irregularities in the E_s layer, observed by a high resolution Ca^+ lidar

*江尻 省[1,2]、中村 卓司[1,2]、津田 卓雄[3]、西山 尚典[1,2]、阿保 真[4]、高橋 透[1]、津野 克彦[5]、川原 琢也[6]、小川 貴代[5]、和田 智之[5]
*Mitsumu K. Ejiri[1,2], Takuji Nakamura[1,2], Takuo T. Tsuda[3], Takanori Nishiyama[1,2], Makoto Abo[4], Toru Takahashi[1], Katsuhiko Tsuno[5], Takuya Kawahara[6], Takayo Ogawa[5], Satoshi Wada[5]

1. 国立極地研究所、2. 総合研究大学院大学、3. 電気通信大学、4. 首都大学東京、5. 理化学研究所光量子工学研究センター、6. 信州大学工学部
1. National Institute of Polar Research, 2. SOKENDAI (Department of Polar Science, The Graduate University for Advanced Studies), 3. The University of Electro-Communications, 4. Tokyo Metropolitan University, 5. RIKEN, RAP, 6. Shinshu University Faculty of Engineering

The vertical fine structures and the time evolution of plasma irregularities in the sporadic E (E_s) layer were observed via calcium ion (Ca^+) density measurements using a resonance scattering lidar with a high time-height resolution (5 s and 15 m) at Tachikawa (35.7˚N, 139.4˚E) on December 24, 2014. The observation successfully provided clearer fine structures of plasma irregularities, such as quasi-sinusoidal variation, localized clumps, “cats-eye” structures, and twist structures, in the sporadic Ca^+ (Ca^+_s) layers at around 100 km altitude. These fine structures suggested that the Kelvin-Helmholtz (K-H) instabilities occurred in the neutral atmosphere whose density changed temporarily or spatially. The maximum Ca^+ density in the Ca^+_s layer was two orders of magnitude smaller than the maximum electron density estimated from the critical frequency (f_oE_s) observed by the ionosonde at Kokubunji (35.7˚N, 139.5˚E) simultaneously. The correlation showed a strong positive correlation with a coefficient of 0.91. These results suggest that Ca^+ contributes forming the E_s layer as well as major metallic ions Fe^+ and Mg^+ in the lower thermosphere. Moreover, the formation of a new Ca^+_s layer at 110 km and the upward motions of the Ca^+_s layers at 100 km and 110 km were observed just after the sunrise time at the conjugation point and before the local sunrise. Although the presence or absence of a causal relationship with the sunrise time was not clear, a possible explanation for the formation and the upward motions of the Ca^+_s layers was the occurrence of strong eastward winds at around 100 km, rather than the enhancement of the eastward electric field.

キーワード：共鳴散乱ライダー、カルシウムイオン密度、スポラディックE層、微細構造、中間圏・下部熱圏領域
Keywords: resonance scattering lidar, calcium ion density, sporadic E layer, fine structure, The mesosphere and lower thermosphere region

