

R005-13

A 会場 : 11/27 AM1 (9:15-10:45)

9:30~9:45:00

#大矢 浩代¹⁾, 古谷 凌汰¹⁾, 土屋 史紀²⁾, 山本 真行³⁾, 鷺見 貴生⁴⁾, 中田 裕之¹⁾, 渡邊 堯⁵⁾, 小林 美樹⁶⁾

(¹⁾ 千葉大学, (²⁾ 東北大学, (³⁾ 高知工科大学, (⁴⁾ 国立天文台, (⁵⁾ 情報通信研究機構, (⁶⁾ 日本流星研究会)

D-Region ionospheric disturbances induced by fireballs and satellite reentries observed with OCTAVE VLF/LF transmitter signals

#Hiroyo Ohya¹⁾, Ryota Furuya¹⁾, Fuminori TSUCHIYA²⁾, Masa-yuki YAMAMOTO³⁾, Tatsuki Washimi⁴⁾, Hiroyuki NAKATA¹⁾, Takashi WATANABE⁵⁾, Miki Kobayashi⁶⁾

(¹⁾ Chiba University, (²) Planetary Plasma and Atmospheric Research Center, Graduate School of Science, Tohoku University,

(³) Kochi University of Technology, (⁴) National Astronomical Observatory of Japan, (⁵) National Institute of Communications and Technology, (⁶) The Nippon Meteor Society

Fireballs are exceptionally bright meteors (magnitude > -4) that enter Earth's atmosphere and burn up due to aerodynamic heating, typically originating from larger meteoroids or small asteroids. Similarly, artificial satellites or other human-made objects can reenter the atmosphere in a controlled or uncontrolled manner, experiencing heating that may cause partial or complete ablation. These atmospheric entry events can ionize the surrounding neutral atmosphere, affecting the D-region ionosphere (60 – 90 km altitude), which can be detected using very low frequency (VLF, 3 – 30 kHz) and low frequency (LF, 30 – 300 kHz) transmitter signals. Previous studies have shown that fireballs generate acoustic and atmospheric gravity waves (AGWs), causing D-region ionospheric fluctuations (Chernogor, 2015; Ohya et al., 2024). However, detailed mechanisms of D-region variations induced by fireballs and satellite reentries remain unclear. This study quantitatively investigates lower ionospheric variations associated with atmospheric entry events using OCTAVE VLF/LF transmitter signals, the F-net seismic observation network, and infrasound data from Kochi University of Technology and the National Astronomical Observatory of Japan. Two events are analyzed: a fireball observed at 14:33 UT on April 23, 2023, and the reentry of a Starlink satellite (Group 6-32 debris 31119) at 12:38 UT on December 26, 2023. Transmitters include JJI (22.2 kHz, Miyazaki, Japan), JJY40 (40.0 kHz, Fukushima, Japan), JJY60 (60.0 kHz, Saga, Japan), and BPC (68.5 kHz, China), with receivers at RKB (Rikubetsu, Japan) and KAG (Kagoshima, Japan). For the fireball, amplitude and phase variations with periods of 200 – 500 s were observed on the JJY60-RKB path, while the JJY40-RKB path exhibited larger distinct variations (18 dB and 200°), likely caused by strong ionization along the fireball trail. Seismic (vertical velocity at Kashiwazaki; KZK) and infrasound (Mozumi; MZM) data also showed variations with periods of 300 – 400 s and 200 – 400 s, respectively. Coherence analysis revealed significant peaks at 200 – 400 s between LF, seismic, and infrasound signals. For the satellite reentry, amplitude and phase variations with periods of 200 – 300 s were observed in the JJY40-KAG signals, and corresponding infrasound variations at Tateyama (TTM) coincided with acoustic wave arrival at the ground. Coherence analysis showed a peak at 256 s. These results indicate that acoustic waves generated by fireballs and satellite reentries propagate upward, inducing disturbances in both the D-region ionosphere and at the Earth's surface. Detailed results will be presented in the session.