The 3-D structure and temporal variations of the TMA-induced emission identified in the SEEK-2 campaign

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The SEEK-2 (Sporadic-E Experiment over Kyushu) campaign was carried out to investigate the generation mechanism of the sporadic-E layer on August 3, 2002. Two sounding rockets (S-310-31 and 32) were launched successively toward the east-southeast at intervals of 15 minutes from Kagoshima Space Center (131.1 drg E, 31.3 deg N). Trimethyl aluminum (TMA) was released in the altitude range from 80 km to 117 km from the S-310-32 rocket. Optical emissions of TMA trails were captured by triangulation from ground-based observation site to derive the altitude profiles of neutral wind. The most exciting result is that we succeeded in measurement of TMA-induced optical emissions that occurred apart from TMA emissions.

We operated an image-intensified CCD (I.I.-CCD) camera near the launch site. This camera takes images with a field-of-view of 8.3 deg x 10.1 deg and at the standard video frame rate (30 frames / sec). An all-sky imager with OI557.7nm, OI630.0nm, OH-band (720 - 910 nm) and background (572.5 nm) filters was operated at Tanegashima about 60 km southward of KSC. A film camera with an exposure of 5 minutes captured TMA trails and TMA-induced emissions from Tengu-Plateau (133.0 deg E, 33.5 deg N), which is located about 400 km northward of the rocket orbit.

Although TMA trails moved following background neutral wind, TMA-induced emissions were confined horizontally within a region just under the rocket orbit and vertically in the altitude range from about 90 km to about 110 km. Their 3-D structure is horizontal sheets with a thickness of about 3 km with separated about 10 km in altitude to each other. These sheet-like structures appeared continuously during the upleg and downleg TMA releases, lasting more than 40 mitnutes. The induced emissions extend from the kinks of the TMA trails. These kinks probably correspond to the wind sheer of the neutral atmosphere and sporadic-E layers with significantly enhanced electron densities. It is also founded that the TMA-induced emissions move with the kinks produced by the neutral wind shears. The all-sky imager at Tanegashima measured TMA-induced emissions at all filters, which suggests that the induced emissions have a large contributing of continuum emissions.

Comparing the optical data with the profiles of neutral winds, electron densities and plasma waves measured by the same S-310-32 rocket, we will investigate the generation mechanism of these emissions. It is suggested that some plasma processes related to the sporadic-E layers generate the TMA-induced optical emissions.