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Zoom meeting C ：11/2 PM2 (15:45-17:30)
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Sporadic Fe layer event simultaneously observed by a resonance scattering lidar and an MF radar at Syowa station (69.0S, 39.6E)

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Metallic layers, which ablate from meteoroids, are known to be formed between 80 and 105 km in the terrestrial mesopause region. Meteoric species such as Fe, Mg, and Na exist as atoms in the layers and their dynamical and chemical variability have been investigated by resonance scattering lidars [Plane et al., 2015 and references therein] and satellite-borne measurements [e.g., Fan et al., 2007; Dawkins et al., 2014; Langowski et al., 2015; Tsuda et al., 2017]. Sporadic E layer, Es layer, is characterized as a thin layer with enhanced electron density and mainly observed by incoherent scatter radars and ionosondes. Mg^+ and Fe^+ ions are regarded as dominant ion components in Es layers due to their long lifetime [Kopp, 1997] and, therefore, sporadic metallic layers are believed to play important roles in forming Es layers. Suggested generation mechanisms of sporadic metallic layers in polar regions are as follows: vertical ion converge and neutralization due to wind shear [e.g., Nygren et al., 1984] and ionospheric electric field [e.g., Kirkwood and von Zahn, 1991], convergent vertical neutral wind associated with atmospheric gravity waves, and sputtering from meteor smoke particle layers [von Zahn et al., 1987].
We identified sporadic Fe, hereafter FeS, event on June 5, 2018 at Syowa station (69.0S, 39.6E), Antarctic, that was observed by a resonance scattering lidar [Ejiri et al., 2019]. This FeS event can be summarized as follows: a center altitude and FWHM of the FeS layer are 90 km and 5 km, respectively. Duration was about 3 hours. Geomagnetic activity was quiet during this event and co-located ionosonde demonstrated intermittent Es activity. Apparent growth rate, which is defined in Alpers et al. [1994], is 1.5 %/min implying that development of the FeS is quite slow. During the FeS event, neutral wind data with from an MF radar at Syowa is available. Meridional and zonal wind profiles at the moment of FeS peak density around 17 UT show strong horizontal wind shear (du/dz is positive and dv/dz is negative), which is consistent with Es layer forming in the southern hemisphere [Chu et al., 2014]. We tried to explain the observed FeS by wind shear theory since ionospheric electric field (less than 10 mV/m) during the FeS can be neglected. Ion-neutral collision frequency for Fe^+ was estimated by an empirical model of Voiculescu and Ignat [2002], NRLMSISE-00, and IGRF-13. In addition, vertical ion velocity and its temporal variations were calculated in consideration of magnetic declination [Yu et al., 2019]. Magnetic declination angle at Syowa station is -51 degree and, therefore, should be taken into account. Estimated vertical ion velocity, w_i, and vertical gradient of w_i, dw_i/dz, were both negative near 12 UT. In particular, dw_i/dz reached at -0.012 m/s/km, that is comparable to simulation result of Yu et al. [2019]. It is also consistent with strong Es (foEs ~ 5 MHz) observed by ionosonde at the moment. However, near 17 UT when FeS peak density was observed, both w_i and dw_i/dz were positive and favorable for vertical ion divergence. This implies that FeS peak was not caused by vertical ion velocity shear at this moment. Our analysis suggests that Fe^+ converge associated with negative dw_i/dz might take place about 4 hours earlier than FeS appearance and subsequently neutralization of Fe^+ led to the observed FeS forming. Above 90 km Fe^+ lifetime ranges from a few minutes to 10^5 s with altitudes [e.g., Plane et al., 2015]. It seems to be roughly consistent with the delayed appearance of FeS. We will examine this scenario based on wind shear theory by further analysis and a simple 1-D numerical simulation.