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Lithium release rocket experiments in evening, dawn, and daytime thermosphere.

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Several kinds of chemical release experiments were successfully carried out and established before 1970's by onboard chemical release canisters of many kinds of gaseous metals and Tri-Methyl- Aluminum (TMA). The TMA release technique has been used in many nighttime rocket campaigns in 4 decades mainly in U.S., however, the Lithium canister technique was not maintained afterwards. Recently, Lithium release experiments in midlatitude thermosphere in evening, dawn, and daytime were carried out in 2007, 2011, and 2012, respectively. In 2007, we rebuilt a Lithium Ejection System (LES) for Japanese sounding rocket program, WIND campaign. The experiment was successful by newly developed LES in Japan, resulting neutral wind profile in evening thermosphere in wide altitude range between 115 km and 400 km. The WIND campaign opened a new 3-D view of thermospheic atmosphere, suggesting interesting boundary at about 180 km as is changing main composition of neutral atmosphere from nitrogen molecule to atomic oxygen. By the resonant scattering mechanism, atomic Lithium can emit red light (670.8 nm wavelength) based on its specific characteristics in the case of sunlit condition. So, evening and dawn sky was reasonable condition for thermospheric imaging and wind measurement by Lithium release, moreover, it has been considered the technique could be applied on daytime experiments because of strong efficiency of the resonant scatter by Lithium.

After the WIND campaign, we started U.S.-Japan collaborative rocket program, Daytime Dynamo campaign with NASA/GDSC and Clemson University for obtaining daytime thermospheric wind, WIND-2 campaign for dawn thermospheric wind, as well. The Daytime Dynamo campaign was carried out at Wallops Flight Facility (WFF), NASA (VA, U.S.A.) on July 10, 2011 and the WIND-2 campaign was at Uchinoura Space Center (USC), JAXA (Kagoshima, Japan) on Jan. 12, 2012. Two rocket launches were successful, however, daytime Lithium imaging was failed, whereas the dawn imaging was halfway in success. One of the reason of losing Lithium images in Daytime Dynamo would be strict S/N condition due to the small separation angle between the Sun and the center of the FOV (Field of View) of Lithium imagers in the morning condition (10:00 LT). Whereas, in the WIND-2 campaign, two of three onboard LES were failed to release the Lithium gas, resulting in imaging of only one Lithium trail in lower thermosphere between 76 km and 127 km.

Here, we will present a review talk about previous and recent Lithium release experiments with showing currently facing problems and some considerable solutions for daytime wind measurement to be held in near future.

Keywords: Lithium release experiment, sounding rocket, thermospheric neutral wind, WIND-2 campaign, Daytime Dynamo campaign