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The Space Weather & Ultraviolet Solar Variability Microsatellite Mission (SWUSV)

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Abstract. We present a summary of the scientific objectives, payload and mission profile of the Space Weather & Ultraviolet Solar Variability Microsatellite Mission (SWUSV) proposed to CNES and ESA (small mission).

Keywords. Space Weather, solar flares, Coronal Mass Ejections, solar variability, ultraviolet.

1. Objectives

The SWUSV mission encompasses three major scientific objectives: (1) Space Weather including the prediction and detection of major eruptions and coronal mass ejections (Lyman-Alpha and Herzberg continuum imaging); (2) solar forcing on the climate through radiation and their interactions with the local stratosphere (UV spectral irradiance from 180 to 400 nm by bands of 20 nm, plus Lyman-Alpha and the CN bandhead); (3) simultaneous radiative budget of the Earth, UV to IR, with an accuracy better than 1% in differential.

SWUSV is targeting the observation of the Space environment, and in particular the premisses, the very early start (“precursor indicators”), of the coronal mass ejections, the interplanetary ones (ICMEs), that are the most important since the only ones with a destructive impact potential on Earth. With Lyman-Alpha (and H-Alpha on ground in complement, 2 major solar lines formed at different heights in the solar chromosphere), we should be able to better predict, hours in advance, the major flares and ICMEs and their geoeffectiveness.

Concerning the solar influence on climate, the ultraviolet part of the spectra (<350 nm) is the only one having its energy completely absorbed in the high atmosphere (stratosphere), in the ozone layer and in the oxygen bands (Herzberg continuum at 200–220 nm). The large variability of UV wavelengths over the solar cycle (5–10% at 200–220 nm, factor 2 at Lyman-Alpha) is probably at the origin of a solar influence on climate, the UV affecting the temperatures and the stratospheric dynamic (the response to the solar heating extends to the poles and down, to the tropopause, modifying planetary waves and meteorological conditions). With these UV observations, and when coupled to a complete local radiative budget from UV to IR, we shall be able to characterize this solar influence to its full dynamical extent.

- **SUAVE** (*Solar Ultraviolet Advanced Variability Experiment*), Lyman-Alpha and 200-220 nm Herzberg continuum imaging (sources of variability) with 3 redundant set of filters to preserve long-term sensitivity
- **UPR** (*Ultraviolet Passband Radiometers*) based on PREMOS & LYRA with 64 UV filter radiometers (16 used; 48 redundant) for Lyman-Alpha, CN bandhead (385-390 nm) and UV from 180 to 400 nm by 20 nm bandpasses
- Scientific Vector Magnetometer & Thermal Plasma Measurements Unit and Langmuir Probes (**SGVM & TPMU+DSL**P from ESA/PROBA-2)
- **SERB** (*Solar irradiance & Earth Radiative Budget*): 4 instruments in a 20 cm cube of 3 kg (including TSI)

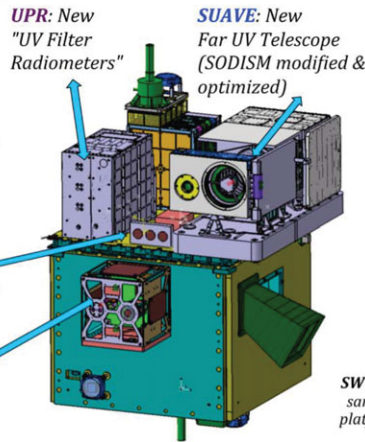


Figure 1. Illustration of the possible accommodation of the SWUSV instruments on the CNES/Myriade microsatellite platform (dimensions 600 x 600 x 800 mm³).

2. Model Payload & Mission Profile

SWUSV includes 5 instruments: SUAVE (*Solar Ultraviolet Advanced Variability Experiment*), an optimized telescope for FUV (Lyman-Alpha) and MUV (200–220 nm Herzberg continuum) imaging (sources of variability); UPR (*Ultraviolet Passband Radiometers*), with 64 UV filter radiometers; a vector magnetometer; thermal plasma measurements and Langmuir probes; and a total and spectral solar irradiance and Earth radiative budget ensemble (SERB, *Solar irradiance & Earth Radiative Budget*). The model payload and microsatellite (CNES/Myriade platform on a Sun synchronous orbit comparable to PICARD: altitude, 725 km; inclination, 98.29°; local time of ascending node, 6h00 +/- 10 minutes) are presented in Fig. 1.

3. Conclusion

The microsatellite investigation SWUSV is responding to the need to understand the influence of stratospheric dynamics on the climate by providing the tools to measure and quantify the influence of UV variability and determine its origin. It also carries, through Lyman-Alpha imaging, probably the best indicator for precursor signs of major Space Weather events. The program has the advantage of relying on technological developments made in very recent microsatellite missions of CNES (PICARD) and ESA (PROBA-2), and on a long expertise of the proposing team in far UV imaging (Lyman-Alpha in particular but also Herzberg continuum at 220 nm). The SWUSV mission is presented in detail in Damé and The SWUSV Team (2013).

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Reference

Damé, L., The SWUSV Team (Meftah, M., Hauchecorne, A., Keckhut, P., Sarkissian, A., Marchand, M., Irbah, A., Quémerais, E., Bekki, S., Foujols, T., Kretzschmar, M., Cessateur, G., Shapiro, A., Schmutz, W., Kuzin, S., Slemzin, V., Urnov, A., Bogachev, S., Merayo, J., Brauer, P., Tsinganos, K., Paschalis, A., Mahrous, A., Khaled, S. A., Ghitas, A., Marzouk, B., Zaki, A., Hady, A. A., & Kariyappa, R.) 2013, *Journal of Adv. Research*, 4, 235