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Véronique Carrère, Xavier Briottet, Stéphane Jacquemoud, Rodolphe Marion, Anne Bourguignon, Malik Chami, Jocelyn Chanussot, Stéphane Chevrel, Philippe Déliot, Marie Dumont, et al.

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THE FRENCH EO HIGH SPATIAL RESOLUTION HYPERSPECTRAL DUAL MISSION HYPXIM – AN UPDATE

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ABSTRACT

More than 25 years of airborne imaging spectroscopy and spaceborne sensors such as Hyperion [1] or HICO [2] have clearly demonstrated the ability of such a remote sensing technique to produce value added information regarding surface composition and physical properties for a large variety of applications [3]. Scheduled missions such as EnMAP [4], HISUI [5] or PRISMA [6] prove the increased interest of the scientific community for such a type of remote sensing data.

In France, after gathering a group of Science and Defence users of imaging spectrometry data (Groupe de Synthèse Hyperspectral, GSH [7]) to establish an up-to-date review of possible applications, define instrument specifications required for accurate, quantitative retrieval of diagnostic parameters, and identify fields of application where imaging spectrometry is a major contribution, CNES (French Space Agency) decided a pre-phase A study for an hyperspectral mission concept called HYPXIM (HYPerspectral-X IMagery), the main fields of applications of which were to be vegetation, coastal and inland waters, geosciences, urban environment, atmospheric sciences, cryosphere and Defence. During this pre-phase A, the feasibility of such a platform was

evaluated, based on specific studies supported by Defence and a more accurate definition of reference radiances and instrument characteristics. Results also pointed to applications where high spatial resolution was necessary and would not be covered by the other foreseen hyperspectral missions. For example, in the case of ecosystem studies, it is generally agreed that many model variables and processes are not accurately represented and that upcoming sensors with improved spatial and spectral capabilities, such as higher resolution imaging spectrometers, are needed to further improve the quality and accuracy of model variables [8, 9]. The growing interest for urban environment related applications also emphasized the need for an increased spatial resolution [10, 11]. Finally, short revisit time is an issue for security and Defense as well as crisis monitoring. Table 1 summarizes the Science and Defence mission requirements at the end of pre-phase A.

Two instrument designs were proposed by the industry (EADS-Astrium and Thales Alenia Space) based on these new requirements [12]: HYPXIM-Challenging, on a micro-satellite platform, with a 15 m pixel and HYPXIM-Performance, on a mini-satellite platform, with a 8 m pixel, and possible TIR hyperspectral capabilities. Both scenarios included a PAN camera with a 1.85 m pixel. Platform agility would allow for "on-event mode" with a 3-day revisit time. CNES decided to select HYPXIM-Performance, the system providing a higher spatial resolution (pixel $\leq$ 8 m, [13, 14]), but without TIR capabilities, for a phase A study [15]. This phase A was to start at the beginning of 2013 but is currently stopped due to budget constraints.

An important part of the activities has been focusing on getting the French community more involved through various surveys and workshops in preparation for the CNES prospective meeting, an important step for the future of the mission. During this prospective meeting, which took place last March, decision was taken to keep HYPXIM alive as a mid-term (2020-2025) mission. The attendance at the recent workshop organized by the SFPT-GH (Société Française de Photogrammétrie et Télédétection, Groupe Hyperspectral) which gathered more than 90 participants from various field of application, including the industry (see http://www.sfpt.fr/hyperspectral for more details), demonstrates the interest and support of the French scientific community for a high spatial resolution imaging spectrometry mission.

Table 1 – Summary of mission requirements as of end of pre-phase A, based on seven Science and Defence user groups and updated at the beginning of phase A through various surveys. These numbers were to be refined during phase A.

Spatial Resolution	Hyperspectral $\leq$ 8m Panchromatic 1.85 m
Spectral range	0.4 – 2.5 µm
Spectral resolution	10 nm
SNR at L2	VIS > 250:1 NIR > 208:1 SWIR > 133:1
Image size	16 x 16 km
Revisit period	19 days (nadir); 3 days (+/- 35°)

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