PhD School on Agriculture, Environment and Bioenergy

(http://sites.unimi.it/dottorato_aab/)

(XXXVIII cycle, 2022-25)

Project draft

1.Field of interest

AGR02

2.Project title

Development of innovative hyperspectral remote sensing methods for agricultural applications

3.Tutor

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4.Relevance of the topic and state of the art:

Hyperspectral (HS) remote sensing Earth Observation systems, differently from commonly used multispectral systems, measure light in a high number of narrow (< 10 nm) spectral bands, thus allowing for quantitative assessment of different biophysical and biochemical properties of land surfaces (Stroppiana et al. 2018). HS remote sensing applications in agriculture have been so far largely limited to airborne and field data, which are generally too costly and complex to handle to develop farm level applications. A new generation of recently launched HS sensors mounted onboard satellites, together with the increased capabilities to analyses large dataset through artificial intelligence, opens-up unprecedented opportunities for quantitative crop assessment with respect to agronomic variables (LAI, pigments, nitrogen and other nutrients, water content, management etc.) from space that can be used to develop cost-effective applications for farm and agricultural land management. The project will have the opportunity to explore potential and limitations of state-of the art satellite sensors such as EnMAP and PRISMA (Brell et al., 2021, Cogliati et al., 2021) to develop new applications for agroecosystems' management.

5.Layout of the project (draft)

5.1.Materials & Methods:

The project general aim is to develop new HS remote sensing applications using new generation satellite data, with a specific focus on agricultural systems in Northern Italy and Southern Germany. Specific aims include to:

- Compare different satellite-borne HS data in their potential to support agricultural applications (e.g., EnMAP, PRISMA, EIS)
- Develop a data processing flow for HS data and link it to the end-to-end (E2E) simulator of OHB
- Develop at least one agricultural test case application with systematic ground data collection to quantitatively estimate agronomic variables for agricultural applications and evaluate the applicability of the approach for regional level applications.

5.2. Schedule and major steps (3 years):

The tentative timeline for the project is summarised in Figure 1. A period of up to 18 months will be based in OHB System AG Oberpfaffenhofen branch (OHB-OPF)

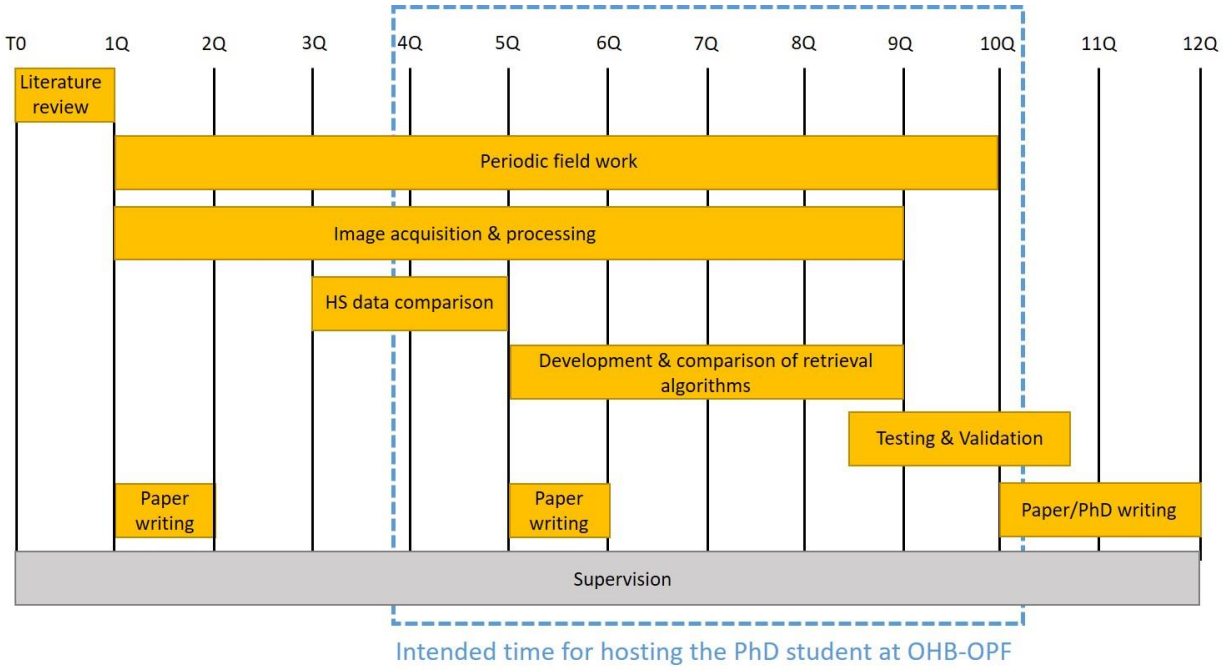

Figure 1: Quarterly plan for the PhD project

6. Available funds (source and amount)

7. Literature:

Brell, M., Guanter, L., Segl, K., Scheffler, D., Bohn, N., Bracher, A., ... & Chabrillat, S. (2021, March). The EnMAP Satellite–Data Product Validation Activities. In 2021 11th Workshop on Hyperspectral Imaging and Signal Processing: Evolution in Remote Sensing (WHISPERS) (pp. 1-5). IEEE.

Cogliati, S., Sarti, F., Chiarantini, L., Cosi, M., Lorusso, R., Lopinto, E., ... & Colombo, R. (2021). The PRISMA imaging spectroscopy mission: Overview and first performance analysis. Remote Sensing of Environment, 262, 112499.

Stroppiana, D., Fava, F., Boschetti, M., & Brivio, P. A. (2018). Estimation of nitrogen content in herbaceous plants using hyperspectral vegetation indices. In Hyperspectral indices and image classifications for agriculture and vegetation (pp. 201-225). CRC Press.