

4.00 credits

30.0 h + 22.5 h

Q2

Teacher(s)	Bontemps Sophie ;Defourny Pierre (coordinator) ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	LBIRE2102 Géomatique appliquée or equivalent introductory class in remote sensing Programming skills (R, python) Related courses : LB RAT2102 Modélisation spatiale des dynamiques territoriales LBRES2101 Smart technologies for environmental engineering LBRAI2221 Agriculture de précision et mécanisation
Main themes	<p>This course aims to develop in-depth understanding and professional skills to process and interpret very high resolution UAV (drone) imagery and Earth Observation satellite time series. Advanced concepts related to signal acquisition, time series quality control and uncertainty characterization are introduced. Radiative transfer modeling and methods for biophysical variables estimation (Leaf Area Index, biomass, nitrogen status, surface temperature, evapotranspiration, soil moisture, height, etc.) and change detection methods are explained and illustrated through practical applications and the European Copernicus Services. Finally, open source tools and systems supporting already operational and forthcoming monitoring systems, including flood monitoring, fire monitoring, forest monitoring and crop monitoring, are discussed in details. The objective of this course is to develop the necessary knowledge and technical skills to use advanced image processing methods (including machine learning and artificial intelligence) and to implement workflow for UAV or satellite monitoring applications in the field of agriculture, forestry, land use land cover change, and water resources management.</p> <p>An additional module also aims to develop in-depth understanding of the challenges and potential of Earth Observation to support operational agriculture monitoring systems. The strengths, assumptions, and shortcomings of current operational early warning systems and crop monitoring systems are discussed based on a technical analysis of workflows and a quality assessment of input data sources. The European Copernicus Services and the monitoring systems of the European Common Agriculture Policy are analyzed. Further developments are designed to better support the agricultural transformation towards sustainable practices. In the context of the big data era designing end-to-end solutions that are fit for purpose is discussed in order to tackle the challenges of sustainable food production.</p>
Learning outcomes	<p>At the end of this learning unit, the student is able to :</p> <p>a. Contribution of the activity to the program learning outcomes Consistency of LO courses with those of the program M1.1., M2.1., M4.4., M4.5</p> <p>b. Specific formulation for this AA activity of the program (maximum 10)</p> <p>At the end of this activity, the student is able to:</p> <p>1 - practically mobilize the advanced concepts and methods of airborne and satellite remote sensing applied to the monitoring and the management of natural resources, to regional planning and to the environment in general;</p> <p>- understand and criticize in depth the operational services, the available products and the existing tools to get the best out of each;</p> <p>- mastering specialized open source remote sensing softwares and developing processing chains including several tools;</p> <p>- design and conduct rigorous digital analyzes of optical and radar time series to respond to specific issues belonging to the bioengineer fields and to formulate the related hypotheses and limits;</p> <p>- be able to grasp technological developments in the field of remote sensing applied to the fields of the bioengineers.</p>
Evaluation methods	Evaluation based on a case study (concrete application of your choice) carried out from A to Z throughout the four-month period and presented as a scientific poster.

Teaching methods	<p>The teaching introduces the concepts and advanced methods while the practicals in computer lab mobilise them in the context of specific applications. The lessons are quite interactive and the practicals rely on an inductive approach based on a case study of your choice.</p> <p>The course and the practicals aim to develop on one hand advanced technical skills in Earth Observation data processing and on the other hand, the ability of critical analysis with regards to existing solutions, services and products. The student learns not only to use open source packages and Google Earth Engine environment but also to assess the quality and to review the validity of the proposed algorithms and datasets for a given application.</p> <p>The practical training is closely linked to the course and includes the use of several open source libraries (including QGIS, SNAP, GDAL, ORFEO, Sen4CAP), the exploitation of the Jupyter notebook environment for quality control and time series analysis, and the workflow coding in Python or R.</p>
Content	<p>The course combines lessons and practicals in computing lab mainly based on open source softwares used to run on your own a case study as a professional.</p> <p>The lessons address the following topics:</p> <ul style="list-style-type: none"> • signal acquisition and preprocessing steps, including quality flags and uncertainty management; • radiative transfer modelling and retrieval of various biophysical variables; • optical and SAR time series analysis, features extraction and pixel-based / object-based metrics; • advanced radar processing including polarimetric and interferometric variables; • introduction to machine learning and artificial intelligence algorithms for Earth observation mapping, monitoring and change detection; • critical review of operational monitoring systems (drought, flooding, fire, forest, crop, locust) and of Copernicus Services freely available. • EO applications related to the environment, agriculture, forestry, water resources and land use planning. <p>The additional module also combines lessons and use case study mainly based on open source software and systems description analysis. The lessons address the following topics among others:</p> <ul style="list-style-type: none"> • global early warning systems for food security, • rangelands monitoring systems, • national, continental and global crop monitoring systems, • certification support system for regenerative or sustainable agriculture.
Inline resources	Training material on Moodle and open source libraries available in the computer lab.
Other infos	<p>This course is part of the Certificate in Applied Geomatics accessible to professionals as part of continuing training. The theoretical knowledge and practical of this course are mobilized in many other courses in different programs and different faculties.</p> <p>This course can be given in English.</p>
Faculty or entity in charge	AGRO

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Certificat d'université : Géomatique appliquée	GEOM2FC	3		