Module	**Forest Ecosystem Monitoring**
Code	MSLS_FS-01
Degree Program	Master of Science in Life Sciences (MSLS)
ECTS Credits	5
Workload	150 h: Contact 60 h; Problem case 50 h; Self-study 40 h
Module Coordinator	**Name** Christian Rosset **Phone** +41 31 910 22 59 **Email** christian.rosset@bfh.ch **Address** Bern University of Applied Sciences, School of Agricultural, Forest and Food Sciences, Laenggasse 85, 3052 Zollikofen
Lecturers	• Gaspard Dumollard • Alex Erbach • Hannes Horneber • Valère Martin • Luuk Dorren • Ulrich Fiedler (BFH-TI) • WWI lecturers (project coaching)
Entry Requirements	None.
Learning Outcomes and Competences	After completing the module students will be able to: • monitor crucial elements and processes (state, dynamics, behavior, interaction) of a system related to sustainable forest management (e.g. biological or technical production system) with key-indicators; the monitoring serves as a basis for a dynamic perception of the system and a better understanding of its complexity as well as to improve system performances up to system optimization, • design a monitoring system based on Systems Engineering for practical use and build-up an IT solution with integrated data workflows and (as far as possible) an automated way to produce the key-indicators, using e.g. Python and/or R and relevant GIS software, • select relevant data sources to build up the monitoring system, taking into account the potentialities and diversity of sensorics (from passive and active remote sensing systems down to embedded system in smartphones and machines) combined with terrestrial data collection and use the necessary infrastructure for data access, processing and management (e.g., Cloud Computing …), • apply proper analytical methods to produce meaningful information as part of the monitoring system, including methods related to time series analysis, data fusion and machine learning, as well as considering data quality and uncertainties, • visualize information in dashboards for practical uses • publish monitoring reports considering basic principles of data visualization,

	• know basics on how to elaborate a dashboard application for broader use with the collaboration of IT specialists based on software engineering and agile development principles.
Module Content	• Monitoring and key-indicator systems, system analysis and design based on Systems Engineering • Data sources and data infrastructures: basics in sensorics and overview of data sources, infrastructures for data access, data processing and data management (e.g. Google Earth Engine, IoT platform for interconnected sensor devices) • Data analysis: track changes and time series analysis, data fusion, machine learning, special focus on data visualization, data quality and uncertainties • Dashboard design and infographics • Collaboration with IT specialists (insight in agile development and software engineering).

Teaching / Learning Methods	A combination of contact lectures, hands-on group exercises and Moodle assignments, both for individual- and teamwork
Assessment of Learning Outcome	1) Oral exam (50%) 2) Group assignment (50%)
Bibliography	Haberfellner, Reinhard et al. Systems Engineering: Fundamentals and Applications. Cham, Switzerland: Birkhäuser, 2019. Rubin, Kenneth S. Essential Scrum : a Practical Guide to the Most Popular Agile Process. 6th printing. Upper Saddle River, N.J: Addison-Wesley, 2015. …
Language	English (with additional explanations in German or French where necessary)
Comments	Compulsory: D1 Handling and Visualizing Data Compulsory: D2 Design and Analysis of Experiments Recommended: D3 Modelling and Exploration Multivariate Data
Last Update	30.04.2021 / Christian Rosset