Introduction to Earth System Interactions in the Context of Climate and Sustainability

Educational subject description sheet

Basic information

Field of study Joint Bachelor in Sustainability	**Education cycle** 2025/26
Speciality Sustainable Physics & Chemistry	**Subject code** UJ.WPAJBSSPCS.840.16405.25
Organizational unit Faculty of Law and Administration	**Lecture languages** english
Study level first cycle (joint degree programme)	**Subject related to scientific research** Yes
Study form full-time degree programme	**Disciplines** Physical sciences, Chemical sciences, Earth sciences and the environment
Education profile General academic	**ISCED classification** 0532 Earth sciences
Mandatory obligatory	**USOS code**

Subject coordinator	Piotr Szwedo
Lecturer	Ditte Taipale, Pauliina Schiestl-Aalto, Risto Taipale, Markku Kulmala, Leena Järvi, Maija Peltola, Ivan Mammarella, Ilona Ylivinkka, Lauri Ahonen, Timo Vesala

Period Semester 3	**Examination** graded credit **Activities and hours** Discussion class: 22 Fieldwork classes: 25	**Number of ECTS points** 5.0

Goals

C1	The main aims of the course are to give students an understanding of Earth system interactions, what role these interactions play in Earth's climate, how humans have been, and are, impacting the Earth's spheres and Earth system interactions, and learn what is a sustainable use of the ecosystems. The teaching sessions will mainly be held in the environments which are relevant for the course topics to give the students firsthand experience of the different ecosystems, their related important sustainability dilemmas, and how measurements of these ecosystems are carried out – all which is intended to support a transformative learning process. As this course is the first course the students following the study track in sustainable chemistry and physics will be taking, social interactions, getting to know each other and developing a sense of community are also important aims of the course and this is supported by including one intensive period at the beginning of the course in Hyytiälä, which is in practice, in the middle of the forest. Hyytiälä hosts the world's largest atmosphere-biosphere field station (SMEAR II), with a 5 km long lake located next to the station as well as the largest preserved wetland in southern Finland (Siikaneva) located approximately 5 km from the station. Measurement sites are installed at both the lake and wetland. The location of Hyytiälä therefore gives fast access to both forest, wetland and lake. The remaining excursions are carried out in Helsinki, which offers a city environment, is located next to the Baltic Sea and also hosts an agricultural measurement site (SMEAR-Agri).

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the basic structure, composition and functioning of the atmosphere, boreal forests, boreal wetlands, boreal lakes, the Baltic Sea and agricultural fields.	JBS_K1_W07	project, presentation
W2	the complexity of the Earth system, list important Earth system interactions, and explain in which way and why they are important.	JBS_K1_W06, JBS_K1_W07	project, presentation
W3	how land use and other human activities (e.g. fishery, water management, traffic, industry) affect different ecosystems, and their interactions with the atmosphere.	JBS_K1_W03, JBS_K1_W04, JBS_K1_W06, JBS_K1_W07	project, presentation
W4	how Earth system interactions are being measured and is able to argue for measuring at different scales.	JBS_K1_W07	project, presentation
W5	key uncertainties and unknowns in Earth system interactions that affect sustainability evaluations of land use and other human activities.	JBS_K1_W04, JBS_K1_W06, JBS_K1_W07	project, presentation
Skills – Student can:			
U1	propose sustainable solutions for ecosystem use taking also economic and social factors into consideration.	JBS_K1_U02, JBS_K1_U03, JBS_K1_U04	project, self-evaluation report
U2	effectively and smoothly collaborate and communicate with others and is able to express his/her own views and feelings clearly and appropriately.	JBS_K1_U02, JBS_K1_U04	project, self-evaluation report
U3	search independently for information as well as analyse and apply information.	JBS_K1_U03	project, self-evaluation report
Social competences – Student is ready for:			
K1	to consider that land use and other human activities are not static, but that different visions of the future exist, and the student develop their own evidence-based opinions in reference to sustainability.	JBS_K1_K03	project, self-evaluation report

Code	Outcomes in terms of	Effects	Examination methods
K2	to critically assess and verbalize their own competencies and skills taught in the course as well as their need for development.	JBS_K1_K04	self-evaluation report

Calculation of ECTS points

Activity form	Activity hours*	
Discussion class	22	
Fieldwork classes	25	
preparation of a multimedia presentation	4	
report preparation	2	
preparation of a project	82	
Student workload	**Hours** 135	**ECTS** 5.0

* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Interactive lecture: Earth system interactions (2hrs, in Hyytiälä)	W1, W2
2.	Discussion and exercise session: Earth system interactions (3hrs, in Hyytiälä)	W1, W2, W5, U2
3.	Interactive lecture: SMEAR (Station for Measuring Ecosystem-Atmosphere Interactions) stations and INAR (Institute for Atmosphere and Earth System Research) work (2hrs, in Hyytiälä)	W2, W4
4.	Tour to SMEAR II (2hrs, in Hyytiälä)	W2, W4
5.	SMEAR II tour part 2 - there will be 6 stops at the station. There will be practical assignments, calculations, discussion and reflection tasks related to SMEAR stations and biosphere-atmosphere interactions divided out on 6 stops, and the students will rotate in groups between these stops (4hrs, in Hyytiälä)	W2, W4, W5, U2
6.	Interactive lecture: forests, forest management, biodiversity, and forests in connection to sustainability and climate (2hrs, in Hyytiälä)	W1, W2, W3, W5
7.	Walk in Helvetinjärvi national park with discussion session. In practice, different topics and questions related to the lecture on forests will be brought up (4hrs).	W1, W2, W3, W5, U1, U2, K1, K2
8.	Interactive lecture: wetlands, wetland use, wetlands historically, wetland-atmosphere interactions, and wetlands in connection to sustainability and climate (2hrs, in Hyytiälä)	W1, W2, W3, W5
9.	Walk in Siikaneva (largest preserved wetland in southern Finland) with discussion session. In practice, different topics and questions related to the lecture on wetlands will be brought up (4hrs).	W1, W2, W3, W4, W5, U1, U2, K1, K2

No.	Course content	Subject's learning outcomes
10.	Interactive lecture: fresh-water lakes, lake usage (also historically), lake-atmosphere interactions and lakes in connection to sustainability and climate (2hrs, in Hyytiälä)	W1, W2, W3, W5
11.	Discussion and exercise session at Lake Kuivajärvi (located in Hyytiälä). In practice, different topics and questions related to the lecture on lakes will be brought up (2hrs).	W1, W2, W3, W4, W5, U1, U2, K1, K2
12.	Interactive lecture: sea, sea-atmosphere interactions and seas in connection to sustainability and climate (2hrs, in Helsinki)	W1, W2, W3, W5
13.	Discussion and exercise session at the seashore in Helsinki. In practice, different topics and questions related to the lecture on seas will be brought up (2hrs).	W1, W2, W3, W4, W5, U1, U2, K1, K2
14.	Interactive lecture: urban environment, urban environment-atmosphere interactions, urban environments in connection to sustainability and climate (2hrs, in Helsinki)	W1, W2, W3, W5
15.	Discussion and exercise session at Mäkelänkatu (big street in Helsinki where many urban atmosphere measurements are being conducted). In practice, different topics, questions and tasks related to the lecture on urban environments will be brought up (2hrs).	W1, W2, W3, W4, W5, U1, U2, K1, K2
16.	Interactive lecture: agriculture, agriculture-atmosphere interactions, agriculture-hydrosphere interactions, agriculture historically, agriculture in connection to sustainability and climate (2hrs, in Helsinki)	W1, W2, W3, W5
17.	Discussion and exercise session at SMEAR-Agri (agricultural SMEAR station in Helsinki). In practice, different topics, questions and tasks related to the lecture on agriculture will be brought up (2hrs).	W1, W2, W3, W4, W5, U1, U2, K1, K2
18.	Orientation about group work and division of groups (2hr)	U1, U2, U3, K1, K2
19.	Mid-term group work presentation with feedback from teachers and peers (2hrs)	U1, U2, U3, K1, K2
20.	Final group work presentation (2 hrs)	U1, U2, U3, K1, K2

Course advanced

Teaching methods :

project method, brainstorming, conversation lecture, lecture with multimedia presentation, discussion

Activities	Examination methods	Credit conditions
Discussion class	project, presentation	The combined grade for the oral presentation and short summary count 70% towards the final grade. The individual self-evaluation related to group work counts 15% towards the final grade. There is no lower threshold as to how many points the students need to get from each assignment, but in total they need to get at least 45% of points in order to pass the course.
Fieldwork classes	self-evaluation report	The combined grade for the oral presentation and short summary count 70% towards the final grade. The individual self-evaluation related to group work counts 15% towards the final grade. There is no lower threshold as to how many points the students need to get from each assignment, but in total they need to get at least 45% of points in order to pass the course.

Entry requirements

None

Literature

Obligatory

1. Lecture notes

Effects

Code	Content
JBS_K1_K03	The graduate can consider different visions of the future and develop own evidence-based opinions in reference to the balance of values linked to economic development, social welfare, and environmental protection.
JBS_K1_K04	The graduate can critically assess and verbalize own competencies and skills related to different aspects of sustainability as well as their need for development.
JBS_K1_U02	The graduate can present and report knowledge, methodologies, ideas, problems and solutions, clearly and comprehensively, in different forms destined for different audiences – including discussions and debates which require defending a substantiated opinion, as well as conversations in a foreign language at the CEFR B2 level.
JBS_K1_U03	The graduate can apply adequate methods and tools, including selected IT tools, to solve problems related to data collection, analysis, and management in the context of sustainability.
JBS_K1_U04	The graduate can plan and effectuate simple sustainability-related projects under supervision and in the context of personal lifelong learning, both individually and in a team, using appropriate transversal skills and taking shared responsibility for the outcome.
JBS_K1_W03	The graduate can give examples of sustainability-related dilemmas and hypothesize on the optimal course of action.
JBS_K1_W04	The graduate can identify sustainability-related problems specific to selected cultural, geographical, and political contexts.
JBS_K1_W06	The graduate can describe interconnections between various aspects of sustainability and identify their significance in the context of natural and social sciences, with a special focus on disciplines included in the selected specialisation track (law and politics; chemistry and physics; chemistry and biology; economics and geography; economics, management and engineering; humanities).
JBS_K1_W07	The graduate can apply the theory and methodology of disciplines included in the selected specialisation track to sustainability-related problems, taking into consideration practical limitations such as protection of intellectual property.