Universitat de Lleida

DEGREE CURRICULUM

WEATHER FORECAST APPLIED TO ENVIRONMENT

Coordination: CASTELLVI SENTIS, FRANCESC

Academic year 2020-21

WEATHER FORECAST APPLIED TO ENVIRONMENT 2020-21

Subject's general information

<table>
<tr><td>Subject name</td><td>WEATHER FORECAST APPLIED TO ENVIRONMENT</td></tr>
<tr><td>Code</td><td>102472</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td><table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Double degree: Bachelor's degree in Forest Engineering and Bachelor's degree in Nature Conservation</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Forest Engineering</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td><table>
<tr><th>Activity type</th><td>PRALAB</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>2.5</td><td>3.5</td></tr>
<tr><th>Number of groups</th><td>1</td><td>1</td></tr>
</table></td></tr>
<tr><td>Coordination</td><td>CASTELLVI SENTIS, FRANCESC</td></tr>
<tr><td>Department</td><td>ENVIRONMENT AND SOIL SCIENCES</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>The ratio is about 1/0.5 (class / own work)</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>English</td></tr>
<tr><td>Distribution of credits</td><td>About 60 % theory and 40% practice (lab).</td></tr>
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WEATHER FORECAST APPLIED TO ENVIRONMENT 2020-21

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CASTELLVI SENTIS, FRANCESC	francesc.castellvi@udl.cat	7,2	

Subject's extra information

Possibility to invite a professors from other countries. It depends on the funding available.
The structural constrains derived by COVID- 19 may modify the objectives pursuit in the course.

Learning objectives

The course aims to achieve skills related to the analysis of climate data, climate simulation, and understanding of man processes involved in the soil - vegetation – atmosphere continuum within the surface boundary layer. The scope of the course are the study of processes of scalar exchange above the canopy top. Some global applications may anialyzed within the framework of remote sensing.

Competences

1.- Organization of a large database. Analysis at different scales (spatial and temporal). Capability to take decisions.
2.- Capability to transfer knowledge.
3.- Capability to apply methods and techniques related with processes that can be observed above the canopy and within the atmospheric surface layer. Applications are aminly at local scale tought some inside may be given at regional escale.

Subject contents

1. Introduction. General concepts.
Warming up. Meteorology and climate. Micrometeorology and microclimate. Global warming and climate change. Terminology.

2. The database and the metadata. Weather generators.
The meteorological network in Catalonia. Free available databases. Quality control of climate time series. Extraterrestrial solar radiation. EStimation of the lobal solar radiation, Rs, the net radiation, Rn, and the soil heat flux, G. Generation of daily precipitation, maximum and minimum air temperatures, and solar radiation. Processes of downscaling to simulate Rs, Rn and G .
3. The atmosphere. General and local circulation. Boundary layers.
Thermodynamics of the air. Determination, estimation and measurement of weather variables. Katabatik and anabatic winds, and breezes. Föhn effect. Oasis effect. Properties of the roughness, inertial and mixing sublayers. The Ekman layer. Geostrophic winds. General circulation.
4. The soil – vegetation – atmospheric surface layer continuum. The surface energy balance.
The evapotranspiration, ET, as a link between micro-meteorology and hydrology. The potential ET, ETP, and the ET of reference, ETr. Semi-empirical equations and procedures for estimating the ETP, the ETr and the ET. Forest productivity.
The Soil heat flux. Instrumentation. The incoming and outgoing long and short wave radiation (the four radiative components). Instrumentation. Efficiency in using the components of the radiation. Temperature of the air and of the canopy elements.
Turbulence. Reynolds averaging. The Monin Obukhov Similarity Theory, MOST. Profiles of the horizontal wind speed, the air temperature and the humidity. Limitation of MOST. Measurement of the turbulence.

Instrumentation. The Eddy Covariance method. Measurement and estimation of the sensible heat flux, the latent heat flux and carbon dioxide flux using time series of scalars measured at high frequency. Footprint analysis.
5. Remote sensing applications.
The land surface temperature, LST. Retrival of LST depending on how it is measured. Spatial ET estimation using MOST and the Surface Energy Balance, SEBAL, method. A study case over a mountain meadow.
6. The land and the climate.
Phytoclimatic indices. Climate classification. Wind breakers. Climate and comfort. Risk of fire. Precipitation, drought and soil erosion.

Methodology

The lectures are combined with a variety of activities. The latter includes resolution of exercises that are analyzed in class and the use of different packages such as, Agromet, Climgen and TK2, elaboration of reports and preparation of short communications.

Development plan

Estimated teachinig loads corresponding to Theory, T, and Activities in class, A:
1. Introduction. T= 4 h. A= 2 h
2. The database and the metadata. Weather generators. T= 6 h. A= 6 h.
3. The atmosphere. General and local circulation. Boundary layers. T= 5 h. A= 2 h.
4. The soil – vegetation – atmospheric surface layer continuum. The surface energy balance. T= 10 h. A = 5 h.
5. Remote sensing applications. T= 5 h. A = 5 h.
6. The land and the climate. T= 5 h. A = 5 h.

Evaluation

Provided that the student assists regularly to class (a minimum 80% of the total teaching load), the global evaluation is obtained by weighting the marks obtained in different activities. The corresponding weights are the following: 70% for exercises and 30% for reports and oral communications. Activities are made in grup. A grup is formed by 2 - 3 persons. The Table lists the number of activities per lecture and the weight per lecture versus the final mark: However, when a student shows up by less than 80% of the classes, the mark correspond to the score obtained in an exam.

Lecture	Activities	Exercices	Weight (%)
Lecture 1	3	3	8.6
Lecture 2	3	8	20.6
Lecture 3	2	7	18.6
Lecture 4	4	12	40
Lecture 5	2	3	10.6
Lecture 6	3	3	10.6
TOTAL	17	36	100

Bibliography

The lectures are available in Sakai (campus virtual).

Complementary material:
Allen, R.G.; Pereira, L.S.; Raes, D., Smith, M. 1998. Crop evapotranspiration. Guidelines for computing crop water

requirements. FAO Irrigation and drainage paper n. 56. FAO Roma (Italia). 300 pp.
Campbell G.S.; J.M: Norman. 1998. An introduction to Environmental Biophysics. 2nd Edition. Springer. 286pp.
Critchfield, H.J., 1983: General Climatology. Prentice-Hall.
Elías Castillo, F. y F. Castellvi (coords.), 2001: Agrometeorología. Ed. Mundi-Prensa.

Monteith, J.L.; M.H. Unsworth. 1990. Principles of Environmental Physics. 2nd Edition.Edward Arnold. 291pp.
Rosenberg N.J.; Blad B.; Verma S.B. 1983. Microclimate. The Biological Environment. 2nd ed. John Wiley & Sons.
R.G.Allen, L.S. Pereira, D. Raes, M. Smith., 2006: Evapotranspiración del cultivo. Guías para la determinación de los requerimientos de agua de los cultivos. (Estudio FAO Riego y Drenaje 56), Roma, 323 p (traducción del original en Inglés del año1998).
Foken, T., 2008. Micrometeorology. Ed. Springer.
Hatfield, J.L., Baker, J.M., (Editors)., 2005. Micrometeorology of Agricultural Systems. American Society of Agronomy Monograph Series No. 47. ASA-CSSA-SSSA. Madison, WI. p. 584.