TEACHING MODULES INFORMATION
EMJMD WACOMA (academic year 2018/19)

1.	**Module Title:** Coastal land subsidence effects on freshwater resources and flood risk
2.	**Module Code:** (not necessary yet)
3.	**Maximum Number of Students:** No limit
4.	**Total ECTS Credits:** 2 ECTS
5.	**Month:** First year, second semester
6.	**Notional Learning Hours (Please fill a number in box)**: **(a) Contact Time - e.g in the classroom, or fieldwork** **(b) Private Study - reading time, preparing and taking assessments** **Format of Teaching:** Lectures 14 Hours (a) Laboratories or Practicals Hours Other (computer workshops) Hours Other (tutorials) Hours Other (private study) 36 Hours (b) **Teaching Strategy:** Lectures – 14 Workshops – Tutorials –
7.	**Convener:** Clara Armaroli
8.	**Institution:** University of Ferrara
9.	**Level (Please tick Y):** Master Degree
10.	**Language(s) of Tuition**: English
11.	**Pre-requisites:** (if any) None
12.	**Co-requisites:** (if any) None
13.	**Programme(s) for which module is core:** Erasmus Mundus Joint Master Degree in Water and Coastal Management (WACOMA)

14.	**Module Description - The Purpose or Aims:** The main purpose of the module is the presentation of the effect of land subsidence on the coastal system and how the exploitation of freshwater resources leads to increasing problems related to the lowering of the elevation of the coastal area and consequent increase of the impact of storms in terms of beach erosion, flooding and loss of coastal ecosystems. Land subsidence also affects groundwater quality and availability, leading to salinization of the aquifer. The module will be especially based on examples of the Emilia-Romagna region in Italy. The freshwater system, that includes also coastal lagoons and drainage systems that are fundamental for agriculture and hydraulic safety, is affected by land subsidence. Several management plans have been activated in Emilia-Romagna to mitigate the impact of land subsidence. Other examples will include the Po delta area and how it has been modified through time to meet human needs and how human-induced and natural subsidence has impacted the delta.
15.	**Learning Outcomes:** The students will learn the basic knowledge on land subsidence and how it can affect coastal areas and freshwater systems. An overview of the general concepts will be provided. The general concepts will be further explained through detailed examples. The students will also understand how management plans are fundamental to counteract the effect of human-induced subsidence and how good practices, with a long-term perspective, are necessary to mitigate the impact of storms on the coastal area. Another fundamental learning outcome will be an overview of the definition of risk for coastal areas and how it has to be evaluated in order to clearly define the variables that have to be included in the definition of risk, their meaning and which are the most common errors of scientists and coastal managers when dealing with risk.
16.	**Summary of Course Content:** The course will include a first part with the definition of the issue (freshwater systems – ground and superficial freshwater – and land subsidence; definition of storms; definition of risk and impacts; methods to evaluate the impact of storms). Then the case study of the Emilia-Romagna region will be presented with several examples. A special focus will be on management plans and actions related to the mitigation of the effect of land subsidence, to present both positive and negative examples. The Po delta area will be finally presented as a further example of one of the largest delta in the world and how human impact has caused different problems to the sedimentary system of the delta and surrounding areas, especially caused by land subsidence.

17.	**Key Skills Taught:** The students will acquire different skills. The first and most important skill is the capacity to have a comprehensive view of the problem from the sources of hazard (non-sustainable management of freshwater resources especially due to excessive land exploitation, storm impact and consequences) to solutions to mitigate the impact of the hazards. They will learn how to deal with the risk of coastal areas becoming skilful in its definition and evaluation. They will be able to use the provided examples to evaluate the same issues in different areas.
18.	**Assessment Methods:** The students will have to answer to twenty multiple-choice questions.
19.	**Assessment Criteria:** A successful candidate should have or be able to do the following: ***Threshold*** A basic understanding of the appropriate science and modelling approach and a reasonable understanding of the model results and their implications. ***Good*** A good understanding of the science and correct model results which are presented and interpreted to a good standard, with some reference to independent literature data and results. ***Excellent*** A good to excellent understanding of the science and correct model results which are presented and interpreted to a high standard, with plenty of references used for comparisons and to critically evaluate the results.

20.	**Resource Implications of Proposal and Proposed Solutions**: (Recommended Bibliography: compulsory, optional, other sources of information) Carminati, E., Martinelli, G., 2002. Subsidence rates in the Po Plain, northern Italy: the relative impact of natural and anthropogenic causation. *Eng. Geol.* 66, 241-255 Teatini, P., Ferronato, M., Gambolati, G., Bertoni, W. and Gonella, M., 2005. A century of land subsidence in Ravenna, Italy. *Environmental Geology* 47, 831-846. Vicinanza, D., Ciavola, P., Biagi, S., 2009. Field Experiment to Control Coastline Subsidence: a Unique Case Study at Lido Adriano (Italy). *Journal of Coastal Research*, SI 56: 1105-1109. **Specific Resource Implications for Students**: None
21.	**Does this module replace existing provision? If so, please indicate modules to be replaced:** The module fits in the area of "Geochemistry"
22.	**Start Date:** First year, second semester
23.	**Is it intended that the module be available every year?** Probably