FORM FOR SUBMISSION OF MODULE FOR A EUROPEAN JOINT MASTERS

1.	**Module Title:** Integrative assessment of sediment quality
2.	**Module Code:**
3.	**Maximum Number of Students:** **15**
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 8 Hours (a) Laboratories or Practicals 6 Hours (a) Other (private study) 36 Hours (b) **Teaching Strategy:** Lectures Practical classes
7.	**Convener:** Sokratis Papaspyrou Ignacio Moreno Garrido
8.	**Institution:** University of Cádiz / CSIC
9.	**Level (Please tick Y):** Master Degree
10.	**Language(s) of Tuition**: English
11.	**Pre-requisites:** It is unlikely that there will be prerequisites beyond the entrance qualifications for a science-based Masters programme.

12.	**Co-requisites:** 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 objective of this course is to provide students (1) the essential knowledge background to understand the necessity of a multidisciplinary approach to sediment ecotoxicology, and (2) the tools to perform and analyse different toxicity tests in this ecological compartment.
15.	**Learning Outcomes:** - Students should understand the importance of sediments in aquatic ecotoxicology and the rationale behind toxicity bioassays in this particular biocenosis. - Attendants to this course will acquire knowledge on sampling strategies and sample conservation. - A general survey on chemical sediment characterization will be also provided in this course. - Students will differentiate between bioaccumulation and biomagnification, and they will understand the importance of those two processes in the trophic web. - Attendants to this course will learn strategies designed to identify ecological stress, through “in vitro” as well as “in situ” experiments. - Students will design, during the laboratory work, a toxicity bioassay involving avoidance (the most recent trend in toxicity bioassays), based on rotifer or artemia displacements in a toxicity gradient.
16.	**Summary of Course Content:** - 1.- Introduction: Rationale of sediment integrative toxicity assessment. - 2.- Sampling strategies and sample conservation and treatment. - 3.- Chemical characterization of sediments. - 4.- Benthic organisms and standard sediment bioassay species. - 5.- Bioavailability, bioaccumulation and biomagnification. - 6.- Identifying ecological stress: in vitro vs. in situ bioassays; classical approaches and new insights. - Practical design of an avoidance tool to measure toxicity using aquatic invertebrates (rotifers, artemia or both) (Two sessions of 2 hours)

17.	**Key Skills Taught:** Designing, planning and undertaking aquatic sediment toxicity assessment. Carrying out sediment sampling, treatment and conservation of samples for bioassays. Performing different chemical analyses for sediments applying modern techniques. Identifying biota present in sediments and carrying out new sediment toxicity bioassays using standard organisms in sediment bioassays. Analysis and interpretation of data Preparing relevant reports and recommendations.
18.	**Assessment Methods:** Continuous assessment by interacting with students during lectures. Level of participation during laboratory practicals (questions, discussions, reports), as well as skills in practical design of sediment toxicity bioassays.
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**:

Specific Resource Implications for Students:

Araújo, C.V.M.; Diz, F.R.; Laiz, L.; Lubián, L.M.; Blasco, J.; Moreno-Garrido, I. 2009. Sediment integrative assessment of the Bay of Cádiz (Spain): an ecotoxicological and chemical approach *Environment International*, 35: 831-841.

ASTM. Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates. American Society for Testing and Materials, 11.05 : E 1706-95b; 1997.

Beiras, R. & His, E. 1995. Toxicity of fresh and freeze-dried hydrocarbon-polluted sediments to Crassostrea gigas embryos. *Marine Pollution Bulletin* 30: 47-49.

Blasco, J.; Sáenz, V. & Gómez-Parra, A. 2000. heavy metal fluxes at the sediment-water interface of the coastal ecosystems from south-west of the Iberian Peninsula. *The Science of the Total Environment*, 247: 189-199.

Champan, P.M. and Wang, F. 2001. Assessing sediment contamination in estuaries. Environmental Toxicology and Chemistry 20(1): 3-22.

Crane, J.L. & MacDonald, D.D. 2003. Applications of numerical sediment quality targets for assessing sediment quality conditions in a US Great Lakes area of concern. *Environmental Management* 32(1): 128-140.

Fletcher, R.; Reynoldson, T.B. & Taylor, W.D. 2001. The use of benthic mesocosms for the assessment of sediment contamination. *Environmental Pollution* 115: 173-182.

Newman, M.C. & Unger, M.A., Ed. 2003. Fundamentals of ecotoxicology, 2nd edition. CRC Press, Boca Ratón. Lewis Publishers.

Sasson-Brickson, G. & Burton, G.A. 1991. In situ and laboratory sediment toxicity testing with *Ceriodaphnia dubia. Environmental Toxicology and Chemistry* 10: 201-207.

SETAC (Society of Environmental Toxicology and Chemistry - Europe). 1993. Guidance document on sediment toxicity tests and bioassays for freshwater and marine environments. From the "workshop on Sediment Toxicity Assessment", November 1993 Renesse, The Netherlands. Hill, I.R.; Matthiessen, P. & Heimbach, F., Edrs.

Shin, P.K.S. & Lam, W.K.C. 2001. Development of a marine sediment pollution index. *Environmental Pollution*, 113: 281-291.

Simpson, S. and Batley, G., Edrs. 2016. Sediment Quality Assessment (a practical guide). Second Edition. CSIRO Publishing, Clayton South, Australia.

Traunspurger, W. & Drews, C. 1996. Toxicity analysis of freshwater and marine sediments with meio- and macrobenthic organisms: a review. *Hydrobiologia* 328: 215-261.

US EPA. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Fresh Water Invertebrates. EPA/600/R-94/024. US Environmental Protection Agency, Office of Research and Development, Washington, DC; 1994.

Van deer Kooij, L.A.; Van de Meent, D.; Van Leeuwen, C.J. & Bruggeman, W.A. 1991. Deriving quality criteria for water and sediment from the results of aquatic toxicity tests and products standards: application of the equilibrium partitioning method. *Wat. Res*. 25(6): 697-705.

21.	**Does this module replace existing provision? If so, please indicate modules to be replaced:** The module fits in the area of "Ecotoxicology evaluation of risk in water and coastal management"
22.	**Start Date:** First year, second semester
23.	**Is it intended that the module be available every year?** Yes