60431 - Analysis, visualization and modelling of geological data

Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	541 - Master's in Geology: Techniques and Applications
ECTS	10.0
Course	1
Period	First semester
Subject Type	Compulsory
Module	---

1.Basic info

1.1.Recommendations to take this course

1.2.Activities and key dates for the course

2.Initiation

2.1.Learning outcomes that define the subject

2.2.Introduction

3.Context and competences

3.1.Goals

3.2.Context and meaning of the subject in the degree

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

5.Activities and resources

5.1.General methodological presentation

Scientists and private-sector professionals in Geology make interpretations by utilizing and combining many different types of data coming from a large variety of investigative methods. An especially appealing aspect for students of Earth Sciences is the ability to examine phenomena at different scales ranging from global observations by satellites to atomic-scale material research. The geological investigations are based on a synthesis of both qualitative and quantitative information from fieldwork, experimental research and model construction of processes operating over a huge range of spatial and temporal scales. Computer simulations, using innovative numerical methods, are increasingly employed to integrate different types of data and to test hypotheses quantitatively. The course programme is designed to enable students to handle complex real-world problems and to develop a wide range of skills. A well-founded knowledge in diverse areas of data analysis, visualization and modelling will turn MSc students into appealing candidates for

recruitment in research, private industry, or governmental institutions.

5.2.Learning activities

The course has a load of 10 ECTS (100 hours of lectures/practicals and 150 hours of personal work) and is taught during the first semester. It is organised into three core modules (units) that combine theory lectures and practical sessions using personal computers. 50% of the course grade comes from exams and the other 50% from course work. The students have also the opportunity of taking an end-of-term examination to pass the course.

5.3.Program

UniT 1 : **Digital analysis of geological data**

Lecture 1 (0,4 ECTS) Global Positioning System (GPS)

Lecture 2 (0,4 ECTS) Geographic Information System (GIS) and digital terrain models.

Lecture 3 (1 ECTS) Software and utilities. QGis

Lecture 4 (0,2 ECTS) LIDAR technology

Unit 2 : **Databases and statistical methods in geology**

Section 2.1- Software applications for the management of geological data.

Lecture 5 (0,5 ECTS) Spreadsheet applications. EXCEL.

Lecture 6 (0,5 ECTS) Database applications. FileMaker Pro.

Section 2.2- Advanced statistical methods in geology

Lecture 7 (1 ECTS) Experimental design and exploratory analysis in geology.

Lecture 8 (1 ECTS) Use of multivariate methods in geological data analysis.

Lecture 9 (0,5 ECTS) Trends and hidden patterns in the sequential data: an introduction.

Lecture 10 (0,5 ECTS) Constructing and processing geological time series.

Lecture 11 (1 ECTS) Geostatistics.

Lecture 12 (1 ECTS) Morphometrics

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Unit 3 : **Principles of modelling in Geology.**

Lecture 13 (0,5 ECTS) Scientific method in the natural sciences.

Lecture 14 (0,5 ECTS) Fundamentals of geological modelling.

Lecture 15 (0,5 ECTS) Conceptual modelling.

Lecture 16 (0,5 ECTS) How to evaluate the quality of a model: validation and verification

5.4.Planning and scheduling

This course has 10 ECTS (100 hours of on-site teaching and 150 hours of personal work) and is taught during the first semester, in 5-hour sessions (Monday and Wednesday afternoon).

The starting and finishing dates of the classes can be found in the web page of the Faculty of Sciences (http://ciencias.unizar.es/).

During the first session, the coordinator of the course will hand out a detailed schedule of the course work, including deadlines and percentage of the grade assigned to each part.

The course will have a Moodle page where all course material will be uploaded and through which most of the communication between students and teachers will be conducted.

5.5.Bibliography and recomended resources

Caers, J. (2011). Modeling uncertainty in the earth sciences. Wiley-Blackwell, 229 pp.

Davis, J. C. 1986. Statistics and data analysis in geology. John Wiley & Sons.

DeMers, M.N., 2009. GIS For Dummies. Wiley Publishing Inc., 380 pp, ISBN: 978-0-470-23682-6.

Diggle, P.J.; Ribeiro Jr. P.J., 2007. *Model-based Geostatistics* . Series in Statistics, Springer, 228 pp. ISBN-10: 0-387-32907-2 ISBN-13: 978-0-387-32907-9

Dillon, R. y Goldstein M. 1984. Multivariate analysis: methods and applications. John Wiley & Sons.

Felsenstein, J. 2004. Inferring phylogenies. Sinauer Associates, Inc. 664 pp.

Gauch, Hugh G. 1982. Multivariate analysis in community ecology. Cambridge University Press.

Graser, A., 2013. *Learning QGIS 2.0* . Packt Publishing, 110 pp. ISBN 978-1-78216-748-8.

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Hammer, Ø., Harper, D.A.T., and P. D. Ryan, 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. Palaeontologia Electronica 4(1): 9pp.

Hammer, Ø. & Harper, D.A.T., 2006. Paleontological Data Analysis. Blackwell Publishing, 351 pp.

Harper, D.A.T. 1999. Numerical Paleobiology. Computer-based modelling and nalysis of fossils and their distributions. John Wiley & Sons. 468 pp.

Hengl, T., 2009. *A Practical Guide to Geostatistical Mapping* . University of Amsterdam, Second Edition, 291 pp. ISBN 978-90-9024981-0.

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

McKillup S & Dyar MD 2010, Geostatistics Explained. An Introductory Guide for Earth Scientist. Cambridge Univ. Press. 396 pp.

Middleton, G.V. y Wilcock, P.R. (1994). Mechanics in the Earth and Environmental Sciences. Cambridge University Press.

Reyment, R.A. 1991. Multidimensional Paleobiology. Pergamon Press.

Reyment, R.A. y Savazzi, E. Aspects of Multivariate Statistical Análisis in Geology. Elsevier. 285 p.

Rohlf, F.J. 1992. NTSYS-pc Numerical Taxonomy and Multivariate Analysis System. Version 1.70. Exeter Software, LTD., New York.

Shi, G.R. 1993. Multivariate data analysis in palaeoecology and palaeobiogeography -A review. Palaeogeography, Palaeoclimatology, Palaeoecology, 105: 199-234.

Walthan, D. 2000. Mathematics. A simple tool for Geologists. Blackwell Publishing.

Weedon G.P. 2003. Time-Series Análisis and Cyclostratigraphy. Examining stratigraphic records of environmental cycles. Cambridge University Press. 259 p.

Books, Manuals and free software:

QGIS http://www.qgis.org

PAST http://folk.uio.no/ohammer/past/

PSPP http://www.gnu.org/software/pspp/

R y R-Commander http://www.r-project.org/

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Arriaza et al. 2008. Estadística Básica con R y R-Commander. Servicio de Publicaciones de la Universidad de Cádiz. ISBN: 978-84-9828-186-6 http://knuth.uca.es/ebrcmdr

Sutton, T., Dassau, O., y Sutton, M., 2009. A Gentle Introduction to GIS. http://docs.qgis.org/2.2/en/docs/gentle_gis_introduction/index.html