Co-funded by the
Erasmus+ Programme
of the European Union

Environmental Management in the Middle East (EMME): Spatial Approaches

Course Syllabus

Course title

SDI-T for Collaborative Environmental Management

Course ECTS credits: 10

Course hour distribution by methods of studies

Lectures	Exercises	Self-study	Seminar	Final project	Total
20	92	120	8	40	280

Annotation of the course

This course is targeted to students of environmental studies, geography, geodesy, cartography, planning, engineering, ecology and sustainability of both undergraduate and graduate levels.

Aim of the course

This course aims at providing an overview of the organizational and technical components of Spatial Data Infrastructures and Technologies (SDI-T). Students will explore theoretical and practical concepts of SDI-T. It includes an introduction to Geographical Information Systems and Remote Sensing to harmonize the terminology and concepts related to spatial data, its analysis and modelling, and spatial databases.

Learners will be presented the concept of SDI-T, data issues, web services, and SDI business analysis and management.

Learning outcomes

On completion of the course, the student should be able to:

Knowledge and understanding

- Discuss the applicability and accessibility of spatial data at all levels
- Understand the fundamentals about SDI-T and its role in decision-making
- Describe critically the factors that influence the development of a SDI
- Practice data retrieval from SDIs and combine it in a GIS environment

Skills and abilities

- Identify SDI-T requirements and stakeholders

- Understand the SDI architecture that enables the availability of data at distinct levels
- Use and manage web services, namely metadata catalogues and map services

Critical judgement and evaluation

- Evaluate critically a SDI (e.g. national or local)
- Describe and review SDI policies and standards
- Understand the process of data disponibilization through SDI-T

Methods of course studies (*Educational approach*)

The course is designed as a full time course with 7 weeks (280 hours). If follows a lecture-integrated approach (theory and practice): theory in parallel with applications and examples.
Each topic is designed for a 1-week activity, including lecture screening, supporting text reading, exercices or project, and all the individual work needed to follow the activities. Theory is given in parallel with applications and examples.
As a student-based learning approach, the teaching model is oriented for self-study, with regular activities (tests, exercices) and a practical final project for evaluation.

Methods for the assessment of student achievements (*the formula and the definition of the cumulative score)*

Tests and Exercises: 60% (average of equally weighted exercises)
Final Project (includes a report and a presentation): 40%

Study subject modules to be completed before this Course studies (*Prerequisites***)**

Basic knowledge of mathematics, geography, physical processing, environmental protection.
Basic skills of Information Technologies.

Tentative Schedule (lectures)

Date	Topic	Objectives
Week 1	**GIS & Geovisualization** (core module, common to the other courses) • Introduction to GIS and Geovisualization (NTUA) • Models and structures - Advanced models and structures (3D, temporal) (NTUA) • Data acquisition (GPS, RS, field surveying) (ENSG – VGTU) • Precision and quality of data (NTUA) • Reference systems and transformations (VGTU) • Spatial Databases (ENSG) • Spatial analysis and modelling of phenomena (LU) • Geovisualization (cartography) (NTUA)	

Week 2	**Remote Sensing** (core module, common to the other courses) • Electromagnetic radiation theories (VGTU) • Platforms and Sensors (VGTU, UL) • Data Acquisition (VGTU) • Preprocessing (Atmospheric and radiometric corrections) (BASU) • Multi-spectral signatures and classification algorithms (VGTU) • Orthophotomapping (ENSG)	
Week 3	**Spatial Data Infrastructures (SDI)** • Introduction to SDI (UT) o Definition o SDI components o SDI hierarchy (local, regional, national, trans-national) • SDI applications (UT) o Environmental protection o Risk management • Organizational dimension of SDI (UT) o Laws, policies, institutions, people o Standards, specifications and metadata for spatial data • Public data (ENSG, UL, UT) o CRS, units, JRC, INSPIRE, etc. o Public participation, VGI • Spatial data issues in the region o Iran (UT, IKIU, BASU) o Yemen (SU, TU)	Be acquainted with SDI fundamentals
Week 4	**Data for SDI** • Data feeding for SDI for environmental management (UL) o Connection to global geographical data websites o Cost free data ▪ Satellite imagery ▪ Meteorological data ▪ Elevation data ▪ Land use data ▪ Population data ▪ Road data o Using metadata to assess data quality • Centralizing real time data (UL) o Most common systems based on sensors with real time data collection ▪ Hardware fundamentals ▪ Meteorological sensors networks ▪ Tide gauges o Participatory and mobile crowdsource data ▪ Sensor types and capabilities ▪ Applications	Be able to understand the availability of data for SDI and the diversity of data, including participatory and crowdsensing data

	▪ Problems of crowdsource data (small data sets, quality of data, irregularity)	
Week 5	**Web Services** • Web Services (UT) o Web services standards / protocols o Geoportals, geovisualization, dashboards o Web service composition, service oriented architectures (LU) o Client examples	Understand Web services
Week 6	**SDI Business Analysis (UL, UT)** • Benefits o Global and national environmental strategies and legal frameworks o Required data for activities subject to legal environmental constraints • Economical evaluation o Costs of the infrastructure o Costs of operation o Possible strategies to generate income • Business models o Types of contracts o Citizens as data suppliers • Project management concepts (AGILE) **SDI Management (UL, UT)** • Performance indicators • SDI evaluation methods • Spatially-enabled society and e-government	Understand SDI monitoring and evaluation
Week 7	**Project** (ENSG, UL, UT)	Knowledge integration Develop an SDI related project

Tentative Schedule (Exercises, Lab work/Self-studies)

Date	topic	Type*/objective
Week 1	Geographic Information Systems (NTUA)	• Data acquisition exercise (ENSG, VGTU) • Digitization, raster-to-vector (NTUA) • Exercise using different data sources (with different CRS) (VGTU) • Import non-spatial data and join with spatial datasets - (Simple) SQL queries (ENSG) • Spatial analysis operations (LU)
Week 2	RS (VGTU)	• Copernicus data access online. Using sentinel 1 and Landsat or MODIS data – work with ESA SNAP

		Toolbox (VGTU, UL) • Mapping desertification using SAR Data (VGTU)
Week 3	Introduction to spatial data infrastructures Organizational dimension of SDI (UT)	• Identify SDI in the Middle East • Select an existing SDI and describe the components • How to coordinate SDI at different hierarchy levels • Identify key factors on why SDI are important for environmental protection • Identify key factors why SDI are important for risk management
Week 4	Data feeding for SDI for environmental management (UL) Centralizing real time data (UL)	• Access distinct data from several SDIs • Access metadata to describe • Provide an insight on sensor-based real time data • Get acquainted with participatory and crowdsource data
Week 5	Web services (UT)	• Symbology Style Layer Description • Using web map services on desktop GIS • GeoPortals and GeoVisualization • Creating tile services (WMTS) • Define access policies
Week 6	SDI analysis and management (UL, UT)	• Strategic analysis (brainstorming, SWOT, scenario development, Delphi) • Development of a business analysis SDI case (user profile, user requirements, partnerships, benefits, business model, marketing, …) • Project economic evaluation (payback, cost-benefit, NPV (net present value), IRR (internal rate of return), …) • Monitoring SDI operation (indicators about metadata, data and service usage, coverage of data and services, indicators about data updating, …)
Week 7	Project (ENSG, UL, TU)	• Exercise involving access, retrieval, extraction of data from various sources • Exercise involving publishing/deployment of spatial data in a SDI • Describe critically SDI-T management topics related with the accessed data from different sources

* e.g. answering questions, collecting data, performing analysis, writing codes, etc.

Tentative Schedule (Seminar, Project)

Date	topic	Type*/objective
Week 1		
Week 2		
Week 3	INSPIRE seminar (UT)	Describe the INSPIRE principles, description and applicability
Week 4		
Week 5		
Week 6		
Week 7	Project (ENSG, UL, UT)	Put in practice the knowledge acquired during the entire course

Main bibliography (no more than 3 sources)

No.	Publication authors, year of issue, name, place of issue, publisher, (address of electronic publications and website)
1	OGC (Open Geospatial Consortium) standards – www.opengeospatial.org
2	Nebert, D.D. (ed.) GSDI cookbook
3	Global Spatial Data Infrastructure Association, SDI cookbooks and guides, available at http://gsdiassociation.org/index.php/publications/sdi-cookbooks.html

Additional bibliography (no more than 10 sources)

No.	Publication authors, name, place of issue, publisher, year of issue (address of electronic publications and website)
1	Rob Rowlands & Jon Coaffee, Project Management Handbook, https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5ab8b561e&appId=PPGMS
2	Ara Toomanian, Ali Mansourian, Lars Harrie, Anders Rydén, Using Balanced Scorecard for Evaluation of Spatial Data Infrastructures: a Swedish Case Study in accordance with INSPIRE. International Journal of Spatial Data Infrastructures Research, 6: 311-343. 2011. http://dx.doi.org/10.2902/1725-0463.2011.06.art14
3	B. van Loenen, J.W.J. Besemer, J.A. Zevenbergen (Editors) SDI Convergence: Research, Emerging Trends, and Critical Assessment, NCG, Nederlandse Commissie voor Geodesie, Netherlands Geodetic Commission, Delft, the Netherlands, 2009
4	Agnieszka Zwirowicz-Rutkowska, A multi-criteria method for assessment of spatial data infrastructure effectiveness, Earth Science Informatics, 10(3), 369–382. 2017. http://dx.doi.org/10.1007/s12145-017-0292-8
5	INSPIRE Geoportal, http://inspire-geoportal.ec.europa.eu/
6	El Fatih Wadidi, K. A. Abdalla, Spatial Data Infrastructure: The Road Map for Middle East Development. Geospatial World, 2009. https://www.geospatialworld.net/article/spatial-data-infrastructure-the-road-map-for-middle-east-development/
7	Farnaghi, M., Mansourian, A. (2018). Multi-agent Planning for Automatic Geospatial Web Service Composition in Geoportals, ISPRS International Journal of Geo-Information, 7(10), 404.
8	Farnaghi, M., Mansourian, A. (2013). Automatic Composition of WSMO based Geospatial Semantic Web Services using

	Artificial Intelligence Planning, Journal of Spatial Science, 58(2), 235-250
9	Mansourian, A., Abdolmajidi, E. (2011). Investigating the system dynamics technique for the modeling and simulation of the development of spatial data infrastructures, International Journal of Geographical Information Science (IJGIS), 25(12), 2001-2023.
10	Mansourian, A., Omidi, E., Toomanian, A., Harrie, L. (2011). Expert System to Enhance the Functionality of Clearinghouse Services, Journal of Computer, Environment and Urban Systems, 35(2), 159-172

Required IT Resources

No.	*Name of the software, manufacturer*	*License type*
1	QGIS (latest release) (a all-purpose multi-platform desktop geographical information system)	open source
2	QGIS plug-ins (additional modules for QGIS)	open source
3	GEONODE (a web-based geospatial content management system and platform for the management and publication of geospatial data)	open source
4	GeoServer (a open source server for sharing geospatial data)	open source

Course completed by

(Signatures)

(Signatures)

Project Coordinator

(Signature)

Confirmation

The module certified by	Faculty of ....., University of		
Chairman of the studies committee (full name, signature)		**Date**	