CIEE Global Institute - Copenhagen

Course name:	GIS and Mapping our Changing World
Course number:	(GI) ENVI 3003 CPDK
Programs offering course:	Copenhagen Open Campus
Open Campus track:	Sustainability and Environmental Sciences
Language of instruction:	English
U.S. semester credits:	3
Contact hours:	45
Term:	Fall 2019

Course Description

This is an introduction to the field of spatial analysis and Geographic Information Systems (GIS). GIS is a vital analytical tool used to examine many local and global problems, such as deforestation, urbanization, human health, resources and conservation, and climate change. In this course, principles of spatial analysis and GIS are coupled with hands-on experience in one GIS software package. Emphasis will be placed on spatial concepts and reasoning as well as acquiring basic mapping and analytic skills using GIS software ESRI ArcGIS. By the end, students will have a complex comprehension of spatial reasoning, GIS functionality, and GIS application in mapping environmental changes on multiple scales.

Learning Objectives

By completing this course, students will be able to:

- Demonstrate important concepts and principles of spatial analysis
- Exhibit literacy using spatial data models and formats
- Show competency using applications of geospatial analysis for local and global environmental issues
- Use basic ESRI ArcGIS
- Apply methods of spatial analysis
- Demonstrate ability to apply knowledge to research project

Methods of Instruction

This course includes reading-based discussions, lectures and demos, student-led presentations, a group mini project, and lab working sessions. In-class and out-of-class computer exercises will be completed on a weekly basis. These exercises are designed to provide hands-on experience with GIS technology and a methodology for implementing a GIS project. In most lab sessions, students will be given time to work on exercises including time for Q&A and problem solving. In addition, discussions will include relevant and contemporary uses of GIS to map and help solve local, regional and global environmental changes.

Assessment and Final Grade

1.	Midterm Exam	20%
2.	Lab Work (6)	20%
3.	Presentation	15%
4.	Final Exam	25%
5.	Class Participation	20%

Course Requirements

Midterm Exam

The midterm examination will assess the students' capabilities by means of shortanswer questions on basic concepts of GIS, data structures and geographic references as well as a practical exercise on handling spatial data and basic map layout.

Lab Work

Lab work consists of practical, hands-on exercises working with GIS software on case studies using local data. The lab work will be graded on the basis of active participation in the exercises, attention to detail on lab methodology, and critical analysis of experiment results.

Presentation

In-class presentations must be well-prepared, use visualization (PPT, Prezi, etc.) and should take 10 minutes followed by a Q&A session. They should explain and transfer the content in a logical and simple manner.

Final Exam

On the final examination, students will use data and software to demonstrate GIS capabilities, and provide written answers to three essay questions on environmental change, GIS and remote sensing.

Participation

Participation is valued as meaningful contribution in the digital and tangible classroom, utilizing the resources and materials presented to students as part of the course. Meaningful contribution requires students to be prepared in advance of each class session and to have regular attendance. Students must clearly demonstrate they have engaged with the materials as directed, for example, through classroom discussions, online discussion boards, peer-to-peer feedback (after presentations), interaction with guest speakers, and attentiveness on co-curricular and outside-of-classroom activities.

Attendance Policy

Regular class attendance is required throughout the program, and all unexcused absences will result in a lower participation grade for any affected CIEE course. Due to the intensive schedules for Open Campus and Short Term programs, unexcused absences that constitute more than 10% of the total course will result in a written warning.

Students who transfer from one CIEE class to another during the add/drop period will not be considered absent from the first session(s) of their new class, provided they were marked present for the first session(s) of their original class. Otherwise, the absence(s) from the original class carry over to the new class and count against the grade in that class.

For CIEE classes, excessively tardy (over 15 minutes late) students must be marked absent. Attendance policies also apply to any required co-curricular class excursion or event, as well as to Internship, Service Learning, or required field placement. Students who miss class for personal travel, including unforeseen delays that arise as a result of personal travel, will be marked as absent and unexcused. No make-up or re-sit opportunity will be provided.

Attendance policies also apply to any required class excursion, with the exception that some class excursions cannot accommodate any tardiness, and students risk being marked as absent if they fail to be present at the appointed time.

Unexcused absences will lead to the following penalties:

Percentage of Total Course Hours Missed	*Equivalent Number of Open Campus Semester classes*	*Minimum Penalty*
Up to 10%	1 content classes, or up to 2 language classes	Participation graded as per class requirements
10 – 20%	2 content classes, or 3-4 language classes	Participation graded as per class requirements; students' grade will be reduced with 3%, **written warning**

More than 20%	3 content classes, or 5 language classes	Automatic **course failure**, and possible expulsion

<u>Weekly Schedule</u>

NOTE: this schedule is subject to change at the discretion of the instructor to take advantage of current experiential learning opportunities.

Week 1: Orientation Week

Class 1:1 Introductory Concepts

This opening lecture will introduce the students to GIS and map analysis.

Reading:
Longley et al. (2011) Chapter 1; Longley et al. (2011) Chapter 3; Harley (1989)

Week 2

Class 2:1 Spatial Referencing Systems, ArcGIS and GIS data

Students will gain knowledge of concepts and principles of spatial referencing systems. They will also be introduced to ArcGIS (Vector GIS) and GIS Data Structures during the lab session. They will apply what they have learned by gathering GPS coordinates for major Copenhagen tourist sites in the city center and mapping them.

Reading:
Longley et al. (2011) Chapter 4

Class 2:2 GIS Basics

Students will learn about the Vector or Object GIS and its capabilities. They will also be introduced to uncertainty in Spatial Data and Analysis

Reading:
Fisher (2000); Longley et al. (2011) Chapter 7; Goodchild (2000); Guesgen et al. (2000)

Week 3

Class 3:1 Lab Work and Excursion Activity

During the lab session, students will learn about topology and linear addressing, data bases and overlays: buffering, merging, clipping and dissolving. Students will map green spaces and analyzing land use and land cover change in Copenhagen.

Reading: Steven A.Sader; Douglas Ahl; Wen-Shu Liou. 1995. 'Accuracy of landsat-TM and GIS rule-based methods for forest wetland classification in Maine' in *Remote Sensing of Environment* Volume 53, Issue 3, September 1995, Pages 133-144

Class 3:2 GIS Applications 1

In this class, students will explore cartography and map creation as well as raster data sets and their capabilities. Finally, they will learn more about land use, land cover and change detection

Reading:
Haley (1989); Mas (1999); Dengsheng et al (2012)

Week 4

Class 4:1 Creating Vegetation, Environmental Indices (Ndvi) and GIS Environmental Applications

Students will learn about creating vegetation and environmental indices (NDVI). During lab, they will be using online GIS and Remote Sensing platforms, such as Earth Engine, Global Forest Watch, for analyzing deforestation in the Amazon.
❖ Midterm Exam

Reading:

Host et al. (1996) & Rodrigues (2013)

Class 4:2 GIS Applications 2

Students will see how GIS can be used in resource management and conservation. Students will also learn how to prepare data bases and 3D data.

Reading:
Tallis et al. (2009)

Class 4:3 Lab Work

During this lab, students will be using GIS for defining conservation units.

Reading: Y.Q.Wanga; X.Y.Zhanga; Roland R.Draxler. 2009. 'TrajStat: GIS-based software that uses various trajectory statistical analysis methods to identify potential sources from long-term air pollution measurement data', in *Environmental Modelling & Software* Volume 24, Issue 8, August 2009, Pages 938-939

Week 5

Class 5:1 GIS, Environment and Society

Students will be introduced to global footprint mapping and environmental justice mapping.

Reading:
Sanderson et al. (2002); Jordon et al. (2011); Klaussner (2014)

Class 5:2 Merging Human Demographics and Environmental Data

Students will learn how to merge human demographics and environmental data. During lab, they will be introduced to concepts such as spatial queries; attribute (field) calculations, location and distance calculations. They will practice the use of GIS to manage and extract environmental and social data, how to use existing datasets to create new layers, such as indices, and how to use GIS to sample layers and obtain data for statistical analyses. The city of Copenhagen will be used as a case study.

Reading:
Alessa et al. (2008)

Class 5:3 Presentations

In-class presentations. Recap of course material.

❖ Class presentations

Week 6

Class 6:1 GIS and the Future

Students will learn how to use GIS to predict and cope with global environmental change through the application of remote sensing and environmental monitoring.

Reading:
Cadenasso et al. (2007); Kozak et al. (2008)

Class 6:2 Lab Work

During this lab, students will practice how to use remote sensing data in GIS for Global Environmental Enforcement. As an activity, they will map the future of our global environment.

❖ Final Exam

Course Materials

Readings

Alessa, L., Kliskey, A., & Brown, G. (2008). Social–ecological hotspots mapping: A spatial approach for identifying coupled social–ecological space. Landscape and Urban Planning, 85, 1, 27-39.

Cadenasso, M. L., Pickett, S. T. A., & Schwarz, K. (2007). Spatial heterogeneity in urban ecosystems: reconceptualizing land cover and a framework for classification. Frontiers in Ecology and the Environment, 5, 2, 80-88.

Dengsheng, L. et al (2012): Land use/cover classification in the Brazilian Amazon using satellite images. Pesquisa Agropecuária Brasileira 47, 9. http://www.scielo.br/pdf/pab/v47n9/04.pdf

Fisher, P. (2000). Sorites paradox and vague geographies. Fuzzy Sets and Systems, 113, 1, 7.

Foley, J. A., Defries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Snyder, P. K. (2005). Global consequences of land use. Science (New York, NY), 309, 5734, 570-4.

Guesgen, H. W., & Albrecht, J. (2000). Imprecise reasoning in geographic information systems. Fuzzy Sets and Systems, 113, 1, 121-131

Goodchild, M.F. (2000). Introduction: special issue on `Uncertainty in geographic information systems'. Fuzzy Sets and Systems, 113, 1, 3-5.

Harley JB. Deconstructing the map. (1989). Cartographica: The international journal for geographic information and geovisualization 26(2):1-20.

Host, G. E., Polzer, P. L., Mladenoff, D. J., White, M. A., & Crow, T. R. (1996). A quantitative approach to developing regional ecosystem classifications. *Ecological Applications*, *6*(2), 608-618.

Jordan, L., Stallins, A., Stokes, I. V. S., Johnson, E., & Gragg, R. (2011). Citizen mapping and environmental justice: Internet applications for research and advocacy. Environmental Justice, 4, 3, 155-162.

Klaussner, G.H.B. (2014): Assessing Urban Environmental Justice in two subprefectures of São Paulo, Brazil – a GIS-based synoptic analysis. Technische Universität Berlin. https://www.urbanmanagement.tu-berlin.de/fileadmin/f6_urbanmanagement/Study_Course/student_work/2014_Guilherme_Klaussner.pdf

Kozak, K. H., Graham, C. H., & Wiens, J. J. (2008). Integrating GIS-based environmental data into evolutionary biology. *Trends in Ecology & Evolution*, *23*(3), 141148.

Longley, Paul A., Michael F. Goodchild, David J. Maguire, David W. Rhind. 2011. Geographic Information Systems and Science, Third Edition. John Wiley & Sons, New York. 539pp.

Maantay, J. (2007). Asthma and air pollution in the Bronx: methodological and data considerations in using GIS for environmental justice and health research. Health & Place, 13, 1, 32-56.

Mas JF. (1999). Monitoring land-cover changes: a comparison of change detection techniques. International journal of remote sensing 20, 1, 139-52.

McHarg, Ian. (1971). Processes as Values. In Design with Nature. The Falcon Press: Philadelphia, PA. pg 103-115.

Rodrigues M. et al (2013): Land cover map production for Brazilian Amazon using NDVI SPOT VEGETATION time series. Canadian Journal of Remote Sensing, 39, 4, 277-289. http://www.scielo.br/pdf/pab/v47n9/04.pdf

Sanderson EW, Jaiteh M, Levy MA, Redford KH, Wannebo AV, Woolmer G. (2002). The Human Footprint and the Last of the Wild: The human footprint is a global map of human influence on the land surface, which suggests that human beings are stewards of nature, whether we like it or not. BioScience. 52, 10, 891-904.

Silayo H.E (2002) Cartography in a GIS Environment. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. XXXIV, Part 6/W6.

Tallis, H., & Polasky, S. (2009). Mapping and valuing ecosystem services as an approach for conservation and natural- resource management. *Annals of the New York Academy of Sciences*, *1162*(1), 265-283.

Y.Q.Wanga; X.Y.Zhanga; Roland R.Draxler. 2009. 'TrajStat: GIS-based software that uses various trajectory statistical analysis methods to identify potential sources from long-term air pollution measurement data', in *Environmental Modelling & Software* Volume 24, Issue 8, August 2009, Pages 938-939

Steven A.Sader; Douglas Ahl; Wen-Shu Liou. 1995. 'Accuracy of landsat-TM and GIS rule-based methods for forest wetland classification in Maine' in *Remote Sensing of Environment* Volume 53, Issue 3, September 1995, Pages 133-144