

A Needs Analysis report

for the masters course

GEO-INFORMATION SCIENCE and EARTH OBSERVATION

for

ENVIRONMENTAL MODELLING AND MANAGEMENT

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Executive Summary – Needs Analysis

This report contains the results of a needs analysis of the Erasmus Mundus masters course entitled: "Geo-Information Science and Earth Observation for Environmental Modelling and Management" (GEM Program), jointly presented by ITC – Netherlands, Southampton University – UK, Lund University – Sweden and Warsaw University - Poland. The analysis was conducted by Nichola Knox, Netherlands as an independent consultant. The analysis was conducted primarily as a desk study, it also included a short questionnaire distributed to GEM alumni. The report is structured based on questions required for the needs analysis report.

To focus the scope of the analysis, only geo-information (GI) masters courses that were delivered in English have been compiled for comparison with the GEM program. It is likely that the same trends will be observed for courses delivered in other languages. It was clear from the wide range of GI courses on offer globally that there is a demand for producing trained staff to be able to carry out practical work that involves implementation of GI technologies. The large number of postgraduate courses on offer within the GI field provides an indication of the potential for growth and research into this still relatively new field. In total 66 GI type masters courses were presented at universities around the world, 44 of these courses combine GI and Environmental issues. Although only masters courses are presented in this analysis there were numerous GI courses offered as certificate level courses and short courses for professionals wishing to bridge their knowledge gap.

Nine (including the GEM program) joint master degree programmes were found that include a focus onto GI technologies. The GEM program is the only one that is spread across four countries, most are collaborations between two international universities or multiple departments within one university. Another Erasmus masters program includes three universities, but focuses only on the technical aspects of GI and does not look into the applications of GI. The applied course content combined with unique living and studying in four countries, together with students from all around the world, expands the depth of the GEM program to be a program that not only offers a top quality qualification, but also a cultural adventure.

Although the questionnaire was not answered by all alumni, from the responses it is already clear that the GEM program has achieved its objectives and could be considered a course that contributes to European education excellence. Ninety one students have graduated from the program in the four years of graduations. Considering three of the four years (this fourth year - 2009- graduated students only completed the course 1 month ago) there is current knowledge on 34 of the alumni. Thirty eight percent of these have continued on for further doctoral studies, 38 % have found employment in either a GI field, environmental field or a field that combines both, 17 % have found employment in another field and only 5% are still unemployed (or still looking for funding for doctoral studies). The GEM program has thus been successful in mobilising individuals and providing them with the tools to find work or study opportunities in GI or environmental fields.

Employers particularly in the environmental field have become aware of the need for spatial sciences to be integrated into environmental work. The demand for training in this combined field is thus a priority for those wishing to pursue a career related to environmental issues. There is undeniably a down turn in employment opportunities as a result of the economic crisis. But if Europe and the rest of the world follows the lead of the United States drive on "Green Energy" and "Green applications", then there will continue to be a need for environmental managers and people with GI training. As long as there is this need there will be suitable motivation for students to pursue a combined study in Geo-information and Environmental management. It might however be wise for the GEM program to include in their program some focus on environmental procedures that link to "Green" technologies.

GEM Needs analysis

Do courses exist with a similar thematic field elsewhere in the world? Describe the polytechnics and/or universities and the type of courses offered.

In a survey of universities presenting courses we searched only for GI masters courses linked to purely theoretical/technical components and courses that combine theoretical aspects to applications linked to environmental processes or management (Table 1). A number of other masters levels courses were also identified that combine theory with applications in social and urban planning environments, but are not listed here. Globally GI courses are also offered in many other languages, we have presented here only those masters courses offered in English, we believe this provides a reflection into the demand that would exist for the subject irrespective of language.

At universities most of the GI courses are offered as postgraduate courses, either as full masters or PhD level courses. Entrance requirements for the courses listed in the table below either required an undergraduate degree in Engineering, Physics, or Mathematics for the very technical degrees (e.g. Munich, Maine, Colorado) or for the more applied programs an undergraduate degree in Geography, Environment Field or Earth Sciences was required.

For most of these institutes listed and many additional institutes GI courses (either for certificate level or bridging courses) were delivered to cater for professionals or students without a university degree, but wishing to expand or bridge there knowledge in either GI or Environmental fields. In order to compare directly with the GEM program only Masters level courses are presented in Table 1.

Table 1: GI Masters courses delivered in English. The Program names and the associated university and departments or faculties in which they are taught are provided. The courses focus on either purely technical aspects of geoinformation systems (Technical), or combine theoretical and application of geoinformation to environmental issues (Technical and Applied). The associated weblinks to each of these programs is given in Appendix 1 of this report

Institute	School/Dept	Program	Technical/Applied
Europe and UK			
University Aberdeen	College Physical Science	Geospatial Information Systems	Technical
University Brighton	Environment and Technology	MSc GIS and environmental management	Technical and Applied
City University - London	Information Science	Geographic Information Systems OR Geographic Information Management	Technical OR Technical
Cranfield University	Environment and Water courses	Geographical Information mgt	Technical and Applied
University of Hull	Geography	GIS and Environmental Modelling	Technical and Applied
Kingston University - London	Distance courses	Applied Geographical Information Systems OR Geographical Information Systems and Science	Technical OR Technical
Kings College London	Environmental Monitoring, Modelling Group	Environmental Monitoring, Modelling and Management	Technical and Applied
University London - Birbeck	Geography	Geographic Information Science	Technical (Full time or Part Time)
Aberstwyth University	Institute Geography and Earth Sciences	GIS and Remote Sensing	Technical & Applied
Bournemouth University	School Conservation Sciences	Environmental Infomatics	Technical & Applied
Manchester Metropolitan	Environmental and	GIS and Spatial Analysis	Technical & Applied

University of Manchester	Geographical Sciences Environment & Development	Geographical Information Science	Technical & Applied
University Leeds	Geography	Geographical Information Systems for Catchment Dynamics and Management OR Geographical Information Systems	Technical & Applied OR Technical & Applied
University of Edinburgh	School of GeoScience	GeoSciences – topic choice	Technical & Applied
University of Leicester	Geography	Environmental Informatics	Technical & Applied
University of Salford	Environment & Life Sciences	Applied Geographical Information Systems and Remote Sensing	Technical & Applied
Coventry University	Business, Environment and Society	Environmental Hazards & Geographical Information Systems	Technical & Applied
University of Glamorgan	Faculty Health, Sport and Science	Conservation and GIS	Technical & Applied
University of Nottingham	Institute of Engineering Surveying and Space Geodesy	Environmental Management and Earth Observation	Technical & Applied
University of Nottingham	Geography (course content mixture from centre from geospatial science and SPLINT)	Geographical Information Science	Technical & Applied
Sheffield Hallam University	Geography	Geographical Information Systems	Technical & Applied
University Portsmouth	Geography	Geographical Information Systems	Technical
Stuttgart University of applied science	International masters	Photogrammetry and Geoinformatics	Technical
ITC - NL	International masters	Various fields of GIS and RS	Technical & Applied
Royal Institute of Technology, Stockholm	Architecture and the Built Environment	Geodesy and Geoinformatics	Technical
Technical University, Munich	Faculty of Civil Engineering and Geodesy	Earth Oriented Space Science and Technology (ESPACE)	Technical
Utrecht University	Geography	Physical Geography – GIS/RS specialisation	Technical & Applied
Helsinki University	Faculty Science	Geoinformatics	Technical & Applied
USA			
Florida state University	Geography	Geographic Information Science (PM)	Technical
University Iowa	Geography	Geographic Information Science	Technical
St Mary University Minnesota	Business and Tech.	Geographic Information Science	Technical
Murray state university, Kentucky	Geosciences	Geoscience	Technical
University Maine	Spatial Information Science and Engineering	Spatial Information Science and Engineering	Technical
Virginia Tech	Geography	Geographic Information Science and Remote sensing	Technical & Applied

University Colorado, Boulder	Aerospace engineering science	Remote sensing, Earth and Space sciences	Technical
Redlands University	College Arts & Sciences	Geographic Information Science	Technical & Applied
University Southern California	Online	Geographic Information Science and Technology (GIST)	Technical
Pennsylvania State – World Campus	Online	Geographic Information Systems	Technical
Ohio State University	Mathematical and physical sciences	Geodesy, photogrammetry or mapping	Technical
University Denver	Geography	Geographic Information Science	Technical & Applied
Ball State University	Geography	Geography – specialises in various GIS/RS fields	Technical & Applied
California State University-Northridge	Geography	Geography- with GIS as full specialisation	Technical & Applied
Indiana University- Purdue University Indianapolis	Geography	Geographic Information Science	Technical & Applied
St Cloud State University	Geography	Geographic Information Science	Technical & Applied
Salem State College	Geography/Geology/Physics	Geo-Information Science	Technical
University Texas – Dallas	School of Economic, Political and Policy Sciences	Geospatial Information Sciences	Technical & Applied

Canada

University of Calgary	Geography	Geographic Information Systems	Technical & Applied
Queens University	Geography	Geography -GIS/RS specialisation	Technical & Applied
Simon Fraser University	Geography	Geography – Spatial Info science and Remote Sensing specialisation	Technical & Applied
University Victoria	Geography	Geography – multiple specialisations	Technical & Applied

Australia

Sydney University	Geosciences	Applied Science (Spatial Information Science) – coursework or research	Technical & Applied
University Southern Queensland	Engineering & Surveying	Spatial Science Technology Geomatics	Technical
Curtin University of Technology	Spatial sciences	Geospatial science	Technical
James Cook University - Australia	Science and Engineering	Geographical Information Systems	Technical & Applied
RMIT	Mathematical and Geospatial sciences	Geospatial Science	Technical
Melbourne University	Engineering	Geographic Information Technology	Technical
University New England - Aus	Environmental and Rural Science	Geographic Information Science	Technical & Applied
University New South Wales	Biological, Earth & Environmental Sciences	Spatial Information	Technical & Applied
University Queensland - Aus	Geography, Planning and Environmental Management	Geographic Information Science (research or theory)	Technical & Applied
University Western Australia	Natural and Agricultural Sciences	Geographical Information Systems (research or theory)	Technical & Applied

		Other	
UNIGIS	Online	GIS	Technical
University Stellenbosch, RSA	Geology, Geography and Environmental Studies	GIS (Environmental Geography)	Technical & Applied
Witwatersrand University, RSA	Geography, Archaeology and Environmental Studies	Geography (GIS specialisation)	Technical & Applied

Describe in what way these courses pay attention to environmental aspects and/or geoinformation?

66 different Masters courses in GI or GI with Environmental management focus, delivered at universities in English were identified. Of these courses 25 focus on delivering the theoretical and technical aspects of GIS to students. Most of the technical courses have as their objectives a goal to provide students with the necessary background to develop and expand on new GIS technologies. The focus of these courses tends to vary between an in depth focus into the physics and mathematics behind the technology, or into the software technology used to implement spatial analyses.

Forty-four of the 66 courses combine theory of both GIS technologies to applications in environmental issues, both the topics are expected to be integrated into final thesis work. For these combined courses principles of GIS and Remote Sensing are covered and different aspects into the applications of these tools into environmental issues are covered. Unlike the purely technical courses these combined courses do often not cover in-depth the physics or mathematics involved in GI technologies, but rather provide the means for GI to be used intelligently as an applied tool.

Are there other international university consortia offering a multiple and/or joint degree in similar thematic fields?

In addition to the 66 masters courses listed in Table 1 that are offered within individual departments of universities, 8 other joint degree programs (JDP), excluding the GEM program, were found to deliver GIS related masters courses in English (Table 2). These programs are either programs formed between multiple departments within the same university or between multiple universities. The Environmental RS and GIS course and the Geographic Information Science for Development and Environment course are JDP that are created between multiple departments within the same university. The six remaining programs were offered between multiple institutes.

Table 2: The delivering institutes and there joint degree programs offered. The programs contain at least a geospatial theme, but for most an applications based theme is combined in the program.

Program	Delivering institutes	Webpage
Environmental RS and GIS	Boston University: Different departments (Geography, Biology, Earth Sciences and International Relations)	http://web.bu.edu/cees/grad/gis.html
International program in Integrated assessment	University Twente and Osnabrueck University	http://www.usf.uos.de/IA/MScIA_Program_of_Study.html
Geo-Information for Spatial Planning and Risk Management Study Program	Gadjah Mada and ITC	http://geo.ugm.ac.id/en/programs/magister/
Earth Observation	Katholieke universiteit – Leuven and Purdue University	https://www.kuleuven.be/onderwijs/aanbod2007/opleidingen/E/SC_50543360.htm
Geographical Information Management and Applications	TU Delft; WUR; Utrecht and ITC	http://www.msc-gima.nl/

Geographic Information Science for Development and Environment (GISDE) Program	Clark University, Centre International Development, Community and Environment (IDCE) and School of Geography	http://www.clarku.edu/departments/idce/academicsGradGISDE.cfm
Integrated Land Management in Drylands	United Nations University; Institut des Régions Arides, Tunisia; Institut National Agronomique de Tunisie, Tunisia; The Cold and Arid Regions Environmental & Engineering Research Institute of the Chinese Academy of Sciences (CAREERI, P.R. China); Arid Land Research Center, Tottori University; and the Global mechanism (UNCCD)	http://www.inweh.unu.edu/inweh/drylands/MS.htm
Geospatial Technologies (Erasmus)	University of Münster; Universitat Jaume I; Universidade Nova de Lisboa	http://geotech.University-muenster.de

What is the added value of the GEM course compared to courses that exist in the same / similar fields at national and international level?

Based on the replies from a short questionnaire sent to GEM alumni, many had considered/investigated attending courses based either in their own country or at a single university, but for the reasons listed below found the GEM program more attractive:

- The opportunity to study at four leading international institutes in courses related to both Environmental management and GIS. This detail was the greatest drawback for most of the students
- The fact that the four institutes were located in four different countries and thus provide the opportunity to not only study at world renowned institutes but also live, experience so many countries.
- Chance to meet with such a broad group of lecturers and scientists in the GI and Environmental field.
- All the courses are taught in English and thus learning different languages for coursework is not necessary.
- The opportunity to receive a scholarship to attend the course for international students (this was a weakness from EU students who found the course to be very expensive if paying from their own budgets. EU students found funding opportunities were not readily available)
- That students are assisted with obtaining all necessary visa's for living in these four countries
- In hindsight respondents found a great strength of the program was not only living in the four different countries, but also that other class participants were international and thus different cultures were combined all into one program.

Does the GEM course contribute to European university excellence and European competitiveness?

University excellence and competitiveness is generally assessed in terms of research output generated. For global comparisons this assessment is made focusing on articles published in journals with high citation indexes. Producing such a publication is not possible within the time frame of the research period within the GEM program. The research output required from the program is a high quality thesis which is researched, written and defended. The possibility of extending these theses into a publication following graduation is possible. The GEM program is still a relatively young program, having only had 4 intakes thus far, none-the-less from these intakes 91 theses have been produced.

In completing this needs analysis a small questionnaire was sent out to the GEM alumni. Only 31 out of the 91 alumni responded in time (alas a very limited response time was possible) to be included in this report. From the GEM 2005 program we had the most respondents, 13 out of 26 possibles. From these respondents there have already been two papers published in ISI journals, another paper was presented at a conference and another three papers are in the pipeline for publication. Already a very promising outcome towards considering the GEM program to be a course of excellence!

Given the time required to produce a scientific publication and the design of the GEM program a more appropriate means to assess the excellence of this program should be used. The introduction to the GEM program for prospective students (<http://www.gem-msc.org/content/introduction/>) states that the course:

“gives you excellent qualifications for employment at research institutes, in government, in companies, as well as in public-private partnerships”

The best means to thus assess this claim and the excellence of this course is to determine the number of alumni that have found work (preferably in a linked field) or have been accepted into PhD programs.

91 alumni have successfully graduated from the GEM program, since its inception year in 2004. Twenty eight of these alumni just graduated 2 months prior to this report, and thus are not included in this assessment. Of the remaining 63 alumni, we were able to obtain information on the employment status of 34 of these:

- 13 have continued on with doctoral studies
- 6 have been employed – in the field of GIS/RS
- 2 have been employed – in the field of Environmental management
- 5 have been employed – both linked
- 6 have been employed – in a different field or field not specified
- 2 are still unemployed

This does not give a complete overview of the GEM program output, but it does show that for many of those graduating from the GEM course they find work opportunities, and the majority of work obtained is within a field covered by courses offered in the GEM program.

How many students/graduates are produced by the similar courses?

Unlike the GEM program, the other courses did not provide information on the number of students graduating from their courses or provide their thesis on-line. An assessment of the graduates produced by these other programmes was thus not possible.

What is the demand for graduates within the thematic field worldwide? In what type of organisations do graduates work?

The objectives of many of the courses offered worldwide specified that graduates from their courses would be qualified (and had been employed) to work in the following organisations:

Government (e.g. those dealing with agriculture, forestry, natural resource management, and combating desertification), industry (some were specific about types e.g. water industry, agro industry), non-profit organisations, environmental consultancy, teaching, research institutions, regulatory agencies and for all of them the possibility of continuing on for further doctoral research.

What is the motivation for students to participate in a course linking environmental aspects with geo-information science?

In many of the environmental fields, practitioners have realised that the spatial component is an integral component to understanding the functioning of ecosystems. The offshoot of this is that industry, government and research institutions have realised they need to either employ or train individuals that will be able to analyse spatial problems. Many undergraduate programmes now offer introductory level courses of GIS and Remote sensing. But the real means to apply this technology to environmental problems is only achieved at postgraduate levels. Employers now require from potential employees to have knowledge and experience on applying spatial answers to their problems.

On the technological side integration of GI into environmental problem solving is still new. Much work still

needs to be done on creating GI technologies and programs that can be readily applied to help solve environmental problems.

These two gaps in the market appear to be the primary motivation for students to participate in programs such as the GEM program. Other individuals that have studied or been involved in environmental work have realised this gap in their own personal knowledge and this is for them the motivation to participate in such a joint course. Students seeking to try and make advances in new GI applications that can be applied to help solve the environmental issues may either join a course such as the GEM program or rather find a program that is more theoretical and software technology based.

Appendix 1

In this table we provide the links of the different universities to their actual web-pages where they offer their GI courses. These links were created in April 2009, and might be replaced by the beginning of the new academic years.

Institute	Link
University Aberdeen	http://www.abdn.ac.uk/prospectus/pgrad/study/taught.php?code=gis
University Brighton	http://www.brighton.ac.uk/set/courses/postgraduate/environment/gis_environmental.php?PageId=313
City University - London	http://www.soi.city.ac.uk/organisation/is/research/giCentre/courses/masters.html
Cranfield University	http://www.cranfield.ac.uk/students/courses/page1503.jsp
University of Hull	http://www.hull.ac.uk/geog/MastersGIS.html
Kingston University - London	http://www.kingston.ac.uk/pggismgt/
Kings College London	http://www.kcl.ac.uk/schools/sspp/geography/masters/courses/msc/emmm.html
University London - Birbeck	http://www.bbk.ac.uk/study/pg/geography/TMSGGINS.html
Aberstwyth University	http://www.ies.aber.ac.uk/en/teaching/courses/postgraduate/gis-and-remote-sensing
Bournemouth University	http://onlineservices.bournemouth.ac.uk/courses/Course.aspx?course=506&school=CS&level=pg&code=MSEI&mode=ft_pd
Manchester Metropolitan University	http://www.egs.mmu.ac.uk/gis-spa.htm
University of Manchester	http://www.manchester.ac.uk/postgraduate/taughtdegrees/courses/atoz/course/?code=07053&pg=2
University Leeds	http://tldynamic.leeds.ac.uk/pgprospectus/taught_getprogs.asp?prog_id=466 OR http://tldynamic.leeds.ac.uk/pgprospectus/taught_getprogs.asp?prog_id=461
University of Edinburgh	http://www.geos.ed.ac.uk/
University of Leicester	http://www.le.ac.uk/geography/postgraduate/msc_ei.html
University of Salford	http://www.els.salford.ac.uk/courses/pginfo.php?course_id=1506
Coventry University	http://wwwm.coventry.ac.uk/postgrad/postgraduate/pages/pgft_BusinessEnvironmentSociety.aspx?itemID=40
University of Glamorgan	http://www.glam.ac.uk/coursedetails/685/459
University of Nottingham	http://pgstudy.nottingham.ac.uk/postgraduate-courses/environmental-management-and-earth-observation-masters-msc_55.aspx
University of Nottingham	http://pgstudy.nottingham.ac.uk/postgraduate-courses/geographical-information-science-masters-msc_261.aspx
Sheffield Hallam University	http://prospectus.shu.ac.uk/op_pglookup1.cfm?id_num=139

University Portsmouth	http://www.port.ac.uk/courses/coursetypes/postgraduate/MScGeographicalInformationSystems/
Stuttgart University of applied science	http://www.hft-stuttgart.de/PhotogrammetryGeoinformatics
ITC - NL	www.itc.nl
Royal Institute of Technology, Stockholm	http://www.infra.kth.se/impgg/
Technical University, Munich	http://www.espace-tum.de/espace.html
Utrecht University	http://www.uu.nl/EN/informationfor/internationalstudents/physicalgeography/Pages/study.aspx
Helsinki University	http://www.helsinki.fi/geography/gimp/
Florida state University	http://www.coss.fsu.edu/geography/
University Iowa	http://www.uiowa.edu/~geog/giscience/giscience.shtml
St Mary University Minnesota	http://www.smumn.edu/GIS.aspx
Murray state university, Kentucky	http://www.murraystate.edu/qacd/cos/geo/geos.htm
University Maine	http://www.spatial.umaine.edu/
Virginia Tech	http://www.geography.vt.edu/PROGRAMS/graduate.htm
University Colorado, Boulder	http://www.colorado.edu/aerospace/rss_focus.html
Redlands University	http://www.institute.redlands.edu/msgis/
University Southern California	http://college.usc.edu/gist/masters/index.cfm
Pennsylvania State – World Campus	http://www.worldcampus.psu.edu/MasterinGIS.shtml
Ohio State University	http://geodeticscience.osu.edu/Academics_Grad_GeoSci.htm
University Denver	http://www.geography.du.edu/degrees/ms-gis/
Ball State University	http://cms.bsui.edu/Academics/CollegesandDepartments/GradSchool/Academics/ProgramsofStudy/MastersDegrees/Geography.aspx
California State University-Northridge	http://www.csun.edu/csbs/departments/geography/resources/graduate_program.html
Indiana University- Purdue University Indianapolis	http://www.iupui.edu/~geogdept/graduate/msgis.html
St Cloud State University	http://bulletin.stcloudstate.edu/gb/programs/geog.asp#gis
Salem State College	http://www.salemstate.edu/graduate/msgeo/
University Texas - Dallas	http://www.utdallas.edu/admissions/graduate/degrees/detail.php?d=311
University of Calgary	http://www.ucalgary.ca/mgis/
Queens University	http://geog.queensu.ca/gisc.asp
Simon Fraser University	http://www.sfu.ca/geography/GraduateStudies.html#MScProgram
University Victoria	http://www.geog.uvic.ca/dept2/research.html
Sydney	http://www.science.usyd.edu.au/fstudent/postgrad/coursework/pgc_spatial.sh

	tml
University Southern Queensland	http://www.usq.edu.au/handbook/2009/eng/MSST.html
Curtin University of Technology	http://www.spatial.curtin.edu.au/master_geospatial.html
James Cook University - Australia	http://www.jcu.edu.au/ees/JCUDEV_014029.html
RMIT	http://www.rmit.edu.au/browse;ID=DR031
Melbourne University	http://coursesearch.unimelb.edu.au/coursedetail.aspx?cid=1026&ctype=4&typeall=0&typepg=1&typeug=0&typesc=0&stype=Keyword&sterm=geo
University New England - Aus	http://www.une.edu.au/courses/2009/courses/MGIS
University New South Wales	http://www.handbook.unsw.edu.au/postgraduate/programs/2009/8714.html
University Queensland - Aus	http://www.uq.edu.au/study/program.html?acad_prog=5177
University Western Australia	http://www.fnas.uwa.edu.au/courses/postgraduate/research/msc-gis
UNIGIS	http://www.unigis.org/
University Witwatersrand	http://web.wits.ac.za/Academic/Science/Geography/Postgraduate/Geography/geomasters.htm
Stellenbosch University	http://academic.sun.ac.za/geo/postgraduate.htm#programmes