Put on the map
History and future of geo-information in Wageningen
Acknowledgement

We would like to thank the following persons for their contribution to this book.

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Graphic design and photography: Karel Hulsteijn, Graphic Design and DTP team, Alterra

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This booklet costs € 15,-. This amount is including tax (where applicable) and handling costs. The booklet can be ordered by paying € 15,- to IBAN number NL 83 RABO 036 70 54 612, swift number RABO NL 2u, by name of Alterra, Wageningen UR. Please refer to '15 years geo-information' and state your name and postal address. Otherwise, to pay by credit card (Visa, Mastercard), first send an e-mail to info.dow@wur.nl.

Wageningen, October 2004.
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Epilogue: Its own right 60
Studying in Wageningen means studying in an unusual environment: students from all around the globe, and in a building which is as unusual as the teaching methods. Doors to deacons' offices have always been open, people knew me by name as well as by the achievements and struggles I encountered. And such struggling. It took me many long conversations and repeated try-outs to understand how to report analytical research. My problem was not my reporting skills, but the fact that I relied entirely on intuition to solve a given problem situation. But when a problem gets too complex, a scientist's eye is needed. Never did my mentors stress my incompatibility. They pushed me to do what I thought was impossible, and guess what…. it turned out to be possible after all!

Menno Ribbens
MSc graduate Geo-Information Science, Wageningen University, 2003
GIS consultant, Saricon bv, Safety & Risk Consultancy, Heerjansdam, the Netherlands
Three decades ago digital techniques made their appearance in the Wageningen research and education arena. With digital cartography in soil mapping, digital imagery (remote sensing) for yield forecasting and vegetation monitoring, and satellite navigation for location (positioning), Wageningen definitely belonged to the early adopters of such techniques.

In retrospect, it is tempting to sketch our history from this incubation phase to our present flourishing CGI, the Centre for Geo-Information, in terms of a logical sequence of events. But such an orderly notion only demonstrates our inclination to arrange historical facts to a set predictability, not the actual course of events. Maybe a skilled fortune-teller could have seen CGI's fate in a crystal ball, but ordinary mortals must conclude that this Centre's present position is the result of unpredictable occurrences. The most decisive occurrence being the merger between Wageningen University and the numerous national agricultural research institutes, to form Wageningen University and Research Centre. Fundamental and applied research met within this merger and the Centre for Geo-Information - offering both education and research - was born. Quality and dedication of individual researchers and teachers have been the decisive factors that have led to the establishment of the MSc programme Geo-Information Science and the sound foundation of the Centre for Geo-Information. By co-operating beyond national borders, a true multinational nucleus has been established, continuously making progress in their field. Occurrences may seem unexpected, but they rarely emerge out of the blue or without a cause. Actions and decisions of individuals initially regarded
seemingly disconnected have turned out to be a key to failure or success. Geo-information and remote sensing in Wageningen could never have developed to the current prominent level and range without the foresight and stamina of a number of our scientists, who we regard as our founding fathers. One of them recently phrased this outcome 'a 100% success resulting from 40% quality, 40% dedication, 40% good luck, and finally minus 20% bureaucratic loss'.

Brooding on the position of GIS and remote sensing at Wageningen University in 2020 may be a sign of over-confidence. And as pride comes before a fall, let's not speculate too much. But in this booklet we will take a peek into the future through the eyes of students, alumni and staff. You see, we still don't believe in crystal balls.

Happy reading.  
Prof.dr. W. van Vierssen  
General Director  
Environmental Sciences Department, Wageningen University and Alterra
1 Mastering geo-information sci
What struck me most during my first week was how many people come from so many different countries of the world. There are a lot of great social events in Wageningen and the best of all is the global village day, where each student shows their culture, food, dance - for the other university communities and other Wageningen residents. This shows that Wageningen is a university which encourages diversity and welcomes different cultures and makes you feel at home. Mind you, the Ethiopian cultural show (our team) won the event.

Assefa Tadelle Worese
MSc graduate Geo-Information Science, Wageningen University, 2004
Tigray Urban Development Center, Adwa, Ethiopia
A palette of international students

Fifteen years of international education in geo-information and remote sensing have made our MSc programme Geo-information Science (MGI) what it is today: a challenging learning environment for students from all over the world. And the Dutch are even outnumbered by their global study mates. Between 1990 and 2003, of the 169 students who took part in Wageningen’s various MSc GIS-programmes, about 17% were Dutch. The other 83% is made up of 29 nationalities. Topping the list are Ethiopia (22), China (17) and Spain (15). The MGI’s students not only differ in nationality but also in their previous BSc education - the orientation and discipline. Such an international setting offers both Dutch and international students an excellent opportunity to improve their ability to function in a professional world. Due to the integration of the internationally oriented MSc in geo-information science and the specialisation in geo-information science in the current MGI programme, the percentage of Dutch students recently increased to about 40%.

Our students are encouraged to develop a critical and independent attitude towards science and towards the development of scientific ideas. This important criterion is for instance used when evaluating the MSc thesis. While working on the MSc thesis students can also show their individualism - another core competence of the MGI. On the other hand, much of the course work is done in co-operation, with students working in small groups. To judge each student’s competencies adequately and fairly, his or her performance should be assessed with regard to various tasks and learning environments. Within Wageningen, MGI offers one of the more practically oriented MSc programmes. We try to balance this practicality with an academic environment where students work independently and acquire a theoretical understanding of the field of work. Nevertheless, some students still express a wish for an even more hands-on mentality in the curriculum.
**Region of origin**

![World map showing regions of origin with corresponding percentages.]

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Developing international competencies

Learning is more than acquiring mere knowledge and skills. Learning is now regarded as the development of competencies. Organisations and companies who seek personnel capable of applying acquired knowledge and skills have encouraged this new educational approach. Momentarily in the Netherlands, universities are determining which competencies should be pursued within the educational programmes. These ‘exit competencies’ help to internationally define and communicate an employee’s personal qualities.

A competence-based approach is also a helpful tool in determining criteria for admission, in deciding on the preparatory programme prior to admission and in determining the optional part of a student’s programme. Though general criteria for admission to the MGI programme have been developed for graduates from some Dutch professional BSc programmes, additional individual assessment remains the norm.

More importantly, Wageningen University implemented the objective of the Bologna Declaration on Higher Education, set by the European Ministers of Education in 1999. This declaration aims at creating more convergence between the European education systems. By introducing the Bachelor-Master structure in the entire European Union students have more flexibility in their choices in internationally oriented educational programmes. But BSc exit competencies
vary strongly between students applying for a MSc programme elsewhere. These differences are related to a student’s cultural preferences, orientation of the BSc (scientific or professional) and his or her disciplinary knowledge. Tuning the selection of courses towards a student’s personal needs can satisfactorily tackle such differences. Wageningen University is now offering a number of MSc programmes with exit competencies fit for both Dutch and international students. Also, since September 2002 Wageningen University offers 16 international BSc programmes and 27 at MSc level. Our international programmes, such as the MGI programme, are successful as we train knowledge and skills at an academic level and address differences in cultural attitudes and preferences in a respectable manner.

By splitting the core competencies into more detailed sub-competencies we can determine which level of theoretical knowledge, proven skills and manifest attitudes is required for the core competence. These sub-competencies are used to translate core competencies into specific learning objectives for each course. For each learning objective we must decide to which level a student should fulfil the competencies. By determining so evidently which competencies are pursued we can clearly communicate to our diverse range of students what can be expected of them during the study and once they have completed the programme. The defined competencies also underline the academic character of the MSc programme.
A melting pot of BSc’s

As there is no BSc programme Geo-Information Science in Wageningen, students come from all over the world and have different knowledge, skills and experiences. What are these differences and what do they mean for the approach to and performance during the MSc?

Differences in BSc orientation
Graduates with a university bachelor are generally more oriented towards science while graduates with a BSc from a polytechnic college or comparable institution show more interest in technical solutions. Students with a BSc from another Dutch university show academic competencies comparable to those in Wageningen. For admission, mainly the domain of their BSc education is relevant. But of course, we welcome students with different backgrounds and will help them choose a programme set to their needs.

Students with a university BSc perform only slightly better in courses than those with a Dutch professional (polytechnic college) BSc. When comparing specific academic competencies however, differences become prominent - especially where abstract thinking comes in. Because of these differences, students with a Dutch professional BSc follow a preparatory programme before beginning the MGI programme.

Students with a BSc from a foreign university show considerable variations in their personally achieved competencies. It is impossible to generalise on their performance and admissibility. Therefore each student is individually assessed before admission, and an individual course programme is put together after admission, via the optional part of the programme.

Different disciplines
Most MGI students at Wageningen University have a background in environmental sciences. In Wageningen many BSc programmes focus on tackling complex questions on environmental issues in an innovative and academic way. The MGI programme therefore builds on the BScs in the broad field of environmental and natural sciences, with an emphasis on geographic and spatial aspects.
So far there has been a limited number of MGI students with a background in informatics. These students show significant competencies in mathematics, statistics and databases. They perform very well in exams and in practical training. But on the other hand, they frequently have problems in understanding and analysing environmental issues. This hampers them in addressing these issues through geo-information. Therefore these students are advised to take courses in environmental sciences before, or shortly after, admission to the MGI programme.

Students with a background in social sciences rarely follow the MGI programme. Nearly all such students are expected to face serious problems during technical courses like remote sensing and data modelling.

Different cultures

In fact, only a few competencies that have been defined for the current MSc programme Geo-Information Science are not culturally dependent. Yet in spite of the cultural differences, students generally judge the courses and the whole programme very positively. And learning to understand another culture better is considered a good learning experience. The students show striking differences in their attitude towards the study. As these differences are often culturally related, a student’s nationality can have an effect on the grade granted for the thesis. The most relevant cultural differences are:

- hierarchal distance between persons in unequal positions
- solidarity versus competition when working on group assignments
- avoidance of uncertainty through a preference for detailed instructions

Dealing with these cultural differences is not institutionalised - for instance by way of a course in cross-cultural communication - within our Centre for Geo-Information. But of course each staff member learns to work with different cultures and approaches each student as an individual in his or her own respect. Where the programme is concerned, we maintain Dutch academic standards, which are described in the competencies.
A closer look at cultural differences and learning attitudes

*Asking a question isn't always easy*

**Hierarchal distance between persons in unequal positions**
How a student communicates with teaching staff depends on her or his perception of hierarchical distance. In the Netherlands, where hierarchical distance is relatively small, a teacher expects academic students to initiate communication, to follow their own route, to analyse and criticise what they are taught. Students who are accustomed to a large hierarchical distance between themselves and staff encounter more problems than their Dutch study mates when they wish to discuss ideas differing from those presented by their teachers. This is specifically the case when formulating a research proposal and writing a MSc thesis.

*The wish to adapt or excel*

**Solidarity versus competition in group assignments**
In the Dutch society solidarity is rewarded and people strive to co-operate in harmony. This feminine or 'soft' attitude suppresses competition. Dutch students show mutual solidarity, especially when working in groups. And according to Dutch teachers the students who perform at an average level are the norm. This leads to an educational climate where social adaptation and co-operation are rewarded. Employers in countries with a solidarity culture therefore appreciate alumni who possess these 'soft' competencies. A complication accompanying such competencies is the evaluation of a student's individual accomplishments.

*To err is human*

**Avoidance of uncertainty: a preference for detailed instructions**
In a culture that regards mistakes as a sign of personal failure and shame, avoidance of uncertainty is high. Students avoiding uncertainty prefer courses where they have to solve problems accurately in a structured fashion - such as computer programming. They find these courses more academic than the loosely structured courses where unclear problems are presented and students are challenged to develop their own ideas and strategies. But the latter courses are essential for developing academic competencies. In societies where risk avoidance is weak, most students can easily cope with less well-defined assignments.
2 Creating an expert in Geo-Info
I just finished my first year of the MSc Geo-Information Science. I have decided to specialize in spatial data infrastructures. This topic examines opportunities for the exchange of spatial data. I really like the scientific character of this specialization, as a wide range of research field aspects are connected to it. For example cultural aspects - how can we exchange spatial data on nature with Germany, when the Netherlands has a different view on the definition of nature? We also approach technical aspects - what is (already) feasible through use of computers and computer software? Economical elements - what is the adding value of spatial data infrastructures for an economy? And there are even more interesting aspects than these.

Floris van Bree
MSc student Geo-Information Science, Wageningen University, since 2003
Intellectual baggage

Wageningen’s MSc Geo-Information Science (MGI) focuses on solving spatial problems in rural areas and urban fringes through use of geographic information systems (GIS) and earth-observation imagery (remote sensing). We teach our students the scientific, technical and organisational aspects of spatial data infrastructures (SDI), remote sensing (RS), and geo-visualisation. Students learn to recognise, describe and analyse environmental problems, and are taught how to develop prototypes or services. There are courses on the acquisition, storage, analysis and visualisation of spatial data. Students learn how to keep up-to-date with scientific and technical developments in geo-information and what these developments mean for the societal issues they are working on. They learn about technical and organisational aspects of use of geo-information in institutes and companies. Moreover, the application of geo-information science is not only a technical matter: students must be able to assess multidisciplinary problems and to communicate with various stakeholders.

Action to improve our world

The Action Cycle: actions presented on the right half - acquisition, storage, analysis and visualisation of spatial data - belong to the domain of geo-information science. The left part refers to the application domain.
Becoming an expert in 24 months

24 months: that is (at least) how long foreign students say goodbye to their homeland for to follow Wageningen’s MGI programme. During these two years students follow both geo-information science courses and ICT-oriented courses. Each year the students must earn sixty European Credit Transfer Points (ECTS) - equivalent to 1600 hours of study. During the first year students follow ten courses of six ECTS each - some of these courses are compulsory, some can be chosen from a range of optional subjects. During the second year, the students work much more independently, producing an MSc thesis of six months (36 ECTS) and accomplishing an internship of four months (24 ECTS).
A run-down on the courses in Geo-Information Science

During the first year four basic courses address geo-information-related subjects at a level of second or third year BSc. One of these basic courses - Introduction to Geo-information Science - is part of several BSc curricula in Wageningen. The courses Geo-information Tools and Remote Sensing are courses that BSc students can chose as optional modules. The course Research Methods in Environmental Science, on the other hand, forms an integral part of several BSc courses.

Three core courses specifically address the domain of geo-information science. Spatial Data Infrastructure deals with organisation and dissemination of spatial data. Spatial Modelling focuses on analysis, whereas RS and GIS Integration addresses advanced topics in integration of remote sensing and GIS results and visualisation of them. The other two core courses are so-called academic Master clusters - compulsory elements of each MSc programme at Wageningen University. In the first academic Master cluster a student selects two subjects out of four: Project Planning and Management, Philosophy and Ethics, Communication Skills Development and Scientific Writing. In the second cluster, students develop various competencies by working in groups on multidisciplinary cases where geo-information plays a leading role.

Specialisation courses offer a student the possibility to develop specific competencies. Students must choose at least one course out of three: Data Management, Spatial Statistics or Qualus (quantitative analysis of land use systems). Ideal is that the choice is related to a student’s thesis research.

Optional courses greatly vary according to a student’s preliminary training and personal preferences. The maximum time spent on optional courses is four months (24 ECTS) for BSc students from Wageningen University who have already completed all basic modules in their BSc. Other students are advised to use part of the 24 ECTS to develop the competencies they still miss.
During the **MSc thesis** (the individual research project) students train their research competencies. Students determine their own research subject. For inspiration they can review the current research areas at the Centre for Geo-Information (CGI).

The **internship** - or work experience - offers students the opportunity to gain experience in the professional environment of a research institute or commercial company. Students can choose whether they follow their internship in the Netherlands or abroad.
Increasing demand for GI & RS education

The growth in the annual number of students concluding their MSc thesis in geo-information and remote sensing reflects a clear demand for geo-information knowledge and skills. Besides students who follow the MGI programme, there are numerous students from other MSc programmes who write a thesis at our Centre for Geo-Information. Since 1990 the number of students doing a thesis in geo-information science increased at a higher rate than the total influx of students in Wageningen’s Master programmes. Subjects chosen by students writing a thesis on geo-information can be equally divided up over three categories: geo-information applications, remote sensing subjects, and scientifically oriented geo-information subjects.

PhD research: Never to old to learn

Since 1999 CGI has published 225 scientific publications - more than fifty articles appeared in peer-reviewed journals and fifteen books or chapters of books were produced. On average at least six PhD’ers were constantly working on their dissertation during this period. When combined with the so called ‘sandwich PhD construction’ this totals to more than eight PhD positions. PhD research takes four years, during which PhDs are coached within a dual system. On the one hand the university’s graduate school is responsible for the quality and coherence of the university research and the facilitation, guidance and control of the PhD programme. On the other hand, CGI’s staff are responsible for coaching the PhD to carry out state-of-the-art research and scientific excellence. All our research should be academically rigorous and practically relevant. Our research should make a real contribution to the academic disciplines with a focus on GIS and remote sensing.

The sandwich construction consists of three phases. An initial six months of preparatory work in Wageningen is followed by approximately three years of research at the PhD candidate’s home institute. Finally the candidate spends another six months in Wageningen to complete the thesis. An advantage of the ‘Sandwich PhD’ is that the home institute remains involved in the research activities and can benefit from the research performed at CGI. Whichever option the student chooses - conventional or sandwich, the PhD research is fully embedded in CGI with 15% of the time spent on education and 85% on thesis research and writing.
Research is organized in thematic working groups, based on the four basic themes of CGI’s primary research focus and expertise. These are Spatial Data Infrastructure, Remote Sensing, Visualisation and Communication and Quality of Geo-Information. Within these themes the PhD dissertations cover a broad range of topics. The selected topics below allow a quick glance into the multidisciplinary approaches and demonstrate the international flavour of the group:

1999 Sanders, M.E. 
Remotely sensed hydrological isolation: A key factor predicting plant species distribution in fens

2001 Addink, E.A. 
Change detection with remote sensing: relating NOAA-AVHRR to environmental impact of agriculture in Europe

2002 Liu, Y. 
Categorical database generalization in GIS

2003 Okoth, P.F. 
A hierarchical method for soil erosion assessment and spatial risk modelling
Leaving Wageningen and looking for a job

With a MSc degree in Geo-information Science (MGI) in the pocket, job perspectives (still) look good. What can a GIS job seeker do? Five core competencies have been determined, based on an analysis of jobs alumni can fulfil within organisations dealing with geo-information. These academic core competencies are based on the two-year MSc programme, and the preliminary BSc.

The job market open for our MSc graduates can be broadly divided into the following jobs:
- GI-researcher (30%)
- GI-project manager (20%)
- GI-advisor or -consultant (20%)
- GI-specialist (15%)
- GI-teacher (5%)
- Other (10%)

We asked a group of leading professionals and employers in the geo-information branch for their opinion on the listed competencies. They considered the type of jobs related to the competencies relevant but ambitious.
3 It's more than maps and data
I am enjoying this challenge in China so much! My work is marvellous, the people around me are so sweet. I haven’t been homesick yet. It’s been quite hectic from the moment I arrived in Beijing. I started work straight after I finished my language course. My job here is very exiting. I work, as the only foreigner, with six Chinese in my office. I’m also involved in a lot of things already. I am organising an international workshop on restoration and sustainable use of peatlands in central China to be held later this year. Soon I go to Dandong (bordering North Korea) for a waterbird workshop. We also just got a year contract with Shell for a biodiversity survey, capacity building and environmental education in Hangzhou bay (south of Shanghai) with an aim to establish a nature reserve in that area.

Anna van Paddenburg
MSc graduate Geo-Information Science, Wageningen University, 2003
Wetlands Project Development Officer, Beijing, China
Synergy in science

Looking for an answer to spatial problems in rural areas and urban fringes? Geo-information and remote sensing can help to provide a solution. It is applied in both national and international issues and addresses multidisciplinary problems, taking social, technical, economical and organisational aspects into account. Together with our colleagues from the research institute Alterra, Wageningen University - the Centre for Geo-information (CGI) - focuses on the collection, storage, analysis and presentation and dissemination of geo-information to enable responsible policy making on spatial development, monitoring of the environment and management of natural resources. Our specialisations are spatial data infrastructures (SDI), spatial data quality and quantitative remote sensing.

The co-operation between the university and Alterra results in a combination of fundamental and applied research. The university concentrates on research in the geo-information domain itself, whereas the research institute focuses on research domains that make use of geo-information. Also staff members of the university can use examples of geo-information and remote sensing - put to practice in specific projects - to illustrate lectures and motivate students. On the other hand Alterra’s staff profits from the fundamental and more scientific research conducted at the university. Colleagues from both organisations work together on projects. Students have the opportunity to see the field of geo-information and remote sensing ‘in action’ and there are possibilities for following an internship at Alterra. The university concentrates on research in the geo-information domain itself, whereas the research institute focuses on research domains that make use of geo-information. And so the best of both worlds is the result of the co-operation and synergy between the university and applied research.

Research mission

The Centre for Geo-Information at Wageningen University wishes to achieve a leading role in the field of geo-information, where environmental sciences are concerned. In our research we focus on a number of integrated key issues that follow the complexity and increased understanding of our environment. A basic requirement for understanding our environment is being adequately informed about its status. This is reflected in our research on spatial data infrastructures (SDI) and spatial data quality. A next step is the ability to monitor its changes.
A key research issue is the development of geo-information based monitoring methodologies. And finally we arrive at the issue of understanding our environment. Initially we focus on physical processes and phenomena in the green environment, as well as on the interaction between vegetation cover and the atmosphere. However, in time, interdisciplinary, bio-geophysical and biogeochemical aspects will be addressed with increasing emphasis, as the discipline evolves over the next few years.

Given the fundamental difficulties of existing numerical models in processes associated with canopy simulation, the areas in which CGI’s effort will be most fruitful are observing, modelling and improving the theory of vegetation conditions. The scale of application ranges from in-situ observations, to vegetation-atmosphere interaction at the spatial scale of climatic zones.

In particular, we envision substantial progress towards understanding CO$_2$ sequestering in the biosphere and its interaction with the atmosphere, as well as the effects of the environment on the physical state of the vegetation. Knowing the physical state of the vegetation has substantial interdisciplinary implications.

**Range of research**

Our co-operative work, between Wageningen University and Alterra, is divided over five research areas. Firstly we provide geo-information on rural areas; we make knowledge and information available to support policy decisions on natural resources. A second area of research is the monitoring of rural areas, at national and global levels. Also on a local to global level we collect geo-biophysical and geo-chemical variables (such as emission of greenhouse gases) from spatially distributed data. This quantitative data is used for environmental management. Another research area focuses on the integration of geo-information and remote sensing in process models for (spatial) planning and scenario studies. Finally we seek new methods of visualisation and communication of geo-information. In this manner multimedia technology can be used to develop and support policies for rural areas. Our projects cover a wide range of subjects and vary from development of a system for requests for agriculture subsidies to historical land coverage maps of the Netherlands.
Infrastructure

To support our research we have various facilities at our disposition. For instance, we operate an instrument pool dedicated to field measurements. A spectrometer enables ground-truth measurements for calibrating remote sensing data. Various global positioning system (GPS) equipment is available for positioning and mapping. This ranges from simple handheld palmtops to personal digital assistants (PDAs) for on-line location-based services to real-time kinematical GPS for land survey with centimetre precision.

Within CGI, the GeoDesk is primarily responsible for technical and organisational support of research and education. One of the tasks is to assure the availability of geo-software for all of Wageningen University and Research Centre (WUR). To realize this the GeoDesk has set up its own infrastructure as an integrated part of WUR’s overall ICT facilities. The GeoDesk also distributes all geo-software for the Ministry of Agriculture, Nature Conservation & Food Quality. Wageningen University, as well as agricultural colleges elsewhere in the country, have access to the geo-database which holds about 250 datasets, covering the entire Dutch territory. Among these datasets are aerial photographs and historical topographic maps. Additionally the GeoDesk distributes, on a commercial basis, geo-data sets that have been produced by Alterra. These datasets show actual land use, historical land use, soil data and geomorphologic data. User support with respect to geo-software and geo-data is therefore a major task of the GeoDesk.
Geo-information and remote sensing put to work

Wageningen University and the research institute Alterra co-operate together within these projects.

- For the Dutch ministry of Economic Affairs we have assessed the overall development of the geo-information sector in the Netherlands. Expectancies presented in the report have resulted in the ministry's active support for a national stimulation programme for the geo-information sector.
- We fulfil a leading role in the formulation of the national Space for Geo-information programme for the further development of the national spatial data infrastructure and research. This programme resulted in an increase of twenty million Euros in governmental funding for the geo-information sector.
- We contribute to the ESA Earth Explorer Core Mission (SPECTRA). Through detailed earth observations, the terrestrial component of the carbon cycle can be better understood. We participated in the definition of this mission and also in the simulation project for the satellite (the Swiss/Belgium ESA PRODEX APEX airborne imaging spectrometer).
- As part of our own research and development programme we have investigated whether geographical information via a mobile telephone. Wireless information can be used during field-checks on subsidy requests, the up-dating of field observations of flora and fauna or for providing information on recreational activities in the area.
- In co-operation with the university’s IT group, CGI conducts research on the use of ‘intelligent agents’ to support spatial modelling. Intelligent agents are software entities that function continuously and autonomously in a particular environment. Using agent-based techniques may provide us with a means to better represent the human factor in spatial models.
- Within the framework of EU-Interreg Participatory Spatial Planning in Europe, we investigate the role of geo-visualisation in different European planning approaches. Through our participation in the Dutch research consortium Virtual Landscape we contribute to the development of a national information infrastructure based on geo-visualisation technologies.
- In the Manolo project, CGI and SPINlab jointly explore the added value of wireless and mobile technologies for higher education. The project aims at formulating clear guidelines on the use of these new technologies in different educational settings.
Past the borders of the academic world

Our research activities in geo-information and remote sensing reflect a multidisciplinary and interdisciplinary approach. As we have discussed Wageningen University co-operates closely with the research institute Alterra. This co-operation provides an entrance to other facilities within the whole of Wageningen University and Research Centre (comprised of the university and various research institutes such as Alterra). In particular the ICT group provides services with respect to telecommunication, data servers, and application development for special needs. In this manner we have access to a variety of expert software for GIS and remote sensing.

Besides our co-operation with Alterra, we co-operate with other groups within Wageningen University who are active in nature conservation, soil inventory, land evaluation, forestry, as well as in landscape, planning and design.
4 The world at your feet: market
prospects

My career highly benefited from my MSc and PhD experience at Wageningen University. I was promoted the youngest professor in the history of my organization in 2001, and also one of the few female professors, supervising several MSc and PhD students. Now I am holding several national level research projects, focusing on wetland and forest landscapes. Geo-information has become the main tool in our research group. The Master course in Geo-Information Science at Wageningen University started my rich international experience. From then on, I have travelled to more than twenty countries in most of the continents for scientific excursions and international conferences, such as Australia, Korea, Russia, the US, and Venezuela. I am also actively working for some international organizations and journals.

Li Xiuzhen
MSc graduate Geo-Information Science, Wageningen University, 1998
PhD graduate Geo-Information Science, Wageningen University, 2000
Professor of Landscape Ecology
Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, China
The sky is the limit

GIS as a rising star. Between 1995 and 2001 employment in the Dutch geo-information sector increased with about 28 thousand full-time jobs from 18 thousand to 46 thousand. Not bad. That's an average annual growth of 17%. The percentage of geo-information personnel within the full Dutch working community also shows a jump in this period: from about 4% to about 8%. So the geo-information sector has grown quicker than other sectors. And this period not only meant more jobs, but also more money: turnover in this sector increased with an annual average of 22%. This means a tripling of the total turnover - from 0.9 billion Euro to 2.7 billion Euro. Looking at that on a national scale, we can say that between 1995 and 2001 the ratio of the geo-information turnover to the total turnover increased with one fifth from 4.0% to 4.8%. (See the table for more information).

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In agreement

Our research included a series of statements on bottlenecks and conditions that influence the geo-information sector. Well over half of the respondents acknowledges that ‘the number of highly-educated personnel with expert knowledge in geo-information is too low’. Only a quarter agrees with the statement that ‘from an international perspective [their] organisation is a leading one with respect to the use of geo-information’. Also a national stimulation programme - initiated by the national government - was widely supported by the respondents. Nearly nine out of ten respondents encouraged this.
The method behind the conclusions

The research on the prospects of the Dutch geo-information sector was jointly carried out by the university chair group Geo-Information and Remote Sensing and Alterra for the Dutch ministry of Economic Affairs in 2002. For this research we used data that 73 companies and institutions supplied in 2002 in response to a questionnaire. These respondents form a representative sample of the entire sector (more than 800 organisations).

Other statements that were reviewed remarkably positively are:

• Geo-information contributes strongly and positively to both internal and external communication.
• Geo-information is generally perceived as an expert field, except by respondents working for organisations that provide geo-information.
• An ample majority has a neutral to positive standpoint with respect to higher investments in scientific research.

Still looking good

Everyone believes in GIS. Governmental organisations and research institutes, companies and service providers share a coherent vision on developments in the geo-information sector. This is a most remarkable result of our research into the prospects of the Dutch geo-information sector for the period 2003-2007. 70% of the respondents expect growth to continue. One in ten even expects growth to be over 50%. Luckily the pessimists are in the minority: just over one in ten foresees a decrease in employment. Figures for expected turnover are even more promising. Three in four foresee a growth, and one fifth of these optimists expects turnover to increase by more than 50%. About 5% of the respondents expects turnover to decrease.
Global trends in GIS

There is scarce data available for comparison of prospects of international geo-information markets. Information that is available on North American markets shows an average annual growth of 10% to 15% over the last decade. But according to a North-American study (2003), annual global growth rate is considerably lower with 5%, but still significant. Revenue for the worldwide GIS core-business grew steadily since 1996 to a total of 1.6 billion US dollar in 2002. Software comprised two-thirds of the pie and services a quarter. Revenue in hardware has been declining for many years and was just 5% of the total revenue in 2002.

In 2002, revenue from the regulated sector accounted for almost half of the 1.6 billion US dollars. Within this sector, utilities (water, gas and electricity) took about half the share and telecommunications companies accounted for approximately a third. Compare this to the share of revenue from other industries in the regulated sector: transportation contributed for 10%, and education for 8%. Revenues from the public sector (governments and governmental organisations) accounted for nearly one third of the total revenue in 2002. The private sector accounts for the remainder: nearly one quarter of the total revenue.

![Worldwide GIS Revenue Chart](chart.png)

Source: Daratak.Inc.
Stars and stripes set the trend

The European industrial society is being transformed into an information society. This transformation rests upon the deregulation of telecommunication and liberalisation of public sector information (PSI). The largest single component of the European public sector information investment is in the geographic sector, including such categories as mapping, land registration, meteorological services, environmental data and hydro-graphic services.

Despite this promising potential, the overall perspective of PSI usage in the European Union (EU) looks rather bleak when compared to the prospects in the US. An American report, based on extensive policy research, presents an enormous discrepancy in economic value of PSI between the EU and US.

| Economic Potential of PSI in EU and US (in billion Euro) |
|-----------------|--------------------|-------------------|
|                 | Investment value   | Economic value    | Ratio (E/I) |
| US              | 68                 | 750               | 40          |
| EU              | 9.5                | 19                | 7.2         |

For the US the ratio of economic value over investment value is about five and a half times higher than the rate in Europe. The striking discrepancy is due to the different business models in the US and Europe. In the US, federal information policy is based on the belief that the society (economically) benefits most when taxpayer funded information is made widely available without restrictions and at no more than the cost of dissemination. In Europe, as well as in other continents, publicly funded government agencies use the information they hold to generate short-term revenue to (partially) recover the costs of collecting the data. This difference is the US model of ‘open access’ as opposed to the European model of ‘cost recovery’.

The European Union PSI Directive, issued in 2002, calls for a change of culture with respect to re-use of public sector information. But the directive does not (directly) regard the issue of data-access. This is addressed on a national level. There is a lack of transparency in where to procure which geo-data, and the procurement is laborious and too costly. Exchange of data is also problematic - there is a variety of exchange formats, resulting in high demands on the hardware. Finally, regulations related to rights for use of geo-data are complex.
Removing such barriers would mean European action at institutional, organisational, economic and juridical levels. Frameworks for sharing and disseminating information must be developed. Regulations should protect intellectual property rights of data providers, without obstructing access to and use of the information. And public organisations must adopt a culture of information documentation, sharing and re-use. The main hurdle however, is abandoning the relatively recent culture of pseudo-privatising (deregulating) of governmental organisations and the related cost-recovery. For the benefit of the geo-information field, public sector information should be made freely available at costs hardly higher than dissemination costs. The stars and stripes already set the trend. Will Europe follow?
5 As students grow, the progra
During my MSc I spent two unique, wonderful years at Wageningen University from a social, cultural and scientific point of view. In the nineties, when I decided to update my academic background in nature conservation planning, I screened a number of schools on possibilities and potential. Initially, the European schools seemed to me to be the philosophically deepest in the world because of the extraordinarily rich history of the continent. Nevertheless, other technical approaches also looked interesting elsewhere in the world (USA, Australia, etc.). But what made me choose Wageningen University was my encounter with Dr. Ron van Lammeren during an international course in Spain.
From one to thirty in fifteen years

One student in 1989. That was how popular Wageningen’s first full MSc programme GIS for Rural Applications (GISRA) was when it commenced. That is a long way from the thirty students we now attract each year. How did it come this far? In the eighties GIS education began to be more institutionalised. (Here GIS stands for ‘geographic information systems’). In 1983 Wageningen offered a post-academic course in Computer Cartography in Landscape Planning - the first proof of geo-information oriented education. Prof. Martien Molenaar, head of the Surveying Department since 1983, was the driving force behind the more theoretical approach to GIS. Soon after, the first GIS-oriented theses were published. It is remarkable that thesis subjects from the begin period show a striking comparison to current subjects: linking models and GIS (for solving allocation problems), development and use of visualisation tools (for spatial simulations), as well as of programming languages for GIS (for building spatial models).

Being and giving an international Master

Another trend in the eighties was the development of some of Wageningen’s internationally oriented summer courses into full MSc programmes. They attracted students from all over the world, but mainly from developing countries. Initially these programmes were kept separate from the regular Dutch educational system. But of course staff was inclined to share expertise and experience with each other and between the students; so at course-level interactions between the two systems gradually increased. Thanks to these links between the systems, the MSc programme GIS for Rural Applications - the course that started with one student in 1989 - triggered the breakthrough of GIS in the regular curriculum. This first MSc programme was set up in co-operation with the International Institute for Geo-Information Science and Earth Observation (ITC) - another Dutch leading institute in GIS. 1992 to 1993 is also important academic year for GIS. With eighteen courses in GIS and remote sensing, GIRS-internship and various thesis-oriented subjects, GIS is really put into the picture in Wageningen.

In the late nineties Wageningen University plans the introduction of a Bachelor-Master system (BaMa). Following the introduction of the new system a specialisation Geo-Information Science - aimed at the university’s own BSc graduates - is set up. This specialisation opens up new possibilities for students and connects geo-information science to other disciplines in the...
environmental sciences. Besides this specialisation, the internationally orientated MSc programme, with some adaptations, remains in practice. It’s international students galore as also an increasing number of EU-students stay in Wageningen for three to six months to follow individual courses in geo-information and remote sensing, within the EU’s Tempus and Erasmus exchange projects.

In 1999 the Bachelor-Master will have to become a definite and sole fact at Wageningen University as the EU chooses to follow this system in all member states. And all MSc programmes in the EU must be offered in English. Wageningen University subsequently decides to integrate its regular Dutch specialisation Geo-Information Science and its separate international MSc programme GISRA into the current single English-language MSc programme Geo-Information Science (MGI) that includes remote sensing. All GIRS courses are therefore in English; only the introduction course has a Dutch counterpart.

The transition to an all-English curriculum has led to an increase in students from EU member states. With this changing student population the focus of the MSc programme also changes rather dramatically. The focus on application in environmental sciences leads to a programme where the central element is solving spatial problems in rural areas and urban fringes through use of GIS and remote sensing. Gaining various explicit academic competences - both general competences and competences specifically oriented towards geo-information science - is put at the forefront.

Keeping up the (technical) pace

Since the early days of GIS Wageningen’s education infrastructure has kept up pace with technological developments in the geo-information sector. As early as 1990 several high-tech PC instruction rooms were equipped with hardware and software for GIS and remote sensing. In 1999, the year we forged our co-operation with the research institute Alterra and settled in their building, our capacity was extended to eighty computers. These are distributed over two modern PC instruction rooms for course work and two additional PC rooms for thesis work.
In a few years (2006 or 2007) Wageningen University will open a new large building, across from our present location. Here we will hold most of our BSc courses and some MSc courses. All of the university libraries, and those of the research institutes within Wageningen UR will also be housed in this building. The functional design of this building anticipates an increasing use of ICT and a variety of learning environments.

Digital learning: fast and furious

A new ICT-development which has had our attention since 1998 is ‘e-learning’: computer enabled web-based learning. We have developed extensive experience with both national and international e-learning environments. Though most of our students feel perfectly at home in our comfortable digital learning environment, they still prefer ‘live teaching’ above pre-programmed instructions via a computer. Therefore we focus on developing digital learning environments in addition to, and integrated with, traditional teaching.

A large-scale introduction of ICT-based learning environments is not yet on the cards as the technology is not sufficiently developed to allow for standard applications that involve more than using the web and e-mail. Otherwise we could introduce highly advanced technological environments such as ‘w-learning’ - via a local wireless network, and ‘m-learning’ - in a fully mobile environment and based on personal digital assistants (PDAs).

A serious hurdle for introducing digital learning environments is the incredible short life cycle that characterises all ICT-based services and products. Investments in course development, equipment, maintenance, and digital infrastructure therefore require additional budgets that are beyond reach for an educational institute. Besides the digital learning environments must be also adapted to specific educational contexts, boosting the costs even more. Within our university these contexts differ greatly; at an international scale contextual differences are even greater.
Students can currently follow some courses via distance learning, denoted briefly as ‘d-learning’. Appropriate and adequate student-teacher interaction is even more important at a distance than it is face to face, as we learned during daily practice and via various pilot projects including video conferencing. In our MGI programme ICT therefore cannot and will not replace a true teacher, not even within distance learning.

**What’s in a name?**

A name change is not just a name change - it is an expression of a change in content and focus. During Wageningen’s GIS history for instance name changes show the development of the field of geo-information and remote sensing. In 1994, Prof. Martien Molenaar’s Surveying Department is renamed chair group for Theory of Geographic Information Systems and Remote Sensing. The Laboratory for Surveying changes its name to Laboratory for GIS and Remote Sensing, or shortly GIRS Lab.

More name changes and organisational changes follow when in 1999 the university (then still named Wageningen Agricultural University) merges with the national Department for Agricultural Research (DLO) to form the current Wageningen University and Research centre (WUR). So agriculture was ‘left behind’, in name at least, and the world should know that Wageningen’s Life Sciences are applicable to many multidisciplinary and societal issues.
Wageningen's GIS history, milestones and key roles

1989 Wageningen Agricultural University starts the international MSc programme ‘GIS for Rural Applications’ (GISRA) organised by the Laboratory for Surveying in co-operation with the International Institute for Geo-information Science and Earth Observation (ITC) in Enschede, the Netherlands. One student follows this course in 1989.

1989 Wageningen Agricultural University establishes its first instruction rooms for GIS.

1991 Wageningen Agricultural University laurels its first graduate in GIS: Yolanda Benitez Gomez, Philippines.

1995 GIS starts to play an integrating role in the multidisciplinary fieldwork in Alora, Spain.

1998 Wageningen Agricultural University implements a specialisation Geo-information Science at MSc level parallel to its international MSc programme GISRA.

1998 WAU appoints two half-time professors at the Laboratory for GIRS as successors for Prof. dr. ir. Martien Molenaar: Dr. ir. Arnold. Bregt for Geo-information science with emphasis on GIS; and Dr. Steven de Jong for Geo-information science with emphasis on RS (remote sensing).

2000 Wageningen University and Alterra join their remote sensing and GIS activities in a common group: the Centre for Geo-information (CGI). The centre is managed by Gerard Nieuwenhuis.

2000 Wageningen University laurels its hundredth graduate in GIS: Menberu Allebachew, Ethiopia.
2000 Wageningen introduces the Bachelor-Master system in the education programmes. This follows the European objective to create a uniform system for higher education in all member states, as determined in Bologna, Italy, 1999.

2001 Wageningen University integrates its international MSc programme GISRA with its Dutch inter-specialisation Geo-Information Science into a two-year international MSc programme Geo-Information Science.

2002 Prof. Steven de Jong leaves Wageningen University for a full-time professorship at the University of Utrecht.

2003 Close co-operation is set up between the International Soil Research and Information Centre (ISRIC) and the Centre for Geo-Information.

2003 Delft University, Utrecht University, the International Institute for Geo-information and Earth Observation (ITC) and Wageningen University start the joint part-time and blended learning MSc programme Geo-information Management and Applications (GIMA).

2004 The Centre for Geo-Information also includes Wageningen Software Labs (WISL).

2004 Wageningen University celebrates '15 years of GIS Education in Wageningen' with an international Master class for PhD students on the occasion of Prof. Michael Schaepman's inaugural speech.
6 What will the future offer us
and we the future?

After graduating as a soil scientist at Wageningen University and working as a researcher in Seville (Spain), I graduated also as geo-information scientist at the same university. Next year I expect to finish my PhD research, which focuses on spatial data infrastructures. For the future, I see the MSc Geo-Information Science as an inspiring teaching environment with dedicated colleagues who are driven by the quest for knowledge and who seek new applications in the domain of geo-information. This should be strongly linked to issues that relate to our dynamic environment of expanding technologies, higher market and user demands, more E-government and participatory planning as well as an emphasis on sustainable development. As you see, I am full of great intentions and looking forward to implementing them together with my colleagues.

Joep Crompvoets
PhD candidate and staff member of the Centre for Geo-Information, Wageningen University
MSc graduate Geo-Information Science, Wageningen University, 1997
MSc graduate Soil Science, Wageningen University, 1993
The future

The Centre for Geo-Information, Wageningen University is proud to have three farsighted, inventive, ingenious, creative, resourceful professors in our midst. We asked them how the how they see the future of geo-information - in both research and education - and which trends will be of influence, as much is changing in the world of geo-information science.

For instance there are considerable changes in information and communication technology (ICT): in the past decades, huge advances in ICT have unbundled geo-information from the paper format and the traditional surveying & mapping processes. ICT is connecting people who are continents apart. Distance learning is becoming an integral part of our educational approach. More methods and techniques for modelling spatially complex processes are being developed. The disciplines geo-information and engineering are learning how to share spatial data.

There are also trends in use and types of knowledge: the division between data-driven thinking and process-driven thinking is diminishing. Geo-data is being linked to biophysical and socio-economic process knowledge. And in doing so there is a shift towards multidisciplinary teams. Also factual knowledge is aging more rapidly, after one year about one third of the knowledge has become out of date. Students need to acquire a critical and analytical attitude above learning technical skills.

Each professor views these trends from his own perspective and chooses himself which issue to focus on. All three look into the future for the Centre for Geo-Information at Wageningen University and envisage a focus on monitoring the environment and on scenario studies. Also, visualising results of geo-information research and communicating these results is an ongoing challenge.
Forecasts and simulations

Prof. Arnold Bregt is since 1998 professor in geo-information science at Wageningen University. He focuses on geographical information systems (GIS).

The past decade has been a period of expansion for geo-information science. The number of areas where digital geo-information is applied has increased from mapping and natural resource management to areas such as marketing, risk management and health care. Navigation systems have become a consumer product and web-sites with geo-information services are of the most popular in the world. Also research and development activities have showed a healthy growth in this period.

What are the challenges and developments in geo-information science for the coming decade? It is both difficult and intriguing to reflect on these developments. I see four main transitions: from map to 4D representation and interaction; from project to infrastructure; from surveying to ‘on the fly’ positioning; from fragmentation to consolidation.

First of all let’s look at the transition from map to 4D representation and interaction. For centuries the classical map has been our window on the world when it comes to describing the world and a tool for analysis. With present-day digital approaches we can now create 3D and even 4D models of the world. Moreover, as interaction possibilities increase, a much richer and more natural description and analysis of real world phenomena will be possible.

The second transition is from project to infrastructure. In the last decade many ad hoc spatial datasets have been produced in various projects. They were not very well managed and are often not reusable. The development of spatial data infrastructures (SDI) is worldwide considered a way to organise and disseminate geo-information. After the initial developments in the previous decade, SDI will gain momentum in the coming years.

From surveying to ‘on the fly’ positioning: the introduction of Global Positioning Systems (GPS) has resulted in a revolution in the determination of positions on the earth. Not so much the determination is new, but the ease and speed by which positions are measured opens a new world for applications. GPS is already embedded in navigation systems, but the coming years we will see large variety of new applications emerging.
Finally there is a transition from fragmentation to consolidation. The last decades various disciplines such as photogrammetry, GIS, remote sensing, cartography, geo-computation, etc emerged. Their object of study was strongly related but the methods and terminology used differ. The coming years we will see a consolidation of all these related fields under the umbrella of geo-information sciences. The theoretical foundations of our field and the applications will highly benefit from this consolidation.

The formulated geo-transitions require a chain of activities, ranging from fundamental research to practical pilots and from undergraduate education to PhD education. With our research and education programme, we will contribute to these developments in the years to come.
Beyond the map

Prof. Martien Molenaar is currently rector of the International Institute for Geo-information Science and Earth Observation (ITC), Enschede. In 1996 he left to become professor at ITC. Since 1996 he holds the endowed chair for Theory of GIS and Remote Sensing at Wageningen University.

Information components of geo-data infrastructures are largely based on the traditional map paradigm. The old concept of maps has evolved into digital maps and these developed into seamless databases. And presently we see ‘scaleless’ databases emerging. The line map is often replaced by object-structured representations and dimensionality has evolved from 2D to 2½D. Data and services allow us to create rectified or draped high-resolution images according to our own needs. New delivery mechanisms - supporting the fast development of location based services and mobile GIS - can provide core data.

But there are new developments that are no longer embedded in the traditional map paradigm. Object structured approaches allow spatial representations that go beyond the old paradigm. The dimensional development of spatial databases to 3D and 4D will provide new types of representations of dynamic spatial complexes. Virtual reality and augmented reality representations - in the form of city models, street models and buildings - are already being built, based on the integration of 3D and 4D images. They allow us to travel through space and through objects. Early progress in combining GIS and CAD (a technical drawing computer program for engineers) shows techniques where city models zoom into individual buildings - to enter and inspect the interior. This type of object information, at multi-resolution levels, is essential to professionals involved in management and development of our living environment. Spatial data then becomes a component of an integrated set of data including administrative, management and planning data.

With these developments geo-information science has become a scientific and professional field in its own right. It incorporates concepts of spatial modelling and representation and all aspects of data acquisition - geo-referencing, digital surface models, the extraction of spatio-thematic object information, spatial data management and processing, representation and visualisation. GIS specialists require professional skills that can no longer be learnt in the margin of other mapping disciplines. Their education and training calls for carefully designed
curricula, programs and courses based on the mature paradigms of geo-information science and its related disciplines. Projects involving spatial information production and use are becoming increasingly advanced and complex. Therefore experts from the relevant spatial disciplines and geo-information scientists should co-operate with one another. In this setting the geo-information scientist is often a production facilitator rather than an information producer. Professionals with different disciplinary backgrounds must learn to understand each other. Geo-information scientists should learn about different contexts of processes involving the production and use of spatial information and experts from other spatial disciplines should be able to understand concepts and tools of geo-information handling.
From local to global understanding

Since 2002 Prof. Michael Schaepman is professor at the Centre for Geo-Information, Wageningen University with an emphasis on Remote Sensing.

Remote sensing data is a significant and practical aspect of geo-spatial information. Earth observation from airborne or space-borne platforms is the only way of providing frequent data at various scales and resolutions. Remote sensing is indispensable in documenting the heterogeneity of the landscape at regional scales and in connecting regional information in a global perspective.

Within the environmental sciences, getting to grips with the physical state of the vegetation presents substantial interdisciplinary and multidisciplinary implications. Our current remote sensing activities demonstrate our ability to tackle such issues. For instance we conduct hierarchical spatial analysis of landscape change, develop the accuracy of monitoring systems in tropical rain forest areas, and map above-ground biomass and carbon fixation of forest ecosystems with spectroscopic and radar remote sensing. We are also working on multi-scale land cover classification and monitoring by integrating remote sensing and geo-statistics. All this demonstrates our interdisciplinary approach.

Although these issues cut across a wide range of disciplines and span a broad range of space-time scales, they are organized around a common concept for numerical modelling. Expanding this numerical concept requires a strong interdisciplinary expertise in mathematical and physical understanding. Besides, empirical and semi-empirical modelling complements physical modelling (fieldwork). The Centre for Geo-Information can meet this challenge.

Measurement campaigns, from ground-based to ‘remote’ at a regional level, provide input to validate and verify models used. And from an educational point of view such campaigns are a must, as vegetation-related remote sensing is based on extensive observations and ground measurements. But besides conventional qualitative canopy observations, fieldwork should provide data on physical features of leaves, structural characteristics of the vegetation, and canopy reflectance.
Several research centres around the world are already working on coupling dynamic models for vegetation and atmosphere. However, Wageningen’s Centre for Geo-Information is unique in its state-of-the-art research activities in linking vegetation and atmospheric observations, theoretical studies, and environmental prediction. Our research is especially fruitful for Wageningen University and the broader geo-information community for field observations, canopy modelling and insights into vegetation conditions. The spatial scale ranges from actual, on site observations to vegetation-atmosphere interaction within climatic zones. Thanks to this specific expertise we can already use coupled vegetation-atmospheric models to combine current vegetation datasets with new data. But our ultimate goal is to enhance simulations of observed environmental processes. Interactions between soil, vegetation and atmosphere, in combination with climatic conditions, will always have an effect on the medium- and long-term predictability of regional and global carbon and nitrogen models.
Its own right
I clearly remember that about seven years ago we received a request to start a programme Geographic Information Systems and Remote Sensing - or GIRS as we called it. At that time we regarded GIS and RS as supporting courses, like forest inventory, research methods and statistics. This perception of the field has rapidly changed. In Wageningen geo-information science, including remote sensing, successfully developed into a full MSc programme in its own right (MGI). In society too we see GIS and RS developing into new disciplines. Due to their orientation towards digital technology, GIS and RS suit new educational approaches - such as digital learning environments and distance learning - very well. The discussion whether geo-information justifies a separate field of science is not relevant anymore. GIS and RS meanwhile are indispensable tools within other disciplines. And precisely that explains their success.

Dr. ir. H. Bartelink
Director of the former Educational Institute for Environmental Sciences, Wageningen University.