

REPORT OF ACTIVITIES

2008



World Soil Information

ISRIC – World Soil Information is an independent foundation receiving funds from the Dutch Government. Our mandate is *to increase worldwide knowledge of the land, its soils in particular, to support their sustainable use and management.*

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Inquiries

C/o The Director, ISRIC – World Soil Information
PO Box 353
6700 AJ Wageningen
The Netherlands
Tele fax: +31-(0)317-471700
E-mail: soil.isric@wur.nl

Contents

INTRODUCTION	1
WORLD SOIL MUSEUM: INFORMATION AND EDUCATION	3
Education	3
Public Information	3
International Year of Planet Earth.....	3
PhD study.....	4
WORLD DATA CENTRE FOR SOILS	7
Website development.....	8
Information services and usage	8
Web-based information systems	9
Collections.....	9
Map Collection.....	9
Monoliths.....	10
Micromorphology	10
Photography	11
APPLIED RESEARCH	12
ISRIC-WISE global soil profile database	12
Harmonized World Soil Database	12
Global Assessment of Land Degradation and Improvement (GLADA)	13
Preliminary findings	13
SOTER activities within GLADA.....	14
SOTER procedures manual and database	14
e-SOTER	15
GlobalSoilMap.net.....	16
Green Water Credits	17
Land resources conservation and degradation.....	18
World Overview of Conservation Approaches and Technologies (WOCAT).....	18
Desertification mitigation and remediation of land (DESIRE)	18
Other activities	19
Consultancy mission to Angola.....	19
International Union of Soil Sciences.....	19
Dutch Society of Soil Science.....	20
Encyclopaedia of Soil Science	20
PUBLICATIONS	21
TRAVEL AND MEETINGS	25
PERSONNEL	29
ABBREVIATIONS	31

INTRODUCTION

'If you can measure a thing and express it in numbers, you know something about it. If you cannot measure it, if you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.' Lord Kelvin's words encapsulate the attitude that made physics the leading science in the last century and, also, opened up a new world of technology (Kelvin is best remembered for the refrigerator). In those days, soil science was not in the van but, more recently, has made its own advances in measurement and expressing things in numbers – and here we may count our own applications of digital technology in the *Global assessment of land degradation and improvement* and the exciting new ventures: *e-SOTER* and *GlobalSoilMap.net*. But the numbers have got to be right. The unglorious but essential work of checking them has always absorbed much of our labour and it is good to be able to report the issue of a new version of our well-used WISE database and steady progress in adding to other databases.

As well as providing the numbers, we are directly addressing some of the big issues of society that hinge on soil use and management: poverty, land degradation, water scarcity, and climatic change. This may seem presumptuous for a small Institute but, in partnership with other foundations and international organisations, we believe that we can make a difference. *Green Water Credits* creates a market in water management services by farmers that are presently unrecognised and unrewarded; the new GEF-UNEP program *Carbon benefits: modelling, measurement and monitoring* seeks to bring soil organic carbon into emerging carbon markets. In both cases, the idea is to make best management practice profitable - otherwise it will not happen – at the same time addressing poverty by diversifying rural livelihoods.

Much work has also gone into devising a new management structure for the ISRIC Foundation to strengthen the collaboration with our host, Wageningen University and Research Centre, and at the same time, secures our international mandate. The new structure - a small Managing Board appointed by Wageningen UR and, also, an International Scientific Advisory Council that advises the Board and Director on matters of science policy - is incorporated in amended Articles that come into effect in 2009 and it is appropriate, here, to thank the outgoing Board of Trustees for their guidance.

Very sadly, I have to record the passing of two former Directors: Roel Oldeman and Hans van Baren whom, in their different ways, epitomised the best face of the Institute and handed on a respected, going concern that continues to serve the scientific community and the world at large.

David Dent

WORLD SOIL MUSEUM: INFORMATION AND EDUCATION

Education

In 2008, more than 30 groups of students, teachers and others visited the World Soil Museum. Most of them took advantage of an introductory lecture and a guided tour through the exhibition, several groups also undertook field excursions around Wageningen. Eight German university groups and others from Belgium, the United Kingdom and the USA visited the museum, each spending one or two days with us. Exercises in the museum are now part of several regular courses of Wageningen University and some 400 visitors from The Netherlands included university and college students from Free University (Amsterdam), University of Amsterdam, UNESCO-IHE (Delft), ITC (Enschede) and Larenstein (Velp), local high school students, and welcome visits from the general public.

Alfred Hartemink organised courses on scientific publishing for doctoral students and members of the CT de Wit Graduate school PE&RC and presented a paper on the symposium *Expecting the unexpected*. Alfred teaches an annual introductory soil science course at UNESCO-IHE, including a three-day excursion to Limburg, and at the National University of Rwanda, under a NUFFIC project. Along with David Dent, he supervises MSc and PhD students from Wageningen University.

Public Information

International Year of Planet Earth

ISRIC is a founder of the International Year of Planet Earth (IYPE) which spans the triennium 2007- 09. David Dent is a member of the Board; Alfred Hartemink chairs the Science Committee and is also a member of the Dutch National Committee. *Soil – Earth's living skin*, the introductory brochure of the soil theme, written by David Dent, Alfred Hartemink and John Kimble, has been translated in 5 languages and widely distributed; a flyer on *Soil – the living skin of planet earth* has been translated in 15 languages and 5000 copies distributed.

In February, David and Alfred attended the opening ceremony of the International Year at the UNESCO Headquarters in Paris and manned a special exhibit demonstrating the variety and global importance of soils. The event was co-organized by the IYPE Corporation and the National Committee of France, together with IUGS and UNESCO. UNESCO's Director General, Koïchiro Matsuura, hosted the event and several Heads of State, ministers and other dignitaries addressed the audience of about 1000 people.

The International Year can already claim success in bringing earth sciences and their contribution to society to a wider public; there have been many outstanding national initiatives and a strong international network has been created.

Alfred Hartemink



Alfred Hartemink and David Dent at the IYPE exhibition at UNESCO

PhD study

Stephan Mantel's field studies in the Chittagong Hills participatory land use planning project (CHARM), in Bangladesh, served as a case study for his PhD research on *Design of decision-support tools on land management practices and planning for local land users*.

Projects in 2009

1. *World Soil Museum* - Thematic exhibition: World Reference Base (WRB) terminology and plain English captions, revamped soil profile information; new themes in 2009 include permanent exhibition of WRB main categories; servicing visiting groups
2. *Educational program* - Establishment of UNESCO Chair in Land Resources; regular courses; supervision of postgraduate students
3. *World of Soils* – Web-based exhibition and learning program
4. *Publications:*

Policy briefs – *Business case for Green Water Credits, Global Assessment of Land Degradation and Improvement*

Books – *Soil Atlas of the Northern Circumpolar Region*: final draft for printing in a joint program with JRC, Agriculture Canada and the University of Vechta; *Soil Atlas of Africa*: construction of a soil profile database of published African soils, as part of a joint program with JRC, the African Soil Science Society, FAO and others; *Farming the black earth - chernozem and agriculture in Moldova*: English translation in partnership with Moldovan Academy of Sciences and Ministry of Agriculture and Food Processing

5. *International Year of Planet Earth* – Board representation, science program



Contribution to the September thematic issue of the *National Geographic* on soils (both US and the Dutch version), including an editorial, and highlighting the work of ISRIC and Dr Wim Sombroek

WORLD DATA CENTRE FOR SOILS

Since 1989, ISRIC - World Soil Information has maintained the World Data Centre for Soils. It is one of over 50 Centres that serve the international scientific community by scrutinising, archiving and distributing geophysical data according to principles laid down by the International Council for Science (ICSU) Panel on World Data Centres. World Data Centres operate with the support of national organizations. Following the ICSU General Assembly in Maputo, the World Data Centres will be incorporated into the new ICSU World Data System and a team is working to arrange the transition without interruption to the services provided by existing organizations.

The World Data Centre for Soils is custodian of world soil information and a focus for soil-related collections and information services. We acquire and maintain both printed and digital data; printed materials are held in the World Soil Library; digital data are stored on servers of Wageningen University and Research Centre, and the Joint Research Centre of the European Commission (JRC) at Ispra; all are being documented using uniform metadata standards in the Global Change Master Directory Portal for the World Data Centres, which means that they become freely accessible to scientists in other disciplines. Our collections of soil monoliths, reference soil materials, and thin sections are housed in our premises in Wageningen or in secure storage in Ede where they may be studied; thematic selections of our monoliths are on display in the World Soil Museum.

Nowadays, fewer new soil data and less new information are being produced; the older, legacy data are being pumped around more and more. Therefore, it is vital to maintain and describe the older data and reference materials that are the foundation of most current information; and users need access to the source materials, for example to assess the reliability of the derived information, through uniform metadata or on-line databases. The World Data Centre for Soils is responding with a program to digitise its holdings and make them available through the worldwide web, and on-line catalogues are under development. Over 1700 full-text reports can already be accessed on-line. Many reports in the archives are complemented by thematic maps, which are being digitized systematically and made available on-line in high-resolution format.

In 2008, all reports of Kenya were scanned and linked to the records of the ISRIC - World Soil Information Database. The map catalogue has been expanded with maps that were acquired over the past couple of years; scans of these new holdings are currently under way in collaboration with the JRC. Currently, some 4000 maps can be downloaded through the ISRIC - World Soil Information Database; most of these maps can also be accessed through the European Digital Archive of Soil Maps (EuDASM).

Otto Spaargaren and Niels Batjes

Website development

Information services and usage

World Data Centre for Soils holdings are being made available on-line through catalogues (e.g. ISRIC – World Soil Information Database), downloadable datasets and through auxiliary portals, using uniform meta-data. The ISRIC website plays a key role in our data dissemination. This year it had some 45 000 visitors, up from 32 000 during 2007, bringing to 100 000 the total number of on-line visitors since June 2006 when the (then new) website was launched. A quarter of requests for information came from Africa, Asia and South America, the remainder mainly from Europe and North America (Fig. 1).

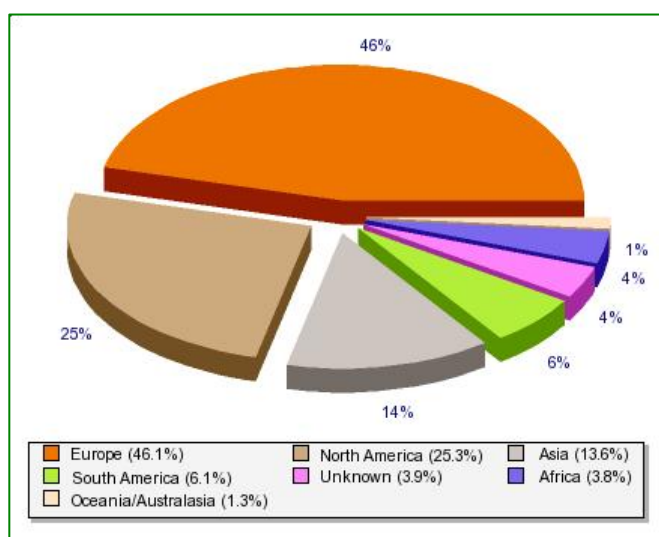


Figure 1. Source of visitors to the ISRIC website (December 2008)

Since June 2007, our datasets have been downloaded some 4860 times; with 3660 downloads in 2008 (Table 1); these figures exclude data hosted at JRC-IES, and stored in the ISRIC - World Soil Information Database.

Table 1. Downloads of datasets through the ISRIC website

Data set	Downloads	
	<i>N</i>	%
WISE	2056	46
SOTER	1097	24
SOTWIS	669	15
GLASOD	73	12
IGBPDIS	28	3

Almost half the downloads concerned *primary* WISE data, one quarter *primary* SOTER data, but with significant use of *secondary* SOTWIS data (i.e. GIS sets in which gaps in measured (*primary*) SOTER data were plugged using taxo-transfer procedures that use soil parameter estimates derived from the WISE soil database).

There is continuing use of historical GLASOD and ASSOD data for land-degradation related assessments. Requests came from over 1400 unique user groups including international organizations, national research institutes, universities, natural resources organizations, and the general public.

Our data find many and diverse applications, mainly at the regional to global scales at which WISE and SOTER operate: agro-ecological zoning, assessments of crop production, assessments of impacts of soil degradation on food supply, soil vulnerability to pollution, modelling of soil organic carbon stock and changes, soil gaseous emission potentials, and payments for environmental services. For details, see www.isric.org.

Niels Batjes

Web-based information systems

More links and services have been implemented in the ISRIC Soil Information System (ISIS): KML files are available on which the monolith sites are located on Google Maps, photographs from the ISRIC collection can now be linked to the monoliths, also relevant reports from the ISRIC Catalogue. As only verified data will be available to the public, the ongoing process of data verification is one constraint on going live. The other is that our web applications are based on the obsolescent Microsoft dot NET 1.1. framework. To facilitate transition to, at least, the 2.0 framework, Piet Tempel attended a 5-day course *Developing Web Applications with Visual Studio 2005* (Info Support, Veenendaal), focussing on user interfaces, web-site structure and functionality, and implementation.

Deployment of project web sites becomes more and more a contractual requirement: four projects in which ISRIC is involved maintain their own web site using Joomla - an open-source content-management system that enables configuration and extension by users using PHP scripting language. To support this activity, Ingrid Haas and Piet Tempel attended a 3-day course on PHP (Hypertext Pre-processor) development given by Internet Opleidingen BV in Ede.

Ingrid Haas and Piet Tempel

Collections

Map Collection

Along with the digitization of the ISRIC map collection under the EuDASM project, about 4000 maps of the Map Collection have been checked, several have been repaired, and metadata have been compiled for 2000 maps, to date, and made available on-line.

Venant Rutunga

Monoliths

Work continued on preparation of the *Glinka Memorial Collection*, the unique collection of soil monoliths from across the former Soviet Union collected by KD Glinka for the First International Congress of Soil Science in Washington in 1927 - but never exhibited; the monoliths, preserved in sugar, are of exceptional quality. A 2m Chernozem profile now graces the permanent display of the main groups of the World Reference Base for Soil Resources and a selection of Glinka monoliths was presented to the new Dokuchaev Museum in St Petersburg.

Seven new monoliths were collected in Chile in the aftermath of the International Soil Classification Conference held in November. They represent typical soils of semi-arid and Mediterranean Chile that were lacking in the World Soil Reference Collection.

A monolith and samples for thin sections were collected from a remarkable dike constructed from seaweed, possibly in the 14th century, revealed by the archaeological excavation near Den Hoorn in Texel, in the UNESCO Wadden Sea Biosphere Reserve.

A training course was conducted to set up a soil reference collection in Senegal. As part of the program, four soil monoliths, representing a Tertiary sea transgression over tropical Podzols, were collected from a quarry in Belgium.

Planning is under way to upgrade the workshop for monolith preparation and sample pre-treatments so as to meet new regulations to reduce phytosanitary risks, and to improve safety and working conditions.

Otto Spaargaren and Ad van Oostrum

Micromorphology

The soil thin section collections of the Soil Science Department of Wageningen University and Alterra, now the Jongerius-Stiboka Collection, were given to ISRIC last year and have been archived by Guest Researcher Maja Kooistra. Thin sections are stored adjacent to the revamped micromorphology facilities; the blocks were transferred to secure storage. All reports on the Jongerius-Stiboka thin sections produced since 1998 have been recovered and are available in print or digital form.

Two papers were completed by visiting researchers using the ISRIC reference collections: Antonio Castellanos-Navarrete, M Pulleman, R de Goede, M Kooistra, C Rodríguez-Aragónés, KD Sayre and L Brussaard *Earthworm populations and physical soil quality in maize-based conventional and conservation agriculture systems in the Central Highlands of Mexico*; and Nina Helt Nielsen, PhD student from the Dept of Prehistoric Archaeology, University of Aarhus, Denmark studied thin sections of Celtic fields in Jutland and the Netherlands.

Maja Kooistra

Photography

Fifteen thousand colour transparencies in the photo collection have been digitised and catalogued, and will be available on the ISRIC web site. We have an on-going program for new acquisitions.

Wouter Bomer

World Reference Base for Soil Resources

2008 saw the publication of translations of the updated *World Reference Base for Soil Resources* (WRB) in Arabic, Chinese, German and Ukrainian. Translations to Polish and Rumanian are in hand.

Otto Spaargaren, as Chair of the IUSS Working Group on WRB, represented WRB at EUROSOIL, meeting in Vienna, the International Conference on Problems of Soils Classification and Diagnostics, meeting in Chernivtsi, Ukraine, and the International Conference and Field Workshop on Soil Classification in Santiago, Chile. He also produced the map legend of the *Soil Atlas of the Northern Circumpolar Region*, based on WRB.

Otto Spaargaren

Projects in 2009

1. *World Soil Library*: maintenance of on-line catalogue; expansion of metadata; digitization of key regional holdings; linking of map, document and monolith catalogues and search facility
2. *Decentralized global digital archive of land resources data*: expansion of the European Digital Archive of Soil Maps (EuDASM) in partnership with JRC, FAO and others
3. *Map library*: update with new holdings, digitisation and indexing by continent and theme, completion of meta-data; output on-line with map location by Google Earth and development of viewing and analysis tool; re-location to the ground floor alongside the World Soil Library
4. *Reference photo collection*: maintenance, on-line catalogue of digital images; web-search application and link to ISIS; selection and commentary for *Hundred best slides*
5. *ISIS database*: enhancement of and web application and link with *World of Soils* learning program
6. *World Archive of Soil Profiles (WASP)*: compilation of data on soil profiles from publicly available sources and selected literature
7. *World Soil Reference Collection*:
 - a. *Caesium behaviour in soils*: joint program using the World Soil Reference Collection with the Université de Louvain-la-Neuve (Belgium)
 - b. Implementation of re-sampling program coordinated with the GEF-UNEP *Carbon Credits* program.

APPLIED RESEARCH

Land resources data are fundamental to any land-related assessment, both in their own right and through their applications along with other related information. The Applied Research Program compiles and applies our own and other data to meet a wide range of needs including land use policy and planning, assessment of food and water security, and predictive models for global climatic change.

ISRIC-WISE global soil profile database

The working version of the *ISRIC-WISE* global soil profile database has been carefully checked and consolidated; the resulting *WISE3* set holds selected site and soil analytical attribute data for some 10 250 soil profiles (47 800 horizons) from 149 countries. Being a compilation of legacy soil data derived from traditional soil survey, the dataset inevitably has gaps that may be of a taxonomic, geographic, and soil-analytical nature: there is no standard set of properties for which all profiles have analytical data because only selected measurements were undertaken during the various original surveys; individual profiles were described and analysed according to methods and standards in the originating countries, which vary between laboratories and over time so, sometimes, results for the same property cannot be compared directly. As a result, the data available for modelling are fewer than might be expected but adroit use of the data will permit a wide range of agricultural and environmental applications at a global and continental scale (1:500 000 and broader). The data set and documentation are available on-line at www.isric.org and a companion paper will be published in *Soil Use and Management* in 2009.

Primary data held in *WISE3* were used to develop taxo-transfer procedures to fill gaps in measured soil attribute data in the *Soil and Terrain database for Senegal and The Gambia*. Similar procedures were used earlier to fill gaps in all primary, regional and continental *SOTER* products; the resulting *SOTWIS* databases provided consistent input for the Harmonized World Soil Database.

Niels Batjes

Harmonized World Soil Database

FAO and IIASA, in collaboration with ISRIC, ISS-CAS and JRC, released the *Harmonized World Soil Database (HWSD)* developed, in the first instance, for global agro-ecological zoning. The 30 arc-second raster database combines updated regional and national soil data (e.g. *SOTWIS*, *European Soil Database*, *Soil Map of China*, and *WISE*) with the information from the 1:5 million scale FAO-UNESCO *Soil Map of the World* (1971-1981); derived soil properties are presented for each grid cell. The reliability of the information in the database is variable; parts that depend on the *Soil Map of the World*, such as North America, Australia, West Africa and South Asia, are considered less reliable; data are considered most reliable for areas

covered by *SOTWIS* databases (Southern Africa, Latin America and the Caribbean, Central and Eastern Europe).

Niels Batjes, Koos Dijkshoorn and Vincent van Engelen

Global Assessment of Land Degradation and Improvement (GLADA)

Within the FAO project *Land Degradation Assessment in Drylands*, ISRIC produced global maps of climate-adjusted changes in biomass based on the *NASA GIMMS* dataset of satellite NDVI data. Deviation from the norm serves as a proxy indicator of land degradation and improvement. By this measure, a quarter of the land surface has been degrading over the last quarter of a century, affecting the livelihoods of a quarter of the world's people; this on top of the legacy of thousands of years of mismanagement in some long-settled areas.

The consequences include reduced productivity, food and water insecurity, loss of biodiversity, damage to underpinning ecosystems and outflows of environmental migrants. The new data indicate that, despite the stated determination of 193 countries that ratified the United Nations Conference to Combat Desertification in 1994, land degradation is worsening rather than improving. Some areas of improvement reflect substantial efforts by some national agencies to promote sustainable land use and management.

The data are part of the larger *Land Degradation Assessment in Drylands* (LADA) released by FAO, UNEP and ISRIC - World Soil Information and funded by the Global Environment Facility and several partners, including ISRIC itself.

Draft reports for the LADA partner countries (Argentina, China, Cuba, Senegal, South Africa, and Tunisia) were reviewed with FAO and partners and revised using a refined methodology. A global report and peer-reviewed papers were published, and two further papers are in press (*Soil Use and Management, Ambio*). Reports on global landforms and enhanced soil and terrain data for the partner countries were also delivered.

Preliminary findings

Land degradation is defined as a long-term decline in ecosystem function and productivity. Over the period 1981-2003, areas severely affected by degradation include Africa south of the Equator with 13 % of global degrading area and 18 % of lost net primary productivity (NPP); South-east Asia (6 % of the degrading area and 14% of lost NPP; and South China with 5 per cent of the degrading area and lost NPP. The lost NPP amounts to one thousand million tonnes C, equivalent to 20% of global carbon emissions for the year 1980 and \$US 50 billion at the shadow price for carbon used by the British Treasury; but emissions from the soil as a result of the degradation are probably an order of magnitude greater. Nineteen per cent of degrading land is cropland (20% of cropland) and 43 % is forest (30 percent of forests).

Bright spots showing improved productivity were also identified: 19% of cropland, 19% of grassland and 10% of forests. Some improvement in cropland is associated

with irrigation but there are also swaths of improvement in rain-fed cropland and pastures in the Great Plains of North America, and western India. Some gains are a result of forest plantations, especially in Europe and North America, and some big land reclamation projects, for instance in North China. However, some of the positive trends represent woodland and bush encroachment into rangeland and farmland - which is not generally regarded as land improvement.

Godert van Lynden, Zhanguo Bai, David Dent

SOTER activities within GLADA

A global landform map at a 5 arc-minute raster and, for LADA partner countries, landform maps at scale 1:1million were generated from the SRTM 90m DEM using GIS-based procedures. New SOTER databases were compiled for China (with the Institute of Soil Science - Chinese Academy of Sciences), Senegal (with the Institut National de Pédologie) and for Tunisia. Existing SOTER databases for Argentina, Cuba and South Africa were updated. In a next step, the SOTER information will be combined with NDVI trends to better explain observed changes in biomass productivity.

SOTER procedures manual and database

Revision of the SOTER procedures manual is under way, including a chapter on SOTER landform mapping. Changing demands and recent experience have revealed that essential information at profile level, e.g. land use and/or vegetation, is not properly stored in the database; better specification of such information will be included in the revised manual. The input software is also updated to include the latest version of the *World Reference Base for Soil Resources*. The use of SOTER concepts and attributes in the new *e-SOTER* project requires some adaptation of data input without losing its compatibility; a draft version of the new Attribute Coding is under consideration by *e-SOTER* partners.

Koos Dijkshoorn, Vincent van Engelen, Jan Huting

The SOTER Data Entry Utility has been adapted – more than once – and has now reached version 4.0. Added, among others, was support for various versions of the WRB in the Profile Data Table.

A common *SOTER* database schema was devised to enable conjoint exploration, both spatially and thematically, of all the data of disparate *SOTER* projects. This is implemented in Postgis - open-source software that adds support for geographic objects to the PostgreSQL object-relational database. Postgis acts as a scale-independent, attribute-set-independent repository for all spatial and attribute data. Work is under way to transfer data from all *SOTER* databases to the central data repository, assuring data integrity as well as referential integrity in the process. Data from *SOTERLAC* as well as *CHARM* were successfully transferred to the repository and possibilities to accommodate other ISRIC data holdings (notably *ISIS*) were briefly investigated.

Postgis can act as a data source for an Open Geospatial Consortium-compliant web-map service (WMS) service. Alternative WMS servers were also investigated. Whereas Postgis and GeoServer may act as the model and controller respectively in a Model-View-Controller approach for *SOTER* data, the view role might be accomplished by OpenLayers for building rich, web-based geographic applications (similar to the Google Maps and MSN Virtual Earth APIs), but in common with much open-source software, evaluation is hampered by lack of documentation.

Piet Tempel

e-SOTER

Soil and land information needed for many interpretations are often inaccessible, incomplete, or out of date. As the European contribution to the Global Soil Observing System proposed by GEO (the Group on Earth Observations), *e-SOTER* addresses the felt need for a global soil and terrain database. It will deliver a web-based *regional pilot platform* with data, methodology, and applications, using remote sensing to validate, augment and extend existing data.



e-SOTER is supported by the EU Framework Program 7 and coordinated by ISRIC – World Soil Information. The inaugural meeting in September was attended by all project partners - 14 natural resources institutes, universities and a private company - from Europe, Morocco and China.

Technical barriers that have to be overcome include: quantitative mapping of landforms; soil parent material and soil attribute characterization and pattern recognition by remote sensing; standardization of methods and measures of soil attributes to convert legacy data. The two research thrusts are: 1) Improvement of *SOTER* methodology at scale 1:1 million in four windows in Europe, China and Morocco; making use of advanced statistical procedures, moderate-resolution optical remote sensing will be combined with existing parent material geology and soil information. 2) Within scale 1:250 000 pilot areas, advanced remote sensing applications will be developed - geomorphic landscape analysis, geological re-classified remote sensing, and remote sensing of soil attributes.

Advances beyond the state-of-the-art include: transformation of pre-existing data and addition of new information with remote sensing and DEM; interpretations of the *e-SOTER* database that address threats defined in the EU Soil Thematic Strategy and comparing the results with current assessments; and delivery through the web service of a data portal.

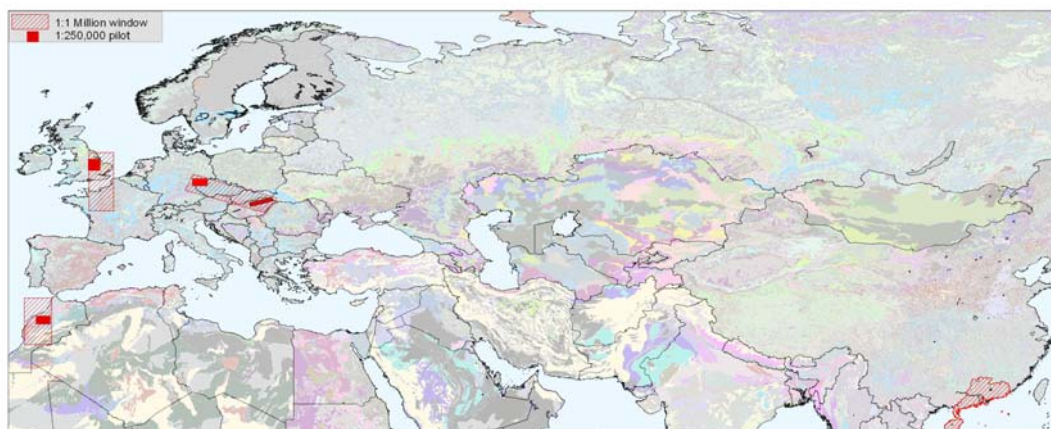


Figure 2. Location of the e-SOTER windows and pilot areas

The objective is a Pilot Platform and a portal providing open access to: 1) methodology to create enhanced *SOTER* databases and an enhanced soil and terrain database at scale 1:1 million for the four windows; 2) an artifact-free 90m digital elevation model; 3) 1:250 000-scale enhanced *SOTER* databases for four pilots; 4) advanced remote sensing techniques to obtain soil attribute data; 5) validation and uncertainty propagation analysis; 6) applications related to major threats to soil quality and performance.

A project website has been launched (www.esoter.net) and Vincent van Engelen drafted subtask US-09-03 Bio-geophysical, Soil & Land Surface Data for the GEO 2009-2011 Work Plan.

Vincent van Engelen

GlobalSoilMap.net

GlobalSoilMap.net is a project to make a new digital soil map of the world over 5 years, using state-of-the-art and emerging technologies for soil mapping and predicting soil properties. The digital map will consist of primary functional soil properties at a grid resolution of 90 by 90 m, supplemented by interpretation and functionality options to support better decisions across global issues like food security, climatic change, and environmental degradation. It will be freely available and web-accessible.

ISRIC - World Soil Information leads a global consortium that includes the Joint Research Centre of the European Commission, the Commonwealth Scientific and Industrial Research Organization and the University of Sydney (Australia), the Chinese Academy of Sciences, the Earth Institute at Columbia University (New York), the US Dept of Agriculture - Natural Resources Conservation Service, the Brazilian Agricultural Research Corporation - Embrapa, and CIAT-TSBF (Nairobi, Kenya). Work has already started in sub-Saharan Africa, through an \$18 million grant from the Bill & Melinda Gates Foundation and the Alliance for a Green Revolution in Africa (AGRA) awarded to CIAT to create Africa Soil Information Service (AfSIS). ISRIC is responsible for compiling the soil legacy data for SSA, coordinating the global methodology, and advocacy.

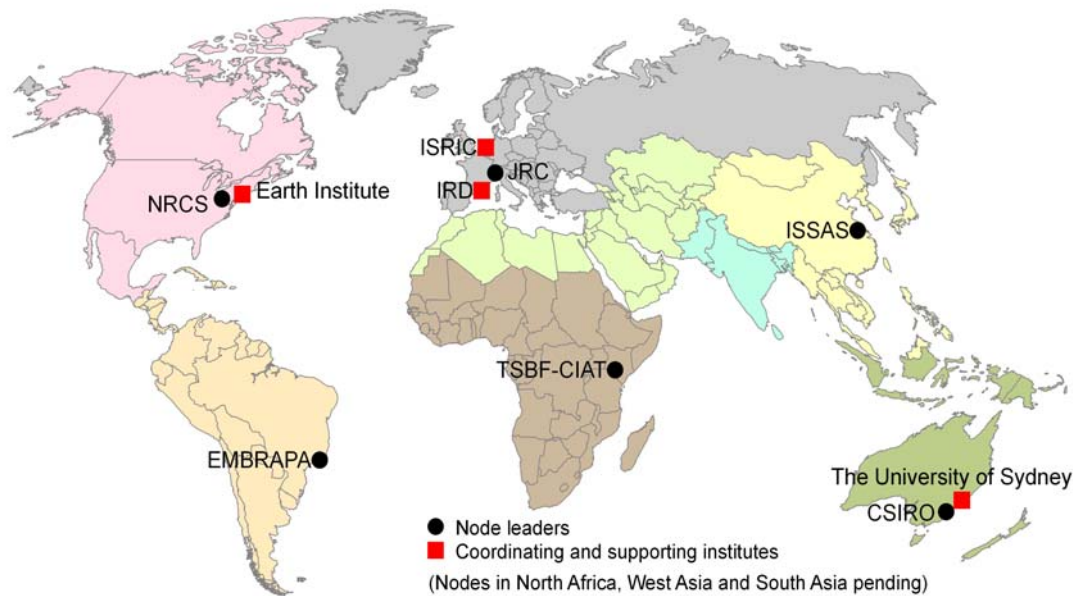


Figure 3. Nodes in *GlobalSoilMap.net*

Alfred Hartemink

Green Water Credits

Green Water Credits create a market in water management services by farmers that are presently unrecognized and unrewarded. Regular payments from downstream water users enable farmers to adopt well-proven, sustainable *green water management* packages; at the same time they combat rural poverty by diversifying income. Water productivity can be significantly increased, the hazards of flood and drought mitigated, and rural livelihoods secured by two fundamental improvements in soil management: increasing infiltration of rainfall, thereby cutting storm runoff, and arresting unproductive evaporation. More infiltration means banking water in soils and aquifers which feed river base flow; less storm runoff means less soil and bank erosion, less flooding, and less siltation of streams reservoirs.

Pilot operations in Kenya are funded by the International Fund for Agricultural Development. These were delayed by political turmoil and changes in personnel but a national management structure is now in place and design and capacity building for the Kenya Water Resources Management Authority (WRMA) is under way. WRMA team leader Joseph Kinyua visited ISRIC 9-20 March; David Dent and Sjef Kauffman made several visits to Kenya and Sjef also presented the program at a meeting of the Katoomba Group in Tanzania, September 15-21. A policy brief has been published in English and French, also a French translation of the summary report of the proof-of-concept study; and a review of science and technology, including relevant projects in the region has been completed.

Preliminary negotiations for pilot operations in China were begun, in partnership with the Changjiang Water Resources Protection Institute in Wuhan.

David Dent and Sjef Kauffman

Land resources conservation and degradation

World Overview of Conservation Approaches and Technologies (WOCAT)

WOCAT is a professional network maintained jointly by Centre for Development and Environment – University of Bern and ISRIC, funded since its inception in 1992 by the Swiss Agency for Development and Cooperation with additional funds from various sources. National or regional partners implement their activities with their own resources but with training or technical assistance provided by the Management Group, Secretariat and some long-term partners.

Godert van Lynden coordinated the 13th annual *WOCAT Workshop and Steering Meeting* in Thun, Switzerland in October with 40 participants from 20 countries, preceded by a Symposium for a wider audience which was attended by over 100 participants from more than 50 countries.

Within the FAO project *Land Degradation Assessment in Drylands*, ISRIC contributed to the extensive revision of the *WOCAT* mapping methodology (also to be used in *DESIRE*) and Godert van Lynden participated in two meetings on this subject in Pretoria.

Desertification mitigation and remediation of land (DESIRE)

The EU-Framework Program 6 project *DESIRE* is a 5-year project coordinated by Alterra. It brings together 28 research institutes and NGOs with policy-makers from around the world. The aim is to devise alternative strategies for the use and protection of areas vulnerable to soil erosion, salinisation and drought. Eighteen study sites have been identified from the Mediterranean region, Australia, Chile, China, Botswana and the USA.

ISRIC coordinates Work Block 1: Environmental and socio-economic context. Godert van Lynden and Stephan Mantel participated in plenary meetings in Cape Verde (January) and Turkey (November), as well as a work block leaders' meeting in Italy (April 08). Godert also attended the leaders' meeting in Leeds (September) and a Review Panel at the European Commission in Brussels. The first Work Package (Information Review) was concluded. The second (Assessment and Mapping) is using both the *WOCAT* and *GLADA* mapping methods; thanks to close collaboration with *LADA* and *WOCAT*, the mapping method has undergone a major revision. Short training was given at the Cape Verde and Turkish meetings.

Stephan Mantel is focusing on identification of drivers of desertification and the socio-economic context in 18 trouble spots around the world: first, by literature review; then mapping and assessment of drivers and policy context; finally, by questionnaire, an inventory is being made of stakeholders' sustainability goals.

Work Block 1 is scheduled to be completed in 2009 but ISRIC will continue to play a role till the end of the project.

Godert van Lynden and Stephan Mantel

Projects in 2009

1. *GLADA*: Manual for field survey of land degradation and improvement; development of indicator of land use change; integration of land use, soil and terrain data in global and national assessments
2. *Green Water Credits*: design and capacity building for pilot operations in Kenya; proof of concept in Morocco; project acquisition for pilot operations in China
3. *Desertification mitigation and remediation of land (DESIRE)*: report on Desertification drivers and policies; report on Stakeholders' sustainability goals; WOCAT mapping at study-site level
4. *SOTER*: Development and maintenance of global SOTER – revised procedures manual; web-based GIS tools for data surfaces
5. *e-SOTER* : Corrected digital elevation model; European SOTER at scale 1: million plus windows at 1:250 000 including China and Morocco
6. *GlobalSoilMap.net*: Project launch; establishment of international network and methodology
7. *WOCAT*: Maintenance of network and database; methodology development; newsletter
8. *Global Carbon Benefits*: Launch of GEF co-funded project
9. *Land Degradation and Risk Mapping in Turkey*: The World Bank project initiative.

Other activities

Consultancy mission to Angola

A consultancy was undertaken to assess the suitability of the soils along the Rio Kwanza for fresh vegetable growing for the Luanda market, in cooperation with COBA-Portugal, in response to a request of the Angolan Ministry of Agriculture and Rural Development.

Field surveys were completed. Reporting awaits the results of the chemical and physical analysis of the soils sampled, which is being undertaken by the Instituto Superior de Agronomia in Lisbon and will be completed in 2009.

Koos Dijkshoorn

International Union of Soil Sciences

In his role as Deputy Secretary General, Alfred Hartemink edited and published two *IUSS Bulletins* and 12 *IUSS Alerts* and maintains the IUSS web site. All IUSS Bulletins and Proceedings of the World Congresses of Soil Science have been scanned and are accessible as pdf files on the web site.

Dutch Society of Soil Science

Stephan Mantel is Secretary-Treasurer of the Dutch Society of Soil Science.

Encyclopaedia of Soil Science

Otto Spaargaren served as member of the Advisory Board of the new, 2008 edition of the *Encyclopaedia of Soil Science*¹ and contributed a several sections on the reference soil groups of the World Reference Base for Soil Resources.

¹ Chesworth W (editor) 2008 *Encyclopedia of Soil Science*. Encyclopedia of Earth Sciences Series. Springer. 902pp

PUBLICATIONS

Alfred Hartemink is joint Editor-in-Chief of *Geoderma* and co-editor of the Elsevier series *Developments in Soil Science*. He is also board member of *Outlook on Agriculture*, *Pedosphere* and *Plagiary*.

David Dent is an Associate Editor of *Soil Use and Management*.

Niels Batjes was invited to join the Editorial Board of *Agriculture, Ecosystems and Environment*.

Papers in peer-reviewed journals

Bai ZG, DL Dent, L Olsson & ME Schaepman 2008 Proxy global assessment of land degradation. *Soil Use and Management* 24, 223-234

Batholomeus HM, ME Schaepman, L Kooistra, A Stevens, WB Hoogmoed & OC Spaargaren 2008 Spectral reflectance based indices for soil organic carbon quantification. *Geoderma* 145, 28-36

Batjes NH 2008b Mapping soil carbon stocks of Central Africa using SOTER. *Geoderma* 146, 58-65

Chorover J, AE Hartemink, AB McBratney, E Perrier & MJ Vepraskas 2008 The times they are a changin'. *Geoderma* 144, 415

Hartemink AE 2008 Soils are back on the global agenda. *Soil Use and Management* 24, 327-330

Hartemink AE 2008 Sugarcane for bio-ethanol: soil and environmental issues. *Advances in Agronomy* 99, 125-182

Hartemink AE 2008 Soil maps and soil scientists needed. *Natural Resources Forum* 32, 163-164

Hartemink AE, J Chorover & AB McBratney 2008 Discussion papers. *Geoderma* 144, 416-417

Hartemink AE & J Huting 2008 Land cover, extent and properties of Arenosols in Southern Africa. *Arid Land Research and Management* 22, 134-147

Hartemink AE & AB McBratney 2008 A soil science renaissance. *Geoderma* 148, 123-129

Hartemink AE, AB McBratney & B Minasny 2008 Trends in soil science: looking beyond the number of students. *Journal of Soil and Water Conservation* 63, 76-83

Hartemink AE, A Veldkamp & ZG Bai 2008 Land cover change and soil fertility decline in tropical regions. *Turkish Journal of Agriculture and Forestry* 32, 195-213

Kooistra MJ & GJ Maas 2008. The widespread occurrence of Celtic field systems in the central part of the Netherlands. *Journal of Archaeological Science* 35, 2318-2328

Ningal T, AE Hartemink & A Bregt 2008 Land use change in the Morobe Province of Papua New Guinea between 1975 and 2000. *Journal of Environmental Management* 87, 117-124

Rutunga V, NK Karanja and CKK Gachene 2008 Six month-duration *Tephrosia vogelii* Hook.f. and *Tithonia diversifolia* (Hemsl.) A.Gray planted fallows for

improving maize production in Kenya. *Biotechnology Agronomy Society and Environment* 12, 262-278

Book

Hartemink AE, AB McBratney & L Mendonca (editors) 2008 *Digital soil mapping with limited data*. Springer, Dordrecht. 445 pp. ISBN 978-1-4020-8591-8

Contributions to edited books

Dent DL & ZG Bai 2008 Assessing land degradation; case study in Kenya using NASA GIMMS. 247-258 in AE Hartemink and others *op cit*.

Dent DL 2008 ISRIC – World Soil Information. In E Derbyshire (editor) *International Year of Planet Earth*. Boston Hannah, New York

Engelen VWP van and Huting JRM 2008. Extrapolation of results to similar environments in Tropical America. 173-192 in L 't Mannelje, MC Amézquita, P Buurman and MA Ibrahim (editors) *Carbon sequestration in tropical grassland ecosystems*. Wageningen Academic Publishers

Hartemink AE 2008 Soil map density and a nation's wealth and income. 53-66 in AE Hartemink and others *op cit*.

Hartemink AE 2008 Soil – Earth's living skin. In E Derbyshire *op cit*.

Kooistra MJ & Maas GJ 2008 *The widespread occurrence of Celtic field systems in the central part of the Netherlands*. *Journal of Archaeological Science* 35:2318-2328

Kooistra MJ 2008 Micromorfologie. 59-78 in JM Koot, L Bruning & RA Houkes *Ypenburg-locatie 4, Een nederzetting met grafveld uit het Midden-Neolithicum in het West-Nederlandse Kustgebied*, Leiden

Contributions to conference proceedings and other publications

Dent DL & J Kauffman 2008 Green Water Credits/Les Crédits Eau Verte. ISRIC – World Soil Information Policy Brief, Wageningen, 8p

Dent DL & R Scholes. Greenness indicator. Methodological note. *KM:Land review of land degradation indicators*. INWEH, Bonn 21-23 January 2008

Engelen VWP van 2008. Regional pilot platform as EU contribution to a Global Soil Observing System (e-SOTER). *3rd Global Workshop on Digital Soil Mapping*, Logan, UT, USA

Hartemink AE 2008 Editorial. *Bulletin International Union of Soil Science* 113, 4

Hartemink AE, S Nortcliff & DL Dent 2008 *Soil - The living skin of planet earth*. International Year of Planet Earth, ISRIC-IUSS, Wageningen

Minasny B, AB McBratney & AE Hartemink 2008 Soil Bibliometrics - Degree of separation. *Pedometron* 24, 10-11

Reports

Bai ZG, DL Dent, L Olsson & MA Schaepman 2008. *Global assessment of land degradation and improvement 1: identification by remote sensing*. Report 2008/01, ISRIC – World Soil Information, Wageningen, 67p

Batjes NH 2008 *ISRIC-WISE harmonized global soil profile dataset (Version 3.1)*. Report 2008/02, ISRIC - World Soil Information, Wageningen

- http://www.isric.org/isric/webdocs/Docs/ISRIC_Report_2008_02.pdf
- Batjes NH 2008 *Soil parameter estimates for Senegal derived from SOTER and WISE (SOTWIS-Senegal, ver. 1.0)*. ISRIC – World Soil Information, Wageningen.
http://www.isric.org/isric/Webdocs/Docs/ISRIC_Report_2008_05.pdf
- Dijkshoorn JA, Engelen VWP van & JRM Huting 2008 *Soil and landform properties for LADA partner countries (Argentina, China, Cuba, Senegal and The Gambia, South Africa and Tunisia)*. ISRIC report 2008/06 and GLADA report 2008/03, ISRIC – World Soil Information and FAO, Wageningen (23 pp with data set)
http://www.isric.org/isric/Webdocs/Docs/ISRIC_Report_2008_06.pdf
- Huting JRM, Dijkshoorn JA, Engelen VWP van 2008 *GIS procedures for mapping SOTER-landform for the LADA partner countries (Argentina, China, Cuba, Senegal and The Gambia, South Africa and Tunisia)*. ISRIC report 2008/04 and GLADA report 2008/02, ISRIC – World Soil Information and FAO, Wageningen 30 p with data set
http://www.isric.org/isric/Webdocs/Docs/ISRIC_Report_2008_04.pdf
- MacMillan RA, DL Dent & T Mayr 2008 *Soil and ecological interpretations of airborne gamma-radiometric data in the Cariboo forest region of British Columbia*. LandMapper Environmental Solutions, ISRIC – World Soil Information & Cranfield University, Edmonton 24p
- Mantel S 2008 *CHARM Project. Final Technical Report of the CHARM Project Bangladesh*. Asia Pro Eco - 1 Programme, Component A: DIAGNOSTIC ACTIVITIES. ISRIC - World Soil Information, Wageningen
- Nachtergaele FO, H van Velthuizen, L Verelst, NH Batjes, JA Dijkshoorn, VWP van Engelen, G Fischer, A Jones, L Montanarella, M Petri, S Prieler, E Teixeira, D Wiberg & X Shi 2008 *Harmonized World Soil Database (version 1.0)*, Food and Agriculture Organization of the United Nations, International Institute for Applied Systems Analysis, ISRIC - World Soil Information, Institute of Soil Science - Chinese Academy of Sciences, Joint Research Centre of the European Commission, Rome
http://www.iiasa.ac.at/Research/LUC/luc07/External-World-soil-database/HWSD_Documentation.pdf

TRAVEL AND MEETINGS

In connection with program activities, ISRIC staff participated in training, workshops, and presented papers and posters at international conferences and symposia

Staff	Event	Venue	Period (2008)	organized by
Bai	Bioenergy and Biodiversity: joint intl workshop on High-Nature-Value Criteria and Potential for Sustainable Use of Degraded Lands	Paris	29 Jun-2 Jul	German Inst of Appl Ecology
Bai, Dent, van Lynden	Mid-term review GLADA technical meeting	Rome	28-29 Jan	FAO/LADA
Batjes	Soil information: recent developments and future	Wageningen	9 Oct	Alterra
Dent	KM: Land expert meeting	Bonn	21-23 Jan	UN University
Dent	Green Water Credits review meeting	Rome	30-31 Jan	IFAD
Dent	IFAD Round Table	Rome	14-15 Feb	IFAD
Dent	Green Water Credits IIED partners meeting	London	18-19 Feb	ISRIC
Dent	Green Water Credits Gvt Kenya meeting and Carbon Benefits meeting with UNEP	Nairobi	18-21 May	ISRIC
Dent	Consultancy airborne radiometrics, Cariboo and Carbon Benefits Protocol Development	Cariboo BC and Edmonton, Alberta	9-18 Jun	LandMapper, Govt Alberta
Dent	UNESCO collaboration	Paris	25-26 Sept	UNESCO
Dent	GLADA presentation to UNCCD	Bonn	13 Oct	UNCCD
Dent	Green Water Credits IIED partners' meeting	London	16 Oct	ISRIC
Dent	ISRIC Board of Trustees meeting	Schiphol, Amsterdam	7-8 Nov	ISRIC
Dent	EU JRC collaboration	Ispra, Italy	10 Nov	ISRIC/JRC
Dent	Pressures on Prime Agricultural Land	Brussels	19 Nov	Dutch Min Agric/COPA/Alterra

Staff	Event	Venue	Period (2008)	organized by
	discussion			
Dent/Hartemink	Intl Year of Planet Earth International launch and Board meeting	Paris	12-13 Feb	Intl Year of Planet Earth/UNESCO
Dijkshoorn	Consultancy Kwanza river project, Angola,	Bom Jesus/ Calumbo, Angola	25 May- 8 Jun	COBA-Portugal and MINADER
van Engelen	FP7 project management	Oegstgeest, Leiden	23-24 Jan	EG-Liaison
van Engelen	EGU conference	Vienna	14-18 Apr	EGU
van Engelen	SOTER database, preparation and soil monolith course	Dakar	4-12 May	ISRIC-INP
van Engelen	7 th Meeting of GEO Science & Technology Committee	Geneva	22-23 May	GEO-STC
van Engelen	FP6/7 GEO projects	Brussels	3-4 Sep	EU DG Research
van Engelen, Batjes, Dijkshoorn, Dent	e-SOTER inaugural meeting	Wageningen	11-12 Sep	ISRIC
van Engelen, Batjes, Dijkshoorn	e-SOTER WP1 and WP2 meeting	Miskolc, Hungary	4-5 Dec	ISRIC, Univ. Miskolc and Szent Istvan
Kauffman	PRESA Intl Advisory Ctte and launch workshop	Entebbe/Kampala, Uganda	27 Apr – 3 May	ICRAF
Kauffman	Green Water Credits, MoUs and work plan	Nairobi, Kenya	4-9 Aug	ISRIC
Kauffman	Eastern and Southern Africa Katoomba Conference and workshop,	Dar es Salaam	15-21 Sep	Katoomba Group
van Lynden	International Conference on Research for Development	Bern	2-4 Jul	CDE - NCCR
van Lynden	FAO Somalia Water and Land Information Management workshop on land use and land degradation	Nairobi	8-12 Sep	FAO
van Lynden	LADA workshop on national assessment	Pretoria	15-19 Sep	FAO/ Min of Ag South Africa
van Lynden	LADA workshop on national and global assessment	Pretoria	15-19 Sep	FAO/DoA-ARC
van Lynden	DESIRE review meeting	Brussels	6 Oct	EU

Staff	Event	Venue	Period (2008)	organized by
van Lynden	WOCAT 13 th Annual Workshop and Steering Meeting (WWSM)	Bern/Thun, Switzerland	20-25 Oct	CDE Univ Bern
van Lynden	UNCCD CRIC7 meeting	Istanbul	3-8 Nov	UNCCD
van Lynden	World Atlas of Desertification, expert consultation	Ispra, Italy	3-5 Dec	JRC
van Lynden, Mantel	DESIRE plenary meeting	Praia, Cape Verde	6-12 Jan	Alterra
van Lynden, Mantel	DESIRE leaders' meeting	Bari	2-5 Apr	Alterra
van Lynden, Mantel	DESIRE plenary meeting	Eskisehir	17-22 Nov	Alterra
Mantel	DESIRE training workshop and leaders' meeting	Bari	30 Mar-6 Apr	Univ Berne
Hartemink	ASSS meeting	Boston	14-22 Jan	JRC
Hartemink	<i>GlobalSoilMap.net</i> meeting	New York	18-23 May	Earth Inst
Hartemink	Teach IHE Unesco	Limburg	17-20 Jun	IHE Unesco
Hartemink	3 rd Global Workshop	Logan, US	24 Sep-4 Oct	IUSS
Hartemink	Presentation World Bank & NRCS	Washington	5-9 Oct	World Bank

PERSONNEL

(As of January 2009)

Board of Trustees

- Ir CT Slingerland (Environmental Sciences Group, representing the Executive Board of Wageningen UR, Acting Chairman)
- Ir GJA Nieuwenhuis (representing Alterra BV)
- Prof. Dr L Brussaard (Environmental Sciences Group, representing Wageningen University)
- Dr A Tengberg (United Nations Development Programme, Thailand, representing the international organisations)
- Prof. Dr S Nortcliff (University of Reading, representing the International Union of Soil Sciences)

Honorary Fellows

Prof. Dr Ir KJ Beek
Prof. Dr J Bouma
Dr R Brinkman
Prof. Dr R Dudal
Dr L Montanarella
Prof. Dr P Sanchez

Staff

- Dr DL Dent – Director
- Ir JH Kauffman – Deputy Director; *Green Water* engineer

- Dr ZG Bai – Global assessment of land degradation and improvement
- Ir NH Batjes – Land resources information systems, soils and global change
- WCWA Bomer – Graphic design, in-house publishing
- Ir JA Dijkshoorn – Soil and terrain databases
- Ir IJ Haas – Webmaster
- Dr AE Hartemink – Head, World Soil Museum; soil fertility
- Ir IIM Huibers-Govaert – Library
- JRM Huting – GIS database management; modelling and mapping
- Drs R de Jong – PhD student: Global Assessment of Land Degradation
- YGL Karpes – Secretariat, communications
- S Mantel MSc - Land evaluation and decision support
- AJM van Oostrum MSc – Curator of collections
- Dr OC Spaargaren – Head, World Data Centre for Soils; taxonomy of soils
- Ir P Tempel - Systems analysis, programming
- Drs VWP van Engelen – Research Team Leader; land resources information systems
- Drs GWJ van Lynden – Land, water and environmental management

Staff change:

Jan Brussen retired 1 May 2008 after more than thirty years servicing the financial administration affairs of ISRIC.

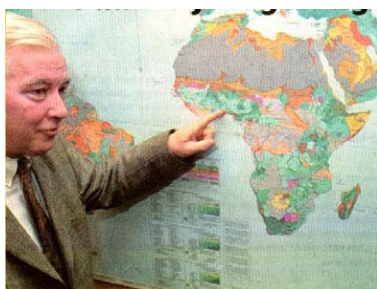
Temporary Staff

M Ahmad MSc (Sep 2008-Sep 2009) - soil monolith workshop
M van Genderen (Aug 2008-Jan 2009) – library
R Geertsma (Jan-Apr 2008) Green Water Credits
L Wilschut - Utrecht University (Oct 2008 – Feb 2009) Green Water Credits

Guest researchers

Drs JHV van Baren - Philosophy of soil science (IUSS program) – *in memoriam*
Dr LP van Reeuwijk – Laboratory methods and quality control
Dr MJ Kooistra – Soil micromorphology
Dr V Rutunga – Soil fertility

In Memoriam



Roel Oldeman (1942-2008)

Project manager, UNEP-ISRIC project World Map on the Status of Human-induced Soil Degradation (1987-1990)
Director ISRIC (1992-2002)

From 1987 to 1990 Roel was the Project manager of a joint UNEP-ISRIC project: *World Map on the Status of Human-Induced Soil Degradation* (GLASOD, published in 1990) which was his masterpiece and is still widely quoted and used by various international agencies. Roel was Director of ISRIC from 1992 to 2002.



Hans van Baren (1936-2009)

Head, Department of Documentation, Information and Education (1971 - 1997)
Acting Director, International Soil Museum (1975 - 1978)
Deputy Director ISRIC (1990 - 1997)
Deputy Secretary General IUSS (1990 - 2002)

Elected Honorary Member IUSS, 2006
Knighted 'Ridder in de Orde van Oranje-Nassau', 2008

Hans van Baren was instrumental in the establishment and development of the World Soil Museum and was Head of Documentation, Information and Education from 1971 to 1997, also serving as Acting Director from 1975 to 1978. He also served as Deputy Director of ISRIC from 1990 to 1997 and continued as a Guest Researcher until 2008. He made major contributions to the Unesco-FAO *Soil Map of the World* and was a first class leader in the ISSS and IUSS, serving as Deputy Secretary General for many years - his contribution was internationally recognised by the award of Honorary Membership at the Philadelphia Congress in 2006.

ABBREVIATIONS

AfSIS	Project: A Globally Integrated African Soil Information Service
AGRA	Alliance for a Green Revolution in Africa
ASSOD	Assessment of Human-induced Soil Degradation in South and Southeast Asia
CDE	Centre for Development and Environment, University of Berne, Switzerland
CHARM	Chittagong Hill Tracts Improved Natural Resources Management project
CIAT-TSBF	Tropical soil biology and Fertility Programme of the International Center for Tropical Agriculture, Cali, Colombia
COBA	Consultores para Obras, Barragens e Planeamento / <i>Company of engineering and environmental consultants</i> , Lisboa, Portugal
COPA	Committee of Professional Agricultural Organisations, Brussels, Belgium
DEM	Digital Elevation Model
DESIRE	Desertification Mitigation and Remediation of land project
EGU	European Geosciences Union
EU	European Union
EuDASM	European Digital Archive of Soil Maps
FAO	Food and Agriculture Organization of the United Nations, Rome, Italy
GEF	Global Environmental Facility
GEO	Group on Earth Observations, Global Soil Observing System
GIMMS	Global Inventory Modelling and Mapping Studies
GIS	Geographic Information System
GLADA	Global Assessment of Land Degradation and Improvement
GLASOD	Global Assessment of the status of humand-induced Soil Degradation
GWC	Green Water Credits project
ICRAF	World Agroforestry Centre, Nairobi, Kenya
ICSU	International Council of Scientific Unions, Paris, France
IFAD	International Fund for Agricultural Development, Rome, Italy
IGBP-DIS	International Geosphere-Biosphere Program – Data Information Service
ISIS	ISRIC Soil Information System
ISRIC	International Soil Reference and Information Centre, Wageningen, The Netherlands
ISS-CAS	Institute of Soil Science, Chinese Academy of Sciences, Nanjing, PR China
ITC	International Institute for Geo-Information Science and Earth Observation, Enschede, The Netherlands
IUGS	International Union of Geological Sciences, Paris, France
IUSS	International Union of Soil Sciences
IYPE	International Year of Planet Earth
JRC	Joint Research Centre of the European Union, Ispra, Italy
JRC-IES	EC Joint Research Centre - Institute for Environment and Sustainability, Ispra, Italy
LADA	Land Degradation Assessment for Dryland Areas
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental Organization

NUFFIC	Netherlands Organization for International Cooperation in Higher Education
PE&RC	Production Ecology and Resource Conservation, Wageningen University
SOTER	Soil and Terrain Database
SOTWIS	Secondary soil databases derived from SOTER and WISE
SRTM	Shuttle Radar Topographic Mission, NASA
SSA	Sub-Saharan Africa
UN	United Nations Organisation, New York, USA
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme, Nairobi, Kenya
UNESCO	United Nations Educational, Scientific and Cultural Organization, Paris, France
UNESCO-IHE	UNESCO-IHE Institute for Water Education, Delft, The Netherlands
Wageningen UR	Wageningen University and Research Centre, The Netherlands
WDC	World Data Centre
WEAP	Water and Evaluation and Planning Tool
WISE	World Inventory of Soil Emission potentials database (Global soil databases)
WOCAT	World Overview of Conservation Approaches and Technologies. CDE, Berne, Switzerland
WRMA	Water Resources Management Authority, Ministry of Water and Irrigation, Nairobi, Kenya

