

## **Research progress report 2008 'earth systems science' project**

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### **Scientific level**

(satisfaction or otherwise with ISI output, recognition of team members as invited speakers, new grants and awards, including funding agencies, etc.)

The ESS team in 2008 has participated in the organization of the following scientific conferences:

- Van der Meer, Member of scientific committee for the 28th EARSEL conference, Istanbul, Turkey.
- Van der Meer, Chairman of the Third workshop of the EARSEL SIG geological applications together with the IGOS geohazards working group and the GRSG on Seismic Geohazards, Istanbul, Turkey.
- Carranza, Member of the International Scientific Committee, IASME/WSEAS (Intl. Assoc. Mech. Eng'g. / World Scientific & Eng'g Academy and Society) 1st International Conference on Geology and Seismology, Portoroz, Slovenia, 15-17 May 2007.
- Tsehaie Woldai, Leading Delegate of the GEO participating organization to the GEO Ministerial Summit, Cape Town, South Africa
- Chris Hecker, established a EARSEL Special interest group on thermal remote sensing which will be hosting sessions in 2009 at EARSEL meetings.
- Van der Meijde, Member of scientific committee for the 9th Nederlands Aardwetenschappelijk Congres (NAC), Veldhoven, Nederland

Key note addresses and tutorials were given by ESS researchers at these conferences in 2008:

- Van der Meer, Van der Werff, tutorial on hyperspectral remote sensing, ACRS 2008, Sri Lanka.
- Van der Meijde, M., van der Werff, H.M.A., Geo-hazards and remote sensing; the latest developments, Earthquake Hazards Pakistan: Post-October 08, 2005 Muzafarabad Earthquake Scenario. Peshawar University Summer Campus, Baragali, Pakistan, 2008.
- Van der Meijde, M., Seismology and water; drowning in theory or thriving on facts? EGU, Vienna, 2008
- Van der Meijde, M., Remote sensing van de ondergrond. TNO symposium on the role of remote sensing in earth sciences, Utrecht, 2008.
- Van der Meijde, M. Remote sensing of the subsurface, NGMSO symposium, Utrecht, 2008.

In addition, ESS PI Van der Meer was re-appointed in 2008 as Adjunct Professor at the School of Environment Engineering of the Asian Institute of Technology (AIT) in Bangkok in 2007.

ESS received various grants in form of matching funded new PhD projects (see below) as well as grants from DHV/NAM of 100.000 Euro for pipeline research (starting 2008), 2 grants from HEC for Pakistan PhD students (Yaseen, Shafique), a grant from the Min. VenW for Dike research (Flood Control 2015, starting 2009), approx 200.000 (total budget for 2008 still undecided). The Project 'Fossil Fuel Deposit Fires; Occurrence Inventory, Design and Assessment of Instrumental Options (short: Fossil Fuel Fires; FFF)' for the Scientific assessments and policy analyses (NRP-CC – WAB) of the Netherlands Research programme on Climate Change (NRP-CC) was granted in 2007 and finished in 2008. A Chinese PhD scholar, Mr. Wang Jun employed by the Shen Hua company as well as the Xi'an University of Science and Technology has started working (and funded by) this grant. Through the proposal "Mapping epithermal deposits in the Ethiopian Rift" submitted to and approved by the National Environment Research Council of the UK (NERC) with University of Hull (lead), ITC, Addis Ababa University and the Ethiopian Road Authority as partners, ESS was involved in a large scale airborne (hyperspectral, lidar) campaign in Ethiopia early 2008.

The ESS team also invested considerable time and effort in shaping up the FTIR thermal infrared spectroscopy facility of ITC. Last year the institute acquired a BRUKER Vertex series FTIR enable measurements in the SWIR-TIR window. The instrument was installed and tested in 2007 and 2008 and recently the last addition to the set-up, the large integrating sphere that allows large rock specimen to be handled, was tested. With the FTIR, ESS will open a new research line on thermal spectroscopy for remote geochemistry. This will be developed in the framework of the PhD research of Chris Hecker. Further collaboration with GIST in Korea follow up the PhD of Eun young Choe on mine waste pollution is foreseen in this context.

In addition, the following project proposals were prepared in 2008:

- MineSense FP7 environment call, lead TNO.
- Hyperspectrale Aardobservatie voor het Monitoren van Veilige en Milieuvriendelijke Ondergrondse Opslag van CO<sub>2</sub> (HyMonC), lead by University Utrecht with partners from ITC and NEO, submitted to Senternovem/under review.
- Planetary mapping project, lead TNO
- On the origin of phyllosilicates on Mars: sedimentary or hydrothermal. submitted as ALW-GO-PL/09-10, together with Utrecht University, ESA ESTEC.
- Imaging African Geodynamics; Filling the Gaps with Satellite Gravity (IMAGE). ALW-GO-09/38, with Wits, Pennstate, Mekelle University, KNMI
- Flood Control 2015 "Nederland als het innovatief voorbeeld van risicobeheersing van hoogwater, partners Arcadis, Fugro, IBM, Haskoning, HKV, TNO, Deltares, Ijkdijk, ITC, submitted to Min. V&W.
- Collaboration with project of Geological Survey of Sweden: Application of GIS in Predictive Mapping of Massive Sulphide Potential in the Skellefte region (ongoing since 2007).
- Uganda mapping project

### **Relevance**

(= valorization, e.g., cooperation interest by NGOs, etc., ways in which research outputs taken up by society, industry, etc., research outputs incorporated into education, etc.)

ESS continued to collaborate with industry partners (Dutch Gas, NAM) as well as consultancy (DHV). This has resulted in the funding of a new PhD position by NAM. In 2007 through ESS member Carranza the team also embarked on collaboration with the Geological Survey of Sweden on the Application of GIS in Predictive Mapping of Massive Sulphide Potential in the Skellefte region. Discussions have also been continued with Shell on future research efforts. ESS research output has been incorporated in education in new modules in ITC curriculum on hyperspectral remote sensing (module 12), Interferometric SAR application (Module 12), 3D geophysics and modeling (Module 13), Multi-sensor thermal infrared RS (Module 14/15) as well as a distance education course on hyperspectral remote sensing offered in 2007 (22 participants) and scheduled for 2008 with 55 applications and too date when writing this report 14 participants starting in 2009. In 2009 ESS staff will participate in a worldbank funded project aimed at mapping the geology and prospectivity of Uganda from multi sensor data.

### **Partners**

(this means scientific partners, thus joint PhD supervision partnerships, partnerships in externally funded research projects such as FP7 projects; name institutes/universities, not persons)

Current ongoing joint PhD supervision partnerships include:

- Formicruz (PhD Pablo de Andrada)
- Indian Institute of Remote Sensing (PhD Bharath)
- Royal Military Academy of Belgium (PhD Shimoni)
- Ethiopian Roads Authority (PhD Yitagesu)
- Addis Ababa University (PhD Yitagesu)
- Gwangju Institute of Science and Technology, S. Korea (Visiting Scientist Eun Young Choe)
- University of Peshawar (PhD Shafique, Saba)

- Utrecht University (PhD Nijland. Luleva)
- Mekelle University (PhD Tedla)
- Chinese Academy of Sciences (PhD Xiaogang)
- NAM, DHV funded PhD (Thi Tam Nguyen) collaboration with Hanoi University
- University of Nairobi (PhD Kuria)
- International Water Management Institute (IWMI), Kenya (PhD Kinoti)
- University of Johannesburg, South Africa (PhD Charles Paradzayi)
- ESA estec
- KNMI
- Penn state university

Research cooperation continued with CSIRO (Australia), NASA JPL (US), BGR (Germany). Through ESS' involvement in the AfricaArray initiative, new research partnerships were established with WITS (SA), Penn State (USA) and 11 academic partners from Africa, 13 non-African academic partners, 9 geological surveys, two African government agencies, 3 academic and industry societies and 6 industrial partners. Through the NRP-CC – WAB Fossil Fuel Fires project, new partnerships were established in 2007 with IPF TU Wien and TU Delft as well as with the Shen Hua company as well as the Xi'an University of Science and Technology. Collaboration with the Asian Institute of Technology, the Vietnam National University and the National University of Laos in the field of geoenvironmental exploration and engineering continued in 2007 in the framework of the EU Asialink programme BRIDGE. Through this collaboration presently 6 MSc students finished thesis work and an extension is implemented with 1 PhD project. Initiatives for other PhD projects funded through mainly Vietnamese governmental resources are foreseen to materialize in 2008. Under the UNU-DGIM, the university Network on Disaster Risk Reduction in Africa (UNEDRA) established in 2005 has resulted in 18 university members in Africa, closely tied to working for joint collaborative research, training and data sharing. This in 2008 will develop into a new PhD partnership (PhD Paradzayi). The PhD partnerships project of Paradzayi of the University of Johannesburg will be funded through the South African Council for GeoScience and will focus on mining impact and arsenic problems on health in South Africa.

### **Coherence**

(coherence of projects/activities within the theme, links to other themes reflecting the coherence of the ITC Research Programme, links to education especially MSc research topics)

ESS research has been linked to (1) the theme "Stochastic methods for image mining and data quality" and (2) the theme Biodiversity in fragmenting landscapes as demonstrated by joint PhD graduations Debba (ad.1) and Noomen (ad.2). ESS has achieved PhD graduations at UU, TUD, and WUR through these joint PhD projects. A new link to the Disaster Management theme was established in 2007 with the joint PhD project of Mila Luleva (supervised by ESS team member Van der Werff, Promotors Van der Meer and Jetten) and the joint PhD project of Ghosh (supervised by ESS team member Carranza, promoter Jetten). Joint PhD project Wiebe Nijland (promotors Van der Meer and De Jong, ESS supervisors van der Meijde, Van der Werff) based in and funded through core subsidy of the University of Utrecht shows ESS linkages to UU. The PhD project of Jennifer Kinoti jointly supervised by Woldai with Su as promoter is a demonstration of new linkage to the ITC Water cycle and climate theme. This research focuses on planning of system innovations in watersheds with emphasis on spatial mapping of environmental and hydrological determinants in Upper Ewaso Ng'iro (Kenya) and Pangani (Tanzania) River Basins, Africa".

### **Evaluation**

(strong and weak points of performance in 2008, plans to strengthen performance)

Strong points in ESS are the high scientific output (ISI, PhD graduations), intimate links with industry and thus the 'real world', linkage of MSc and PhD research, high scientific quality of the staff. Unfortunately Dr Sally Barritt will leave ITC in 2009 and with her ESS loses a resource person in airborne geophysical data processing and interpretation. With Dr. Paul van Dijk moving to the ITC research bureau his involvement inevitably will be downscaled leading

to lesser activity in economic geology. Besides this loss of expertise which we try to resolve through intensifying relevant external collaborative efforts as well as through recruitment of new staff, no weak points were encountered so no plans to strengthen performance.