



WORKSHOP
EVIDENCE FROM SPACE

ISPL ESA STUDY
THE USE OF SATELLITE-DERIVED INFORMATION AS EVIDENCE

UCL ESRC PROJECT
ON THE USE OF SATELLITE INFORMATION IN AUSTRALIA



WILKINS OLD REFECTORY, UCL, GOWER STREET, LONDON WC1E 6BT
TUESDAY 5 OCTOBER 2010

WORKSHOP PROGRAMME

- 8.15** *Sign in – Coffee and tea will be provided*
- 8.45** *Welcome and Introduction – Overview of Project*
Workshop Chairman: Mark Doherty
ISPL Director: Sa'id Mosteshar Key issues in use of satellite-derived information.
Evaluation of previous research.
New research under the Study.
- 8.55** *Methodology – Rules of Evidence*
Moderator: Luc Govaert
Presenter: Kevin Madders Relevant principles of evidence, practical issues
including authentication, audit trail, processing
reliability and security
- 9.25** *Systems Capabilities – Satellite and Data Processing Features*
Moderator: Gordon Campbell
Presenters: David Morten Satellite capabilities for land motion measurement
Robert Gurney Calibration and system reliability
Marc Journal Satellite capabilities for oil spill detection and
polluter identification
- 10.15** **Coffee**
- 10.30** *Cases using EO Information - Space and Aerial Information*
Moderator: Tanja Masson-Zwaan
Presenter: Alessandro Ferretti Cases, including Rovigo
Simon Kay Agricultural Subsidy Claims, Verification,
Fraud and Expert Evidence
Egbert Jongsmā Cases prosecuted
- 11.15** *Jurisdictional Treatment – Case Reports and Regulatory Experience – Comparative Perspectives*
Moderator: Kai-Uwe Schrogl
Presenter: Sa'id Mosteshar UK and US
Kevin Madders Belgium, The Netherlands
Lucien Rapp France
Sa'id Mosteshar Germany
Maureen Williams International law
- 12.30** **Buffet Lunch in the Wilkins North Cloisters**

- 13.30 UCL ESRC Project – Use of Satellite Information in Australia and Lessons Learned**
 Moderator: *Richard Macrory*
 Presenter: *Ray Purdy* Use of satellite derived information,
 perceptions and impact
- 14.30 Case Study I – Land subsidence**
 Moderator: *Luc Govaert*
 Presenters: *Sa'id Mosteshar and Alessandro Ferretti*
- 15.30 Tea**
- 15.45 Case Study II – Oil Spill**
 Moderator: *Gordon Campbell*
 Presenter: *Kevin Madders and Marc Journal*
- 16.45 Questions Raised – Issues Identified, Areas for Further Study, Actions and Conclusions**
 Moderator: *Sa'id Mosteshar*
 Panelists: *Gordon Campbell, Luc Govaert, Robert Gurney, Tanja Masson-Zwaan,
 Ray Purdy, Kai-Uwe Schrogl, Maureen Williams*
- 17.15 Closing report and concluding remarks by the ESA Project Managers and Institute Director**
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LAND SUBSIDENCE CASE STUDY

The hypothetical scenario

Property A is the site of the office and a state of the art patented design warehouse owned by Four Level Ltd. (“FL”), a private defence contractor. Property B is adjacent to Property A and is the site of the office and warehouse of Glass Suppliers (“GS”), a plate-glass manufacturing company.

In January 2009, in order to increase the capacity of its storage facility by installing a basement, FL started excavating an area close to the boundary with Property B. The excavation and subsequent building works continued until March 2009. In April 2009, GS alleges that it observed cracks in the concrete foundations of its warehouse due to land subsidence. By September 2009, GS alleges that the degree of land movement caused damage to its stock and serious structural damage to its warehouse. GS alleges that the excavation by FL on Property A caused the land movement and claims damages.

There is satellite data available that covers both Property A and Property B. The data was processed as indicated in the Technical Annex. The resulting information shows subsidence in the area of the excavation. Details of the subsidence and the technique used to measure the relevant land movement are also given in the Technical Annex. Two specialists were involved in the technical analysis of the data and its interpretation.

Aerial sensed information was also available. There are two sets, one dated December 2008 and another dated October 2009. These were produced by the government as part of its annual land mapping survey and made available to the public.

The ground evidence available was limited. Surveys were conducted in March 2008 for initial construction of the warehouse on Property A. No ground inspection has been carried out on Property B because FL did not consent to have surveyors on its property. However there are surveys conducted by an expert engaged by GS on Property B, and also observing Property A from Property B in October 2009.

Both the aerial and land surveys support the satellite derived information.

Technical Annex

The satellite evidence was gathered from the ascending and descending orbits of the ESA satellites ERS-1 and 2 that produced satellite synthetic aperture radar (“SAR”)¹ data covering the period from January 2001 - June 2010. This was processed through the Permanent (or Persistent) Scatter Technique (“PSInSAR”)² to identify permanent scatter points on both properties that over a series of images demonstrate deformation in the level of the land and buildings. PSInSAR technique facilitates detection of land movement at rates as low as 1 millimetre a year, depending on the number of radar images available, the type of radar sensor used, and the phenomena under study.

Analysis of the data shows the following land movement over an area of 500 metres by 500 metres, with the boundary of Property A and B at its centre:

1. 20 measurement points were identified
2. Using measurements at two monthly intervals the rate of change per year were:

January 2008 to June 2008	Rise at 0.2 cm
June 2008 to January 2009	No change
3. Area outside immediate vicinity of boundary to June 2010 No change detected
4. At Boundary of Properties:

January 2009 to February 2009	No change
February 2009 to March 2009	Drop of 0.2 cm
March 2009 to April 2009	Drop of 0.7 cm
April 2009 to May 2009	Drop of 0.2 cm
May 2009 to June 2010	Drop of 0.3 cm

¹ Synthetic-aperture radar (SAR) is a form of radar in which multiple radar images are processed to yield higher-resolution images than would be possible by conventional means. Either a single antenna mounted on a moving platform (such as an airplane or spacecraft) is used to illuminate a target scene or many low-directivity small stationary antennae are scattered over a reception area, each imaging the target.

² Interferometric synthetic aperture radar, also abbreviated InSAR or IfSAR, is a radar technique used in geodesy and remote sensing. This geodetic method uses two or more synthetic aperture radar (SAR) images to generate maps of surface deformation or digital elevation, using differences in the phase of the waves returning to the satellite. Persistent or Permanent Scatter techniques are a relatively recent development from conventional InSAR, and rely on studying pixels that remain coherent over a sequence of interferograms. In 1999, researchers at Politecnico di Milano, Italy, developed a new multi-image approach in which one searches the stack of images for objects on the ground providing consistent and stable radar reflections back to the satellite. These objects could be the size of a pixel or, more commonly, sub-pixel sized, and are present in every image in the stack. PSInSAR™ is an international trademark of Politecnico di Milano.

OIL SPILL CASE STUDY

Hypothetical Scenario

Despite protests by shipping and environmental interests, the port of Haven in Country A in January doubled its berthing, to manage demand.

Company MakeProfit, registered in Country B, owns the container vessel *Dark Sea*, registered in Country C. *Dark Sea* is old and poorly maintained. According to one of the crew, Nga Duc, the ship's master, Captain Salt, said he had pointed this out to MakeProfit's CEO, Shirley Doller, who had told Salt to "make do". Salt recounted that she had also instructed him to keep berthing costs "at the level they were before". The only way Salt can do this is to spend less time in port. This leaves little opportunity to evacuate properly the fuel oil waste and engine lubricant residues ("slops") that accumulate in larger than normal quantities on the vessel because of its condition.

Unusual atmospheric conditions arose in February and continued into March, when *Dark Sea* set out for Haven from Capetown. The conditions, caused by volcanic ash, left coastal surveillance aircraft grounded. Knowing that aircraft were the chief means of detecting discharges, Captain Salt apparently decided to evacuate slops directly into the sea en route to Haven. It seems this was done at night on 21 March 20 kilometres off the coast of Country E, in waters where ships frequently wait before proceeding on to Haven so as to reduce their time at berth. It is common knowledge that some ships use the waiting time to flush their tanks in this area of the sea, which lies outside Country E's territorial waters but within its declared Exclusive Economic Zone ("EEZ"). This area is regularly monitored with SAR images.

Salt then made for Haven at 14:00 on 22 March, leaving behind a patchy slick extending for 2 kilometres within the EEZ. The slick went on to beach in Countries E, F and A. Coastal fishermen from these countries are prevented from fishing in the affected area for a period of two weeks, so losing revenue.

Other Relevant Facts

SAR and optical images from two different satellite systems are available for the period before, during and after this incident, as well as AIS data. The *Dark Sea* had left the area before any surface vessel could the affected area to investigate.

Country C disputes Country E's EEZ. Countries A and E are EU Member States. A is a civil law jurisdiction with an inquisitorial tradition, while E is a common law jurisdiction with an adversarial tradition.

The Brief

The maritime surveillance authority, state prosecutor of Country E, and FishHelp (the association representing fishermen's interests of countries E, F and A) have asked you to advise on their course of action, on the basis of the evidence available. The brief for the consultation identifies the following issues:

- Surveillance means normally available and the practical value of the evidence in the circumstances
- Providers of satellite evidence and the scope, accuracy and reliability of their data, especially AIS and the two systems, SAR and optical
- Sample collection techniques for the slops and experience in similar circumstances
- Evidential law – admissibility and weight of the types of evidence concerned in relation to criminal and civil proceedings
- Authorities to be involved that are responsible for surveillance and verification under legislation based on MARPOL and European regional conventions on sea pollution
- Tribunals with jurisdiction
- Initiation of proceedings and locus standi
- Applicable substantive and procedural law

ATTENDANCE LIST
WORKSHOP: EVIDENCE FROM SPACE
5 OCTOBER 2010

Moderators and Presenters

Gordon Campbell	Directorate of EO Programmes, Project Manager, ESA ESRIN
Mark Doherty	Head of Exploitation Division, ESA ESRIN
Alessandro Ferretti	Chief Executive Officer, TRE
Luc Govaert	Project Manager, ESA ESRIN
Professor Robert Gurney	Director, Environmental Systems Science Centre, Reading University
Egbert Jongmsa	Audit Manager, Netherlands Court of Audit
Marc Journel	Satellite Based Monitoring Services, EMSA
Dr Simon Kay	Head of Unit, Joint Research Centre, MARS
Professor Richard Macrory	Director, Centre for Law and the Environment, UCL
Professor Kevin Madders	Systemics Network International; KCL; ISPL Faculty
Tanja Masson-Zwaan	President IISL; Deputy Director, IIASL Leiden; ISPL Faculty
David Morten	Managing Director, Fugro NPA
Professor Sa'id Mosteshar	Director, ISPL
Ray Purdy	Deputy Director, Centre for Law and the Environment, UCL; ISPL Faculty
Professor Lucien Rapp	Toulouse University; ISPL Faculty
Professor Kai-Uwe Schrogl	Director ESPI; ISPL Faculty
Professor Maureen Williams	University of Buenos Aires/Conicet; Chair, Space Law Committee, ILA

Rapporteurs

Susan Barham	Partner, Barlow Lyde & Gilbert
Klaus Becher	Space Policy Consultant; ISPL Faculty
Dr Hervé Borrión	Science Manager, Jill Dando Institute of Crime Science, UCL
Dr Andrew Brearley	Debris Policy Specialist
Richard Graham	Senior Associate, Bird & Bird; ISPL Faculty
David Halbert	Technical Project Manager, Infoterra
Dr Stephen Hobbs	Director, Cranfield Space Research Centre, Cranfield University
Mikael Kamp Sørensen	Director, GRAS
Yeliz Korkmaz	Researcher, Leiden University
Professor Jan-Peter Muller	Image Understanding & Remote Sensing, Space & Climate Physics, UCL
Matxalen Sánchez Aranzamendi	Resident Fellow, ESPI
Neil F Stevens	General Counsel, Atrium; ISPL Faculty
Professor Geoffrey Wadge	Chairman, Monserrat Science Committee; NERC-ESSC
Ilaria Zilioli	Contracts Officer, ESA; ISPL Faculty

Participants

Maria Adams	Head of Future Missions, UK Space Agency
Jonathan Amos	Science Correspondent, BBC News
Philip Annetts	Department for Environment Food & Rural Affairs, DEFRA
Tony Ballard	Partner, Harbottle & Lewis, ISPL Trustee
Cristina Barreau	Environmental Lawyer, Surfrider Foundation Europe
Darcy Beamer-Downie	General Counsel, Airclaims Ltd
Dr Ulrike Bohlmann	Legal Administrator, ESA
Rasmus Borgstrøm	Geographic Resource Analysis & Science Ltd., GRAS
Ann Brosnan	Head of Serious Casework, Environment Agency UK
Alan Brunstrom	Integrated Applications Promotion IAP, ESA
Giovanni Cannizzaro	Business Development, Telespazio
Marco Cattadori	Booz & Co
Dario Cau	Captain, Italian Coastguard ITCG
Antidia Citores	Law and Lobbying Coordinator, Surfrider Foundation Europe
Robin Cleverly	Law of the Sea Consultant, UK Hydrographic Office
Vivian Contin-Williams	International Lawyer
Willibald Croi	Project Manager, Applications, LuxSpace
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Julien Delanoe	ESA Climate Office

Martin Ditter	Project Manager, ESA Harwell Centre
Samantha Duckett	Helical Bar
Ruth Eldon	ISPL Workshop Administrator
Yanal Abul Failat	Student, Kingston University
Chris Forsyth	Partner, Freshfields Bruckhaus Deringer
His Honour Simon Goldstein	ISPL Trustee
Caroline Grace	Grace & Co, ISPL Trustee
Geoffrey Hall	Principal & Director, Moreton Hall Associates
Lars Boye Hansen	Geographic Resource Analysis & Science Ltd., GRAS
Professor Ray Harris	Emeritus Professor of Geography, UCL
Elizabeth Hiester	Solicitor, former Partner, Clifford Chance
Dr Richard Hilton	Business Development Manager, Space Services, Infoterra Ltd
DS Steve Hubbard	Deputy Project Manager, Op Javelin, Metropolitan Police
Sam Hutchinson	Helical Bar
Professor Bhupendra Jasani	Visiting Professor, Department of War Studies, King's College London
Dr Shaida Johnston	Science & Technology Policy, Law Department, George Washington University
Professor Rónán Kennedy	Faculty of Law, National University of Ireland, Galway
Daniel Lawrence	Of Counsel, Environment, Regulatory & Planning, Freshfields Bruckhaus Deringer
Dr George Leloudas	Gates and Partners
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Stephen Mason	Barrister, Visiting Fellow, BIICL
Florent Mazurelle	European Security Policy Administrator, ESA
Mr Justice Sir Richard McCombe	
DCI Mick Neville	Project Manager, Op Javelin, Metropolitan Police
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Pat Norris	Logica
Rolf S Olofsson	Partner, White & Case
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Chiara Spena	PhD Candidate, University of Rome 'La Sapienza'
Dr Jerry Stanley	Director, Rondle Ltd
Dr Jill Stuart	Department of Government, Politics of Outer Space, London School of Economics
Christian Tøttrup	Geographic Resource Analysis & Science Ltd., GRAS
Wouter Veening	Chairman & President, Institute for Environmental Security
Robert Volterra	Partner, Latham & Watkins
Luc Willems	Deputy Secretary-General – Benelux, Telindus
Michael Williams	External Relations Manager - Group on Earth Observations, GEO Secretariat