

Exploration & Production **Technology**

delivering breakthrough solutions



Integrated Space Applications in Transport, Energy & Safety – Oil & Gas Exploration

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BP – Some Remote Sensing Applications



- Arctic Sea Ice Monitoring
- Gulf of Mexico Ocean Current Monitoring
- Pipeline Route Monitoring
- Landslide Monitoring
- Ground Settlement Monitoring

BP - Remote Sensing Collaborators



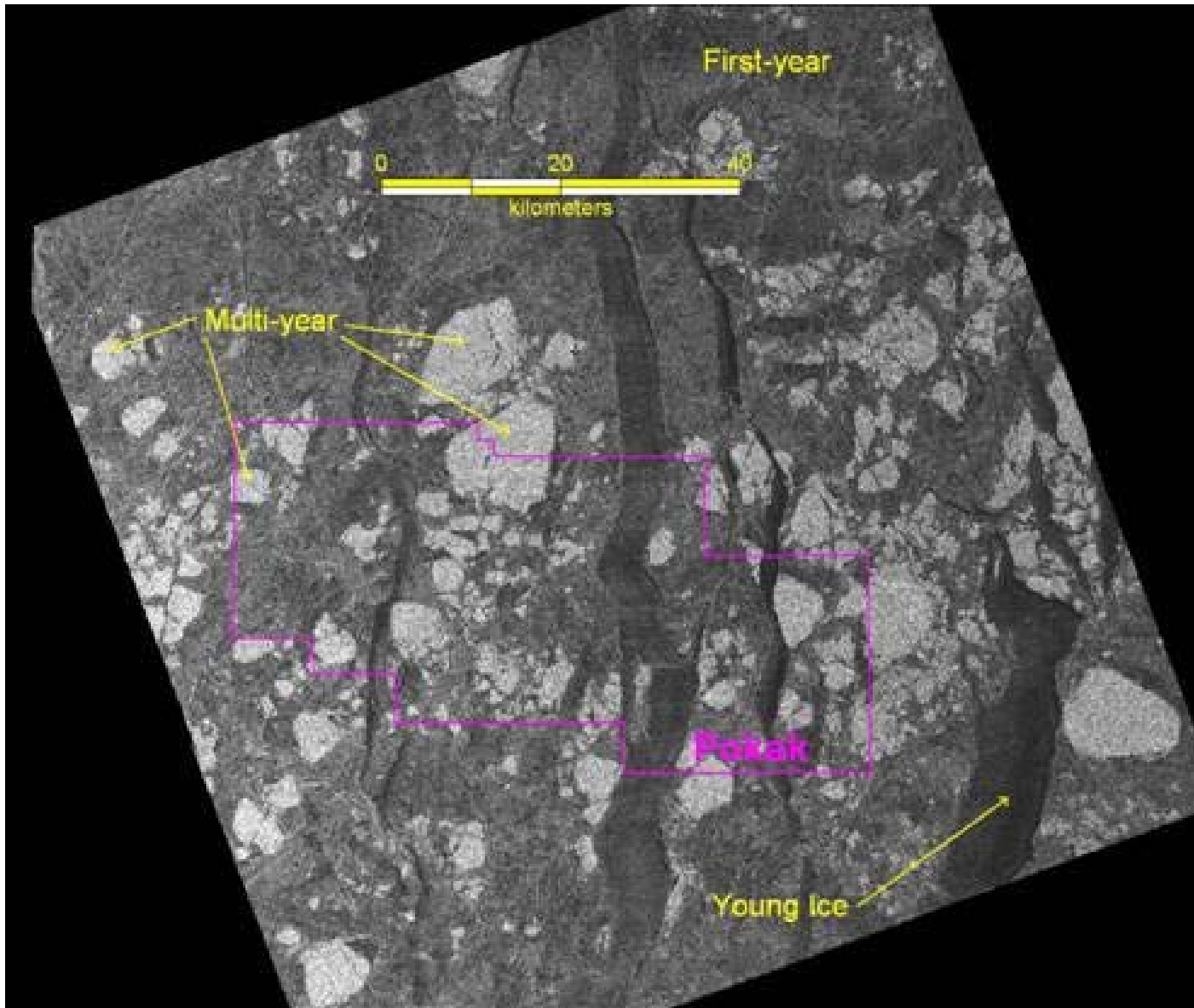
- Birkbeck College, London
- British Geological Survey
- Canatec
- Desert Research Institute (Reno)
- Fugro NPA
- Horizon Marine Inc
- Ove Arup
- Portsmouth University
- Scott Wilson
- University of Colorado
- University of Nottingham

Arctic Operations



EPT

Arctic sea ice monitoring – radar in winter



Radar image in summer



August 24, 2005.



Multi-year

First-year

EPT

Sea ice issues



- In summer difficult to identify first year from multi year ice
- Main features used for discrimination:
 - floe shape, fracture and melting ponds – require optical imagery.
- But optical images limited by cloud cover and cannot be relied on for operational support
- Challenge – all weather remote identification of multi-year ice in summer??

Gulf of Mexico Offshore

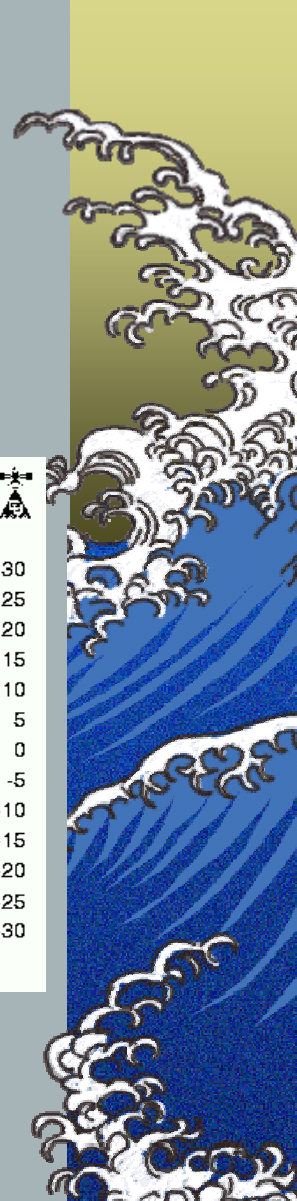
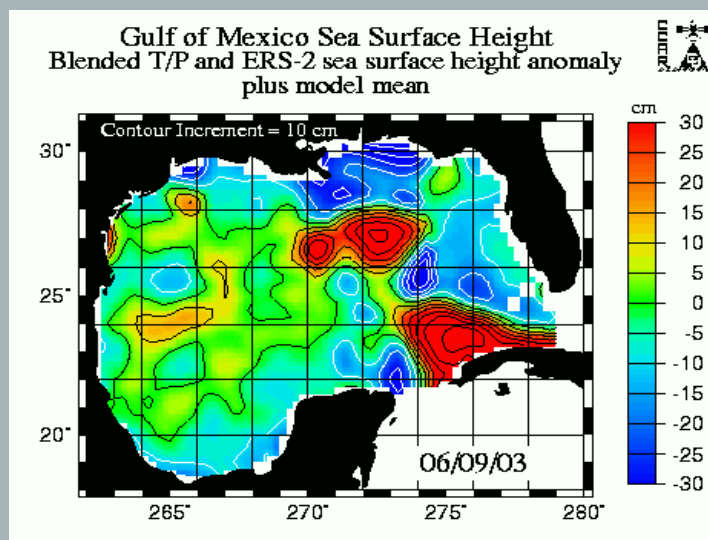
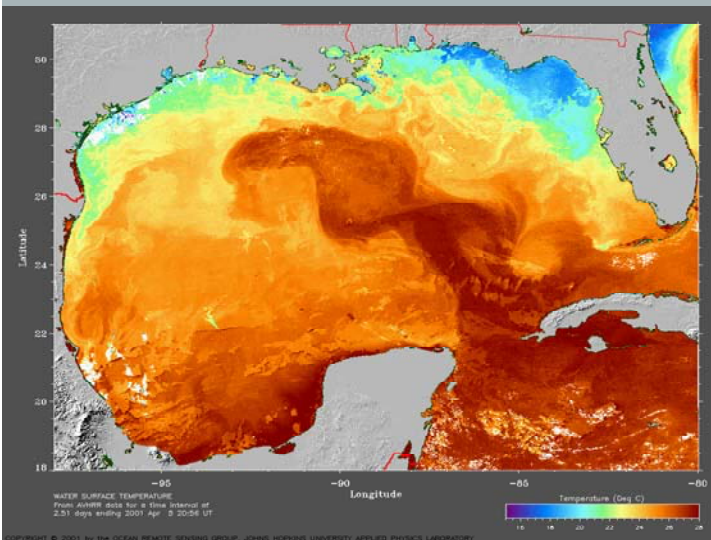


Monitoring The Loop Current and Loop Current Eddies

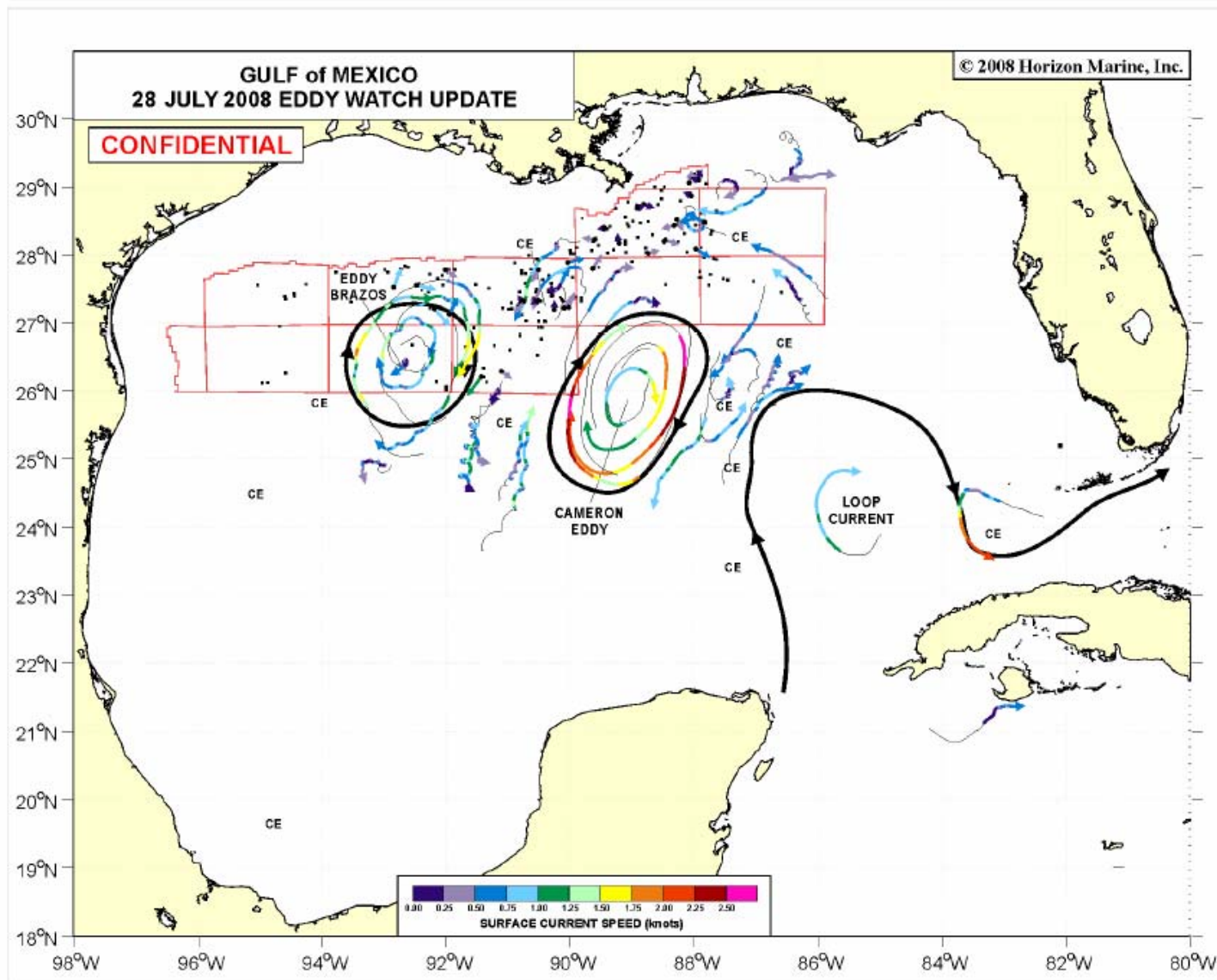
Satellites

Sea Surface Temperature

Sea Surface Height



Loop and Eddy Forecast Service



Onshore Applications



- Satellite technologies are rapidly evolving and provide enormous opportunities to enhance the planning, design and long-term monitoring on some of BP's major pipeline and facilities projects
- The Environmental Technology team has initiated a project to develop guidelines for the use of satellite imagery and remote sensing for onshore projects.

Satellite Imagery and Remote Sensing



The challenge is to understand the best ways to use satellite-based technologies to:

- Assess the risks to our pipelines associated with natural hazards
- Predict the cost and schedule implications of the ground conditions
- Assist the long-term monitoring of remote region pipeline systems

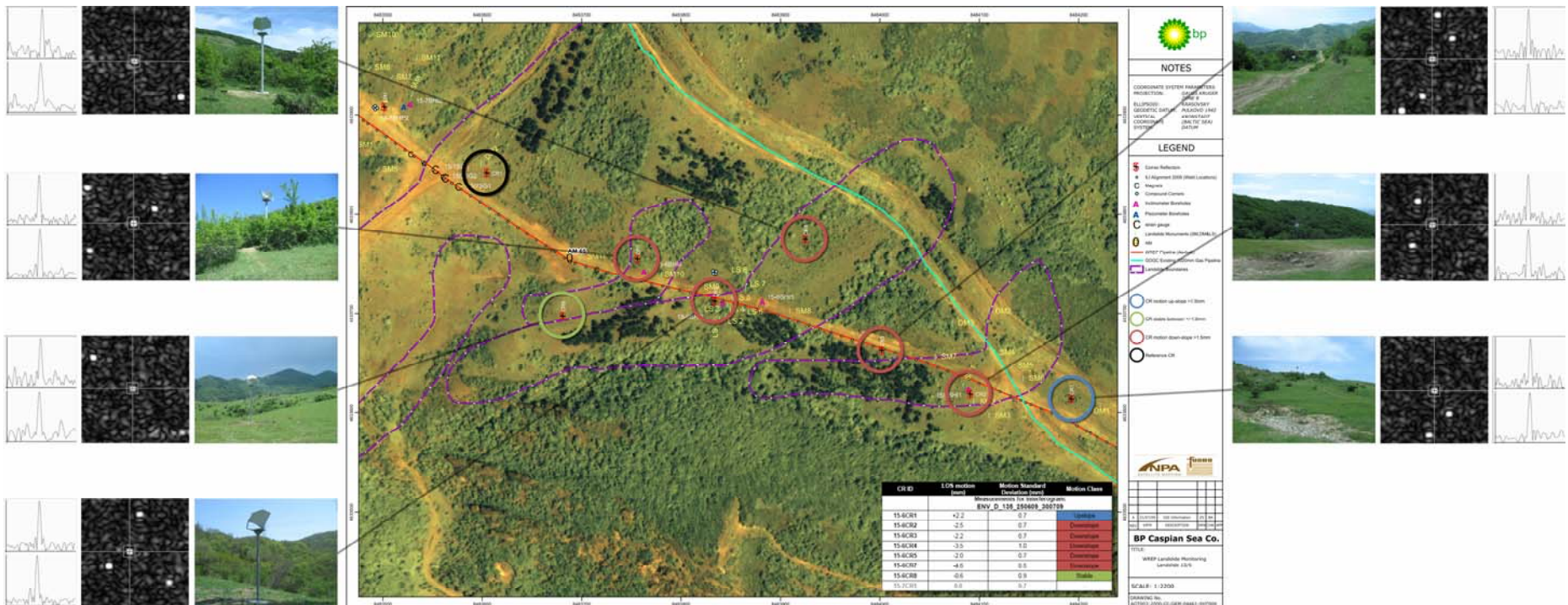
Mountainous Terrain: landslides and erosion



Rivers: pipelines exposed by erosion and scour



Satellite Radar for Landslide Monitoring: Georgia

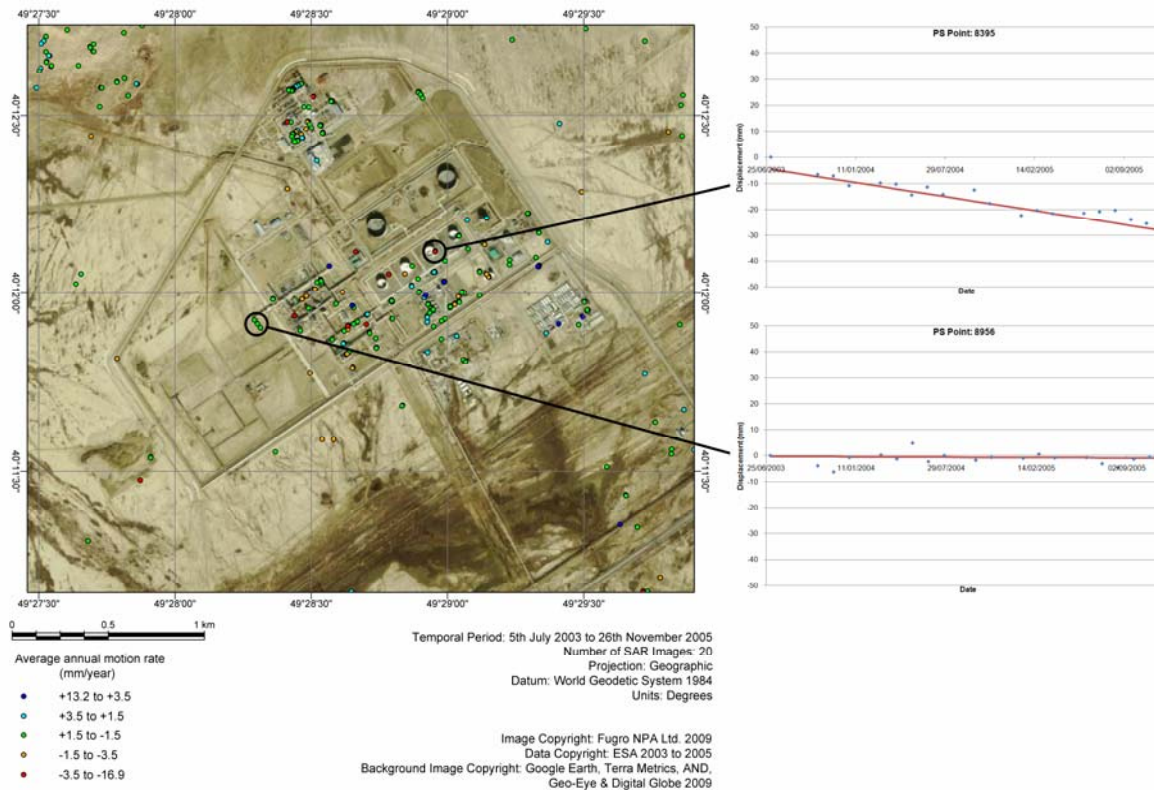


The Western Route Export Pipeline (WREP), Georgia: the deployment and monthly InSAR monitoring of 21 Corner Reflectors (CRs) across 3 landslide sites.

The main image shows the CR network installed across a landslide. Each CR is shown by a coloured circle which indicates the up-slope or down-slope motion for a 1-month period June to July 2009, relative to a stable reference CR site.

The sequence of images which point to each CR show (in order): An image of the installed CR, the CR response within a Synthetic Aperture Radar image, the Radar Cross-Section for the CR response (highlighting the high amplitude of the CR response relative to background radar clutter).

Satellite Radar for Ground Movement: Azerbaijan



BP's Sangachal Terminal suffers from collapsing soils. A satellite InSAR assessment has helped establish long term settlements on site. There are a number of large structures and steel tanks which act as great radar reflectors.

Persistent Scatterer InSAR (PSI) revealed the levels of ground and structure motion that had occurred at scatterer points between July 2003 and November 2005. The charts highlight the displacement of individual scatterers during this period.

The image shows the persistent scatterer points across the Terminal site. Each scatterer is colour-coded according to its average annual motion rate.

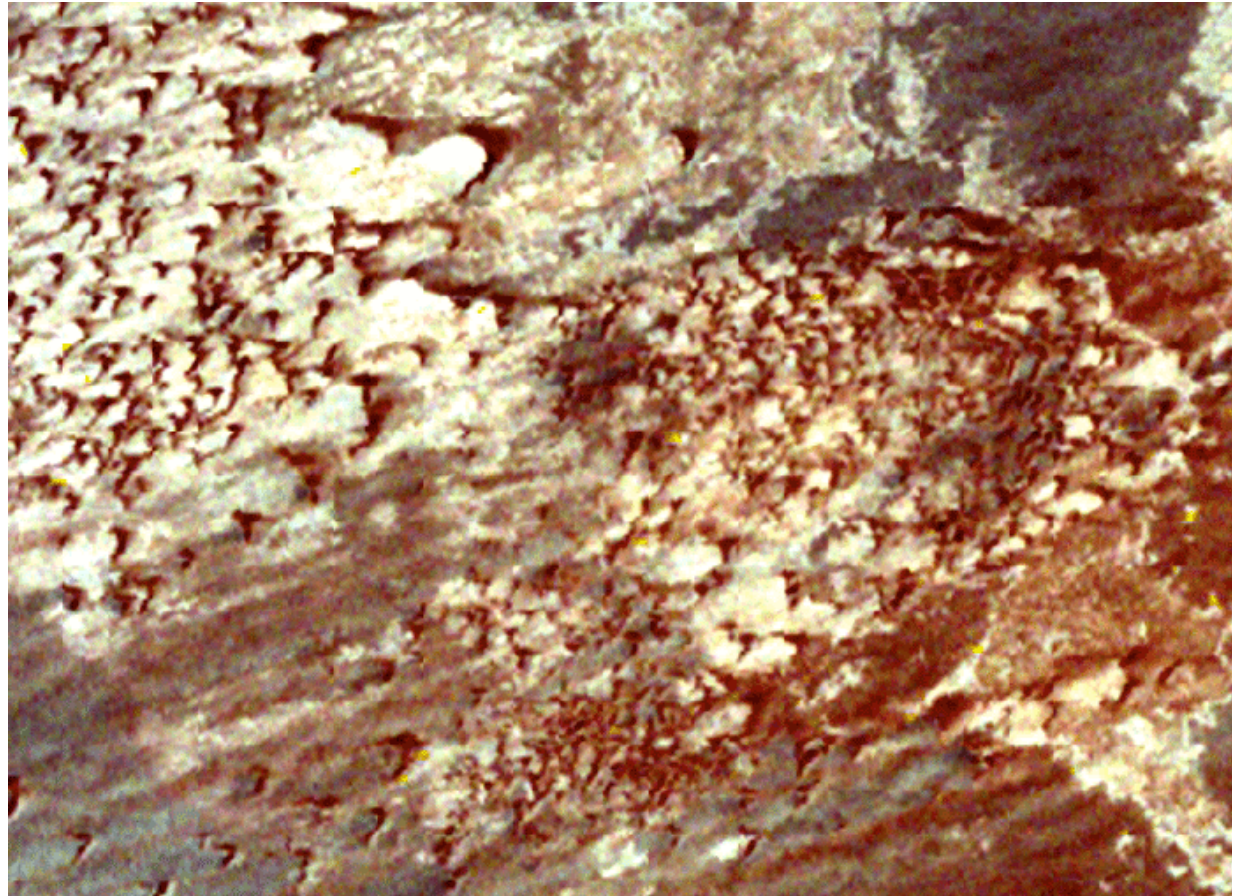
Satellite Monitoring of Sand Dune Movement



Novel Cosi-Corr technology is being used to detect sand dune movement rates in order to assess risks to pipelines crossing dune fields in Algeria.

Cosi-Corr enables sub-pixel scale movements to be accurately determined from sequences of archive satellite images.

Courtesy:
P Vermeesch
Birkbeck College



This animation made from 7 Landsat TM images taken between 1984 and 2008. It shows the downwind migration of barchan dunes from the NE to the SW of the image. The white patches are desert plains that remain stationary.