# Hunting for Landslides in St Lucia... by Catherine Pennington

Tom updating the outline of a landslide in Guesneau, St Lucia

Dr Colm Jordan and Dr Tom Dijkstra have both just returned from a trip to the Caribbean. This may sound like a glamorous location, but their work is associated with more serious matters.

## Hurricanes and devastation

In October 2010, Hurricane Tomas hit the Caribbean causing death and destruction, particularly on the islands of St Lucia, Grenada and St Vincent.

St Vincent and the Grenadines saw damage to around 1200 homes, disruption to power supplies and devastation to the agricultural sector, but fortunately no casualties.

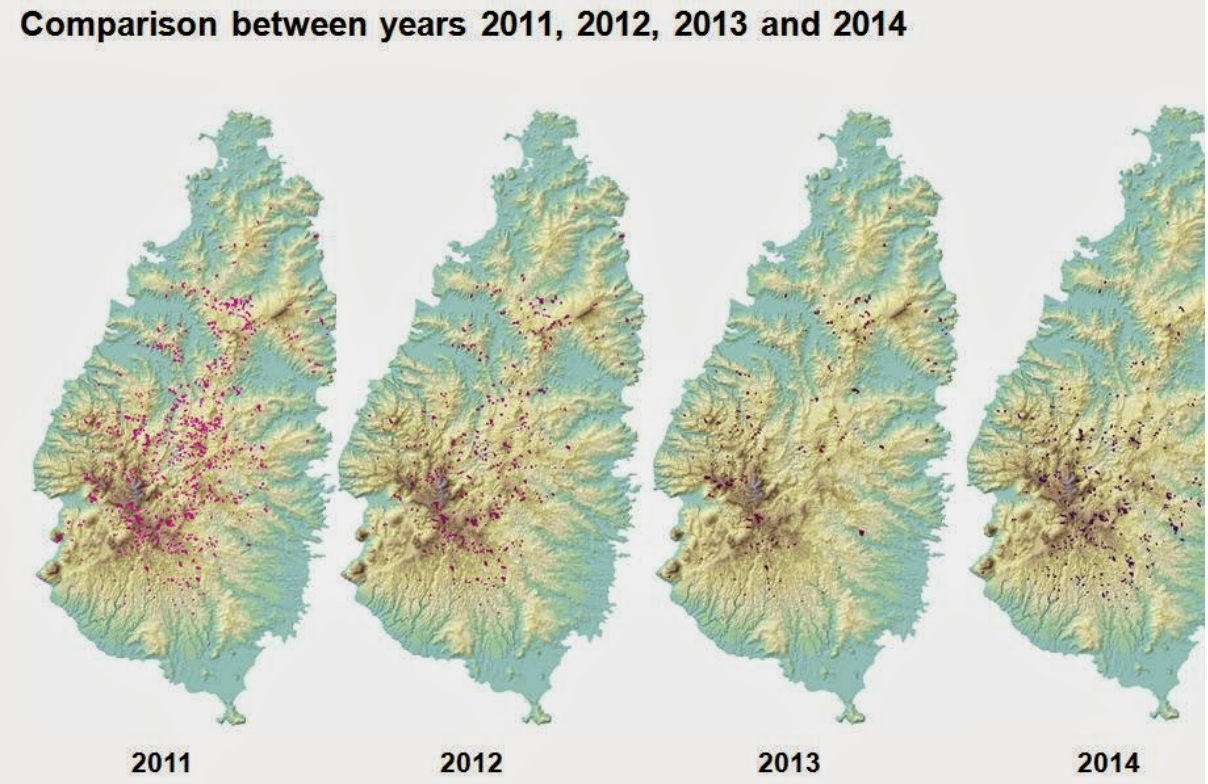
St Lucia bore the brunt of the hurricane. The storm brought with it high winds and 21 hours of uninterrupted torrential rain. About two years worth of rain fell during this time. The Prime Minister declared a state of emergency and appealed for international assistance. Most damage was in the southern part of the island where homes, buildings, bridges, roads and vehicles were washed away by landslides and floods and at least 14 people were killed. Many hillside farms were severely affected by landslides that destroyed fields and completely wiped out rural roads.

As well as suffering Hurricane Tomas, St Lucia is no stranger to heavy rain and frequent cyclones. The capital, Castries, is surrounded by steep slopes upon which informal hillside communities reside with limited drainage or infrastructure to deal with heavy rainfall. Improvements are being carried out to make the hills less susceptible to landslides, but these communities, and the capital itself, are still highly vulnerable to landslides triggered by rainfall.

Tom and Colm have been working on a project, funded by the European Space Agency, which is trying to show how the careful analysis of satellite images can be useful for disaster management in the Caribbean. This feeds data to an over-arching World Bank project led by University Twente in the Netherlands, that is developing a Caribbean handbook for risk information management (CHaRIM).

## Hunting for landslides from the office

Before heading to St Lucia, Tom and Colm worked with Dr Claire Dashwood and Dr Stephen Grebby at BGS to analyse satellite images that had been taken in 2010, 2011, 2012, 2013 and 2014. Most of these images were taken at five-metre resolution and the images of 2014 achieved a resolution of 0.5 m. This is very high quality and is the equivalent of being able to see detail on the ground that are only some 0.5 m large. This meant the team were able to see and map the effects of both Hurricane Tomas, and also a period of wet weather known as the December Trough in 2013, in great detail. The use of these time-stamped images also meant it was possible to see that some landslides had become inactive with time but many continue to move:
"*We were able to see the landscape slowly recovering post Hurricane Tomas. Then the December Trough of 2013 caused reactivation of many sites plus a considerable number of new landslides*".



Landslides identified over time. There are most in 2011 immediately after Hurricane Tomas. In 2012 and 2013, the number of landslides decreases. The 2014 image shows both new landslides and reactivations of pre-existing ones.

The team found over 1250 landslides on the island, many of which were initiated by Hurricane Tomas. They produced a database of these landslides, something BGS has a long history in, as well as a map showing where they thought the landslides were. The next phase of work was to travel to St Lucia to see if the work done in the office matched what they saw on the ground.

## Landslide hunting on the ground

Tom and Colm spent just five days in St Lucia. Each day, they visited many landslide sites targeting those previously identified in the office. They took photographs, made field notes to refine their interpretation of landslide activity and checked they were happy with the lines they had drawn on the map.

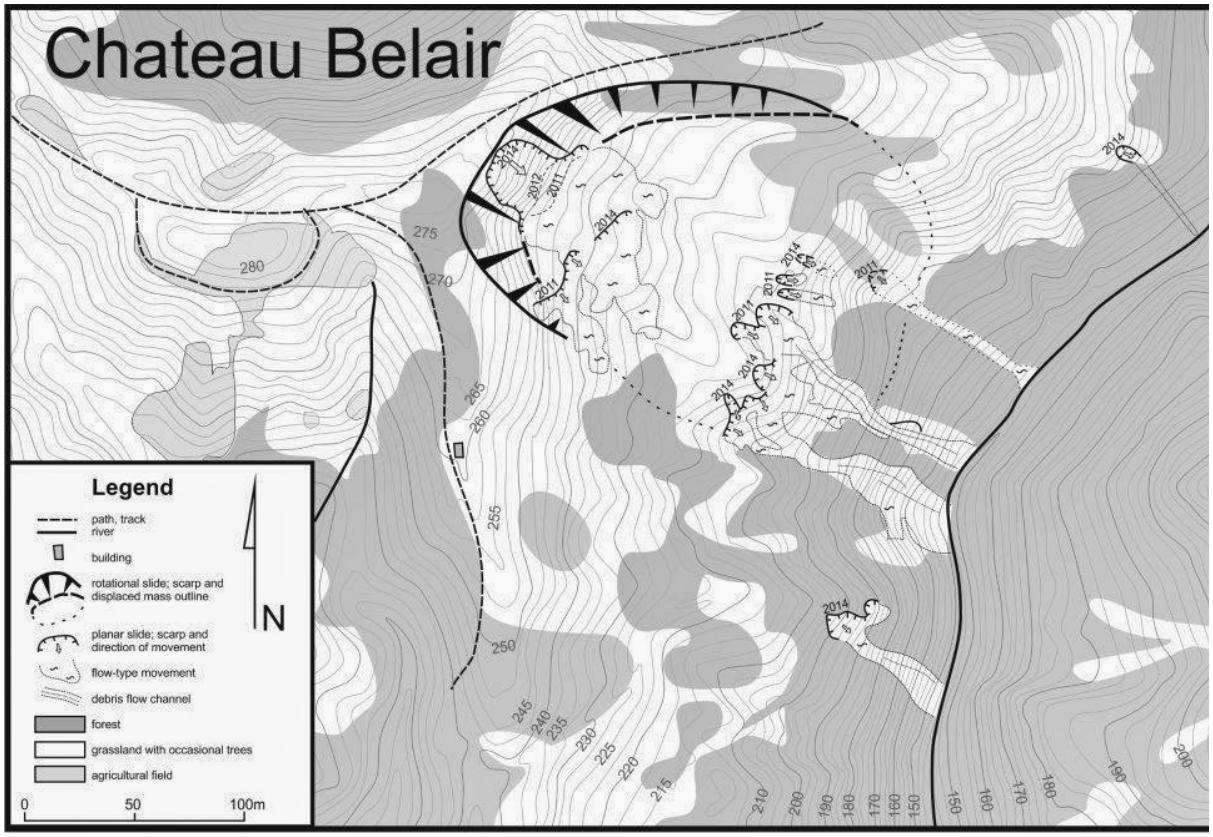
Getting around the island was not an easy task. The landslides triggered by Hurricane Tomas had destroyed many of the roads as Tom recounts:
"*In the five days we were there, we drove over 650 kilometres. Some of the small roads in the centre of the island were still barely passable and we regularly had to abandon the car and continue on foot*".

Left: Some conditions typical of the smaller roads. Right: Colm trying to find a way through a road blocked by landslide debris and vegetation – now only passable on foot.

St Lucia is still a very active environment when it comes to landslides as Colm explains: "*We were staying near the Pitons and we heard a rock fall overnight. The next day we were able to find the scar where the rocks had come from*".

This is an example of how the work done in the office translated to that on the ground:

The satellite image.  Here, not only was it possible to map the outline of the landslide but the details within it were visible too.




Drawing of the interpretation of the satellite images and the topographic model.

What Tom and Colm saw in St Lucia which matched very closely with the satellite interpretation.

## Communicating the findings

While they were there, Colm and Tom presented their work at a CHaRIM meeting where they explained that the final maps and data would be freely available. Here, local government, planners, GIS specialists and engineers from the five islands and Belize as well as representatives from the World Bank and US Army Corps of Engineers were able to see the new data and expertise BGS was able to bring them. The presentation was well received and the feedback was very positive.

Tom presenting the landslides work to government, planners, GIS specialists and engineers from the five islands and Belize as well as representatives from the World Bank and US Army Corps of Engineers.

## Final thoughts

Before satellite images made it possible for geologists to interpret wide expanses of ground, the landslide situation on St Lucia would be very difficult to map. The vegetation is particularly dense and parts of the road network have been completely destroyed. To attempt this kind of assessment from the ground would have been very time consuming, and therefore expensive, not to mention dangerous!

This project is an example of how high resolution satellite images can help us map widespread natural disasters both accurately and quickly. It also allows us to understand the magnitude and consequences of such events as Hurricane Tomas.

By creating different maps over time (in this case one per year), we can get an insight into how the landscape is affected by big weather events such as Hurricane Tomas and the 2013 December Trough. This helps us to better understand how slopes recover from major disasters, for example through vegetation regrowth. It was clear that in St Lucia the recovery of the landscape had not been complete and therefore the 2013 rainfall event not just re-activated many of the previous landslides, but also caused many more slopes to fail.

Catherine