satsense
High Resolution Ground Stability Data

SatSense Deformation Mapping

Improving passenger safety through rail monitoring

SatSense produces maps of ground deformation that are updated on a regular basis. These maps show movement of the ground with mm/year accuracy, which can be used to identify potential hazards for rail networks such as landslides.

How does it work?

SatSense takes readings from radar satellite and converts it to high resolution ground movement. The Sentinel-1 constellation consists of two radarbearing satellites, which between them return to the same orbit every 6 days and acquire a new radar image. Sophisticated processing of these images using proprietary SatSense algorithms, which build on a technique known as InSAR, produces detailed maps of ground movement between satellite passes. These maps show movement either towards or away from the satellite and by combining images acquired from different geometries, horizontal and vertical motion can be derived.

SatSense algorithms build on academic algorithms developed by founders Andy Hooper and Tim Wright, Professors at the University of Leeds [1], and in particular on new algorithms that allow us to robustly separate signal from noise at high spatial resolution [2] data (InSAR). This data is automatically updated every 6 days and stored for online access by our customers and partners.

About SatSense Ground Stability Data
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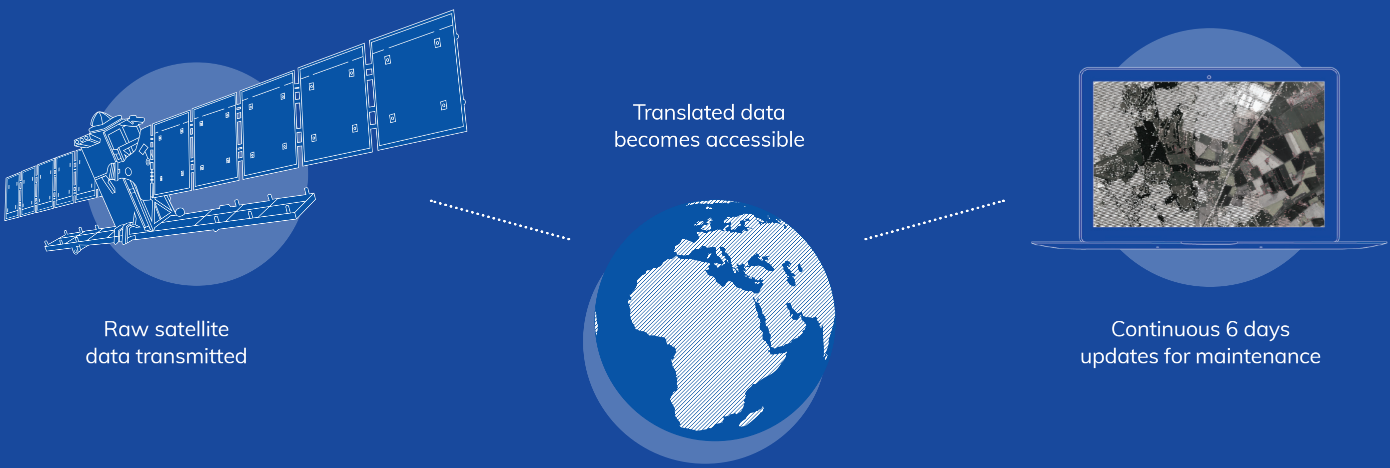
Advantages of SatSense Data

1.
Requires no instrumentation on the ground

2.
Unrivalled measurement density

3.
Continuous updates every 6 days

4.
Derived products to meet your exact needs



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Example over rail network in Kent

SatSense processed Sentinel-1 data over a site on the Dover to London mainline near Folkestone. The railway line at this site crosses one of the largest active landslides along the English coast, the deepseated Folkestone Warren Landslide, which has had a major impact on the railway since a major reactiviation in 1915 [3]. Satsense analysed all of the available Sentinel-1 data from four different tracks over the area of interest in order to build up a more complete picture of the deformation.

To distinguish between vertical and horizontal deformation, SatSense were able to combine data from all four tracks, each of which is sensitive to motion in a different direction. By assuming that the deformation seen in each track is the result of both vertical deformation and horizontal motion down the slope, SatSense were able to separate horizontal and vertical motion, using methods originally developed by one of the founders [4].

The results (Figure 1) show complex ground movement. Significant horizontal movement of the landslide is occurring at rates of up to 10 mm/yr. The head of the landslide is subsiding at up to 4 mm/yr and the toe of the landslide is uplifting. Network Rail were able to connect specific features identified in the SatSense results to ground-based observations.

In addition to the average velocities, SatSense are able to extract detailed time series for each data point in the image (Figure 2). These show that the motion of the Landslide is not steady in time. SatSense time series are automatically kept fully up-to-date, enabling Sentinel-1 data to be used for operational monitoring of ground stability.

References

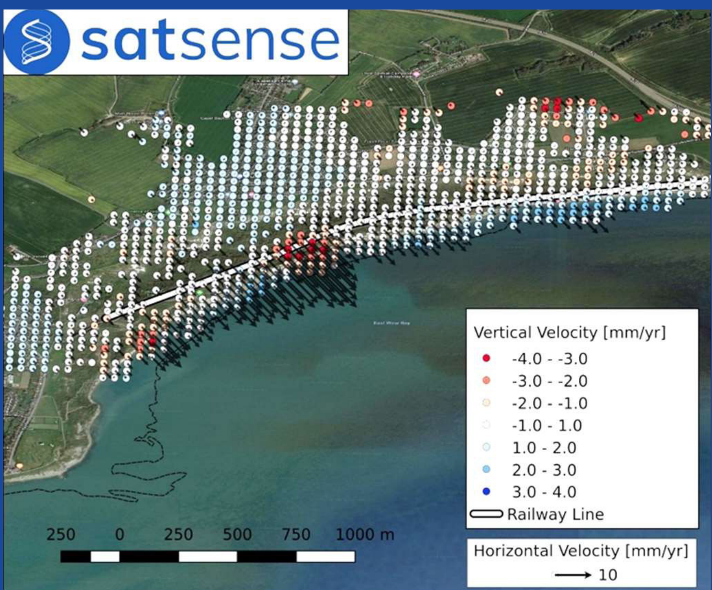
[1] Hooper et al., Geophysical Research Letters, 2004.

[2] Spaans and Hooper, Journal of Geophysical Research, 2016.

[3] https://www.bgs.ac.uk/landslides/folkestoneWarren.html

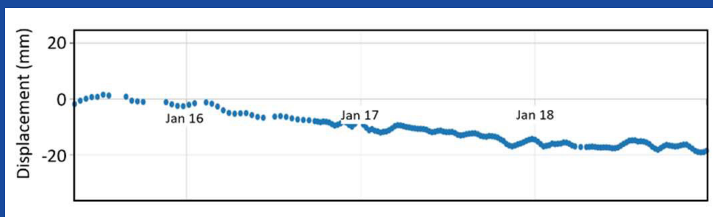
[4] Wright et al., Geophysical Research Letters, 2004.

Figure 1



Vertical and horizontal deformation around the Dover-London mainline. Red colours indicate subsidence and blue colours indicate heave.

Figure 2



Example of a time series for SatSense data. Each of the blue points corresponds to a new satellite observation of the position of an individual point.

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