



# Surface Movement Monitoring GeoView User Guide

Version 1.2

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## Abbreviations

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Abbreviation	Description
2D	Two-Dimensional
DS	Defence and Space
OSM	OpenStreetMap
SMM	Surface Movement Monitoring

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## 1 Introduction

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The Surface Movement Monitoring (SMM) GeoView of Airbus Defence and Space (DS) is a web-based application with graphical user interface, allowing the visualisation of SMM results as a 2D (two-dimensional) point cloud. A web browser such as Mozilla Firefox or Internet Explorer is needed to access the server of Airbus DS. In addition to the 2D point cloud, the movement time series for every measurement pixel can be displayed as a graphic chart. For the background, minimum an OpenStreetMap (OSM) ([www.openstreetmap.org](http://www.openstreetmap.org)) map is being used. The current version of the SMM GeoView is published solely in English.

The SMM product is being created by Airbus DS on a customer-demand basis, with the delivery of digital result files to the customer. The access to SMM GeoView can be selected as an option to the SMM product for visualisation purposes.

### 1.1 Scope

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This document describes the specification and individual features of the SMM GeoView interface.

## 2 SMM GeoView Interface

### 2.1 Technical Requirements

A web browser such as Mozilla Firefox (Version 56), Internet Explorer (Version 11) or Google Chrome (Version 52) is needed on the customer side to access the server of Airbus DS.

### 2.2 User Administration

Each individual user account can be accessed via login name and password that will be issued to the user by Airbus DS on a project basis. After the correct login, the user are presented with an overview of the different SMM results, they have access to. They choose a SMM result by clicking on the corresponding image link.

### 2.3 2D Point Cloud Visualisation

The display of the 2D point cloud is scalable, and is visualised differently at varying zoom levels.

At large scale (zoom level up to 15), quadtree clustering of the measurement pixels is being applied to generate a quick overview (see for example Figure 2-1). At smaller scale, individual measurement pixels are being summarised to official house / road / rail polygons (from zoom level 16 onwards, if available, see Figure 2-2), and starting from zoom level 18 individual measurement pixels are displayed (see Figure 2-3).

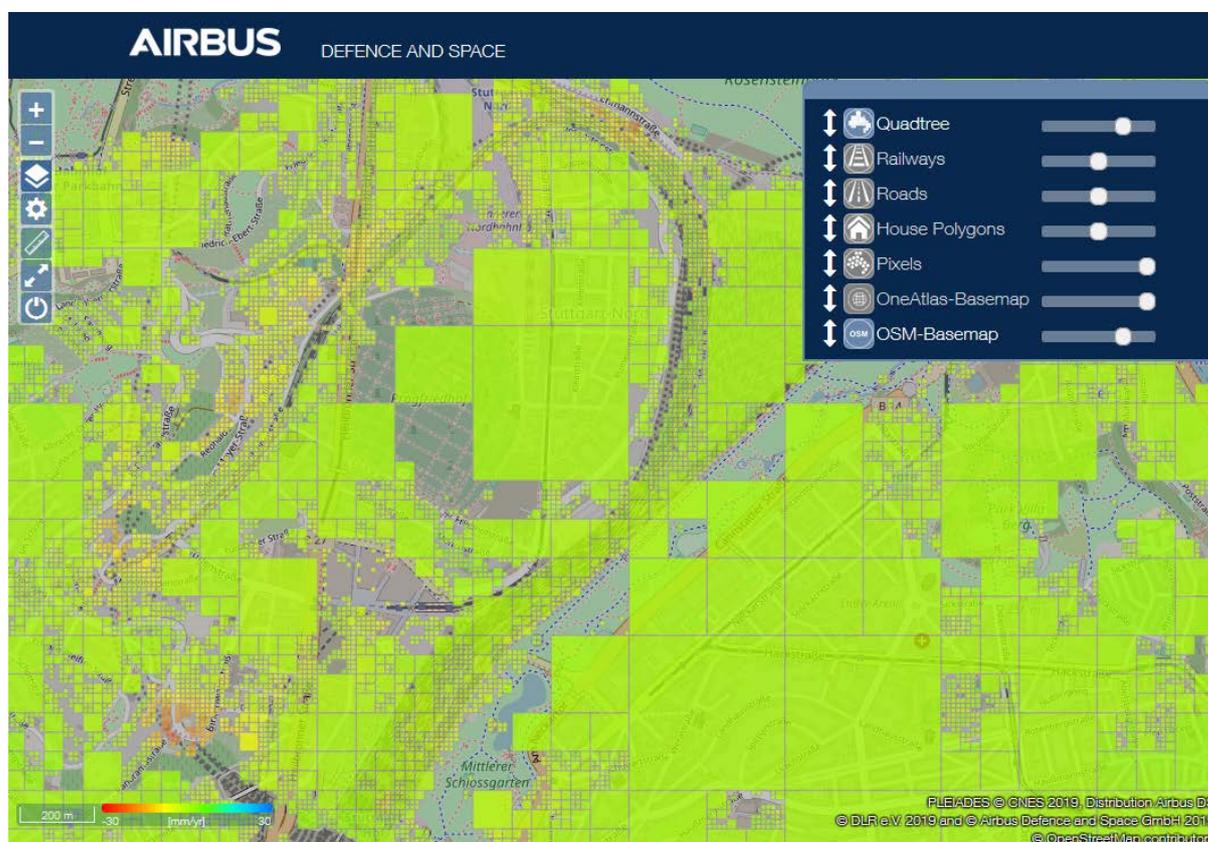


Figure 2-1: Quadtree clustering of SMM measurement result at large scale.

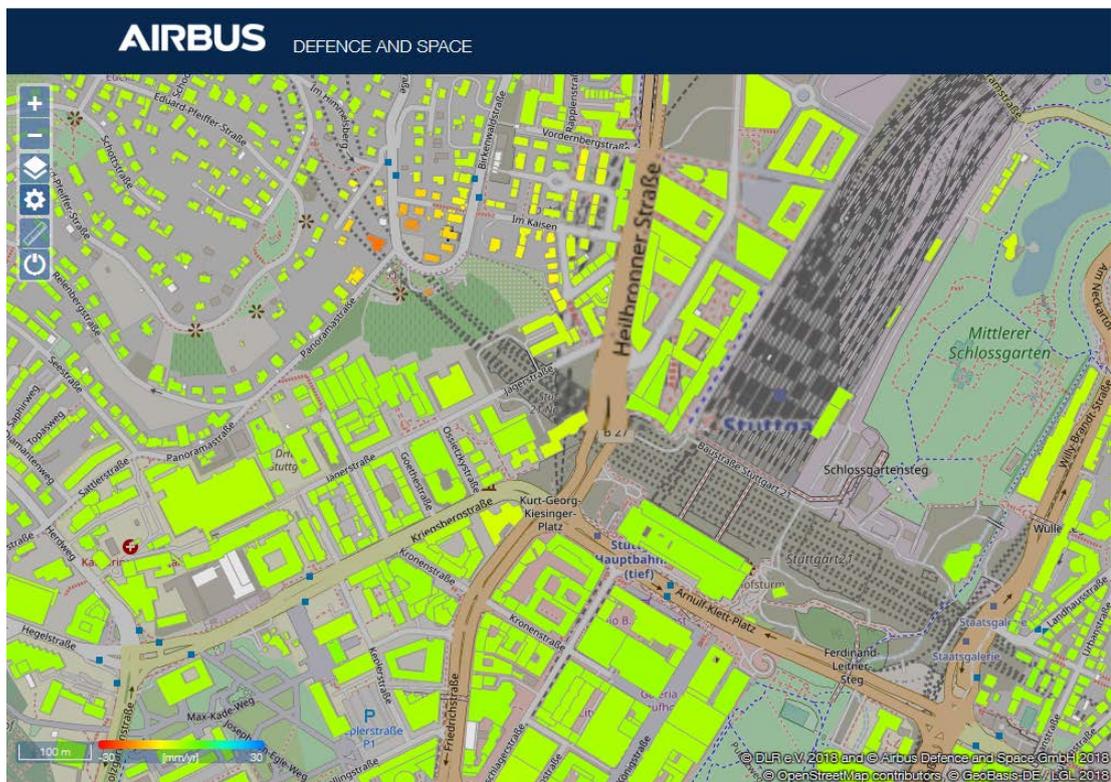


Figure 2-2: Official house polygons (if available) created of SMM measurement result at medium scale.

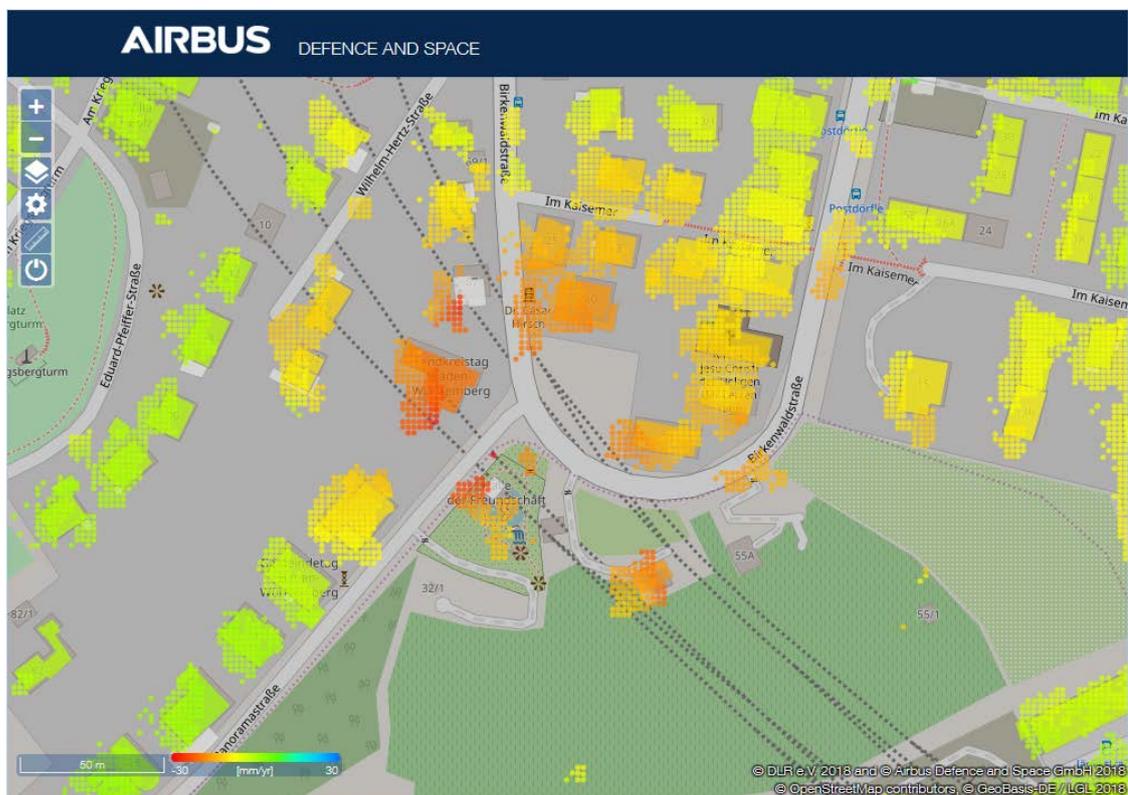


Figure 2-3: Individual SMM measurement pixels are shown at small scale.

The quadrants, the house polygons, and the pixels are colour-coded according to the legend specified at the bottom left of the screen, which is based on the movement of the individual elements (Green = stable, Red = subsiding, Blue = uplifting).

The scale is graphically displayed left next to the colour legend in form of a ruler.

## 2.4 Information Chart

The quadrants, house polygons or measurement pixels can be selected individually and an information chart appears with a list of details regarding the chosen element: geographic coordinates (geographical latitude and longitude in decimal degree), average annual velocity (in mm per year), as well as the measure 'Deviation from Linearity' (in mm) quantifying the standard deviation of movement with respect to the linear movement model (average velocity) (see Figure 2-4).

With the house polygons, additional quality parameters are shown within the information chart:

- 1) number of measurement pixels falling inside a house polygon,
- 2) pixel coverage of the house polygon in %, and
- 3) similarity measure in % to indicate the similarity of the velocity value of a pixel to the average velocity value of the house polygon (100% identical, 0% no similarity, i.e. when the difference in velocity is above 3 mm per year).

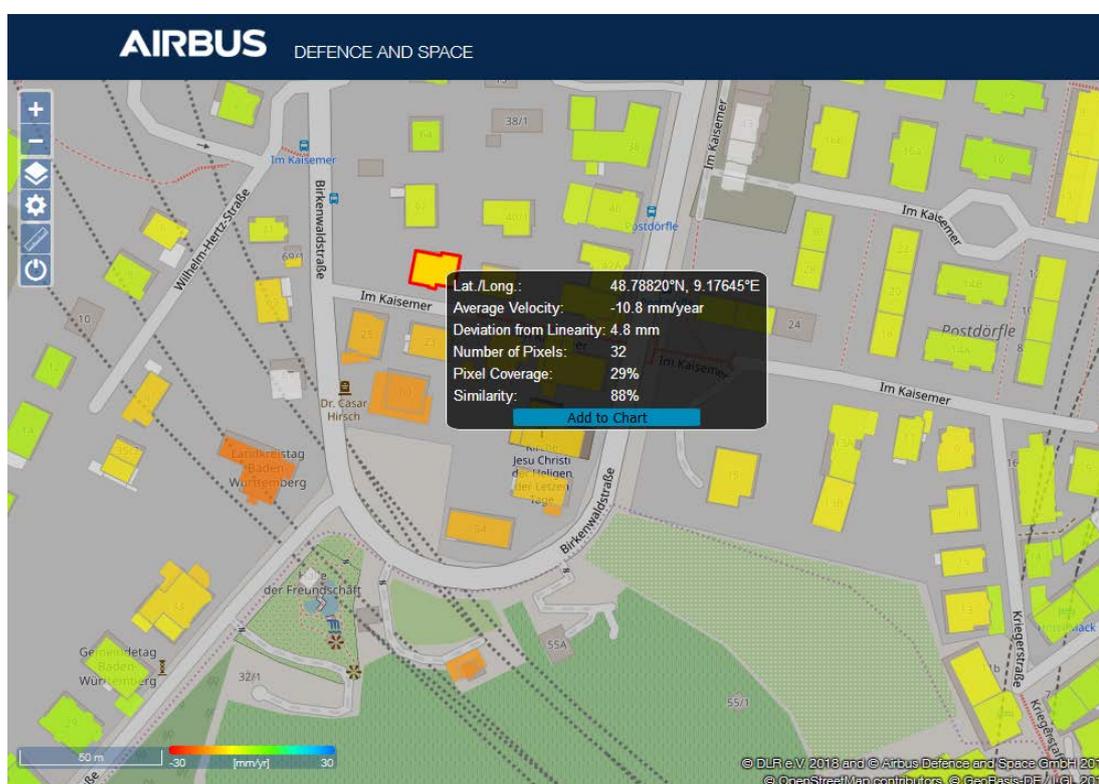


Figure 2-4: Information chart with characteristics of a selected house polygon.

Clicking the button 'Add to Chart' creates a time series chart of the corresponding element (see Figure 2-5).

## 2.5 Time Series Chart

The time series chart shows the movement of an element (quadrant, house polygon or measurement pixel) against time and relative to the first measurement date. The date is plotted on the horizontal axis, the ground movement (in mm) on the vertical axis (see Figure 2-5).

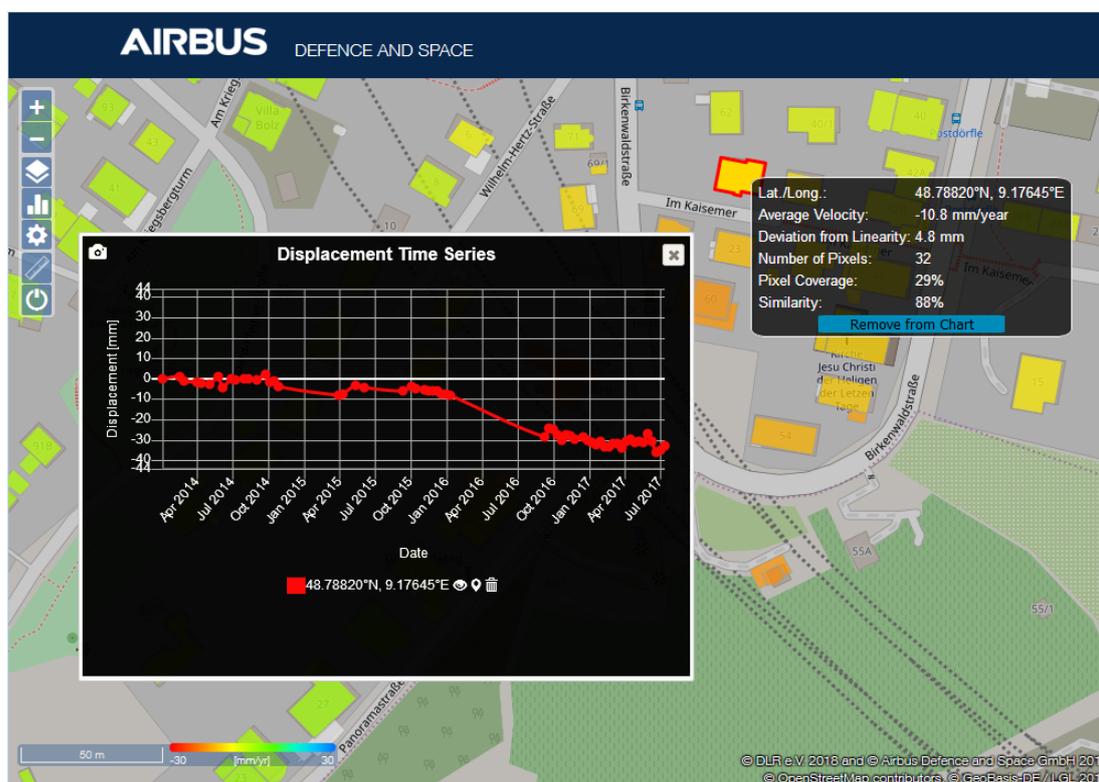


Figure 2-5: Time series chart of a selected house polygon.

The geographic coordinates of each added element are shown in the legend underneath the graph. Up to five time series of different elements can be displayed simultaneously in a single chart. The individual curves can be switched on or off (by clicking the 'Eye' symbol) or deleted (by clicking the 'Waste Basket' symbol), and the corresponding measurement pixel can be located on the map (by clicking the 'Point-of-Interest' symbol).

The time series chart can be exported as JPEG image by clicking on the 'Camera' symbol in the top left corner of the time series chart. To specify the file name and folder for image download, the browser settings need to be adjusted accordingly.

## 2.6 Menu Bar

The menu bar is located at the top left side of the screen. It includes the following buttons in descending order (see also Figure 2-5):

- 1) Zoom In
- 2) Zoom Out
- 3) Layer Control
- 4) Time Series Chart (is being displayed after the creation of the first plot; switch-on button)
- 5) Settings
- 6) Measurement Tool
- 7) Back to Selection

## 2.7 Layer Control

Pressing the 'Layer Control' button on the menu bar, a rectangular box with all available layers appears (see Figure 2-6). Active layers are displayed as blue buttons, none-active ones as grey buttons. Some layers are only activated at specific zoom levels. An active layer can be switched off by pressing the corresponding blue button.

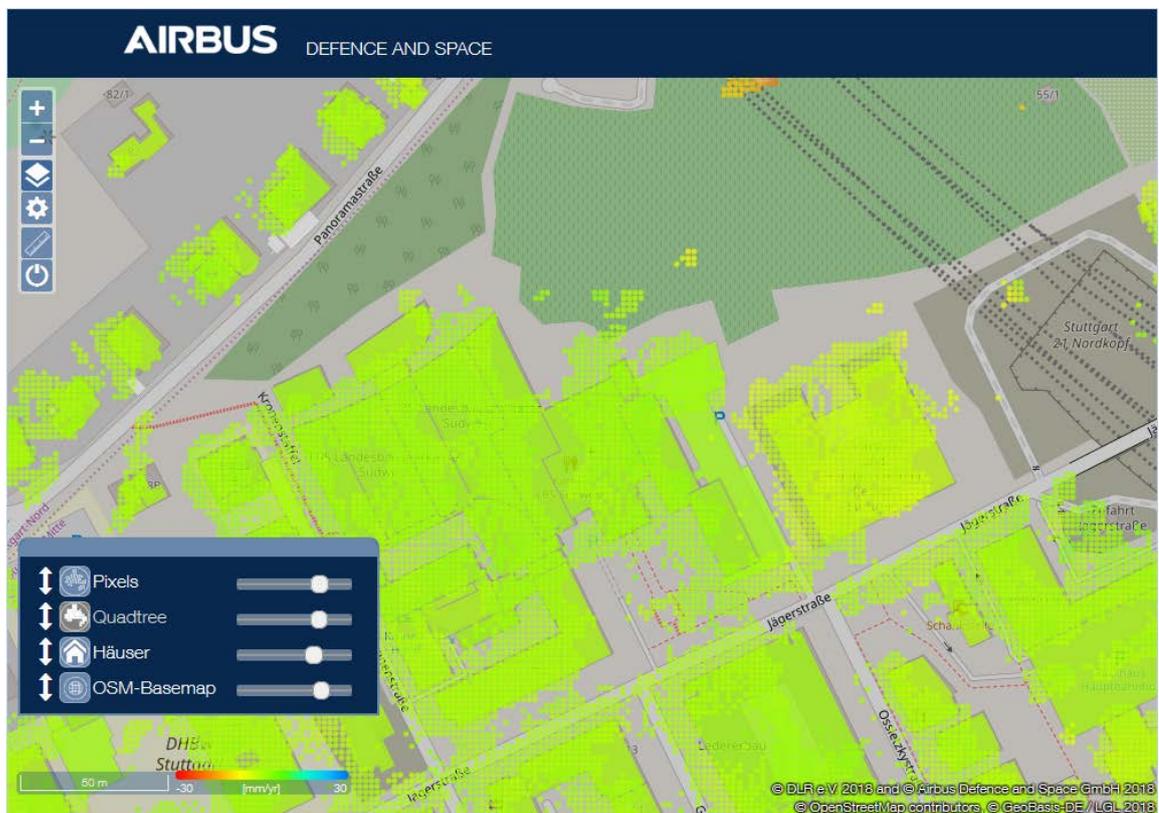


Figure 2-6: The Layer Control box appears at the bottom left of the screen after pressing the 'Layer Control' button in the menu bar.

With the slider on the right of each layer, the layer's opacity can be regulated. The layers can be re-ordered in the list by moving the mouse over the layer name, and then clicking and dragging the layer onto the desired position within the list. The top layer always overlays all subsequent layers.

## 2.8 Settings

The window for changing further settings appears by clicking the 'Settings' button on the menu bar (see Figure 2-6).



Figure 2-7: The Settings window appears at the bottom of the screen after pressing the 'Settings' button in the menu bar.

The following paragraph describes the individual setting options starting from the left:

- 1) The slider 'Average Velocity' or 'Displacement' allows the adjustment of the colour legend to highlight specific movement phenomena. The minimum and maximum velocity or displacement values within the map detail are shown underneath the slider and can be changed by clicking into the slider boxes.
- 2) With the 'Min & Max Values' slider, elements within a certain movement interval can be displayed. For example, only uplifting elements can be shown by moving the minimum slider to 0 mm (per year). The movement interval changes according to the elements displayed on screen.
- 3) The slider 'Deviation from Linearity' allows displaying only elements within a specific deviation interval. It refers to the measure 'Deviation from Linearity' (in mm) of each SMM measurement element, as described in Section 2.4 . The deviation interval changes according to the elements displayed on screen.

- 4) With the button 'Unit – Velocity / Displacement', it is possible to switch between the units 'Velocity' (mm per year) and cumulative 'Displacement' (mm). When clicking, the units of the colour legend and of the sliders will change automatically.
- 5) The 'Time Slider' is only active when the unit is set to cumulative 'Displacement'. It allows the visualisation of the movement evolution within the 2D point cloud.
- 6) The actual zoom level is displayed at the right side of the settings toolbar.

## 2.9 Measurement Tool

To measure the length of a line or the area of a polygon the 'Measurement Tool' (or 'Ruler') button on the menu bar can be pressed. Two small buttons will then appear to the right of the 'Measurement Tool' button: 'Measure Line' and 'Measure Area' (see Figure 2-8). By pressing either button, a small circle will appear under the cursor indicating the measurement mode. The lines or polygons can be drawn by repeatedly clicking and setting marker points on the map. To finish a line or polygon double-click for the last marker point. The result will be displayed at the center of the drawn feature in m or m<sup>2</sup>, respectively. Multiple features can be measured. To exit the measurement mode and erase all features the 'Measurement Tool' button can be pressed.

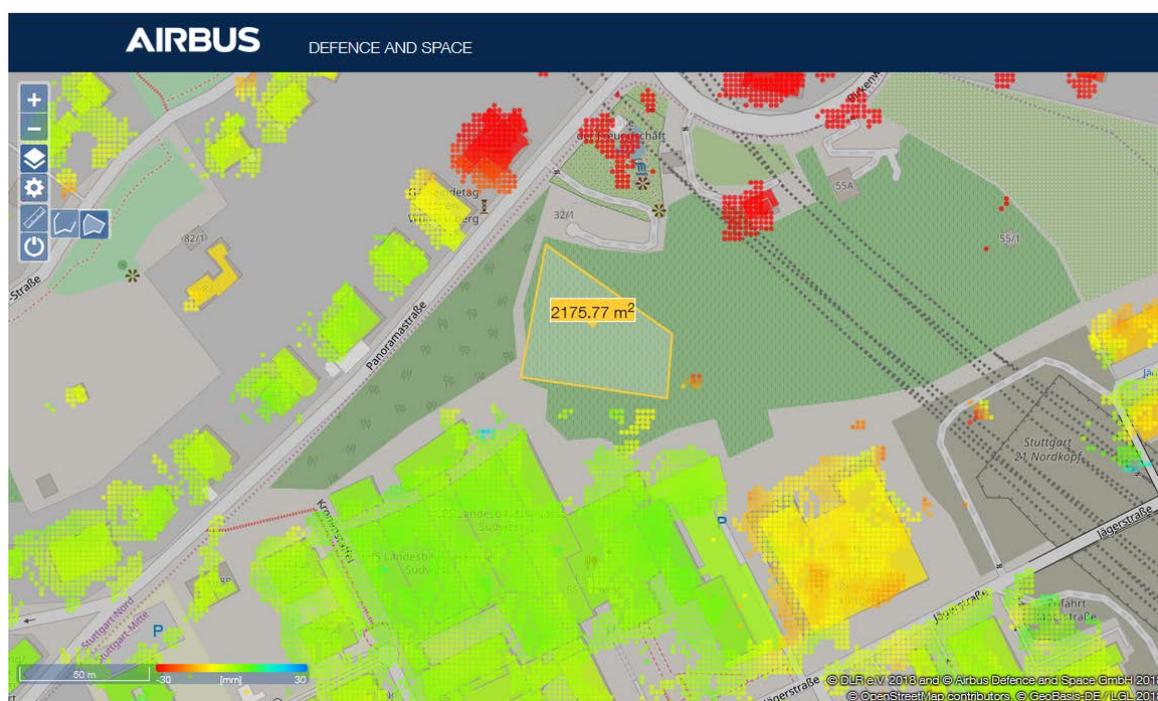


Figure 2-8: Measurement Tool - the area of the polygon drawn is shown at its centre.