Overflight

OVERFLIGHT PREDICTION AND ANALYSIS

GMV's ***Overflight*** calculates ***Overflight* events** for a set of satellites over a set of points/zones over the Earth's surface. The software presents two main functionalities:

- **Estimation of *Overflight* events over regions of interest**: the software computes time intervals in which a point or a polygonal zone over the Earth's surface is visible by the satellites of interest defined in a catalogue.
- **Estimation of downlink events over regions of interest**: the software also computes the time intervals in which satellites of interest could send acquired information to downlink zones.

The **estimation of *Overflight* events over regions of interest** is characterized by the following technical aspects:

- The analysis is performed for all the satellites defined by the user in a catalogue. Orbital information is taken from an input **TLE catalogue**.

  The zones of interest are defined by **latitude-longitude points** over the Earth's surface and can be a single point or a polygonal region.

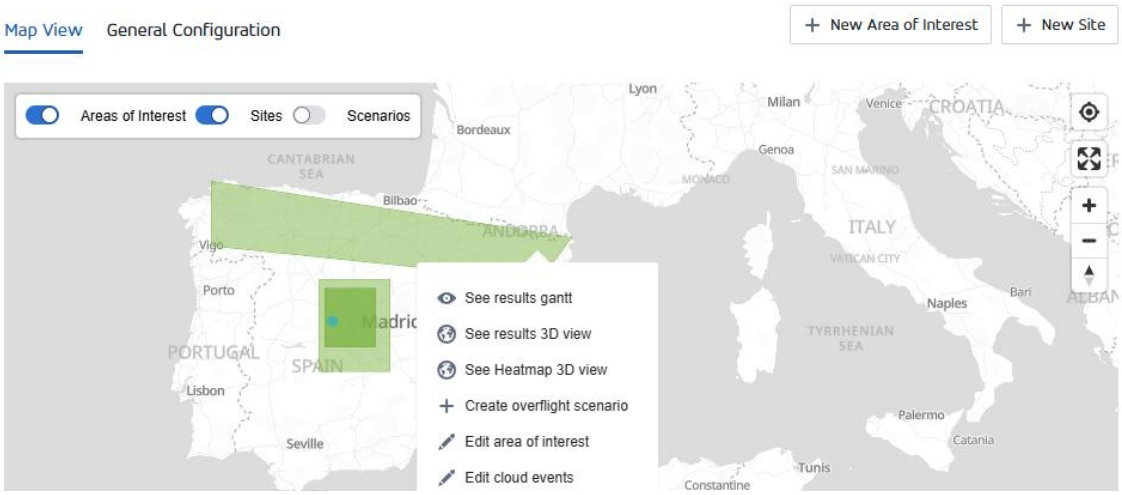

Figure 1: Example of zones of interest map (point and polygonal region)

- The satellite swath can be customized for each satellite, considering a **conical sensor** in which angles of aperture are defined by the user. The sensor pointing is also configurable by the user through attitude mode and sensor position and orientation.
- The visibility events can be filtered depending on weather or day/night conditions. The user can information specifying periods in which a region is not visible due to clouds. Three types of sensors can be considered in this respect: **optical sensors**, which cannot observe zones under cloudy or night conditions; **infra-red sensors**, which can take images at night conditions, but cannot observe through clouds; **radar sensors**, which are not affected by the previously mentioned conditions.

The **estimation of downlink events over regions of interest** it is characterized by the following aspects:

- Downlink events for each satellite defined by the user in a catalogue are calculated for a list of zones of interest, defined as in the previous case.
- A **minimum elevation angle** or an azimuth-dependent **elevation mask** can be considered for each zone. If a satellite is above the minimum elevation of the considered zone, it is considered that the data is being sent to the zone.
- Downlink events are **associated to the corresponding satellite visibility event**.

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In both cases, either estimation of overflight events or estimation of downlink events, the software is able to take as input **detailed terrain elevation information**, either in DTED or DEM format. In such cases, the software computes the azimuth-dependent elevation mask for the points or stations of interest based on the digital terrain information and from there, the visibilities are computed.

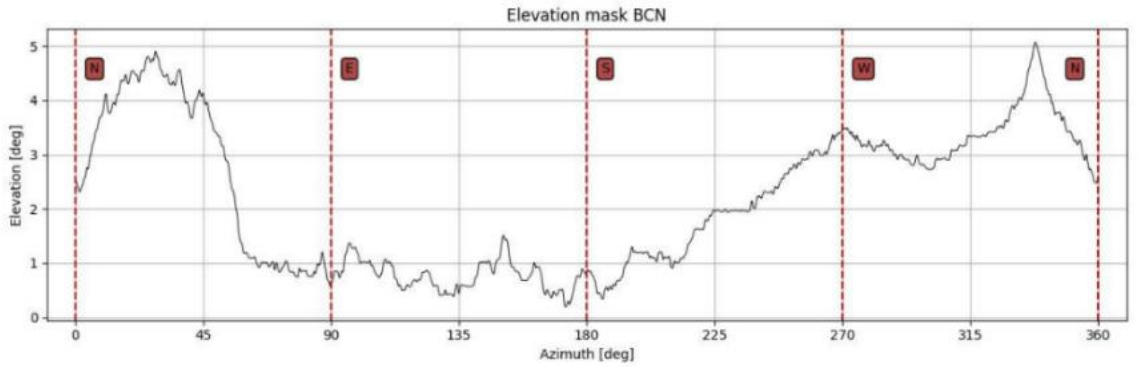

Figure 2: Elevation mask computed by the software from digital terrain information

In terms of run-time performance, considering a single core of a modern server, ***Overflight*** is able to perform an overflight events analysis for regions defined by points in seconds. If the regions of interest are defined by polygonal zones, algorithm is more complex and computation time may rise to some minutes depending on the number of satellites and zones, the time span and the discretization of the FOV. Terrain elevation information can be used for a high precision calculation. Computational time increases with this last configuration.

As end user products, ***Overflight*** generates the following products:

- **List of events**, including a list of all the detected events: visibility of regions from satellites, downlink and weather-related events, that can be visualized in the GUI as a Gantt chart.

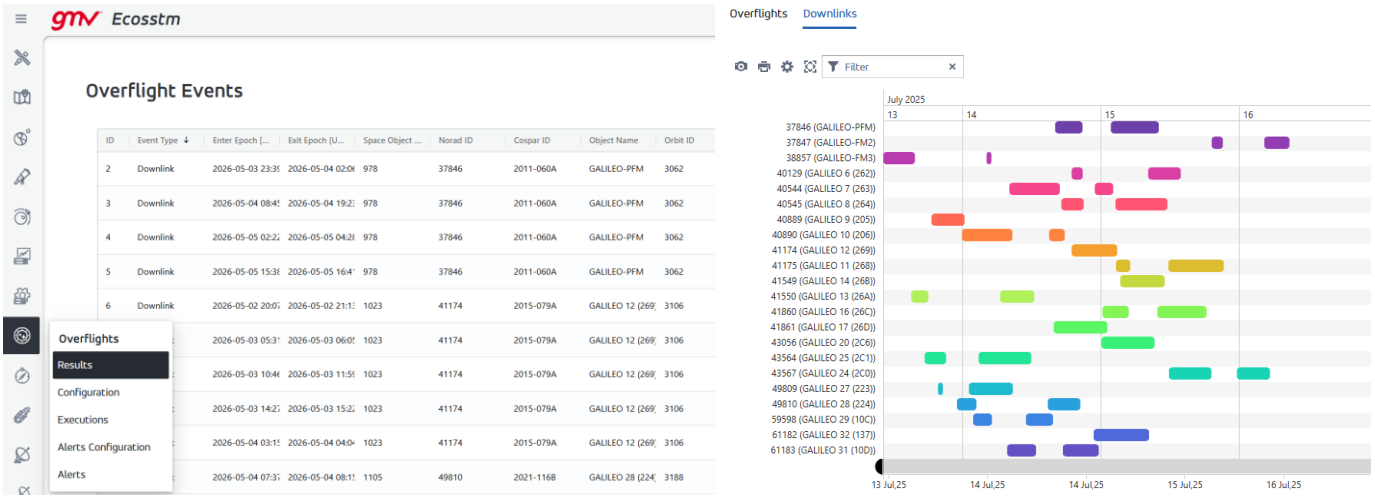

Figure 3: Example of overflight events page and Gantt visualization in ***Overflight***

- **3D visualization of the events,** as an animation of all the generated events.

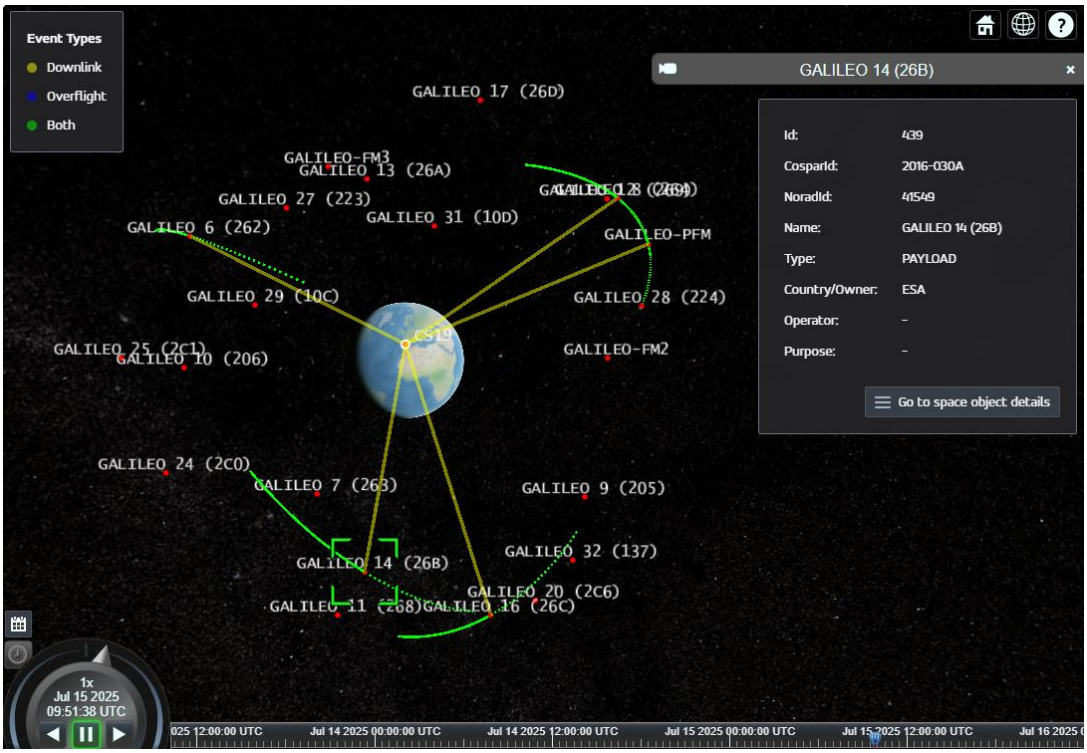

Figure 4: 3D visualization of the events generated by ***Overflight***

- **Heatmap of the events,** as an animation of all the generated events.

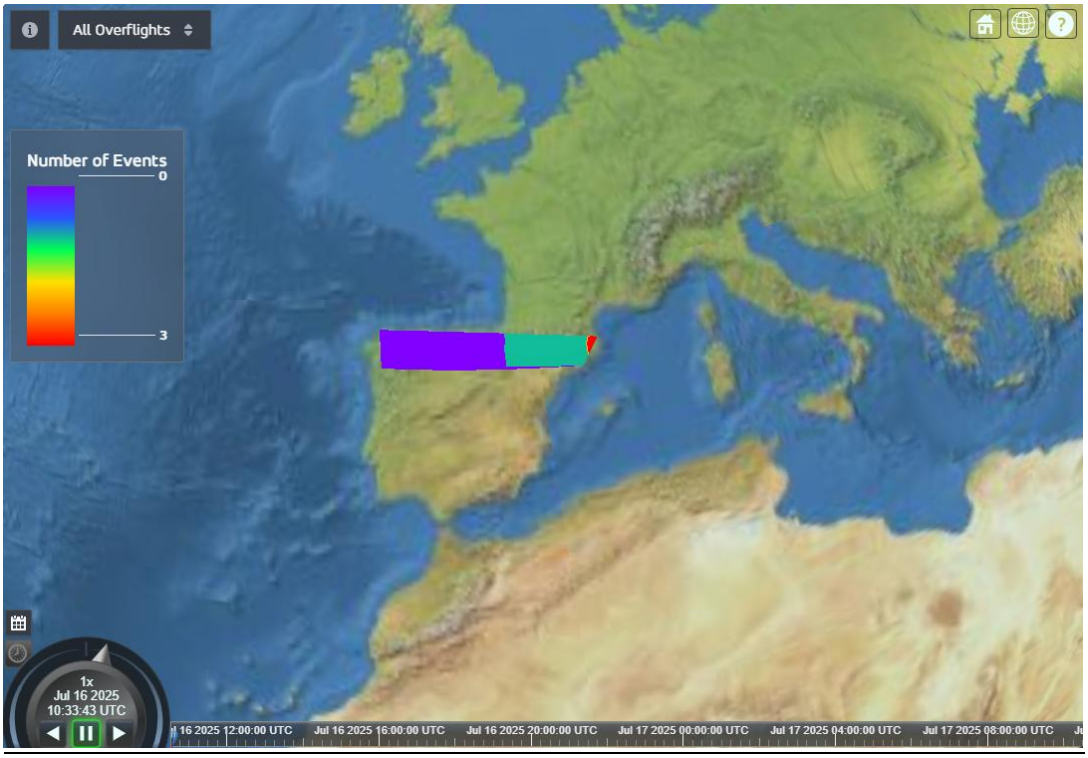

Figure 5: Heatmap of the events generated by ***Overflight***