Temporal: The forgotten resolution

Temporal resolution shouldn't be forgotten when considering satellite imagery; however it's often neglected, with its partners of spatial and spectral resolution getting the limelight. The reason is the special relationship spatial and spectral has, where a higher spectral resolution has meant a lower spatial resolution and vice-versa, because of limited satellite disk space and transmission capabilities. Therefore, when considering imagery most people focus on their spatial or spectral needs and go with whatever best suits their needs, rarely giving temporal resolution a second thought, other than if immediate data acquisition is required.

Temporal resolution is the amount of time it takes a satellite to return to collect data for exactly the same location on Earth, also known as the revisit or recycle time, expressed as a function of time in hours or days. Global coverage satellites tend to have low earth polar, or near-polar, orbits travelling at around 27,000kph and taking around 100 minutes to circle the Earth. With each orbit the Earth rotates twenty-five degrees around its polar axis, and so on each successive orbit the ground track moves to the west, meaning it takes a couple of weeks to fully rotate, for example, Landsat has a 16 day absolute revisit time.

Only seeing the part of the Earth you want to image once every few weeks, isn't very helpful if you want to see daily changes. Therefore, there are a number of techniques satellites use to improve the temporal resolution:

- **Swath Width**- A swath is the area of ground the satellite sees with each orbit, the wider the swath the greater the ground coverage, but generally a wider swath means lower spatial resolution. A satellite with a wide swath will have significant overlaps between orbits that allows areas of the Earth to be imaged more frequently, reducing the revisit time. MODIS uses a wide swath and it images the globe every one to two days.
- **Constellations** – If you have two identical satellites orbiting one hundred and eighty degrees apart you will reduce revisit times, and this approach is being used by ESA's Sentinel missions. Sentinel-1A was launched in 2014, with its twin Sentinel-1B is due to be launched in 2016. When operating together they will provide a temporal resolution of six days. Obviously, adding more satellites to the constellations will continue to reduce the revisit time.
- **Pointing** – High-resolution satellites in particular use this method, which allows the satellites to point their sensors at a particular point on earth, and so can map the same area from multiple orbits. However, pointing changes the angle the sensor looks at the Earth, and means the ground area it can observe can be distorted.
- **Geostationary Orbits** – Although technically not the same, a geostationary satellite remains focussed on an area of the Earth at all times and so the temporal resolution is the number of times imagery is taken, for example, every fifteen minutes. The problem is that you can only map a restricted area.

Hopefully, this has given you a little oversight on temporal resolution, and whilst spectral and spatial resolution are important factors when considering what imagery you need; do spent a bit a time considering temporal needs too!