Supporting Soil Fertility From Space

Last Tuesday I was at the academic launch event for the Tru-Nject project at Cranfield University. Despite the event's title, it was in fact an end of project meeting. Pixalytics has been involved in the project since July 2015, when we agreed to source and process high resolution satellite Earth Observation (EO) imagery for them.

The Tru-Nject project is funded via Innovate UK. It's official title is 'Tru-Nject: Proximal soil sensing based variable rate application of subsurface fertiliser injection in vegetable/ combinable crops'. The focus is on modelling soil fertility within fields, to enable fertiliser to be applied in varying amounts using point-source injection technology which reduces the nitrogen loss to the atmosphere when compared with spreading fertiliser on the soil surface.

To do this the project created soil fertility maps from a combination of EO products, physical sampling and proximal soil sensing - where approximately 15 000 georeferenced hyperspectral spectra are collected using an instrument connected to a tractor. These fertility maps are then interpreted by an agronomist, who decides on the relative application of fertiliser.

Initial results have shown that applying increased fertiliser to areas of low fertility improves overall yield when compared to applying an equal amount of fertiliser everywhere, or applying more fertiliser to high yield areas.

Pixalytics involvement in the work focussed on acquiring and processing, historical, and new, sub 5 metre optical satellite imagery for two fields, near Hull and York. We have primarily acquired data from the Kompsat satellites operated by the Korea Aerospace Research Institute (KARI), supplemented with WorldView data from DigitalGlobe. Once we'd acquired the imagery, we processed it to:

- remove the effects of the atmosphere, termed atmospheric correction, and then
- converted them to maps of vegetation greenness

The new imagery needed to coincide with a particular stage of crop growth, which meant the satellite data acquisition period was narrow. This led to a pleasant surprise for Dave George, Tru-Nject Project Manager, who said, "I never believed I'd get to tell a satellite what to do.' To ensure that we collected data on specific days we did task the Kompsat satellites each year.

Whilst we were quite successful with the tasking the combination of this being the UK, and the fact that the fields were relatively small, meant that some of the images were partly affected by cloud. Where this occurred we gap-filled with Copernicus Sentinel-2 data, it has coarser spatial resolution (15m), but more regular acquisitions.

In addition, we also needed to undertake vicarious adjustment to ensure that we produced consistent products over time whilst the data came from different sensors with different specifications. As we cannot go to the satellite to measure its calibration, vicarious adjustment is a technique which uses ground measurements and algorithms to not only cross-calibrate the data, but also adjusts for errors in the atmospheric correction.

An example of the work is at the top, which shows a Sentinel-2 pseudo-true colour composite from 2016 with a Kompsat-3 Normalized Difference Vegetation Index (NDVI) product from 2015 inset. The greener the NDVI product the more green the vegetation is, although the two datasets were collected in different years so the planting within the field varies.

We’ve really enjoyed working with Stockbridge Technology Centre Ltd (STC), Manterra Ltd, and Cranfield University, who were the partners in the project. Up until last week all the work was done via telephone and email, and so it was great to finally meet them in-person, hear about the successful project and discuss ideas for the future.