North Wyke Farm Platform

Research case study no. 2

The Potential of Remote Sensing

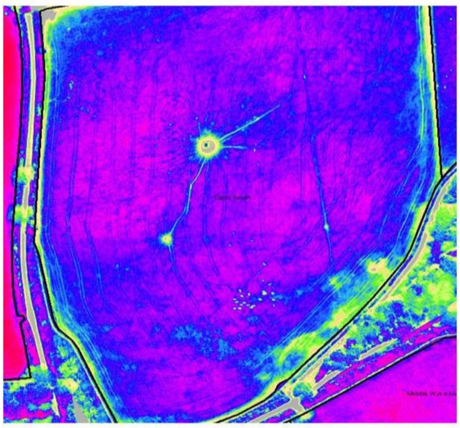
Anita Shepherd

Commonly, remote sensing (RS) is the study of reflectance values of a ground surface or the material of which it is composed. These tend to have a specific reflectance signature, and give information about the state of that surface or material. Other forms of RS include the use of radar and sonar data.

RS can be thought of as remote in that it does not touch the material and is a form of non-destructive testing, regardless of how far away the sensor is located. We have studied reflectance values of grassland from sensors mounted on low level drones and octocopters (figure top right); and via the use of hand held sensors.

We are interested in relating reflectance to biological variables, such as biomass and crop nitrogen. Such relationships are often found to be strong in arable systems, but for grasslands, research in developing such relationships is in its infancy. A research goal is to replace or compliment expensive and/or destructive field surveys for the given variables with the use of reflectance data.

Reflectance may be classified into wavebands. When you see a rainbow, the light is being split into separate wavebands of colour. The light from a sensor is split similarly, but sensors can see beyond the visible spectrum providing bands such as near infra red - an important band for vegetation. The most common plant pigments strongly absorb red light for photosynthesis and reflect a small amount of green. However beyond the visible range, a healthy plant reflects a much larger amount of near infra red. The spongy mesophyll layer in a leaf reflects the near infra red light when cells are healthy, full of fluid and turgid. Less near infra red is reflected from an unhealthy plant with more flaccid cells.



If we calculate the ratio of the high near infra red reflection with the low red reflection, we can relate this to the general health of the crop and distinguish the crop from the soil background. Many such ratios or indices have been proposed, the most common being the Normalized Difference Vegetation Index (NDVI).

Developing such relationships is not limited to the use of indices and formulating relationships via the individual wavebands themselves can also be considered. This can be especially important when reflectance data is in a hyperspectral form (100's of narrow wavebands) as opposed to a multispectral form (six or seven broad wavebands).

The RS of grassland is complex, and the subject is not without issues. For example, relationships between biomass and NDVI can be considerably weakened by surface litter, which has no live plant pigment. In a pilot study, a reasonable NDVI relationship with biomass (R^2 = 0.51) only occurred for biomass data that had less than 8% surface litter.

The bottom left figure is the NDVI map (via a drone) of a pasture grazed by cattle. High values are red/pink denoting heathy pasture. Pasture compressed by a tractor but still healthy, gives lower NDVI values shown in blue and displayed as parallel lines. Edges of fields do not receive fertilizer within 2m of water courses which could be a reason for the blue edges. The central cattle resting area is bare soil and radiating out from it there are well-worn cattle tracks in yellow-green with NDVI values below those for live vegetation or live leaf canopy. Various blue-green patches around the field have been determined as bare soil. A road on the left and bare early spring trees, bottom right, also have low NDVI values - below that for live vegetation.