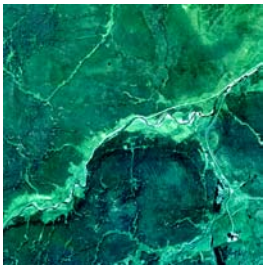
The UK Environmental Change Network

Data, monitoring and research to detect and interpret environmental change



LINKING EARTH OBSERVATIONS FROM THE GROUND UP

As the UK's long-term environmental monitoring and research (LTER) programme, ECN has been collecting detailed environmental information from a range of terrestrial sites over the past 20 years. Work at these sites has great potential for ground truthing Earth Observation (EO) data collected by satellites, aircraft and Unmanned Aerial Vehicles (UAVs, drones). Meanwhile, monitoring at ECN sites should benefit from recent advances in satellite image resolution. A range of exploratory studies are helping to elucidate links between reflectance signals and a range of ecosystem properties and processes. These studies could also benefit the development of tools for conservation management.

ECN is network of sites spanning the UK conducting environmental monitoring using standard methods. The 11 active terrestrial sites cover a wide range of upland and lowland habitats including moorland, chalk grassland, woods and forests, farmland. A range of research institutes and universities use the sites for experiments and long-term environmental research.

ECN SITE MEASUREMENTS TO SUPPORT EARTH OBSERVATION

Site code (see map)	HIL	NOR	POR	ROT	WYT	ALI	CAI	GLE	SOU	MOO	SNO
ECN site since...	1992	1992	1994	1992	1992	1992	1999	1992	1992	1992	1995
Meteorology data (hourly resolution)	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Soil data	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Vegetation plot data	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Land Cover Map data	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Land cover and land use records	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Weekly fixed point photos				◆	◆	◆	◆			◆	◆
Aerial photos ◆1994 ◆1994+other yrs	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Phenocam images					◆	◆				◆	
UAV images/data										◆[1]	
COSMOS-UK soil moisture measurements		◆	◆	◆	◆	◆		◆	◆	◆	
Others					◆[2,3,4]						

Main habitat type: Lowland grassland/agricultural Wooded Upland moor/pasture. For details see http://data.ecn.ac.uk/sites/sites.asp

[1]From CEH operated UAV. Potential to overfly other sites, subject to funding; [2]FPAR; [3]hyperspectral data; [4]Lidar

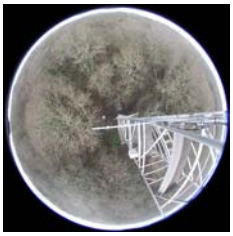
MODIS image of UK (above): Jacques Descloitres, MODIS Land Rapid Response Team, NASAGSFC

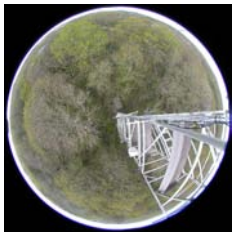
EXAMPLES OF RECENT WORK

WYTHAM WOOD

Wytham is a mainly wooded site near Oxford. NPL have deployed FPAR[1] instruments to calibrate & validate MODIS satellite output. CEH are monitoring phenology using COSMOS[2] phenocams & ECN fixed-point photos, spectroradiometer and satellite data, and a University of Oxford study has assessed great tit breeding success in relation to oak leaf phenology and peak caterpillar abundance. Wytham has also been the focus of a University of Cambridge study using airborne lidar[3] and hyperspectral data to estimate aboveground biomass, to map species and to analyse leaf chemistry. Meanwhile, UCL and the University of Salford have used Wytham as a test site for ground-based lidar.

Winter and Summer images of the tree canopy from a camera mounted on the flux tower at Wytham





Four fish eye images of the Alice Holt tree canopy from the flux tower, taken at different times of the year, show leaf emergence

ALICE HOLT

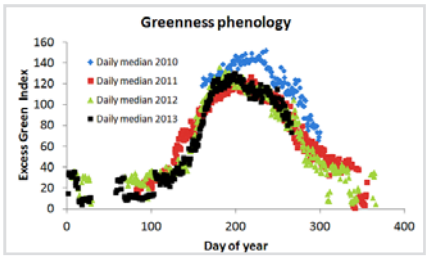
Alice Holt is a research forest in Hampshire. Forest Research have installed 180° field of view 'fish eye' cameras mounted on a flux tower, two viewing the canopy and one facing upwards. Digital images captured every 30 minutes from these cameras over a two year period were analysed and compared with eddy covariance measurements of CO_2, H_2O and energy fluxes. The RGB 'Hue' parameter was found to correlate closely with actual photosynthetic rate, demonstrating the potential of very simple imagery to inform on changes in this fundamental ecosystem function.

MOOR HOUSE

Moor House is a moorland site in the North Pennines. CEH have been collecting daily images of dominant vegetation types since 2010 from fixed cameras. Digital image analysis used to infer variation in greenness and flowering patterns is now being complemented by NDVI[4] sensors. Separately, images from a series of drone flights during 2015 are being used to characterise the spatial distribution of broad habitats at sub-metre resolution. This approach should assist land managers in assessing the changing ecological quality of their sites.

left: Moor House habitat map derived from sub-metre resolution drone imagery

below: Seasonal change in greenness of a Moor House meadow plot determined from digital images



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[1]Fraction of Photosynthetically Active Radiation; [2]Cosmic Ray Soil Moisture Monitoring Network [3]Light Detection and Ranging; [4]Normalised Difference Vegetation Index