

## 4.4 Leaf Area Index

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Leaf Area Index (LAI) is a measure of the amount of plant leaf material in an ecosystem and is important for assessing the productivity or growth of vegetation. LAI is strongly related to the structure of a plant canopy and plays a key role in interactions between the atmosphere and the vegetation in processes such as water interception, evapotranspiration, photosynthesis, respiration, and leaf litter fall. LAI is also an important component in ecosystem process models designed to simulate biogeochemical cycles, hydrological budgets and carbon assimilation and sequestration.



Photo: © Ned Dwyer



Artist's impression of Envisat. Source: ESA

### Measurements

LAI can be calculated directly by collecting leaf material over a certain area, or indirectly by measurements from hemispherical photography and other optical instruments. In Ireland ground-based measurements of LAI are being made as part of a number of research projects investigating ecosystem processes and carbon fluxes; however, no long-term, continuous measurement systems are in place.

LAI is calculated from satellite-sensor data using reflectance information from the visible and infrared part of the spectrum. Global maps of LAI have been generated on a regular basis using sensors such as MODIS and MERIS.

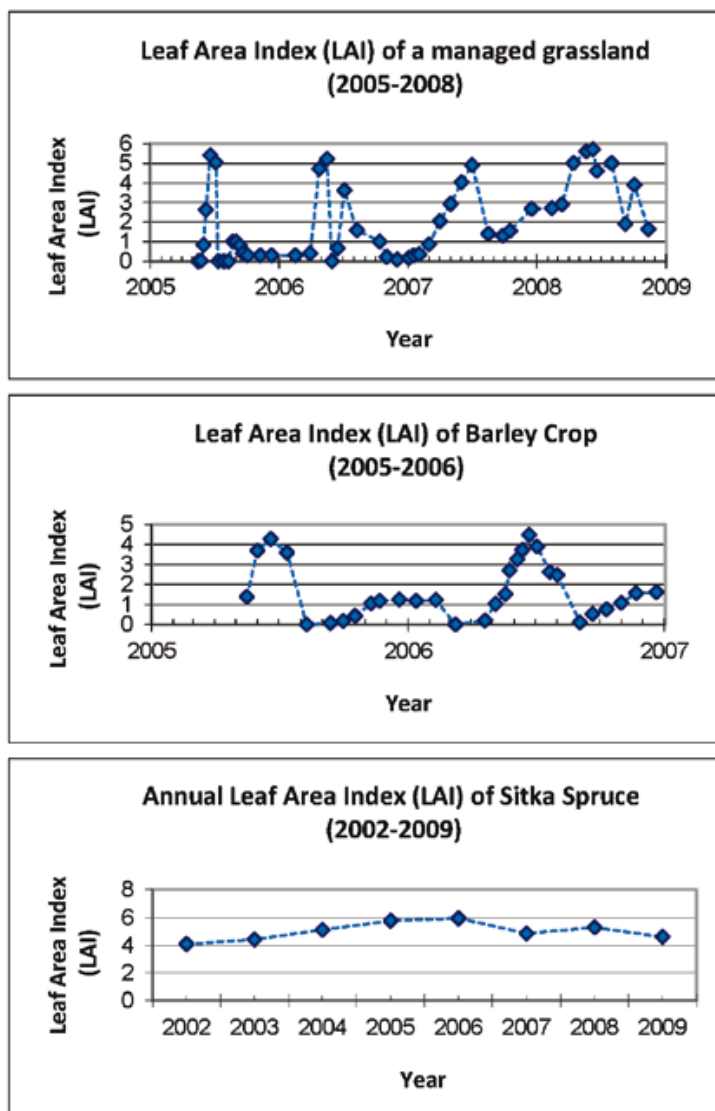
'An observed increase in the annual average LAI over Europe may be linked to increased average annual temperatures.'

## Time-series and Trends

Measurements of LAI are being made at a grassland site in Co. Carlow. [Figure 4.7](#) shows the observations between 2005 and 2008. Two silage cuts were made each year followed by cattle grazing. The impact of these land-use practices on the LAI is evident. Measurements made on a barley crop in Co. Carlow in

2005 and 2006 illustrate the increase in LAI during the crop growth phase and its steep decline after harvest, with some subsequent increases over autumn and winter due to the growth of barley volunteer seedlings and weeds. Measurements since 2002 made over a Sitka Spruce stand in Co. Laois planted in 1998 show a slight increase in LAI. The decreases in 2007 and 2009 are due to thinning of the stand in these years.

A recently published study, based on the analysis of a global set of satellite data for the period 1981 to 2006, indicates that there is a slight increase in the annual average LAI over Europe. At European latitudes, temperature is a controlling variable on plant growth,



**Figure 4.7.** Leaf Area Index (LAI) measurements made at a grassland, crop and forest site respectively.

so this increase may be linked to increased average annual temperatures.

The example map<sup>21</sup> of LAI in [Fig. 4.8](#) has been calculated with data from the *MERIS* sensor for 11 June 2005. Black indicates areas of no data (cloud or inland water). The areas of highest LAI (dark green) correspond to pasture, crops and forest whilst the areas of lowest LAI (yellow, red) correspond to upland, heath and urban cover types.



**Figure 4.8.** Leaf Area Index (LAI) derived from *ENVISAT MERIS* data for 11 June 2005.

<sup>21</sup> Courtesy of Thomas Lankester, Infoterra.

‘Long-term ground-based measurements of LAI over a number of different vegetation types are required to improve understanding of ecosystem processes and for the validation of satellite-derived measurements.’

## Maintaining the Observations

Current ground-based measurements of LAI are funded as part of short-term projects. Long-term ground-based measurements over a number of different vegetation types are required to improve understanding of ecosystem processes and for the validation of satellite-derived measurements. The EPA and Teagasc are currently considering the designation of one or more sites to contribute to the ICOS as part of which measurements of LAI are required.

This would provide the opportunity to exploit the satellite datasets and validate them against ground-based measurements.

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### Further Information and Data Sources

Siliang, L., Ronggao, L. and Yang, L. (2010) Spatial and temporal variation of global LAI during 1981–2006, *Journal of Geographical Sciences*, Vol. 20, No. 3, pp. 323–32.

IMECC (Infrastructure for Measurements of the European Carbon Cycle):  
<http://imecc.ipsl.jussieu.fr/>

GHG Europe (Greenhouse gas management in European) land use systems:  
<http://www.ghg-europe.eu/>

The Integrated Carbon Observing System:  
<http://www.icos-infrastructure.eu/>