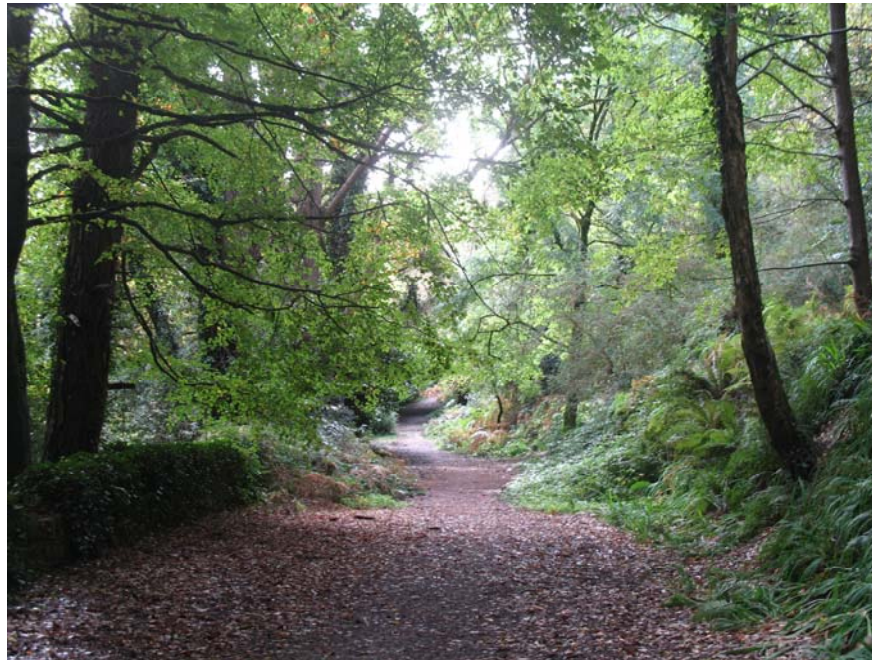


# SATellite MOonitoring of VEgetation Seasonality SAT-MOVES



Brian O' Connor, Ned Dwyer, Fiona Cawkwell

# Objective:

To investigate a methodology for the potential of earth observation satellites to monitor vegetation seasonality dynamics across the island of Ireland



# Evidence of Seasonality Changes

- **Global:** Spring warming causing earlier growth (1982-1998) throughout N. hemisphere

(Xiao & Moody, 2005)

- **Ireland:** Beginning of growing season will occur earlier by 5 to 8 days for every 1°C rise in spring air temperature, depending on the species

(Sweeney et al., 2002)

# Irish Phenological Gardens

JFK Arboretum(1966)

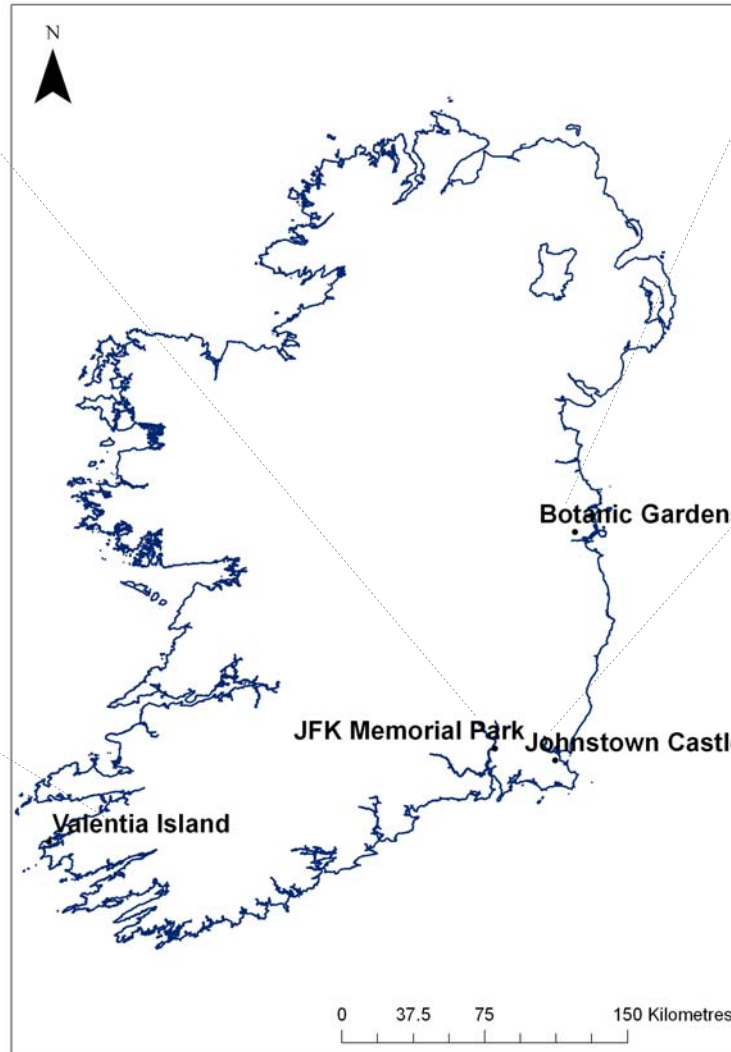


<http://homepage.eircom.net/~killarneyhouse/attractions.html>

Valentia Island (1966)



<http://www.kerryholiday.co.uk/ring.html>



Nat. Botanic Gardens (1966)



<http://www.botanicgardens.ie>

Johnstown Castle, Wexford (1967)



<http://www.lookaroundireland.com>

# In-situ and satellite monitoring

In-situ observations are:

- Site dependent (mostly coastal and southern)
- Species specific (e.g., *Betula pubescens*, *Tilia cordata*)

Satellite Data:

- Is Regular and Repeatable
- Tracks vegetation growth over time
- Captures island-wide vegetation cover

# Envisat MERIS-Characteristics

ENVISAT Medium Resolution Imaging Spectrometer (MERIS) launched in February, 2002 by ESA

- Wide-swath (1150 km) imaging spectrometer
- Ground spatial resolution of 300m (1.2 km) in full (reduced) mode
- 15 narrow bands from 390nm to 1040nm spectral range
- Blue band atmospheric correction

# MERIS FAPAR product

Fraction of Absorbed Photosynthetically Active Radiation (FAPAR): bio-geophysical measure

- Acquired in a **two-step procedure**:

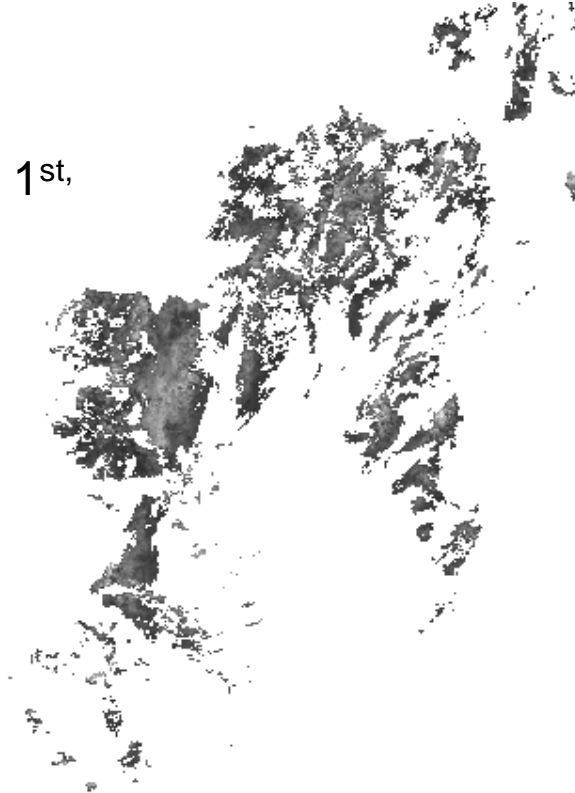
1. Geometric and atmospheric corrections are applied to spectral measurements in the red (R) and NIR bands to produce the **rectified R and NIR values**.

2. Rectified values are input to a mathematical formula which calculates **numerical values of FAPAR** (on a scale from 0 to 1)

# Image composites

- Some or all of Ireland is cloud-covered on a daily basis

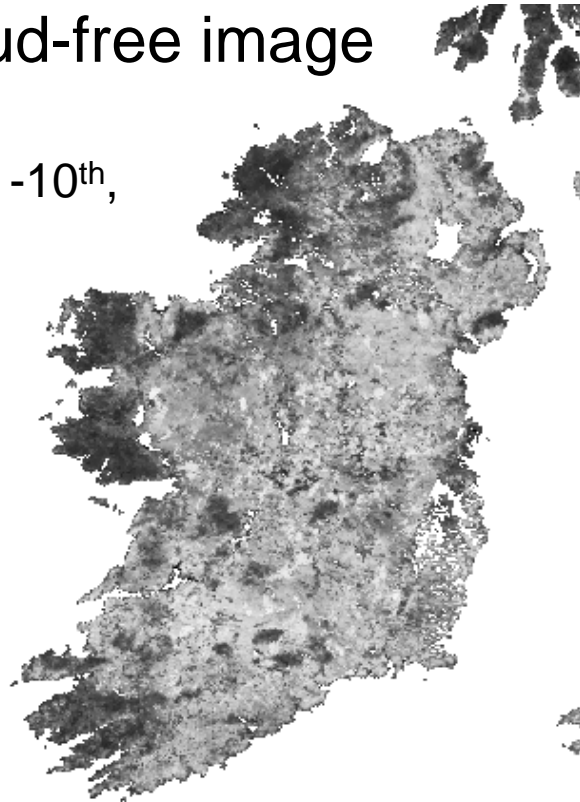
March 1<sup>st</sup>,  
2008



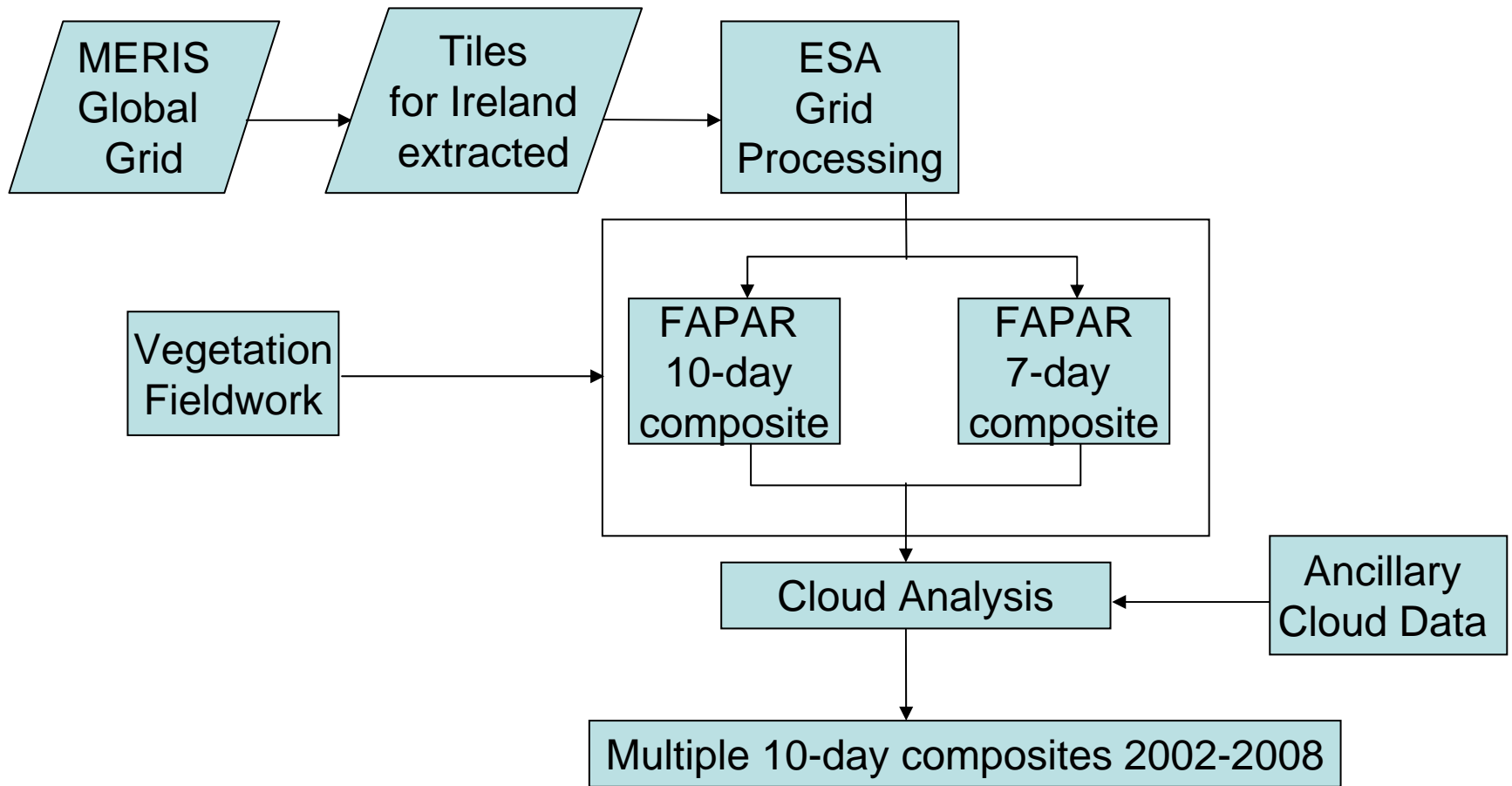
# Image composites

- Many daily images together give one spatially-continuous, cloud-free image

March 1<sup>st</sup> -10<sup>th</sup>,  
2008



# Choosing an optimal composite period



# Vegetation Fieldwork

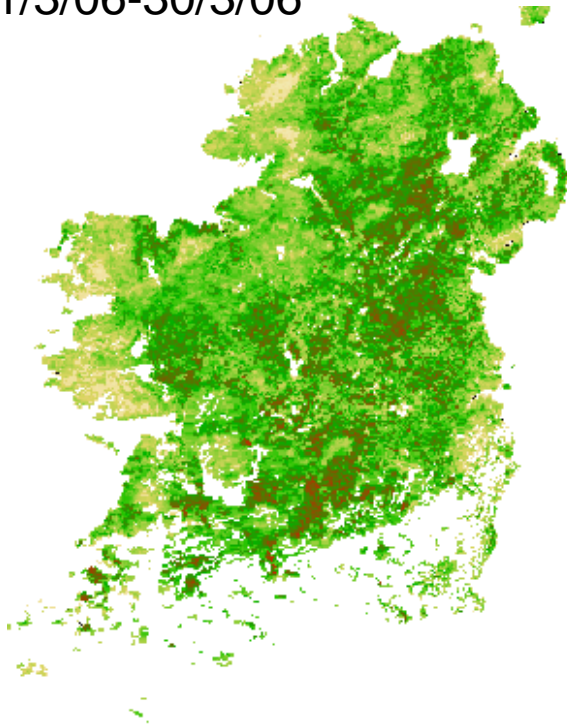
- Mixed woodland
- Weekly observations from March-May, 2008
- Monitored budburst and leafout
- 30 trees from 6 indicator species  
Beech, Birch, Sycamore,  
Oak, Horse Chestnut, Ash



# Shorter composite period = loss of image data due to cloud

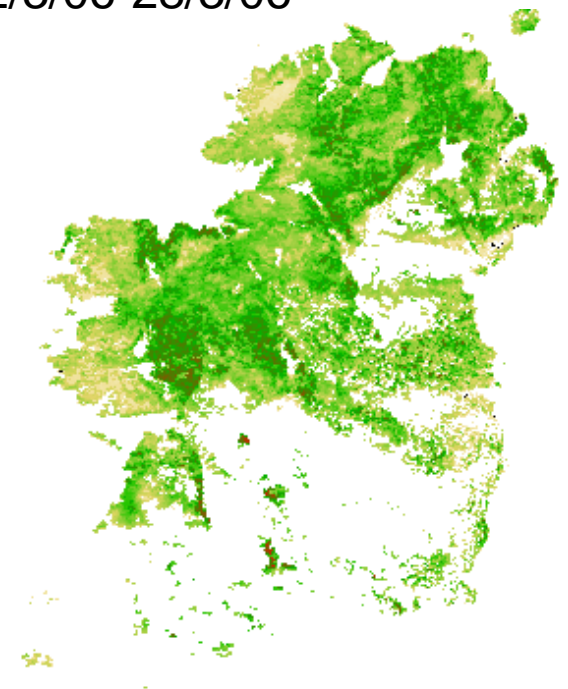
**10-day MGVI/FAPAR**

21/3/06-30/3/06



**7-day MGVI/FAPAR**

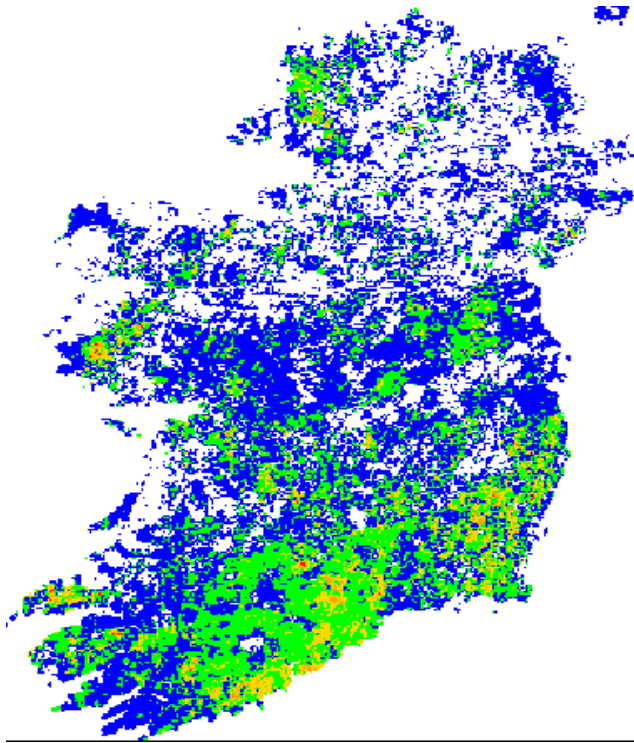
22/3/06-28/3/06



# Cloud spatial analysis, cloud periods increase in 7-day composite

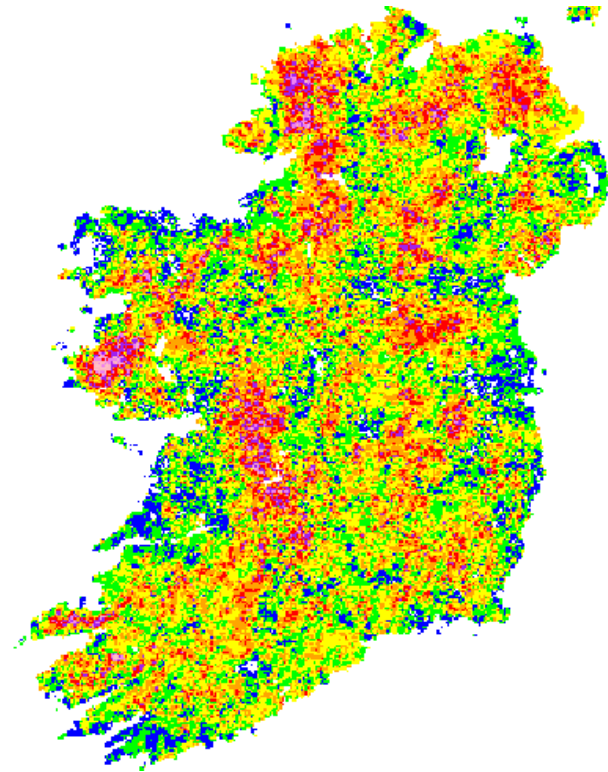
- March 1st to June 29<sup>th</sup>, 2006

13 X 10-day periods

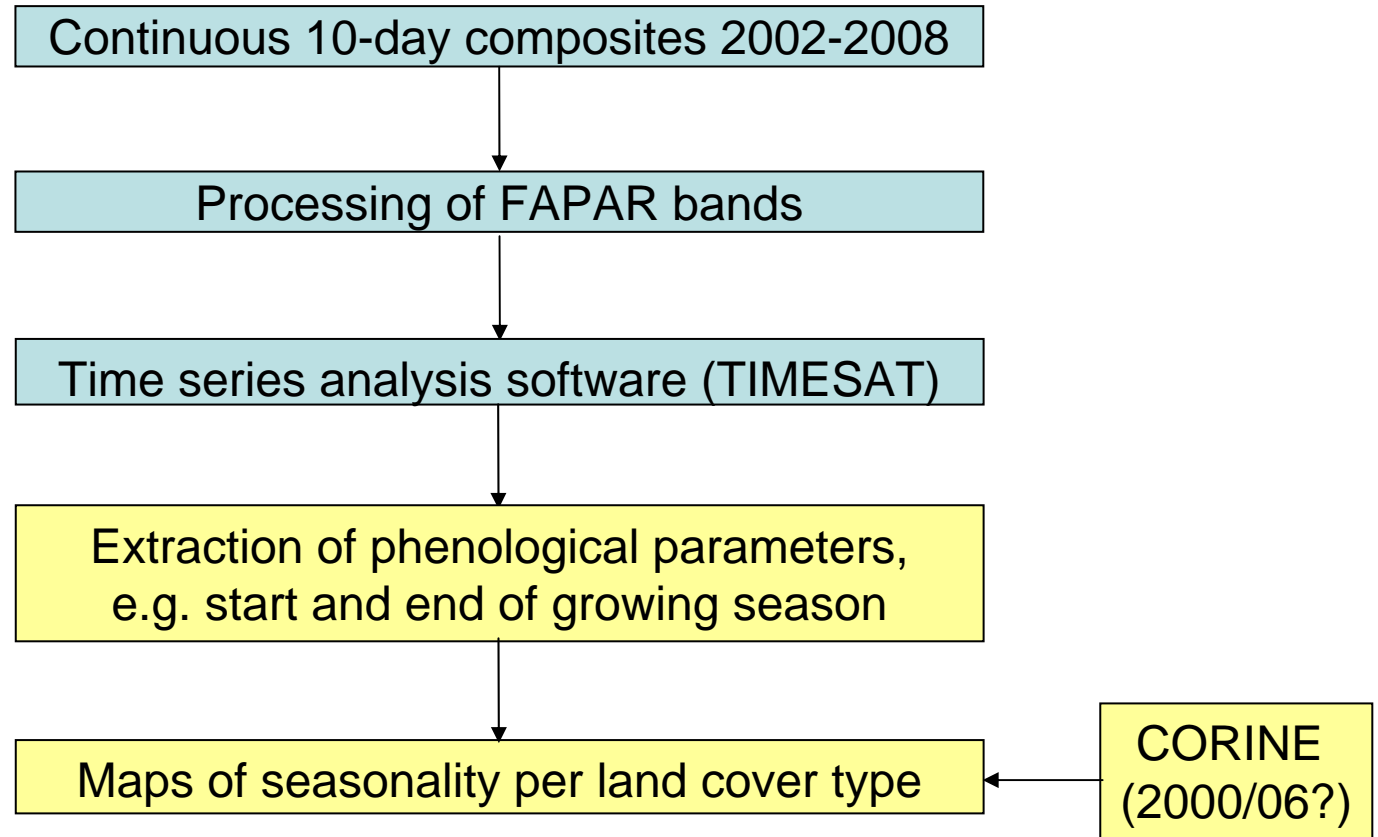


0 cloud periods	White
1 cloud period	Blue
2 cloud periods	Green
3 cloud periods	Yellow
4 cloud periods	Orange
5 cloud periods	Red
6 cloud periods	Purple
7 cloud periods	Pink
8 cloud periods	Brown
9 cloud periods	Light Pink
10 cloud periods	Light Purple

18 X 7-day periods

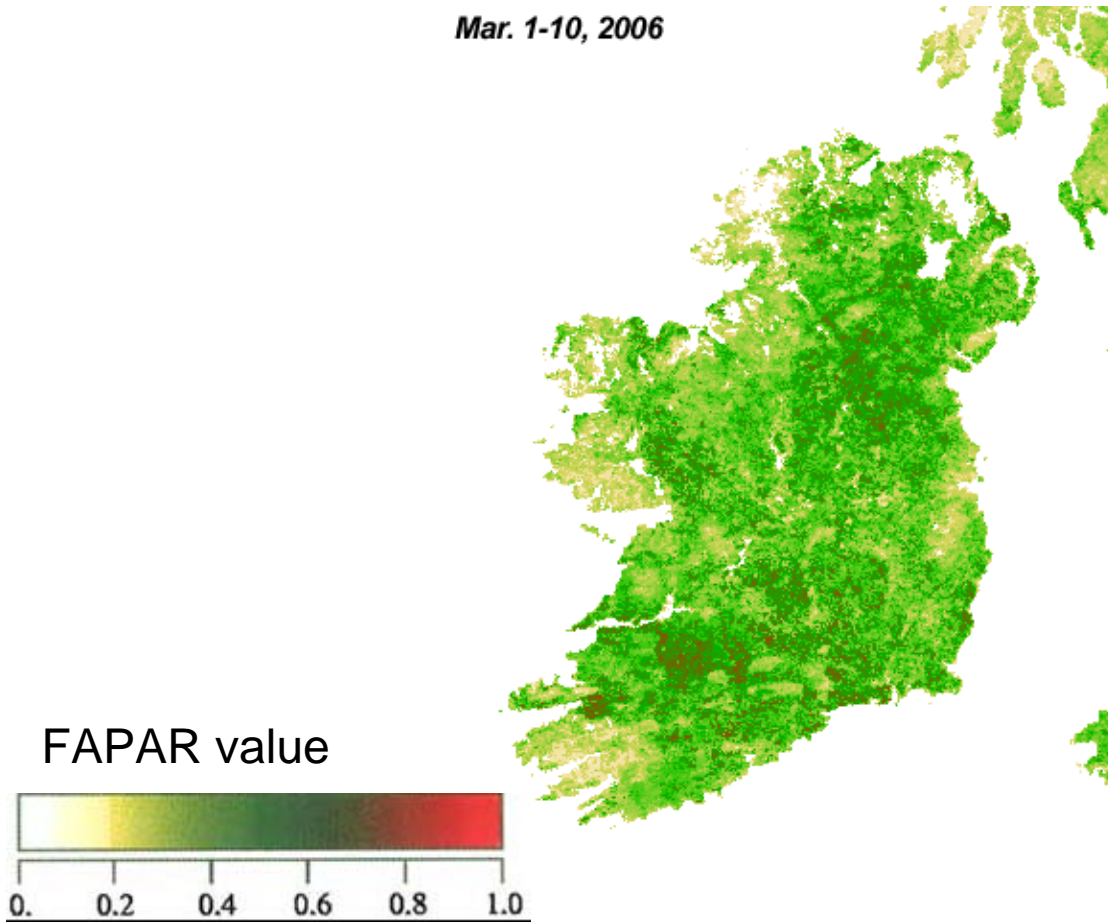


# Extraction of phenological measures



# Spring greening, March –July, 2006

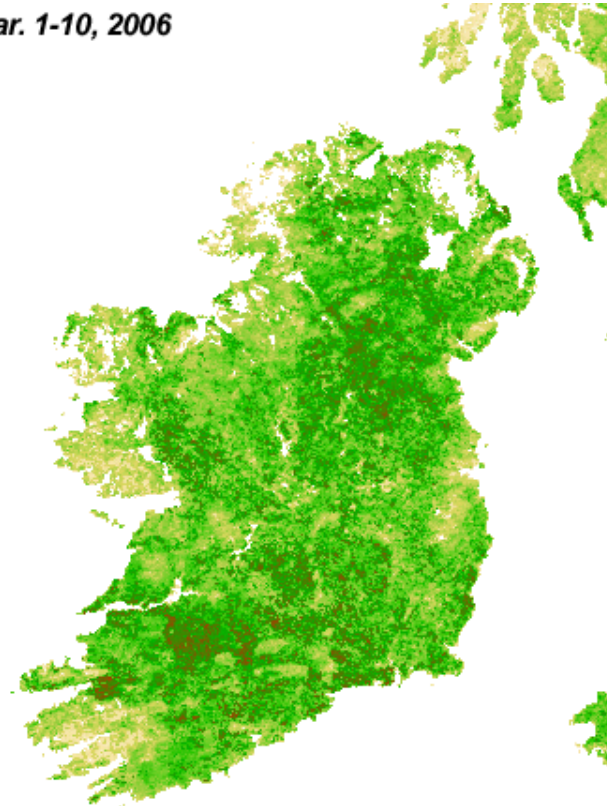
Mar. 1-10, 2006



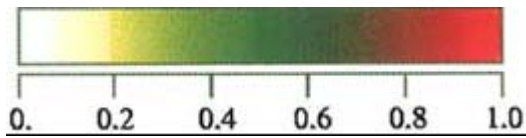
Beige colour has little or no active vegetation cover while red areas contain very active vegetation.

# Spring greening, March – July, 2006

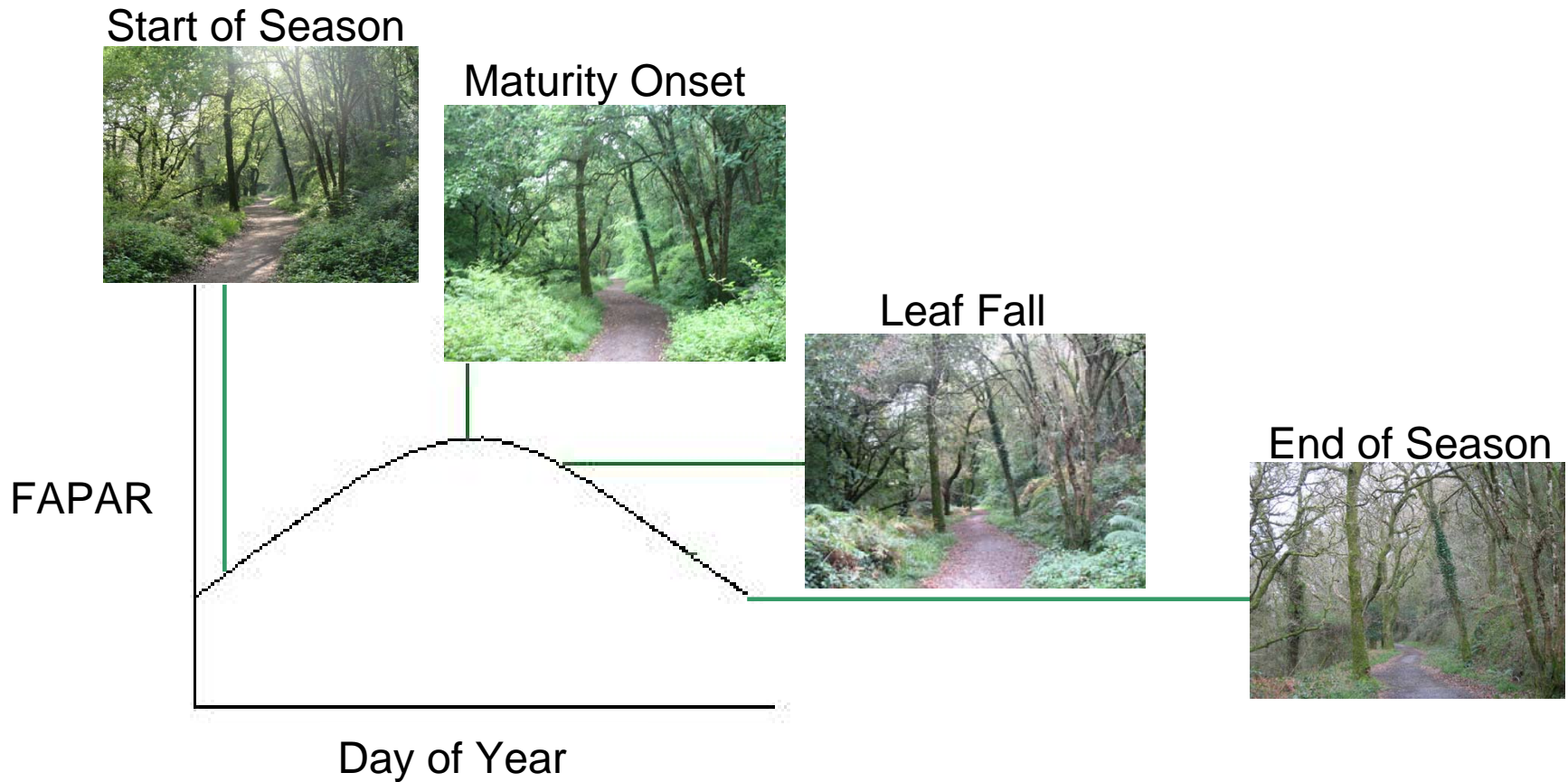
Mar. 1-10, 2006



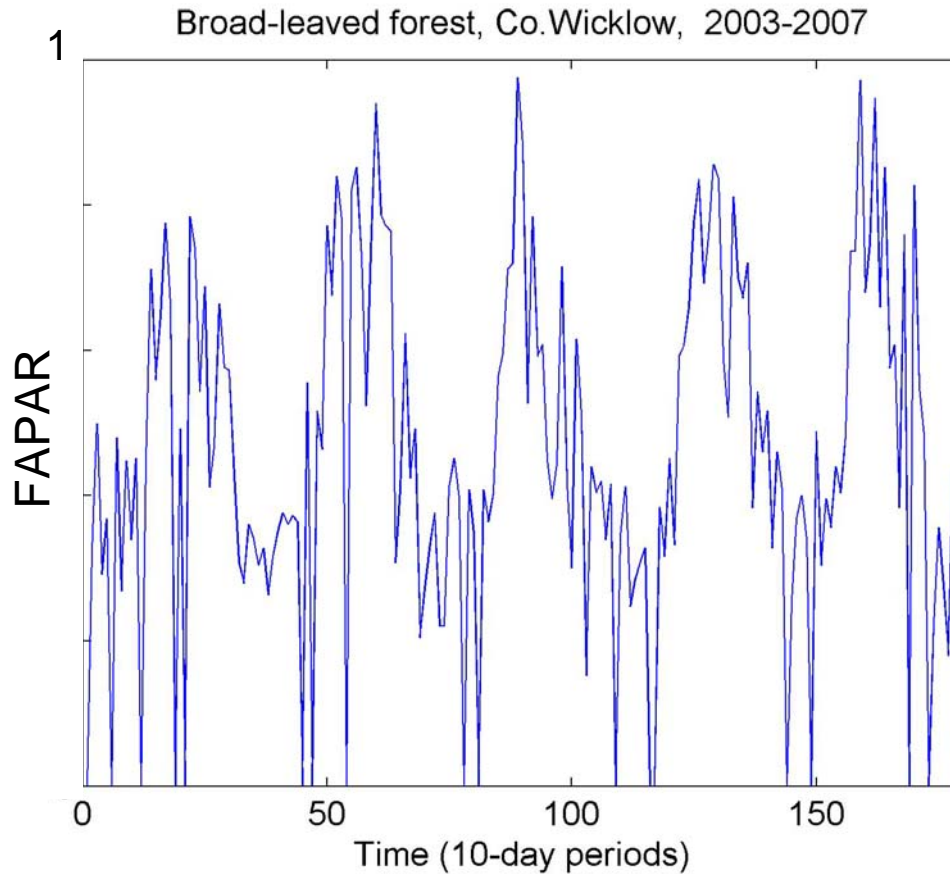
FAPAR value



# Idealised seasonal curve

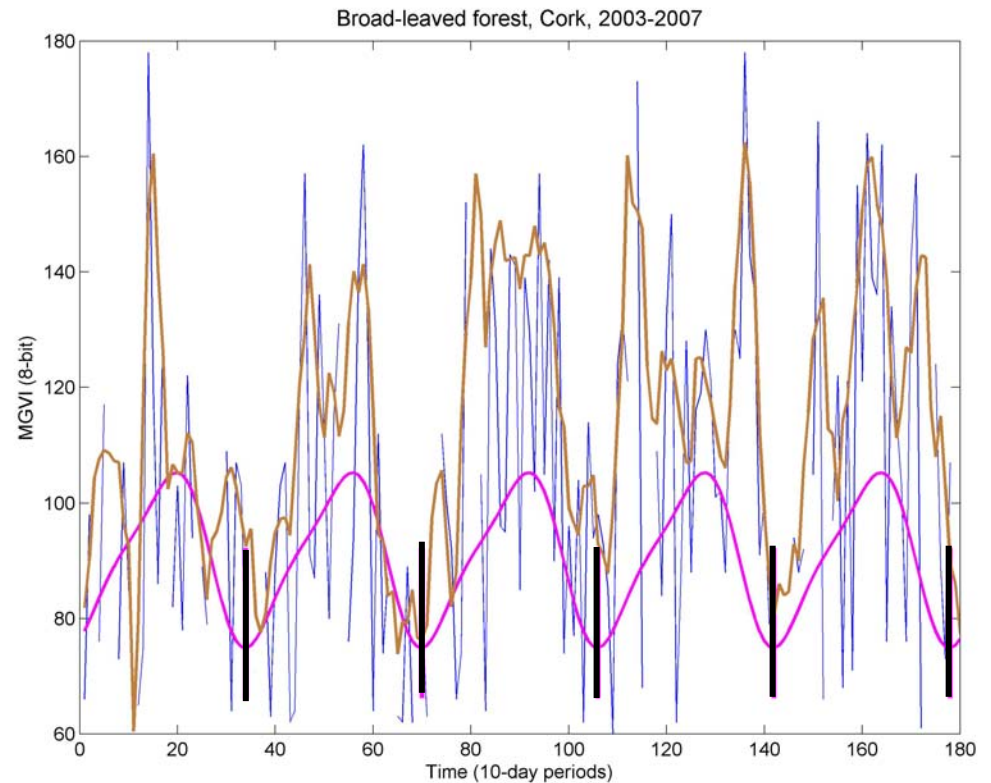


# Real data curve, 2003-2007



# Function fitted to raw data

- Raw data curve
- Idealised curve-  
No. of seasons
- Metrics derived  
from the fitted  
curve



# Current status

- Characterised **cloud distribution** over Ireland
- **MERIS FAPAR** as a new method for monitoring vegetation seasonality in Ireland
- **Partnership** with Irish Climate Change Impacts on Phenology (CCIP) project

# Acknowledgements

- Environmental Protection Agency, Ireland (EPA)
- ESA-ESRIN facility: Grid Processing on Demand (G-POD)
- Climate Change Impacts on Phenology (CCIP project), Trinity College Dublin
- Joint Research Centre (JRC), European Commission
- Eklundh, L. and Jönsson, P., Lund University, Sweden for TIMESAT

[brian.oconnor@ucc.ie](mailto:brian.oconnor@ucc.ie)