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# Scenario Characterisation within a Multi-Factorial Study of Climate Change Impacts on Whole-Farm Systems

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**British-Italian project 2003**

**"A multi-factorial analysis of the impact of climate change on  
marginal agriculture systems"**



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# Rationale

- ✓ Holistic studies of climate change (CC) impacts on whole farm systems require a range of assessment metrics to characterise the change scenarios
- ✓ Characterisation of the change scenarios is required to enable results from an overall holistic study to be put into context
- ✓ This will aid interpretation of output, which will then permit potential adaptation and amelioration strategies to be identified and developed

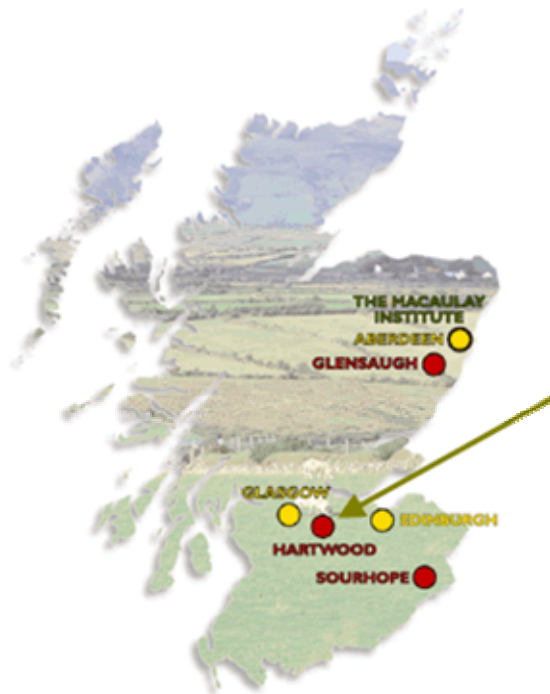
# Objective

- ✓ To detail the use of several metrics, as the first part of a comprehensive holistic study...
- ✓ ... to investigate and quantify the additional risk that climate change may have on the financial, social and environmental viability of two different farming systems

# Site 1

## Hartwood Research Station:

Hartwood, Lanarkshire, Scotland, United Kingdom;  
lat.: 55.80 North, long.: -3.85 East, elev.: 150-300 m  
a.s.l.; area: 350 ha

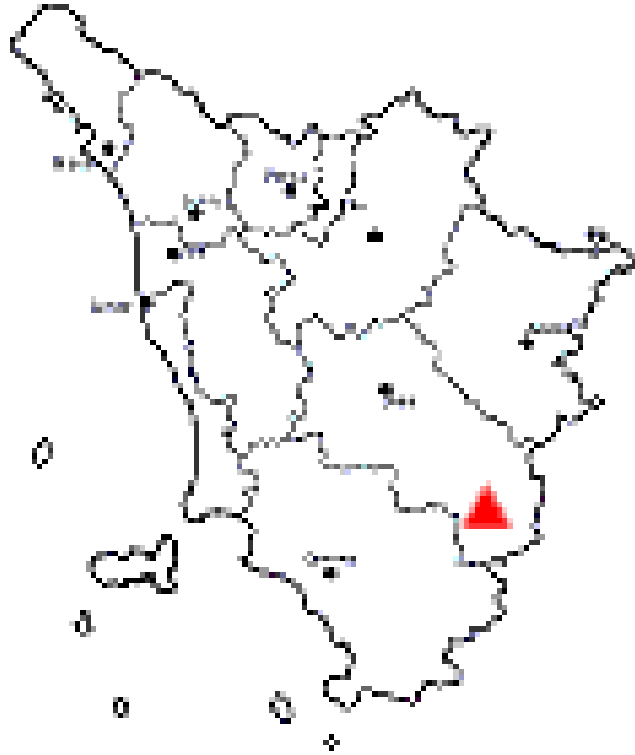


- cold wet winters and cool moist summers
- combined sheep and suckler cow grazing system

## Site 2

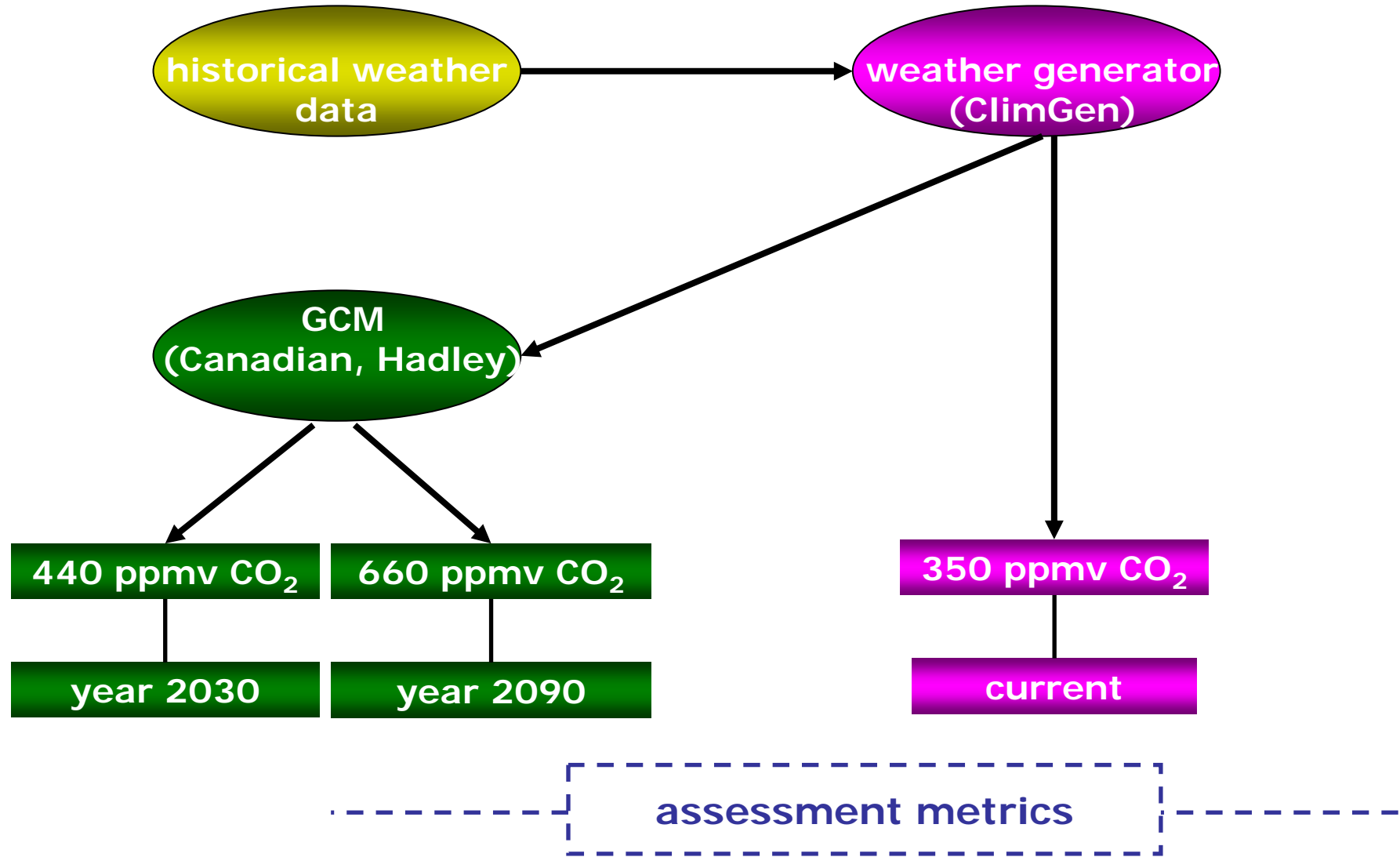
### **Agrichiana Farming:**

Montepulciano, Siena, Tuscany, Italy; lat.: 43.08  
North, long.: 11.78 East, elev.: 250 m a.s.l.; area:  
300 ha



- cool moist winters and warm dry summers
- integrated cropping and indoor reared beef system

# Methodology



# Climate Metrics

## Basic weather variables

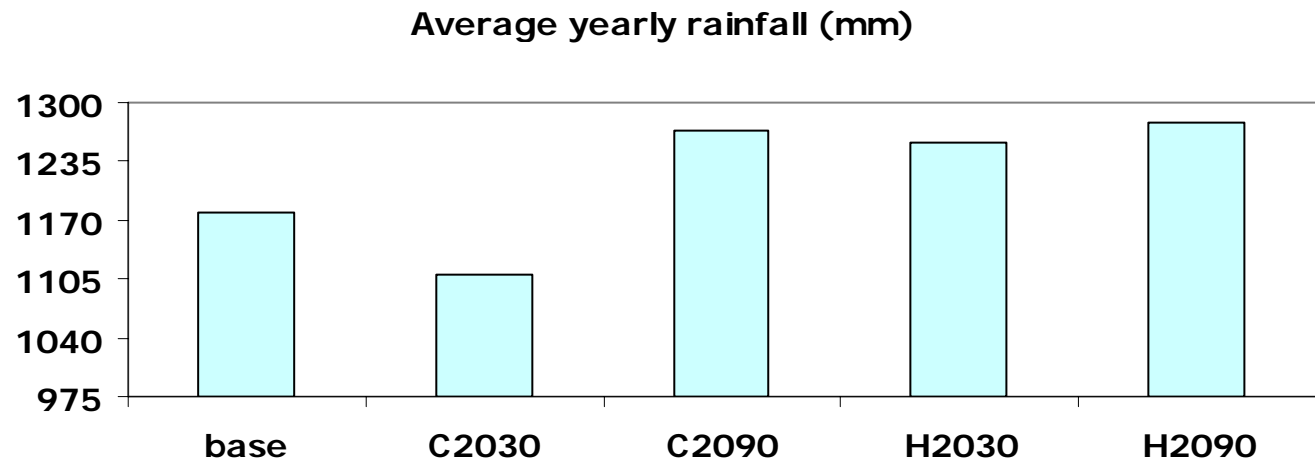
- ✓ rainfall (mm)
- ✓ air temperature ( $^{\circ}\text{C}$ )
- ✓ evapotranspiration ( $\text{mm d}^{-1}$ )

## Derived weather variables

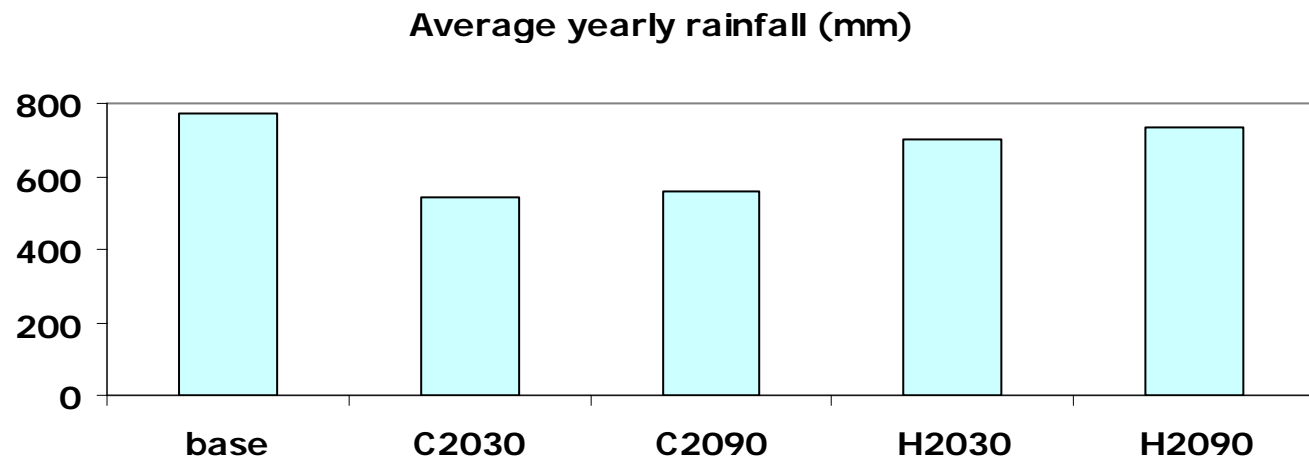
- ✓ access period (days)
- ✓ maximum summer soil moisture deficit (mm)
- ✓ air-dried soil (days)
- ✓ return to field capacity (date)
- ✓ ending field capacity (date)
- ✓ excess winter rainfall (mm)
- ✓ accumulated temperatures above  $0^{\circ}\text{C}$  for January to June ( $^{\circ}\text{C-d}$ )
- ✓ last spring air frost (date)
- ✓ mean air temperature above  $5^{\circ}\text{C}$  (number of months)

# Rainfall

## Hartwood



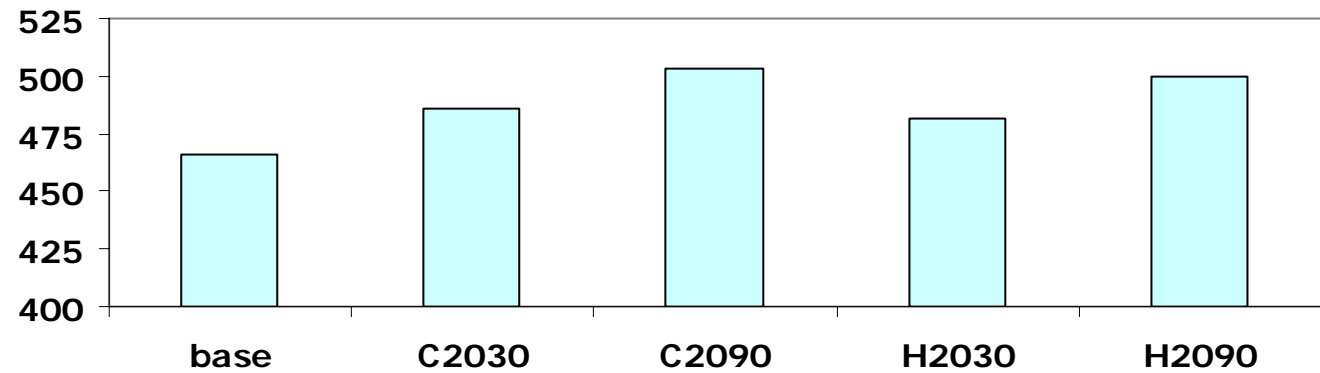
## Montepulciano



# Evapotranspiration

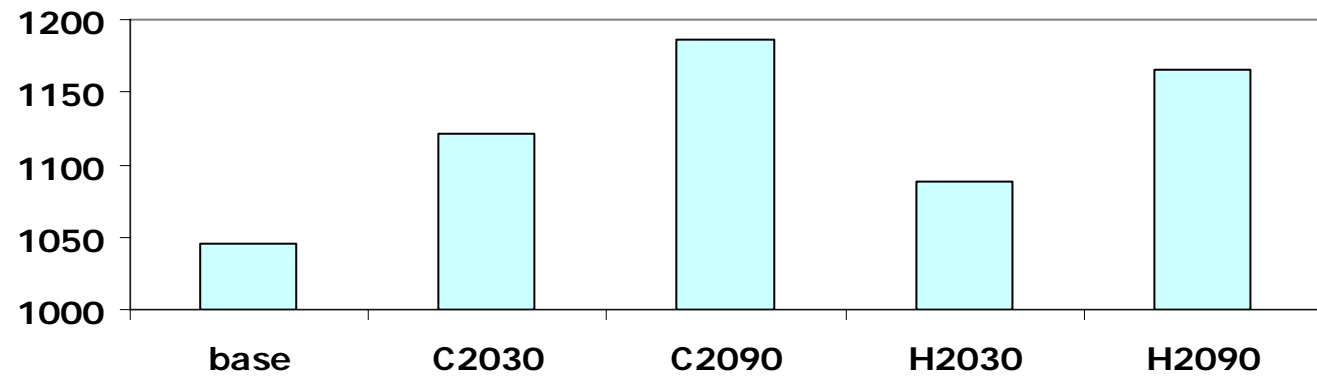
Average Priestley-Taylor  $ET_0$  (mm)

Hartwood



Average Priestley-Taylor  $ET_0$  (mm)

Montepulciano



# Summer Water Deficit

| <b>current</b>  | <b>C2030</b> | <b>C2090</b> | <b>H2030</b> | <b>H2090</b> |
|---|--------------|--------------|--------------|--------------|
| <b>Hartwood (Max Soil Moisture Deficit, mm, median)</b> |              |              |              |              |
| <b>85</b>   | <b>48</b>    | <b>60</b>    | <b>82</b>    | <b>76</b>    |
| <b>Montepulciano (Air-Dried Soil, days)</b>             |              |              |              |              |
| <b>73</b>   | <b>105</b>   | <b>110</b>   | <b>83</b>    | <b>86</b>    |

# Access Period

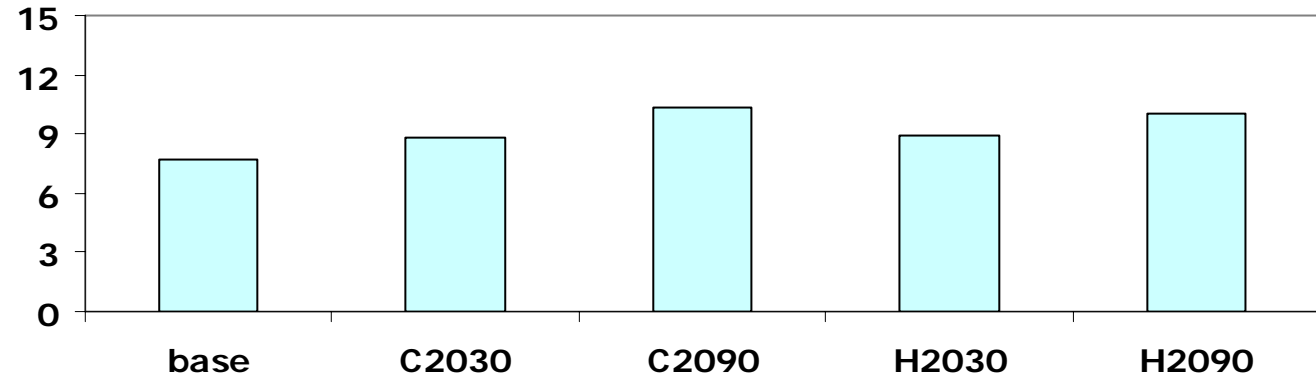
(median number of days)

| <b>current</b> | <b>C2030</b>         | <b>C2090</b> | <b>H2030</b> | <b>H2090</b> |
|----------------|----------------------|--------------|--------------|--------------|
|                | <b>Hartwood</b>      |              |              |              |
| <b>185</b>     | <b>188</b>           | <b>193</b>   | <b>185</b>   | <b>188</b>   |
|                | <b>Montepulciano</b> |              |              |              |
| <b>318</b>     | <b>346</b>           | <b>365</b>   | <b>332</b>   | <b>326</b>   |

# Air Temperature

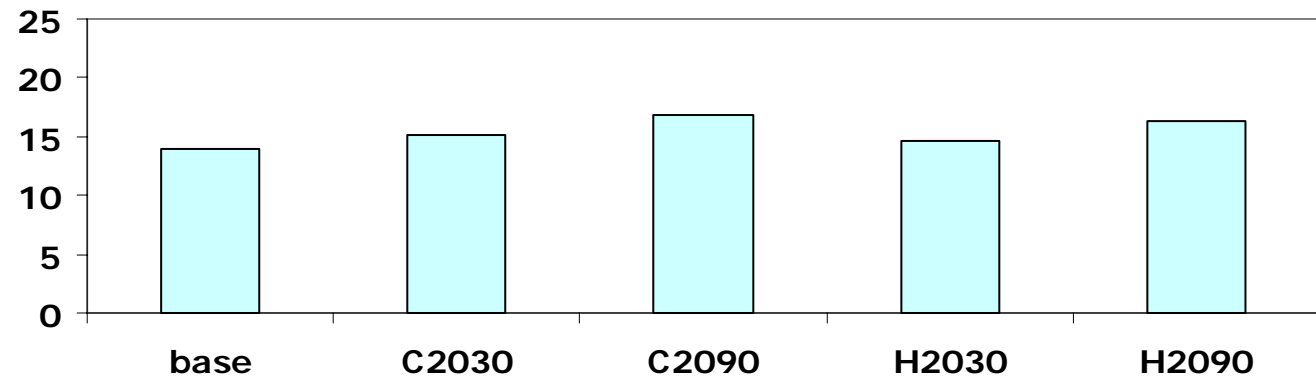
Average air temperature (°C)

Hartwood



Average yearlr air temperature (°C)

Montepulciano



# Late Spring Air Frost (median day of year)

| current                     | C2030                       | C2090                       | H2030                       | H2090                       |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| <b>Hartwood</b>             |                             |                             |                             |                             |
| <b>130</b><br>(early May)   | <b>119</b><br>(late April)  | <b>116</b><br>(late April)  | <b>119</b><br>(late April)  | <b>112</b><br>(late April)  |
| <b>Montepulciano</b>        |                             |                             |                             |                             |
| <b>30</b><br>(late January) | <b>0</b><br>(early January) | <b>0</b><br>(early January) | <b>3</b><br>(early January) | <b>0</b><br>(early January) |

# Accumulated temperatures above 0 °C January-June (°C-days, median)

| <b>current</b> | <b>C2030</b>         | <b>C2090</b> | <b>H2030</b> | <b>H2090</b> |
|----------------|----------------------|--------------|--------------|--------------|
|                | <b>Hartwood</b>      |              |              |              |
| <b>1149</b>    | <b>1197</b>          | <b>1503</b>  | <b>1350</b>  | <b>1519</b>  |
|                | <b>Montepulciano</b> |              |              |              |
| <b>2143</b>    | <b>2318</b>          | <b>2632</b>  | <b>2289</b>  | <b>2576</b>  |

# Remarks

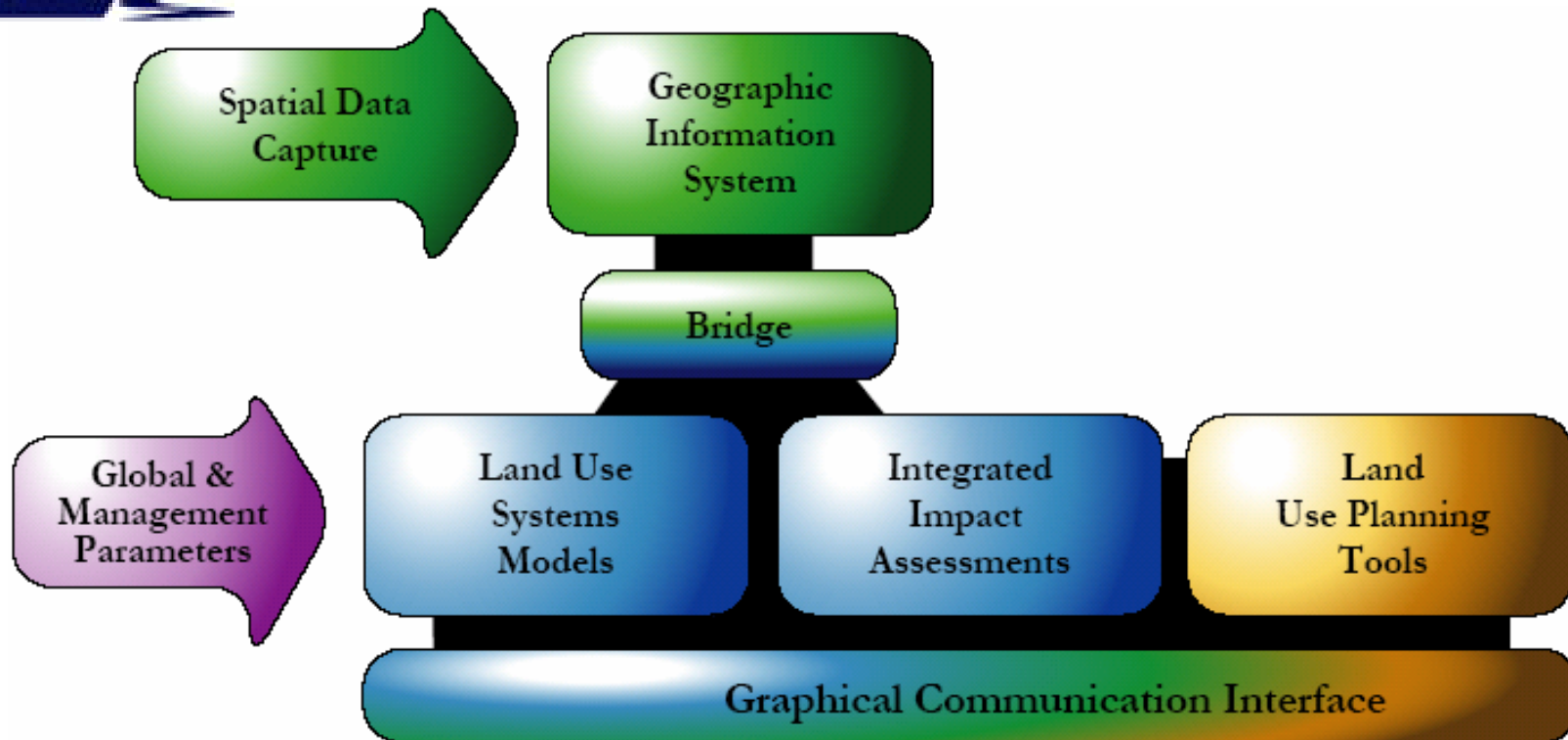
- ✓ The results demonstrate the need to characterise climate change scenarios as part of holistic whole farm impact studies
- ✓ Warmer, wetter conditions in Scotland may favour land use production, whilst in Italy water stress may limit some land uses
- ✓ Access to land at Hartwood appears not to be an issue; there will be an increased irrigation requirement for Montepulciano

# LADSS

These results will be used within a decision support system to identify how CC impacts manifest themselves in the whole-farm system



<http://www.macaulay.ac.uk/ladss/ladss.shtml>





Thank you!