

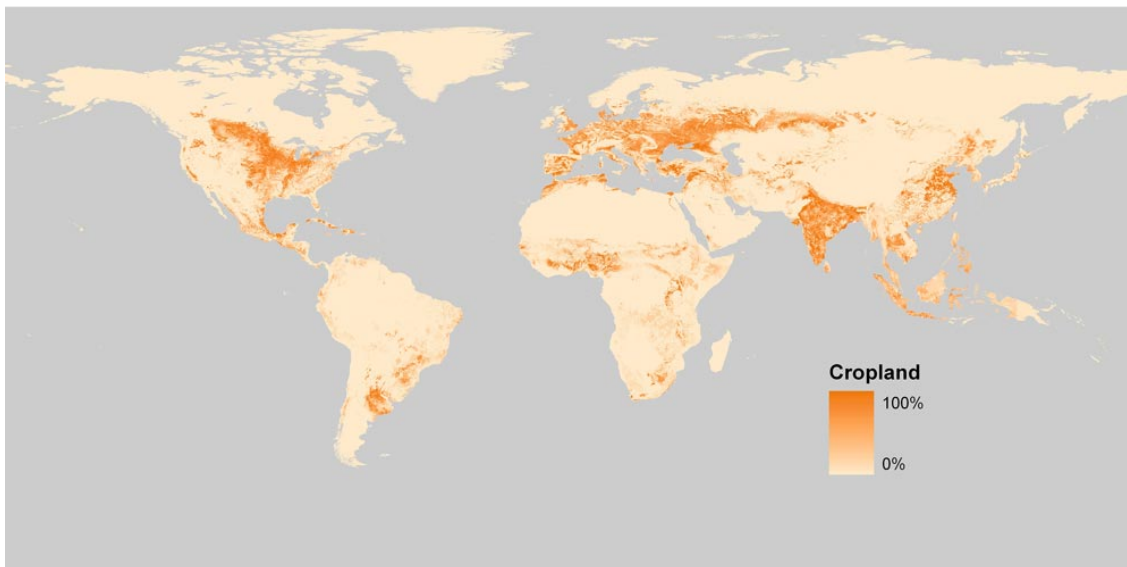
# Crops for JULES

Tim Wheeler and Tom Osborne

Crops and Climate Group

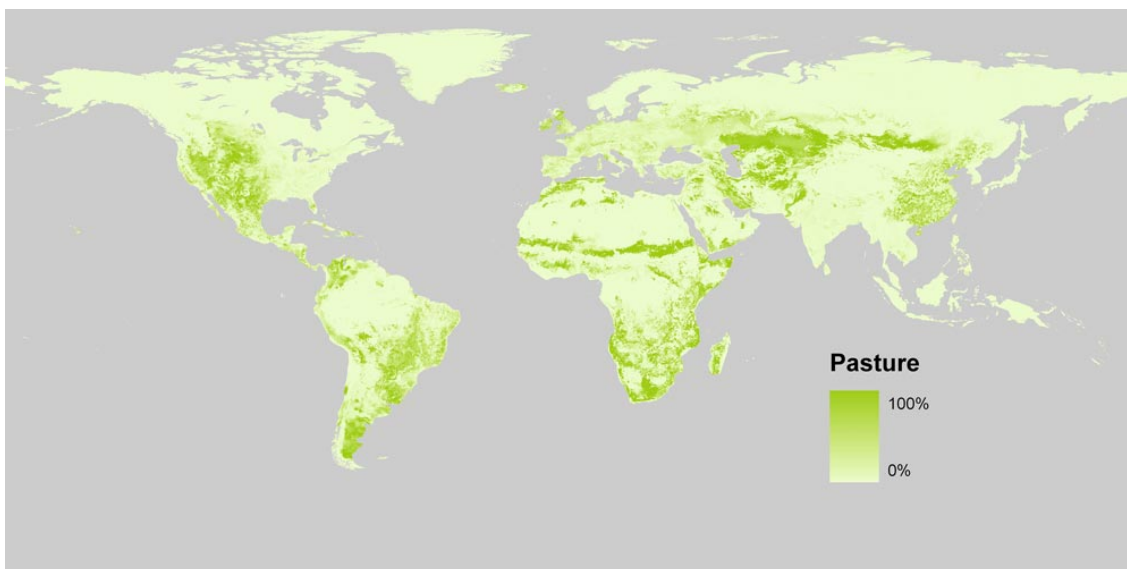
- Why include crops?
- How are crops different?
- Simulating crops in land surface schemes

# Significant global coverage



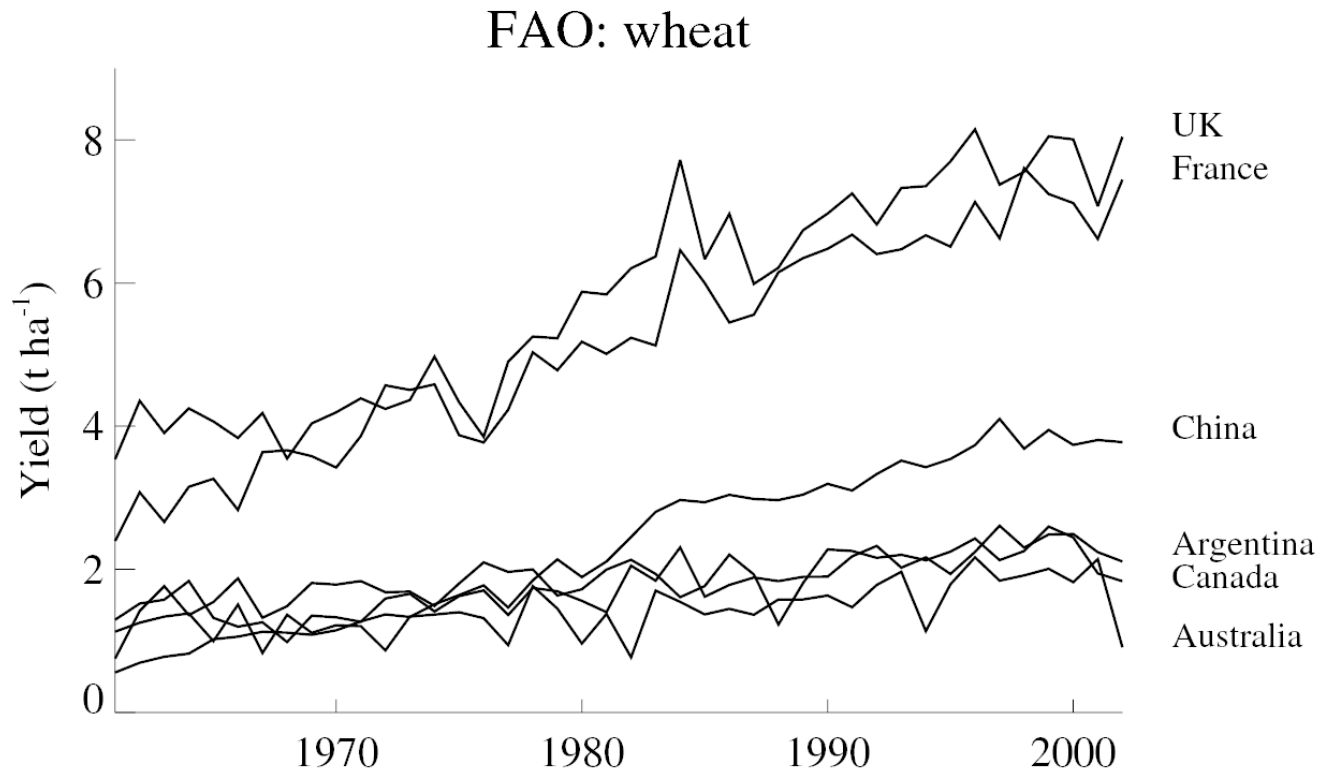
About 40% of the land surface is managed for crops and pasture

(Foley et al. 2005)



Source: SAGE  
[www.sage.wisc.edu/](http://www.sage.wisc.edu/)

# Variability of growth and yield



Spatial variability due to climate, soils and management  
Temporal variability due to technology, management and climate

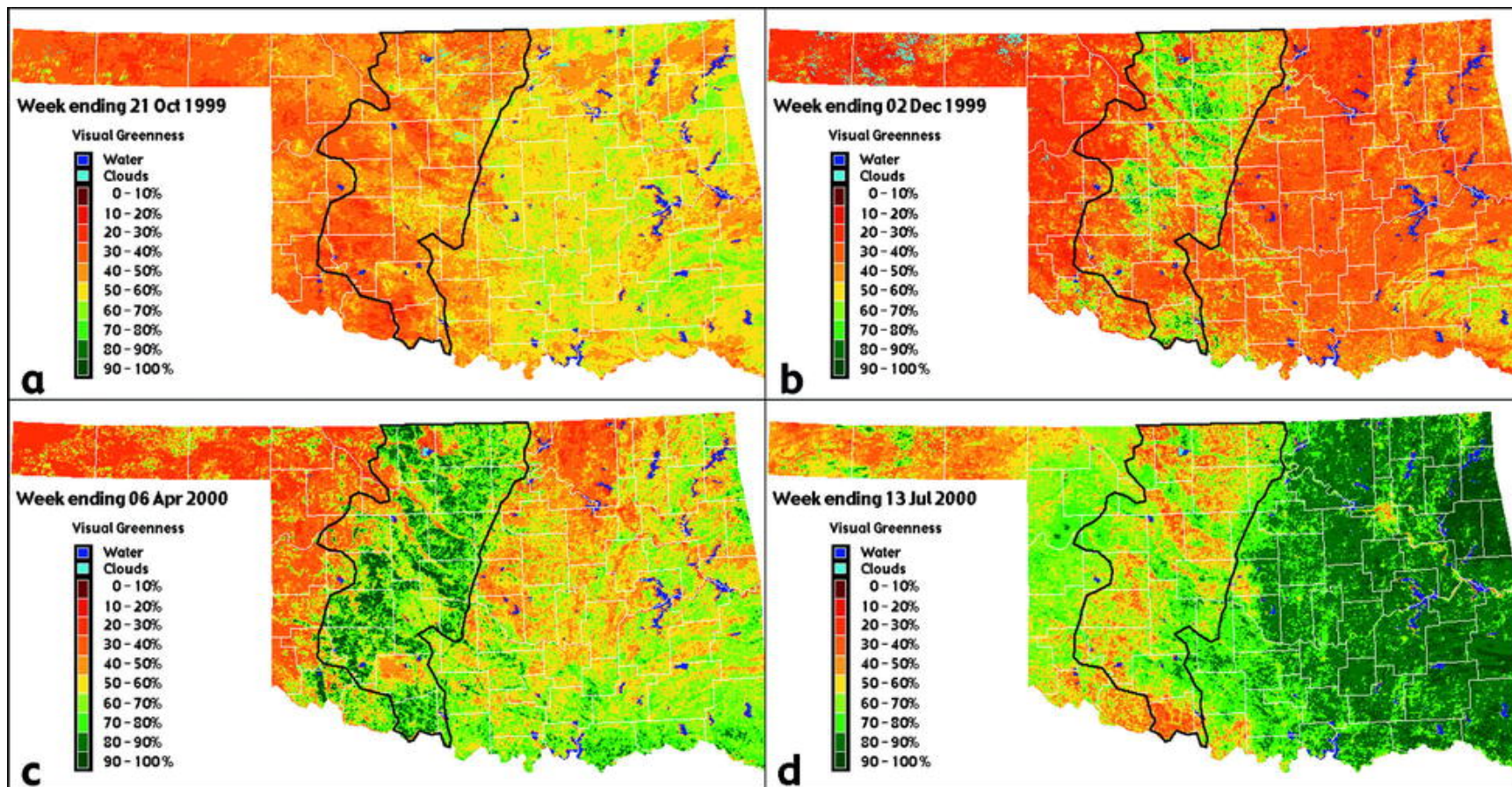
## Actively managed for yield and profit

- Crop variety, fertiliser, irrigation, pest and disease control, timing of growth and harvest

## Selected and bred varieties

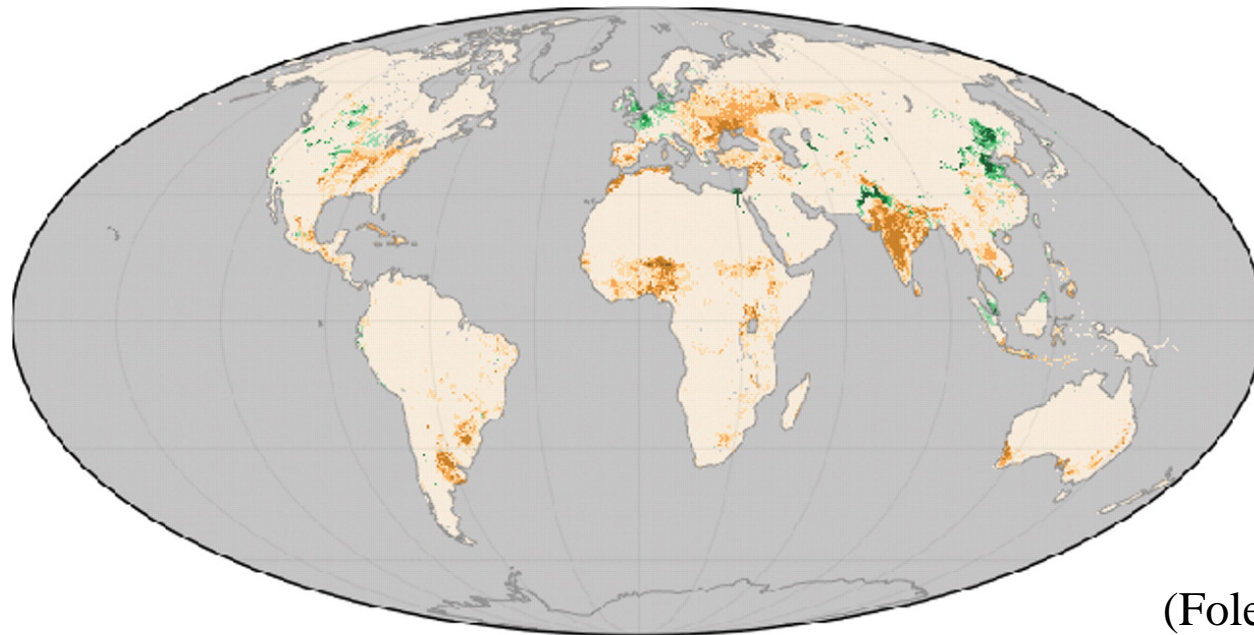
- Partitioning to yield, efficiency of resource use, high rates of growth

# Timing of growth and harvest

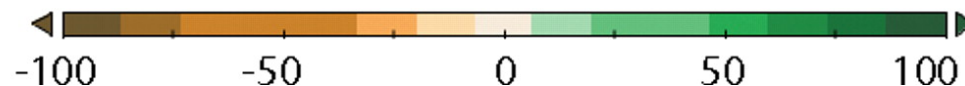


Natural grasslands not a good proxy for wheat in Oklahoma  
(McPherson *et al.* 2004)

## Estimated change (%) in natural NPP from croplands



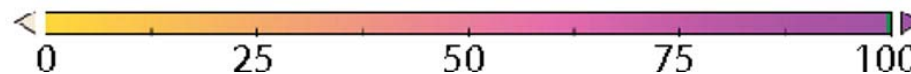
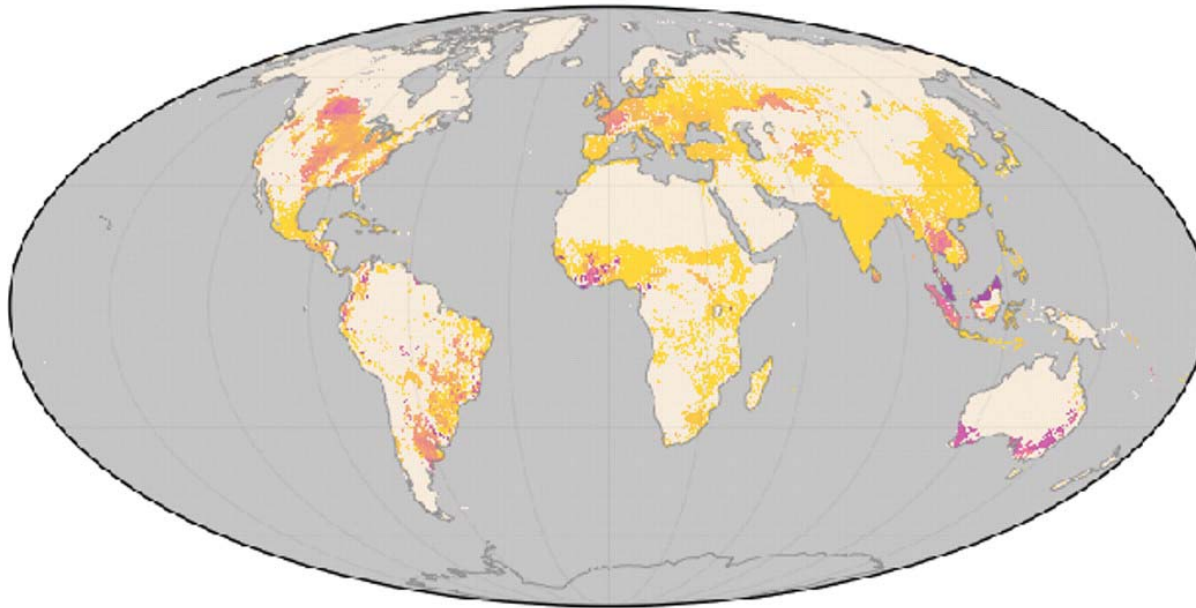
(Foley *et al*, 2007)



Mechanization, irrigation, and fertilization increase cropland productivity above natural rates, while crop NPP in other regions is less than the natural NPP

# Where does crop NPP go?

Estimated fate of managed terrestrial ecosystem production.



(Foley *et al*, 2007)

Allocation (%) of crop NPP bound for international export - the remainder is for domestic consumption

## Maximum attainable yield

yield of experimental/on-farm plots with no physical, biological, and economic constraints and with the best-known management practices at a given time and in a given ecology.

## Farm-level yield

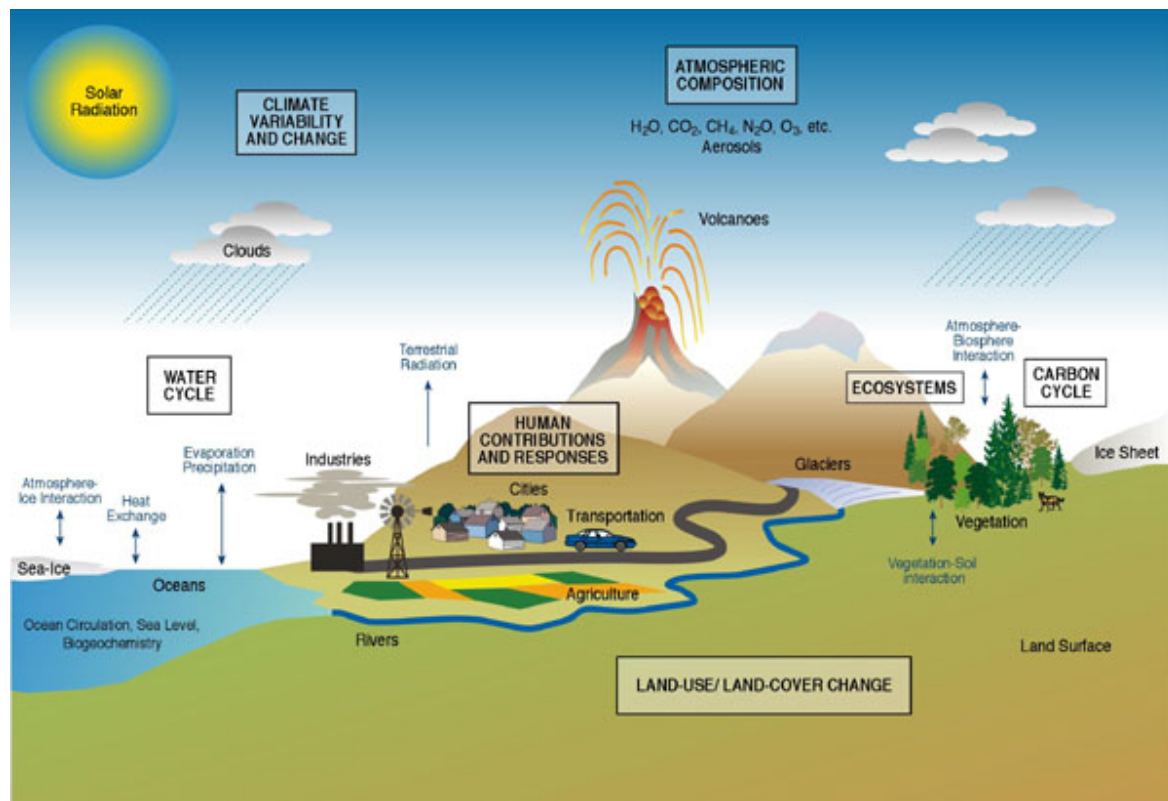
is the average farmers' yield in a given target area at a given time and in a given ecology.

## Why is there this yield gap?

<b>Biophysical</b>	climate/weather, soils, water, pest pressure, weeds
<b>Management</b>	tillage, variety/seed selection, water, nutrients, weeds, pests, and post-harvest management
<b>Socio-economic</b>	socio-economic status, farmer's traditions and knowledge, family size, household income/expenses/investment.
<b>Institutional/policy</b>	government policy, prices, credit, input supply, land tenure, market, research, development, extension.
<b>Technology transfer</b>	competence of extension/ advisory services, uptake of technology

Crops in JULES will allow for the assessment of crop impacts consistent with alterations to:

- water resources
- surface fluxes
- climate (when coupled to HadGEM)



## Different complexity of crop model

FAO empirical

Simple process-based

Complex process-based

## Requirements of a crop representation for JULES

Applicable over large areas

Evaluate against farmer's field yields or research station?

Evaluate against fPAR

Consistent with approaches of JULES

Consistent with approaches of ED?

# What's been done already?

## Wheat and maize in Europe

ORCHIDEE-STICS by Gervios *et al.* 2004

## Crops in US

Agro-IBIS by Kucharik & Brye 2003

## Many crops globally

LPJ-mL model by Bondeau *et al.* 2007

## Annual crops globally

GLAM-MOSES by Osborne *et al.* 2007

For example ...

Many crops globally

LPJ-mL model by Bondeau et al. 2007

11 crop functional types

2 managed grassland types

Fertilisation data

Irrigation data

Sowing date

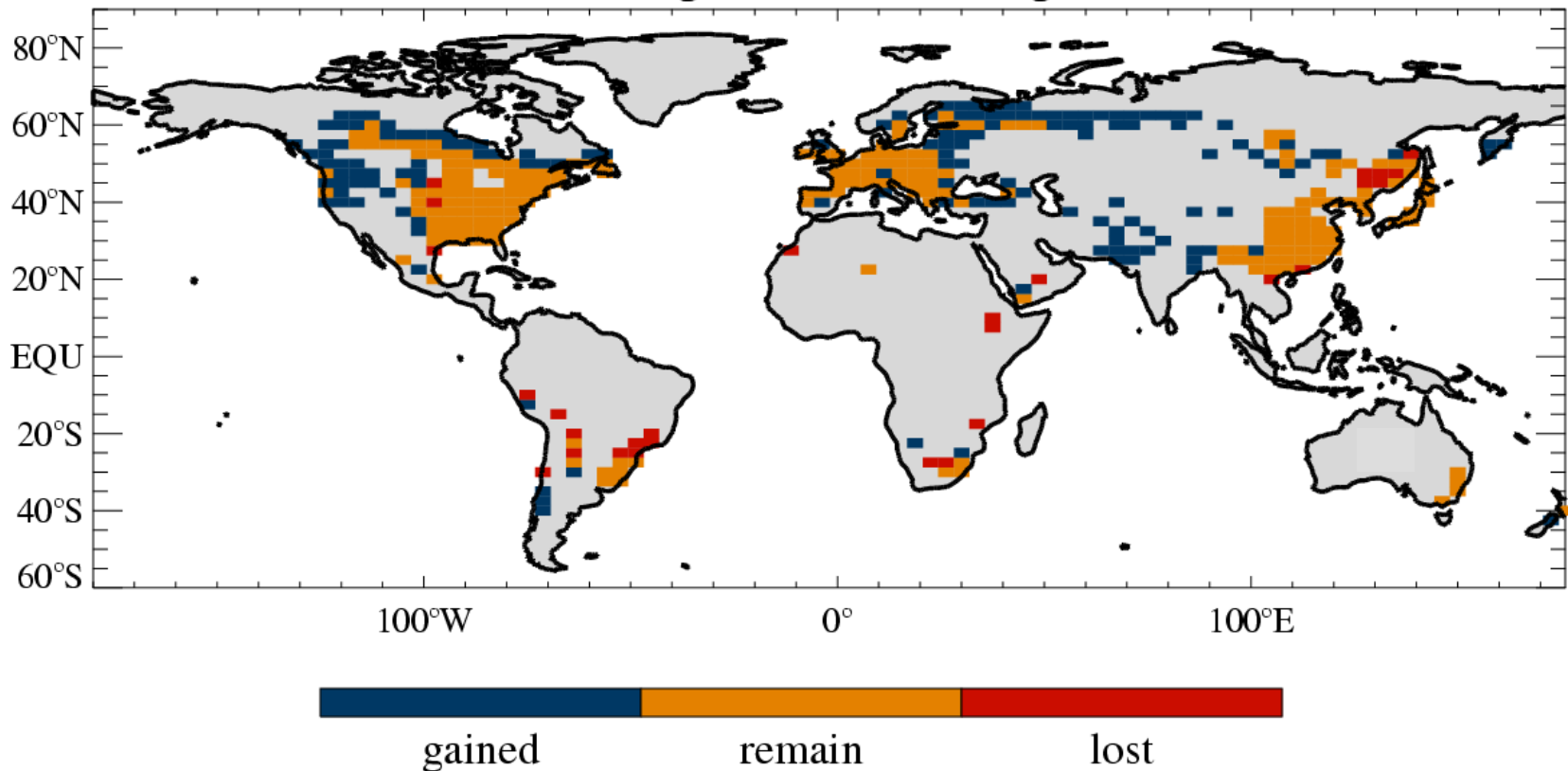
Optimum variety simulation

Crop models used: SWAT, EPIC, SWIM

For example ...

## Annual crops globally GLAM-MOSES by Osborne et al. 2007

Changes in wheat coverage



Doubled CO<sub>2</sub> rainfed run

- Comparison of existing crop modelling approaches for simulation of crops in JULES
- Better evaluation with farm-level yields and resource use
- Improved representation of crop management

# Thank you

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[t.m.osborne@rdg.ac.uk](mailto:t.m.osborne@rdg.ac.uk)