Crops for JULES

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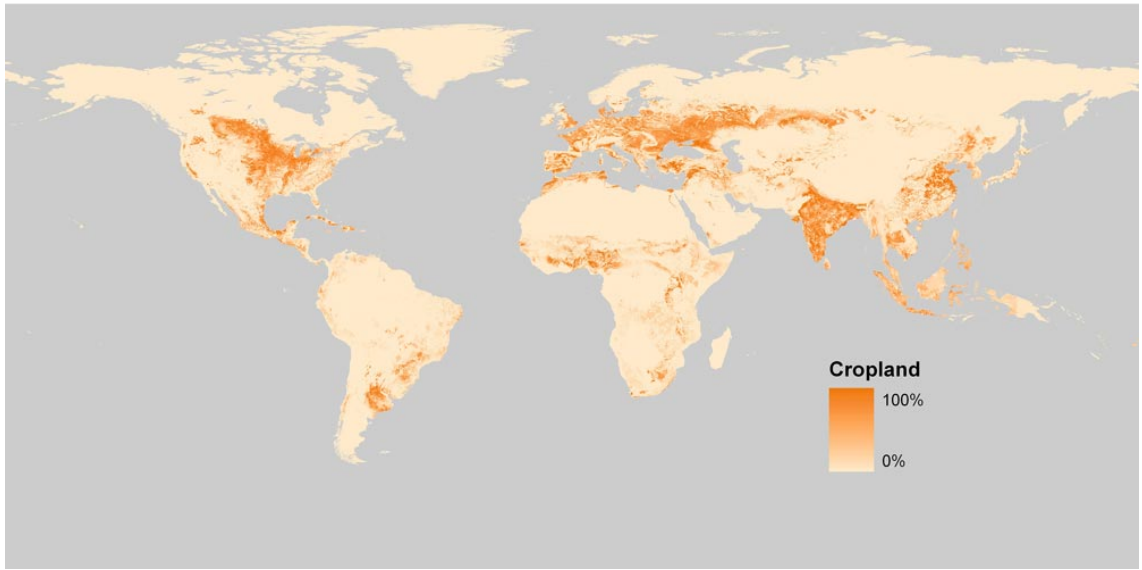
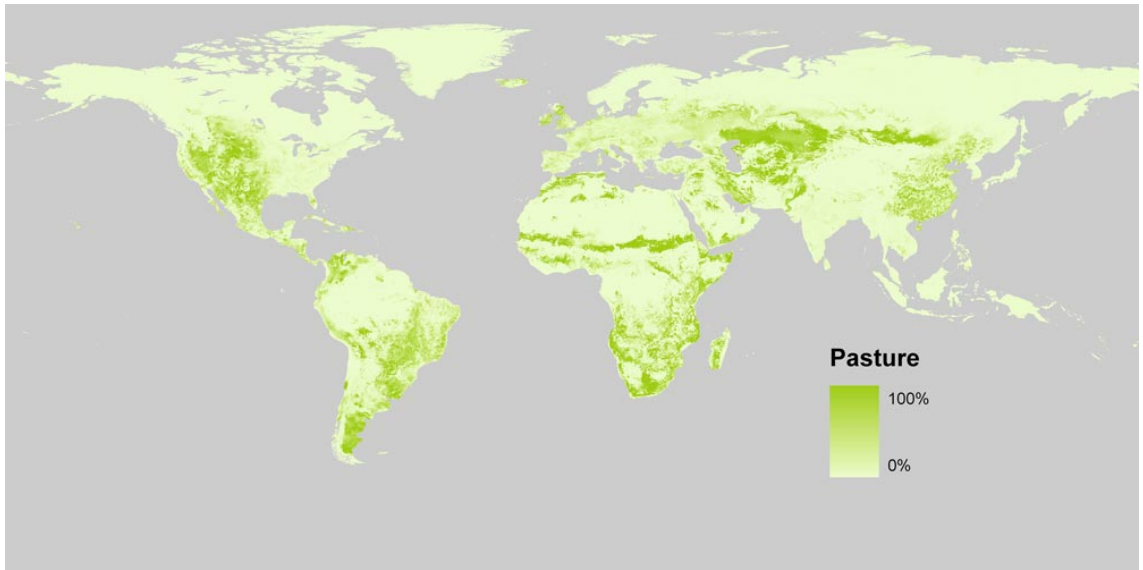
Outline

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

Significant global coverage



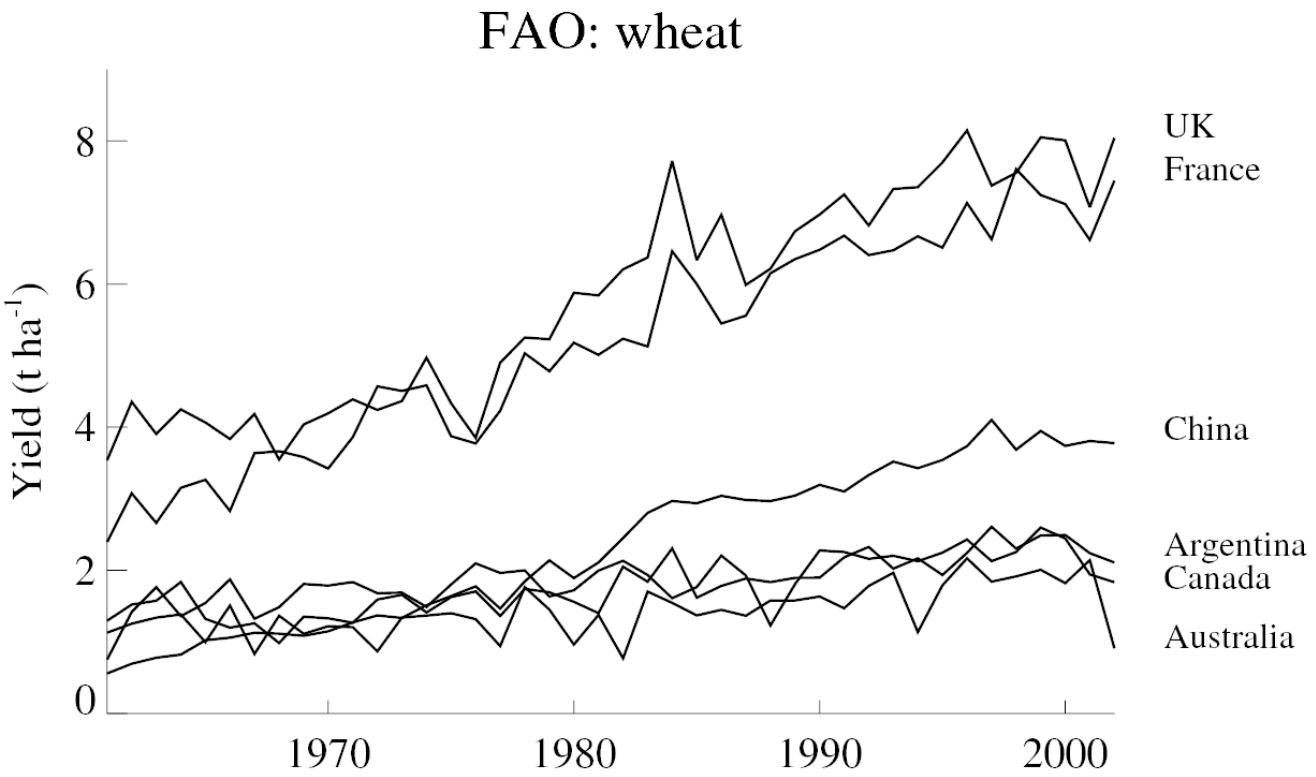


About 40% of the land surface is managed for crops and pasture

(Foley et al. 2005)

Source: SAGE
www.sage.wisc.edu/

Variability of growth and yield



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

How are crops different?

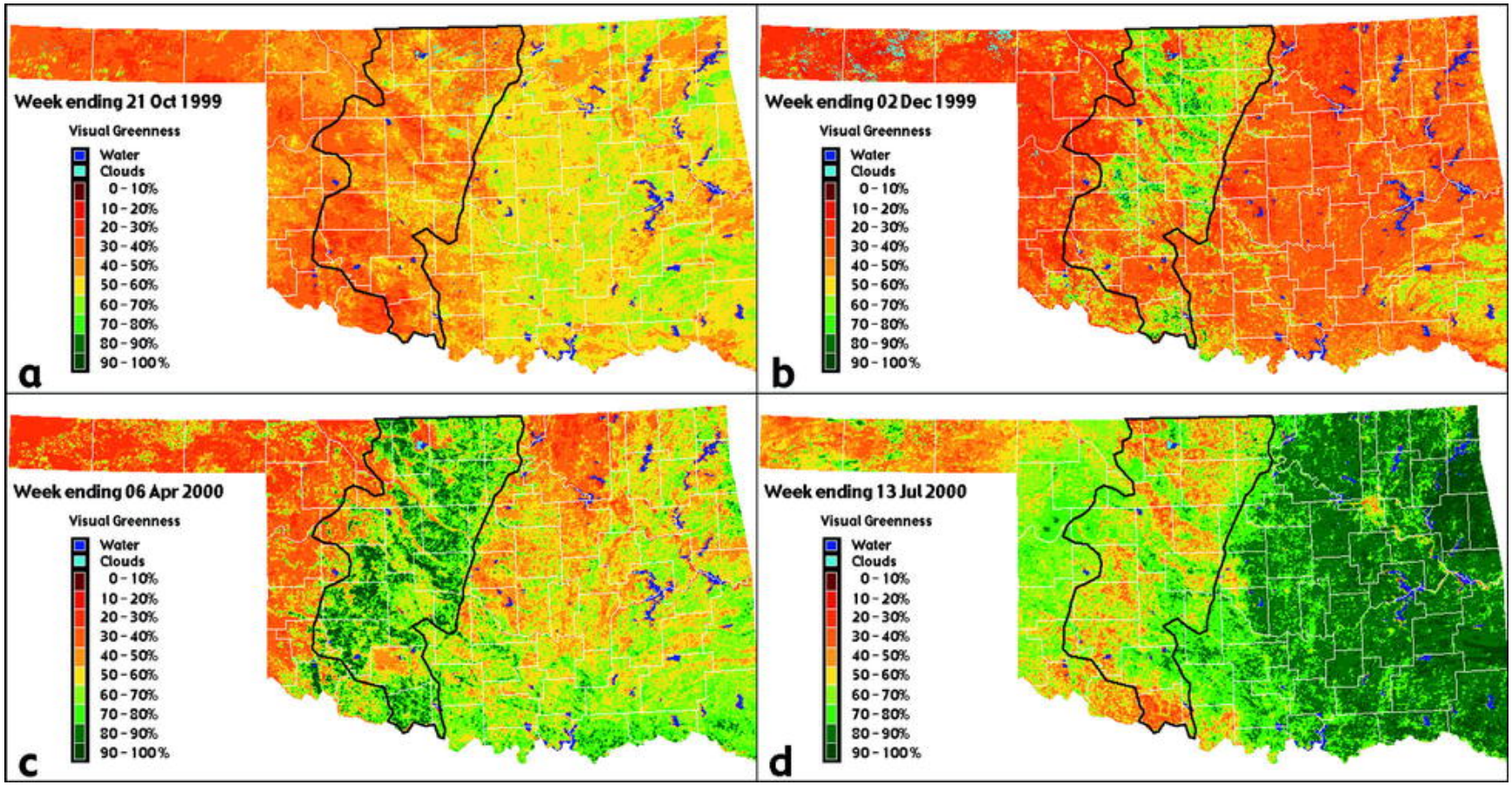
Actively managed for yield and profit

- 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

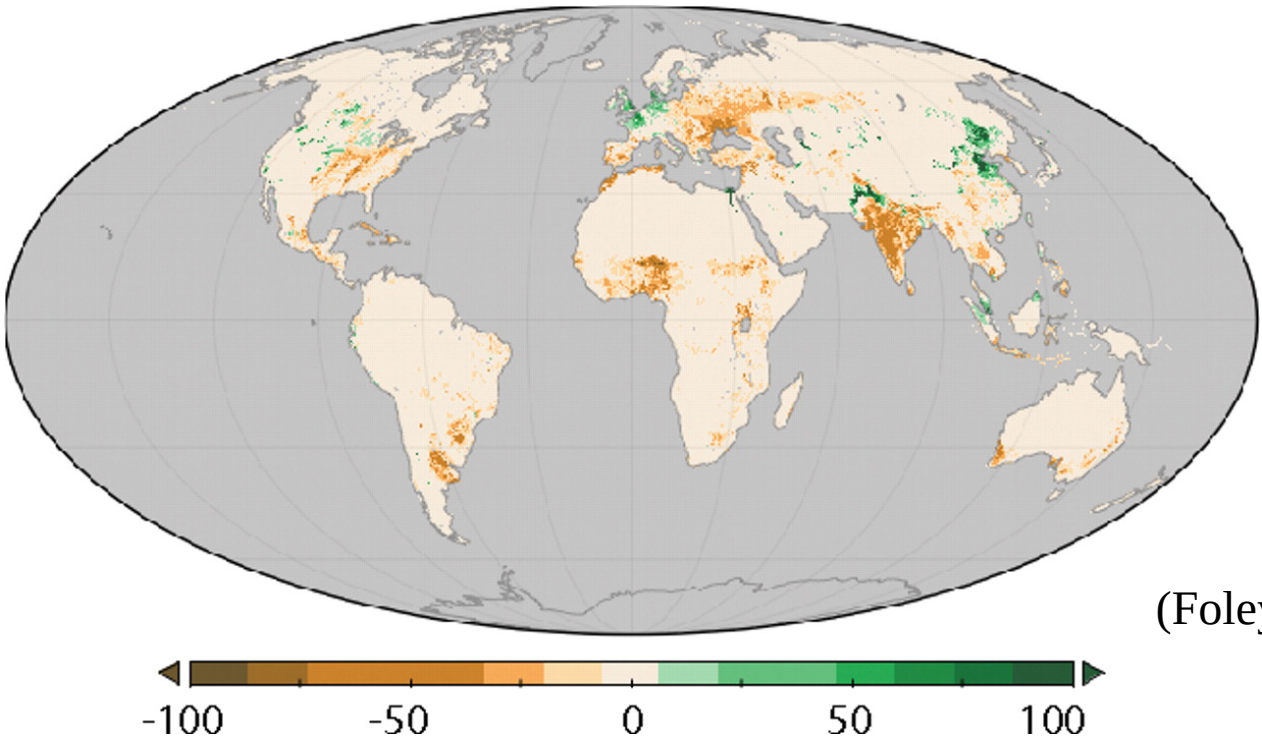
Timing of growth and harvest



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

Can we use NPP?

Estimated change (%) in natural NPP from croplands

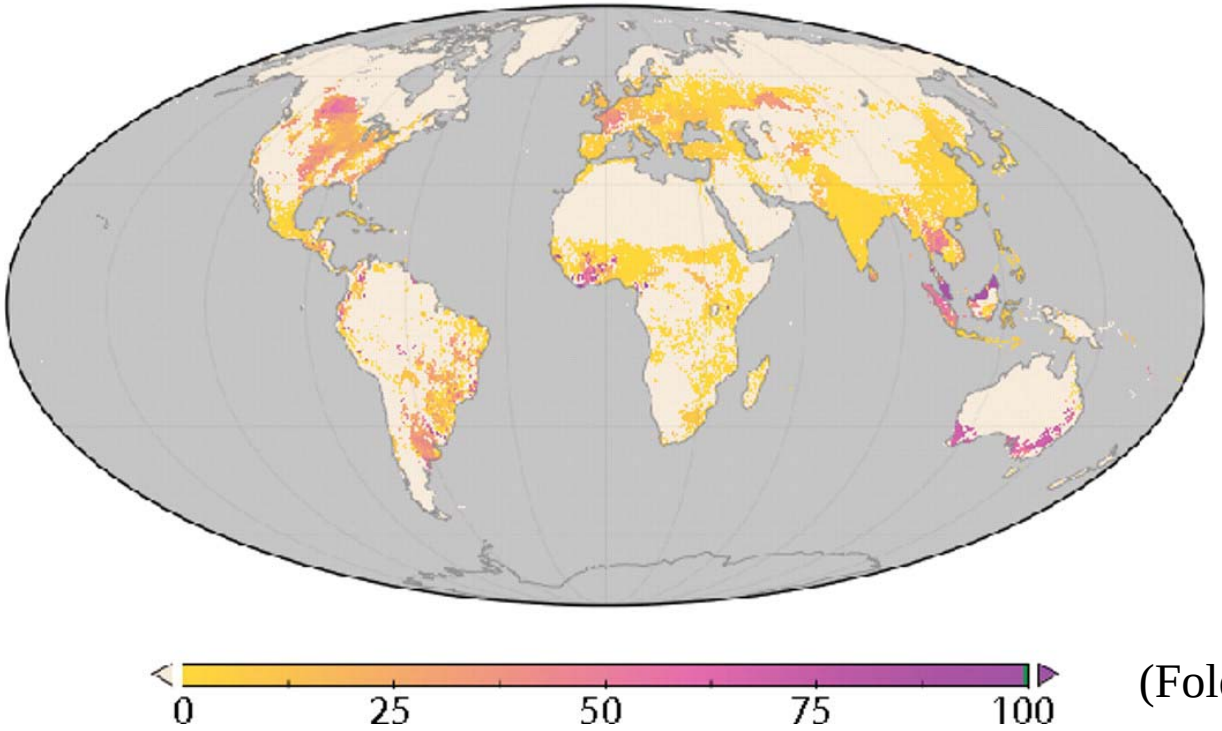


(Foley *et al*, 2007)

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

Yield

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.

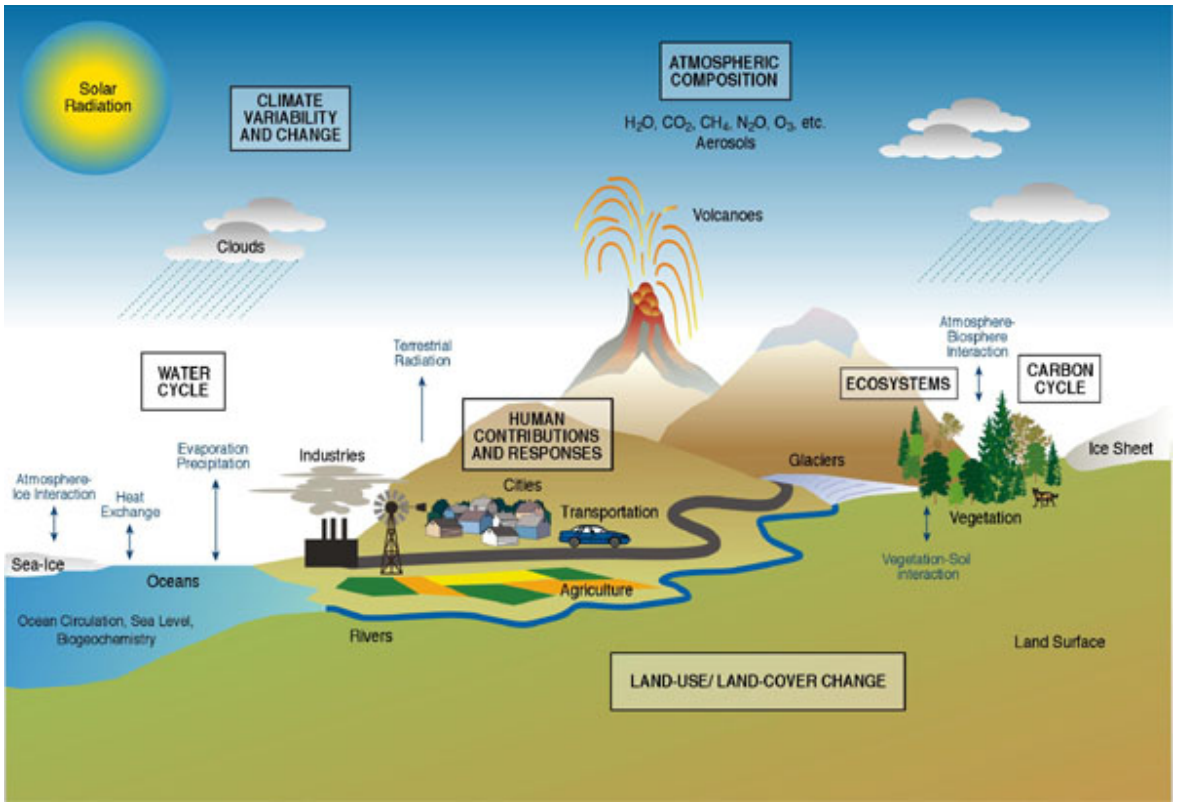
Why is there this yield gap?

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

Coupled impacts

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

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



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Simulating crops in land surface schemes

Walker INSTITUTE

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?

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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 …

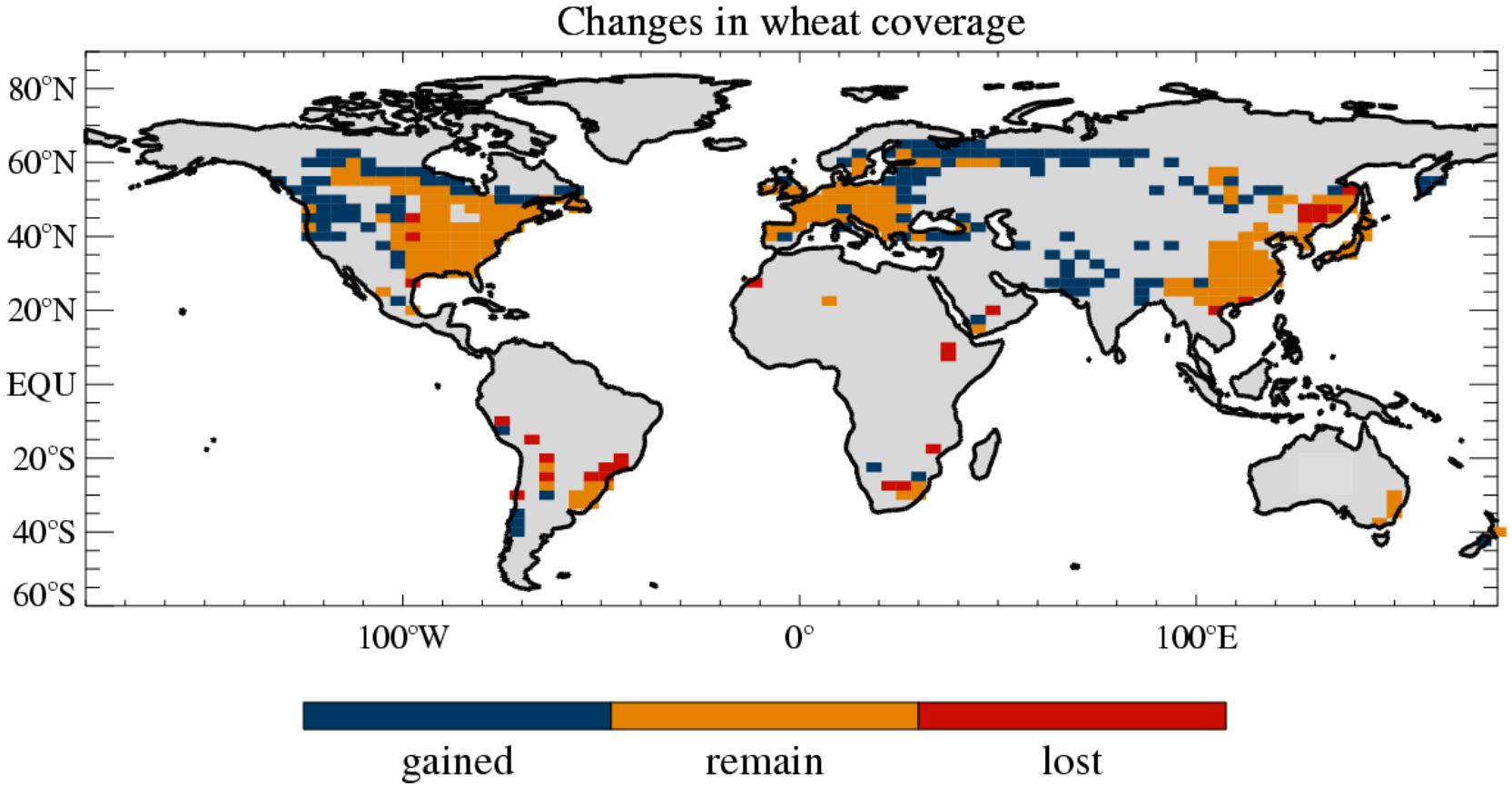
Many crops globally

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



Doubled CO_2 rainfed run

Research needs

- 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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