



Met Office  
Hadley Centre

# Implementation of land cover changes..

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# CarboEurope-IP

[www.carboeurope.org/](http://www.carboeurope.org/)

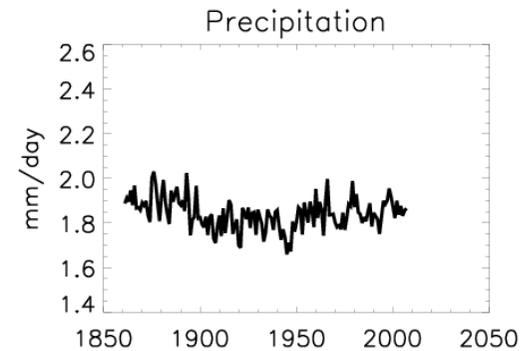
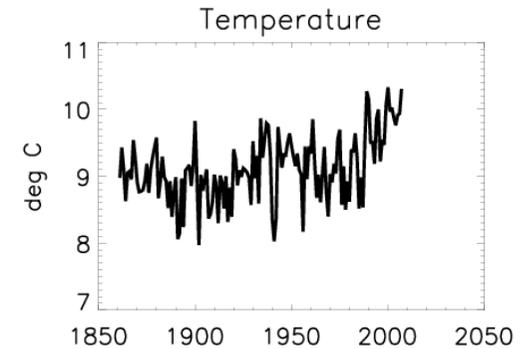
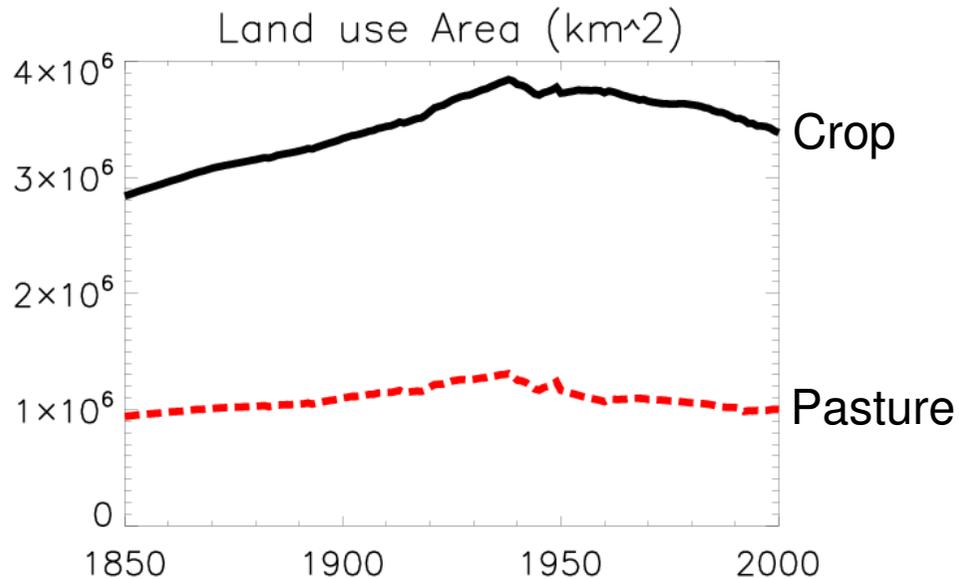


- Inter-comparison of simulations of European carbon balance.
- 9 different land surface models (including LPJ and ORCHIDEE)
  1. site level simulations
  2. climate and CO<sub>2</sub> effects
  3. climate, CO<sub>2</sub>, and land use.

# CarboEurope-IP

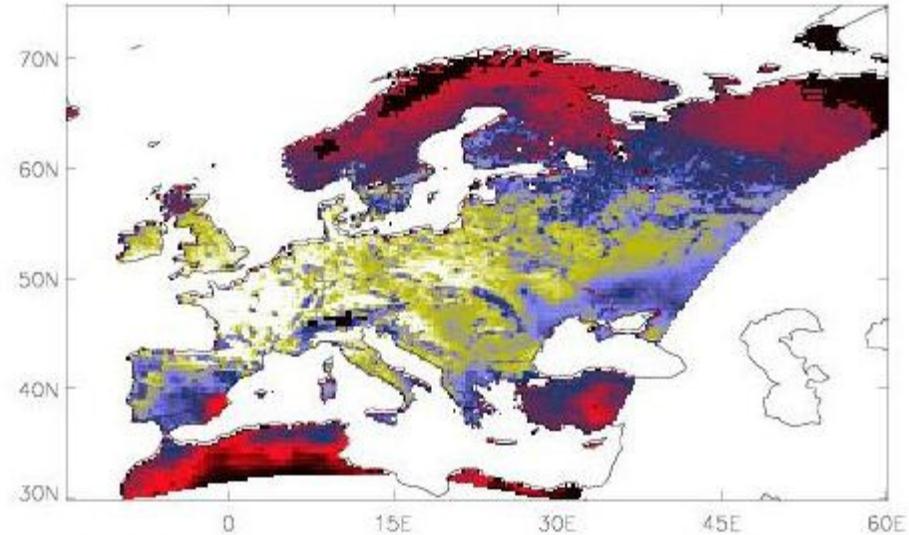


- Common meteorology data
- Common land use data
- Common modelling protocol



Meteorology prior to 1861  
Is 1900-1930 repeated.

# Stage 3 simulations



Using the standard release of JULES 2.0  
as starting point.

This is also an ideal test case for  
developing a basic representation of  
land use change for inclusion in  
HadGEM2-ES GCM (but places  
constraints on development).



# Constraints

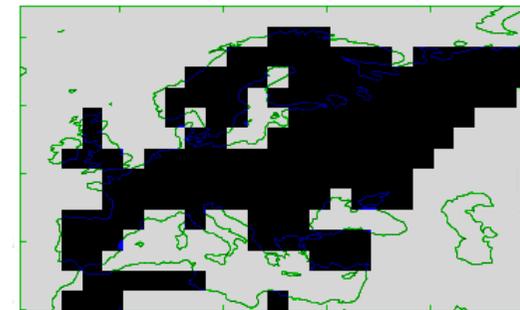
However the dual goal placed constraints on what we could do.

The deadlines of CarboEurope meant that we couldn't do anything too complex or rather wait for other groups to finish development of better models. But also its use in HadGEM2-ES meant :

- No extra PFTs
- Also, in GCM only interested in large scale feedbacks – assume can do this without complicated (or computationally expensive) modelling

# European Simulations

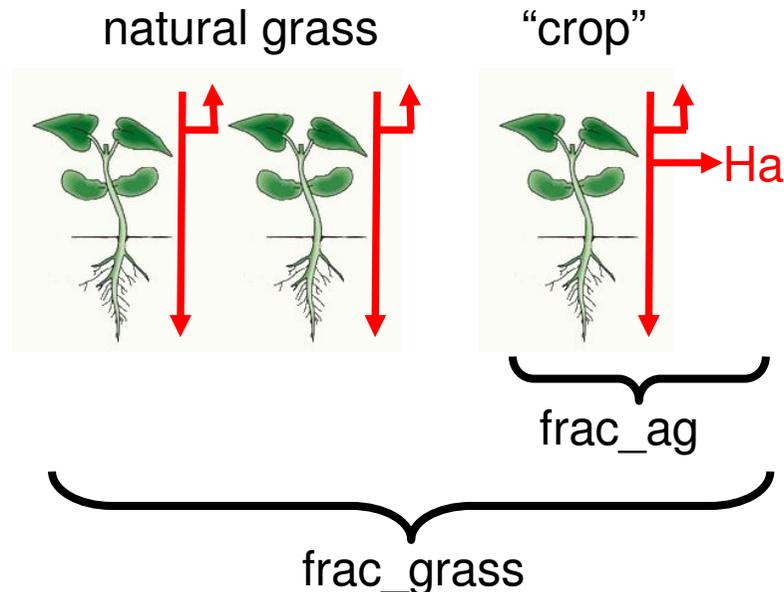
- All forcings (1/4°)
- CLIM,CO<sub>2</sub>,LU (1°)
- 30-ensemble, All, (3°)  
c-cycle uncertainty



# Implementing harvesting

$Ha$  is proportional to  $\text{frac\_ag}$ , above ground carbon ratio and NPP.

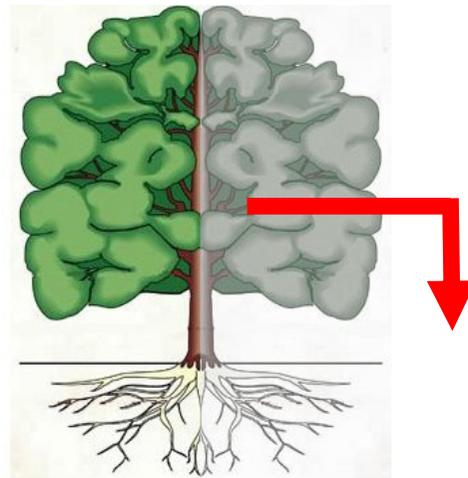
$Ha$  is saved out as a new output diagnostic for offline processing (pool allocation or spatial redistribution).



# Forest clearance

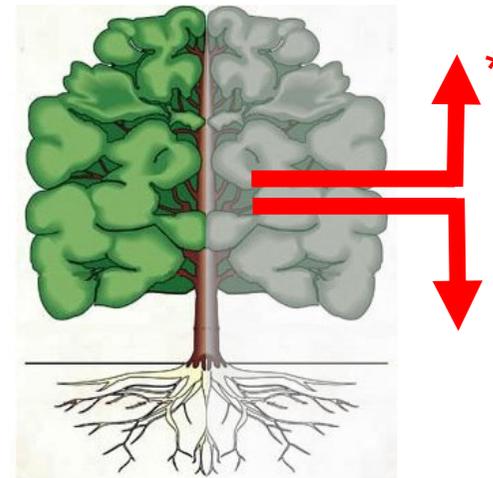
- Correct accounting for when land use expands into regions of previously forested – redirection of above ground and below ground carbon.

Standard scheme



Reduced  
frac cover

Updated scheme



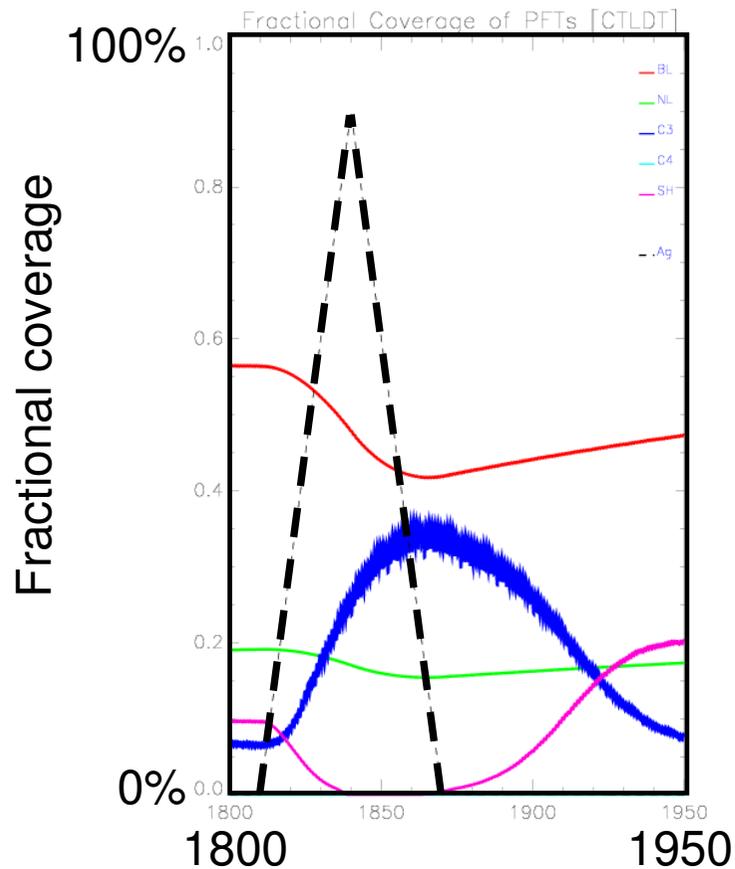
\* When due to  
land use expansion



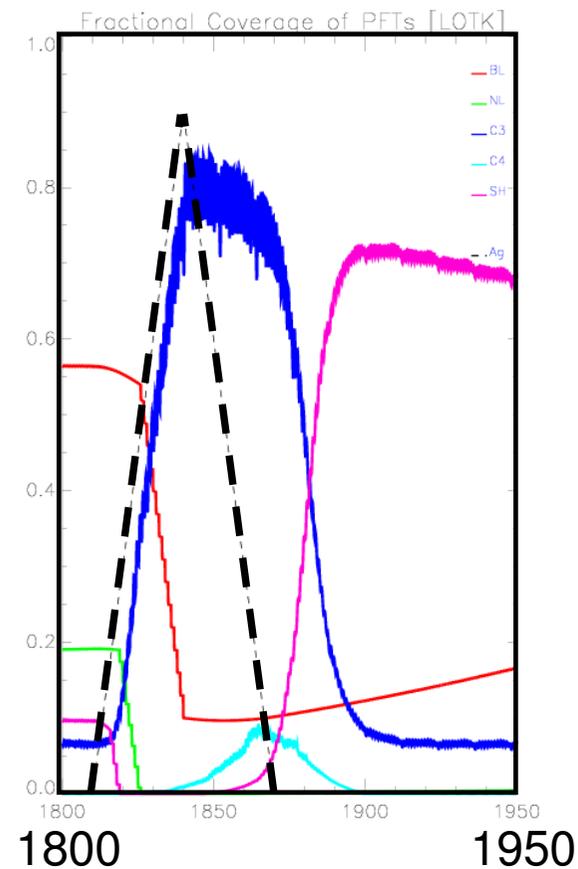
# Dynamic *frac\_ag*

Single point JULES run (equilibrium = forest),  
simple 0-90%-0 forcing, 150 years.

Original response



Corrected response





# Time templating implemented

## Standard INIT\_AGRIC

```
#####  
## Agricultural fraction.  
>INIT_AGRIC  
  
F, 'asc'                ! readFile, fileFo  
'input/agr.dat'        ! fileName  
0, 0                    ! rheaderFile, rhea  
1, 'frac_agr'          ! fieldNum, varNam  
1                        ! nagrDim  
'Land'                 ! agrDim  
  
# Data fields to be read from this file should appear  
>DATA  
60000*0.0              ! frac_agr  
  
#####
```



## Updated INIT\_AGRIC

```
#####  
## Agricultural fraction.  
>INIT_AGRIC  
  
T                        ! readFile  
'asc'                  ! fileFormat  
F                        ! agricVaryT  
F                        ! readList  
-1, -1                  ! agricDataPer, agric  
1, -1                   ! nagricFileTime, agr  
2                        ! nfieldAgricfile  
'/data/cr2/hadhu/JULES/ANCIL/FIELDS/CE3/CE3_COMB_1700  
17000101, '00:00:00'    ! agricFileDate(1), agr  
F                        ! agricEndTime  
0.0                     ! harvest fractions for  
0.0  
0.4  
0.4  
0.0  
  
>ASCBIN  
0, 0                    ! rheaderFile, rheaderFi  
1                        ! fieldNum  
  
# Data fields to be read from this file should appear  
>DATA  
10000*0.0              ! frac_agr  
  
#####
```

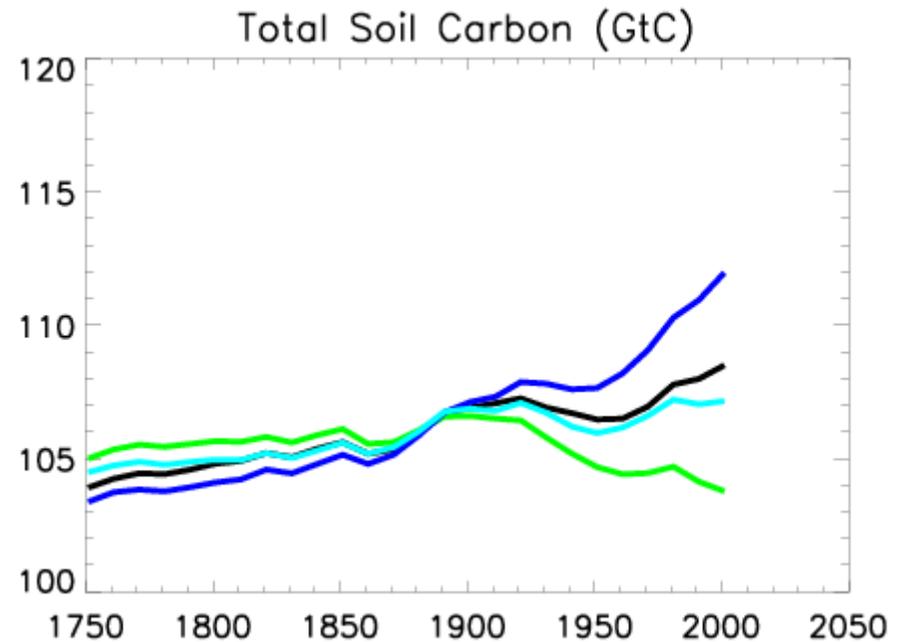
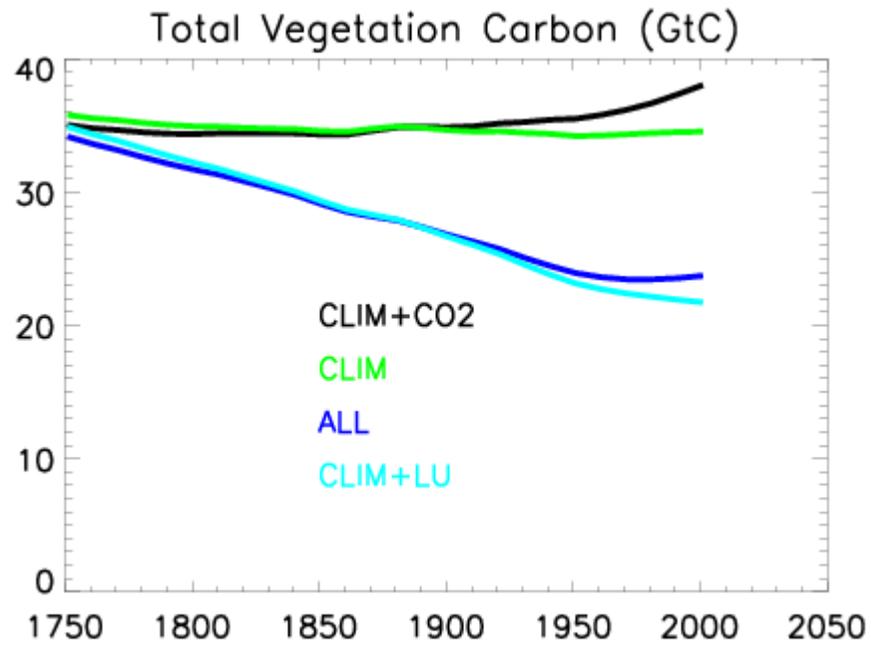


# (some) Limitations

- Nitrogen limitation not included.
- Management not included
- Crop yield carbon pool not included
- Spatial redistribution of carbon not included

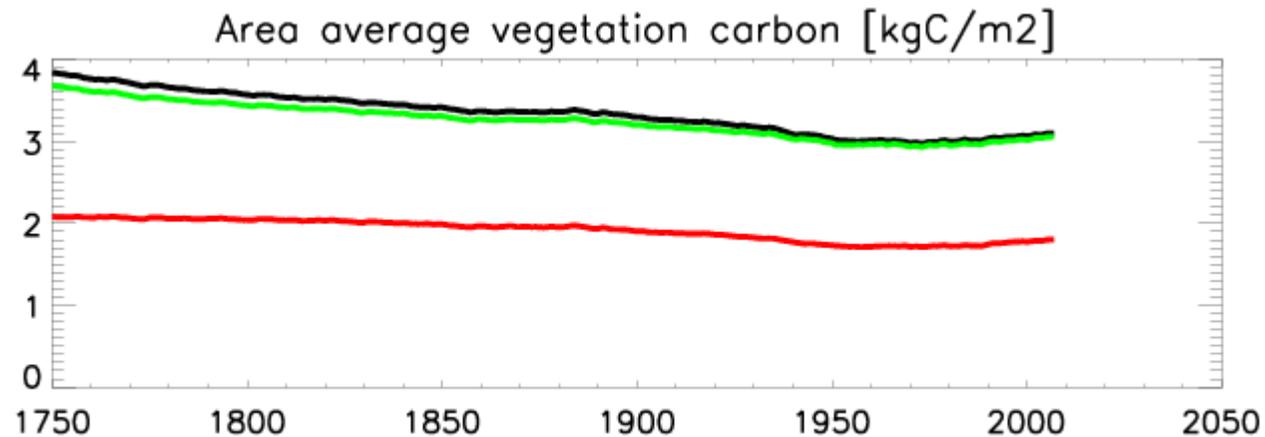
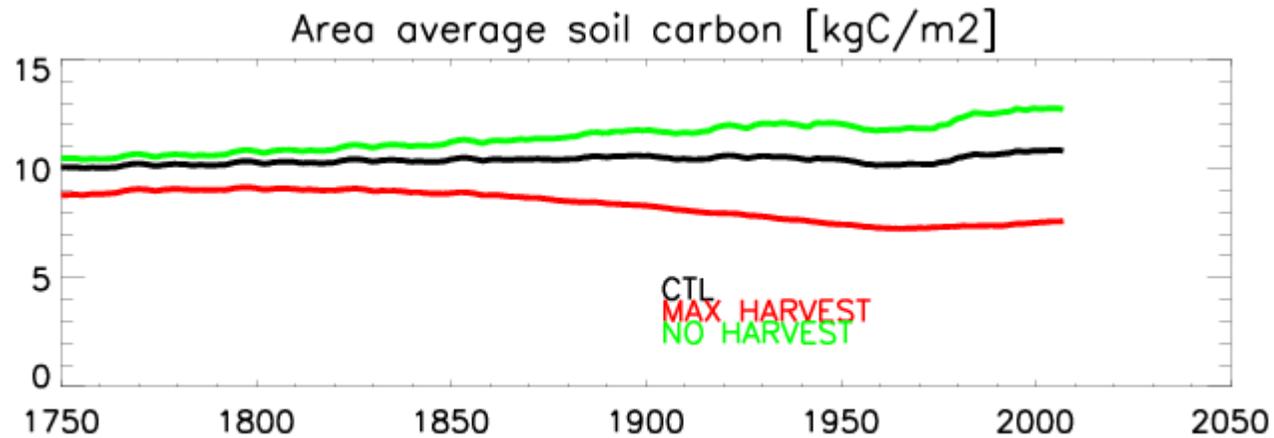
# Results

- Different effects



# Results

- Sensitivity to harvesting parameters



# NEP uncertainty

