Agricultural Intensification

Main scenario: A2 climate change (2001-2100)
Atmospheric deposition scenario (2010-2100)

Arable:

RA1:

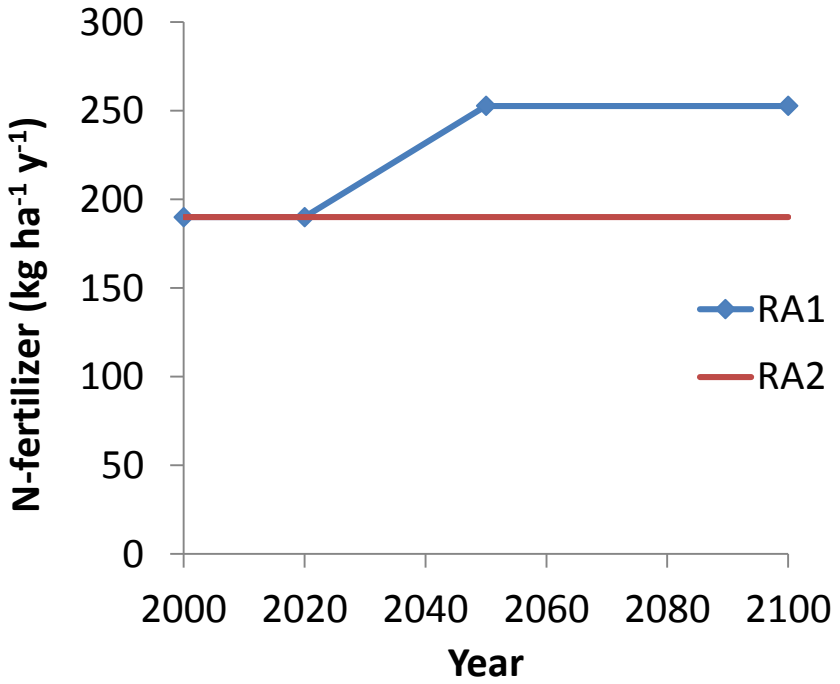
Improved crop varieties

+

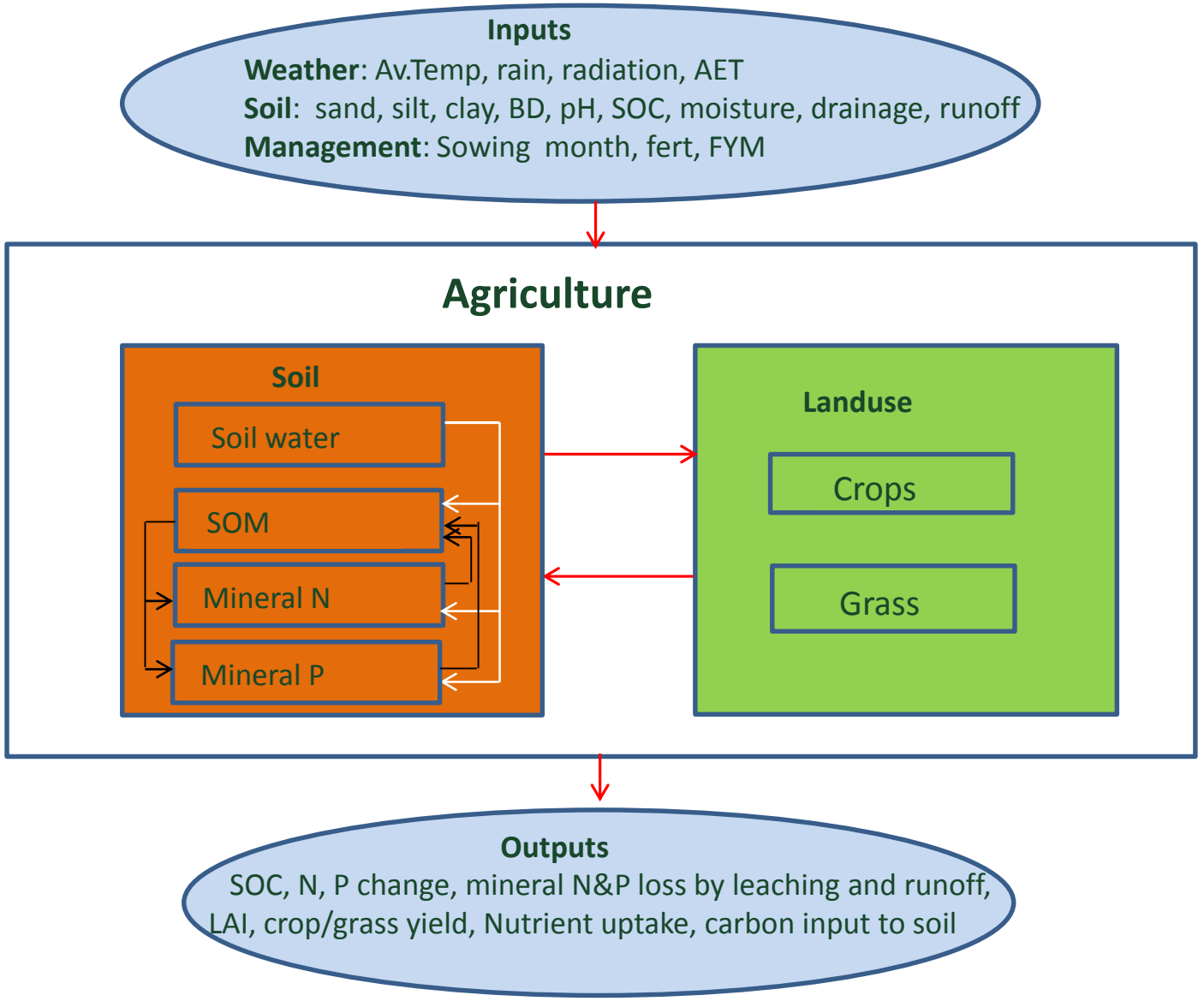
increase in N-fertilizer application rate (by 1/3rd)

RA2:

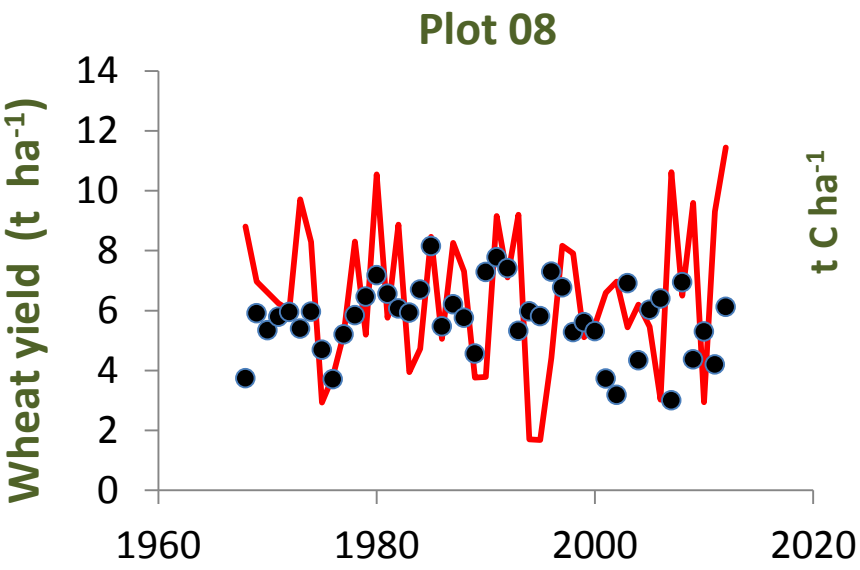
Improved crop varieties only

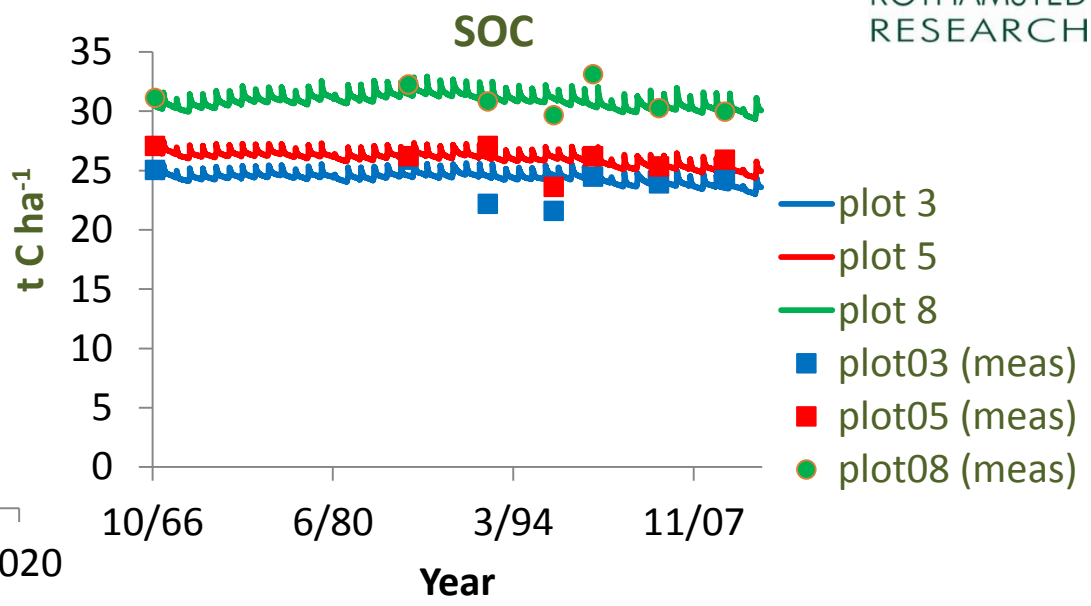


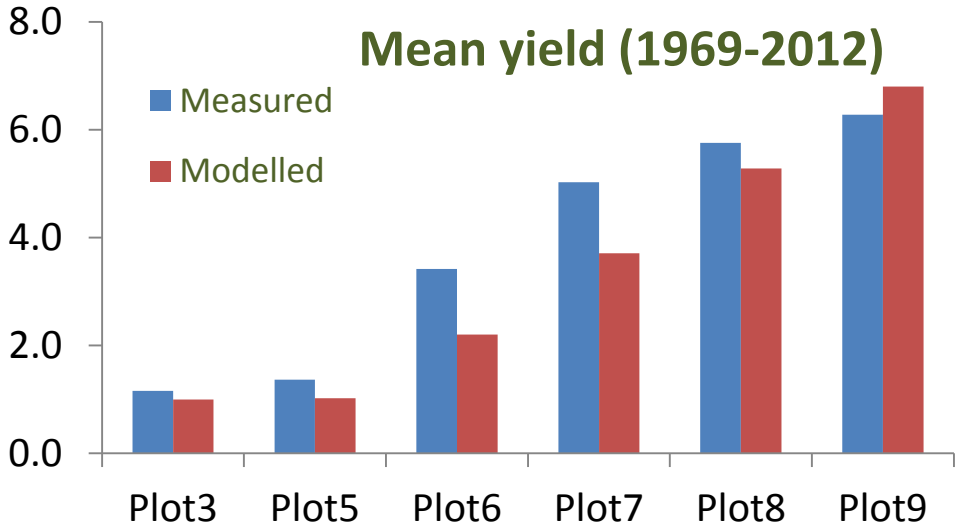
Agricultural model (AM)



Model testing - Broadbalk data



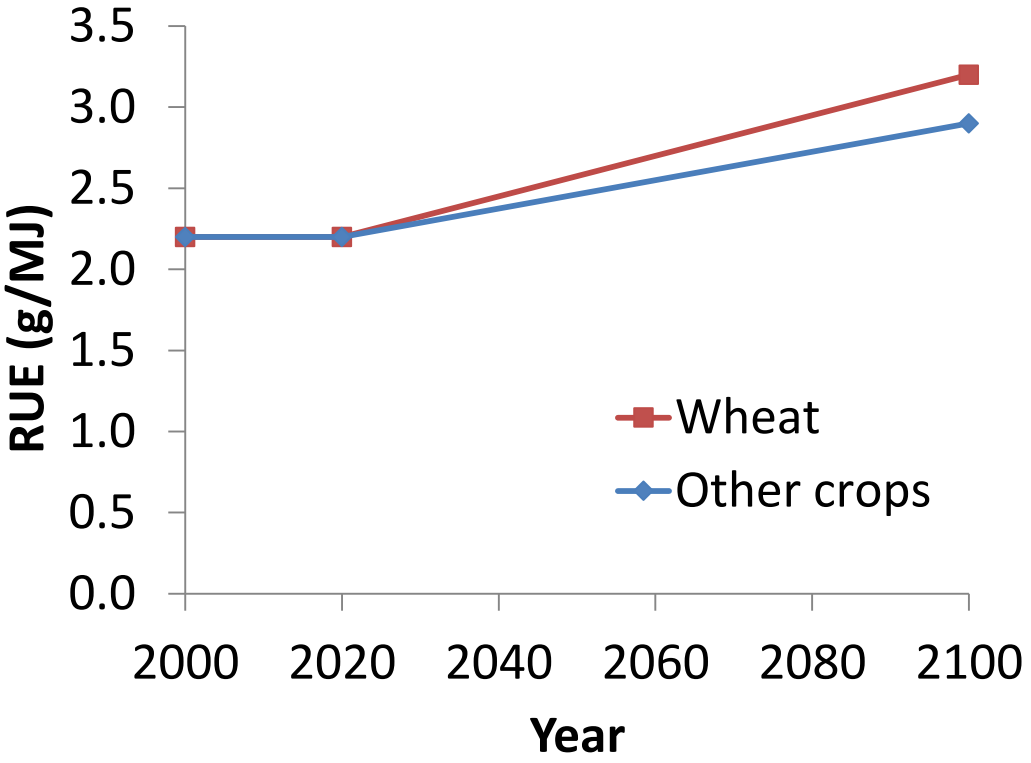




Plot3	Nil
Plot5	PK
Plot6	48N+PK
Plot7	96N+PK
Plot8	144N+PK
Plot9	192N+PK

Crop (model) adaptation for Climate Change

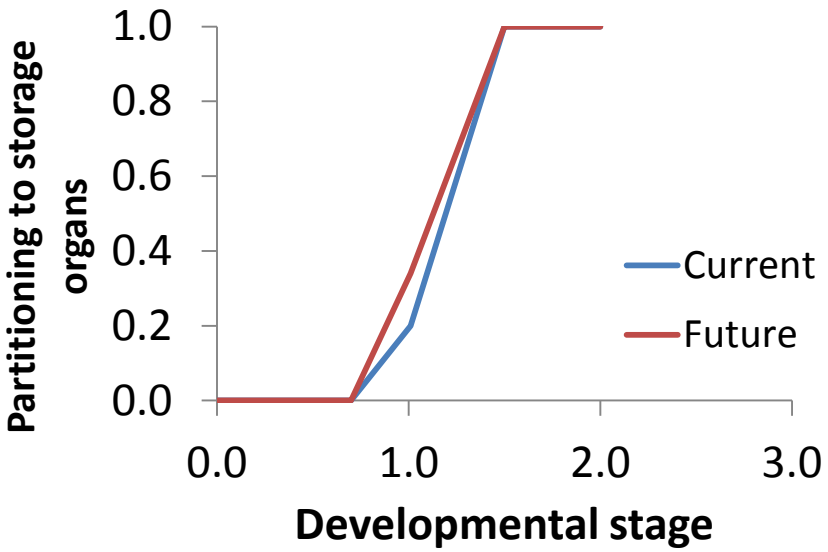
- Doubling in CO_2 by 2100 increase RUE by 30%
- Extended duration in grain filling
- Healthy green area index ('stay green')
- Drought tolerance

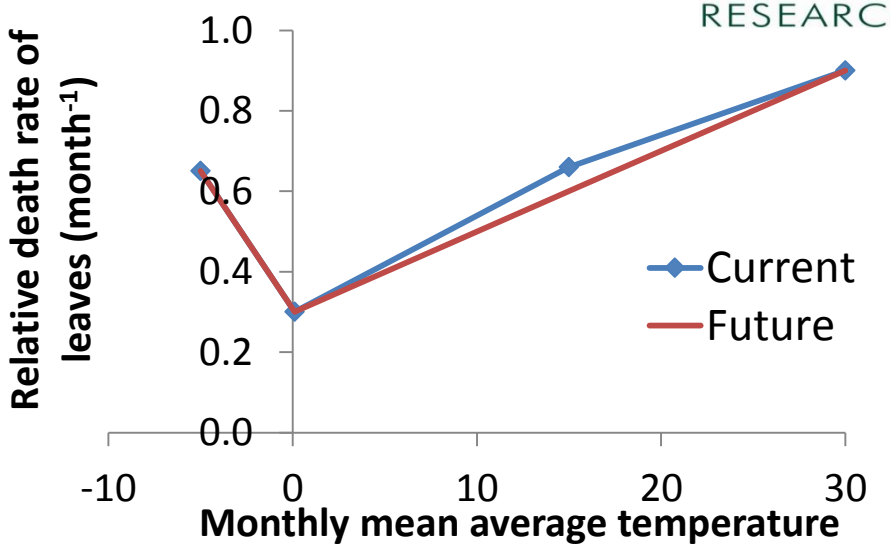


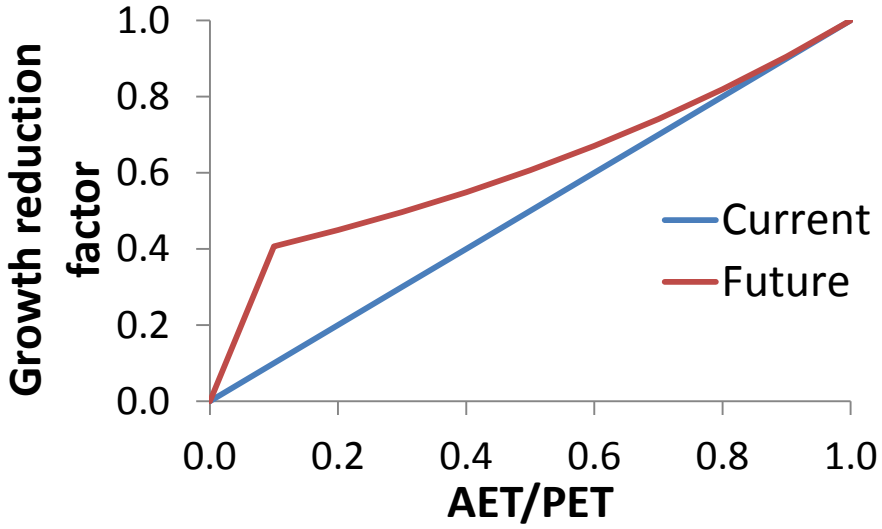
(Semenov *et al*., 2014)

(for wheat, 10% increase in RUE by crop improvement also)

Grain filling and stress tolerance (wheat)



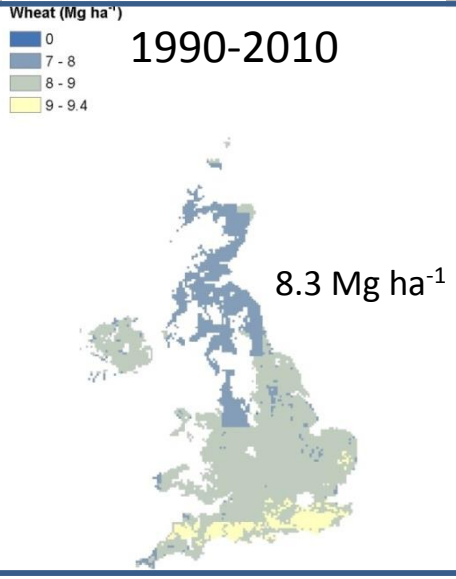




Arable: Crop yields (Wheat)

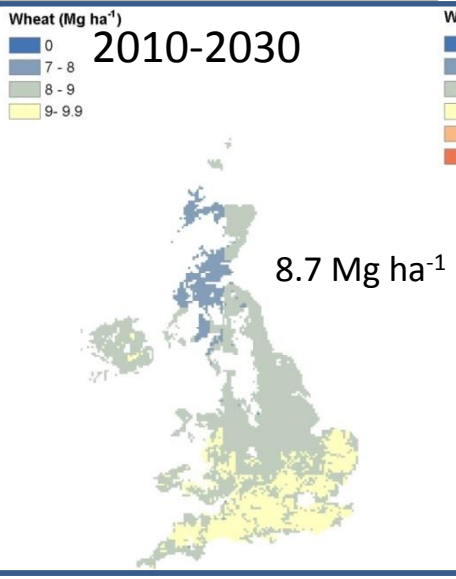
RA2

1990-2010



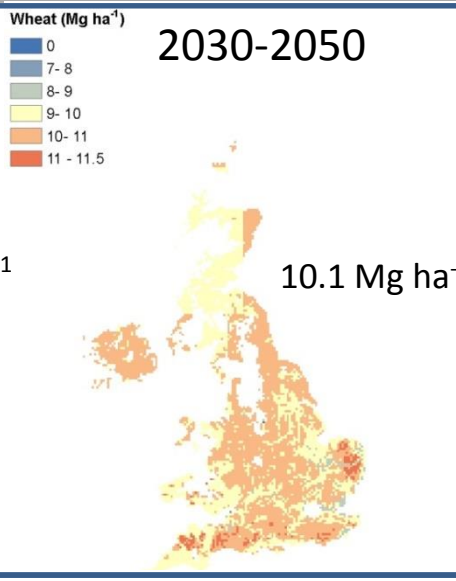
8.3 Mg ha^{-1}

2010-2030



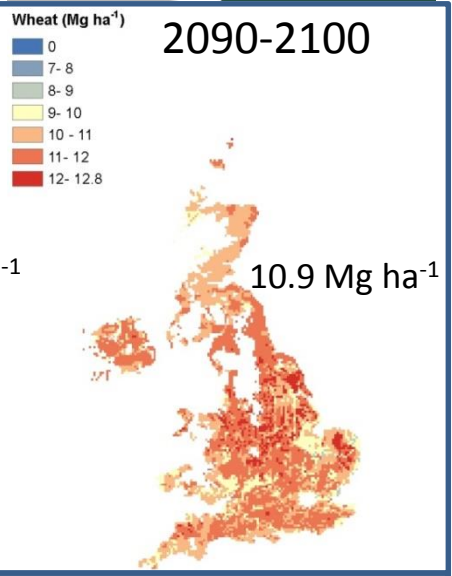
8.7 Mg ha^{-1}

2030-2050



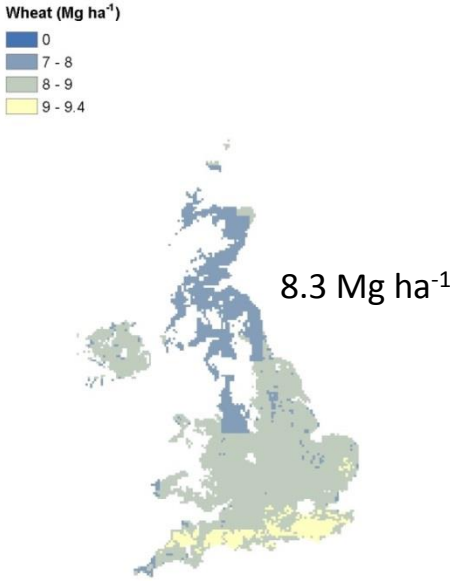
10.1 Mg ha^{-1}

2090-2100

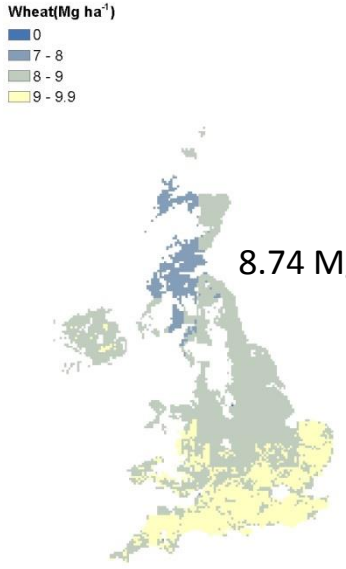


10.9 Mg ha^{-1}

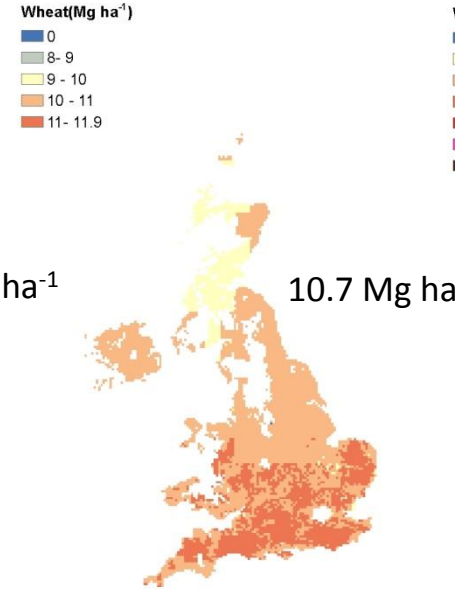
RA1



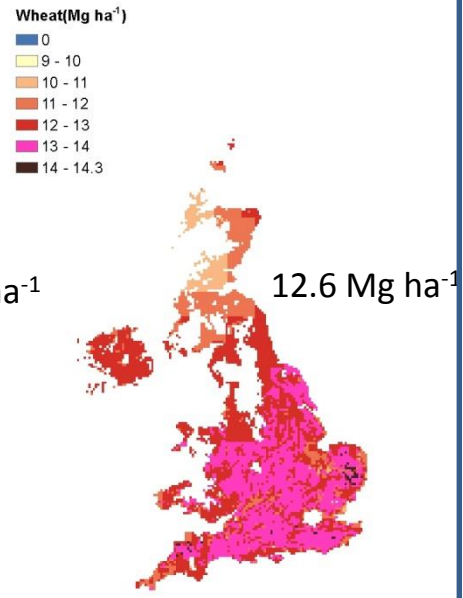
8.3 Mg ha^{-1}



8.74 Mg ha^{-1}



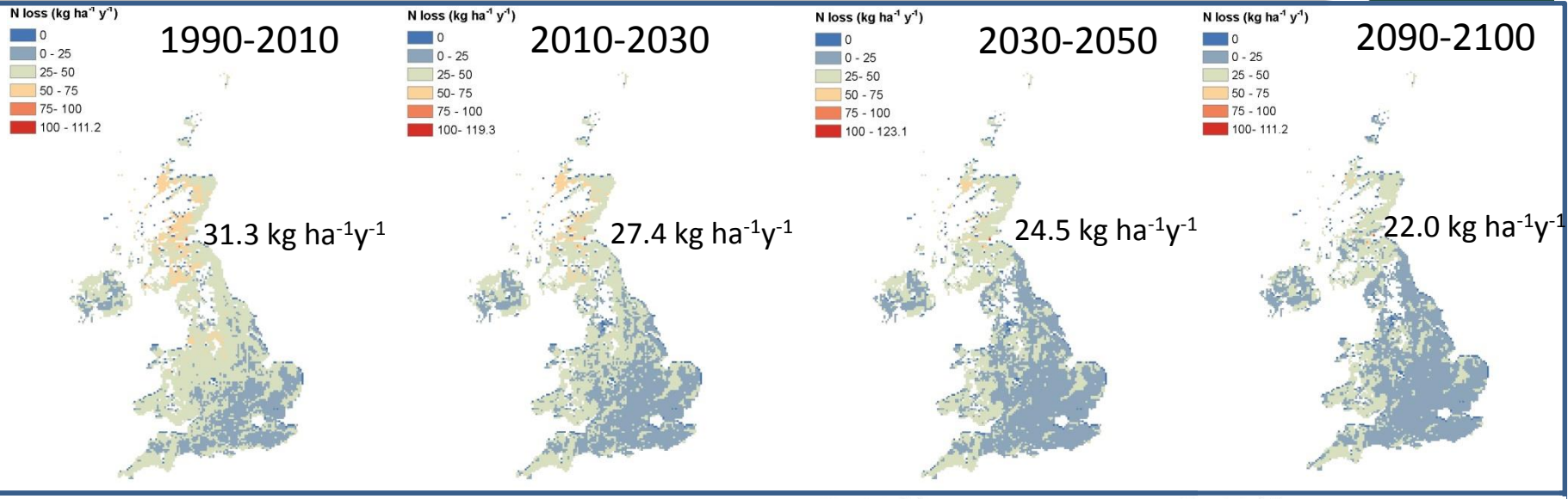
10.7 Mg ha^{-1}



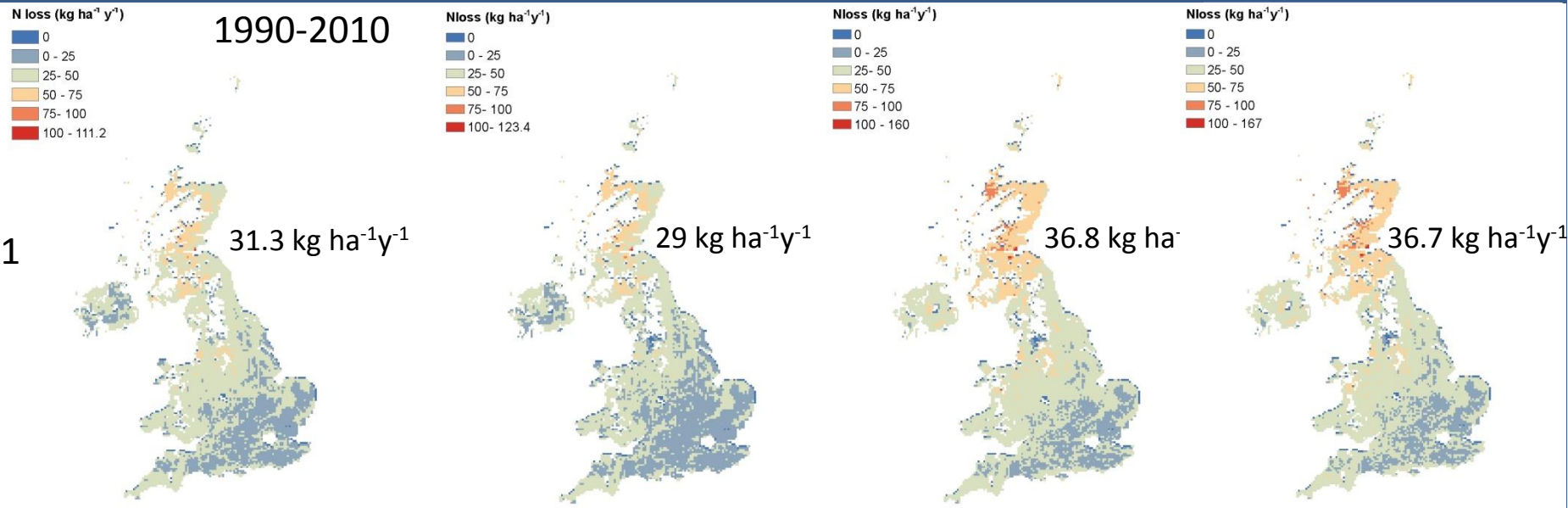
12.6 Mg ha^{-1}

Arable: N-loss (Leaching+ runoff)

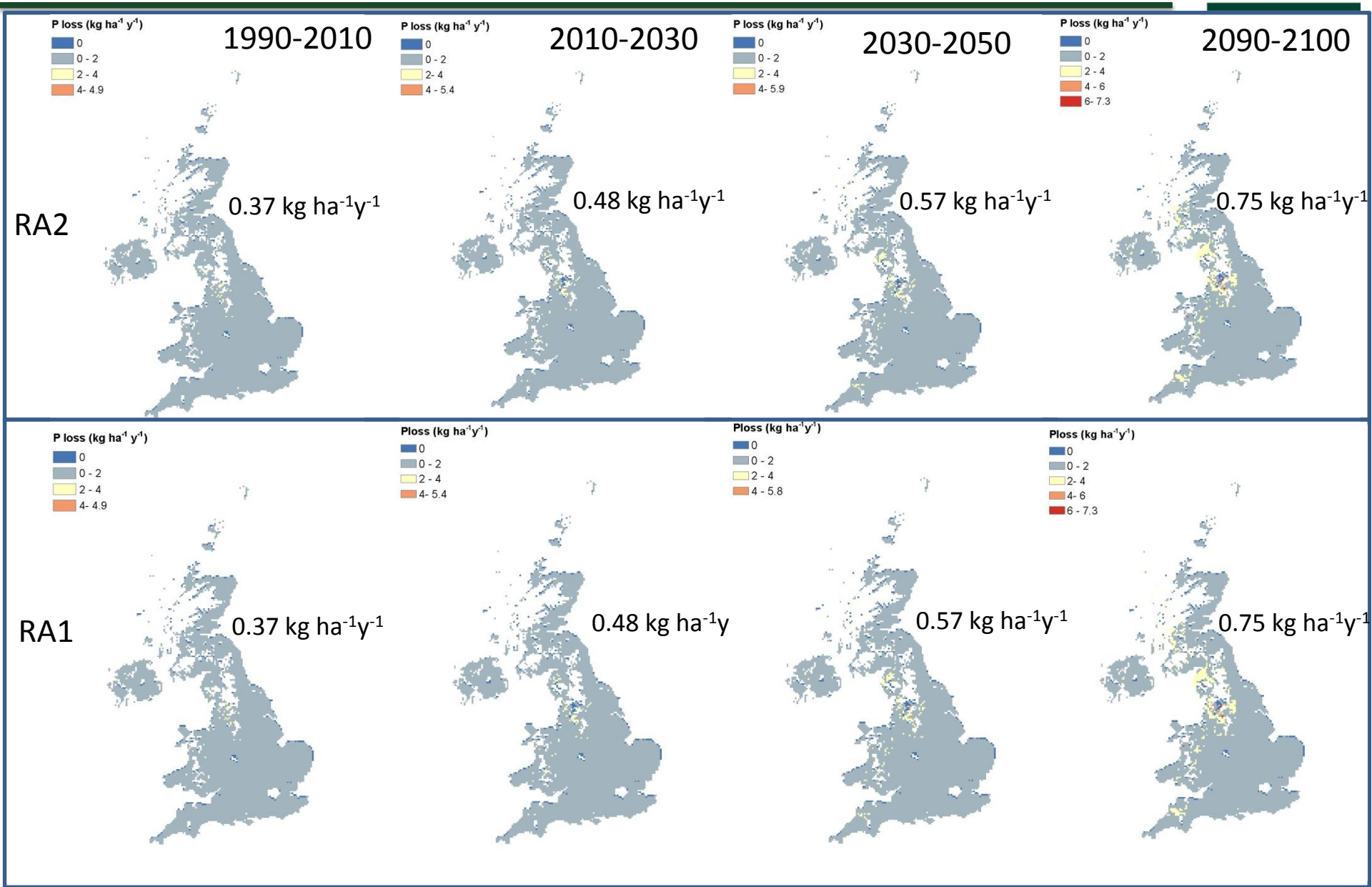
RA2



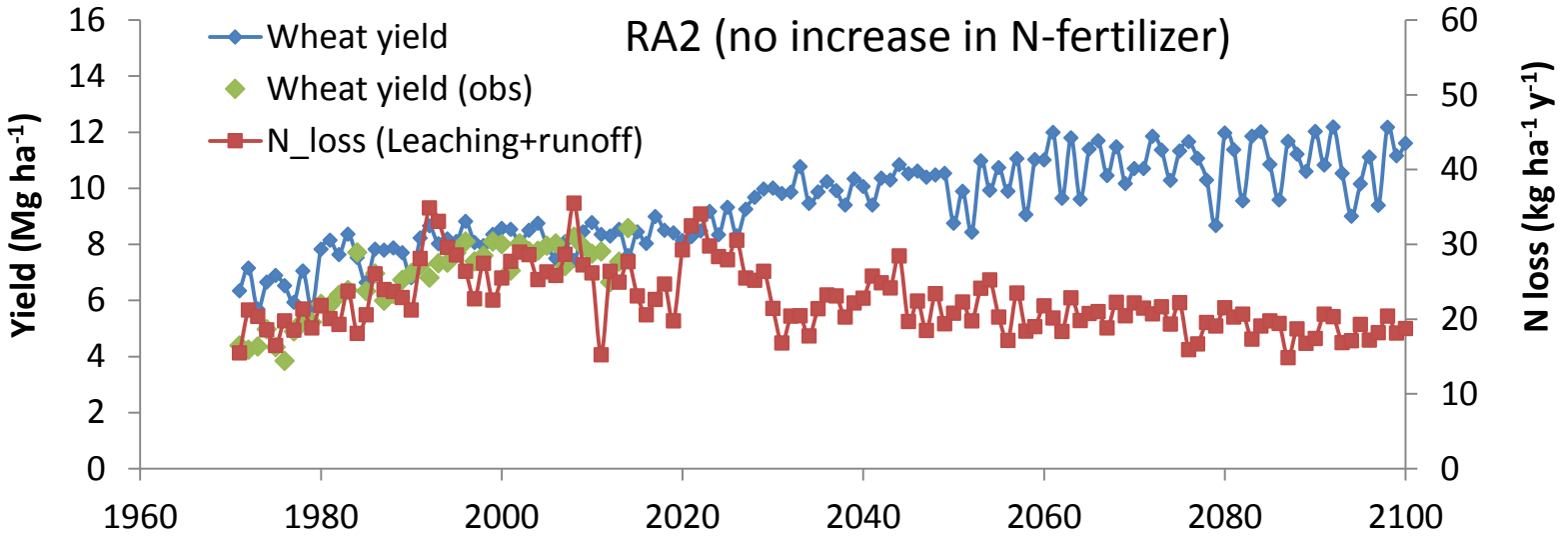
RA1

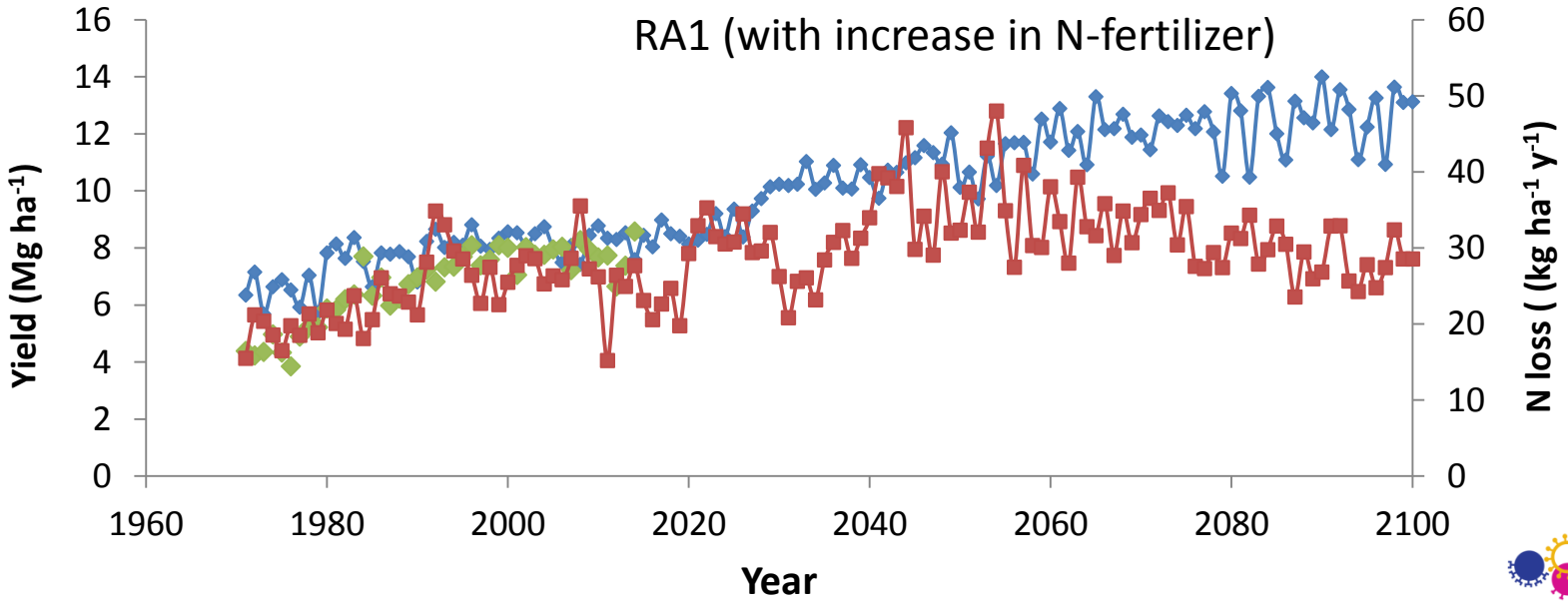


Arable: P-loss (runoff)



Current-to-future trend (whole UK)





Summary and conclusions

- Crop yield increase by 1/3rd in RA2 and more than ½ in RA1 by 2100
- N loss decrease by 30% in RA2 and increase by 17% in RA1
- P loss increase by double in both RA2 and RA1
- Crop adaptation to climate change can increase the yield and NUE of the crops and there by N losses

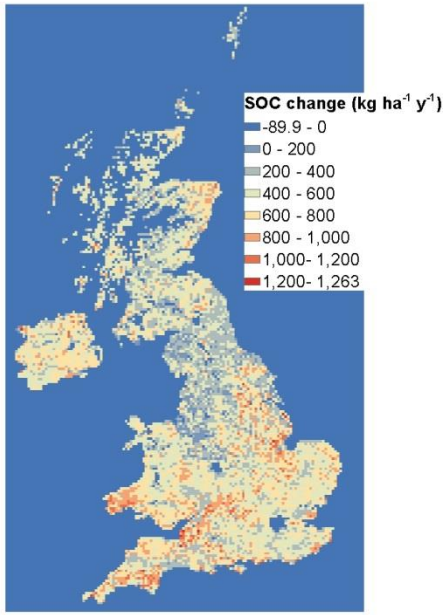
ROTHAMSTED RESEARCH

Thank you!

BBSRC bioscience for the future

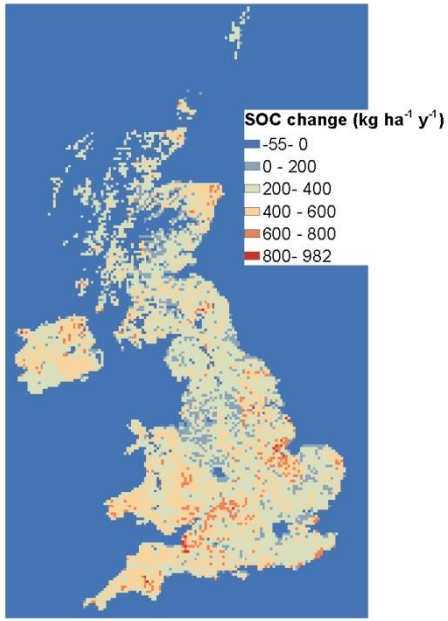
Improved Grass: Soil organic carbon change

1990-2010



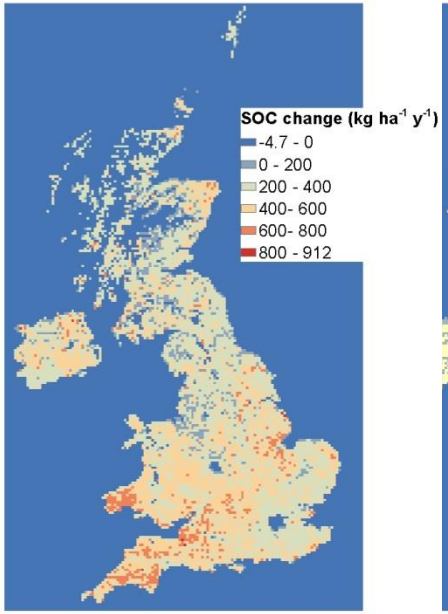
512 kg $ha^{-1}y^{-1}$

2010-2030



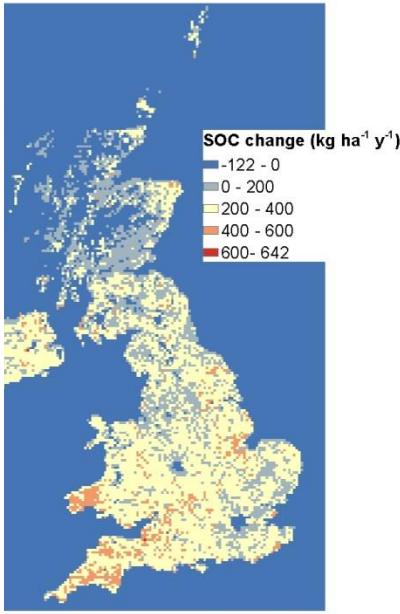
341 kg $ha^{-1}y^{-1}$

2030-2050



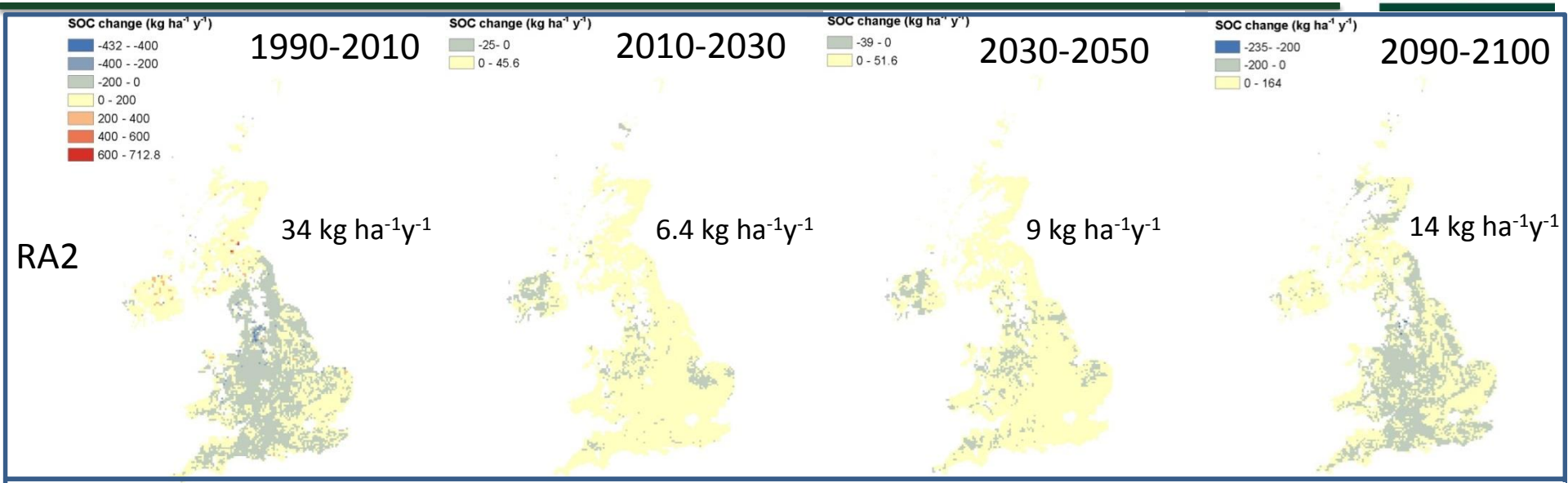
360 kg $ha^{-1}y^{-1}$

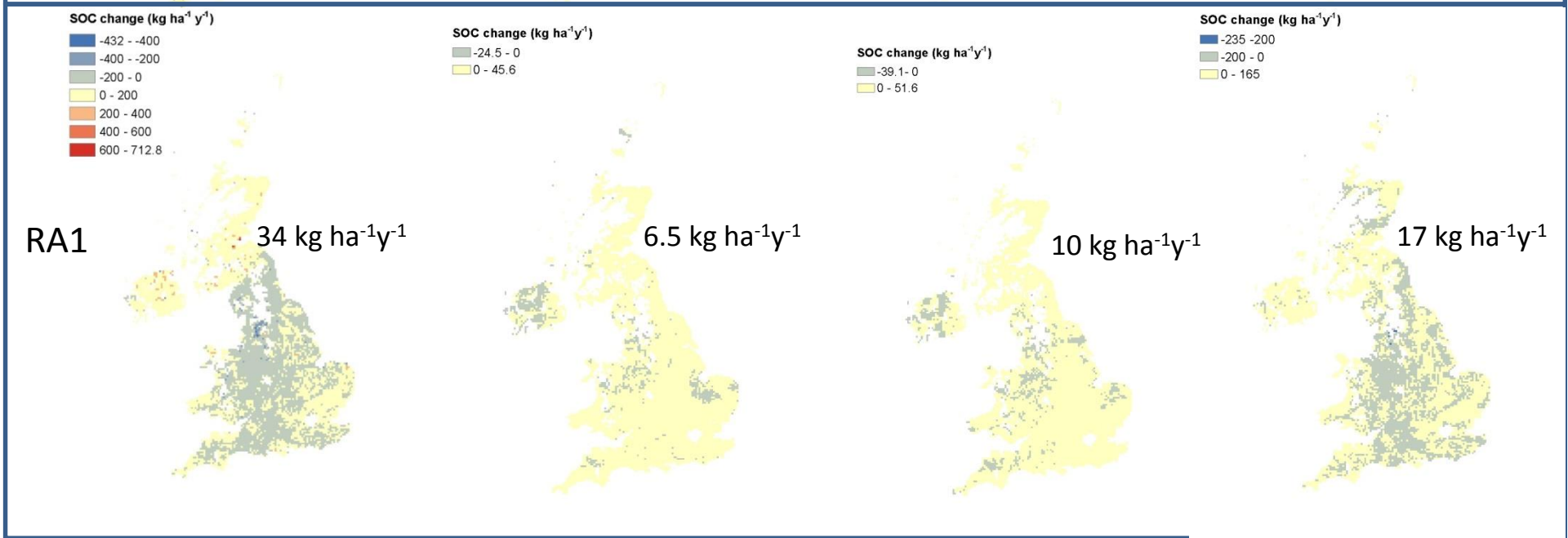
2090-2100



238 kg $ha^{-1}y^{-1}$

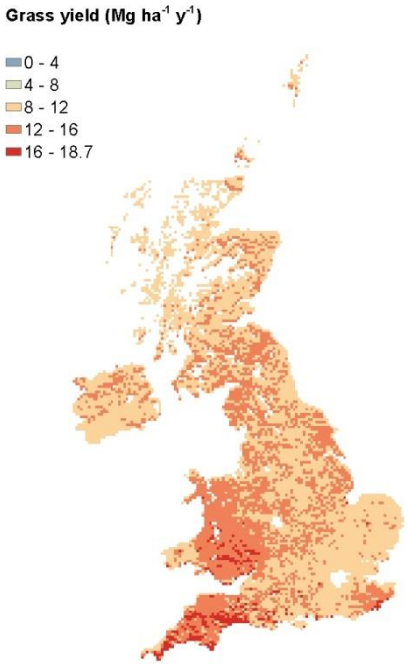
Arable: Soil organic carbon change



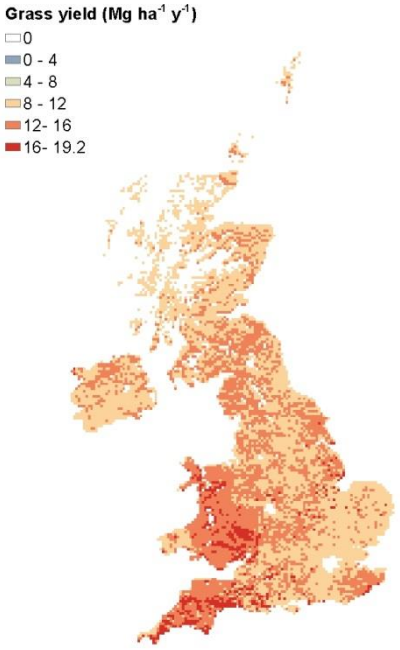


Improved Grass: yield

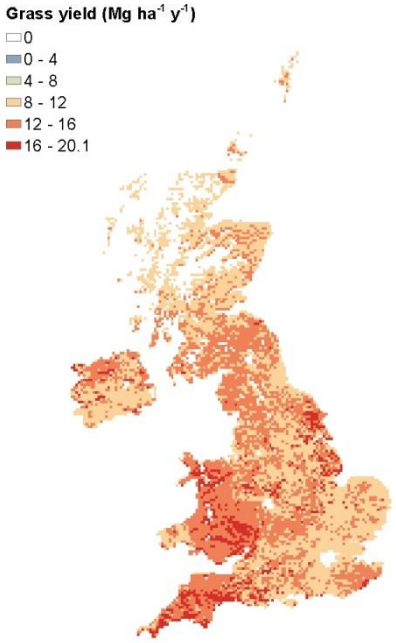
1990-2010



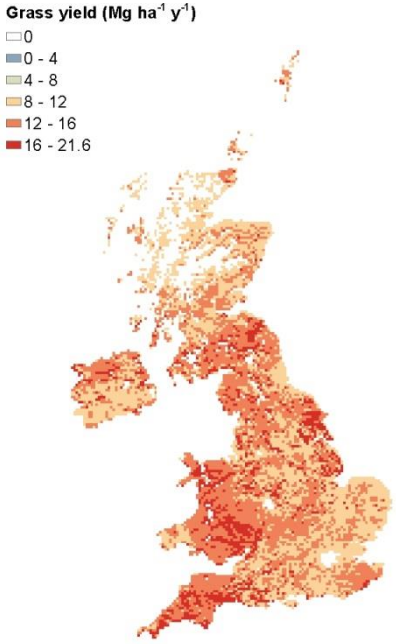
2010-2030



2030-2050

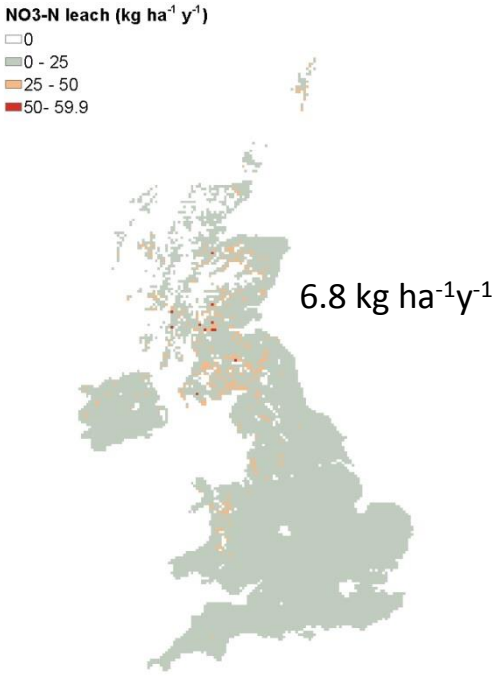


2090-2100



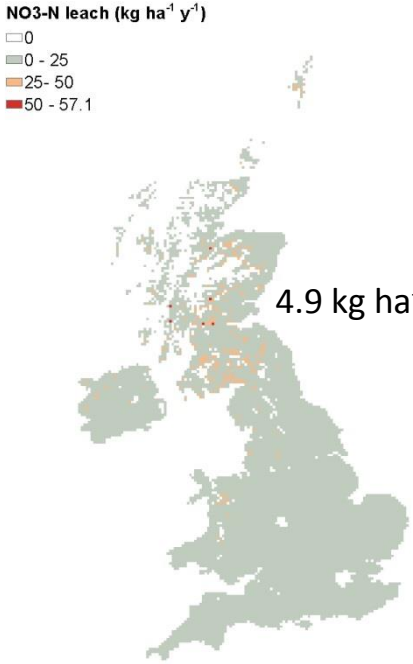
Improved Grass: N-loss (Leaching)

1990-2010



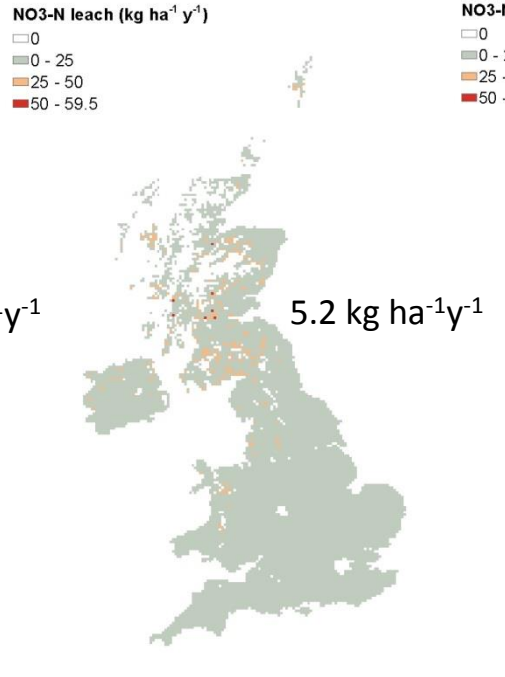
6.8 kg $ha^{-1}y^{-1}$

2010-2030



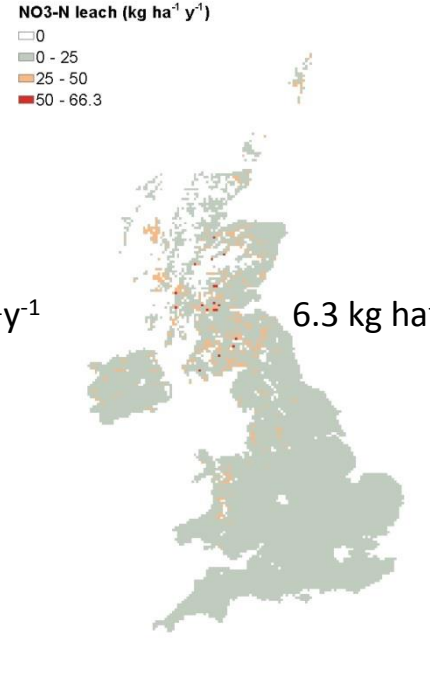
4.9 kg $ha^{-1}y^{-1}$

2030-2050



5.2 kg $ha^{-1}y^{-1}$

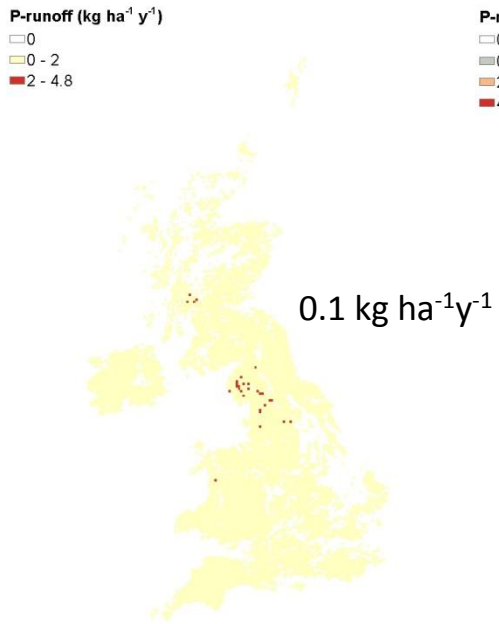
2090-2100



6.3 kg $ha^{-1}y^{-1}$

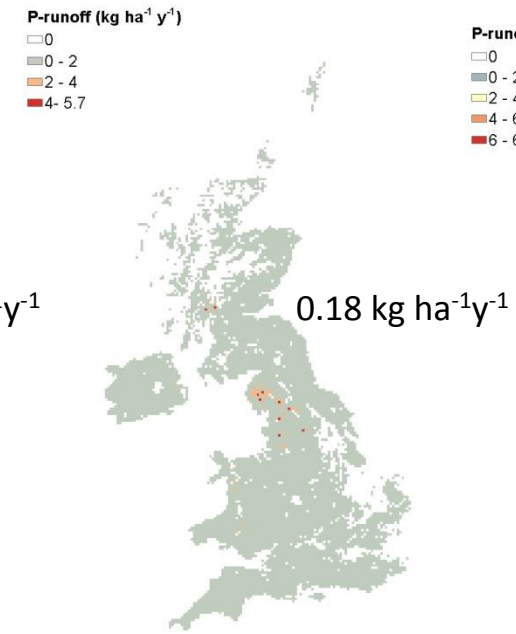
Improved Grass: P-loss (runoff)

1990-2010



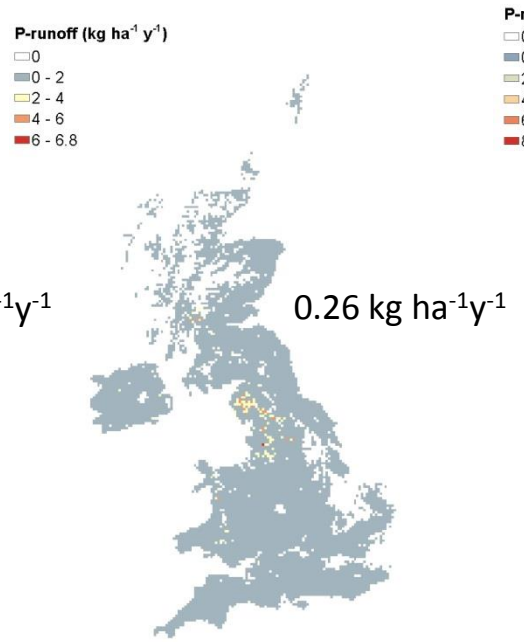
0.1 kg $ha^{-1}y^{-1}$

2010-2030



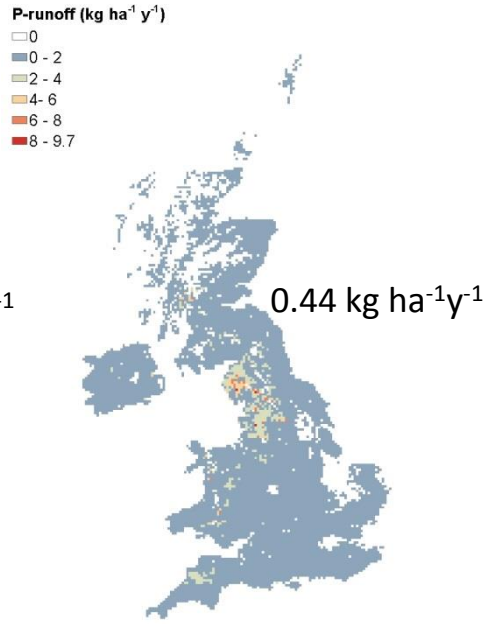
0.18 kg $ha^{-1}y^{-1}$

2030-2050



0.26 kg $ha^{-1}y^{-1}$

2090-2100



0.44 kg $ha^{-1}y^{-1}$