



# NUTCAT-2050

Estimating Nutrients in Catchments to 2050



## Modelling the effect of climate, land use and land management changes on water quality in a headwater agricultural catchment

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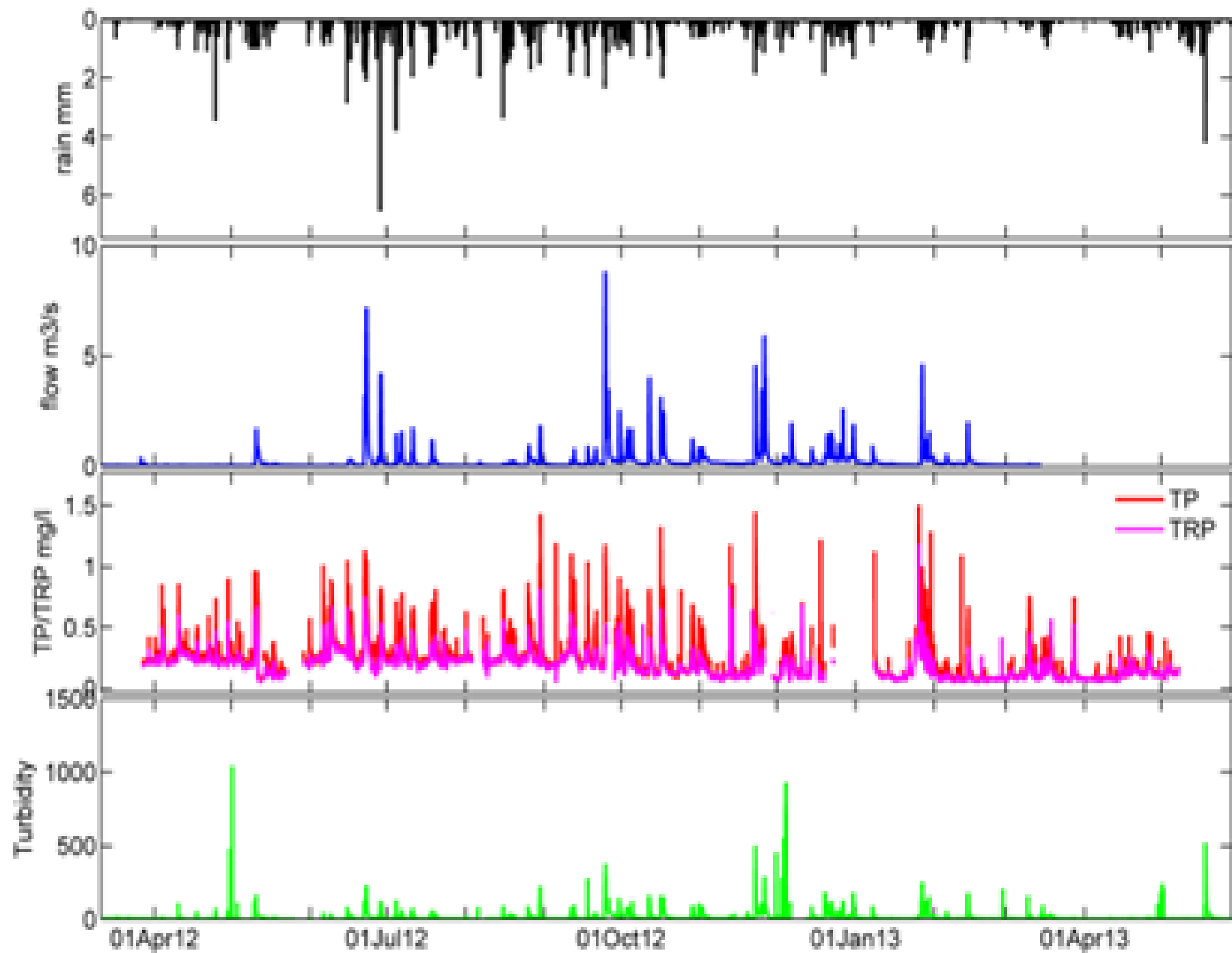


# Phosphorus and water quality

- Phosphorus (P) in rivers results in poor water quality (eutrophication)
- How will P transfer respond to future change?

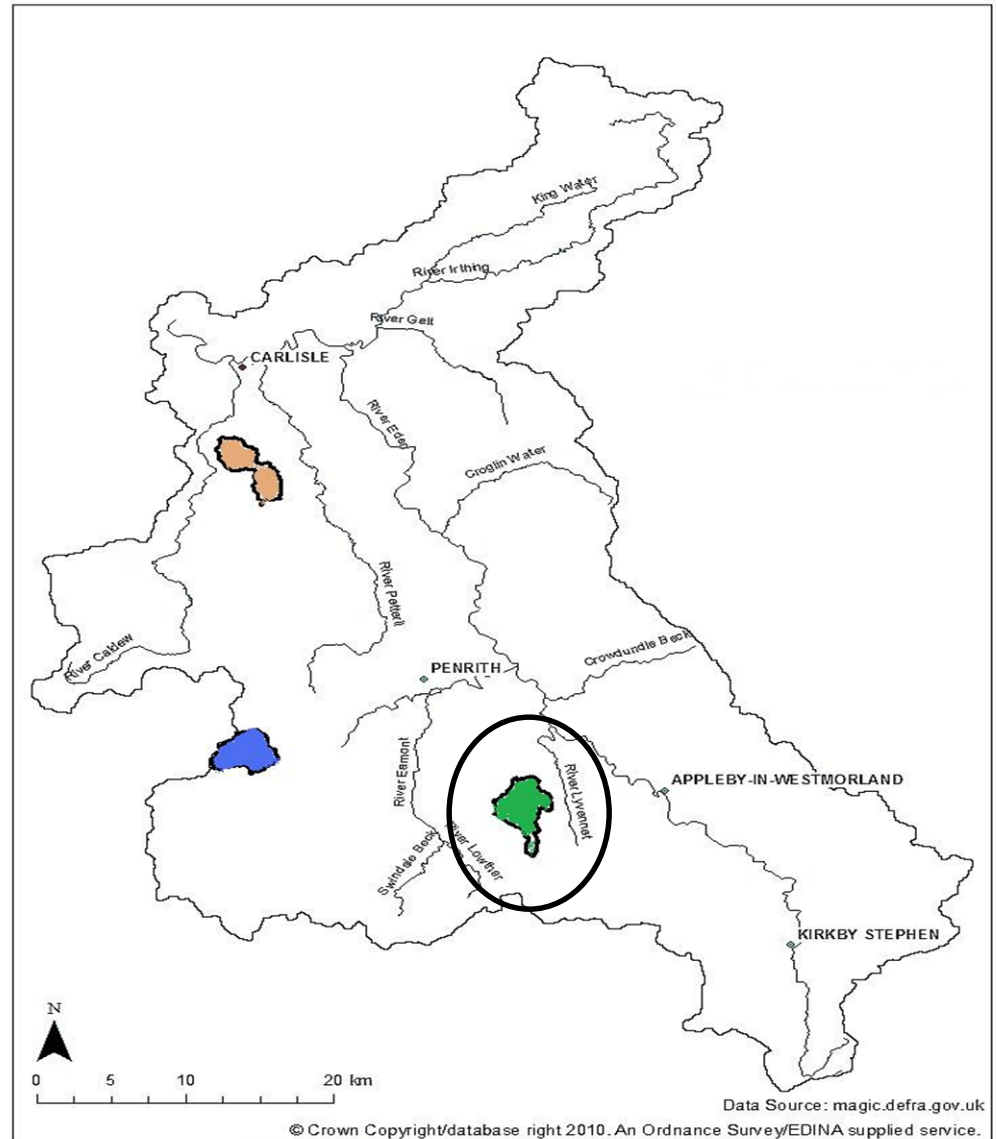


**Aim: How will  
climate driven land  
use and  
management  
changes affect  
future water  
quality?**



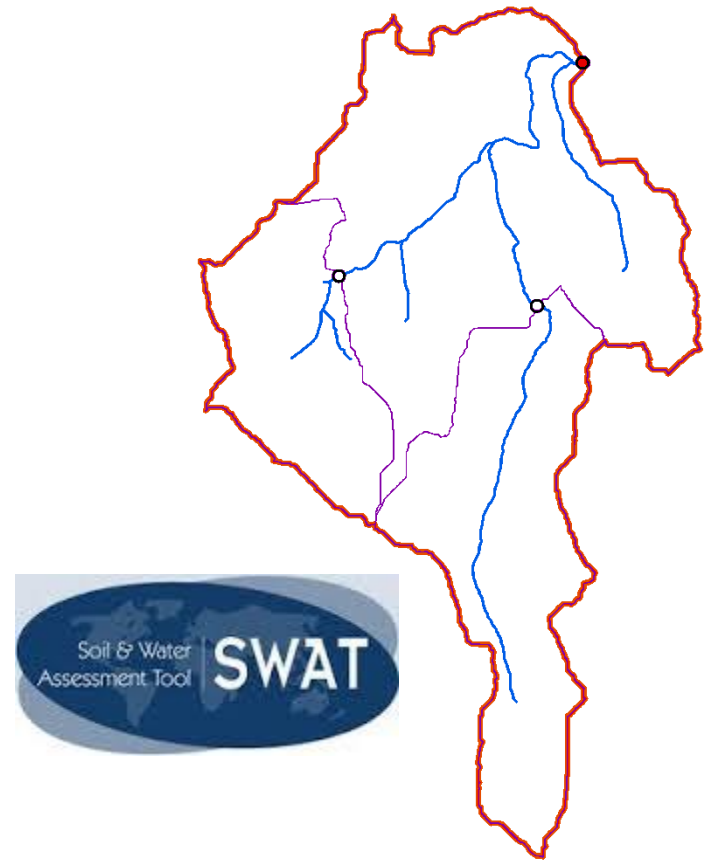
# The River Eden Catchment

- 3 small headwater catchments (10 km<sup>2</sup>)
- High resolution rainfall, discharge and turbidity data at 9 sites (15 mins)
- High resolution phosphorus data at 2 sites (30 mins)



# The Soil and Water Assessment Tool (SWAT)

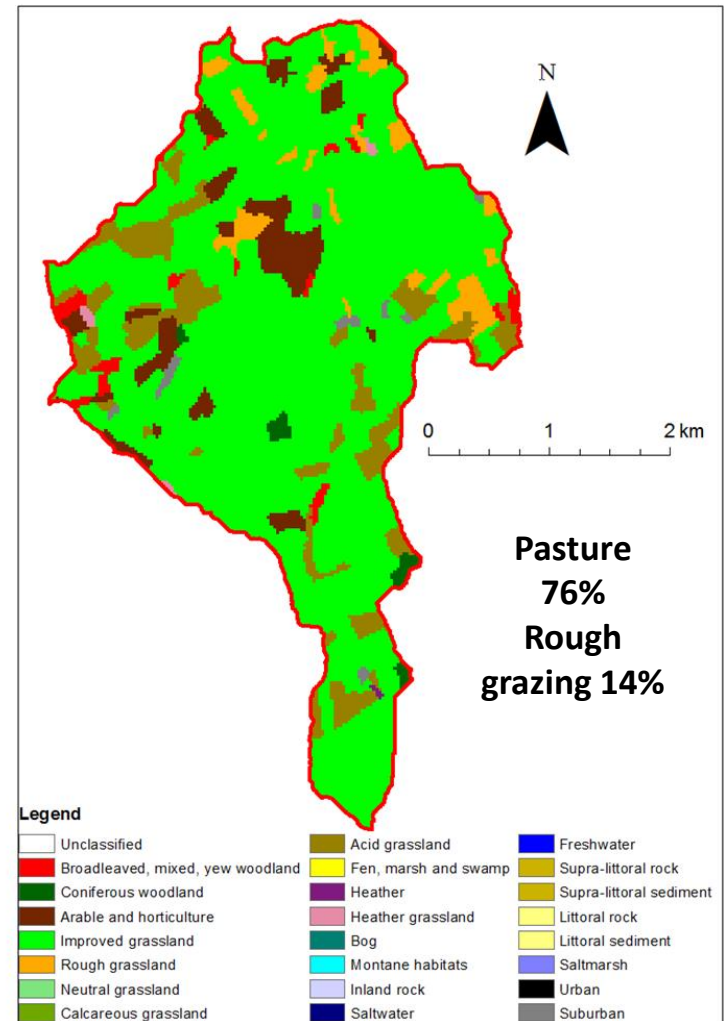
- Semi-distributed process based model.
- Watershed delineated Digital Elevation Model (DEM) data.
- Hydrological response units (HRU) defined by soil type, land type and slope.



Newby Beck catchment in the Eden, delineated using 5m NEXTMAP data.

# Defining the land use scenarios through expert elicitation

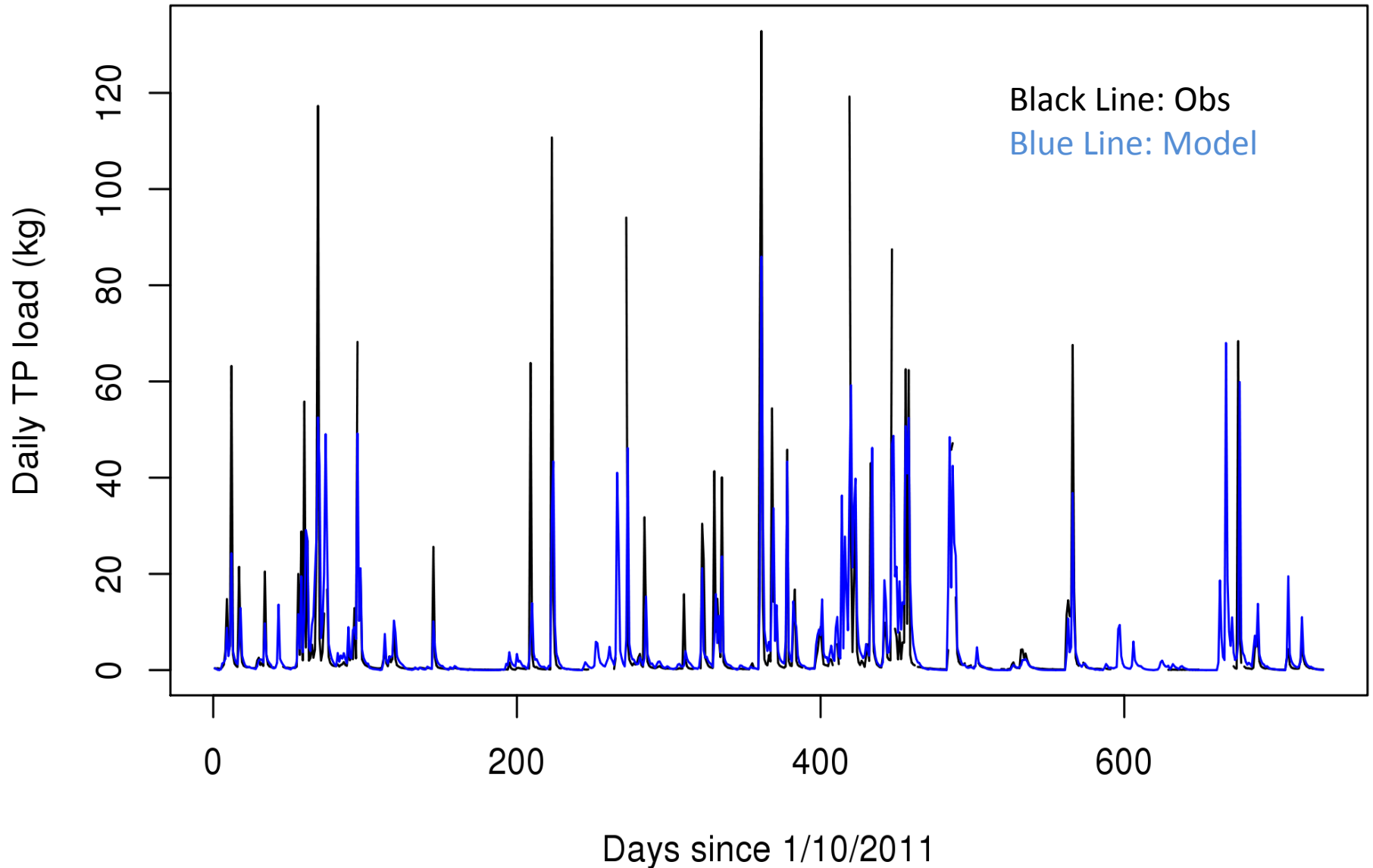
- Land use scenarios based around regional studies and refined by expert elicitation (through stakeholder workshops)
- General feeling is change in management rather than land use. E.g. Increased stocking densities



# Land Use Scenarios

Scenario Name	Modification	Land types affected
<b>DBLCAT</b>	Double cattle stocking density	Pasture
<b>DBLSHP</b>	Double sheep stocking density	Pasture, rough grassland
<b>DBLBTH</b>	Double both cattle and sheep stocking densities	Pasture, rough grassland
<b>DBLFRT</b>	Double fertiliser applications after pasture cut	Pasture
<b>ADDCUT</b>	Extra cut over summer	Pasture
<b>ALLMGT</b>	All management changes	Pasture rough grassland
<b>LNDONLY</b>	Land use change from pasture to rough grassland – <b>no management changes</b>	Pasture changed to rough grassland.
<b>LNDMGT</b>	Land use change from pasture to rough grassland – <b>with management changes</b>	Pasture changed to rough grassland

# Calibration for 2011-2012 and 2012-2013 hydrological years





# Impact of management changes

Scenario	% Change to control 2011/2012	% Change to control 2012/2013
DBLCAT	2.6	7.1
DBLSHP	2.6	7.9
DBLBTH	6.3	18.3
DBLFRT	2.4	6.6
ADDCUT	2.2	3.5
ALLMGT	16.0	38.4

## ANNUAL

**2011-2012 Annual load under control scenario:** 1460.6 kg $\text{yr}^{-1}$

**2012-2013 Annual load under control scenario:** 2020.8 kg $\text{yr}^{-1}$

Scenario	% Change to control 2011/2012	% Change to control 2012/2013
DBLCAT	0.5	9.1
DBLSHP	0.9	10.4
DBLBTH	1.6	24.0
DBLFRT	0.5	8.4
ADDCUT	0.5	4.1
ALLMGT	4.6	48.3

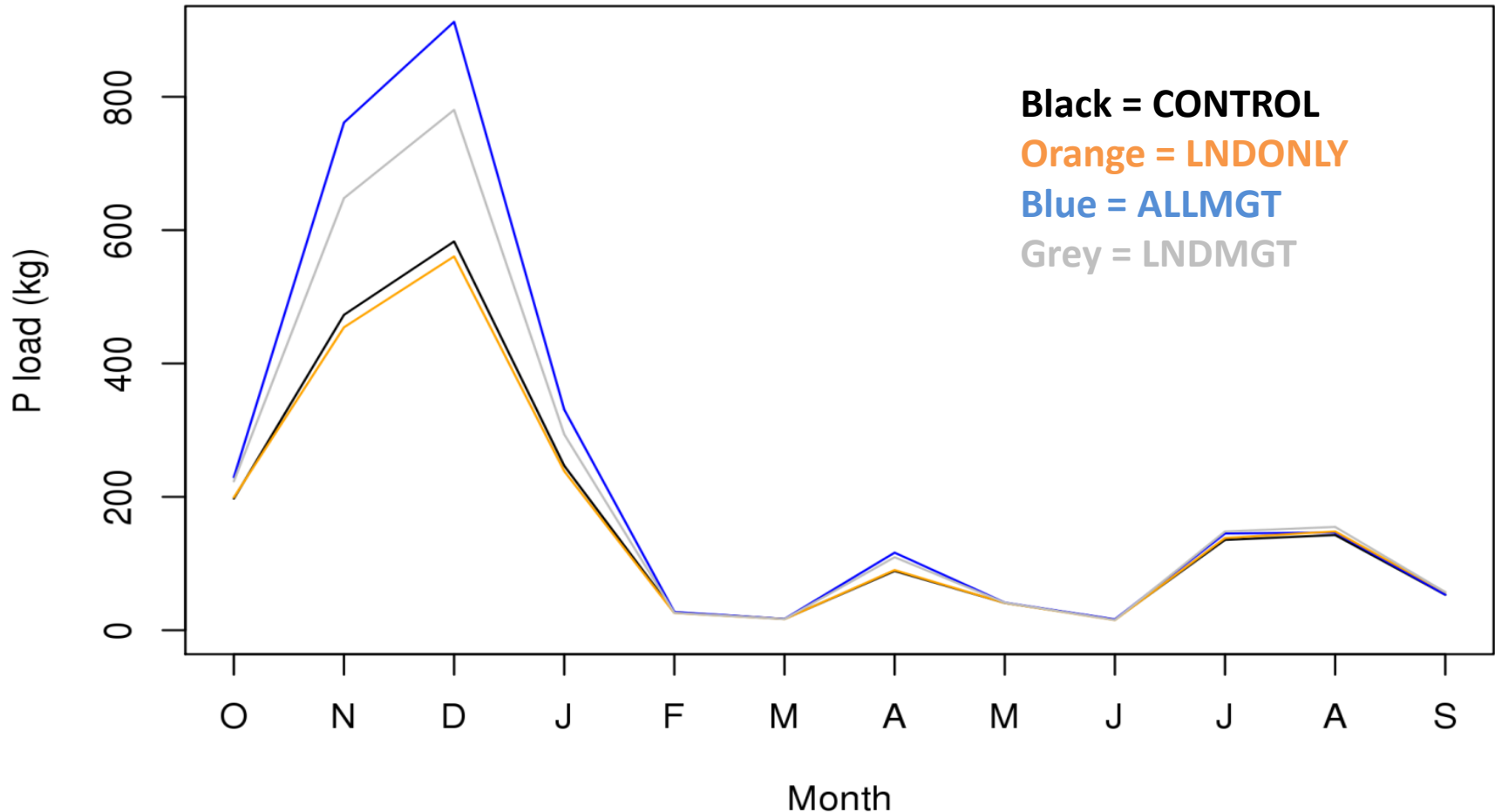
## WINTER

**2011-2012 DJF load under control scenario:** 539.8 kg $\text{yr}^{-1}$

**2012-2013 DJF load under control scenario:** 856.6 kg $\text{yr}^{-1}$

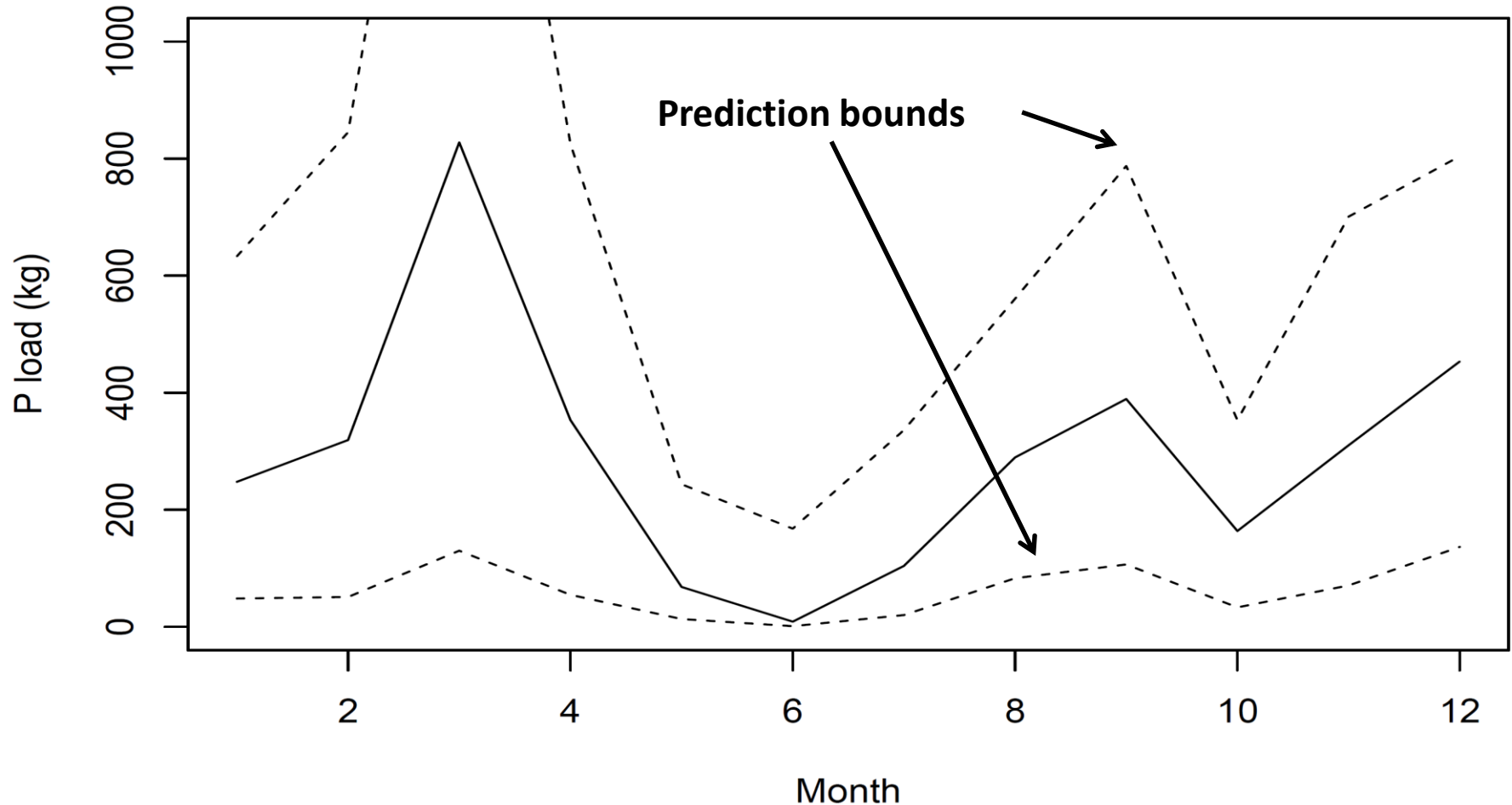
# Impact of land use changes

Monthly TP loads for 2012-2013 Hydrological year



# But what about uncertainty?

Monthly TP loads for 2011–2012 Hydrological year



# Conclusions

- Change in land management practices tend to produce the largest impact on modelled P loads.
- Pasture to rough grazing appears to offset increases associated with management changes.
- High seasonal variability in impact of land management changes.
- High P transfer in winter of 2012/2013 water year after drier 2011/2012.
- High uncertainty in model predictions!

# Next Steps

- Combine the land use change scenarios with climate change scenarios for Newby Beck and other Eden catchments.
- Hold further stakeholder workshops in the Eden and the other DTC catchments (Wensum and Hampshire Avon) to refine land use scenarios.
- Incorporate model uncertainty into scenarios.

# Thank you



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For further information, please visit our website:

<http://nutcat2050.org.uk/>