LTLS: River Modelling Component

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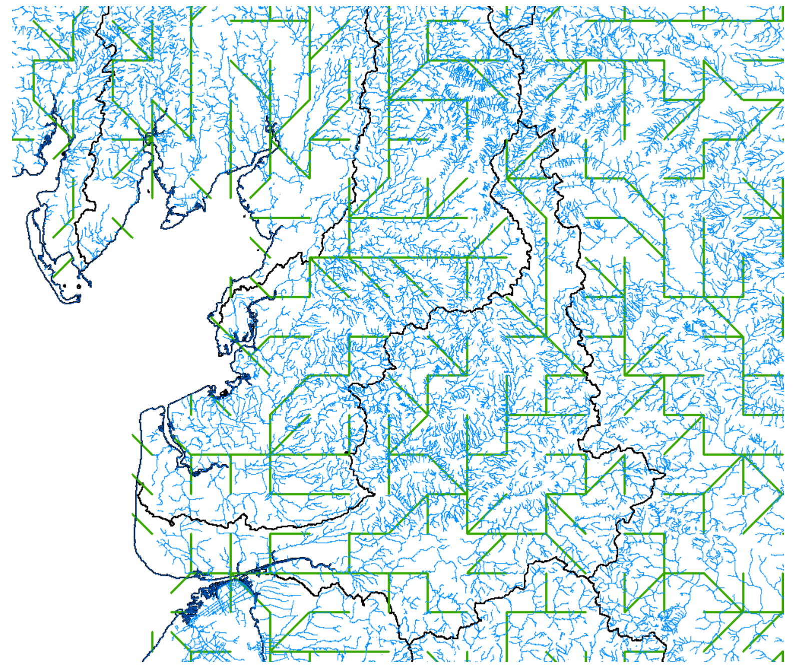
INTRODUCTION LTLS is focused on the long-term and large-scale. It aims to explain the current nutrient status of UK terrestrial and freshwater ecosystems based on past nutrient inputs, land-use and climate. The river model is one component of the Integrated Model being developed.

WATER PHASE	PARTICULATE PHASE	OTHER RIVERINE VARIABLES
dissolved inorganic carbon	Fine sediment	pH
dissolved organic carbon	labile particulate organic carbon	oxygen
^{14}C in dissolved organic carbon	non-labile particulate organic carbon	algae
ammonium	labile particulate radiocarbon	macrophytes
nitrate	non-labile particulate radiocarbon	water temperature
dissolved organic nitrogen	labile particulate organic nitrogen	
total dissolved phosphorus	non-labile particulate organic nitrogen	**GASEOUS LOSSES FROM RIVER**
calcium	ammonium adsorbed to sediment	CO_2 (degassing)
sulphate	labile particulate organic phosphorus	CO_2 (decomposition of DOC)
silicon	non-labile particulate organic phosphorus	CO_2 (decomposition of POCL)
	phosphorus adsorbed onto particles	N (denitrification)
	mineral particulate phosphorus	

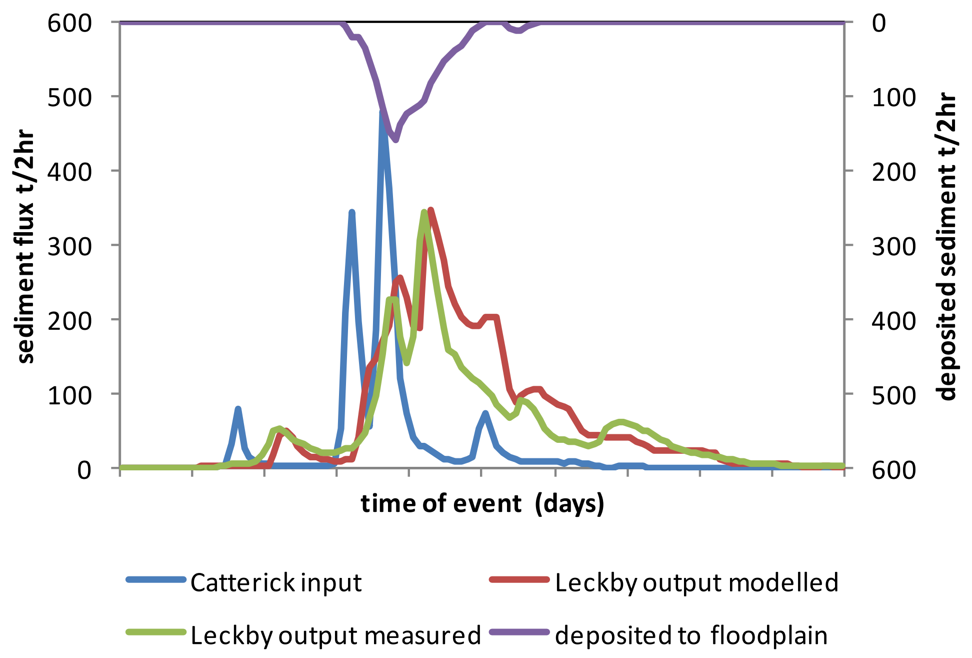
LTLS river model variables: flow routing and flux accounting for both the water and particulate phase variables are computed at a 5km grid scale

FLOODPLAIN SEDIMENT LOSSES MODEL

- floodplain and bankfull flow grids
- simple model based on relative conveyance on flood plain and in channel (after Nicholas *et al*., 2006)
- sediment-bound nutrients delivered to floodplain



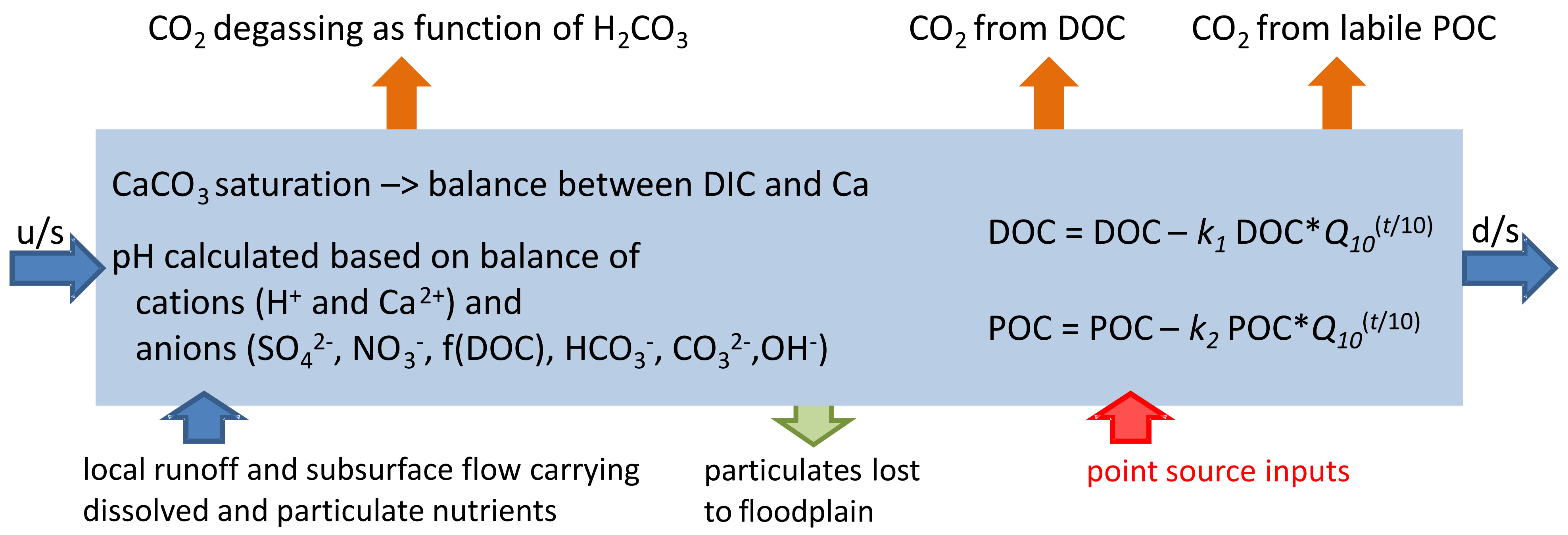
Example of the 5km generalised river network compared to 1:50k rivers



Application of flood plain losses model to a 35km stretch of the River Swale-Ouse, Yorkshire, using LOIS data

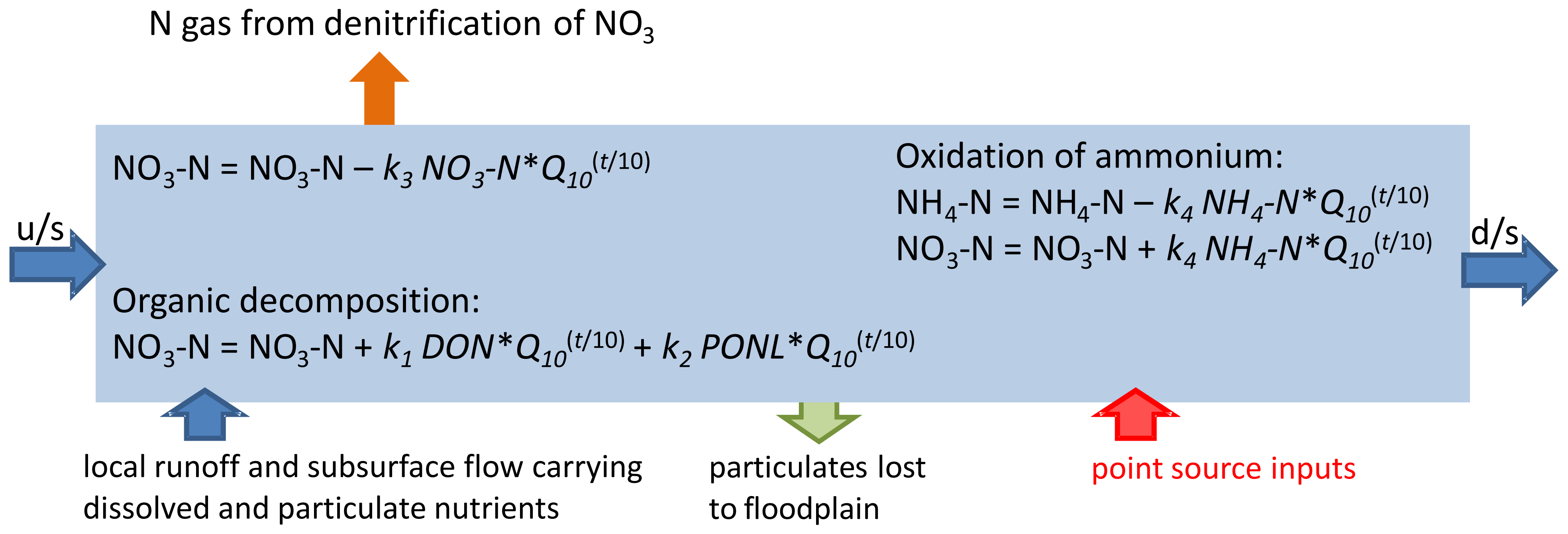
CHEMICAL TRANSFORMATIONS WITHIN RIVER REACHES

- pH, pCO_2, degassing, decomposition of DOM and POM



k_1, k_2, k_3, k_4 are rate coefficients
Q_{10} is rate of change consequent on increasing temperature by 10°C
t is water temperature

- denitrification and oxidation of NH_3



References

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Foy *et al*. (1995) Upward trend in soluble phosphorus loadings to Lough Neagh despite phosphorus reduction at sewage treatment works. *Water Research*, **29**, 1051-1063.

Nicholas *et al*. (2006) Development and evaluation of a new catchment-scale model of floodplain sedimentation . *Water Resources Research*, **42**(10).

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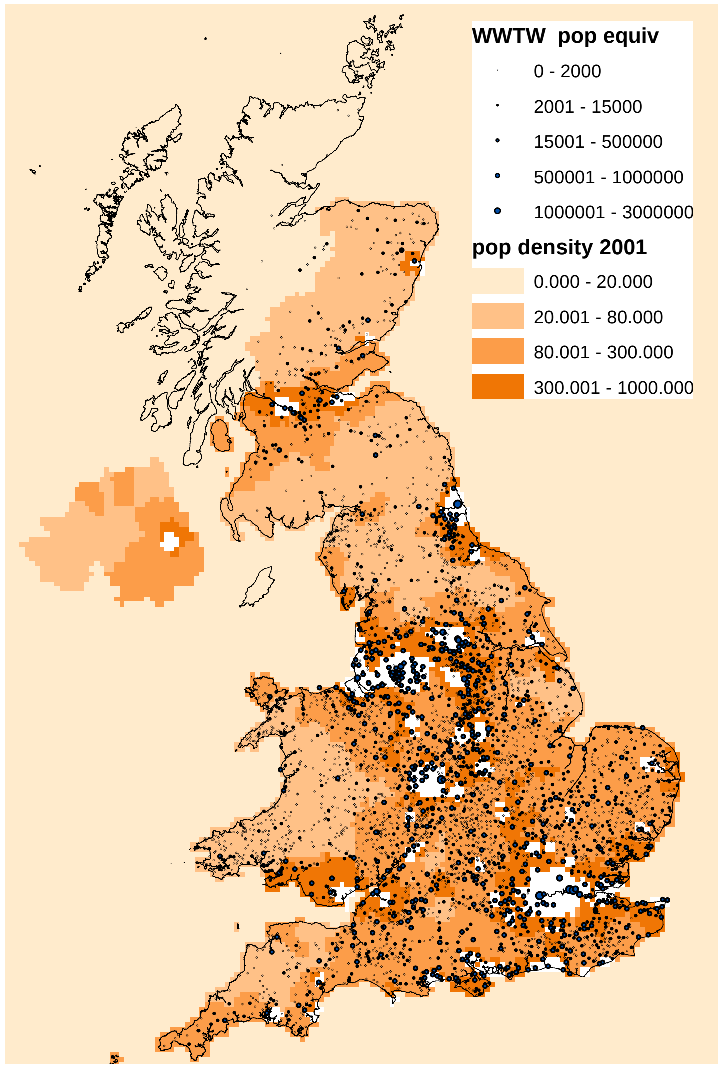
ESTIMATING WASTEWATER INPUTS FROM POPULATION

Nutrient load = f(population, amount/person, connection to sewer, loss on treatment)



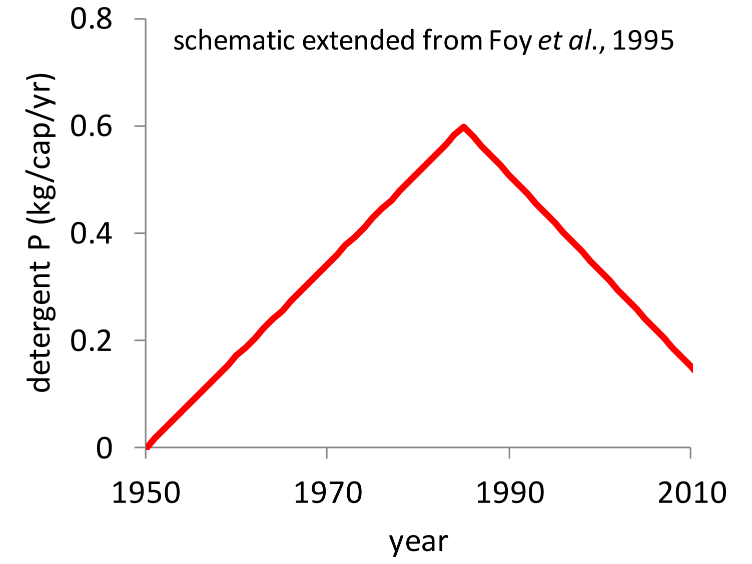
Wastewater treatment works population equivalents and population density /km^2 for 2001 (urban areas >500/km^2 are shown in white)

Nutrients/person

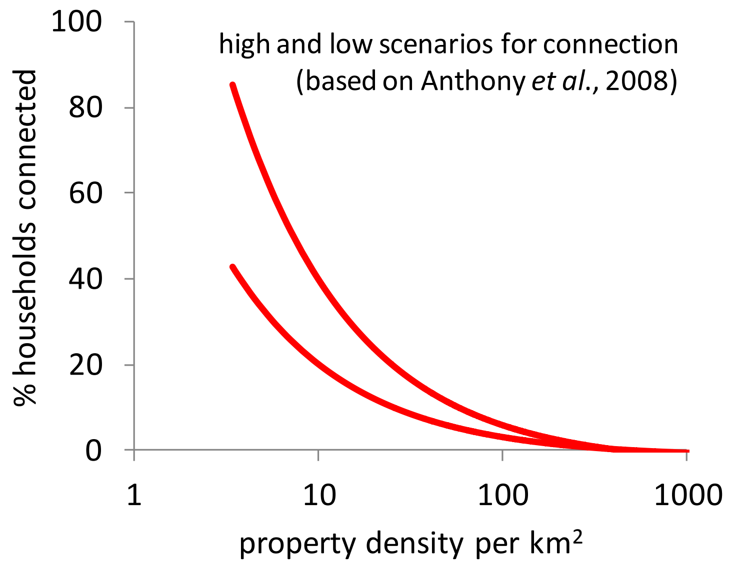
N: 3.94-4.56 kgN/person/yr *f(protein in diet)*

P: 0.44-0.65 kgP/person/yr *(in diet)*

C: 11 kgC/person/yr



Change in detergent P inputs over time



Estimating connection to sewer

Nutrient loss in wastewater treatment

	%N	%P	%C
Primary	10-20	10-30	50
Secondary	20-40	20-40	90
Tertiary	60	85-97	90
P-stripping		99	
septic tanks	40-50	10-80	40-50

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