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Modelling pollutants in runoff from the Colworth experimental catchment

- Narayanan Kannan, Sue White, Fred Worrall and Mick Whelan

OBJECTIVES

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Model pesticide behaviour at the small catchment scale using SWAT-2000

Test and upgrade the model to improve suitability for UK conditions

Feed developments into the TERRACE model

TERRACE - **T**errestrial **R**unoff modelling for **R**isk **A**ssessment of **C**hemical **E**xposure

OUR REQUIREMENTS

1. Proper modelling of crop growth and ET
2. Acceptable performance in
   a) hydrological modelling
   b) sediment modelling
   c) Pesticide modelling
   d) Scenario trials

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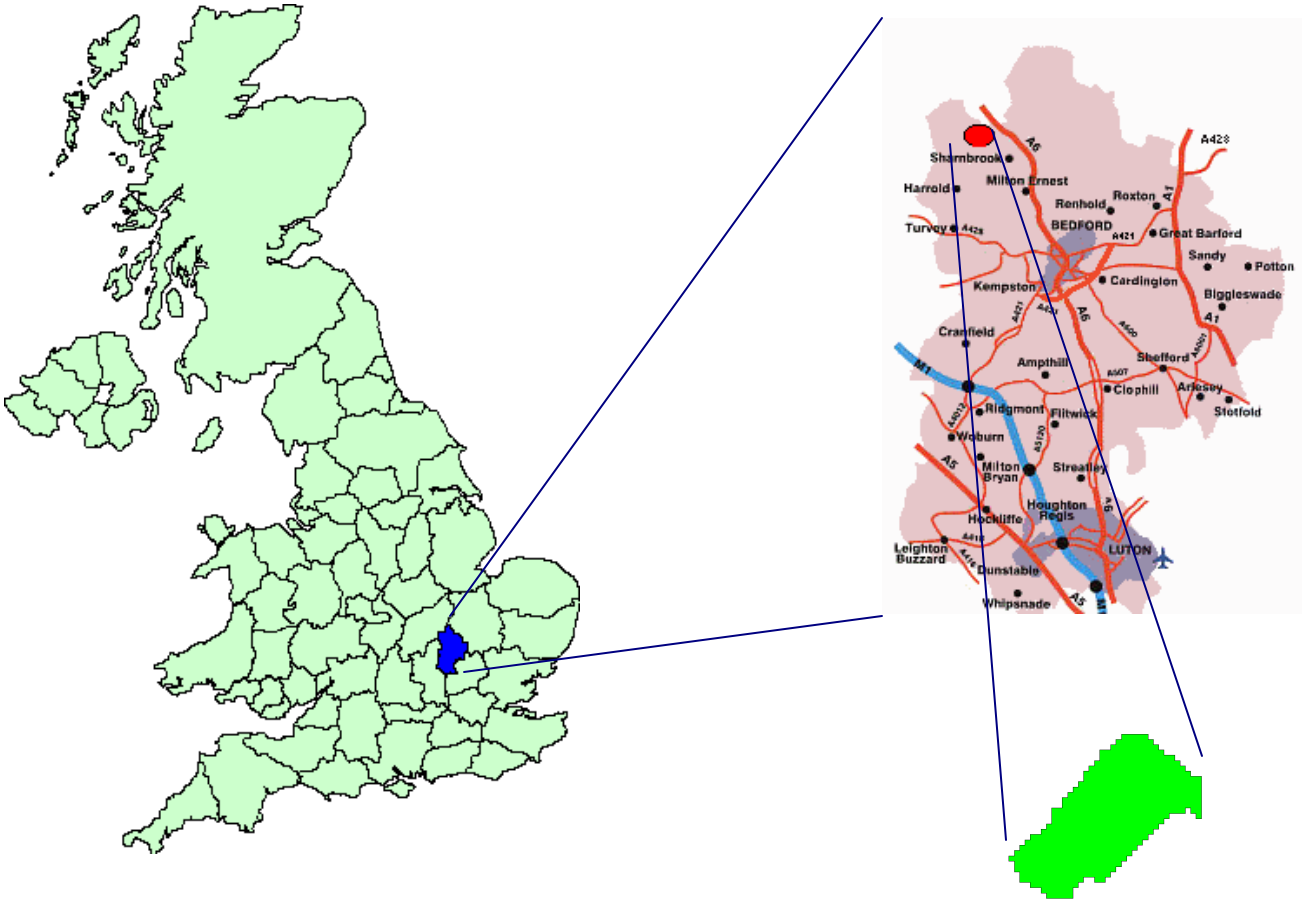
BEDFORDSHIRE



UNITED KINGDOM

COLWORTH CATCHMENT

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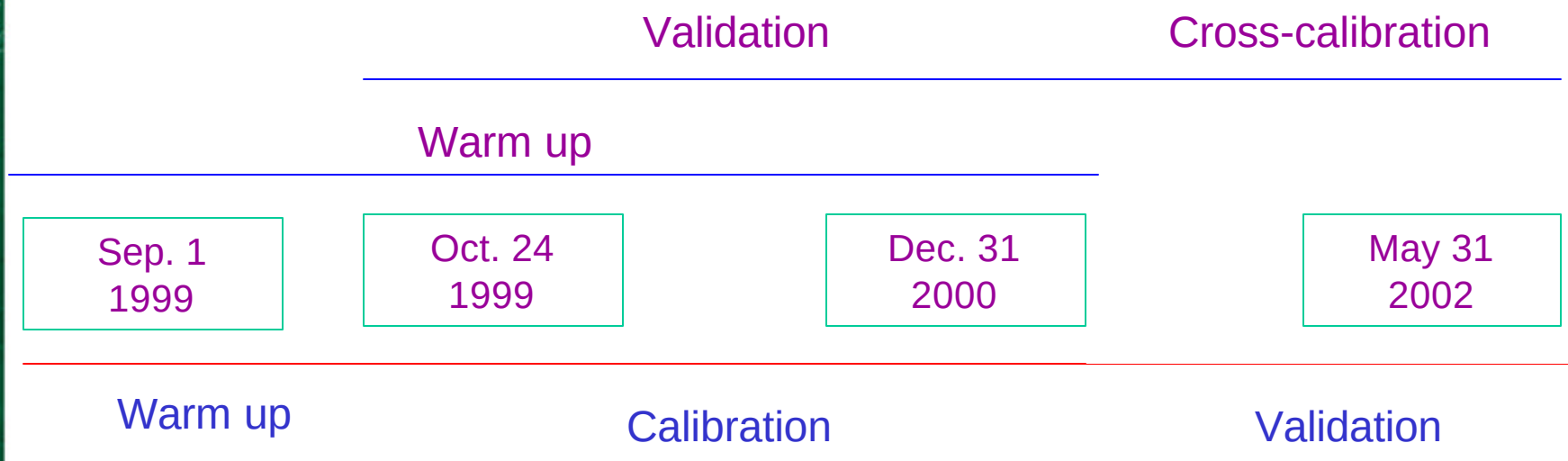
DIFFERENT CALIBRATION SCHEMES

	Runoff modelling		Evapotranspiration	
	Curve Number	Green & Ampt	Hargreaves	Penman Montieth
Scheme 1	x		x	
Scheme 2	x			x
Scheme 3		x	x	
Scheme 4		x		x



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SENSITIVITY ANALYSIS

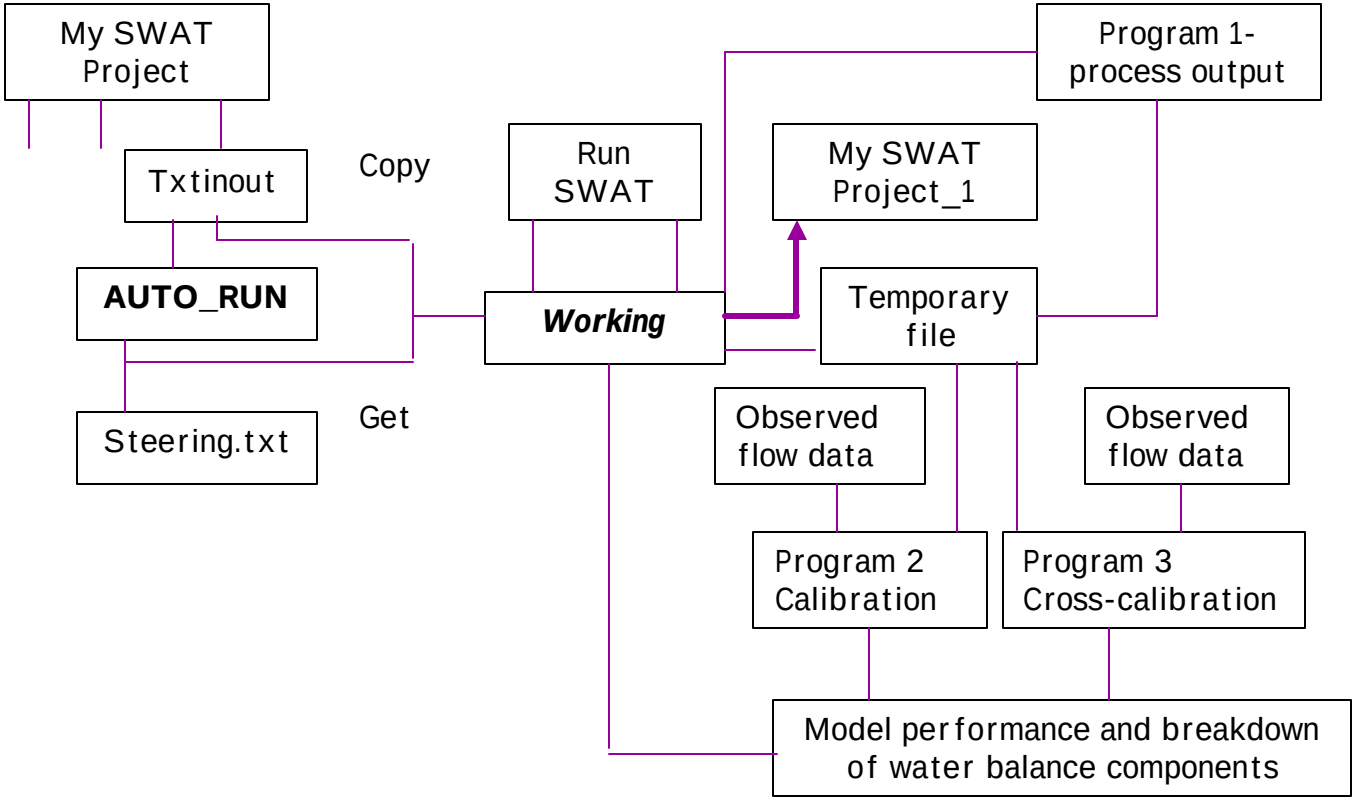
Sensitive parameters

1. A threshold-decides quantity of base flow - GWQMN
2. Soil evaporation compensation factor - ESCO
3. Available water capacity - AWC
4. Saturated hydraulic conductivity – K_{sat}

Three ranges considered – Low, Medium and High

Green & Ampt method (3x3x3x3=81) Curve Number (81x3=243)

CALIBRATION SET UP



AUTORUN — PERL SCRIPT + FORTRAN

PERFORMANCE EVALUATION OF HYDROLOGICAL MODELLING

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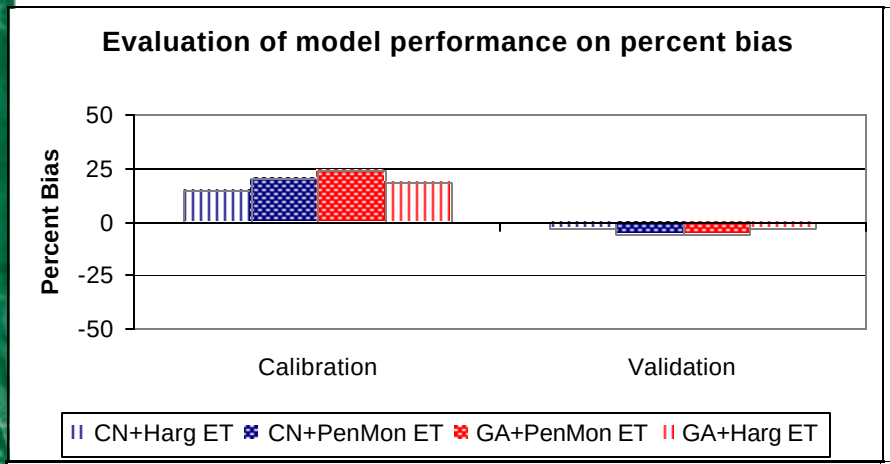

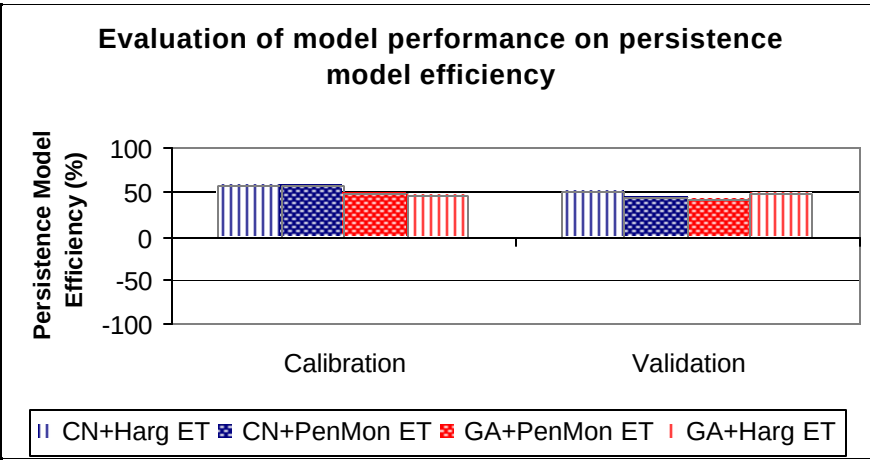

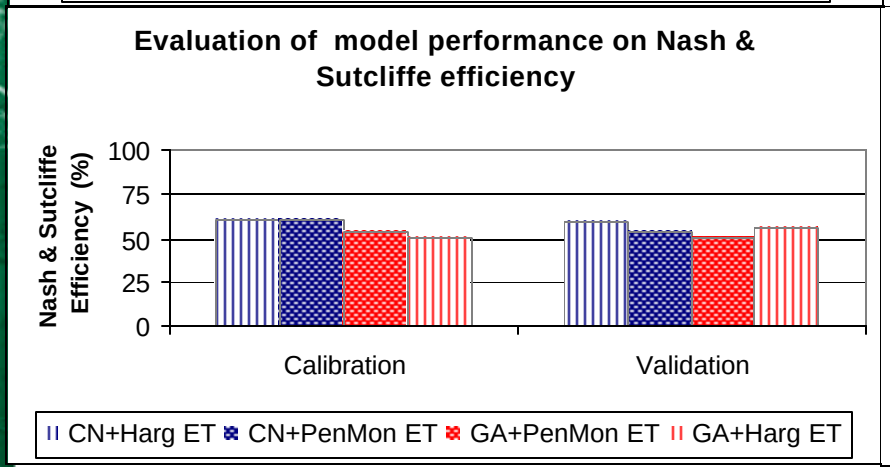

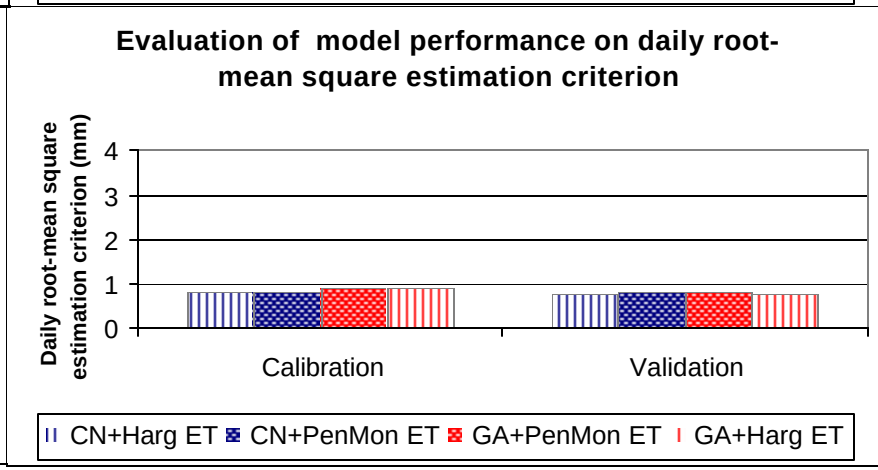

CN-Curve Number GA-Green and Ampt

Harg- Hargreaves PenMon-Penman-Montieth

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CALIBRATION OR CROSS-CALIBRATION?

Period	Method	PBIAS	PME	NSE	DRMS
Oct. 1999 to Dec. 2000 (wet period)	Calibration-Validation	14.84	57.35	61.20	0.80
	Validation-Cross-calibration	26.20	53.38	57.59	0.84
Jan. 2001 to May 2002 (dry period)	Calibration-Validation	-3.15	51.46	59.57	0.74
	Validation-Cross-calibration	12.39	53.18	61.00	0.72

Wet period – Above average rainfall

Dry period – Below average rainfall

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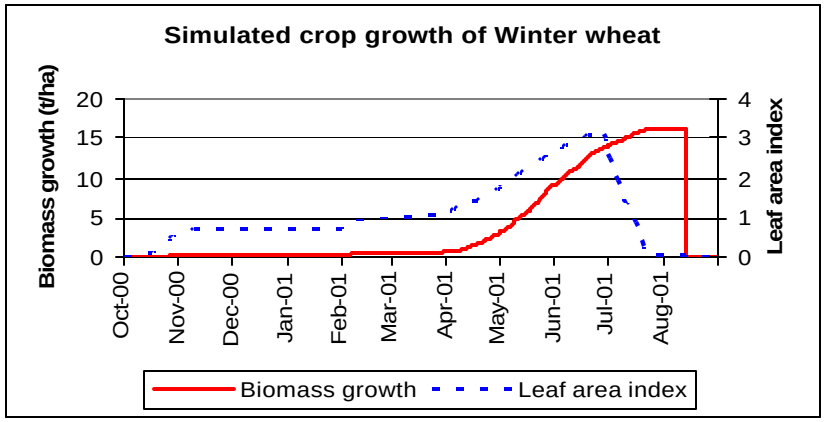
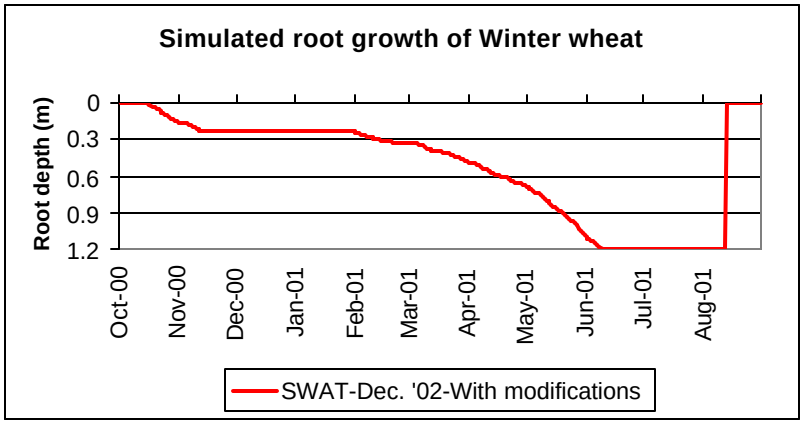
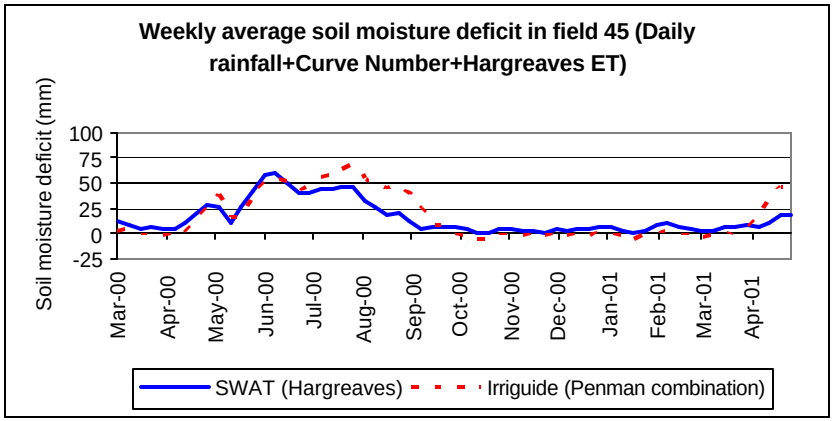
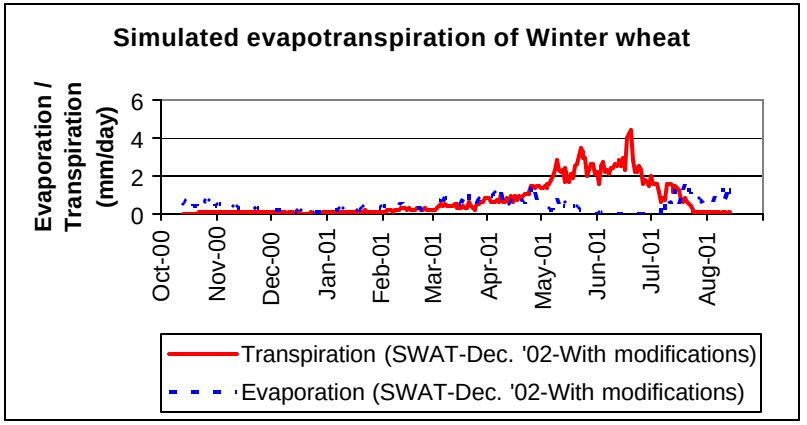
PROCESSES DRIVING WATER BALANCE









COMPARISON OF PREDICTED AND OBSERVED DAILY STREAM FLOW

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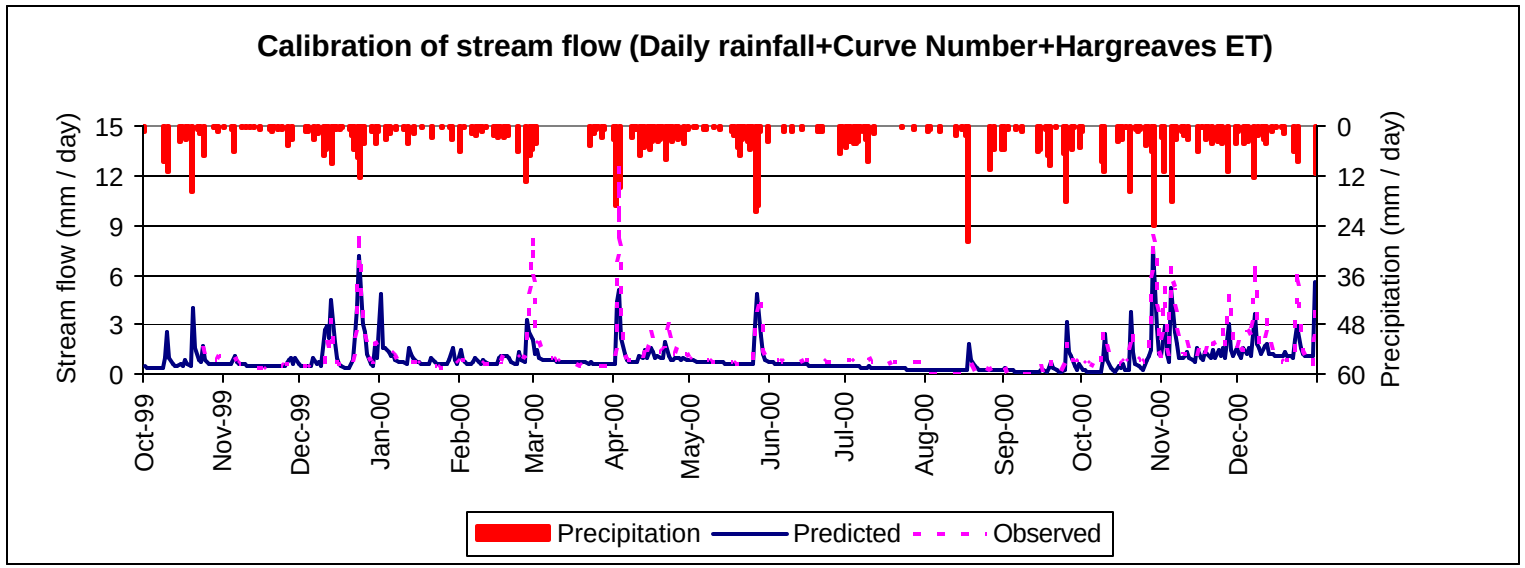

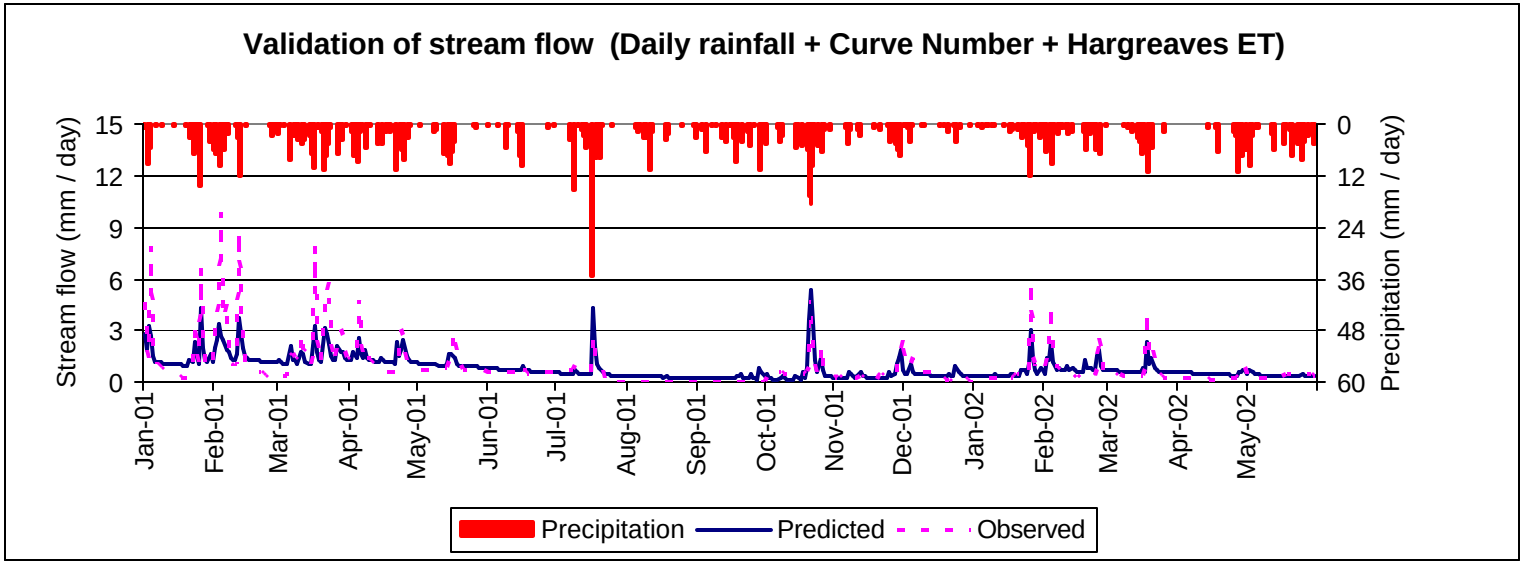

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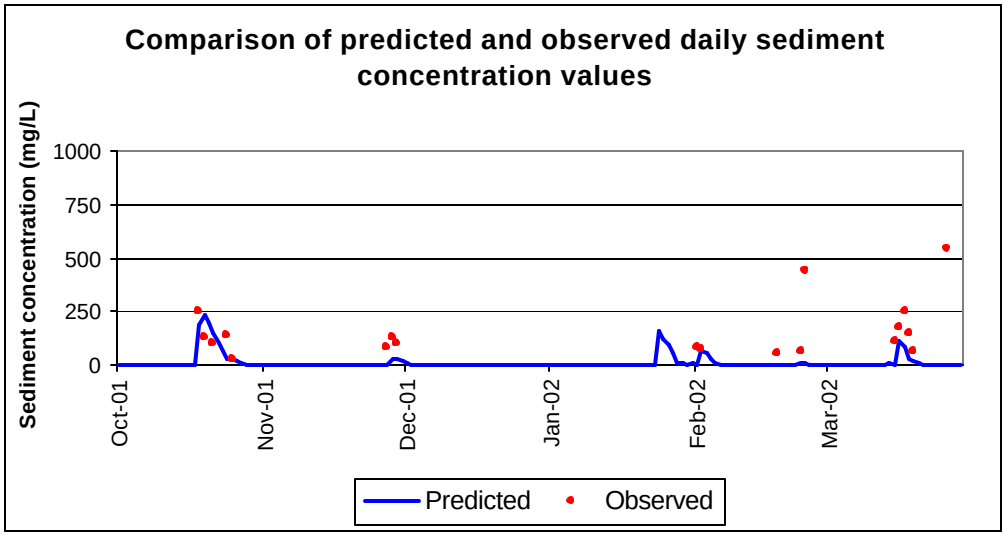
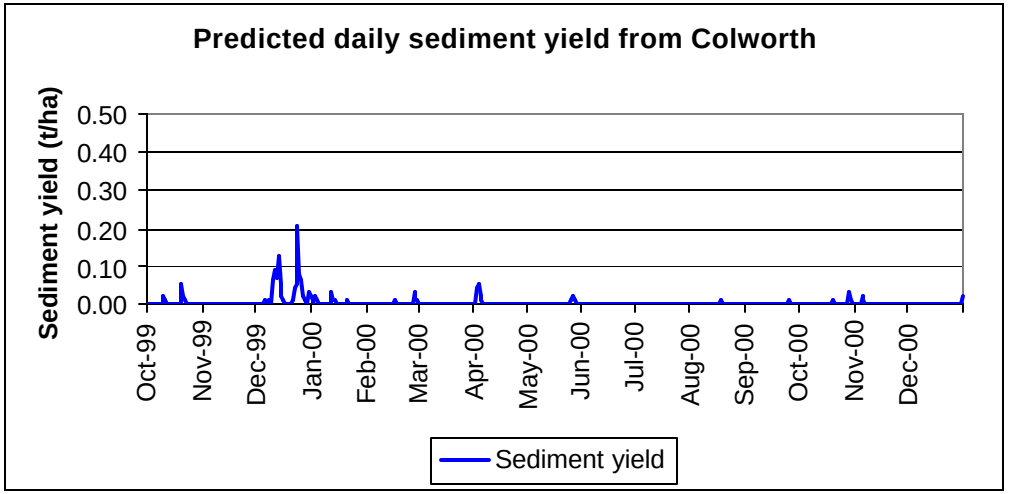
RESULTS OF SEDIMENT MODELLING





Annual sediment yield (Oct. 1999 to Sep. 2000)=1.43 t/ha/year

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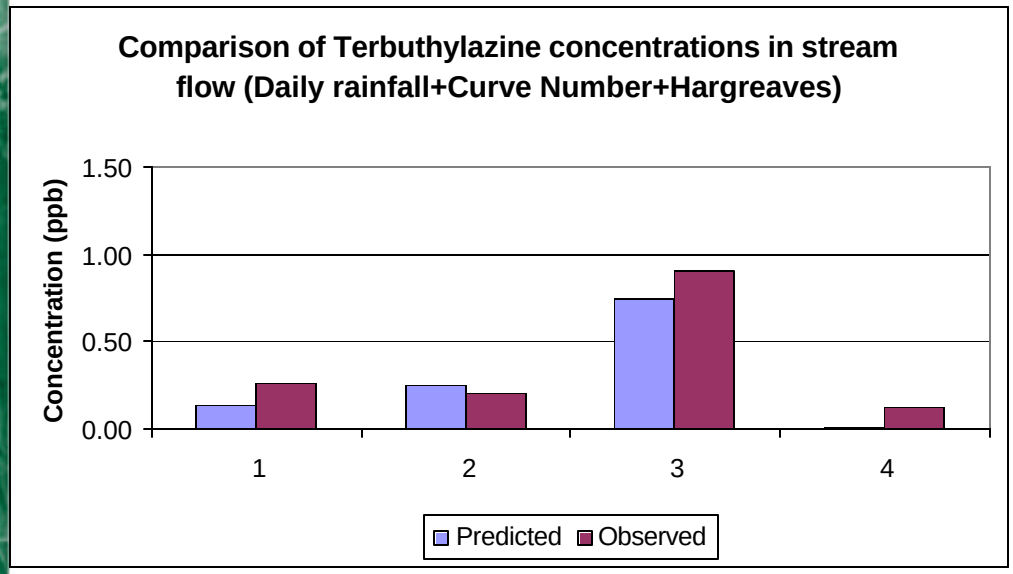


Terbuthylazine

Pesticide application : April 1

Event 1 : April 13-April 16

Event 2: April 22-April 23

Event 3 : May 26-May 28

Event 4 : Oct. 9-Oct. 10

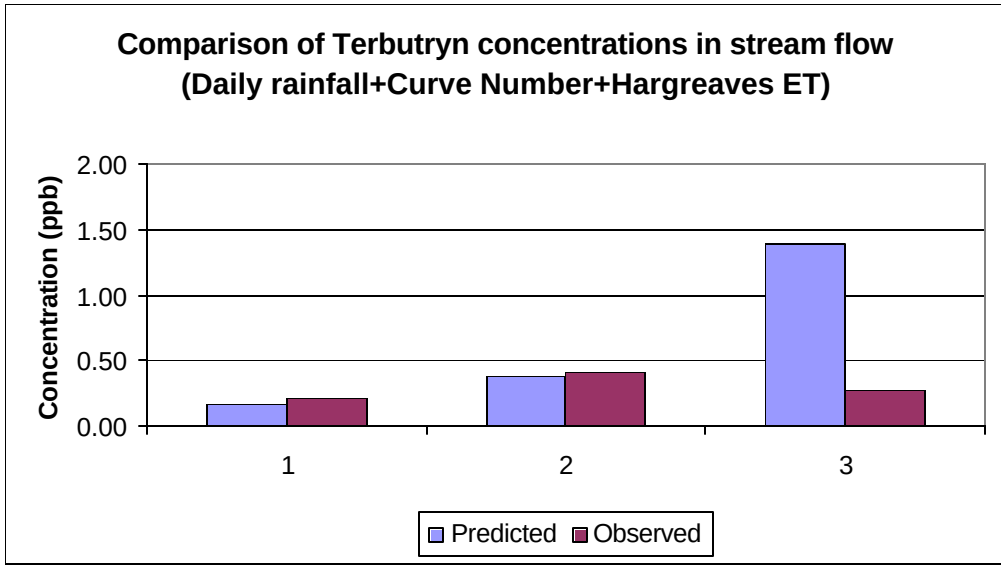
Terbutryn

Pesticide application : April 1

Event 1 : April 13-April 16

Event 2: April 22-April 23

Event 3 : May 26-May 28



THE FUTURE

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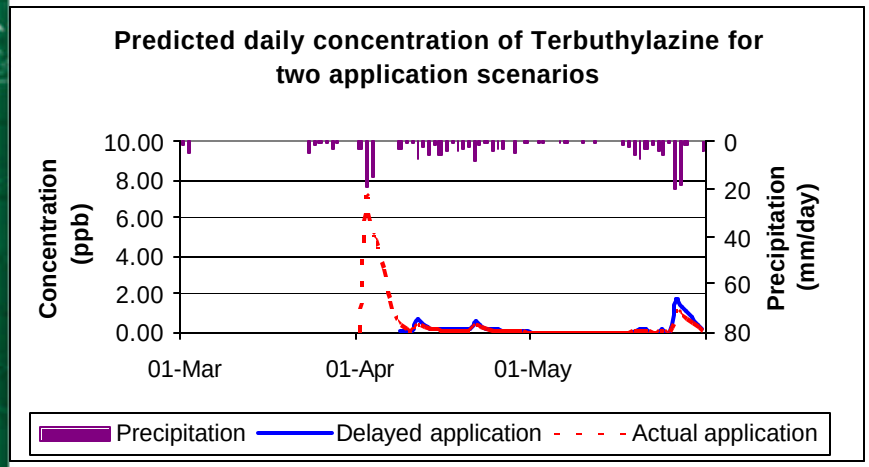
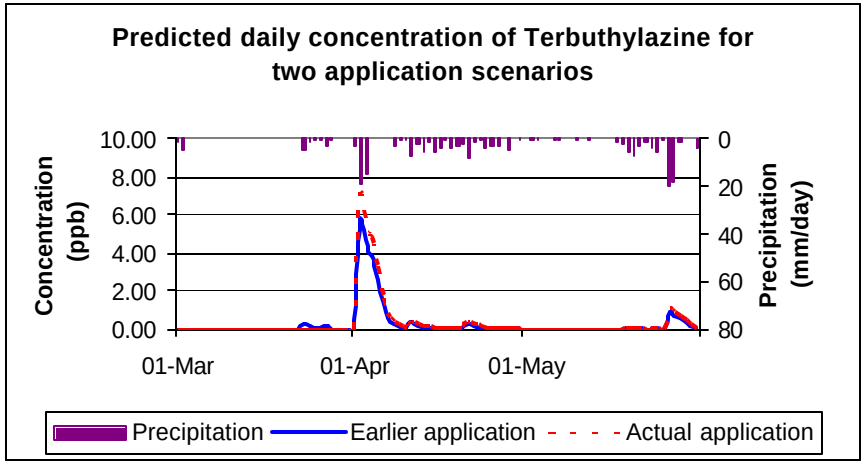
- Scenario trials – Change in pesticide behaviour for a change in land use, rainfall pattern etc.

  -Predicting the optimum time for pesticide application based on weather forecast and soil moisture conditions





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CONCLUSIONS

- Calibrating SWAT for wet conditions gives better results than calibrating for dry conditions
- The Curve Number method can be used to simulate stream flow under United Kingdom conditions
- SWAT adequately simulates stream flow with simultaneously correct simulation of processes controlling water balance
- SWAT can be used as a tool to understand pesticide behaviour

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ACKNOWLEDGEMENTS

1. Unilever – Funding this work
2. Agricultural Development and Advisory Service – Collecting data
3. British Atmospheric Data Centre – Access to weather data