



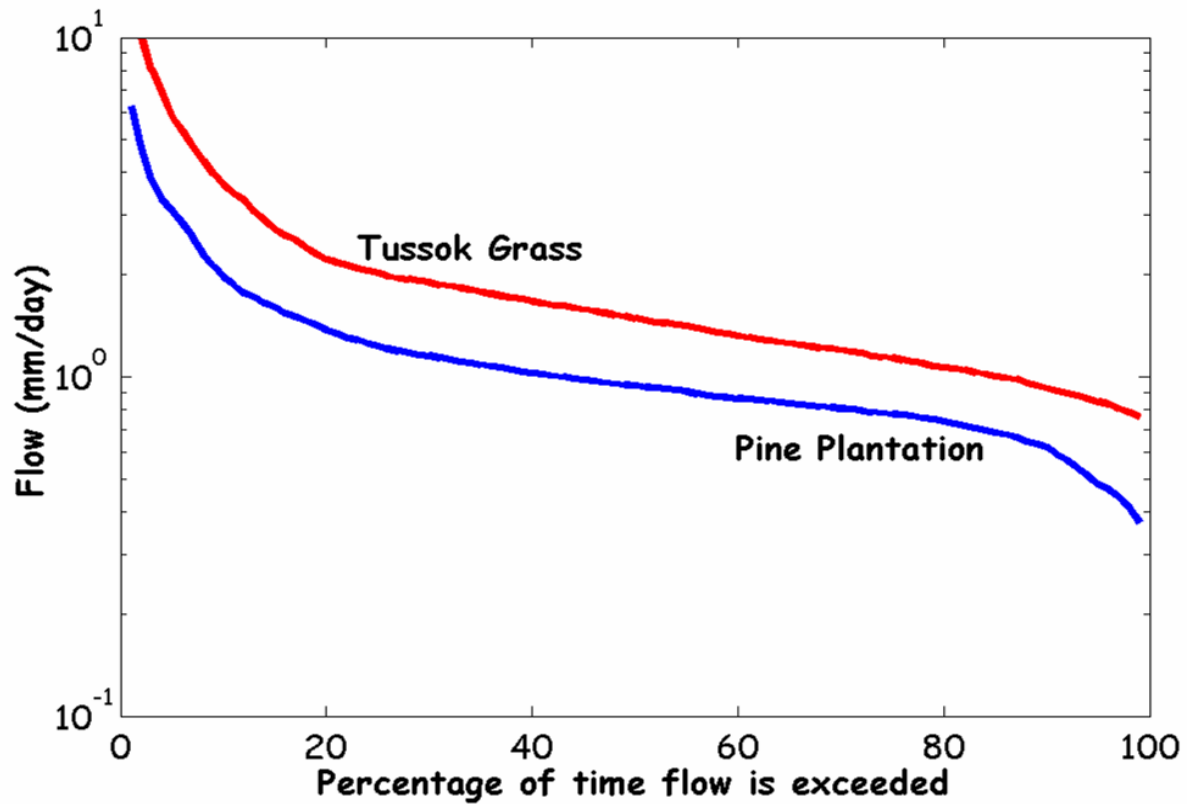
Predicting the Impacts of Afforestation on Flow Duration Curves

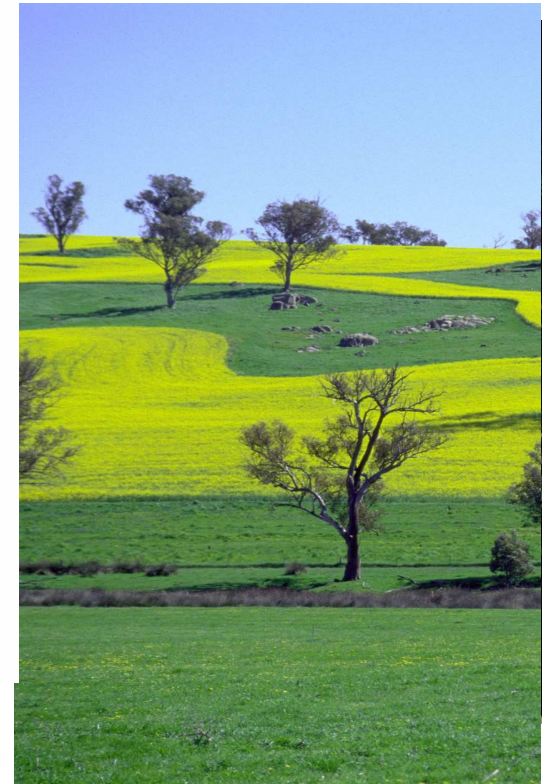
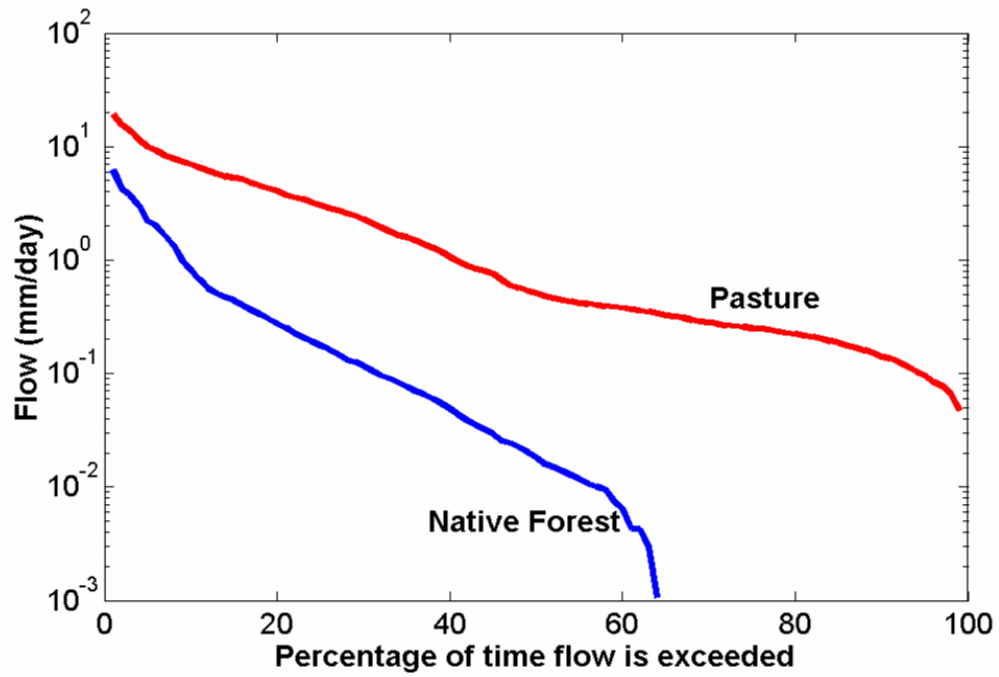
Lu Zhang, Alice Brown, Xiaoping Zhang

October 2005



Flow Duration curves under different vegetation types high rainfall area



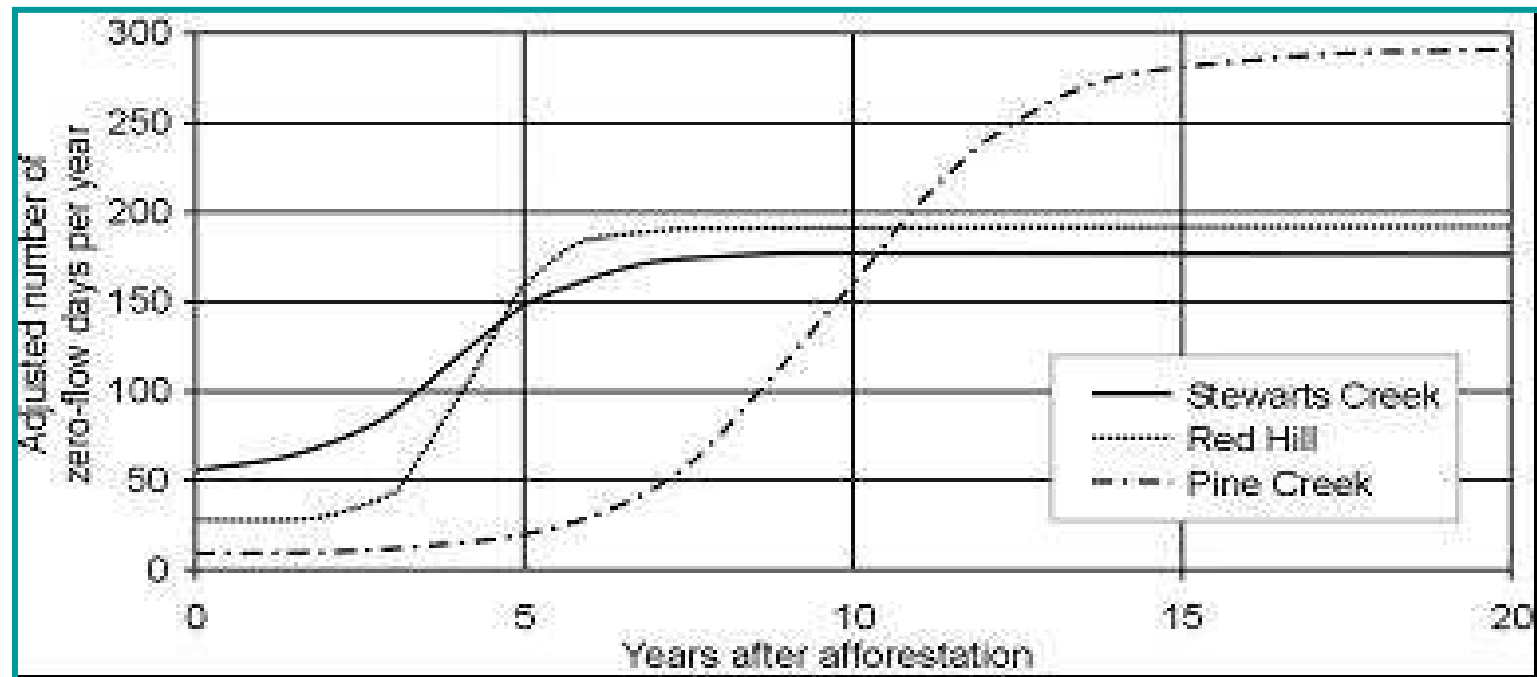




Increased zero-flow days



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Current Predictive Models



Mean annual water balance model (Zhang curves)



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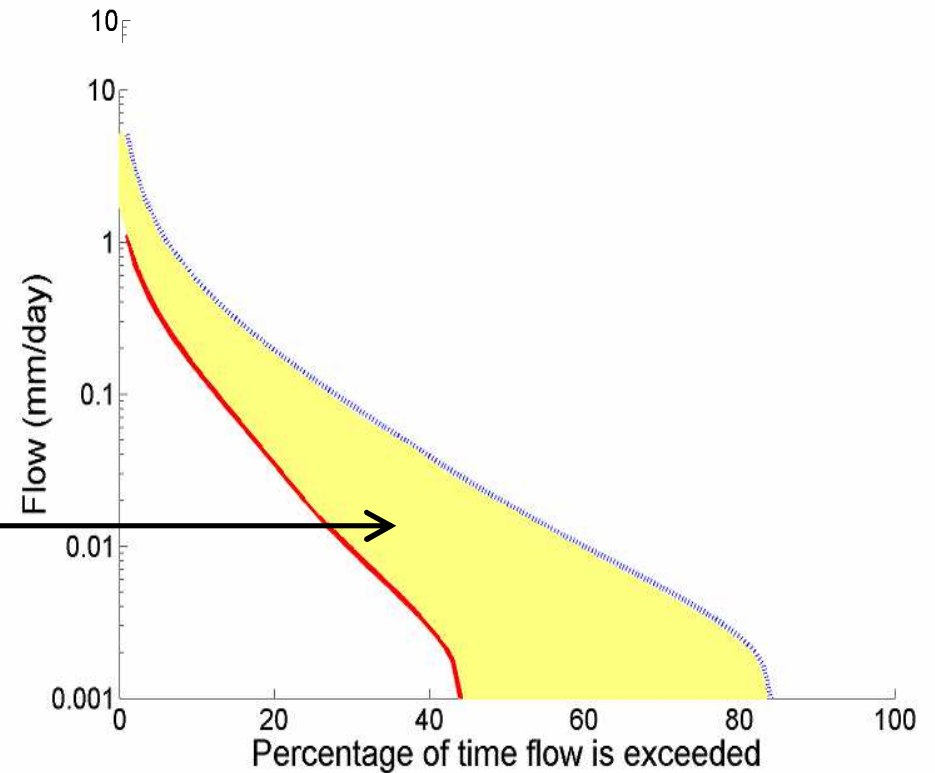
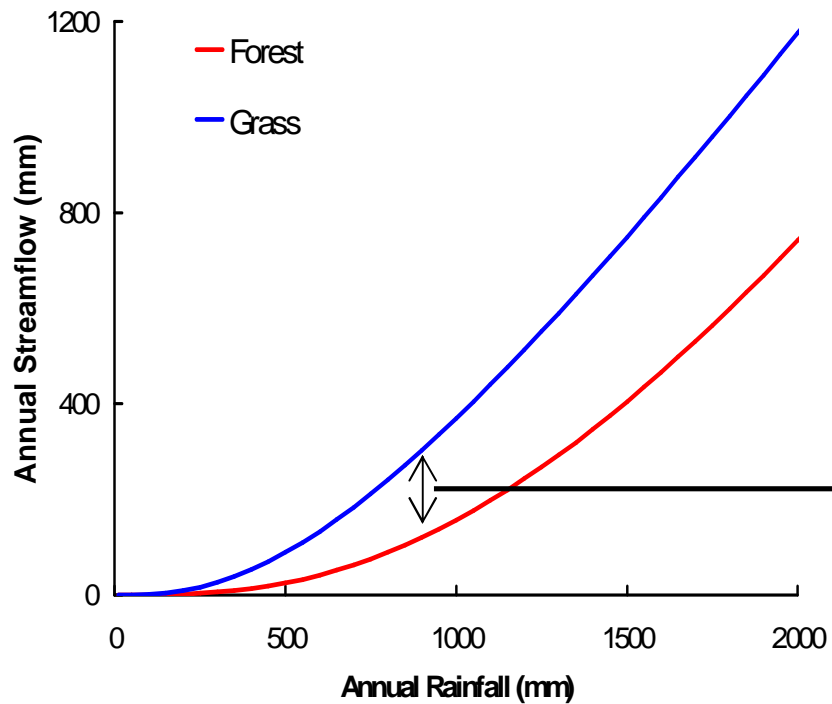




Current Predictive Models



AI
Interns





FDC and Vegetation changes

Developing a predictive model



Step 1

- Parameterise the FDC



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Parameterise the FDC

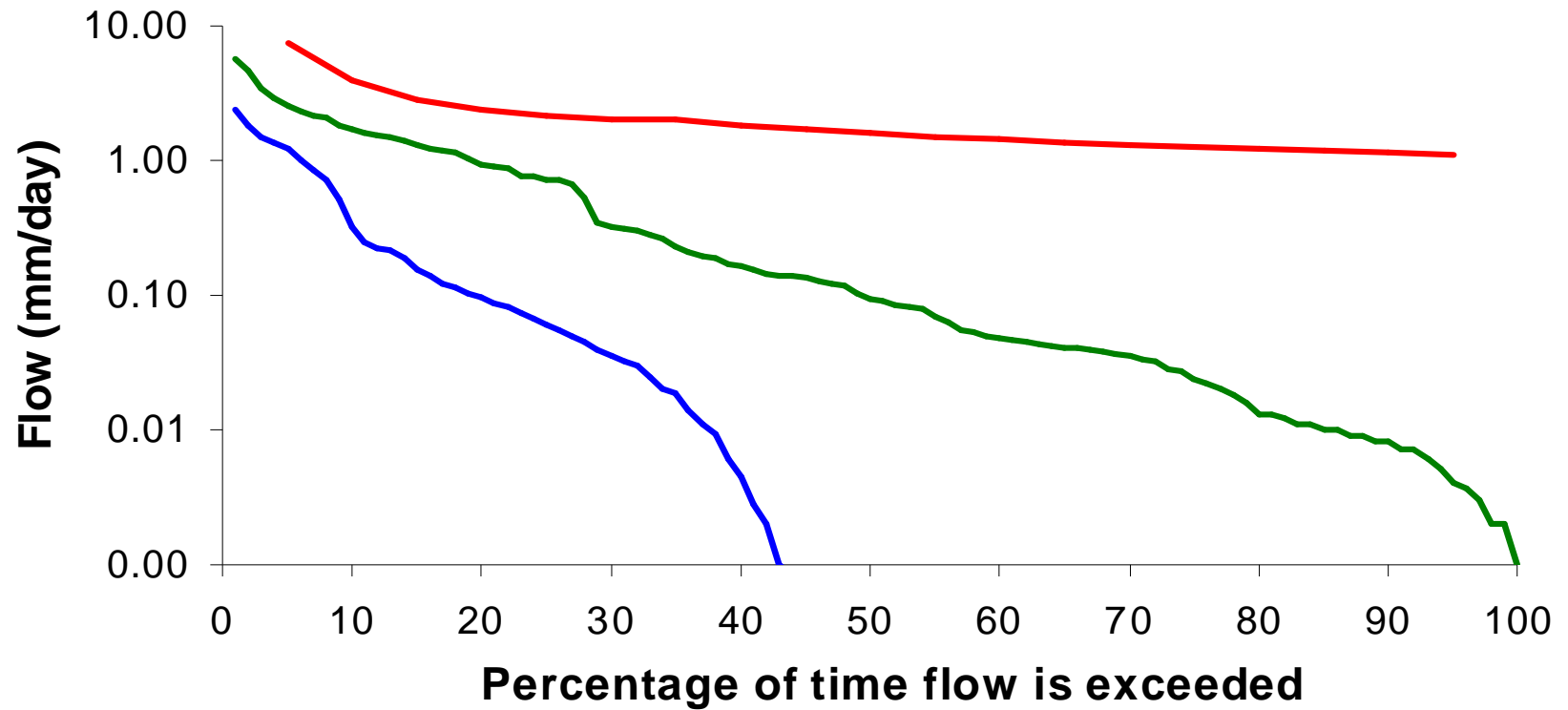


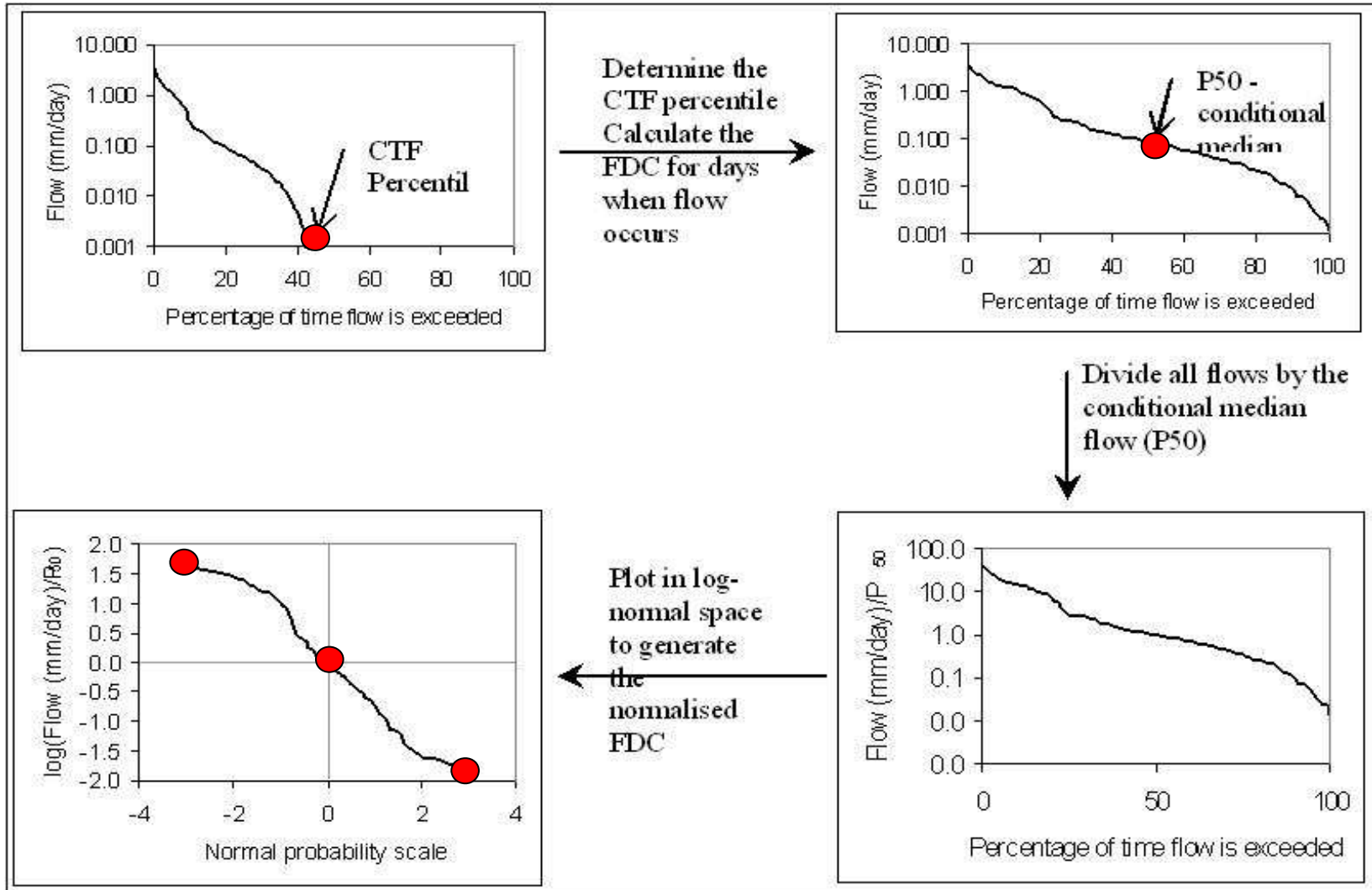
Develop a model that will allow the range of FDCs to be described

Steps involved



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FDCs and Vegetation change

A predictive model



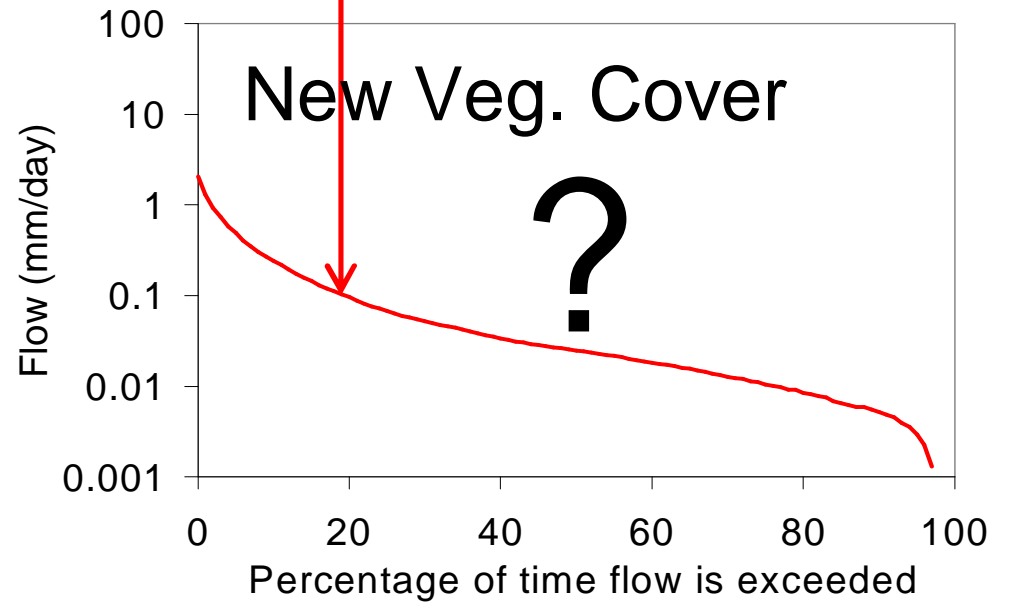
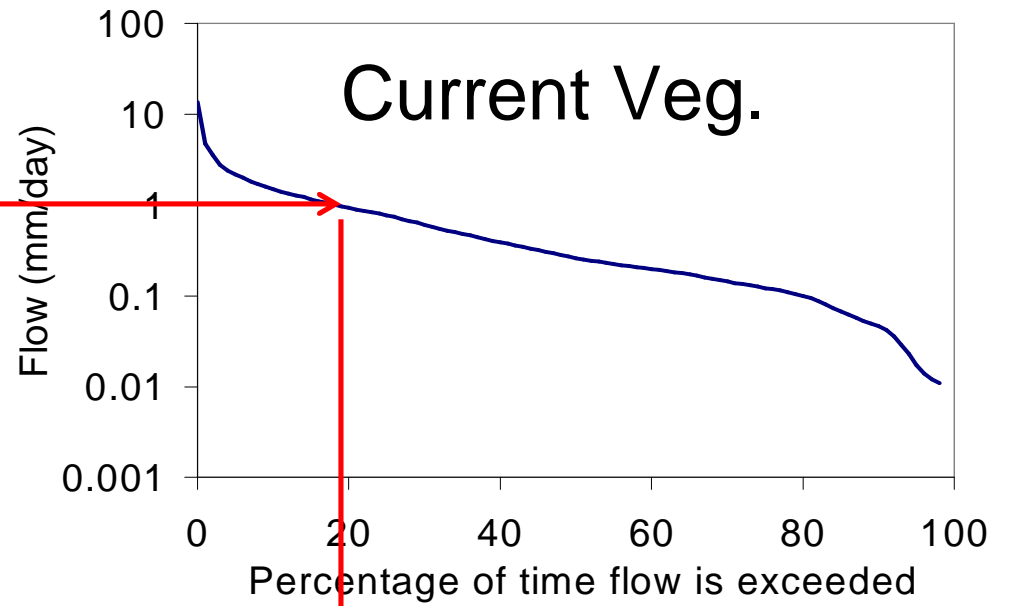
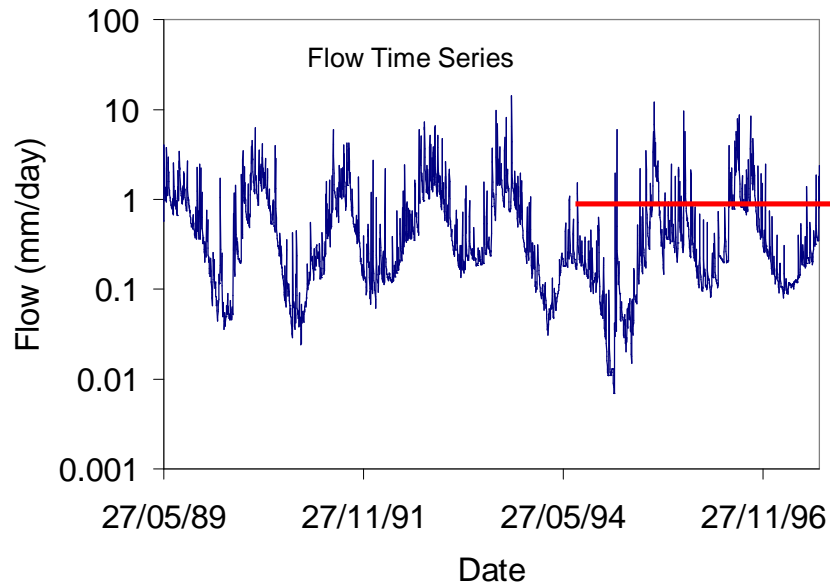
Step 1

- Parameterise the FDC

Step 2

- Link the parameterisation of the FDC to the mean annual water balance model of Zhang *et al.*



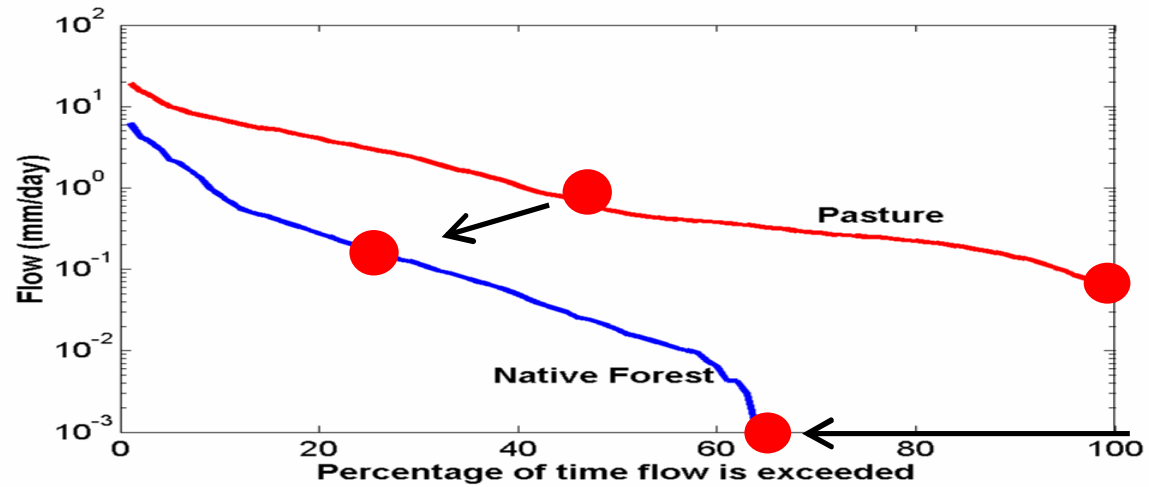
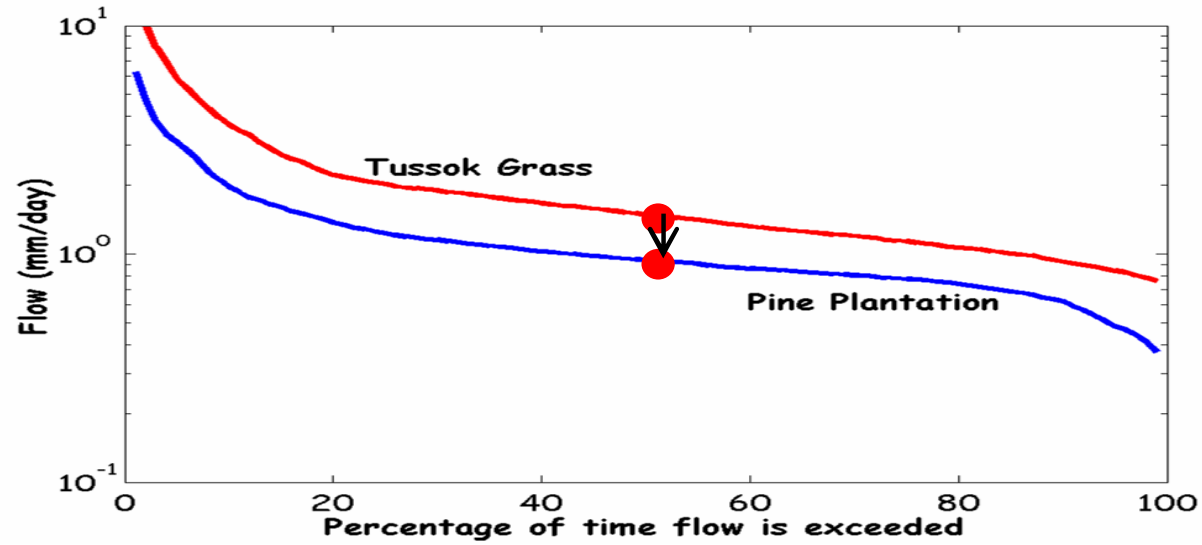




Type of responses



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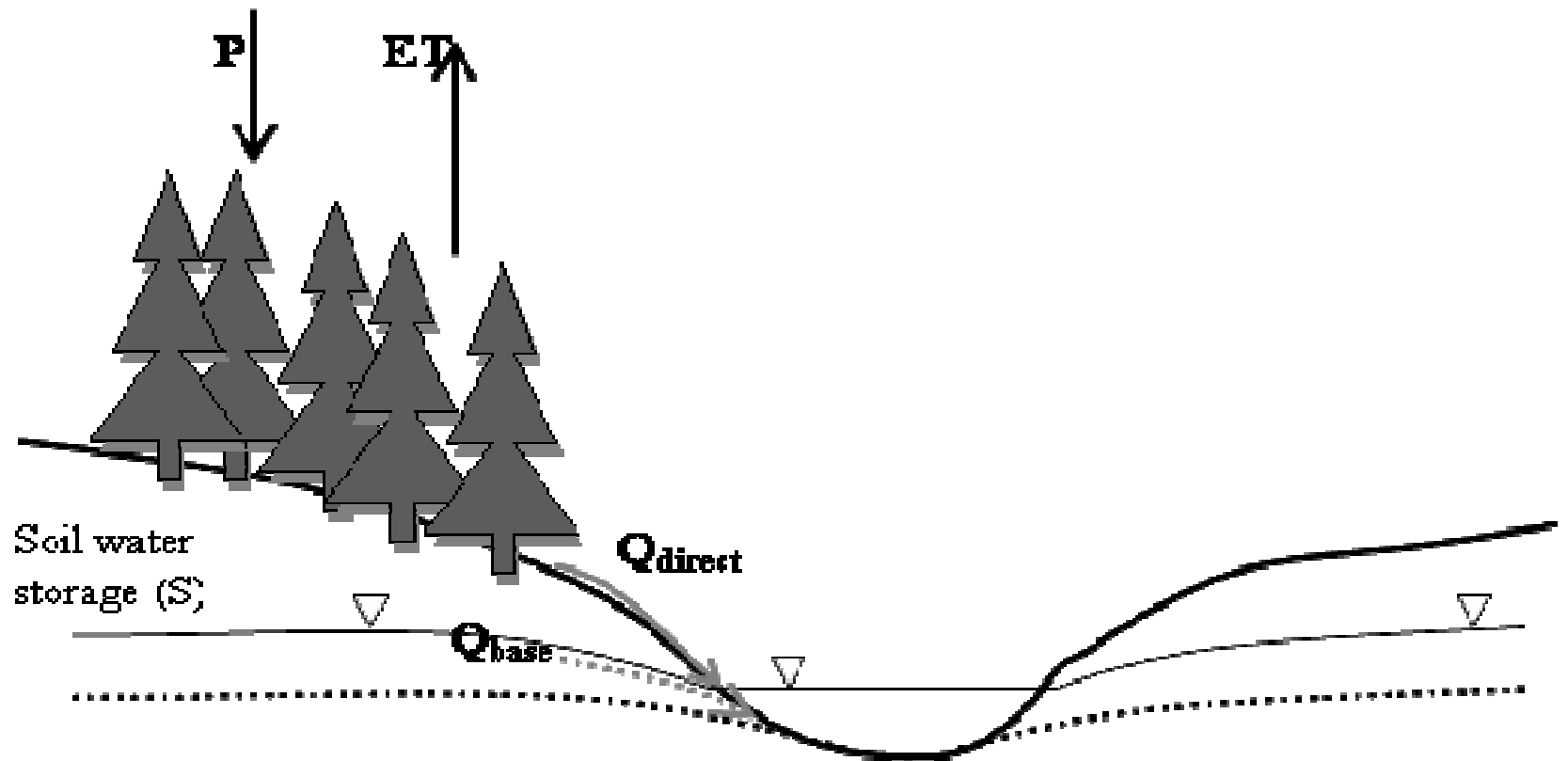




Adjusting the CTF



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CTF Percentile



A simple rainfall runoff model

- 3 parameters



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Aimed to get mass balance and pick up days when flow occurs.





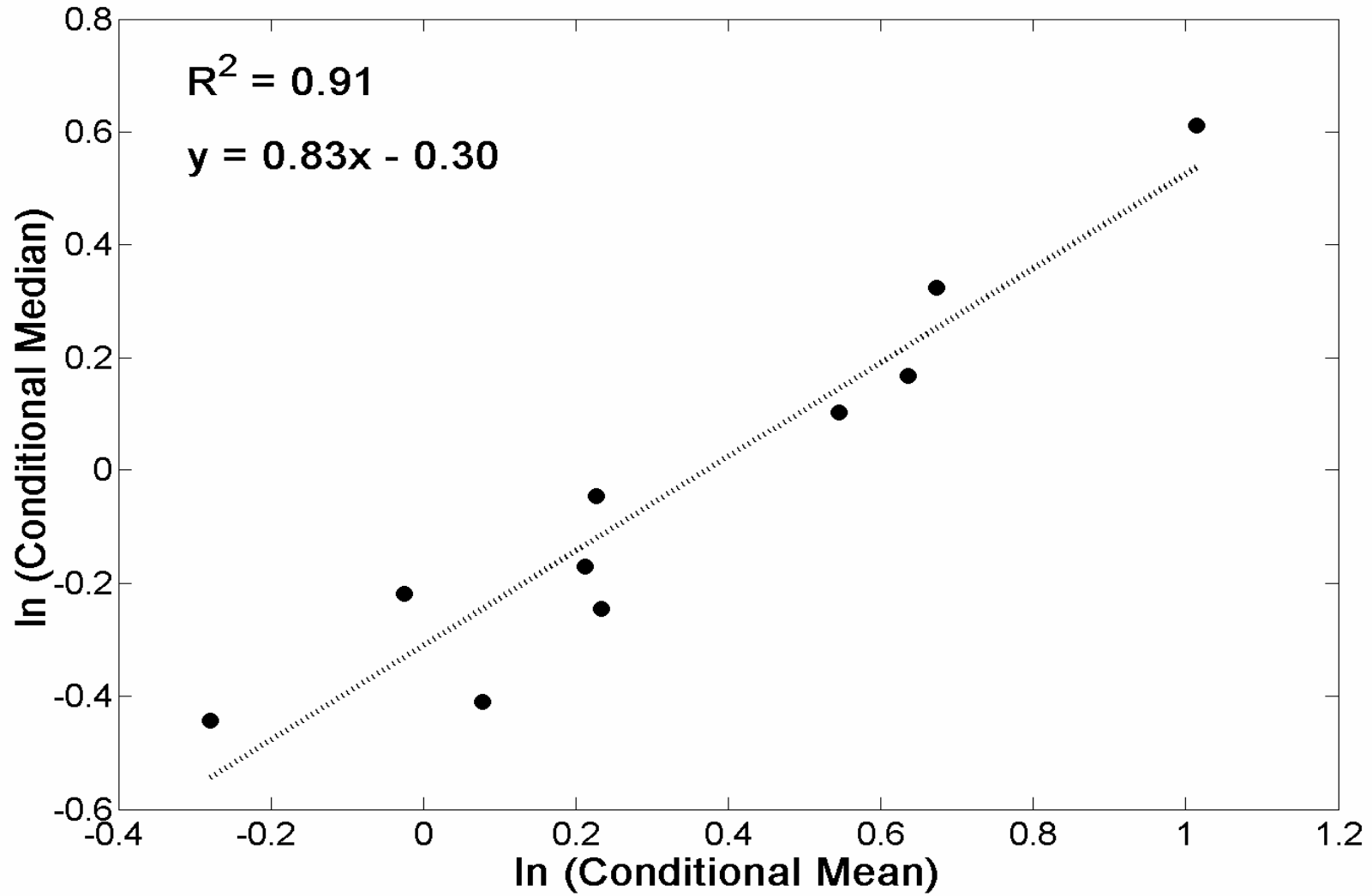
Median Flow

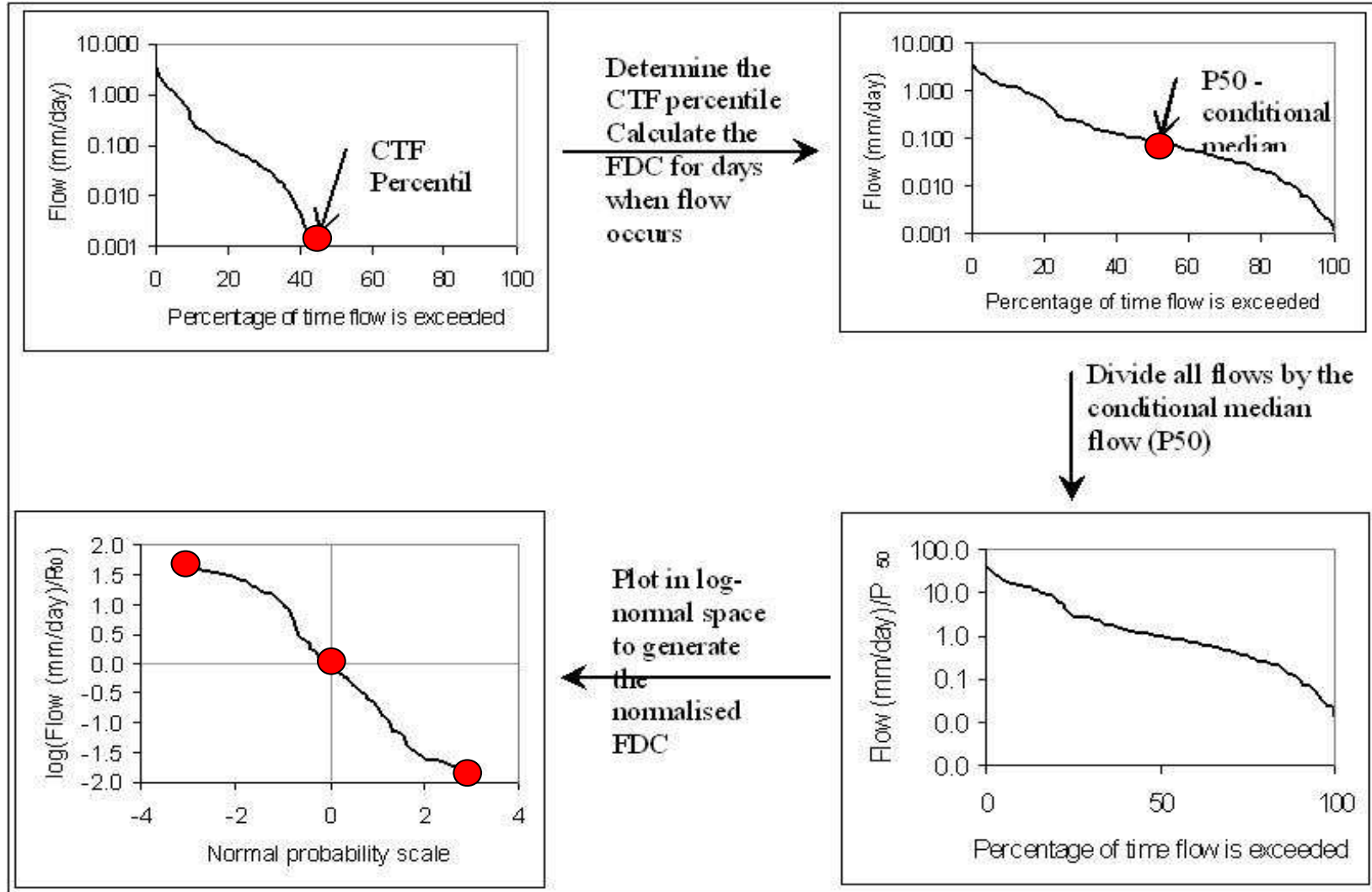


Water Year	Conditional					Mean
	Median	Slope	Upper	Lower		
1940	0.63	-0.26	-0.08	-0.62	0.82	
1941	1	-0.3	0.06	-0.49	1.28	
1942	1.63	-0.57	0.4	-0.94	2.66	
1943	1.16	-0.43	0.13	-1.19	1.82	
1944	1.02	-0.31	-0.11	-0.62	1.47	
1945	1.37	-0.59	0.56	-1.21	2.13	
1946	1.27	-0.54	0.19	-1.18	2.27	
1947	1.04	-0.29	-0.13	-0.26	1.41	
1948	0.86	-0.39	-0.11	-1.07	1.44	
1949	1.2	-0.39	0.24	-0.67	1.62	



Median







Curve fitting parameters



Slope

- Determined as the slope for the period of record FDC

Lower exponent

- Determined from the slope and either the CTF percentile of 95% flow

Upper exponent

- Determined as the upper exponent for the period of record FDC



www.toolkit.net.au

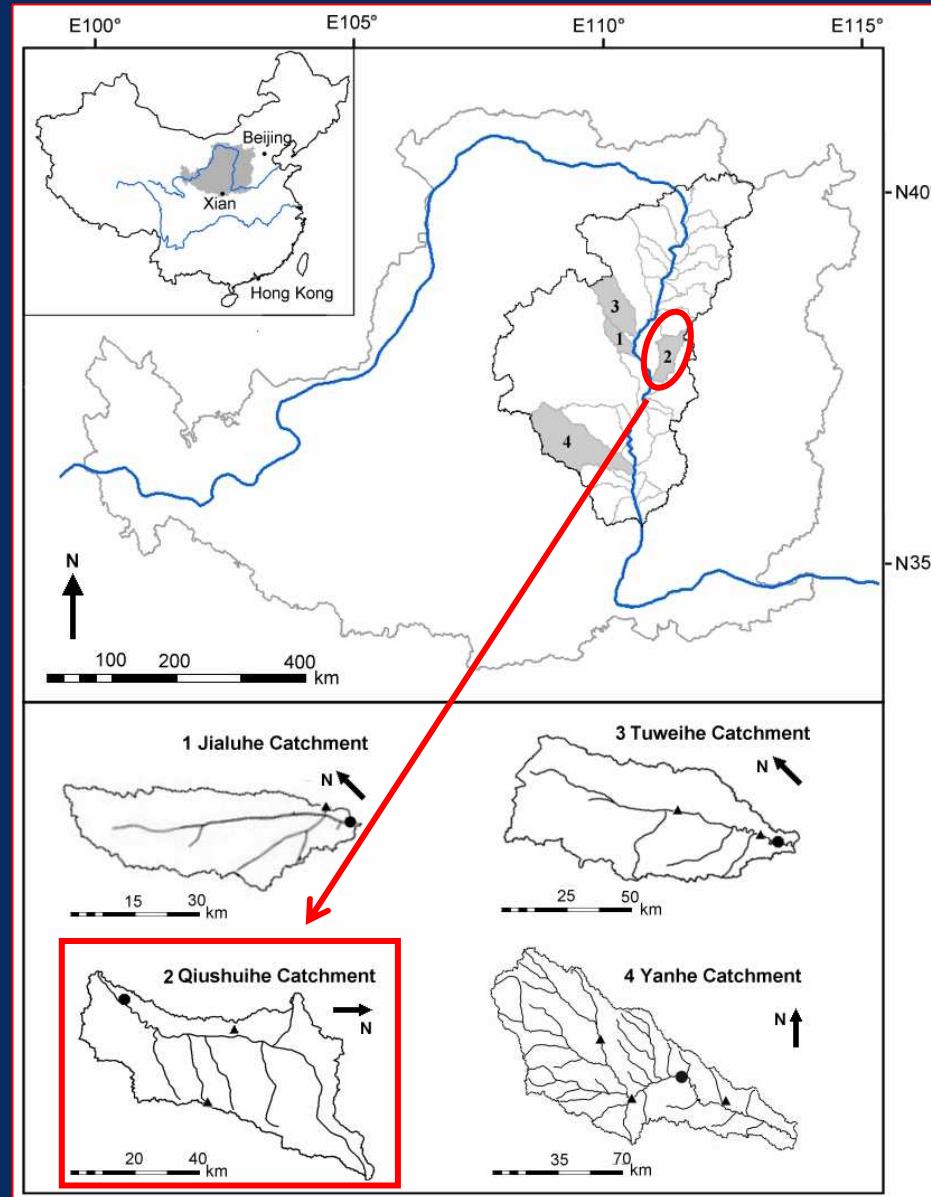
An example of predicting the impact of vegetation on the FDC

Quishui River

catchment
MODELLING **TOOLKIT**



Study Catchment



Quishui River



- Qiushui River catchment is characterized by loess hills and bed rocks; and is highly fragmented with gullies.
- Area of 1989 km²
- Average rainfall of 509 mm
- Average potential evaporation of 1820 mm





Complex soil conservation measures



Catchment	Year	Terrace		Dams		Afforestation		Pasture		Total	RPC
		km ²	RA(%)	km ²	RA(%)	km ²	RA(%)	km ²	RA(%)	km ²	%
Qiushui (1,989 km ²)	1969	72.4	59	4.6	4	37.3	30	8.3	7	122.6	6.5
	1979	141.9	51	12.7	5	113.6	41	12.1	4	280.3	15.0
	1989	167.2	42	17.5	4	200.7	50	14.8	4	400.2	21.4
	1996	263.4	42	24.2	4	318.5	51	19.8	3	625.8	33.4

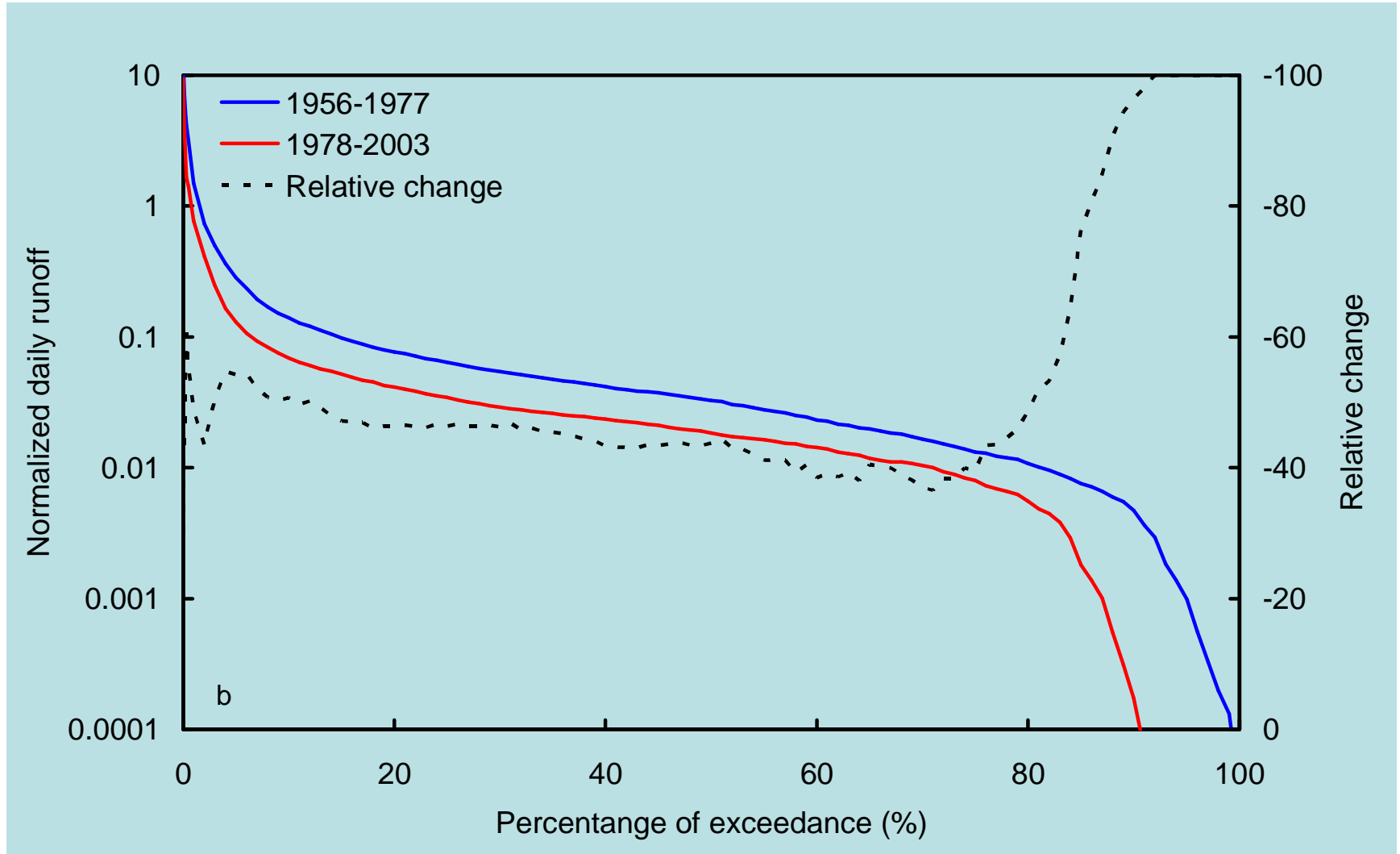




Changes in flow duration curves (FDCs)



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Input to FCFC

FCFC Wizard V1.0.0

Data Input

Daily flow data

Catchment area: km² Units:

Daily rainfall data

Daily PET data

Current forest proportion: %



Calibrating FCFC



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FCFC Wizard V1.0.0

Results
Click "Calculate" to estimate or re-estimate model parameters.

Calculate

Yearly flow duration shape parameters and statistics

Year	Con median	CTF	Slope	Upper	Lower	Mean	Con Mean	CF
1978	0.066	95.9	-0.497	-0.278	-0.197	0.187	0.195	0.9
1979	0.039	99.7	-0.203	-0.781	0.057	0.072	0.072	0.9
1980	0.033	96.2	-0.265	-0.629	0.196	0.063	0.066	0.9
1981	0.028	90.1	-0.374	-0.553	-0.491	0.089	0.099	0.8
1982	0.032	84.9	-0.323	-0.491	0.295	0.055	0.064	0.9

Mean-Median Correlation: 0.6657 Water year: Observed data Predicted data

Observed and fitted flow duration curves

Low flow parameters

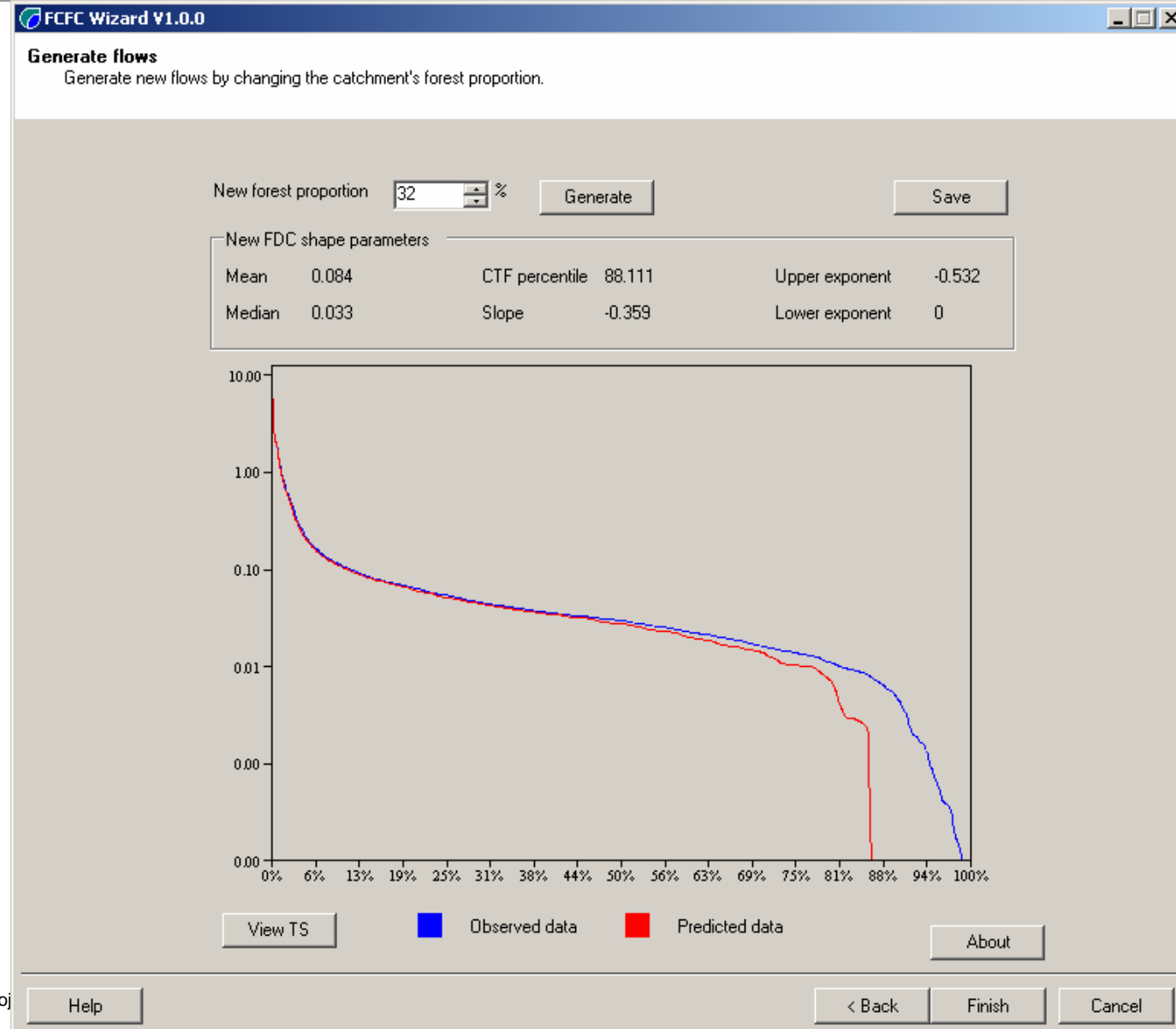
Smax: 49.32 mm
Smin: 0.18 mm
Sbase: 0 mm
Kbase: 0.00483 mm/d

Volume match (%) 0.006 Percentile match (%) 0.062 About

Help < Back Next > Cancel



Predicting change in FDC





Summary



- Afforestation will modify streamflow regime and a flow duration curve is a simple and powerful way to represent streamflow regime.
- The FCFC is a useful and practical tool to predict changes in flow duration curves due to afforestation.
- Application of the model to the Quishui River catchment showed encouraging results. However, more detailed analyses are required to understand the model parameters.





谢谢

Thank You

