



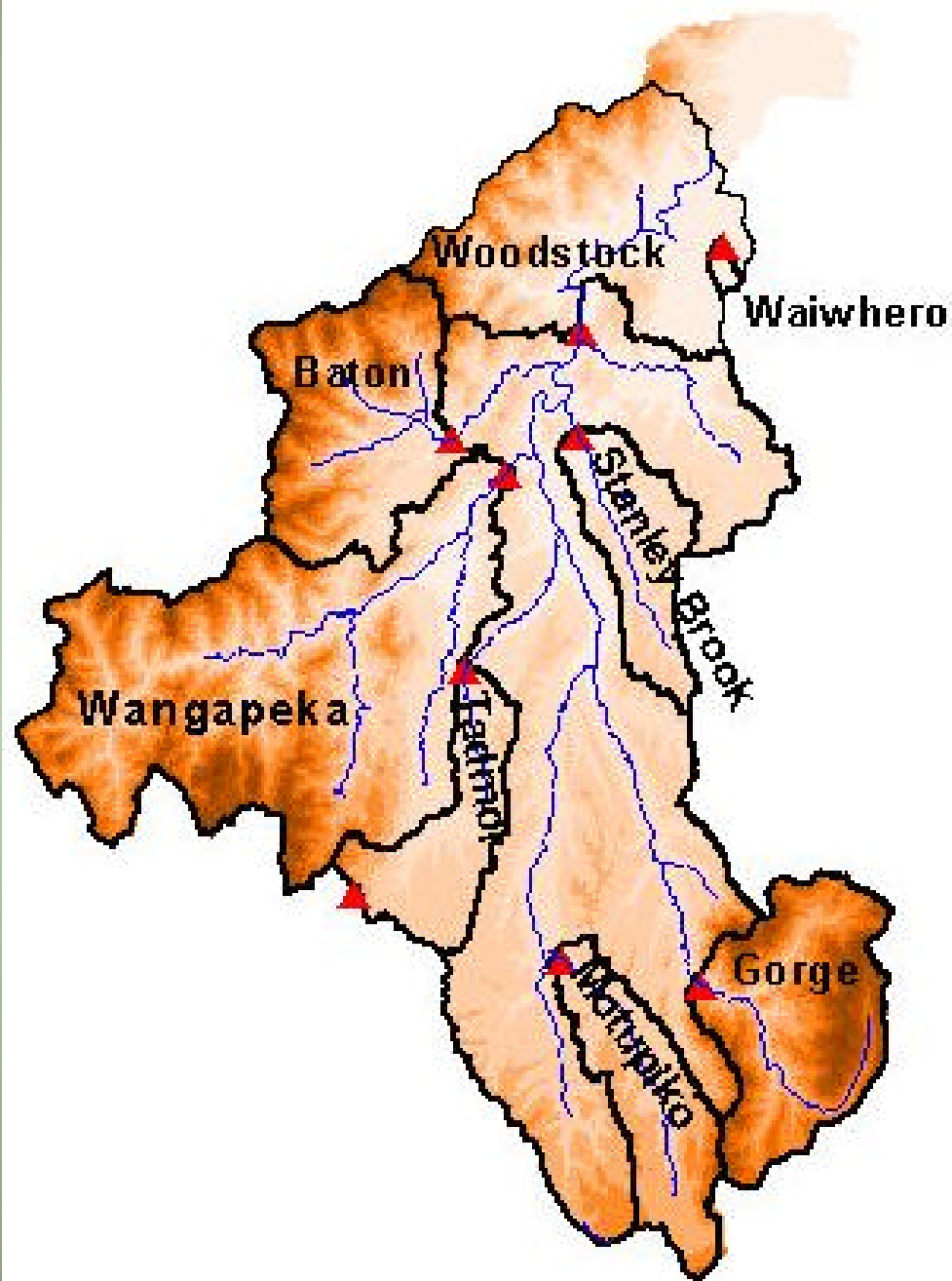
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Application of SWAT in a large mountainous catchment with high spatial variability

Wenzhi Cao¹, William B. Bowden², Tim Davie¹,
Andrew Fenemor¹

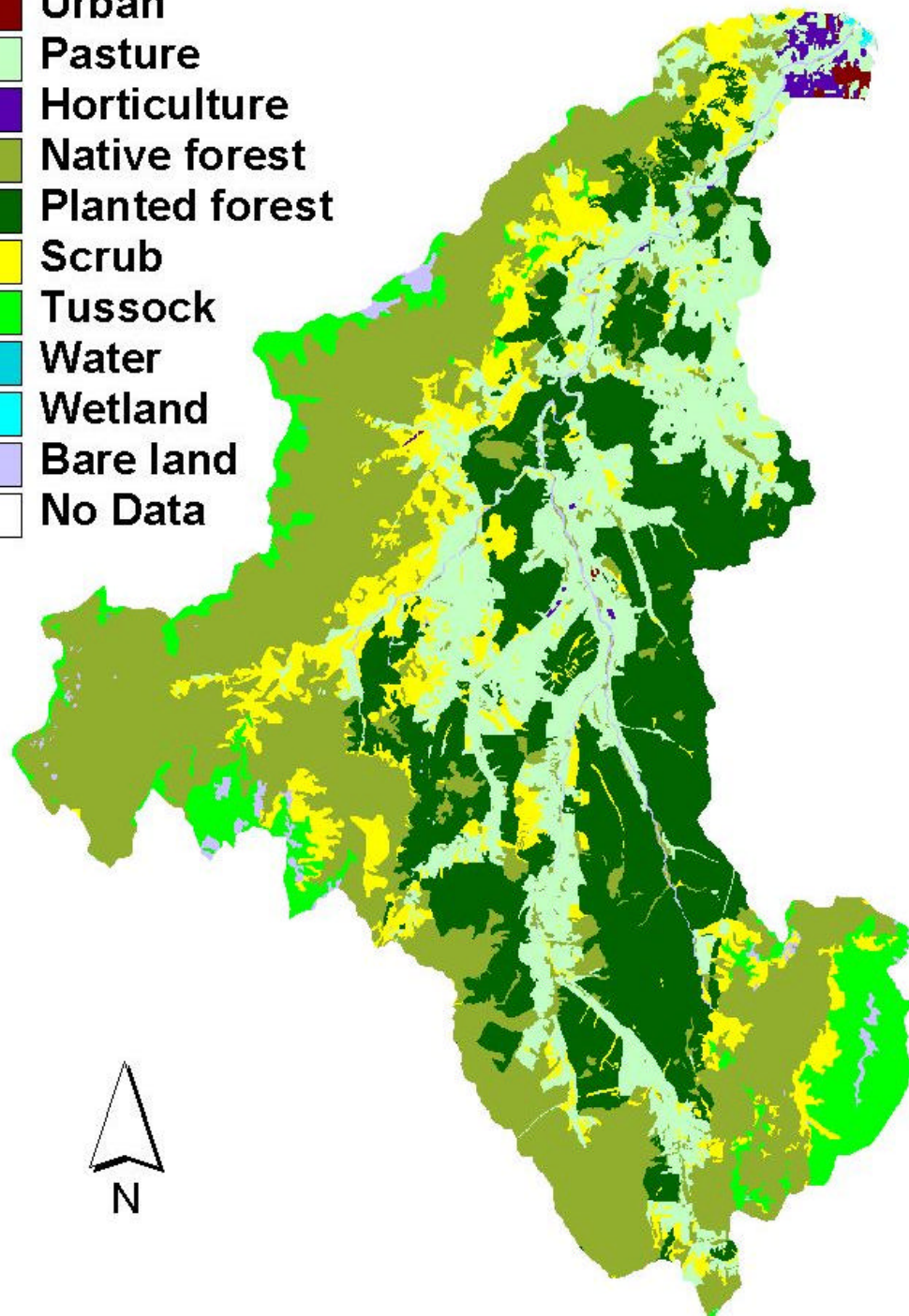
¹Landcare Research, New Zealand

²University of Vermont, USA



Subcatchments

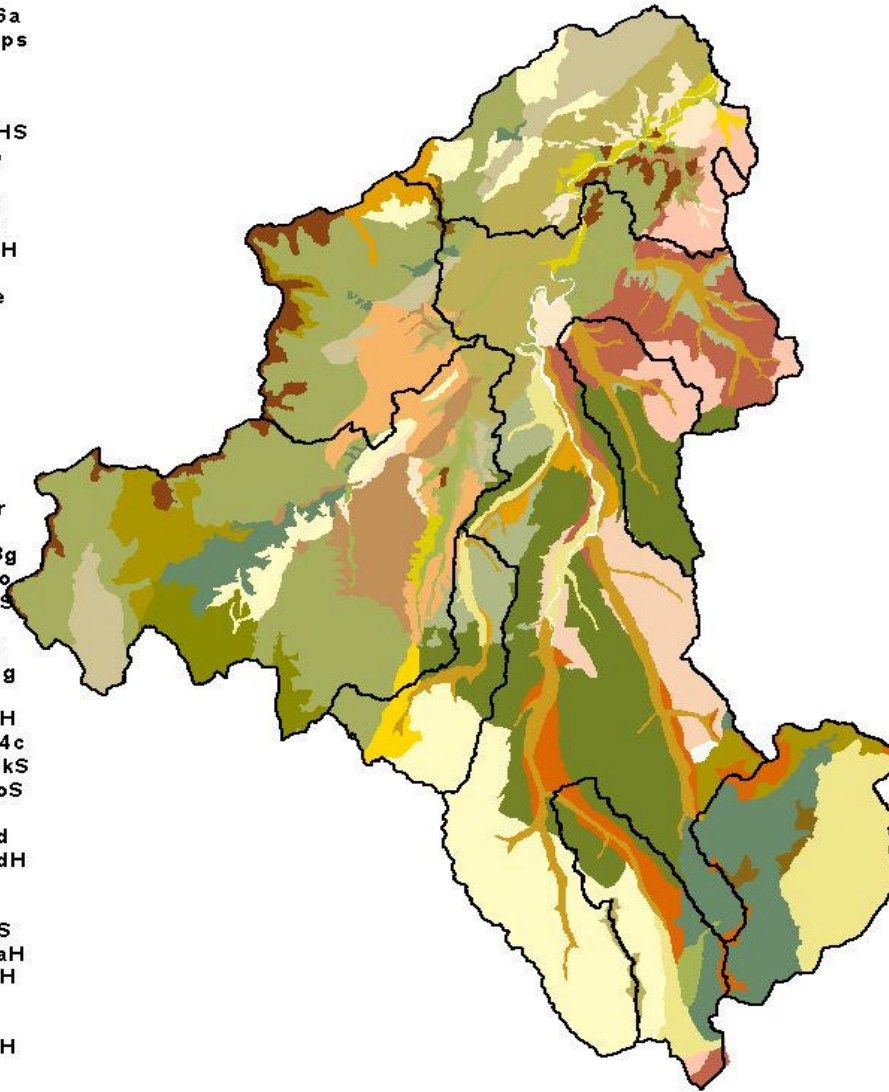
-  Urban
-  Pasture
-  Horticulture
-  Native forest
-  Planted forest
-  Scrub
-  Tussock
-  Water
-  Wetland
-  Bare land
-  No Data



Land cover

Soil types in Motueka

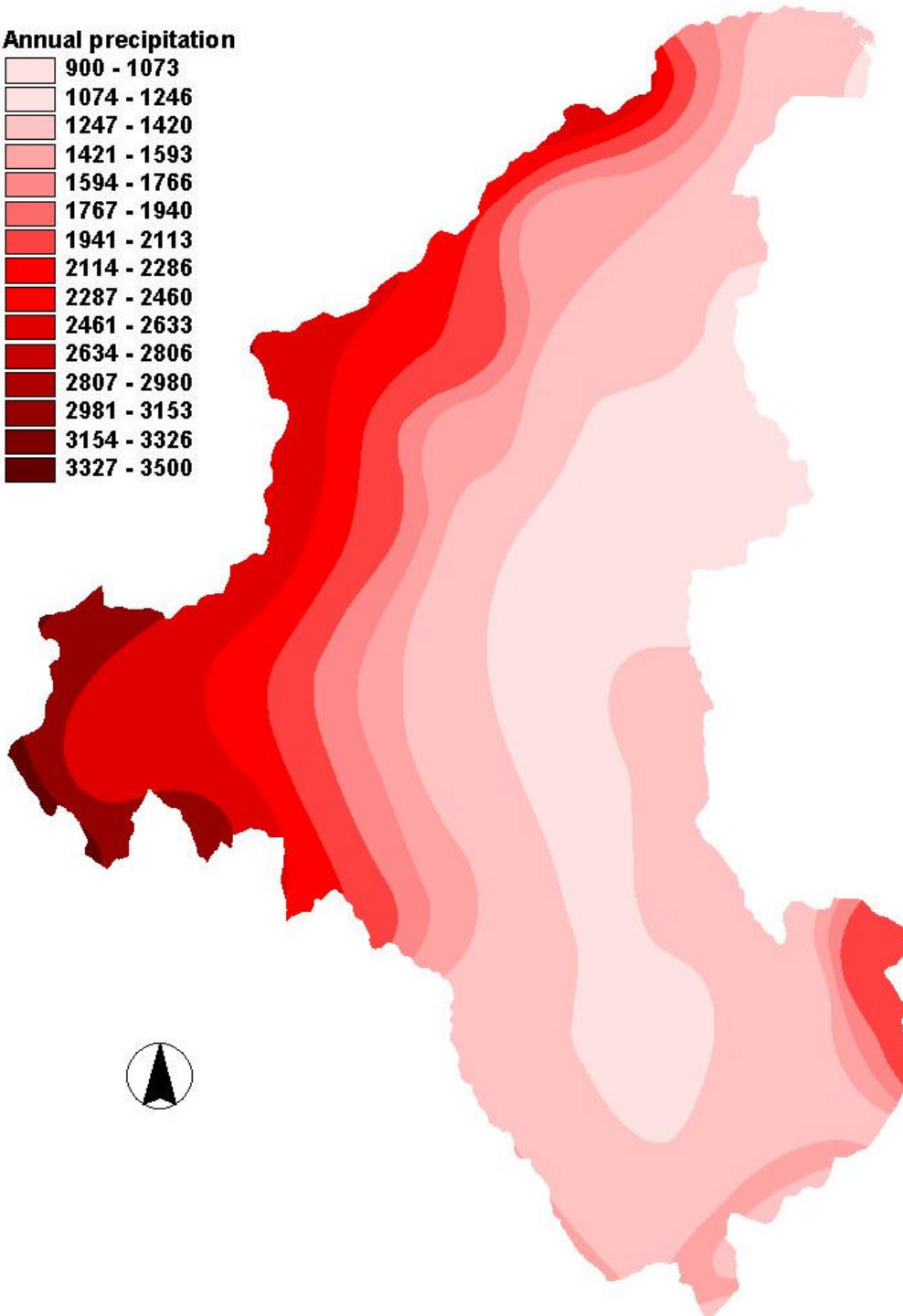
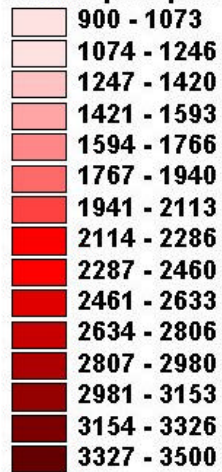
- Atapo-Ap
- Braeburn-B
- Braeburn-Bn
- Brooklyn-BrH
- Brooklyn-BrS
- Dovedale-D
- Dun-79
- Glenhope-66a
- Glenhope-Gps
- Graham-G
- Haupiri-65b
- Haupiri-HrS
- Heslington-HS
- Hohonu-67b
- Hope-45bH
- Howard-45a
- Kaiteriteri-K
- Kaiteriteri-KH
- Katrine-53b
- Kawatiri-47e
- Kikiwa-34b
- Kikiwa-Ka
- Kikiwa-Kar
- Korere-45H
- Korere-KeH
- Lewis-65
- Mapua-Mp
- Matariki-Ma
- Matariki-Mar
- Matiri-65f
- Motupiko-33g
- Motupiko-Mo
- Ngatimoti-NS
- Orinoco-O
- Orinoco-OH
- Patriarch-67g
- Pelorus-65c
- Pelorus-65cH
- Pikikiruna-74c
- Pikikiruna-PkS
- Pokororo-PoS
- Riwaka-R
- Rosedale-Rd
- Rosedale-RdH
- Sherry-Sy
- Spenser-58
- Spenser-SnS
- Spooner-37aH
- Spooner-SoH
- Stanley-St
- Stanley-StH
- Tadmor-44cH
- Tadmor-T
- Tadmor-TH
- Tadmor-TsH
- Tapawera-Tw
- Tophouse-52a
- Wakamarama-65d
- Wangapeka-Wp
- Whitcombe-67



Soil



Annual precipitation



Annual precipitation



Calibration and validation methods

- Single variable method, e.g. outlet streamflow, selected as the sole calibration criterion;
- Auto-calibration method, e.g. the generalized likelihood uncertainty estimation **GLUE**, the genetic algorithms, and the shuffled complex evolution (**SCE-UA**) global optimization algorithm;
- Multi-variable and multiple site approach proposed here for application SWAT in the Motueka Catchment.

Variables and sites for calibration and validation

Variables and sites	Calibration
Daily precipitation	Ö+?
Daily maximum and minimum temperature	Ö
Potential evapotranspiration	Ö
Annual water yield	Ö
Groundwater flow	Ö
Daily stream flow	Ö
Soil moisture	?
Six subcatchments	Ö+?

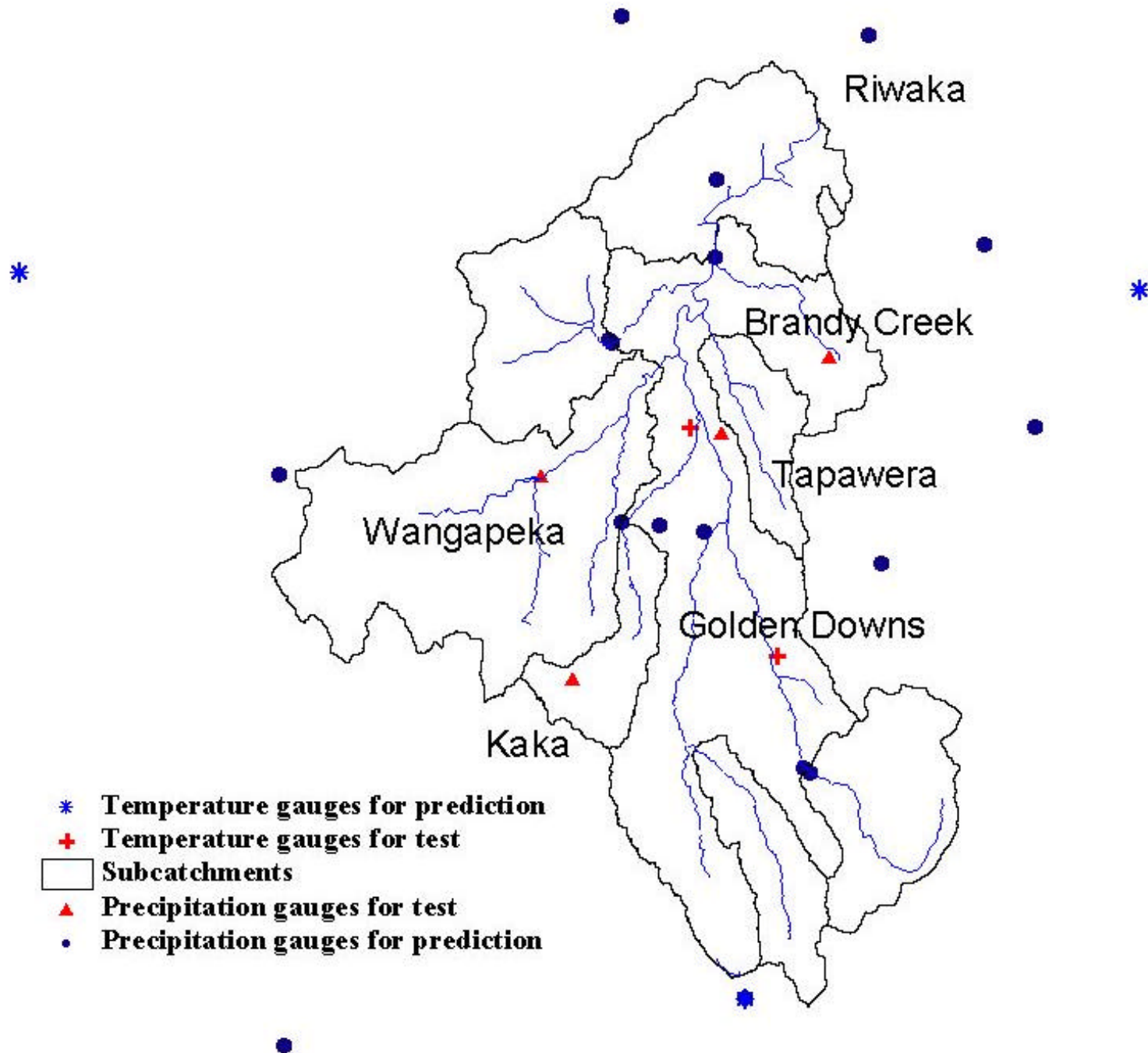




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Daily precipitation and temperature

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Daily precipitation prediction test

Test gauges	Nash-Sutcliffe	R²
Tapawera	0.65	0.62
Wangapeka	0.70	0.71
Brandy Creek	0.65	0.65
Kaka	0.36	0.45

Daily max and mini temperature prediction test

Test stations	Nash-Sutcliffe		R²	
	Max	Min	Max	Min
Tapawera	0.83	0.84	0.92	0.91
Golden Downs	0.86	0.89	0.93	0.89

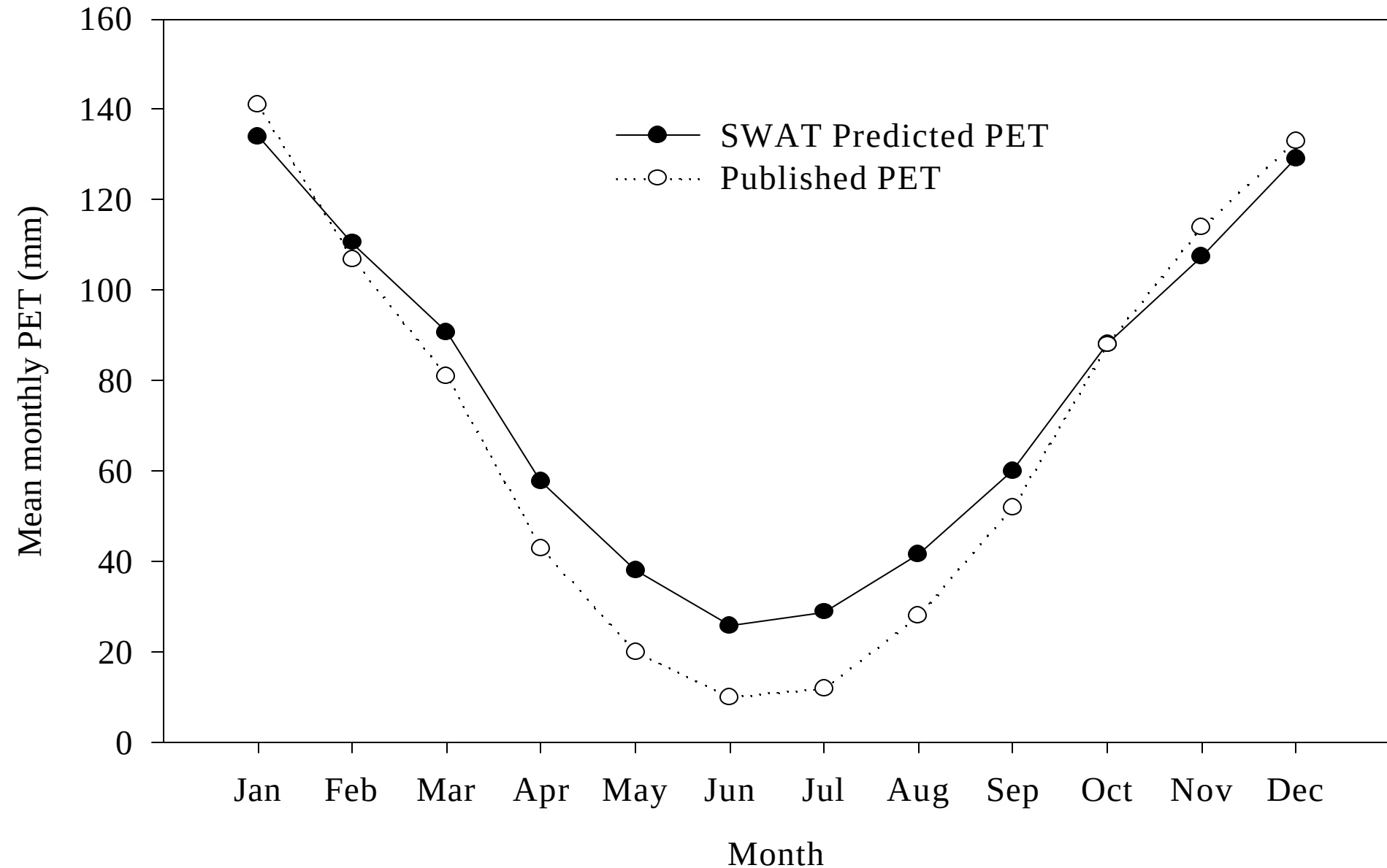


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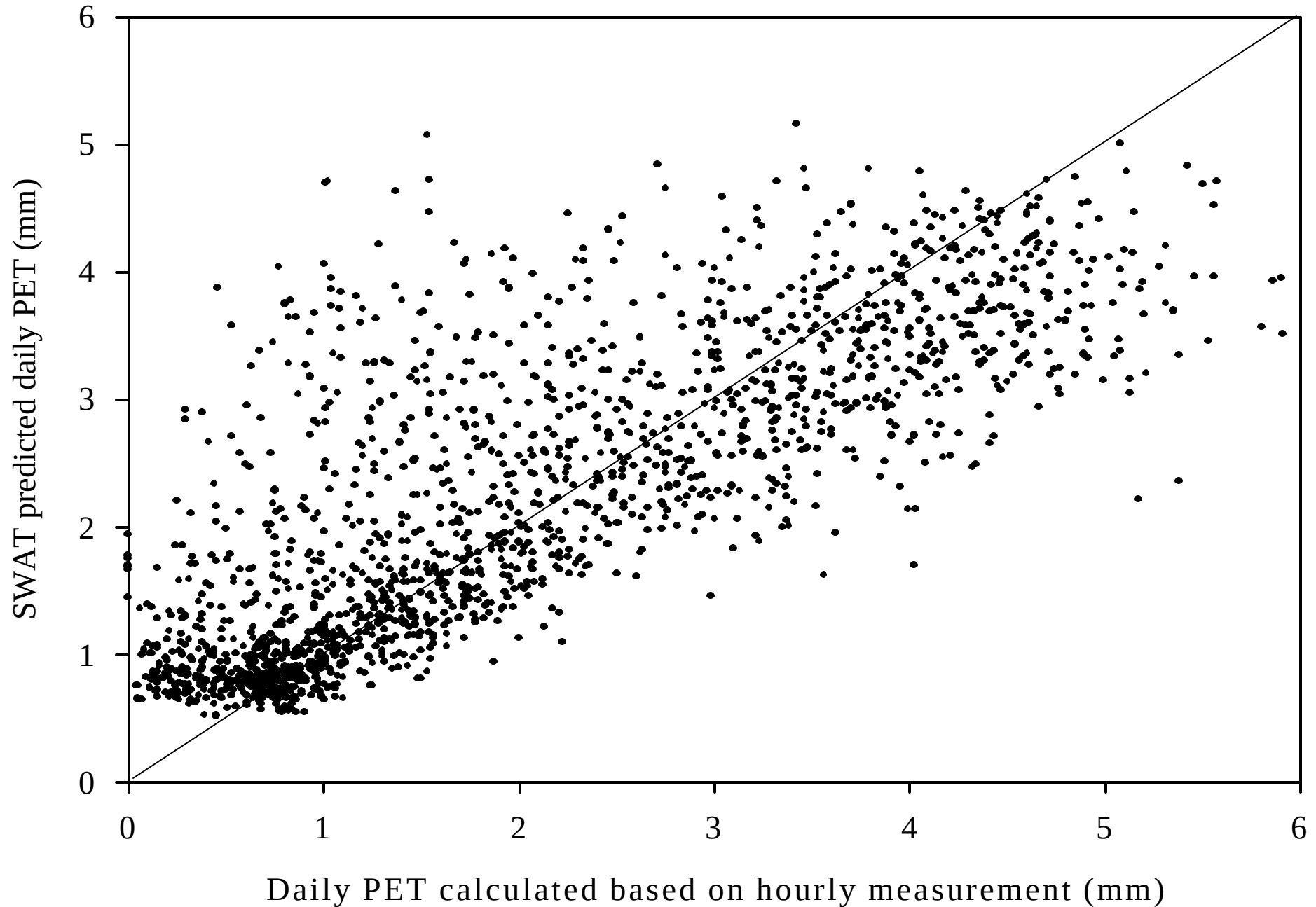
Potential evapotranspiration

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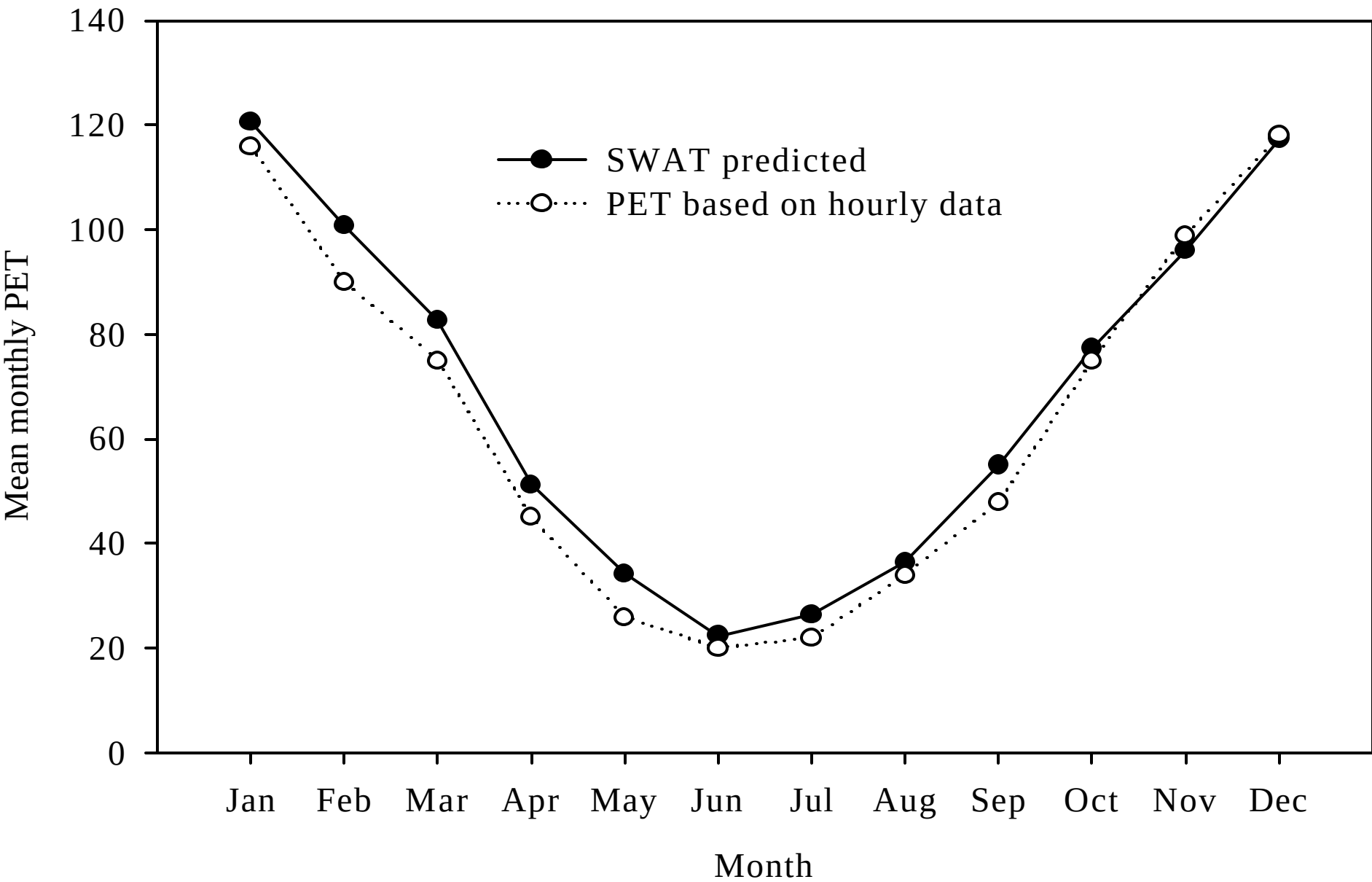
SWAT predicted PET and published data



SWAT predicted daily PET and estimation (hourly data)



SWAT predicted PET against the PET estimation (hourly data)



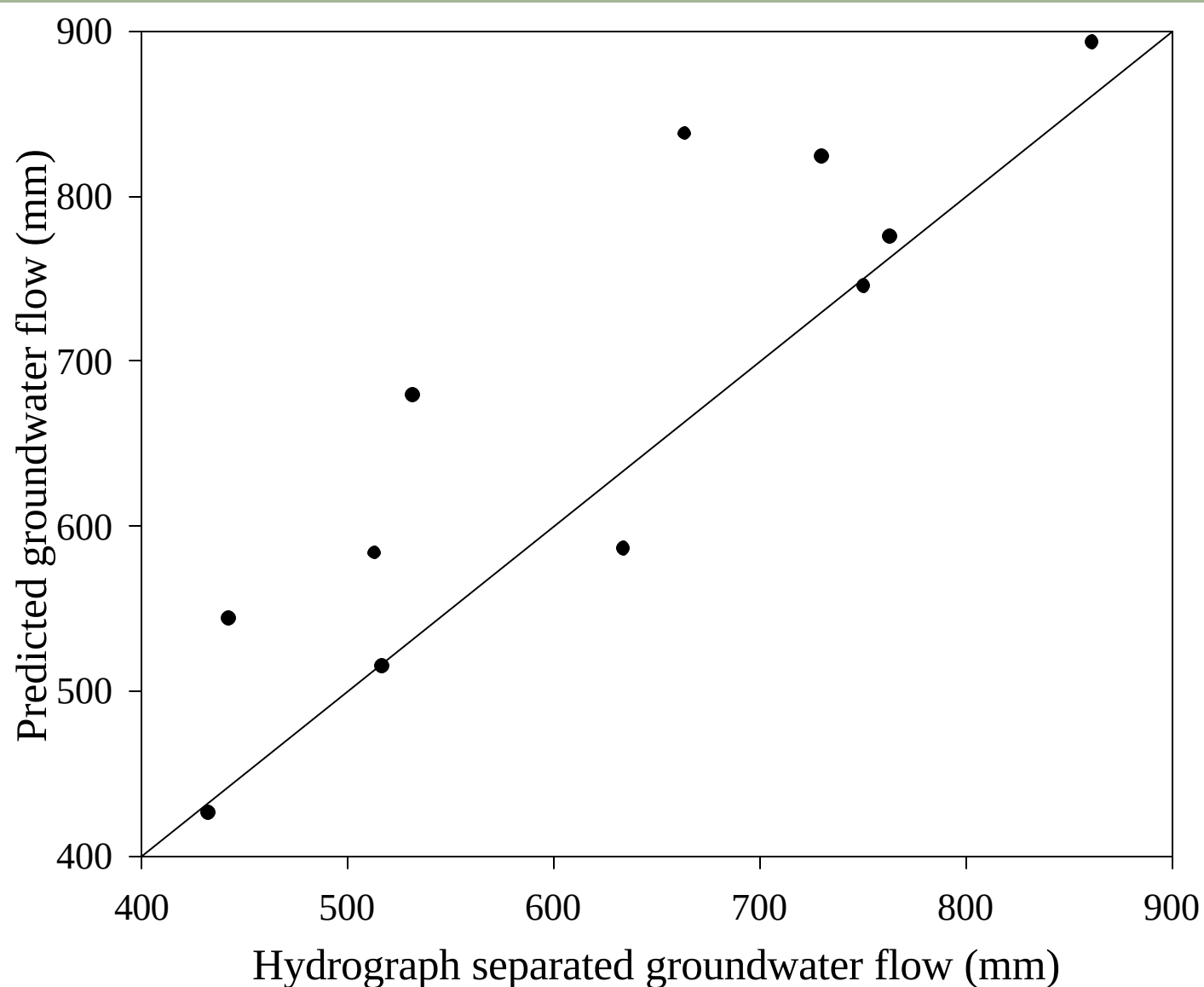


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Groundwater contributions

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SWAT predicted against hydrograph separated groundwater flow at Woodstock



Predicted and hydrograph separated groundwater flow

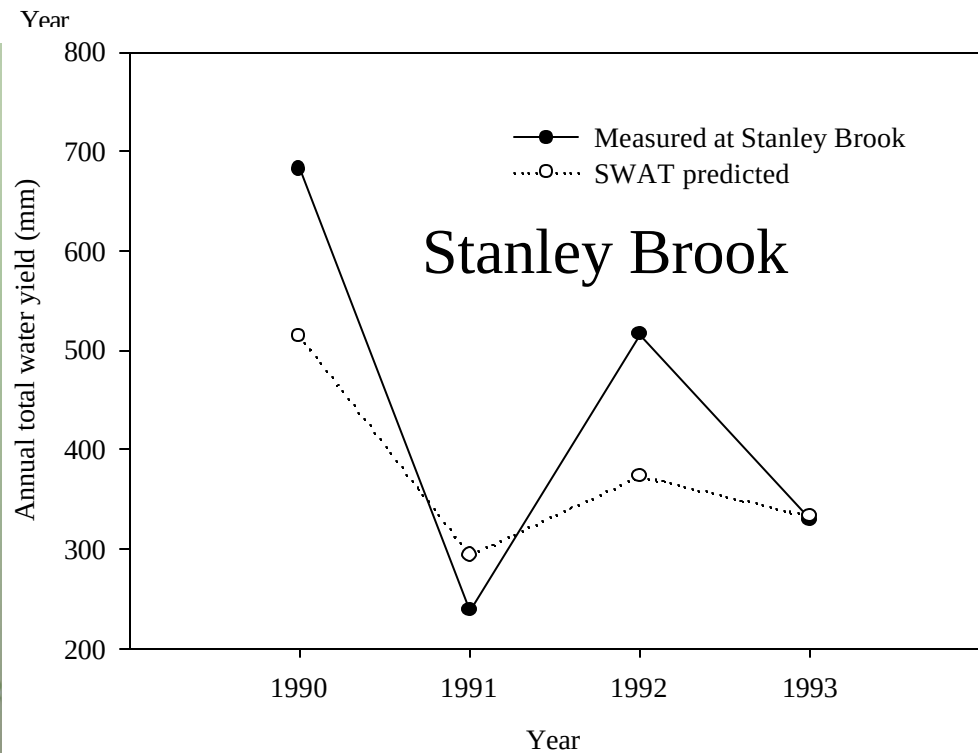
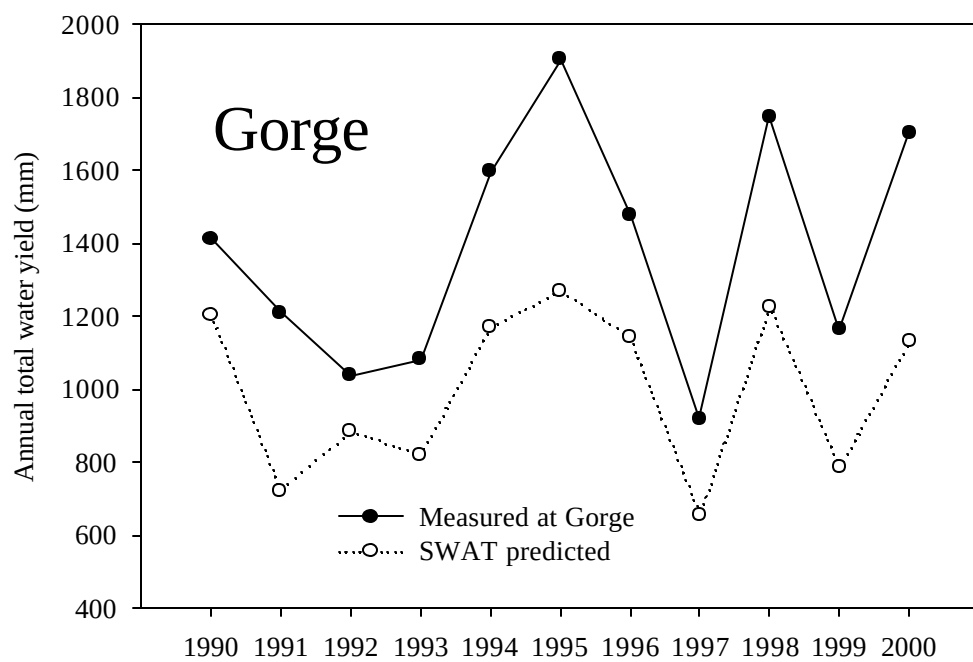
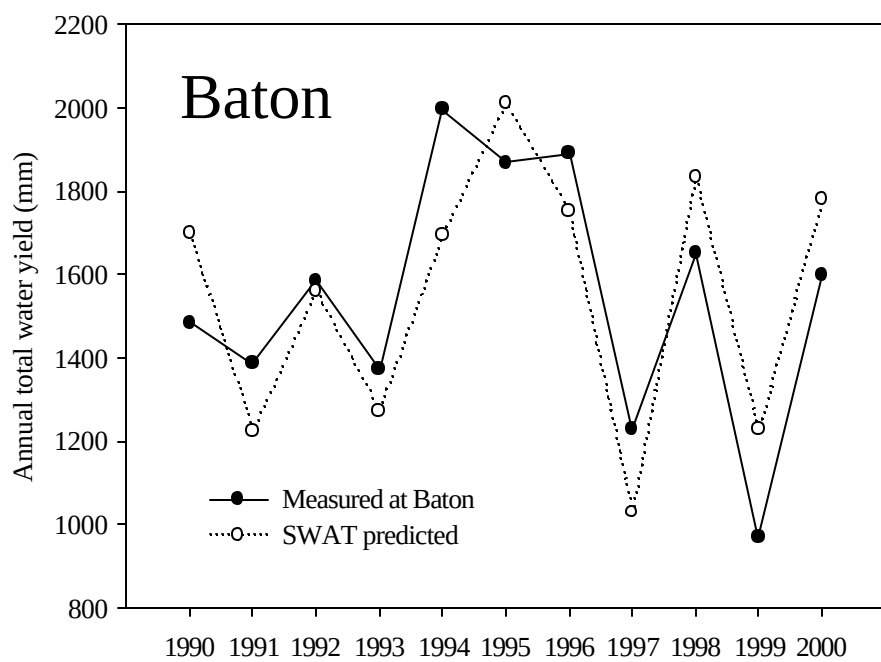
No	Subcatchments	R ²
1	Baton	0.46
2	Upper Motueka at Gorge	0.70
3	Stanley Brook	-
4	Tadmor	0.90
5	Wangapeka	0.58
6	Motupiko	0.75
	Motueka at Woodstock	0.79

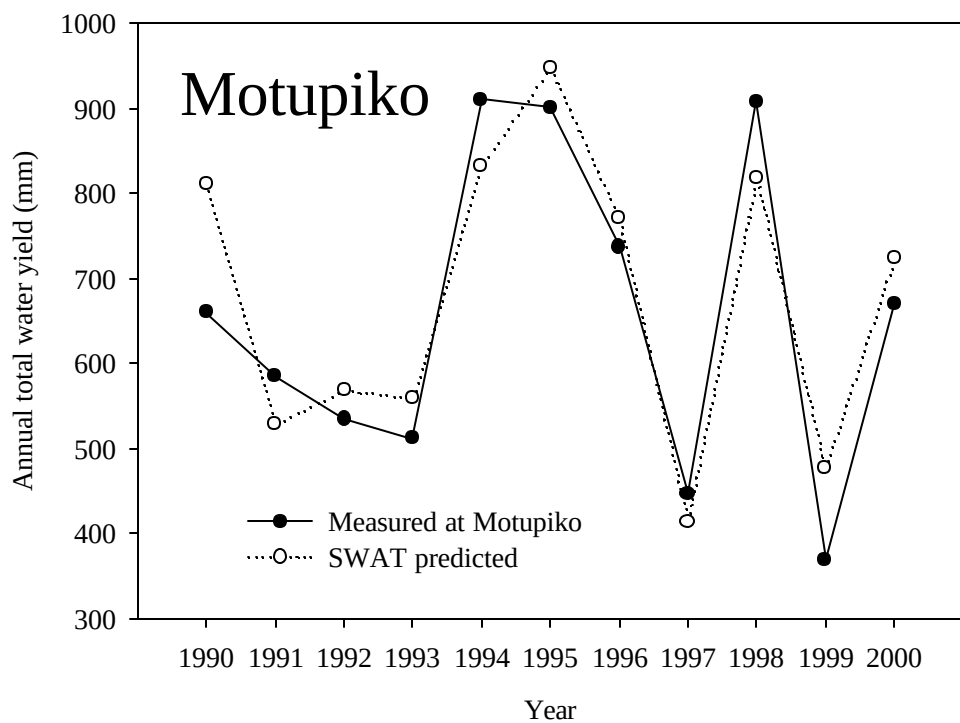
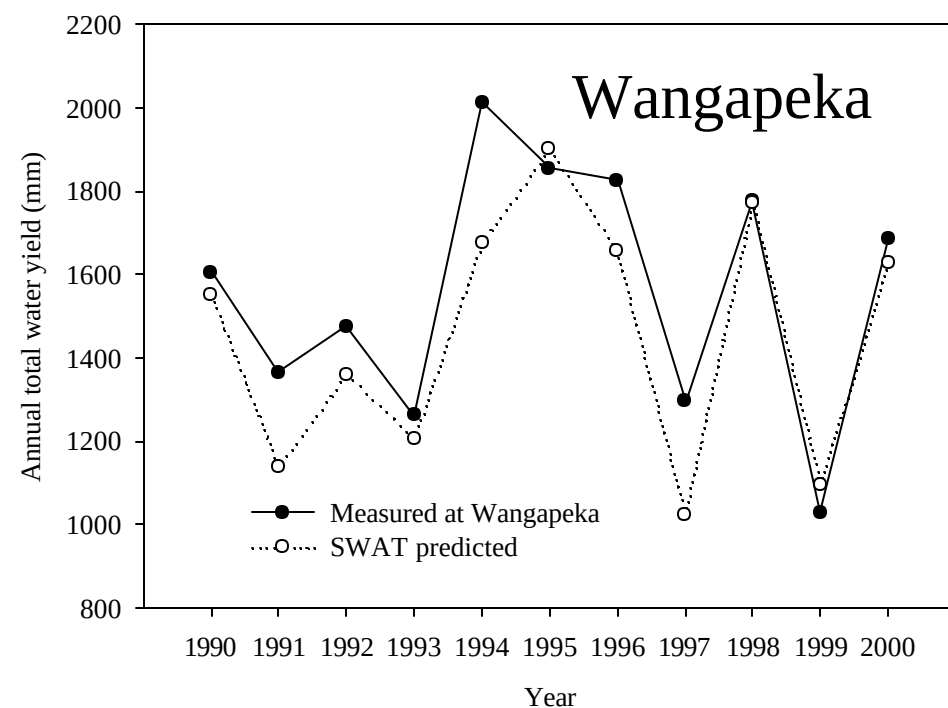
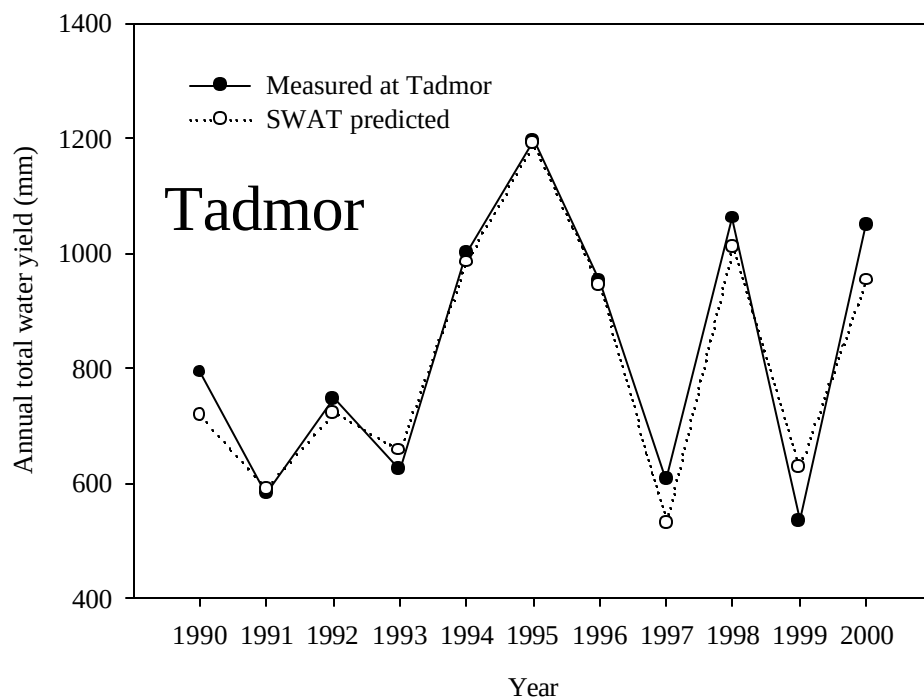


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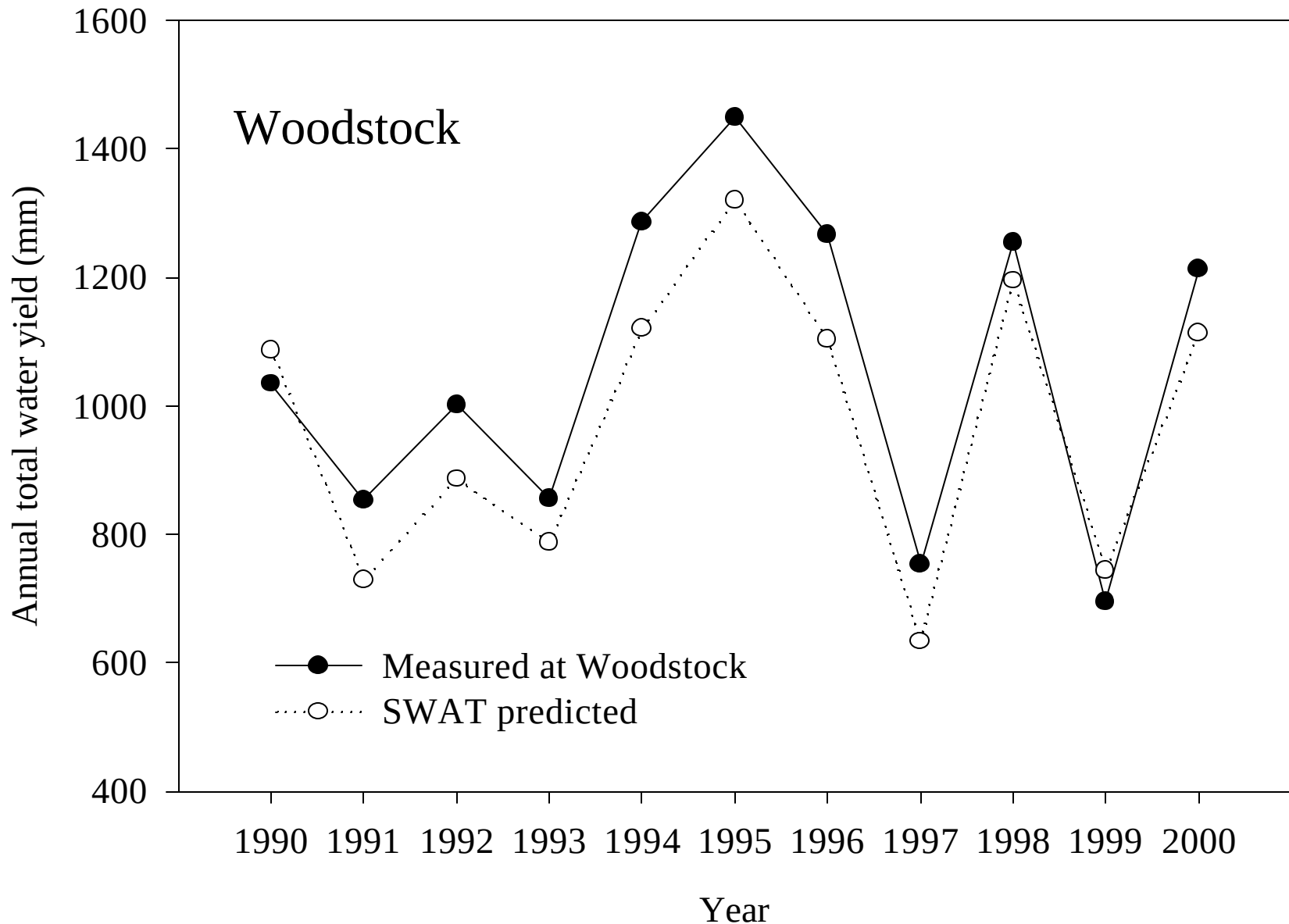
Annual water yield

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Annual water yield and the measured at Woodstock





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Daily streamflow

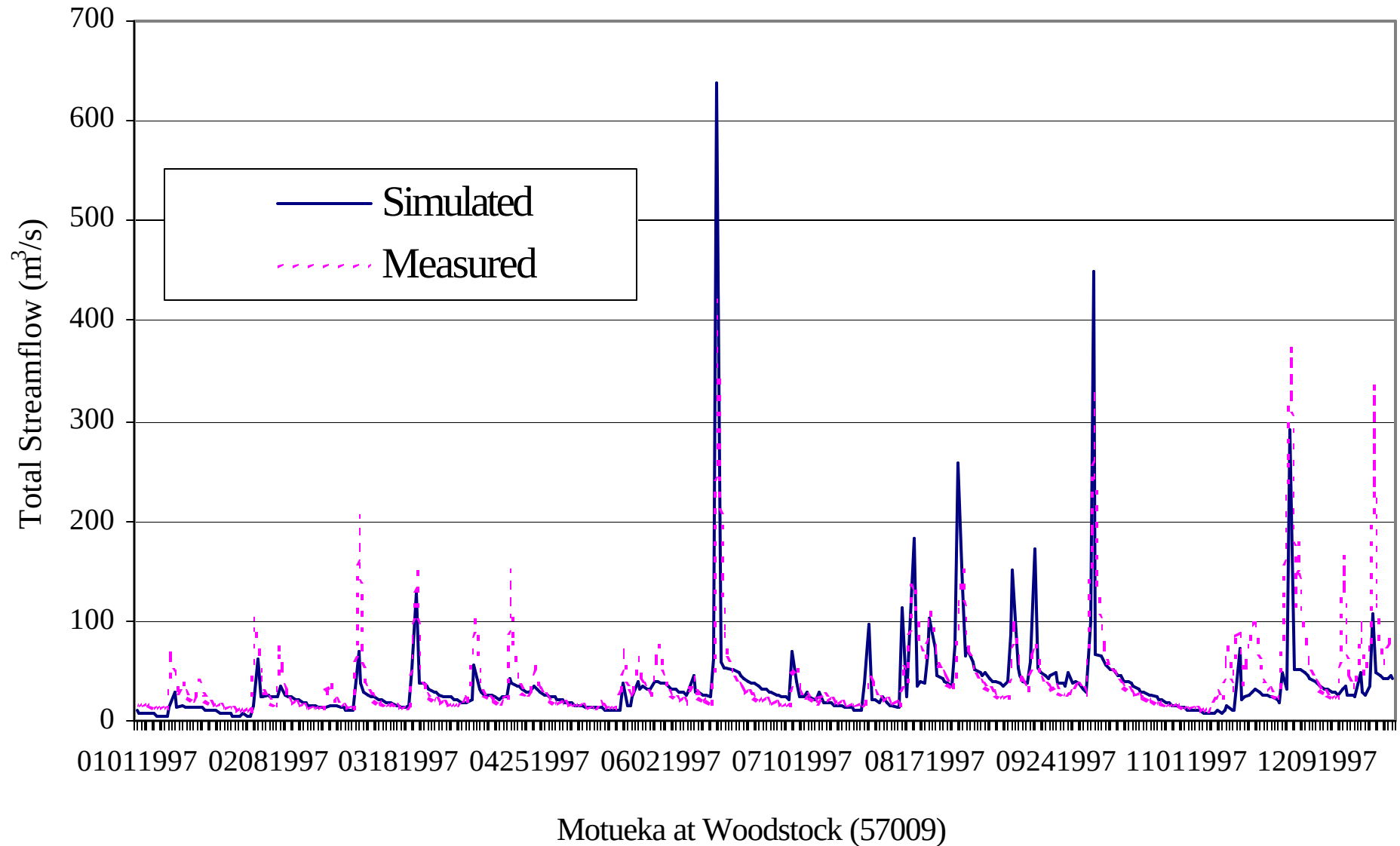
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Daily streamflow calibration and validation result

Subcatchments	Nash-Sutcliffe coefficient	
	Calibration	Validation
Baton	0.36	0.35
Upper Motueka at Gorge	0.42	0.41
Stanley Brook	0.59	-
Tadmor	0.61	0.55
Wangapeka	0.60	0.51
Motupiko	0.40	0.57
Motueka at Woodstock	0.78	0.72



Predicted daily streamflow against the measured at Woodstock in 1997



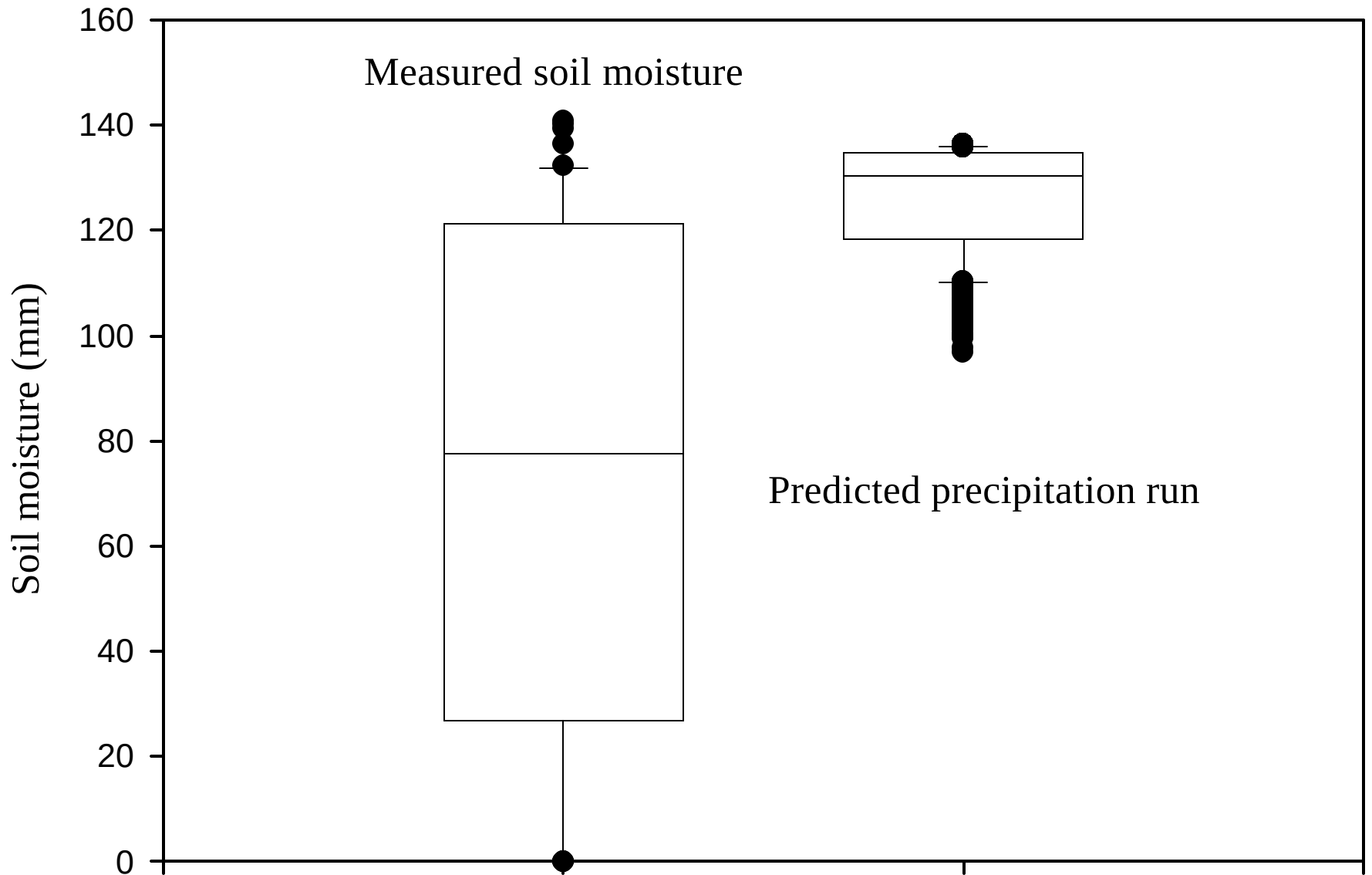


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Soil moisture

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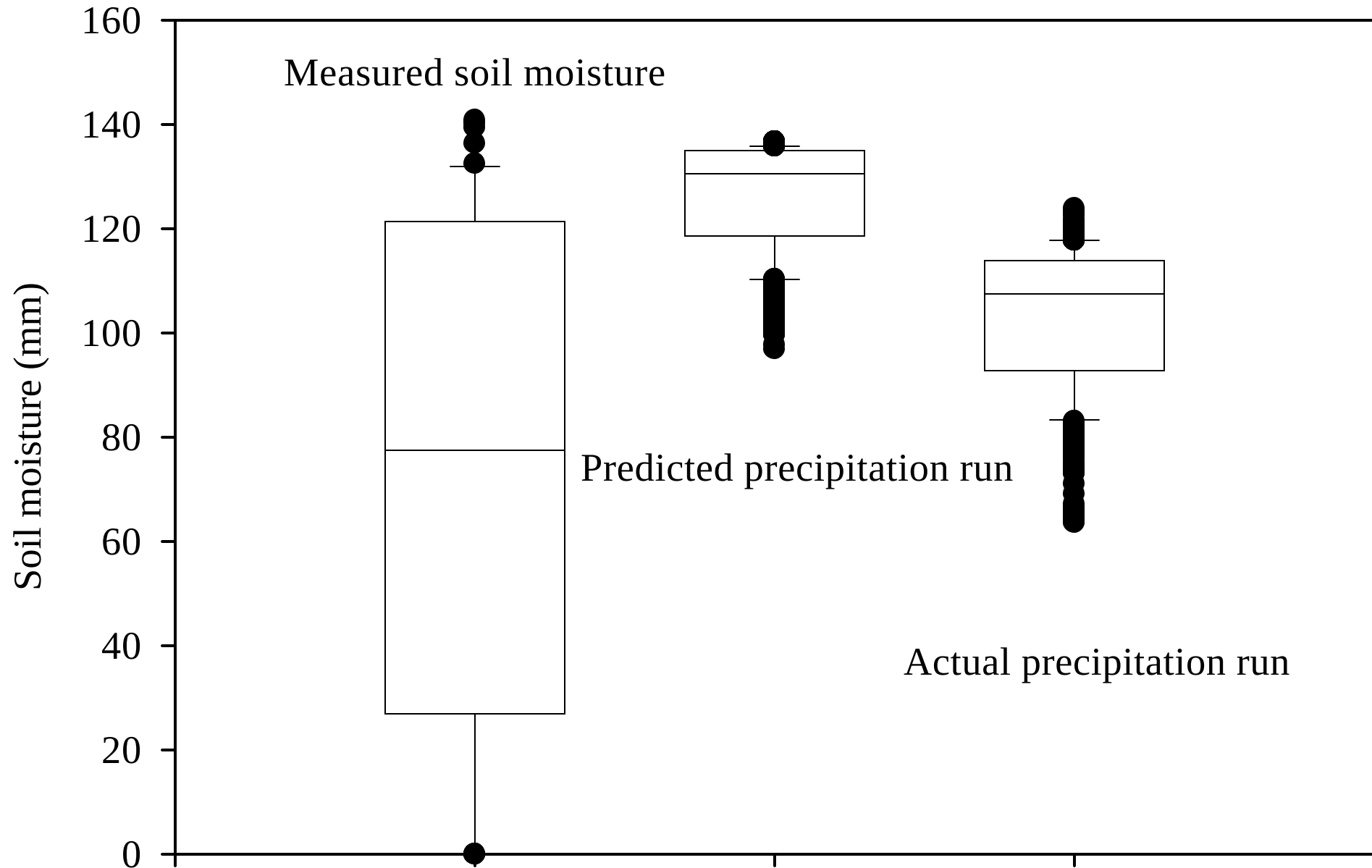
Soil moisture in the Waiwhero catchment



Predicted precipitation and that measured in the Waiwhero catchment

	Total Days (days)	Total precipitation (mm)	Wet days (days)	Mean precipitation Per event (mm)
Predicted	783	2688	486	5.5
Measured	783	2327	241	9.7

Soil moisture in the Waiwhero catchment



Conclusions

The multiple variable and multiple site calibration and validation approach resulted in:

- more realistic parameter values across both the hydrologic processes and the geographic areas;
- the highlighted the areas and the hydrological processes requiring greater calibration effort (e.g. understanding precipitation distribution)
- a validated SWAT model for scenario test in our “Integrated Catchment Management (**ICM**)” research programme in Motueka Catchment.

For more information, please visit:

- **<http://icm.LandcareResearch.co.nz>**

