NIWA
Taihoro Nukurangi

Mahurangi Catchment

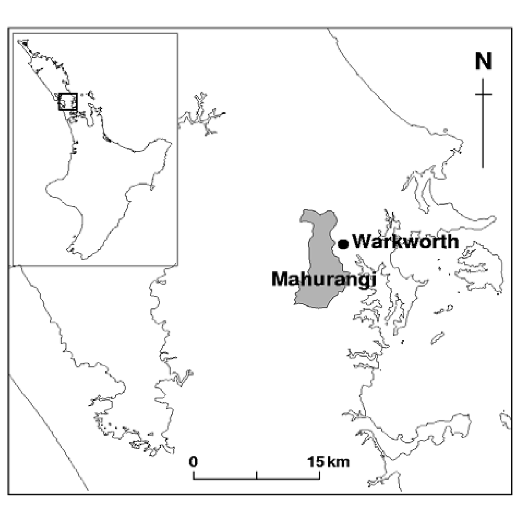
Northland, New Zealand

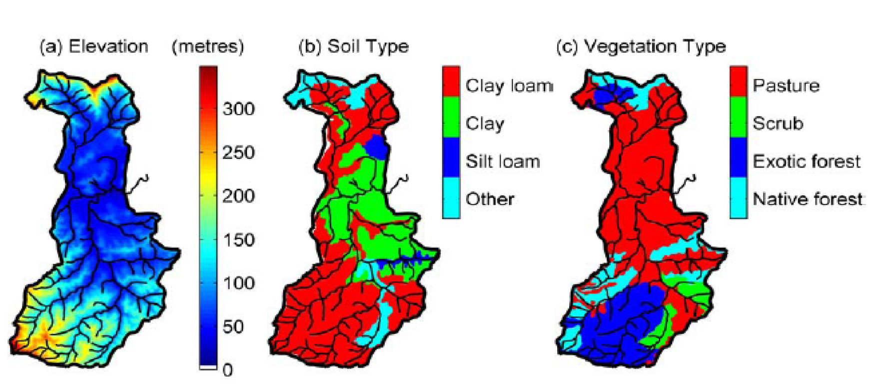
Contributors to the MARVEX campaign:
- NIWA, New Zealand
- University of Auckland, New Zealand
- University of Melbourne, Australia

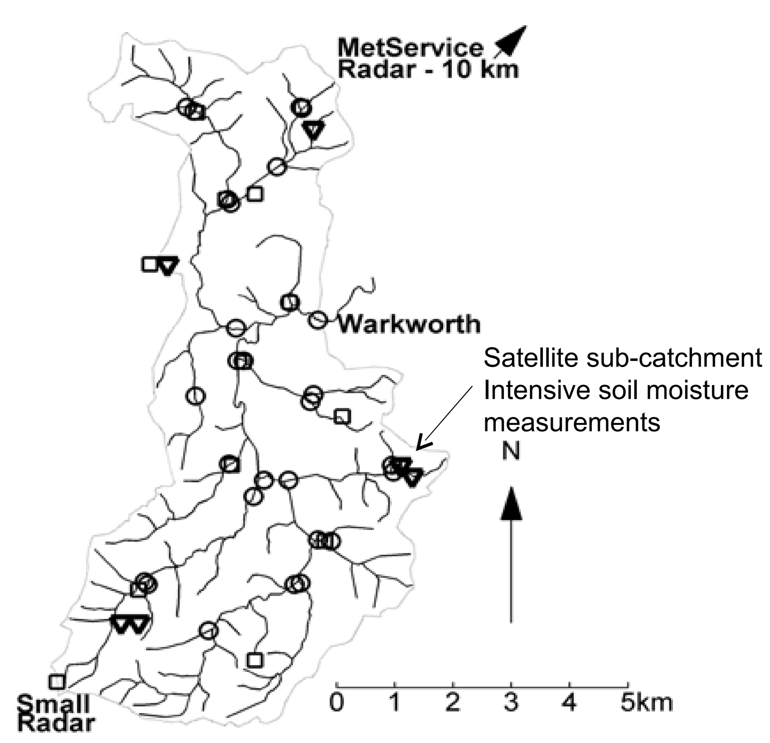
Basin characteristics

River Basin / River Basin (according EU-WFD)	Mahurangi River Basin
Operation (from… to…)	1997 – 2001 (MARVEX programme)
Gauge coordinates / Gauge datum:	29 nested stream gauges. Approx 36.4ºS,174.7ºE
Catchment area:	47 km².
Elevation range:	0 - 250m a.s.l.
Basin type: (alpine, mountainous, lowland)	Hills and lowland
Climatic parameters: (mean precipitation, temperature and others)	Annual rainfall 1628mm, Annual pan evaporation 1315mm, Annual streamflow 842mm, Mean temp. 14 degC
Land use:	50% pasture, 25% plantation forest, 25% native forest
Soils:	Clay loams, < 1m deep
Geology:	Alternating layers of sandstone and siltstone
Hydrogeology: (Type of aquifers, hydraulic conductivity)	Runoff is dominated by baseflow from soil and regolith reservoirs

Map of the research basin

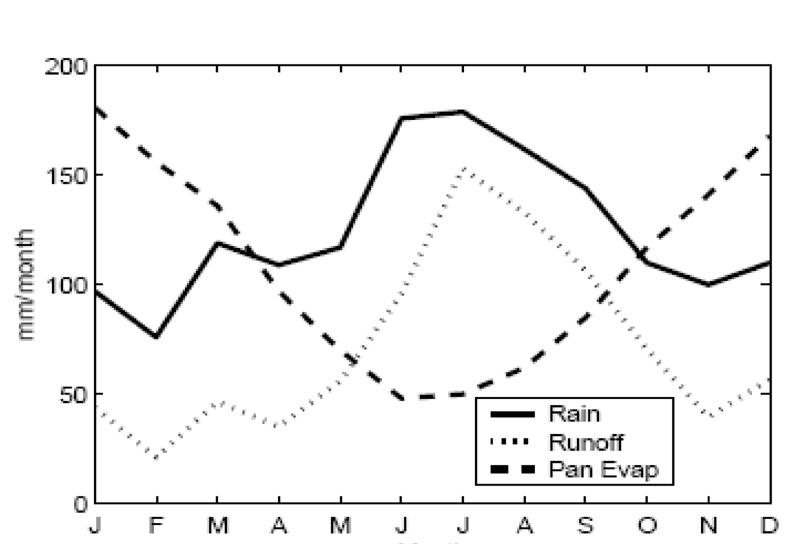




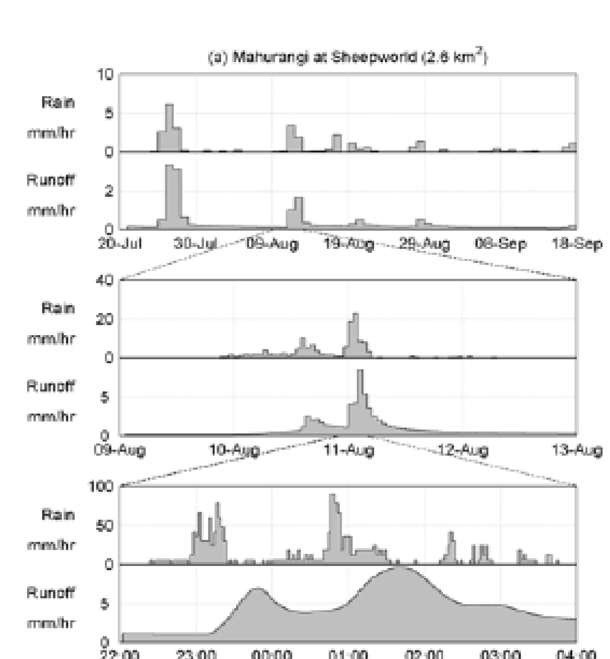


Location of catchment instrumentation.
Circles = flow gauges, triangles = rain gauges

Mean hydrograph / Example hydrograph



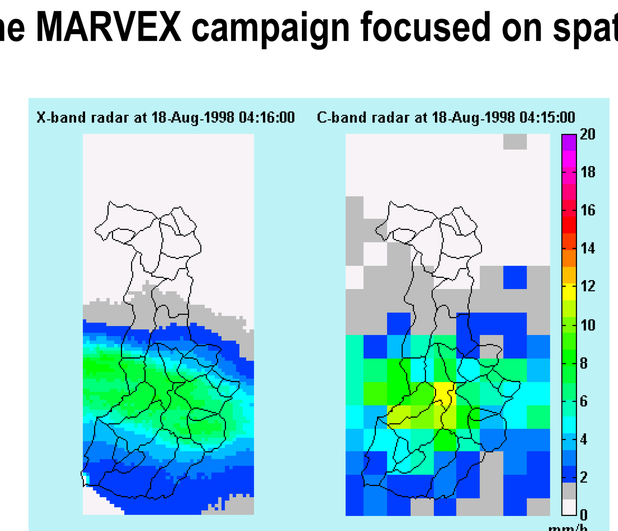
Mean monthly values for rain, runoff and pan evaporation



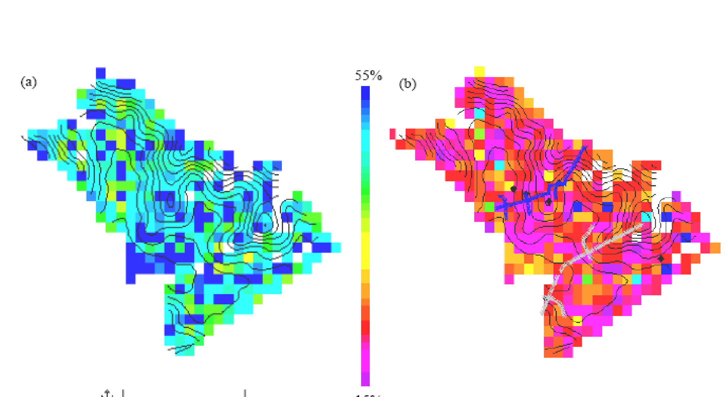
Exploration of temporal variability in rainfall and runoff

Spatial Variability

The MARVEX campaign focused on spatial variability of hydrological variables



Instantaneous rainfall rates, X-band and C-band radar



Soil Moisture patterns for (a) August 1998 and (b) February 1999

Instrumentation and data

Measured hydrological parameters	Measuring period	Temporal resolution	Number of stations
Rainfall – Tipping bucket gauges	1997 – 2001	2 mins	13
Rainfall – C band radar	1997 – 2001	15 mins	1 km grid
Rainfall – X band radar	Individual events	5 secs / 2 mins	150 m grid
Streamflow	1997 – 2001	2 mins	29
Soil Moisture (pseudo-TDR)	1997 – 2001	30 mins	18
Soil Moisture (TDR)	6 * campaigns	N/A	10-40m grid

Applied models

Mahurangi catchment has been used as a test site to explore model building techniques and model complexity (e.g. Chirico *et al.*, 2003; Atkinson *et al.*, 2003; McMillan *et al.*, this workshop), rather than as a site for application of standard models.

Main scientific results

1. Streamflow spatial variation: Rainfall is the dominant source of spatial pattern in streamflow at space scales of 1 km2 and greater, for all timescales
2. Streamflow generation: The runoff process is associated with a clear threshold in soil moisture, with significant runoff being generated only for moisture contents above about 42%. It is also thought that at these high average moisture contents, the spatial distribution of soil water is critical in the control of runoff behaviour.
3. Soil Moisture: at space scales from 10 m to 1 km², topography is a relatively weak control of soil moisture. Small-scale variability (< 100m) of soil moisture is associated with soil structure and preferential flow pathways.
4. Flow pathways: "The soils have residence times of at least several months to a few years. The streams are reactive, but this appears to be driven by a combination of direct channel interception and local runoff from the near-stream margin. One quarter to one third of total runoff occurs as quickflow. The largest portion of streamflow originates as baseflow from soil and regolith reservoirs that may be several metres to perhaps several 10's of metres deep" (Bowden *et al.*, 2000).
5. Model Complexity: During winter periods the soils are wet and accurate predictions of stormflow can be achieved using lumped models. Conversely, during summer periods the soils are dry, and complex and fully distributed models are required for accurate predictions of stormflow (Atkinson *et al.*, 2003). The storage-discharge relationship varies through the year depending on recharge history, and hence models require multiple storage reservoirs (McMillan *et al.*, this workshop).

Key references for the basin

1. Atkinson, S.E.; Sivapalan, M.; Viney, N.R.; Woods, R.A (2003). Predicting space–time variability of hourly streamflow and the role of climate seasonality: Mahurangi Catchment, New Zealand. *Hydrological Processes* 17: 2171 – 2193.
2. Bowden, W. B., Fahey, B., Basher, L., Stewart, M. K., Woods, R. A. & Bidwell, V. (2000) Sub-surface flow dynamics in a pasture hillslope, North Island, New Zealand. EOS 81(48), F463
3. Chirico, G.B.; Grayson, R.B.; Western, A.W. (2003). A downward approach to identifying the structure and parameters of a process based model for a small experimental catchment. *Hydrological Processes* 17: 2239 – 2258.
4. Western, A.W.; Zhou, S.L.; Grayson, R.B.; McMahon, T.A.; Bloeschl, G.; Wilson, D.J. (2004). Spatial correlation of soil moisture in small catchments and its relationship to dominant spatial hydrological processes. *Journal of Hydrology* 286 (1-4): 113-134.
5. Woods, R.A.; Grayson, R.B.; Western, A.W.; Duncan, M.J.; Wilson, D.J.; Young, R.I.; Ibbitt, R.P.; Henderson, R.D.; McMahon, T.A. (2001). Experimental Design and Initial Results from the Mahurangi River Variability Experiment: MARVEX. In: Lakshmi, V.; Albertson, J.D.; Schaake, J. (eds). Observations and Modelling of Land Surface Hydrological Processes, pp. 201-213. Water Resources Monographs. American Geophysical Union, Washington, DC.

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