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Implications of Climate Change for Water Resources in Canterbury

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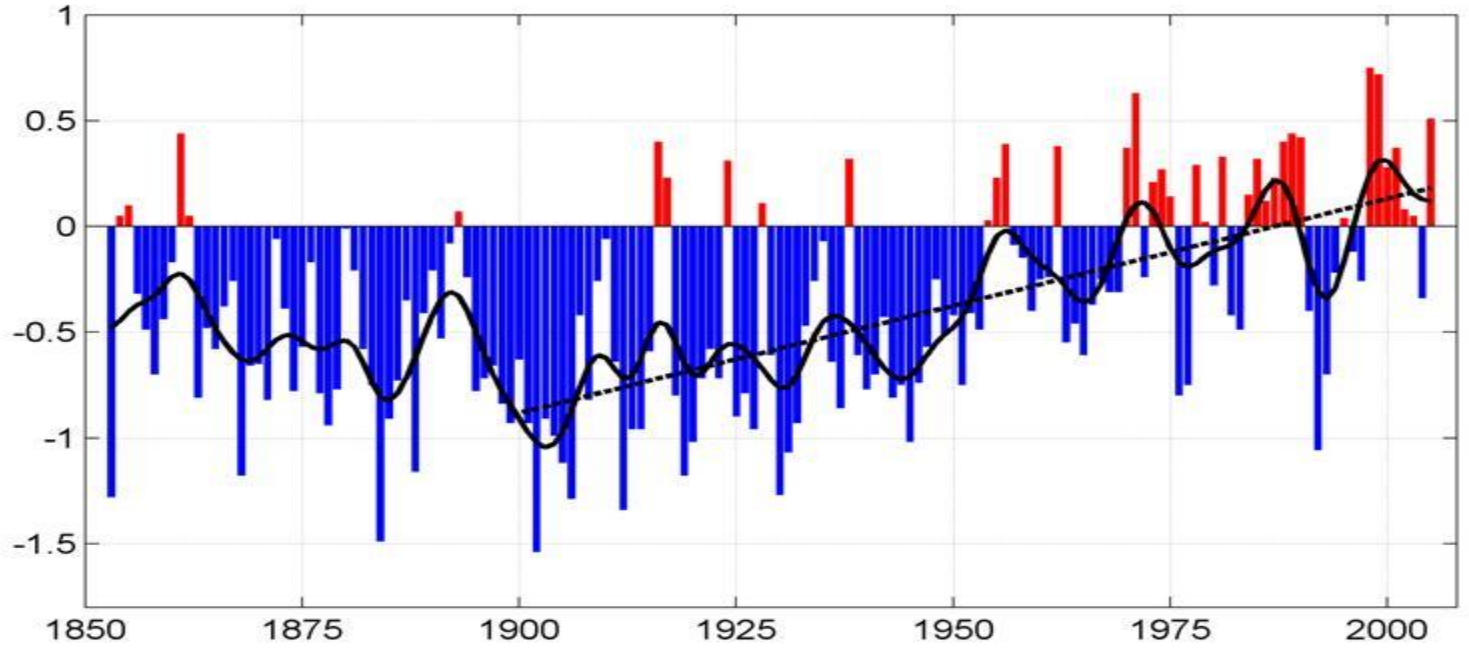
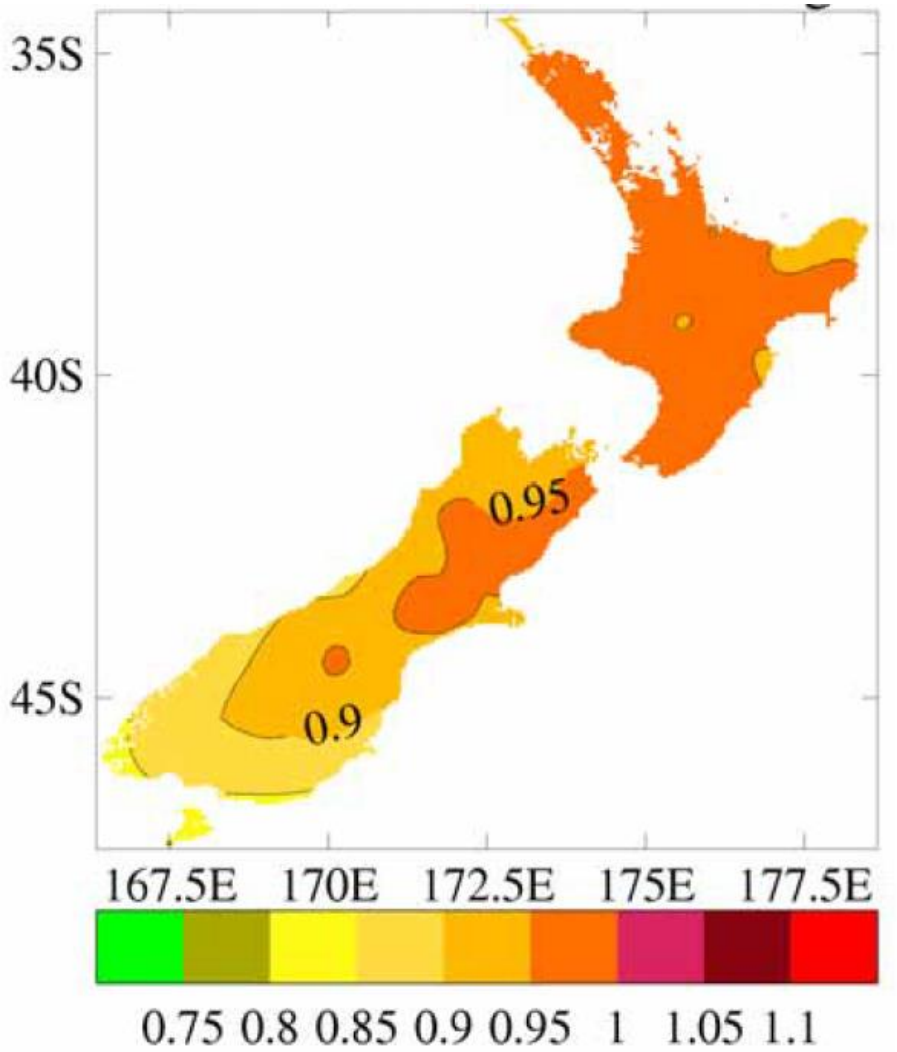
Waterways Centre: University of Canterbury and Lincoln University

INTRODUCTION

- Canterbury on dry East Coast of NZ's South Island
- Agricultural economy highly dependent on water
  - 89% of consumptive use
- Agriculture is dominant source of greenhouse gases
  - 47% of emission profile
- Need for adaptation and opportunities to mitigate

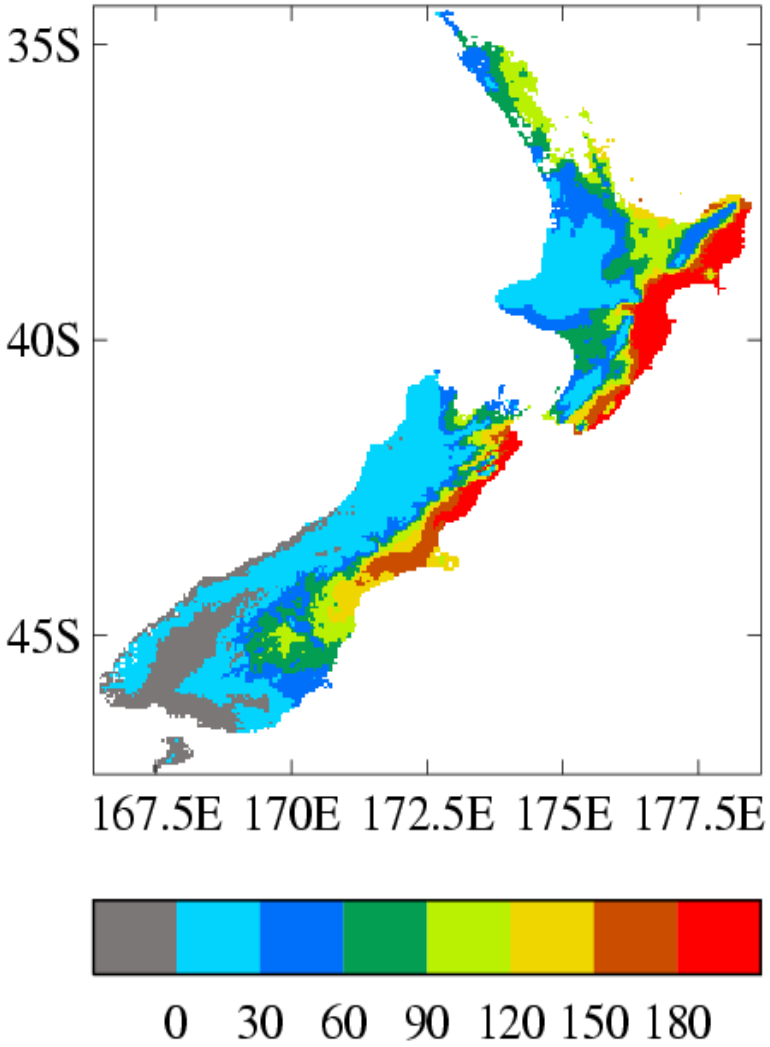
NZ AVERAGE SURFACE TEMPERATURE





CHANGES IN THE ANNUAL MEAN TEMPERATURE (°C) IN 2040 RELATIVE TO 1990

Average over 12 climate models for A1B emission scenario (Ministry for the Environment 2008)



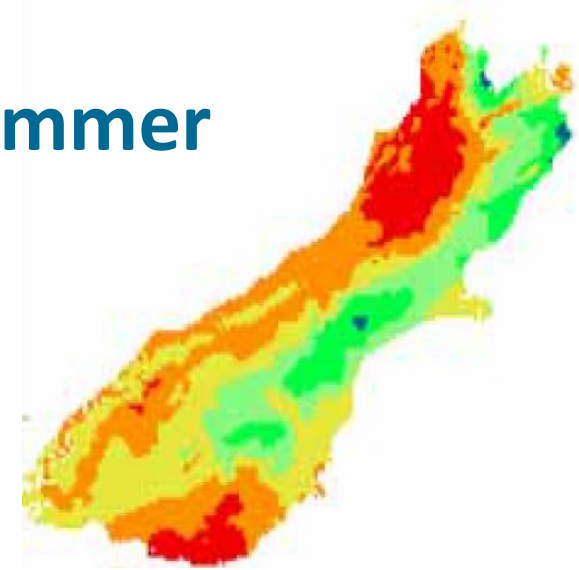
CHANGES IN THE ANNUAL AVERAGE PED (MM) CURRENT TO 2080

Based on Hadley Climate Model for 2080 scaled to IPCC 75% global warming

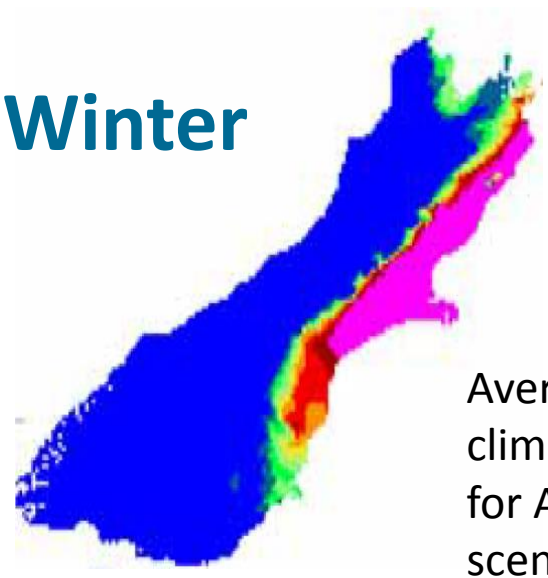
Source: Mullen et al 2005

PROJECTED SEASONAL RAINFALL CHANGE (IN %) FOR 2090 RELATIVE TO 1990

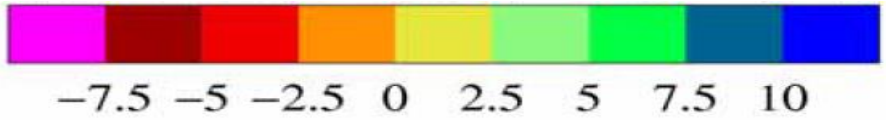
Summer



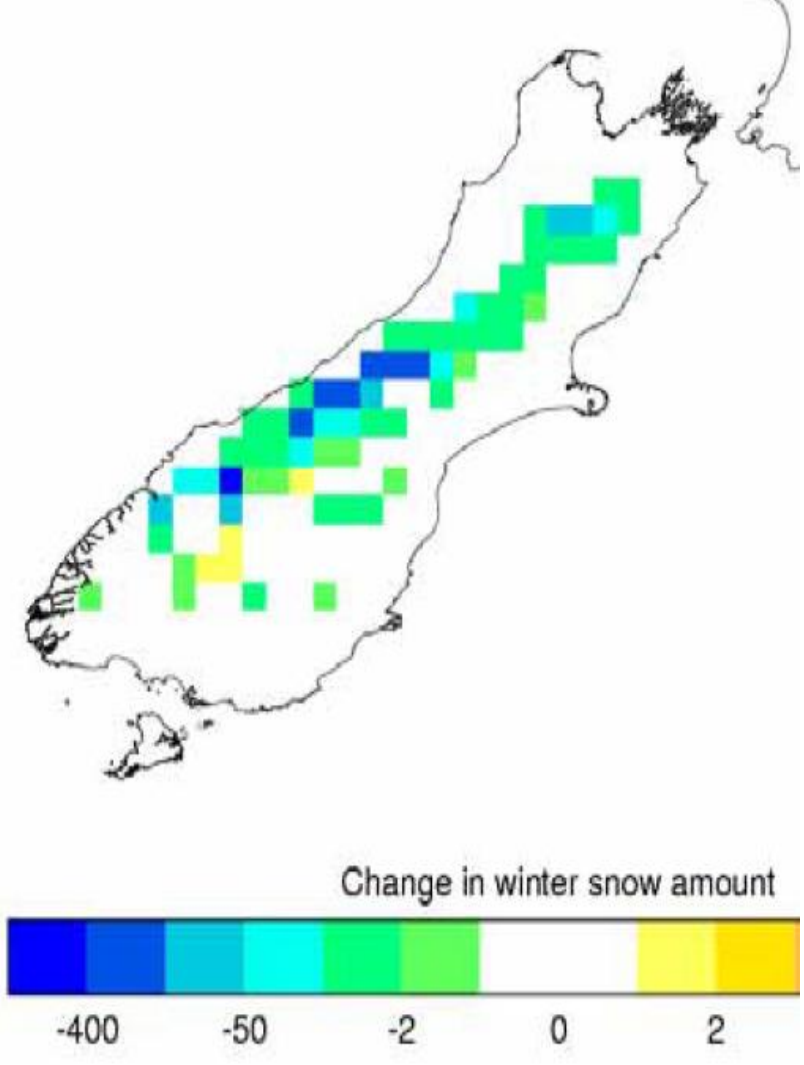
Winter



% Change



Average over 12 climate models for A1B emission scenario
Source: MfE (2008)



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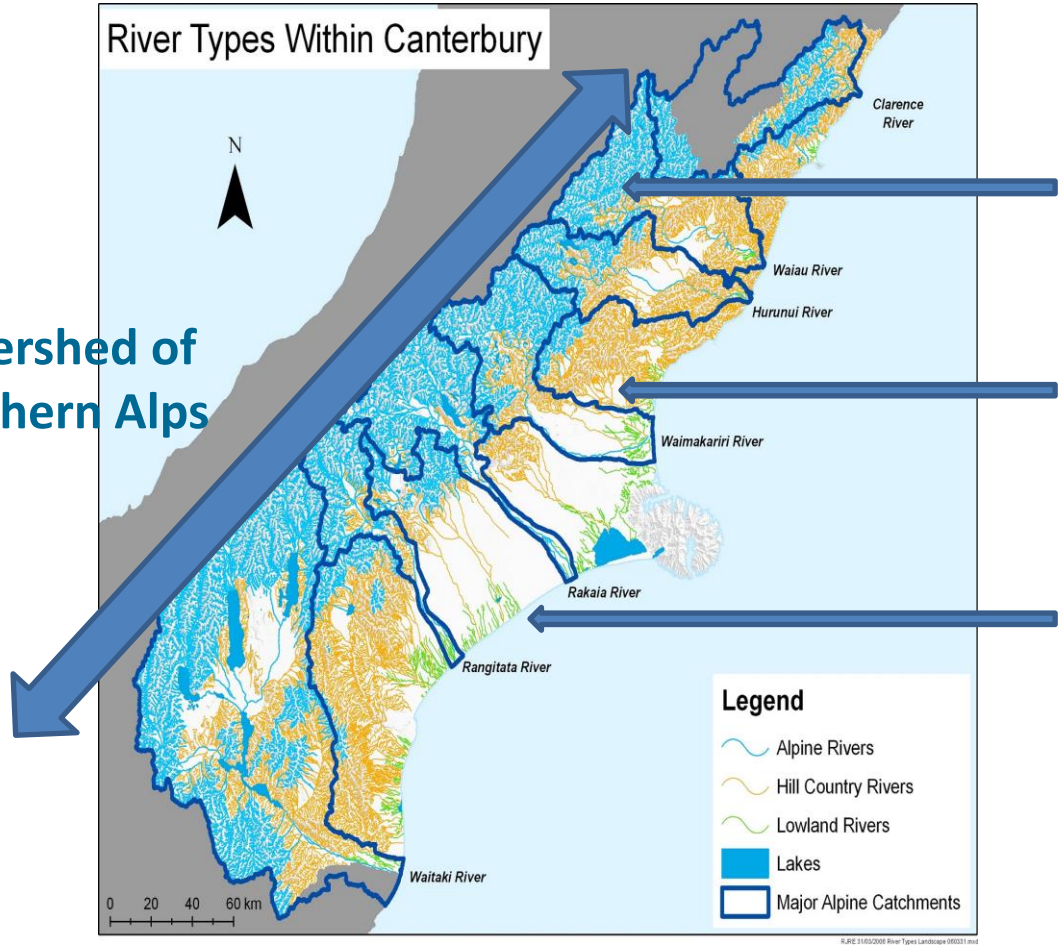
CHANGE IN WINTER SNOW (KG/M2)

from 1980-1999 to 2080-2099 under Scenario A2

(Ministry for Environment 2008)

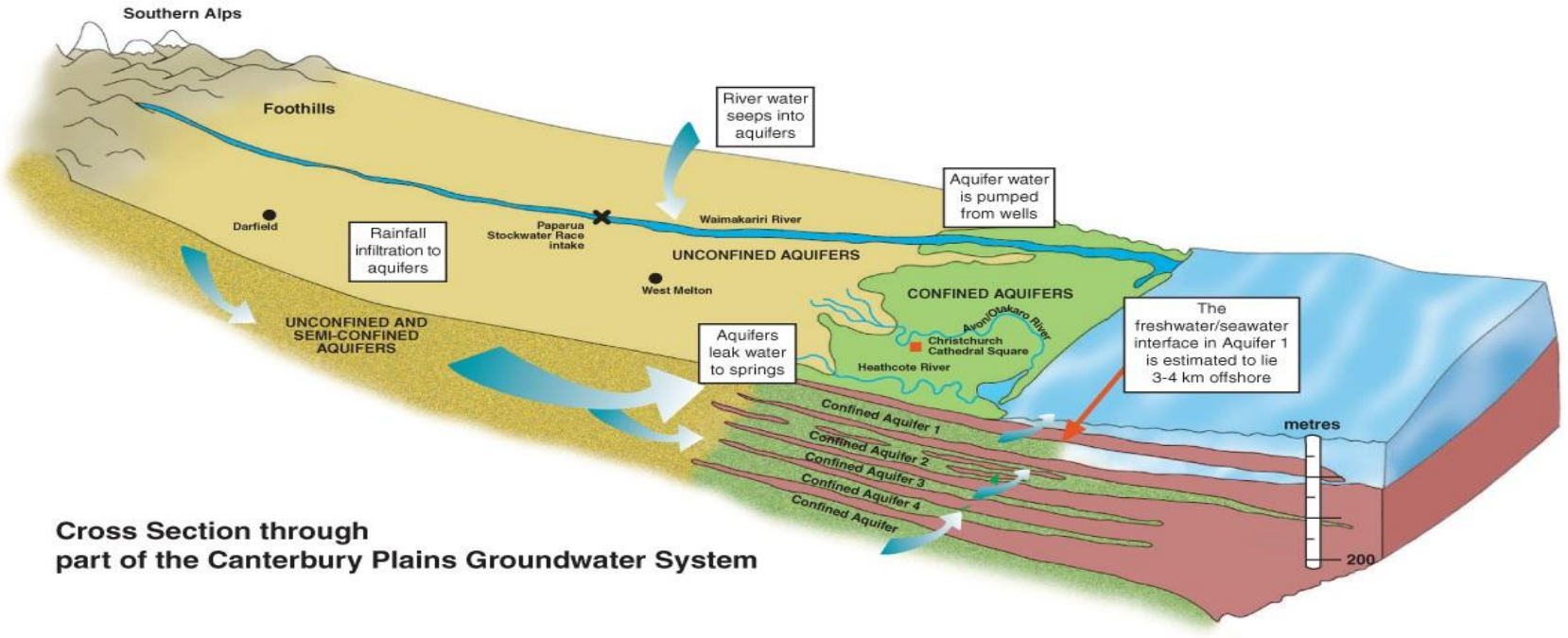


Watershed of Southern Alps

Alpine Rivers with headwaters in the Southern Alps

Hill Country Rivers with headwaters in foothills of the Southern Alps

Lowland Rivers which are spring-fed from groundwater on the Canterbury Plains

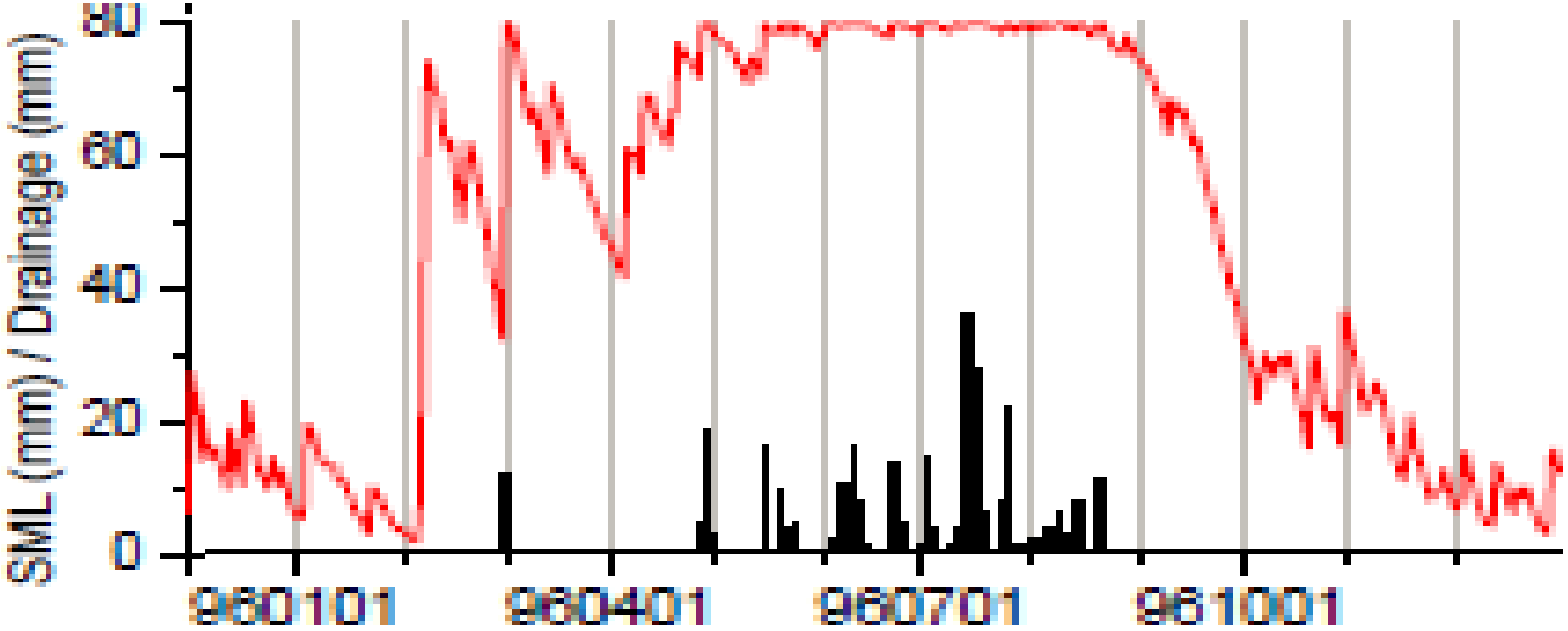


Cross Section through part of the Canterbury Plains Groundwater System

AQUIFER RECHARGE: ANNUAL CYCLE

Red - Soil moisture level

Black - Drainage to Groundwater



FRESHWATER IMPLICATIONS

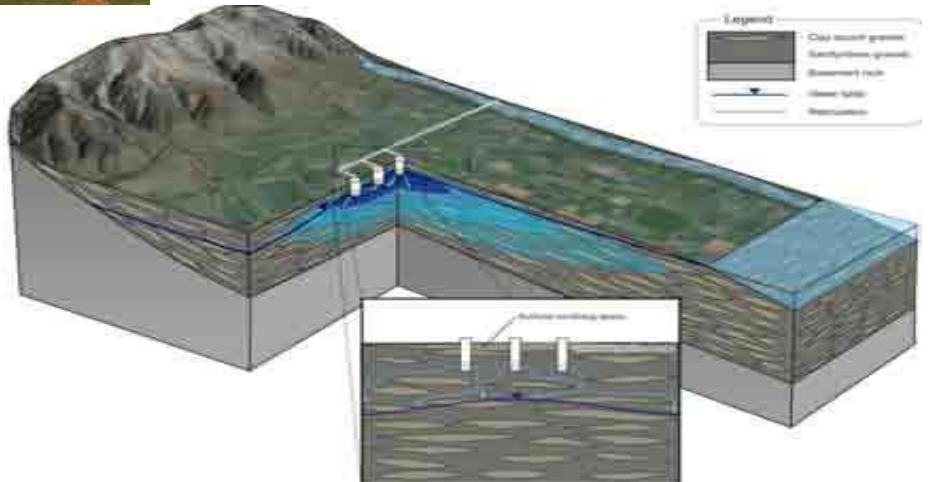
- Increased PED – increased irrigation demand
- Decreased winter rainfall on the plains – reduced aquifer recharge, reduced lowland stream flows
- East Coast drier – lower flows in foothill rivers
- West Coast wetter and warmer in winter – reduced snow, increased winter flows and reduced summer flows in alpine rivers

FRESHWATER ADAPTATIONS

- Increased demand for water with less reliance on run-of-river and groundwater
- Need to increase water use efficiency and resource productivity
- Potential role for storage and inter-basin transfer (if sustainable)
- Resilient solutions: harvest higher alpine river winter flows for groundwater recharge

OFF-RIVER STORAGE OF WINTER FLOWS

MANAGED AQUIFER RECHARGE

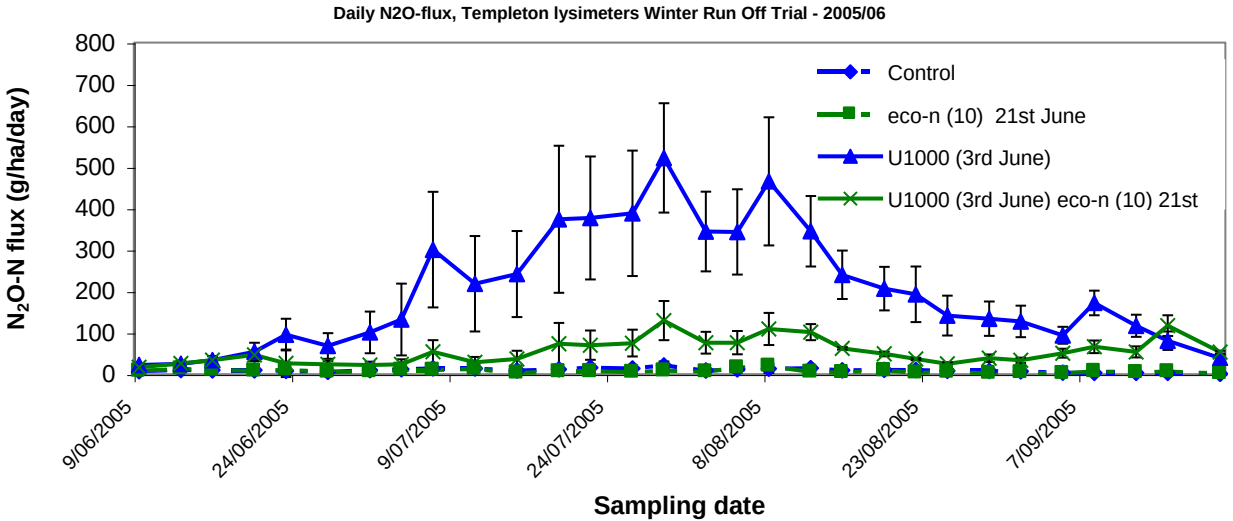


OPPORTUNITIES TO MITIGATE

- Nitrogen Inhibitors
  - enzyme that reduces the conversion of ammonia to nitrate and nitrous oxide

  - increased grass production and decreased greenhouse gas emission

Di et al., 2007



NEGATIVE ACTIONS

- Forest clearance for dairy farms
- Loss of sink and increased emissions

POSITIVE ACTIONS

- Incorporation of hydro generation in irrigation schemes

CONCLUDING COMMENTS

- Significant implications for water management in Canterbury
- Adaptation required to accommodate change
- Opportunities to mitigate and offset greenhouse gas emissions