‘Climate change’ impact on lake systems in South-east Australia

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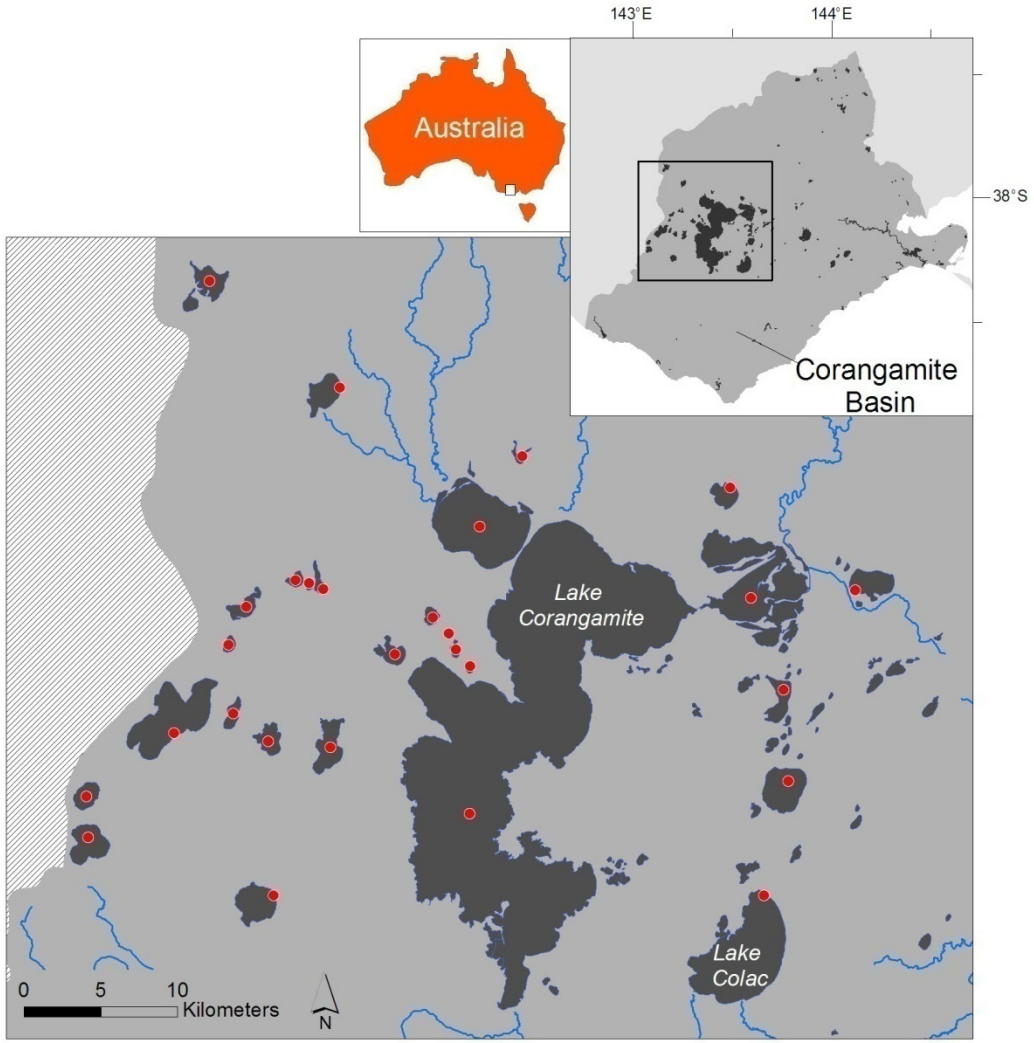
CORANGAMITE CMA

MONASH University

DEAKIN UNIVERSITY

Study area

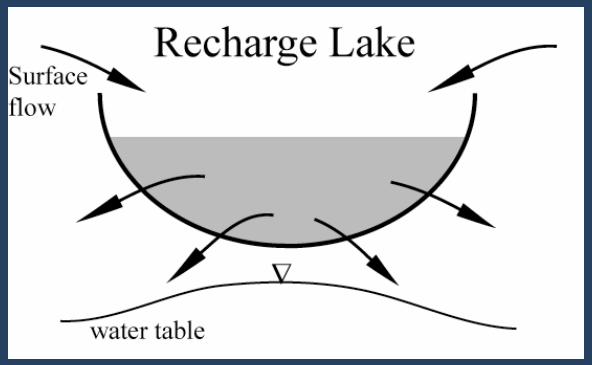


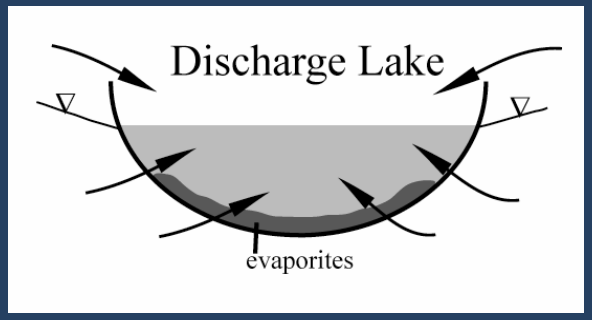
28 Lakes

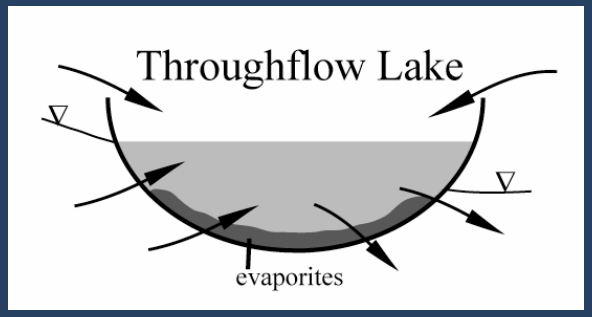
- mostly shallow (< 6 m)
- Range in sizes
  - ➢ 0.13 to 241 km^2
- Mostly saline
  - ➢ up to > 400 mS/cm

⇒ 7 are Ramsar sites

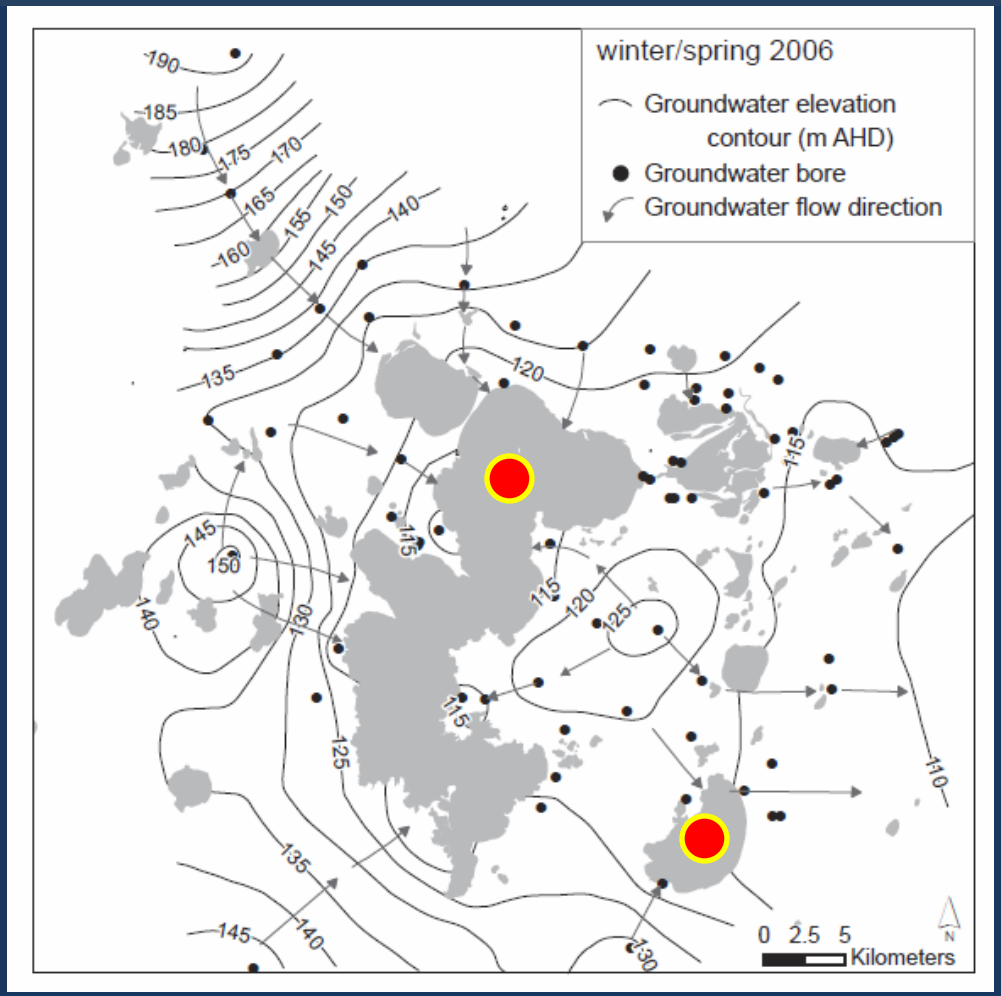
Groundwater and lakes interaction



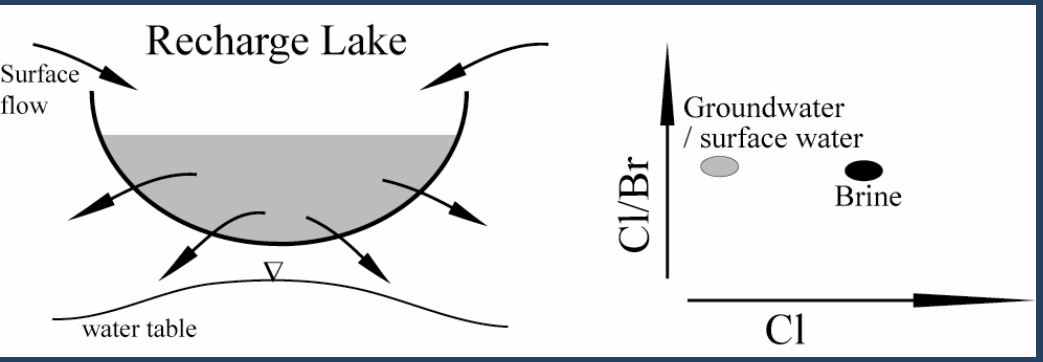




- Not enough physical hydrogeological monitoring data

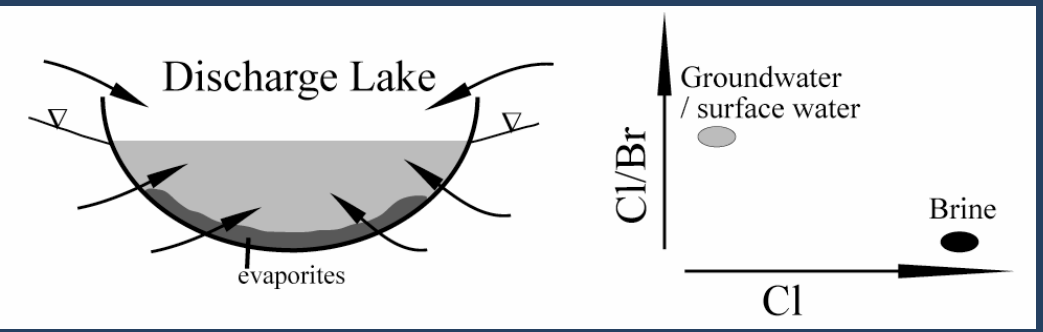


Groundwater and lakes interaction



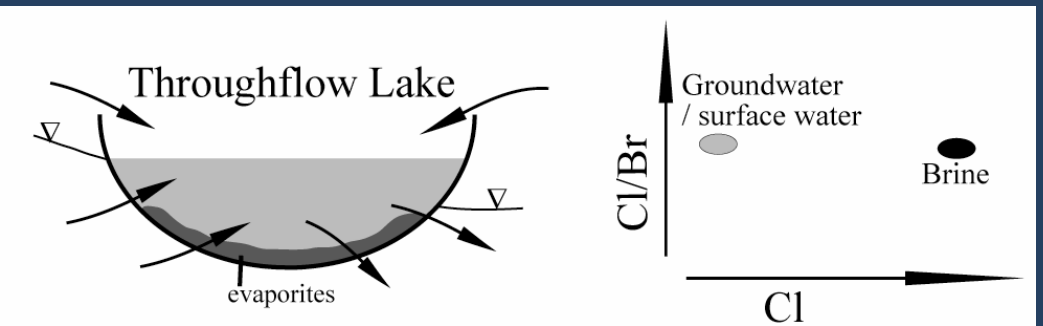
Recharge:

- Cl/Br ratios constant
  - no halite precipitation



Discharge

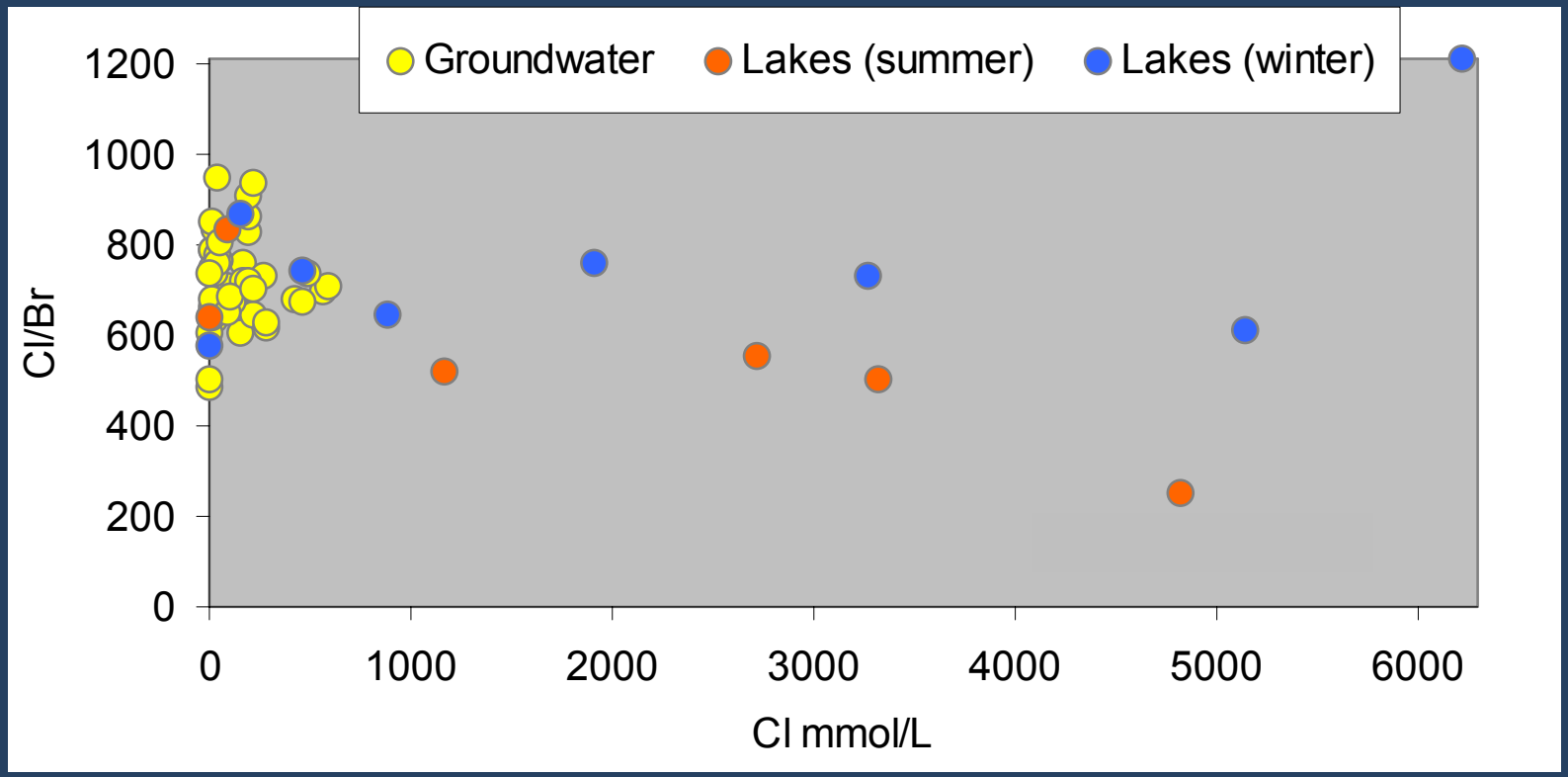
- Cl/Br ratios decrease
  - halite precipitation



Throughflow

- Cl/Br ratio moderate
  - inflow of moderate Cl/Br gw
  - outflow of low Cl/Br lake water

Groundwater-fed lakes

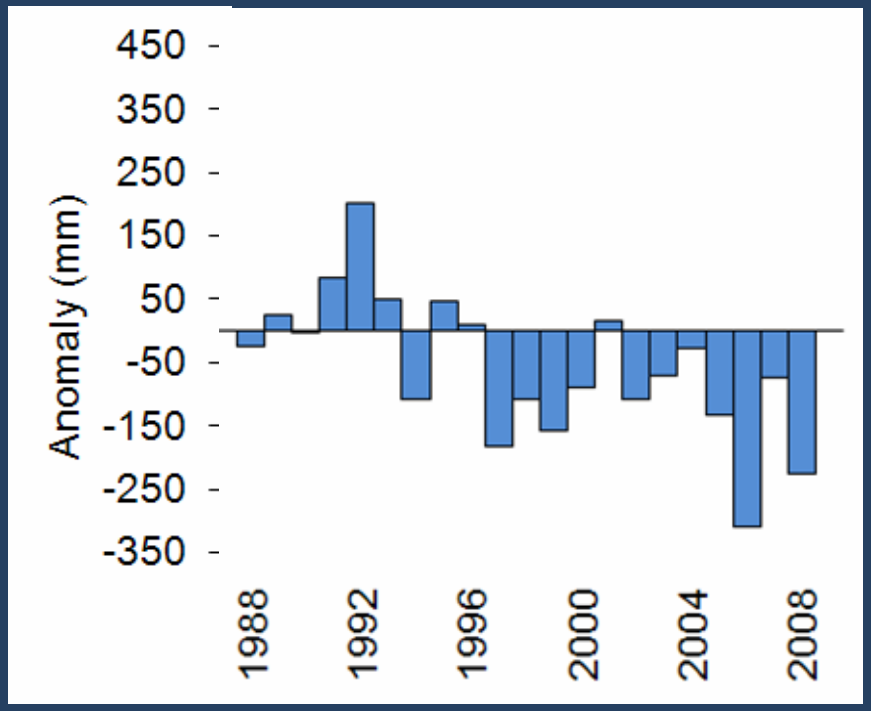


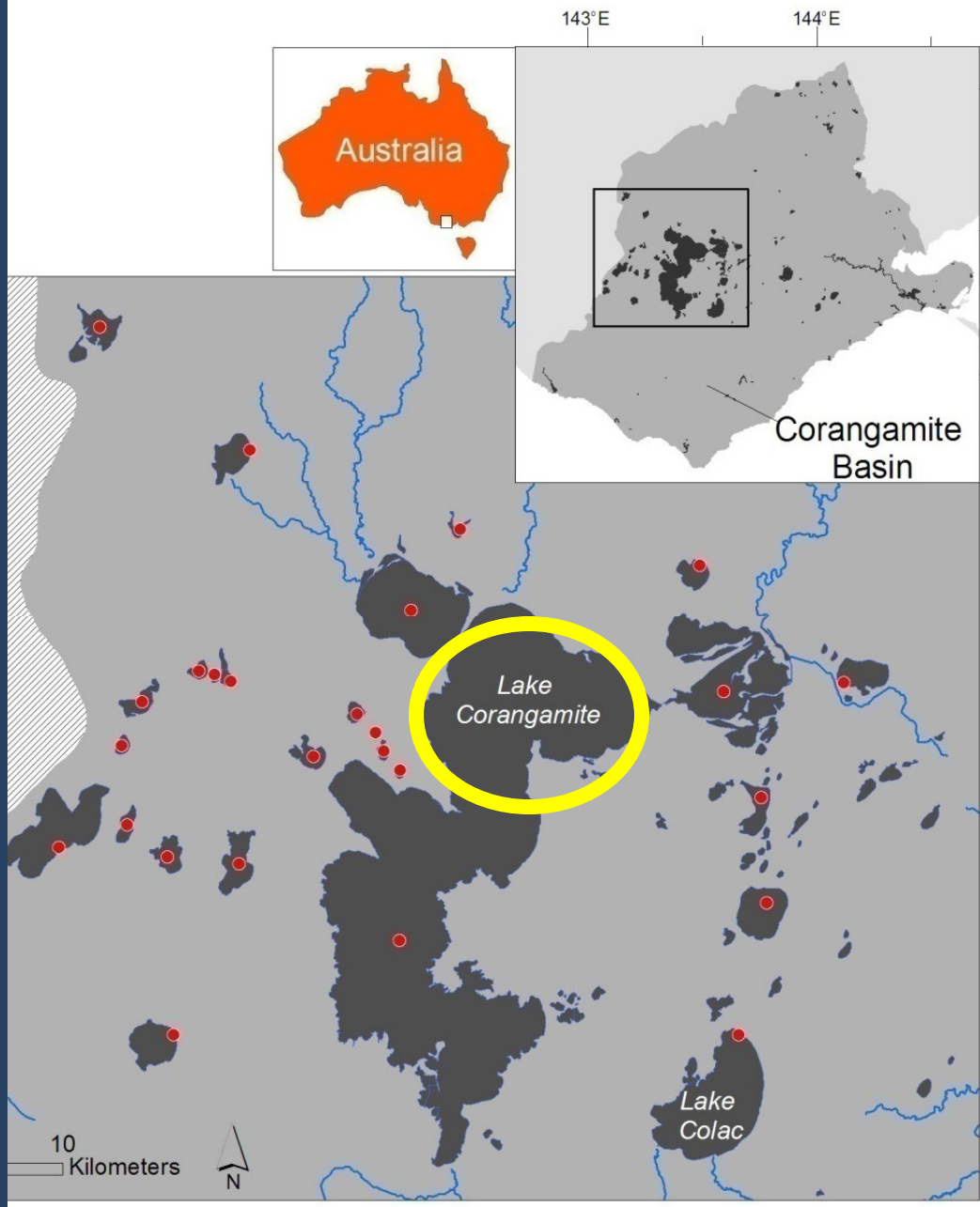
Over the long term

=> Most lakes throughflow

What has happened during the drought?

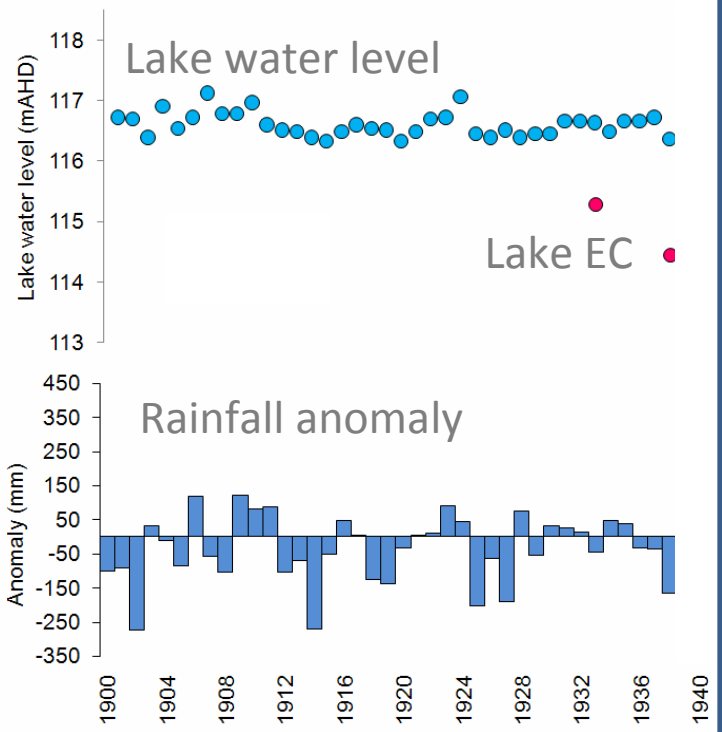
e.g. Lake Corangamite





1900-1938: low rainfall

European settlement expansion continued from the 1830s into the early 1900s



Lake Corangamite takes its name from the Colijon tribe word koraiyn, meaning bitter or salty

EC: 78 -124 mS/cm (1933-38)

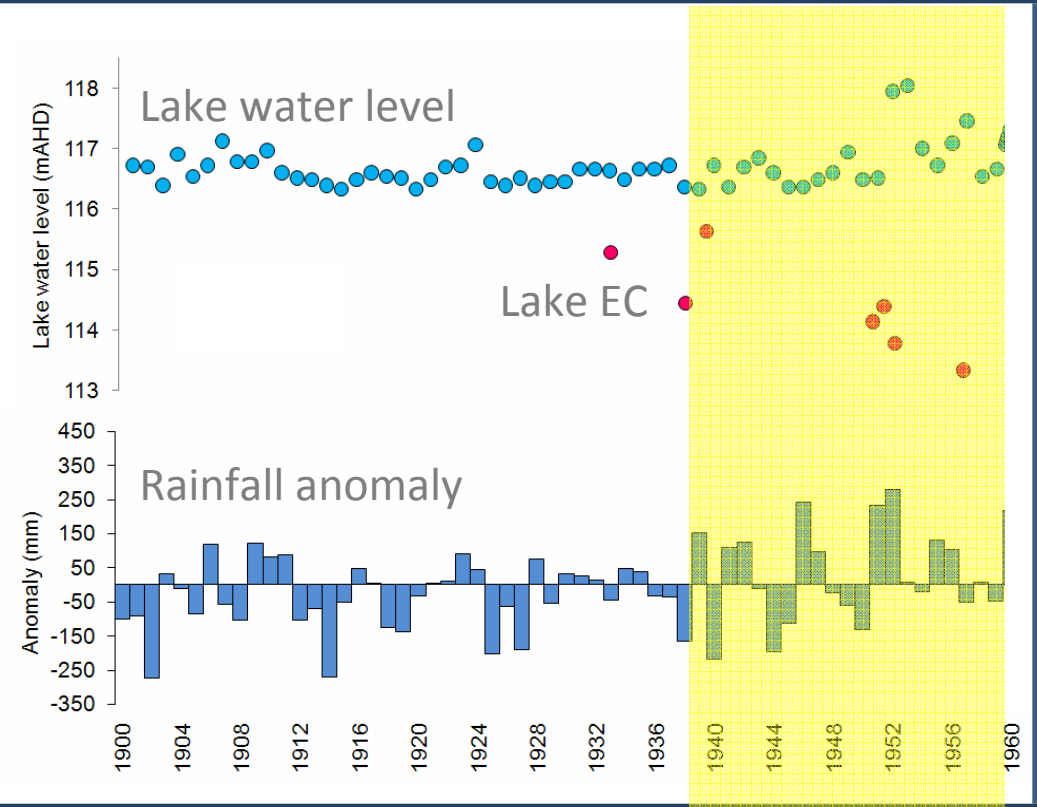
Salt beside Lake Corangamite, c. 1920
(La Trobe Picture Collection, State Library of Victoria).

	1900-1937
Max change in water level (m)	↓ 0.7
Max change in EC (mS/cm)	-

Agriculture surrounding lakes

But, as closed lakes they are sensitive to climatic variability…

1939-1959: increased rainfall

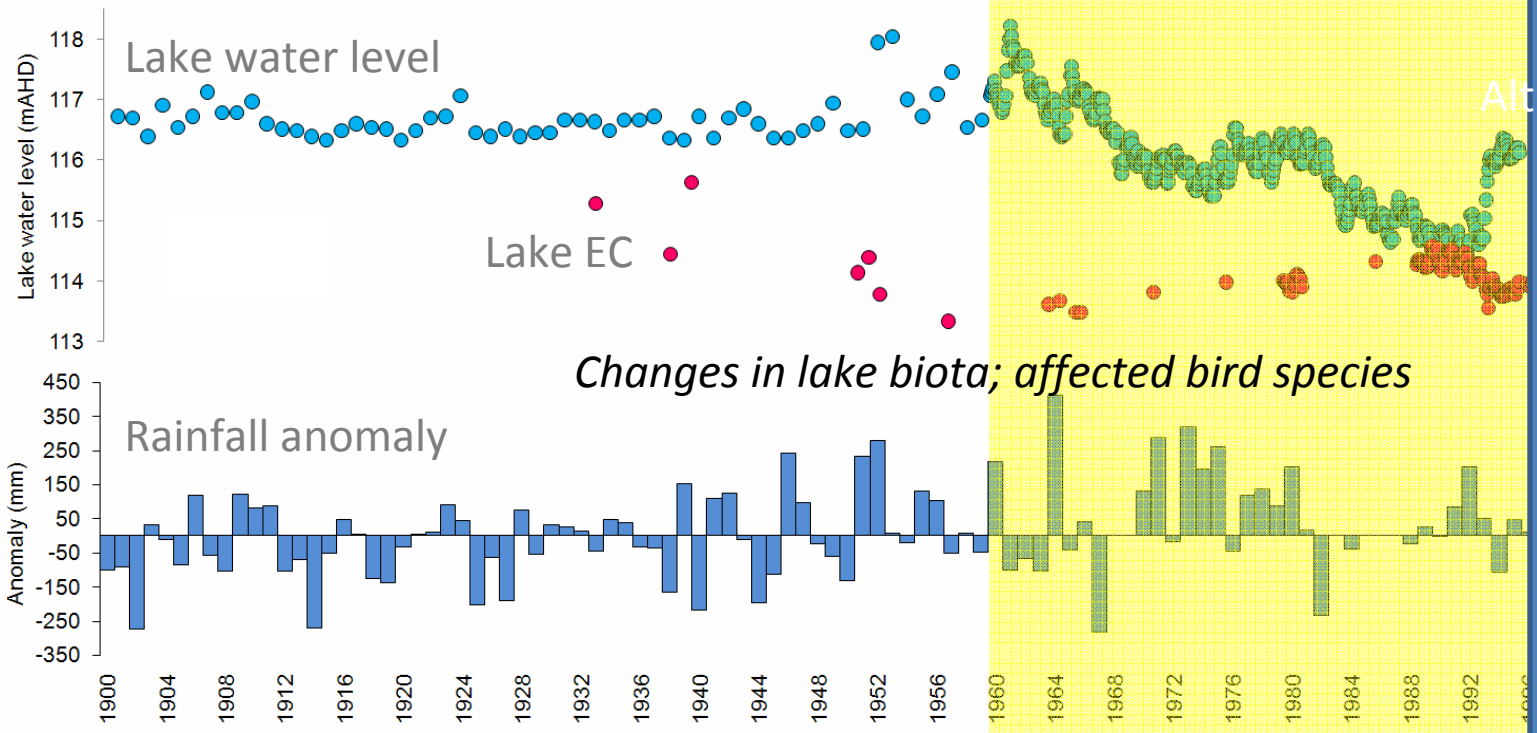


floods

A flooded farmhouse beside Lake Corangamite 1958 (La Trobe Picture Collection, State Library of Victoria).

	1900-1937	1939-1959
Max change in water level (m)	↓ 0.7	↑ 1.7
Max change in EC (mS/cm)	-	↓ 120

1960-1996: water diversion

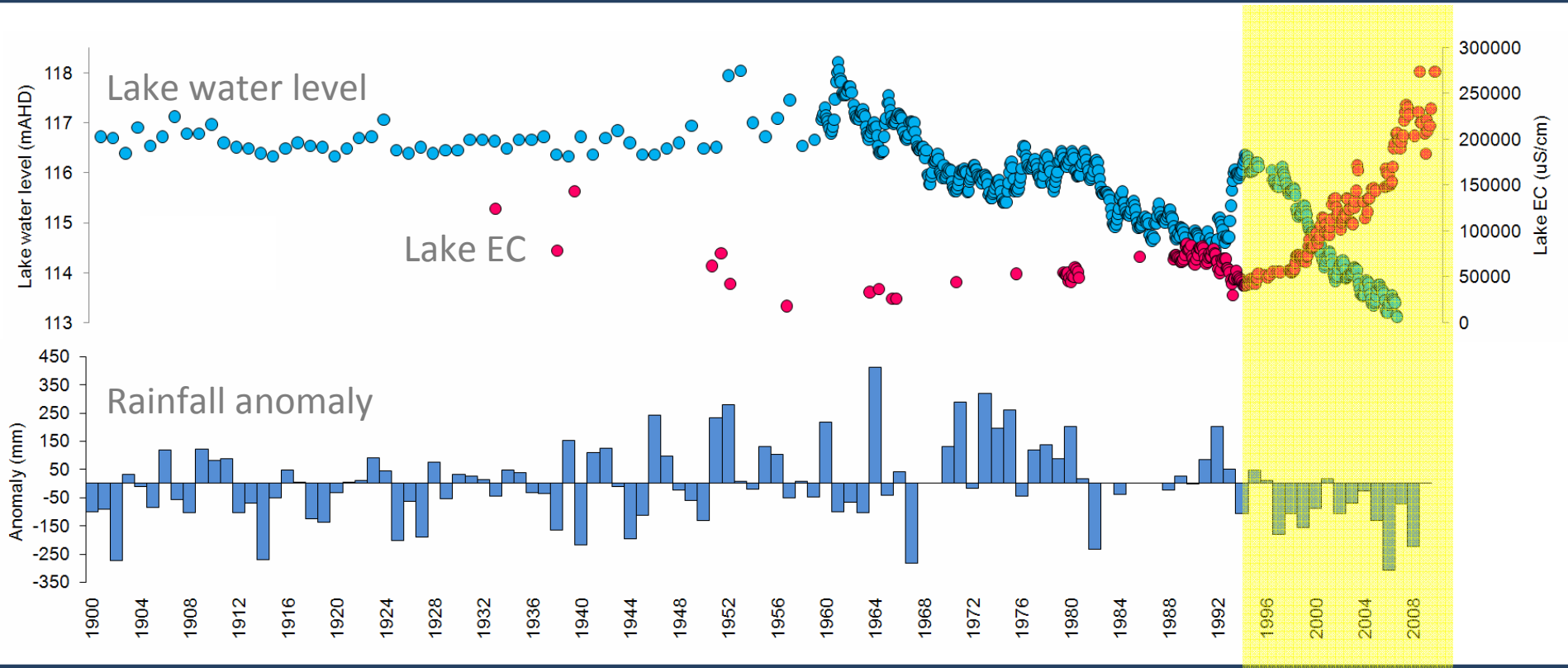


Changes in lake biota; affected bird species

Although during a high rainfall period, the surface water diversion resulted in record low water levels and increased lake EC

	1900-1937	1939-1959	1960-1993
Max change in water level (m)	↓ 0.7	↑ 1.7	↓ 3.6
Max change in EC (mS/cm)	-	↓ 120	↑ 53

1994 - present: drought



	1900-1937	1939-1959	1960-1993	1994-2009
Max change in water level (m)	↓ 0.7	↑ 1.7	↓ 3.6	↓ 3.2
Max change in EC (mS/cm)	-	↓ 120	↑ 53	↑ 230

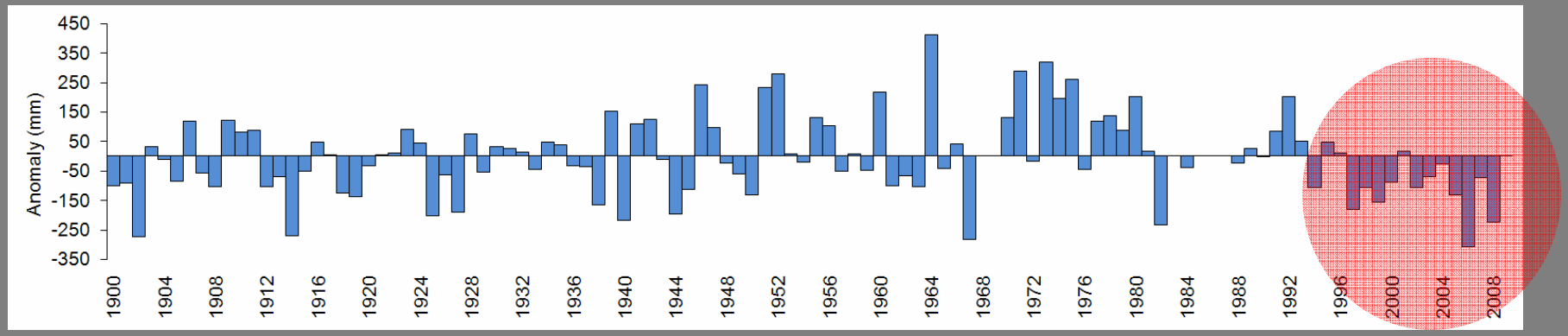
Drought

Water budget

Which process is controlling the decline in lake water levels?

Is there a temporal change in these controls?

1. Reduced rainfall



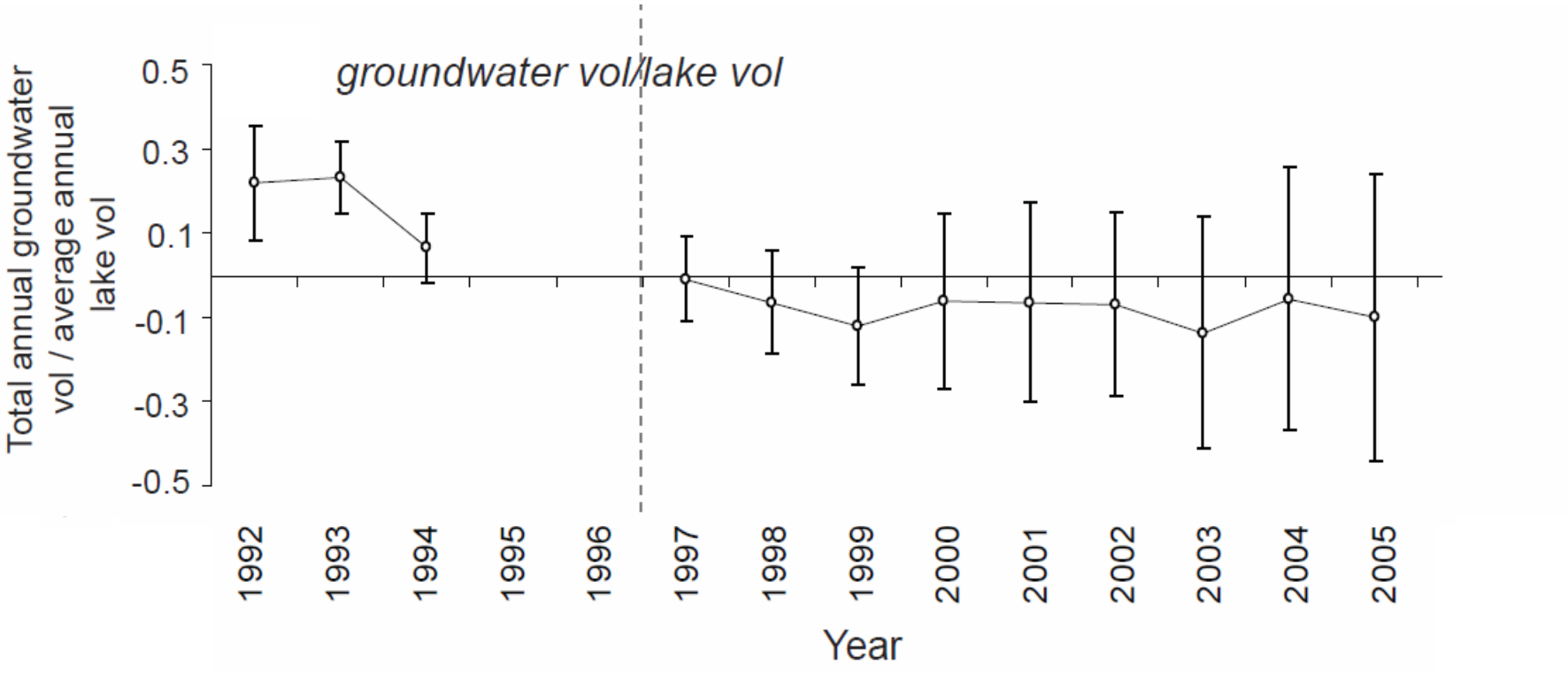
2. Decrease in groundwater discharge

During the drought the water table has decreased
e.g. by 1.24 m from 1992-2006 during winter months

Water budget

Decrease and then little change in groundwater discharge

Reduced rainfall controlling declines in lake levels



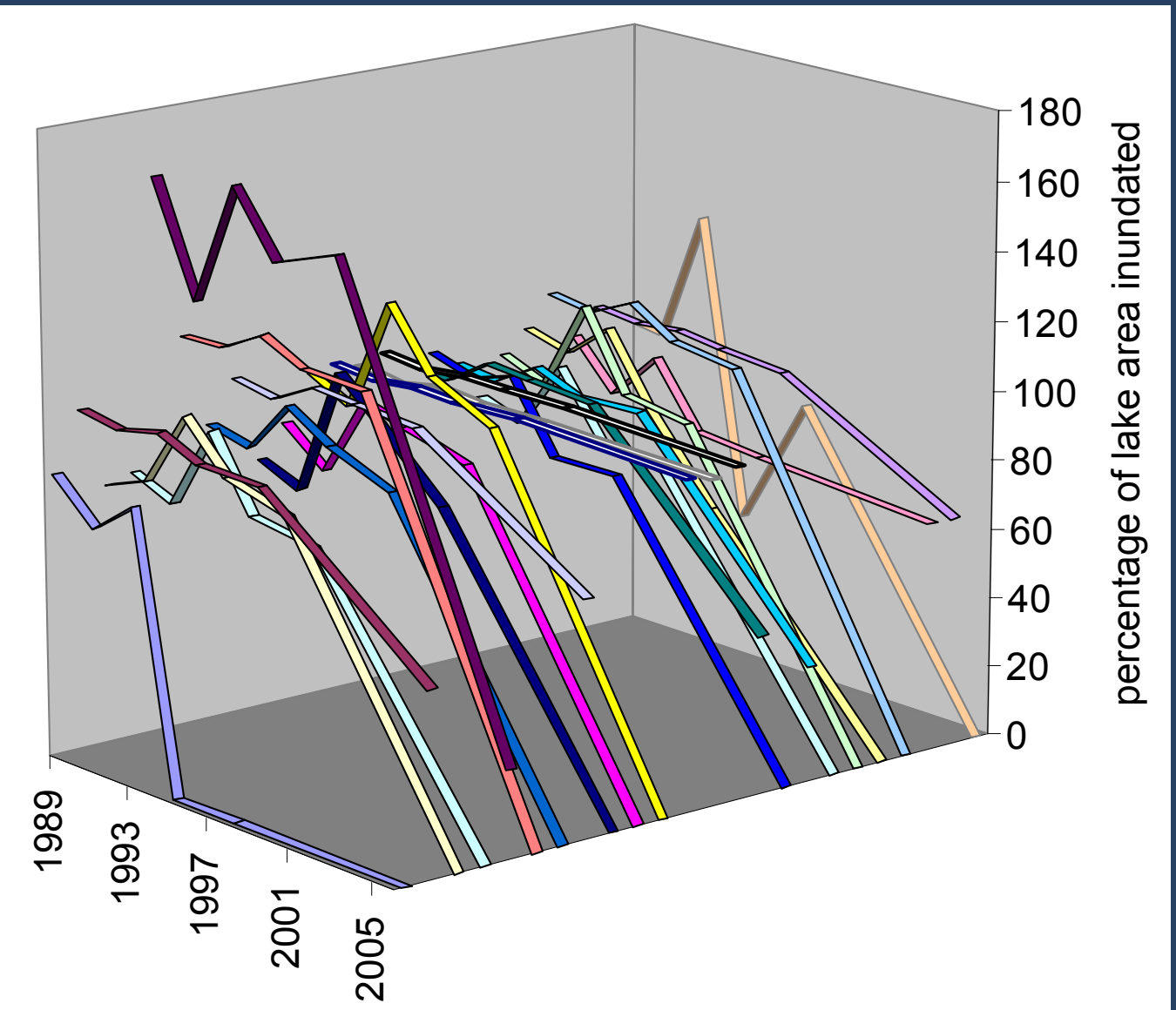
What about the other 27 lakes?

Regional water and evaporite mapping

December 2006

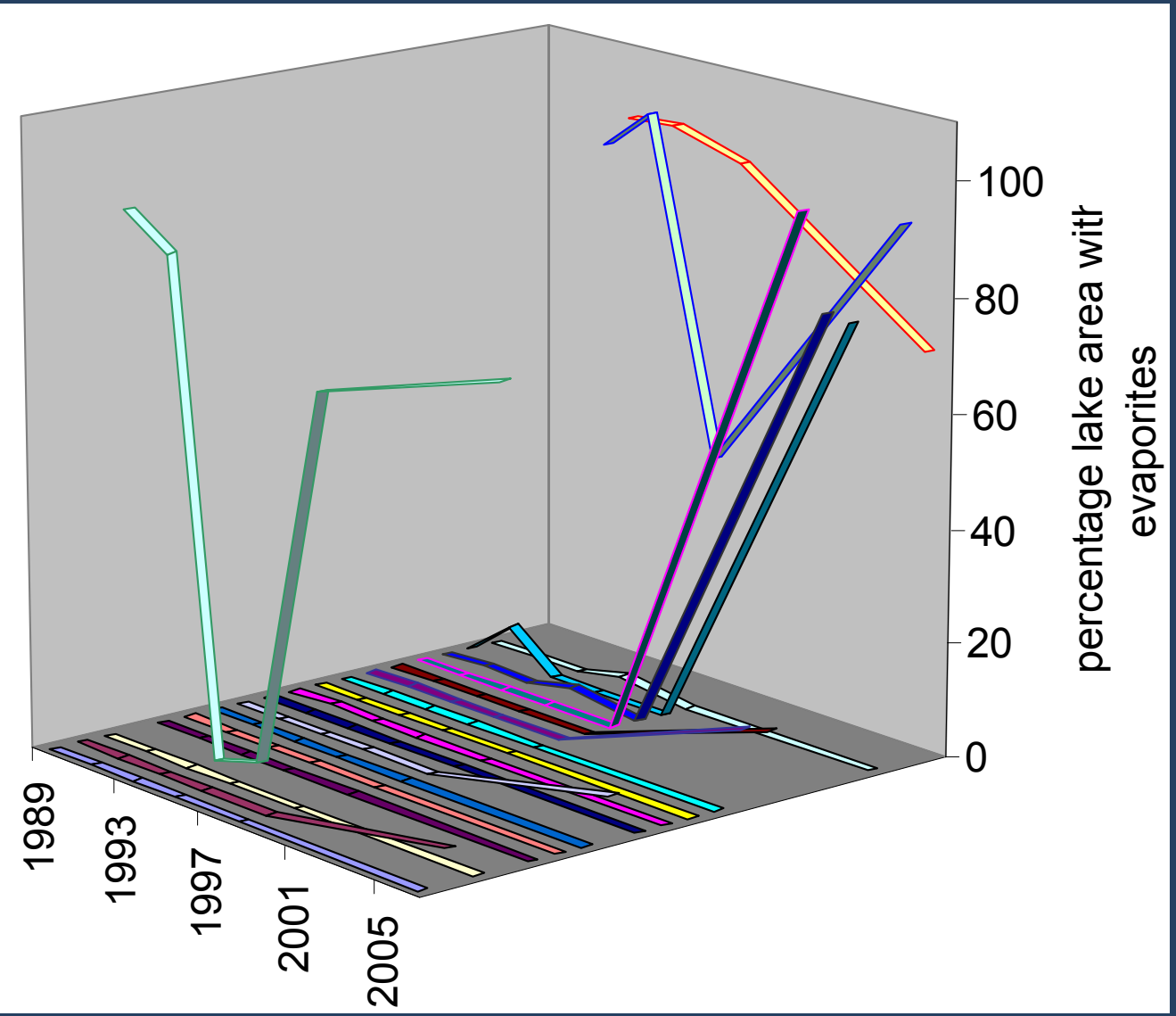
- Remote sensing data (Landsat-5TM)
- Water and evaporites mapped during summer 1989, 1991, 1993, 1995, 1998, 2006
- Evaporites halite, gypsum, calcite, dolomite and magnesite

Regional water mapping



- Most lakes water decreased by 2006
  - 16 dry
- First lake to dry is located highest in the landscape
- Most lakes dry in 2006 are smaller lakes

Regional evaporite mapping

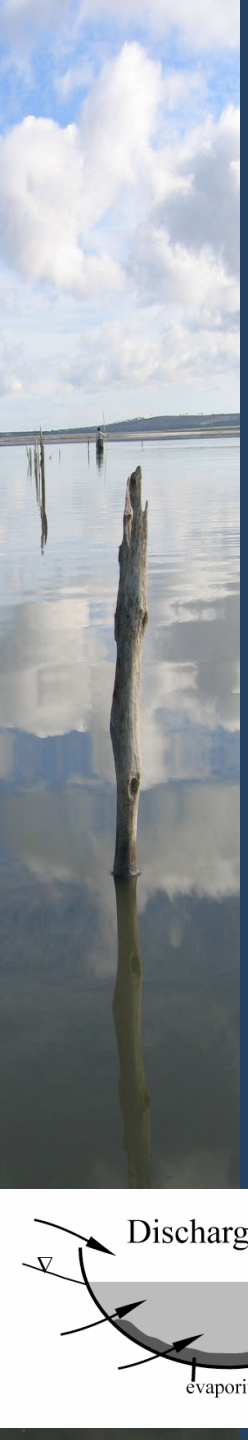


10 of the 28 lakes;

- evaporites present in December 2006

For 7 of these lakes;

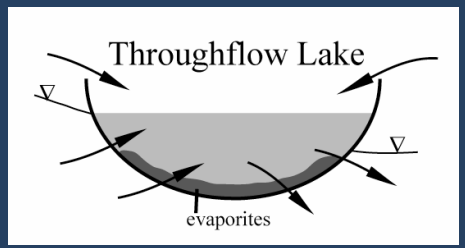
- evaporites only appear in Dec 2006



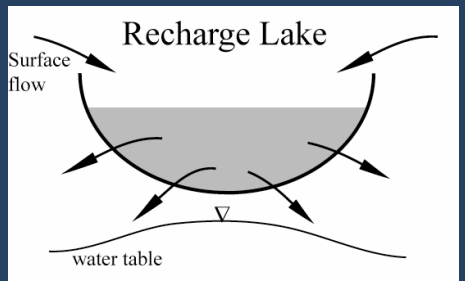
Conclusions

1. Groundwater-fed lakes
2. Groundwater-fed lakes also sensitive to climate variability
3. Lake Corangamite
   - Record declines in water level and increase in salinity
   - Little change in groundwater-lake interaction
4. Other lakes
   - impacts on gw-lake interaction
     - 10 of 28 had changed from discharge or throughflow to intermittent recharge lakes
   - Onset of evaporites
     - 25% of the lakes

or



drought



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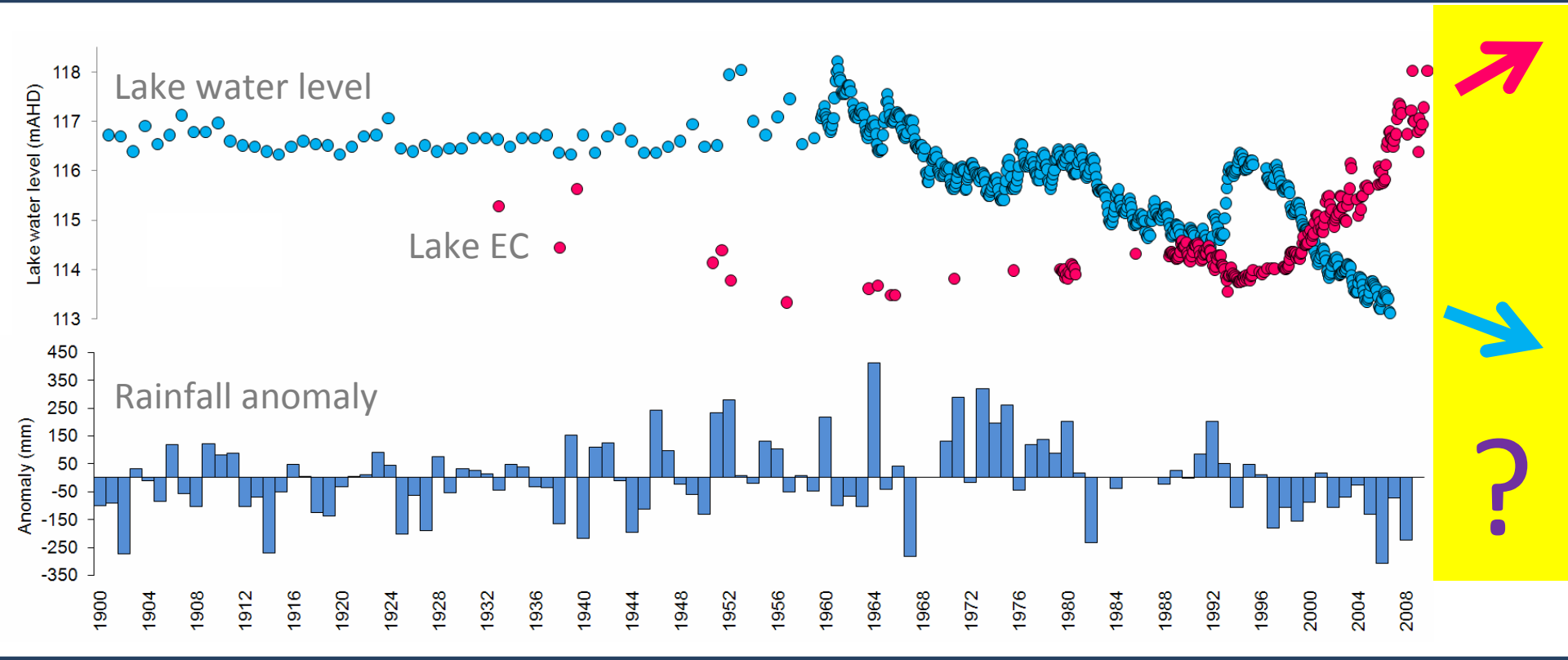
Lake water level
Lake EC
Lake water level (mAHD)
118
117
116
115
114
113
Rainfall anomaly
Anomaly (mm)
450
350
250
150
50
-50
-150
-250
-350
1900
1904
1908
1912
1916
1920
1924
1928
1932
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2008
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