Global changes in transboundary basins: a view from space

.. on the scale, magnitude and interactions of changes in water resources

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MURRAY-DARLING BASIN: THE BIG DRY

➢OUR TRANSBOUNADRY BASIN: shared by 5 states

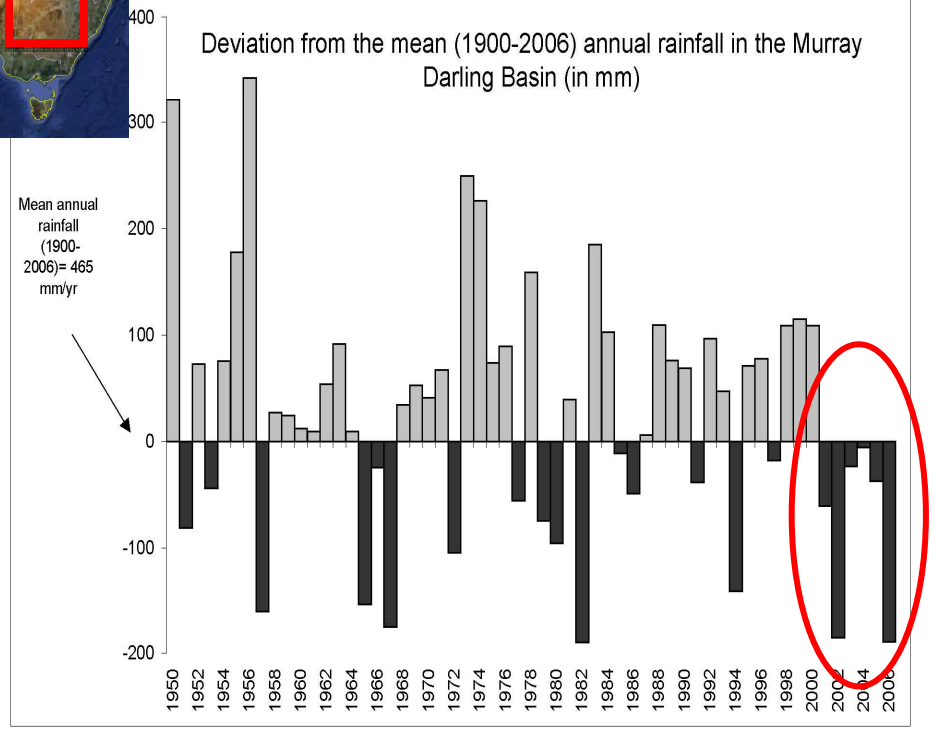
➢Location: Southeast Australia

➢Area: ~ 1.061 x10^6 km^2 semiarid region

➢~ 60-70% of Australian irrigated land

➢~ 42% of gross value of agriculture productions

DROUGHT: critical situation for farming, industry and urban water supply !



2002-2006: Total rainfall deficit of ~455 km^3

Surface water: the focus of attention

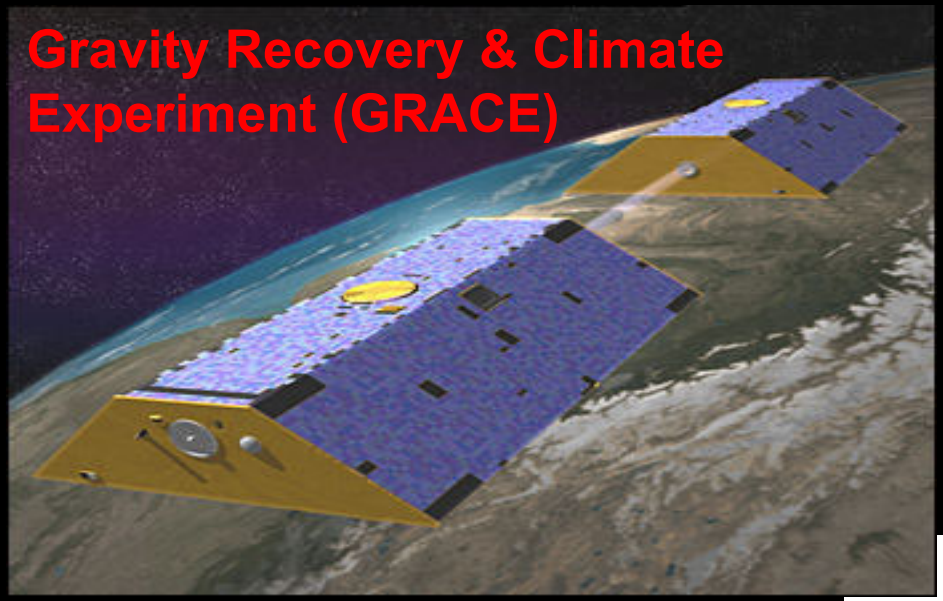
Example of water supply storage: Lake Eppalock, photo June 2008

Location: Bendigo

Total capacity: ~ 304 GL

Water storage Dec. 2007: ~ 6 % total capacity

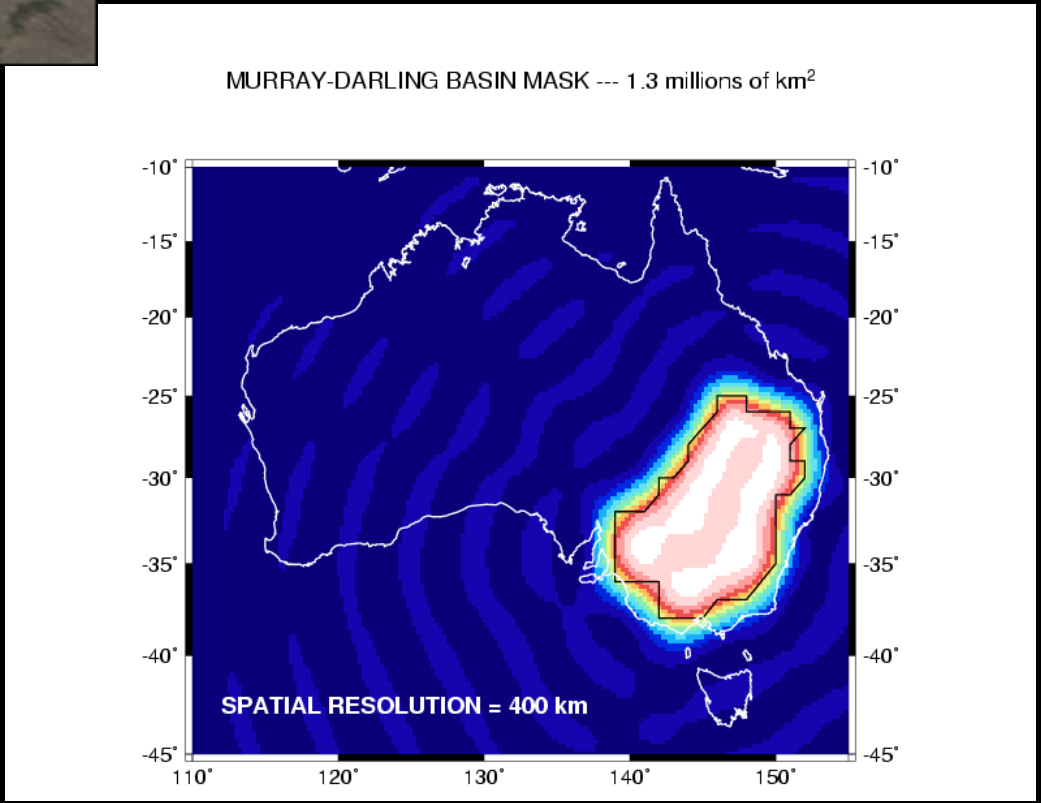
SATELLITE BASED ESTIMATE OF TOTAL WATER DEFICIT

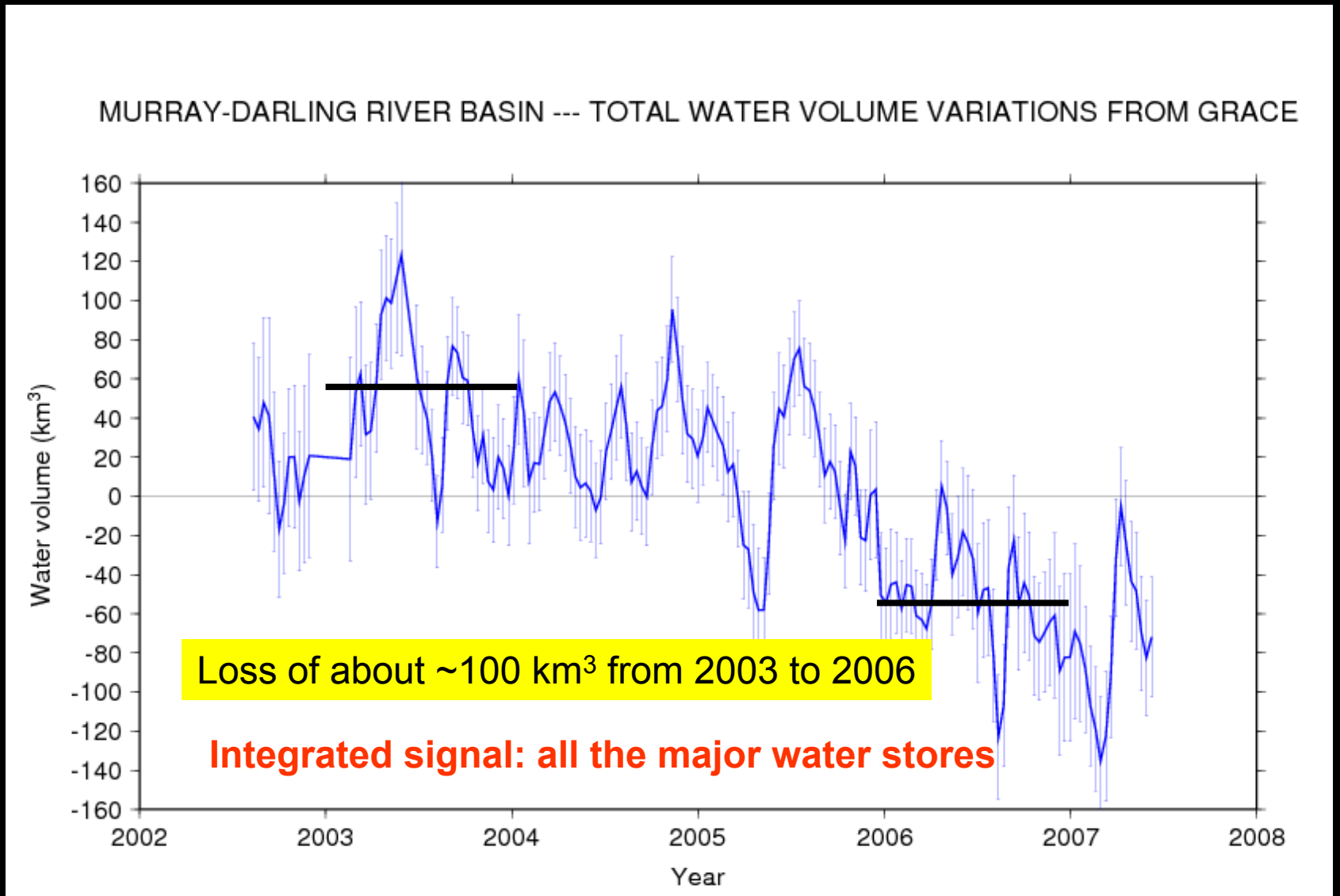


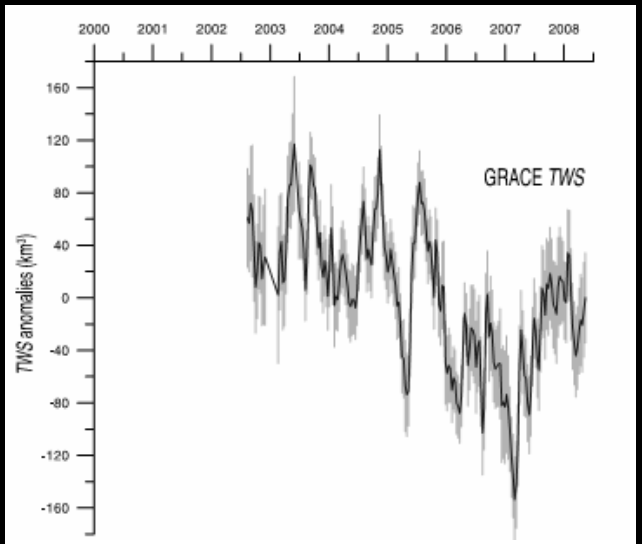
- sampled every 10-days from 08/2002 to 06/2007
- developed up to degree N=50
- Corrected from atmosphere mass (ECMWF)and ocean tides (MOG-2D)

Integrated measure of changes in water storage:

- -surface water
- -soil water
- -groundwater




MURRAY-DARLING RIVER BASIN --- TOTAL WATER VOLUME VARIATIONS FROM GRACE
Water volume (km3)
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
2002
2003
2004
2005
2006
2007
2008
Year
Loss of about ~100 km3 from 2003 to 2006
Integrated signal: all the major water stores

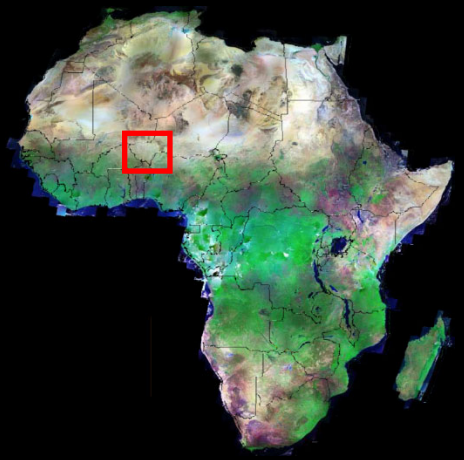


Conclusions

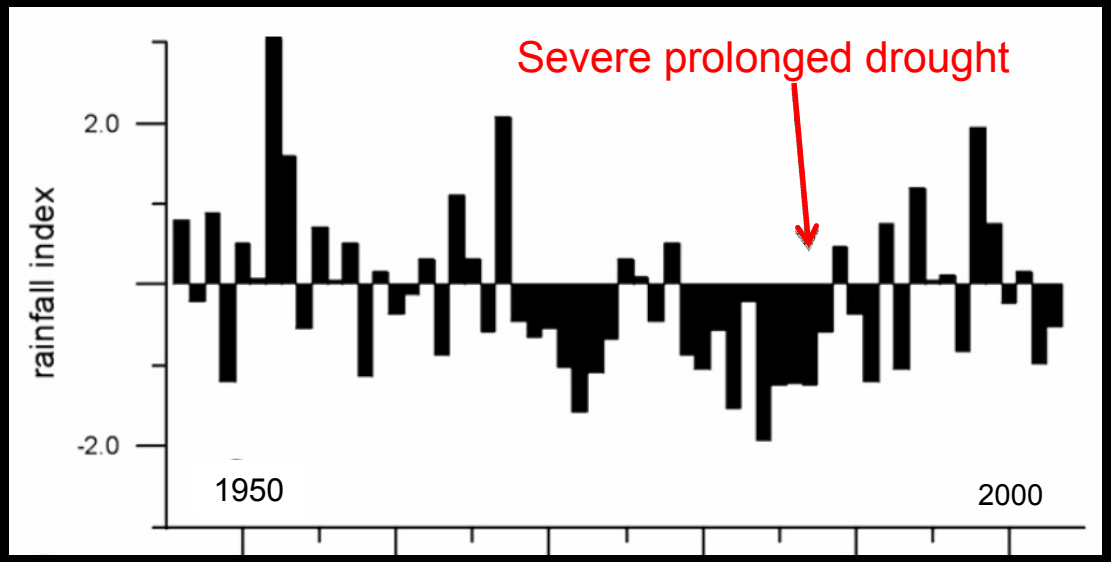
- SW and SM reach near-stationary low levels only two years after the onset of drought in 2001
- Important depletion in the shallow aquifers.
  - In-situ monitoring
  - Confirmed by GRACE
- Of all the water lost between 2000-06
  - 61% is GW
  - 33% is SM
  - 6% is SW
- GW still declining 6 years after the onset of the drought
- Need for integrated water accounting

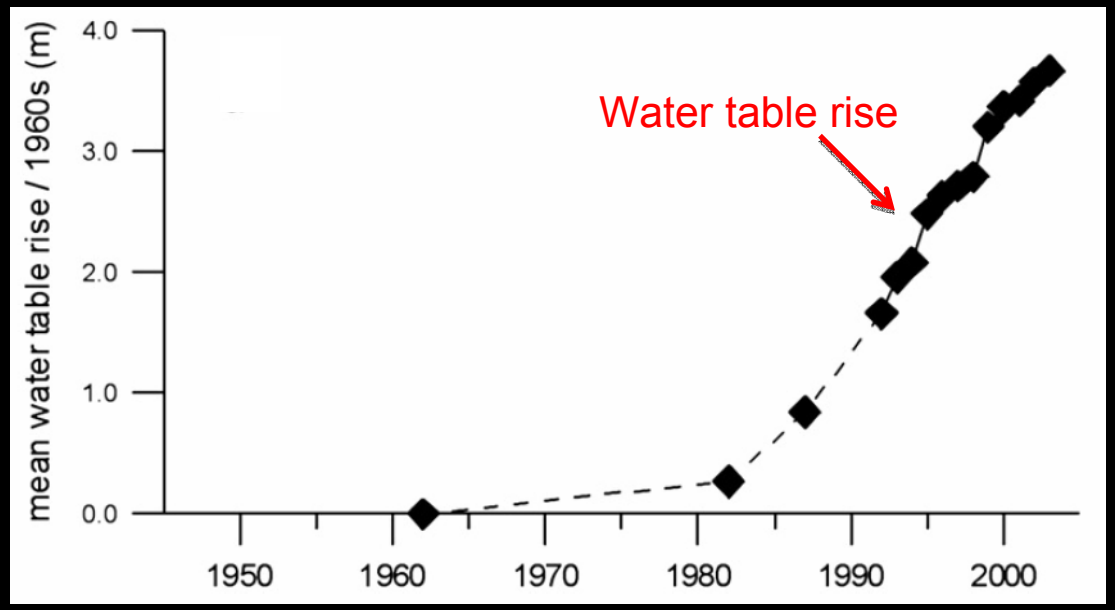
A hydrological paradox: a rising water-table during a drought

- **The Sahelian drought**



Study area east of Niamey, Niger Basin, Niger-West Africa



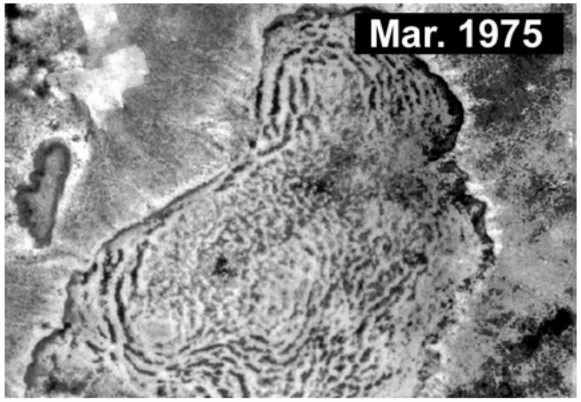


- **Long-term rise of WT**
- **Regional phenomenon**

C. Leduc, G. Favreau and P. Schroeter, 2001. *Long-term rise in a Sahelian water-table: the Continental Terminal in South-West Niger*

Archive aerial photographs

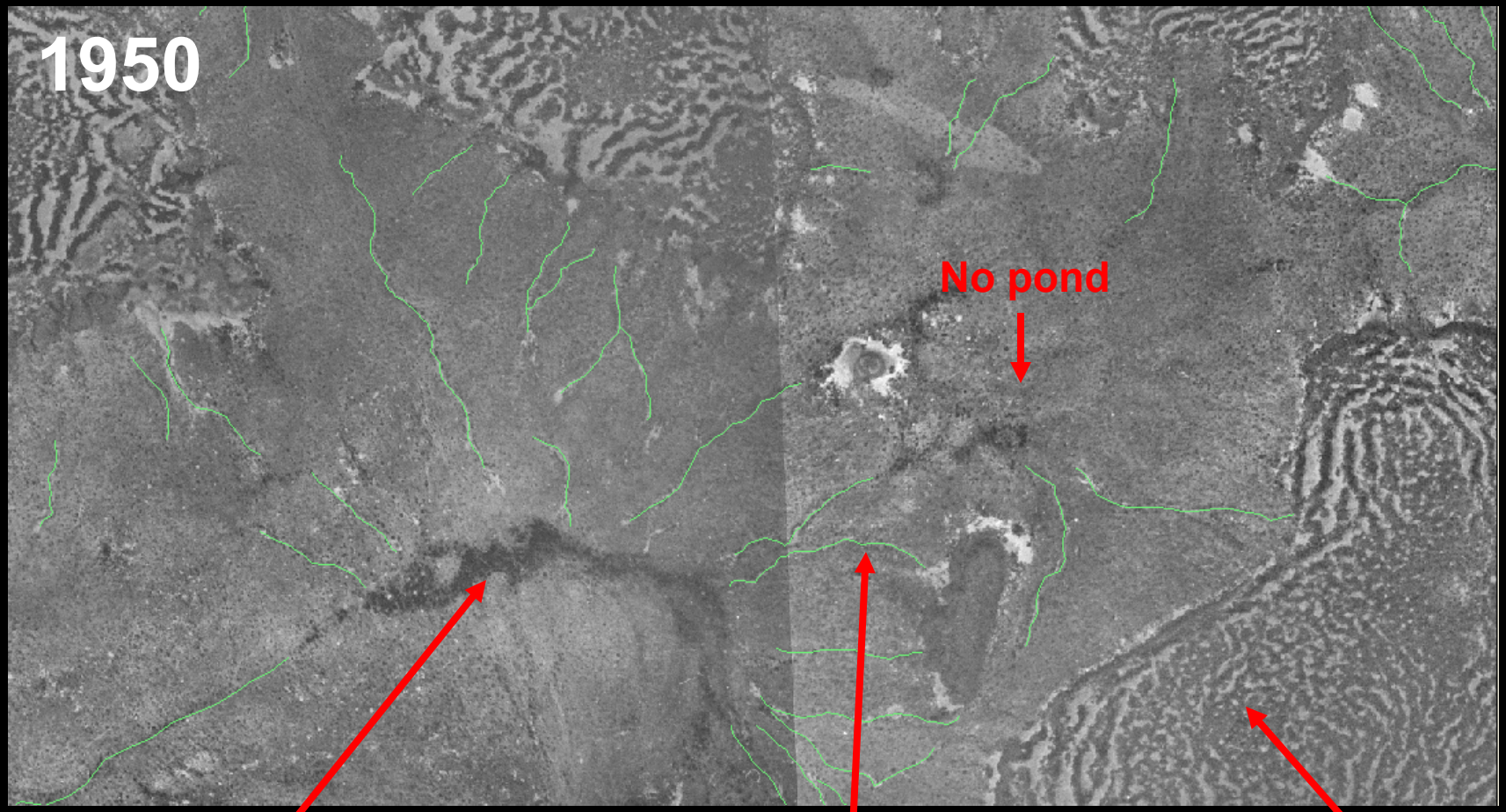
A long record of reliable, high resolution observations ...



Land clearing

~ 80% of the woody vegetation cleared between 1950 and 1992

From deforestation to water-table rise?



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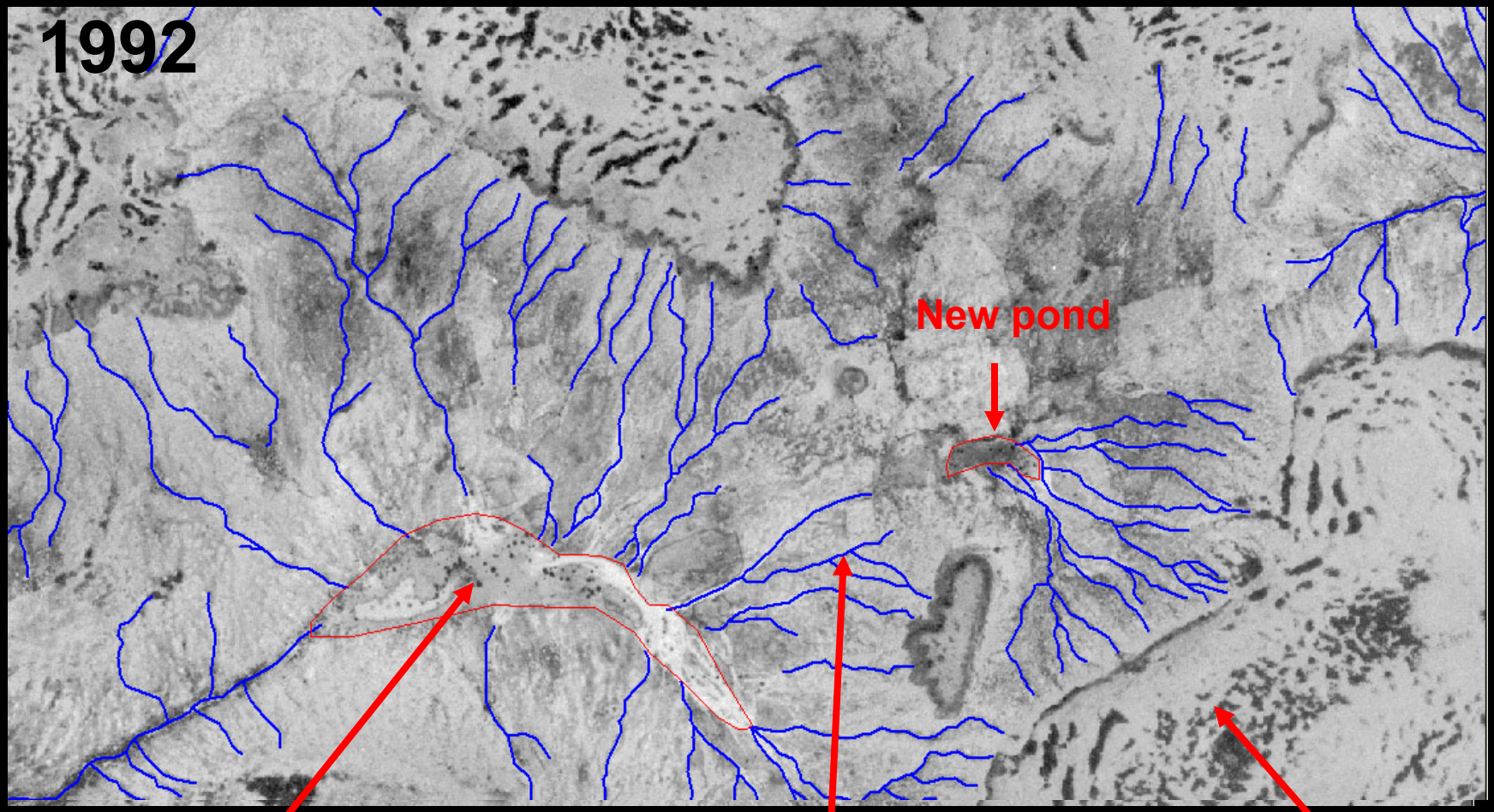

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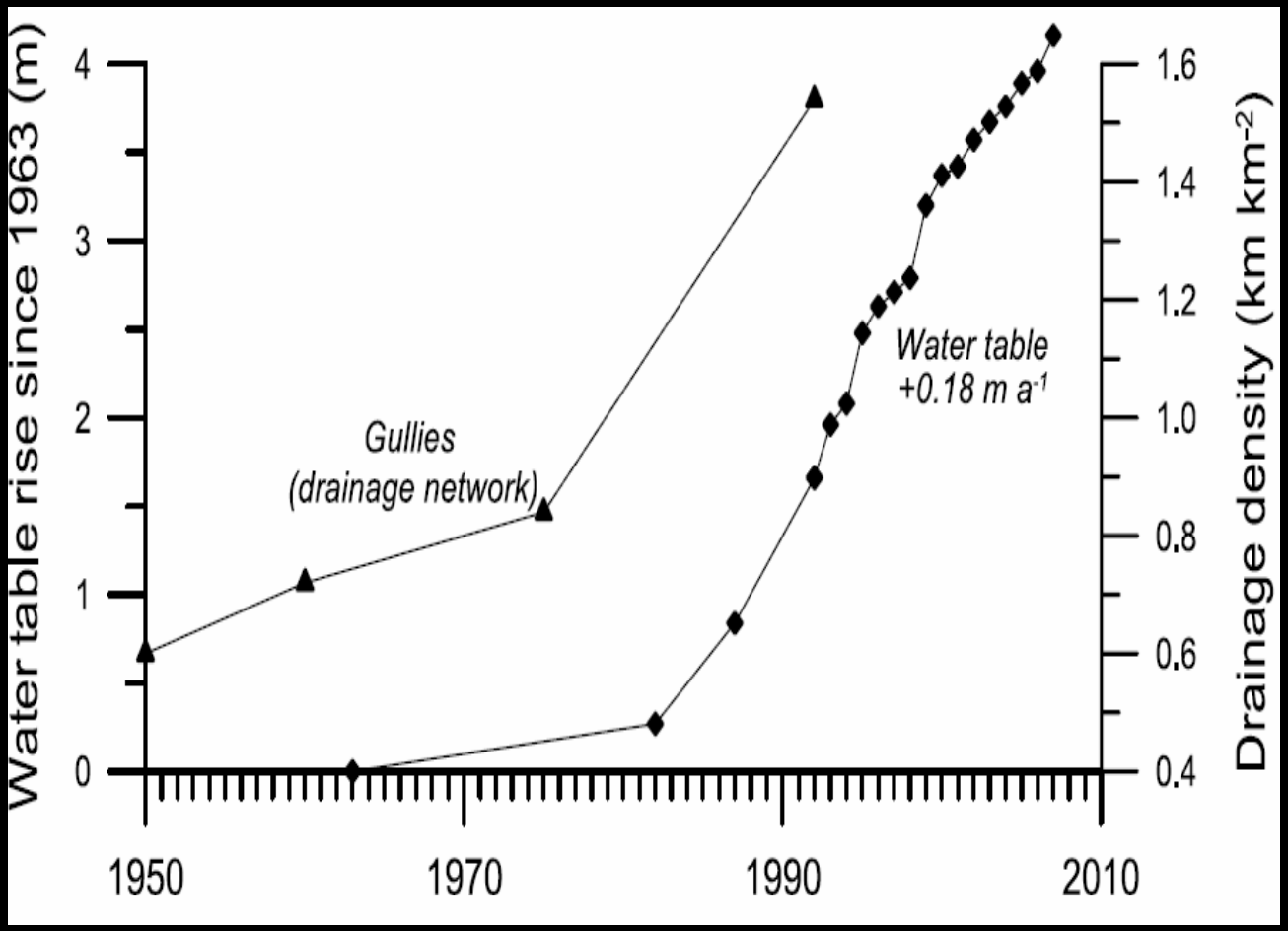
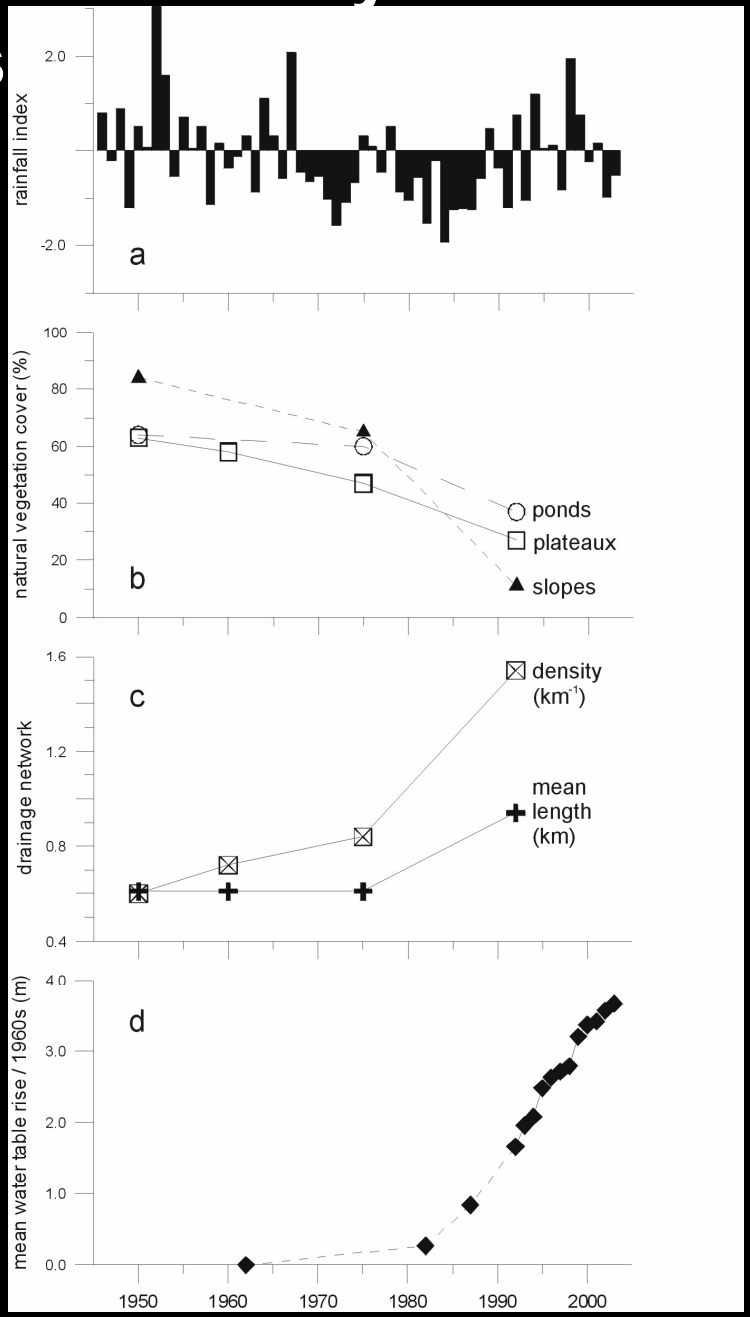
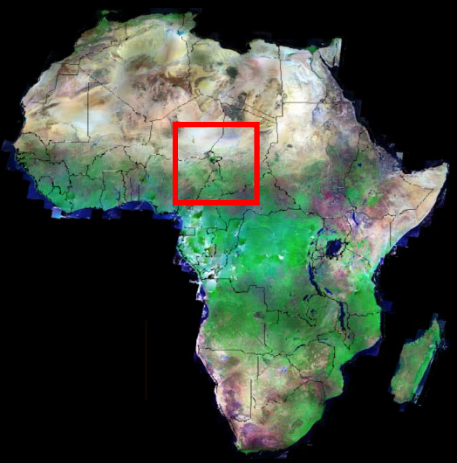


- 2.5 fold increase in the density of the drainage network
- increase in focused or localised recharge
- ~ 4m rise of WT

Impact of land use and climate variability on water resources

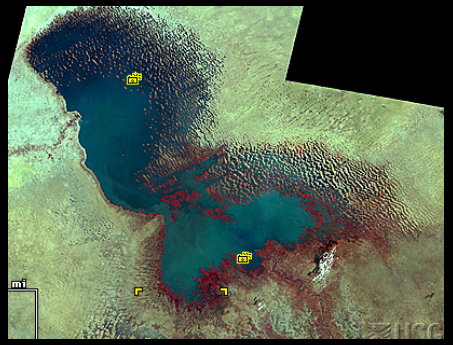
- Increase in water resources despite drought
- Impact of land use change can be stronger than that of climatic variations
- Important to capture changes in hydrological processes and interactions within the water cycle





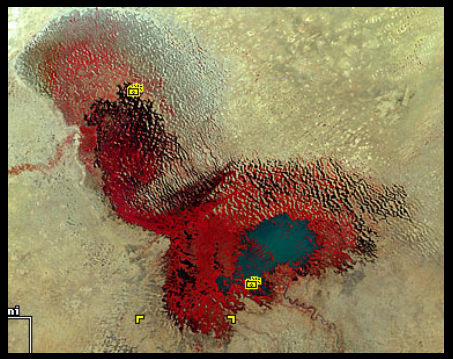
Hydrological variability of the lake Chad basin during the Holocene

Max. 1963



Max. 1973

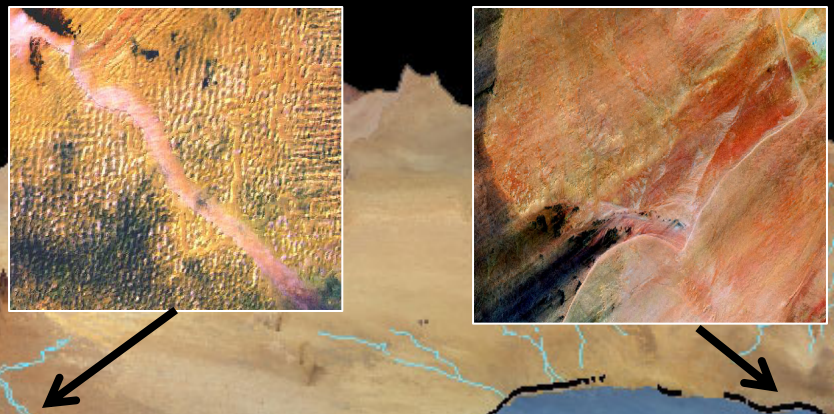
Max. 1987



Max. 2007

From Mega to Small Lake Chad

- paleoshoreline
- paleorivers
- paleodeltas



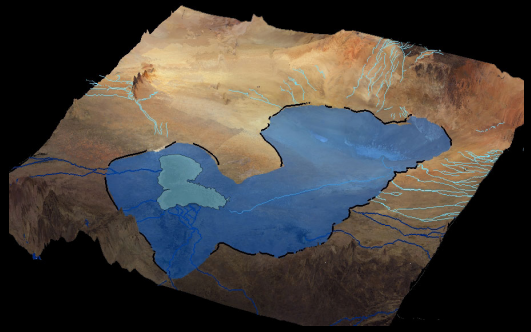
- Extent: 340,000 **km**2
- 2nd largest lake in the world
- Last Megalake event ~ 6000 BP

Leblanc, M. J., Leduc, C., Stagnitti, F., van Oevelen, P. J., Jones, C., Mofor, L. A., Razack, M., Favreau, G., 2006. Evidence for Megalake Chad, north-central Africa, during the late Quaternary from satellite data. Palaeogeography, Palaeoclimatology, Palaeoecology, 230 (3-4), 230-242.

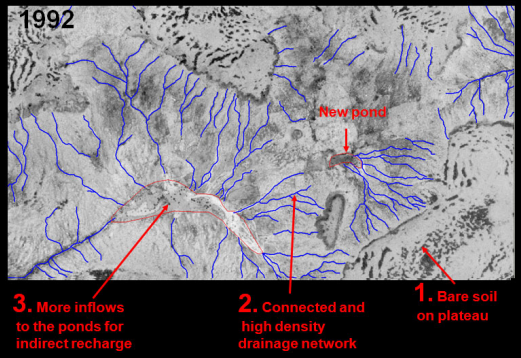
CONCLUSIONS

- Major changes observed across the globe
- Climate and land use change major drivers
- Value of long-term observations
- Importance of spatial information in water management
- Need for integrated water accounting
- Good understanding of interactions and feedbacks within the water cycle

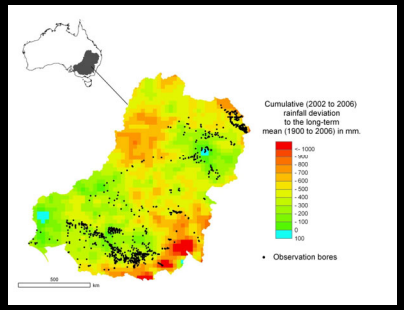
Megalake Chad



Land clearing vs drought in the Sahel



Drought in SE Australia



Thank you

The data used in this presentation have been obtained from

- IRD (Institut de Recherche pour le Développement,France)
- DREM, the hydrological services of the Chad Republic.
- Lake Chad Basin Commission
- Direction de l'Hydraulique du Niger
- NASA
- ESA
- GRGS
- Murray Darling Basin Authority
- Australian Bureau of Meteorology

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A river in winter…

Coliban River, Murray Darling Basin, photo June 2008