

**Groundwater and surface water  
– Garth van der Kamp**



[Spring runoff, St Denis NWA, April 2, 2005]

# Groundwater interactions with soil moisture and surface water

*[van der Kamp in collaboration with Hayashi, Woodbury, and others]*

**Overall objective:** Determine changes of total surface and subsurface moisture and partition these changes with depth (surface water, shallow soil moisture, subsoil moisture, groundwater).

## **Specific tasks:**

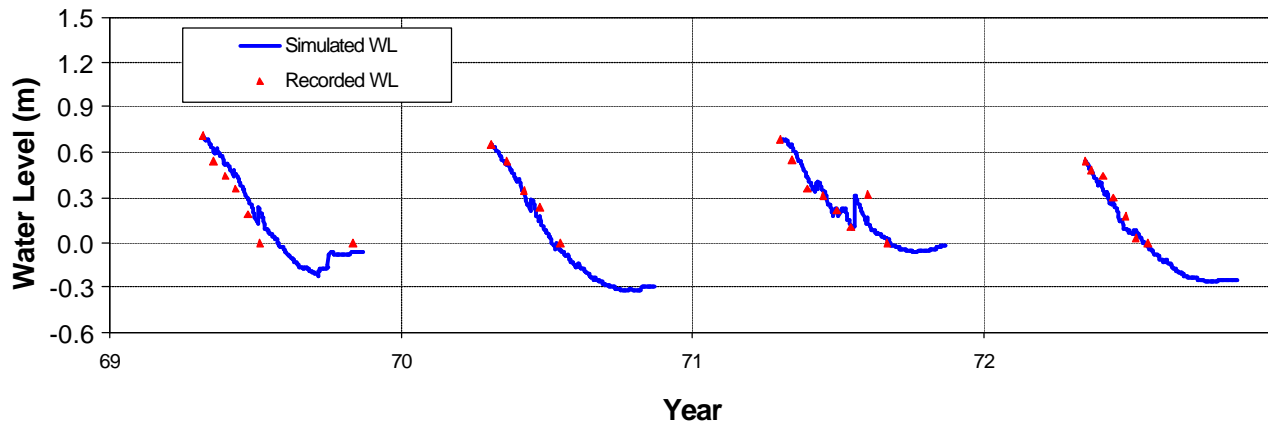
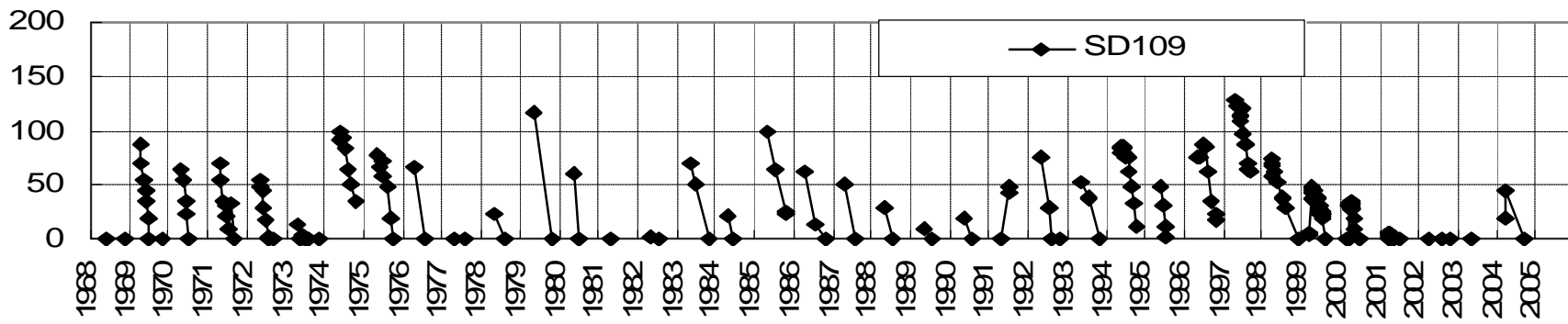
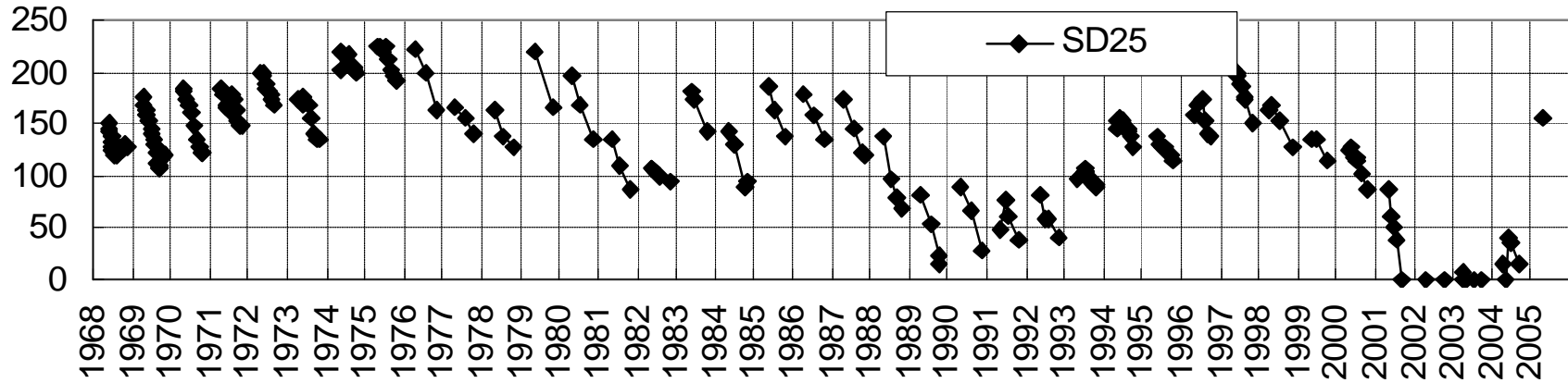
- Evapotranspiration from small prairie wetlands, by measurements and modeling of water balance.
- Changes of groundwater storage deduced from observation well records
- Using geological weighing lysimeters (clay piezometers and deep observation wells) to establish vertical water balance over areas of ~10 ha and areas of ~100km<sup>2</sup>.
- Compilation of long-term lake level records for closed-basin lakes – runoff and groundwater input versus evaporation.

**Locations:** St Denis NWA, BERMS flux towers, observation wells, 4 wetland monitoring areas, prairie lakes





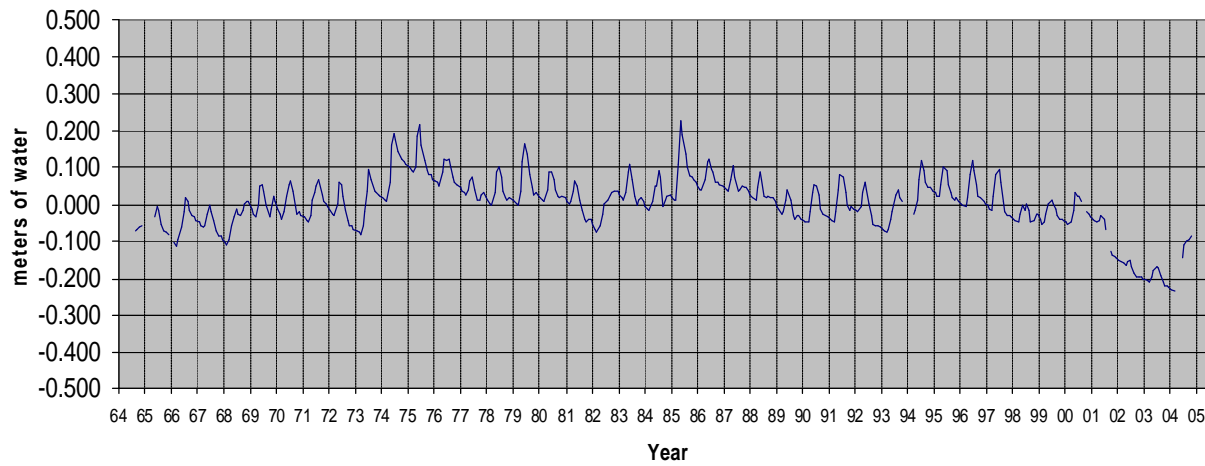
# Wetland water level data St Denis NWA, 1968-2005



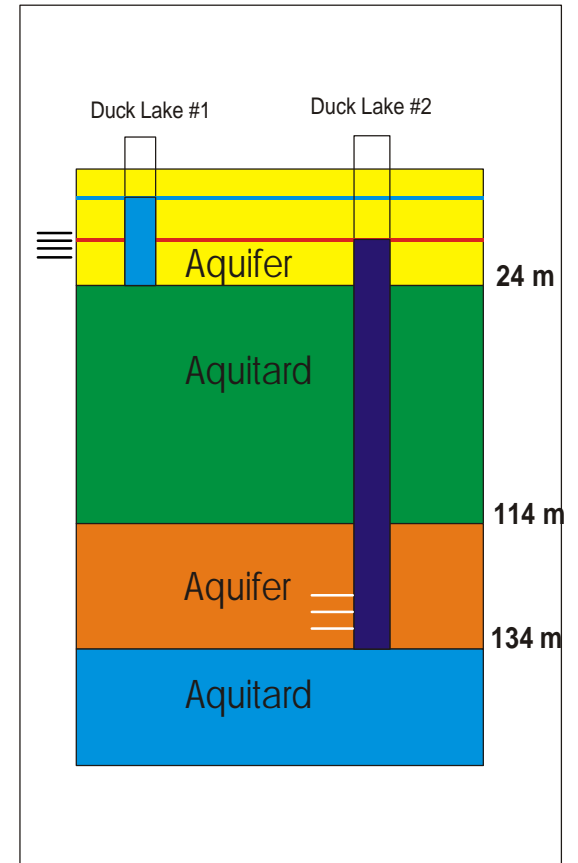
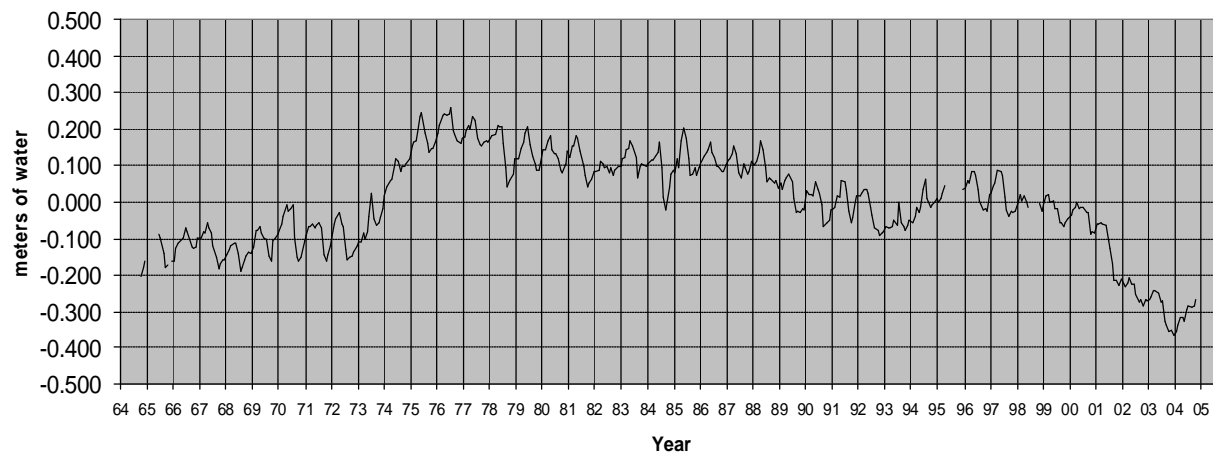
Modeling summer recessions with wetland water balance model

# Groundwater recharge and total vertical water balance

SRC Duck Lake Obs Well No. 1 - water table storage - depth 4 m

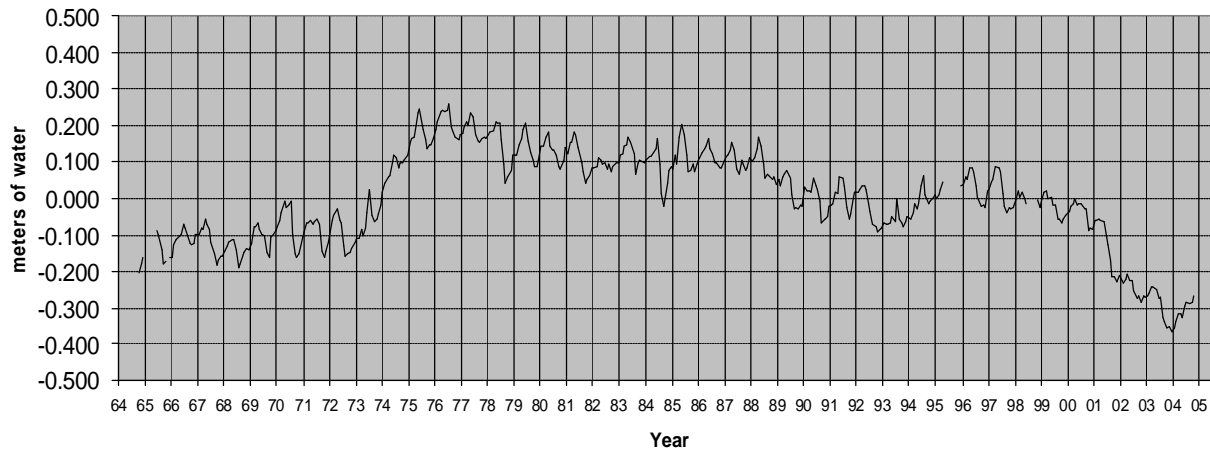


SRC Duck Lake Obs Well No. 2 - Vertical Moisture Balance

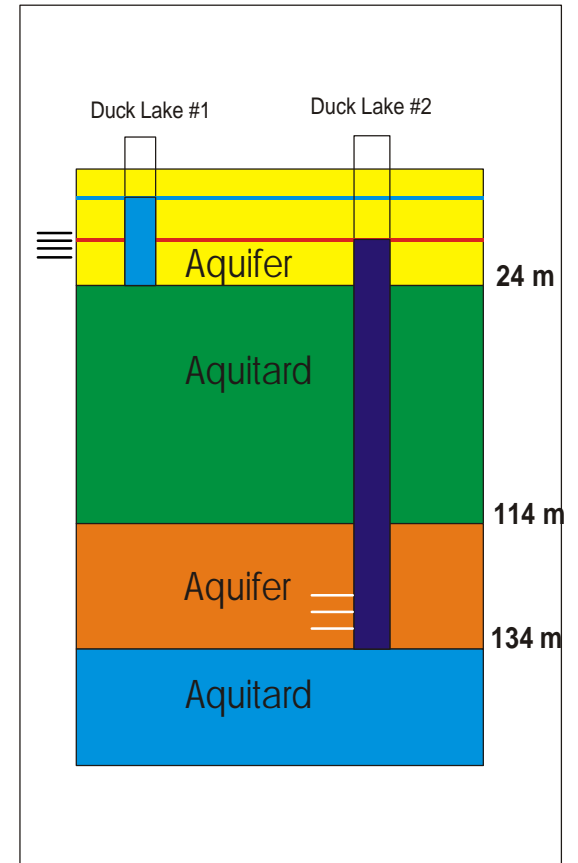
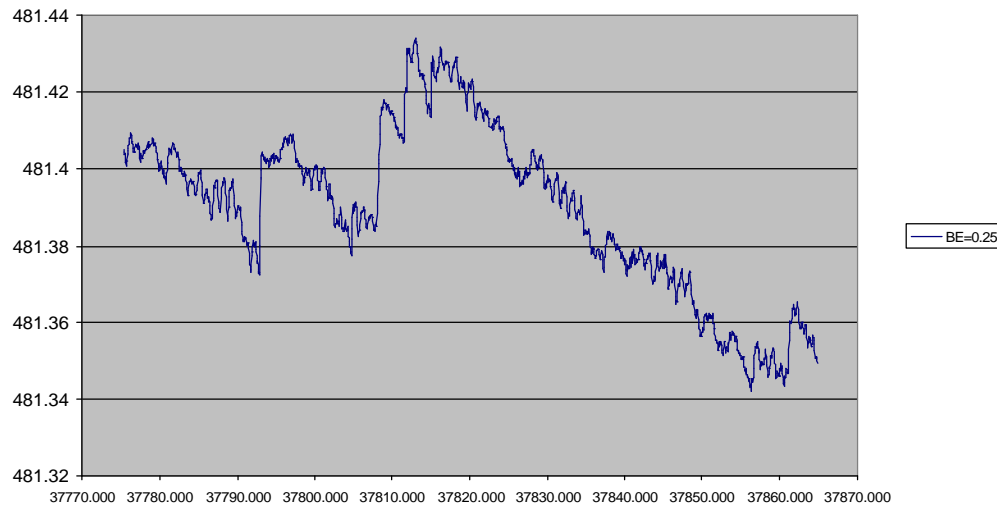


# Groundwater recharge and total vertical water balance

**SRC Duck Lake Obs Well No. 2 - Vertical Moisture Balance**

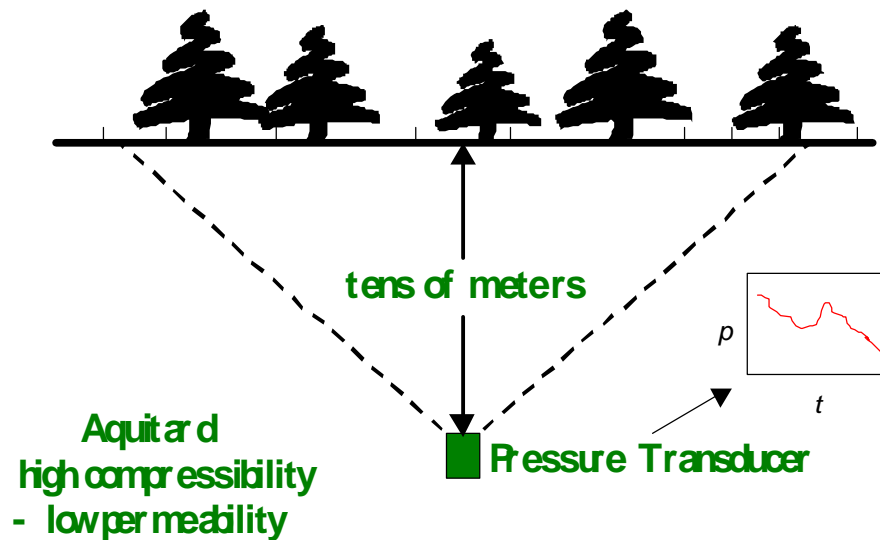


**SRC Duck Lake No. 2 - June to August 2003.**  
[No earth tides correction, yet]

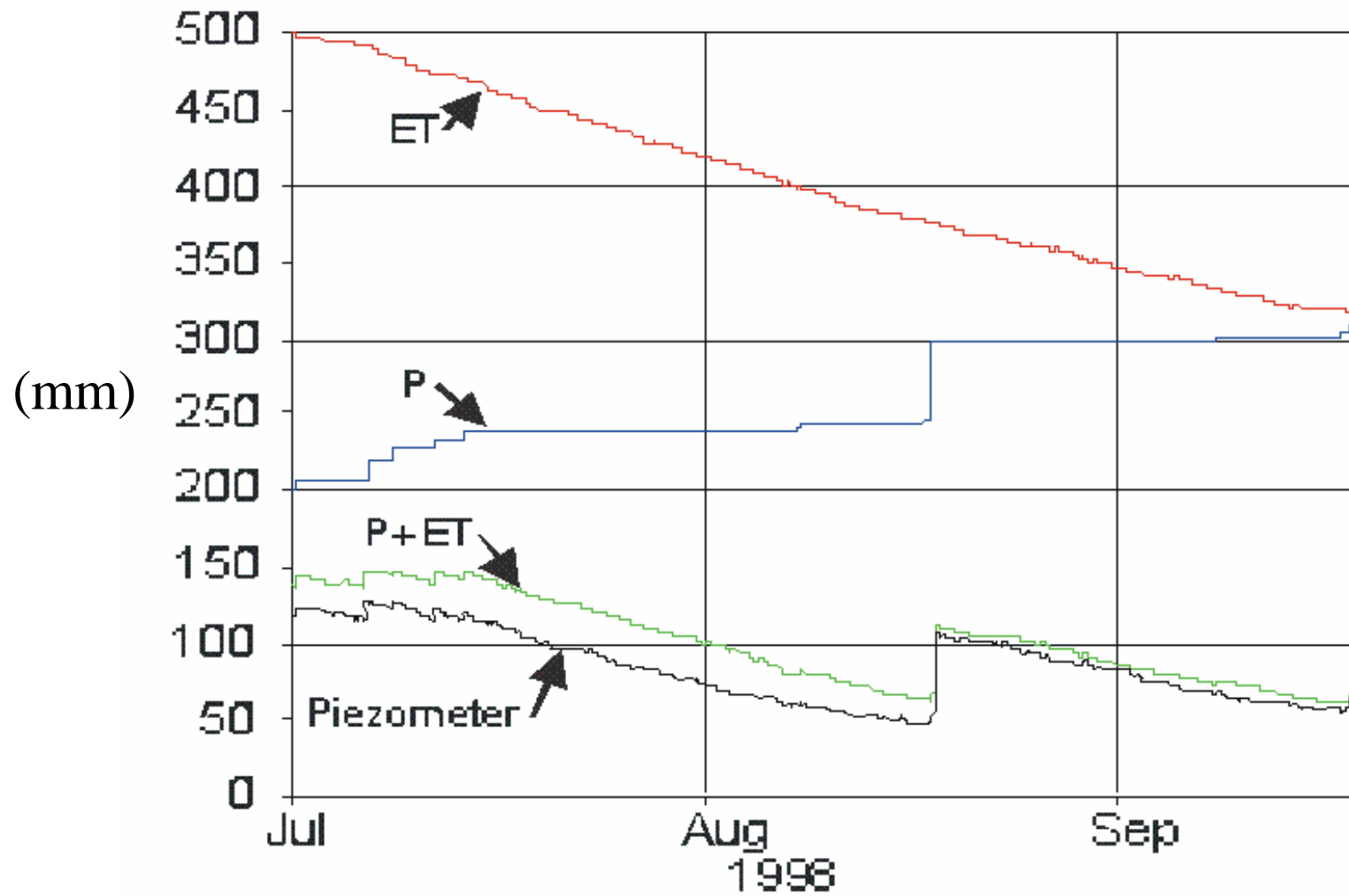


# Geological Weighing Lysimeter Concept

- Deep in thick, unfractured clay formations, changes in groundwater pressure are caused by changes in mass loading.
- Similar to conventional weighing lysimeters but on a much larger scale and with no significant disturbance of site.

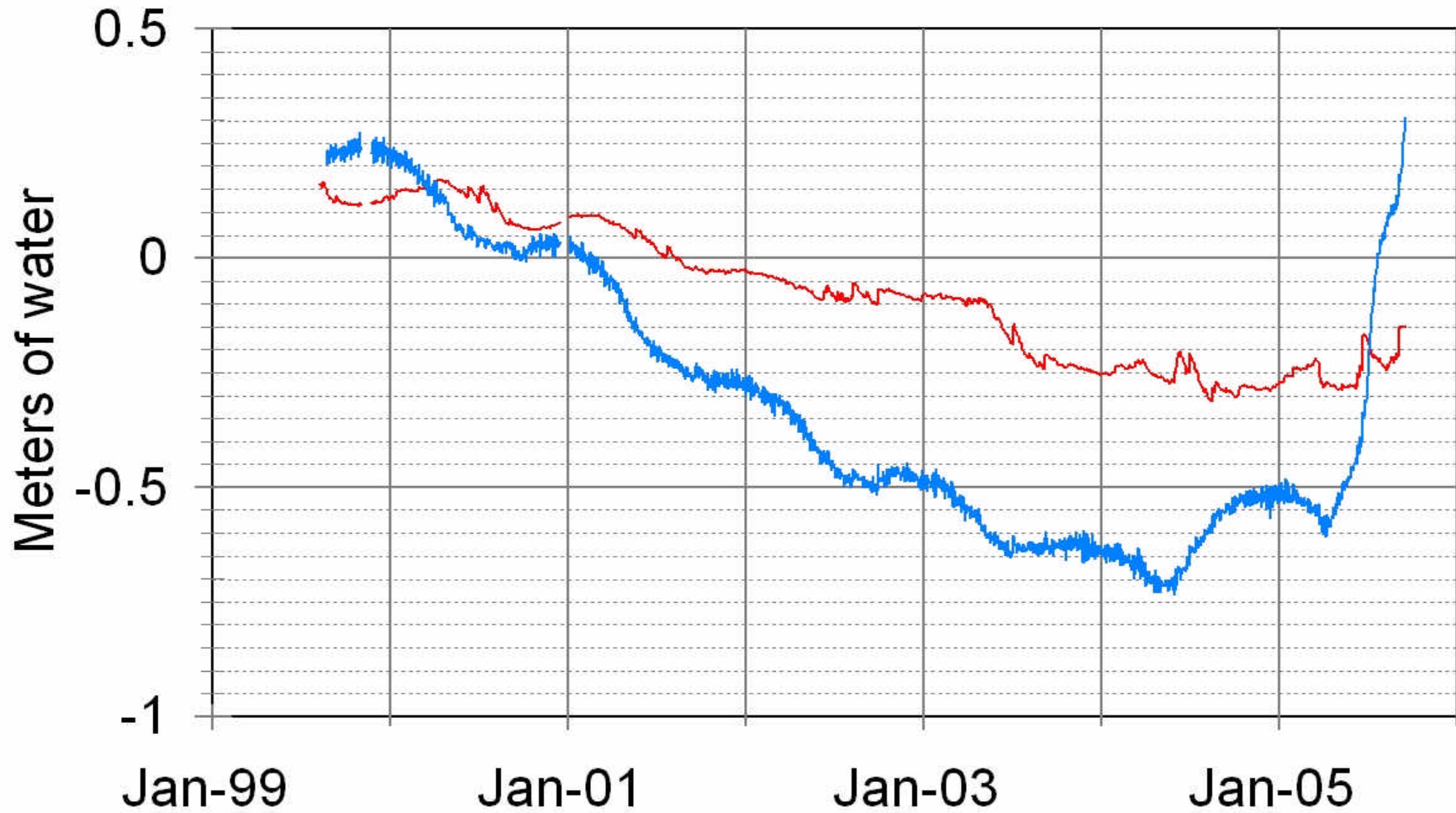


# Kernen Prairie: Geological weighing lysimeter records compared with calculated P + ET.





# Kernen Prairie Moisture 1999 to 2005

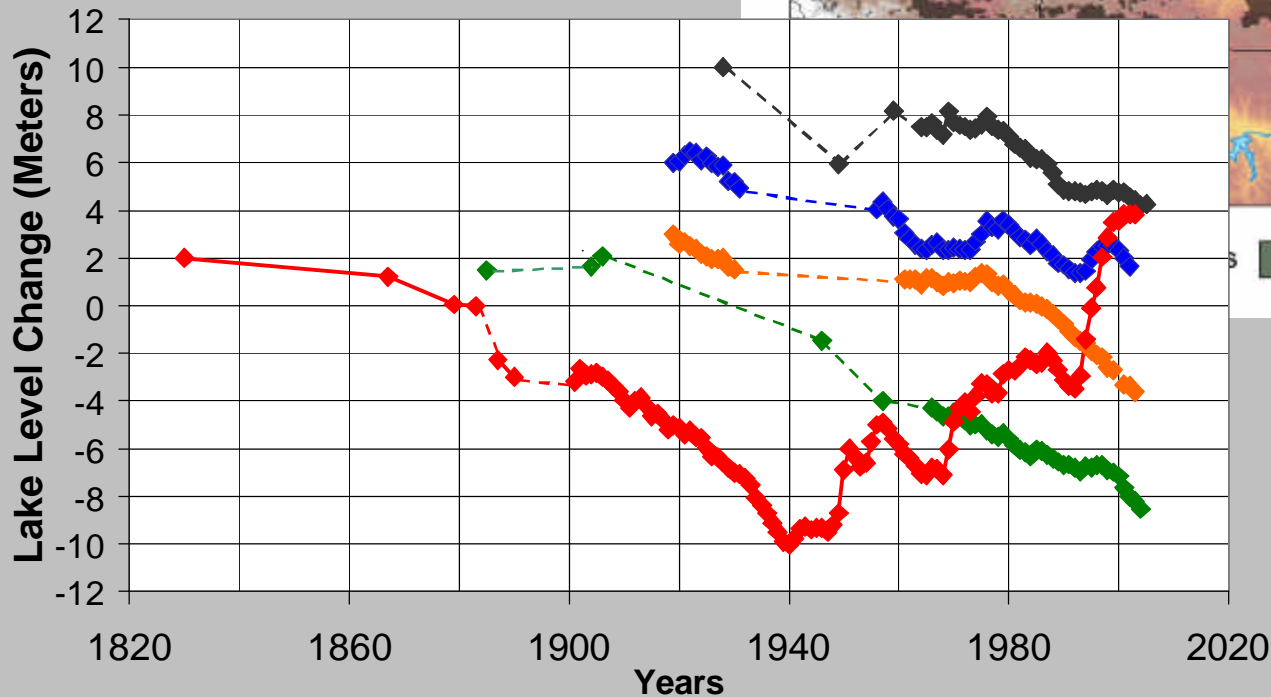
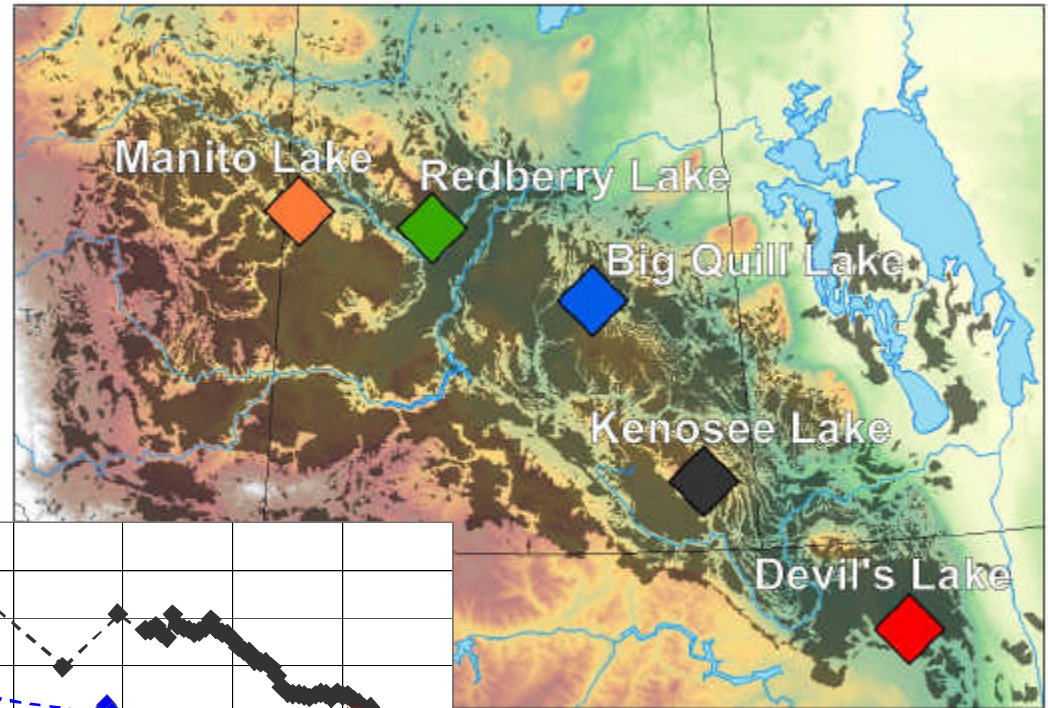


— Weighing Lysimeter

— Forestry Farm Aquifer

## Prairie lakes 1820 – 2004:

Devil's Lake (ND) is rising since 1940 (likely due to increased rainfall), while nearby Canadian prairie lakes (Kenosee and Big Quill) are falling.



Non Contributing Drainage Areas  
Drainage Data from the Prairie Farm Rehabilitation Administration (PFRA)

- ◆ Kenosee Lake (SK)    ◆ Big Quill Lake (SK)    ◆ Manito Lake (SK)
- ◆ Redberry Lake (SK)    ◆ Devil's Lake (USA)

# Old Aspen Site Characteristics

- BOREAS/BERMS tower flux site
- Southern edge of Canadian boreal forest
- Uniform fetch for 3 km from eddy-covariance flux tower



Environment Canada  
Meteorological Service of Canada  
Climate Research Branch

Environnement Canada  
Service météorologique du Canada  
Direction de la recherche climatologique



## BERMS Old Aspen

### Precipitation and evapotranspiration 1994-2004

