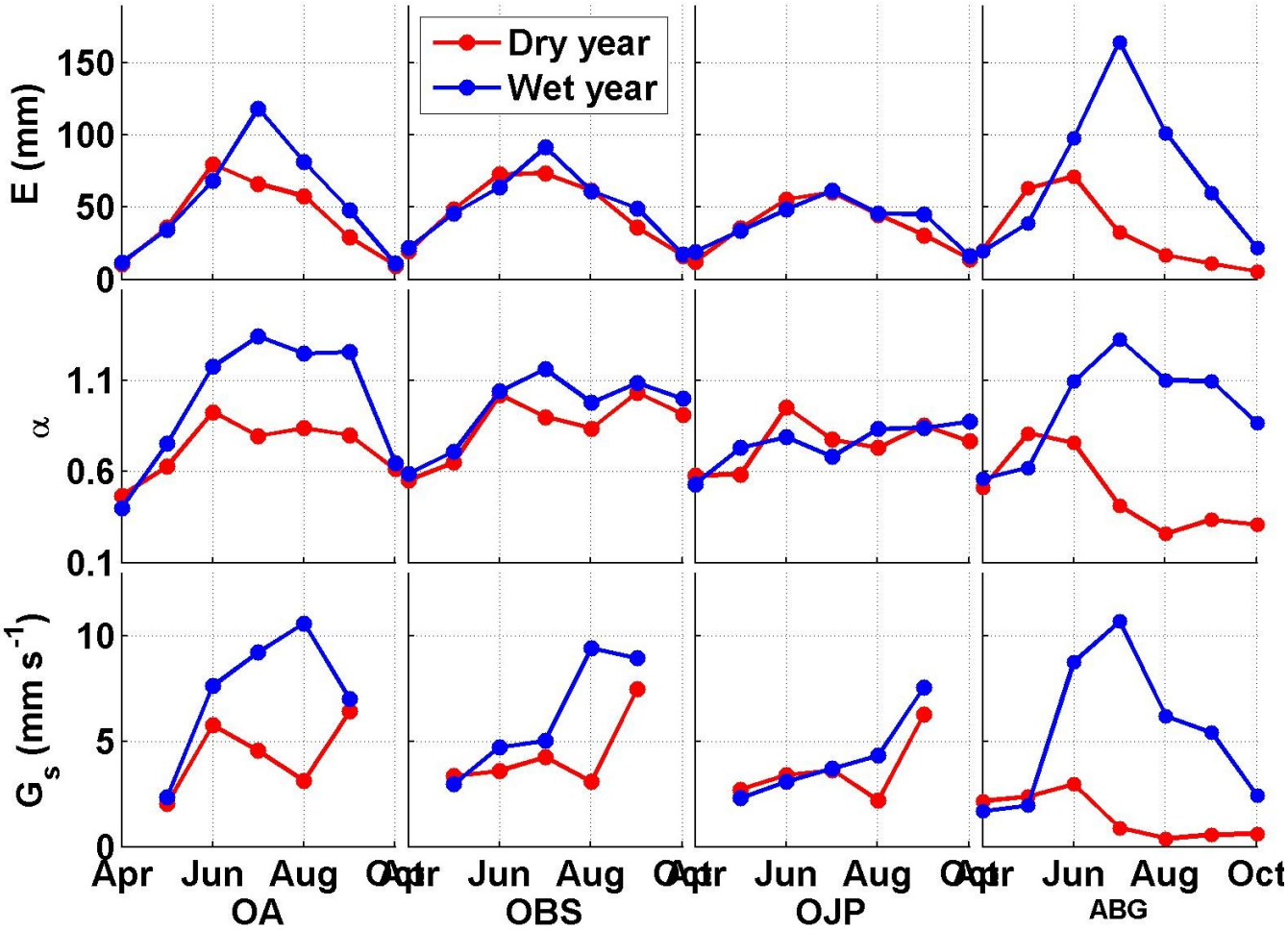
van der Kamp:

Characterizing drought:

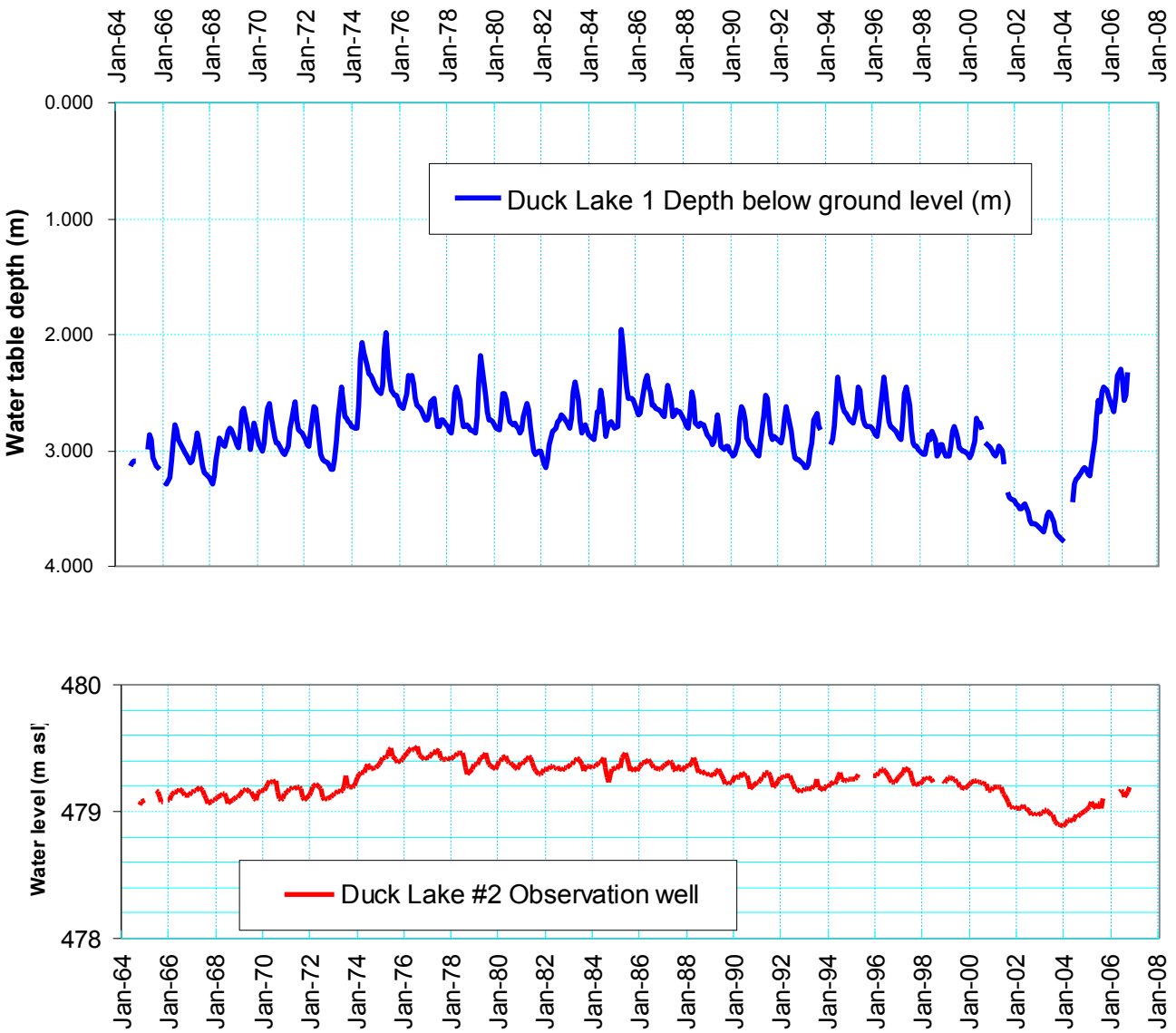
- Comparison of evapotranspiration from forest and grassland **Fluxnet** sites (with Barr and Zhan, Environment Canada).
- **groundwater levels** – water level records for shallow provincial observation wells (with Sauchyn, U of Regina).
- Comparison of geological weighing **lysimeters and GRACE** (with Yirdaw and Snelgrove, Memorial U).
- **Soil moisture** –regional: geological weighing lysimeters (with Anochikwa and Barbour, U of Saskatchewan).

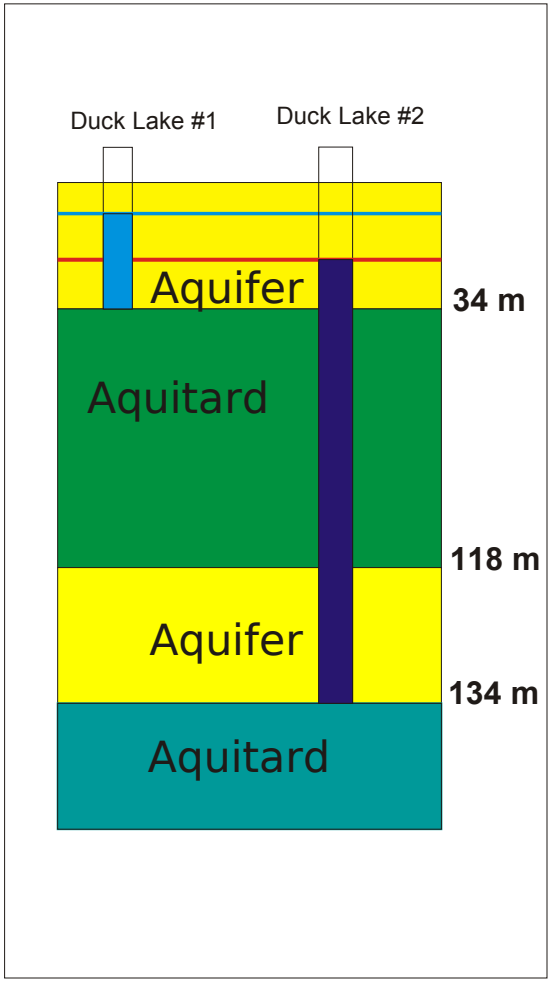
Saskatchewan BERMS Forest flux sites (Old Aspen – OA, Old Black Spruce - OBS and Old Jack Pine – OJP) compared with Alberta Grassland site (ABG): Comparison of Monthly E,α and G_s Between Dry year (2003 for SK Sites, 2001 for ABG) And Wet Year 2005 *[Zhan et al. in prep]*



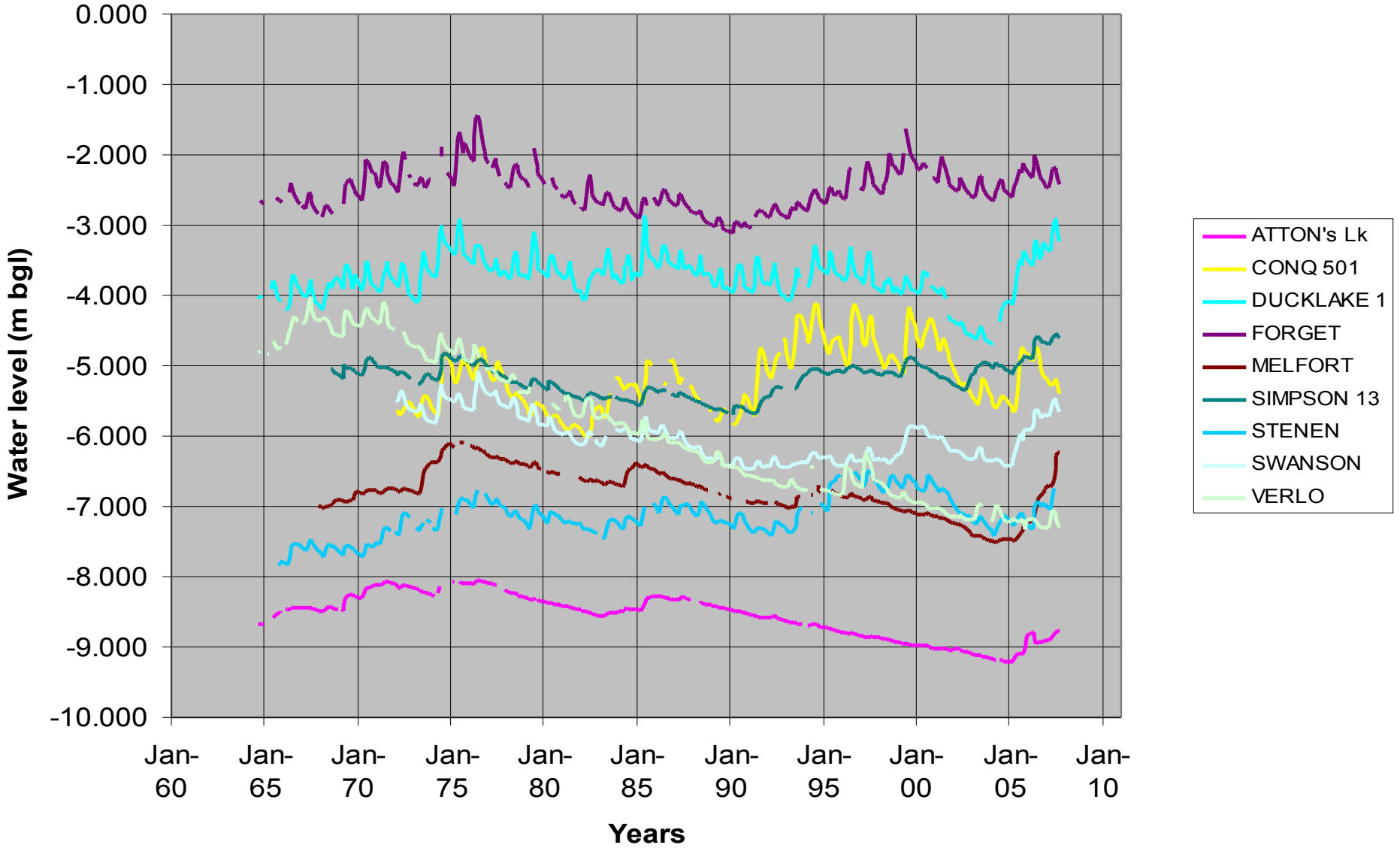
Duck Lake SK Observation wells: water levels, 1964-2006

[Source: SK Watershed Authority, www.swa.ca]



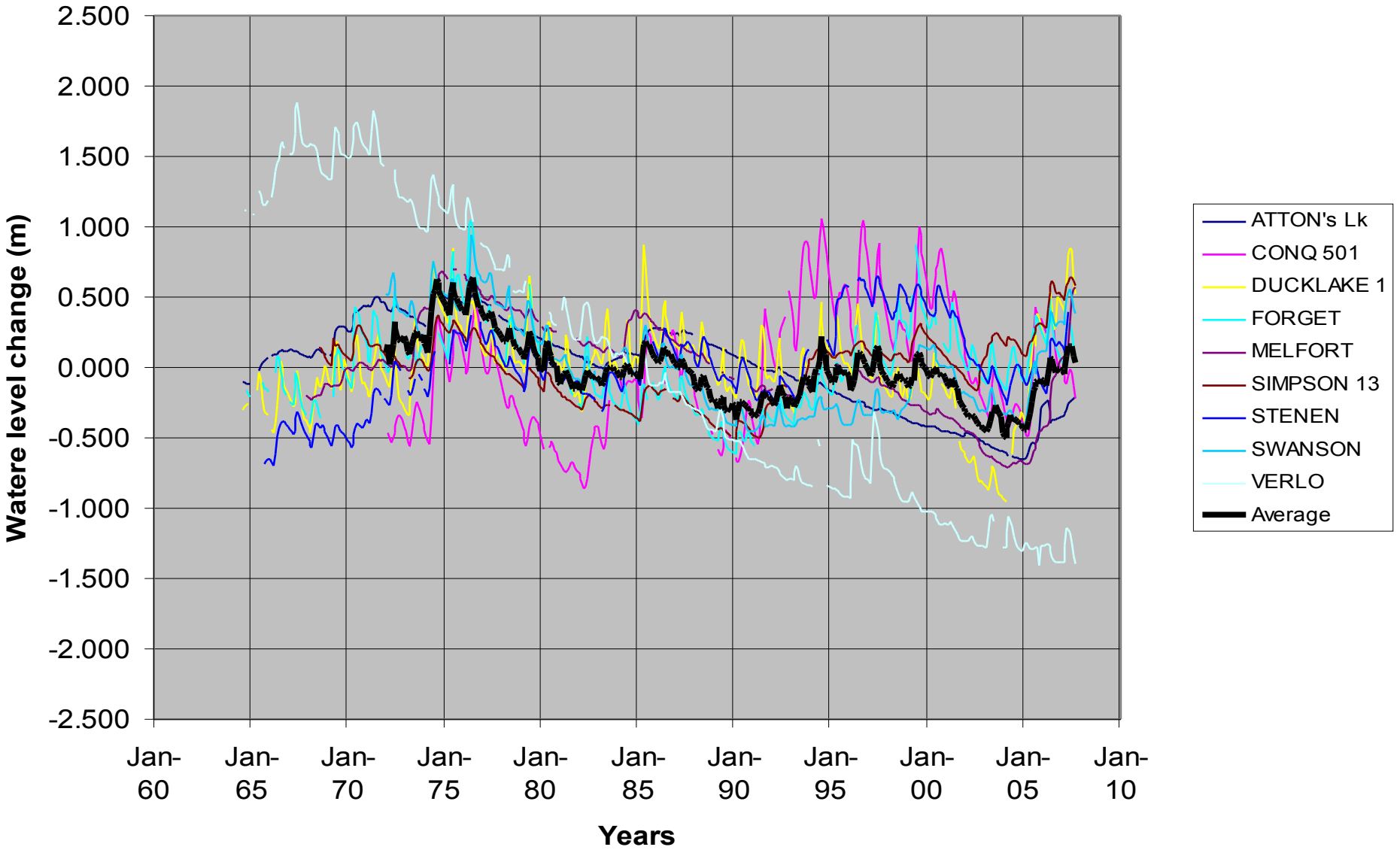


Shallow observation wells in SK – water level records 1964-2007:
water table depths below ground level (m)



Shallow observation wells in SK – water level changes 1964-2007

Water-table drawdown during the 2001-2003 drought averaged about 0.5 m, corresponding to ~ 150 mm groundwater storage depletion



Overview of the Weighing Lysimeter Instrumentation

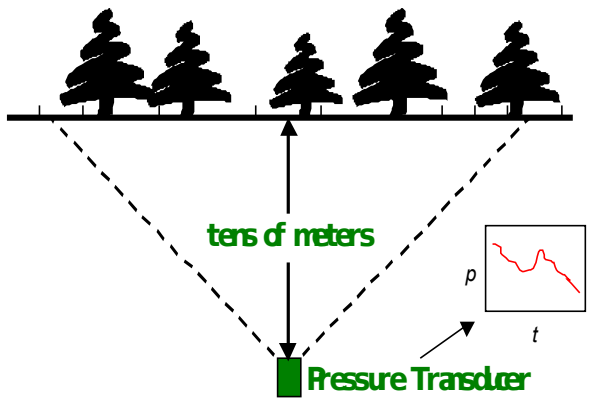
Fundamentals

- Change of mechanical surface loading is instantaneously transmitted to deep saturated formations resulting in change of pore water pressure;

- Piezometers in saturated formations can therefore detect pore pressure changes due to hydrological processes such as:

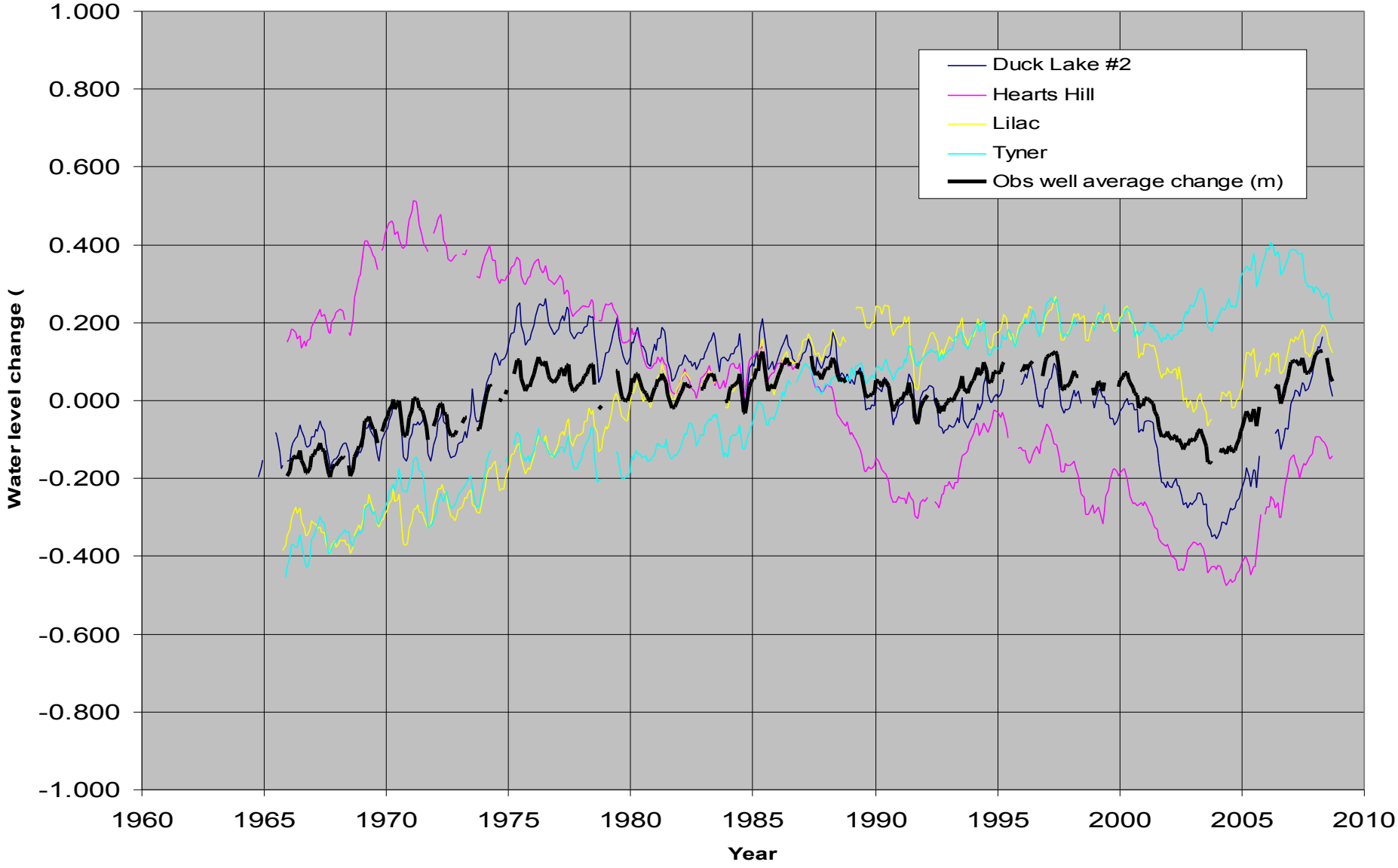
  - ✓ Snow accumulation;
  - ✓ Rainfall;
  - ✓ Evapotranspiration

Conceptual Sketch of Piezometric Weighing Lysimeter Installation



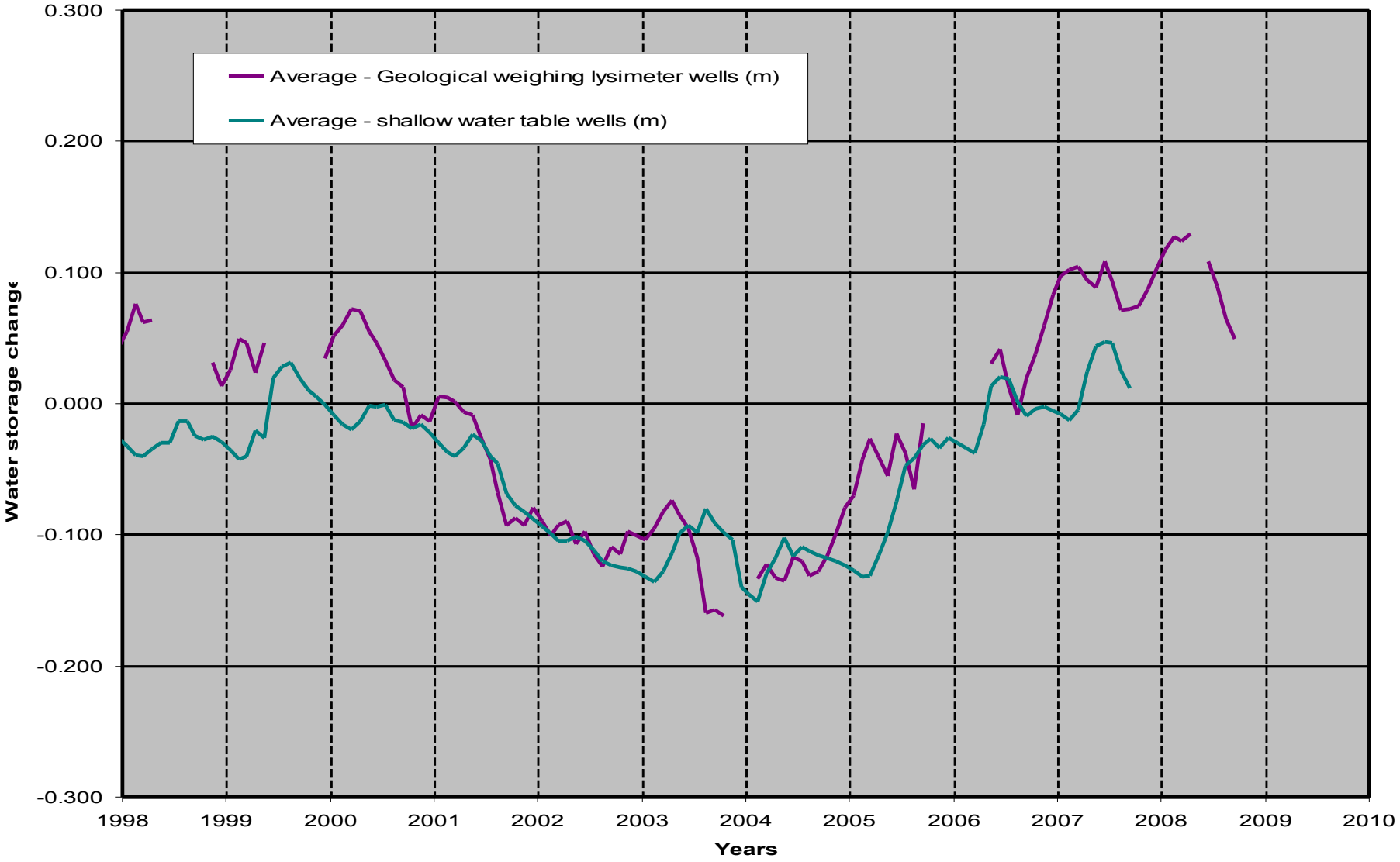
Van der Kamp et al, 2003

Deep observation wells = “Geological weighing lysimeters” – southern Saskatchewan, 1965 - 2008



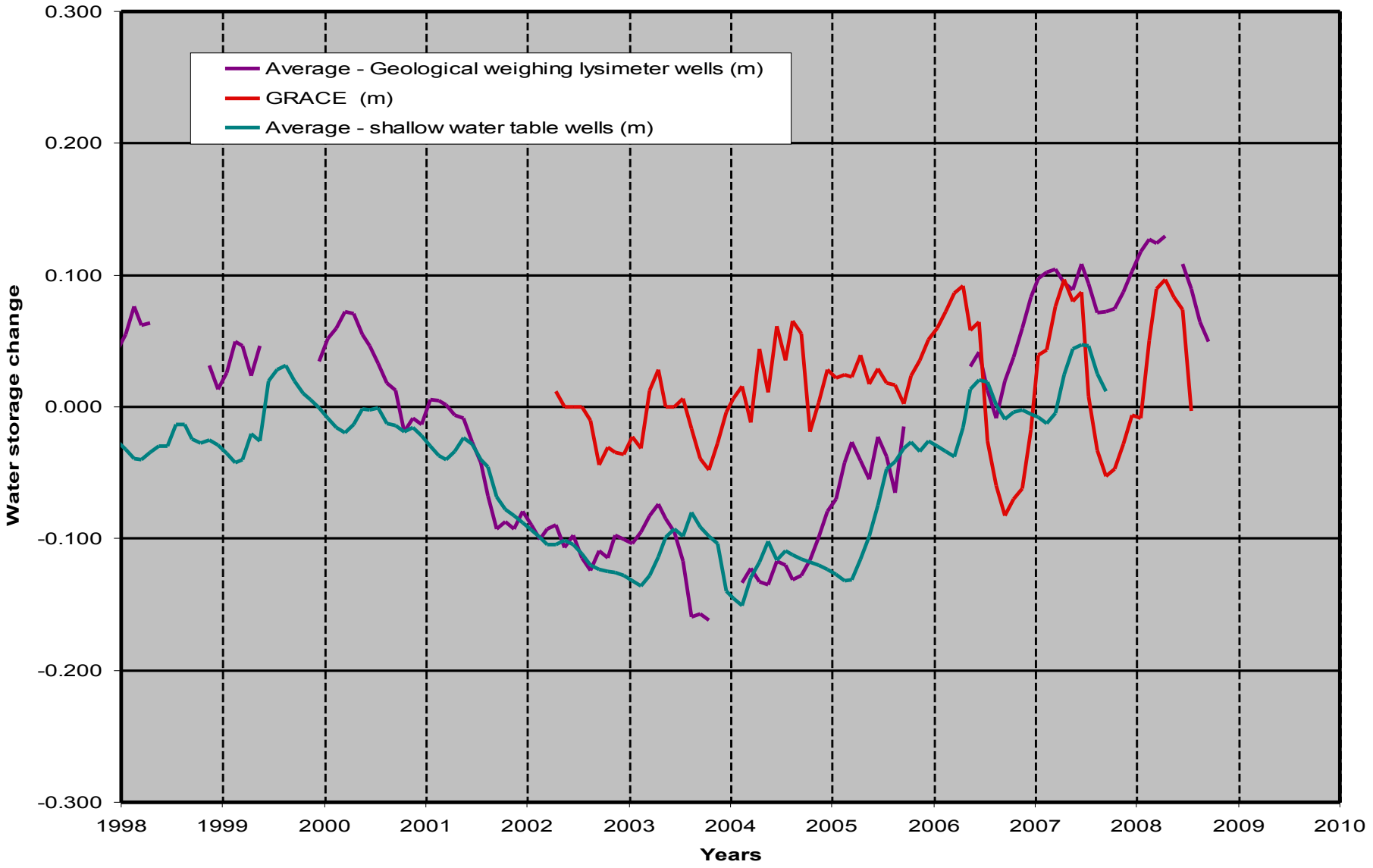
Regional water storage changes in southern Saskatchewan:

- Average of 4 Geological Weighing Lysimeter wells,
- Average of 9 water table wells.



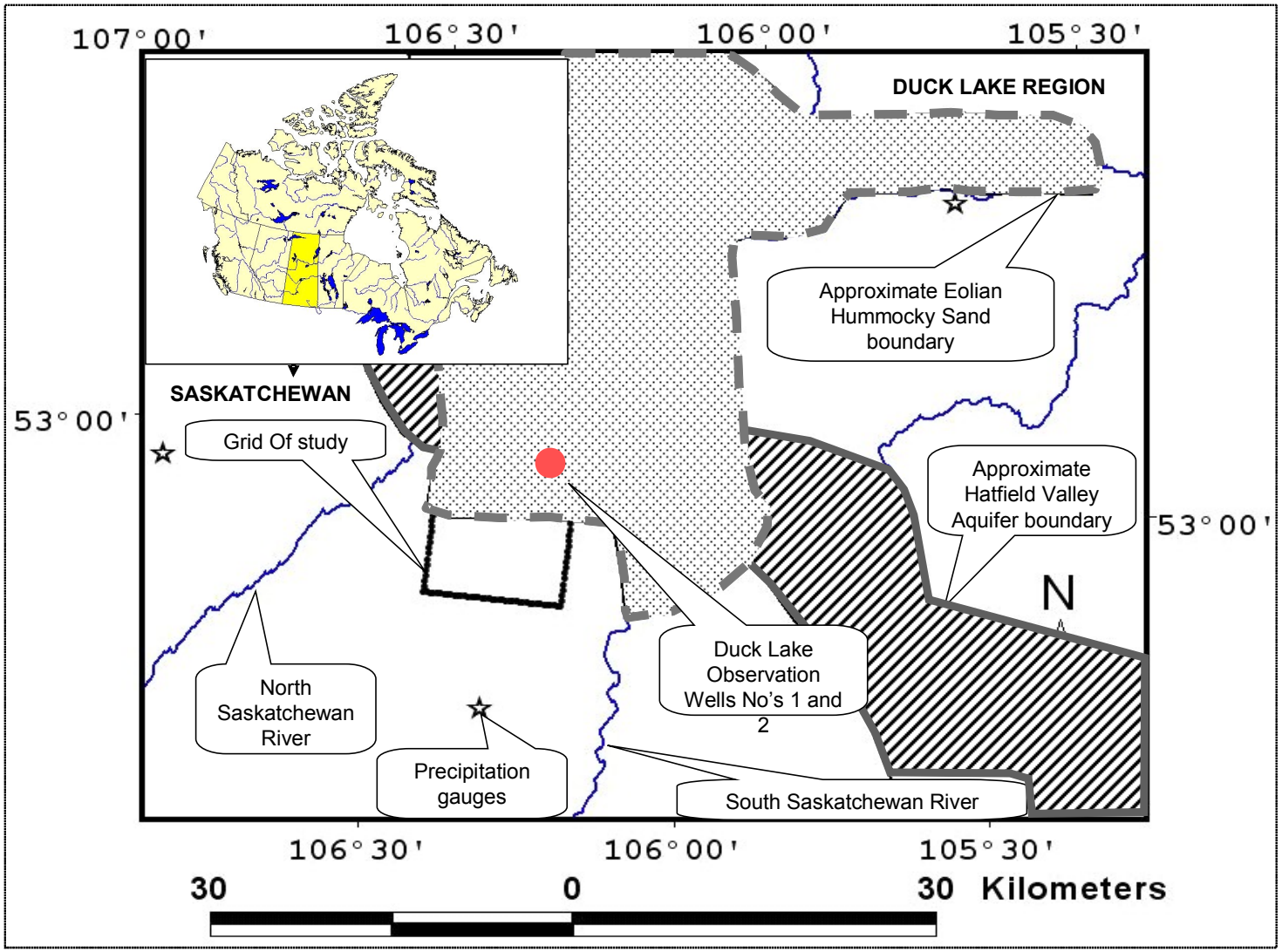
Regional water storage changes in southern Saskatchewan:

- GRACE for southern Saskatchewan *[provided by Yirdaw and Snelgrove]*
- Average of Geological Weighing Lysimeter wells
- Average of water table wells

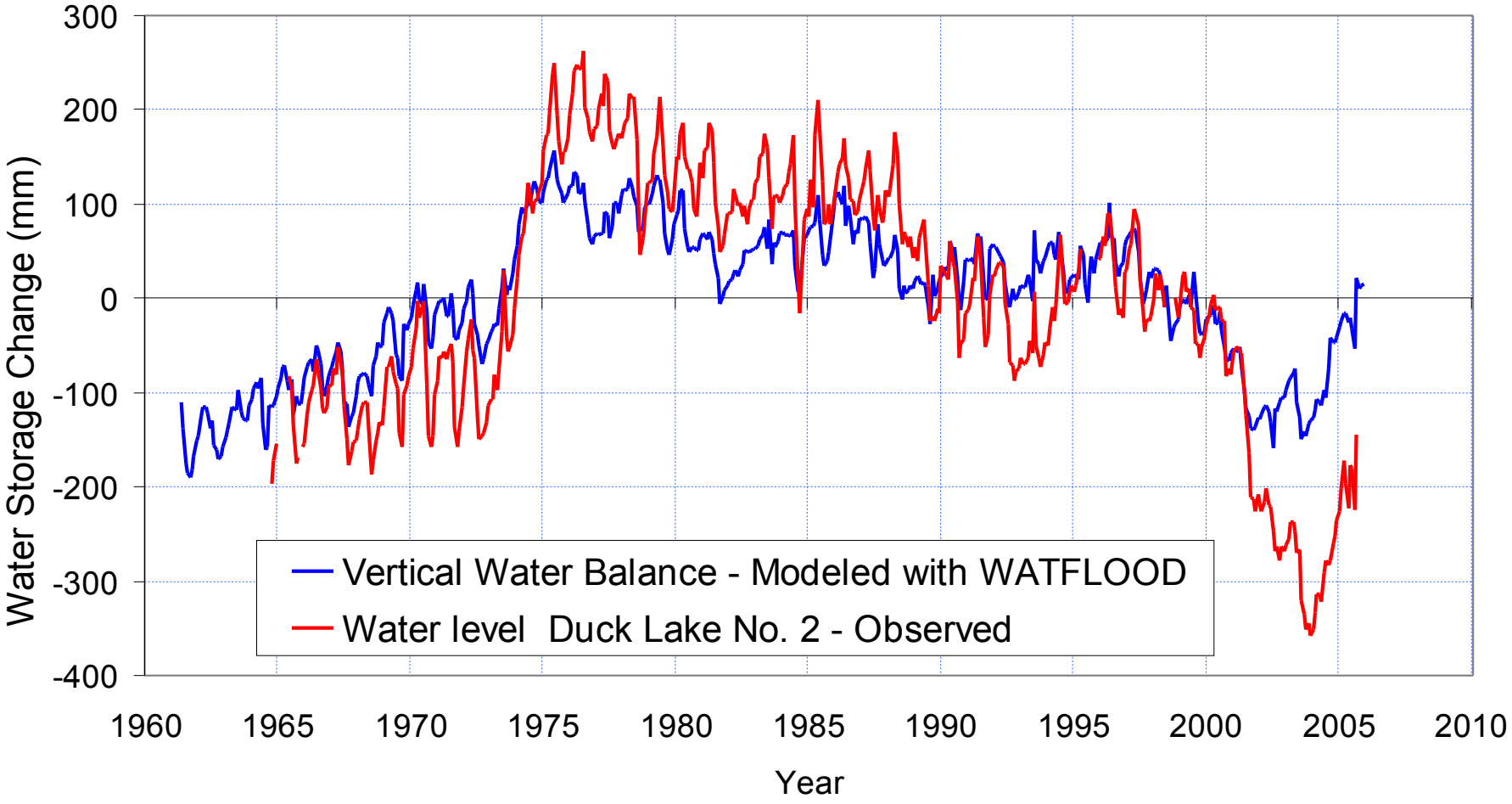


Location of Duck Lake observations wells and Watflood grid cell

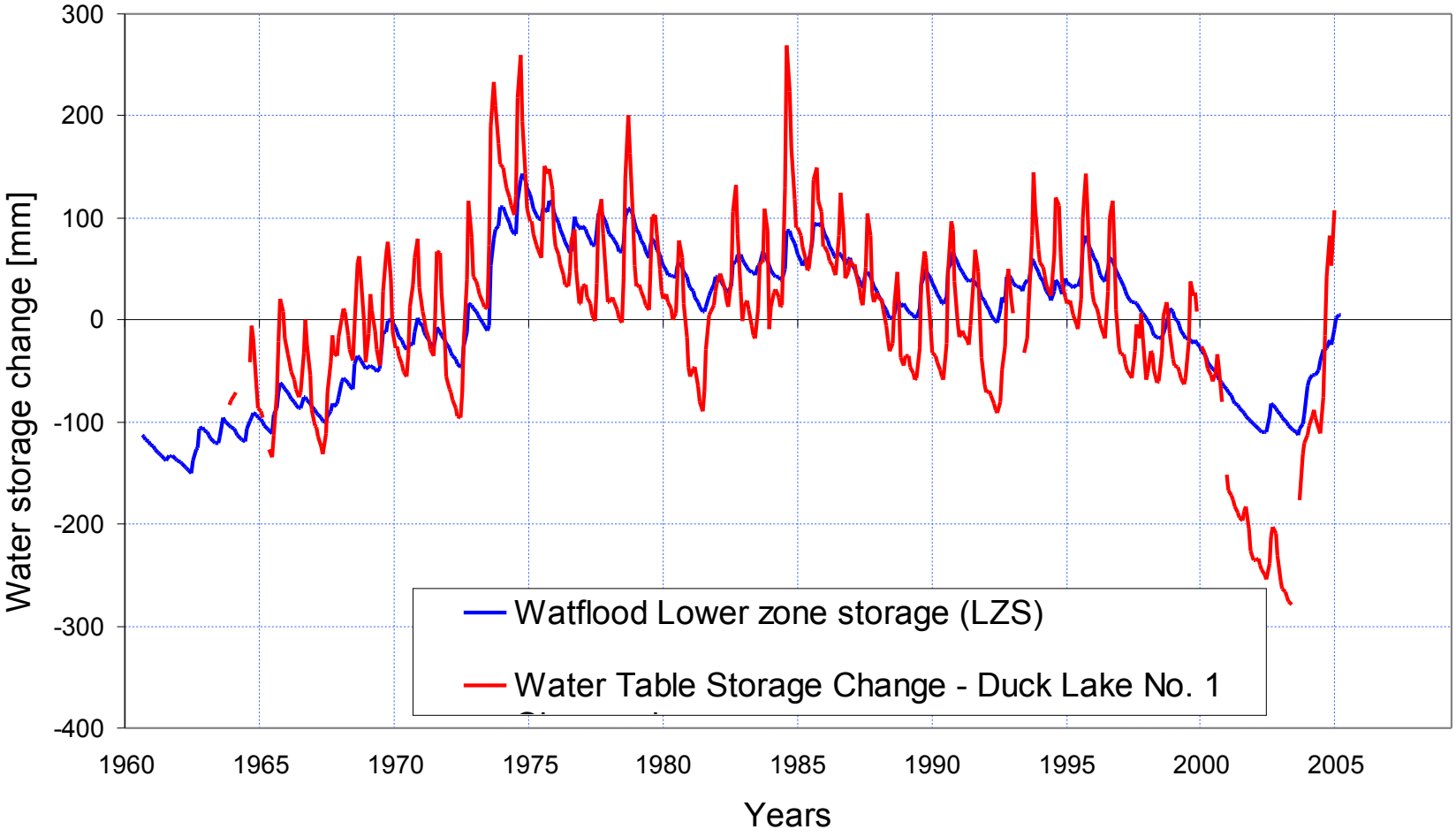
[Marin et al. in prep.]



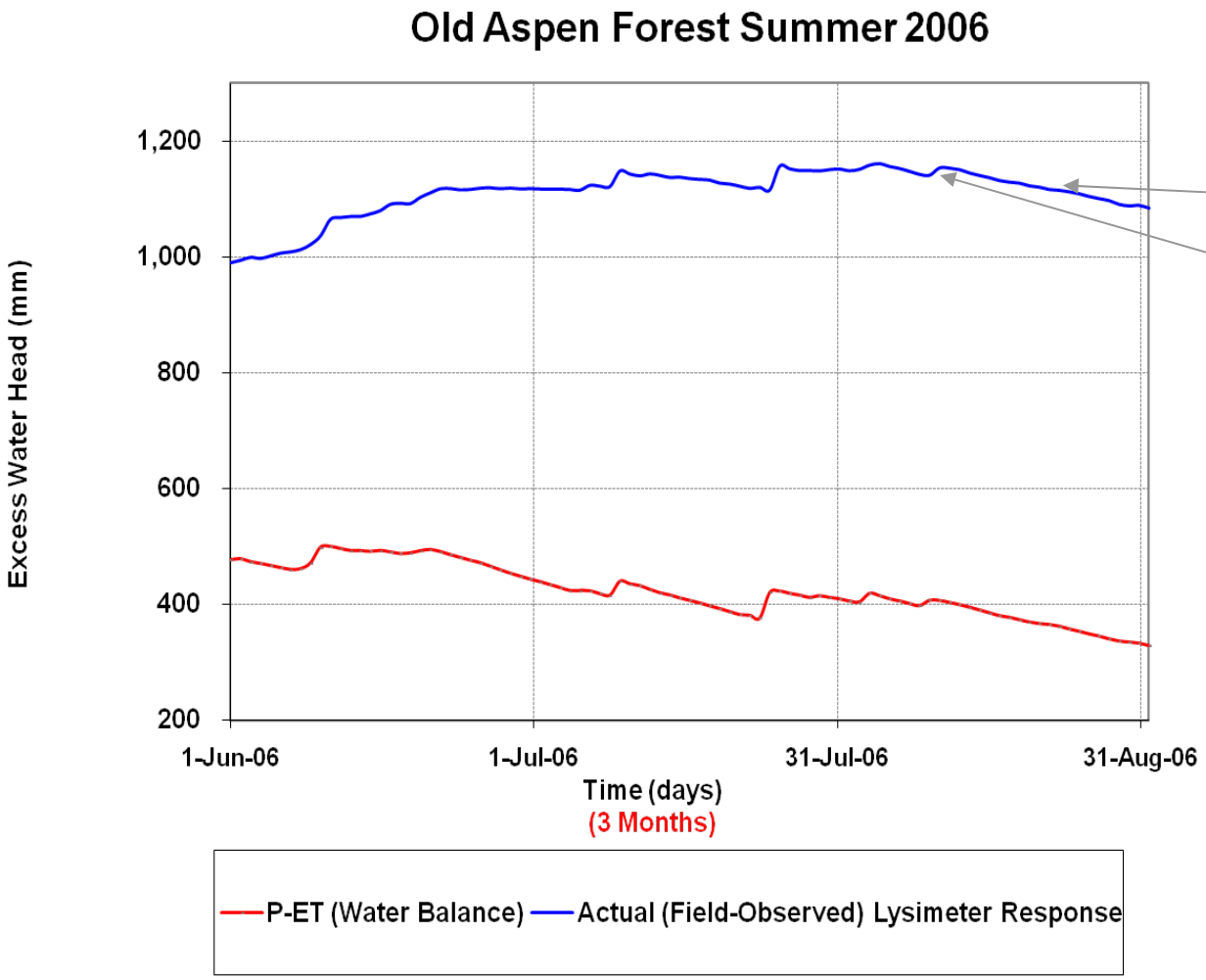
Comparison of Duck Lake No. 2 (geological weighing lysimeter) water level record with Watflood simulation of the vertical water balance



Comparison of Duck Lake No. 1 (water table storage change) with Watflood simulation of the changes of groundwater storage



Modeling of Piezometric Lysimeter Response to Rainfall & Evapotranspiration and water table changes (Anochikwa, MSc U of Saskatchewan)



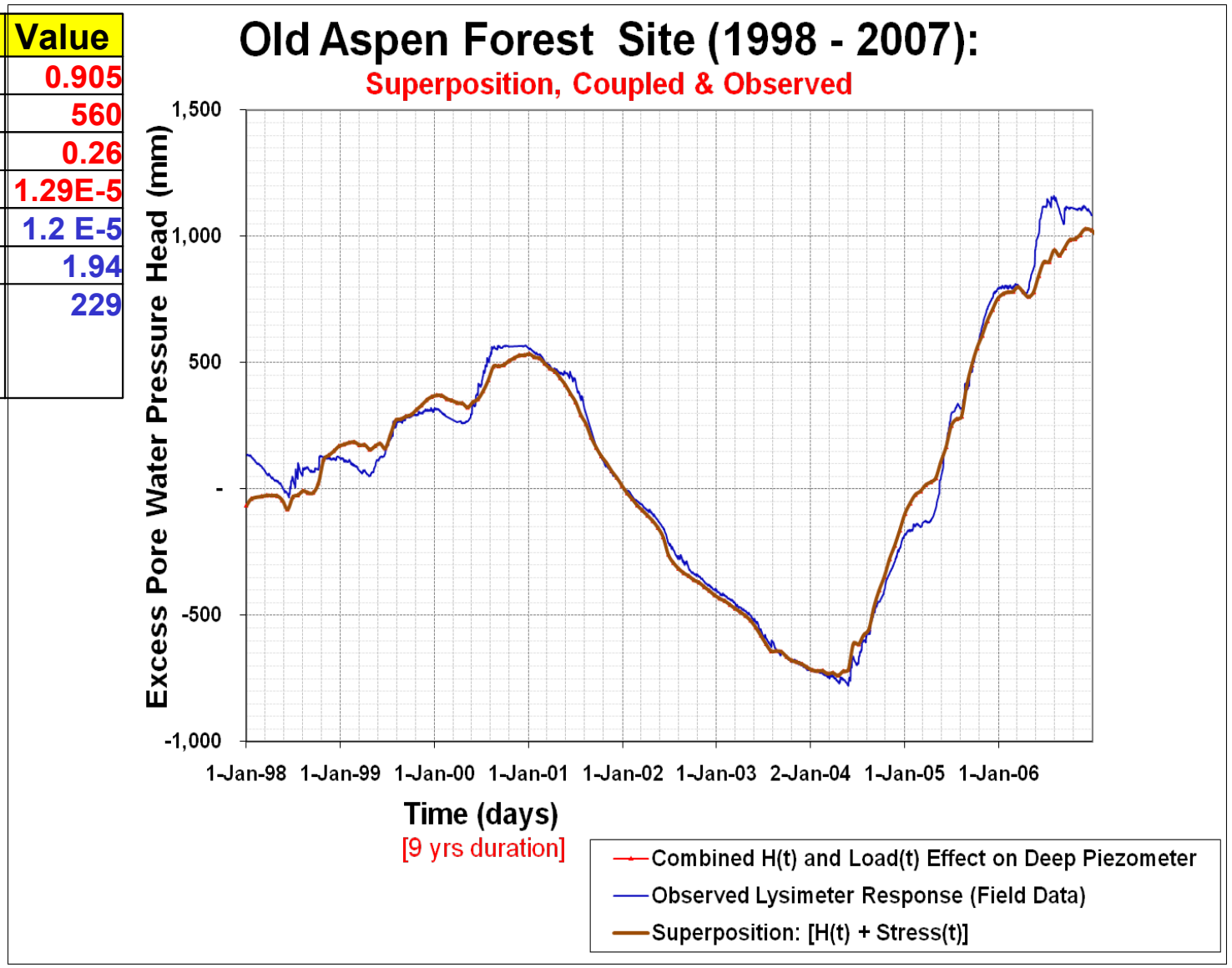
Evapotranspiration

Rainfall

(Using Environment Canada Data)

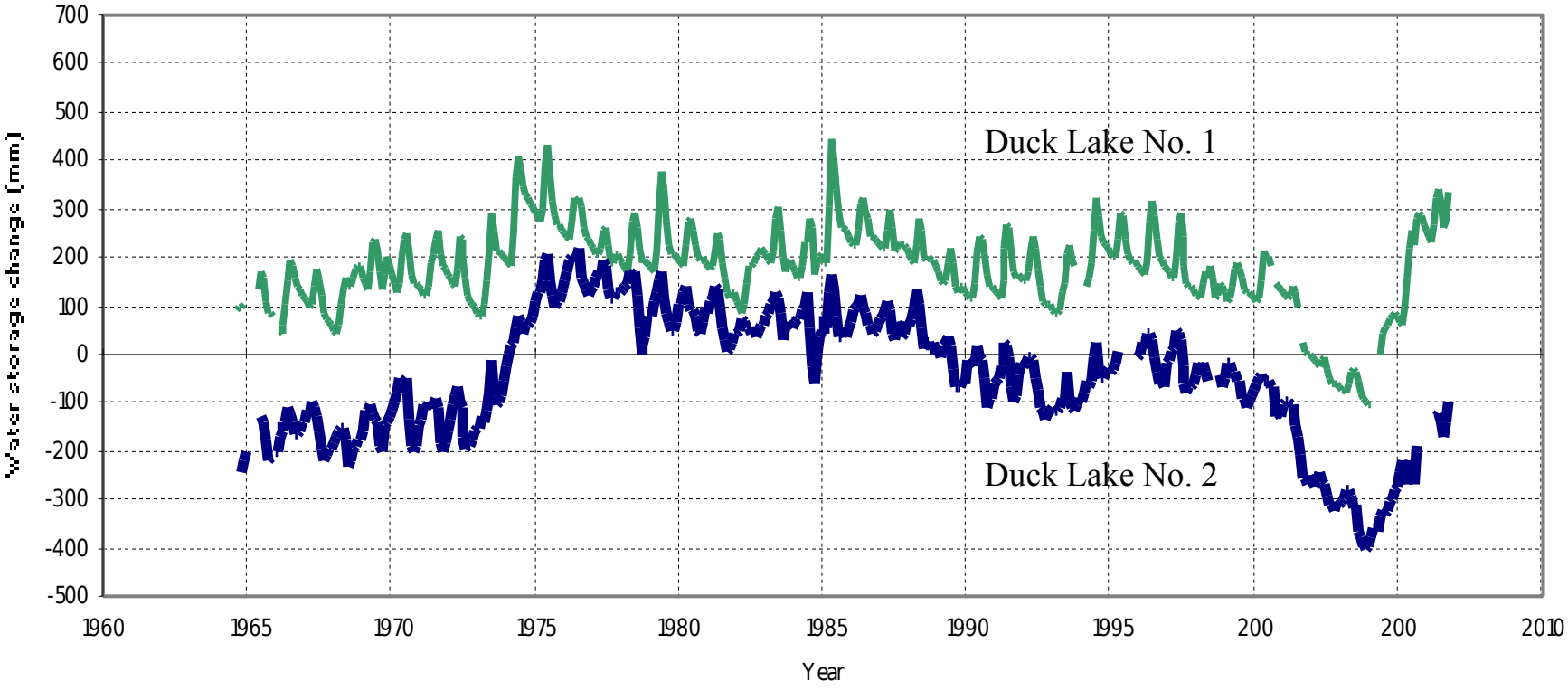
Simulation of observed lysimeter response using SeepW/SigmaW geotechnical model

Properties	Value
Bbar	0.905
E (MPa)	560
n	0.26
Ss (/m)	1.29E-5
Kv (m/day)	1.2 E-5
D (m2/day)	1.94
Characteristic time scale (days)	229

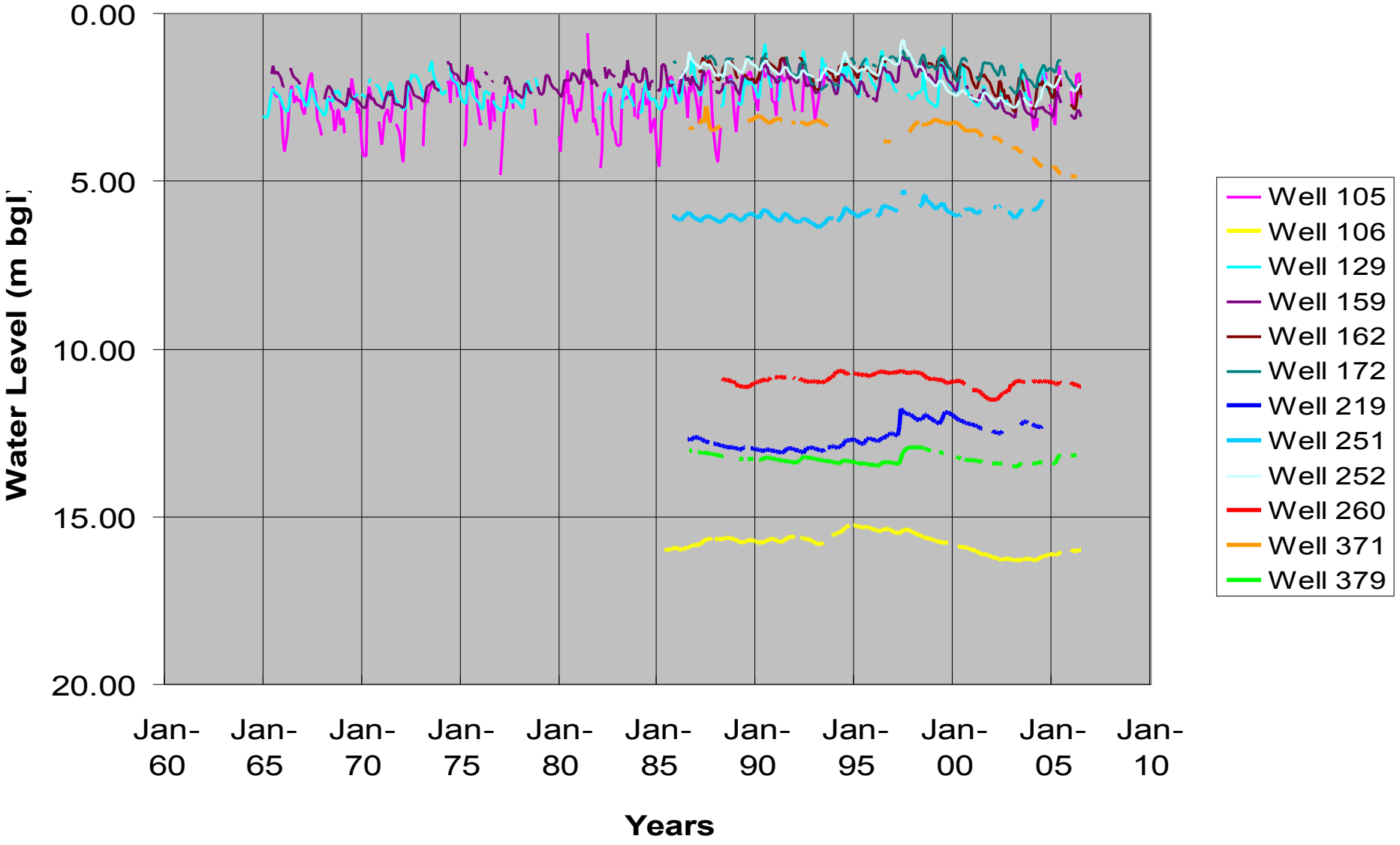


Water storage changes observed for Duck Lake SK observation wells 1965-2007:

Duck Lake No. 1 – Shallow water table well with specific yield = 0.30
Duck Lake No. 2 – Deep well in confined aquifer (geological weighing lysimeter)



Shallow observation wells in AB – water level records 1965-2006:
water table depths below ground level (m)



Shallow observation wells in AB – water level changes 1965-2006

Water table drawdown averaged ~ 0.6 m corresponding to about 200 mm depletion of groundwater storage. But note lack of recovery after the drought