Model Development for Drought-Tolerant Groundwater Management in the Prairies

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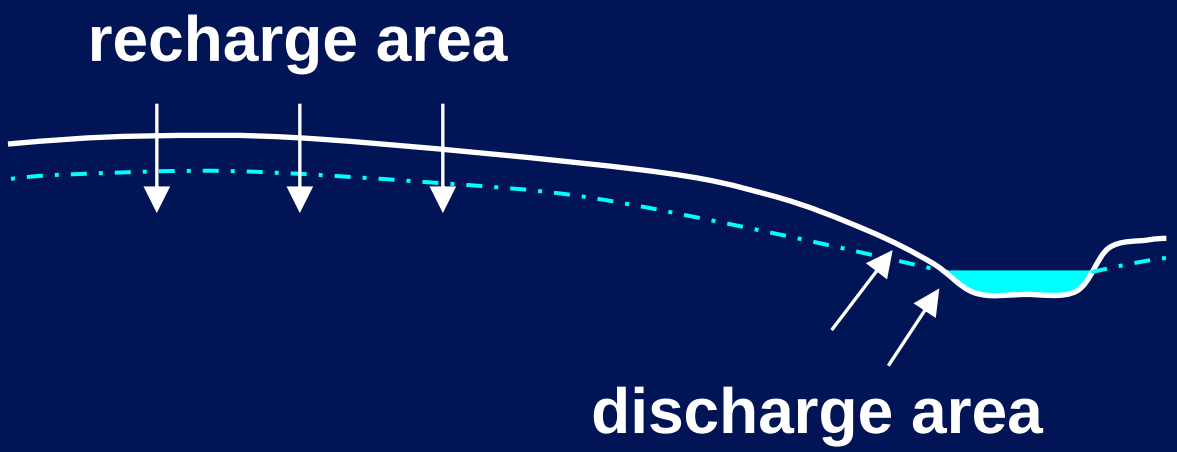
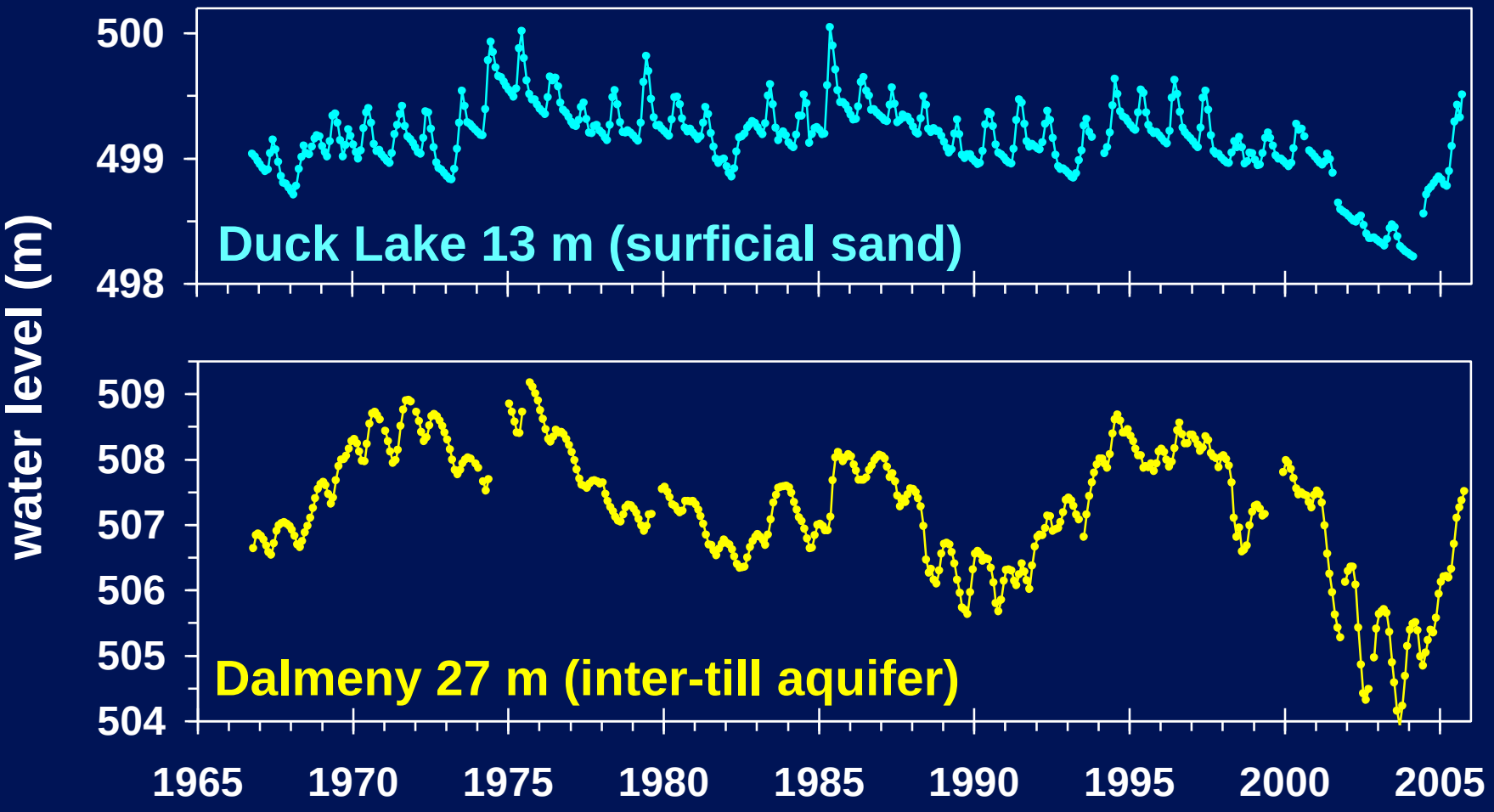
Water Balance: Basis of GW Management

Recharge - Discharge = Storage change
(groundwater level ↑↓)

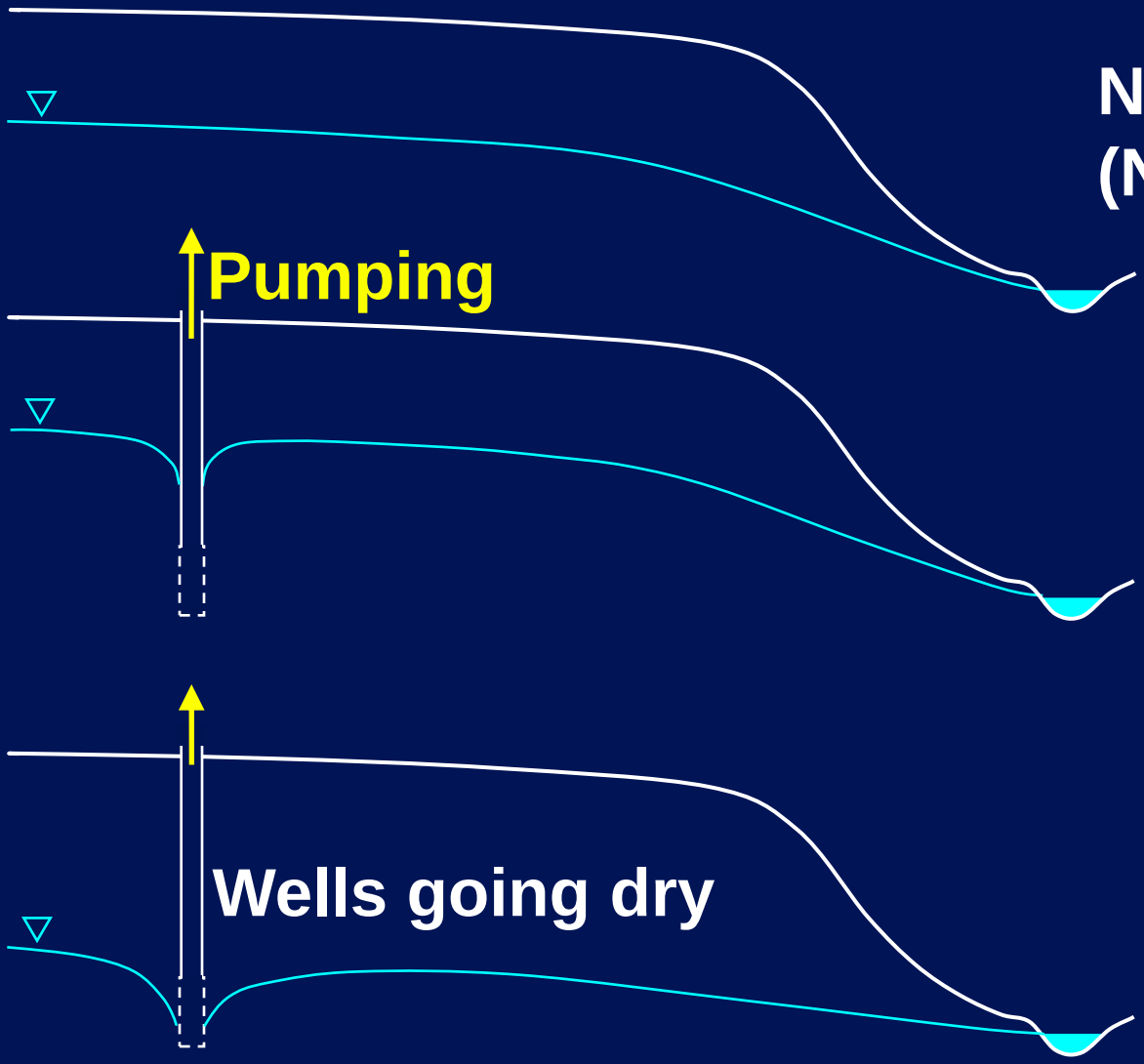


Water Level in Undisturbed Prairie Aquifers

Data from Sask. Obs. Well Network



Summary of Pumping Effects

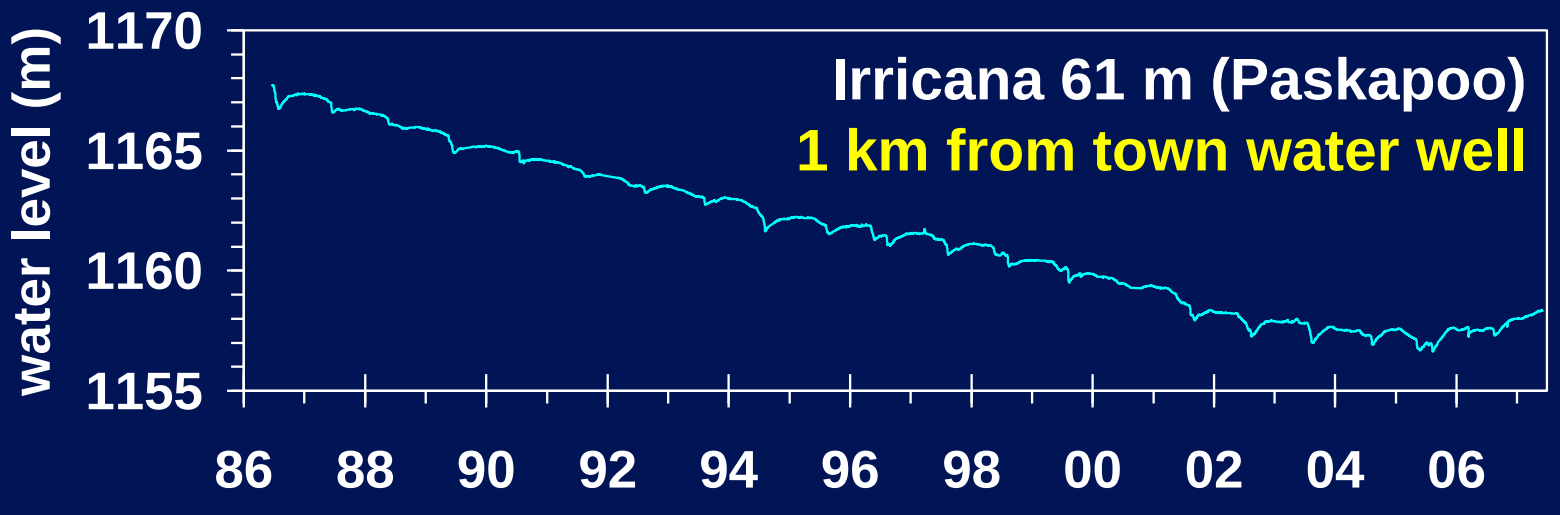


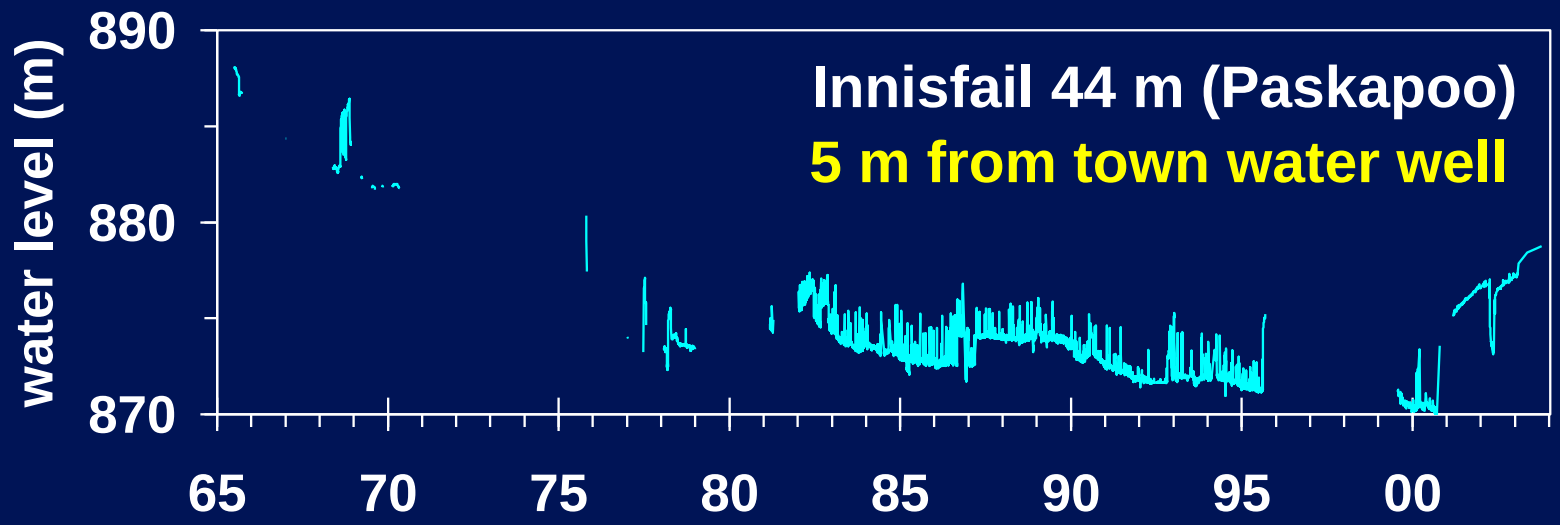
No pumping
(Natural balance)

Decreasing
storage

Diminishing
baseflow

Alberta Environment Monitoring Wells

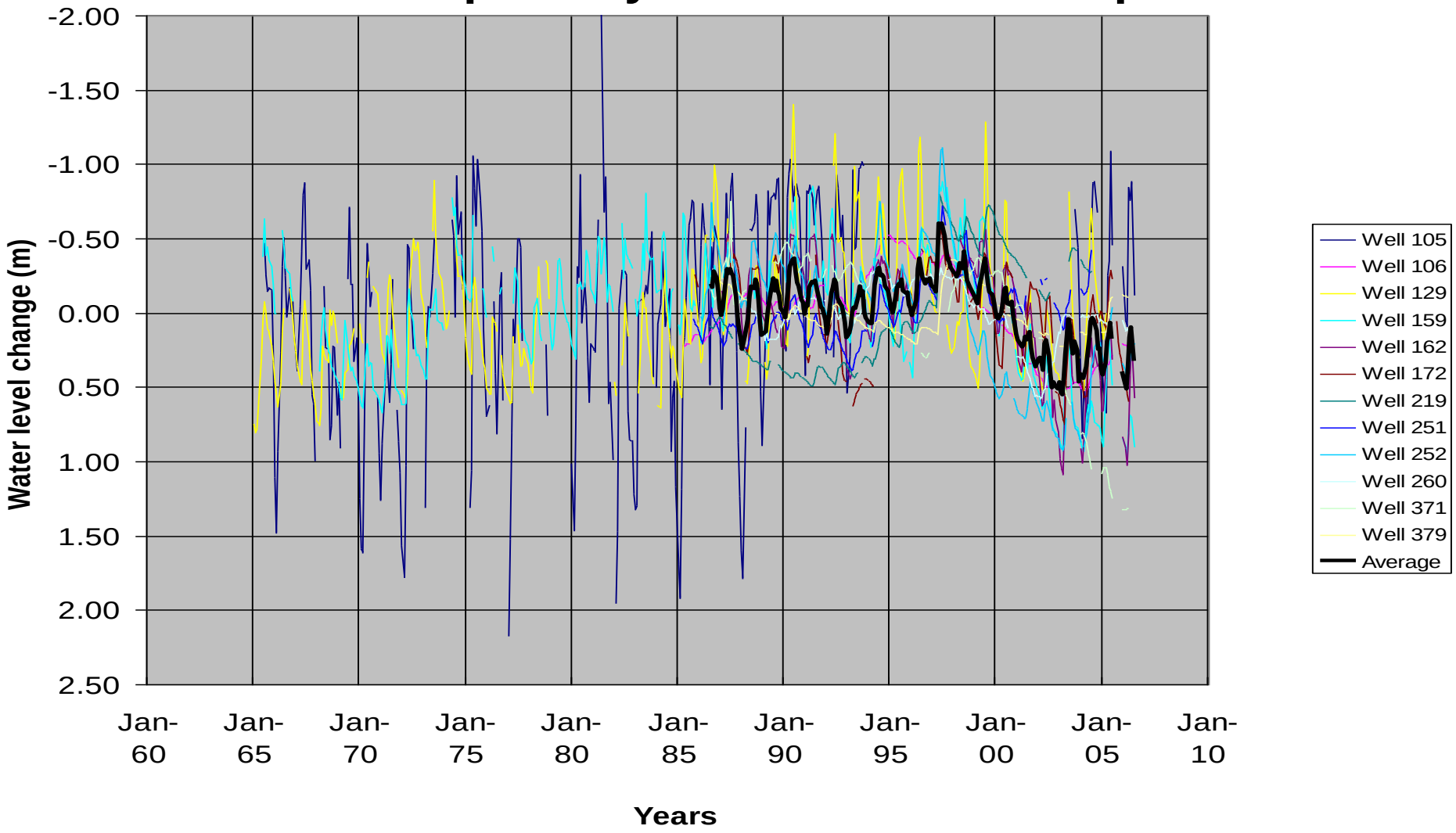




Data by Carole Holt Oduro (Alberta Environment)

Shallow observation wells in AB
Water level changes during 1965-2006

Data compiled by Garth van der Kamp



Groundwater Model Coupled with Soil Water Balance Model

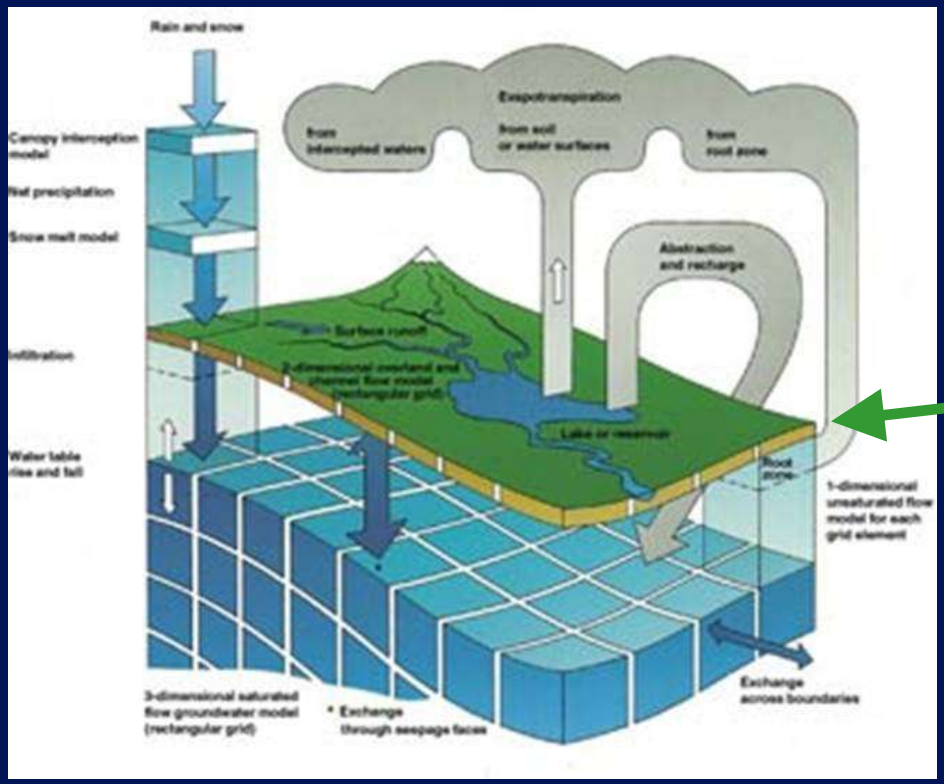
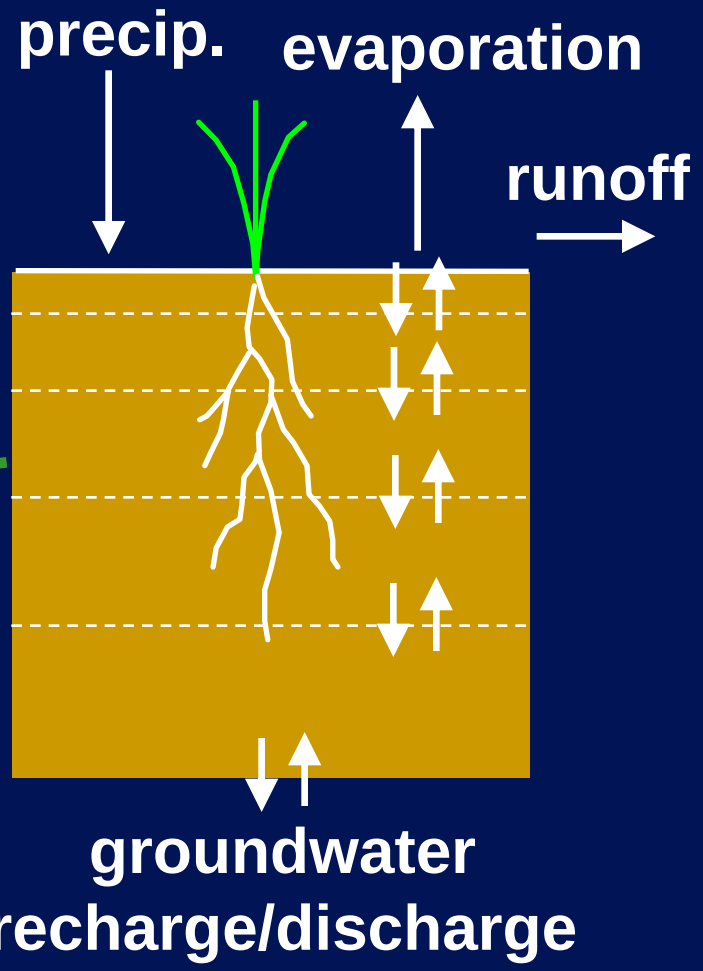
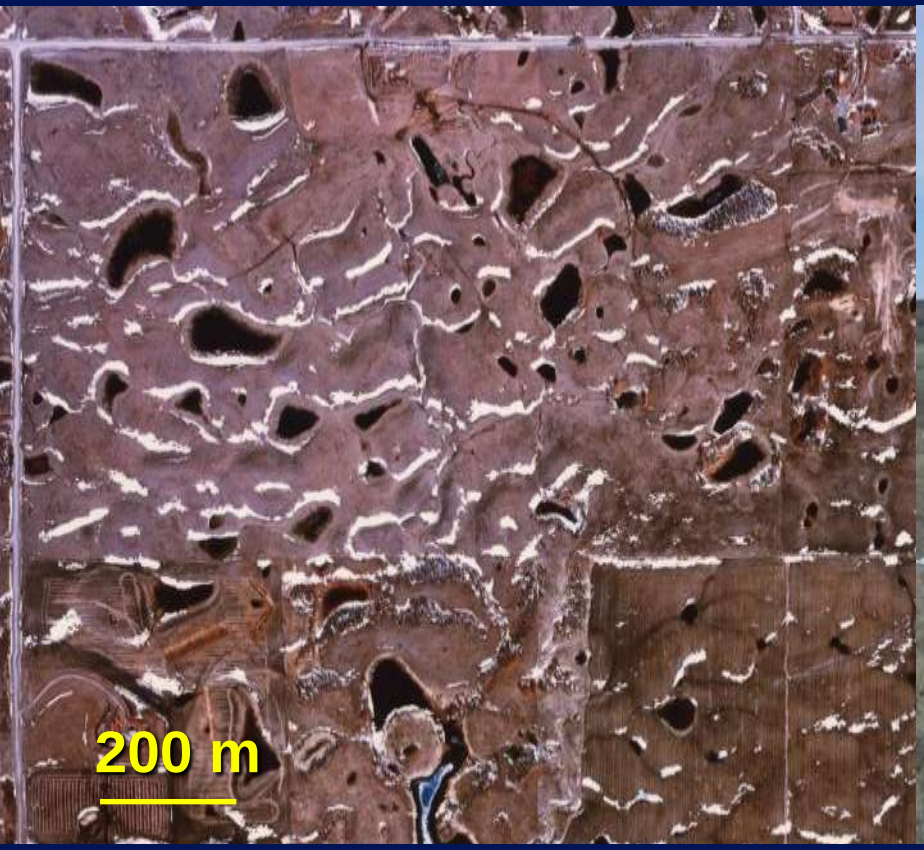


Figure from: www.dhisoftware.com



Snowmelt Runoff Fills Depressions

West Nose Creek watershed near Calgary

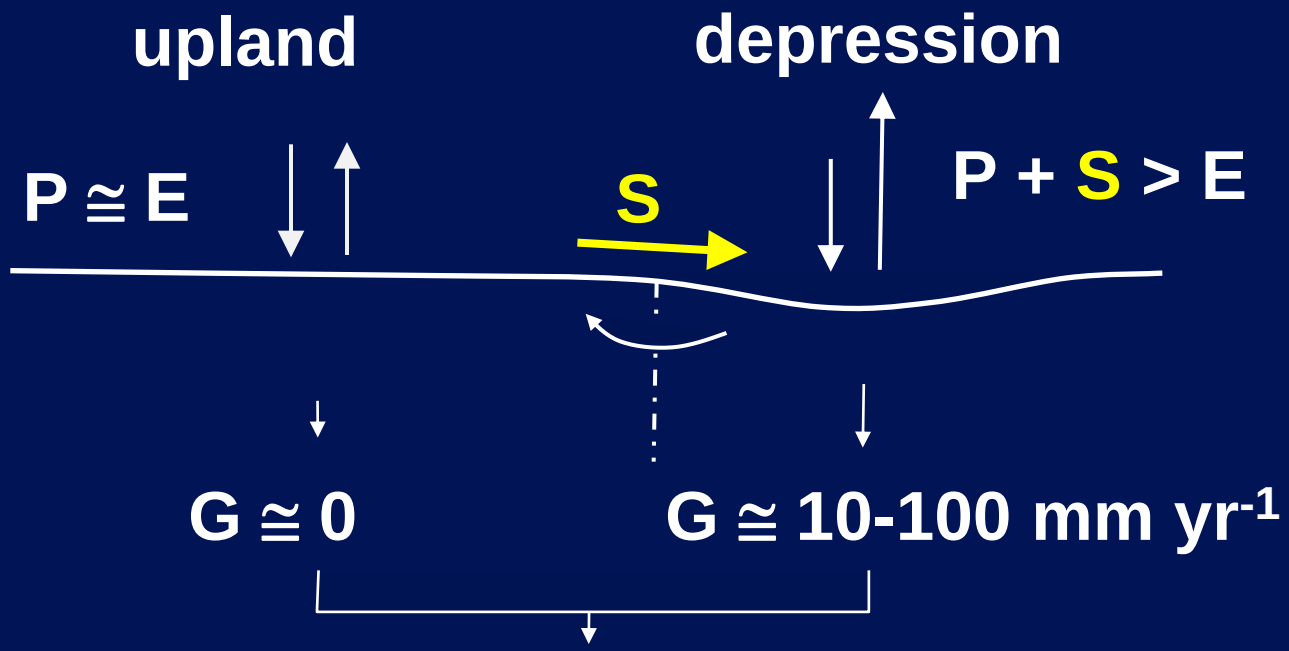


Typical Climate of the Prairies

Precip. (P) = 300-500 mm yr^{-1}

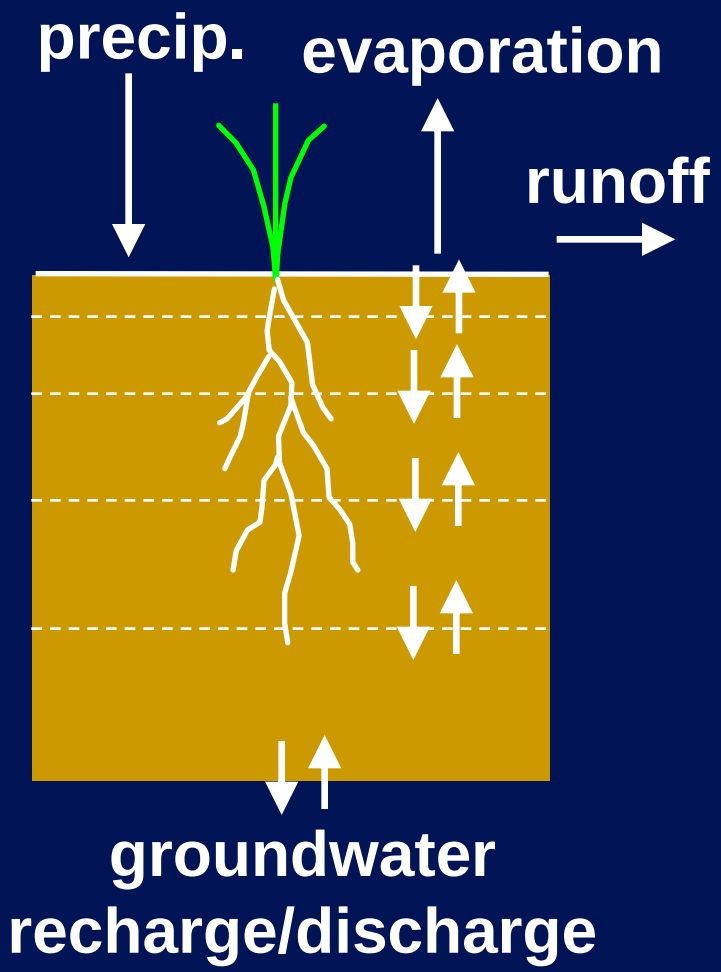
Evaporation (E), potential = 700-800 mm yr^{-1}

Snowmelt (S) → additional water input



Versatile Soil Moisture Budget (VSMB)

Used by Alberta Agriculture and Agriculture Canada



- Potential E by Priestley-Taylor
- $E = E_{pot} \times$ drying function
- Crop stages by degree-day
- Gravity drainage of soil water to field capacity
- Soil temperature does not consider freezing
- Snowmelt runoff by a simple rational method

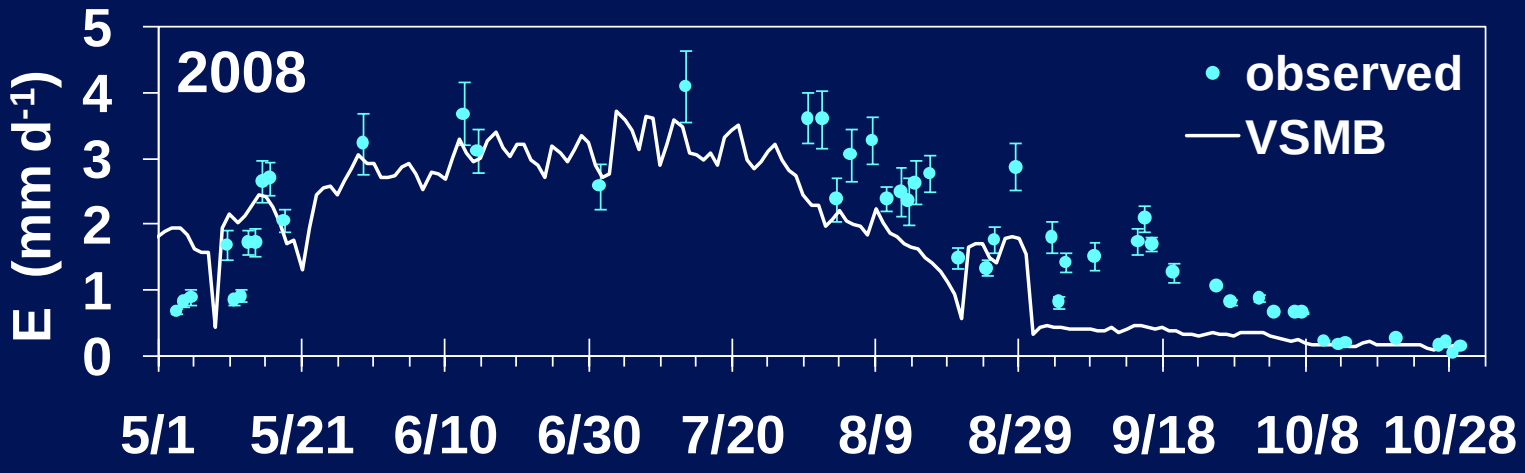
Model Testing for Perennial Grass

Spy Hill Farm – West Nose Creek watershed

Eddy flux measurement.

Uncertainty estimates based on energy balance.

Current operational VSMB.



Model Testing for Perennial Grass

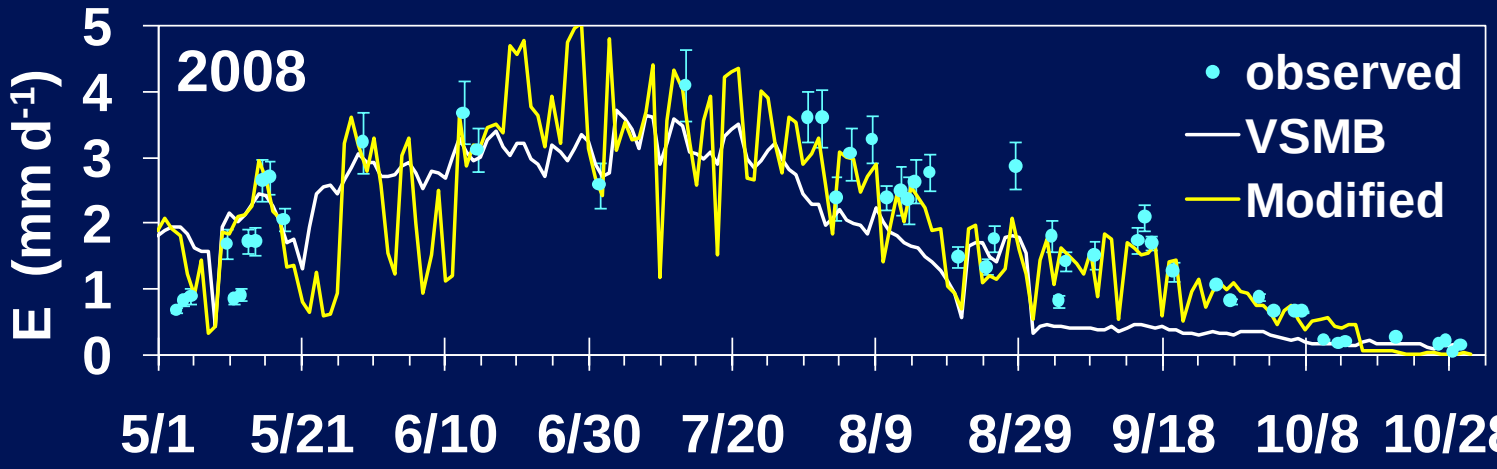
Spy Hill Farm – West Nose Creek watershed

Eddy flux measurement.

Uncertainty estimates based on energy balance.

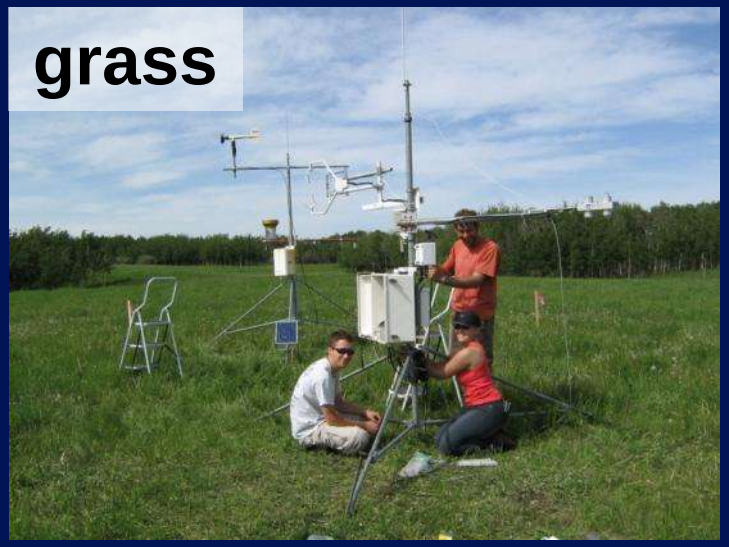
Current operational VSMB.

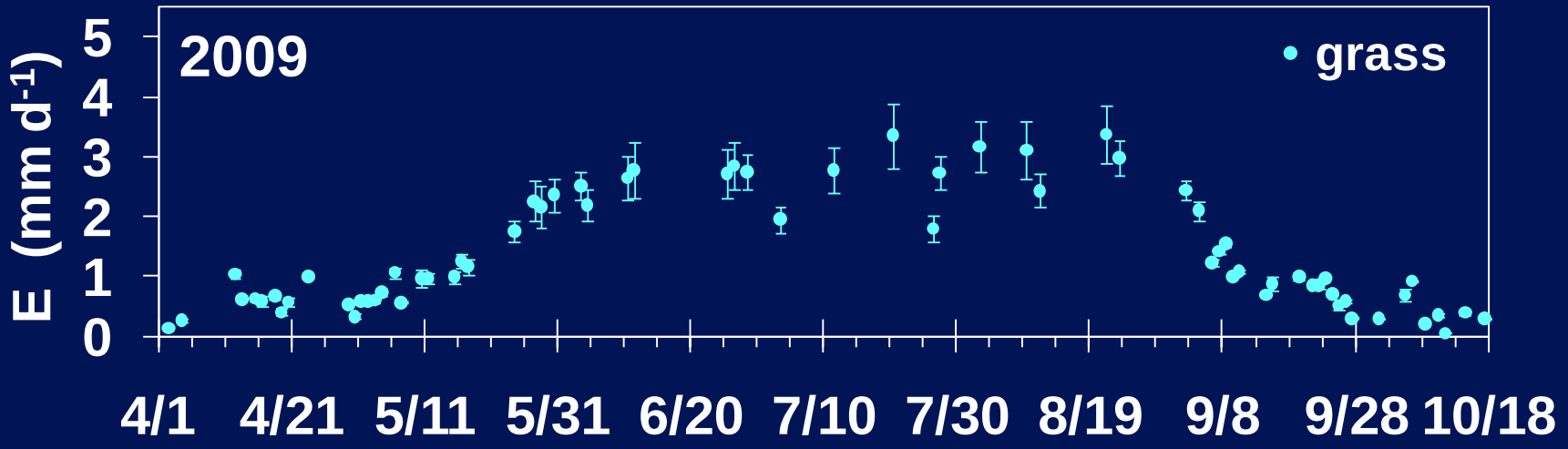
Modification: radiation, crop stage, soil depth, etc.



Evaporation Flux: Landuse Comparison

Same instruments, only 10 km away





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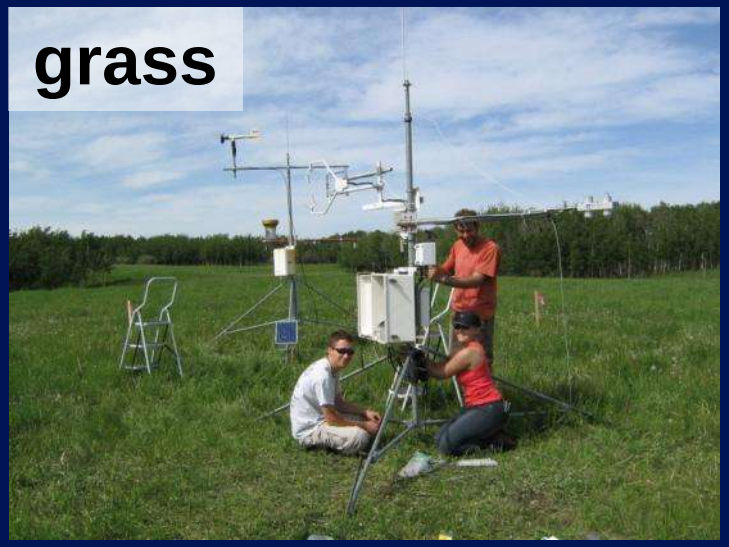
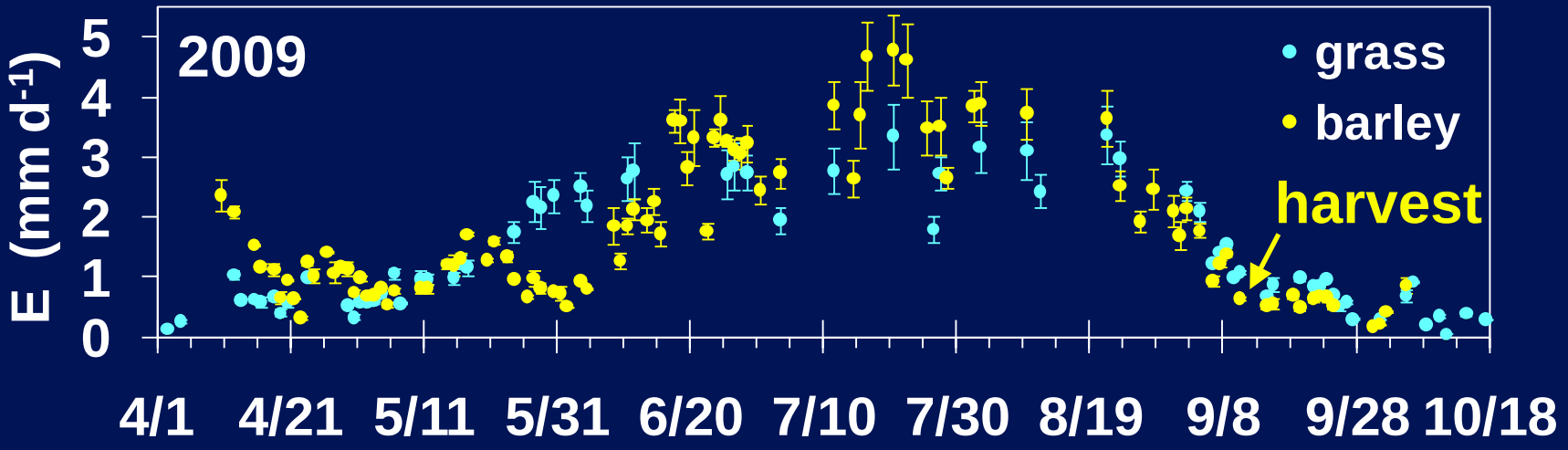
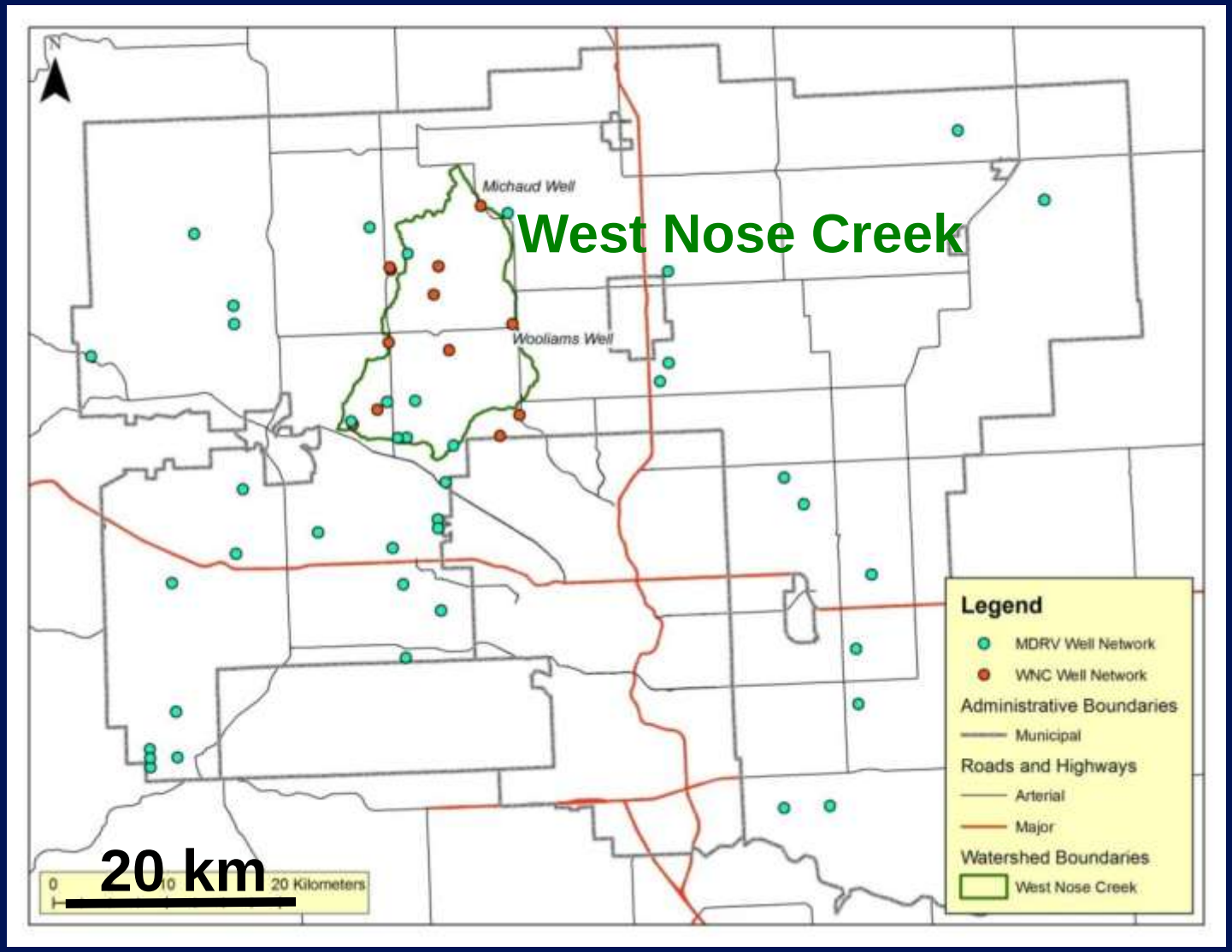




MD of Rocky View Monitoring Network

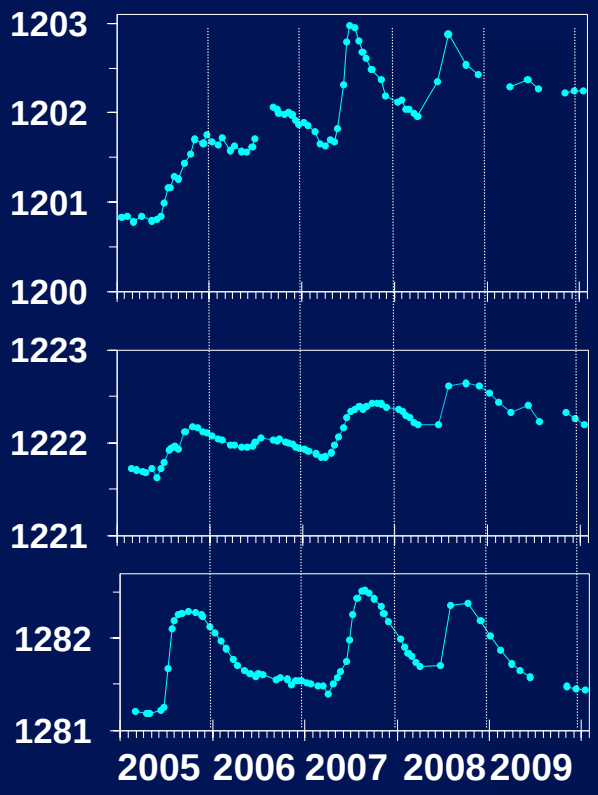
Observation by Well Owners

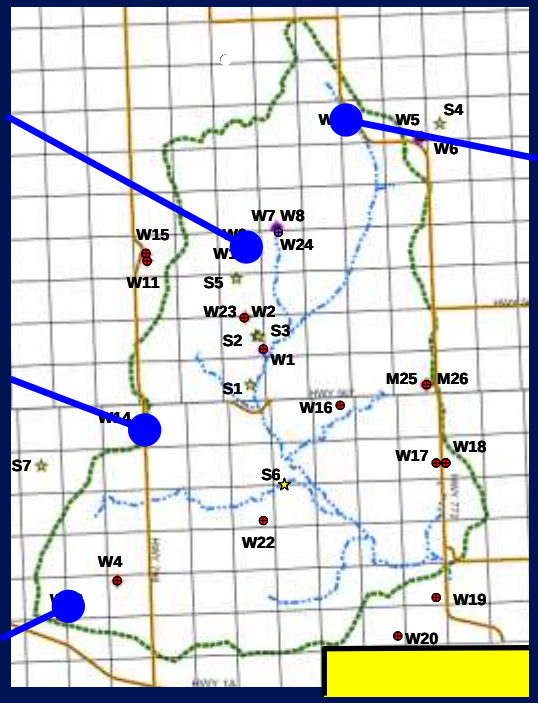


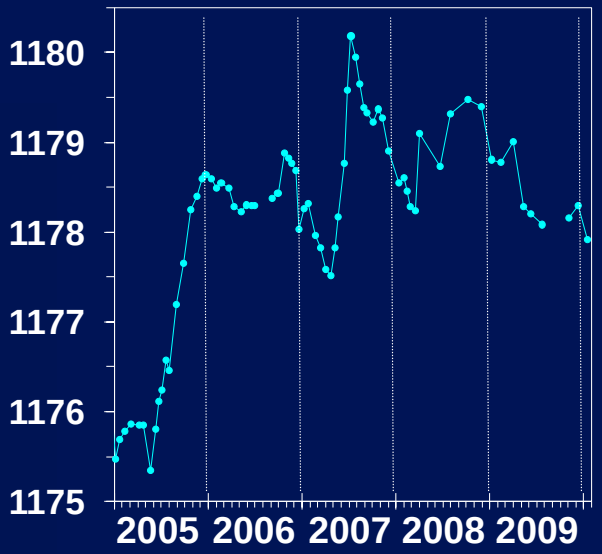
Water Level in Selected Monitoring Wells

Jan. 2005 – Jan. 2010

Elevation (m) above mean sea level







Calgary

Summary

Sustainable groundwater management must be watershed-based; **recharge-storage-discharge**.

Integrated hydrological model will provide an effective tool, when combined with a **high-density monitoring well network**.

Acknowledgement

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