

Crop growth under water limited conditions of the Canadian Prairies: Observations and Modelling

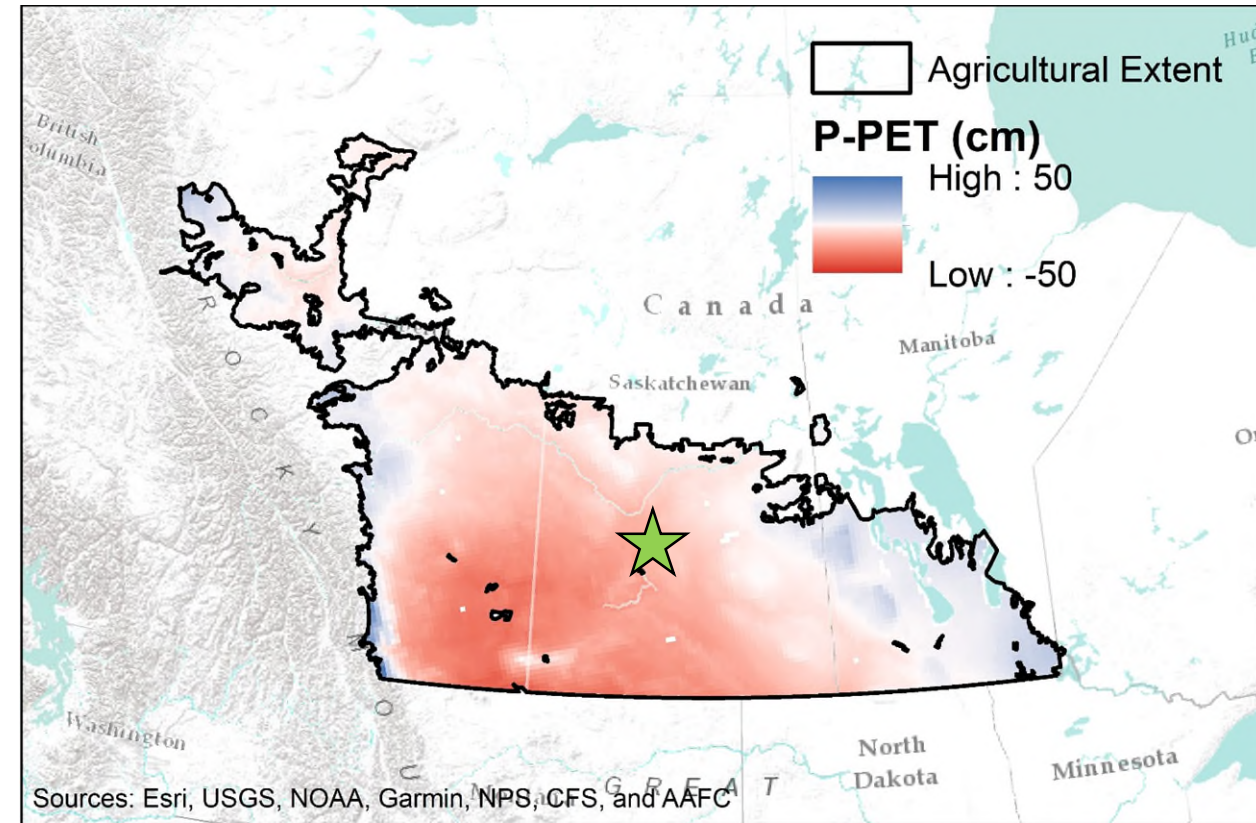


Phillip Harder¹, Warren Helgason^{1,2}, John W. Pomeroy¹, Bruce Johnson³

Centre for Hydrology¹, Department of Civil, Geological and Environmental Engineering², and
Global Institute for Water Security³, University of Saskatchewan, Saskatoon

Canadian prairie agriculture

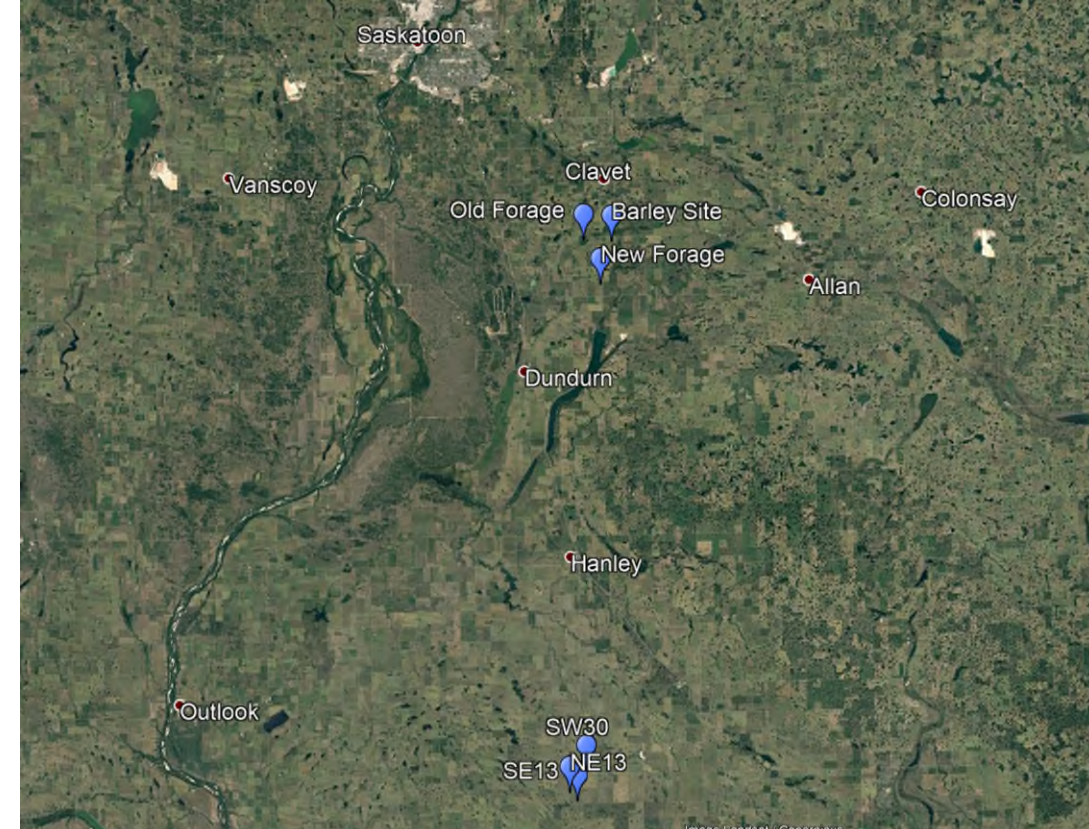
- Agriculture occurs on 25 million hectares (50%) of the prairie ecozone
 - 3.4% irrigated
- Water availability is the major limitation for crop growth
- Water balance observations that capture the seasonal crop growth and water use dynamics are scarce.



Canadian Prairie EcoZone extent and mean annual moisture deficit (Precipitation – Potential Evapotranspiration)

Data

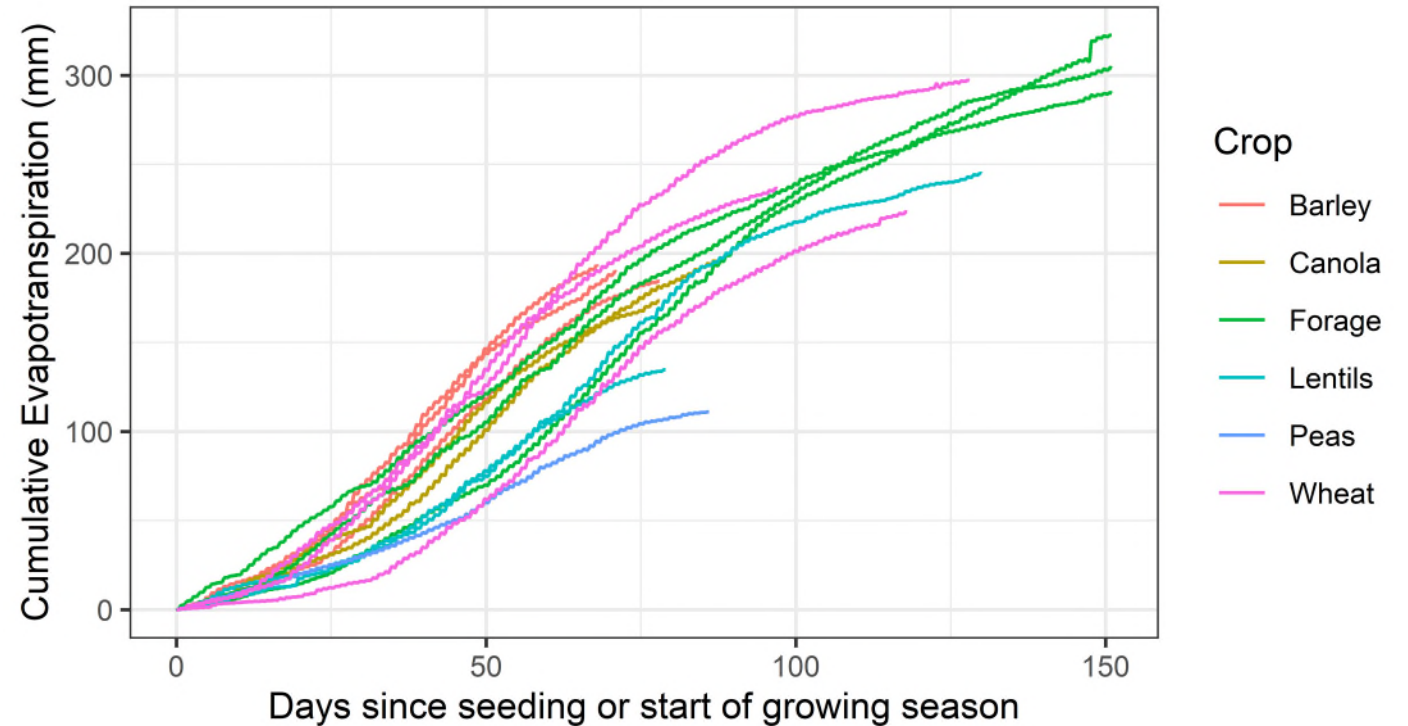
- 16 site-years from sites near Saskatoon, Saskatchewan
- Consistent instrumentation:
 - Direct measurement of all components of the energy and water balances during the growing season
- Biophysical measurements:
 - LAI, biomass, crop height, yield, etc.





Crop Water Usage

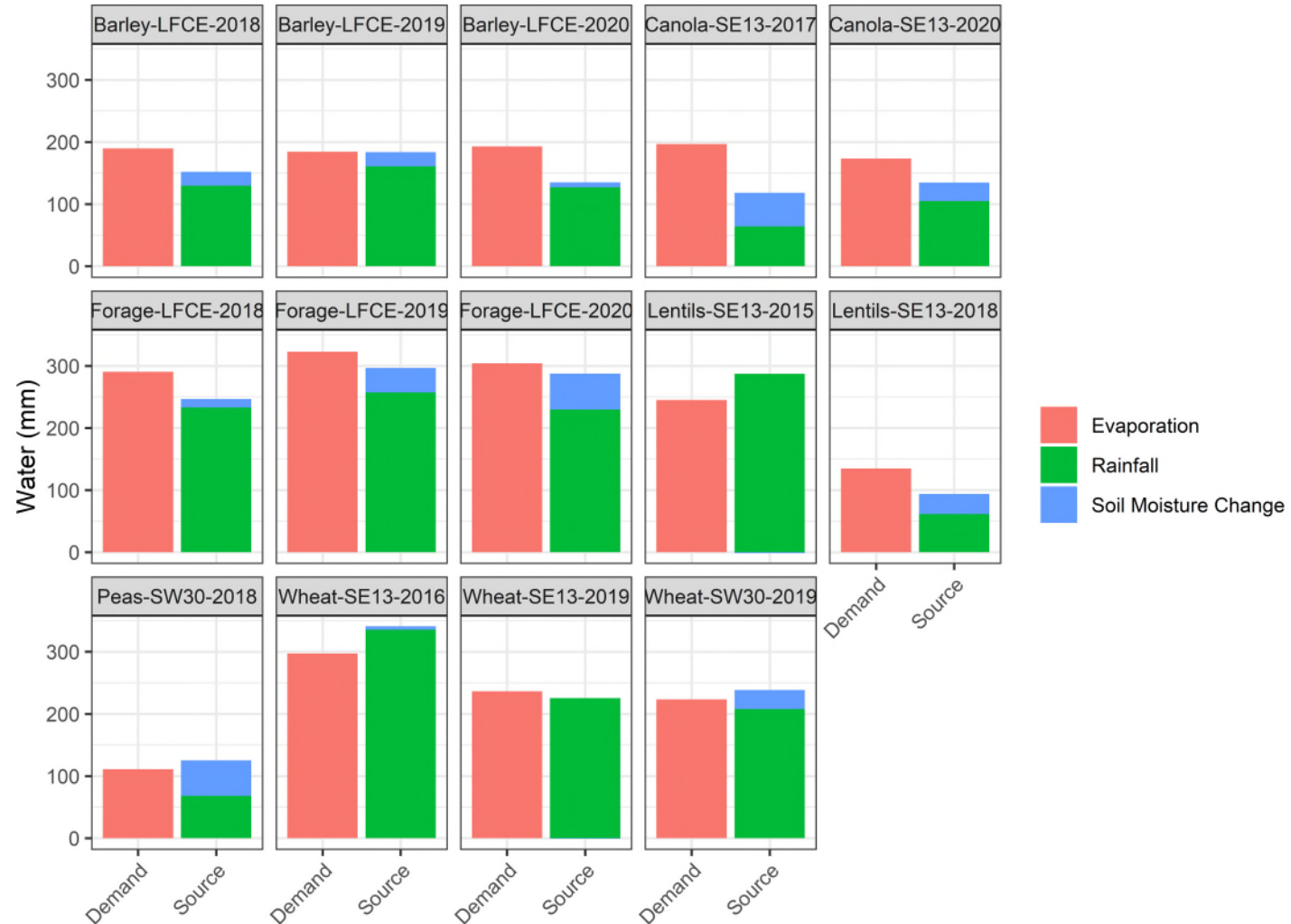
- Growing season ET ranges between 100 and 300 mm
 - << Potential Evapotranspiration (600-1100mm)



Growing Season Water Balance

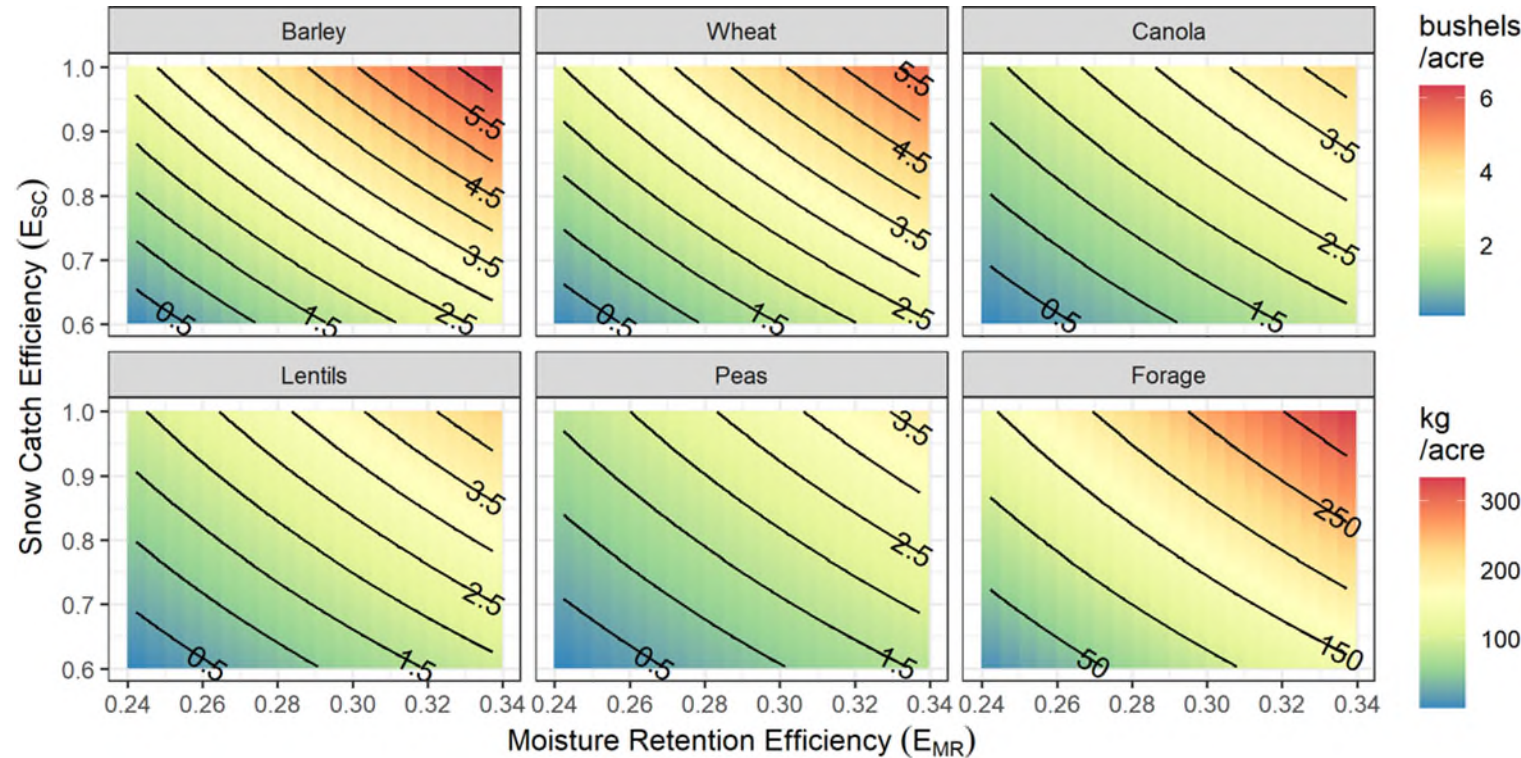
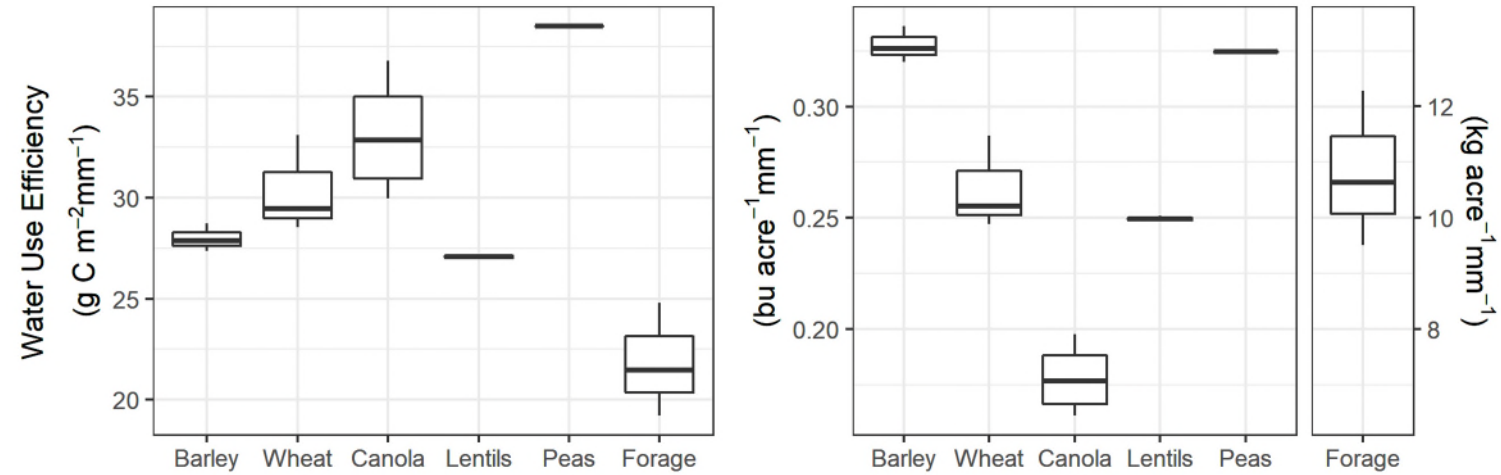
$$ET = Rainfall + \Delta SM$$

- Mean water balance closure 8.4%
 - Differences due to scale representations of observations
- Rainfall is consistently dominant water source
- Soil moisture (SM) is an important but variable source



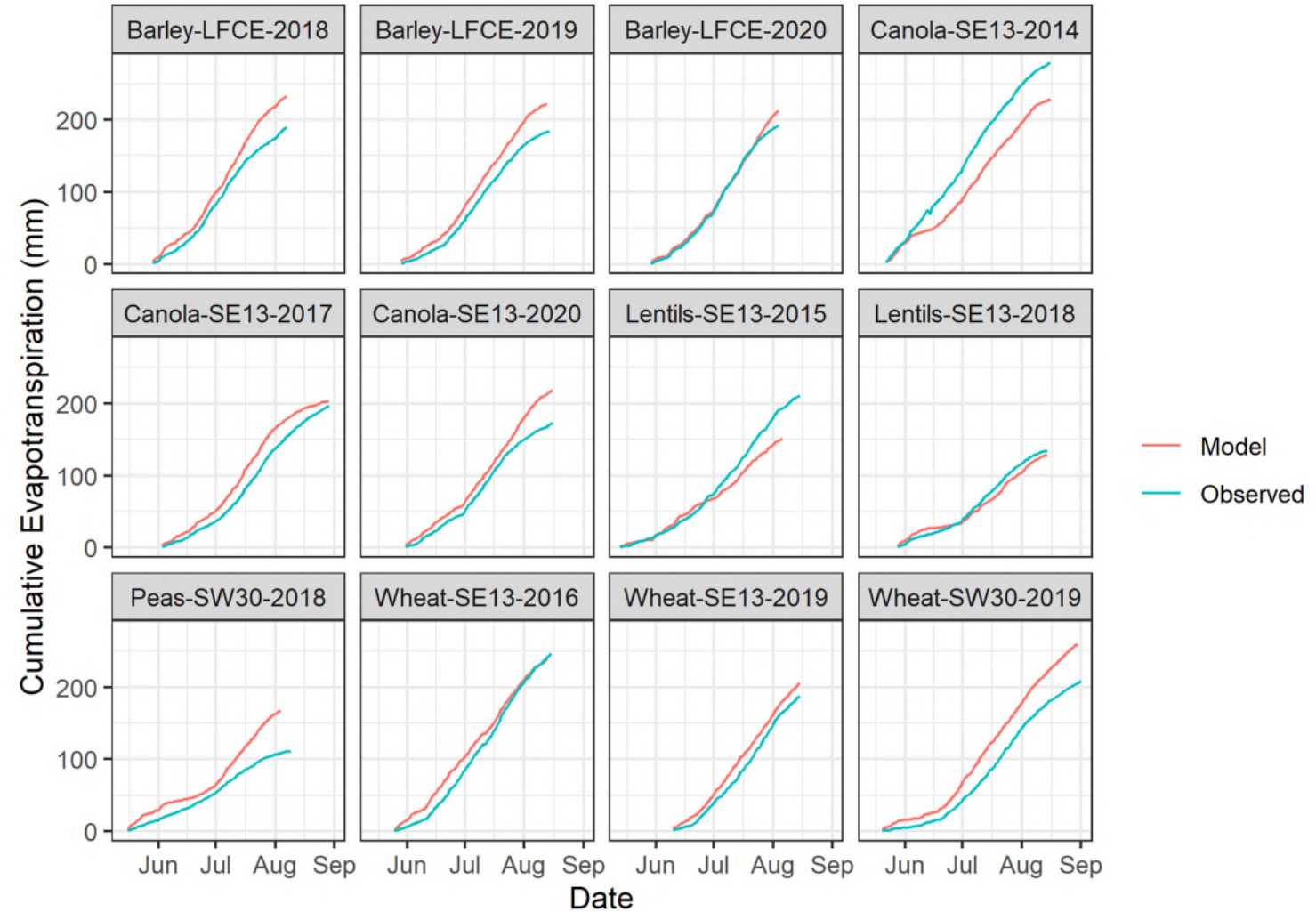
Water Use Efficiency

- Poor understanding of crop water use efficiency
- We measured GPP-based WUE from eddy covariance
- Evaluating the impact of changes in managing practices and their yield implications



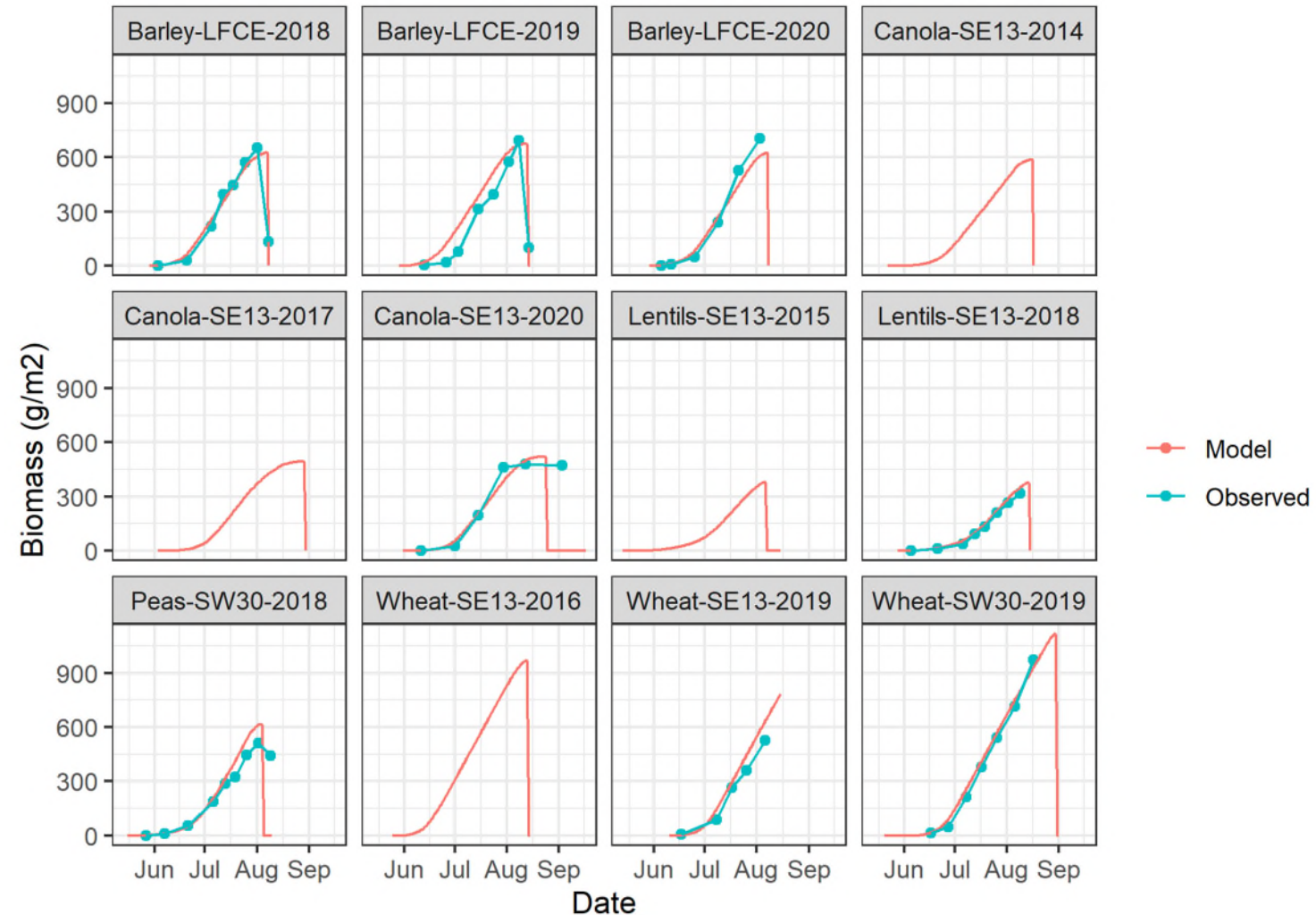
Crop Modelling

- Validating AquaCropOS crop model to simulate crop growth and water use



Crop Modelling

- Validating AquaCropOS crop model to simulate crop growth and water use
- Future modelling will address:
 - Irrigation potential
 - Climate impacts
 - Regional and national scale impacts



Summary

- Crop growth on the Canadian Prairies is water limited
 - challenging environment for modelling of crop-climate-hydrology interactions
- Ongoing modelling work is quantifying:
 - current crop water dynamics with updated WUE observations
 - crop-climate interactions and what that means for future agriculture in the Canadian prairies
 - irrigation implications/opportunities

