Spatial Variability of Evapotranspiration during Prairie Drought

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Evapotranspiration

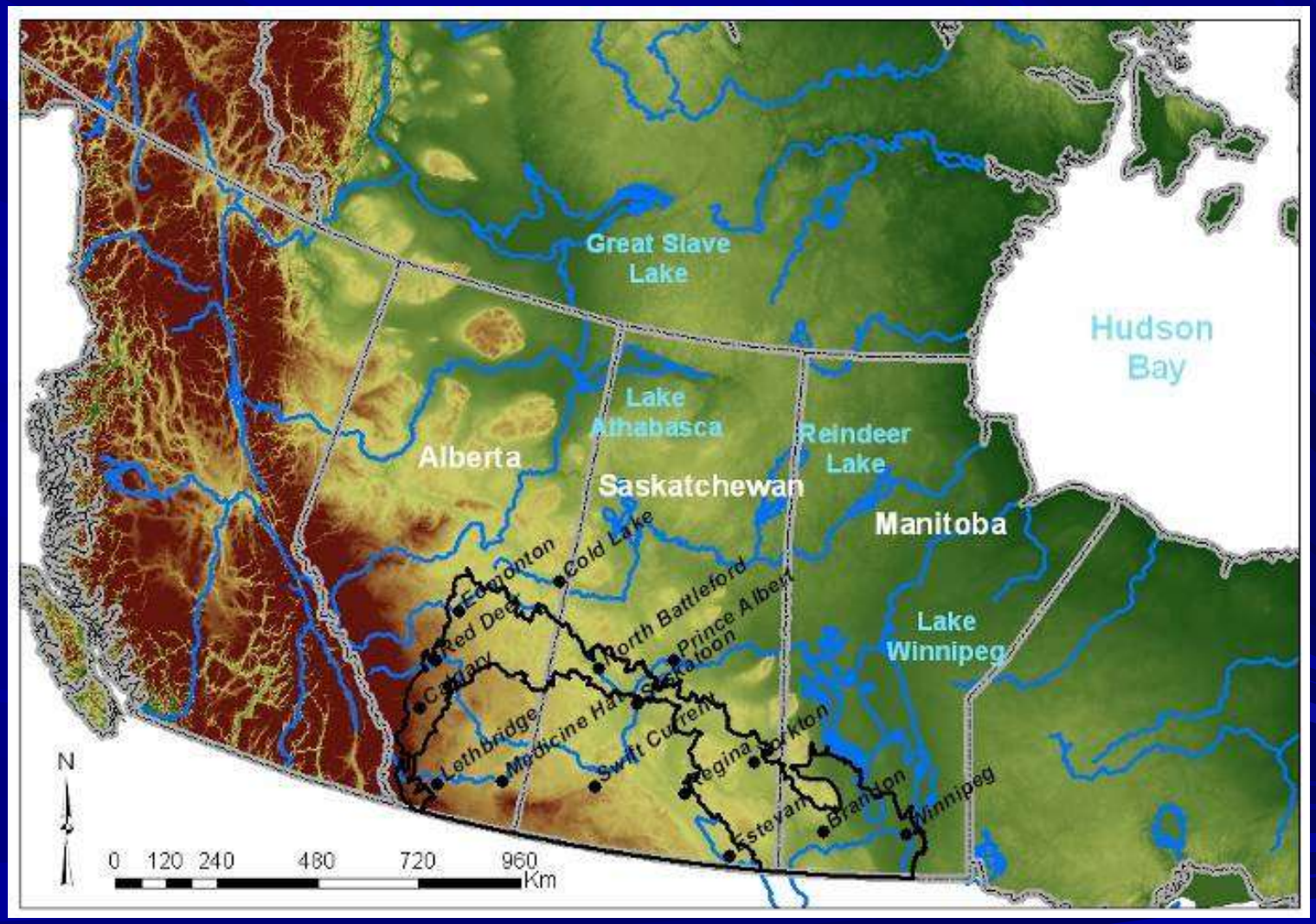
- Indicator of plant productivity, ecosystem function
- Impaired by drought and cold weather
  - Lower in cold or dry conditions
  - Higher in warm and/or wet conditions
- Controlled not only by summer meteorology, but by vegetation type, length of winter, snowmelt infiltration, runoff, soil texture, soil moisture status
- Excellent indicator of the impact of drought on surface hydrology

Objective

- Background
  - Evapotranspiration highly variable spatially
- Objective
  - Examine spatial variations in ET across Prairie region during drought period
- Study region and Archived data
  - Prairie region
  - Reanalysis data found unsuitable
  - 15 Env. Canada stations with archived data from 1960 – 2005

Study Region

Station locations, Prairie ecozone and Palliser Triangle boundaries

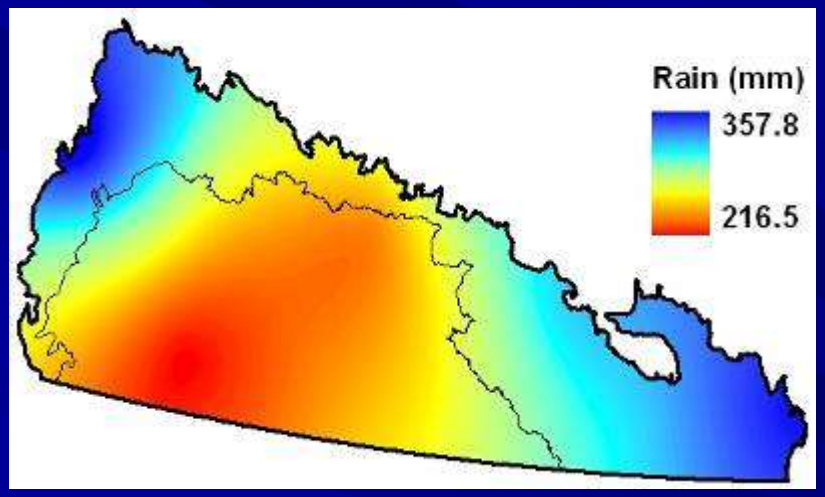


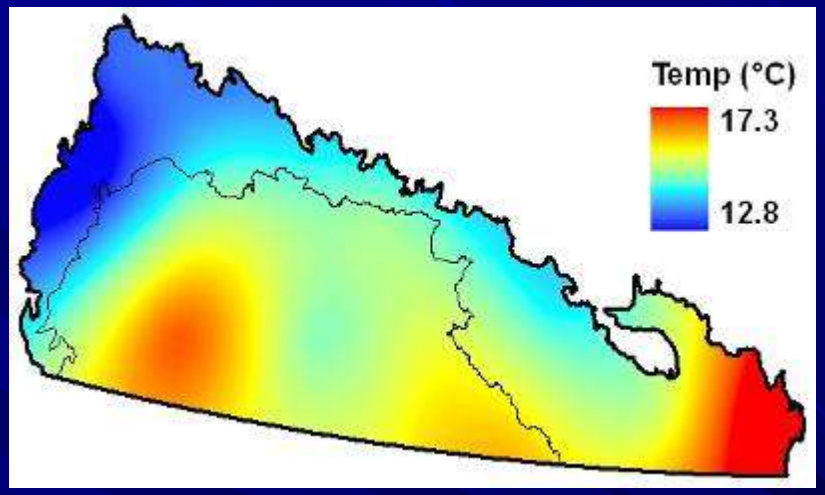
Model Setup and Inputs

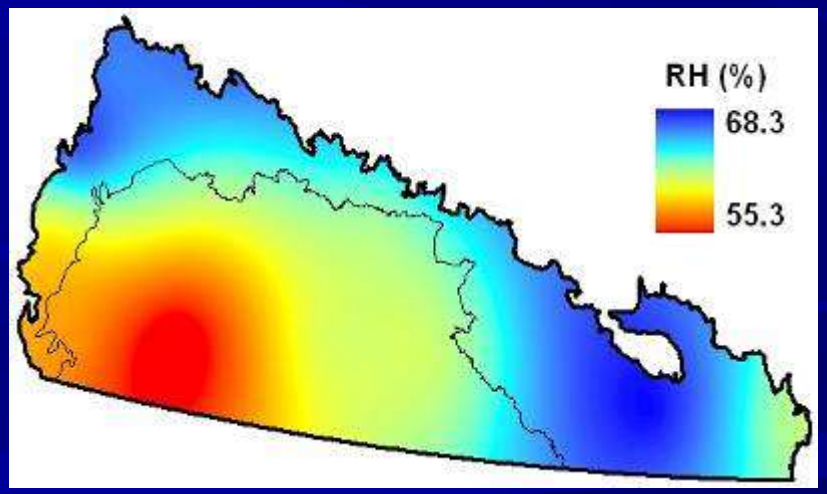
- Continuous model simulations using CRHM
- Vegetation: simple linear growth to max heights (crop/fallow and grass)
  - Stubble left for snow capture; Fallow no growth
  - Specified Julian dates for start, maturity and harvest
- Simulations started on January,1 1960
  - Spin-up year: standardized initial soil moisture conditions at each location : 50% of available water holding capacity (drought year)

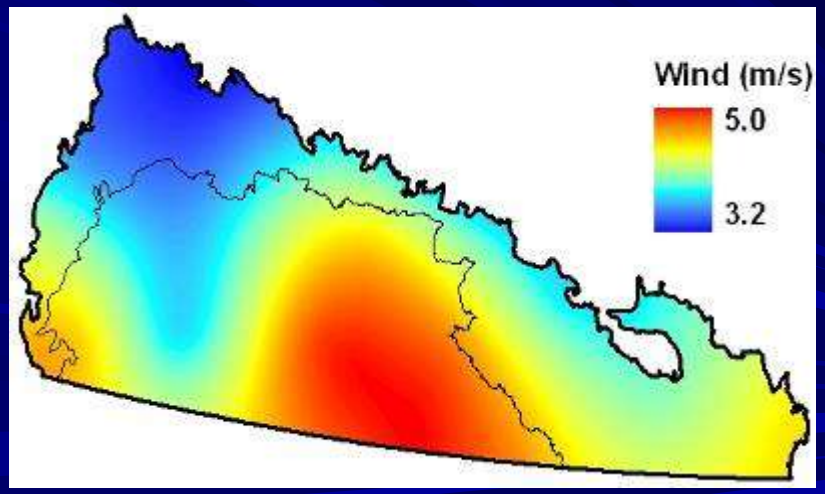
Growing Season Climate Normals (1971-2000)

- If Capt. Palliser only had GIS!





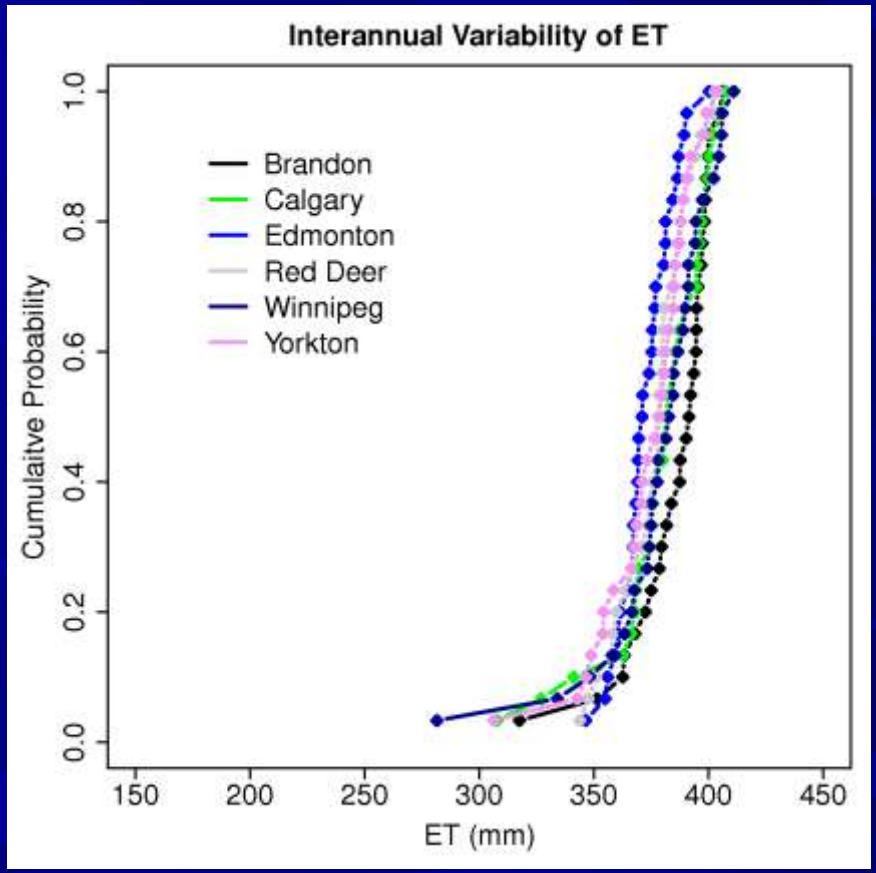




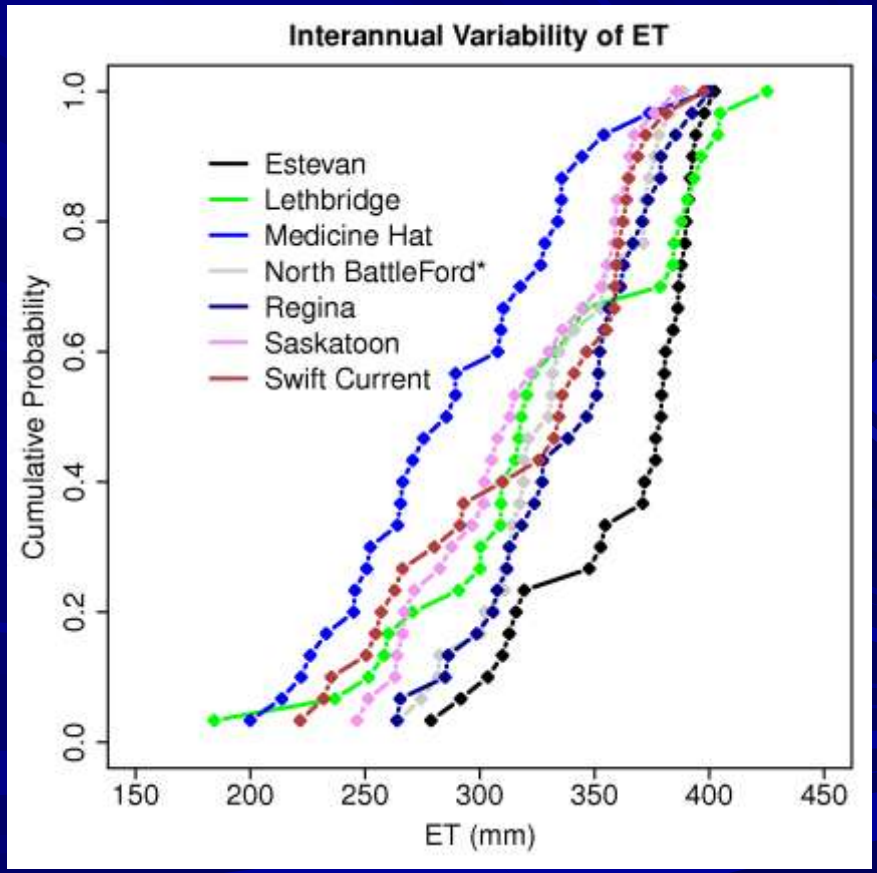
Interannual Variability of Growing Season ET over a Normal Period: 1971-2000

- Distributions reflect influence of climate
  - Outside Palliser: low variability
  - Within Palliser: high variability, impacted by dry periods

Outside Palliser



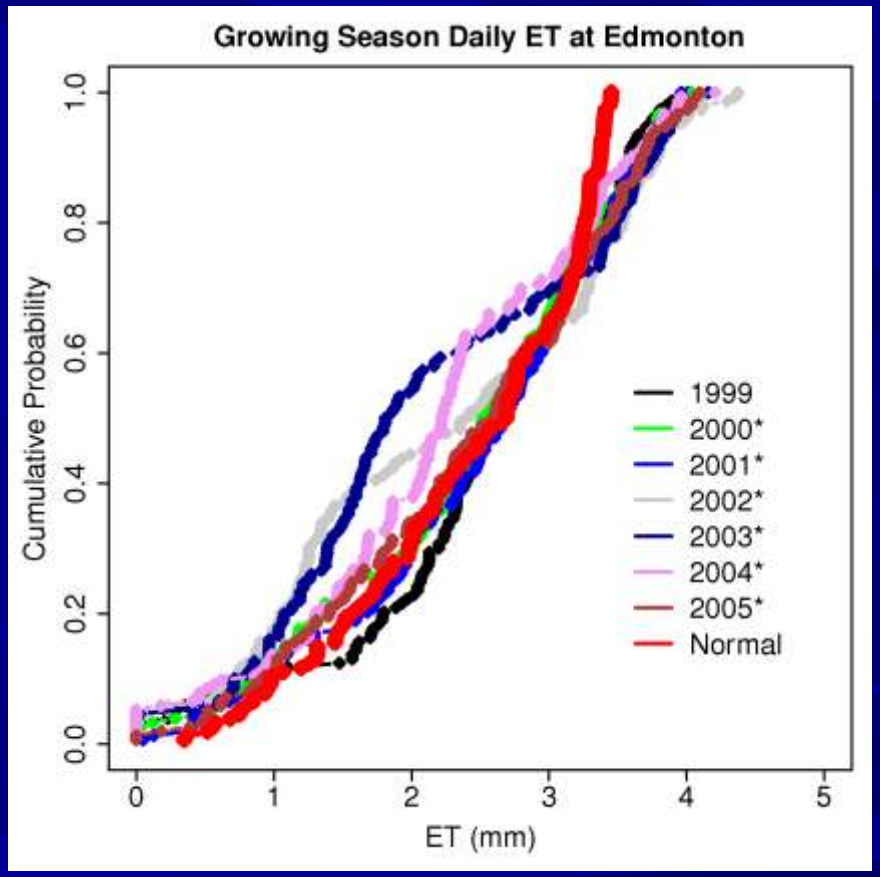
Within Palliser



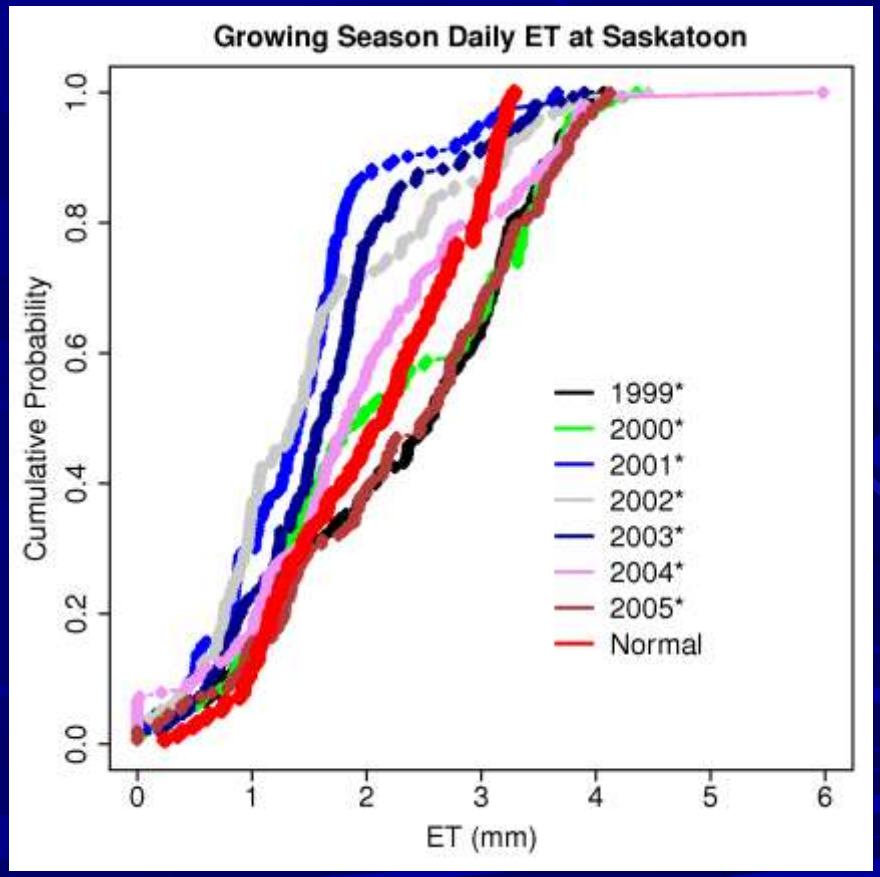
Daily ET During Drought and Wet Periods

- Influence of climate at a point
  - Drought year: ET less variable, distribution shifted to far left
  - Wetter year: ET more variable, distribution shifted to right

Outside Palliser



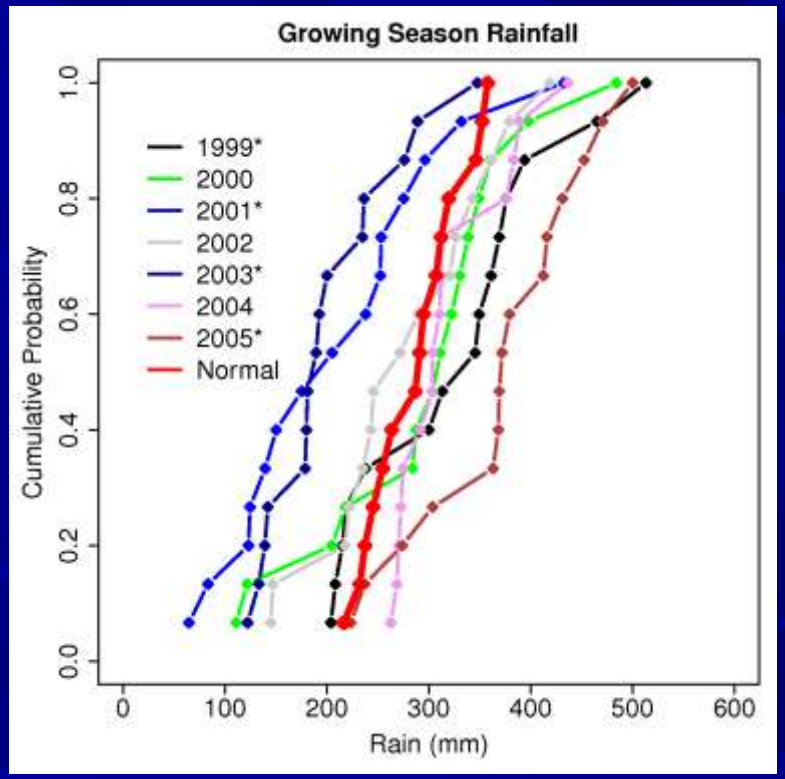
Within Palliser

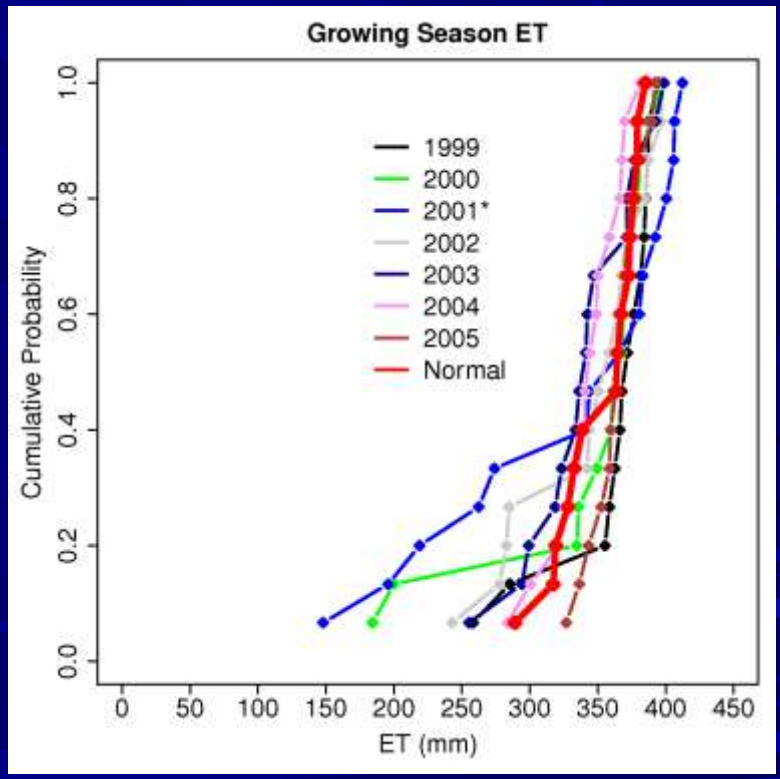


* Significant difference from Normal at 0.05 level (95%)

Spatial Variation of Rainfall and ET among Stations

- All 15 stations considered
  - Rainfall more variable and dynamic from year to year than ET
  - Drought vs wet year: variability of ET increases, median >> mean
  - Wet year across region (2005): variability is low





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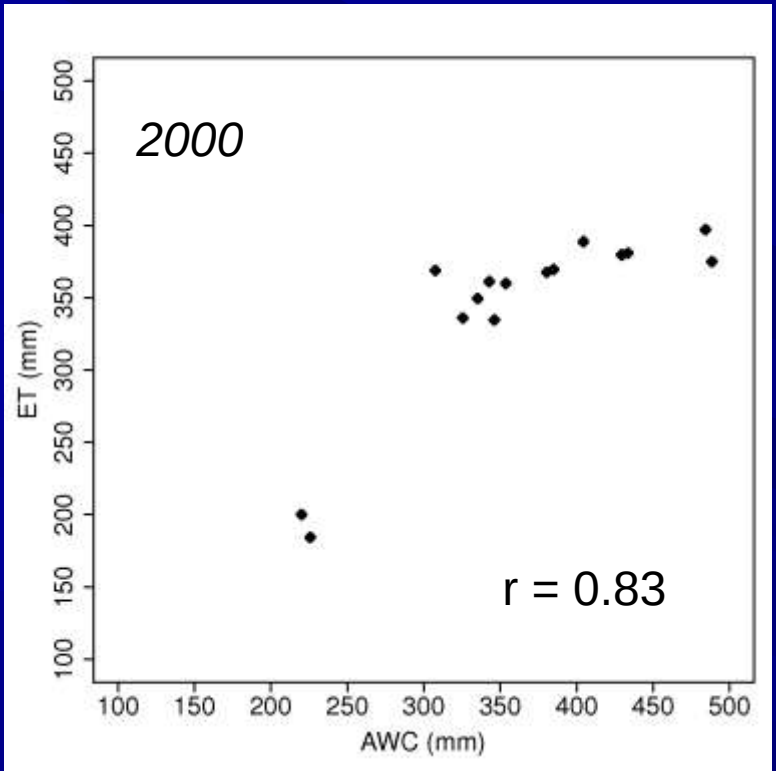
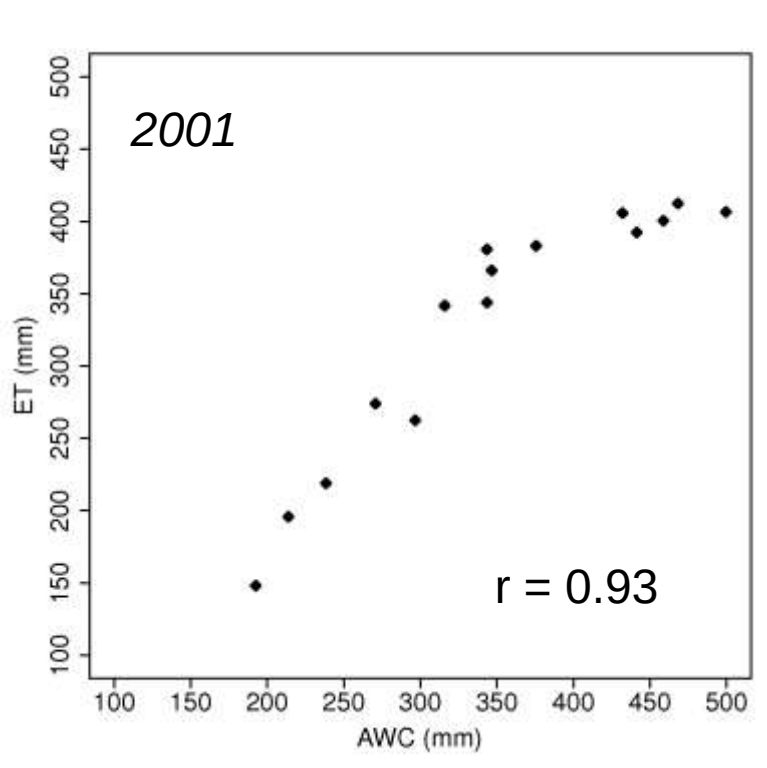
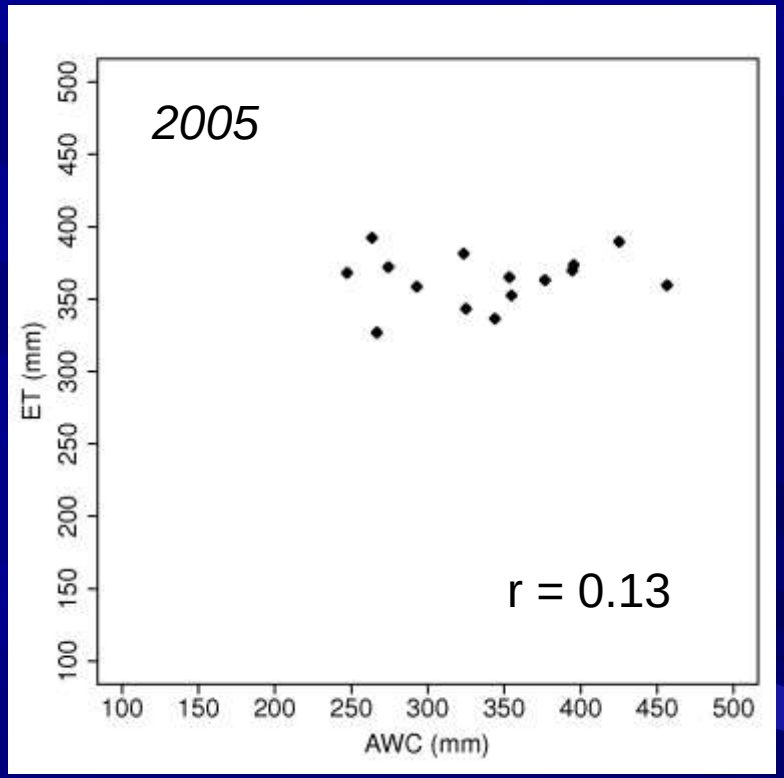
Correlation of Total ET and Available Water Content (AWC) on May 1 among Stations





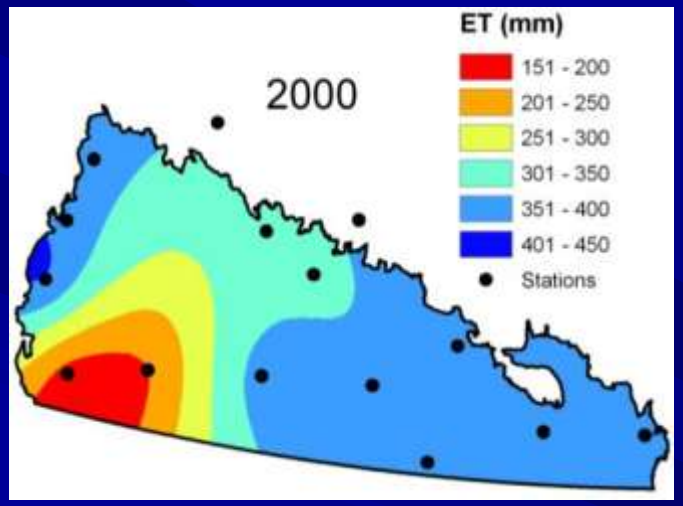
- Assessing available water content prior to the growing season may provide an indication of seasonal ET during extreme drought periods

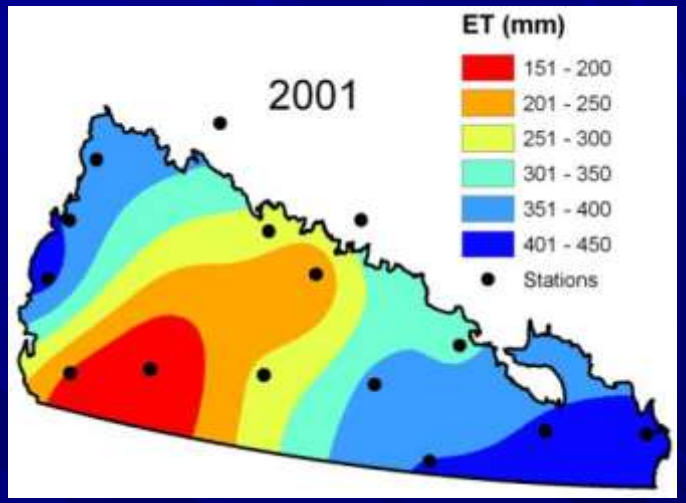
Correlation of Total ET and AWC on May 1 among Stations

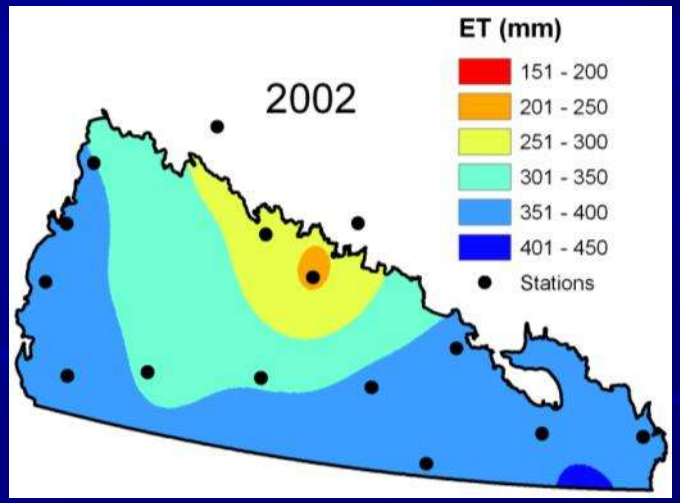


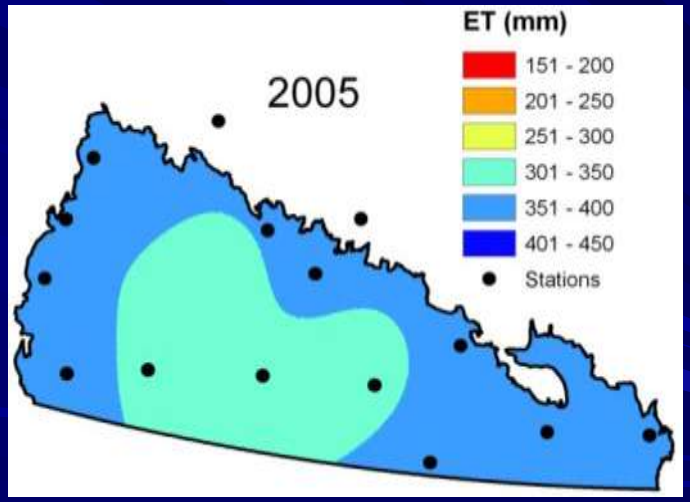
- Not the case as conditions become more uniform

Growing Season ET



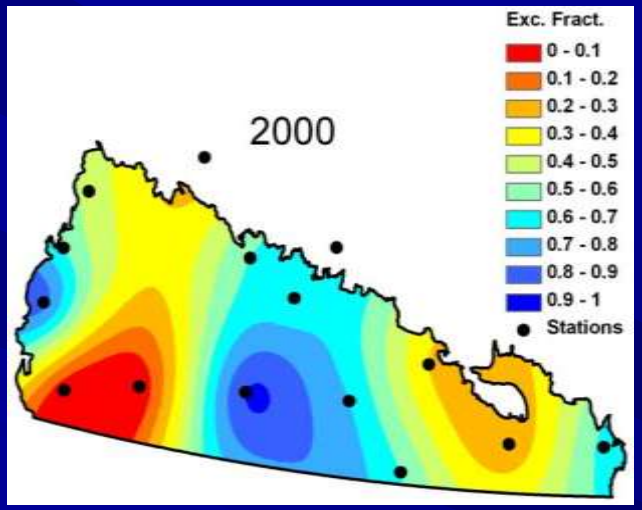


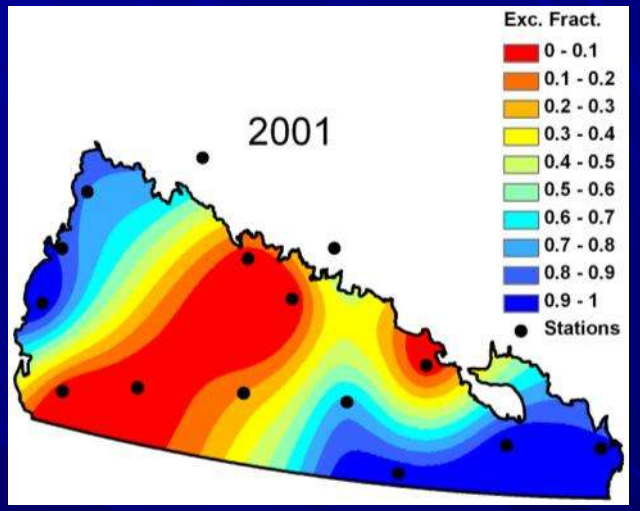


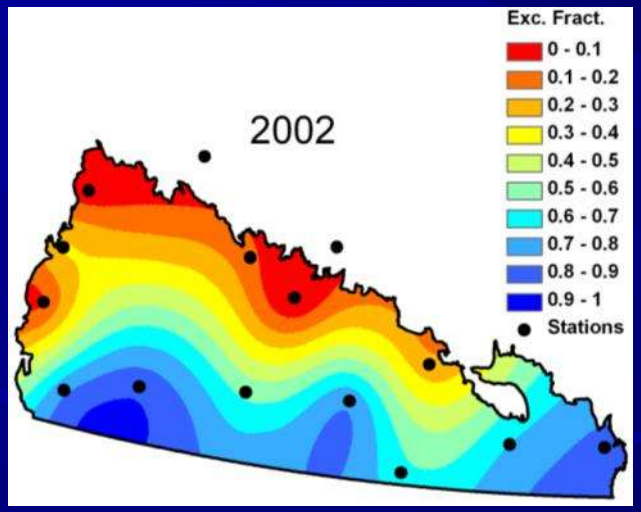


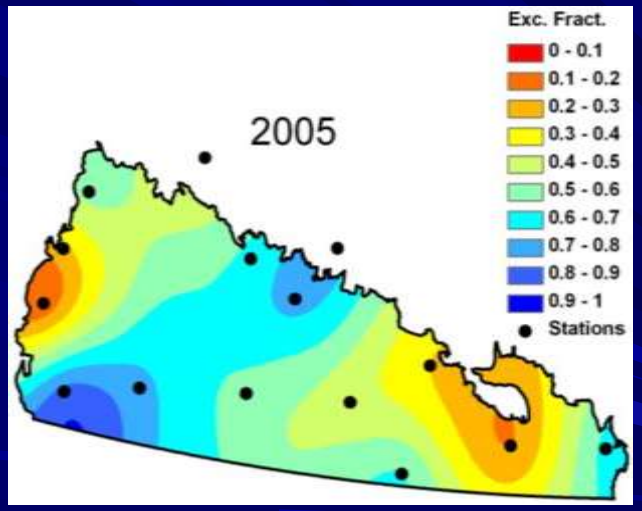
- Interpolation based on 15 stations shows general trends in ET but lacks information relative to the variability for the normal period

Exceedence Fraction of ET









- Changes in the spatial and temporal distribution of ET can be mapped by considering the exceedence fraction of interannual variability compared to the normal period

Summary and Conclusions

- Spatial frequency distributions of ET are potential drought descriptors
- Spatial correlation between soil moisture and ET weaken as conditions become wetter
- Knowing the pre-growing season available water content may be useful as an indicator of growing season ET in drought
- Growing season ET exceedence probability maps provide information on the variability of ET during drought in reference to normal periods

Acknowledgments

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