Changing Hydrology under a Changing Climate for a Coastal Plain Watershed

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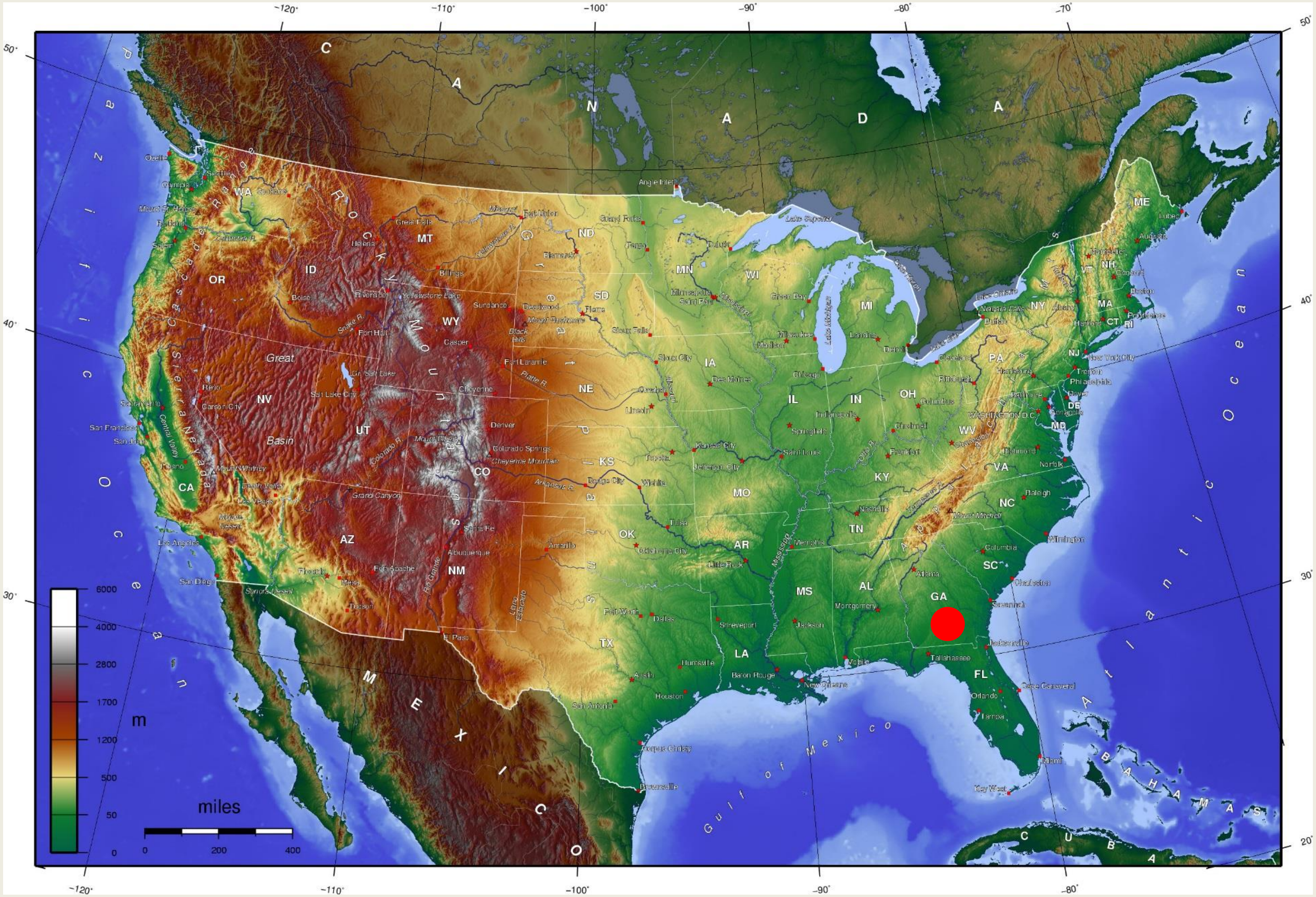
Objectives

1. Project changes in average air temperature and precipitation for the Coastal Plain region of the US.
2. Estimate impacts of projected climate change on regional water availability.
3. Compare to historical observations.

Study Region – South Atlantic Coastal Plain region of Georgia, USA



Data Sources

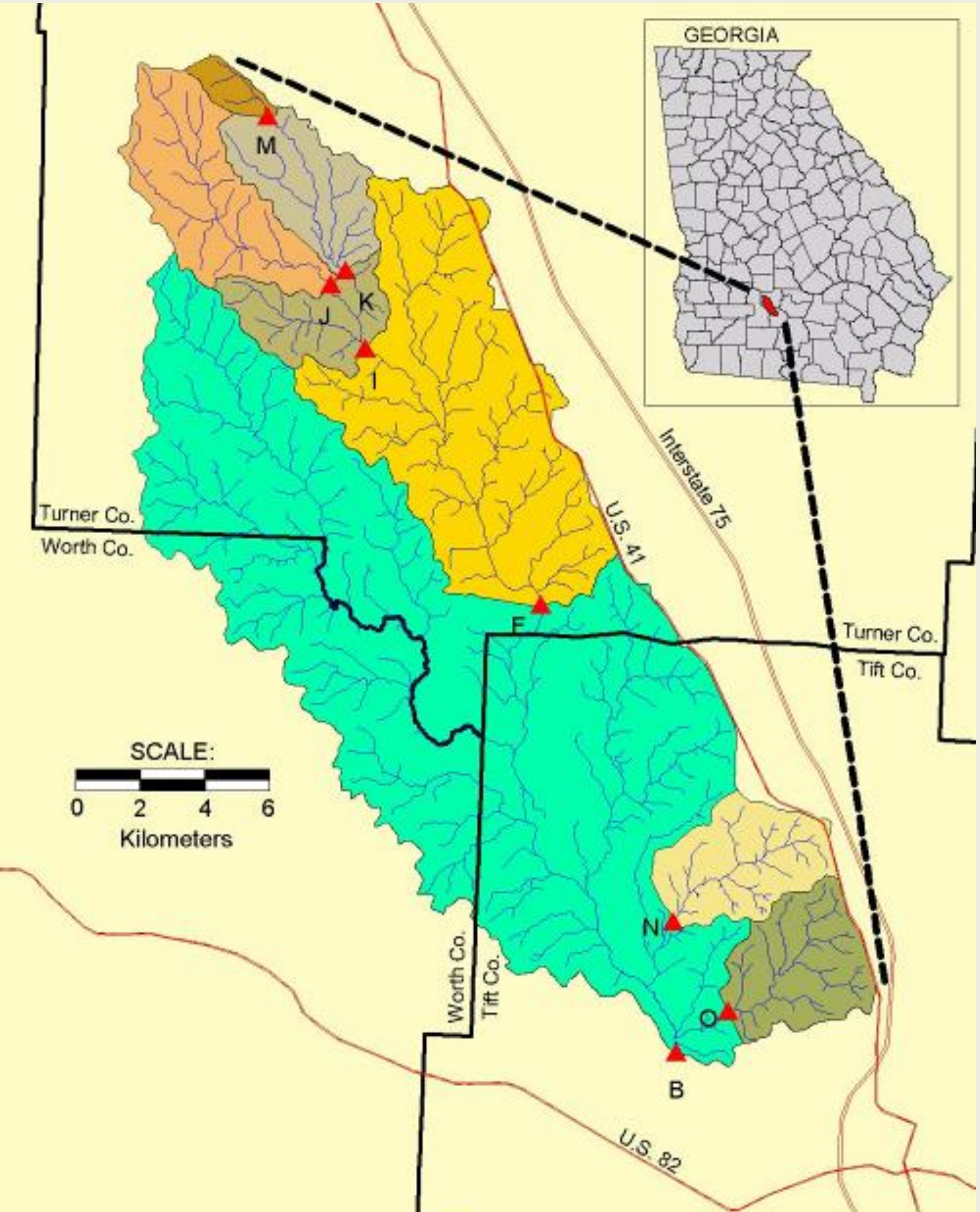
Observed

- Precipitation data obtained from the Little River Watershed database; (LRW)
- Temperature data obtained from the National Climate Data Center, Tifton Station, US Historical Climate Network (1911-2010) (NCDC-Tifton)

Climate Projections

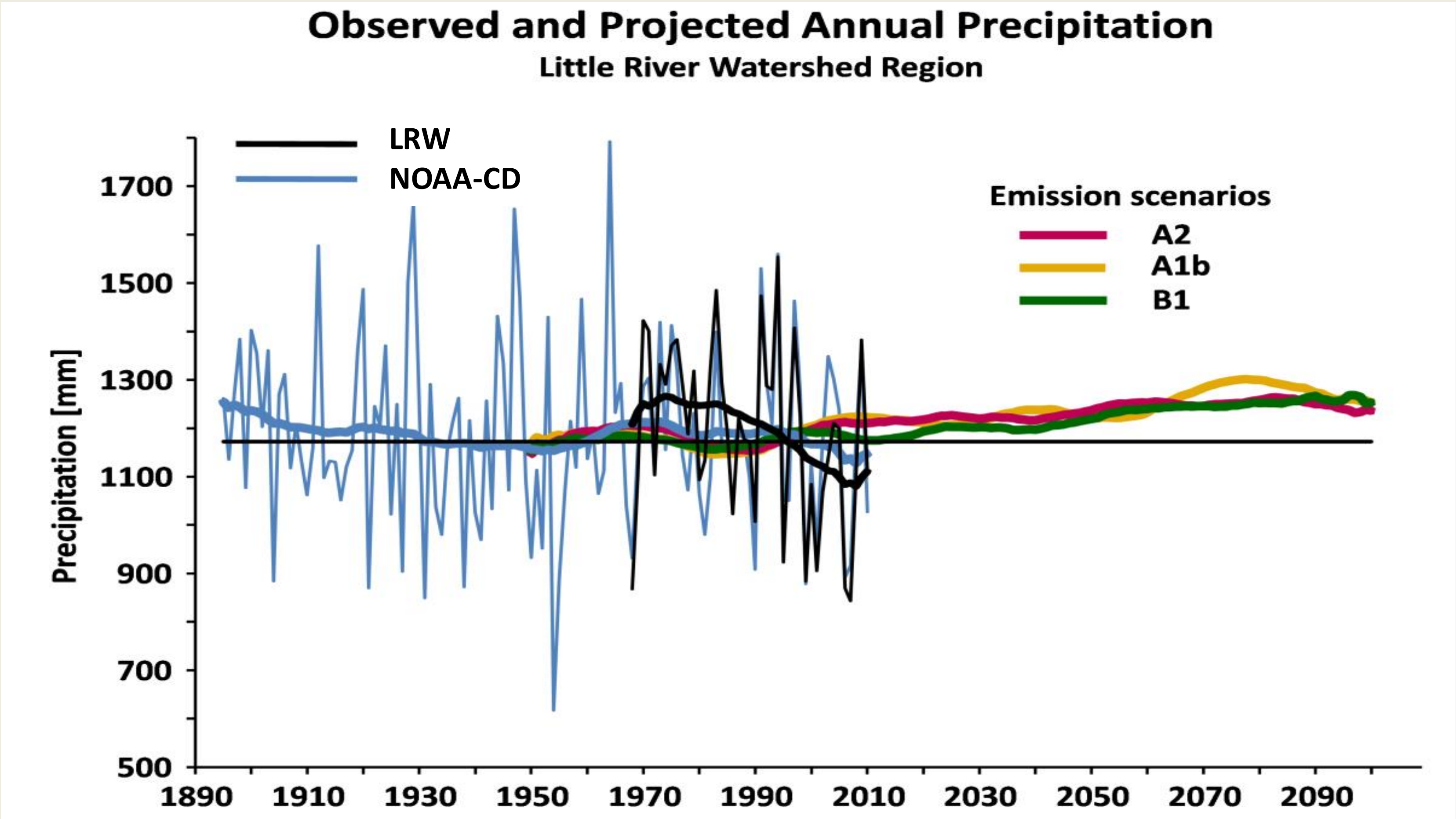
- World Climate Research Programme's Coupled Model Intercomparison Phase 3 Projection (CMIP3)
- Simulations from multiple Global Circulation Models (GCM) (average of 7)
- Used three green house gas (GHG) emission scenarios for each GCM simulation; high, middle, and low

Observed Precipitation Data: Little River Experimental Watershed



- Established in late 1960s
- 334 km^2 (82,500 ac)
- USDA-ARS regional experimental watershed
- Climate is humid subtropical
- Average annual precipitation is 1208 mm yr^{-1}
- Mean annual temperature is 18.7° C

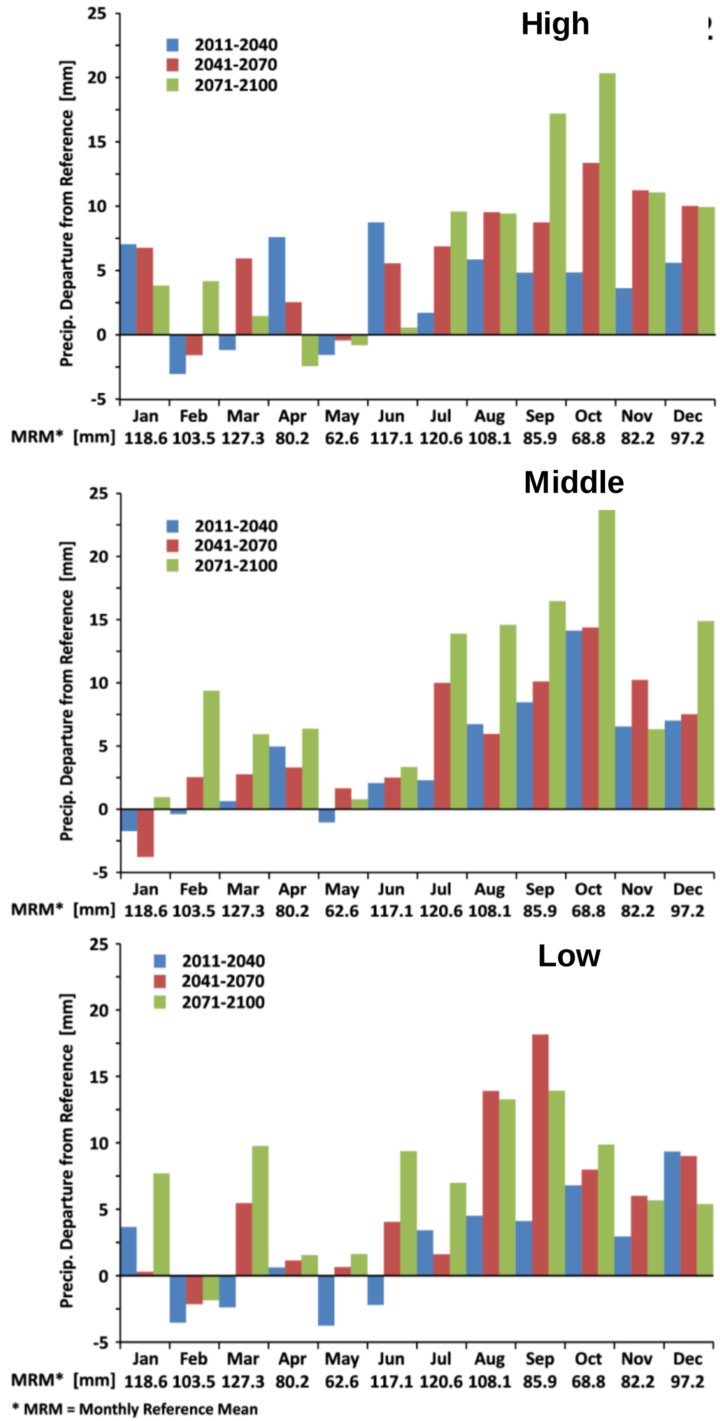
Results – Projected Annual Precipitation



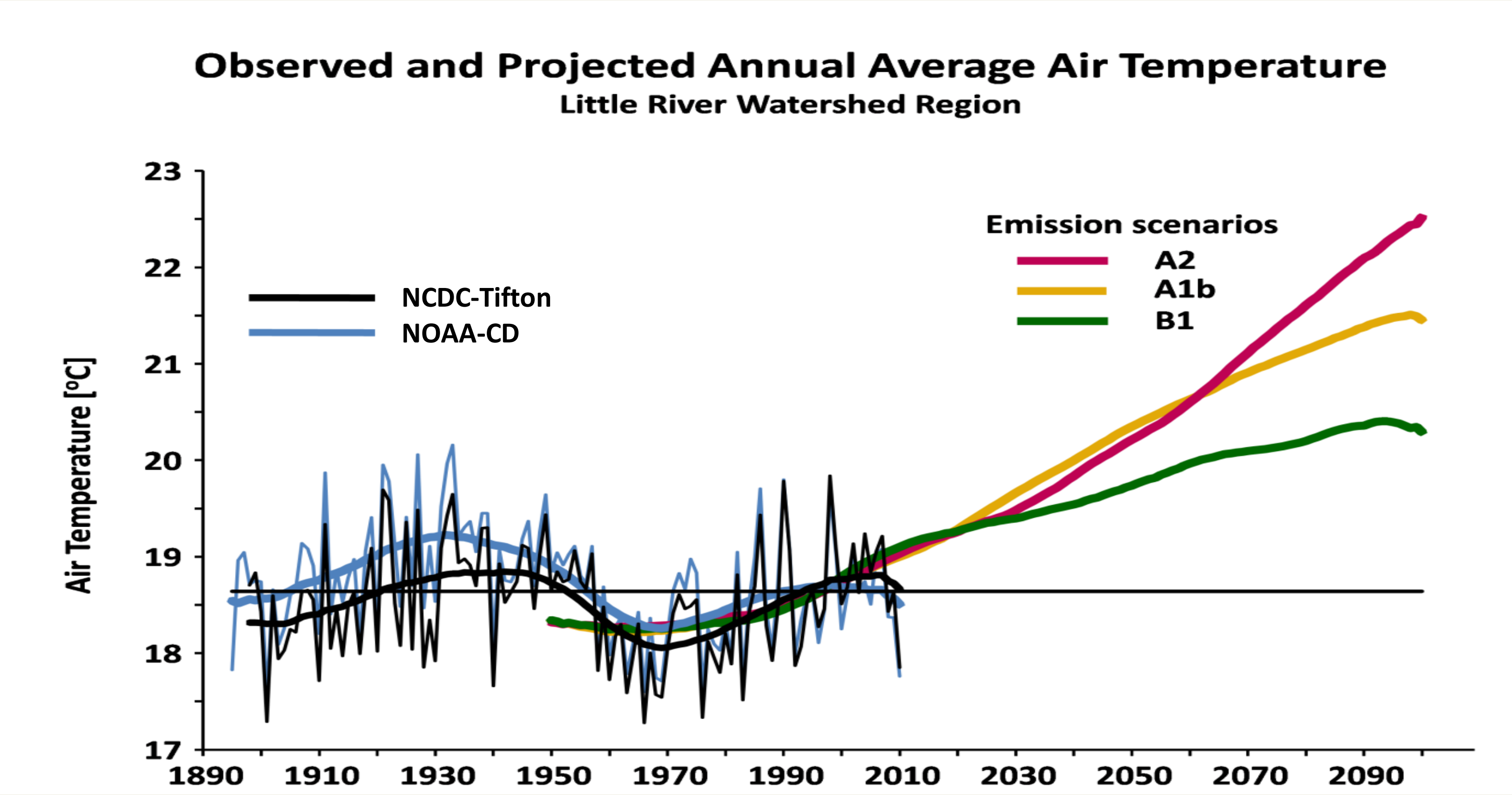
Overall, the trend in the projected annual precipitation of the LRW indicated slightly increasing precipitation for the next 90 yr period. Approximately 30 mm over next 90 yrs.

Results – Projected Precipitation, seasonal trends

Greatest increase in precipitation is expected in June through December period (@5 mm/month). Consistent across all emission scenarios.



Results – Projected Temperature, annual

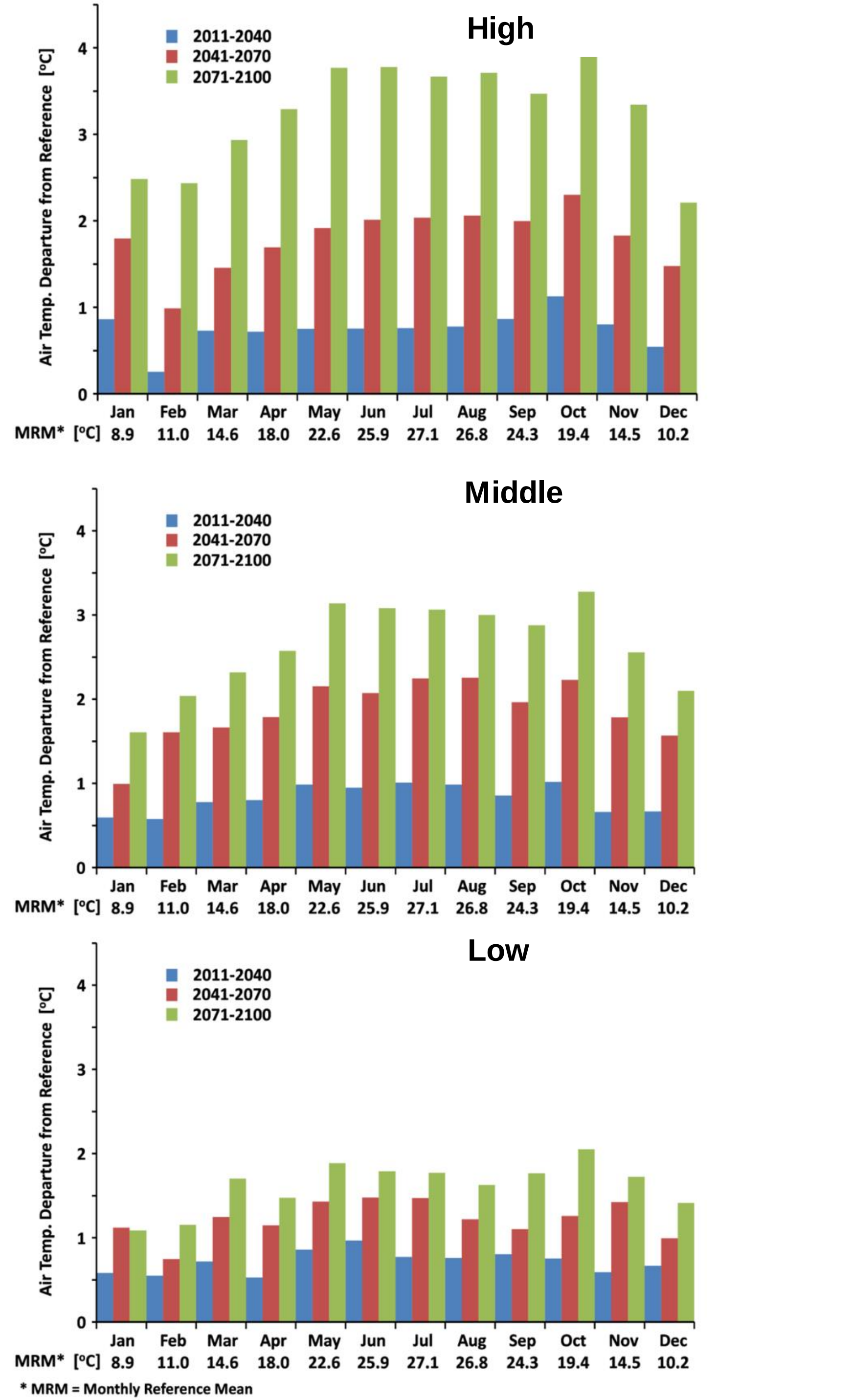


All trends of projected annual temperature are increasing and statistically significant. Approximately 3^{0} C increase over 90 yrs.

Results – Projected Temperature, seasonal trends

Departures of projected monthly air temperature from 1981-2010 observations.

All months and seasons showed statistically increasing temperatures over 90 year projection; Increases expected to be the greatest from May – October.



Baseline SWAT Simulation

Precipitation – Used observed daily precipitation from the LRW, 1972-2004.

Temperatures – Used observed max and min temperatures from the NCDC-Tifton Site

SWAT Soil & Water Assessment Tool

Climate Change Scenario (32 yrs)

Precipitation – Generated precipitation input equating to 30 mm annual increase (projection for 2040), occurring only in the months from June through November, @ 5 mm/month

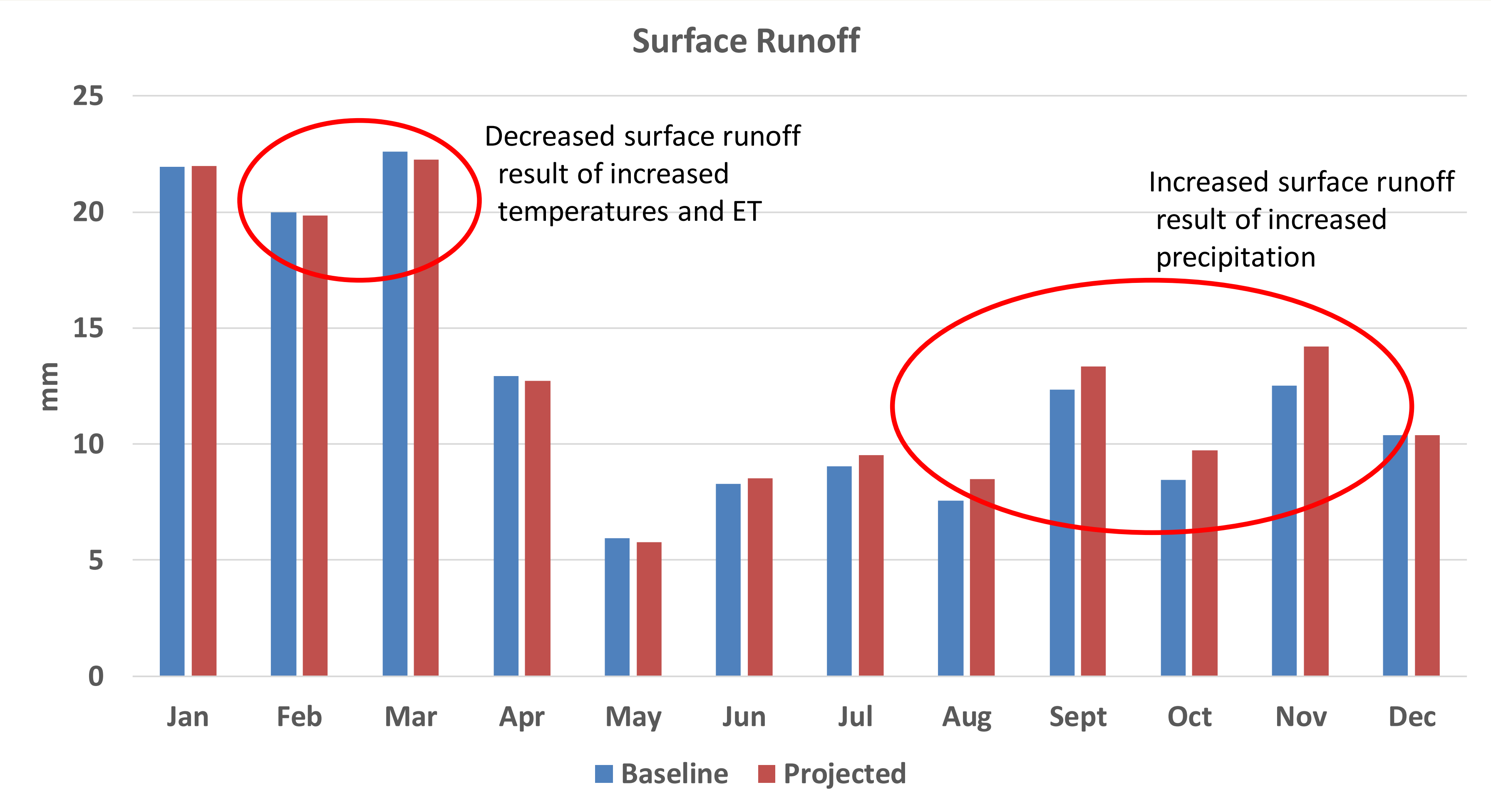
Temperatures – Generated temperature input equating to a 1.0° C daily increase from January through April, a 1.5° C daily increase from May through October and a 1.0° C daily increase in November and December (projection for 2040).

SWAT Soil & Water Assessment Tool

Results – Average Annual Mass Balance

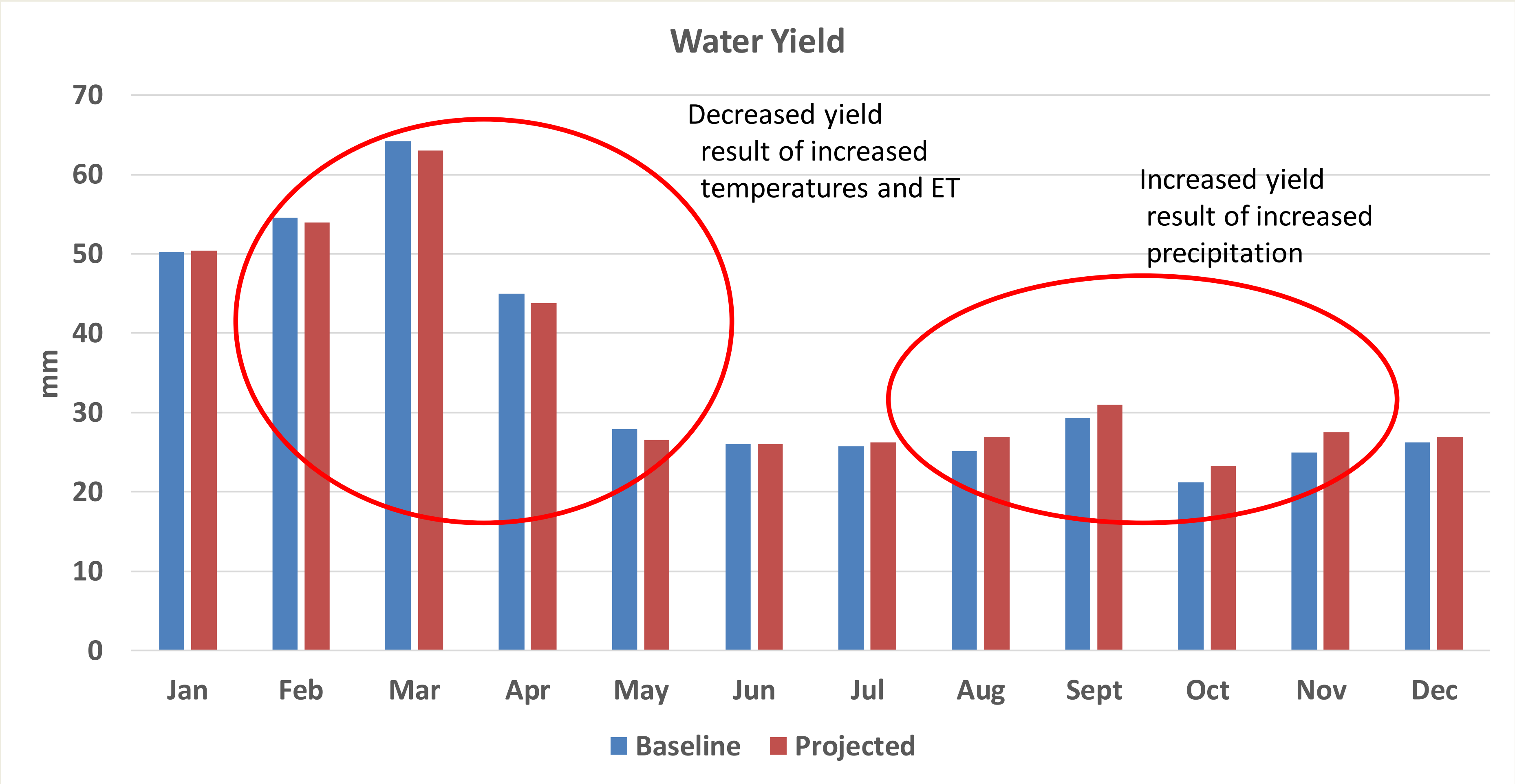
	Baseline Scenario	Projection	Net
Precipitation (mm)	1215	1245	+30 (2%)
Surface Runoff (mm)	151	156	+5 (3%)
Total Water Yield (mm)	419	424	+5 (1%)
Evapotranspiration (mm)	772	797	+25 (3%)
Potential Evapotranspiration (mm)	1216	1262	+46 (4%)

Results Seasonal Variability



Observations
Elevated runoff in Fall, likely not high impact

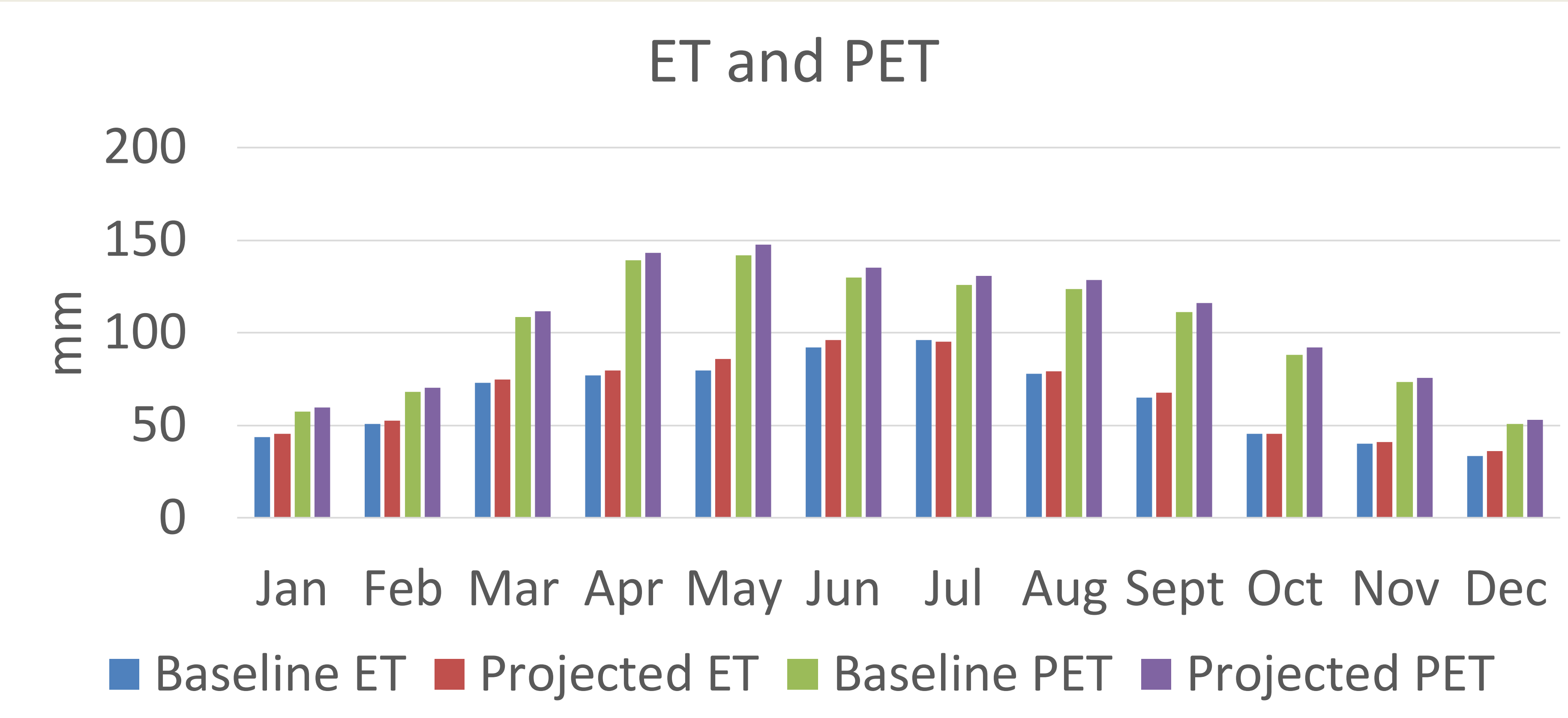
Results Seasonal Variability



Observations

Water Yield Reflects Surface Runoff, slight decrease in spring, increase in fall.

Seasonal Variability

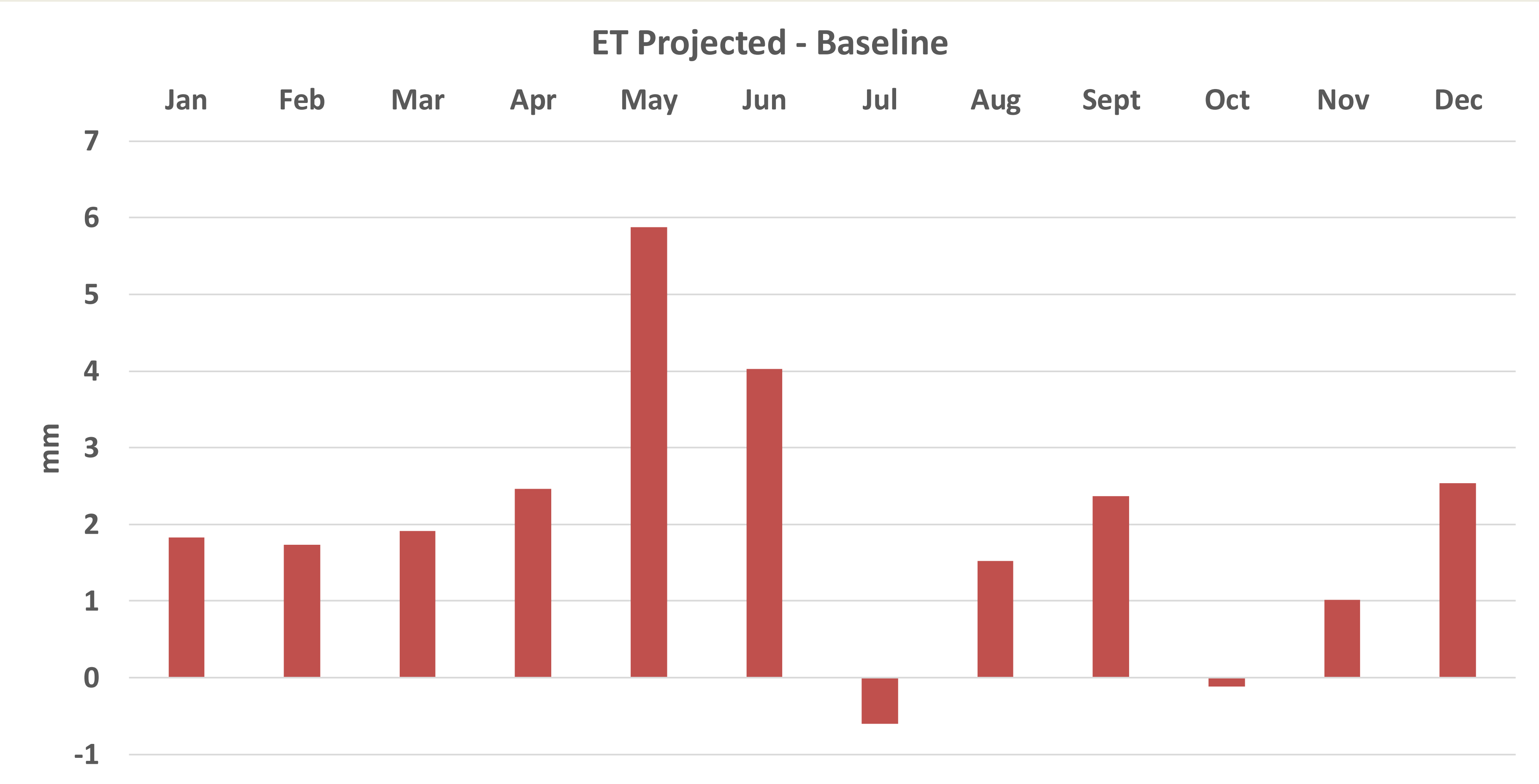


Observations

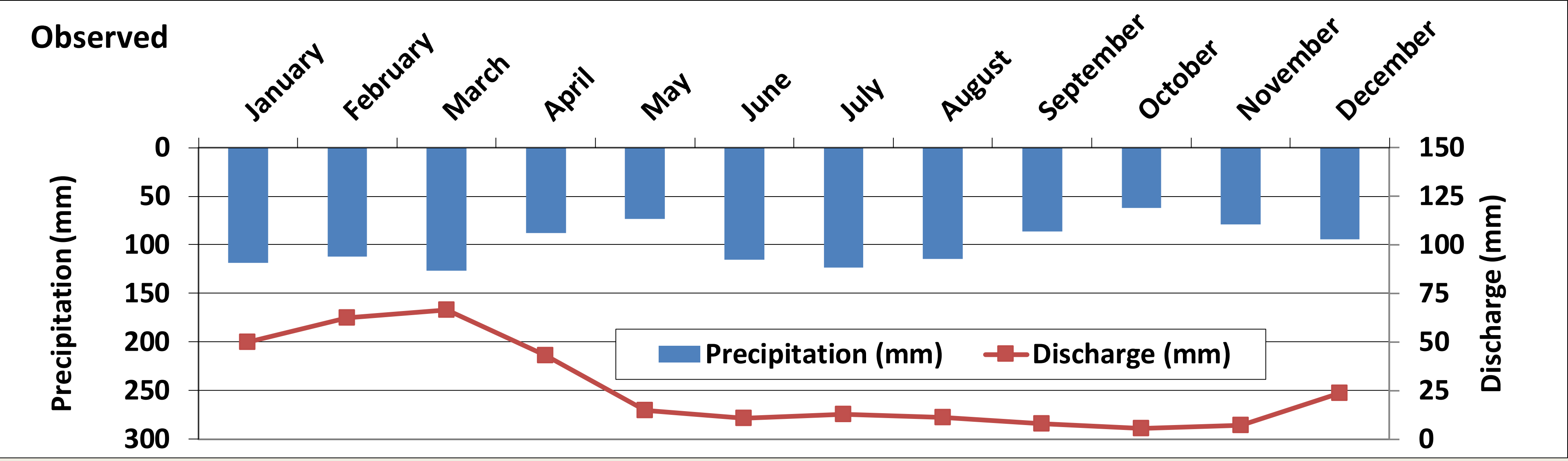
Increased PET, primarily throughout the summer

Increased actual ET

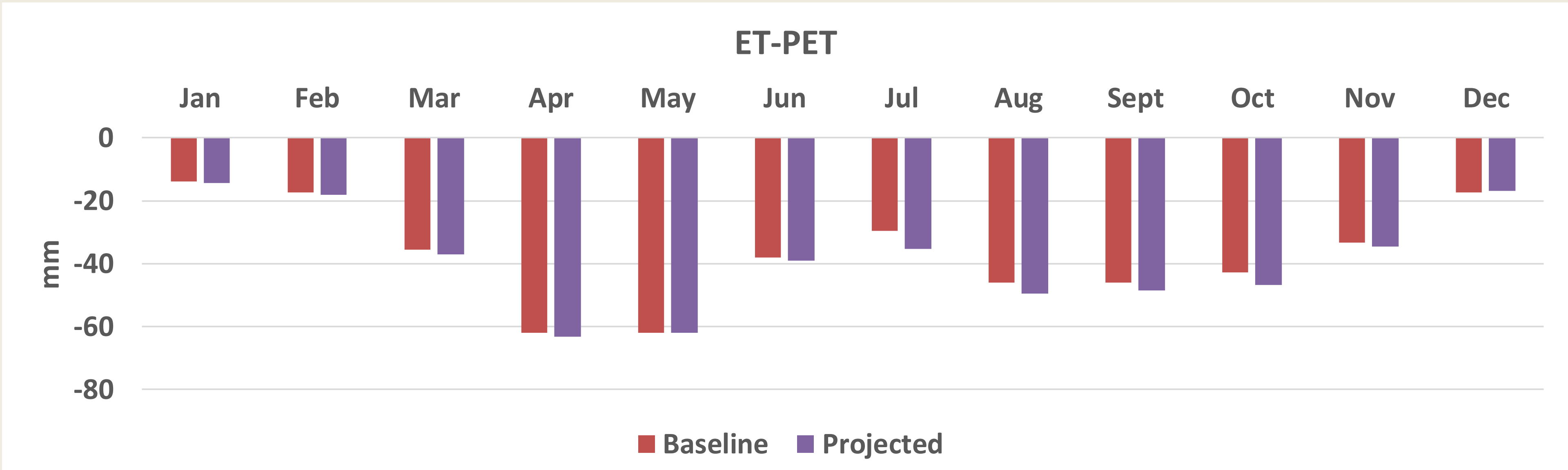
Results Seasonal Variability



Observations
- Increased ET in Spring and Early Summer, reduced effects in fall
- May impact crop selection

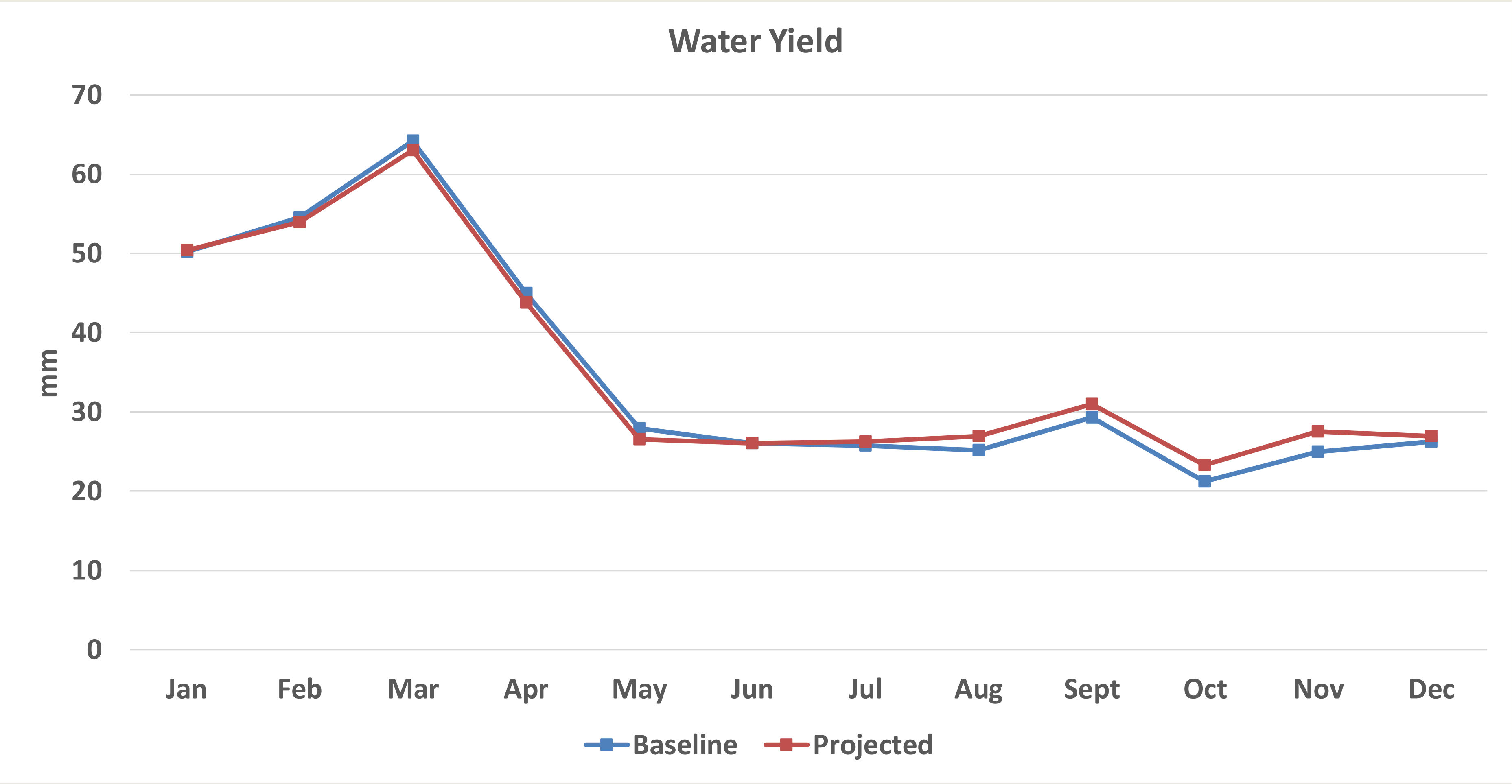


Typically most runoff in the late winter and spring.



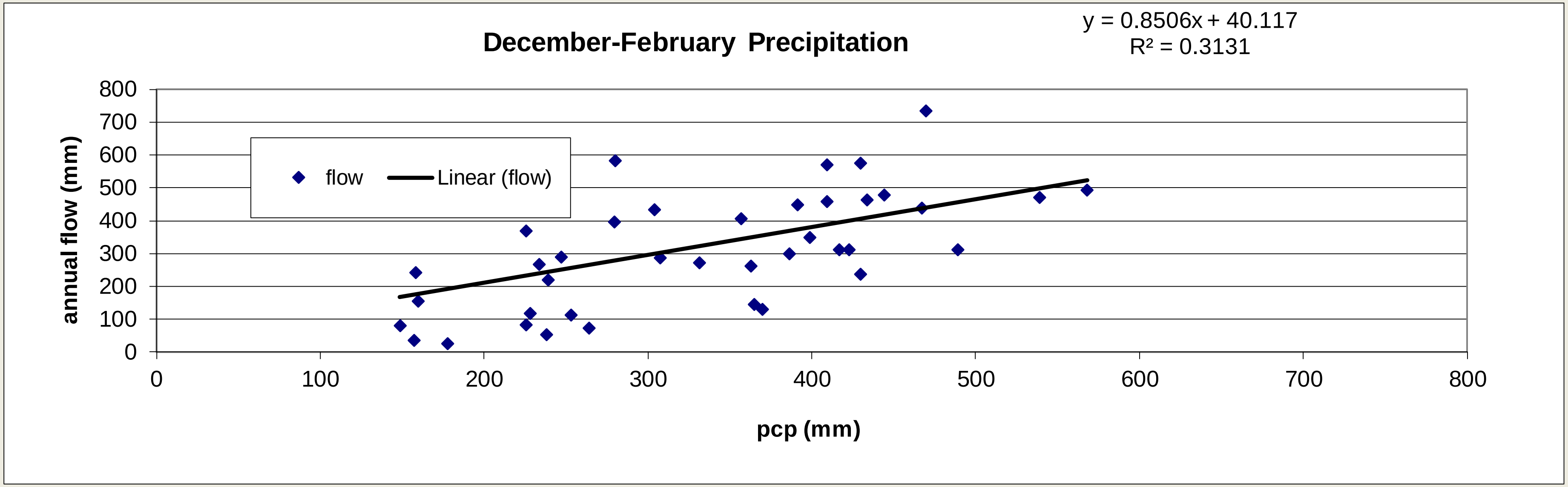
Large gap between ET and PET, small increases in precipitation are balanced by increases in temperature. Leading to only small increases in streamflow.

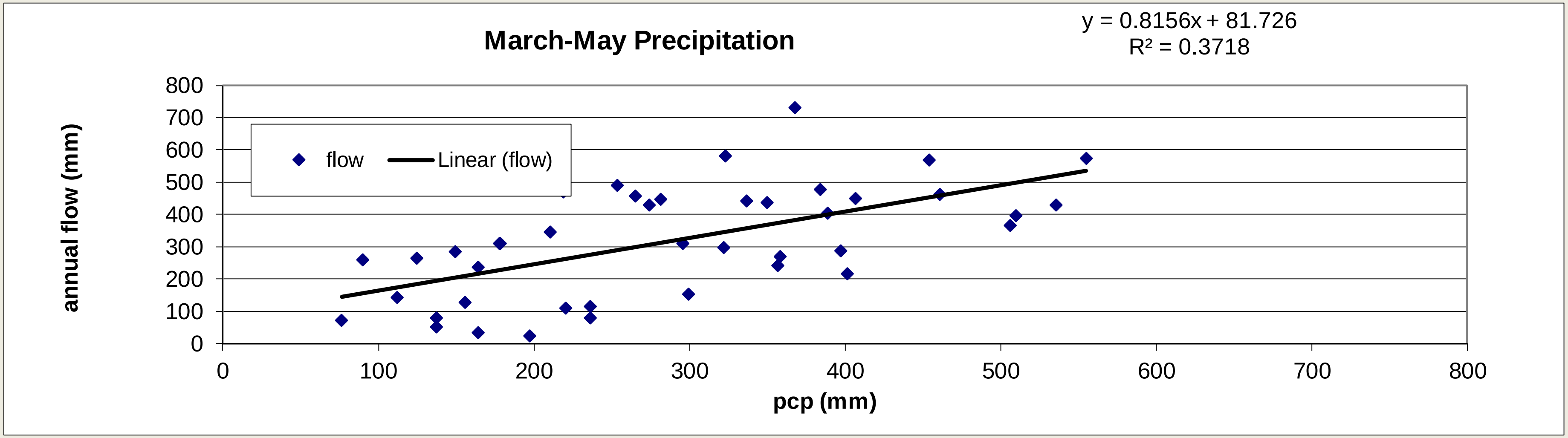
Results Seasonal Variability



Larger increases in precipitation would need to be observed to overcome large differences between ET and PET.

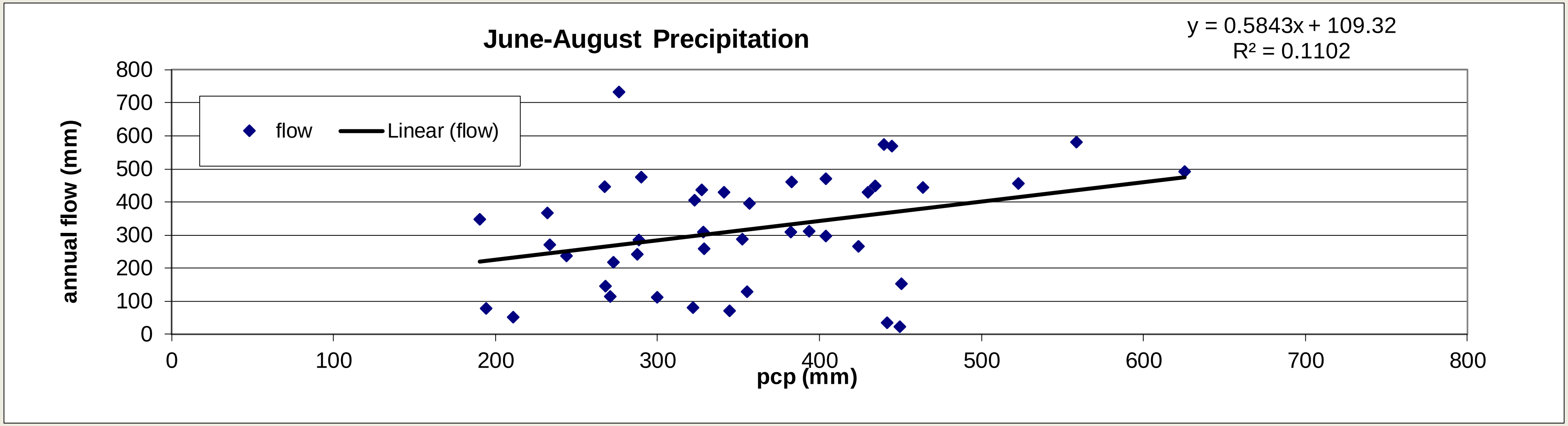
Prior Observations: Quarterly precipitation vs Annual Flow

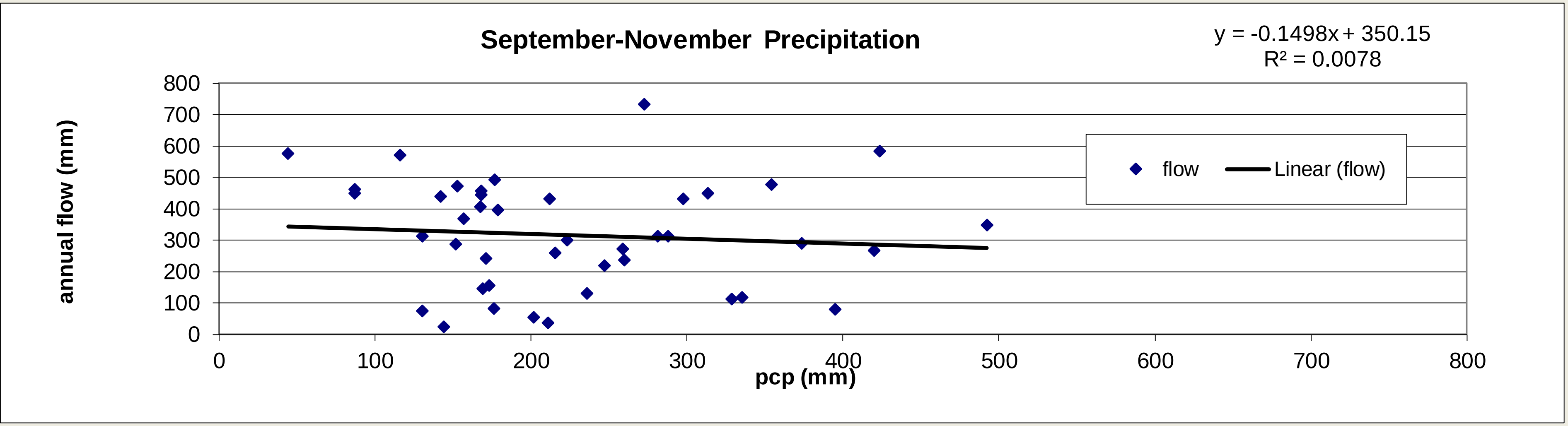




Both December-February and March-May Precipitation Yield High Streamflow at a similar rate.

Prior Observations: Quarterly precipitation vs Annual Flow





June-August and September-November, in particular, have much less impact on streamflow. > Added rainfall in June-December has less impact on streamflow volume.

Conclusions

1. Climate change in south-central GA over the 21st century is anticipated to be primarily in the form of a rise in air temperature (@ 0.3 ^{o}C /dc) for all calendar months with a slight increase in annual precipitation (@ 10 mm/dc).
2. Greatest anticipated change in precipitation will occur in June through December (@ +5-10 mm/dc for the season).
3. All monthly temperatures are expected to increase (@ +0.15 ^{o}C /dc) with the greatest anticipated increases in the months from May through October (@ +0.20 ^{o}C /dc).
4. These projected changes in precipitation and temperature are not anticipated to create significant changes in streamflow patterns.
5. There may be small changes in evapotranspiration which may be accompanied by changes in plant biomass.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