WATERSHED ANALYSIS OF RUNOFF AND EROSION POTENTIAL ON SANTA CRUZ WATERSHED: IMPACT OF CLIMATE AND LAND COVER CHANGES

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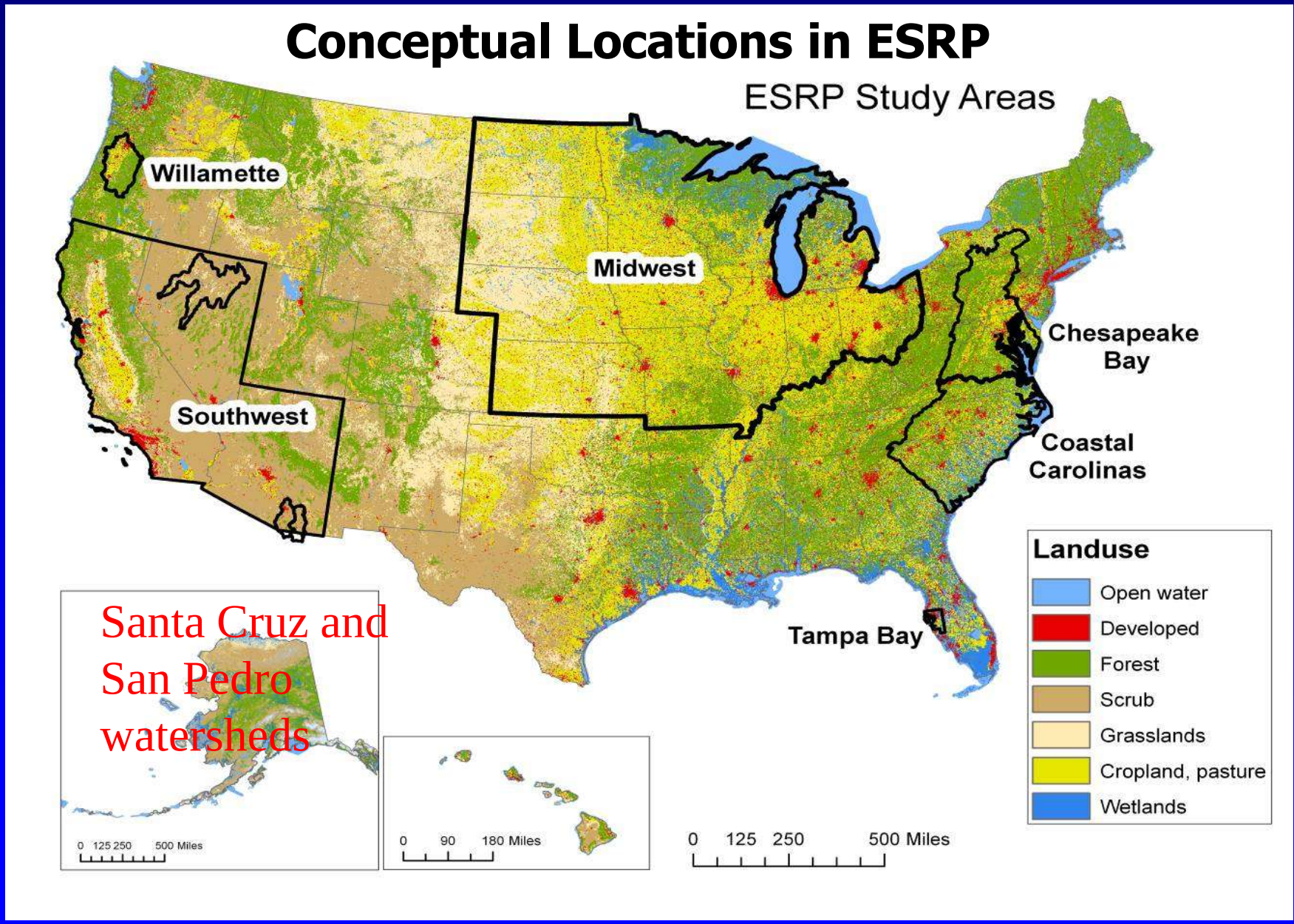
Ecosystem Services Research Project (ESRP) in EPA

- **To study the science to protect and restore the goods and services of nature.**
- **To advance ecosystem services research and improve knowledge to protect, and restore the services of nature.**

http://www.epa.gov/ecology/

Ecosystem Services Research Project (ESRP) in EPA

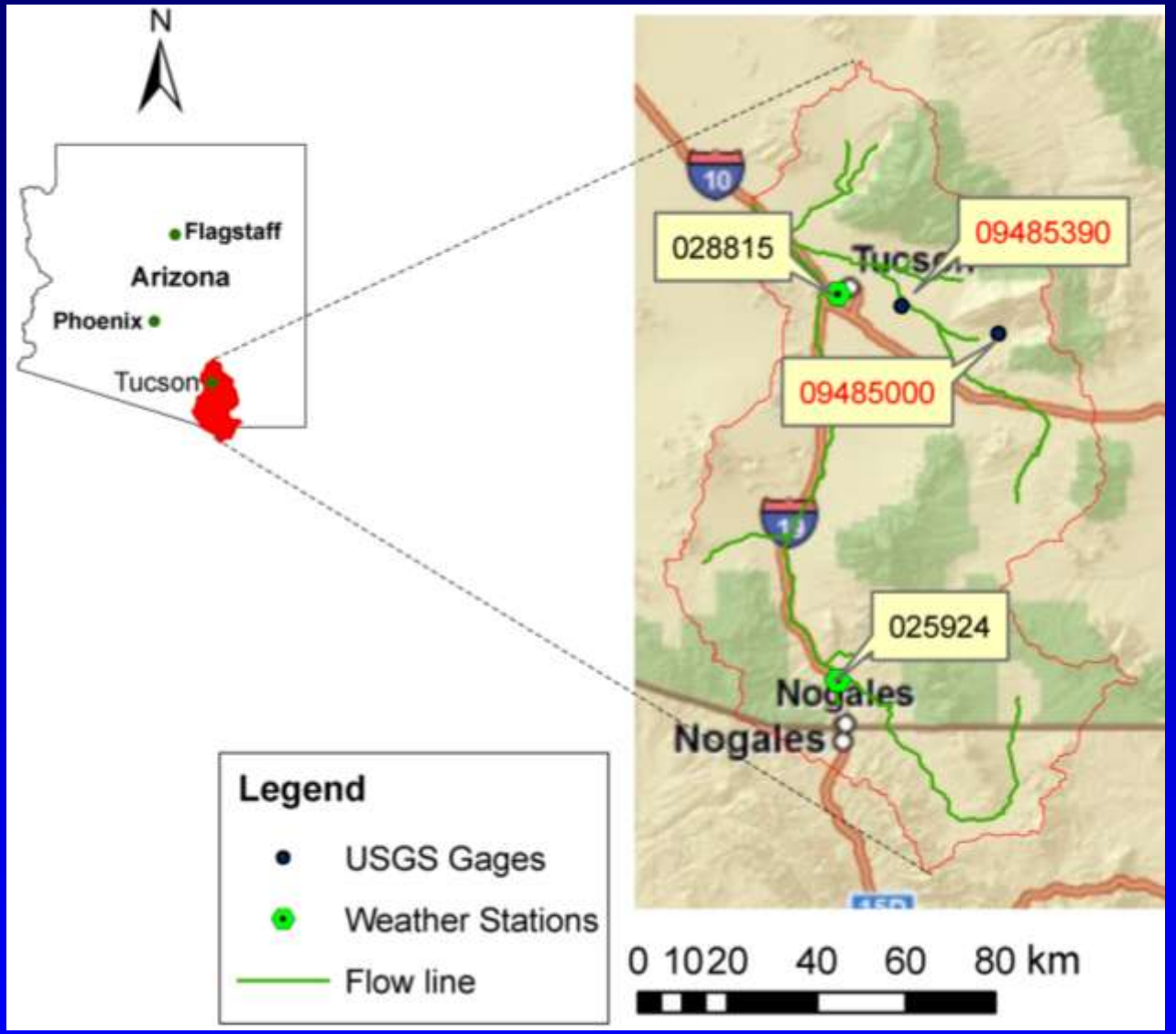


Conceptual Aspects of Southwest ESRP

- The goal of the Southwest ESRP was to quantify current and future ecosystem services across the Southwest region and to examine changes expected to occur as a result of the landuse and climate changes.
- Demand for water is growing due to population growth.
- Precipitation is likely decreasing and temperature is likely increasing due to climate change.
- Water availability has become a dominant issue in arid and semi-arid Southwest US.
- Increased erosion potential due to landuse and climate changes is of a particular concern.

Objectives

- Examine historical climate and streamflow changes.
- Analyze potential threats to water quality and quantity.



Upper Santa Cruz Watershed

Area

9,073 km²

Elevations

496 - 2883 m

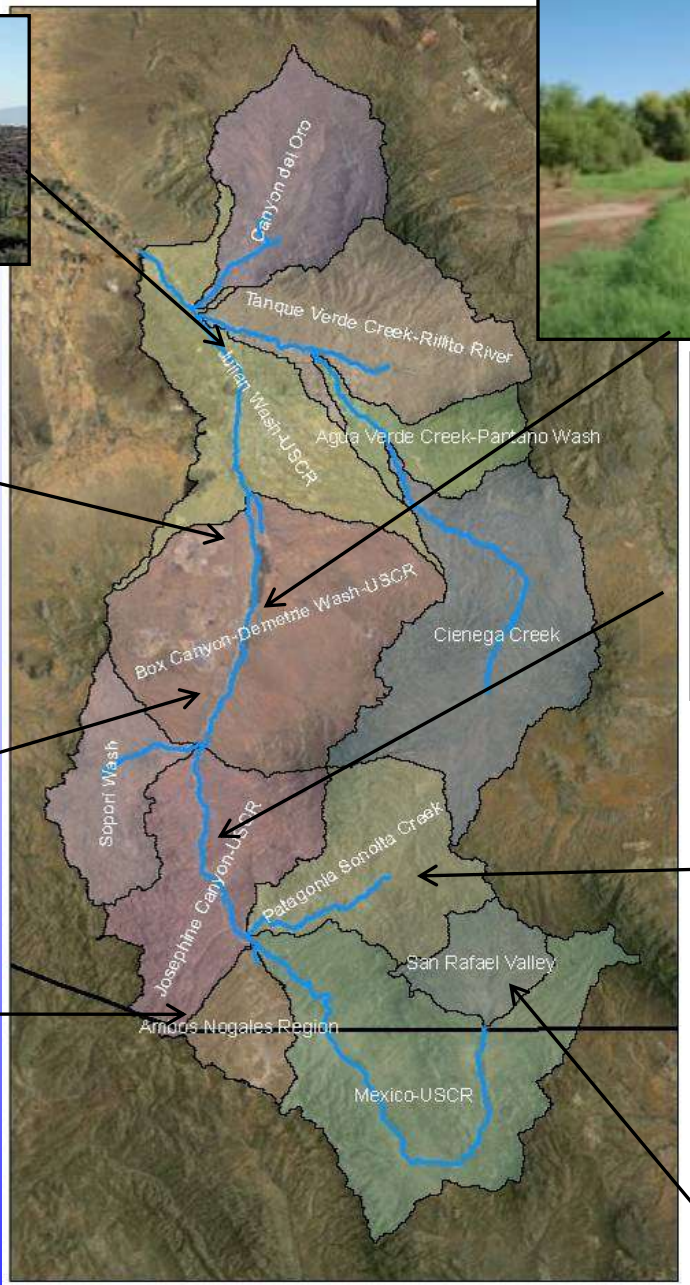
Annual Rainfall

200 - 800 mm

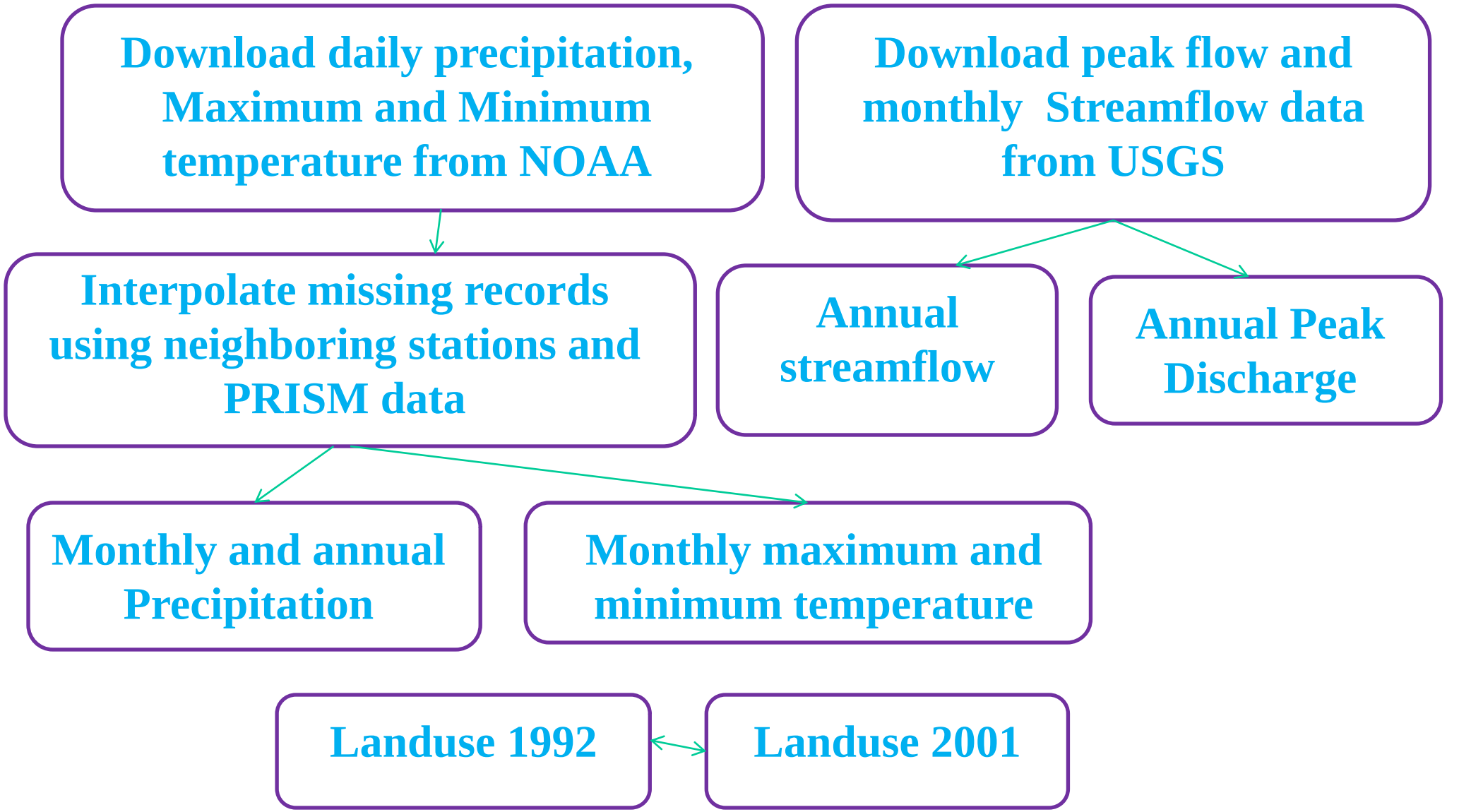
Dominant Vegetation

Desert shrub (70%)

Location of the Upper Santa Cruz Watershed (Arizona/Mexico)


Canyon del Oro
Tanque Verde Creek-Rillito River
Julian Wash-USCR
Agua Verde Creek-Pantano Wash
Box Canyon-Demetrie Wash-USCR
Cienega Creek
Soppri Wash
Josephine Canyon-USCR
Patagonia Sonoita Creek
San Rafael Valley
Arroyo Nogales Region
Mexico-USCR
0 5 10 20 Miles
0 5 10 20 Kilometers

Data Analysis



Two Weather Stations

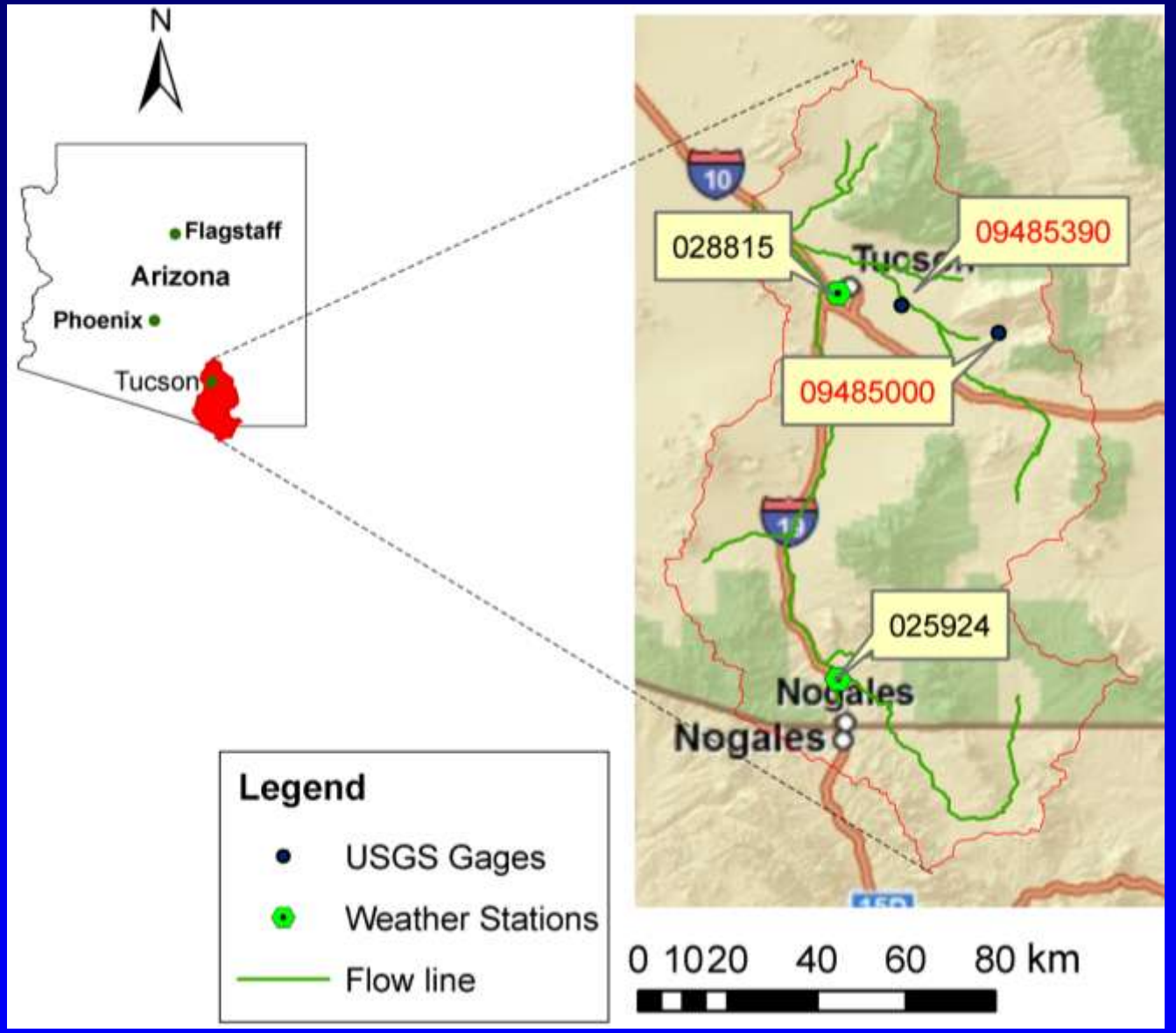
028815 (742 m)

025924 (1055 m)

Two USGS Gauges

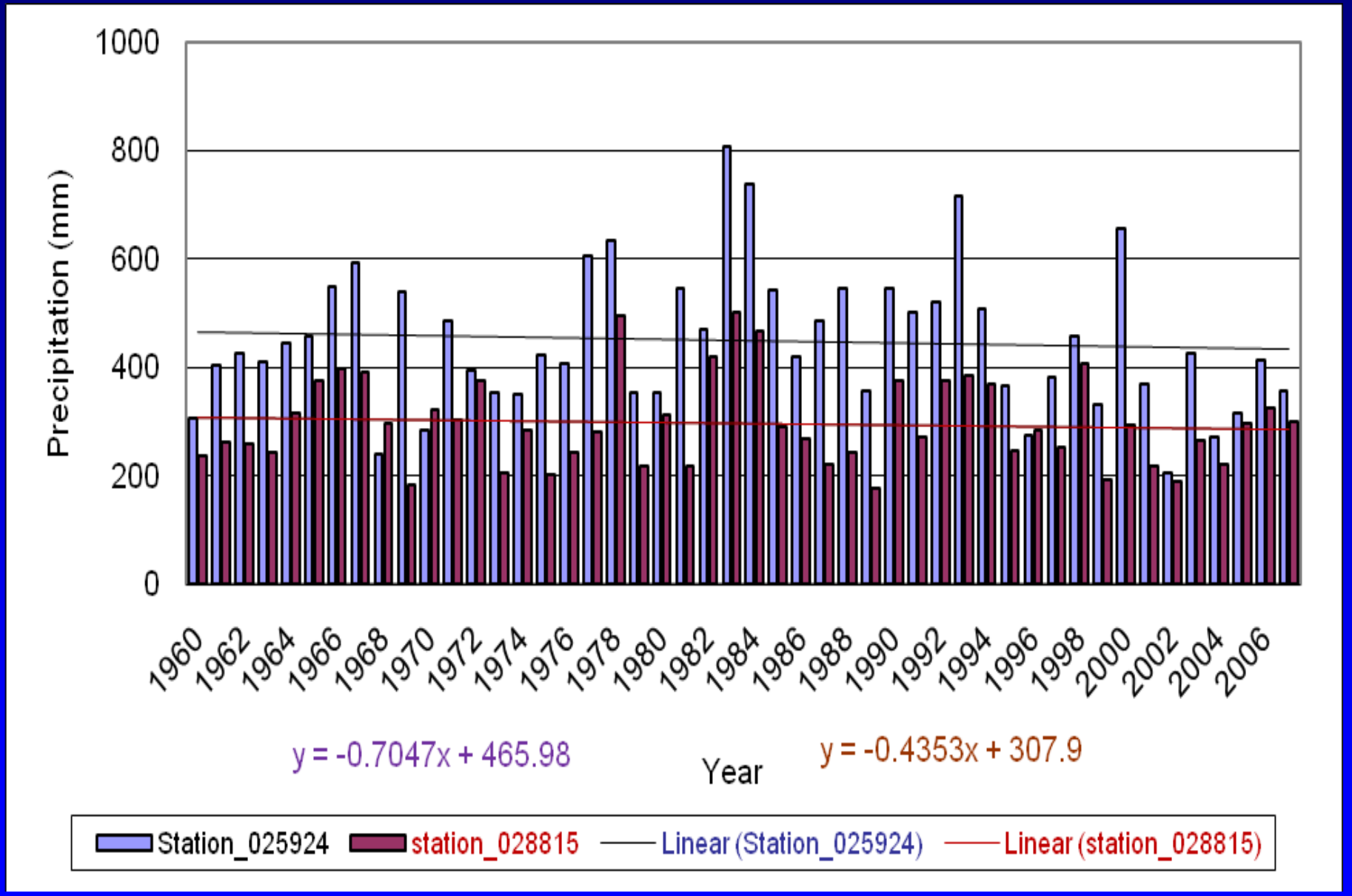
09485000

09485390

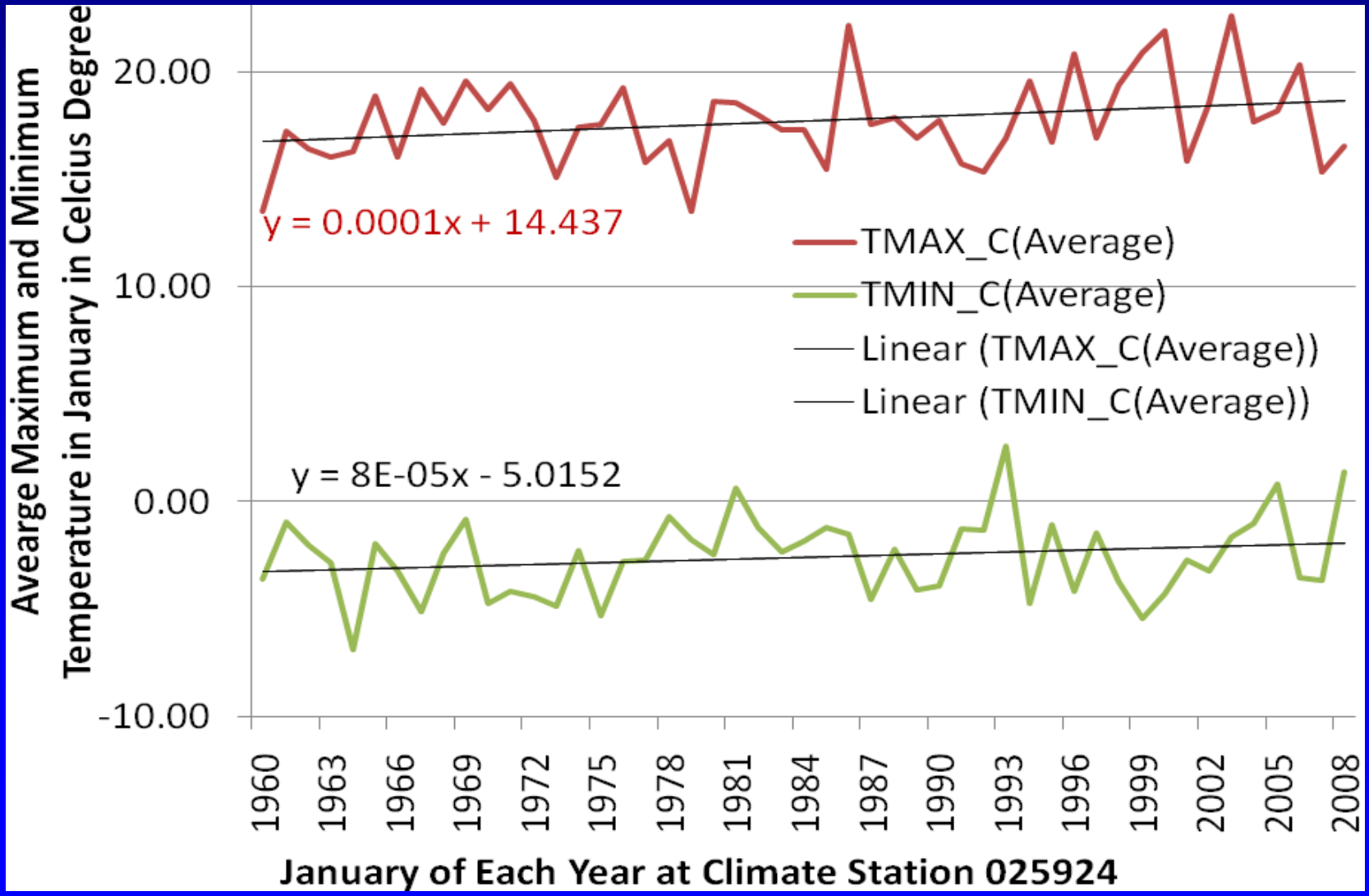


Location of Weather Stations and USGS Gauges

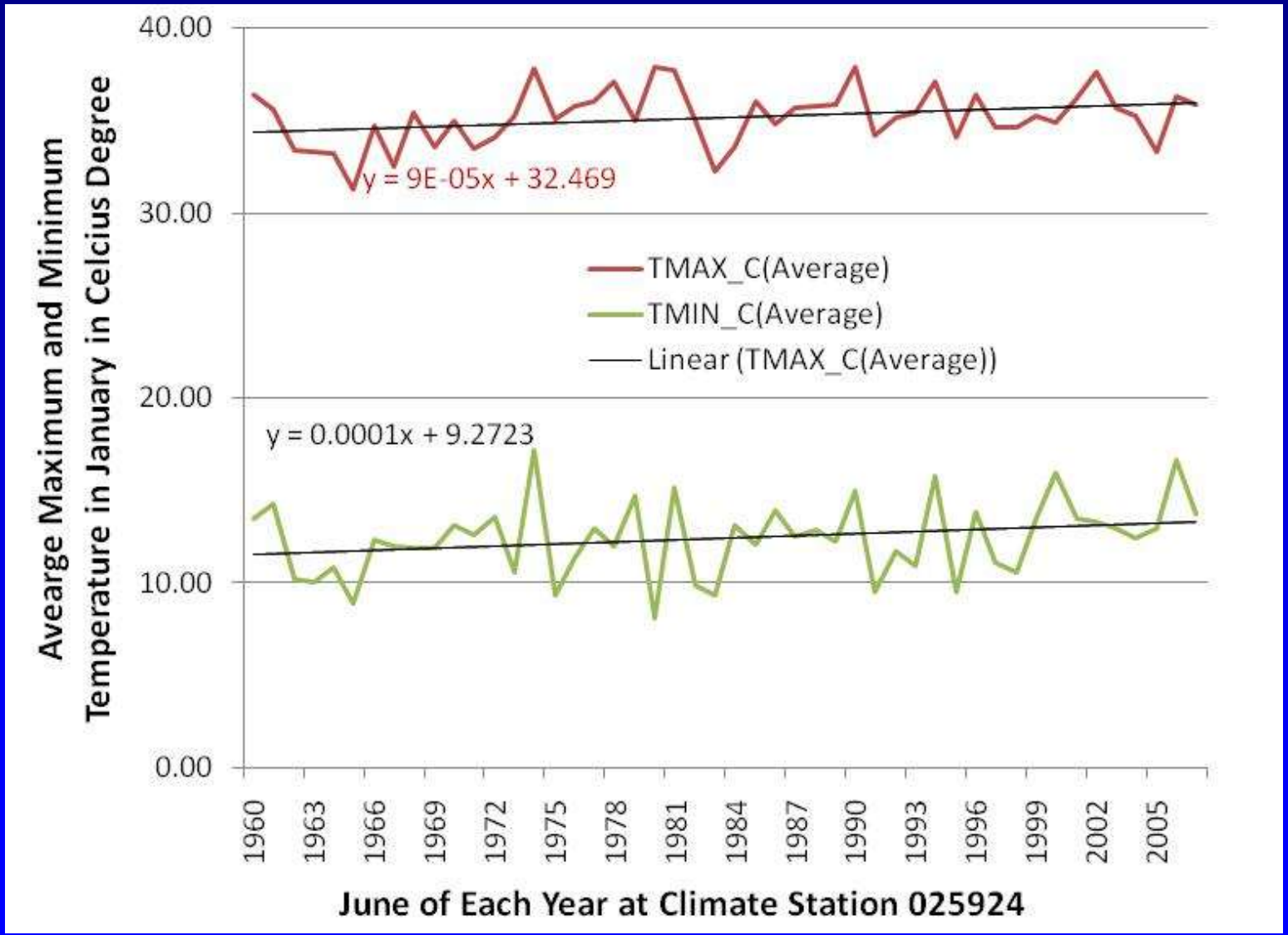
Annual Rainfall

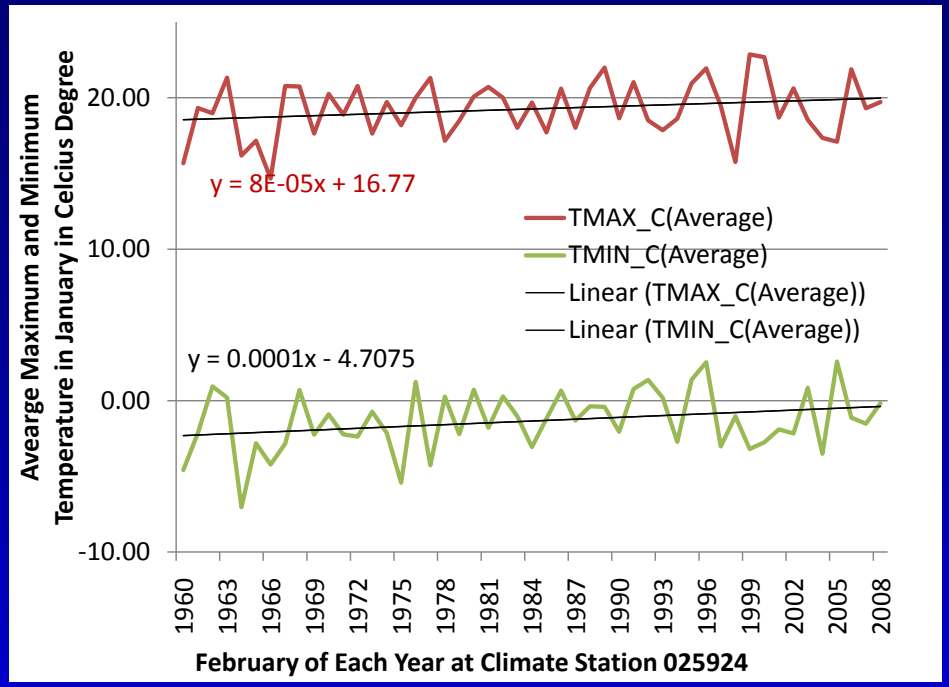


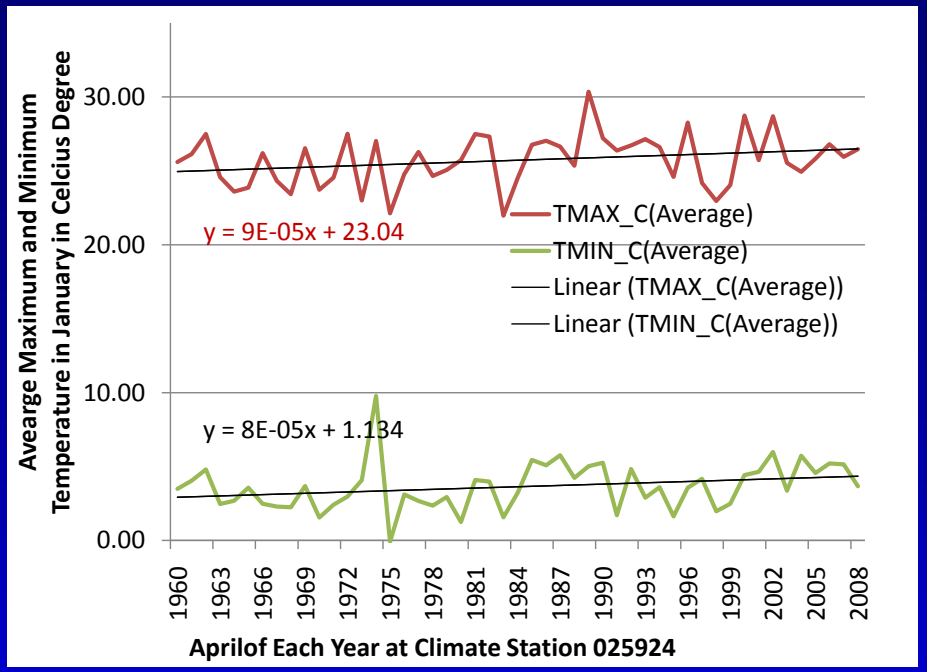
Average Maximum and Minimum Temperature in January at Station 025924 (1055 m)

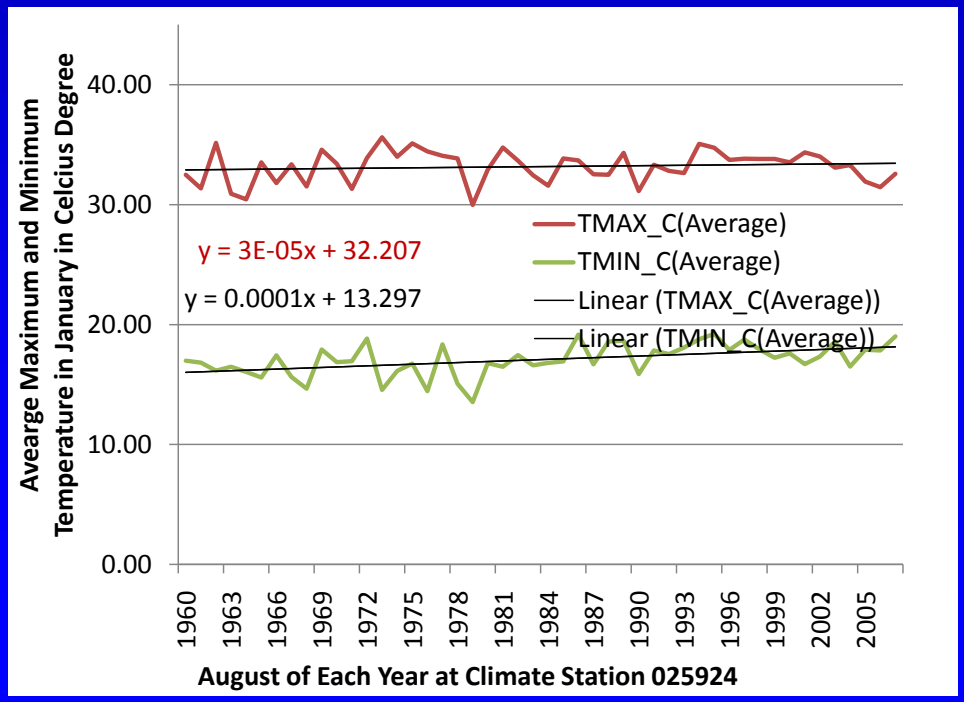


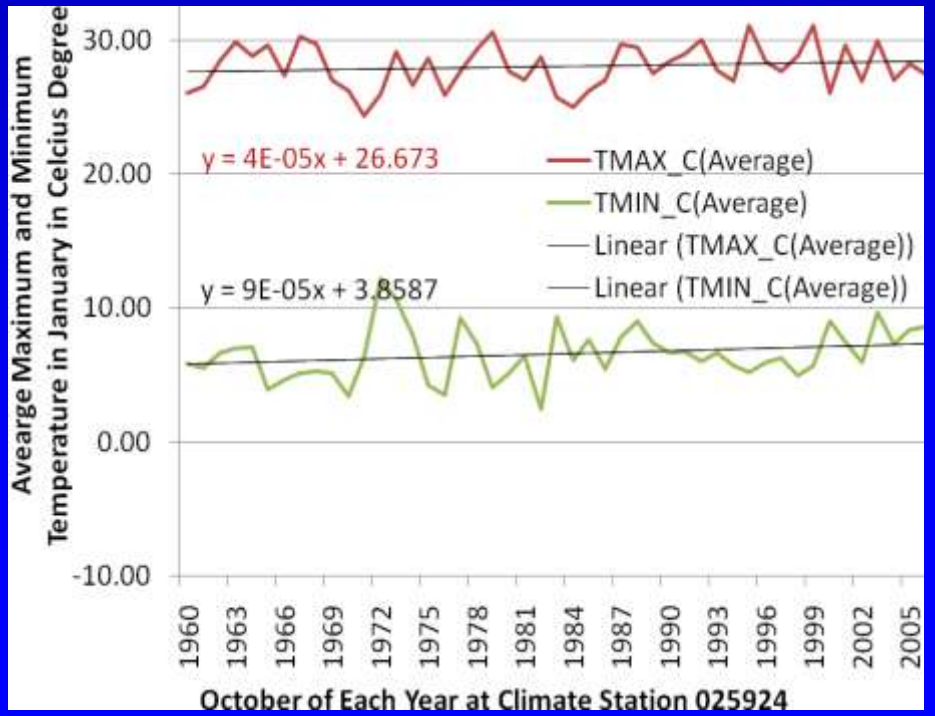
Average Maximum and Minimum Temperature in June at Station 025924 (1055 m)



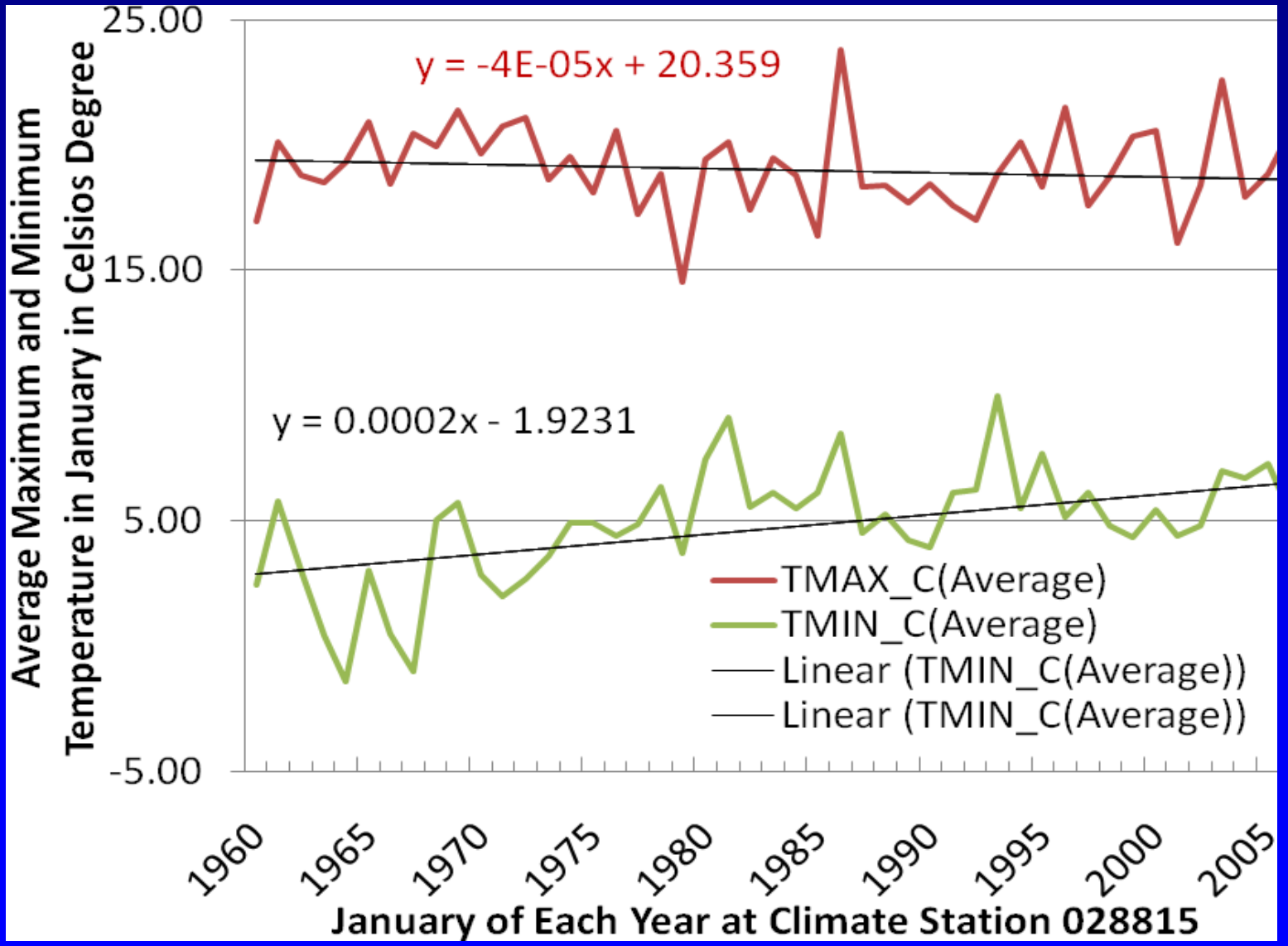

Avearge Maximum and Minimum Temperature in January in Celcius Degree
20.00
10.00
0.00
-10.00
y = 8E-05x + 16.77
y = 0.0001x - 4.7075
TMAX_C(Average)
TMIN_C(Average)
Linear (TMAX_C(Average))
Linear (TMIN_C(Average))
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999 2002 2005 2008
February of Each Year at Climate Station 025924


Avearge Maximum and Minimum Temperature in January in Celcius Degree
30.00
20.00
10.00
0.00
y = 9E-05x + 23.04
y = 8E-05x + 1.134
TMAX_C(Average)
TMIN_C(Average)
Linear (TMAX_C(Average))
Linear (TMIN_C(Average))
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999 2002 2005 2008
Aprilof Each Year at Climate Station 025924

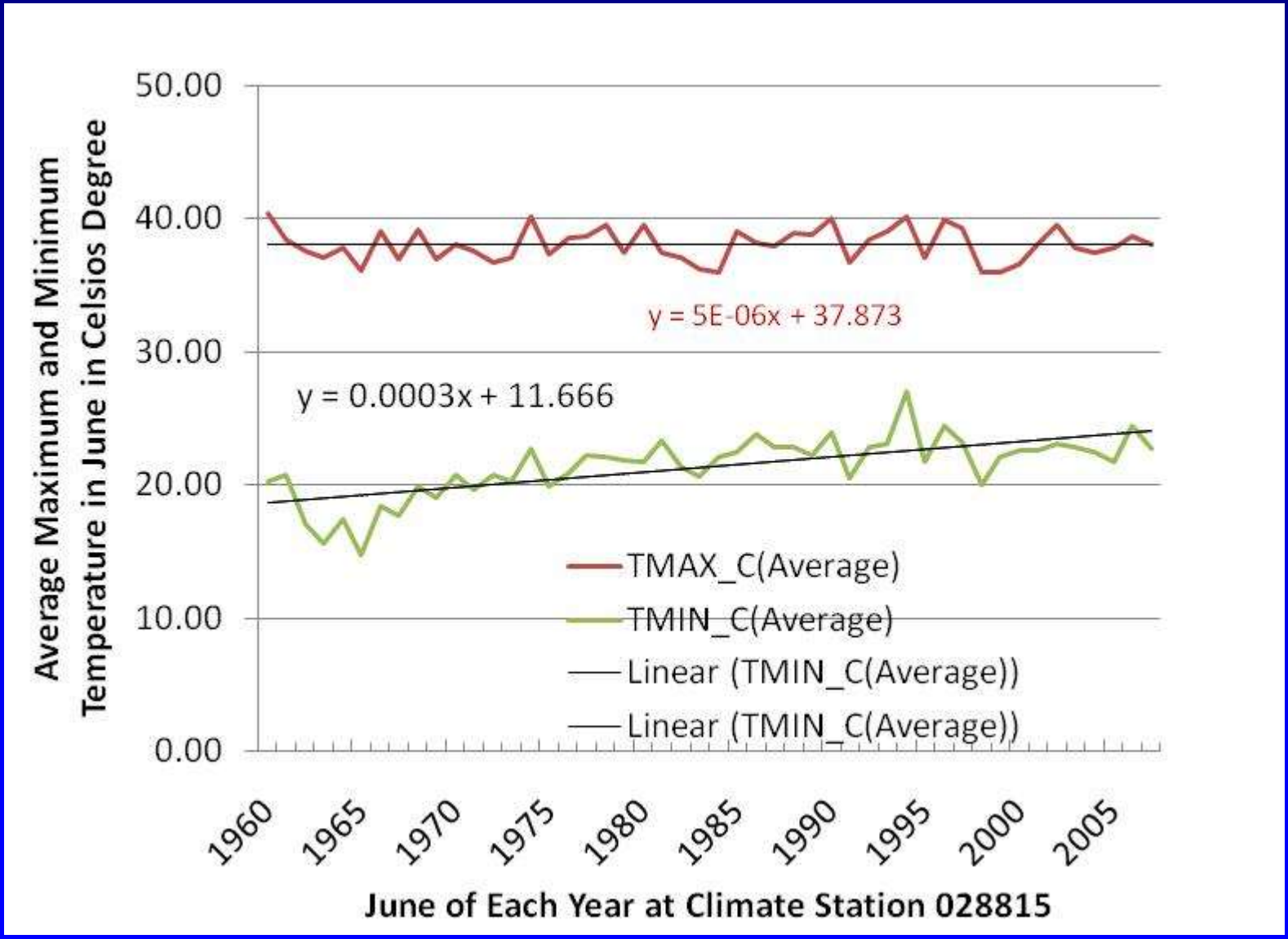

Avearge Maximum and Minimum Temperature in January in Celcius Degree
40.00
30.00
20.00
10.00
0.00
y = 3E-05x + 32.207
y = 0.0001x + 13.297
TMAX_C(Average)
TMIN_C(Average)
Linear (TMAX_C(Average))
Linear (TMIN_C(Average))
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999 2002 2005
August of Each Year at Climate Station 025924


Avearge Maximum and Minimum Temperature in January in Celcius Degree
30.00
20.00
10.00
0.00
-10.00
y = 4E-05x + 26.673
y = 9E-05x + 3.8587
TMAX_C(Average)
TMIN_C(Average)
Linear (TMAX_C(Average))
Linear (TMIN_C(Average))
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999 2002 2005
October of Each Year at Climate Station 025924

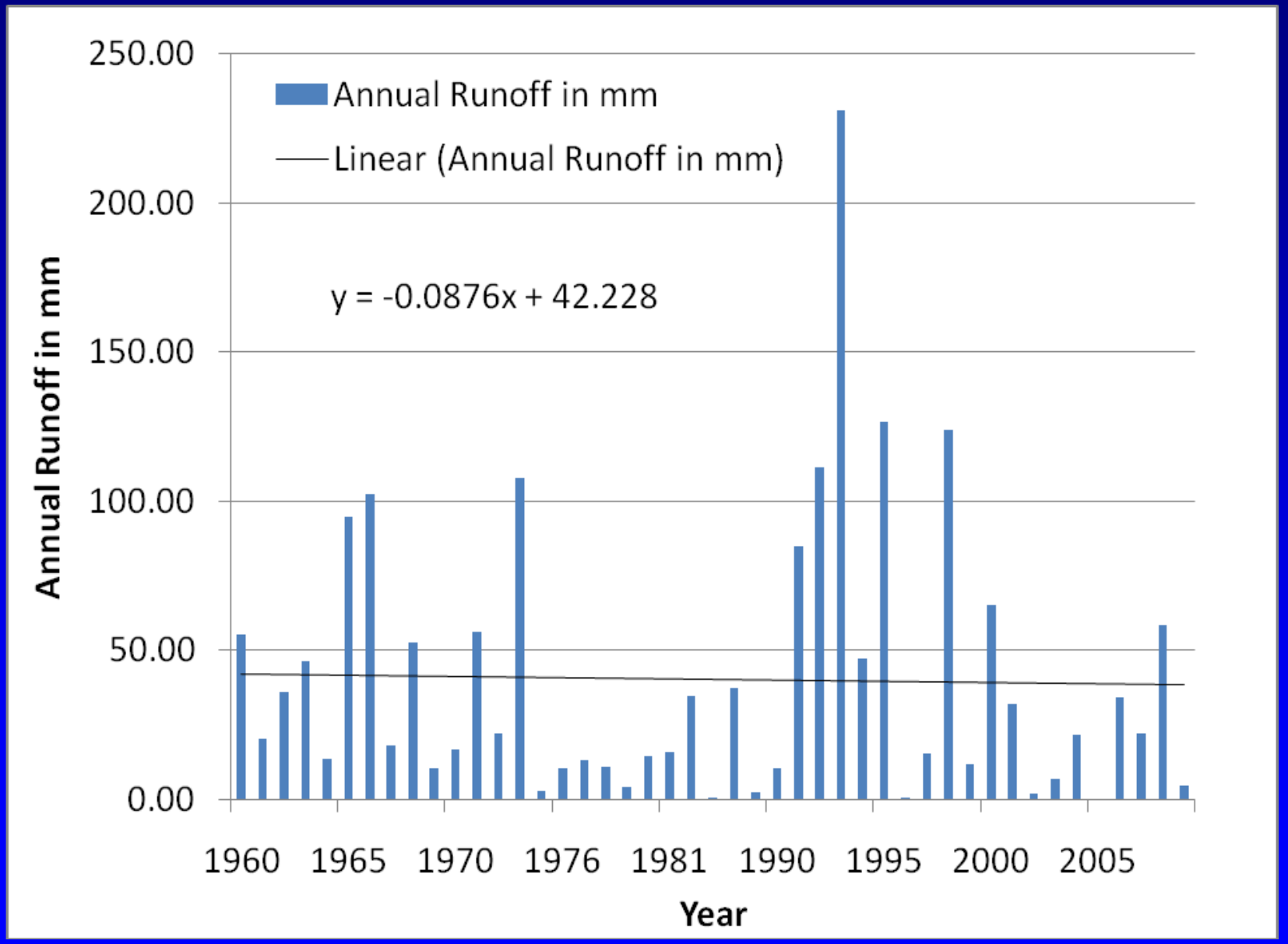
Average Maximum and Minimum Temperature in January at Station 028815 (742 m)



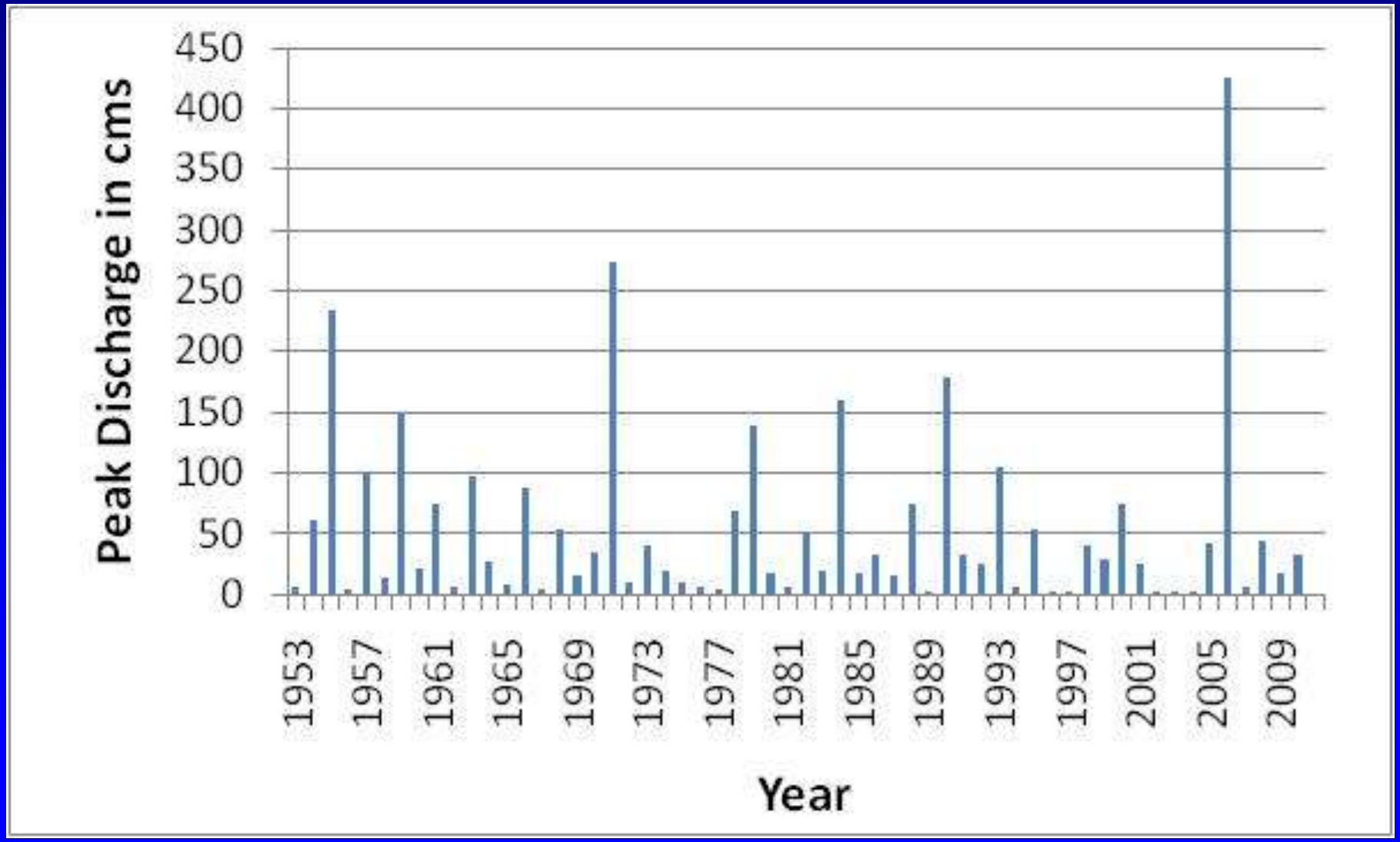
Average Maximum and Minimum Temperature in June at Station 028815 (742 m)



Annual Stream flow from 1960 to 2010



Peak Discharge



Landuse and Landcover between 1992 and 2001

	Area (Hectare)			Percent
Land Use	1992	2001	2001-1992	2001-1992
Developed	45782	66528	***20746***	***45.31***
Agriculture	8552	4657	-3895	-45.55
Forest	102297	98079	-4218	-4.12
Shrub	655382	652377	-3004	-0.46
Water	613	245	-368	-59.99
Barren	13007	14429	1422	10.93
Grassland/Pasture	67875	56284	***-11591***	***-17.08***
Wetland	42	951	909	2165.36

Discussions and Conclusions

- Annual precipitation and runoff have a decreasing trend.
- The monthly minimum temperature is increasing.
- The monthly maximum temperature can be increasing or decreasing depending on elevation of monitoring station.
- Although total annual runoff is decreasing, high peak discharge from individual events was observed which indicates the occurrence of higher intensity rainfall.
- Increased peak discharge potentially results in more soil erosion which leads to increases in sediment loading.
- The watershed is likely more vulnerable to flooding risk and degraded water quality.

Thank You!

Questions?

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