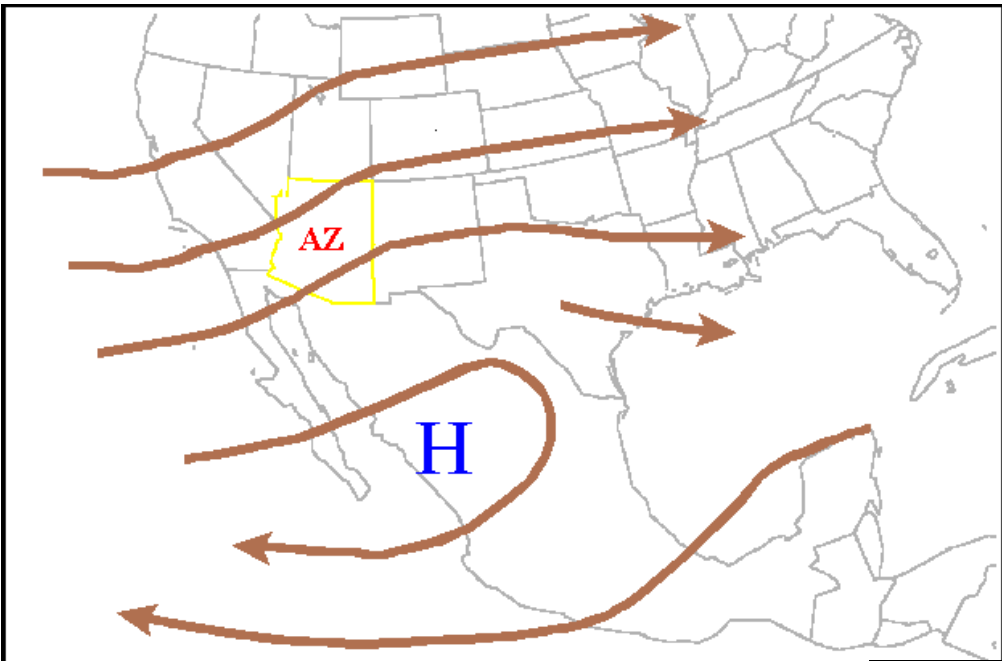


Eastern Pacific Tropical Cyclones and the North American Summer Monsoon

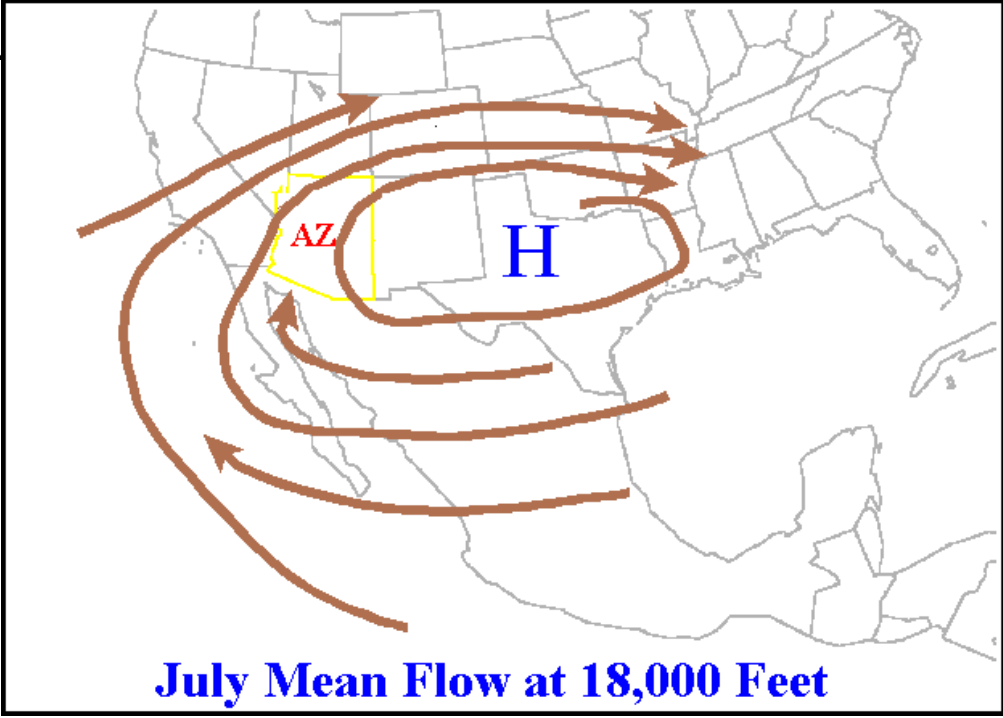
**Kristen L. Corbosiero
Lance Bosart, Michael Dickinson,
Susanna Hopsch, Kelly Lombardo, Matt
Novak, Brandon Smith, Alicia Wasula**

Introduction:

- **Monsoon: a seasonal reversal of wind direction**
- **Traditional monsoonal flow in the southwest United States is easterly or southerly**
- **Rainfall events are discrete, and have many “flavors”**
 - ~ **Traditional monsoon (ridge to NE)**
 - ~ **Cut off lows**
 - ~ **Trough passages**
 - ~ **Potential vorticity (PV) critters**
 - ~ **Tropical cyclones**



June Mean Flow at 18,000 Feet



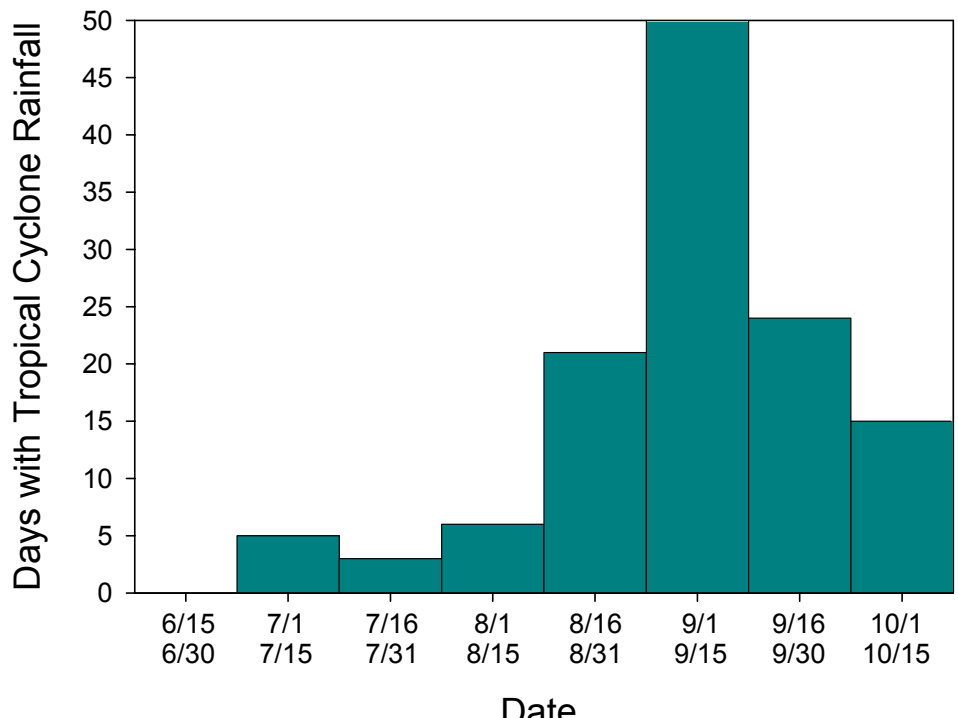
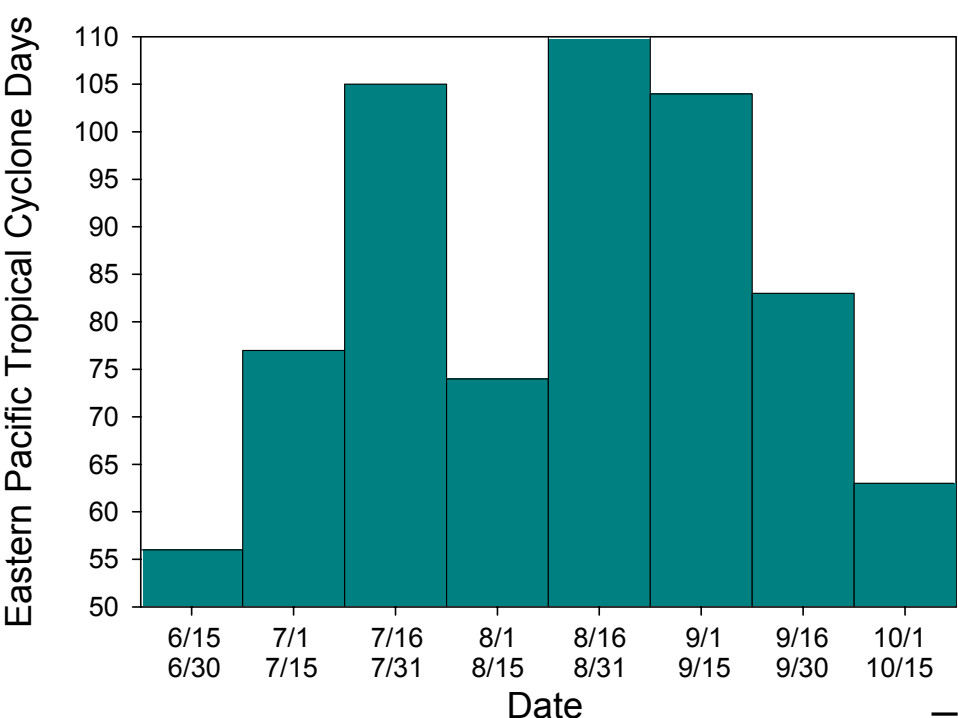
July Mean Flow at 18,000 Feet

Data and Methodology:

- **NHC/TPC Best track Dataset**
 - ~ Latitude and longitude every 6 hours
 - ~ East Pacific TCs that crossed 25° N from 1958-1998
- **NCEP Unified Precipitation Dataset (UPD)**
 - ~ Gridded, daily precipitation for the contiguous US on a .25° x .25° grid
 - ~ Daily and storm total maps

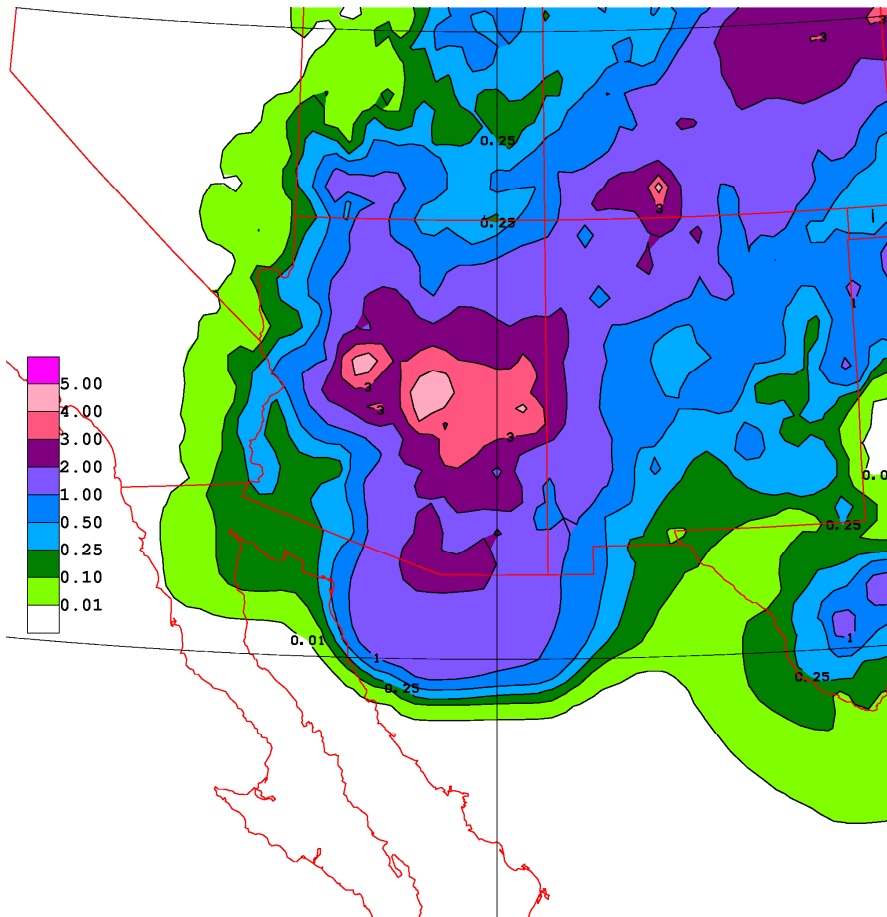
Year	Storm Name	Dates	States with >25% summer rain
1958	TS 10	9/10 – 9/14	AZ CO NM UT
	H 11	10/4 – 10/6	AZ
1959	H 10	9/11 – 9/15	AZ CA NV
1960	H Diana	8/19 – 8/23	AZ CA NV
1962	TS Claudia	9/22 – 9/26	AZ CA NM NV
1963	TS Jen-Kath	9/17 – 9/21	AZ CA NV UT
1965	H Emily	9/4 – 9/7	UT
1966	H Kirsten	9/28 – 10/2	-
1967	H Katrina	9/1 – 9/5	AZ CA NV
1968	TS Hyacinth	8/19 – 8/21	AZ
	H Pauline	10/2 – 10/5	AZ CA UT
1970	TS Norma	9/3 – 9/7	AZ CO NM UT
1971	H Olivia	9/29 – 10/1	AZ CA CO NM UT
1972	H Hyacinth	9/6 – 9/10	CA CO
	H Joanne	10/5 – 10/7	AZ CA CO NM UT
1976	H Kathleen	9/10 – 9/12	AZ CA NV
	H Liza	10/1 – 10/3	NV UT
1977	H Doreen	8/15 – 8/18	AZ CA NV UT
	TS Glenda	9/26 – 9/28	AZ
	H Heather	10/6 – 10/8	AZ CA
1982	H Olivia	9/24 – 9/28	CA NV UT
1983	H Manuel	9/18 – 9/20	CA

1984	H Marie	9/9 – 9/12	AZ CA NV
	H Norbert	9/25 – 9/27	AZ
1986	H Newton	9/23 – 9/26	AZ CA CO NM UT
1989	H Raymond	10/4 – 10/6	AZ CO NM
1992	H Lester	8/21 – 8/25	AZ CA CO NM UT
1993	H Hilary	8/26 – 8/30	AZ CA CO NM UT
1995	H Ismael	9/14 – 9/16	NM
1996	H Fausto	9/14 – 9/16	AZ UT
1997	H Nora	9/24 – 9/27	AZ CA UT
1998	H Isis	9/3 – 9/7	AZ CA NV UT
1999	H Hilary	9/22 – 9/24	AZ CA
2003	H Ignacio	8/26 – 8/29	AZ CA NV
	H Marty	9/24 – 9/26	AZ

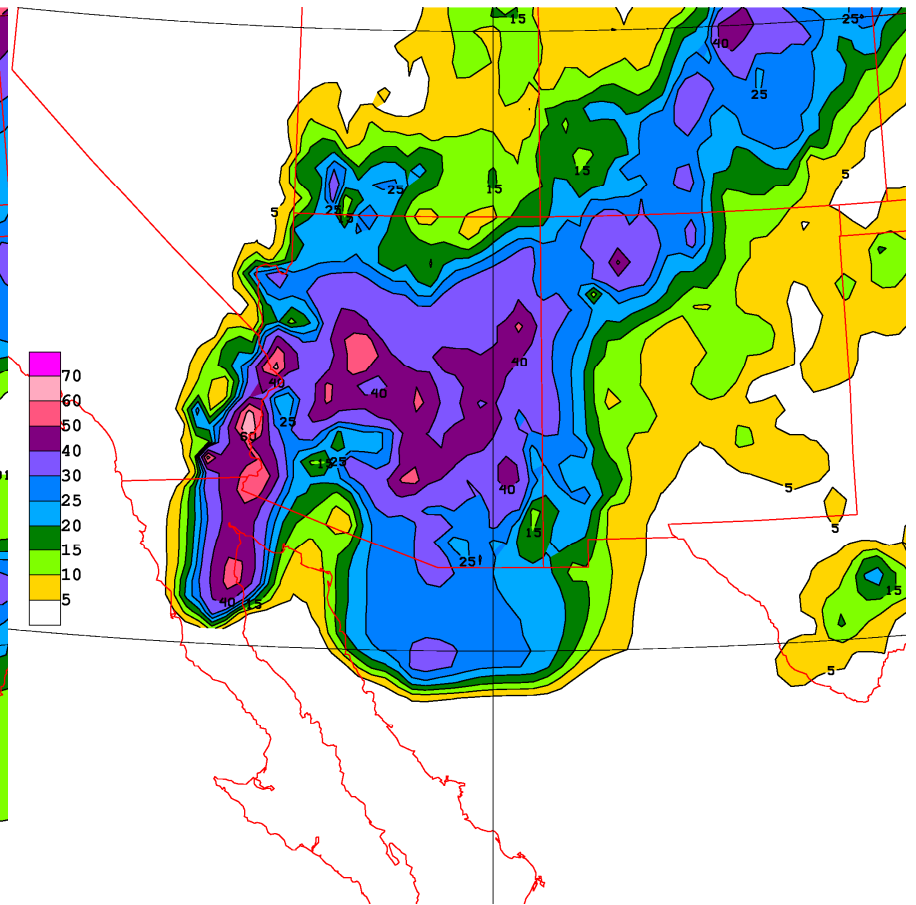


Hurricane Lester (1992)

Storm Total Rainfall

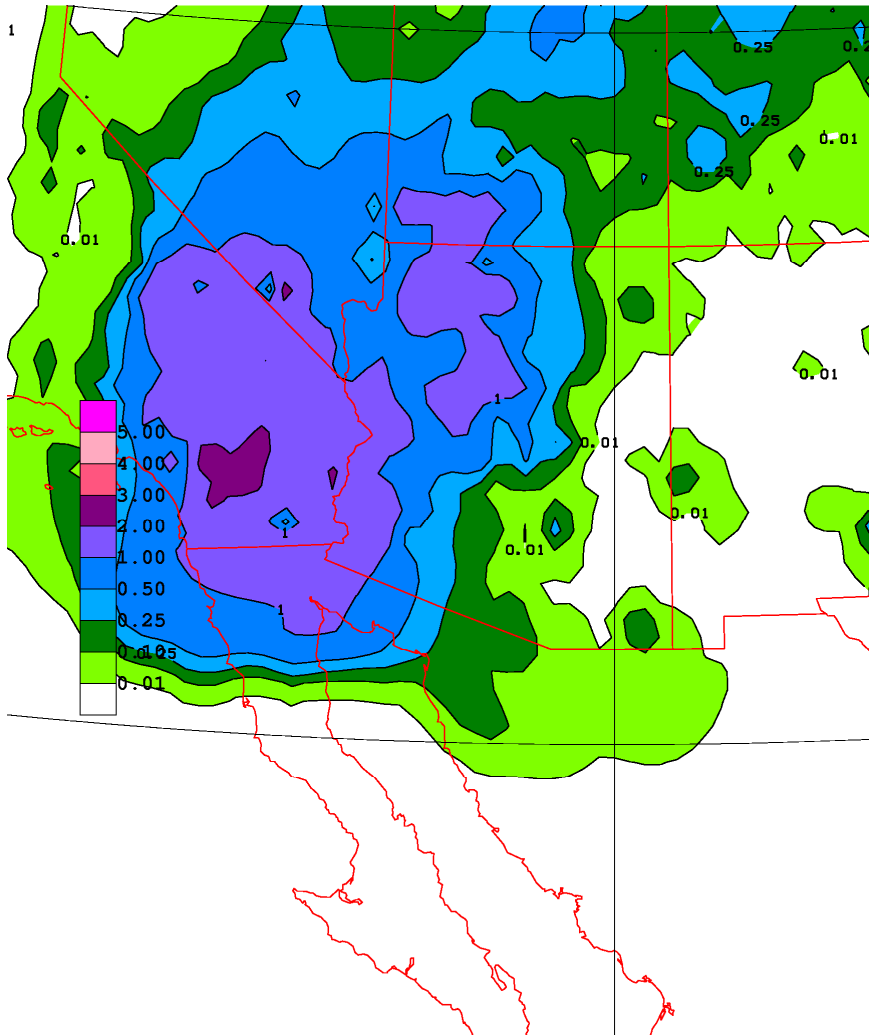


% of Summer Rainfall

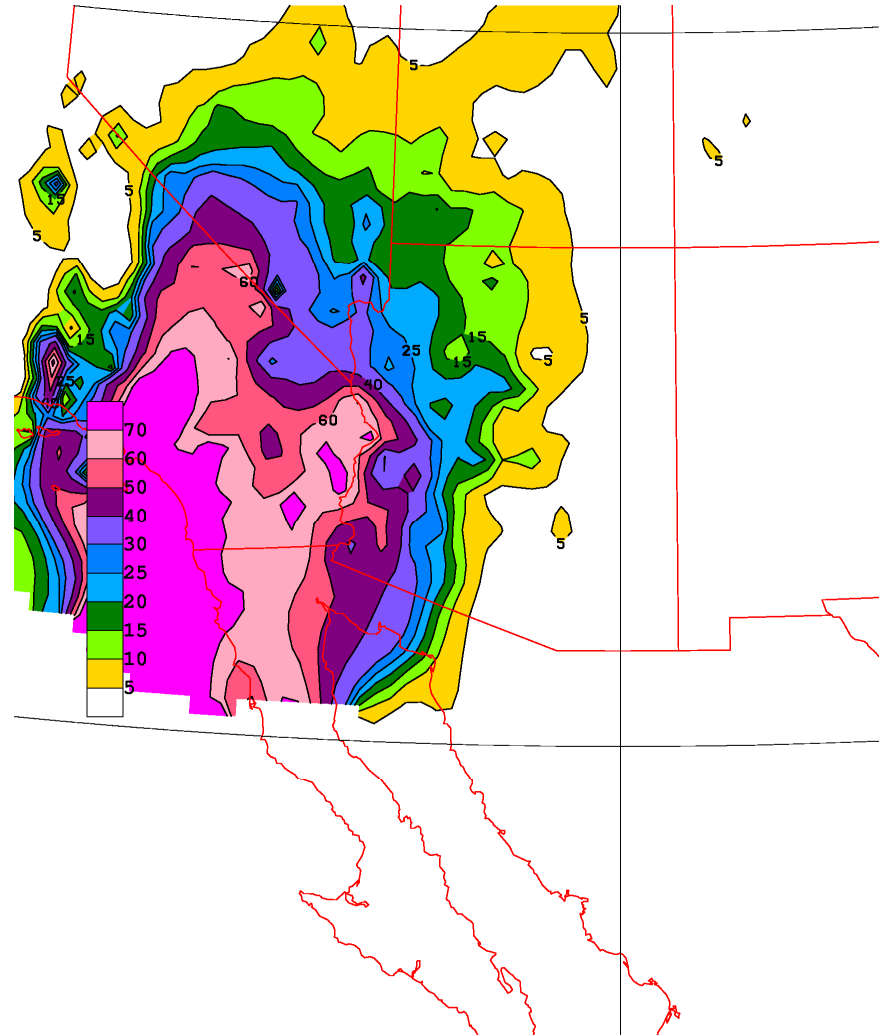


Hurricane Nora (1997)

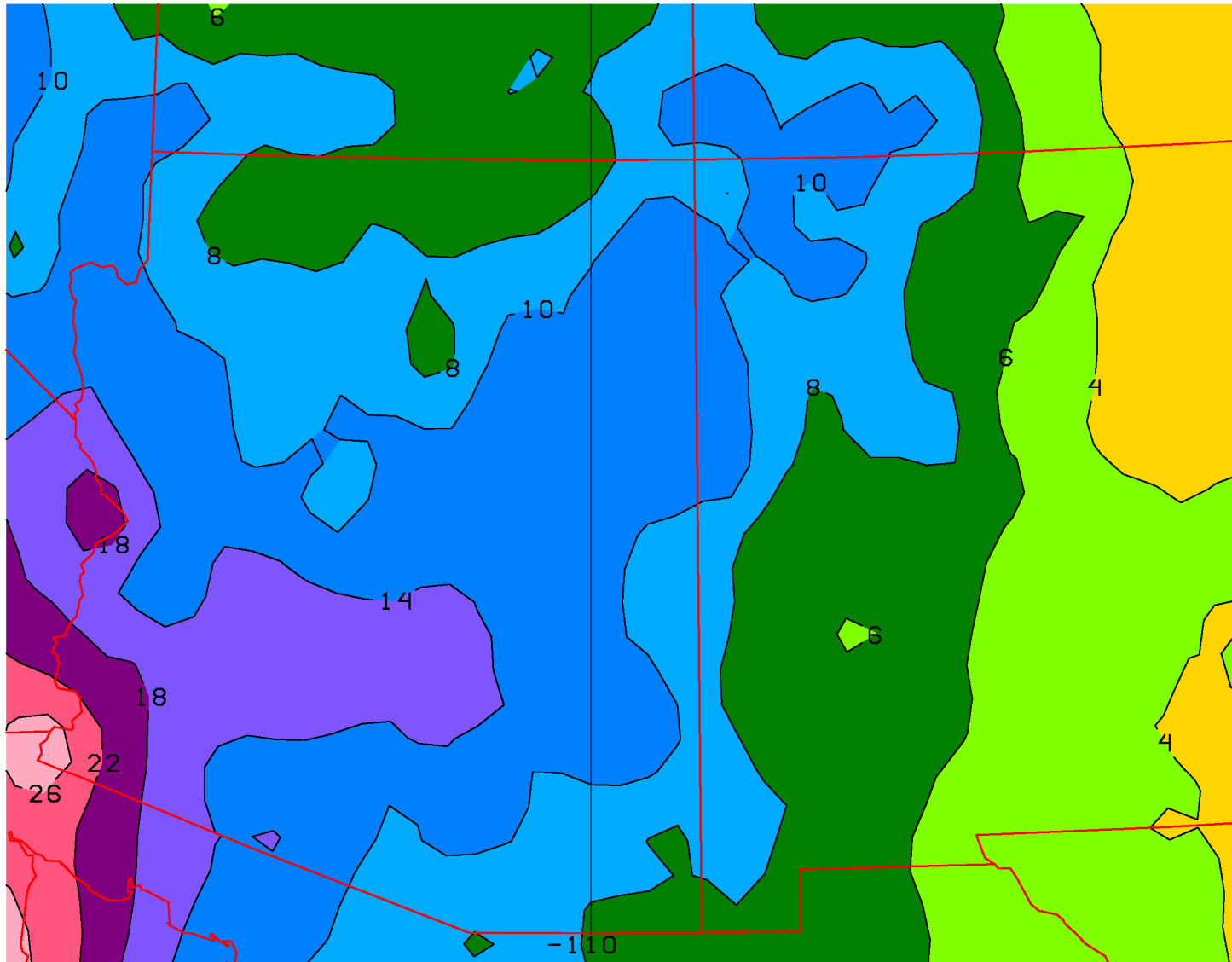
Storm Total Rainfall

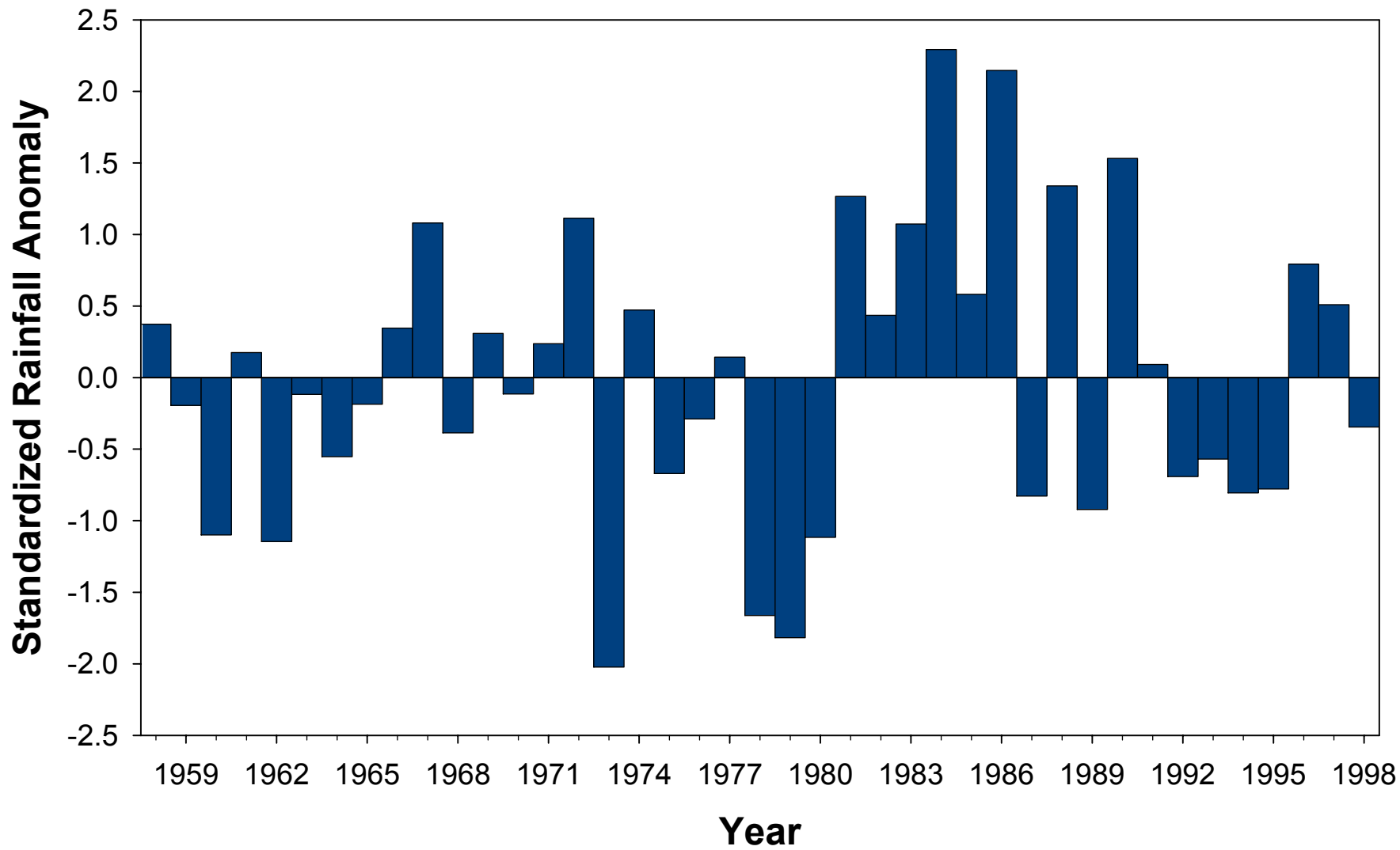


% of Summer Rainfall

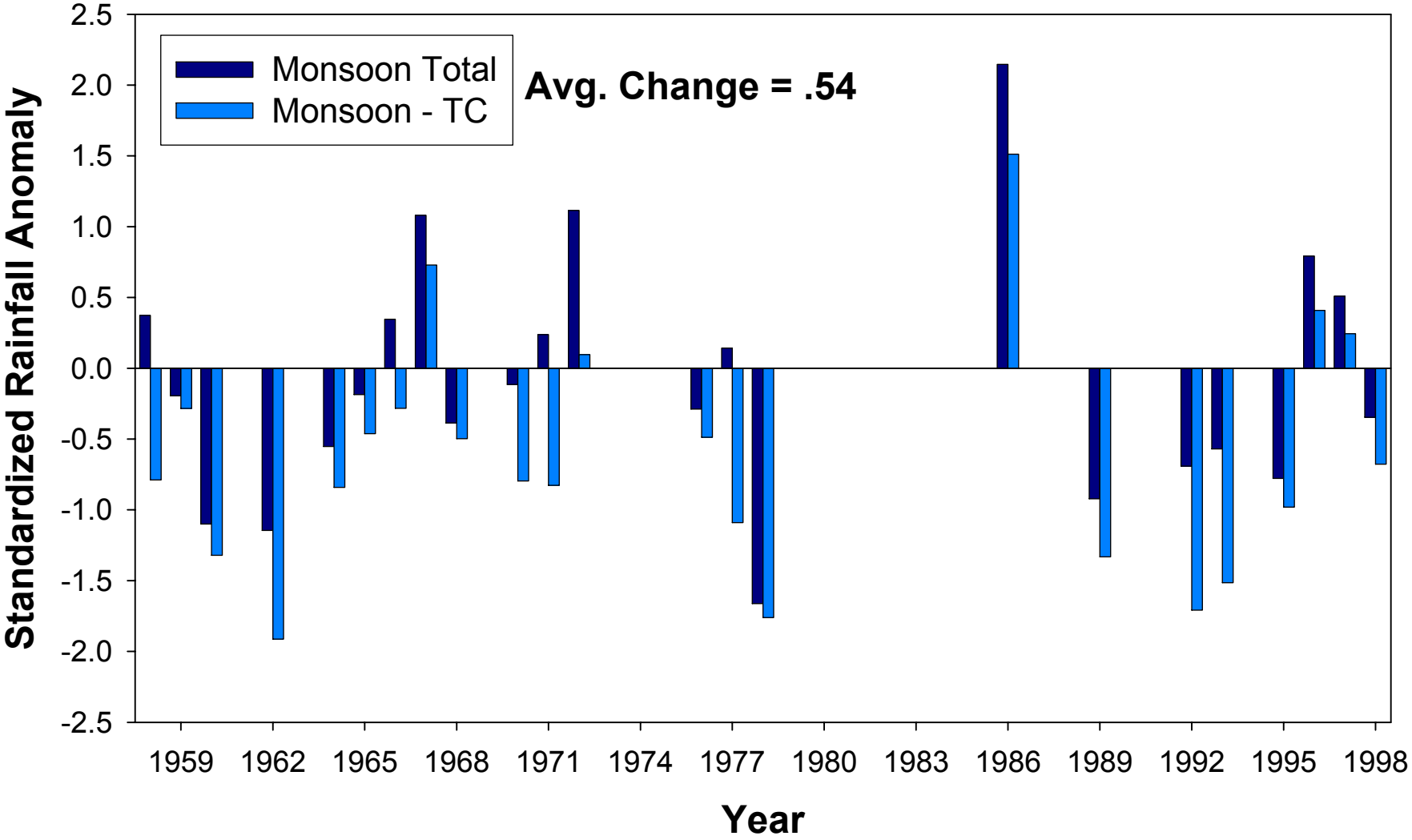


Average Summer Rainfall from Tropical Cyclones





Monsoon Rainfall - TC Rainfall



Summary

- On average, 3 TCs bring rainfall to the southwest every 4 years, most often during the last 2 weeks of September
- 10-25% of the monsoon seasonal rainfall is contributed by TCs, with the largest impact over SW Arizona and southern California
- TC rainfall is twice as likely in years that are climatologically dry

Future Research

- **Where do TC remnants go after they are no longer tracked by NHC?**
 - ~ Extratropical transition
- **What large scale flow patterns control how many TCs effect the southwest per year?**
- **Connection to El Niño**