Assessing Climate Variability and Its Impact on Vegetation Using Historic Landsat Data

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Previous Work by our Group

-Devitt et al. (2010) measured annual ET throughout 2005-2007 in Spring Valley, NV

-ET values were used in combination with Landsat scenes to empirically estimate annual ET throughout the phreatophytic zone of Spring Valley.

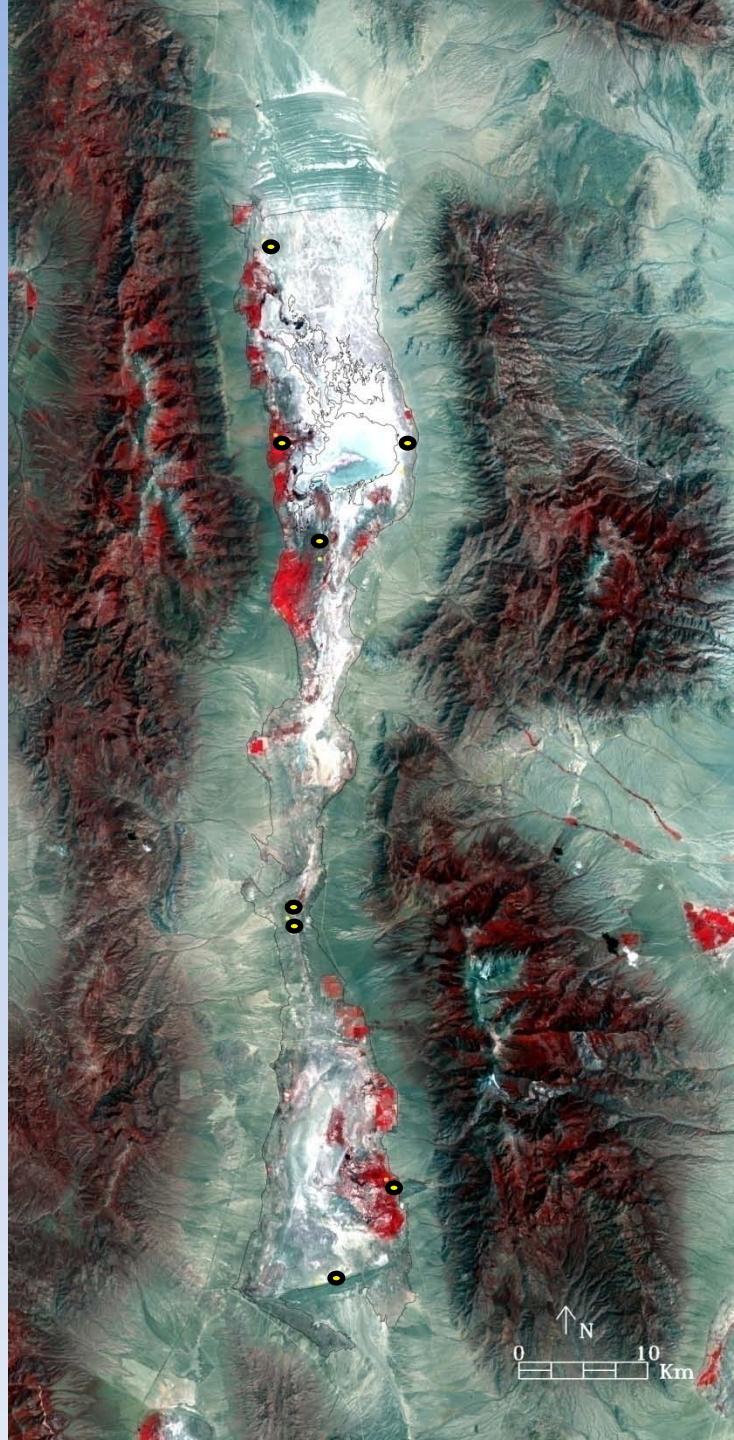
-A significant relationship was found between winter precipitation, ET and NDVI values; $r^2 = 0.93$ for winter precipitation and annual ET, and $r^2 = 0.97$ for annual ET and growing season average NDVI.

Research Goal

- Examine impact of climate variability on vegetation response
  - *Hypothesis 1: Trends in vegetation index values calculated from historic Landsat data will correspond to trends in precipitation.*
  - *Hypothesis 2: Growth rings in Big Sagebrush (*Artemesia tridentata*) can be used to interpret historic precipitation thereby extend limited measurement records and will be correlated with Landsat NDVI; see Apodaca poster.*

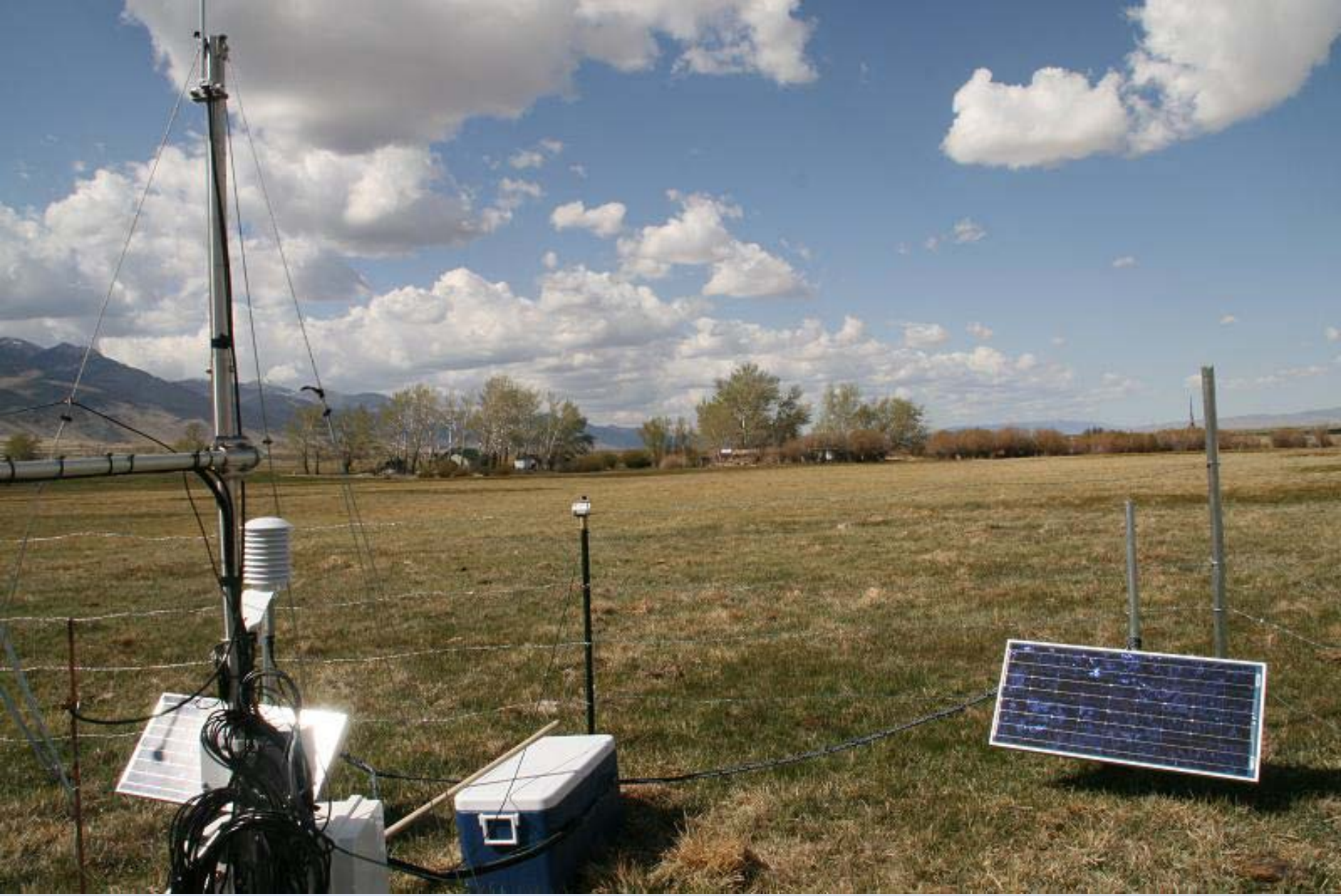
Study Site

- Spring Valley in east central NV (100 km by 15 km)
- Focus on previous ET study sites, i.e., 8 eddy covariance tower sites
- 5 sites in native shrub (greasewood & big sagebrush), 1 mixed grass/shrub site and 2 irrigated agriculture



Spring Valley 1 (27% cover)

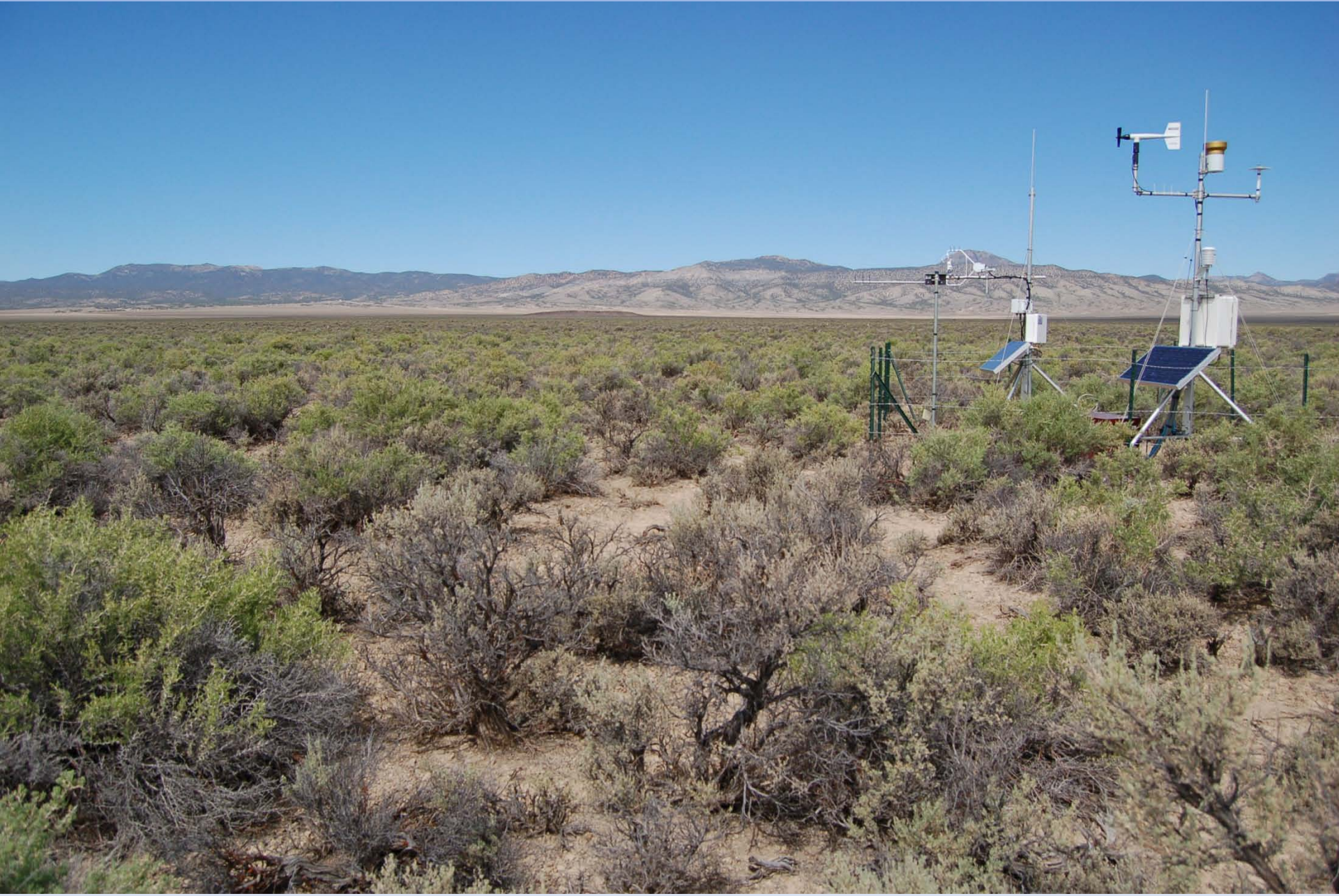
Spring Valley 2 (62% cover)



Spring Valley 2b (100% cover)

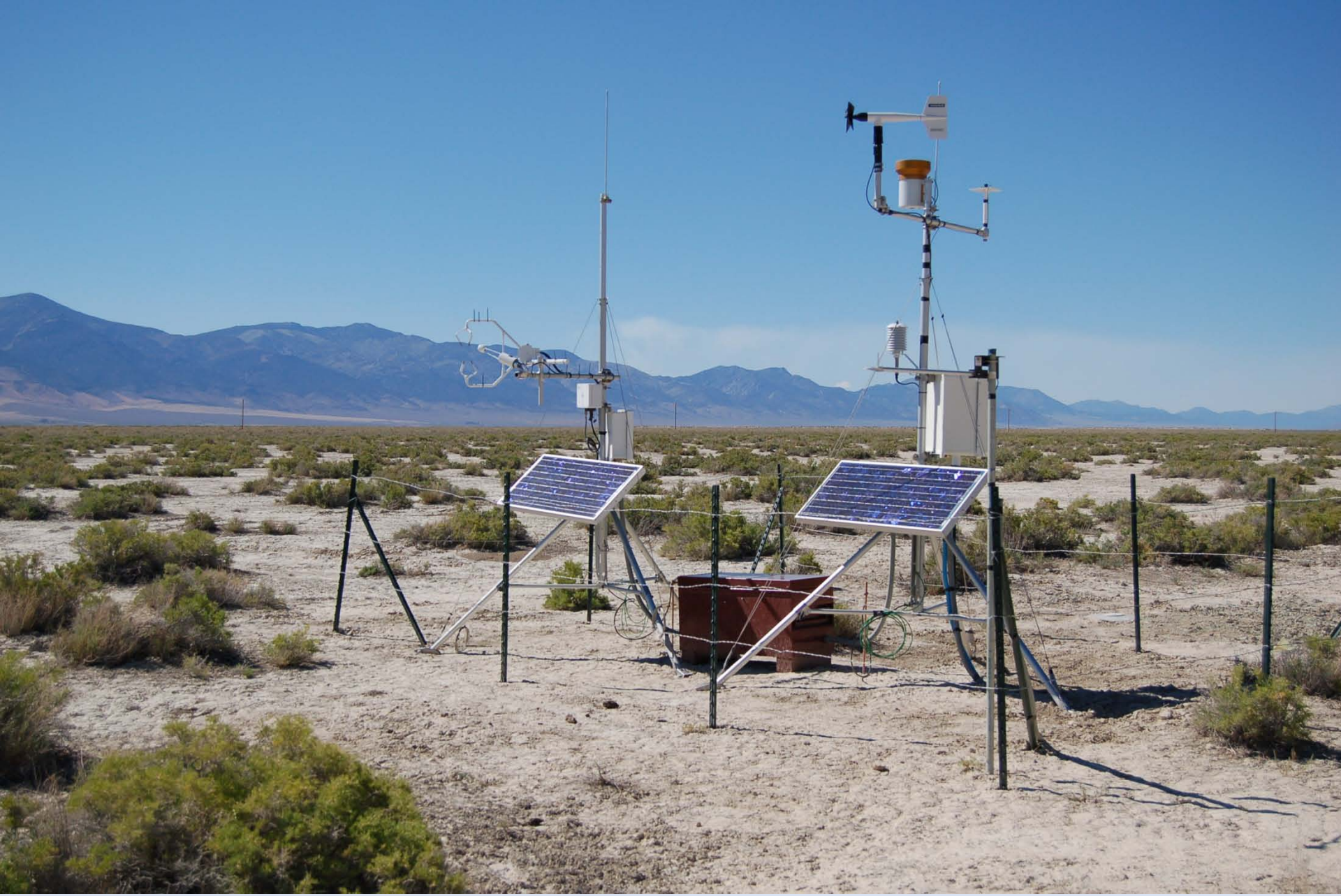
Spring Valley 3 (32% cover)

Spring Valley 4 (100% cover)



Spring Valley 5 (85% cover)

Spring Valley 6 (76% cover)



Spring Valley 7 (19% cover)

Materials and Methods

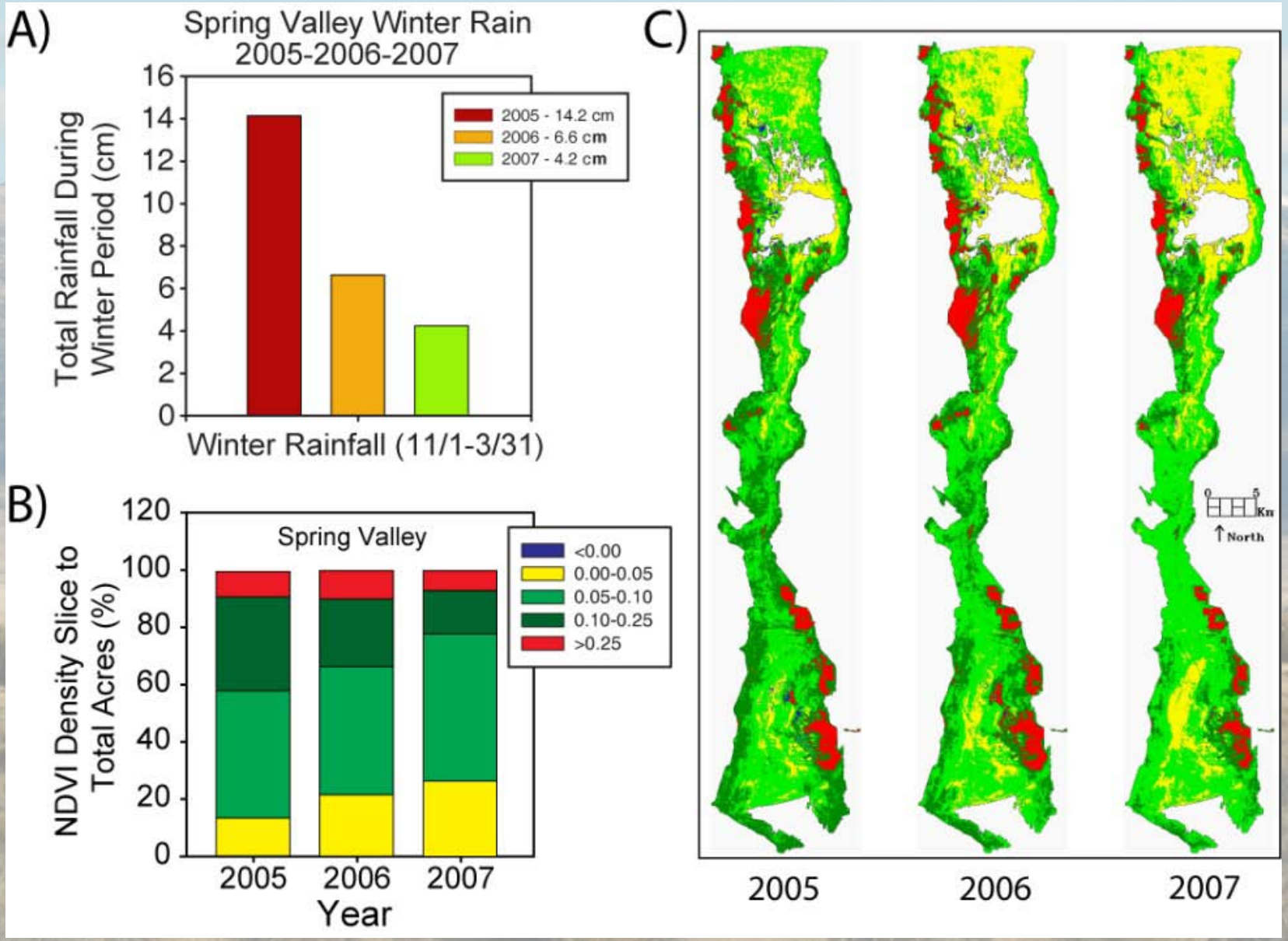
Year	Dates of Landsat Scenes (< 30% Cloud)	Year	Dates of Landsat Scenes
1975	5/13, 5/31, 6/9, 6/27, 7/06, 7/15, 7/24, 8/2, 9/7, 9/25	1993	5/24, 6/9, 7/11, 7/27, 8/12, 8/28, 9/13, 9/29
1976	5/16, 5/25, 6/21, 6/30, 7/9, 8/5, 8/23, 9/1	1994	6/12, 6/28, 7/30, 8/31, 9/16
1977	4/23, 6/16, 8/9, 8/27	1996	4/14, 4/30, 6/1, 6/17, 7/19, 8/4, 8/20, 9/21
1979	5/19, 6/15, 6/24, 7/3, 7/30, 9/4, 9/22	1997	4/17, 5/19, 6/20, 7/6, 9/24
1980	7/6, 7/24, 8/11, 9/16, 9/25	1999	6/26, 8/13, 8/29, 9/30
1981	6/13, 7/19, 8/6, 8/24	2000	4/25, 5/11, 5/27, 9/16
1983	5/21, 6/22, 8/9, 8/25, 9/10	2001	4/28, 5/30, 6/15, 7/1, 8/2, 9/19
1984	4/13, 7/18, 8/3	2002	5/17, 6/18, 7/4, 8/5, 8/21, 9/22
1985	6/19, 7/5, 8/22, 9/7	2003	5/20, 6/5, 7/7, 8/24
1986	4/19, 5/21, 6/22, 8/25, 9/26	2004	4/4, 6/7, 7/9, 8/10, 9/27
1987	4/22, 6/25, 8/12, 9/29	2005	4/14, 5/25, 6/1, 6/26, 7/19, 8/29, 9/5, 9/14
1988	4/24, 5/10, 6/11, 7/29, 8/14, 9/15	2006	4/26, 5/12, 6/29, 7/15, 8/16, 9/1, 9/17
1989	4/11, 5/29, 6/30, 7/16, 8/1, 9/2	2007	4/13, 4/29, 5/15, 5/31, 6/16, 7/2, 7/18, 8/19, 9/20
1990	5/16, 6/17, 7/3, 9/21	2008	5/1, 5/17, 6/18, 8/21, 9/6, 9/22
1991	6/20, 7/22, 8/7, 9/24	2009	4/18, 5/4, 6/21, 7/7, 7/23, 9/9, 9/25
1992	4/19, 7/24, 8/25, 9/26	2010	5/7, 6/8, 7/1, 8/11, 8/27, 9/12

181 total Landsat MSS and TM scenes; only scenes with <30% cloud cover were acquired.

Data Analysis

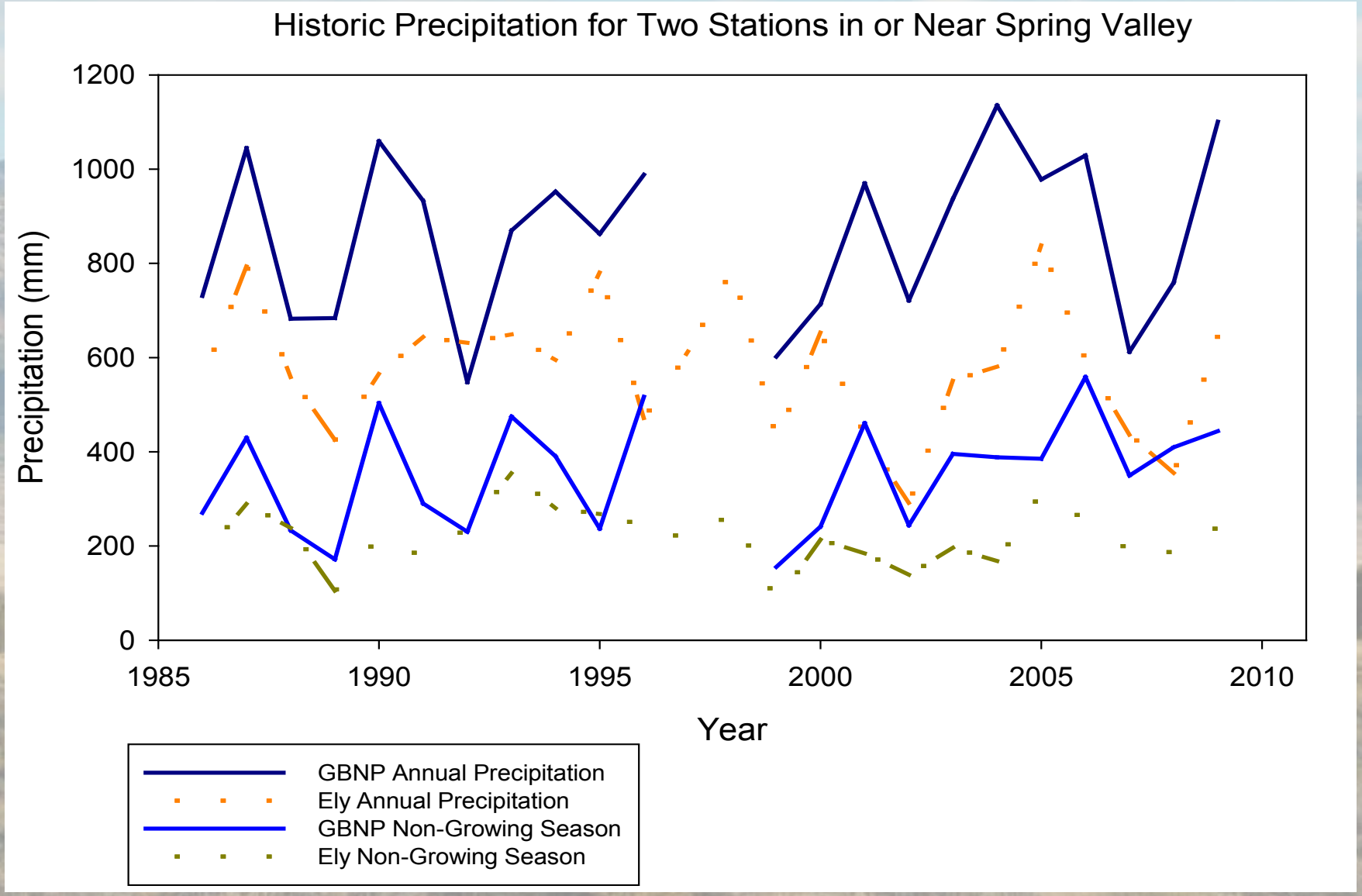
- Preprocessing: radiometric calibration, atmospheric correction (ELM) and normalization
- Generation of Normalized Difference Vegetation Index (NDVI) images
- Extraction of NDVI values at previous study tower locations and eventually all locations where Big Sagebrush (*Artemesia Tridentata*) are being sampled for growth ring analysis
- Statistical and time series analyses of NDVI, precipitation and growth ring data

Results: Prior study

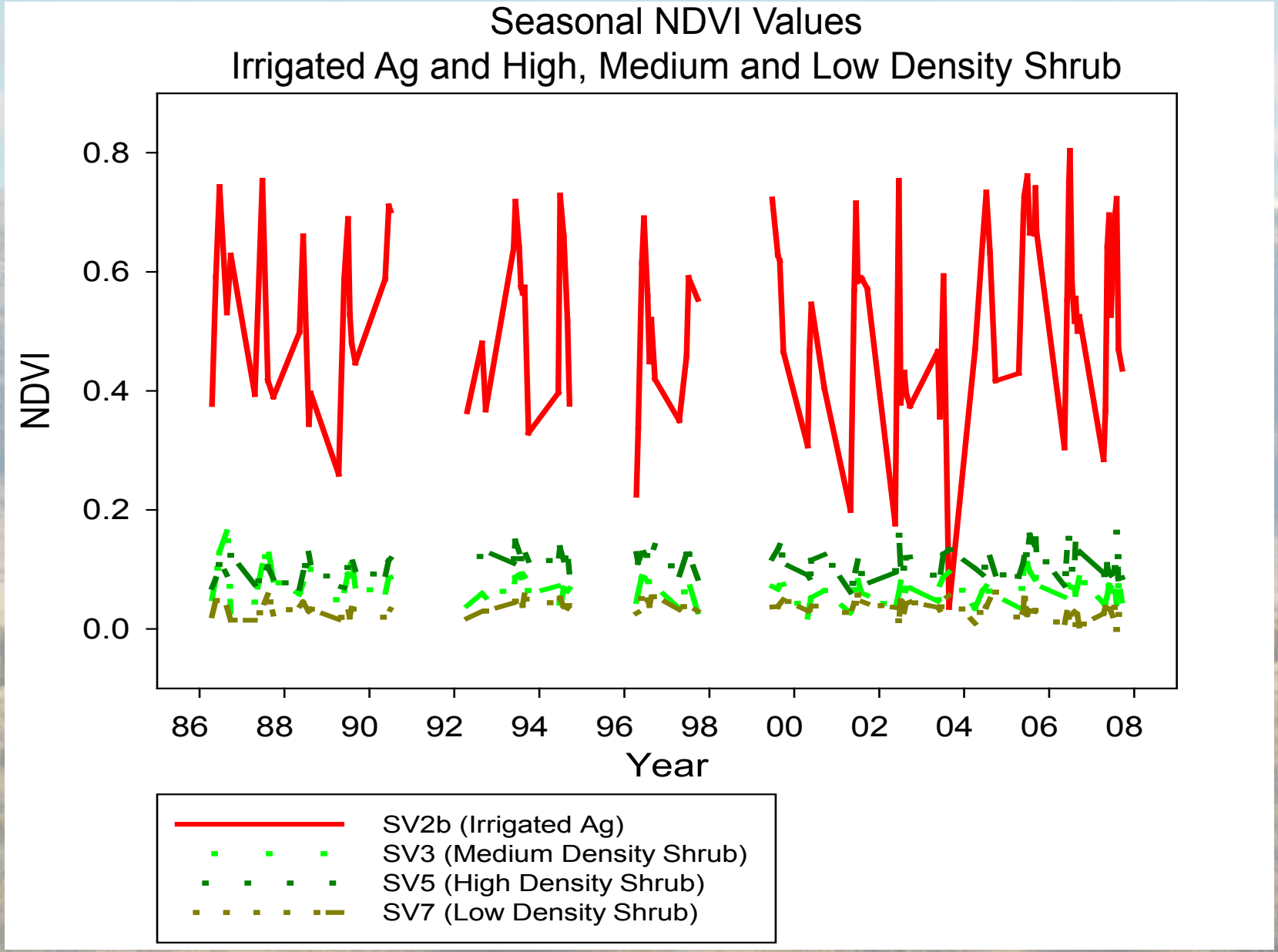


Devitt et al., Ecohydrology 2010

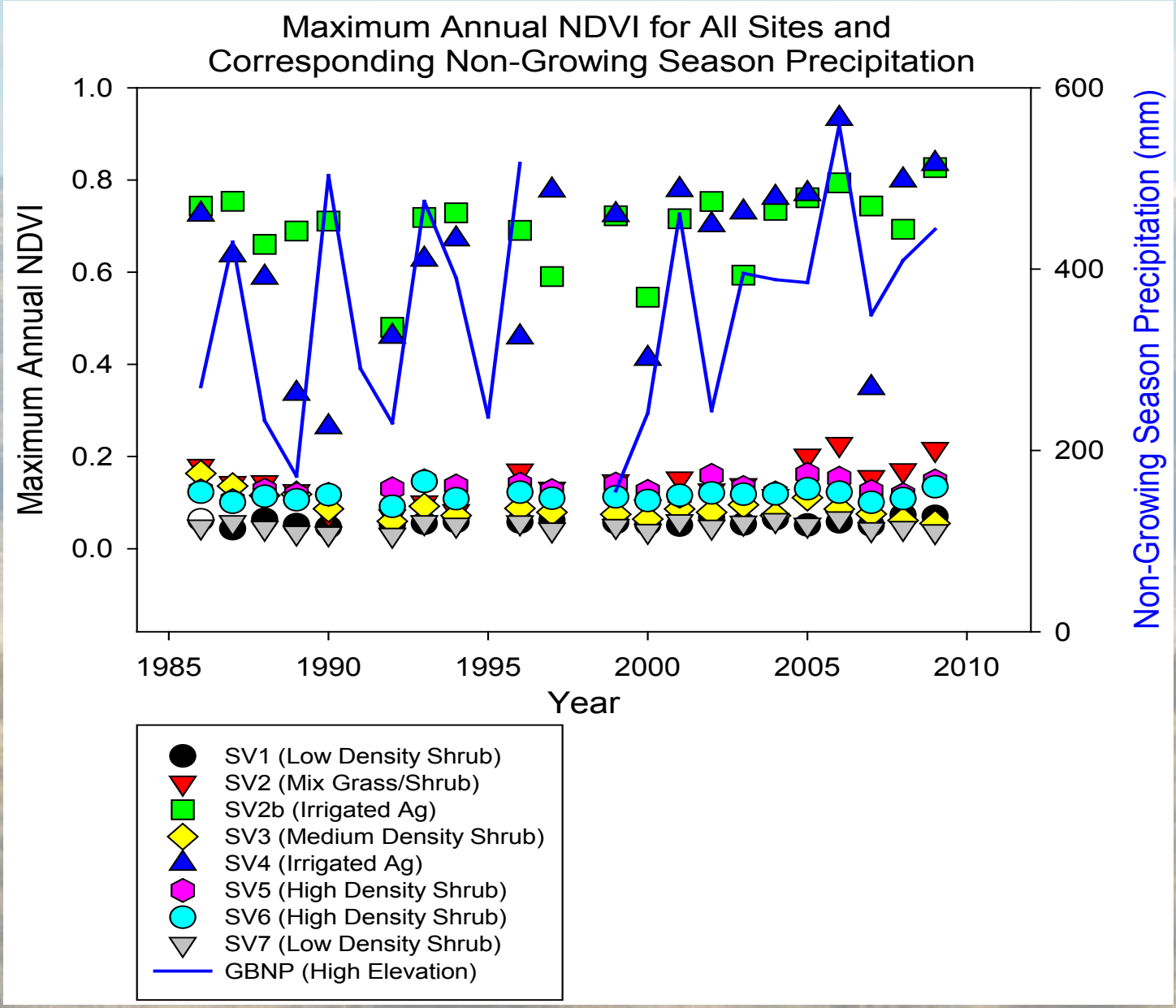
Preliminary Results: Current Study



Preliminary Results: Current Study, Cont.



Preliminary Results: Current Study, Cont.

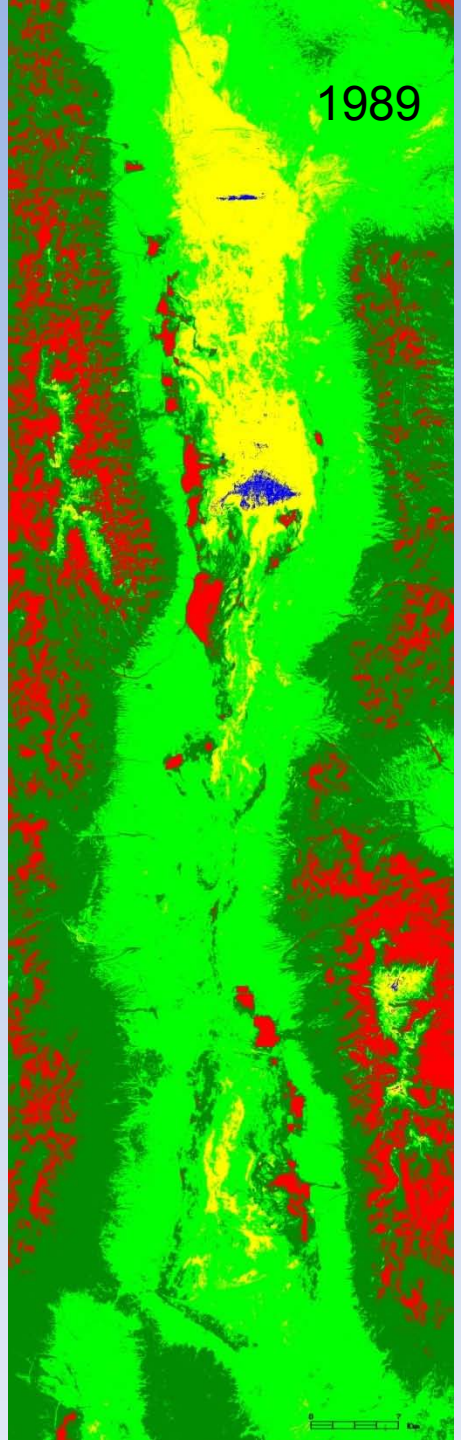


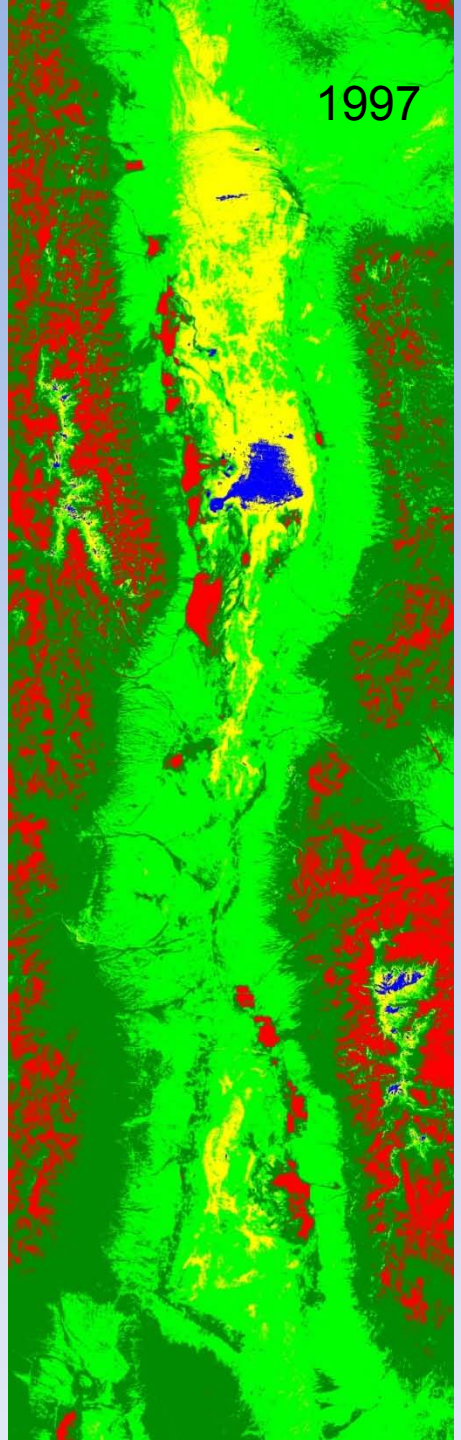
Preliminary Results Cont.

-Average NDVI images reveal significant increase in acreage of higher NDVI values as well as more standing water in Yelland Playa with increased precipitation.

-1989 Precipitation: 426 mm total annual precipitation and 105 mm of winter precipitation.

-1997 Precipitation: 613 mm total precipitation and 214 mm of winter precipitation.





Conclusions To Date

- While an earlier study showed a significant relationship between winter precipitation, ET and NDVI, initial regression analyses for this study are not significant.
- Time series analysis should reveal significant vegetation response (changes in NDVI) to changes in precipitation.
- It is anticipated that big sagebrush growth ring data will provide information about climate variability that will have a stronger relationship to vegetation response as measured by NDVI.