

# **An Example of Using Baseline, Surveillance, Unstressed, and Targeted Monitoring in the Evaluation of Changing Conditions of Groundwater Quantity and Quality**

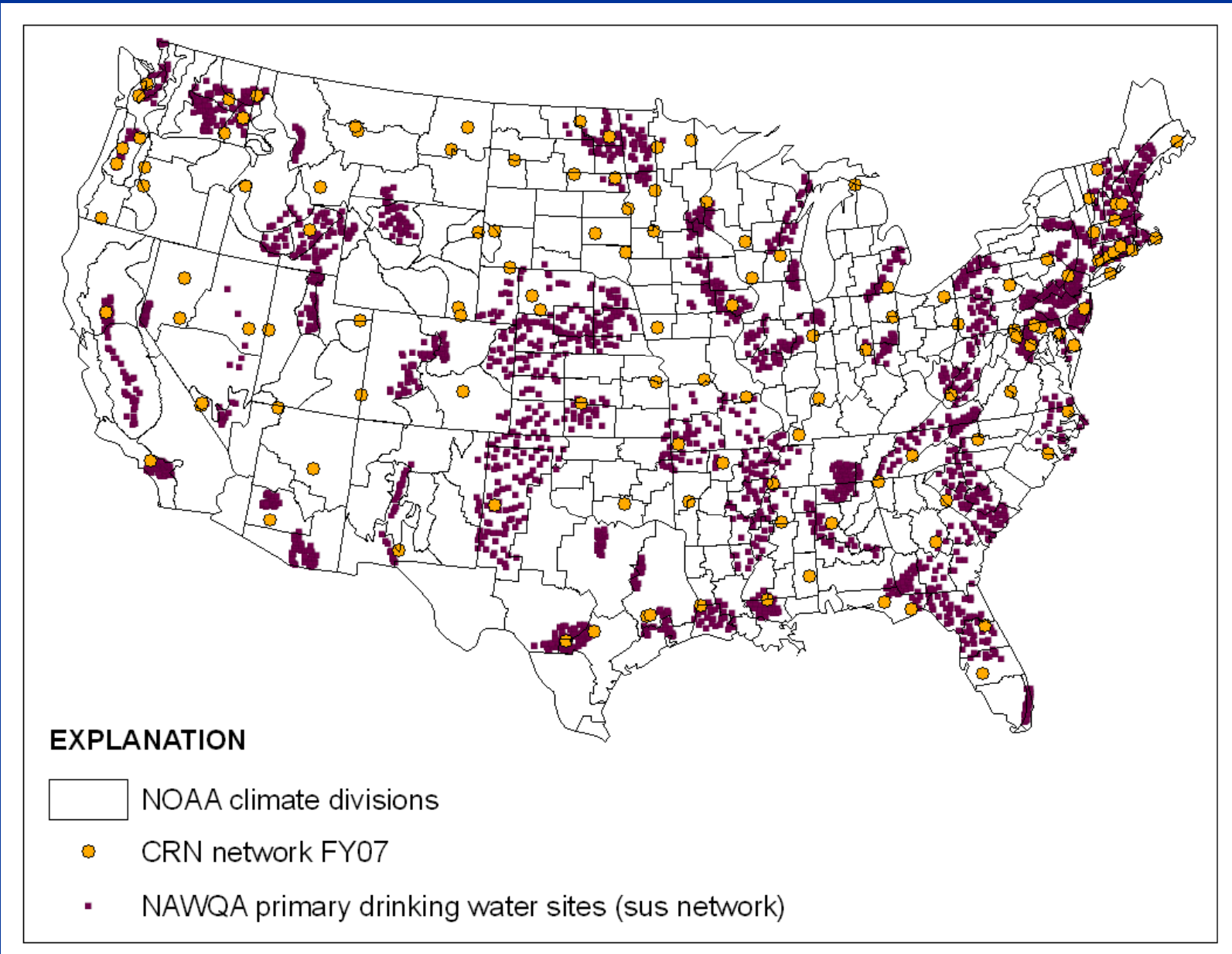
**Rick Copeland  
Florida Geological Survey**

- **NWQMC Sixth National Monitoring Conference**
  - **Denver, Colorado**
  - **April 25-29, 2010**

# Network Design Features

- **NGWMN - Incorporates existing federal, regional, state, and local GW Mon. Programs**
  - **“Network-of-Networks”**
- **Will not replace existing Mon. Programs**
- **Will not address site-specific issues**
  - **E.G. Contaminated industrial sites.**

# USGS Climate Response Network and NAWQA Major Aquifer Wells



# Regional Monitoring Network

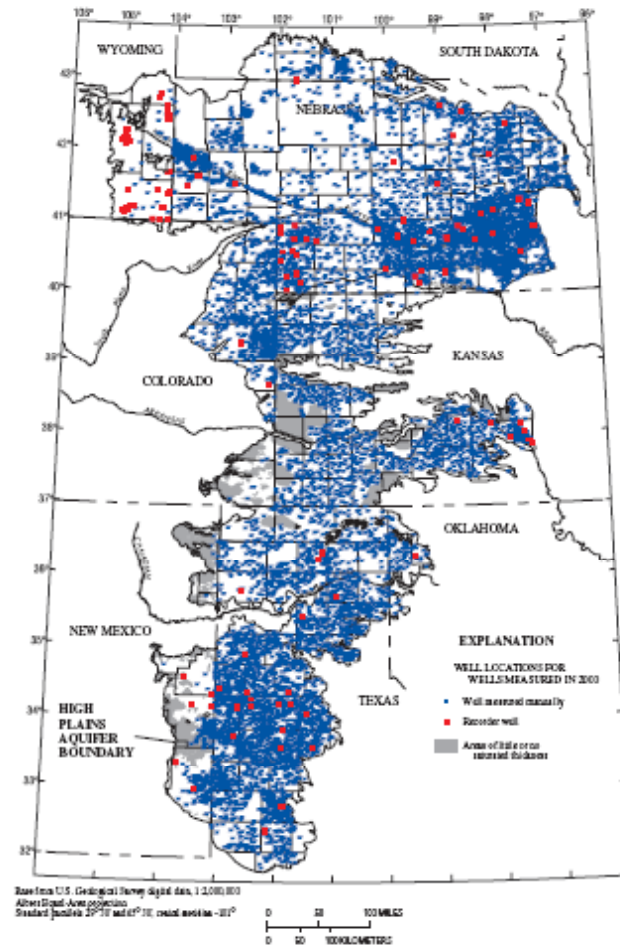
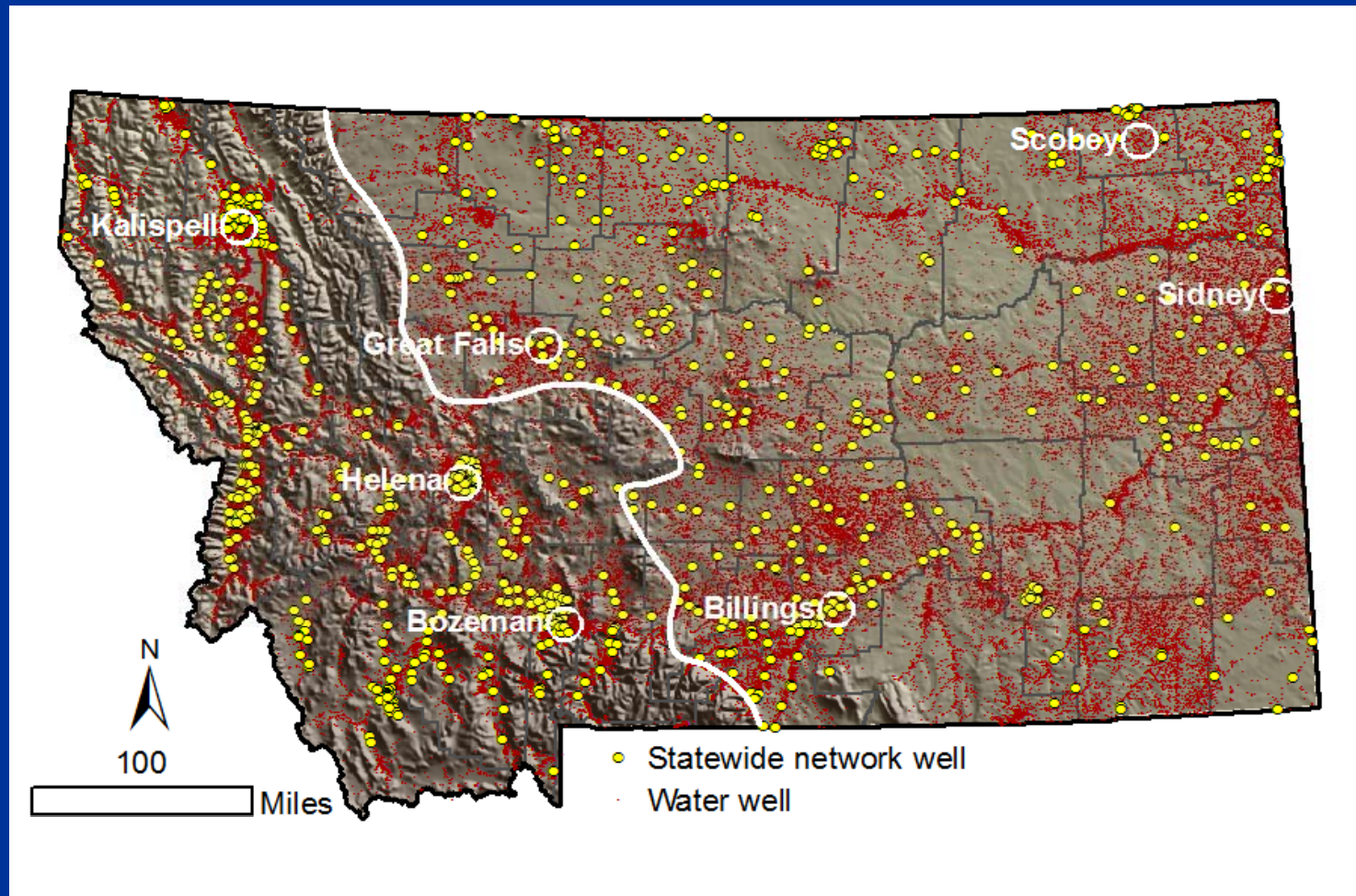


Figure 11. Well locations for wells screened in the High Plains aquifer and measured in the year 2000.

# Montana's Monitoring Network





# **SOGW**

- Objectives of the NGWMN are stated as questions
- Thus, the NGWMN is designed to address specific questions



# Questions Addressed

- **Level I: Required (Primary)**
  - Answered by NGWMN data, only
  - Regional and national scales
- **Level II – Encouraged (Secondary)**
  - Require ancillary data to answer
  - Local, State, Regional and National scales



# Examples of Level I Questions

- **What are baseline water level and quality conditions?**
- **How are conditions (levels and quality) changing over time?**

# Examples of Level II Questions

- **What are the impacts of climate variability on GW resources?**
- **What are the impacts to GW and SW due to excessive pumping?**

# Network Design Features

- **“Sub-Networks”**
  - ‘Unstressed’
  - ‘Targeted’
- **Monitoring “Categories”**
  - ‘Baseline’
  - ‘Surveillance’
  - ‘Trend’
  - ‘Special Studies’

# Network Design Features

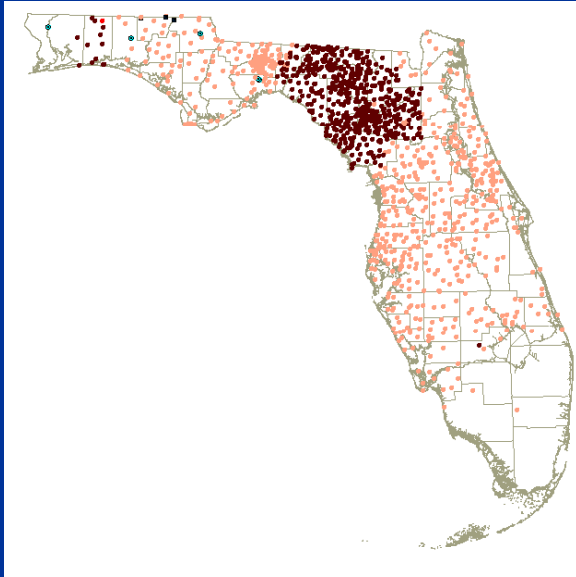
- **Unstressed** – areas that have either no stress or have only been minimally impacted by human activities.

# Network Design Features

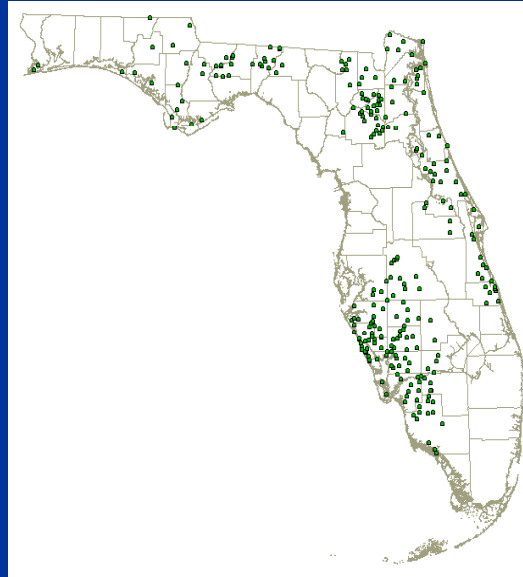
- **“Targeted”**
  - Areas that are, or are anticipated to be, influenced by human activities
    - Pumping stress
    - Impaired ground-water quality

# Network Design Features

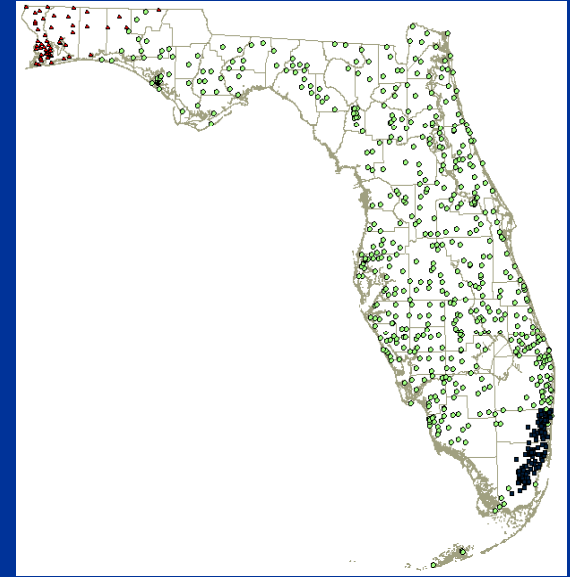
- **Monitoring “Categories”**
  - **‘Baseline’**
    - Initial Event, “Before”
  - **‘Surveillance’**
    - Periodic synoptic long-term trends
  - **‘Trend’**
    - Periodic (higher freq, more stations  
Evaluate for trends and seasonality)
    - **Special studies: Variable**



**Floridan  
Aquifer  
System**



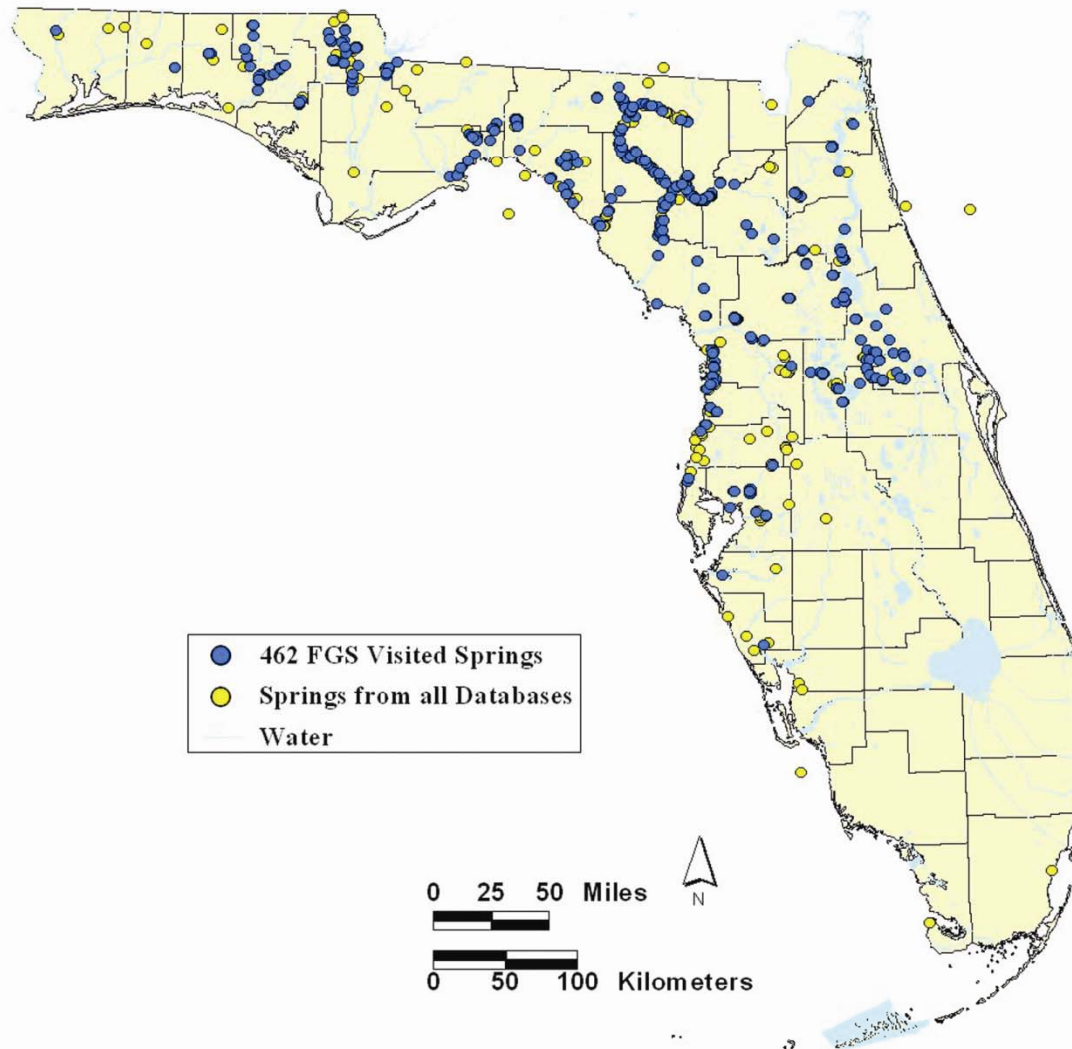
**Intermediate  
Aquifer  
System**



**Surficial  
Aquifer  
System**

**Distribution of Florida's GW Quality Monitoring Network**





Location of Springs in Florida

# Example - Before and After

Baseline (or initial); Before and After  
Surveillance – using two synoptic events

- Springs of Florida – ↑ Nitrate Contamination
- FL Springs Task Force 1999 – How severe?
- 63 springs sampled in both 1972 and 2001

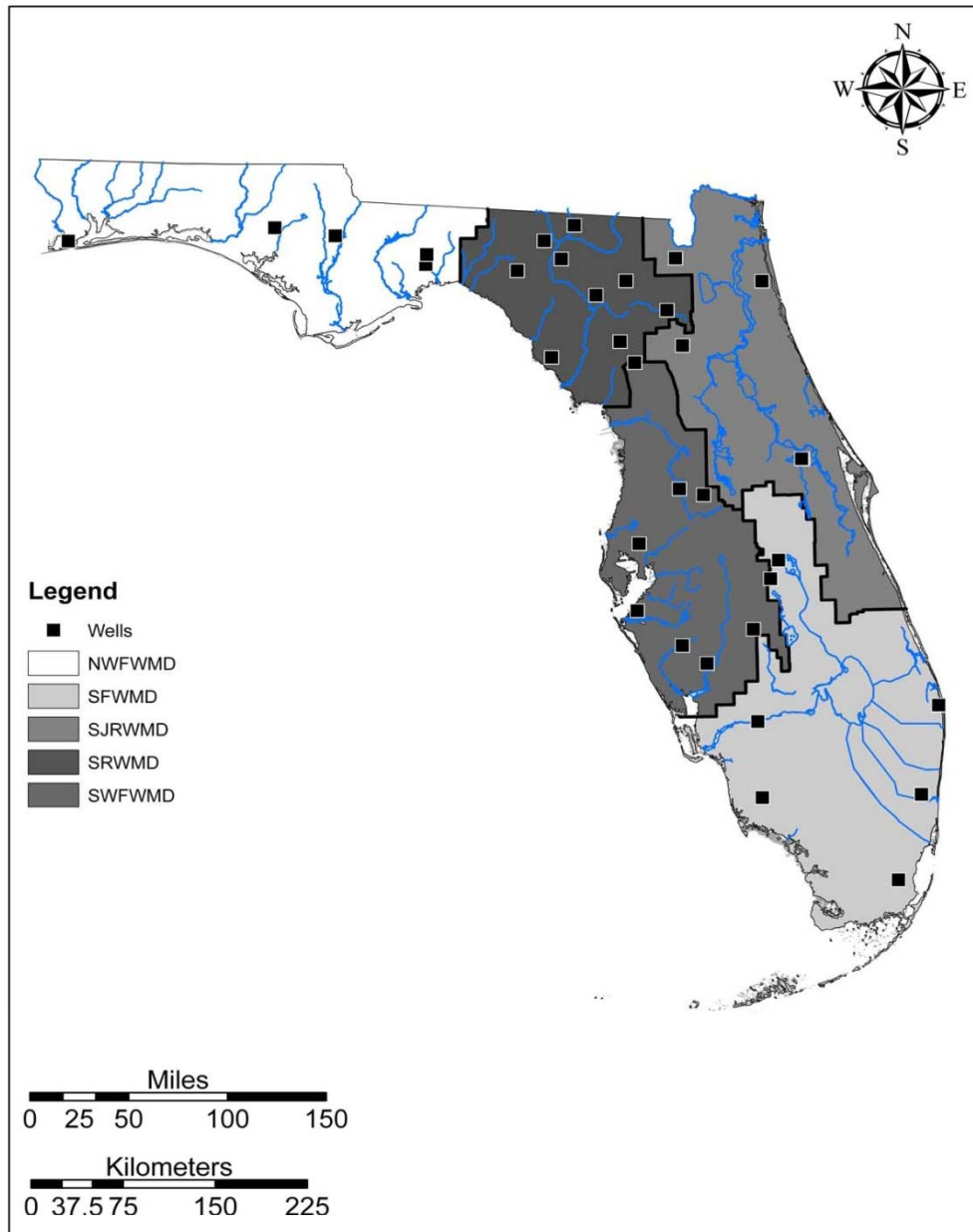
# Example - Before and After Surveillance

- **Baseline (Before)** (Rosenau et al. ,1977)
  - mean = 0.42 mg/L      median = 0.20 mg/L
- **After** (Scott et al. 2004)
  - mean = 0.73 mg/L      median = 0.43 mg/L
- **Difference (means)** – Significant (P-Val = 0.02)

# Example – Trend Monitoring

(Periodic re-sampling; Long-term trends)

- **46** wells (Florida's “**Backbone**” Net)
- Three Aquifer Systems
- Network - Operational since 1991



Location of Florida's Trend Monitoring Wells

# Trend Monitoring

## Significant Trends (1991 – 2003)

- Severe Drought 1998-2002



## Statewide Trends

Variable	Trend Direction	P-Value
Water Level	Down	0.014
Temperature	Up	<0.001
pH	Down	<0.001
Ca	Down	<0.001

# Significant Statewide Trends Springs (1991 – 2003)

Variable	Trend Direction	P-Value
Flow	Down	0.007
Alk	Up	<0.001
Ca	Up	<0.001
Cl	Up	<0.001
F	Up	<0.001
K	Up	0.001
Mg	Up	<0.001
Na	Up	0.007
SC	Up	<0.001
Sr	Up	<0.001
SO <sub>4</sub>	Up	<0.001
TDS	UP	<0.001

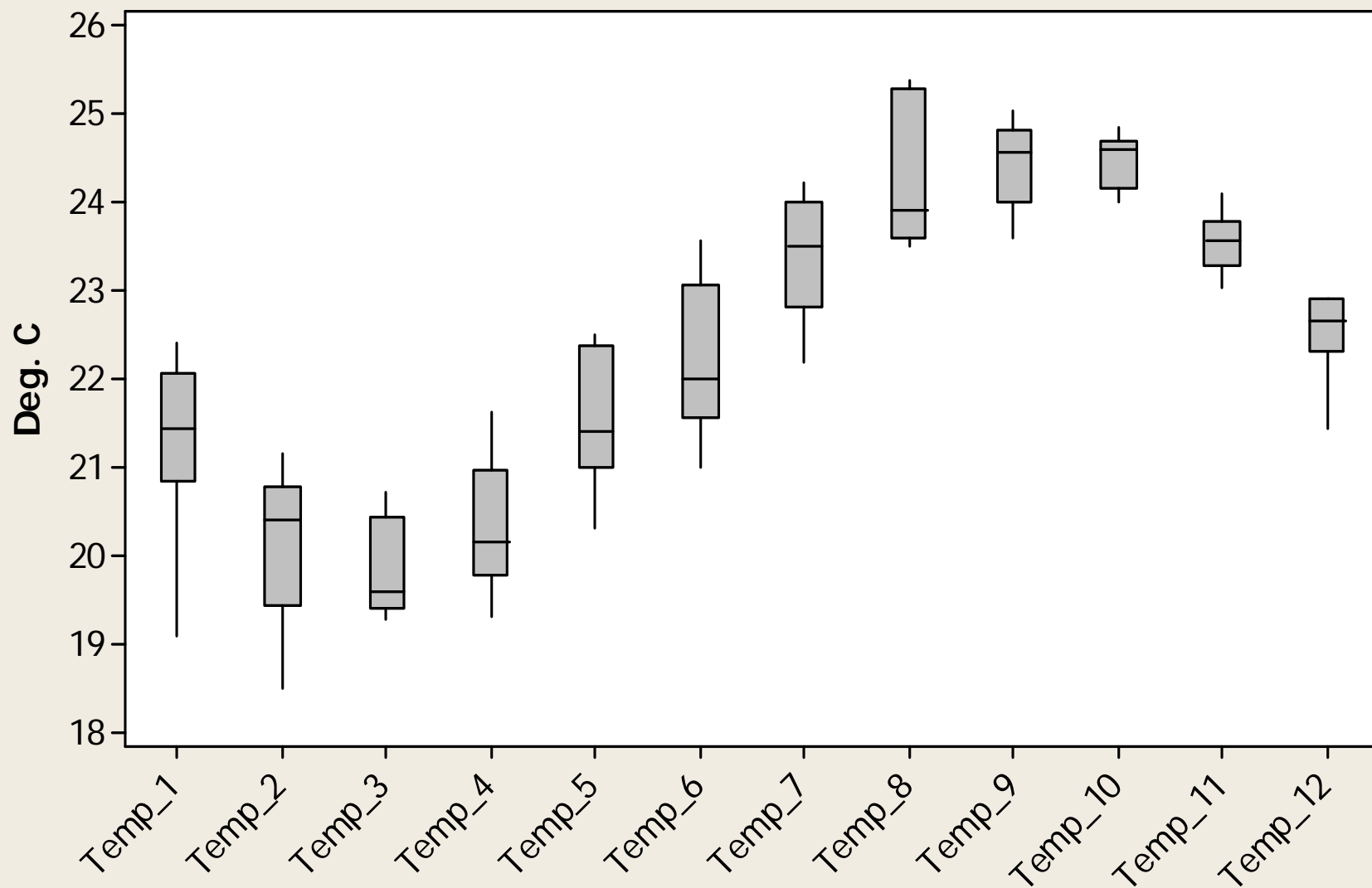


# Example - Trend Monitoring

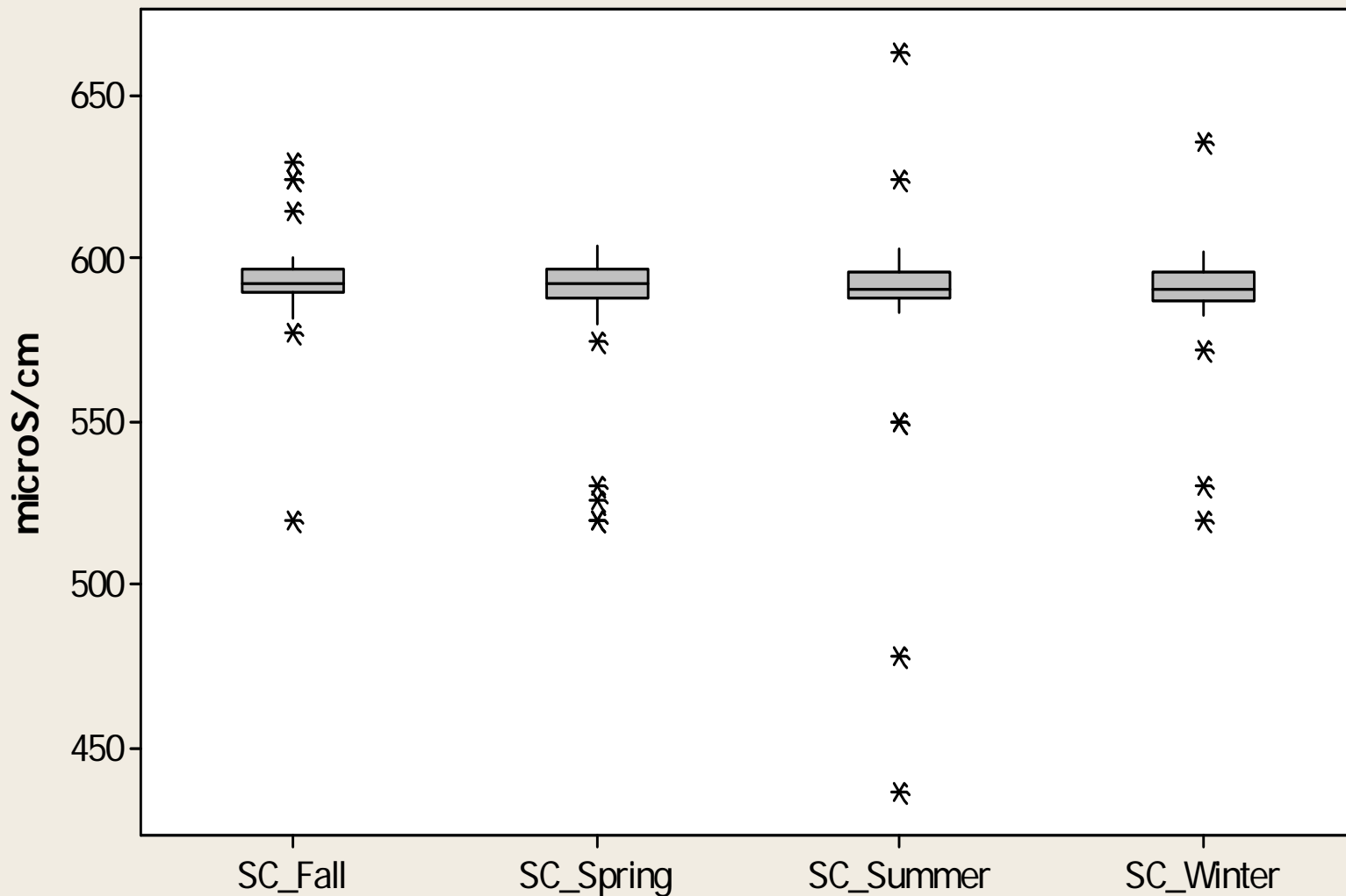
(Check and seasonality)

- **Florida Checked for seasonality**  
**26** variables
- **Period of record: 1991-2003**
- **Results are given for two:**
  - **Temperature (Temp)**
  - **Specific Conductance (SC)**

## Seasonality for Temp in Well 2465



### Field SC - No Seasonality Well 1087



K-W Test ; P-Val = 0.648

# Of Interest

## Seasonality in FL GW

- Scales - Monthly and Quarterly

• Variable	Frequency
• Temperature	Often
• Alkalinity	Moderate
• All others	Rare

# Example: Control - Impact

- **NO<sub>3</sub>** in GW
  - **Surficial Aquifer System**
- “Citrus Ridge” VISA (**Targeted**)
- FL’s Background Net. (**Unstressed**)

FLORIDA GEOLOGICAL SURVEY



Figure 3. VISA Network

# Results

- **NO3** in GW - “Citrus Ridge” VISA
- **1996**

	# Wells	Med (mg/L)	P-Val	Conclusion
Unstressed	13	0.08		
VISA	15	17.00	<0.001	<b>VISA&gt;BkGrnd</b>



# I will be glad to answer questions

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