
Validation of DSM2 Volumetric Fingerprints Using Grab Sample Mineral Data

CWEMF Annual Meeting

March 2006

Presentation Content

- Objective
- Methodology
- Results
- Conclusions & Recommendations

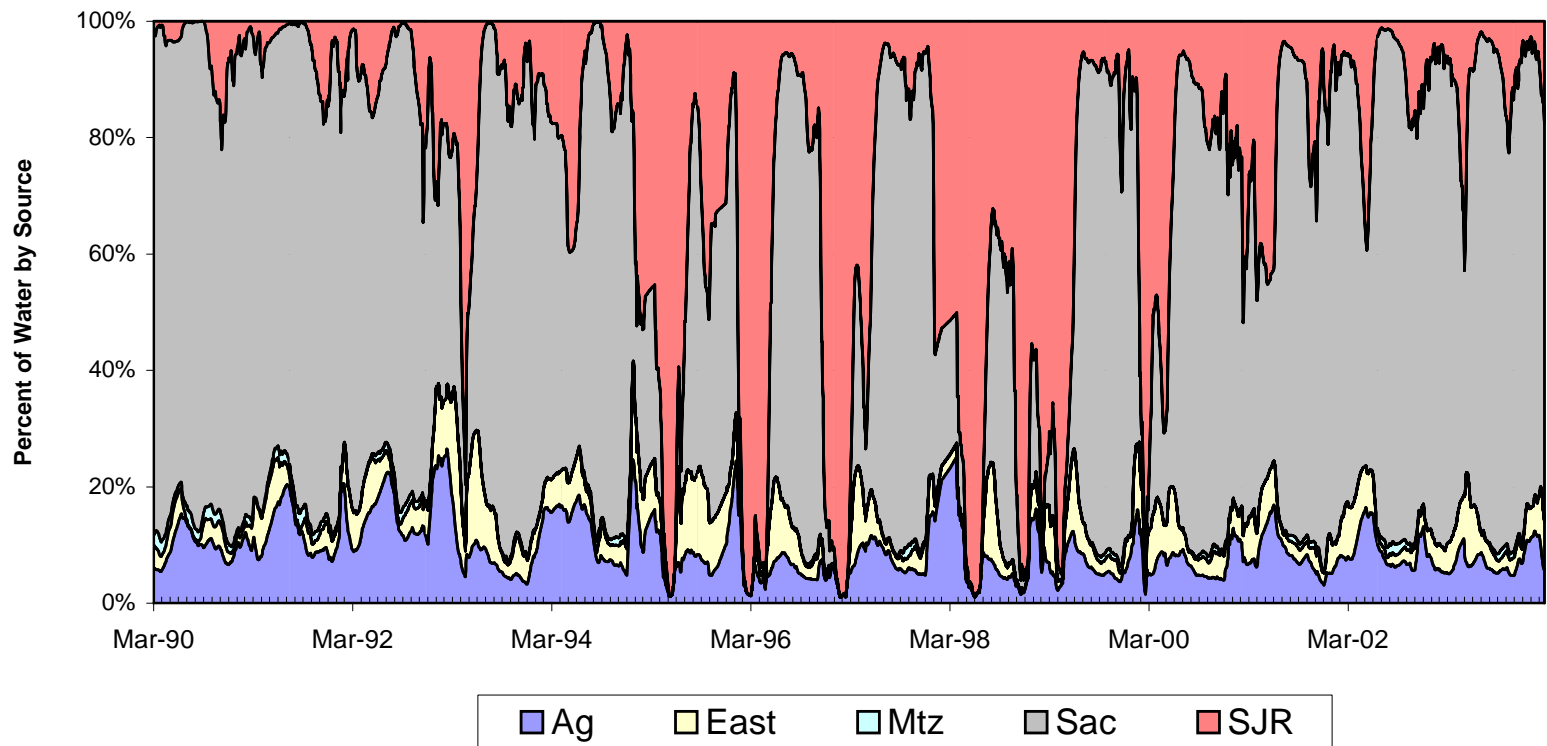
Objective

Develop an approach to validate volumetric fingerprinting results

Validate – According to Webster

To support or corroborate on a sound or authoritative basis

Volumetric Fingerprint at Banks
April 1990 - March 2004



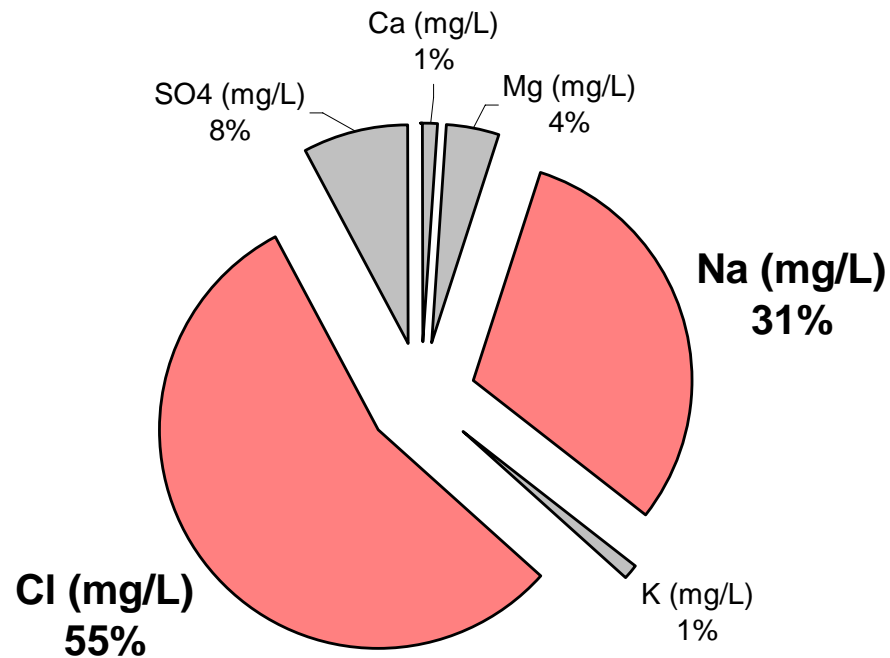
Presentation Content

- Objective
- Methodology
 - Typical Mineral Composition of Source Waters
 - Promising Source Fingerprints
 - Data
- Results
- Conclusions & Recommendations

Methodology

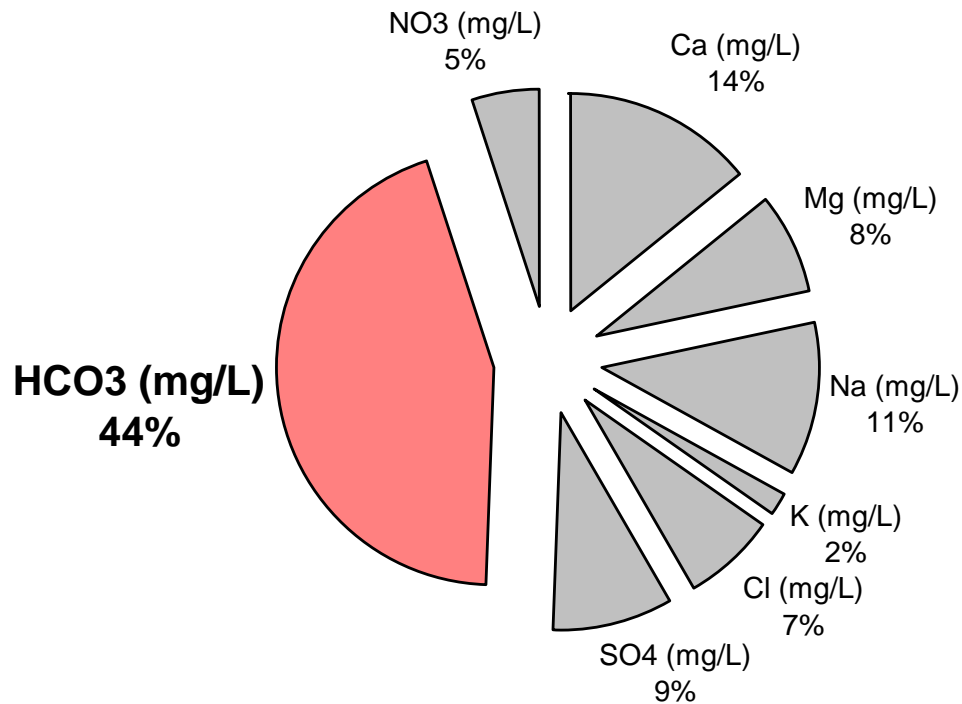
Investigate the value of mineral data in fingerprinting source water contributions at various Delta locations

Typical Mineral Composition Seawater (TDS = 34,500 mg/L)



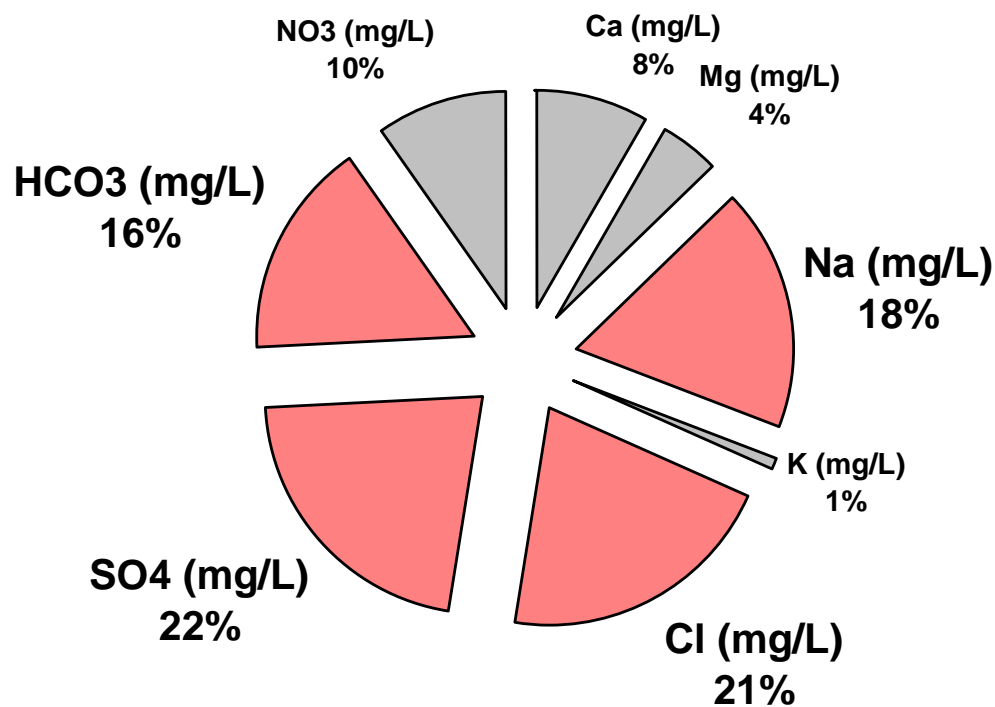
Typical Mineral Composition

Sacramento River at Greenes (TDS = 100 mg/L)



Typical Mineral Composition

San Joaquin River at Vernalis (TDS = 300 mg/L)



Methodology

Promising Source Fingerprints

- **Seawater has a high chloride-to-sulfate ratio**
 - Seawater ~ 7
 - Sacramento and San Joaquin Rivers ~ 1
- **San Joaquin River has a high proportion of sulfate relative to Sacramento River**
- **Sacramento River has a high proportion of bicarbonate relative to San Joaquin River**

Methodology

Data

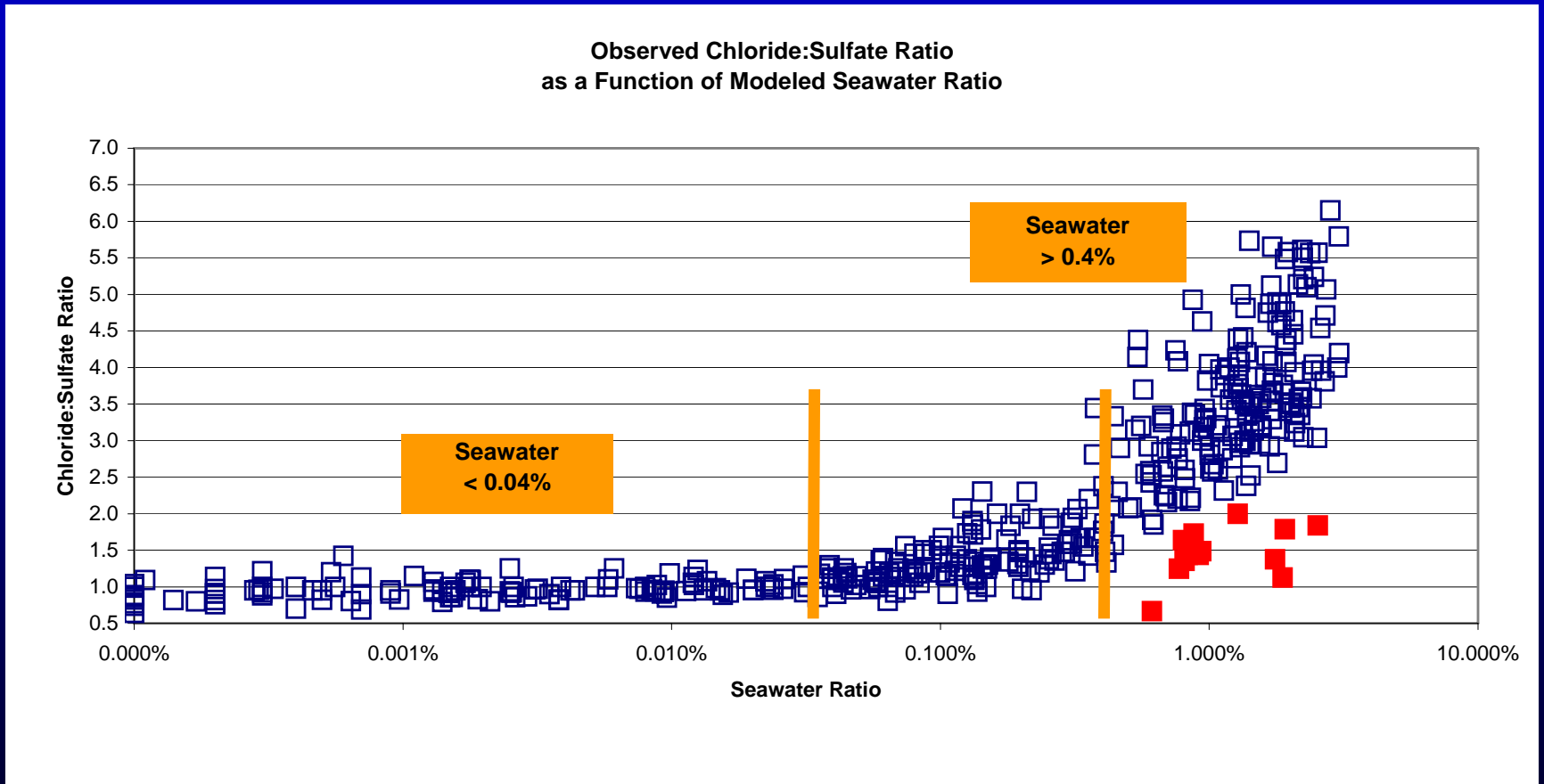
Location	Observations	Period	Source(s)
Old River @ Bacon	156	Nov 1994 – Oct 2005	MWQI
Banks	261	Apr 1990 – Mar 2004	MWQI DWR O&M
Tracy	141	Apr 1990 – May 1999	MWQI

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 - Seawater Fingerprints
 - Riverine Fingerprints
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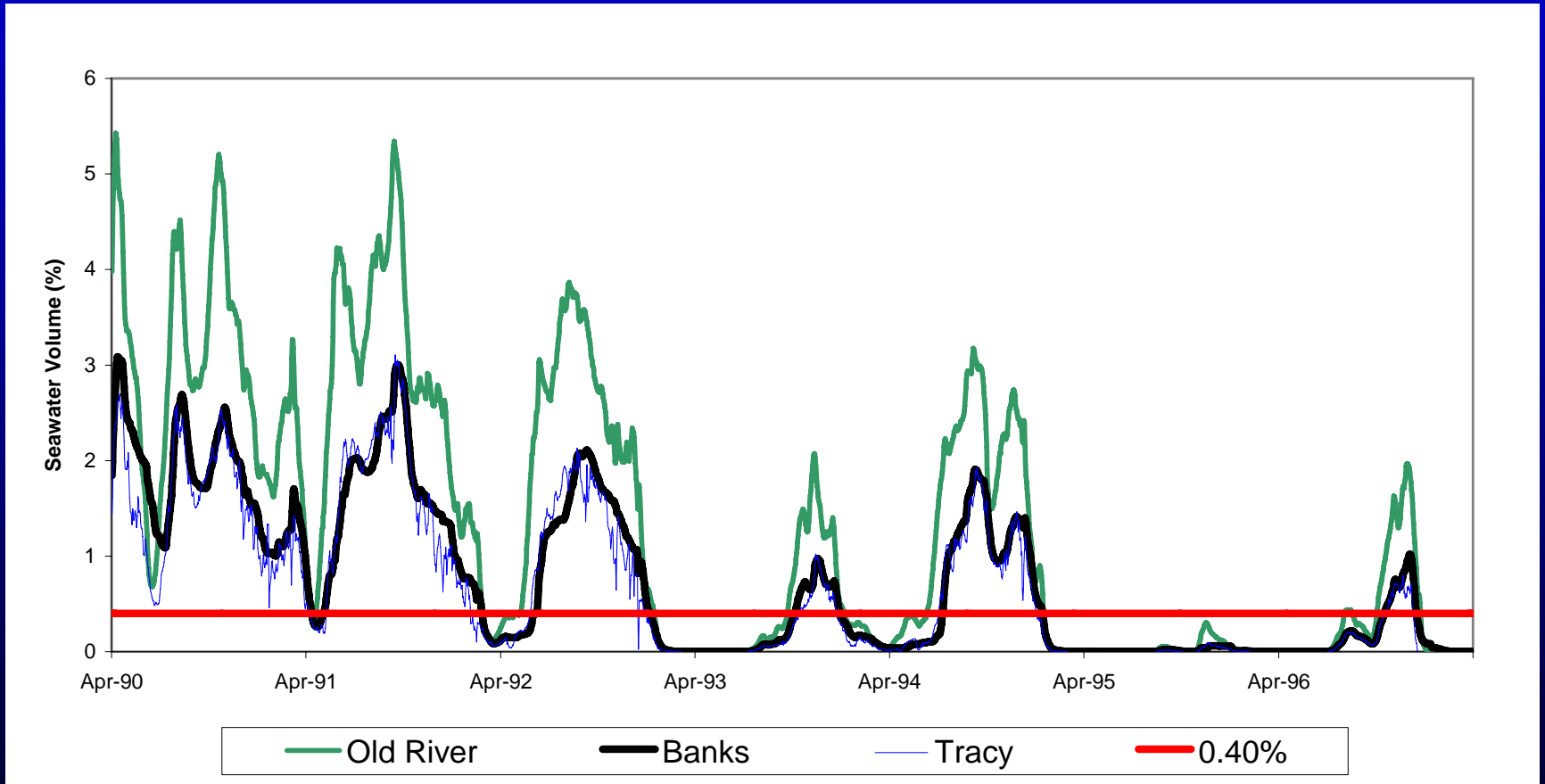
Seawater Fingerprint

Chloride-to-Sulfate Ratio



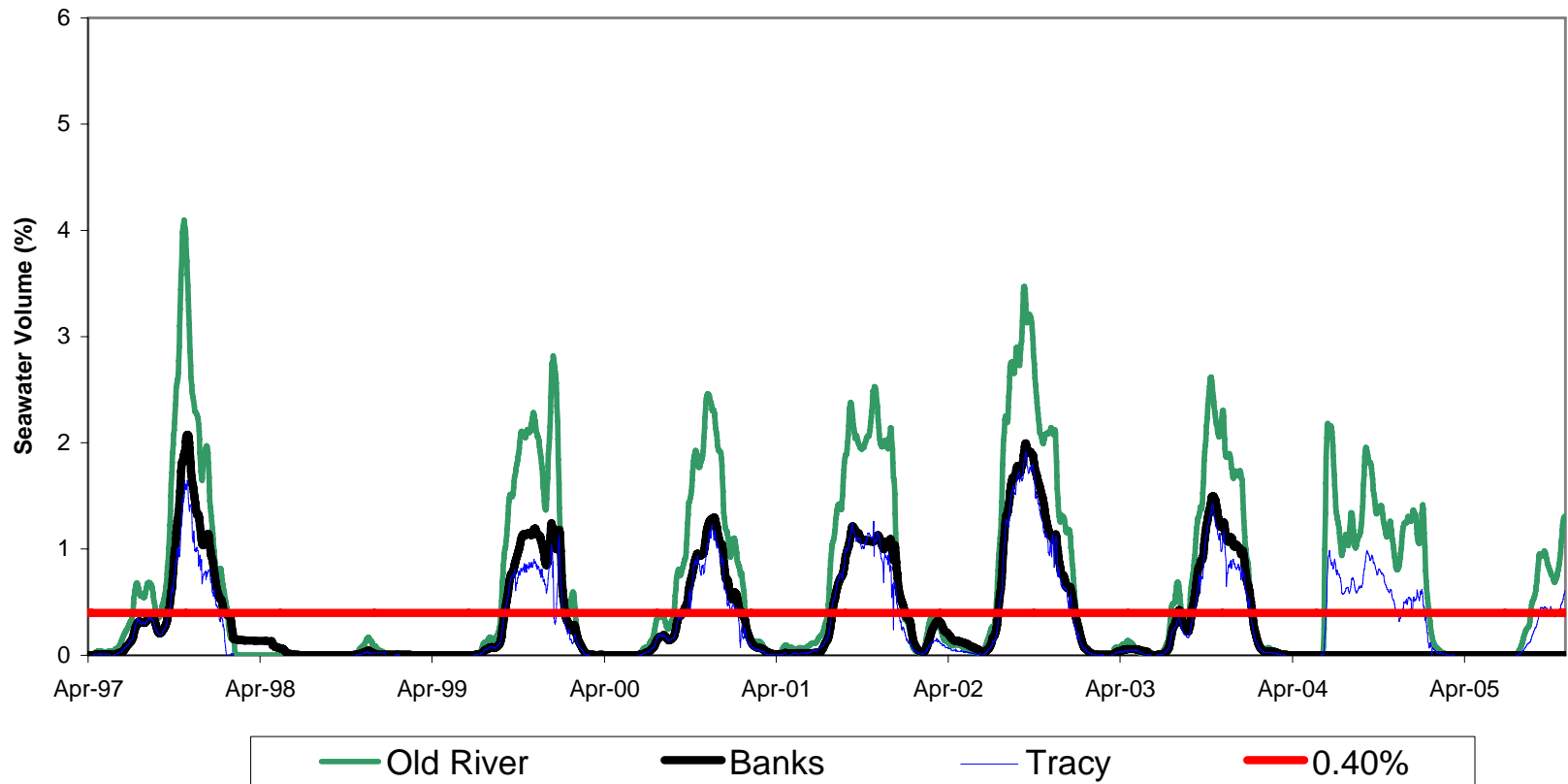
Seawater Fingerprint

Apr 1990 – Mar 1997

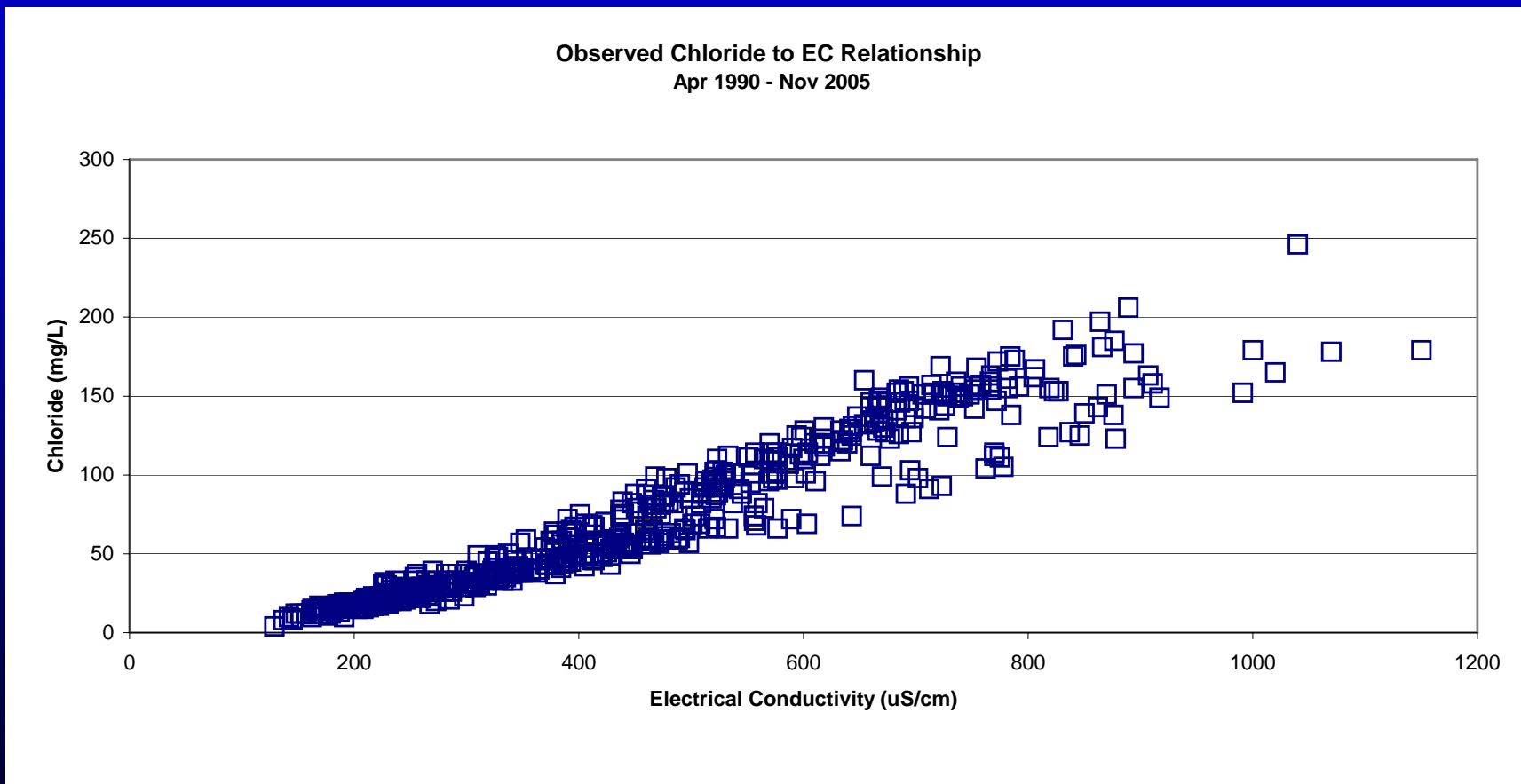


Seawater Fingerprint

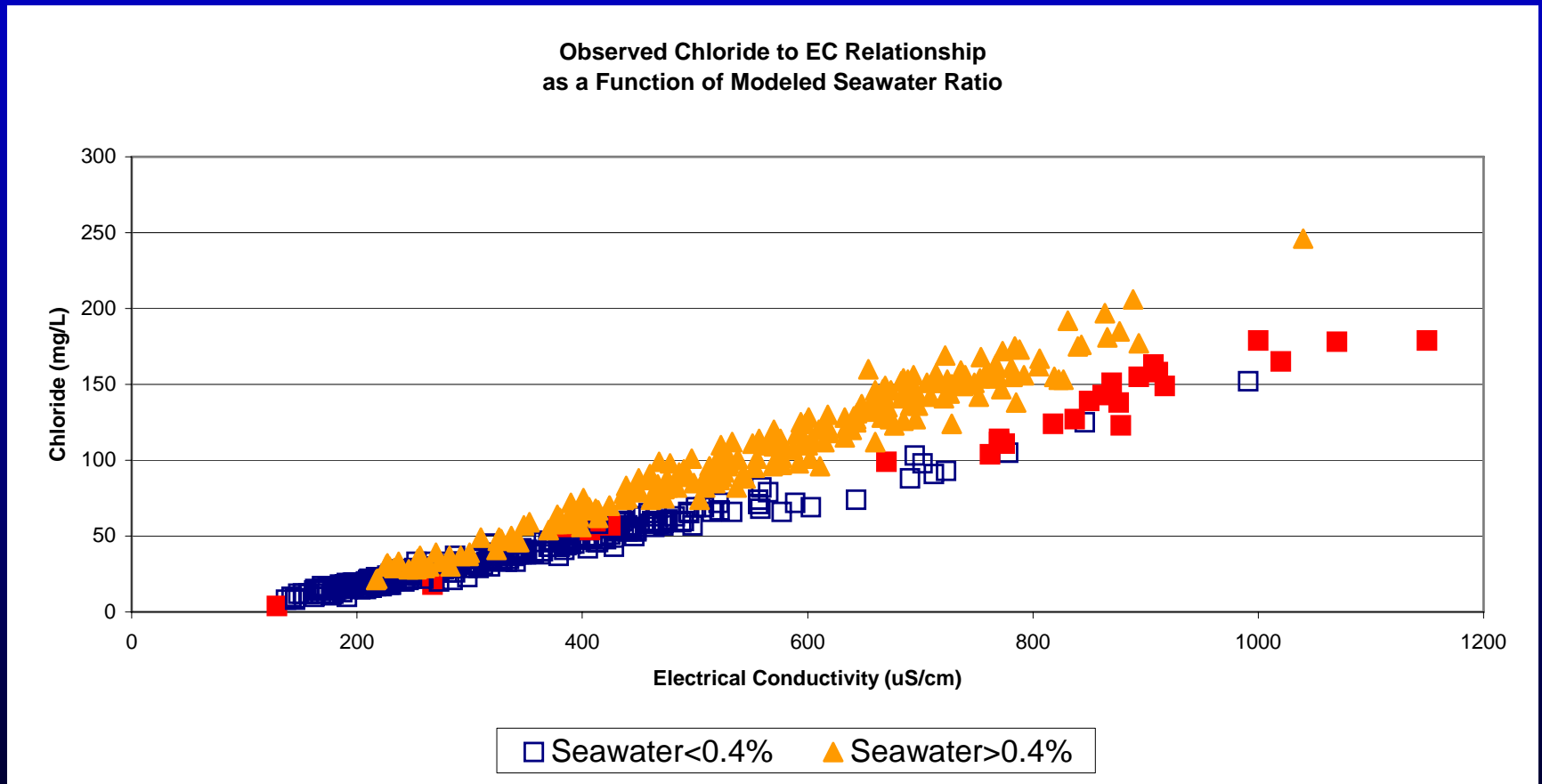
Apr 1997 – Oct 2005



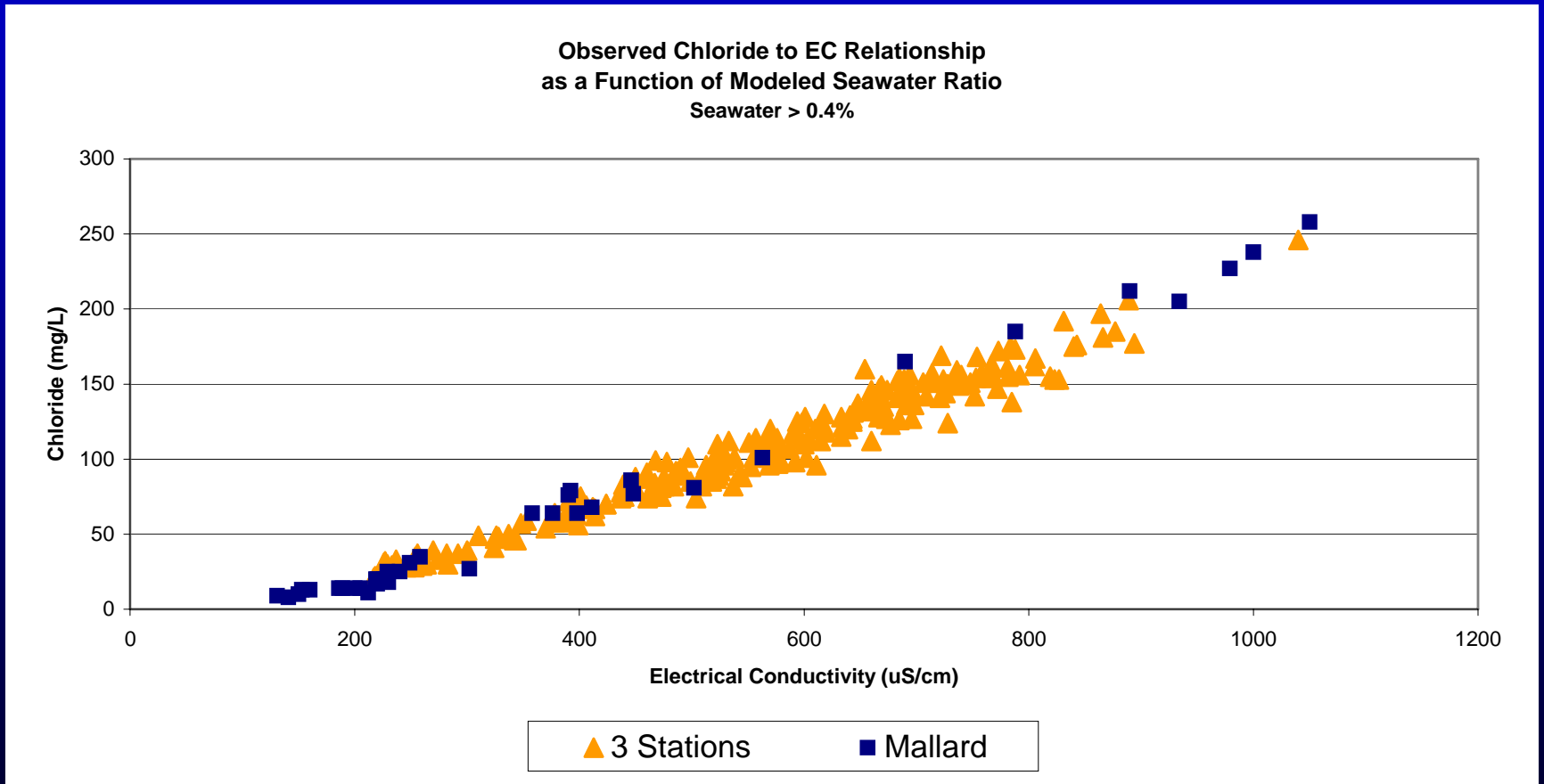
Seawater Fingerprint Chloride



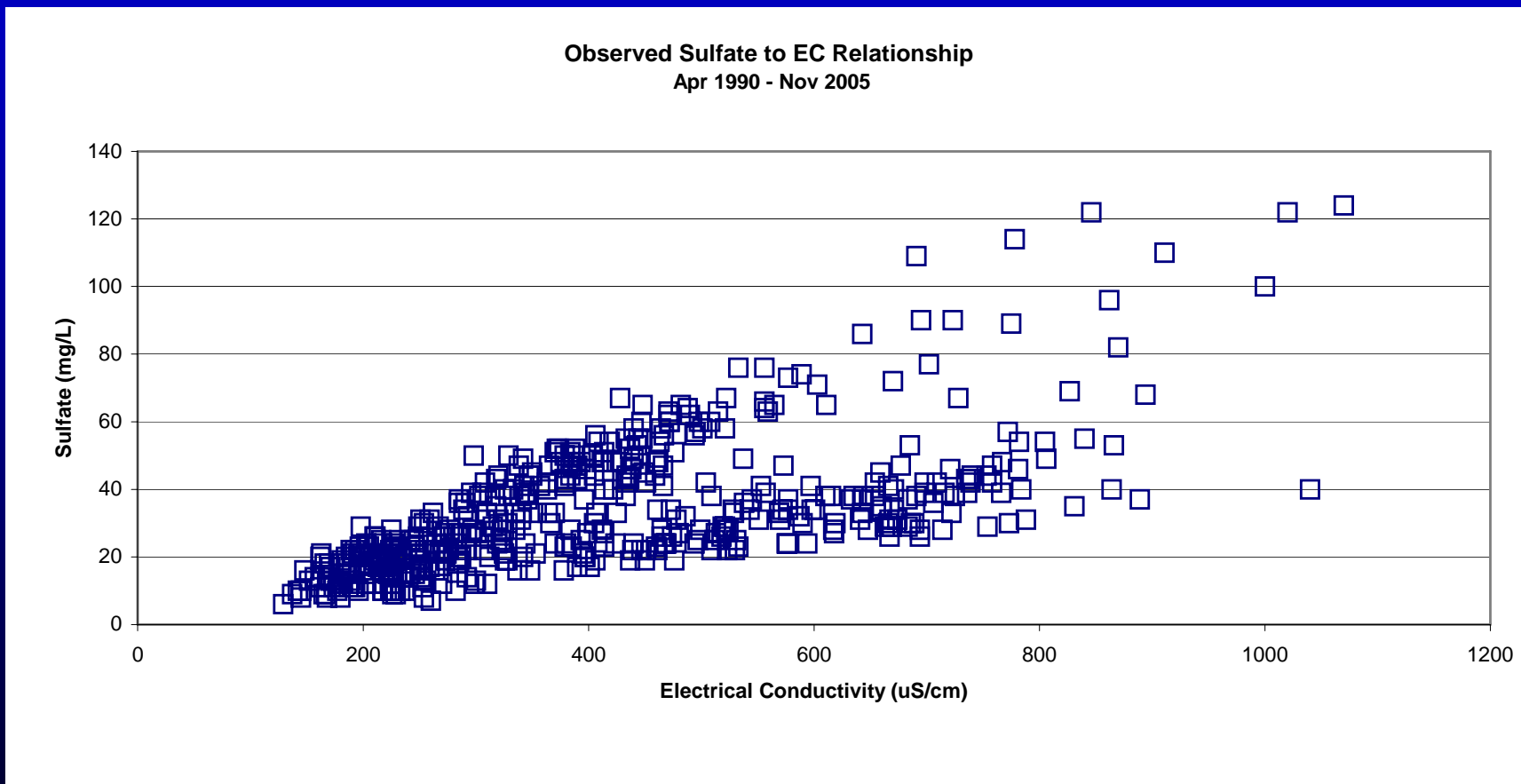
Seawater Fingerprint Chloride



Seawater Fingerprint Chloride

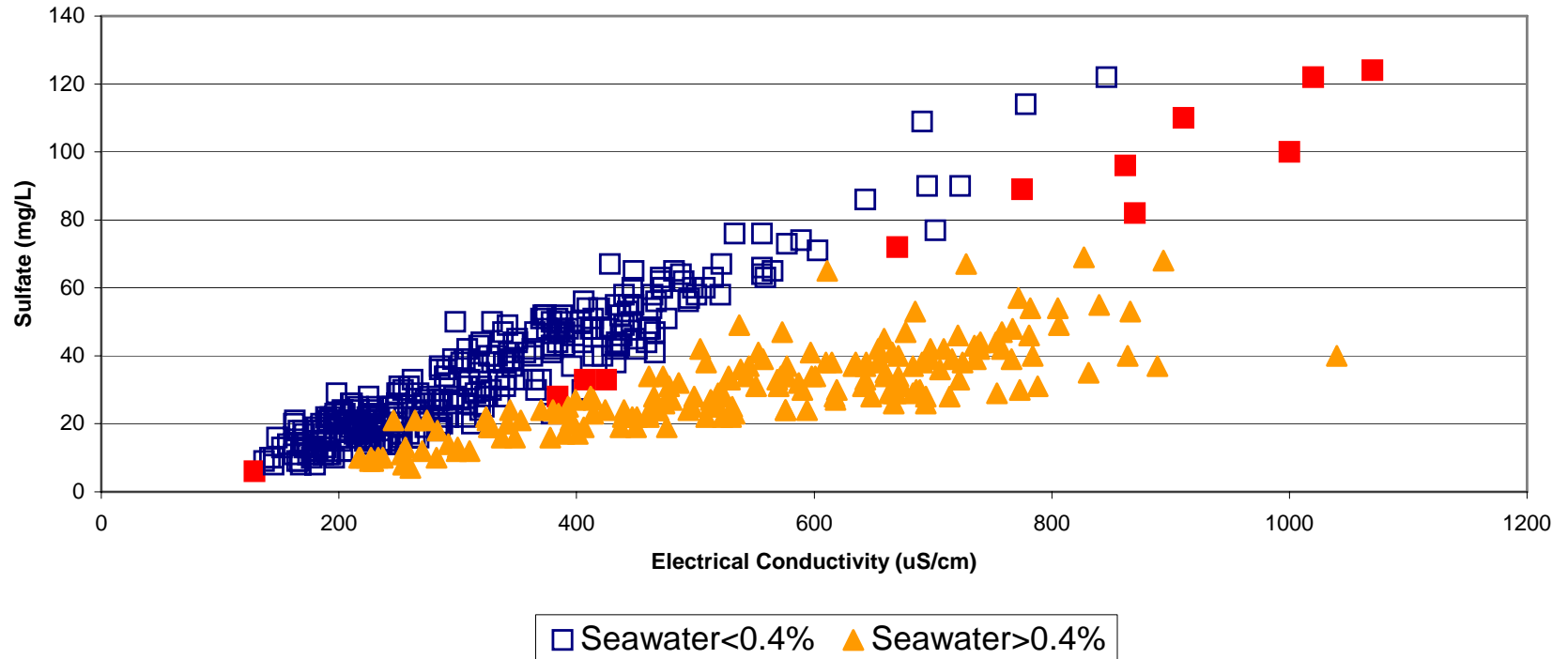


Seawater Fingerprint Sulfate

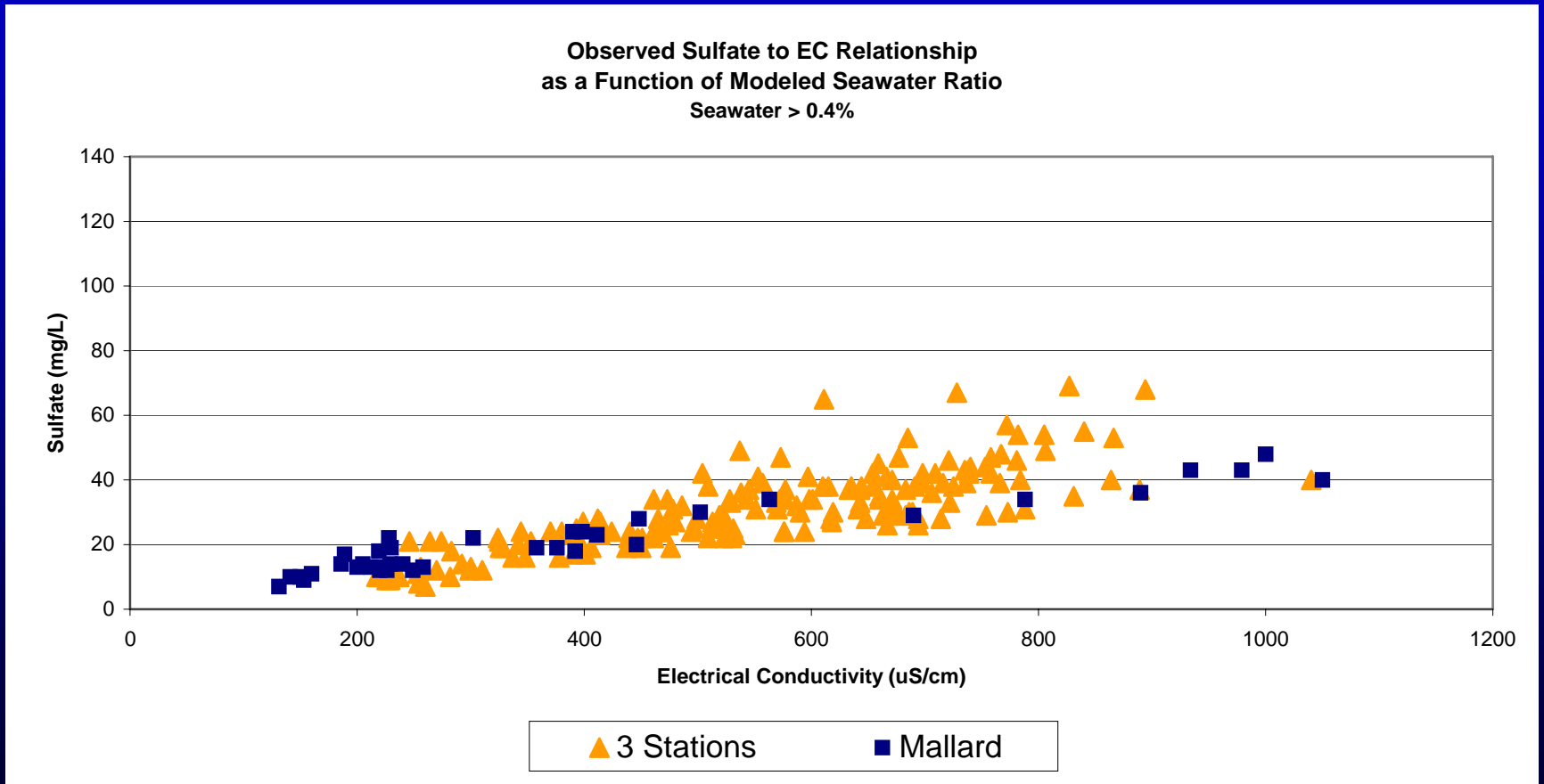


Seawater Fingerprint Sulfate

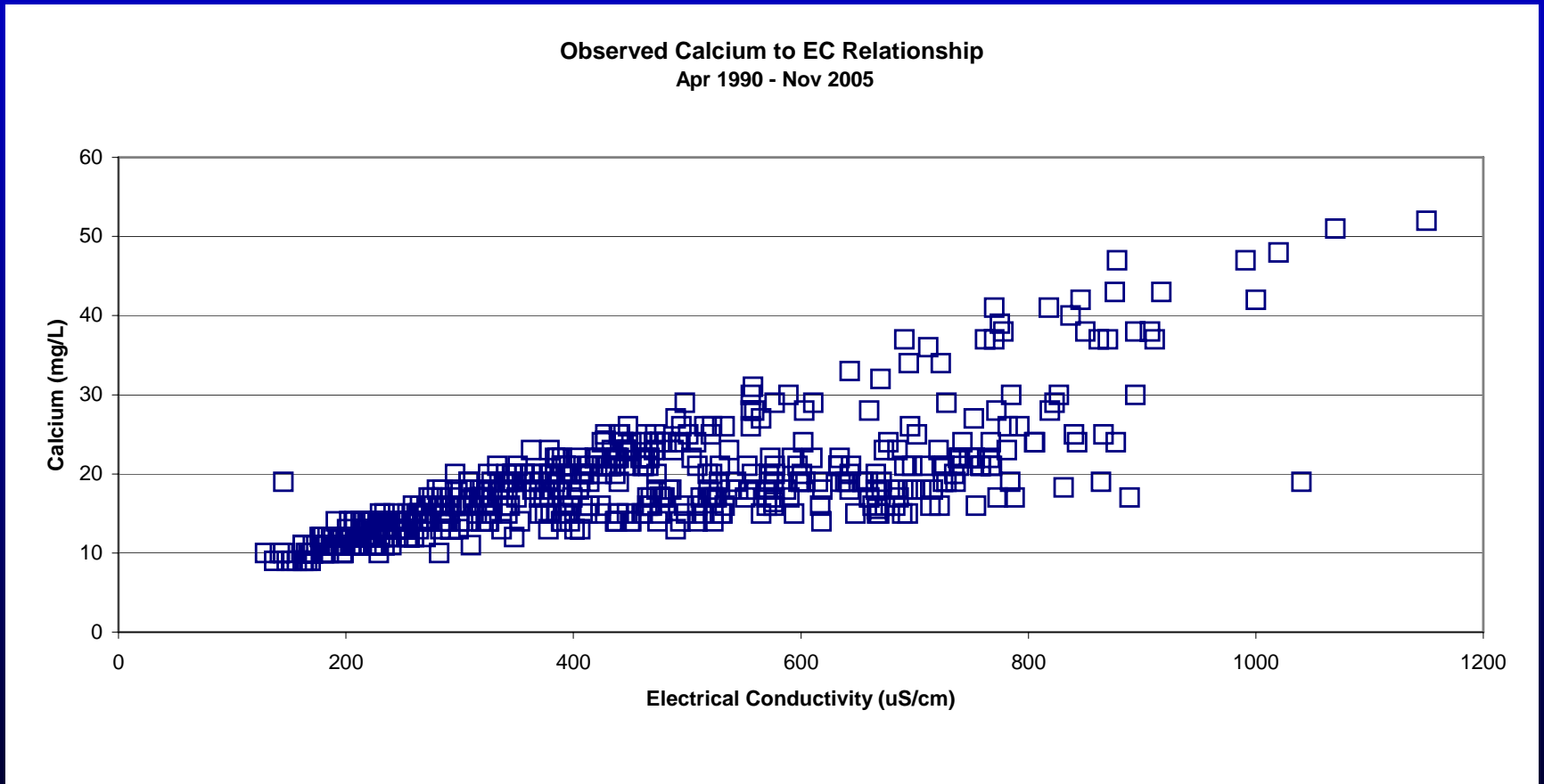
Observed Sulfate to EC Relationship
as a Function of Modeled Seawater Ratio



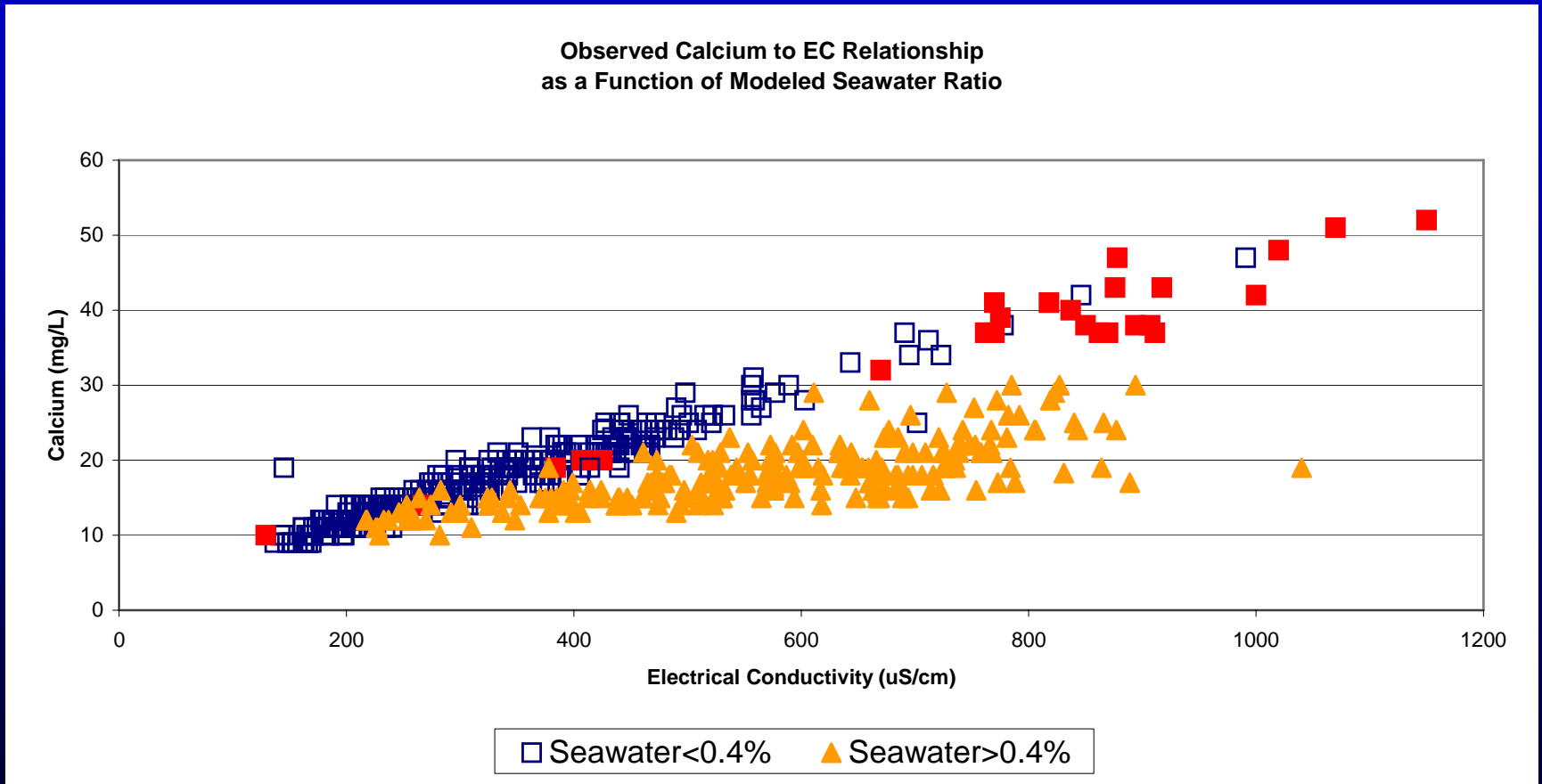
Seawater Fingerprint Sulfate



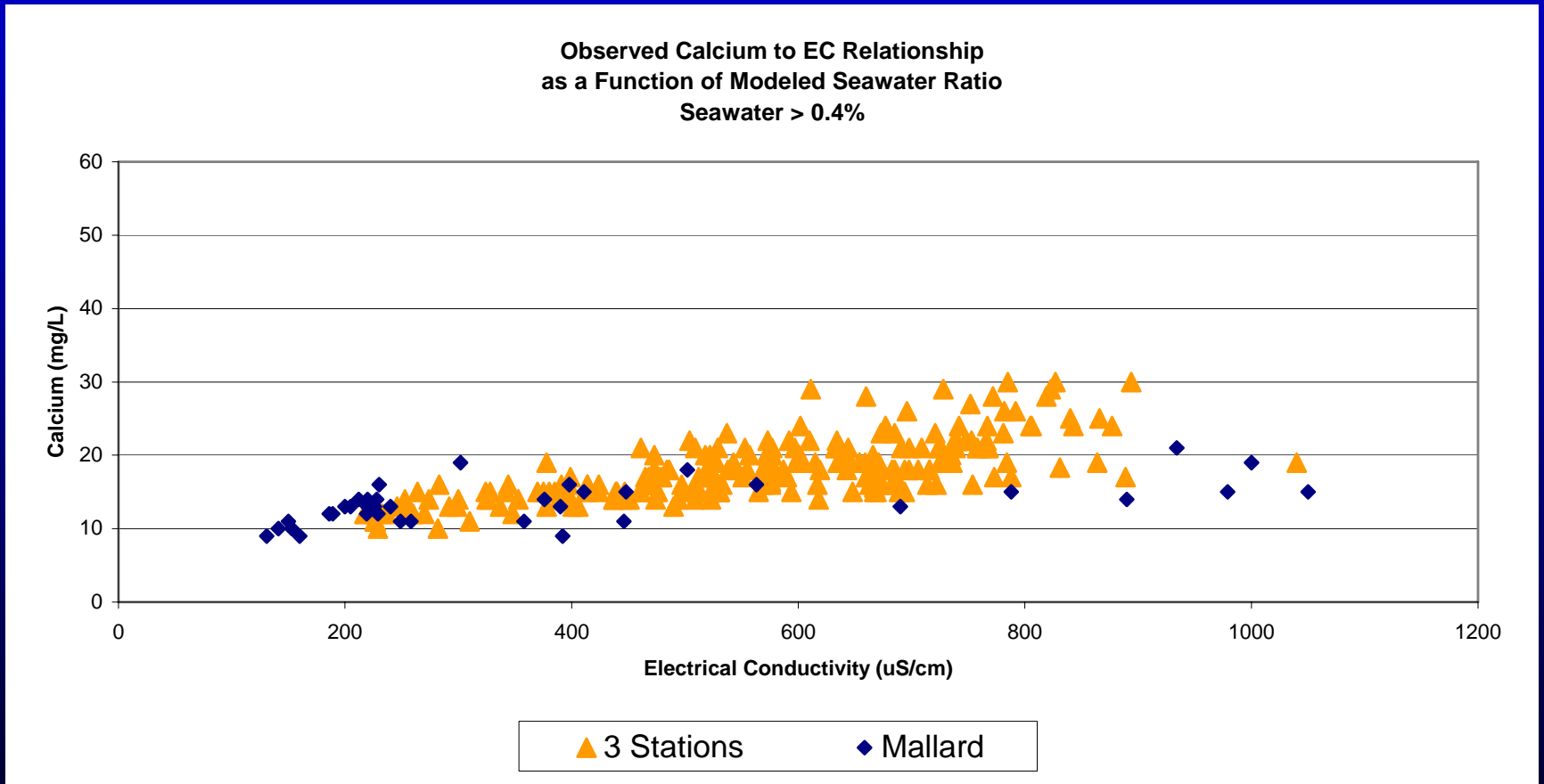
Seawater Fingerprint Calcium



Seawater Fingerprint Calcium



Seawater Fingerprint Calcium



Riverine Fingerprints

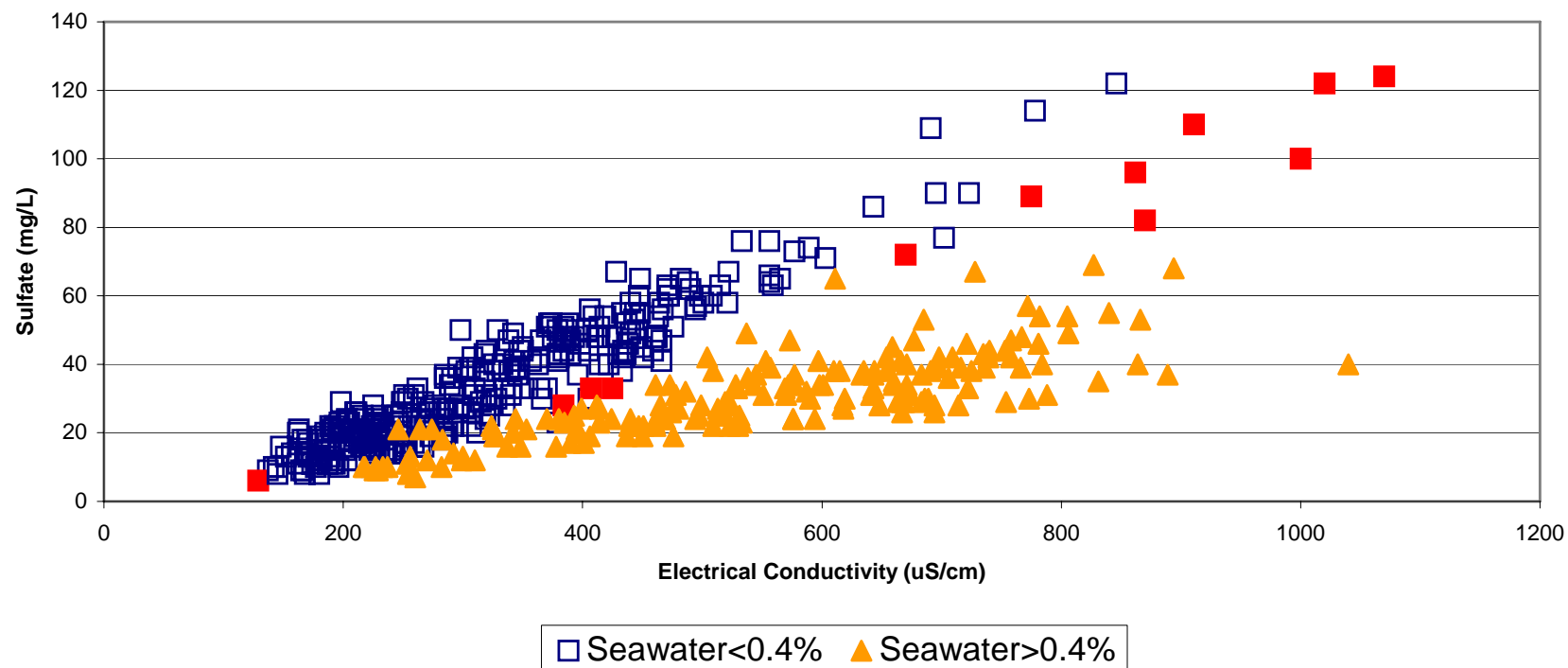
■ Classification

- Sac volume fingerprint $< 20\%$ (dominated by San Joaquin River and agricultural drainage)
- Sac volume fingerprint 20-80%
- Sac volume fingerprint $> 80\%$ (dominated by Sacramento and Mokelumne Rivers)

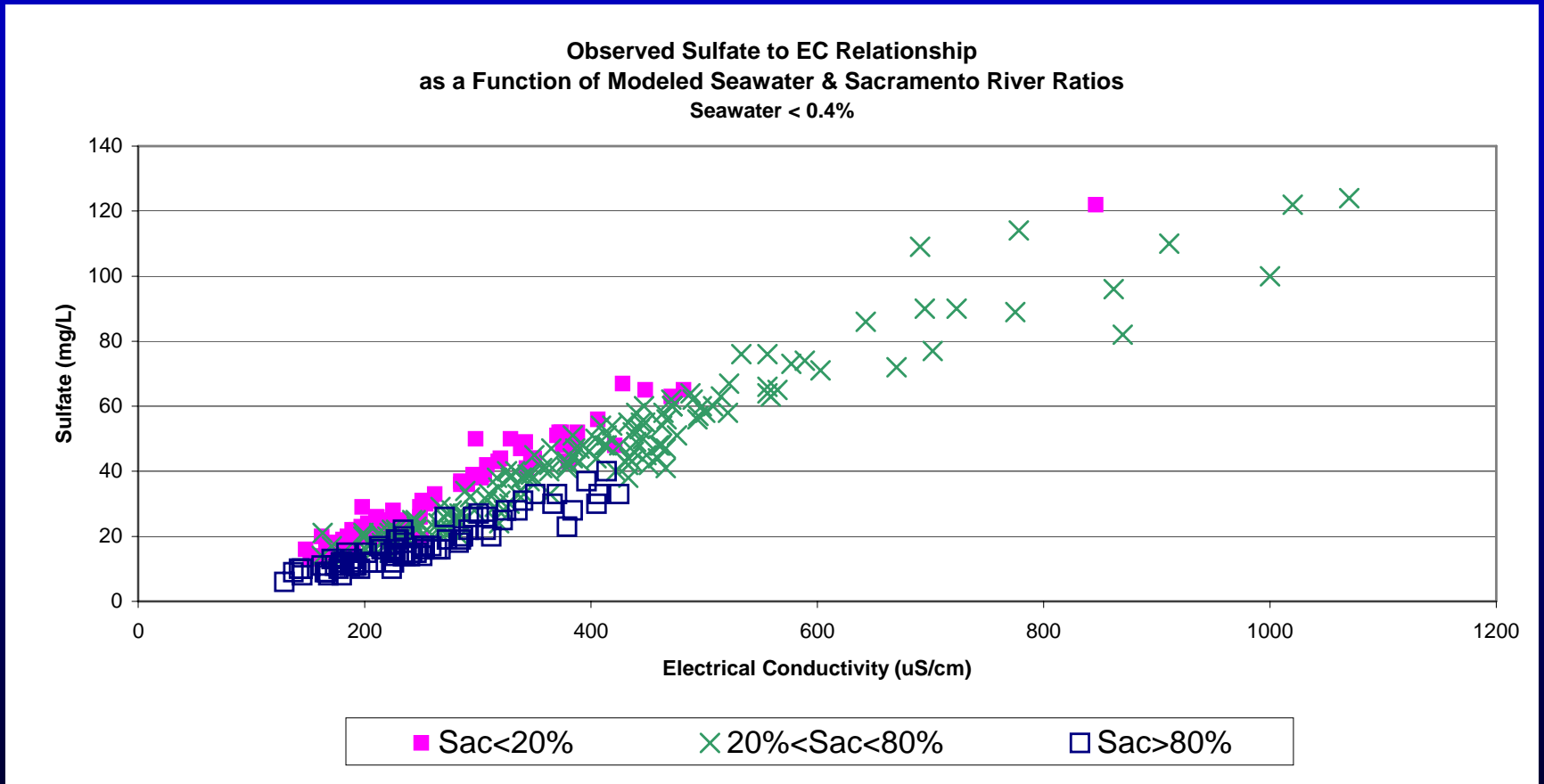
■ Riverine fingerprints are not detected when seawater $> 0.4\%$

Riverine Fingerprint Sulfate

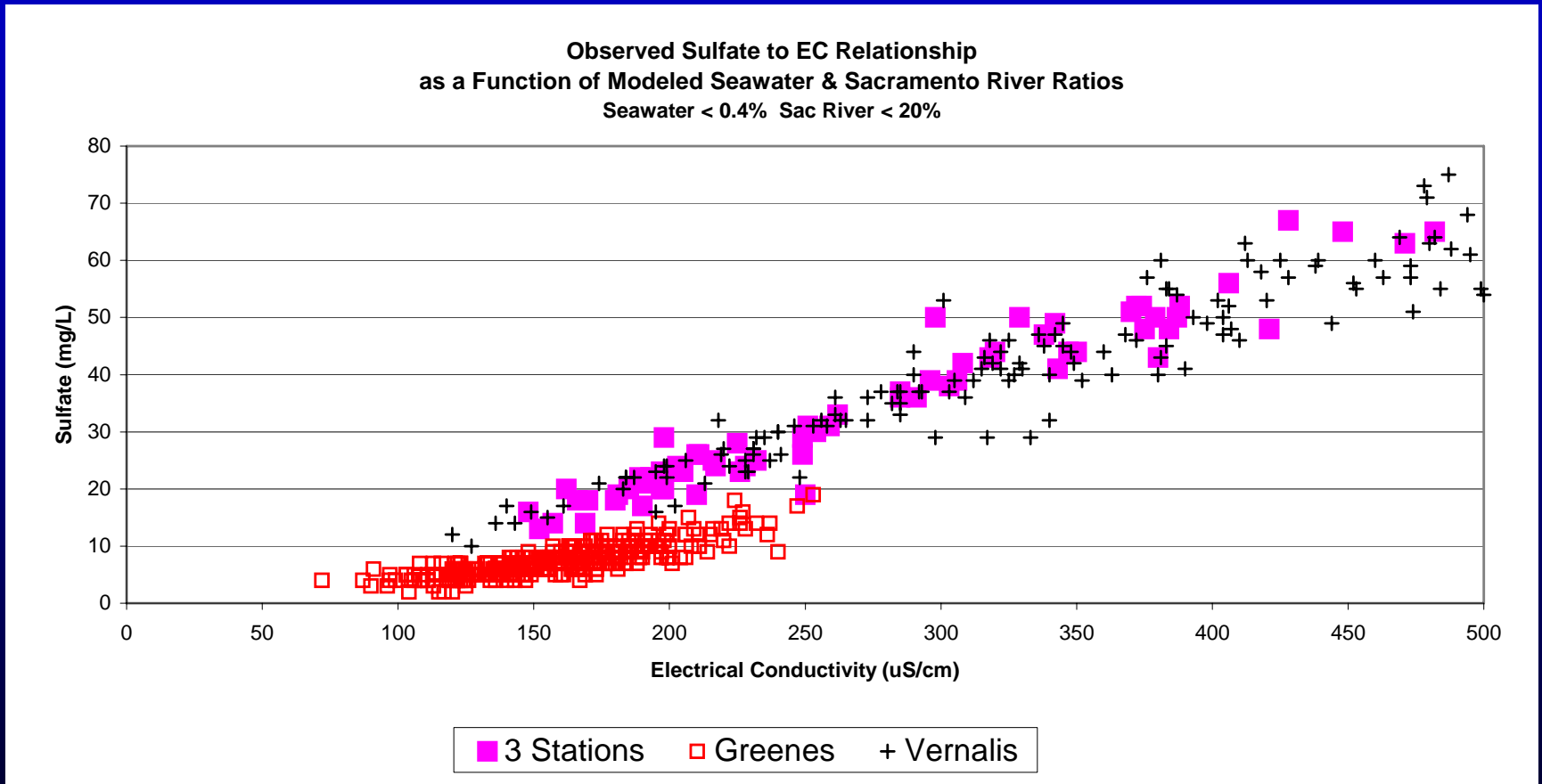
Observed Sulfate to EC Relationship
as a Function of Modeled Seawater Ratio



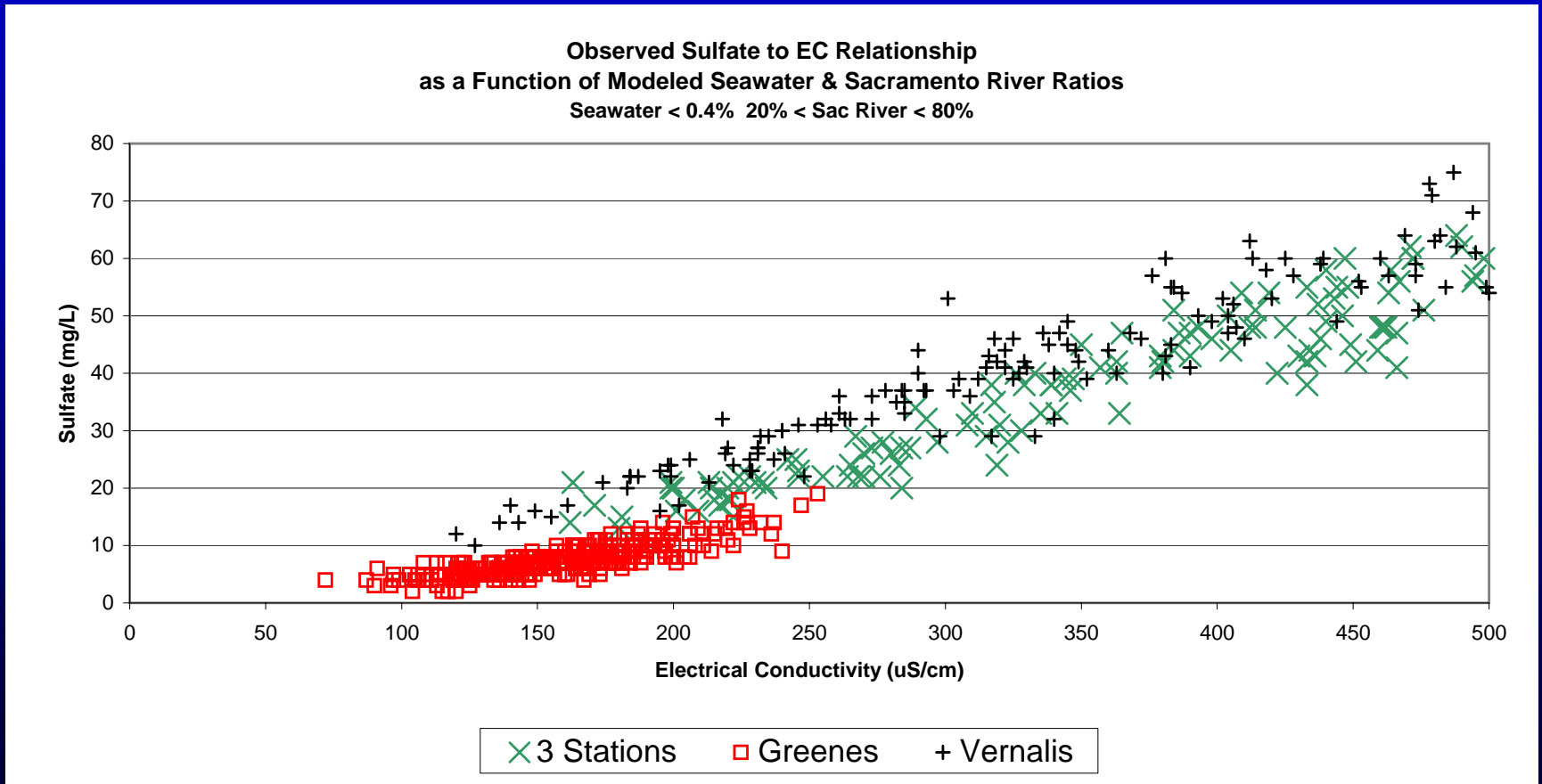
Riverine Fingerprint Sulfate



Riverine Fingerprint Sulfate

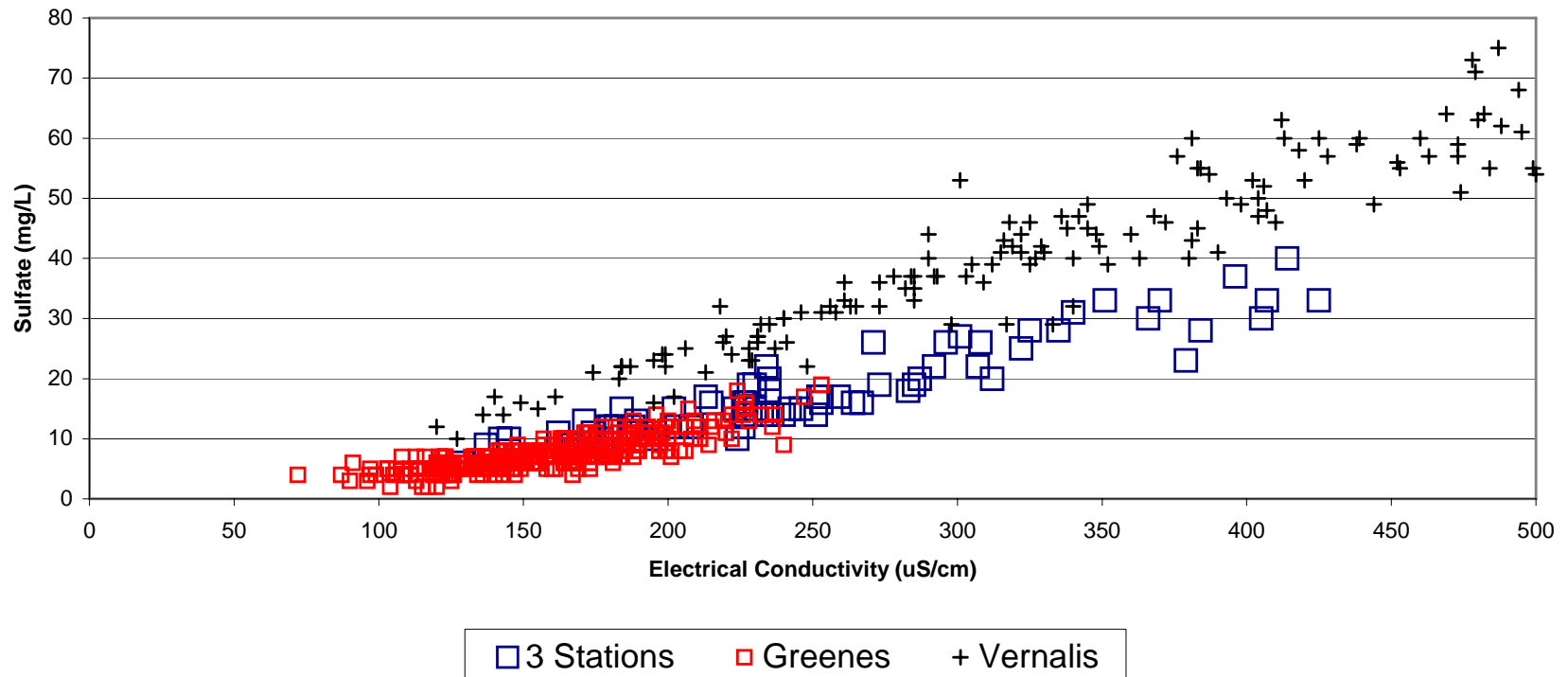


Riverine Fingerprint Sulfate

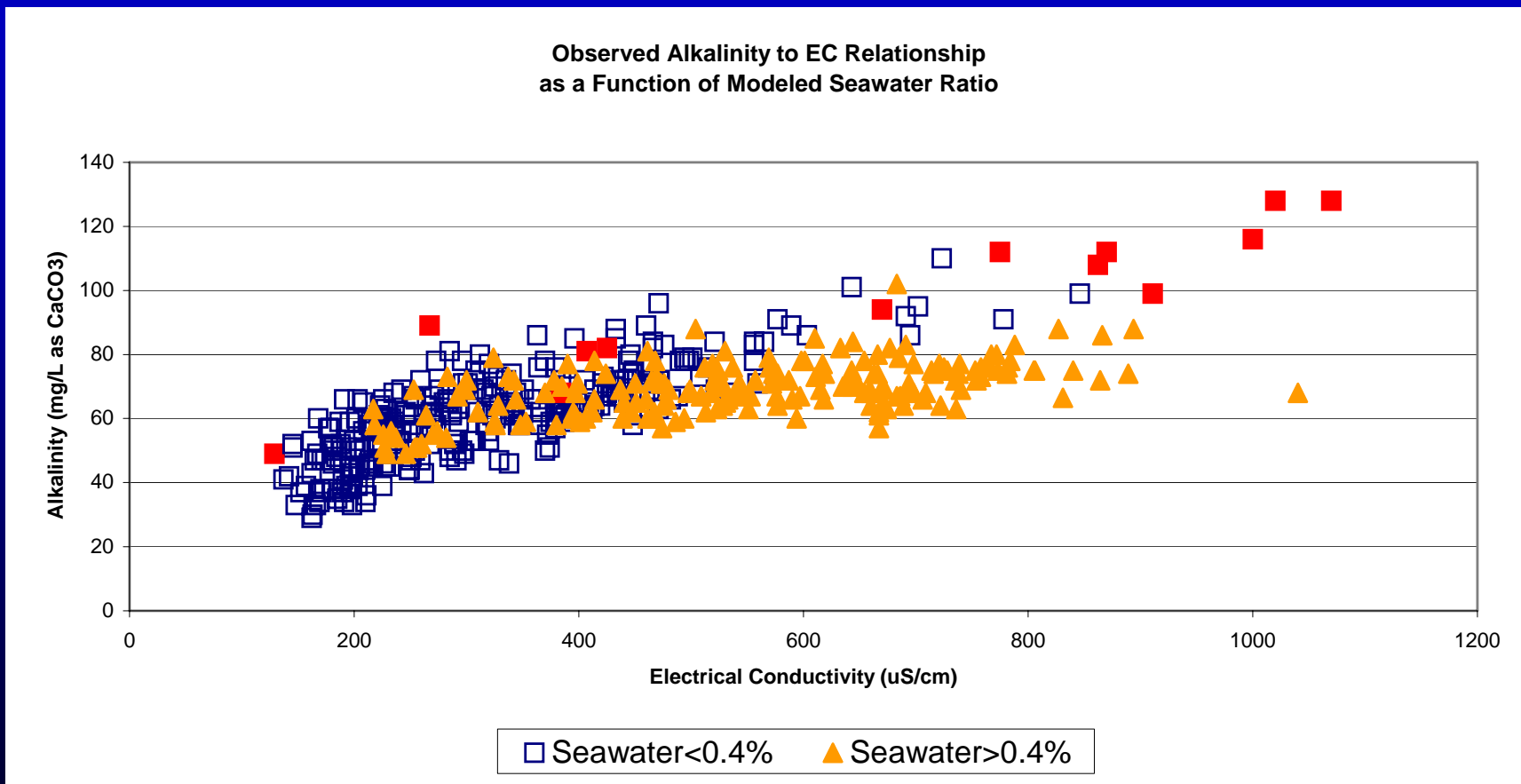


Riverine Fingerprint Sulfate

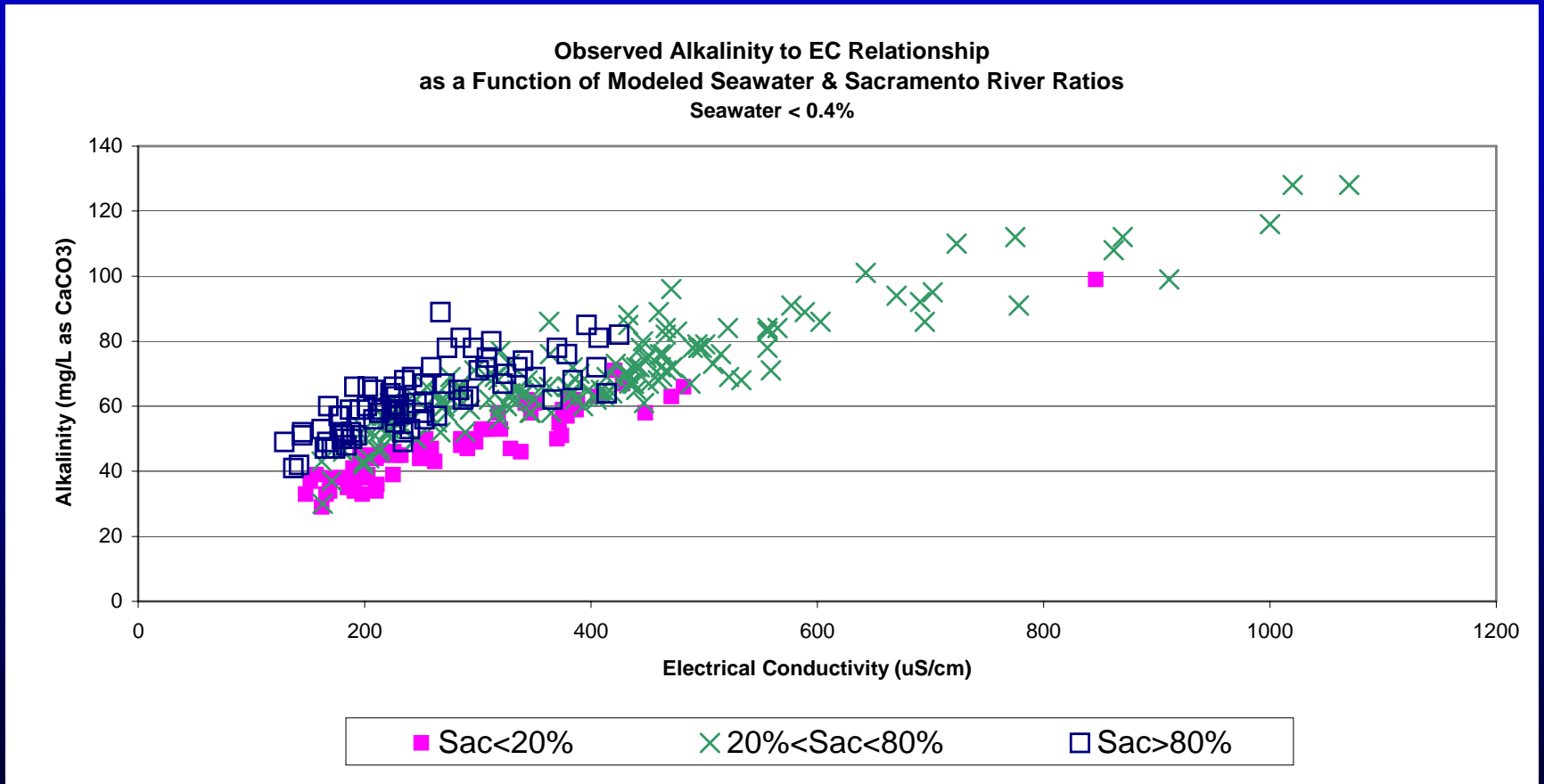
Observed Sulfate to EC Relationship
as a Function of Modeled Seawater & Sacramento River Ratios
Seawater < 0.4% Sac River > 80%



Riverine Fingerprint Bicarbonate

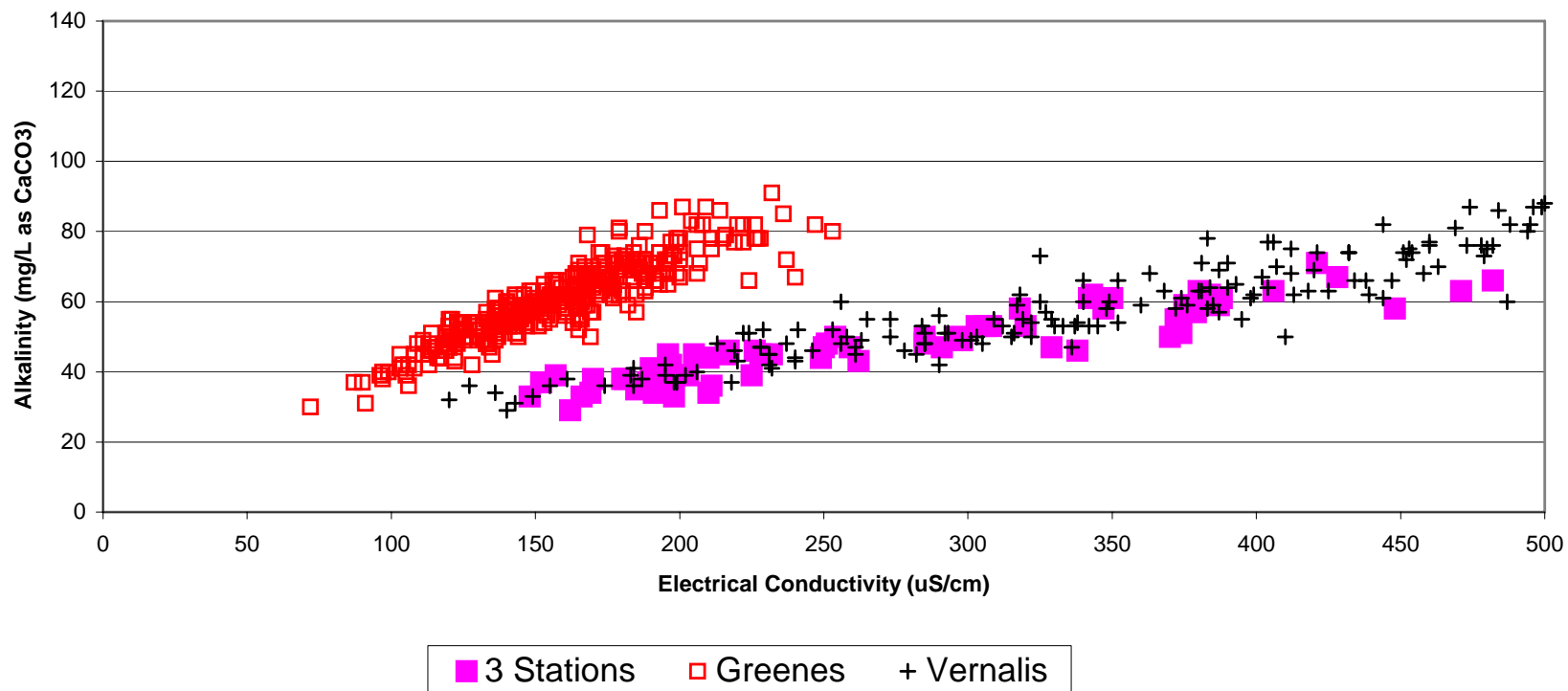


Riverine Fingerprint Bicarbonate



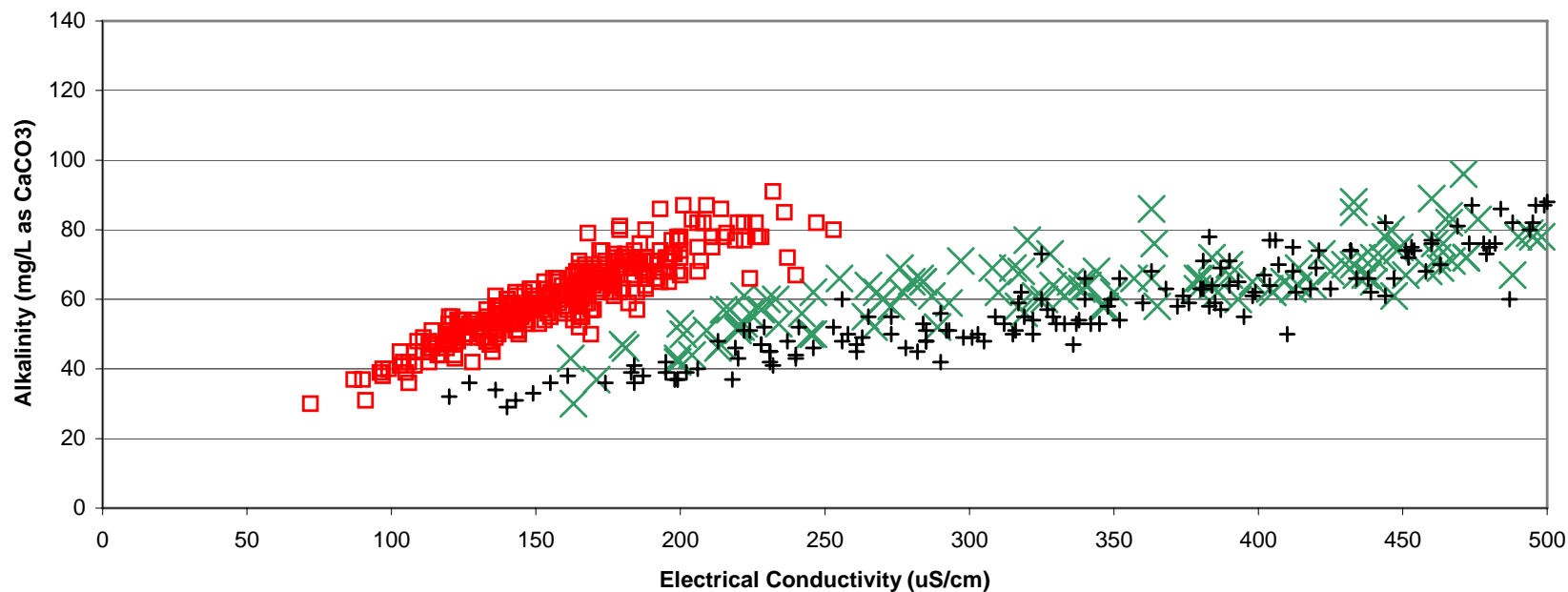
Riverine Fingerprint Bicarbonate

Observed Old River @ Bacon Alkalinity to EC Relationship
as a Function of Modeled Seawater & Sacramento River Ratios
Seawater < 0.4% Sac River < 20%



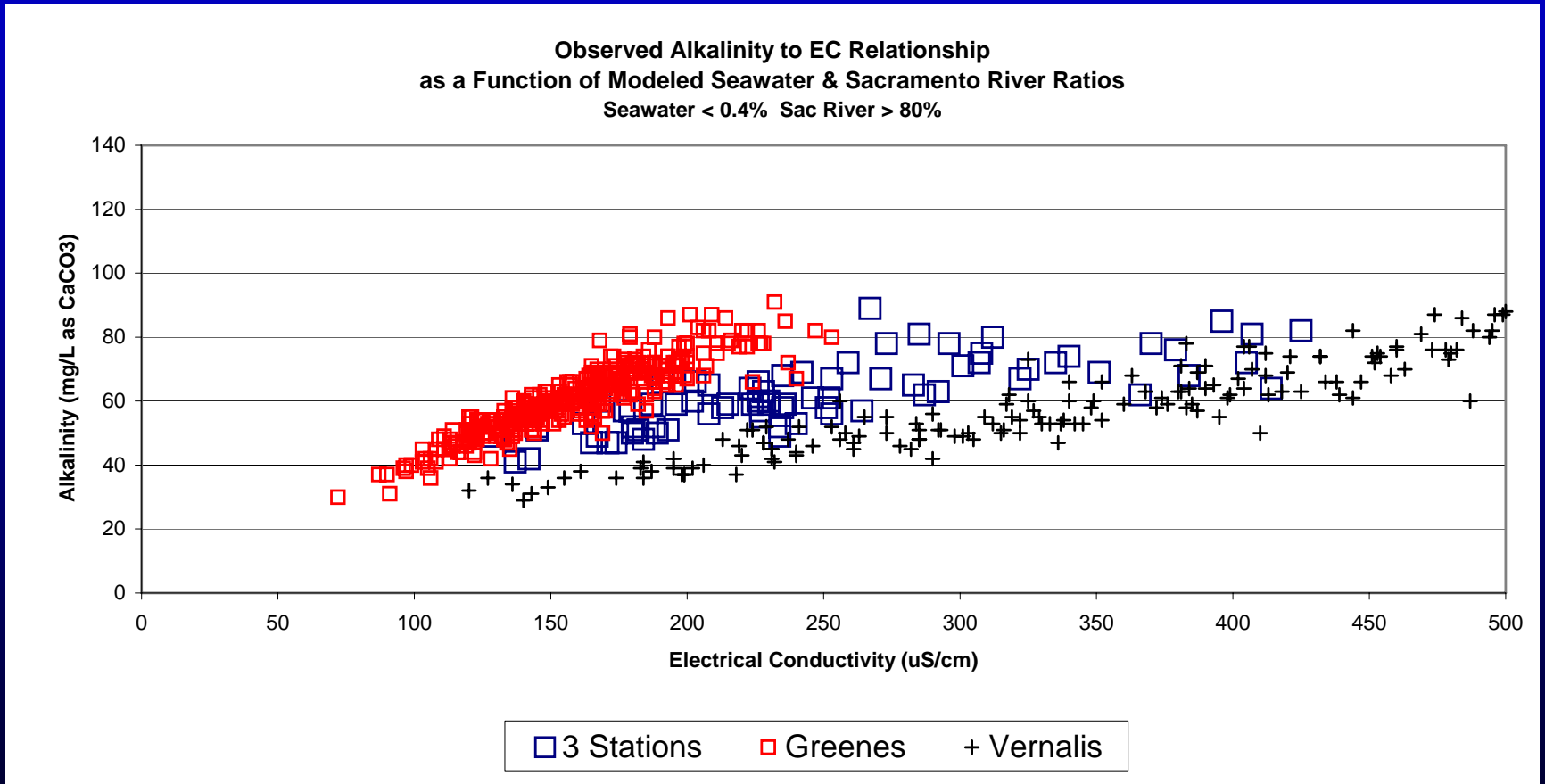
Riverine Fingerprint Bicarbonate

Observed Alkalinity to EC Relationship
as a Function of Modeled Seawater & Sacramento River Ratios
Seawater < 0.4% 20% < Sac River < 80%



× 3 Stations □ Greenes + Vernalis

Riverine Fingerprint Bicarbonate



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Conclusions

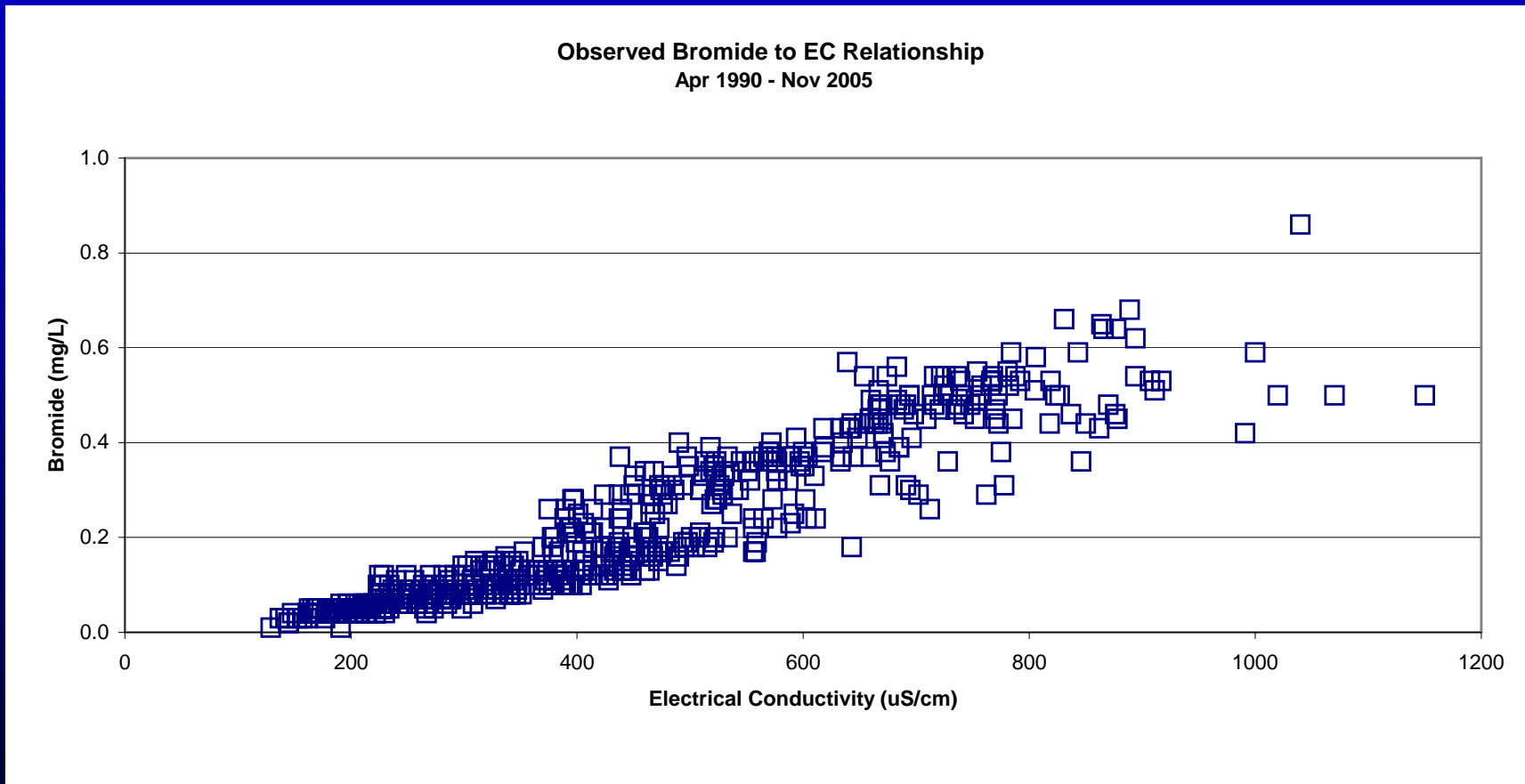
- **Observed relationships between mineral concentrations and electrical conductivity correspond to modeled seawater influence. Anion data provide the most obvious fingerprints of seawater influence.**
- **Observed relationships between sulfate / bicarbonate concentrations and electrical conductivity correspond to modeled Sacramento and San Joaquin River influences.**
- **Mineral data provide an indirect means to validate DSM2 volumetric fingerprints.**

Recommendations

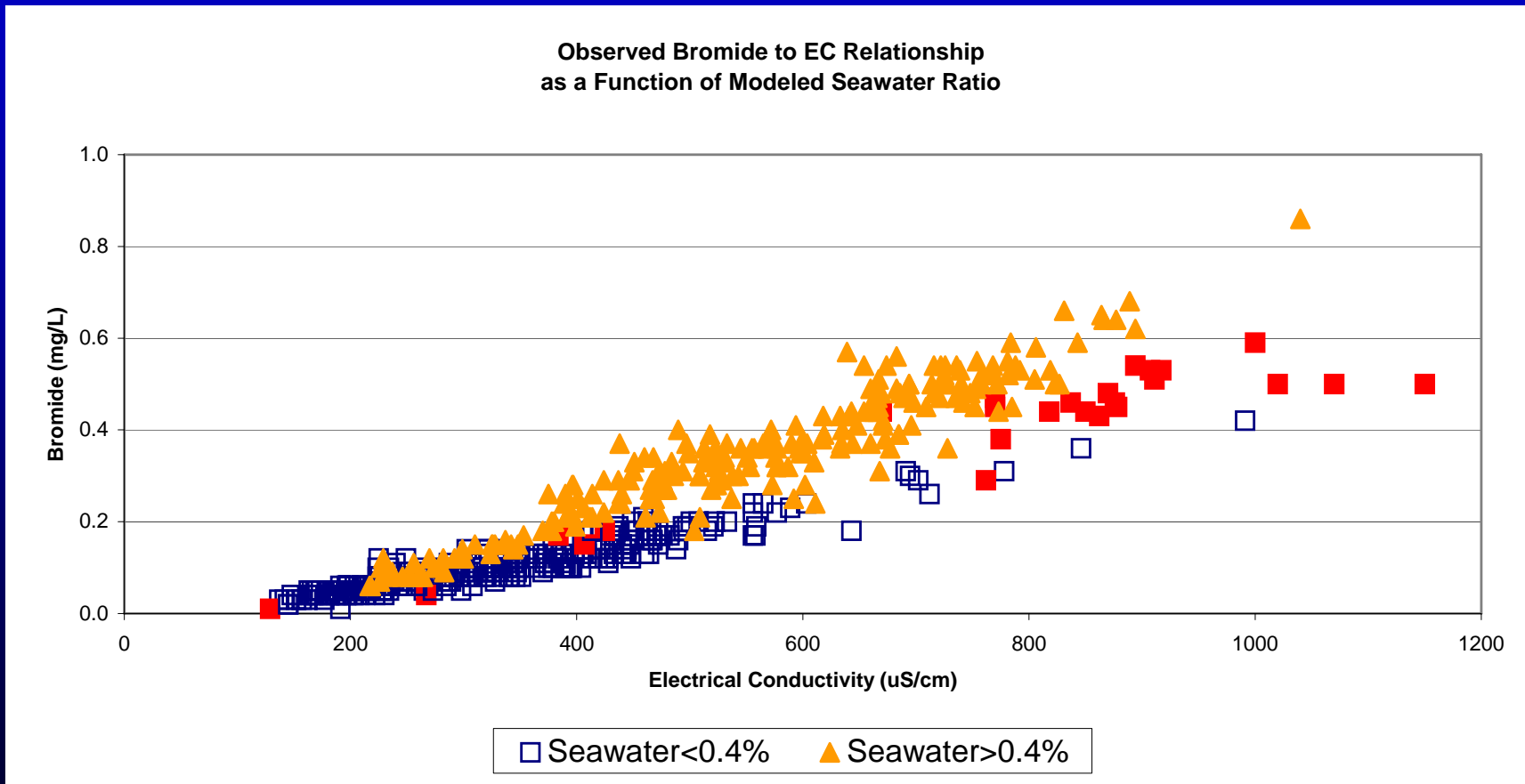
- Refine regression relationships between electrical conductivity and mineral concentrations at various Delta locations.
 - Potential use in water quality forecasts and planning studies
 - Potential use in DSM2 validation
- Investigate outlier data (Tracy 1990-92)
- Collect more mineral data in the Delta. Anion data is particularly valuable.

Extra Slides

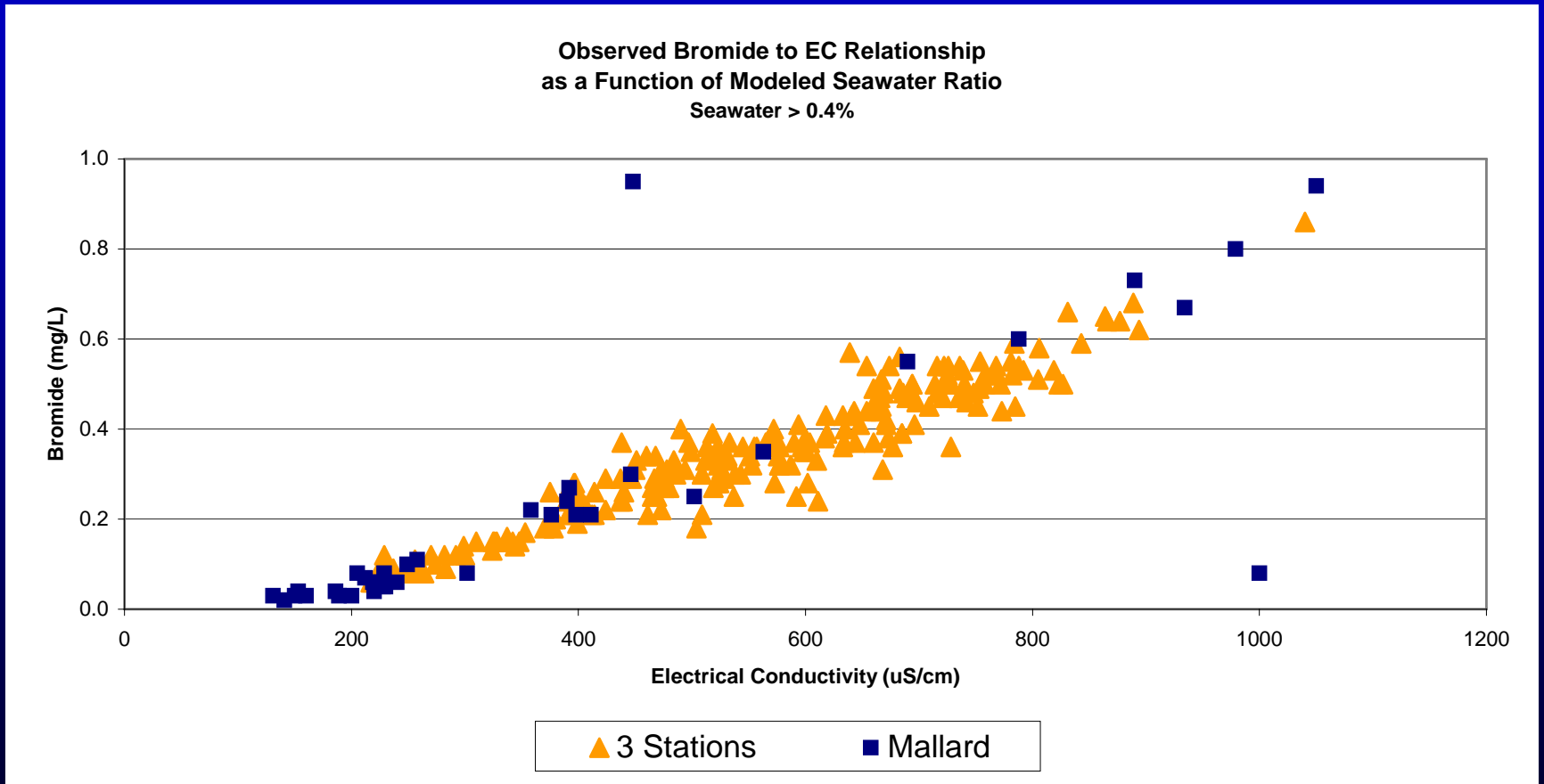
Seawater Fingerprint Bromide



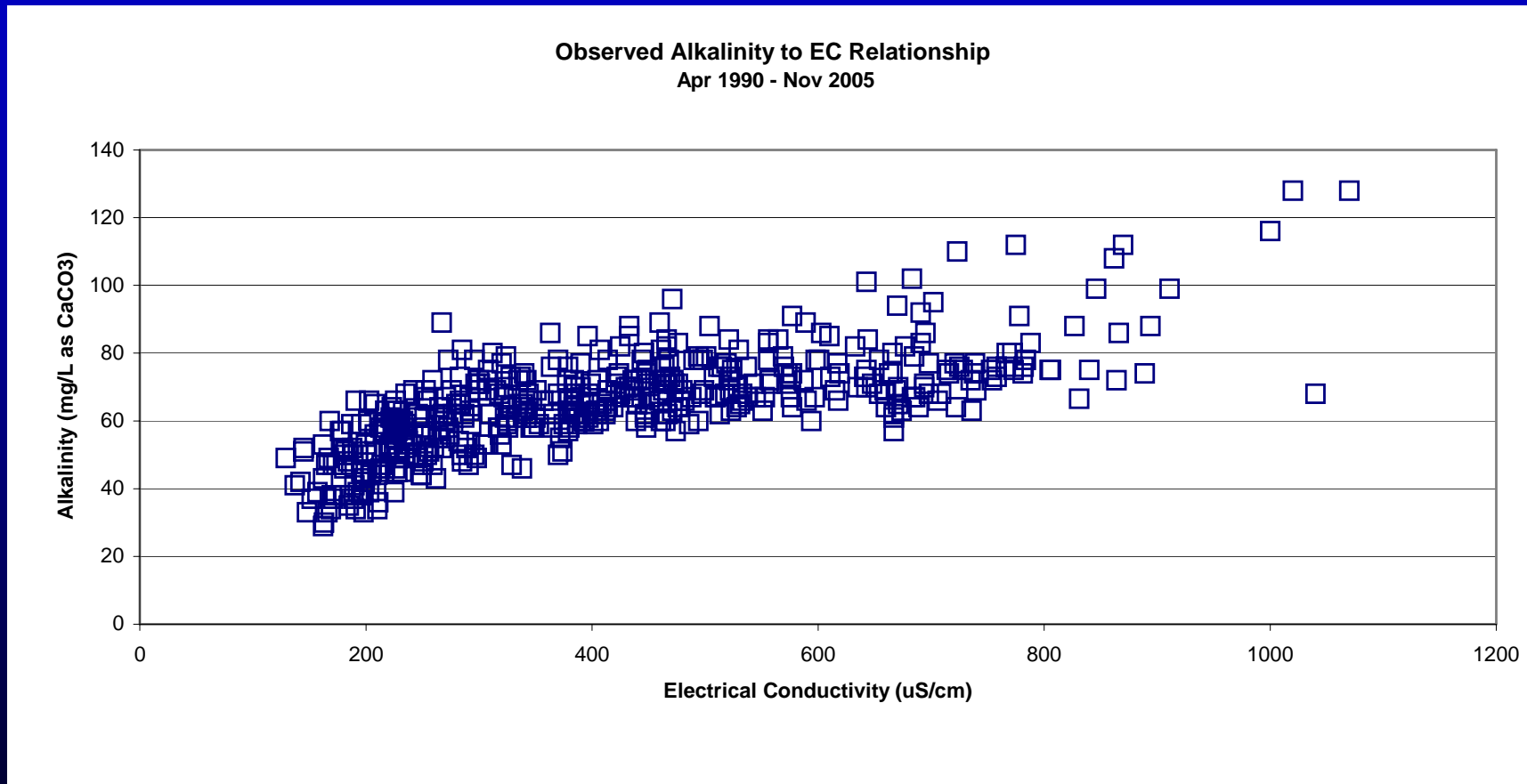
Seawater Fingerprint Bromide



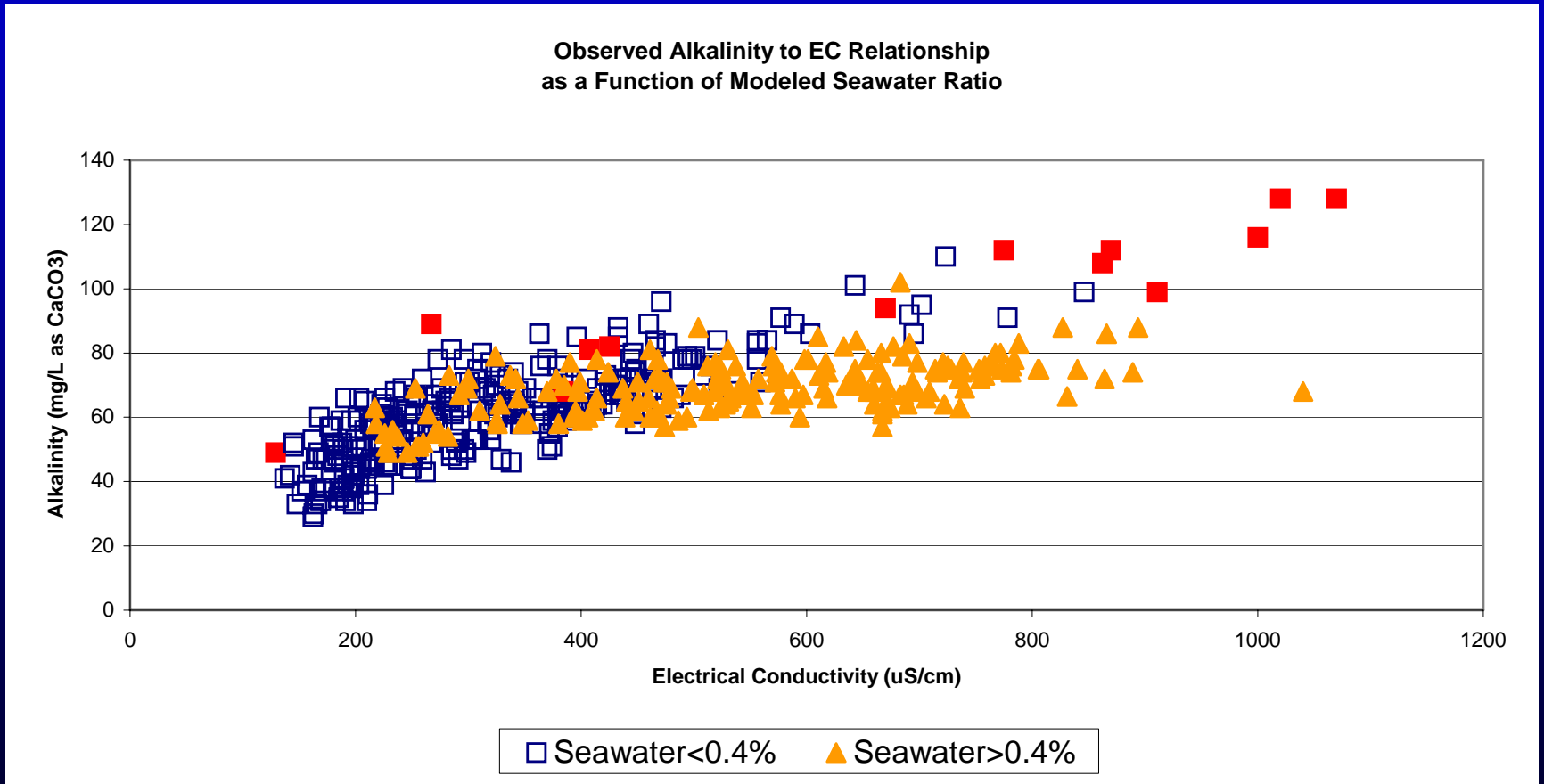
Seawater Fingerprint Bromide



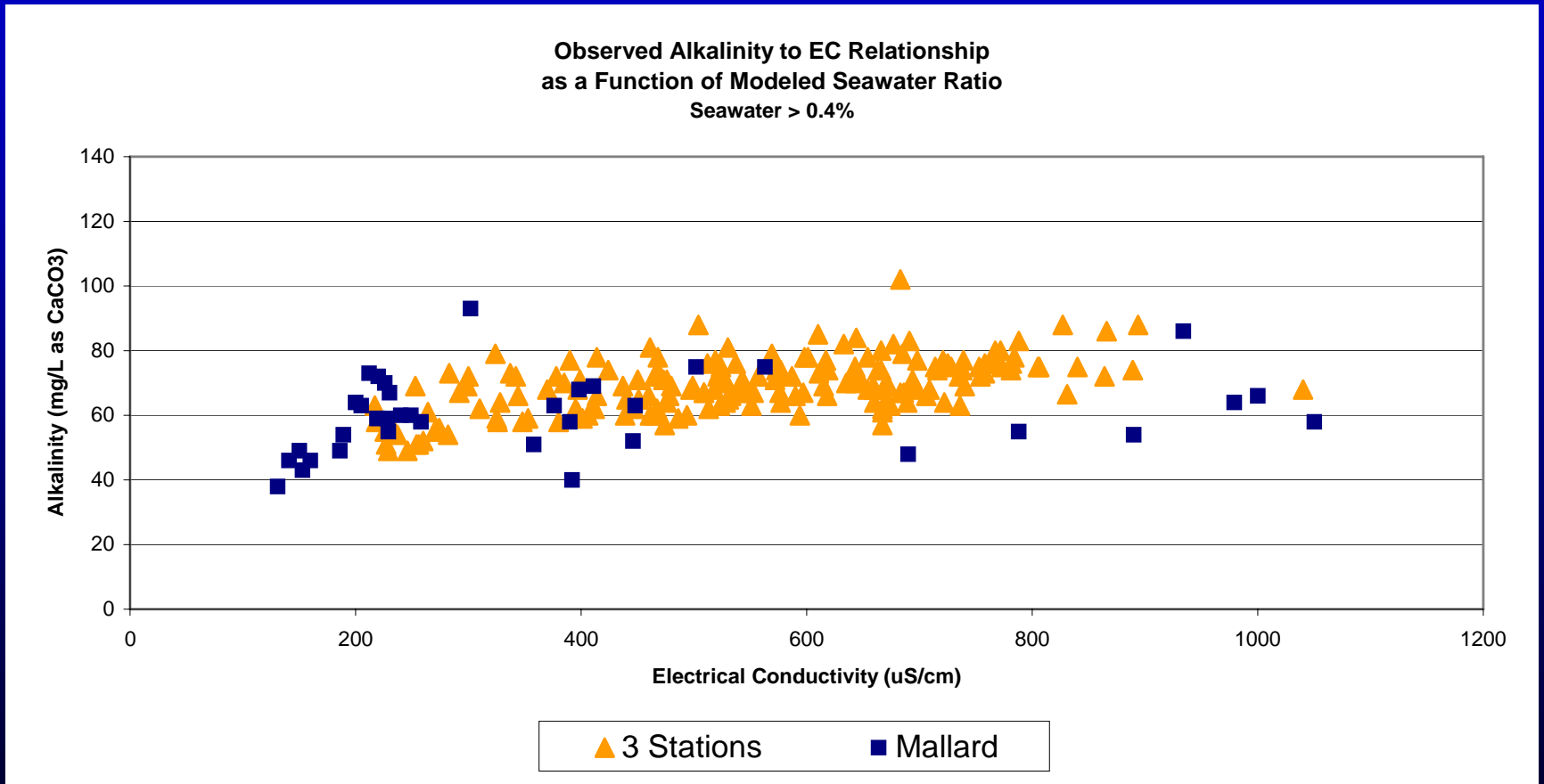
Seawater Fingerprint Bicarbonate



Seawater Fingerprint Bicarbonate

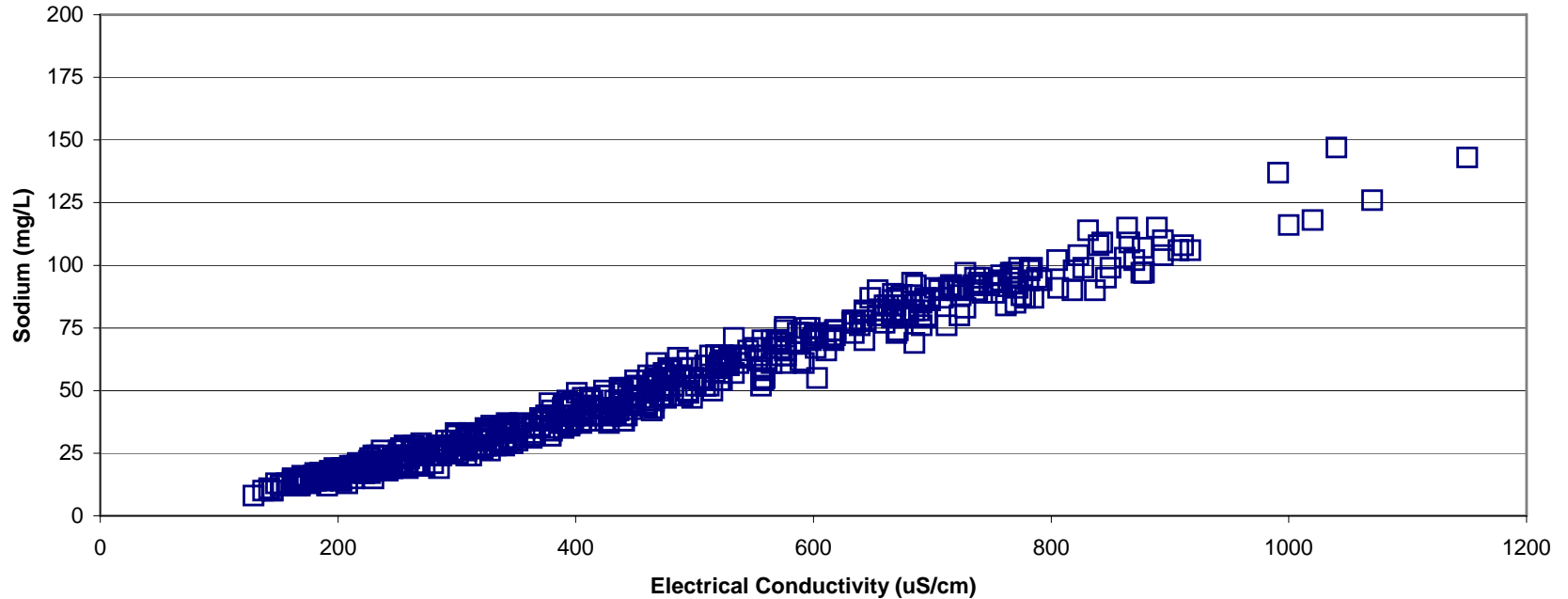


Seawater Fingerprint Bicarbonate



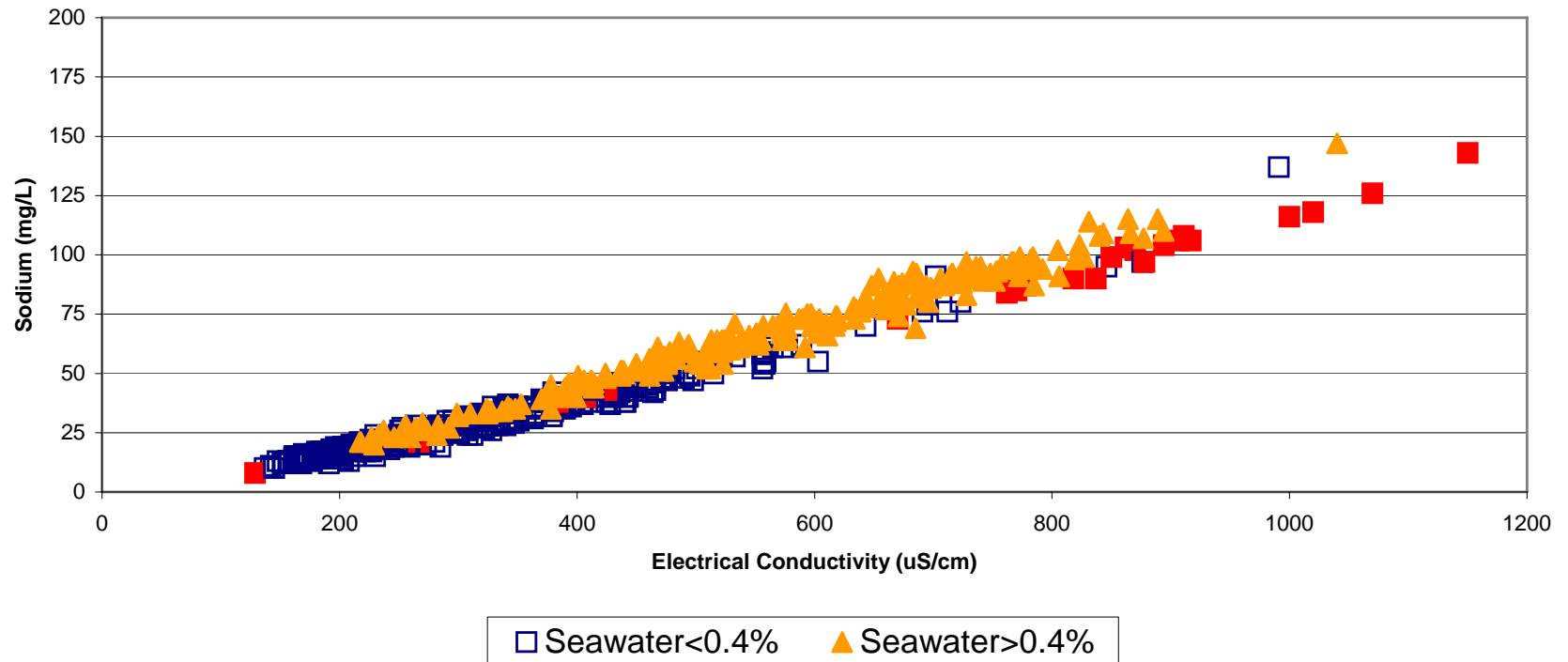
Seawater Fingerprint Sodium

Observed Sodium to EC Relationship
Apr 1990 - Nov 2005



Seawater Fingerprint Sodium

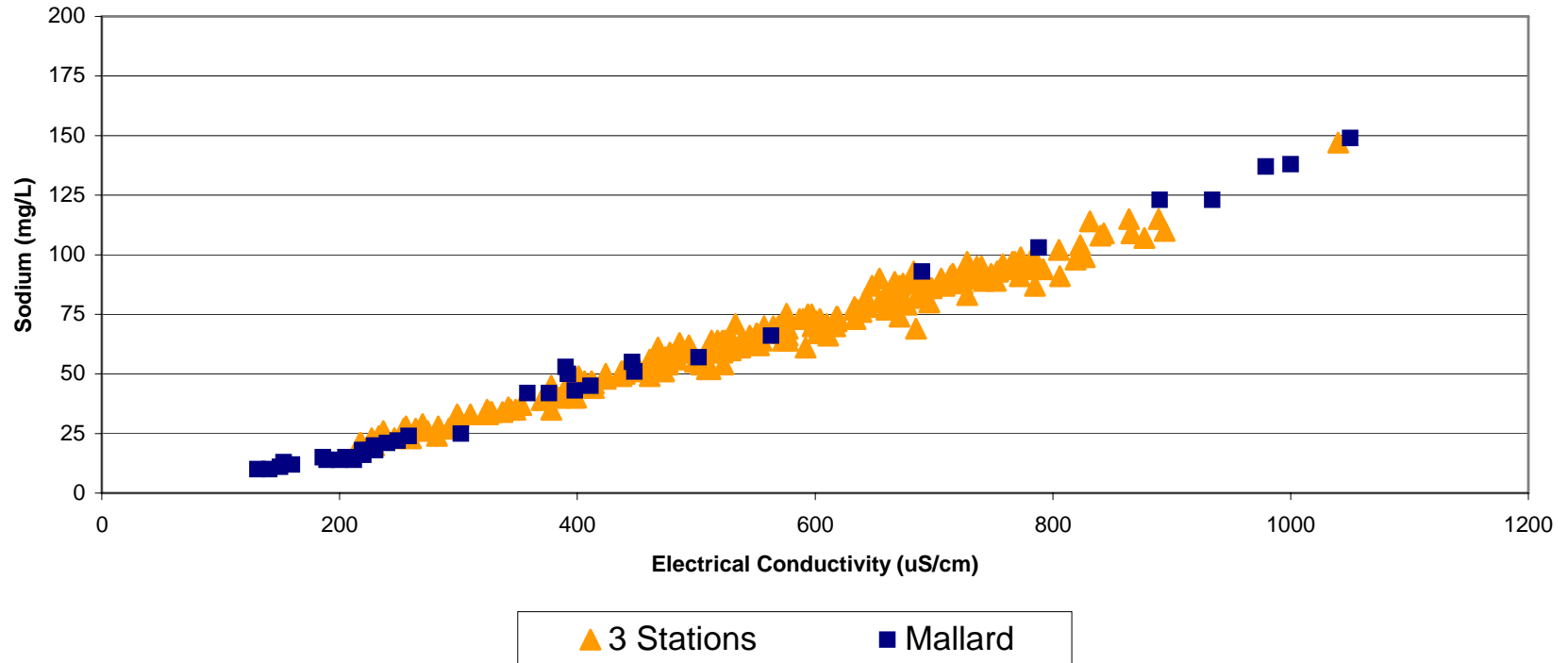
Observed Sodium to EC Relationship
as a Function of Modeled Seawater Ratio



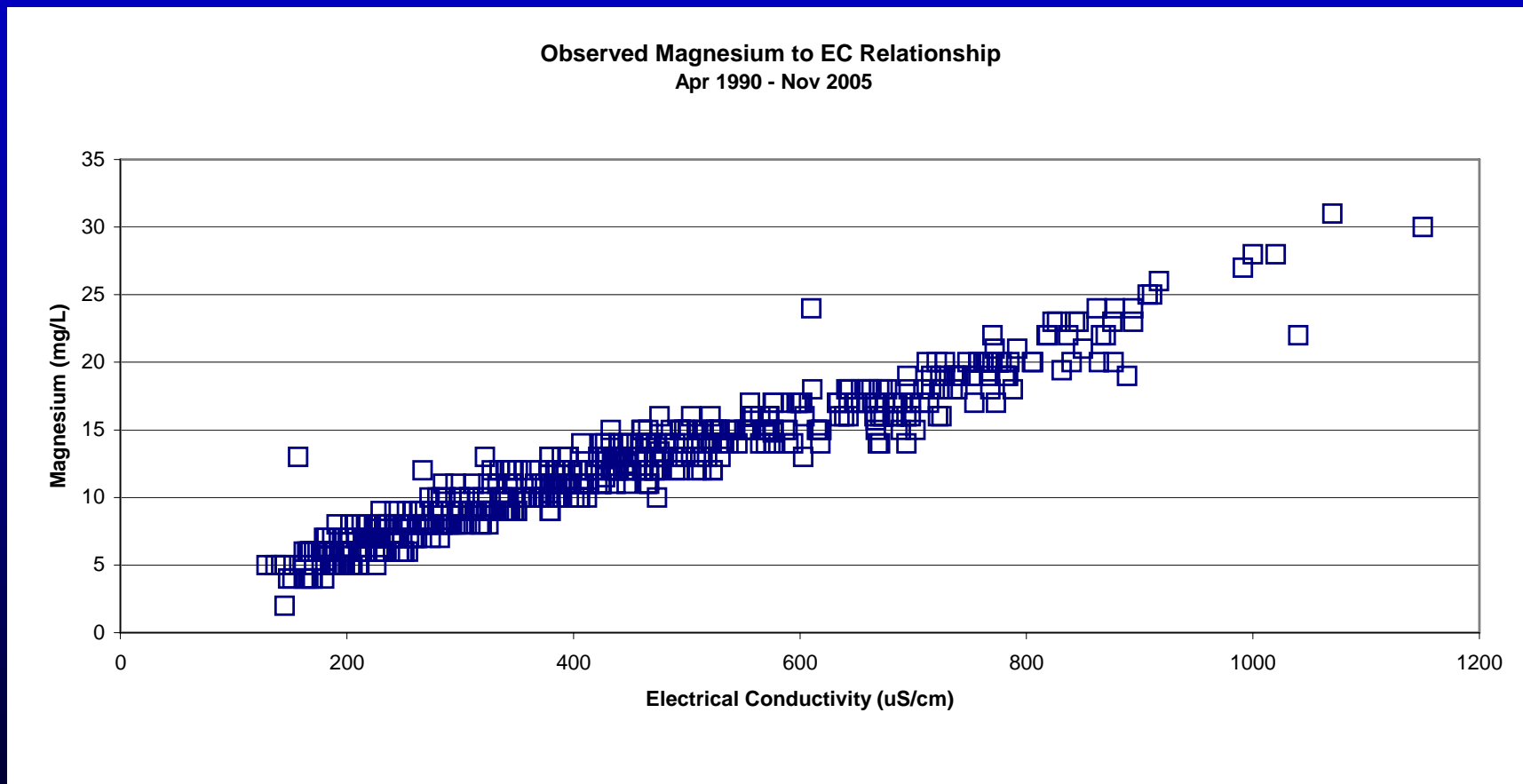
Seawater Fingerprint

Sodium

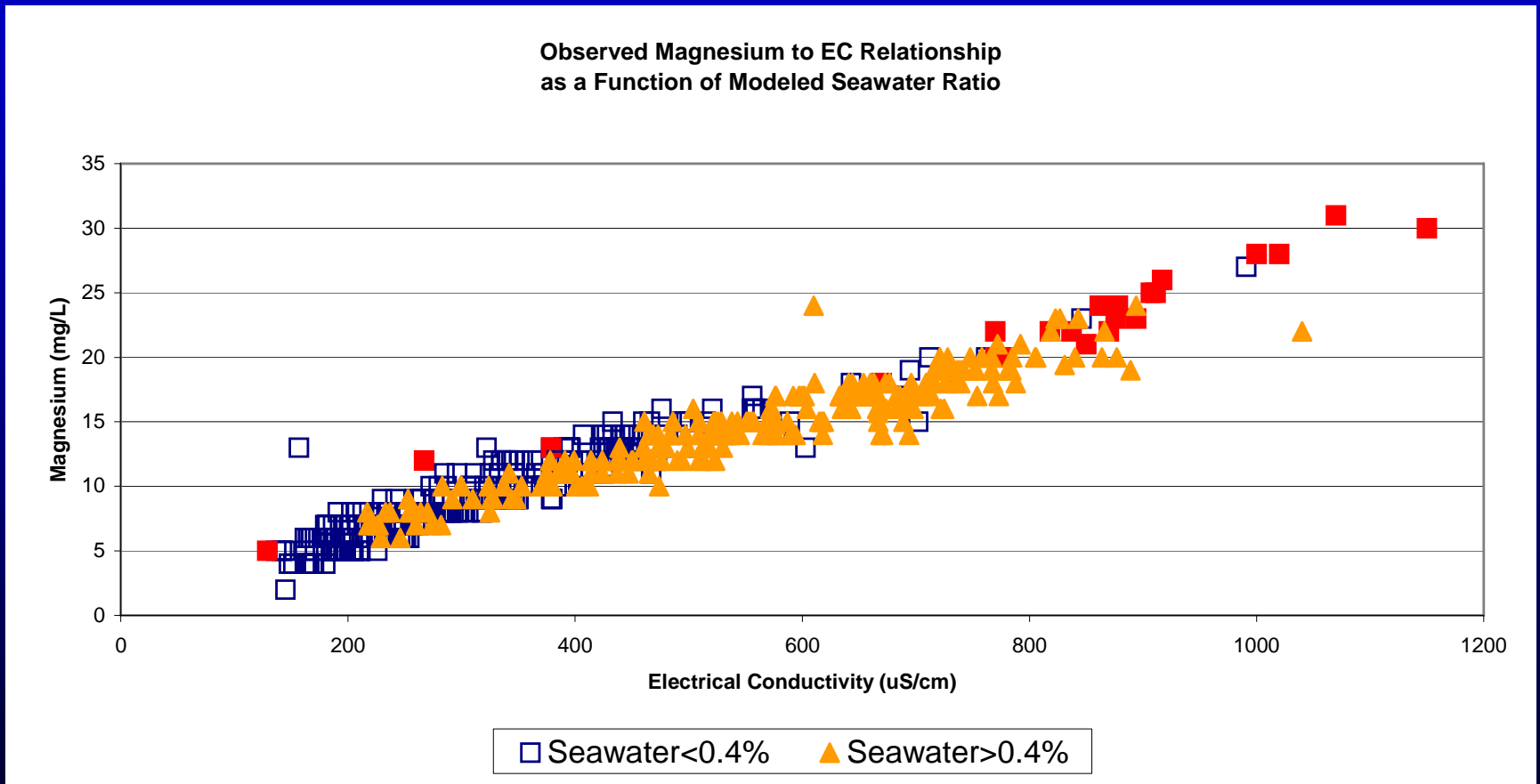
Observed Sodium to EC Relationship
as a Function of Modeled Seawater Ratio
Seawater > 0.4%



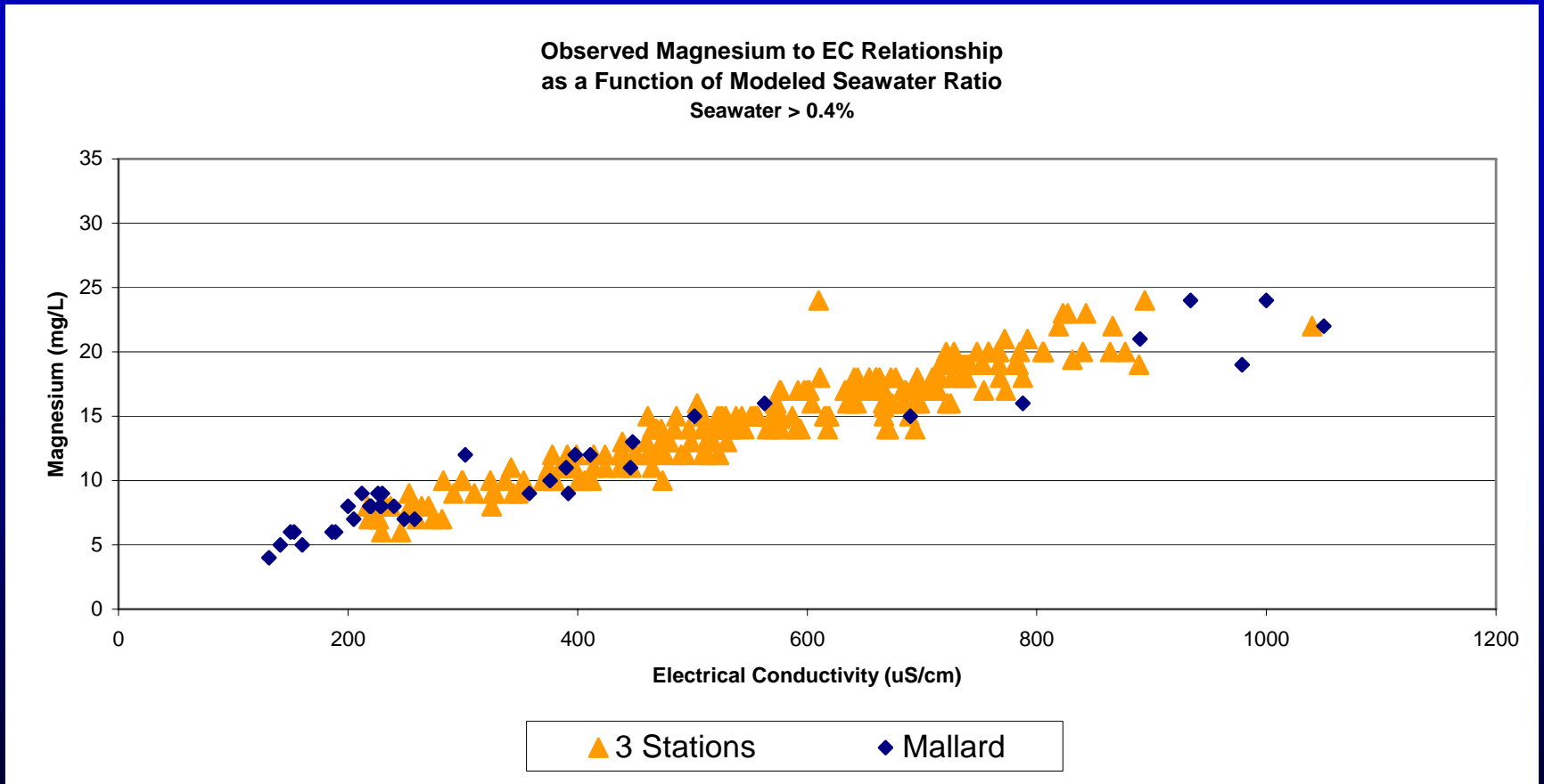
Seawater Fingerprint Magnesium



Seawater Fingerprint Magnesium

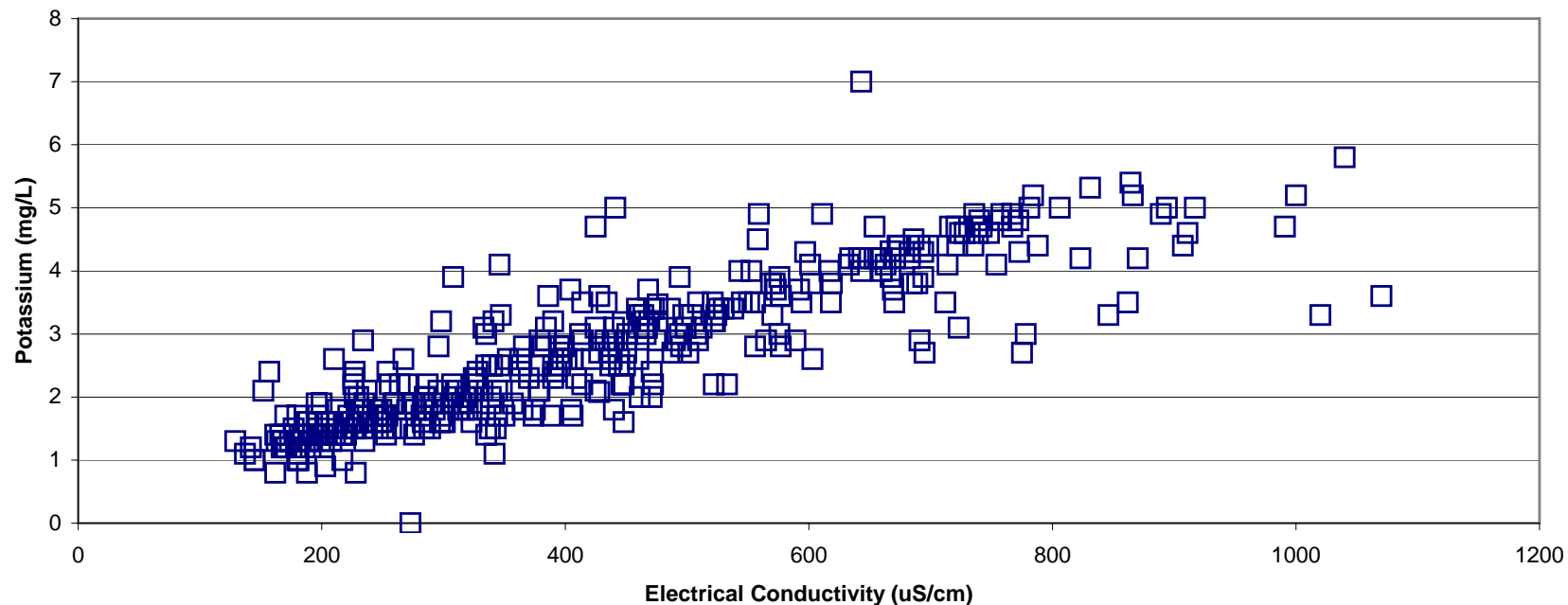


Seawater Fingerprint Magnesium

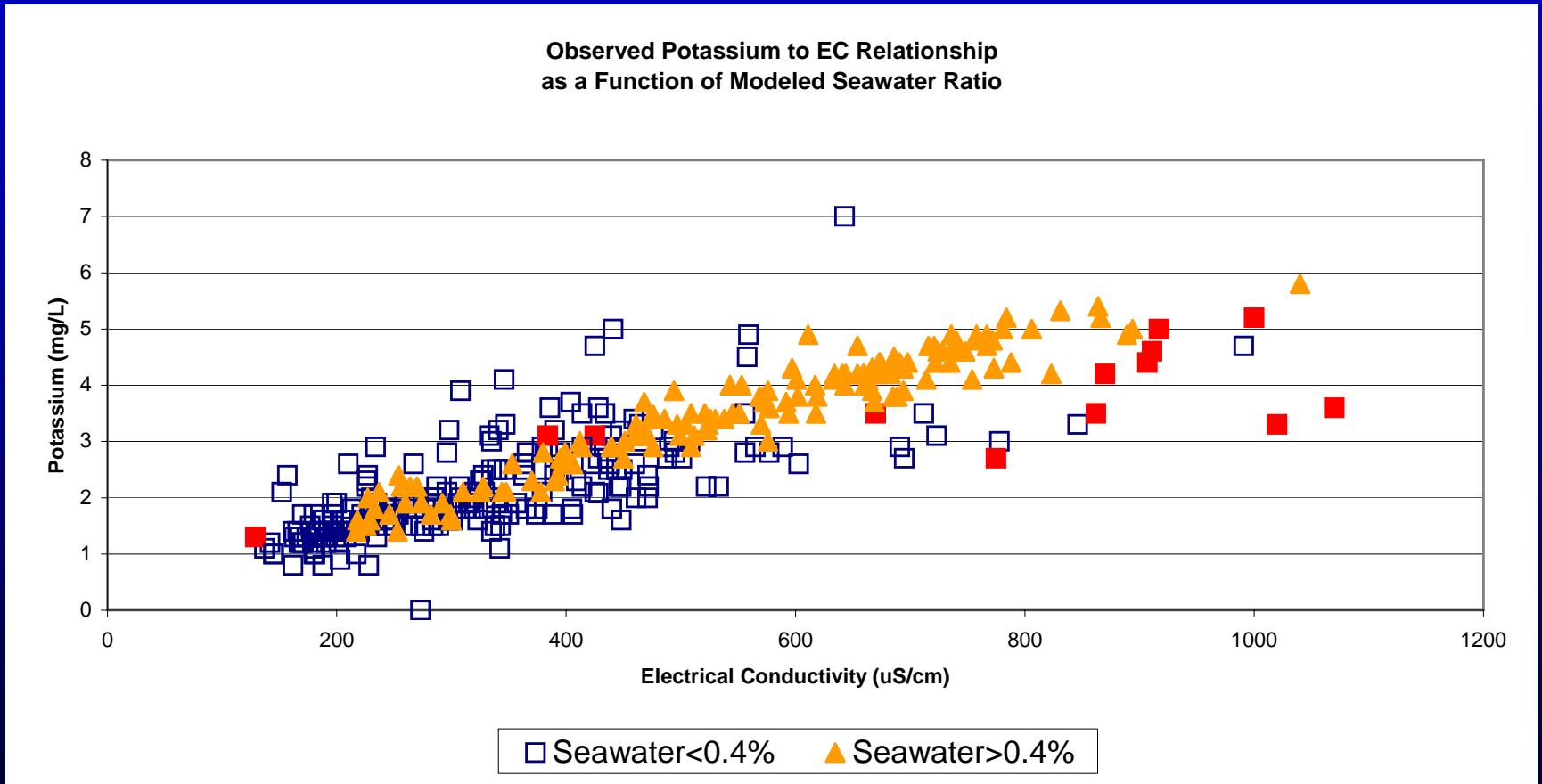


Seawater Fingerprint Potassium

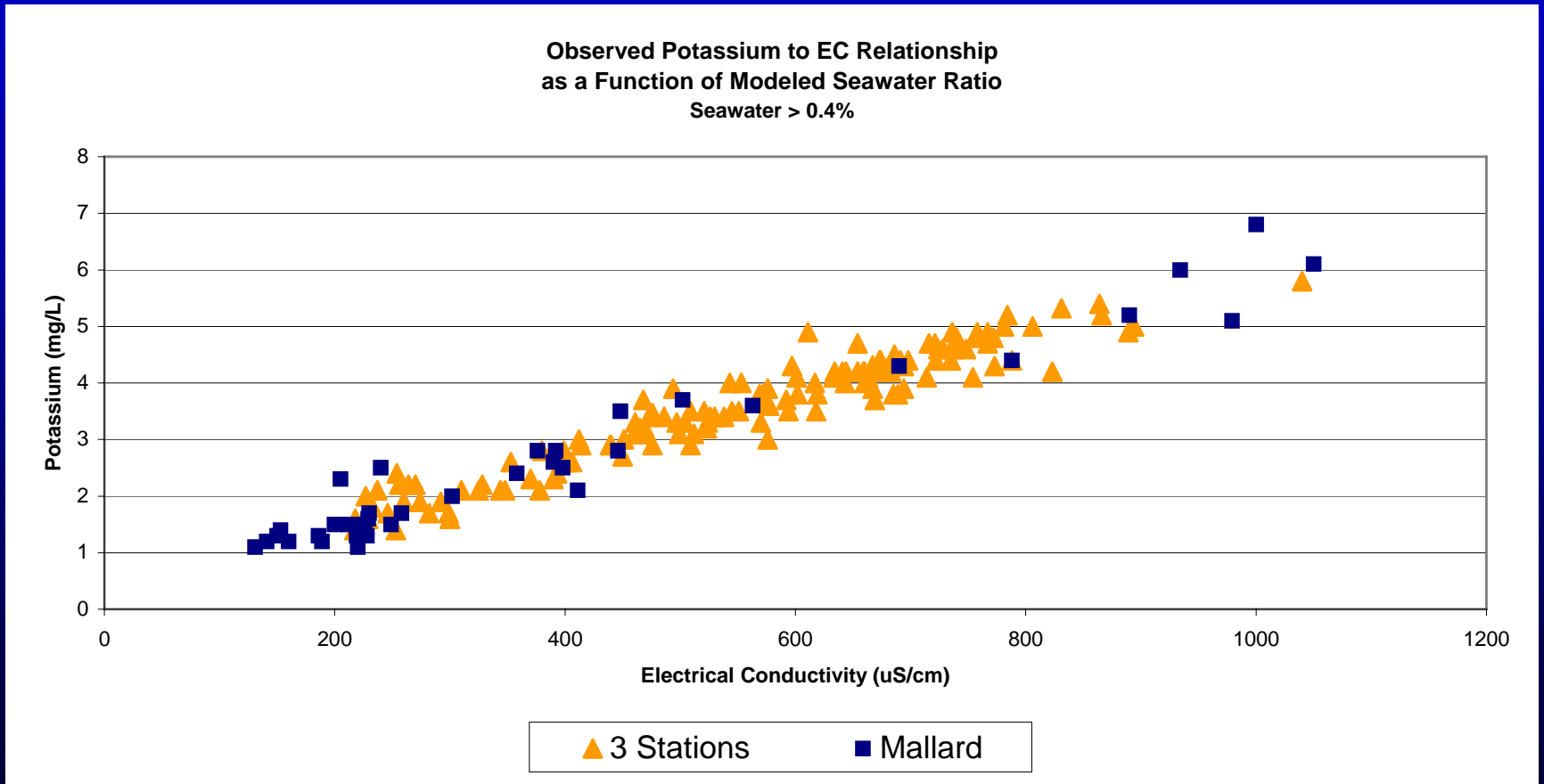
Observed Potassium to EC Relationship
Apr 1990 - Nov 2005



Seawater Fingerprint Potassium

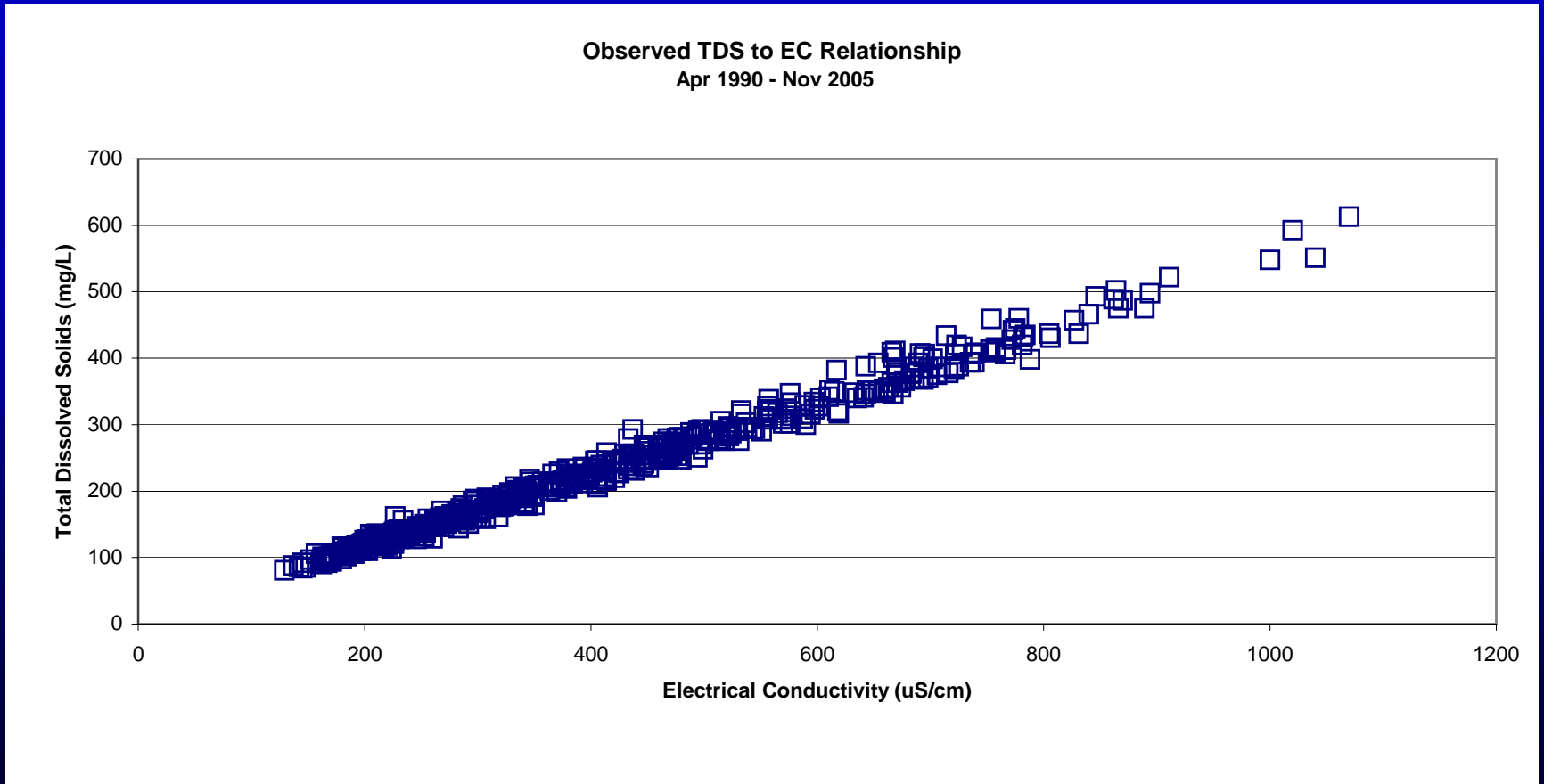


Seawater Fingerprint Potassium



Seawater Fingerprint

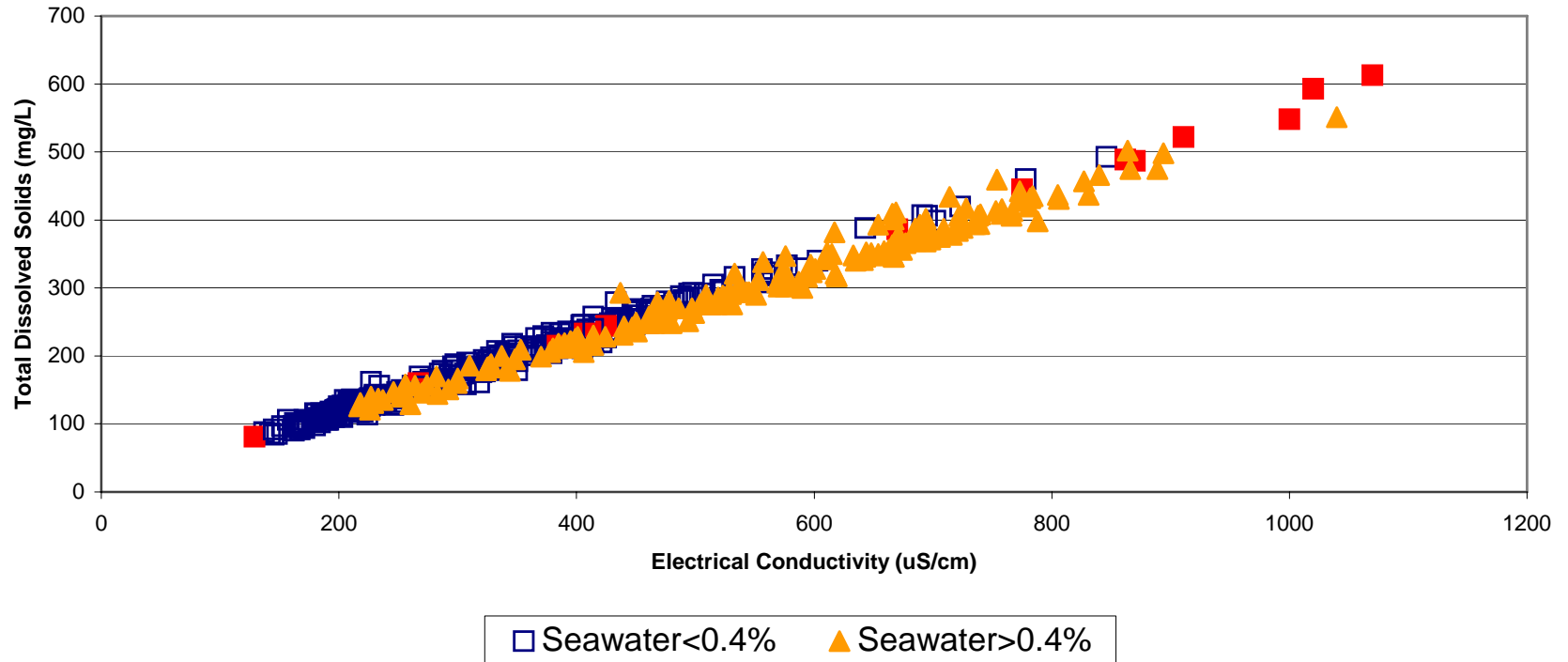
Total Dissolved Solids



Seawater Fingerprint

Total Dissolved Solids

Observed TDS to EC Relationship
as a Function of Modeled Seawater Ratio



Seawater Fingerprint

Total Dissolved Solids

