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GAMA Special Study Project- Nitrate Fate and Transport in the Salinas Valley

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September, 2011

Presentation to the California Regional Water Quality Control
Board (Region 3) on September 1, 2011 in San Luis Obispo

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California Regional Water Quality Control Board, Region 3
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GAMA in the Salinas-Monterey Area

- Priority Basin Project – 94 wells sampled in July-October, 2005
 - Data summary report: 2007
 - Interpretive report: 2011
- Special Studies Project
 - Nitrate fate and transport
- Domestic Well Project
 - Sampling of ~200 wells recently completed

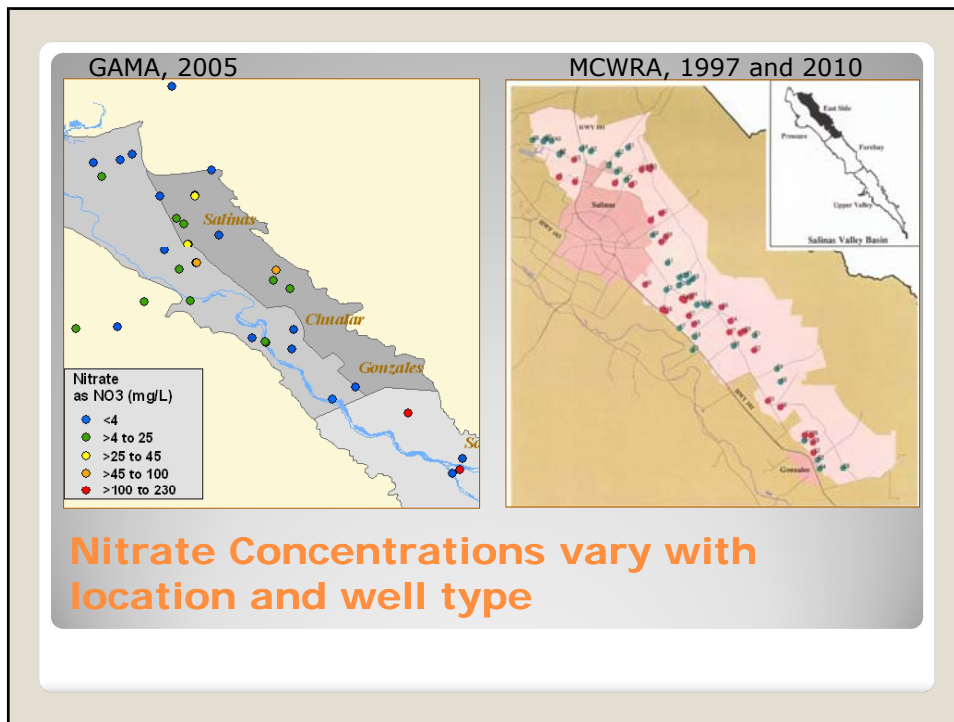


The State Water Resources Control Board GAMA program: Special Studies

- Focus is on groundwater quality topics of state-wide relevance
- Studies use observable parameters
- LLNL is the technical lead
- Previous studies:
 - Denitrification at dairies
 - Nitrate co-contaminants (e.g., PCPs and pesticides)
 - Water quality changes at artificial recharge sites
 - Vulnerability to nitrate contamination in Llagas Subbasin

Presentation Outline

- Study goals and study design
- Water sources and water flow
- Nitrate sources and fate of nitrate
 - Arroyo Seco
 - Nested monitoring wells along Salinas River
 - San Jerardo drinking water well
- Continuing work



Study goals

- Study goals addressed three questions:
 - What is the natural background nitrate concentration for the study area?
 - What happens to nitrate in the Salinas River during recharge and transport?
 - What is the source of nitrate in a contaminated drinking water well?

- Samples were collected from 19 sites and analyzed for myriad chemical and isotopic tracers, including
 - isotopes of nitrate
 - groundwater age
- Analytical results were integrated with
 - river discharge data
 - water level data from MCWRA
 - GAMA priority basin data
 - USGS water chemistry data from the Salinas River at Chualar location.



Study design

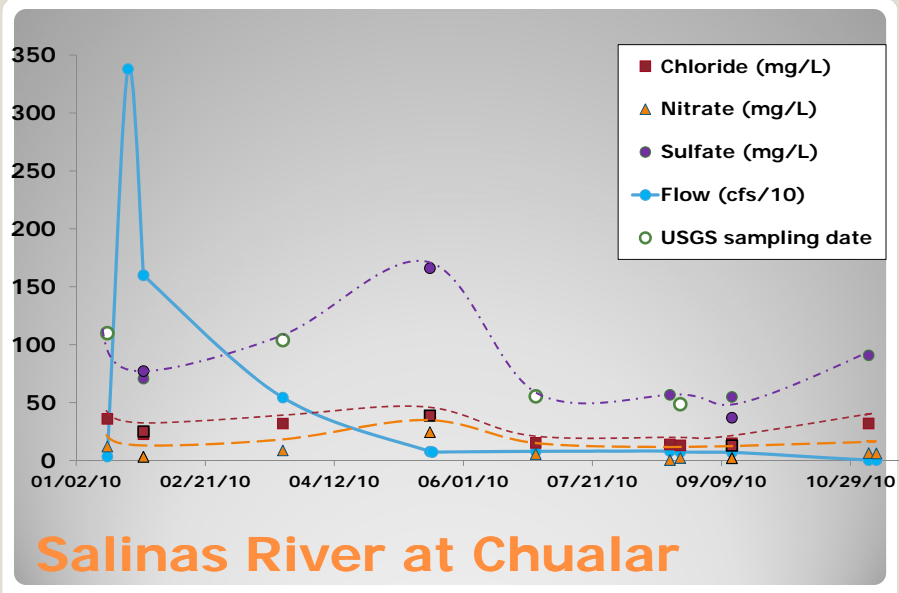
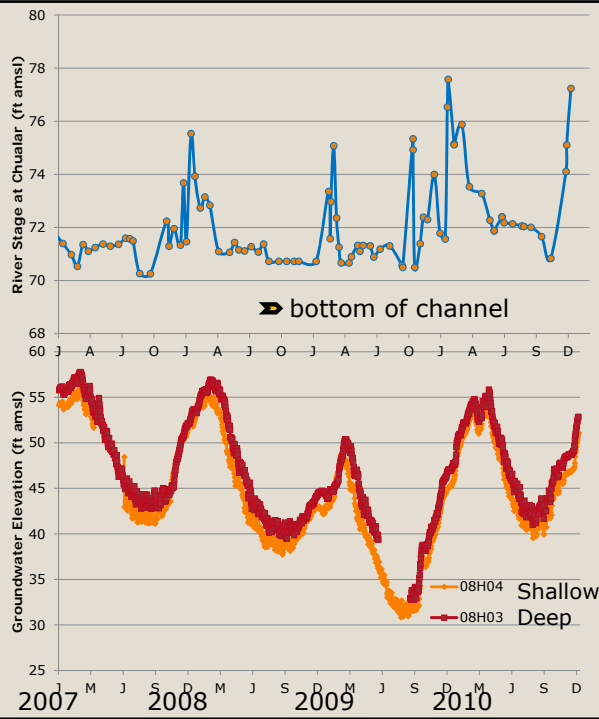
- Several lines of evidence for rainwater source for water and solutes
 - $\delta^{18}\text{O}$, δD of H_2O
 - $\delta^{15}\text{N}$, $\delta^{18}\text{O}$ of NO_3
 - Low tritium concentrations
 - Low TDS that is only slightly higher in groundwater than surface water



Natural background groundwater nitrate concentration is ≈ 3 mg/L, in agreement with the mode of 116 wells in the deep Pressure zone)

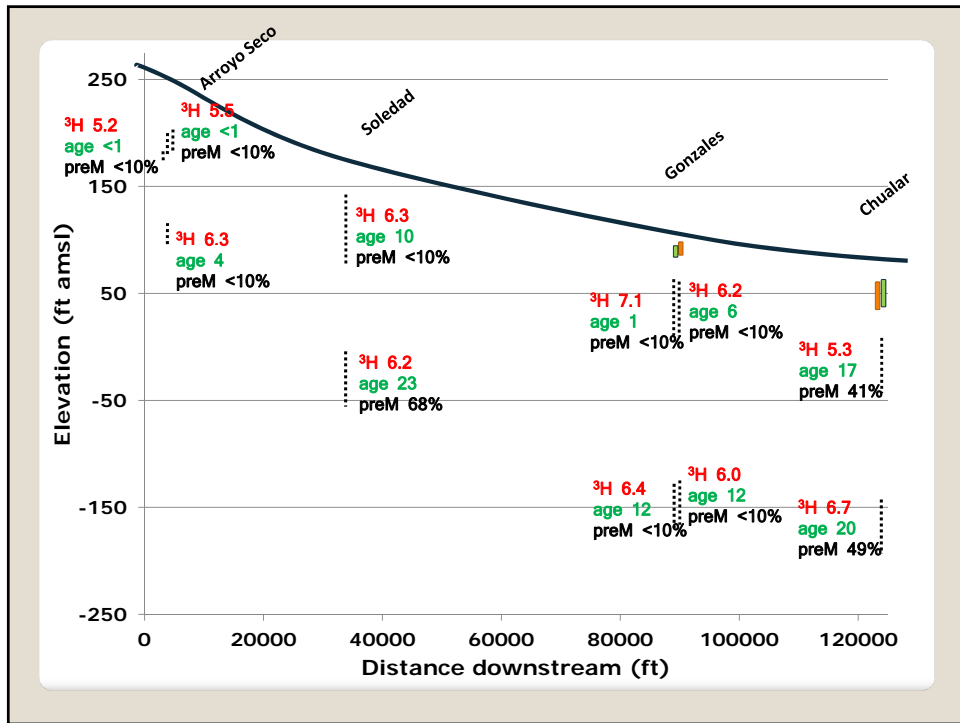
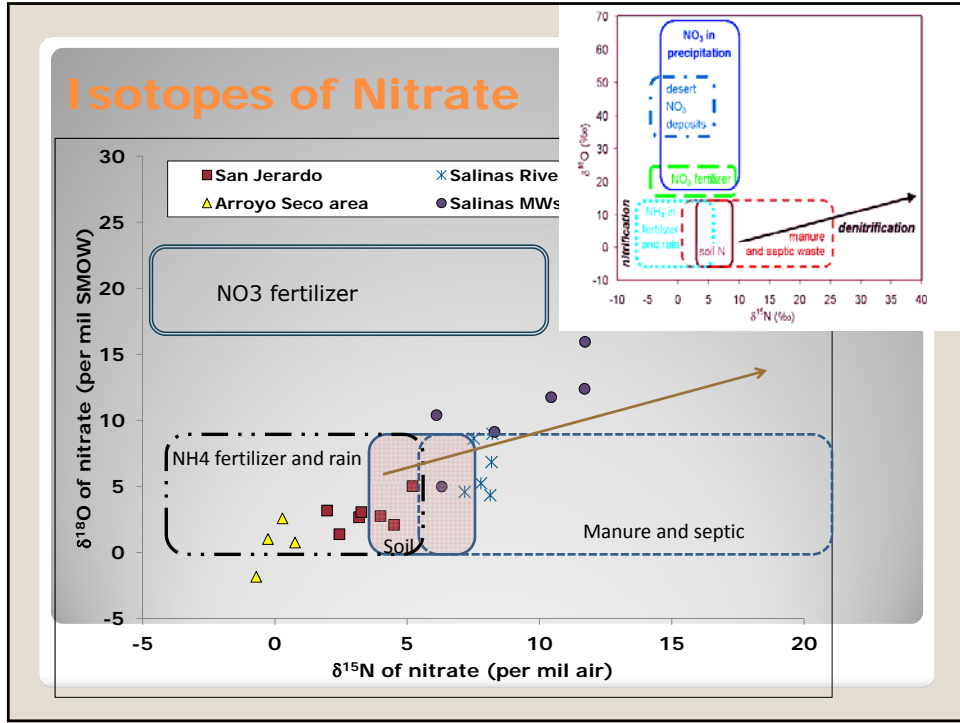
Arroyo Seco: background nitrate

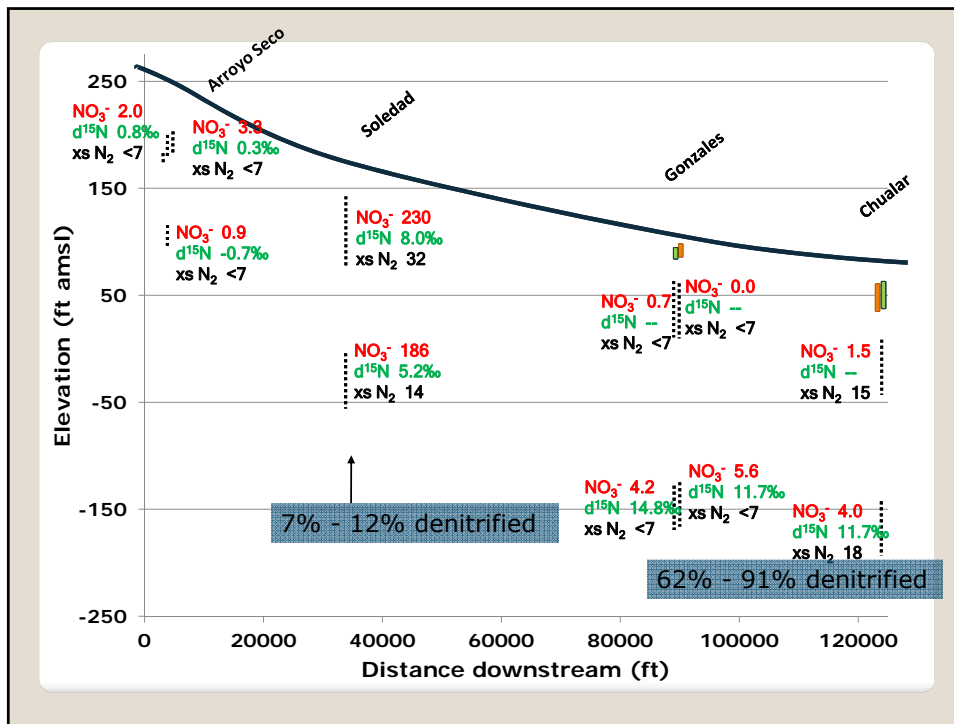
Comparison of river stage and groundwater levels at Chualar shows a strongly losing river

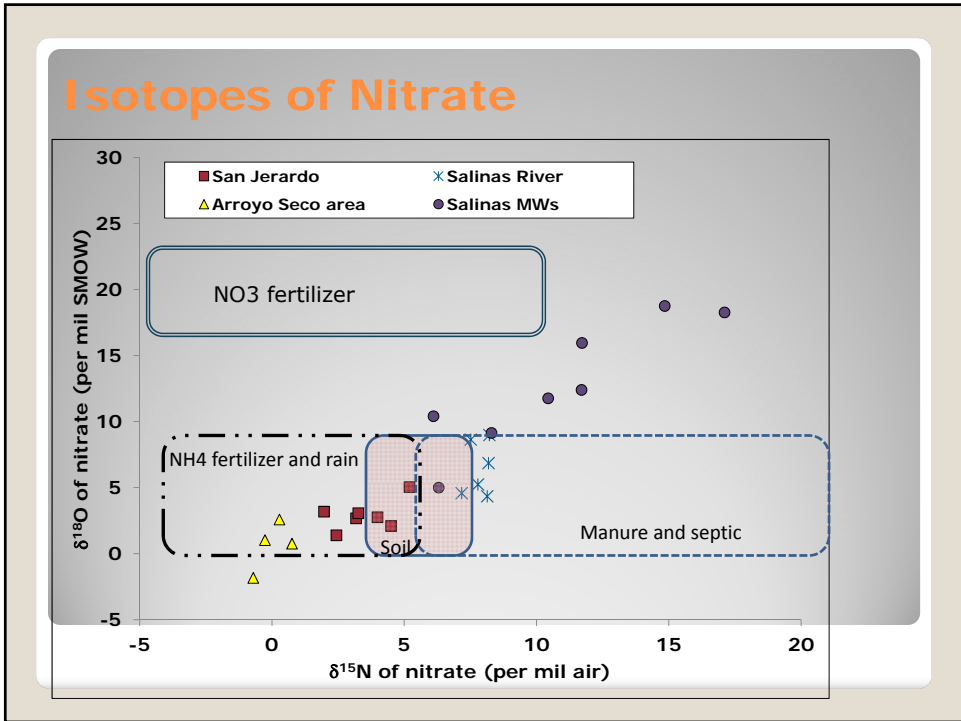
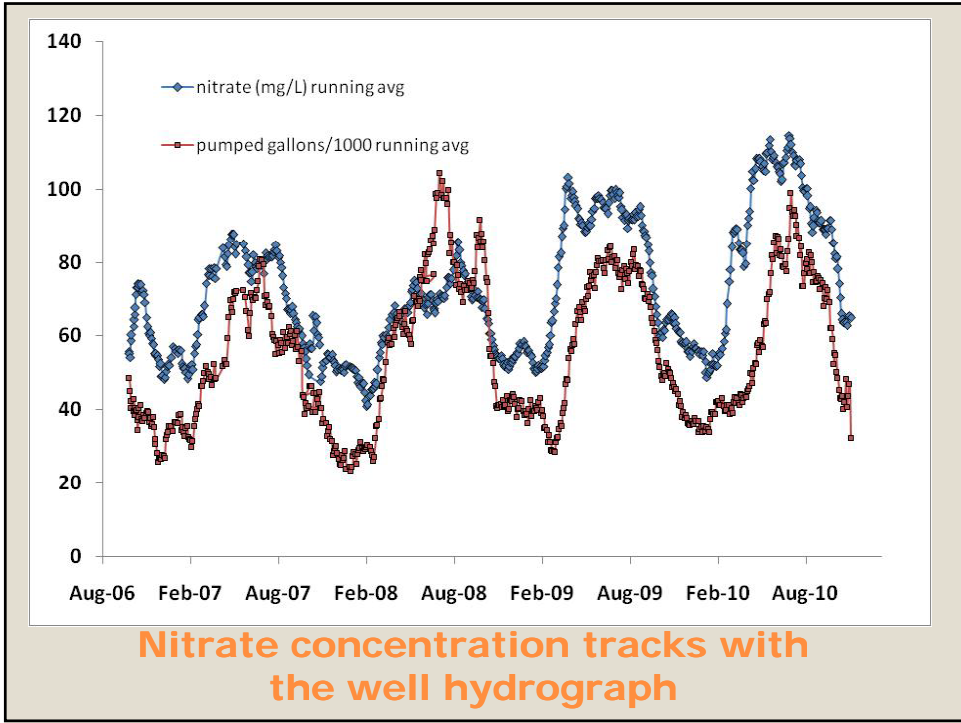


Salinas River at Chualar

A pulse of high TDS water (23 mg/L as NO₃⁻) enters the river at high runoff. A dilution effect is also evident



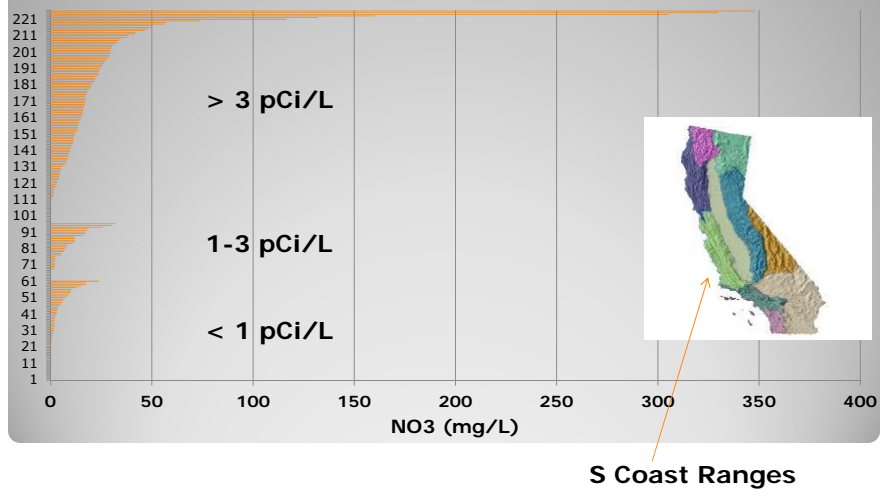




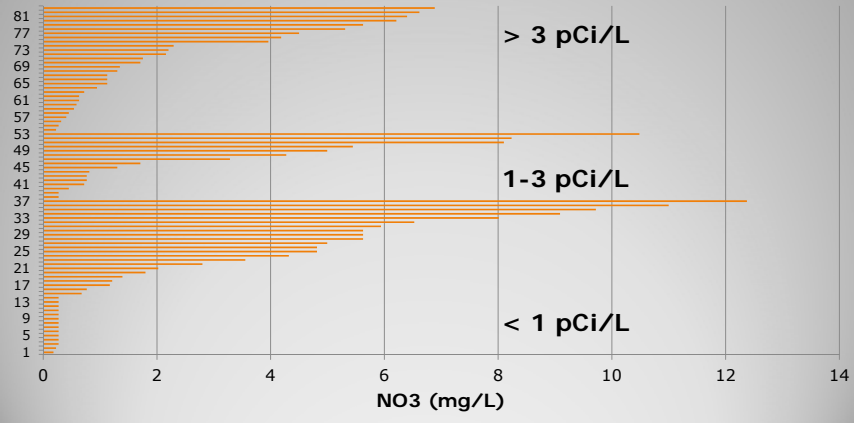
- When rainwater and soil N are the sources of solutes, nitrate concentrations in groundwater are very low (< 4 mg/L as NO₃)
- Groundwater from wells adjacent to the river has recharged relatively recently, even in wells 300' deep. Older water is found in the confined zone (below Chualar) and in the Eastside subbasin (San Jerardo)
- Denitrification is taking place in the vadose zone and in the aquifer in groundwater near the Salinas River
- San Jerardo well nitrate concentrations vary with the hydrograph
 - Isotopic composition of nitrate is consistent with synthetic anhydrous N fertilizer
 - High-nitrate, irrigation return water drawn into well capture zone in spring and summer

Findings

Groundwater age and nitrate



Unimpacted Study Area



Basin/Range

Questions and Comments

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