

Techniques to assess human and climate impacts on groundwater the High Plains aquifer perspective

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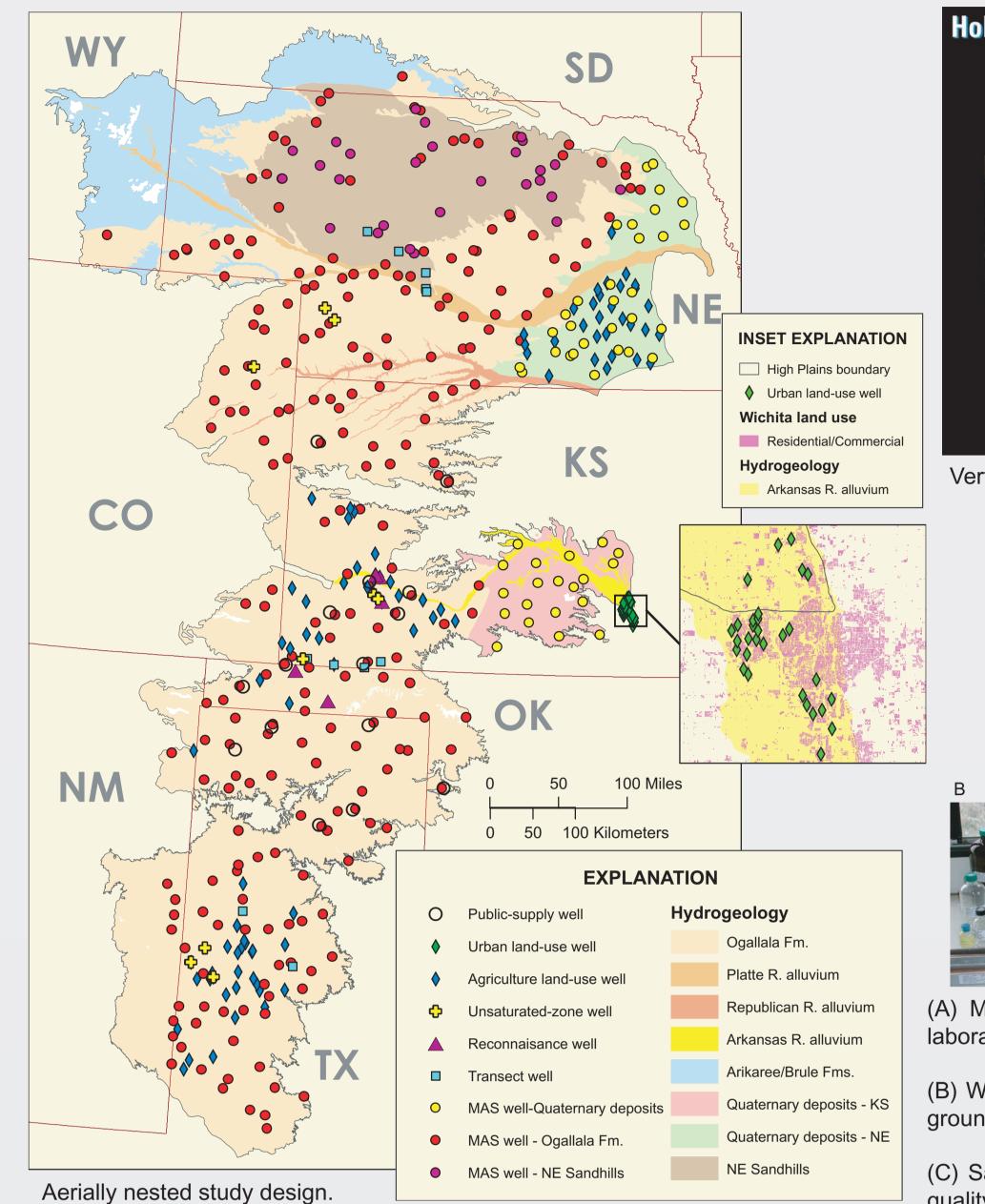
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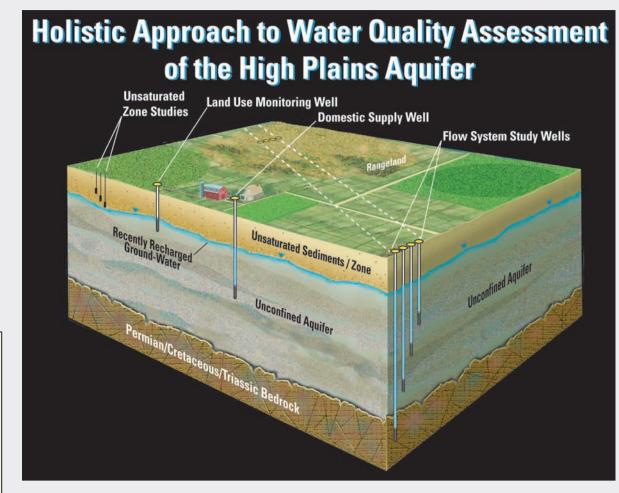
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Regional Groundwater-Quality Assessment - Nested Study Design





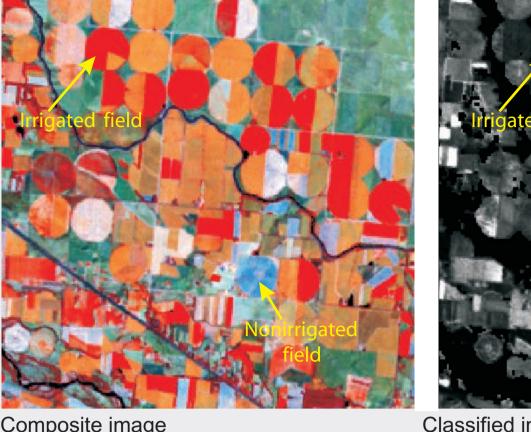
Vertically nested study design

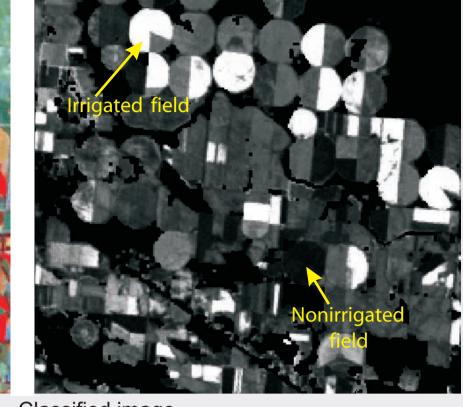




Irrigated, non-irrigated, and rangeland.



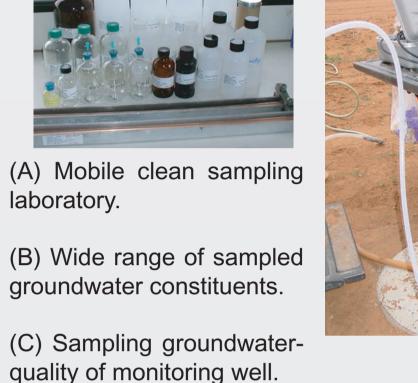


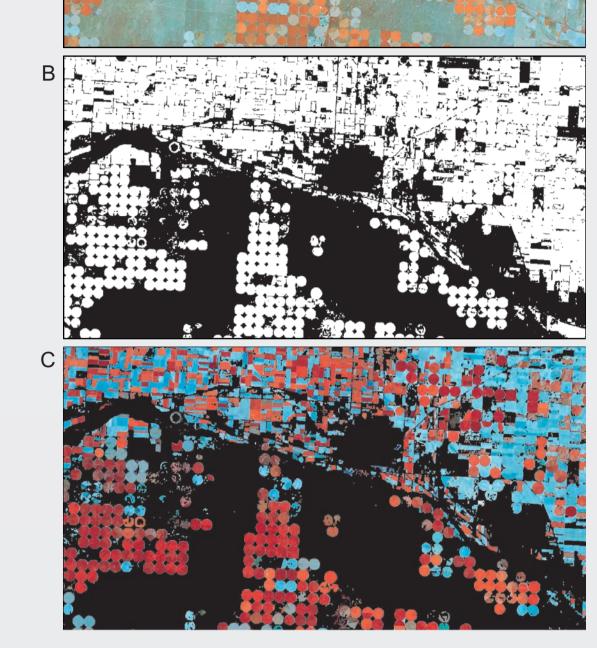


Classified image

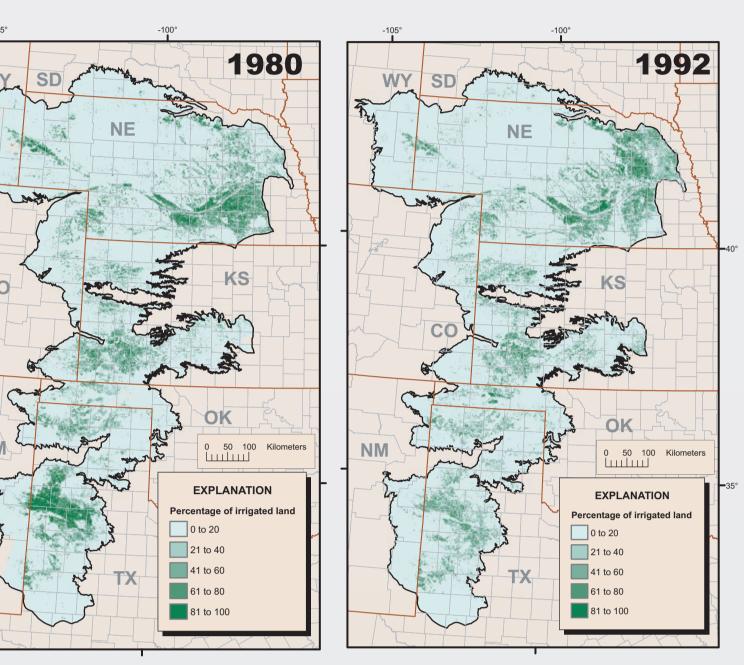
Example of a composite and resulting classification image. The white/gray areas represent irrigated land and the black areas represent nonirrigated land.







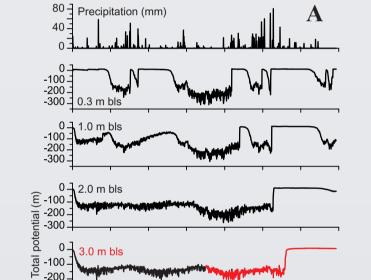
Example of masked satellite image: A - Original composite band image, B - Agricultural areas designated by NLCD, C - Resulting image to be processed.



Comparison of irrigated density between 1980 and 1992.

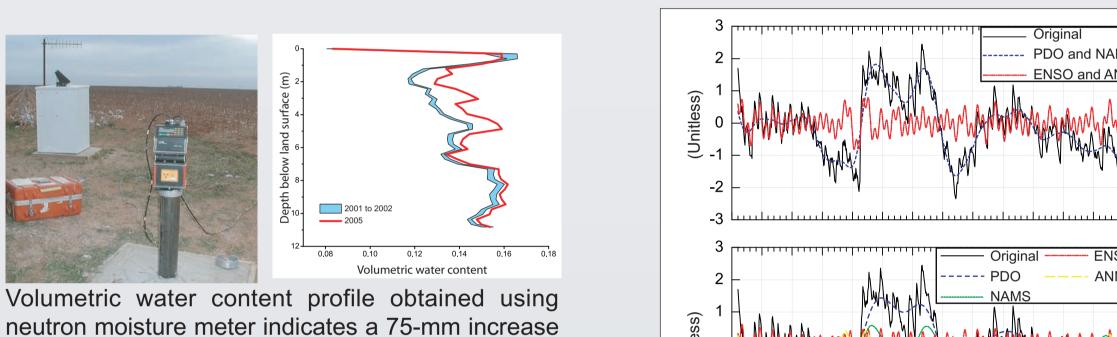
Groundwater and Unsaturated Zone Response to Natural Climate Variability

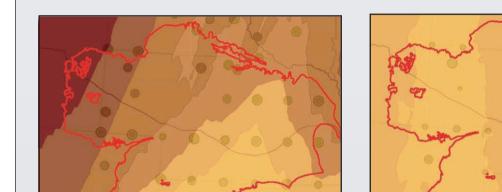


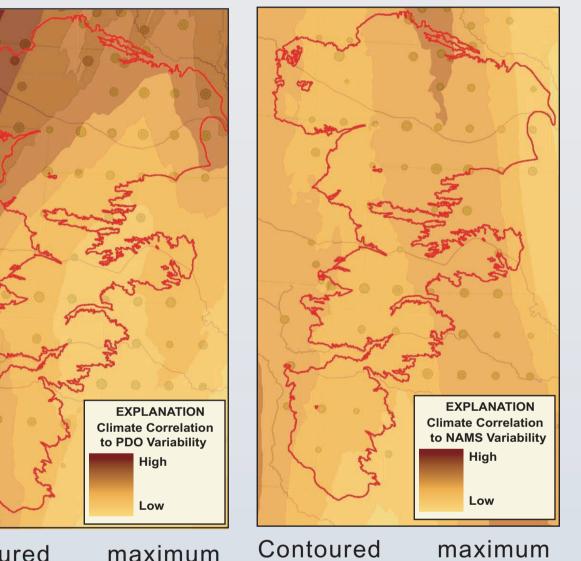


80 Precipitation (mm)

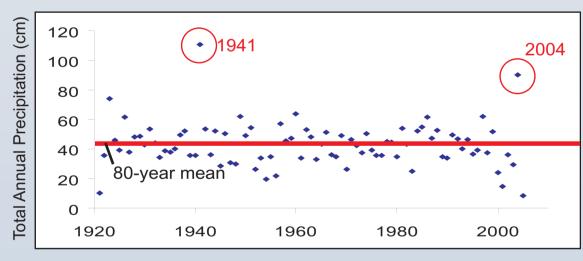








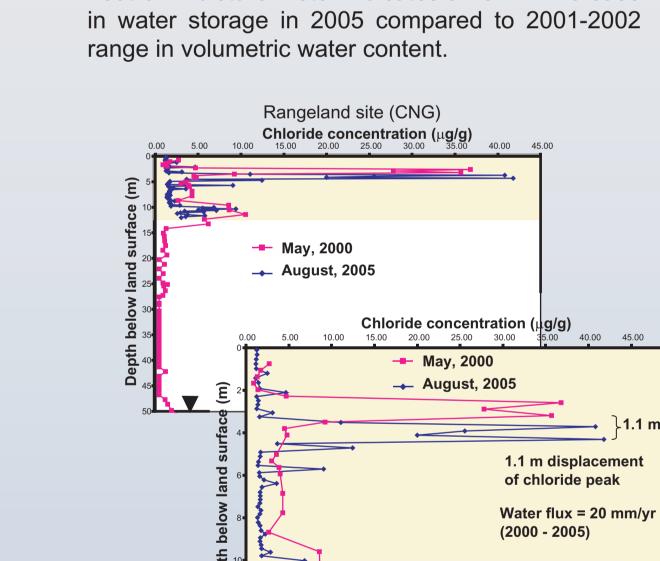
Weather station located at NHP rangeland unsaturated zone monitoring site.



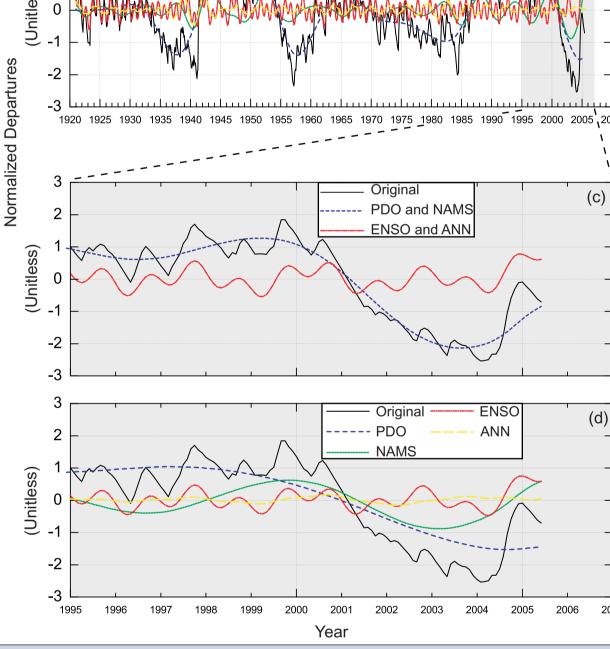
Total annual precipitation at SHP rangeland unsaturated zone monitoring site

Daily precipitation and total potential profiles indicate deep percolation events beneath SHP unsaturated zone sites at (A) rangeland setting, and (B) irrigated agricultural setting.

1.5 m bls



Chloride profiles indicate a 1.1 m downward displacement. Water flux for 2000 to 2005 is 20 mm/yr; long-term mean water flux is 5 mm/yr.

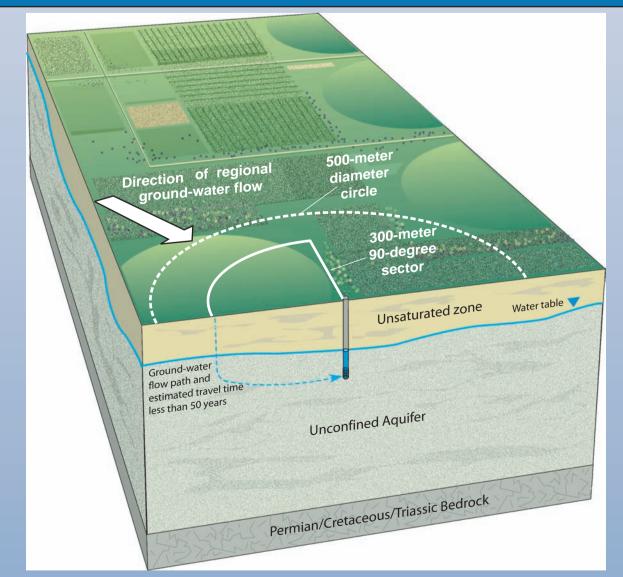


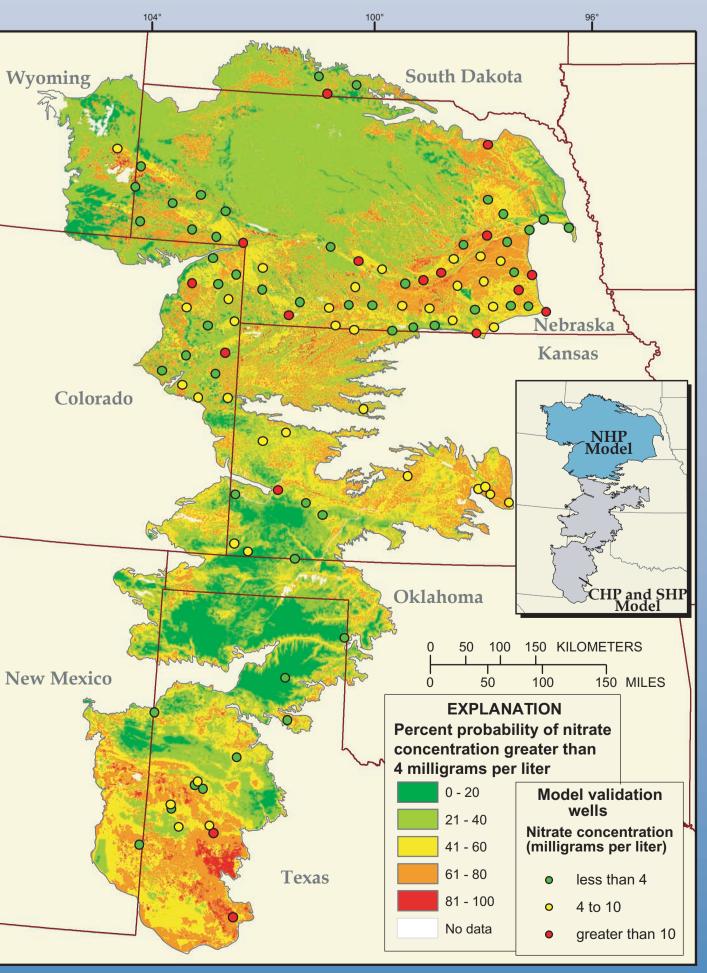
Singular Spectral Analysis (SSA) reconstructed components for long-term precipitation time series at SHP rangeland unsaturated zone monitoring site.

maximum Contoured periodicity for the Pacific Decadal Oscillation (PDO) (10-25 climate years) cycles kriging by precipitation and tree-ring indices.

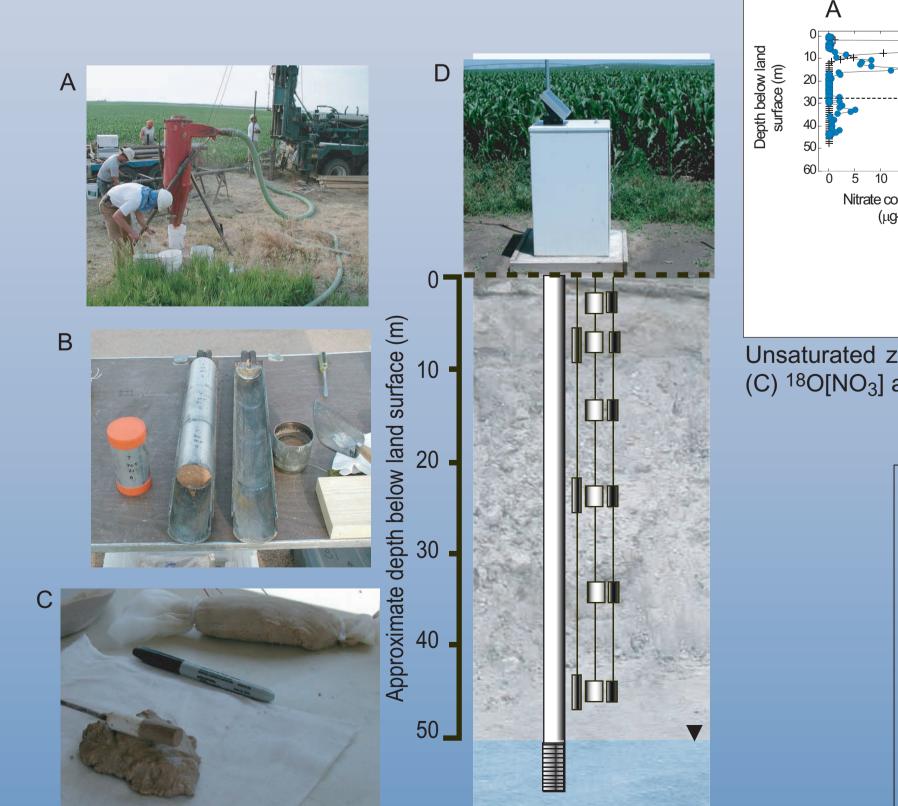
maximum periodicity for the North Monsoonal American System (NAMS) (7-10 years) climate cycles by kriging precipitation and tree-ring indices.

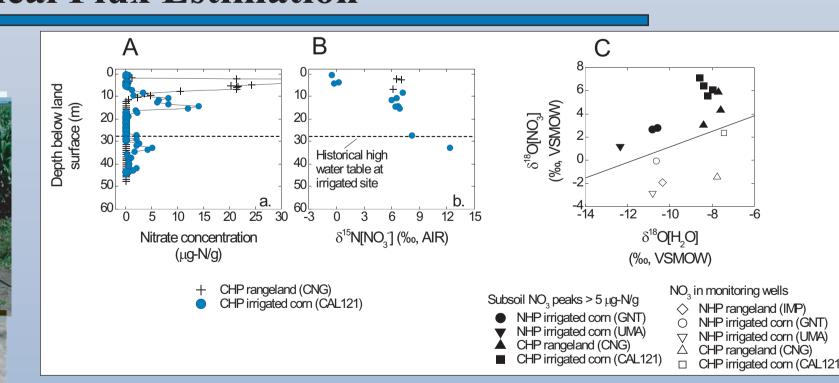
Groundwater-Vulnerability Assessment - Nonpoint Source Nitrate





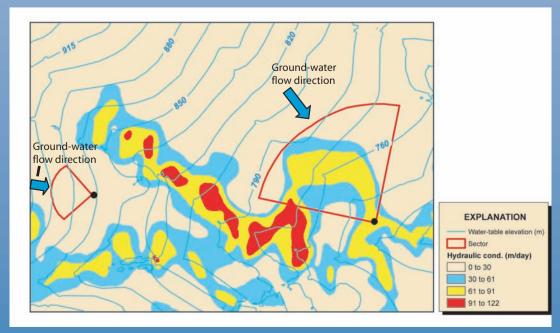
Unsaturated Zone Water and Chemical Flux Estimation





Unsaturated zone sediment (A) NO₃ concentrations, (B) ¹⁵N values, and

GIS-based extraction using 90-degree sector contributing area as input for logistic regression based groundwater-vulnerability assessment.



Groundwater-flow and particle-tracking simulations constrained contributing area, used during groundwatervulnerability model calibration and map construction

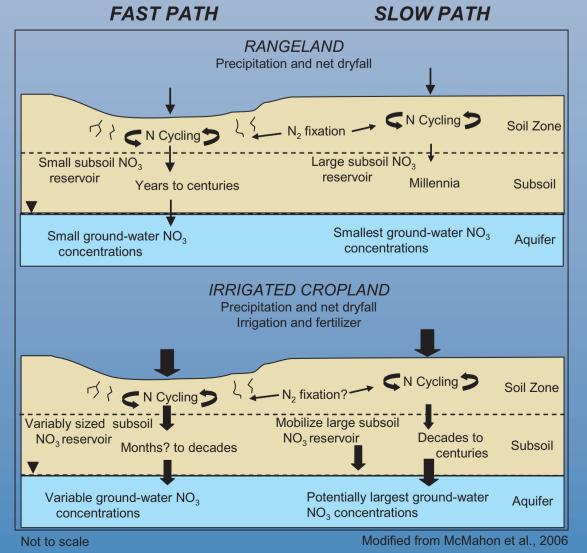
Vulnerability map illustrates the predicted probability of detecting nitrate > 4 mg/L in recently recharged groundwater (< 50 years). Nitrate concentrations from validation well network is shown.

Unsaturated zone monitoring site installation: A. Casing-advance, dry-drilling technology.

- B. Collect cores for water content, chemical, and physical analyses.
- C. Heat dissipation probe (HDP) preparation.

D. Final installation, includes HDP, lysimeters, gas sampling ports, monitoring well, weather stations, and remote data storage and transmission to office.





Conceptual model of nitrate transport to water table.

Questions



International Symposium on GRAPHIC - Kyoto, Japan April 4-6, 2006 Groundwater Resources Assessment under the Pressures of Humanity and Climate Change

For additional information, please visit our homepage at http://co.water.usgs.gov/nawqa/hpgw/index.html