Using Landsat 7 Data to Determine Groundwater Discharge Areas

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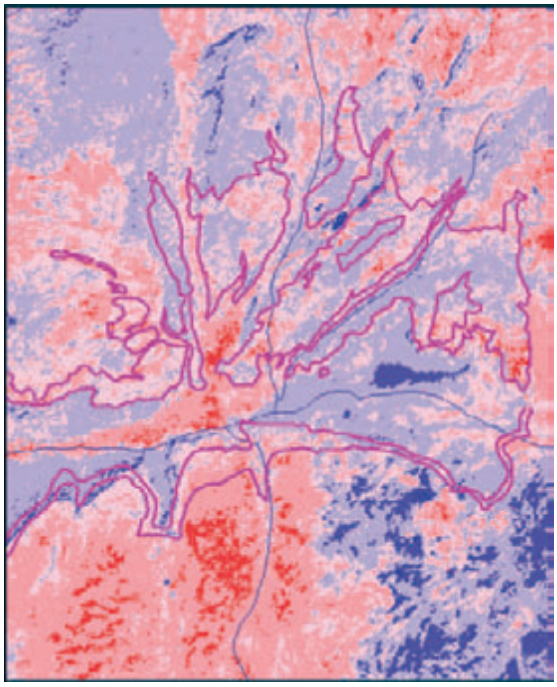
INTERA used Landsat band 7 (near-infrared) data to determine areas of regional groundwater discharge in support of development of a complex, 3-D groundwater flow model in western New Mexico. In order to correctly define discharge boundary conditions in the model, it was first necessary to determine the nature and extent of regional groundwater discharge from outcrop zones by evapotranspiration.

Since the near-infrared portion of the spectrum represented by Landsat band 7 is absorbed by water, these data can be used to determine relative soil moisture differences on a regional scale. Analysis of band 7 reflectance values reveals areas of relatively higher soil moisture (areas of higher relative absorption of the near-infrared portion of the spectrum), which often are associated with regional groundwater discharge.

The figure at right shows colorized Landsat band 7 data. Blue areas are characterized by low reflectance values, indicating relatively higher soil moisture. Note that the areas of increased soil moisture often are associated with outcrop areas, shown in magenta. These were identified as areas of regional groundwater discharge. The streams in the areas are ephemeral, thus baseflow does not exist and discharge is principally by evapotranspiration.



Landsat band 7 reflectance imaging. Darkest blue = highest soil moisture, darkest red = lowest soil moisture.

As a cross-check, Landsat results were compared to aerial photography from digital orthophoto quarter quadrangles to identify areas of increased vegetation along the outcrop zones. Typically, more vegetation was found associated with the outcrop zones, confirming that these were indeed regional discharge areas and that the plant communities were present due to additional water from the concomitant groundwater discharge.

In order to improve the mass balance in the model, we needed to identify the location and magnitude of the regional groundwater discharge. The Landsat analysis allowed us to identify the locations associated with regional discharge, while further calibration of the model allowed us to determine the magnitude of that discharge.

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