Monitoring and Modeling Hydrologic Connectivity in Semi-arid Watersheds

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Looking at hydrologic connectivity between the headwaters and the irrigated valley.
Study sites
Field data collection

Different water budget components are being measured.
Field data collection cont’d

- Multiple weather and hydrologic parameters are being monitored.

Soil moisture/soil properties  Soil moisture/deep percolation  Weather

Shallow groundwater  Stream flow  Acequia stage/flow
Surface water and groundwater connectivity – Alcalde site
Surface water and groundwater connectivity – Watershed

Water table map created based on field measurements shows ground water flows westward towards the Rio Grande.
Surface water and groundwater connectivity - Valley

Seasonal water table fluctuations.

Adapted from Ochoa et al. 2013b
Aquifer response to ditch and irrigation inputs?

- A significant amount of delayed return flow is observed after the end of the ditch flow season.

Adapted from Ochoa et al. 2013b
<table>
<thead>
<tr>
<th>Component</th>
<th>Amount from canal diversion + total precipitation (%)</th>
<th>Range (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow control diversion</td>
<td>9.5</td>
<td>0 to 14</td>
</tr>
<tr>
<td>Crop field runoff</td>
<td>8.9</td>
<td>0 to 19</td>
</tr>
<tr>
<td>Canal outflow</td>
<td>40.9</td>
<td>28 to 67</td>
</tr>
<tr>
<td>Canal seepage</td>
<td>12.1</td>
<td>5 to 17</td>
</tr>
<tr>
<td>Deep percolation</td>
<td>21.2</td>
<td>9 to 32</td>
</tr>
<tr>
<td>Crop evapotranspiration</td>
<td>7.4</td>
<td>1 to 15</td>
</tr>
</tbody>
</table>

Total 100.0

Table 1. Three-year (2005-2007) averaged water budget of the Alcalde main irrigation canal.

Ochoa et al. 2011
Head waters and floodplain valley - hydrologic connectivity

River response to tributary inflow
River stage increased up to 0.3 m after a flashflood event with peak discharge of 17.9 m$^3$ s$^{-1}$ at the tributary stage-measuring station.

Adapted from Ochoa et al. 2013a
Head waters and floodplain valley - hydrologic connectivity

- Water levels in wells near the river increased in response to rainstorm inflow.
Modeling hydrologic connectivity – System dynamics

Concept

Feedback

Causal loop diagram

Systems model
Hydrologic connectivity – cross disciplinary

Adapted from Fernald et al. 2012
Community participation

• Support from our collaborators has been critical for the success of the research activities.

Acequia parciantes, extension faculty, and researchers meeting in Santa Fe, NM.
Our thanks to our multiple collaborators:

Acequia parciantes, ranchers, well owners, acequia associations, and mutual domestic water associations in the communities of Alcalde, Velarde, Truchas, Valdez, Arroyo Hondo, and El Rito, NM.

Las Nueve Acequias en el Rio Grande
A. de Alcalde, A. de la Canova, A. Ancon, A. San Rafael del Guique, A. Madre del Bosque, A. de Los Chicos, A. Garcia, A. del Medio, A. Rinconada Isla.

Acequias of the Rio Hondo
La Cuchilla ditch, A. de Los Prando, A. de San Antonio, Canoncitos ditch north, Canonictos ditch south, A. de Atalaya, A. Madre del Llano, A. de La Plaza.

Acequias of El Rito
References:


http://www.waterconnections.org