Last Call at the Oasis: Will There Be Enough Water for the 21st Century?

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Hot Science, Cool Talks
26 October 2012, Environmental Science Institute
University of Texas at Austin
While John Anderson, Variety, and Cheryl Eddy, San Francisco International Film Festival, discuss the importance of water for California, the 2012 SXSW Film Festival highlights "Last Call at the Oasis."
The original trailer
My Big Screen debut
With UT DGS PhD Matt Rodell, December, 2012
California for water
Estimating water storage changes with GRACE

GRACE is like a giant scale in the sky that tells you how much weight you’ve gained or lost each month.
Estimating water storage changes with GRACE
Estimating groundwater storage changes with GRACE

\[ \Delta S_{\text{LAND}} = \Delta S_{\text{SNOW}} + \Delta S_{\text{SW}} + \Delta S_{\text{SM}} + \Delta S_{\text{GW}} \]

\[ \Delta S_{\text{GW}} = \Delta S_{\text{LAND}} - \Delta S_{\text{SNOW}} - \Delta S_{\text{SW}} - \Delta S_{\text{SM}} \]

Remove this (\(\Delta S_{\text{SNOW}} + \Delta S_{\text{SW}} + \Delta S_{\text{SM}}\)) from \(\Delta S_{\text{LAND}}\)…

To isolate this (\(\Delta S_{\text{GW}}\))
Groundwater depletion in California’s Central Valley, October, 2003 – March, 2009

- California’s Central Valley is one of the most productive agricultural regions in the world.
- Sacramento River Basin agricultural regions in the world.
- Produces more than 250 different crops worth $17 billion per year (2002), or 8% of the food produced in the U.S.
- Accounts for 1/6 of irrigated land in the U.S.
- Supplies 1/5 of the demand for groundwater in the U.S.
- Is the second most pumped aquifer in the U.S.
- Groundwater depletion and subsidence have been documented there for decades (e.g., Faunt, 2009).
Groundwater depletion in California’s Central Valley, October, 2003-March, 2009

• Since GRACE ‘sees’ all the water storage changes on land, in order to estimate the groundwater storage change signal, the snow, surface water and soil moisture mass changes must be estimated and removed

\[
\Delta S_{\text{Groundwater}} = \Delta S_{\text{Total}} - \Delta S_{\text{Snow}} - \Delta S_{\text{Surface Water}} - \Delta S_{\text{Soil Moisture}}
\]

• The snow, surface water and soil moisture signals were estimated using best available observed and modeled data sets

Famiglietti et al., 2011
Groundwater depletion in California’s Central Valley, October, 2003-March, 2009

<table>
<thead>
<tr>
<th>Water Storage Type</th>
<th>Trend (mm/yr)</th>
<th>Volume lost (km³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRACE Total Water Storage</td>
<td>-37</td>
<td>31.3</td>
</tr>
<tr>
<td>Snow</td>
<td>-2</td>
<td>1.7</td>
</tr>
<tr>
<td>Surface Water</td>
<td>-9</td>
<td>7.6</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>-2</td>
<td>1.7</td>
</tr>
<tr>
<td>Groundwater</td>
<td>-24</td>
<td>20.3</td>
</tr>
</tbody>
</table>

- In the 78 month period analyzed, the water stored in the combined Sacramento-San Joaquin River Basin decreased by over 31 km³, or nearly the volume of Lake Mead.
- Nearly two-thirds of this, or roughly 20 km³, came from changes in groundwater storage, primarily from the Central Valley.
GRACE Observed Total Water Variation

Courtesy of Bridget Scanlon, BEG, Jackson School of Geosciences

Texas Drought
2005-2006

Texas Drought
2011
Groundwater depletion in India, August, 2002 – October, 2008

Reported groundwater withdrawals as a percentage of estimated recharge in India

4.0 ± 1.0 cm/yr
17.7 ± 4.5 km³/yr
August, 2002 – October, 2008

Rodell et al., 2009
Groundwater depletion in the Tigris-Euphrates River Basins, 2003-2010

- Total water loss of 143 km³ between 2003 and 2010
- Equivalent to the volume of the Dead Sea, or more than 4 times the volume of Lake Mead in the U.S.
- Roughly two-thirds of this attributed to a loss of groundwater

Voss et al., 2012, in prep
ucchm.org
Estimating water storage changes with GRACE for California
Trends in Freshwater Storage from GRACE, 2002-2010

Famiglietti et al., 2012, in prep

water for california
Is the water cycle changing?
Are wet areas getting wetter, dry areas getting drier?

IPCC AR4, Projected Patterns of Precipitation Change

Figure SPM.7. Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change.
Are wet areas getting wetter, dry areas getting drier?

Trends in Freshwater Storage from GRACE, 2002-2010

Are we already seeing the predicted redistribution?

Famiglietti et al., 2012, in prep
ucchm.org
Can water managers benefit from our data?

Trends in total water storage from GRACE, 2004-2012
Groundwater depletion in the Tigris-Euphrates River Basins, 2003-2010

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Voss et al., 2012, in prep

ucchm.org
From toilets to tap

The cover story discusses the importance of water conservation in California. It highlights the need to tap into greywater and recycled water systems to save precious water resources. The article includes an infographic that explains the process of converting household waste water into usable water.

Justices side with funeral picketers

The article also covers the legal battle against funeral homes, where picketers have been protesting the practice of disposing of funeral ashes in unmarked graves. The court case is significant as it could set a precedent for environmental and ethical considerations in the funeral industry.

Reminders of shooting, pain linger for Greens

After a shooting incident, the survivors are left with feelings of pain and trauma. The article offers reminders and support for those affected, emphasizing the importance of mental health and community support in the healing process.
Perhaps...we need a pitch man!
Communication: Responsibility or Pain in the Neck?

As a community, we need to elevate our issues to the level of everyday understanding.
Is this our 'Inconvenient Truth'?

california for water

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