

Estimating the groundwater depletion in the Middle East from GRACE Data

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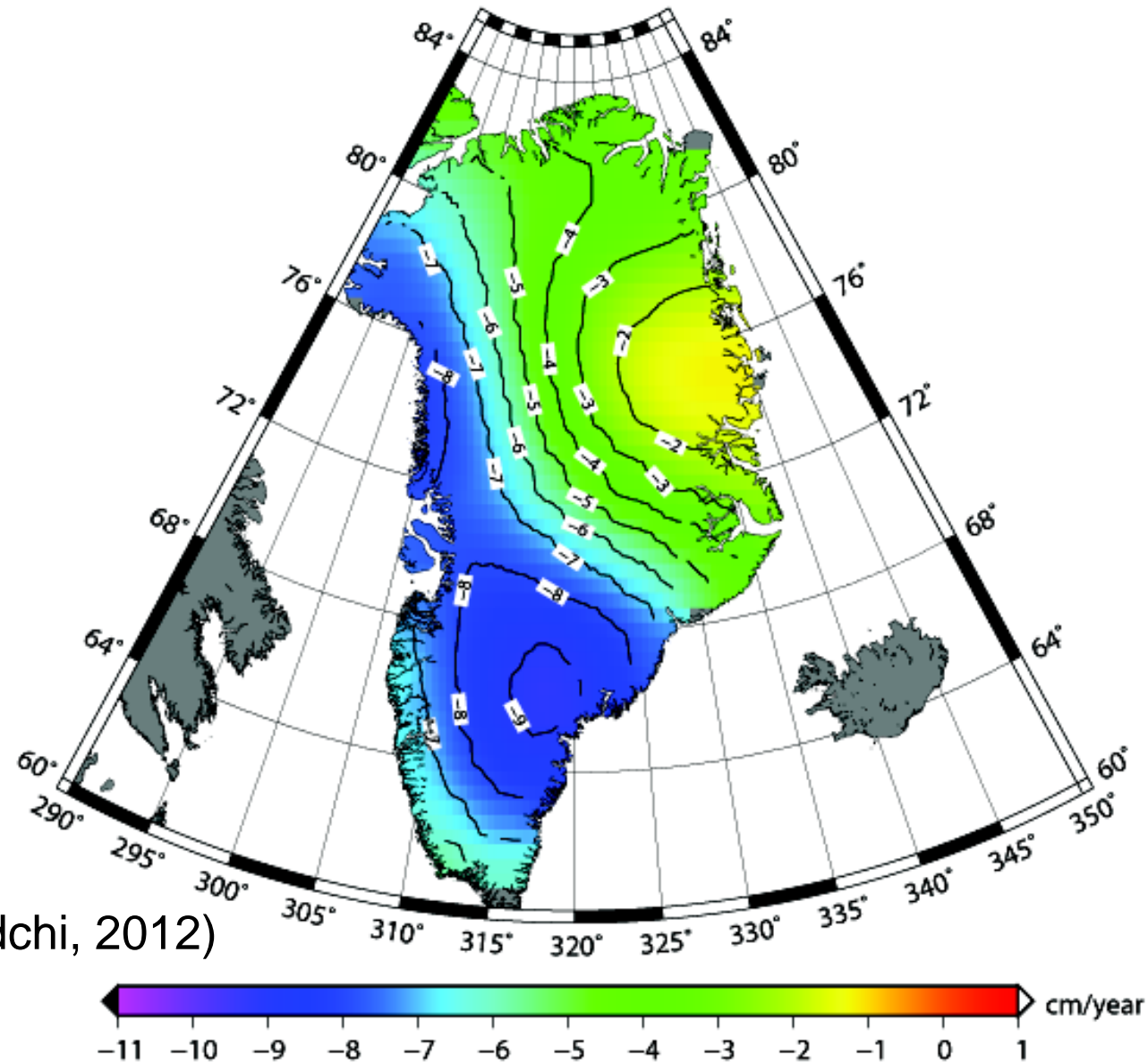
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GRACE (Gravity Recovery and Climate Experiment) mission

- USA-German joint mission
- Launched in March 2002, end in October 2017
- Twin satellites, dedicated to the measurement of the time-variable gravity field
- Mapping the Earth's gravity field by accurate measurements of the distance between the two satellites
- GRACE Follow On satellite mission (launched 2018 and is in the orbit now)

GRACE monthly gravity field solution

- Oceanography
- Hydrology
- Glaciology
- Solid Earth



GRACE Shows Change in Water from March 2010 to March 2011

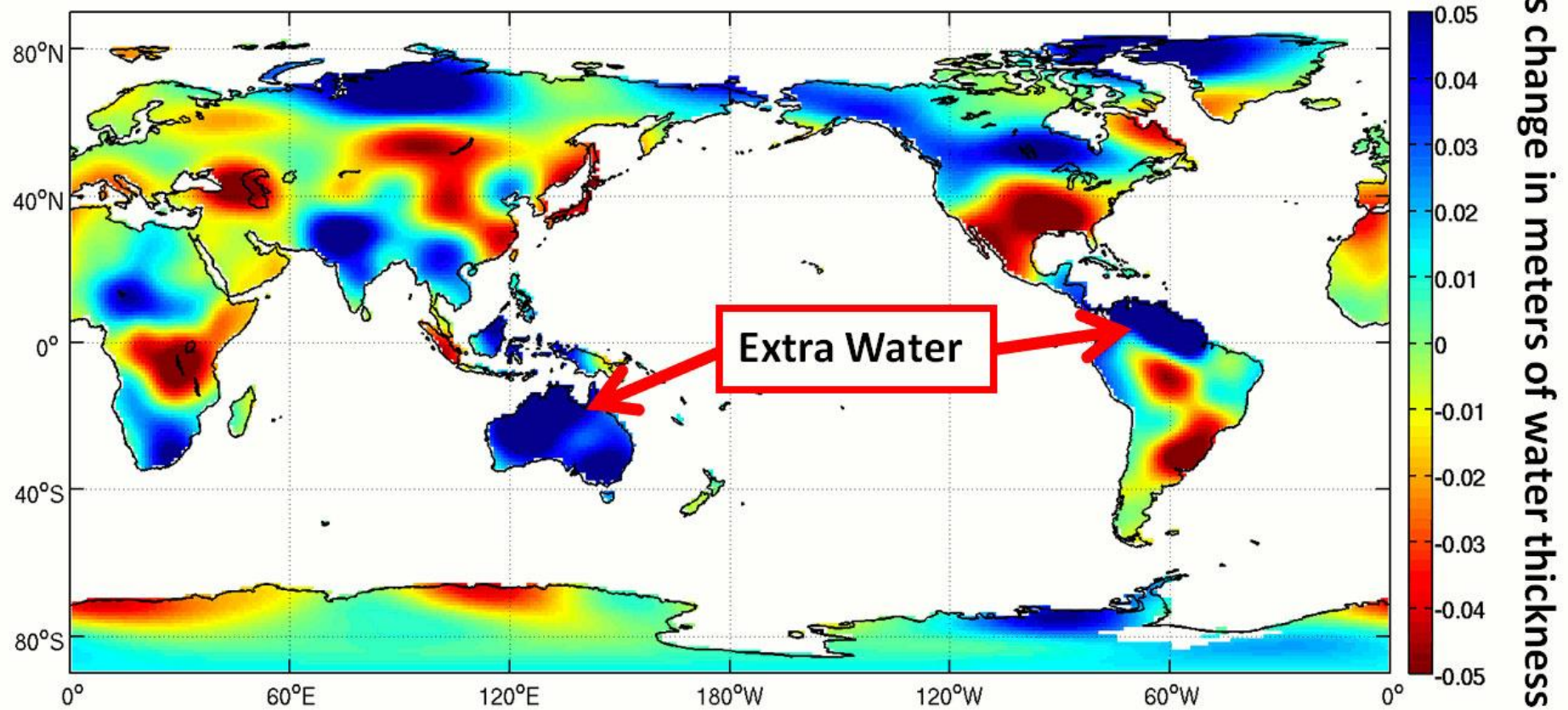


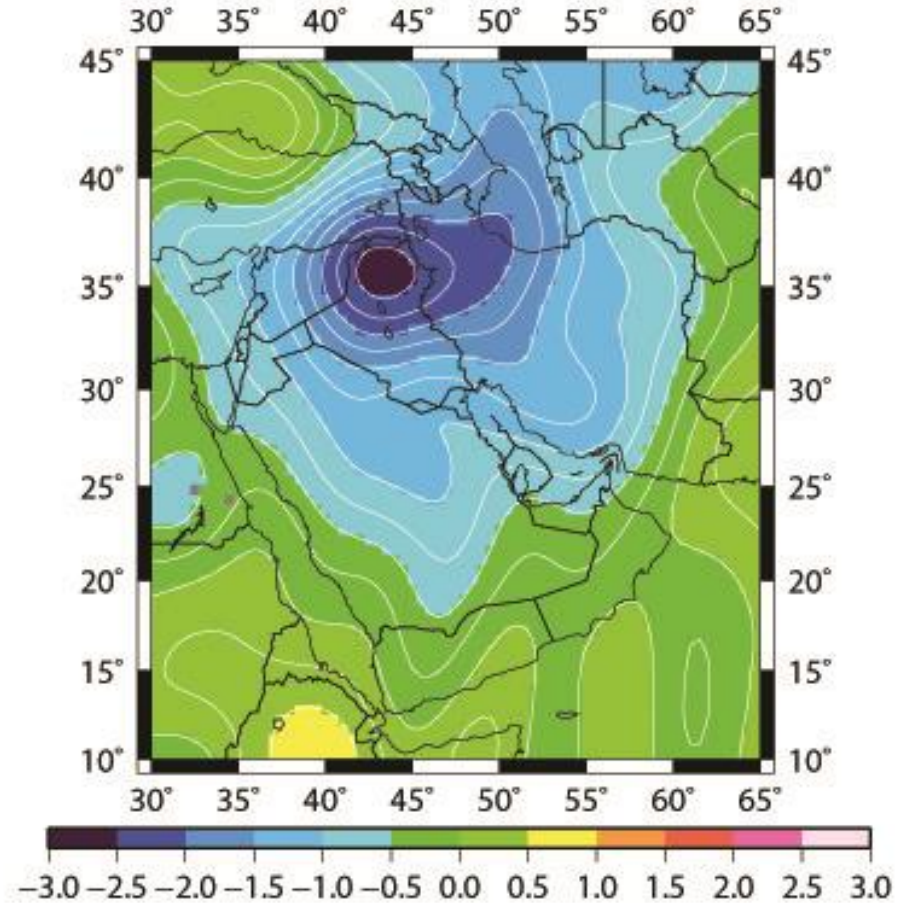
Image from NASA JPL.

Estimating the human contribution to groundwater depletion in the Middle East, from GRACE data, land surface models, and well observations

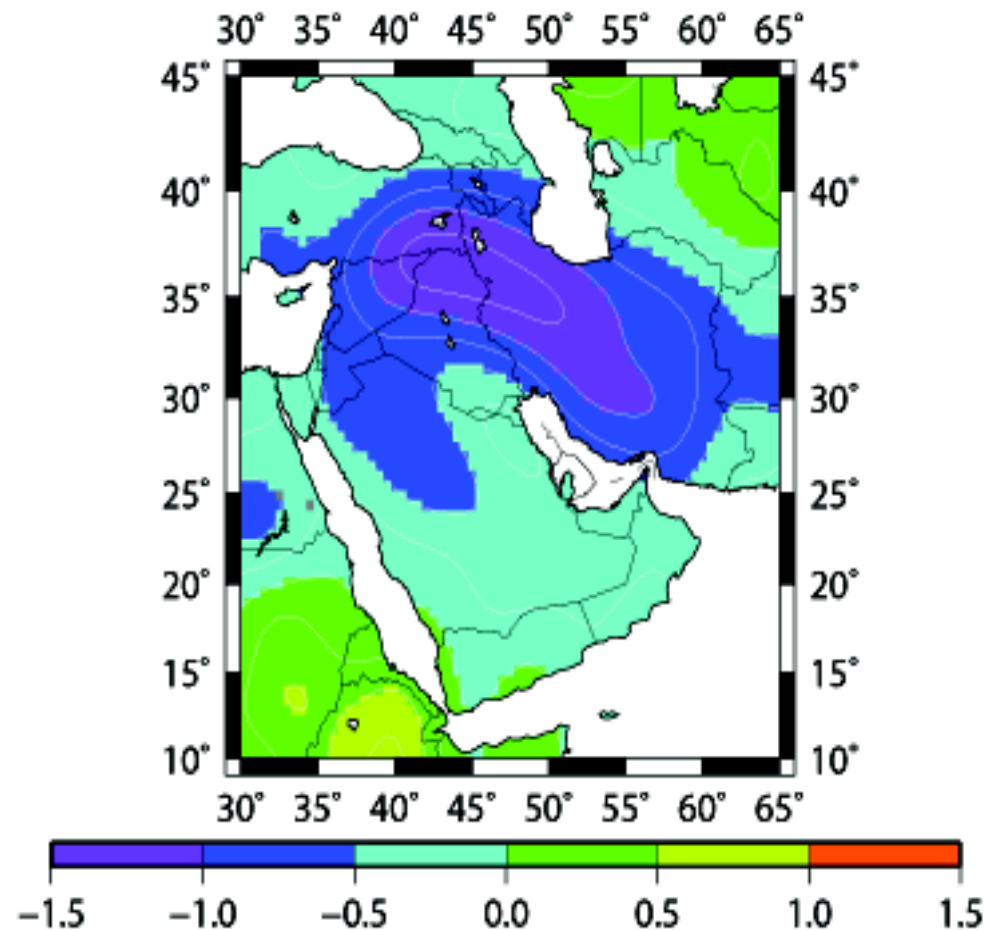
Gholamreza Joodaki, John Wahr, and Sean Swenson

<https://doi.org/10.1002/2013WR014633>

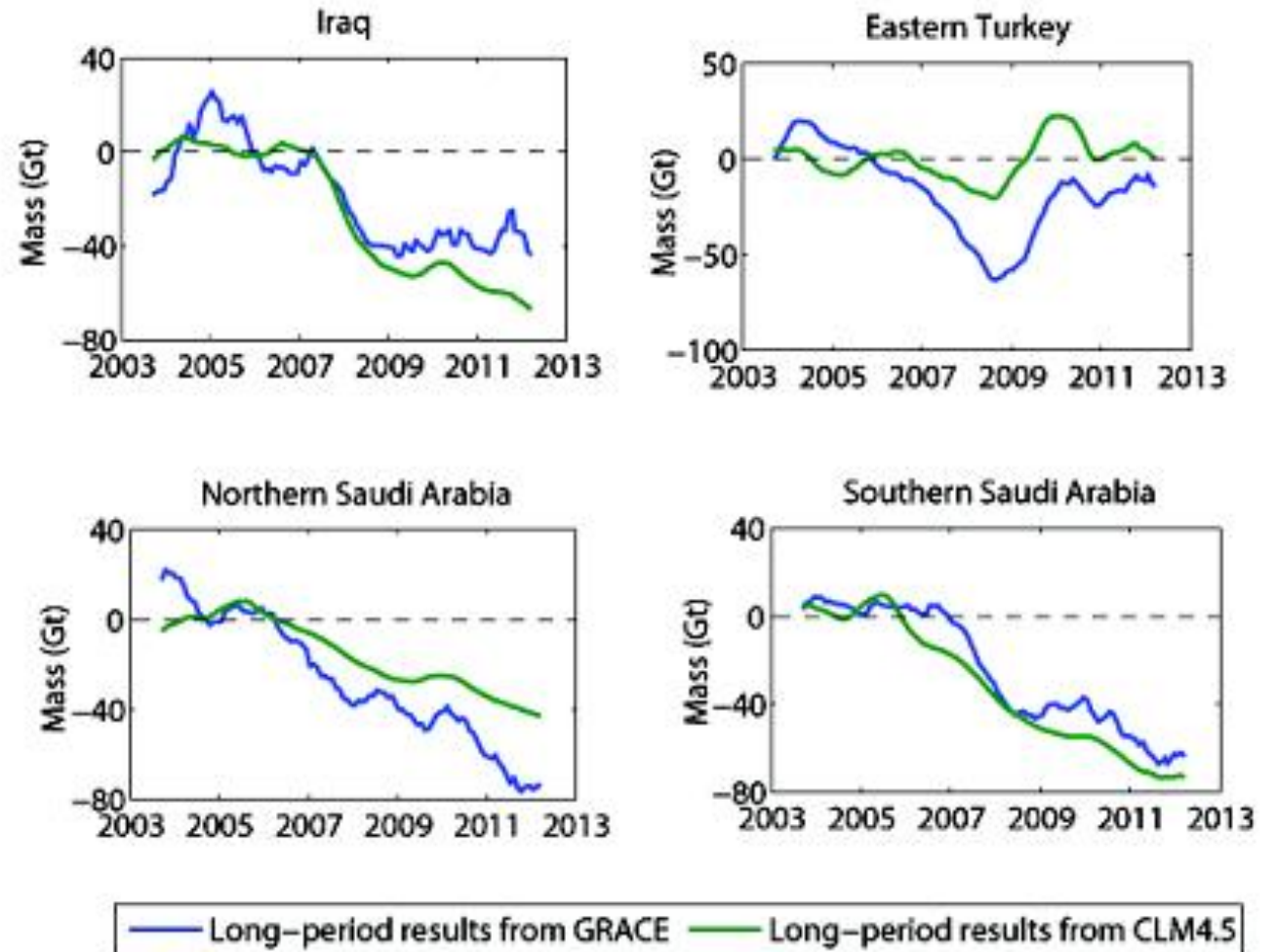
The 2003-2012 secular trend maps (cm/year) over the Middle East



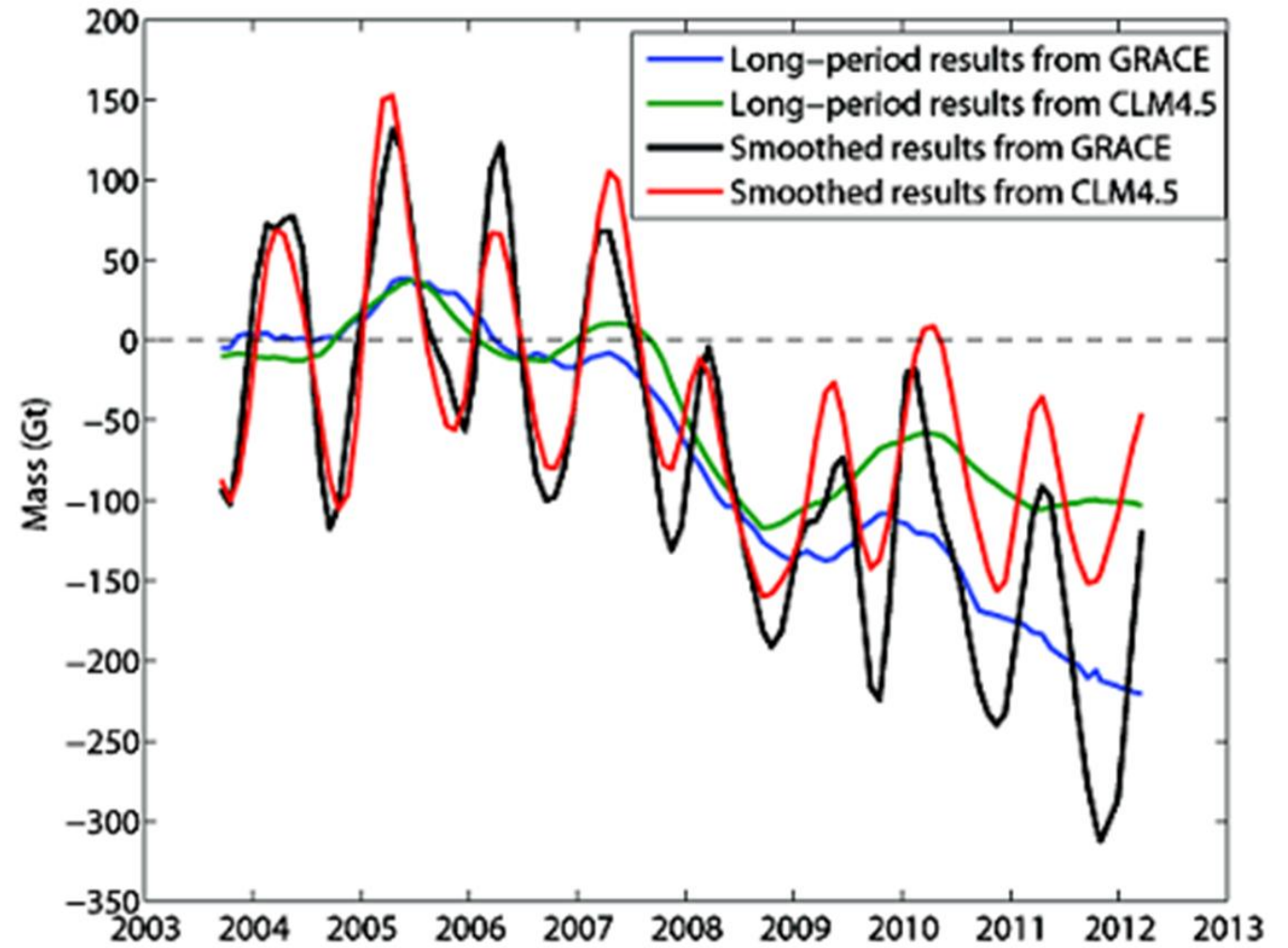
- Secular trend in groundwater (cm/yr) during 2003-2012.



- Changes in water storage, in gton for Iraq, eastern Turkey, and northern and southern Saudi Arabia.



- Changes in water storage, in gton, for Iran



Total groundwater storage

Region	Secular trend Gt/yr
Iran	-25±6
Iraq	-2±3
Eastern Turkey	-5±2
Northern Saudi Arabia	-6±5
Southern Saudi Arabia	-5±2

Remark

- GRACE offers a valuable and unique opportunity to understand hydrologic trends in data-inaccessible regions.

Thank you for your attention!

Any question?