Welcome!

Water Forum III: Droughts and Other Extreme Weather Events

October 14–15, 2013

Jackson School of Geosciences
University of Texas at Austin
Sharon Mosher, Dean

Changing the World of Geoscience

THE UNIVERSITY OF TEXAS AT AUSTIN
JACKSON
SCHOOL OF GEOSCIENCES

JSG Vision & Goals

- **Address fundamental geosciences questions involving coupling of Earth systems and processes**

  … to advance the geosciences & benefit society

- **Provide world-class education for students at all levels**

  … so they can create, innovate, and lead the geosciences in the future

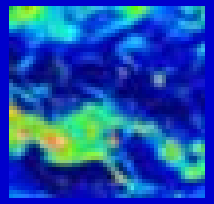
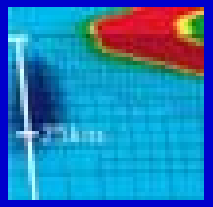
Jackson School of Geosciences

- **Components**
  - Department of Geological Sciences (DGS)
  - Institute for Geophysics (UTIG)
  - Bureau of Economic Geology (BEG)
- **UTA Cross-College Partnerships**
  - Center for Integrated Earth System Science
  - Environmental Science Institute
  - Center for International Energy & Environmental Policy
  - Energy Institute
- **Outreach**
  - GeoFORCE Texas
  - TXESS Revolution
  - Earth is Calling
  - Hot Science, Cool Talks

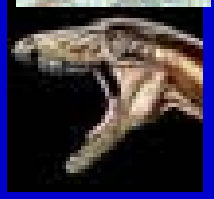
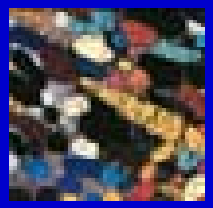
- **Personnel**
  - 58 faculty
  - 90 research scientists
  - 40 research staff
  - 40 postdoctoral fellows
- **Students**
  - ~ 330 undergraduates
  - ~300 graduate students
    - 60% Ph.D.'s; 40% Masters

JSG Breadth and Depth

- Climate Dynamics
- Computational Geosciences
- Geochemistry & Thermo- & Geo-chronology
- Geophysics & Seismology
- Hydrogeology & Glaciology
- Paleontology & Geobiology
- Petrology & Mineral Physics
- Sedimentary Geology & Stratigraphy
- Structural Geology & Lithospheric Geodynamics



Vision for Jackson School

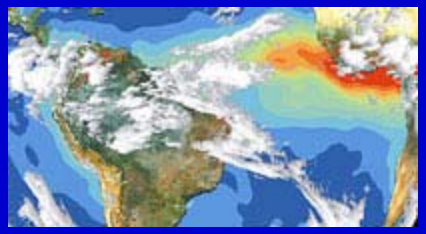
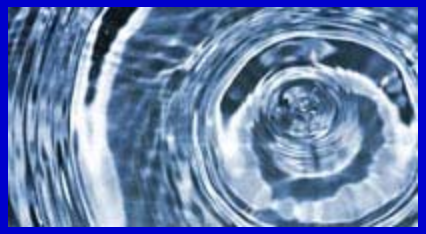
Transformative Research

- **Interdisciplinary –** working at the interfaces between disciplines

….have most potential for future major breakthroughs

- **Coupling & interaction**
  - physical, biological, chemical and geologic processes
  - Earth's interior, surface, hydrosphere, biosphere and atmospheric systems

Major Research Themes


- Climate, Carbon & Geobiology
- Surface and Hydrologic Processes
- Planetary Geosciences
- Solid Earth & Tectonic Processes
- Marine Geosciences
- Energy Geosciences

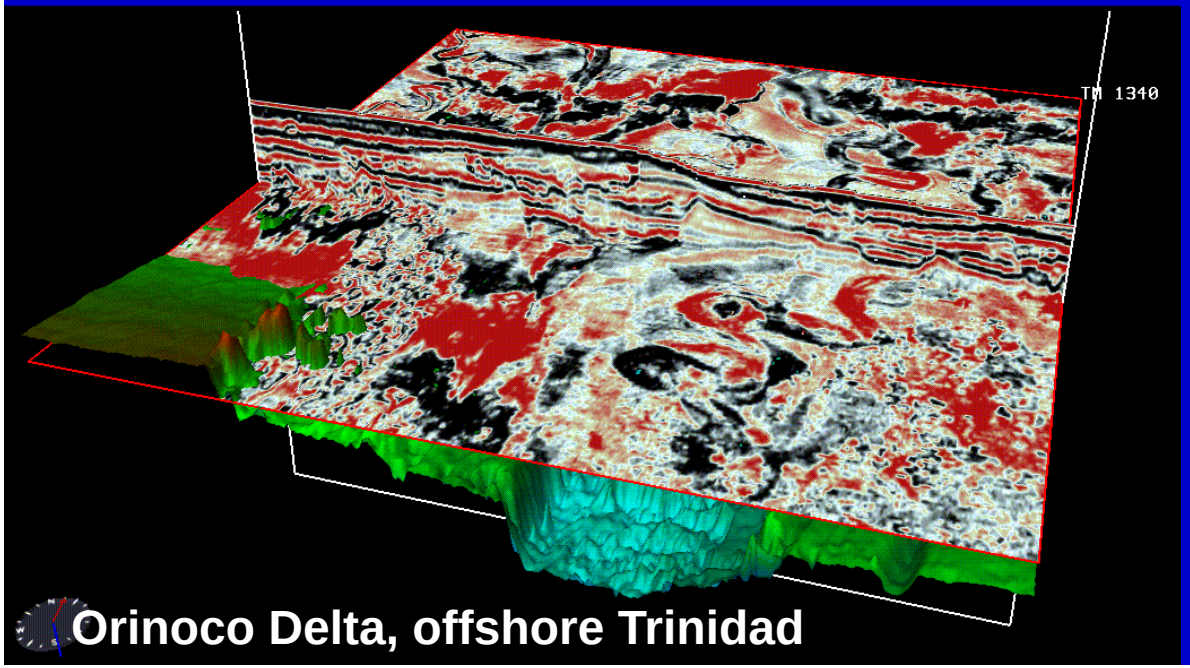


Our research blends

– study of present day geoscience processes that impact society

– with study of deep time

Wax Lake Delta, LA



Orinoco Delta, offshore Trinidad

using geologic record to determine long term consequences of short term processes

satellite & airborne observations

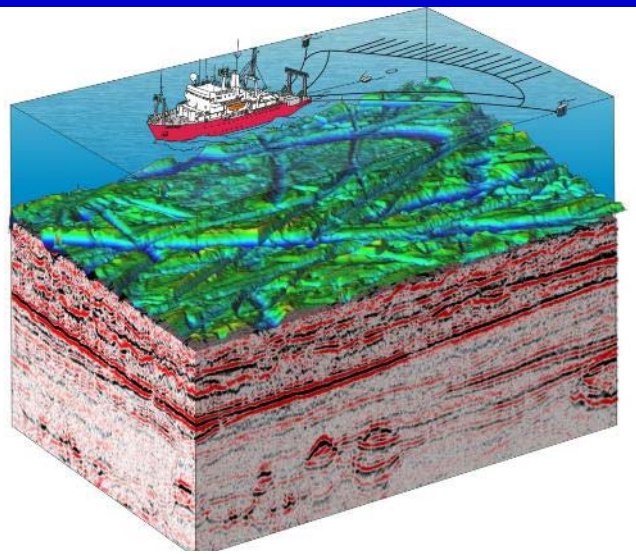
field observations

Co-seismic uplift in Solomon islands

Research Integration

lab experiments & analyses

TACC



marine geophysics

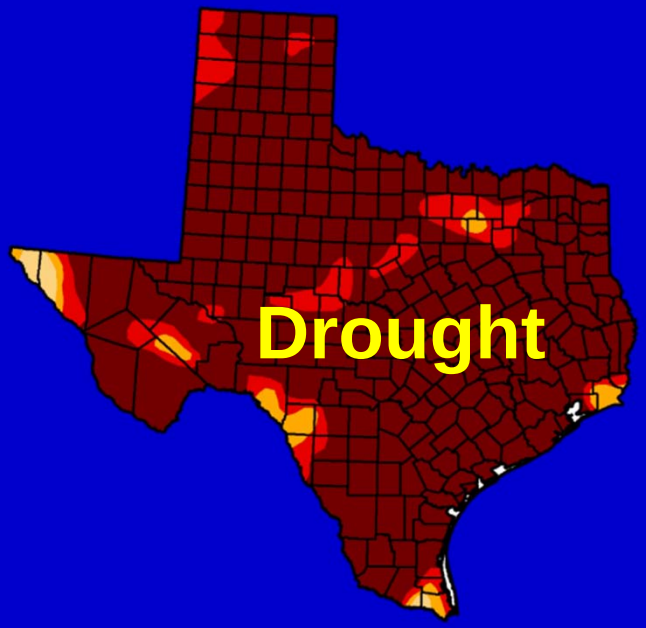
computation modeling & simulation

Many disciplines collaborating to tackle significant problems

Hydrology:
Measuring soil water storage & soil moisture – precipitation feedback

Geochemistry:
Reconstructing past droughts using speleothems

Geophysics:
Measuring ground water depletion using GRACE



Computational Geosciences: ***Modeling*** **predictions uncertainties for extreme events at regional scales**

Paleontology:
Evaluating extinction records from Paleo-droughts

Climate dynamics:
Determining decadal scale climate patterns & effect on precipitation in watersheds

Comprehensive academic program in land surface – atmosphere interaction and hydrogeology

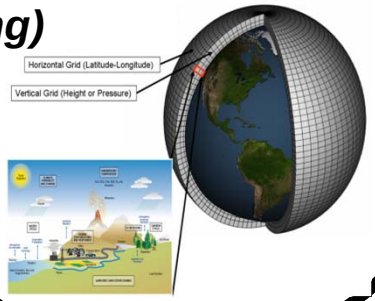
Jackson School Focus

- Ground-truthing data for input into models
- Using satellite data to drive models
- Optimizing input to understand atmospheric components – dust, aerosols, snow data assimilation
- Reduce uncertainty
- Modeling: Land surface, weather / climate, water

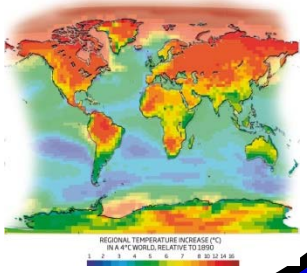
Combined effort to determine total flux of climate system & inform decision makers

Climate/land model development/assimilation, evaluation/uncertainty quantification and application/projection

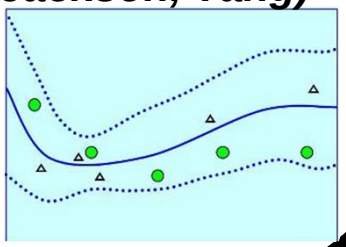
Model development/data assimilation (Dickinson, Yang)

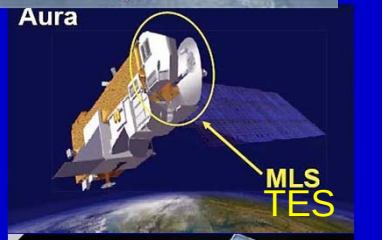


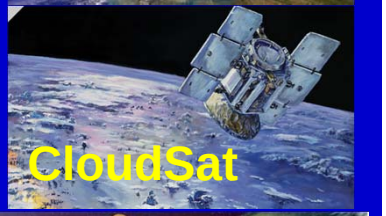
Application/Projection (Cook, Fu, Jackson, Okumura, Yang)



Model Evaluation/ Uncertainty/quantification (Fu, Jackson, Yang)

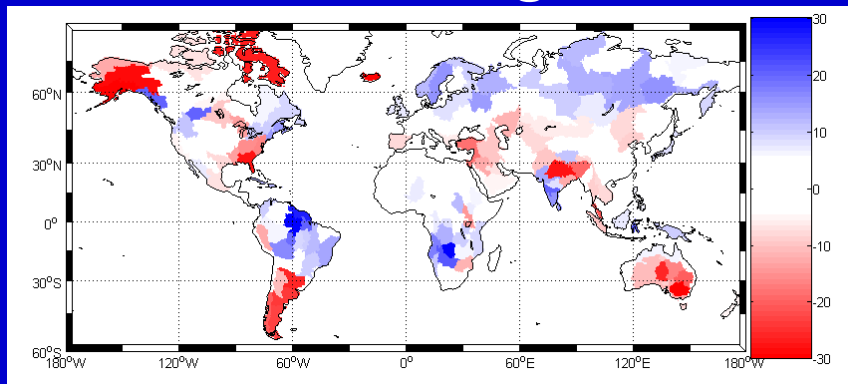






Water Resource Applications of GRACE

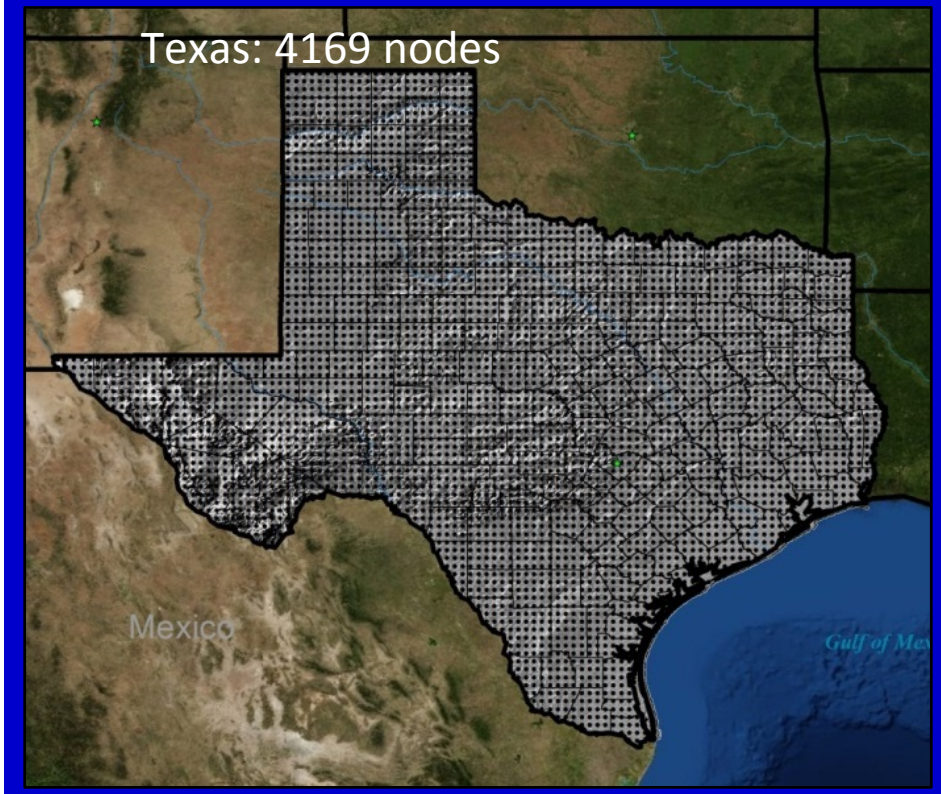
- **Drought monitoring: total water storage**
  - **soil moisture versus groundwater storage**
  - **obtain better ground-truthing to reduce uncertainty in measurements**
- **Global application to water storage changes**
  - **improve land surface models**
- **Constrain applications with a priori data**
  - **spatial and temporal distribution of water storage**

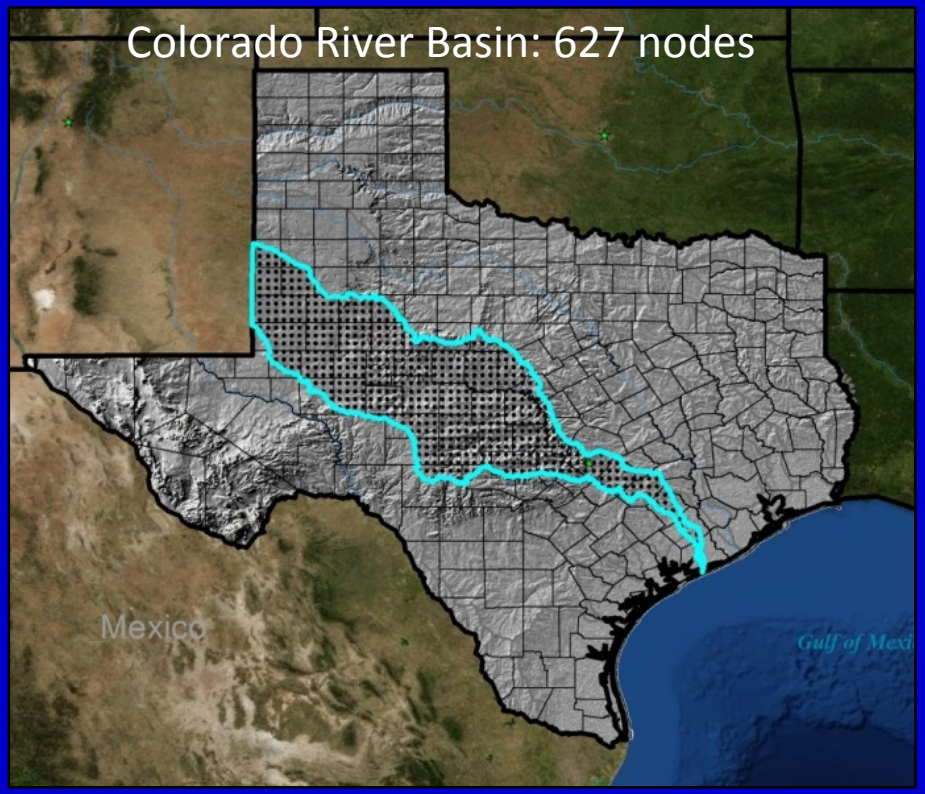


GRACE Total Water Storage Change
(GRGS) (mm/yr)
Trend (2003 – 2009)

Land Data Assimilation Systems: Ground Verification

NLDAS-2: ⅛° grid (~14 km) on CONUS, 224x464=104,000 nodes





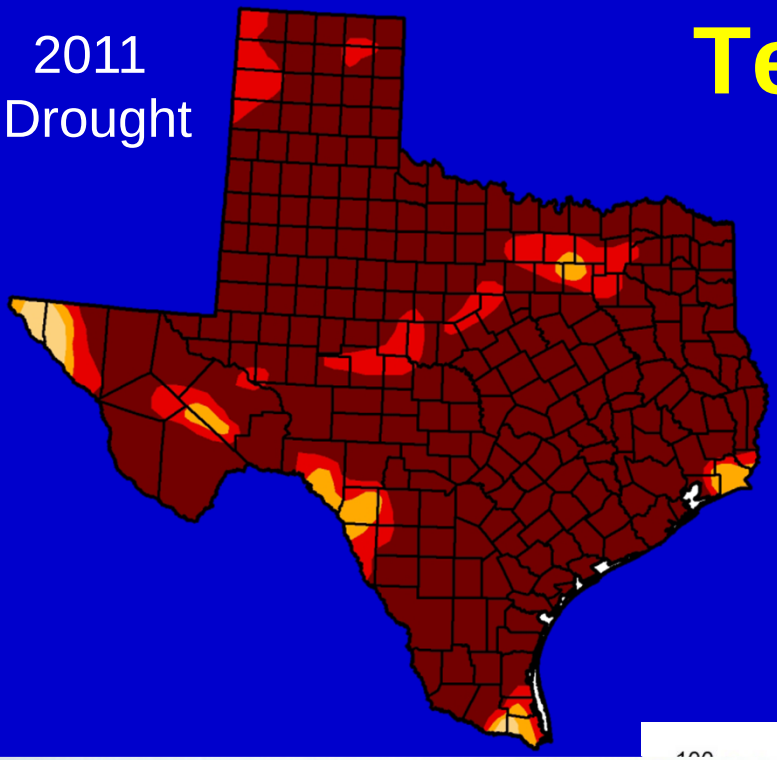
Caldwell, Long, Scanlon, Young: Scale does not fit management needs

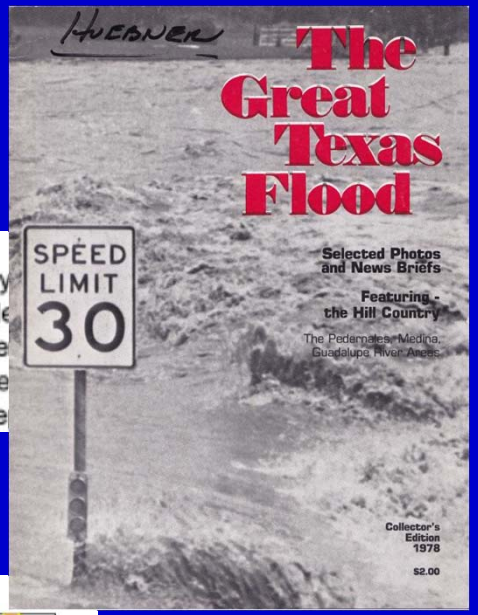
- River managers need to predict recovery of lake systems and release water to downstream users at specific rate
- 2011 drought – how dry was the soil? Why with current precipitation, are reservoirs near record lows (37% full)

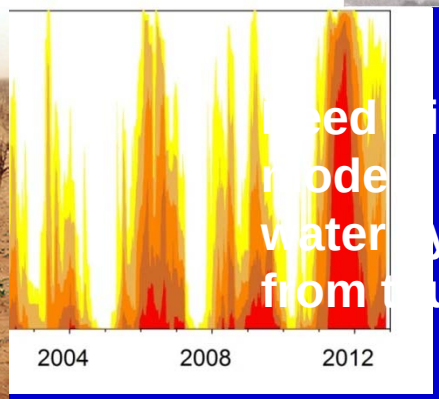
Need to downscale NLDAS data & create field-level monitoring networks to upscale to NLDAS footprint

Texas Drought

2011
Drought







Need High Resolution climate models to predict regional water cycle & heavy rains from thunderstorms

es during 2011 drought