Southeast Regional Carbon Sequestration Partnership (SECARB) Stakeholders' Briefing, 03 March 2009

Task 7 MVA Crosscut Support

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Subtask 7.1 Identify Emerging Technologies to Fill MVA Gaps
Subtask 7.2 Support Field Validation MVA

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Risk Assessment

- •DOE lists Risk Assessment as just one of the five Focus Areas for CO_2 sequestration
- •For CO_2 sequestration, programmatic risks and technical risks are coupled and mutually reinforcing

- •DOE goals include development and application of innovative, advanced, process-based risk assessment models to determine quantitative risks and predict quantitative impacts at CO_2 sequestration field project sites:
  - –Identify all vulnerabilities associated with the effort;
  - –Estimate the likelihood of damage associated with each vulnerability;
  - –Estimate the costs of recovery from the damage;
  - –Identify and summarize possible protective measures and their costs; and
  - –Estimate savings that may result from better protective measures.
- •The resulting risk assessment models and protocols that can be readily integrated with advanced simulation models and MVA technologies.

- •Emerging technologies – identify uncertainties, ambiguities affecting risk assessment.

MMV → Monitoring, Verification & Accounting (MVA)

- The designated objectives of MVA Focus Area
  - Monitor the movement of CO_2 into, through, and out of the targeted geologic storage area.
  - Verify the location of CO_2 that has been placed in geologic storage.
  - Account for the entire quantity of CO_2 that has been transported to geologic storage sites.
- These will overlap other technical Focus Areas
  - Mathematically simulate the placement, storage, movement, and release of CO_2 into, through, and from geologic formations.
  - Assess the risks associated with the placement of the CO_2 in geologic formations and the potential release of CO_2 from these formations after it is stored.

MMV → Monitoring, Verification & Accounting (MVA)

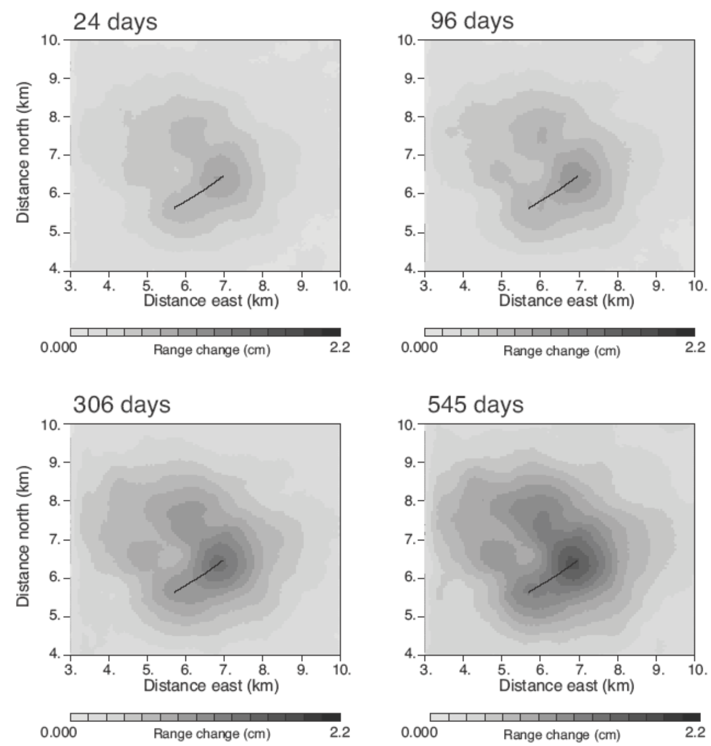
- Carbon Sequestration Technology Roadmap and Program Plan 2007
  - 2008 - develop MVA protocols that enable 95% of stored CO_2 to be credited as net emission reduction.
  - 2012 - develop MVA protocols that enable 99% of stored CO_2 to be credited as net emissions reduction.
- Future Goals
  - By 2014, develop improved algorithms to enhance the monitoring of CO_2 injected into deep geologic formations.
  - By 2018, demonstrate that a suite of technologies coupled with simulation can be used to accurately determine leakage rates (if they exist) from a storage reservoir.

Monitoring Techniques – Leak/Seep Detection

- Differential absorption lidar
  - –Atmospheric CO_2 measurement, precision to detect concentration variations over 4km optical path. Horizontal path measurements are more accurate than vertical path, but require fixed placement. RMS errors < 3%.
- Multi-spectral aerial imaging
  - –High resolution (<1m) catalog of biomass and ground cover over time to detect anomalies due to leakage. Demonstrated at Mammoth Mtn geological event; baseline and time measurements underway at Wyoming EOR site.

Monitoring Techniques – Reservior Changes

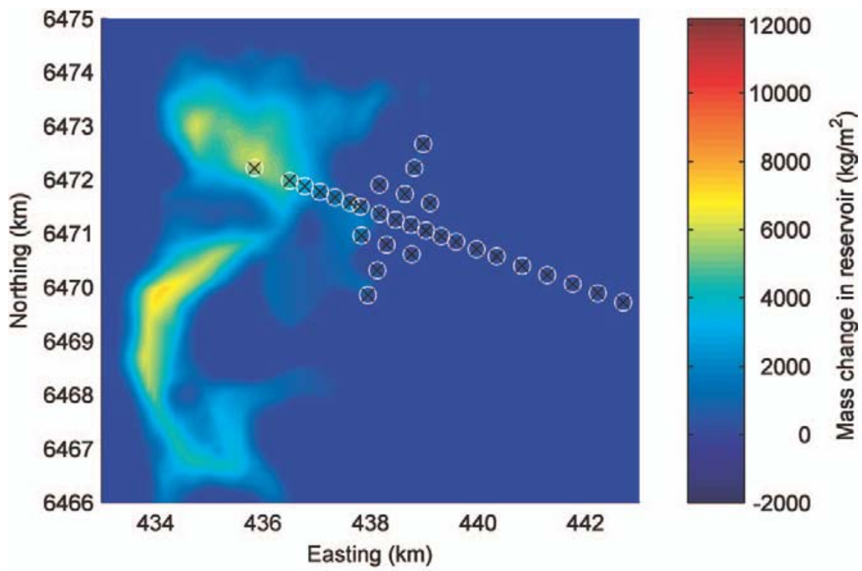
- Interferometric synthetic aperture radar
  - –Remote sensing of large area (10's km^2) surface deformations due to reservoir changes; infer reservoir flow and pressure changes from models. Applied to CO_2 injection site Krechba Field, Algeria.



Surface deformations over time at Krechba injectioin (Vasco 2008).

Monitoring Techniques – Reservior Changes

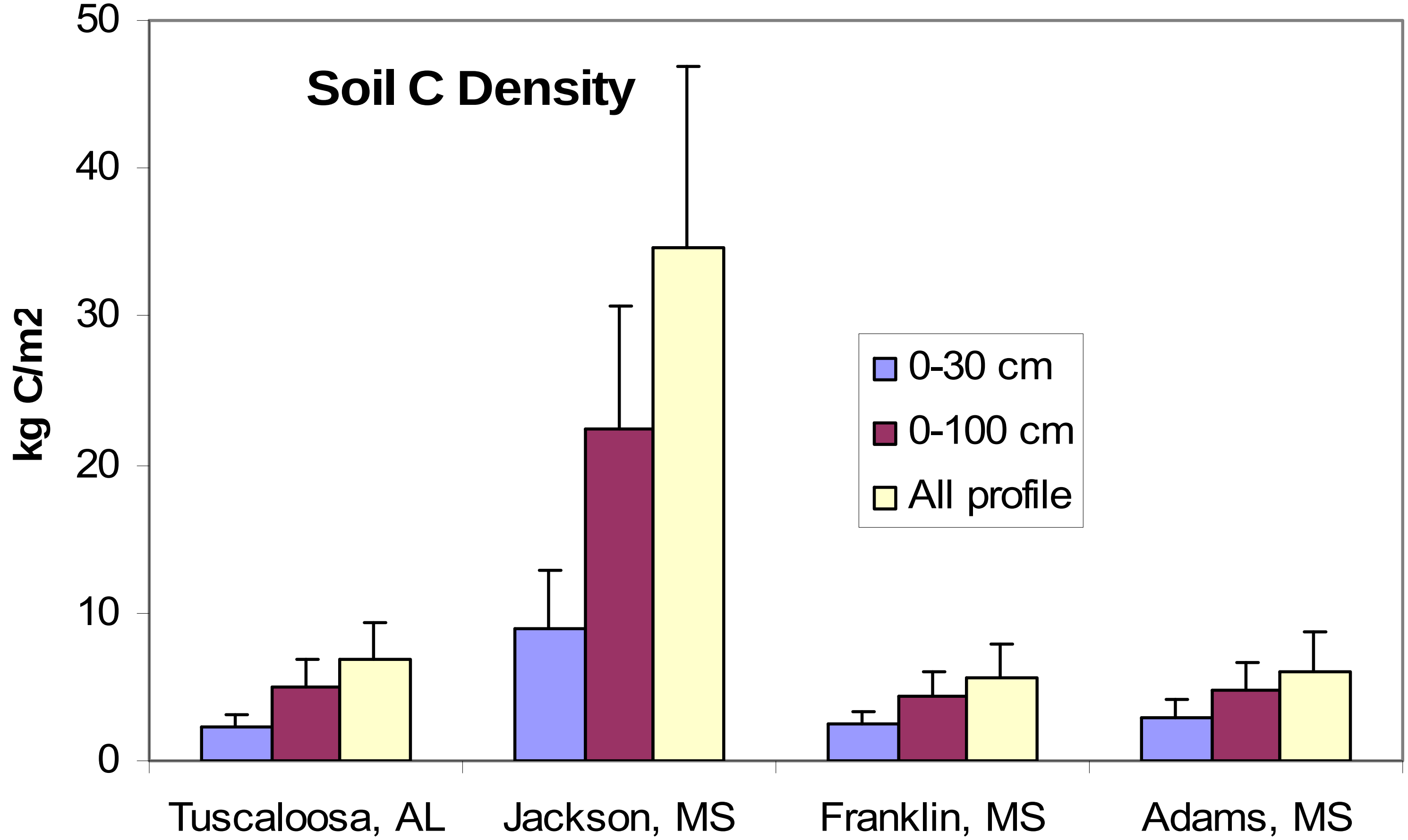
- Gravimetric measurements
  - Precision gravimeter measurements in borehole and on area grid; infer reservoir extent and mass changes from models. Sleipner injection field mapped.



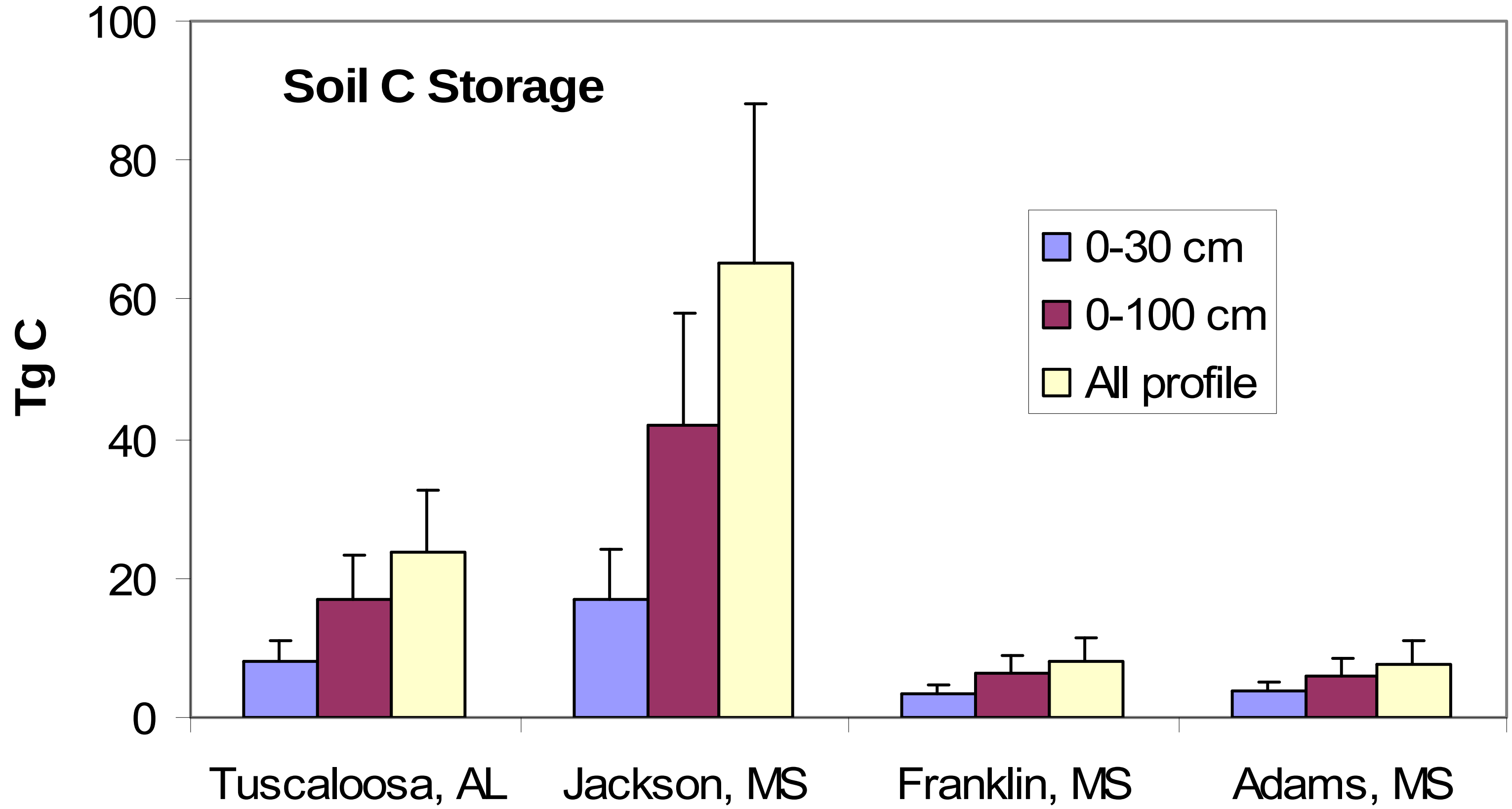
Estimated mass change in Sleipner Øst Ty reservoir 2002 - 2005. From a constrained inversion of the time-lapse gravimetric data (Alnes 2008).

Prediction of Background Soil CO_2 Flux and Application for Potential CO_2 Leakage

- This study indicates that there may be much higher soil gas flux and gas exchange in Plant Daniel fields located in Jackson, MS than Cranfield (Adams and Franklin, MS) and ECBM Tuscaloosa, AL. Soil gas flux is contributed by three major sources: a majority from soil heterotrophic respiration and a small portion from mycorrhiza and plant roots. In general, soil CO_2 gas flux was significantly related to total carbon loading and especially labile carbon.
- Variation of soil gas flux is also dependent upon climatic, biotic and other environmental factors such as temperature, moisture, nutrient availability and properties of soil humic materials.
- Soil-atmosphere exchange of gases is related to total soil carbon and its properties, soil texture and compaction, moisture and others.
- We will continue in modeling and predicting background CO_2 flux and application for potential CO_2 leakage from geological C sequestration.



Comparison of average county-level soil carbon density (kg C/m^2) in four demonstration sites.



Comparison of total county-level soil carbon storage (Tg C, 10^{12} g) in four demonstration sites.

Other Activities

- Attended Plant Daniel field demonstration, CB&SG Symposium
- Support ECBM, Tuscaloosa
- New Project - Chemical Analysis and Thermodynamic Modeling of Groundwater Samples from the Vicinity of Cranfield Oilfield, Mississippi supported by UT BEG

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