NRAP Tool Webinar Series

Webinar 8
NRAP-Integrated Assessment Model for Carbon Storage and Reservoir ROM Generation (RROM-Gen) tool

Monday December 7, 2015

Presenters:
Rajesh Pawar\textsuperscript{1},
Seth King\textsuperscript{2,3}

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\textsuperscript{2} National Energy Technology Laboratory, Morgantown, WV
\textsuperscript{3} AECOM, Morgantown, WV
Outline

• Welcome and Overview of NRAP – Technical Approach and Tool Development
• RROM-Gen
  – What does RROM-Gen do?
  – Input specification
  – Output specification
  – Grid discussion
• NRAP-IAM-CS
  – Navigating the IAM-CS tool
  – Example use cases
  – Demonstration of IAM-CS Viewer
  – Quality Assurance
• Questions and Discussion
National Risk Assessment Partnership (NRAP)

NRAP leverages DOE’s capabilities to help quantify uncertainties and risks necessary to remove barriers to full-scale CO₂ storage deployment.

Objective: Building toolset and improving the science base to address key questions about potential impacts related to release of CO₂ or brine from the storage reservoir, and potential ground-motion impacts due to injection of CO₂
NRAP’s approach to quantifying performance relies on reduced-order models to probe uncertainty in the system.

A. Divide system into discrete components

B. Develop detailed component models that are validated against lab/field data

C. Develop reduced-order models (ROMs) that rapidly reproduce component model predictions

D. Link ROMs via integrated assessment models (IAMs) to predict system performance & risk; calibrate using lab/field data from NRAP and other sources

E. Develop strategic monitoring protocols that allow verification of predicted system performance
NRAP Tools
Now available for beta testing

- NRAP-IAM-CS
- Aquifer Impact Model
- Short Term Seismic Forecasting
- Wellbore Leakage Analysis Tool
- Design for Risk Evaluation and Monitoring
- Natural Seal ROM
- Reservoir Evaluation and Visualization

www.edx.netl.doe.gov/nrap → TOOL BETA TESTING link
## Schedule for NRAP Tool Webinar Series

<table>
<thead>
<tr>
<th>Date/ Time</th>
<th>Tool</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 13</td>
<td>Integrated Assessment Model–Carbon Storage (NRAP-IAM-CS) (2.5 hours)</td>
<td>Rajesh Pawar</td>
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<tr>
<td>Time: 1pm ET</td>
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<tr>
<td>October 19</td>
<td>Natural Seal ROM (NSealR) (1 hour)</td>
<td>Nicolas Huerta, Ernest Lindner</td>
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<tr>
<td>October 26</td>
<td>Reservoir Evaluation and Visualization (REV) Tool (1 hour)</td>
<td>Seth King</td>
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<tr>
<td>November 2</td>
<td>Wellbore Leakage Analysis Tool (WLAT) (1.5 hour)</td>
<td>Nicholas Huerta</td>
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<tr>
<td>November 9</td>
<td>Aquifer Impact Model (AIM) (1.5 hour)</td>
<td>Diana Bacon</td>
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<tr>
<td>November 16</td>
<td>Design for Risk Evaluation and Monitoring (DREAM) (1 hour)</td>
<td>Catherine Ruprecht Yonkofski</td>
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<tr>
<td>November 30</td>
<td>Short Term Seismic Forecasting (STSF) (1 hour)</td>
<td>Josh White, Corinne Bachmann</td>
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<td>Time: 1pm ET</td>
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<tr>
<td>December 7</td>
<td>Integrated Assessment Model–Carbon Storage (NRAP-IAM-CS) and RROM-Gen Tool (1.5 hours)</td>
<td>Rajesh Pawar, Seth King</td>
</tr>
<tr>
<td>Time: 1pm ET</td>
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Check for updates at [www.edx.netl.doe.gov/nrap](http://www.edx.netl.doe.gov/nrap)
What will RROM-Gen do for me?

• Prepares reservoir simulation data for use in the NRAP-IAM-CS
  – Extracts single layer to represent the reservoir-seal interface
  – Uses piecewise bi-linear interpolation to translate the data onto a compatible (100x100) grid
    • Optionally data can be reduced to a subdomain
  – Writes output files in the format specified by the IAM
What are the outputs?

• Standard Output Files:
  – Pressure data – time series of 2-D grid data
  – Saturation data – time series of 2-D grid data

• Optional output files:
  – Elevation – 2-D grid data
  – Dissolved CO2 – time series of 2-D grid data
  – Temperature – time series of 2-D grid data
  – Permeability – 2-D grid data

• Additive and multiplicative factors can be used to translate and convert optional data output

• Not all file formats have optional data available in this case additive factor can be used to make constant value files
Reservoir ROM Generation Tool - Main Page

- Input Specifications
- Output Files

Enter Parameters

Generate

RRom-Gen is a program to generate NRAP-IAM-CS reservoir ROM files from simulation pressure and saturation data.

NRAP
National Risk Assessment Partnership

Version: 1.0.0
Main Contact: Seth King
Email: seth.king@netl.doe.gov

Acknowledgements
References
User Manual

NETL
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
Pacific Northwest National Laboratory

U.S. Department of Energy
Pressure Comparison

Max Pressure
5.4 MPa vs 4.5 MPa

Poor resolution where details may be important
Regular 100x100 grid comparison
Regular 100x100 grid comparison
Pressure Comparison
Relative Grid

Original pressures

New pressures
Questions?

Reservoir ROM Generation (RROM-Gen) tool

Questions/comments not addressed during the scheduled meeting time can be addressed to NRAP@netl.doe.gov

Acknowledgements

This technical effort was performed in support of the National Energy Technology Laboratory’s research under the RES contract DE-FE-0004000.

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Input Parameters

- Input File Type: TP3D
- Input File:
- Zip File:
- New Grid X: 100
- New Grid Y: 100
- Layer of Interest: 1
- X Min: original grid min x
- Y Min: original grid min y
- X Max: original grid max x
- Y Max: original grid max y
- Grid: regular
- X Grid Definition: [10x10, 10x8, 10x6, 10x4, 5x2, 9x1, 5x2, 10x4, 10x6, 10x8, 10x10]
- Y Grid Definition: [10x10, 10x8, 10x6, 10x4, 5x2, 9x1, 5x2, 10x4, 10x6, 10x8, 10x10]
- Convert ft
- Convert Pa
- Convert psi
- Convert days
- Initial Realization: 1
- Final Realization: 1
- Visualize
- Plot Files: plot_files.png

Revert Parameters to Defaults

Cancel
Save
Input File Type Selection

![Reservoir ROM Generation Tool](image)

- Input File Type Selection
  - CMG-GEM
  - TP3D
  - FEHM
  - TOUGH2
  - STOMP

- Pressures File
- Saturation File
- Zip File
Input File Selection
## Input Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>New Grid X</td>
<td>100</td>
</tr>
<tr>
<td>New Grid Y</td>
<td>100</td>
</tr>
<tr>
<td>Layer of Interest</td>
<td>3</td>
</tr>
<tr>
<td>X Min</td>
<td>original grid min x</td>
</tr>
<tr>
<td>Y Min</td>
<td>original grid min y</td>
</tr>
<tr>
<td>X Max</td>
<td>original grid max x</td>
</tr>
<tr>
<td>Y Max</td>
<td>original grid max y</td>
</tr>
<tr>
<td>Grid</td>
<td>regular</td>
</tr>
<tr>
<td>X Grid Definition</td>
<td></td>
</tr>
<tr>
<td>Y Grid Definition</td>
<td></td>
</tr>
</tbody>
</table>
Input Parameters

- Convert ft
- Convert Pa
- Convert psi
- Convert days

Initial Realization: 1
Final Realization:

Visualize
Plot Files: G:\run\plot_files.png

Revert Parameters to Defaults
Cancel
Save
Pressure and Saturation Files

![Reservoir ROM Generation Tool](image)
Elevation File

- Elevation Output File: G:\montecarlo\sim\02\Lookup_reservoir_elev.txt
- Elevation Multiplier: 1
- Elevation Additive Factor: 0
## Dissolved CO2 File

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved CO2 Output File</td>
<td>G:\montecarlo\sim{0:02}\Lookup_reservoir_dis.txt</td>
</tr>
<tr>
<td>Dissolved CO2 Multiplier</td>
<td>1</td>
</tr>
<tr>
<td>Dissolved CO2 Additive Factor</td>
<td>0</td>
</tr>
</tbody>
</table>
Temperature File

- Temperature Output File: G:\montecarlo\sim{0:02}\Lookup_reservoir_temp.txt
- Temperature Multiplier: 1
- Temperature Additive Factor: 121
Permeability

- Permeability Output File: G:\montecarlo\sim{0:02}\Lookup_reservoir_perm.txt
- Permeability Multiplier: 1
- Permeability Additive Factor: 7.4682e-13

Buttons:
- Revert Parameters to Defaults
- Cancel
- Save
Reservoir ROM Generation Tool - Main Page

- Input Specifications
- Output Files

Enter Parameters

Generate

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