



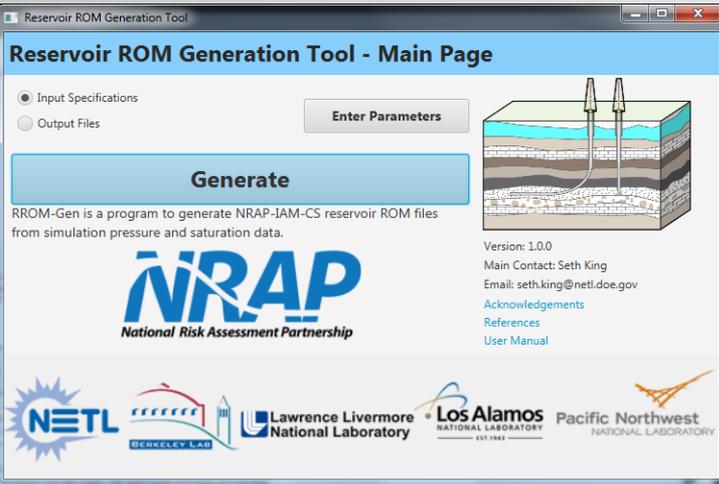
NRAP Tool Webinar Series

Webinar 8

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

Monday December 7, 2015

Presenters:
Rajesh Pawar¹,
Seth King^{2,3}



¹ Los Alamos National Laboratory, Los Alamos, NM
² National Energy Technology Laboratory, Morgantown, WV
³ AECOM, Morgantown, WV



Outline

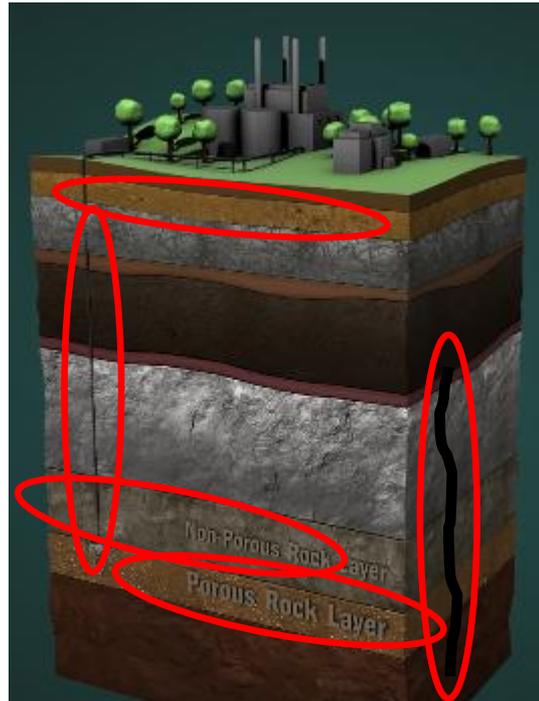
- **Welcome and Overview of NRAP – Technical Approach and Tool Development**
- **RROM-Gen**
 - What does RROM-Gen do?
 - Input specification
 - Output specification
 - Grid discussion
- **NRAP-IAM-CS**
 - Navigating the IAM-CS tool
 - Example use cases
 - Demonstration of IAM-CS Viewer
 - Quality Assurance
- **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

Technical Team

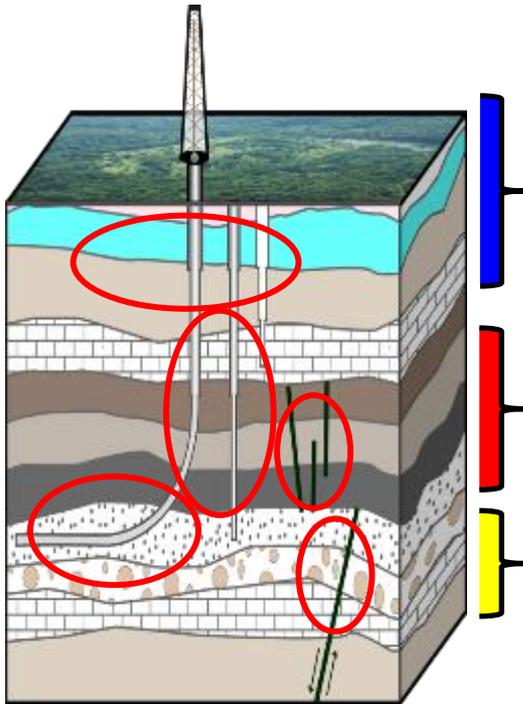


Stakeholder Group

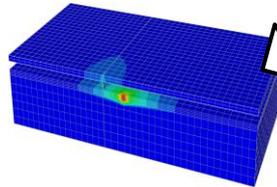


NRAP's approach to quantifying performance relies on reduced-order models to probe uncertainty in the system.

A. Divide system into discrete components

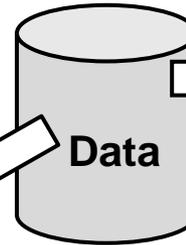


B. Develop detailed component models that are validated against lab/field data

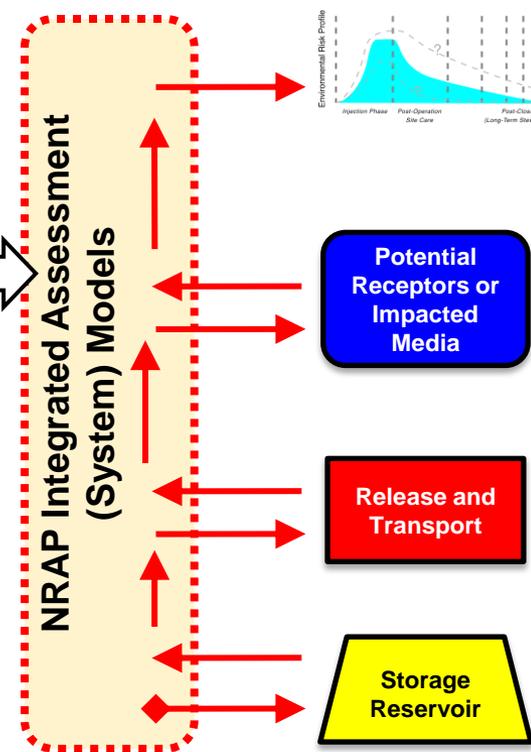


C. Develop reduced-order models (ROMs) that rapidly reproduce component model predictions

Energy Data Exchange (EDX)



IAM

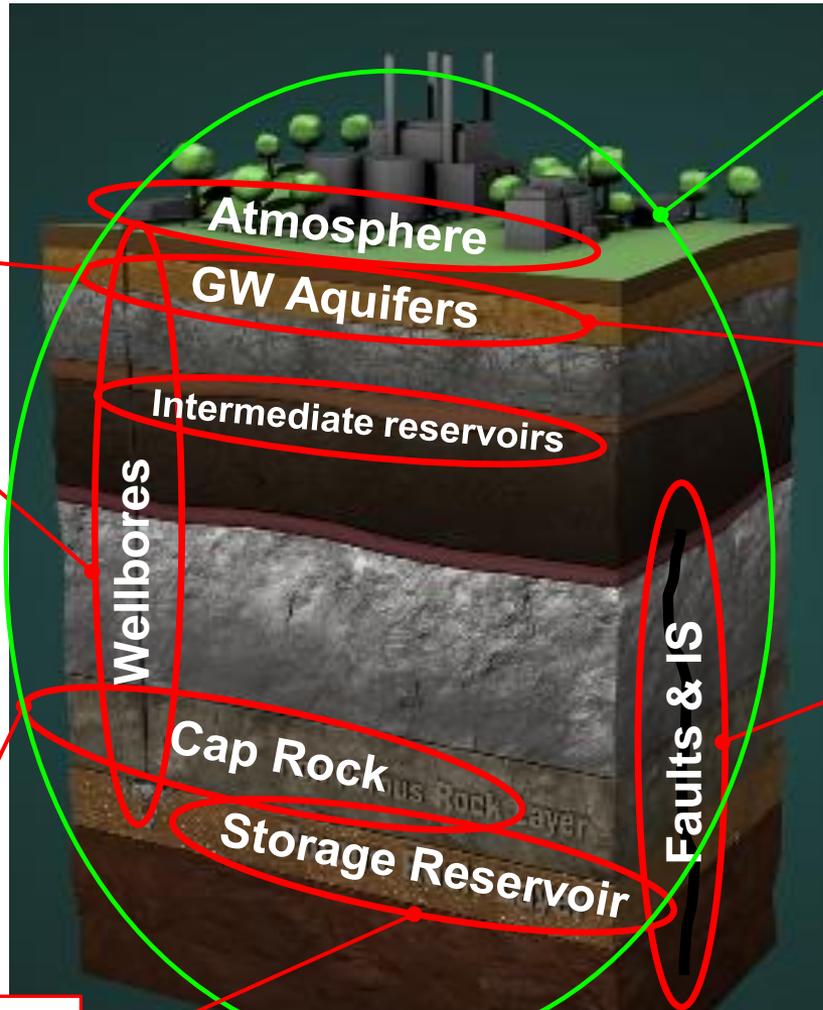


D. Link ROMs via integrated assessment models (IAMs) to predict system performance & risk; calibrate using lab/field data from NRAP and other sources

E. Develop strategic monitoring protocols that allow verification of predicted system performance

NRAP Tools

Now available for beta testing



NRAP-IAM-CS

Design for Risk Evaluation and Monitoring

Aquifer Impact Model

Wellbore Leakage Analysis Tool

Short Term Seismic Forecasting

Natural Seal ROM

Reservoir Evaluation and Visualization

www.edx.netl.doe.gov/nrap → TOOL BETA TESTING link

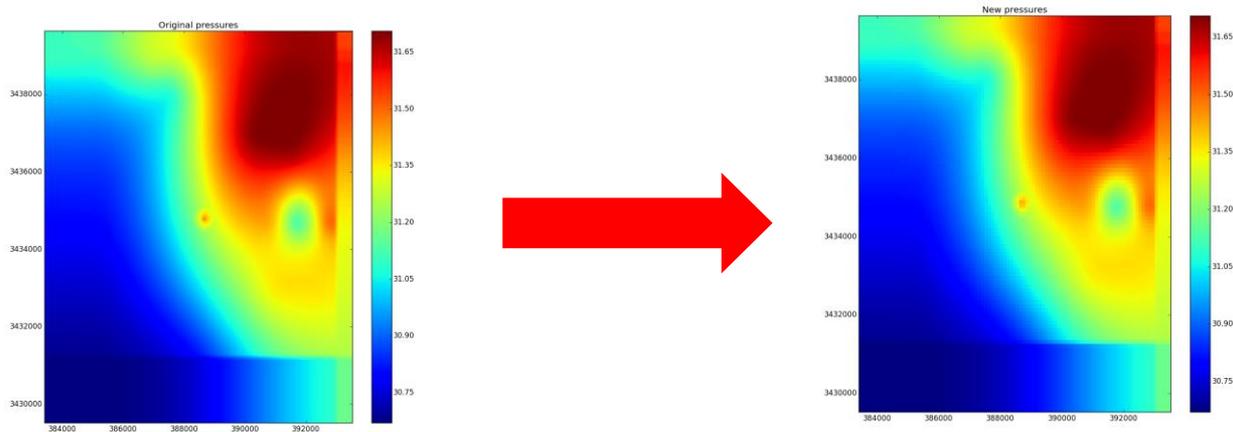
Schedule for NRAP Tool Webinar Series

Date/ Time	Tool	Presenter(s)
October 13 Time: 1pm ET	Integrated Assessment Model–Carbon Storage (NRAP-IAM-CS) (2.5 hours)	Rajesh Pawar
October 19 Time: 1pm ET	Natural Seal ROM (NSealR) (1 hour)	Nicolas Huerta, Ernest Lindner
October 26 Time: 1pm ET	Reservoir Evaluation and Visualization (REV) Tool (1 hour)	Seth King
November 2 Time: 1pm ET	Wellbore Leakage Analysis Tool (WLAT) (1.5 hour)	Nicholas Huerta
November 9 Time: 1pm ET	Aquifer Impact Model (AIM) (1.5 hour)	Diana Bacon
November 16 Time: 1pm ET	Design for Risk Evaluation and Monitoring (DREAM) (1 hour)	Catherine Ruprecht Yonkofski
November 30 Time: 1pm ET	Short Term Seismic Forecasting (STSF) (1 hour)	Josh White, Corinne Bachmann
December 7 Time: 1pm ET	Integrated Assessment Model–Carbon Storage (NRAP-IAM-CS) and RROM-Gen Tool (1.5 hours)	Rajesh Pawar, Seth King

Check for updates at www.edx.net/doi.gov/nrap

What will RRROM-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**

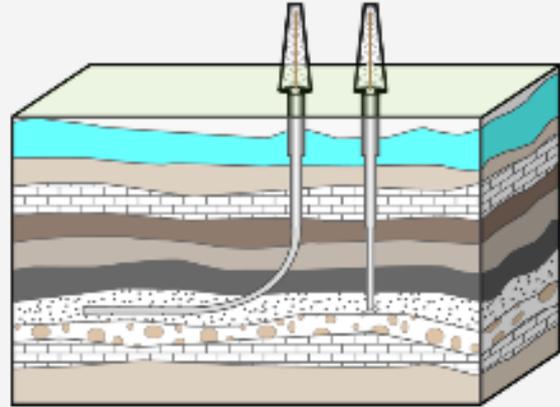
Reservoir ROM Generation Tool - Main Page

- 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.

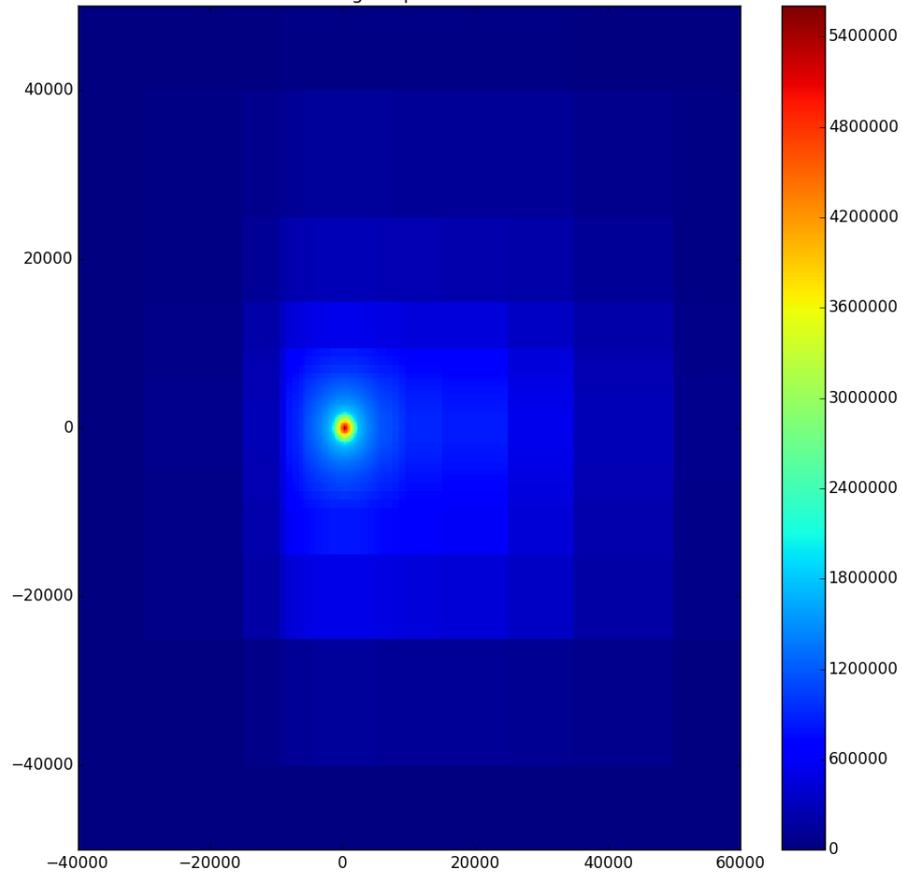


Version: 1.0.0
 Main Contact: Seth King
 Email: seth.king@netl.doe.gov
[Acknowledgements](#)
[References](#)
[User Manual](#)

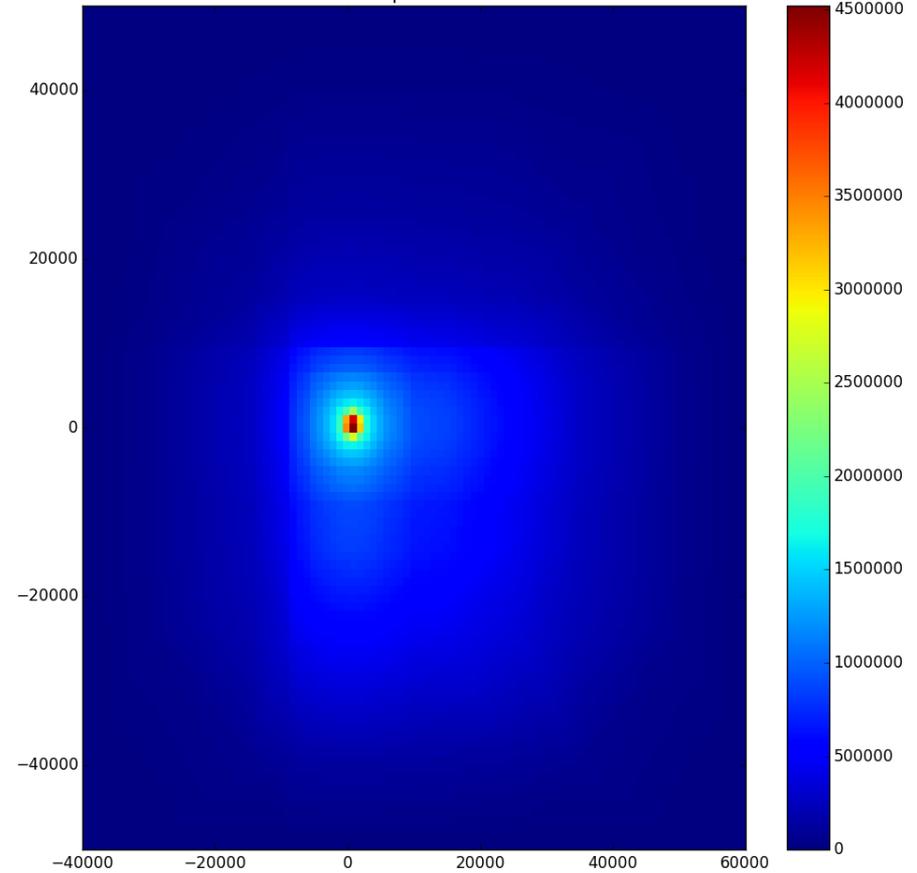


Pressure Comparison

Original pressures



New pressures



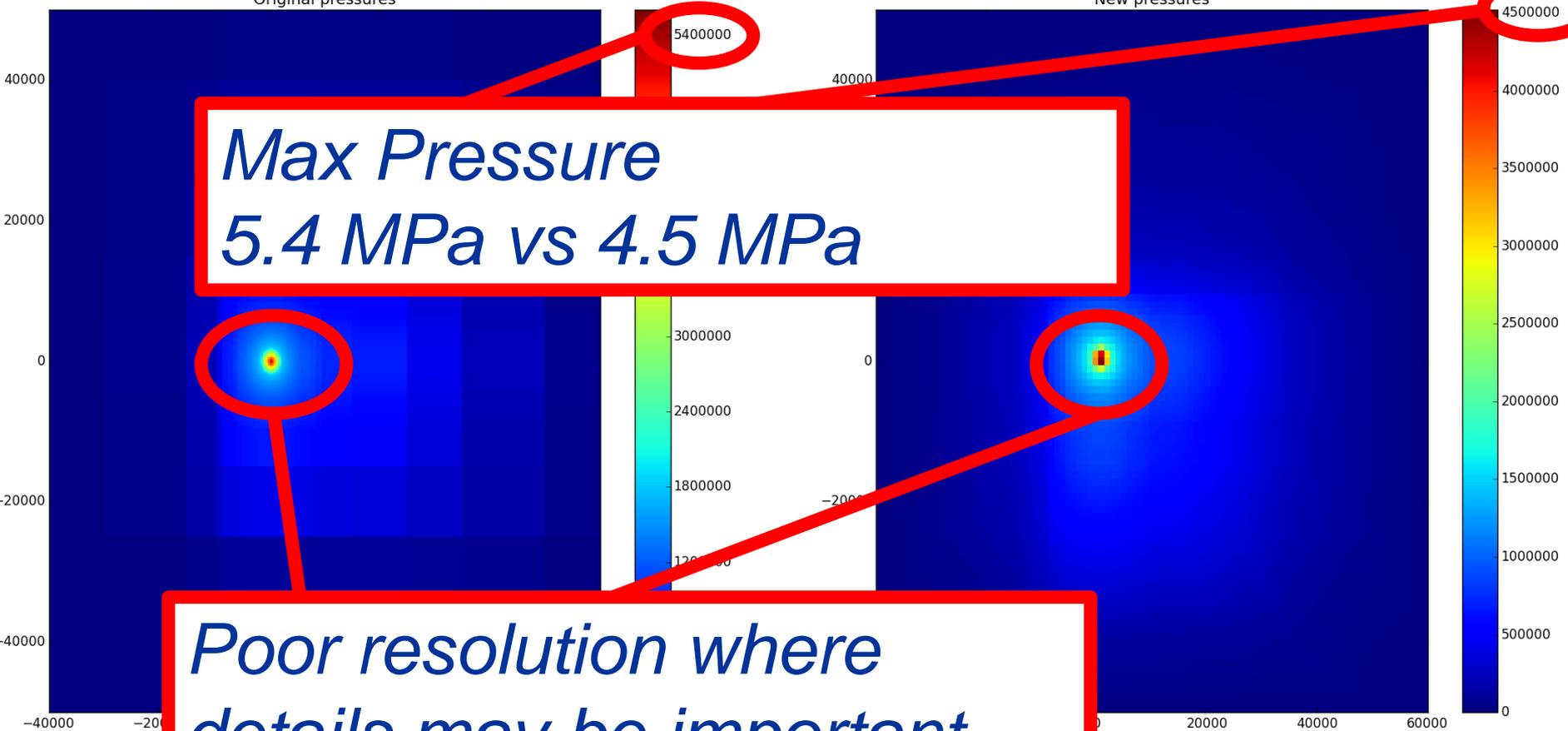
Pressure Comparison

Original pressures

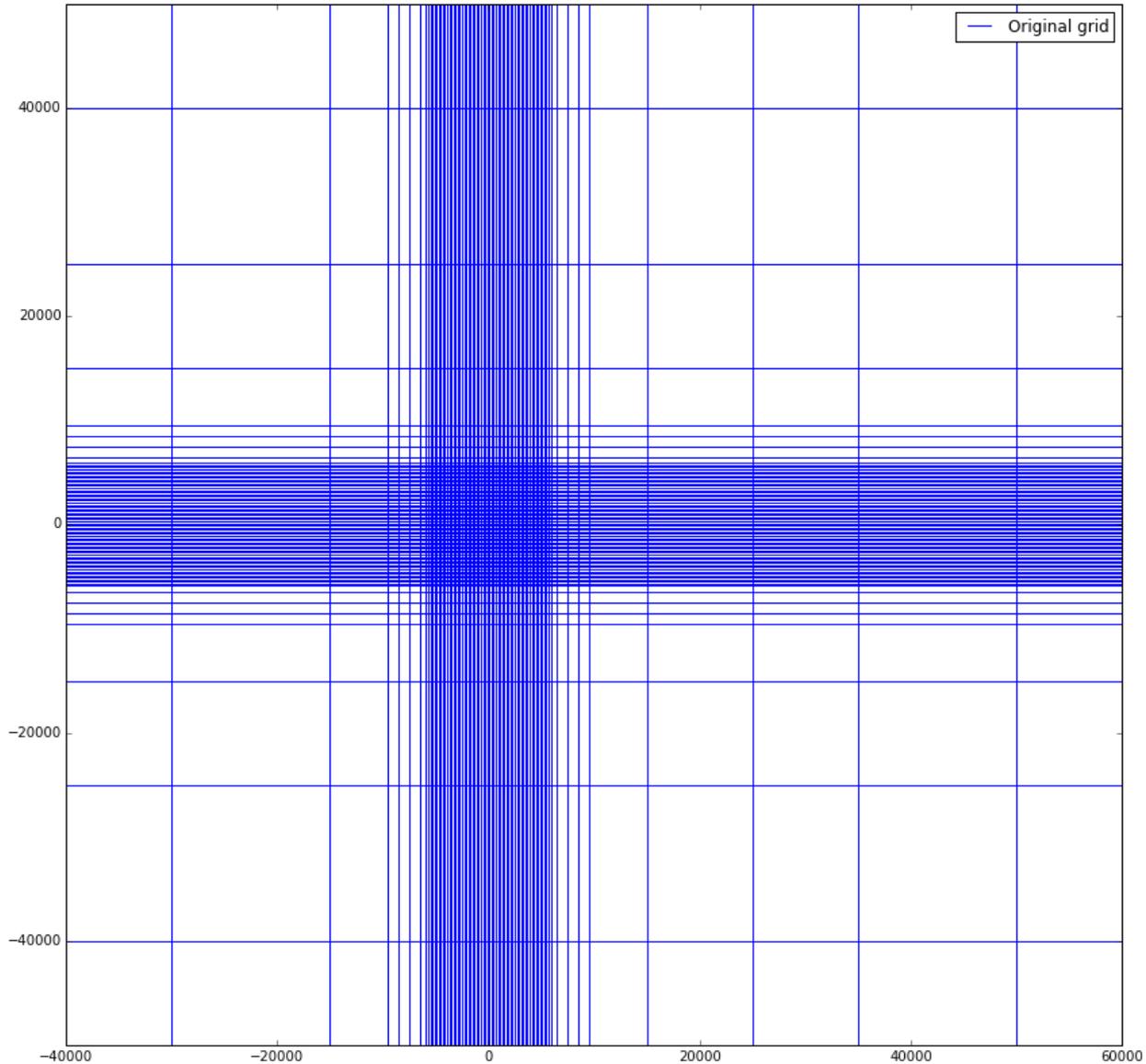
New pressures

*Max Pressure
5.4 MPa vs 4.5 MPa*

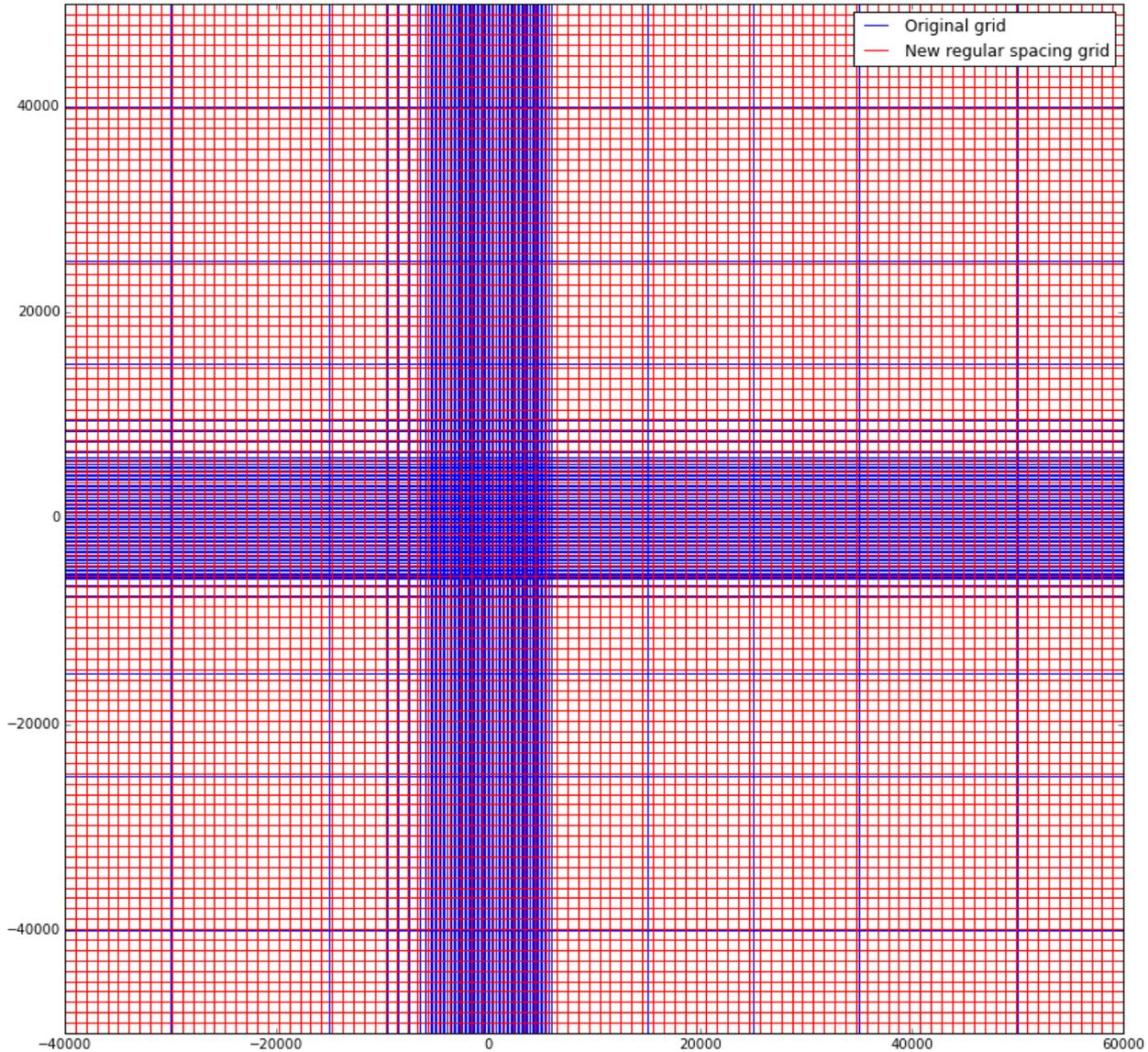
*Poor resolution where
details may be important*



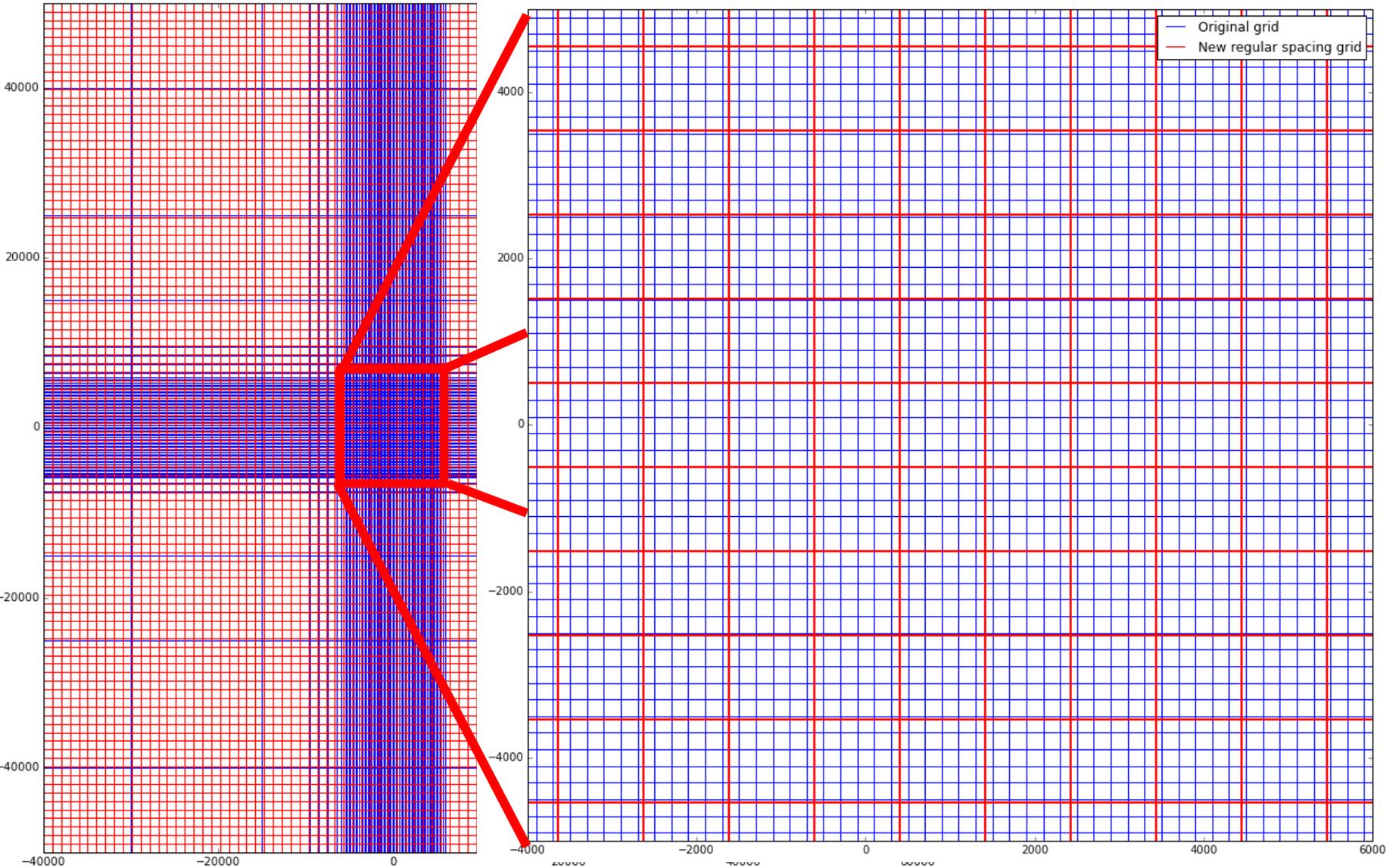
Original Grid (76x76)



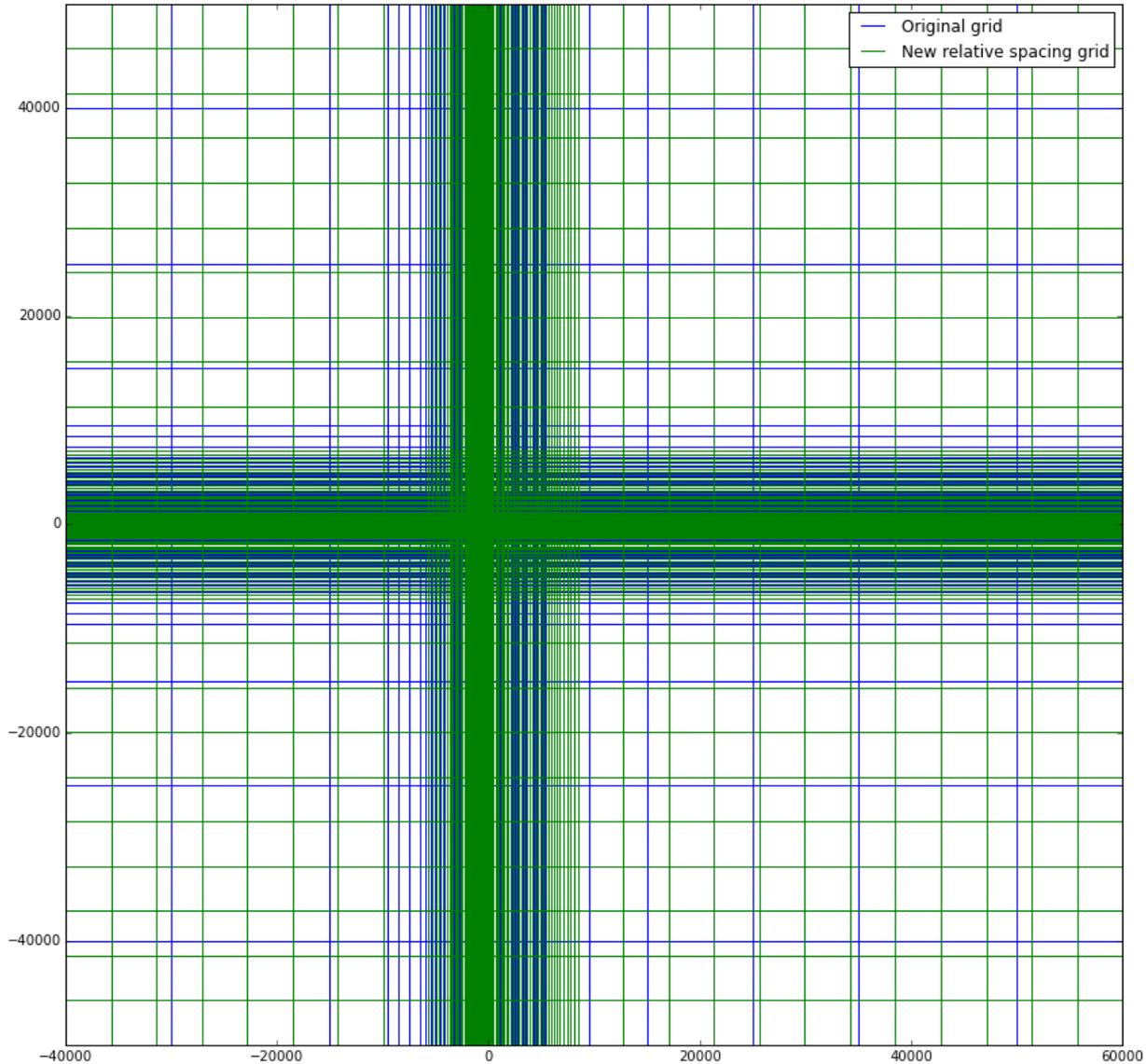
Regular 100x100 grid comparison



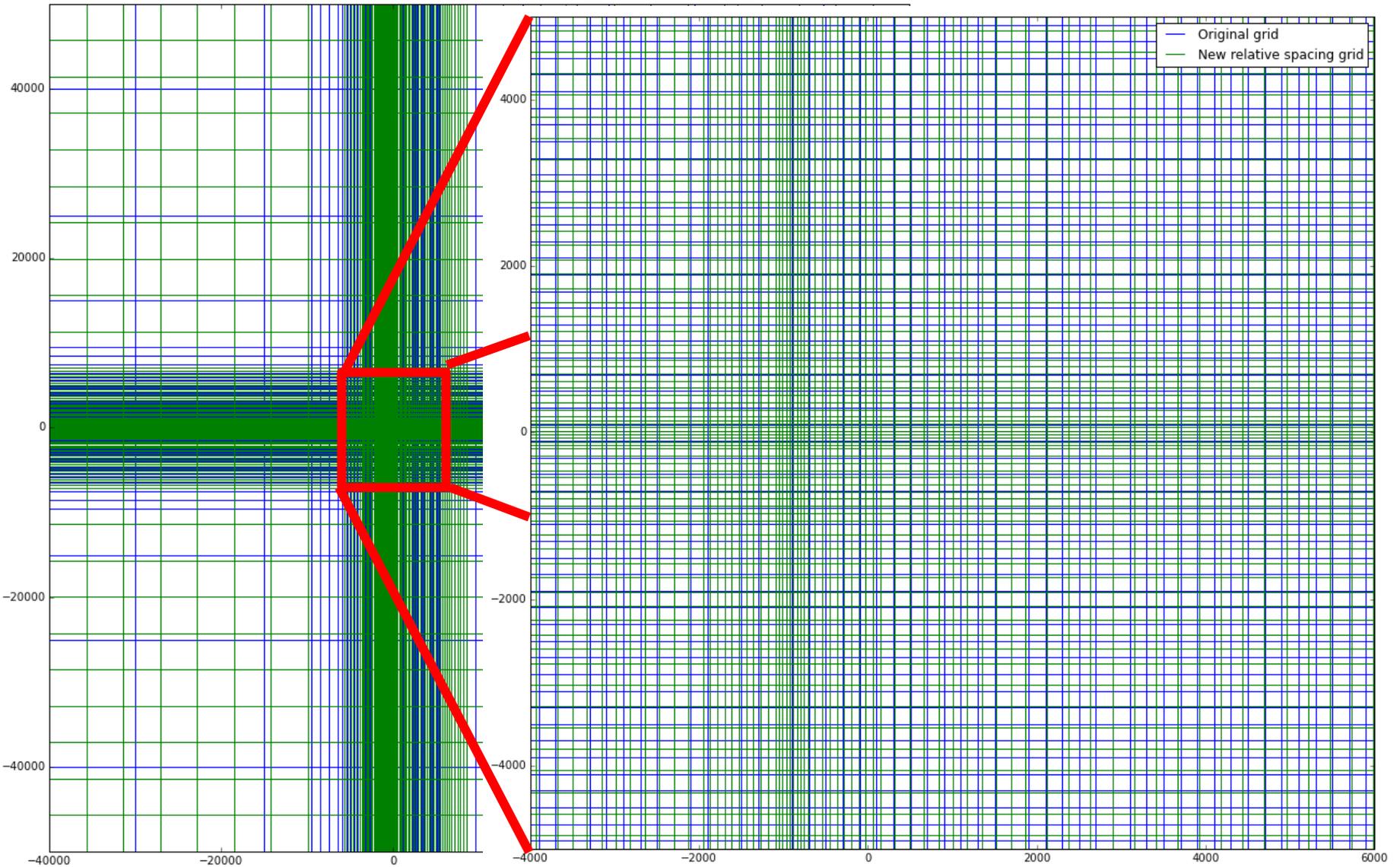
Regular 100x100 grid comparison



Relative 100x100 grid comparison

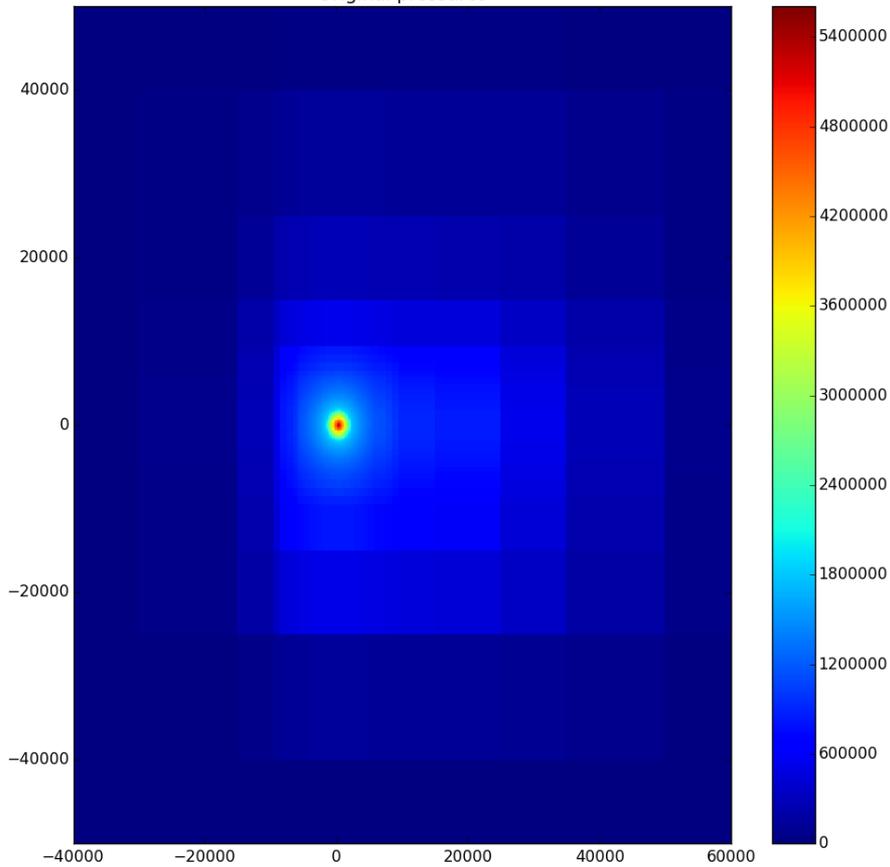


Regular 100x100 grid comparison

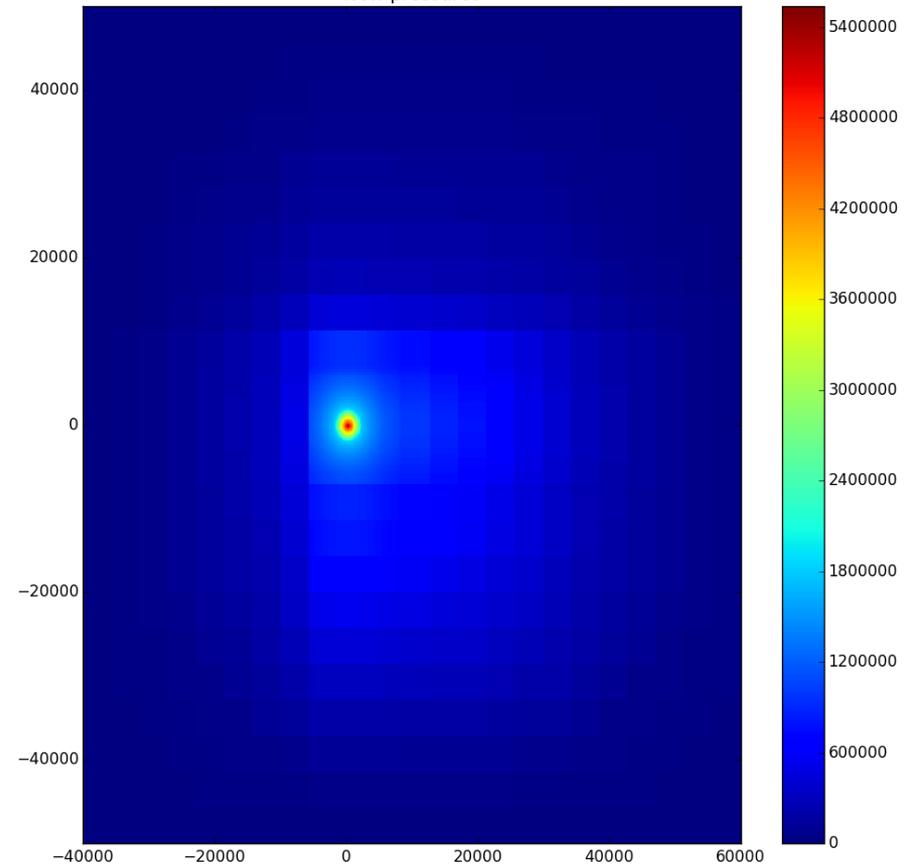


Pressure Comparison Relative Grid

Original pressures



New pressures



Questions?

Reservoir ROM Generation (RRROM-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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File

Input Output

Input File Type

TP3D

Input File

Browse

 Zip File

Browse

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

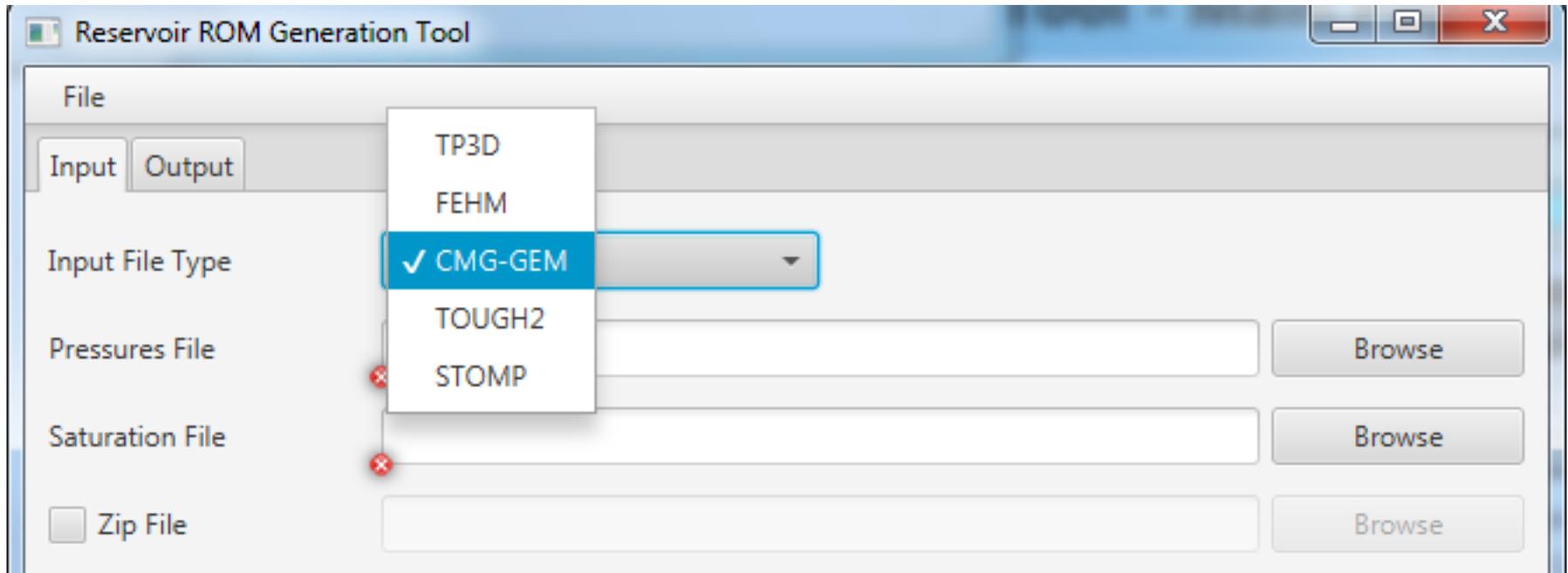
plot_files.png

Revert Parameters to Defaults

Cancel

Save

Input File Type Selection



Input File Selection

The screenshot shows a software window titled "Reservoir ROM Generation Tool". It features a "File" menu and two tabs: "Input" and "Output". Under the "Input" tab, there are three main sections:

- Input File Type:** A dropdown menu currently set to "CMG-GEM".
- Pressures File:** A text input field containing "G:\run{0:02}\pressure_file_run{0:02}.txt" and a "Browse" button to its right.
- Saturation File:** A text input field containing "G:\run{0:02}\saturation_file_run{0:02}.txt" and a "Browse" button to its right. This field is highlighted with a blue border.
- Zip File:** A checkbox that is currently unchecked, followed by an empty text input field and a "Browse" button.

Input Parameters

New Grid X	<input type="text" value="100"/>	New Grid Y	<input type="text" value="100"/>
Layer of Interest	<input type="text" value="3"/>		
X Min	<input type="text" value="original grid min x"/>	Y Min	<input type="text" value="original grid min y"/>
X Max	<input type="text" value="original grid max x"/>	Y Max	<input type="text" value="original grid max y"/>
Grid	<input type="text" value="regular"/>		
X Grid Definition	<input type="text"/>		
Y Grid Definition	<input type="text"/>		

Input Parameters

<input checked="" type="checkbox"/> Convert ft	<input type="checkbox"/> Convert Pa	<input checked="" type="checkbox"/> Convert psi	<input checked="" type="checkbox"/> Convert days
Initial Realization	<input type="text" value="1"/>	Final Realization	<input type="text"/>
<input checked="" type="checkbox"/> Visualize	Plot Files	<input type="text" value="G:\run{0:02}\plot_files.png"/>	
<input type="button" value="Revert Parameters to Defaults"/>		<input type="button" value="Cancel"/>	<input type="button" value="Save"/>

File

Input Output

Pressure Filename

pressure_file.txt

Saturation Filename

saturation_file.txt

 Elevation Output File

elevation_filename

Elevation Multiplier

1

Elevation Additive Factor

0

 Dissolved CO2 Output File

disco2_filename

Dissolved CO2 Multiplier

1

Dissolved CO2 Additive Factor

0

 Temperature Output File

temperature_filename

Temperature Multiplier

1

Temperature Additive Factor

0

 Permeability Output File

perm_filename

Permeability Multiplier

1

Permeability Additive Factor

0

Revert Parameters to Defaults

Cancel

Save

Pressure and Saturation Files

The screenshot shows a software window titled "Reservoir ROM Generation Tool". It has a "File" menu and two tabs: "Input" and "Output". The "Output" tab is selected. There are two text input fields:

- Pressure Filename: G:\montecarlo\sim{0:02}\Lookup_reservoir_pres.txt
- Saturation Filename: G:\montecarlo\sim{0:02}\Lookup_reservoir_co2sat.txt

Elevation File

<input checked="" type="checkbox"/> Elevation Output File	G:\montecarlo\sim{0:02}\Lookup_reservoir_elev.txt
Elevation Multiplier	1
Elevation Additive Factor	0

Dissolved CO2 File

<input checked="" type="checkbox"/> Dissolved CO2 Output File	G:\montecarlo\sim{0:02}\Lookup_reservoir_dis.txt
Dissolved CO2 Multiplier	1
Dissolved CO2 Additive Factor	0

Temperature File

Temperature Output File

G:\montecarlo\sim{0:02}\Lookup_reservoir_temp.txt

Temperature Multiplier

1

Temperature Additive Factor

121

Permeability

<input checked="" type="checkbox"/> Permeability Output File	G:\montecarlo\sim{0:02}\Lookup_reservoir_perm.txt
Permeability Multiplier	1
Permeability Additive Factor	7.4682e-13

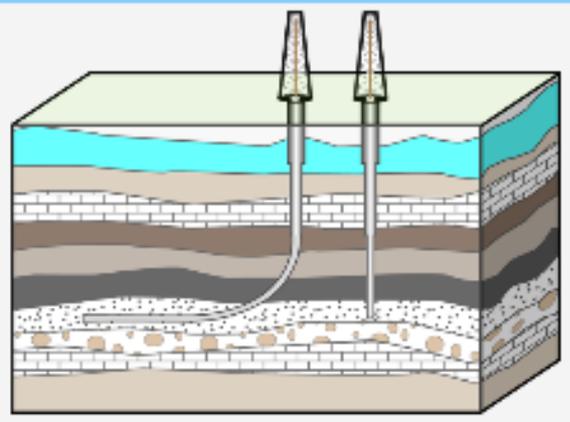
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