PART 3 of 3

STATE OF NEW MEXICO
DEPARTMENT OF ENERGY, MINERALS AND NATURAL RESOURCES
OIL CONSERVATION DIVISION

APPLICATION OF PERMIAN OILFIELD PARTNERS, LLC
FOR APPROVAL OF SALT WATER DISPOSAL WELL
IN LEA COUNTY, NEW MEXICO

Case No. 20961
(RAMROD FEE)

HEARING EXHIBITS

Exhibit 1: Application, C-108, and Supporting Documentation

Exhibit 2: Notice Affidavit

Exhibit 3: Fisher Seismicity Statement

Exhibit 3

Fisher Seismicity Statement

Attachment to C-108 Application for Authorization to Inject
Permian Oilfield Partners, LLC
Ramrod Fee SWD #1
323' FSL & 2227' FEL
Sec 17, T21S, R28E
Eddy County, NM

September 25, 2019

STATEMENT REGARDING SEISMICITY

Examination of the USGS and TexNet seismic activity databases has shown minimal historic seismic activity in the area (< 30 miles) of our proposed above referenced SWD well as follows:

Magnitude	Date	Lat	Lon	Distance (mi.)	Bearing (°)
M3.1 USGS	3/18/2012	32.281	-103.892	18.36	133.50
M4.1 USGS	3/28/2010	32.438	-104.501	23.23	276.13
M3.4 USGS	8/26/2004	32.582	-104.505	24.49	287.74
M3.0 USGS	10/28/2004	32.604	-104.499	24.67	291.35
M3.6 USGS	6/21/2003	32.665	-104.505	26.80	299.49

Permian Oilfield Partners does not own any 2D or 3D seismic data in the area of this proposed SWD well. Our fault interpretations are based on well to well correlations and publicly available data and software as follows:

1. USGS Quaternary Fault & Fold database shows no quaternary faults in the nearby area.
2. Based on offset well log data, we have not interpreted any faults in the immediate area.
3. Basement PreCambrian faults are documented in the Snee & Zoback paper, “State of stress in the Permian Basin, Texas and New Mexico: Implications for induced seismicity”, published in the February 2018 issue of the SEG journal, The Leading Edge, along with a method for determining the probability of fault slip in the area.
4. Fault data was also correlated to the publicly available USGS GIS geologic units & structural features database, to Ewing’s 1990 Tectonic map of Texas (via Ruppel’s 2005 Preparation of Maps Depicting Geothermal Gradient and PreCambrian Structure in the Permian Basin), and to fault maps as published in the New Mexico Geological Society Special Publication 13A, “Energy and Mineral Resources of New Mexico: Petroleum Geology,” by R. F. Broadhead, 2017.

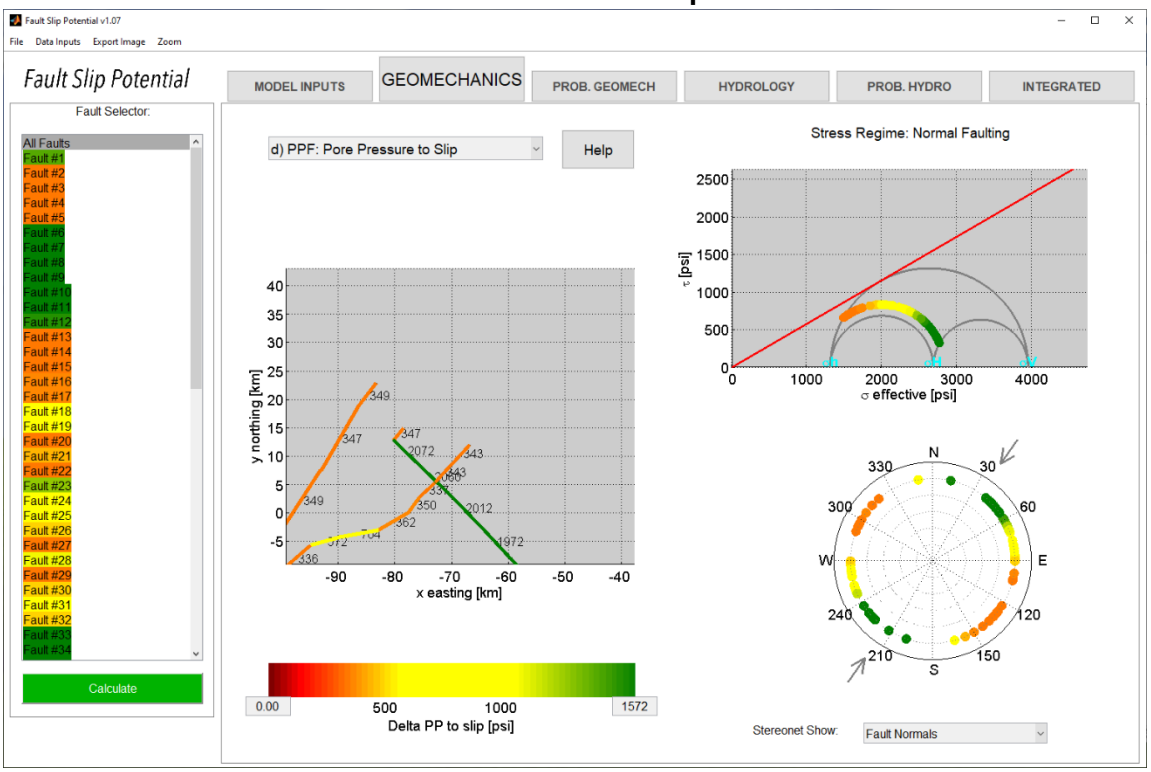
5. Software as discussed in #3 from the Stanford Center for Induced and Triggered Seismicity, “FSP 1.0: A program for probabilistic estimation of fault slip potential resulting from fluid injection”, was used to calculate the probability of a fault being stressed so as to create an induced seismic event, assuming full proposed capacity of 50,000 BBL/day for 30 years.
6. Two FSP scenarios were run:
    a. The first FSP scenario assumes PreCambrian faults as per the available data described above, with an improbable catastrophic well failure that would allow full rate injected water to penetrate the Montoya and Simpson permeability barriers, the Ellenburger, and the Cambrian to access the PreCambrian faults.
    b. Because there is evidence that the PreCambrian faults extend into the Devonian in areas, we ran a second FSP scenario with Devonian depth & lithology assumptions.
7. The distance from the proposed injection well to the nearest fault is approximately 22km. The probability of an induced seismic event in the PreCambrian is calculated to be 0% after 5, 10, 20, & 30 years as per the FSP results screenshots below. The probability of an induced seismic event in the Devonian is also calculated to be 0% after 5, 10, 20, & 30 years.
8. As per NM OCD requirements (injection well to injection well spacing minimum of 1.5 miles), this proposed above referenced SWD well is located 1.55 miles away from the nearest active or permitted Devonian disposal well (Judah Oil Shinnery Oak Fed SWD #2, in Sec 15-21S-28E).

Part 6 a: PreCambrian Fault Scenario

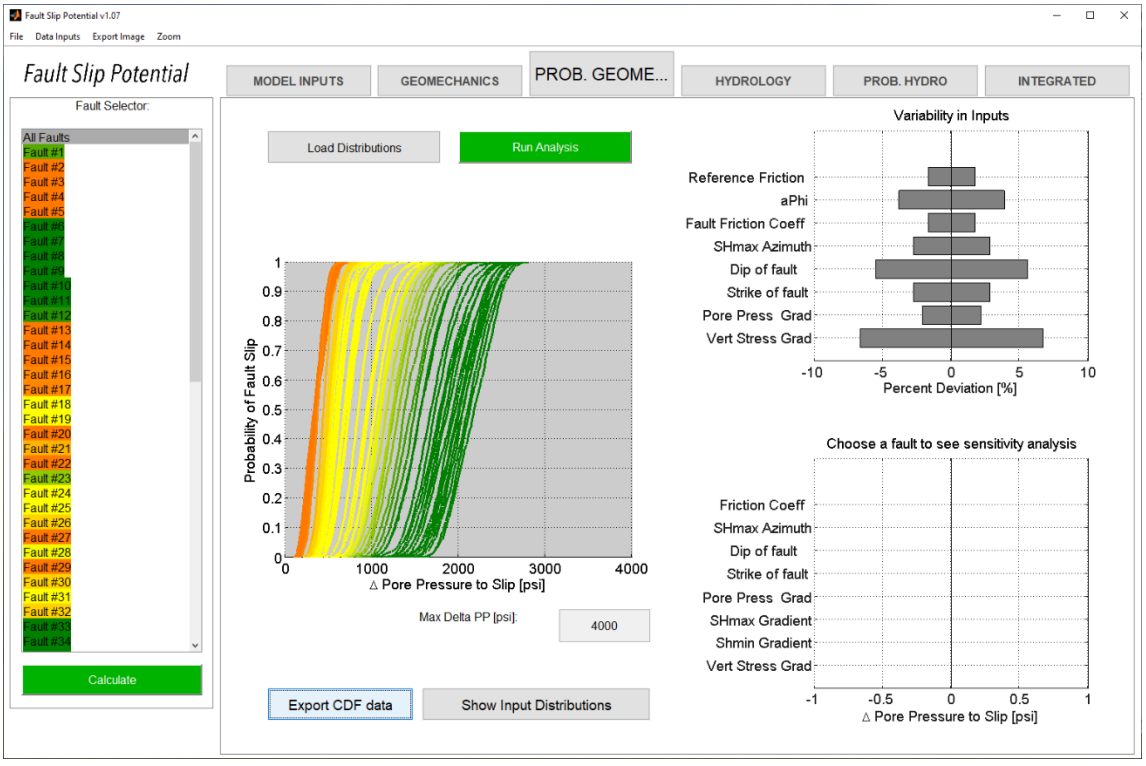
PreCambrian input assumptions:

Rate (BBL/day)	50000
Interval height (ft)	1000
Average Porosity (%)	3
Vert stress gradient (psi/ft)	0.75
Hor stress direction (deg N)	35
Fault dip (deg)	75
Ref depth (ft)	14126
Initial res press gradient (psi/ft)	0.47
A phi	0.52
Friction coefficient	0.58
Average perm (mD)	12.5
Fluid density (kg/m3)	1100
Dynamic viscosity (Pa-s)	0.0003
Fluid compressibility (/Pa)	4 e-10
Rock compressibility (/Pa)	1.08 e-09

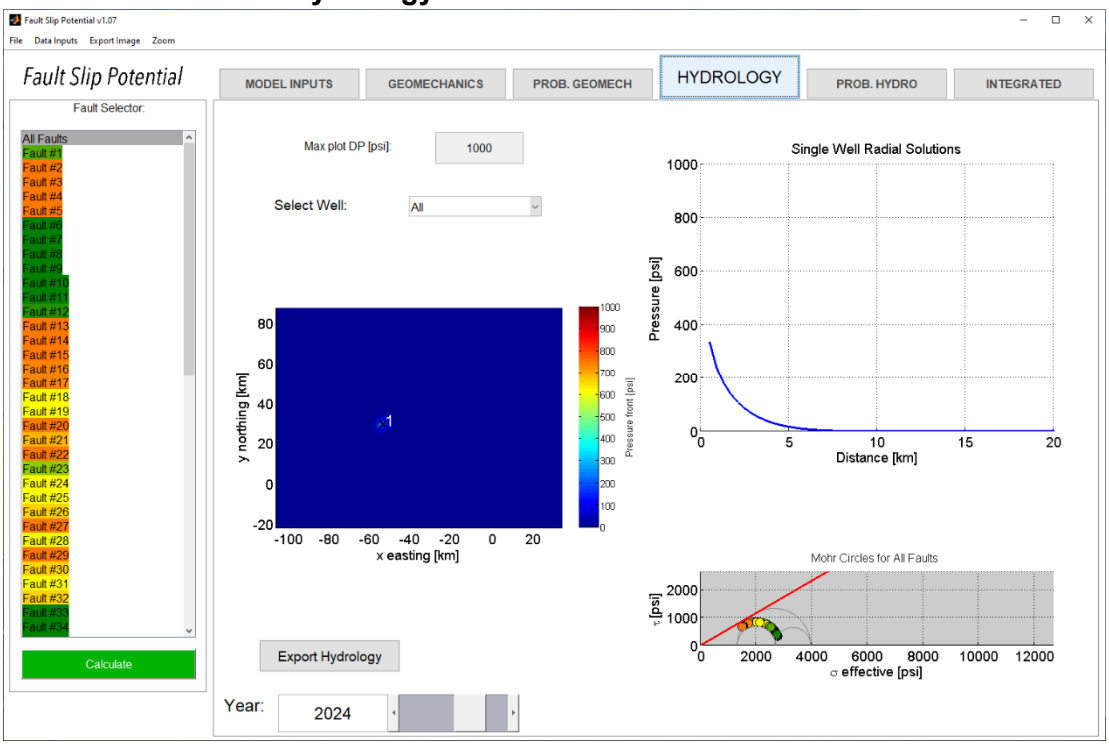
PreCambrian Geomechanics Pore Pressure to Slip



PreCambrian GeoMechanics Variability

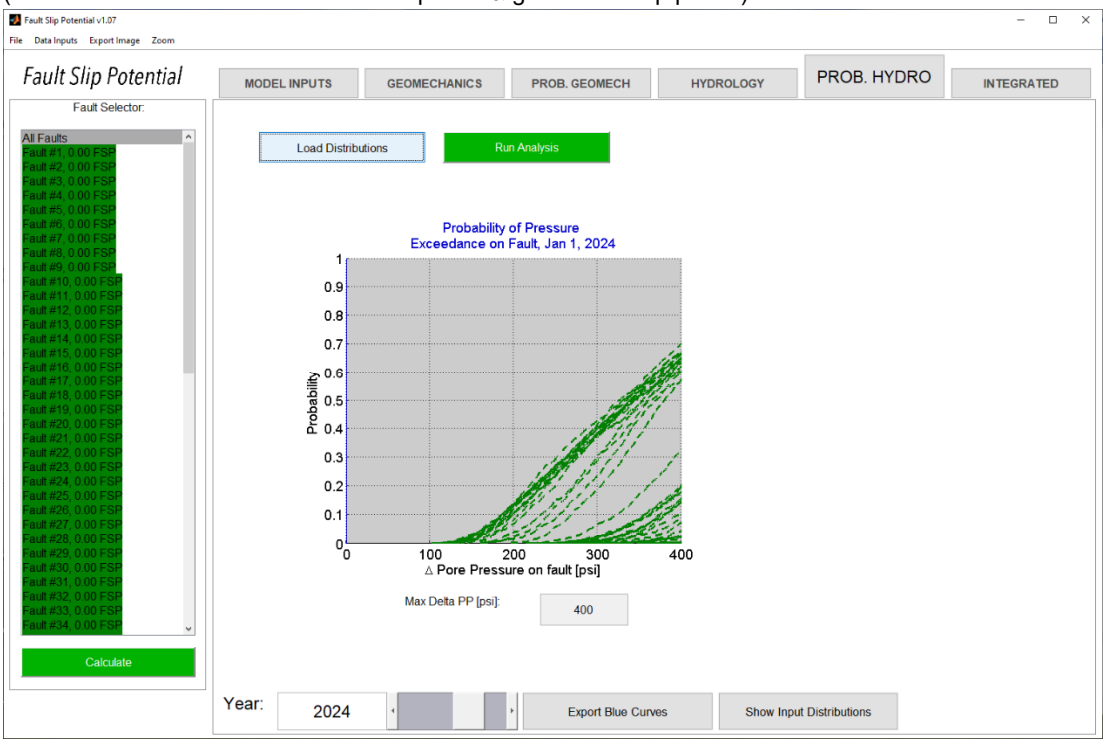


PreCambrian Year 5 Hydrology



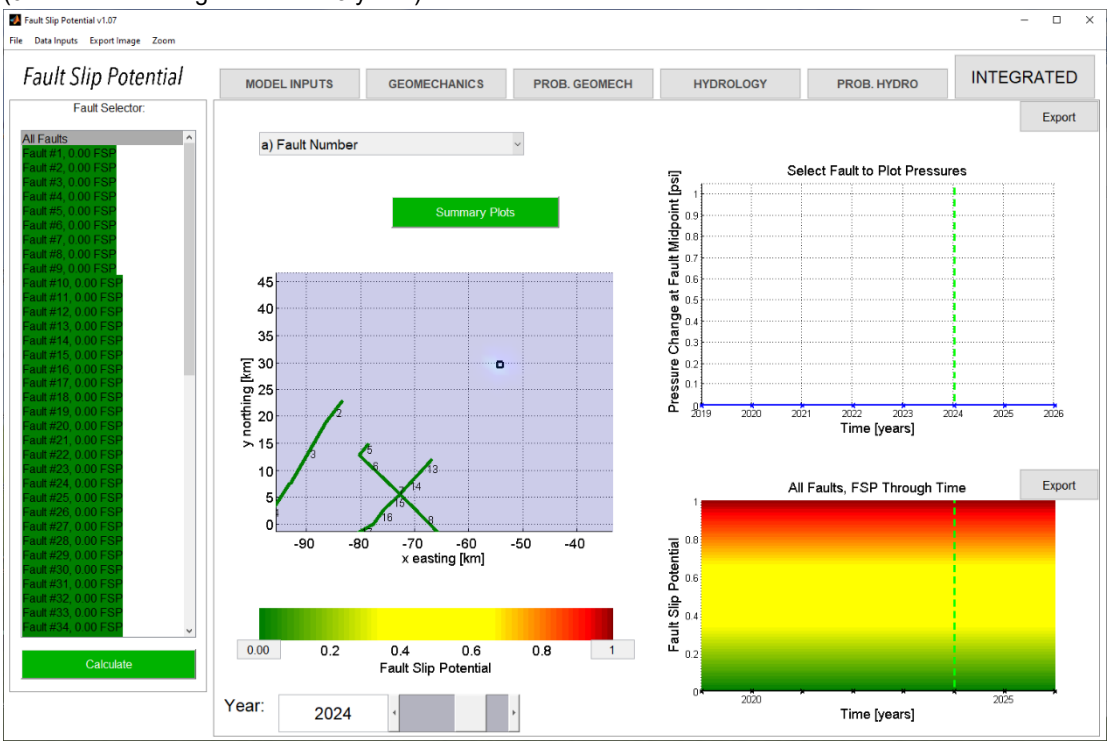
PreCambrian Year 5 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)

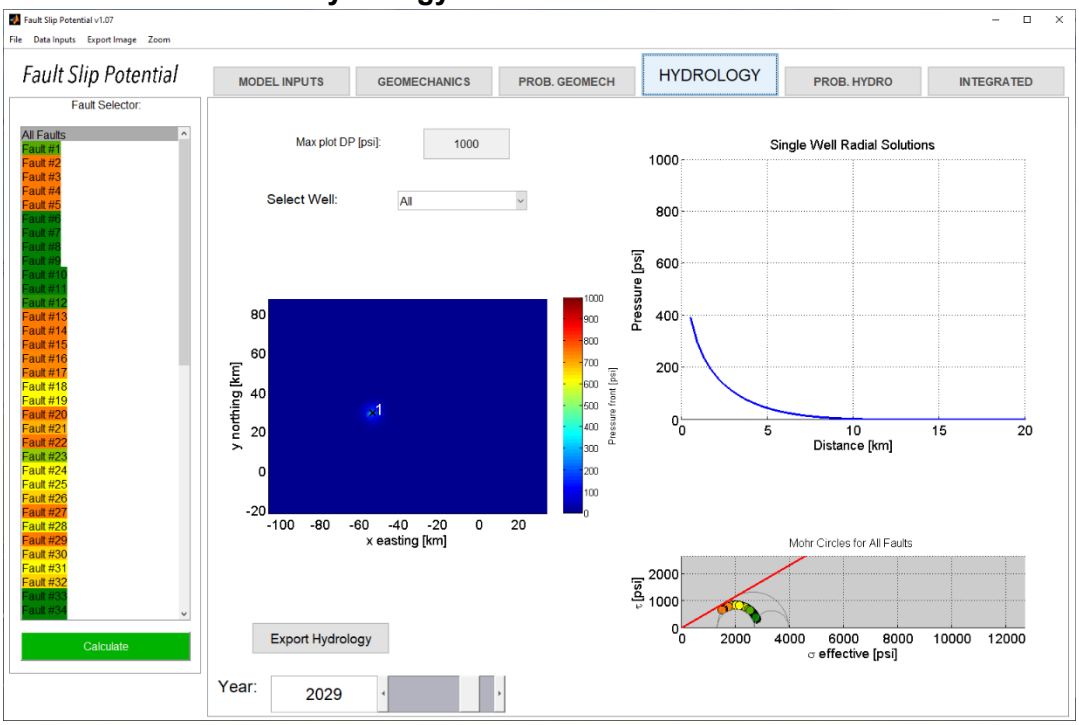


PreCambrian Year 5 Fault Slip Probability

(0% for all fault segments after 5 years)

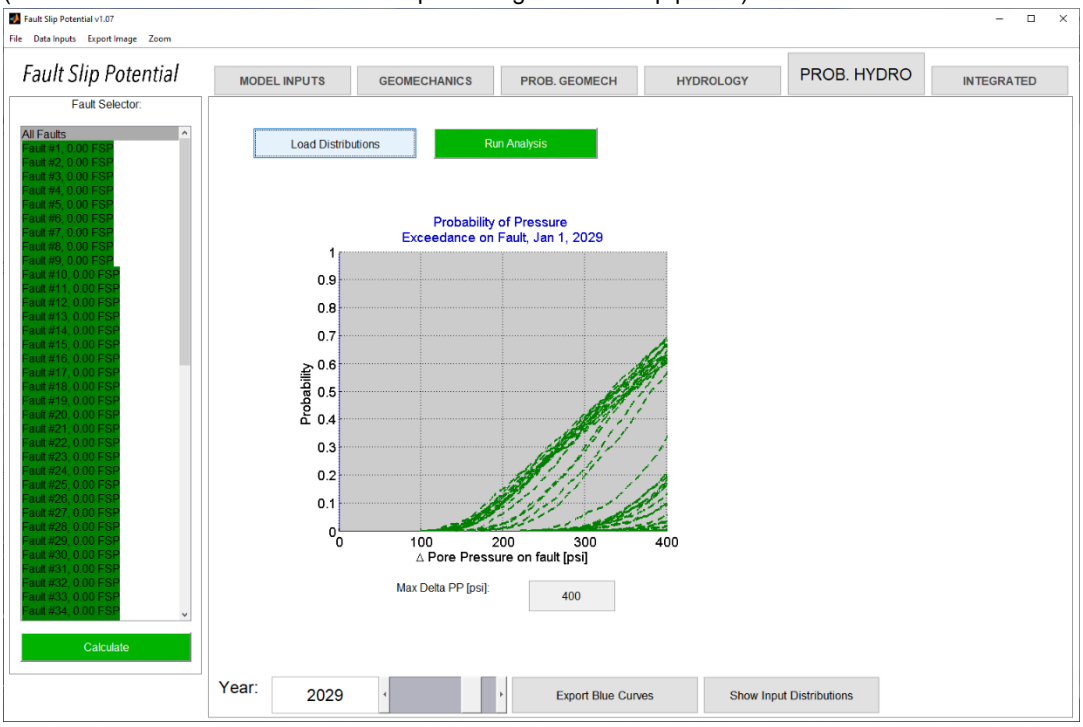


PreCambrian Year 10 Hydrology



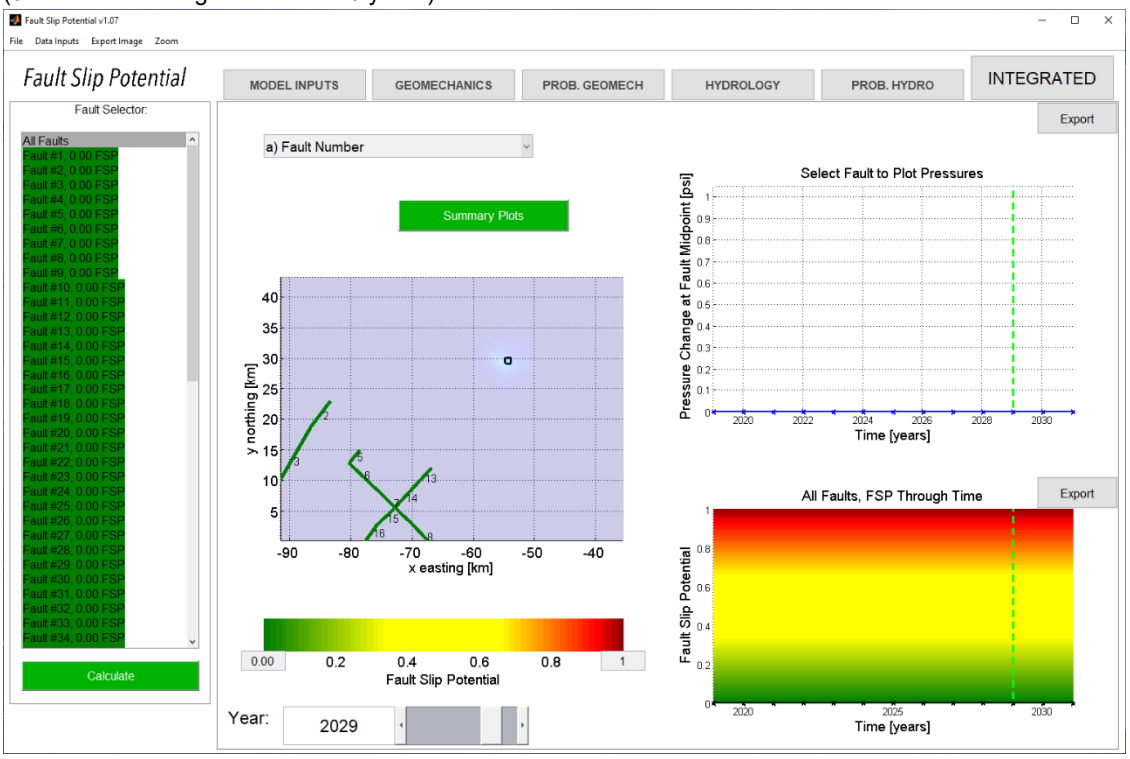
PreCambrian Year 10 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)

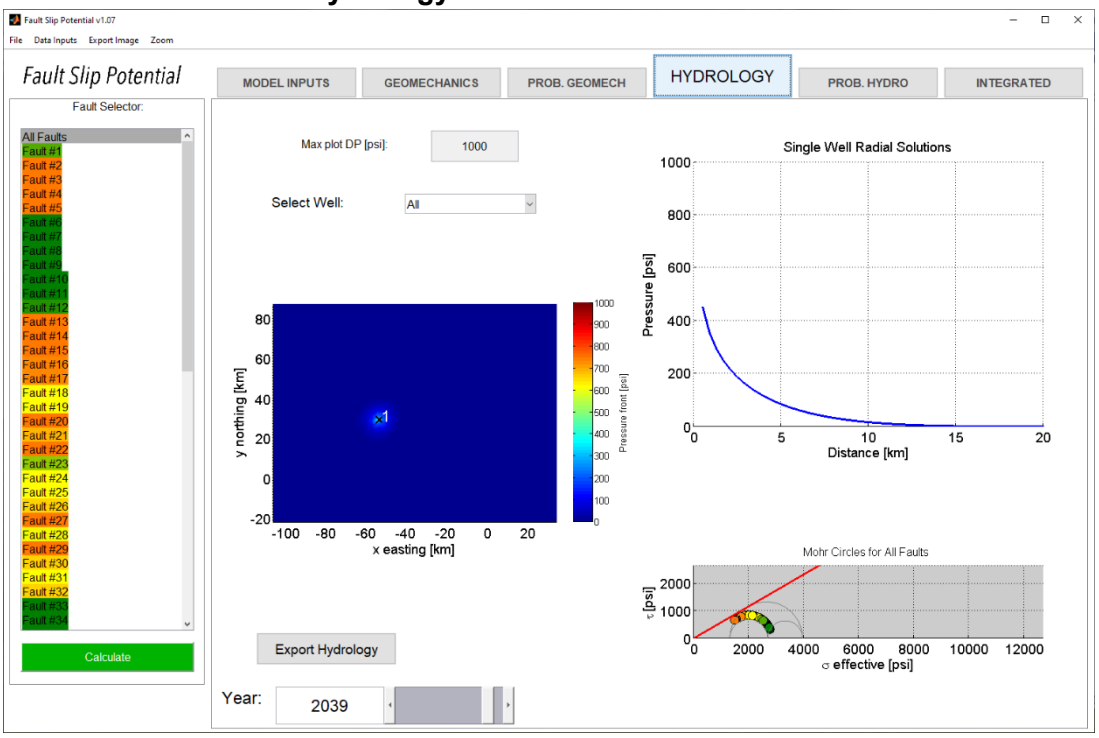


PreCambrian Year 10 Fault Slip Probability

(0% for all fault segments after 10 years)

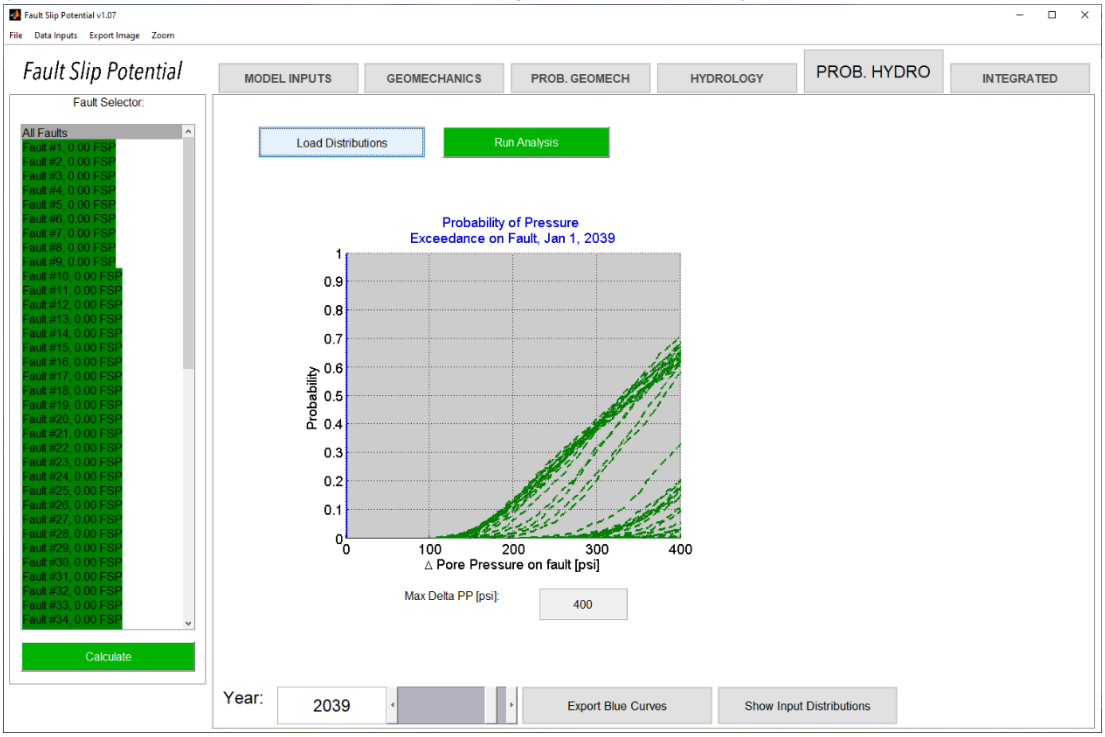


PreCambrian Year 20 Hydrology



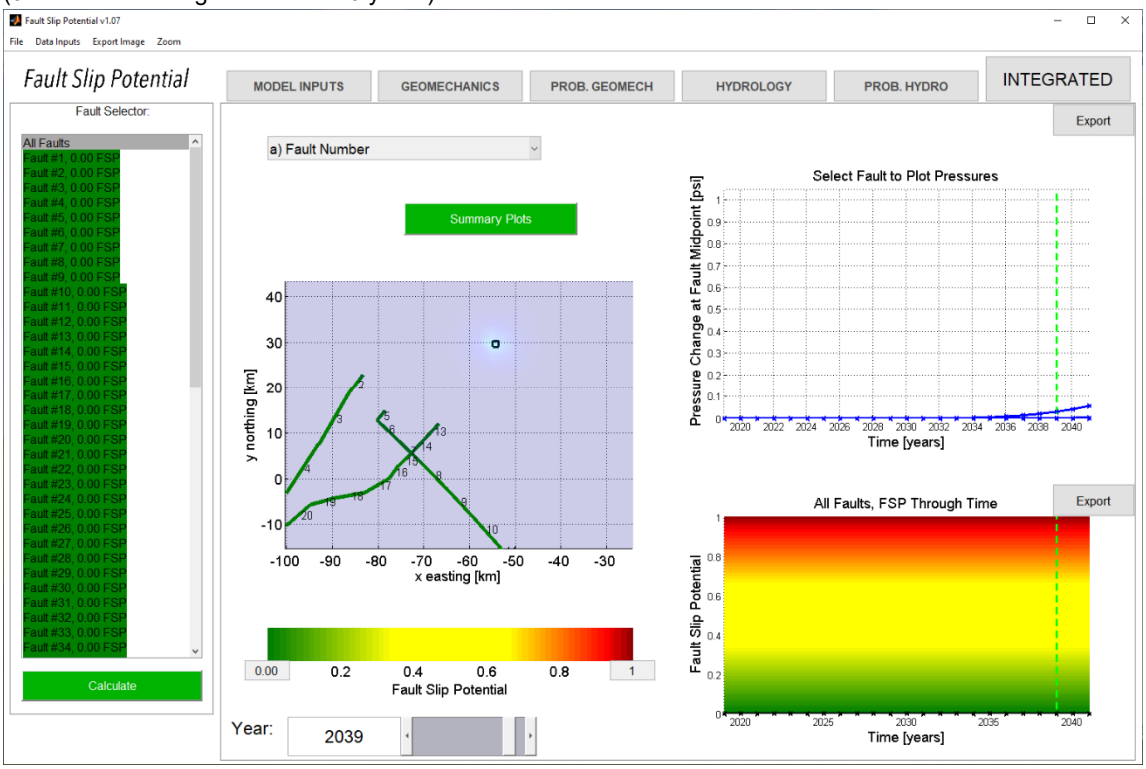
PreCambrian Year 20 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)

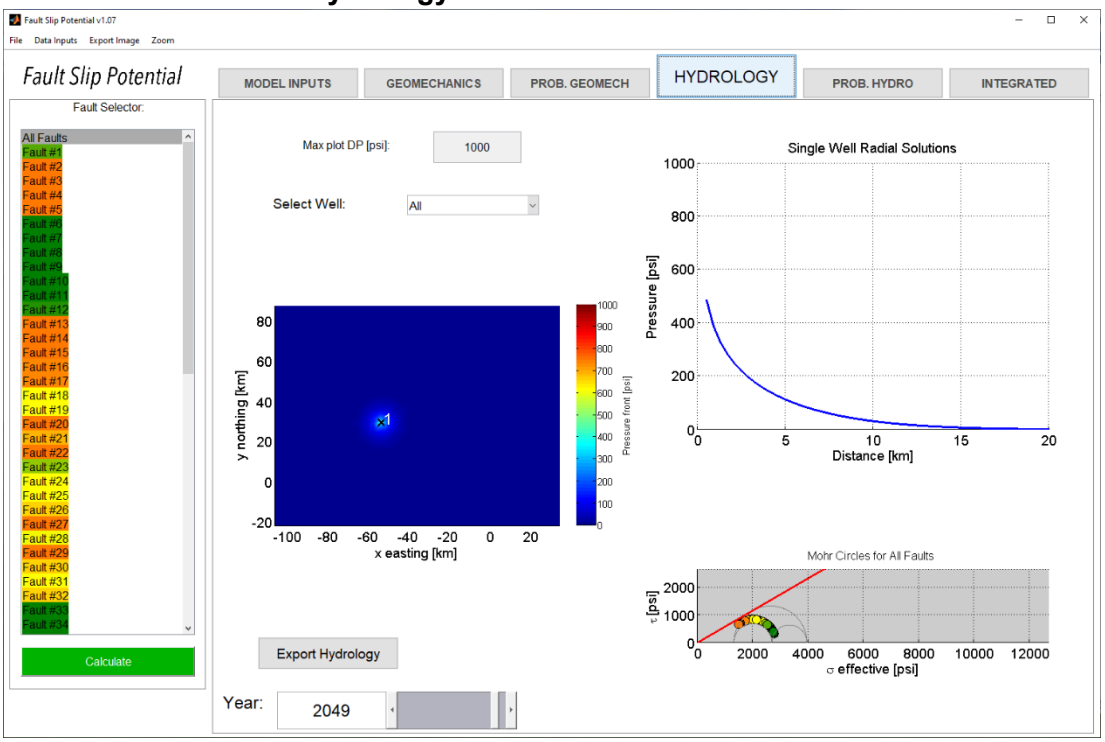


PreCambrian Year 20 Fault Slip Probability

(0% for all fault segments after 20 years)

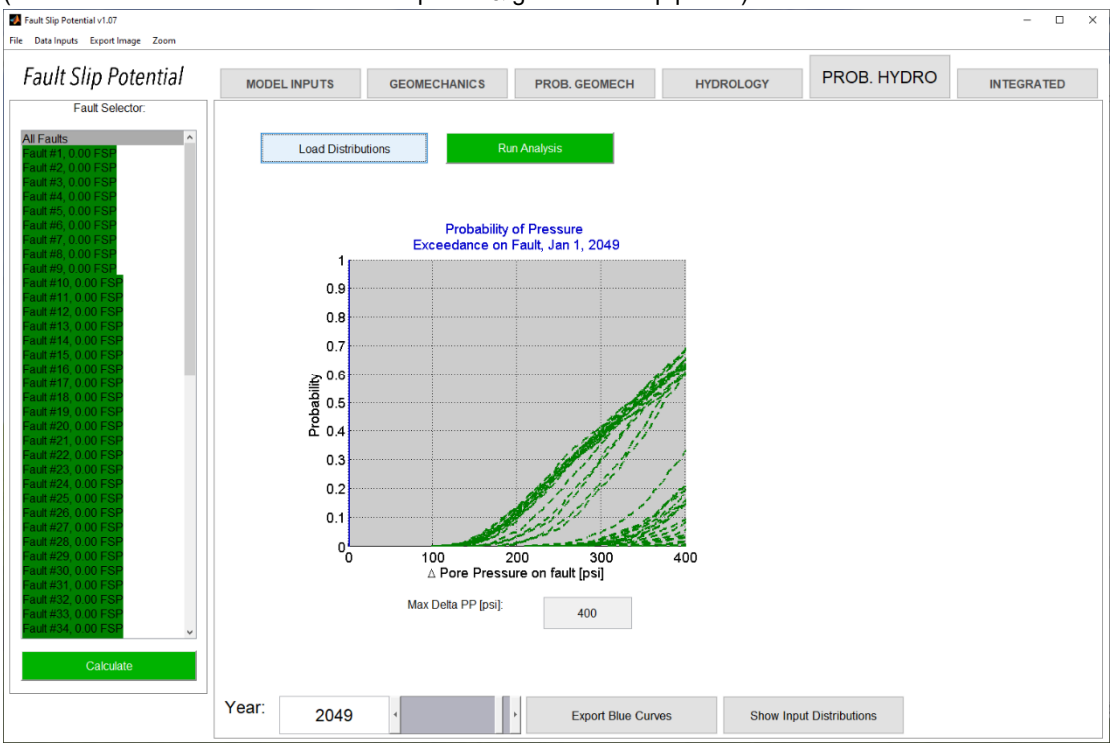


PreCambrian Year 30 Hydrology



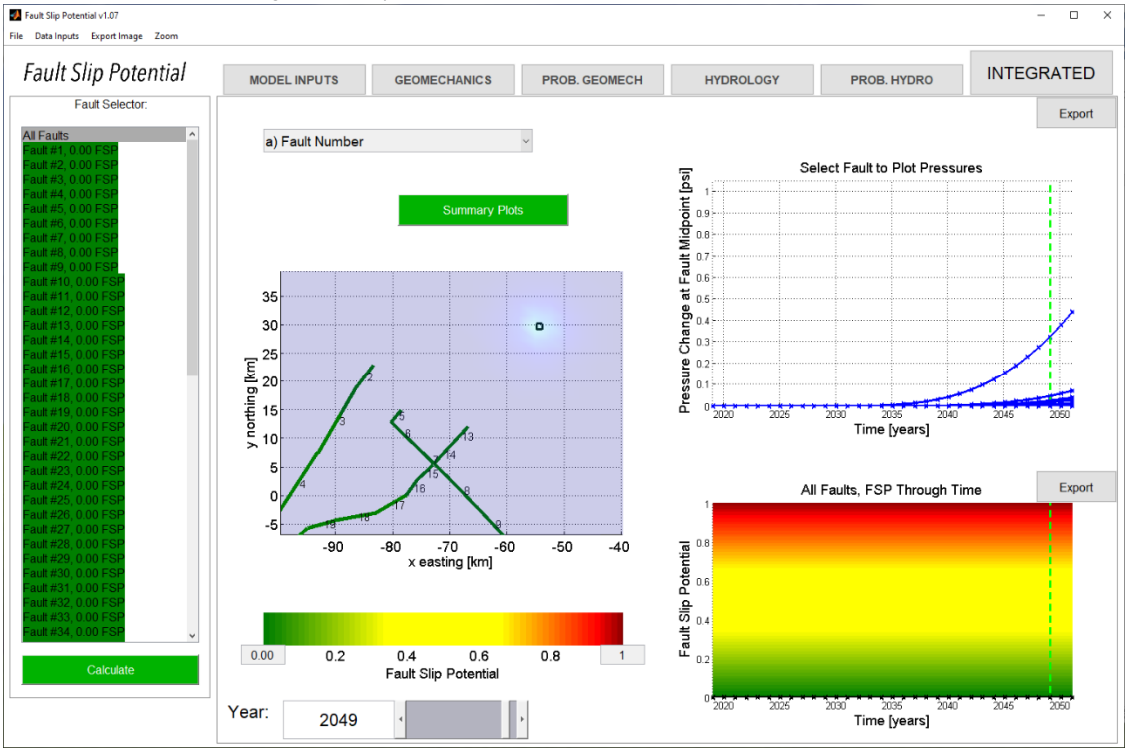
PreCambrian Year 30 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)



PreCambrian Year 30 Fault Slip Probability

(0% for all fault segments after 30 years. 0.3 psi fault delta pressure is much less than the 343 psi required for fault slip in the closest fault segment #13)

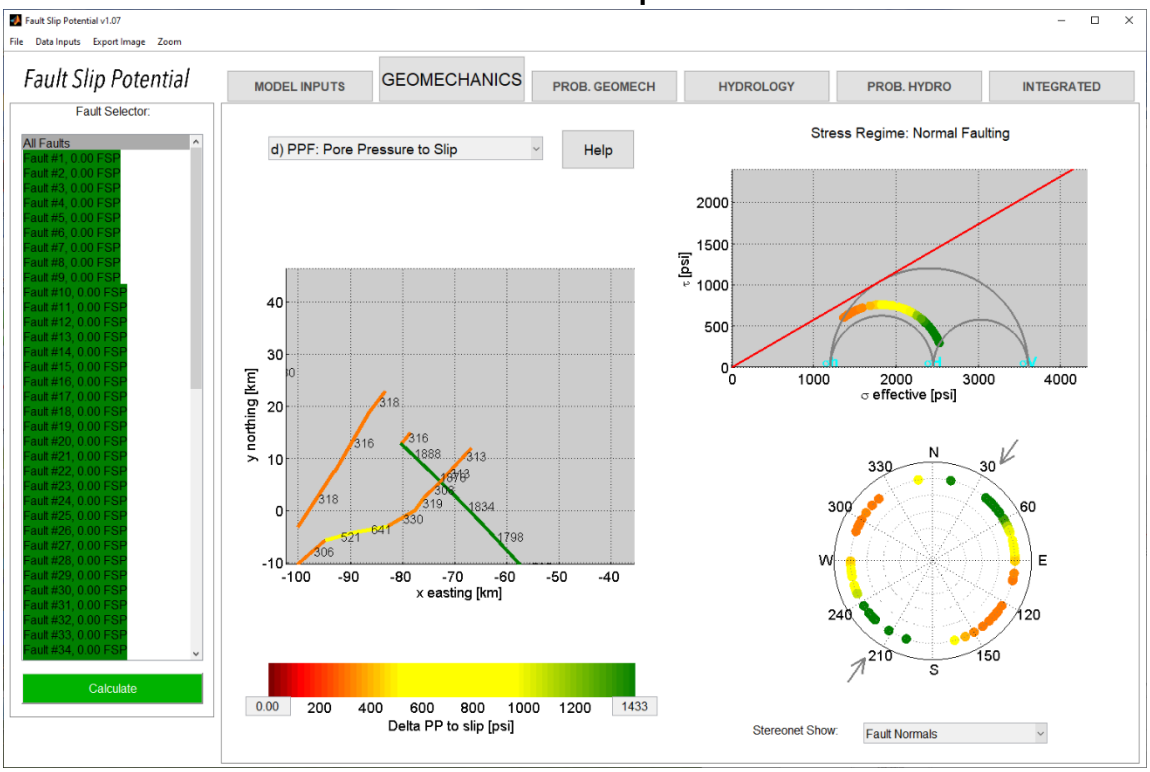


Part 6 b: Devonian Fault Scenario

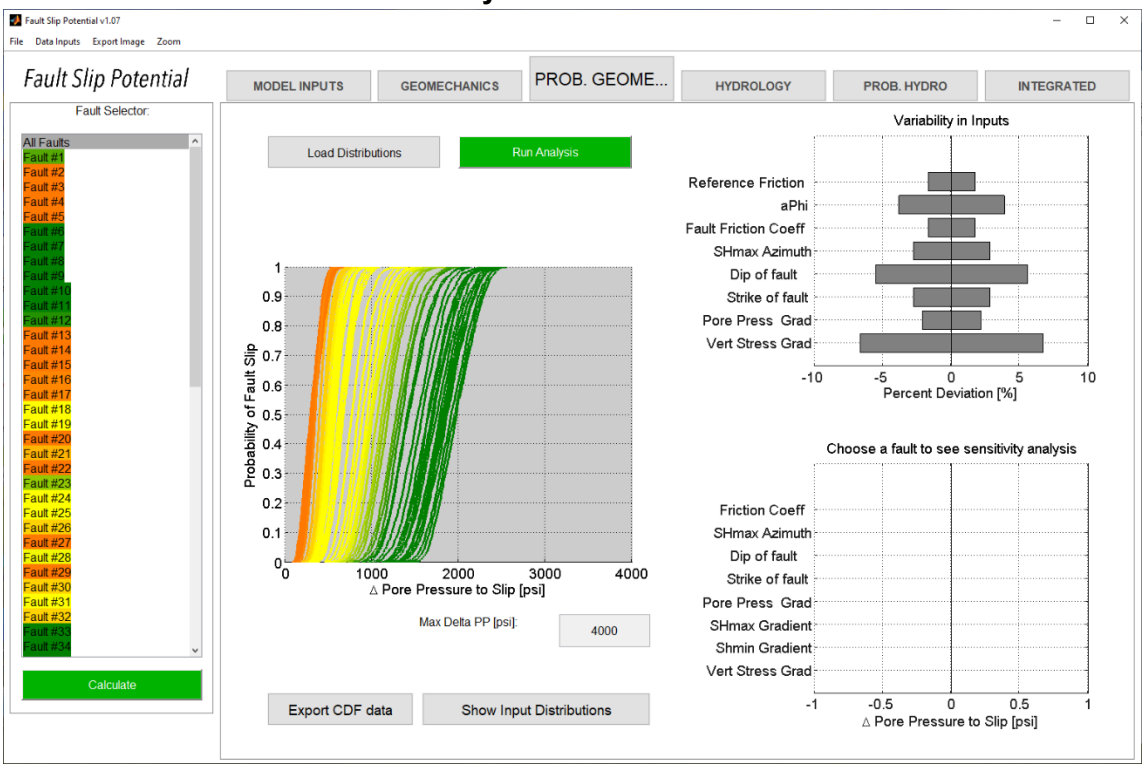
Devonian input assumptions:

Rate (BBL/day)	50000
Interval height (ft)	679
Weighted Average Porosity (%)	3.3
Vert stress gradient (psi/ft)	0.75
Hor stress direction (deg N)	35
Fault dip (deg)	75
Ref depth (ft)	12851
Initial res press gradient (psi/ft)	0.47
A phi	0.52
Friction coefficient	0.58
Weighted Average perm (mD)	19
Fluid density (kg/m3)	1100
Dynamic viscosity (Pa-s)	0.0003
Fluid compressibility (/Pa)	4 e-10
Rock compressibility (/Pa)	1.08 e-09

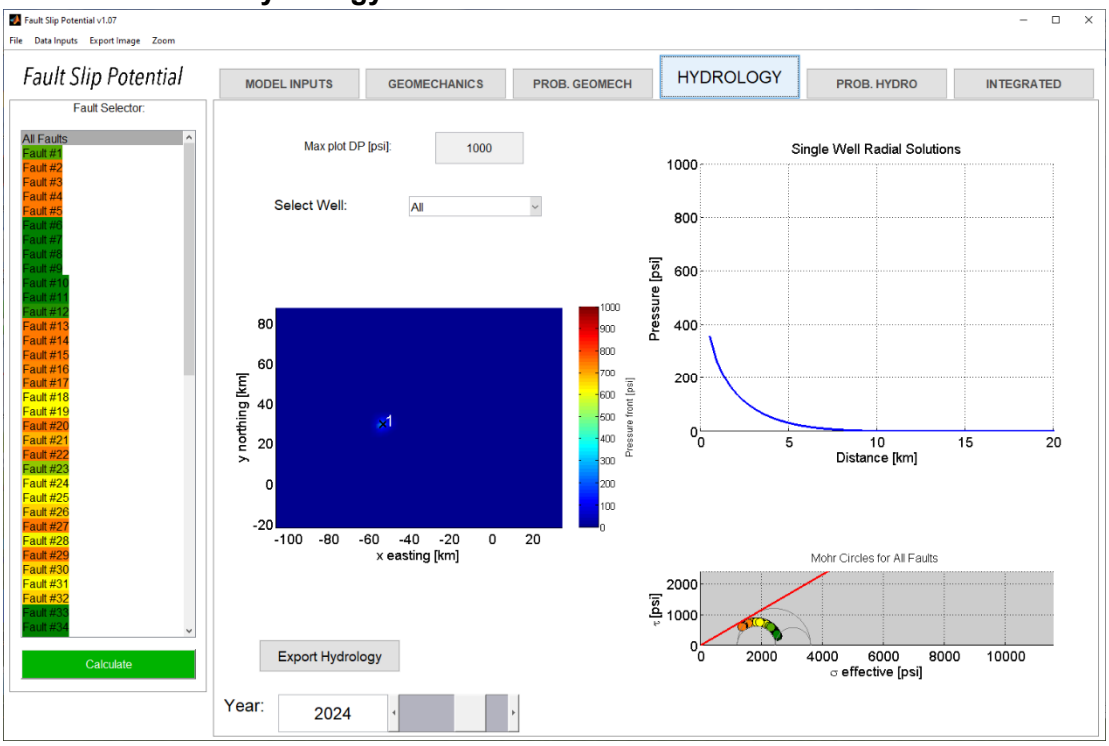
Devonian Geomechanics Pore Pressure to Slip



Devonian GeoMechanics Variability

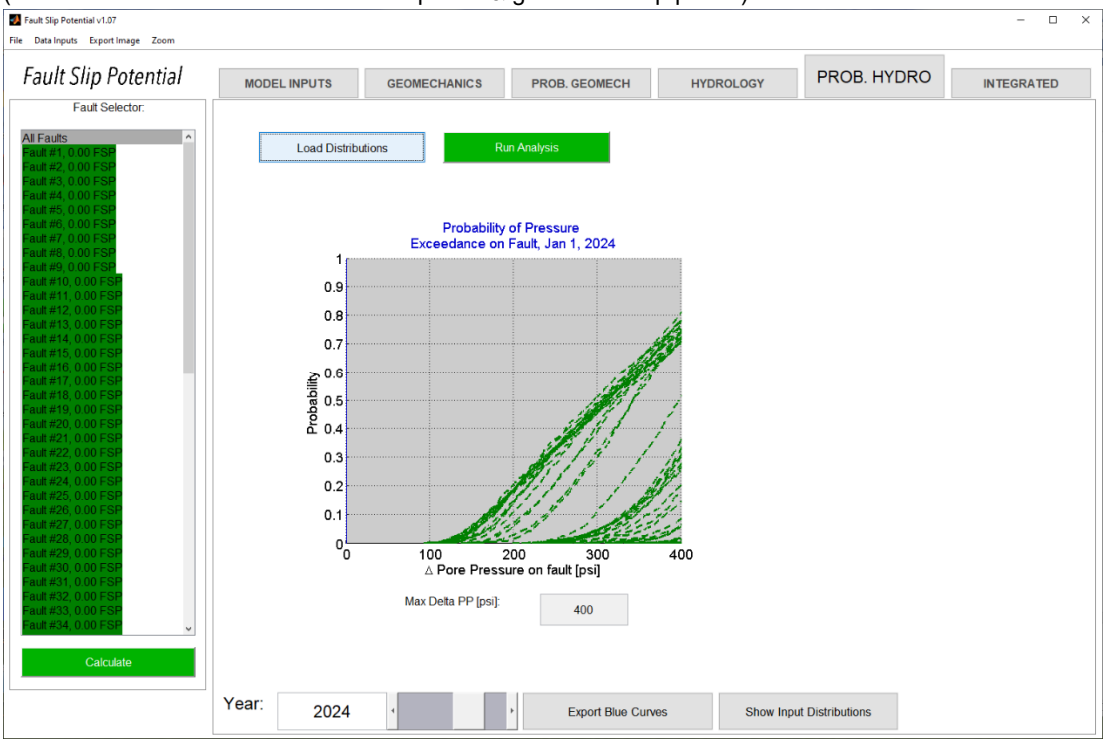


Devonian Year 5 Hydrology



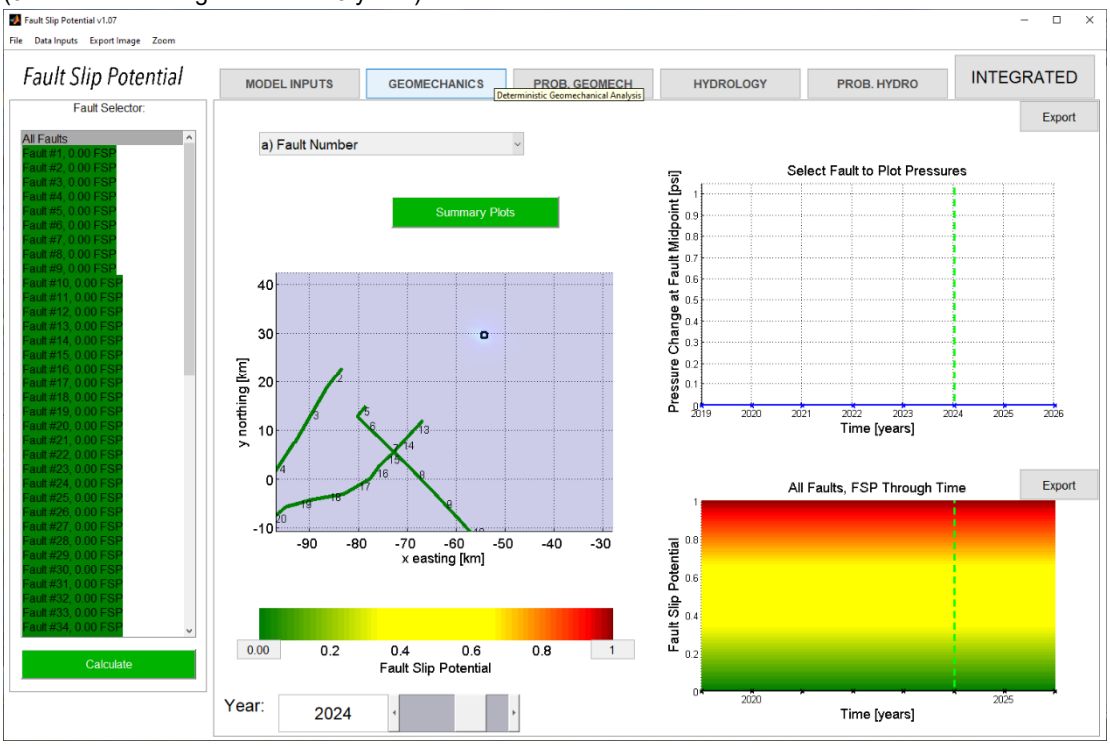
Devonian Year 5 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)

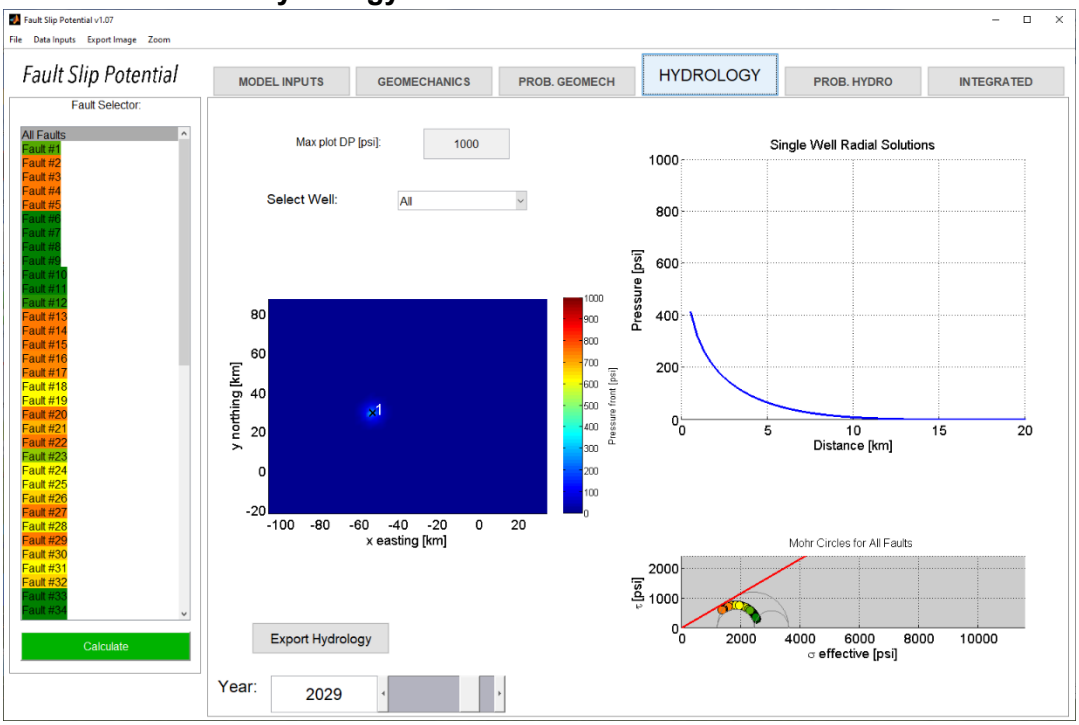


Devonian Year 5 Fault Slip Probability

(0% for all fault segments after 5 years)

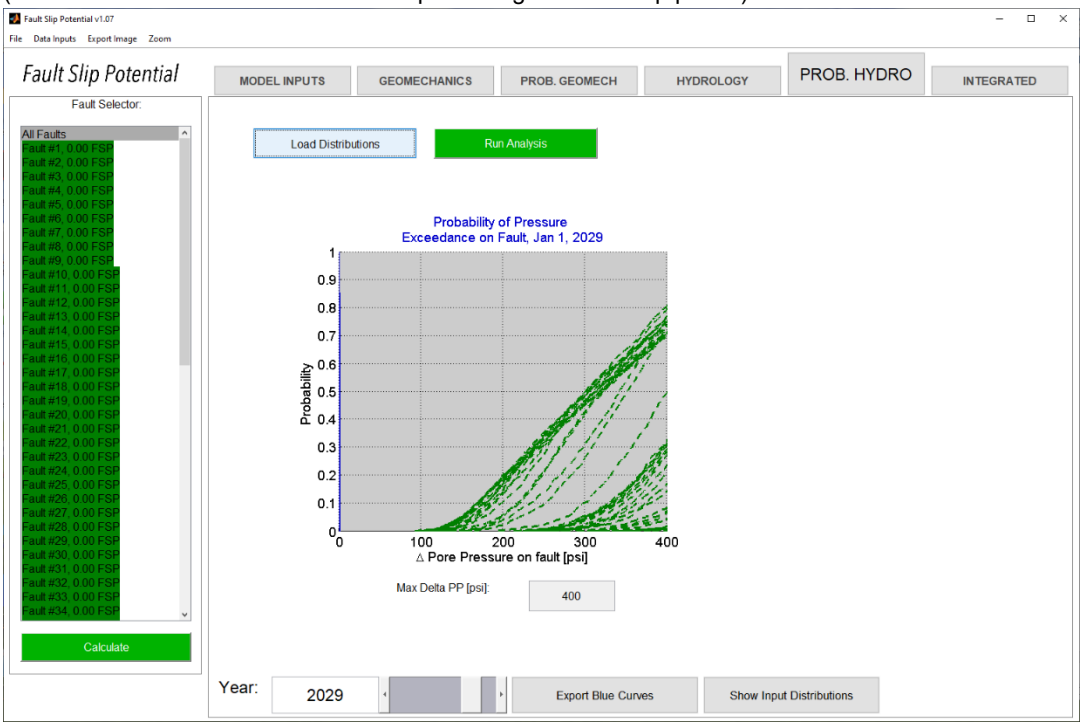


Devonian Year 10 Hydrology



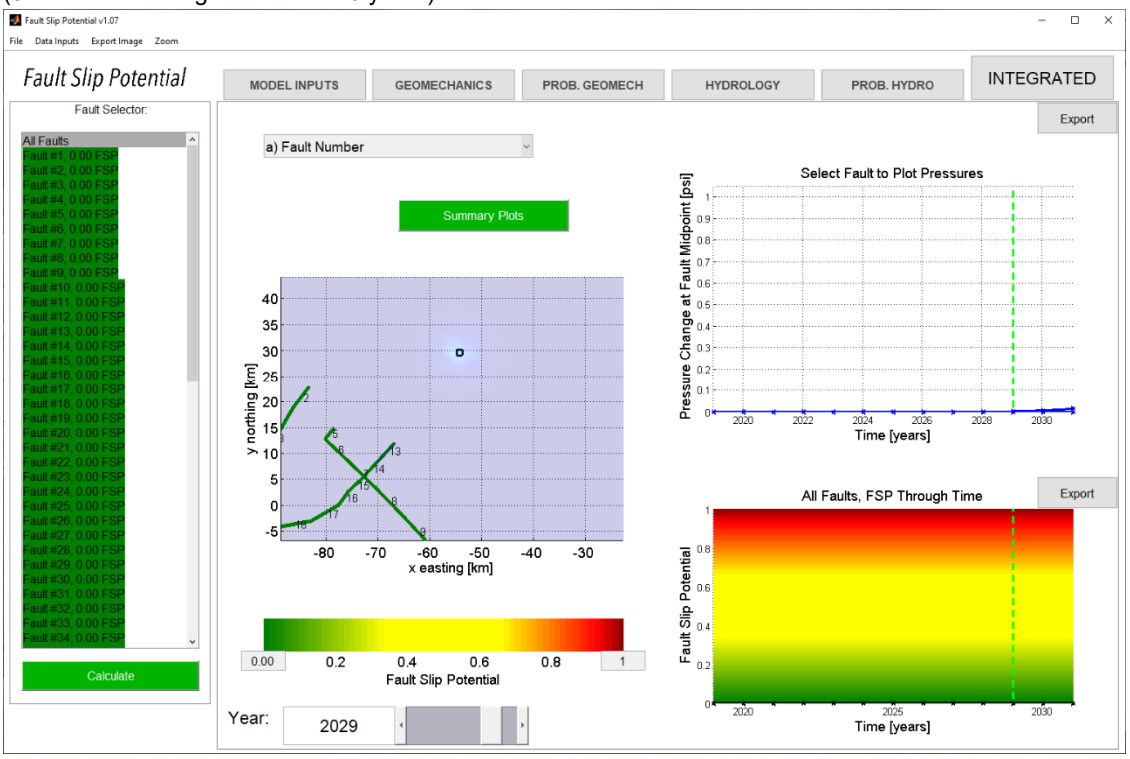
Devonian Year 10 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)

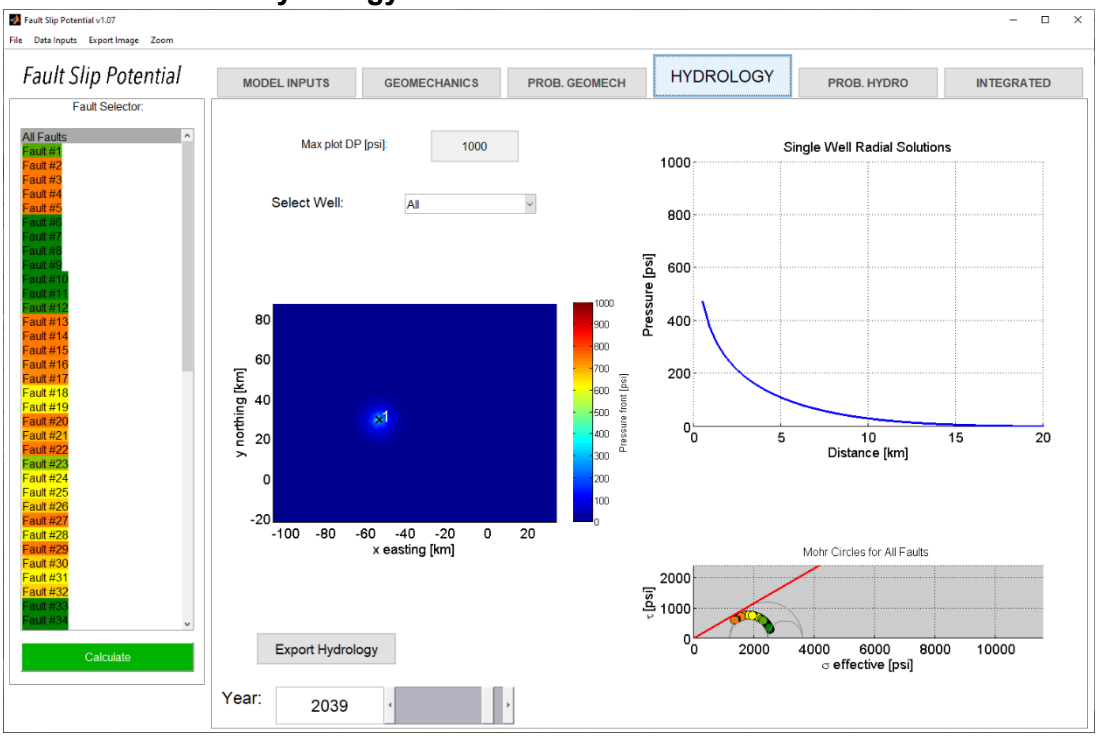


Devonian Year 10 Fault Slip Probability

(0% for all fault segments after 10 years)

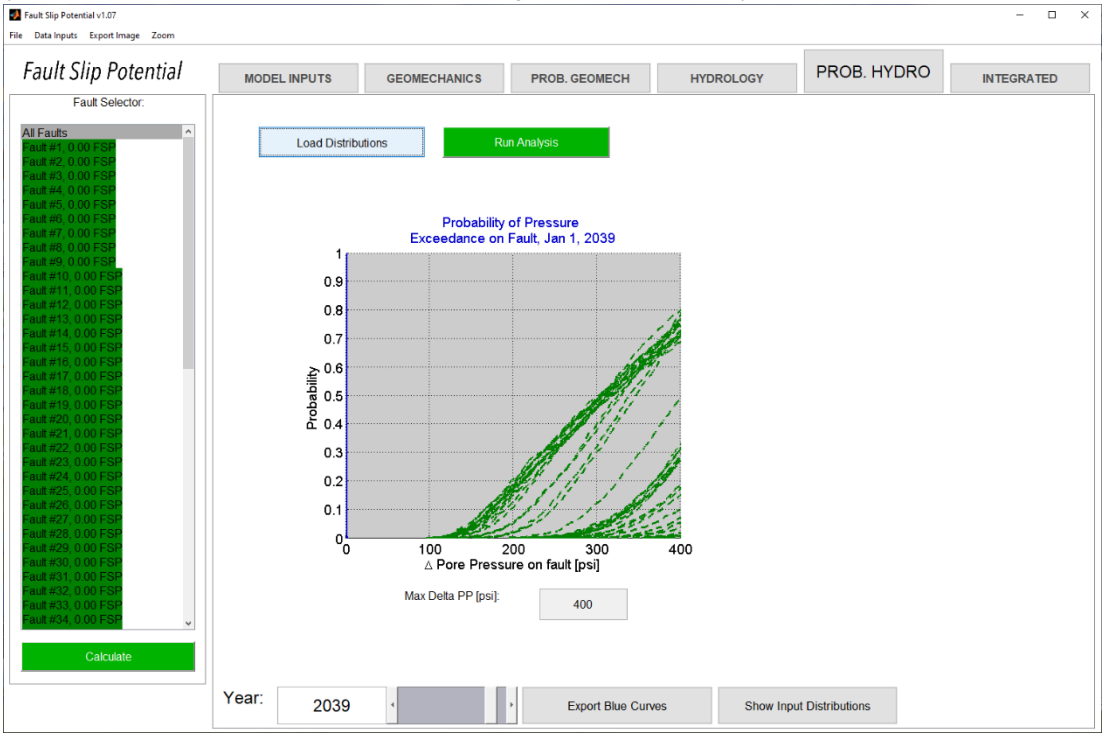


Devonian Year 20 Hydrology



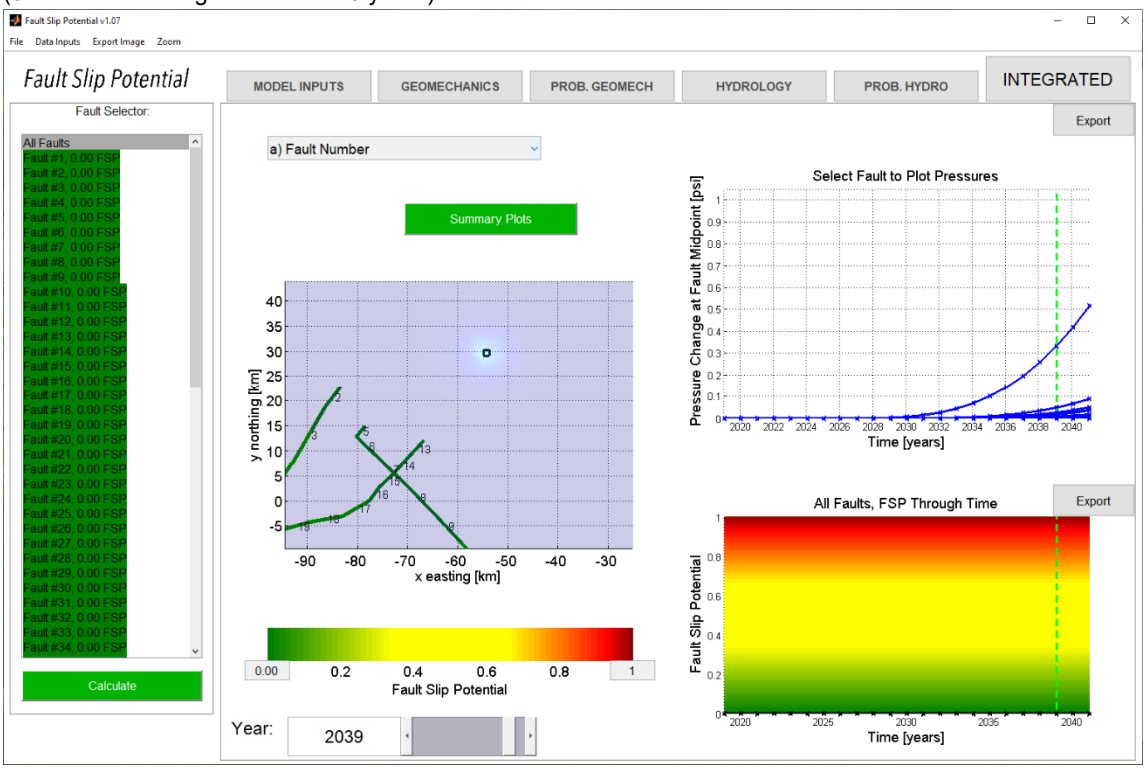
Devonian Year 20 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)

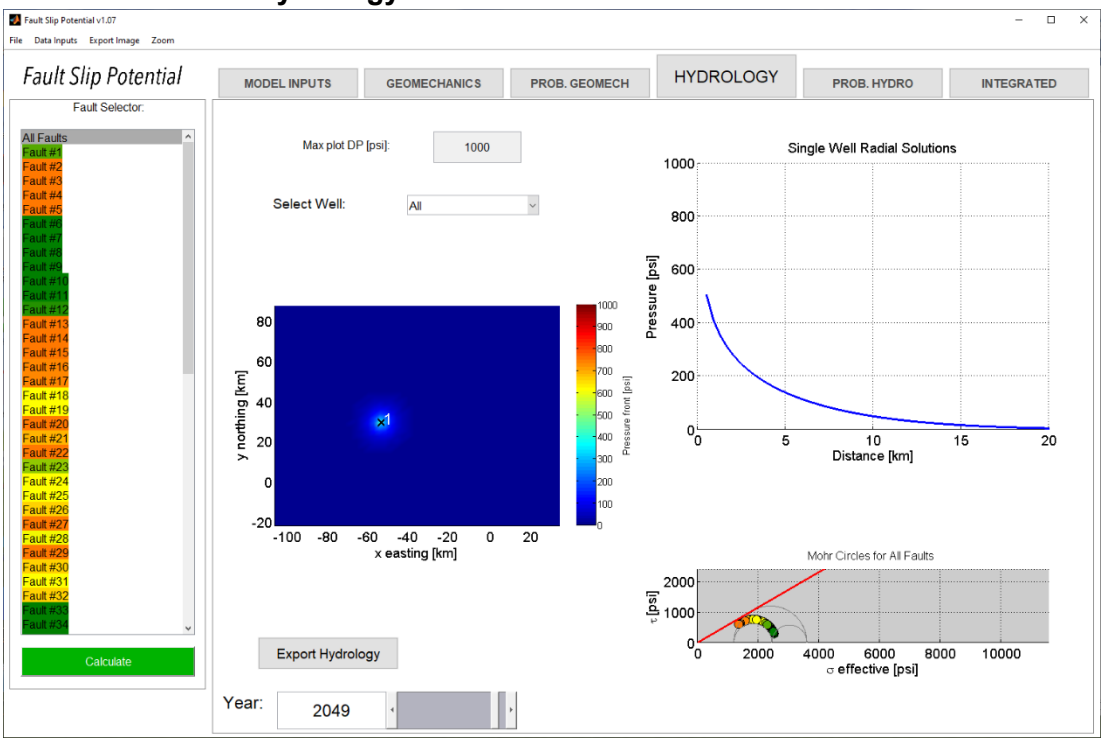


Devonian Year 20 Fault Slip Probability

(0% for all fault segments after 20 years)

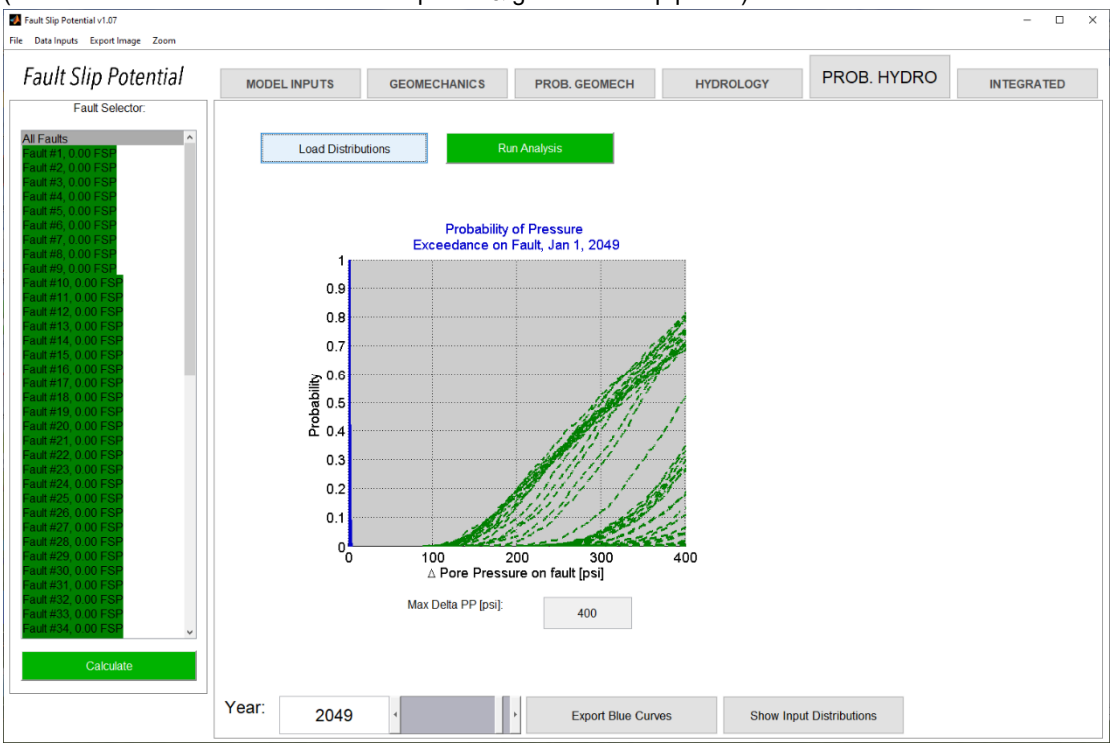


Devonian Year 30 Hydrology



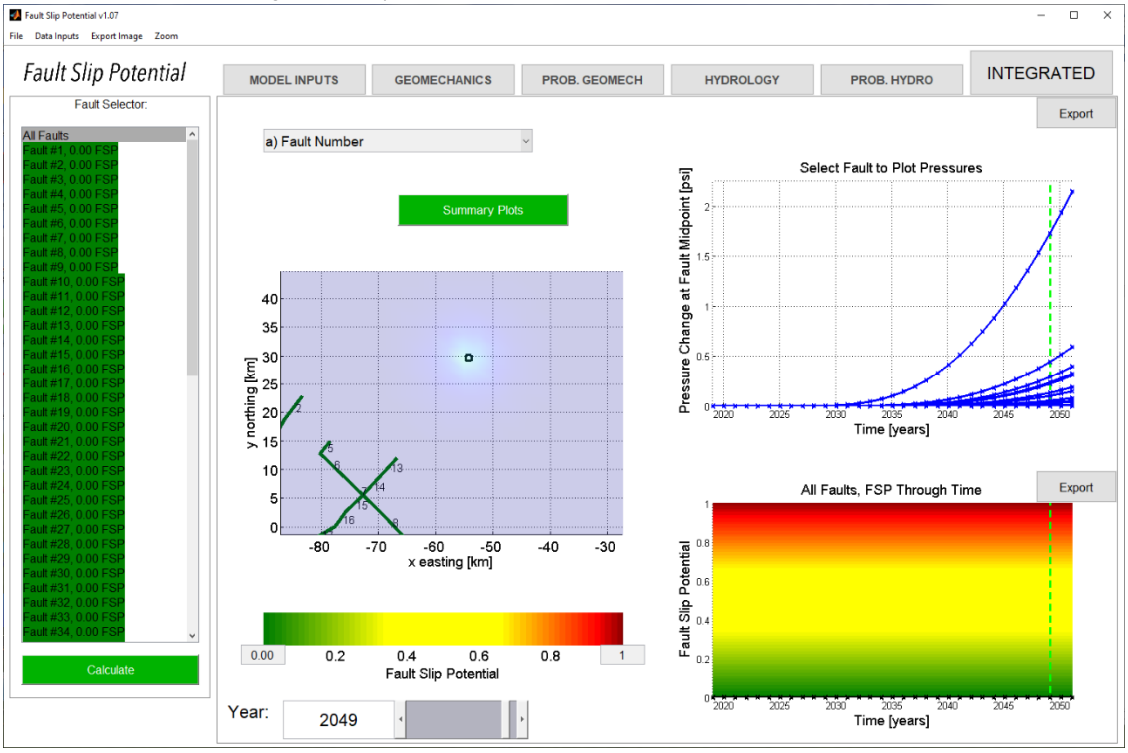
Devonian Year 30 Probabilistic Hydrology

(note no crossover between blue delta-press. & green fault slip press.)



Devonian Year 30 Fault Slip Probability

(0% for all fault segments after 30 years. 1.75 psi fault delta pressure is much less than the 313 psi required for fault slip in the closest fault segment #13)



gfisher@popmidstream.com
(817) 606-7630