

Oil-Water Simulation using the IMPES Method

Objective

The objective of this exercise is to study effects of numerical dispersion, upstream selection of mobilities and capillary dispersion by variation of:

- grid block size
- time step size
- mobility selection
- capillary pressure

in simulation of displacement of oil by water.

Assignment

The oil-water IMPES model **ow.f** and input data files **SYST.DAT**, **PVT.DAT** and **SAT.DAT** may be copied from the home page of the course. Compile the code **ow.f**. The content of the input data files is self-explanatory. Output files are **SW.OUT**, **PO.OUT** and **WELLS.OUT**

- a) Download **ow.f** from Blackboard or the external home page and placed in a new folder on your user on the server computer **pet.geo.ntnu.no**. Start the terminal window (Xwin32 on Windows or Xquartz on Mac). In the terminal window go to the new folder and compile & link the program using the command:

```
f95 -o exercise2 ow.f
```

The executable module **exercise2** is then generated in your folder.

- b) Edit the input files **SYST.DAT** and **SAT.DAT** to correspond to cases a), b), c) and d) below (one at a time). Use an editor on **pet.geo.ntnu.no** such as **emacs** (type **emacs SYST.DAT** and make changes). Be sure to rename the generated output files after each run, since the next run will overwrite **SW.OUT**, **PO.OUT** and **WELLS.OUT**. For instance you may rename the output files as follows:

SWA.OUT, **POA.OUT**, **WELLSA.OUT**

SWB.OUT, **POB.OUT**, **WELLSB.OUT**

SWC.OUT, **POC.OUT**, **WELLSC.OUT**

SWD.OUT, **POD.OUT**, **WELLSD.OUT**

After editing input files for each case below type **exercise2** to run the program. Output files **SW.OUT**, **PO.OUT** and **WELLS.OUT** will be generated in your folder.

Run the following cases:

- Effect of no. of grid blocks: 5, 10, 50, 100. Time step size 1 sec. **PCMLT=0** (no capillary pressure).
- Effect of time step sizes: 1, 5, 10 sec. No. of grid blocks 20. **PCMLT=0** (no capillary pressure)
- Effect of upstream selection (**USO** and **USW**): 1.0, 0.5, 0.0. No. of grid blocks 20 Time step size 2.5 sec. **PCMLT=0** (no capillary pressure).
- Effect of capillary pressure: **PCMLT= 0., 1., 5** (multiplier for the input **Pc-table** in **SAT.DAT**). No. of grid blocks 20 Time step size 2.5 sec.

Open the file **SW.OUT** (as renamed for for each case) in Excel and plot **Sw** vs. **x** at **t=300** sec. for all the cases listed above (a-d) on the same figure., and can be imported in Excel and plotted. **Please make comments for each case.**

Use the base data on the next page and make appropriate changes in **N**, **DT**, **USO**, **USW**, **PCMLT** for the 4 cases.

SYST.DAT

$L = 100 \text{ cm}$	$A = 1000 \text{ cm}^2$	$k = 0.1 \text{ Darcy}$	$\phi = 0.25$
$c_r = 45 \cdot 10^{-6} \text{ atm}^{-1}$	$Sw_i^{t=0} = 0.2$		
$Q_w = 25 \text{ cm}^3 / \text{s}$	$Po_i^{t=0} = 200 \text{ atm}$	$P_R = 200 \text{ atm}$	

SAT.DAT

12 *NSAT*

<i>Sw</i>	<i>Kro</i>	<i>Krw</i>	<i>Pc (atm)</i>
0.2	0.95	0	1
0.3	0.86	0.01	0.52
0.35	0.8	0.021	0.41
0.4	0.71	0.039	0.34
0.45	0.59	0.058	0.28
0.5	0.46	0.09	0.23
0.55	0.36	0.245	0.18
0.6	0.21	0.42	0.14
0.65	0.12	0.545	0.1
0.7	0.06	0.8	0.06
0.75	0.02	0.91	0.03
0.8	0	0.96	0

PVT.DAT

3 *NPVT*

<i>P (atm)</i>	<i>Bo</i>	<i>Bw</i>	<i>Muo (cp)</i>	<i>Muw (cp)</i>
100	1.522	1.0044	0.45	0.95
200	1.5	1.0	0.5	1.0
300	1.478	0.9956	0.55	1.05