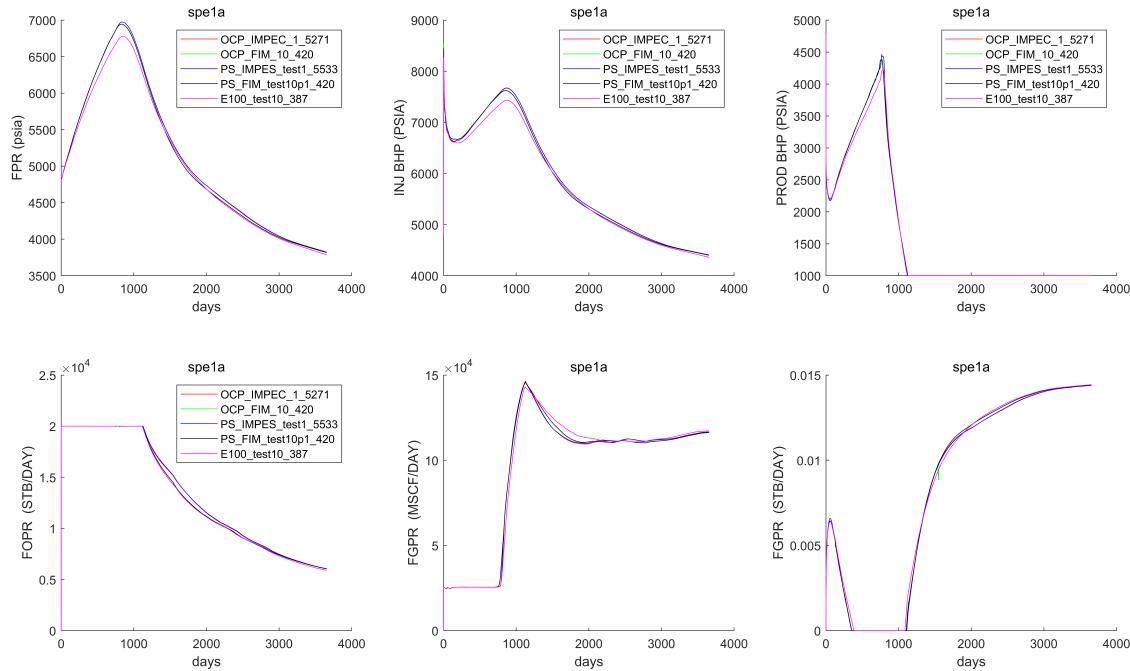


Numerical Results for Comparison

SPE1A



PS_IMPES_1

```
0.1 1 0.1
```

```
Final time:           3655.5 Days
Total time steps:    5533
Total nonlin steps:  5533
Total linear steps: 8828
Linear solver time: 0.932773s
Simulation time:    2.44659s
```

OCP_IMPEC_1

```
.\OpenCAEPoro.exe ..\..\data\spe1a\spe1a.data  IMPEC  0.1 1 0.1
```

```
Final time:           3655.500 Days
Total time steps:    5271
Total Newton steps:  5271 (+39 wasted steps)
Total linear steps: 8327 (+73 wasted steps)
Linear solve time:  0.816s (57.926%)
Simulation time:    1.408s
```

PS_FIM_10

1 10 0.1

Final time: 3655.5 Days
 Total time steps: 420
 Total Newton steps: 434
 Wasted Newton steps: 1
 Total linear steps: 1235
 Linear solver time: 3.62965s
 Simulation time: 4.08421s

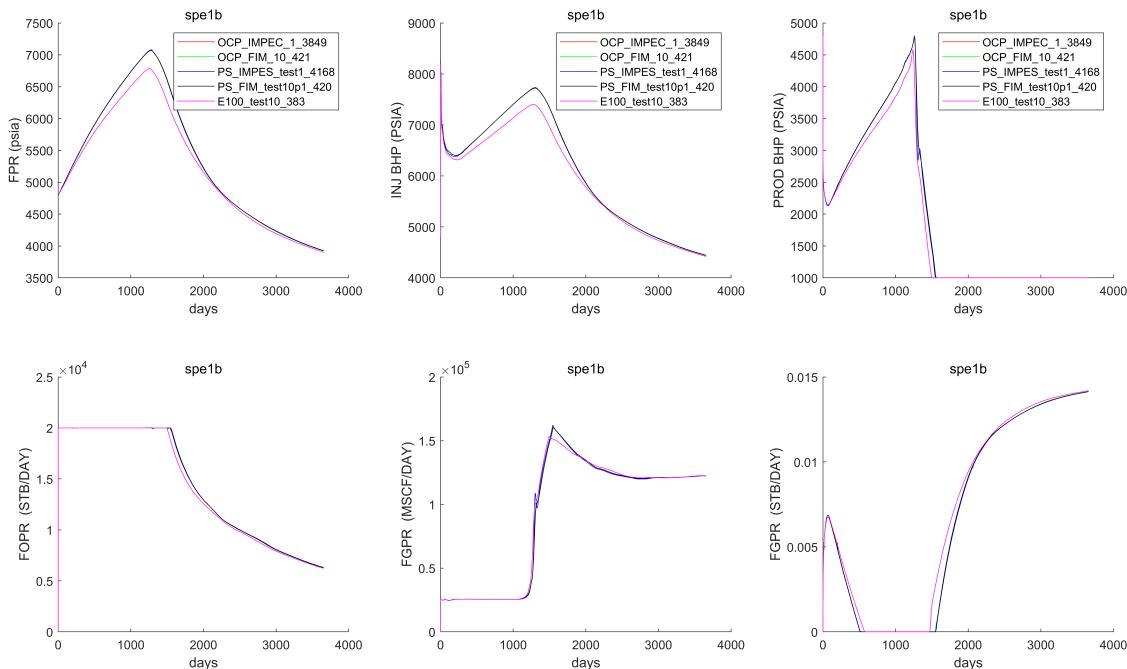
OCP_FIM_10

.\OpenCAEPoro.exe ...\\data\\spe1a\\spe1a.data FIM 1 10 0.1

precond_type = 69

Final time: 3655.500 Days
 Total time steps: 420
 Total Newton steps: 481 (+1 wasted steps)
 Total linear steps: 6301 (+18 wasted steps)
 Linear solve time: 0.460s (62.080%)
 Simulation time: 0.741s

SPE1B



PS_IMPES_1

0.1 1 0.1

Final time: 3655.5 Days
Total time steps: 4168
Total nonlin steps: 4168
Total linear steps: 7601
Linear solver time: 0.824397s
Simulation time: 1.99241s

OCP_IMPEC_1

.\OpenCAEPoro.exe ..\..\data\spe1b\spe1b.data IMPEC 0.1 1 0.1

Final time: 3655.500 Days
Total time steps: 3849
Total Newton steps: 3849 (+9 wasted steps)
Total linear steps: 7198 (+15 wasted steps)
Linear solve time: 0.654s (60.250%)
Simulation time: 1.086s

PS_FIM_10

1 10 0.1

Final time: 3655.5 Days
Total time steps: 420
Total Newton steps: 437
Wasted Newton steps: 1
Total linear steps: 1212
Linear solver time: 2.6363s
Simulation time: 3.08908s

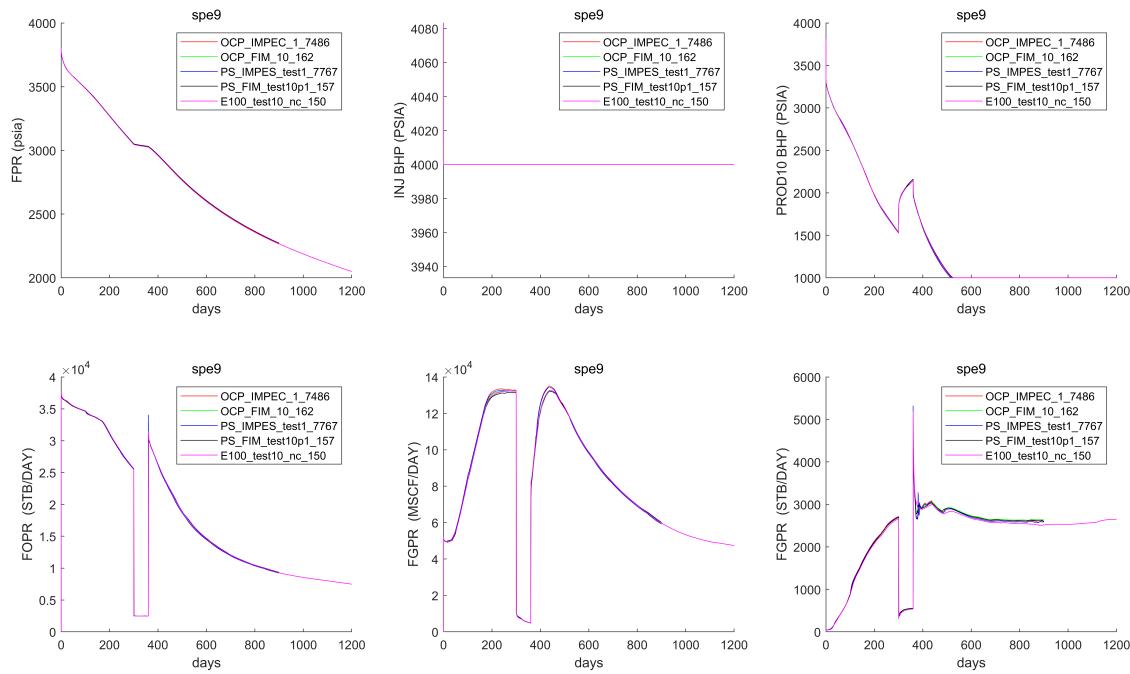
OCP_FIM_10

.\OpenCAEPoro.exe ..\..\data\spe1b\spe1b.data FIM 1 10 0.1

precond_type = 69

Final time: 3655.500 Days
Total time steps: 421
Total Newton steps: 507 (+1 wasted steps)
Total linear steps: 6361 (+19 wasted steps)
Linear solve time: 0.467s (61.599%)
Simulation time: 0.759s

SPE9



PS_IMPEPS_1

0.1 1 0.1

Final time: 900 Days
 Total time steps: 7767
 Total nonlin steps: 7767
 Total linear steps: 12465
 Linear solver time: 57.9099s
 Simulation time: 276.62s

OCP_IMPEC_1

.\OpenCAEporo.exe ...\\data\\spe9\\spe9_IMPEC.data

Final time: 900.000 Days
 Total time steps: 7486
 Total Newton steps: 7486 (+43 wasted steps)
 Total linear steps: 9897 (+96 wasted steps)
 Linear solve time: 55.544s (61.784%)
 Simulation time: 89.900s

PS_FIM_10

1 10 0.1

Final time: 900 Days
 Total time steps: 157
 Total Newton steps: 216
 Wasted Newton steps: 53
 Total linear steps: 1061
 Linear solver time: 12.3944s
 Simulation time: 27.515s

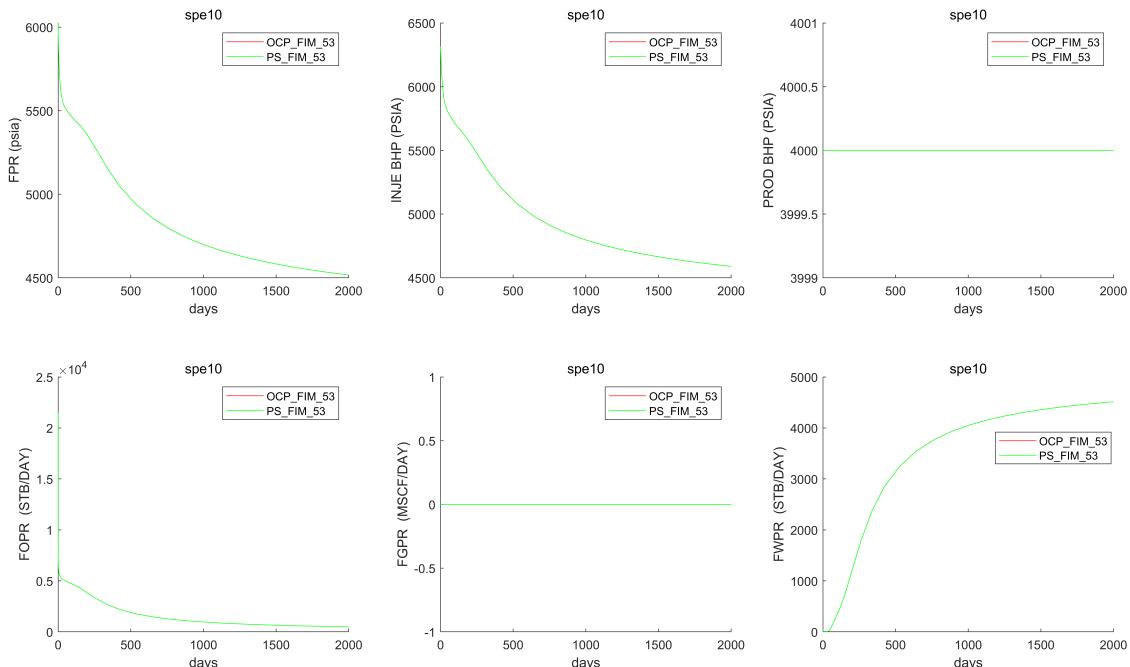
OCP_FIM_10

.\OpenCAEPOro.exe ...\\data\\spe9\\spe9_FIM.data

precond_type = 69

Final time: 900.000 Days
 Total time steps: 162
 Total Newton steps: 227 (+60 wasted steps)
 Total linear steps: 3284 (+824 wasted steps)
 Linear solve time: 8.752s (55.793%)
 Simulation time: 15.686s

SPE10



PS_FIM

```

Final time:      2000 Days
Total time steps: 53
Total Newton steps: 215
Wasted Newton steps: 5
Total linear steps: 1305
Linear solver time: 1413.86s
Simulation time: 2905.24s

```

OCP_FIM

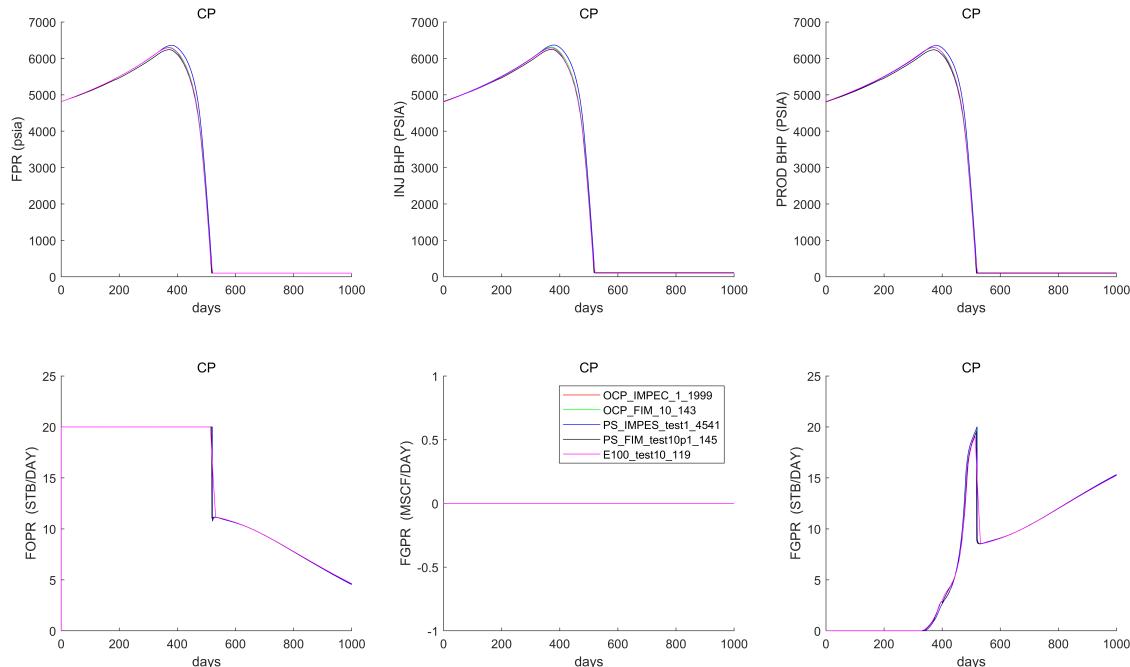
```
.\OpenCAEPoro.exe ...\\data\\spe10\\spe10.data
```

```

Final time:      2000.000 Days
Total time steps: 53
Total Newton steps: 215 (+5 wasted steps)
Total linear steps: 1278 (+40 wasted steps)
Linear solve time: 1403.826s (74.590%)
Simulation time: 1882.050s

```

CP



PS_IMPEC_1

```
0.1 1 0.1
```

```

Final time:      1000.000 Days
Total time steps: 4541
Total nonlin steps: 4541

```

```
Total linear steps: 4543  
Linear solver time: 2.269s  
Simulation time: 28.627s
```

OCP_IMPEC_1

```
.\OpenCAEPoro.exe ..\..\data\cornerpoint\CP.data IMPEC 0.1 1 0.1
```

```
Final time: 1000.000 Days  
Total time steps: 1999  
Total Newton steps: 1999 (+3 wasted steps)  
Total linear steps: 13516 (+35 wasted steps)  
Linear solve time: 0.045s (38.852%)  
Simulation time: 0.115s
```

PS_FIM_10

```
1 10 0.1
```

```
Final time: 1000.000 Days  
Total time steps: 145  
Total Newton steps: 256  
Wasted Newton steps: 4  
Total linear steps: 263  
Linear solver time: 0.745s  
Simulation time: 1.654s
```

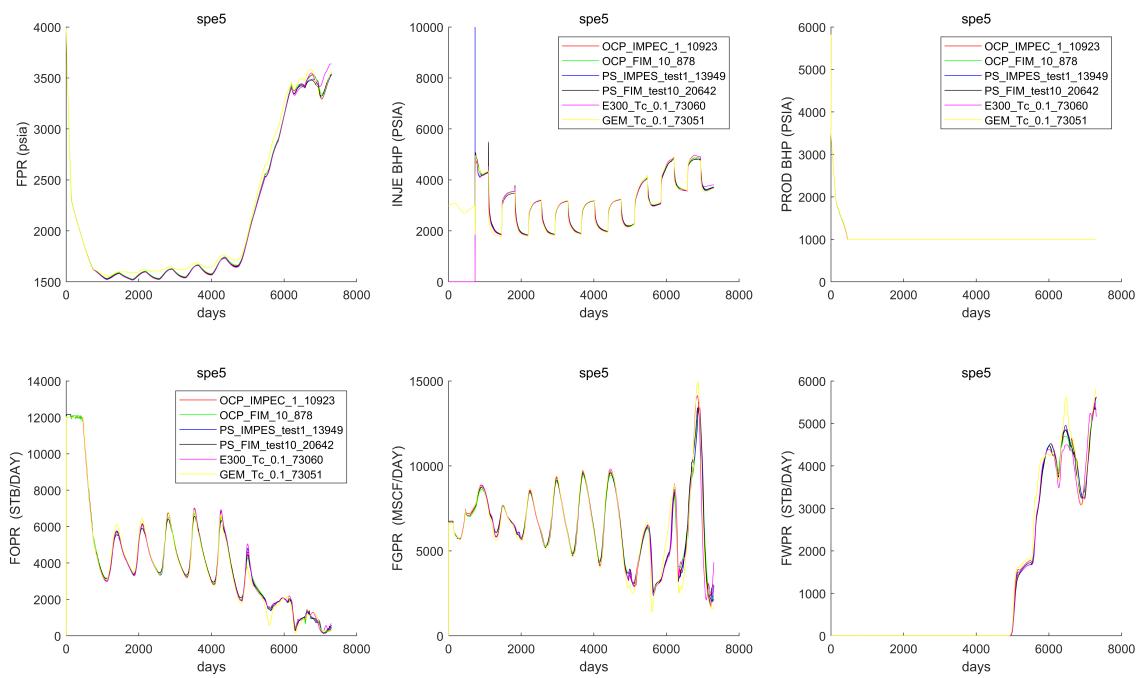
OCP_FIM_10

```
.\OpenCAEPoro.exe ..\..\data\cornerpoint\CP.data FIM 1 10 0.1
```

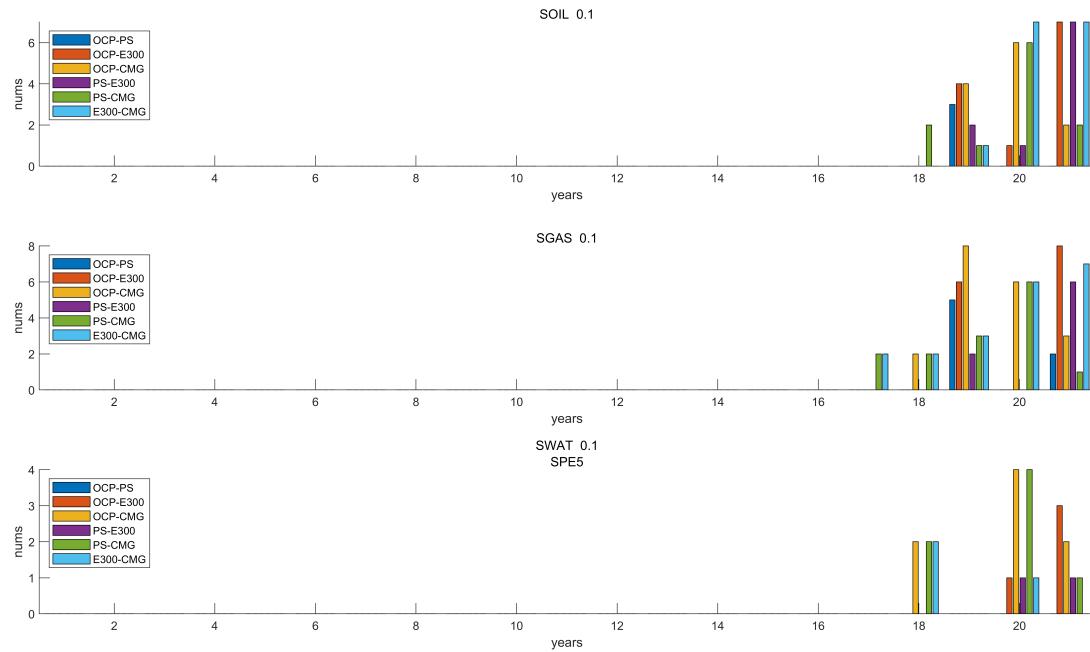
```
precond_type = 69
```

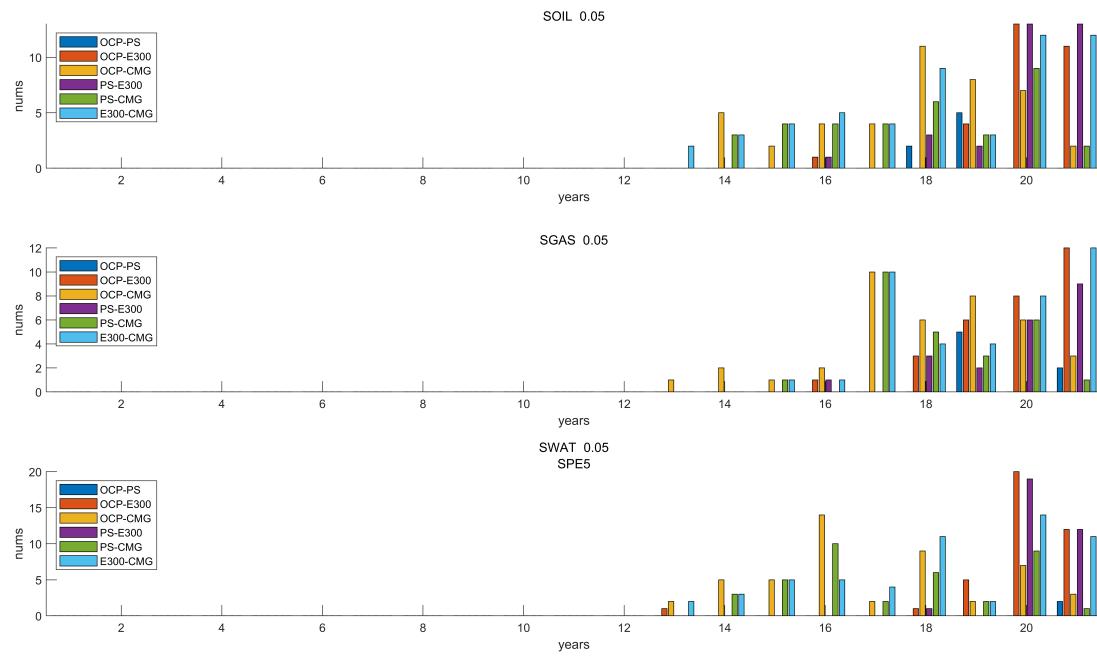
```
Final time: 1000.000 Days  
Total time steps: 143  
Total Newton steps: 245 (+7 wasted steps)  
Total linear steps: 2293 (+68 wasted steps)  
Linear solve time: 0.037s (43.154%)  
Simulation time: 0.086s
```

SPE5

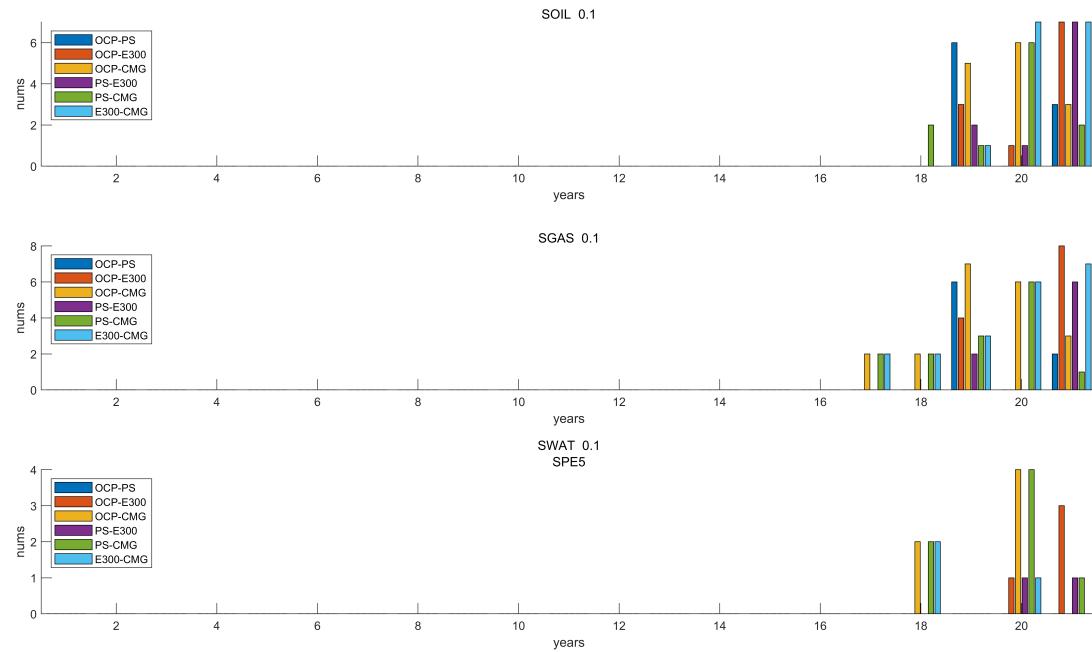


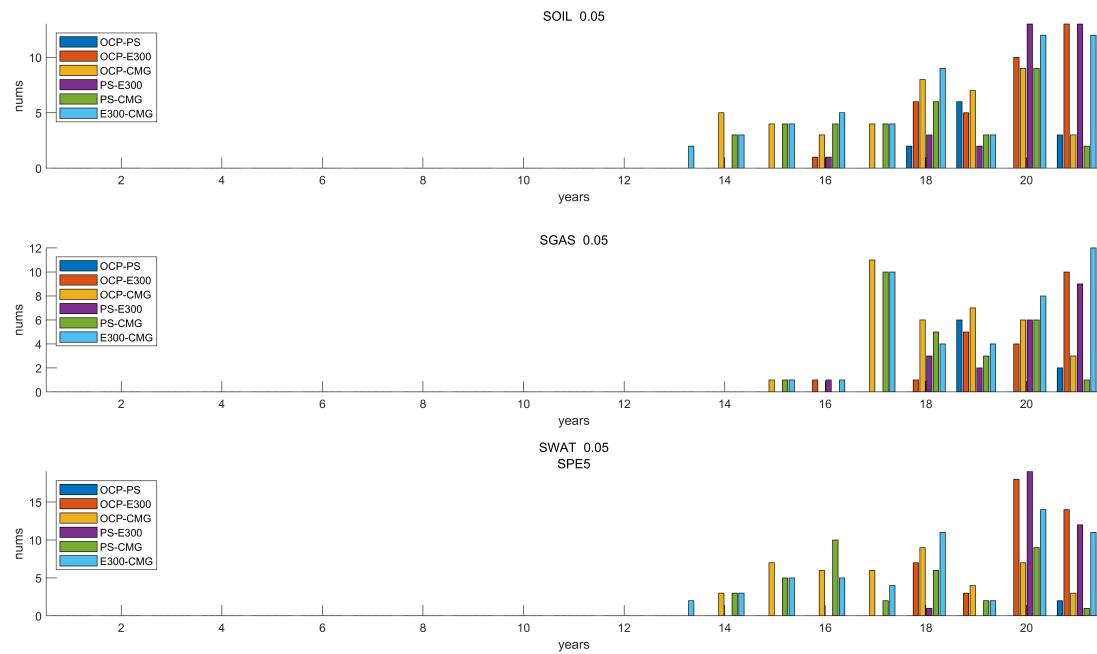
饱和度差异对比 (OCP_FIM)





饱和度差异对比 (OCP_IMPEC)





PS_IMPES

TMARCH

```
0.1 1 0.1 5 0.3 0.3 300 0.2 0.3 0.001
```

```
Final time: 7305 Days
Total time steps: 14228
Total nonlin steps: 14228
Total linear steps: 20914
flux time(MassConserve): 0.246282s
flux time(updateproperty): 0.133042s
MassConserve time: 0.596821s
updateProperty time: 47.4394s
Linear solver time: 1.4444s
Simulation time: 51.0602s
```

Method	iters	maxIt	tol
SSMSTA	49846316	300	1E-12 1E-2
SSMSP	7802131	100	1E-5
NRSP	3091611	55	1E-6

OCP_IMPEC

```
.\OpenCAEPoro.exe ..\..\data\spe5\spe5.data IMPEC 0.1 1 0.1
```

```
SSMSTA: 6511743
NRSTA: 20659
SSMSP: 9579276
NRSP: 1741235
```

```
Final time:      7305.000 Days
Total time steps: 10923
Total Newton steps: 10923 (+80 wasted steps)
Total linear steps: 17386 (+156 wasted steps)
Linear solve time: 1.153s (7.288%)
Simulation time: 15.818s
```

PS_FIM

```
1 10 0.01
```

```
Final time:      7305 Days
Total time steps: 21060
Total Newton steps: 23072
Wasted Newton steps: 13992
Total linear steps: 55425
Linear solver time: 74.4161s
Simulation time: 288.01s
```

Method	iters	maxIt	tol
SSMSTA	312298023	100	1E-12
SSMSP	15015547	100	1E-6
NRSP	5624310	55	1E-12

OCP_FIM

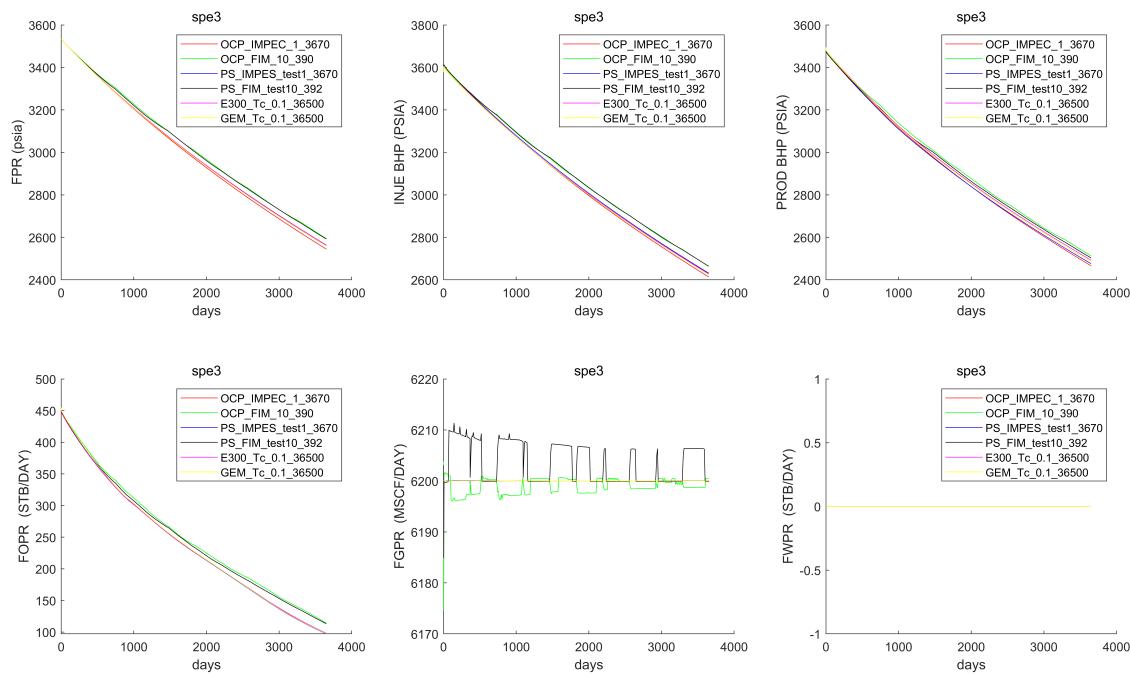
```
.\OpenCAEPoro.exe ..\..\data\spe5\spe5.data FIM 1 10 0.1
```

```
precond_type = 64
```

```
SSMSTA: 1156364
NRSTA: 7900
SSMSP: 1710655
NRSP: 242509
```

```
Final time:      7305.000 Days
Total time steps: 878
Total Newton steps: 1633 (+26 wasted steps)
Total linear steps: 4970 (+58 wasted steps)
Linear solve time: 13.091s (74.471%)
Simulation time: 17.579s
```

SPE3



饱和度误差均在 5% 以内

PS_IMPES

0.1 1 0.1

Final time: 3650 Days
 Total time steps: 3670
 Total nonlin steps: 3670
 Total linear steps: 7345
 flux time(MassConerve): 0.179398s
 flux time(updateproperty): 0.175264s
 MassConserve time: 0.485313s
 updateProperty time: 164.133s
 Linear solver time: 1.25312s
 Simulation time: 176.526s

Method	iters	maxIt	tol
SSMSTA	102544160	300	1E-12 1E-2
SSMSP	22778402	100	1E-5
NRSP	6775525	55	1E-12

OCP_IMPEC

.\OpenCAEPoro.exe ..\..\data\spe5\spe5.data IMPEC 0.1 1 0.1

SSMSTA: 23835193
 NRSTA: 19507
 SSMSP: 24063413
 NRSP: 1468770

```
=====
Final time:      3650.000 Days
Total time steps: 3670
Total Newton steps: 3670 (+0 wasted steps)
Total linear steps: 7318 (+0 wasted steps)
Linear solve time: 1.037s (2.543%)
Simulation time: 40.777s
```

PS_FIM

1 10 0.1

```
Final time:      3650 Days
Total time steps: 390
Total Newton steps: 588
Total linear steps: 941
Linear solver time: 5.61642s
Simulation time: 39.5691s
```

Method	iters	maxIt	tol
SSMSTA	17690167	300	1E-12
SSMSP	3674930	100	1E-5
NRSP	1222903	55	1E-12

OCP_FIM

.\OpenCAEPoro.exe ..\..\data\spe3\spe3.data FIM 1 10 0.1

precond_type = 64

```
SSMSTA:      3984873
NRSTA:       10756
SSMSP:        3929150
NRSP:         238198
```

```
=====
Final time:      3650.000 Days
Total time steps: 390
Total Newton steps: 559 (+0 wasted steps)
Total linear steps: 747 (+0 wasted steps)
Linear solve time: 4.464s (30.473%)
Simulation time: 14.649s
```