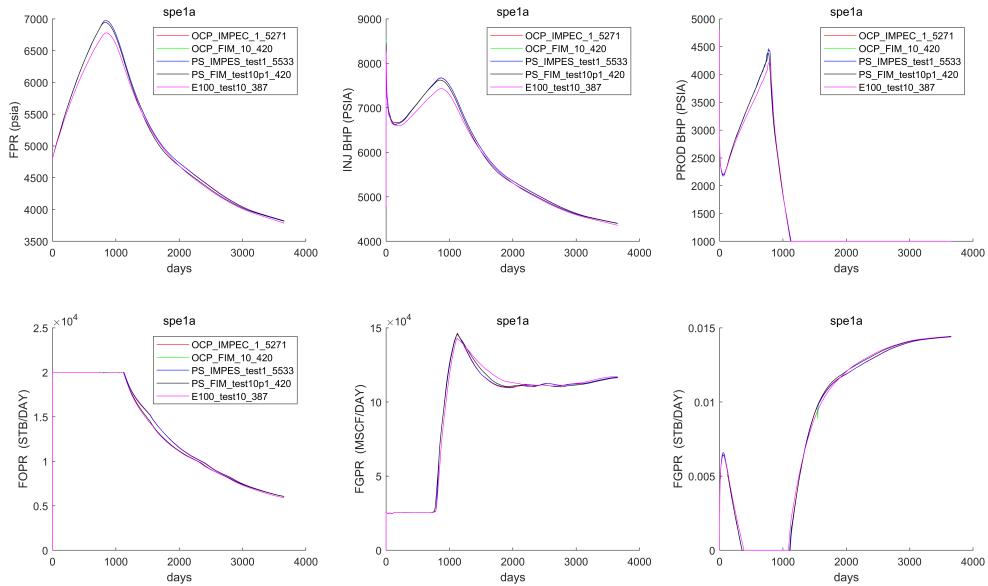


Numerical Results for Comparison

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: 0.825s (58.022%)
Simulation time:   1.422s
```

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

```
. \OpenCAE\Poros.exe ...\\data\\spela\\spela.data  FIM  1  10  0.1
```

```
precond_type          = 69
```

```

Final time:           3655.500 Days
Total time steps:    420
Total Newton steps:  480 (+1 wasted steps)
Total linear steps:  6290 (+18 wasted steps)
Linear solve time:   0.387s (58.302%)
Simulation time:     0.663s

```

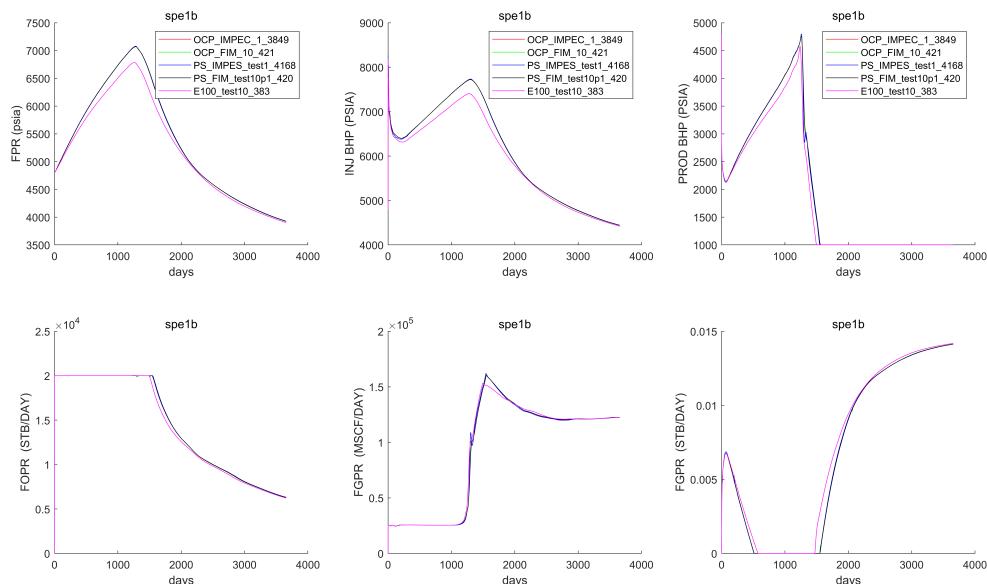
Precise precision

```

Final time:           3655.500 Days
Total time steps:    420
Total Newton steps:  480 (+1 wasted steps)
Total linear steps:  6290 (+18 wasted steps)
Linear solve time:   0.336s (43.490%)
Simulation time:     0.772s

```

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:  0.663s (60.853%)
Simulation time:    1.090s
```

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
```

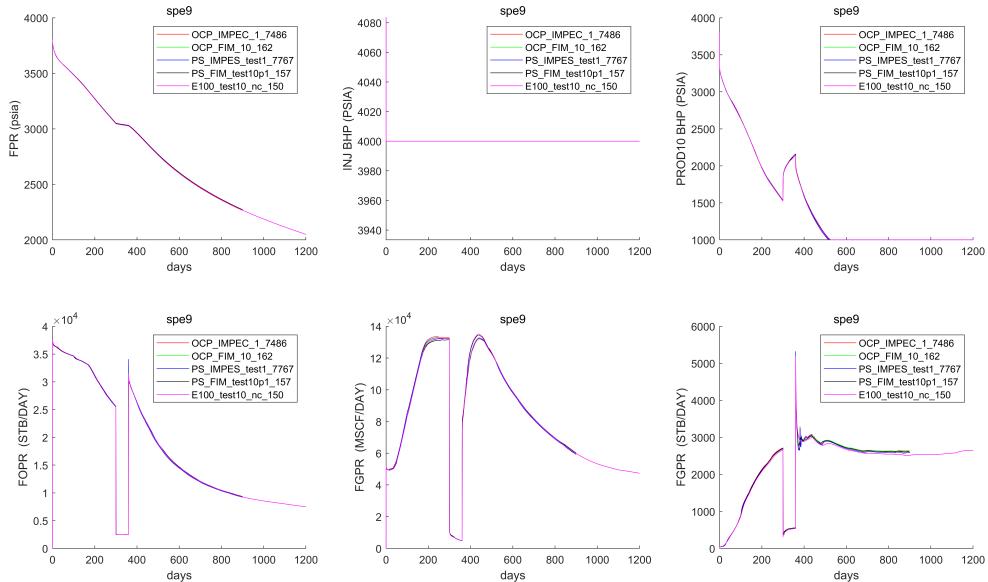
```
precond_type          = 69

Final time:          3655.500 Days
Total time steps:   421
Total Newton steps: 505 (+1 wasted steps)
Total linear steps: 6320 (+19 wasted steps)
Linear solve time:  0.365s (55.638%)
Simulation time:    0.656s
```

Precise precision

```
Final time:          3655.500 Days
Total time steps:   421
Total Newton steps: 505 (+1 wasted steps)
Total linear steps: 6320 (+19 wasted steps)
Linear solve time:  0.366s (45.755%)
Simulation time:    0.801s
```

SPE9



PS_IMPEs_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:  55.336s (62.533%)
Simulation time:    88.490s
```

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

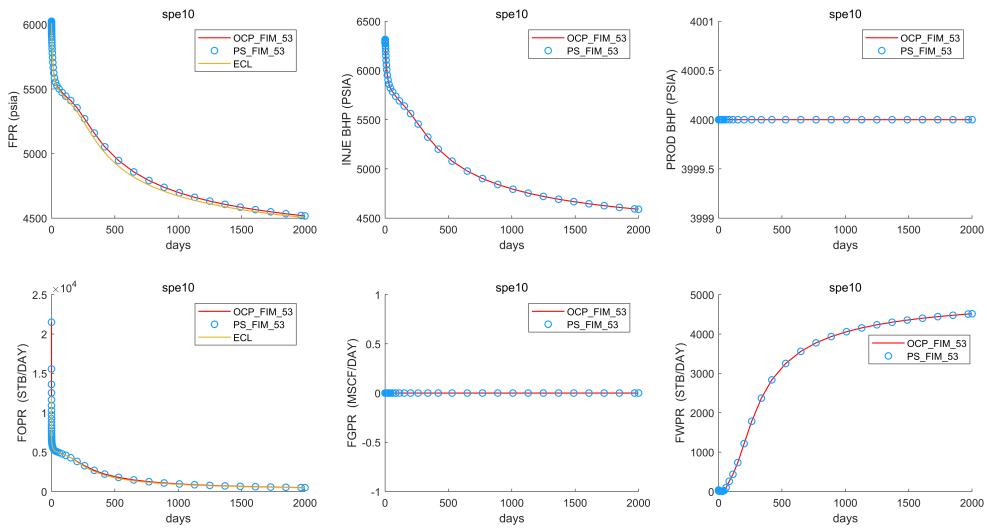
precond_type = 69

Final time: 900.000 Days
Total time steps: 163
Total Newton steps: 224 (+60 wasted steps)
Total linear steps: 3236 (+803 wasted steps)
Linear solve time: 8.590s (55.453%)
Simulation time: 15.491s

Precise precision

Final time: 900.000 Days
Total time steps: 164
Total Newton steps: 224 (+62 wasted steps)
Total linear steps: 3234 (+834 wasted steps)
Linear solve time: 9.224s (51.685%)
Simulation time: 17.846s

SPE10



PS_FIM

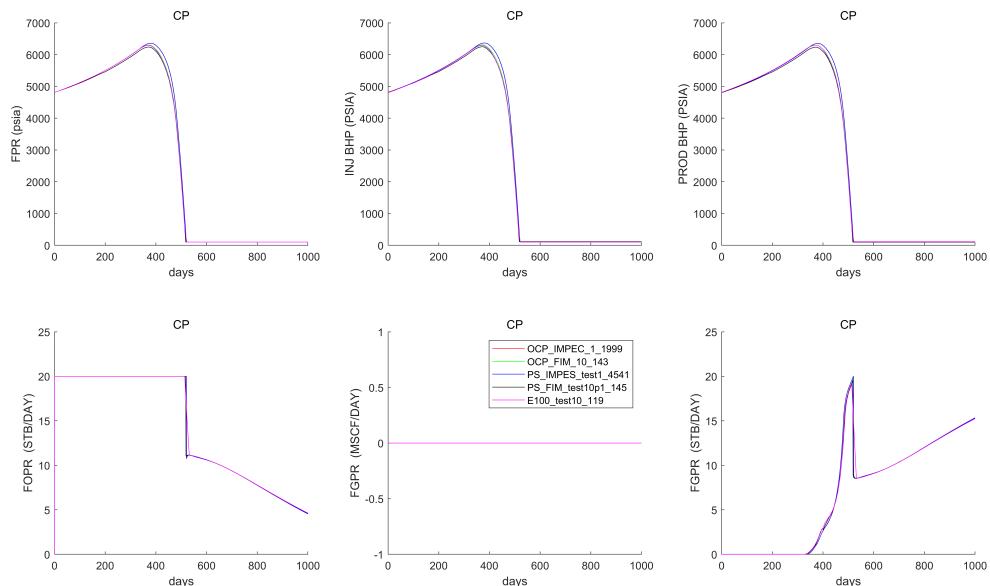
Final time: 2000 Days
Total time steps: 53
Total Newton steps: 215
Wasted Newton steps: 5
Total linear steps: 1305
Linear solver time: 1413.86s
Simulation time: 2905.24s

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



OCP_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: 0.043s (39.826%)
Simulation time: 0.109s
```

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
```

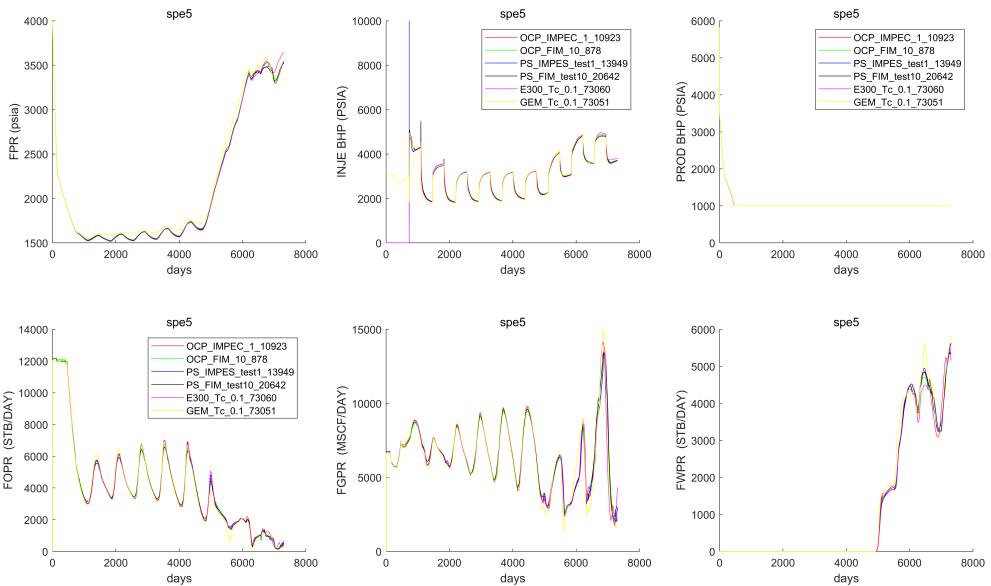
```
precond_type = 69
```

```
Final time: 1000.000 days
Total time steps: 143
Total Newton steps: 245 (+6 wasted steps)
Total linear steps: 2290 (+57 wasted steps)
Linear solve time: 0.037s (44.989%)
Simulation time: 0.083s
```

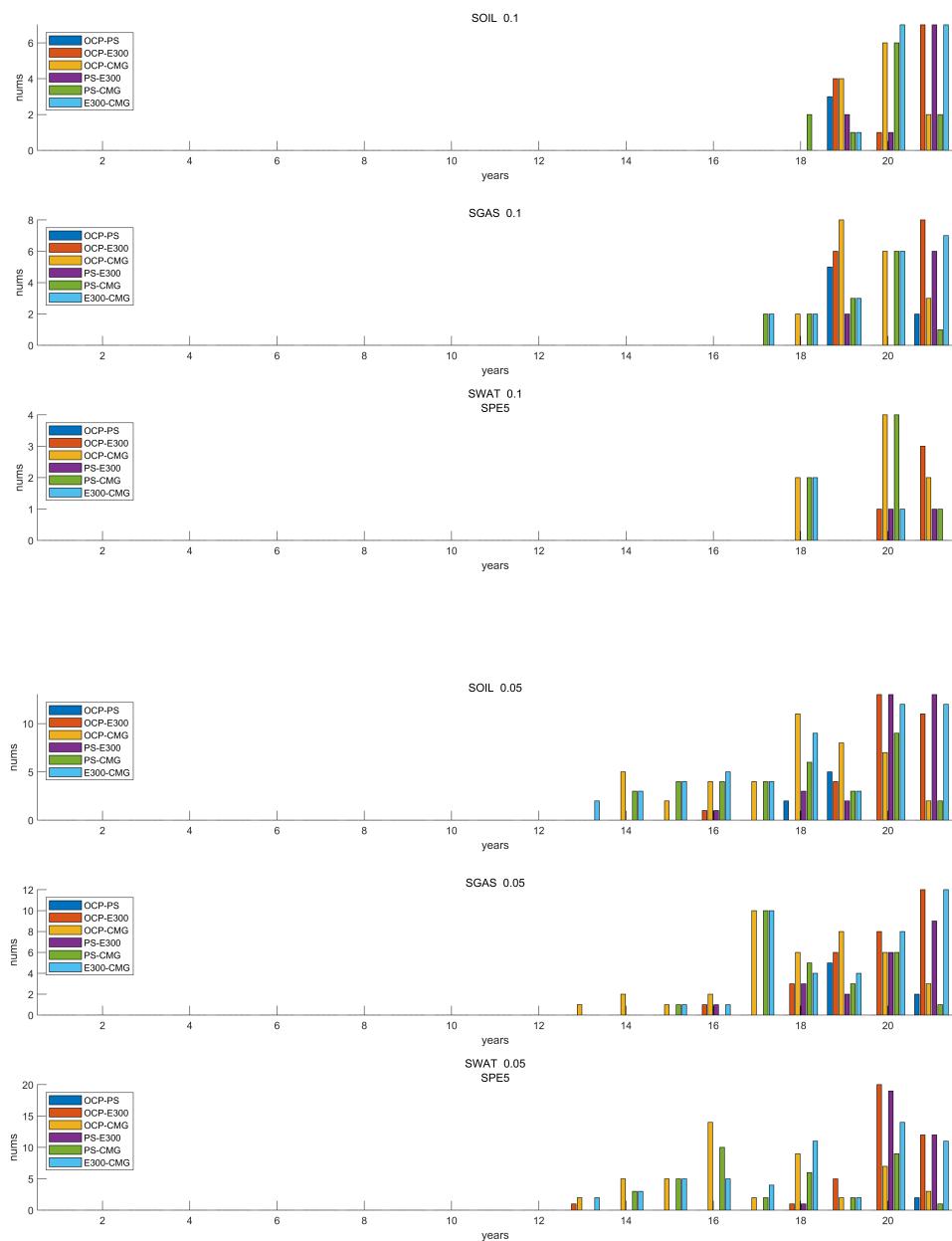
```
Precise precision
```

```
Final time: 1000.000 days
Total time steps: 143
Total Newton steps: 245 (+6 wasted steps)
Total linear steps: 2290 (+57 wasted steps)
Linear solve time: 0.037s (30.058%)
Simulation time: 0.122s
```

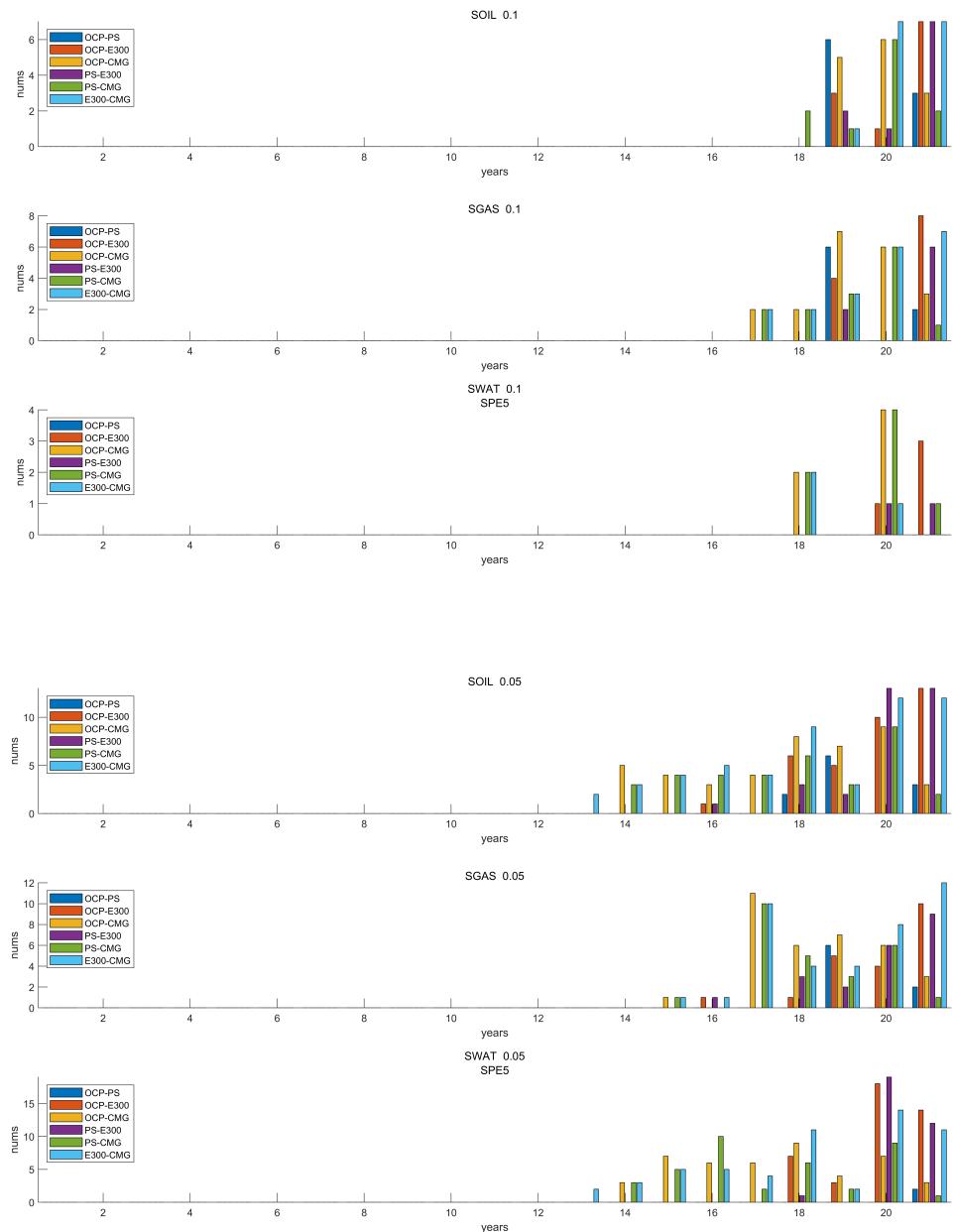
SPES



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(MassConerve): 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: 1.136s (7.188%)
Simulation time: 15.802s
```

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: 1168210
NRSTA: 8293
SSMSP: 1692706
NRSP: 242678
```

```
=====Final time: 7305.000 Days
Total time steps: 884
Total Newton steps: 1629 (+56 wasted steps)
Total linear steps: 4955 (+141 wasted steps)
```

```

Linear solve time: 12.310s (74.666%)
Simulation time: 16.486s

```

Precise precision

SSMSTA: 1139807

NRSTA: 7772

SSMSP: 1665139

NRSP: 240399

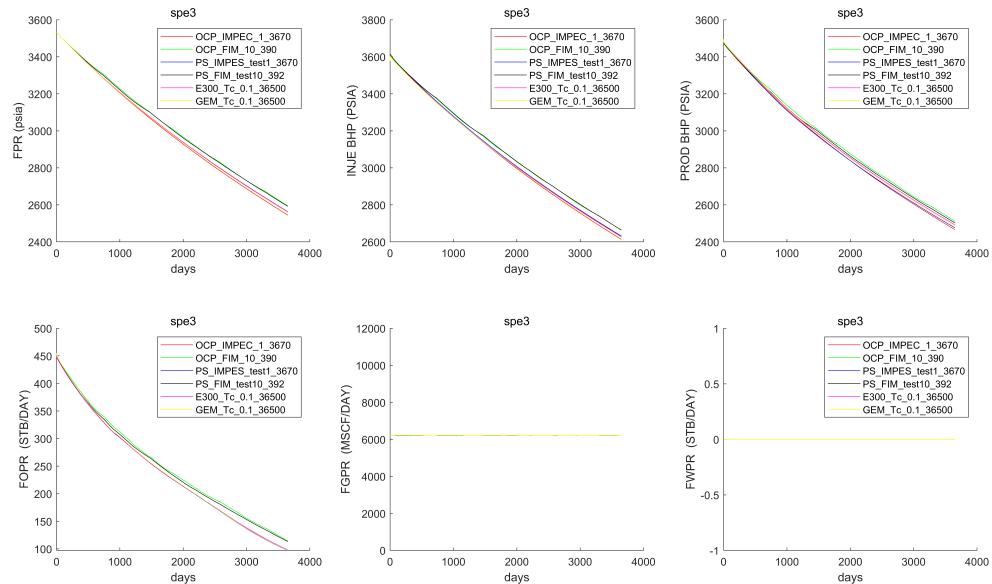
=====

```

Final time: 7305.000 Days
Total time steps: 880
Total Newton steps: 1622 (+34 wasted steps)
Total linear steps: 4887 (+77 wasted steps)
Linear solve time: 11.882s (65.229%)
Simulation time: 18.215s

```

SPE3



饱和度误差均在 5% 以内

PS_IMPESTest1_3670

0.1 1 0.1

```

Final time: 3650 Days
Total time steps: 3670
Total nonlin steps: 3670
Total linear steps: 7345
flux time(MassConserve): 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: 1.010s (2.487%)
Simulation time: 40.635s

```

```

-----
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  1E-2
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:    3971560
NRSTA:     10755
SSMSP:     3922595
NRSP:      236608
=====

Final time:      3650.000 days
Total time steps: 390
Total Newton steps: 556 (+0 wasted steps)
Total linear steps: 746 (+0 wasted steps)
Linear solve time: 3.842s (29.132%)

```

```
simulation time: 13.188s
```

```
Precise precision
```

```
SSMSTA: 3971557
```

```
NRSTA: 10755
```

```
SSMSP: 3922595
```

```
NRSP: 236610
```

```
=====
```

```
Final time: 3650.000 Days
```

```
Total time steps: 390
```

```
Total Newton steps: 556 (+0 wasted steps)
```

```
Total linear steps: 746 (+0 wasted steps)
```

```
Linear solve time: 3.911s (20.936%)
```

```
Simulation time: 18.679s
```