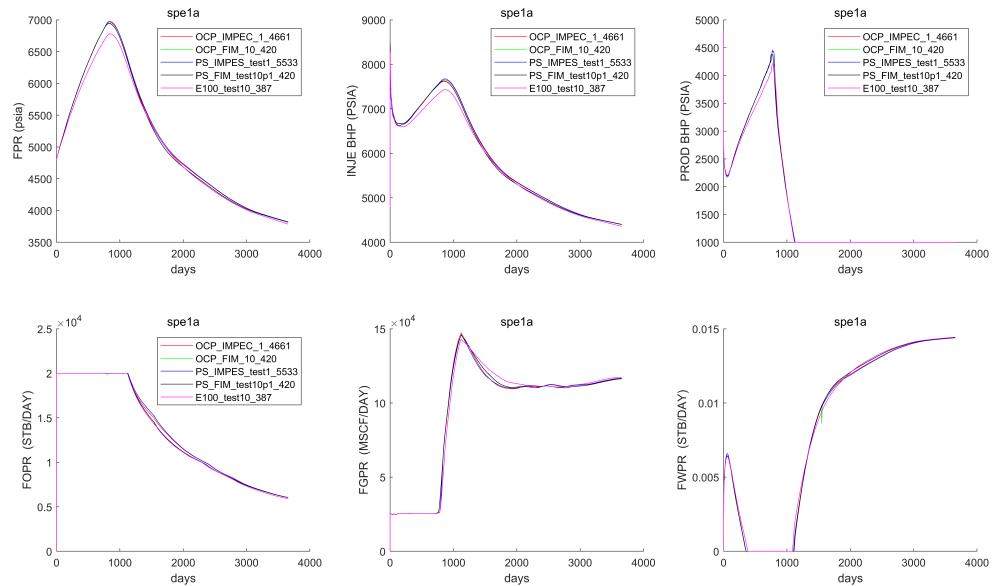


SPE1A



PS_IMPEC_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

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

1 10 0.1

precond_type = 64

```
Final time: 3655.500 Days
Total time steps: 420
Total Newton steps: 474 (+1 wasted steps)
Total linear steps: 1414 (+4 wasted steps)
Linear solve time: 4.950s (94.546%)
Simulation time: 5.235s
```

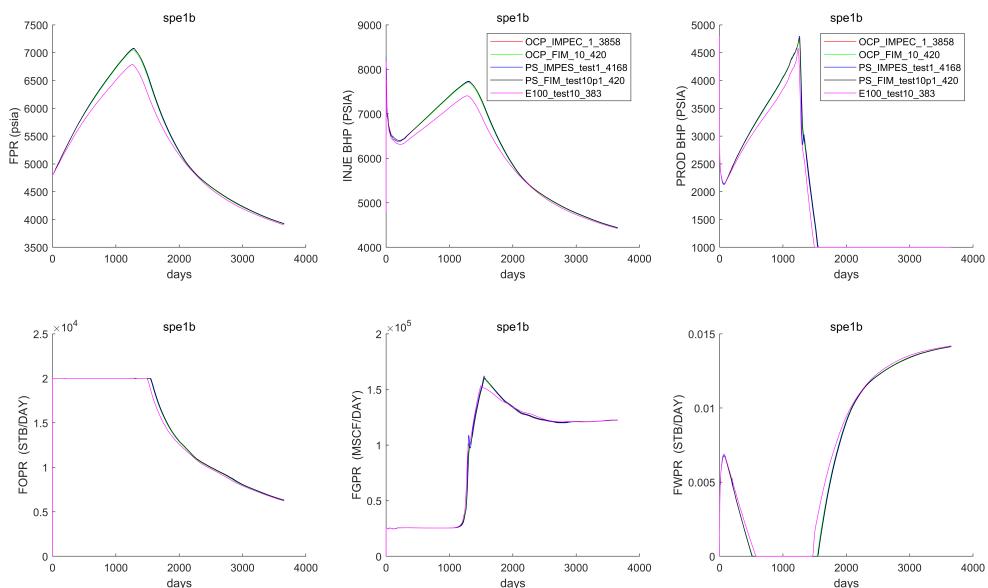
OCP_FIM_10

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

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: 0.668s (60.435%)
Simulation time: 1.105s

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

1 10 0.1

precond_type = 64

Final time: 3655.500 Days
Total time steps: 420
Total Newton steps: 502 (+1 wasted steps)
Total linear steps: 1495 (+4 wasted steps)
Linear solve time: 3.356s (91.629%)
Simulation time: 3.663s

OCP_FIM_10

1 10 0.1

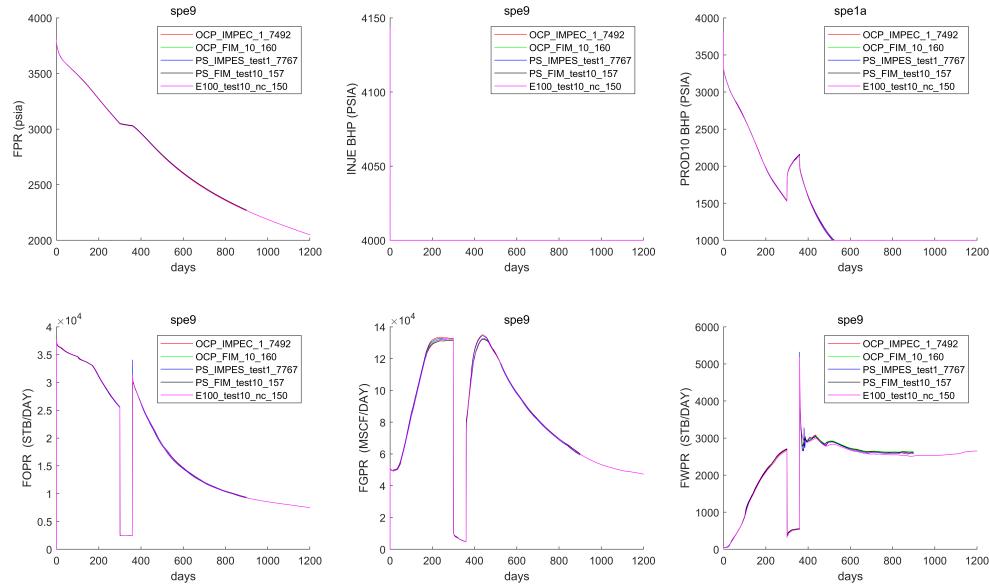
precond_type = 69

```

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:  0.473s (61.809%)
Simulation time:    0.766s

```

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

0.1 1 0.1
dplim dslim dnlm dverrlim
300 0.0005 0.3 0.001

```

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:  55.433s (61.564%)
Simulation time:    90.041s

```

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

1 10 0.1

precond_type = 64

Final time: 900.000 Days
Total time steps: 161
Total Newton steps: 225 (+58 wasted steps)
Total linear steps: 854 (+247 wasted steps)
Linear solve time: 12.950s (67.510%)
Simulation time: 19.182s

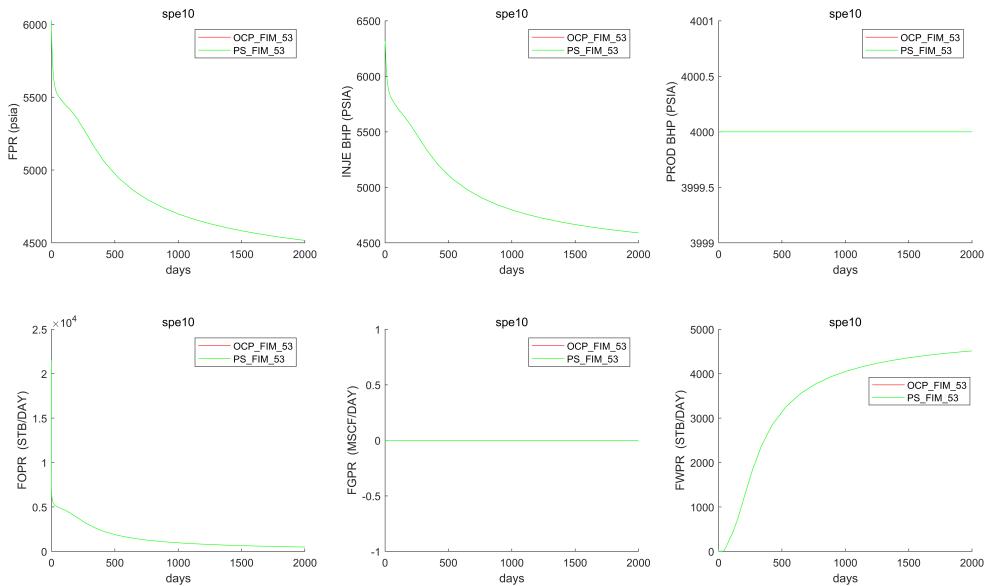
OCP_FIM_10

1 10 0.1

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

```

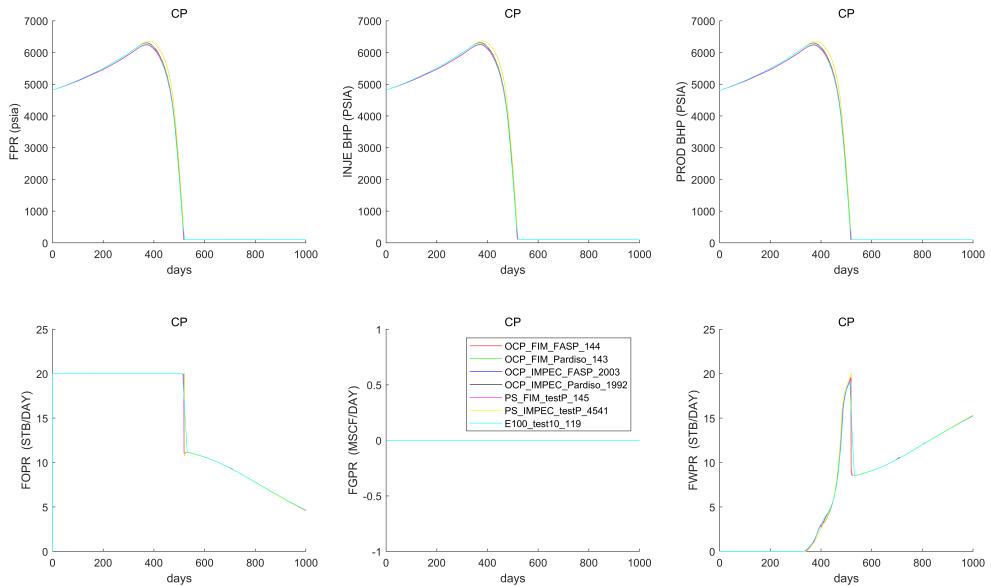
OCP_FIM

```

Final time:          2000.000 Days
Total time steps:    53
Total Newton steps: 217 (+5 wasted steps)
Total linear steps: 1294 (+40 wasted steps)
Linear solve time: 1424.577s (75.943%)
Simulation time:    1875.844s

```

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

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

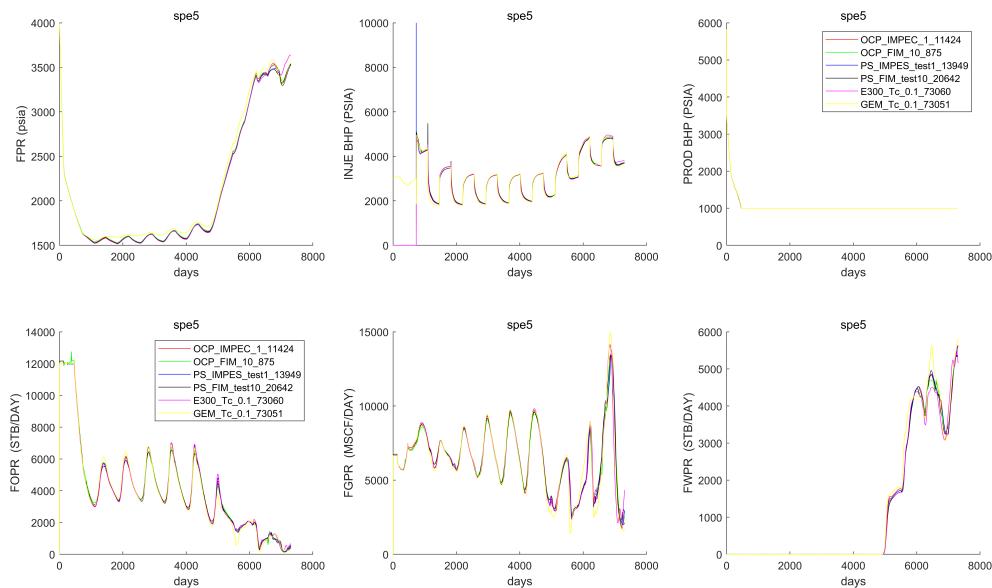
```

OCP_FIM_10

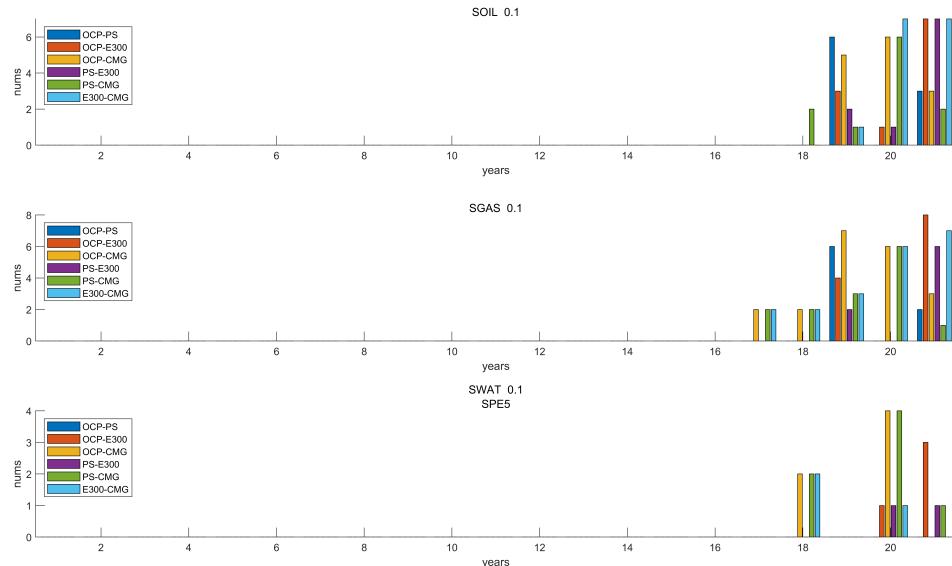
```
1 10 0.1  
precond_type = 69
```

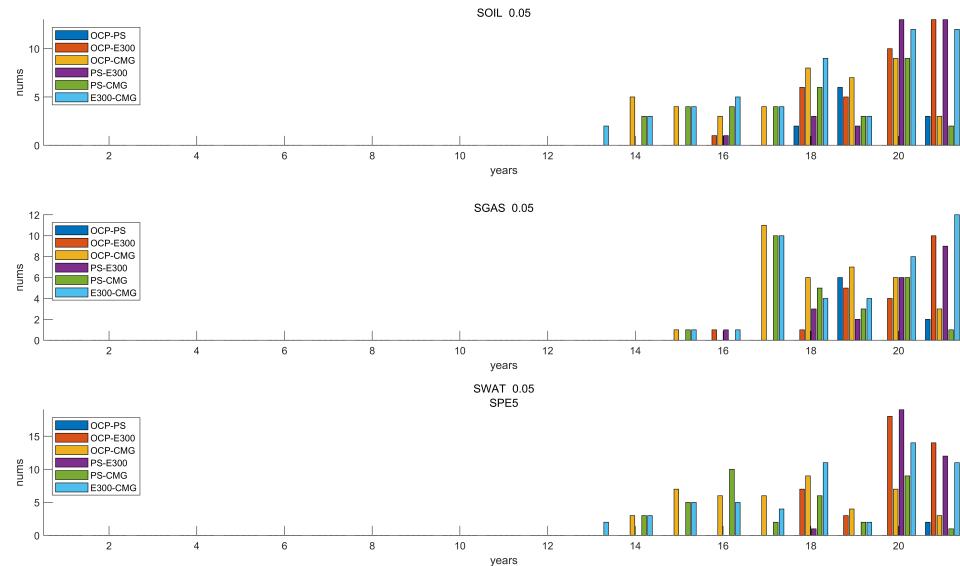
```
Final time: 1000.000 days  
Total time steps: 143  
Total Newton steps: 245 (+7 wasted steps)  
Total linear steps: 2293 (+68 wasted steps)  
Linear solve time: 0.037s (41.269%)  
Simulation time: 0.090s
```

SPE5

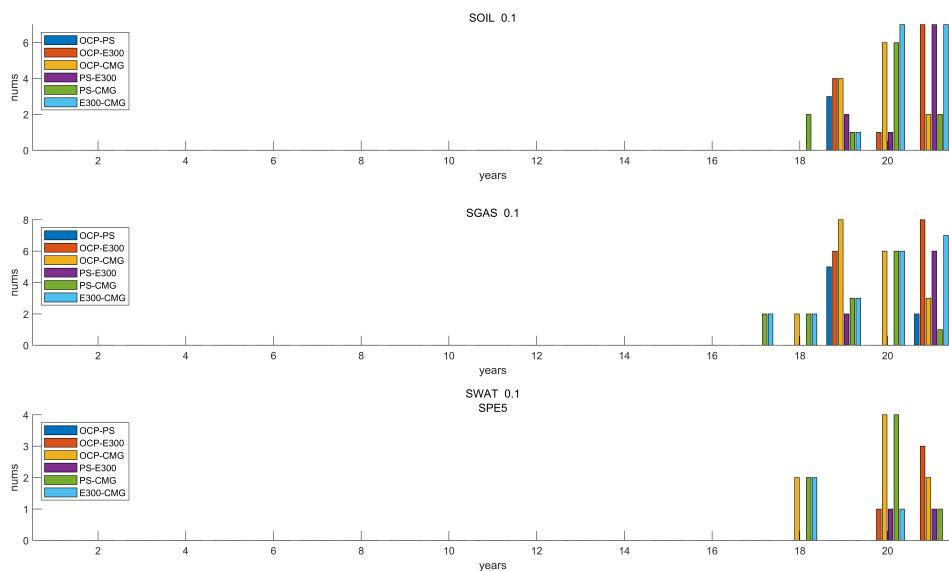


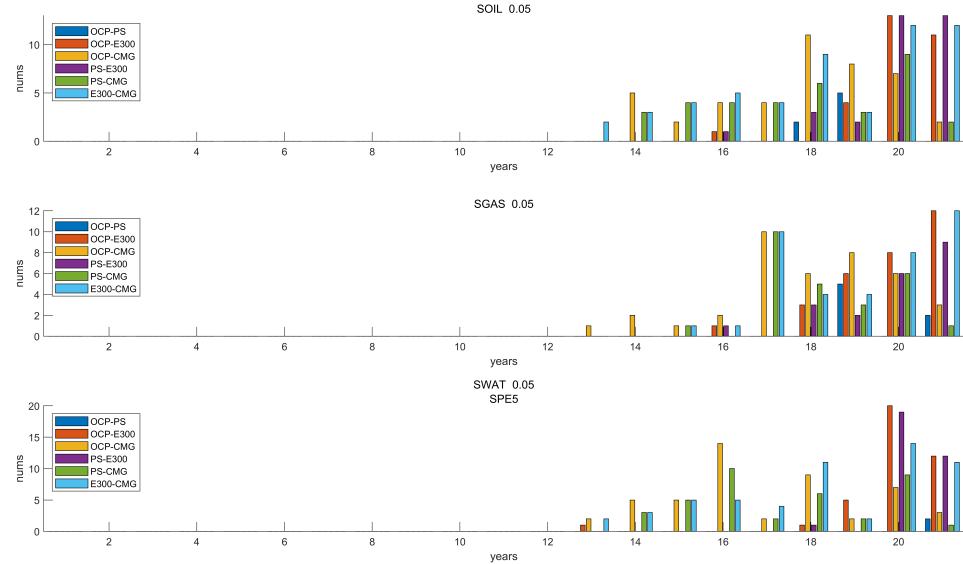
饱和度差异对比 (OCP_FIM)





饱和度差异对比 (OCP_IMPEC)





OCP 的 Flash 部分存在效率问题

PS 数据图与下列数据有些差异，但结果几无二致。

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

```
0.1 1 0.1
```

```

SSMSTA:      6718352
NRSTA:       19695
SSMSP:       19786221
NRSP:        1463313
=====
```

```

Final time:          7305.000 Days
Total time steps:   11424

```

```
Total Newton steps: 11424 (+72 wasted steps)
Total linear steps: 17859 (+139 wasted steps)
Linear solve time: 1.234s (5.886%)
Simulation time: 20.969s
```

```
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
```

```
1 10 0.1
precond_type = 64
```

```
SSMSTA: 1187658
NRSTA: 8035
SSMSP: 3085834
NRSP: 218804
```

```
=====
Final time: 7305.000 Days
Total time steps: 875
Total Newton steps: 1703 (+30 wasted steps)
Total linear steps: 5191 (+70 wasted steps)
Linear solve time: 12.436s (71.856%)
Simulation time: 17.306s
```

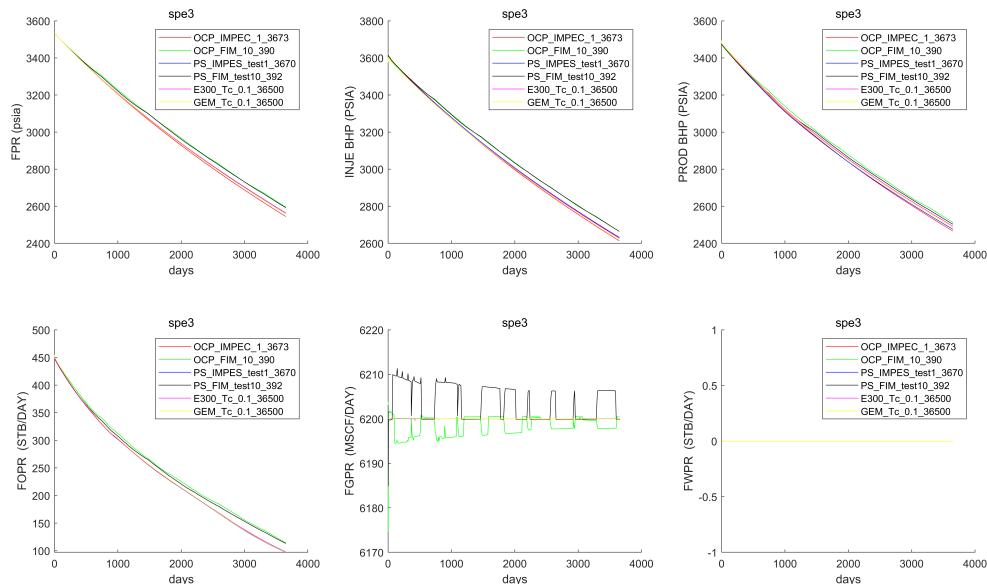
```
SSMSTA: 1154156
NRSTA: 7649
SSMSP: 1708720
NRSP: 242712
```

```

=====
Final time:          7305.000 Days
Total time steps:    876
Total Newton steps: 1634 (+26 wasted steps)
Total linear steps: 4966 (+58 wasted steps)
Linear solve time:  11.929s (74.470%)
Simulation time:    16.018s

```

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

0.1 1 0.1

SSMSTA: 23868228
NRSTA: 19537
SSMSP: 92506242
NRSP: 1829508

=====

Final time: 3650.000 Days
Total time steps: 3673
Total Newton steps: 3673 (+0 wasted steps)
Total linear steps: 7321 (+0 wasted steps)
Linear solve time: 1.104s (1.121%)
Simulation time: 98.496s

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 1E-2
SSMSP	3674930	100	1E-5
NRSP	1222903	55	1E-12

OCP_FIM

1 10 0.1
precond_type = 64

SSMSTA: 3984257
NRSTA: 10759
SSMSP: 14585718
NRSP: 288417

=====

Final time: 3650.000 Days
Total time steps: 390
Total Newton steps: 558 (+0 wasted steps)

```
Total linear steps: 715 (+0 wasted steps)
Linear solve time: 3.696s (16.837%)
Simulation time: 21.954s
```

```
SSMSTA: 3984948
```

```
NRSTA: 10757
```

```
SSMSP: 3930901
```

```
NRSP: 238102
```

```
=====
```

```
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: 3.844s (29.179%)
```

```
Simulation time: 13.176s
```