

pestpp-ies_the_wrong_way

July 1, 2019

1 Run PESTPP-IES the wrong way...

```
In [1]: %matplotlib inline
import os
import shutil
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib as mpl
plt.rcParams['font.size']=12
import flopy
import pyemu
%matplotlib inline
```

flopy is installed in /Users/jeremyw/Dev/gw1876/activities_csiro/notebooks/flopy

1.1 SUPER IMPORTANT: SET HOW MANY PARALLEL WORKERS TO USE

```
In [2]: num_workers = 15
```

```
In [3]: t_d = "template"
m_d = "master_wrong_ies"
```

```
In [4]: pst = pyemu.Pst(os.path.join(t_d, "freyberg.pst"))
pst.write_par_summary_table(filename="none")
```

```
Out[4]:
```

	type	transform	count	initial value	upper bound	\
cn_hk8	cn_hk8	log	1	0	1	
cn_ss6	cn_ss6	log	1	0	1	
gr_hk3	gr_hk3	log	705	0	1	
pp_strt1	pp_strt1	log	32	0	0.0211893	
cn_sy8	cn_sy8	log	1	0	0.243038	
gr_strt4	gr_strt4	log	705	0	0.0211893	
pp_sy2	pp_sy2	log	32	0	0.243038	
cn_vka8	cn_vka8	log	1	0	1	
pp_hk2	pp_hk2	log	32	0	1	
pp_strt0	pp_strt0	log	32	0	0.0211893	

gr_prsity4	gr_prsity4	log	705	0	0.176091
cn_sy7	cn_sy7	log	1	0	0.243038
cn_strt8	cn_strt8	log	1	0	0.0211893
welflux_k02	welflux_k02	log	6	0	1
pp_sy1	pp_sy1	log	32	0	0.243038
cn_prsity7	cn_prsity7	log	1	0	0.176091
pp_vka0	pp_vka0	log	32	0	1
pp_prsity2	pp_prsity2	log	32	0	0.176091
gr_sy3	gr_sy3	log	705	0	0.243038
cn_vka7	cn_vka7	log	1	0	1
cn_sy6	cn_sy6	log	1	0	0.243038
gr_sy4	gr_sy4	log	705	0	0.243038
gr_hk5	gr_hk5	log	705	0	1
gr_ss4	gr_ss4	log	705	0	1
cn_prsity8	cn_prsity8	log	1	0	0.176091
cn_ss8	cn_ss8	log	1	0	1
cn_strt6	cn_strt6	log	1	0	0.0211893
cn_hk7	cn_hk7	log	1	0	1
gr_ss3	gr_ss3	log	705	0	1
cn_strt7	cn_strt7	log	1	0	0.0211893
...
gr_strt5	gr_strt5	log	705	0	0.0211893
pp_prsity0	pp_prsity0	log	32	0	0.176091
cn_prsity6	cn_prsity6	log	1	0	0.176091
gr_sy5	gr_sy5	log	705	0	0.243038
cn_ss7	cn_ss7	log	1	0	1
gr_vka5	gr_vka5	log	705	0	1
drncond_k00	drncond_k00	log	10	0	1
pp_rech1	pp_rech1	log	32	0	0.0413927
strk	strk	log	40	0	2
pp_vka2	pp_vka2	log	32	0	1
gr_vka3	gr_vka3	log	705	0	1
welflux	welflux	log	2	0	1
pp_ss0	pp_ss0	log	32	0	1
pp_hk1	pp_hk1	log	32	0	1
cn_rech5	cn_rech5	log	1	0	0.0413927
pp_hk0	pp_hk0	log	32	0	1
pp_vka1	pp_vka1	log	32	0	1
cn_hk6	cn_hk6	log	1	0	1
flow	flow	log	1	0	0.09691
gr_rech2	gr_rech2	log	705	0	0.0413927
gr_vka4	gr_vka4	log	705	0	1
gr_prsity5	gr_prsity5	log	705	0	0.176091
gr_rech3	gr_rech3	log	705	0	0.0413927
pp_ss2	pp_ss2	log	32	0	1
pp_strt2	pp_strt2	log	32	0	0.0211893
pp_prsity1	pp_prsity1	log	32	0	0.176091
pp_sy0	pp_sy0	log	32	0	0.243038

cn_rech4	cn_rech4	log	1	0	0.0413927
gr_hk4	gr_hk4	log	705	0	1
gr_ss5	gr_ss5	log	705	0	1

	lower bound	standard deviation
cn_hk8	-1	0.5
cn_ss6	-1	0.5
gr_hk3	-1	0.5
pp_strt1	-0.0222764	0.0108664
cn_sy8	-0.60206	0.211275
gr_strt4	-0.0222764	0.0108664
pp_sy2	-0.60206	0.211275
cn_vka8	-1	0.5
pp_hk2	-1	0.5
pp_strt0	-0.0222764	0.0108664
gr_prsity4	-0.30103	0.11928
cn_sy7	-0.60206	0.211275
cn_strt8	-0.0222764	0.0108664
welflux_k02	-1	0.5
pp_sy1	-0.60206	0.211275
cn_prsity7	-0.30103	0.11928
pp_vka0	-1	0.5
pp_prsity2	-0.30103	0.11928
gr_sy3	-0.60206	0.211275
cn_vka7	-1	0.5
cn_sy6	-0.60206	0.211275
gr_sy4	-0.60206	0.211275
gr_hk5	-1	0.5
gr_ss4	-1	0.5
cn_prsity8	-0.30103	0.11928
cn_ss8	-1	0.5
cn_strt6	-0.0222764	0.0108664
cn_hk7	-1	0.5
gr_ss3	-1	0.5
cn_strt7	-0.0222764	0.0108664
...
gr_strt5	-0.0222764	0.0108664
pp_prsity0	-0.30103	0.11928
cn_prsity6	-0.30103	0.11928
gr_sy5	-0.60206	0.211275
cn_ss7	-1	0.5
gr_vka5	-1	0.5
drncond_k00	-1	0.5
pp_rech1	-0.0457575	0.0217875
strk	-2	1
pp_vka2	-1	0.5
gr_vka3	-1	0.5
welflux	-1	0.5

pp_ss0	-1	0.5
pp_hk1	-1	0.5
cn_rech5	-0.0457575	0.0217875
pp_hk0	-1	0.5
pp_vka1	-1	0.5
cn_hk6	-1	0.5
flow	-0.124939	0.0554622
gr_rech2	-0.0457575	0.0217875
gr_vka4	-1	0.5
gr_prsity5	-0.30103	0.11928
gr_rech3	-0.0457575	0.0217875
pp_ss2	-1	0.5
pp_strt2	-0.0222764	0.0108664
pp_prsity1	-0.30103	0.11928
pp_sy0	-0.60206	0.211275
cn_rech4	-0.0457575	0.0217875
gr_hk4	-1	0.5
gr_ss5	-1	0.5

[65 rows x 7 columns]

Let's be true academics and fix every parameter except grid-scale HK...sounds like every paper ever published in WRR...

```
In [5]: par = pst.parameter_data
        # grid pars
        should_fix = par.loc[par.pargp.apply(lambda x: "gr_hk" not in x), "parname"]

        # if we want to fix some pars, do it here
        pst.parameter_data.loc[should_fix, "partrans"] = "fixed"
        pst.npar, pst.npar_adj
```

Out[5]: (14819, 2115)

1.1.1 Run PESTPP-IES in original mode and post process

```
In [6]: pst.pestpp_options["ies_num_reals"] = 50
        #pst.pestpp_options["ies_par_en"] = "prior.jcb"
        #pst.pestpp_options["ies_bad_phi_sigma"] = 2.0
        #pst.pestpp_options["overdue_giveup_fac"] = 10.0
        pst.control_data.noptmax = 4
```

```
In [7]: pst.write(os.path.join(t_d, "freyberg_ies.pst"))
```

noptmax:4, npar_adj:2115, nnz_obs:14

```
In [8]: pyemu.os_utils.start_slaves(t_d, "pestpp-ies", "freyberg_ies.pst", num_slaves=num_workers)
```

A cheap phi progress plot

```

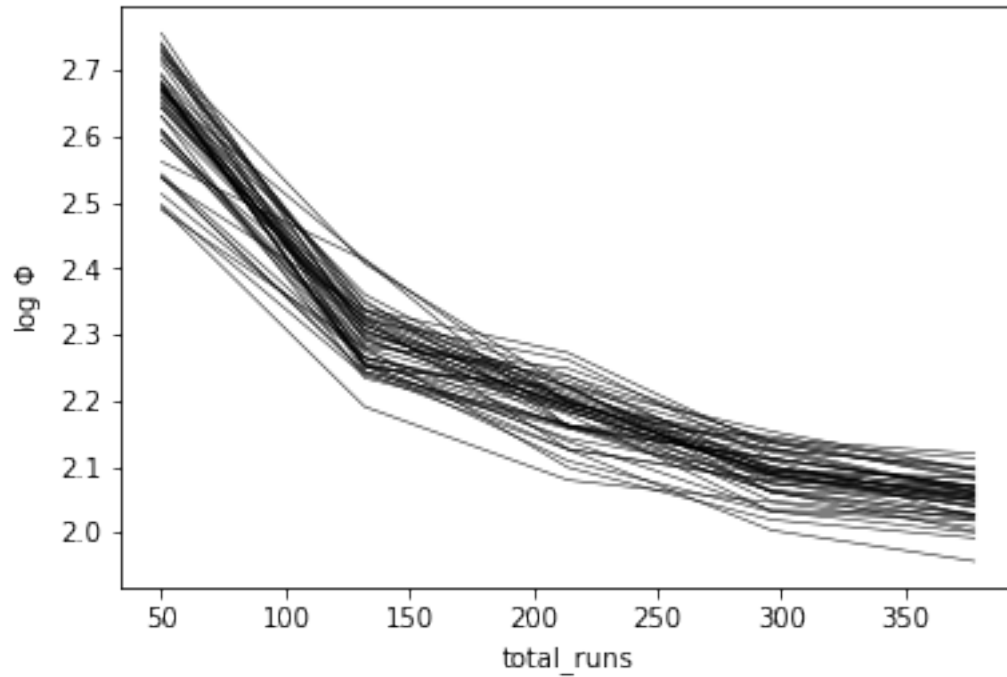
In [9]: phi = pd.read_csv(os.path.join(m_d, "freyberg_ies.phi.actual.csv"), index_col=0)
        phi.index = phi.total_runs
        phi.iloc[:,6:].apply(np.log10).plot(legend=False, lw=0.5, color='k')
        plt.ylabel('log  $\Phi$ ')
        plt.figure()
        phi.iloc[-1,6:].hist()
        plt.title("Final  $\Phi$  Distribution")

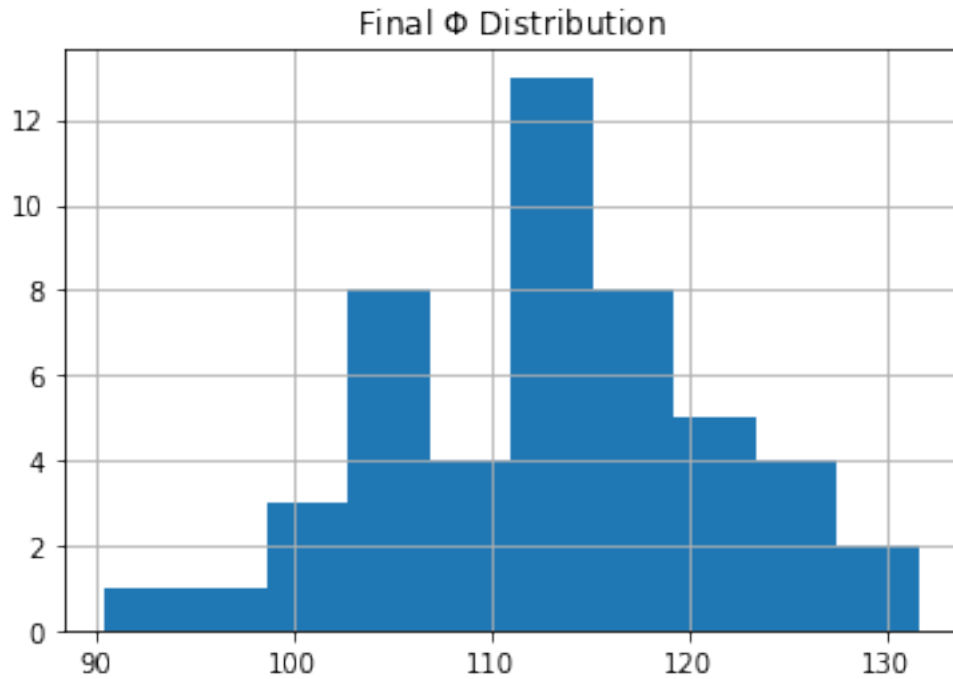
```

```

Out[9]: Text(0.5, 1.0, 'Final  $\Phi$  Distribution')

```





Plot forecast prior and posterior histograms with “truth” (red line)

```
In [10]: oe_pr = pd.read_csv(os.path.join(m_d, "freyberg_ies.0.obs.csv"), index_col=0)
oe_pt = pd.read_csv(os.path.join(m_d, "freyberg_ies.{0}.obs.csv".format(pst.control_da
obs = pst.observation_data
fnames = pst.pestpp_options["forecasts"].split(",")
for forecast in fnames:
    ax = plt.subplot(111)
    oe_pr.loc[:, forecast].hist(ax=ax, color="0.5", alpha=0.5)
    oe_pt.loc[:, forecast].hist(ax=ax, color="b", alpha=0.5)
    ax.plot([obs.loc[forecast, "obsval"], obs.loc[forecast, "obsval"]], ax.get_ylim(), "r")
    ax.legend(['truth', 'prior', 'posterior'], loc='upper right')

    ax.set_title(forecast)
plt.show()
```

