

setup_pest_interface

May 2, 2019

1 Setup the PEST(++) interface around the enhanced Freyberg model

In this notebook, we will construct a complex model independent (non-intrusive) interface around an existing MODFLOW-NWT model using the python/flopy/pyemu stack.

```
In [1]: import os
import shutil
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import flopy
import pyemu
import prep_deps
import redis
```

flopy is installed in /Users/jeremyw/Dev/gw1876/activities_2day_mfm/notebooks/flopy

```
In [2]: b_d = os.path.join("../", "base_model_files")
nam_file = "freyberg.nam"
```

This seemingly simple function call will spatially rediscretize the original freyberg model by cutting each row and column by 3's

```
In [3]: #redis_fac = 3
#mr = redis.redis_freyberg(fac=redis_fac, b_d=b_d)
#b_d = mr.model_ws
```

1.0.1 load the model and run once to make sure everything is good-to-go

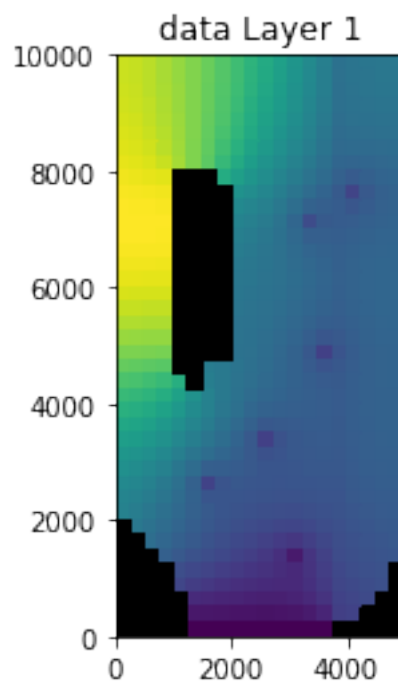
```
In [4]: m = flopy.modflow.Modflow.load(nam_file, model_ws=b_d, check=False, forgive=False)

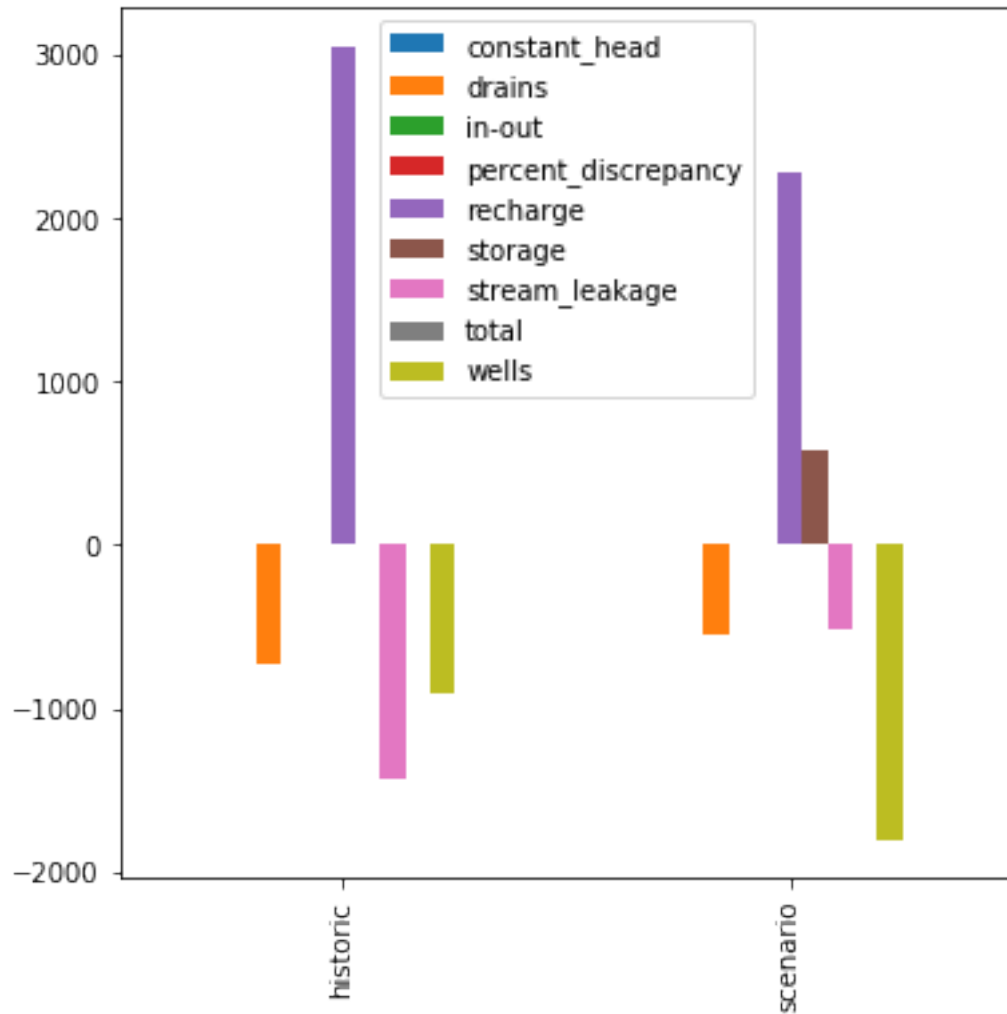
In [5]: m.exe_name = "mfwt"
m.change_model_ws("temp", reset_external=True)
m.write_input()
prep_deps.prep_template(t_d="temp")
pyemu.os_utils.run("{0} {1}".format("mfwt", m.name+".nam"), cwd=m.model_ws)
```

```
changing model workspace...  
temp
```

```
In [6]: hds = flopy.utils.HeadFile(os.path.join(m.model_ws,m.name+".hds"),model=m)  
hds.plot(mflay=0)  
lst = flopy.utils.MfListBudget(os.path.join(m.model_ws,m.name+".list"))  
df = lst.get_dataframes(diff=True)[0]  
ax = df.plot(kind="bar",figsize=(6,6))  
ax.set_xticklabels(["historic","scenario"])
```

```
Out[6]: [Text(0, 0, 'historic'), Text(0, 0, 'scenario')]
```

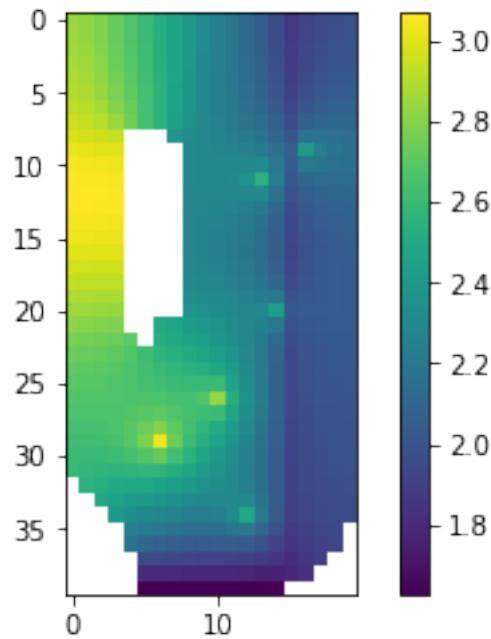




We can see the effect of the “scenario” in the second stress period with less recharge and more abstraction.

Plot depth to water

```
In [7]: dtw = m.dis.top.array - hds.get_data()[0,:,:]
        dtw = np.ma.masked_where(m.bas6.ibound[0].array==0,dtw)
        c = plt.imshow(dtw)
        plt.colorbar(c)
        plt.show()
```

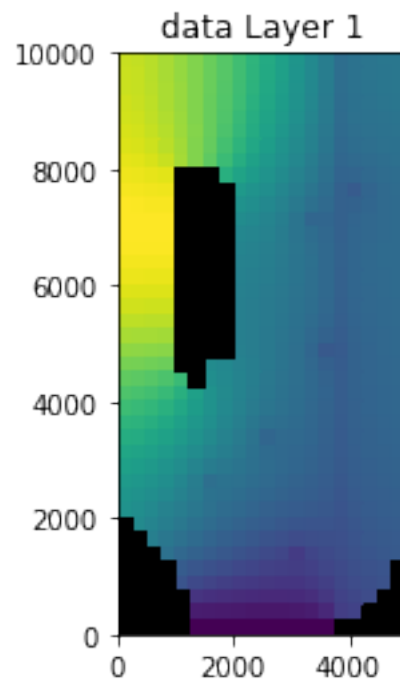


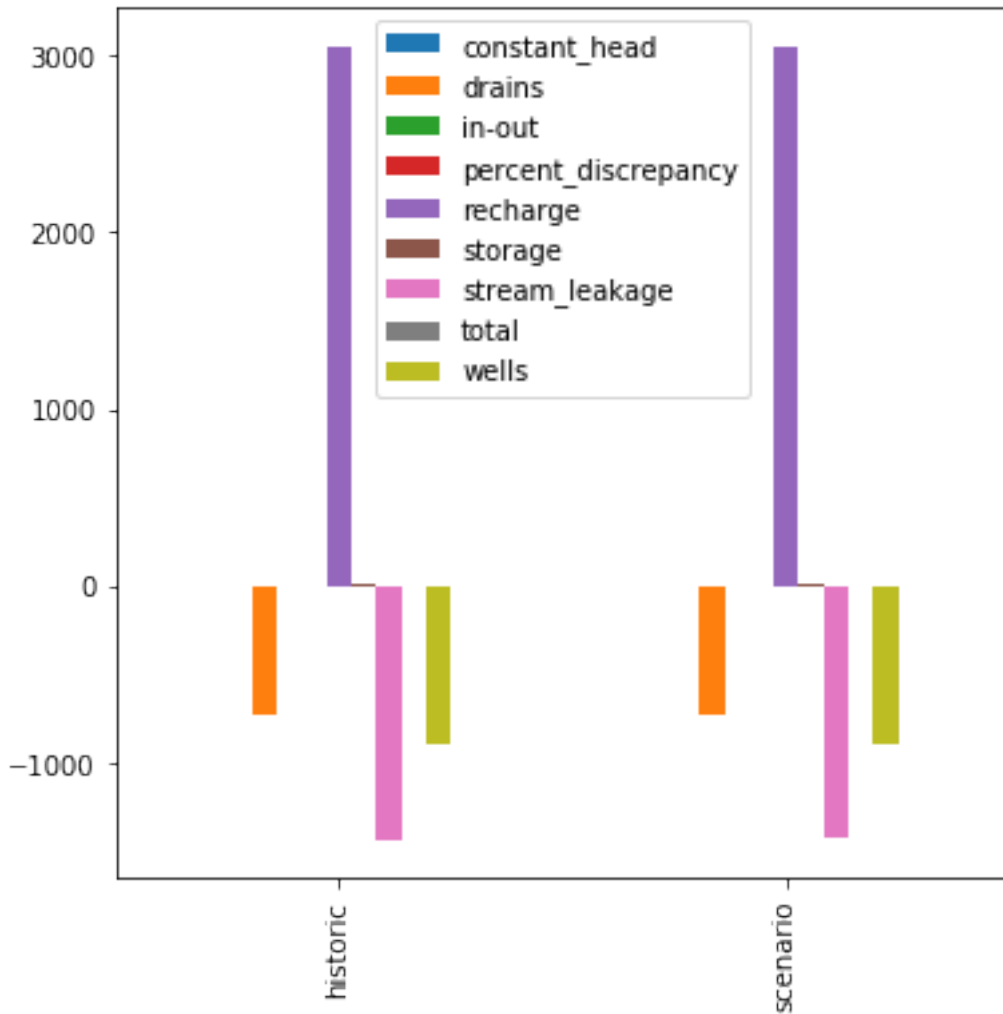
We are going to do is implement the scenario with parameters so we can more easy account for the stochastic nature of the forcing conditions during the scenario stress period and also make implementation of future scenarios work in this stochastic framework:

```
In [8]: # reset scenario period recharge
m.rch.rech[1] = m.rch.rech[0]
# reset scenario period abstraction
m.wel.stress_period_data[1] = m.wel.stress_period_data[0]
m.write_input()
pyemu.os_utils.run("{0} {1}".format("mfnt",m.name+".nam"),cwd=m.model_ws)
hds = flopy.utils.HeadFile(os.path.join(m.model_ws,m.name+".hds"),model=m)
axes = hds.plot(mflay=0)

lst = flopy.utils.MfListBudget(os.path.join(m.model_ws,m.name+".list"))
df = lst.get_dataframes(diff=True)[0]
ax = df.plot(kind="bar",figsize=(6,6))
ax.set_xticklabels(["historic","scenario"])
```

```
Out[8]: [Text(0, 0, 'historic'), Text(0, 0, 'scenario')]
```





Now we see that the scenario and historic periods have the same water balance

1.0.2 setup data structures related to what we want to parameterize and what we want to observe

```
In [9]: props = []
        paks = ["upw.hk", "upw.vka", "upw.ss", "upw.sy", "bas6.strt", "extra.prsity"]
        for k in range(m.nlay):
            props.extend([[p,k] for p in paks])
        props.append(["rch.rech", 0])
        props.append(["rch.rech", 1])

In [10]: spatial_list_props = [["wel.flux", 2], ["drn.cond", 0]]
         temporal_list_props = [["wel.flux", 0], ["wel.flux", 1]]

In [11]: hds_kperk = [[0,k] for k in range(m.nlay)]
         hds_kperk.extend([[1,k] for k in range(m.nlay)])
```

Here we setup monitoring of the SFR ASCII outputs. we will accumulate the first 20 reaches and last 20 reaches together to form forecasts of sw-gw exchange in the headwaters (hw) and tailwaters (tw). Then we will also add each reach individually for monitoring as well

```
In [12]: sfr_obs_dict = {"hw":np.arange(1,int(m.nrow/2))}
         sfr_obs_dict["tw"] = np.arange(int(m.nrow/2),m.nrow)
         for i in range(m.nrow):
             sfr_obs_dict[i] = i+1
```

1.0.3 here we go...

This class has grown into a monster...it does (among other things): - sets up combinations of multiplier parameters for array inputs, including uniform, zones, pilot points, grids, and KL expansion types - sets up combinations of multiplier parameters for list inputs - handles several of the shitty modflow exceptions to the array and list style inputs - sets up large numbers of observations based on arrays or time series - writes .tpl, .ins, .pst, etc - writes a python forward run script (WAT?!) - writes a prior parameter covariance matrix using geostatistical correlations - draws from the prior parameter covariance matrix to generate a prior parameter ensemble

This will be slow because the pure python kriging...but, hey, its free!

```
In [13]: pst_helper = pyemu.helpers.PstFromFlopyModel(nam_file,new_model_ws="template",org_model_ws=
                                                    const_props=props,spatial_list_props=spat.
                                                    temporal_list_props=temporal_list_props,
                                                    grid_props=props,pp_props=props,sfr_pars=
                                                    sfr_obs=sfr_obs_dict,build_prior=False,m
                                                    pp_space=4)
         prep_deps.prep_template(t_d=pst_helper.new_model_ws)
```

2019-05-02 21:57:37.058610 starting: loading flopy model

Creating new model with name: freyberg

Parsing the namefile --> temp/freyberg.nam

External unit dictionary:

OrderedDict([(2, filename:temp/freyberg.list, filetype:LIST), (11, filename:temp/freyberg.dis,

ModflowBas6 free format:True

loading dis package file...

Loading dis package with:

3 layers, 40 rows, 20 columns, and 2 stress periods

loading laycbd...

loading delr...

loading delc...

loading top...

```

loading botm...
    for 3 layers and 0 confining beds
loading stress period data...
    for 2 stress periods
adding Package: DIS
    DIS package load...success
    LIST package load...skipped
loading bas6 package file...
adding Package: BAS6
    BAS6 package load...success
loading upw package file...
    loading ipakcb, HDRY, NPUPW, IPHdry...
    loading LAYTYP...
    loading LAYAVG...
    loading CHANI...
    loading LAYVKA...
    loading LAYWET...
    loading hk layer 1...
    loading vka layer 1...
    loading ss layer 1...
    loading sy layer 1...
    loading hk layer 2...
    loading vka layer 2...
    loading ss layer 2...
    loading sy layer 2...
    loading hk layer 3...
    loading vka layer 3...
    loading ss layer 3...
    loading sy layer 3...
Adding freyberg.cbc (unit=50) to the output list.
adding Package: UPW
    UPW package load...success
loading rch package file...
    loading rech stress period 1...
    loading rech stress period 2...
adding Package: RCH
    RCH package load...success
loading nwt package file...
adding Package: NWT
    NWT package load...success
loading oc package file...
Adding freyberg.hds (unit=51) to the output list.
adding Package: OC
    OC package load...success
loading lmt package file...
adding Package: LMT6
    LMT6 package load...success
loading wel package file...

```



```

    loading <class 'flopy.modflow.mfwel.ModflowWel'> for kper      1
    loading <class 'flopy.modflow.mfwel.ModflowWel'> for kper      2
adding Package:  WEL
    WEL  package load...success
loading sfr2 package file...
Adding freyberg.sfr.out (unit=60) to the output list.
adding Package:  SFR
    SFR  package load...success
loading drn package file...
    loading <class 'flopy.modflow.mfdrn.ModflowDrn'> for kper      1
    loading <class 'flopy.modflow.mfdrn.ModflowDrn'> for kper      2
adding Package:  DRN
    DRN  package load...success
    DATA(BINARY) file load...skipped
        freyberg.cbc
    DATA(BINARY) file load...skipped
        freyberg.hds
    DATA file load...skipped
        freyberg.sfr.out
Warning: external file unit 0 does not exist in ext_unit_dict.

The following 10 packages were successfully loaded.
    freyberg.dis
    freyberg.bas
    freyberg.upw
    freyberg.rch
    freyberg.nwt
    freyberg.oc
    freyberg.lmt6
    freyberg.wel
    freyberg.sfr
    freyberg.drn
The following 1 packages were not loaded.
    freyberg.list
2019-05-02 21:57:37.090752 finished: loading flopy model took: 0:00:00.032142
2019-05-02 21:57:37.090912 starting: updating model attributes
2019-05-02 21:57:37.091010 finished: updating model attributes took: 0:00:00.000098
2019-05-02 21:57:37.091198 WARNING: removing existing 'new_model_ws'

creating model workspace...
    template

changing model workspace...
    template
2019-05-02 21:57:38.337410 starting: writing new modflow input files

Writing packages:
    Package:  DIS

```

```

Util2d:delr: resetting 'how' to external
Util2d:delc: resetting 'how' to external
Util2d:model_top: resetting 'how' to external
Util2d:botm_layer_0: resetting 'how' to external
Util2d:botm_layer_1: resetting 'how' to external
Util2d:botm_layer_2: resetting 'how' to external
    Package:  BAS6
Util2d:ibound_layer_0: resetting 'how' to external
Util2d:ibound_layer_1: resetting 'how' to external
Util2d:ibound_layer_2: resetting 'how' to external
Util2d:strt_layer_0: resetting 'how' to external
Util2d:strt_layer_1: resetting 'how' to external
Util2d:strt_layer_2: resetting 'how' to external
    Package:  UPW
Util2d:hk: resetting 'how' to external
Util2d:vka: resetting 'how' to external
Util2d:ss: resetting 'how' to external
Util2d:sy: resetting 'how' to external
Util2d:hk: resetting 'how' to external
Util2d:vka: resetting 'how' to external
Util2d:ss: resetting 'how' to external
Util2d:sy: resetting 'how' to external
Util2d:hk: resetting 'how' to external
Util2d:vka: resetting 'how' to external
Util2d:ss: resetting 'how' to external
Util2d:sy: resetting 'how' to external
    Package:  RCH
Util2d:rech_1: resetting 'how' to external
Util2d:rech_2: resetting 'how' to external
    Package:  NWT
    Package:  OC
    Package:  LMT6
    Package:  WEL
    Package:  SFR
    Package:  DRN

```

```

2019-05-02 21:57:38.481792 finished: writing new modflow input files took: 0:00:00.144382
2019-05-02 21:57:38.482521 forward_run line:pyemu.os_utils.run('mfntw freyberg.nam 1>freyberg.
2019-05-02 21:57:38.482768 starting: setting up 'template/arr_org' dir
2019-05-02 21:57:38.483174 finished: setting up 'template/arr_org' dir took: 0:00:00.000406
2019-05-02 21:57:38.483624 starting: setting up 'template/arr_mlt' dir
2019-05-02 21:57:38.484053 finished: setting up 'template/arr_mlt' dir took: 0:00:00.000429
2019-05-02 21:57:38.484222 starting: setting up 'template/list_org' dir
2019-05-02 21:57:38.484686 finished: setting up 'template/list_org' dir took: 0:00:00.000464
2019-05-02 21:57:38.484965 starting: setting up 'template/list_mlt' dir
2019-05-02 21:57:38.485349 finished: setting up 'template/list_mlt' dir took: 0:00:00.000384
2019-05-02 21:57:38.485654 starting: processing temporal_list_props
2019-05-02 21:57:38.509101 finished: processing temporal_list_props took: 0:00:00.023447

```

```

2019-05-02 21:57:38.509505 starting: processing spatial_list_props
2019-05-02 21:57:38.675346 finished: processing spatial_list_props took: 0:00:00.165841
2019-05-02 21:57:38.733014 forward_run line:pyemu.helpers.apply_list_pars()

2019-05-02 21:57:38.765637 'extra' pak detected:extra.prsity
2019-05-02 21:57:38.805036 'extra' pak detected:extra.prsity
2019-05-02 21:57:38.845121 'extra' pak detected:extra.prsity
2019-05-02 21:57:38.894621 'extra' pak detected:extra.prsity
2019-05-02 21:57:38.928622 'extra' pak detected:extra.prsity
2019-05-02 21:57:38.961758 'extra' pak detected:extra.prsity
2019-05-02 21:57:39.005103 'extra' pak detected:extra.prsity
2019-05-02 21:57:39.037638 'extra' pak detected:extra.prsity
2019-05-02 21:57:39.071812 'extra' pak detected:extra.prsity
2019-05-02 21:57:39.152051 starting: writing grid tpl:hk3.dat_gr.tpl
2019-05-02 21:57:39.160698 finished: writing grid tpl:hk3.dat_gr.tpl took: 0:00:00.008647
2019-05-02 21:57:39.163120 starting: writing grid tpl:vka3.dat_gr.tpl
2019-05-02 21:57:39.172170 finished: writing grid tpl:vka3.dat_gr.tpl took: 0:00:00.009050
2019-05-02 21:57:39.174828 starting: writing grid tpl:ss3.dat_gr.tpl
2019-05-02 21:57:39.183807 finished: writing grid tpl:ss3.dat_gr.tpl took: 0:00:00.008979
2019-05-02 21:57:39.186516 starting: writing grid tpl:sy3.dat_gr.tpl
2019-05-02 21:57:39.195373 finished: writing grid tpl:sy3.dat_gr.tpl took: 0:00:00.008857
2019-05-02 21:57:39.198313 starting: writing grid tpl:strt3.dat_gr.tpl
2019-05-02 21:57:39.207269 finished: writing grid tpl:strt3.dat_gr.tpl took: 0:00:00.008956
2019-05-02 21:57:39.209957 starting: writing grid tpl:prsity3.dat_gr.tpl
2019-05-02 21:57:39.220913 finished: writing grid tpl:prsity3.dat_gr.tpl took: 0:00:00.010956
2019-05-02 21:57:39.223708 starting: writing grid tpl:hk4.dat_gr.tpl
2019-05-02 21:57:39.232364 finished: writing grid tpl:hk4.dat_gr.tpl took: 0:00:00.008656
2019-05-02 21:57:39.235218 starting: writing grid tpl:vka4.dat_gr.tpl
2019-05-02 21:57:39.243929 finished: writing grid tpl:vka4.dat_gr.tpl took: 0:00:00.008711
2019-05-02 21:57:39.246591 starting: writing grid tpl:ss4.dat_gr.tpl
2019-05-02 21:57:39.255757 finished: writing grid tpl:ss4.dat_gr.tpl took: 0:00:00.009166
2019-05-02 21:57:39.258321 starting: writing grid tpl:sy4.dat_gr.tpl
2019-05-02 21:57:39.266793 finished: writing grid tpl:sy4.dat_gr.tpl took: 0:00:00.008472
2019-05-02 21:57:39.269677 starting: writing grid tpl:strt4.dat_gr.tpl
2019-05-02 21:57:39.278563 finished: writing grid tpl:strt4.dat_gr.tpl took: 0:00:00.008886
2019-05-02 21:57:39.281370 starting: writing grid tpl:prsity4.dat_gr.tpl
2019-05-02 21:57:39.295210 finished: writing grid tpl:prsity4.dat_gr.tpl took: 0:00:00.013840
2019-05-02 21:57:39.298243 starting: writing grid tpl:hk5.dat_gr.tpl
2019-05-02 21:57:39.307181 finished: writing grid tpl:hk5.dat_gr.tpl took: 0:00:00.008938
2019-05-02 21:57:39.309868 starting: writing grid tpl:vka5.dat_gr.tpl
2019-05-02 21:57:39.319361 finished: writing grid tpl:vka5.dat_gr.tpl took: 0:00:00.009493
2019-05-02 21:57:39.322055 starting: writing grid tpl:ss5.dat_gr.tpl
2019-05-02 21:57:39.331098 finished: writing grid tpl:ss5.dat_gr.tpl took: 0:00:00.009043
2019-05-02 21:57:39.333794 starting: writing grid tpl:sy5.dat_gr.tpl
2019-05-02 21:57:39.342684 finished: writing grid tpl:sy5.dat_gr.tpl took: 0:00:00.008890
2019-05-02 21:57:39.345359 starting: writing grid tpl:strt5.dat_gr.tpl
2019-05-02 21:57:39.354455 finished: writing grid tpl:strt5.dat_gr.tpl took: 0:00:00.009096
2019-05-02 21:57:39.356976 starting: writing grid tpl:prsity5.dat_gr.tpl

```

2019-05-02 21:57:39.368784 finished: writing grid tpl:prsity5.dat_gr.tpl took: 0:00:00.011808
 2019-05-02 21:57:39.371476 starting: writing grid tpl:rech2.dat_gr.tpl
 2019-05-02 21:57:39.380744 finished: writing grid tpl:rech2.dat_gr.tpl took: 0:00:00.009268
 2019-05-02 21:57:39.383268 starting: writing grid tpl:rech3.dat_gr.tpl
 2019-05-02 21:57:39.393386 finished: writing grid tpl:rech3.dat_gr.tpl took: 0:00:00.010118
 2019-05-02 21:57:39.396067 starting: writing const tpl:hk6.dat_cn.tpl
 2019-05-02 21:57:39.401814 finished: writing const tpl:hk6.dat_cn.tpl took: 0:00:00.005747
 2019-05-02 21:57:39.404469 starting: writing const tpl:vka6.dat_cn.tpl
 2019-05-02 21:57:39.410612 finished: writing const tpl:vka6.dat_cn.tpl took: 0:00:00.006143
 2019-05-02 21:57:39.413424 starting: writing const tpl:ss6.dat_cn.tpl
 2019-05-02 21:57:39.419253 finished: writing const tpl:ss6.dat_cn.tpl took: 0:00:00.005829
 2019-05-02 21:57:39.421900 starting: writing const tpl:sy6.dat_cn.tpl
 2019-05-02 21:57:39.427915 finished: writing const tpl:sy6.dat_cn.tpl took: 0:00:00.006015
 2019-05-02 21:57:39.430705 starting: writing const tpl:strt6.dat_cn.tpl
 2019-05-02 21:57:39.436780 finished: writing const tpl:strt6.dat_cn.tpl took: 0:00:00.006075
 2019-05-02 21:57:39.439507 starting: writing const tpl:prsity6.dat_cn.tpl
 2019-05-02 21:57:39.445475 finished: writing const tpl:prsity6.dat_cn.tpl took: 0:00:00.005968
 2019-05-02 21:57:39.448170 starting: writing const tpl:hk7.dat_cn.tpl
 2019-05-02 21:57:39.454066 finished: writing const tpl:hk7.dat_cn.tpl took: 0:00:00.005896
 2019-05-02 21:57:39.457195 starting: writing const tpl:vka7.dat_cn.tpl
 2019-05-02 21:57:39.463405 finished: writing const tpl:vka7.dat_cn.tpl took: 0:00:00.006210
 2019-05-02 21:57:39.466336 starting: writing const tpl:ss7.dat_cn.tpl
 2019-05-02 21:57:39.472080 finished: writing const tpl:ss7.dat_cn.tpl took: 0:00:00.005744
 2019-05-02 21:57:39.474864 starting: writing const tpl:sy7.dat_cn.tpl
 2019-05-02 21:57:39.480699 finished: writing const tpl:sy7.dat_cn.tpl took: 0:00:00.005835
 2019-05-02 21:57:39.483471 starting: writing const tpl:strt7.dat_cn.tpl
 2019-05-02 21:57:39.489777 finished: writing const tpl:strt7.dat_cn.tpl took: 0:00:00.006306
 2019-05-02 21:57:39.492699 starting: writing const tpl:prsity7.dat_cn.tpl
 2019-05-02 21:57:39.498548 finished: writing const tpl:prsity7.dat_cn.tpl took: 0:00:00.005849
 2019-05-02 21:57:39.501210 starting: writing const tpl:hk8.dat_cn.tpl
 2019-05-02 21:57:39.507419 finished: writing const tpl:hk8.dat_cn.tpl took: 0:00:00.006209
 2019-05-02 21:57:39.510265 starting: writing const tpl:vka8.dat_cn.tpl
 2019-05-02 21:57:39.516386 finished: writing const tpl:vka8.dat_cn.tpl took: 0:00:00.006121
 2019-05-02 21:57:39.519099 starting: writing const tpl:ss8.dat_cn.tpl
 2019-05-02 21:57:39.525349 finished: writing const tpl:ss8.dat_cn.tpl took: 0:00:00.006250
 2019-05-02 21:57:39.528423 starting: writing const tpl:sy8.dat_cn.tpl
 2019-05-02 21:57:39.534568 finished: writing const tpl:sy8.dat_cn.tpl took: 0:00:00.006145
 2019-05-02 21:57:39.537281 starting: writing const tpl:strt8.dat_cn.tpl
 2019-05-02 21:57:39.544831 finished: writing const tpl:strt8.dat_cn.tpl took: 0:00:00.007550
 2019-05-02 21:57:39.548120 starting: writing const tpl:prsity8.dat_cn.tpl
 2019-05-02 21:57:39.554091 finished: writing const tpl:prsity8.dat_cn.tpl took: 0:00:00.005971
 2019-05-02 21:57:39.556876 starting: writing const tpl:rech4.dat_cn.tpl
 2019-05-02 21:57:39.563075 finished: writing const tpl:rech4.dat_cn.tpl took: 0:00:00.006199
 2019-05-02 21:57:39.565930 starting: writing const tpl:rech5.dat_cn.tpl
 2019-05-02 21:57:39.571985 finished: writing const tpl:rech5.dat_cn.tpl took: 0:00:00.006055
 2019-05-02 21:57:39.598222 starting: setting up pilot point process
 2019-05-02 21:57:39.598594 WARNING: pp_geostruc is None, using ExpVario with contribution=1 and
 2019-05-02 21:57:39.601959 pp_dict: {0: ['hk0', 'vka0', 'ss0', 'sy0', 'strt0', 'prsity0', 'rech0']}

```

2019-05-02 21:57:39.602254 starting: calling setup_pilot_point_grid()
2019-05-02 21:57:40.188116 640 pilot point parameters created
2019-05-02 21:57:40.189013 pilot point 'pargp':hk0,vka0,ss0,sy0,strt0,prsity0,rech0,rech1,vka1
2019-05-02 21:57:40.189356 finished: calling setup_pilot_point_grid() took: 0:00:00.587102
2019-05-02 21:57:40.192200 starting: calculating factors for p=hk0, k=0
2019-05-02 21:57:40.193040 saving krige variance file:template/pp_k0_general_zn.fac
2019-05-02 21:57:40.193099 saving krige factors file:template/pp_k0_general_zn.fac
starting interp point loop for 800 points
took 2.372833 seconds
2019-05-02 21:57:42.620086 finished: calculating factors for p=hk0, k=0 took: 0:00:02.427886
2019-05-02 21:57:42.621145 starting: calculating factors for p=vka0, k=0
2019-05-02 21:57:42.622035 finished: calculating factors for p=vka0, k=0 took: 0:00:00.000890
2019-05-02 21:57:42.623270 starting: calculating factors for p=ss0, k=0
2019-05-02 21:57:42.624509 finished: calculating factors for p=ss0, k=0 took: 0:00:00.001239
2019-05-02 21:57:42.625551 starting: calculating factors for p=sy0, k=0
2019-05-02 21:57:42.626451 finished: calculating factors for p=sy0, k=0 took: 0:00:00.000900
2019-05-02 21:57:42.627199 starting: calculating factors for p=strt0, k=0
2019-05-02 21:57:42.628860 finished: calculating factors for p=strt0, k=0 took: 0:00:00.001661
2019-05-02 21:57:42.630213 starting: calculating factors for p=prsity0, k=0
2019-05-02 21:57:42.631097 finished: calculating factors for p=prsity0, k=0 took: 0:00:00.000808
2019-05-02 21:57:42.632029 starting: calculating factors for p=rech0, k=0
2019-05-02 21:57:42.632809 finished: calculating factors for p=rech0, k=0 took: 0:00:00.000780
2019-05-02 21:57:42.633418 starting: calculating factors for p=rech1, k=0
2019-05-02 21:57:42.634151 finished: calculating factors for p=rech1, k=0 took: 0:00:00.000733
2019-05-02 21:57:42.634787 starting: calculating factors for p=vka1, k=1
2019-05-02 21:57:42.635514 saving krige variance file:template/pp_k1_general_zn.fac
2019-05-02 21:57:42.635631 saving krige factors file:template/pp_k1_general_zn.fac
starting interp point loop for 800 points
took 2.490187 seconds
2019-05-02 21:57:45.179071 finished: calculating factors for p=vka1, k=1 took: 0:00:02.544284
2019-05-02 21:57:45.180492 starting: calculating factors for p=sy1, k=1
2019-05-02 21:57:45.181604 finished: calculating factors for p=sy1, k=1 took: 0:00:00.001112
2019-05-02 21:57:45.182367 starting: calculating factors for p=ss1, k=1
2019-05-02 21:57:45.183373 finished: calculating factors for p=ss1, k=1 took: 0:00:00.001006
2019-05-02 21:57:45.184476 starting: calculating factors for p=prsity1, k=1
2019-05-02 21:57:45.185800 finished: calculating factors for p=prsity1, k=1 took: 0:00:00.001308
2019-05-02 21:57:45.186589 starting: calculating factors for p=strt1, k=1
2019-05-02 21:57:45.187422 finished: calculating factors for p=strt1, k=1 took: 0:00:00.000833
2019-05-02 21:57:45.188083 starting: calculating factors for p=hk1, k=1
2019-05-02 21:57:45.188885 finished: calculating factors for p=hk1, k=1 took: 0:00:00.000802
2019-05-02 21:57:45.189639 starting: calculating factors for p=strt2, k=2
2019-05-02 21:57:45.190312 saving krige variance file:template/pp_k2_general_zn.fac
2019-05-02 21:57:45.190365 saving krige factors file:template/pp_k2_general_zn.fac
starting interp point loop for 800 points
took 2.715426 seconds
2019-05-02 21:57:47.950606 finished: calculating factors for p=strt2, k=2 took: 0:00:02.760967
2019-05-02 21:57:47.951515 starting: calculating factors for p=hk2, k=2
2019-05-02 21:57:47.952238 finished: calculating factors for p=hk2, k=2 took: 0:00:00.000723

```

```

2019-05-02 21:57:47.953278 starting: calculating factors for p=prsity2, k=2
2019-05-02 21:57:47.954223 finished: calculating factors for p=prsity2, k=2 took: 0:00:00.0009
2019-05-02 21:57:47.954767 starting: calculating factors for p=sy2, k=2
2019-05-02 21:57:47.955566 finished: calculating factors for p=sy2, k=2 took: 0:00:00.000799
2019-05-02 21:57:47.956357 starting: calculating factors for p=vka2, k=2
2019-05-02 21:57:47.957383 finished: calculating factors for p=vka2, k=2 took: 0:00:00.001026
2019-05-02 21:57:47.957918 starting: calculating factors for p=ss2, k=2
2019-05-02 21:57:47.958553 finished: calculating factors for p=ss2, k=2 took: 0:00:00.000635
2019-05-02 21:57:47.958883 starting: processing pp_prefix:prsity2
2019-05-02 21:57:47.971020 starting: processing pp_prefix:strt2
2019-05-02 21:57:47.980076 starting: processing pp_prefix:sy2
2019-05-02 21:57:47.988914 starting: processing pp_prefix:prsity0
2019-05-02 21:57:47.998247 starting: processing pp_prefix:sy1
2019-05-02 21:57:48.007465 starting: processing pp_prefix:prsity1
2019-05-02 21:57:48.015682 starting: processing pp_prefix:rech0
2019-05-02 21:57:48.024291 starting: processing pp_prefix:ss1
2019-05-02 21:57:48.033474 starting: processing pp_prefix:hk1
2019-05-02 21:57:48.041727 starting: processing pp_prefix:vka2
2019-05-02 21:57:48.050473 starting: processing pp_prefix:vka1
2019-05-02 21:57:48.058853 starting: processing pp_prefix:strt0
2019-05-02 21:57:48.068111 starting: processing pp_prefix:ss0
2019-05-02 21:57:48.076935 starting: processing pp_prefix:hk2
2019-05-02 21:57:48.086097 starting: processing pp_prefix:strt1
2019-05-02 21:57:48.095263 starting: processing pp_prefix:rech1
2019-05-02 21:57:48.103653 starting: processing pp_prefix:hk0
2019-05-02 21:57:48.111772 starting: processing pp_prefix:ss2
2019-05-02 21:57:48.120058 starting: processing pp_prefix:sy0
2019-05-02 21:57:48.129530 starting: processing pp_prefix:vka0
2019-05-02 21:57:48.230588 finished: setting up pilot point process took: 0:00:08.632366
2019-05-02 21:57:48.231002 starting: setting up grid process
2019-05-02 21:57:48.231083 WARNING: grid_geostruc is None, using ExpVario with contribution=1
2019-05-02 21:57:48.231201 finished: setting up grid process took: 0:00:00.000199
2019-05-02 21:57:48.233896 starting: save test mlt array arr_mlt/hk0.dat_pp
2019-05-02 21:57:48.236684 finished: save test mlt array arr_mlt/hk0.dat_pp took: 0:00:00.0027
2019-05-02 21:57:48.237763 starting: save test mlt array arr_mlt/vka0.dat_pp
2019-05-02 21:57:48.240352 finished: save test mlt array arr_mlt/vka0.dat_pp took: 0:00:00.002
2019-05-02 21:57:48.241317 starting: save test mlt array arr_mlt/ss0.dat_pp
2019-05-02 21:57:48.244106 finished: save test mlt array arr_mlt/ss0.dat_pp took: 0:00:00.0027
2019-05-02 21:57:48.245194 starting: save test mlt array arr_mlt/sy0.dat_pp
2019-05-02 21:57:48.247641 finished: save test mlt array arr_mlt/sy0.dat_pp took: 0:00:00.0024
2019-05-02 21:57:48.248613 starting: save test mlt array arr_mlt/strt0.dat_pp
2019-05-02 21:57:48.251157 finished: save test mlt array arr_mlt/strt0.dat_pp took: 0:00:00.00
2019-05-02 21:57:48.251974 starting: save test mlt array arr_mlt/prsity0.dat_pp
2019-05-02 21:57:48.254628 finished: save test mlt array arr_mlt/prsity0.dat_pp took: 0:00:00.
2019-05-02 21:57:48.255617 starting: save test mlt array arr_mlt/hk1.dat_pp
2019-05-02 21:57:48.263090 finished: save test mlt array arr_mlt/hk1.dat_pp took: 0:00:00.0074
2019-05-02 21:57:48.264356 starting: save test mlt array arr_mlt/vka1.dat_pp
2019-05-02 21:57:48.266793 finished: save test mlt array arr_mlt/vka1.dat_pp took: 0:00:00.002

```

2019-05-02 21:57:48.267745 starting: save test mlt array arr_mlt/ss1.dat_pp
 2019-05-02 21:57:48.270253 finished: save test mlt array arr_mlt/ss1.dat_pp took: 0:00:00.0025
 2019-05-02 21:57:48.271231 starting: save test mlt array arr_mlt/sy1.dat_pp
 2019-05-02 21:57:48.273529 finished: save test mlt array arr_mlt/sy1.dat_pp took: 0:00:00.0022
 2019-05-02 21:57:48.274487 starting: save test mlt array arr_mlt/strt1.dat_pp
 2019-05-02 21:57:48.276799 finished: save test mlt array arr_mlt/strt1.dat_pp took: 0:00:00.002
 2019-05-02 21:57:48.277897 starting: save test mlt array arr_mlt/prsity1.dat_pp
 2019-05-02 21:57:48.280248 finished: save test mlt array arr_mlt/prsity1.dat_pp took: 0:00:00.
 2019-05-02 21:57:48.281238 starting: save test mlt array arr_mlt/hk2.dat_pp
 2019-05-02 21:57:48.283477 finished: save test mlt array arr_mlt/hk2.dat_pp took: 0:00:00.0022
 2019-05-02 21:57:48.284492 starting: save test mlt array arr_mlt/vka2.dat_pp
 2019-05-02 21:57:48.286869 finished: save test mlt array arr_mlt/vka2.dat_pp took: 0:00:00.0023
 2019-05-02 21:57:48.287931 starting: save test mlt array arr_mlt/ss2.dat_pp
 2019-05-02 21:57:48.290408 finished: save test mlt array arr_mlt/ss2.dat_pp took: 0:00:00.0024
 2019-05-02 21:57:48.291364 starting: save test mlt array arr_mlt/sy2.dat_pp
 2019-05-02 21:57:48.293691 finished: save test mlt array arr_mlt/sy2.dat_pp took: 0:00:00.0023
 2019-05-02 21:57:48.294461 starting: save test mlt array arr_mlt/strt2.dat_pp
 2019-05-02 21:57:48.296473 finished: save test mlt array arr_mlt/strt2.dat_pp took: 0:00:00.002
 2019-05-02 21:57:48.297442 starting: save test mlt array arr_mlt/prsity2.dat_pp
 2019-05-02 21:57:48.300078 finished: save test mlt array arr_mlt/prsity2.dat_pp took: 0:00:00.
 2019-05-02 21:57:48.301381 starting: save test mlt array arr_mlt/rech0.dat_pp
 2019-05-02 21:57:48.304140 finished: save test mlt array arr_mlt/rech0.dat_pp took: 0:00:00.002
 2019-05-02 21:57:48.305601 starting: save test mlt array arr_mlt/rech1.dat_pp
 2019-05-02 21:57:48.309008 finished: save test mlt array arr_mlt/rech1.dat_pp took: 0:00:00.003
 2019-05-02 21:57:48.310427 starting: save test mlt array arr_mlt/hk3.dat_gr
 2019-05-02 21:57:48.313747 finished: save test mlt array arr_mlt/hk3.dat_gr took: 0:00:00.0033
 2019-05-02 21:57:48.314921 starting: save test mlt array arr_mlt/vka3.dat_gr
 2019-05-02 21:57:48.317850 finished: save test mlt array arr_mlt/vka3.dat_gr took: 0:00:00.002
 2019-05-02 21:57:48.318908 starting: save test mlt array arr_mlt/ss3.dat_gr
 2019-05-02 21:57:48.322286 finished: save test mlt array arr_mlt/ss3.dat_gr took: 0:00:00.0033
 2019-05-02 21:57:48.323837 starting: save test mlt array arr_mlt/sy3.dat_gr
 2019-05-02 21:57:48.327487 finished: save test mlt array arr_mlt/sy3.dat_gr took: 0:00:00.0036
 2019-05-02 21:57:48.328992 starting: save test mlt array arr_mlt/strt3.dat_gr
 2019-05-02 21:57:48.332636 finished: save test mlt array arr_mlt/strt3.dat_gr took: 0:00:00.003
 2019-05-02 21:57:48.334164 starting: save test mlt array arr_mlt/prsity3.dat_gr
 2019-05-02 21:57:48.337797 finished: save test mlt array arr_mlt/prsity3.dat_gr took: 0:00:00.
 2019-05-02 21:57:48.338927 starting: save test mlt array arr_mlt/hk4.dat_gr
 2019-05-02 21:57:48.341558 finished: save test mlt array arr_mlt/hk4.dat_gr took: 0:00:00.0026
 2019-05-02 21:57:48.342666 starting: save test mlt array arr_mlt/vka4.dat_gr
 2019-05-02 21:57:48.346396 finished: save test mlt array arr_mlt/vka4.dat_gr took: 0:00:00.003
 2019-05-02 21:57:48.347916 starting: save test mlt array arr_mlt/ss4.dat_gr
 2019-05-02 21:57:48.351587 finished: save test mlt array arr_mlt/ss4.dat_gr took: 0:00:00.0036
 2019-05-02 21:57:48.352992 starting: save test mlt array arr_mlt/sy4.dat_gr
 2019-05-02 21:57:48.356678 finished: save test mlt array arr_mlt/sy4.dat_gr took: 0:00:00.0036
 2019-05-02 21:57:48.358216 starting: save test mlt array arr_mlt/strt4.dat_gr
 2019-05-02 21:57:48.361852 finished: save test mlt array arr_mlt/strt4.dat_gr took: 0:00:00.003
 2019-05-02 21:57:48.363588 starting: save test mlt array arr_mlt/prsity4.dat_gr
 2019-05-02 21:57:48.367179 finished: save test mlt array arr_mlt/prsity4.dat_gr took: 0:00:00.

2019-05-02 21:57:48.368695 starting: save test mlt array arr_mlt/hk5.dat_gr
 2019-05-02 21:57:48.372395 finished: save test mlt array arr_mlt/hk5.dat_gr took: 0:00:00.0037
 2019-05-02 21:57:48.374041 starting: save test mlt array arr_mlt/vka5.dat_gr
 2019-05-02 21:57:48.377150 finished: save test mlt array arr_mlt/vka5.dat_gr took: 0:00:00.003
 2019-05-02 21:57:48.378659 starting: save test mlt array arr_mlt/ss5.dat_gr
 2019-05-02 21:57:48.382479 finished: save test mlt array arr_mlt/ss5.dat_gr took: 0:00:00.0038
 2019-05-02 21:57:48.384037 starting: save test mlt array arr_mlt/sy5.dat_gr
 2019-05-02 21:57:48.387578 finished: save test mlt array arr_mlt/sy5.dat_gr took: 0:00:00.0035
 2019-05-02 21:57:48.388678 starting: save test mlt array arr_mlt/strt5.dat_gr
 2019-05-02 21:57:48.391656 finished: save test mlt array arr_mlt/strt5.dat_gr took: 0:00:00.00
 2019-05-02 21:57:48.393180 starting: save test mlt array arr_mlt/prsity5.dat_gr
 2019-05-02 21:57:48.396716 finished: save test mlt array arr_mlt/prsity5.dat_gr took: 0:00:00.
 2019-05-02 21:57:48.398316 starting: save test mlt array arr_mlt/rech2.dat_gr
 2019-05-02 21:57:48.403640 finished: save test mlt array arr_mlt/rech2.dat_gr took: 0:00:00.00
 2019-05-02 21:57:48.405118 starting: save test mlt array arr_mlt/rech3.dat_gr
 2019-05-02 21:57:48.408612 finished: save test mlt array arr_mlt/rech3.dat_gr took: 0:00:00.00
 2019-05-02 21:57:48.409935 starting: save test mlt array arr_mlt/hk6.dat_cn
 2019-05-02 21:57:48.413138 finished: save test mlt array arr_mlt/hk6.dat_cn took: 0:00:00.0032
 2019-05-02 21:57:48.414369 starting: save test mlt array arr_mlt/vka6.dat_cn
 2019-05-02 21:57:48.417637 finished: save test mlt array arr_mlt/vka6.dat_cn took: 0:00:00.003
 2019-05-02 21:57:48.419036 starting: save test mlt array arr_mlt/ss6.dat_cn
 2019-05-02 21:57:48.422708 finished: save test mlt array arr_mlt/ss6.dat_cn took: 0:00:00.0036
 2019-05-02 21:57:48.423808 starting: save test mlt array arr_mlt/sy6.dat_cn
 2019-05-02 21:57:48.426985 finished: save test mlt array arr_mlt/sy6.dat_cn took: 0:00:00.0031
 2019-05-02 21:57:48.428513 starting: save test mlt array arr_mlt/strt6.dat_cn
 2019-05-02 21:57:48.432142 finished: save test mlt array arr_mlt/strt6.dat_cn took: 0:00:00.00
 2019-05-02 21:57:48.433765 starting: save test mlt array arr_mlt/prsity6.dat_cn
 2019-05-02 21:57:48.436875 finished: save test mlt array arr_mlt/prsity6.dat_cn took: 0:00:00.
 2019-05-02 21:57:48.438261 starting: save test mlt array arr_mlt/hk7.dat_cn
 2019-05-02 21:57:48.441589 finished: save test mlt array arr_mlt/hk7.dat_cn took: 0:00:00.0033
 2019-05-02 21:57:48.442894 starting: save test mlt array arr_mlt/vka7.dat_cn
 2019-05-02 21:57:48.445908 finished: save test mlt array arr_mlt/vka7.dat_cn took: 0:00:00.003
 2019-05-02 21:57:48.446913 starting: save test mlt array arr_mlt/ss7.dat_cn
 2019-05-02 21:57:48.449300 finished: save test mlt array arr_mlt/ss7.dat_cn took: 0:00:00.0023
 2019-05-02 21:57:48.450828 starting: save test mlt array arr_mlt/sy7.dat_cn
 2019-05-02 21:57:48.454403 finished: save test mlt array arr_mlt/sy7.dat_cn took: 0:00:00.0035
 2019-05-02 21:57:48.455756 starting: save test mlt array arr_mlt/strt7.dat_cn
 2019-05-02 21:57:48.458843 finished: save test mlt array arr_mlt/strt7.dat_cn took: 0:00:00.00
 2019-05-02 21:57:48.459857 starting: save test mlt array arr_mlt/prsity7.dat_cn
 2019-05-02 21:57:48.462511 finished: save test mlt array arr_mlt/prsity7.dat_cn took: 0:00:00.
 2019-05-02 21:57:48.464083 starting: save test mlt array arr_mlt/hk8.dat_cn
 2019-05-02 21:57:48.467336 finished: save test mlt array arr_mlt/hk8.dat_cn took: 0:00:00.0032
 2019-05-02 21:57:48.468641 starting: save test mlt array arr_mlt/vka8.dat_cn
 2019-05-02 21:57:48.471525 finished: save test mlt array arr_mlt/vka8.dat_cn took: 0:00:00.002
 2019-05-02 21:57:48.473002 starting: save test mlt array arr_mlt/ss8.dat_cn
 2019-05-02 21:57:48.476299 finished: save test mlt array arr_mlt/ss8.dat_cn took: 0:00:00.0032
 2019-05-02 21:57:48.477728 starting: save test mlt array arr_mlt/sy8.dat_cn
 2019-05-02 21:57:48.480657 finished: save test mlt array arr_mlt/sy8.dat_cn took: 0:00:00.0029


```

2019-05-02 21:57:48.481967 starting: save test mlt array arr_mlt/strt8.dat_cn
2019-05-02 21:57:48.484853 finished: save test mlt array arr_mlt/strt8.dat_cn took: 0:00:00.00
2019-05-02 21:57:48.486650 starting: save test mlt array arr_mlt/prsity8.dat_cn
2019-05-02 21:57:48.489501 finished: save test mlt array arr_mlt/prsity8.dat_cn took: 0:00:00.0
2019-05-02 21:57:48.490640 starting: save test mlt array arr_mlt/rech4.dat_cn
2019-05-02 21:57:48.493568 finished: save test mlt array arr_mlt/rech4.dat_cn took: 0:00:00.00
2019-05-02 21:57:48.494659 starting: save test mlt array arr_mlt/rech5.dat_cn
2019-05-02 21:57:48.498010 finished: save test mlt array arr_mlt/rech5.dat_cn took: 0:00:00.00
2019-05-02 21:57:49.112862 forward_run line:pyemu.helpers.apply_array_pars()

all zeros for runoff...skipping...
all zeros for hcond1...skipping...
all zeros for pptsw...skipping...
2019-05-02 21:57:49.246311 starting: processing obs type mflist water budget obs
2019-05-02 21:57:49.360013 forward_run line:pyemu.gw_utils.apply_mflist_budget_obs('freyberg.1
2019-05-02 21:57:49.360583 finished: processing obs type mflist water budget obs took: 0:00:00
2019-05-02 21:57:49.361112 starting: processing obs type hyd file
2019-05-02 21:57:49.361446 finished: processing obs type hyd file took: 0:00:00.000334
2019-05-02 21:57:49.361670 starting: processing obs type external obs-sim smp files
2019-05-02 21:57:49.361959 finished: processing obs type external obs-sim smp files took: 0:00
2019-05-02 21:57:49.362201 starting: processing obs type hob
2019-05-02 21:57:49.362365 finished: processing obs type hob took: 0:00:00.000164
2019-05-02 21:57:49.362573 starting: processing obs type hds
[[0, 0], [0, 1], [0, 2], [1, 0], [1, 1], [1, 2]]
2019-05-02 21:57:49.812520 finished: processing obs type hds took: 0:00:00.449947
2019-05-02 21:57:49.813188 starting: processing obs type sfr
writing 'sfr_obs.config' to template/sfr_obs.config
2019-05-02 21:57:50.186239 finished: processing obs type sfr took: 0:00:00.373051
2019-05-02 21:57:50.186794 changing dir in to template
2019-05-02 21:57:50.187612 starting: instantiating control file from i/o files
2019-05-02 21:57:50.187764 tpl files: drn.csv.tpl,wel.csv.tpl,hk3.dat_gr.tpl,vka3.dat_gr.tpl,s
2019-05-02 21:57:50.188009 ins files: freyberg.hds.dat.ins,vol.dat.ins,freyberg.sfr.out.proces
2019-05-02 21:57:50.523055 finished: instantiating control file from i/o files took: 0:00:00.3
2019-05-02 21:57:50.763382 starting: writing forward_run.py
2019-05-02 21:57:50.764576 finished: writing forward_run.py took: 0:00:00.001194
2019-05-02 21:57:50.764667 writing pst template/freyberg.pst
2019-05-02 21:57:52.547350 starting: running pestchek on freyberg.pst
2019-05-02 21:57:52.648610 pestcheck:PESTCHEK Version 13.0. Watermark Numerical Computing.
2019-05-02 21:57:52.648975 pestcheck:
2019-05-02 21:57:52.649033 pestcheck:Errors ----->
2019-05-02 21:57:52.649091 pestcheck:Line 2403 of file freyberg.pst: parameter name "prsity300
2019-05-02 21:57:52.649129 pestcheck:12 characters long.
2019-05-02 21:57:52.649756 pestcheck:Line 2404 of file freyberg.pst: parameter name "prsity300
2019-05-02 21:57:52.649819 pestcheck:12 characters long.
2019-05-02 21:57:52.649861 pestcheck:Line 2404 of file freyberg.pst: parameter name "prsity300
2019-05-02 21:57:52.650086 pestcheck:once.
2019-05-02 21:57:52.650145 pestcheck:Line 2405 of file freyberg.pst: parameter name "prsity300
2019-05-02 21:57:52.650184 pestcheck:12 characters long.

```

2019-05-02 21:57:52.650232 pestcheck:Line 2405 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.650712 pestcheck:once.
2019-05-02 21:57:52.650774 pestcheck:Line 2406 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.650815 pestcheck:12 characters long.
2019-05-02 21:57:52.650862 pestcheck:Line 2406 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.650898 pestcheck:once.
2019-05-02 21:57:52.650949 pestcheck:Line 2407 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.651065 pestcheck:12 characters long.
2019-05-02 21:57:52.651118 pestcheck:Line 2407 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.651223 pestcheck:once.
2019-05-02 21:57:52.651272 pestcheck:Line 2408 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.651312 pestcheck:12 characters long.
2019-05-02 21:57:52.651419 pestcheck:Line 2408 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.651530 pestcheck:once.
2019-05-02 21:57:52.651578 pestcheck:Line 2409 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.651618 pestcheck:12 characters long.
2019-05-02 21:57:52.651723 pestcheck:Line 2409 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.651918 pestcheck:once.
2019-05-02 21:57:52.652026 pestcheck:Line 2410 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.652077 pestcheck:12 characters long.
2019-05-02 21:57:52.652117 pestcheck:Line 2410 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.652221 pestcheck:once.
2019-05-02 21:57:52.652329 pestcheck:Line 2411 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.652383 pestcheck:12 characters long.
2019-05-02 21:57:52.652439 pestcheck:Line 2411 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.652586 pestcheck:once.
2019-05-02 21:57:52.652646 pestcheck:Line 2412 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.652753 pestcheck:12 characters long.
2019-05-02 21:57:52.652812 pestcheck:Line 2412 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.652920 pestcheck:once.
2019-05-02 21:57:52.652974 pestcheck:Line 2413 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.653075 pestcheck:12 characters long.
2019-05-02 21:57:52.653126 pestcheck:Line 2414 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.653166 pestcheck:12 characters long.
2019-05-02 21:57:52.653271 pestcheck:Line 2414 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.653381 pestcheck:once.
2019-05-02 21:57:52.653429 pestcheck:Line 2415 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.653536 pestcheck:12 characters long.
2019-05-02 21:57:52.653644 pestcheck:Line 2415 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.653764 pestcheck:once.
2019-05-02 21:57:52.653968 pestcheck:Line 2416 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.654080 pestcheck:12 characters long.
2019-05-02 21:57:52.654195 pestcheck:Line 2416 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.654304 pestcheck:once.
2019-05-02 21:57:52.654355 pestcheck:Line 2417 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.654463 pestcheck:12 characters long.
2019-05-02 21:57:52.654570 pestcheck:Line 2417 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.654692 pestcheck:once.

2019-05-02 21:57:52.654800 pestcheck:Line 2418 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.654856 pestcheck:12 characters long.
2019-05-02 21:57:52.654958 pestcheck:Line 2418 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.655065 pestcheck:once.
2019-05-02 21:57:52.655182 pestcheck:Line 2419 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.655289 pestcheck:12 characters long.
2019-05-02 21:57:52.655339 pestcheck:Line 2419 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.655380 pestcheck:once.
2019-05-02 21:57:52.655483 pestcheck:Line 2420 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.655591 pestcheck:12 characters long.
2019-05-02 21:57:52.655638 pestcheck:Line 2420 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.655680 pestcheck:once.
2019-05-02 21:57:52.655783 pestcheck:Line 2421 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.655976 pestcheck:12 characters long.
2019-05-02 21:57:52.656083 pestcheck:Line 2421 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.656133 pestcheck:once.
2019-05-02 21:57:52.656173 pestcheck:Line 2422 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.656276 pestcheck:12 characters long.
2019-05-02 21:57:52.656383 pestcheck:Line 2422 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.656501 pestcheck:once.
2019-05-02 21:57:52.656608 pestcheck:Line 2423 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.656726 pestcheck:12 characters long.
2019-05-02 21:57:52.656833 pestcheck:Line 2424 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.656960 pestcheck:12 characters long.
2019-05-02 21:57:52.657101 pestcheck:Line 2424 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.657203 pestcheck:once.
2019-05-02 21:57:52.657353 pestcheck:Line 2425 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.657399 pestcheck:12 characters long.
2019-05-02 21:57:52.657465 pestcheck:Line 2425 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.657679 pestcheck:once.
2019-05-02 21:57:52.657803 pestcheck:Line 2426 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.657931 pestcheck:12 characters long.
2019-05-02 21:57:52.657987 pestcheck:Line 2426 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.658088 pestcheck:once.
2019-05-02 21:57:52.658143 pestcheck:Line 2427 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.658254 pestcheck:12 characters long.
2019-05-02 21:57:52.658362 pestcheck:Line 2427 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.658481 pestcheck:once.
2019-05-02 21:57:52.658589 pestcheck:Line 2428 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.658641 pestcheck:12 characters long.
2019-05-02 21:57:52.658680 pestcheck:Line 2428 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.658731 pestcheck:once.
2019-05-02 21:57:52.658841 pestcheck:Line 2429 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.658976 pestcheck:12 characters long.
2019-05-02 21:57:52.659085 pestcheck:Line 2429 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.659195 pestcheck:once.
2019-05-02 21:57:52.659324 pestcheck:Line 2430 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.659391 pestcheck:12 characters long.

2019-05-02 21:57:52.659515 pestcheck:Line 2430 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.659579 pestcheck:once.
2019-05-02 21:57:52.659686 pestcheck:Line 2431 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.659806 pestcheck:12 characters long.
2019-05-02 21:57:52.659922 pestcheck:Line 2431 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.659970 pestcheck:once.
2019-05-02 21:57:52.660009 pestcheck:Line 2432 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.660111 pestcheck:12 characters long.
2019-05-02 21:57:52.660215 pestcheck:Line 2432 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.660333 pestcheck:once.
2019-05-02 21:57:52.660438 pestcheck:Line 2433 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.660552 pestcheck:12 characters long.
2019-05-02 21:57:52.660656 pestcheck:Line 2434 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.660769 pestcheck:12 characters long.
2019-05-02 21:57:52.660872 pestcheck:Line 2434 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.660961 pestcheck:once.
2019-05-02 21:57:52.661032 pestcheck:Line 2435 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.661136 pestcheck:12 characters long.
2019-05-02 21:57:52.661249 pestcheck:Line 2435 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.661354 pestcheck:once.
2019-05-02 21:57:52.661403 pestcheck:Line 2436 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.661506 pestcheck:12 characters long.
2019-05-02 21:57:52.661610 pestcheck:Line 2436 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.661657 pestcheck:once.
2019-05-02 21:57:52.661760 pestcheck:Line 2437 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.661863 pestcheck:12 characters long.
2019-05-02 21:57:52.661981 pestcheck:Line 2437 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.662084 pestcheck:once.
2019-05-02 21:57:52.662130 pestcheck:Line 2438 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.662169 pestcheck:12 characters long.
2019-05-02 21:57:52.662268 pestcheck:Line 2438 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.662372 pestcheck:once.
2019-05-02 21:57:52.662421 pestcheck:Line 2439 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.662460 pestcheck:12 characters long.
2019-05-02 21:57:52.662560 pestcheck:Line 2439 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.662694 pestcheck:once.
2019-05-02 21:57:52.662983 pestcheck:Line 2440 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.663051 pestcheck:12 characters long.
2019-05-02 21:57:52.663192 pestcheck:Line 2440 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.663249 pestcheck:once.
2019-05-02 21:57:52.663347 pestcheck:Line 2441 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.663399 pestcheck:12 characters long.
2019-05-02 21:57:52.663503 pestcheck:Line 2441 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.663606 pestcheck:once.
2019-05-02 21:57:52.663654 pestcheck:Line 2442 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.663757 pestcheck:12 characters long.
2019-05-02 21:57:52.663858 pestcheck:Line 2442 of file freyberg.pst: parameter name "prsity300.
2019-05-02 21:57:52.663905 pestcheck:once.

2019-05-02 21:57:52.664007 pestcheck:Line 2443 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.664123 pestcheck:12 characters long.
2019-05-02 21:57:52.664223 pestcheck:Line 2444 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.664325 pestcheck:12 characters long.
2019-05-02 21:57:52.664370 pestcheck:Line 2444 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.664471 pestcheck:once.
2019-05-02 21:57:52.664573 pestcheck:Line 2445 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.664619 pestcheck:12 characters long.
2019-05-02 21:57:52.664720 pestcheck:Line 2445 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.664823 pestcheck:once.
2019-05-02 21:57:52.664869 pestcheck:Line 2446 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.664970 pestcheck:12 characters long.
2019-05-02 21:57:52.665085 pestcheck:Line 2446 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.665185 pestcheck:once.
2019-05-02 21:57:52.665288 pestcheck:Line 2447 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.665333 pestcheck:12 characters long.
2019-05-02 21:57:52.665435 pestcheck:Line 2447 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.665569 pestcheck:once.
2019-05-02 21:57:52.665637 pestcheck:Line 2448 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.665737 pestcheck:12 characters long.
2019-05-02 21:57:52.665840 pestcheck:Line 2448 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.665952 pestcheck:once.
2019-05-02 21:57:52.666069 pestcheck:Line 2449 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.666171 pestcheck:12 characters long.
2019-05-02 21:57:52.666273 pestcheck:Line 2449 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.666319 pestcheck:once.
2019-05-02 21:57:52.666419 pestcheck:Line 2450 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.666522 pestcheck:12 characters long.
2019-05-02 21:57:52.667382 pestcheck:Line 2450 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.667516 pestcheck:once.
2019-05-02 21:57:52.667625 pestcheck:Line 2451 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.667731 pestcheck:12 characters long.
2019-05-02 21:57:52.667846 pestcheck:Line 2451 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.667953 pestcheck:once.
2019-05-02 21:57:52.668000 pestcheck:Line 2452 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.668104 pestcheck:12 characters long.
2019-05-02 21:57:52.668209 pestcheck:Line 2452 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.668324 pestcheck:once.
2019-05-02 21:57:52.668428 pestcheck:Line 2453 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.668546 pestcheck:12 characters long.
2019-05-02 21:57:52.668651 pestcheck:Line 2454 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.668699 pestcheck:12 characters long.
2019-05-02 21:57:52.668802 pestcheck:Line 2454 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.668908 pestcheck:once.
2019-05-02 21:57:52.668955 pestcheck:Line 2455 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.669059 pestcheck:12 characters long.
2019-05-02 21:57:52.669163 pestcheck:Line 2455 of file freyberg.pst: parameter name "prsity3002
2019-05-02 21:57:52.669209 pestcheck:once.

2019-05-02 21:57:52.669312 pestcheck:Line 2456 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.669417 pestcheck:12 characters long.
2019-05-02 21:57:52.669536 pestcheck:Line 2456 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.669641 pestcheck:once.
2019-05-02 21:57:52.669754 pestcheck:Line 2457 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.669858 pestcheck:12 characters long.
2019-05-02 21:57:52.669905 pestcheck:Line 2457 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.670009 pestcheck:once.
2019-05-02 21:57:52.670114 pestcheck:Line 2458 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.670161 pestcheck:12 characters long.
2019-05-02 21:57:52.670266 pestcheck:Line 2458 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.670370 pestcheck:once.
2019-05-02 21:57:52.670417 pestcheck:Line 2459 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.670594 pestcheck:12 characters long.
2019-05-02 21:57:52.670642 pestcheck:Line 2459 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.670746 pestcheck:once.
2019-05-02 21:57:52.670851 pestcheck:Line 2460 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.670965 pestcheck:12 characters long.
2019-05-02 21:57:52.671069 pestcheck:Line 2460 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.671184 pestcheck:once.
2019-05-02 21:57:52.671289 pestcheck:Line 2461 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.671336 pestcheck:12 characters long.
2019-05-02 21:57:52.671440 pestcheck:Line 2461 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.671563 pestcheck:once.
2019-05-02 21:57:52.671668 pestcheck:Line 2462 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.671773 pestcheck:12 characters long.
2019-05-02 21:57:52.671819 pestcheck:Line 2462 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.671925 pestcheck:once.
2019-05-02 21:57:52.672030 pestcheck:Line 2463 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.672077 pestcheck:12 characters long.
2019-05-02 21:57:52.672182 pestcheck:Line 2464 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.672286 pestcheck:12 characters long.
2019-05-02 21:57:52.672334 pestcheck:Line 2464 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.672438 pestcheck:once.
2019-05-02 21:57:52.672561 pestcheck:Line 2465 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.672664 pestcheck:12 characters long.
2019-05-02 21:57:52.672769 pestcheck:Line 2465 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.672816 pestcheck:once.
2019-05-02 21:57:52.672920 pestcheck:Line 2466 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.673025 pestcheck:12 characters long.
2019-05-02 21:57:52.673072 pestcheck:Line 2466 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.673176 pestcheck:once.
2019-05-02 21:57:52.673282 pestcheck:Line 2467 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.673329 pestcheck:12 characters long.
2019-05-02 21:57:52.673401 pestcheck:Line 2467 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.673574 pestcheck:once.
2019-05-02 21:57:52.673685 pestcheck:Line 2468 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.673735 pestcheck:12 characters long.

2019-05-02 21:57:52.673773 pestcheck:Line 2468 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.673884 pestcheck:once.
2019-05-02 21:57:52.674023 pestcheck:Line 2469 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.674070 pestcheck:12 characters long.
2019-05-02 21:57:52.674109 pestcheck:Line 2469 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.674299 pestcheck:once.
2019-05-02 21:57:52.674364 pestcheck:Line 2470 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.674478 pestcheck:12 characters long.
2019-05-02 21:57:52.674536 pestcheck:Line 2470 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.674645 pestcheck:once.
2019-05-02 21:57:52.674755 pestcheck:Line 2471 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.674802 pestcheck:12 characters long.
2019-05-02 21:57:52.674841 pestcheck:Line 2471 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.674944 pestcheck:once.
2019-05-02 21:57:52.675051 pestcheck:Line 2472 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.675097 pestcheck:12 characters long.
2019-05-02 21:57:52.675201 pestcheck:Line 2472 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.675307 pestcheck:once.
2019-05-02 21:57:52.675353 pestcheck:Line 2473 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.675457 pestcheck:12 characters long.
2019-05-02 21:57:52.675576 pestcheck:Line 2474 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.675679 pestcheck:12 characters long.
2019-05-02 21:57:52.675782 pestcheck:Line 2474 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.675831 pestcheck:once.
2019-05-02 21:57:52.675934 pestcheck:Line 2475 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.676038 pestcheck:12 characters long.
2019-05-02 21:57:52.676083 pestcheck:Line 2475 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.676185 pestcheck:once.
2019-05-02 21:57:52.676287 pestcheck:Line 2476 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.676332 pestcheck:12 characters long.
2019-05-02 21:57:52.676434 pestcheck:Line 2476 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.676551 pestcheck:once.
2019-05-02 21:57:52.676653 pestcheck:Line 2477 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.676755 pestcheck:12 characters long.
2019-05-02 21:57:52.676800 pestcheck:Line 2477 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.676903 pestcheck:once.
2019-05-02 21:57:52.677006 pestcheck:Line 2478 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.677050 pestcheck:12 characters long.
2019-05-02 21:57:52.677153 pestcheck:Line 2478 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.677256 pestcheck:once.
2019-05-02 21:57:52.677301 pestcheck:Line 2479 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.677403 pestcheck:12 characters long.
2019-05-02 21:57:52.677560 pestcheck:Line 2479 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.677991 pestcheck:once.
2019-05-02 21:57:52.678367 pestcheck:Line 2480 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.678645 pestcheck:12 characters long.
2019-05-02 21:57:52.678704 pestcheck:Line 2480 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.678812 pestcheck:once.

2019-05-02 21:57:52.678924 pestcheck:Line 2481 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.678975 pestcheck:12 characters long.
2019-05-02 21:57:52.679081 pestcheck:Line 2481 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.679187 pestcheck:once.
2019-05-02 21:57:52.679243 pestcheck:Line 2482 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.679335 pestcheck:12 characters long.
2019-05-02 21:57:52.679441 pestcheck:Line 2482 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.679560 pestcheck:once.
2019-05-02 21:57:52.679666 pestcheck:Line 2483 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.679780 pestcheck:12 characters long.
2019-05-02 21:57:52.679886 pestcheck:Line 2484 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.679936 pestcheck:12 characters long.
2019-05-02 21:57:52.680041 pestcheck:Line 2484 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.680146 pestcheck:once.
2019-05-02 21:57:52.680260 pestcheck:Line 2485 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.680364 pestcheck:12 characters long.
2019-05-02 21:57:52.680478 pestcheck:Line 2485 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.680597 pestcheck:once.
2019-05-02 21:57:52.680702 pestcheck:Line 2486 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.680806 pestcheck:12 characters long.
2019-05-02 21:57:52.680921 pestcheck:Line 2486 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.681026 pestcheck:once.
2019-05-02 21:57:52.681140 pestcheck:Line 2487 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.681244 pestcheck:12 characters long.
2019-05-02 21:57:52.681359 pestcheck:Line 2487 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.681464 pestcheck:once.
2019-05-02 21:57:52.681582 pestcheck:Line 2488 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.681687 pestcheck:12 characters long.
2019-05-02 21:57:52.681800 pestcheck:Line 2488 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.681905 pestcheck:once.
2019-05-02 21:57:52.682019 pestcheck:Line 2489 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.682123 pestcheck:12 characters long.
2019-05-02 21:57:52.682173 pestcheck:Line 2489 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.682277 pestcheck:once.
2019-05-02 21:57:52.682382 pestcheck:Line 2490 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.682431 pestcheck:12 characters long.
2019-05-02 21:57:52.682608 pestcheck:Line 2490 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.682738 pestcheck:once.
2019-05-02 21:57:52.682839 pestcheck:Line 2491 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.682887 pestcheck:12 characters long.
2019-05-02 21:57:52.682989 pestcheck:Line 2491 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.683091 pestcheck:once.
2019-05-02 21:57:52.683136 pestcheck:Line 2492 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.683237 pestcheck:12 characters long.
2019-05-02 21:57:52.683339 pestcheck:Line 2492 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.683385 pestcheck:once.
2019-05-02 21:57:52.683425 pestcheck:Line 2493 of file freyberg.pst: parameter name "prsity3003
2019-05-02 21:57:52.683621 pestcheck:12 characters long.

2019-05-02 21:57:52.683723 pestcheck:Line 2494 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.683825 pestcheck:12 characters long.
2019-05-02 21:57:52.683873 pestcheck:Line 2494 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.683975 pestcheck:once.
2019-05-02 21:57:52.684077 pestcheck:Line 2495 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.684125 pestcheck:12 characters long.
2019-05-02 21:57:52.684226 pestcheck:Line 2495 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.684329 pestcheck:once.
2019-05-02 21:57:52.684377 pestcheck:Line 2496 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.684479 pestcheck:12 characters long.
2019-05-02 21:57:52.684661 pestcheck:Line 2496 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.684763 pestcheck:once.
2019-05-02 21:57:52.684873 pestcheck:Line 2497 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.684975 pestcheck:12 characters long.
2019-05-02 21:57:52.685022 pestcheck:Line 2497 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.685064 pestcheck:once.
2019-05-02 21:57:52.685162 pestcheck:Line 2498 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.685263 pestcheck:12 characters long.
2019-05-02 21:57:52.685374 pestcheck:Line 2498 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.685476 pestcheck:once.
2019-05-02 21:57:52.685591 pestcheck:Line 2499 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.685693 pestcheck:12 characters long.
2019-05-02 21:57:52.685738 pestcheck:Line 2499 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.685779 pestcheck:once.
2019-05-02 21:57:52.685877 pestcheck:Line 2500 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.685978 pestcheck:12 characters long.
2019-05-02 21:57:52.686059 pestcheck:Line 2500 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.686130 pestcheck:once.
2019-05-02 21:57:52.686232 pestcheck:Line 2501 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.686343 pestcheck:12 characters long.
2019-05-02 21:57:52.686445 pestcheck:Line 2501 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.686563 pestcheck:once.
2019-05-02 21:57:52.686664 pestcheck:Line 2502 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.686709 pestcheck:12 characters long.
2019-05-02 21:57:52.686747 pestcheck:Line 2502 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.686845 pestcheck:once.
2019-05-02 21:57:52.686946 pestcheck:Line 2503 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.686994 pestcheck:12 characters long.
2019-05-02 21:57:52.687095 pestcheck:Line 2504 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.687196 pestcheck:12 characters long.
2019-05-02 21:57:52.687244 pestcheck:Line 2504 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.687346 pestcheck:once.
2019-05-02 21:57:52.687448 pestcheck:Line 2505 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.687563 pestcheck:12 characters long.
2019-05-02 21:57:52.687701 pestcheck:Line 2505 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.687798 pestcheck:once.
2019-05-02 21:57:52.687911 pestcheck:Line 2506 of file freyberg.pst: parameter name "prsity3004
2019-05-02 21:57:52.688013 pestcheck:12 characters long.

```

2019-05-02 21:57:52.688125 pestcheck:Line 2506 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.688226 pestcheck:once.
2019-05-02 21:57:52.688272 pestcheck:Line 2507 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.688373 pestcheck:12 characters long.
2019-05-02 21:57:52.688475 pestcheck:Line 2507 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.688590 pestcheck:once.
2019-05-02 21:57:52.688691 pestcheck:Line 2508 of file freyberg.pst: parameter name "prsity3000
2019-05-02 21:57:52.688802 pestcheck:12 characters long.
2019-05-02 21:57:52.689114 finished: running pestchek on freyberg.pst took: 0:00:00.141764
2019-05-02 21:57:52.689194 starting: saving intermediate _setup_<> dfs into template
2019-05-02 21:57:52.826338 finished: saving intermediate _setup_<> dfs into template took: 0:00:00.141764
2019-05-02 21:57:52.826652 all done

```

The `pst_helper` instance contains the `pyemu.Pst` instance:

```

In [14]: pst = pst_helper.pst
         pst.npar,pst.nobs

```

```

Out[14]: (14819, 4434)

```

Oh snap!

1.0.4 Add modpath input files, instruction files and calls

```

In [15]: mp_files = [f for f in os.listdir(b_d) if "mp" in f or "location" in f]
         [shutil.copy2(os.path.join(b_d,f),os.path.join(pst_helper.new_model_ws,f)) for f in mp_files]

```

```

Out[15]: ['template/mp_ibound_1.ref',
         'template/mp_ibound_2.ref',
         'template/mp_ibound_3.ref',
         'template/freyberg.locations',
         'template/freyberg.mpsim',
         'template/freyberg.mpbas',
         'template/freyberg.mpsnam']

```

```

In [16]: pst_helper.frun_post_lines.append("os.system('mp6 freyberg.mpsim >mp6.stdout')")
         pst_helper.tmp_files.append("freyberg.mpenpt")
         pst_helper.write_forward_run()

```

```

In [17]: out_file = "freyberg.mpenpt"
         ins_file = out_file + ".ins"
         with open(os.path.join(pst_helper.new_model_ws,ins_file),'w') as f:
             f.write("pif ~\n")
             f.write("l7 w w w !part_status! w w !part_time!\n")
         df = pst_helper.pst.add_observations(os.path.join(pst_helper.new_model_ws,ins_file),os.path.join(pst_helper.new_model_ws,ins_file))

error using inschek for instruction file ./freyberg.mpenpt.ins:File b'template/./freyberg.mpenpt.ins' does not exist
observations in this instruction file will have generic values.

```

```

In [18]: for k in range(m.nlay):
         np.savetxt(os.path.join(pst_helper.new_model_ws,"arr_org","prsity_layer_{0}.ref".format(k)),df[k,:])

```

1.0.5 Final bits and bobs

We need to set some realistic parameter bounds and account for expected (but stochastic) scenario conditions:

```
In [19]: par = pst.parameter_data
         # properties
         tag_dict = {"hk": [0.1, 10.0], "vka": [0.1, 10], "strt": [0.95, 1.05], "prsity": [0.1, 1.0]}
         for t, [l, u] in tag_dict.items():
             t_pars = par.loc[par.parnme.apply(lambda x: t in x), "parnme"]
             par.loc[t_pars, "parubnd"] = u
             par.loc[t_pars, "parlbnd"] = l

         # recharge - just change the uniform recharge mult
         scen_rch = ["cn_rech5"]
         hist_rch = ["cn_rech4"]
         par.loc[par.pargp.apply(lambda x: x in scen_rch), "parubnd"] = 0.8
         par.loc[par.pargp.apply(lambda x: x in scen_rch), "parlbnd"] = 0.1
         par.loc[par.pargp.apply(lambda x: x in scen_rch), "parval1"] = 0.4
         par.loc[par.pargp.apply(lambda x: x in hist_rch), "parubnd"] = 1.2
         par.loc[par.pargp.apply(lambda x: x in hist_rch), "parlbnd"] = 0.8
         par.loc[par.pargp.apply(lambda x: x in hist_rch), "parval1"] = 1.0

         # well abstraction
         par.loc["welflux_001", "parval1"] = 1.5
         par.loc["welflux_001", "parlbnd"] = 1.0
         par.loc["welflux_001", "parubnd"] = 2.0
         par.loc["welflux_000", "parval1"] = 1.0
         par.loc["welflux_000", "parlbnd"] = 0.5
         par.loc["welflux_000", "parubnd"] = 1.5

In [20]: # table can also be written to a .tex file
         pst.write_par_summary_table(filename="none").sort_index()
```

```
Out[20]:
```

| | type | transform | count | initial value | \ |
|------------|------------|-----------|-------|---------------|---|
| cn_hk6 | cn_hk6 | log | 1 | 0 | |
| cn_hk7 | cn_hk7 | log | 1 | 0 | |
| cn_hk8 | cn_hk8 | log | 1 | 0 | |
| cn_prsity6 | cn_prsity6 | log | 1 | 0 | |
| cn_prsity7 | cn_prsity7 | log | 1 | 0 | |
| cn_prsity8 | cn_prsity8 | log | 1 | 0 | |
| cn_rech4 | cn_rech4 | log | 1 | 0 | |
| cn_rech5 | cn_rech5 | log | 1 | -0.39794 | |
| cn_ss6 | cn_ss6 | log | 1 | 0 | |
| cn_ss7 | cn_ss7 | log | 1 | 0 | |
| cn_ss8 | cn_ss8 | log | 1 | 0 | |
| cn_strt6 | cn_strt6 | log | 1 | 0 | |
| cn_strt7 | cn_strt7 | log | 1 | 0 | |
| cn_strt8 | cn_strt8 | log | 1 | 0 | |

| | | | | |
|-------------|-------------|-----|-----|---------------|
| cn_sy6 | cn_sy6 | log | 1 | 0 |
| cn_sy7 | cn_sy7 | log | 1 | 0 |
| cn_sy8 | cn_sy8 | log | 1 | 0 |
| cn_vka6 | cn_vka6 | log | 1 | 0 |
| cn_vka7 | cn_vka7 | log | 1 | 0 |
| cn_vka8 | cn_vka8 | log | 1 | 0 |
| drncond_k00 | drncond_k00 | log | 10 | 0 |
| flow | flow | log | 1 | 0 |
| gr_hk3 | gr_hk3 | log | 705 | 0 |
| gr_hk4 | gr_hk4 | log | 705 | 0 |
| gr_hk5 | gr_hk5 | log | 705 | 0 |
| gr_prsity3 | gr_prsity3 | log | 705 | 0 |
| gr_prsity4 | gr_prsity4 | log | 705 | 0 |
| gr_prsity5 | gr_prsity5 | log | 705 | 0 |
| gr_rech2 | gr_rech2 | log | 705 | 0 |
| gr_rech3 | gr_rech3 | log | 705 | 0 |
| ... | ... | ... | ... | ... |
| gr_strt5 | gr_strt5 | log | 705 | 0 |
| gr_sy3 | gr_sy3 | log | 705 | 0 |
| gr_sy4 | gr_sy4 | log | 705 | 0 |
| gr_sy5 | gr_sy5 | log | 705 | 0 |
| gr_vka3 | gr_vka3 | log | 705 | 0 |
| gr_vka4 | gr_vka4 | log | 705 | 0 |
| gr_vka5 | gr_vka5 | log | 705 | 0 |
| pp_hk0 | pp_hk0 | log | 32 | 0 |
| pp_hk1 | pp_hk1 | log | 32 | 0 |
| pp_hk2 | pp_hk2 | log | 32 | 0 |
| pp_prsity0 | pp_prsity0 | log | 32 | 0 |
| pp_prsity1 | pp_prsity1 | log | 32 | 0 |
| pp_prsity2 | pp_prsity2 | log | 32 | 0 |
| pp_rech0 | pp_rech0 | log | 32 | 0 |
| pp_rech1 | pp_rech1 | log | 32 | 0 |
| pp_ss0 | pp_ss0 | log | 32 | 0 |
| pp_ss1 | pp_ss1 | log | 32 | 0 |
| pp_ss2 | pp_ss2 | log | 32 | 0 |
| pp_strt0 | pp_strt0 | log | 32 | 0 |
| pp_strt1 | pp_strt1 | log | 32 | 0 |
| pp_strt2 | pp_strt2 | log | 32 | 0 |
| pp_sy0 | pp_sy0 | log | 32 | 0 |
| pp_sy1 | pp_sy1 | log | 32 | 0 |
| pp_sy2 | pp_sy2 | log | 32 | 0 |
| pp_vka0 | pp_vka0 | log | 32 | 0 |
| pp_vka1 | pp_vka1 | log | 32 | 0 |
| pp_vka2 | pp_vka2 | log | 32 | 0 |
| strk | strk | log | 40 | 0 |
| welflux | welflux | log | 2 | 0 to 0.176091 |
| welflux_k02 | welflux_k02 | log | 6 | 0 |

| | upper bound | lower bound | standard deviation |
|-------------|-------------|-------------|--------------------|
| cn_hk6 | 1 | -1 | 0.5 |
| cn_hk7 | 1 | -1 | 0.5 |
| cn_hk8 | 1 | -1 | 0.5 |
| cn_prsity6 | 0 | -1 | 0.25 |
| cn_prsity7 | 0 | -1 | 0.25 |
| cn_prsity8 | 0 | -1 | 0.25 |
| cn_rech4 | 0.0791812 | -0.09691 | 0.0440228 |
| cn_rech5 | -0.09691 | -1 | 0.225772 |
| cn_ss6 | 1 | -1 | 0.5 |
| cn_ss7 | 1 | -1 | 0.5 |
| cn_ss8 | 1 | -1 | 0.5 |
| cn_strt6 | 0.0211893 | -0.0222764 | 0.0108664 |
| cn_strt7 | 0.0211893 | -0.0222764 | 0.0108664 |
| cn_strt8 | 0.0211893 | -0.0222764 | 0.0108664 |
| cn_sy6 | 0.243038 | -0.60206 | 0.211275 |
| cn_sy7 | 0.243038 | -0.60206 | 0.211275 |
| cn_sy8 | 0.243038 | -0.60206 | 0.211275 |
| cn_vka6 | 1 | -1 | 0.5 |
| cn_vka7 | 1 | -1 | 0.5 |
| cn_vka8 | 1 | -1 | 0.5 |
| drncond_k00 | 1 | -1 | 0.5 |
| flow | 0.09691 | -0.124939 | 0.0554622 |
| gr_hk3 | 1 | -1 | 0.5 |
| gr_hk4 | 1 | -1 | 0.5 |
| gr_hk5 | 1 | -1 | 0.5 |
| gr_prsity3 | 0 | -1 | 0.25 |
| gr_prsity4 | 0 | -1 | 0.25 |
| gr_prsity5 | 0 | -1 | 0.25 |
| gr_rech2 | 0.0413927 | -0.0457575 | 0.0217875 |
| gr_rech3 | 0.0413927 | -0.0457575 | 0.0217875 |
| ... | ... | ... | ... |
| gr_strt5 | 0.0211893 | -0.0222764 | 0.0108664 |
| gr_sy3 | 0.243038 | -0.60206 | 0.211275 |
| gr_sy4 | 0.243038 | -0.60206 | 0.211275 |
| gr_sy5 | 0.243038 | -0.60206 | 0.211275 |
| gr_vka3 | 1 | -1 | 0.5 |
| gr_vka4 | 1 | -1 | 0.5 |
| gr_vka5 | 1 | -1 | 0.5 |
| pp_hk0 | 1 | -1 | 0.5 |
| pp_hk1 | 1 | -1 | 0.5 |
| pp_hk2 | 1 | -1 | 0.5 |
| pp_prsity0 | 0 | -1 | 0.25 |
| pp_prsity1 | 0 | -1 | 0.25 |
| pp_prsity2 | 0 | -1 | 0.25 |
| pp_rech0 | 0.0413927 | -0.0457575 | 0.0217875 |
| pp_rech1 | 0.0413927 | -0.0457575 | 0.0217875 |
| pp_ss0 | 1 | -1 | 0.5 |

| | | | |
|-------------|---------------------|---------------|----------------------|
| pp_ss1 | 1 | -1 | 0.5 |
| pp_ss2 | 1 | -1 | 0.5 |
| pp_strt0 | 0.0211893 | -0.0222764 | 0.0108664 |
| pp_strt1 | 0.0211893 | -0.0222764 | 0.0108664 |
| pp_strt2 | 0.0211893 | -0.0222764 | 0.0108664 |
| pp_sy0 | 0.243038 | -0.60206 | 0.211275 |
| pp_sy1 | 0.243038 | -0.60206 | 0.211275 |
| pp_sy2 | 0.243038 | -0.60206 | 0.211275 |
| pp_vka0 | 1 | -1 | 0.5 |
| pp_vka1 | 1 | -1 | 0.5 |
| pp_vka2 | 1 | -1 | 0.5 |
| strk | 2 | -2 | 1 |
| welflux | 0.176091 to 0.30103 | -0.30103 to 0 | 0.0752575 to 0.11928 |
| welflux_k02 | 1 | -1 | 0.5 |

[65 rows x 7 columns]

In [21]: pst.write_obs_summary_table(filename="none")

Out [21]:

| | group | value | non-zero weight | \ |
|-------------|-------------|------------------------------|-----------------|---|
| flaqx | flaqx | -977.239 to 32.171 | 84 | |
| flout | flout | 10069 to 226396 | 84 | |
| flx_constan | flx_constan | 0 | 2 | |
| flx_drains | flx_drains | -723.325 to -723.028 | 2 | |
| flx_in-out | flx_in-out | 0.012695 to 0.046143 | 2 | |
| flx_percent | flx_percent | 0 | 2 | |
| flx_recharg | flx_recharg | 3045.6 | 2 | |
| flx_storage | flx_storage | 5.7734 to 8.01049 | 2 | |
| flx_stream_ | flx_stream_ | -1430.27 to -1428.3 | 2 | |
| flx_total | flx_total | 0.0126953 to 0.0461426 | 2 | |
| flx_wells | flx_wells | -900 | 2 | |
| hds | hds | 32.5065 to 39.6612 | 4230 | |
| obgnme | obgnme | 1E+10 | 2 | |
| vol_constan | vol_constan | 0 | 2 | |
| vol_drains | vol_drains | -2.90404E+06 to -2.64014E+06 | 2 | |
| vol_in-out | vol_in-out | 45 to 63 | 2 | |
| vol_percent | vol_percent | 0 | 2 | |
| vol_recharg | vol_recharg | 1.11164E+07 to 1.22281E+07 | 2 | |
| vol_storage | vol_storage | 29238.3 to 31345.6 | 2 | |
| vol_stream_ | vol_stream_ | -5.74182E+06 to -5.22049E+06 | 2 | |
| vol_total | vol_total | 45 to 63 | 2 | |
| vol_wells | vol_wells | -3.6135E+06 to -3.285E+06 | 2 | |

| | zero weight | weight | standard deviation | percent error |
|-------------|-------------|--------|--------------------|---------------------------|
| flaqx | 0 | 1 | 1 | 0.102329 to 833.333 |
| flout | 0 | 1 | 1 | 0.000441704 to 0.00993147 |
| flx_constan | 0 | 1 | 1 | NA |
| flx_drains | 0 | 1 | 1 | 0.13825 to 0.138307 |

| | | | | |
|-------------|---|---|---|----------------------------|
| flx_in-out | 0 | 1 | 1 | 2167.18 to 7877.12 |
| flx_percent | 0 | 1 | 1 | NA |
| flx_recharg | 0 | 1 | 1 | 0.0328343 |
| flx_storage | 0 | 1 | 1 | 12.4836 to 17.3208 |
| flx_stream_ | 0 | 1 | 1 | 0.0699167 to 0.0700133 |
| flx_total | 0 | 1 | 1 | 2167.2 to 7876.92 |
| flx_wells | 0 | 1 | 1 | 0.111111 |
| hds | 0 | 1 | 1 | 2.52136 to 3.07631 |
| obgnme | 0 | 1 | 1 | 1E-08 |
| vol_constan | 0 | 1 | 1 | NA |
| vol_drains | 0 | 1 | 1 | 3.44348E-05 to 3.78768E-05 |
| vol_in-out | 0 | 1 | 1 | 1.5873 to 2.22222 |
| vol_percent | 0 | 1 | 1 | NA |
| vol_recharg | 0 | 1 | 1 | 8.1779E-06 to 8.99569E-06 |
| vol_storage | 0 | 1 | 1 | 0.00319024 to 0.00342017 |
| vol_stream_ | 0 | 1 | 1 | 1.74161E-05 to 1.91553E-05 |
| vol_total | 0 | 1 | 1 | 1.5873 to 2.22222 |
| vol_wells | 0 | 1 | 1 | 2.7674E-05 to 3.04414E-05 |

Lets run the process once (noptmax=0) to make sure its all plumbed up

```
In [22]: pst.control_data.noptmax = 0
pst.write(os.path.join(pst_helper.new_model_ws,"freyberg.pst"))
pyemu.os_utils.run("pestpp-ies freyberg.pst",cwd=pst_helper.new_model_ws)
```

Now we need to generate the prior parameter covariance matrix and stochastic realizations. We will use the geostatistical covariance information in the pst_helper instance for this:

```
In [23]: if pst_helper.pst.npar < 15000:
cov = pst_helper.build_prior(fmt="coo",filename=os.path.join(pst_helper.new_model_ws,"cov.coo"))
cov = np.ma.masked_where(cov.x==0,cov.x)
fig = plt.figure(figsize=(10,10))
ax = plt.subplot(111)
ax.imshow(cov)
```

2019-05-02 21:58:02.162939 starting: building prior covariance matrix

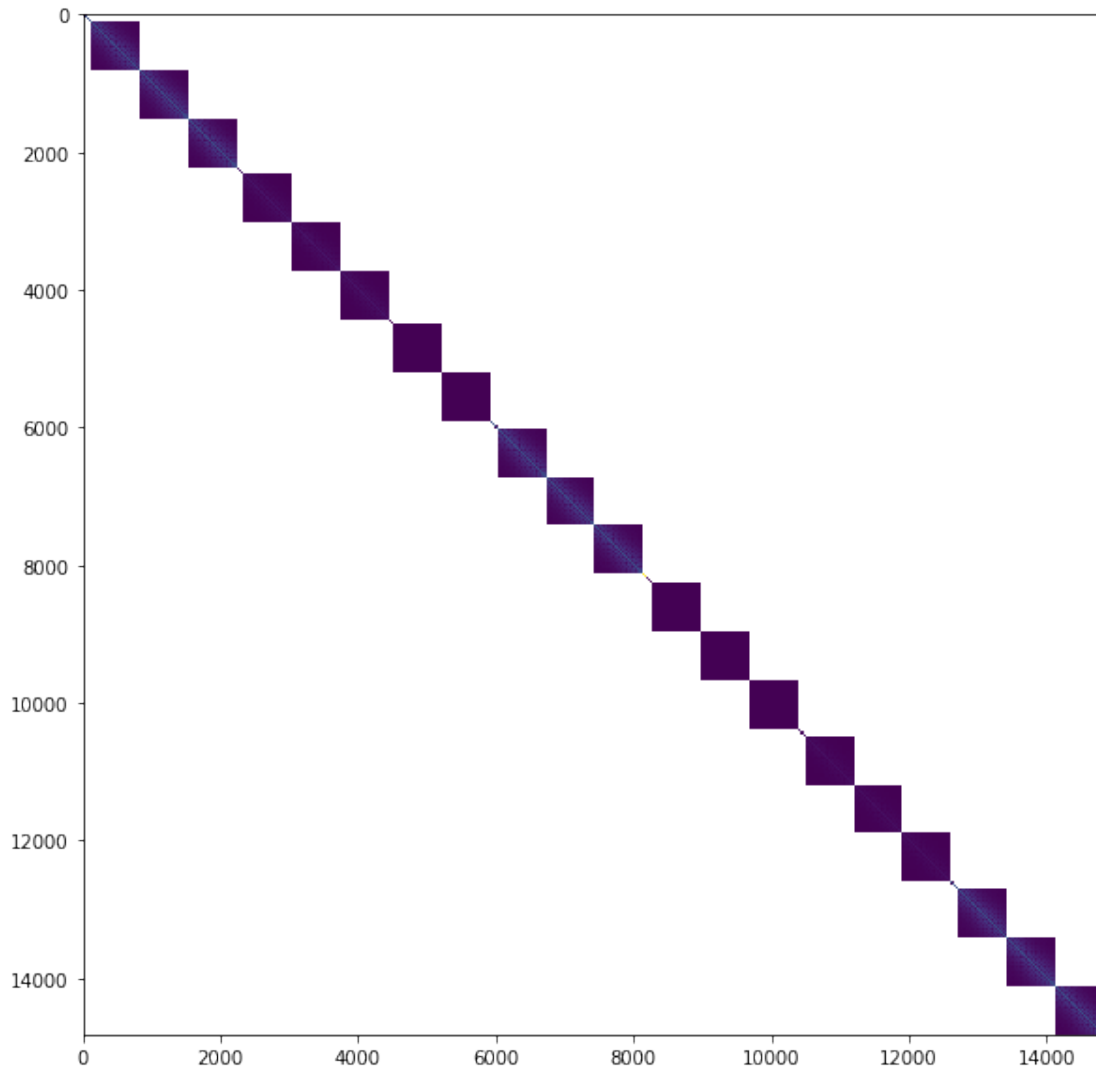
2019-05-02 21:58:02.270694 WARNING: geospatial prior not implemented for SFR pars

/Users/jeremyw/miniconda3/lib/python3.5/site-packages/pandas/core/indexing.py:362: SettingWithCopyWarning: A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: <http://pandas.pydata.org/pandas-docs/stable/indexing.html>
self.obj[key] = _infer_fill_value(value)
/Users/jeremyw/miniconda3/lib/python3.5/site-packages/pandas/core/indexing.py:543: SettingWithCopyWarning: A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: <http://pandas.pydata.org/pandas-docs/stable/indexing.html>
self.obj[item] = s

2019-05-02 21:58:08.907720 saving prior covariance matrix to file template/prior_cov.jcb
2019-05-02 21:58:13.235835 finished: building prior covariance matrix took: 0:00:11.072896



In [24]: pe = pst_helper.draw(200)

2019-05-02 21:58:30.155612 starting: drawing realizations
building diagonal cov
processing name:struct1,nugget:0.0,structures:
name:var1,contribution:1.0,a:1000.0,anisotropy:1.0,bearing:0.0


```

working on pargroups ['pp_hk0']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_vka0']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_ss0']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_sy0']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_strt0']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_prsity0']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_rech0']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_rech1']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness

```

```

working on pargroups ['pp_vka1']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_sy1']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_ss1']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_prsity1']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_strt1']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_hk1']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_strt2']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_hk2']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness

```

```

working on pargroups ['pp_prsity2']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_sy2']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_vka2']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['pp_ss2']
build cov matrix
done
getting diag var cov 32
scaling full cov by diag var cov
making full cov draws with home-grown goodness
processing name:struct1,nugget:0.0,structures:
name:var1,contribution:1.0,a:180.0,anisotropy:1.0,bearing:0.0

```

```

working on pargroups ['welflux']
build cov matrix
done
getting diag var cov 2
scaling full cov by diag var cov
making full cov draws with home-grown goodness
processing name:struct1,nugget:0.0,structures:
name:var1,contribution:1.0,a:2500.0,anisotropy:1.0,bearing:0.0

```

```

working on pargroups ['drncond_k00']

```

```

/Users/jeremyw/miniconda3/lib/python3.5/site-packages/pandas/core/indexing.py:362: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

```

```

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
self.obj[key] = _infer_fill_value(value)
/Users/jeremyw/miniconda3/lib/python3.5/site-packages/pandas/core/indexing.py:543: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

```

See the caveats in the documentation: <http://pandas.pydata.org/pandas-docs/stable/indexing.html>

```
self.obj[item] = s
```

```
build cov matrix
```

```
done
```

```
getting diag var cov 10
```

```
scaling full cov by diag var cov
```

```
making full cov draws with home-grown goodness
```

```
working on pargroups ['welflux_k02']
```

```
build cov matrix
```

```
done
```

```
getting diag var cov 6
```

```
scaling full cov by diag var cov
```

```
making full cov draws with home-grown goodness
```

```
processing name:struct1,nugget:0.0,structures:
```

```
name:var1,contribution:1.0,a:2500.0,anisotropy:1.0,bearing:0.0
```

```
working on pargroups ['gr_hk3']
```

```
build cov matrix
```

```
done
```

```
getting diag var cov 705
```

```
scaling full cov by diag var cov
```

```
making full cov draws with home-grown goodness
```

```
working on pargroups ['gr_vka3']
```

```
build cov matrix
```

```
done
```

```
getting diag var cov 705
```

```
scaling full cov by diag var cov
```

```
making full cov draws with home-grown goodness
```

```
working on pargroups ['gr_ss3']
```

```
build cov matrix
```

```
done
```

```
getting diag var cov 705
```

```
scaling full cov by diag var cov
```

```
making full cov draws with home-grown goodness
```

```
working on pargroups ['gr_sy3']
```

```
build cov matrix
```

```
done
```

```
getting diag var cov 705
```

```
scaling full cov by diag var cov
```

```
making full cov draws with home-grown goodness
```

```
working on pargroups ['gr_strt3']
```

```
build cov matrix
```

```
done
```

```
getting diag var cov 705
```

```
scaling full cov by diag var cov
```

```

making full cov draws with home-grown goodness
working on pargroups ['gr_prsity3']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_hk4']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_vka4']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_ss4']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_sy4']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_strt4']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_prsity4']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_hk5']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov

```

```

making full cov draws with home-grown goodness
working on pargroups ['gr_vka5']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_ss5']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_sy5']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_strt5']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_prsity5']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_rech2']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
working on pargroups ['gr_rech3']
build cov matrix
done
getting diag var cov 705
scaling full cov by diag var cov
making full cov draws with home-grown goodness
adding remaining parameters to diagonal
2019-05-02 21:58:37.535433 finished: drawing realizations took: 0:00:07.379821

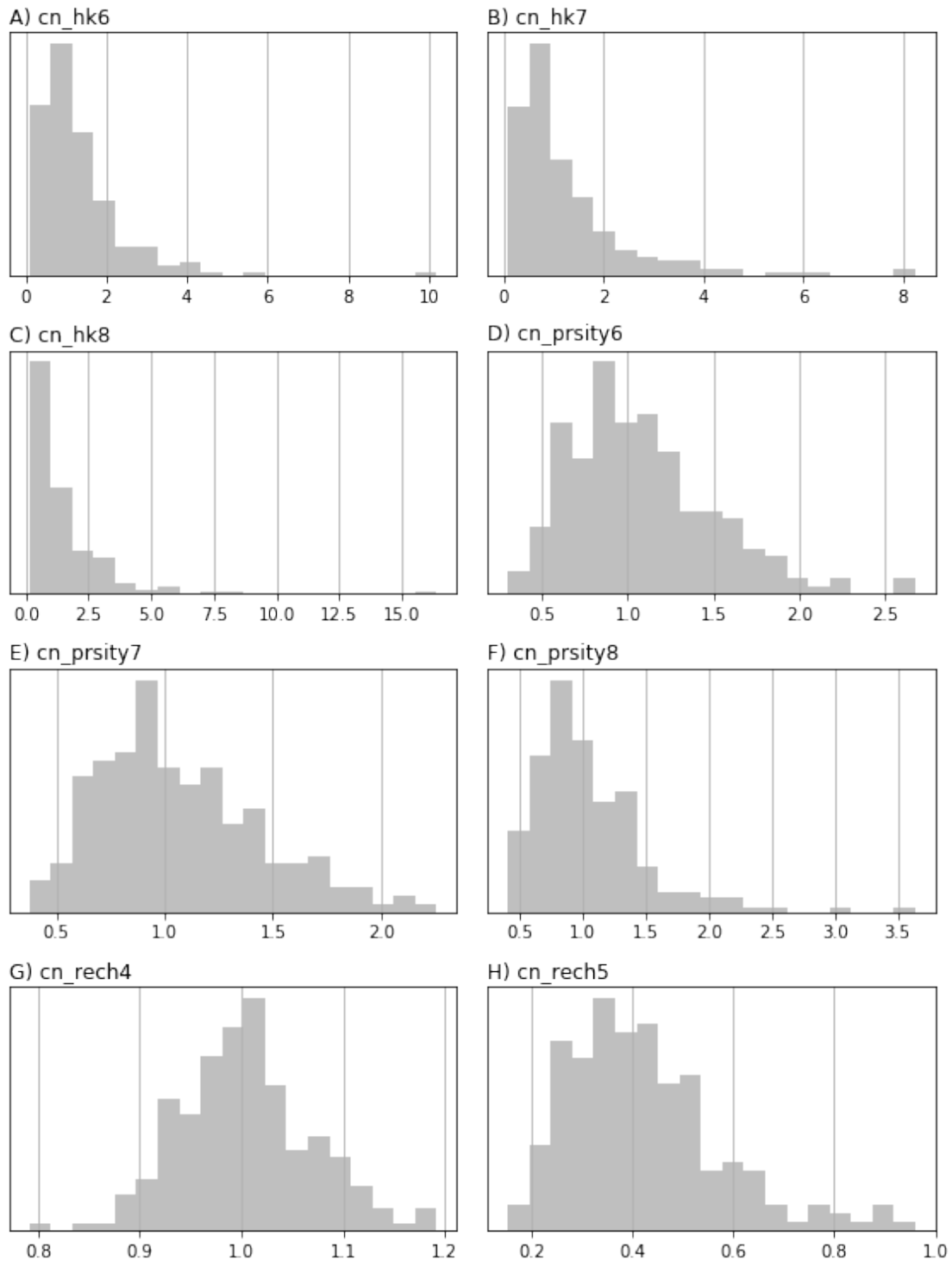
```

You can see that parameters are treated in parameter group (pargp) blocks for this ensemble

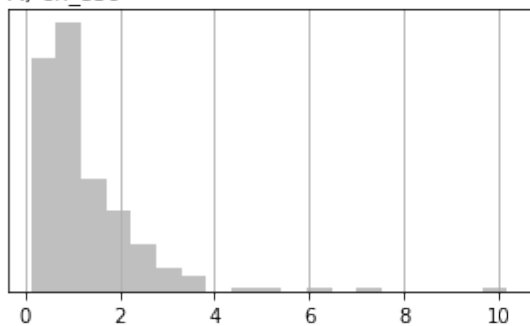
generation. Let's plot one parameter:

```
In [25]: par = pst_helper.pst.parameter_data
         pyemu.plot_utils.ensemble_helper(pe,plot_cols=par.groupby("pargp").groups,bins=20)
```

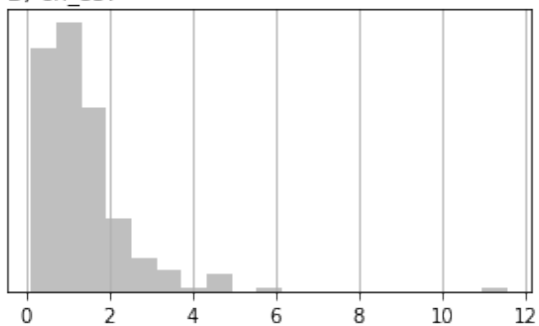
<Figure size 576x756 with 0 Axes>



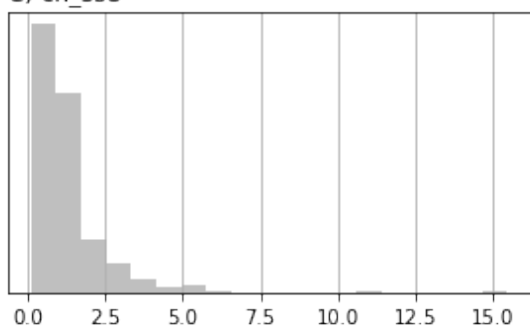
A) cn_ss6



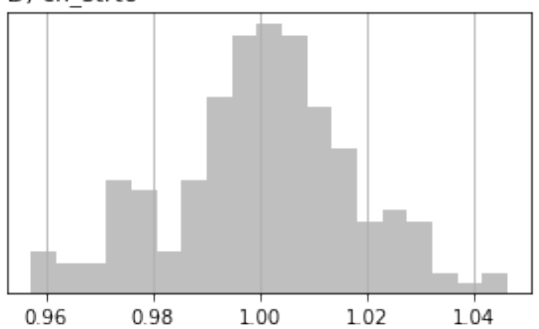
B) cn_ss7



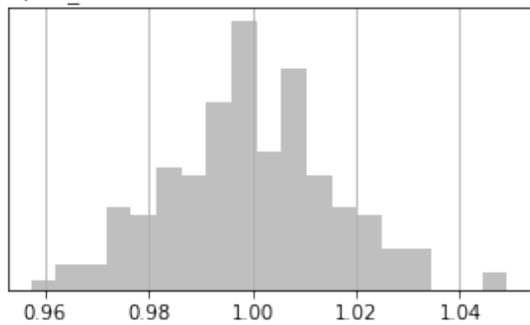
C) cn_ss8



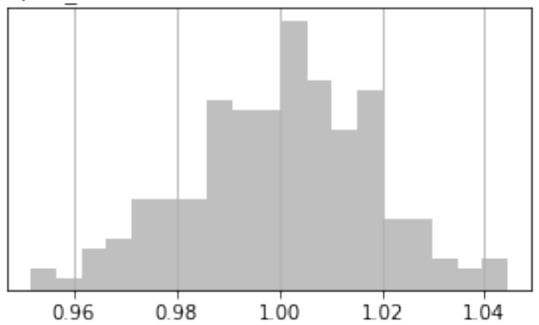
D) cn_strt6



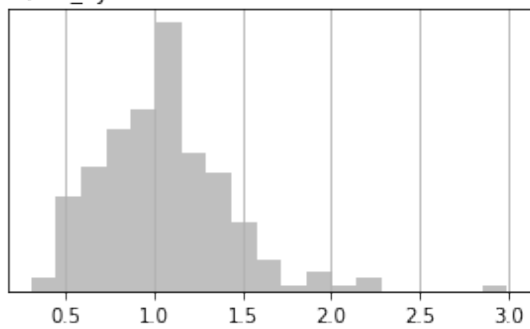
E) cn_strt7



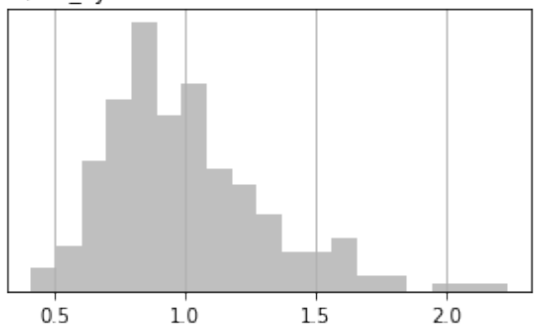
F) cn_strt8



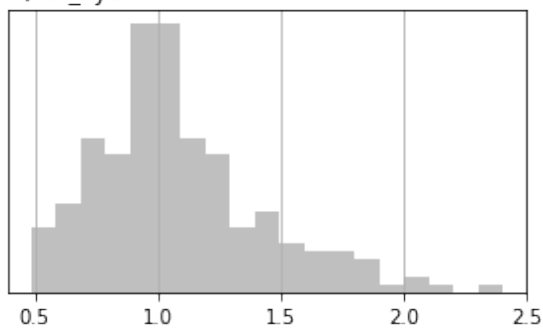
G) cn_sy6



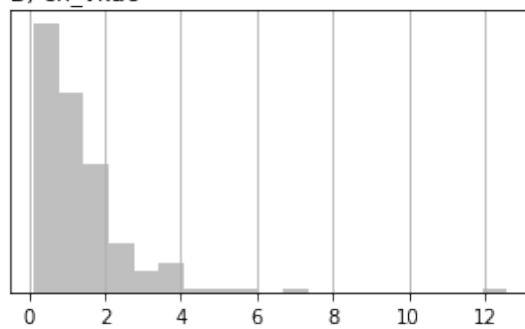
H) cn_sy7



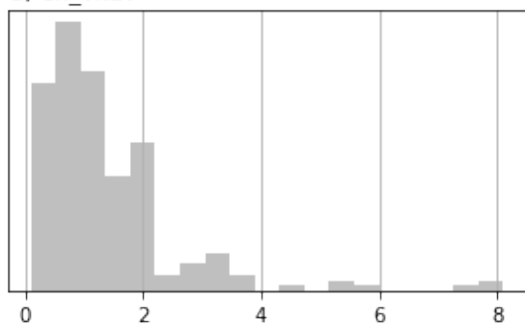
A) cn_sy8



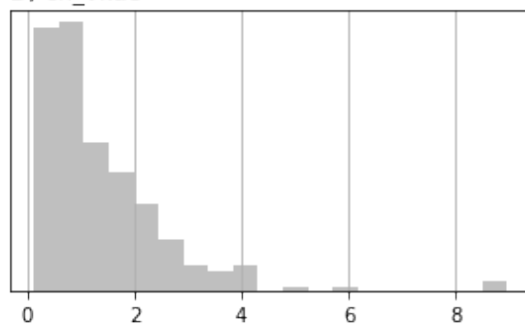
B) cn_vka6



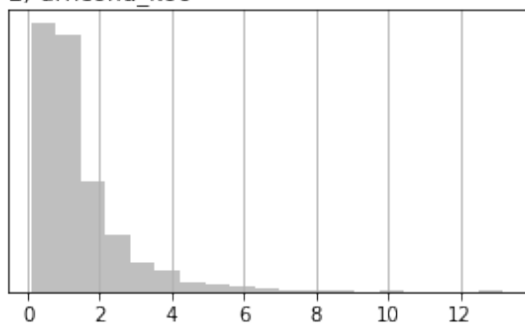
C) cn_vka7



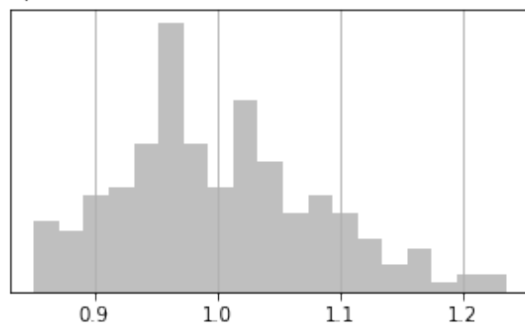
D) cn_vka8



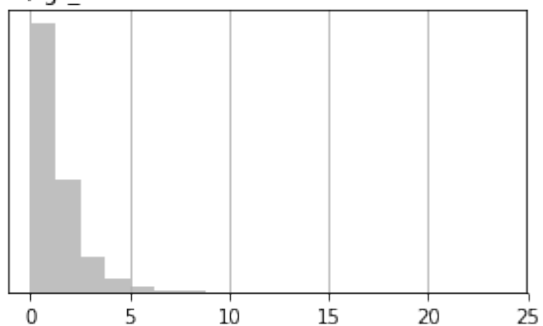
E) drncond_k00



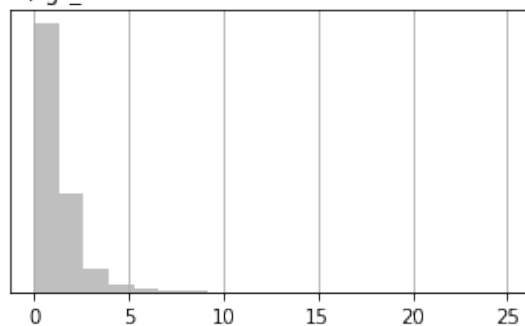
F) flow



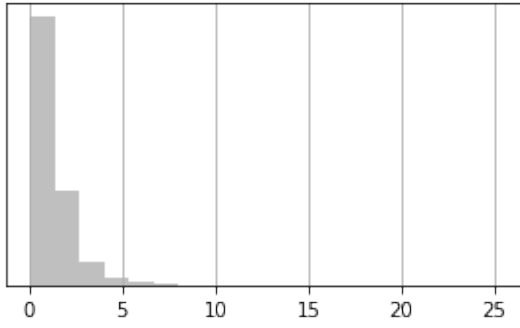
G) gr_hk3



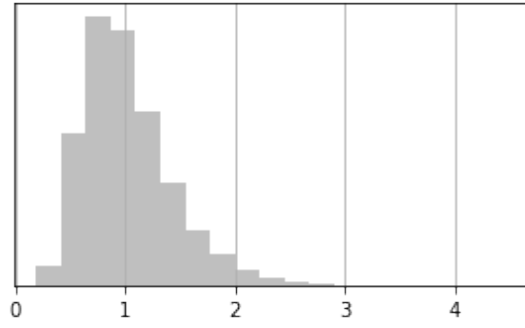
H) gr_hk4



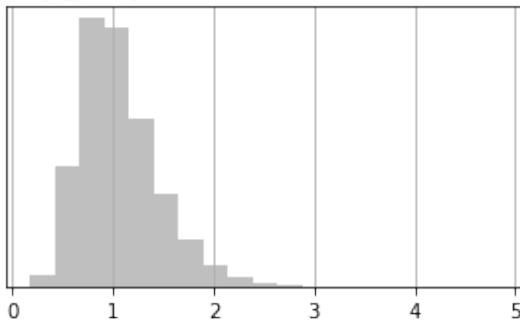
A) gr_hk5



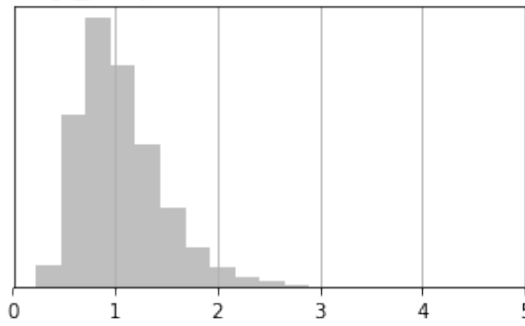
B) gr_prsity3



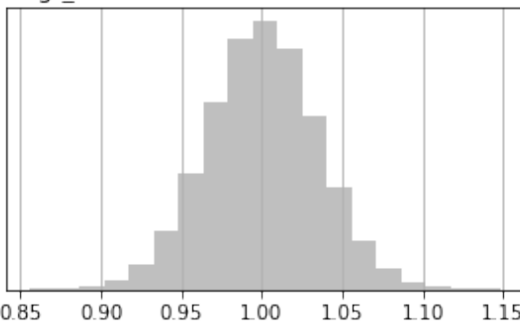
C) gr_prsity4



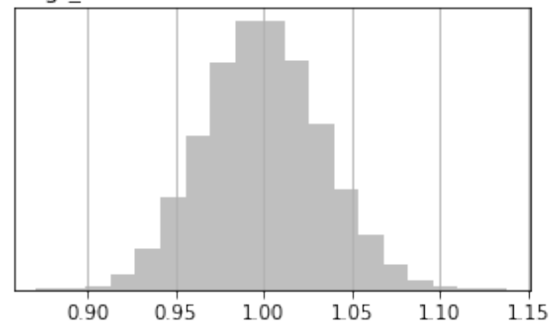
D) gr_prsity5



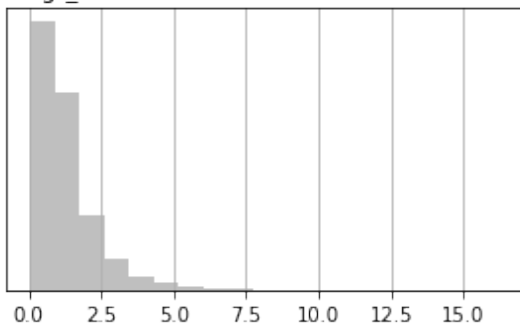
E) gr_rech2



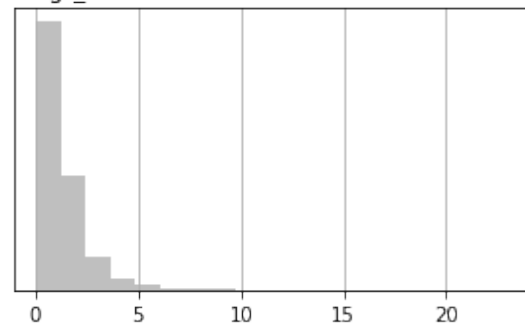
F) gr_rech3



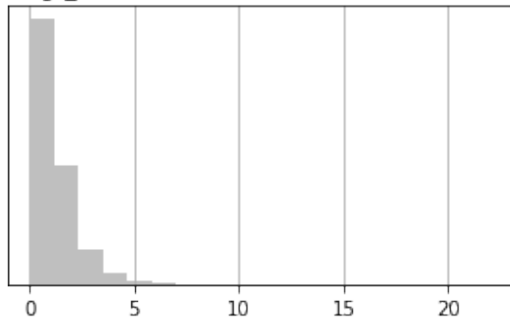
G) gr_ss3



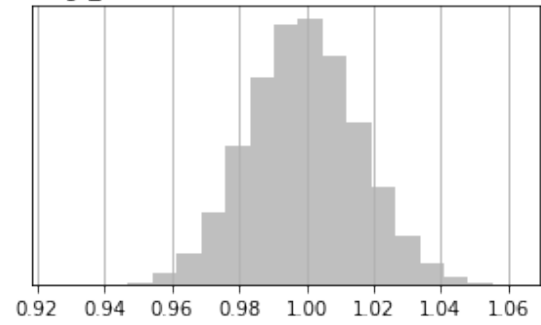
H) gr_ss4



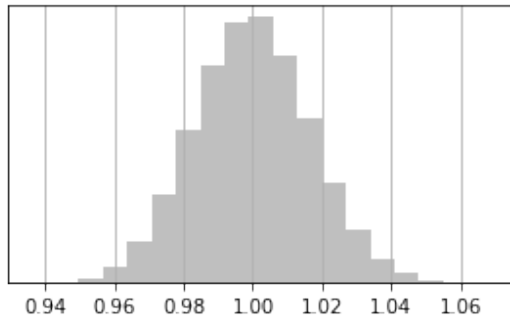
A) gr_ss5



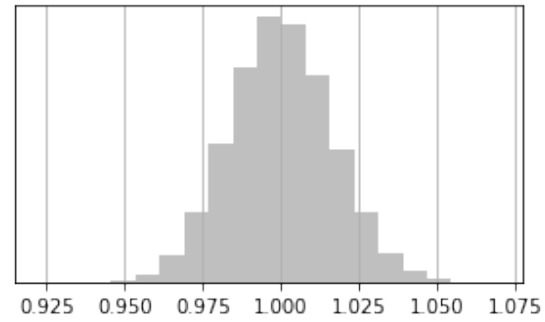
B) gr_strt3



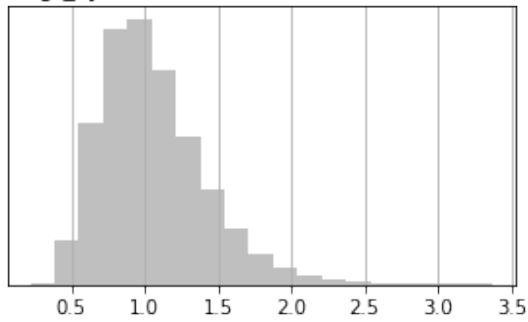
C) gr_strt4



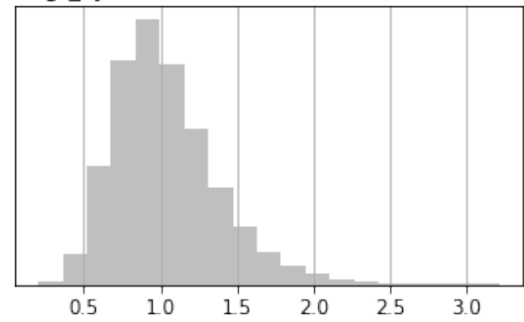
D) gr_strt5



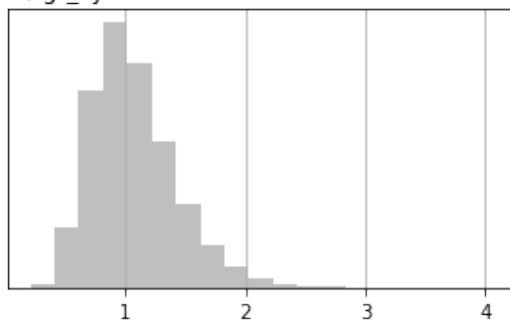
E) gr_sy3



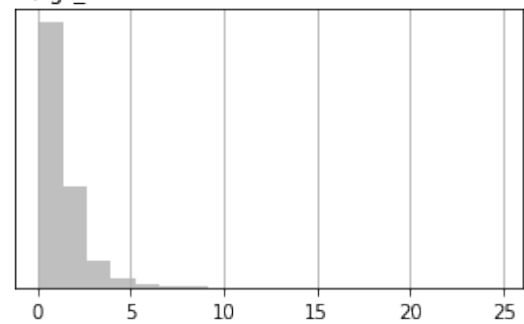
F) gr_sy4



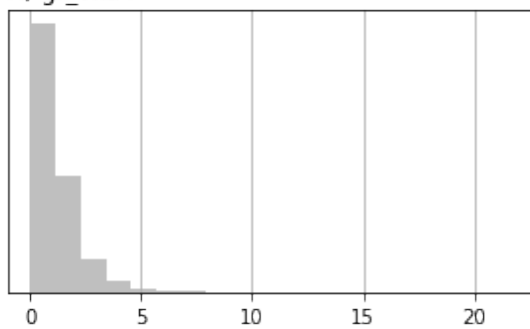
G) gr_sy5



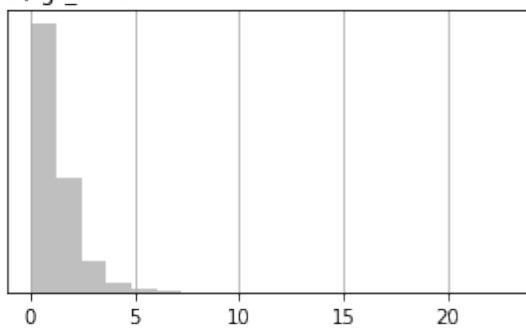
H) gr_vka3



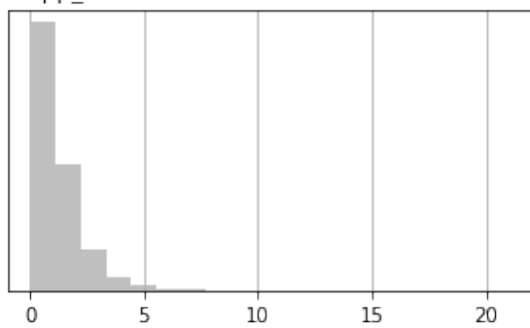
A) gr_vka4



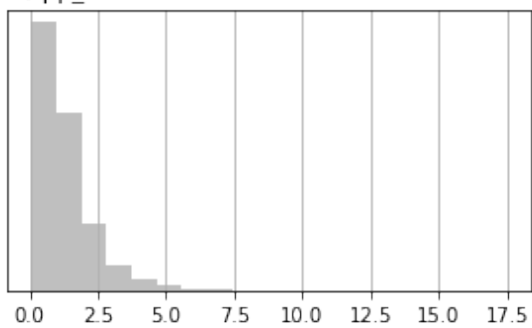
B) gr_vka5



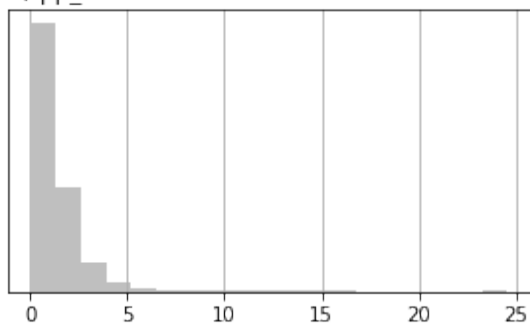
C) pp_hk0



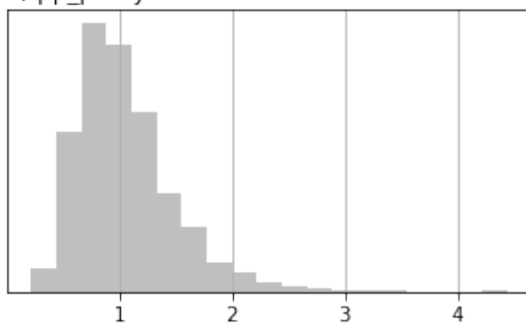
D) pp_hk1



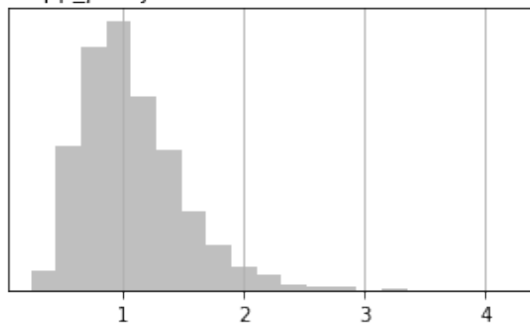
E) pp_hk2



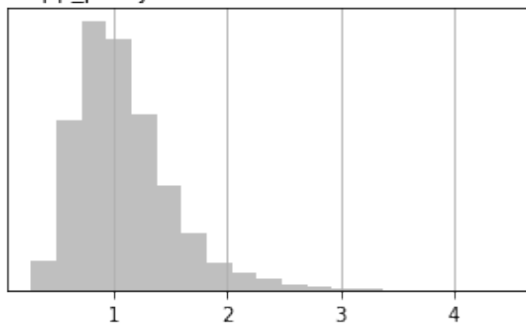
F) pp_prsity0



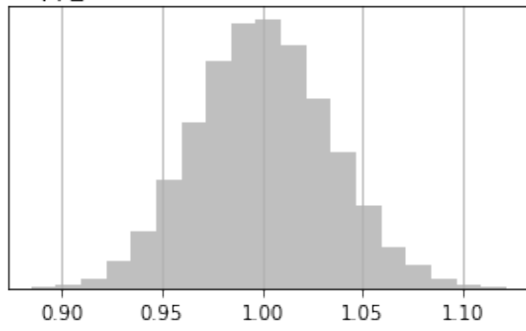
G) pp_prsity1



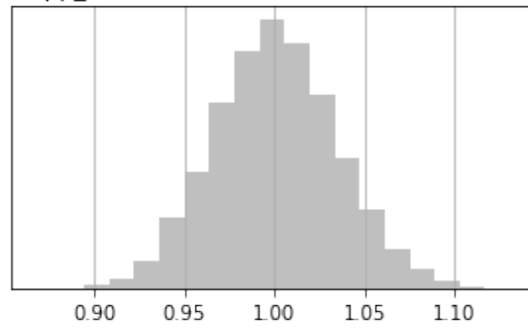
H) pp_prsity2



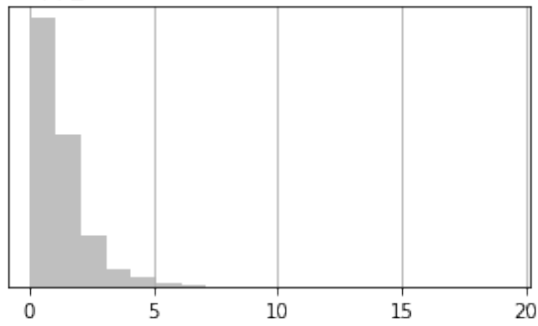
A) pp_rech0



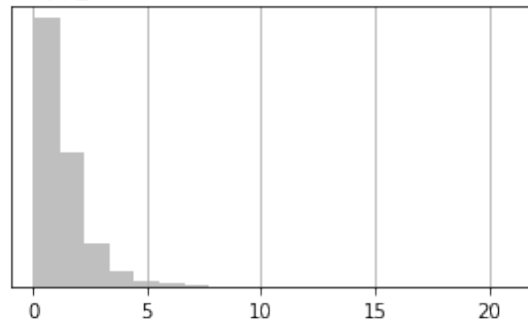
B) pp_rech1



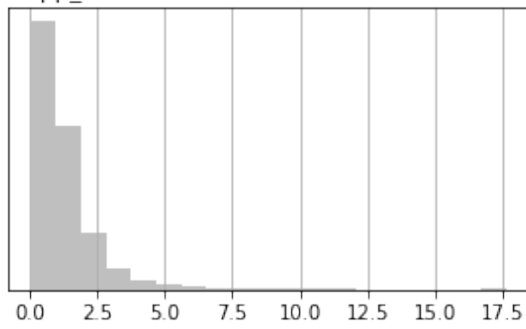
C) pp_ss0



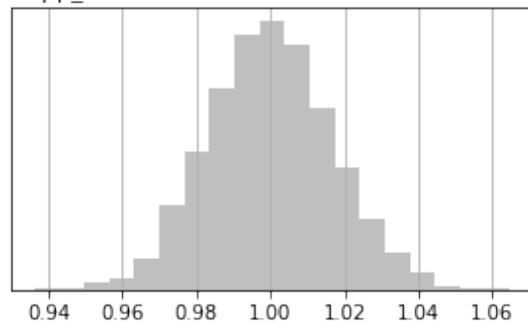
D) pp_ss1



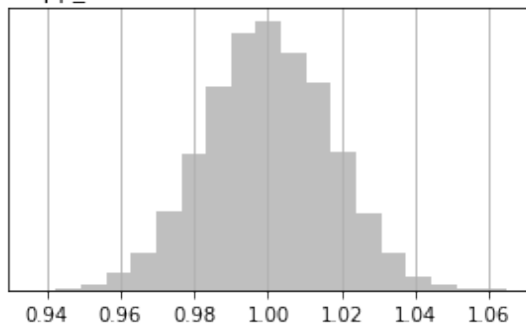
E) pp_ss2



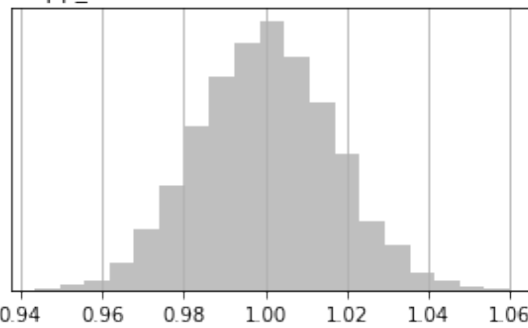
F) pp_strt0



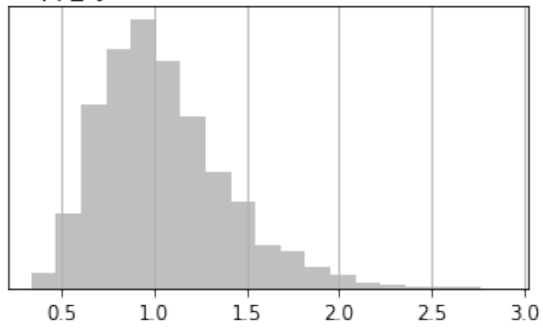
G) pp_strt1



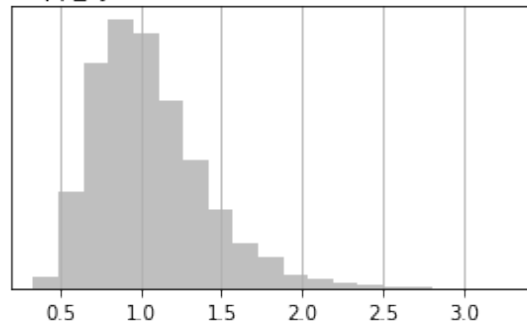
H) pp_strt2



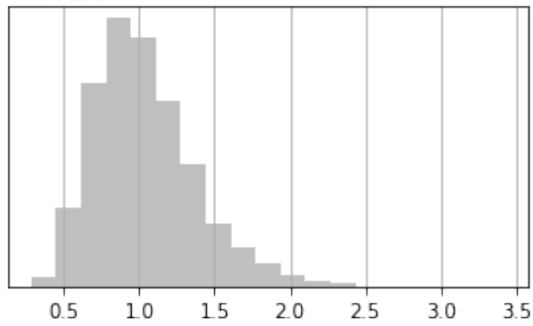
A) pp_sy0



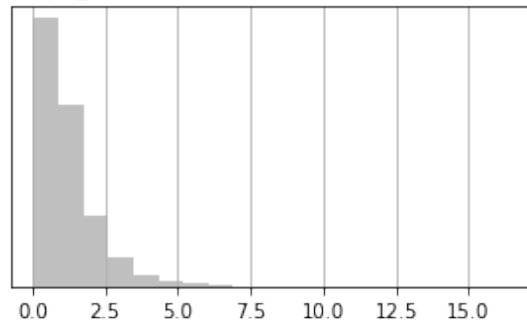
B) pp_sy1



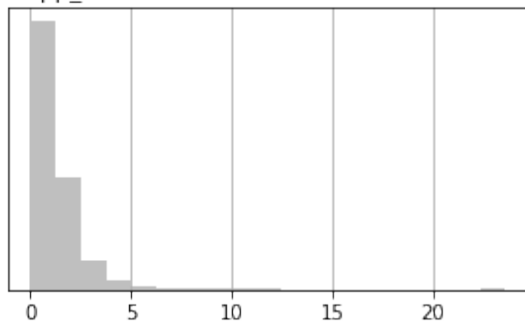
C) pp_sy2



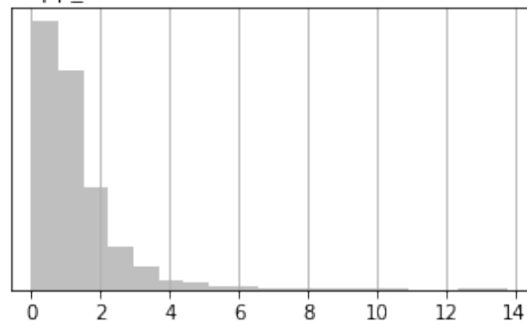
D) pp_vka0



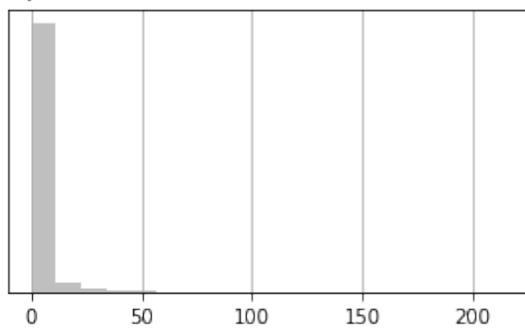
E) pp_vka1



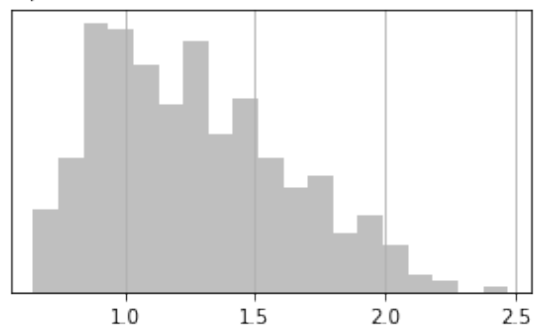
F) pp_vka2

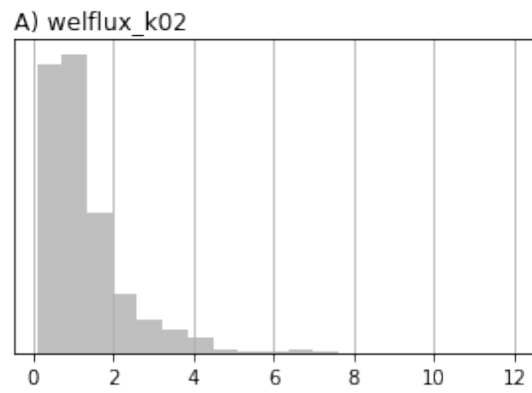


G) strk



H) welflux





Now we need to enforce parameter bounds and save this ensemble for later

```
In [26]: pe.enforce()  
         pe.to_binary(os.path.join(pst_helper.new_model_ws, "prior.jcb"))
```

1.0.6 set weights for “observations” and identify forecasts

The next major task is to set the weights on the observations. So far, in the `pst_helper` process, we simply identified what outputs from the model we want to observe. We now use a pre-cooked csv file to set nonzero weights only for GW level observation locations used in the original Freyberg model. We will also use the SFR flow out of the last reach (`fo` in the last row in 19791230)

```
In [27]: obs_locs = pd.read_csv(os.path.join("../", "base_model_files", "obs_loc.csv"))
        if pst_helper.m.nrow != 40:
            obs_locs.loc[:, "row"] = (obs_locs.row * redis_fac) + int(redis_fac / 2.0)
            obs_locs.loc[:, "col"] = (obs_locs.col * redis_fac) + int(redis_fac / 2.0)
            #build obs names that correspond to the obsnme values in the control file
            obs_locs.loc[:, "obsnme"] = obs_locs.apply(lambda x: "hds_00_{0:03d}_{1:03d}_000".format(x["row"], x["col"]), axis=1)
        obs_locs
```

```
Out [27]:
```

| | row | col | obsnme |
|----|-----|-----|--------------------|
| 0 | 3 | 16 | hds_00_002_015_000 |
| 1 | 3 | 10 | hds_00_002_009_000 |
| 2 | 4 | 9 | hds_00_003_008_000 |
| 3 | 10 | 2 | hds_00_009_001_000 |
| 4 | 14 | 11 | hds_00_013_010_000 |
| 5 | 16 | 17 | hds_00_015_016_000 |
| 6 | 22 | 11 | hds_00_021_010_000 |
| 7 | 23 | 16 | hds_00_022_015_000 |
| 8 | 25 | 5 | hds_00_024_004_000 |
| 9 | 27 | 7 | hds_00_026_006_000 |
| 10 | 30 | 16 | hds_00_029_015_000 |
| 11 | 34 | 8 | hds_00_033_007_000 |
| 12 | 35 | 11 | hds_00_034_010_000 |

Set all weights to zero first, then turn on the weights at only a few locations. These nonzero obs will be given meaningful weights in the prior monte carlo excersize!

```
In [28]: obs = pst.observation_data
        obs.loc[:, "weight"] = 0.0
        obs.loc[obs_locs.obsnme, "weight"] = 1.0
        obs.loc[obs_locs.obsnme, "obgnme"] = "calhead"
        fo_obs = "fo_{0}_19791230".format(pst_helper.m.nrow-1)
        obs.loc[fo_obs, "weight"] = 1.0
        obs.loc[fo_obs, "obgnme"] = "calflux"
        pst.nnz_obs_names
```

```
Out [28]: ['fo_39_19791230',
            'hds_00_002_009_000',
            'hds_00_002_015_000',
            'hds_00_003_008_000',
            'hds_00_009_001_000',
            'hds_00_013_010_000',
            'hds_00_015_016_000',
```



```
'hds_00_021_010_000',
'hds_00_022_015_000',
'hds_00_024_004_000',
'hds_00_026_006_000',
'hds_00_029_015_000',
'hds_00_033_007_000',
'hds_00_034_010_000']
```

Now we will define which model outputs are going to be treated as “forecasts” and save the control file

```
In [29]: swgw_forecasts = obs.loc[obs.obsnme.apply(lambda x: "fa" in x and ("hw" in x or "tw" :
print(swgw_forecasts)
hds_fore_name = "hds_00_{0:03d}_{1:03d}".format(int(pst_helper.m.nrow/3),int(pst_help
hds_forecasts = obs.loc[obs.obsnme.apply(lambda x: hds_fore_name in x),"obsnme"].tolis
forecasts = swgw_forecasts
forecasts.extend(hds_forecasts)
forecasts.append("part_time")
forecasts.append("part_status")
pst_helper.pst.pestpp_options["forecasts"] = forecasts
pst.write(os.path.join(pst_helper.new_model_ws,"freyberg.pst"))

['fa_hw_19791230', 'fa_hw_19801229', 'fa_tw_19791230', 'fa_tw_19801229']
```

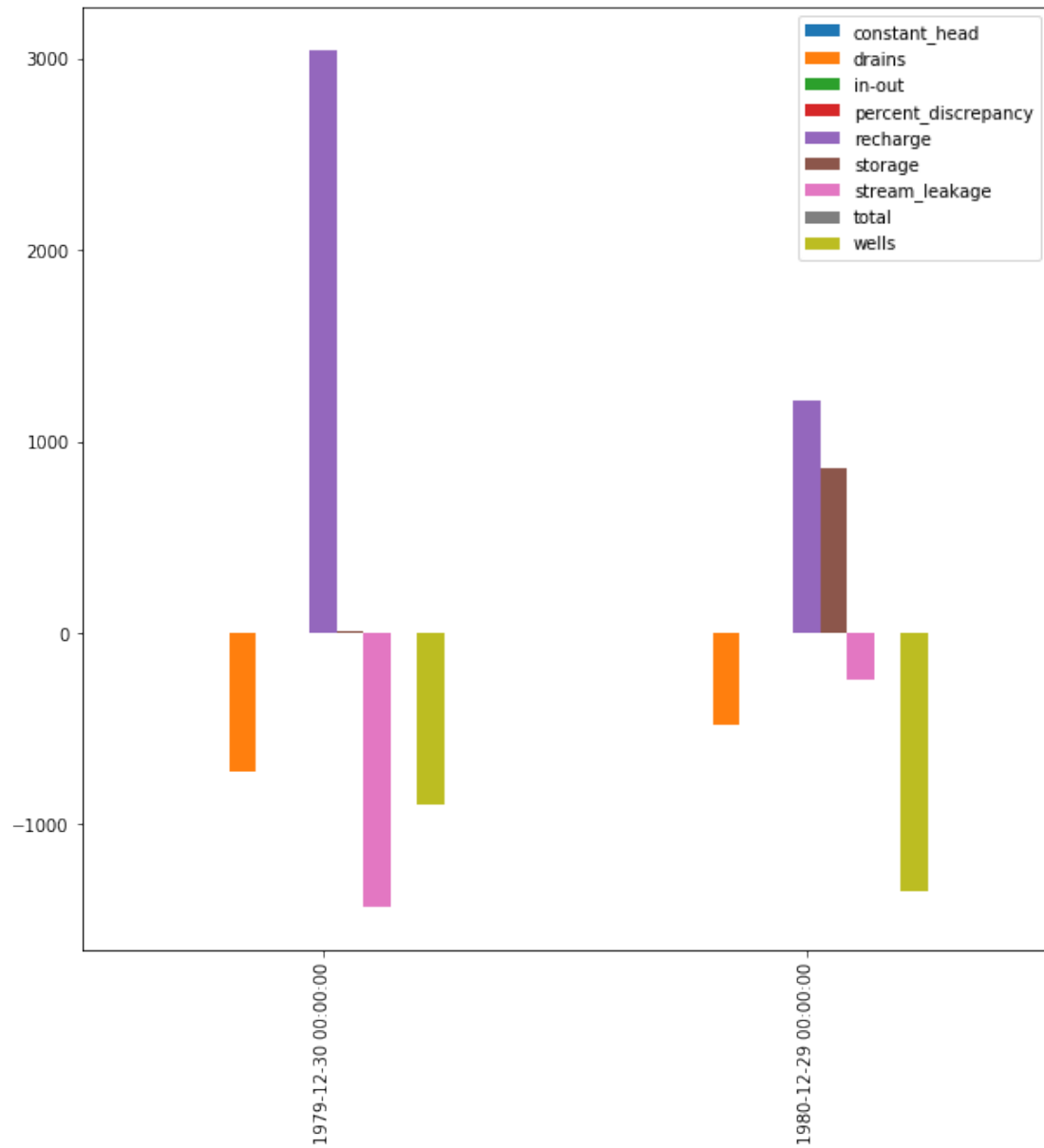
Run one last time. phi should be near zero since we haven’t change the parval1 values for historic stress period and only the 13 gw level obs have nonzero weights

```
In [30]: pyemu.os_utils.run("pestpp-ies.exe freyberg.pst",cwd=pst_helper.new_model_ws)
pst = pyemu.Pst(os.path.join(pst_helper.new_model_ws,"freyberg.pst"))
pst.phi
```

```
Out [30]: 9.456182577320024e-19
```

```
In [31]: lst = flopy.utils.MfListBudget(os.path.join("template","freyberg.list"))
df = lst.get_dataframes(diff=True)[0]
df.plot(kind="bar",figsize=(10,10))
```

```
Out [31]: <matplotlib.axes._subplots.AxesSubplot at 0x11c5e9198>
```



We see the effect of our parameterized scenario - a large drop in recharge and more abstraction.