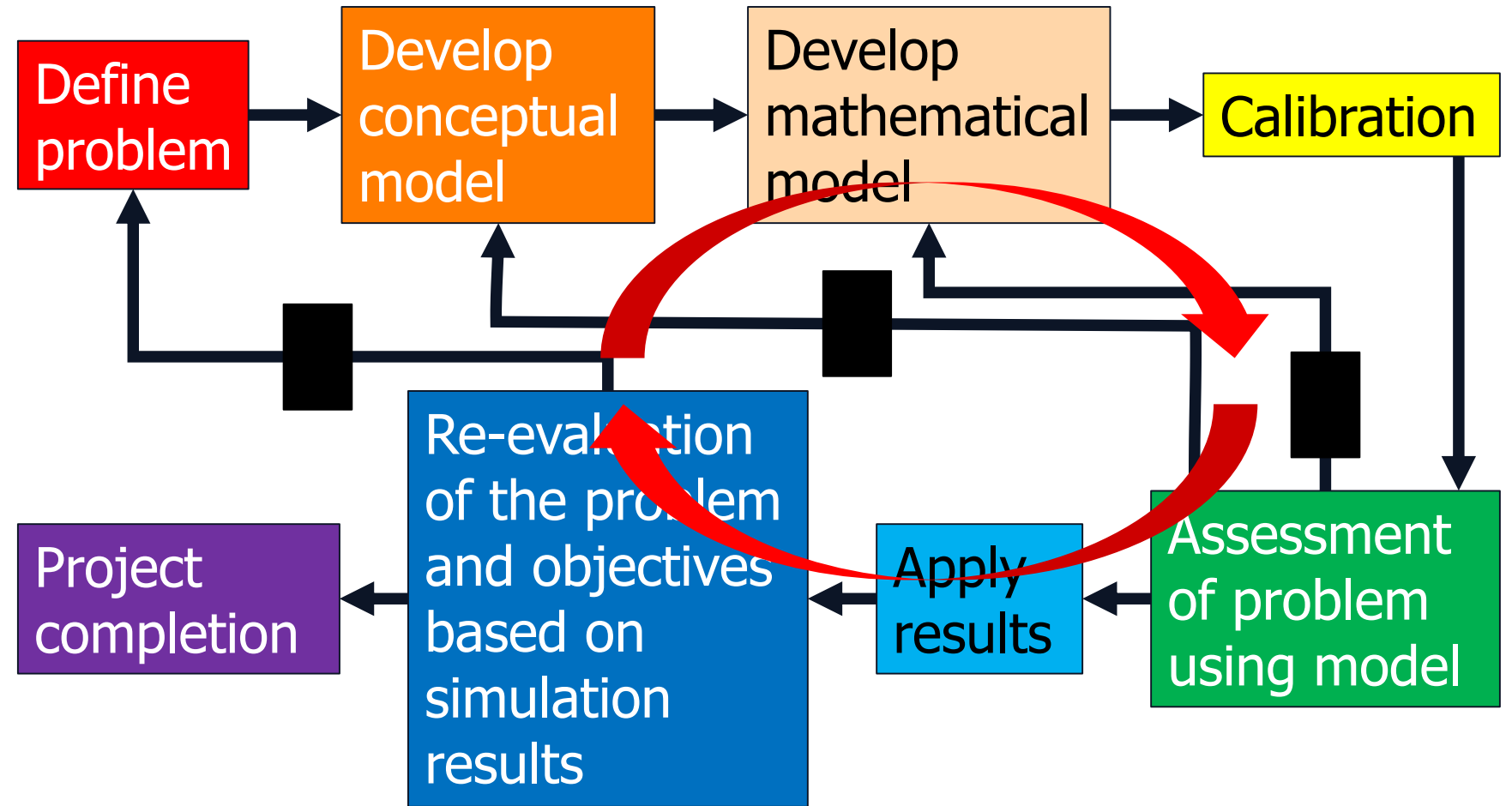


General Progress Update

Stephen Hundt

Context

The modeling process



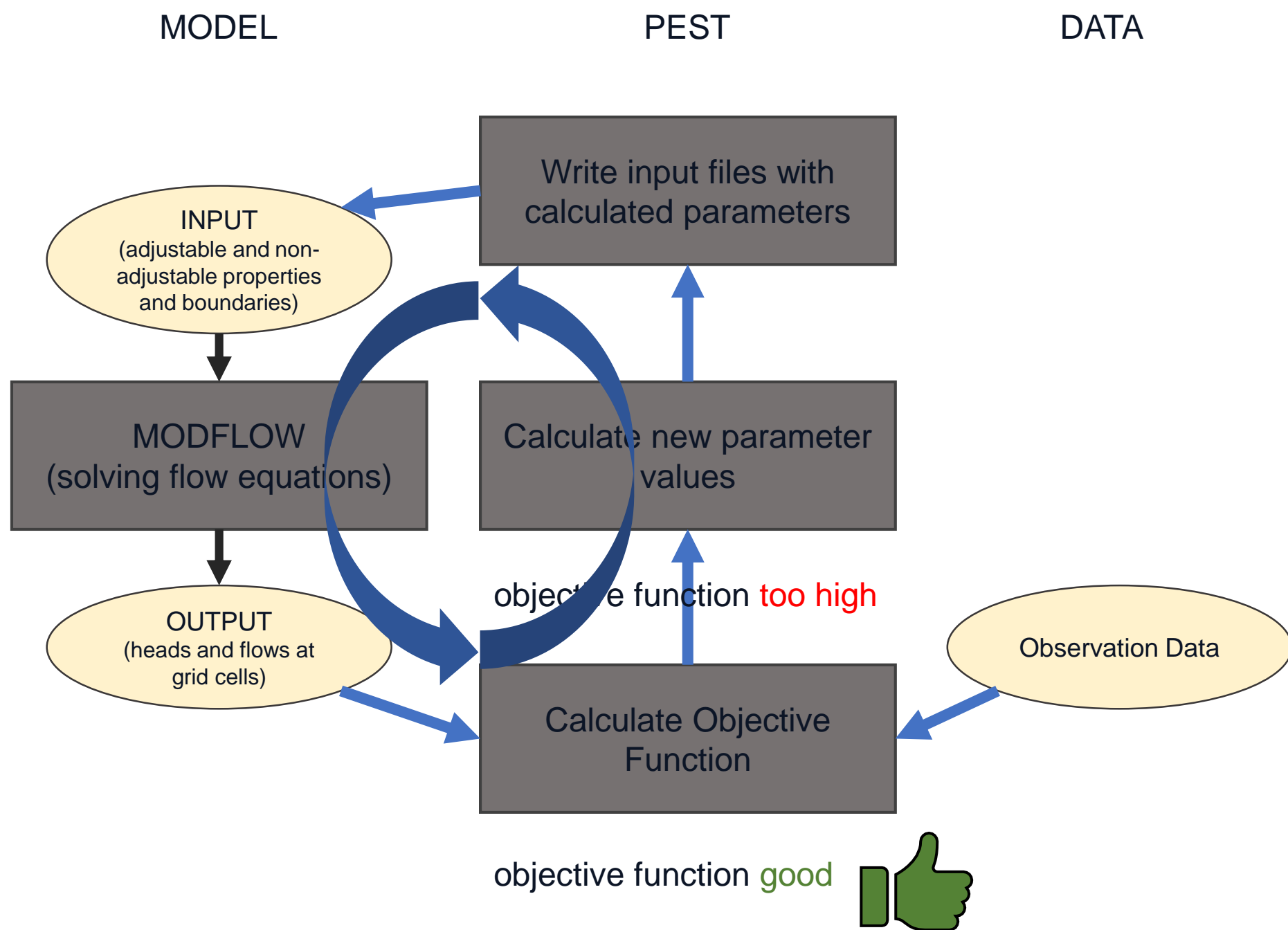
After Reilly (2001) TWRI 3,B8

Major Tasks

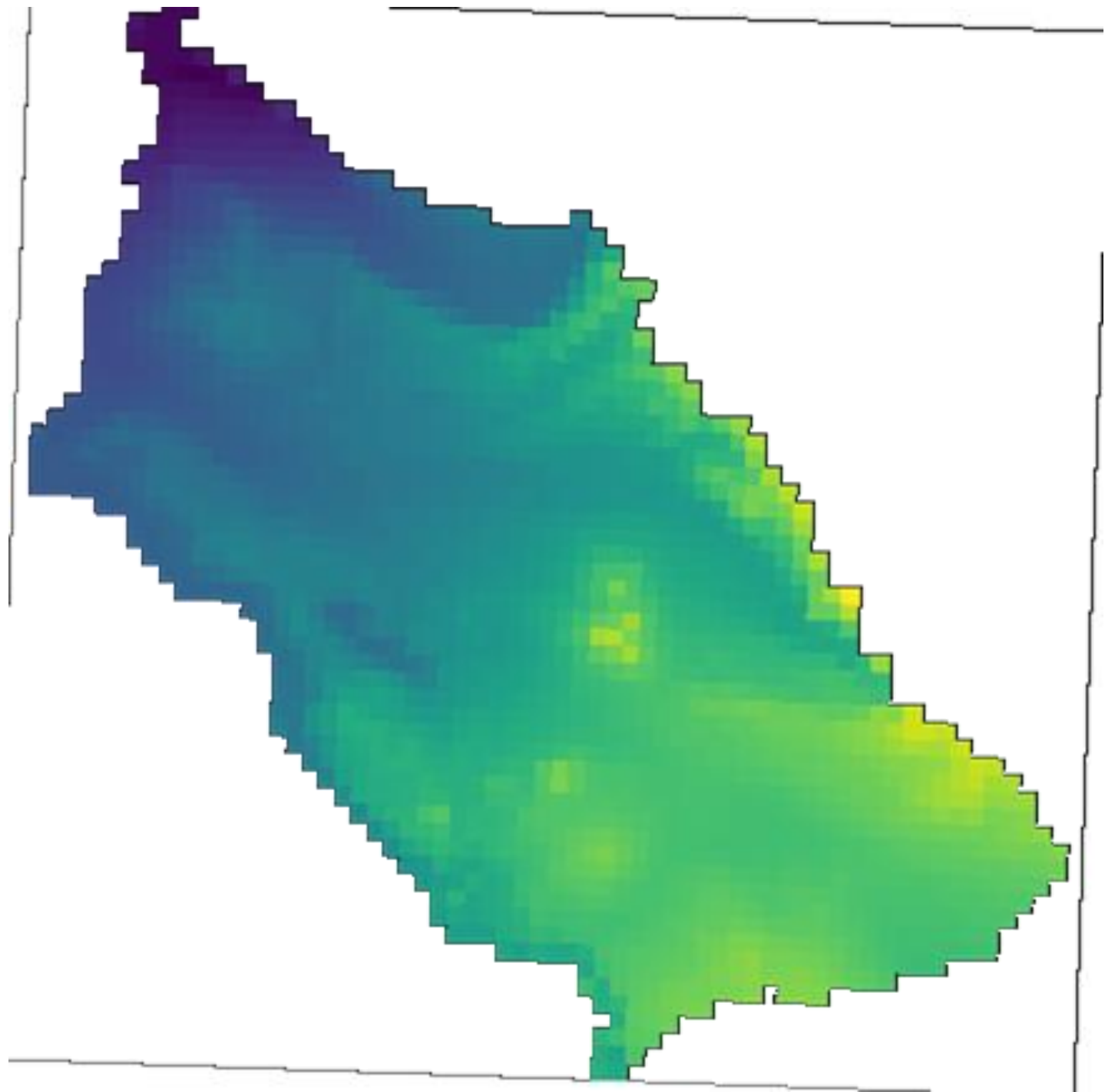
- **Calibration: settings and adjustments**
 - Parameter weighting
 - Parameter bounds
 - Estimation settings
 - Uncertainty analysis approach
 - Parallel computing
 - Using framework information
 - Selecting outputs of interest
- **Model structure and budget error fixes and adjustments**
 - Refining graphical feedback of inputs and results
 - Fixing input data
 - Tweaking structure
 - Boundary condition geometry
 - Boundary condition stresses
 - Layers
- **Adding last few stragglers**
 - NY Canal
 - Drain discharge
 - Runoff

Calibration tasks

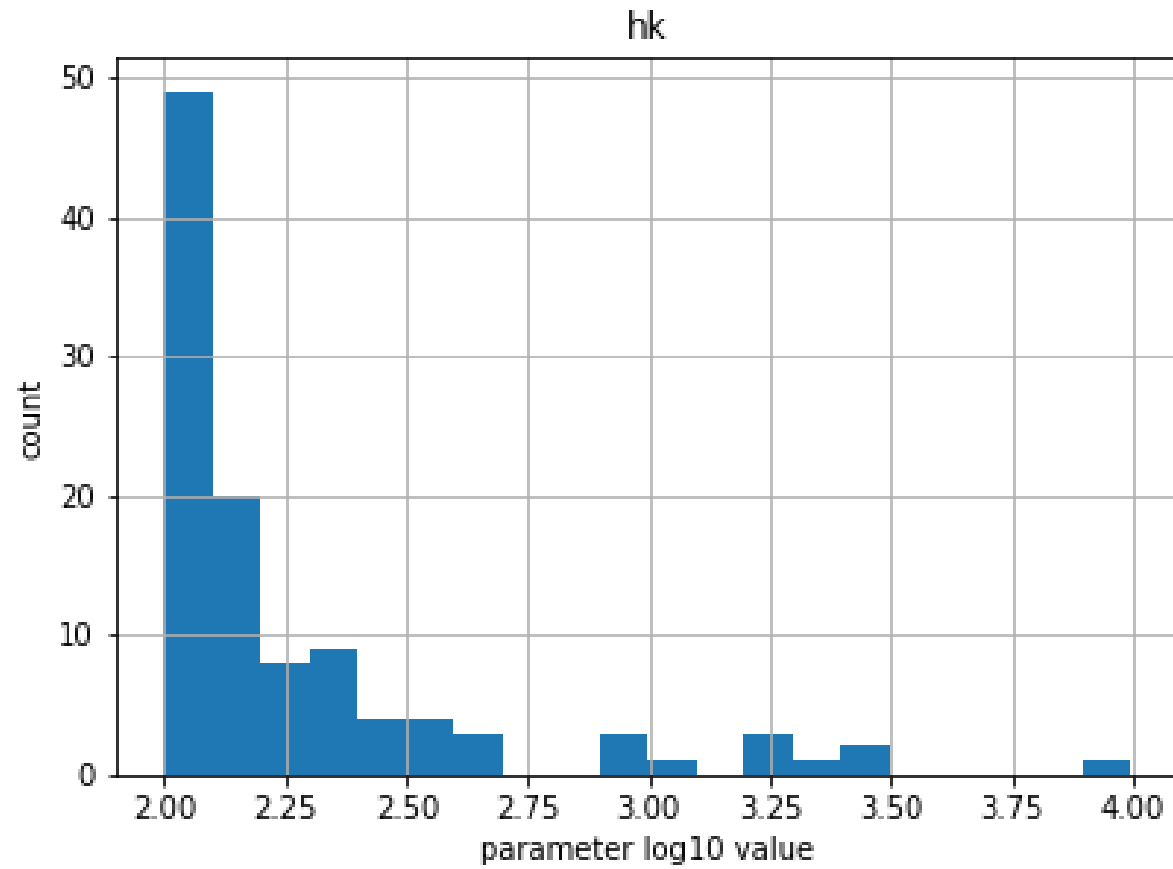
Estimating Parameters



Huh?

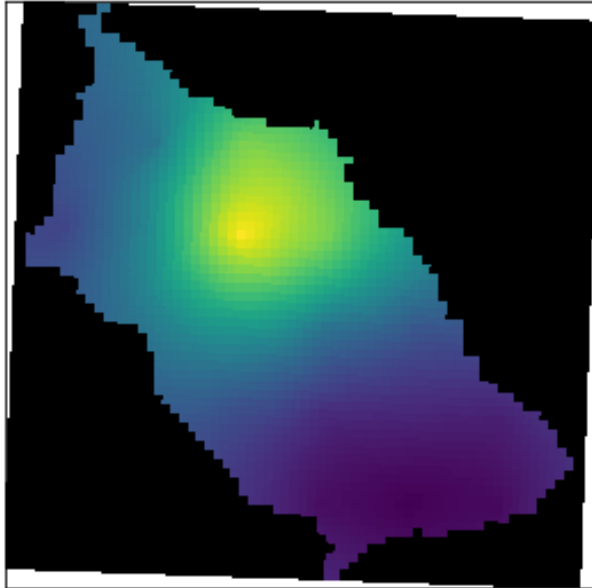


Huh?

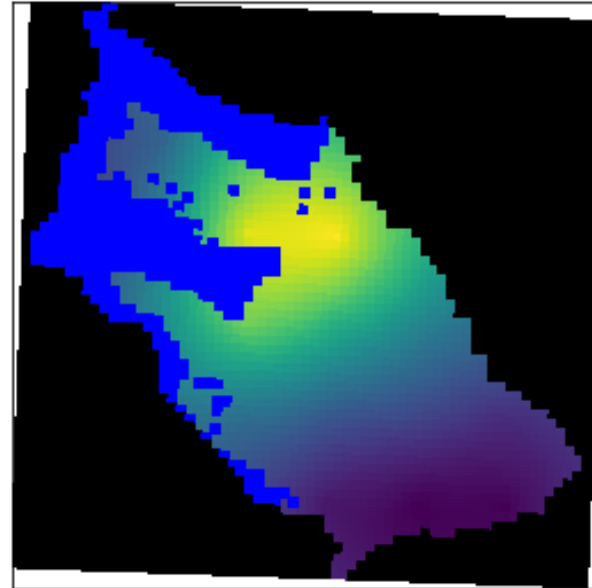


Huh?

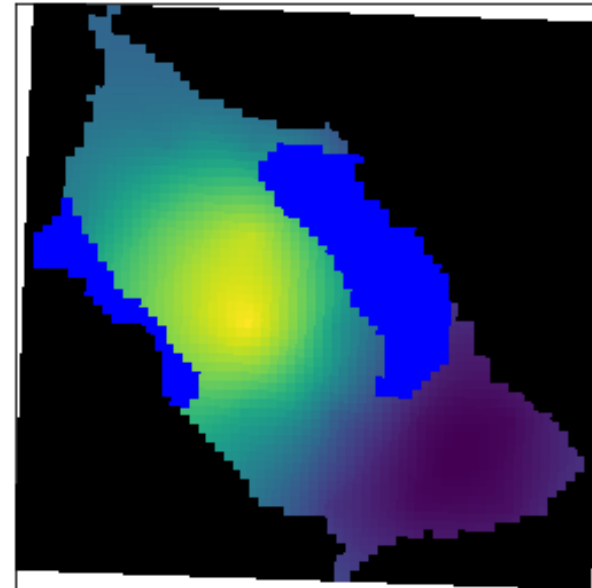
Log10 hk: layer 1



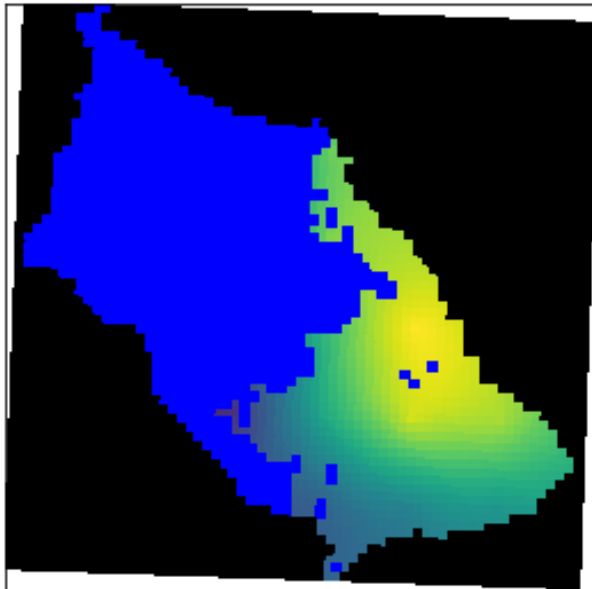
Log10 hk: layer 3



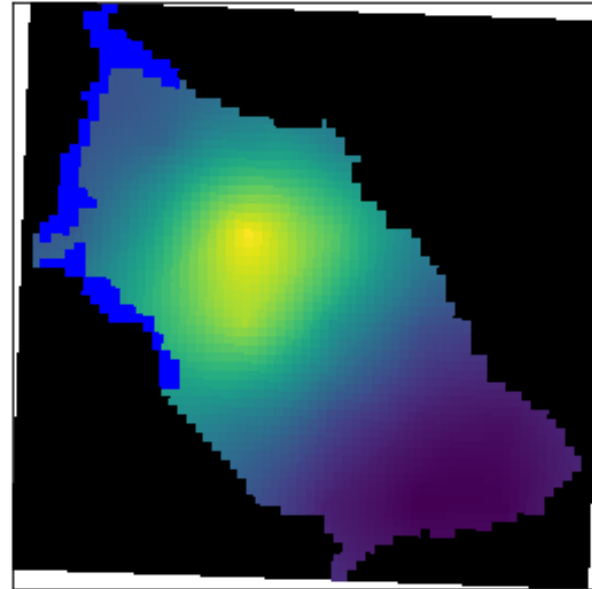
Log10 hk: layer 5



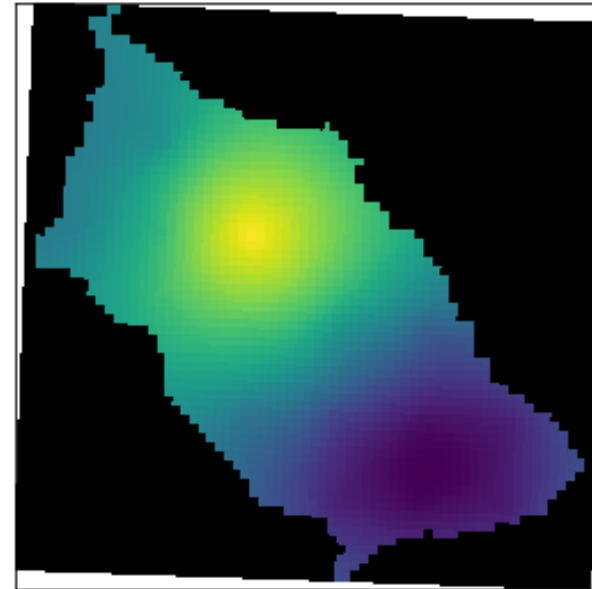
Log10 hk: layer 2



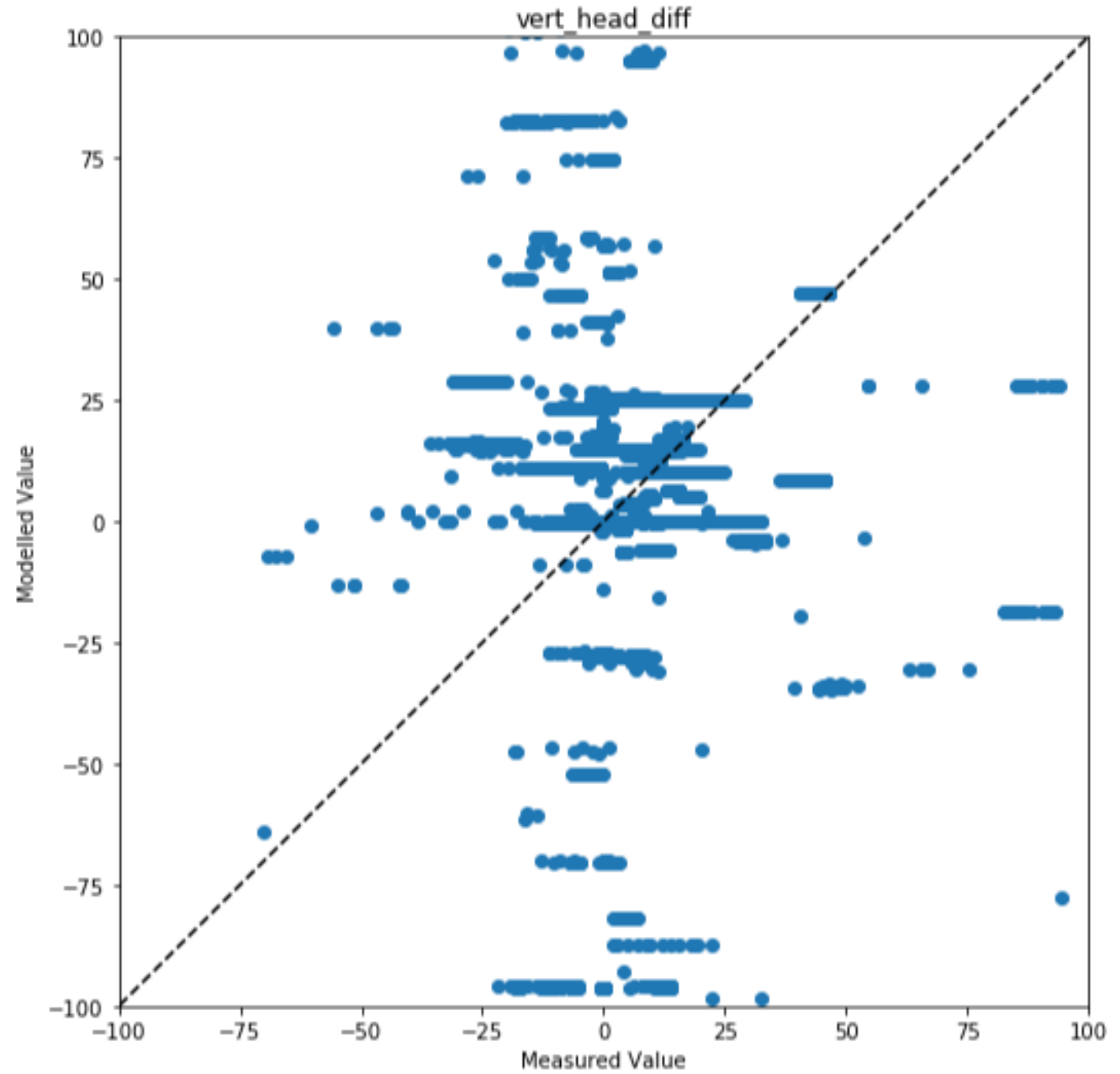
Log10 hk: layer 4



Log10 hk: layer 6



Huh?



PEST(++) Settings

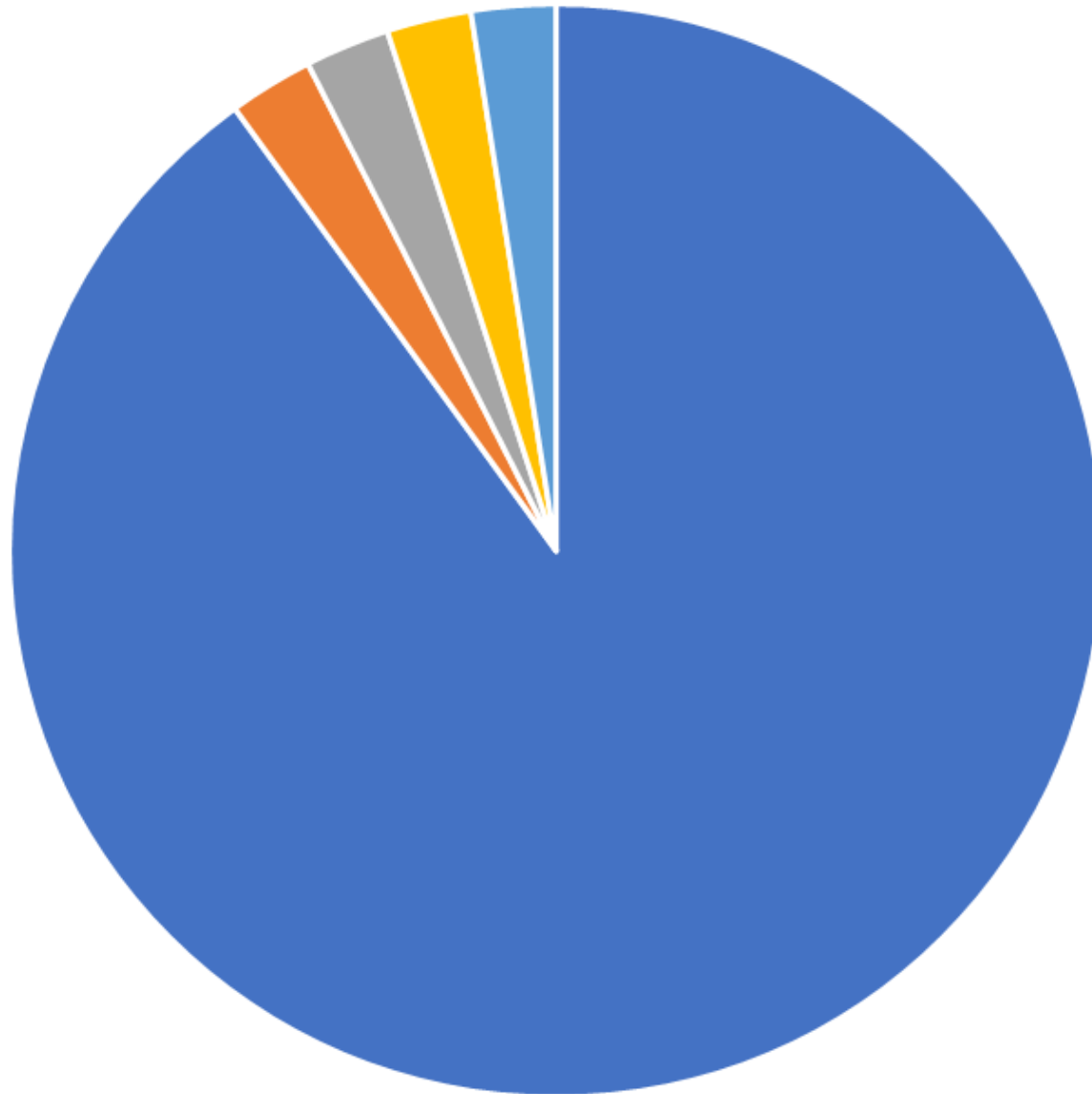
```

* control data
      restart      estimation
      677      52585      14      0      5      0
      28      5      single      point      1      0      0      noobsxref
2.000000E+01 -3.000000E+00 3.000000E-01 1.000000E-02 -7      999      lamforgive      nodexforgive
1.000000E+01 1.000000E+01 1.000000E-03      0      0
1.000000E-01      1      1.100000E+00      noau      rosenkruss      noboundscale
10      1.000000E-02      3      3      1.000000E-02      3      0.000000E+00      1      -1.000000E+00
      0      0      0      0      icosave      verbosexec      icosaveitn      reisaveitn      parsaveitn      nodarsaverun
* singular value decomposition
      1
      30      1.000000E-05
1
* parameter groups
hk      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
vk      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
ss      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
leakfac      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
infacirr      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
infacsemi      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
runfac      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
drncnd      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
zivcond      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
tribmult      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
et      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
zivcondoth      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
leakdistprop      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
lowellcond      relative      1.000000000000E-02      0.0      switch      2.000000000000E+00      parabolic      1.000000000000E-05      5.000000000000E-01      smaller
* parameter data
drncnd_01      log      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_02      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_03      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_04      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_05      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_06      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_07      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_08      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_09      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_10      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_11      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_12      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_13      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_14      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_15      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
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drncnd_17      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
drncnd_18      tied      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      drncnd      1.000000000000E+00      0.000000000000E+00      1
et_factor      log      factor      1.000000000000E+00      1.100000000000E-10      1.100000000000E+10      et      1.000000000000E+00      0.000000000000E+00      1
hkl_00      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1
hkl_01      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1
hkl_02      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1
hkl_03      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1
hkl_04      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1
hkl_05      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1
hkl_06      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1
hkl_07      log      factor      1.000000000000E+02      1.100000000000E-10      1.100000000000E+10      hk      1.000000000000E+00      0.000000000000E+00      1

```

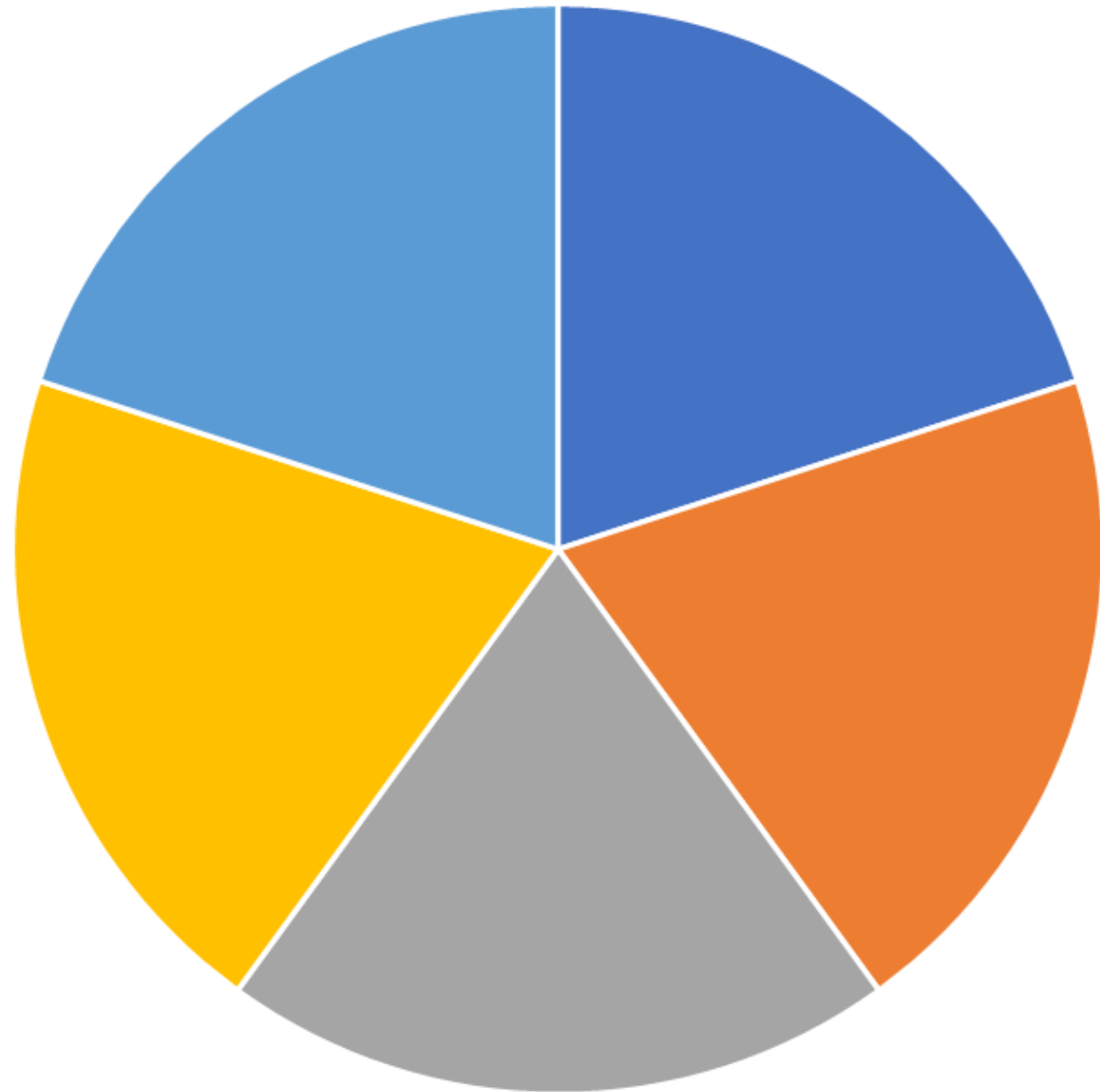
Observation Weighting

objective function



Observation Weighting

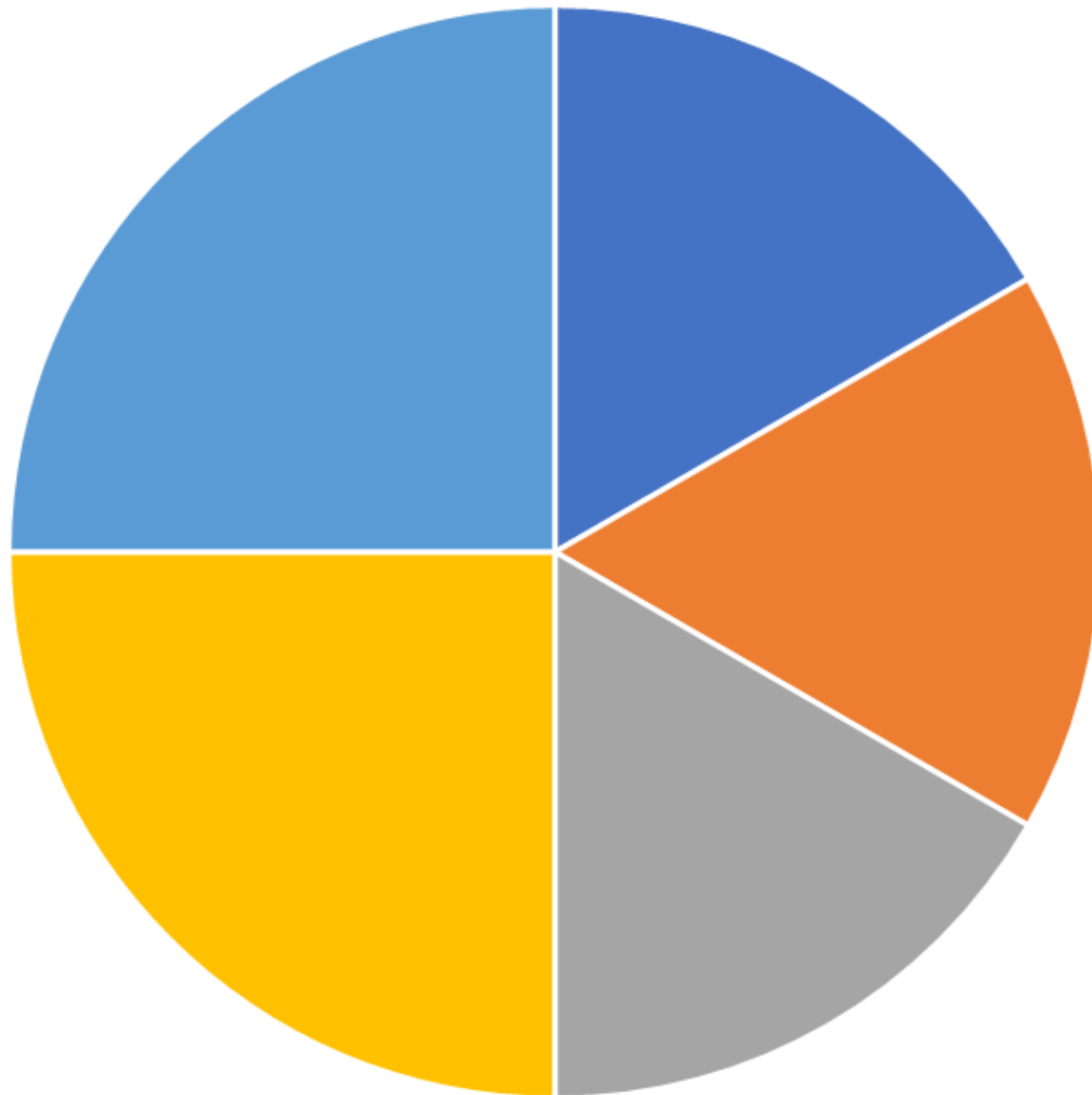
objective function



■ heads ■ temp diff ■ vert diff ■ drains ■ lowell

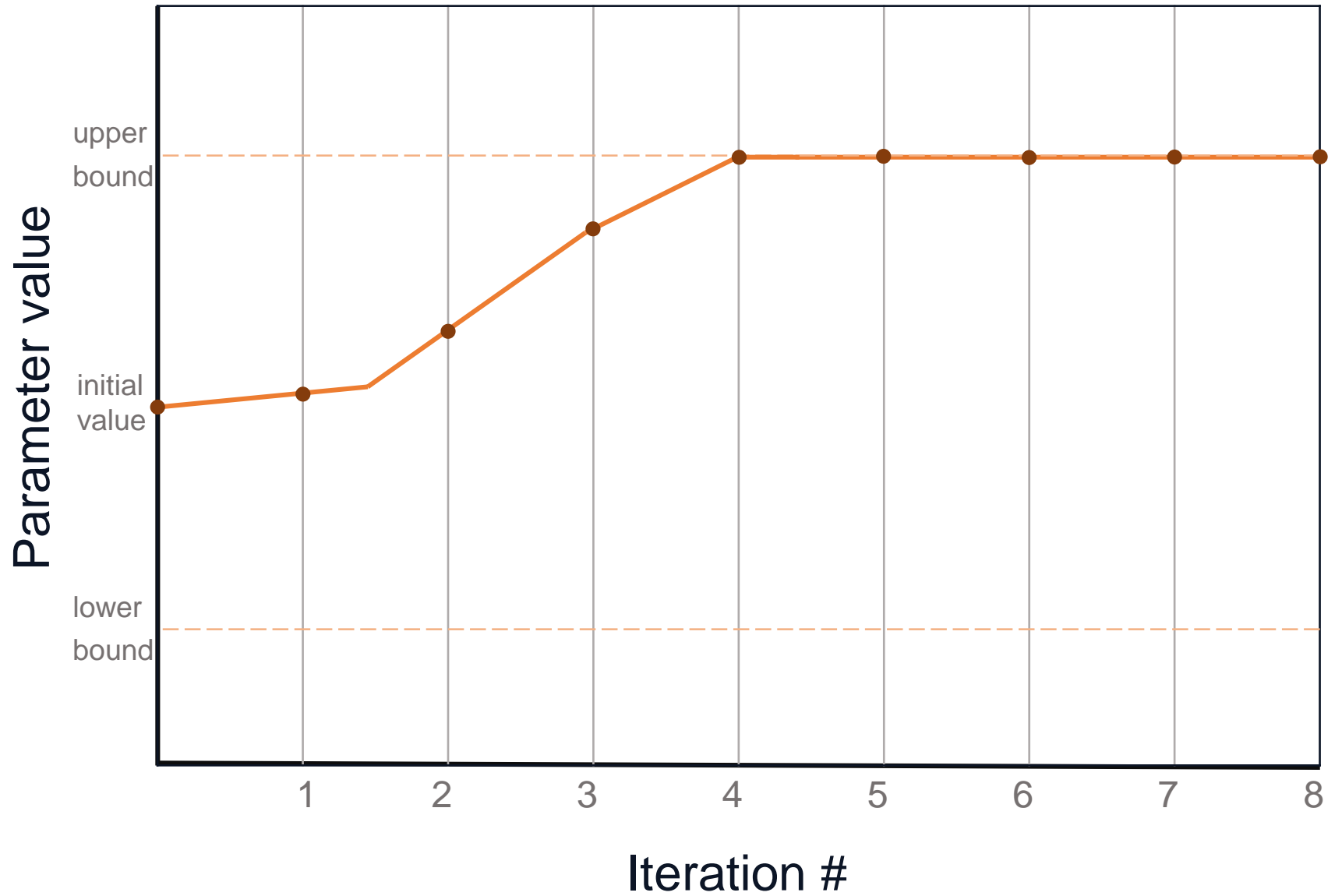
Observation Weighting

objective function







■ heads ■ temp diff ■ vert diff ■ drains ■ lowell

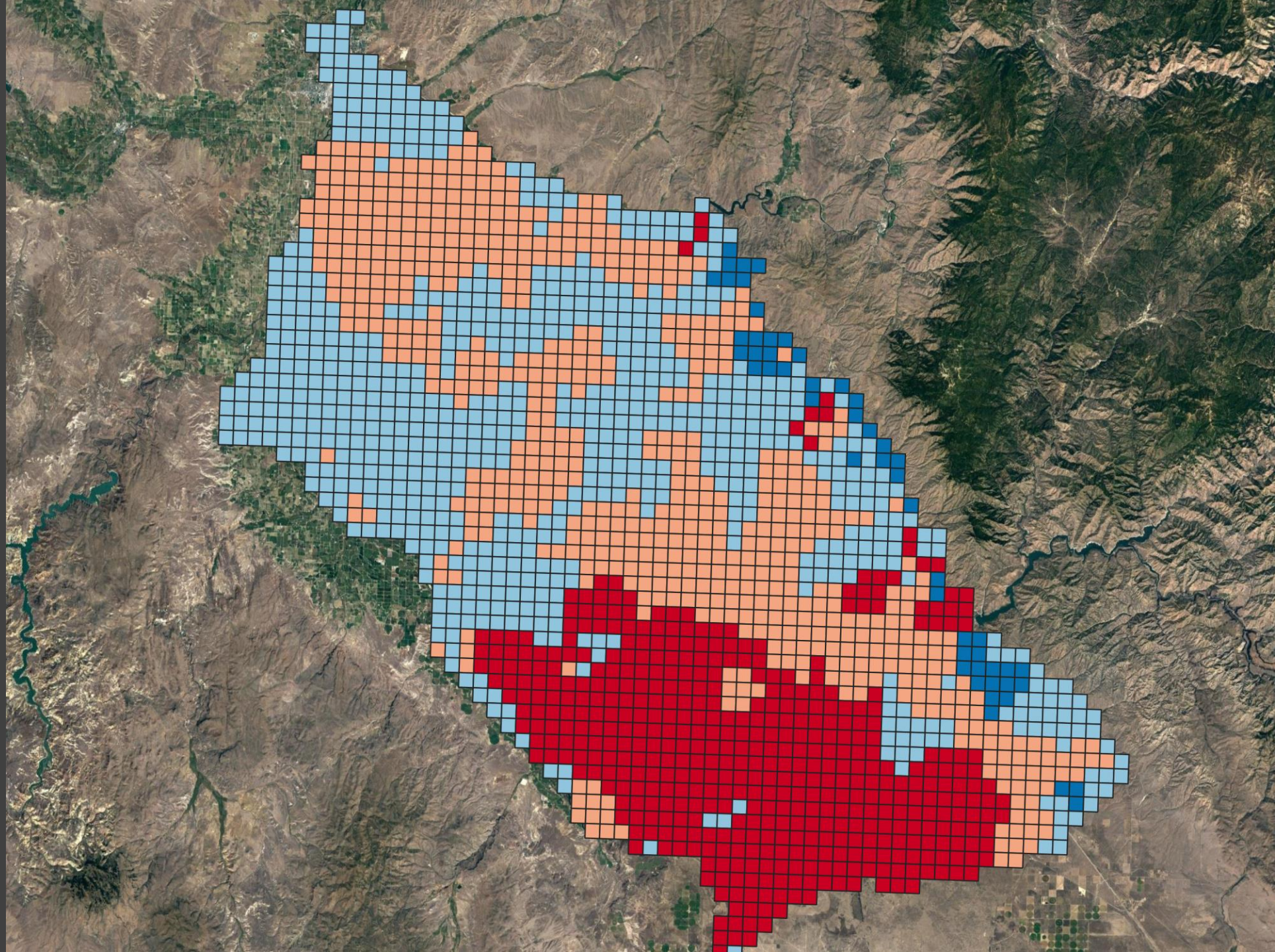
Parameter Bounds



Framework information in parameter estimation

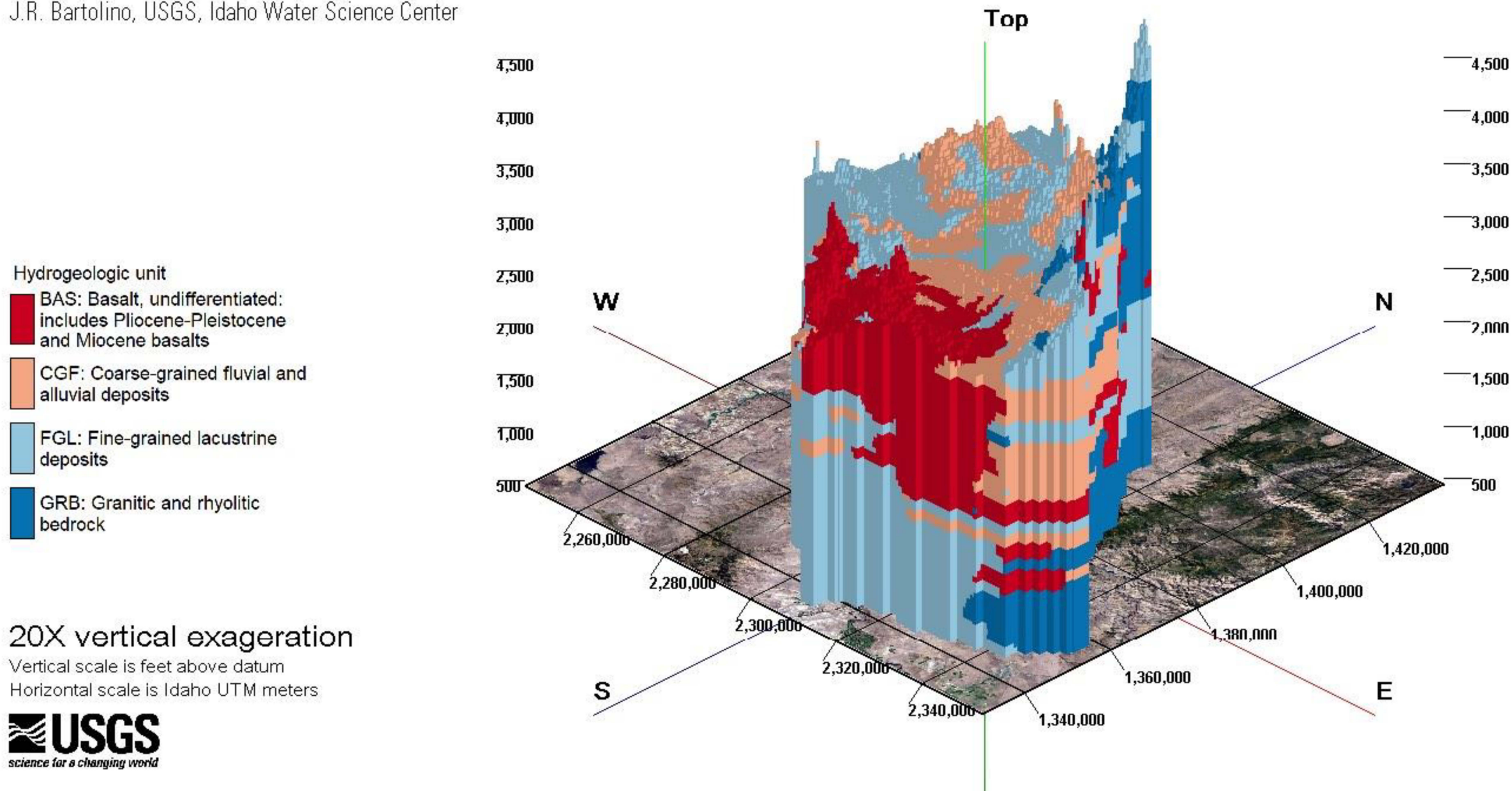
Hydrogeologic unit

-  BAS: Basalt, undifferentiated: includes Pliocene-Pleistocene and Miocene basalts
-  CGF: Coarse-grained fluvial and alluvial deposits
-  FGL: Fine-grained lacustrine deposits
-  GRB: Granitic and rhyolitic bedrock

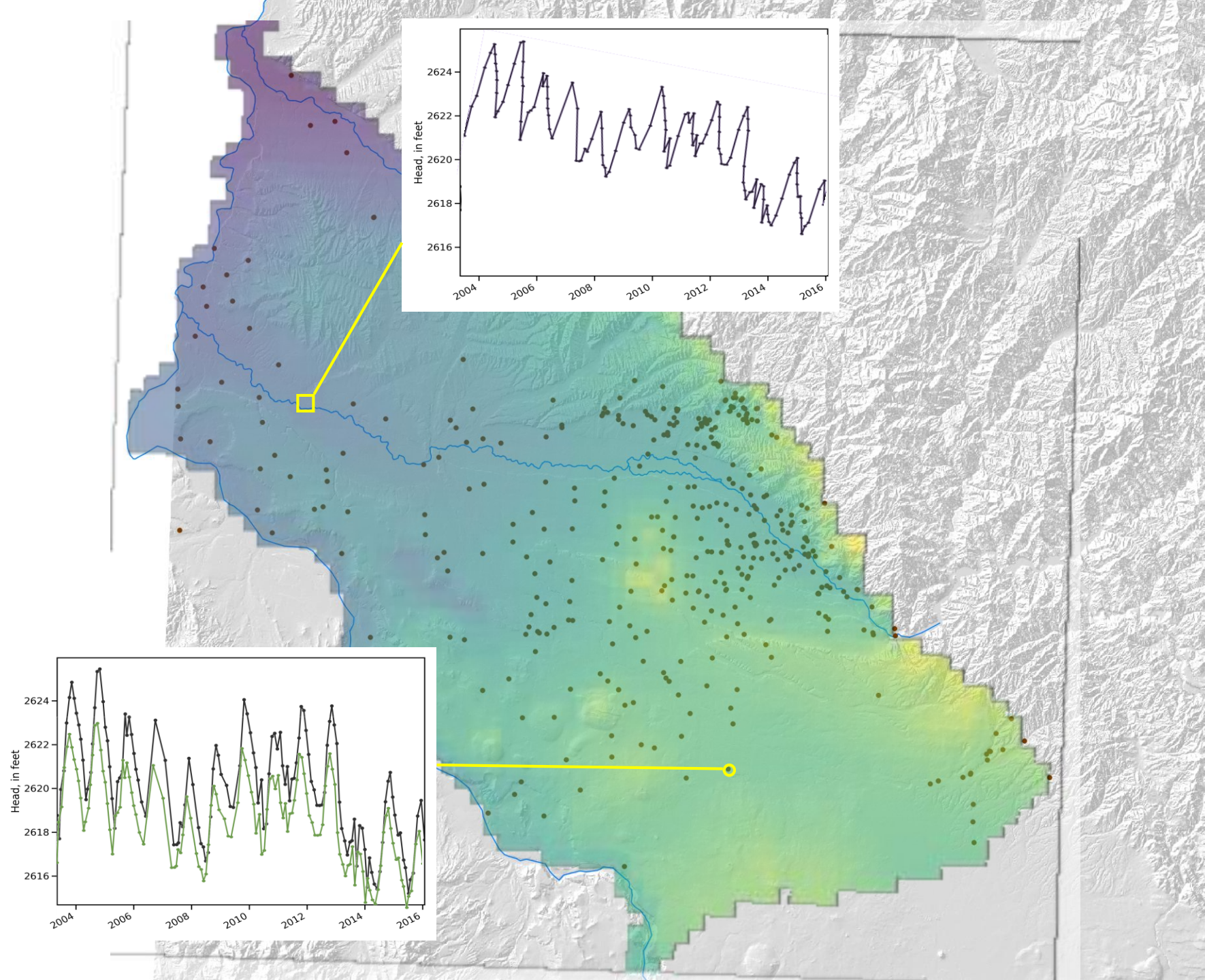


Hydrogeologic Framework of the Treasure Valley and Surrounding Area, Idaho and Oregon

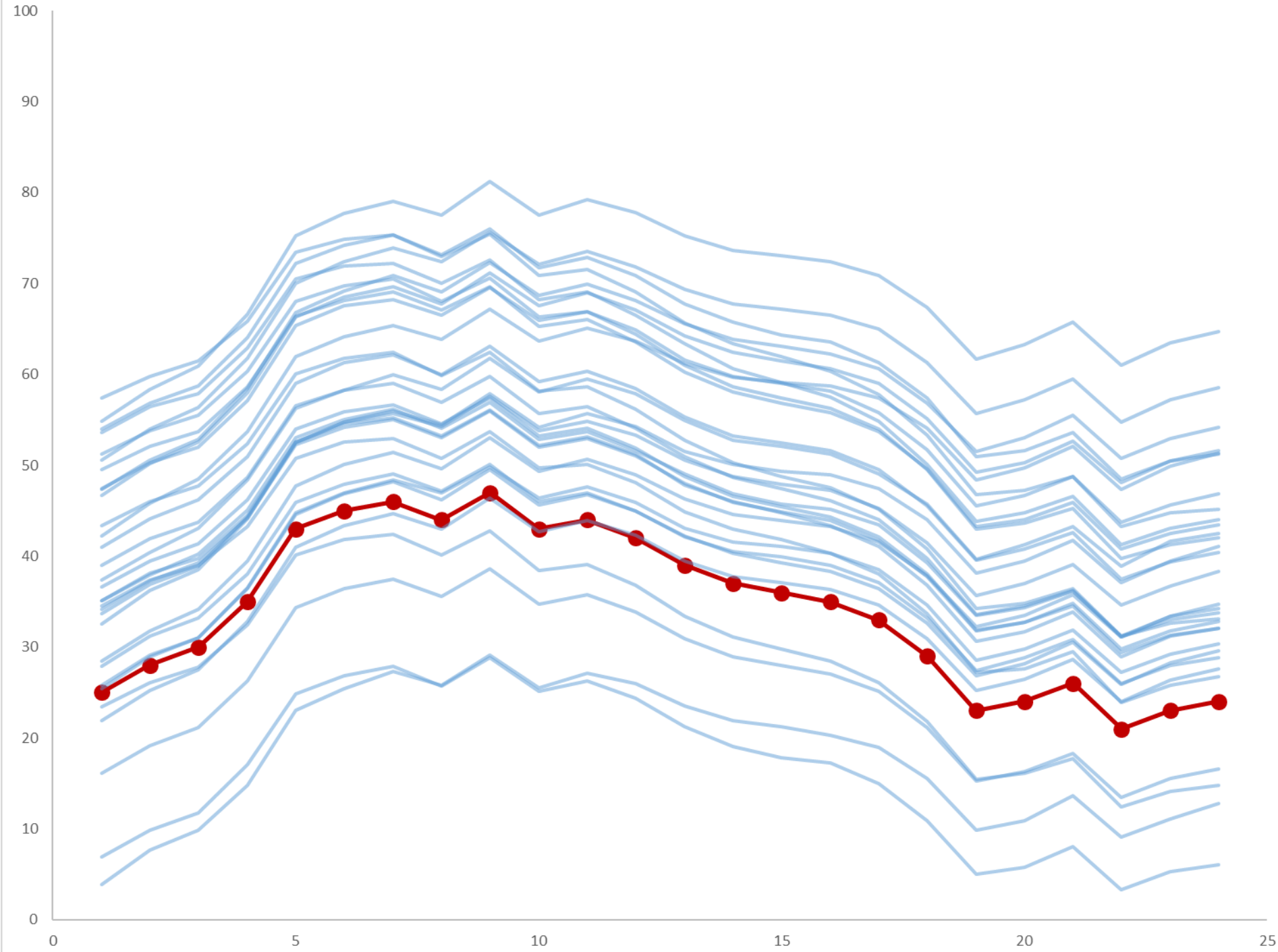
J.R. Bartolino, USGS, Idaho Water Science Center



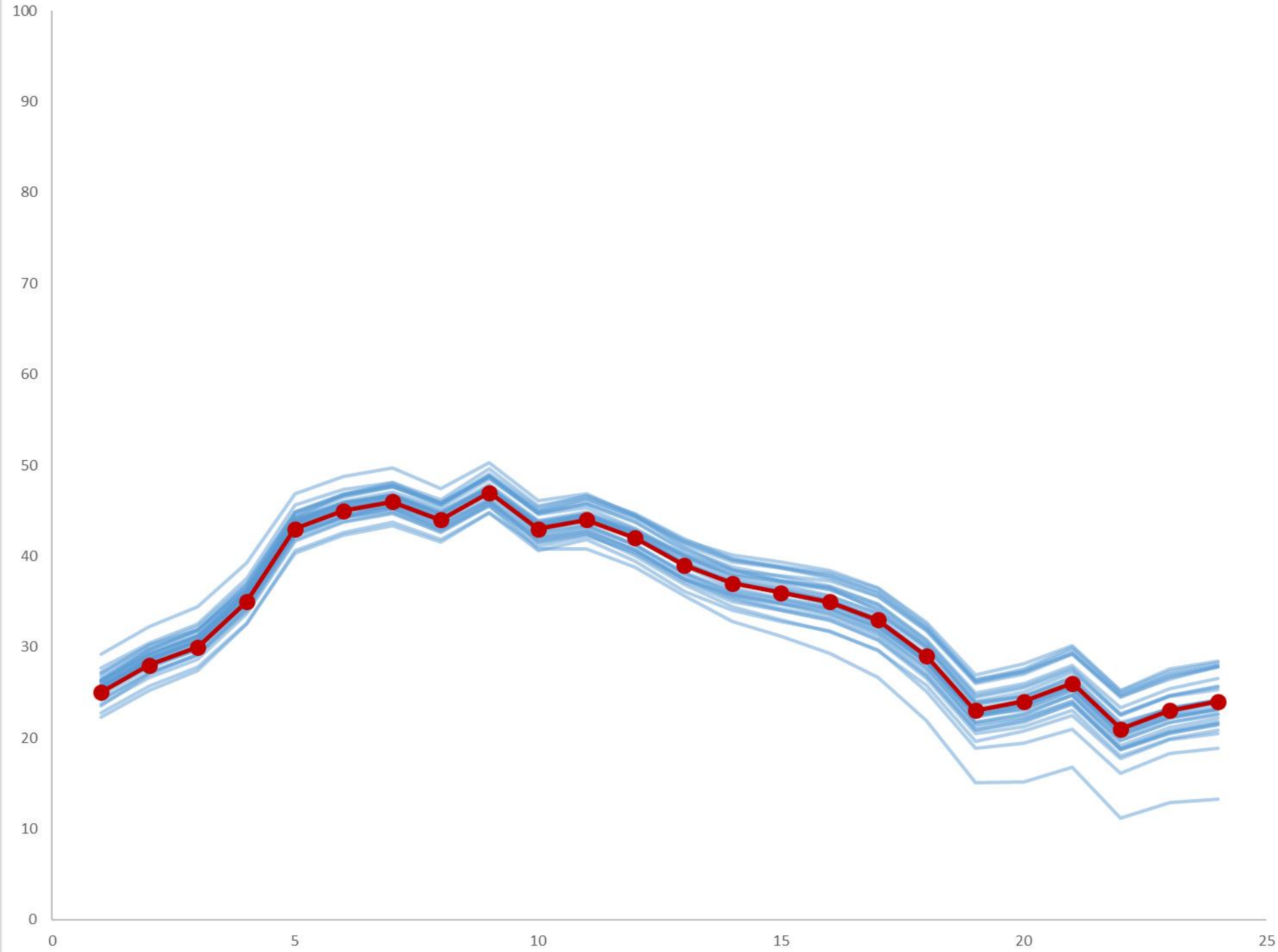
Selecting outputs of interest



Approach to Uncertainty



Approach to Uncertainty



High-throughput computing


```
dot          module-git  module-info  modules      null          use.own
----- /etc/modulefiles -----
allinea/6.0.6                jbigkit/2.1-gcc                qiime/1.9.2
autoconf/2.69-gcc            libtool/2.4.6-gcc              spack
autoconf/2.69-intel          libtool/2.4.6-intel            stacks/1.35
automake/1.15-gcc            m4/1.4.17-gcc                  stereopipeline/2.4.2
automake/1.15-intel          matlab/mcr-R2013a-v81          stereopipeline/2.5.0
baysass/3.0.4-gnu            matlab/R2014b                   stereopipeline/2.5.1
beopest/beopest-13.6-gcc-openmpi-1.10.2  matlab/R2015b                   stereopipeline/2.5.2
beopest/beopest-13.6-intel    mct/2.8-intel                   structure/2.3.4
boost/1.59.0-gcc             mct/2.9-gcc                     tools/beopest-11.13-gnu
bunzip2/2.2.5-gcc            matlab/5.1.0-gcc                tools/beopest-11.13-intel
```

HPC SYSTEMS




General Purpose HPC

- Good place to start
- CPU and GPU
- 143 nodes
- 3,728 CPU, 56,596 CUDA
- 100 Tflop/s

Yeti 

Flagship System

- Large-scale Models
- CPU Only
- 232 nodes
- 9,280 CPU (18,560 hyper-threads)
- 448 Tflop/s

Denali 


Prototype System

- ML and Analytics at scale
- Built-in Software Stack
- 22 nodes, 792 CPU
- 122, 800 CUDA
- 15,360 Tensor

Tallgrass 

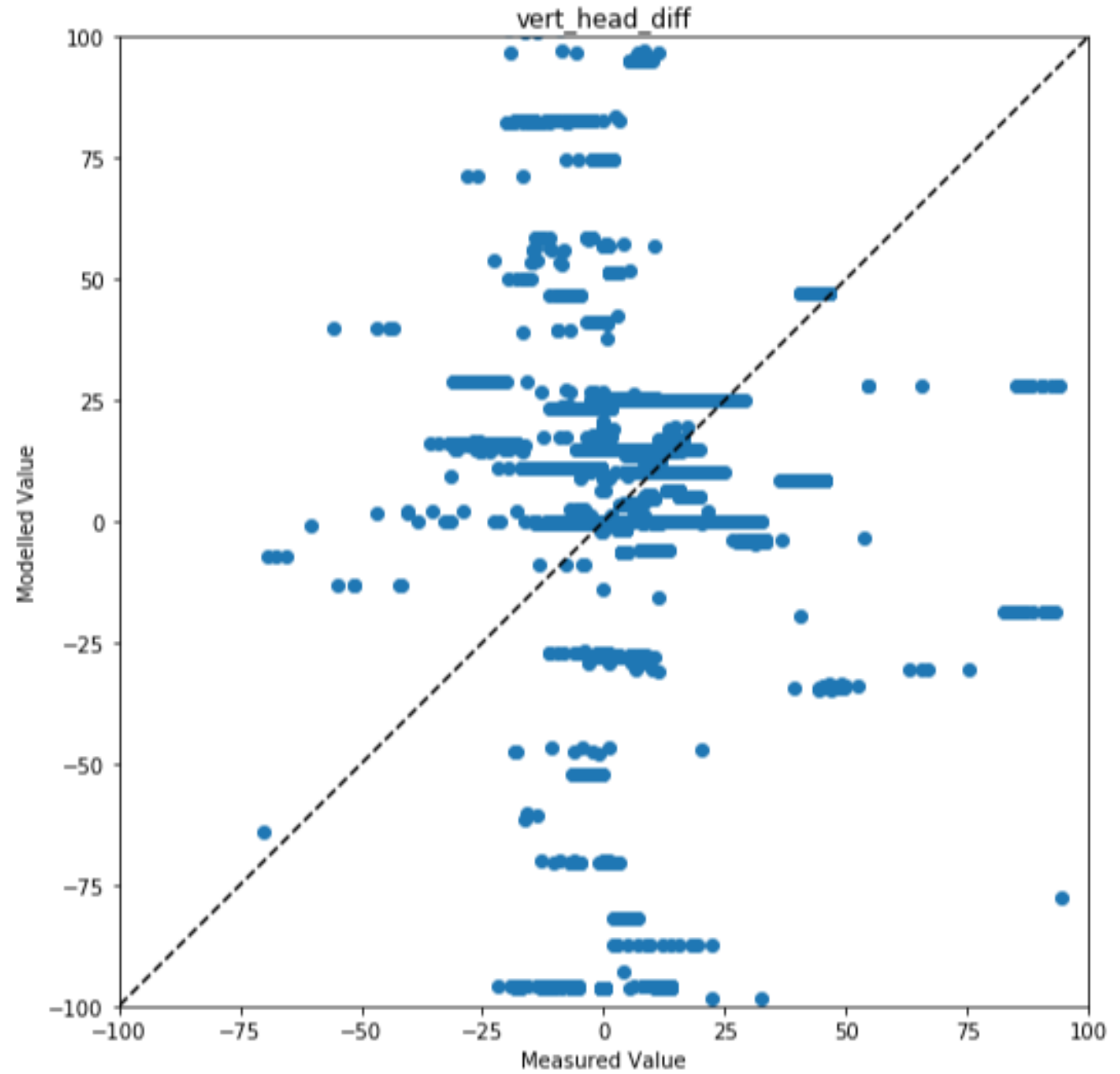
Tiered Storage System

- 4.2 PB Total
- Connects to Denali & Tallgrass
- Provide tiers of storage (high performance & object)

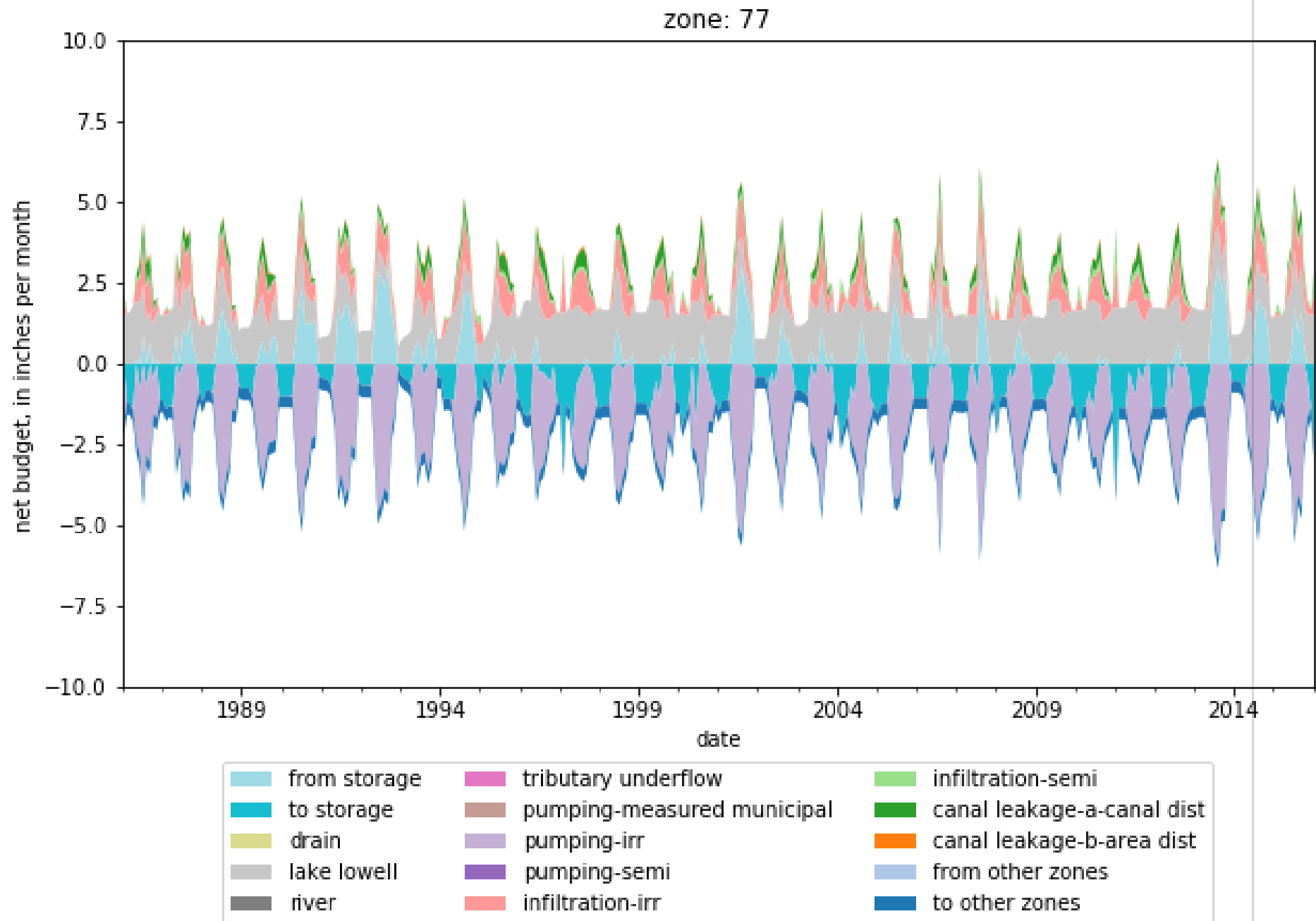
Caldera 

Structure and budget fixes

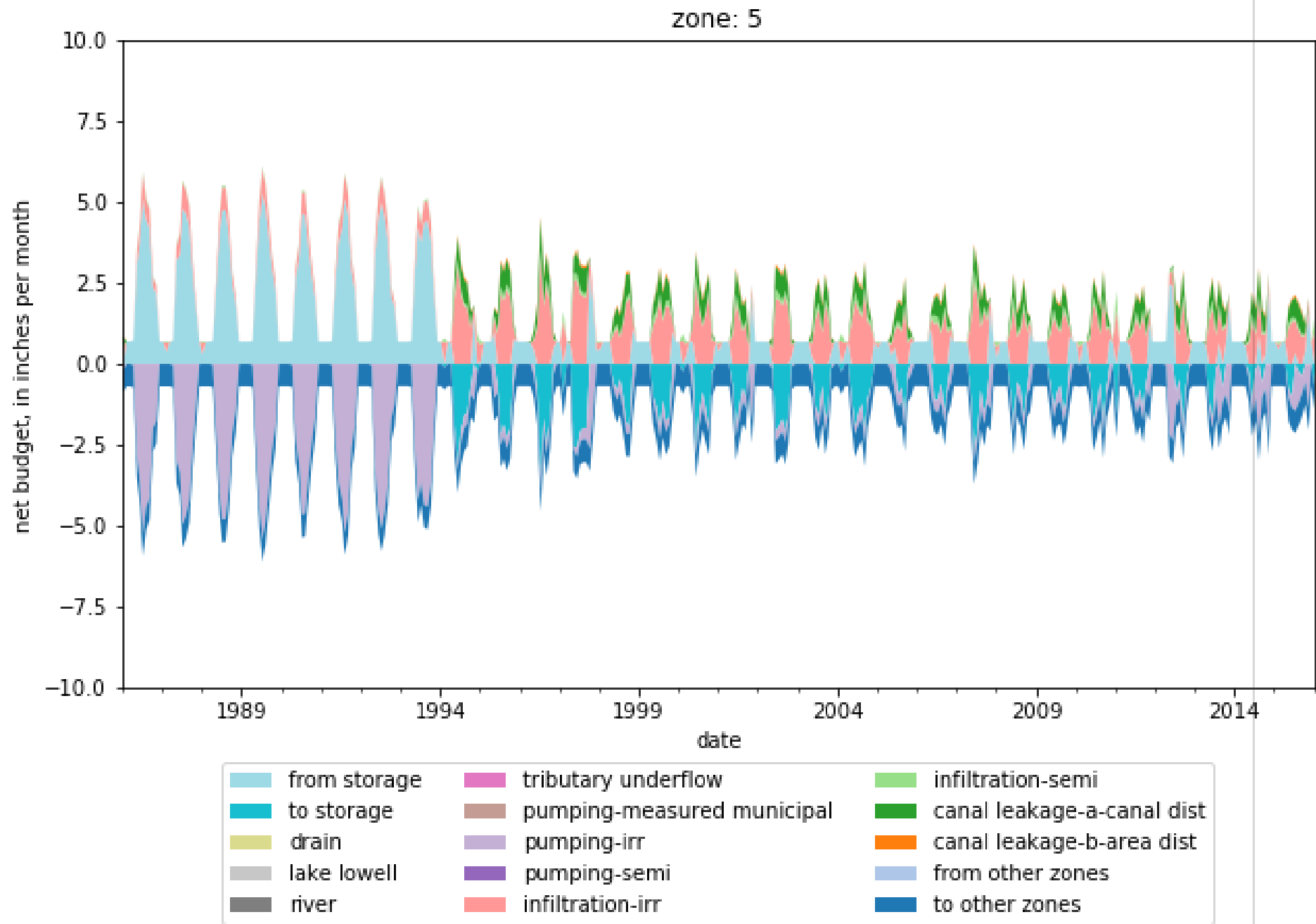
Huh?



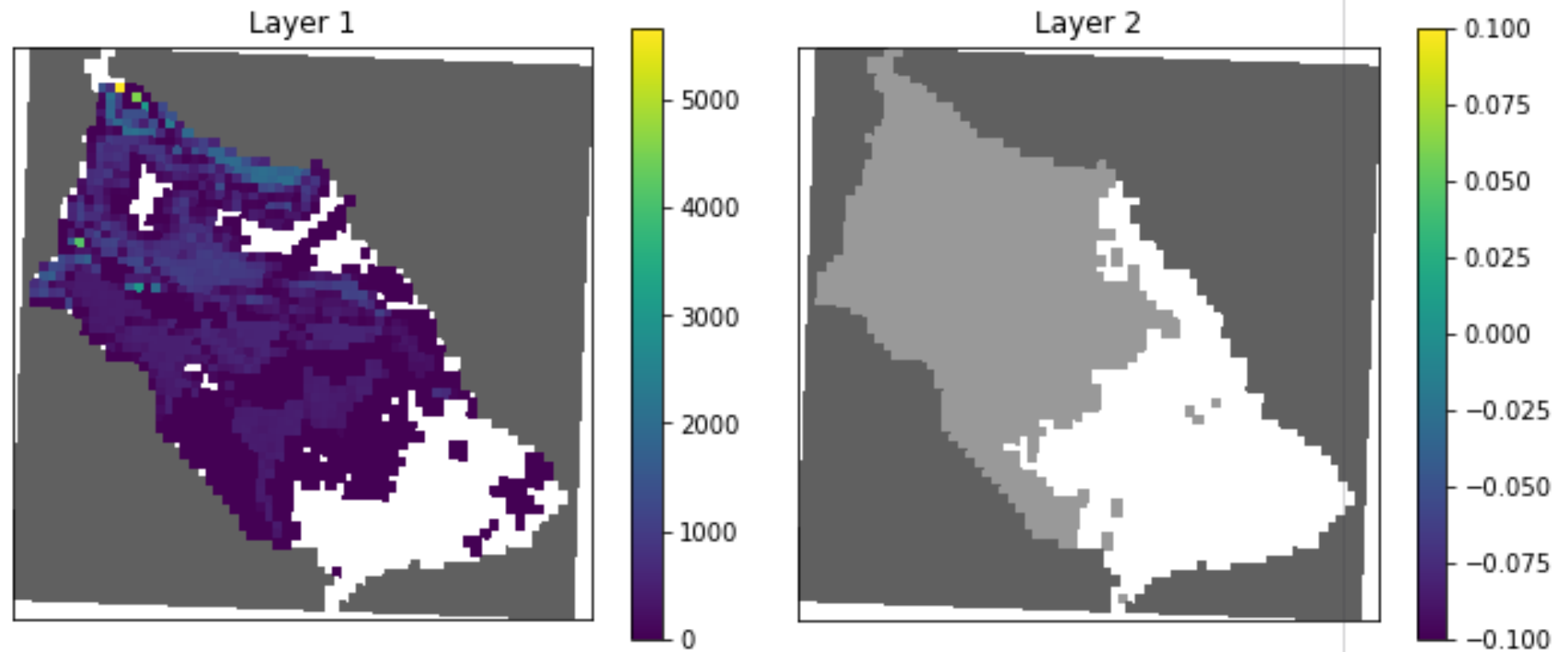
Zonal Budgets



Huh?



Huh?



Major Tasks

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 - Parameter weighting
 - Parameter bounds
 - Estimation settings
 - Uncertainty analysis approach
 - Parallel computing
 - Using framework information
 - Selecting outputs of interest
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Thanks for listening!