

```
In [5]: from AtmoBuilder import AtmoBuilder
```

```
import numpy as np
import matplotlib.pyplot as plt
import copy

%matplotlib inline
```

```
In [6]: ab = AtmoBuilder()
```

```
Found 16 MODTRAN files:
Pachon_MODTRAN.10.7sc
Pachon_MODTRAN.11.7sc
Pachon_MODTRAN.12.7sc
Pachon_MODTRAN.13.7sc
Pachon_MODTRAN.14.7sc
Pachon_MODTRAN.15.7sc
Pachon_MODTRAN.16.7sc
Pachon_MODTRAN.17.7sc
Pachon_MODTRAN.18.7sc
Pachon_MODTRAN.19.7sc
Pachon_MODTRAN.20.7sc
Pachon_MODTRAN.21.7sc
Pachon_MODTRAN.22.7sc
Pachon_MODTRAN.23.7sc
Pachon_MODTRAN.24.7sc
Pachon_MODTRAN.25.7sc
MODTRAN files have been read.
```

```
Read filter data from LSST software stack.
Filters: ['u', 'g', 'r', 'i', 'z', 'y4']
Read hardware data from LSST software stack.
```

```
In [7]: ab.readAll()
```

```
# Read 988 MS stars from /Users/joachim/lsst/DarwinX86/sims_sed_library/2014.1
# Read 849 white dwarfs from /Users/joachim/lsst/DarwinX86/sims_sed_library/20
# Read 74 mlt stars from /Users/joachim/lsst/DarwinX86/sims_sed_library/2014.1
# Generated 2520 galaxies at redshifts between 0.000000 and 3.000000
# Generated 76 quasars at redshifts between 0.000000 and 7.500000
# Generated 39 sn's at redshifts between 0.000000 and 1.200000 on days ['0',
'20', '40']
```

```
In [8]: maxp = 2.0
```

```
minp = 0.5
airmass = 2.0
deltaGrey_obs = 12.0
colorRange = [0.2,5.0]
```

```
def deltaGreyLimitPlot(comp, maxp=maxp, minp=minp, deltaGrey=deltaGrey_obs, d
eltaGreyRange=[-20.0,20.0],
                      err=5.0, componentBins=50, deltaGreyBins=51, colorRang
e=colorRange, regressionSed='mss'):
```

```
    prange, pnum = ab._componentCheck(comp,20)
```

```
    atmo_std = ab.buildAtmo(ab.parameters, airmass)
```

```
    name_max = 'max_dGTest_giCut_OR' + str(int(maxp*100.0))
    name_min = 'min_dGTest_giCut_OR' + str(int(minp*100.0))
```

```
    ab.computeDeltaGreyFit(comp, deltaGrey, atmo_std, deltaGreyRange=deltaGre
yRange, componentBins=componentBins,
                           deltaGreyBins=deltaGreyBins, regressionSed=regress
ionSed, pickleString=name_max, plotDmags=False, override=True, overrideValu
e=maxp, colorRange=colorRange)
```

```
    ab.computeDeltaGreyFit(comp, deltaGrey, atmo_std, deltaGreyRange=deltaGre
yRange, componentBins=componentBins,
                           deltaGreyBins=deltaGreyBins, regressionSed=regress
ionSed, pickleString=name_min, plotDmags=False, override=True, overrideValu
e=minp, colorRange=colorRange)
```

```
    return
```

## **Components:**

- $H_2O$
- $O_2$
- $O_3$
- Rayleigh
- Aerosol
- Alpha

$H_2O$

```
In [9]: deltaGreyLimitPlot('H2O')
```

```
Computing nonlinear regression for H2O.  
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]  
Observed atmosphere airmass: 2.0  
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]  
Standard atmosphere airmass: 1.2  
Observed atmosphere parameter for H2O: 1.0  
  
Fitting for H2O between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.  
  
Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.  
  
Regressing 2550 parameter combinations per filter...  
Magnitude Error: 5.0 mmags  
  
Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...  
  
Calculating best fit parameters for u filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_max_dGTest_giCut_OR200.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.  
  
Calculating best fit parameters for g filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_max_dGTest_giCut_OR200.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.  
  
Calculating best fit parameters for r filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_max_dGTest_giCut_OR200.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.  
  
Calculating best fit parameters for i filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_max_dGTest_giCut_OR200.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.  
  
Calculating best fit parameters for z filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_max_dGTest_giCut_OR200.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.  
  
Calculating best fit parameters for y4 filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_max_dGTest_giCut_OR200.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
  
AtmoBuilder.py:893: FutureWarning: comparison to `None` will result in an elementwise object comparison in the future.  
    if sedkeylist == None:  
        /Users/joachim/lsst/DarwinX86/anaconda/2.2.0/lib/python2.7/site-packages/matplotlib/text.py:52: UnicodeWarning: Unicode equal comparison failed to convert both arguments to Unicode - interpreting them as being unequal  
            if rotation in ('horizontal', None):
```

Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.

Best fit parameters (Filter, H2O, dG, logL, Chi-Squared):  
u 0.98 12.00 1.17629668847e-06 2.35259337693e-06  
g 0.98 12.00 1.08470677551e-06 2.16941355102e-06  
r 0.98 12.00 3.35293072153e-06 6.70586144307e-06  
i 0.98 12.00 3.13038441811e-06 6.26076883622e-06  
z 0.98 12.00 0.000561524351588 0.00112304870318  
y4 0.98 12.00 0.00708956660293 0.0141791332059

Override best fit parameters (Filter, H2O, dG):  
u 2.00 12.00  
g 2.00 12.00  
r 2.00 12.00  
i 2.00 12.00  
z 2.00 12.00  
y4 2.00 12.80

Computing nonlinear regression for H2O.  
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]  
Observed atmosphere airmass: 2.0  
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]  
Standard atmosphere airmass: 1.2  
Observed atmosphere parameter for H2O: 1.0

Fitting for H2O between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...  
Magnitude Error: 5.0 mmags

Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_H20\_dG\_XSTD12\_DGR-2020\_E5\_mss\_u\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.

Calculating best fit parameters for g filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_H20\_dG\_XSTD12\_DGR-2020\_E5\_mss\_g\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.

Calculating best fit parameters for r filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_H20\_dG\_XSTD12\_DGR-2020\_E5\_mss\_r\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.

Calculating best fit parameters for i filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_H20\_dG\_XSTD12\_DGR-2020\_E5\_mss\_i\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.

Calculating best fit parameters for z filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_H20\_dG\_XSTD12\_DGR-2020\_E5\_mss\_z\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.

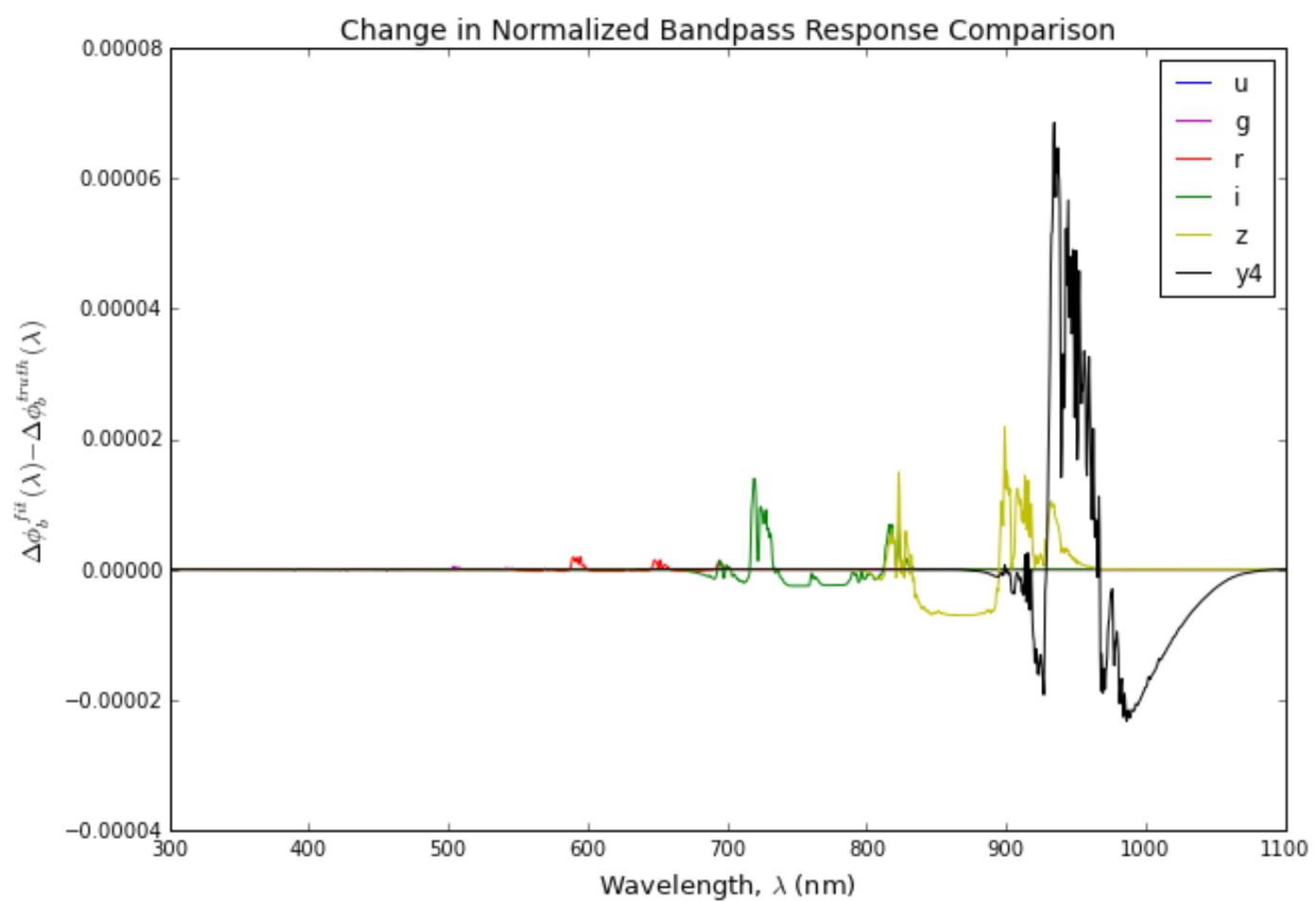
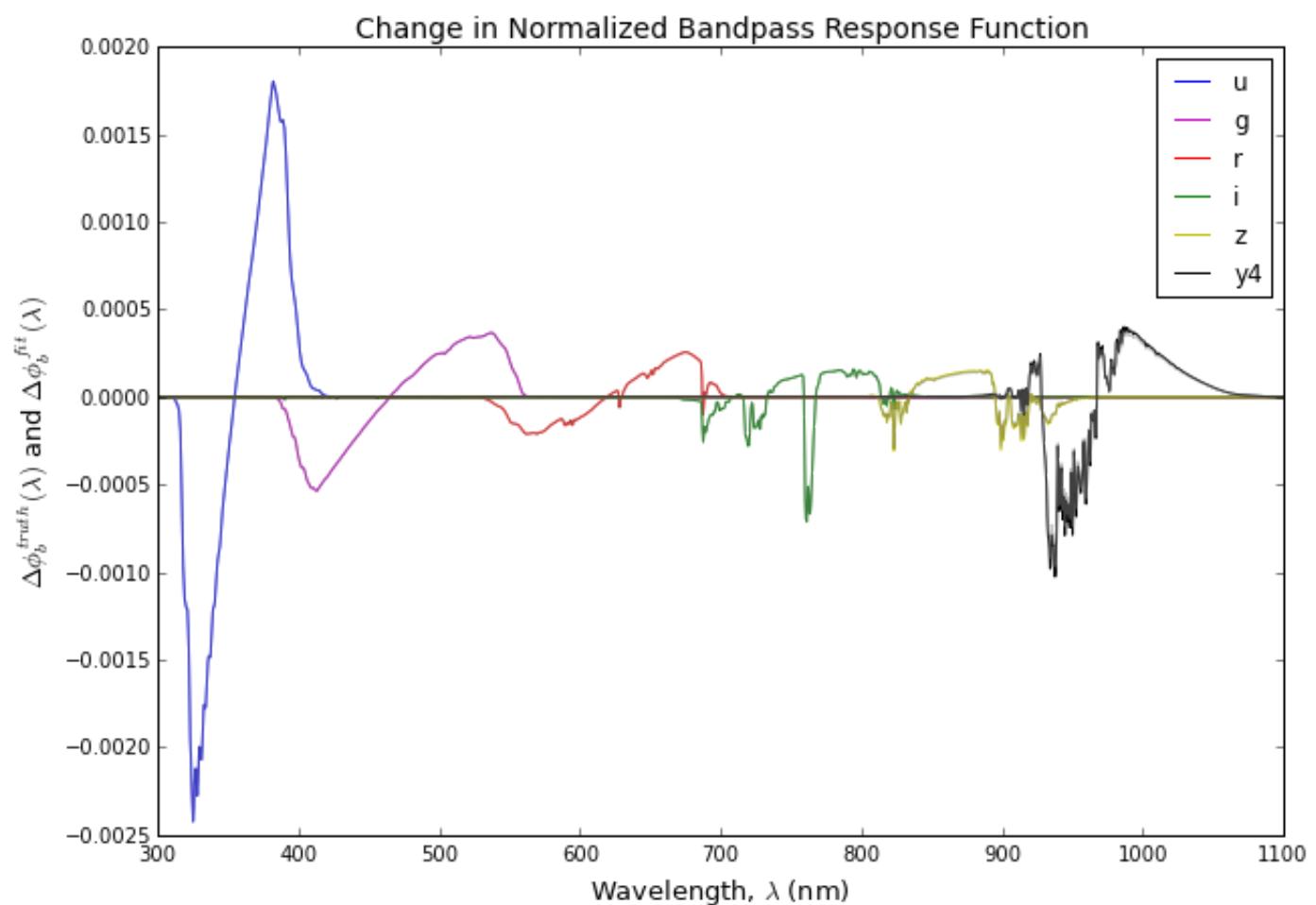
Calculating best fit parameters for y4 filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_H20\_dG\_XSTD12\_DGR-2020\_E5\_mss\_y4\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.

Best fit parameters (Filter, H2O, dG, logL, Chi-Squared):  
u 0.98 12.00 1.17629668847e-06 2.35259337693e-06  
g 0.98 12.00 1.08470677551e-06 2.16941355102e-06

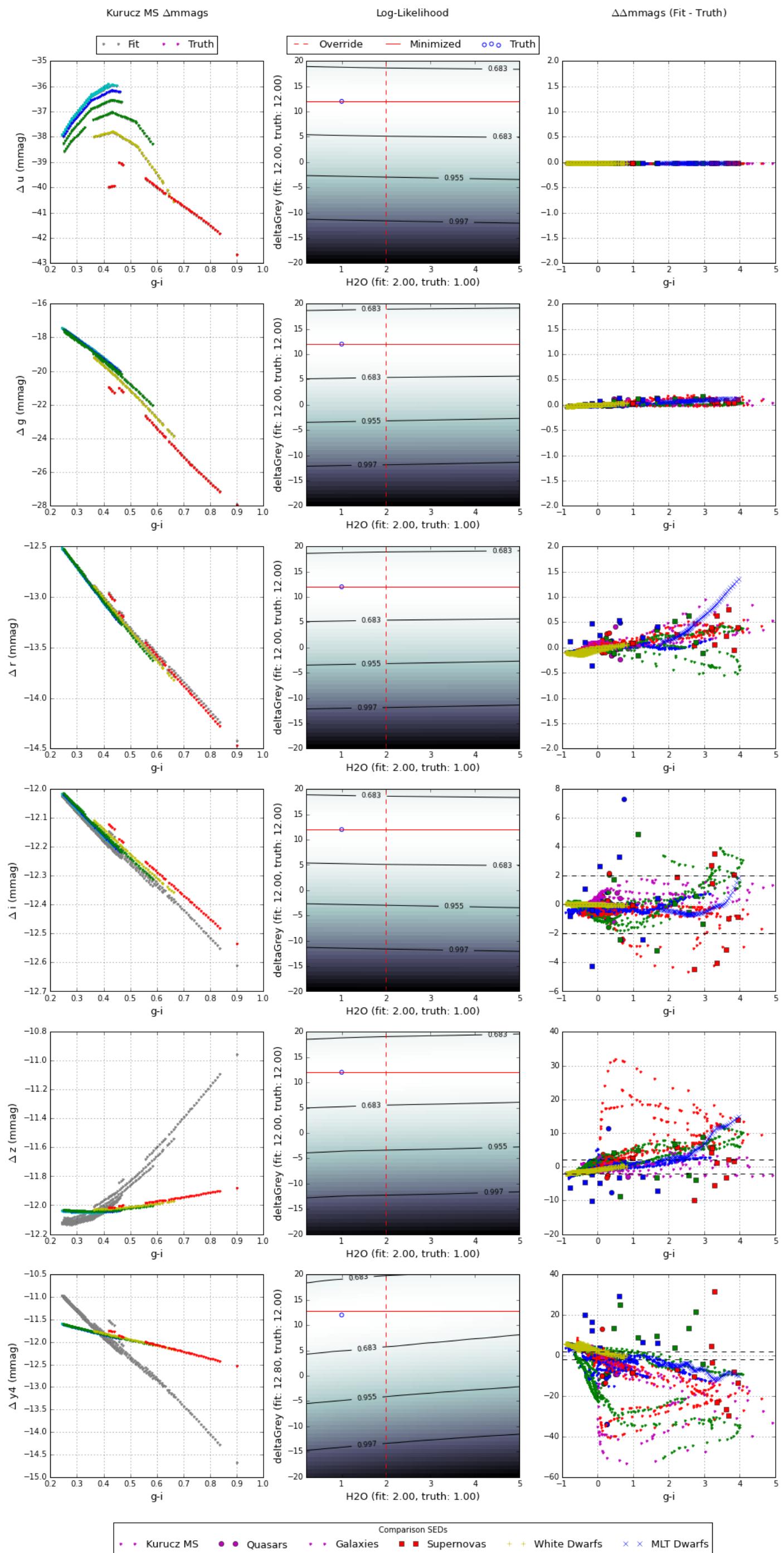
```
r 0.98 12.00 3.35293072153e-06 6.70586144307e-06
i 0.98 12.00 3.13038441811e-06 6.26076883622e-06
z 0.98 12.00 0.000561524351588 0.00112304870318
y4 0.98 12.00 0.00708956660293 0.0141791332059
```

```
Override best fit parameters (Filter, H2O, dG):
u 0.50 12.00
g 0.50 12.00
r 0.50 12.00
i 0.50 12.00
z 0.50 12.00
y4 0.50 11.20
```

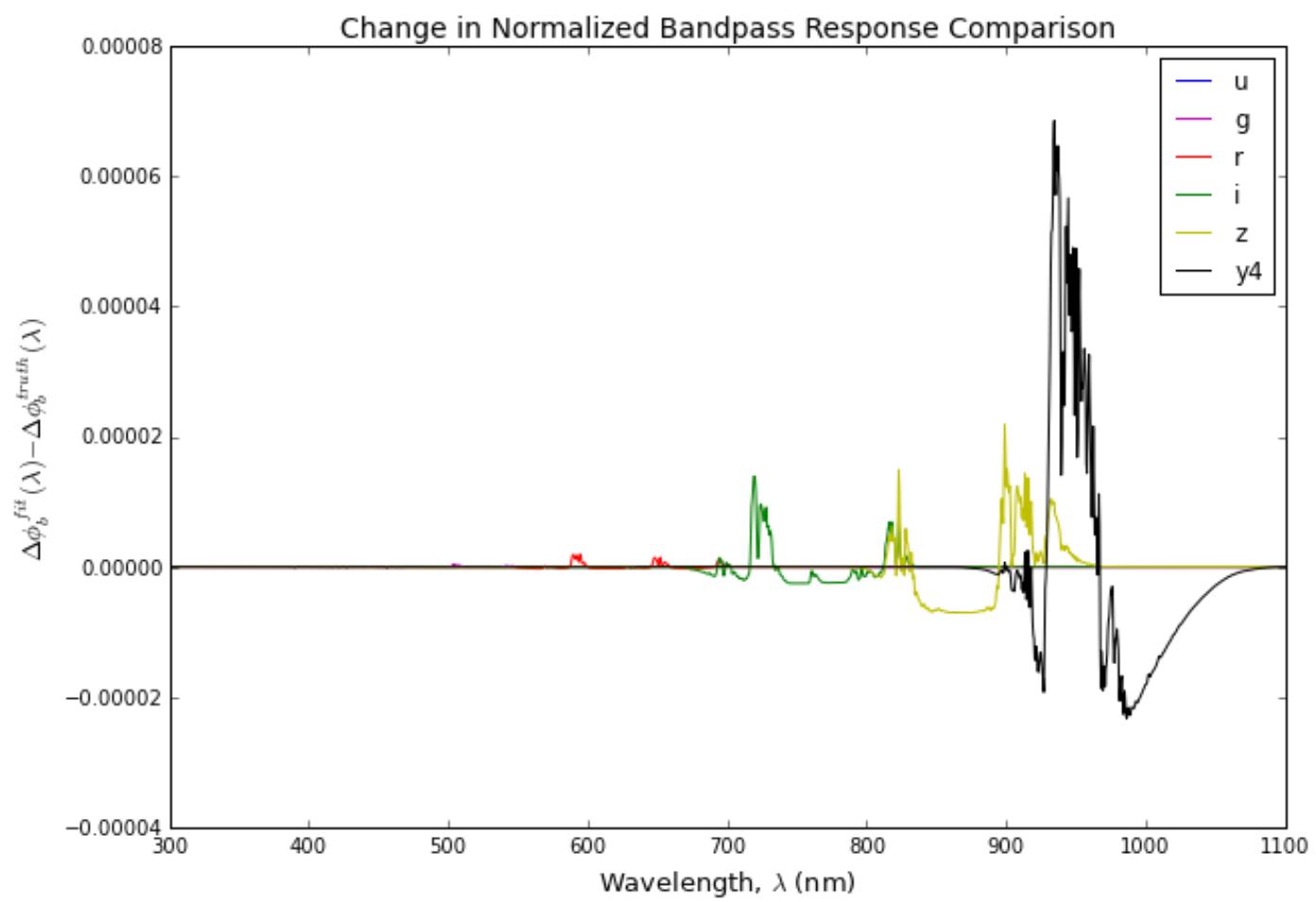
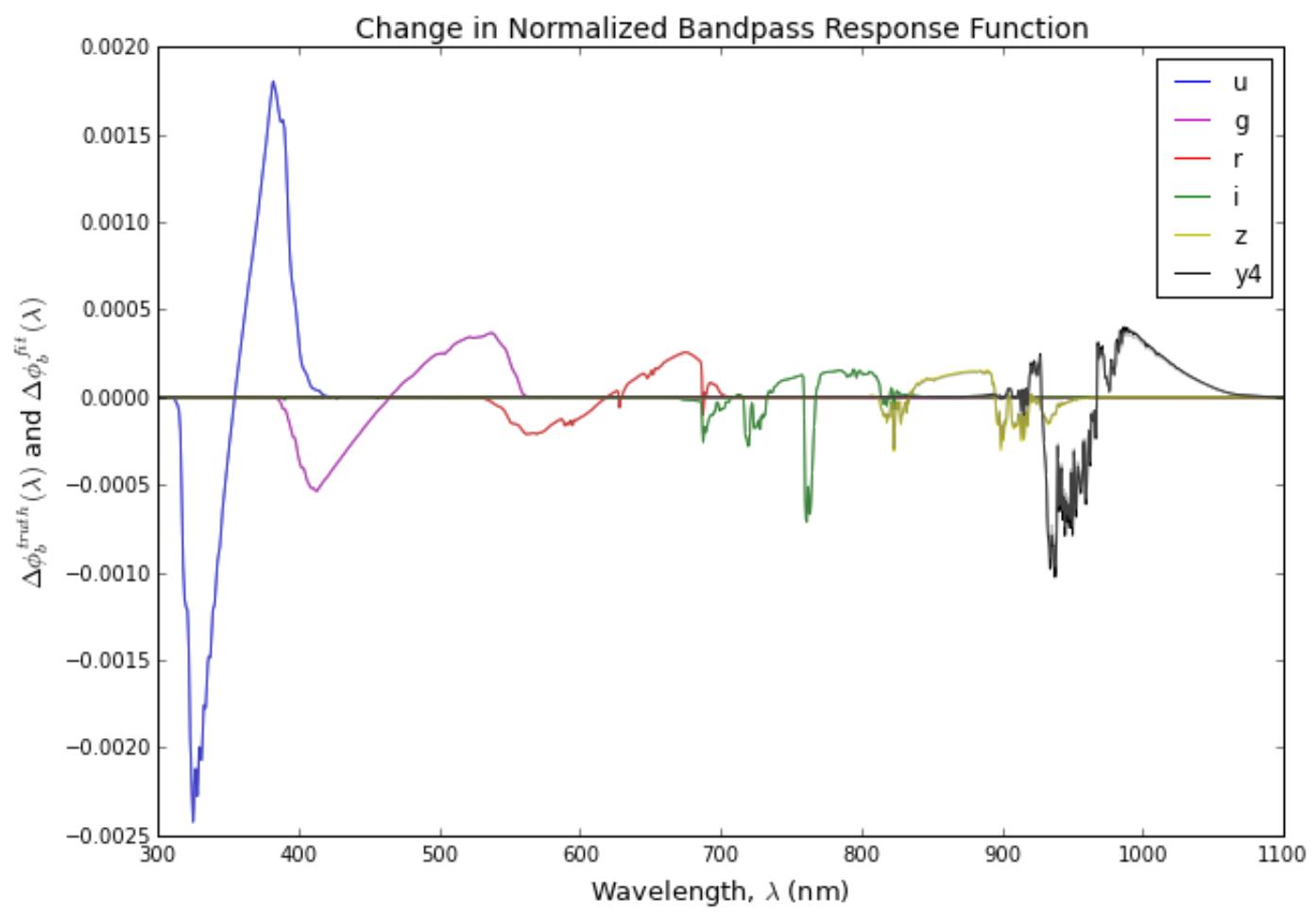
```
/Users/joachim/lsst/DarwinX86/anaconda/2.2.0/lib/python2.7/site-packages/matplotlib/text.py:54: UnicodeWarning: Unicode equal comparison failed to convert both arguments to Unicode - interpreting them as being unequal
    elif rotation == 'vertical':
```



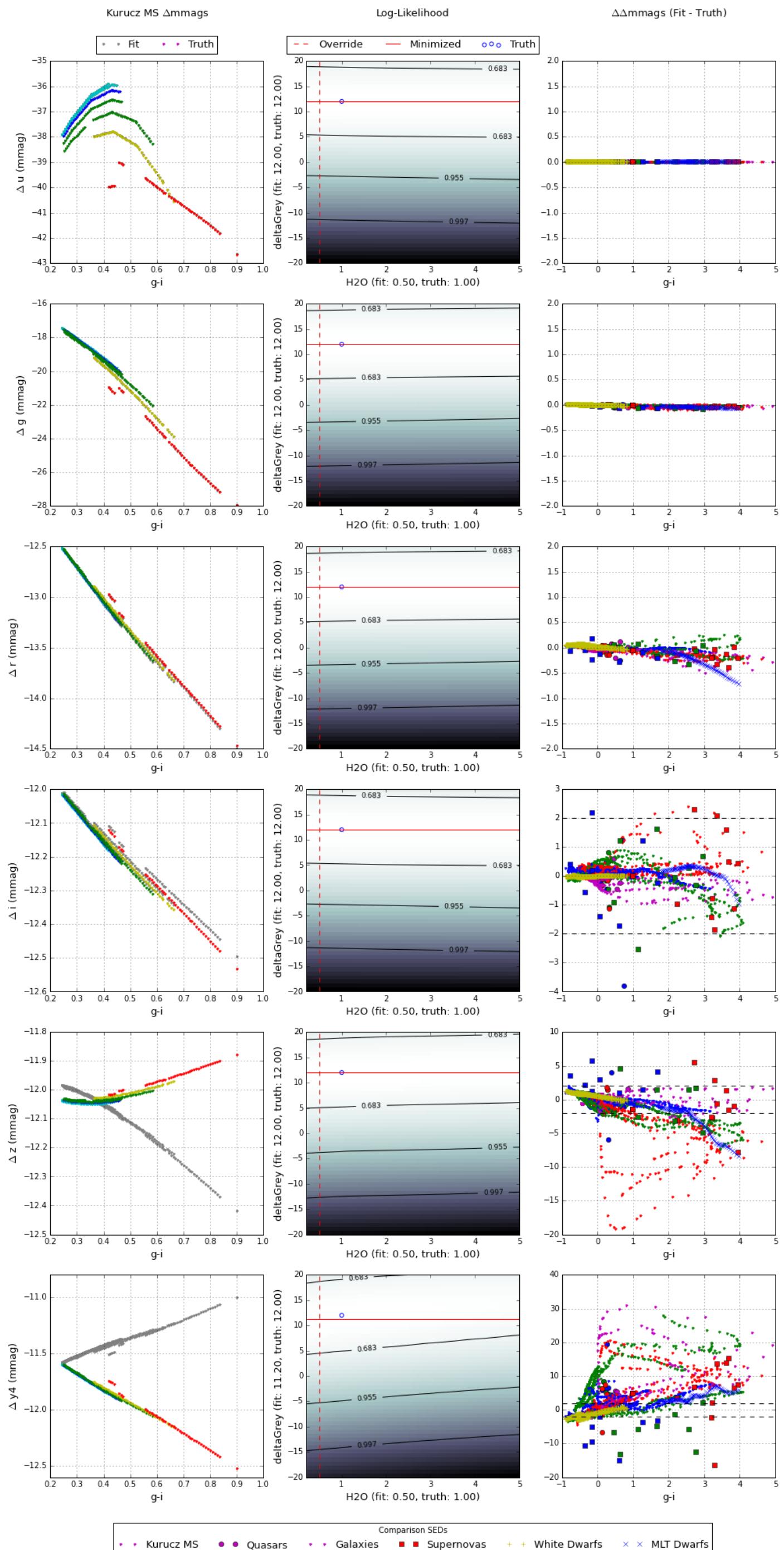
$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



Comparison SEDs



$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



Comparison SEDs

• Kurucz MS    • Quasars    • Galaxies    ■ Supernovas    + White Dwarfs    × MLT Dwarfs

```
In [10]: deltaGreyLimitPlot('H2O',deltaGreyBins=50)
```

```

Computing nonlinear regression for H2O.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for H2O: 1.0

Fitting for H2O between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H20_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

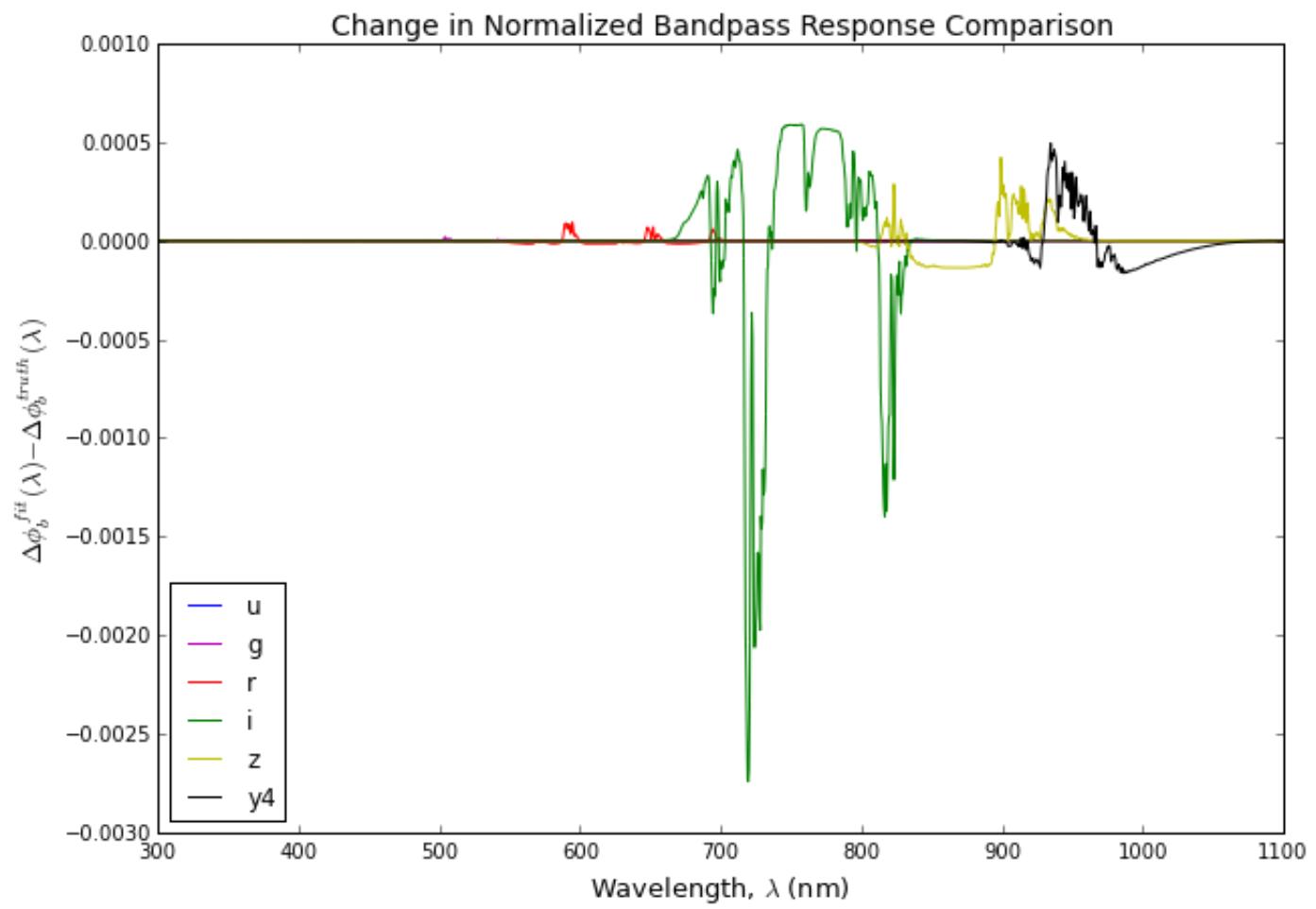
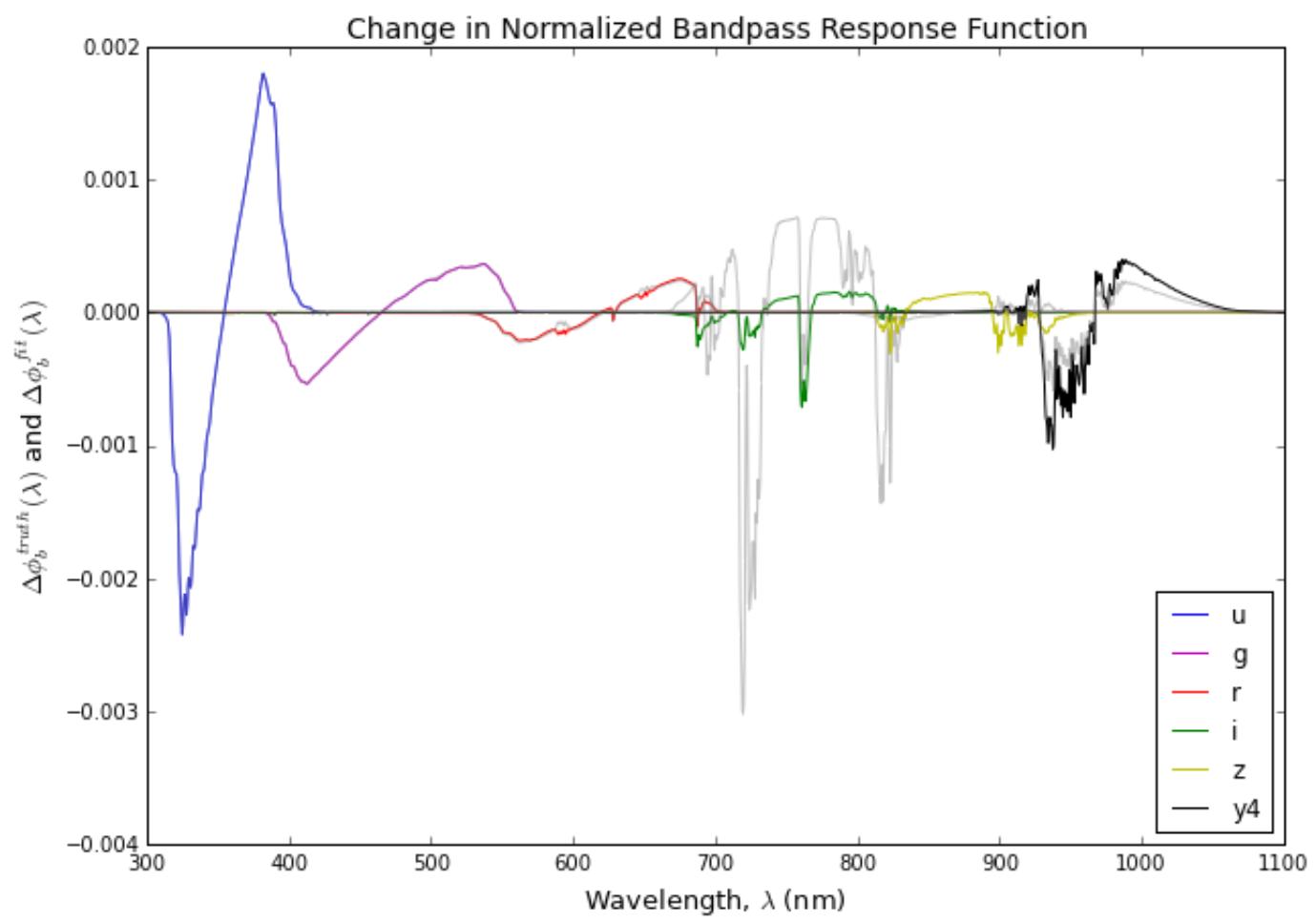
Best fit parameters (Filter, H2O, dG, logL, Chi-Squared):
u 5.00 11.84 0.206138812245 0.412277624489
g 0.20 11.84 0.355700900792 0.711401801585
r 0.20 11.84 0.343664056014 0.687328112028
i 5.00 11.84 0.184158121637 0.368316243274
z 0.69 11.84 0.182056496796 0.364112993593
y4 0.89 11.84 0.305757940394 0.611515880789

Override best fit parameters (Filter, H2O, dG):
u 2.00 11.84
g 2.00 11.84
r 2.00 11.84
i 2.00 11.84
z 2.00 12.65
y4 2.00 12.65

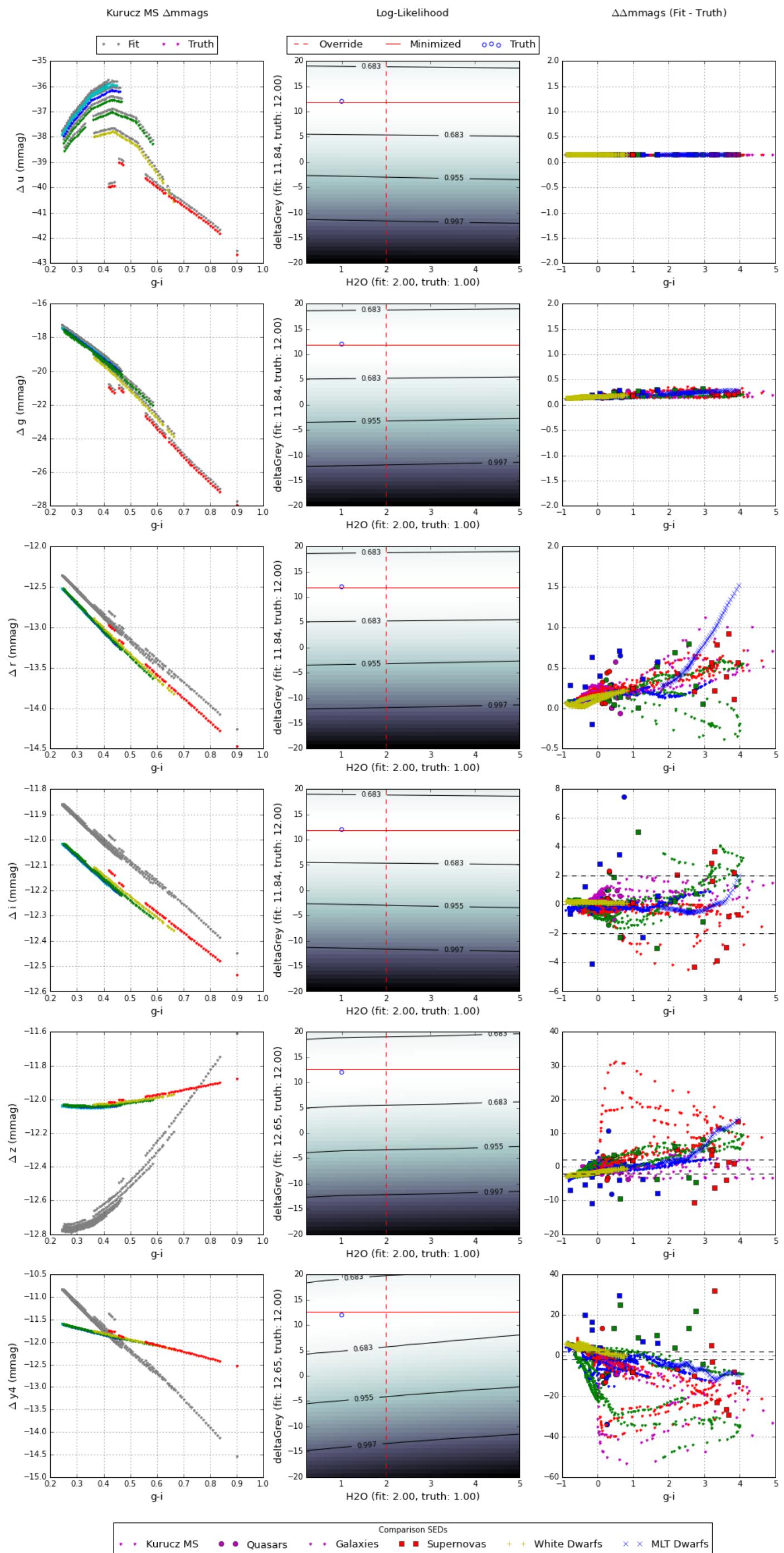
Computing nonlinear regression for H2O.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for H2O: 1.0

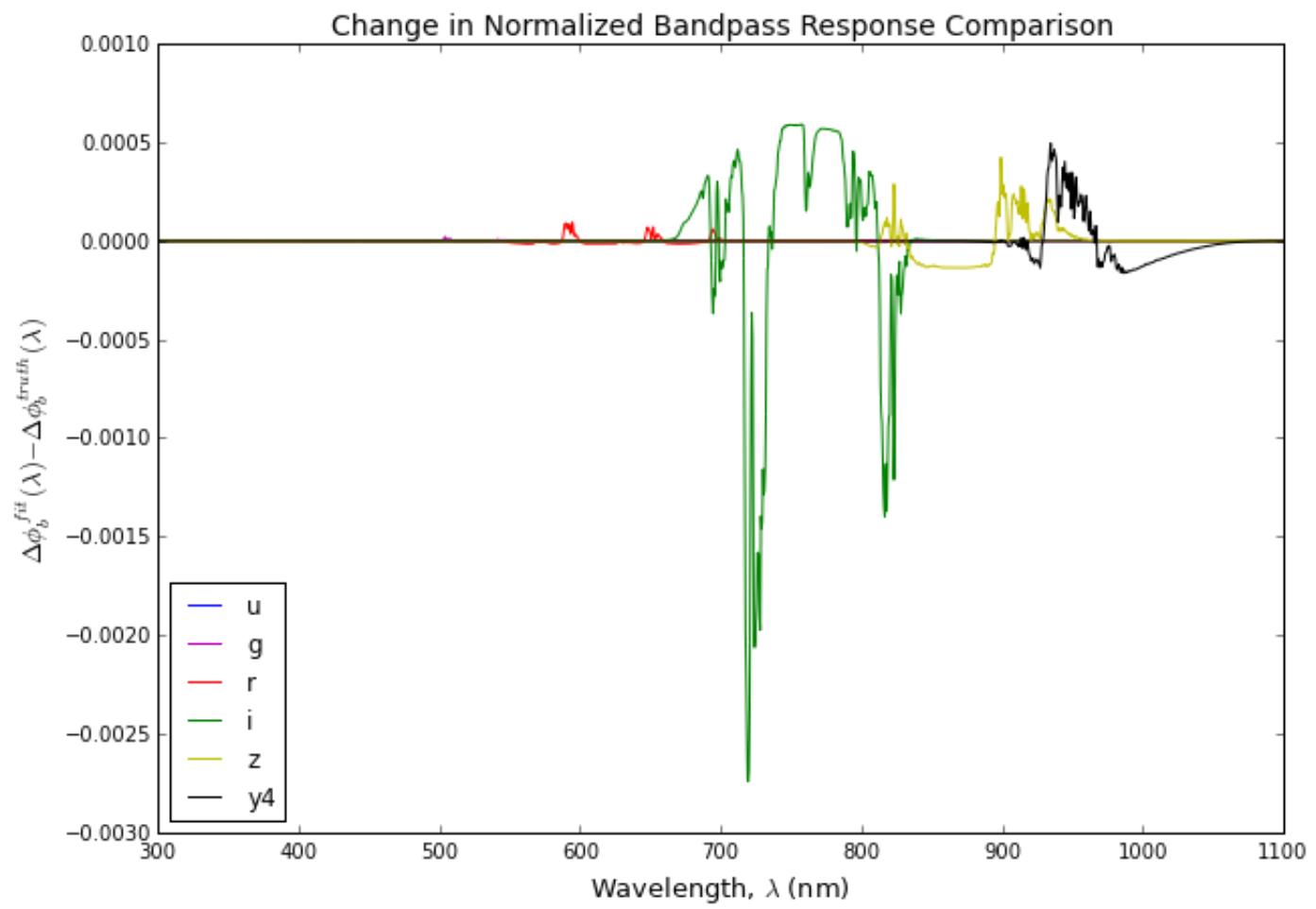
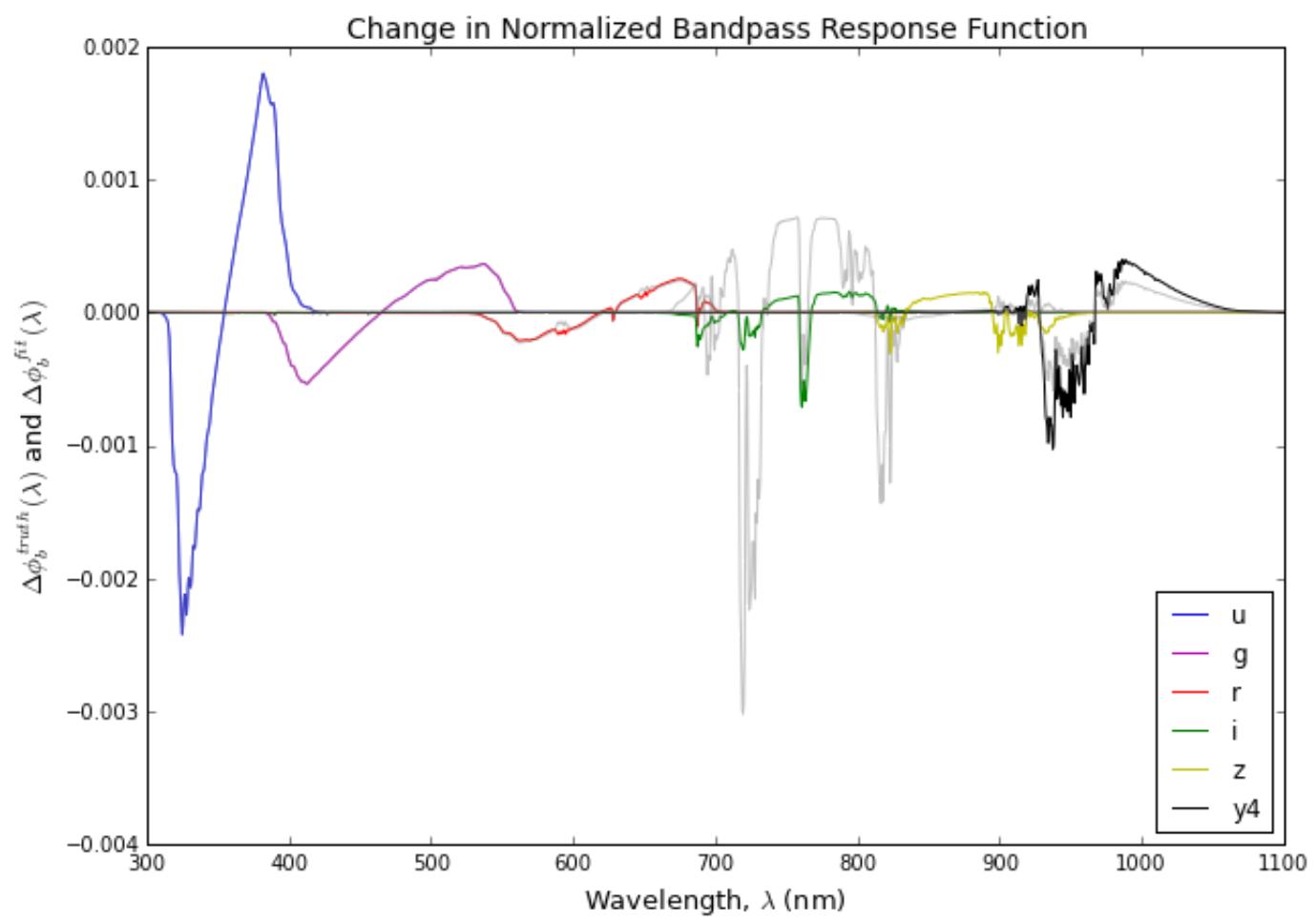
```

```
Fitting for H2O between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.  
  
Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.  
  
Regressing 2500 parameter combinations per filter...  
Magnitude Error: 5.0 mmags  
  
Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at ne  
w component best-fit value...  
  
Calculating best fit parameters for u filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H2  
O_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.  
  
Calculating best fit parameters for g filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H2  
O_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.  
  
Calculating best fit parameters for r filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H2  
O_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.  
  
Calculating best fit parameters for i filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H2  
O_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.  
  
Calculating best fit parameters for z filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H2  
O_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.  
  
Calculating best fit parameters for y4 filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_H2  
O_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.  
  
Best fit parameters (Filter, H2O, dG, logL, Chi-Squared):  
u 5.00 11.84 0.206138812245 0.412277624489  
g 0.20 11.84 0.355700900792 0.711401801585  
r 0.20 11.84 0.343664056014 0.687328112028  
i 5.00 11.84 0.184158121637 0.368316243274  
z 0.69 11.84 0.182056496796 0.364112993593  
y4 0.89 11.84 0.305757940394 0.611515880789  
  
Override best fit parameters (Filter, H2O, dG):  
u 0.50 11.84  
g 0.50 11.84  
r 0.50 11.84  
i 0.50 11.84  
z 0.50 11.84  
y4 0.50 11.84
```

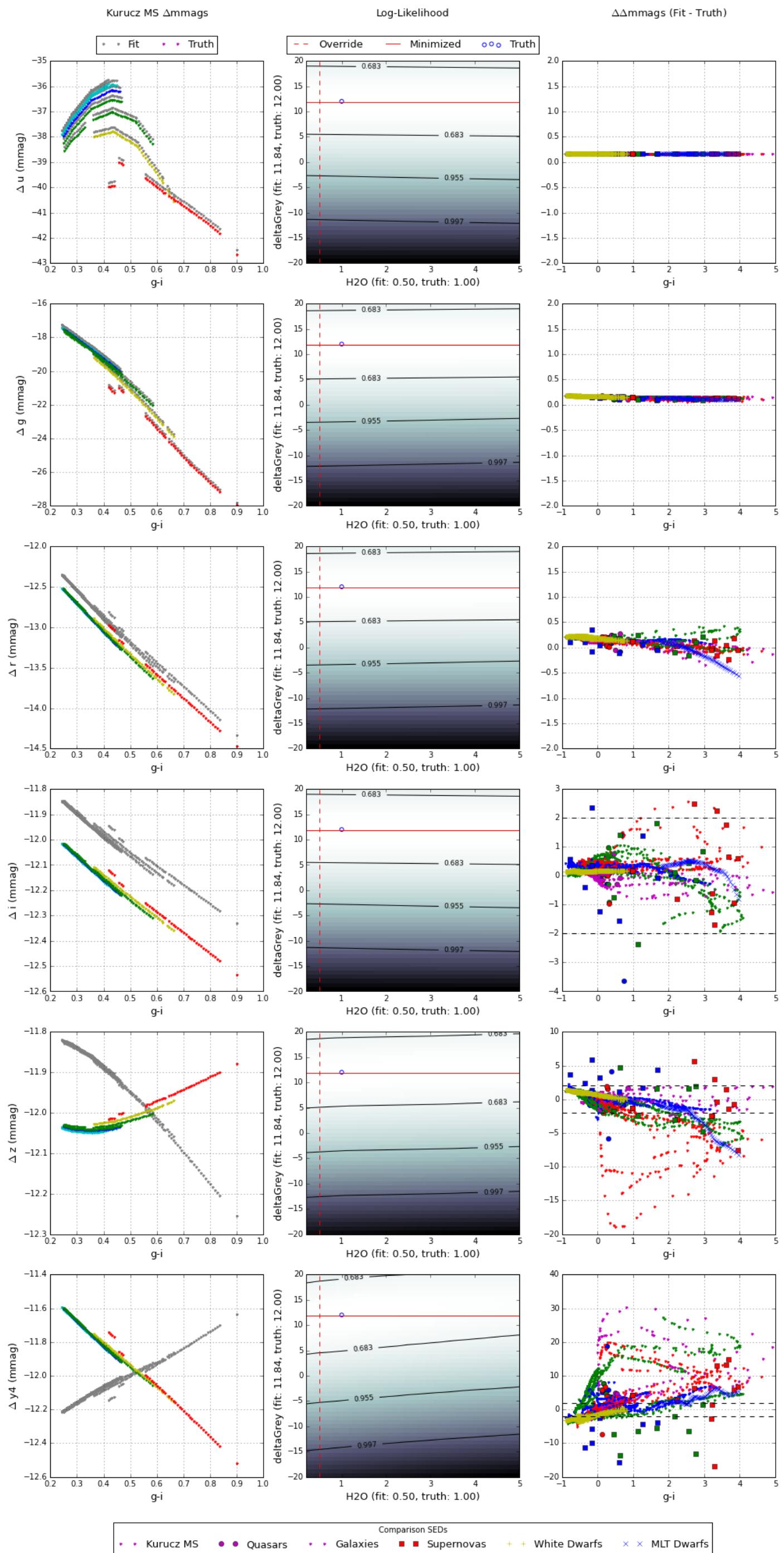


$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



Comparison SEDs

$O_2$

```
In [11]: deltaGreyLimitPlot('O2')
```

```

Computing nonlinear regression for O2.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O2: 1.0

Fitting for O2 between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

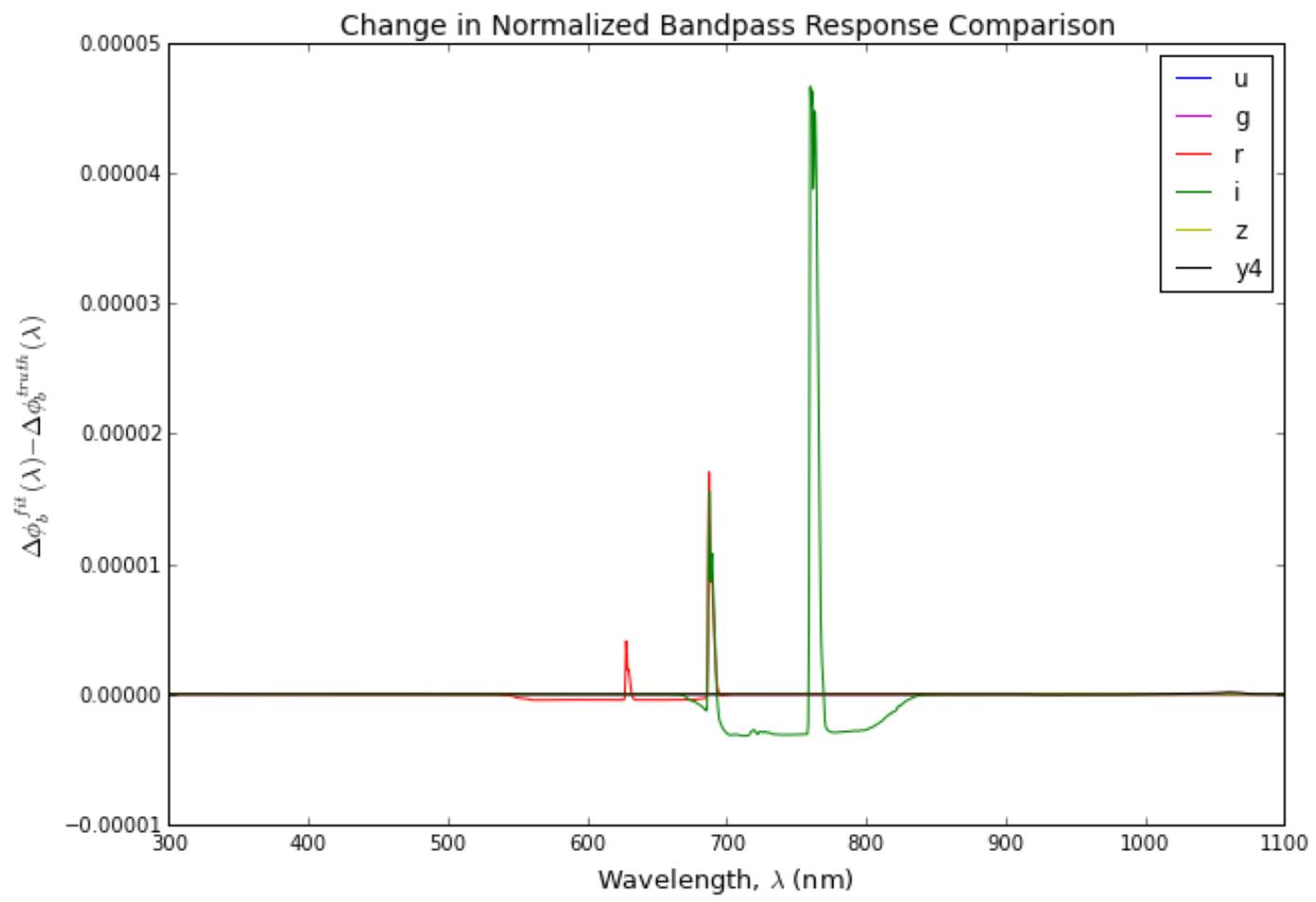
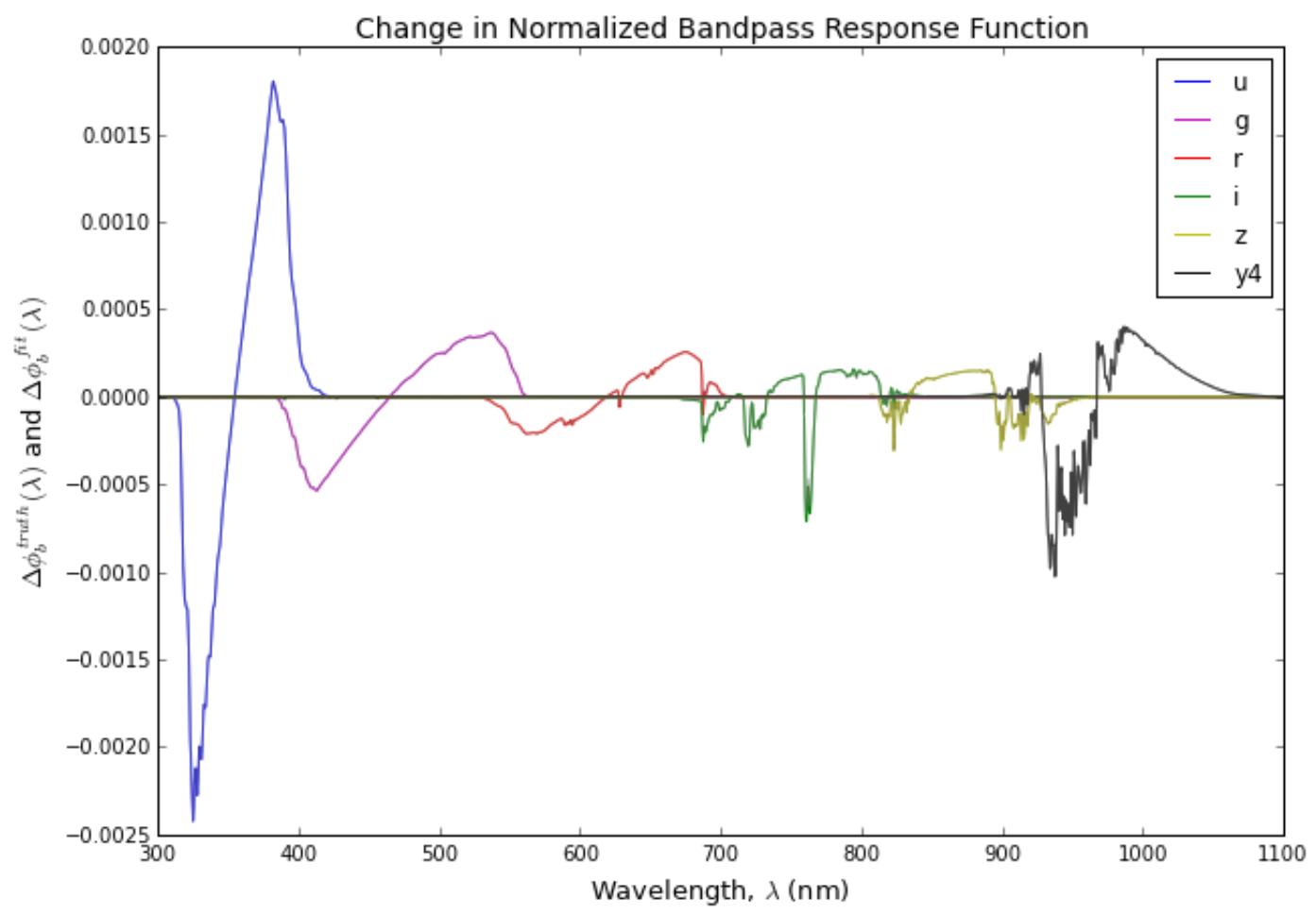
Best fit parameters (Filter, O2, dG, logL, Chi-Squared):
u 0.98 12.00 6.56132150786e-08 1.31226430157e-07
g 0.98 12.00 5.52829861283e-09 1.10565972257e-08
r 0.98 12.00 0.000402915229623 0.000805830459246
i 0.98 12.00 1.0682924054e-05 2.1365848108e-05
z 0.98 12.00 6.81043674544e-10 1.36208734909e-09
y4 0.98 12.00 1.36168053485e-07 2.72336106971e-07

Override best fit parameters (Filter, O2, dG):
u 2.00 12.00
g 2.00 12.00
r 2.00 12.00
i 2.00 12.00
z 2.00 12.00
y4 2.00 12.00

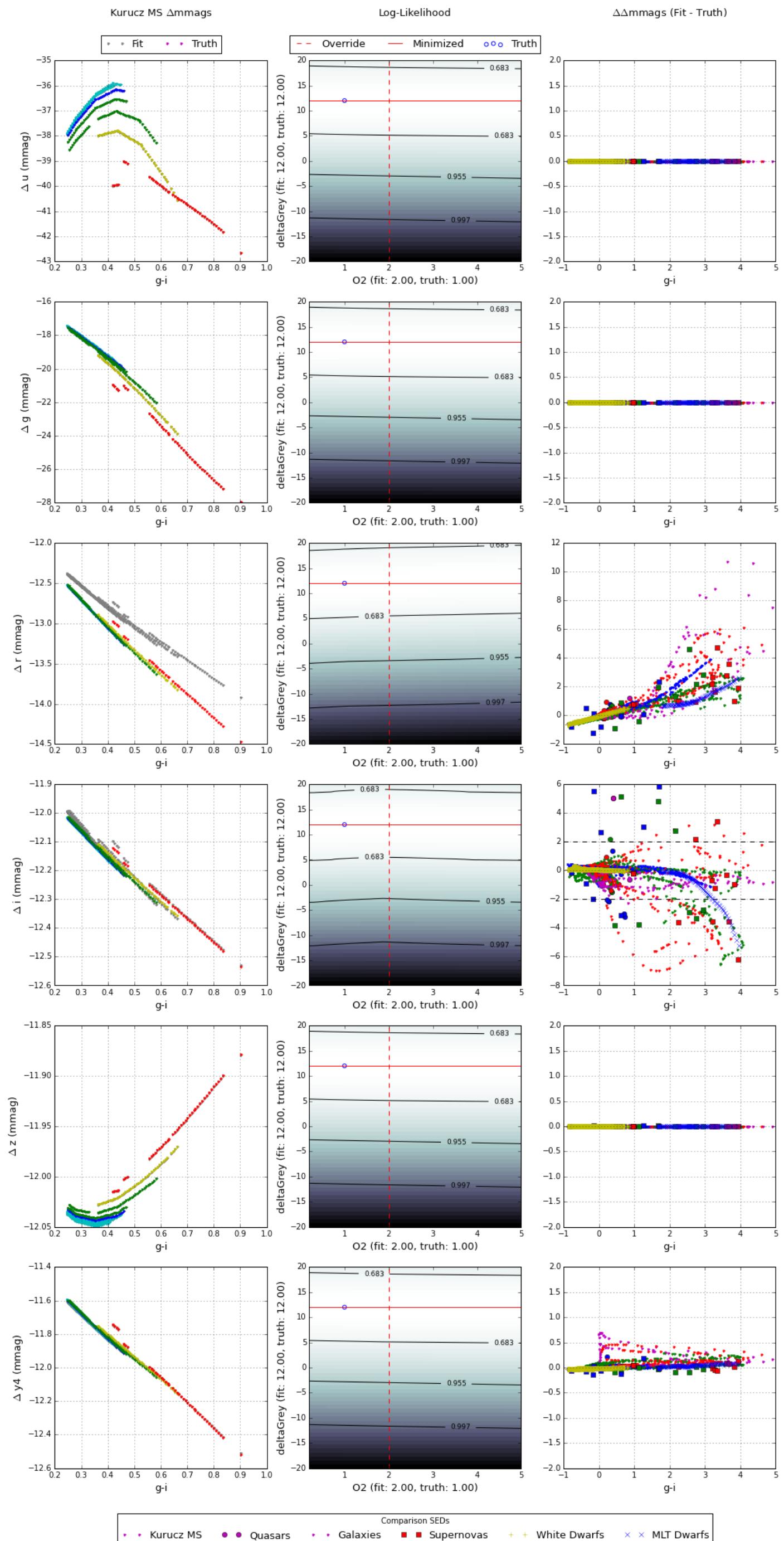
Computing nonlinear regression for O2.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O2: 1.0

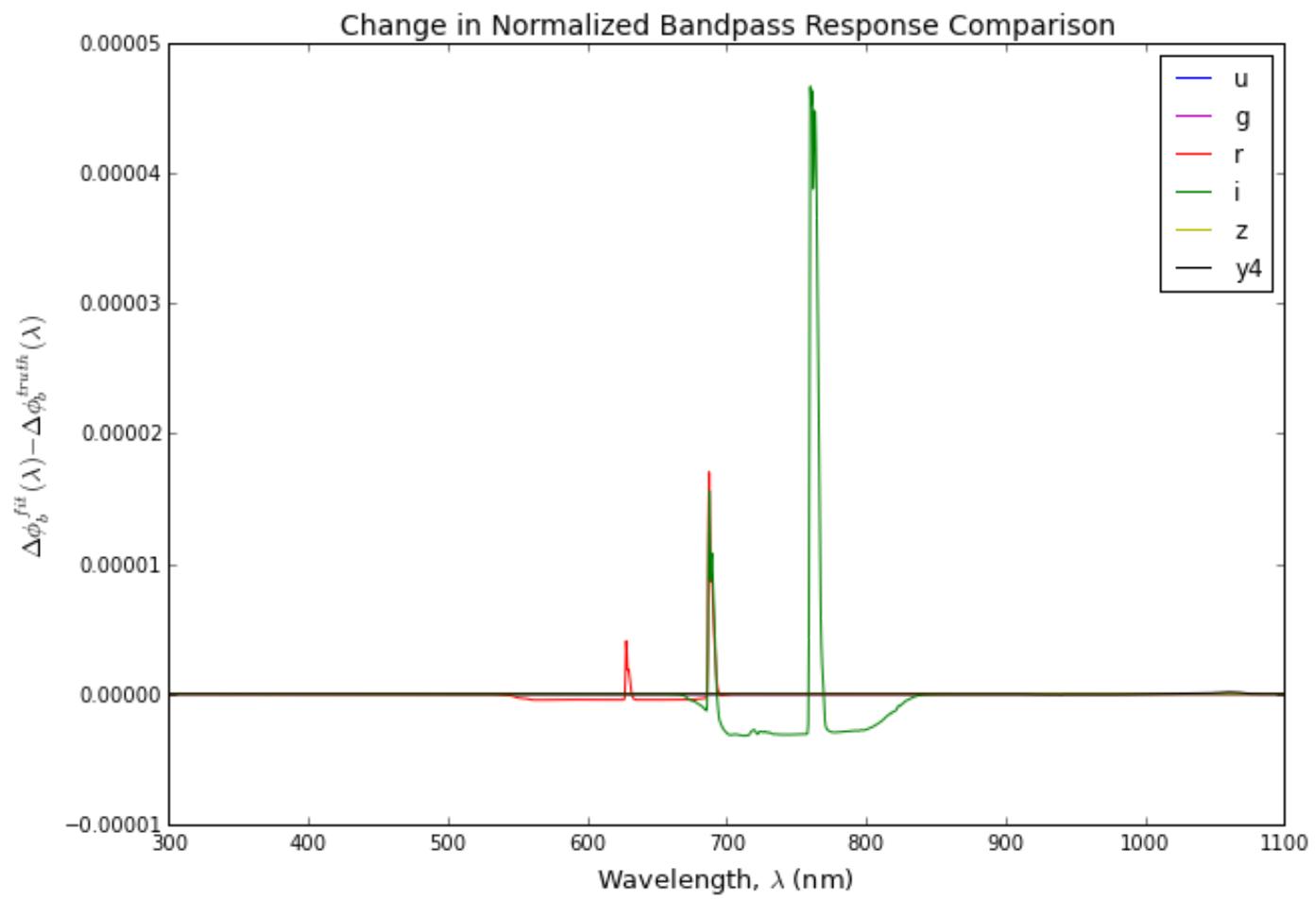
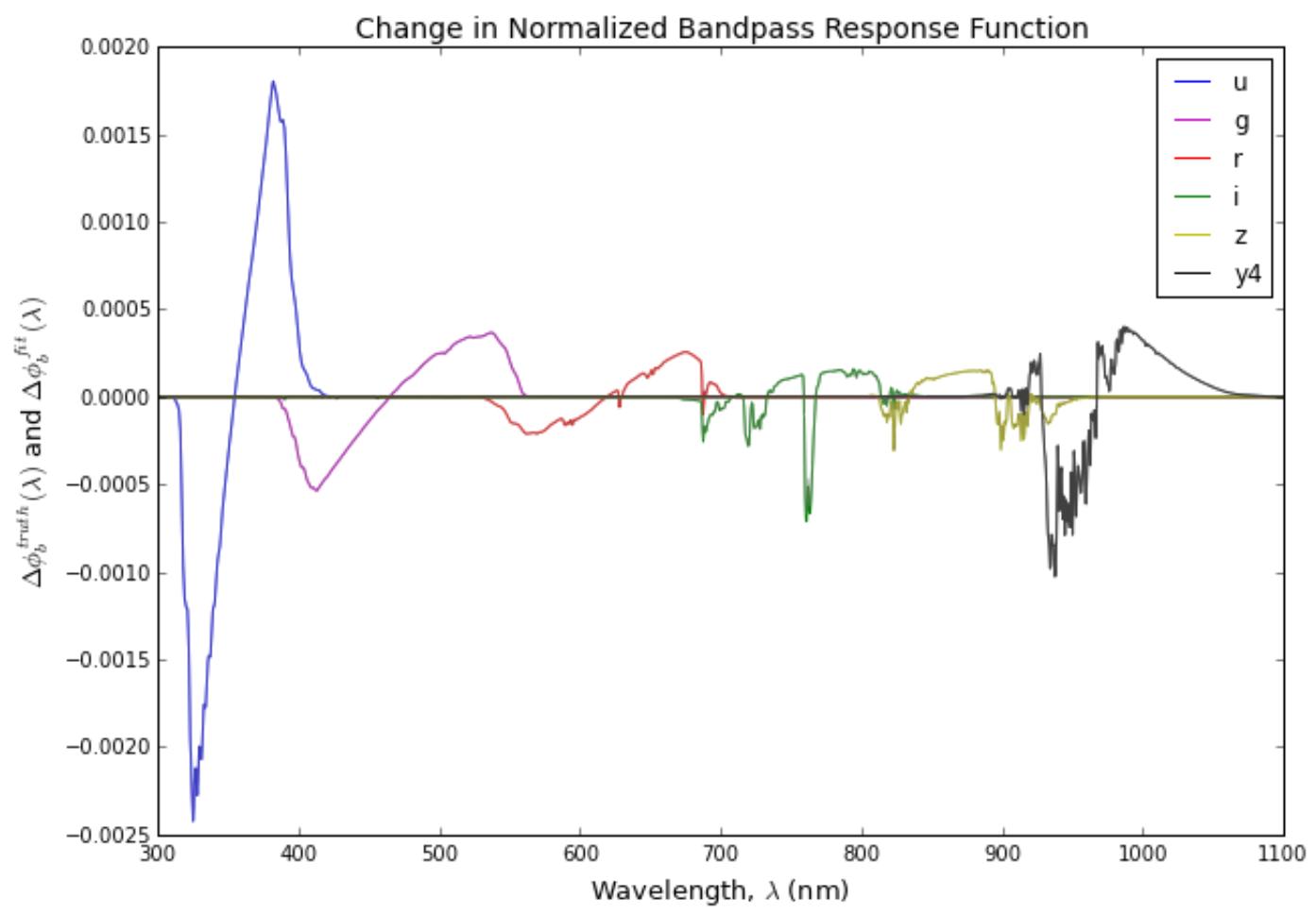
```

```
Fitting for O2 between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.  
  
Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.  
  
Regressing 2550 parameter combinations per filter...  
Magnitude Error: 5.0 mmags  
  
Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at ne  
w component best-fit value...  
  
Calculating best fit parameters for u filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_0  
2_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.  
  
Calculating best fit parameters for g filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_0  
2_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.  
  
Calculating best fit parameters for r filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_0  
2_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.  
  
Calculating best fit parameters for i filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_0  
2_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.  
  
Calculating best fit parameters for z filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_0  
2_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.  
  
Calculating best fit parameters for y4 filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_0  
2_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.  
  
Best fit parameters (Filter, O2, dG, logL, Chi-Squared):  
u 0.98 12.00 6.56132150786e-08 1.31226430157e-07  
g 0.98 12.00 5.52829861283e-09 1.10565972257e-08  
r 0.98 12.00 0.000402915229623 0.000805830459246  
i 0.98 12.00 1.0682924054e-05 2.1365848108e-05  
z 0.98 12.00 6.81043674544e-10 1.36208734909e-09  
y4 0.98 12.00 1.36168053485e-07 2.72336106971e-07  
  
Override best fit parameters (Filter, O2, dG):  
u 0.50 12.00  
g 0.50 12.00  
r 0.50 12.00  
i 0.50 12.00  
z 0.50 12.00  
y4 0.50 12.00
```

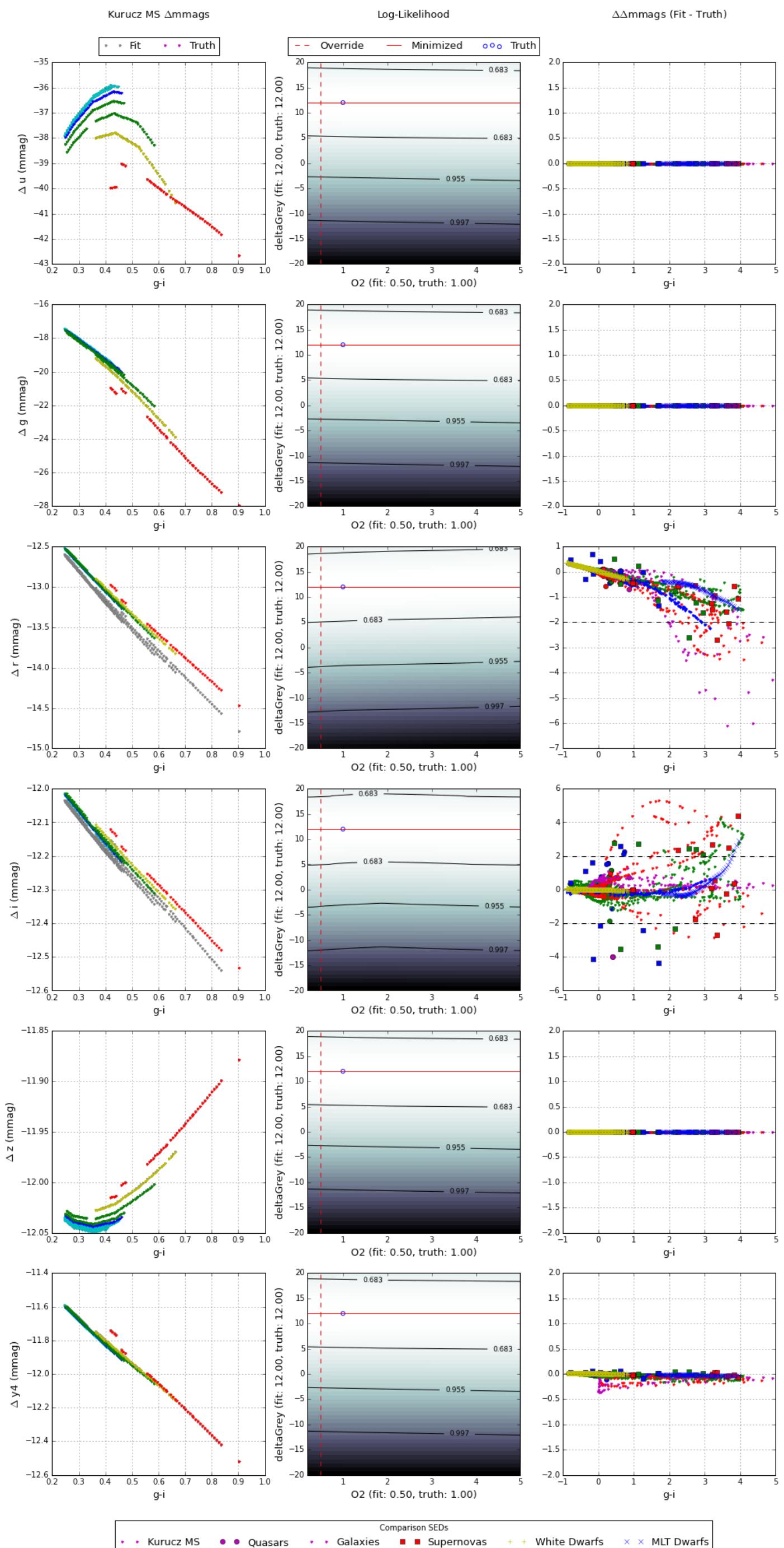


$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



```
In [12]: deltaGreyLimitPlot('O2',deltaGreyBins=50)
```

```

Computing nonlinear regression for O2.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O2: 1.0

Fitting for O2 between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

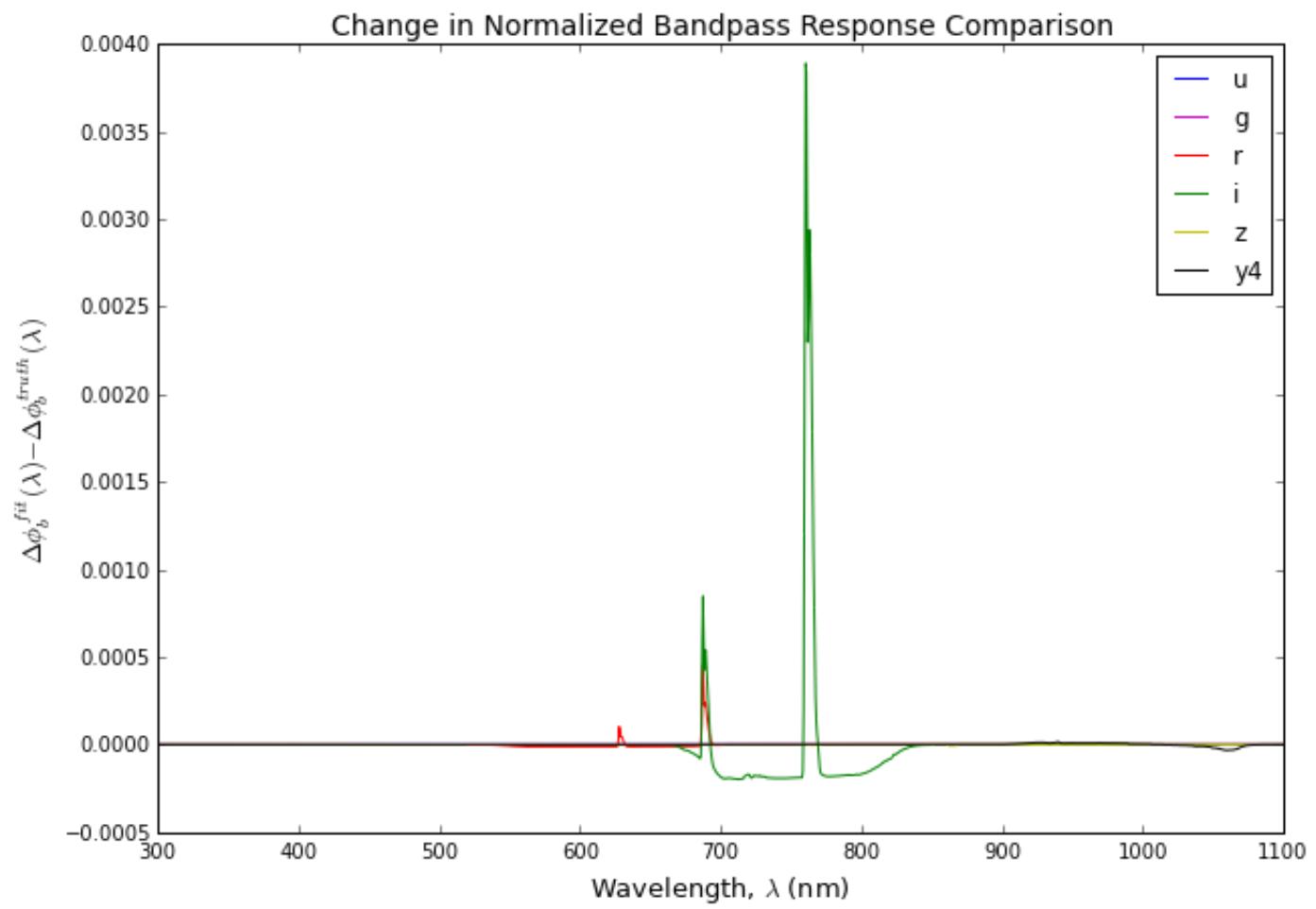
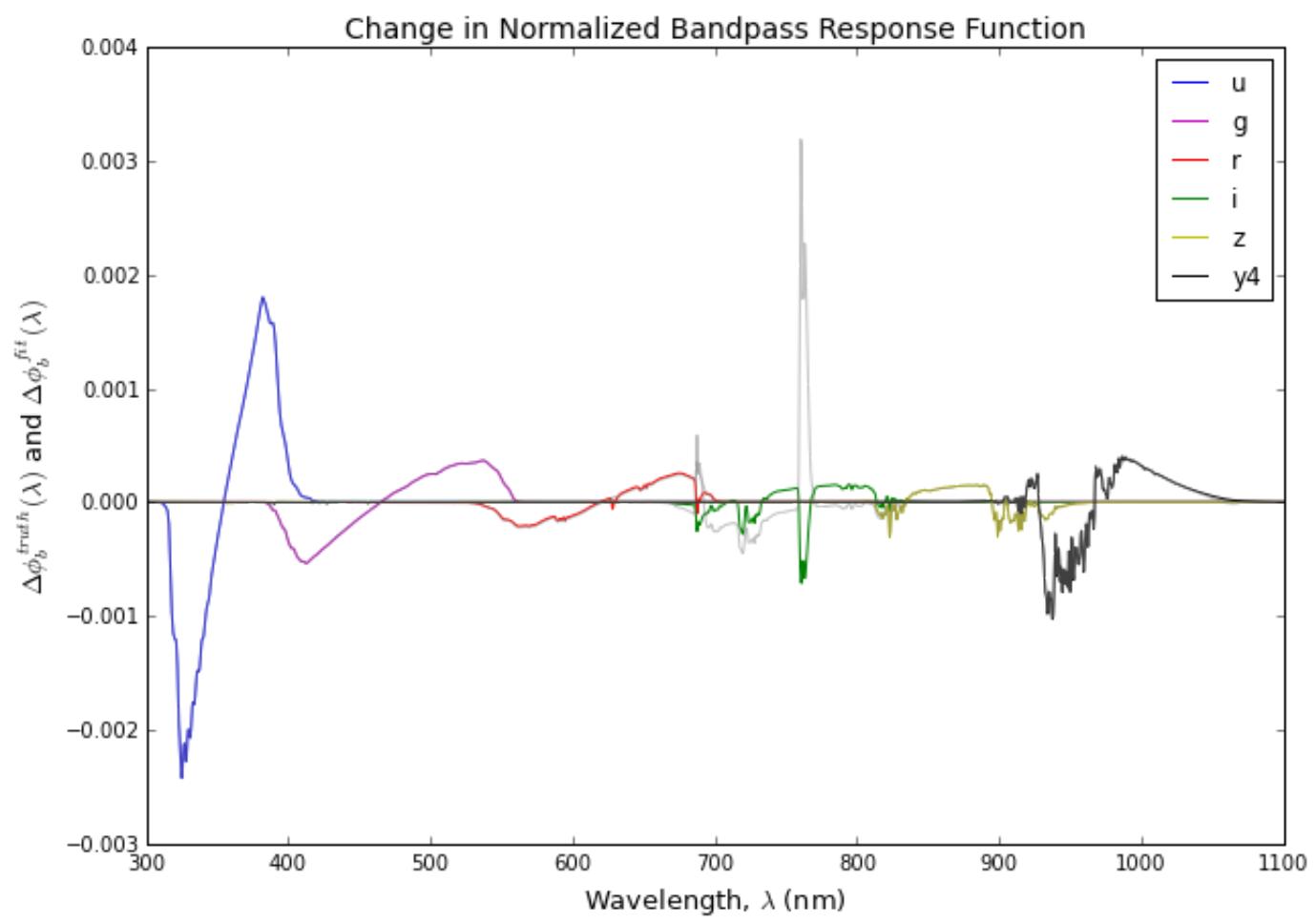
Best fit parameters (Filter, O2, dG, logL, Chi-Squared):
u 5.00 11.84 0.34824123255 0.696482465099
g 5.00 11.84 0.385246550407 0.770493100813
r 0.59 11.84 0.104013843676 0.208027687352
i 0.20 11.84 0.154882525021 0.309765050041
z 5.00 11.84 0.395870515251 0.791741030502
y4 5.00 11.84 0.335272865745 0.670545731489

Override best fit parameters (Filter, O2, dG):
u 2.00 11.84
g 2.00 11.84
r 2.00 12.65
i 2.00 11.84
z 2.00 11.84
y4 2.00 11.84

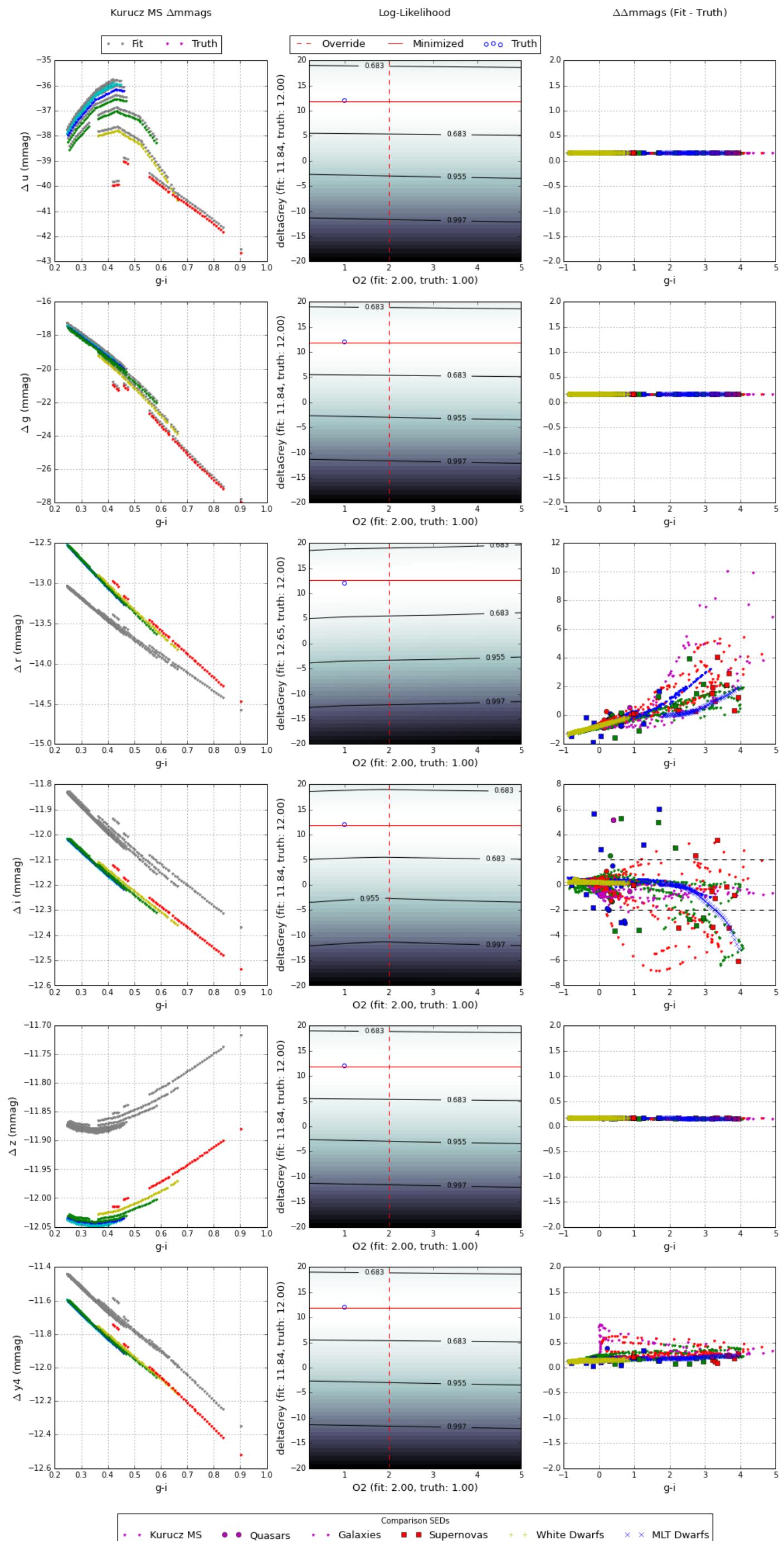
Computing nonlinear regression for O2.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O2: 1.0

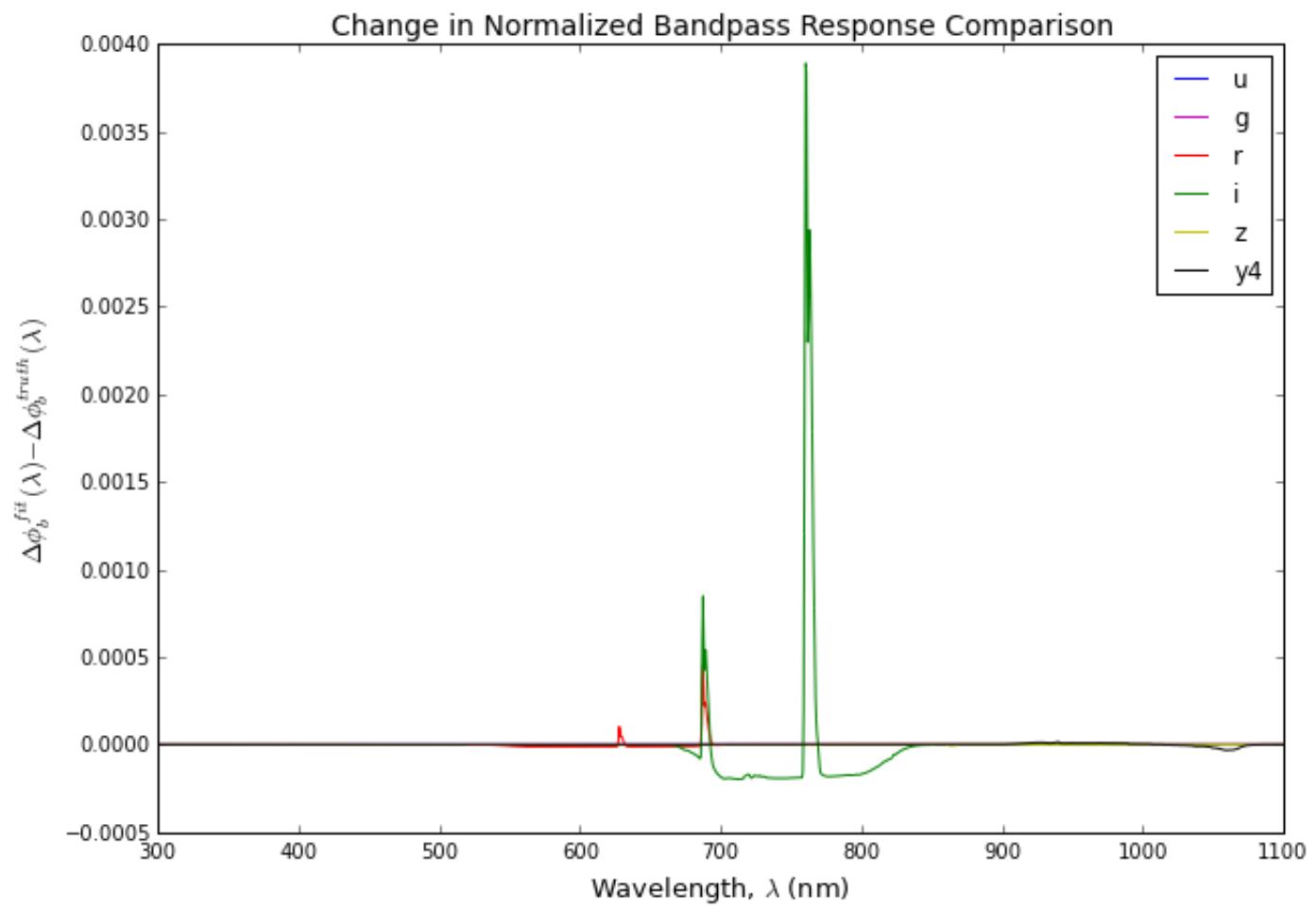
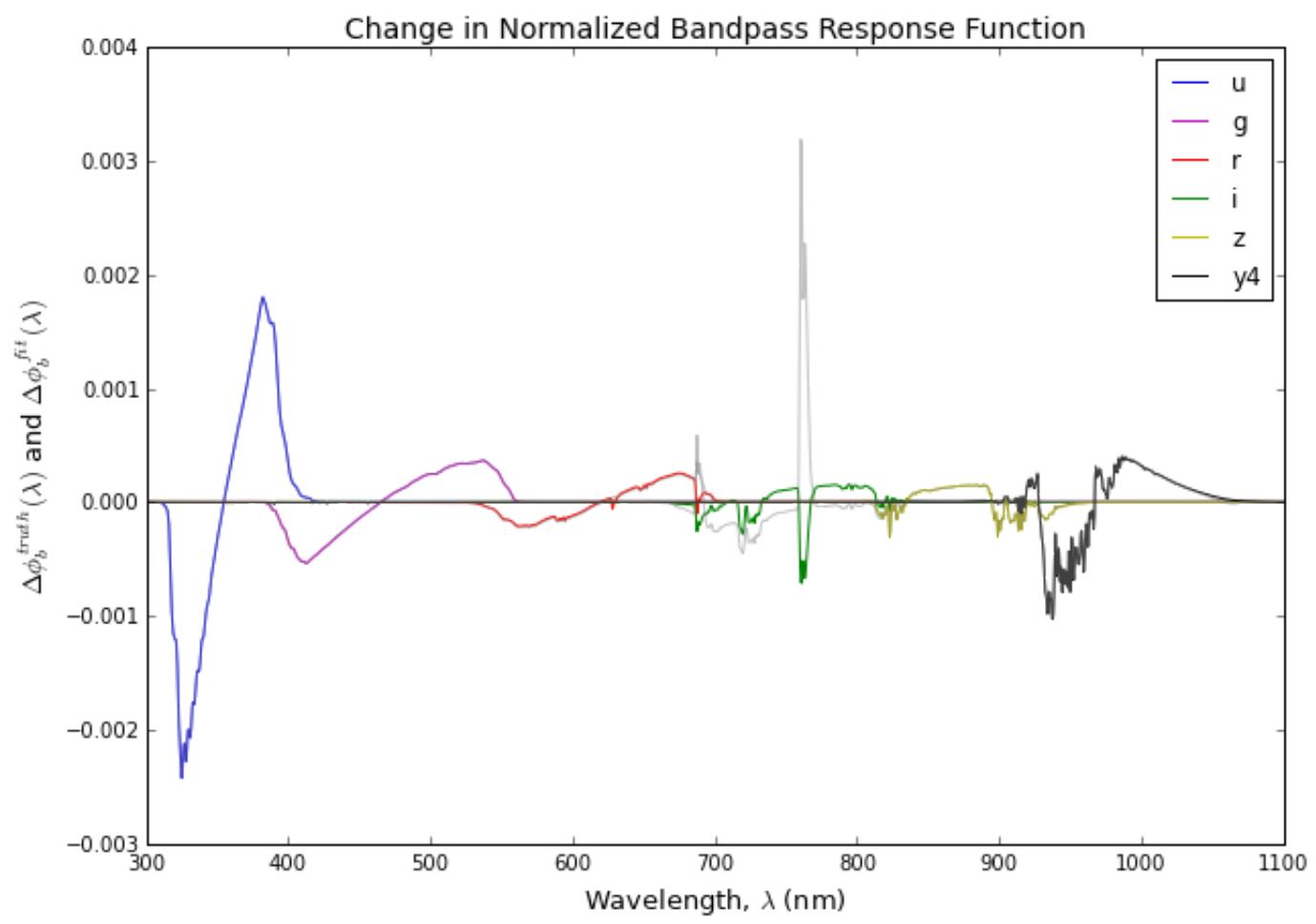
```

```
Fitting for O2 between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.  
  
Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.  
  
Regressing 2500 parameter combinations per filter...  
Magnitude Error: 5.0 mmags  
  
Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...  
  
Calculating best fit parameters for u filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.  
  
Calculating best fit parameters for g filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.  
  
Calculating best fit parameters for r filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.  
  
Calculating best fit parameters for i filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.  
  
Calculating best fit parameters for z filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.  
  
Calculating best fit parameters for y4 filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O2_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.  
  
Best fit parameters (Filter, O2, dG, logL, Chi-Squared):  
u 5.00 11.84 0.34824123255 0.696482465099  
g 5.00 11.84 0.385246550407 0.770493100813  
r 0.59 11.84 0.104013843676 0.208027687352  
i 0.20 11.84 0.154882525021 0.309765050041  
z 5.00 11.84 0.395870515251 0.791741030502  
y4 5.00 11.84 0.335272865745 0.670545731489  
  
Override best fit parameters (Filter, O2, dG):  
u 0.50 11.84  
g 0.50 11.84  
r 0.50 11.84  
i 0.50 11.84  
z 0.50 11.84  
y4 0.50 11.84
```

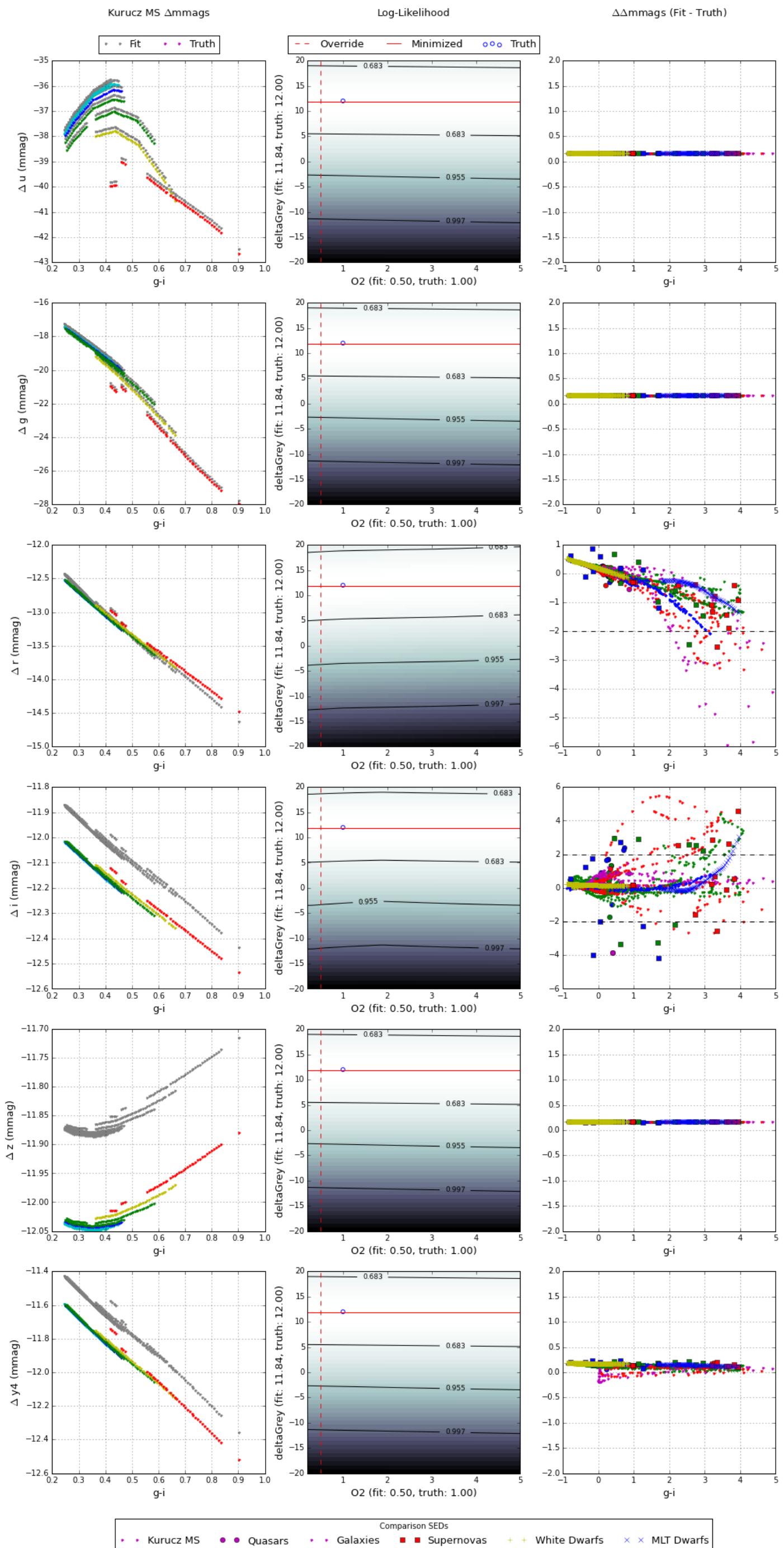


$\Delta$ mags, Regression Contours,  $\Delta\Delta$ mags for each LSST filter ( $\delta$ Grey: 12.0)





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



$O_3$

```
In [13]: deltaGreyLimitPlot('03')
```

```

Computing nonlinear regression for O3.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O3: 1.0

Fitting for O3 between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DGR-2020_E5_mss_u_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DGR-2020_E5_mss_g_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DGR-2020_E5_mss_r_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DGR-2020_E5_mss_i_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DGR-2020_E5_mss_z_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DGR-2020_E5_mss_y4_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

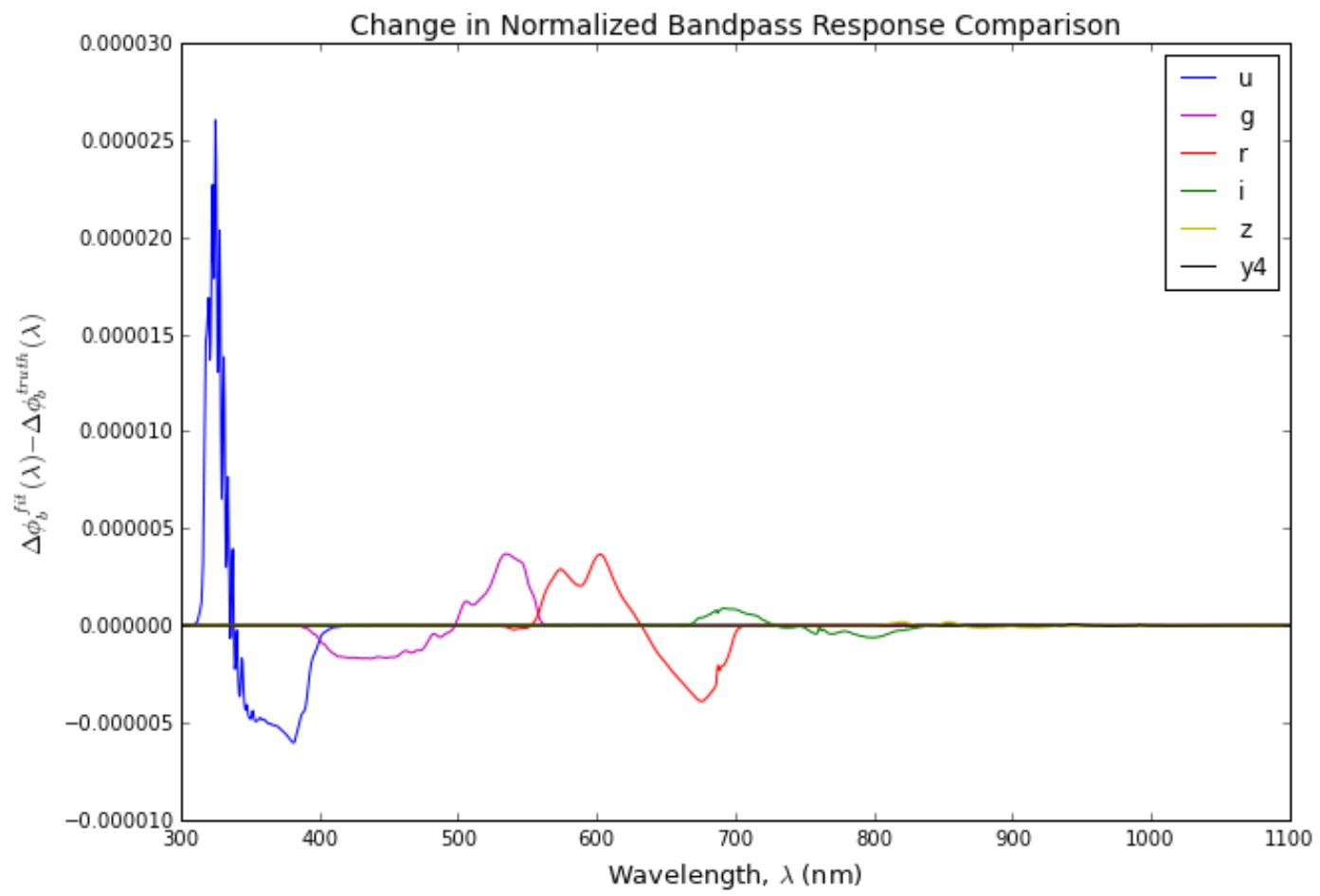
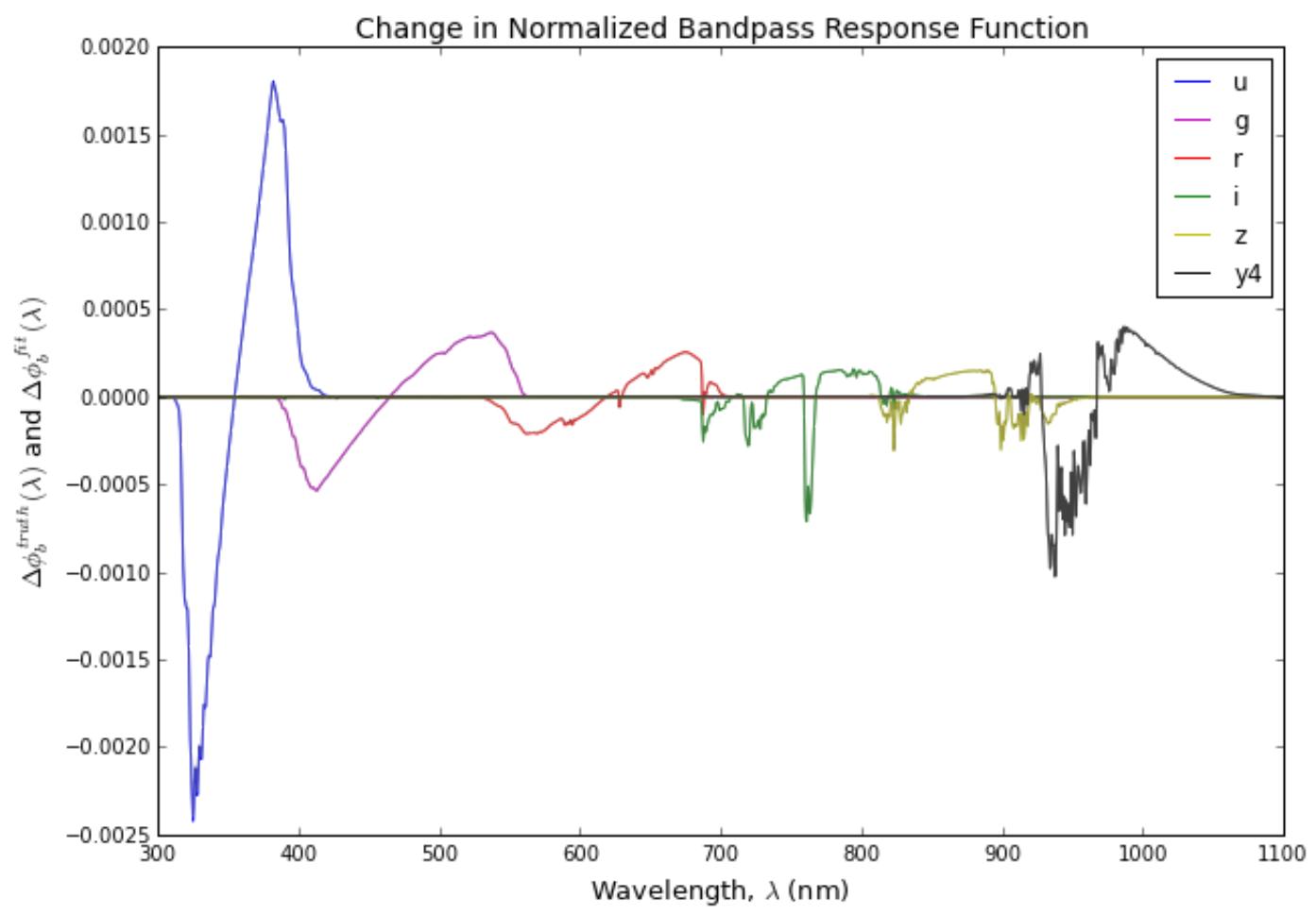
Best fit parameters (Filter, O3, dG, logL, Chi-Squared):
u 0.98 12.00 0.315012101925 0.63002420385
g 0.98 12.00 0.0300107300471 0.0600214600942
r 0.98 12.00 0.00358836755351 0.00717673510702
i 0.98 12.00 5.59857710864e-05 0.000111971542173
z 0.98 12.00 6.07359517704e-07 1.21471903541e-06
y4 0.98 12.00 1.76363142833e-07 3.52726285667e-07

Override best fit parameters (Filter, O3, dG):
u 2.00 4.00
g 2.00 14.40
r 2.00 11.20
i 2.00 12.00
z 2.00 12.00
y4 2.00 12.00

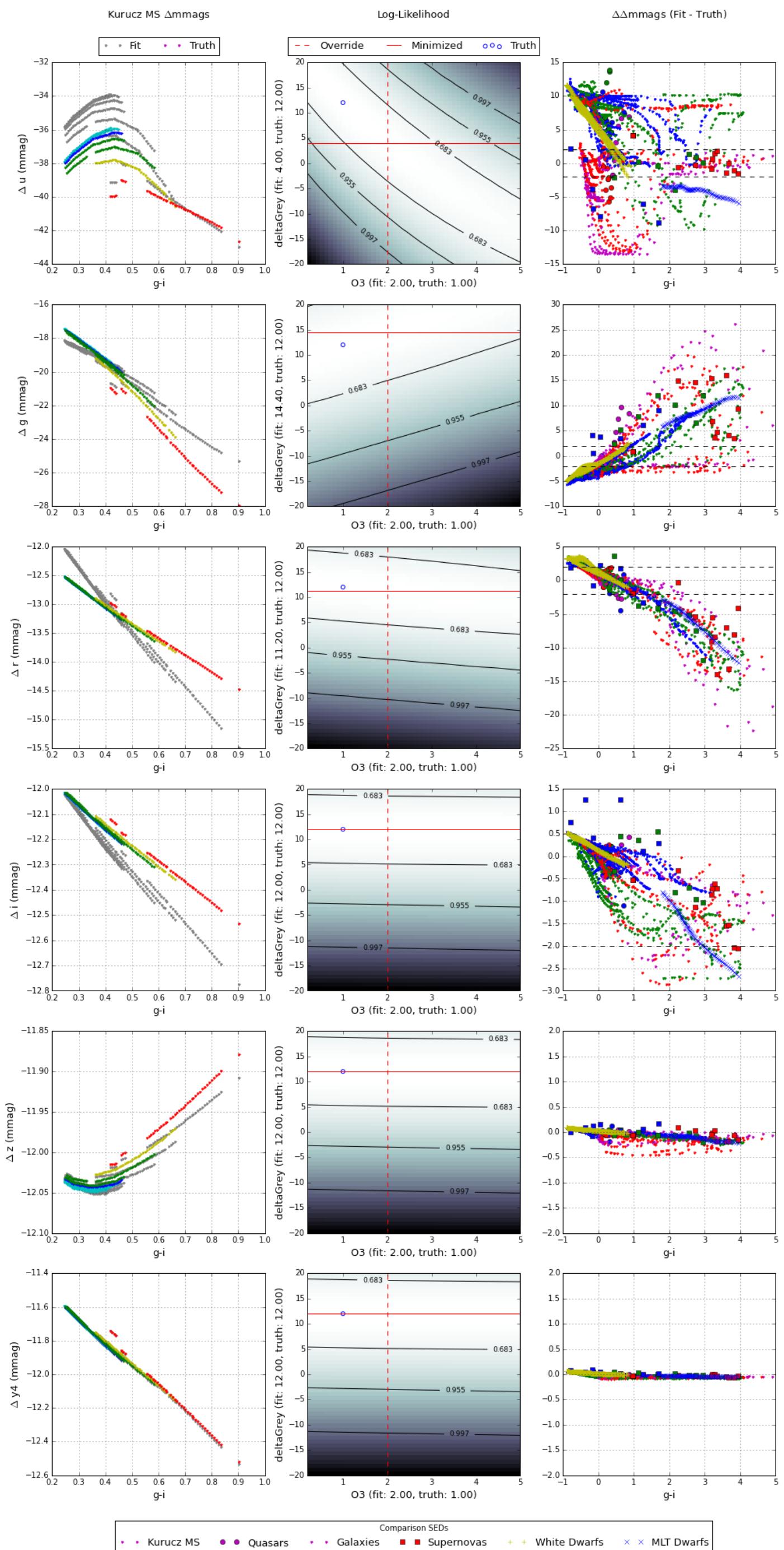
Computing nonlinear regression for O3.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O3: 1.0

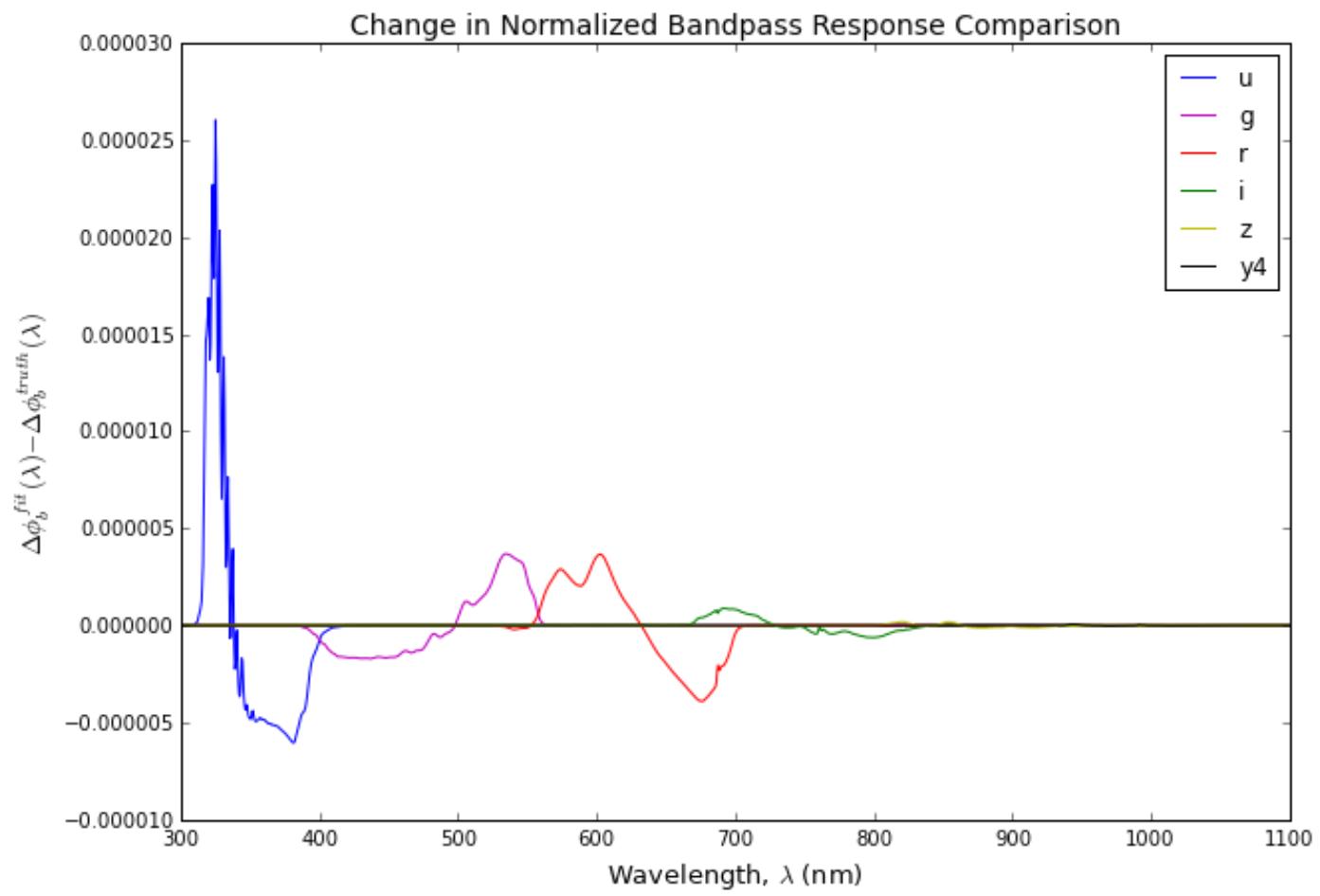
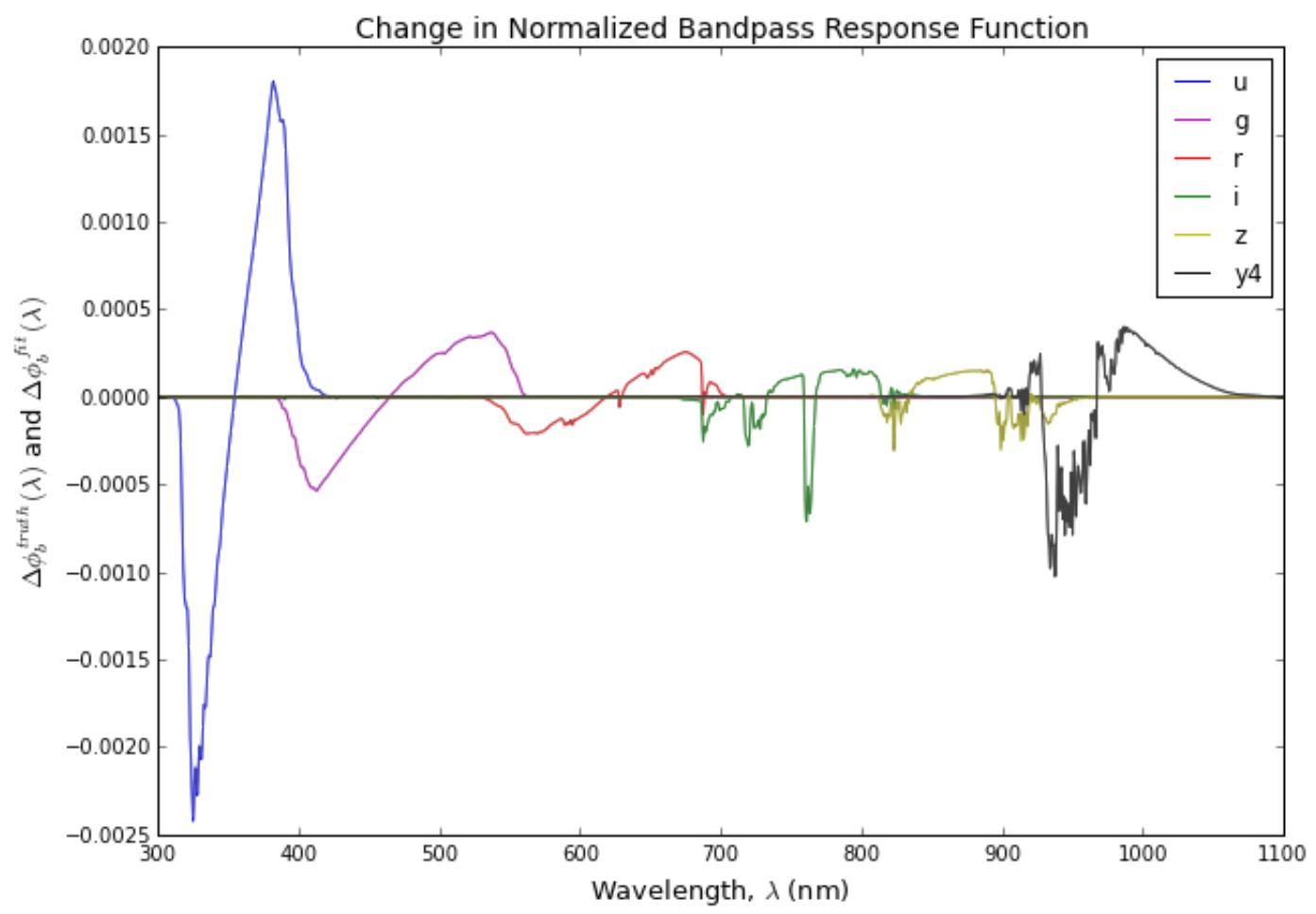
```

```
Fitting for O3 between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.  
  
Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.  
  
Regressing 2550 parameter combinations per filter...  
Magnitude Error: 5.0 mmags  
  
Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...  
  
Calculating best fit parameters for u filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.  
  
Calculating best fit parameters for g filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.  
  
Calculating best fit parameters for r filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.  
  
Calculating best fit parameters for i filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.  
  
Calculating best fit parameters for z filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.  
  
Calculating best fit parameters for y4 filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.  
  
Best fit parameters (Filter, O3, dG, logL, Chi-Squared):  
u 0.98 12.00 0.315012101925 0.63002420385  
g 0.98 12.00 0.0300107300471 0.0600214600942  
r 0.98 12.00 0.00358836755351 0.00717673510702  
i 0.98 12.00 5.59857710864e-05 0.000111971542173  
z 0.98 12.00 6.07359517704e-07 1.21471903541e-06  
y4 0.98 12.00 1.76363142833e-07 3.52726285667e-07  
  
Override best fit parameters (Filter, O3, dG):  
u 0.50 16.80  
g 0.50 10.40  
r 0.50 12.00  
i 0.50 12.00  
z 0.50 12.00  
y4 0.50 12.00
```

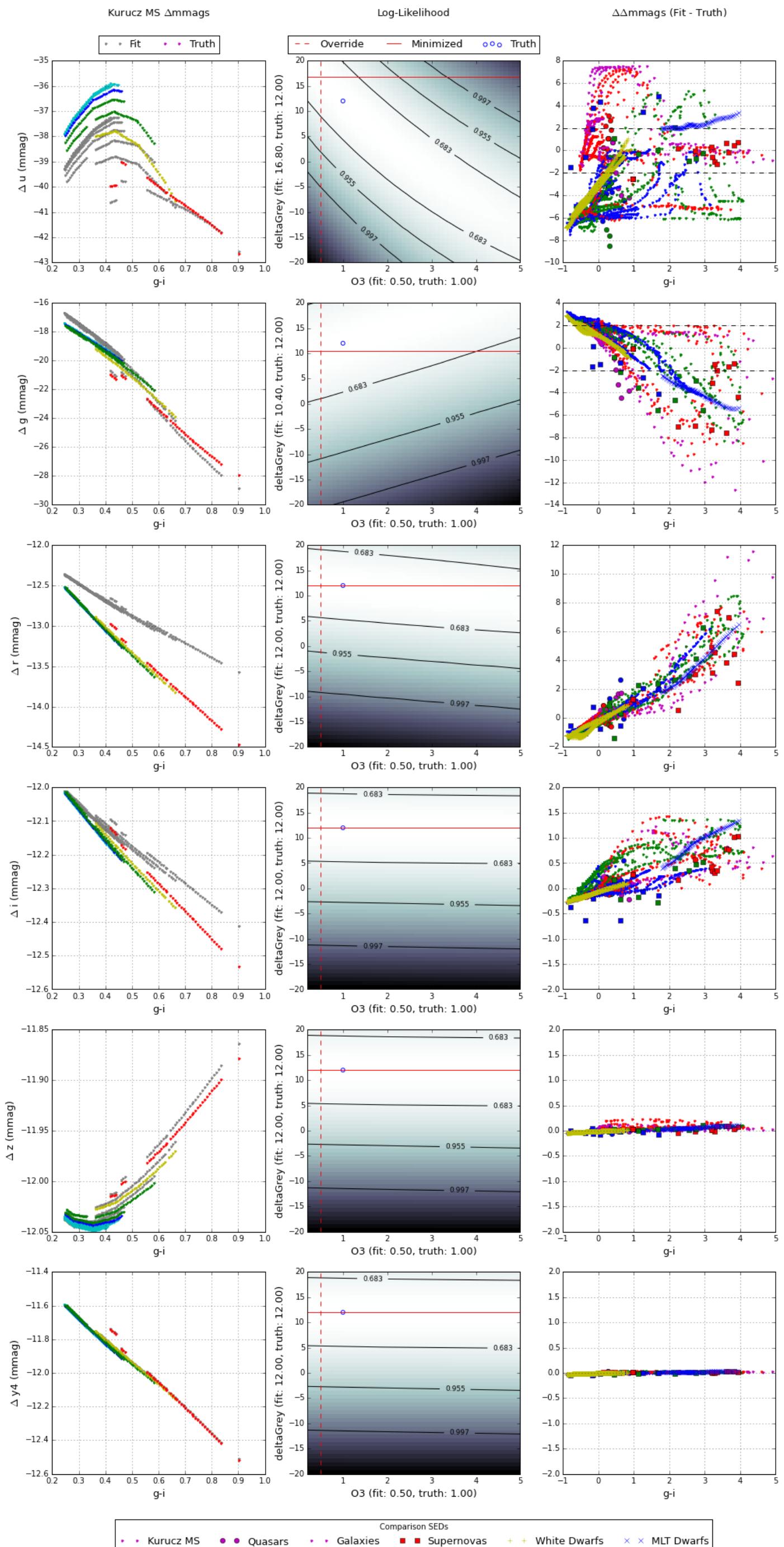


$\Delta$ mags, Regression Contours,  $\Delta\Delta$ mags for each LSST filter ( $\delta$ Grey: 12.0)





$\Delta$ mags, Regression Contours,  $\Delta\Delta$ mags for each LSST filter ( $\delta$ Grey: 12.0)



```
In [14]: deltaGreyLimitPlot('O3',deltaGreyBins=50)
```

```

Computing nonlinear regression for O3.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O3: 1.0

Fitting for O3 between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

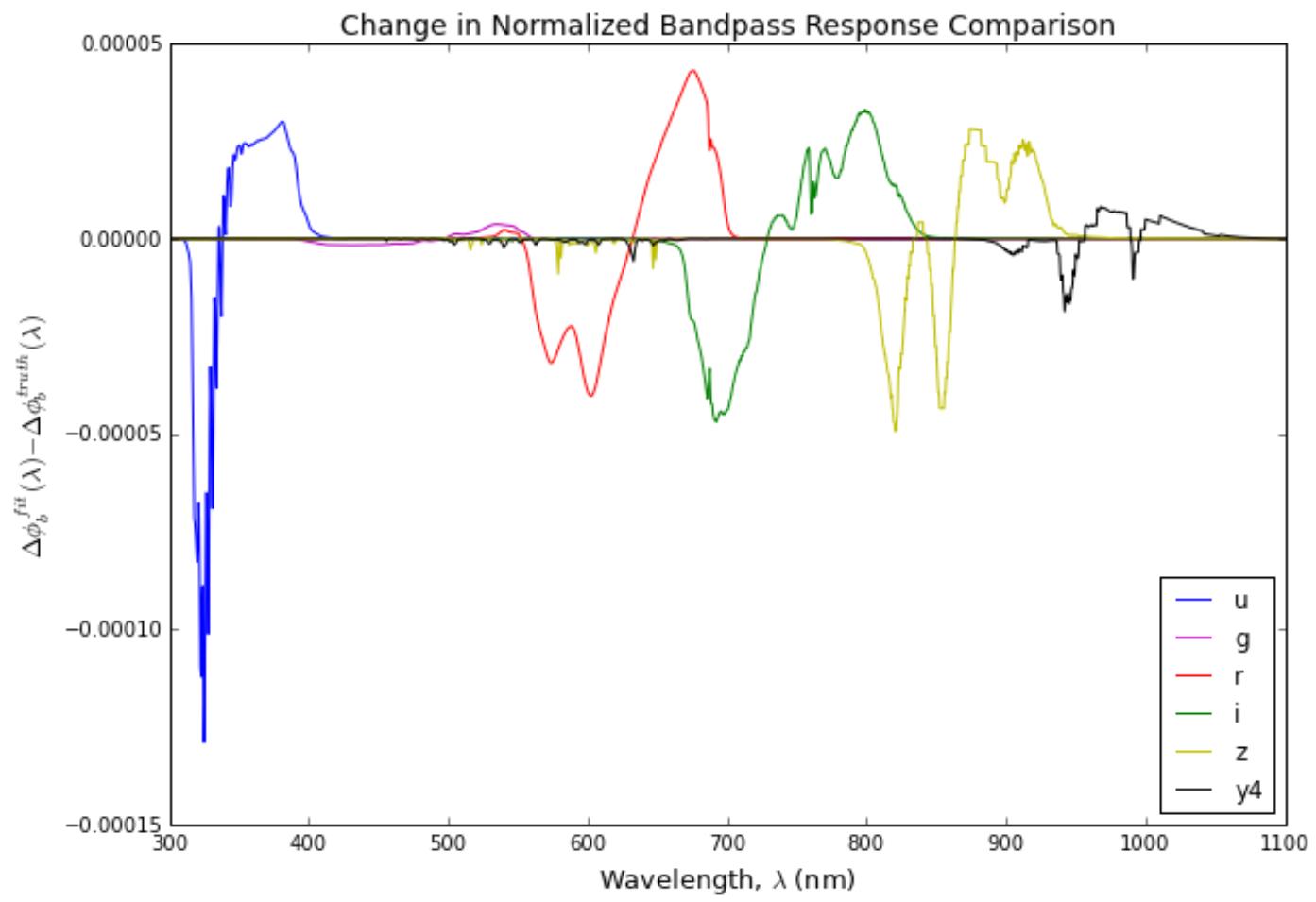
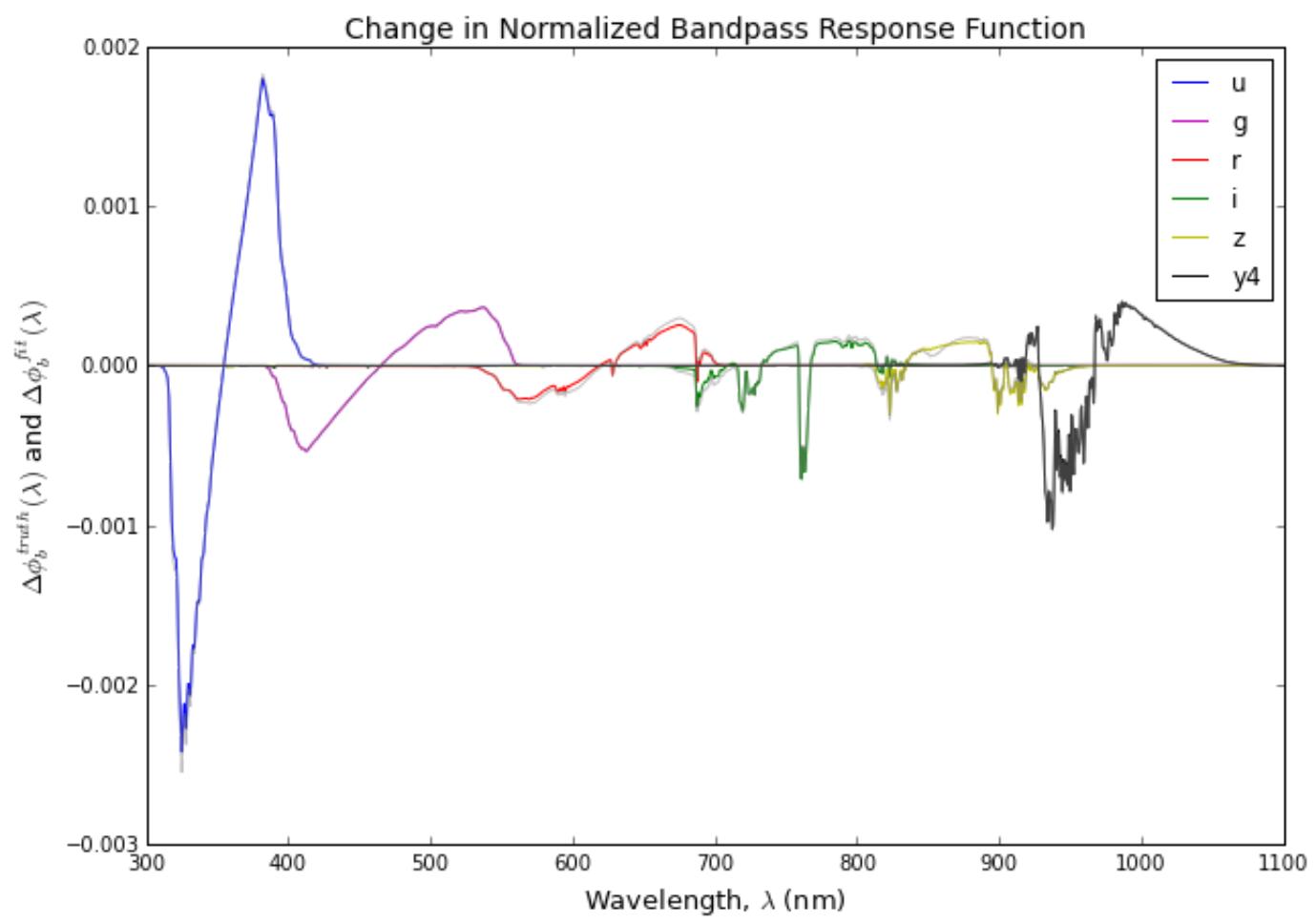
Best fit parameters (Filter, O3, dG, logL, Chi-Squared):
u 1.08 11.02 1.33428962213 2.66857924425
g 0.98 11.84 0.225140645695 0.450281291389
r 1.18 11.84 0.181230089604 0.362460179209
i 1.87 11.84 0.259013331881 0.518026663761
z 5.00 11.84 0.288129308045 0.576258616089
y4 5.00 11.84 0.34966405786 0.699328115721

Override best fit parameters (Filter, O3, dG):
u 2.00 3.67
g 2.00 14.29
r 2.00 11.02
i 2.00 11.84
z 2.00 11.84
y4 2.00 11.84

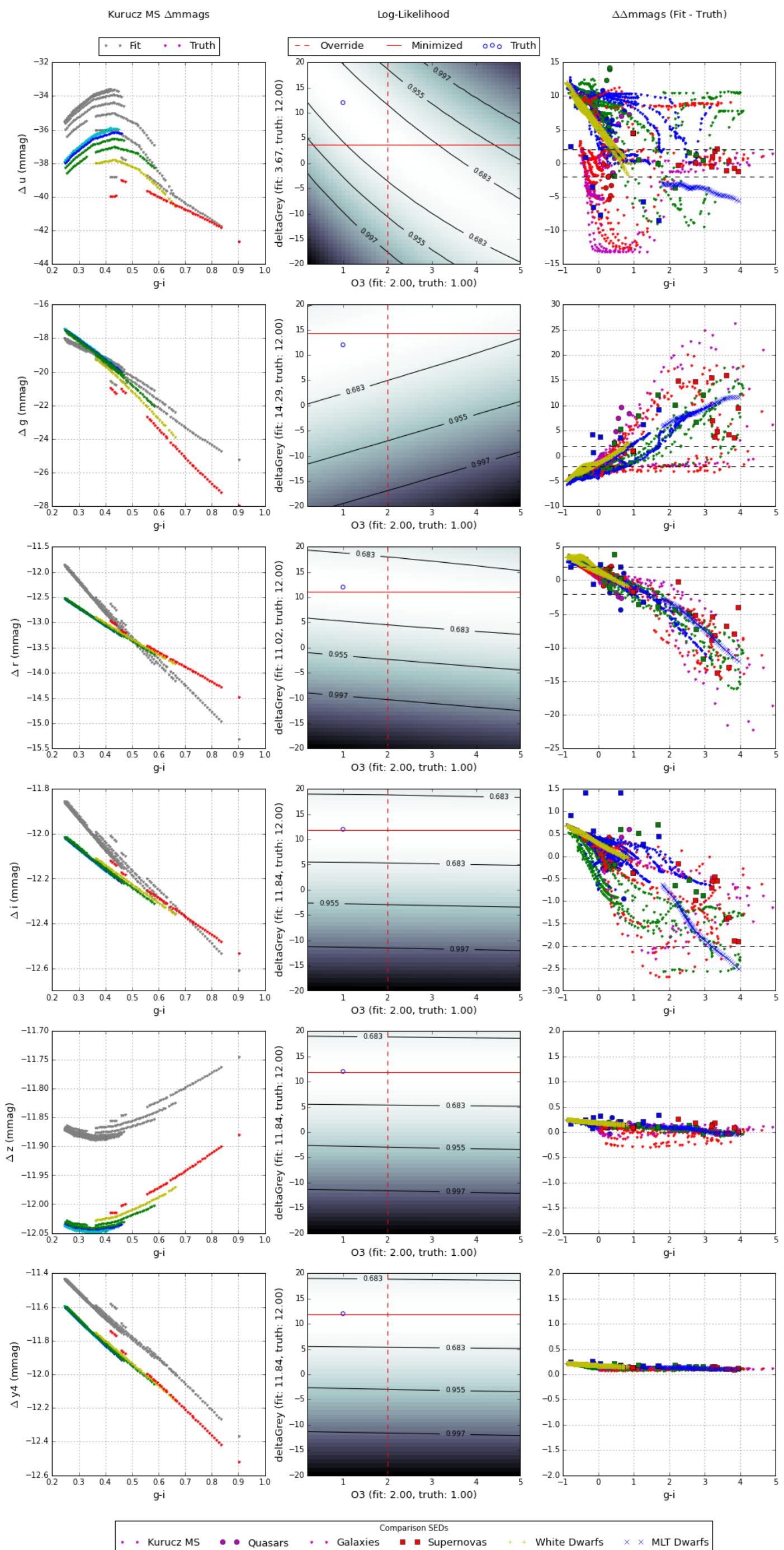
Computing nonlinear regression for O3.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for O3: 1.0

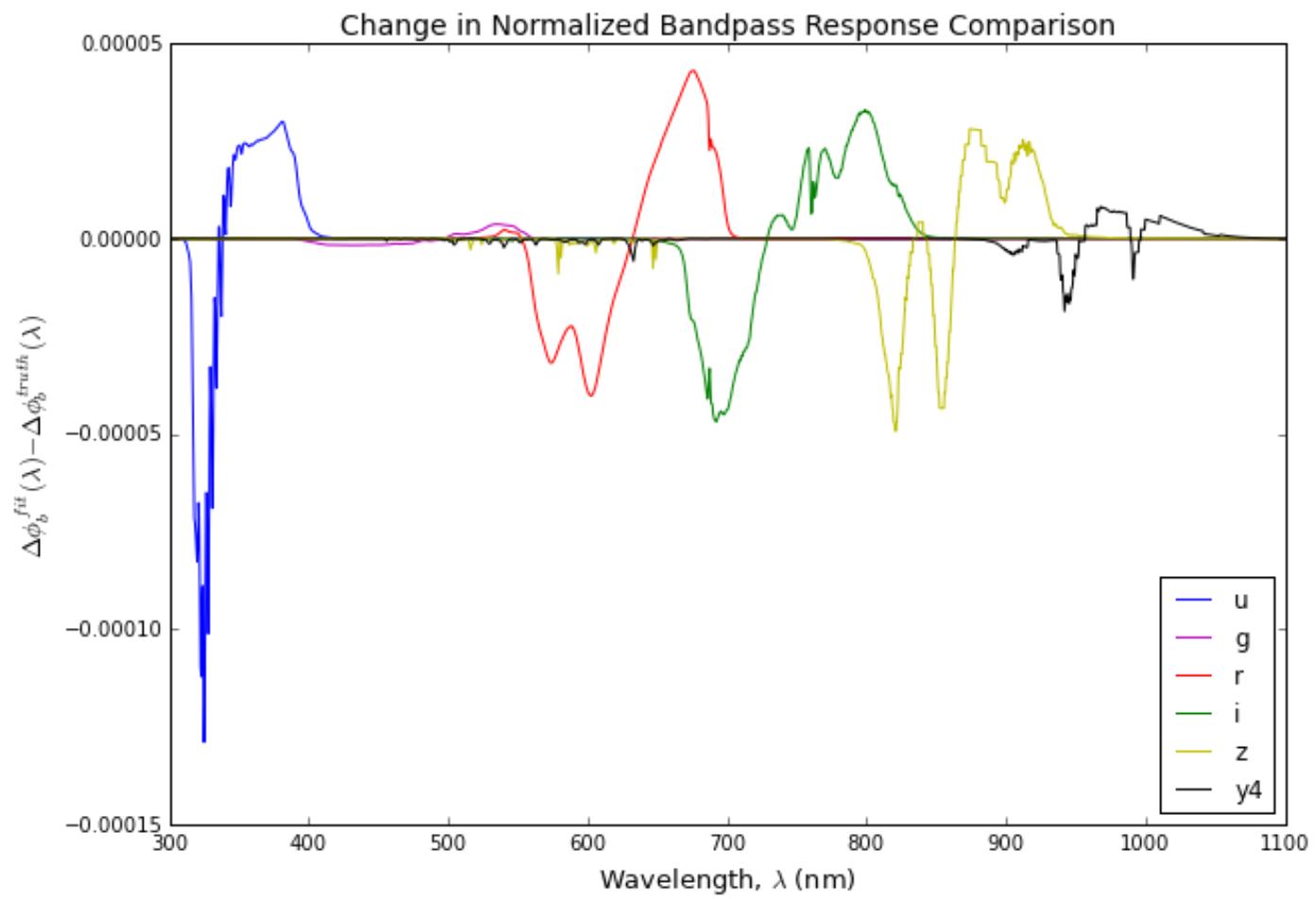
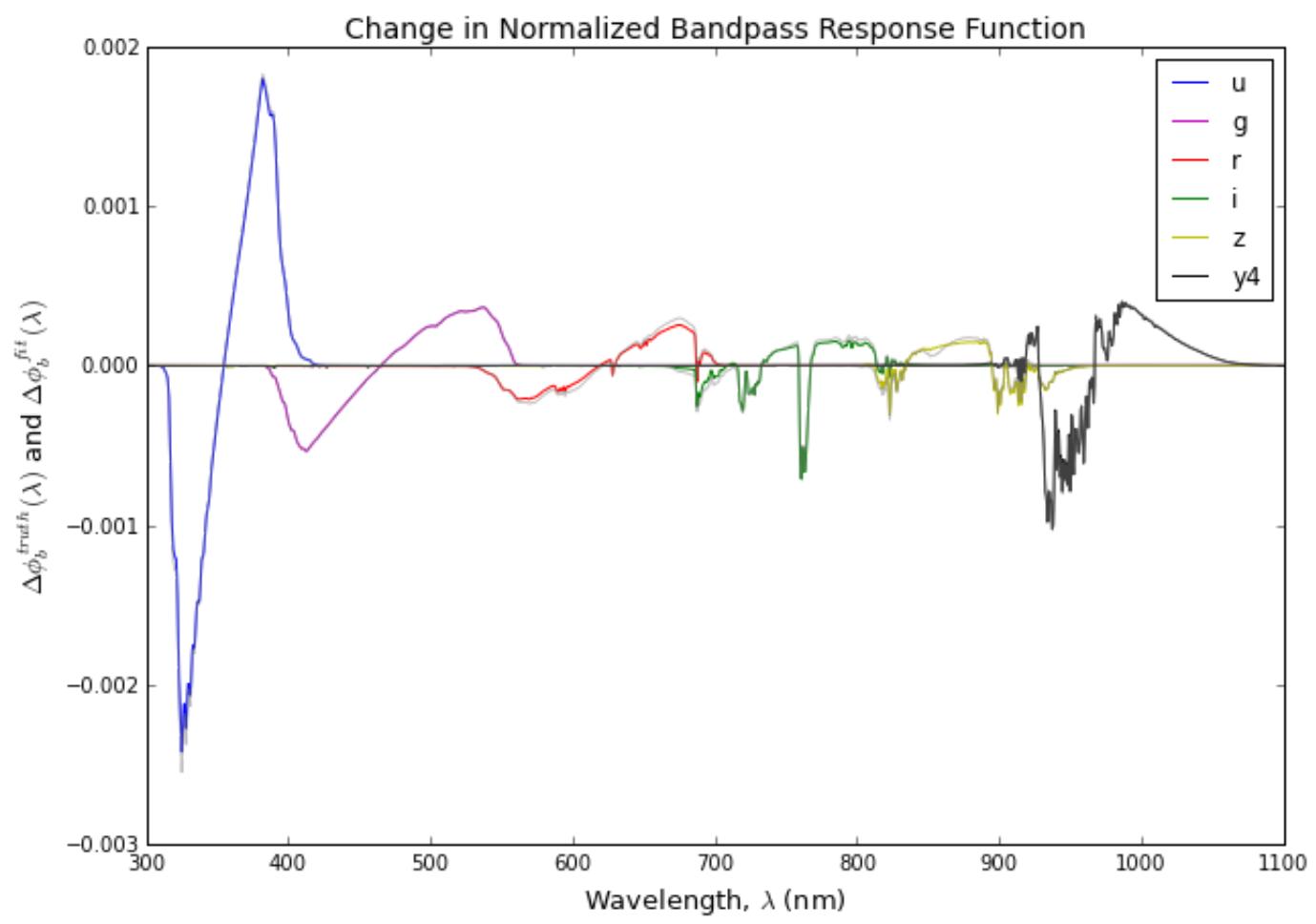
```

```
Fitting for O3 between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.  
  
Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.  
  
Regressing 2500 parameter combinations per filter...  
Magnitude Error: 5.0 mmags  
  
Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...  
  
Calculating best fit parameters for u filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.  
  
Calculating best fit parameters for g filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.  
  
Calculating best fit parameters for r filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.  
  
Calculating best fit parameters for i filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.  
  
Calculating best fit parameters for z filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.  
  
Calculating best fit parameters for y4 filter...  
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_O3_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_min_dGTest_giCut_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.  
  
Best fit parameters (Filter, O3, dG, logL, Chi-Squared):  
u 1.08 11.02 1.33428962213 2.66857924425  
g 0.98 11.84 0.225140645695 0.450281291389  
r 1.18 11.84 0.181230089604 0.362460179209  
i 1.87 11.84 0.259013331881 0.518026663761  
z 5.00 11.84 0.288129308045 0.576258616089  
y4 5.00 11.84 0.34966405786 0.699328115721  
  
Override best fit parameters (Filter, O3, dG):  
u 0.50 16.73  
g 0.50 11.02  
r 0.50 12.65  
i 0.50 11.84  
z 0.50 11.84  
y4 0.50 11.84
```

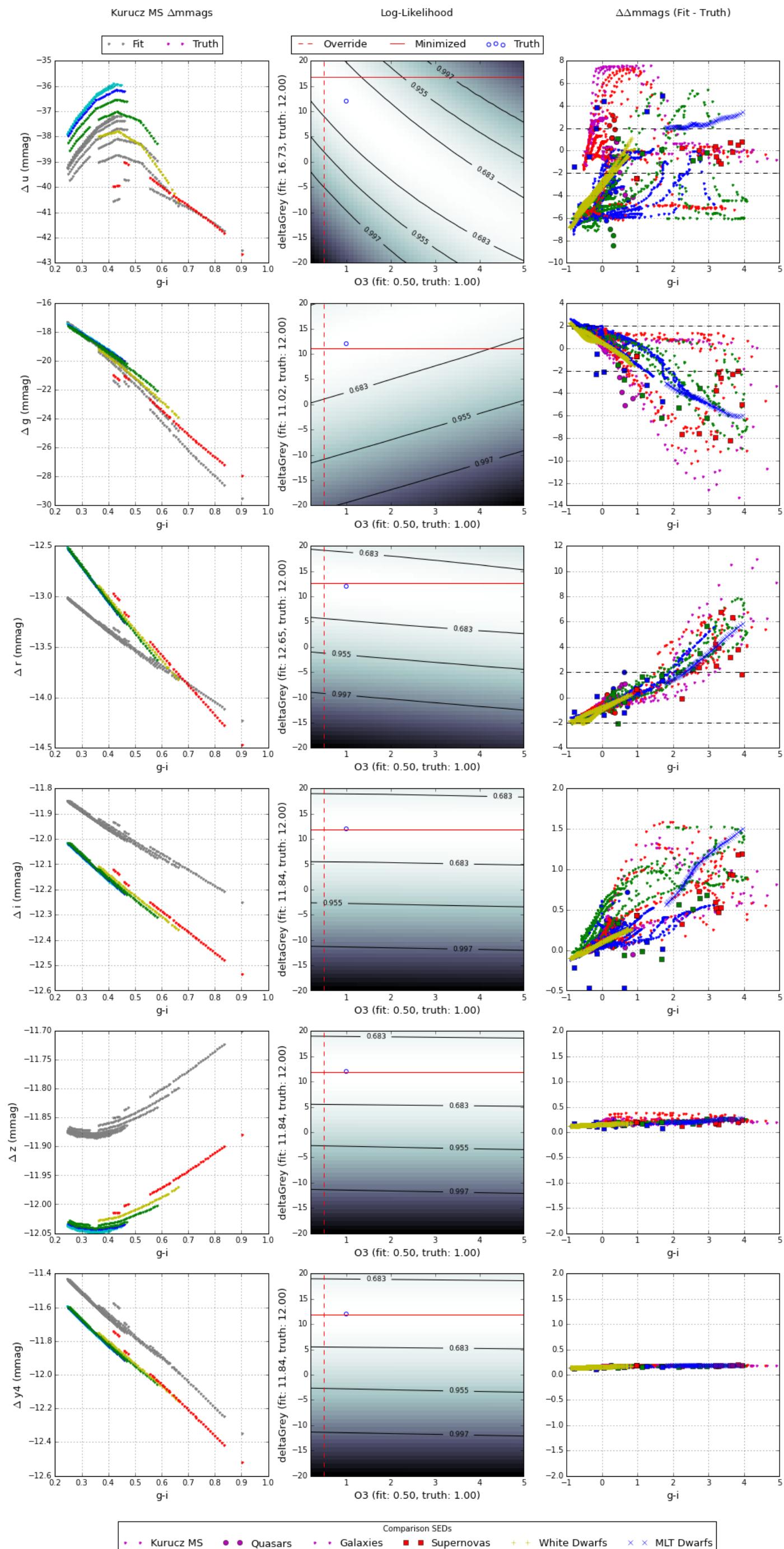


$\Delta$ mags, Regression Contours,  $\Delta\Delta$ mags for each LSST filter ( $\delta$ Grey: 12.0)





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



```
In [15]: deltaGreyLimitPlot('Rayleigh')
```

```

Computing nonlinear regression for Rayleigh.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Rayleigh: 1.0

Fitting for Rayleigh between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

Best fit parameters (Filter, Rayleigh, dG, logL, Chi-Squared):
u 0.98 12.80 1.33338729602 2.66677459203
g 0.98 12.00 1.17052373042 2.34104746084
r 0.98 12.00 0.00862756921748 0.017255138435
i 0.98 12.00 0.000227895126179 0.000455790252357
z 0.98 12.00 3.30696414294e-05 6.61392828588e-05
y4 0.98 12.00 2.22433972147e-05 4.44867944294e-05

Override best fit parameters (Filter, Rayleigh, dG):
u 2.00 -20.00
g 2.00 -3.20
r 2.00 10.40
i 2.00 12.00
z 2.00 12.00
y4 2.00 12.00

Computing nonlinear regression for Rayleigh.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2

```

Observed atmosphere parameter for Rayleigh: 1.0

Fitting for Rayleigh between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...  
Magnitude Error: 5.0 mmags

Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_u\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.

Calculating best fit parameters for g filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_g\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.

Calculating best fit parameters for r filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_r\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.

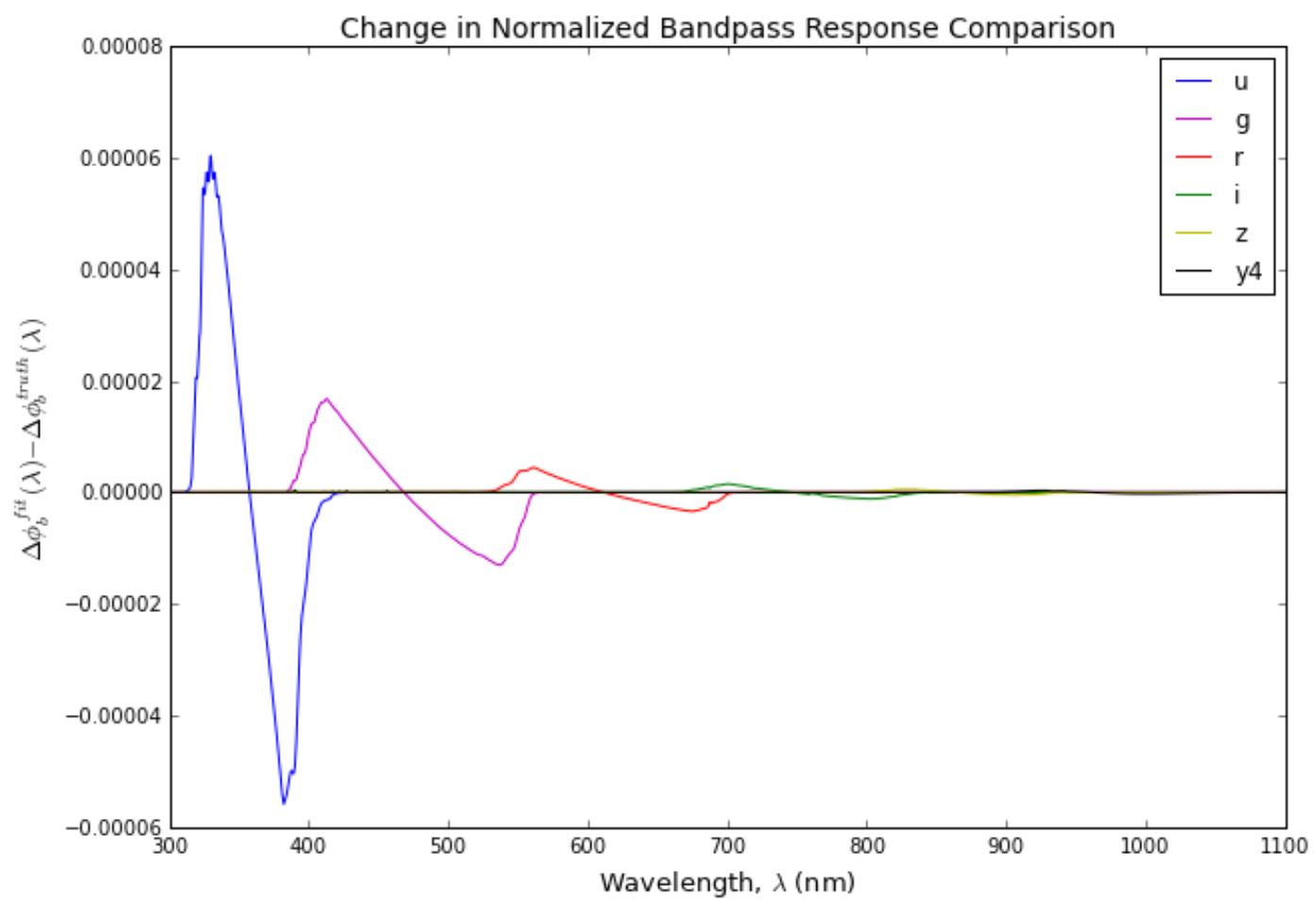
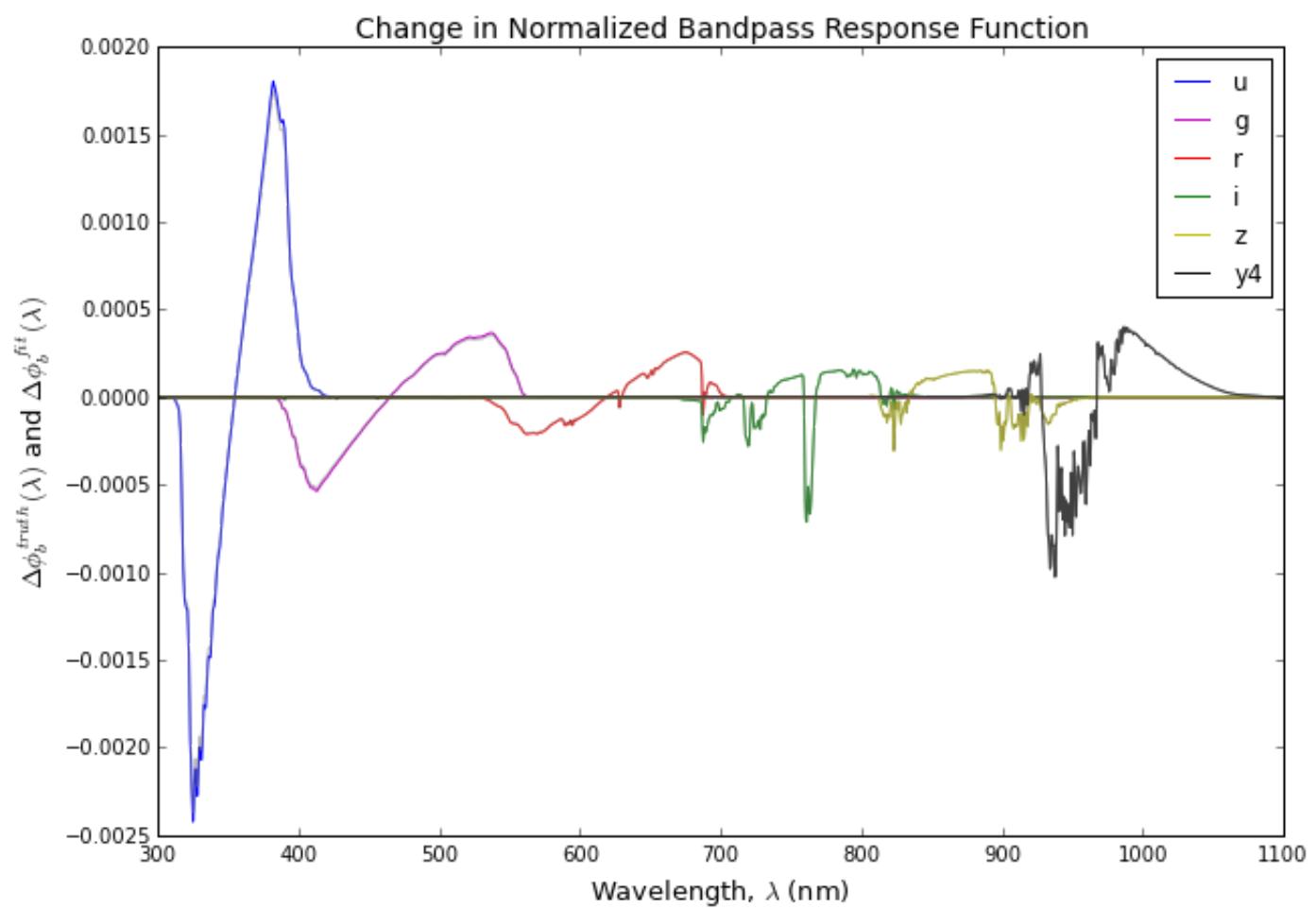
Calculating best fit parameters for i filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_i\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.

Calculating best fit parameters for z filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_z\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.

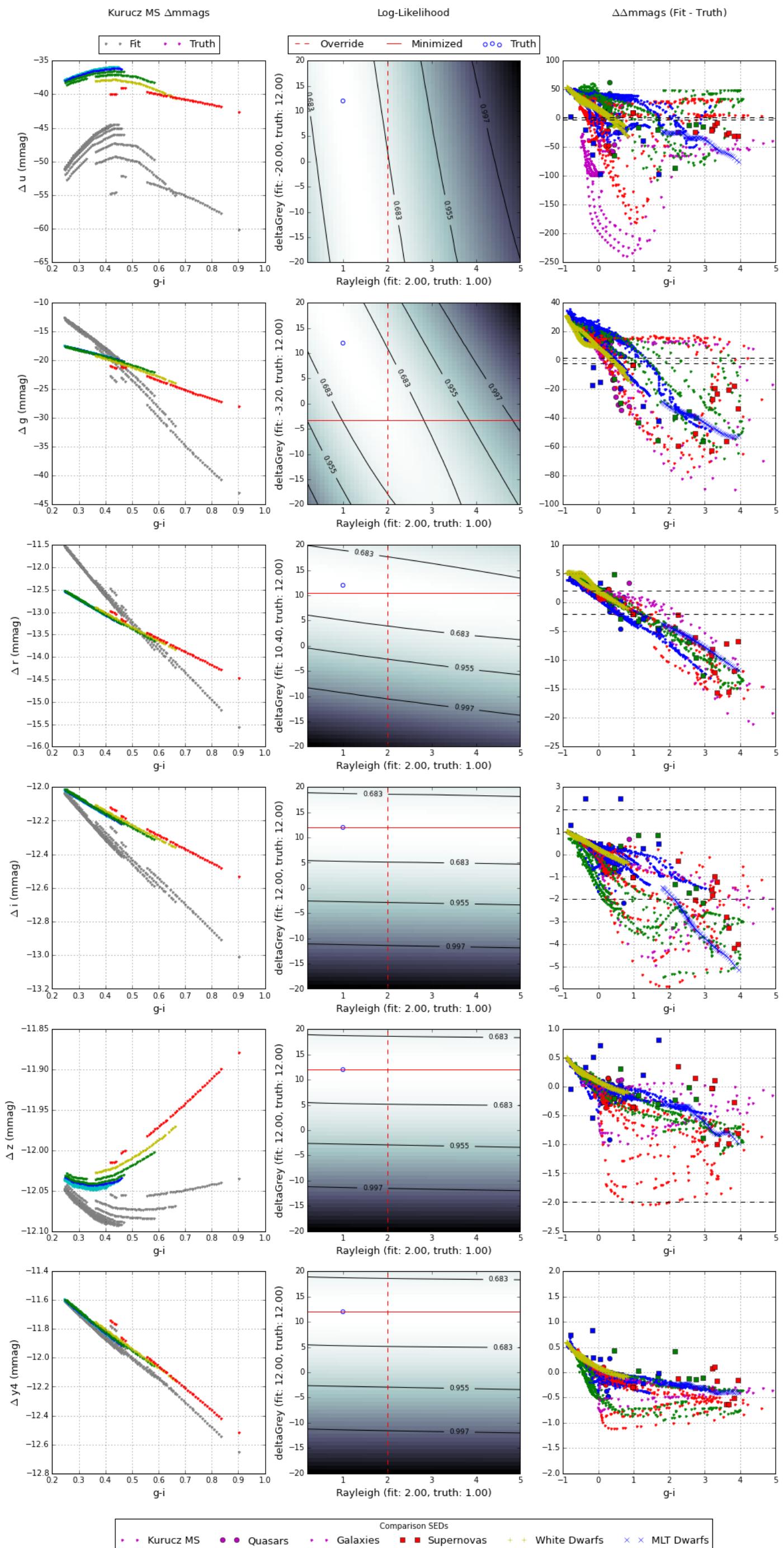
Calculating best fit parameters for y4 filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_y4\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.

Best fit parameters (Filter, Rayleigh, dG, logL, Chi-Squared):  
u 0.98 12.80 1.33338729602 2.66677459203  
g 0.98 12.00 1.17052373042 2.34104746084  
r 0.98 12.00 0.00862756921748 0.017255138435  
i 0.98 12.00 0.000227895126179 0.000455790252357  
z 0.98 12.00 3.30696414294e-05 6.61392828588e-05  
y4 0.98 12.00 2.22433972147e-05 4.44867944294e-05

Override best fit parameters (Filter, Rayleigh, dG):  
u 0.50 20.00  
g 0.50 20.00  
r 0.50 12.80  
i 0.50 12.00  
z 0.50 12.00  
y4 0.50 12.00

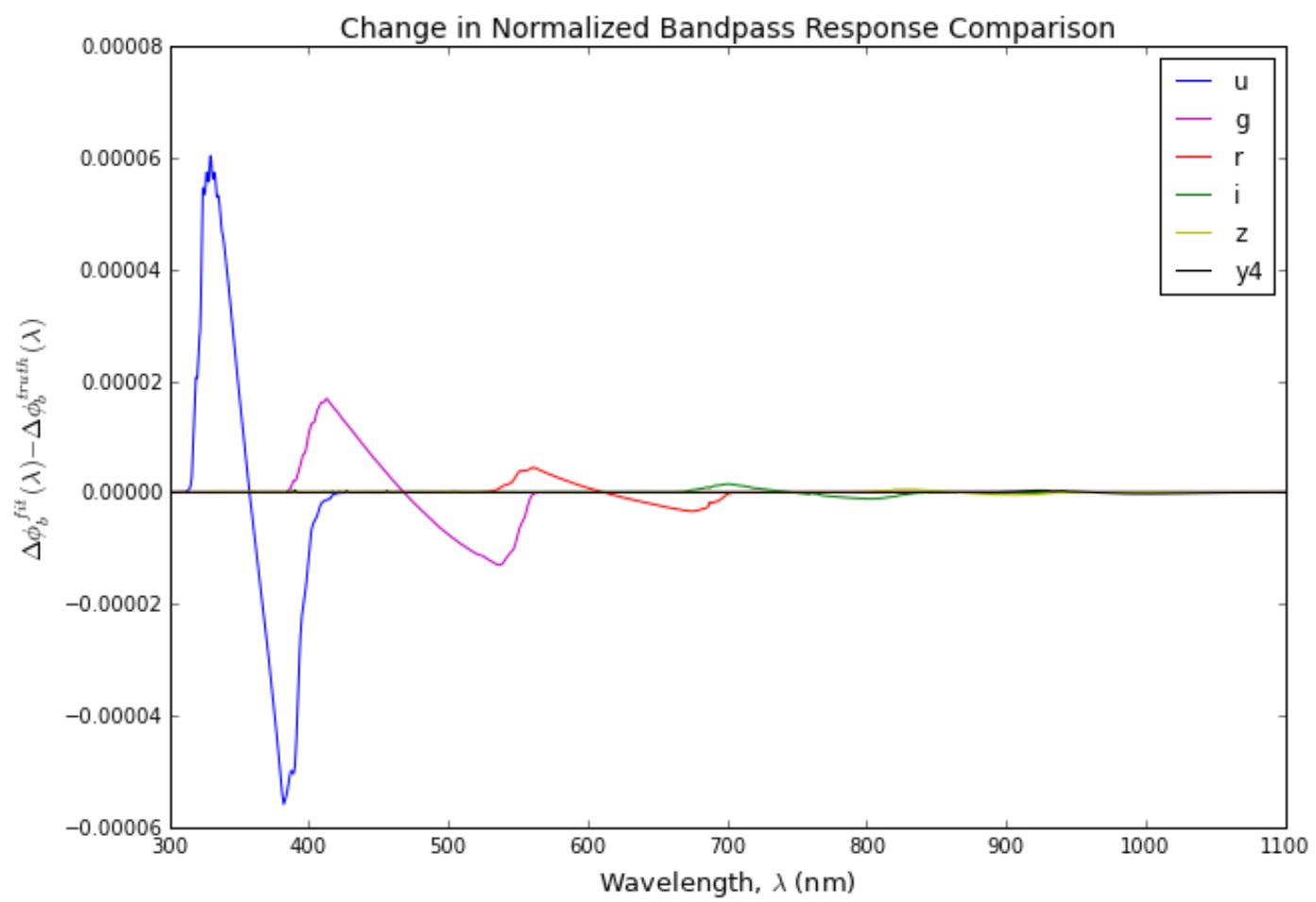
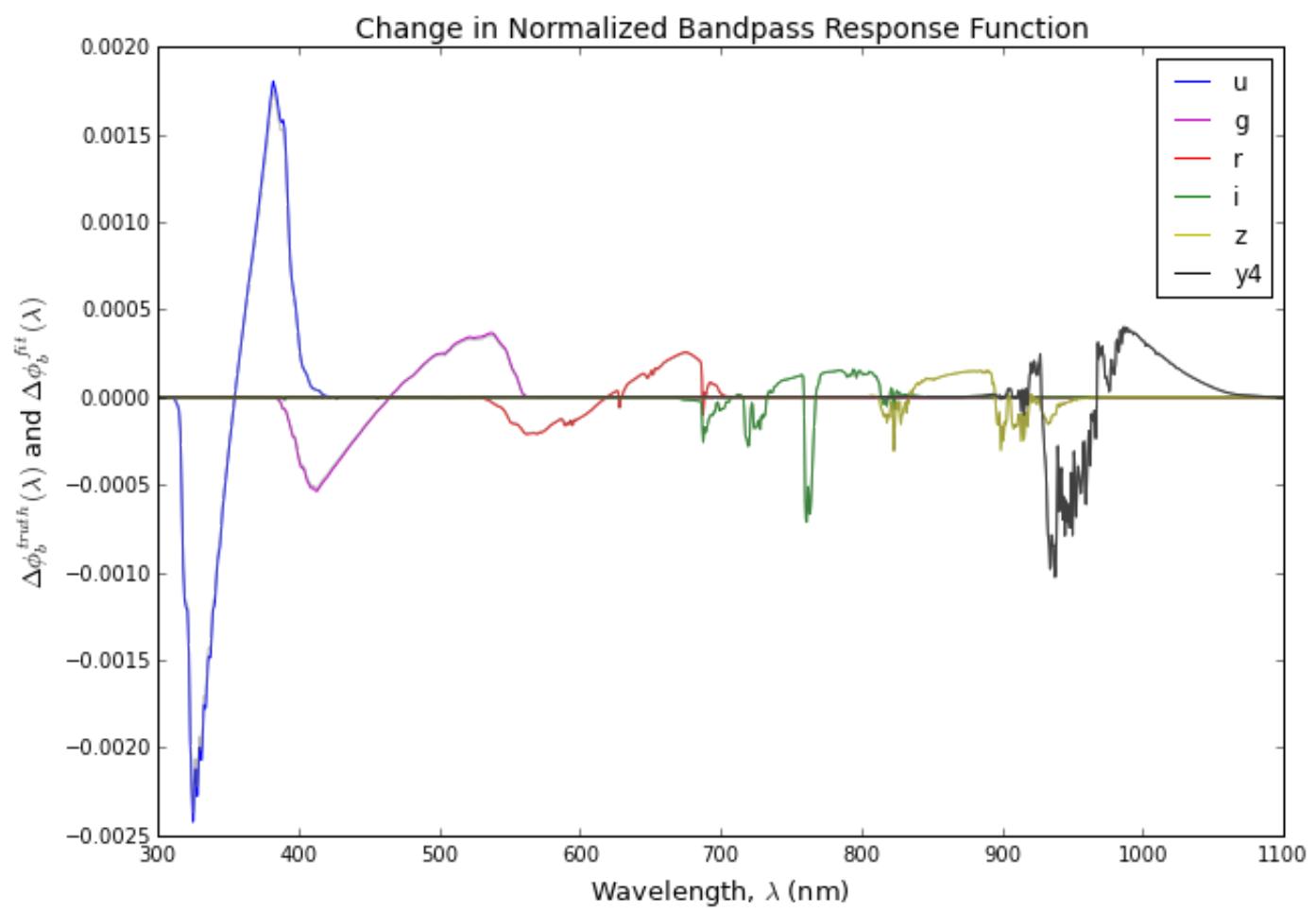


$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )

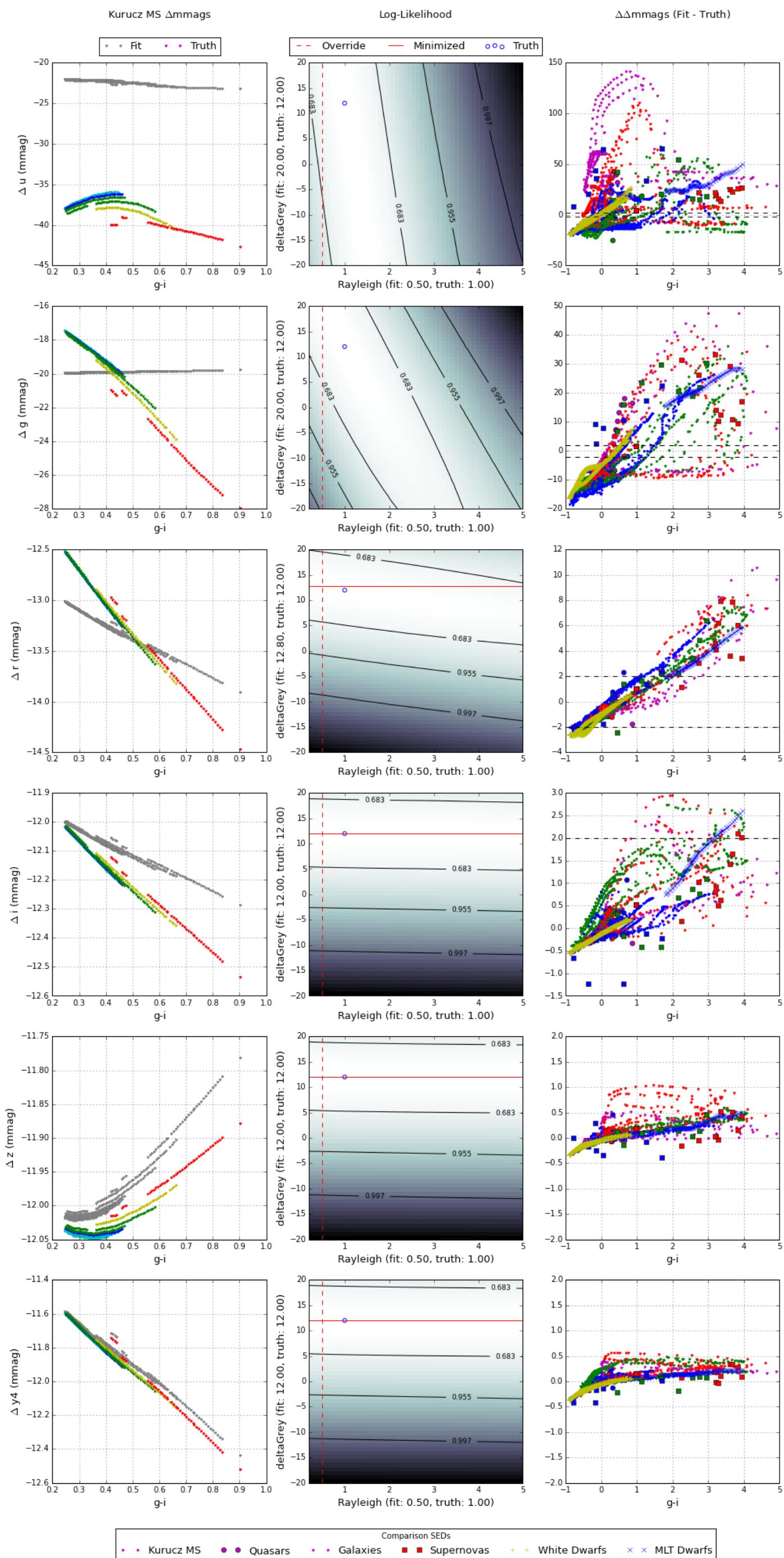


Comparison SEDs

• Kurucz MS • Quasars • Galaxies ■ Supernovas + White Dwarfs × MLT Dwarfs



$\Delta$ mags, Regression Contours,  $\Delta\Delta$ mags for each LSST filter ( $\delta$ Grey: 12.0)



```
In [16]: deltaGreyLimitPlot('Rayleigh',deltaGreyBins=50)
```

```

Computing nonlinear regression for Rayleigh.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Rayleigh: 1.0

Fitting for Rayleigh between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Rayleigh_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

Best fit parameters (Filter, Rayleigh, dG, logL, Chi-Squared):
u 0.98 12.65 2.55045933043 5.10091866086
g 0.98 12.65 2.43393869854 4.86787739708
r 1.08 11.84 0.129085190299 0.258170380598
i 1.47 11.84 0.235468269554 0.470936539109
z 2.75 11.84 0.143399751836 0.286799503672
y4 2.65 11.84 0.226291873754 0.452583747509

Override best fit parameters (Filter, Rayleigh, dG):
u 2.00 -20.00
g 2.00 -3.67
r 2.00 11.02
i 2.00 11.84
z 2.00 11.84
y4 2.00 11.84

Computing nonlinear regression for Rayleigh.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2

```

Observed atmosphere parameter for Rayleigh: 1.0

Fitting for Rayleigh between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...  
Magnitude Error: 5.0 mmags

Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_u\_50dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.

Calculating best fit parameters for g filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_g\_50dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.

Calculating best fit parameters for r filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_r\_50dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.

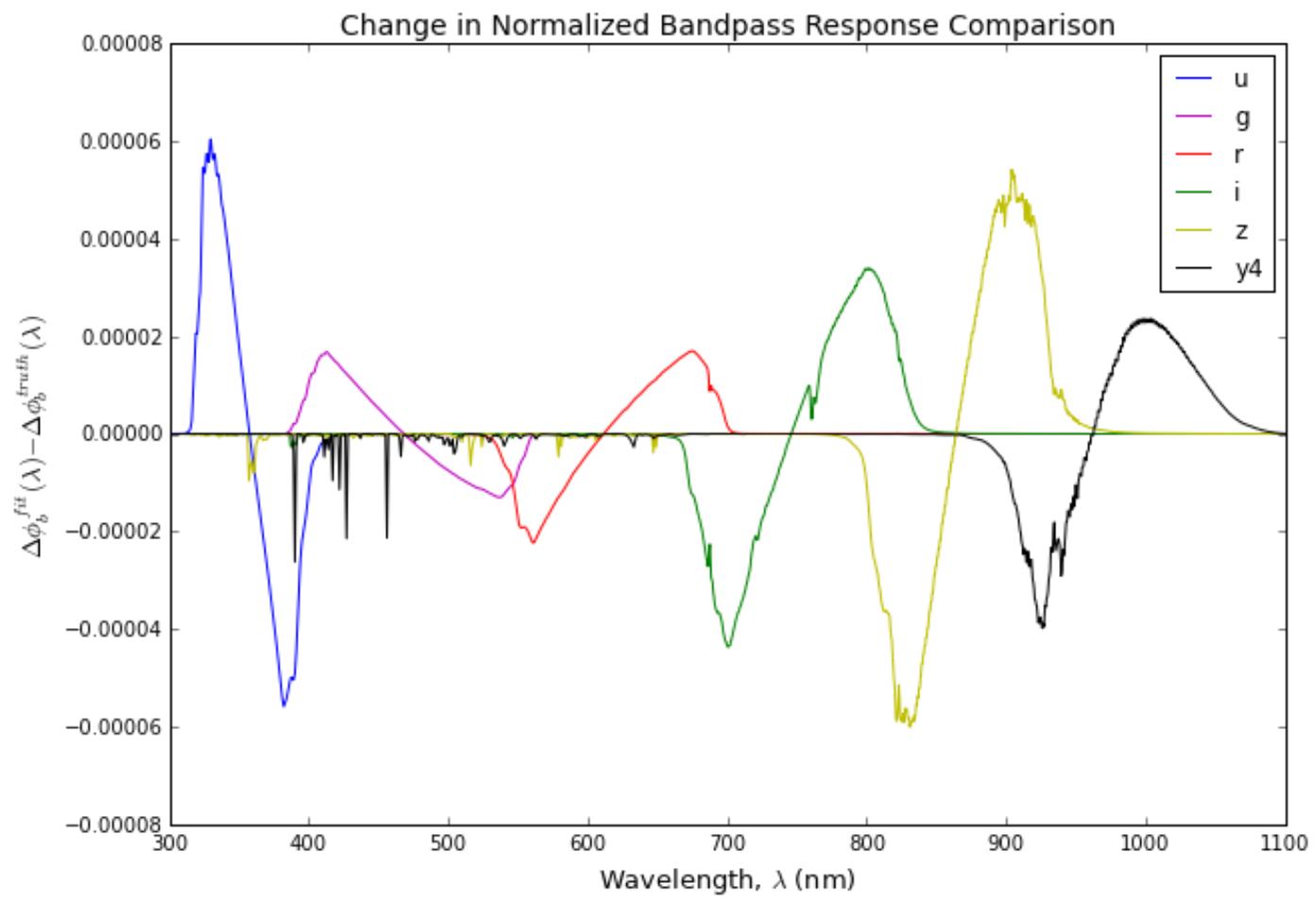
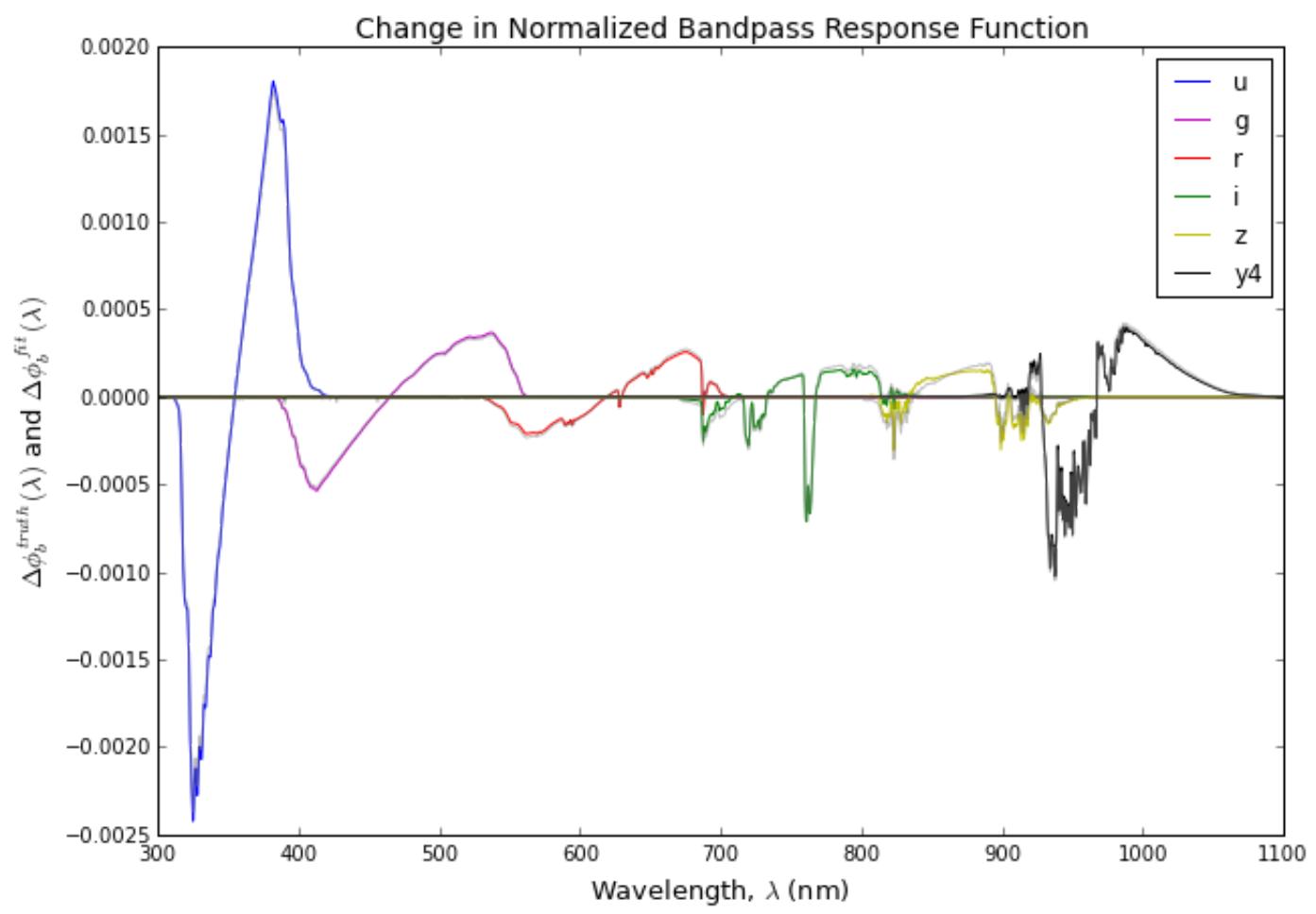
Calculating best fit parameters for i filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_i\_50dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.

Calculating best fit parameters for z filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_z\_50dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.

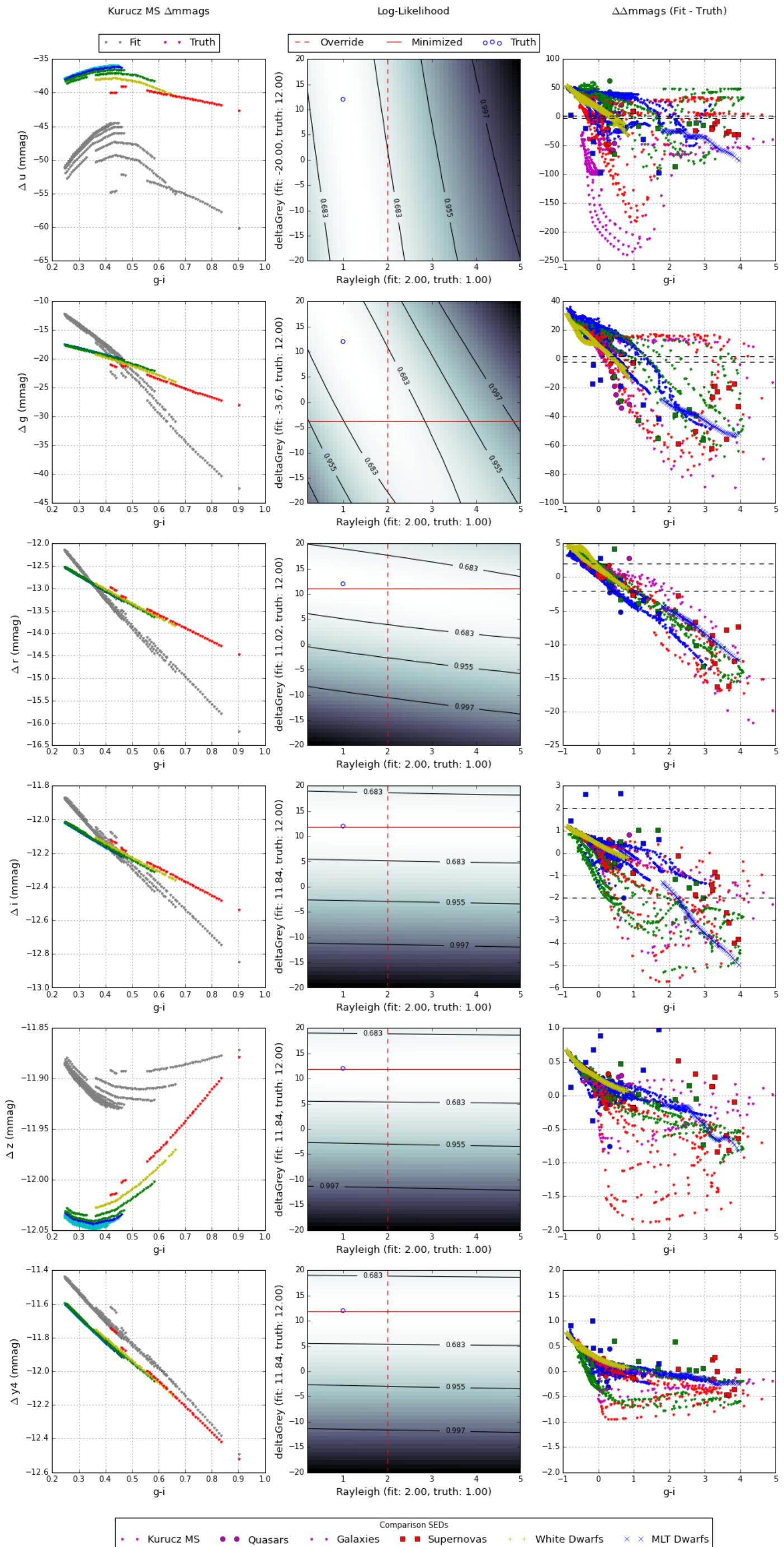
Calculating best fit parameters for y4 filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Rayleigh\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_y4\_50dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.

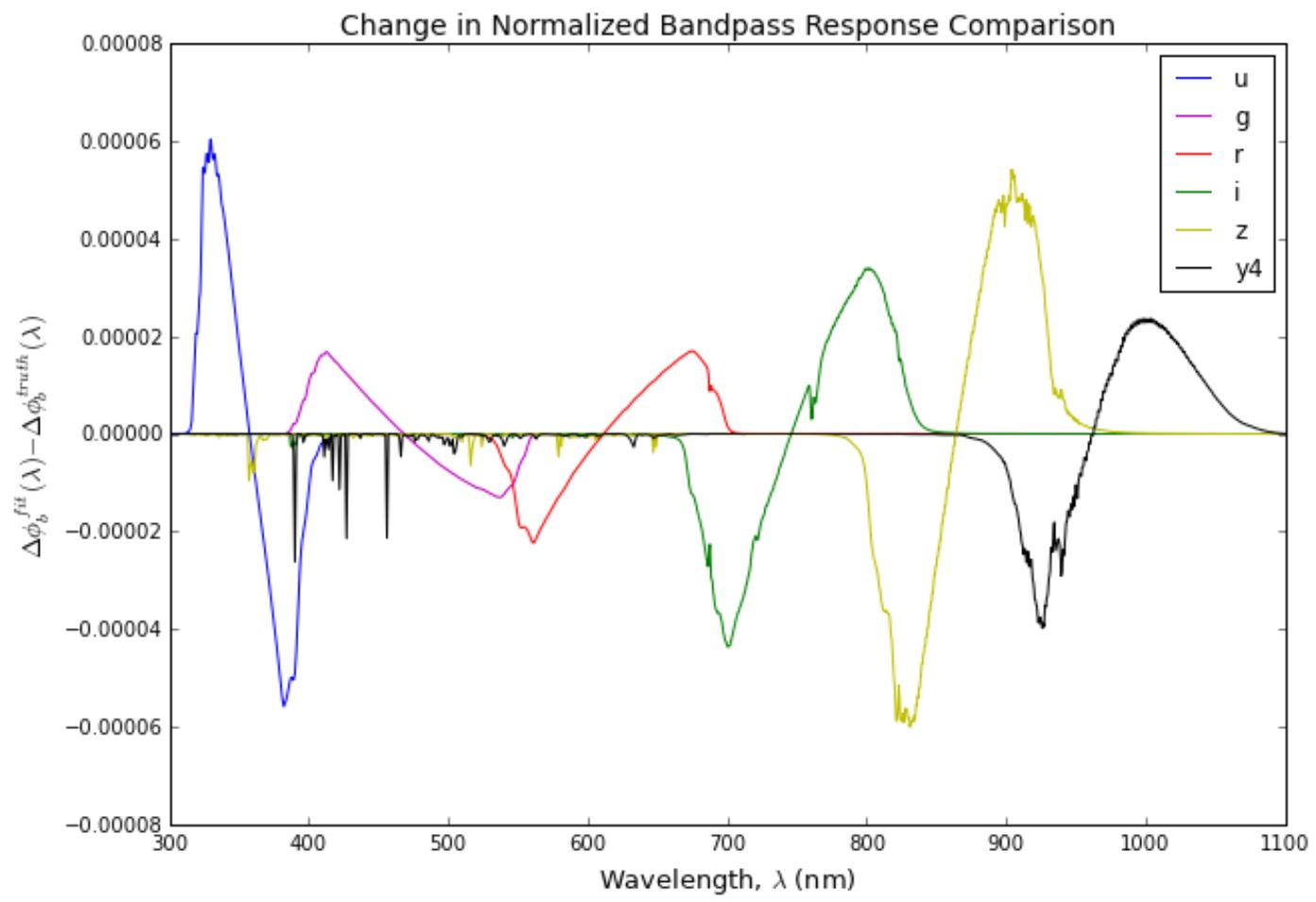
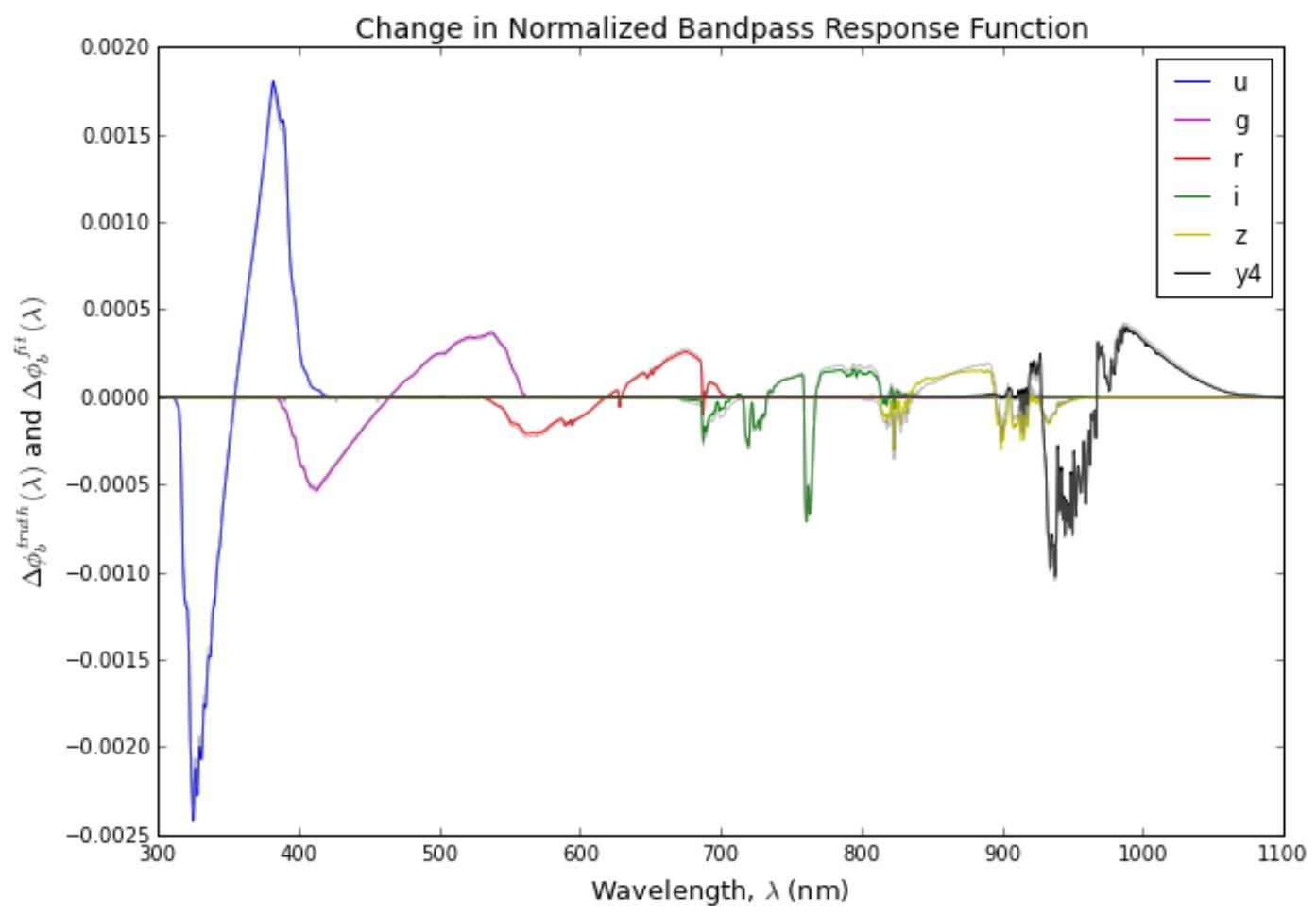
Best fit parameters (Filter, Rayleigh, dG, logL, Chi-Squared):  
u 0.98 12.65 2.55045933043 5.10091866086  
g 0.98 12.65 2.43393869854 4.86787739708  
r 1.08 11.84 0.129085190299 0.258170380598  
i 1.47 11.84 0.235468269554 0.470936539109  
z 2.75 11.84 0.143399751836 0.286799503672  
y4 2.65 11.84 0.226291873754 0.452583747509

Override best fit parameters (Filter, Rayleigh, dG):  
u 0.50 20.00  
g 0.50 20.00  
r 0.50 12.65  
i 0.50 11.84  
z 0.50 11.84  
y4 0.50 11.84

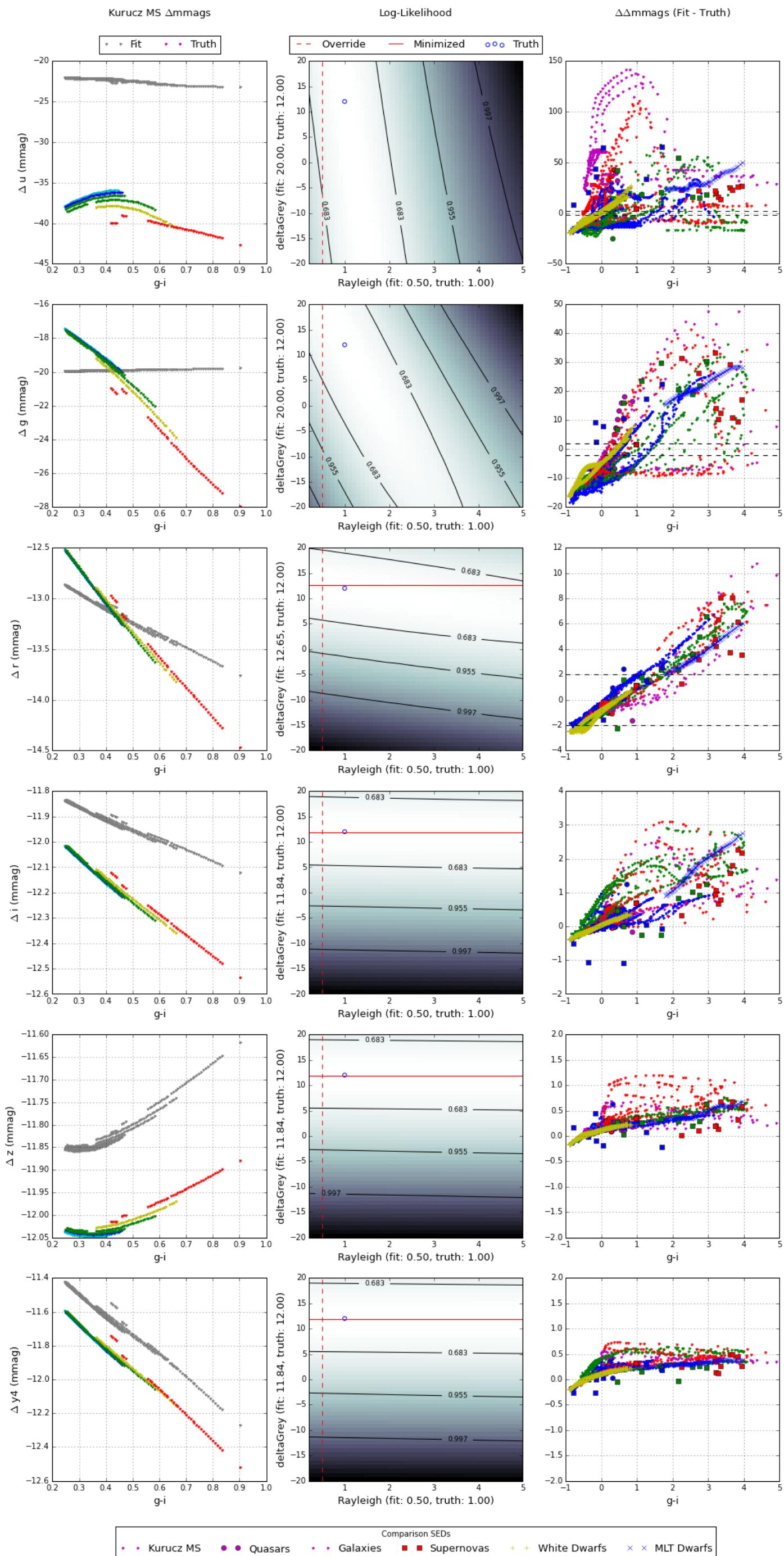


$\Delta$ mmags, Regression Contours,  $\Delta\Delta$ mmags for each LSST filter ( $\delta$ Grey: 12.0)





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



```
In [17]: deltaGreyLimitPlot('Aerosol')
```

```

Computing nonlinear regression for Aerosol.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Aerosol: 1.0

Fitting for Aerosol between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

Best fit parameters (Filter, Aerosol, dG, logL, Chi-Squared):
u 0.98 12.00 0.654060329896 1.30812065979
g 0.98 12.00 0.179917376896 0.359834753792
r 0.98 12.00 0.0049668047697 0.00993360953941
i 0.98 12.00 0.000295117203829 0.000590234407659
z 0.98 12.00 2.69435077775e-05 5.3887015555e-05
y4 0.98 12.00 1.71187987423e-05 3.42375974846e-05

Override best fit parameters (Filter, Aerosol, dG):
u 2.00 -0.80
g 2.00 5.60
r 2.00 11.20
i 2.00 12.00
z 2.00 12.00
y4 2.00 12.00

Computing nonlinear regression for Aerosol.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Aerosol: 1.0

```

Fitting for Aerosol between 0.20 and 5.00 in 50 bins.  
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...  
Magnitude Error: 5.0 mmags

Override triggered...  
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Ae\_rosol\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_u\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for u filter.  
Saved Chi-Squared at best fit deltaGrey for u filter.  
Completed u filter.

Calculating best fit parameters for g filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Ae\_rosol\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_g\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for g filter.  
Saved Chi-Squared at best fit deltaGrey for g filter.  
Completed g filter.

Calculating best fit parameters for r filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Ae\_rosol\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_r\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for r filter.  
Saved Chi-Squared at best fit deltaGrey for r filter.  
Completed r filter.

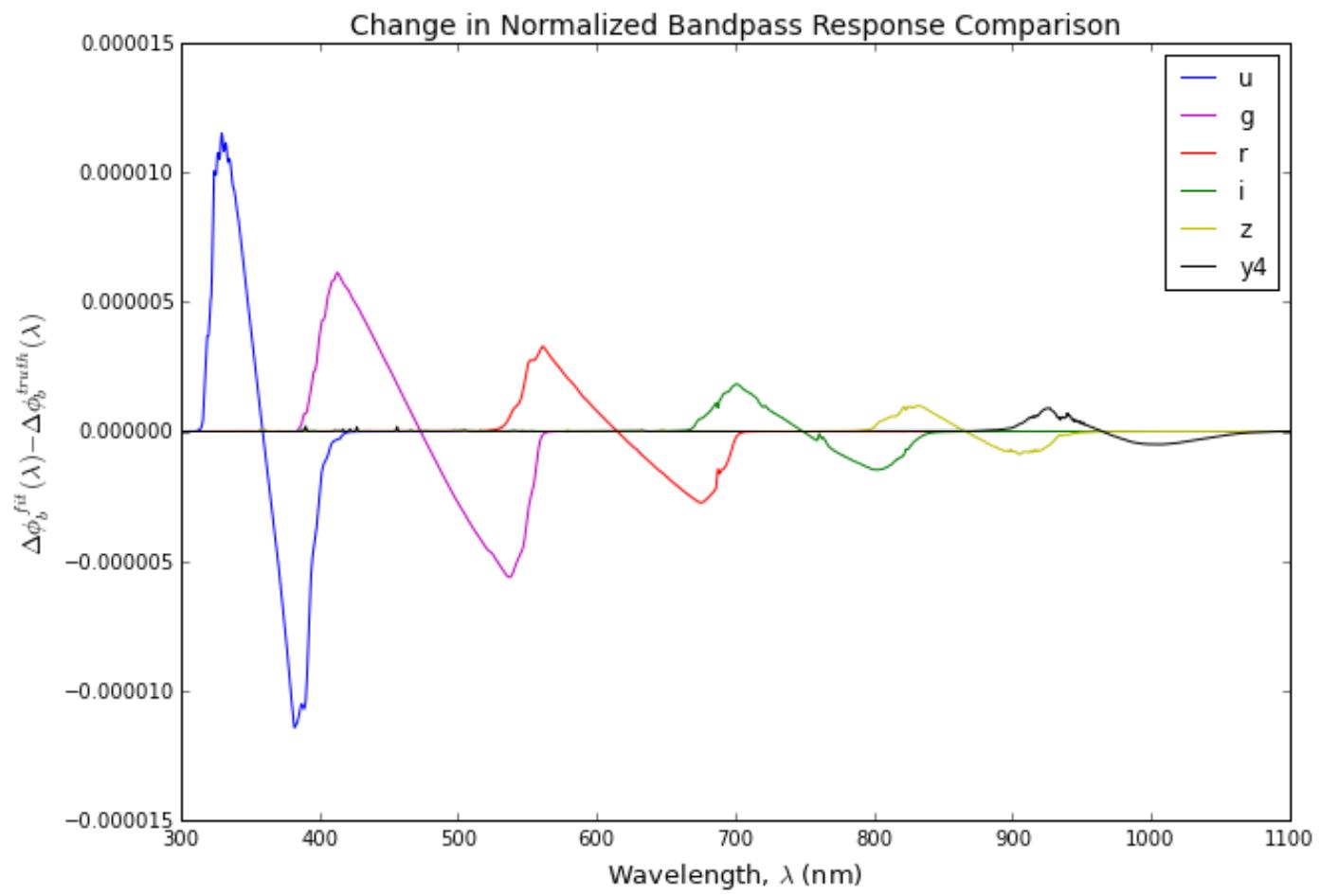
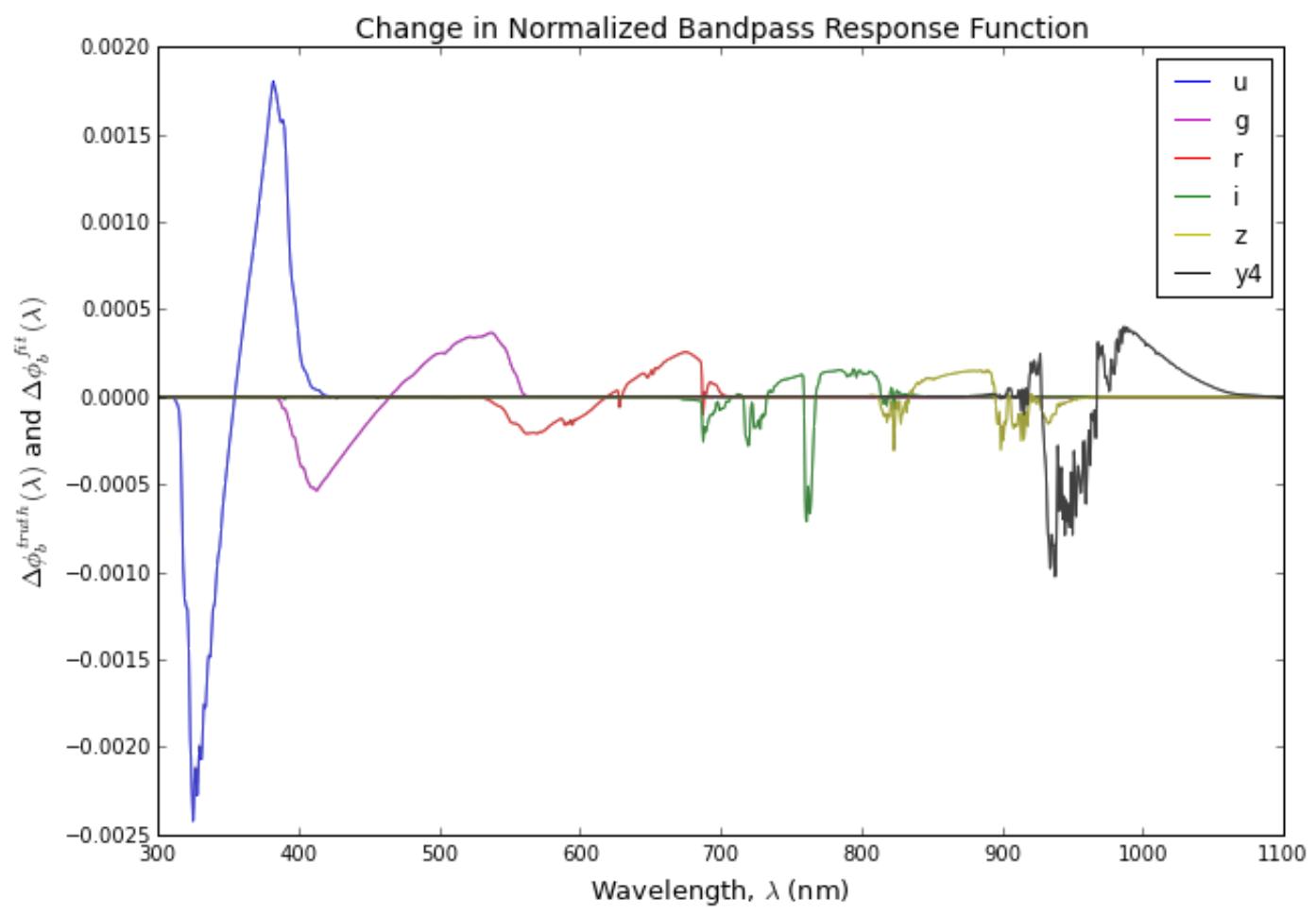
Calculating best fit parameters for i filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Ae\_rosol\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_i\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for i filter.  
Saved Chi-Squared at best fit deltaGrey for i filter.  
Completed i filter.

Calculating best fit parameters for z filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Ae\_rosol\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_z\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for z filter.  
Saved Chi-Squared at best fit deltaGrey for z filter.  
Completed z filter.

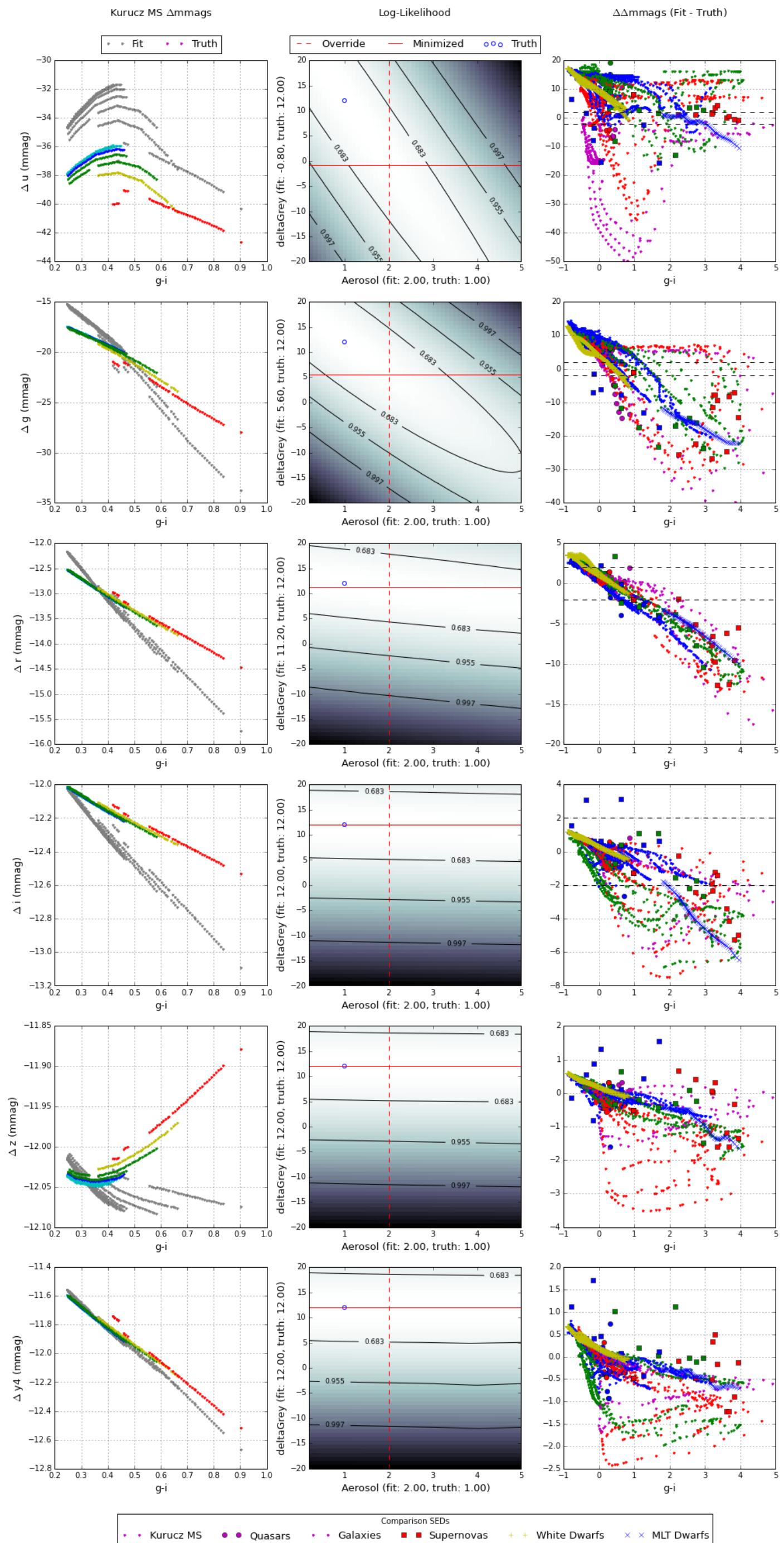
Calculating best fit parameters for y4 filter...  
@pickle\_results: computing results and saving to 'pickles/X20\_P101010101017\_Ae\_rosol\_dG\_XSTD12\_DG120\_DGR-2020\_E5\_mss\_y4\_51dgb\_50b\_min\_dGTest\_giCut\_OR50.pkl'  
Saved LogL at best fit deltaGrey for y4 filter.  
Saved Chi-Squared at best fit deltaGrey for y4 filter.  
Completed y4 filter.

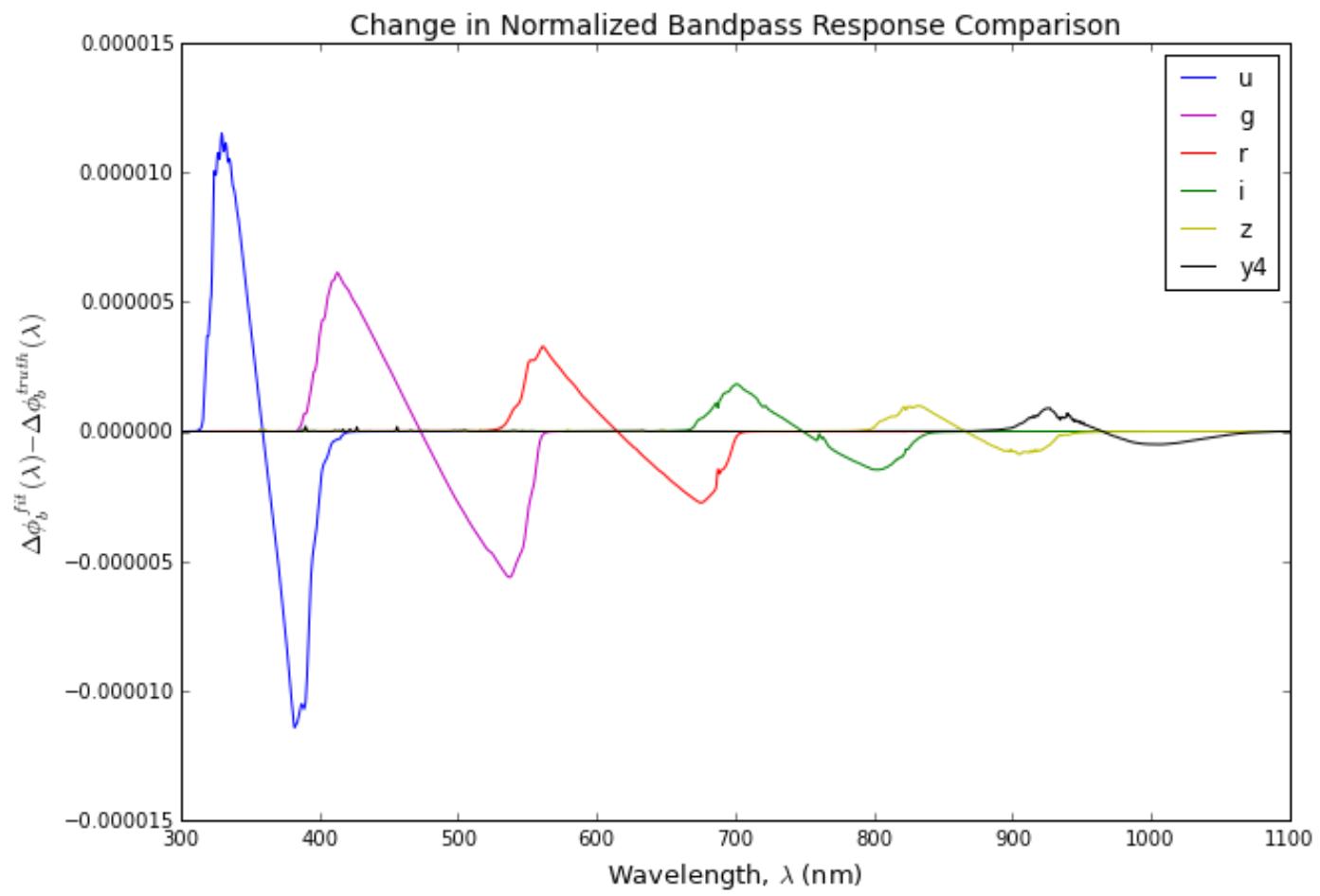
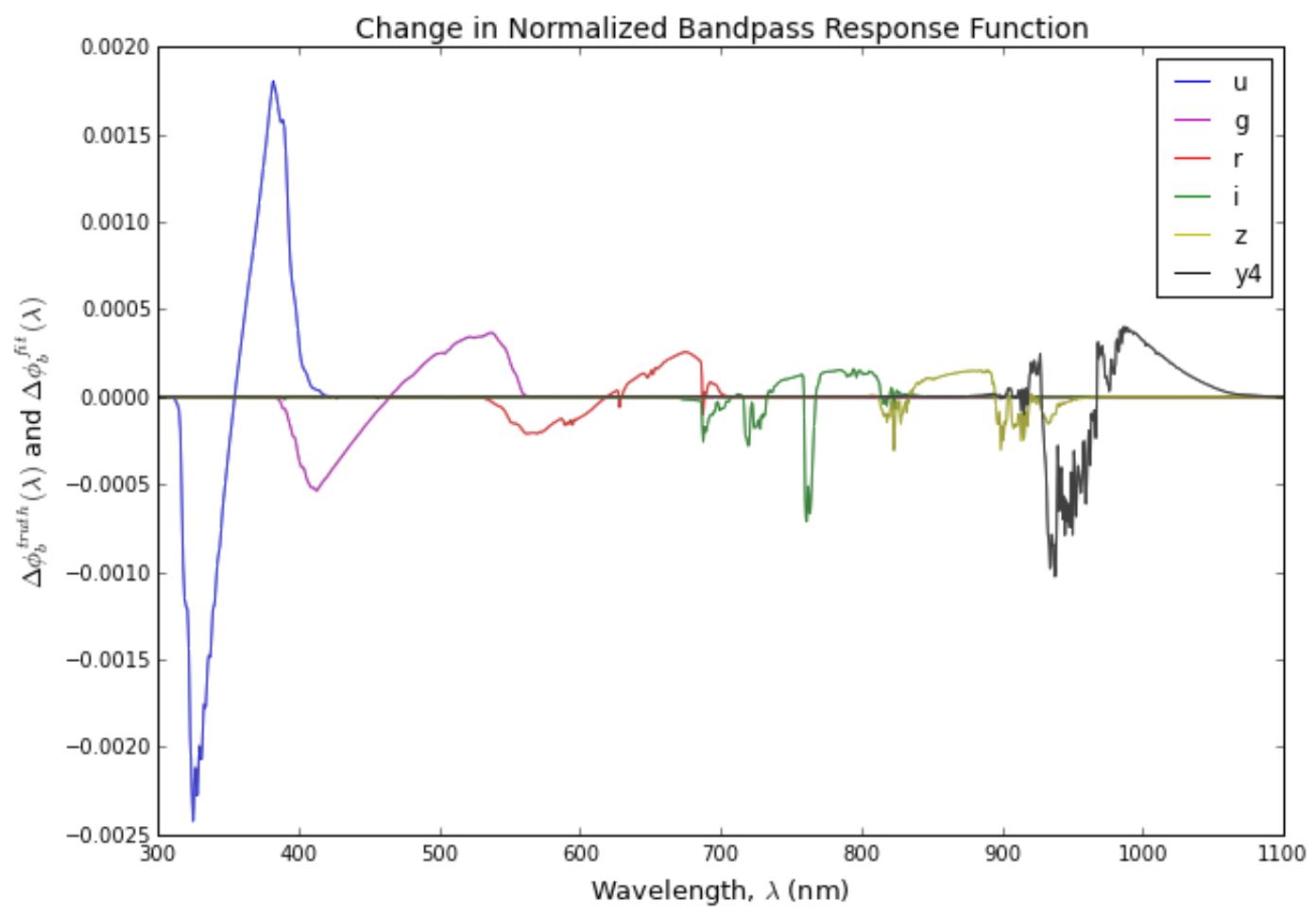
Best fit parameters (Filter, Aerosol, dG, logL, Chi-Squared):  
u 0.98 12.00 0.654060329896 1.30812065979  
g 0.98 12.00 0.179917376896 0.359834753792  
r 0.98 12.00 0.0049668047697 0.00993360953941  
i 0.98 12.00 0.000295117203829 0.000590234407659  
z 0.98 12.00 2.69435077775e-05 5.3887015555e-05  
y4 0.98 12.00 1.71187987423e-05 3.42375974846e-05

Override best fit parameters (Filter, Aerosol, dG):  
u 0.50 18.40  
g 0.50 15.20  
r 0.50 12.80  
i 0.50 12.00  
z 0.50 12.00  
y4 0.50 12.00

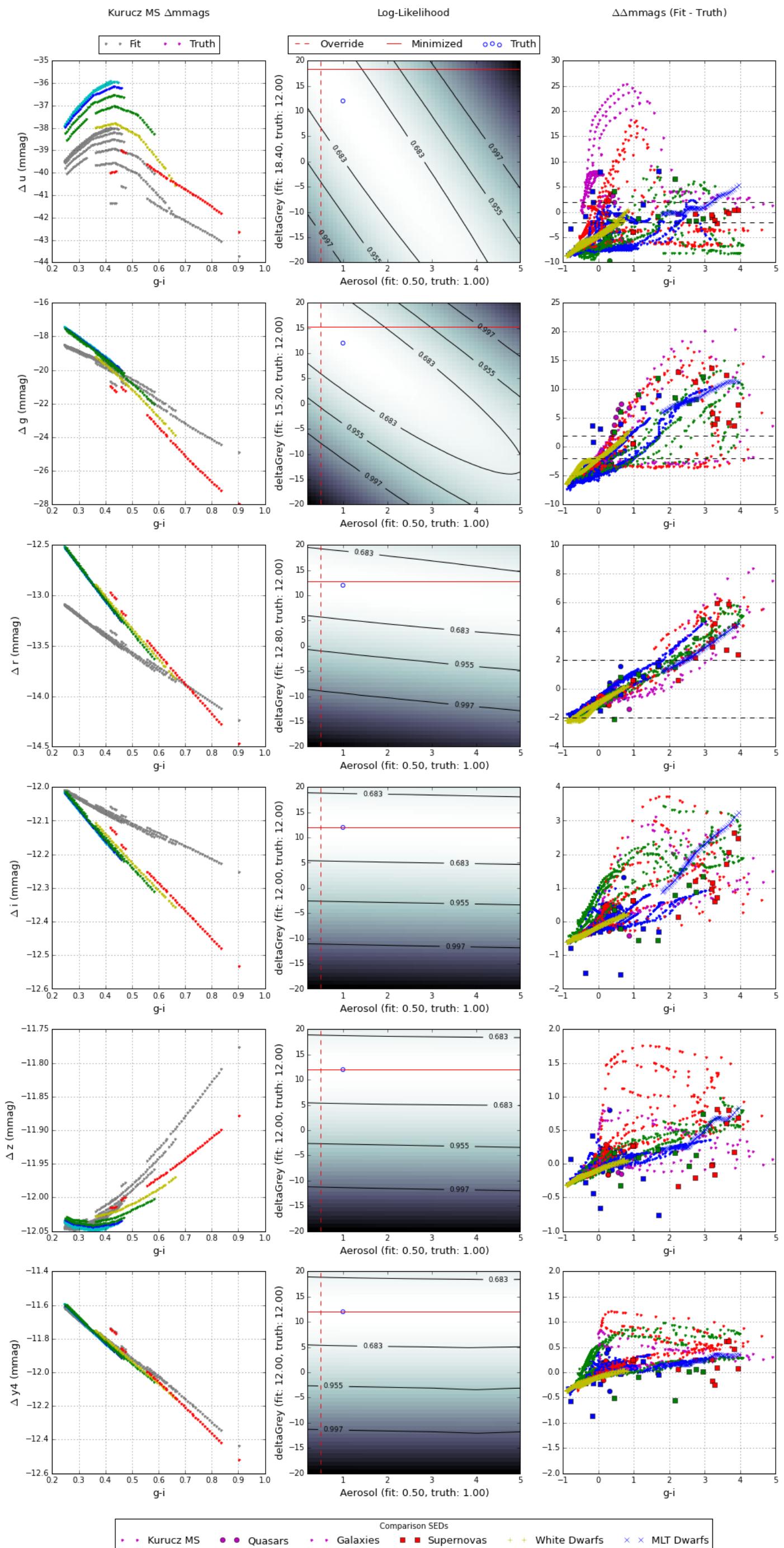


$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



```
In [18]: deltaGreyLimitPlot('Aerosol',deltaGreyBins=50)
```

```

Computing nonlinear regression for Aerosol.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Aerosol: 1.0

Fitting for Aerosol between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

Best fit parameters (Filter, Aerosol, dG, logL, Chi-Squared):
u 1.08 11.02 0.799502119436 1.59900423887
g 0.98 11.84 1.07798968669 2.15597937339
r 1.08 11.84 0.1562622899 0.3125245798
i 1.38 11.84 0.257631027978 0.515262055957
z 2.36 11.84 0.221527138946 0.443054277892
y4 1.57 11.84 0.369628121545 0.739256243089

Override best fit parameters (Filter, Aerosol, dG):
u 2.00 -0.41
g 2.00 6.12
r 2.00 11.02
i 2.00 11.84
z 2.00 11.84
y4 2.00 11.84

Computing nonlinear regression for Aerosol.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Aerosol: 1.0

```

```

Fitting for Aerosol between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

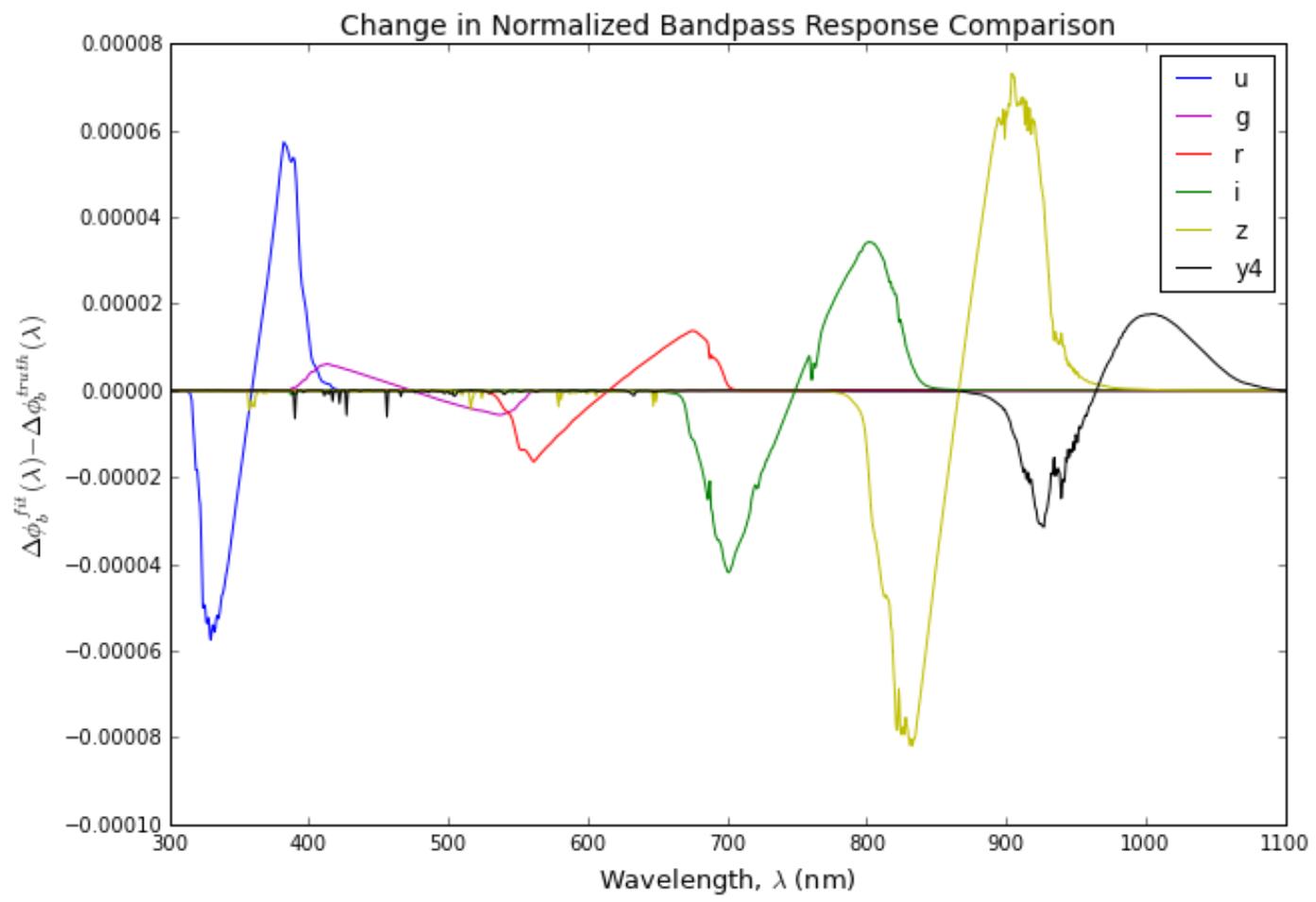
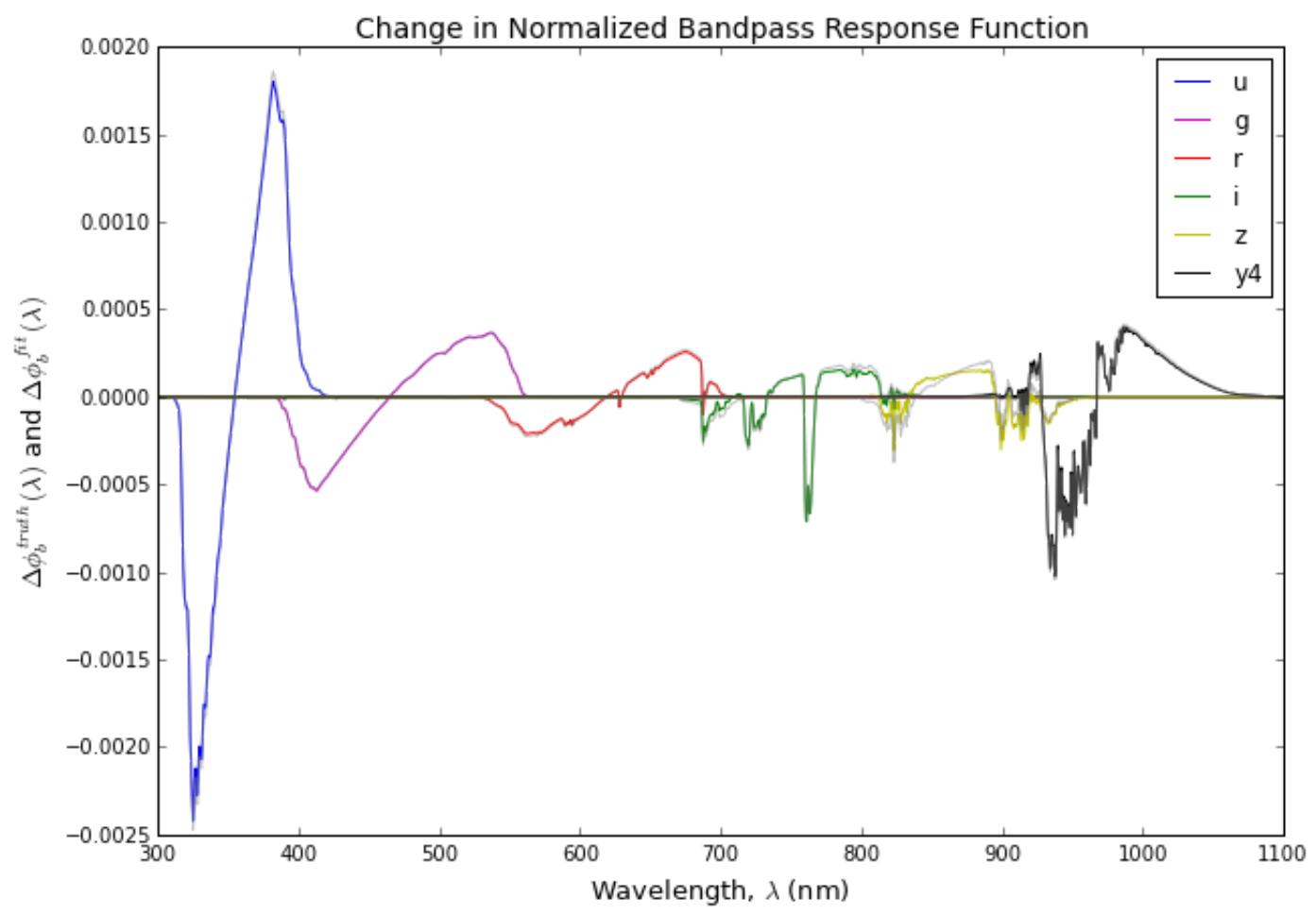
Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Aerosol_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

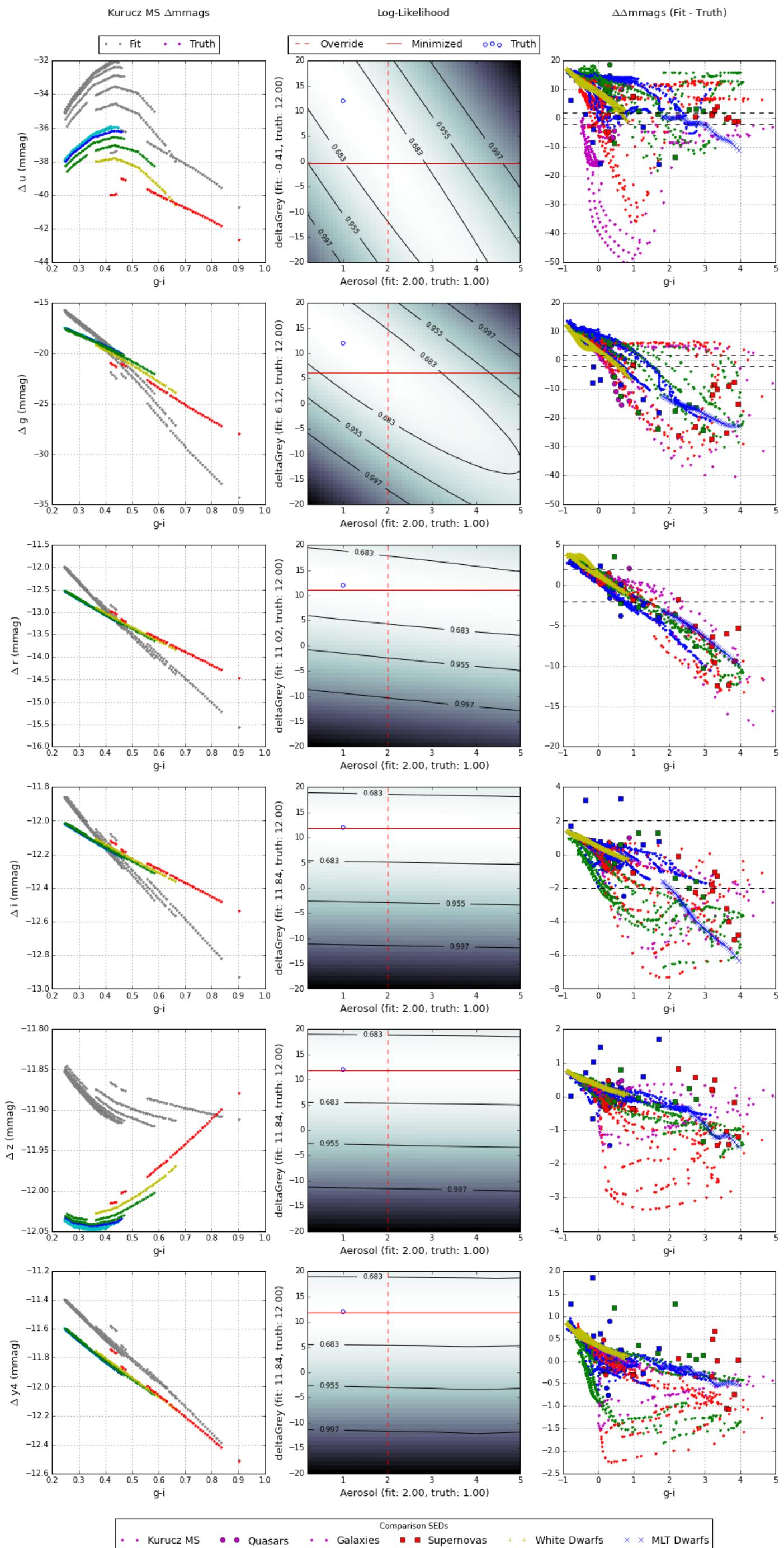
Best fit parameters (Filter, Aerosol, dG, logL, Chi-Squared):
u 1.08 11.02 0.799502119436 1.59900423887
g 0.98 11.84 1.07798968669 2.15597937339
r 1.08 11.84 0.1562622899 0.3125245798
i 1.38 11.84 0.257631027978 0.515262055957
z 2.36 11.84 0.221527138946 0.443054277892
y4 1.57 11.84 0.369628121545 0.739256243089

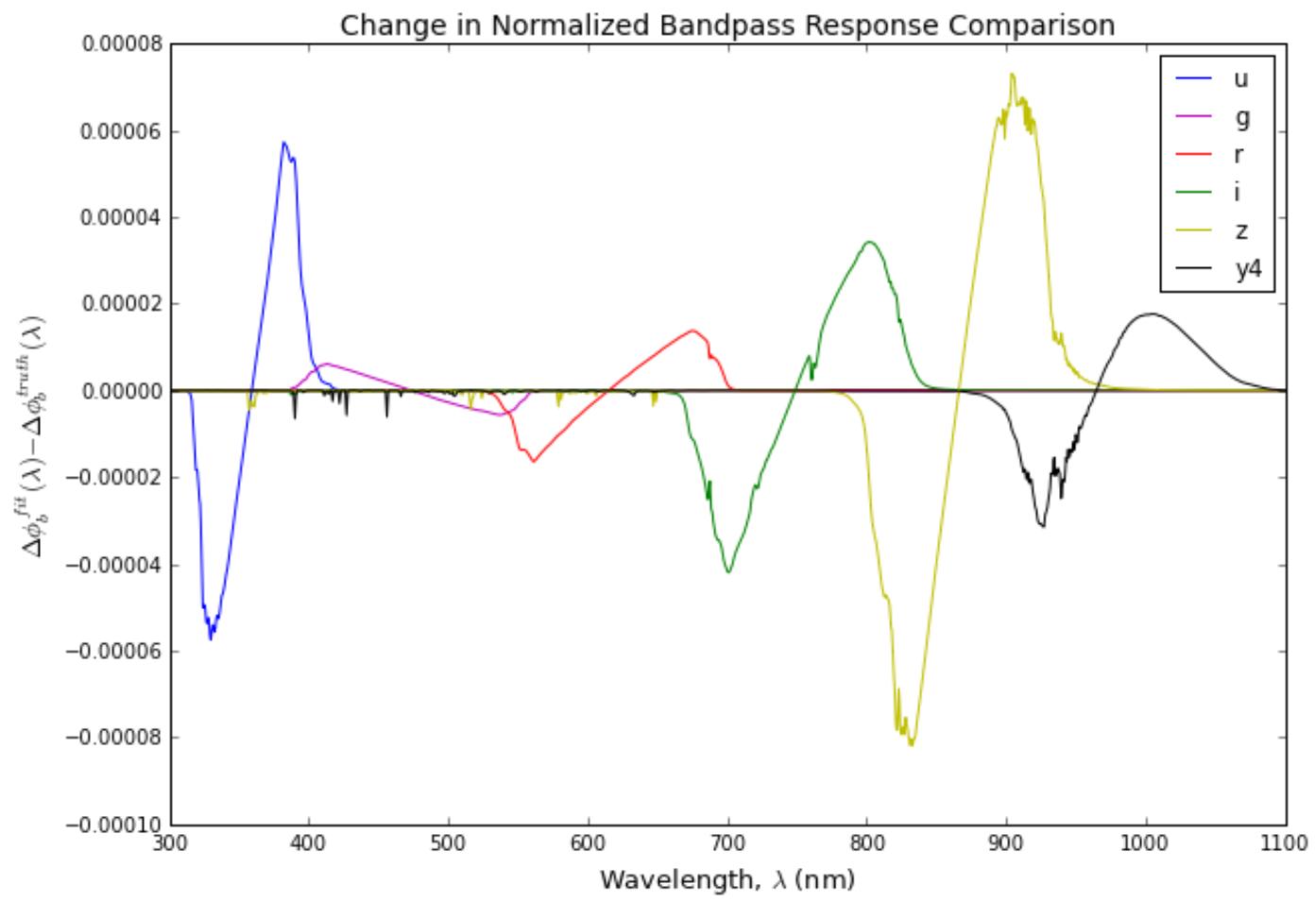
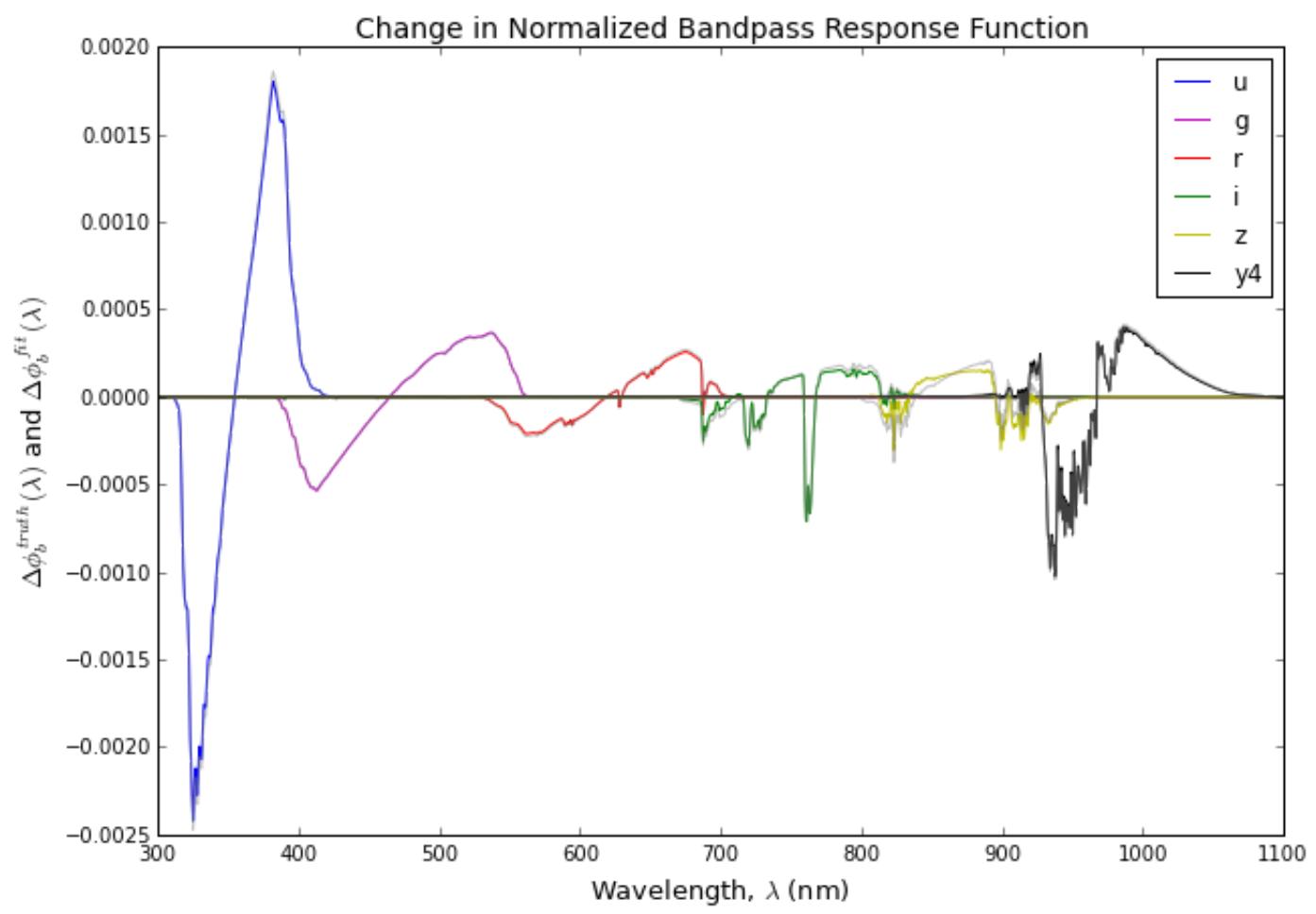
Override best fit parameters (Filter, Aerosol, dG):
u 0.50 18.37
g 0.50 15.10
r 0.50 12.65
i 0.50 11.84
z 0.50 11.84
y4 0.50 11.84

```

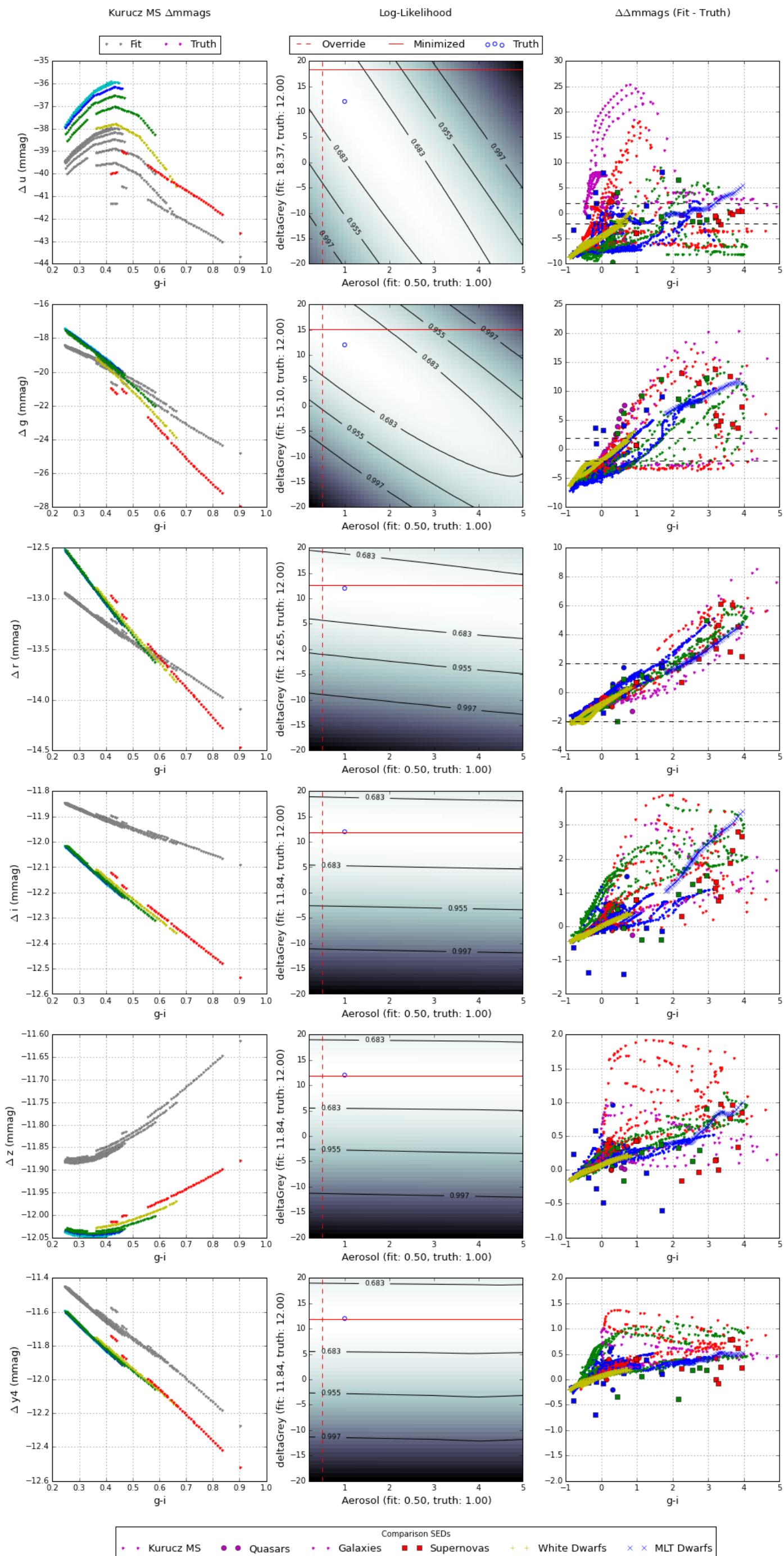


$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )





$\Delta$ mags, Regression Contours,  $\Delta\Delta$ mags for each LSST filter ( $\delta$ Grey: 12.0)



```
In [19]: deltaGreyLimitPlot('Alpha')
```

```

Computing nonlinear regression for Alpha.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Alpha: 1.7

Fitting for Alpha between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

Best fit parameters (Filter, Alpha, dG, logL, Chi-Squared):
u 1.77 11.20 0.64317320574 1.28634641148
g 1.67 12.00 0.356063742862 0.712127485724
r 1.67 12.00 0.00413046796106 0.00826093592213
i 1.67 12.00 9.64630624314e-05 0.000192926124863
z 1.67 12.00 8.82638270541e-06 1.76527654108e-05
y4 1.67 12.00 7.62804466794e-06 1.52560893359e-05

Override best fit parameters (Filter, Alpha, dG):
u 2.00 8.00
g 2.00 10.40
r 2.00 12.00
i 2.00 12.00
z 2.00 12.00
y4 2.00 12.00

Computing nonlinear regression for Alpha.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Alpha: 1.7

```

```

Fitting for Alpha between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 51 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2550 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at ne
w component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Al
pha_dG_XSTD12_DG120_DGR-2020_E5_mss_u_51dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Al
pha_dG_XSTD12_DG120_DGR-2020_E5_mss_g_51dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Al
pha_dG_XSTD12_DG120_DGR-2020_E5_mss_r_51dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Al
pha_dG_XSTD12_DG120_DGR-2020_E5_mss_i_51dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

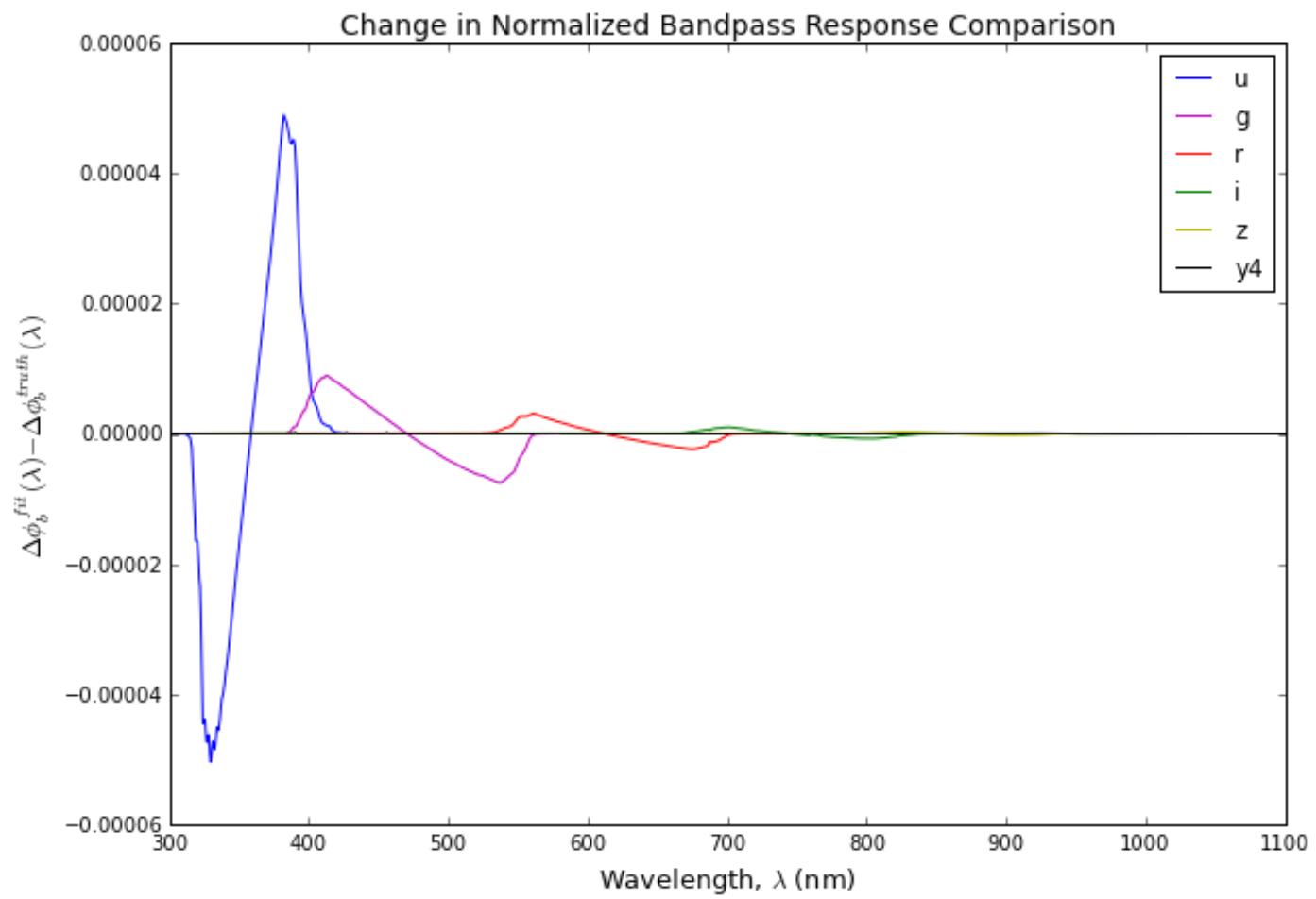
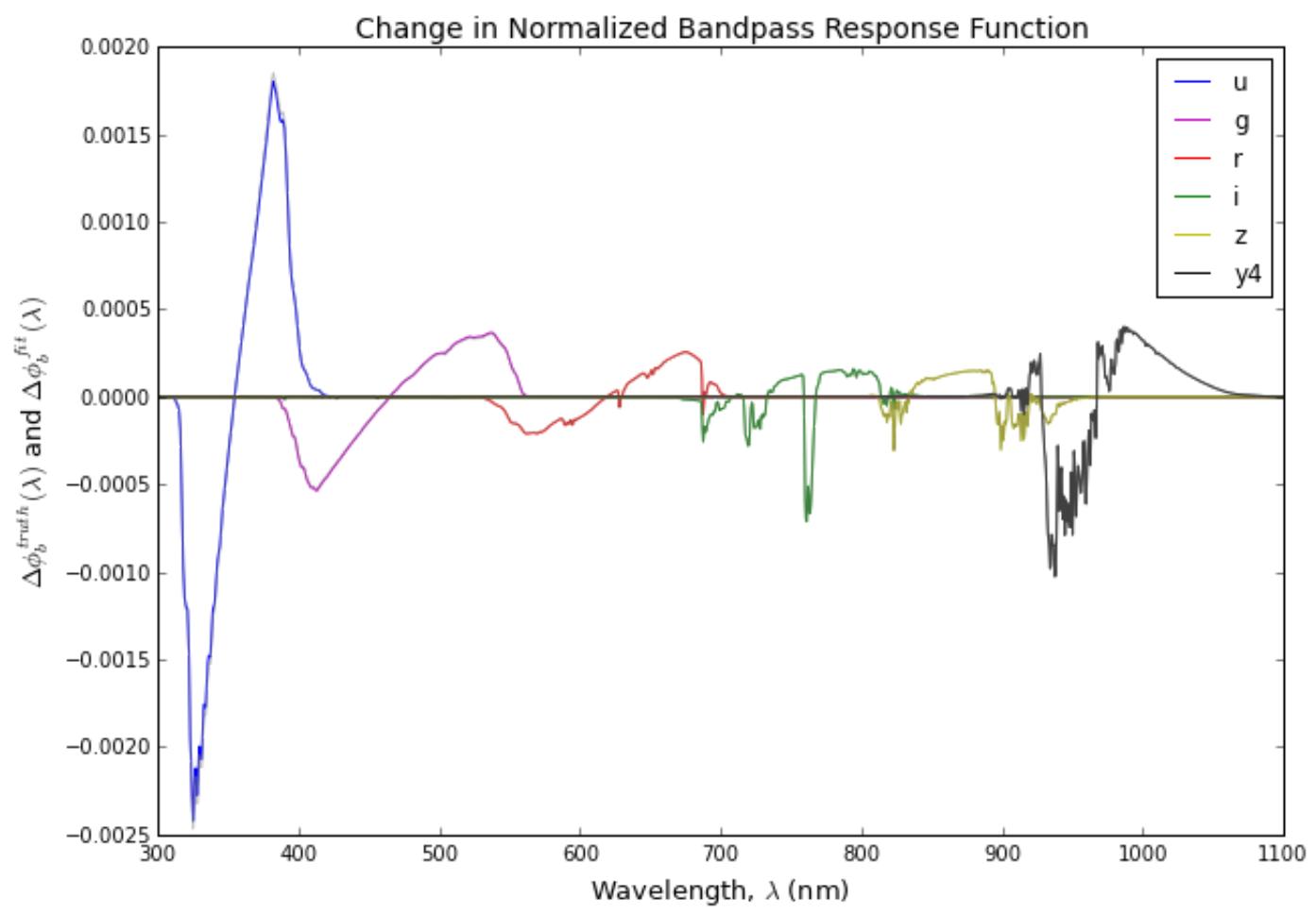
Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Al
pha_dG_XSTD12_DG120_DGR-2020_E5_mss_z_51dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Al
pha_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_51dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

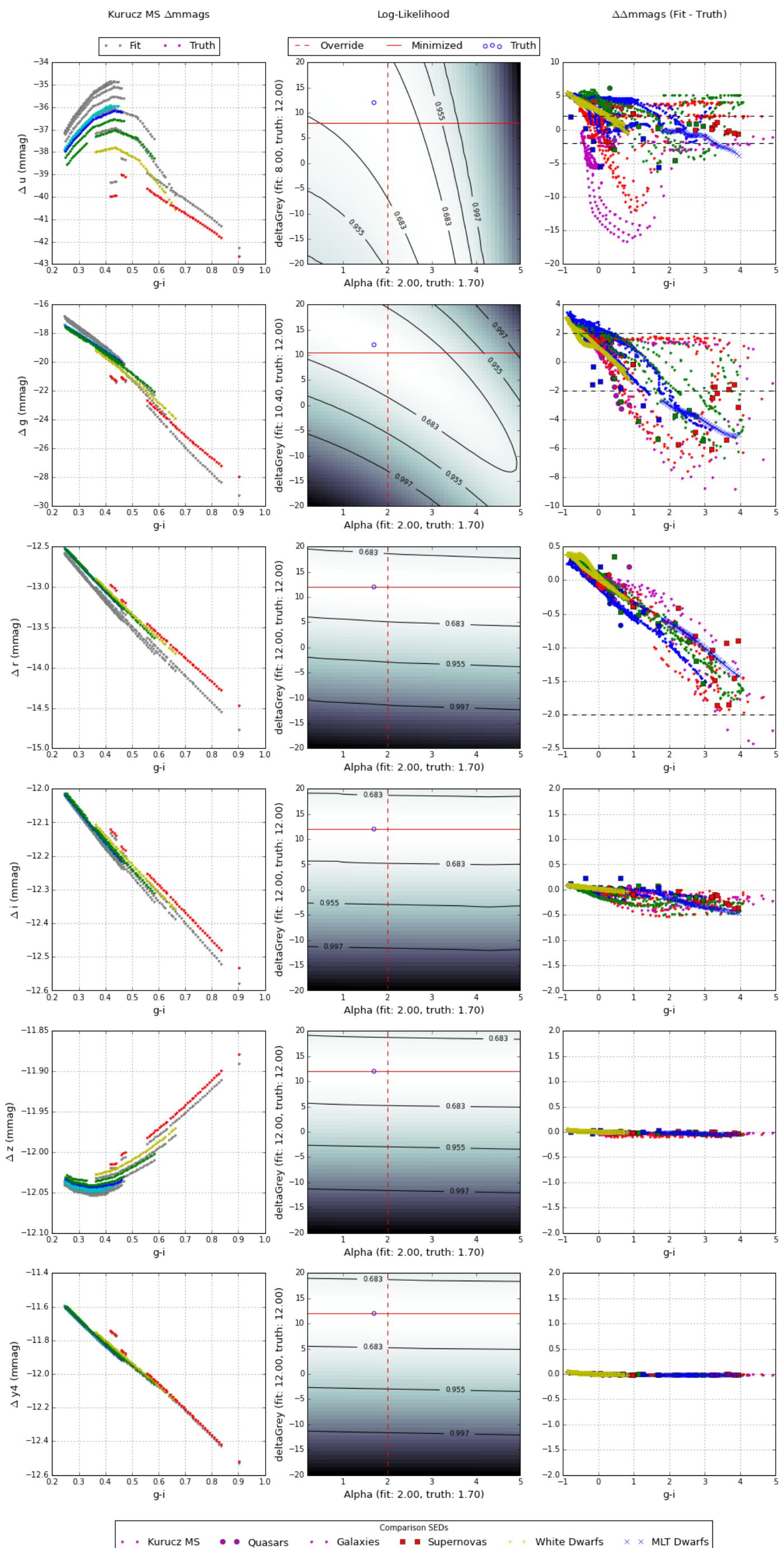
Best fit parameters (Filter, Alpha, dG, logL, Chi-Squared):
u 1.77 11.20 0.64317320574 1.28634641148
g 1.67 12.00 0.356063742862 0.712127485724
r 1.67 12.00 0.00413046796106 0.00826093592213
i 1.67 12.00 9.64630624314e-05 0.000192926124863
z 1.67 12.00 8.82638270541e-06 1.76527654108e-05
y4 1.67 12.00 7.62804466794e-06 1.52560893359e-05

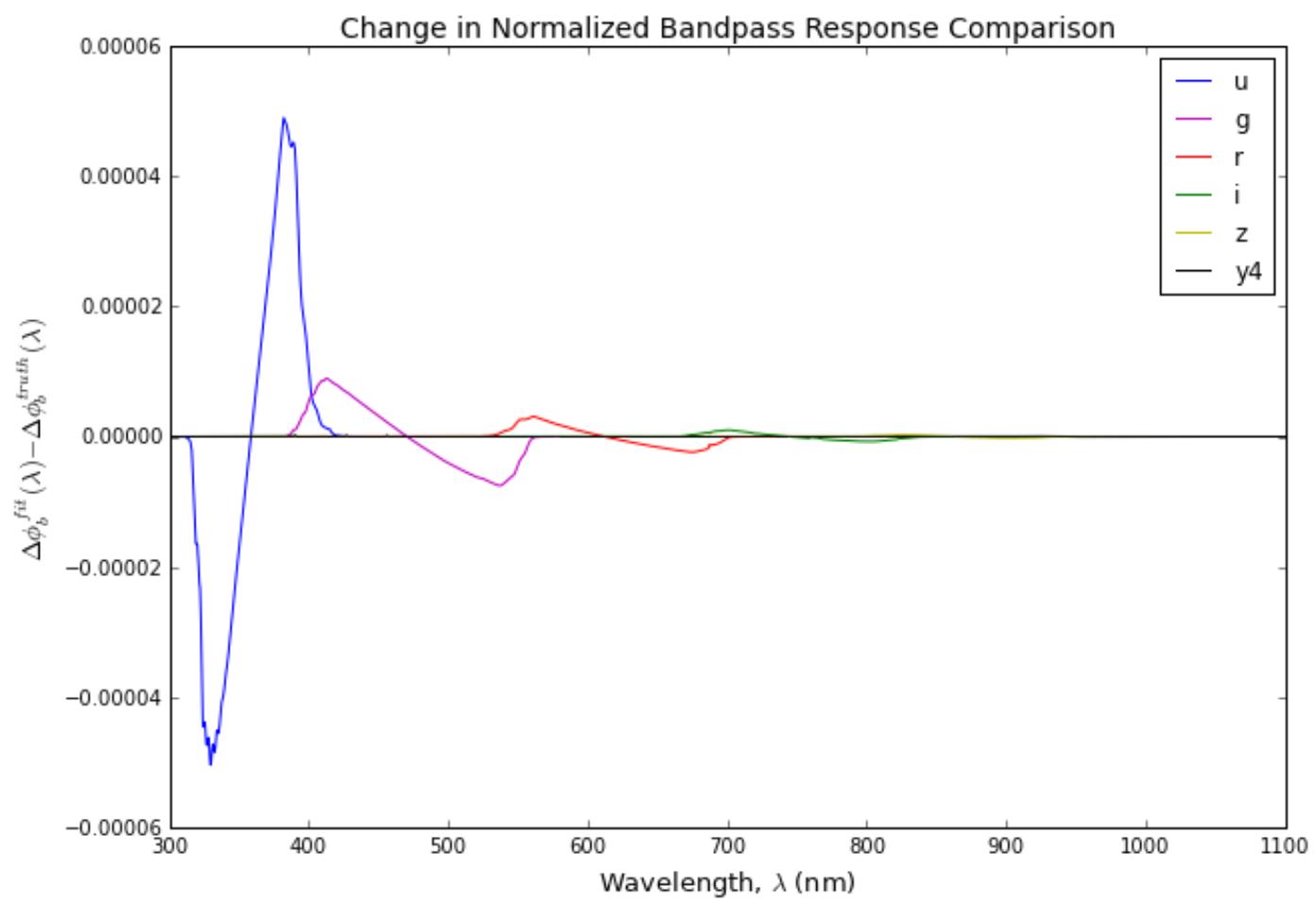
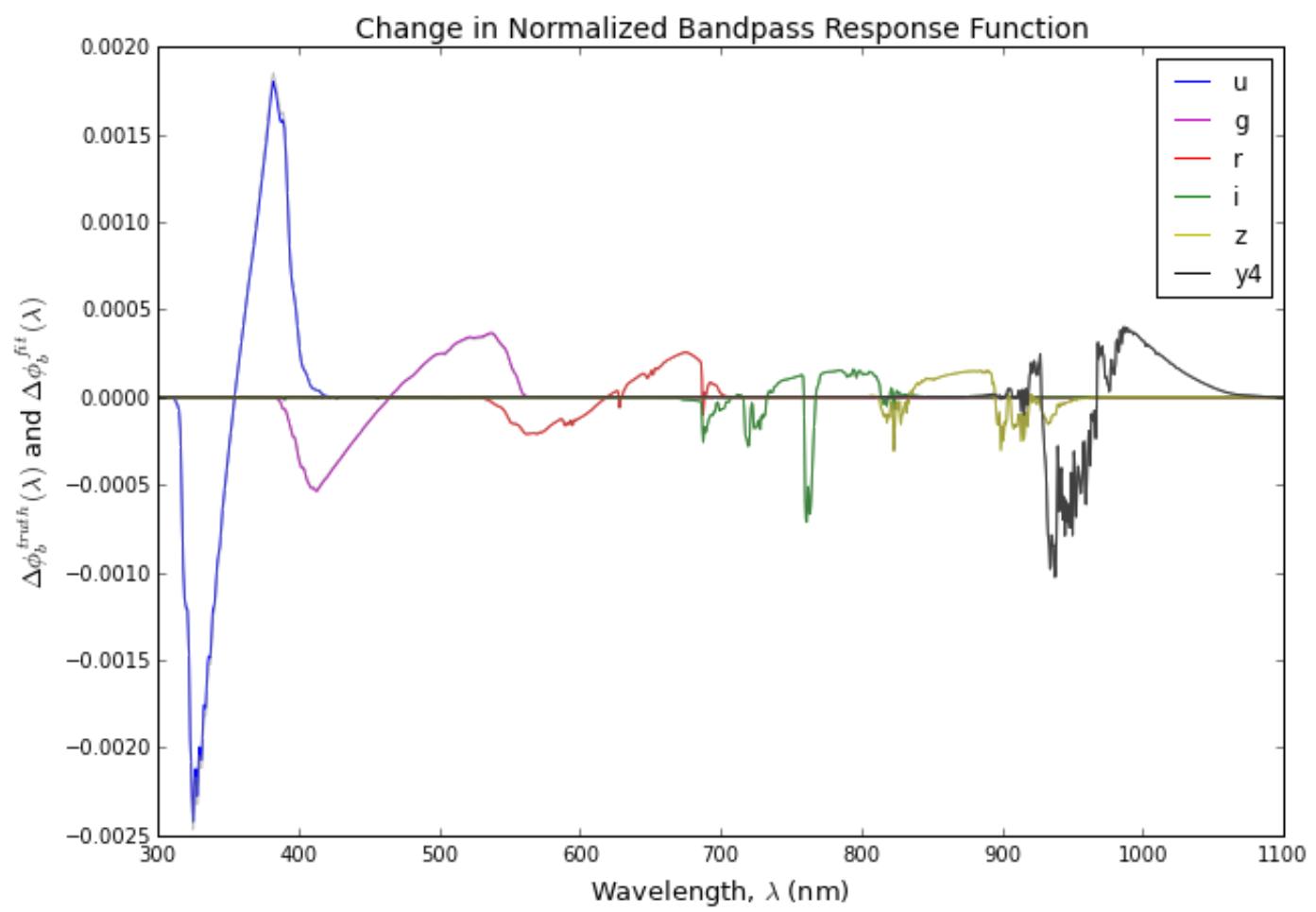
Override best fit parameters (Filter, Alpha, dG):
u 0.50 20.00
g 0.50 16.80
r 0.50 12.80
i 0.50 12.00
z 0.50 12.00
y4 0.50 12.00

```

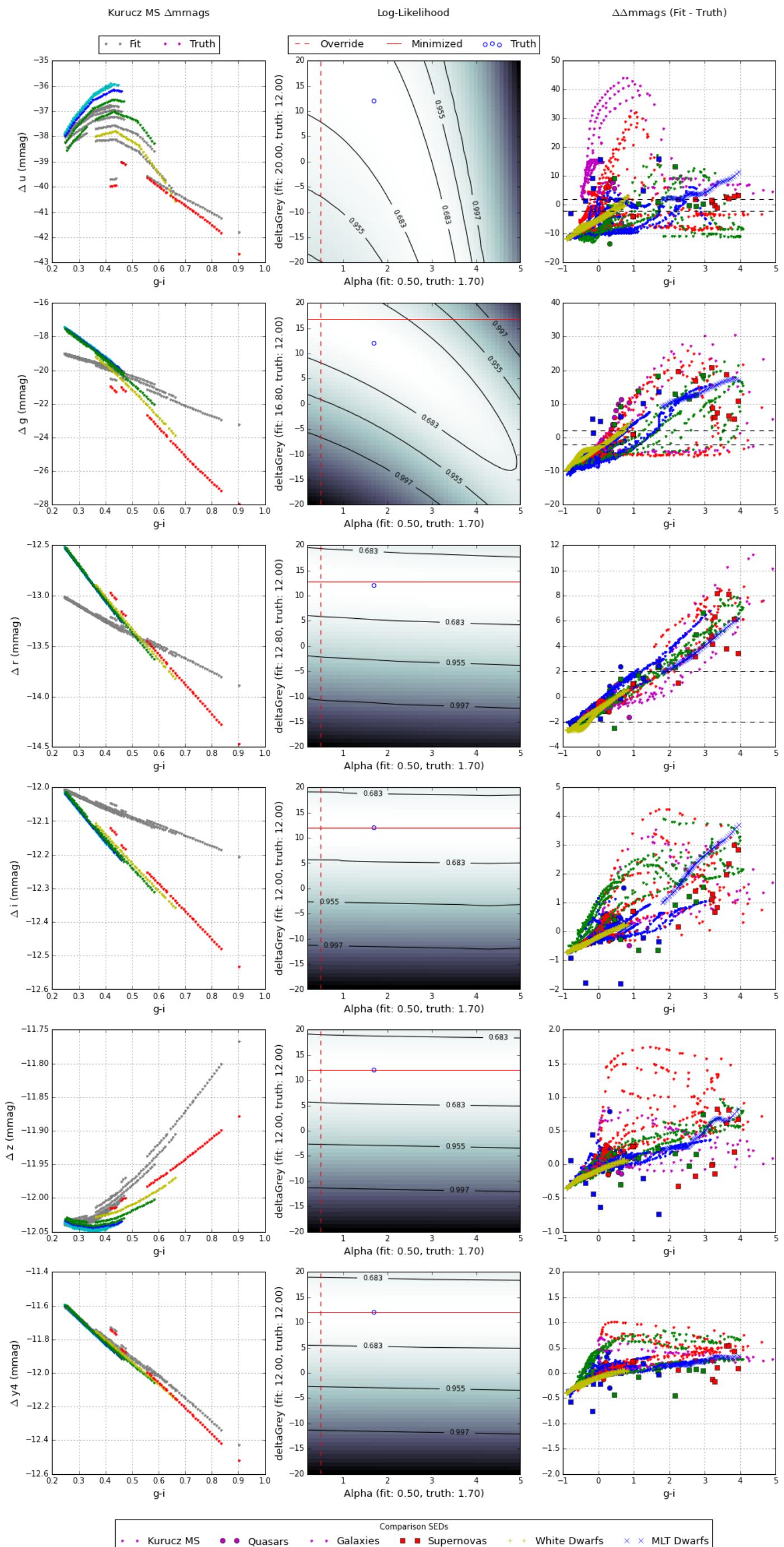


$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



```
In [20]: deltaGreyLimitPlot('Alpha',deltaGreyBins=50)
```

```
Computing nonlinear regression for Alpha.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Alpha: 1.7

Fitting for Alpha between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_max_dGTest_giCut_OR200.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

Best fit parameters (Filter, Alpha, dG, logL, Chi-Squared):
u 1.77 11.02 0.719168332052 1.4383366641
g 1.77 11.84 0.599669685056 1.19933937011
r 1.96 11.84 0.126387487559 0.252774975117
i 4.90 11.84 0.20181862691 0.403637253821
z 5.00 11.84 0.195408400408 0.390816800816
y4 5.00 11.84 0.134257382519 0.268514765039

Override best fit parameters (Filter, Alpha, dG):
u 2.00 7.76
g 2.00 10.20
r 2.00 11.84
i 2.00 11.84
z 2.00 11.84
y4 2.00 11.84

Computing nonlinear regression for Alpha.
Observed atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Observed atmosphere airmass: 2.0
Standard atmosphere parameters: [1.0, 1.0, 1.0, 1.0, 1.0, 1.7]
Standard atmosphere airmass: 1.2
Observed atmosphere parameter for Alpha: 1.7
```

```

Fitting for Alpha between 0.20 and 5.00 in 50 bins.
Fitting for deltaGrey between -20.00 and 20.00 mmags in 50 bins.

Regression SEDs: 747 Kurucz MS SEDs between 0.20 and 5.00 g-i color.

Regressing 2500 parameter combinations per filter...
Magnitude Error: 5.0 mmags

Override triggered...
Override value detected, proceeding with deltaGrey best-fit minimization at new component best-fit value...

Calculating best fit parameters for u filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_u_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for u filter.
Saved Chi-Squared at best fit deltaGrey for u filter.
Completed u filter.

Calculating best fit parameters for g filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_g_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for g filter.
Saved Chi-Squared at best fit deltaGrey for g filter.
Completed g filter.

Calculating best fit parameters for r filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_r_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for r filter.
Saved Chi-Squared at best fit deltaGrey for r filter.
Completed r filter.

Calculating best fit parameters for i filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_i_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for i filter.
Saved Chi-Squared at best fit deltaGrey for i filter.
Completed i filter.

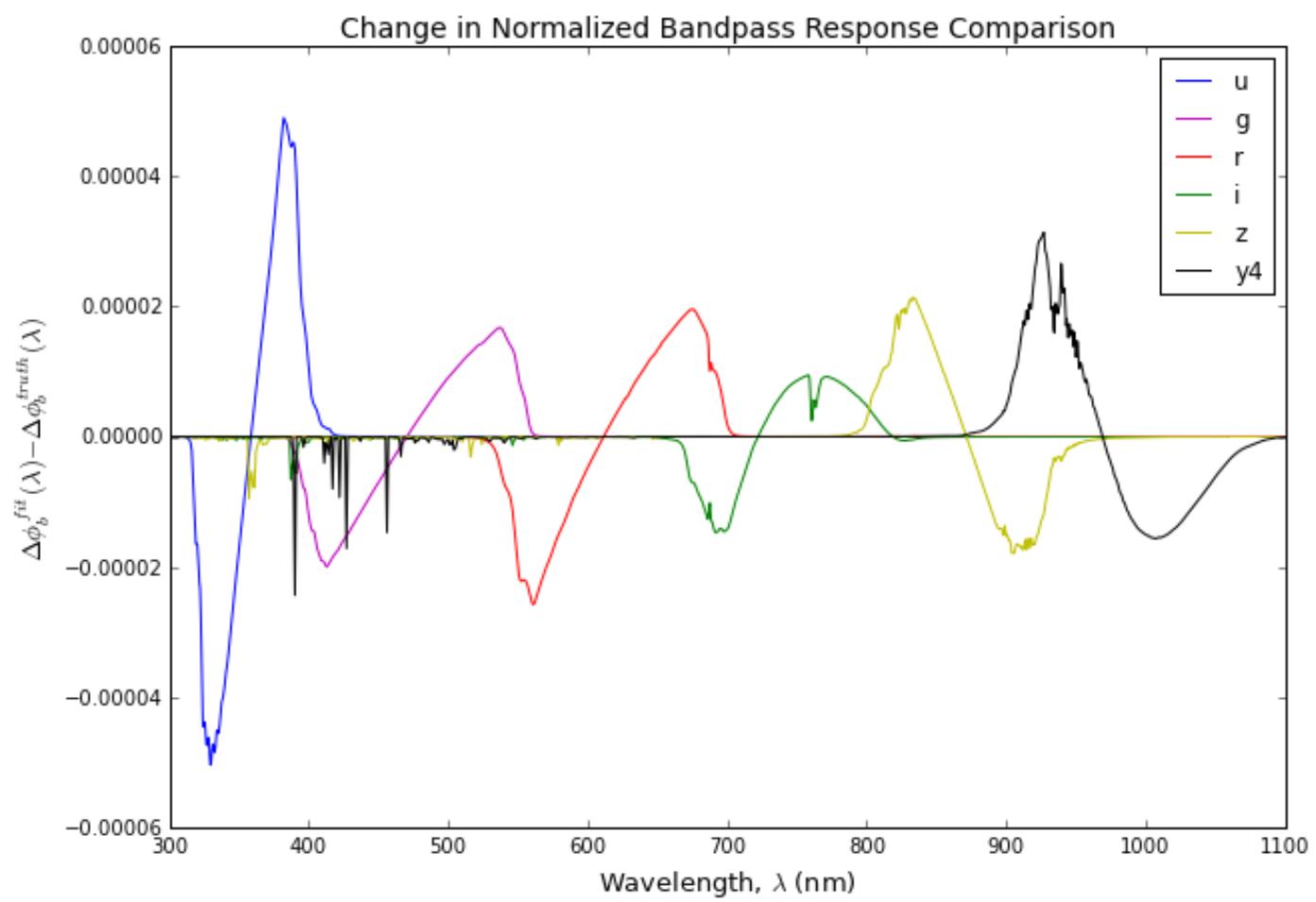
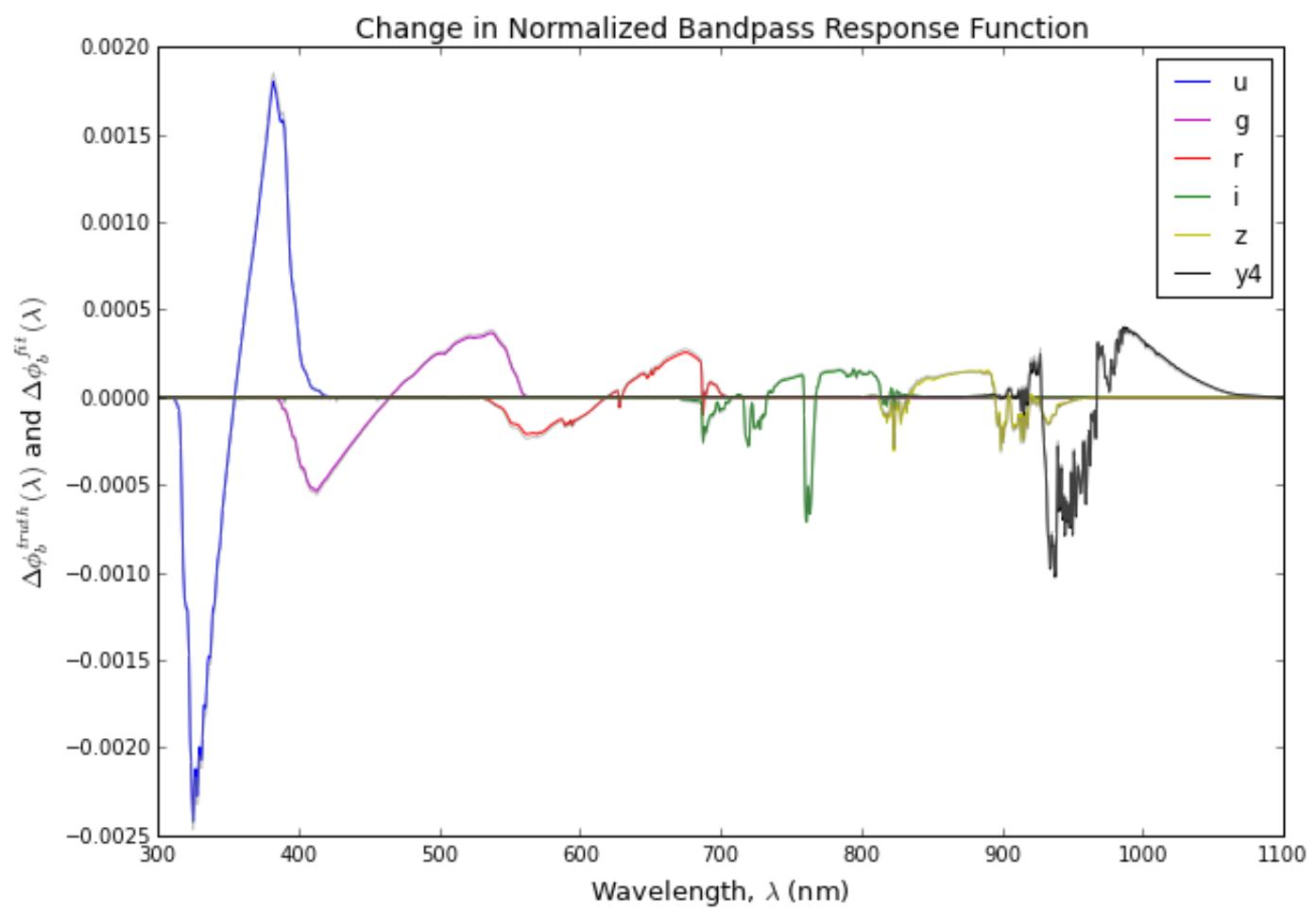
Calculating best fit parameters for z filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_z_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for z filter.
Saved Chi-Squared at best fit deltaGrey for z filter.
Completed z filter.

Calculating best fit parameters for y4 filter...
@pickle_results: computing results and saving to 'pickles/X20_P101010101017_Alpha_dG_XSTD12_DG120_DGR-2020_E5_mss_y4_50dgb_50b_min_dGTest_giCut_OR50.pkl'
Saved LogL at best fit deltaGrey for y4 filter.
Saved Chi-Squared at best fit deltaGrey for y4 filter.
Completed y4 filter.

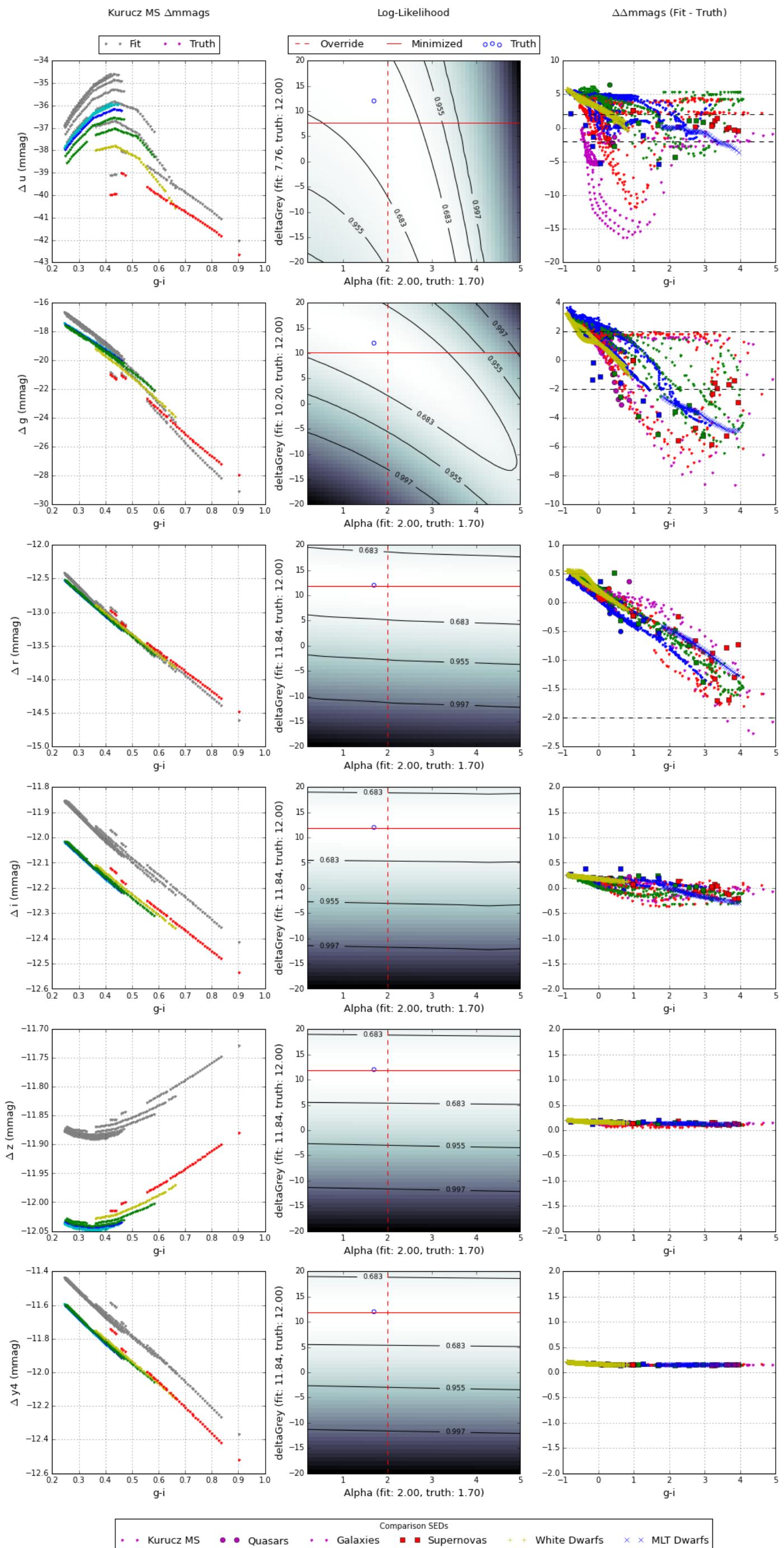
Best fit parameters (Filter, Alpha, dG, logL, Chi-Squared):
u 1.77 11.02 0.719168332052 1.4383366641
g 1.77 11.84 0.599669685056 1.19933937011
r 1.96 11.84 0.126387487559 0.252774975117
i 4.90 11.84 0.20181862691 0.403637253821
z 5.00 11.84 0.195408400408 0.390816800816
y4 5.00 11.84 0.134257382519 0.268514765039

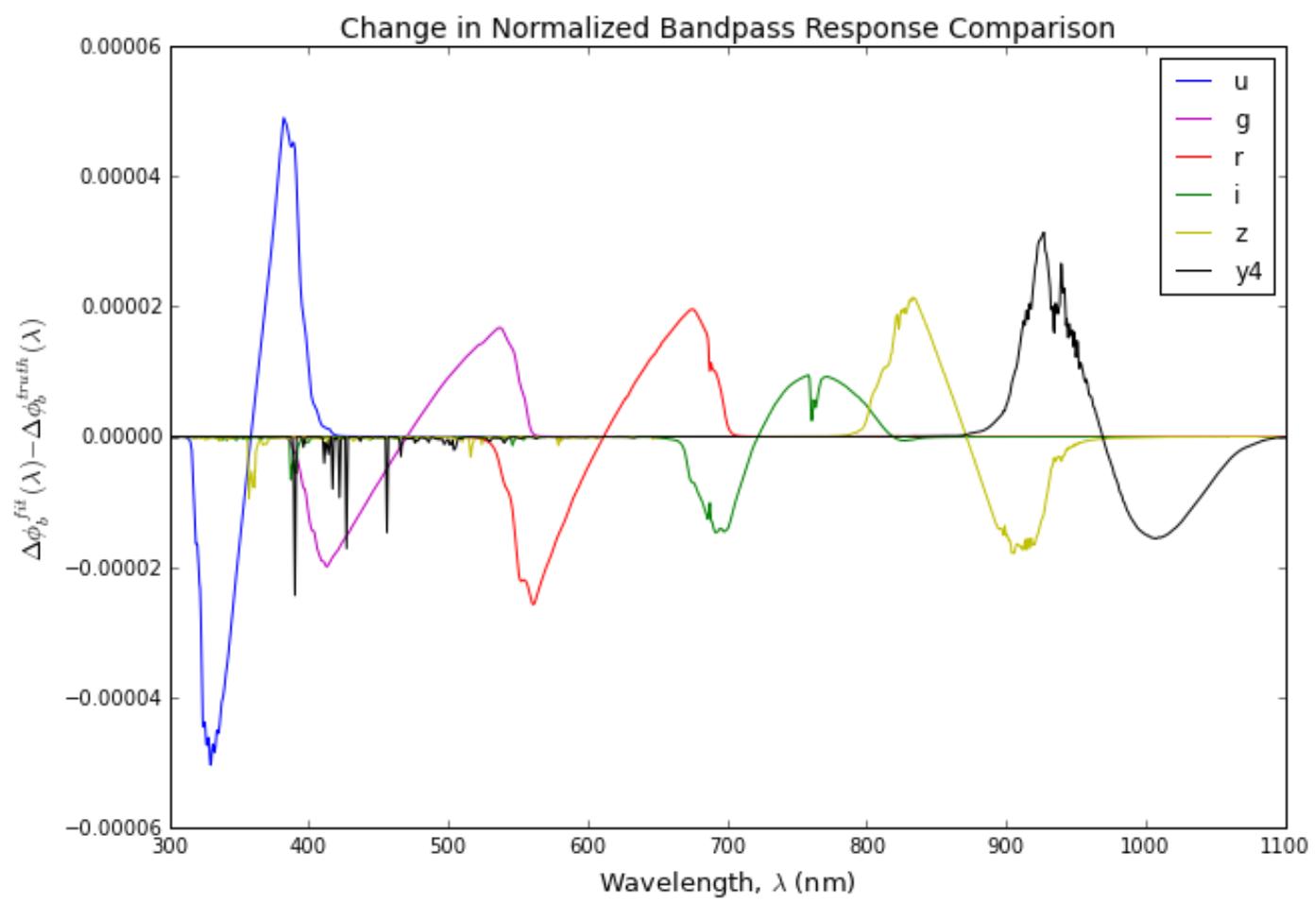
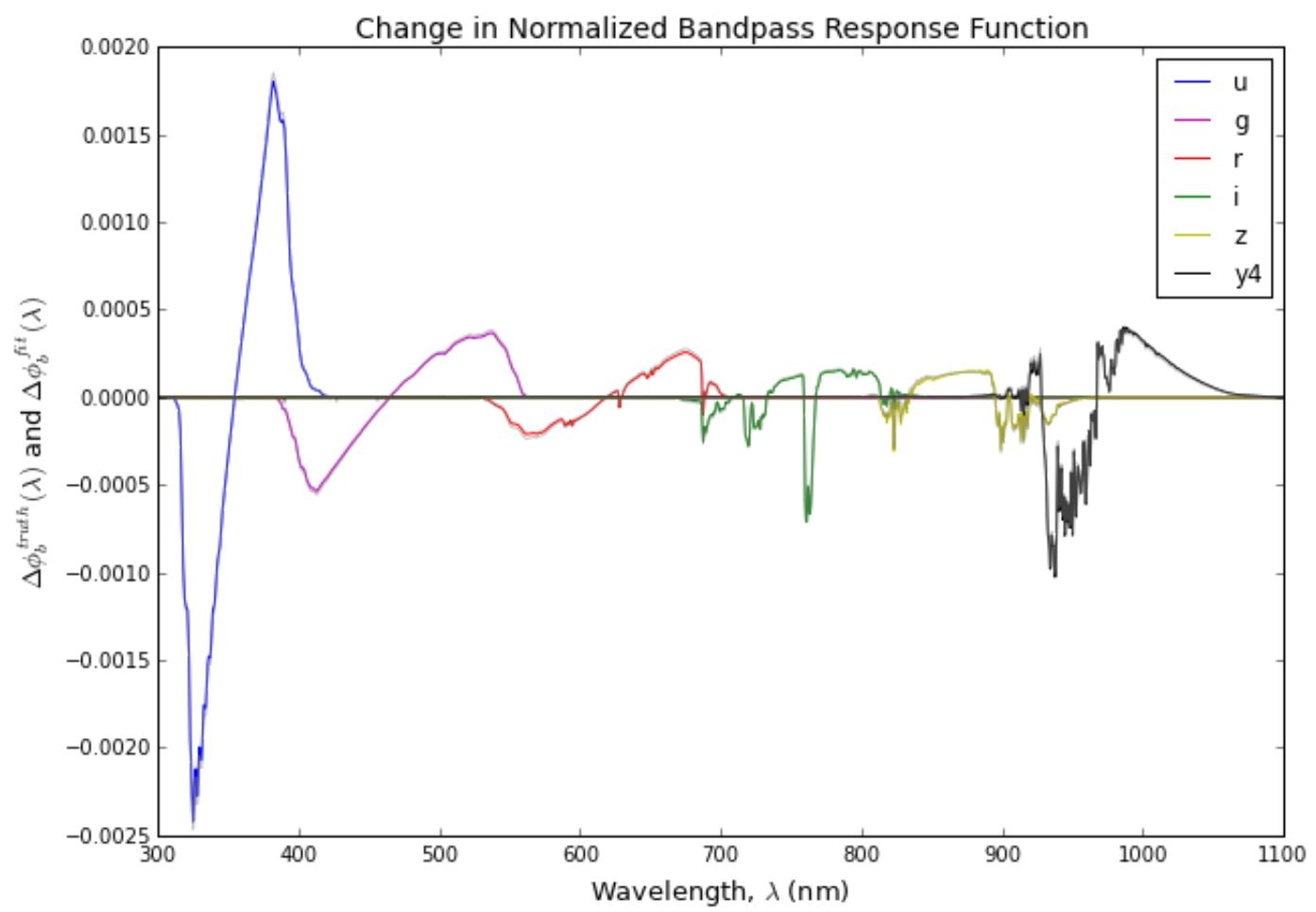
Override best fit parameters (Filter, Alpha, dG):
u 0.50 20.00
g 0.50 16.73
r 0.50 12.65
i 0.50 11.84
z 0.50 11.84
y4 0.50 11.84

```

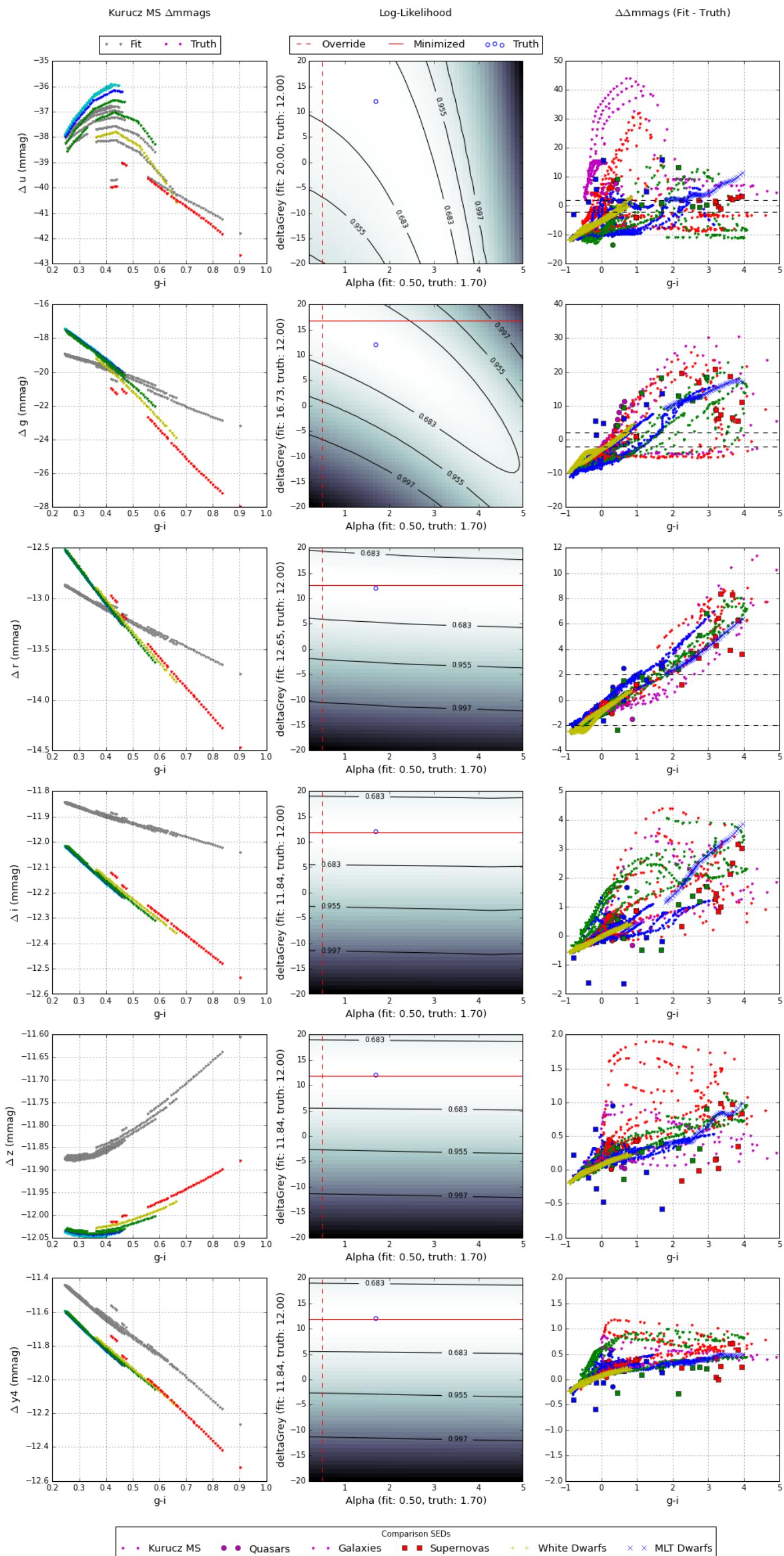


$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )





$\Delta\text{mmags}$ , Regression Contours,  $\Delta\Delta\text{mmags}$  for each LSST filter ( $\delta\text{Grey}: 12.0$ )



In [ ]: