ctools - Bug #1503

Pull distributions of stacked analysis look shifted

07/03/2015 10:03 AM - Buehler Rolf

Status:	Closed	**Start date:**	07/03/2015	
Priority:	Normal	**Due date:**		
Assigned To:	Knödlseder Jürgen	**% Done:**	100%	
Category:		**Estimated time:**	0.00 hour	
Target version:	1.0.0			

Description

I modyfied cspull to handle stacked observations. Using it to simulate and fit three observations, containing the Crab and a CTA background as sources, results in the following pull distributions:

The seems to be an atribution of source photons to the background. The used observations and source models are attached. I will push the modified cspull after some small further improvements to it.

History

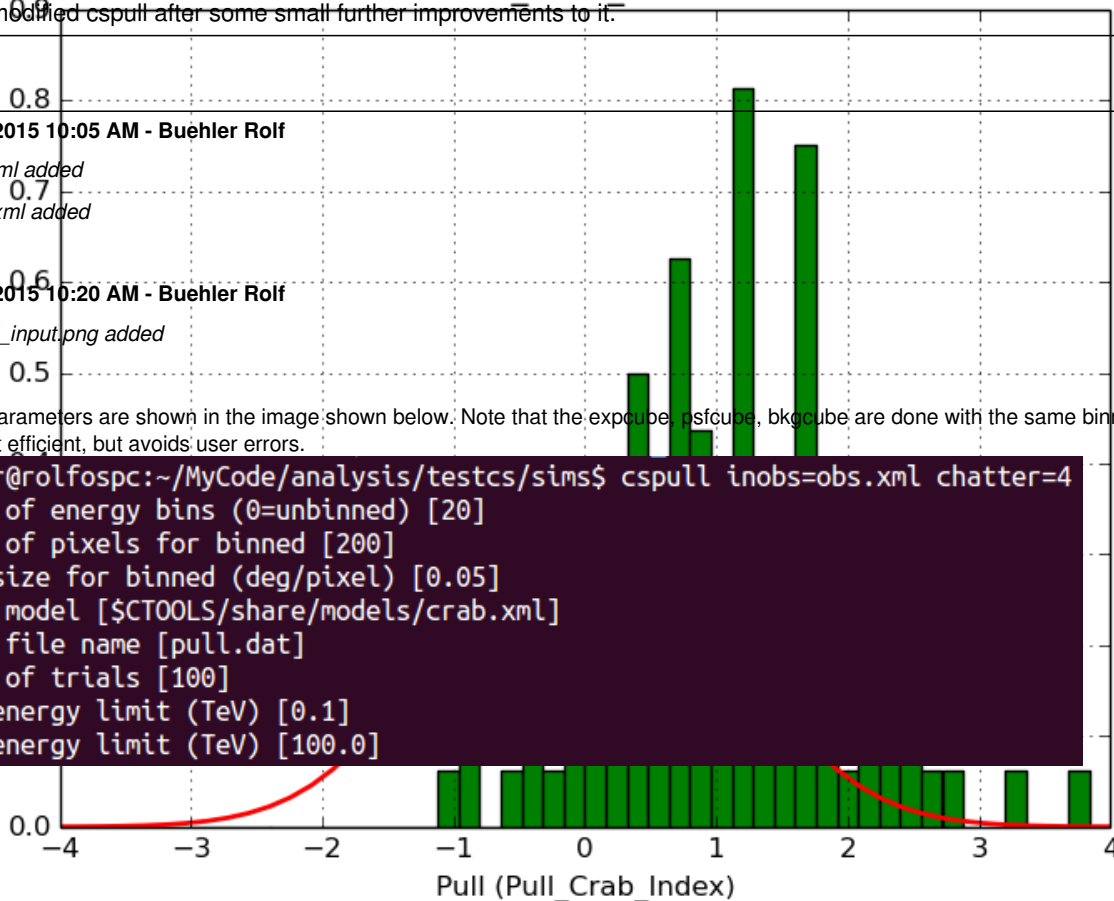**#1 - 07/03/2015 10:05 AM - Buehler Rolf**

- File obs.xml added

- File crab.xml added

#2 - 07/03/2015 10:20 AM - Buehler Rolf

- File cspull_input.png added

The input parameters are shown in the image shown below. Note that the expcube, psfcube, bkgcube are done with the same binning as the ctscube, which is not efficient, but avoids user errors.

```
buehler@rolfospc:~/MyCode/analysis/testcs/sims$ cspull inobs=obs.xml chatter=4
Number of energy bins (0=unbinned) [20]
Number of pixels for binned [200]
Pixel size for binned (deg/pixel) [0.05]
Source model [$CTOOLS/share/models/crab.xml]
Output file name [pull.dat]
Number of trials [100]
Lower energy limit (TeV) [0.1]
Upper energy limit (TeV) [100.0]
```


#3 - 07/03/2015 10:30 AM - Buehler Rolf

- File cspull_input.png added

#4 - 07/03/2015 12:34 PM - Buehler Rolf

- File cspull_input.png added

- File Pull_BackgroundModel_Index.png added

- File Pull_BackgroundModel_Prefactor.png added

- File Pull_Crab_Index.png added

- File Pull_Crab_Prefactor.png added

I fixed a bug in my cspull version. This changed the distributions, but they are now even more offset for the background (I updated the figures, so the plots above show the correct plots). I will push my cspull modifications into devel.
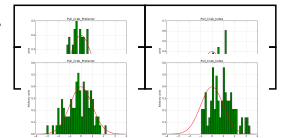
#5 - 07/03/2015 04:09 PM - Knödlseder Jürgen

- File pull_b20_prefactor.png added

- File pull_b20_index.png added

- File pull_b40_index.png added

- File pull_b40_prefactor.png added

- File pull_b40_bkg_prefactor.png added

- File pull_b40_bkg_index.png added

I integrated the modified cspull script into ctools. Please note that I have removed the expcube, psfcube and bkgcube parameters from cspull as they were in fact not used. You need to clean-up your pfiles folder so that you don't have an old version with these parameters lurking around.

It turned out that the background cube model indeed had the livetime correction twice. The background cube rates are counts/livetime, but then there was an additional correction in the GCTAModelCubeBackground code. I removed that. The background pulls are now much more reasonable.

Below a comparison of 20 energy bins (top row) to 40 energy bins (bottom row). This does not seem to impact the results.

I also provide for reference the background model spectral parameter pull histograms for 40 bins.

Pull_BackgroundModel_Prefactor

Pull_BackgroundModel_Index

Note that the fitting shows always a residual in Npred. Not clear whether this is a bad Npred computation, or whether this is actually a problem in the fit (which seems to converge):

```
2015-07-03T14:10:40: +=================================+
2015-07-03T14:10:40: | Maximum likelihood optimisation |              |
2015-07-03T14:10:40: +=================================+
2015-07-03T14:10:41: >Iteration   0: -logL=47448.077, Lambda=1.0e-03
2015-07-03T14:10:42: >Iteration   1: -logL=47447.780, Lambda=1.0e-03, delta=0.298, max(|grad|)=7186008816.917294 [Index:7]
2015-07-03T14:10:43: >Iteration   2: -logL=47447.779, Lambda=1.0e-04, delta=0.000, max(|grad|)=7186004339.309735 [Index:7]
2015-07-03T14:10:43:
2015-07-03T14:10:43: +================+
2015-07-03T14:10:43: | Curvature matrix |
2015-07-03T14:10:43: +================+
2015-07-03T14:10:43: === GMatrixSparse ===
2015-07-03T14:10:43:  Number of rows ............: 10
2015-07-03T14:10:43:  Number of columns .........: 10
2015-07-03T14:10:43:  Number of nonzero elements : 16
2015-07-03T14:10:43:  Number of allocated cells .: 528
2015-07-03T14:10:43:  Memory block size .........: 512
2015-07-03T14:10:43:  Sparse matrix fill ........: 0.16
2015-07-03T14:10:43:  Pending element ...........: 0
2015-07-03T14:10:43:  Fill stack size ...........: 0 (none)
2015-07-03T14:10:43:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T14:10:43:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T14:10:43:  0, 0, 188.146, -286.823, 0, 0, 1.12635e+06, 3.47759e+06, 0, 0
2015-07-03T14:10:43:  0, 0, -286.823, 8616.04, 0, 0, -2.7315e+07, -9.1871e+07, 0, 0
2015-07-03T14:10:43:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T14:10:43:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T14:10:43:  0, 0, 1.12635e+06, -2.7315e+07, 0, 0, 1.63675e+17, 5.60271e+17, 0, 0
```

```
2015-07-03T14:10:43:  0, 0, 3.47759e+06, -9.1871e+07, 0, 0, 5.60271e+17, 1.93156e+18, 0, 0
2015-07-03T14:10:43:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T14:10:43:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T14:10:43:
2015-07-03T14:10:43: +=======================================+
2015-07-03T14:10:43: | Maximum likelihood optimization results |
2015-07-03T14:10:43: +=======================================+
2015-07-03T14:10:43: === GOptimizerLM ===
2015-07-03T14:10:43:  Optimized function value ..: 47447.779
2015-07-03T14:10:43:  Absolute precision ........: 0.005
2015-07-03T14:10:43:  Acceptable value decrease .: 2
2015-07-03T14:10:43:  Optimization status .......: converged
2015-07-03T14:10:43:  Number of parameters ......: 10
2015-07-03T14:10:43:  Number of free parameters .: 4
2015-07-03T14:10:43:  Number of iterations ......: 2
2015-07-03T14:10:43:  Lambda ....................: 1e-05
2015-07-03T14:10:43:  Maximum log likelihood ....: -47447.779
2015-07-03T14:10:43:  Observed events  (Nobs) ...: 39586.000
2015-07-03T14:10:43:  Predicted events (Npred) ..: 37661.415 (Nobs - Npred = 1924.59)
```

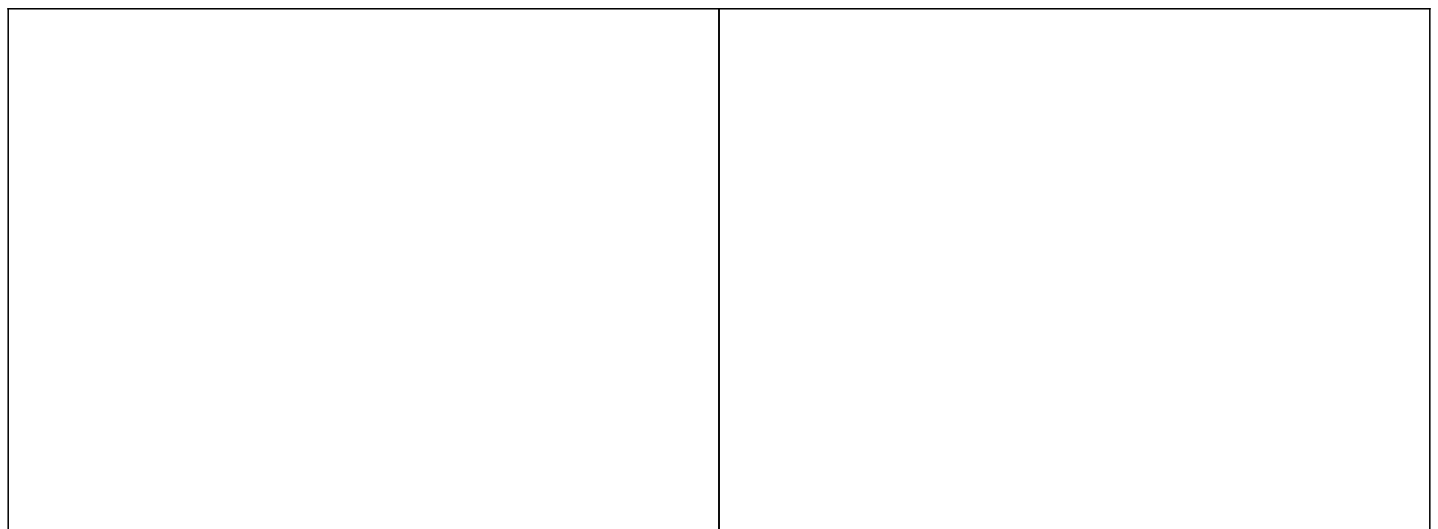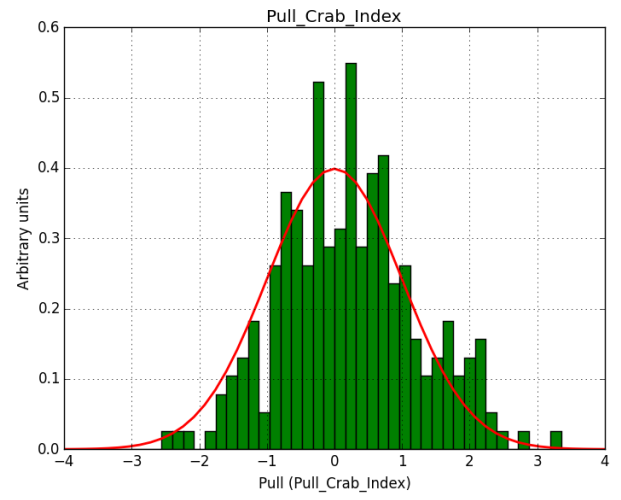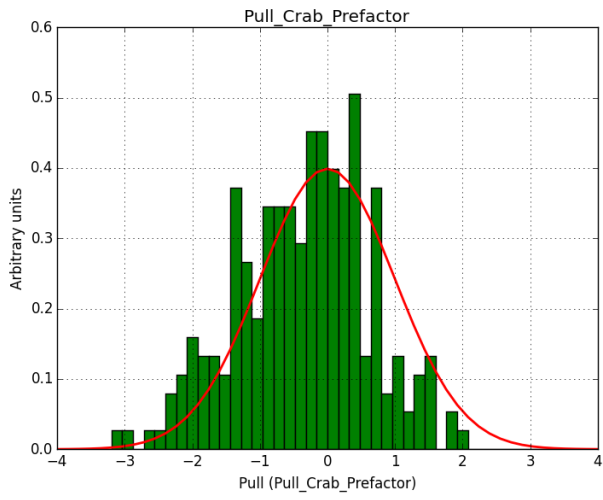**#6 - 07/03/2015 06:04 PM - Knödlseder Jürgen**

- File pull_b20_prefactor_binsz002.png added

- File pull_b20_index_binsz002.png added

There is a dependence on the size of the counts map. The original runs were for a 100 x 100 pixel map with 0.05 deg pixels, hence covering an area of 5 x 5 deg.

I tried a smaller map with a binsize of 0.02 deg and still 100 x 100 pixels, covering 2 x 2 deg.

There is still an issue with the Npred value:

```
2015-07-03T16:02:29: +=======================================+
2015-07-03T16:02:29: | Maximum likelihood optimization results |
2015-07-03T16:02:29: +=======================================+
2015-07-03T16:02:29: === GOptimizerLM ===
2015-07-03T16:02:29:  Optimized function value ..: 16666.857
2015-07-03T16:02:29:  Absolute precision ........: 0.005
2015-07-03T16:02:29:  Acceptable value decrease .: 2
2015-07-03T16:02:29:  Optimization status .......: converged
2015-07-03T16:02:29:  Number of parameters ......: 10
2015-07-03T16:02:29:  Number of free parameters .: 4
2015-07-03T16:02:29:  Number of iterations ......: 15
2015-07-03T16:02:29:  Lambda ....................: 0.01
2015-07-03T16:02:29:  Maximum log likelihood ....: -16666.857
```

2015-07-03T16:02:29: Observed events (Nobs) ...: 16452.000
2015-07-03T16:02:29: Predicted events (Npred) ..: 15032.236 (Nobs - Npred = 1419.76)

#7 - 07/03/2015 06:04 PM - Knödlseder Jürgen

- Status changed from New to In Progress

- Assigned To set to Knödlseder Jürgen

- % Done changed from 0 to 10

#8 - 07/03/2015 06:24 PM - Knödlseder Jürgen

I did another test without offset between the runs, hence 3 observations with the same pointing (Crab) and an ROI of 5 deg.

I used 20 bins in energy and 100 x 100 pixels of 0.05 deg/pixel, i.e. a 5 x 5 deg counts map. Below the resulting pull distribution. There is still the bias in the index. This seems to be inherent to large maps.

The Npred value is also too large:

2015-07-03T16:23:52: === GOptimizerLM ===
2015-07-03T16:23:52: Optimized function value ..: 10240.417
2015-07-03T16:23:52: Absolute precision ....: 0.005
2015-07-03T16:23:52: Acceptable value decrease .: 2
2015-07-03T16:23:52: Optimization status ....: converged
2015-07-03T16:23:52: Number of parameters ......: 10
2015-07-03T16:23:52: Number of free parameters .: 4
2015-07-03T16:23:52: Number of iterations ......: 6
2015-07-03T16:23:52: Lambda ....: 0.1
2015-07-03T16:23:52: Maximum log likelihood ....: -10240.417
2015-07-03T16:23:52: Observed events (Nobs) ...: 45473.000
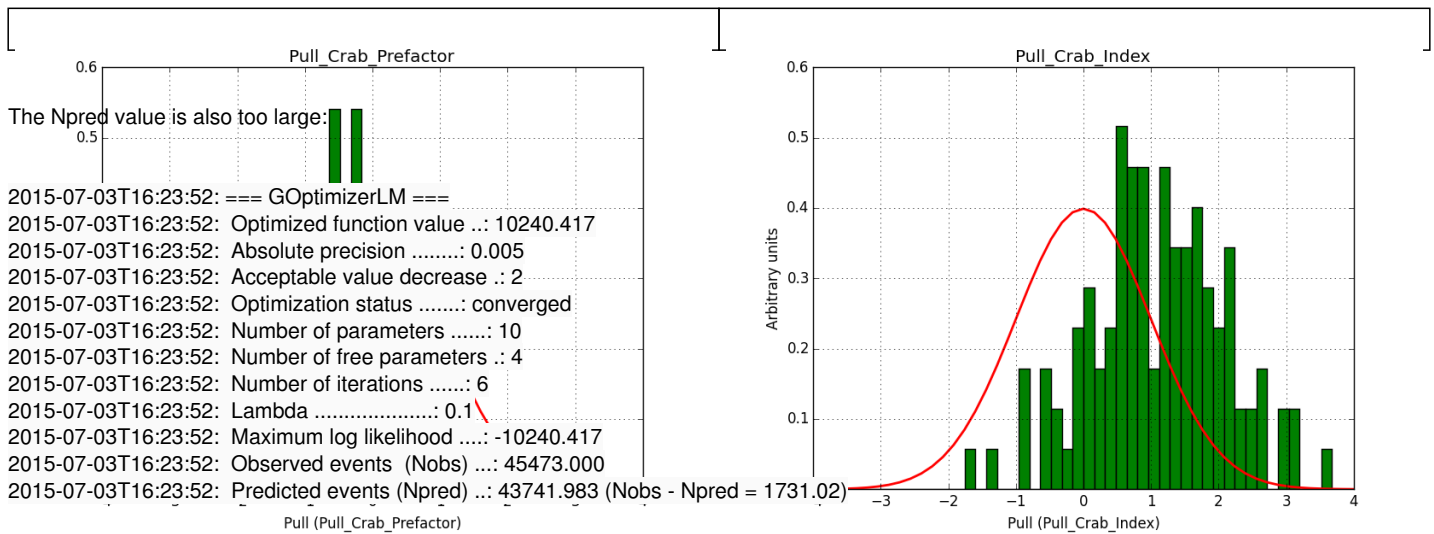2015-07-03T16:23:52: Predicted events (Npred) ..: 43741.983 (Nobs - Npred = 1731.02)

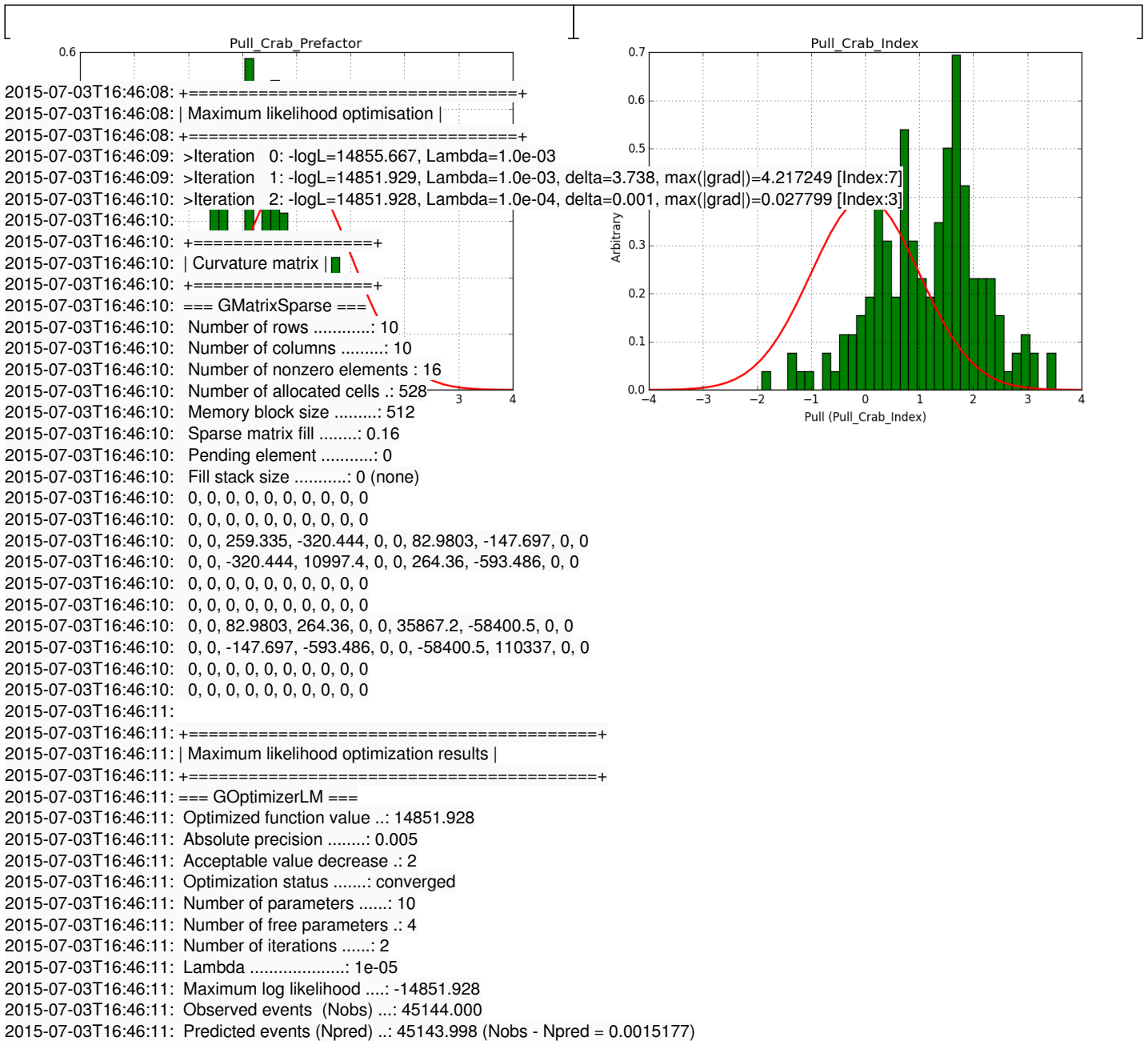### #9 - 07/03/2015 06:41 PM - Knödlseder Jürgen

- File pull_b20_id_index.png added

- File pull_b20_id_prefactor.png added

#10 - 07/03/2015 06:46 PM - Knödlseder Jürgen

- File pull_b20_single_prefactor.png added

- File pull_b20_single_index.png added

For comparison, I did the same simulation, but now using a classical binned analysis. The difference is now that the response information is taken from the original IRFs, and not the stacked versions. The results show the same shifts, but the Npred number is now correct. Note that the fit gradients are also much smaller.

I'm wondering whether there are in fact two different problems to understand.


```
2015-07-03T16:46:08: +==================================+
2015-07-03T16:46:08: | Maximum likelihood optimisation |
2015-07-03T16:46:08: +==================================+
2015-07-03T16:46:09:  >Iteration   0: -logL=14855.667, Lambda=1.0e-03
2015-07-03T16:46:09:  >Iteration   1: -logL=14851.929, Lambda=1.0e-03, delta=3.738, max(|grad|)=4.217249 [Index:7]
2015-07-03T16:46:10:  >Iteration   2: -logL=14851.928, Lambda=1.0e-04, delta=0.001, max(|grad|)=0.027799 [Index:3]
2015-07-03T16:46:10:
2015-07-03T16:46:10: +==================+
2015-07-03T16:46:10: | Curvature matrix |
2015-07-03T16:46:10: +==================+
2015-07-03T16:46:10: === GMatrixSparse ===
2015-07-03T16:46:10:  Number of rows ............: 10
2015-07-03T16:46:10:  Number of columns .........: 10
2015-07-03T16:46:10:  Number of nonzero elements : 16
2015-07-03T16:46:10:  Number of allocated cells .: 528
2015-07-03T16:46:10:  Memory block size .........: 512
2015-07-03T16:46:10:  Sparse matrix fill ........: 0.16
2015-07-03T16:46:10:  Pending element ...........: 0
2015-07-03T16:46:10:  Fill stack size ...........: 0 (none)
2015-07-03T16:46:10:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T16:46:10:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T16:46:10:  0, 0, 259.335, -320.444, 0, 0, 82.9803, -147.697, 0, 0
2015-07-03T16:46:10:  0, 0, -320.444, 10997.4, 0, 0, 264.36, -593.486, 0, 0
2015-07-03T16:46:10:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T16:46:10:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T16:46:10:  0, 0, 82.9803, 264.36, 0, 0, 35867.2, -58400.5, 0, 0
2015-07-03T16:46:10:  0, 0, -147.697, -593.486, 0, 0, -58400.5, 110337, 0, 0
2015-07-03T16:46:10:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T16:46:10:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T16:46:11:
2015-07-03T16:46:11: +=======================================+
2015-07-03T16:46:11: | Maximum likelihood optimization results |
2015-07-03T16:46:11: +=======================================+
2015-07-03T16:46:11: === GOptimizerLM ===
2015-07-03T16:46:11:  Optimized function value ..: 14851.928
2015-07-03T16:46:11:  Absolute precision ........: 0.005
2015-07-03T16:46:11:  Acceptable value decrease .: 2
2015-07-03T16:46:11:  Optimization status .......: converged
2015-07-03T16:46:11:  Number of parameters ......: 10
2015-07-03T16:46:11:  Number of free parameters .: 4
2015-07-03T16:46:11:  Number of iterations ......: 2
2015-07-03T16:46:11:  Lambda ....................: 1e-05
2015-07-03T16:46:11:  Maximum log likelihood ....: -14851.928
2015-07-03T16:46:11:  Observed events  (Nobs) ...: 45144.000
2015-07-03T16:46:11:  Predicted events (Npred) ..: 45143.998 (Nobs - Npred = 0.0015177)
```

#11 - 07/03/2015 11:26 PM - Knödlseder Jürgen

- File residual.fits.gz added

I checked the difference between a model map computed from the IRFs and a model map computed from the cube response, for the same input parameters and observation definition (1800 seconds, Crab as a single source).

I used the following script to compute the residual map:

```
import gammalib

map_irf     = gammalib.GSkyMap("modcube_irf.fits")
map_stacked = gammalib.GSkyMap("modcube_stacked.fits")

residual = (map_irf - map_stacked) / map_irf

residual.save("residual.fits", True)
```

There is a ring-like residual at the position of the Crab, but the amplitude of this residual in individual pixels does not exceed 1-2%. Attached the generated FITS file (attachment:residual.fits.gz). The response computation is thus consistent.

#12 - 07/03/2015 11:51 PM - Knödlseder Jürgen

- % Done changed from 10 to 50

I finally found the bug in the Npred computation: when removing the deadtime correction I also removed some renormalization of the gradients that was needed to get their right amplitude. The gradients of the background model were thus wrong. This is now corrected.

For reference, here the fit when using the IRF computation for the binned analysis:

```
2015-07-03T21:32:26: +=================================+
2015-07-03T21:32:26: | Maximum likelihood optimisation |
2015-07-03T21:32:26: +=================================+
2015-07-03T21:32:28: >Iteration   0: -logL=39901.606, Lambda=1.0e-03
2015-07-03T21:32:29: >Iteration   1: -logL=39899.679, Lambda=1.0e-03, delta=1.928, max(|grad|)=6.256420 [Index:7]
2015-07-03T21:32:31: >Iteration   2: -logL=39899.678, Lambda=1.0e-04, delta=0.001, max(|grad|)=-0.059539 [Index:3]
2015-07-03T21:32:31:
2015-07-03T21:32:31: +=================+
2015-07-03T21:32:31: | Curvature matrix |
2015-07-03T21:32:31: +=================+
2015-07-03T21:32:31: === GMatrixSparse ===
2015-07-03T21:32:31:  Number of rows ............: 10
2015-07-03T21:32:31:  Number of columns .........: 10
2015-07-03T21:32:31:  Number of nonzero elements : 16
2015-07-03T21:32:31:  Number of allocated cells .: 528
2015-07-03T21:32:31:  Memory block size .........: 512
2015-07-03T21:32:31:  Sparse matrix fill ........: 0.16
2015-07-03T21:32:31:  Pending element ...........: 0
2015-07-03T21:32:31:  Fill stack size ...........: 0 (none)
2015-07-03T21:32:31:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:32:31:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
```

```
2015-07-03T21:32:31:   0, 0, 83.7417, -95.0523, 0, 0, 25.4407, -46.9068, 0, 0
2015-07-03T21:32:31:   0, 0, -95.0523, 3812.11, 0, 0, 89.0835, -199.93, 0, 0
2015-07-03T21:32:31:   0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:32:31:   0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:32:31:   0, 0, 25.4407, 89.0835, 0, 0, 9879.25, -16499.1, 0, 0
2015-07-03T21:32:31:   0, 0, -46.9068, -199.93, 0, 0, -16499.1, 31620.7, 0, 0
2015-07-03T21:32:31:   0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:32:31:   0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:32:32:
2015-07-03T21:32:32: +=======================================+
2015-07-03T21:32:32: | Maximum likelihood optimization results |
2015-07-03T21:32:32: +=======================================+
2015-07-03T21:32:32: === GOptimizerLM ===
2015-07-03T21:32:32:  Optimized function value ..: 39899.678
2015-07-03T21:32:32:  Absolute precision ........: 0.005
2015-07-03T21:32:32:  Acceptable value decrease .: 2
2015-07-03T21:32:32:  Optimization status .......: converged
2015-07-03T21:32:32:  Number of parameters ......: 10
2015-07-03T21:32:32:  Number of free parameters .: 4
2015-07-03T21:32:32:  Number of iterations ......: 2
2015-07-03T21:32:32:  Lambda ....................: 1e-05
2015-07-03T21:32:32:  Maximum log likelihood ....: -39899.678
2015-07-03T21:32:32:  Observed events  (Nobs) ...: 13359.000
2015-07-03T21:32:32:  Predicted events (Npred) ..: 13358.998 (Nobs - Npred = 0.00151521)
2015-07-03T21:32:32: === GModels ===
2015-07-03T21:32:32:  Number of models ..........: 2
2015-07-03T21:32:32:  Number of parameters ......: 10
2015-07-03T21:32:32: === GModelSky ===
2015-07-03T21:32:32:  Name ......................: Crab
2015-07-03T21:32:32:  Instruments ...............: all
2015-07-03T21:32:32:  Instrument scale factors ..: unity
2015-07-03T21:32:32:  Observation identifiers ...: all
2015-07-03T21:32:32:  Model type ................: PointSource
2015-07-03T21:32:32:  Model components ..........: "SkyDirFunction" * "PowerLaw" * "Constant"
2015-07-03T21:32:32:  Number of parameters ......: 6
2015-07-03T21:32:32:  Number of spatial par's ...: 2
2015-07-03T21:32:32:   RA .......................: 83.6331 [-360,360] deg (fixed,scale=1)
2015-07-03T21:32:32:   DEC ......................: 22.0145 [-90,90] deg (fixed,scale=1)
2015-07-03T21:32:32:  Number of spectral par's ..: 3
2015-07-03T21:32:32:   Prefactor ................: 5.78359e-16 +/- 1.10915e-17 [1e-23,1e-13] ph/cm2/s/MeV (free,scale=1e-16,gradient)
2015-07-03T21:32:32:   Index ....................: -2.49196 +/- 0.0164354 [-0,-5]  (free,scale=-1,gradient)
2015-07-03T21:32:32:   PivotEnergy ..............: 300000 [10000,1e+09] MeV (fixed,scale=1e+06,gradient)
2015-07-03T21:32:32:  Number of temporal par's ..: 1
2015-07-03T21:32:32:   Normalization ............: 1 (relative value) (fixed,scale=1,gradient)
2015-07-03T21:32:32: === GCTAModelIrfBackground ===
2015-07-03T21:32:32:  Name ......................: CTABackgroundModel
2015-07-03T21:32:32:  Instruments ...............: CTA
2015-07-03T21:32:32:  Instrument scale factors ..: unity
2015-07-03T21:32:32:  Observation identifiers ...: all
2015-07-03T21:32:32:  Model type ................: "PowerLaw" * "Constant"
2015-07-03T21:32:32:  Number of parameters ......: 4
2015-07-03T21:32:32:  Number of spectral par's ..: 3
2015-07-03T21:32:32:   Prefactor ................: 1.01899 +/- 0.0280579 [0.001,1000] ph/cm2/s/MeV (free,scale=1,gradient)
2015-07-03T21:32:32:   Index ....................: 0.0189749 +/- 0.0156848 [-5,5]  (free,scale=1,gradient)
2015-07-03T21:32:32:   PivotEnergy ..............: 1e+06 [10000,1e+09] MeV (fixed,scale=1e+06,gradient)
2015-07-03T21:32:32:  Number of temporal par's ..: 1
2015-07-03T21:32:32:   Normalization ............: 1 (relative value) (fixed,scale=1,gradient)
```

And here the same for the stacked analysis (now is basically identical):

```
2015-07-03T21:48:48: +===============================+
2015-07-03T21:48:48: | Maximum likelihood optimisation |
2015-07-03T21:48:48: +===============================+
2015-07-03T21:48:49: >Iteration   0: -logL=39901.545, Lambda=1.0e-03
2015-07-03T21:48:50: >Iteration   1: -logL=39899.629, Lambda=1.0e-03, delta=1.916, max(|grad|)=6.221122 [Index:7]
2015-07-03T21:48:51: >Iteration   2: -logL=39899.628, Lambda=1.0e-04, delta=0.001, max(|grad|)=-0.060144 [Index:3]
2015-07-03T21:48:51:
2015-07-03T21:48:51: +================+
2015-07-03T21:48:51: | Curvature matrix |
2015-07-03T21:48:51: +================+
2015-07-03T21:48:51: === GMatrixSparse ===
2015-07-03T21:48:51:  Number of rows ............: 10
```

```
2015-07-03T21:48:51:  Number of columns .........: 10
2015-07-03T21:48:51:  Number of nonzero elements : 16
2015-07-03T21:48:51:  Number of allocated cells .: 528
2015-07-03T21:48:51:  Memory block size .........: 512
2015-07-03T21:48:51:  Sparse matrix fill ........: 0.16
2015-07-03T21:48:51:  Pending element ...........: 0
2015-07-03T21:48:51:  Fill stack size ...........: 0 (none)
2015-07-03T21:48:51:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:48:51:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:48:51:  0, 0, 83.7761, -95.0742, 0, 0, 25.3675, -46.7484, 0, 0
2015-07-03T21:48:51:  0, 0, -95.0742, 3812.14, 0, 0, 88.6885, -199.063, 0, 0
2015-07-03T21:48:51:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:48:51:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:48:51:  0, 0, 25.3675, 88.6885, 0, 0, 9881.05, -16501.8, 0, 0
2015-07-03T21:48:51:  0, 0, -46.7484, -199.063, 0, 0, -16501.8, 31624.7, 0, 0
2015-07-03T21:48:51:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:48:51:  0, 0, 0, 0, 0, 0, 0, 0, 0, 0
2015-07-03T21:48:52:
2015-07-03T21:48:52: +=========================================+
2015-07-03T21:48:52: | Maximum likelihood optimization results |
2015-07-03T21:48:52: +=========================================+
2015-07-03T21:48:52: === GOptimizerLM ===
2015-07-03T21:48:52:  Optimized function value ..: 39899.628
2015-07-03T21:48:52:  Absolute precision ........: 0.005
2015-07-03T21:48:52:  Acceptable value decrease .: 2
2015-07-03T21:48:52:  Optimization status .......: converged
2015-07-03T21:48:52:  Number of parameters ......: 10
2015-07-03T21:48:52:  Number of free parameters .: 4
2015-07-03T21:48:52:  Number of iterations ......: 2
2015-07-03T21:48:52:  Lambda ....................: 1e-05
2015-07-03T21:48:52:  Maximum log likelihood ....: -39899.628
2015-07-03T21:48:52:  Observed events  (Nobs) ...: 13359.000
2015-07-03T21:48:52:  Predicted events (Npred) ..: 13358.998 (Nobs - Npred = 0.00150876)
2015-07-03T21:48:52: === GModels ===
2015-07-03T21:48:52:  Number of models ..........: 2
2015-07-03T21:48:52:  Number of parameters ......: 10
2015-07-03T21:48:52: === GModelSky ===
2015-07-03T21:48:52:  Name ......................: Crab
2015-07-03T21:48:52:  Instruments ...............: all
2015-07-03T21:48:52:  Instrument scale factors ..: unity
2015-07-03T21:48:52:  Observation identifiers ...: all
2015-07-03T21:48:52:  Model type ................: PointSource
2015-07-03T21:48:52:  Model components ..........: "SkyDirFunction" * "PowerLaw" * "Constant"
2015-07-03T21:48:52:  Number of parameters ......: 6
2015-07-03T21:48:52:  Number of spatial par's ...: 2
2015-07-03T21:48:52:   RA .......................: 83.6331 [-360,360] deg (fixed,scale=1)
2015-07-03T21:48:52:   DEC ......................: 22.0145 [-90,90] deg (fixed,scale=1)
2015-07-03T21:48:52:  Number of spectral par's ..: 3
2015-07-03T21:48:52:   Prefactor ................: 5.78242e-16 +/- 1.10892e-17 [1e-23,1e-13] ph/cm2/s/MeV (free,scale=1e-16,gradient)
2015-07-03T21:48:52:   Index ....................: -2.49208 +/- 0.0164353 [-0,-5]  (free,scale=-1,gradient)
2015-07-03T21:48:52:   PivotEnergy ..............: 300000 [10000,1e+09] MeV (fixed,scale=1e+06,gradient)
2015-07-03T21:48:52:  Number of temporal par's ..: 1
2015-07-03T21:48:52:   Normalization ............: 1 (relative value) (fixed,scale=1,gradient)
2015-07-03T21:48:52: === GCTAModelCubeBackground ===
2015-07-03T21:48:52:  Name ......................: BackgroundModel
2015-07-03T21:48:52:  Instruments ...............: CTA, HESS, MAGIC, VERITAS
2015-07-03T21:48:52:  Instrument scale factors ..: unity
2015-07-03T21:48:52:  Observation identifiers ...: all
2015-07-03T21:48:52:  Model type ................: "PowerLaw" * "Constant"
2015-07-03T21:48:52:  Number of parameters ......: 4
2015-07-03T21:48:52:  Number of spectral par's ..: 3
2015-07-03T21:48:52:   Prefactor ................: 1.01894 +/- 0.0280565 [0,infty[ ph/cm2/s/MeV (free,scale=1,gradient)
2015-07-03T21:48:52:   Index ....................: 0.0189205 +/- 0.0156844 [-10,10]  (free,scale=1,gradient)
2015-07-03T21:48:52:   PivotEnergy ..............: 1e+06 MeV (fixed,scale=1e+06,gradient)
2015-07-03T21:48:52:  Number of temporal par's ..: 1
2015-07-03T21:48:52:   Normalization ............: 1 (relative value) (fixed,scale=1,gradient)
```

What remains to be understood is why the pull distribution of the classical binned and the stacked analyses have a bias when using a large field.
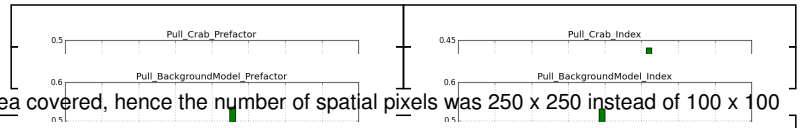
#13 - 07/04/2015 01:02 AM - Knödlseder Jürgen
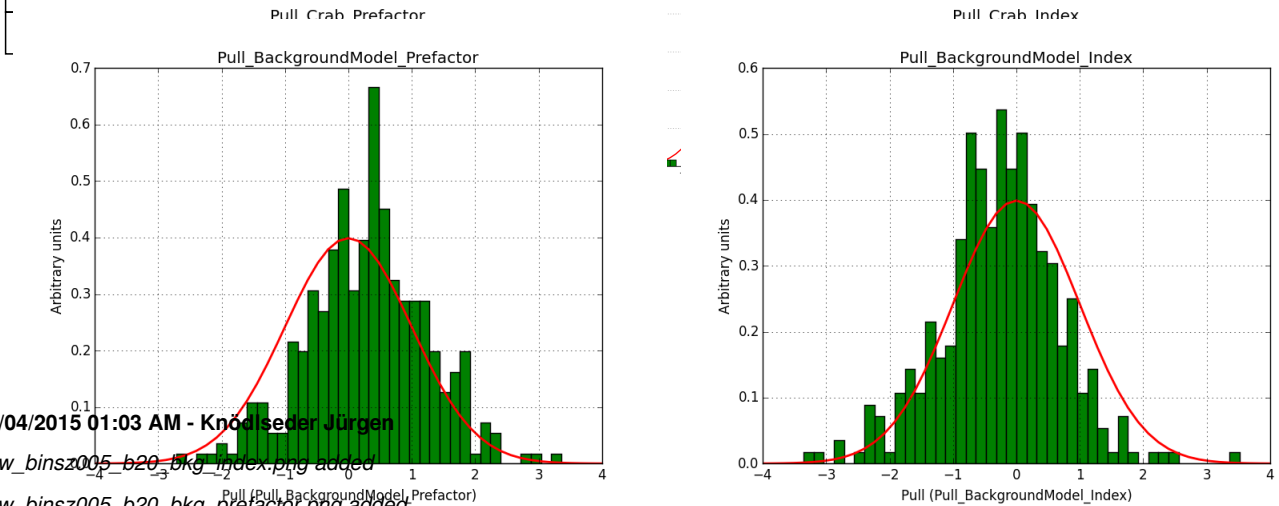
- % Done changed from 50 to 90

I understand the problem!

A bias occurs if the binning used is not sufficiently fine grained. In the actual simulations, a binning of 0.05 deg / pixel was used. This is slightly worse than the best angular resolution and introduces a biases, in particular in the fitted spectral index.

Here for reference the results for a 0.05 deg / pixel spatial binning:

And here the results for a 0.02 deg / pixel spatial binning (same area covered, hence the number of spatial pixels was 250 x 250 instead of 100 x 100 before):

#14 - 07/04/2015 01:03 AM - Knödlseder Jürgen

- File new_binsz005_b20_bkg_index.png added

- File new_binsz005_b20_bkg_prefactor.png added

- File new_binsz005_b20_index.png added

- File new_binsz005_b20_prefactor.png added

#15 - 07/04/2015 01:55 AM - Knödlseder Jürgen

- File new_binsz002_b20_bkg_index.png added

- File new_binsz002_b20_bkg_prefactor.png added

- File new_binsz002_b20_index.png added

- File new_binsz002_b20_prefactor.png added

#16 - 07/04/2015 01:56 AM - Knödlseder Jürgen

- Status changed from In Progress to Feedback

- % Done changed from 90 to 100

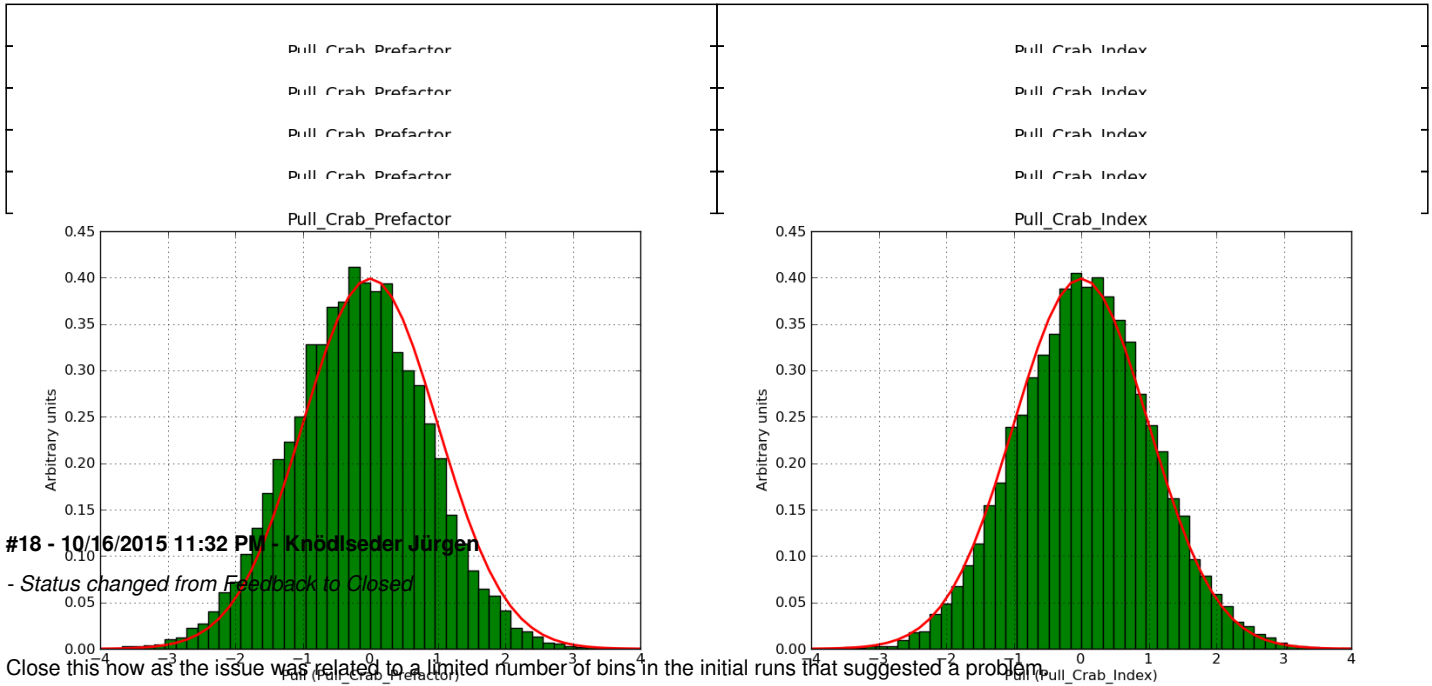I put this issue now on feedback.

We still need to do more pull distributions. I plan to do one for all spectral laws so that we also have a reference for the stacked analysis.

#17 - 08/21/2015 03:08 PM - Knödlseder Jürgen

- File plaw_binsz002_b10_index.png added

- File plaw_binsz002_b10_prefactor.png added

- File plaw_binsz002_b15_index.png added

- File plaw_binsz002_b15_prefactor.png added

- File plaw_binsz002_b20_index.png added

- File plaw_binsz002_b20_prefactor.png added

- File plaw_binsz002_b30_index.png added

- File plaw_binsz002_b30_prefactor.png added

- File plaw_binsz002_b40_index.png added

- File plaw_binsz002_b40_prefactor.png added

Here some more results for 0.02° spatial binning an 10, 15, 20, 30 and 40 energy bins between 0.1 and 100 TeV. At least 30 energy bins are needed to reduce the bias to an acceptable level.

#18 - 10/16/2015 11:32 PM - Knödlseder Jürgen

- Status changed from Feedback to Closed

Close this how as the issue was related to a limited number of bins in the initial runs that suggested a problem.

Files

Name	Size	Date	Author
Pull_BackgroundModel_Index.png	41.3 KB	07/03/2015	Buehler Rolf
Pull_BackgroundModel_Prefactor.png	42.8 KB	07/03/2015	Buehler Rolf
Pull_Crab_Index.png	38 KB	07/03/2015	Buehler Rolf
Pull_Crab_Prefactor.png	39.1 KB	07/03/2015	Buehler Rolf
obs.xml	1.79 KB	07/03/2015	Buehler Rolf
crab.xml	1.13 KB	07/03/2015	Buehler Rolf
cspull_input.png	25.6 KB	07/03/2015	Buehler Rolf
cspull_input.png	27.4 KB	07/03/2015	Buehler Rolf
cspull_input.png	36.3 KB	07/03/2015	Buehler Rolf
Pull_BackgroundModel_Index.png	41.8 KB	07/03/2015	Buehler Rolf
Pull_BackgroundModel_Prefactor.png	38.9 KB	07/03/2015	Buehler Rolf
Pull_Crab_Index.png	38 KB	07/03/2015	Buehler Rolf
Pull_Crab_Prefactor.png	39 KB	07/03/2015	Buehler Rolf
pull_b20_prefactor.png	41.3 KB	07/03/2015	Knödlseder Jürgen
pull_b20_index.png	39.7 KB	07/03/2015	Knödlseder Jürgen
pull_b40_index.png	39.8 KB	07/03/2015	Knödlseder Jürgen
pull_b40_prefactor.png	41.1 KB	07/03/2015	Knödlseder Jürgen
pull_b40_bkg_prefactor.png	44.7 KB	07/03/2015	Knödlseder Jürgen
pull_b40_bkg_index.png	43.7 KB	07/03/2015	Knödlseder Jürgen
pull_b20_prefactor_binsz002.png	41.3 KB	07/03/2015	Knödlseder Jürgen
pull_b20_index_binsz002.png	40.1 KB	07/03/2015	Knödlseder Jürgen
pull_b20_id_index.png	39.9 KB	07/03/2015	Knödlseder Jürgen
pull_b20_id_prefactor.png	41.2 KB	07/03/2015	Knödlseder Jürgen
pull_b20_single_prefactor.png	41.3 KB	07/03/2015	Knödlseder Jürgen
pull_b20_single_index.png	40 KB	07/03/2015	Knödlseder Jürgen
residual.fits.gz	5.72 MB	07/03/2015	Knödlseder Jürgen

new_binsz005_b20_bkg_index.png	44.1 KB	07/03/2015	Knödlseder Jürgen
new_binsz005_b20_bkg_prefactor.png	45.5 KB	07/03/2015	Knödlseder Jürgen
new_binsz005_b20_index.png	48 KB	07/03/2015	Knödlseder Jürgen
new_binsz005_b20_prefactor.png	41.8 KB	07/03/2015	Knödlseder Jürgen
new_binsz002_b20_bkg_index.png	44.2 KB	07/03/2015	Knödlseder Jürgen
new_binsz002_b20_bkg_prefactor.png	45.2 KB	07/03/2015	Knödlseder Jürgen
new_binsz002_b20_index.png	40.2 KB	07/03/2015	Knödlseder Jürgen
new_binsz002_b20_prefactor.png	49.1 KB	07/03/2015	Knödlseder Jürgen
plaw_binsz002_b10_index.png	43.9 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b10_prefactor.png	45.3 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b15_index.png	43.9 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b15_prefactor.png	45.2 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b20_index.png	43.7 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b20_prefactor.png	45 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b30_index.png	43.5 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b30_prefactor.png	44.8 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b40_index.png	43.7 KB	08/21/2015	Knödlseder Jürgen
plaw_binsz002_b40_prefactor.png	44.6 KB	08/21/2015	Knödlseder Jürgen