ctools - Bug #2861

Discrepancy between simulated counts and model for radial source

03/26/2019 10:57 AM - Tiziani Domenico

Status:	Closed	**Start date:**	03/26/2019
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	1.7.0		

Description

If I simulate a source with a GModelSpatialRadialDisk spatial model with IRFs from a run of the H.E.S.S. public data release 1, I experience discrepancies in the number of events between simulated counts and modelled counts.

The simulated number of counts is 91389 and the number of model counts is 85285. I simulate only the source and no background. The residual map (counts-model) does also not look empty (See attached image).

I also attached a script for reproducing the simulation.

History

#1 - 03/26/2019 11:06 AM - Knödlseder Jürgen

Try taking the model cube definition from the counts cube via the incube parameter. This should make sure that the correct bin weighting is applied.

#2 - 03/26/2019 12:18 PM - Tiziani Domenico

user#3 wrote:

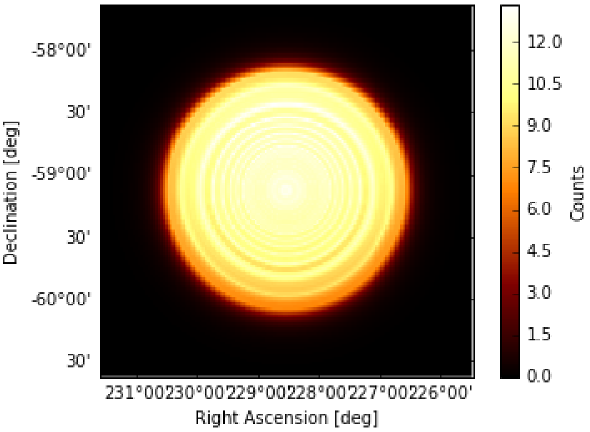
> Try taking the model cube definition from the counts cube via the incube parameter. This should make sure that the correct bin weighting is applied.

I have tried this but it does not change the number of model events.

#3 - 03/26/2019 12:25 PM - Tiziani Domenico

- File model.png added

Something else that I noticed is that the model map shows some strange ring shapes. This seems to originate from the IRF convolution but doesn't look physically sensible if I am not missing something.


-58°00'
30'
-59°00'
30'
-60°00'
30'
Declination [deg]
231°00'
230°00'
229°00'
228°00'
227°00'
226°00'
Right Ascension [deg]
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
Counts

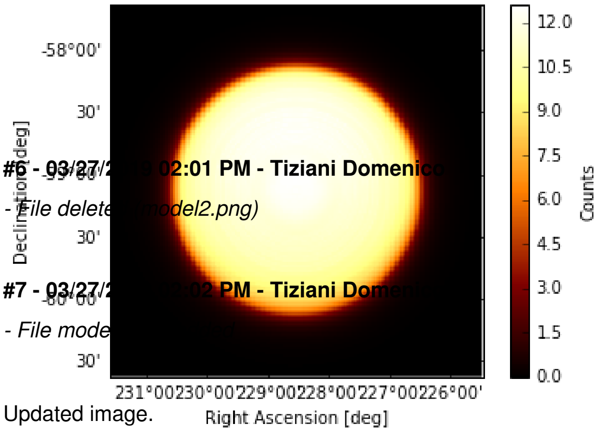
#4 - 03/27/2019 12:13 PM - Knödlseder Jürgen

Have a look at #2860, I just increased the integration precision for extended source models since it was apparently not sufficient for the broad H.E.S.S. PSF. Could your issue be related to this? New code is in the devel branch since yesterday evening.

#5 - 03/27/2019 01:59 PM - Tiziani Domenico

- File model2.png added

In my test scenario, the fix in #2860 changes the number of counts in the model cube to 89149. (In the unbinned case: Nobs - Npred = 93267.000 - 93322.253 = -55.253)
The model map now looks much smoother:



#6 - 03/27/2019 02:01 PM - Tiziani Domenico

- File deleted (model2.png)

#7 - 03/27/2019 02:02 PM - Tiziani Domenico

- File model2.png added

Updated image.

#8 - 03/27/2019 10:47 PM - Knödlseder Jürgen

- Tracker changed from Support to Bug

- Status changed from New to In Progress

- Target version set to 1.7.0

- % Done changed from 0 to 10

I looked a bit in the problem and played around with the integration precisions in GCTAResponseIrf::irf_radial. Below a summary of the results, obtained using a modified simulation.py script where the cube energy range was limited to 0.5-90 TeV (to make sure to stay away from the threshold). I tried a variant where the maximum delta of the PSF was restricted to 99% of the PSF containment, but this led to some artefacts in the model cube at high energies. Setting the number of iterations in rho and phi to 6, as done in #2860, reduces the discrepancy between model and counts to about 3%. 1% is only reached when further increasing the integration precision in phi, but this brings the computation time to 10 min instead of 1 min when compared to the initial precision. In other words, the speed penalty would be a factor of 10, while with 6/6 it would be a factor of 4, which is already quite bad.

rho	**phi**	**Nobs**	**Nmodel**	**ctmodel time**	**delta_max**	**model cube aspect**
5	5	84169	78538 (-6.7%)	1m12sec	99% of PSF	Artefacts in the model cube at high energies
6	6	84169	82332.2 (-2.2%)	4m09sec	99% of PSF	Artefacts in the model cube at high energies
6	6	84132	81336 (-3.3%)	5m03sec	Full range	Still faint ring-like structures at high energies
7	6	84132	81355.4 (-3.3%)	9m44sec	Full range	Model looks now very smooth, extremely little radial structure
6	7	84132	83359.9 (-0.9%)	9m37sec	Full range	Still faint ring-like structures at high energies
7	7	84132	83381.6 (-0.9%)	19m09sec	Full range	Almost perfectly smooth
5	7	84132	83625.4 (-0.6%)	4m53sec	Full range	Strong ring-like

						structures over all energies

I prefer for the time being (and release 1.6) to fix the precision at 6/6, and defer it to the next release to think about a more precise but fast integration scheme. I keep this issue open for that purpose.

#9 - 03/28/2019 03:13 PM - Tiziani Domenico

I agree, the computation time of ctmodel should be kept short.
Just to keep in track of it: We should also not forget about GCTAResponseIrf::irf_elliptical, where I see similar problems when going to large semi-axes.

#10 - 03/28/2019 03:24 PM - Knödlseder Jürgen

user#195 wrote:

> I agree, the computation time of ctmodel should be kept short.
> Just to keep in track of it: We should also not forget about GCTAResponseIrf::irf_elliptical, where I see similar problems when going to large semi-axes.

That's the method where I discovered the issue. I changed the precision in both methods.

#11 - 07/14/2020 12:12 AM - Knödlseder Jürgen

- Status changed from In Progress to Closed

- Assigned To set to Knödlseder Jürgen

- % Done changed from 10 to 100

Files

residual.png	46 KB	03/26/2019	Tiziani Domenico
simulation.py	4.61 KB	03/26/2019	Tiziani Domenico
model.png	29.6 KB	03/26/2019	Tiziani Domenico
model2.png	26.1 KB	03/27/2019	Tiziani Domenico