ctools - Action #2752

Check On/Off analysis for H.E.S.S. DR1

11/14/2018 08:03 PM - Knödlseder Jürgen

Status:	Closed	**Start date:**	11/14/2018
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	1.6.0		

Description

Related issues:

Related to ctools - Action # 2711: Adapt cscripts to support any kind of back...	**Closed**	**11/05/2018**

History

#1 - 11/15/2018 01:45 PM - Knödlseder Jürgen

- Status changed from New to In Progress

- % Done changed from 0 to 10

Here the H.E.S.S. analysis results for On/Off analysis using 40 reconstructed energy bins from 0.67-30 TeV, compared to the results for unbinned and stacked analysis. The wstat statistic was used. 300 true energy bins between 0.1-100 TeV were used, the On region was centred on Right Ascension of 83.633 deg and Declination of 22.0145 deg with a radius of 0.2 deg.

Analysis	Edisp	logL	TS	Prefactor	Index	CPU
Unbinned	Yes	98196.591	2030.800	4.148e-17 +/- 2.005e-18	2.734 +/- 0.070	116.4
Stacked	Yes	54059.739	1874.717	3.918e-17 +/- 2.022e-18	2.698 +/- 0.076	2737.0
Joint On/Off	Yes	78.972	1126.106	4.458e-17 +/- 2.539e-18	2.626 +/- 0.074	0.1
Stacked On/Off	Yes	24.074	1349.707	4.507e-17 +/- 2.704e-18	2.612 +/- 0.077	0.0

#2 - 11/15/2018 01:55 PM - Knödlseder Jürgen

And here the impact of disabling the clipping in true energy:

Analysis	logL	TS	Prefactor	Index	CPU
Joint On/Off	78.972	1126.106	4.458e-17 +/- 2.539e-18	2.626 +/- 0.074	0.1
Stacked On/Off (clipping)	24.074	1349.707	4.507e-17 +/- 2.704e-18	2.612 +/- 0.077	0.0
Stacked On/Off (no	23.206	1351.443	4.558e-17 +/-	2.623 +/- 0.072	0.0

clipping)			2.531e-18		

#3 - 11/23/2018 11:45 AM - Knödlseder Jürgen

- % Done changed from 10 to 20

Here the results when fitting the background model using CSTAT (no clipping is implemented in the code anymore). The background model produces using csbkgmodel was used. See #2711 for the adaption of the code that makes this possible.

Analysis	logL	TS	Prefactor	Index	CPU
Joint On/Off	2022.488	988.621	4.364e-17 +/- 2.548e-18	2.633 +/- 0.078	0.6
Stacked On/Off	3860.357	1105.846	4.407e-17 +/- 2.543e-18	2.633 +/- 0.076	0.1

Note that some hand-tweeking of the model was needed. When running csphagen, the instrument in the model is HESS, but we need a model with HESSOnOff observation for model fitting. Hence we should add an output model to csphagen that produces a model that can be readily fitted using ctlike (see #2711).

#4 - 11/23/2018 01:26 PM - Knödlseder Jürgen

- Related to Action #2711: Adapt cscripts to support any kind of background model added

#5 - 11/23/2018 10:44 PM - Knödlseder Jürgen

- File residual_joint.png added

- File residual_stack_clipping_nonorm.png added

- File residual_stack_clipping.png added

- File residual_stack_noclipping.png added

To understand whether the response should be clipped or not I inspected the residual spectra for a simulation of Crab observations with different energy thresholds. Below a few plots for different analysis configurations.

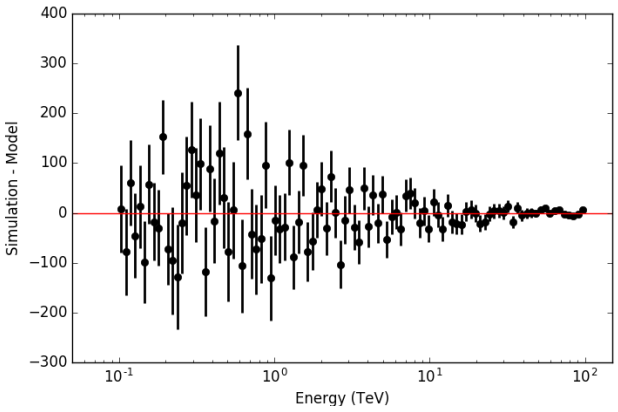
The first plot is for a joint analysis, hence clipping does not impact the results since the data are not stacked.

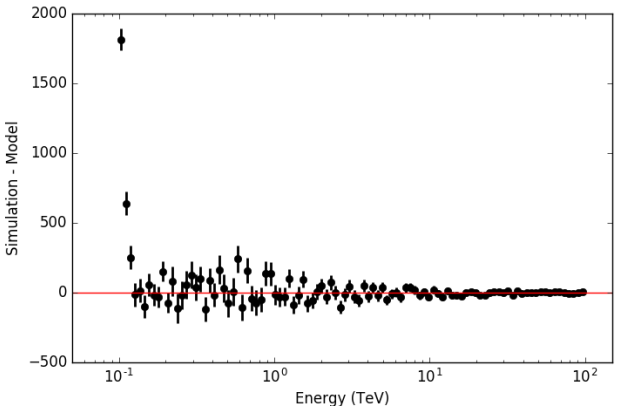
The second plot shows the residuals for a stacked analysis where the ARF and RMF where clipped, but the RMF was not re-normalized. A big residual appears.

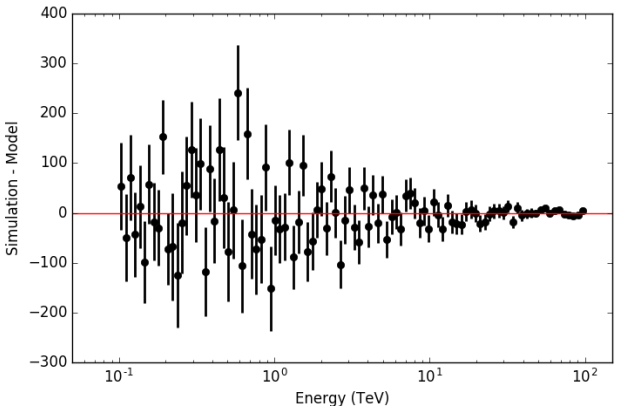
The third plot is for a stacked analysis where the ARF and RMF where clipped and the RMF was renormalized. This makes the residual disappear.

The forth plot is for a stacked analysis without clipping. In details the residuals are closer to the joint residuals, hence the ARF and RMF should not be clipped, consistent with the stacked 3D analysis.

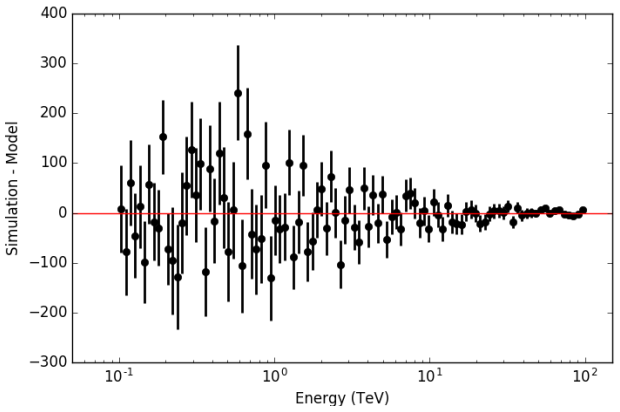
Joint	

	
Stacked, no normalization of RMF, clipping	

	
Stacked, clipping	



Stacked, no clipping


400
300
200
100
0
−100
−200
−300
Simulation - Model
10^{-1}
10^{0}
10^{1}
10^{2}
Energy (TeV)

#6 - 11/27/2018 10:38 AM - Knödlseder Jürgen

- % Done changed from 20 to 50

I also checked the On/Off analysis for the RX J1713.7-3946 observation. The tricky thing here is that the emission is quite extended, and if a On region radius of 0.8 deg is chosen, no Off regions exist. I therefore reduced the On region radius to 0.5 deg, which resulted in Off regions for 4 observations.

The results of the On/Off analysis for these 4 observations are listed below, where they are compared to the unbinned and stacked analysis results without energy dispersion.

Analysis	logL	TS	Prefactor	Index	Cutoff
Unbinned	537778.100	741.007	2.025e-17 +/- 1.983e-18	1.925 +/- 0.118	5.569 +/- 2.057
Stacked	212467.591	688.935	1.776e-17 +/- 1.483e-18	1.931 +/- 0.108	7.092 +/- 2.612
Joint, cstat	13964.036	132.212	1.746e-17 +/- 2.139e-18	1.923 +/- 0.180	16.002 +/- 10.444
Stacked, cstat	20490.631	110.990	2.017e-17 +/- 3.502e-18	1.773 +/- 0.254	6.843 +/- 4.821
Joint, wstat	72.500	149.492	2.603e-17 +/- 6.593e-18	1.787 +/- 0.309	4.523 +/- 3.617
Stacked, wstat	22.311	163.271	2.215e-17 +/- 2.763e-18	1.956 +/- 0.181	11.185 +/- 7.684

For comparison also the results for a power law fit.

Analysis	logL	TS	Prefactor	Index
Joint, cstat	13962.781	129.697	1.568e-17 +/- 1.690e-18	2.158 +/- 0.108
Stacked, cstat	20488.540	106.807	1.602e-17 +/- 1.666e-18	2.182 +/- 0.108
Joint, wstat	75.526	143.440	1.881e-17 +/- 1.638e-18	2.257 +/- 0.102
Stacked, wstat	23.804	160.285	1.910e-17 +/- 1.634e-18	2.216 +/- 0.090

Overall the results look good. I therefore consider the On/Off analysis as validated.

#7 - 11/27/2018 10:48 AM - Knödlseder Jürgen

- Status changed from In Progress to Closed

- % Done changed from 50 to 100

Files

residual_joint.png	26.2 KB	11/23/2018	Knödlseder Jürgen
residual_stack_clipping_nonorm.png	22.2 KB	11/23/2018	Knödlseder Jürgen
residual_stack_clipping.png	26.3 KB	11/23/2018	Knödlseder Jürgen
residual_stack_noclipping.png	26.2 KB	11/23/2018	Knödlseder Jürgen