GammaLib - Feature #3442

Add GCTAModelCubeSky class

11/09/2020 08:47 AM - Knödlseder Jürgen

Status:	Closed	**Start date:**	11/09/2020
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	2.0.0		

Description

The GCTAModelCubeSky is the analogy of GCTAModelCubeBackground but for sky models. Using this class allows to precompute sky models using ctmodel and using such models in a model fit.

History

#1 - 11/09/2020 08:48 AM - Knödlseder Jürgen

Renamed to GCTAModelSkyCube (which is more logical).

#2 - 11/09/2020 11:28 AM - Knödlseder Jürgen

- Status changed from New to In Progress

- % Done changed from 0 to 50

I implemented the class and defined corresponding XML file format that is very similar to typical sky models:

```
<?xml version="1.0" standalone="no"?>
<source_library title="source library">
  <source name="CTA sky cube" type="CTASkyCube" instrument="CTA">
    <spatialModel type="ModelCube" file="crab_modcube.fits">
      <parameter name="Normalization" scale="1" value="1" min="0.1" max="10" free="0"/>
    </spatialModel>
    <spectrum type="PowerLaw">
      <parameter name="Prefactor"   scale="1e-16" value="5.7"  min="1e-07" max="1000.0" free="1"/>
      <parameter name="Index"       scale="-1"    value="2.48" min="0.0"   max="+5.0"   free="1"/>
      <parameter name="PivotEnergy" scale="1e6"   value="0.3"  min="0.01"  max="1000.0" free="0"/>
    </spectrum>
  </source>
</source_library>
```

I then generated a sky model cube for the Crab nebula where I used a constant spectral model with normalisation 1, so that when fitting the sky cube I should get the same spectra as fitting the crab directly.

Fitting the Crab directly I got:

```
2020-11-09T10:21:40: === GModelSky ===
2020-11-09T10:21:40:  Name .....: Crab
2020-11-09T10:21:40:  Instruments .....: all
2020-11-09T10:21:40:  Observation identifiers ...: all
2020-11-09T10:21:40:  Model type .....: PointSource
2020-11-09T10:21:40:  Model components .....: "PointSource" * "PowerLaw" * "Constant"
2020-11-09T10:21:40:  Number of parameters .....: 6
2020-11-09T10:21:40:  Number of spatial par's ...: 2
2020-11-09T10:21:40:   RA .....: 83.6331 [-360,360] deg (fixed,scale=1)
2020-11-09T10:21:40:   DEC .....: 22.0145 [-90,90] deg (fixed,scale=1)
2020-11-09T10:21:40:  Number of spectral par's ..: 3
2020-11-09T10:21:40:   Prefactor .....: 1.53831332825568e-16 +/- 5.11840122058421e-18 [1e-23,1e-13] ph/cm2/s/MeV
 (free,scale=1e-16,gradient)
2020-11-09T10:21:40:   Index .....: -2.41186783653758 +/- 0.0250296097002891 [-5,-0]  (free,scale=-1,gradient)
2020-11-09T10:21:40:   PivotEnergy .....: 300000 [10000,1000000000] MeV (fixed,scale=1000000,gradient)
2020-11-09T10:21:40:  Number of temporal par's ..: 1
2020-11-09T10:21:40:   Normalization .....: 1 (relative value) (fixed,scale=1,gradient)
2020-11-09T10:21:40:  Number of scale par's .....: 0
```

while fitting the Crab using a sky model cube I got

```
2020-11-09T10:21:07: === GCTAModelSkyCube ===
2020-11-09T10:21:07:  Name .....: CTA sky cube
2020-11-09T10:21:07:  Instruments .....: CTA
2020-11-09T10:21:07:  Observation identifiers ...: all
2020-11-09T10:21:07:  Model type .....: "PowerLaw" * "Constant"
2020-11-09T10:21:07:  Number of parameters .....: 5
2020-11-09T10:21:07:  Number of spectral par's ..: 3
2020-11-09T10:21:07:   Prefactor .....: 1.53831332825558e-16 +/- 5.11840122058387e-18 [1e-23,1e-13] ph/cm2/s/MeV
 (free,scale=1e-16,gradient)
2020-11-09T10:21:07:   Index .....: -2.41186783653759 +/- 0.0250296097002891 [-5,-0]  (free,scale=-1,gradient)
2020-11-09T10:21:07:   PivotEnergy .....: 300000 [10000,1000000000] MeV (fixed,scale=1000000,gradient)
2020-11-09T10:21:07:  Number of temporal par's ..: 1
2020-11-09T10:21:07:   Normalization .....: 1 (relative value) (fixed,scale=1,gradient)
```

Within the numerical precision the results are identical.

#3 - 11/09/2020 12:36 PM - Knödlseder Jürgen

- Status changed from In Progress to Pull request

- % Done changed from 50 to 90

I added unit tests, fixed a number of minor issues, and started the integration check.

#4 - 11/09/2020 01:37 PM - Knödlseder Jürgen

- Status changed from Pull request to Closed

- % Done changed from 90 to 100

Merged into devel.