

GammaLib - Bug #1481

Node function fit results in large difference between observed and modeled Npred value

06/20/2015 12:58 PM - Knödlseeder Jürgen

Status:	Rejected	Start date:	06/20/2015
Priority:	Normal	Due date:	
Assigned To:	Knödlseeder Jürgen	% Done:	100%
Category:		Estimated time:	0.00 hour
Target version:	1.0.0		
Description			
During a pull distribution test a large offset between observed and modeled Npred value has been observed:			
2015-06-19T22:40:19: +=====+			
2015-06-19T22:40:19: Simulate observation			
2015-06-19T22:40:19: +=====+			
2015-06-19T22:40:19: === Observation ===			
2015-06-19T22:40:19: Simulation area: 1.9635e+11 cm2			
2015-06-19T22:40:19: Simulation cone: RA=83.63 deg, Dec=22.01 deg, r=5.5 deg			
2015-06-19T22:40:19: Time interval: 0 - 1800 s			
2015-06-19T22:40:19: Photon energy range: 100 GeV - 100 TeV			
2015-06-19T22:40:19: Event energy range: 100 GeV - 100 TeV			
2015-06-19T23:04:53: MC source photons: 244136909 [Crab]			
2015-06-19T23:04:53: MC source events: 25435364 [Crab]			
2015-06-19T23:04:53: MC source events: 25435364 (all source models)			
2015-06-19T23:05:03: MC background events: 13112			
2015-06-19T23:05:03: MC events: 25448476 (all models)			
...			
2015-06-19T23:08:13: +=====+			
2015-06-19T23:08:13: Maximum likelihood optimisation			
2015-06-19T23:08:13: +=====+			
2015-06-19T23:14:20: >Iteration 0: -logL=-84714926.705, Lambda=1.0e-03			
2015-06-19T23:20:43: >Iteration 1: -logL=-84714942.616, Lambda=1.0e-03, delta=15.911, max(grad)=20189.418265			
[Intensity1:5]			
2015-06-19T23:27:19: Iteration 2: -logL=-84714942.616, Lambda=1.0e-04, delta=-7.027, max(grad)=61905.752114 [Intensity1:5]			
(stalled)			
2015-06-19T23:34:02: >Iteration 3: -logL=-84714942.882, Lambda=1.0e-03, delta=0.266, max(grad)=18276.417243 [Intensity1:5]			
2015-06-19T23:40:42: Iteration 4: -logL=-84714942.882, Lambda=1.0e-04, delta=-8.636, max(grad)=52339.893580 [Intensity1:5]			
(stalled)			
2015-06-19T23:47:12: Iteration 5: -logL=-84714942.111, Lambda=1.0e-03, delta=-0.771, max(grad)=16566.013235 [Intensity1:5]			
(stalled)			
2015-06-19T23:54:02: Iteration 6: -logL=-84714942.014, Lambda=1.0e-02, delta=-0.097, max(grad)=14950.076140 [Intensity1:5]			
(stalled)			
2015-06-20T00:00:57: Iteration 7: -logL=-84714942.004, Lambda=1.0e-01, delta=-0.010, max(grad)=14906.566158 [Intensity1:5]			
(stalled)			
2015-06-20T00:07:39: Iteration 8: -logL=-84714942.004, Lambda=1.0e+00, delta=-0.001, max(grad)=14903.413753			
[Intensity1:5] (stalled)			
2015-06-20T00:14:14: Iteration 9: -logL=-84714942.004, Lambda=1.0e+01, delta=-0.000, max(grad)=14905.973680			
[Intensity1:5] (stalled)			
2015-06-20T00:20:49: Iteration 10: -logL=-84714942.004, Lambda=1.0e+02, delta=-0.000, max(grad)=14906.498404			
[Intensity1:5] (stalled)			
2015-06-20T00:27:42: Iteration 11: -logL=-84714942.004, Lambda=1.0e+03, delta=-0.000, max(grad)=14906.558966			
[Intensity1:5] (stalled)			
2015-06-20T00:34:18: Iteration 12: -logL=-84714942.004, Lambda=1.0e+04, delta=-0.000, max(grad)=14906.566163			
[Intensity1:5] (stalled)			
2015-06-20T00:41:04: >Iteration 13: -logL=-84714942.004, Lambda=1.0e+05, delta=0.000, max(grad)=14906.565672			
[Intensity1:5]			
2015-06-20T00:47:39:			
2015-06-20T00:47:39: +=====+			
2015-06-20T00:47:39: Maximum likelihood optimization results			
2015-06-20T00:47:39: +=====+			
2015-06-20T00:47:39: === GOptimizerLM ===			

2015-06-20T00:47:39: Optimized function value ...: -84714942.004
2015-06-20T00:47:39: Absolute precision: 0.005
2015-06-20T00:47:39: Acceptable value decrease ..: 2
2015-06-20T00:47:39: Optimization status: converged
2015-06-20T00:47:39: Number of parameters: 11
2015-06-20T00:47:39: Number of free parameters ..: 4
2015-06-20T00:47:39: Number of iterations: 13
2015-06-20T00:47:39: Lambda: 10000
2015-06-20T00:47:39: Maximum log likelihood: 84714942.004
2015-06-20T00:47:39: Observed events (Nobs) ...: 25448476.000
2015-06-20T00:47:39: Predicted events (Npred) ..: 25447393.506 (Nobs - Npred = 1082.49)

The following XML model had been used;

```
<?xml version="1.0" standalone="no"?>
<source_library title="source library">
  <source name="Crab" type="PointSource">
    <spectrum type="NodeFunction">
      <node>
        <parameter scale="1.0" name="Energy" min="0.1" max="1.0e20" value="1.0" free="0"/>
        <parameter scale="1e-07" name="Intensity" min="1e-07" max="1000.0" value="1.0" free="1"/>
      </node>
      <node>
        <parameter scale="1.0" name="Energy" min="0.1" max="1.0e20" value="10.0" free="0"/>
        <parameter scale="1e-07" name="Intensity" min="1e-07" max="1000.0" value="0.1" free="1"/>
      </node>
    </spectrum>
    <spatialModel type="SkyDirFunction">
      <parameter free="0" max="360" min="-360" name="RA" scale="1" value="83.6331" />
      <parameter free="0" max="90" min="-90" name="DEC" scale="1" value="22.0145" />
    </spatialModel>
  </source>
  <source name="Background model" type="CTAInfBackground" instrument="CTA">
    <spectrum type="PowerLaw">
      <parameter name="Prefactor" scale="1.0" value="1.0" min="1e-3" max="1e3" free="1"/>
      <parameter name="Index" scale="1.0" value="0.0" min="-5.0" max="+5.0" free="1"/>
      <parameter name="Scale" scale="1e6" value="1.0" min="0.01" max="1000.0" free="0"/>
    </spectrum>
  </source>
</source_library>
```

History

#1 - 06/20/2015 01:08 PM - Knödlseider Jürgen

- Status changed from New to In Progress
- Assigned To set to Knödlseider Jürgen
- Target version set to 1.0.0
- % Done changed from 0 to 50

It seem that the problem was related to the fact that the XML file defined two nodes at 1 MeV and 10 MeV, hence there was a high level arm when extrapolating this to the TeV domain. Also, the intensities chosen led to a large number of events.
Changing the XML file to

```
<?xml version="1.0" standalone="no"?>
<source_library title="source library">
  <source name="Crab" type="PointSource">
    <spectrum type="NodeFunction">
      <node>
        <parameter scale="1.0e5" name="Energy" min="0.1" max="1.0e20" value="1.0" free="0"/>
        <parameter scale="1e-15" name="Intensity" min="1e-07" max="1000.0" value="8.69" free="1"/>
      </node>
    </spectrum>
  </source>
</source_library>
```

```

</node>
<node>
  <parameter scale="1.0e8" name="Energy" min="0.1" max="1.0e20" value="1.0" free="0"/>
  <parameter scale="1e-22" name="Intensity" min="1e-07" max="1000.0" value="3.16" free="1"/>
</node>
</spectrum>
<spatialModel type="SkyDirFunction">
  <parameter free="0" max="360" min="-360" name="RA" scale="1" value="83.6331" />
  <parameter free="0" max="90" min="-90" name="DEC" scale="1" value="22.0145" />
</spatialModel>
</source>
<source name="Background model" type="CTAIfBackground" instrument="CTA">
  <spectrum type="PowerLaw">
    <parameter name="Prefactor" scale="1.0" value="1.0" min="1e-3" max="1e3" free="1"/>
    <parameter name="Index" scale="1.0" value="0.0" min="-5.0" max="+5.0" free="1"/>
    <parameter name="Scale" scale="1e6" value="1.0" min="0.01" max="1000.0" free="0"/>
  </spectrum>
</source>
</source_library>

```

gave a much smaller (though not perfect) Npred difference:

```

2015-06-20T11:02:41: +=====+
2015-06-20T11:02:41: | Simulate observation |
2015-06-20T11:02:41: +=====+
2015-06-20T11:02:41: === Observation ===
2015-06-20T11:02:41: Simulation area .....: 1.9635e+11 cm2
2015-06-20T11:02:41: Simulation cone .....: RA=83.63 deg, Dec=22.01 deg, r=5.5 deg
2015-06-20T11:02:41: Time interval .....: 0 - 1800 s
2015-06-20T11:02:41: Photon energy range .....: 100 GeV - 100 TeV
2015-06-20T11:02:41: Event energy range .....: 100 GeV - 100 TeV
2015-06-20T11:02:41: MC source photons .....: 208050 [Crab]
2015-06-20T11:02:41: MC source events .....: 2869 [Crab]
2015-06-20T11:02:41: MC source events .....: 2869 (all source models)
2015-06-20T11:02:46: MC background events .....: 13267
2015-06-20T11:02:46: MC events .....: 16136 (all models)
...
2015-06-20T11:02:47: +=====+
2015-06-20T11:02:47: | Maximum likelihood optimisation |
2015-06-20T11:02:47: +=====+
2015-06-20T11:02:47: >Iteration 0: -logL=101707.792, Lambda=1.0e-03
2015-06-20T11:02:48: >Iteration 1: -logL=101707.231, Lambda=1.0e-03, delta=0.562, max(|grad|)=-0.547137 [Prefactor:7]
2015-06-20T11:02:48: >Iteration 2: -logL=101707.228, Lambda=1.0e-04, delta=0.003, max(|grad|)=0.017482 [Index:8]
2015-06-20T11:02:49:
2015-06-20T11:02:49: +=====+
2015-06-20T11:02:49: | Maximum likelihood optimization results |
2015-06-20T11:02:49: +=====+
2015-06-20T11:02:49: === GOptimizerLM ===
2015-06-20T11:02:49: Optimized function value ..: 101707.228
2015-06-20T11:02:49: Absolute precision .....: 0.005
2015-06-20T11:02:49: Acceptable value decrease ..: 2
2015-06-20T11:02:49: Optimization status .....: converged
2015-06-20T11:02:49: Number of parameters .....: 11
2015-06-20T11:02:49: Number of free parameters ..: 4
2015-06-20T11:02:49: Number of iterations .....: 2
2015-06-20T11:02:49: Lambda .....: 1e-05
2015-06-20T11:02:49: Maximum log likelihood .....: -101707.228
2015-06-20T11:02:49: Observed events (Nobs) ...: 16136.000
2015-06-20T11:02:49: Predicted events (Npred) ..: 16134.988 (Nobs - Npred = 1.01196)

```

Note, however, that the relative Npred difference is comparable for both cases (4.2e-5 in the first case compared to 6.3e-5 in the second case).

#2 - 06/20/2015 01:14 PM - Knödseder Jürgen

- *Status changed from In Progress to Rejected*

- *% Done changed from 50 to 100*

This does not seem to be a bug, just a feature of the XML model used. Issue rejected.