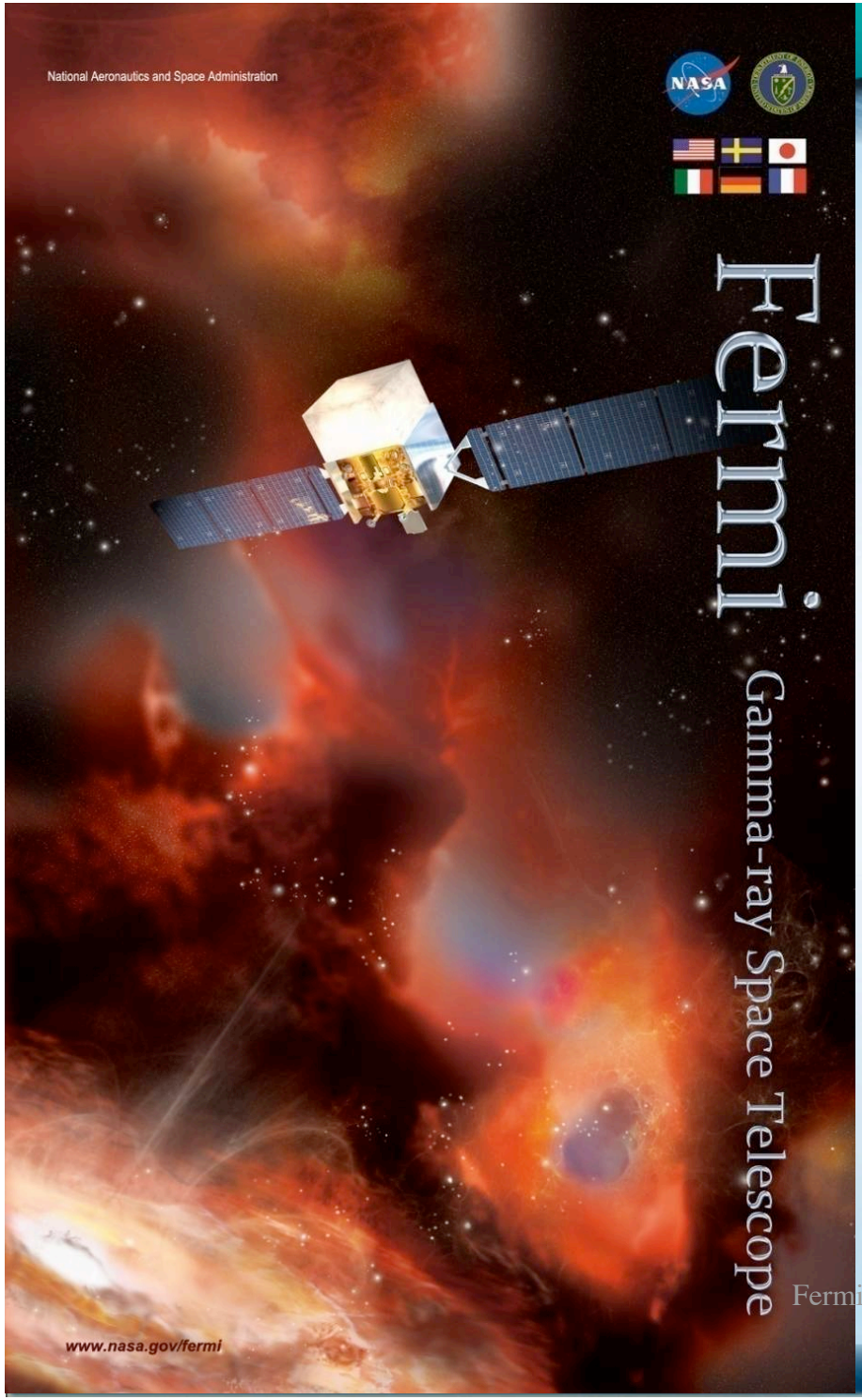
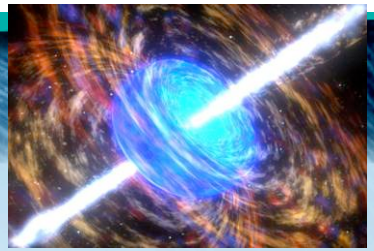


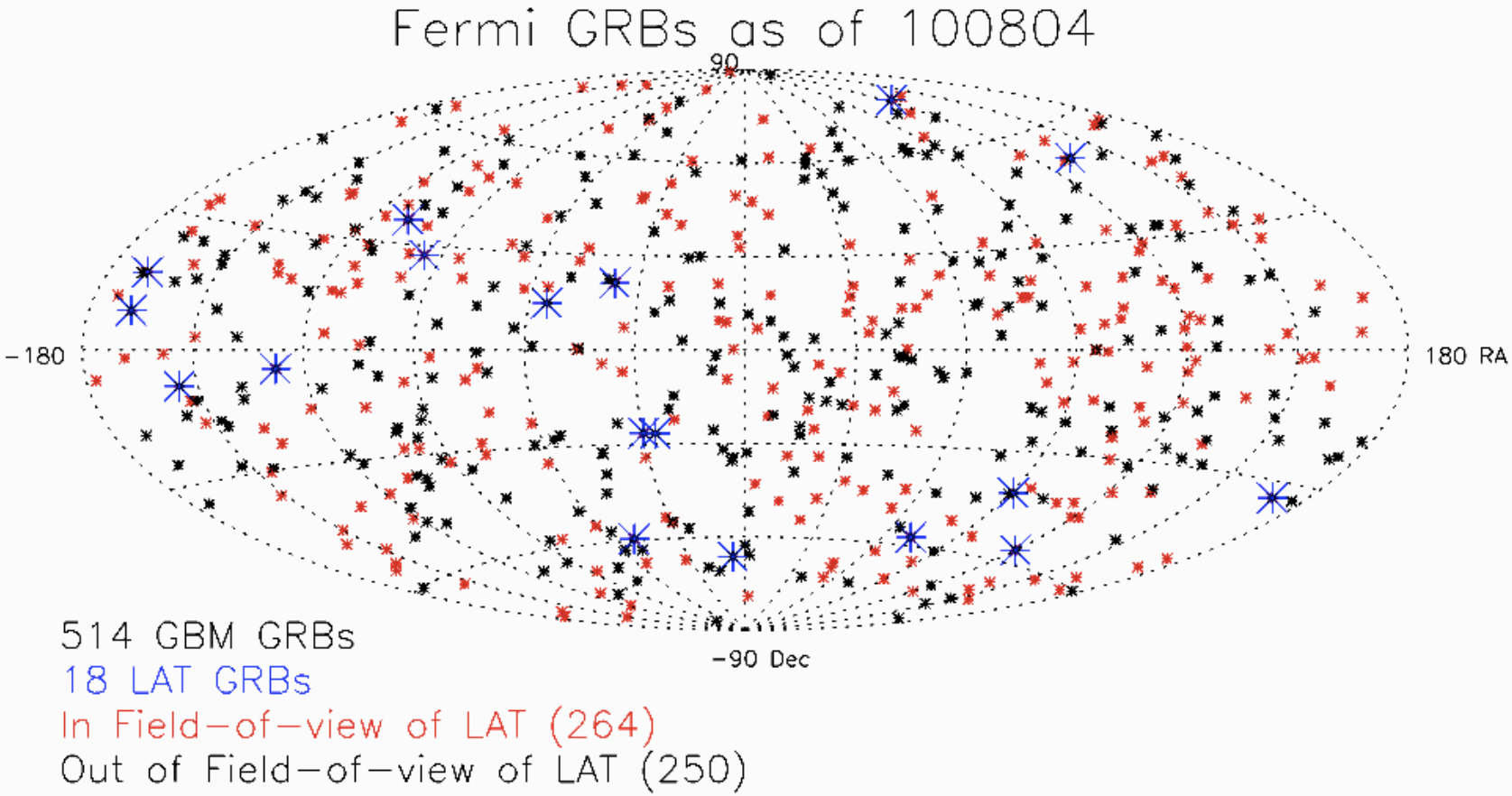
Fermi GBM Status, Results, Plans

Bill Paciesas

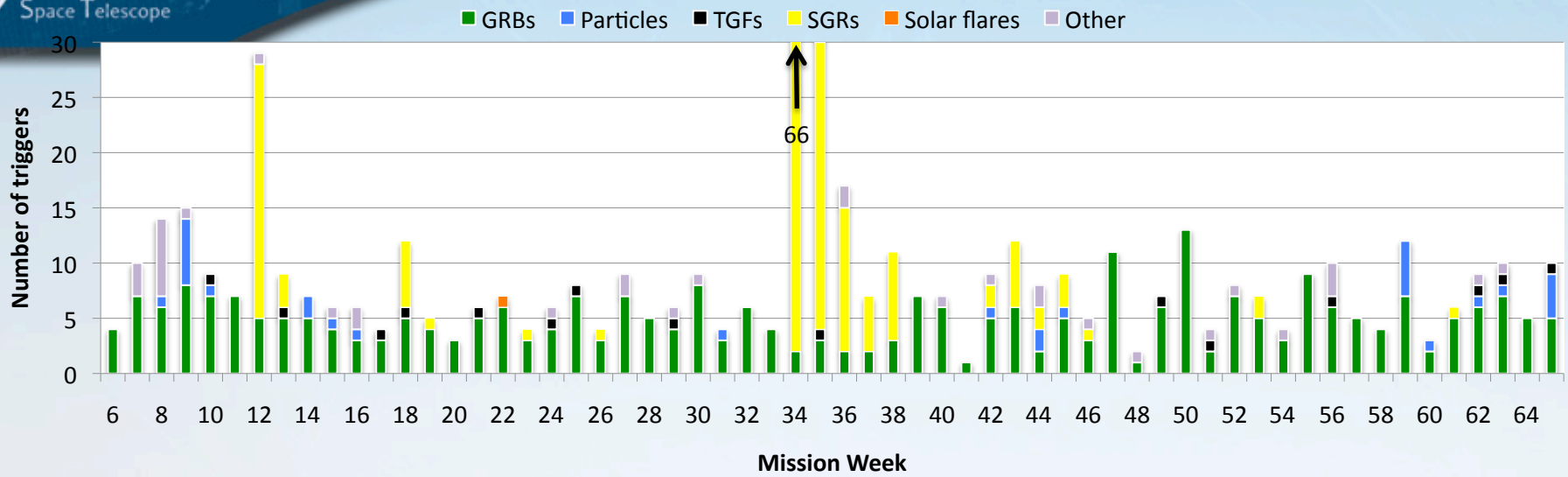
Fermi Users Group
5 November 2010

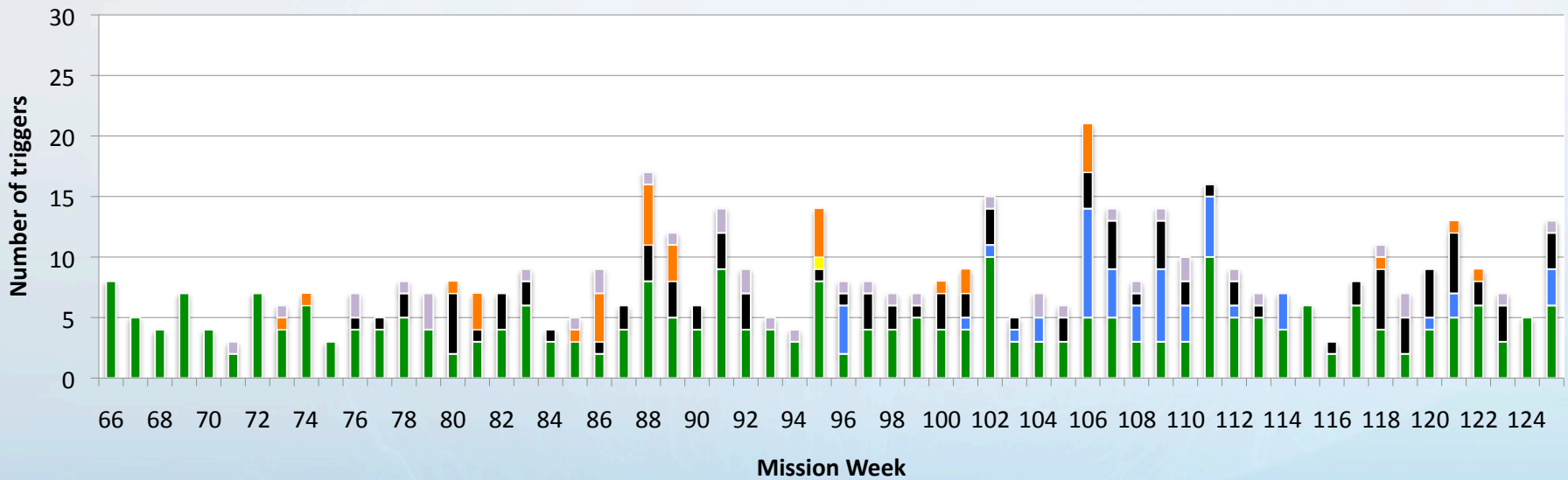
Gamma Ray Bursts





GBM Trigger History





GBM Triggered Sources
(as of Nov 3)

- 1055 triggers (excluding commanded)
  - Gamma-ray bursts (GRBs): 576
  - Soft gamma repeaters (SGRs) aka magnetars: 170 (from 4 sources)
  - Terrestrial gamma flashes (TGFs): 113
  - Solar Flares: 39
  - Short transients detected by on-board trigger algorithm: 1-2
- ~45 ARRs

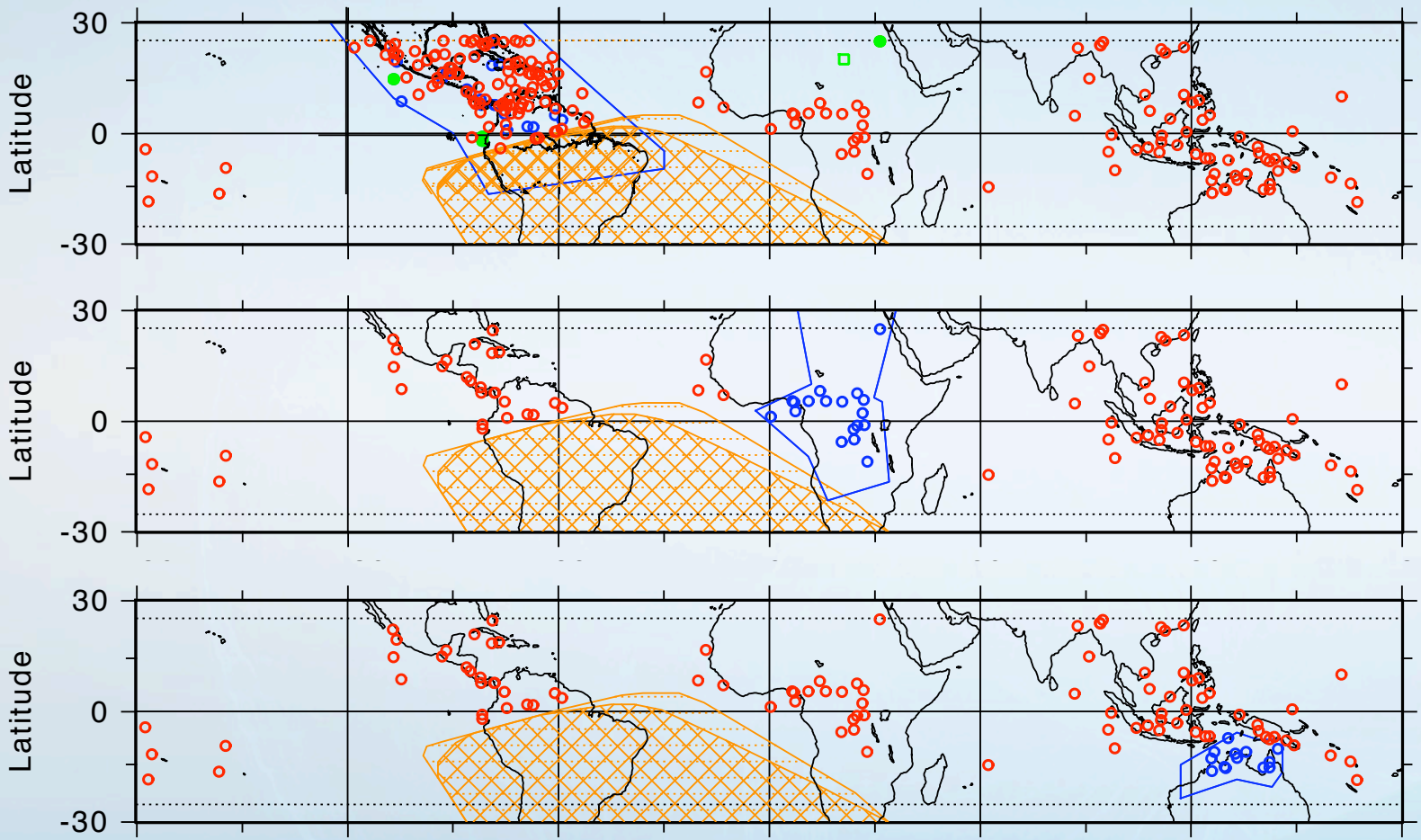
Operational Changes

- FSW Version 2.6
  - Installed 15 July 2010
  - Added new commands for control of continuous TTE mode
  - Avoid interference with triggering
    - Handle conflicts where trigger mode overlaps with continuous TTE production
- Insert commands in ATS to turn TTE on/off when inside selected geographical region
  - Command times based on orbit predictions
  - Geographical region covers Central America & northern South America
- Data are public & delivered to FSSC

TGFs

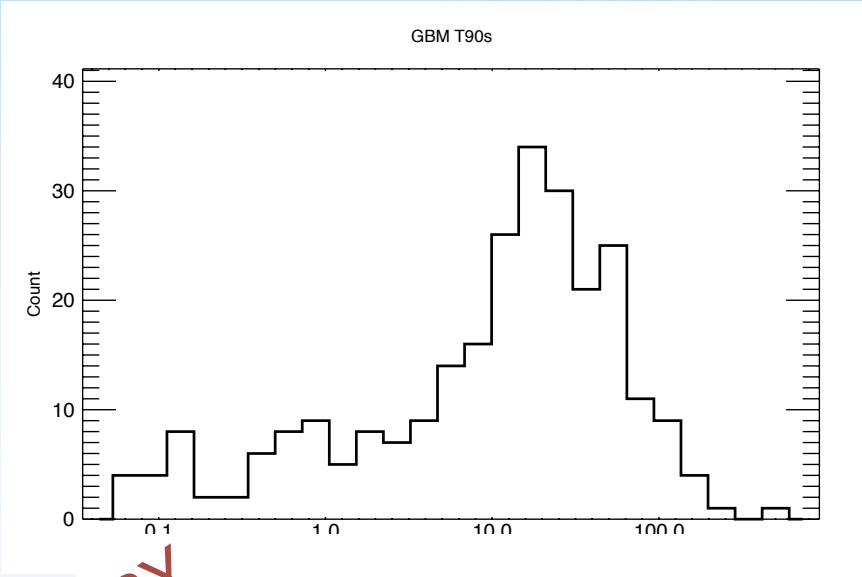
107 GBM TGFs

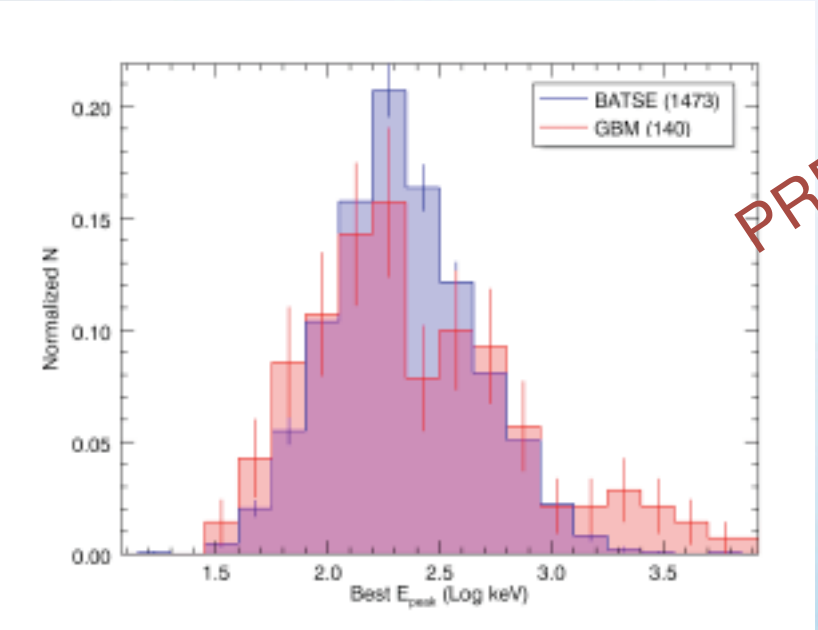
Americas Box



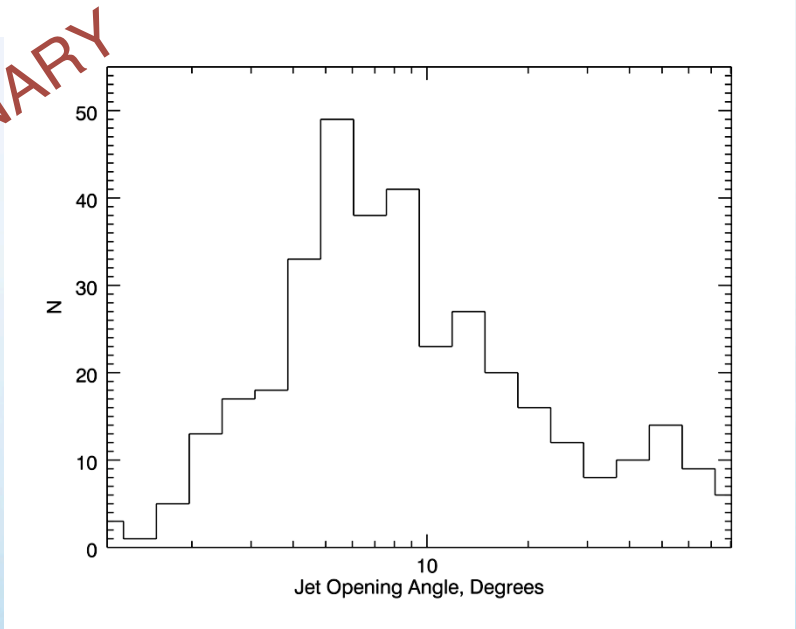
GBM Catalogs

- General GRB Catalog
  - Location, peak flux, fluence, duration
- GRB Spectral Catalog
  - 5 models * 2 spectra
- First 2 years
- Release in ~1 month





PRELIMINARY



GBM GRB Localizations

- Localizations are produced in three ways, with increasing accuracy but greater delays.
- The location accuracies have been determined by comparing to locations of high accuracy from other instruments using a Bayesian method.

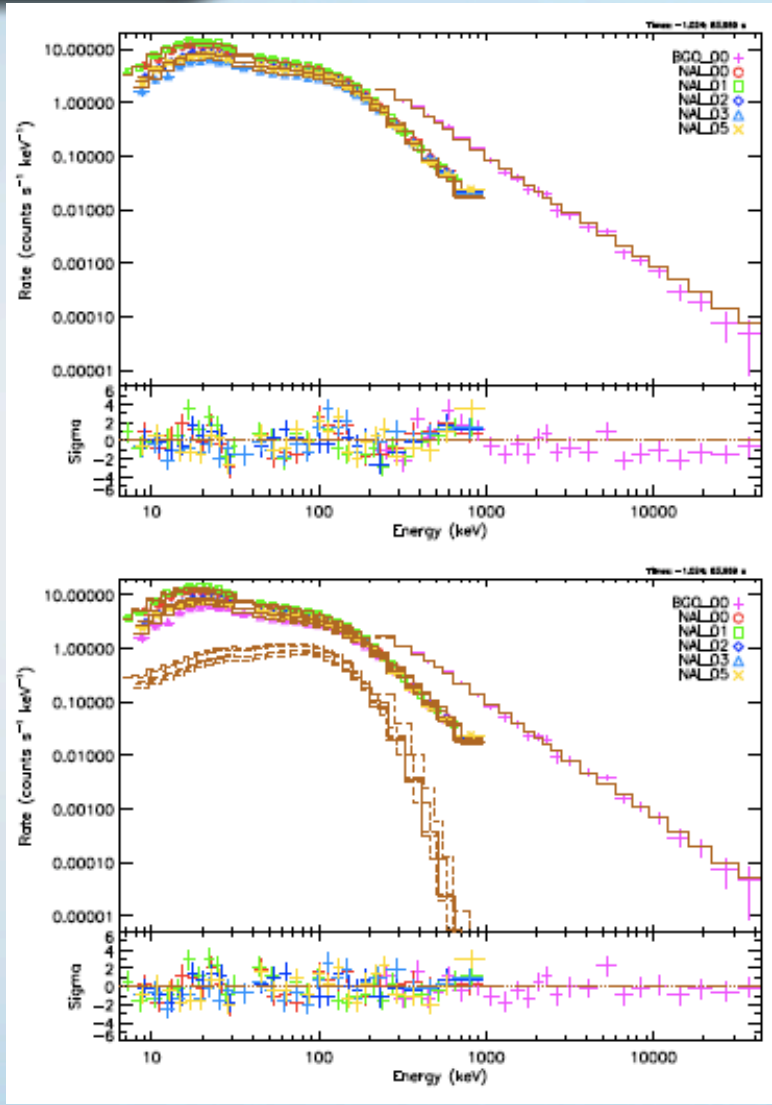
PRELIMINARY

Type	Delay	σ core (degrees)	Core fraction	σ tail (degrees)
Flight SW	from seconds	9.2		
Ground Auto	tens seconds	3.2	0.7	9.5
Human guided	many min	2.8	0.7	8.4

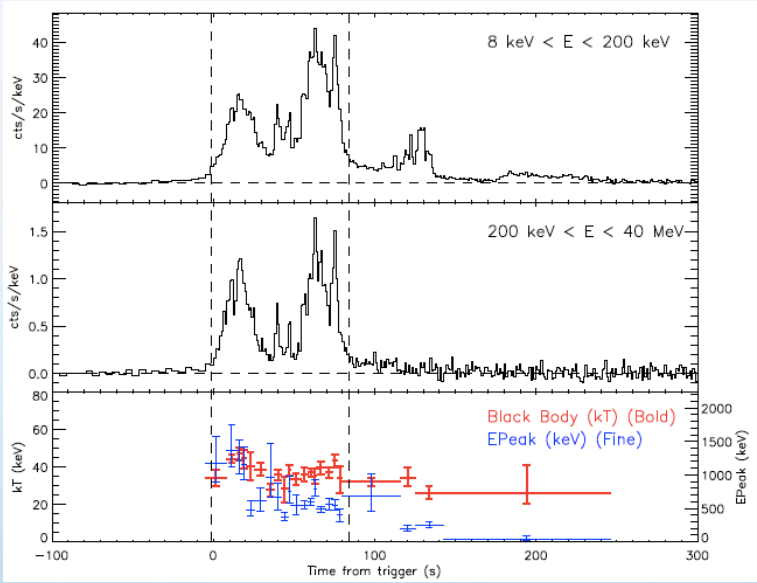
Thermal spectral component

Guiriec et al. 2010

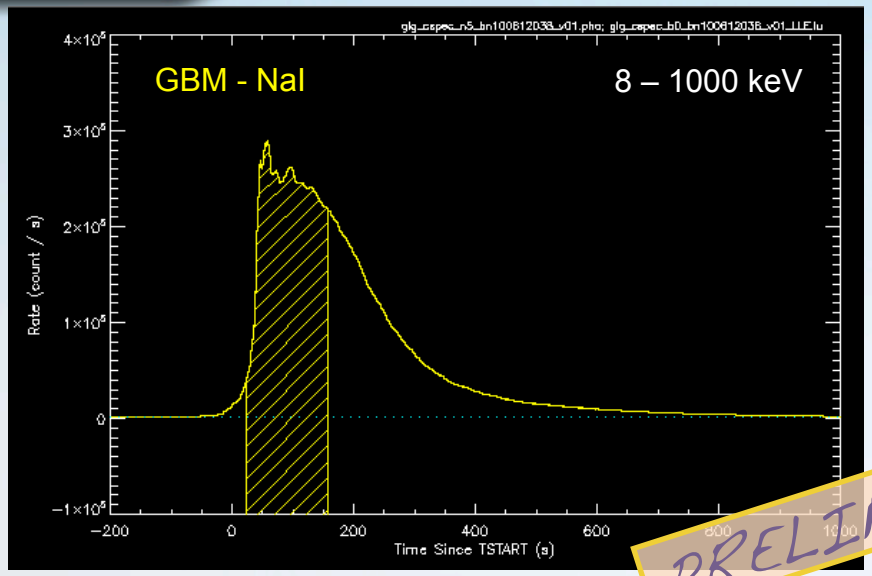
GRB100724B

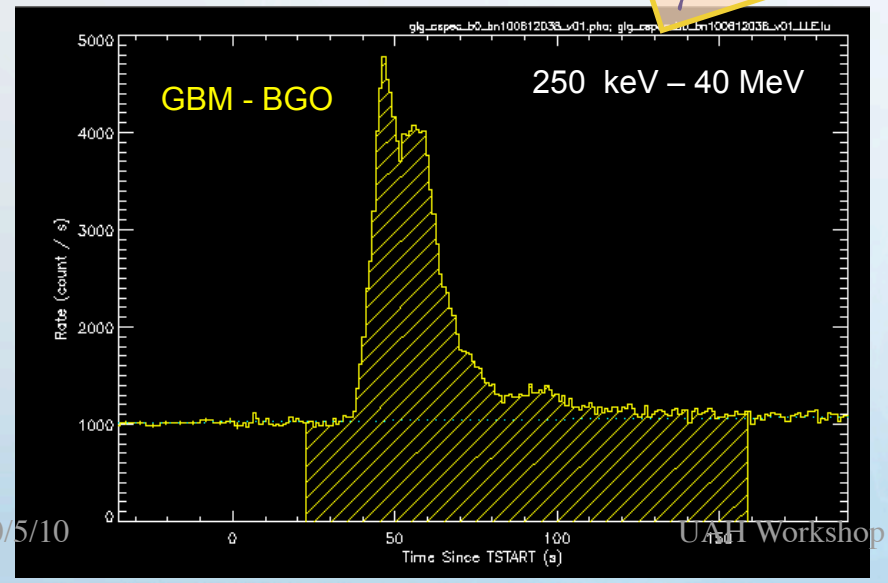


- Band function fit is not the best
- Systematic trends in residuals
- Needs additional blackbody component
- Expected from theory
- Blackbody less variable than non-thermal component

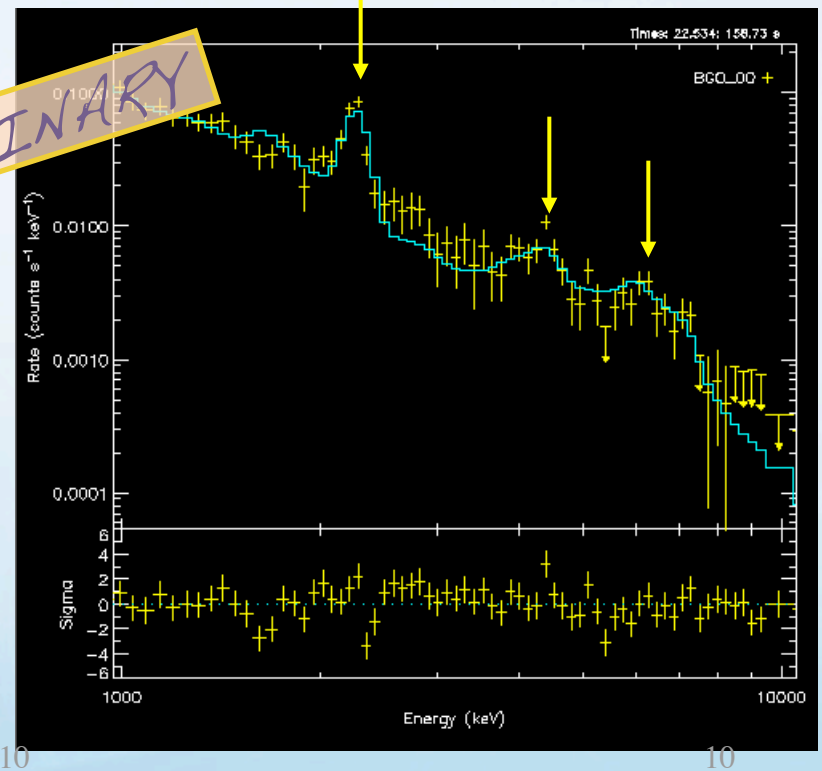


Solar Flares (GBM)





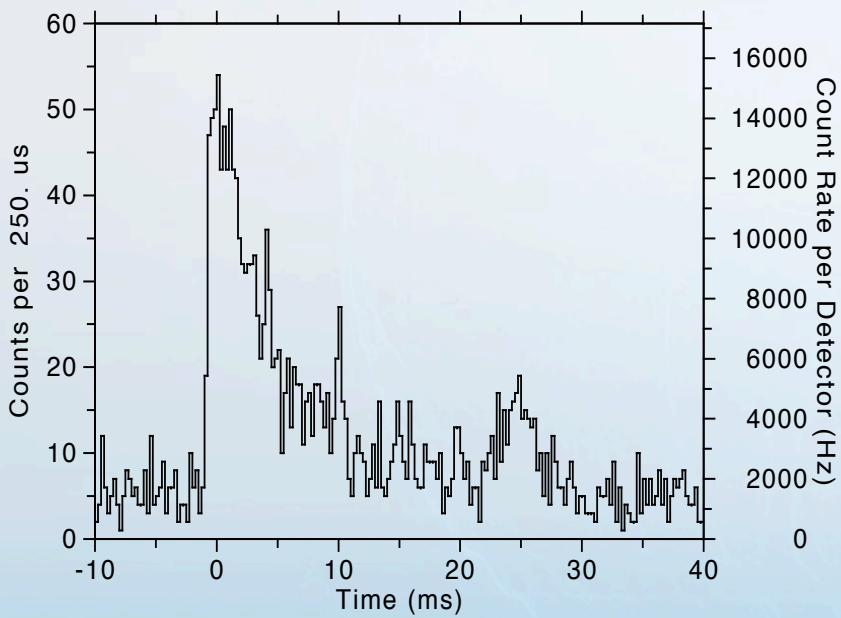
- June 12, 2010: First GBM solar flare with nuclear lines
  - 2.2 MeV ^{1}H neutron capture line
  - 4.4 MeV $^{12}C^{*}$ nuclear interaction line
  - 6.1 MeV $^{16}O^{*}$ nuclear interaction line
- Flare class M2.0

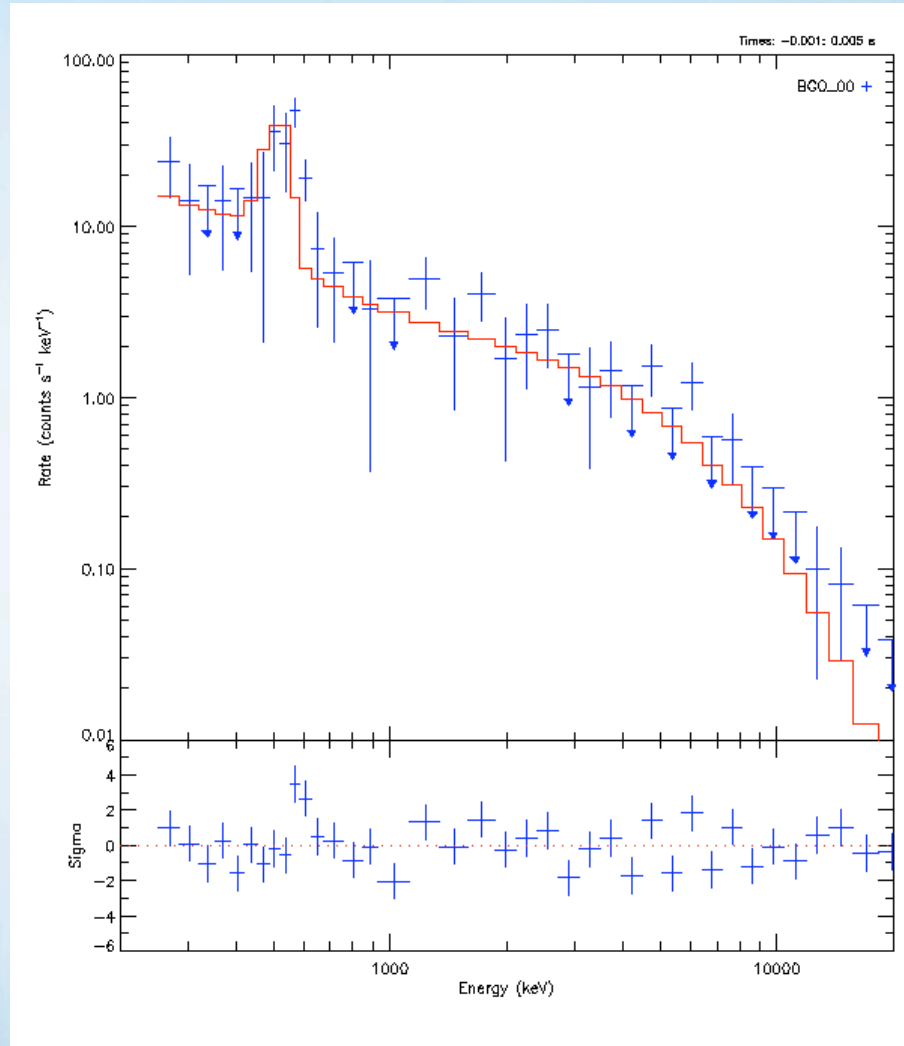


TGF: Direct Particles?

Briggs et al. 2010

- TGF duration distribution is bimodal
- ~10% are much longer
- Direct particles
- GBM sees 511 keV line ➔ positron component

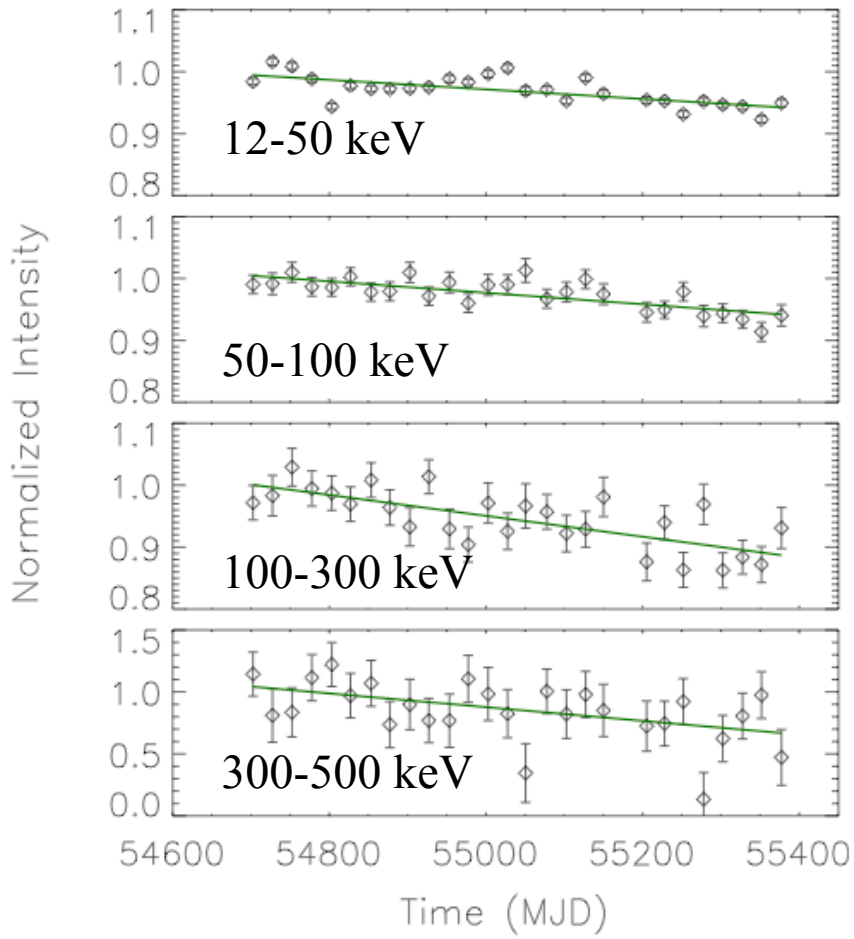




GBM Observations of the Crab Nebula

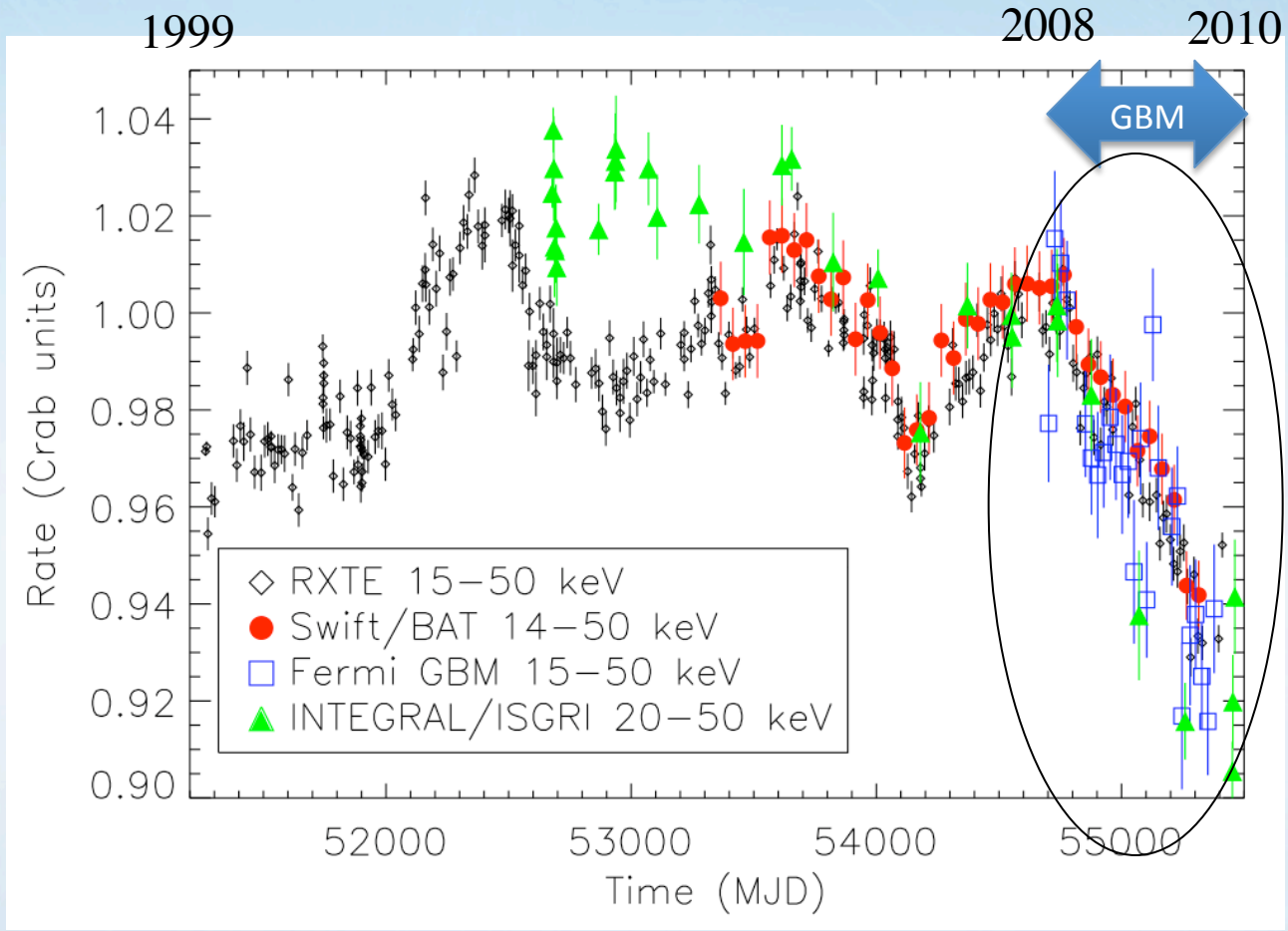
Wilson-Hodge et al. 2010

- 25-day averages
- Normalized to long-term average in each band
- Decline in Crab flux (MJD 54690-55390):
  - 5.4 ± 0.4% 12-50 keV
  - 6.6 ± 1.0% 50-100 keV
  - 12 ± 2% 100-300 keV
  - 39 ± 12% 300-500 keV
- Decline appears larger as energy increases
- No changes in GBM response or calibration



The Crab Flickers!

- In the two years since Fermi's launch, the Crab hard X-ray intensity has faded by 7%!
- First discovered with GBM.
- Confirmed with NASA's Swift and Rossi X-ray Timing Explorer satellites and ESA's INTEGRAL satellite.



Wilson-Hodge et al. 2010

Summary & Near-term Plans

- GBM operations and performance are nominal
  - Trigger rates are in line with pre-launch expectations
  - Repoint recommendations are appropriate
  - Right types of GRBs, acceptable frequency
  - Non-GRB triggers are not a significant burden and many are of scientific interest
- Science results are coming out
  - GRB spectral components, electron/positron TGFs, magnetars, Crab variability, solar flares, etc.
- Collection of untriggered TTE data from a geographical region has been productive
  - Ground search TGF rate: ~1/day
- Operational changes planned for next few months
  - Change geographical region for collection of continuous TTE to winter focus
  - Use two separate regions, one over a portion of Africa and one over northern Australia