PRBEM
Standard Data Analysis Procedure

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PRBEM Presentation

- PRBEM is the COSPAR Panel for Radiation Belt Environment Modeling

- Established to develop a standard model of the Earth's trapped radiation belts using theory and data:

  - Provide guidelines for development and data analysis of radiation monitor

  - Promote critical discussion to establish the quality of datasets

What's on the PRBEM Github (what could be)

- https://github.com/PRBEM contains the following, community maintained projects:
  - The PRBEM website https://prbem.github.io with standard documents:
    - Data analysis procedure
    - Standard file format guidelines for particle fluxes
    - Standard file format guidelines for particle count rates
    - Response file format and organization guidelines
  - The IRBEM library (magnetic field models and magnetic coordinates computation)

- The PRBEM Github could host the discussions for new PRBEM standards and guidelines:
  - Public, traceable discussions plateforme
  - Collaborative writing of the standard (e.g. using Markdown)

- Other collaborative, open-source libraries could be hosted here too

PRBEM Data Analysis Procedure (DAP)

- Available on the PRBEM website :

    https://prbem.github.io/docs/

- Goal of the document: propose baseline and safe data analysis methodologies for space radiation measurements to improve space radiation models

- Defines:
    - Coordinates computation
    - Cross-contamination detection and removal
    - Background levels identification
    - Inter-calibration

- The DAP could benefit from an update, proposed axes of amelioration are written in green

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Coordinates definition and computation

- We should compare different instruments observation at the same locations. If the instruments are not on the same satellite, we need to know their position using appropriate coordinates systems: magnetic coordinates (L*, equatorial pitch angle, MLT)

- The PRBEM DAP specify the magnetic field model for the coordinates computation:

         IGRF + Oltson-Pfitzer Quiet-Time 1977(OPQuiet)

- This model is fast to compute and can be computed without external data (so for all missions), but only applies to quiet times…

- What about populations only observed during disturbed times?

- How to properly account for magnetic field uncertainties?

Data contamination

- ## Guidelines for data filtering :
  - of SEP and trapped protons contamination in electron channels
  - of relatistic electrons contamination in proton channels

- ## Possibility to automate the fitting process in correlation plots?
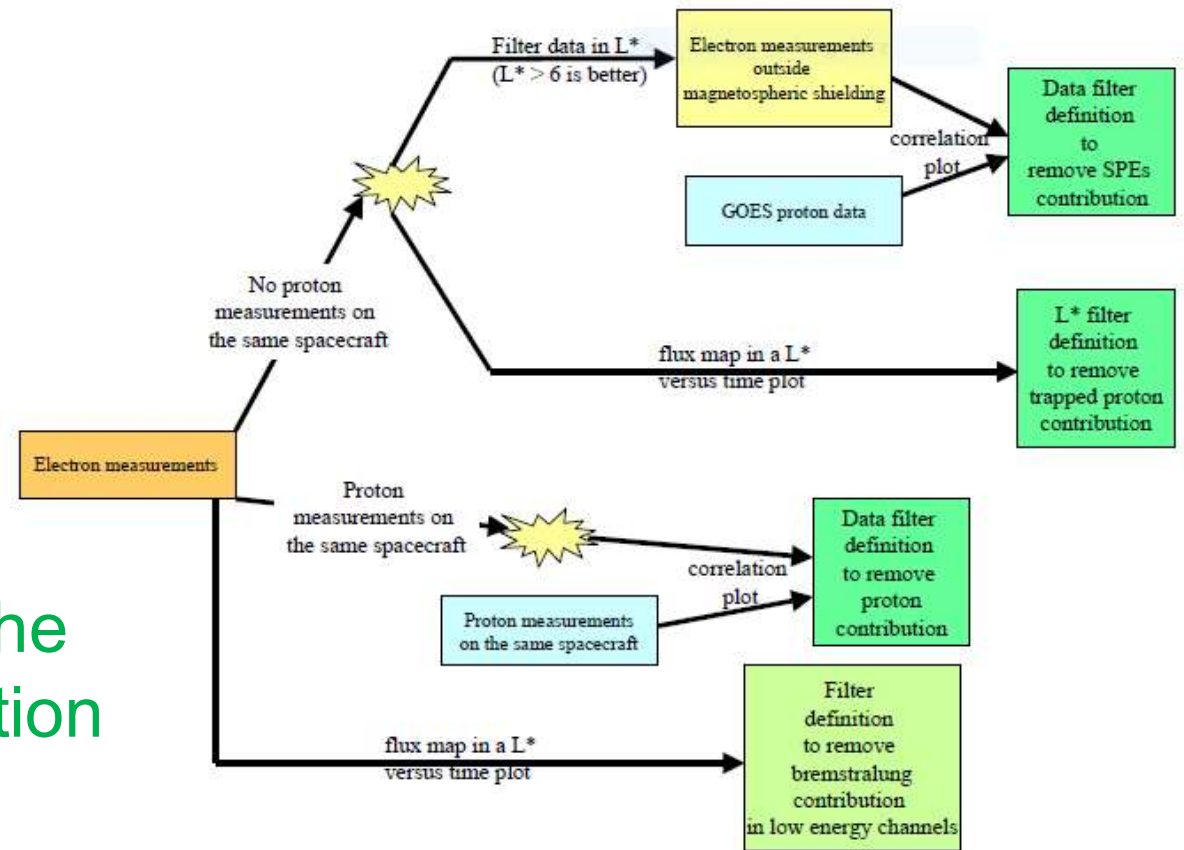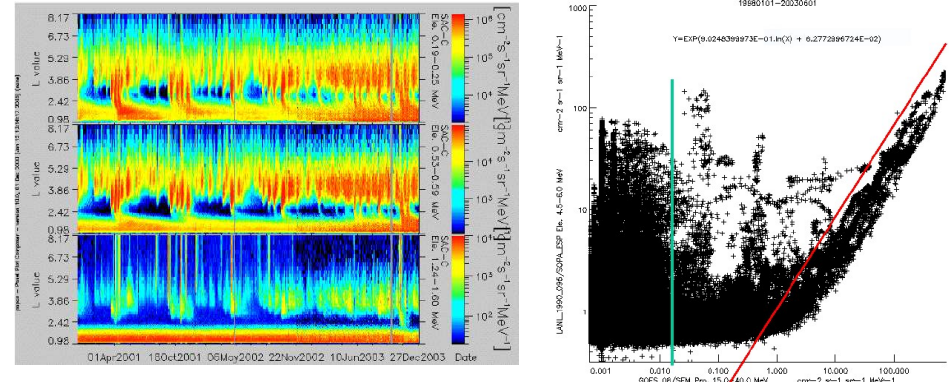
Background and saturation

- Guidelines for detection and filtering of background noise, particularly GCR induced background (with solar-cycle dependency)

- Detection of Poisson uncertainties/discretisation errors

- The DAP mentions background correction (substracting GCR from fluxes) and data removal (instead of flagging)

- Saturation: No mention of dead time correction in the DAP

Background

Saturation

E2:678 keV
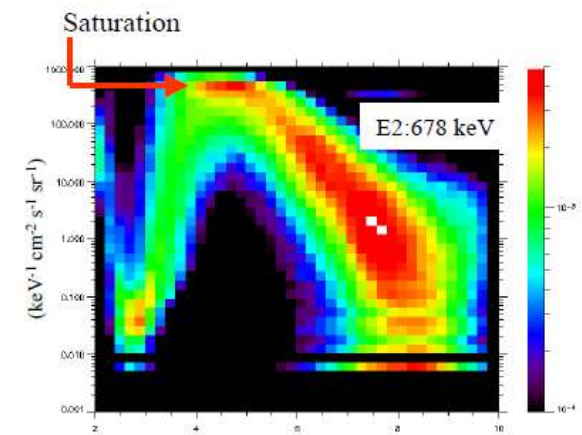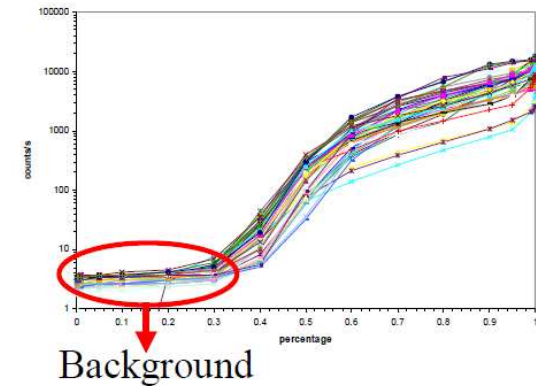
Inter-calibration on trapped particle dynamics

- Guidelines for on-orbit calibration scaling the spectra to a « gold standard »:
  - CRRES/MEA for electrons 300keV-1.6MeV
  - GOES8/SEM for protons 10-100MeV
  - Newer missions should probably be considered here
- Find calibration factors for a set of conjunctions, take the average excluding outliers
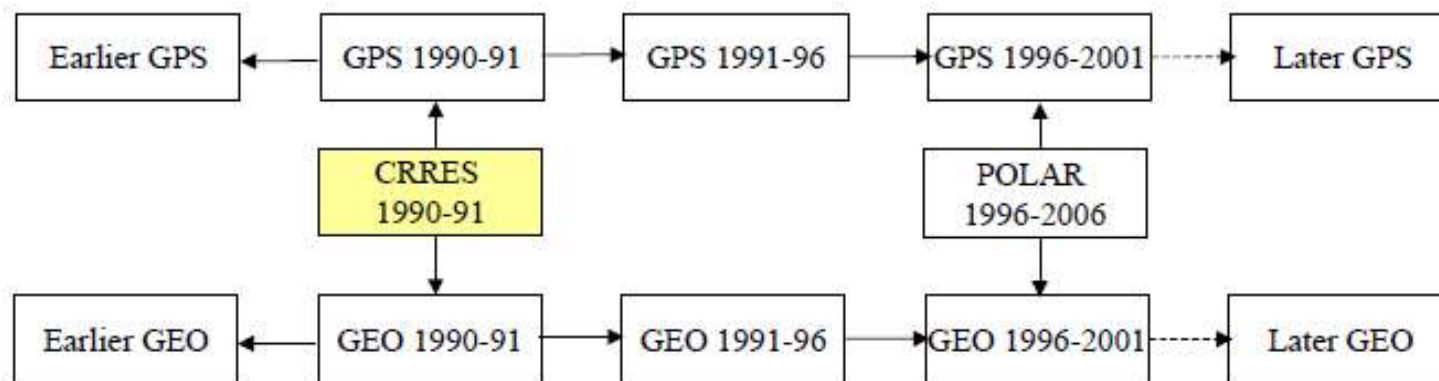
Conjunctions

- ## Conjunctions definition:

  1. $L^* < 6.$ and $\Delta L^* < 0.1$

  2. $\Delta(B/B_{eq}) < 0.1$ and B/B_{eq} as close as possible to one

  3. Magnetic Local Time (MLT) within 2 hours of 06 :00 and 18 :00

  4. Magnetospheric activity quiet ($Kp < 2$) for two days before conjunction

  5. $\Delta t < 3$ hours

  6. Particle energy > 100 keV (particle must be trapped)

- These conditions are sometimes too strict (esp. in GEO) to provide a reasonable number of conjunctions, but reduce the impact of magnetic field uncertainties

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Inter-calibration on SEP

- Calibration of high energy proton (>5MeV) observation outside of the geomagnetic shielding:
  - L*>7, or
  - L*>5.5 and Ec>10MeV for GEO

- Proton fluxes should be very well correlated during SEP events

- What about anisotropy during SEP onset?
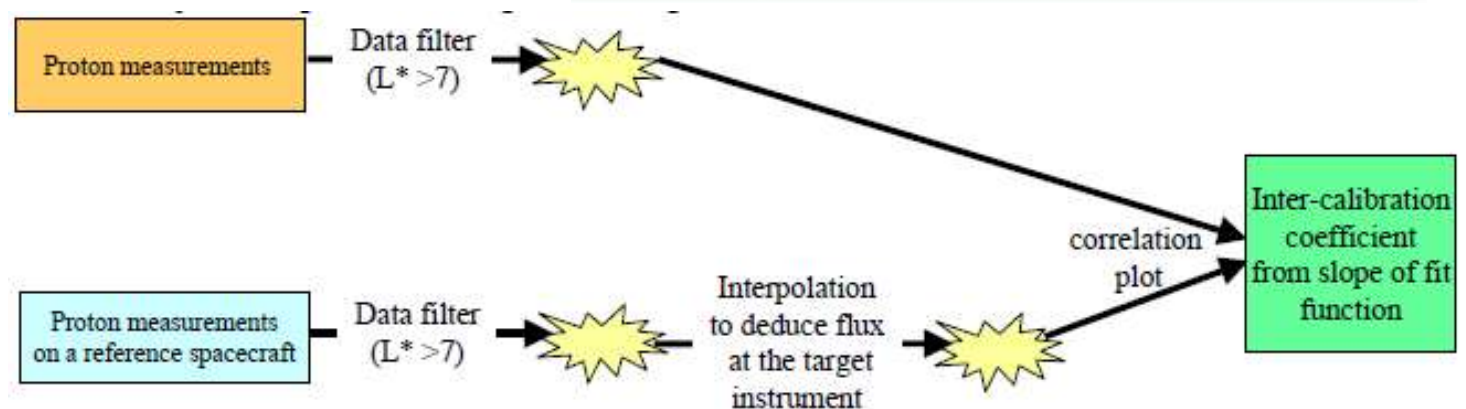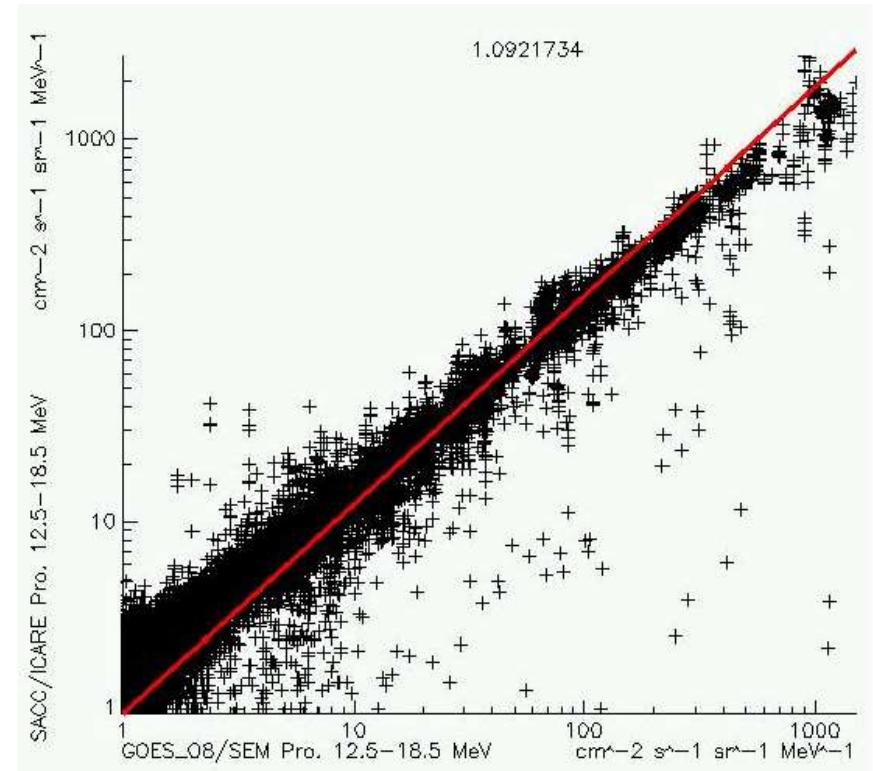
Conclusion

- The PRBEM Data Analysis Procedure gives general guidelines for the processing of trapped particles observation

- The document hasn't been updated for a while, and a new version could be written:

  - Standard magnetic field model to use

  - Updated definitions for the « gold standard »

  - Standardization/guidelines for inversion

  - How to manage non-omnidirectional fluxes?

  - etc.

- The PRBEM would be a fitting frame for this discussion and the writting of these updated guidelines