Cross-Calibration of GOES-11 and -13 Helium Channels

ESWW15
Harmonisation of SEP Data Calibrations Topical Discussion Meeting
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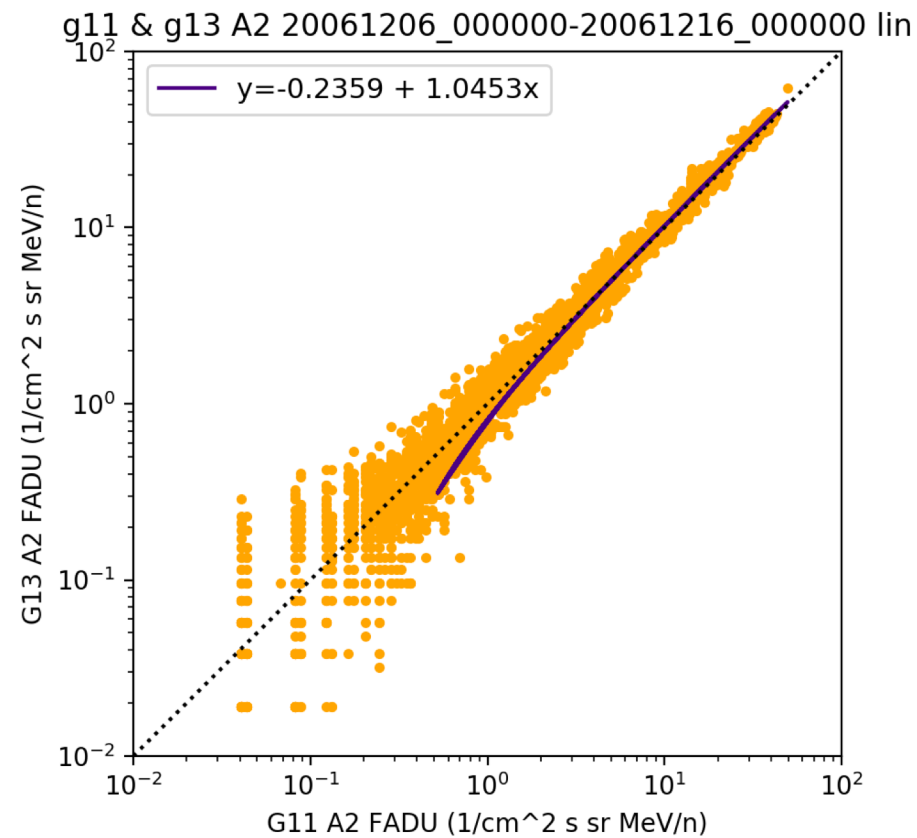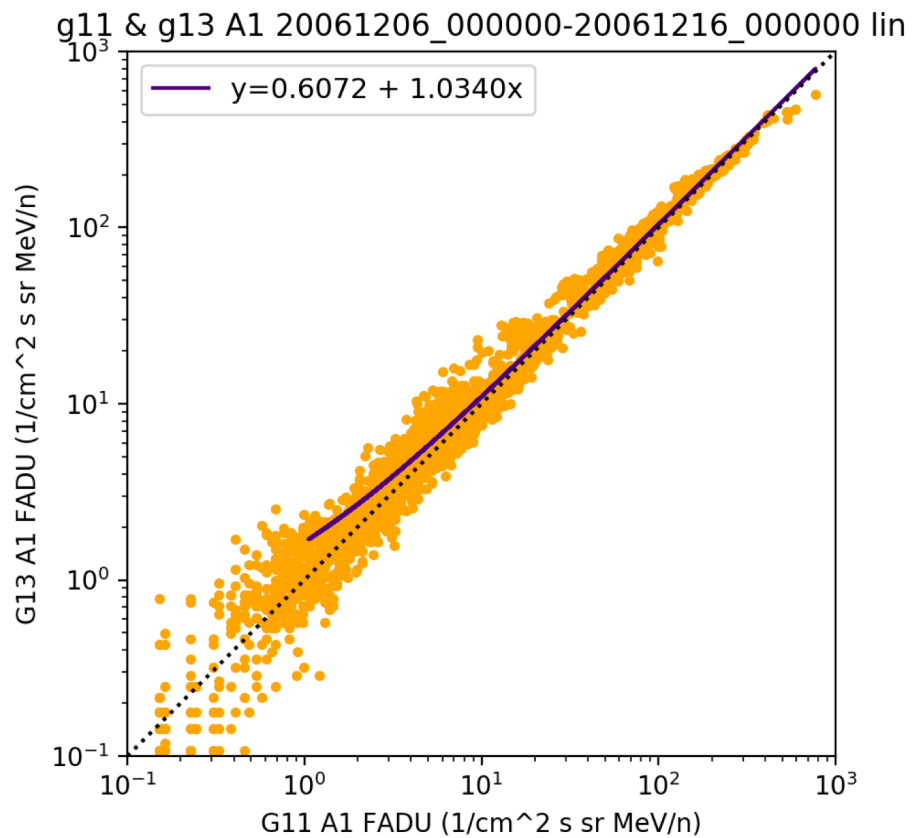
Introduction

- The December 2006 SEP events provide the only opportunity to cross-calibrate solar proton and helium measurements from the GOES 8-12 series and the GOES 13-15 series (identical designs)

- Cross-calibration of GOES-10 and -13 protons during these events was reported by Rodriguez et al. (2014)

- Similar cross-calibration has not been performed between GOES solar alpha (helium) channels

- Motivated by use of SEPEM RDS v2 GOES-11 effective energies for GOES-13 and -15 helium fluxes: what is the error in this?
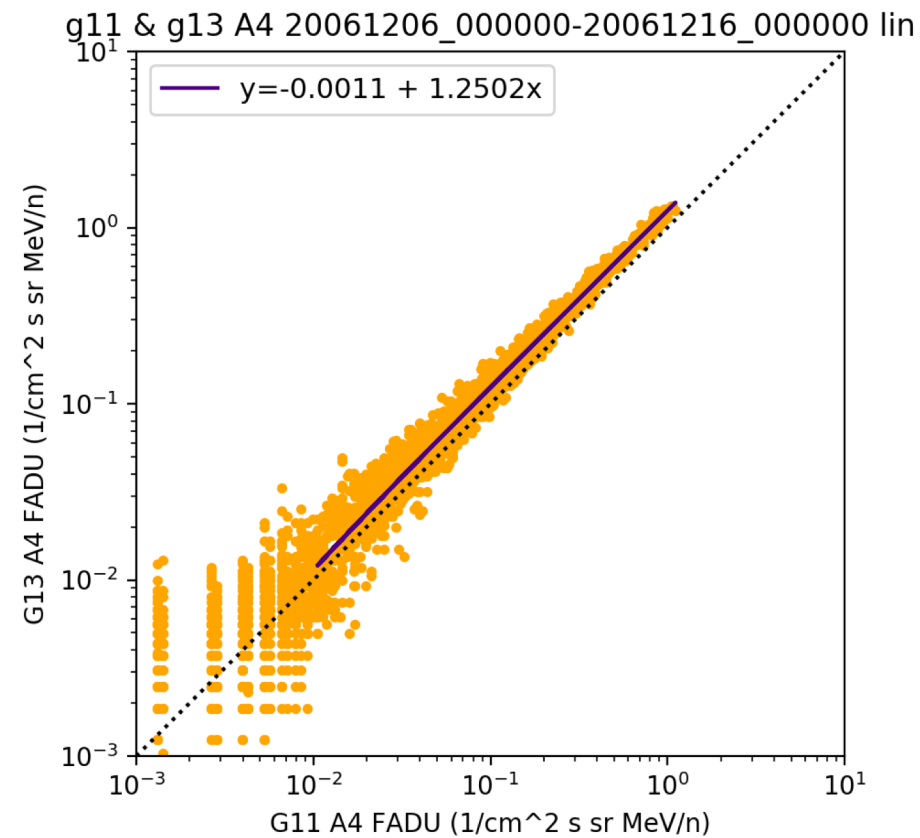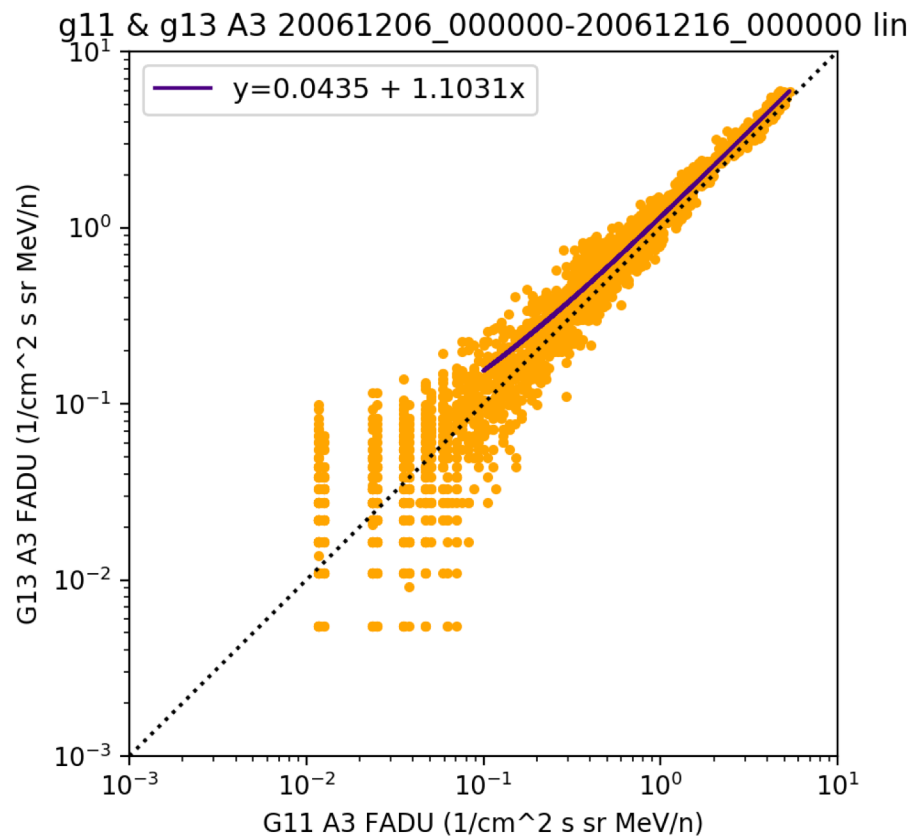
Analysis Approach

- GOES-11 and GOES-13A looking westward (GOES-13 inverted) during the December 2006 events
  - Need solar wind Pdyn ≥ 10 nPa to cross-calibrate eastward-looking data (GOES-13B) – such data are sparse
- Approach:
  - This presentation: Cross-calibrate GOES-11 and GOES-13A (looking <u>westward</u>) during December 2006
    - Used Theil-Sen regression
  - Future: Cross-calibrate GOES-13A (looking <u>eastward</u>) with GOES-13B and GOES-14 and -15 using SC24 SEP events to transfer effective energies from GOES-11
- GOES-13 EPEAD proton and alpha data from Dec 2006 have been released to public by NCEI
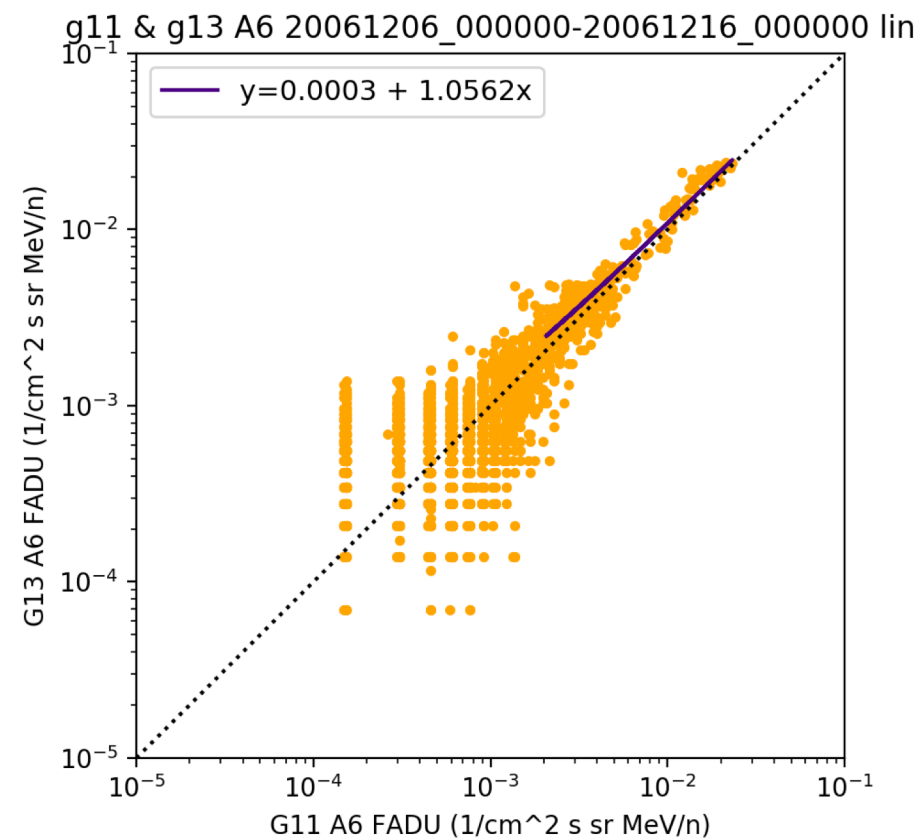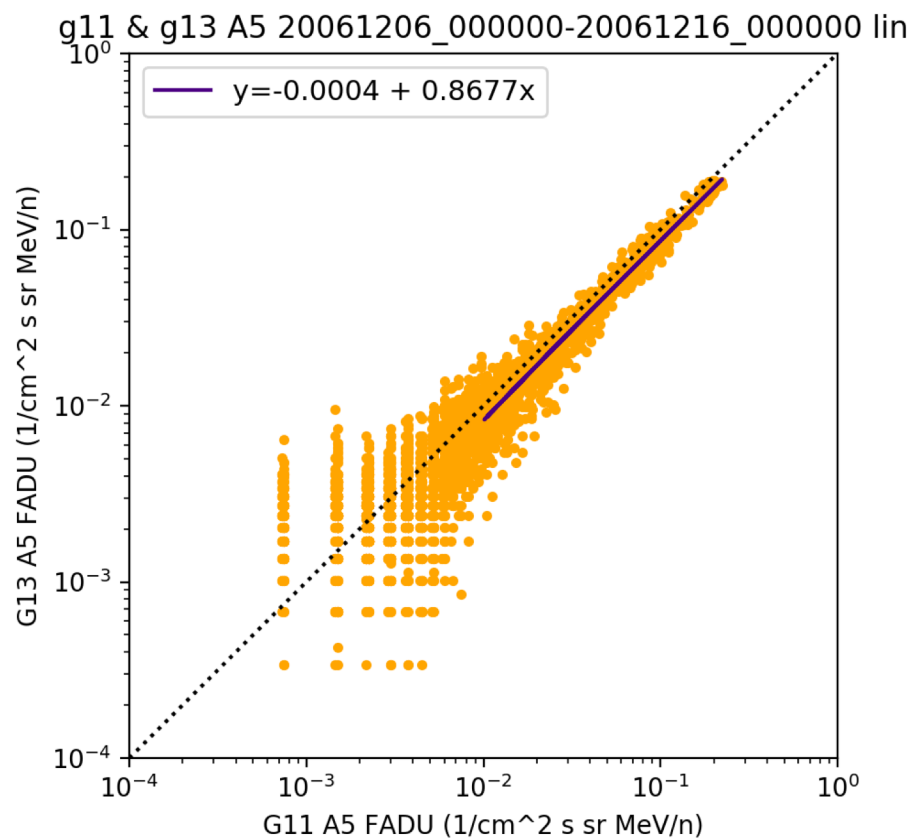
A1 (1.6 MeV/n) and A2 (3.7 MeV/n)

A3 (8.7 MeV/n) and A4 (17.4 MeV/n)

g11 & g13 A3 20061206_000000-20061216_000000 lin

y=0.0435 + 1.1031x

g11 & g13 A4 20061206_000000-20061216_000000 lin

y=-0.0011 + 1.2502x

A5 (39.3 MeV/n) and A6 (77.8 MeV/n)

g11 & g13 A5 20061206_000000-20061216_000000 lin

y=-0.0004 + 0.8677x

G13 A5 FADU (1/cm^2 s sr MeV/n)

G11 A5 FADU (1/cm^2 s sr MeV/n)

g11 & g13 A6 20061206_000000-20061216_000000 lin

y=0.0003 + 1.0562x

G13 A6 FADU (1/cm^2 s sr MeV/n)

G11 A6 FADU (1/cm^2 s sr MeV/n)

Equate Cross-Calibration Differences to Effective Energy Differences

$$j_{13} = k \ j_{11}$$

$$j_{11} = j_0 \ E_{eff,11}^{-\gamma}$$

$$j_{13} = j_0 \ E_{eff,13}^{-\gamma} = k \ j_0 \ E_{eff,11}^{-\gamma}$$

$$E_{eff,13} = k^{-1/\gamma} \ E_{eff,11}$$

$$\text{Assume } \gamma = 4$$

	k	k^(-1/gamma)	Eeff,11	Eeff,13	Eeff,13/Eeff,11
A1	1.0340	0.9917	1.598	1.585	0.9917
A2	1.0453	0.9890	3.717	3.676	0.9890
A3	1.1031	0.9758	8.680	8.470	0.9758
A4	1.2502	0.9457	17.450	16.503	0.9457
A5	0.8677	1.0361	39.320	40.740	1.0361
A6	1.0562	0.9864	77.790	76.734	0.9864

- Largest error in GOES-13A alpha channels effective energies using GOES-11 energies is 5.4% (A4)
- This level of error may not be of concern to many data users
- Such a correction is necessary if flux errors <25% are needed