



Air Force Research Laboratory



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Atmospheric and
Environmental Research



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AE9/AP9 V1.50.001 Model Comparison Summary Report: Standard Orbit Comparisons

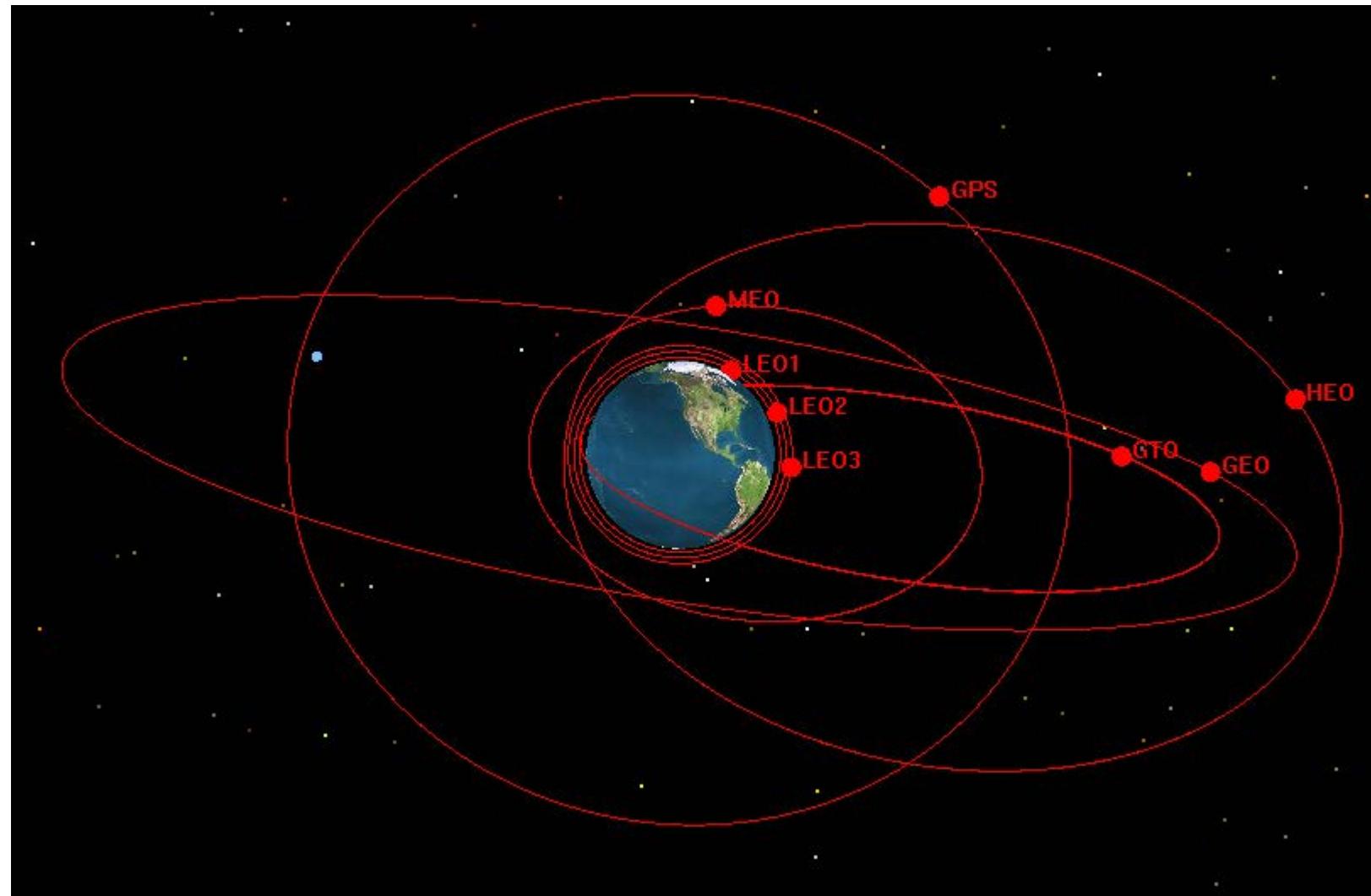
28 September 2017

AE9/AP9/SPM Development Team

Note: SPM results are
unchanged from V1.20



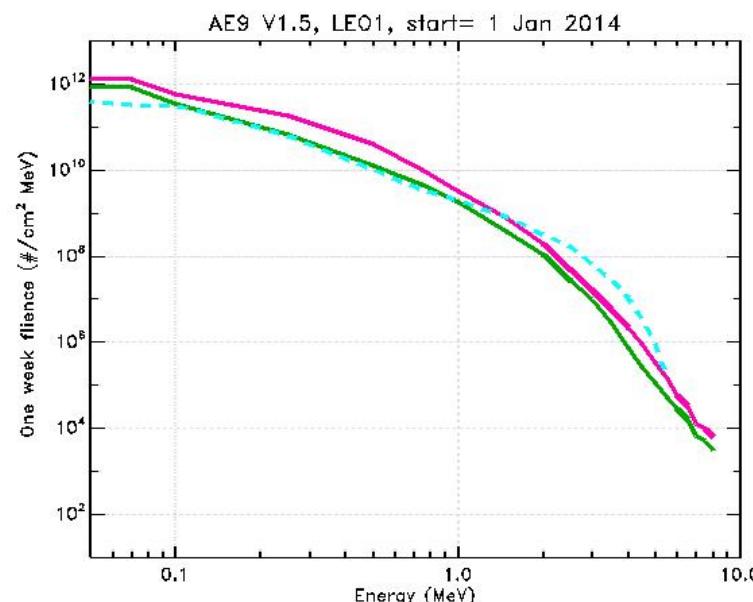
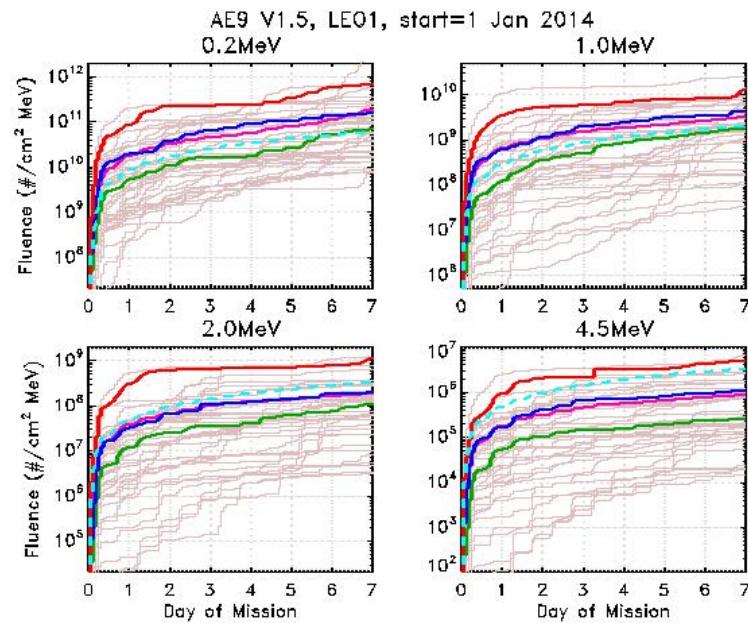
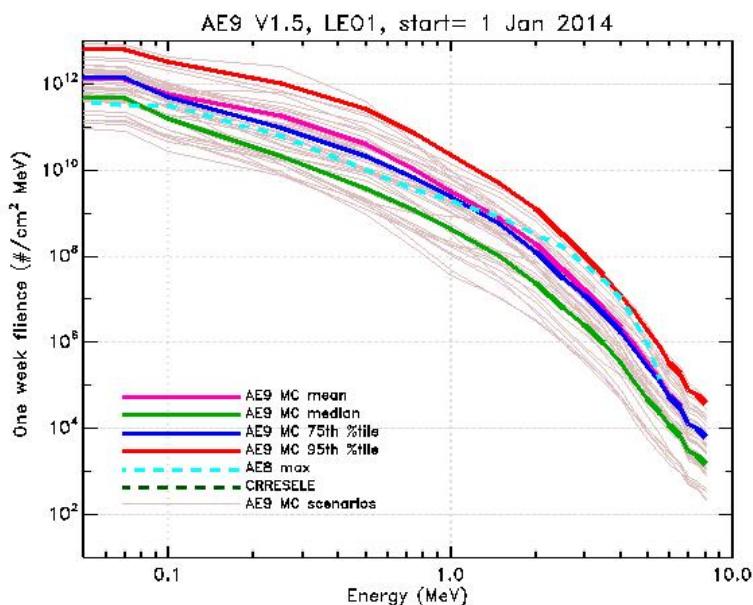
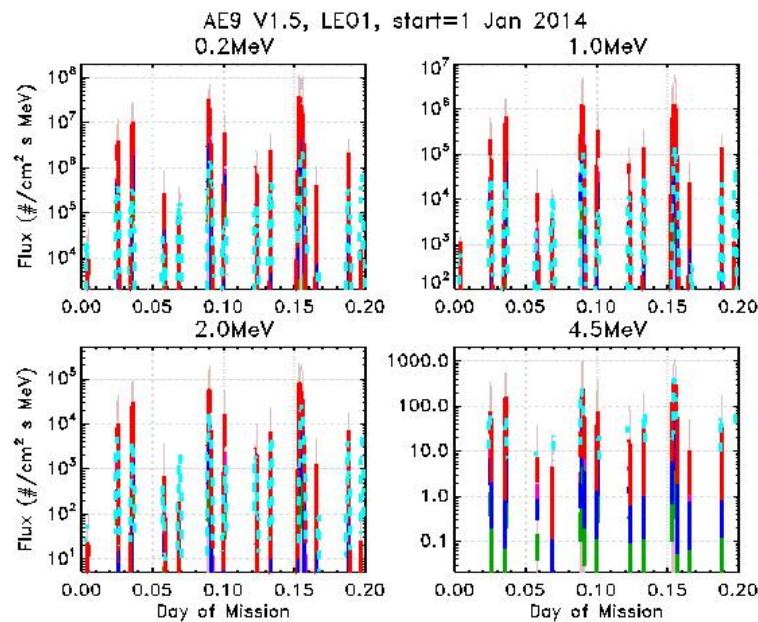
AE9/AP9/SPM Comparison to Other Models



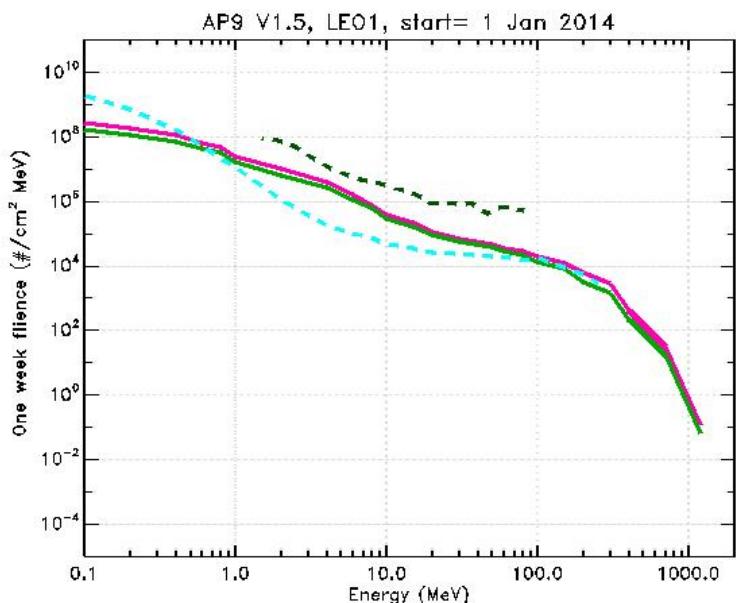
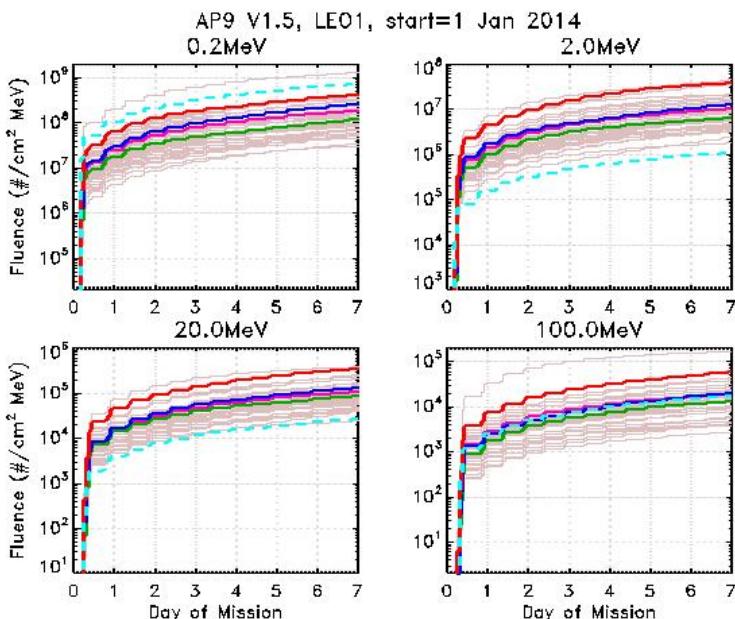
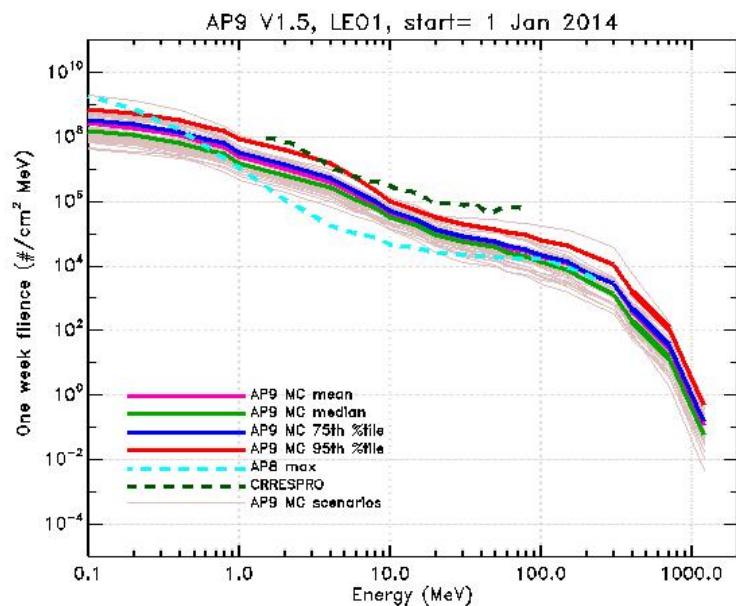
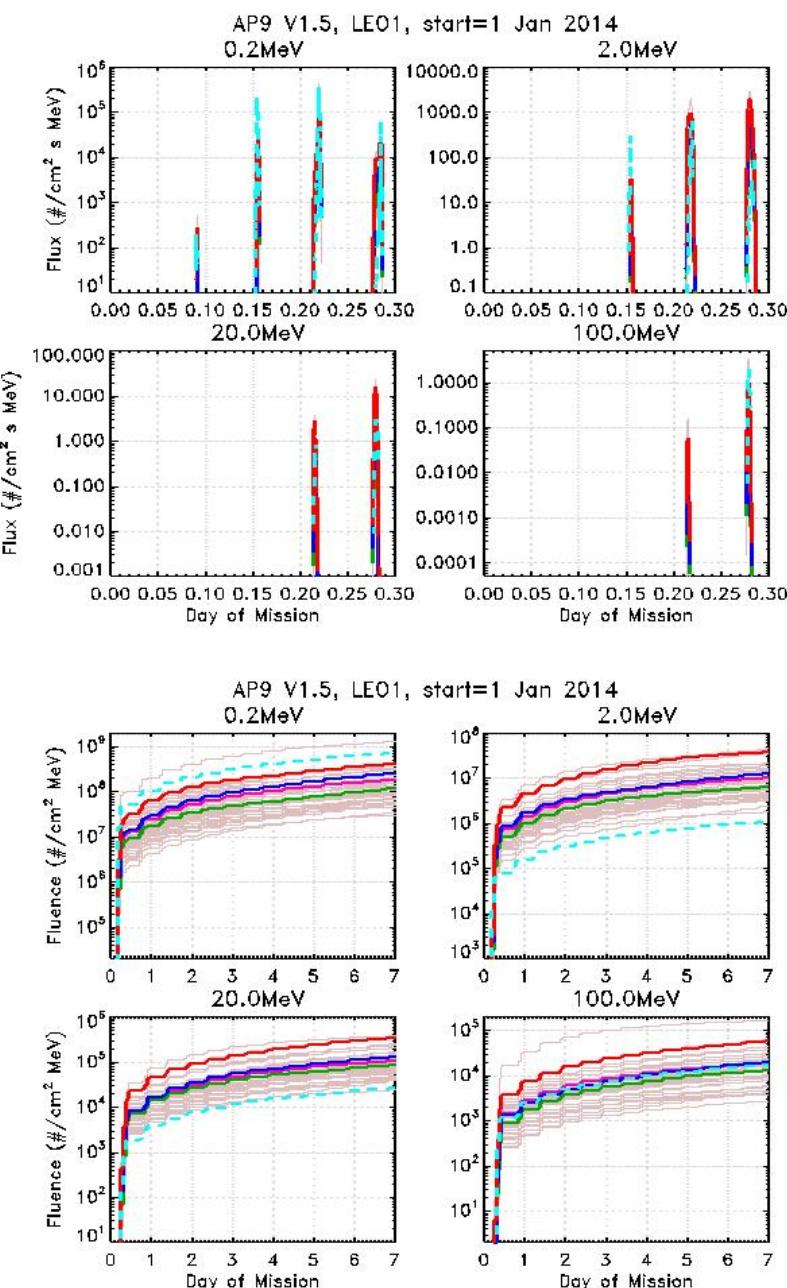
Orbit	Apogee (km)	Perigee (km)	Incl. (deg)	Models Compared
LEO-1	400	400	90.0	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE
LEO-2	800	800	90.0	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE
LEO-3	1200	1200	90.0	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE
GTO	30600	500	10.0	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE
HEO	38900	1475	63.4	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE
MEO	14100	3900	120.0	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE
GPS	20200	20200	55.0	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE
GEO	35786	35786	0.0	AP8, AE8, CRRESELE, CRRESPRO, CAMMICE, LANL-2007, IGE-2006

- All scenarios run for 2 weeks mission time (minimum)
- AE9/AP9 mean, perturbed mean (40 scenarios) and Monte-Carlo (40 scenarios) computed
- SPMH/SPMHE/SPMO/SPME mean and perturbed mean (40 scenarios) computed
- Summarized in this set of charts:
 - AP9/AE9 - Monte-Carlo flux and fluence vs time; Monte-Carlo and mean spectra
 - SPM – Perturbed mean flux and fluence vs time; perturbed mean and mean spectra

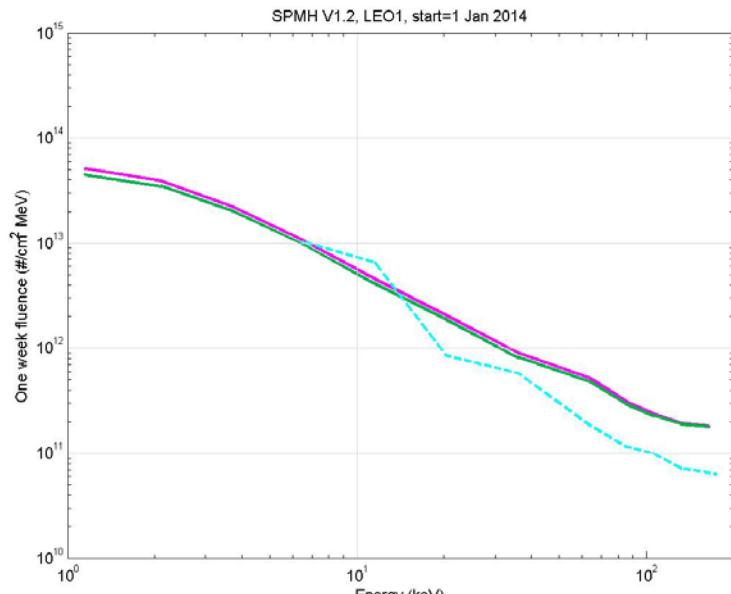
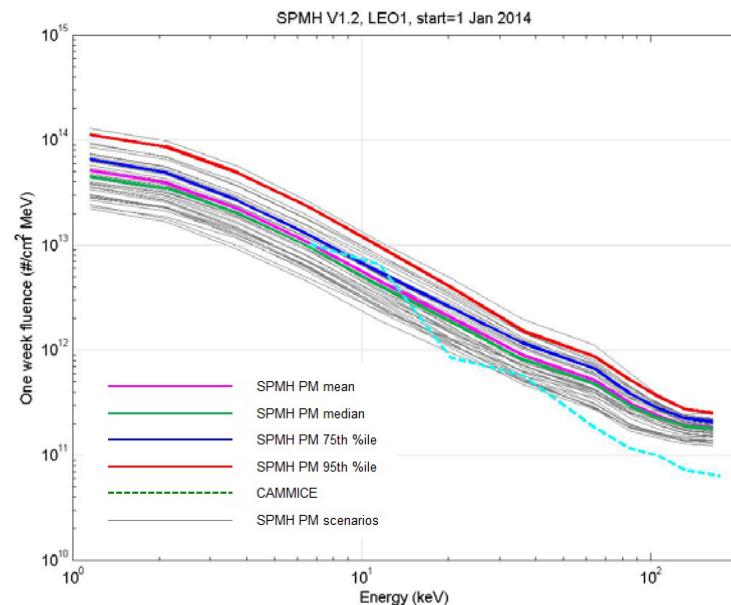
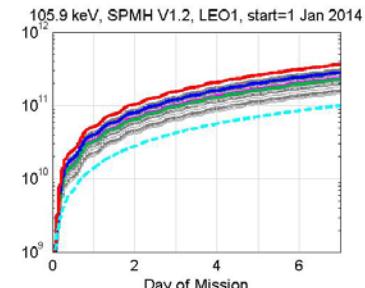
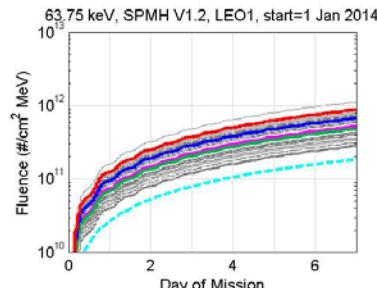
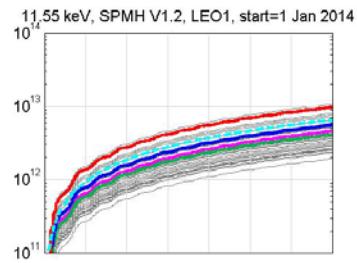
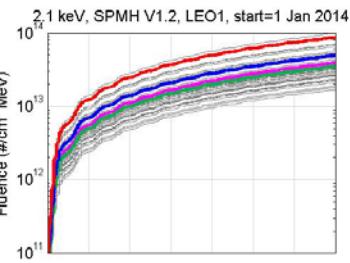
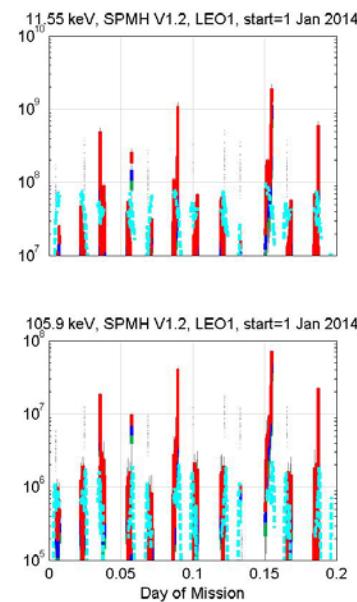
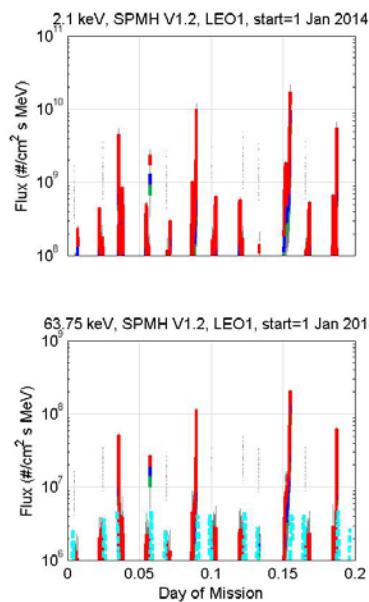
LEO1

AE9**LEO1 (400 km circular, 90 deg)**

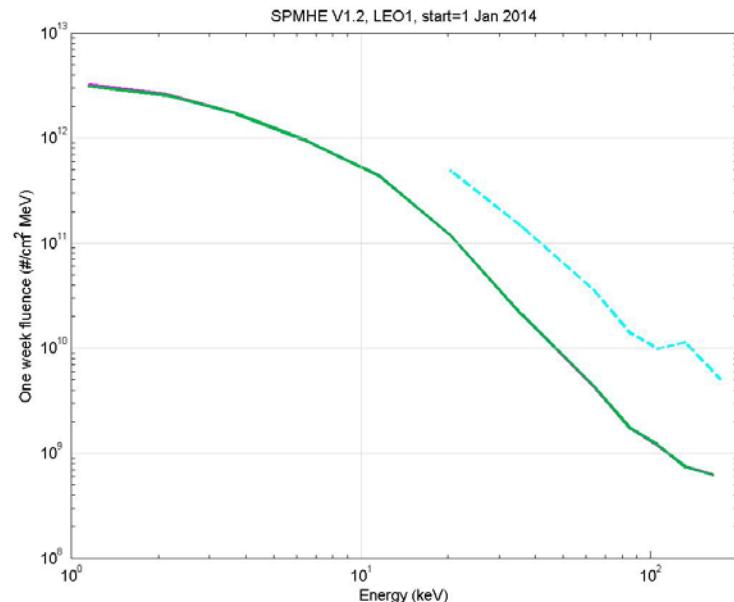
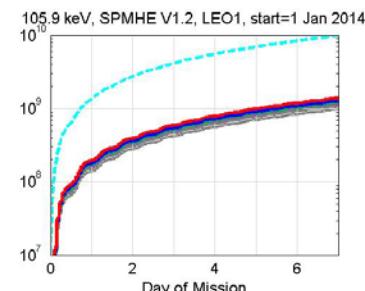
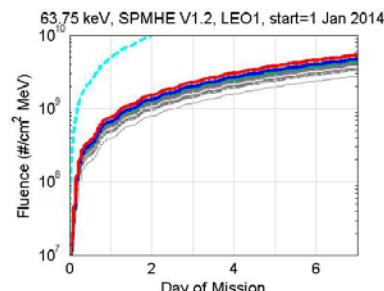
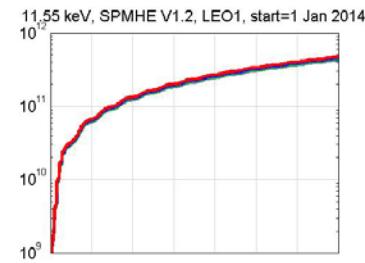
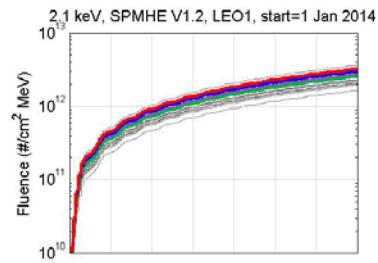
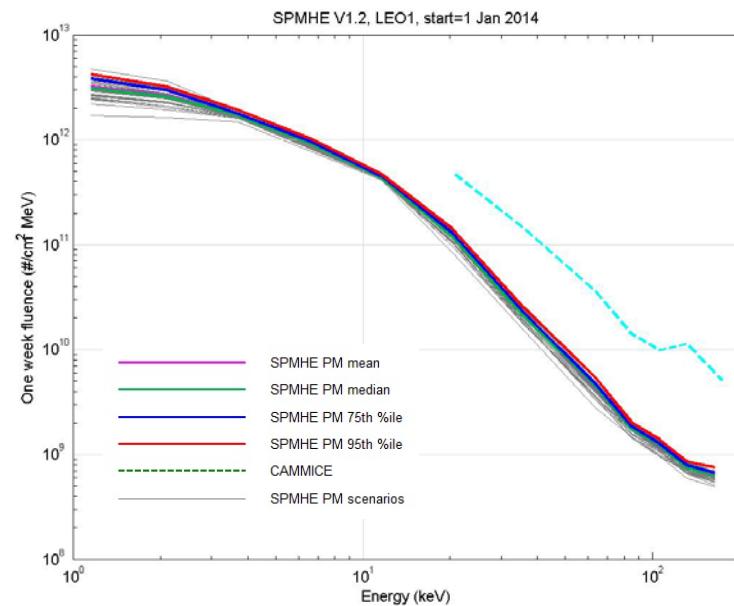
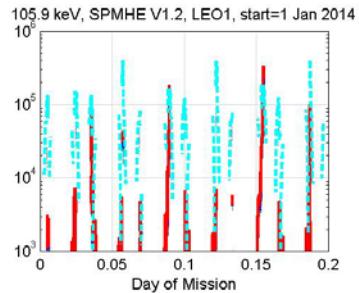
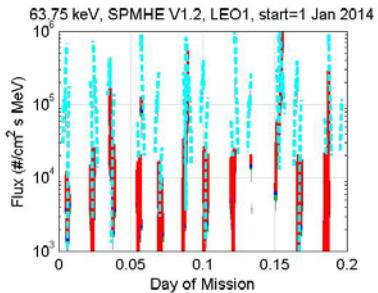
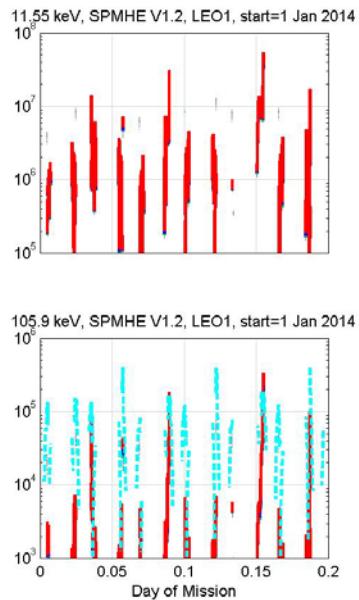
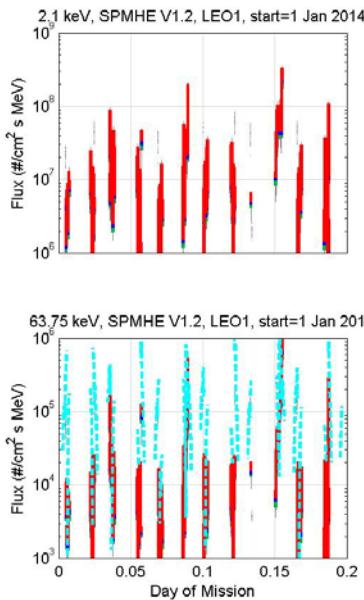
Distribution A

AP9**LEO1 (400 km circular, 90 deg)**

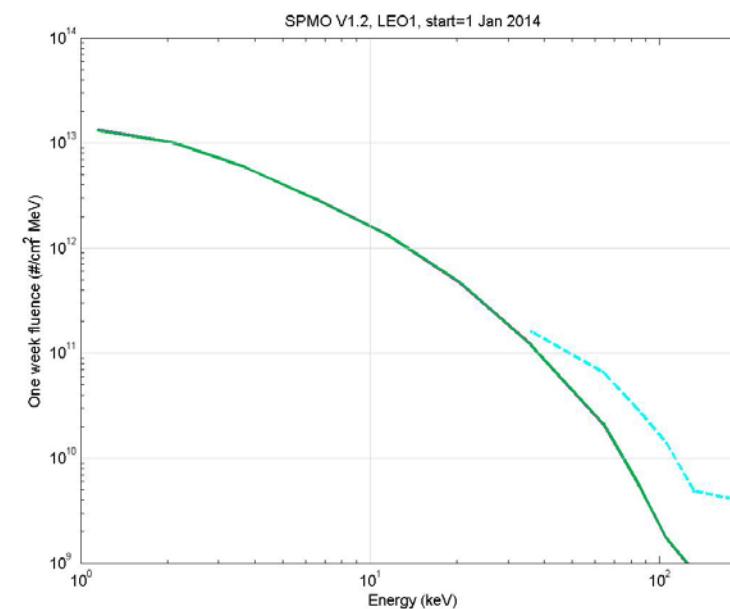
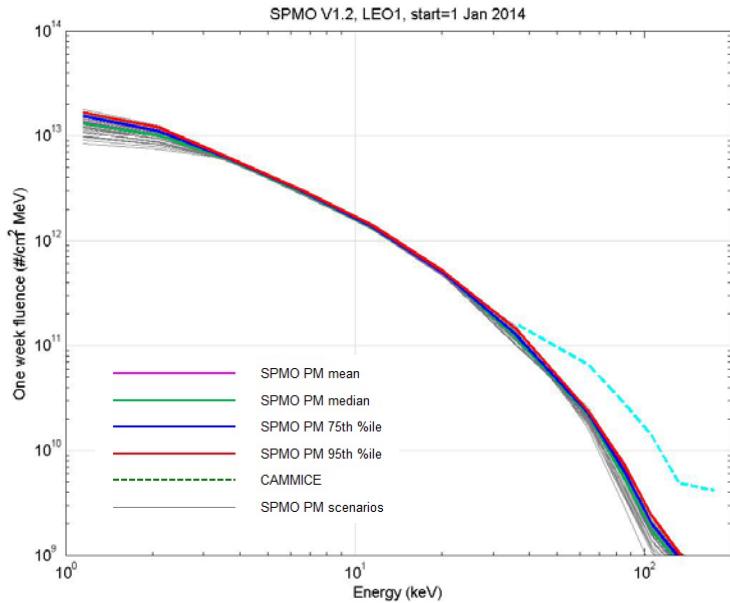
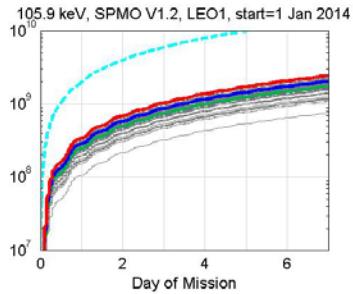
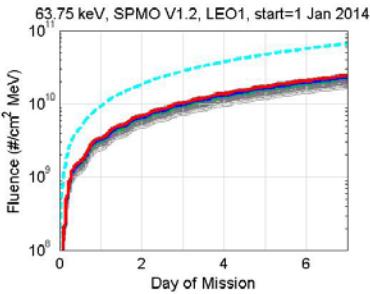
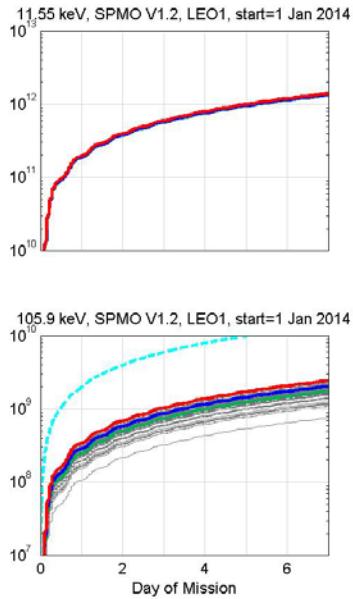
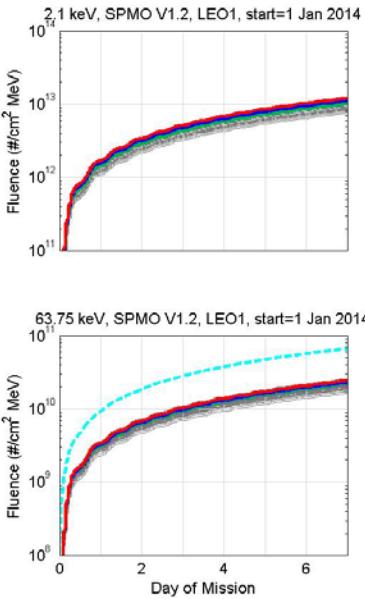
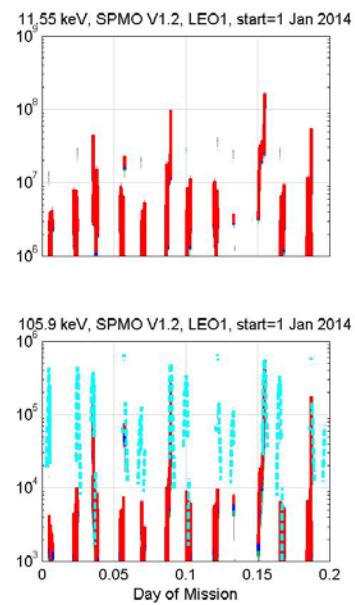
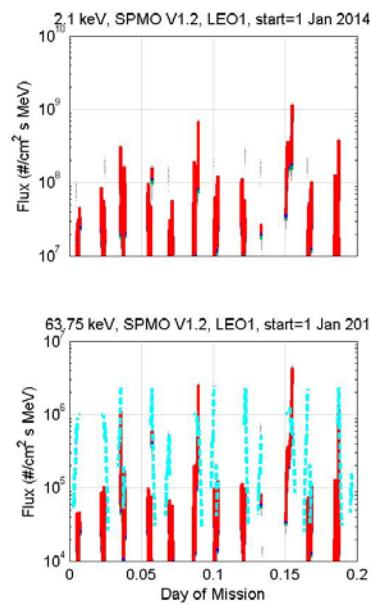
Distribution A

SPMH**LEO1 (400 km circular, 90 deg)****Distribution A**

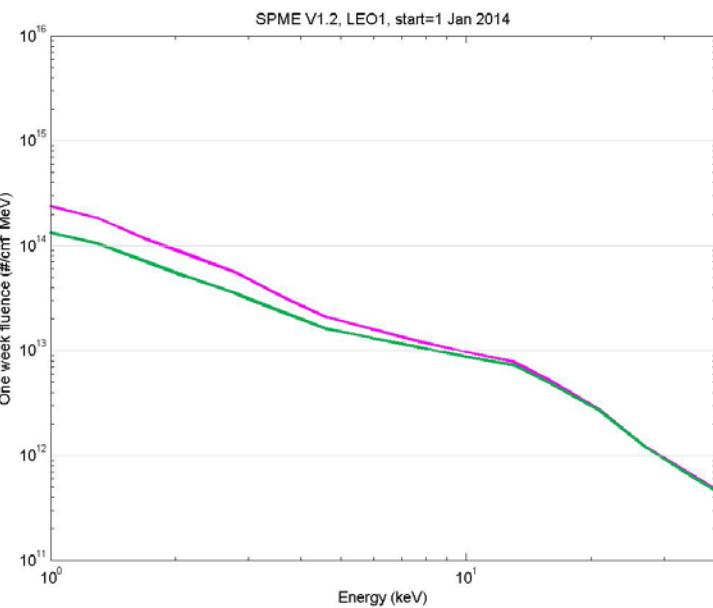
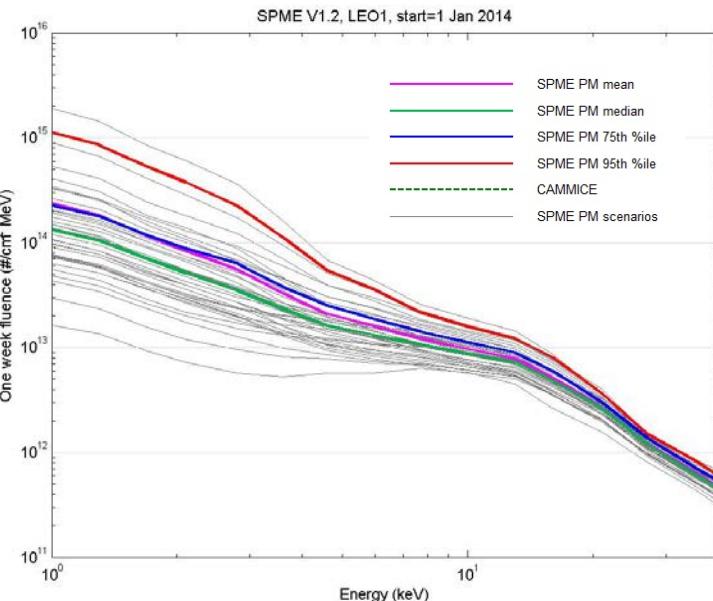
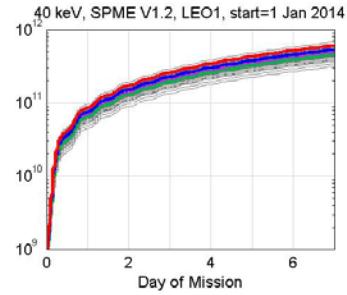
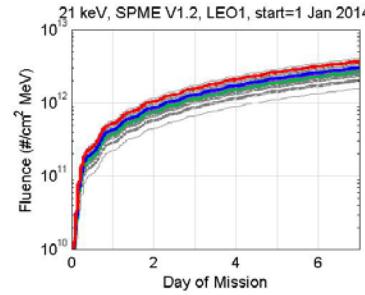
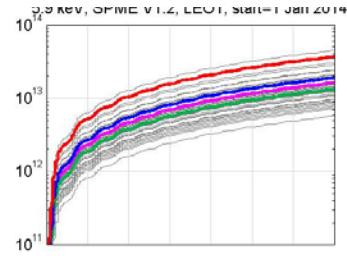
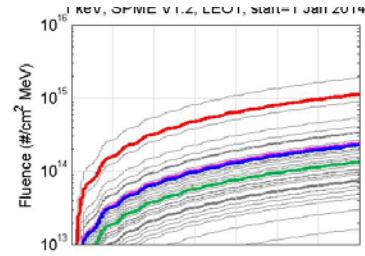
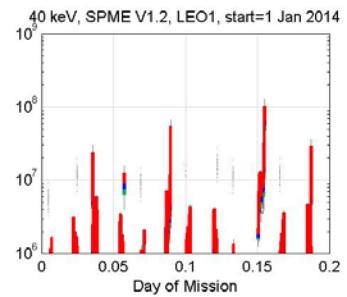
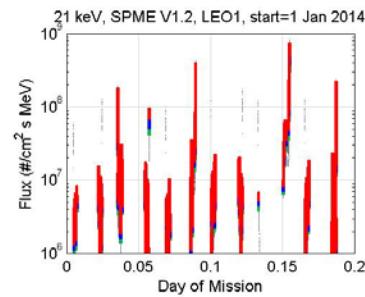
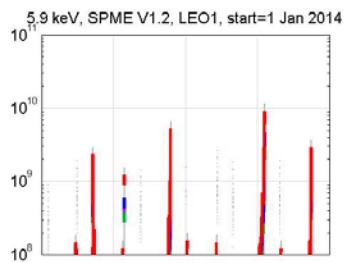
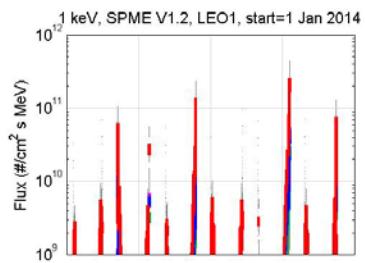
SPMHE LEO1 (400 km circular, 90 deg)



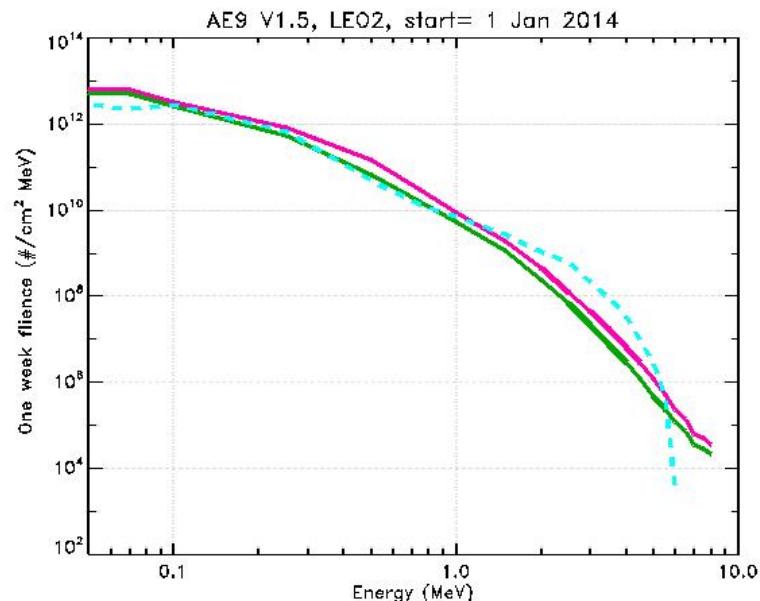
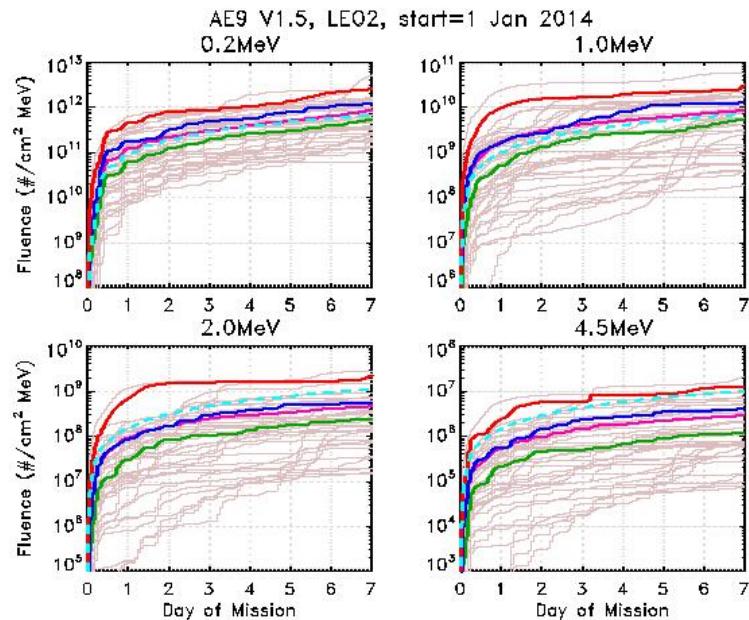
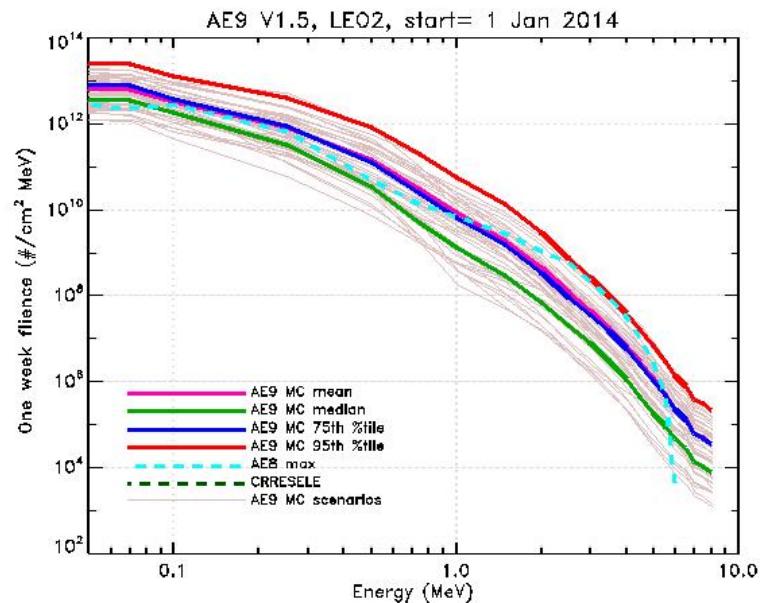
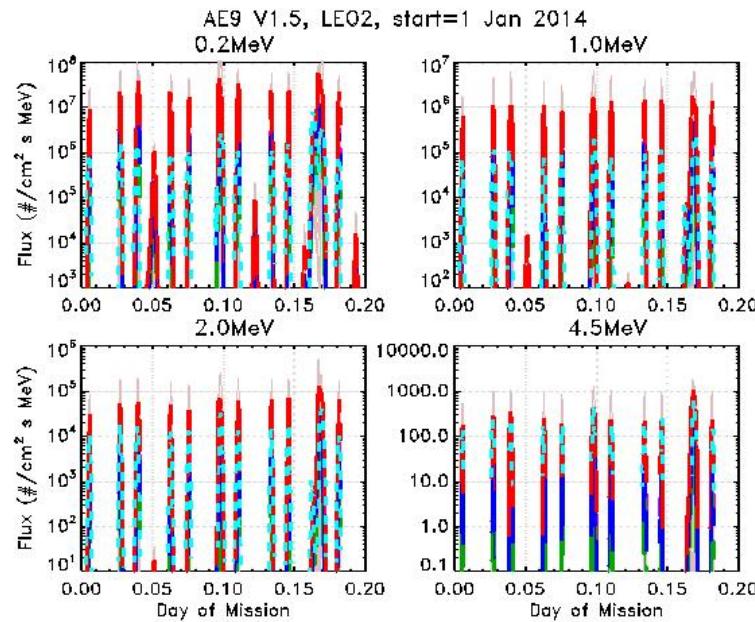
Distribution A

SPMO**LEO1 (400 km circular, 90 deg)**

Distribution A

SPME**LEO1 (400 km circular, 90 deg)****Distribution A**

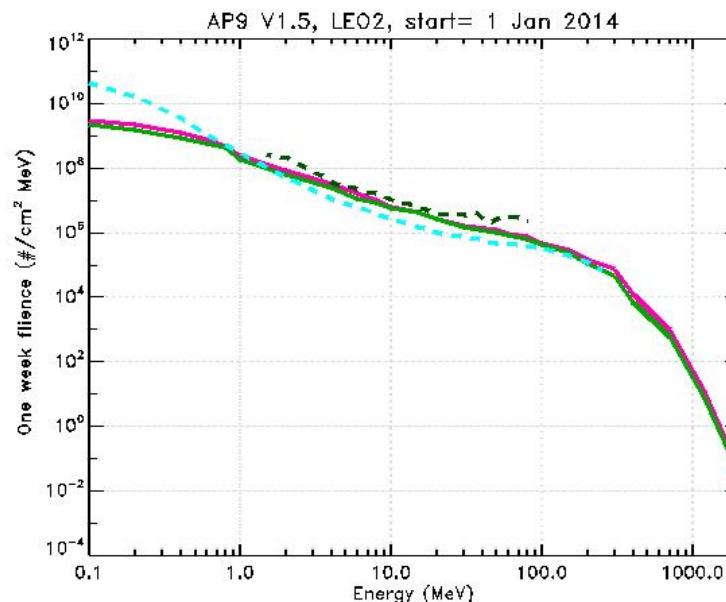
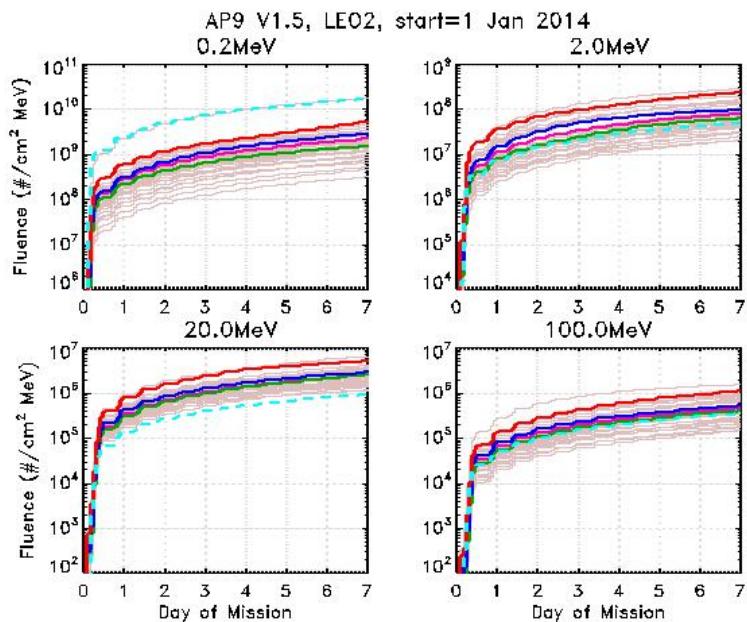
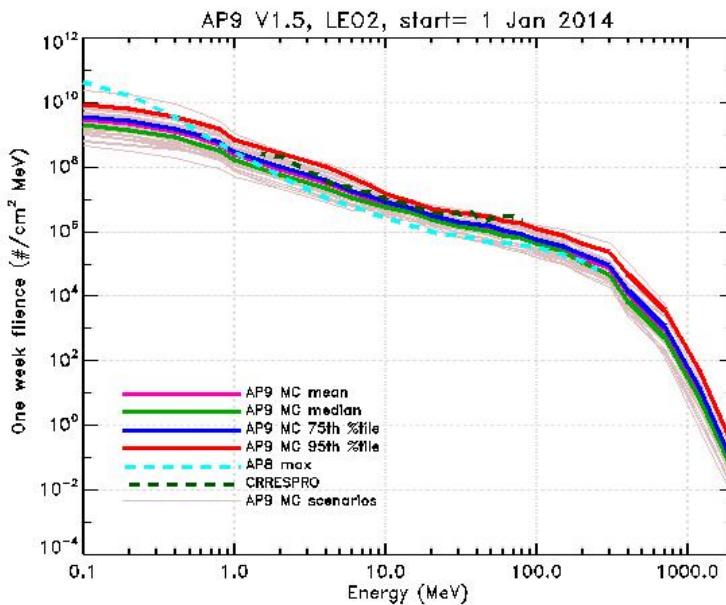
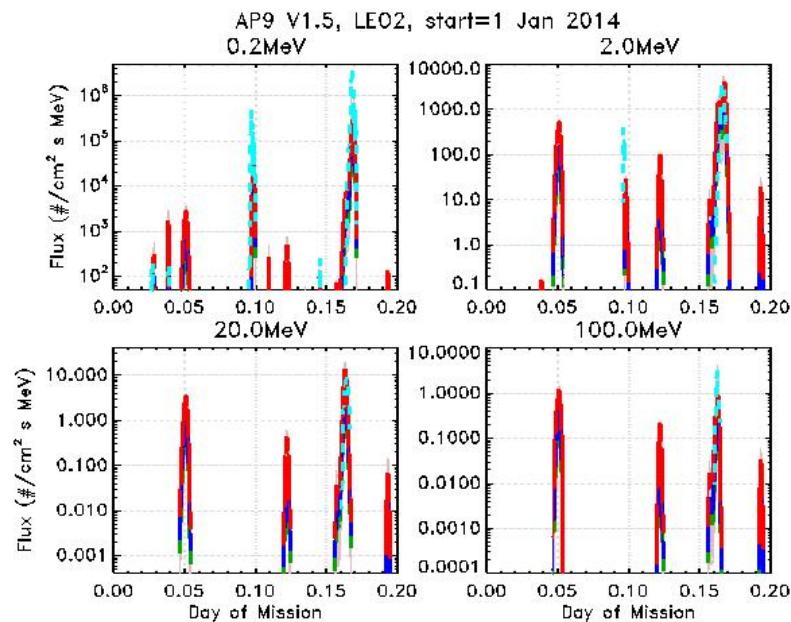
LEO2

AE9**LEO2 (800 km circular, 90 deg)**

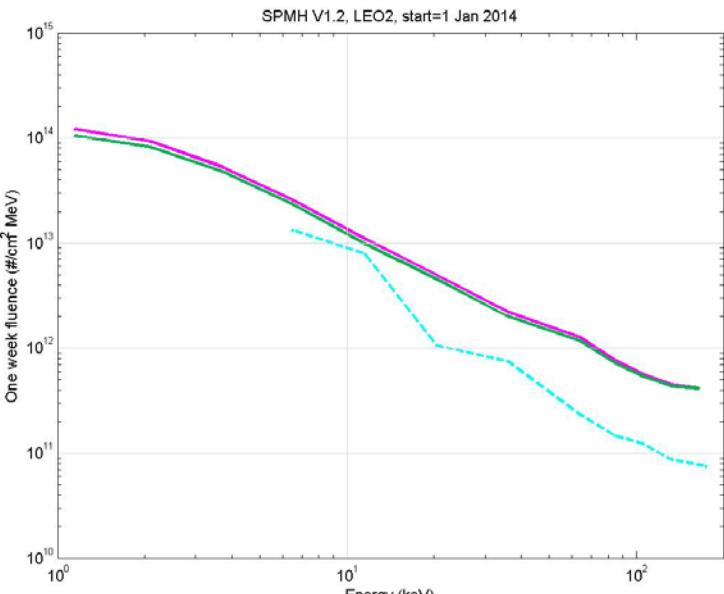
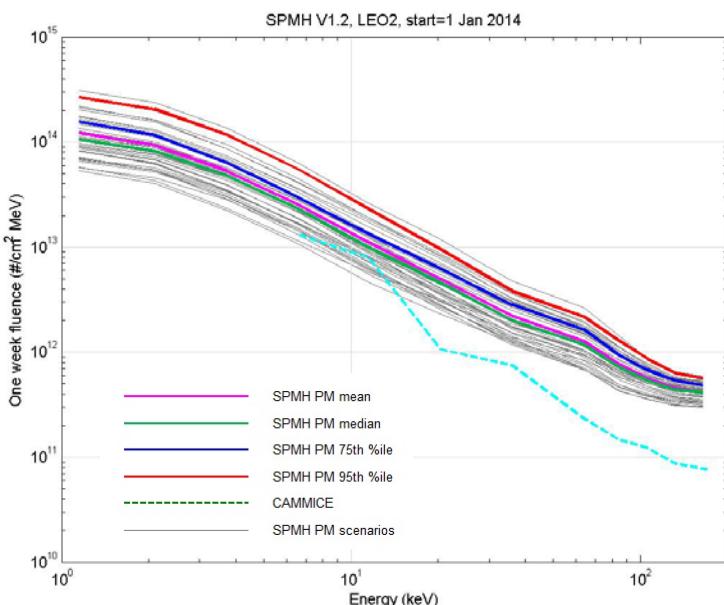
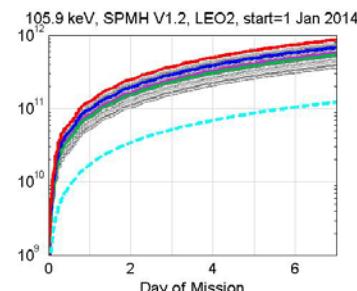
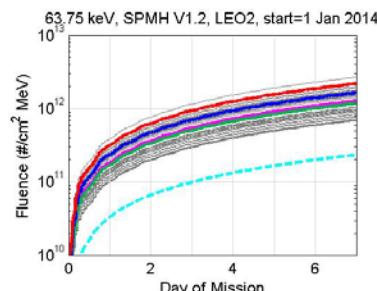
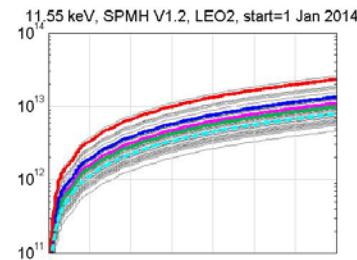
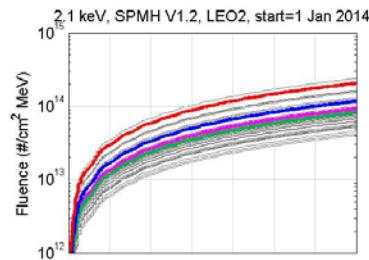
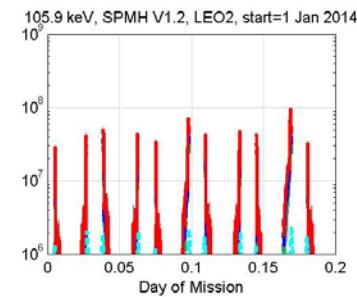
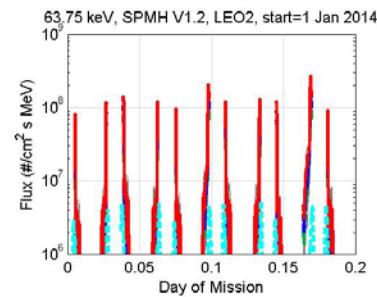
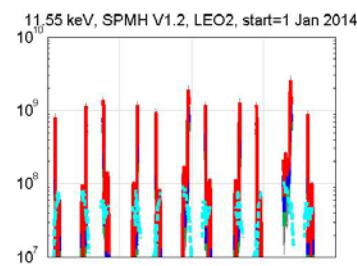
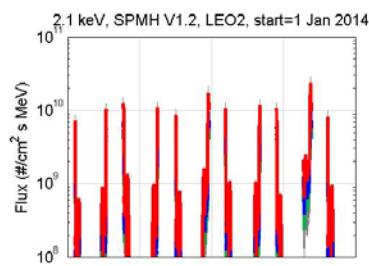
Distribution A

AP9

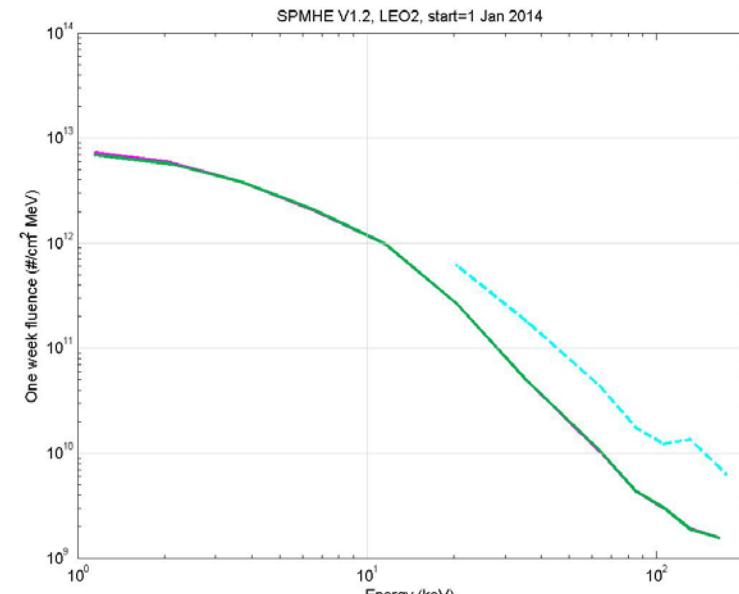
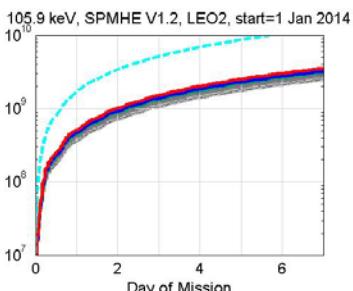
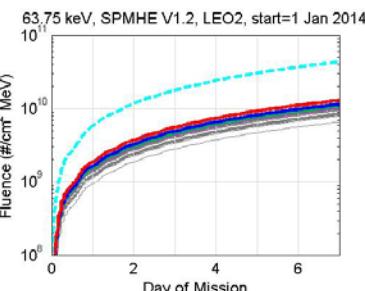
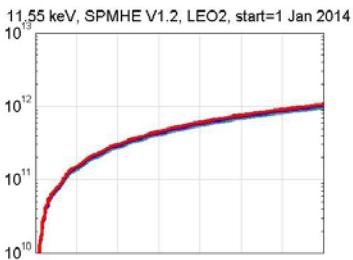
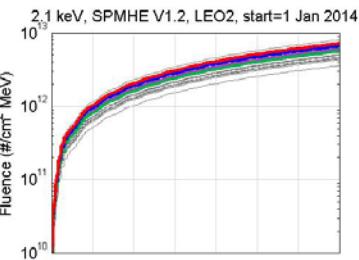
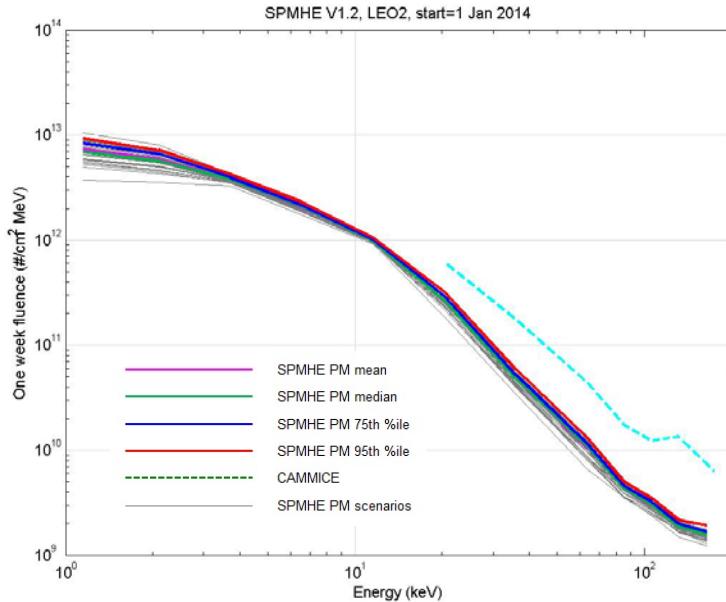
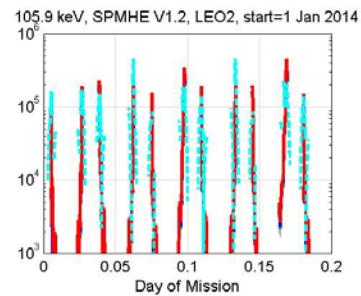
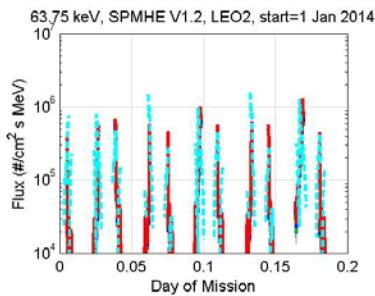
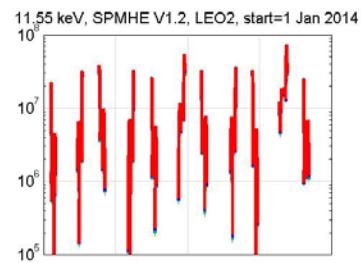
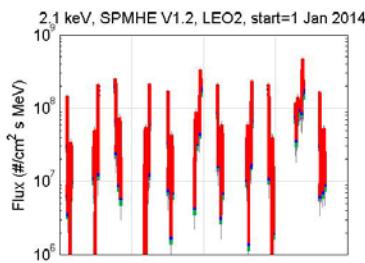
LEO2 (800 km circular, 90 deg)



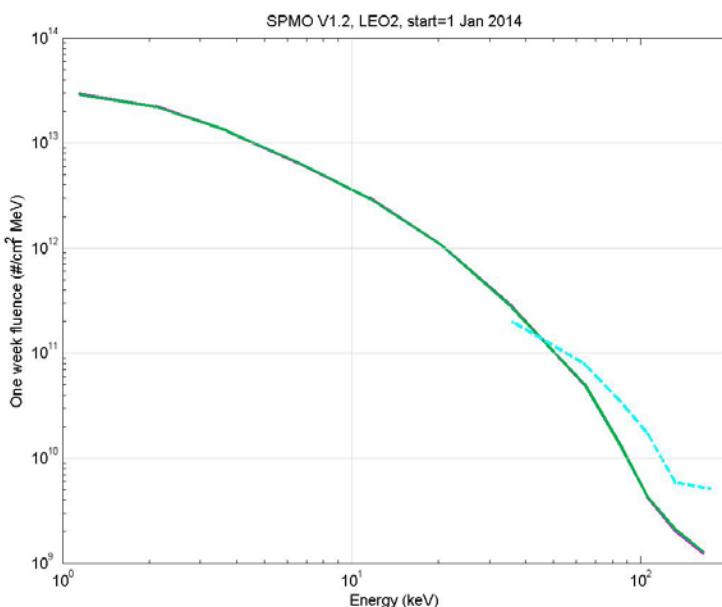
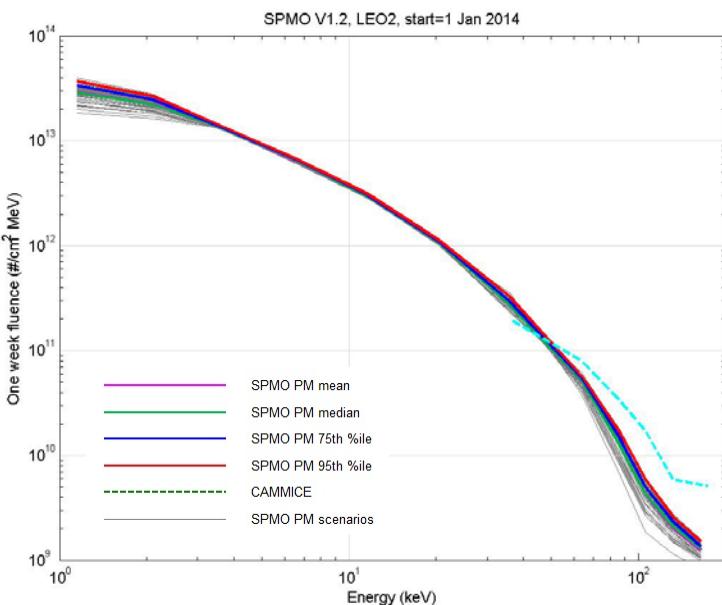
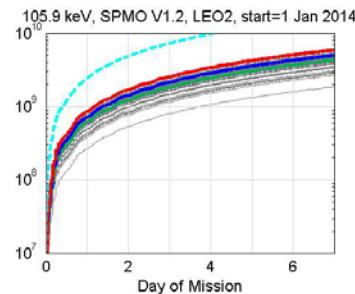
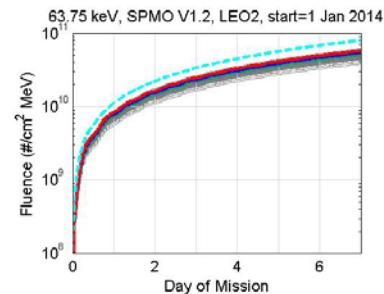
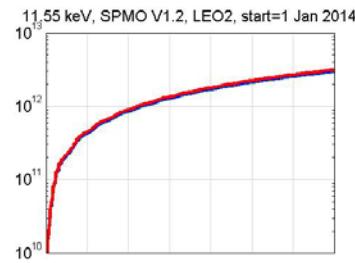
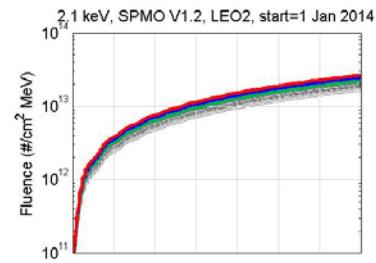
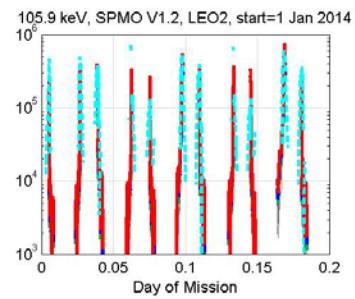
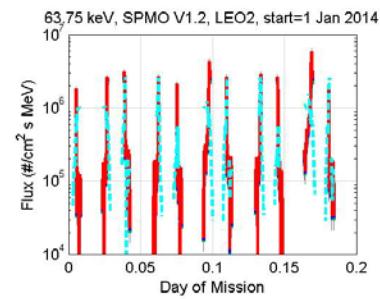
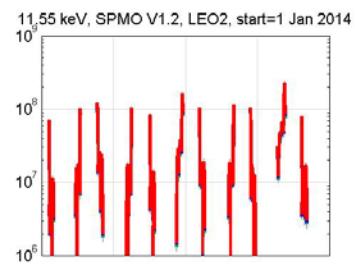
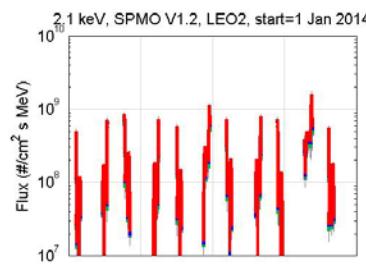
Distribution A

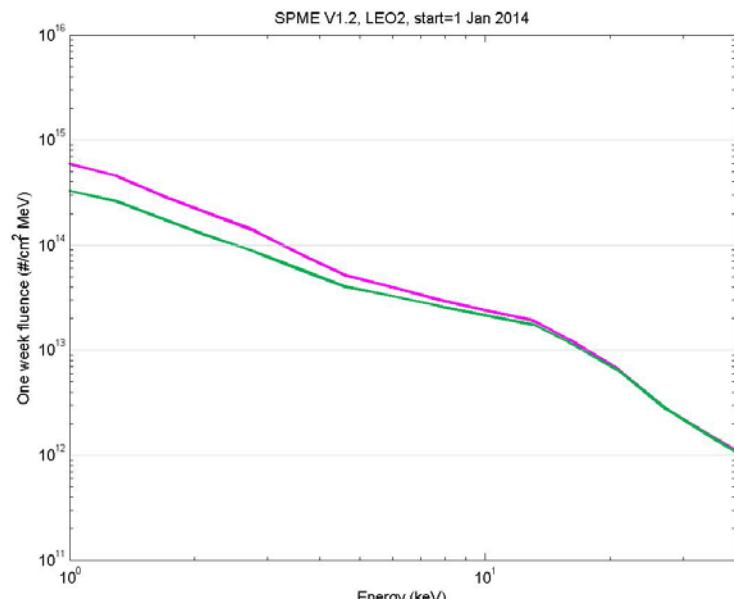
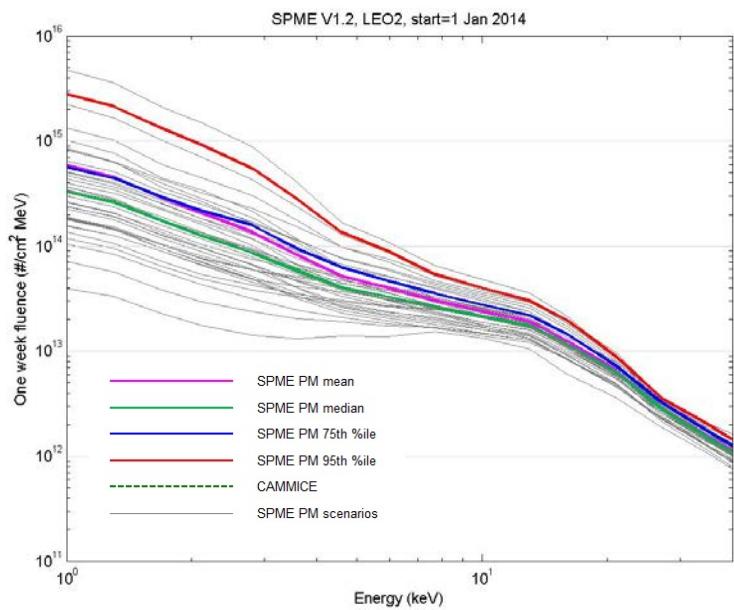
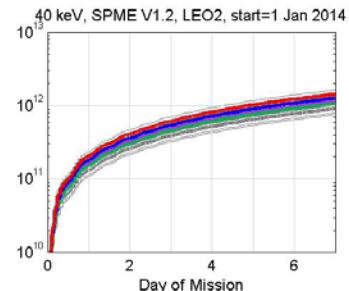
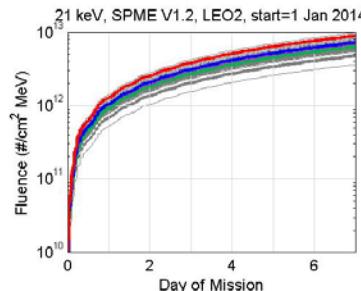
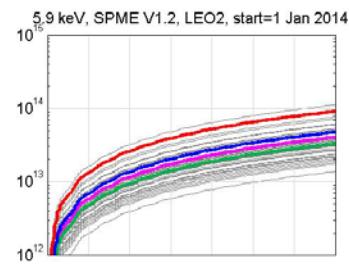
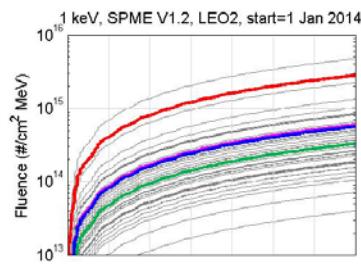
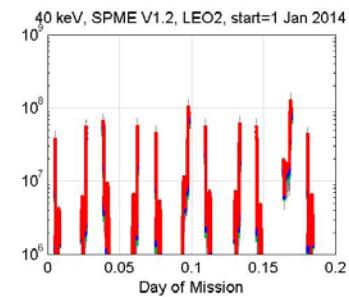
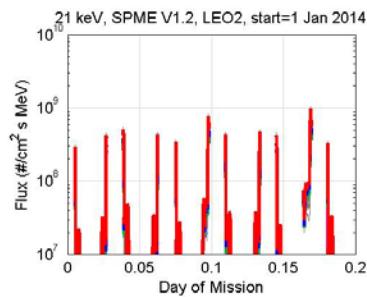
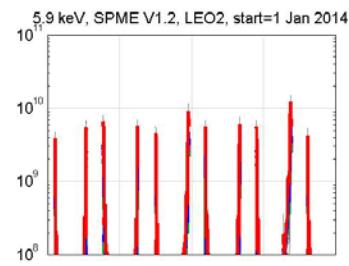
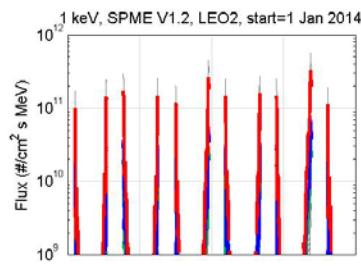
SPMH**LEO2 (800 km circular, 90 deg)****Distribution A**

SPMHE LEO2 (800 km circular, 90 deg)

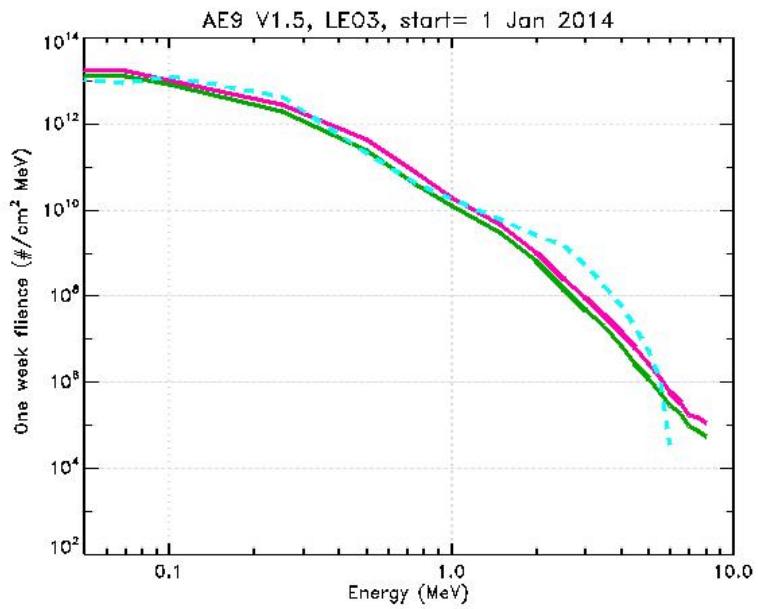
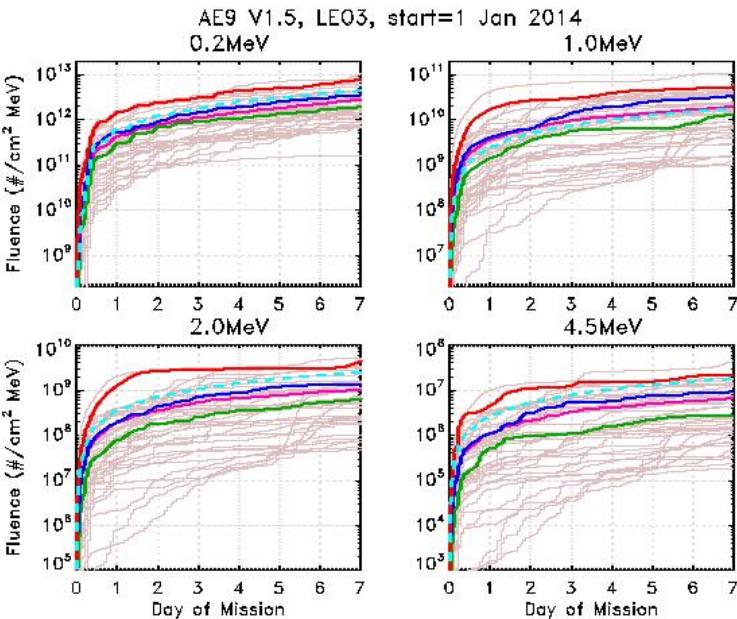
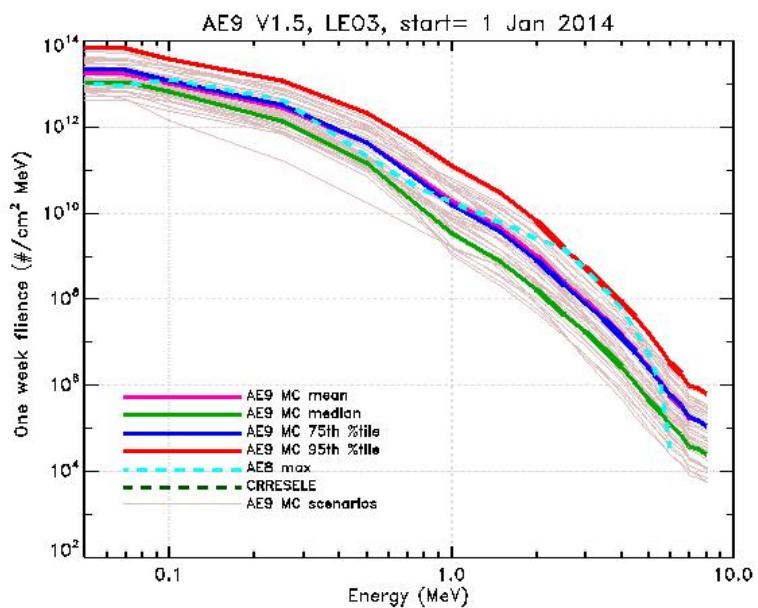
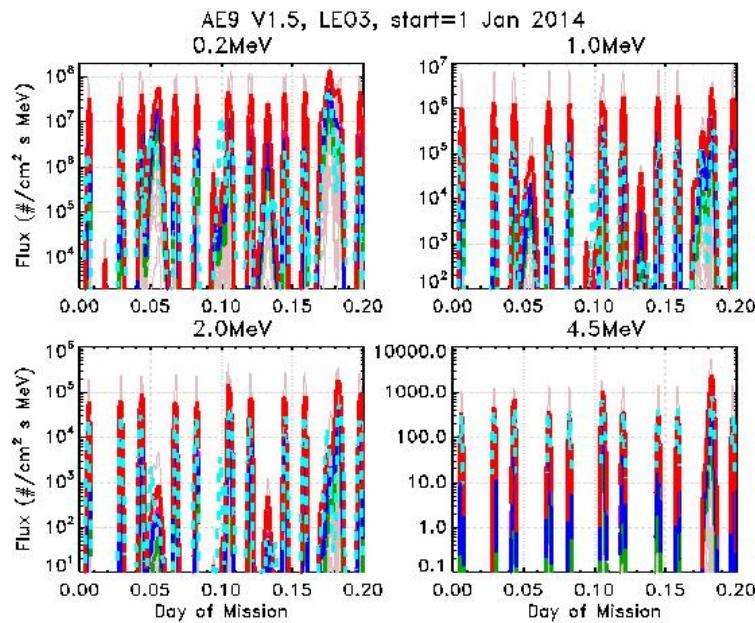


Distribution A

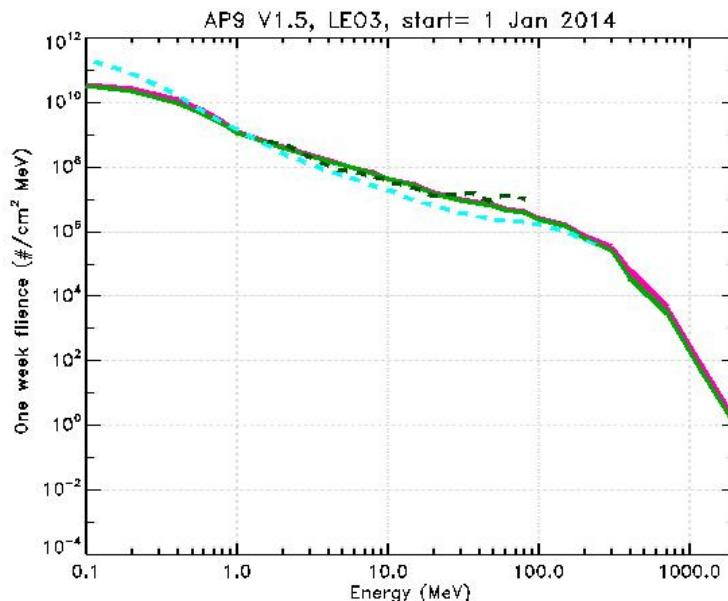
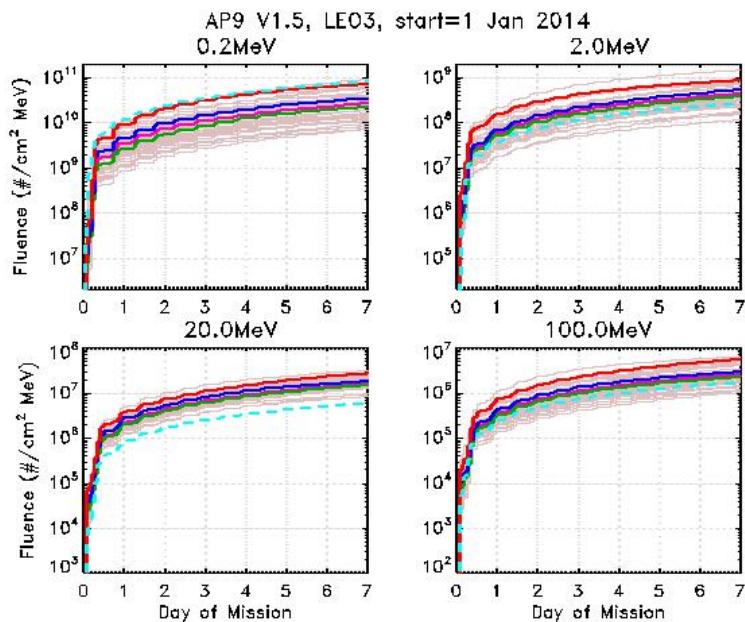
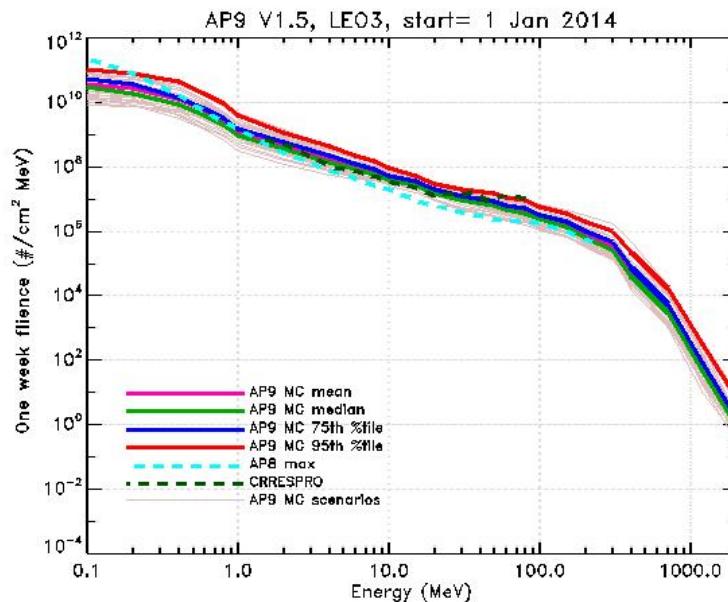
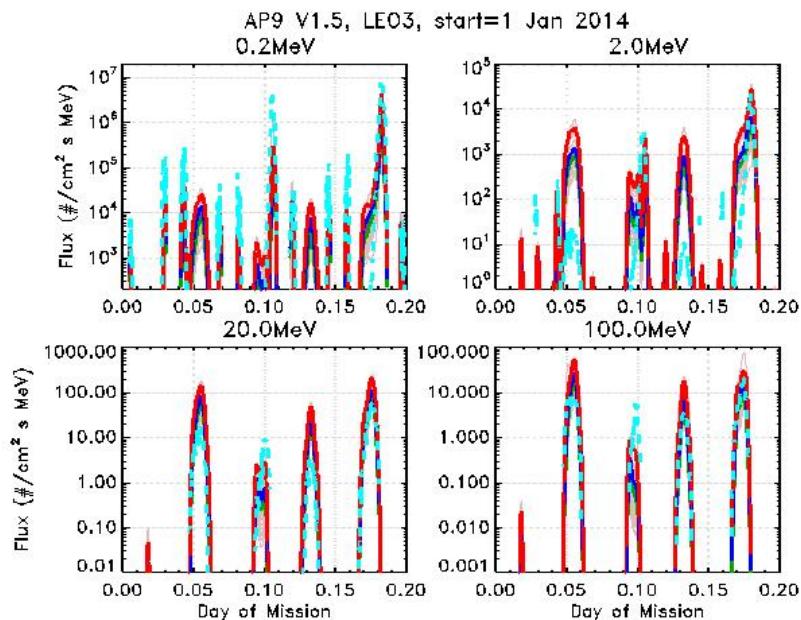


SPME**LEO2 (800 km circular, 90 deg)****Distribution A**

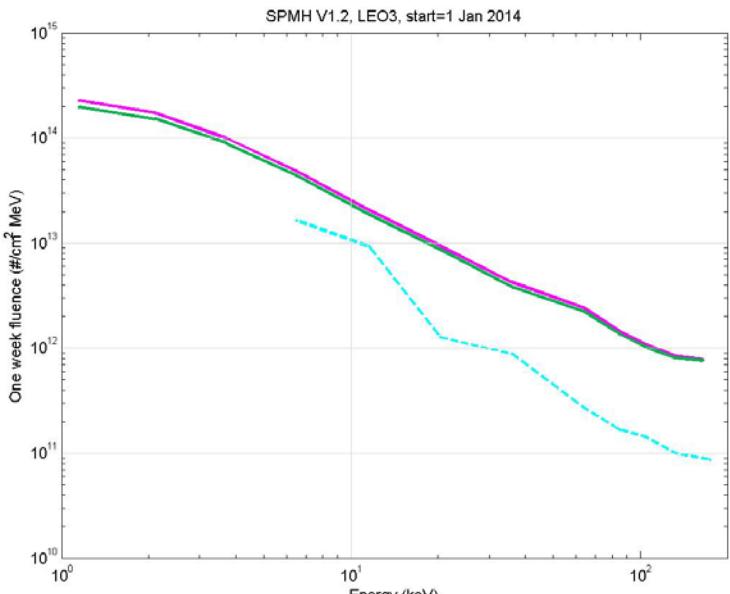
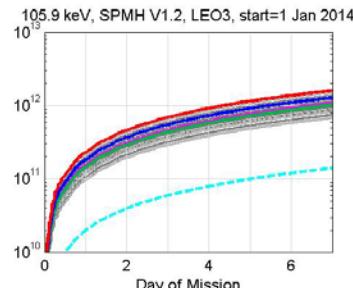
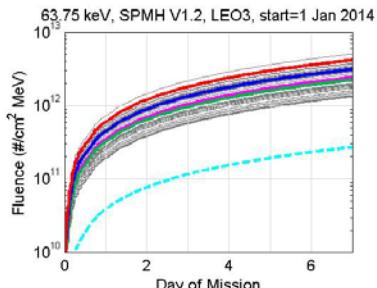
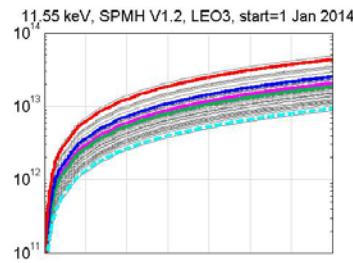
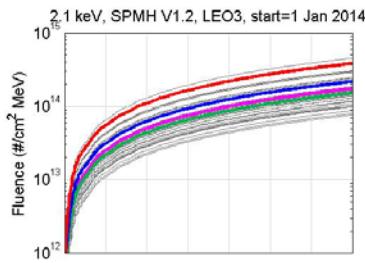
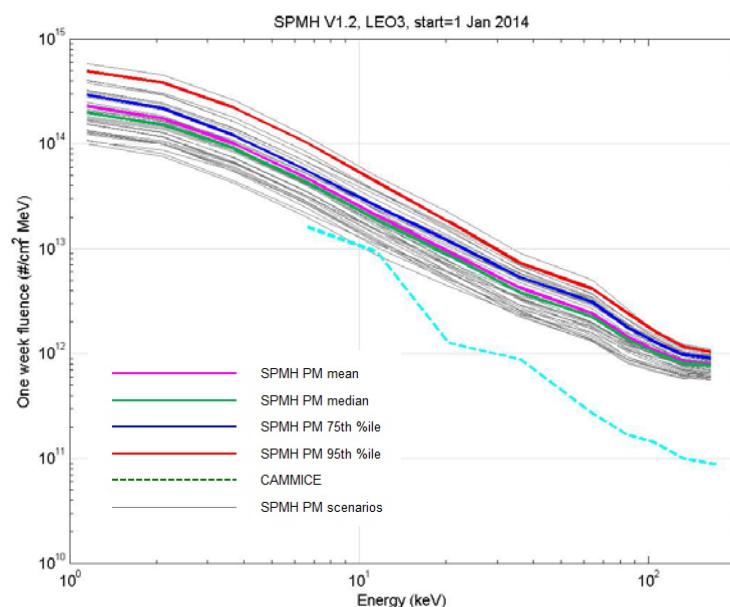
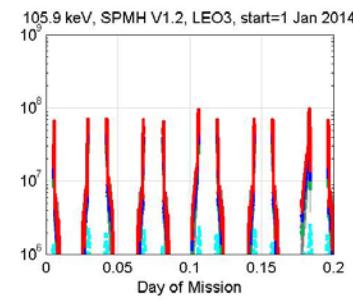
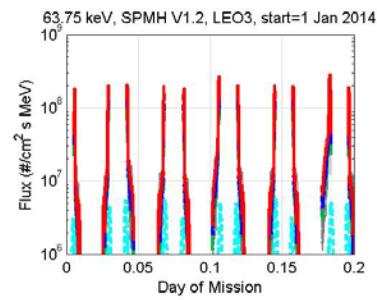
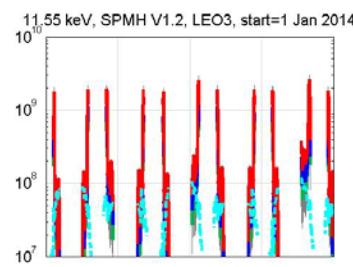
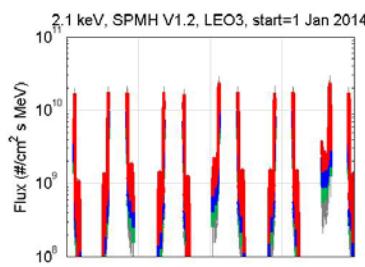
LEO3

AE9**LEO3 (1200 km circular, 90 deg)**

Distribution A

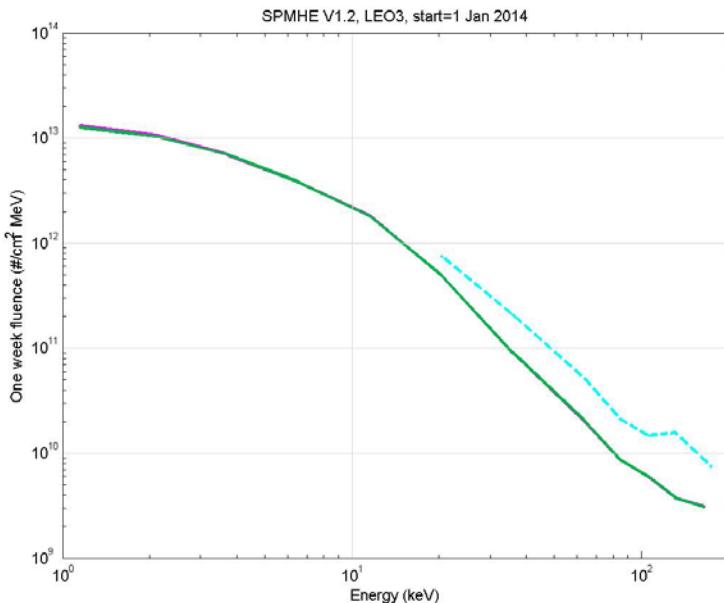
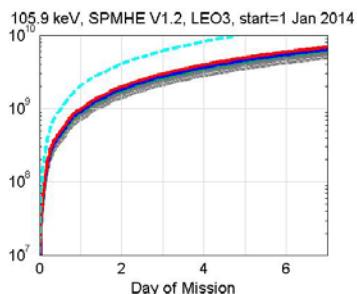
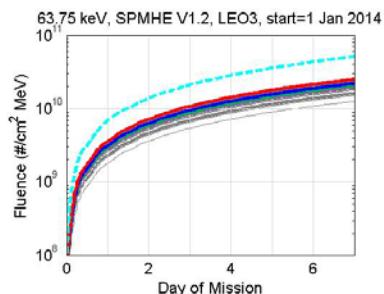
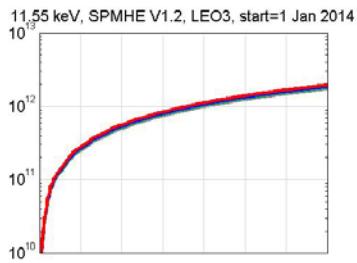
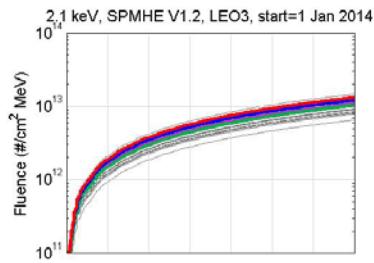
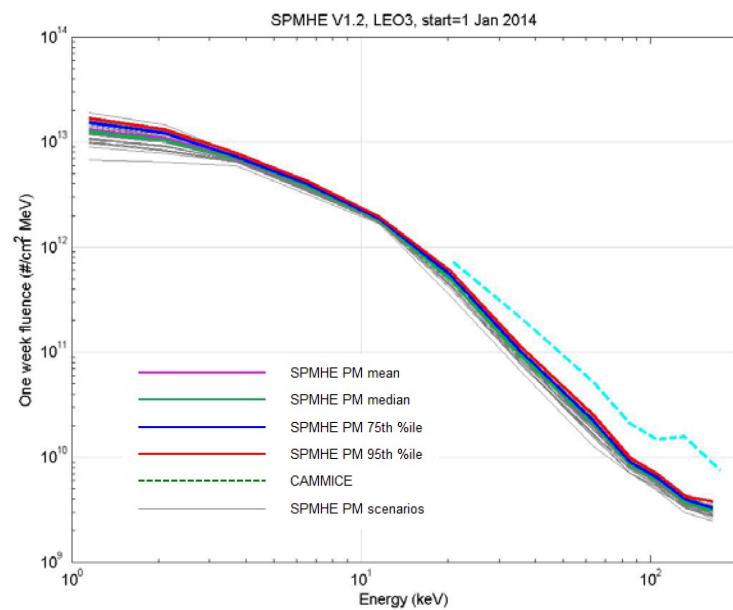
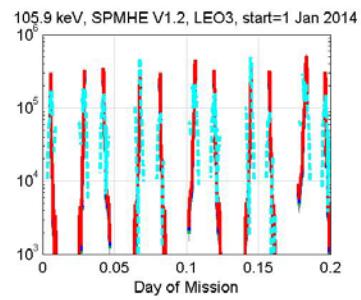
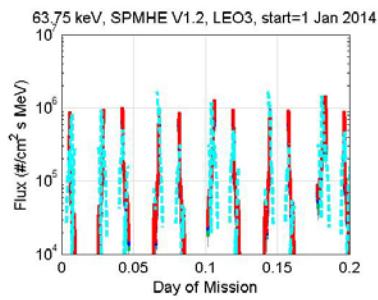
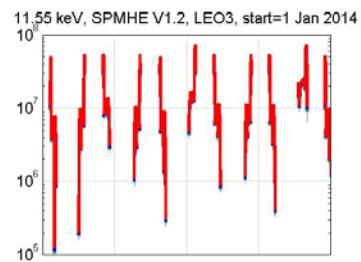
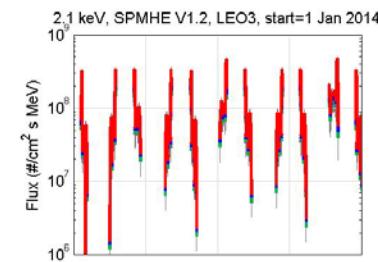
AP9**LEO3 (1200 km circular, 90 deg)**

Distribution A

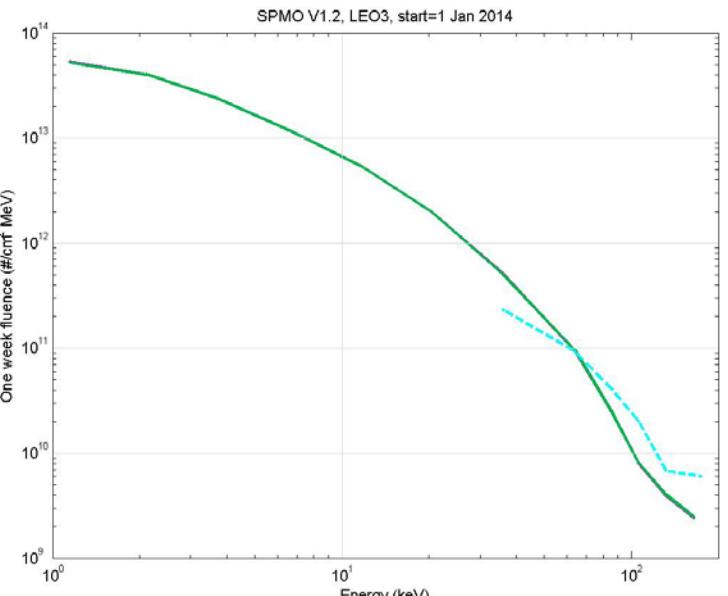
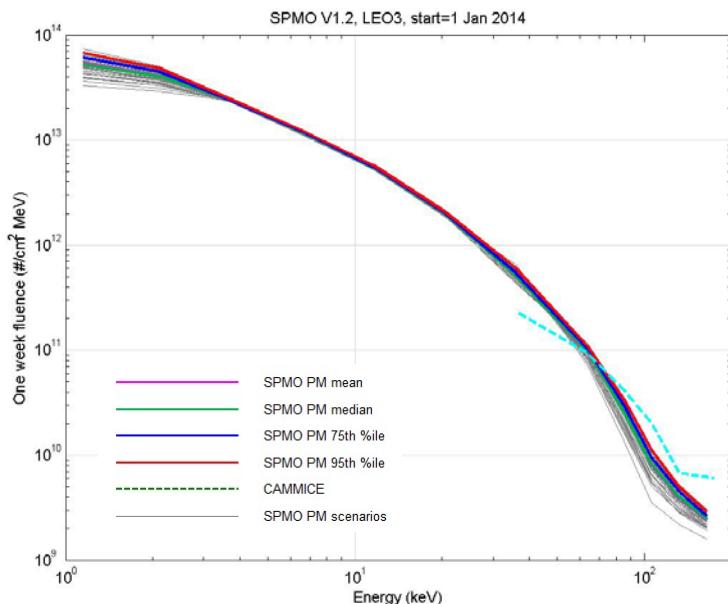
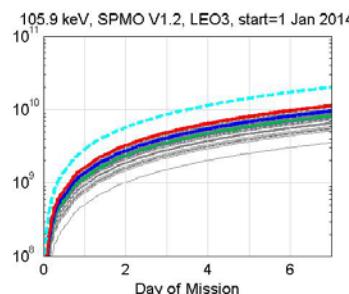
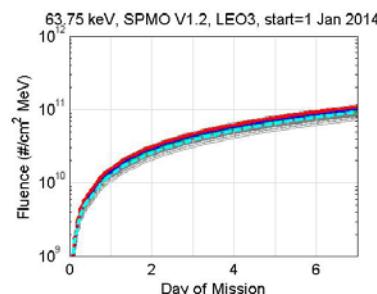
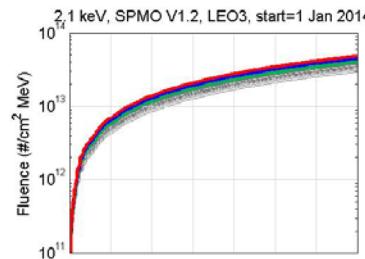
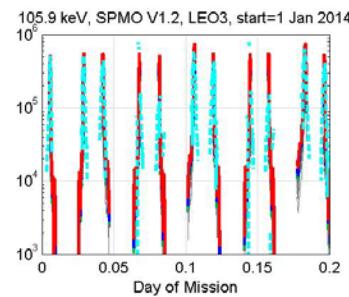
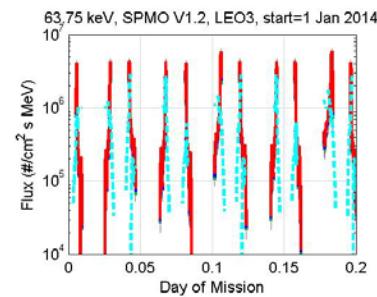
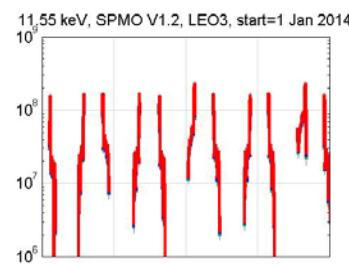
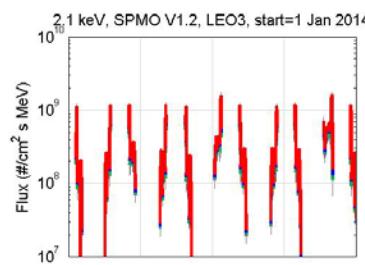


Distribution A

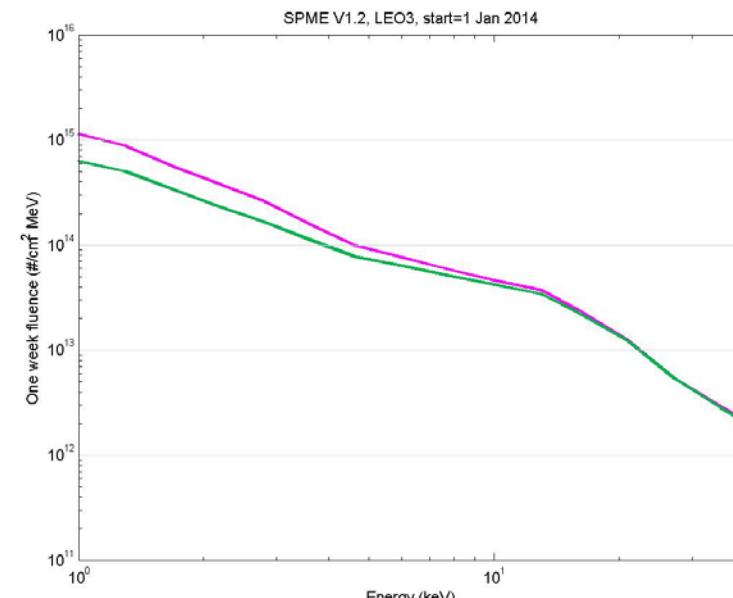
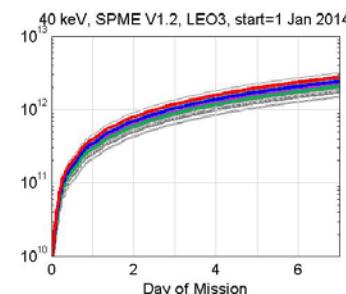
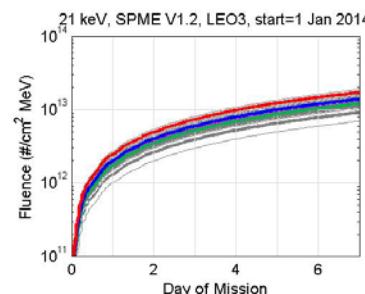
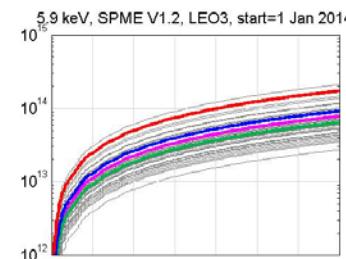
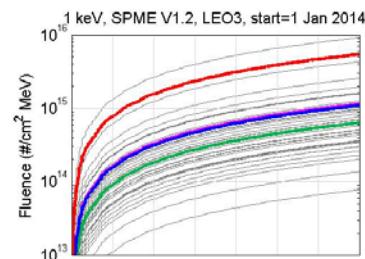
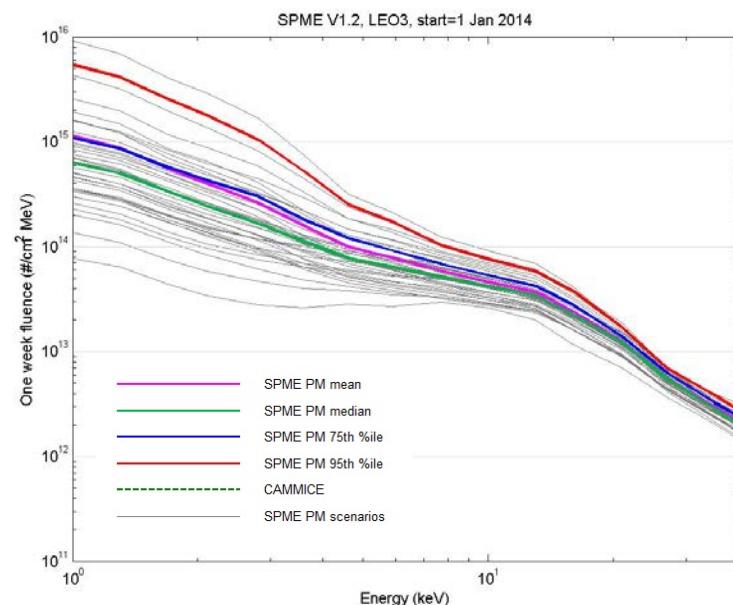
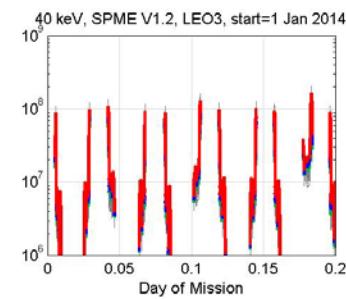
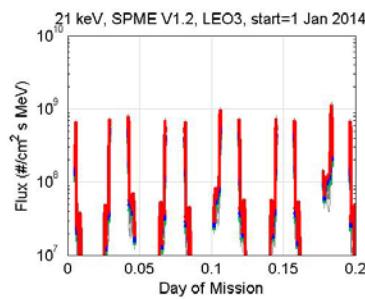
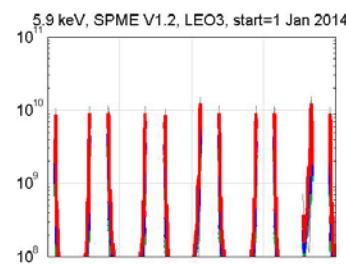
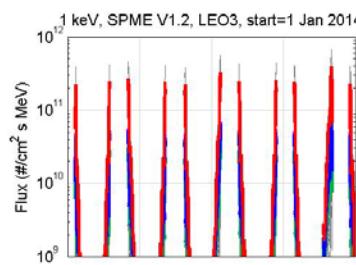
SPMHE LEO3 (1200 km circular, 90 deg)



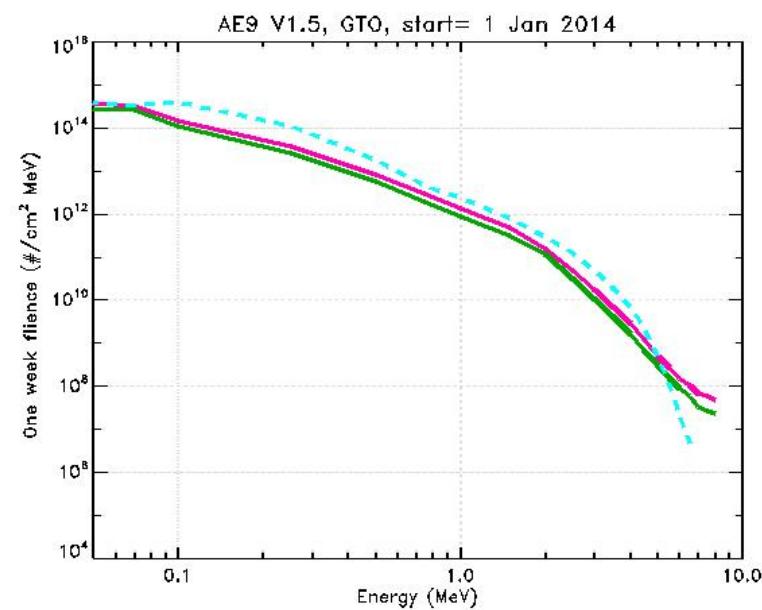
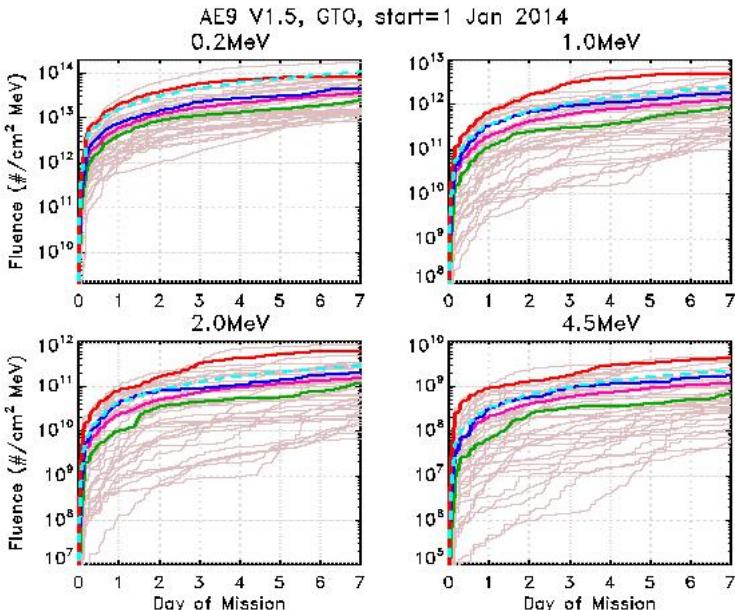
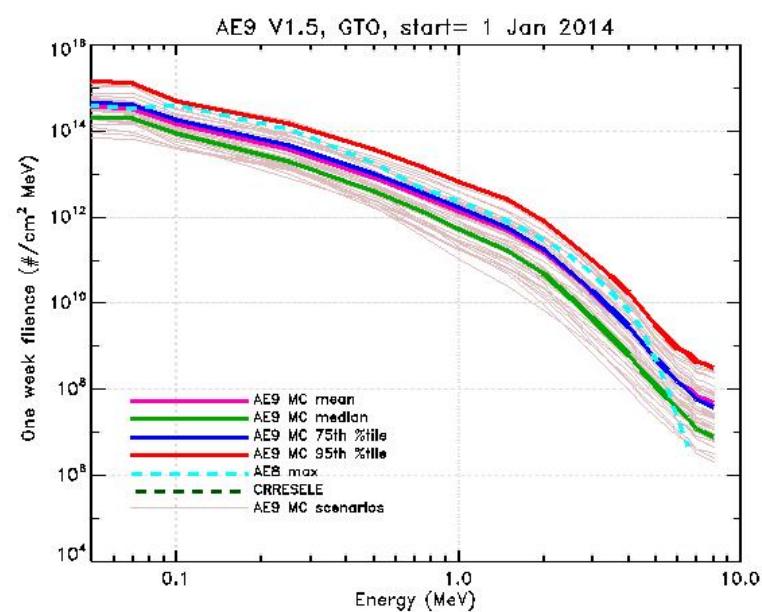
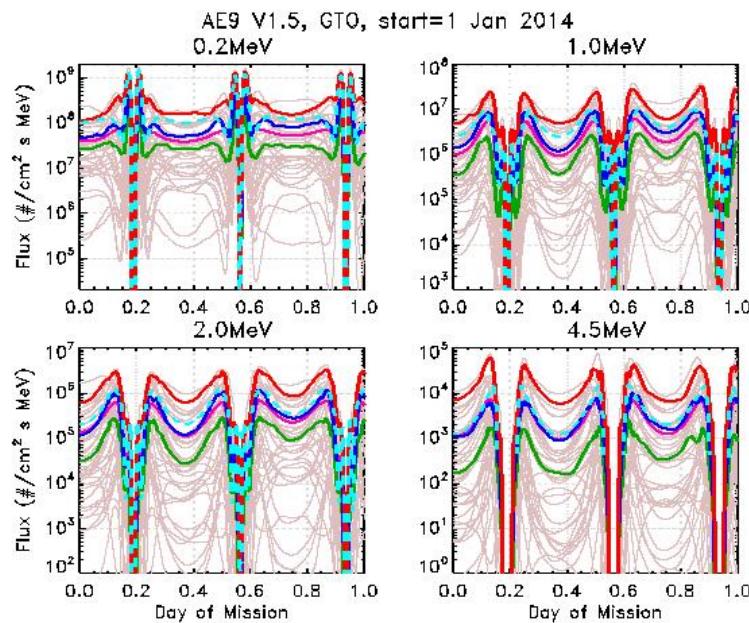
Distribution A



Distribution A

SPME**LEO3 (1200 km circular, 90 deg)****Distribution A**

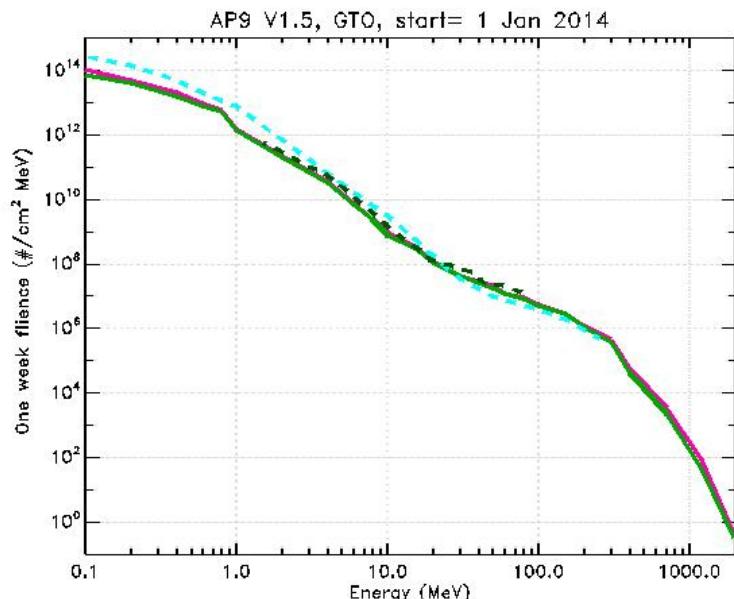
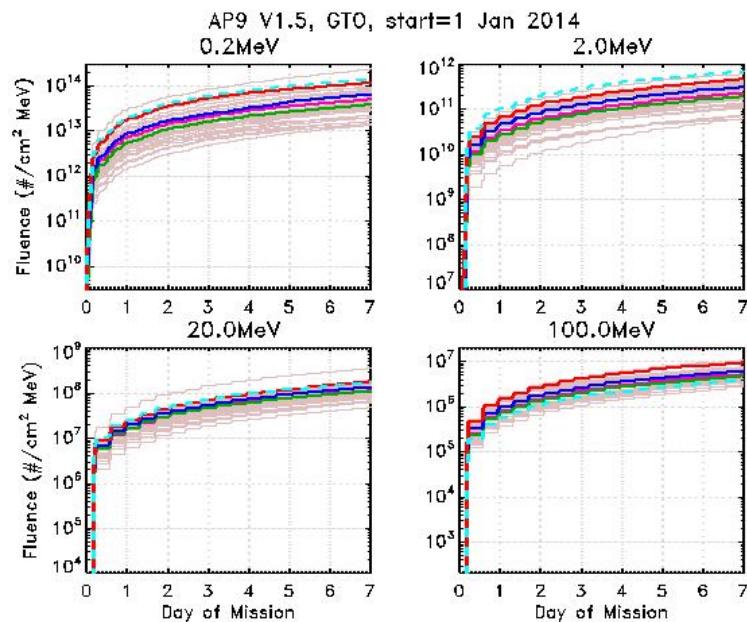
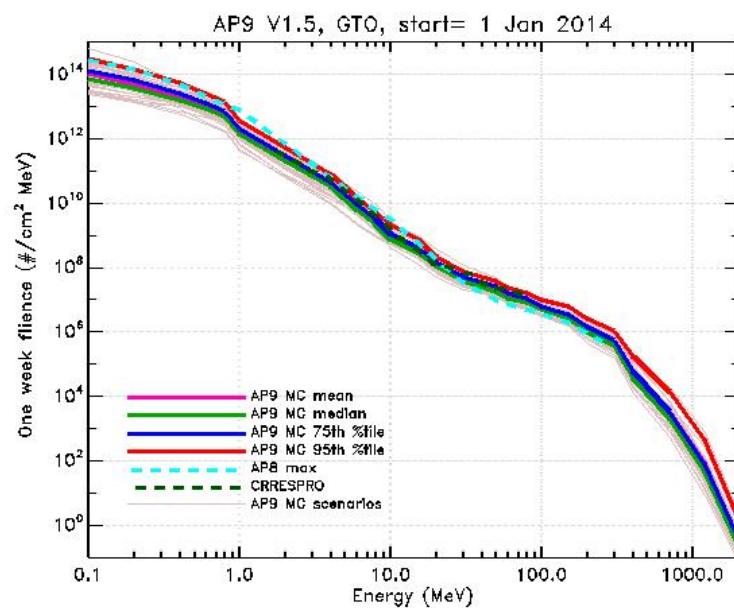
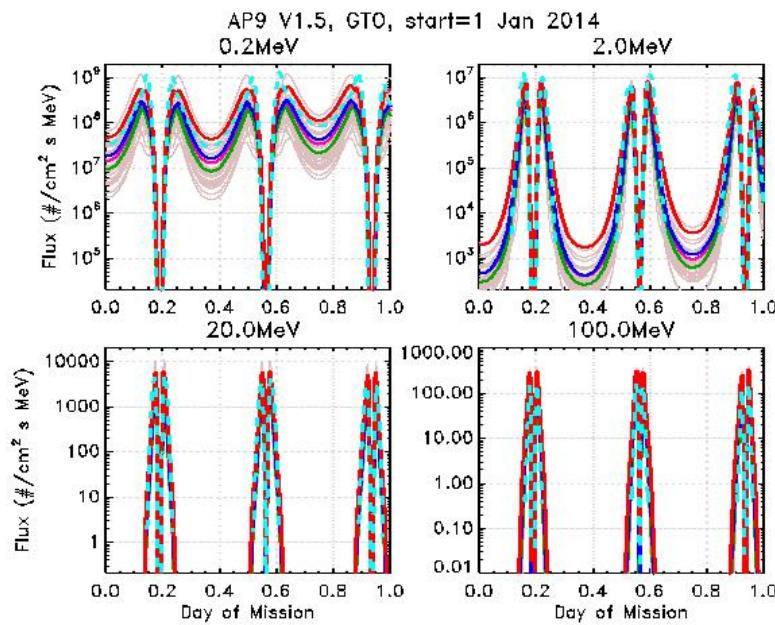
GTO

AE9**GTO (30600 km x 500 km, 10 deg) (RBSP)**

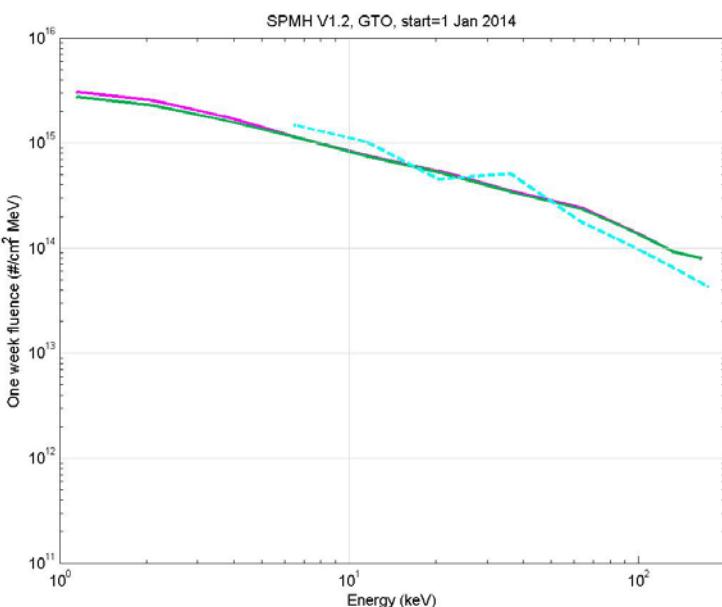
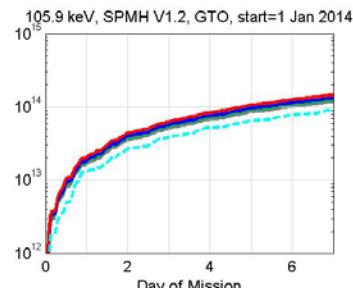
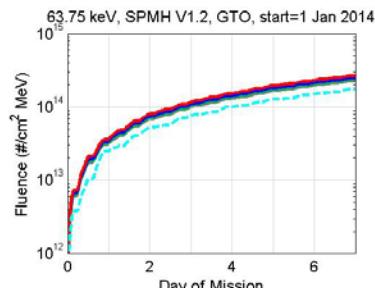
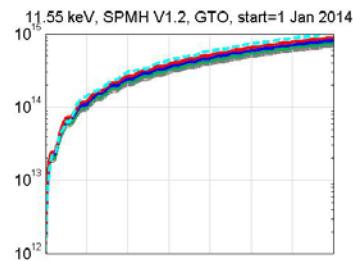
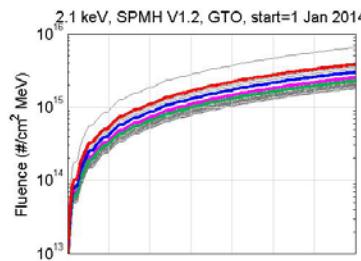
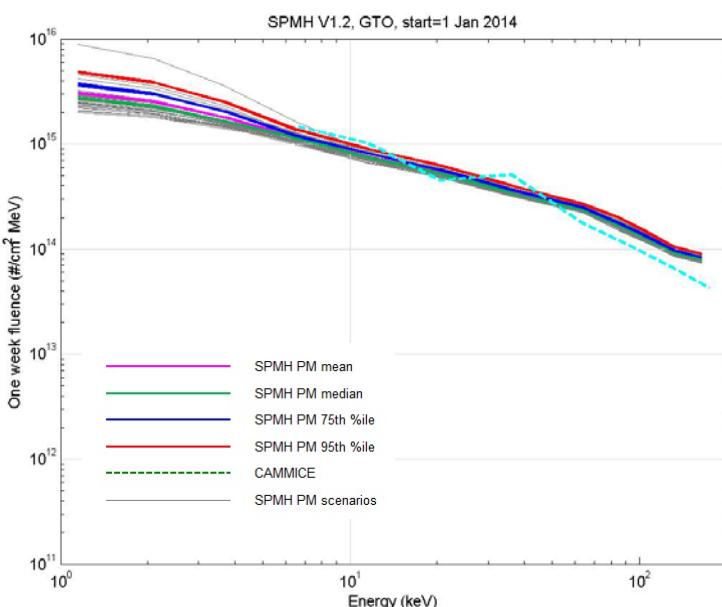
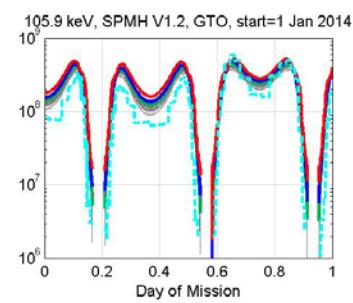
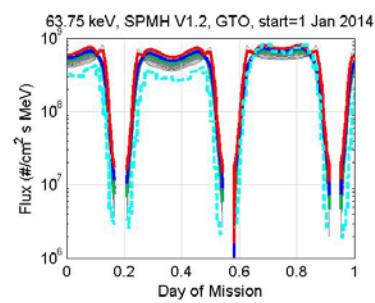
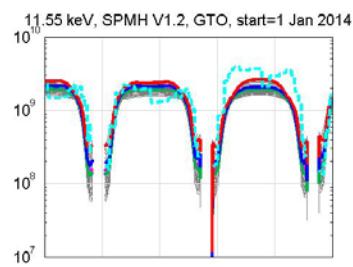
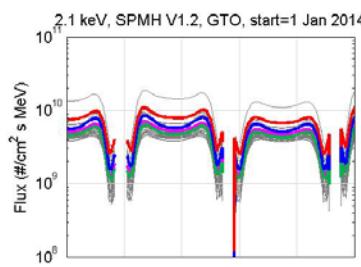
Distribution A

AP9

GTO (30600 km x 500 km, 10 deg) (RBSP)

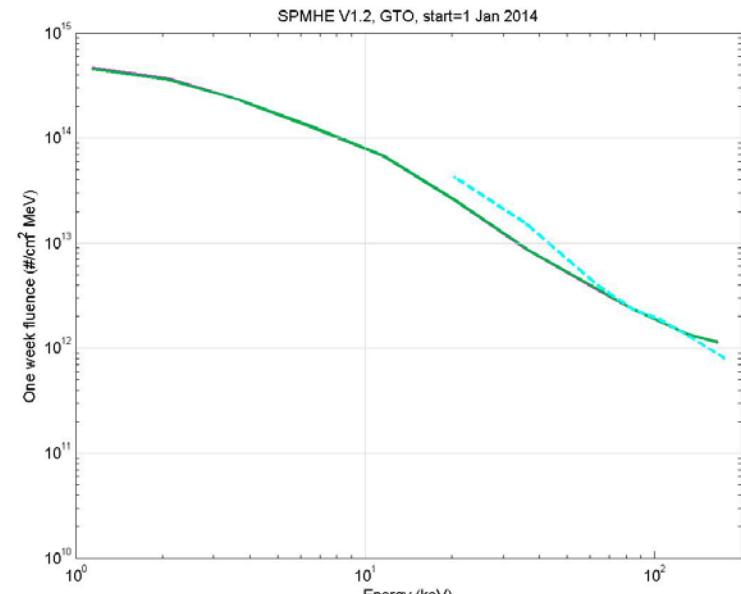
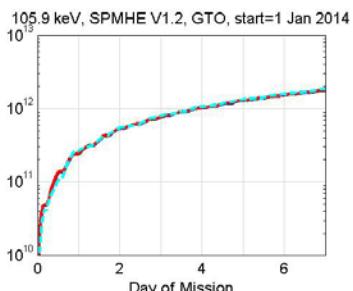
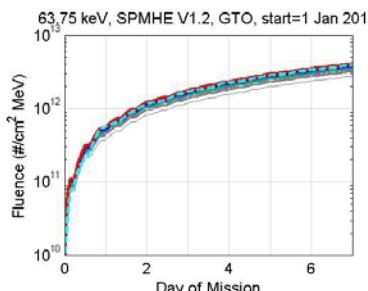
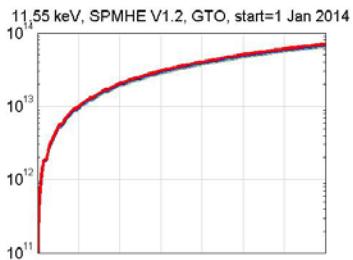
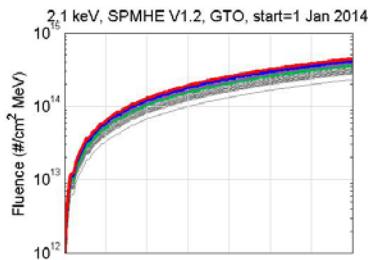
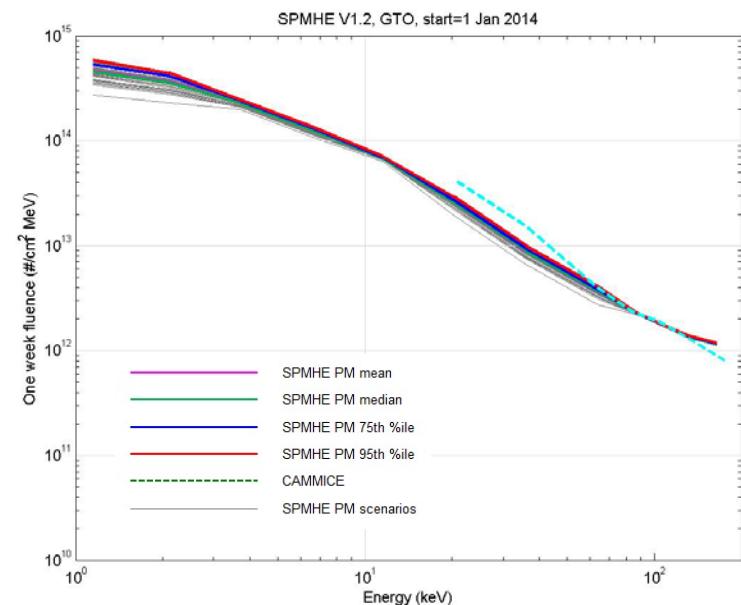
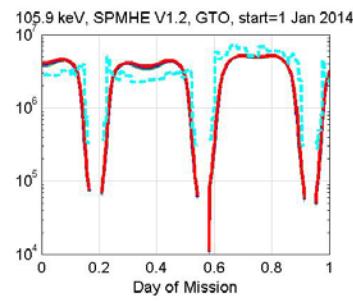
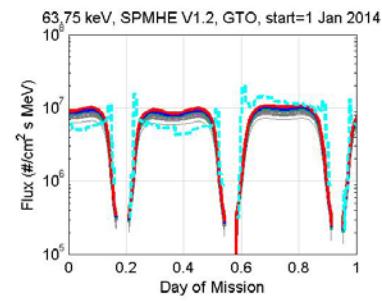
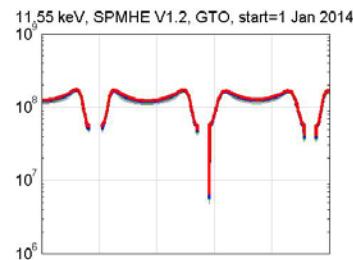
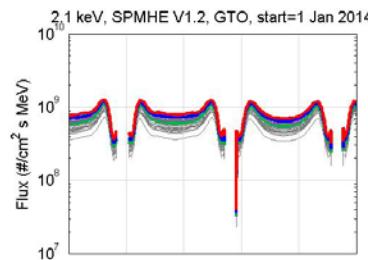


Distribution A

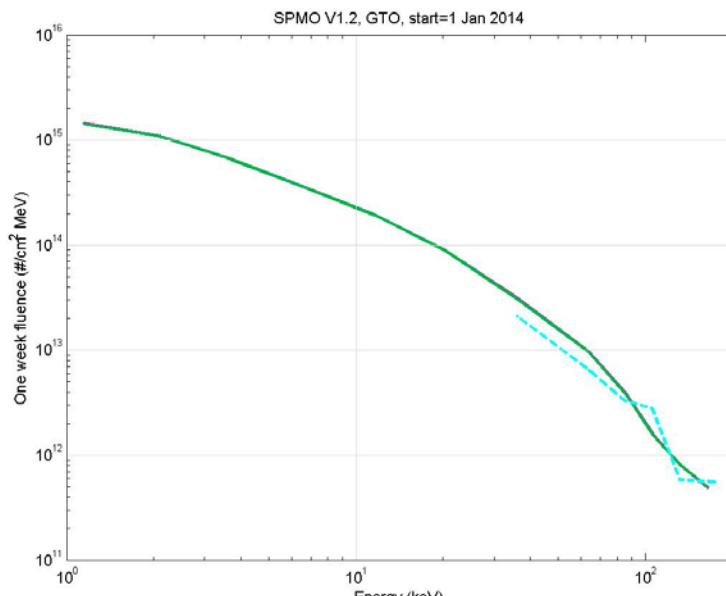
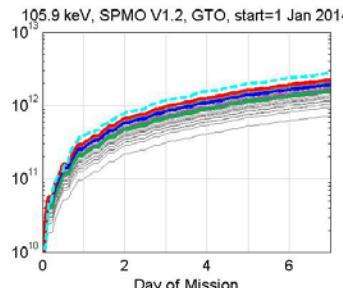
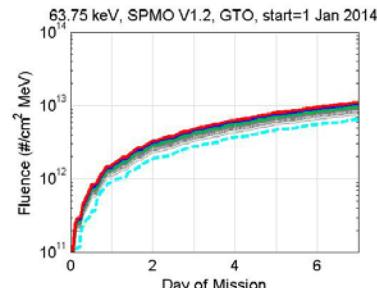
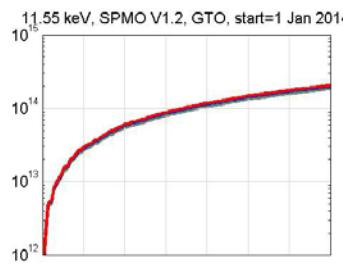
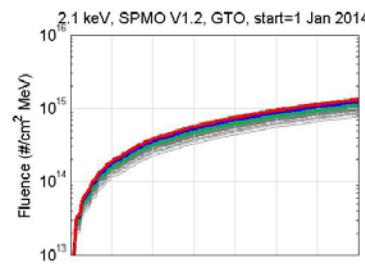
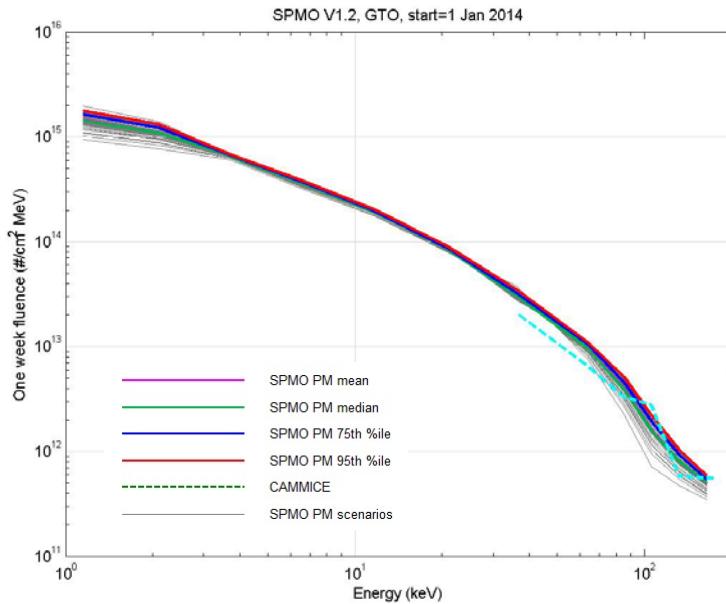
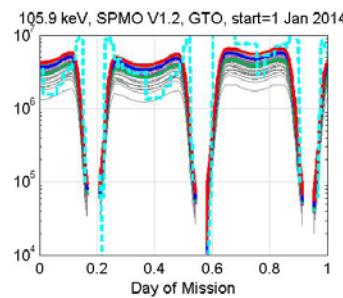
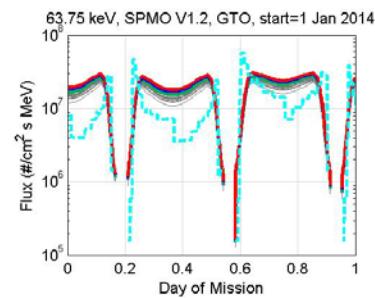
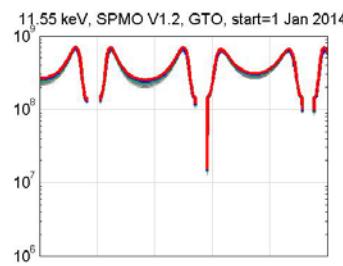
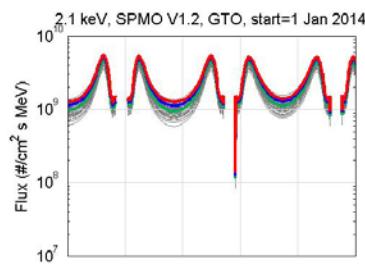


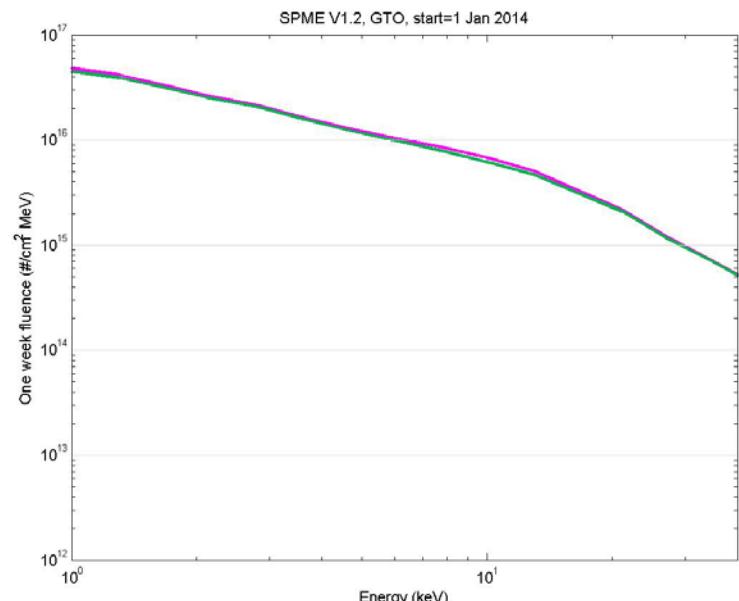
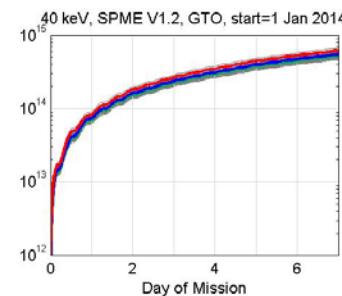
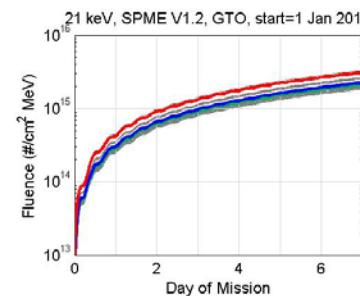
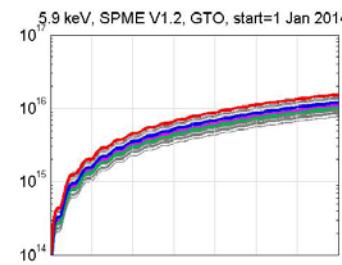
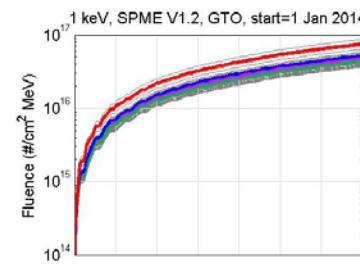
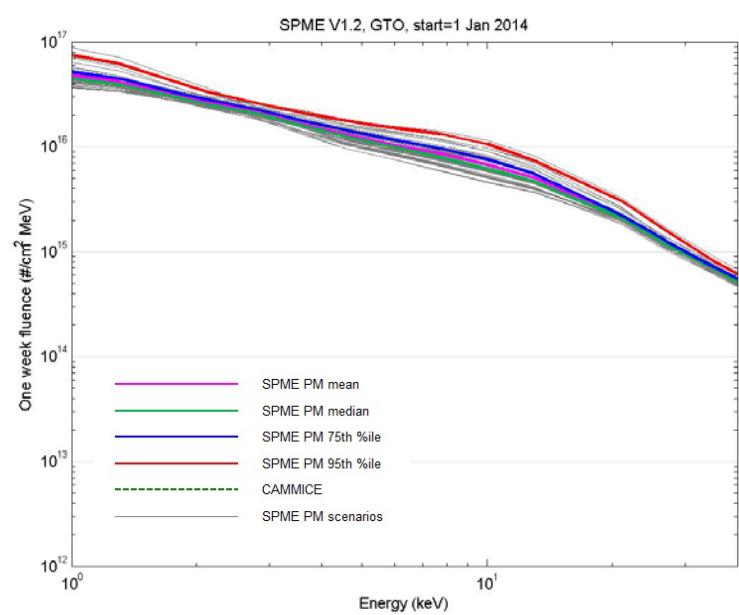
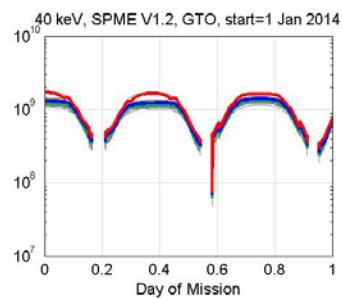
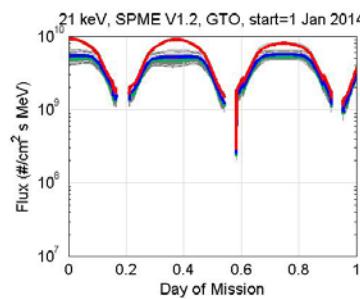
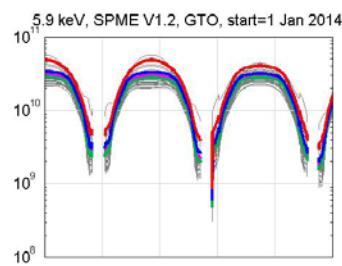
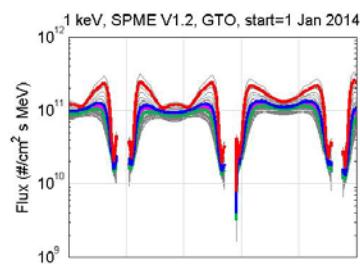
Distribution A

SPMHE GTO (30600 km x 500 km, 10 deg) (RBSP)

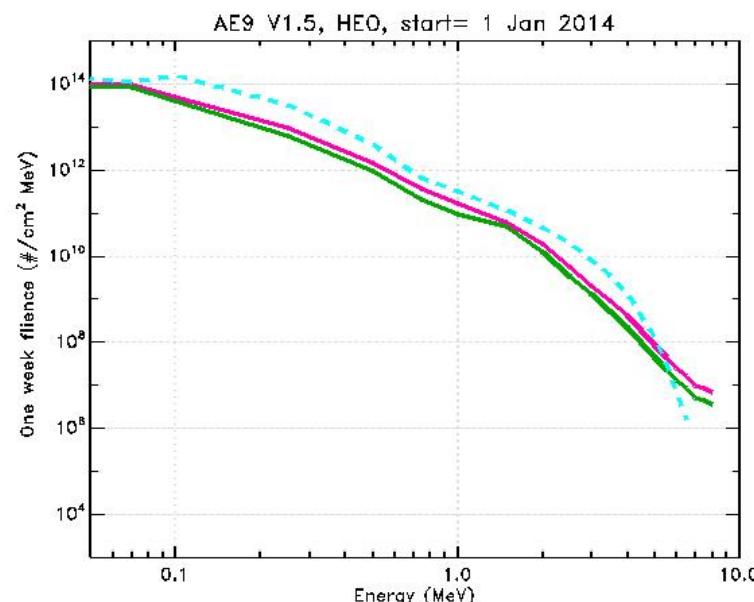
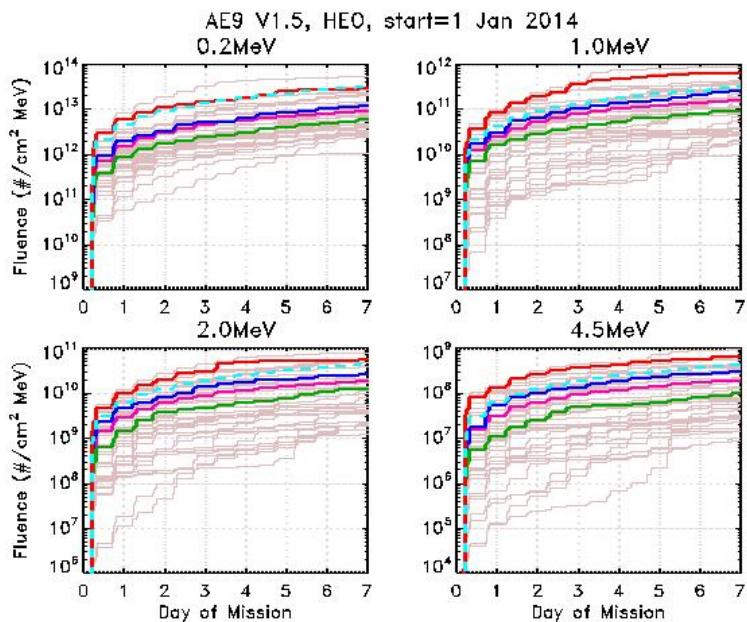
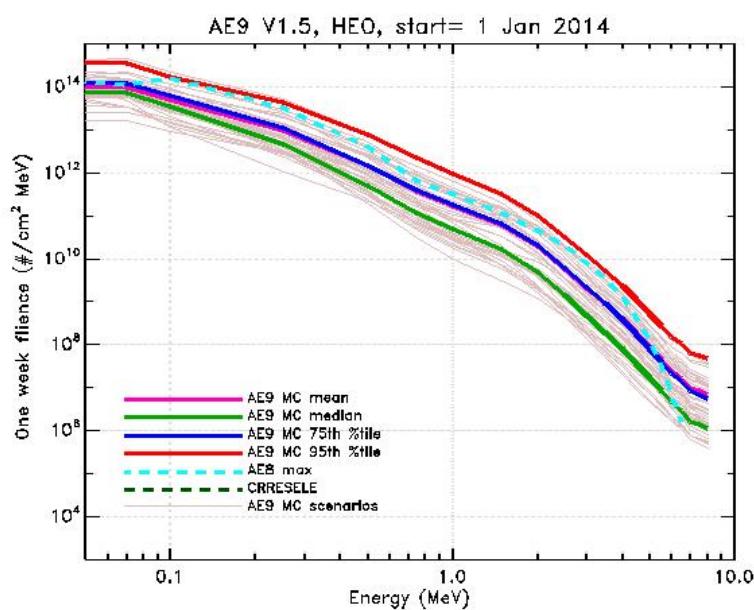
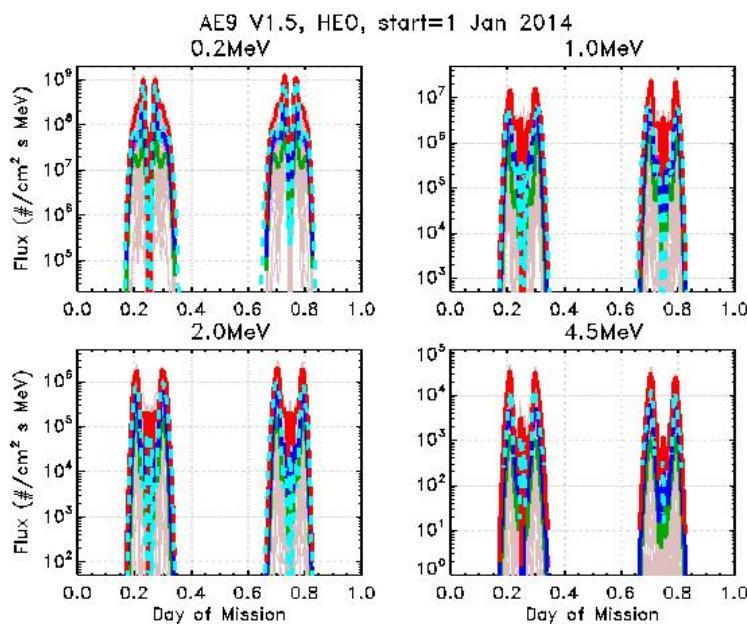


Distribution A

SPMO**GTO (30600 km x 500 km, 10 deg) (RBSP)****Distribution A**

SPME**GTO (30600 km x 500 km, 10 deg) (RBSP)****Distribution A**

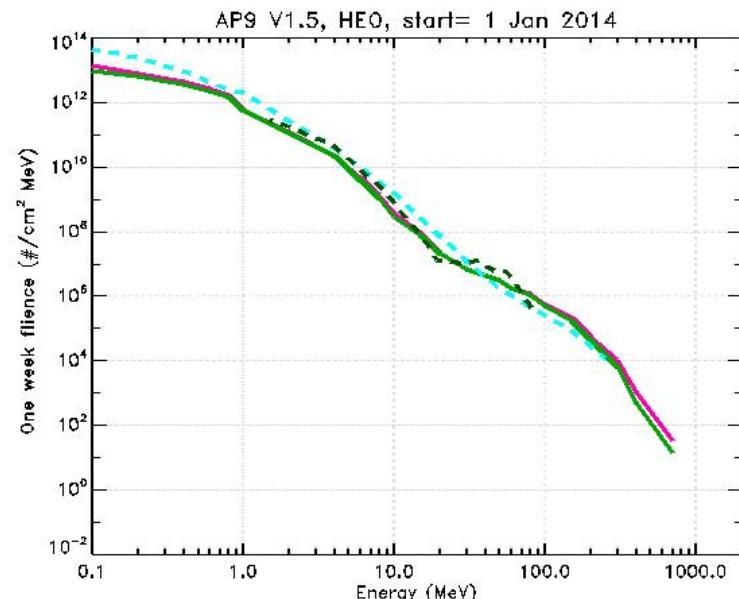
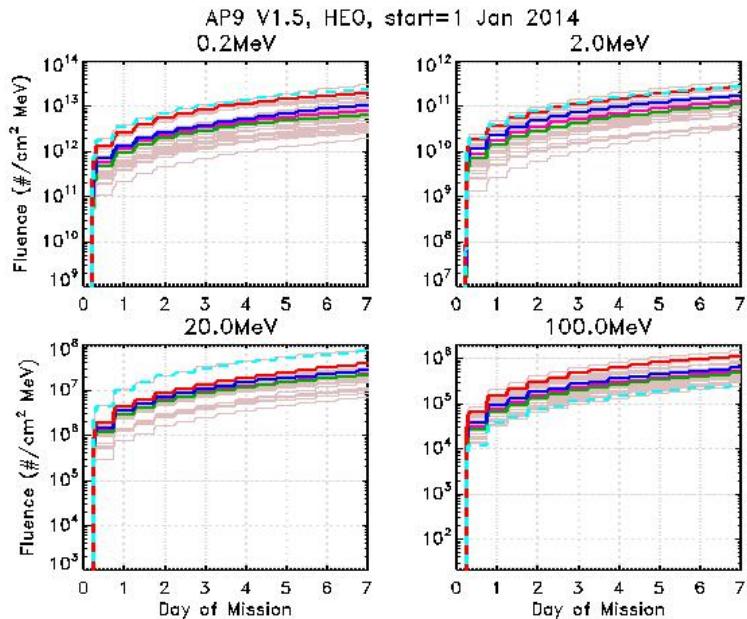
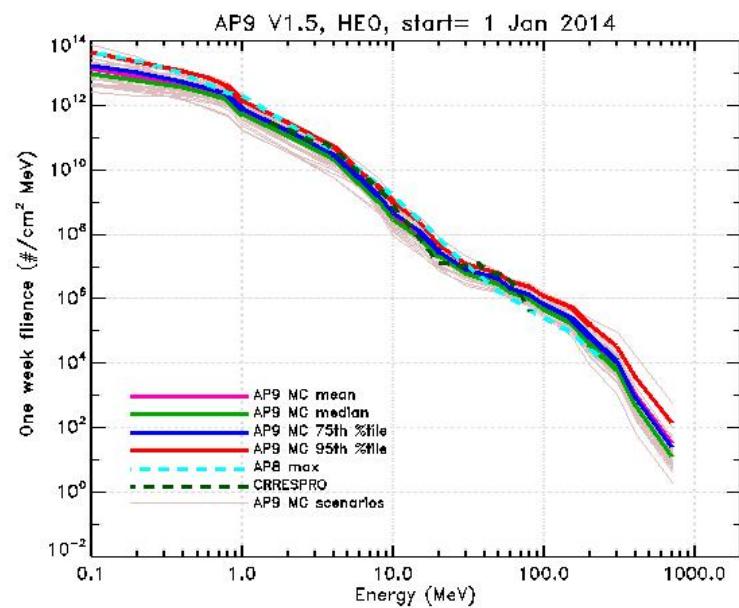
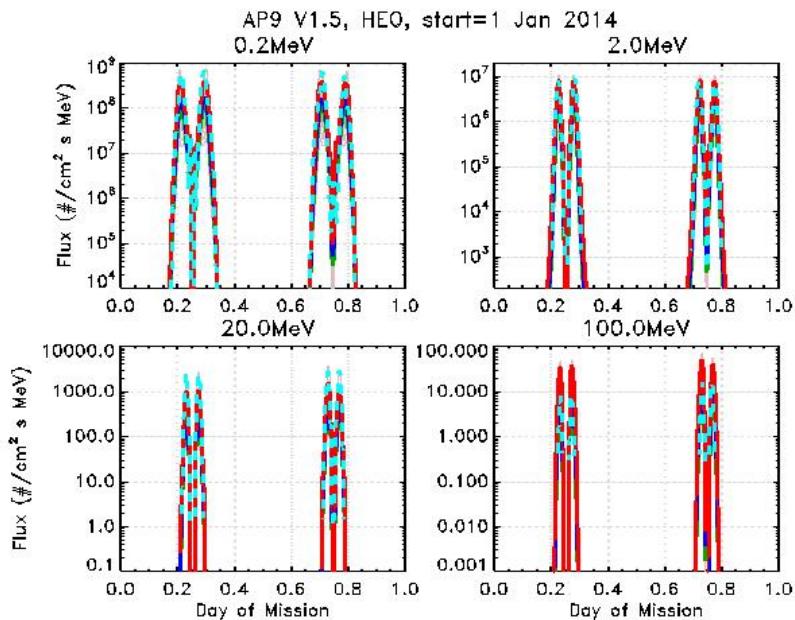
HEO

AE9**HEO (38900 km x 1475 km, 63.4 deg)**

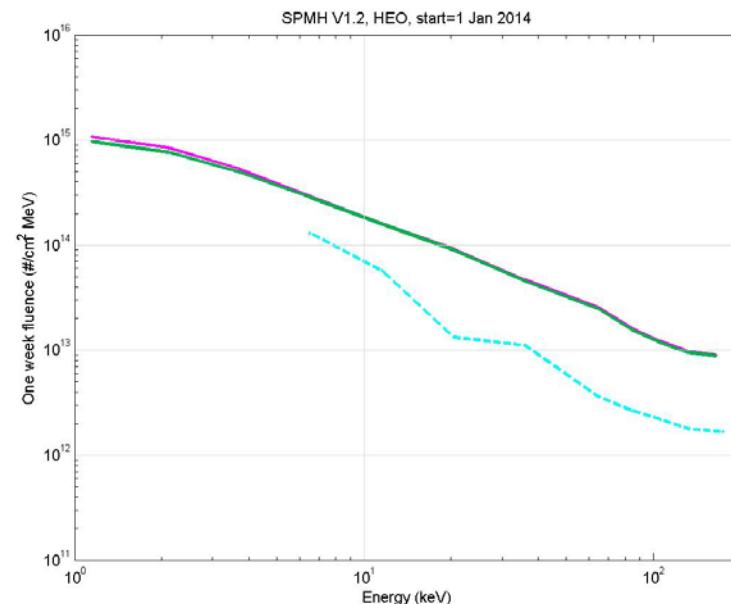
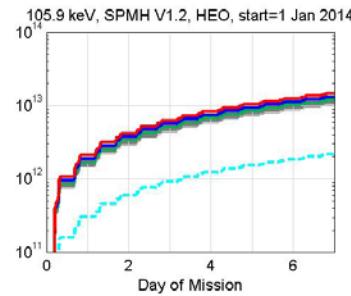
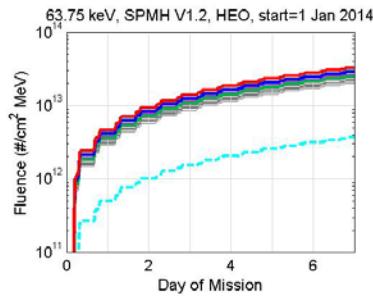
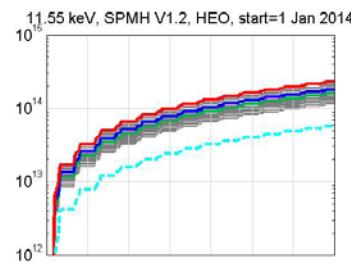
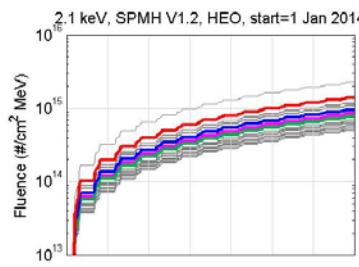
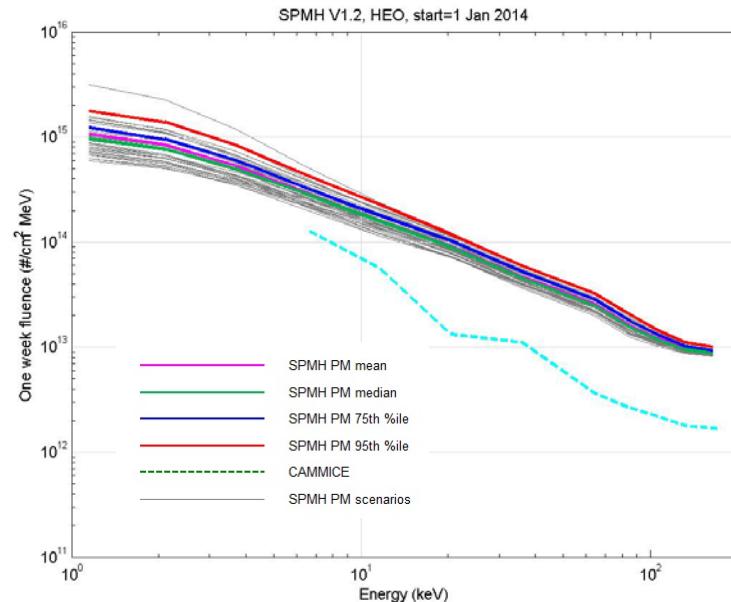
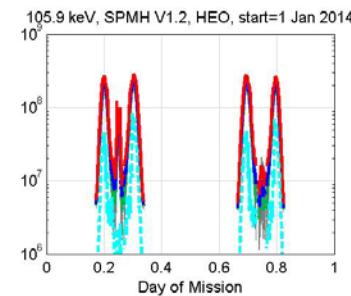
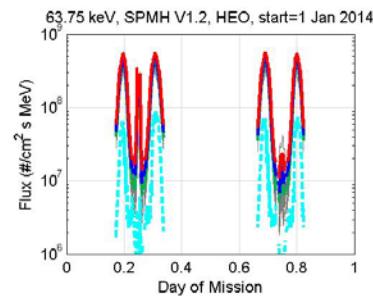
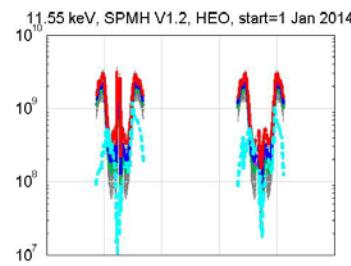
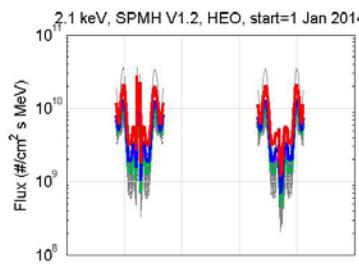
Distribution A

AP9

HEO (38900 km x 1475 km, 63.4 deg)

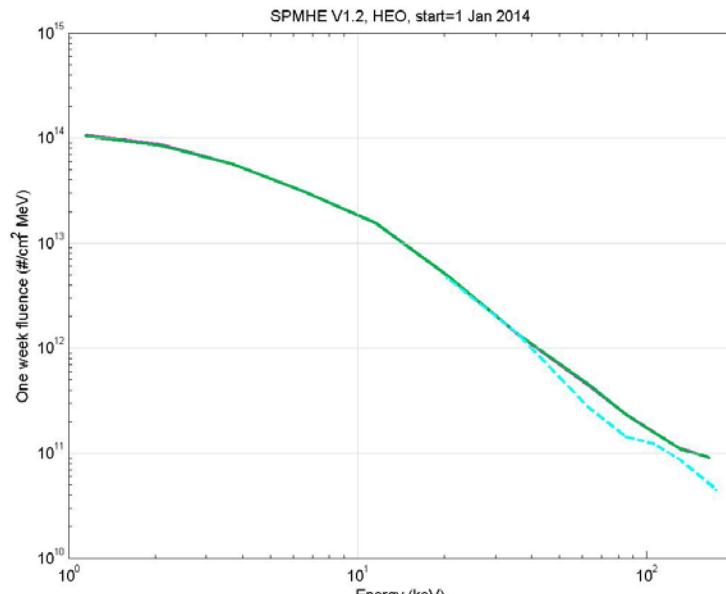
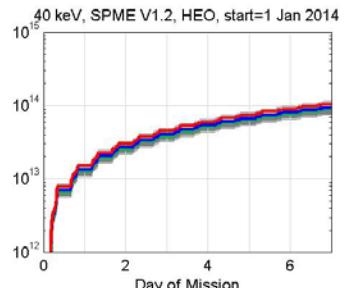
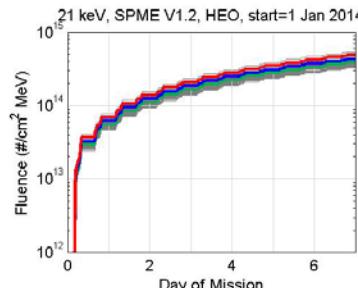
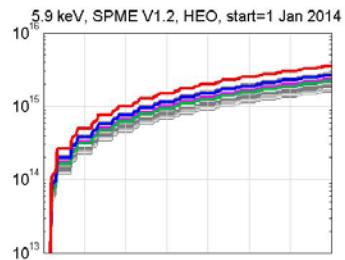
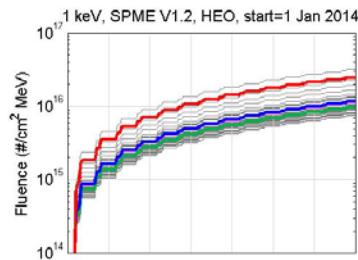
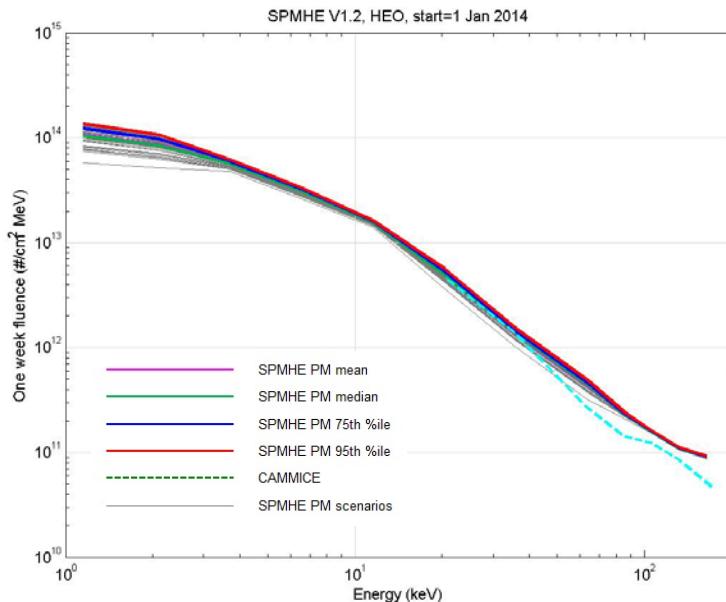
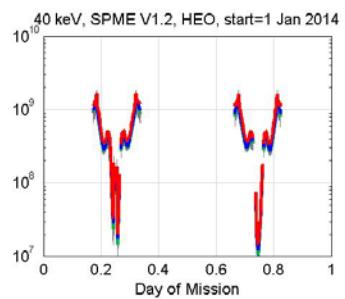
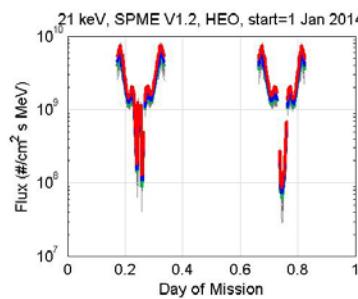
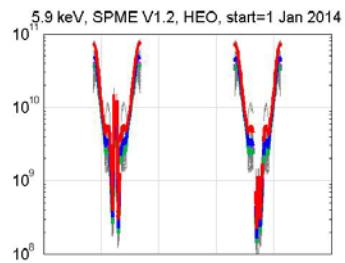
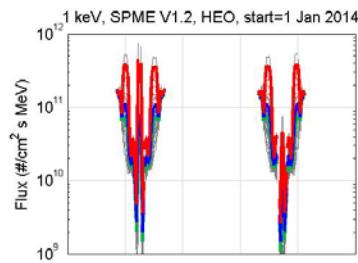


Distribution A

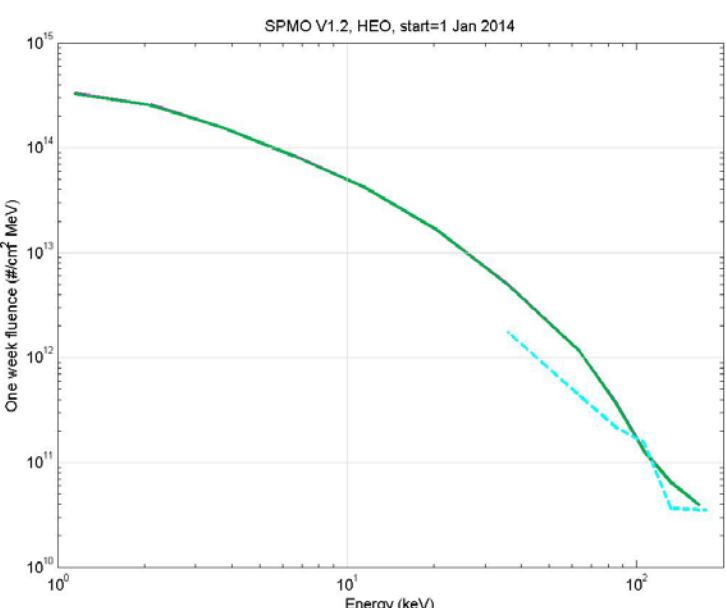
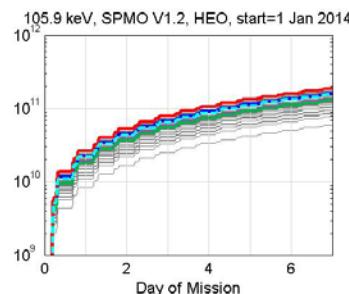
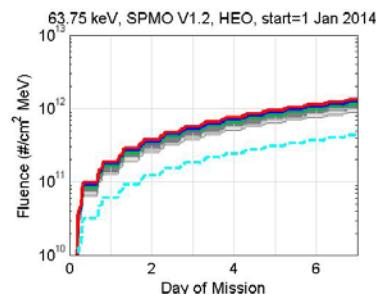
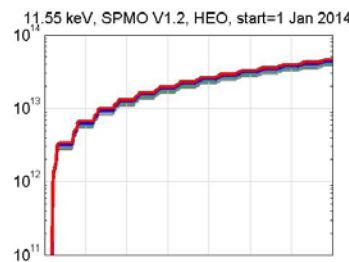
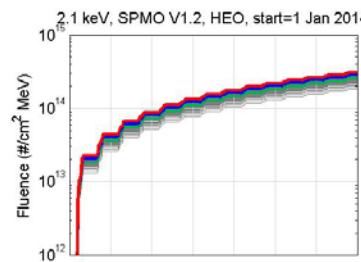
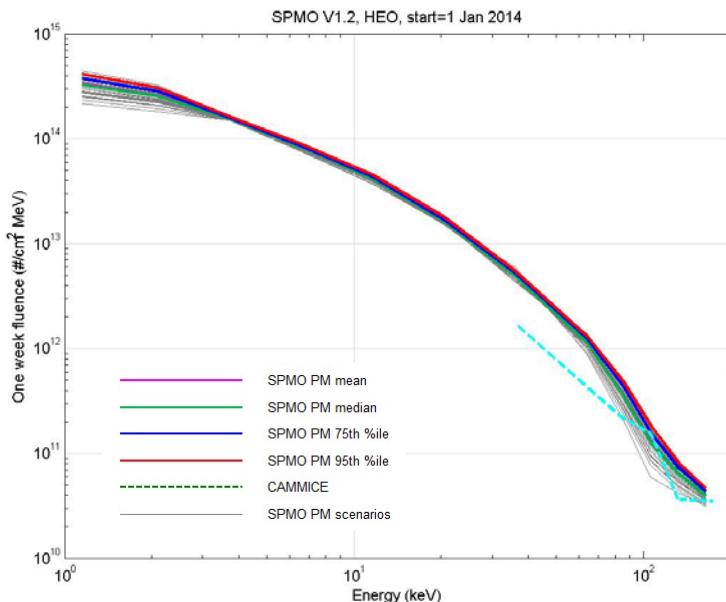
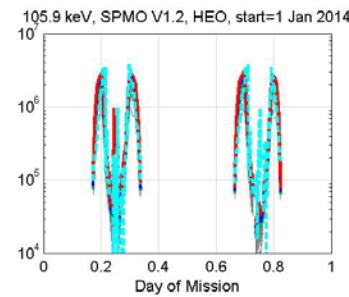
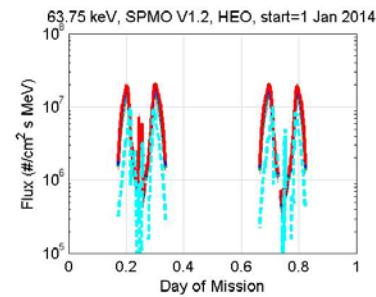
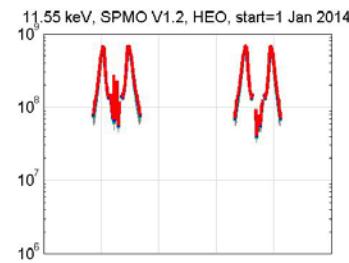
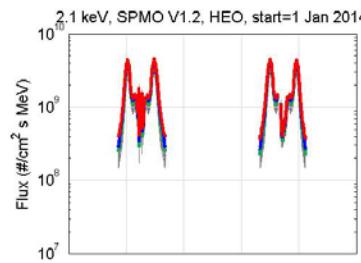


Distribution A

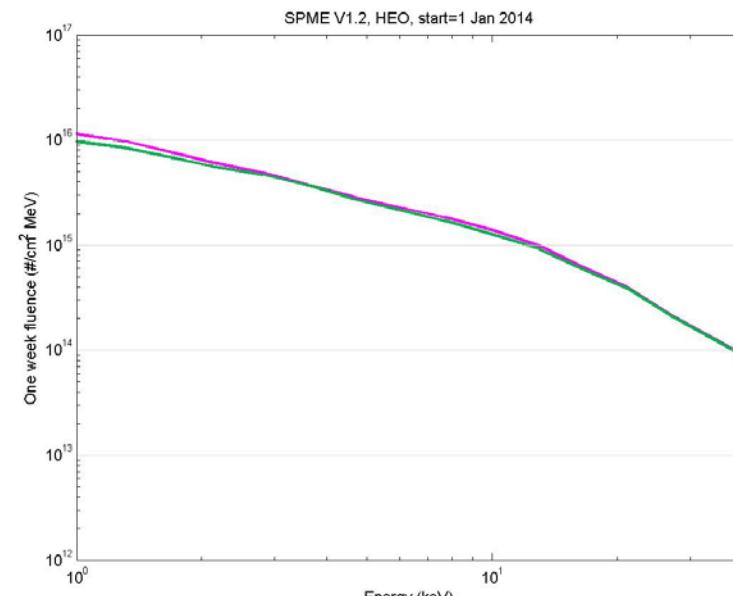
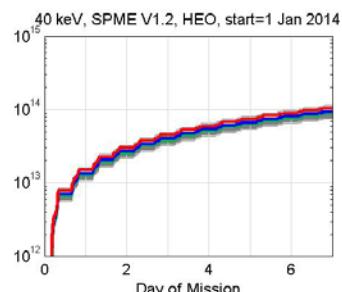
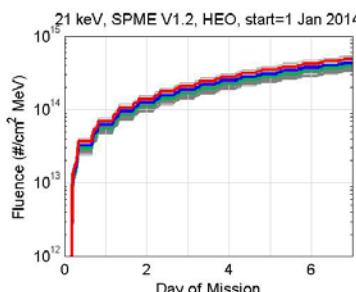
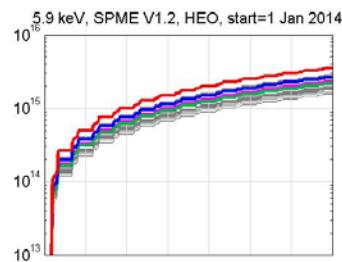
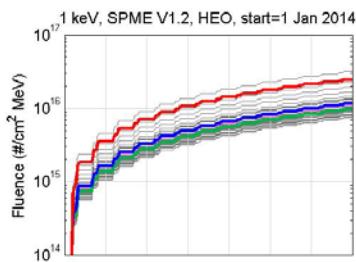
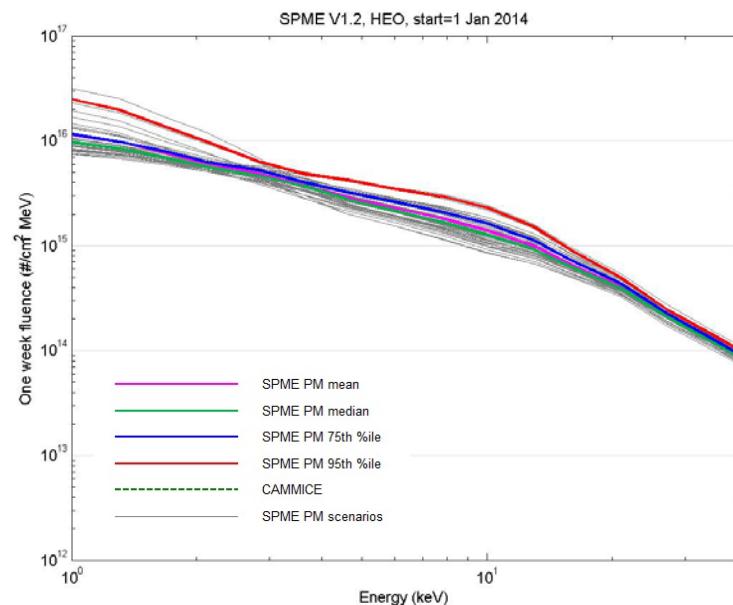
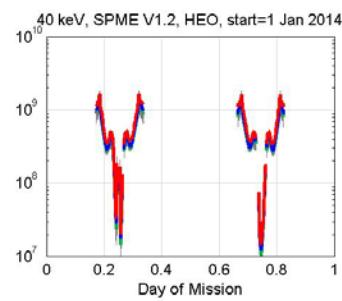
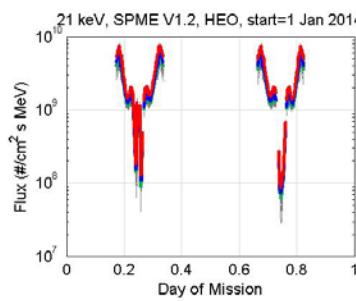
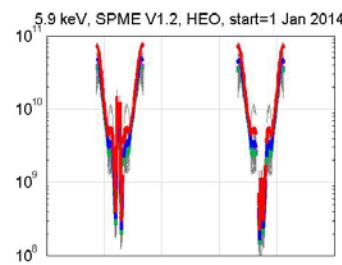
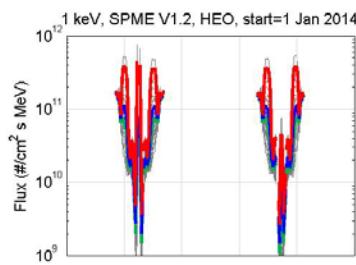
SPMHE HEO (38900 km x 1475 km, 63.4 deg)



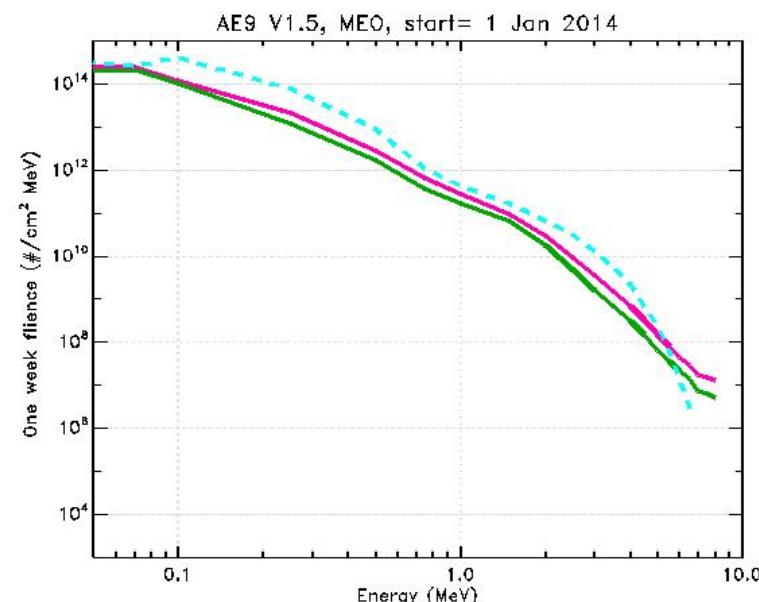
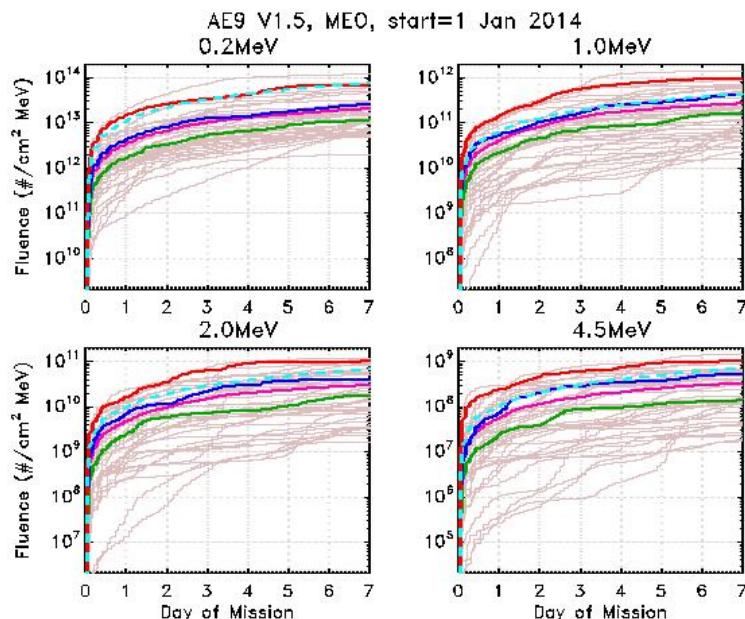
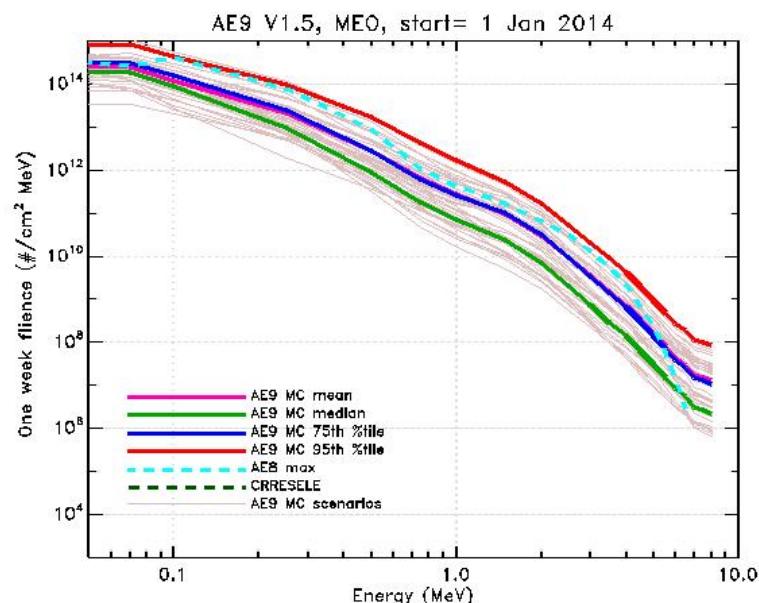
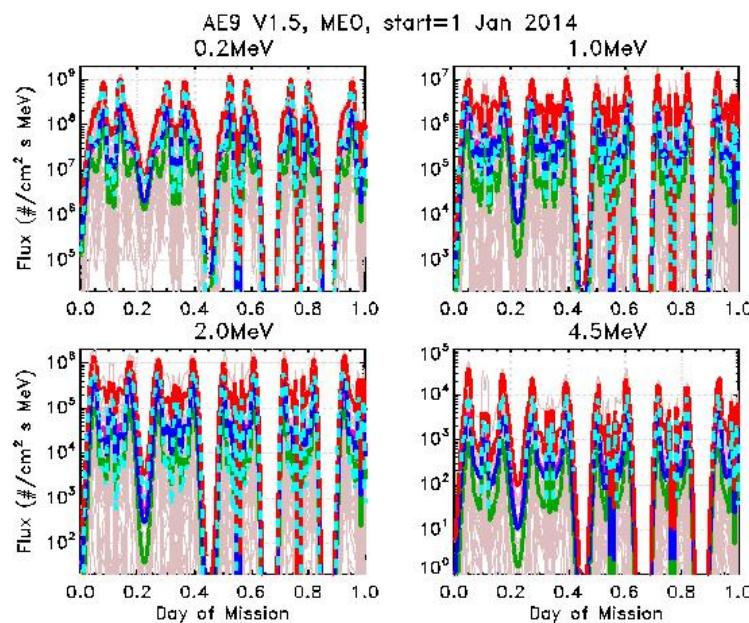
Distribution A



Distribution A

SPME**HEO (38900 km x 1475 km, 63.4 deg)****Distribution A**

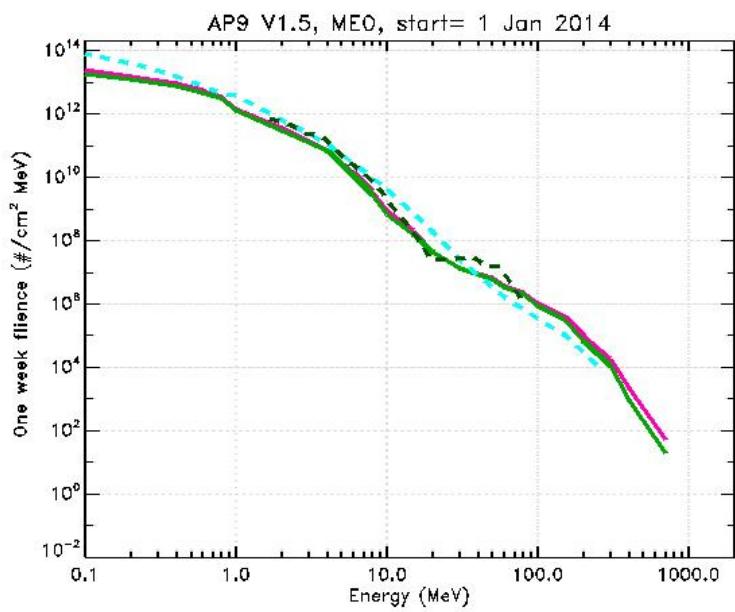
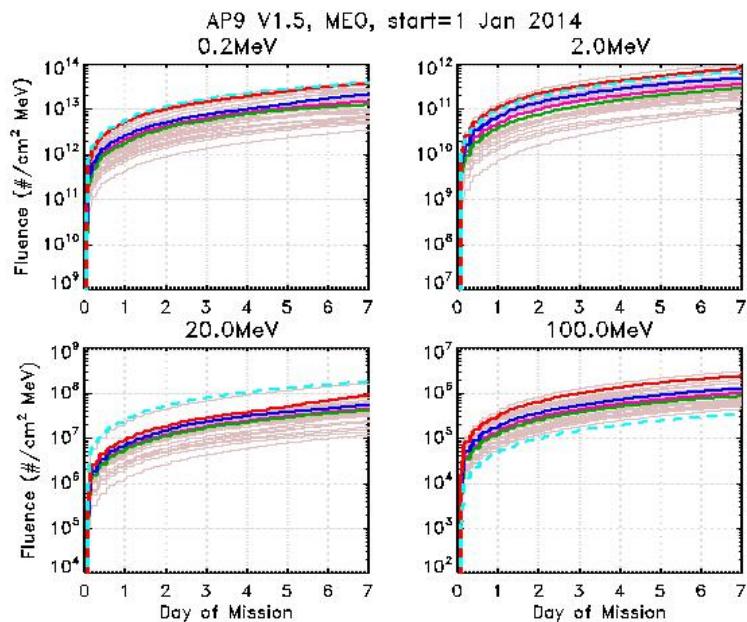
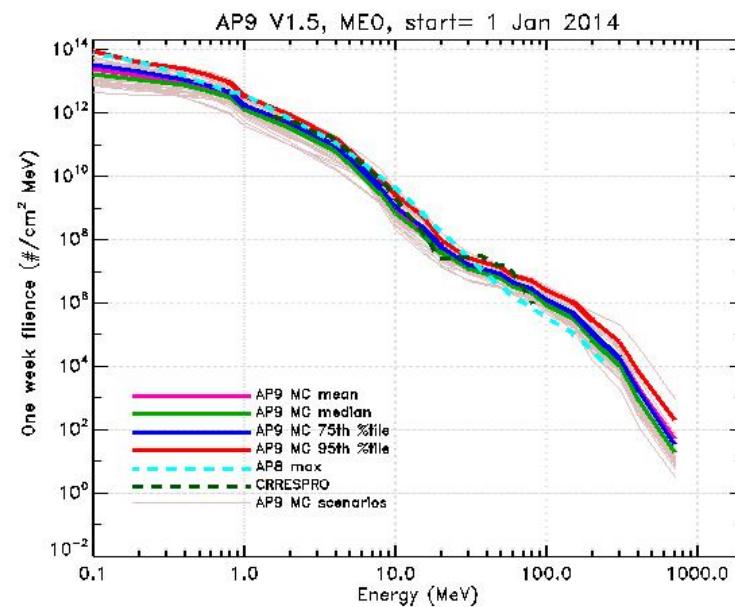
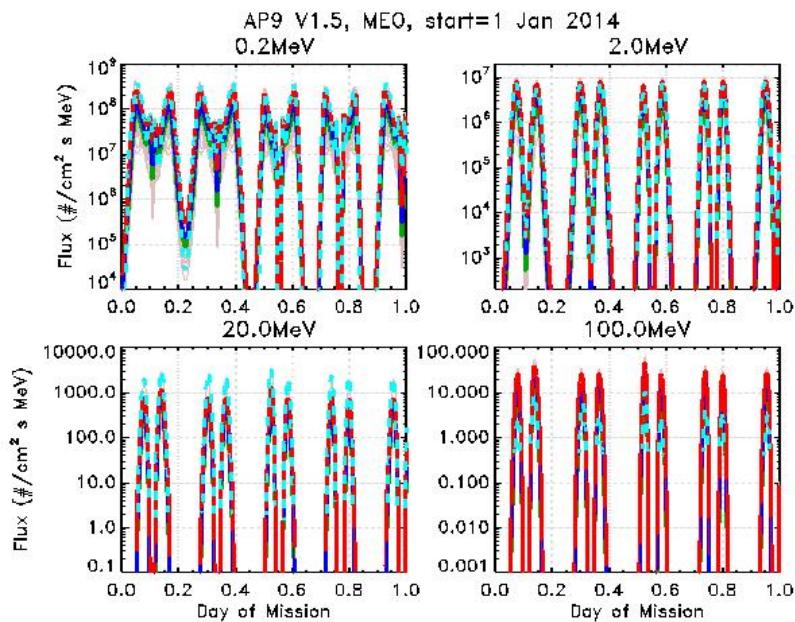
MEO

AE9**MEO (14100km x 3900 km, 120 deg) (DSX)**

Distribution A

AP9

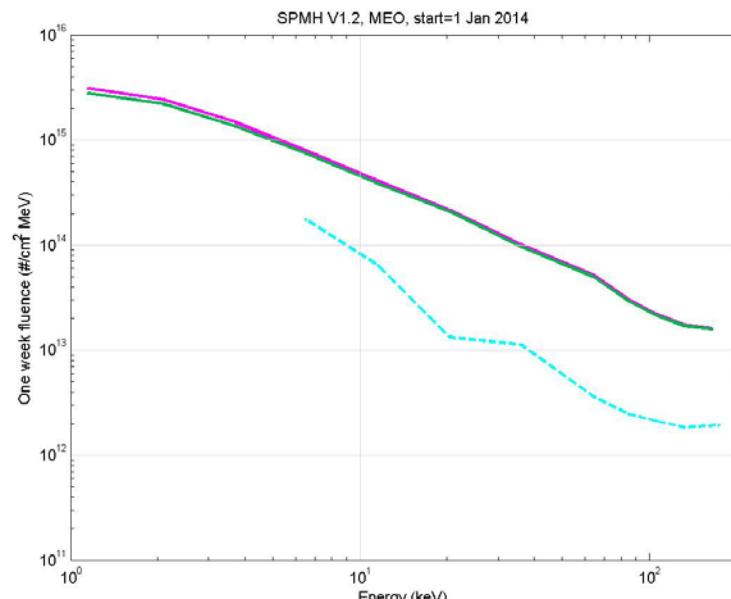
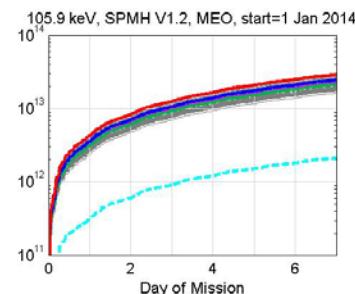
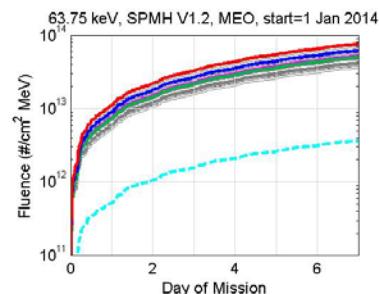
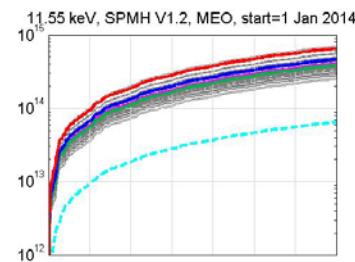
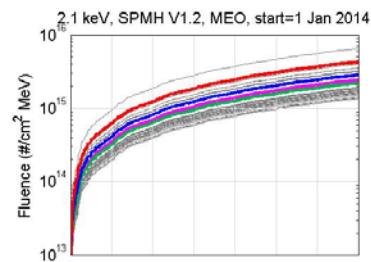
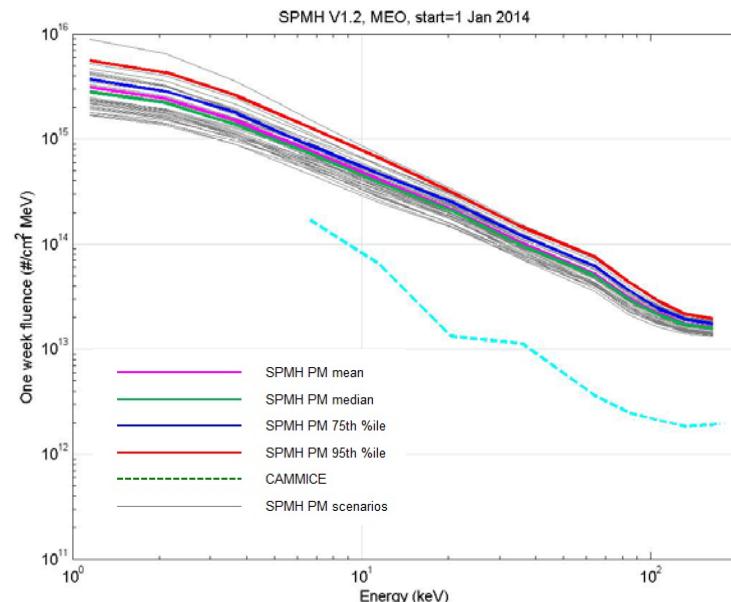
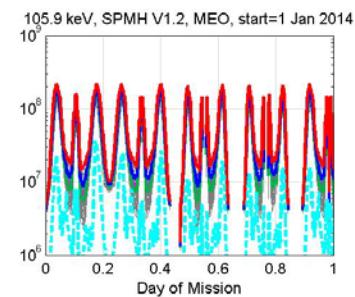
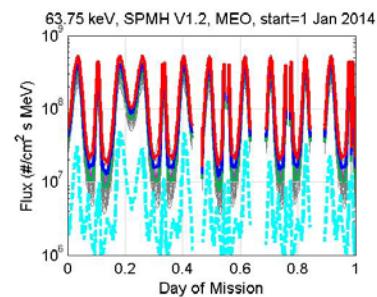
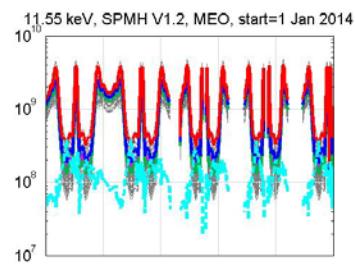
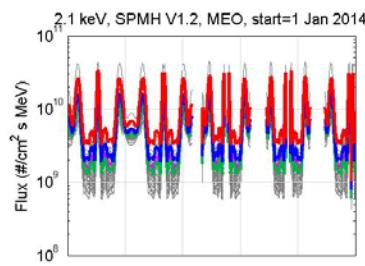
MEO (14100km x 3900 km, 120 deg) (DSX)



Distribution A

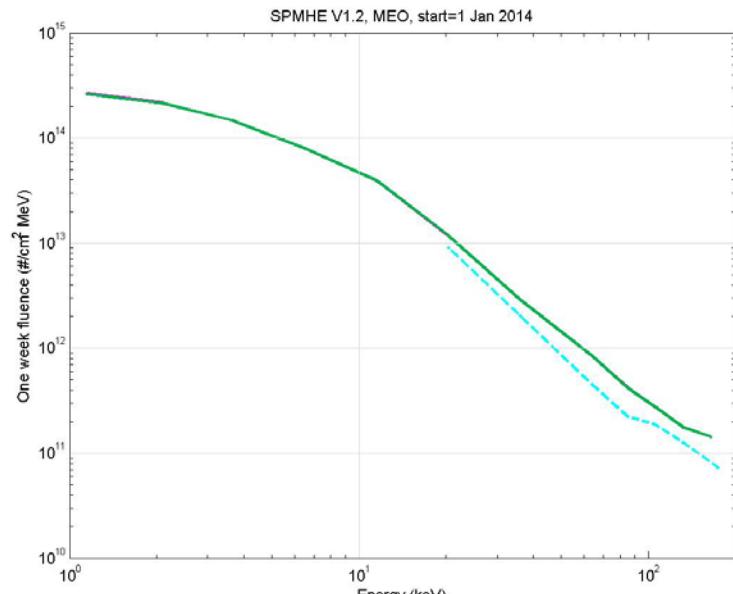
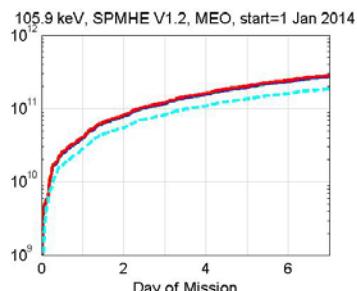
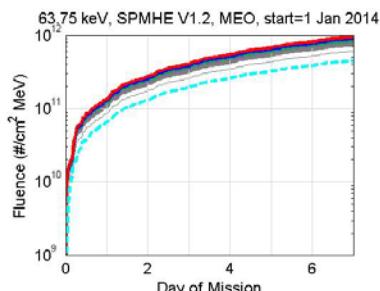
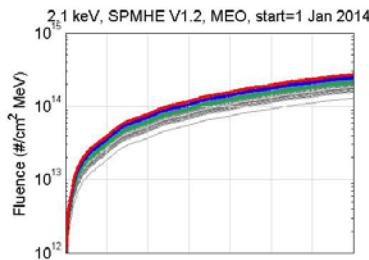
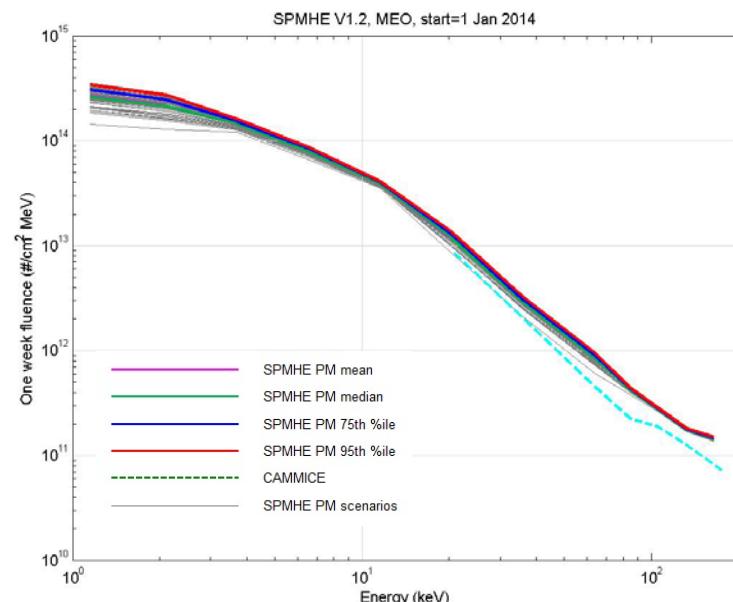
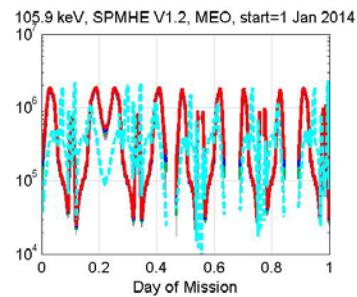
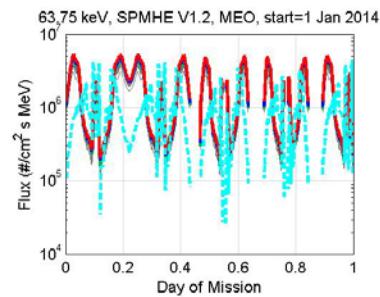
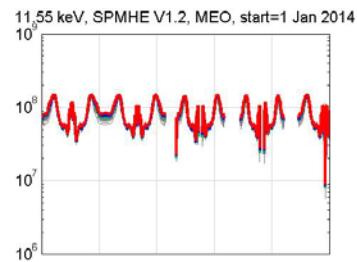
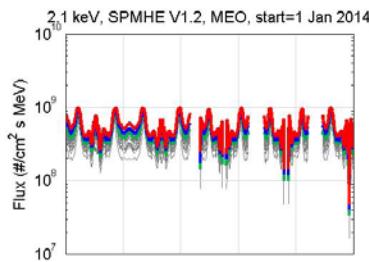
SPMH

MEO (14100km x 3900 km, 120 deg) (DSX)

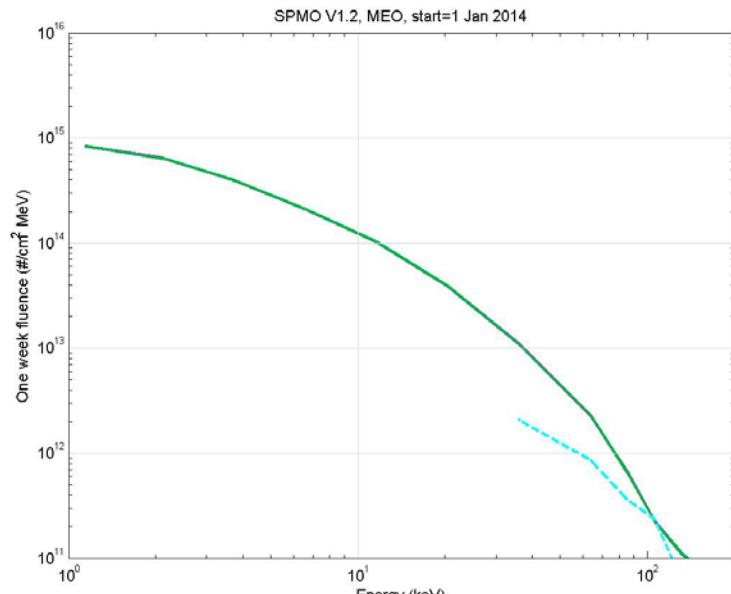
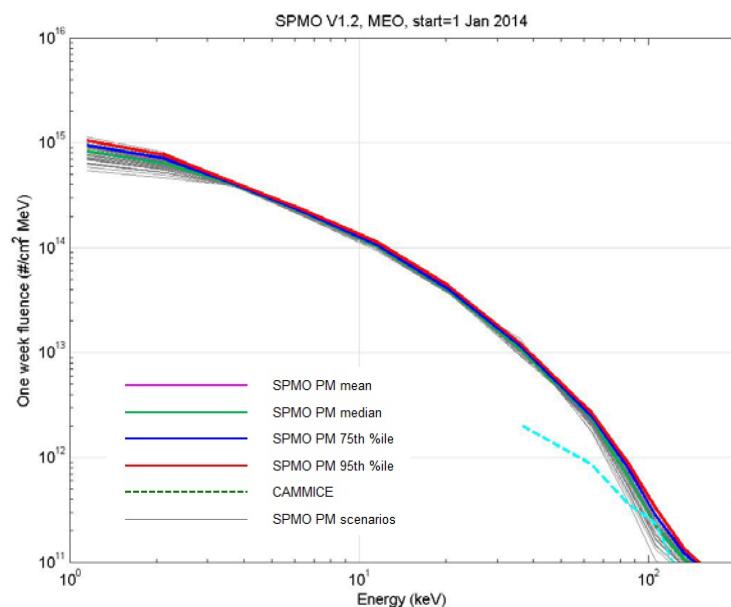
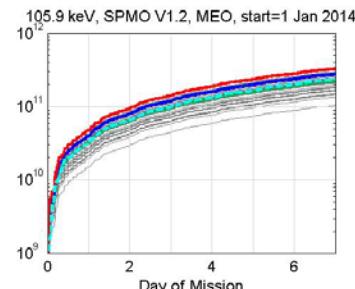
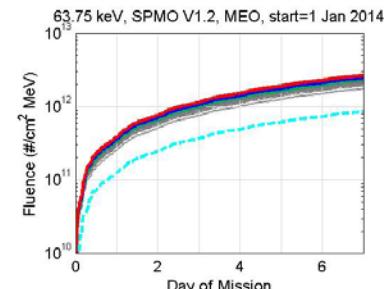
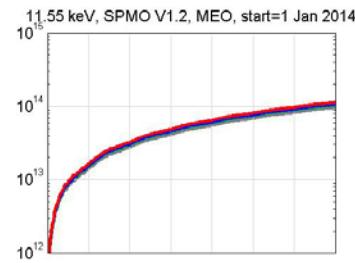
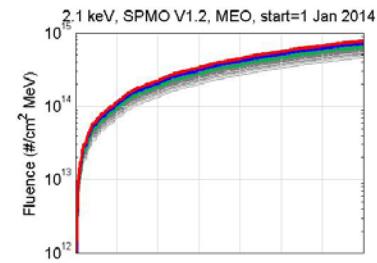
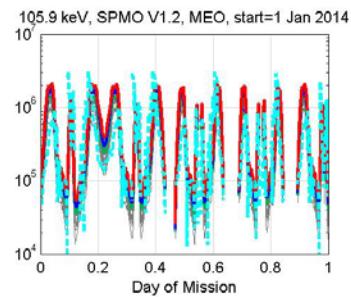
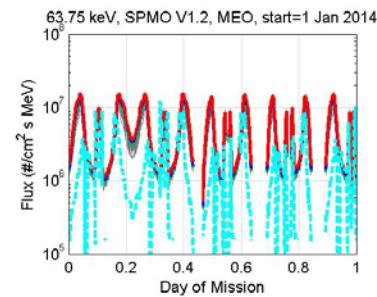
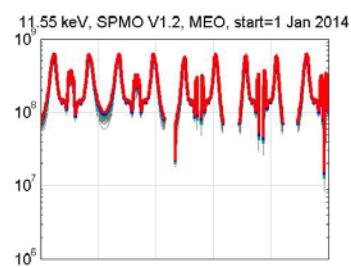
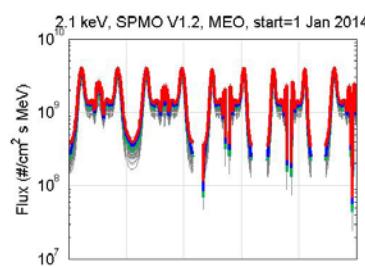


Distribution A

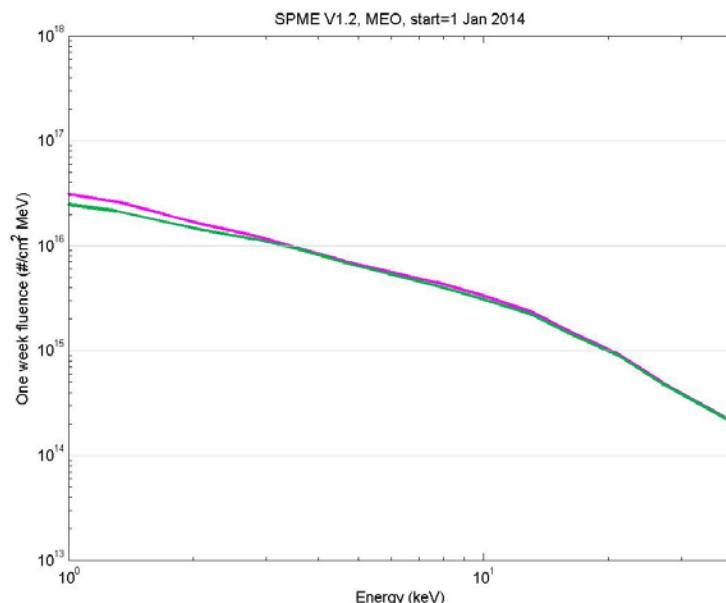
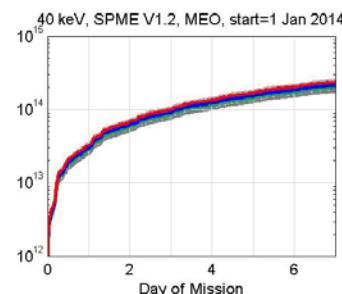
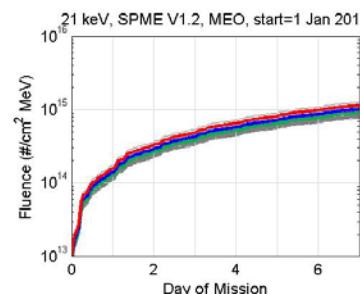
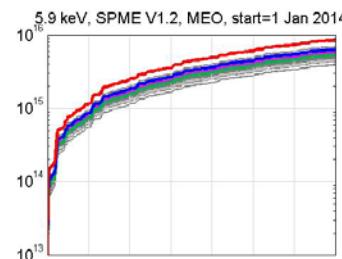
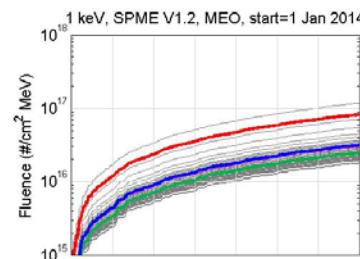
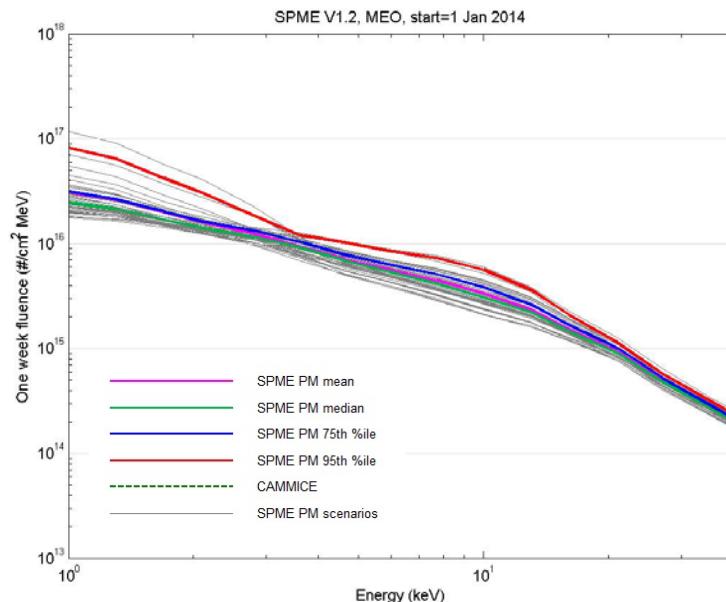
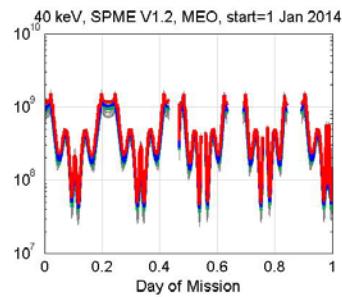
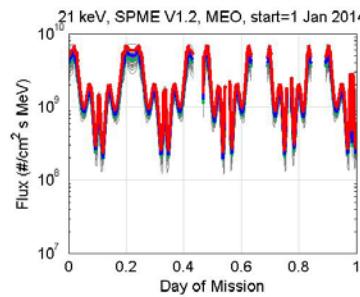
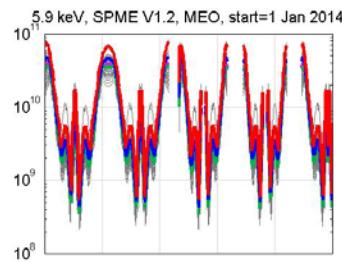
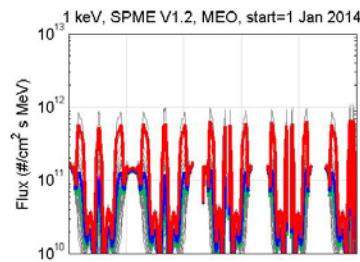
SPMHE MEO (14100km x 3900 km, 120 deg) (DSX)



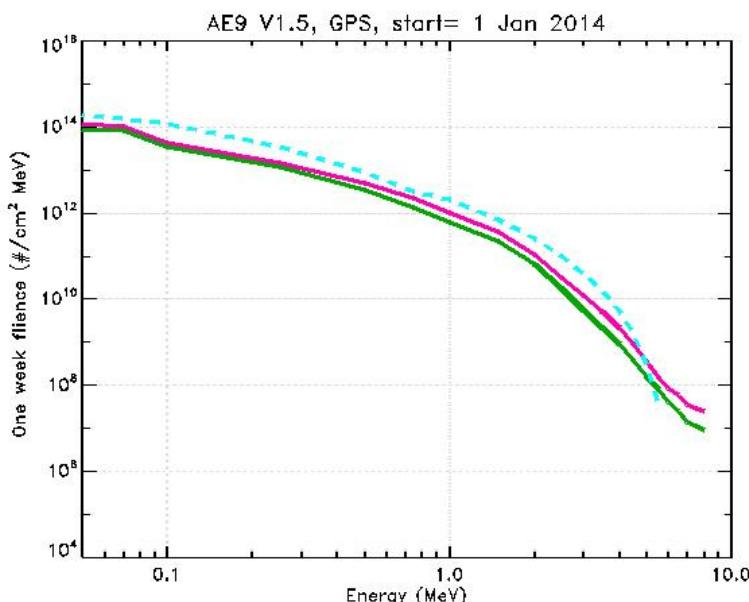
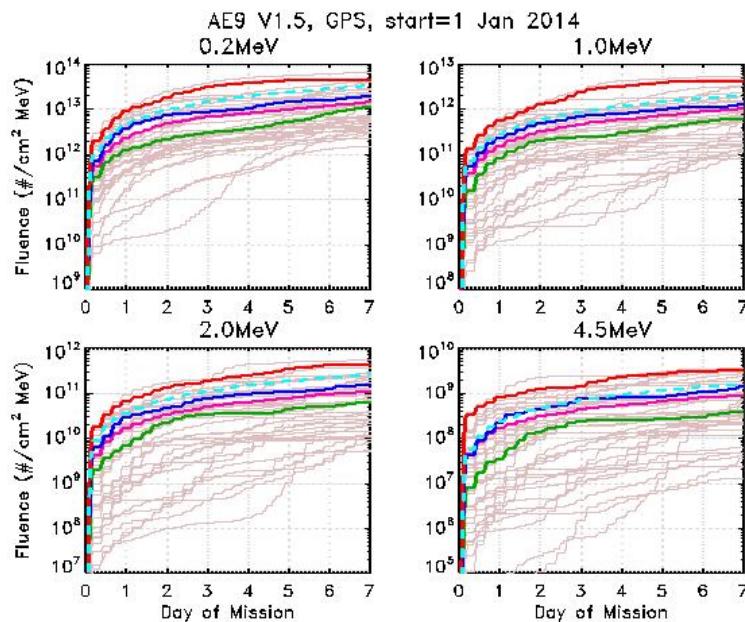
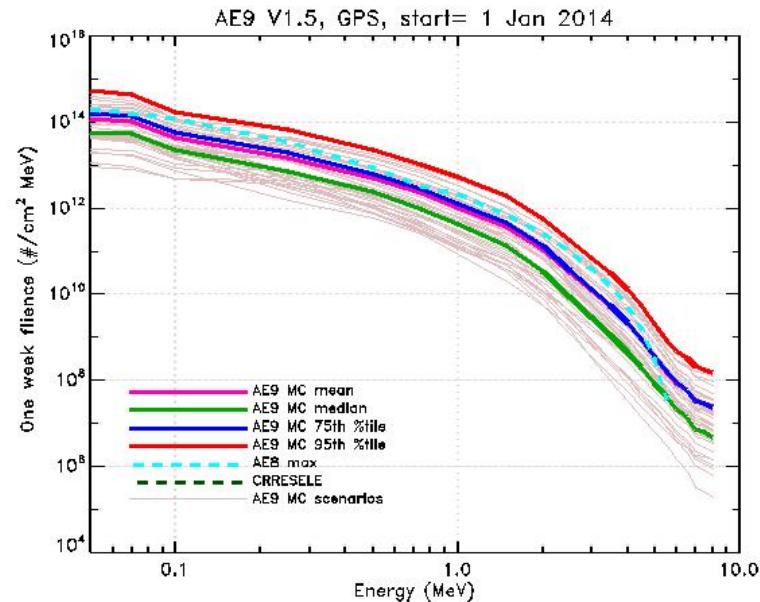
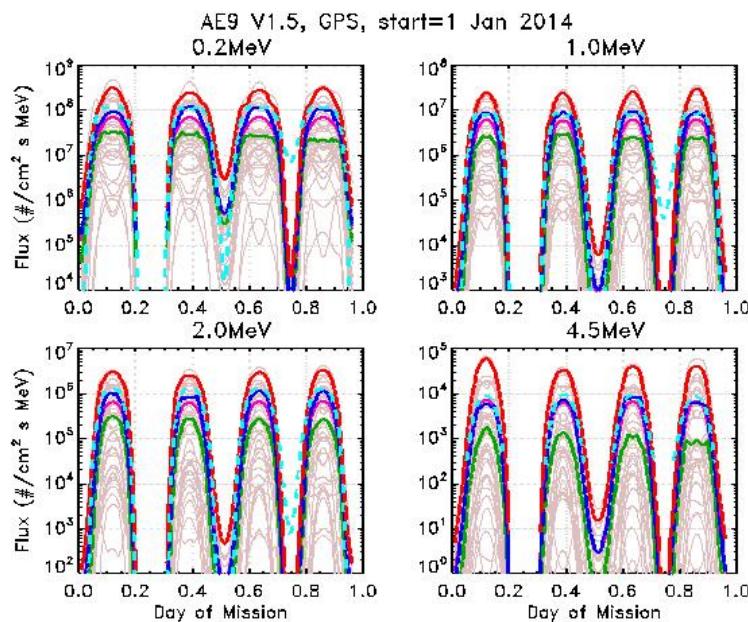
Distribution A



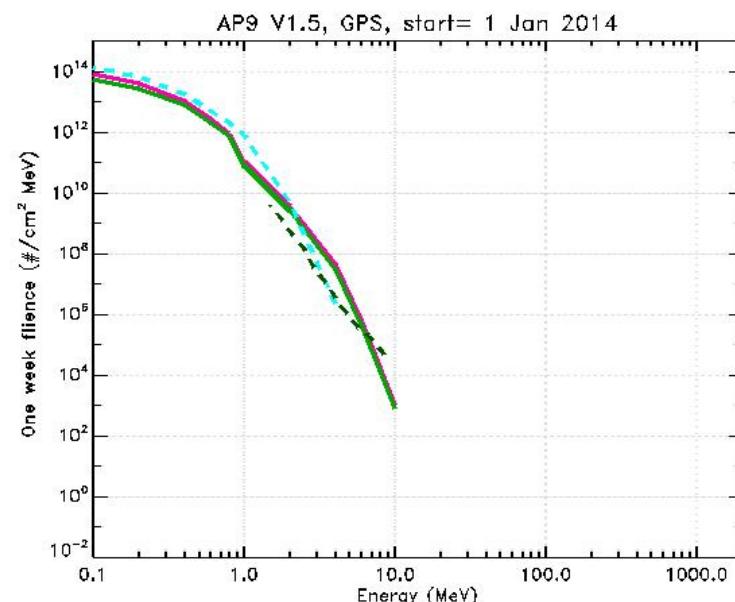
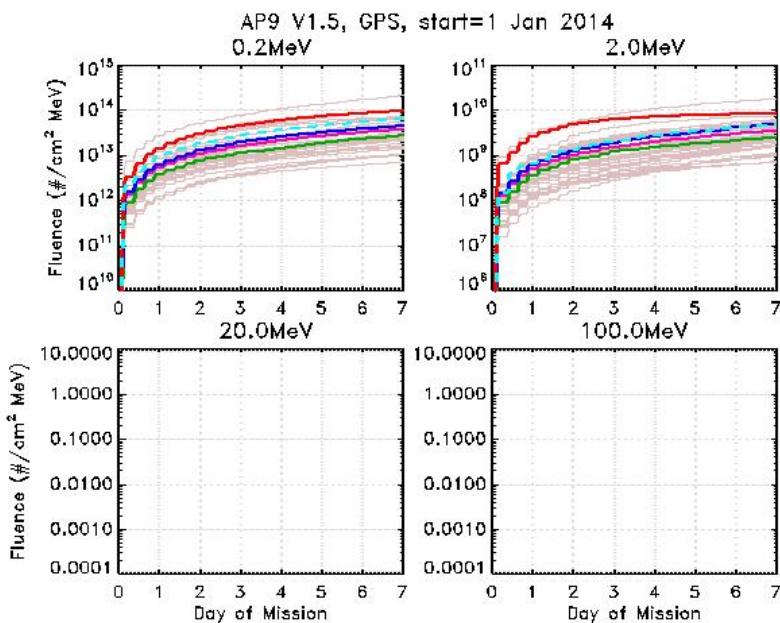
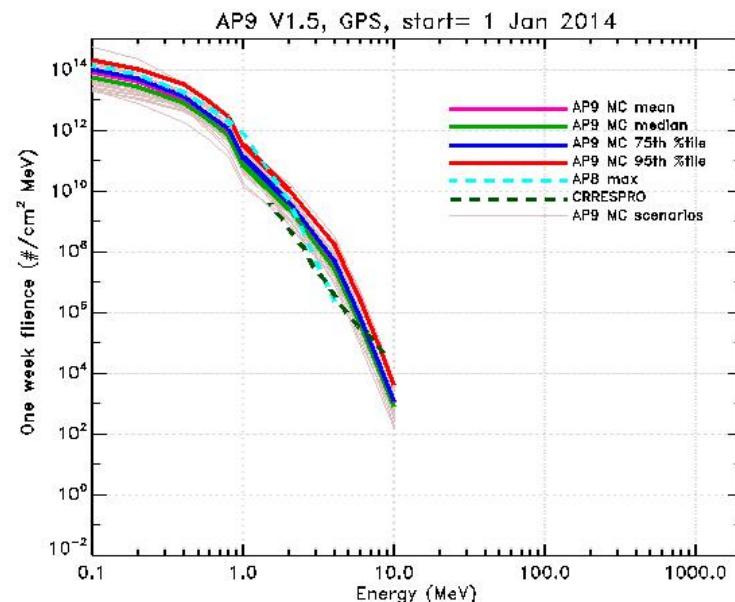
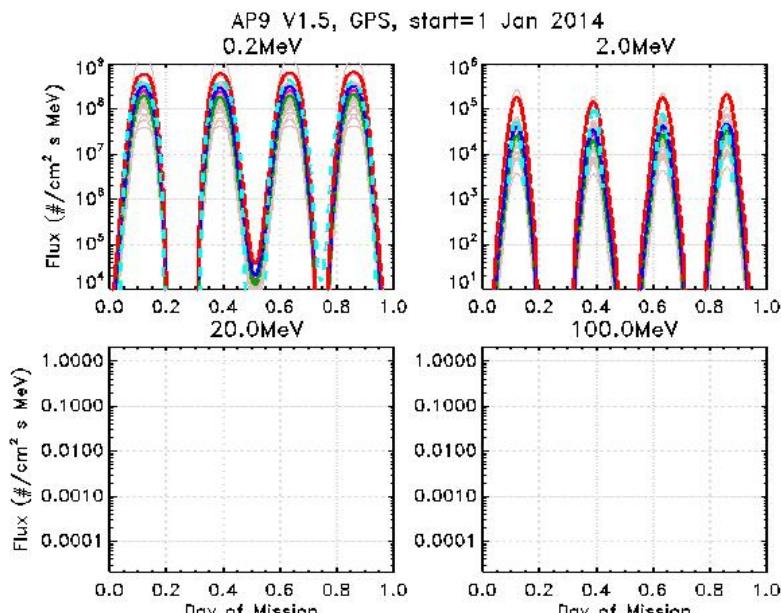
Distribution A

SPME**MEO (14100km x 3900 km, 120 deg) (DSX)****Distribution A**

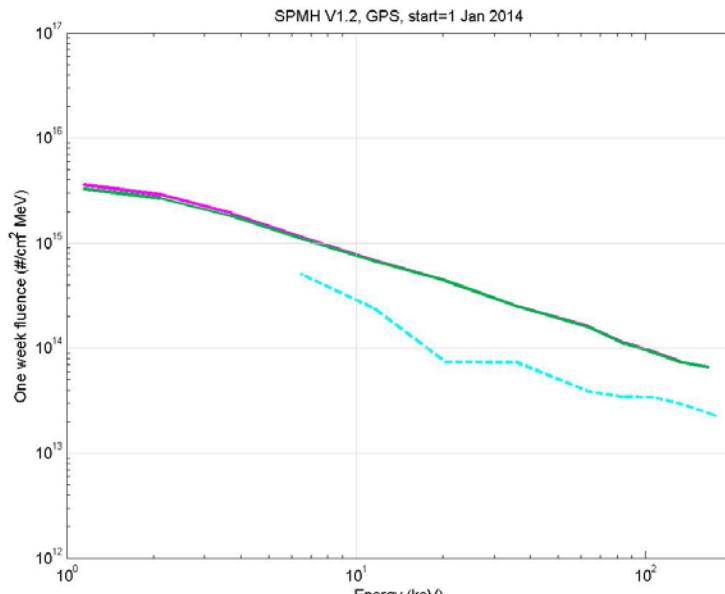
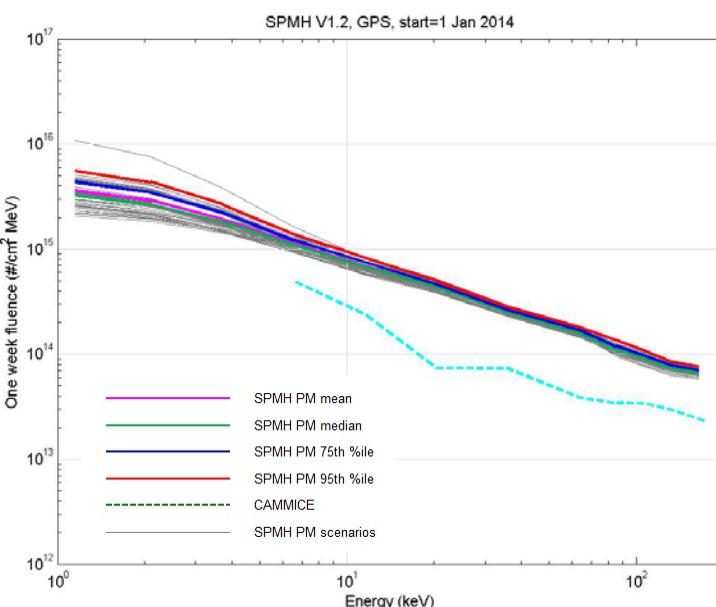
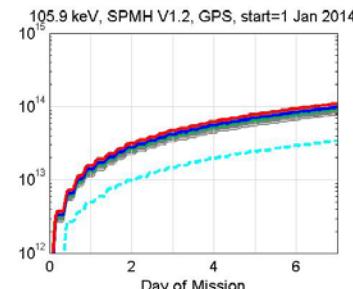
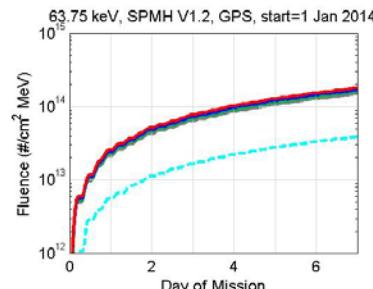
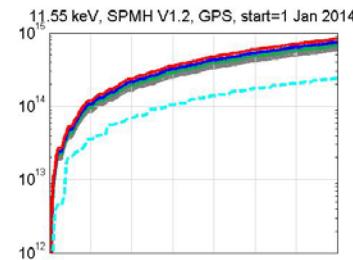
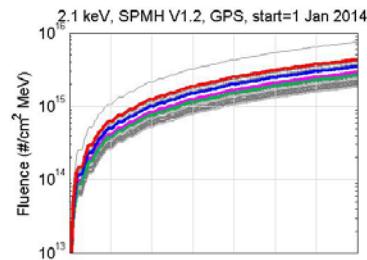
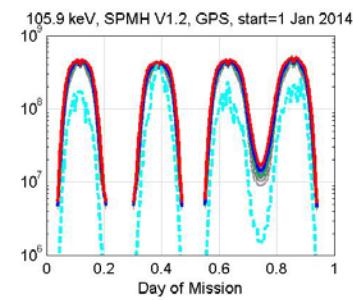
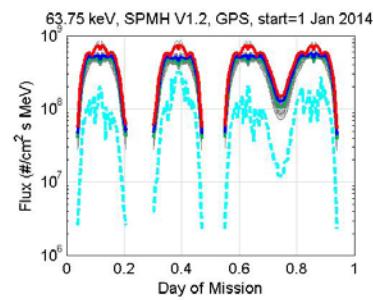
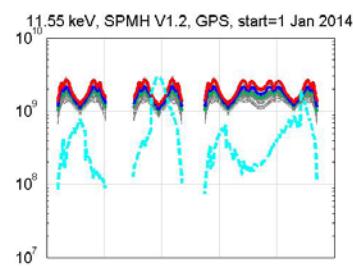
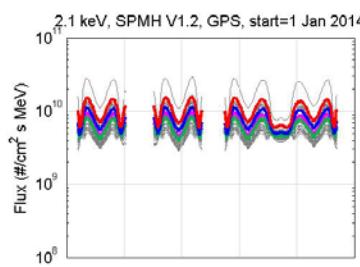
GPS

AE9**GPS (20200 km circular, 55 deg)**

Distribution A

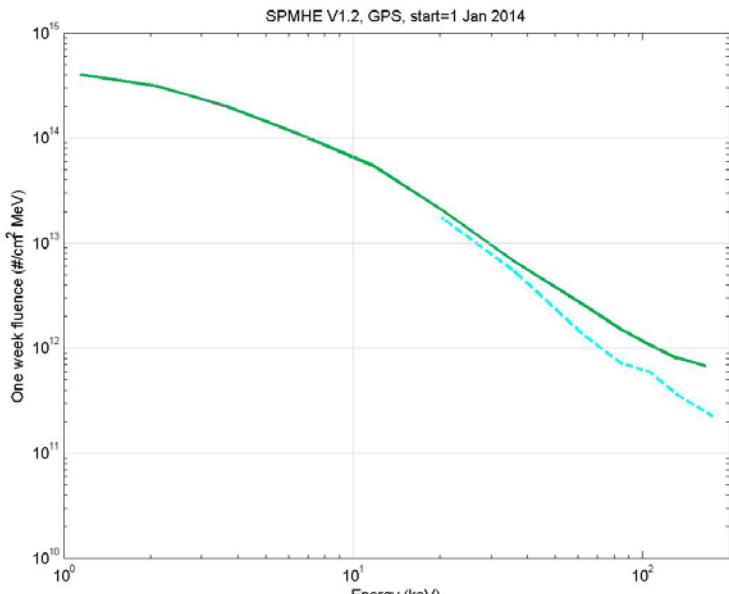
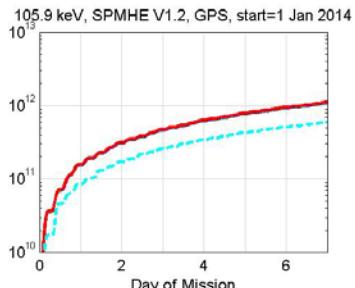
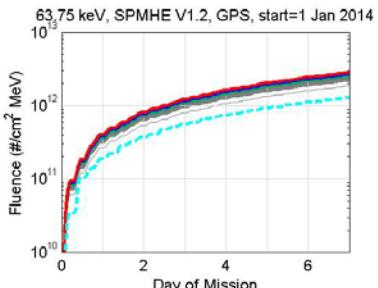
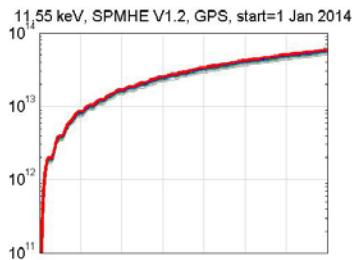
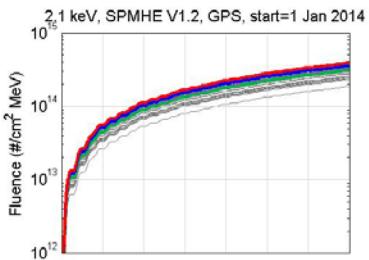
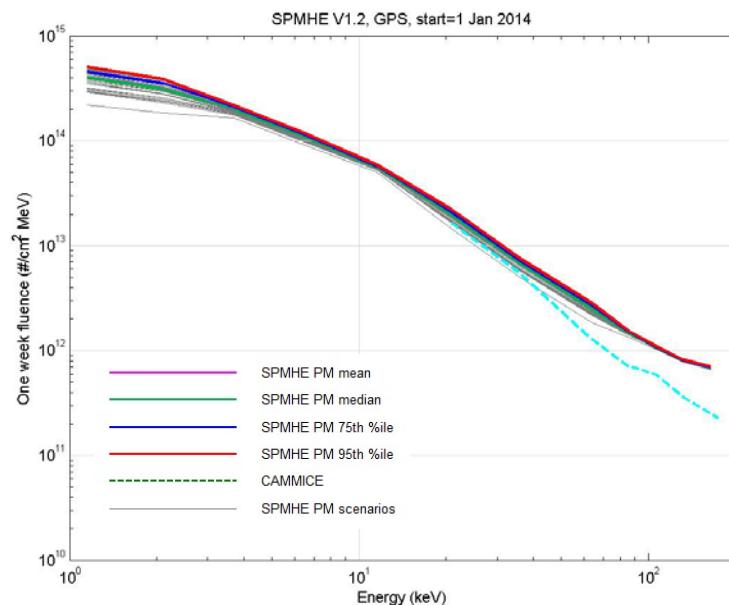
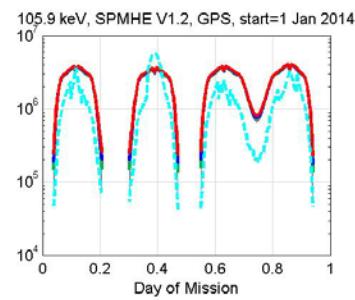
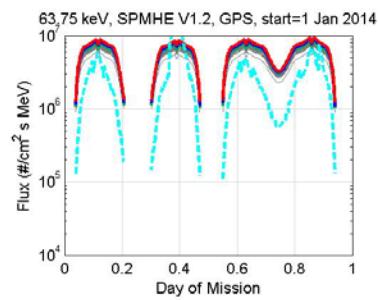
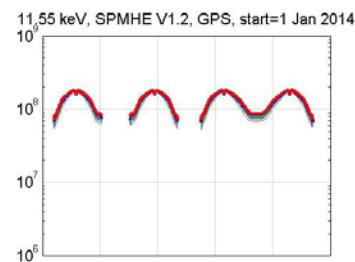
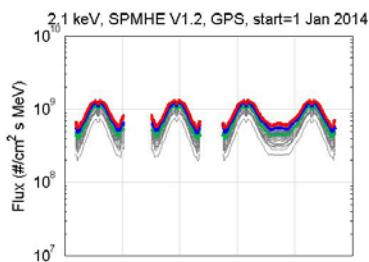
AP9**GPS (20200 km circular, 55 deg)**

Distribution A

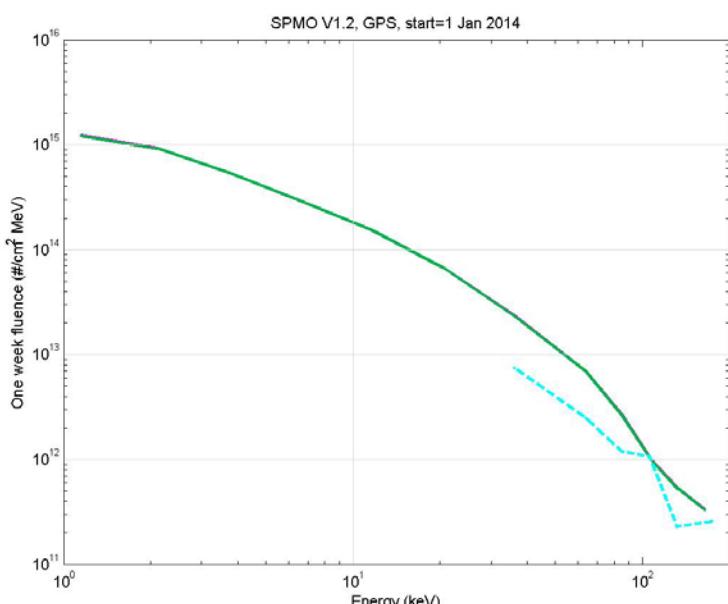
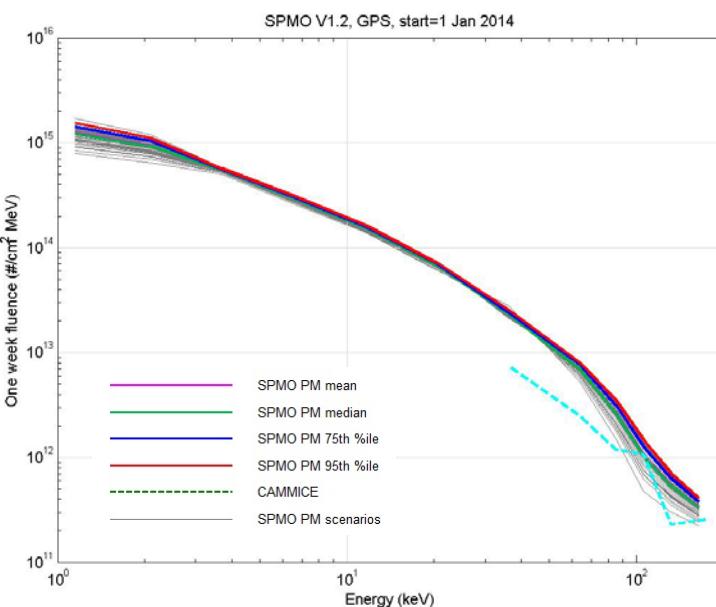
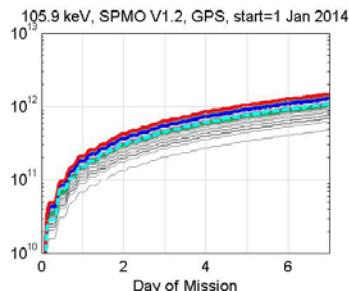
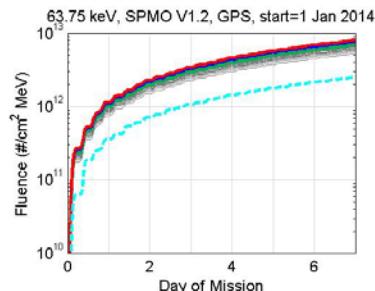
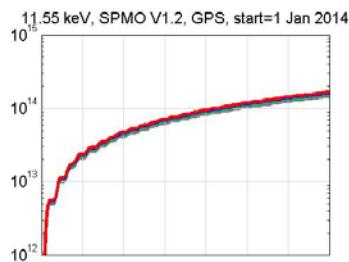
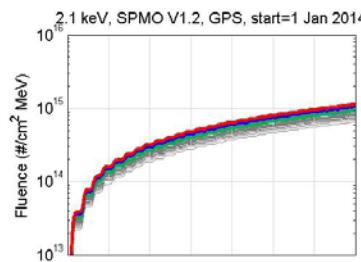
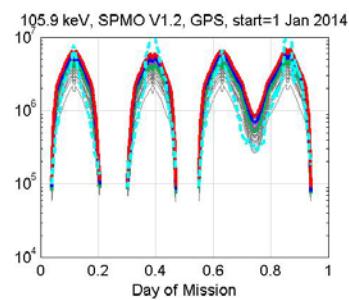
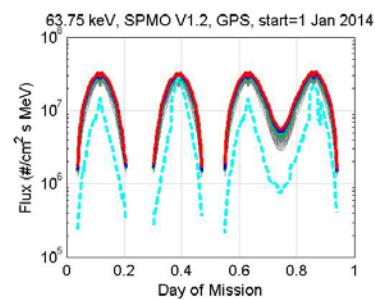
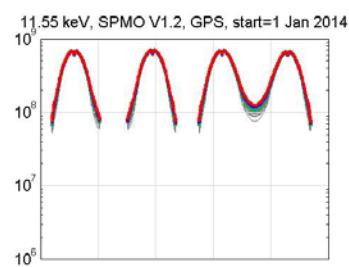
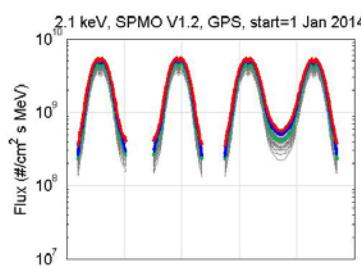


Distribution A

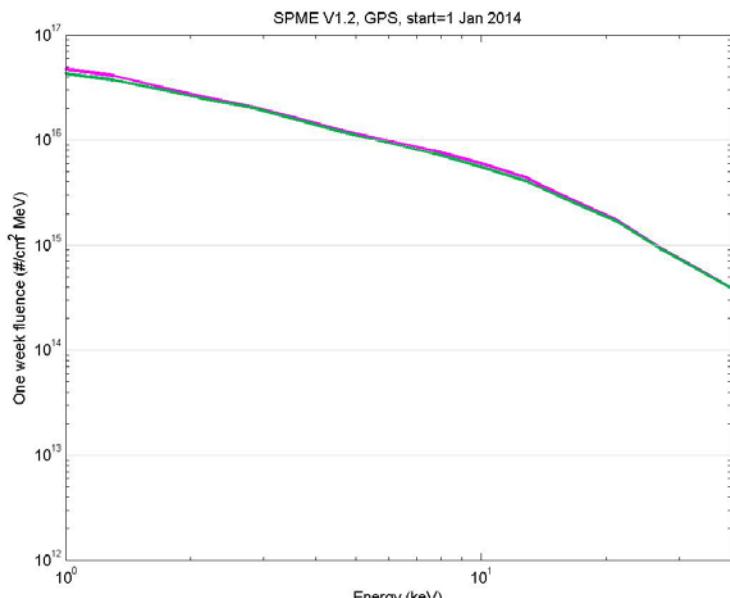
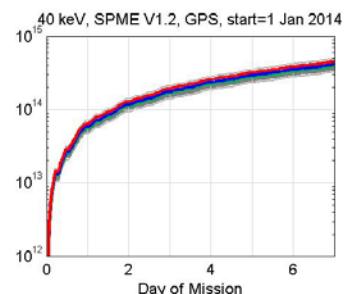
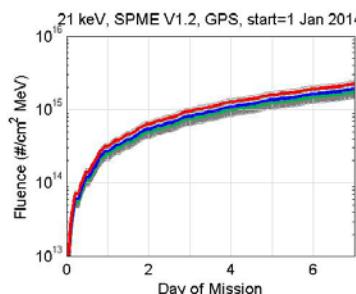
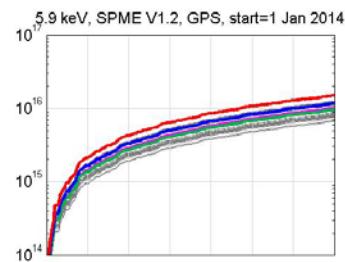
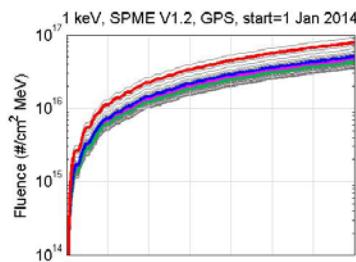
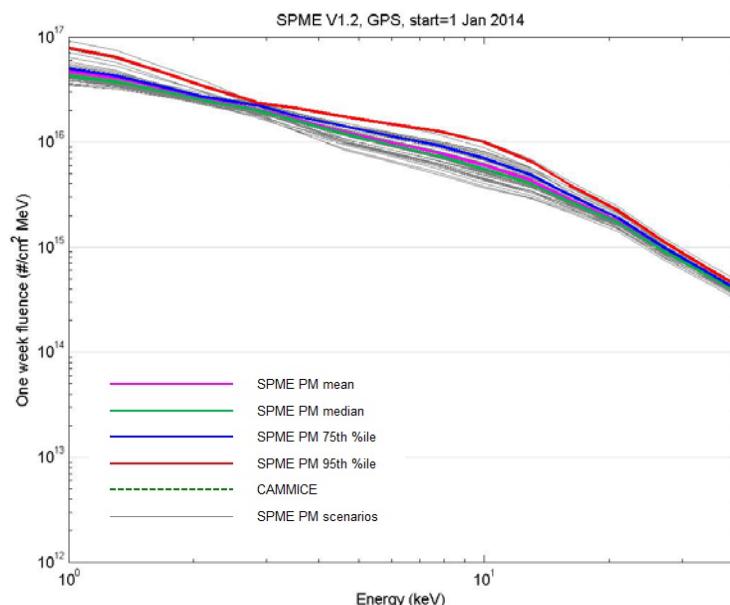
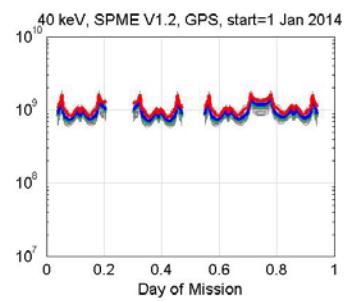
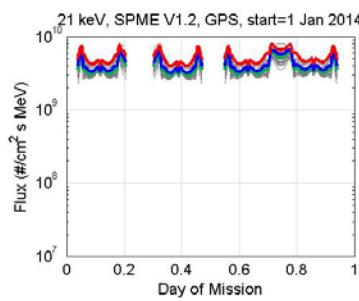
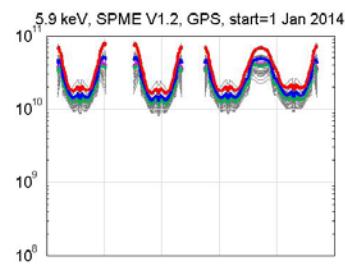
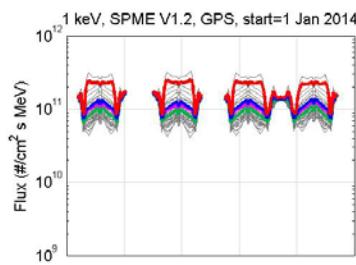
SPMHE GPS (20200 km circular, 55 deg)



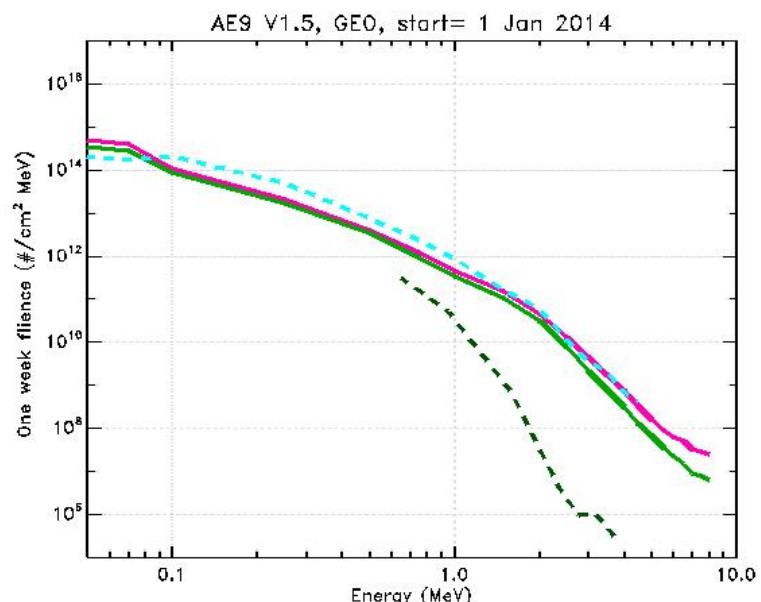
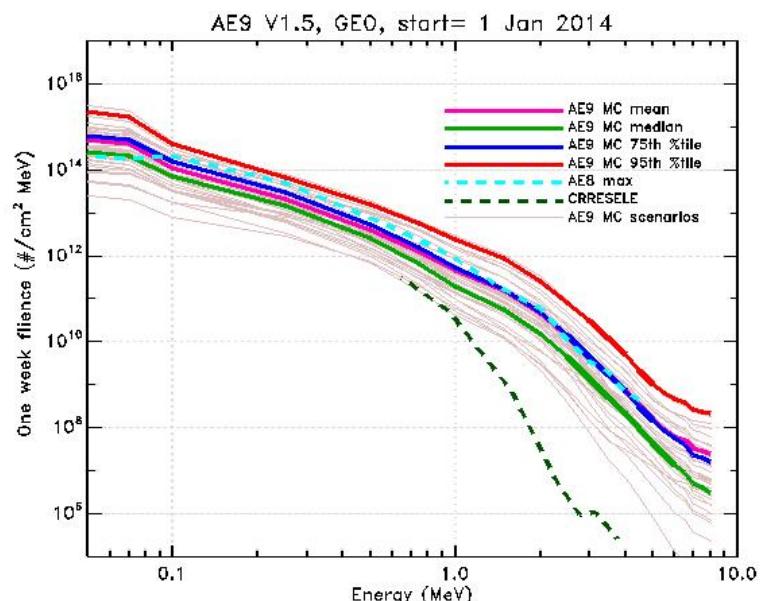
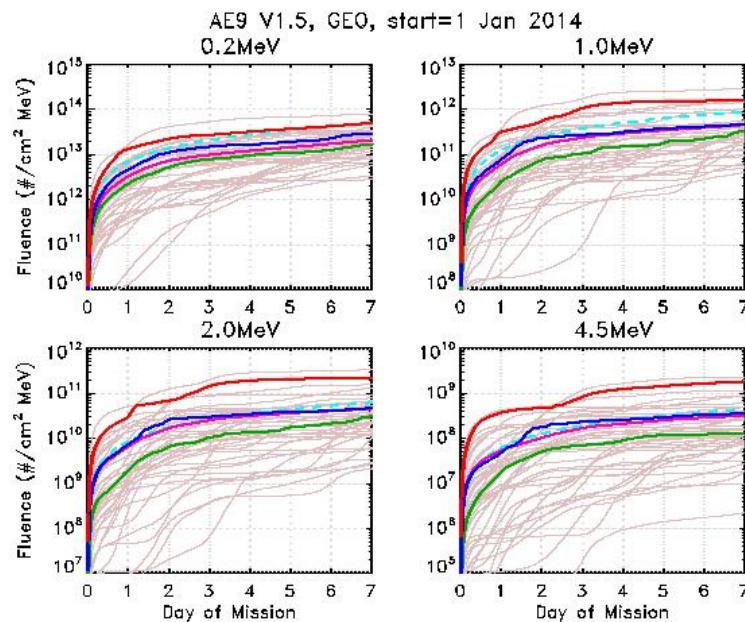
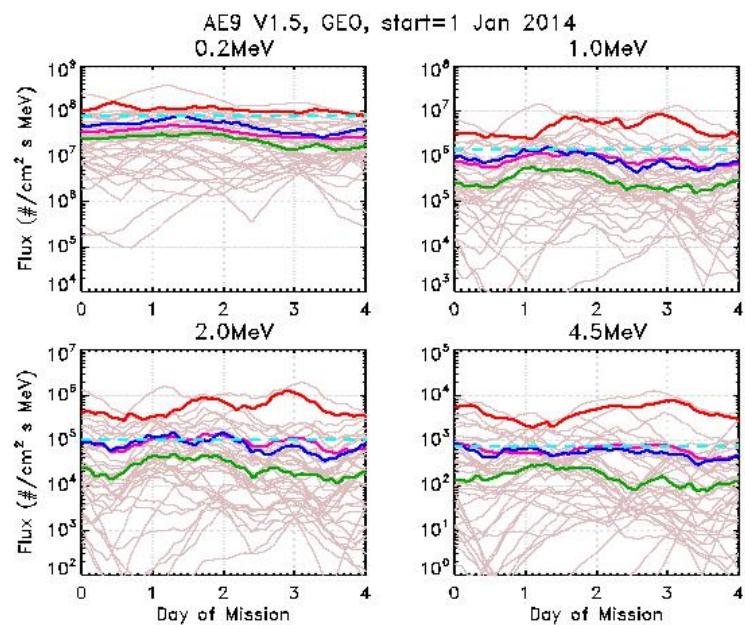
Distribution A



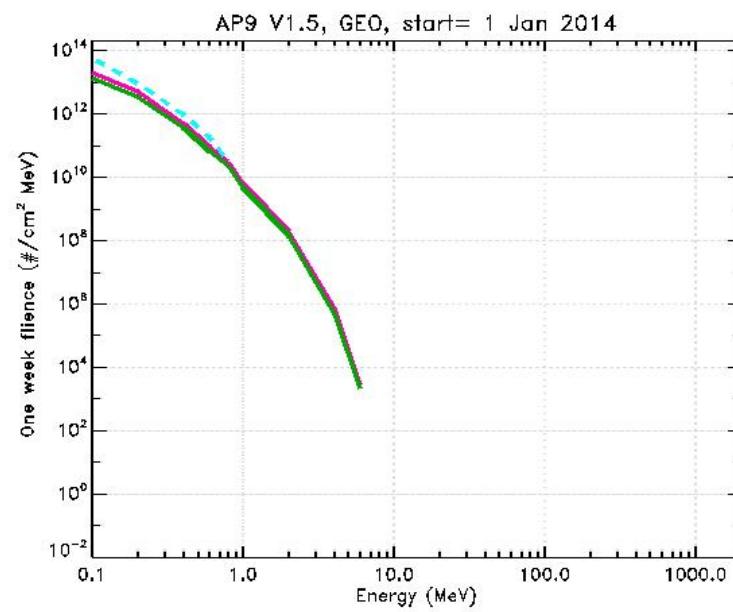
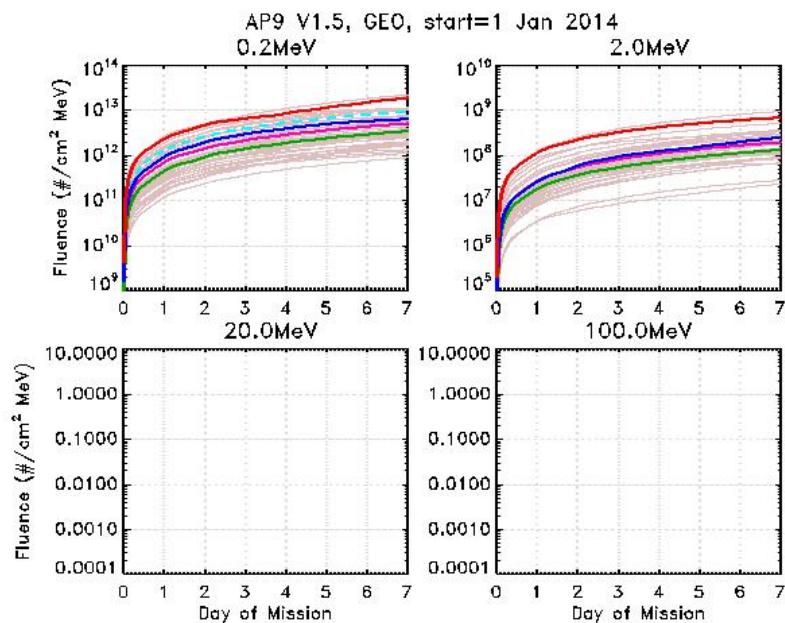
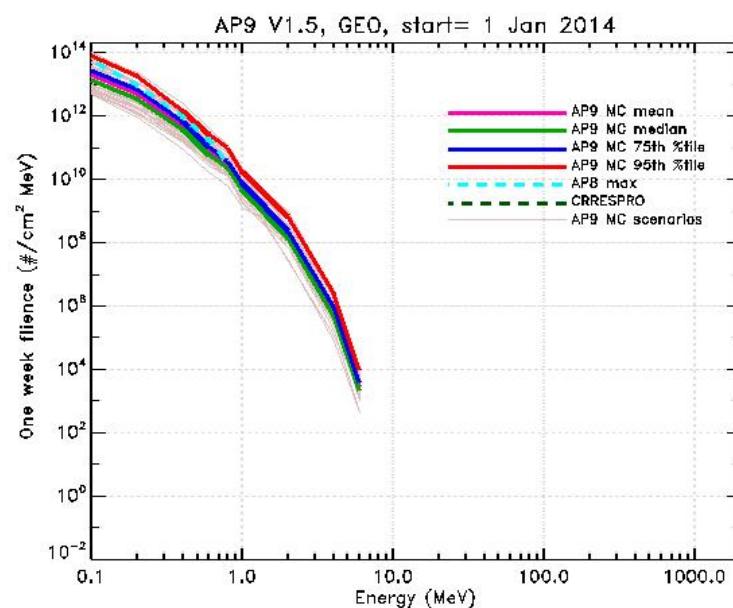
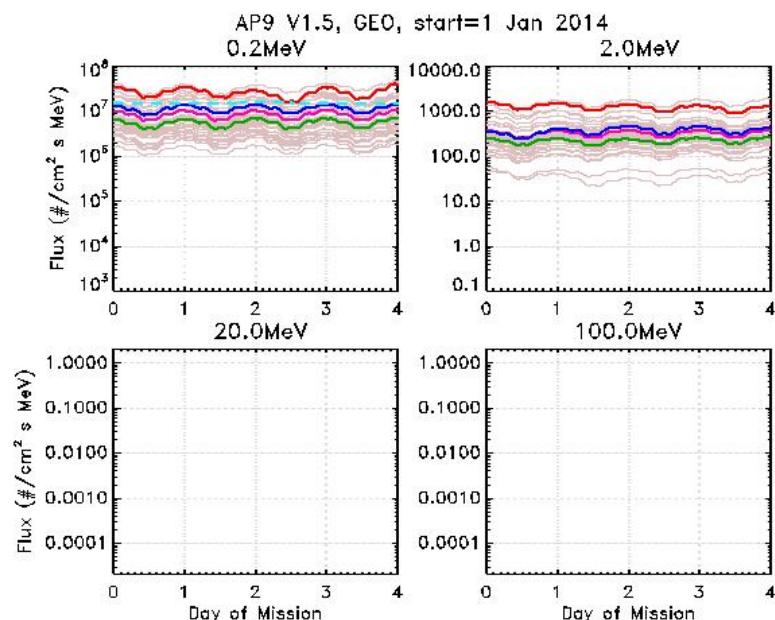
Distribution A

SPME**GPS (20200 km circular, 55 deg)****Distribution A**

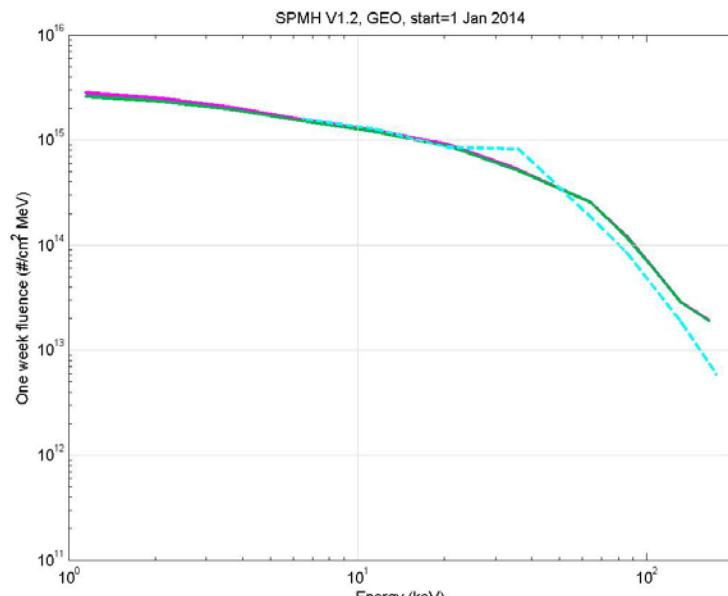
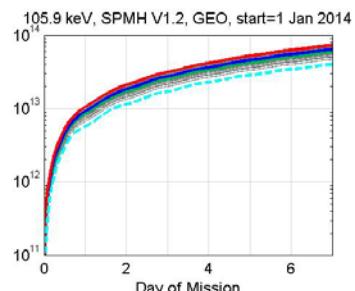
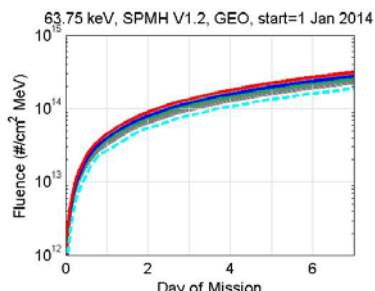
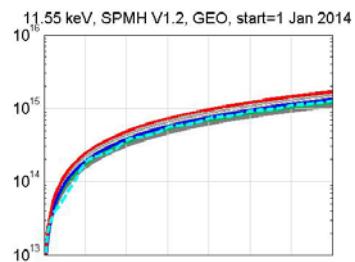
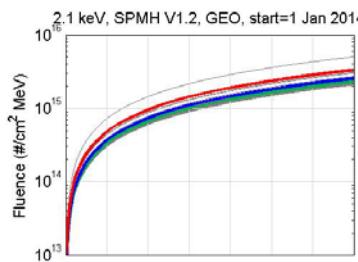
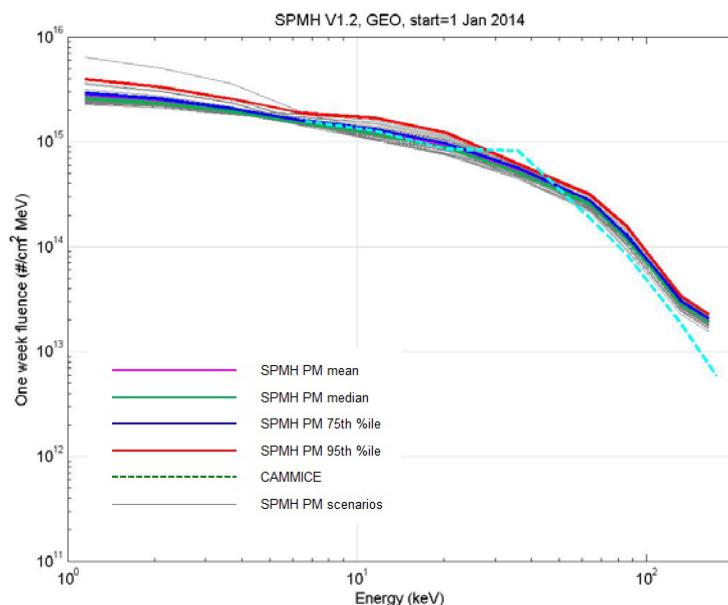
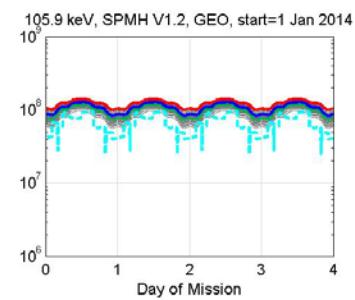
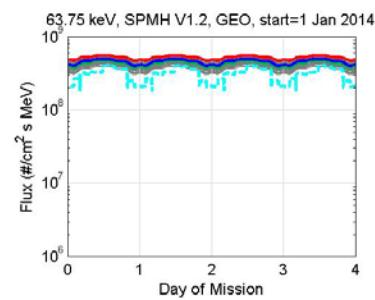
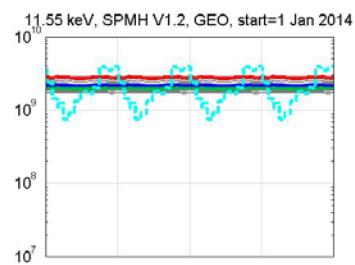
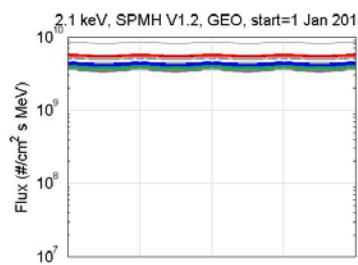
GEO

AE9**GEO (35786 km circular, 0 deg)**

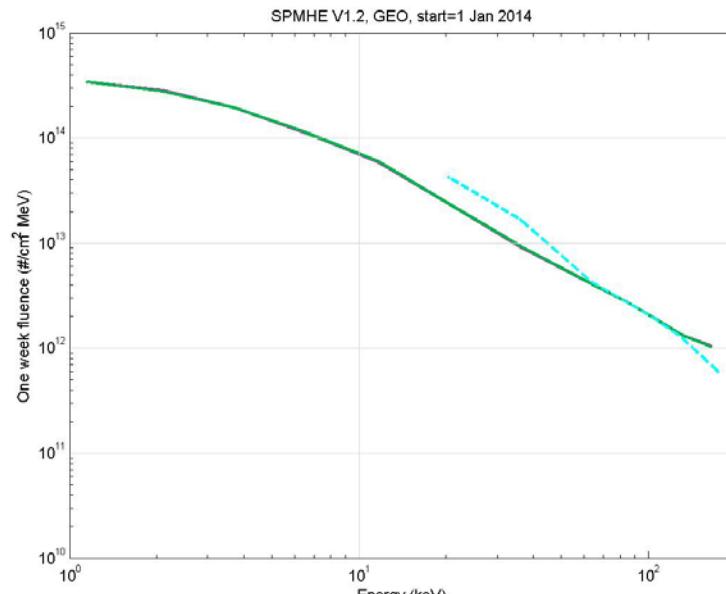
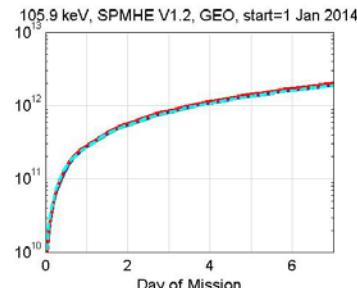
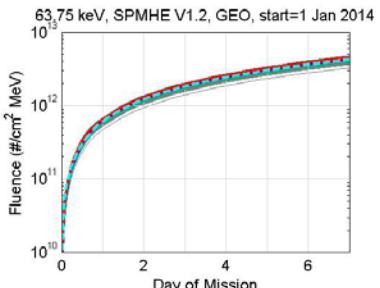
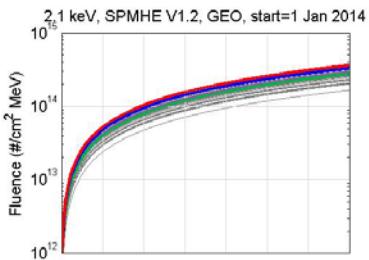
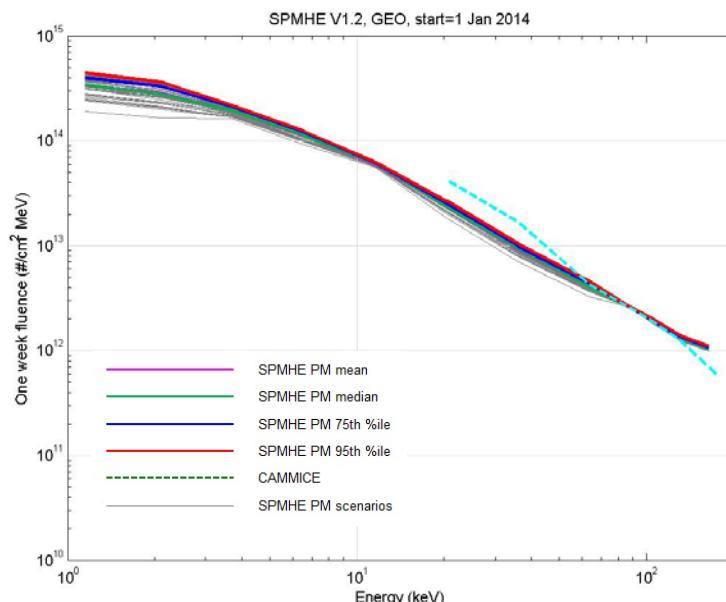
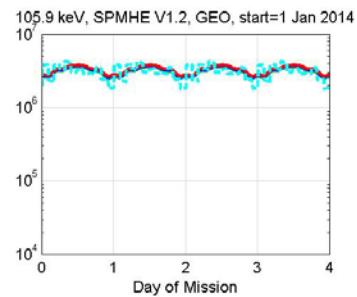
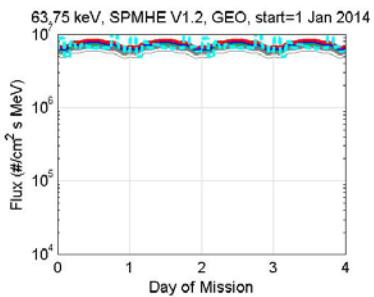
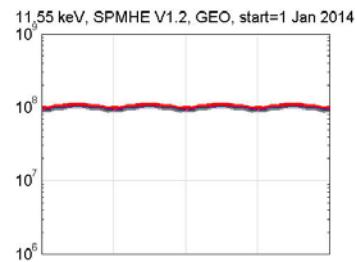
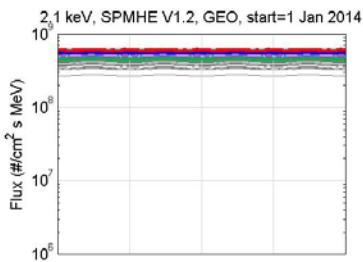
Distribution A

AP9**GEO (35786 km circular, 0 deg)**

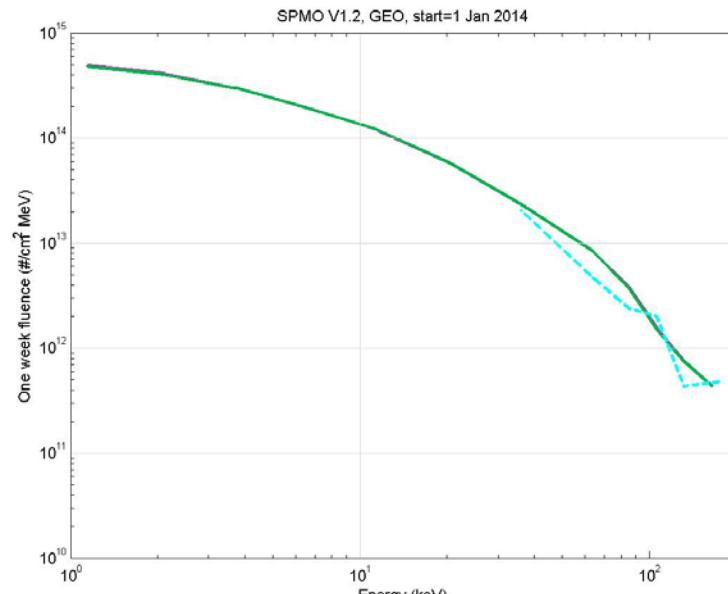
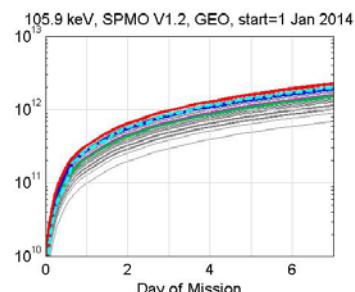
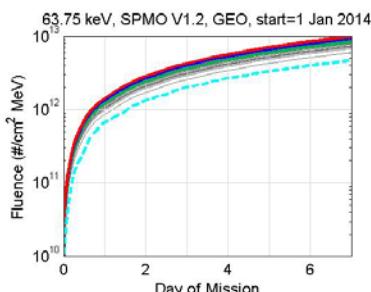
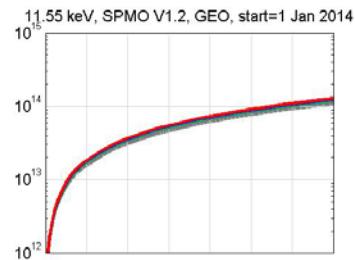
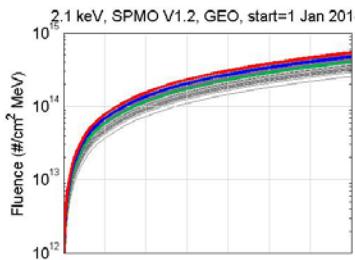
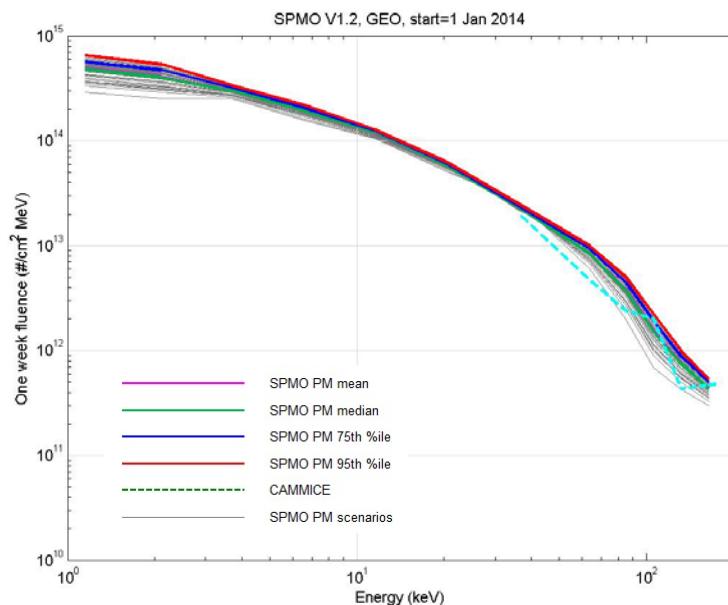
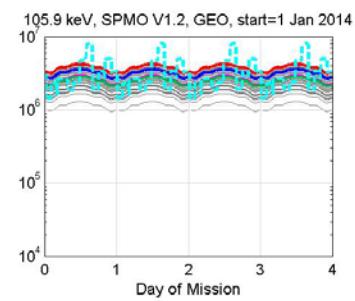
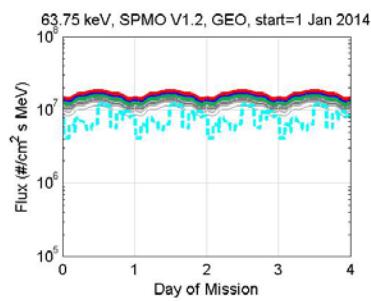
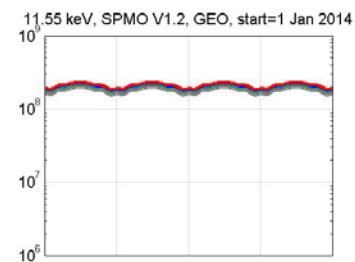
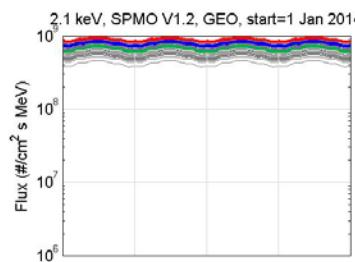
Distribution A

SPMH**GEO (35786 km circular, 0 deg)****Distribution A**

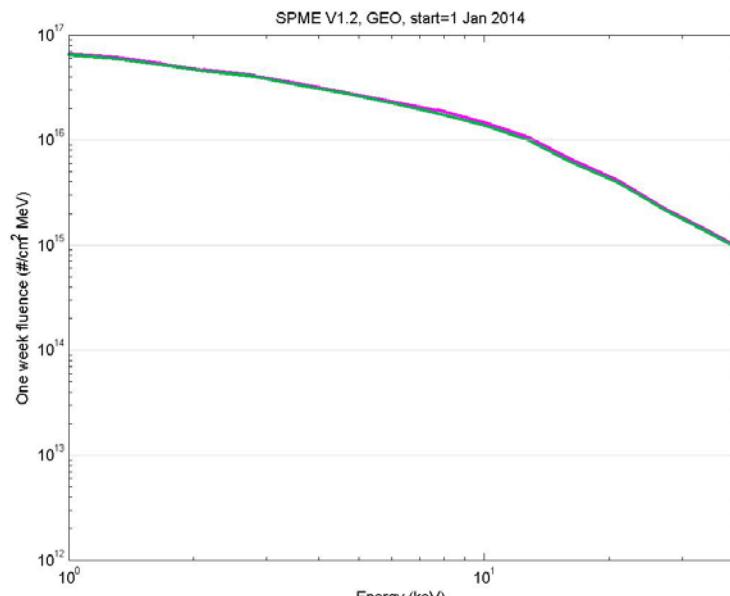
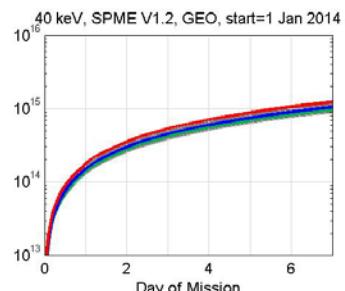
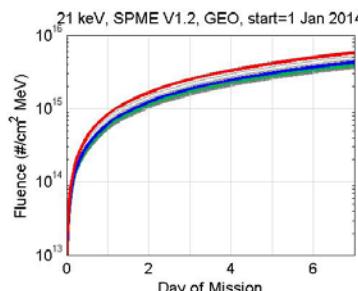
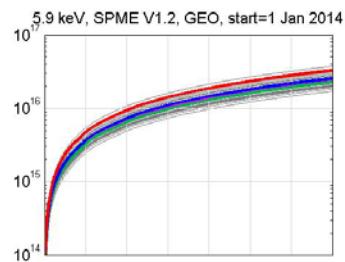
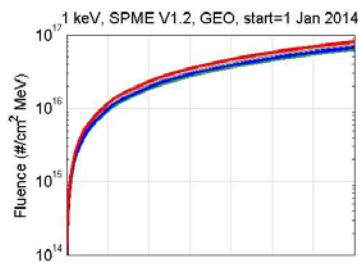
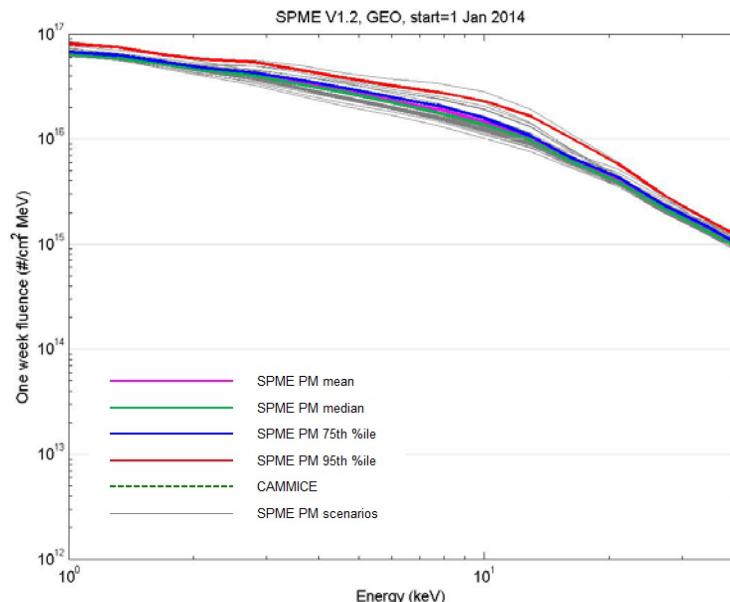
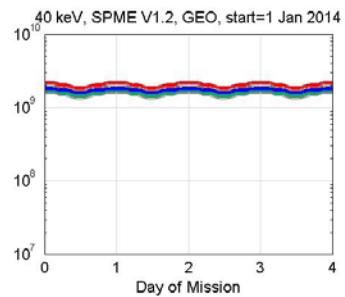
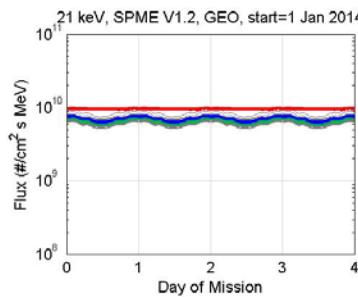
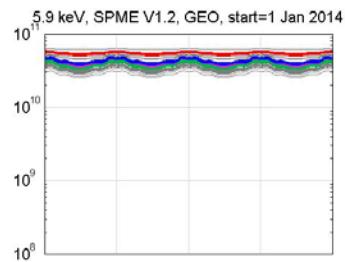
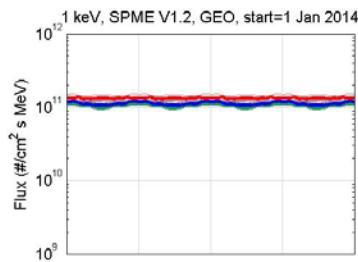
SPMHE GEO (35786 km circular, 0 deg)



Distribution A



Distribution A

SPME**GEO (35786 km circular, 0 deg)****Distribution A**