Energetic Electron Flux Measurements using KSEM PD on GeoKompsat-2A

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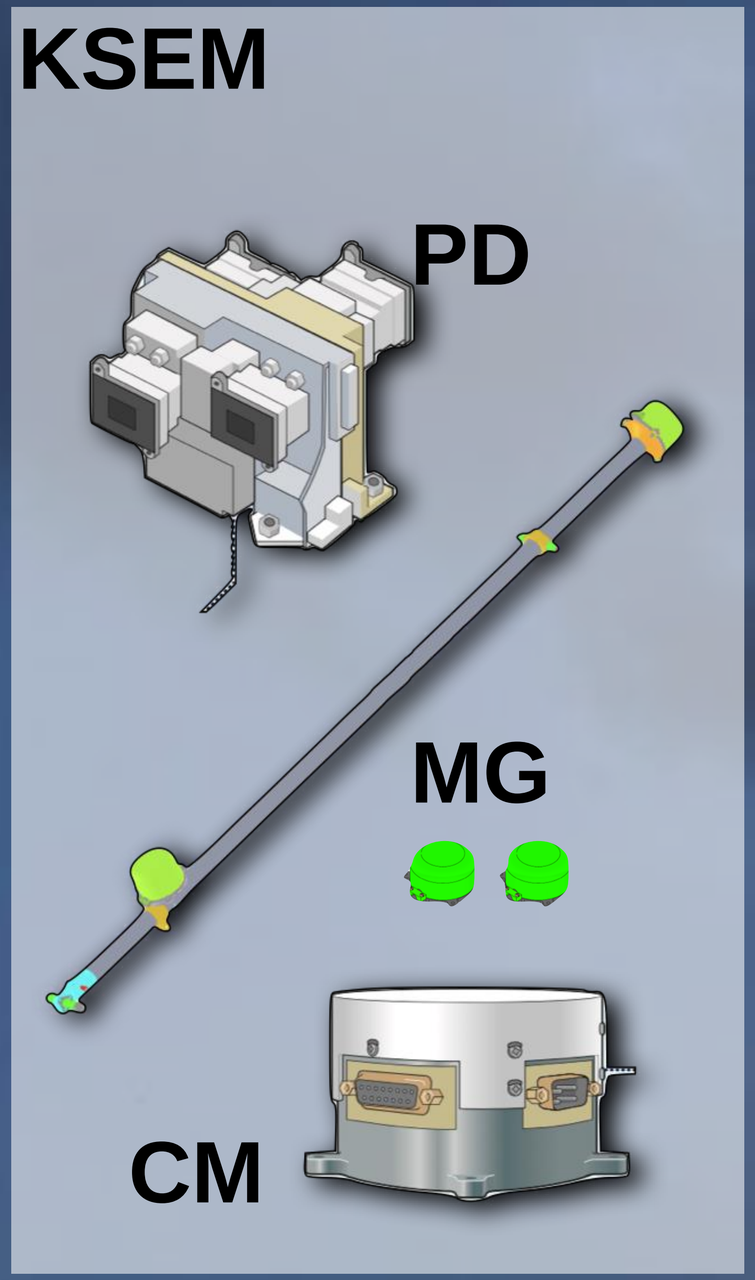
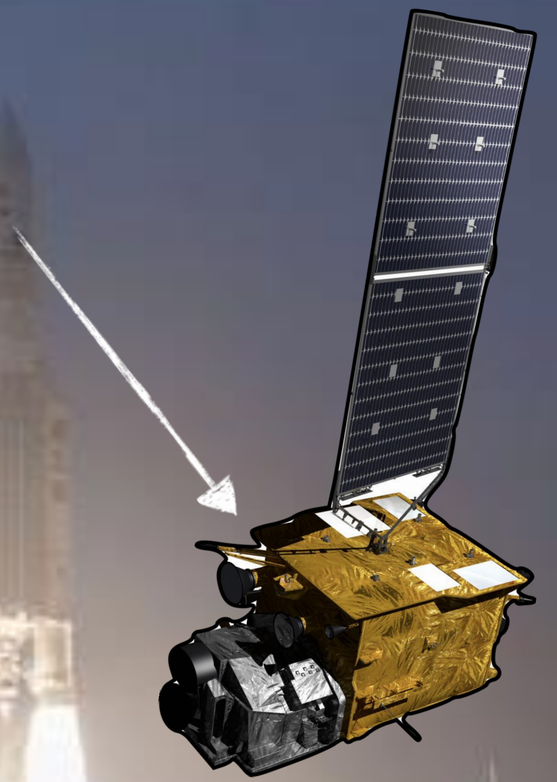
Korean Space Weather Monitor on GK2A: KSEM

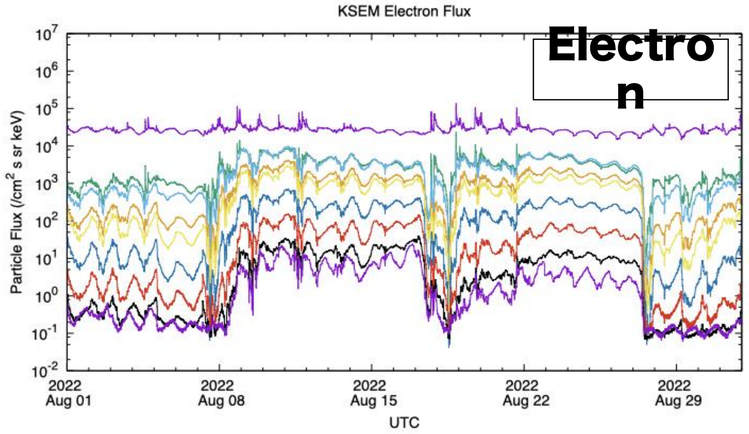


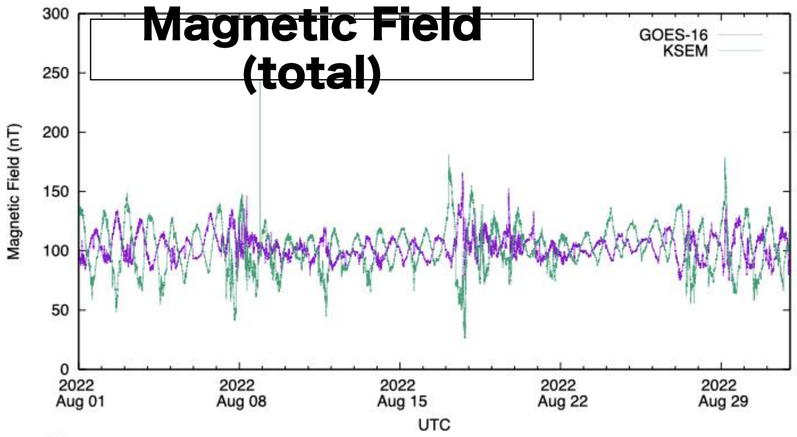
Sensor	Parameter	Specification
PD	Energy range	e: 100 keV - 3.8 p: 77 keV - 6 MeV
	Energy resolution	$\Delta E/E \leq 0.2\%$
	View direction	6 directions
MG	Accuracy	≤ 1 nT
	Boom length	1 m
CM	Range	± 3 pA/cm^2
	Accuracy	≤ 0.01 pA/cm^2

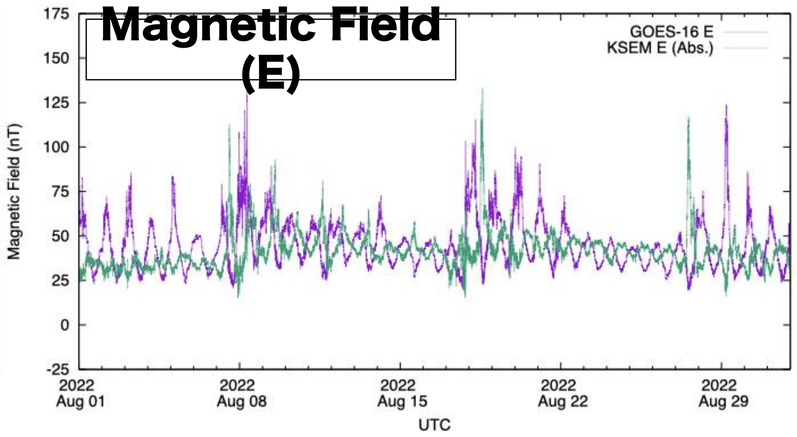


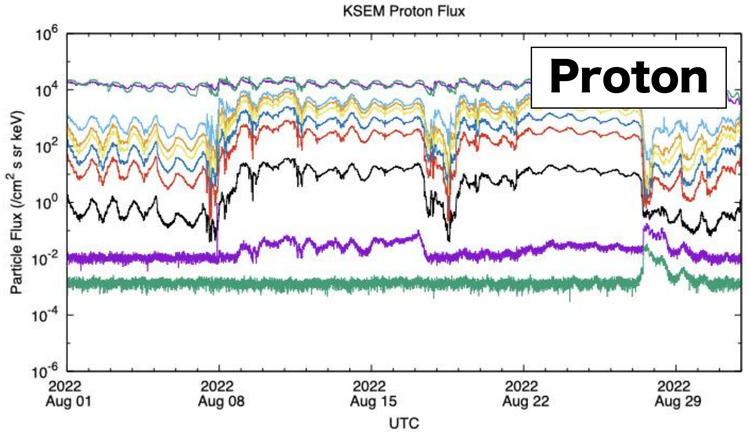
The first geostationary satellite that provides multiple continuous measurements of space weather over the eastern hemisphere

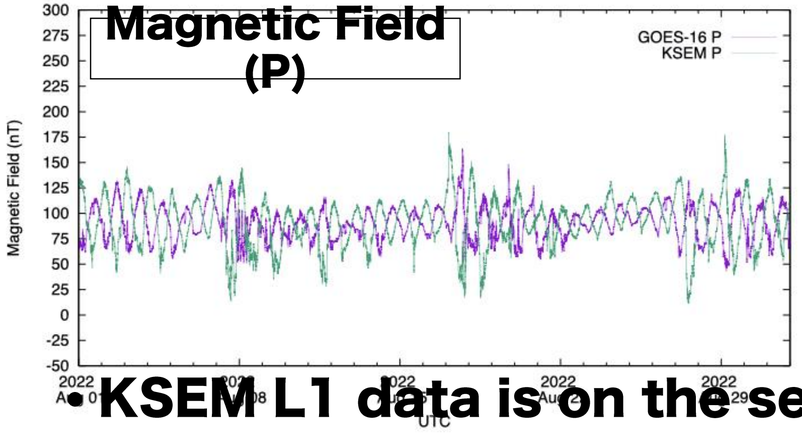
1 Data from KSEM on service

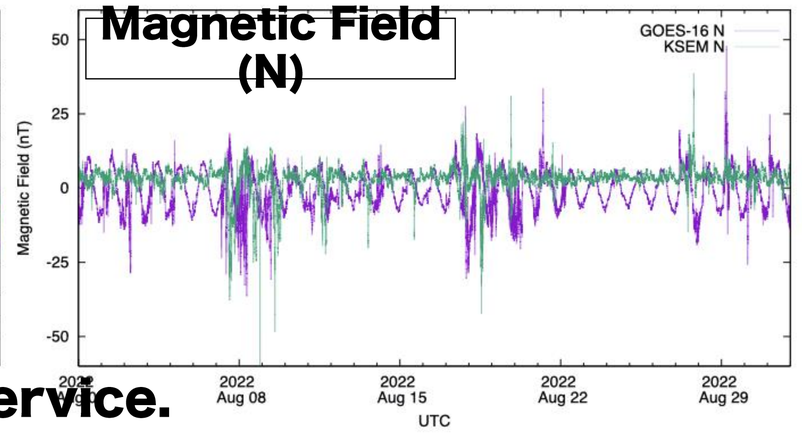


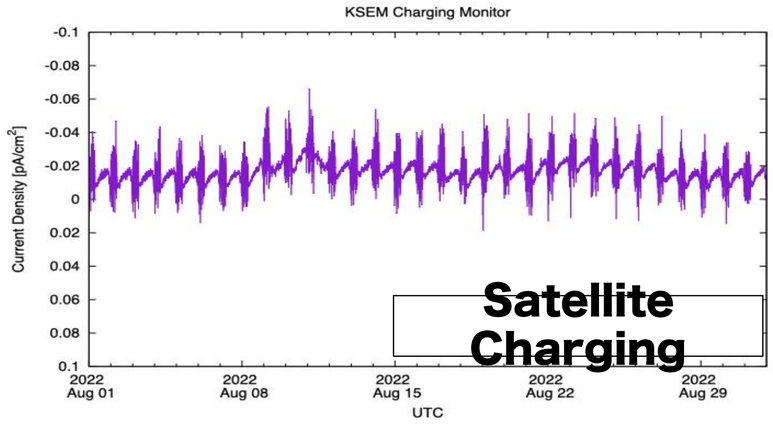






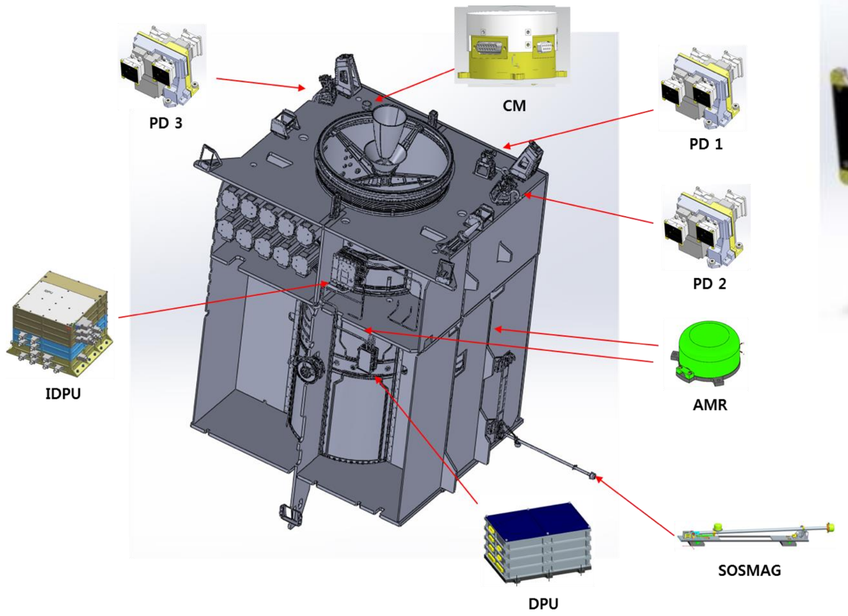


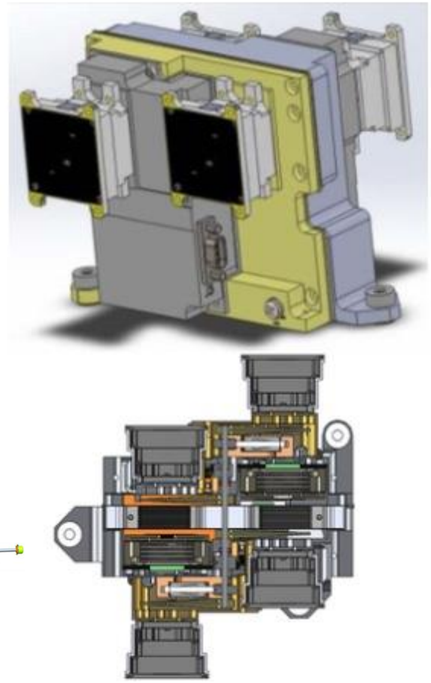


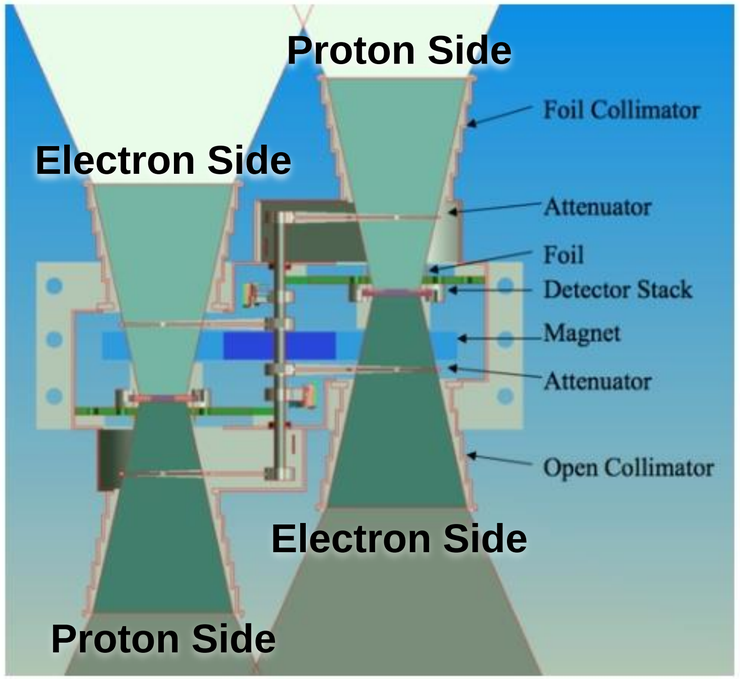


- **KSEM L1 data is on the service.**
- **The effort to improve the data quality and reliability is on going.**
  - **Activities on inter-calibration working group of Space Weather Correlation Group (SWCG) in CGMS**
  - **Collaborating with NOAA to conduct inter-calibration and quality control of satellite-based space weather observations**

ectron detection by KSEM PD

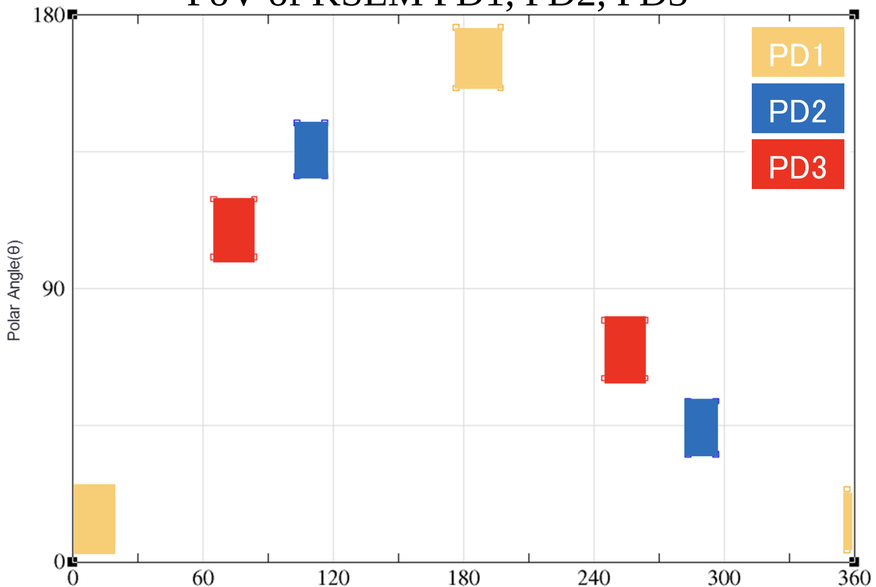






Energy Range	100 keV ≤ E ≤ 3.8 MeV
Time Resolution	1Hz
View Direction	6
Field of View	20º x 20º
Energy Bands	10 channels (50 sub-channels)

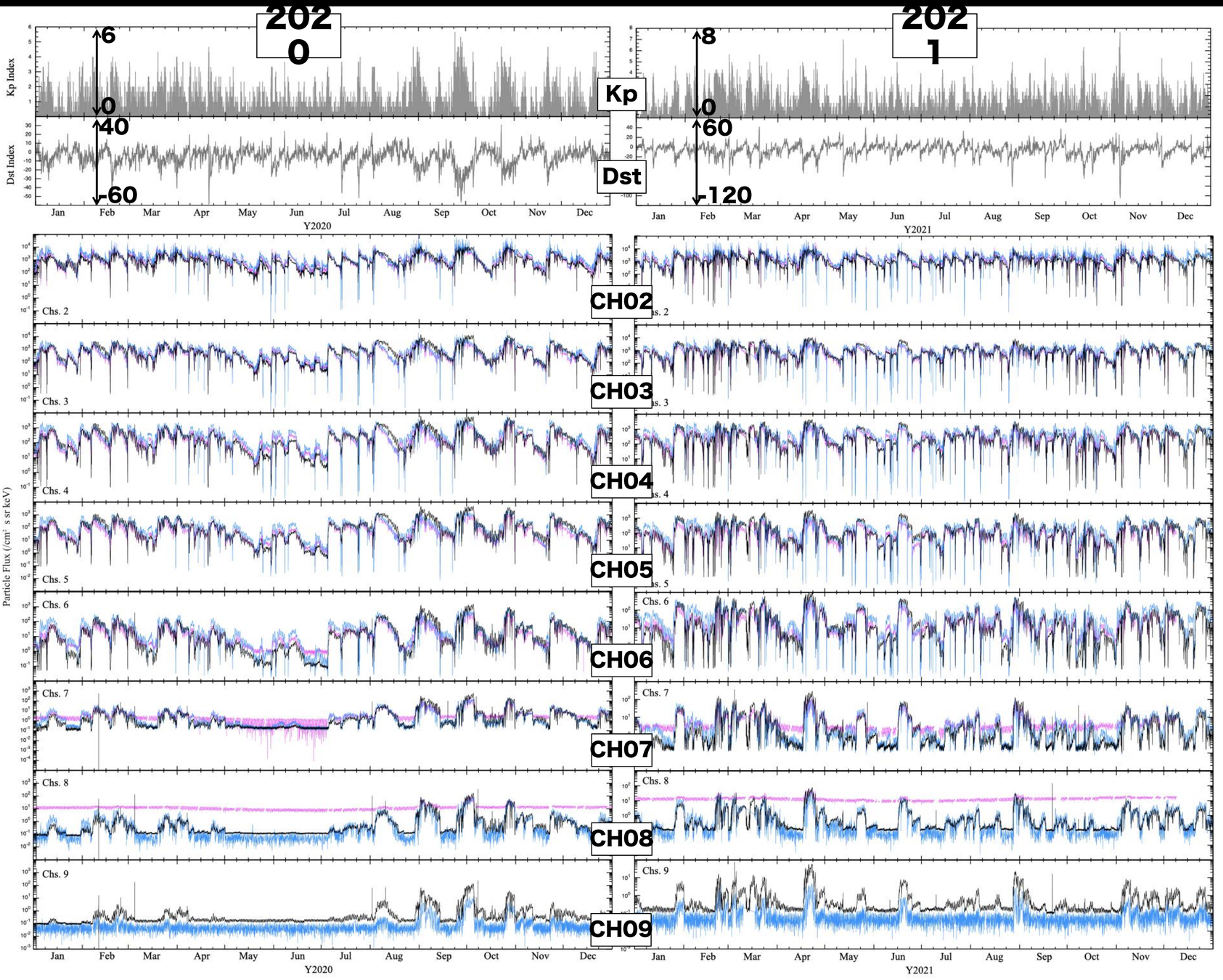
FoV of KSEM PD1, PD2, PD3

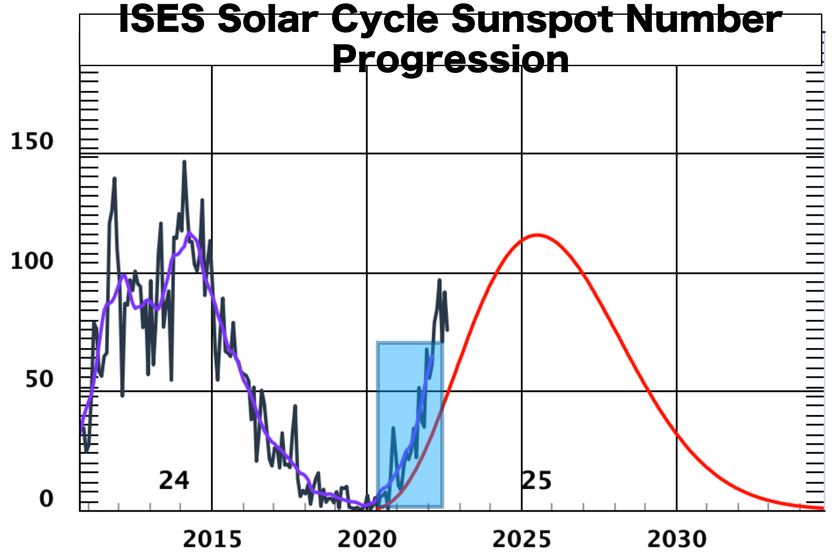


KSEM PD and MPS-Hi electron channels

Chs. No.	KSEM PD energy (keV)	MPS-Hi energy (keV)
1	100-150	90-145
2	150-225	145-230
3	225-325	230-325
4	325-450	325-460
5	450-700	460-705
6	700-1350	705-1360
7	1350-1800	1360-1785
8	1800-2600	1785-2685
9	2600-3800	2685-4345
10	2000-3800	>2000 (integral)

ron Flux of 2020 and 2021: from KSEM PD and MPS-HI





KSEM PD

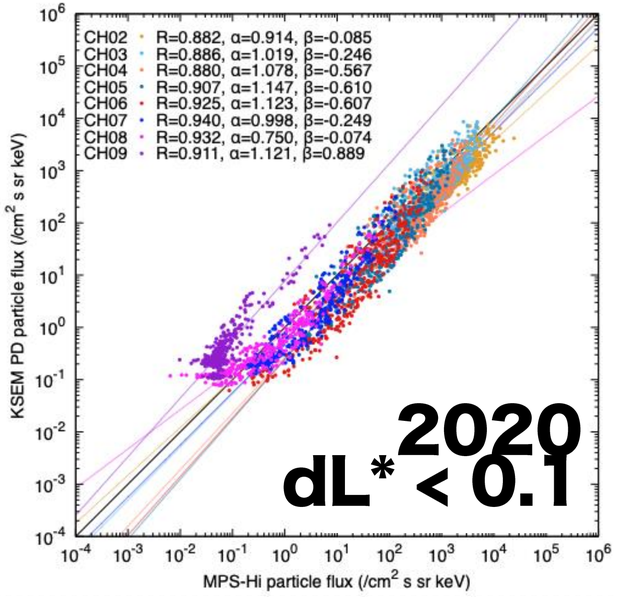
MPS-HI

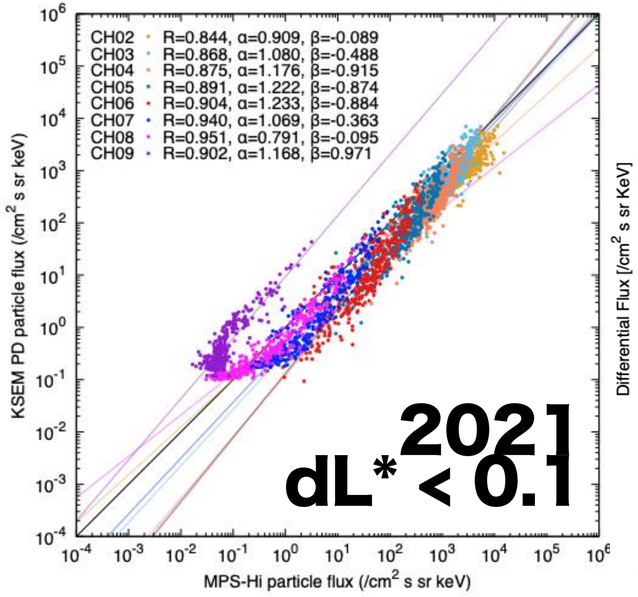
Y2021

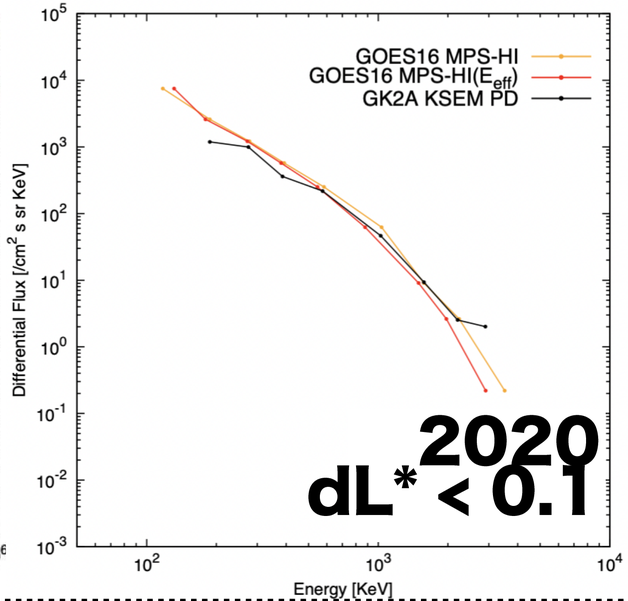
- **Y2020-Y2021 is belonged to the bottom phase between solar cycle 24 and 25.**
- **The solar activity had been mostly calm and there were only a few strong space weather events.**

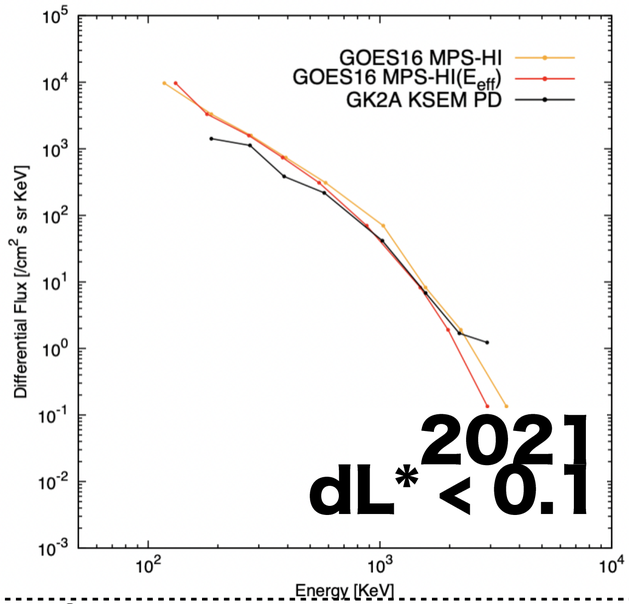
-> Appropriate for the cross-comparison of multi-point

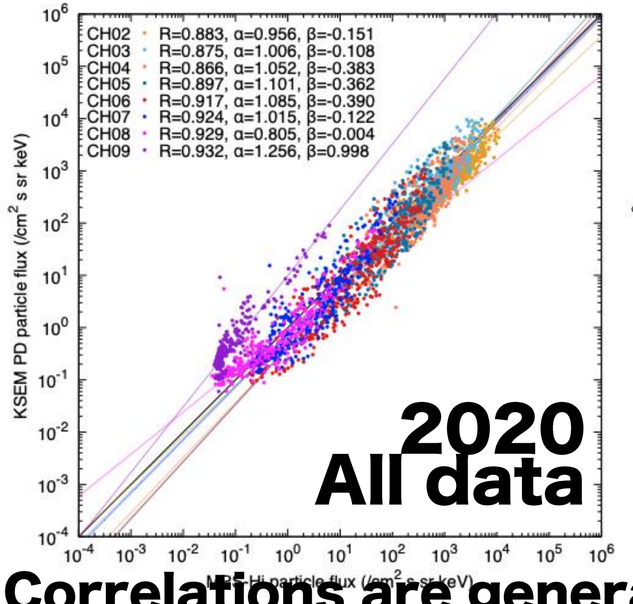
on flux relationship between KSEM PD and MPS-HI (Day-avera

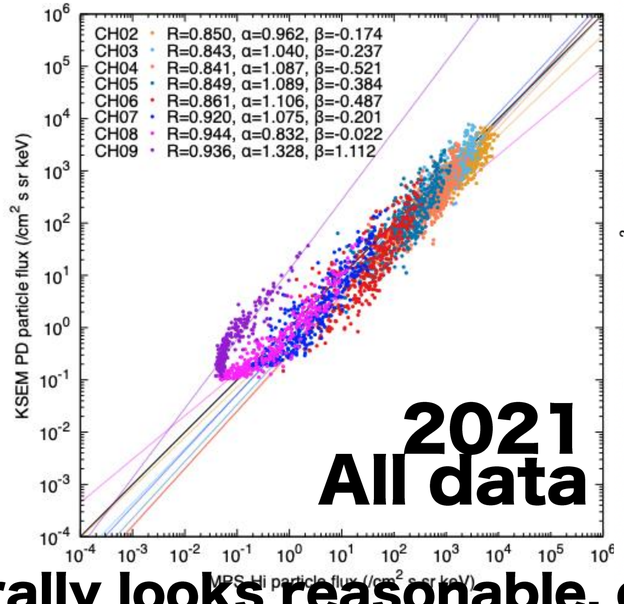


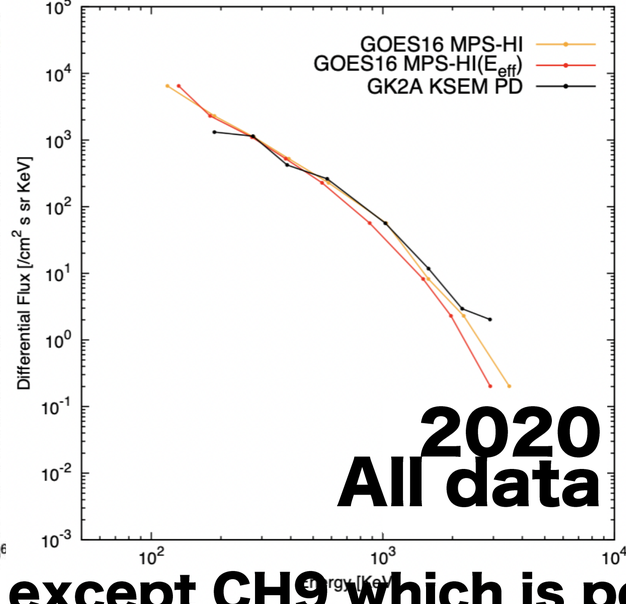


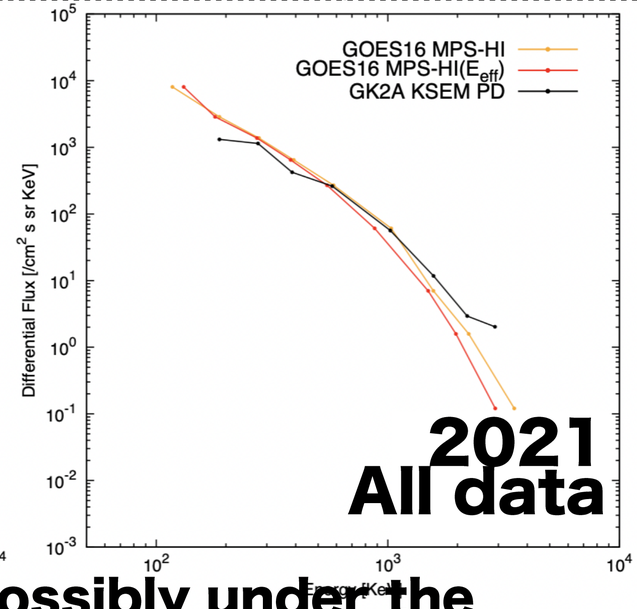








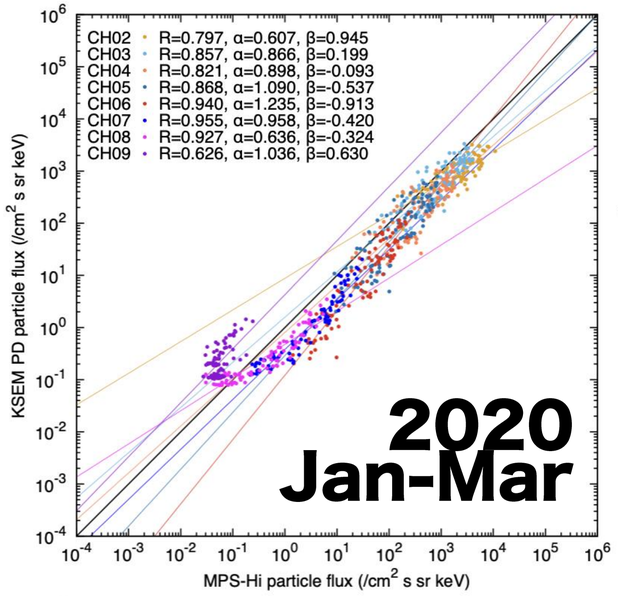


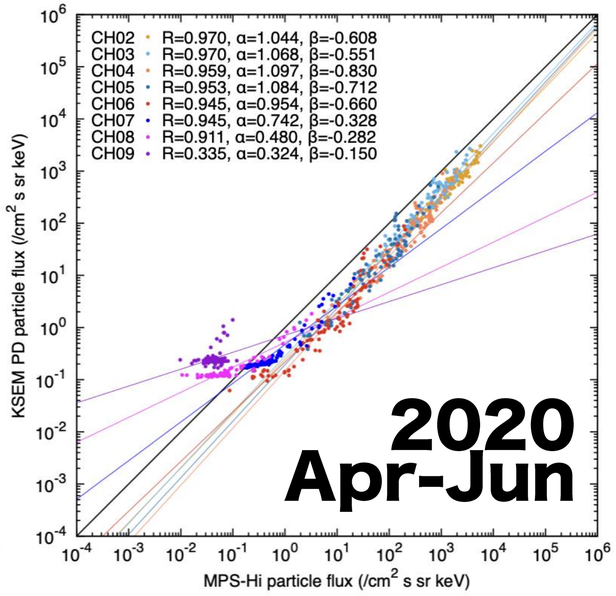


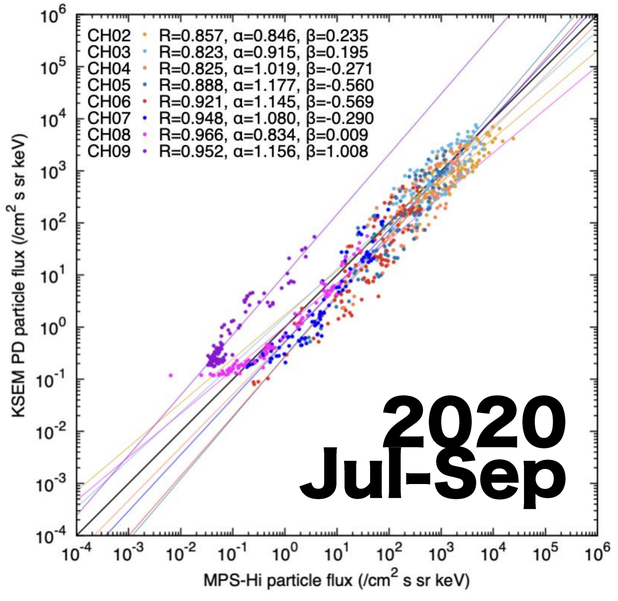
- Correlations are generally looks reasonable, except CH9 which is possibly under the affection of proton contamination.
- There is no significant difference between using all data and using dL* < 0.1 data.

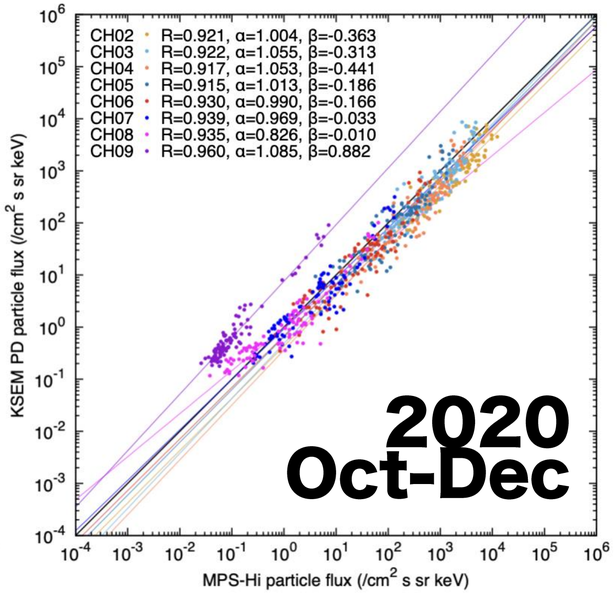
Correlation based on log[$Flux_{KSEM\ PD}$]=αlog[

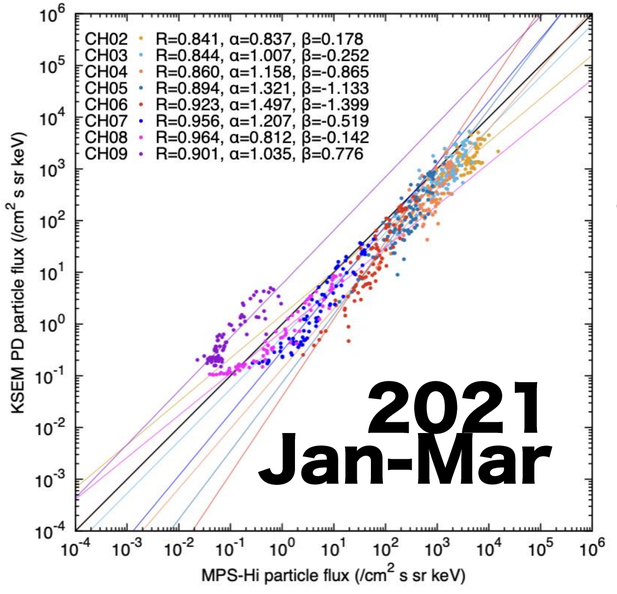
Seasonal changes in the relationship - dL*<0.1 data, Day-aver

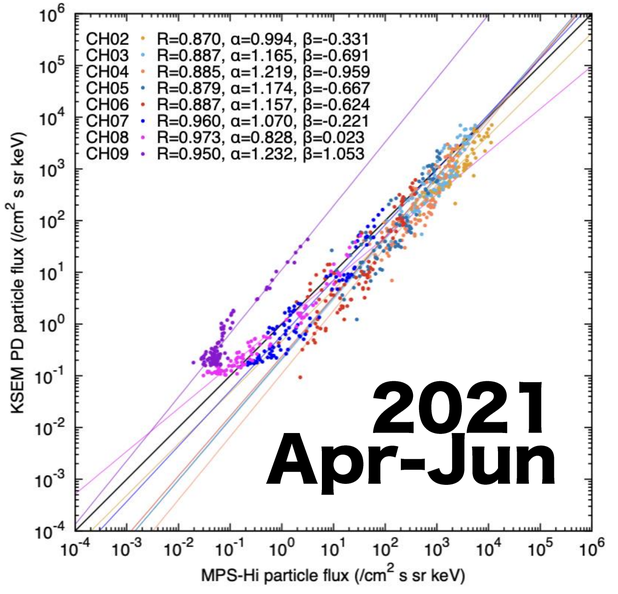


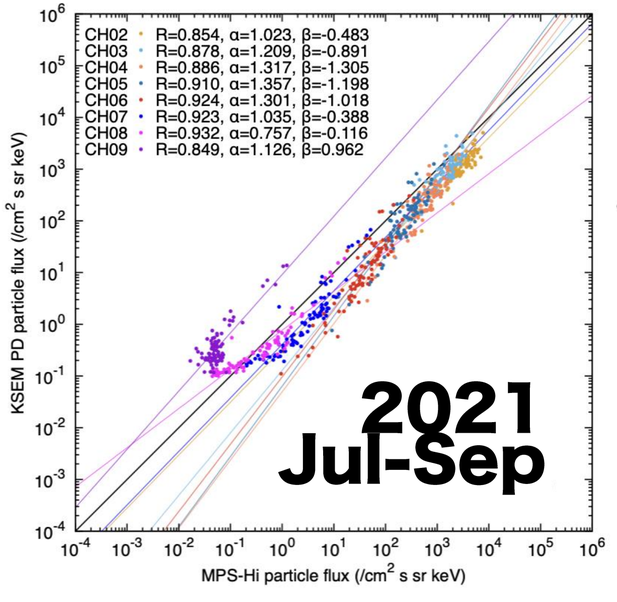


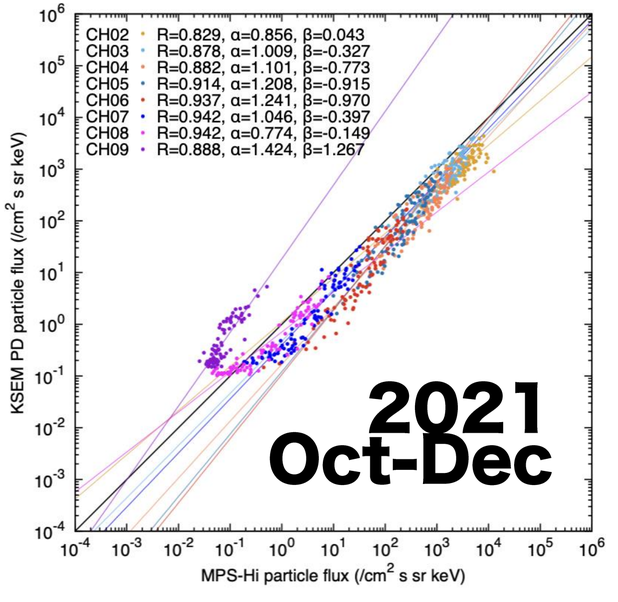








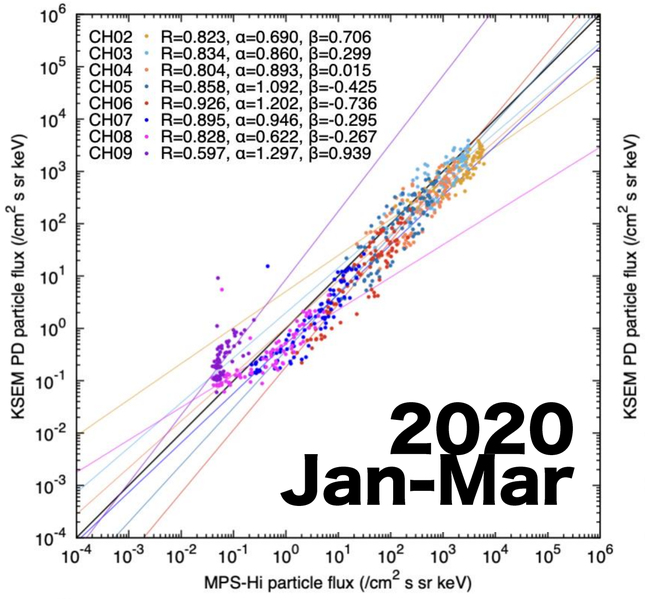


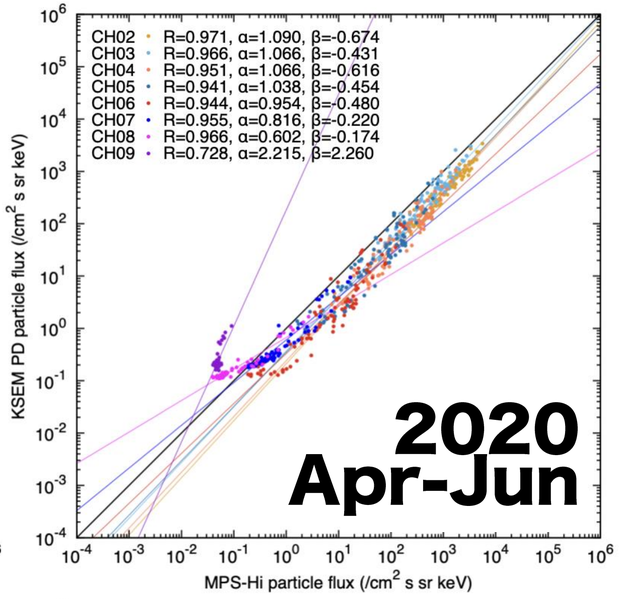


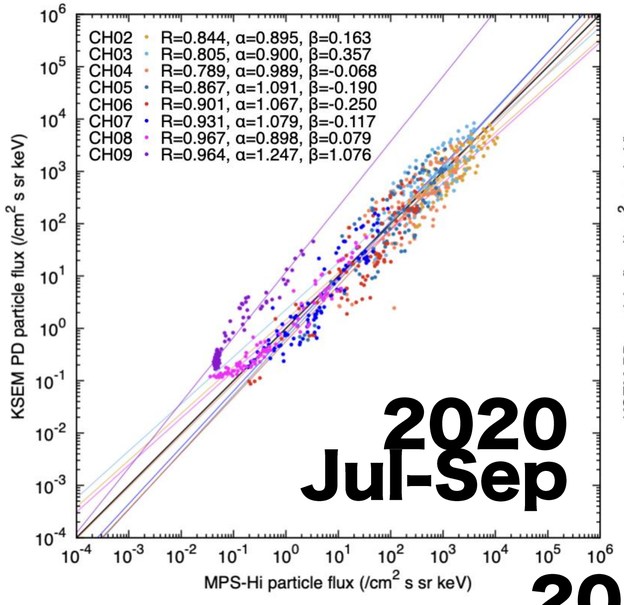
- **No clear seasonal change could be found.**

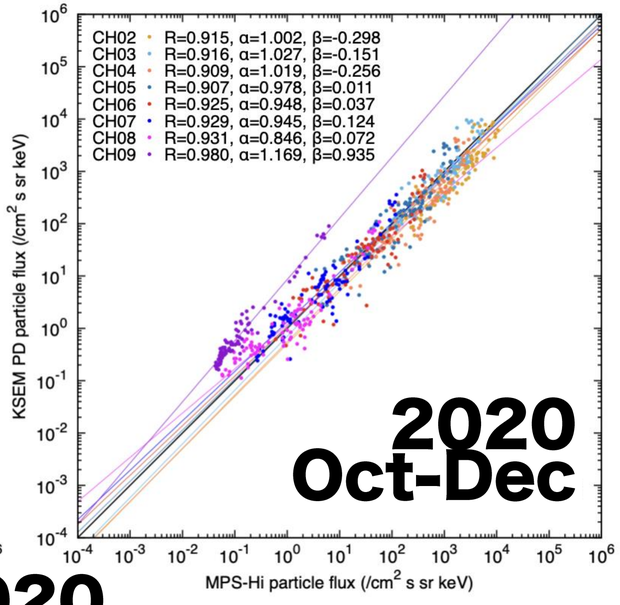
Correlation based from: $\log[\mathrm{Flux}_{\mathrm{KSEM\ PD}}] = \alpha \log[$

Seasonal changes in the relationship - All data, Day-averaged

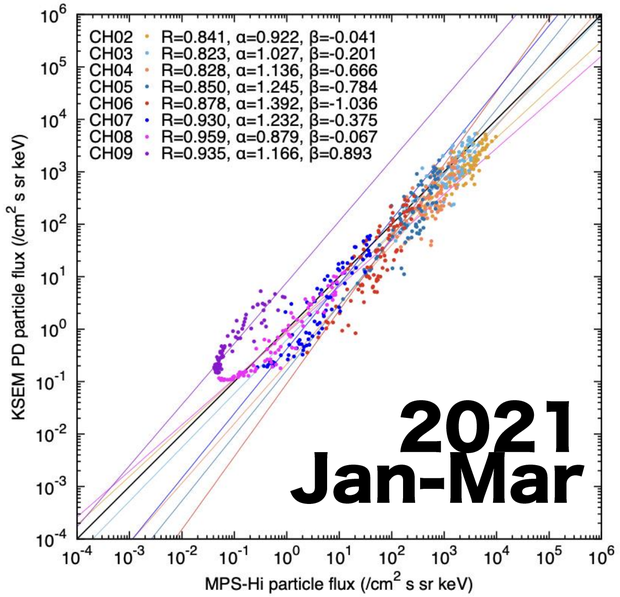


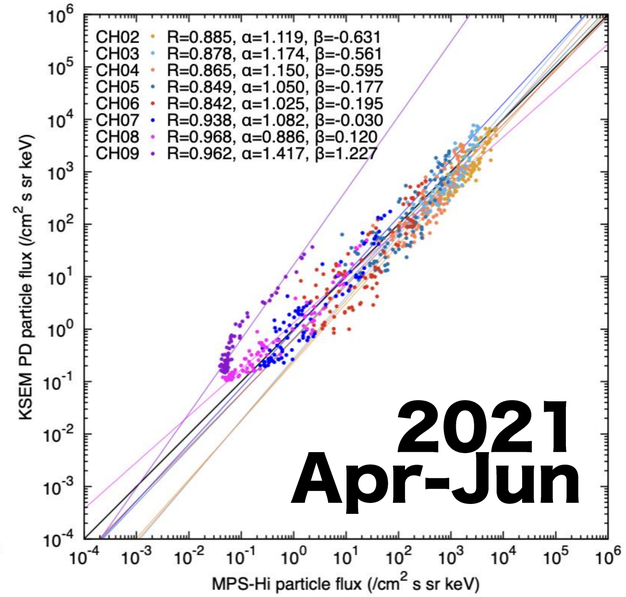


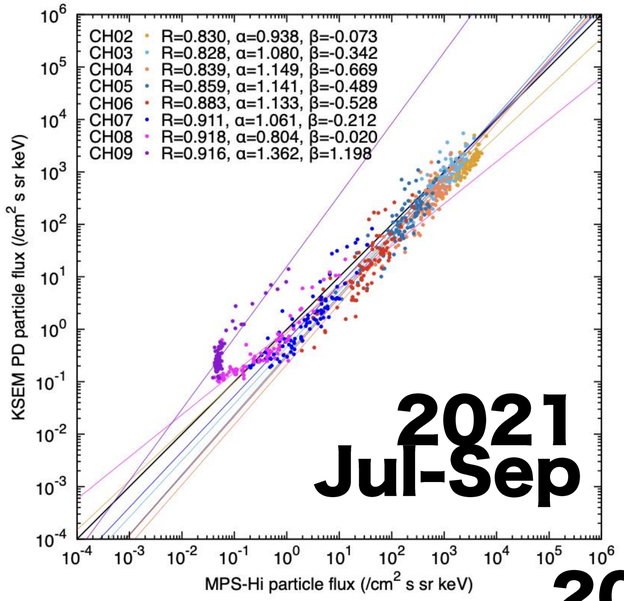


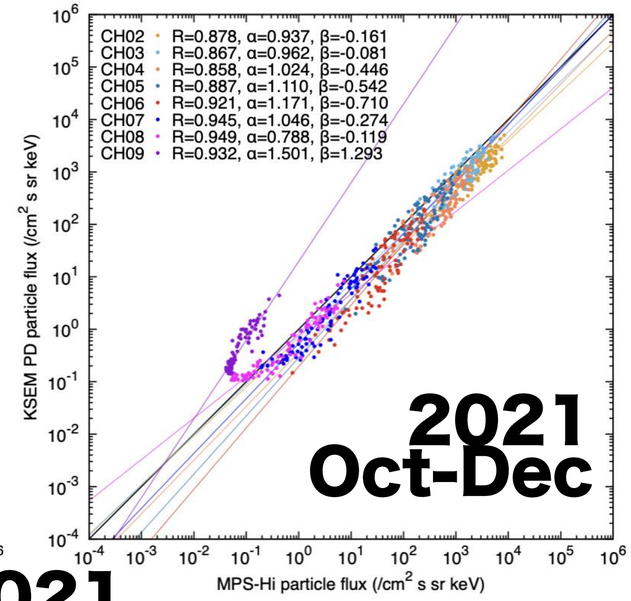


2020







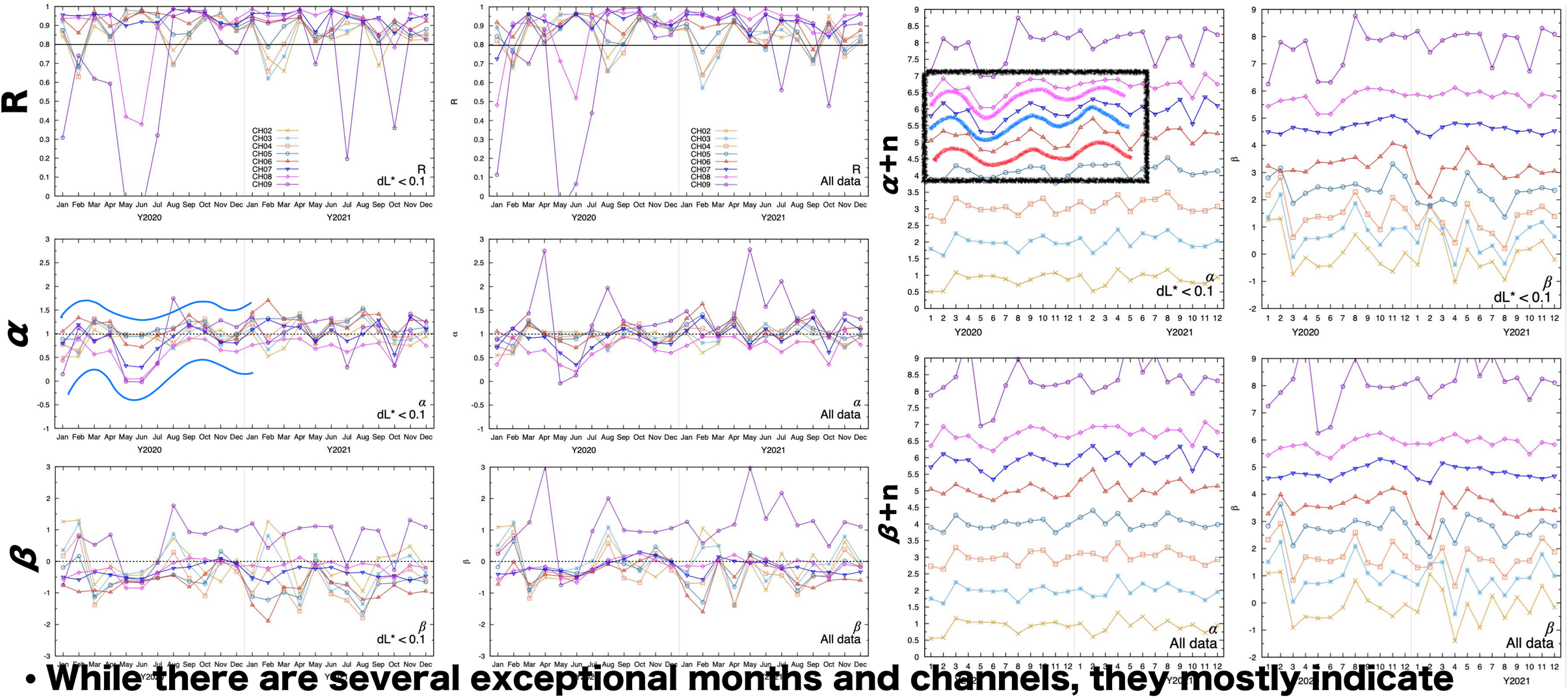


2021

- **No clear seasonal change could be found.**

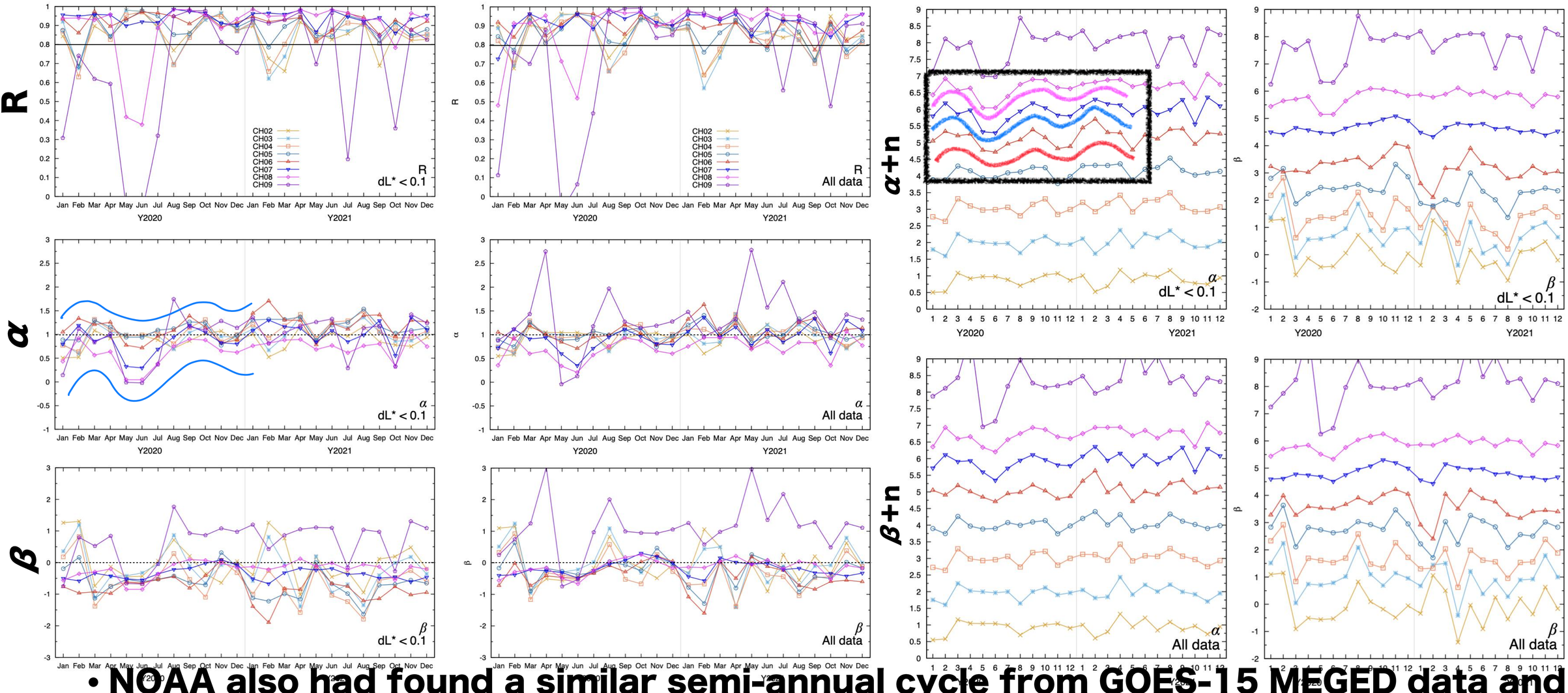
Correlation based from: $\log[\mathrm{Flux}_{\mathrm{KSEM\ PD}}] = \alpha \log[$

Monthly changes in correlation coefficients: log[Flux$_{KSEM\ PD}$]=α



- **While there are several exceptional months and channels, they mostly indicate reasonable correlations.**
- **No significant periodicity could be found from R and β.**
- ***Weak* semi-annual periodic changes can be found from α, especially on middle-high channels (CH06-CH08), from Y2020 to early Y2021, when using dL*<0.1 data.**

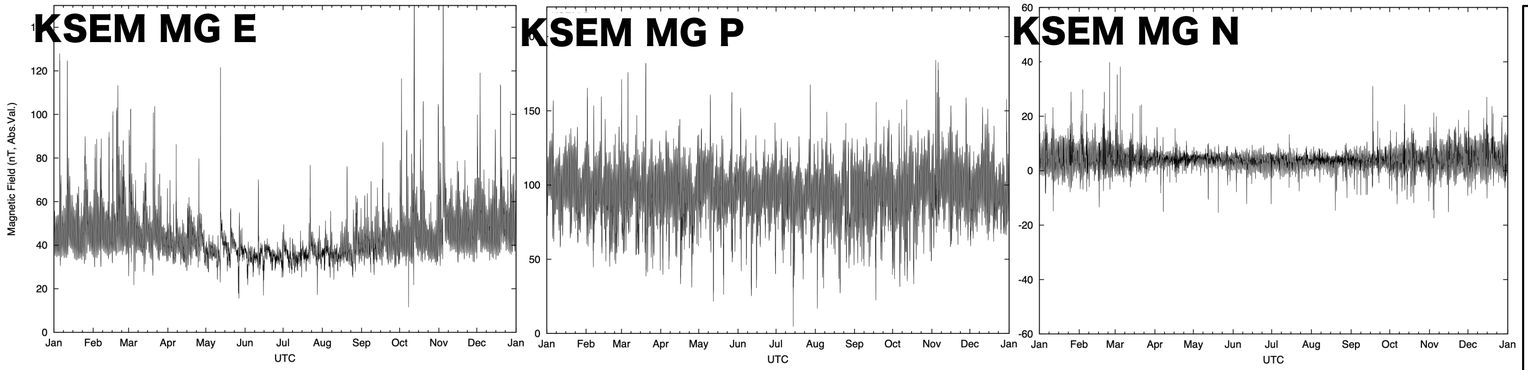
Monthly changes in correlation coefficients: log[Flux$_{KSEM\ PD}$]=α

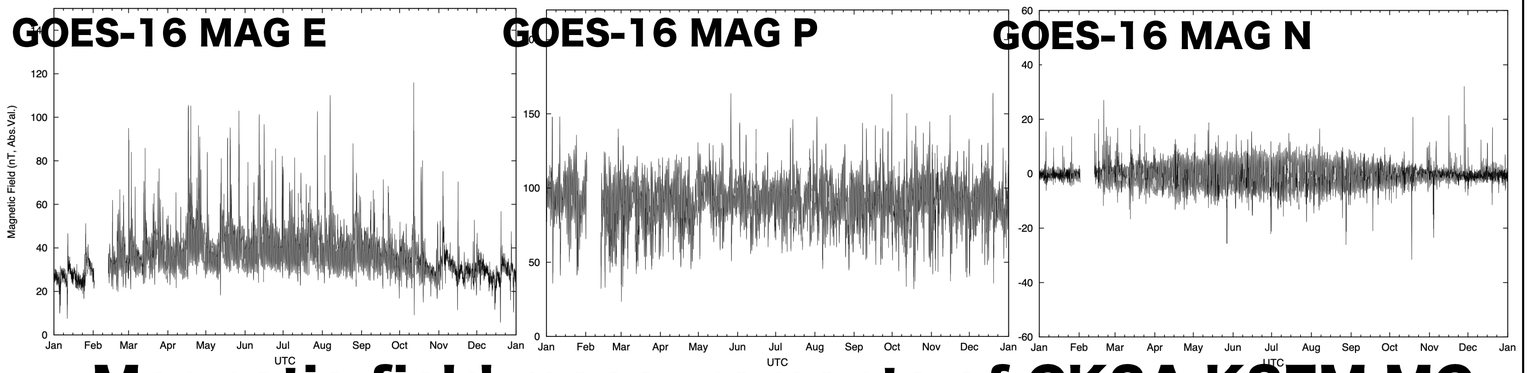


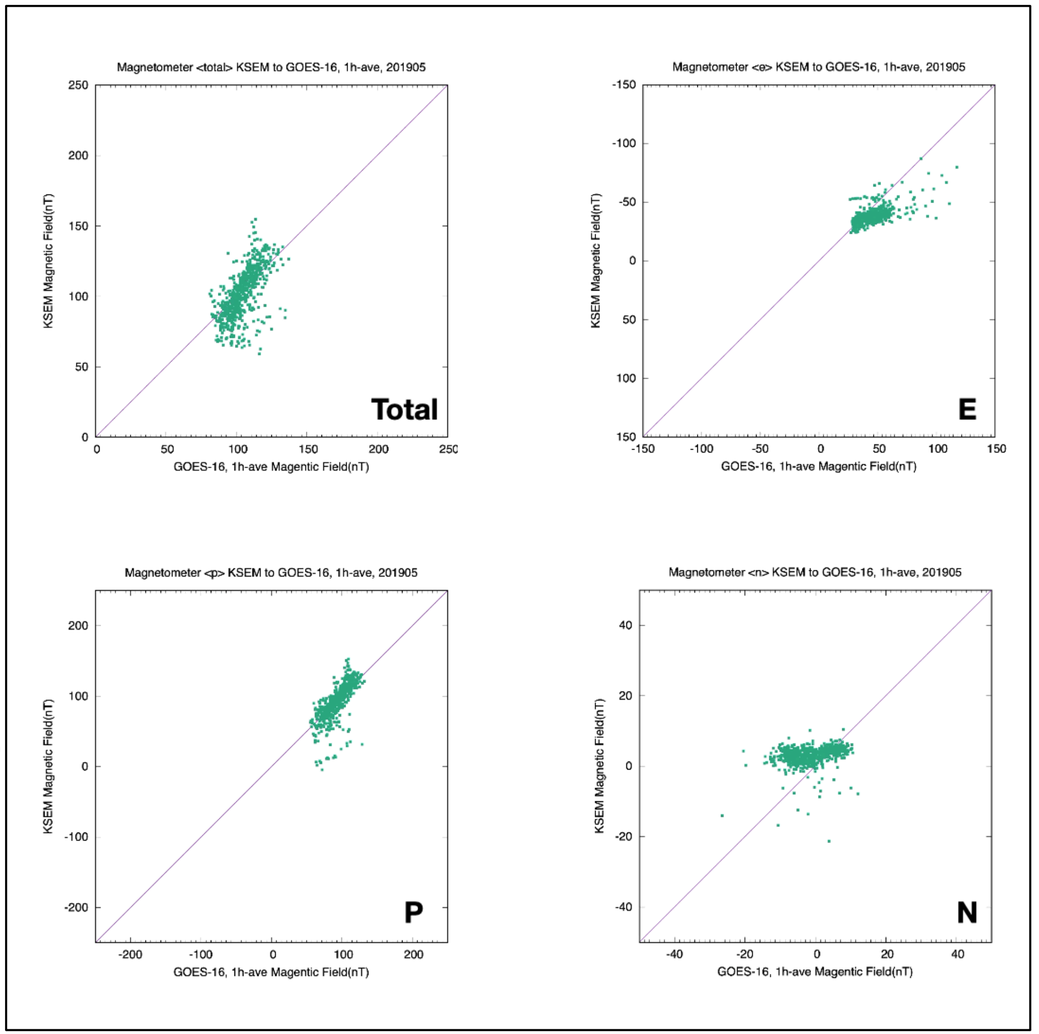
- **NOAA also had found a similar semi-annual cycle from GOES-15 MEGED data and others.**
- **Not yet understood what caused the cycle. Usual suspects: seasonal change of temperature or pitch angle**

- ***Weak* semi-annual periodic changes can be found from α, especially on middle-high channels (CH06-CH08), from Y2020 to early Y2021, when using dL*<0.1 data.**

Additional mention: Magnetic field measurements of GK2A an



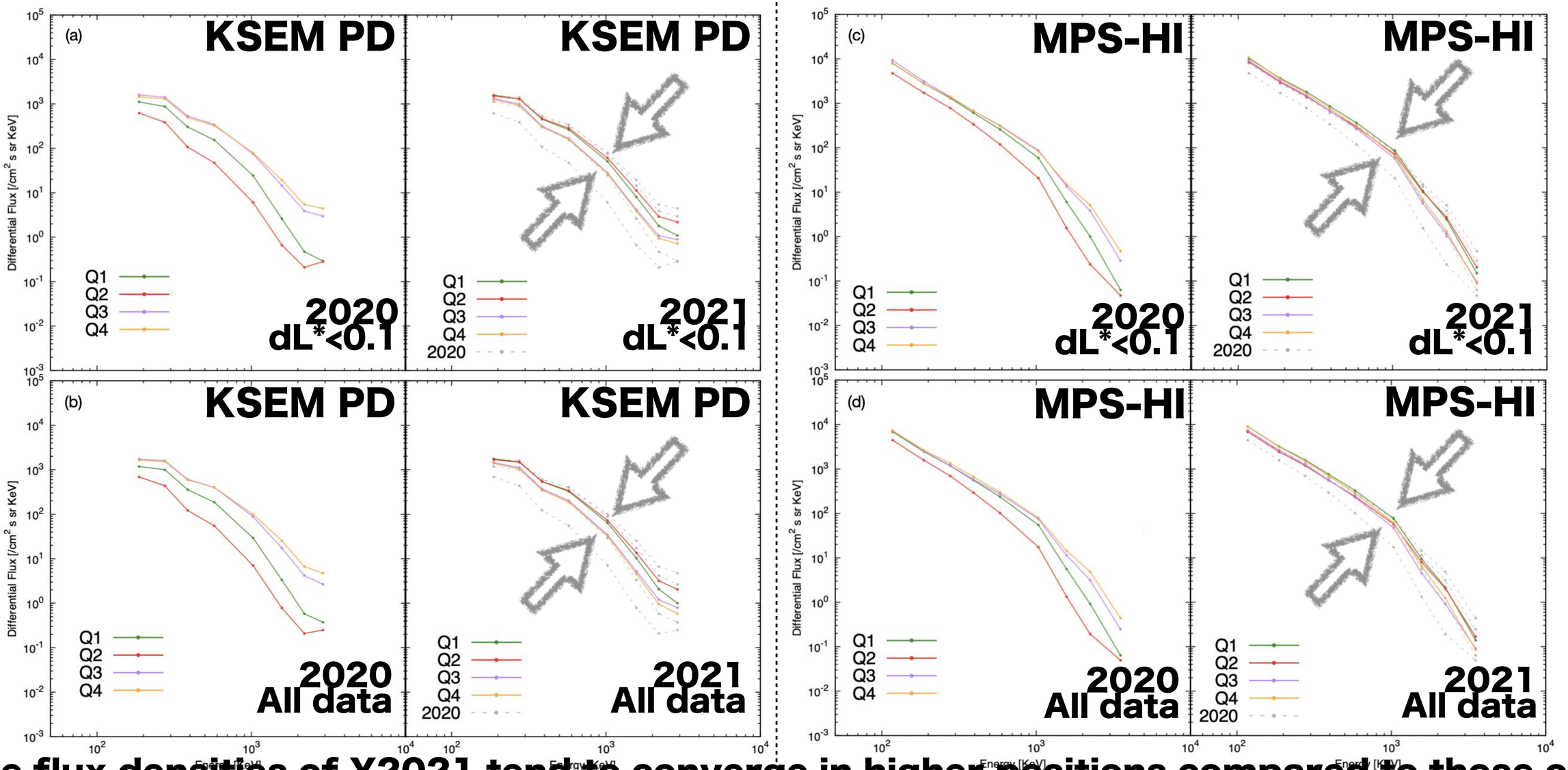




- **Magnetic field measurements of GK2A KSEM MG and GOES-16 MAG show nearly opposite phase in their yearly periodic response.**
  - **Higher values & daily validations appears in**
    - **Early and late the year: KSEM MG**
    - **Middle of the year: GOES-16 MAG**

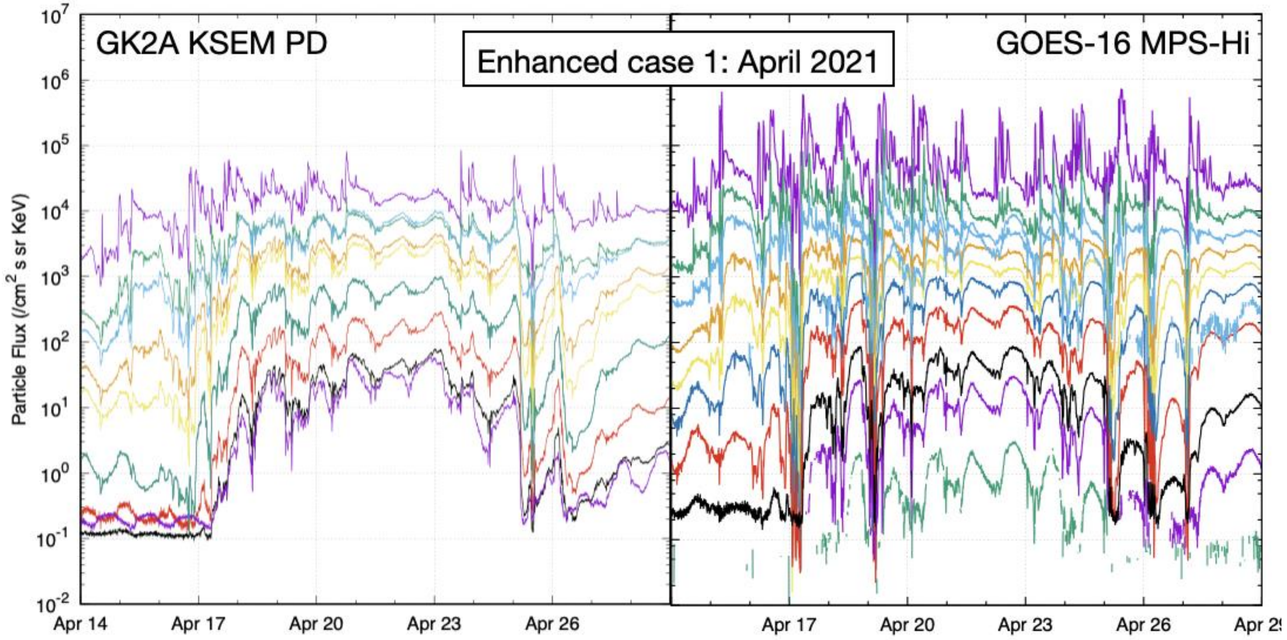
- **-> Location dependency of geostationary orbit magnetic field must be considered In the data validations based on inter-comparisons.**

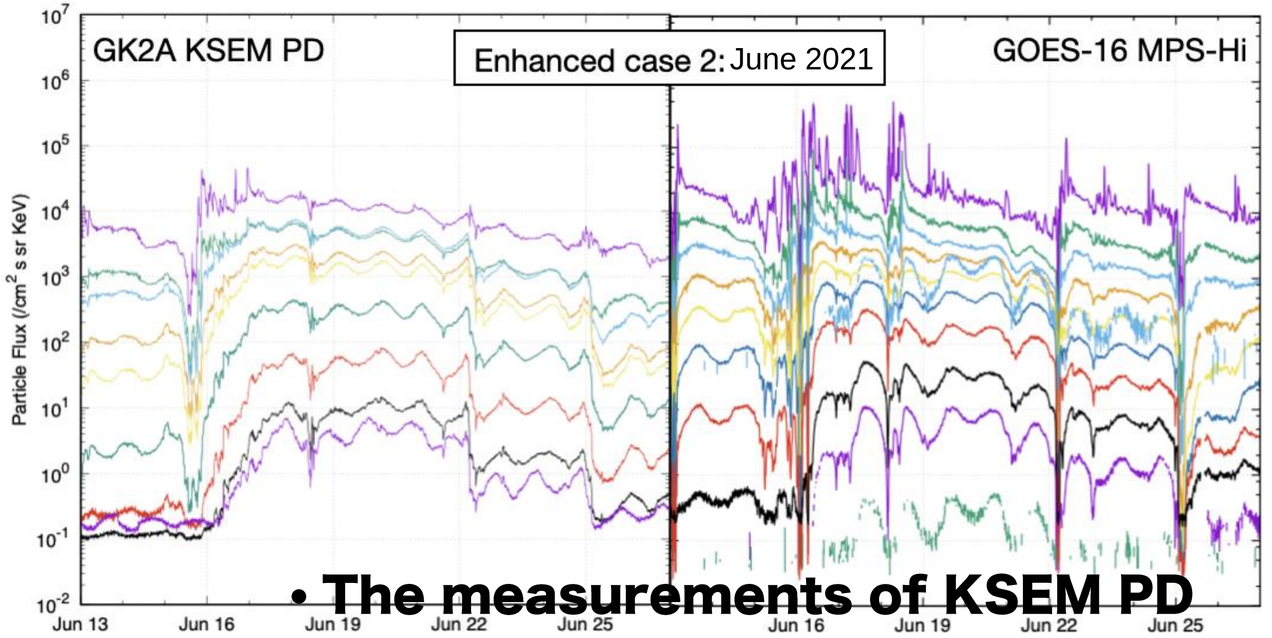
Seasonal flux spectra of KSEM PD and MPS-HI

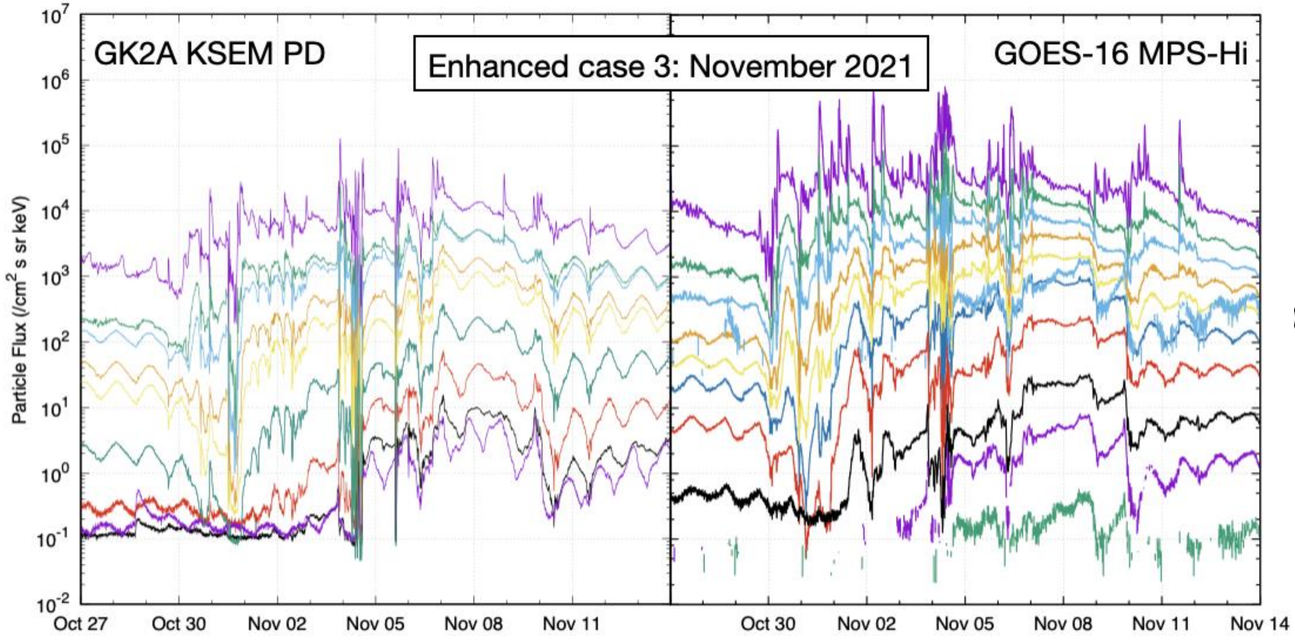


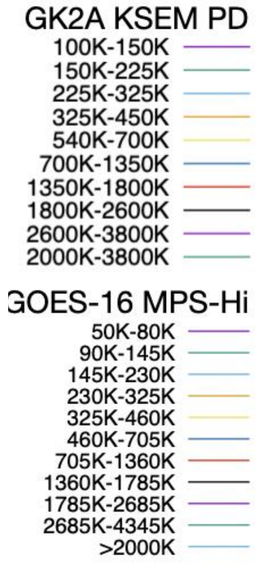
- The flux densities of Y2021 tend to converge in higher positions compared to those of Y2020.
  - Y2021 is the end of the minimum phase of solar cycle and the solar activity slowly increased again

Responses to minor enhancement environments









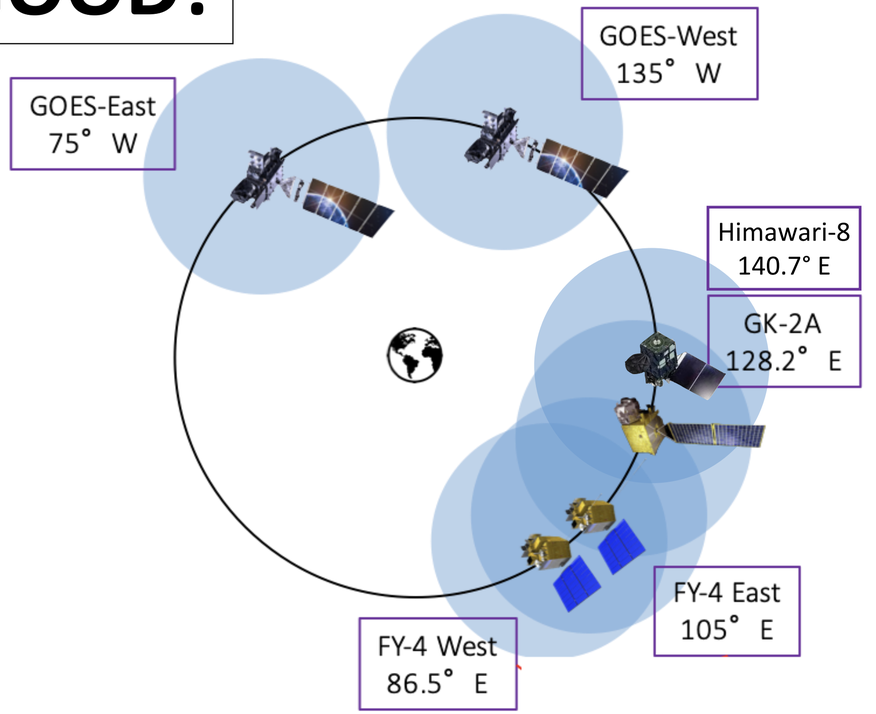
- **The measurements of KSEM PD and MPS-HI show similar response, but also with different timing and variation of fluctuations**
  - **Indicate the locational dependence of the response and the characteristics of the sensors.**

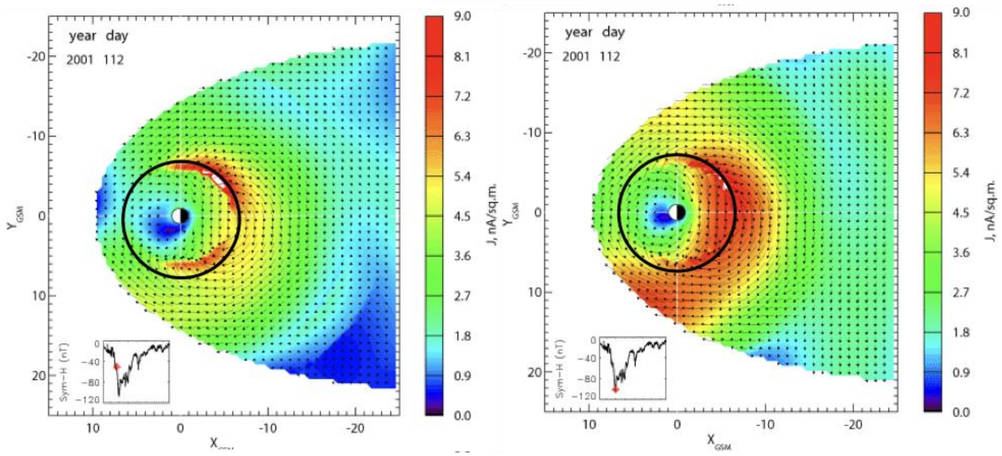
Conclusion and the future

Electron flux data from KSEM PD is pretty GOOD!

For the future...

- Combining the real-time data from multiple satellites, we can monitor the space weather condition of the orbit for almost 16 hours continuously.
- Longer observation times will provide more chance to detect short-time events such as sudden magnetopause crossing on the day side, and substorms on the night side.
- This also make it possible to do more precise studies on asymmetric phenomena which may have some physical relationship occurring on different hemispheres.
- Such studies can be used for better assessing the level of space weather activities and developing more accurate and reliable space weather forecasting models.





Asymmetric equatorial current density change in April 2001 storm (Sitnov et al., 2008), Black Circle: Geo-orbit

Thank you

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