



The dependence of the peak velocities of HSS on the co-latitudes of their source CHs

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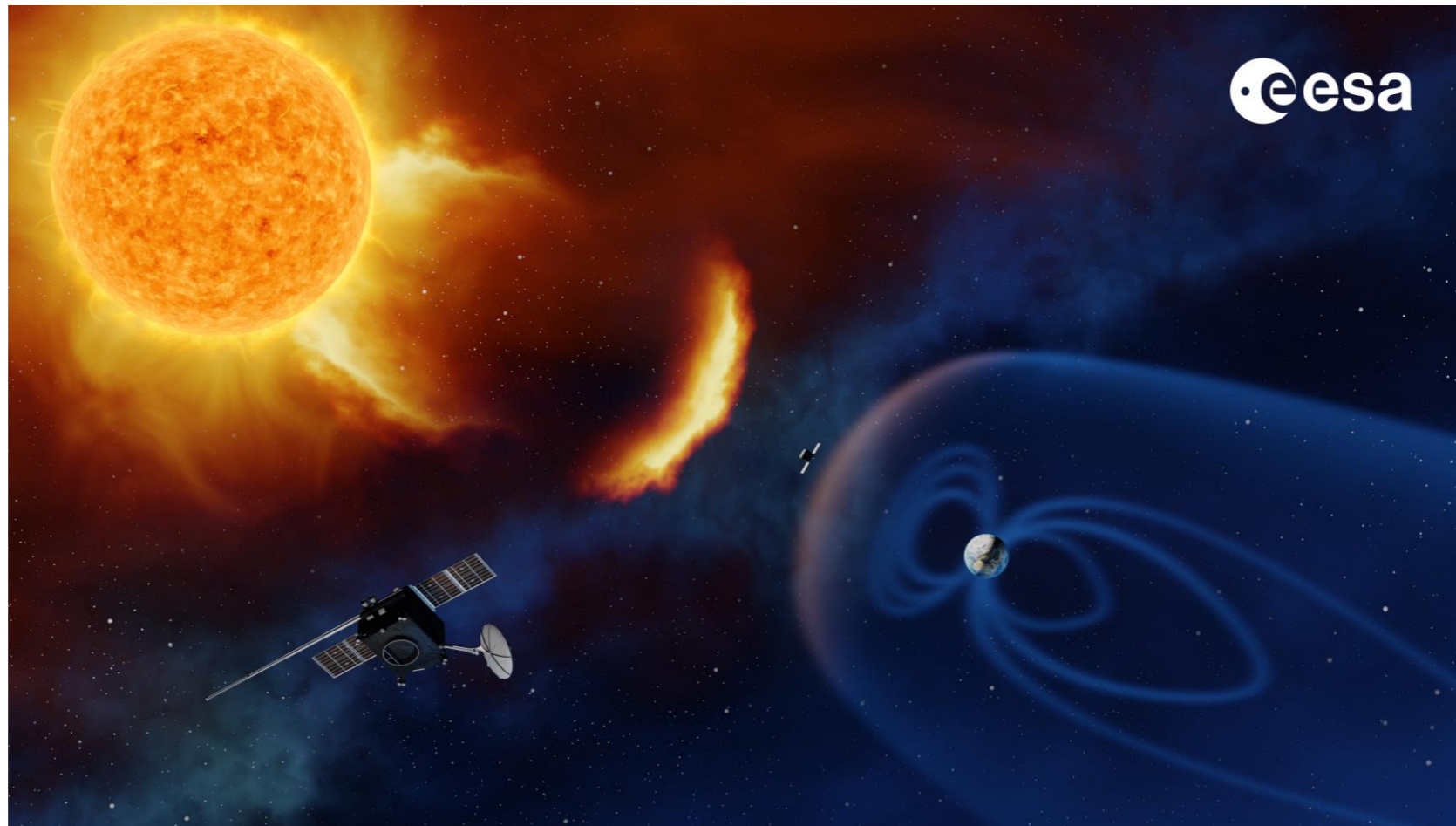
1: University of Graz, Austria

2: DTU Space, Denmark

3: Hvar Observatory, Croatia

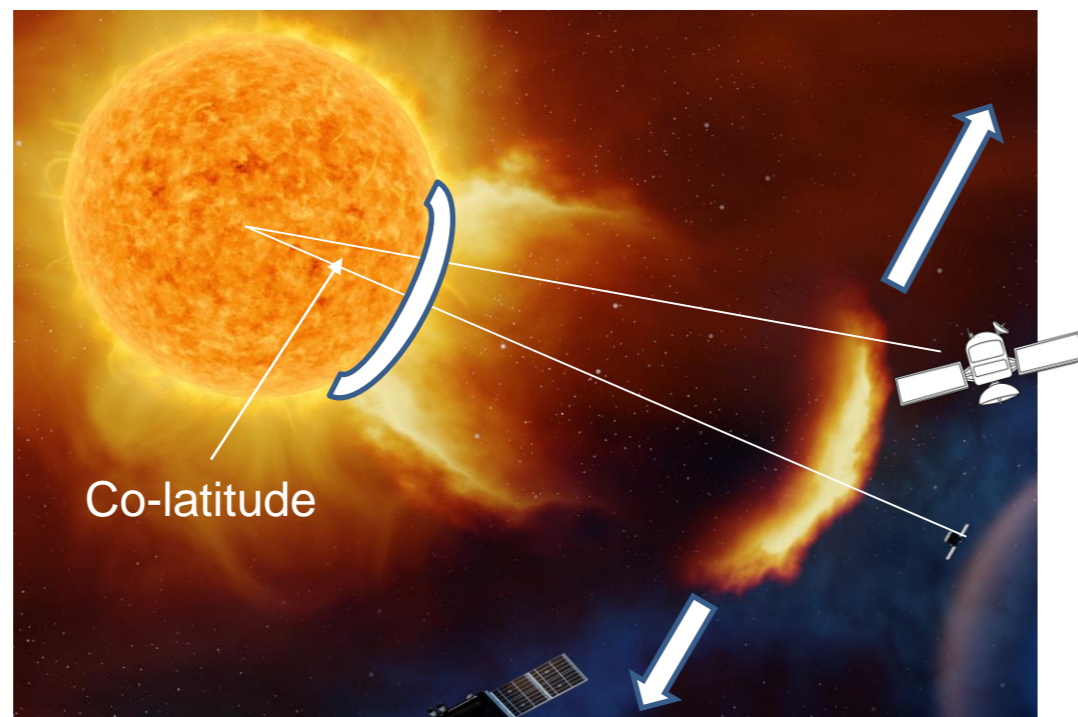
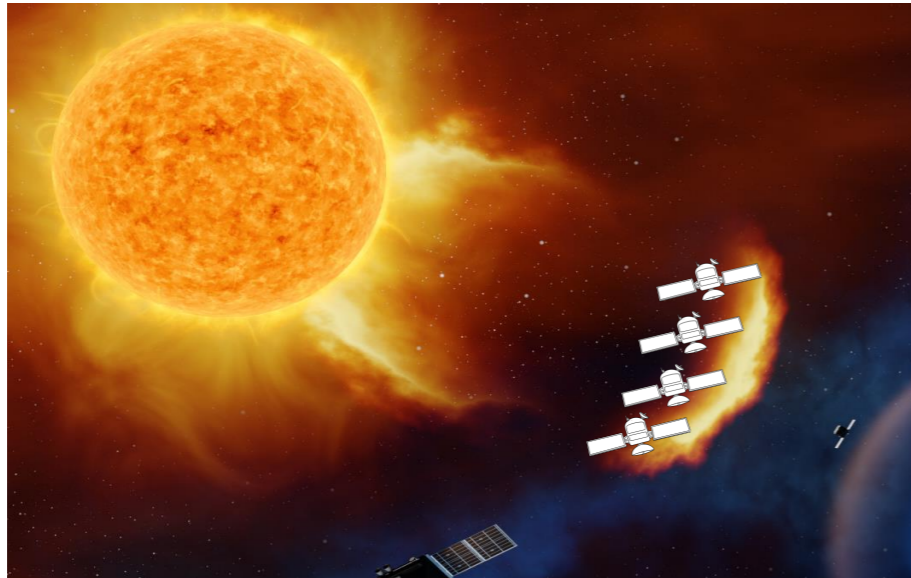
4: University of Kiel, Germany

The latitudinal dependence



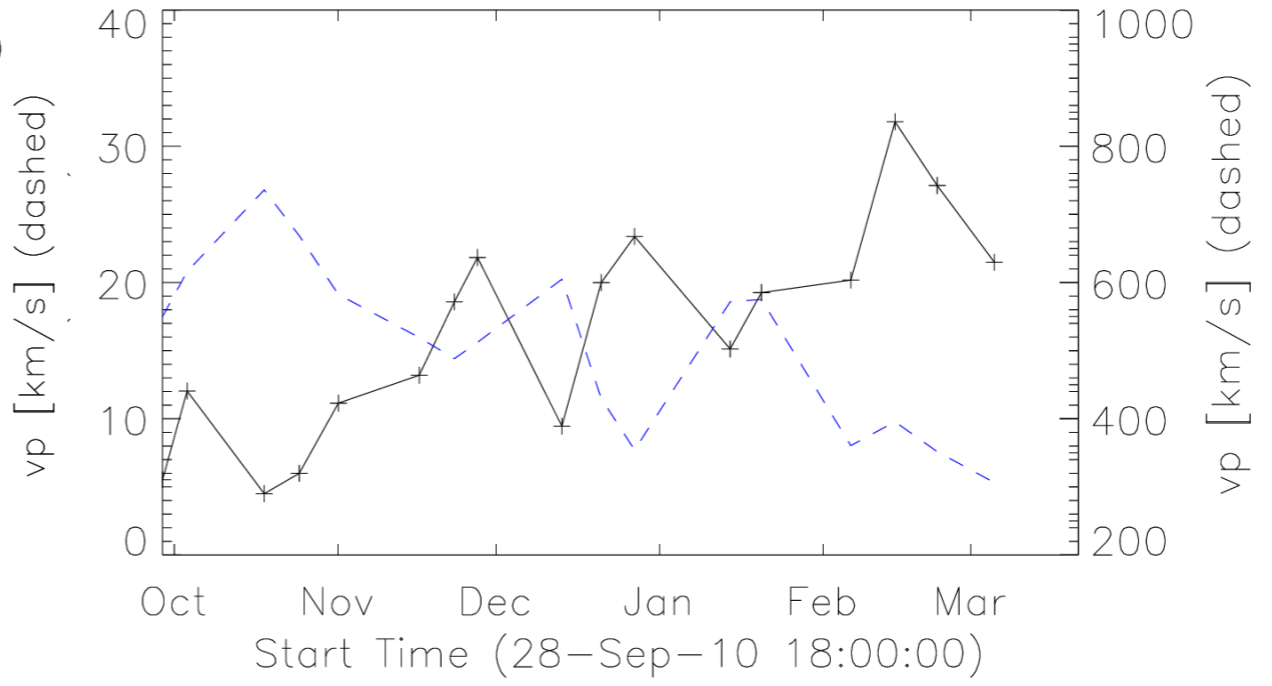
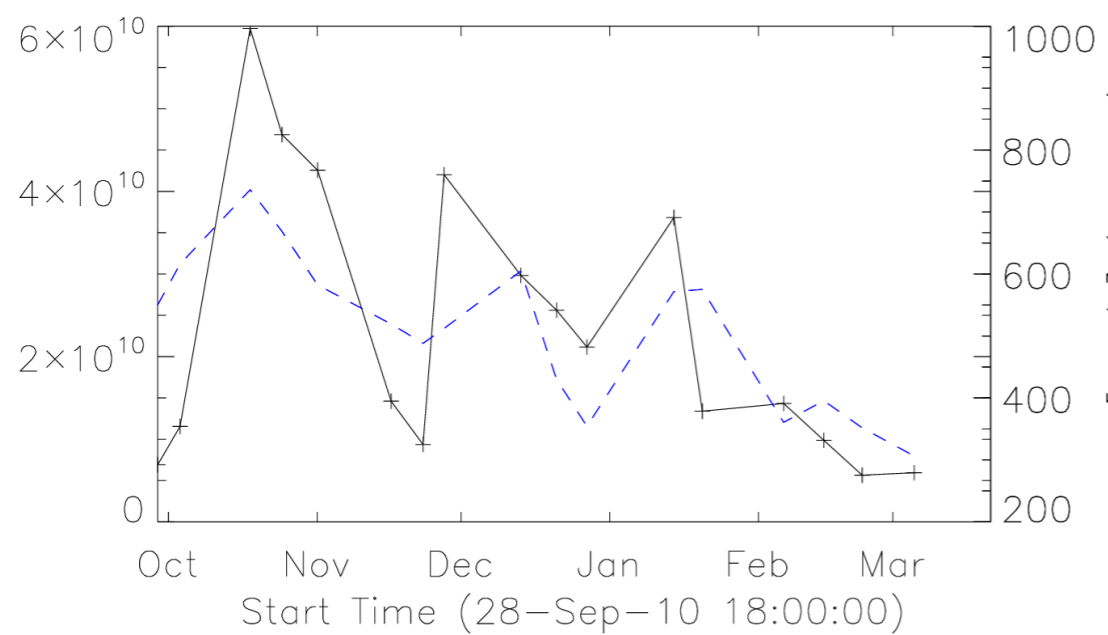
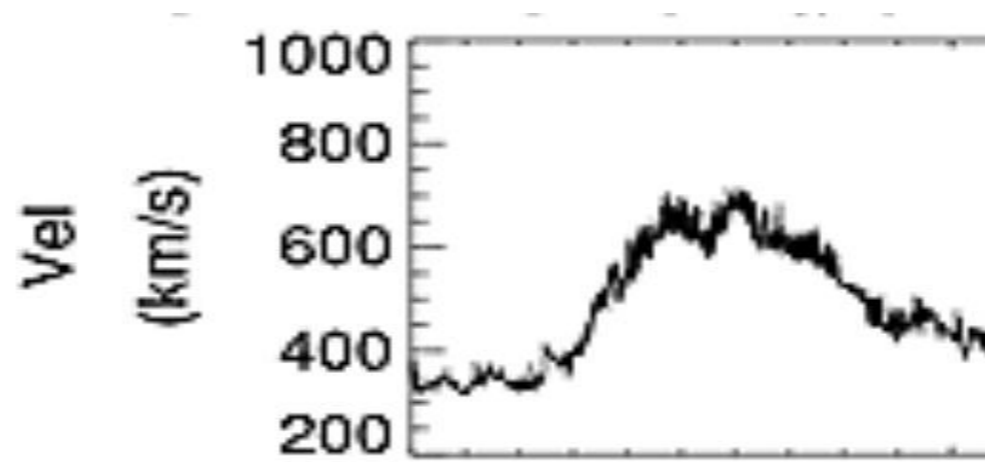
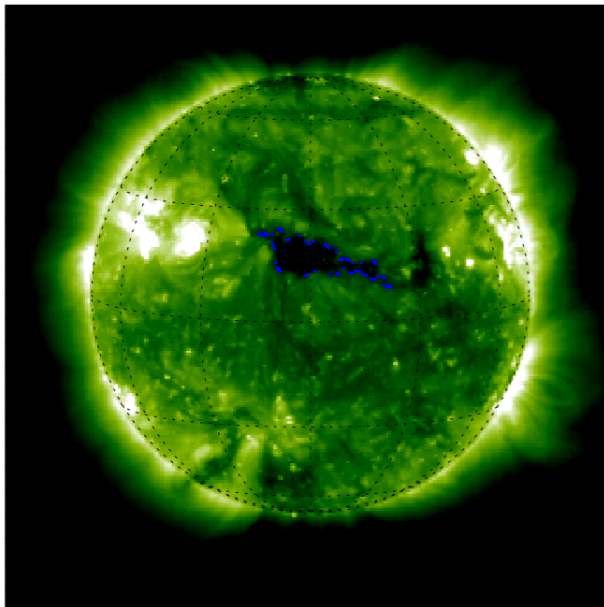
- A dependence of the properties measured on the position of the satellite within the HSS is well accepted
- But: almost no studies on the latitudinal dependence
- Still one of the big open issues

The latitudinal dependence



- Create a dataset with many CHs/HSS to sample the latitudinal distribution
- But: works only if all HSS have similar distributions!

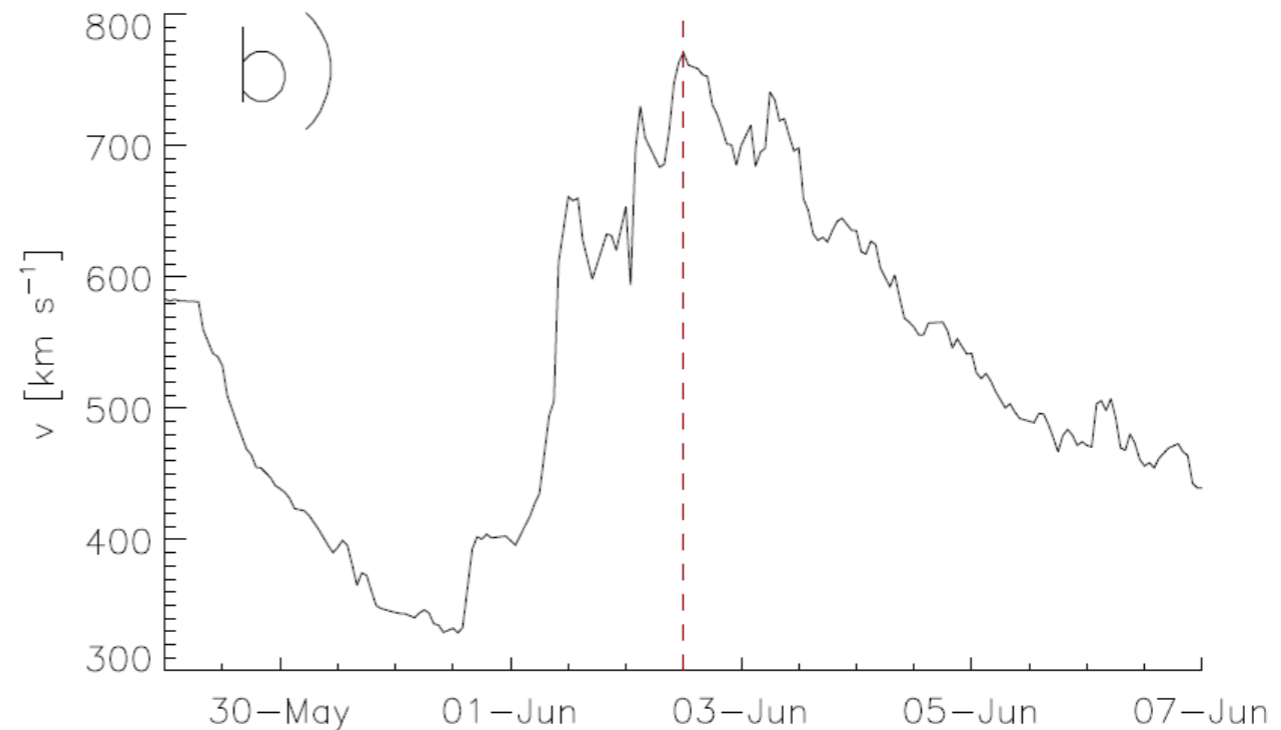
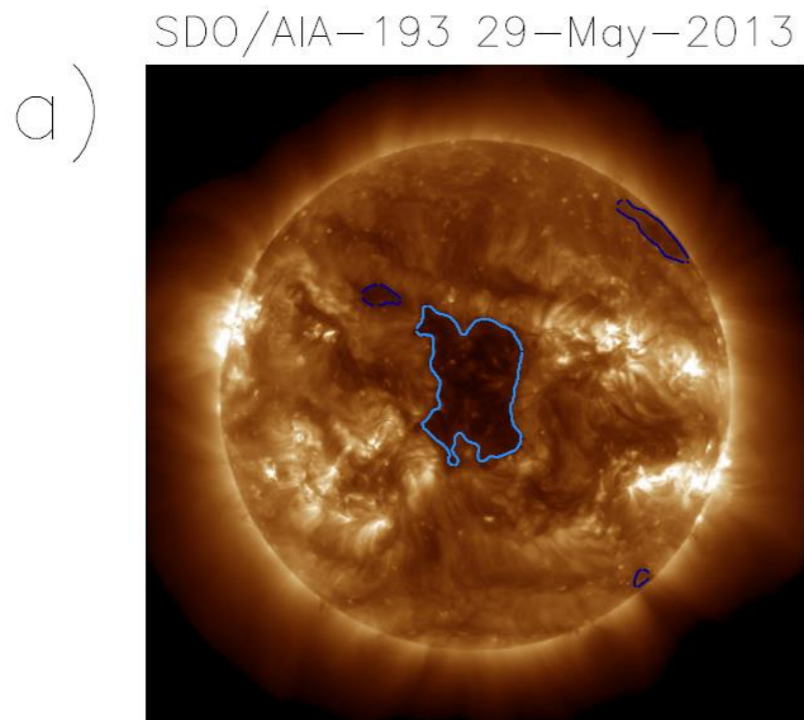
A first test: a case study on one CH/HSS



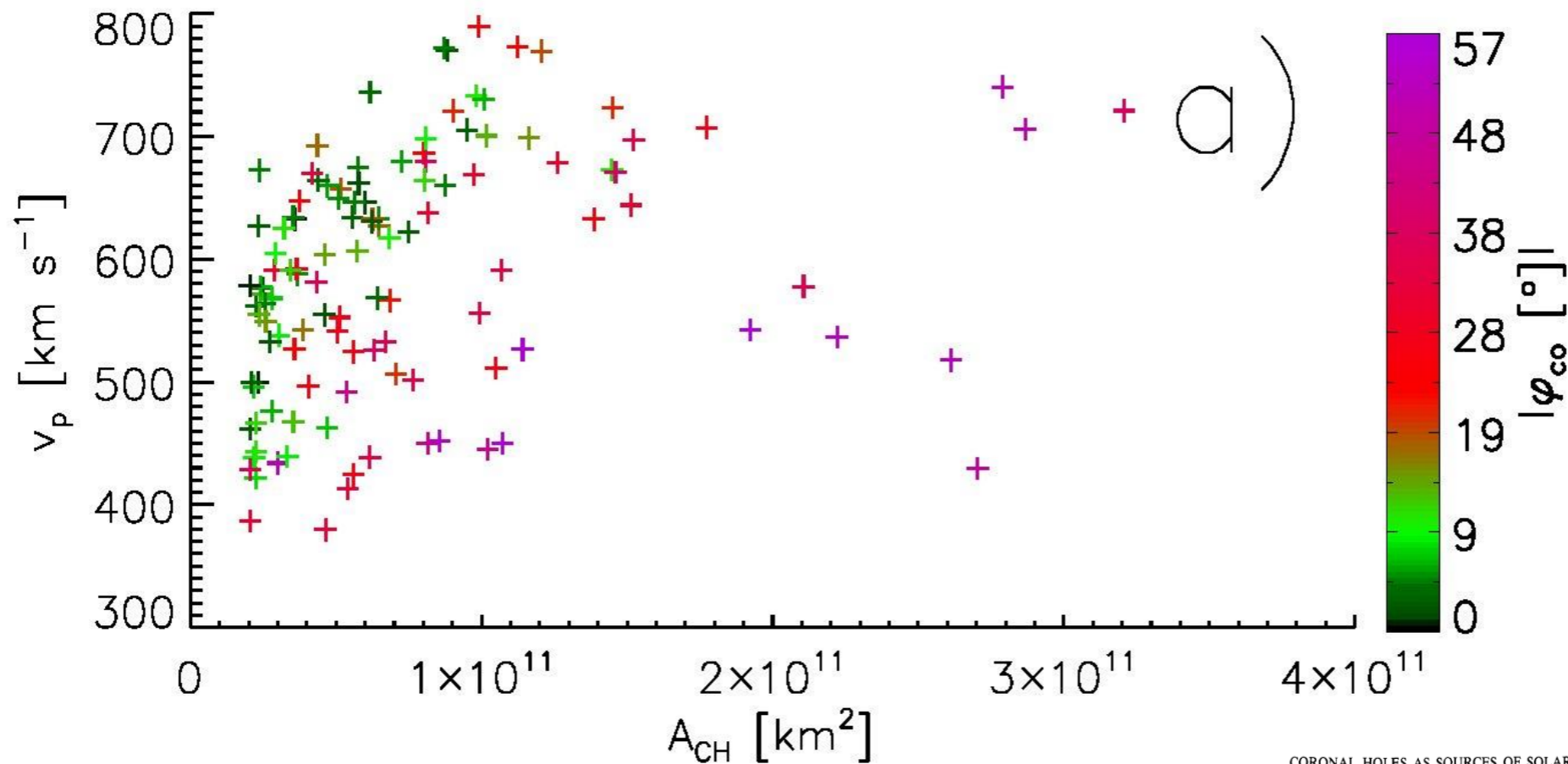
- Correlation of HSS peak velocity with CH area
- Anti-correlation with co-latitude!

Extending the dataset: 115 CHs/HSS

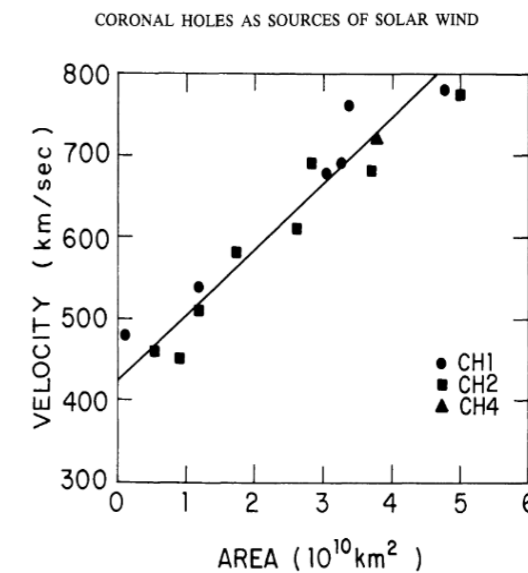
- CHs: SDO/AIA-193, STA+STB/EUVI-195
- HSS: ACE/SWEPAM, STA+STB/PLASTIC
- Only „clear“ events!



Peak velocity – area relationship

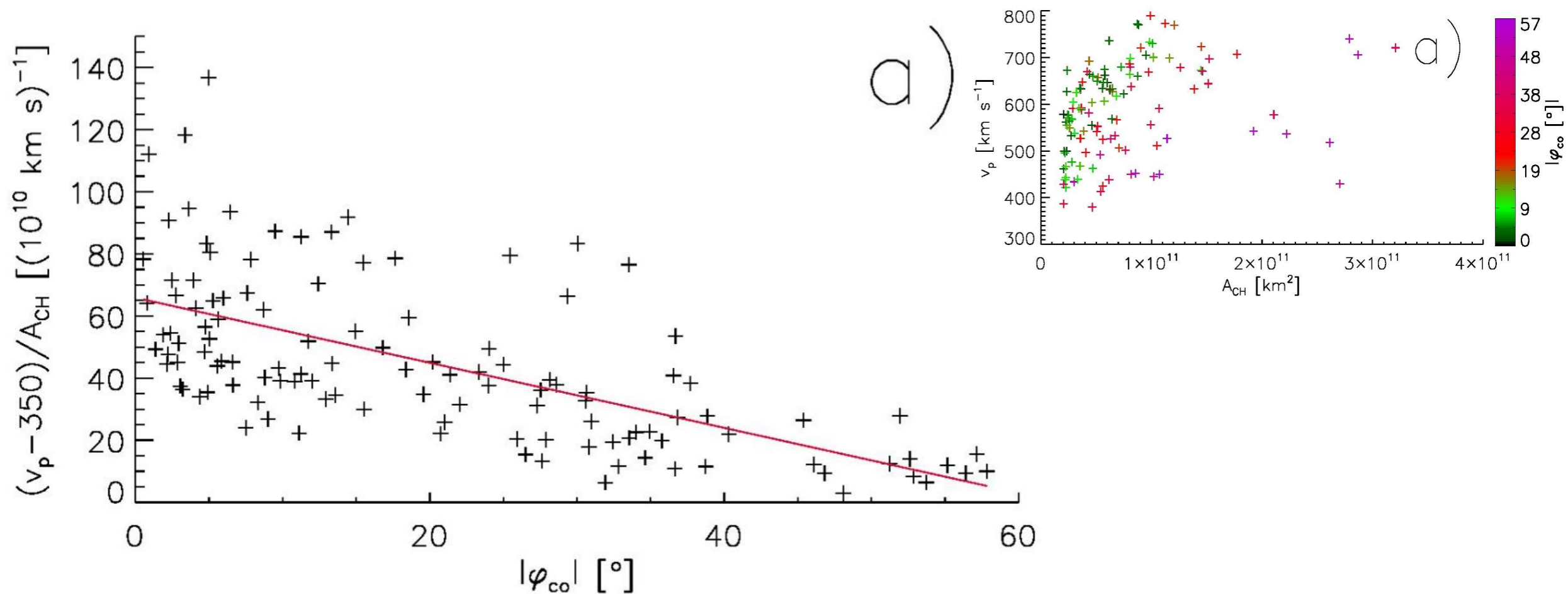


- $(v\text{-const}) / A \neq \text{const!}$
- $(v\text{-const}) / A = f(\varphi_{co})$
- Largest v when satellite in the center of the HSS ($\varphi_{co} = 0$)
- Co-latitude structures our data!



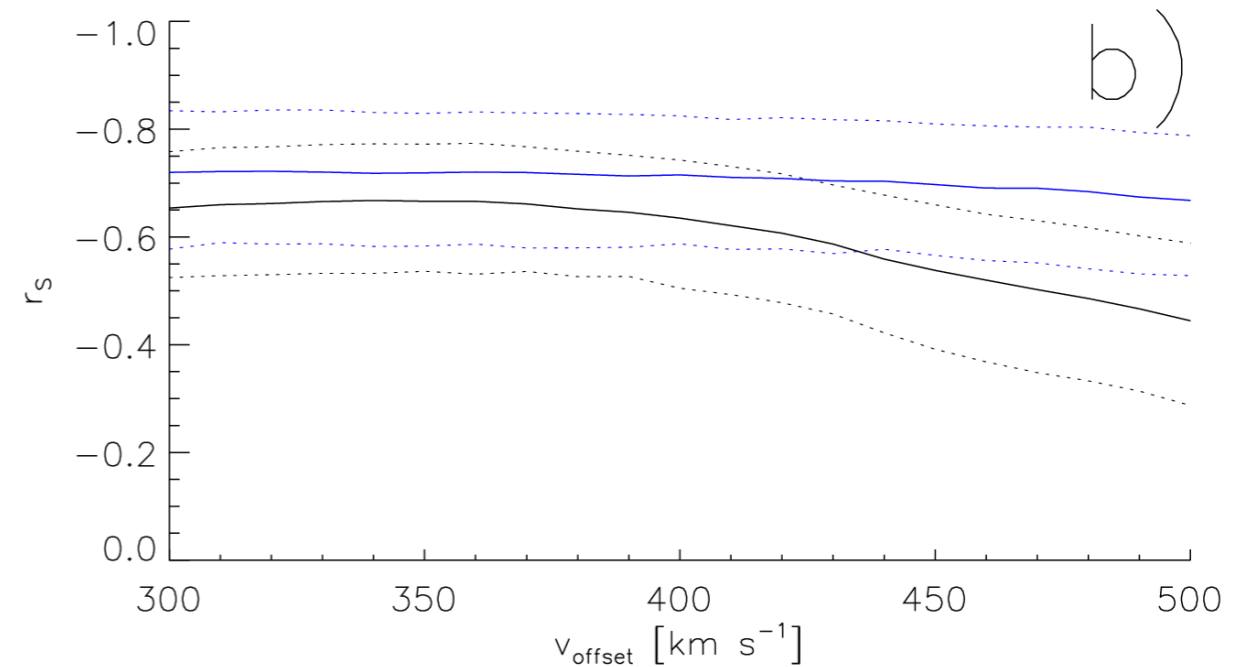
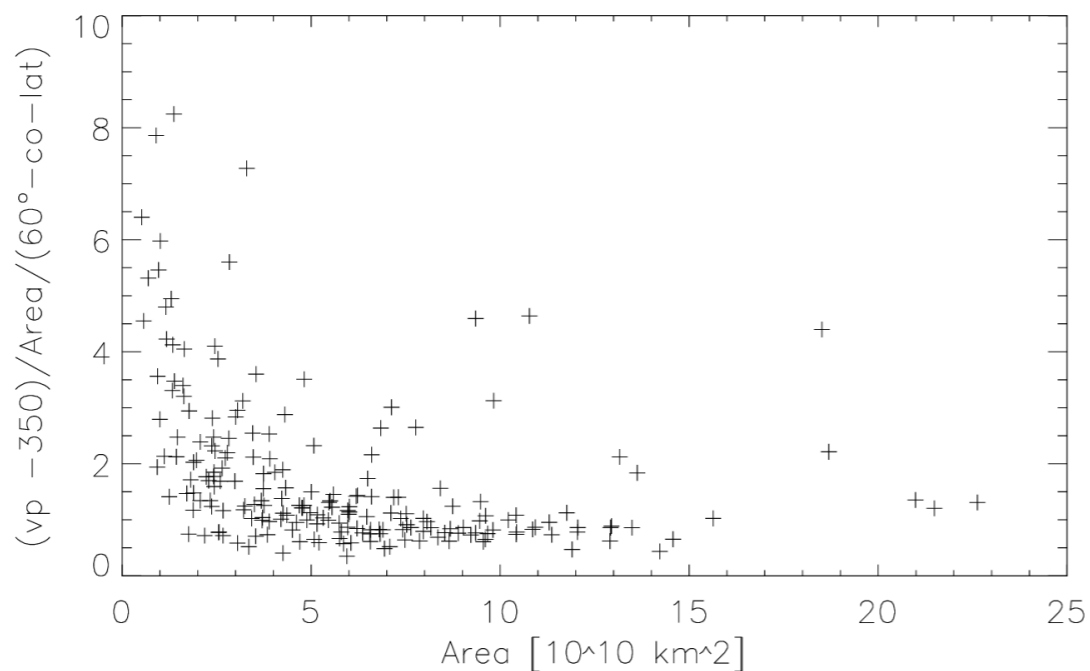
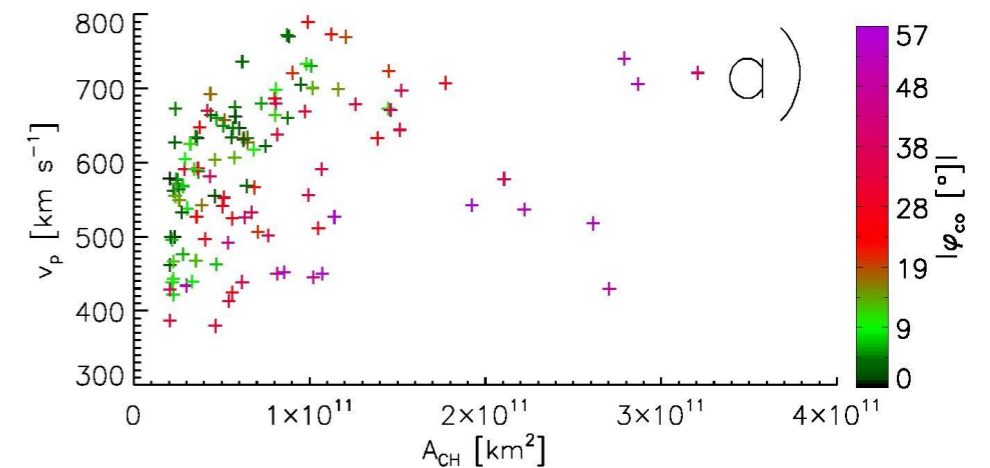
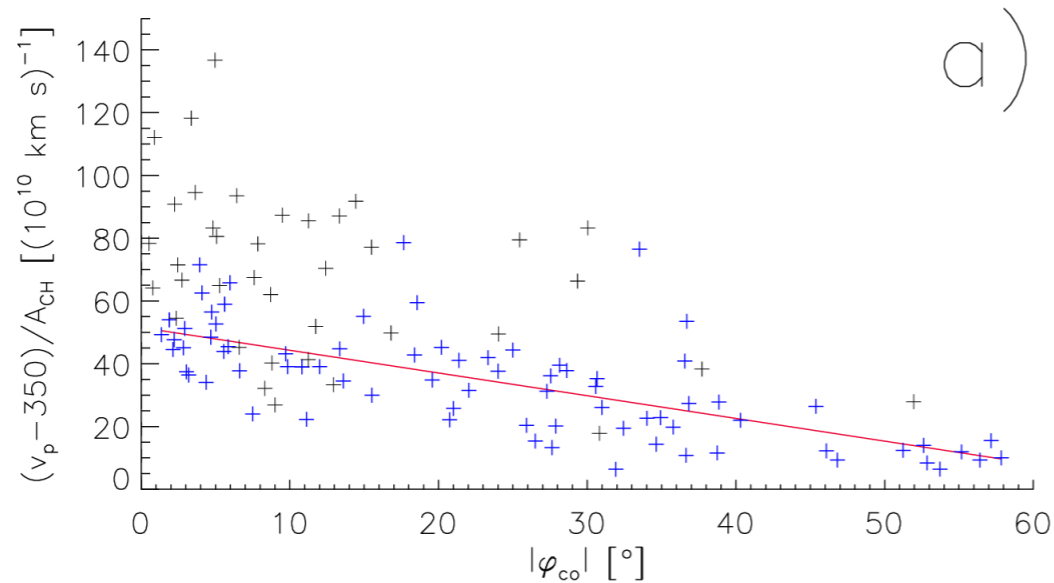
From: HSS peak velocities vs. CH areas. From Nolte et al. (1976).

Velocity increase per area



- Velocity increase per area: $(v_p - v_{\text{offset}}) / A_{CH}$
- Linearly decreasing with increasing φ_{co}
- $(v_p - v_{\text{offset}}) / A_{CH} = 0$ @ $\varphi_{co} \sim 60^\circ$
- $cc = 0.40 \rightarrow 0.72$

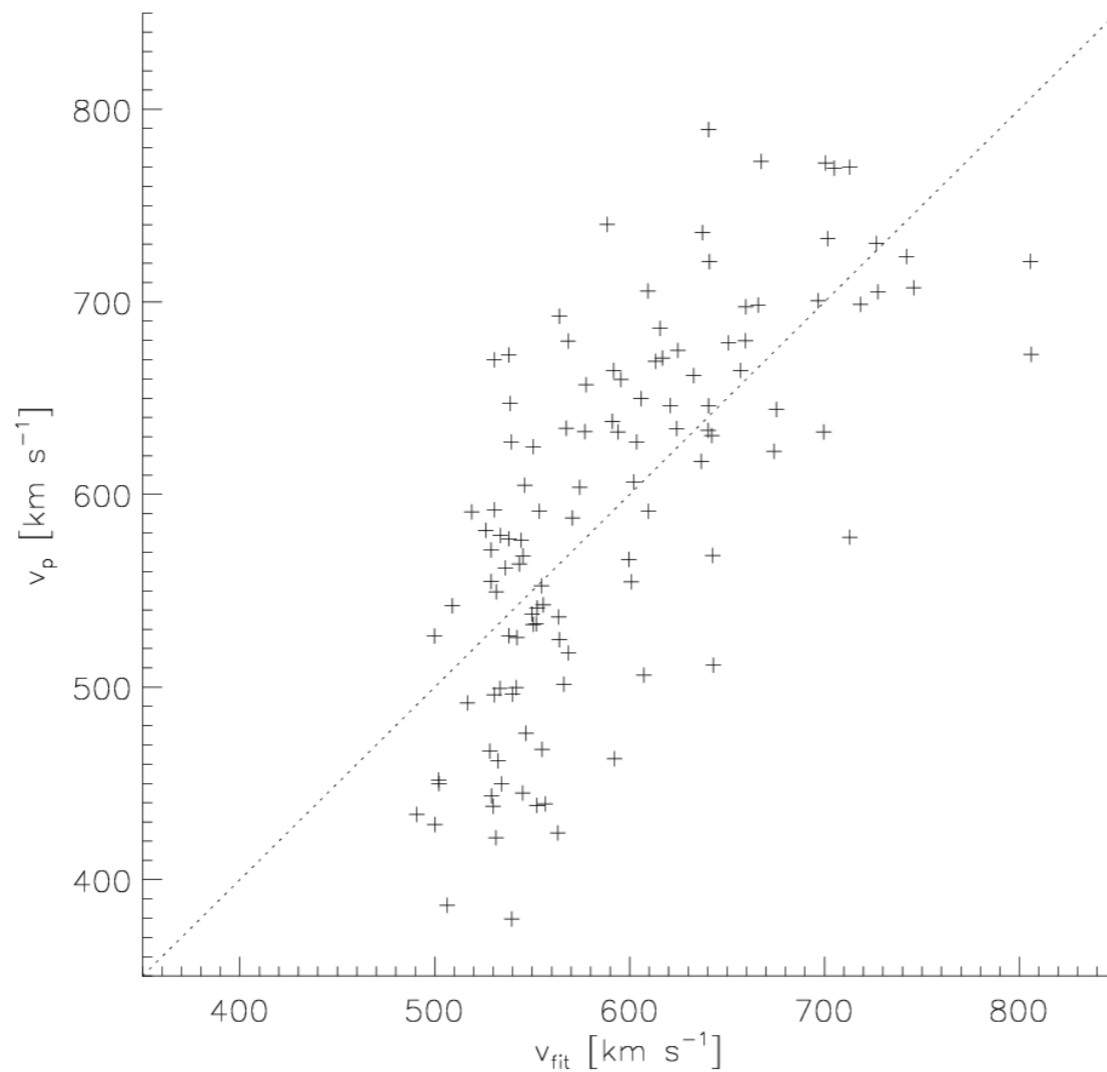
Velocity increase per area – only for $A_{CH} > 4 * 10^{10}$ km²



- Relationship changes for $A_{CH} > 4 * 10^{10}$ km²
- High correlation for all offset velocities

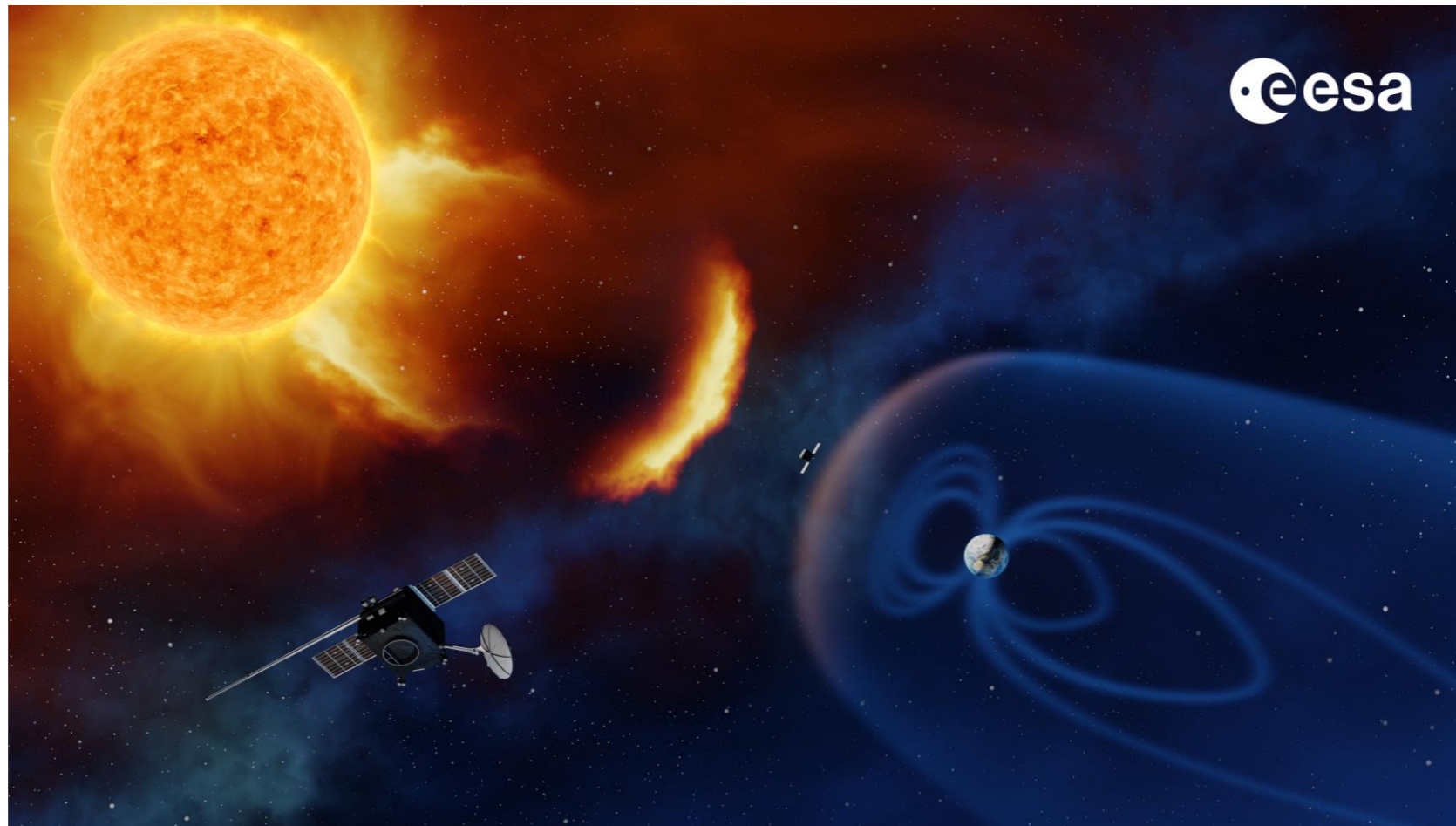
Fitting the data

$$|v_{\text{fit}}[\text{km s}^{-1}] = 478 + (2.77 \cdot 10^{-9} \cdot A_{\text{CH}}[\text{km}^2]) \cdot (1 - |\varphi_{\text{co}}[^\circ]| / 61.4)$$



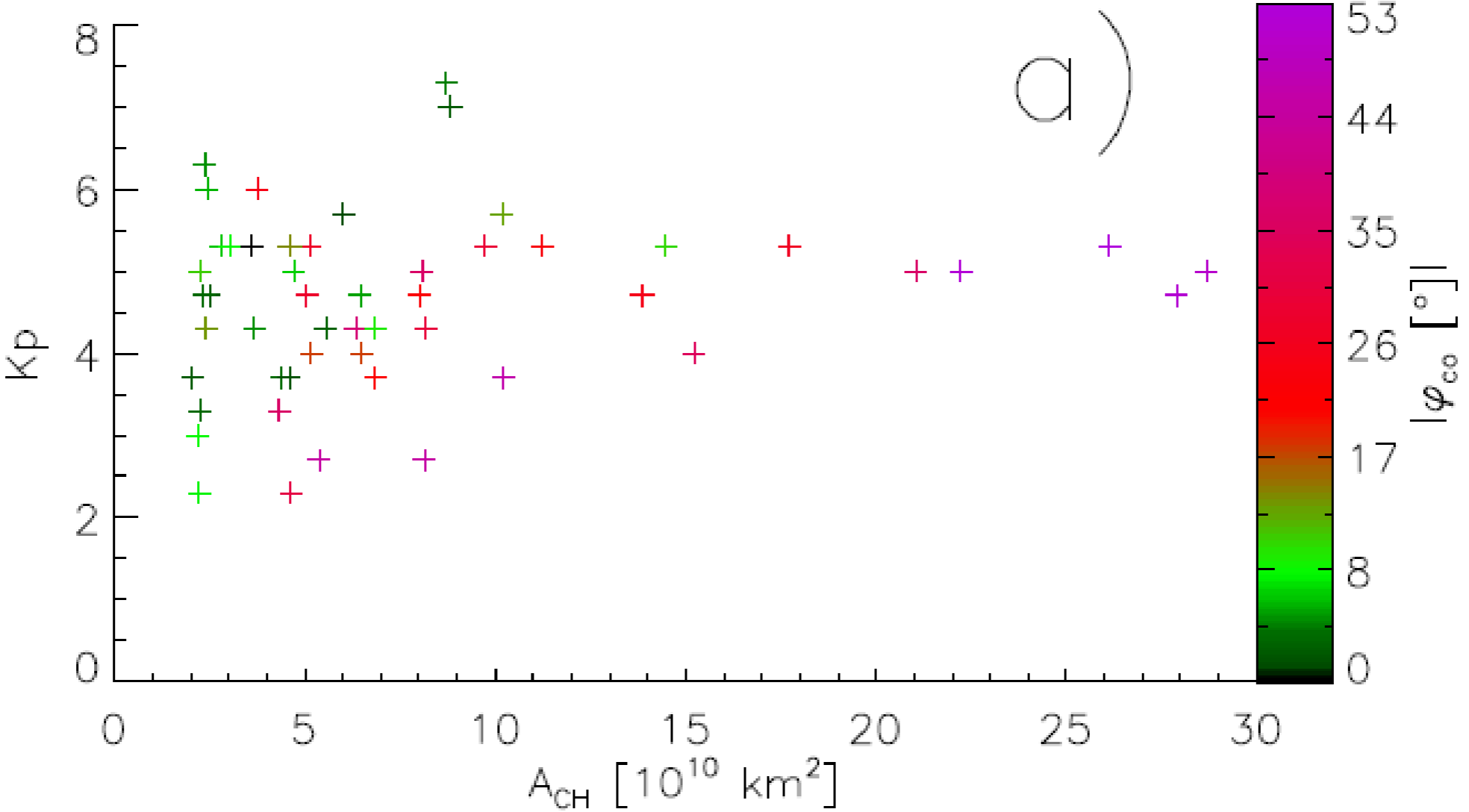
Follows well the trend!

Geomagnetic Indices

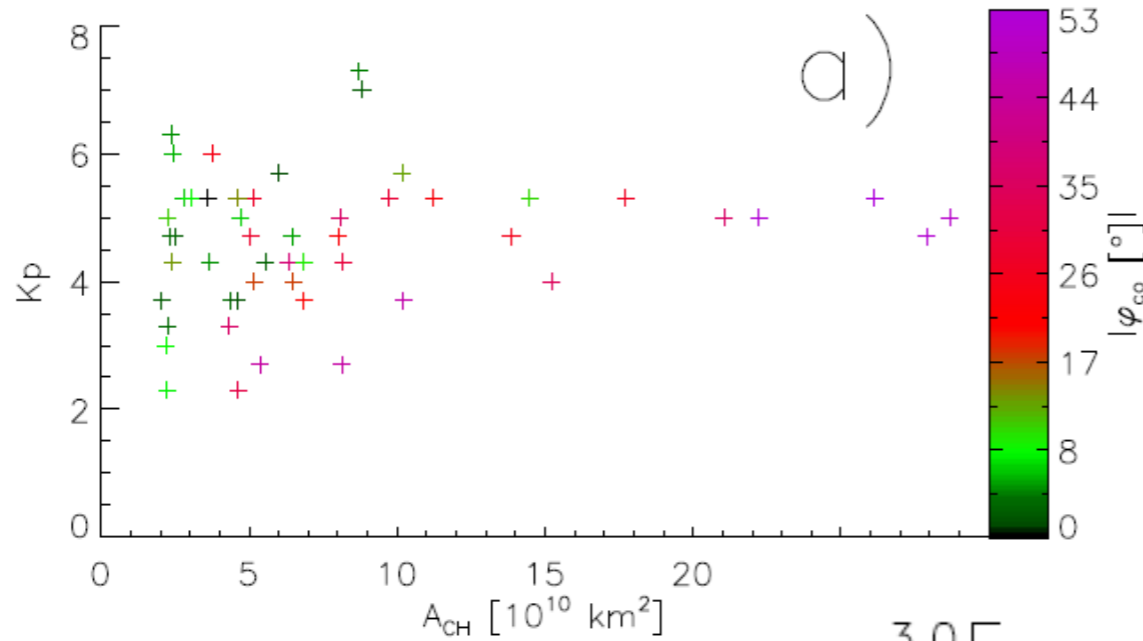


- Velocity increases per coronal hole area decreases linearly from center of HSS to its flanks
- Temperature is correlated, density anti-correlated to solar wind speed -> also a latitudinal dependence
- Magnetic field distribution?...
- Also geomagnetic consequences should be dependent on where the Earth is located within the HSS

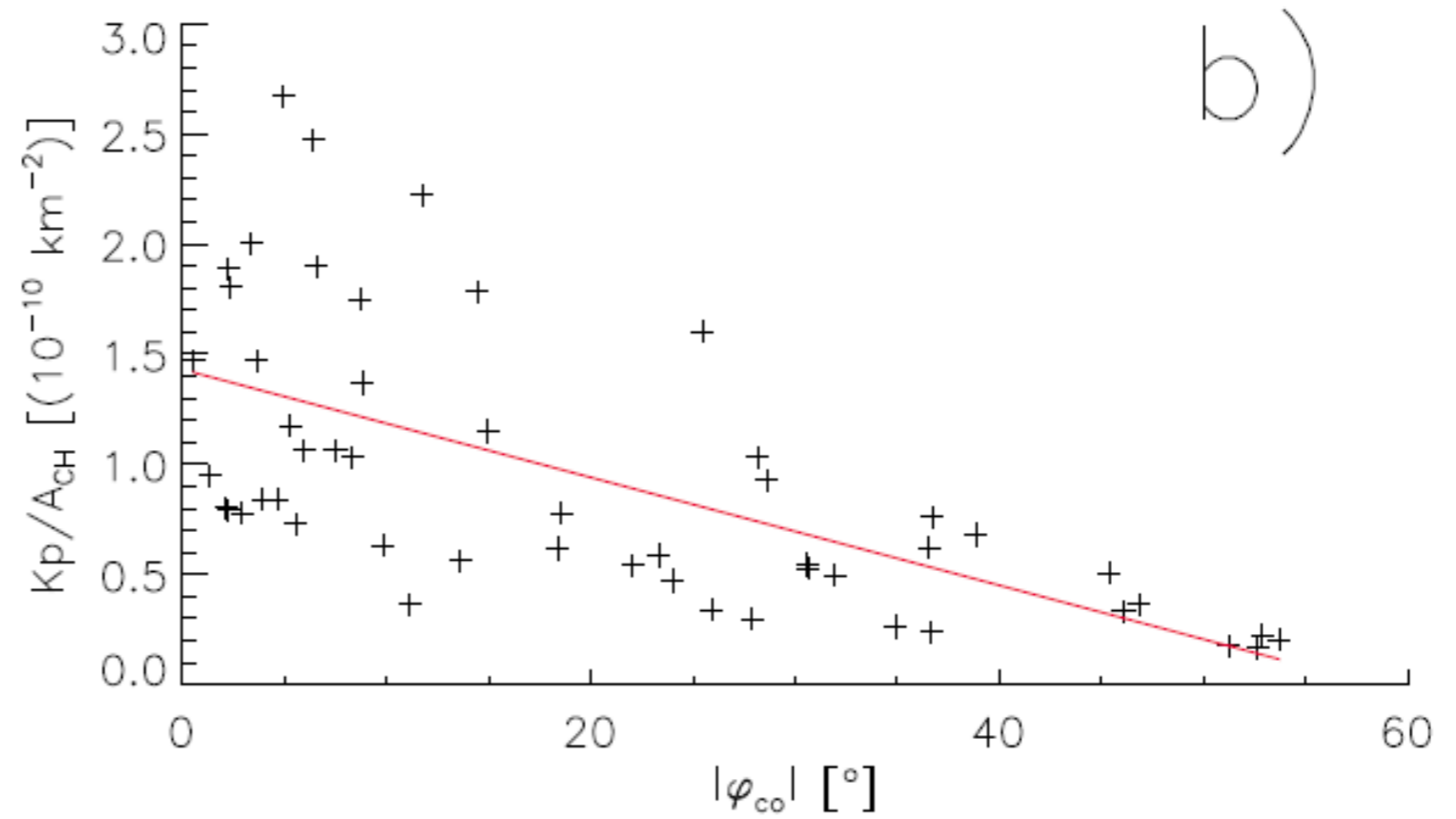
Kp index



Kp index

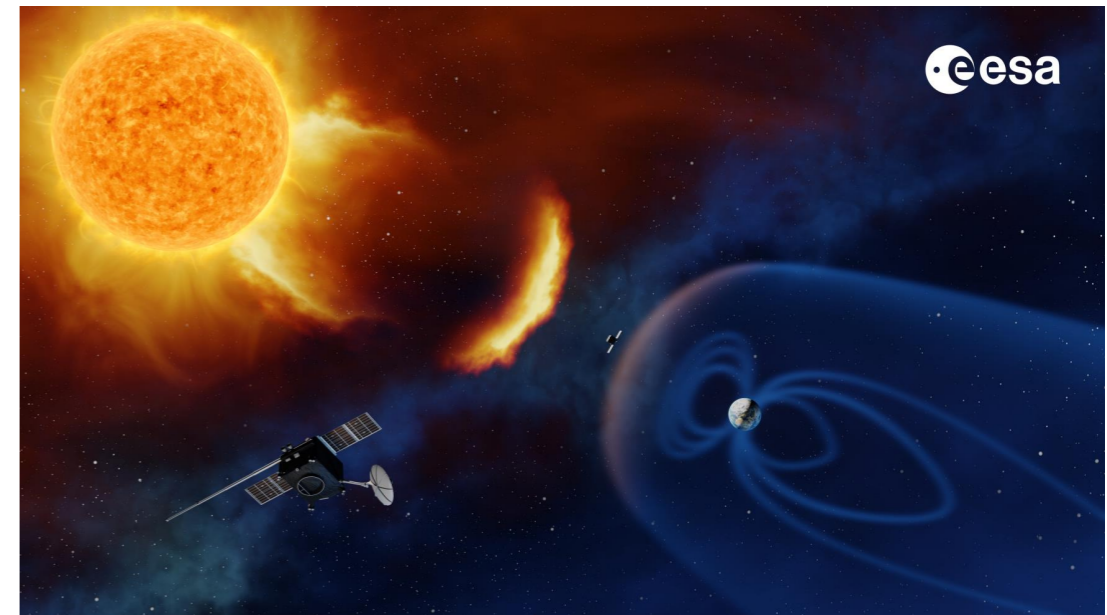


Analog dependencies for geomagnetic indices!



Conclusions:

Strong dependence of the Peak velocity measured/ Kp index on the position of the measuring satellite/Earth within the HSS



- increases cc from 0.40 to 0.72
- HSS arising from $\varphi_{co} > 60^\circ$ have a high chance to not reach the ecliptic
- Data analysis: structures your data
- Forecast: co-latitude as input parameter

This is only one of many ways on how to investigate the co-latitudinal dependence.

We do not need to wait for Solar Orbiter, we have all the data we need to derive the latitudinal profile of HSS. Let's start.