

# *Average Behavior of Disturbed Types of Solar Wind*

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Several results have been published and may be found in  
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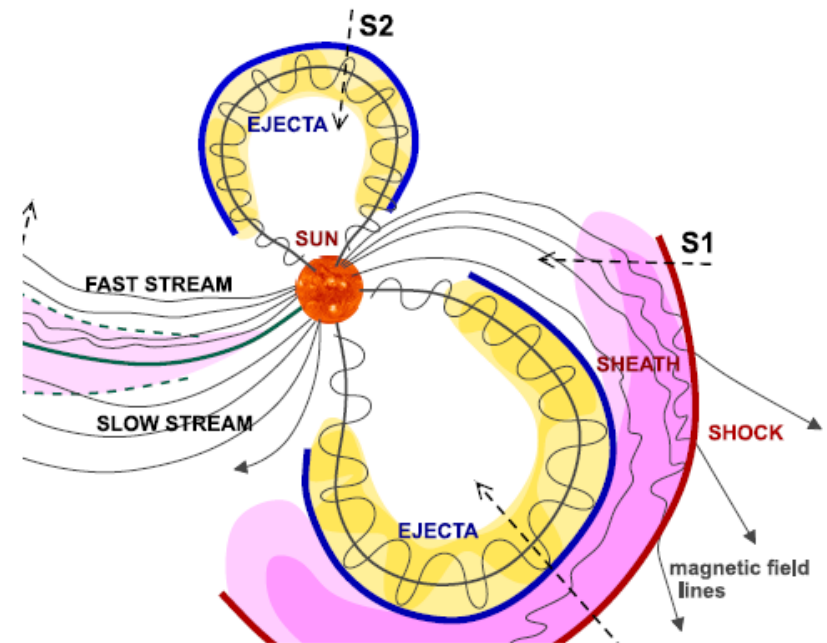
# Introduction

- Disturbed types of solar wind (SW) are the main sources of the Space Weather effects on the Earth.
- Usual way of study: disturbance on the Earth => sources in the solar wind or on the Sun (i.e. selection of only geoeffective SW types).
- To understand geoeffectiveness of various types of SW streams, it is necessary to compare the characteristics of the streams inducing magnetic storm with the characteristics of all events of this type independently of possibility to storm generation.
- In the present work we analyze full sets of various solar wind types for interval 1976–2000 on the basis of OMNI data set.

# SW types and interaction between them

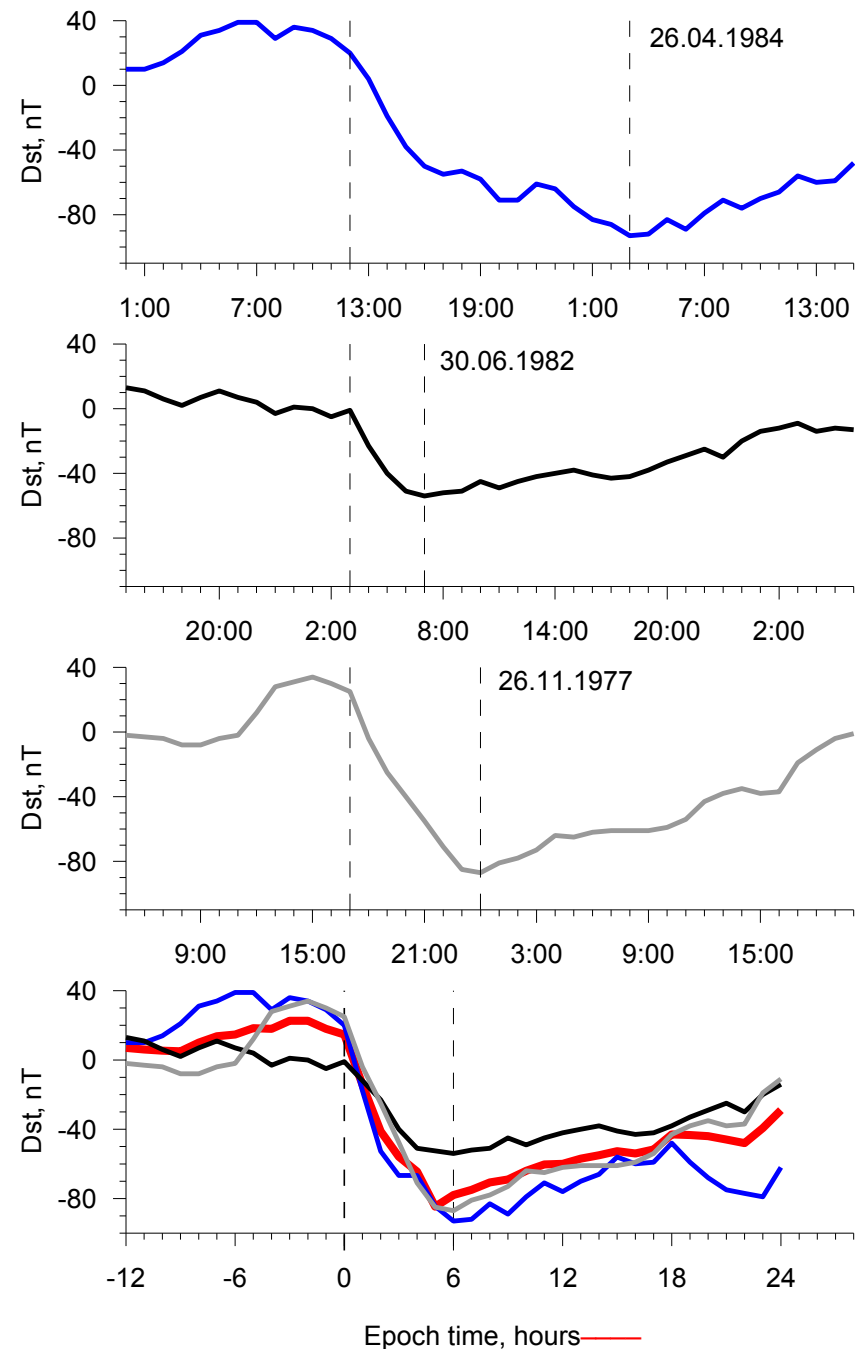
- we separately analyze the following sequences of the phenomena:

- (1) SW/**CIR**/SW,
- (2) SW/IS/**CIR**/SW,
- (3) SW/**Ejecta**/SW,
- (4) SW/**Sheath**/**Ejecta**/SW,
- (5) SW/IS/**Sheath**/**Ejecta**/SW,
- (6) SW/**MC**/SW,
- (7) SW/**Sheath**/**MC**/SW, and
- (8) SW/IS/**Sheath**/**MC**/SW

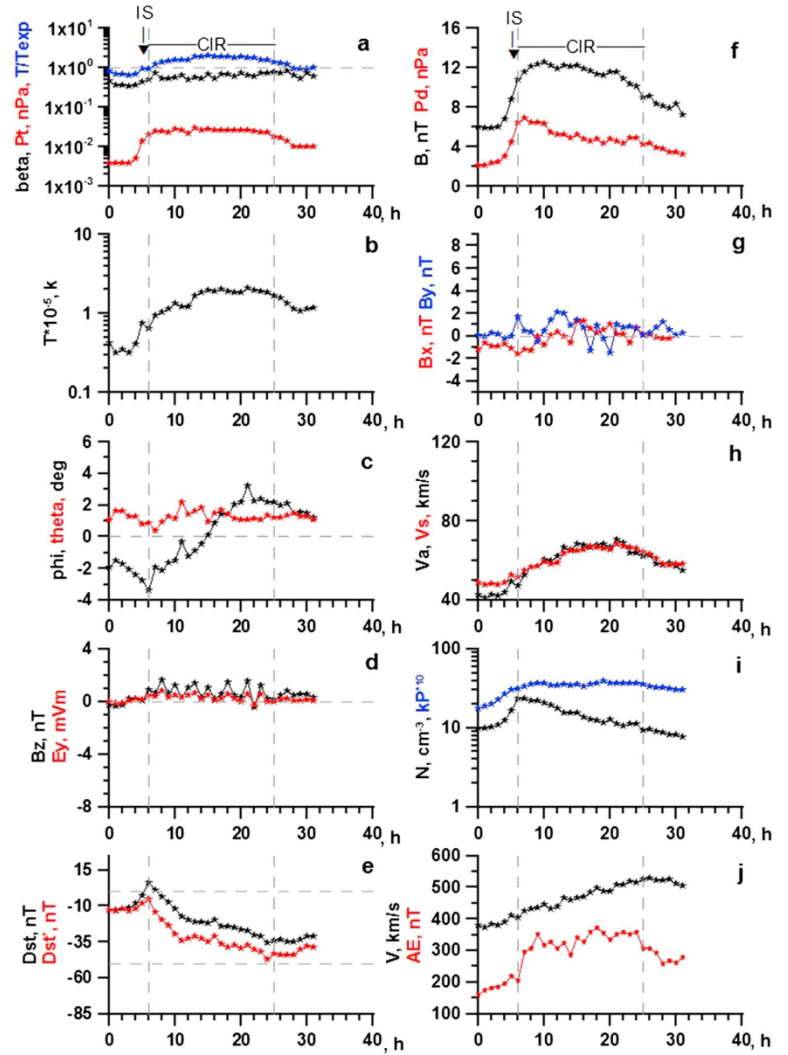
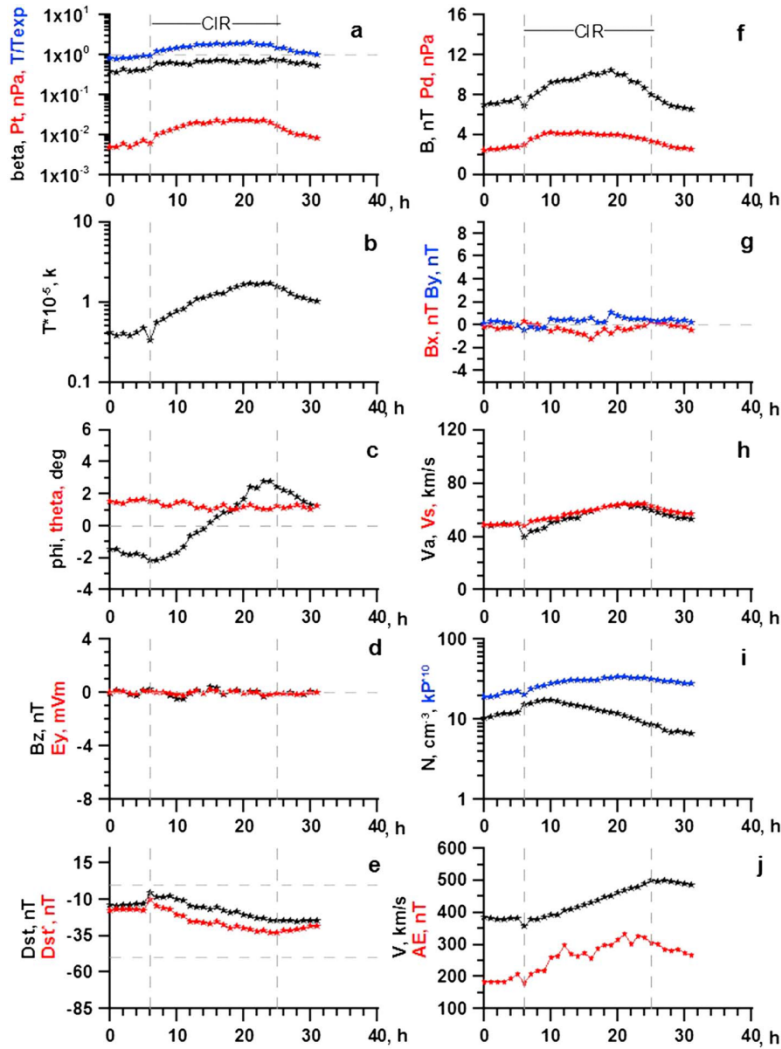


# Method

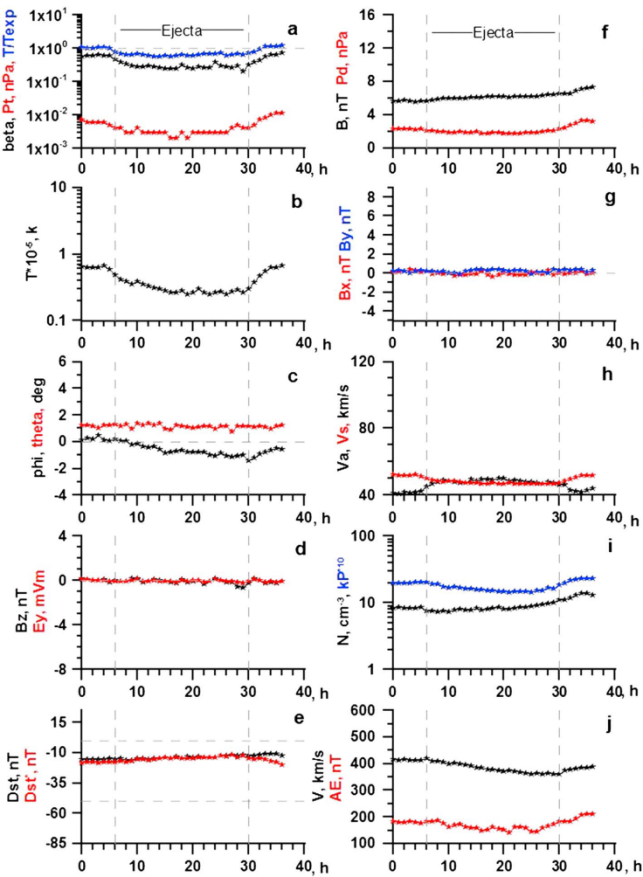
- To take into account the different durations of SW types, we use the double superposed epoch analysis (DSEA) method: rescaling the duration of the interval for all types in such a manner that, respectively, beginning and end for all intervals of selected type coincide.



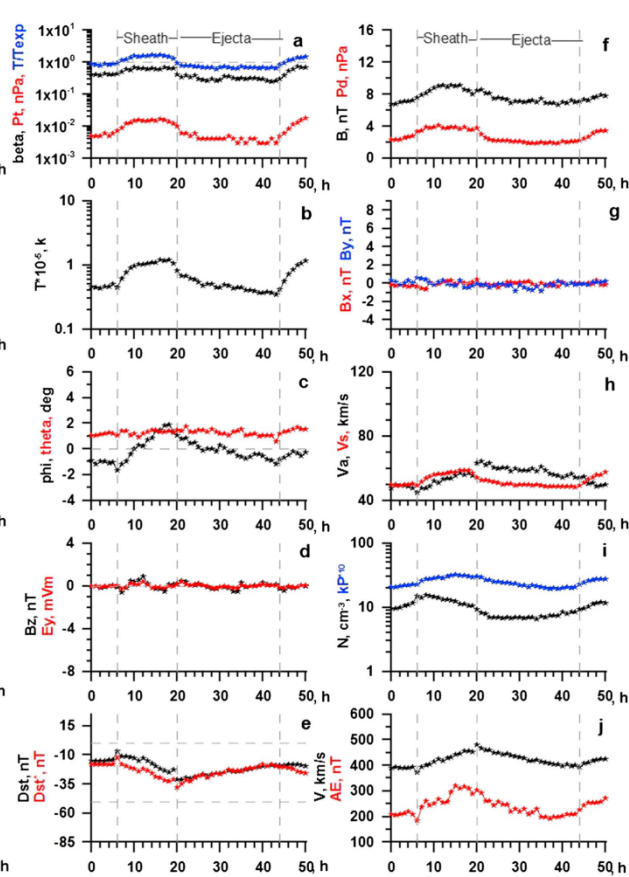
# CIR



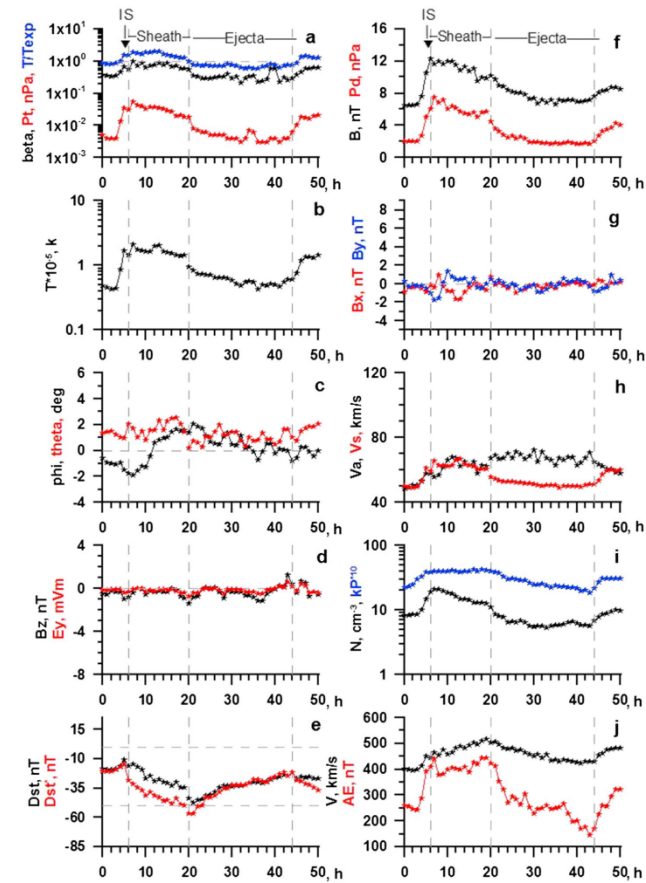
# Ejecta



Ejecta

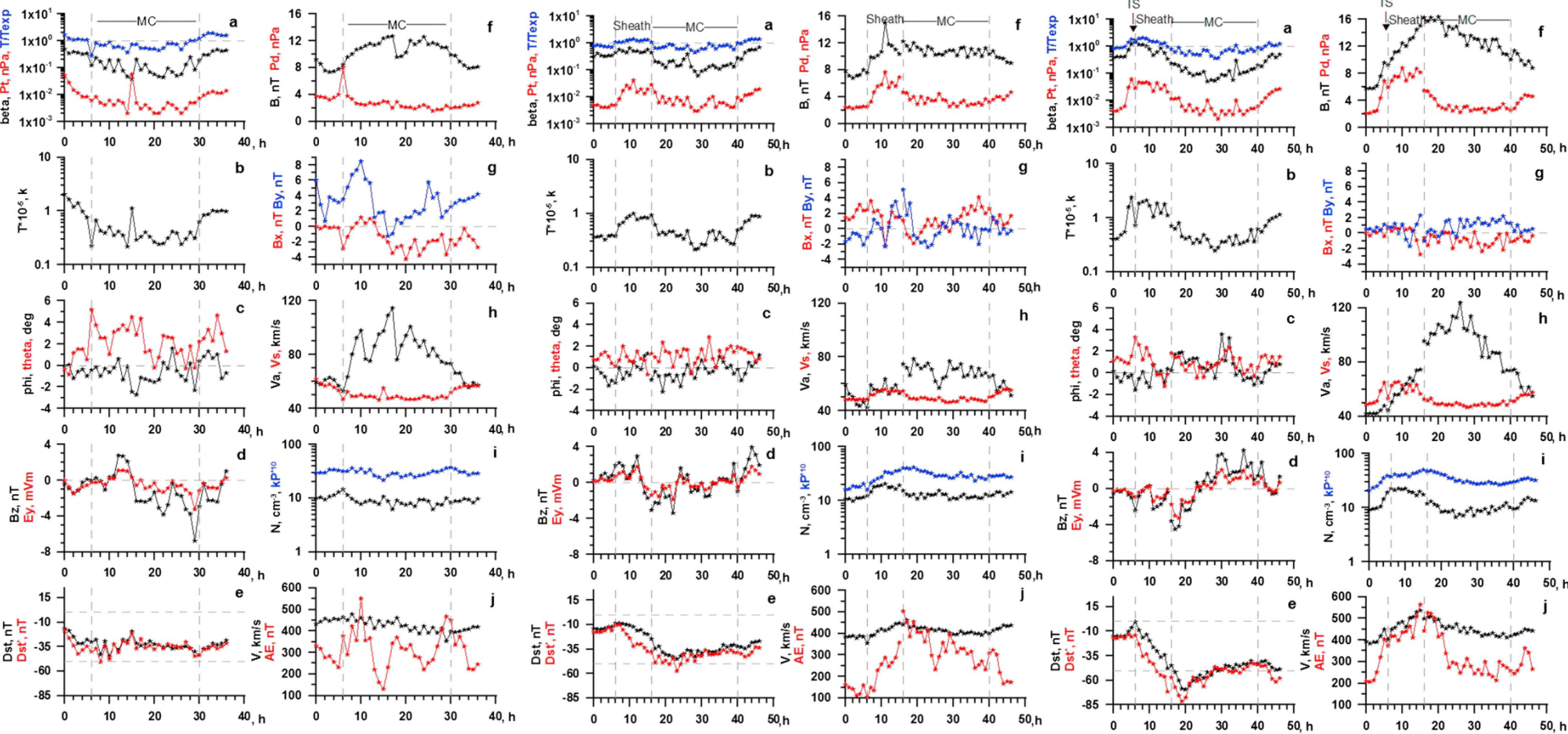


Sheath + Ejecta



IS + Sheath + Ejecta

# Magnetic Cloud

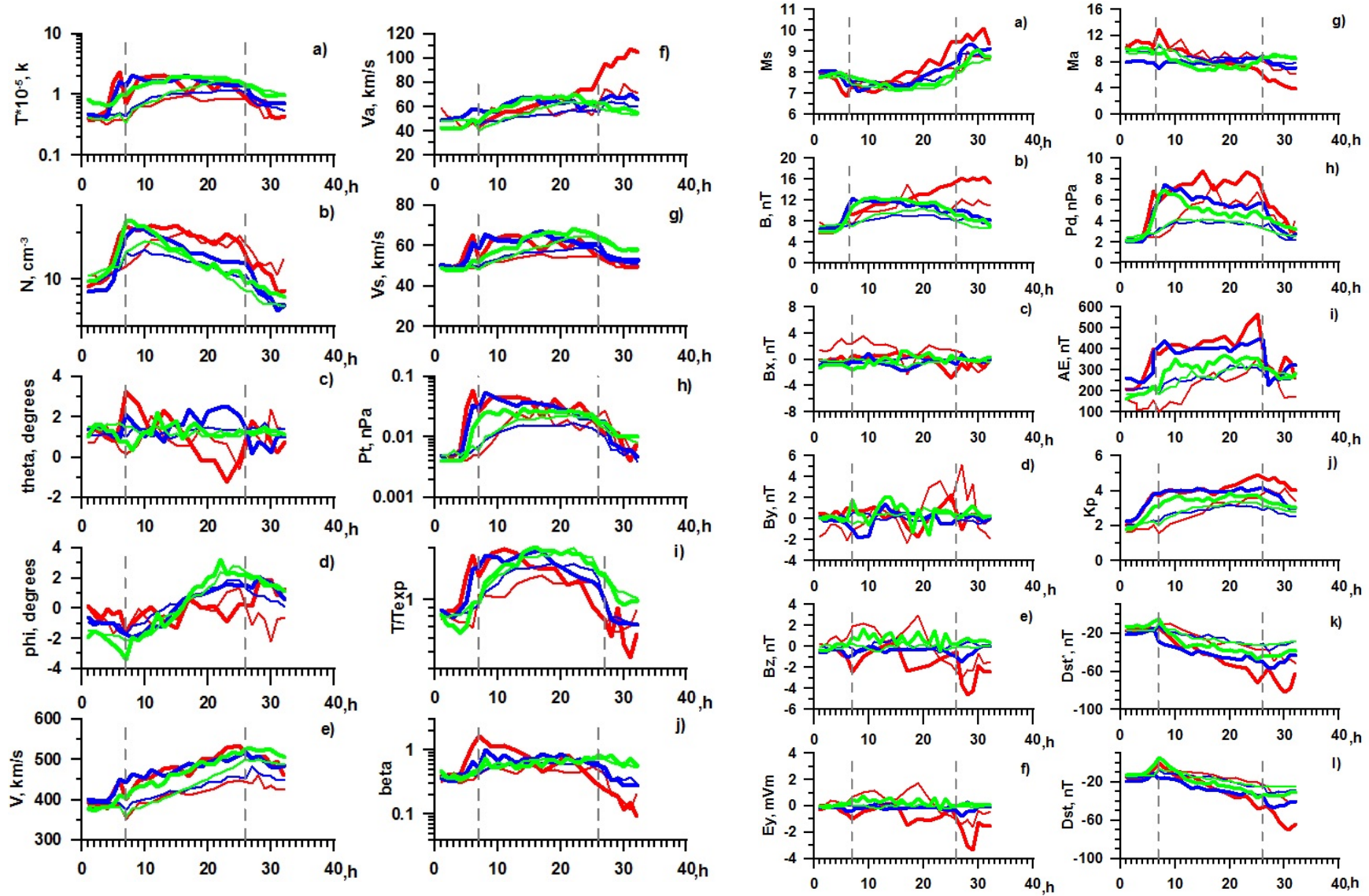


MC

Sheath + MC

IS + Sheath + MC

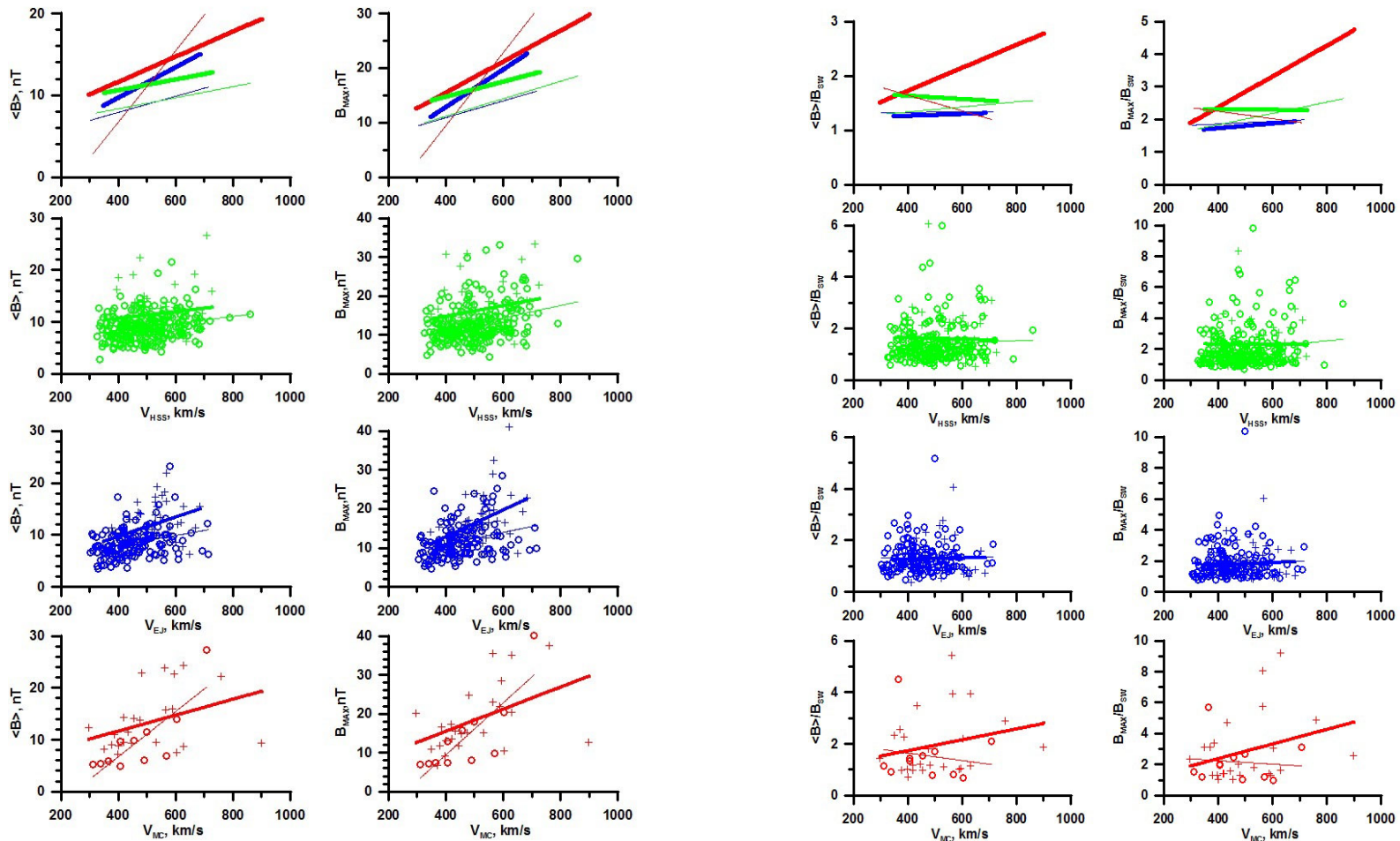
# Comparison CIR and Sheath (before Ejecta and MC)



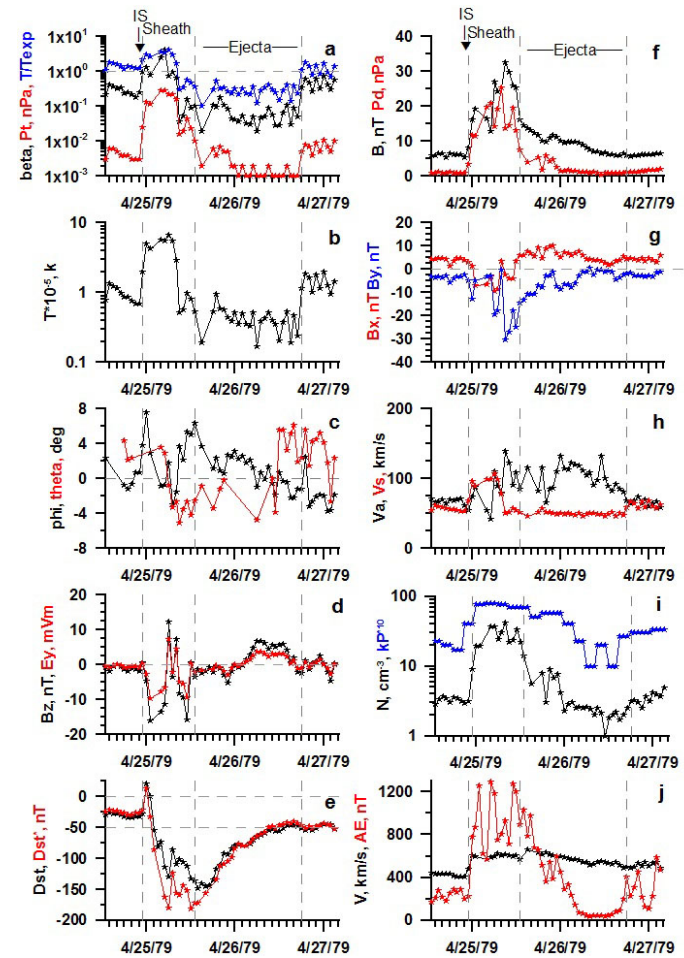
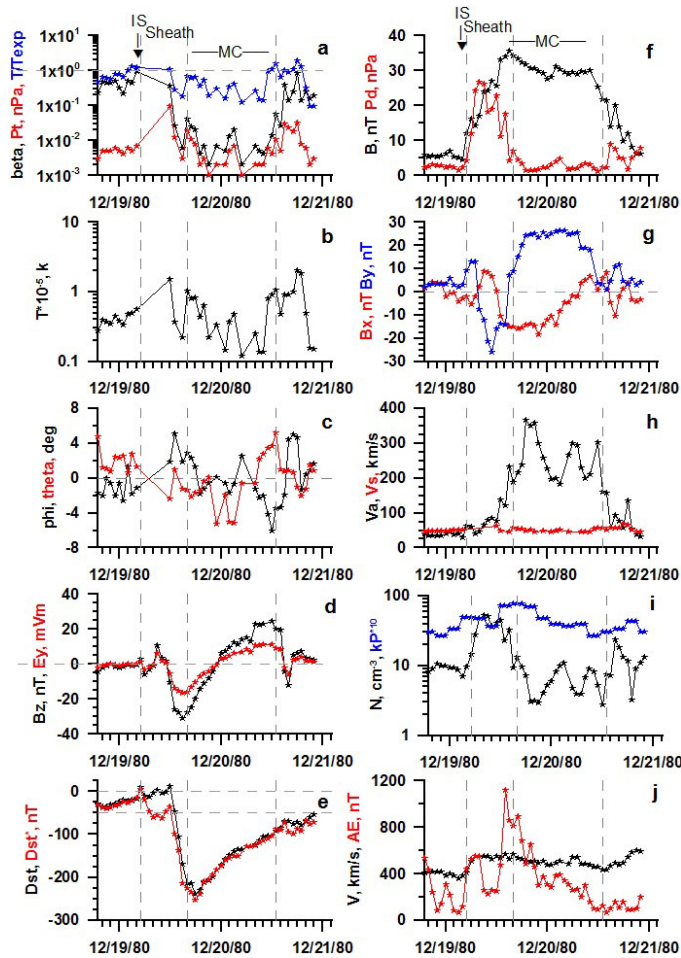


# Magnetic field in CIR and Sheath

Gopalswamy et al., 2015: "MHD compression in the sheath can increase  $B_t$  only by a factor  $<4$ ."



# Magnetic field in Sheath



# Efficiency of magnetic storm generation by different SW types

Coefficients CE (and CE\*) of linear relation between Dst (and Dst\*) and integral of interplanetary electric field  $E_y = V_x B_z$   
(Nikolaeva et al., 2013, 2015)

SW type	MC	Sheath	CIR	Ejecta
CE (for Dst)	$-2.55 \pm 0.75$	$-3.2 \pm 1.6$	$-2.8 \pm 1.1$	$-2.3 \pm 1.0$
CE* (for Dst*)	$-2.0 \pm 1.1$	$-3.4 \pm 1.9$	$-3.0 \pm 1.5$	$-2.1 \pm 1.1$

# Conclusions

- Evidences of interaction of the disturbed SW types among themselves and with undisturbed SW.
- The speed angle  $\phi$  in ICME changes from  $2$  to  $-2^\circ$  while in CIR and Sheath it changes from  $-2$  to  $2^\circ$ , i.e., the streams in CIR/Sheath and ICME deviate in the opposite side.
- CIR and Sheath before ICME are very similar SW types.
- Sheath can contain large value of magnetic field and be very geoeffective.