

# MID-LATITUDE GEOMAGNETIC EFFECTS DURING SOME INTENSE SUBSTORMS

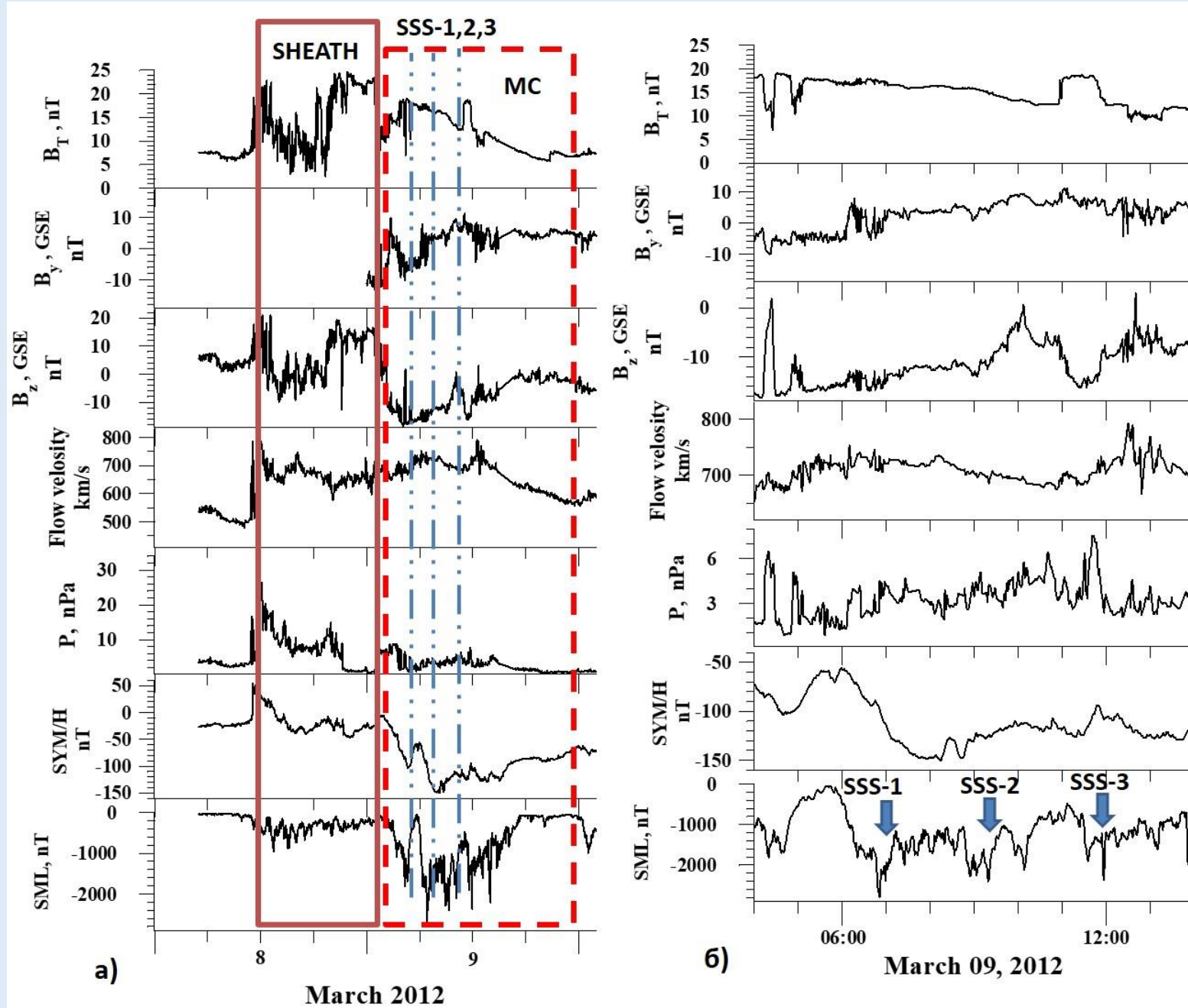
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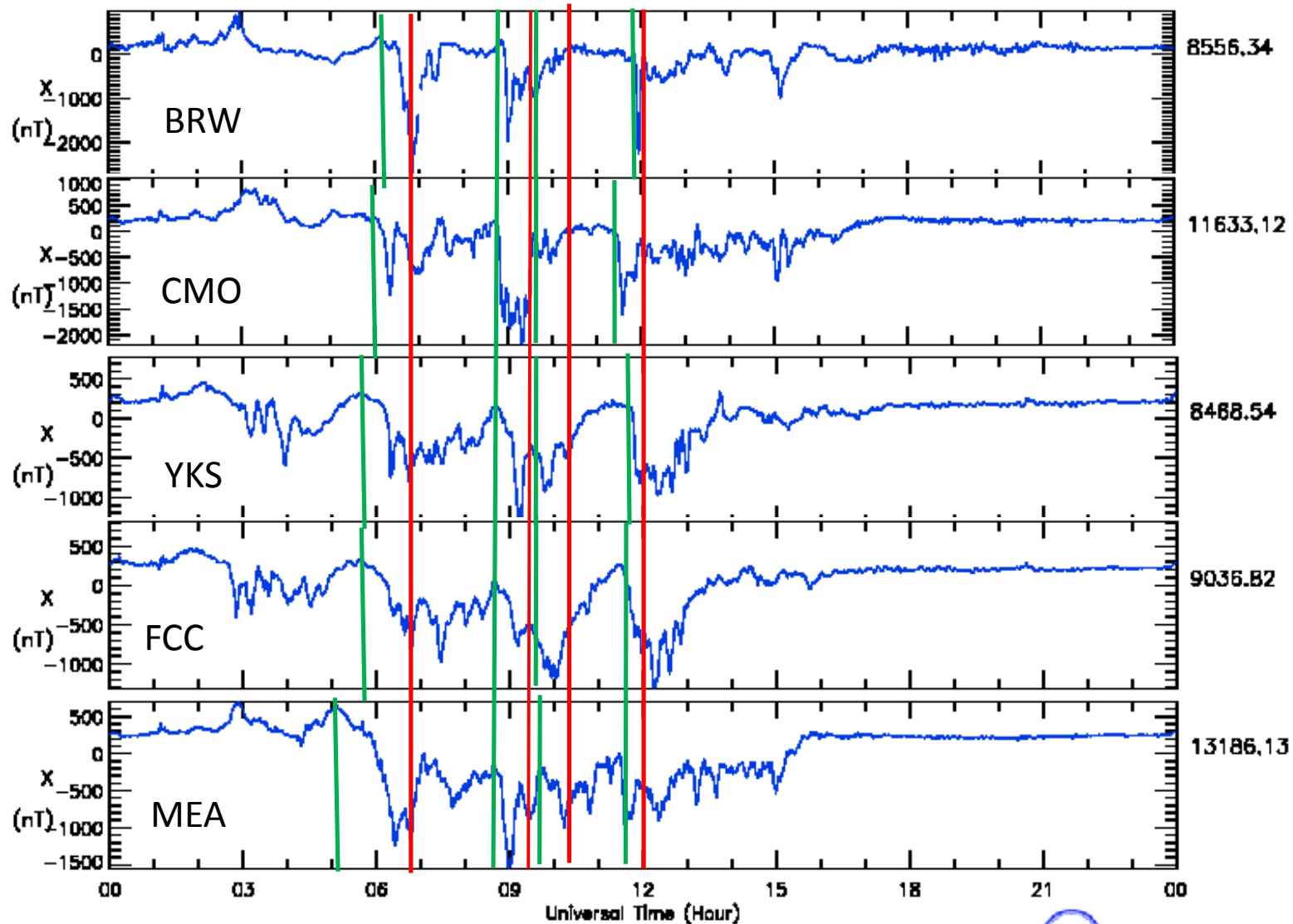
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**Abstract.** The aim of this work is to find possible mid-latitudes magnetic effects of intense substorms. We examined two intense magnetic storms: on 9 March 2012 (Dst  $\sim$  -140 nT) and on 11-12 April 2001 (Dst  $\sim$  -300 nT), during which 7 intense substorms were observed. The substorms intensity was determined by SML and AL indices of geomagnetic activity. The ground-based mid- and low-latitudes magnetic substorms have been studied by the global magnetometer networks SuperMAG, INTERMAGNET and IMAGE data as the positive magnetic bays observed simultaneously with the negative bays at auroral latitudes. It should be noted that very intense substorms with large negative values of SML index ( $\leq$  -2000 nT) were recently called “supersubstorms” (SSS). Six SSSs were identified during these two storms: four events on 9 March 2012 (06:51, 09:19, 10:08 and 11:57 UT) and two events on 11-12 April 2001 (16:09 UT on 11 April and 20:24 UT on 12 April). We found that all of them were accompanied by mid-latitude magnetic bays. However, the converting latitude of the sign of the magnetic bay associated with the intense substorms events was located at geomagnetic latitudes which were  $\sim$  10 degrees lower than for the usual substorms and the amplitudes of these mid-latitudes magnetic bays were about 2 times larger than their typical values.



Interplanetary and geomagnetic conditions during 8-10 March 2012. The structures in the solar wind are marked by rectangles in the left panel. The times of the supersubstorms are indicated by vertical dashed-dotted blue lines. The right panel presents a magnified picture of the conditions on 9 March 2012, when 3 supersubstorms occurred (marked by blue arrows).



CGMLAT/CGMLON  
MLT

8556.34  
70.37/254.07  
18:02

11633.12  
65.16/266.48  
18:45

8468.54  
69.13/303.46  
21:00

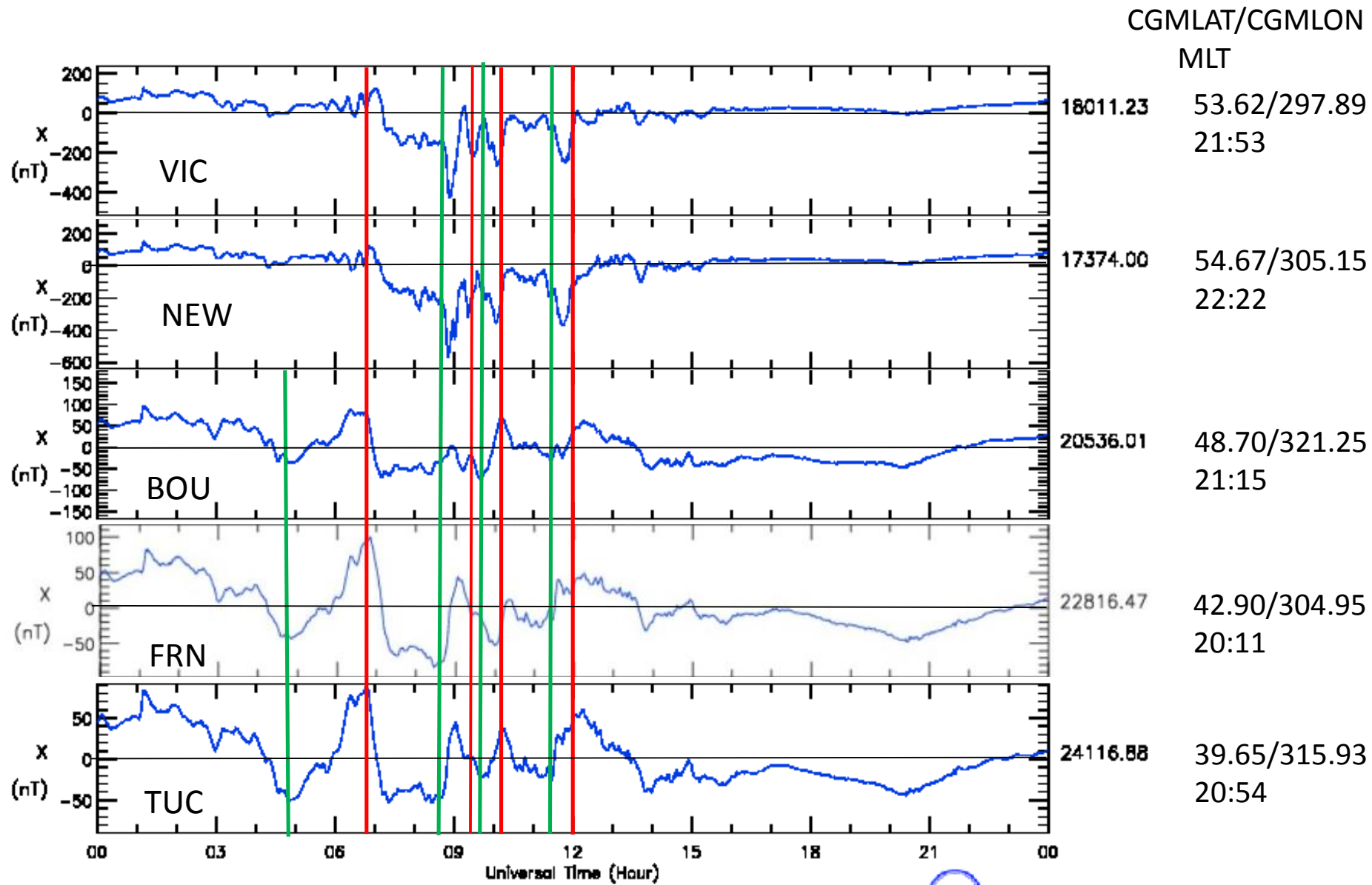
9036.82  
68.15/334.47  
23:03

13186.13  
61.70/308.00  
20:37

Bx component of the magnetic field at the higher latitude stations.

The red lines indicate the SML index minimum. The green lines mark the beginning of the observed substorms by the Bx disturbances at each station. To the right of the figure the geomagnetic coordinates of the stations and the MLT at the first observed substorm beginning are given.





The Bx component at the stations of lower latitudes. The mid-latitude positive bays at BOU, FRN and TUC are clearly expressed. The green lines mark the beginning of the observed substorms by the Bx disturbances of the most southern station TUC.



## Parameters of the observed positive bays at the mid-latitude stations during the four substorms

N	Stn	min1 UT/MLT	max UT	min2 UT	ampl1	ampl2	duration	conversion	SML min
1	BOU	-36.91 4:50/21:15	87.09 6:24	-70.41 7:11	124	157.5	2:21 141 min	55° (MEA-BOU)	-2791 nT 6:51
	FRN	-42.97 4:51/20:11	99.93 6:50	-67.17 7:31	142.9	167.1	2:40 160 min		
	TUC	-51.8 4:50/20:54	87.62 6:46	-52.08 7:21	139.42	140.42	2:31 151 min		
2	BOU	-----	---	---	---	---	---		
	FRN	-83.27 8:27/23:48	43.29 9:03	-52.57 10:00	126.56	95.86	1:33 93 min	49° (NEW-FRN)	-2401 nT 9:19
	TUC	-47.38 8:39/00:43	45.82 9:03	-21.98 9:41	93.2	67.8	1:02 62 min		
3	BOU	-74.61 9:39/02:04	68.19 10:12	-29.91 11:26	142.8	98.1	1:47 107 min	52° (NEW-BOU)	-2112 nT 10:08
	FRN	-52.57 10:00/01:20	11.63 10:22	-27.57 11:07	64.2	39.2	1:07 67 min		
	TUC	-20.08 9:51/01:54	37.72 10:15	-12.58 10:35	58.52	50.3	44 min		
4	BOU	-29.91 11:26/03:52	60.29 12:16	-52.71 13:59	90.2	113	2:33 153 min	52° (NEW-BOU)	-2372 nT 11:57
	FRN	-27.57 11:07/02:28	48.33 12:15	-31.97 13:49	75.9	80.3	2:42 162 min		
	TUC	-26.18 11:28/03:33	60.32 12:15	-38.98 13:49	86.5	99.3	2:21 141 min		



## Conclusions

- The mid-latitude magnetic bays during SSS are clearly expressed;
- The converting latitude of the sign of the magnetic bay is in the range  $49^{\circ}$ - $55^{\circ}$  GMCLat, which is lower than the observed one during the usual substorms;
- The amplitude of the maxima in Bx is much higher than during the usual substorms (~30-50 nT) and depend on the SML index:
  - at  $SML < -2700$  nT,  $A > 100$  nT (140-170 nT)
  - at lower SML ( $-2000 \div -2500$  nT),  $A \sim 50$ -100 nT
- The duration of the maxima is greater and also depend on the stage of disturbance (it is above 1h, in most of the cases above 2 h, versus ~20 min. for the usual substorms).

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**Thank you for the attention!**