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Variations of induction vector before Tohoku earthquake 11.03.2011 near Japan

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After recent catastrophic earthquake of 11.03.2011 near Japan we processed with high resolution program [1] available data of 17 Japanese geomagnetic observatories (Fig. 1) during last 10-20 years. We used time series of 3 components of geomagnetic field with temporal reading every 1 min and obtained monthly mean values of 4 components of induction vector A_u, B_u, A_v, B_v (where *A* – northern component of induction vector, *B* – eastern component, indexes *u* and *v* denote real and imaginary components respectively) for 5 period intervals: 2.5-5, 5-10, 10-20, 20-40 and 40-60 min. At long periods we see annual periodic variations which should be taken into account as a background for the precursors study. Aperiodic variations of induction vectors were observed at shorter periods 2.5-20 min at 4 stations [Haramachi (HAR), Kakioka (KAK), Otaki (OTA) and Kanozan (KNZ)] near the epicentral zone. These variations lasted 2-5 years (depending on station) before EQ mainly at real eastern component with clear enhancement to the shortest period. Variations of induction vector of geodynamic origin can be caused by change of underground electrical conductivity and by lithosphere EM emission. We also process with multi-windows robust program [1] the data of every observatory synchronously with the reference observatory Kakioka and obtain anomalous tensor [M] of horizontal geomagnetic components. It reflects two mentioned causes of temporal variations differently then induction vector and can help to distinguish the causes. We processed also 1 s data of KAK and KNZ with high resolution program and obtained induction vector for every day of February and March 2011. Processing used two versions of data: full day and only 6 hours around local night: results are not identical. We do not found a clear change of induction vector at February 22, 2011, expected according results reported in [2]. But our results are rather multi-component: 4 components of induction vector at 5 periods and each of 20 is obtained from several averaging intervals (6, 10, 15, 20, 30, 40, 60 s) of rough data. And several dozen obtained values are not identical each other, temporal variations of induction vectors components also not identical. It is the case for any observatory, even in stable regions, but in Japanese observatories KAK and KNZ in 2011 temporal variations are very strong and complicated, especially at shortest periods 2.5-5 min and < 2,5 min. So, separation of the EQ's precursors is rather problematic that we can see in fig. 4. At upper graph,

precursory variations can be suggested, at lower one strong anomaly began in the day of EQ. Now we are processing the same data with multi-windows robust program and hope to get more stable result.

References

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[2.] Yu.A. Kopytenko, V.S. Ismaguilov, K. Hattori, M. Hayakawa, Anomaly disturbances of the magnetic fields before the strong earthquake in Japan on March 11, 2011, Annals of Geophysics, 55, No 1, 2012.

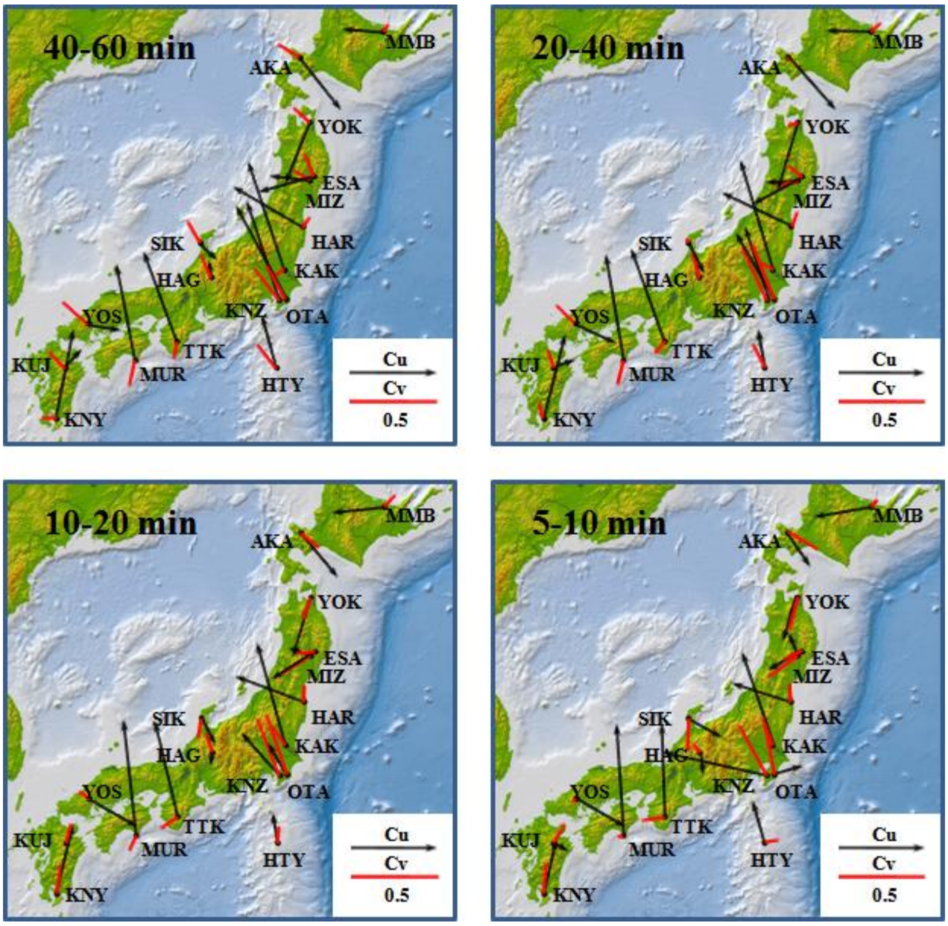

Fig. 1: Mean induction vectors for 2011 on 17 observatories of Japan for periods 40-60 min, 20-40 min, 10-20 min, 5-10 min. Real induction vectors C_u are denoted by black arrows, imaginary C_v – by red lines.

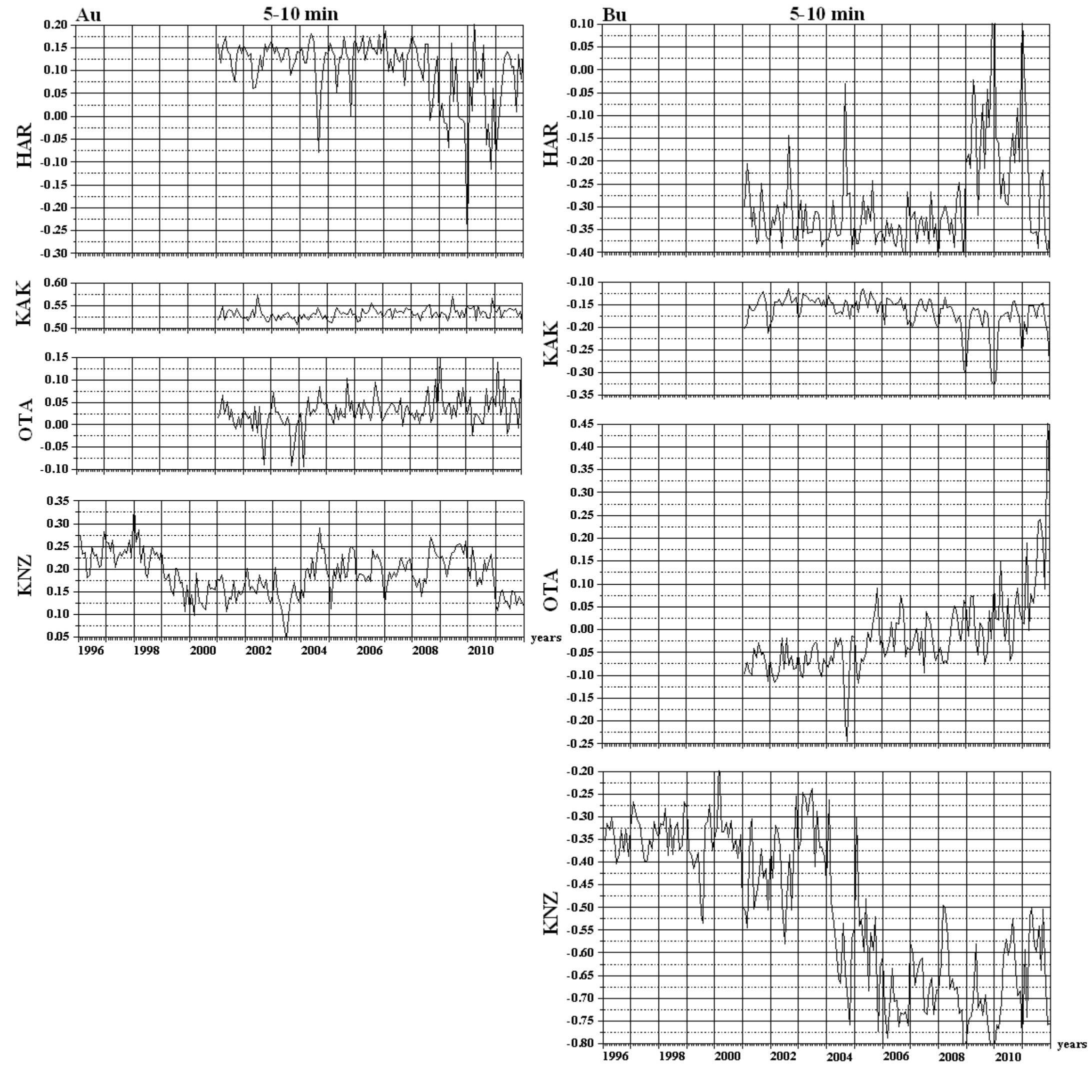

Fig. 2: Anomalous changes of monthly mean values of real induction vector components before earthquake 11.03.2011 on four observatories HAR, KAK, OTA and KNZ for periods 5-10 min.

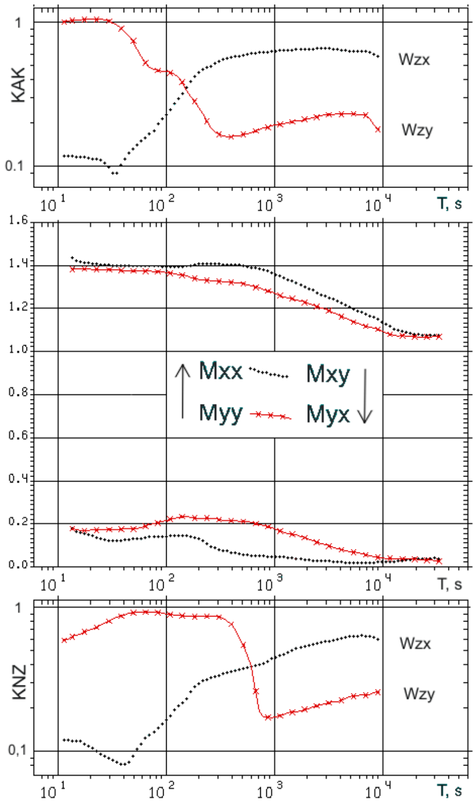

Fig. 3: The [M] tensor components calculated for KNZ observatory with reference to base observatory Kakioka, (middle graph). Upper and bottom graphs show tipper amplitude components at both observatories obtained with Varentsov's multi-windows robust program [1] using the 1 second data of June 2006.

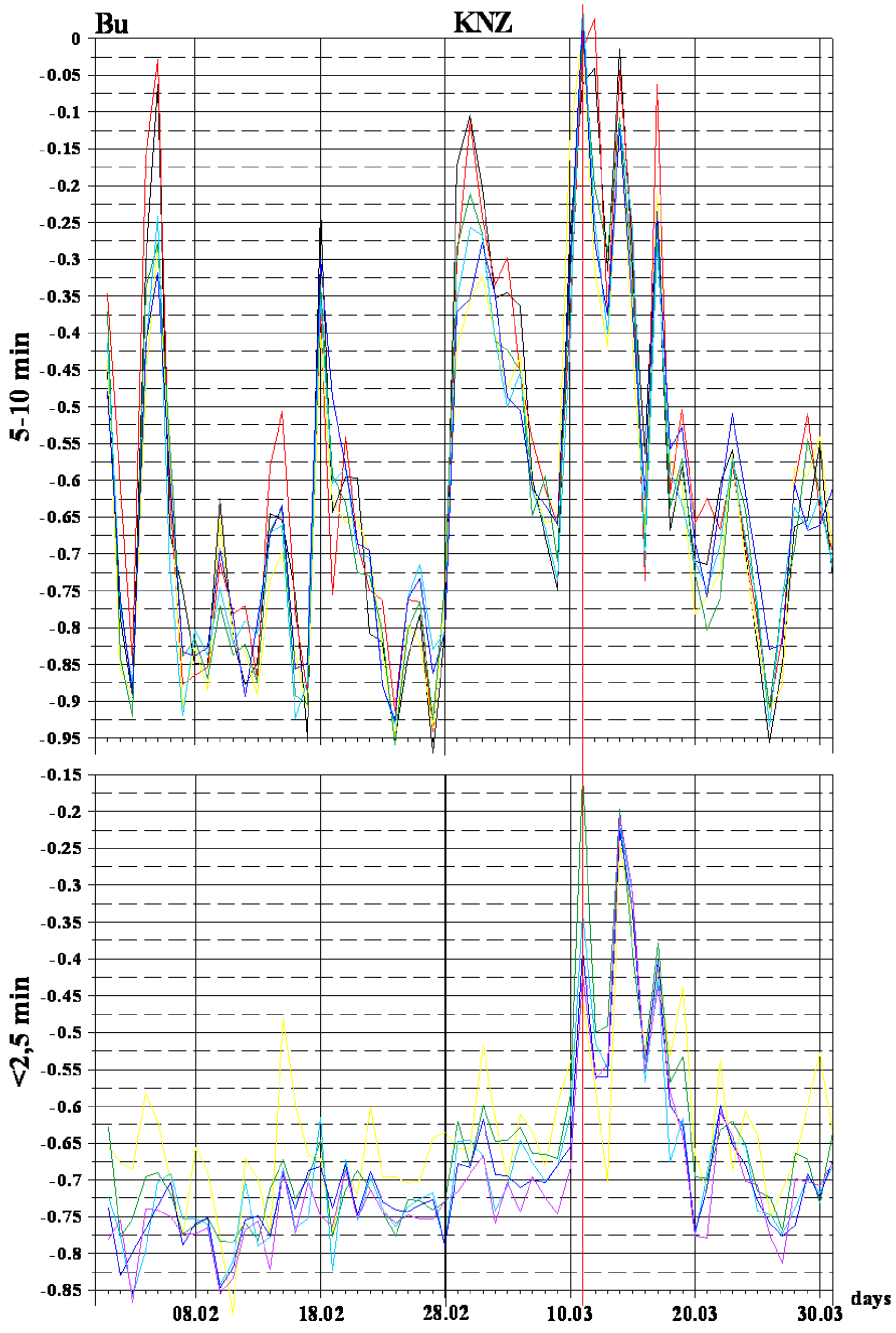

Fig. 4: Daily means of real induction vector component B_u for periods 5-10 min and <2,5 min on KNZ for February-March 2011. Colors of curves correspond to the averaging intervals: black line – 60 s, red – 40 s, yellow – 30 s, green – 20 s, blue – 15 s, dark blue – 10 s, purple – 6 s. EQ 11.03.2011 is marked by vertical red line.