A critical look at studying the interplanetary drivers of the magnetospheric disturbances

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Although the main types of solar wind (the so-called interplanetary drivers), which may contain the southward component of the interplanetary magnetic field (Bz < 0) and cause disturbances in the magnetosphere, have long been known, it has only recently been discovered that different types of drivers cause a different reaction of the magnetosphere for identical field variations (Borovsky and Denton, 2006, Yermolaev et al., 2013). This discovery led to a significant increase in the number of investigations studying the response of the magnetosphere-ionosphere system to various drivers. At the same time, the number of incorrect approaches in this direction of research has increased. These errors can be attributed to 4 large classes. (1) First class includes works whose authors uncritically reacted to previously published works and use incorrect results to identify types of drivers. (2) Some authors independently incorrectly identified driver types. (3) Very often, authors associate the perturbation of the magnetosphere-ionosphere system caused by a complex driver (a sequence of single drivers) with one of the drivers, ignoring the complex nature. For example, a magnetic storm is often caused by a compression region Sheath in front of an interplanetary CME (ICME), but the authors consider the ICME to be a cause of disturbance, not Sheath. (4) Finally, there is a “lost driver” of magnetospheric disturbances: some authors simply do not consider the Sheath compression region before ICME if there is no interplanetary shock (IS) before Sheath, although this type of driver, “Sheath without IS”, generates about 10% of moderate and strong geomagnetic storms (Yermolaev et al., 2017, 2020). These errors lead to numerous mistakes and incorrect conclusions.

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References
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