Comment on "Current understanding of magnetic storms: Storm-substorm relationships," by Y. Kamide et al.

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With 14 distinguished coauthors and 153 references, this recent paper [*Kamide et al*., 1998; hereinafter referred to as K98] symbolizes a definitive and authoritative work due a measure of respect. Considered significant enough to be assigned a separate section 7.2, the authors describe reasons that the disturbance storm time (*Dst*) index, the universal indicator of global magnetic storms, is not the representation of a symmetric ring current (RC) encircling the Earth in the equatorial magnetosphere, as has been supposed by most of the space-science community since the index design was formalized 34 years ago [*Sugiura*, 1964]. The K98 authors enumerate a number of factors governing their reasoning: (1) the main contributions of partial ring currents, (2) the existence of strong field-aligned currents, (3) the problem of averaging just four stations for the index, (4) the artificially of making ring-symmetry latitude adjustments, (5) the introduction of false values encountered in removing a "quiet day" field on the nonquiet day of the storm, and (6) the presence of associated magnetotail currents. K98 (p. 17,723) state "Thus the present *Dst* contains significantly an artificially symmetric value resulting from asymmetric perturbations. . ." Restated simply, K98 authors say that because of the listed facts it is false to assume that *Dst* = RC.

I see two problems with their presentation. First, K98 neglect referencing those who have in the past produced considerable evidence for the major *Dst* = RC inconsistencies that are given in section 7.2. The K98 conclusions are not so obvious that references are unnecessary. K98 coauthors were fully aware of references disputing *Dst* = RC from my presentations of the "Ring-Current Myth": on October 9, 1992, at the Space Environment Laboratory of NOAA (noted in the work of Campbell, [1996a]); on August 10, 1993 [*Campbell*, 1993], at the IAGA Assembly in Buenos Aires; and at the February 12, 1996 [*Campbell*, 1996b], Chapman Conference on Magnetic Storms in Pasadena.

In addition to the paper by Campbell [1996a] on the *Dst* = RC myth, I produced an EOS Space Physics and Aeronomy Section News item [*Campbell*, 1996c] containing such information. K98 authors also could have referred to *Campbell* [1997, pp. 168–172], the first textbook to caution acceptance of *Dst* = RC in contrast to *Mayaud*'s [1980] classic rendition of the index.

The second problem with the K98 paper is that the authors neglected to present these other important difficulties with the *Dst* = RC assumption: (1) satellite in situ measurements in the RC region fail to find processes paralleling the storm growth and decay phases indicated by the classic interpretation of *Dst*; (2) determinations within the RC region show insufficient field to account for the surface observations of *Dst*; (3) there are lunar-tidal effects in *Dst* that should not occur in *Dst*; (4) the enhancement of storm time ionospheric currents at the dayside dip equator indicates the existence of strong ionospheric currents providing fields to the low-latitude *Dst* observatories; (5) the Earth's midnightside low-latitude fields track the seasonal position and activity changes in the storm time magnetospheric tail-current patterns; (6) the extremely high conductivity of the Earth's interior shields observatory reception of a partial RC source field from the opposite side of the Earth; and (7) Earth-mantle conductivity determinations from an assumed RC source fields are unreliable.

It is the ensemble of non-ring-current contributions, not just one or two problems, that destroys the classic interpretation of *Dst* and begs for another explanation of the characteristic main phase to recovery phase shape of the "magnetic storm." My publications on the ring-current myth provide accumulated referenced works showing that during a geomagnetic storm period it is wrong to suppose that *Dst* = RC (the symmetric ring current is just one of many contributors to the index) and demonstrating that with *Dst* showing a unique "storm time" pattern resulting from a summation of many processes and stations, the lognormal distribution characteristics possibly provide a reason for the regularly appearing storm shape (named by *Chapman* [1951]). The present problem with *Dst* is to determine how much each process is contributing to the index. Soon, using the equatorial enhancement studies, researchers may be able to extract at least the ionospheric contribution.

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