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Substorm current system as viewed by simultaneous GOES, THEMIS and ground-based observations interpreted using new Substorm Current Wedge model.

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During initial stage of substorm expansion a central process is the disruption of near-Earth portion of the tail current, which was intensified during the preceeding growth phase. The 3-d current system at that stage is generally thought to be represented by the Substorm Current Wedge (SCW). In situ observations of magnetic perturbations on multiple spacecraft and on ground magnetometer network, compared to the predictions of recent quantitative SCW model, clearly display the systematic deviations from predictions provided by that model. Particularly, it become clear that sometimes only a small part of the disrupted tail current is diagnosed by the ground network. Same effect is seen at GEO orbit in the case of weak magnetotail stretching. To a large extent, the discrepancy can be partly attributed to additional azimuthal (Region-2 type polarity) current loop in the inner magnetosphere, whose effects partly canceal the perturbations produced by the original R1-like SCW current loop. In this talk we analyse the multi-spacecraft observations and statistical relationships between perturbations in different regions to evaluate the radial location of additional R2 loop, its dependence on the magnetotail stretching and the relationship between intensities of these two current loops. We also discuss the origin of two-loop configuration as revealed by recent simulations of the flow bursts propagated in the plasma sheet.