On the scale sizes of magnetosheath jets

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The subsolar magnetosheath is oftentimes permeated by jets. These are localized entities of enhanced dynamic pressure with respect to the ambient plasma. Magnetosheath jets are thought to arise from bow shock ripples and/or foreshock structures. They can easily propagate through the entire magnetosheath and impact on the magnetopause, where they can cause large amplitude indentations, launch magnetopause surface waves, or modulate magnetopause reconnection. The scale size distributions of magnetosheath jets observed by single spacecraft are relatively well modeled by exponential functions with characteristic scales of 0.71 Earth radii (RE) and 1.34 RE in the directions parallel and perpendicular to the jet propagation direction, respectively. However, these functions do not represent the actual, true jet scale size distributions, because of two reasons: (1) Spacecraft are much more likely to observe large scale jets rather than small scale jets. Hence, the observed scale size distributions are biased towards larger scales. (2) The distributions modeled by exponential functions highly overestimate observation probabilities of jets of smallest scales (on the order of 0.1 RE). We overcome both shortcomings by replacing the exponential functions by log-normal functions, which can be corrected for the bias. By re-analyzing THEMIS multi-spacecraft data, we obtain, for the first time, unbiased, i.e., actual jet scale size distributions. Our results reveal a large population of jets of smallest scales that have not been accounted for, so far. Consequently, we find median scale sizes of jets to be about an order of magnitude smaller than previously thought: 0.15 and 0.12 RE in the parallel and perpendicular directions, respectively.