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Cluster crossings of the magnetopause to be used in two fluid simulations to investigate Kelvin-Helmholtz instability.

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Kelvin-Helmholtz (KH) instability plays a fundamental role in the entry of solar wind plasma into the magnetosphere during northward interplanetary magnetic field. This instability may drive the formation of a mixing layer due to the development of small-scale secondary instabilities after the formation of large-scale rolled-up vortices. A number of spacecraft observations have shown that physical quantities measured at the flank low-latitude magnetopause/boundary layer are compatible with Kelvin-Helmholtz vortex structures. These observations are in agreement with different types of numerical simulations (MHD, two-fluid, particle-in-cell). Nevertheless simulations are usually performed by assuming idealized initial conditions for the magnetopause boundary e.g. very thin magnetopause, constant density and/or temperature across the boundary etc.
Here we perform Cluster spacecraft data analysis of the low latitude boundary layer in order to obtain more realistic initial conditions to be used in two-fluid simulations of KH instability. The goal is to study and understand how such more realistic large-scale conditions affect the onset and evolution of small-scale secondary instabilities such as Rayleigh-Taylor and reconnection. We made a list of magnetopause/boundary layer crossings possibly close to the onset of KH instability and provide large-scale profiles of several quantities across the boundary (velocity, density, magnetic field, etc.) close to equilibrium. For a few cases, we use such profiles as initial conditions for two-fluid simulations of KH instability and discuss the occurrence and evolution of secondary instabilities within KH vortexes.

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