The validation project on the TORPEX basic plasma physics experiment

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Abstract. Owing to its detailed diagnostics, feasibility of parameter scans, and relatively simple configuration, the basic plasma physics experiment TORPEX is an ideal testbed in which to perform experiment/simulation comparisons and to contribute to the corresponding methodological framework. Focusing on observables related to Langmuir probe measurements, we consider a number of physical quantities that can be used as observables for experiment/simulation comparison. We classify the observables according to a hierarchy that sums the number of model assumptions and measurement combinations used to obtain an observable from experimental measurements and simulation results. The more assumptions needed, the less stringent the comparison with respect to this observable and, thus, its weight in the evaluation of the agreement between experiment and simulation should be decreased. We then propose a metric to quantify the agreement between experiment and simulation, based on three logical steps. First, relative to each observable chosen to perform the comparison, we quantify the agreement between experiment and simulation. Second, the levels of agreement relative to each observable are cast into a single real number, referred to as the composite metric χ, with the goal of quantifying the global agreement between experiment and simulation. This process requires that each observable is weighted correctly. Third, we introduce an index that quantifies the degree of agreement between experiment and simulation. This methodology has been used to validate two models that have been recently developed to simulate TORPEX turbulence: a three-dimensional two-fluid model, able to describe the global evolution of TORPEX plasma, and a reduced two-dimensional two-fluid model, able to describe only the evolution of $k_\parallel = 0$ modes. We show that the validation metric reveals the unsatisfactory agreement of the two-dimensional model and the experiment when $k_\parallel \neq 0$ modes are present in the experiment.