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Paper Title:	Developing and Distributing a CubeSat Model Based System Engineering (MBSE) Reference Model
Abstract:	<p>Model Based Systems Engineering (MBSE) is a key practice to advance systems engineering that can benefit CubeSat missions. MBSE creates a system model that helps integrate other discipline specific engineering models and simulations.</p> <p>The International Council on Systems Engineering (INCOSE) established the MBSE Initiative to promote, advance, and institutionalize the practice of MBSE. The INCOSE Space Systems Working Group Challenge team has been investigating the applicability of MBSE for designing CubeSats since 2011.</p> <p>Our application of MBSE uses System Modeling Language (SysML), a graphical modeling language, to model all aspects of a system either directly or through an interface with another model. SysML diagrams are used to describe requirements, structures, behaviors, and parametrics from the system down to the component level.</p> <p>The first phase of SSWG CubeSat project created a CubeSat reference model and applied it to the Radio Aurora Explorer (RAX). The second phase focused on expanding the model to include modeling behaviors and interfacing with several Commercial Off the Shelf (COTS) simulation tools. The third phase included incorporating additional design and operational characteristics into the RAX model. Behaviors were implemented to demonstrate how operational trade studies can be performed.</p> <p>The modeling effort starts anew in this fourth phase. The CubeSat domain includes the CubeSat mission element, external environment, and external constraints. The external environment consists of the natural and induced environments. The CubeSat mission element contains the space system, ground system, launch vehicle interface system, launch services, and communication services. The CubeSat model accommodates an entire project lifecycle from conception through retirement. The model accommodates all phases of operations from launch, early operations, normal operations, sustainment, and degraded operations.</p> <p>Since we are just providing a reference model, another CubeSat team can apply their own mission lifecycle and engineering processes to customize and populate the model.</p>