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The Basic Model Interface 2.0: A standard interface for coupling numerical models and data in the hydrologic sciences

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The hydrologic modeling and data community has embraced the open source movement as evidenced by the ever increasing number of FAIR models and datasets available to investigators. Although this has resulted in new science through innovative model application, development, and coupling, the idiosyncratic design of many of these models and datasets acts as a speed bump that slows the time-to-science.

The Basic Model Interface version 2.0 (BMI) specification lowers this hurdle by defining a standardized interface for both models and data. This allows all models and datasets with a BMI to look alike, regardless of their underlying implementation or, in fact, even if they are truly a model or a dataset. With idiosyncratic implementation details obscured, models and data are more easily and quickly picked up and used - if you know how to use one BMI model, you know how to use any BMI model.

In addition, a common interface allows models and data to more easily be brought into a single framework in which they can be queried, run, coupled, and analyzed using a standard set of tools. The Community Surface Dynamics Modeling System (CSDMS) has developed such a modeling framework, the Python Modeling Toolkit (pymt). Although this framework was initially written for the coupling of BMI-enabled numerical models, we have extended it to include BMI-enabled datasets as well. Within such a framework, investigators are able, in a reproducible way, to: compare models to one another using a common dataset, validate models to data, ingest data into a model, swap models and data within a workflow.

As a demonstration of model-data coupling within the pymt, we present examples where BMI-enabled datasets (e.g. USGS gage data, the Operational National Hydrologic Model, NOAA's National Water Model) are used to drive hydrologic models (e.g. FaSTMECH, PRMS).