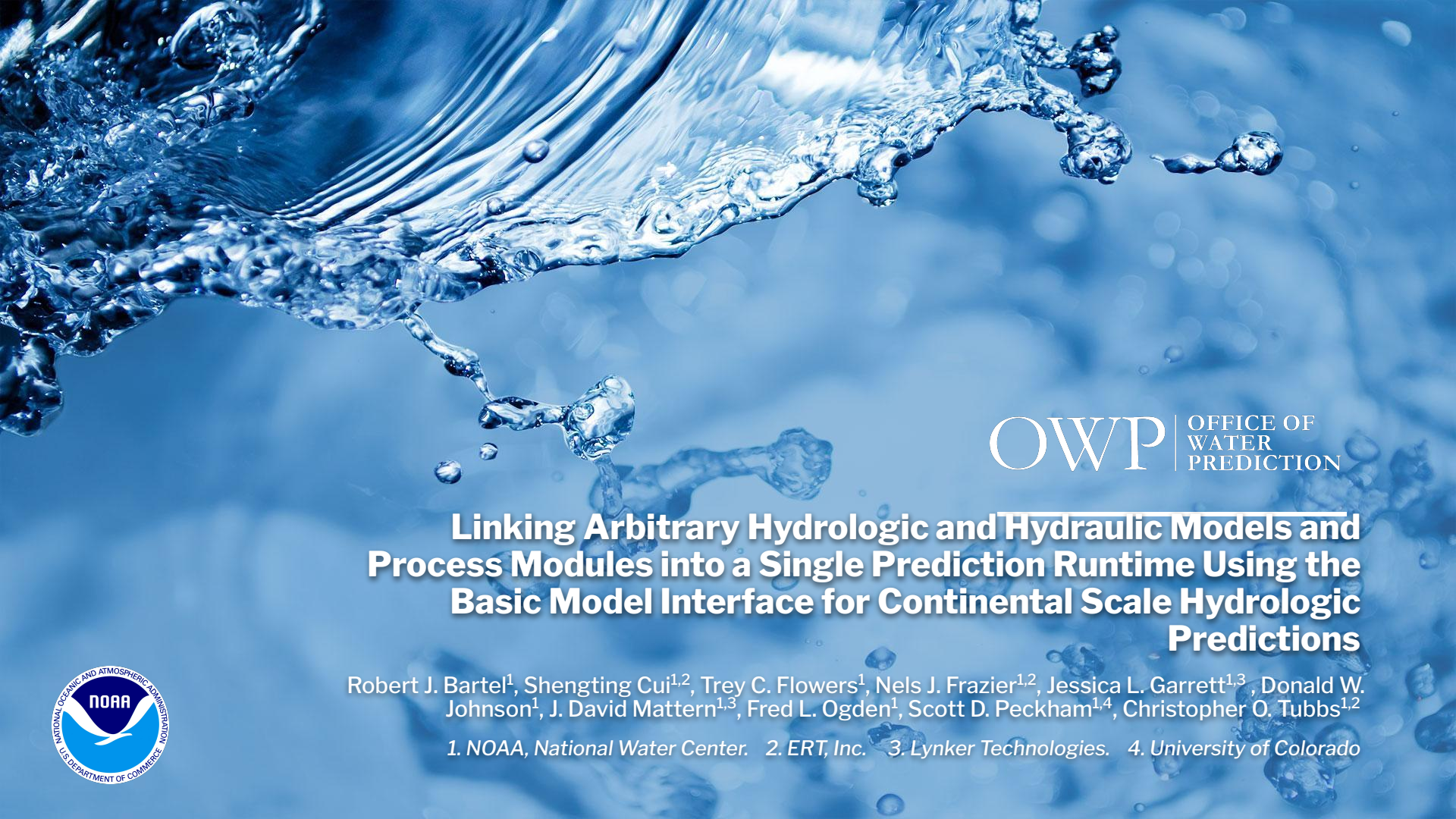

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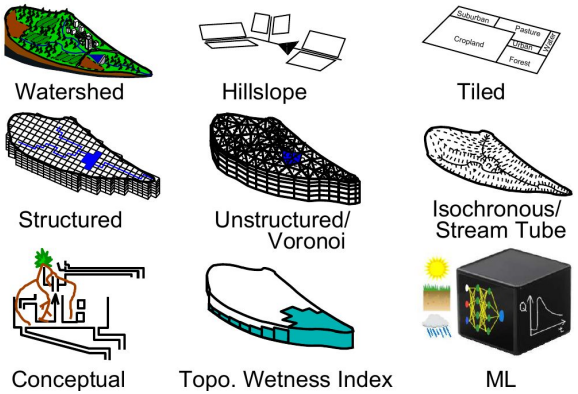
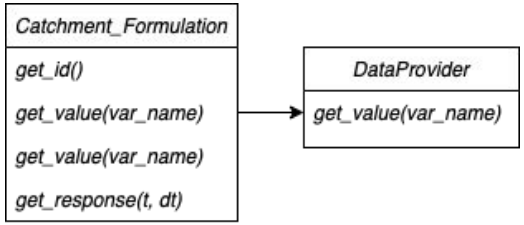
Linking Arbitrary Hydrologic and Hydraulic Models and Process Modules into a Single Prediction Runtime Using the Basic Model Interface for Continental Scale Hydrologic Predictions

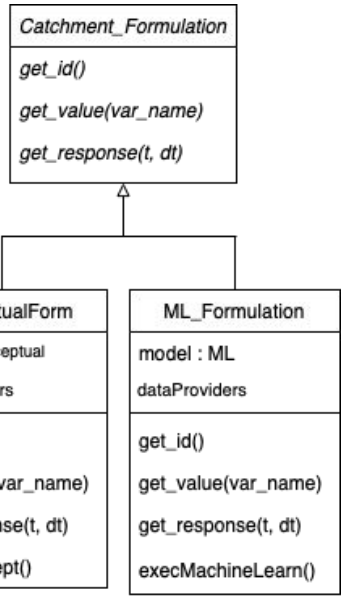
Robert J. Bartel[1], Shengting Cui[1,2], Trey C. Flowers[1], Nels J. Frazier[1,2], Jessica L. Garrett[1,3], Donald W. Johnson[1], J. David Mattern[1,3], Fred L. Ogden[1], Scott D. Peckham[1,4], Christopher O. Tubbs[1,2]

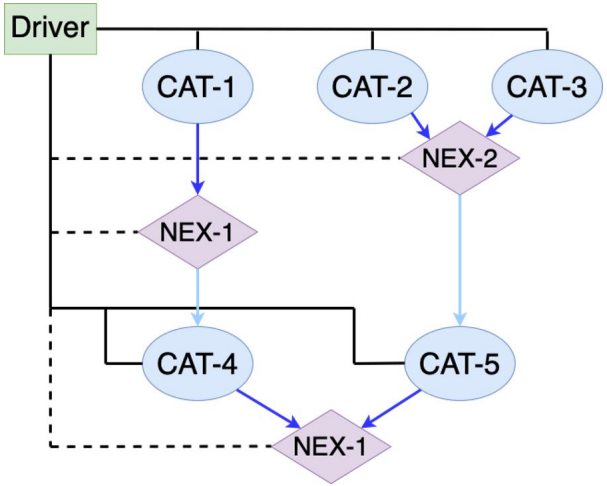
1. NOAA, National Water Center. 2. ERT, Inc. 3. Lynker Technologies. 4. University of Colorado

A Framework For Multiple Models

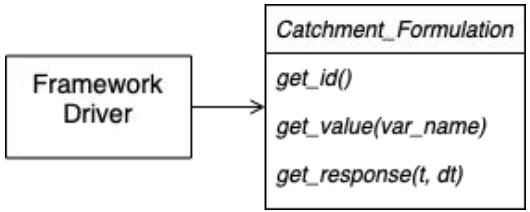








- *Polymorphism*: 1 type, many forms
- Requires abstract interfaces

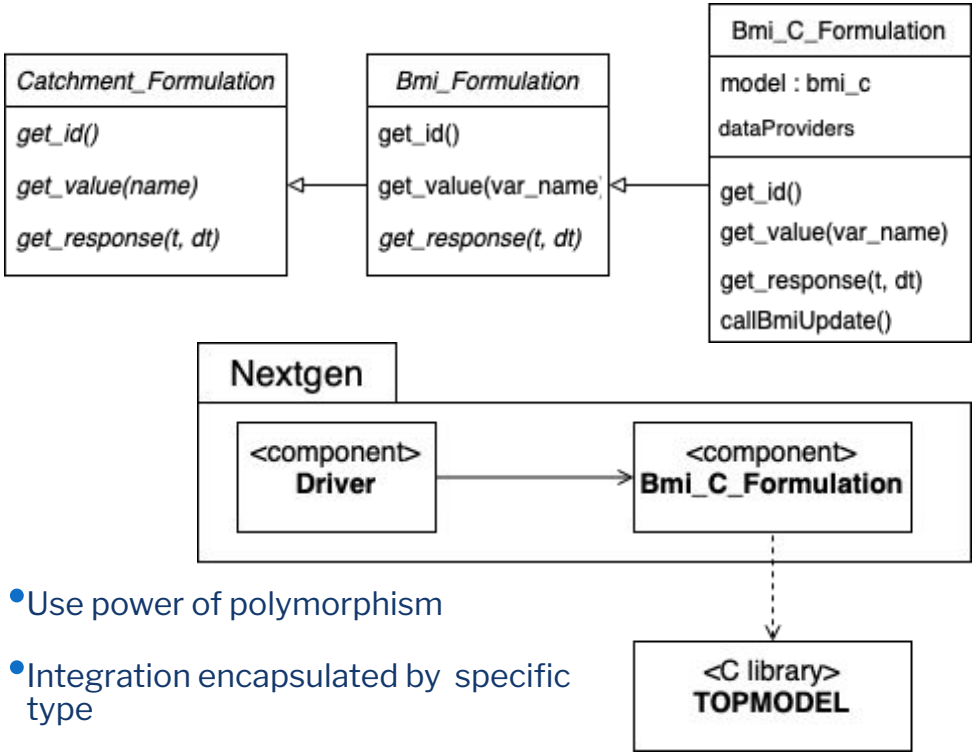


- Build network of feature objects
- *Formulation_Manager* creates right specific type and provides to driver
- Driver sees each as just another *Catchment_Formulation*

A Framework For Linking Community Models

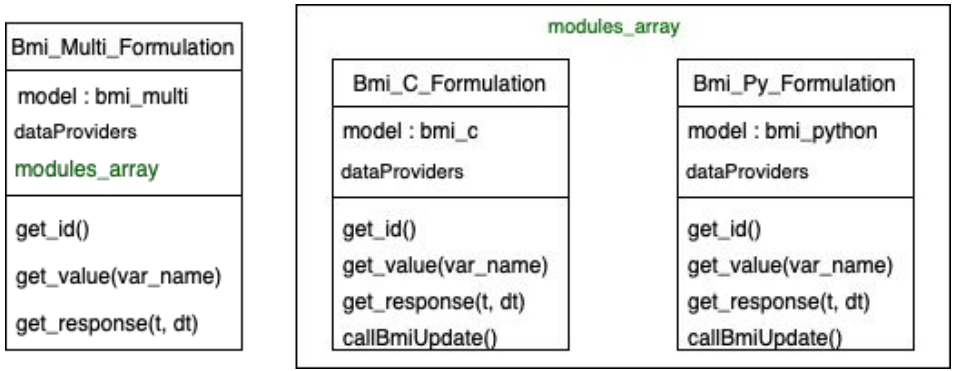
- Framework design already lends well to this
- Only need formulation types that can couple to external modules
- Makes these as general as possible for reuse
- Important to select design that still supports community engagement

Model Language	BMI API	Nextgen Support
C	✓	✓
C++	✓	✓
Fortran	✓	✓
Python	✓	✓



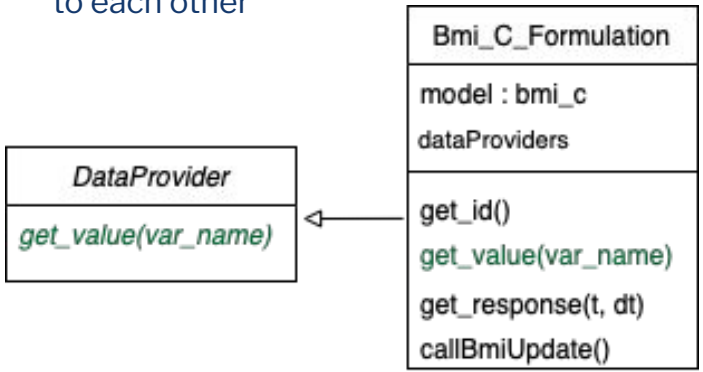
- Use power of polymorphism
- Integration encapsulated by specific type
- Driver sees *Catchment_Formulation* and is agnostic to "internals," even if actually external

A Framework For Configuring Model Compositions



- *Bmi_Multi_Formulation* has an array of nested formulation objects
- Combined together these form the composite model
- Reuses same types as stand-alone
- Driver again just sees another generic *Catchment_Formulation*

- Polymorphism applied for data also
- Lets nested formulations provide data to each other




```
"variables_names_map": {
    "MOD_1_BEN": "OB_1",
    ...
"variables_names_map": {
    "MOD_2_MSTR": "OB_1",
    ...
```

Configures variable to be known inside framework

Sets source of data to MOD_2_MSTR input

A Framework For Users

- Use multiple models
- Apply different models individually to specific catchments in any desired combination
- Use existing or new models in multiple languages
- Combine specialized components together into composite models
- Access the framework source code and run the framework freely

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Thank You!

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https://water.noaa.gov

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