Overview of CSDMS Technology

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Photo by Martin Sanchez on Unsplash

bmi

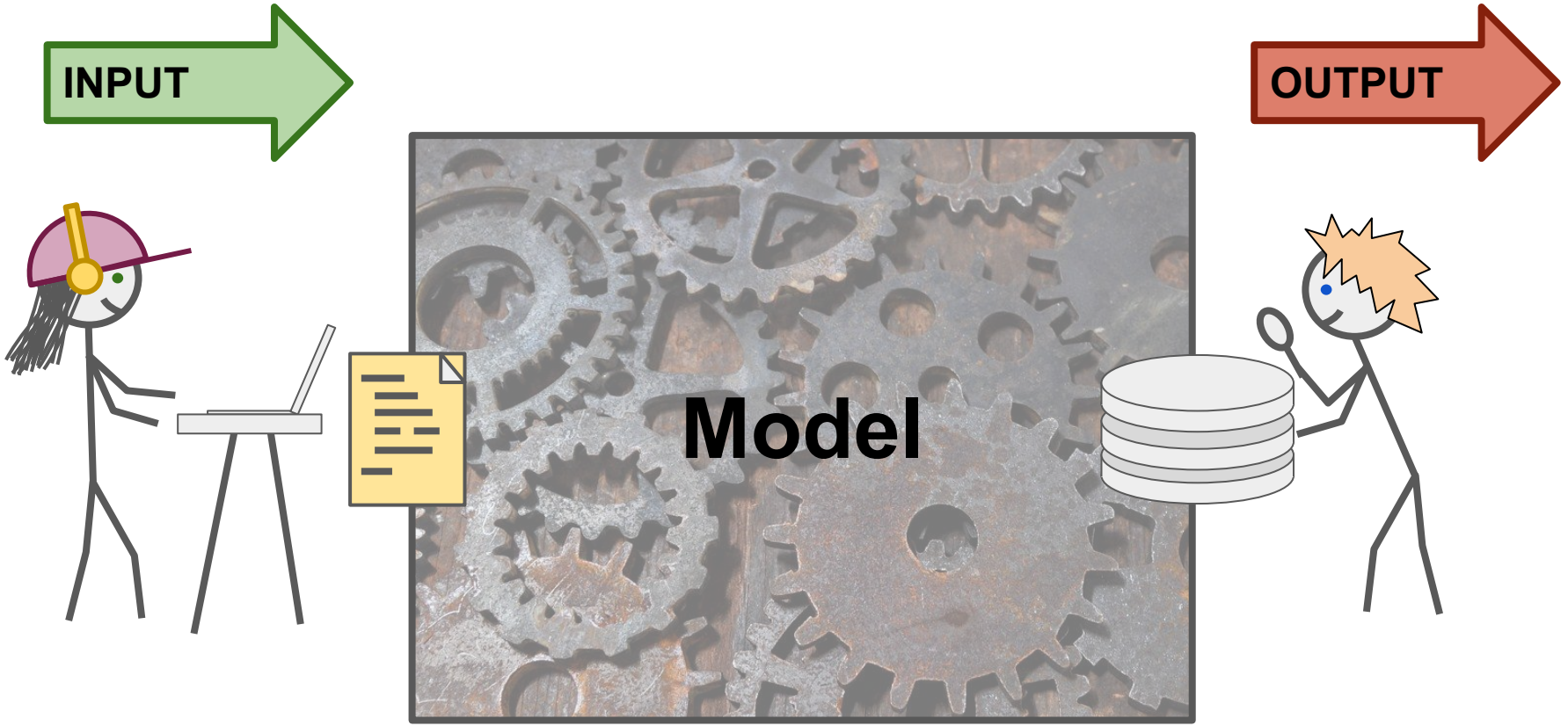
bmi

pymt

How to provide easy access to models?

How to standardize model coupling?

Traditionally, we interact with *models* only at the *start* or the *finish*



Standards: The Basic Model Interface (*BMI*)

The *BMI* is both:

- Design pattern
- Well-defined interface specification

Some groups using the *BMI*:

THE OPEN MODELING FOUNDATION

TU Delft

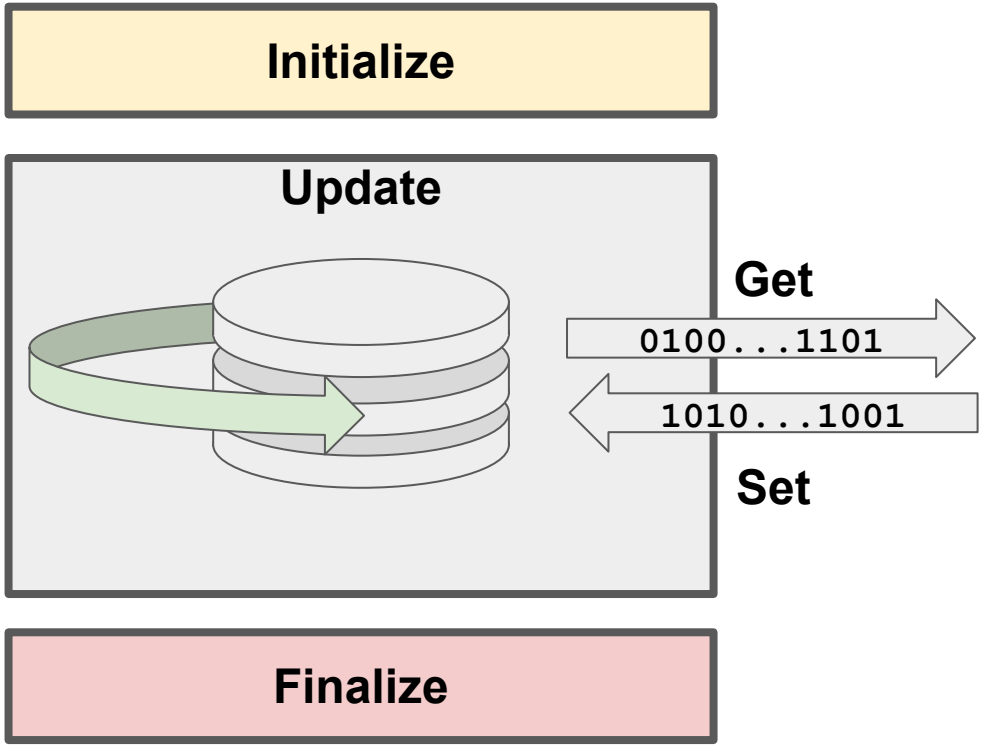
The *Basic Model Interface* (BMI) provides a standard interface for model communication.

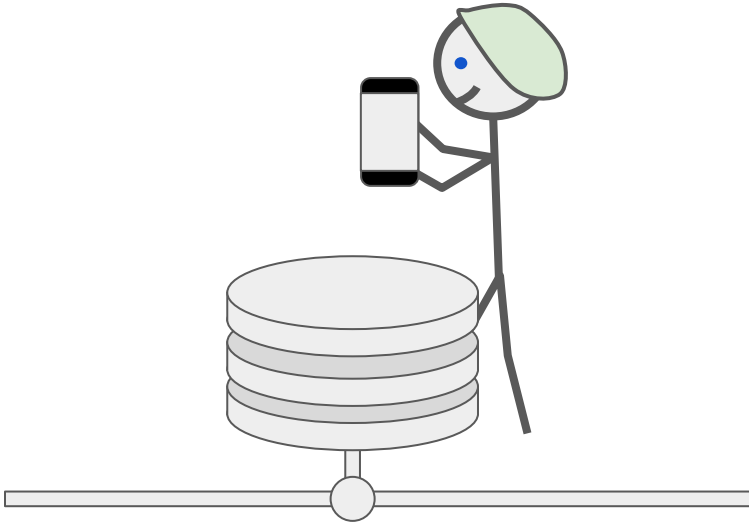
BMI identifies about 30 functions needed for model coupling.

- Not all of them need be implemented
- Many of them are trivial to implement

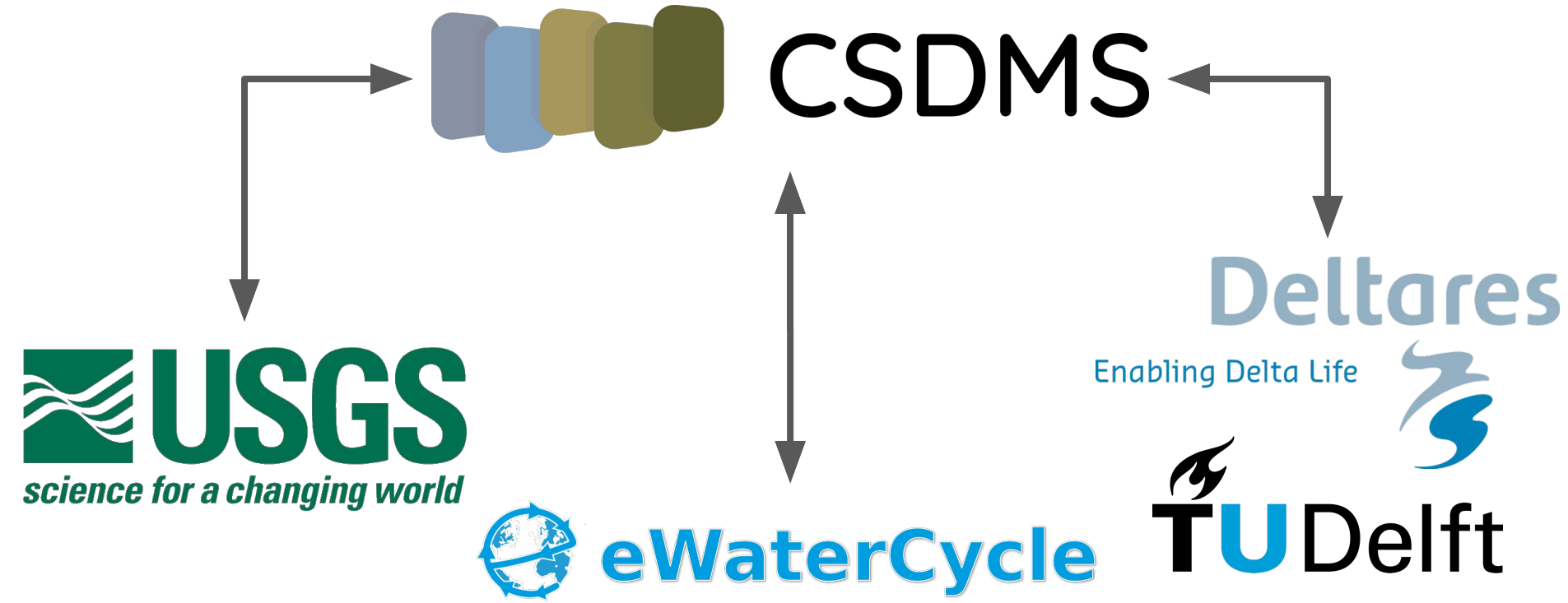
```
void initialize(in string config_file);
void update(void);

void get_var_grid(in string var_name, out int gid);
void get_var_units(in string var_name, out string units);

void get_value(in string var_name, in array<> dest);
```

When a *model* becomes a *component*, we are able to interact with it while it's running

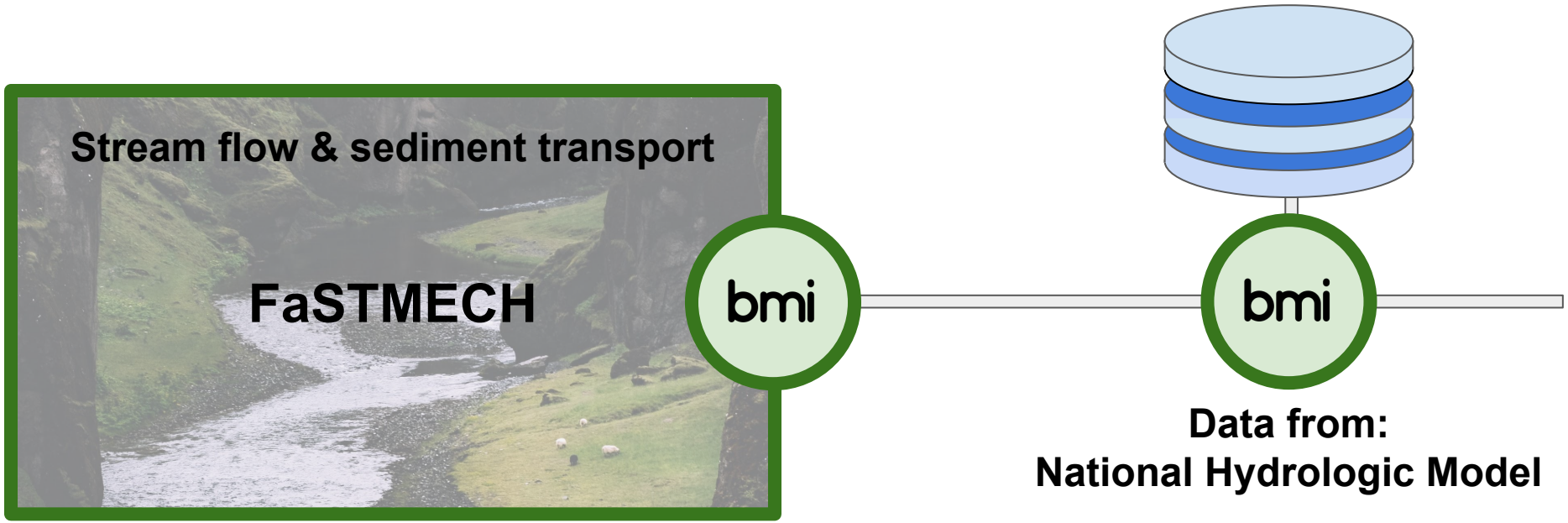




BMI Use Cases: CSDMS *coordinates* BMI activity

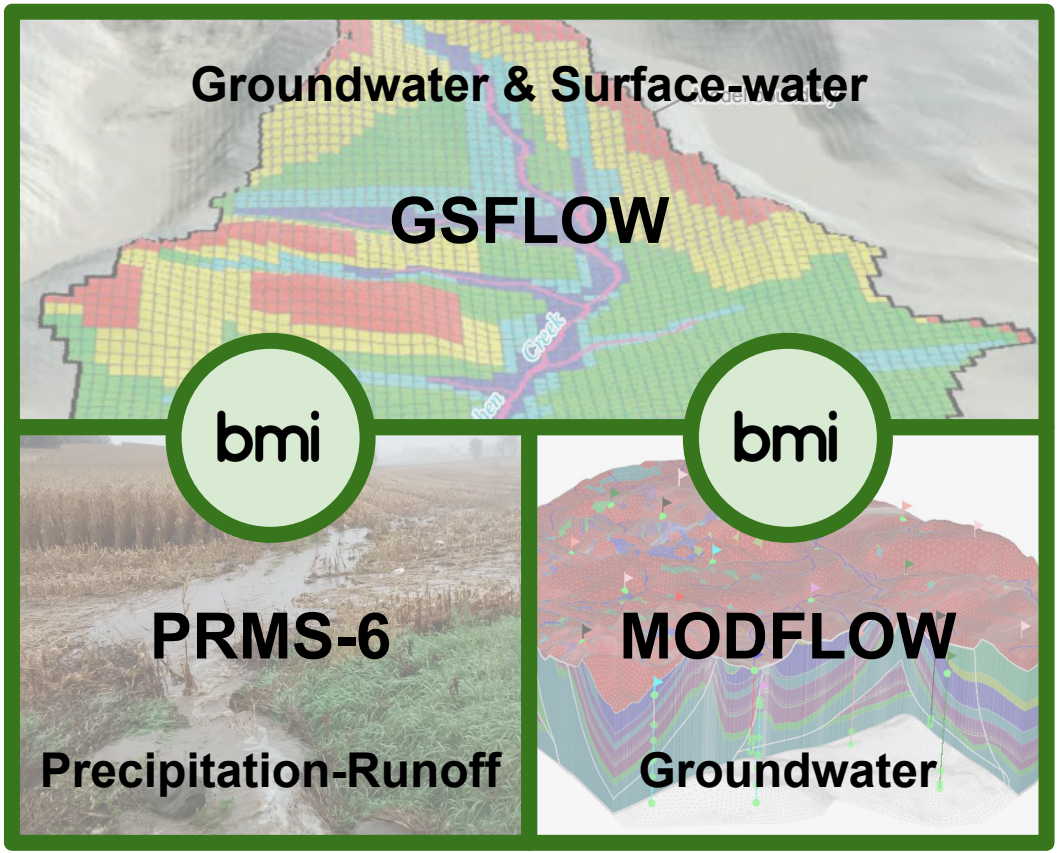


BMI: USGS FaSTMECH & oNHM



USGS
science for a changing world

BMI: USGS - GSFLOW



USGS
science for a changing world

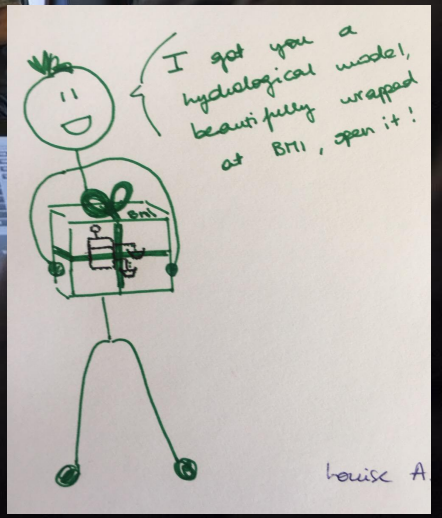
BMI: The Alcatraz Escape

TU Delft

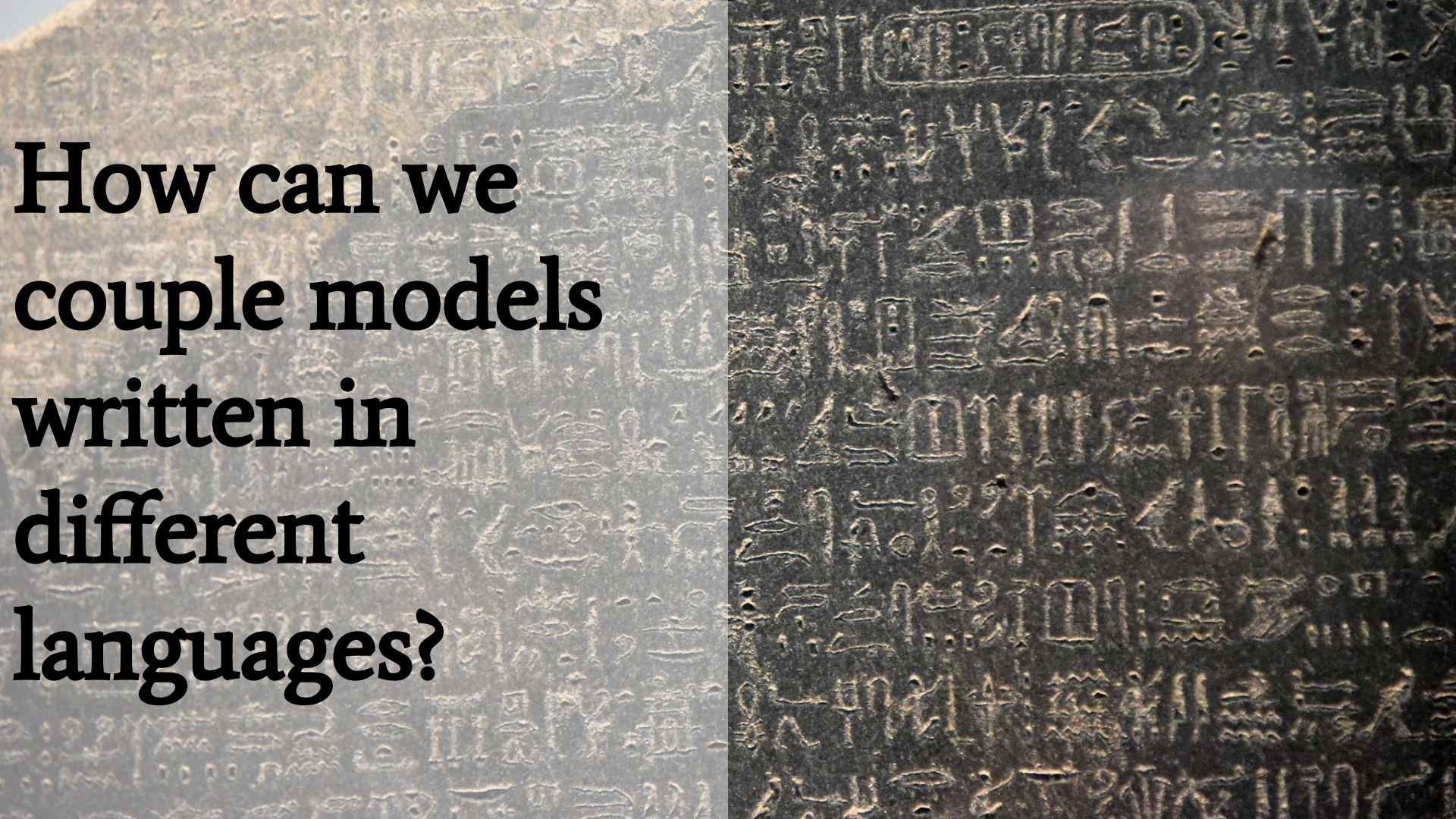
Deltares
Enabling Delta Life

BMI: eWaterCycle II

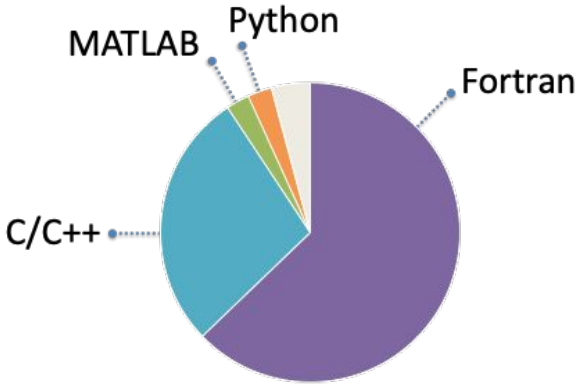
“Nice hydrographs for everyone from everyone”



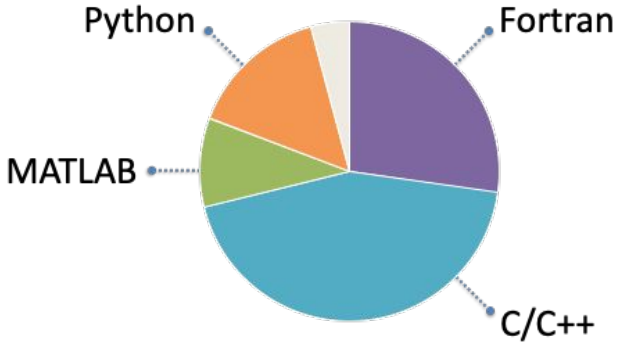
eWaterCycle


How can we couple models written in different languages?

The CSDMS model repository has over 300 community-contributed models

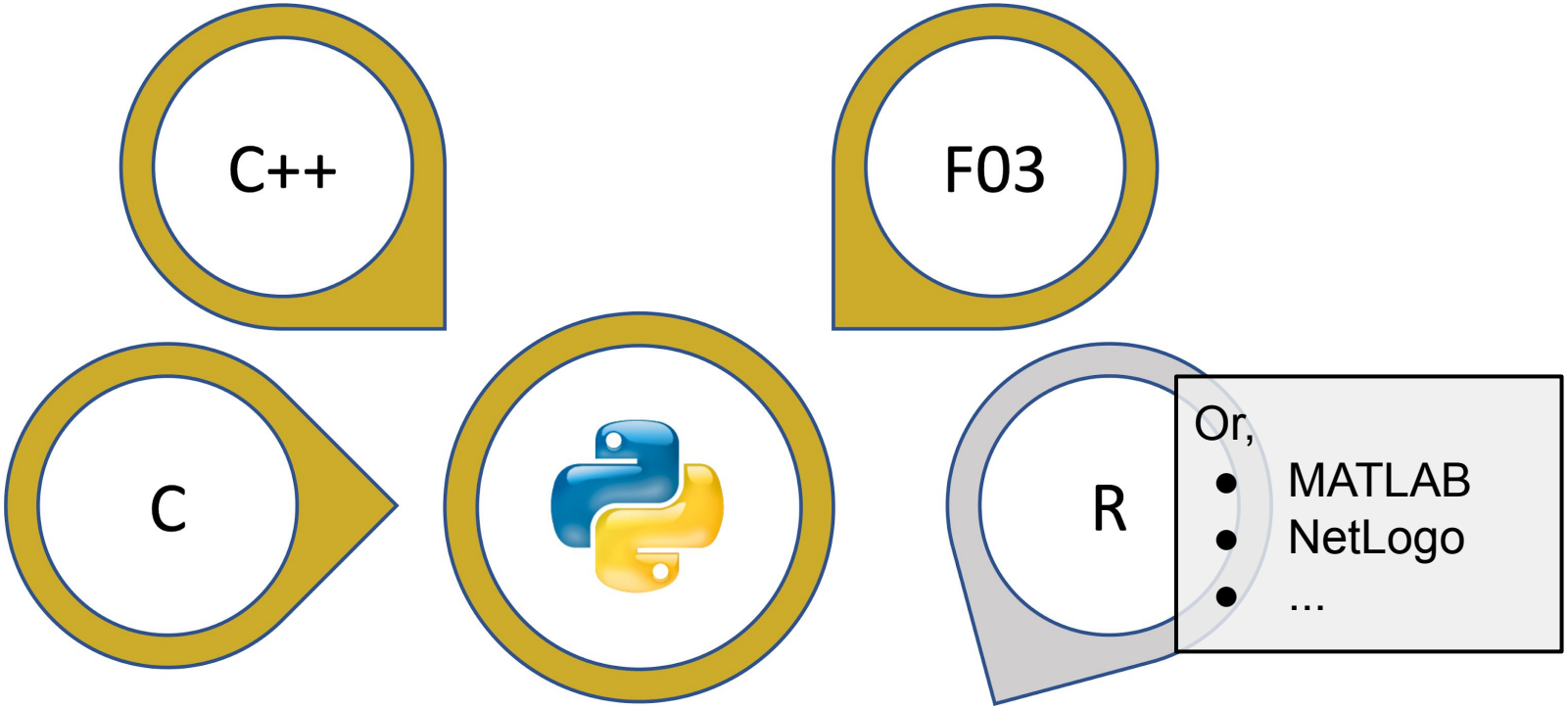


Lines of code

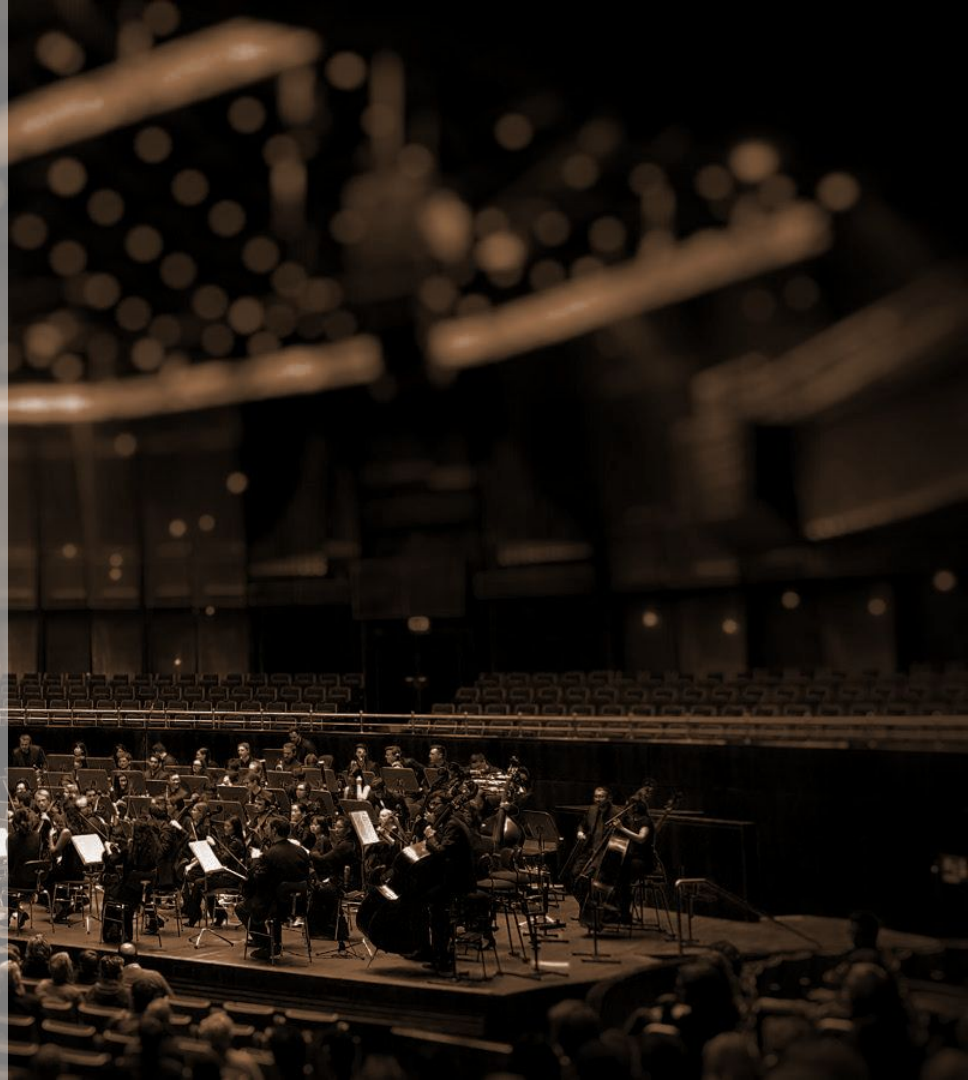


Number of models

The *Babelizer* provides language interoperability



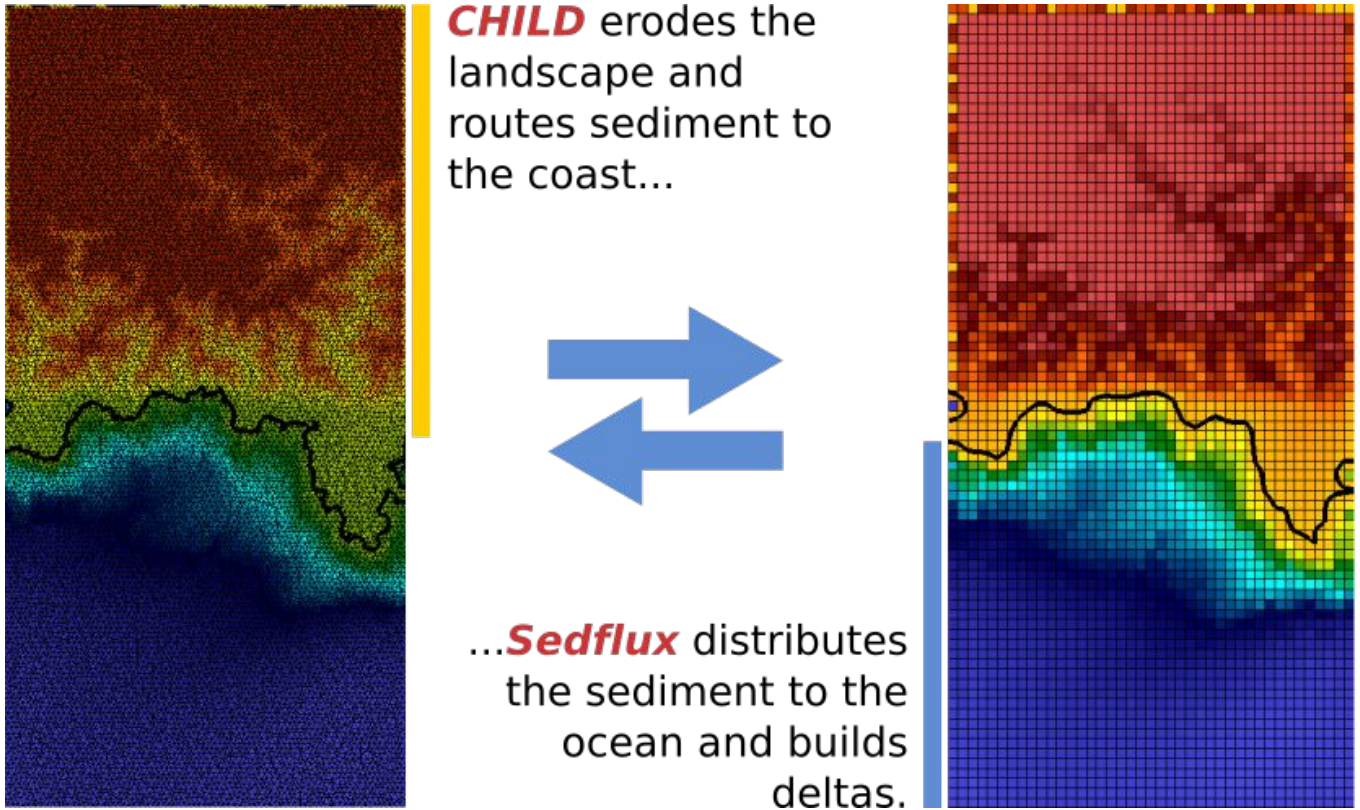
How can we put all this together?



pymt The Python Modeling Toolkit

```
>>> from pymt.models import Cem, Waves

>>> waves = Waves()
>>> cem = Cem()

>>> waves.initialize(*waves.setup())
>>> cem.initialize(*cem.setup())

>>> for time in range(1000):
...     waves.update()
...     angle = waves.get_value("wave_angle")
...     cem.set_value("wave_angle", angle)
...     cem.update()
```

pymt The Python Modeling Toolkit



Run CSDMS software in the cloud

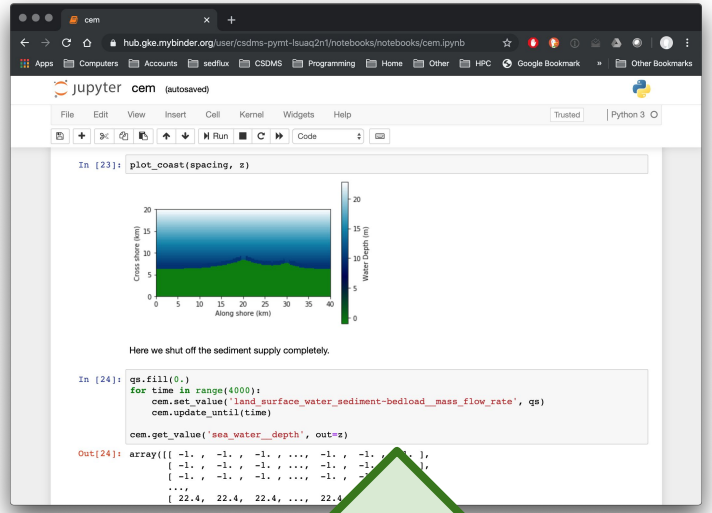
For users who want to:

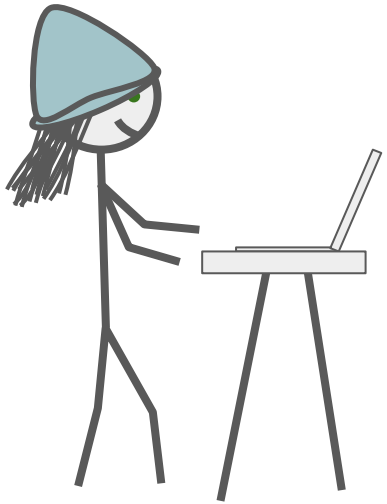
- Try out a model
- Follow along in a class
- Use more resources

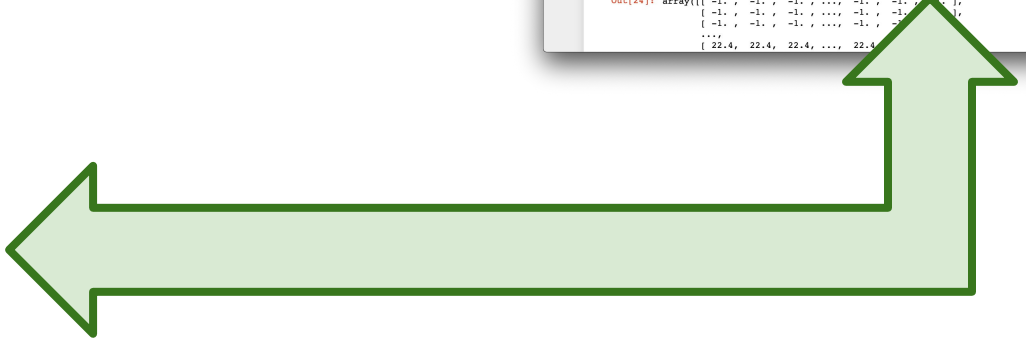
binder

HYDROSHARE

jupyterhub



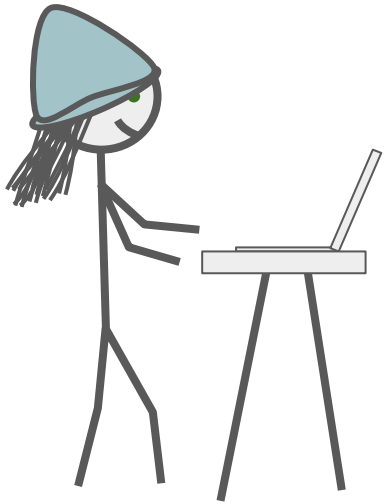


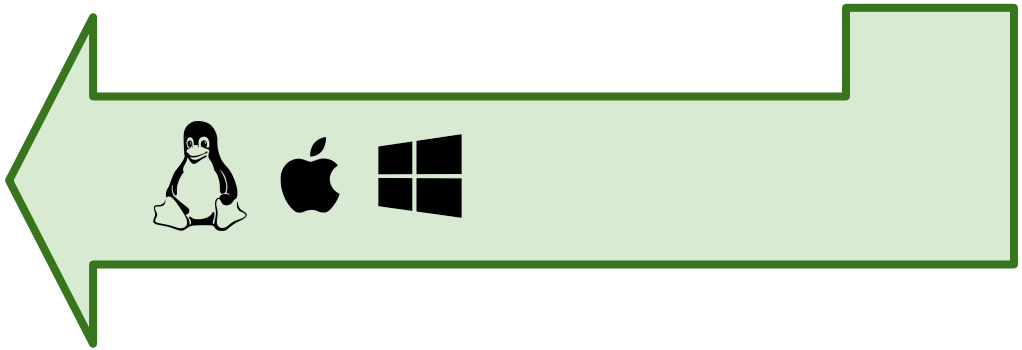


CSDMS provides binary distributions of its software

For users who want to:

- Create components
- Modify components
- Use more resources





ANACONDA CLOUD


Questions?