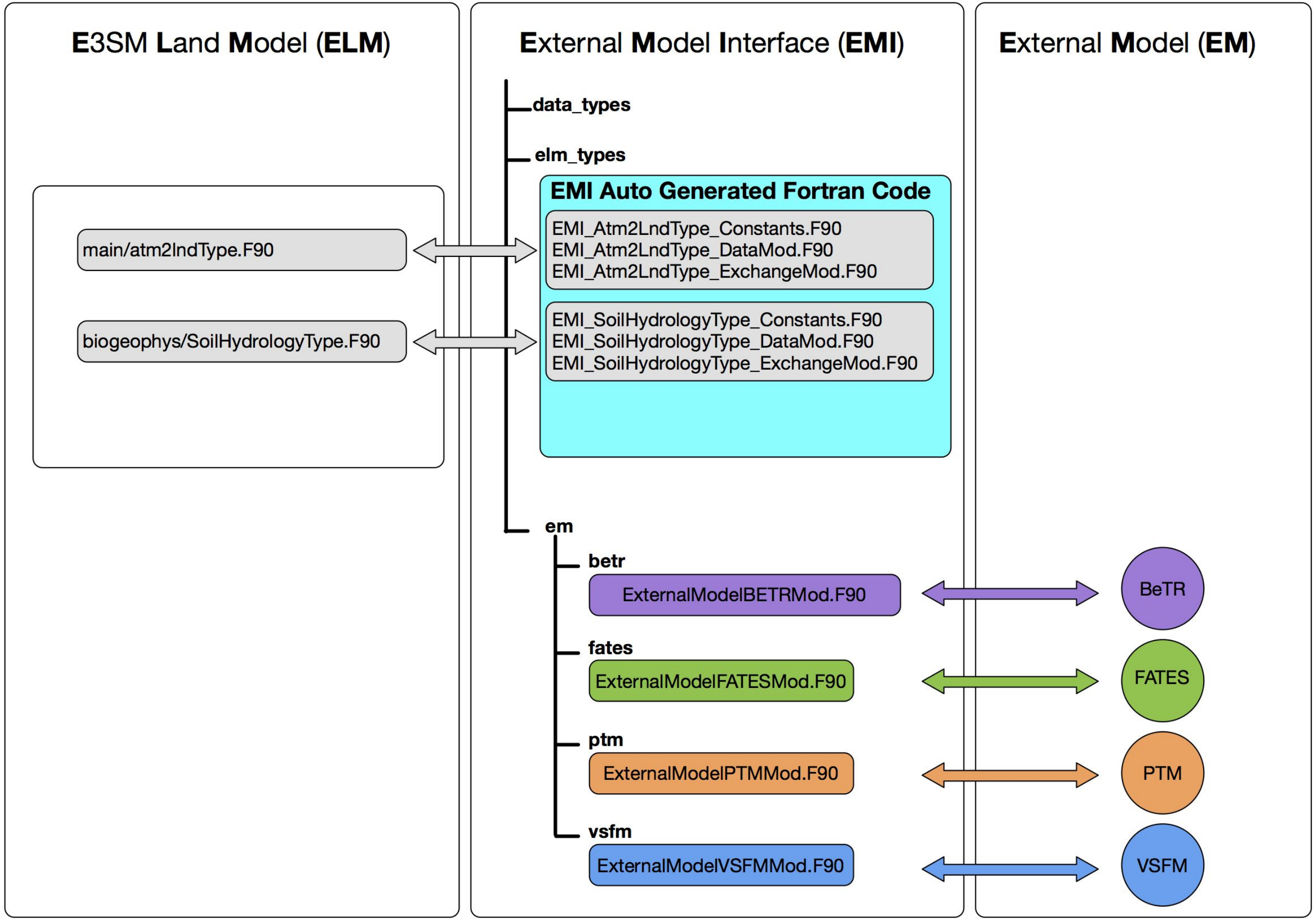
External Model Interface (EMI) for ELM

Why do we need a common interface?

- Many stakeholders who want to connect to a central piece of software (ELM)
- Previous implementations of new submodels and functions by different groups have led to a complex and fragile ELM code base, with several different incompatible interfaces for different submodels
  - FATES, BeTR, PFLOTRAN all have own interfaces

Interface design

Gautam will go into more detail on this in a little bit



E3SM Land Model (ELM)
External Model Interface (EMI)
External Model (EM)
main/atm2lndType.F90
biogeophys/SoilHydrologyType.F90
data_types
elm_types
EMI Auto Generated Fortran Code
EMI_Atm2LndType_Constants.F90
EMI_Atm2LndType_DataMod.F90
EMI_Atm2LndType_ExchangeMod.F90
EMI_SoilHydrologyType_Constants.F90
EMI_SoilHydrologyType_DataMod.F90
EMI_SoilHydrologyType_ExchangeMod.F90
em
betr
ExternalModelBETRMod.F90
BeTR
fates
ExternalModelFATESMod.F90
FATES
ptm
ExternalModelPTMMod.F90
PTM
vsfm
ExternalModelVSFMMod.F90
VSFM

Advantages of this type of interface design

Features include: Double buffering, registration of variables at initialization step

- **Clarity:** Make it clear to everyone what the initial conditions and boundary conditions going in and out of a model are. Helps us quickly understand the needs of each other’s model
- **Organized**: This system forces us to organize inputs and outputs.
- **Common**: We are all using the same language to describe communication, so it's easier for modules to cross-communicate
- **Flexible/robust**: This interface can handle different kinds of modules and processes, and will be more robust to changes on either the ELM or external module side without breaking things
- **Facilitates rapid development**: Incorporating new modules will not require extensive new interface developments or reorganization, and prototyping/testing of modules and connections can be done with simplified tools like the “ELM stub demo” that Gautam has developed

Who is using it?

So far, these groups have signed on:

- FATES
- PFLOTRAN
- BETR
- VSFM
- PTM
- YOUR MODEL???

Remaining challenges

- The ELM core handles many processes that are not part of the EMI interface. Can/should we move them?
- How to run multiple external models without redundant effects on physical processes
    - For example, how do we handle mycorrhizal fungi that are associated with vegetation but have a soil decomposition function?