CAT Interface Walkthrough

Authors: Marc Spraragen, Yolanda Gil
March 17, 2005

Outline:

I. Sample workflow template in CAT
II. CAT Interface and Component library
III. Reusing a workflow template
IV. Building a workflow template
V. Adding a workflow template component to library

I. Sample workflow template in CAT

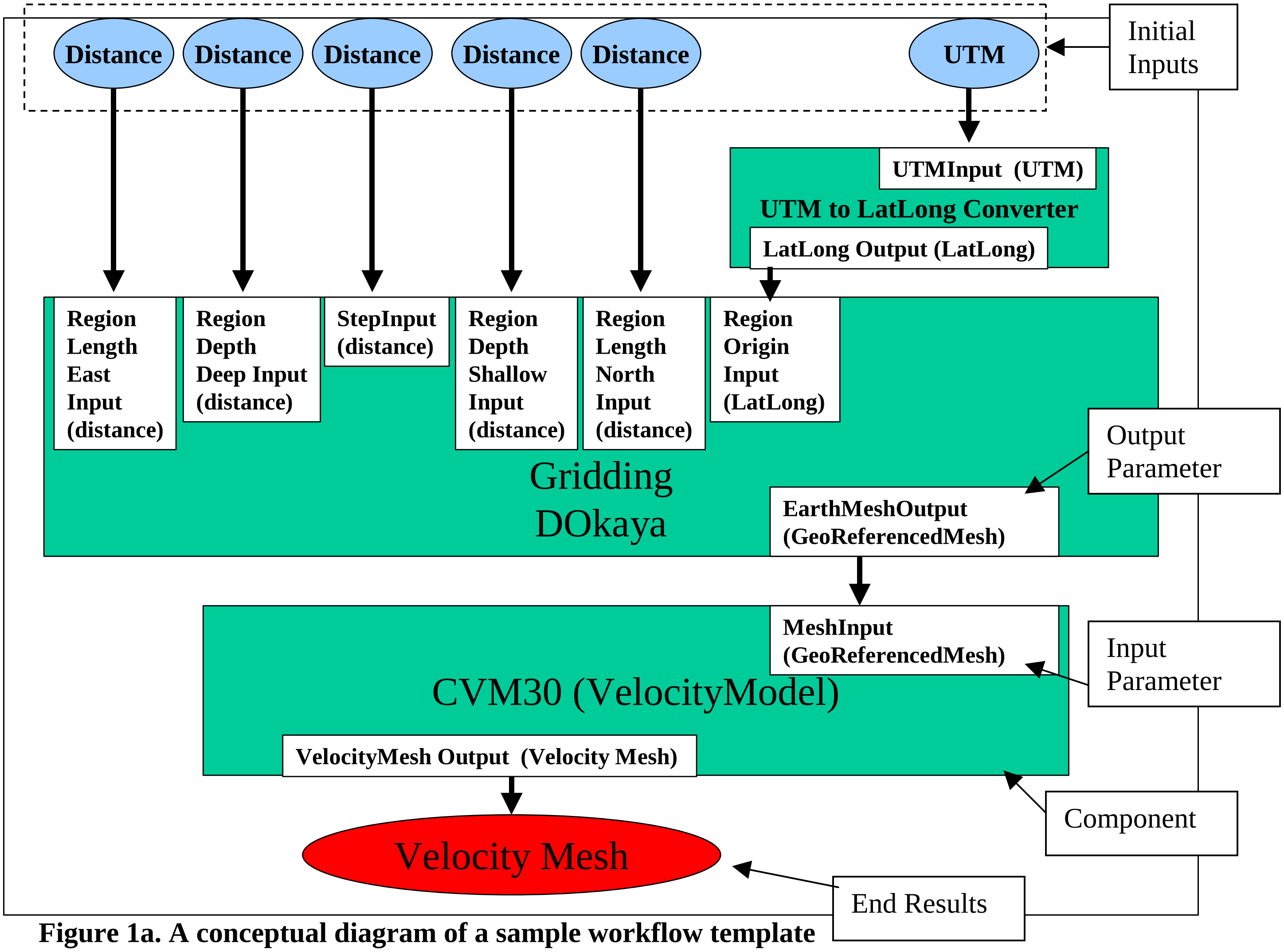
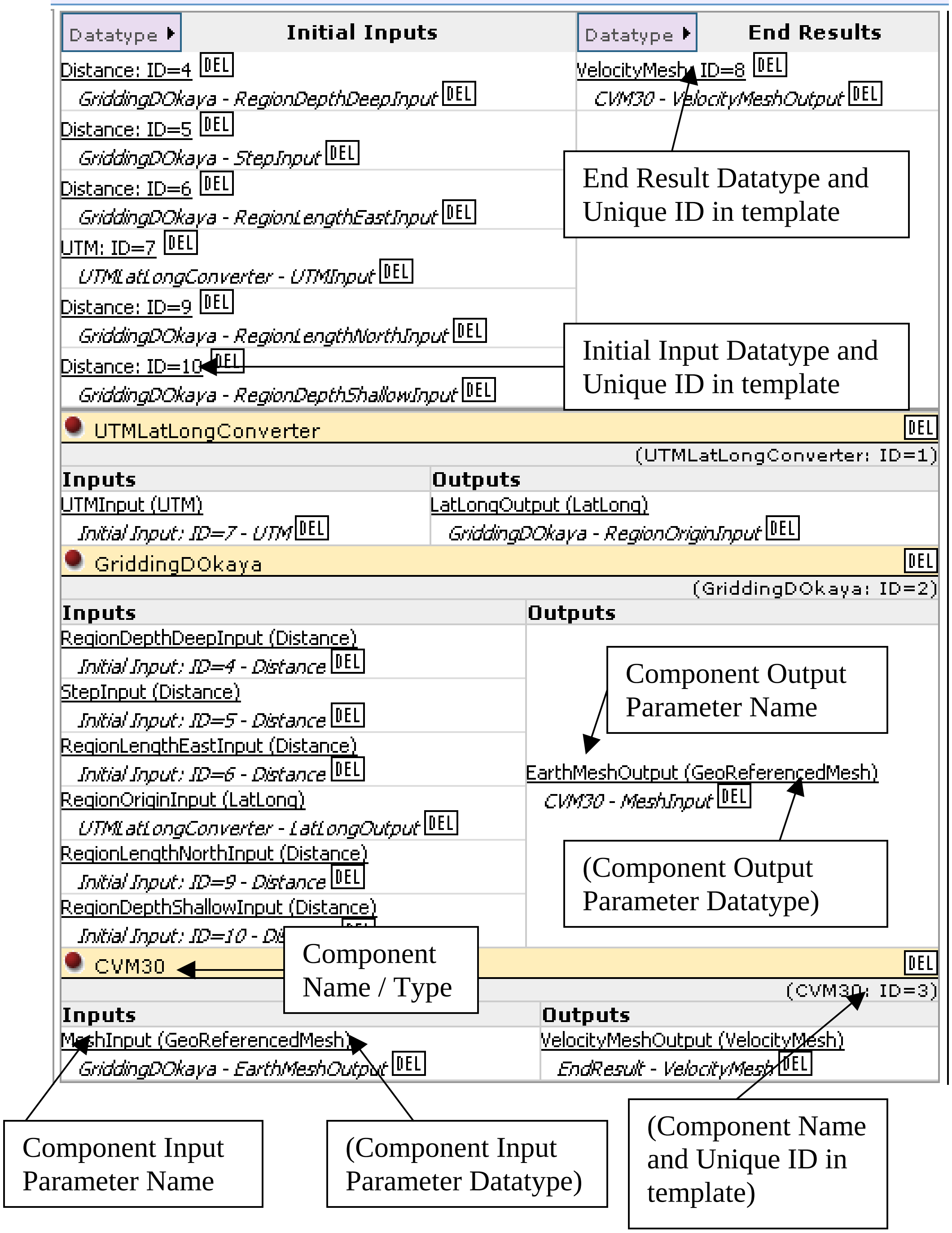

Distance
Distance
Distance
Distance
Distance
UTM
Initial Inputs
UTMInput (UTM)
UTM to LatLong Converter
LatLong Output (LatLong)
Region Length East Input (distance)
Region Depth Deep Input (distance)
StepInput (distance)
Region Depth Shallow Input (distance)
Region Length North Input (distance)
Region Origin Input (LatLong)
Output Parameter
Gridding DOkaya
EarthMeshOutput (GeoReferencedMesh)
MeshInput (GeoReferencedMesh)
Input Parameter
CVM30 (VelocityModel)
VelocityMesh Output (Velocity Mesh)
Component
Velocity Mesh
End Results

Figure 1a. A conceptual diagram of a sample workflow template

Figure 1a shows a conceptual example of a workflow template. Figure 1b shows the same template in the CAT interface. Note the need to differentiate between the parameter names and their datatypes (in parentheses). Example: Component "Gridding DOKaya", input parameter "Region Length East Input" has a datatype of "distance".



Datatype ▸ Initial Inputs

Distance: ID=4 DEL
GriddingDOkaya - RegionDepthDeepInput DEL
Distance: ID=5 DEL
GriddingDOkaya - StepInput DEL
Distance: ID=6 DEL
GriddingDOkaya - RegionLengthEastInput DEL
UTM: ID=7 DEL
UTMLatLongConverter - UTMInput DEL
Distance: ID=9 DEL
GriddingDOkaya - RegionLengthNorthInput DEL
Distance: ID=10 DEL
GriddingDOkaya - RegionDepthShallowInput DEL

Datatype ▸ End Results

VelocityMesh: ID=8 DEL
CVM30 - VelocityMeshOutput DEL

● UTMLatLongConverter DEL
(UTMLatLongConverter: ID=1)

Inputs	Outputs
UTMInput (UTM) Initial Input: ID=7 - UTM DEL	LatLongOutput (LatLong) GriddingDOkaya - RegionOriginInput DEL

● GriddingDOkaya DEL
(GriddingDOkaya: ID=2)

Inputs	Outputs
RegionDepthDeepInput (Distance) Initial Input: ID=4 - Distance DEL StepInput (Distance) Initial Input: ID=5 - Distance DEL RegionLengthEastInput (Distance) Initial Input: ID=6 - Distance DEL RegionOriginInput (LatLong) UTMLatLongConverter - LatLongOutput DEL RegionLengthNorthInput (Distance) Initial Input: ID=9 - Distance DEL RegionDepthShallowInput (Distance) Initial Input: ID=10 - Di	EarthMeshOutput (GeoReferencedMesh) CVM30 - MeshInput DEL

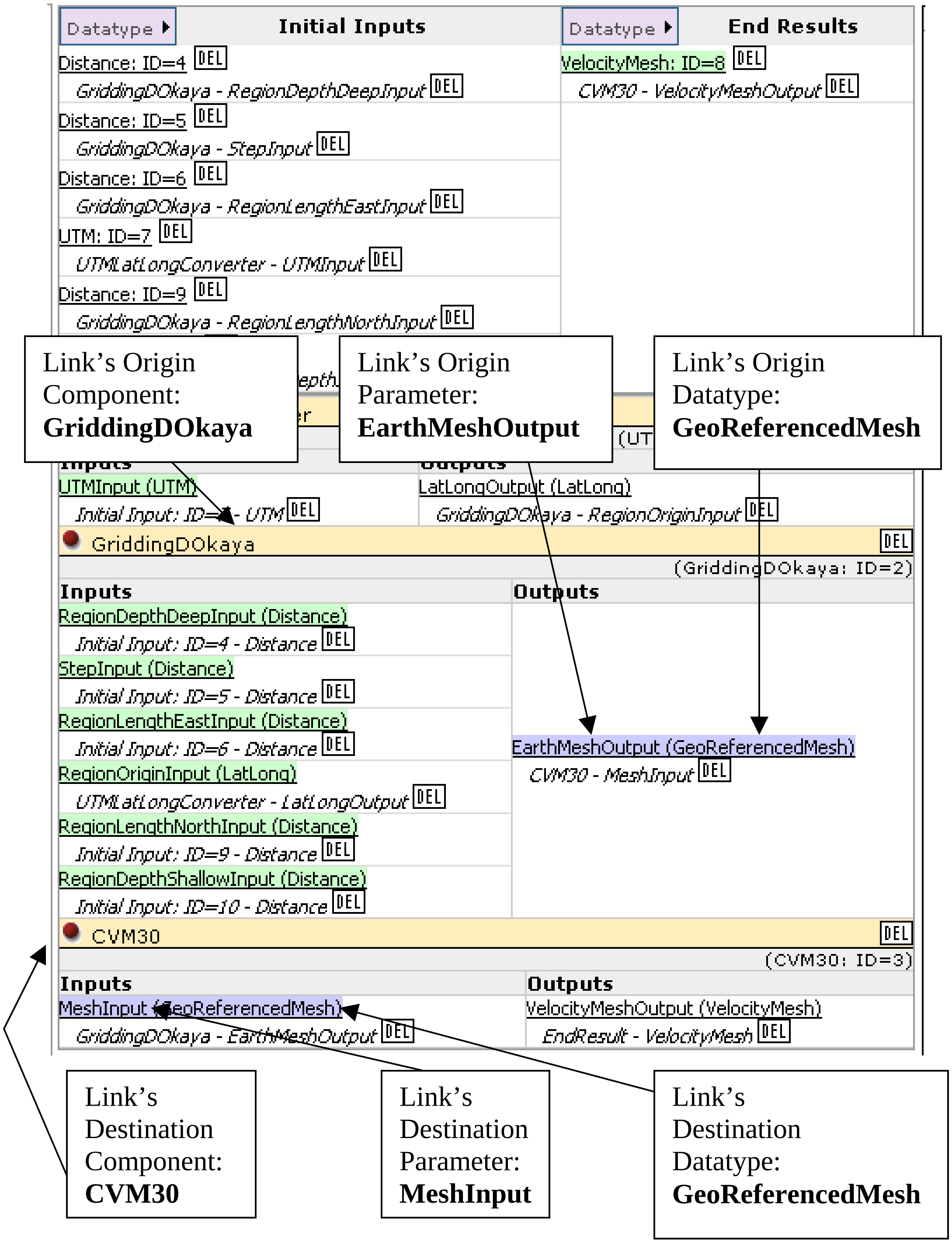
● CVM30 DEL
(CVM30: ID=3)

Inputs	Outputs
MeshInput (GeoReferencedMesh) GriddingDOkaya - EarthMeshOutput DEL	VelocityMeshOutput (VelocityMesh) EndResult - VelocityMesh DEL

End Result Datatype and Unique ID in template
Initial Input Datatype and Unique ID in template
Component Output Parameter Name
(Component Output Parameter Datatype)
Component Name / Type
Component Input Parameter Name
(Component Input Parameter Datatype)
(Component Name and Unique ID in template)

Figure 1b. Viewing in CAT: the workflow template from Figure 1a.

In CAT, each component, initial input, and end result in the template has a unique ID (in case more than one component / initial input / result of the same type is added into the template).



Datatype ▸ Initial Inputs

Distance: ID=4 DEL
GriddingDOkaya - RegionDepthDeepInput DEL
Distance: ID=5 DEL
GriddingDOkaya - StepInput DEL
Distance: ID=6 DEL
GriddingDOkaya - RegionLengthEastInput DEL
UTM: ID=7 DEL
UTMLatLongConverter - UTMInput DEL
Distance: ID=9 DEL
GriddingDOkaya - RegionLengthNorthInput DEL

Datatype ▸ End Results

VelocityMesh: ID=8 DEL
CVM30 - VelocityMeshOutput DEL

UTMInput (UTM)
Initial Input: ID=7 - UTM DEL
LatLongOutput (LatLong)
GriddingDOkaya - RegionOriginInput DEL

● GriddingDOkaya DEL
(GriddingDOkaya: ID=2)

Inputs
RegionDepthDeepInput (Distance)
Initial Input: ID=4 - Distance DEL
StepInput (Distance)
Initial Input: ID=5 - Distance DEL
RegionLengthEastInput (Distance)
Initial Input: ID=6 - Distance DEL
RegionOriginInput (LatLong)
UTMLatLongConverter - LatLongOutput DEL
RegionLengthNorthInput (Distance)
Initial Input: ID=9 - Distance DEL
RegionDepthShallowInput (Distance)
Initial Input: ID=10 - Distance DEL

Outputs
EarthMeshOutput (GeoReferencedMesh)
CVM30 - MeshInput DEL

● CVM30 DEL
(CVM30: ID=3)

Inputs
MeshInput (GeoReferencedMesh)
GriddingDOkaya - EarthMeshOutput DEL

Outputs
VelocityMeshOutput (VelocityMesh)
EndResult - VelocityMesh DEL

Link's Origin Component: **GriddingDOkaya**

Link's Origin Parameter: **EarthMeshOutput**

Link's Origin Datatype: **GeoReferencedMesh**

Link's Destination Component: **CVM30**

Link's Destination Parameter: **MeshInput**

Link's Destination Datatype: **GeoReferencedMesh**

Figure 1c. The same template, featuring a highlighted dataflow link.

Links show dataflow across components. For example:

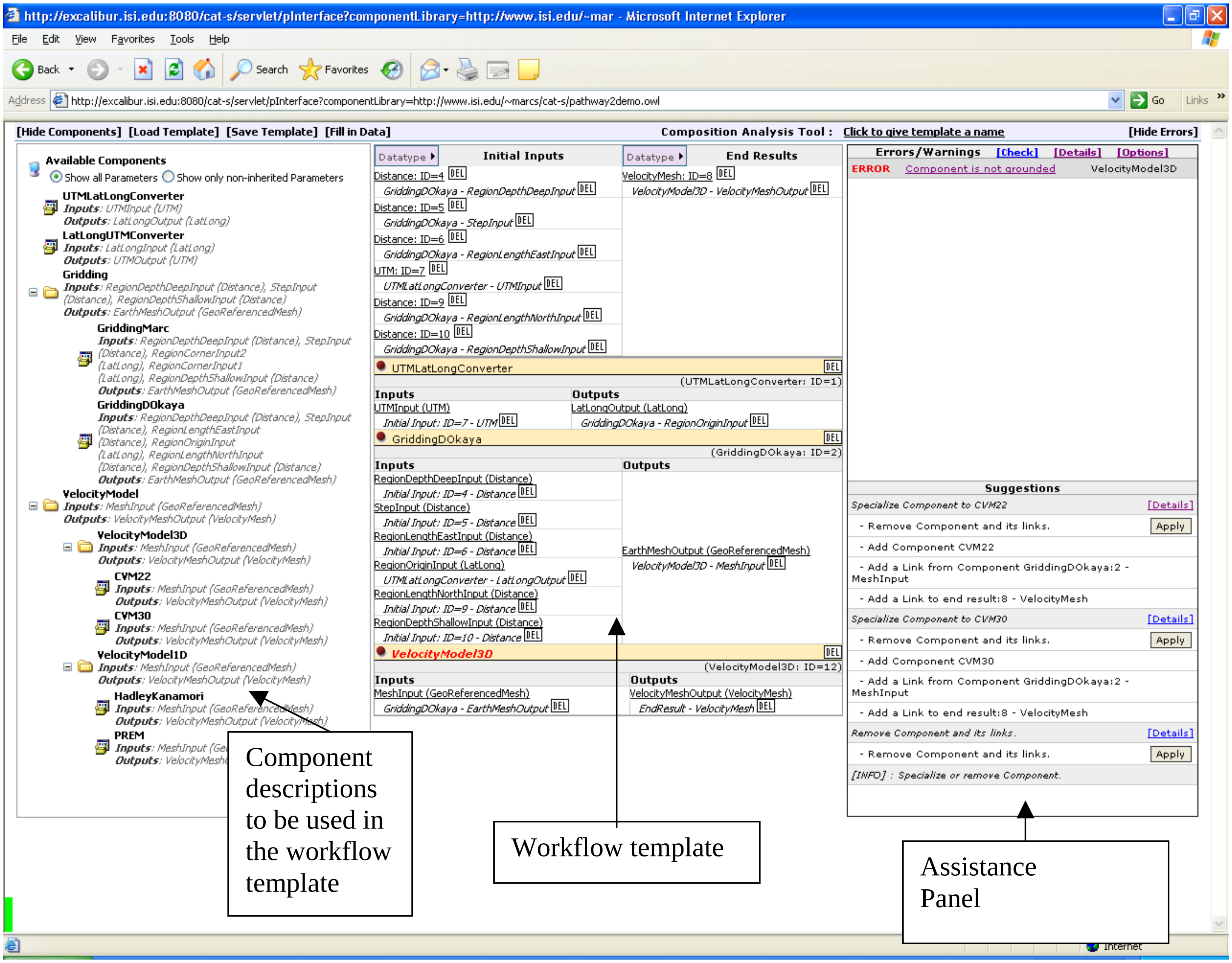
output (origin) component: "GriddingDOkaya", ID=2, parameter: "EarthMeshOutput", datatype: "GeoReferencedMesh"

and

input (destination) component: "CVM30", ID=3, parameter: "MeshInput", datatype "GeoReferencedMesh"

Figure 1c shows how this link is represented in CAT.

II. CAT Interface and Component library


http://excalibur.isi.edu:8080/cat-s/servlet/pInterface?componentLibrary=http://www.isi.edu/~mar - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
Go
Links
Internet
Component descriptions to be used in the workflow template
Workflow template
Assistance Panel

http://excalibur.isi.edu:8080/cat-s/servlet/pInterface?componentLibrary=http://www.isi.edu/~marcs/cat-s/pathway2demo.owl

[Hide Components] [Load Template] [Save Template] [Fill in Data] Composition Analysis Tool : Click to give template a name [Hide Errors]

Available Components

○ Show all Parameters ○ Show only non-inherited Parameters

UTMLatLongConverter
Inputs: UTMInput (UTM)
Outputs: LatLongOutput (LatLong)

LatLongUTMConverter
Inputs: LatLongInput (LatLong)
Outputs: UTMOutput (UTM)

Gridding
Inputs: RegionDepthDeepInput (Distance), StepInput (Distance), RegionDepthShallowInput (Distance)
Outputs: EarthMeshOutput (GeoReferencedMesh)

GriddingMarc
Inputs: RegionDepthDeepInput (Distance), StepInput (Distance), RegionCornerInput2 (LatLong), RegionCornerInput1 (LatLong), RegionDepthShallowInput (Distance)
Outputs: EarthMeshOutput (GeoReferencedMesh)

GriddingDOkaya
Inputs: RegionDepthDeepInput (Distance), StepInput (Distance), RegionLengthEastInput (Distance), RegionOriginInput (LatLong), RegionLengthNorthInput (Distance), RegionDepthShallowInput (Distance)
Outputs: EarthMeshOutput (GeoReferencedMesh)

VelocityModel
Inputs: MeshInput (GeoReferencedMesh)
Outputs: VelocityMeshOutput (VelocityMesh)

VelocityModel3D
Inputs: MeshInput (GeoReferencedMesh)
Outputs: VelocityMeshOutput (VelocityMesh)

CVM22
Inputs: MeshInput (GeoReferencedMesh)
Outputs: VelocityMeshOutput (VelocityMesh)

CVM30
Inputs: MeshInput (GeoReferencedMesh)
Outputs: VelocityMeshOutput (VelocityMesh)

VelocityModel1D
Inputs: MeshInput (GeoReferencedMesh)
Outputs: VelocityMeshOutput (VelocityMesh)

HadleyKanamori
Inputs: MeshInput (GeoReferencedMesh)
Outputs: VelocityMeshOutput (VelocityMesh)

PREM
Inputs: MeshInput (Ge
Outputs: VelocityMesh

Datatype ▸ Initial Inputs	Datatype ▸ End Results
Distance: ID=4 DEL *GriddingDOkaya - RegionDepthDeepInput* DEL	VelocityMesh: ID=8 DEL *VelocityModel3D - VelocityMeshOutput* DEL
Distance: ID=5 DEL *GriddingDOkaya - StepInput* DEL	
Distance: ID=6 DEL *GriddingDOkaya - RegionLengthEastInput* DEL	
UTM: ID=7 DEL *UTMLatLongConverter - UTMInput* DEL	
Distance: ID=9 DEL *GriddingDOkaya - RegionLengthNorthInput* DEL	
Distance: ID=10 DEL *GriddingDOkaya - RegionDepthShallowInput* DEL	

● UTMLatLongConverter DEL

(UTMLatLongConverter: ID=1)

Inputs	Outputs
UTMInput (UTM) *Initial Input: ID=7 - UTM* DEL	LatLongOutput (LatLong) *GriddingDOkaya - RegionOriginInput* DEL

● GriddingDOkaya DEL

(GriddingDOkaya: ID=2)

Inputs	Outputs
RegionDepthDeepInput (Distance) *Initial Input: ID=4 - Distance* DEL	
StepInput (Distance) *Initial Input: ID=5 - Distance* DEL	
RegionLengthEastInput (Distance) *Initial Input: ID=6 - Distance* DEL	EarthMeshOutput (GeoReferencedMesh) *VelocityModel3D - MeshInput* DEL
RegionOriginInput (LatLong) *UTMLatLongConverter - LatLongOutput* DEL	
RegionLengthNorthInput (Distance) *Initial Input: ID=9 - Distance* DEL	
RegionDepthShallowInput (Distance) *Initial Input: ID=10 - Distance* DEL	

● ***VelocityModel3D*** DEL

(VelocityModel3D: ID=12)

Inputs	Outputs
MeshInput (GeoReferencedMesh) *GriddingDOkaya - EarthMeshOutput* DEL	VelocityMeshOutput (VelocityMesh) *EndResult - VelocityMesh* DEL

Errors/Warnings [Check] [Details] [Options]

ERROR	Component is not grounded	VelocityModel3D

Suggestions

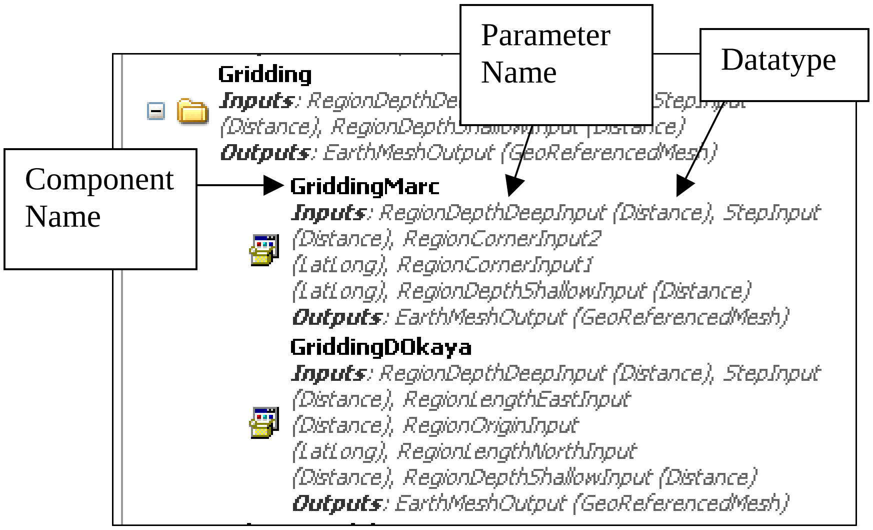
Specialize Component to CVM22 [Details]
- Remove Component and its links. Apply
- Add Component CVM22
- Add a Link from Component GriddingDOkaya:2 - MeshInput
- Add a Link to end result:8 - VelocityMesh

Specialize Component to CVM30 [Details]
- Remove Component and its links. Apply
- Add Component CVM30
- Add a Link from Component GriddingDOkaya:2 - MeshInput
- Add a Link to end result:8 - VelocityMesh

Remove Component and its links. [Details]
- Remove Component and its links. Apply

[INFO] : Specialize or remove Component.

Figure 2a: the CAT Interface



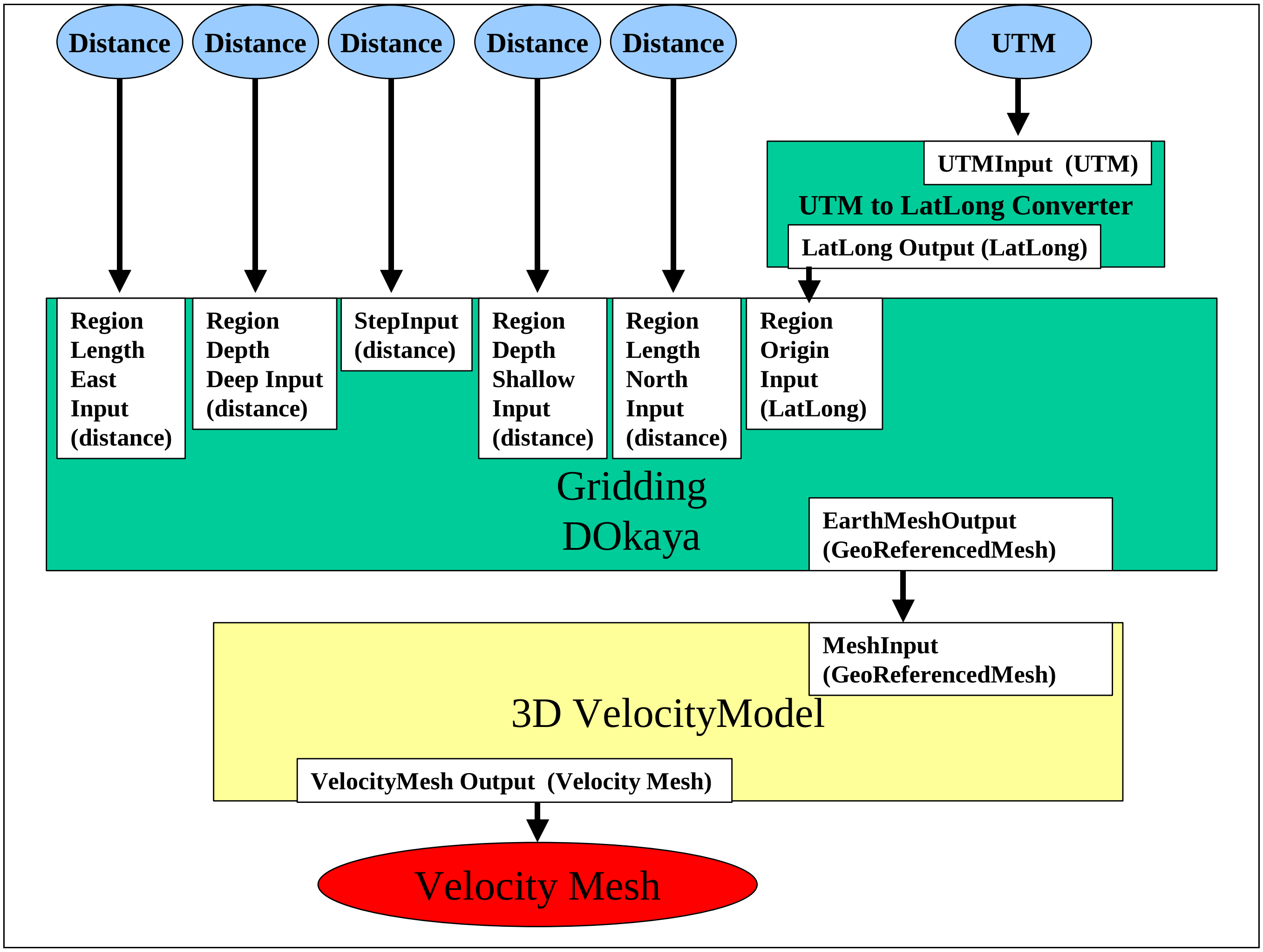
Gridding
Inputs: RegionDepthDe StepInput
(Distance), RegionDepthShallowInput (Distance)
Outputs: EarthMeshOutput (GeoReferencedMesh)

GriddingMarc
Inputs: RegionDepthDeepInput (Distance), StepInput
(Distance), RegionCornerInput2
(LatLong), RegionCornerInput1
(LatLong), RegionDepthShallowInput (Distance)
Outputs: EarthMeshOutput (GeoReferencedMesh)

GriddingDOkaya
Inputs: RegionDepthDeepInput (Distance), StepInput
(Distance), RegionLengthEastInput
(Distance), RegionOriginInput
(LatLong), RegionLengthNorthInput
(Distance), RegionDepthShallowInput (Distance)
Outputs: EarthMeshOutput (GeoReferencedMesh)

Figure 2b. The component description library in CAT.

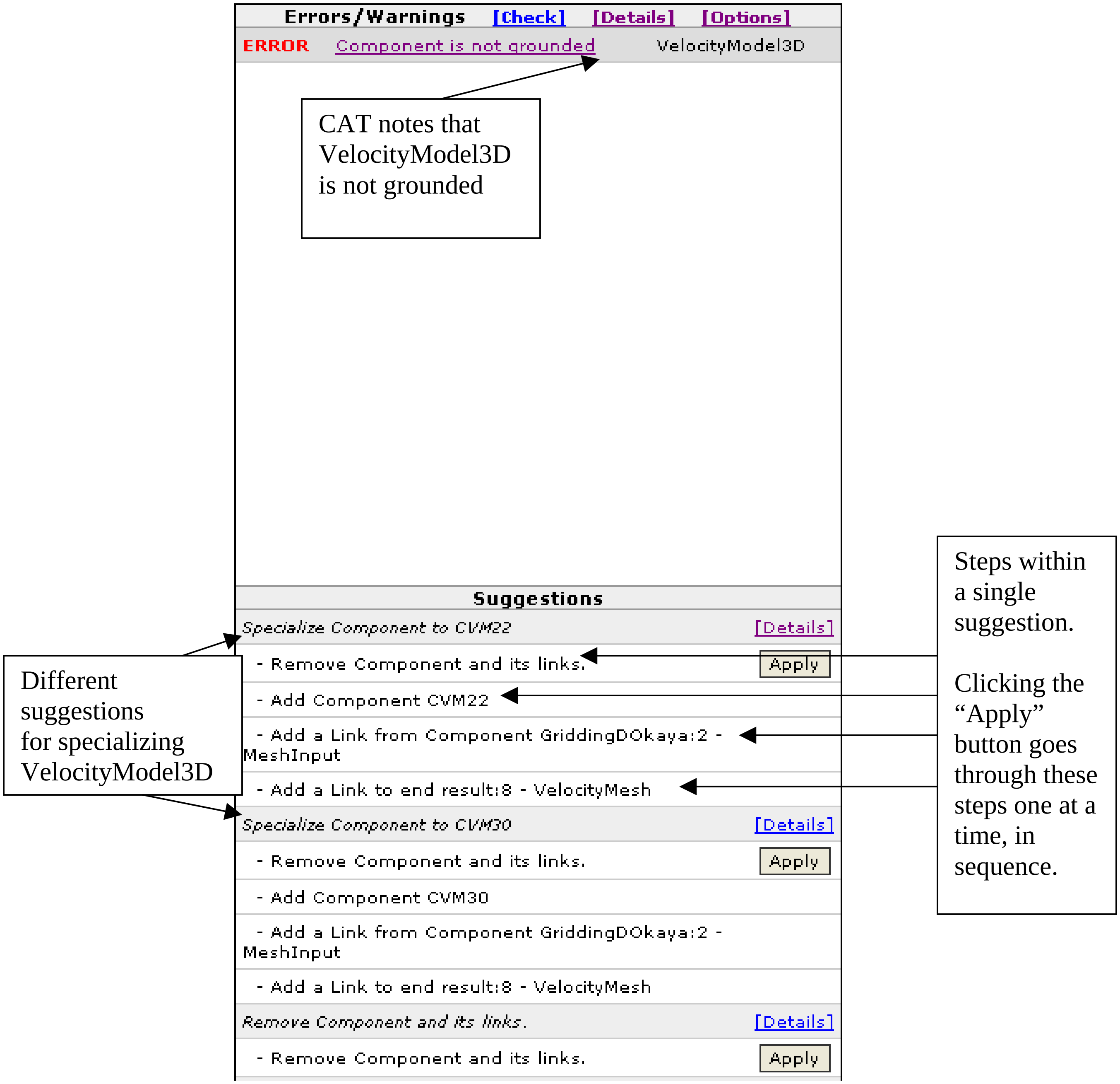
III. Reusing a workflow template



Distance
Distance
Distance
Distance
Distance
UTM
UTMInput (UTM)
UTM to LatLong Converter
LatLong Output (LatLong)
Region Length East Input (distance)
Region Depth Deep Input (distance)
StepInput (distance)
Region Depth Shallow Input (distance)
Region Length North Input (distance)
Region Origin Input (LatLong)
Gridding DOkaya
EarthMeshOutput (GeoReferencedMesh)
MeshInput (GeoReferencedMesh)
3D VelocityModel
VelocityMesh Output (Velocity Mesh)
Velocity Mesh

Figure 3a. Ungrounded (abstract) component "3D Velocity Model" in template

Figure 3a shows a template that has an abstract component: “3D Velocity Model”. When loading it, CAT tells the user (see top of figure 3b) that this component needs to be specified. CAT looks in the component library and makes the suggestions shown at the bottom of figure 3b. If “3D Velocity Model” is specialized to “CVM30”, the resulting workflow template will look like figure 1a.



Errors/Warnings [Check] [Details] [Options]

ERROR Component is not grounded VelocityModel3D

CAT notes that VelocityModel3D is not grounded

Suggestions

Specialize Component to CVM22 [Details]

- Remove Component and its links. Apply
- Add Component CVM22
- Add a Link from Component GriddingDOkaya:2 - MeshInput
- Add a Link to end result:8 - VelocityMesh

Specialize Component to CVM30 [Details]

- Remove Component and its links. Apply
- Add Component CVM30
- Add a Link from Component GriddingDOkaya:2 - MeshInput
- Add a Link to end result:8 - VelocityMesh

Remove Component and its links. [Details]

- Remove Component and its links. Apply

Different suggestions for specializing VelocityModel3D

Steps within a single suggestion.

Clicking the “Apply” button goes through these steps one at a time, in sequence.

Figure 3b. The assistance panel in CAT, referring to the ungrounded component from the workflow of figure 3a.

IV. Building a workflow template

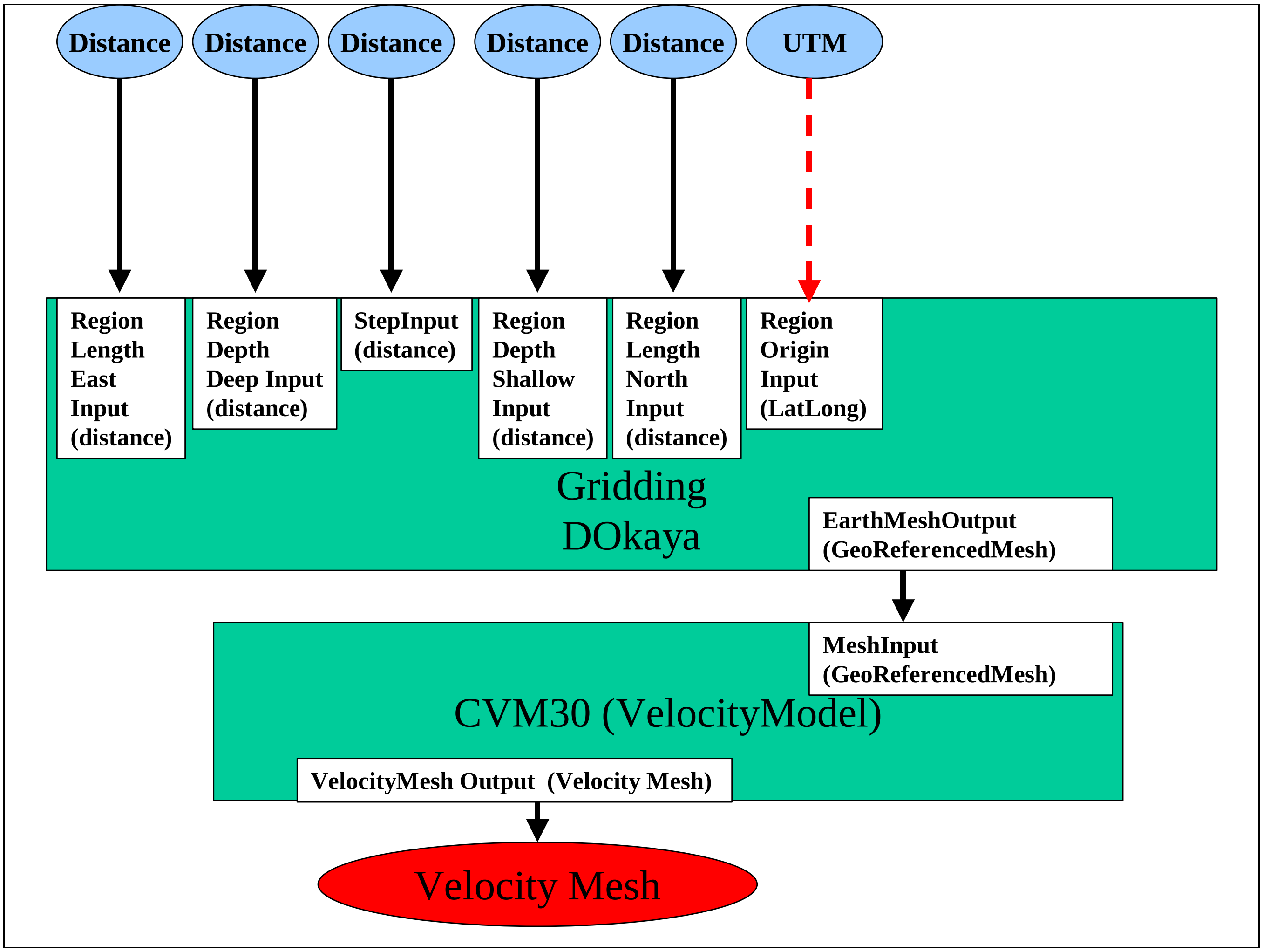
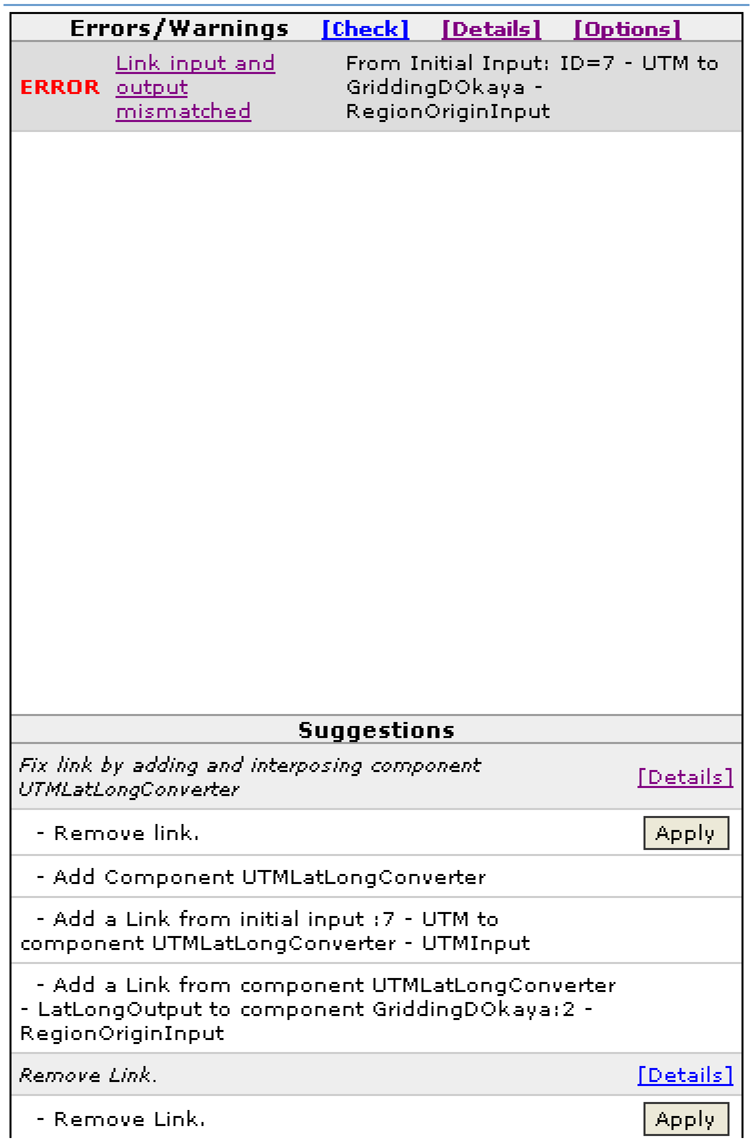

Distance
Distance
Distance
Distance
Distance
UTM
Region Length East Input (distance)
Region Depth Deep Input (distance)
StepInput (distance)
Region Depth Shallow Input (distance)
Region Length North Input (distance)
Region Origin Input (LatLong)
Gridding DOkaya
EarthMeshOutput (GeoReferencedMesh)
MeshInput (GeoReferencedMesh)
CVM30 (VelocityModel)
VelocityMesh Output (Velocity Mesh)
Velocity Mesh

Figure 4a. Inconsistent Link between datatype "UTM" and datatype "LatLong" in template

Suppose the user is building the workflow template from figure 1a from scratch. Suppose the user selects and links the gridding and velocity model components. While composing, the user mistakenly puts in initial input "UTM" to link to the input parameter "Region Origin Input". However, this parameter's datatype is LatLong coordinates. This results in a "link input and output mismatched" error, as shown by the dashed link in figure 4a, and by the error message in figure 4b. If the suggestion to "fix link by adding and interposing component UTMLatLongConverter" is applied, then the resulting workflow template will look like figure 1a.



ERROR Link input and output mismatched From Initial Input: ID=7 - UTM to GriddingDOkaya - RegionOriginInput

Fix link by adding and interposing component UTMLatLongConverter [Details]

- Remove link. Apply

- Add Component UTMLatLongConverter

- Add a Link from initial input :7 - UTM to component UTMLatLongConverter - UTMInput

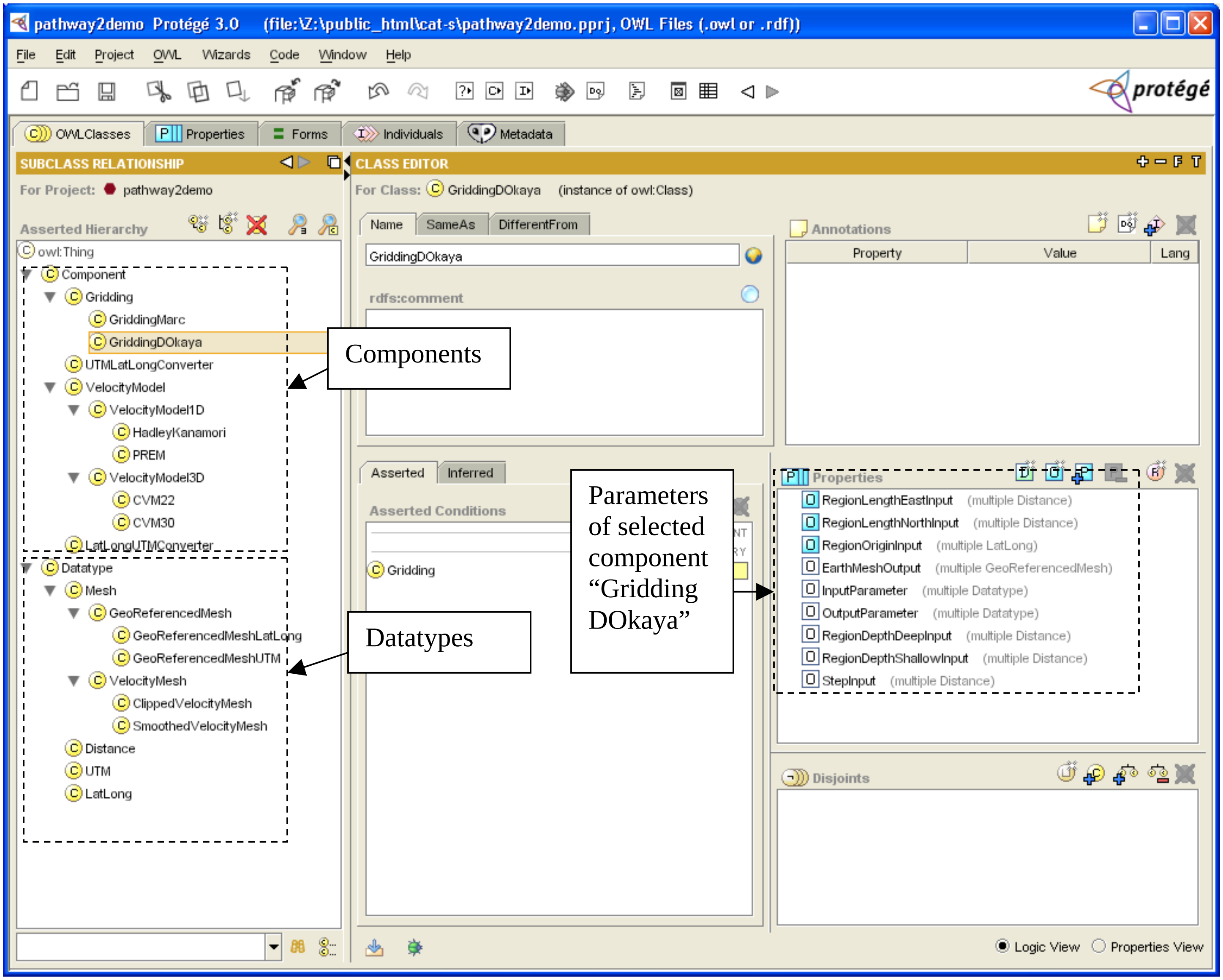
- Add a Link from component UTMLatLongConverter - LatLongOutput to component GriddingDOkaya:2 - RegionOriginInput

Remove Link. [Details]

- Remove Link. Apply

Figure 4b. The Assistance panel in CAT, pointing out a link that has input and output of incompatible datatypes.

V. Adding a workflow template component to the library


pathway2demo Protégé 3.0 (file:\Z:\public_html\cat-s\pathway2demo.pprj, OWL Files (.owl or .rdf))
File Edit Project OWL Wizards Code Window Help
protégé
OWLClasses Properties Forms Individuals Metadata
SUBCLASS RELATIONSHIP
CLASS EDITOR
Name SameAs DifferentFrom
Annotations
Property Value Lang
rdfs:comment
Asserted Inferred
Asserted Conditions
Disjoints
● Logic View ○ Properties View

For Project: pathway2demo

For Class: GriddingDOkaya (instance of owl:Class)

Asserted Hierarchy

- owl:Thing
  - Component
    - Gridding
      - GriddingMarc
      - GriddingDOkaya
    - UTMLatLongConverter
    - VelocityModel
      - VelocityModel1D
        - HadleyKanamori
        - PREM
      - VelocityModel3D
        - CVM22
        - CVM30
    - LatLongUTMConverter
  - Datatype
    - Mesh
      - GeoReferencedMesh
        - GeoReferencedMeshLatLong
        - GeoReferencedMeshUTM
      - VelocityMesh
        - ClippedVelocityMesh
        - SmoothedVelocityMesh
    - Distance
    - UTM
    - LatLong

Name: GriddingDOkaya

Asserted Conditions: Gridding

Properties

- RegionLengthEastInput (multiple Distance)
- RegionLengthNorthInput (multiple Distance)
- RegionOriginInput (multiple LatLong)
- EarthMeshOutput (multiple GeoReferencedMesh)
- InputParameter (multiple Datatype)
- OutputParameter (multiple Datatype)
- RegionDepthDeepInput (multiple Distance)
- RegionDepthShallowInput (multiple Distance)
- StepInput (multiple Distance)

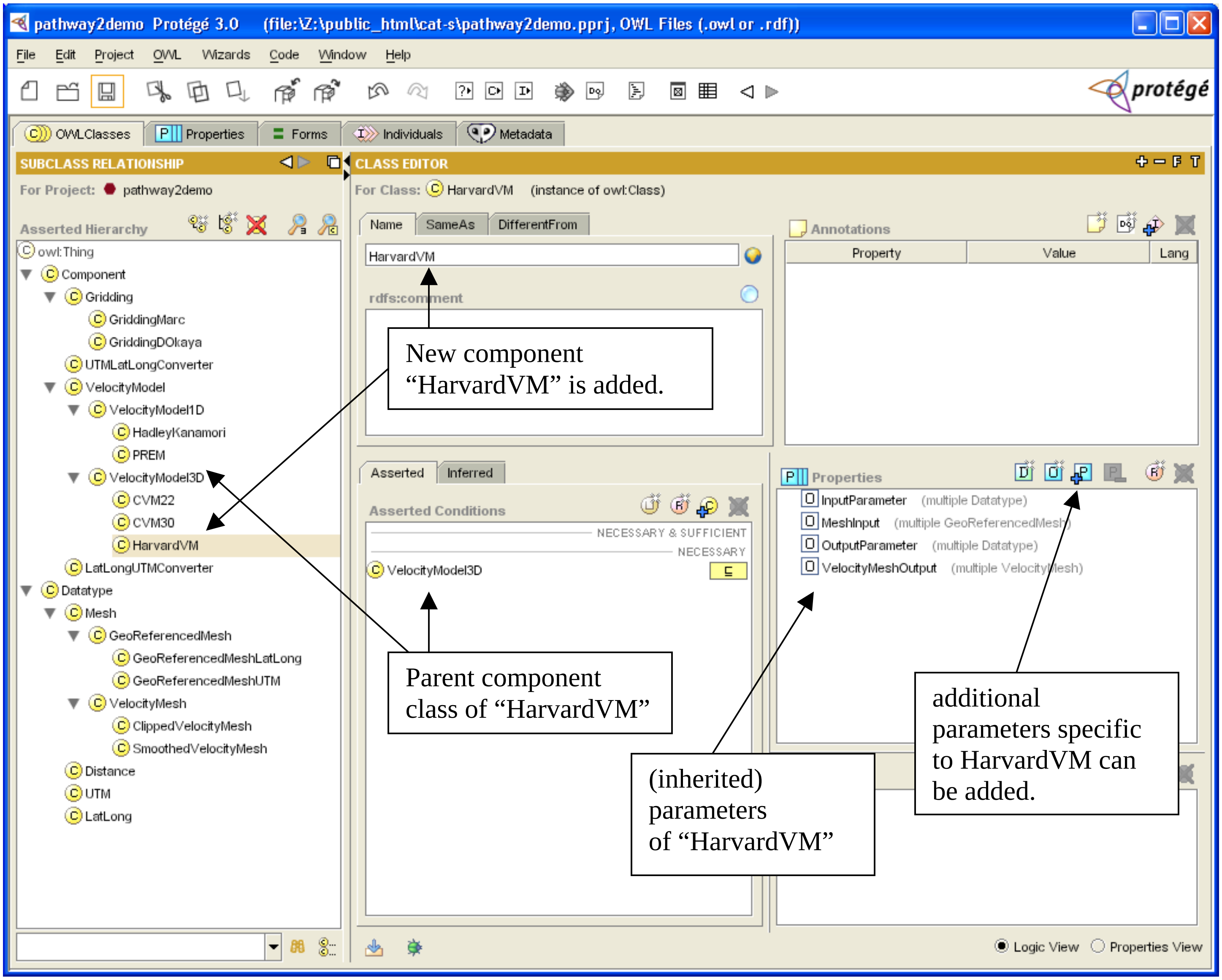
Components

Datatypes

Parameters of selected component “Gridding DOkaya”

Figure 5a. The component library in Protégé.

Currently, the library loaded into CAT is written in the OWL (Ontology Web Language) standard. The Protégé ontology editor is an easy way to create or modify CAT’s component library. The library used in this walkthrough (and shown in CAT in figure 2b) is shown in the Protégé editor in figure 5a. Adding / removing / changing a component or a datatype is fairly simple in Protégé, as is editing the parameters (and their datatypes) of a given component.



New component "HarvardVM" is added.

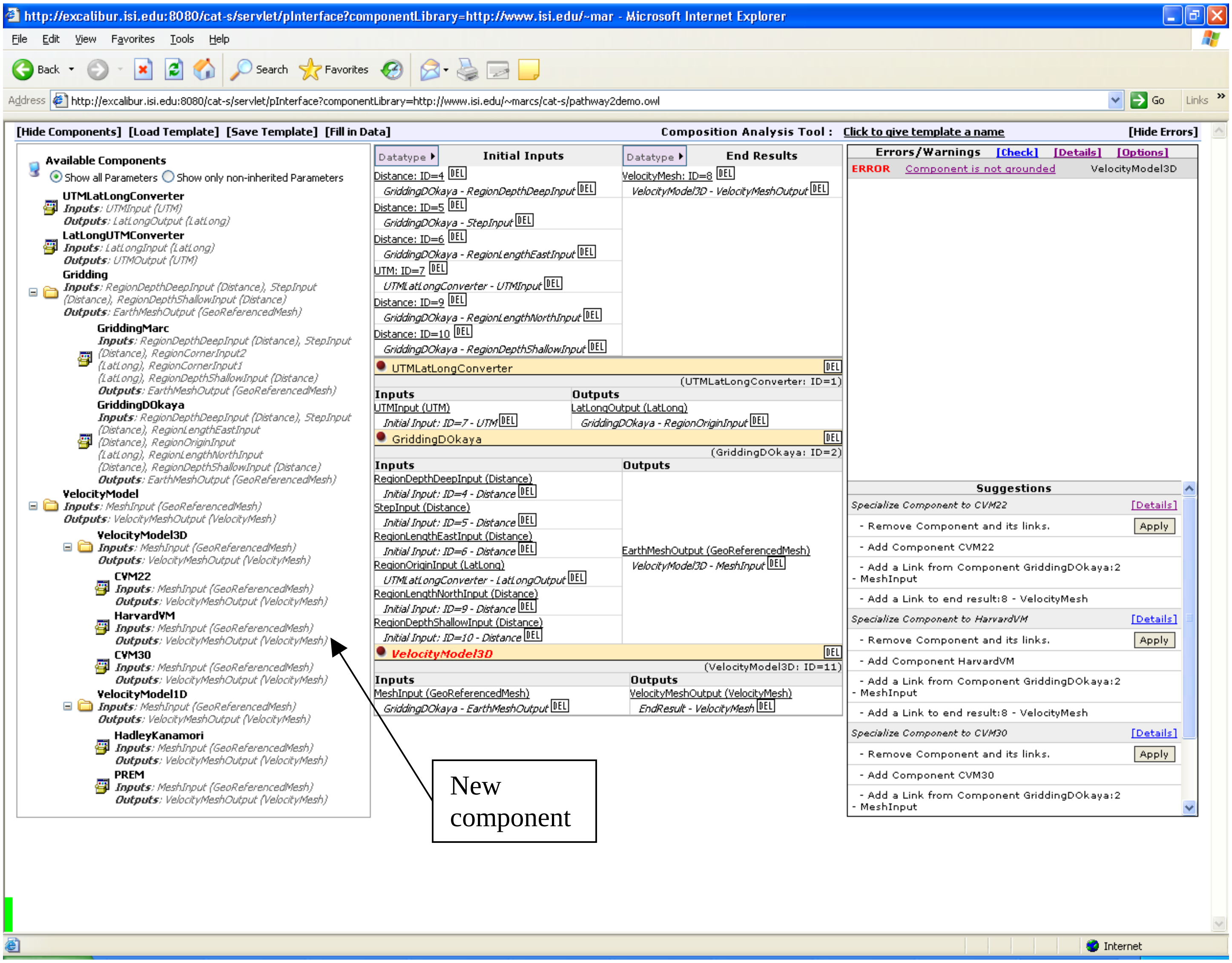
Parent component class of "HarvardVM"

(inherited) parameters of "HarvardVM"

additional parameters specific to HarvardVM can be added.

Figure 5b. A new component "HarvardVM" is added.

Assume that the user adds a new component called "HarvardVM." If "HarvardVM" is defined as a subclass of "VelocityModel3D", then it will automatically inherit all input and output parameters of its parent class. Any changes made and saved in Protégé will be saved in an OWL file. CAT uses the OWL specification, so the new component can be seen in CAT's component library when CAT is reloaded, as seen in figure 5c (compare with figure 2a).


http://excalibur.isi.edu:8080/cat-s/servlet/pInterface?componentLibrary=http://www.isi.edu/~mar - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://excalibur.isi.edu:8080/cat-s/servlet/pInterface?componentLibrary=http://www.isi.edu/~marcs/cat-s/pathway2demo.owl
Go
Links
Internet
New component

[Hide Components] [Load Template] [Save Template] [Fill in Data]

Composition Analysis Tool : Click to give template a name

[Hide Errors]

Available Components

● Show all Parameters ○ Show only non-inherited Parameters

UTMLatLongConverter
Inputs: UTMInput (UTM)
Outputs: LatLongOutput (LatLong)

LatLongUTMConverter
Inputs: LatLongInput (LatLong)
Outputs: UTMOutput (UTM)

Gridding
Inputs: RegionDepthDeepInput (Distance), StepInput (Distance), RegionDepthShallowInput (Distance)
Outputs: EarthMeshOutput (GeoReferencedMesh)

- **GriddingMarc**
  Inputs: RegionDepthDeepInput (Distance), StepInput (Distance), RegionCornerInput2 (LatLong), RegionCornerInput1 (LatLong), RegionDepthShallowInput (Distance)
  Outputs: EarthMeshOutput (GeoReferencedMesh)
- **GriddingDOkaya**
  Inputs: RegionDepthDeepInput (Distance), StepInput (Distance), RegionLengthEastInput (Distance), RegionOriginInput (LatLong), RegionLengthNorthInput (Distance), RegionDepthShallowInput (Distance)
  Outputs: EarthMeshOutput (GeoReferencedMesh)

VelocityModel
Inputs: MeshInput (GeoReferencedMesh)
Outputs: VelocityMeshOutput (VelocityMesh)

- **VelocityModel3D**
  Inputs: MeshInput (GeoReferencedMesh)
  Outputs: VelocityMeshOutput (VelocityMesh)
  - **CVM22**
    Inputs: MeshInput (GeoReferencedMesh)
    Outputs: VelocityMeshOutput (VelocityMesh)
  - **HarvardVM**
    Inputs: MeshInput (GeoReferencedMesh)
    Outputs: VelocityMeshOutput (VelocityMesh)
  - **CVM30**
    Inputs: MeshInput (GeoReferencedMesh)
    Outputs: VelocityMeshOutput (VelocityMesh)
- **VelocityModel1D**
  Inputs: MeshInput (GeoReferencedMesh)
  Outputs: VelocityMeshOutput (VelocityMesh)
  - **HadleyKanamori**
    Inputs: MeshInput (GeoReferencedMesh)
    Outputs: VelocityMeshOutput (VelocityMesh)
  - **PREM**
    Inputs: MeshInput (GeoReferencedMesh)
    Outputs: VelocityMeshOutput (VelocityMesh)

Datatype ▸ **Initial Inputs**	Datatype ▸ **End Results**
Distance: ID=4 DEL *GriddingDOkaya - RegionDepthDeepInput* DEL	VelocityMesh: ID=8 DEL *VelocityModel3D - VelocityMeshOutput* DEL
Distance: ID=5 DEL *GriddingDOkaya - StepInput* DEL	
Distance: ID=6 DEL *GriddingDOkaya - RegionLengthEastInput* DEL	
UTM: ID=7 DEL *UTMLatLongConverter - UTMInput* DEL	
Distance: ID=9 DEL *GriddingDOkaya - RegionLengthNorthInput* DEL	
Distance: ID=10 DEL *GriddingDOkaya - RegionDepthShallowInput* DEL	

● UTMLatLongConverter DEL

(UTMLatLongConverter: ID=1)

Inputs	**Outputs**
UTMInput (UTM) *Initial Input: ID=7 - UTM* DEL	LatLongOutput (LatLong) *GriddingDOkaya - RegionOriginInput* DEL

● GriddingDOkaya DEL

(GriddingDOkaya: ID=2)

Inputs	**Outputs**
RegionDepthDeepInput (Distance) *Initial Input: ID=4 - Distance* DEL	EarthMeshOutput (GeoReferencedMesh) *VelocityModel3D - MeshInput* DEL
StepInput (Distance) *Initial Input: ID=5 - Distance* DEL	
RegionLengthEastInput (Distance) *Initial Input: ID=6 - Distance* DEL	
RegionOriginInput (LatLong) *UTMLatLongConverter - LatLongOutput* DEL	
RegionLengthNorthInput (Distance) *Initial Input: ID=9 - Distance* DEL	
RegionDepthShallowInput (Distance) *Initial Input: ID=10 - Distance* DEL	

● ***VelocityModel3D*** DEL

(VelocityModel3D: ID=11)

Inputs	**Outputs**
MeshInput (GeoReferencedMesh) *GriddingDOkaya - EarthMeshOutput* DEL	VelocityMeshOutput (VelocityMesh) *EndResult - VelocityMesh* DEL

Errors/Warnings [Check] [Details] [Options]

ERROR Component is not grounded VelocityModel3D

Suggestions

Specialize Component to CVM22 [Details]
- Remove Component and its links. Apply
- Add Component CVM22
- Add a Link from Component GriddingDOkaya:2 - MeshInput
- Add a Link to end result:8 - VelocityMesh

Specialize Component to HarvardVM [Details]
- Remove Component and its links. Apply
- Add Component HarvardVM
- Add a Link from Component GriddingDOkaya:2 - MeshInput
- Add a Link to end result:8 - VelocityMesh

Specialize Component to CVM30 [Details]
- Remove Component and its links. Apply
- Add Component CVM30
- Add a Link from Component GriddingDOkaya:2 - MeshInput

Figure 5c. CAT interface with new component "HarvardVM" in library.