PyLith Modeling Tutorial

Meshing with Complex Geometry

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Meshing Complex Geometry

Steps in creating a mesh

- Determine geometric features needed
  - Fault geometry
  - Topography
  - Sharp structural boundaries
  - Magma sources with complex geometry
- Create spline curve (2D) or NURBS surface (3D) in CUBIT/Trelis
- If using surface in several models export it for future use
- Use surfaces within CUBIT/Trelis to webcut volumes
- Choose discretization according to type of problem

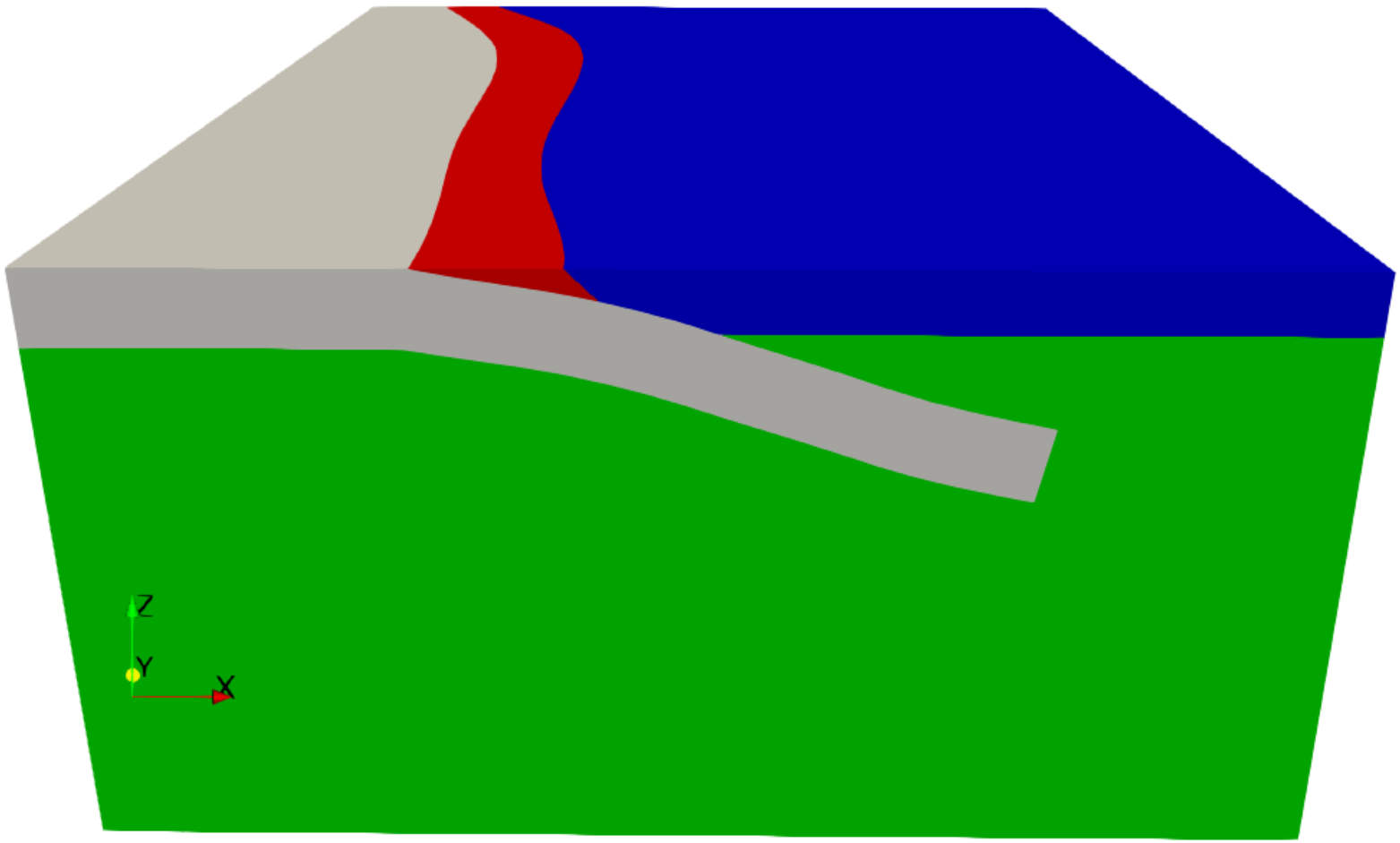
Meshing of a subduction zone

3-D coarse meshing of Cascadia with a simulated splay fault

- Three-dimensional Cascadia subduction zone example `examples/3d/subduction/mesh`
  - Generate fault surfaces and export as ACIS files using `generate_surfjou.py` script to create `geometry_surfs.jou` file.
    - Generate subduction interface from SLAB1.0 contours – script performs georeferencing to our local coordinates system as well as creating journal files.
    - Generate slab bottom as an offset from subduction interface.
    - Generate fictitious splay fault along a contour of subduction interface.
  - Generate volume geometry using `geometry.jou`.
  - Generate mesh using either `mesh_hex.jou` or `mesh_tet.jou`.

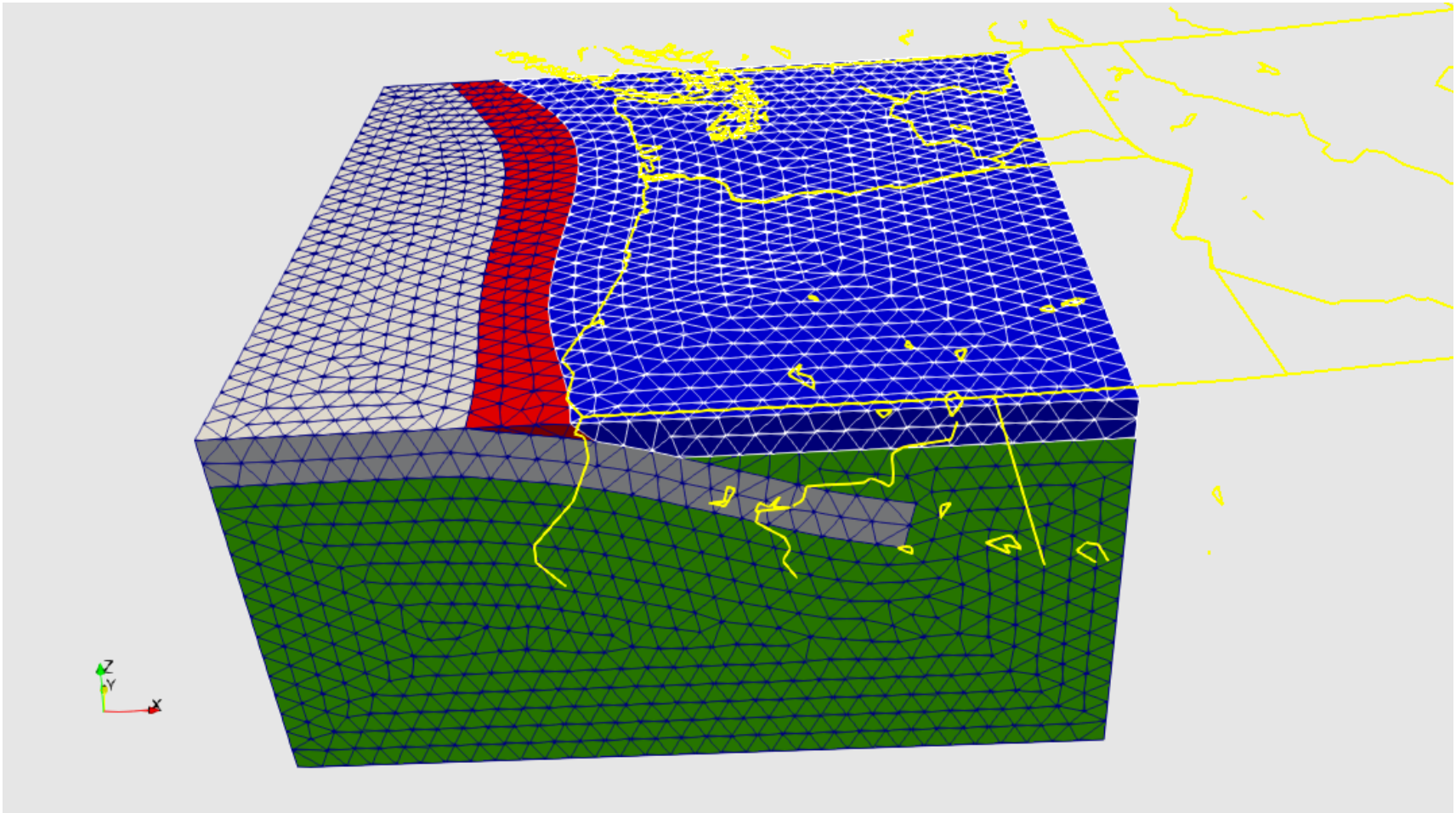
Simulated Cascadia Subduction Zone

Geometry with subduction thrust, slab and crust bottom, and splay fault



Tetrahedral mesh generated for Cascadia problem

Constant resolution mesh with approximately 144k cells



What's missing

Additional modifications for real problems

- Mesh needs to be larger to move boundaries away from region of interest.
  - Enclose inner region in a larger box.
  - Let Trelis/Cubit mesh internal surfaces (untested).
- The mesh is much too coarse and not graded.
  - Use sizing function to create a nicely graded mesh. See `examples/meshing/cubit_cellsize` for an example.

NOTE: If anyone does not have Cubit/Trelis, the mesh is available on the PyLith wiki:
https://wiki.geodynamics.org/software:pylith:cdm2017