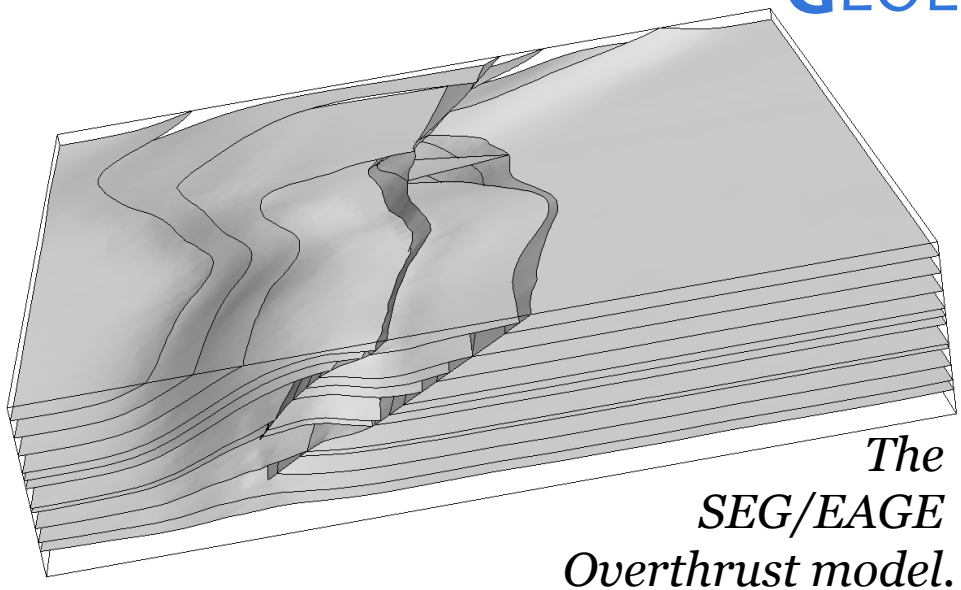
RINGMESH: AN OPEN-SOURCE DATA MODEL FOR INTEGRATIVE NUMERICAL GEOLOGY



The SEG/EAGE Overthrust model.

http://www.ringmesh.org

Francois Bonneau (RING/GeoRessources)
Arnaud Botella (ASGA/Total S.A.)
Pierre Anquez (RING/GeoRessources)
Antoine Mazuyer (RING/GeoRessources)
Benjamin Chauvin (EPS/Harvard)
Guillaume Caumon (RING/GeoRessources)

A Geological Model

A tool to explore subsurface uncertainties & test scenarios

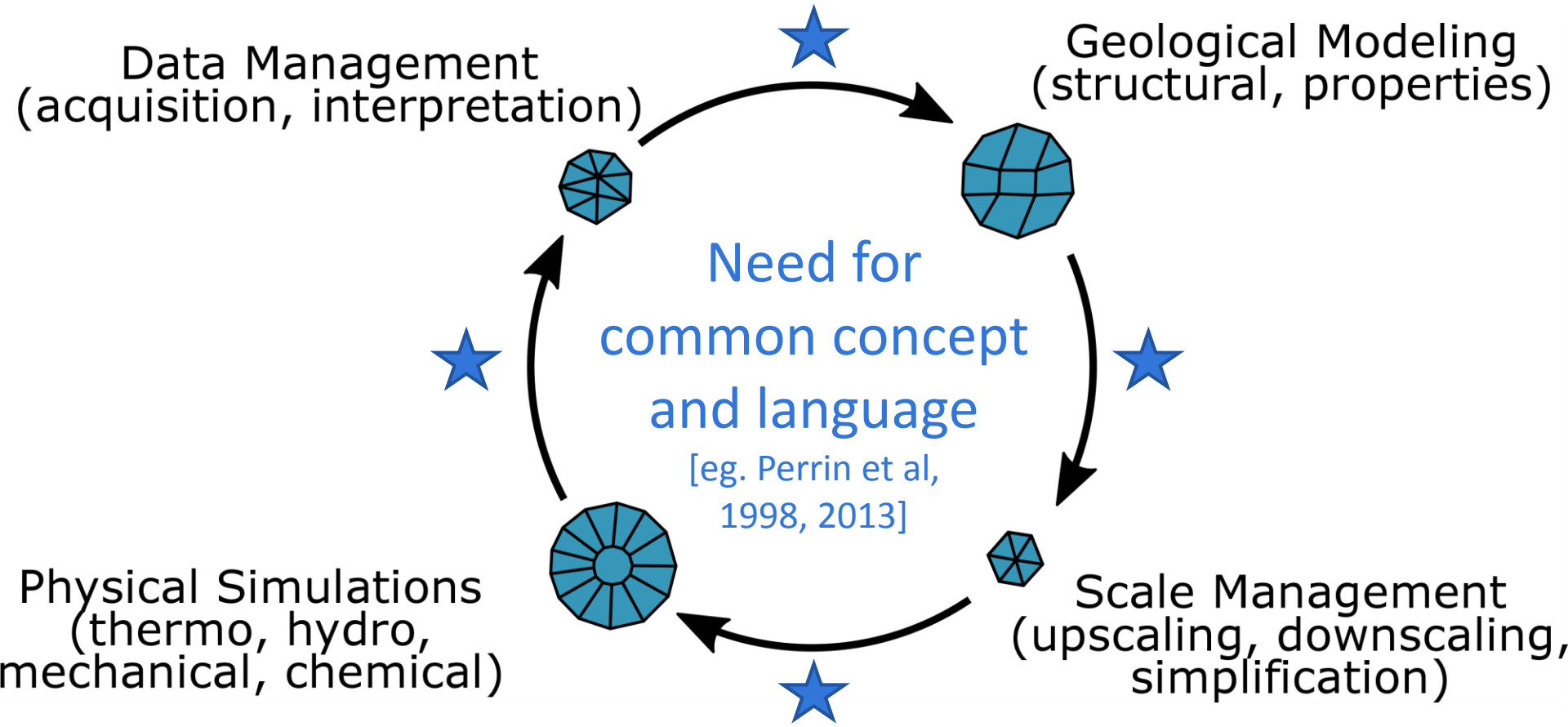
Confronts subsurface data and geological concepts to support decisions

Communicates with physical simulators at the appropriate scale

The classical modeling chain

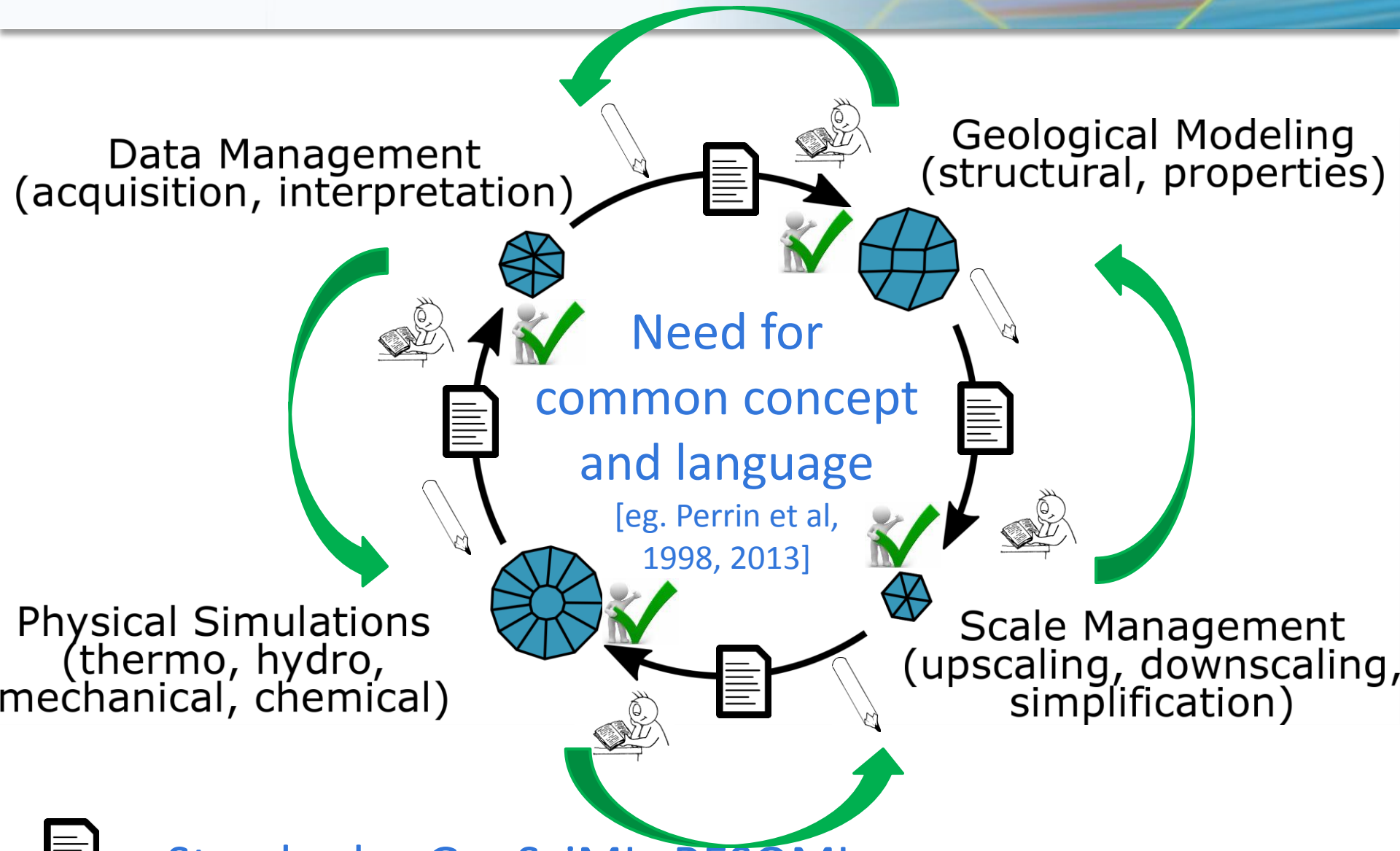
Data Management
(acquisition, interpretation)

The classical modeling chain



★ Share data/interpretations/uncertainties

The classical modeling chain

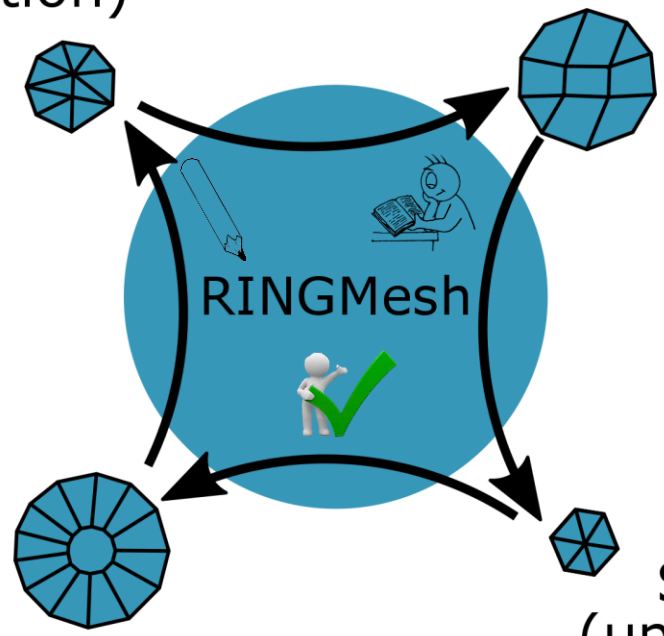


Standards : GeoSciML, RESQML [Morandini et al., 2011, 2017]

Platform to exchange geomodeling information

Data Management
(acquisition, interpretation)

Geological Modeling
(structural, properties)



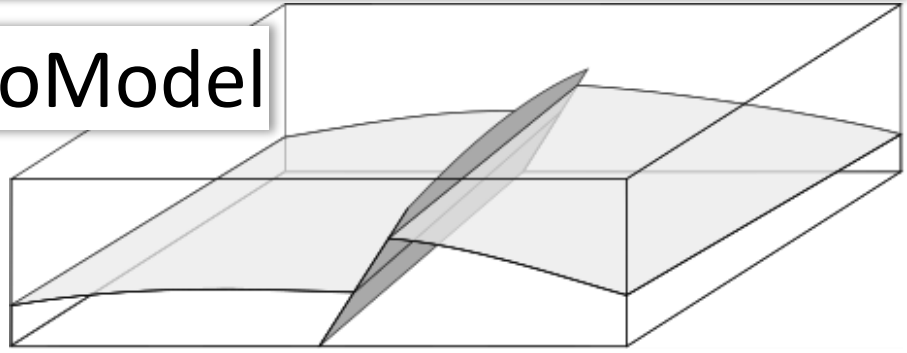
Physical Simulations
(thermo, hydro,
mechanical, chemical)

Scale Management
(upscaling, downscaling,
simplification)

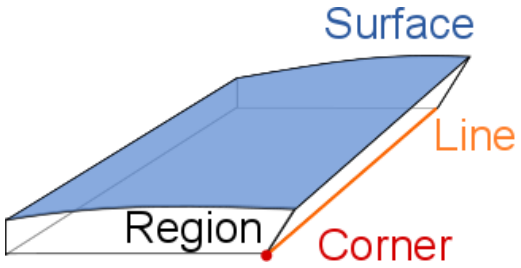
Pellerin et al. C&G, 2017

An open and extensive data model

The GeoModel

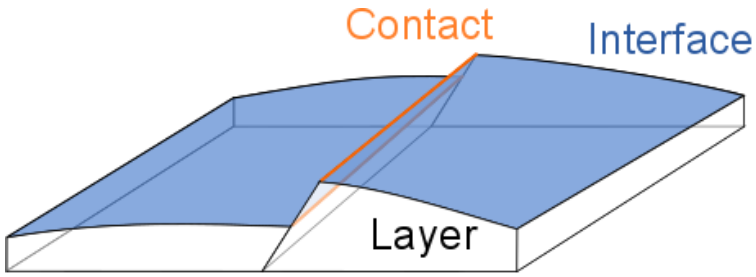


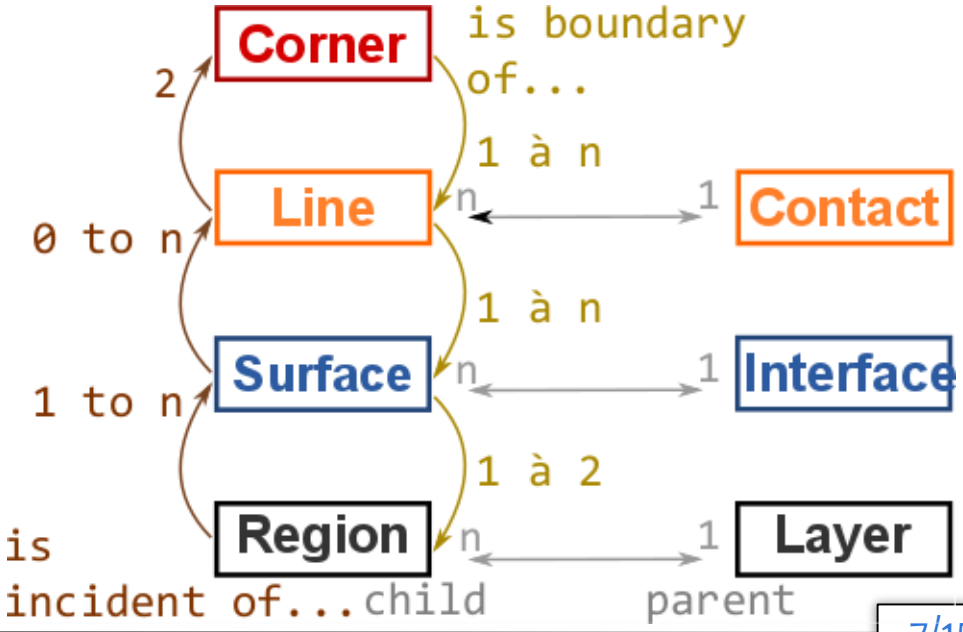
Geometrical entities



Topological Relationships

Geological entities

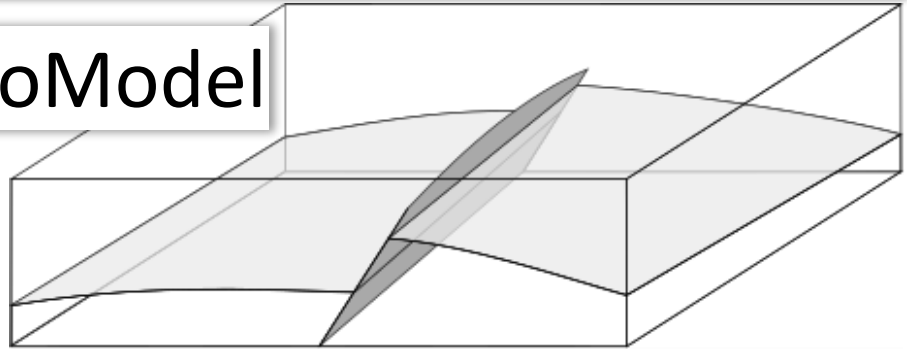




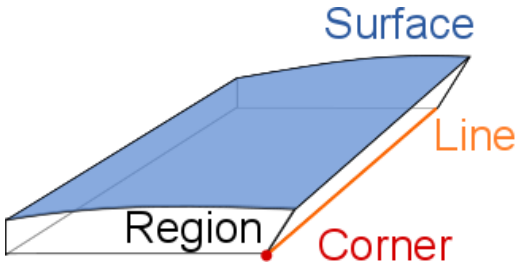
Pellerin et al. C&G, 2017

An open and extensive data model

The GeoModel



Geometrical entities



Topological Relationships

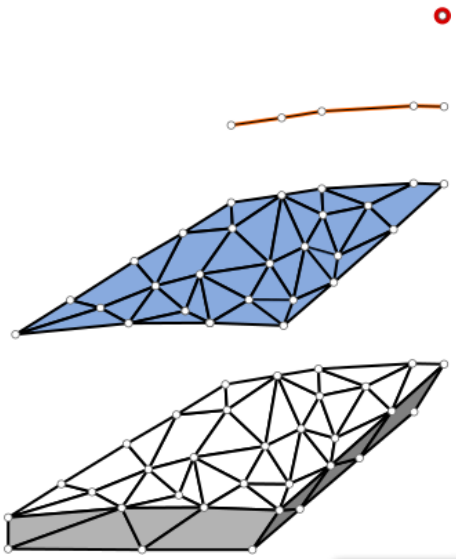
Mesh held by geometrical entities

Corner
one vertex

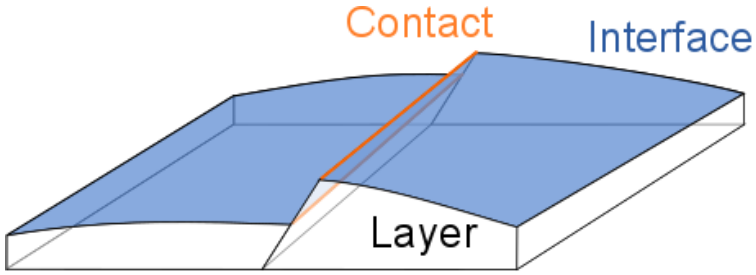
Line
Set of edges

Surface
Set of polygons

Region
Set of cells



Geological entities



Pellerin et al. C&G, 2017

Geogram, B. Levy

An open and extensive toolbox

- Integrative
  - Supports various input/output file formats
  - Loads and exports GeoModel → smart converter

  → To-do : add standard file formats

- Validity checks
  - Topological & geometrical validity check

  → To-do : provide customizable validity check

- Visualization tools (e.g. http://mazuyer-cageo2017.ring-team.org)

- Extensible platform
  - Plugin manager
  - Open-source project

Application: stress estimation

by solving PDEs with

the FEM method

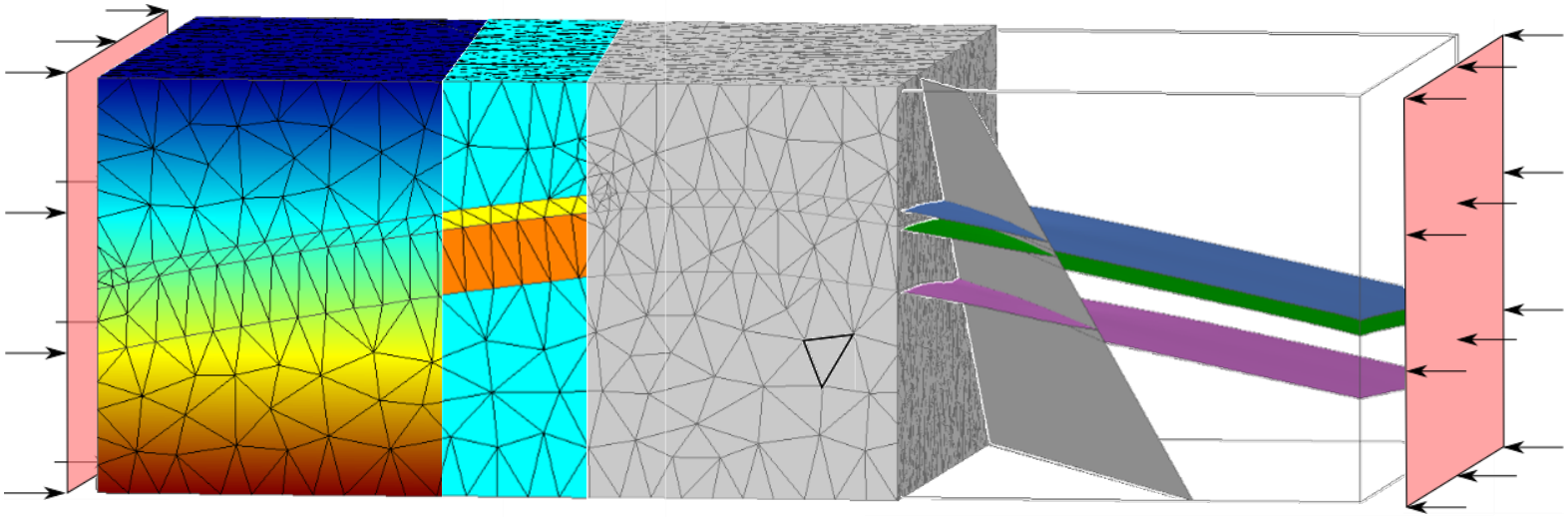
on unstructured meshes..

➔Several complementary solvers can be used…

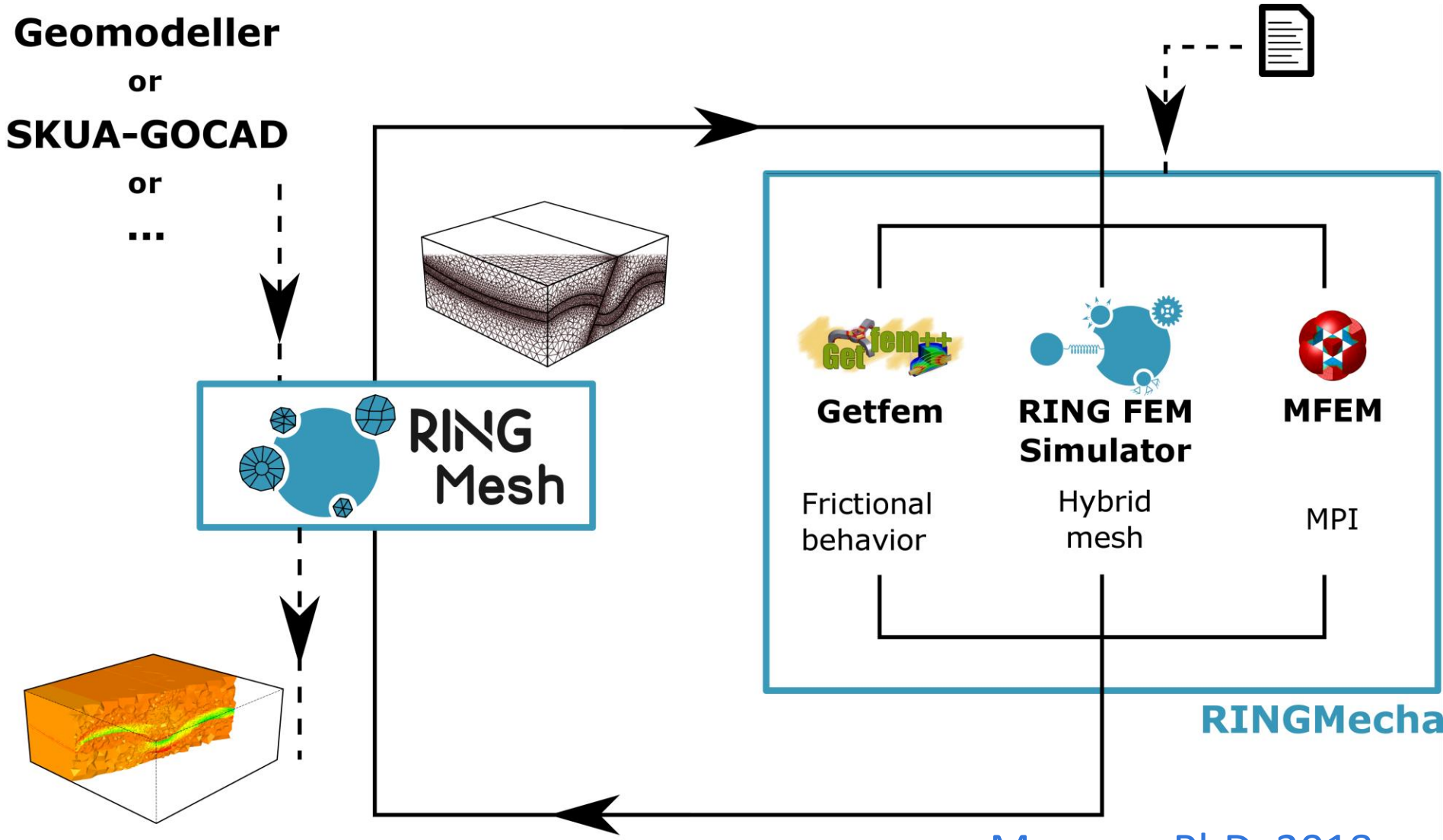
How to efficiently benefit from their strength?

Ease model definitions

- Geological model
  - Boundary representation
  - Volume discretization
  - Rock properties
- Physical model
  - Equation(s)
  - State properties
  - Boundary and initial conditions

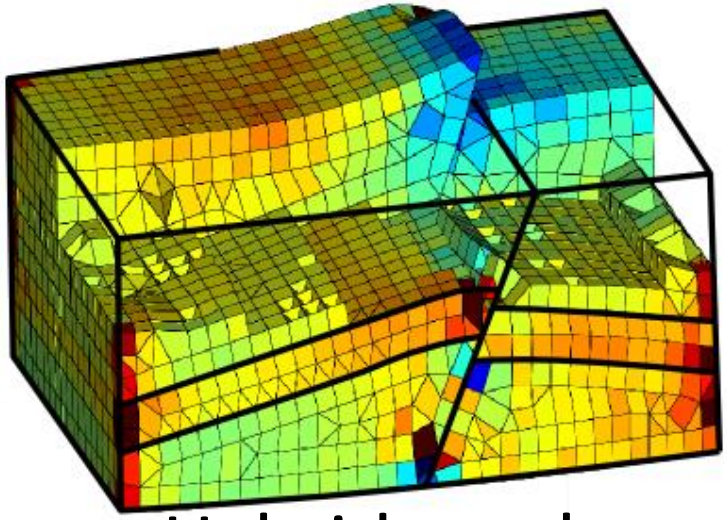


Bind software and libraries



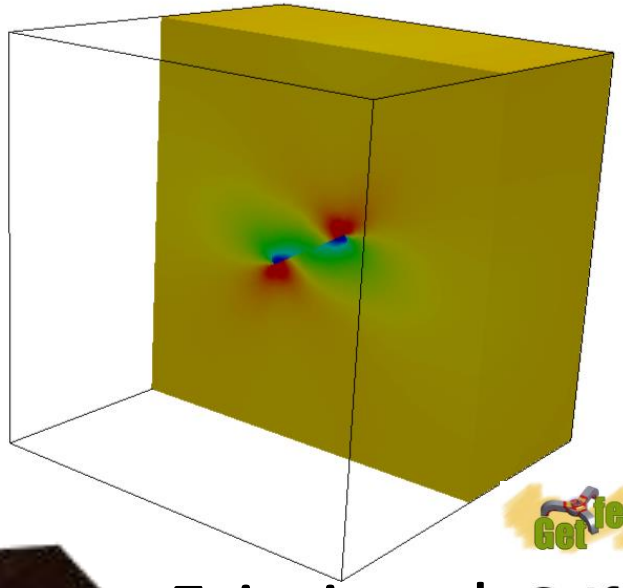
Mazuyer PhD, 2018

Results … Antoine Mazuyer's PhD



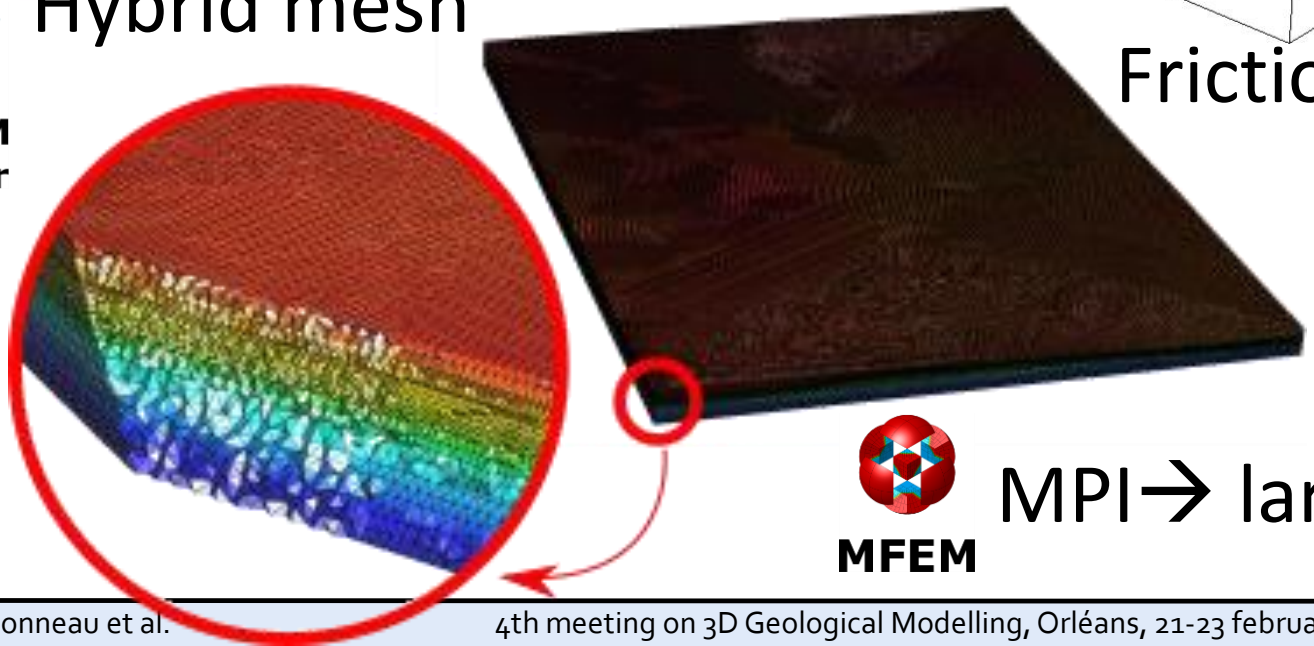
Hybrid mesh

RING FEM Simulator



Frictional behavior

Getfem



MFEM

MPI→ large mesh

RINGMesh: open-source development platform

- The GeoModel data structure
  - allows integrative workflow
  - enhances the interoperability between software packages
  - independently represents the topology and the geometry of geological models

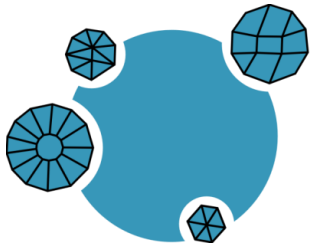
- Generic tools:
  - support various in/out file formats
  - check the validity of GeoModels
  - visualize GeoModels

- Open-source and extensible toolbox

Thank you for your attention

We welcome and encourage any

feedback and external contributions



- Source code on GitHub: https://github.com/ringmesh
- Information and tutorial: http://ringmesh.org/
- Contact us : contact@ringmesh.org

Thanks to:

- **The RING-Gocad consortium and Total for funding**
- **INRIA** for the GeoGram Library : **http://alice.loria.fr/software/geogram/doc/html/index.html**