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SIMO project

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Faculty of Agriculture and Forestry / Department of Forest Resource Management / SIMO

What is SIMO?

- SIMO
  - SIMulation and Optimization project
  - 1.10. 2004 – 31.9.2007
- General aim
  - to develope moduls of forest planning system as open source software
  - not necessarily to produce a ready-made planning system such as MELA
  - but to provide forestry knowledge for IT companies to build planning systems for each organization involved
- Everything the project produces is freely dowloadable from http://honeybee.helsinki.fi/mmvar/SIMO/

Involved parties

- UPM-Kymmene forest
  - Coordinator of the project forestry director Jyrki Kangas
- Tornator oy
  - governs forests owned formerly by Stora-Enso in Finland
- Metsämannut oy
  - governs forests owned by Metsäliitto (M-REAL)
- Finnish Forest and Park Service (Metsähallitus)
  - governs state-owned forests
- Forestry Development Centre Tapio
  - private forestry organization
- Forestry Centres
  - regional organizations of private forestry

Funding

- Funding of the project comes
  - almost 3/4 directly from the forestry organizations
  - 1/4 from the funds of Helsinki University
- The forestry organizations get 50% of their funding from TEKES
  - Finnish Funding Agency for Technology and Innovation

People involved

- Leader of the project has been professor Timo Tokola
- Annika Kangas will continue when Timo leaves to Joensuu
- Researchers
  - Jussi Rasinmäki
  - Jouni Kalliovirta and
  - Antti Mäkinen
- ”Senior adviser”
  - Timo Pekkonen
- and four graduate students

The phases of the project

1. Data model
   - how the data is described in the system
2. Simulator
   - the growth and yield models
   - information of forest development
3. New generation optimization methods
   - meta-heuristics
   - linear programming (at least interface with JLP)
4. Quality control
   - quality of measured data
   - quality of data calculated with the system
     - depending on age of data etc.

Specific aims (1)

- The planning system should be
  - Flexible with respect to the data sets it uses
    - system can utilise stand inventory data, sample plot data, remote sensing data or a combination of all these
  - Flexible with respect to the models it uses
    - both treewise or standwise growth prediction models can be used, even for the same task
    - old models can be calibrated or adjusted to regional conditions

Specific aims (2)

- The planning system should be
  - Adaptable to the planning problem, for instance
    - number of alternatives per stand can be defined by user
      - small number for long-term problems
      - large number for short-term problems
    - all parameters like prices, interest rate and costs can be modified by the user
    - the length of each period can be chosen freely
      - e.g. 1-year periods or 5-year periods or a combination of them

Specific aims (3)

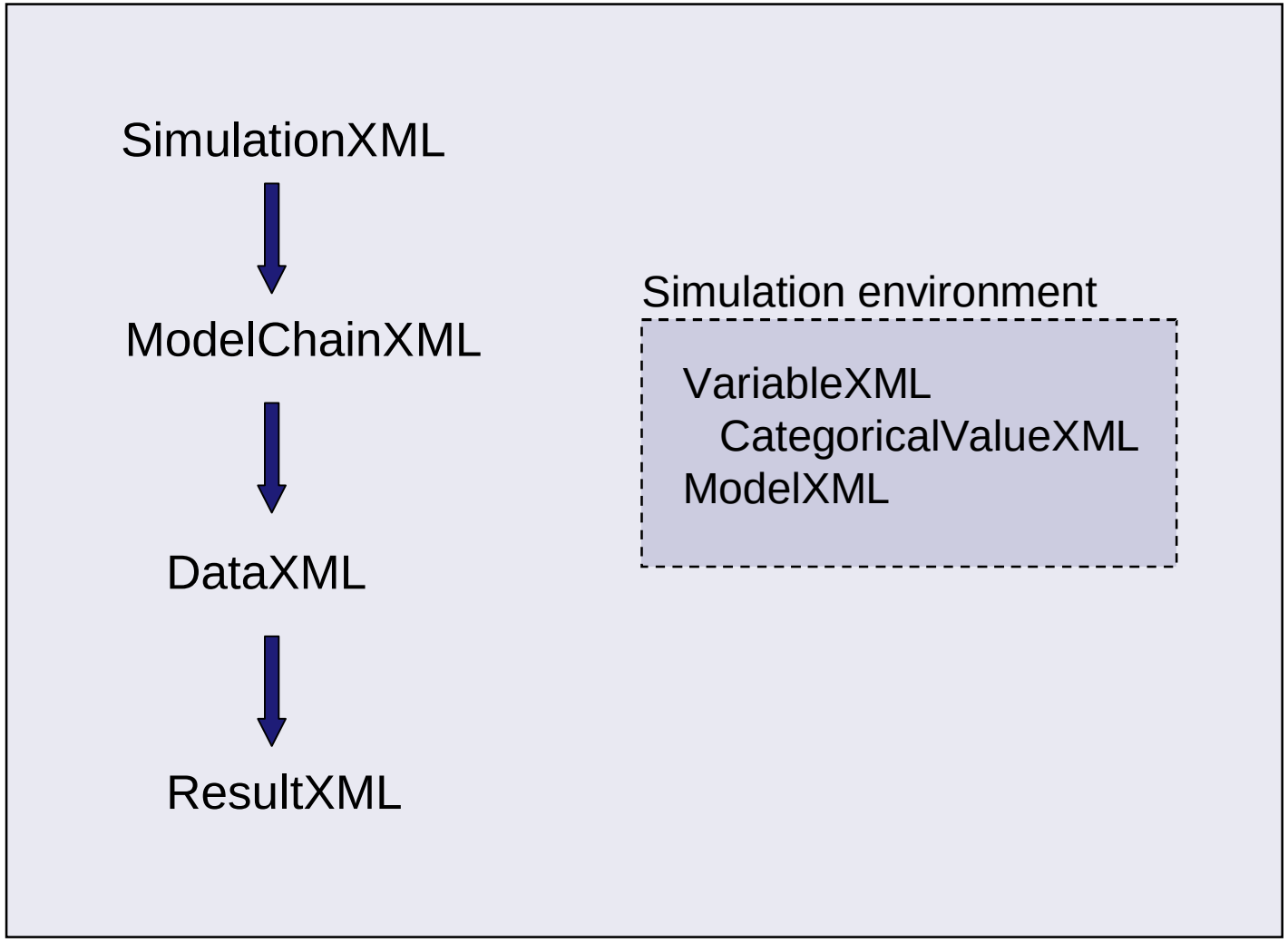
- The planning system should be
  - Extendable to future needs
    - new models can be introduced to the system by users (for instance for Russian or Baltic areas)
    - whole new simulation chains can be introduced by the user (when the model chains are different in different countries)
    - new variables and new data levels can be introduced by the user
      - variables concerning biomass, timber quality, etc.
      - sub-compartments

To accomplish all this...

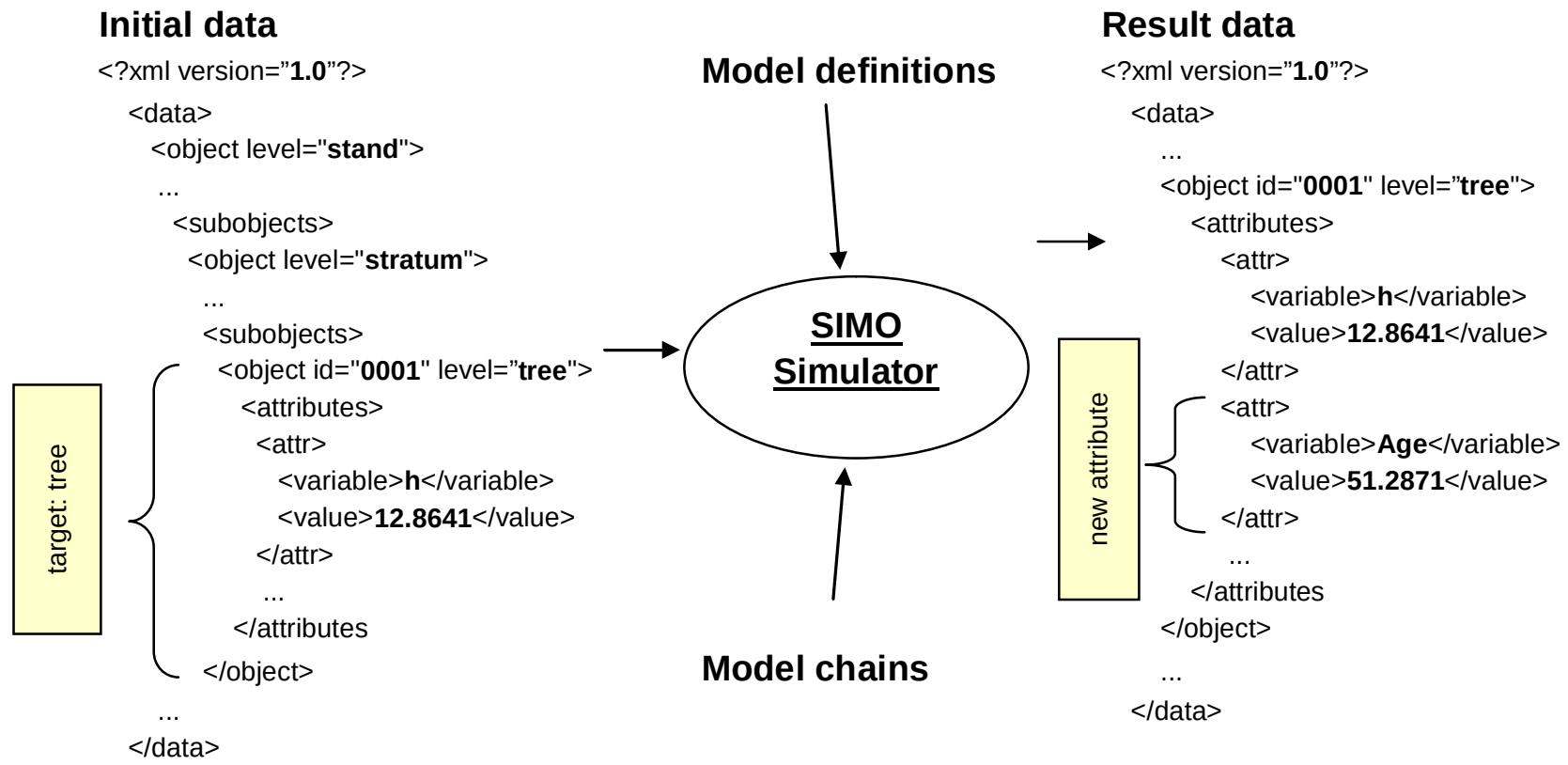
- The system itself is independent of the forestry information that needs to be modifiable
  - All forestry knowledge is presented in XML files
- XML files describe both
  - the data itself
  - and the description of the data
- The system itself
  - is programmed with Python language
  - reads the XML files
  - and builds the simulator from the XML files each time the program is used

SIMO XML -simulator

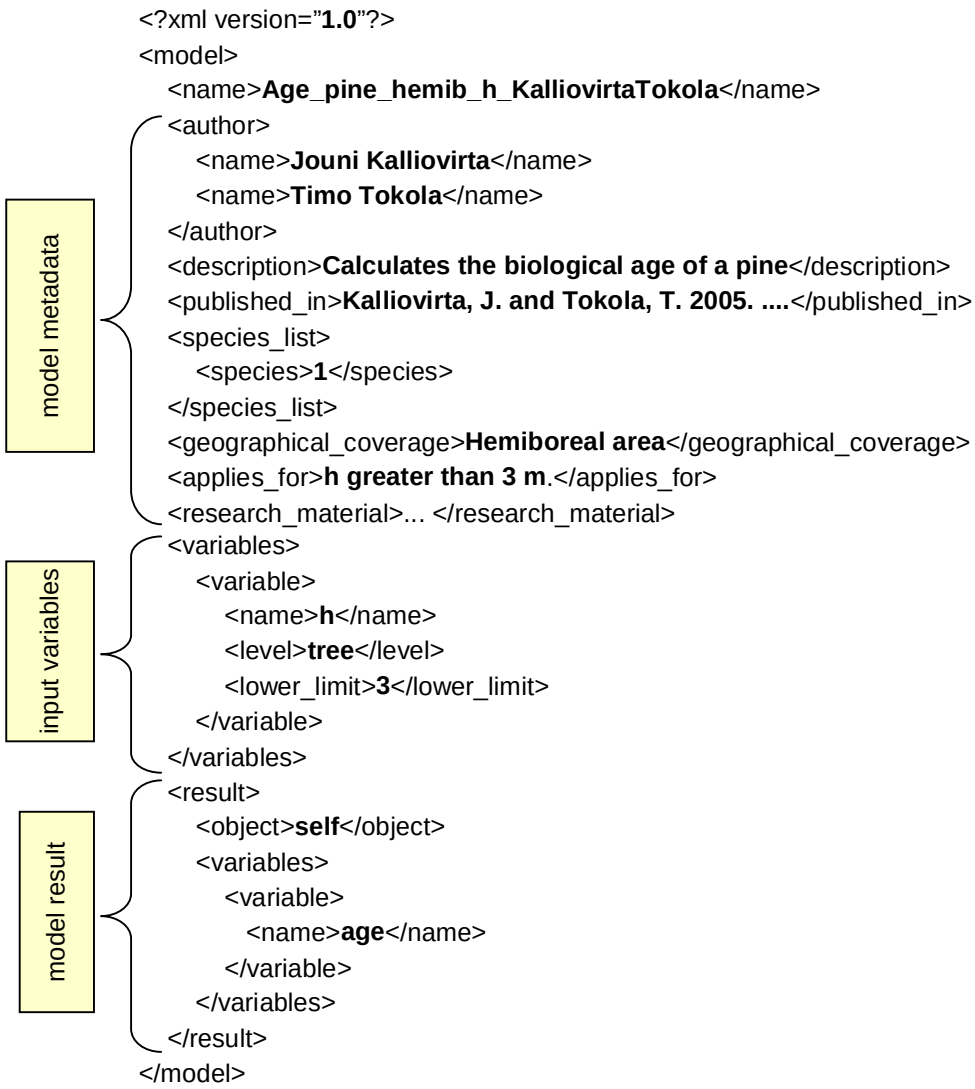
XML file view of the simulator



Example of SIMO data

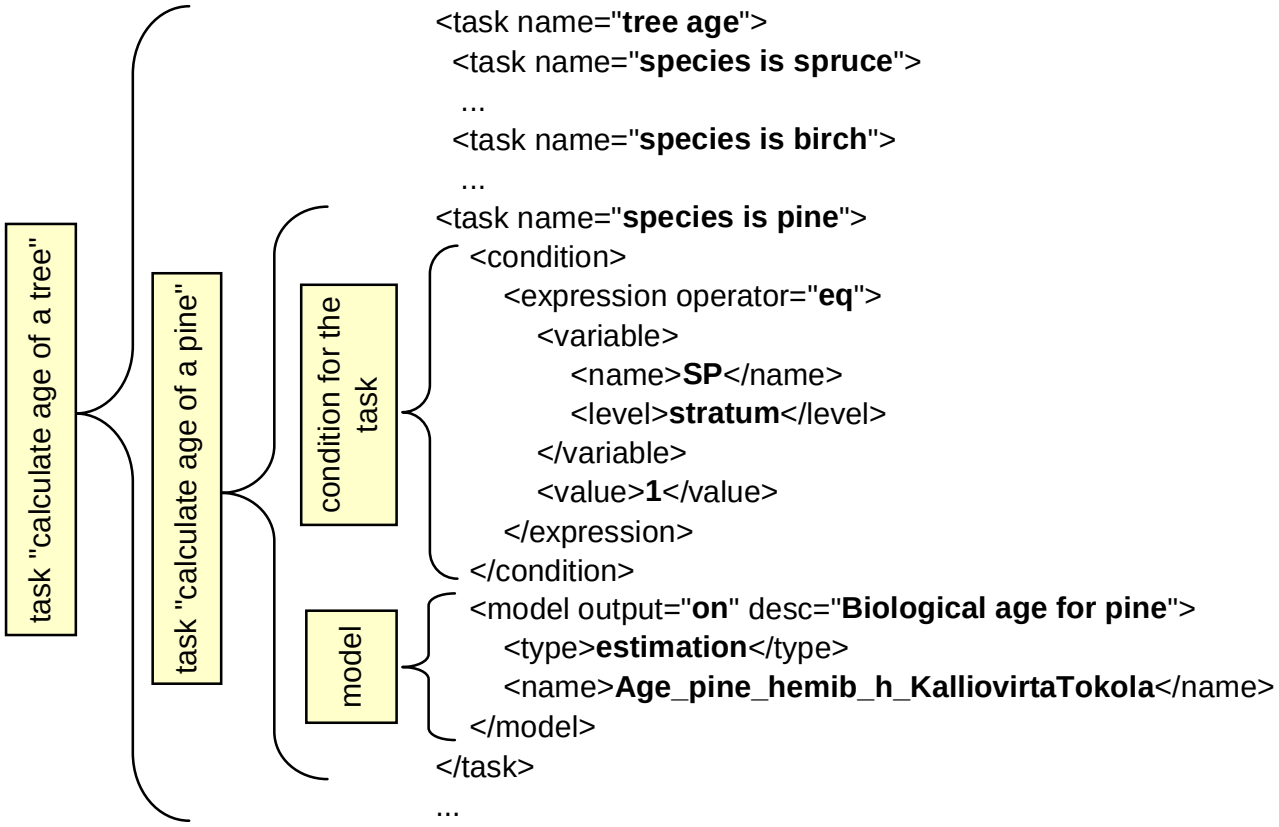


Example of a model




```
<?xml version="1.0"?>
<model>
   <name>Age_pine_hemib_h_KalliovirtaTokola</name>
   <author>
      <name>Jouni Kalliovirta</name>
      <name>Timo Tokola</name>
   </author>
   <description>Calculates the biological age of a pine</description>
   <published_in>Kalliovirta, J. and Tokola, T. 2005. ....</published_in>
   <species_list>
      <species>1</species>
   </species_list>
   <geographical_coverage>Hemiboreal area</geographical_coverage>
   <applies_for>h greater than 3 m.</applies_for>
   <research_material>... </research_material>
   <variables>
      <variable>
         <name>h</name>
         <level>tree</level>
         <lower_limit>3</lower_limit>
      </variable>
   </variables>
   <result>
      <object>self</object>
      <variables>
         <variable>
            <name>age</name>
         </variable>
      </variables>
   </result>
</model>
```

Example of a simulation task




```
<?xml version="1.0"?>
<model_chain>
   ...
   <task name="tree age">
    <task name="species is spruce">
     ...
    <task name="species is birch">
     ...
   <task name="species is pine">
      <condition>
         <expression operator="eq">
            <variable>
               <name>SP</name>
               <level>stratum</level>
            </variable>
            <value>1</value>
         </expression>
      </condition>
      <model output="on" desc="Biological age for pine">
         <type>estimation</type>
         <name>Age_pine_hemib_h_KalliovirtaTokola</name>
      </model>
   </task>
   ...
</model_chain>
```