

SimAmazonia-2, a basin-wide simulation model of Amazon landscape dynamics



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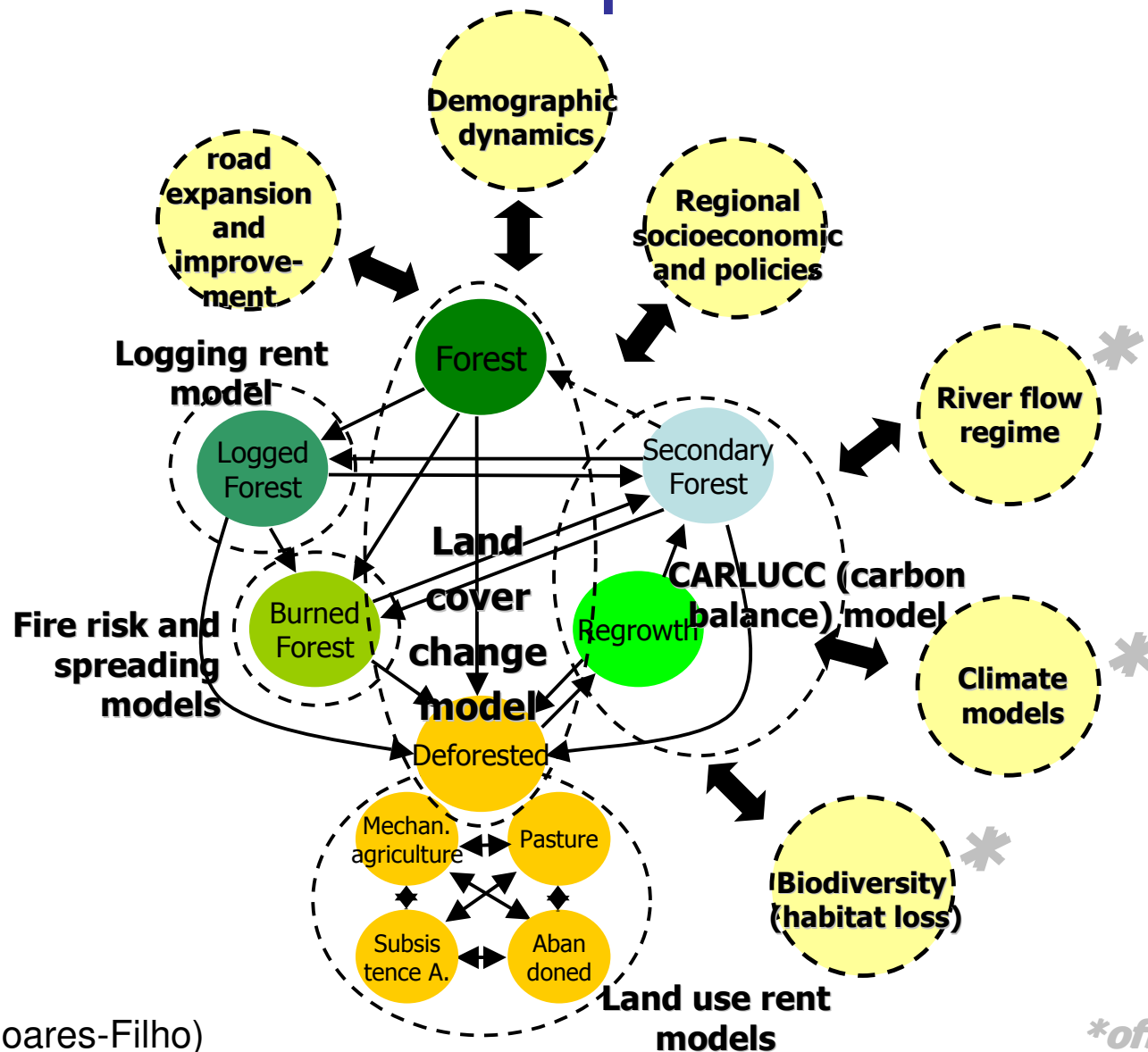


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SimAmazonia 2

- SimAmazonia 2 consists of a series of models, which simulate the various processes that describe Amazon landscape dynamics

Concept View



(Source: Soares-Filho)

**offline interaction*

Models

- **Deforestation model: responsive to public policies, migratory movements, infrastructure improvement, and cropland and cattle herd expansions ***
- Soybean crop rent model
- Cattle raising rent model

Models

- Economic logging model
- **Fire risk model** **
- CARLUCC: a model that simulates flows and sinks of carbon within the forest and from the forest to the atmosphere in response to climate change and forest disturbance

Implementation

- All models run simultaneously, exchanging data among themselves and employing together, as input, over a hundred maps at 2x2 km² raster resolution, each one composed of 2103x1561 cells
- Potential problems:
 - Complexity
 - Poor performance
 - Bad memory management
- Solution:
 - Choose the underlying simulation platform carefully.

Dinamica EGO

- **E**nvironment for **G**eoprocessing **O**bjects.
- Spatially explicit simulation model of landscape dynamics.
- Tool to investigate trajectory of landscapes and dynamics of spatial phenomena.
- Platform used to implement SimAmazonia 2.

Dinamica EGO

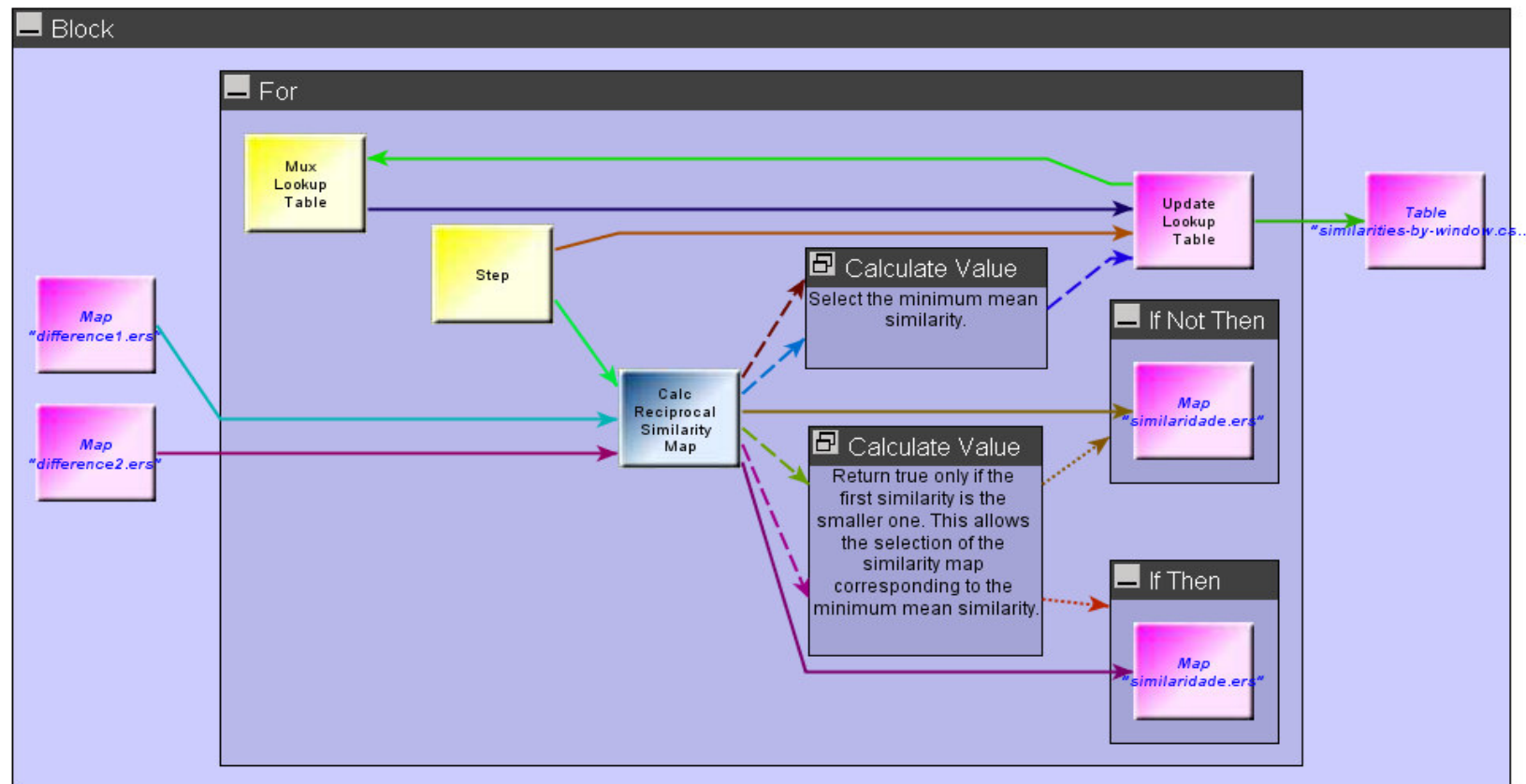
The screenshot displays the Dinamica EGO 1.0 software interface. The title bar indicates the file path: `D:\apresentacoes\Modelos\Rain\rain.xml`. The menu bar includes File, Edit, Viewer, Functors, Log level, Tools, and Help. The toolbar contains icons for file operations and simulation control.

The main workspace is divided into several panels:

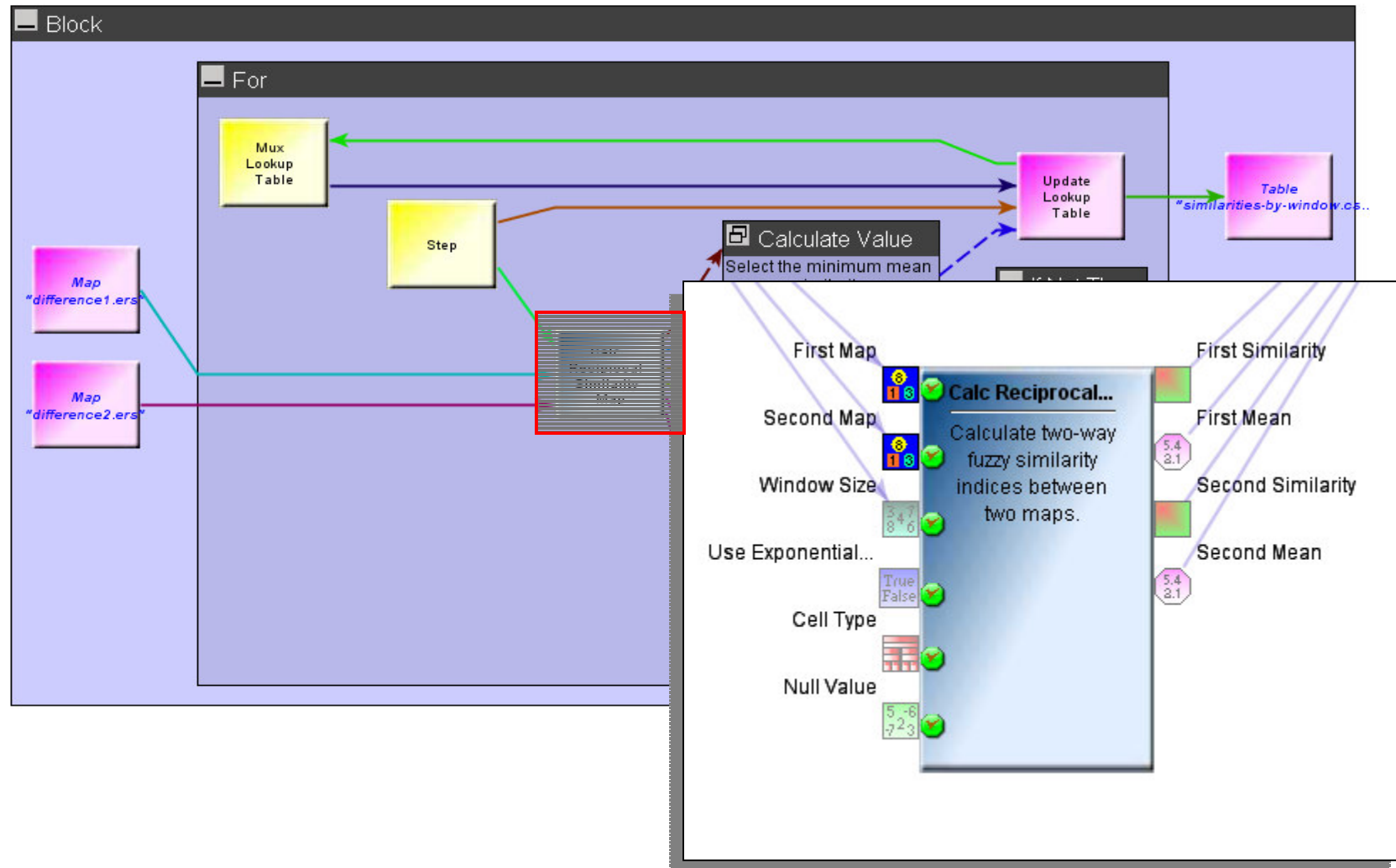
- Bird View:** A small map showing the spatial layout of the model.
- Tree view:** A hierarchical list of model components, including Root, LoadMap, SaveMap, Repeat, and MixMap.
- Functors Panel:** A grid of available functors categorized by function type: Map Algebra (Suppl.), Region, Simulation, Simulation (Suppl.), Stack, Stack (Suppl.), Statistics, Table, Validation, Calibration, Calibration (Suppl.), CarLuc, Control, Deprecated, Input/Output, Logging, and Map Algebra. Specific functors shown include Block, Exit, For, For Each, For Each Category, If Not Then, If Then, Join Categorical Map, Join Double, and Join Look Table.
- Model Canvas:** The central area where the model workflow is built. It shows a sequence of functors: a 'Repeat' functor, followed by a 'Block' containing multiple 'Calculate Map' functors, and a 'Repeat' functor at the end. The 'Calculate Map' functors are connected by a series of 'For Each' functors, indicating a nested loop structure.
- Repeat Dialog:** A modal dialog box titled 'Repeat' is open, showing the 'Number of iterations' set to 20. The dialog includes an 'Input' section and a 'Close' button.
- Message Log:** A panel at the bottom showing the execution log, including messages about reading and parsing the model script.

The status bar at the bottom indicates 'Editing model' and the copyright notice 'Dinamica ©'.

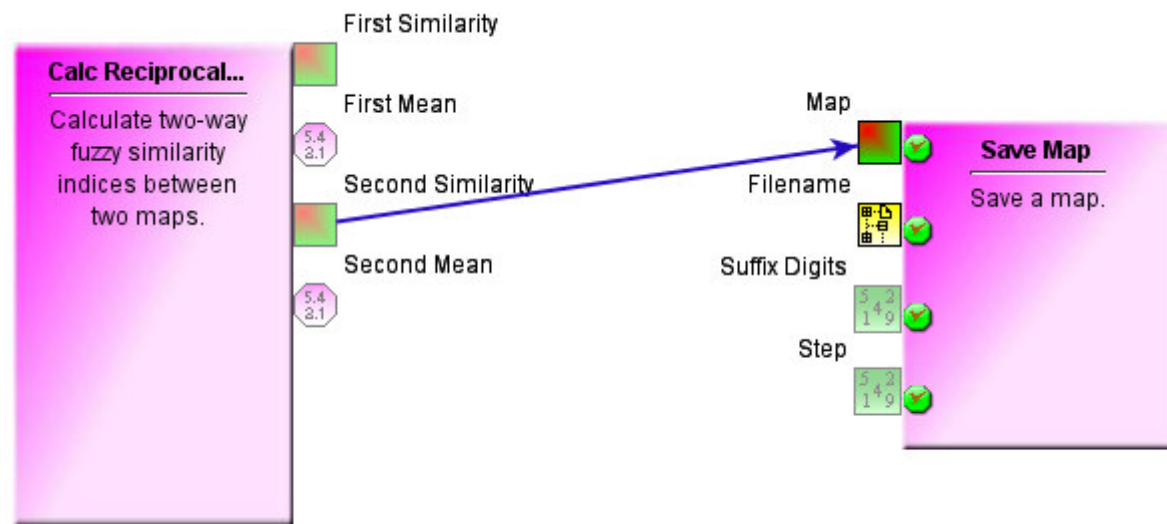
Dinamica EGO: In practical terms is a dataflow programming language



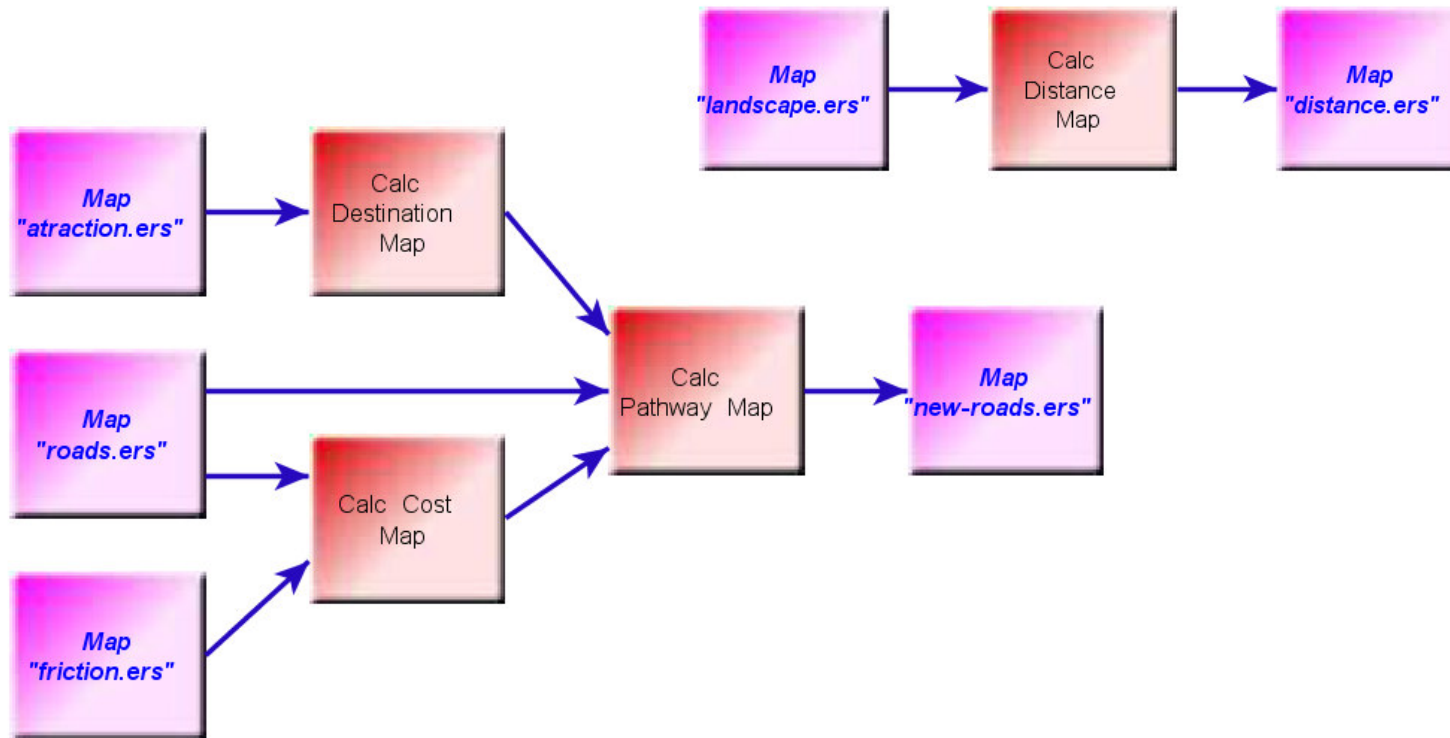
Operator



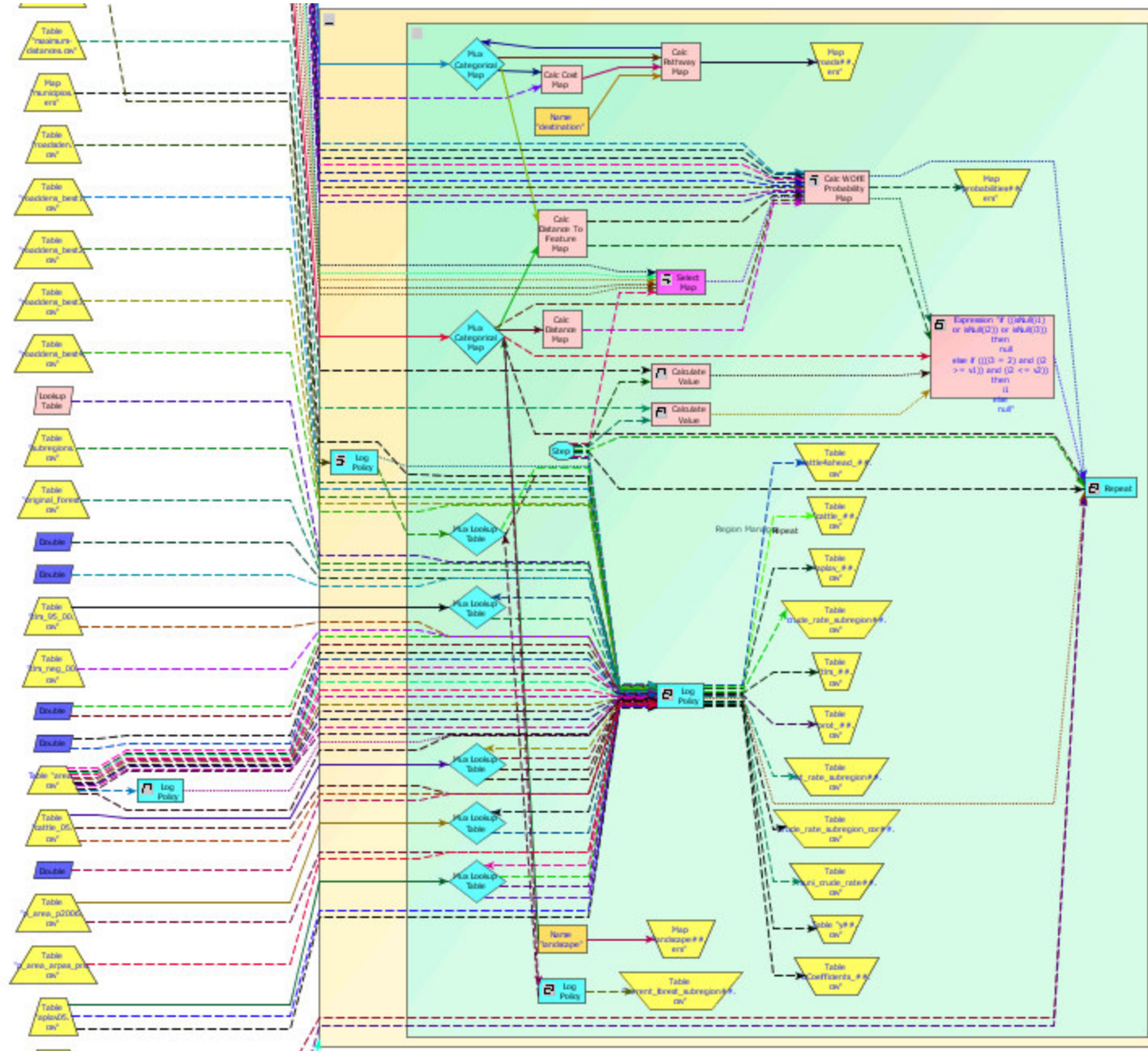
Operator Chaining



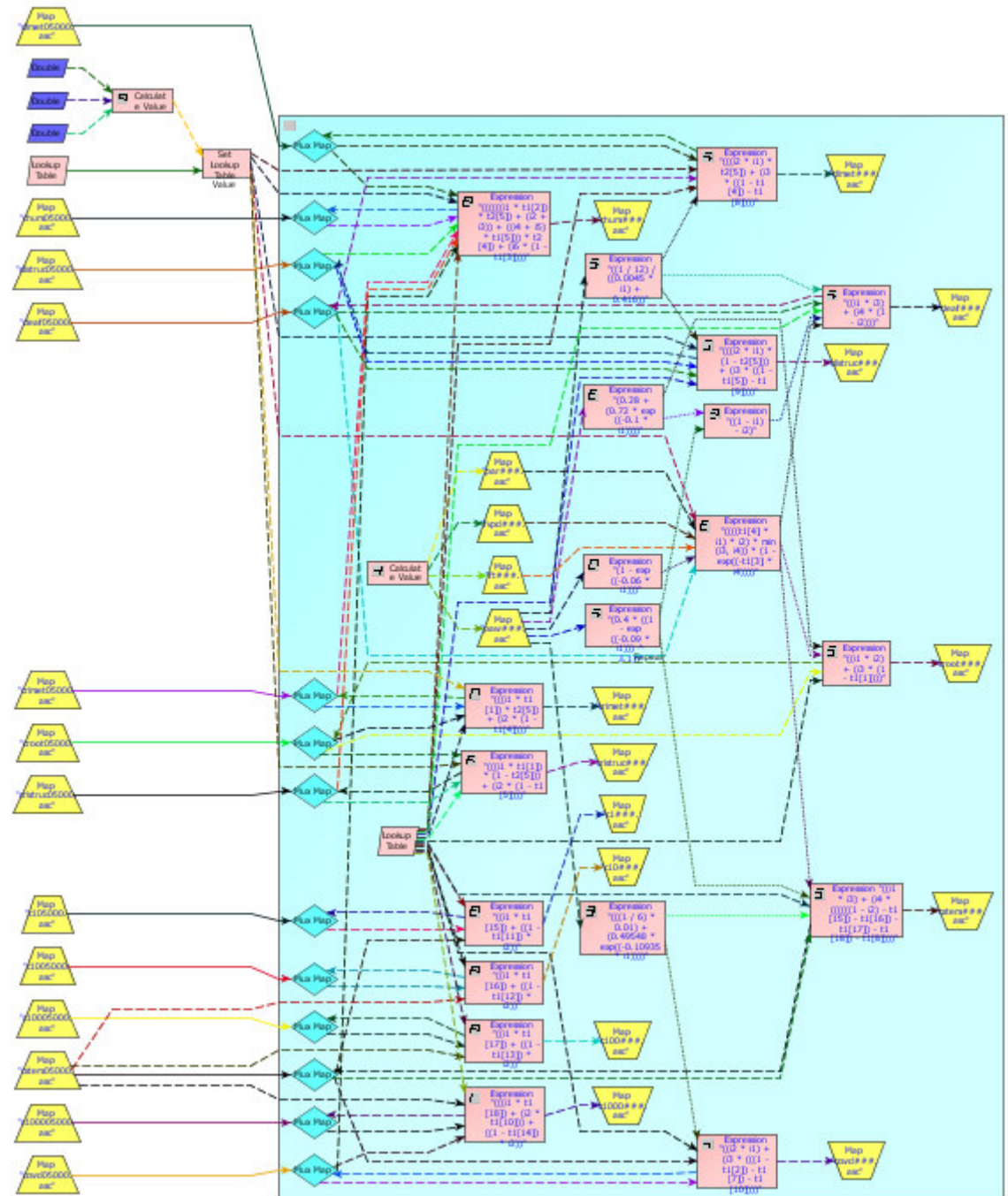
Operator chaining (Example)



Deforestation model implemented in Dinamica EGO 1.2

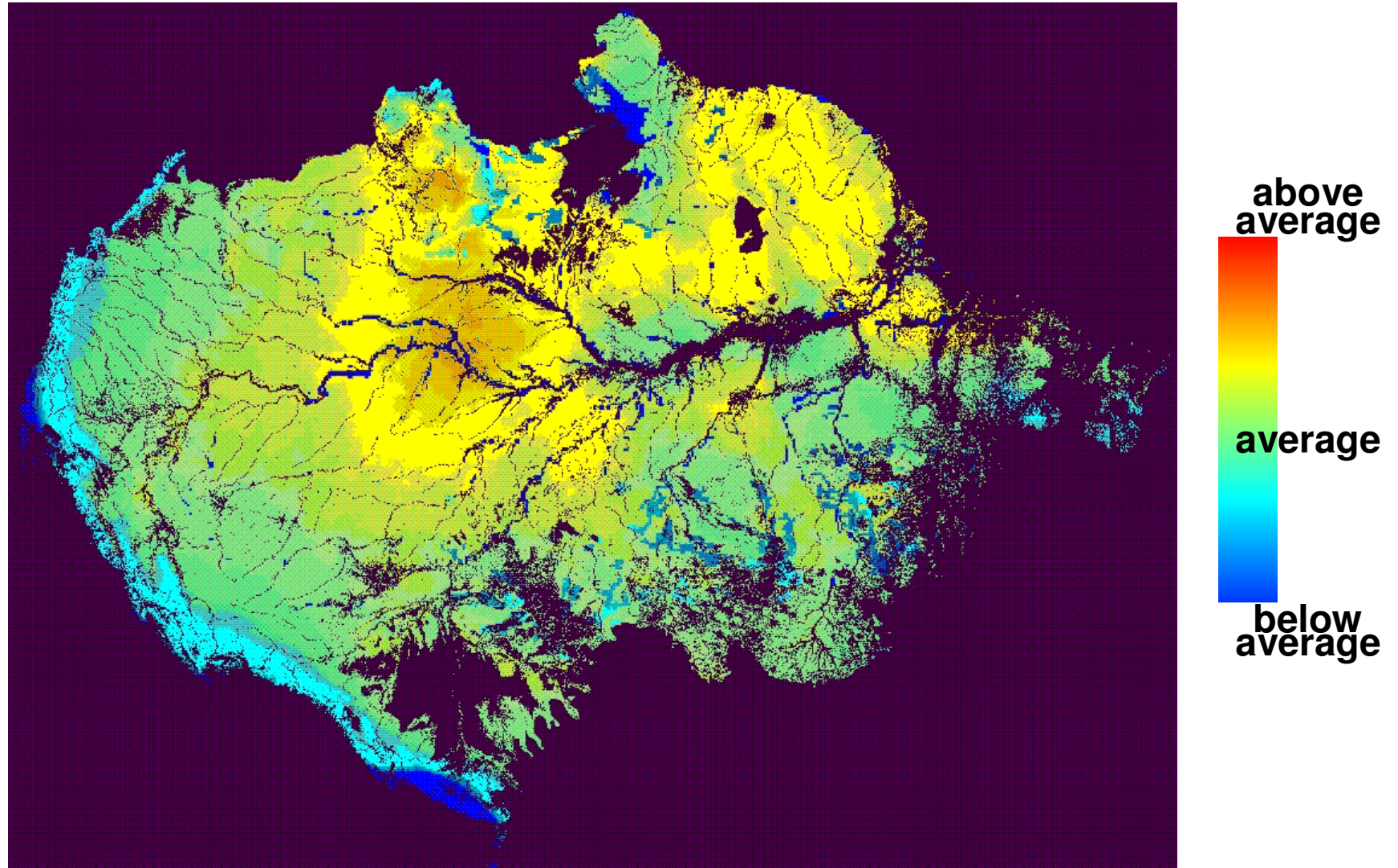


CARLUCC Implemented in Dinamica EGO 1.2



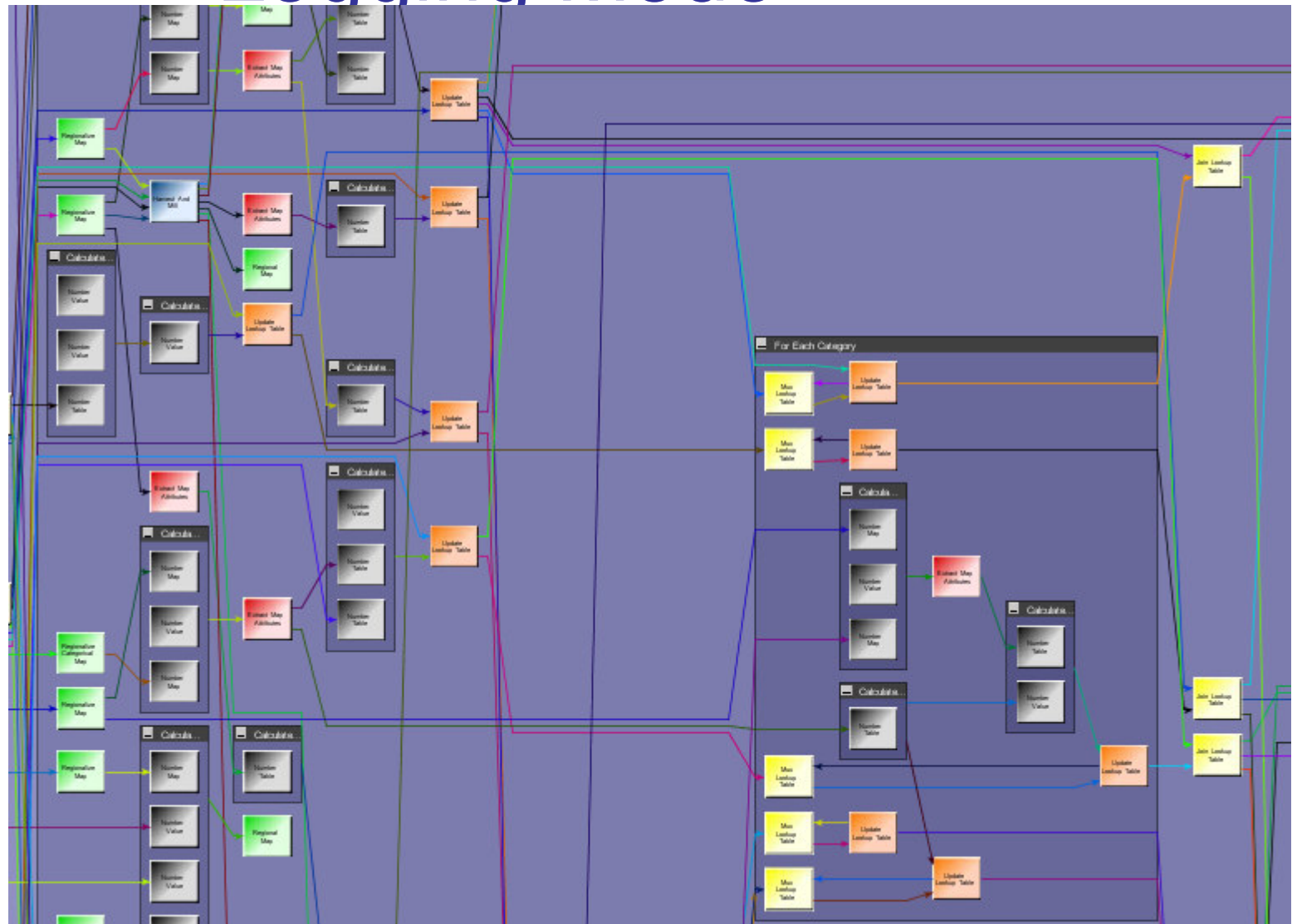
CARLUCC, simulating carbon flows

Hirsch *et al.*, 2004

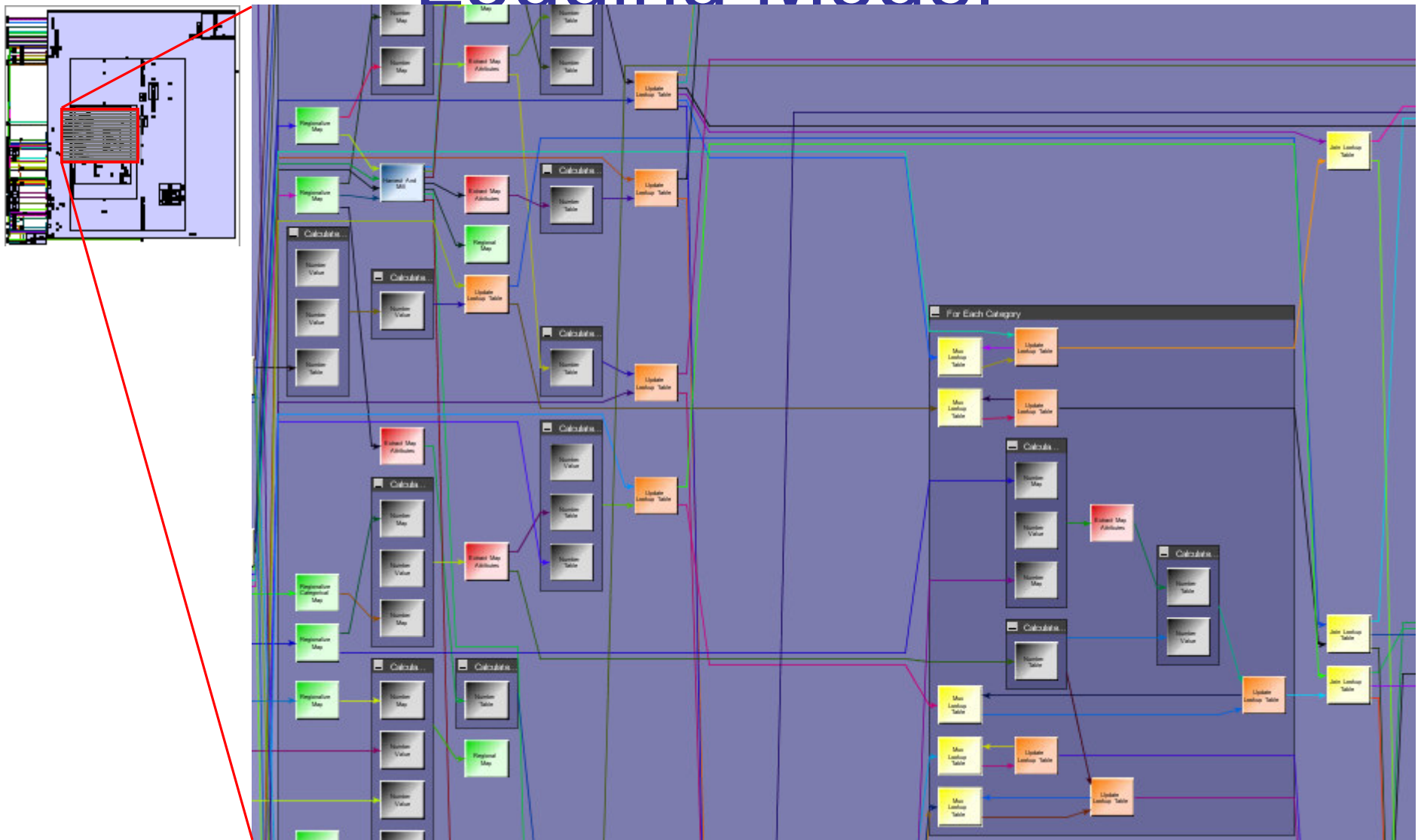


Monthly carbon content in leaves from 1999-2005

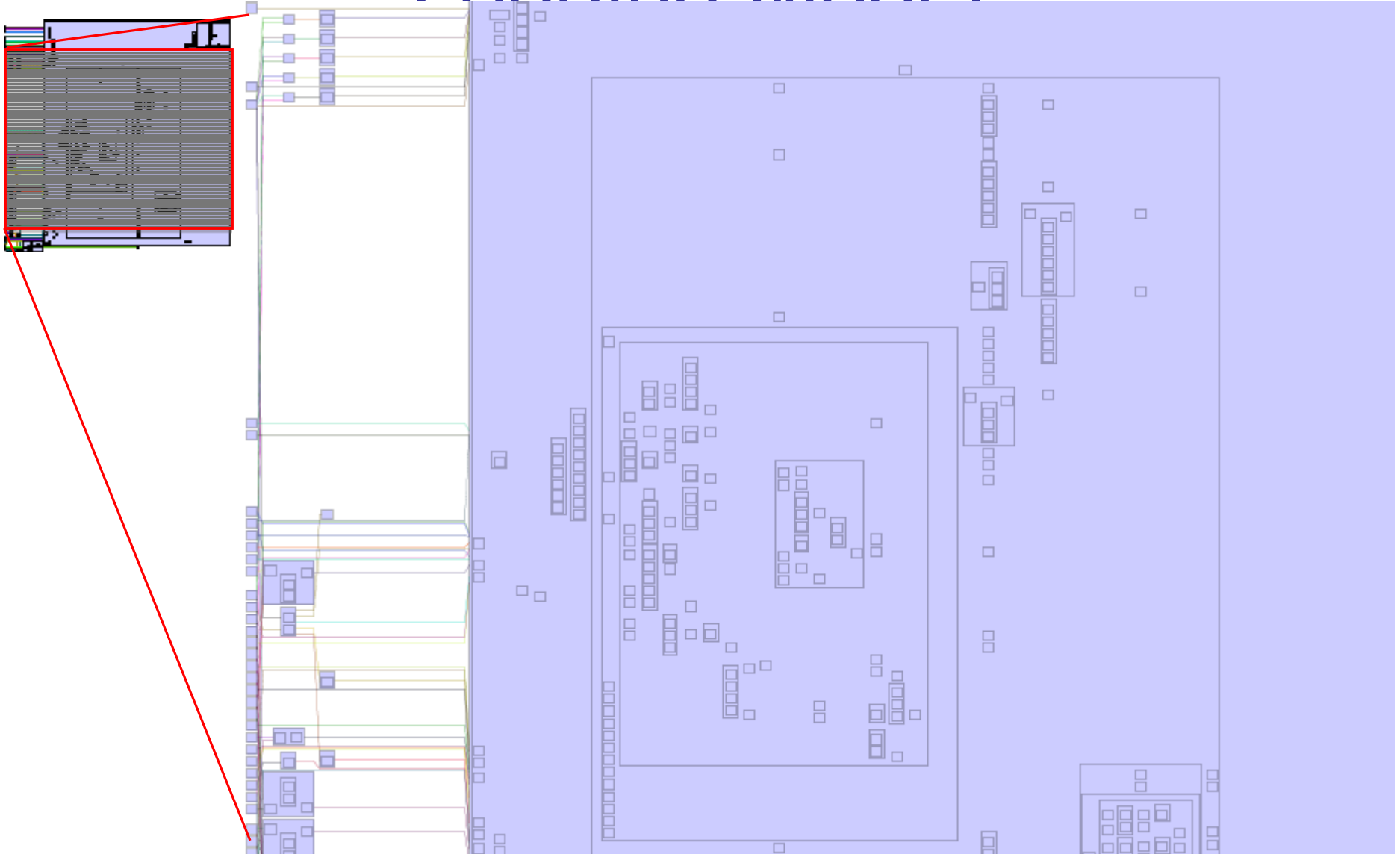
Model Complexity– Economic Logging Model



Model Complexity – Economic Loading Model



Model Complexity – Economic Loading Model



Text Version - Economic Logging Model

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```
// Faz a divisão das áreas de domínio de cada polo. Isso permite que os mapas
// correspondentes a cada polo sejam tratados individualmente.
RegionManager regions {{

    // Analisa cada polo ativo individualmente.
    ForEachCategory activePoles2 {{
        // Guarda o passo corrente como o número do polo atual.
        pole = step;

        // Re-injeta as tabela já preenchidas por outros polos nos passos anteriores nesse
        // passo.
        poleVolumes2 := MuxLookupTable poleVolumes feedbackPoleVolumes;
        poleRemainingVolumes2 := MuxLookupTable poleRemainingVolumes feedbackPoleRemainingVolumes;
        poleConsumptionCostRatios2 := MuxLookupTable poleConsumptionCostRatios feedbackPoleConsumptionCostRatios;

        nextPole2 := MuxDouble nextPole feedbackNextPole;

        newPoleCounting2 := MuxLookupTable [] newPoleCounting;
        nextPoles2 := MuxLookupTable [] nextPoles;

        // Determina a região do polo atual.
        Region pole {{

            // Obtem versões dos mapas que RHV, lucro e polos inicial que abrangem somente os
            // domínios do polo atual
            localRhv := RegionalizeMap rhv;
            localProfit := RegionalizeMap profit;
```

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What we expect from SimAmazonia 2

- Simulation of future deforestation, under a set of policy and economic scenarios, and the assessments of its impacts on habitat loss and fragmentation.
- Study of the feedbacks between climate change, agricultural expansion, and forest impoverishment due to increasing fire regimes under a warmer and drier Amazon climate.
- The evaluation of the level of endangerment for protected areas.

What we expect from SimAmazonia 2

- The calculation of logging potential of forest concessions.
- The calculation of opportunity and marginal costs, taking into consideration an emergent carbon credit market for reduced deforestation.
- ...

Partnerships

- INPA
- INPE
- YALE
- University of East Anglia
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- UFRN (Rio Grande do Norte)
- UFSC (Santa Catarina)
- UFA (Acre)
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- IPAM
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- Santa Fe Institute
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