



Spatial Analysis and Modeling Tool (SAMT), a spatial modeling toolkit written in Python

Ralf Wieland

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SAMT

Implementation Graphical User Interface Number crunching Open Science

Is an integrated **spatial simulation toolkit:**

- Matlab: matrix operations, powerful visualization
- GIS: points, lines, polygons, raster with geographic coordinates, database connection
- Between Matlab and a GIS to support spatial simulations



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- Open Source Project: https://github.com/Ralf3/samt2
- Toolkit consists of: SAMT, SAMTFUZZY, SADATO



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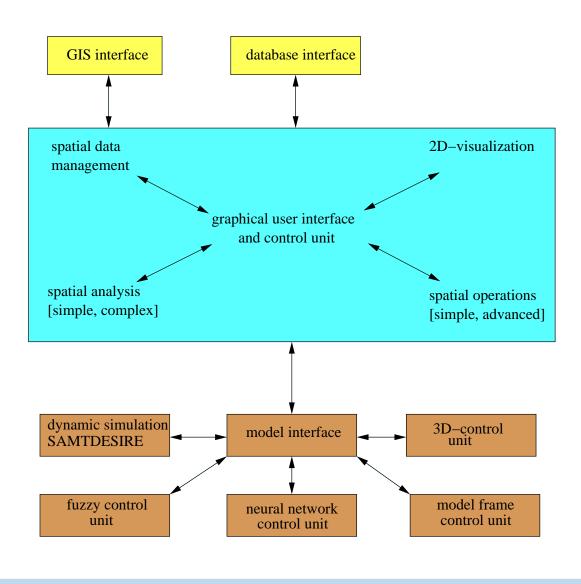
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- Open Source Project: https://github.com/Ralf3/samt2
- Toolkit consists of: SAMT, SAMTFUZZY, SADATO
 - Can be used with a graphical user interface,
 - as a part of a simulation on the computer cluster,
 - as a tool to build a bridge between the modeler and the stakeholder: "Open Science"



Structure of SAMT



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C/C++ is more an assembler than a high level language Basic libraries are changing permanently (not compatible)

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- Implementation Graphical User
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- C/C++ is more an assembler than a high level language Basic libraries are changing permanently (not compatible)
- Python is a well structured high level language, easy to learn and use, but slow



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- NumPy can be used to vectorization of programs, (Matlab) x[x>6.35] = x[x>6.35]*28.33E-03



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- SciPy provides common scientific methods (solve differential eqns)
- SciKit includes nearly all methods of soft computing



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- Other modules helps for daily work: datetime, hdf5, pandas,...



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IO: ASCII, HDF, random Access: header, value, matc, matp

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IO: ASCII, HDF, random

- Access: header, value, matc, matp
- Visualization: show, showi, show3d, showbw, show_hist
- Statistics: hist, mean_std, min, max, unique, corr, sample
- Simple: norm, classify, replace, add, mul
- Complex: invert, lut, border, cut, varpart



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- Combination: mul, add, min, max, or
- Point: transform, interpolation, voronoi, distance
- Flow: d4, d8, grad_d4, grad_d8, floodFill

Additionally: full access to all scientific Python modules



Graphical User Interface

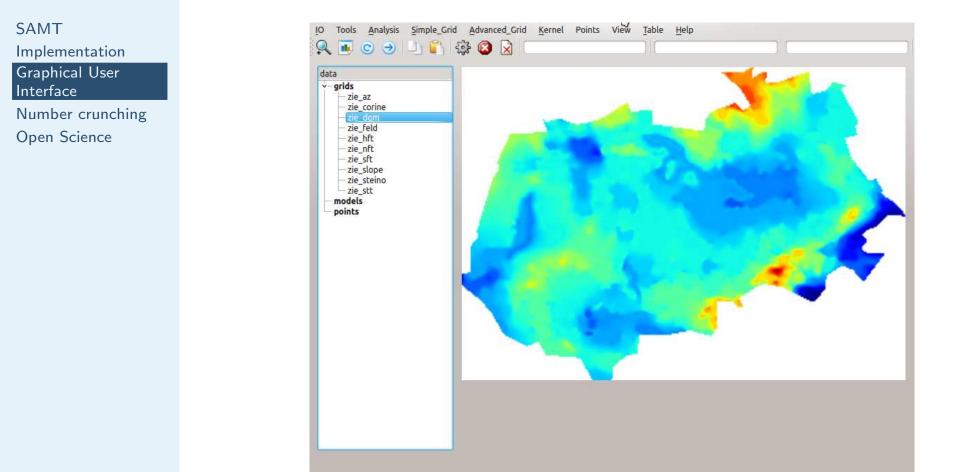


Figure 1: SAMT2 with some data

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Graphical User Interface

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result	exec						
Expression	np.power(np.log10(a_+1),b_/10.0)						
Numpy mathe	matical functions	a: np.f e.g.: a	_+ 50 * b_ *np.sin(c	_+ 2.0)			
sin(x)	cos(x)	tan(x)	arcsin(x)	arccos(x)	arctan(x)	deg2rad(x)	rad2deg(x
sinh(x)	cosh(x)	tanh(x)	arcsinh(x)	arccosh(x)	arctanh(x)		
round(x,dec)	rint(x)	fix(x)	floor(x)	ceil(x)	trunc(x)		
exp(x)	exp2(x)	log(x)	log10(x)	log2(x)			
add(x1,x2)	subtract(x1,x2)	multiply(x1,x2)	divide(x1,x2)	power(x1,x2)			<
sqrt(x)	square(x)	fabs(x)	maximum(x1,x2)	minimum(x1,x2)			

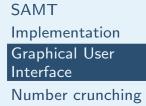
Figure 2: Expression builder of SAMT2

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Graphical User Interface



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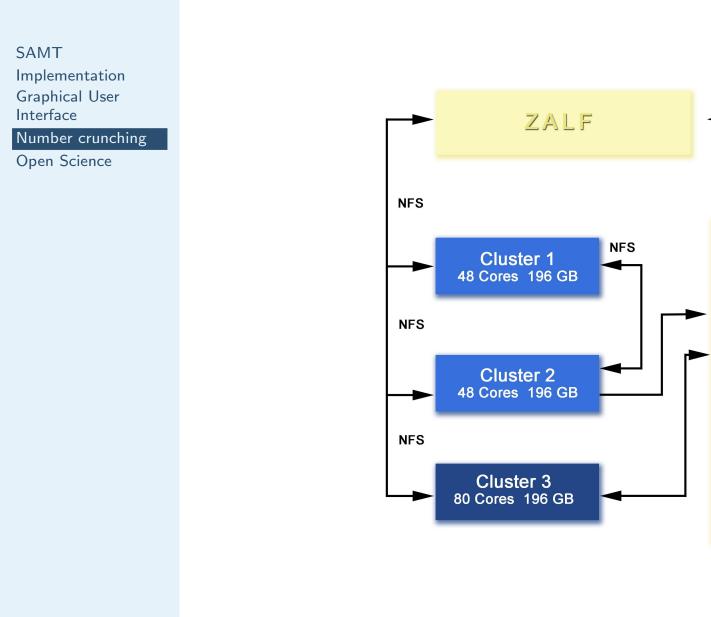
zie dgm 0 100 Klein Ziethe Groß Zethen 200 8 198 Y 300 Serwest Senftenhütte 400 400 0 100 200 300 500 600 х

Figure 3: Access to OSM data

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Samba

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Application:

 Yield estimation under climate change large regions in Germany (Brandenburg, Thuringia and Saxony with an grid size of 1ha)



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- Analysis of soil slices from X-Ray CT image stack



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- Python controls the cluster using MPI load data, calc, collect data



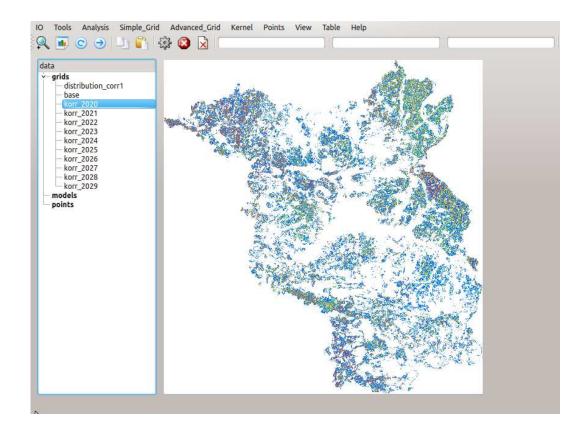
Implementation Graphical User Interface

interface

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yield estimation based on market scenarios and climate change with 1ha resolution



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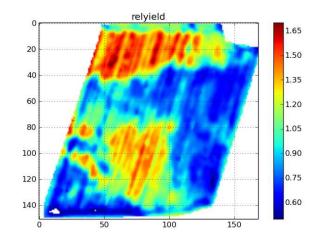


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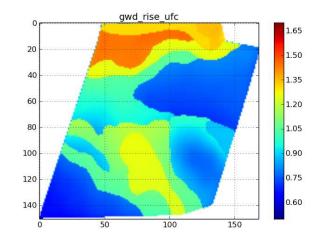
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relyield from equipment



measured yield

SVM



ground water distance, capillary rise, usable field capacity

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Application: Can the user be included in modeling?

- Science is data collection plus modeling
- Applied science is an application of science to problems

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 - open source software,
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 - interactivity



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 - interactivity
- the stakeholders have knowledge (models) and knows the problems, why do we not include them in science?