



Poznańskie Centrum Superkomputerowo-Sieciowe
Poznan Supercomputing and Networking Center

Hands on: IBEX ACH-04 - IPPLM/PSNC

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IBEX

(IMAS variables EXplorer)



What is IBEX?

IBEX is a general purpose graphical tool for exploring the content of IMAS structured data (IDS).

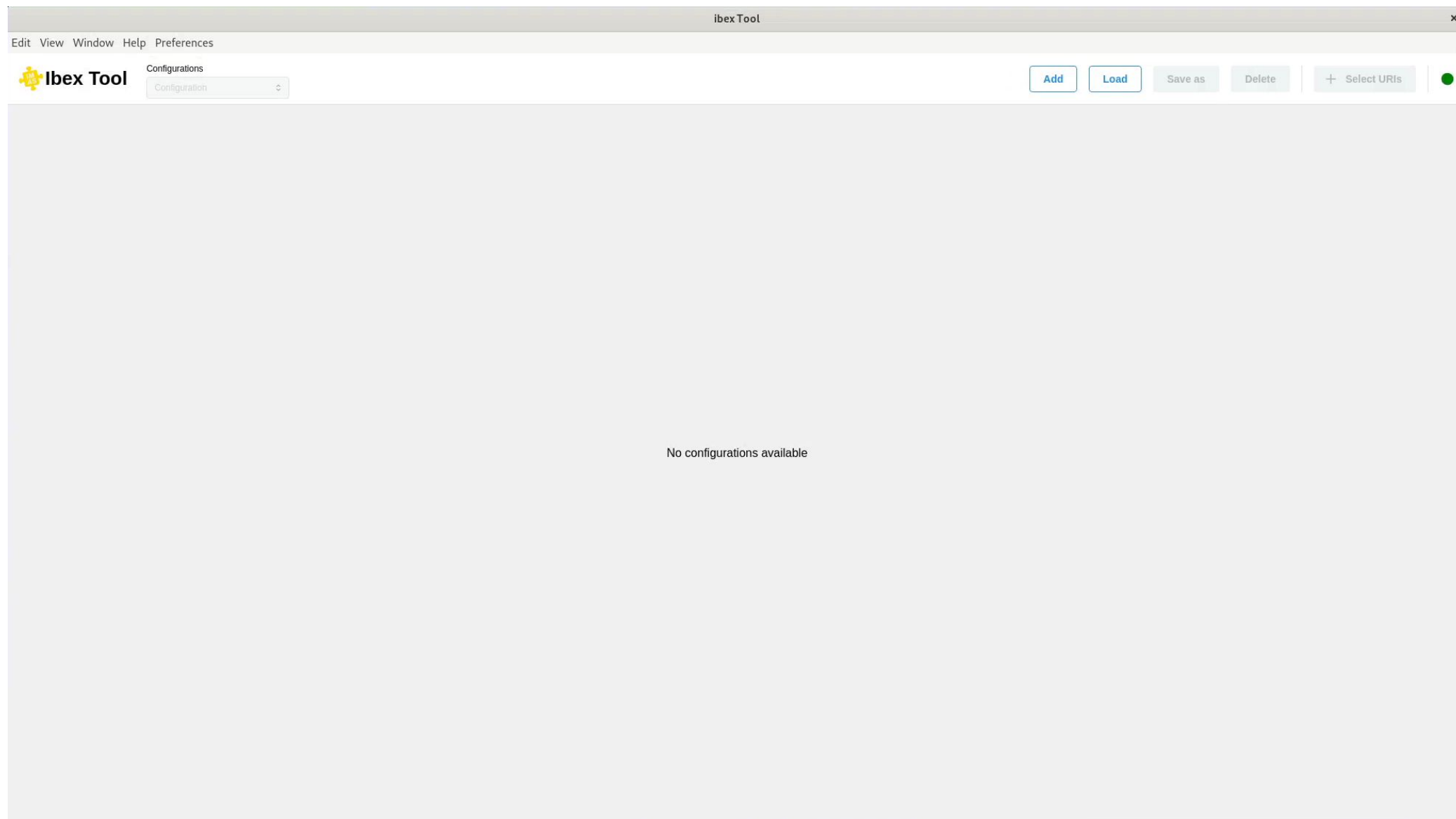
(<https://github.com/iterorganization/IBEX>)

Running IBEX on EFGW

- > module load ach-modules
 - > module load IBEX
 - > ibex
-
- > module load ach-modules/2025b
 - > module load IBEX
 - > ibex

Bonus - loading IMAS-Validator on EFGW

- > module load ach-modules
 - > module load IMAS-Validator
 - > imas_validator *(cli)*
-
- > module load ach-modules/2025b
 - > module load IMAS-Validator
 - > imas_validator *(cli)*



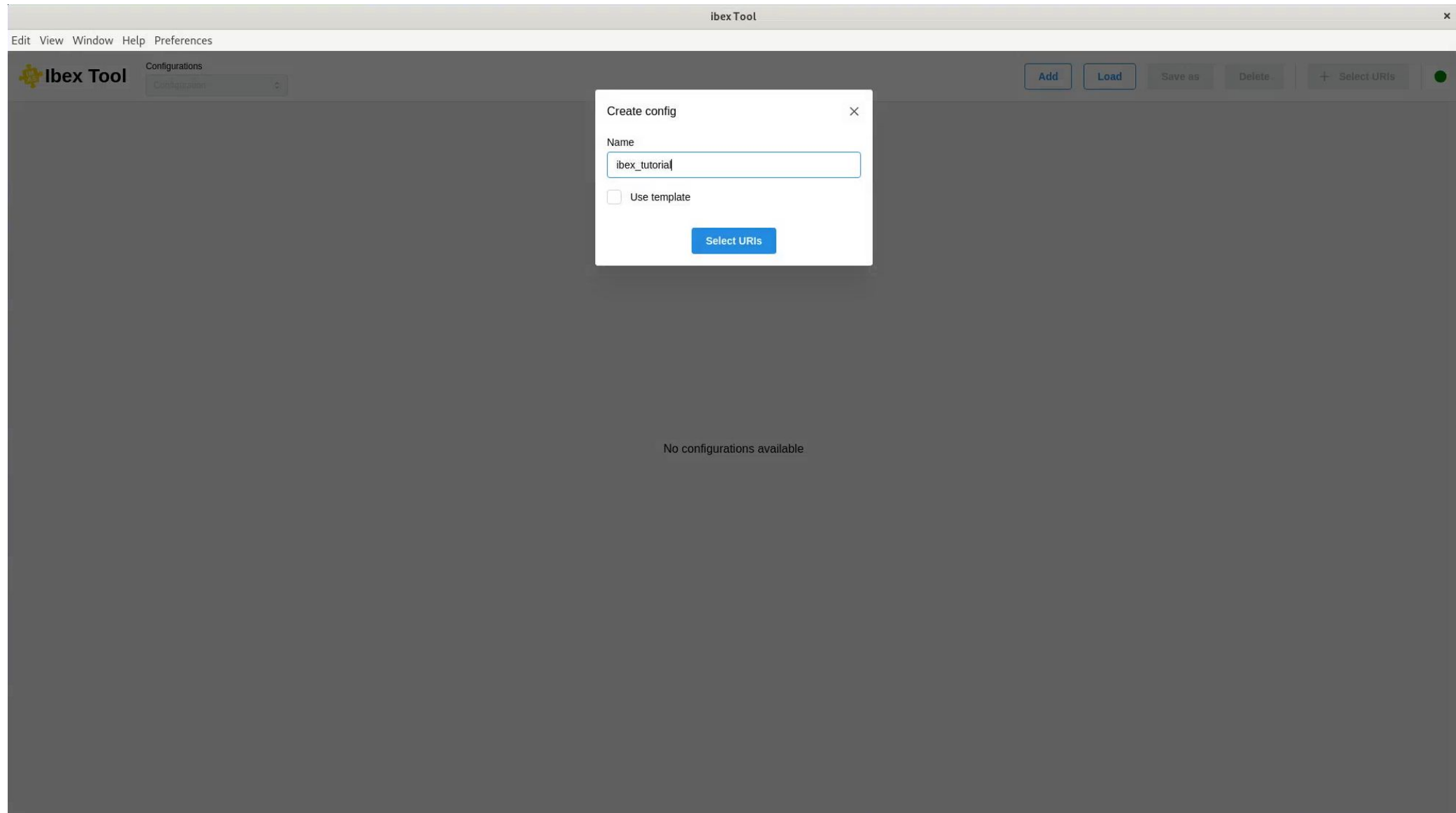
URIs used in the slides

- `imas:hdf5?user=g2dpc;pulse=38384;run=7;database=aug;version=3`
- `imas:hdf5?user=g2dpc;pulse=32408;run=15;database=aug;version=3`

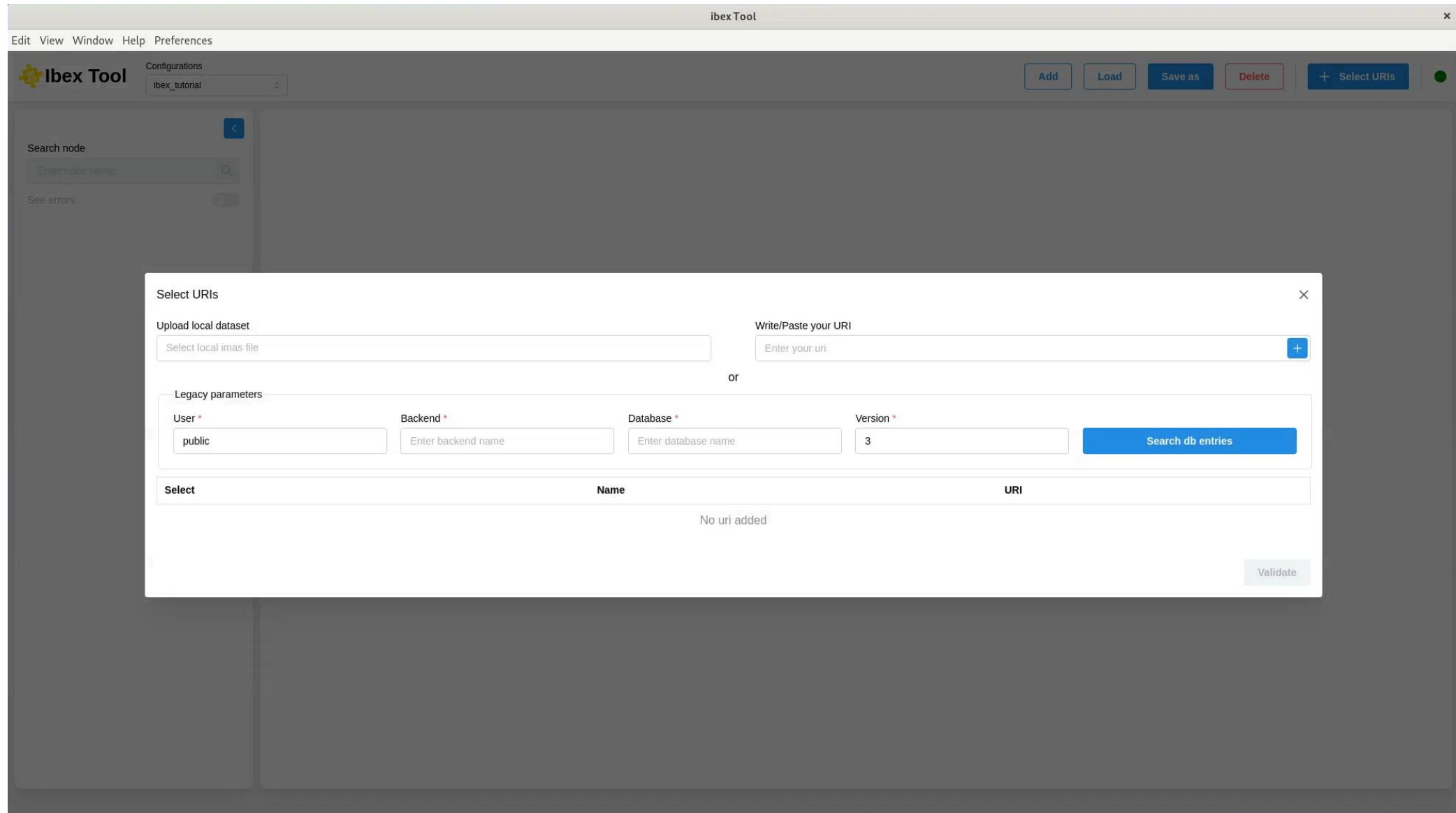
Section 1 - basic usage

- creating configuration
- selecting pulsefile(s)
- accessing 0D nodes
- plotting 1D quantity
- accessing plot metadata
- plot visual configuration

Selecting configuration



Selecting pulsefiles (1/2)



Selecting pulsefiles (2/2)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2

URI-1
imas:hdf5?user=g2

Select URIs

Upload local dataset
Select local imas file

Write/Paste your URI
imas:hdf5?user=g2dpc;pulse=32408;run=15;database=aug;version=3

or

Legacy parameters

User * Backend * Database * Version *

public Enter backend name Enter database name 3

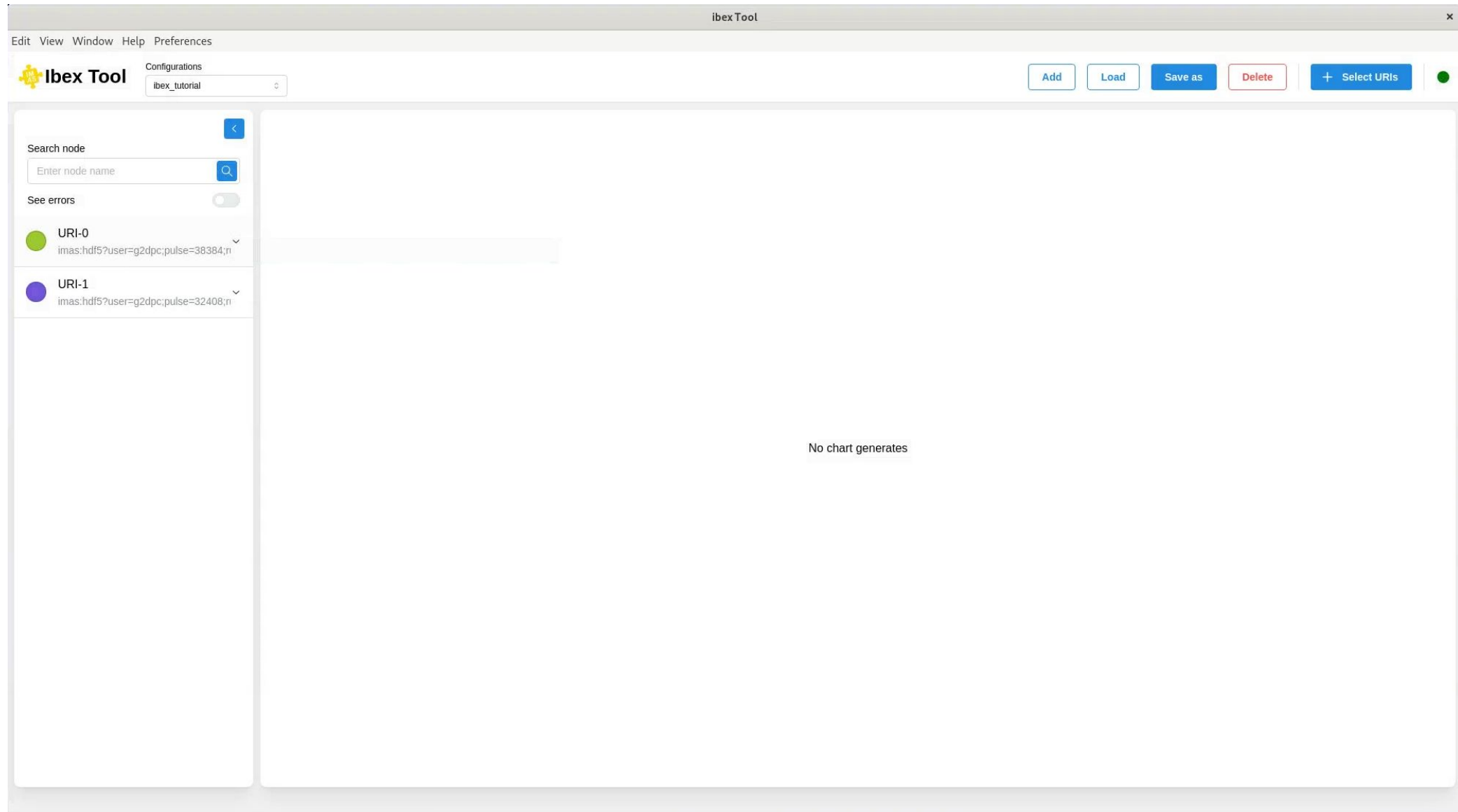
Search db entries

Select	Name	URI	
☒	URI-0	imas:hdf5?user=g2dpc;pulse=38384;run=7;database=aug;version=3	☒
☒	URI-1	imas:hdf5?user=g2dpc;pulse=32408;run=15;database=aug;version=3	☒

< 1 >

Validate

Selecting quantities (1/3)



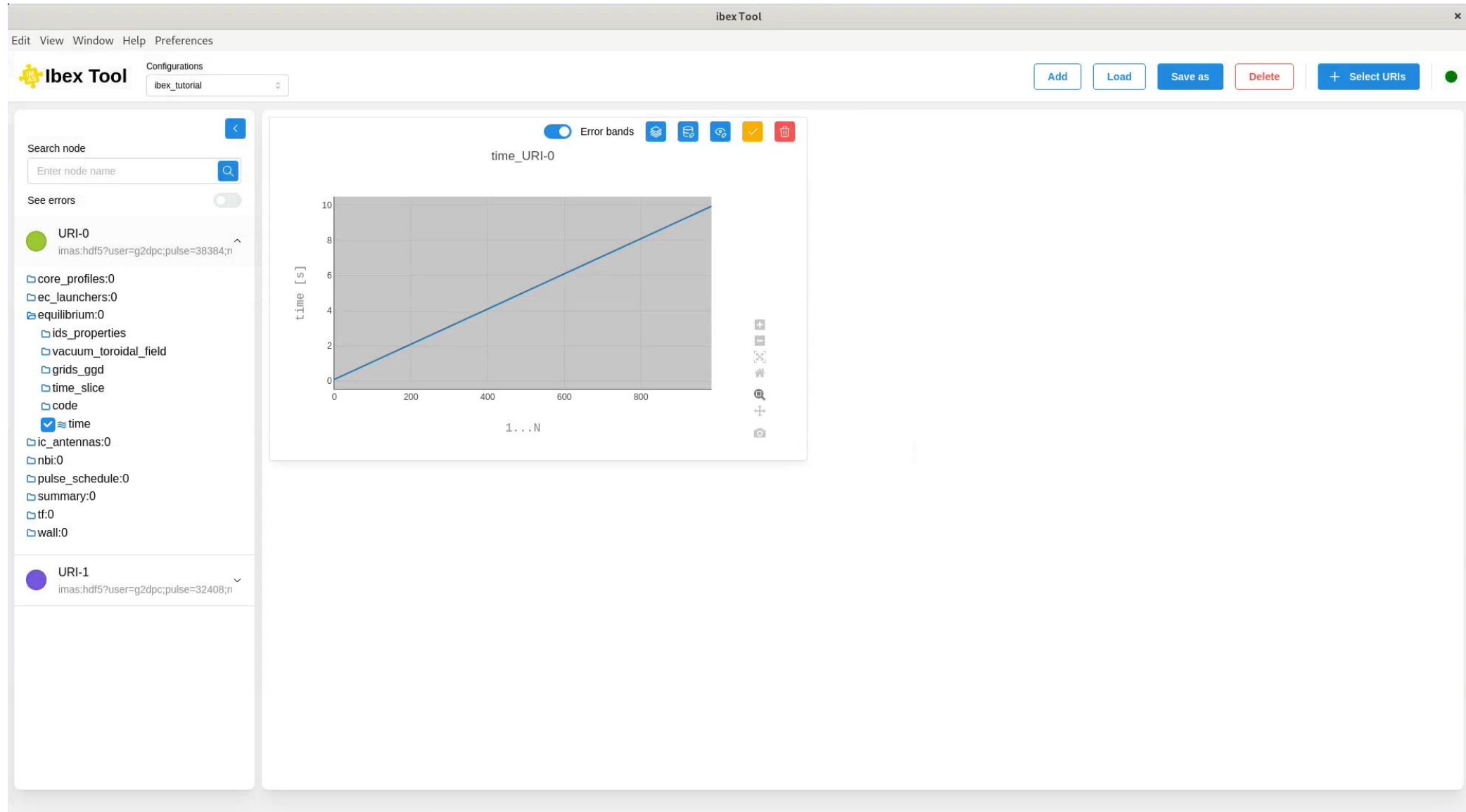
Selecting quantities (2/3)

The screenshot displays the Ibex Tool interface. On the left, a sidebar shows a tree view of nodes. The 'URI-0' node is selected, and its sub-nodes are expanded. The 'ids_properties' node is expanded, and the 'data_dictionary' checkbox is checked. The 'value' field in the 'data_dictionary' row is highlighted with a blue selection box.

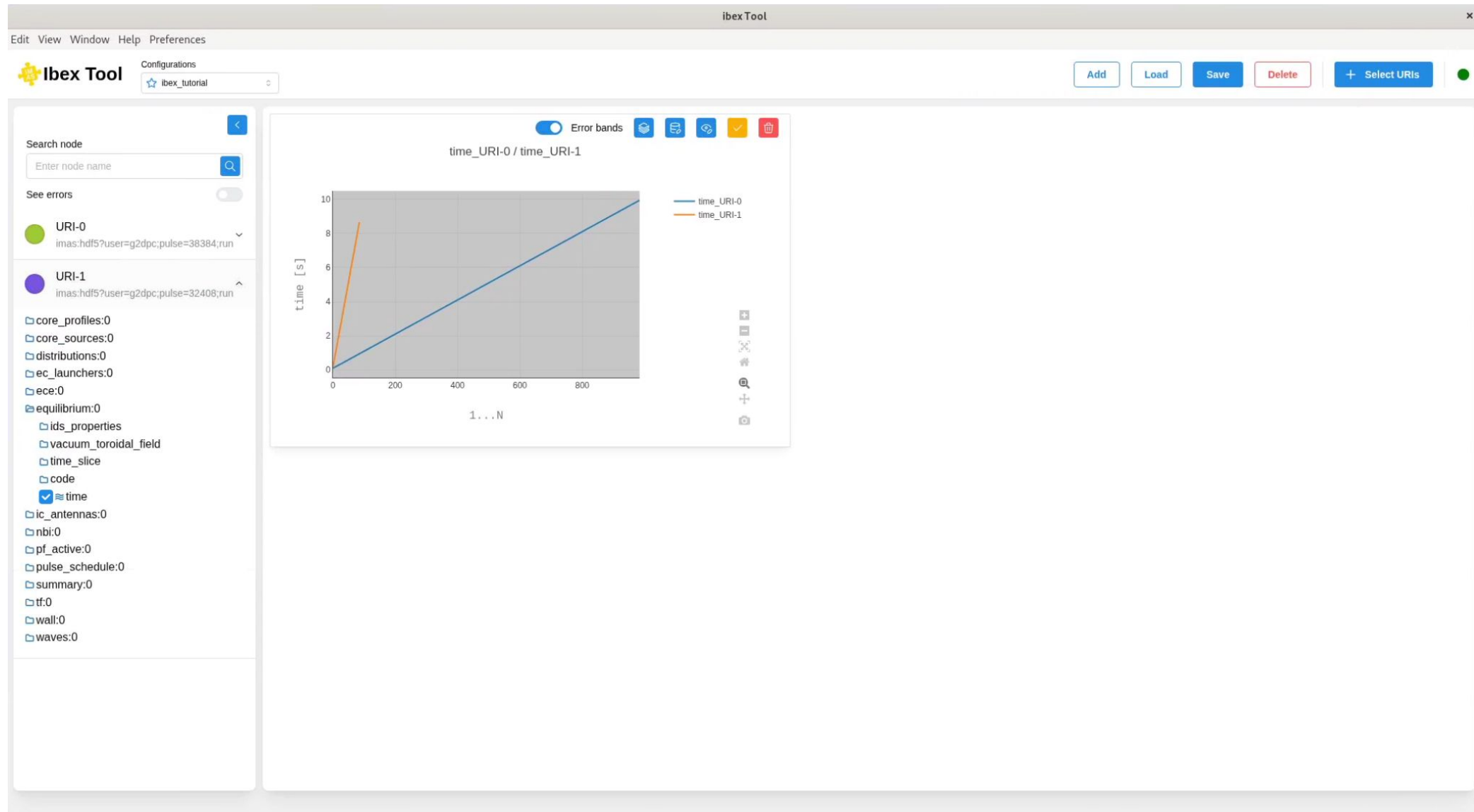
The main panel displays the 'Metadatas' for the selected 'data_dictionary_URI-0' node. The table below shows the metadata details:

Metadatas	
uri	imas:hdf5? user=g2dpc;pulse=38384;run=7;database=aug;version=3#equilibrium:0/ids_properties/version_
name	data_dictionary_URI-0
path	#equilibrium/ids_properties/version_put/data_dictionary
unit	N/A
shape	6
dimension	0
value	3.34.0
min	N/A
max	N/A
mean	N/A

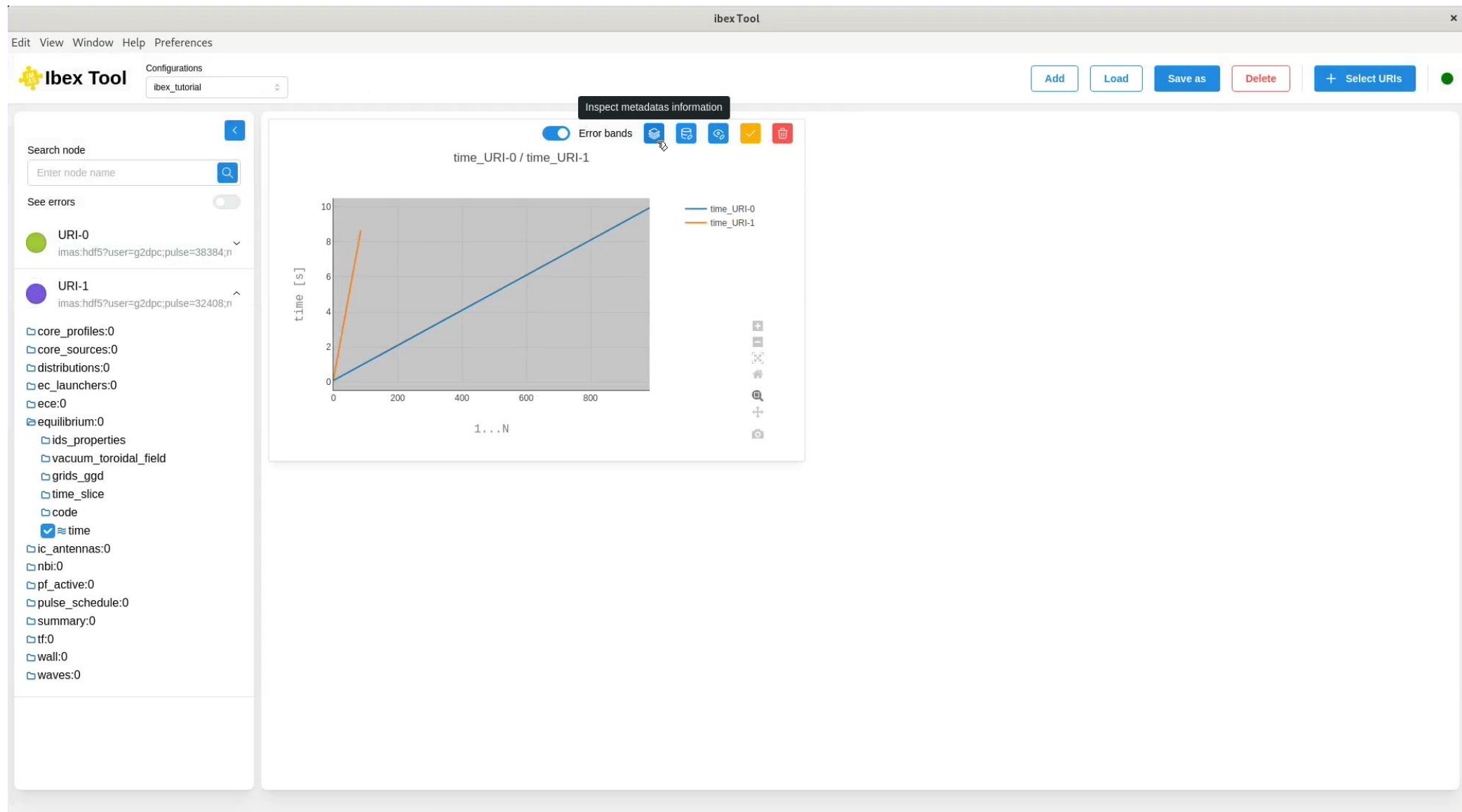
Selecting quantities (3/3)



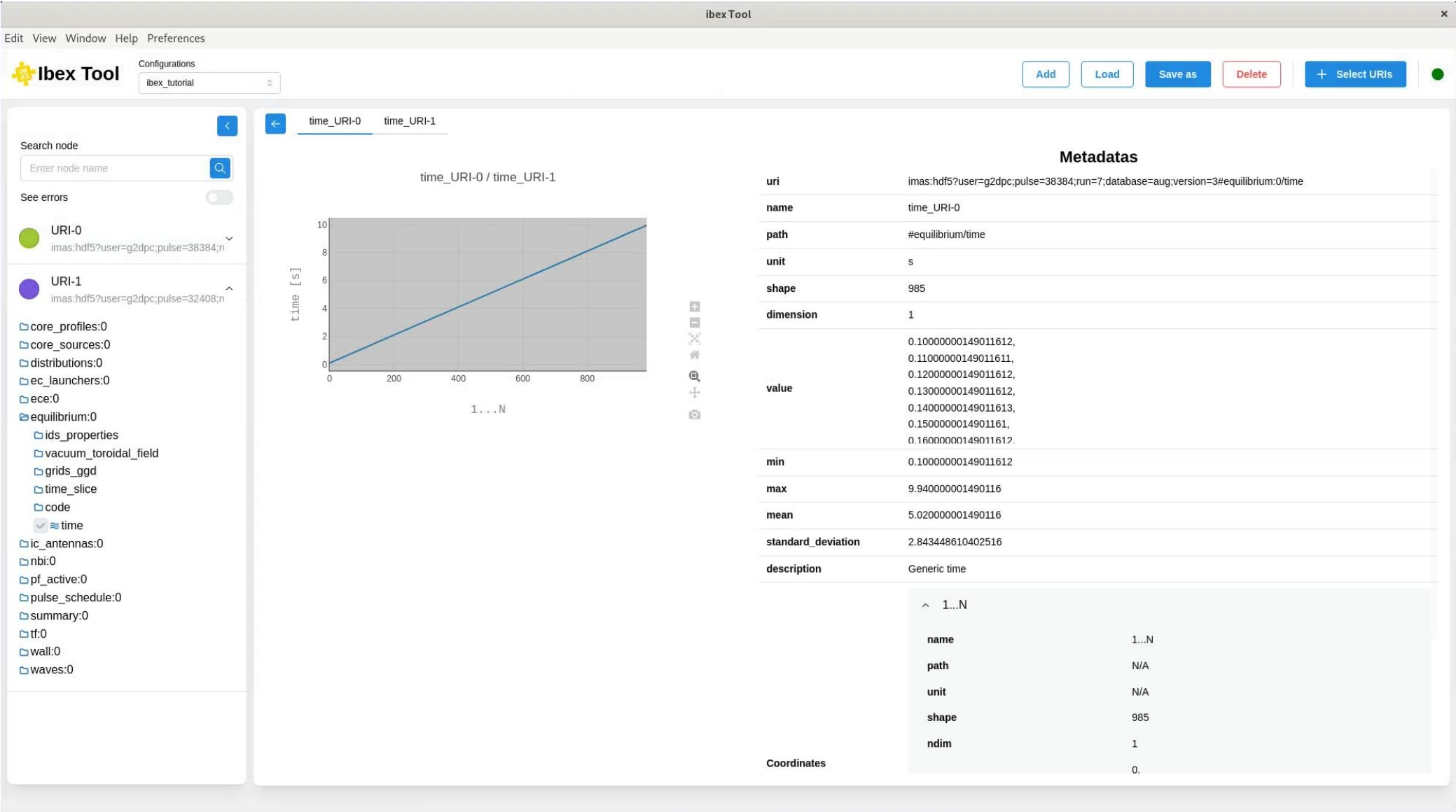
Selecting multiple quantities



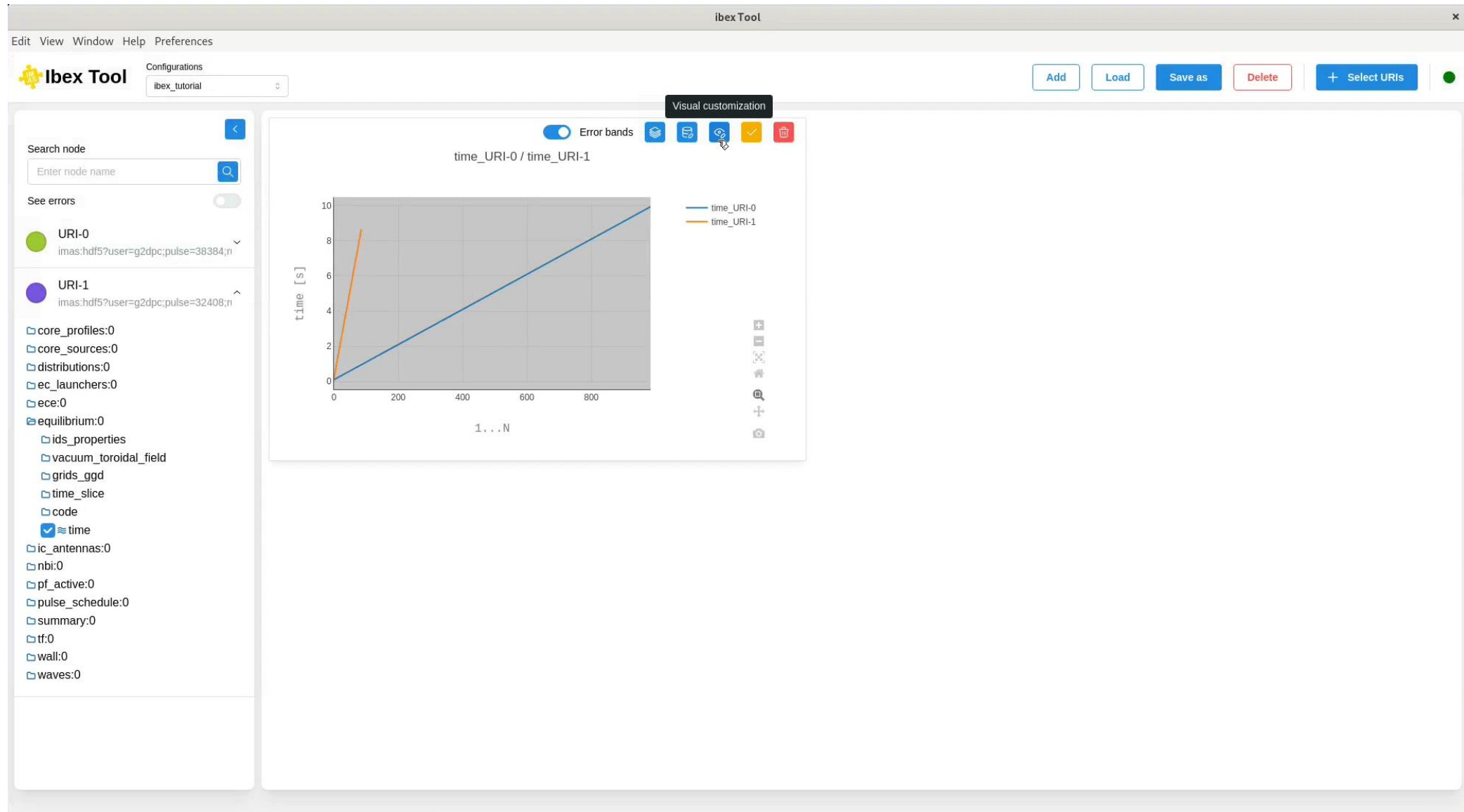
Displaying metadata (1/2)



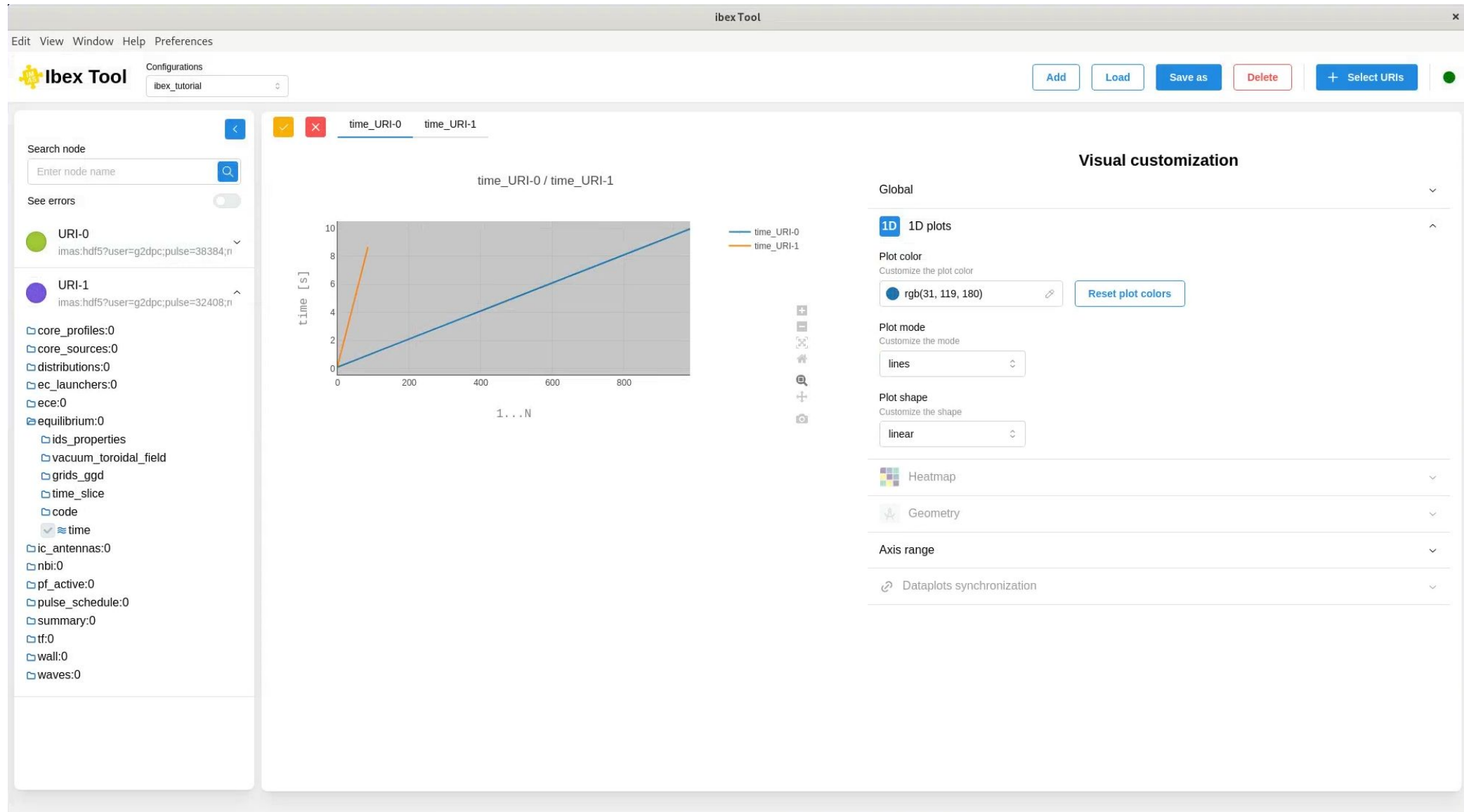
Displaying metadata (2/2)



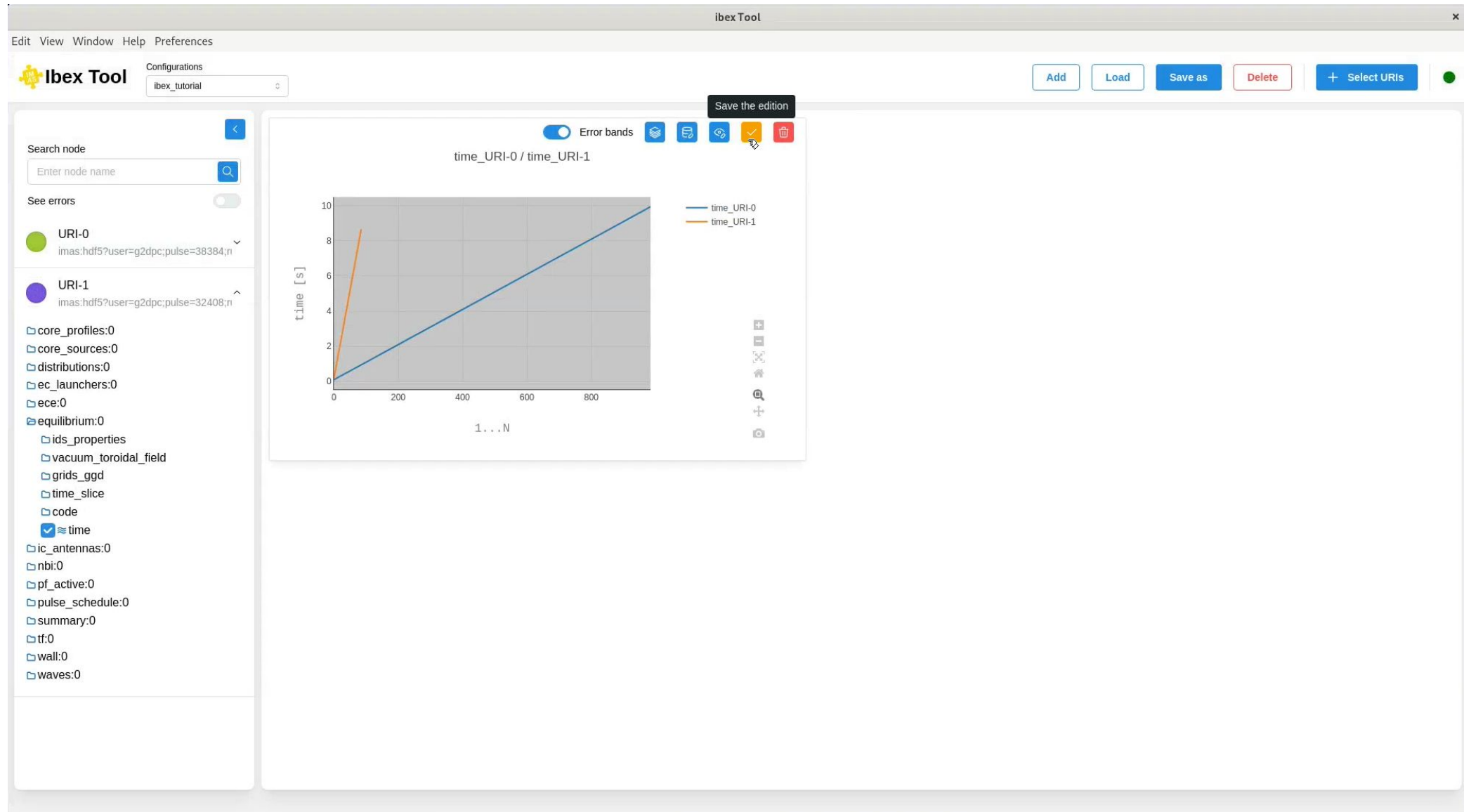
Visual configuration (1/2)



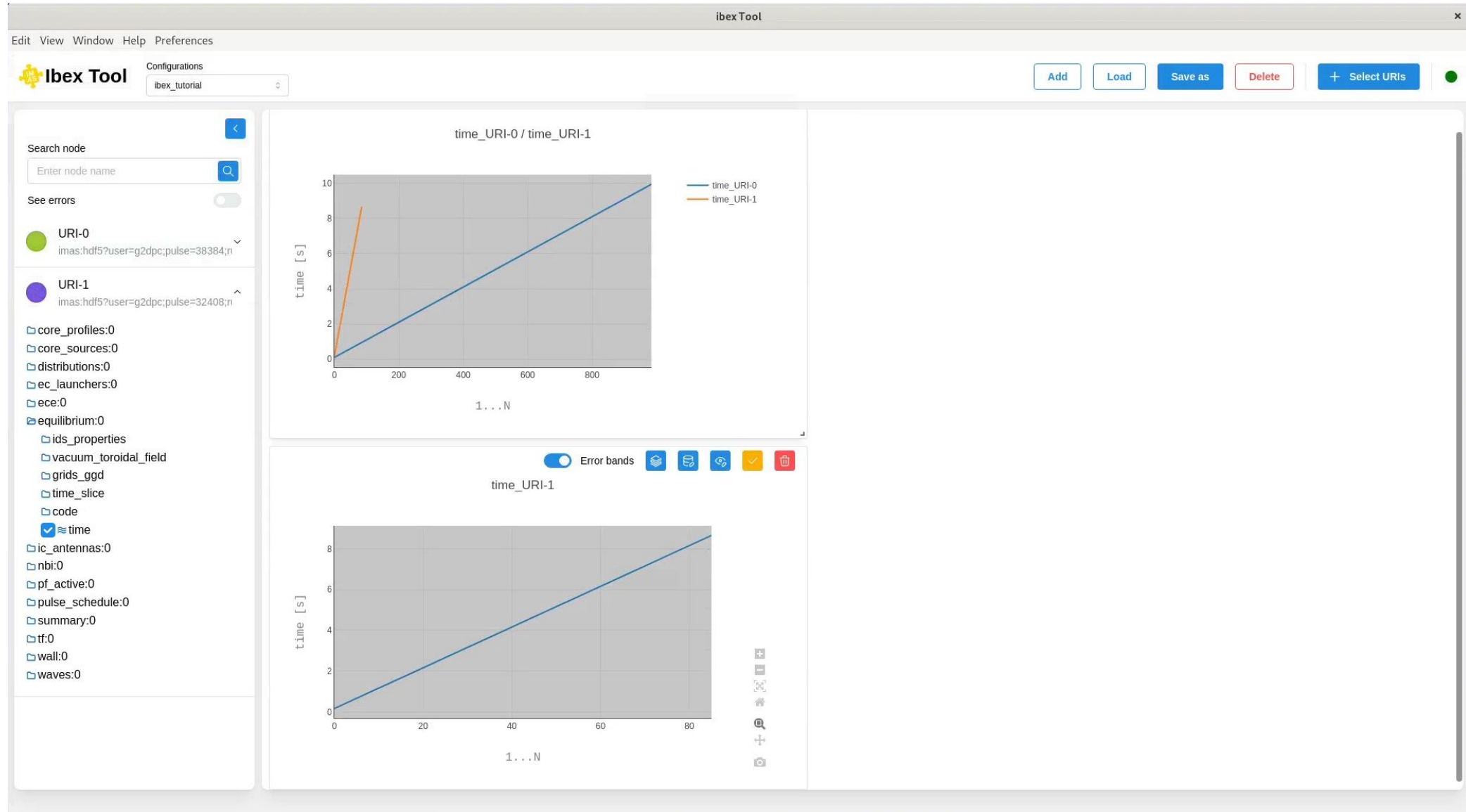
Visual configuration (2/2)



Locking the plot



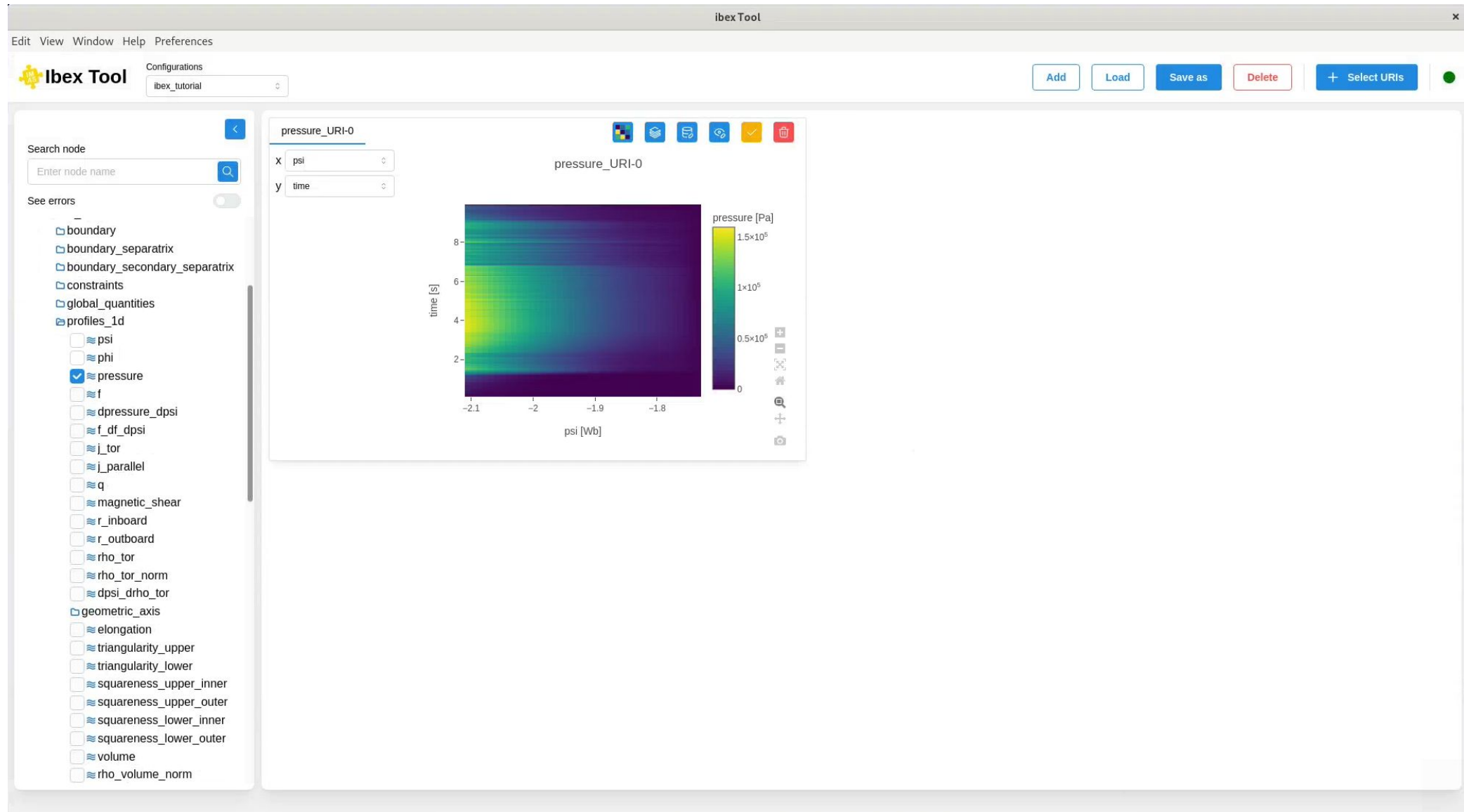
Opening quantity in new plot window



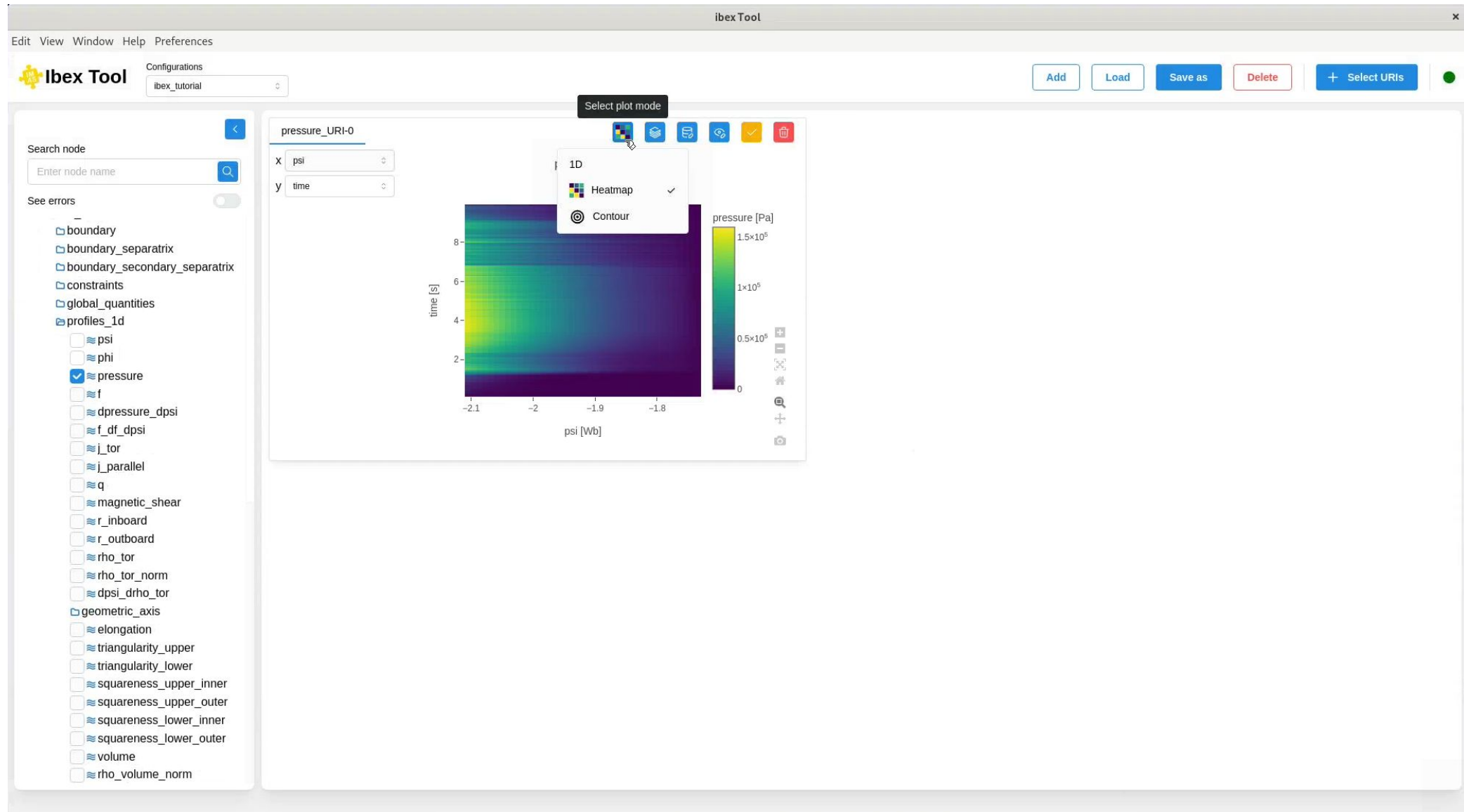
Section 2 - more plotting

- 1+D quantities
- switching axis
- heatmaps

Selecting 1D+ quantity (1/4)



Selecting 1D+ quantity (2/4)



Selecting 1D+ quantity (3/4)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

- boundary
- boundary_separatrix
- boundary_secondary_separatrix
- constraints
- global_quantities
- profiles_1d
 - ☐ psi
 - ☐ phi
 - ☒ pressure
 - ☐ f
 - ☐ dpressure_dpsi
 - ☐ f_df_dpsi
 - ☐ j_tor
 - ☐ j_parallel
 - ☐ q
 - ☐ magnetic_shear
 - ☐ r_inboard
 - ☐ r_outboard
 - ☐ rho_tor
 - ☐ rho_tor_norm
 - ☐ dpsi_drho_tor
- geometric_axis
 - ☐ elongation
 - ☐ triangularity_upper
 - ☐ triangularity_lower
 - ☐ squareness_upper_inner
 - ☐ squareness_upper_outer
 - ☐ squareness_lower_inner
 - ☐ squareness_lower_outer
 - ☐ volume
 - ☐ rho_volume_norm

time

psi

pressure_URI-0

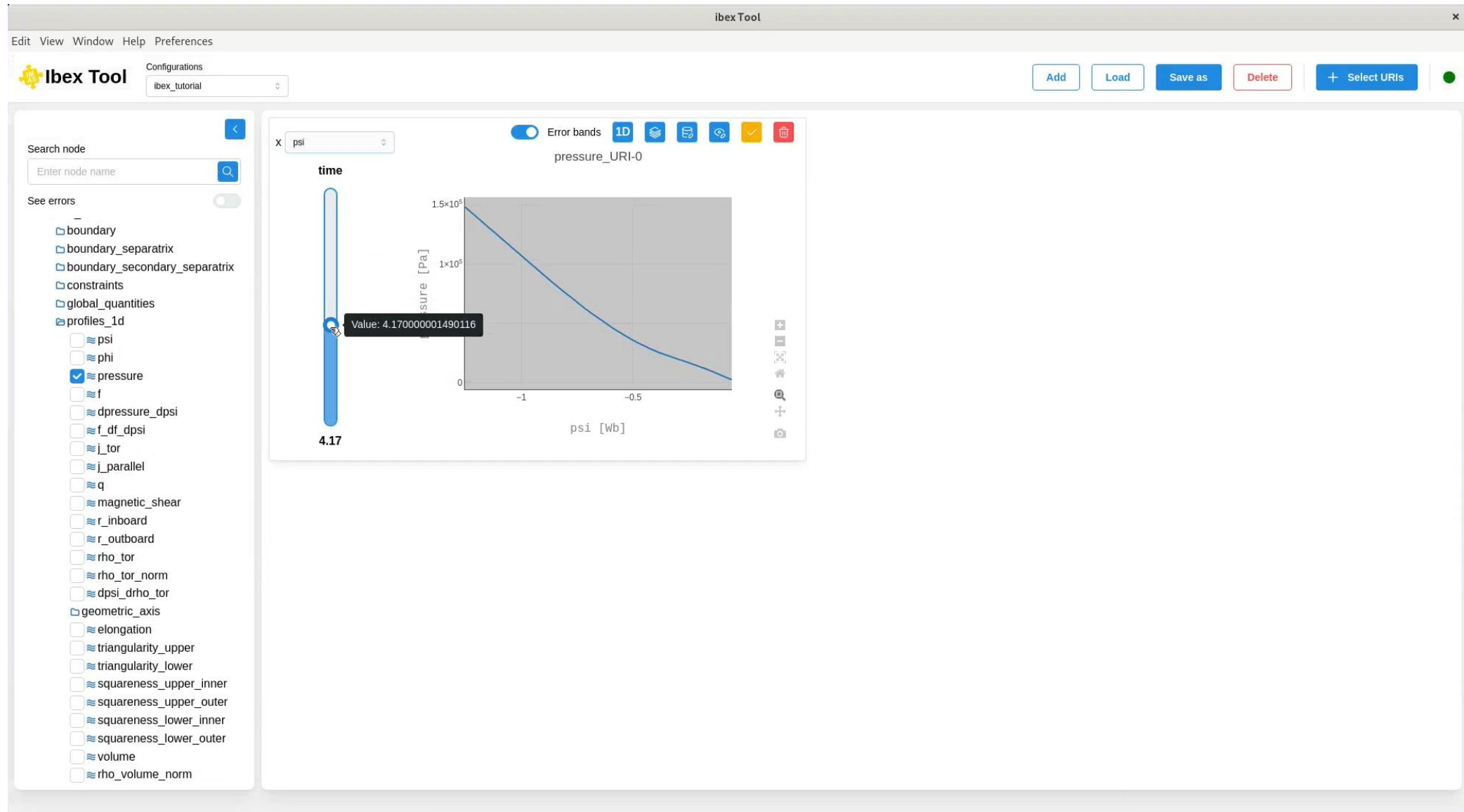
pressure [Pa]

psi [Wb]

0.10

Error bands 1D

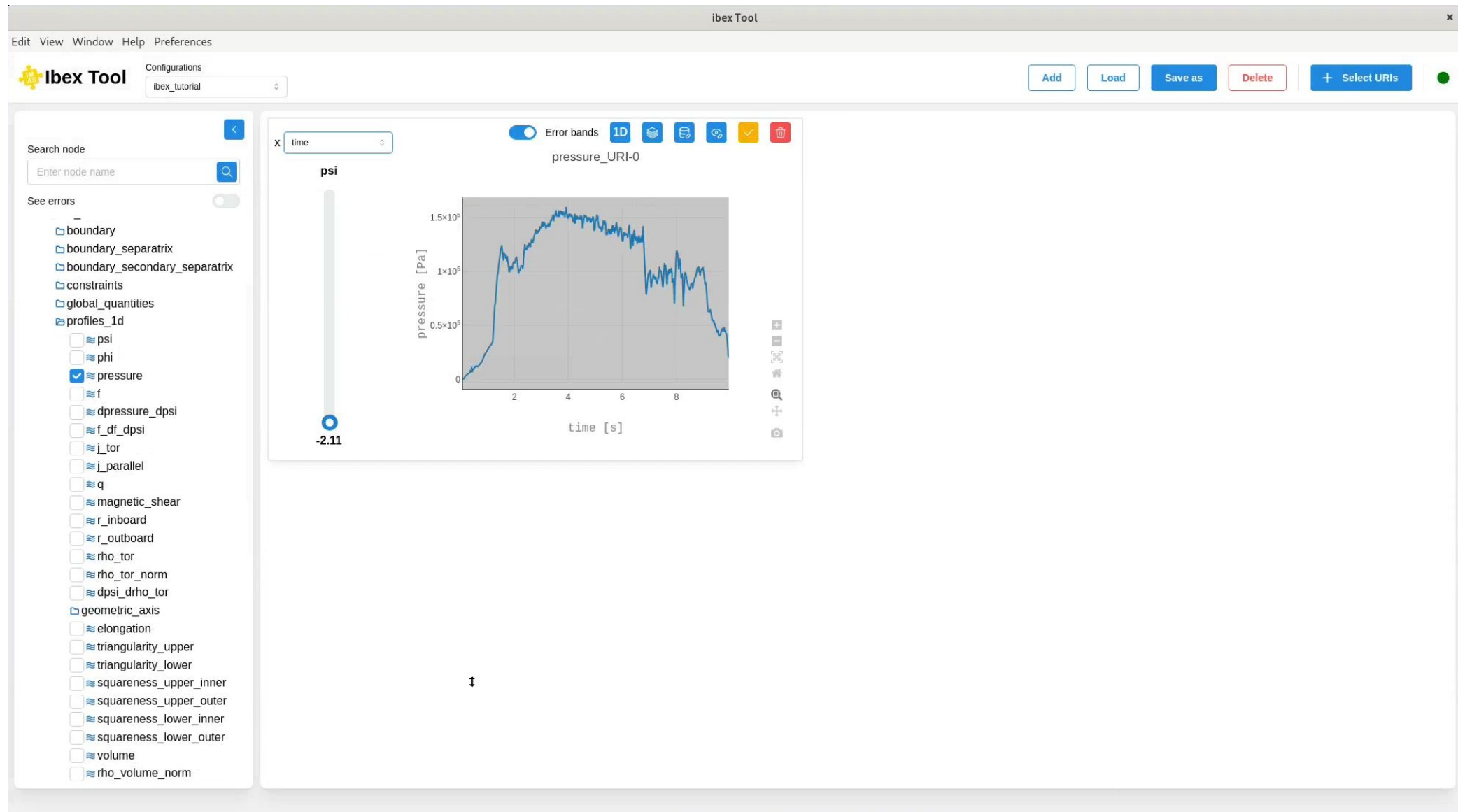
Selecting 1D+ quantity (4/4)



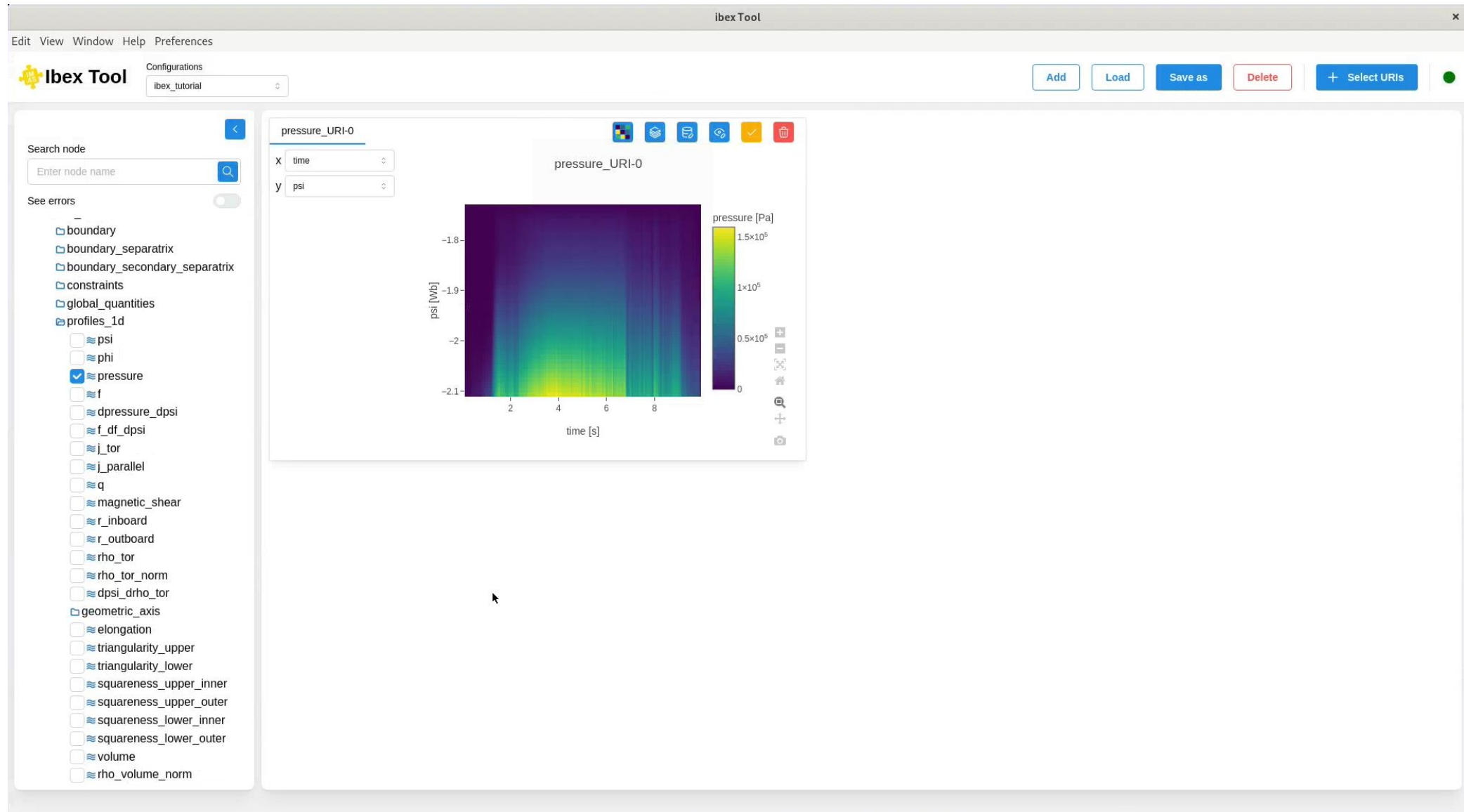
Switching axis (1/2)



Switching axis (2/2)



Back to heatmap



Section 3 - multidimensional data

- 2D quantities
- contour plot
- geometry

Selecting 2D quantity (1/4)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - grids_ggd
 - time_slice
 - boundary
 - boundary_separatrix
 - boundary_secondary_separatrix
 - constraints
 - global_quantities
 - profiles_1d
 - profiles_2d
 - grid_type
 - grid
 - ☐ r
 - ☐ z
 - ☒ psi
 - ☐ theta
 - ☐ phi
 - ☐ j_tor
 - ☐ j_parallel
 - ☐ b_r
 - ☐ b_field_r
 - ☐ b_z
 - ☐ b_field_z
 - ☐ b_tor

psi_URI-0

X R
Y Z

profiles... time

0 0.10

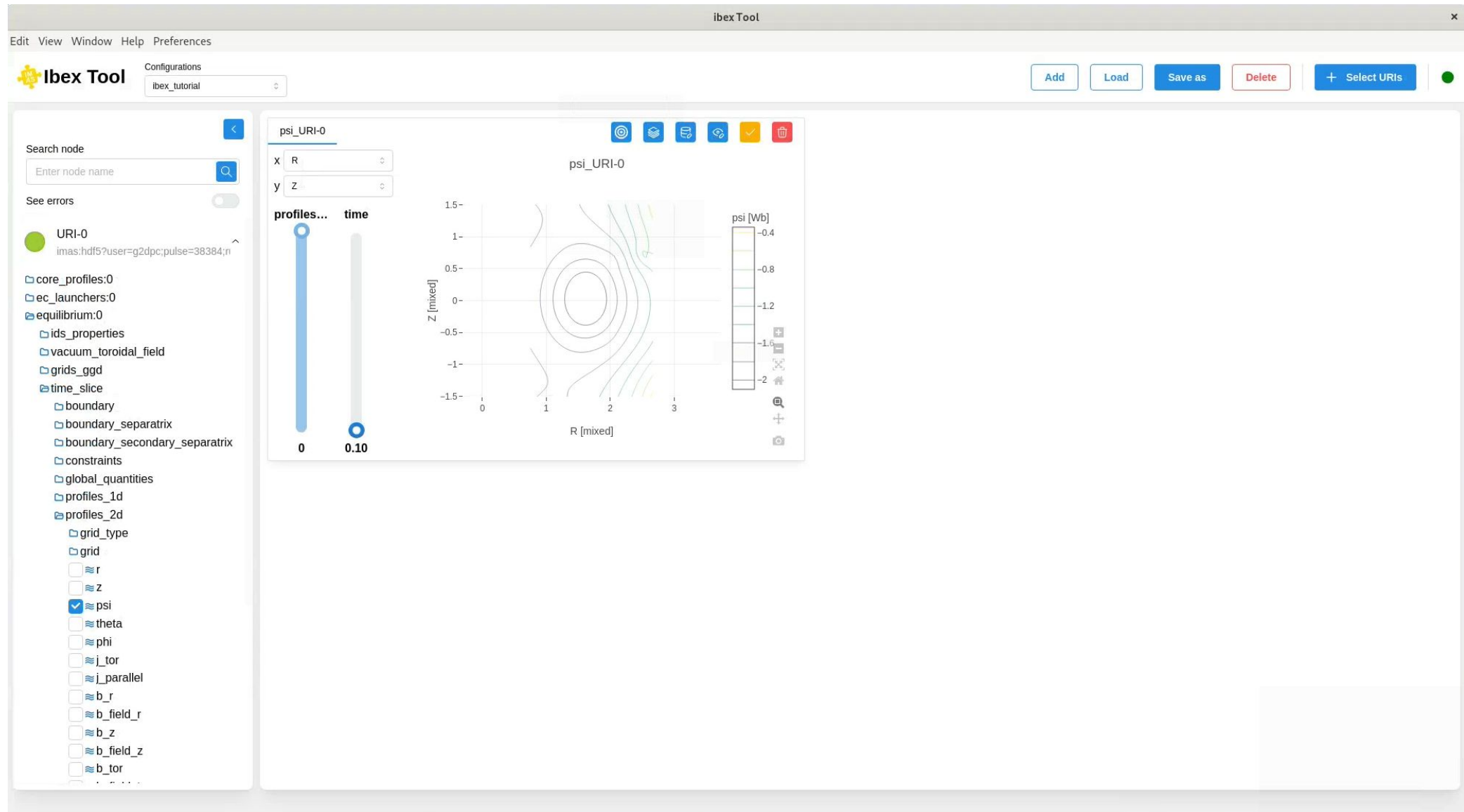
psi_URI-0

psi [Wb]

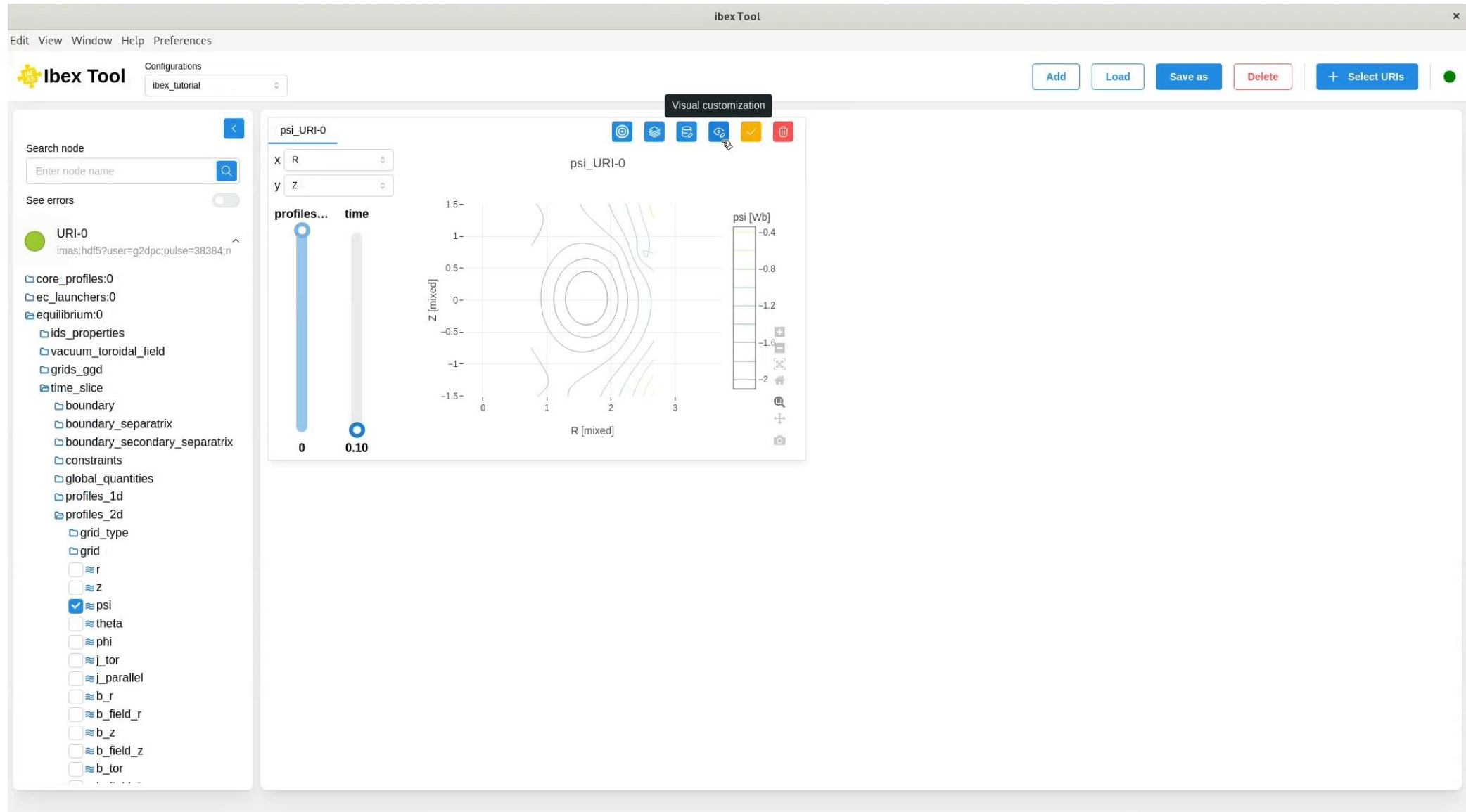
Z [mixed]

R [mixed]

Switching to contour map



Selecting geometry (1/5)



Selecting geometry (2/5)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - grids_ggd
 - time_slice
 - boundary
 - boundary_separatrix
 - boundary_secondary_separatrix
 - constraints
 - global_quantities
 - profiles_1d
 - profiles_2d
 - grid_type
 - grid
 - r
 - z
 - psi
 - theta
 - phi
 - i_tor
 - i_parallel
 - b_r
 - b_field_r
 - b_z
 - b_field_z
 - b_tor

psi_URI-0

psi_URI-0

psi [Wb]

z [mixed]

R [mixed]

Visual customization

Global

1D 1D plots

Heatmap

Geometry

URI containing geometries
Pick a URI

Geometries to display
Pick a geometry

Axis range

Dataplots synchronization

Selecting geometry (3/5)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - grids_ggd
 - time_slice
 - boundary
 - boundary_separatrix
 - boundary_secondary_separatrix
 - constraints
 - global_quantities
 - profiles_1d
 - profiles_2d
 - grid_type
 - grid
 - r
 - z
 - psi
 - theta
 - phi
 - i_tor
 - i_parallel
 - b_r
 - b_field_r
 - b_z
 - b_field_z
 - b_tor

psi_URI-0

psi_URI-0

psi [Wb]

z [mixed]

R [mixed]

Visual customization

Global

1D 1D plots

Heatmap

Geometry

URI containing geometries

imas:hdf5?user=g2dpc;pulse=38384;run

Geometries to display

Pick a geometry

URI-0#ic_antennas:0/antenna[:]/module[:]/strap[:]/geometry/

URI-0#wall:0/description_2d[:]/limiter/unit[:]/outline/

Selecting geometry (4/5)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - grids_ggd
 - time_slice
 - boundary
 - boundary_separatrix
 - boundary_secondary_separatrix
 - constraints
 - global_quantities
 - profiles_1d
 - profiles_2d
 - grid_type
 - grid
 - r
 - z
 - psi
 - theta
 - phi
 - i_tor
 - i_parallel
 - b_r
 - b_field_r
 - b_z
 - b_field_z
 - b_tor

psi_URI-0

psi_URI-0

psi [Wb]

z [mixed]

R [mixed]

wall:0/limiter

Visual customization

Global

1D 1D plots

Heatmap

Geometry

URI containing geometries

imas:hdf5?user=g2dpc;pulse=38384;run

Geometries to display

URI-0#wall:0/description_2d[]/limiter/u... x

Pick a geometry

URI-0#ic_antennas:0/antenna[]/module[]/strap[]/geometry/

URI-0#wall:0/description_2d[]/limiter/unit[]/outline/

Selecting geometry (5/5)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - grids_ggd
 - time_slice
 - boundary
 - boundary_separatrix
 - boundary_secondary_separatrix
 - constraints
 - global_quantities
 - profiles_1d
 - profiles_2d
 - grid_type
 - grid
 - ☐ r
 - ☐ z
 - ☒ psi
 - ☐ theta
 - ☐ phi
 - ☐ j_tor
 - ☐ j_parallel
 - ☐ b_r
 - ☐ b_field_r
 - ☐ b_z
 - ☐ b_field_z
 - ☐ b_tor

psi_URI-0

X R
Y Z

profiles... time

0 0.10

psi_URI-0

psi [Wb]

— wall:0/limiter

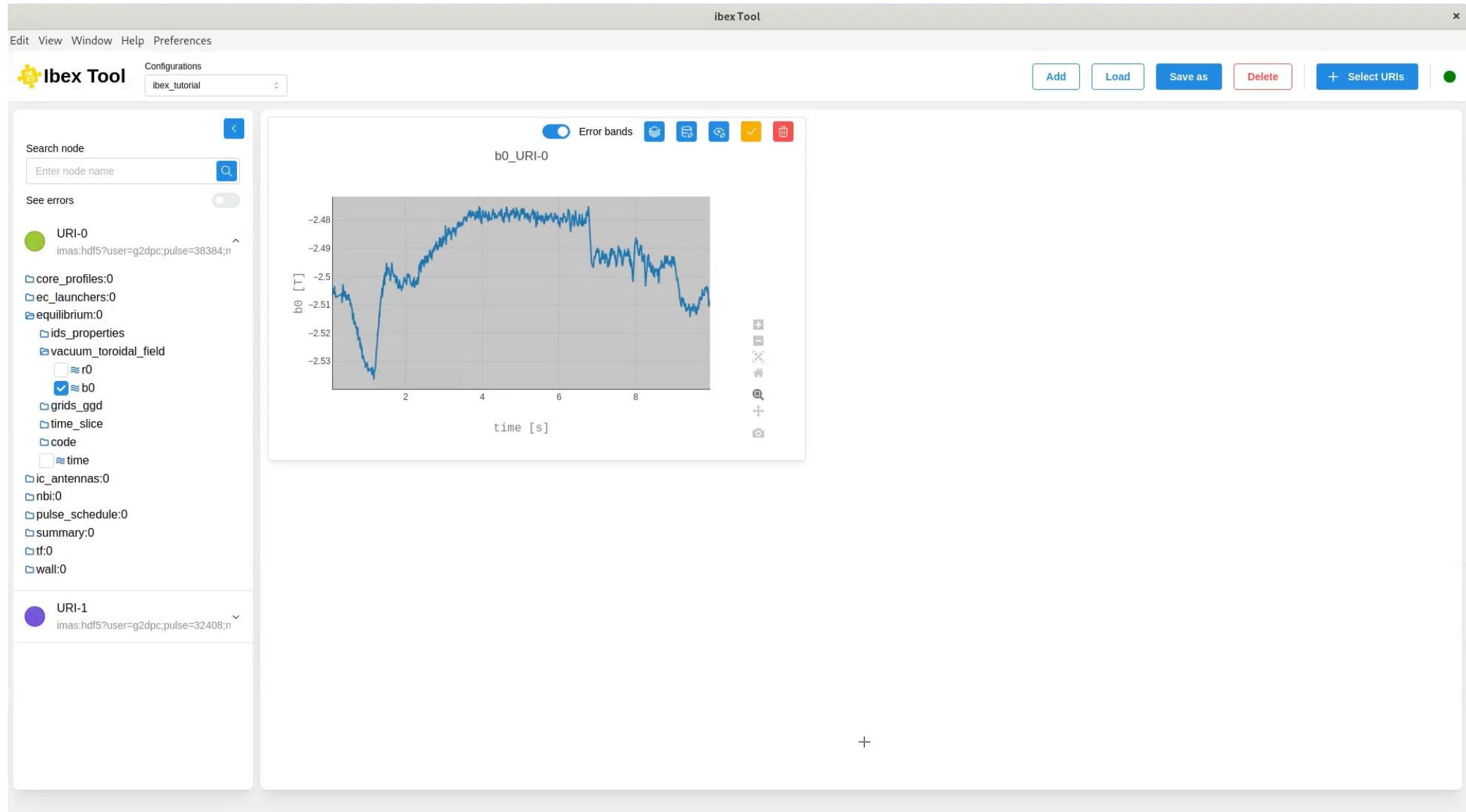
Z [mixed]

R [mixed]

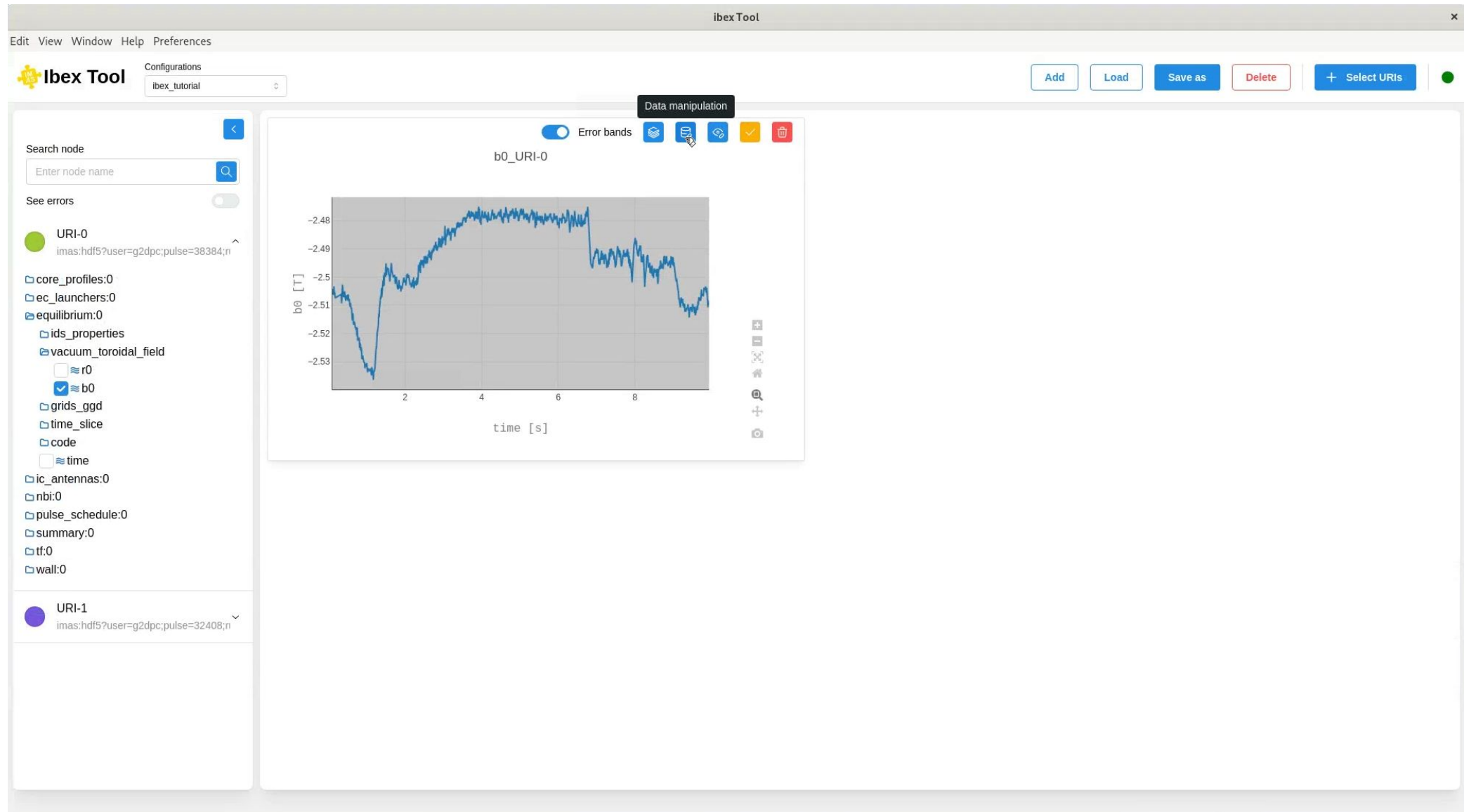
Section 4 - data manipulation

- data operations
- data smoothing
- downsampling

Simple data operations (1/6)



Simple data operations (2/6)



Simple data operations (3/6)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - b0**
 - grids_ggd
 - time_slice
 - code
 - time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Interpolation

Data smoothing

Data operations

Kind
Operand type
Constant

Operation
Select the operation
Select the operation

Value
Scalar value for the operation
1

✓ Constant

Signal

Apply Restore

Simple data operations (4/6)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - b0**
 - grids_ggd
 - time_slice
 - code
 - time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Interpolation

Data smoothing

Data operations

Kind
Operand type
Constant

Operation
Select the operation
Select the operation

Value
Scalar value for the operation
1

+ Add operation

Addition
Subtraction
Multiplication
Division
Exponentiation
Nth root

Simple data operations (5/6)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - b0**
 - grids_ggd
 - time_slice
 - code
 - time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Interpolation

Data smoothing

Data operations

Kind
Operand type
Constant

Operation
Select the operation
Exponentiation

Value
Scalar value for the operation
2

+ Add operation

Apply Restore

Simple data operations (6/6)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - b0**
 - grids_ggd
 - time_slice
 - code
 - time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Interpolation

Data smoothing

Data operations

Kind
Operand type
Constant

Operation
Select the operation
Exponentiation

Value
Scalar value for the operation
2

Kind
Operand type
Constant

Operation
Select the operation
Nth root

Value
Scalar value for the operation
2

+ Add operation

Apply Restore

Data smoothing (1/3)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - b0**
 - grids_ggd
 - time_slice
 - code
 - time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Interpolation

Data smoothing

Method
Select the method
gaussian_filter

Sigma
Standard deviation for Gaussian kernel
1

Apply Restore

Data operations

Data smoothing (2/3)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - b0**
 - grids_ggd
 - time_slice
 - code
 - time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Interpolation

Data smoothing

Method
Select the method
gaussian_filter

Sigma
Standard deviation for Gaussian kernel
5

Apply Restore

Data operations

Data smoothing (3/3)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - b0**
 - grids_ggd
 - time_slice
 - code
 - time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Interpolation

Data smoothing

Method
Select the method
savitzky-golay_filter

Window length
Length of the filter window
5

Polyorder
Order of the polynomial
2

Deriv
Order of the derivative to compute
0

Delta
Spacing of the samples (used if deriv > 0)
1

Mode
Padding mode at the edges
interp

Cval
Value to fill past the edges (mode 'constant')
0

Apply Restore

Data operations

Downsampling (1/2)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - ☒ b0
 - grids_ggd
 - time_slice
 - code
 - time
 - ic_antennas:0
 - nbi:0
 - pulse_schedule:0
 - summary:0
 - tf:0
 - wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Method
Select the method

None

Size of the leaf node
Number of elements to retain in the leaf node

100

Downsampled data

- ☒ None
- Step
- Step average
- Min-Max
- M4
- LTTB
- Min-Max + TTR

Downsampling (2/2)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - r0
 - ☒ b0
 - grids_ggd
 - time_slice
 - code
 - time
 - ic_antennas:0
 - nbi:0
 - pulse_schedule:0
 - summary:0
 - tf:0
 - wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

b0_URI-0

b0 [T]

time [s]

Data manipulation

Downsampling

Method
Select the method
Step

Size of the leaf node
Number of elements to retain in the leaf node
50

Get downsampled data

Interpolation

Data smoothing

Data operations

Section 5 - utilities and miscellaneous info

- configuration saving
- hiding empty nodes
- showing unit aliases
- error bands

Saving the configuration (1/2)

ibex Tool

Edit View Window Help Preferences

Configurations
ibex_tutorial

Add Load Save as Delete + Select URIs

Search node
Enter node name

See errors

URI-0
imas:hdf5?user=g2dpc;pulse=38384;n

- core_profiles:0
- ec_launchers:0
- equilibrium:0
 - ids_properties
 - vacuum_toroidal_field
 - ☐ r0
 - ☒ b0
 - grids_ggd
 - time_slice
 - code
 - ☐ time
- ic_antennas:0
- nbi:0
- pulse_schedule:0
- summary:0
- tf:0
- wall:0

URI-1
imas:hdf5?user=g2dpc;pulse=32408;n

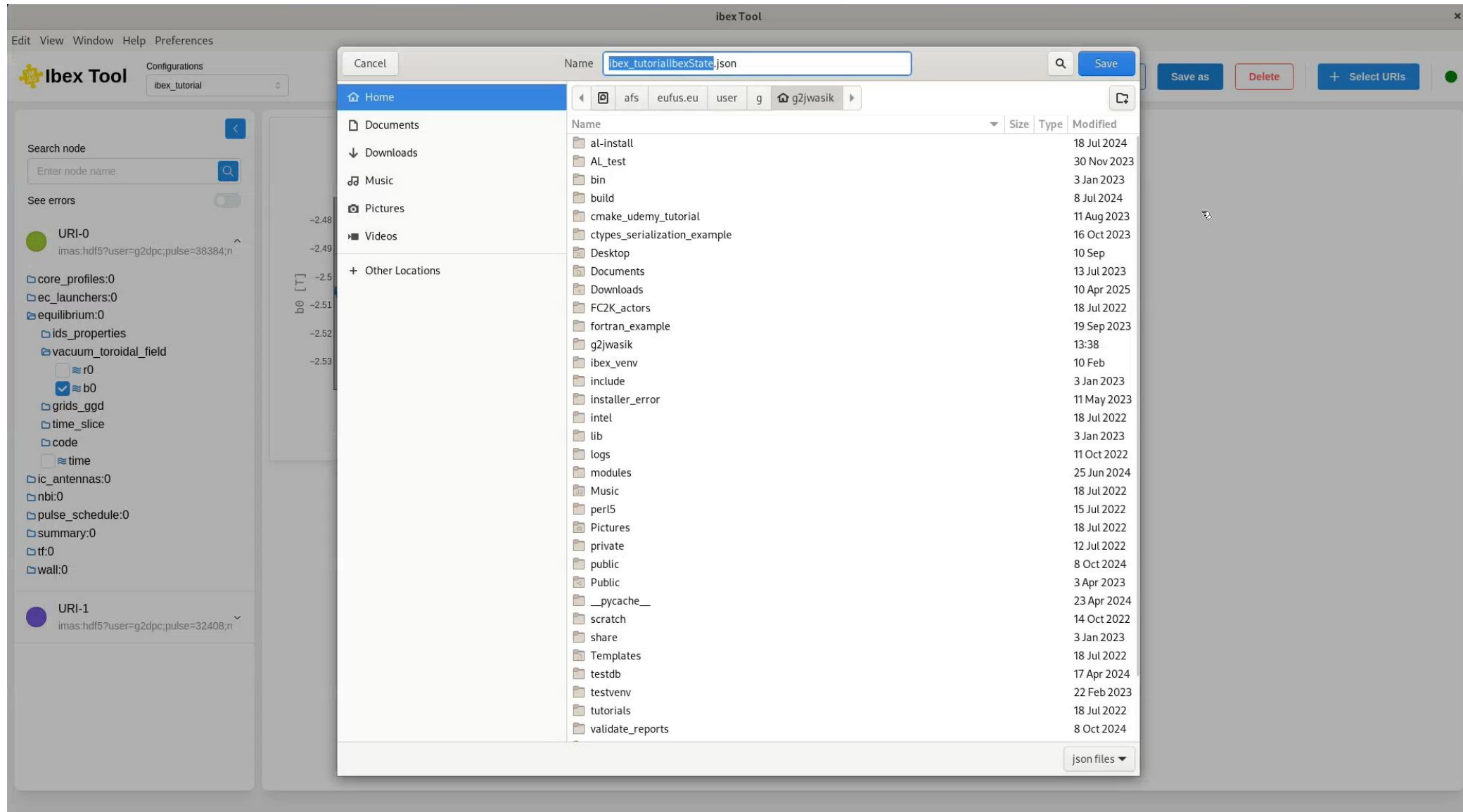
b0_URI-0

Error bands

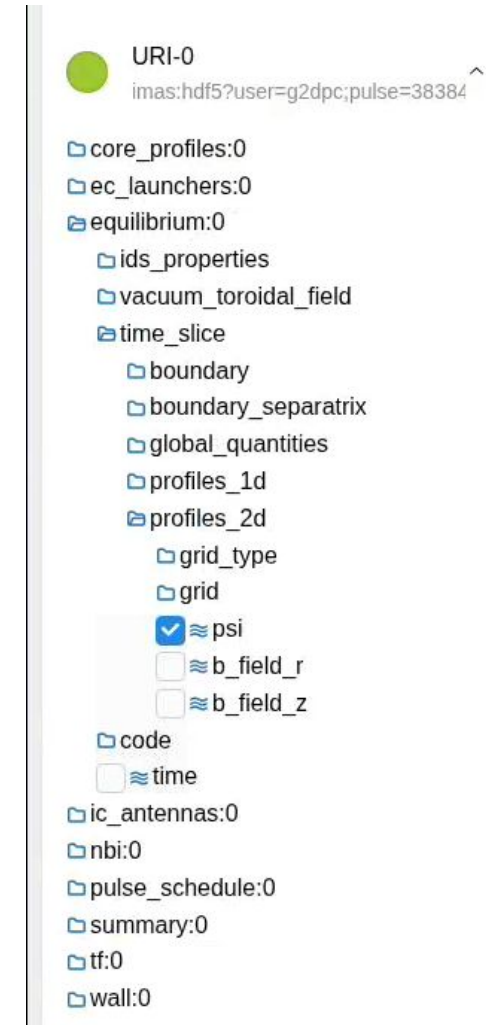
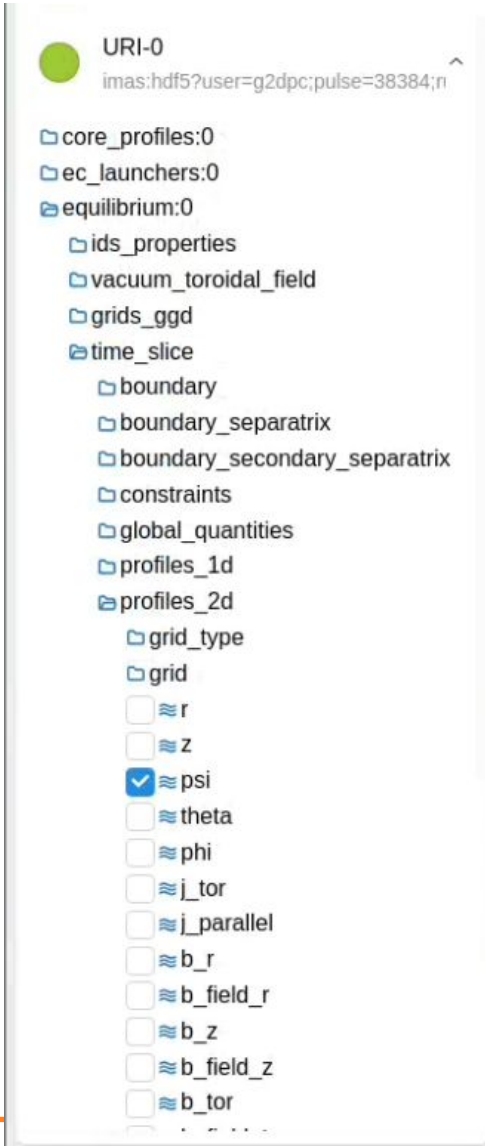
b0 [T]

time [s]

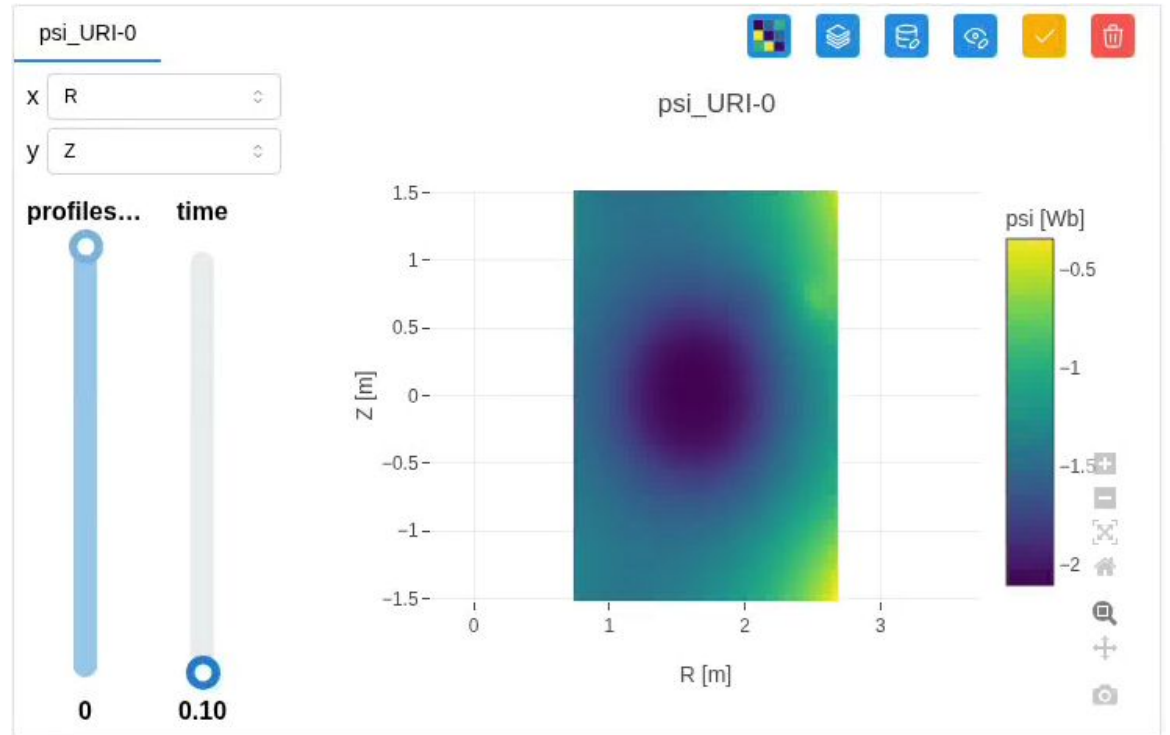
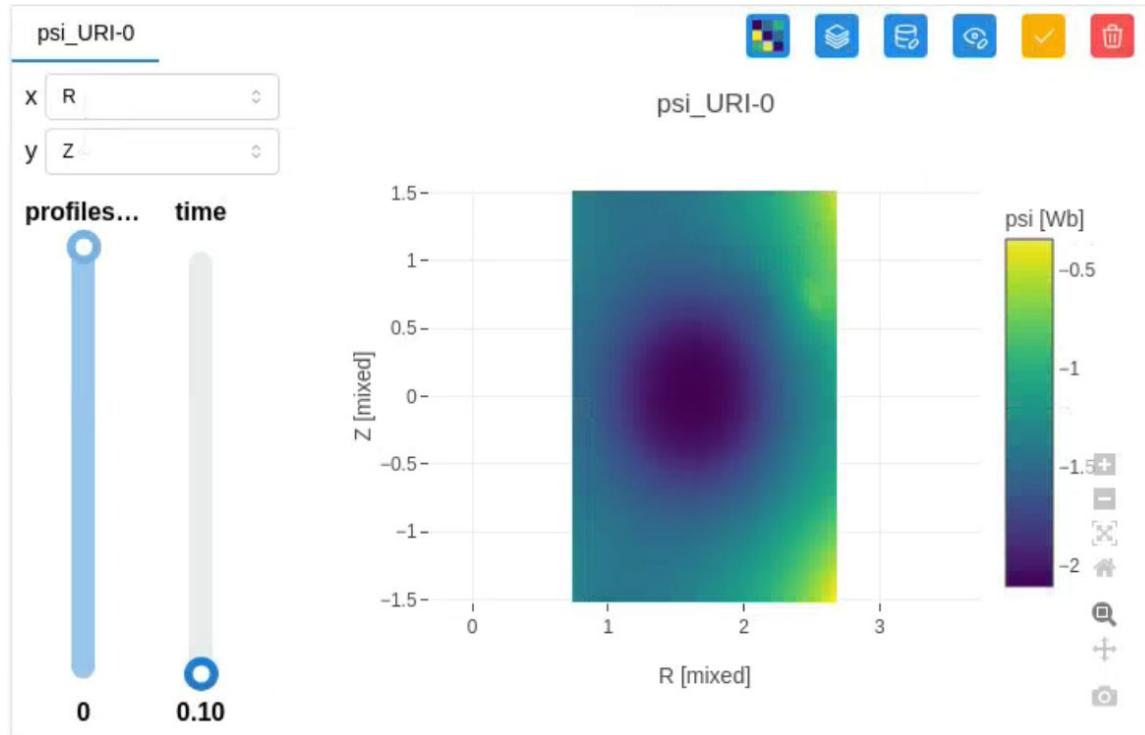
Saving the configuration (2/2)



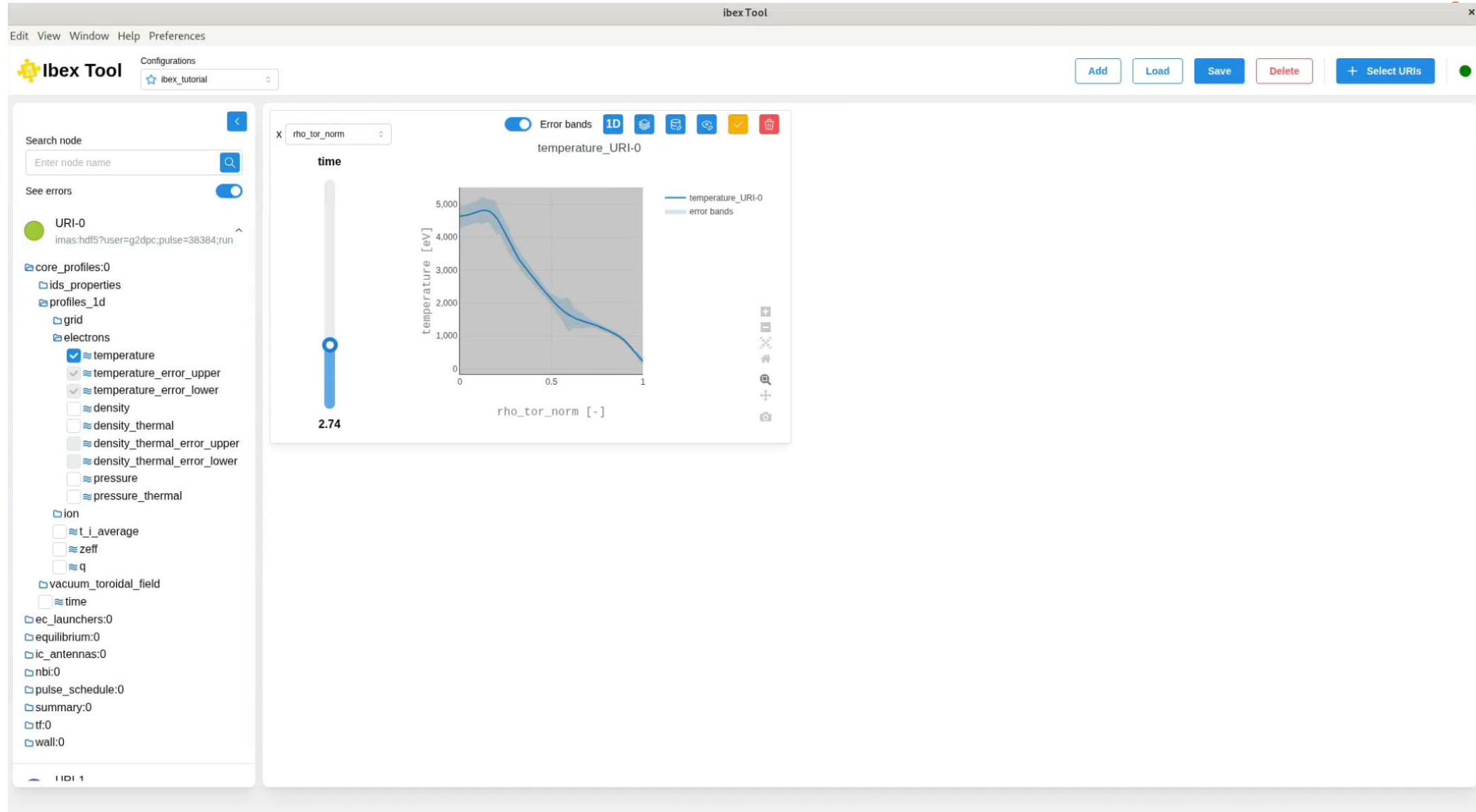
For IMAS-Core >= 5.7 and IMAS-Python >= 2.2.2 IBEX exploration tree shows only filled nodes



For IMAS-Python ≥ 2.3 IBEX shows unit aliases



If the error bands are present - they will be displayed if “error bands” option is checked





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Thank you.

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