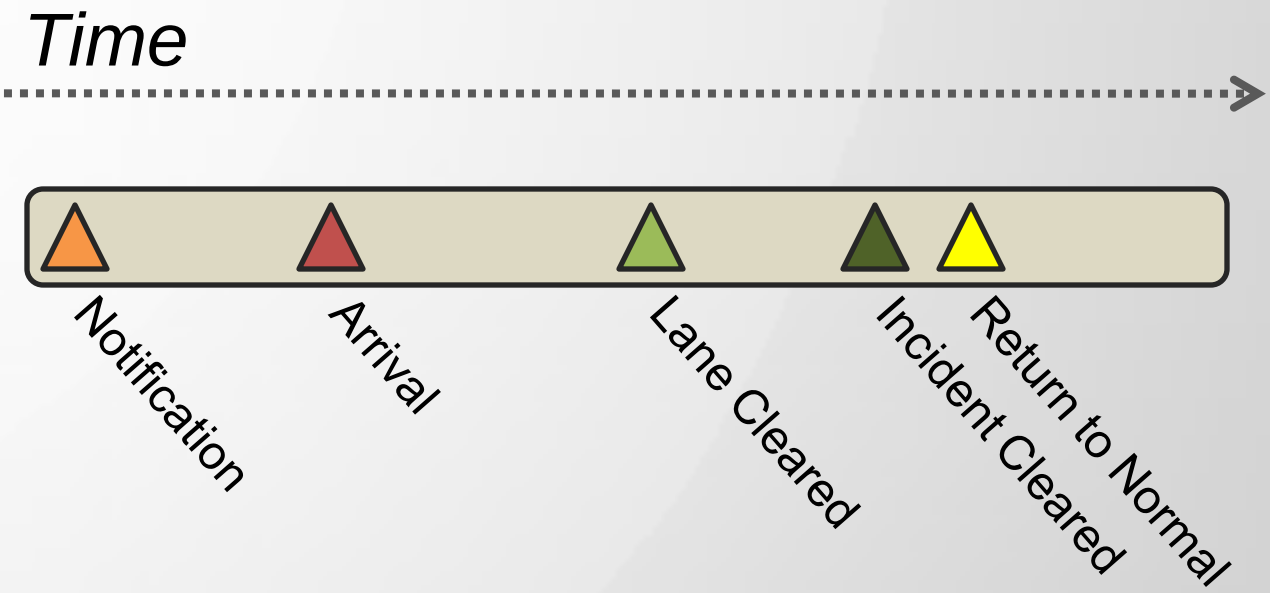
Visualizing Temporal Events in Traffic Incidents

John Alexis Guerra-Gómez
Krist Wongsuphasawat
Catherine Plaisant
Ben Shneiderman

Human-computer Interaction Lab
University Of Maryland

6th International Visualization in Transportation Symposium

Traffic Incident



Traffic Incidents

The Problem

- Traffic incidents
- Vast amounts of collected data.
- Temporal component makes it difficult to analyze
  - Traditional tools like SQL result inadequate
- Data quality issues.
- Can we find best practices, measure performance, compare behavior

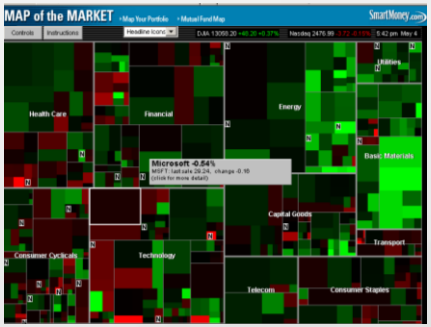
Information Visualization

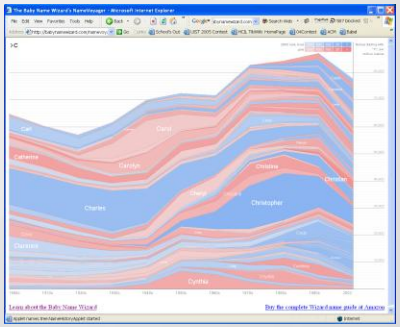
compact **graphical presentation** and **user interface**

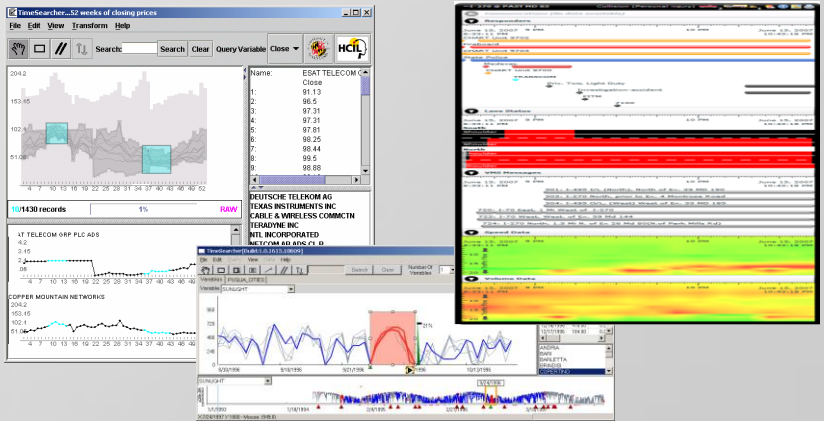
for manipulating large numbers of items (10^2 - 10^6),

enables users to make
discoveries, decisions, or explanations
about patterns or groups of items

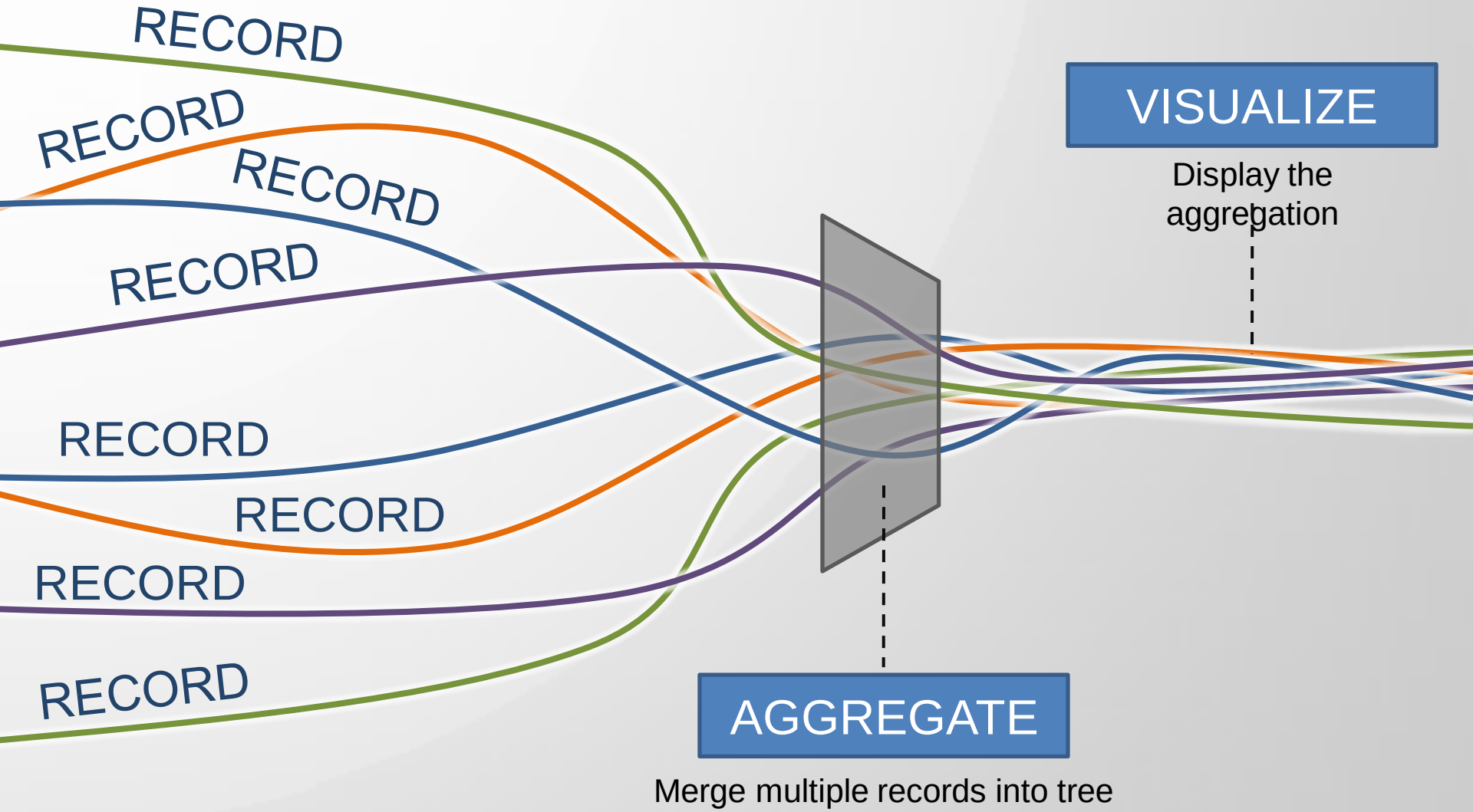
visual bandwidth is enormous





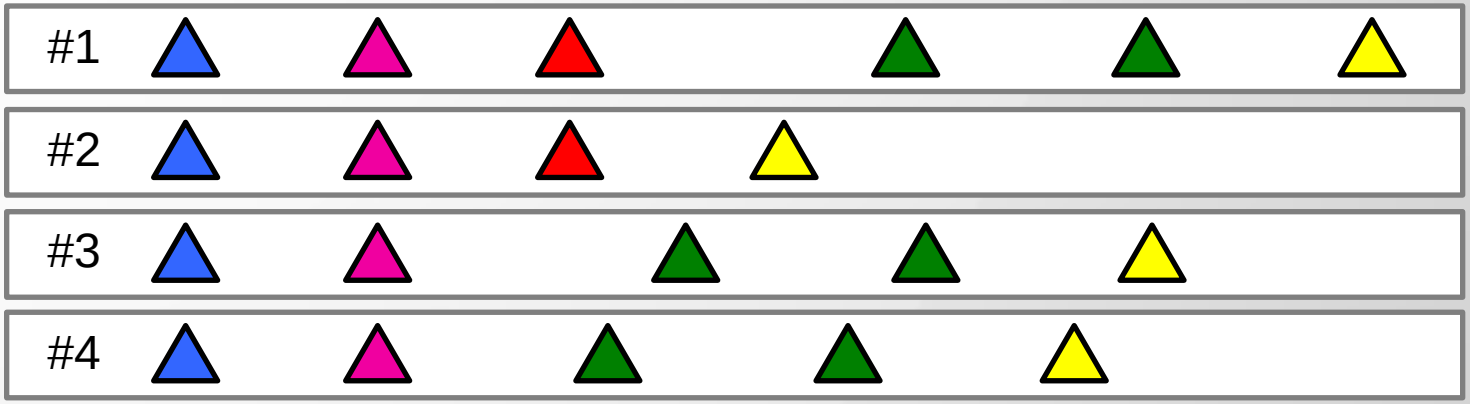


Lifeflow


RECORD
RECORD
RECORD
RECORD
RECORD
RECORD
RECORD
RECORD
VISUALIZE
Display the aggregation
AGGREGATE
Merge multiple records into tree

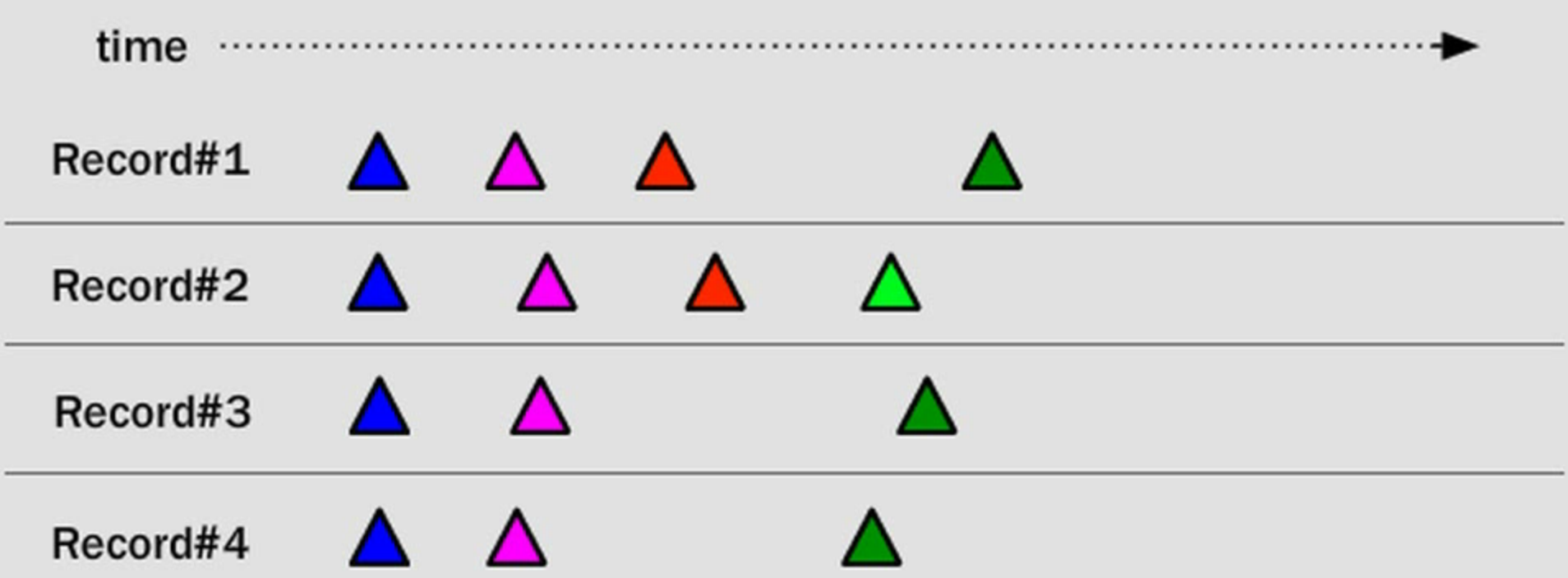
Aggregate

- Aggregate by prefix

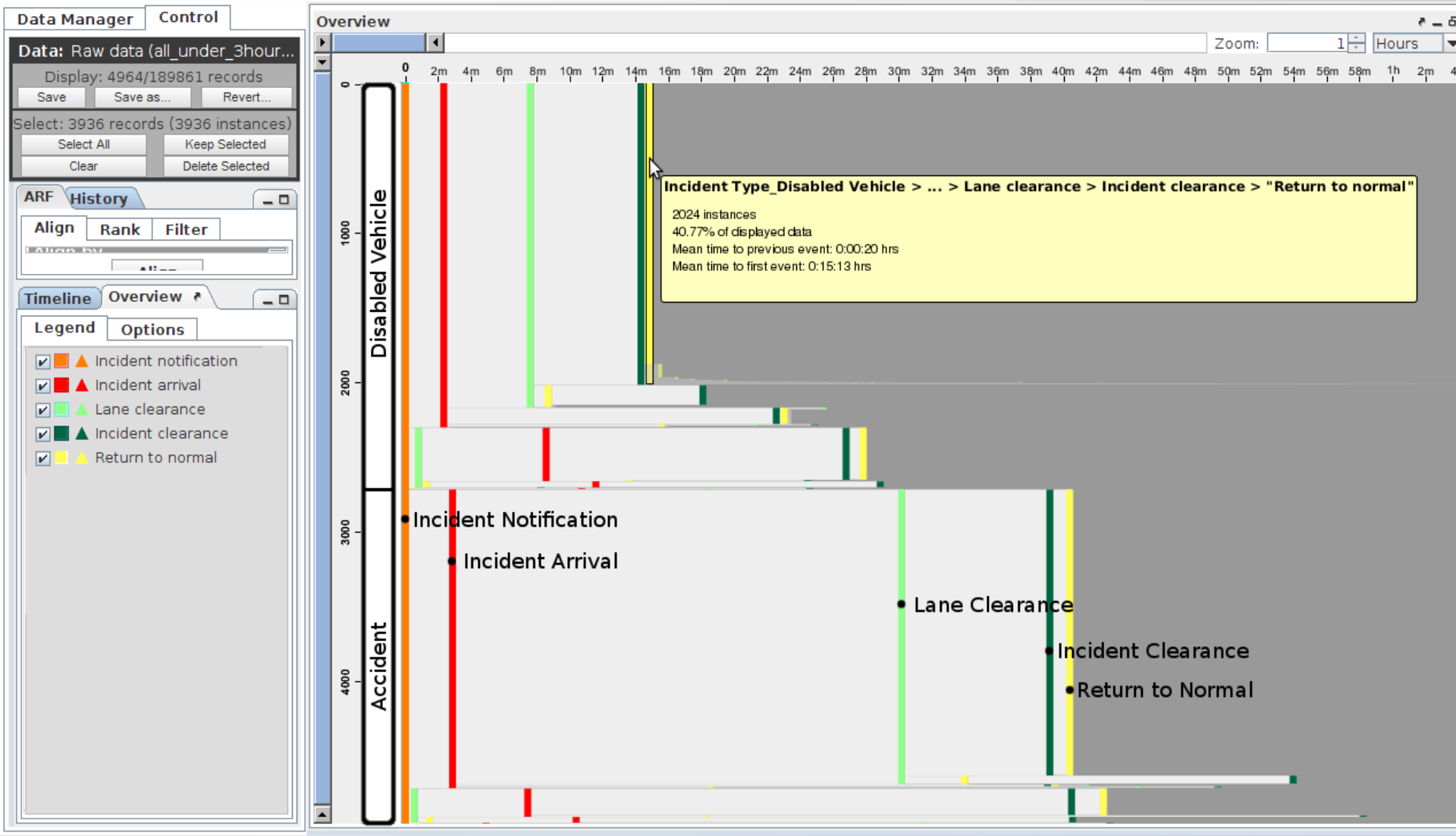


Example with records

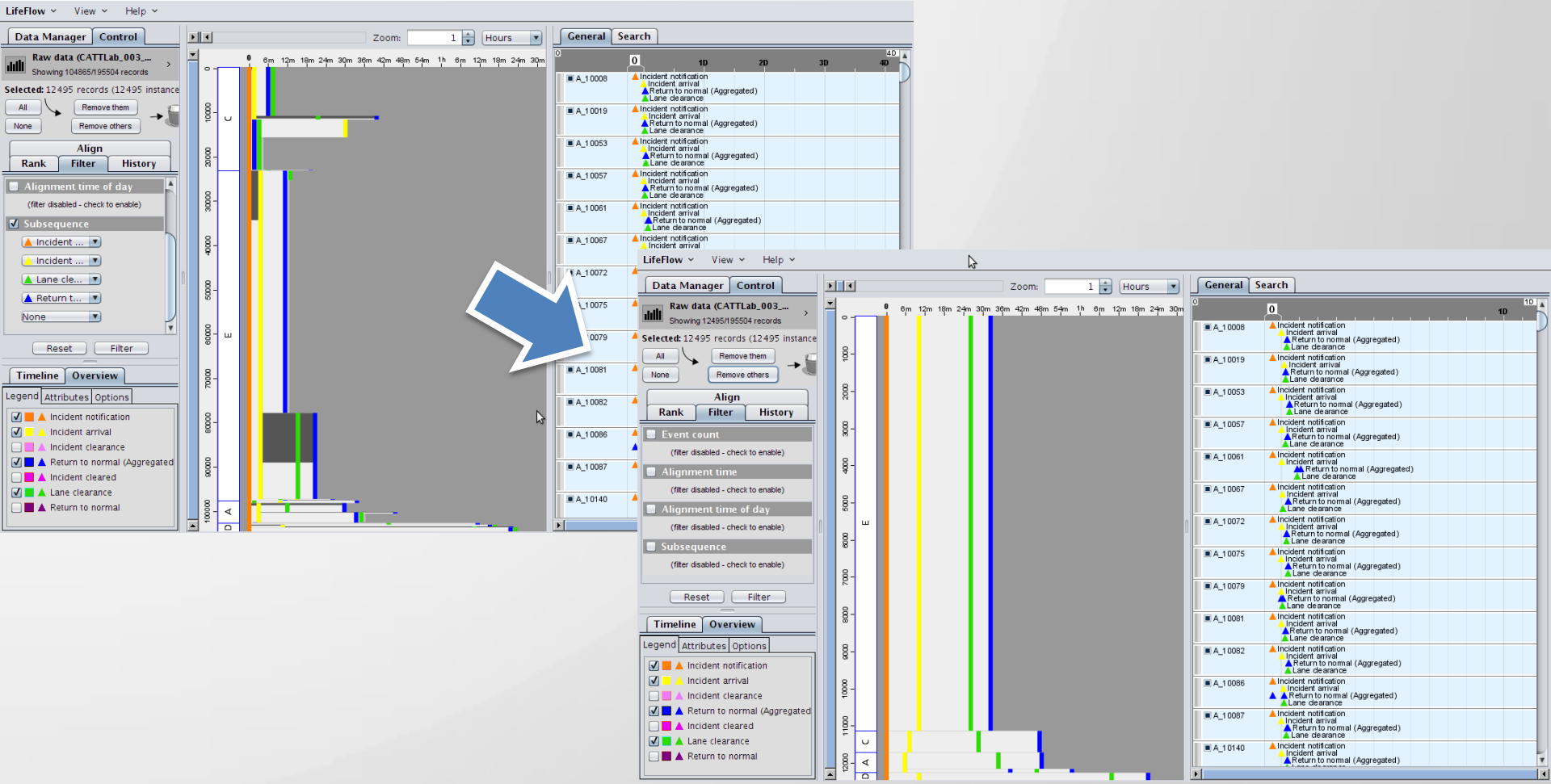
CREATING LIFEFLOW



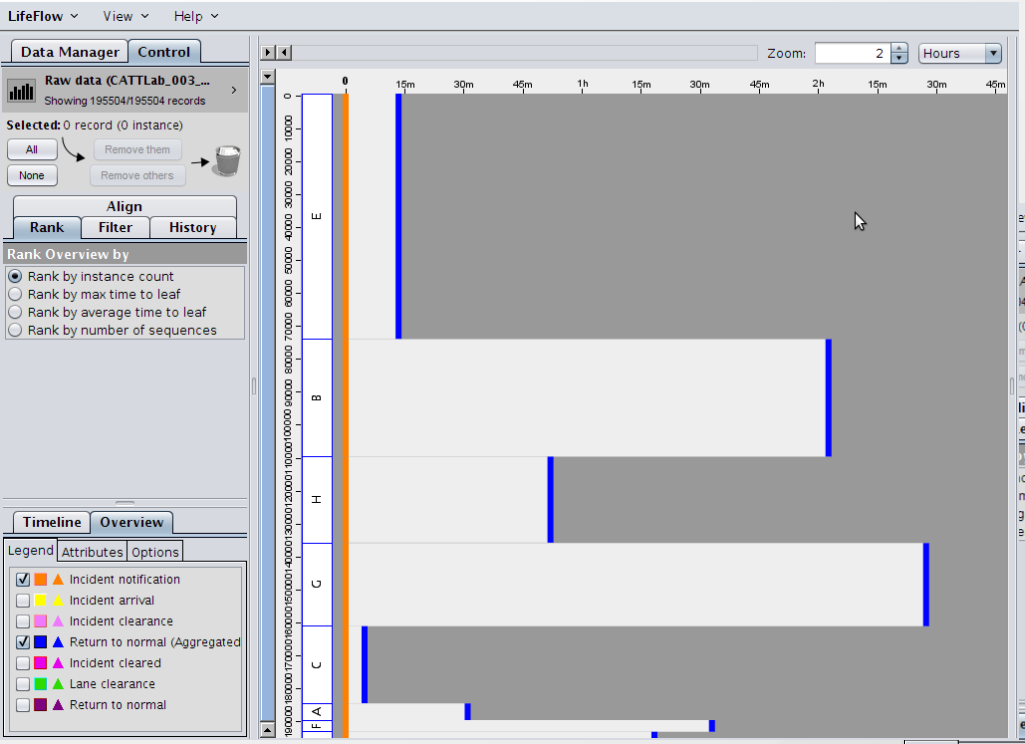
LifeFlow Sample Data



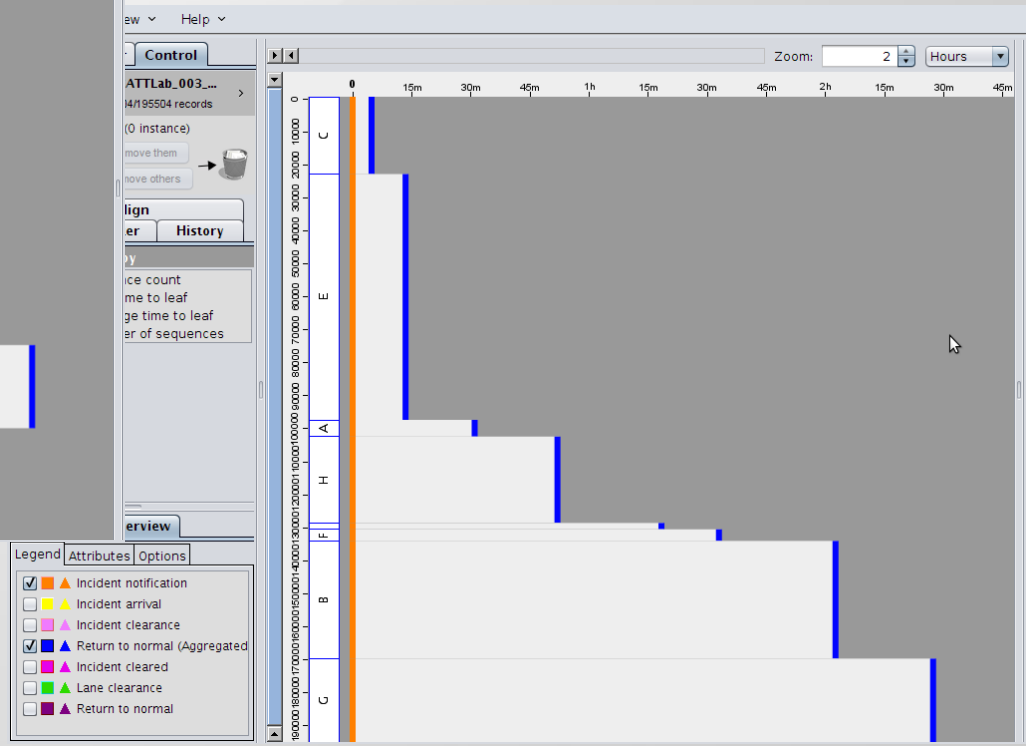
Filter


LifeFlow
View
Help
Data Manager
Control
Raw data (CATTLab_003_...
Showing 104865/195504 records
Selected: 12495 records (12495 instance
All
None
Remove them
Remove others
Align
Rank
Filter
History
Alignment time of day
(filter disabled - check to enable)
Subsequence
Incident ...
Lane cle...
Return t...
None
Reset
Filter
Timeline
Overview
Legend
Attributes
Options
Incident notification
Incident arrival
Incident clearance
Return to normal (Aggregated
Incident cleared
Lane clearance
Return to normal
Zoom:
Hours
General
Search
Event count
Alignment time

Rank

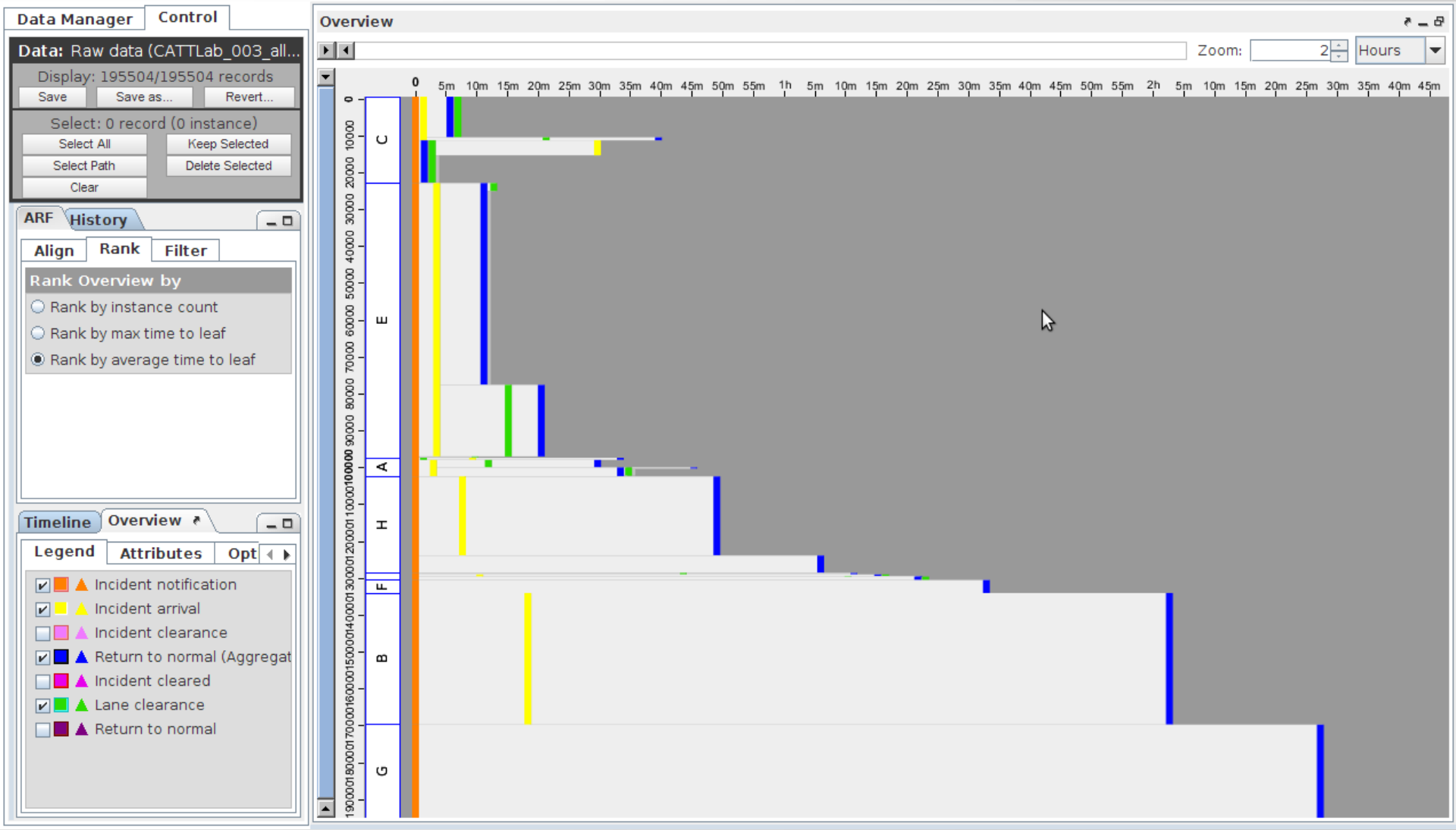


By time



By instance count

Non temporal Attributes

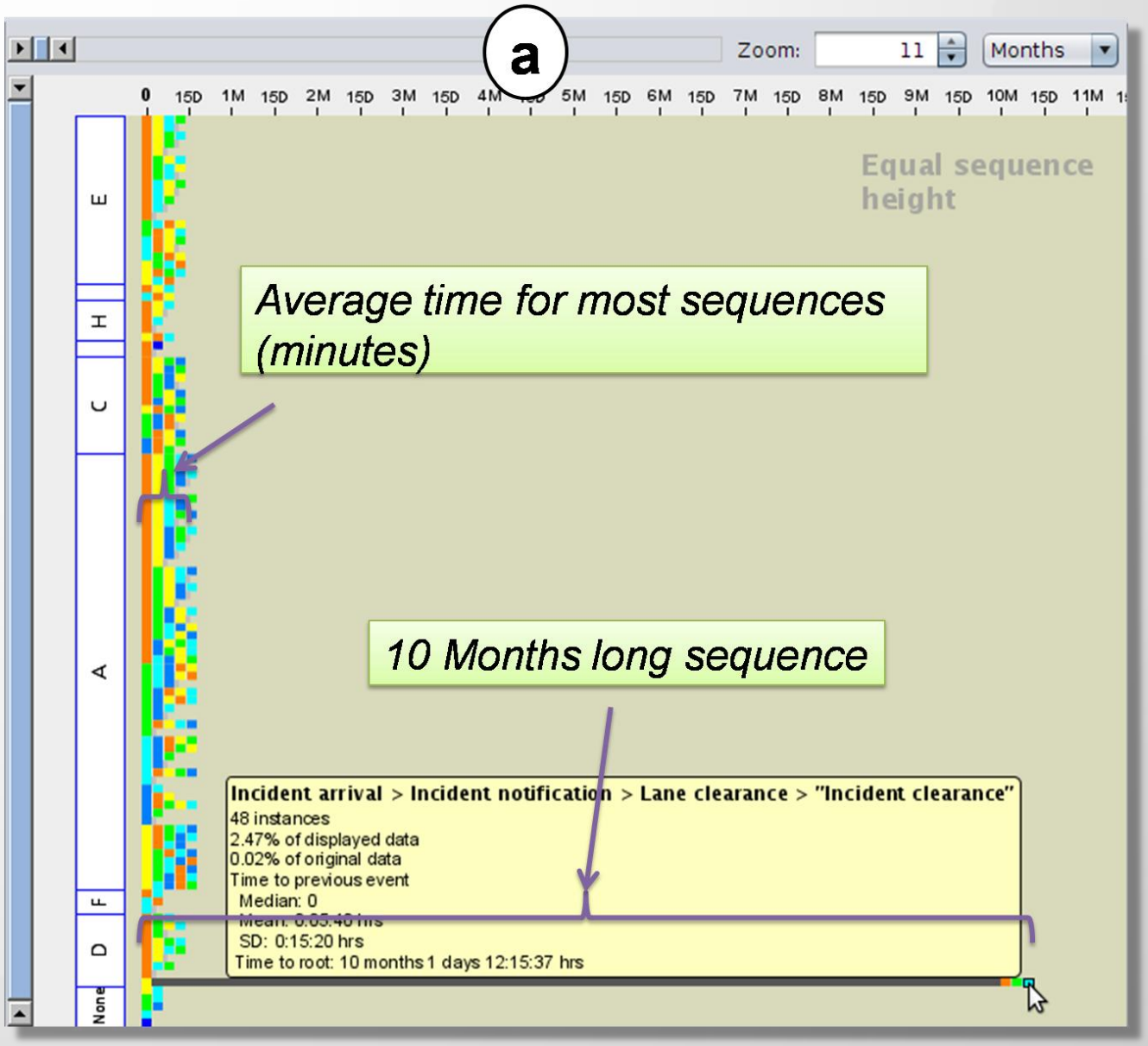


Applications

- National Cooperative Highway Research Program (NCHRP) dataset that included 203,214 traffic incidents from 8 agencies.
  - Agencies, Event Types
  - Temporal Events (Notification, Cleared, etc)
- Maryland MDOT dataset, comparing +500k traffic incidents in the State
  - More non temporal attributes

Findings!!

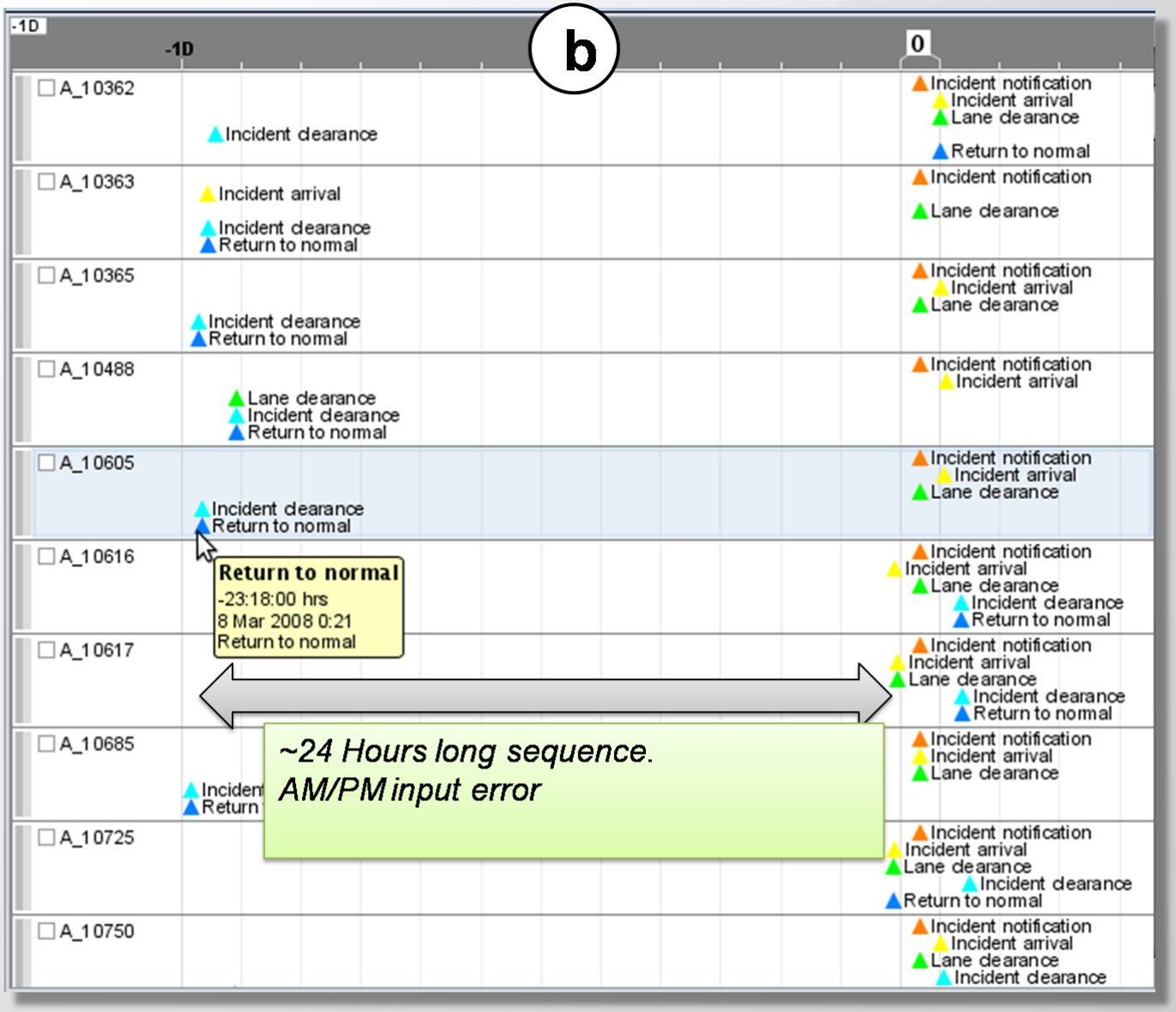
Abnormal data



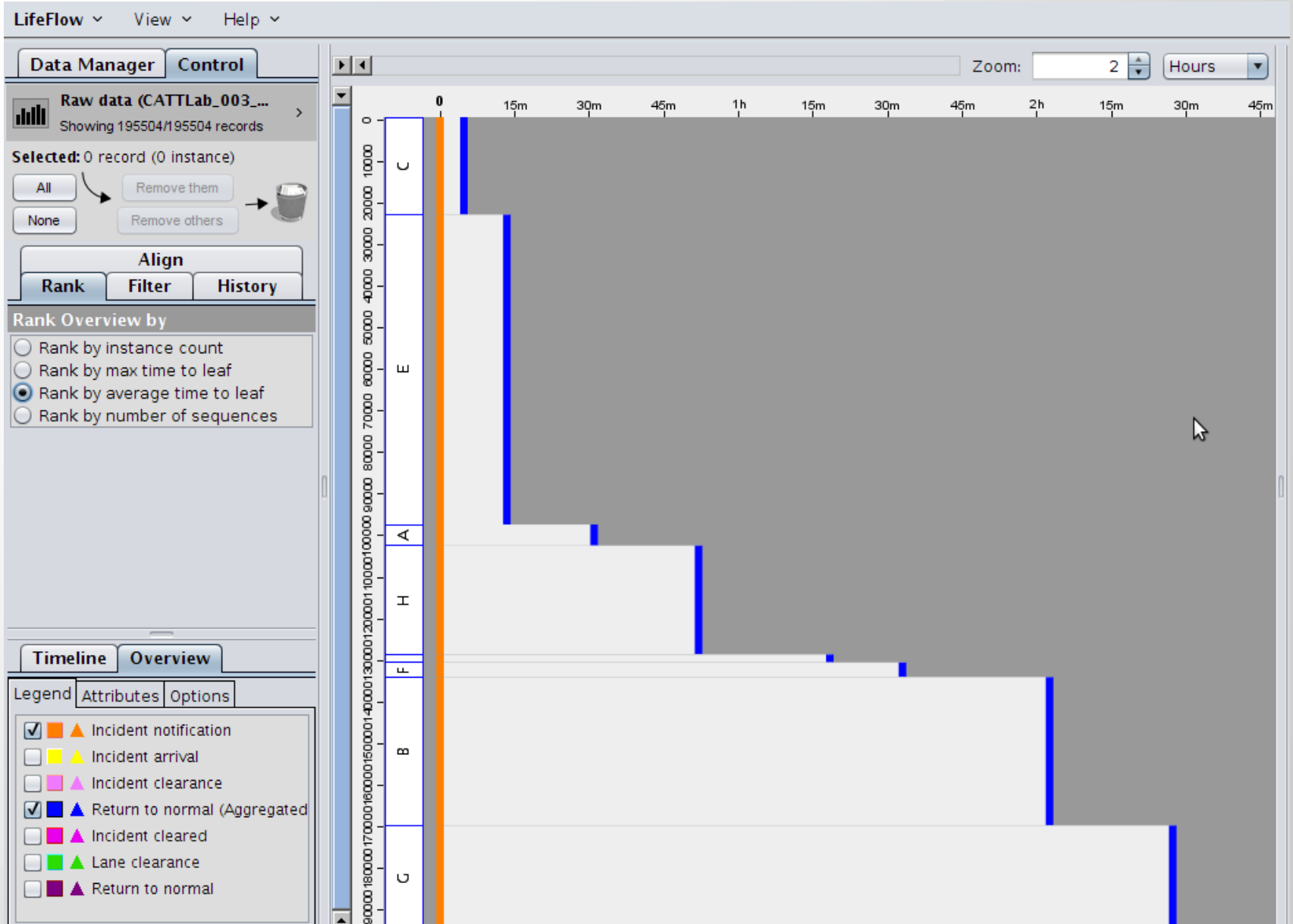
Equal Sequence Height View

Abnormal data (II)

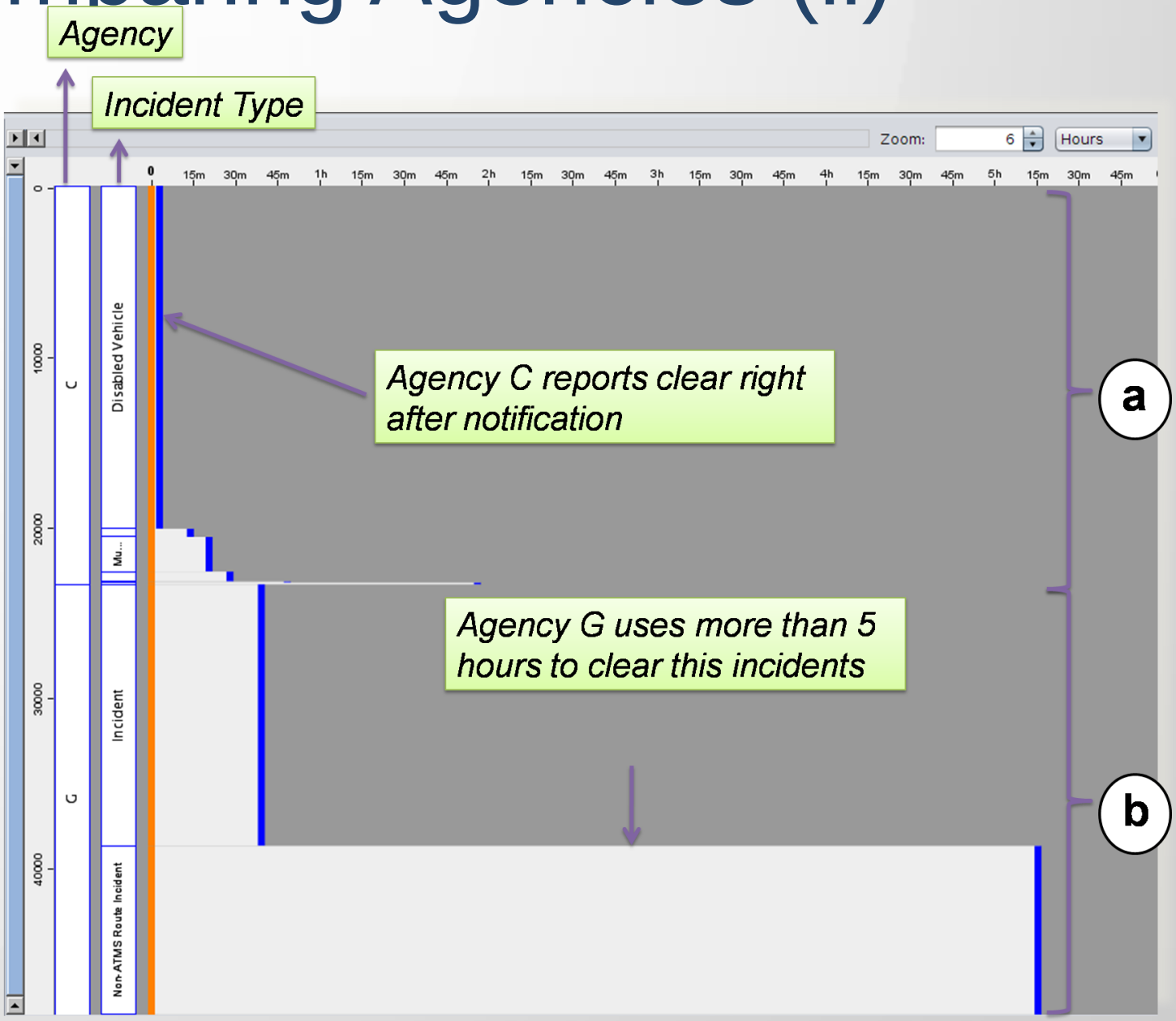
Detailed View



Comparing Agencies (i)

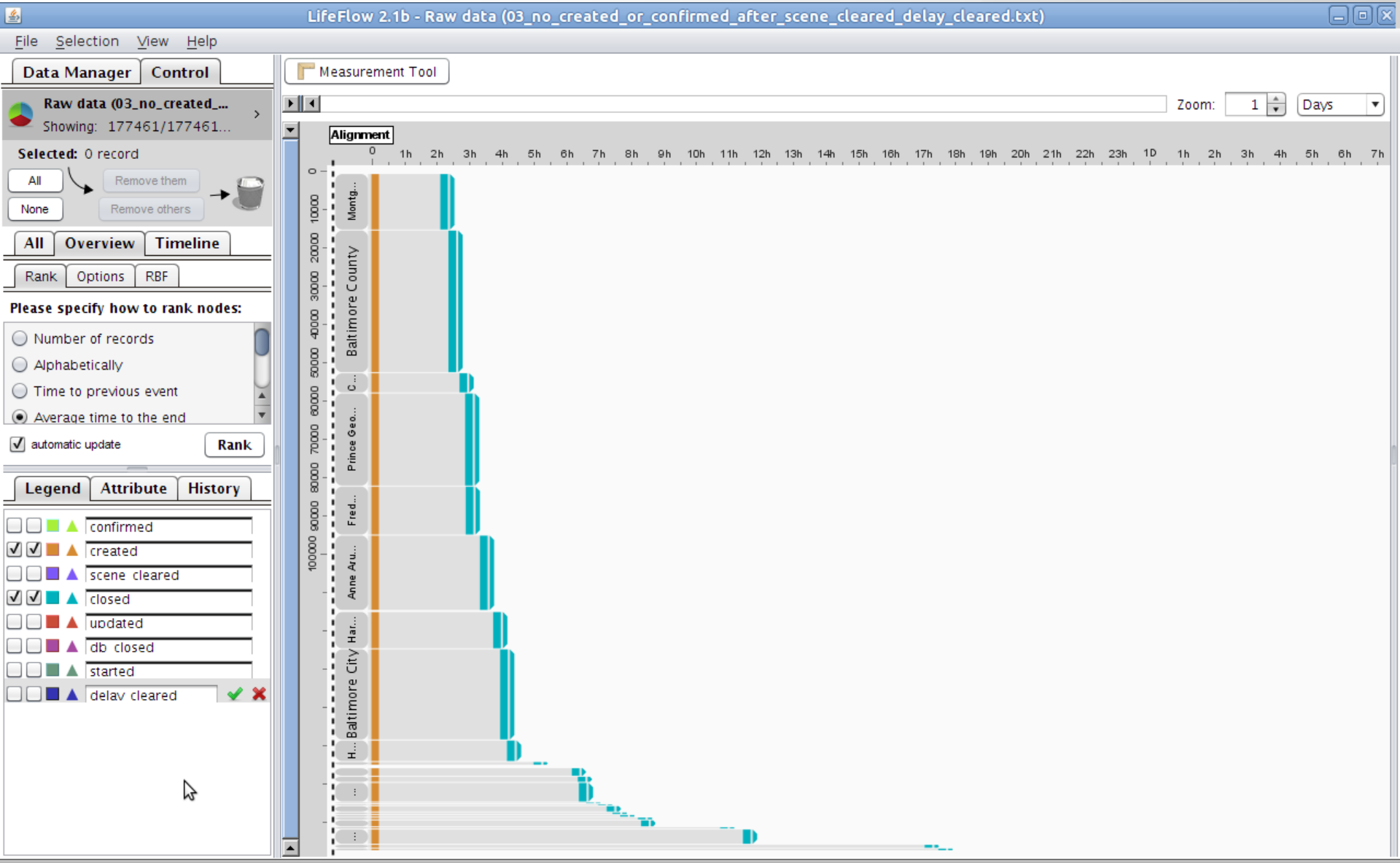


Comparing Agencies (ii)

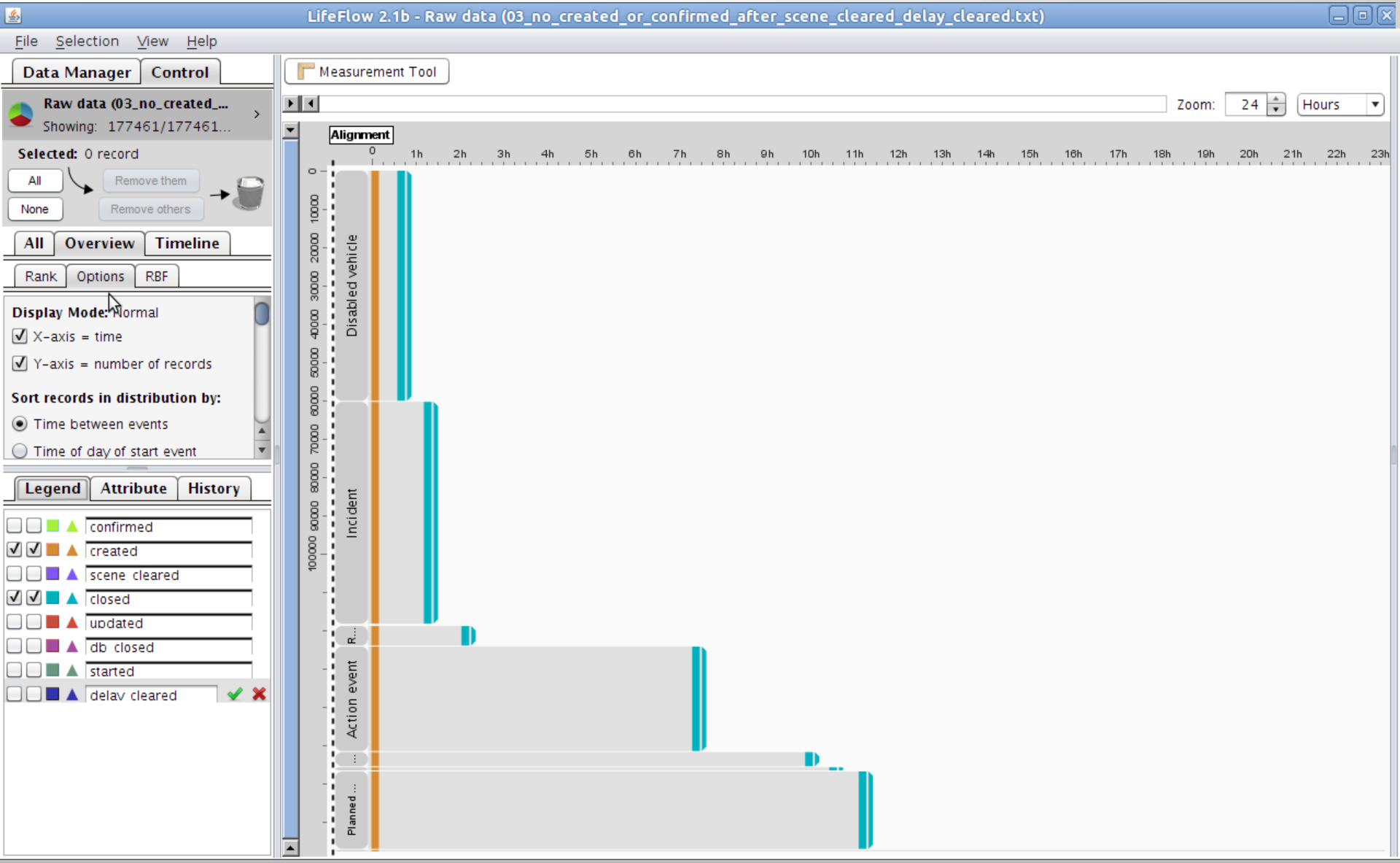


We want to compare more!

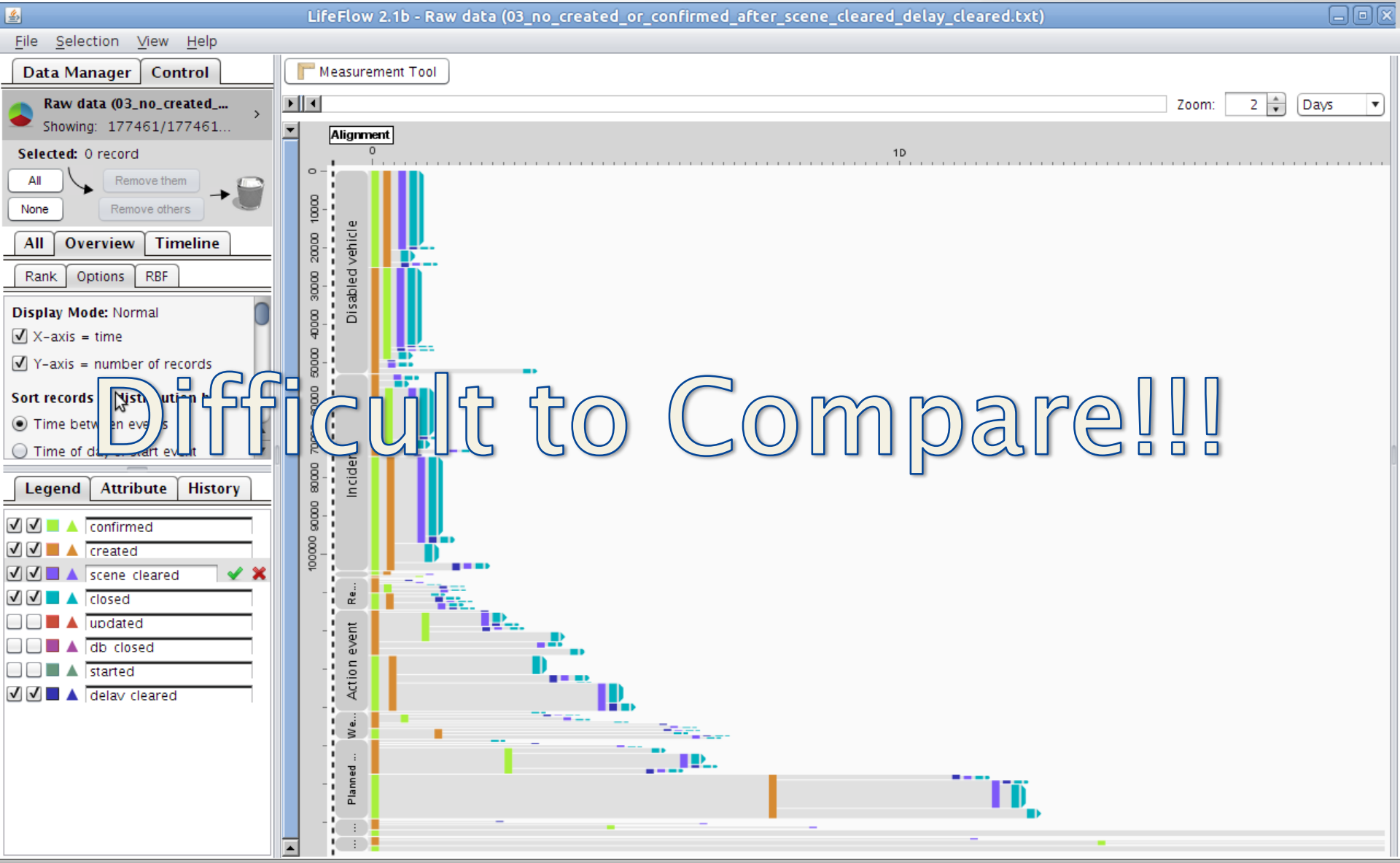
Ranking of Counties

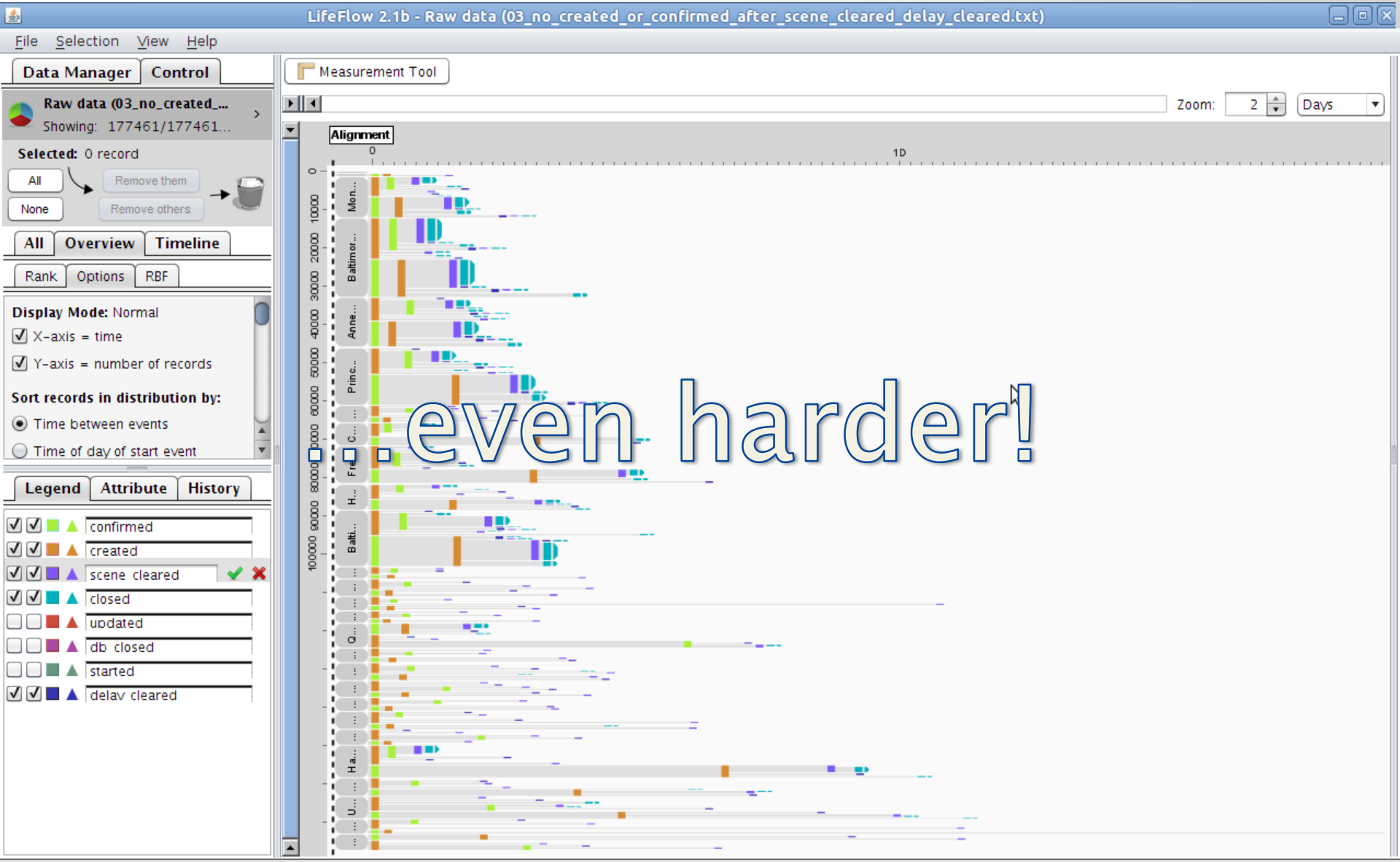


Ranking of Incident Types



Incident Types Expanded



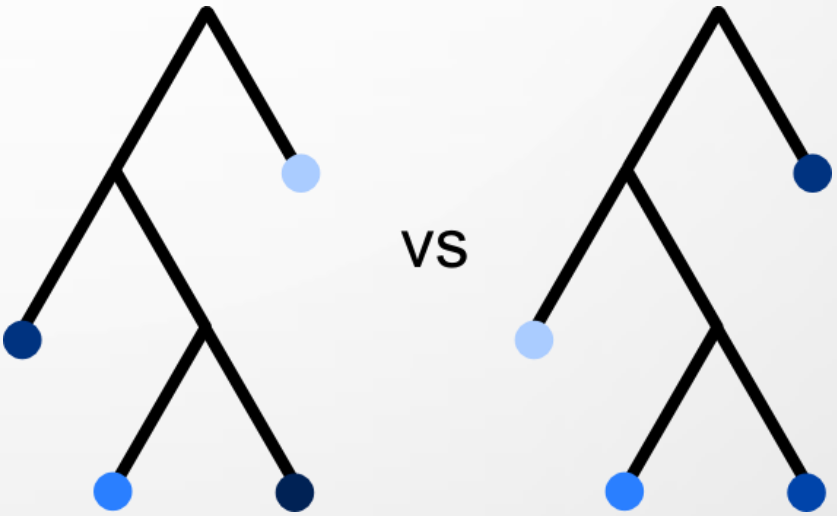

LifeFlow 2.1b - Raw data (03_no_created_or_confirmed_after_scene_cleared_delay_cleared.txt)
File
Selection
View
Help
Data Manager
Control
Raw data (03_no_created_...
Showing: 177461/177461...
Selected: 0 record
All
None
Remove them
Remove others
All
Overview
Timeline
Rank
Options
RBF
Display Mode: Normal
X-axis = time
Y-axis = number of records
Sort records in distribution by:
Time between events
Time of day of start event
Legend
Attribute
History
confirmed
created
scene cleared
closed
updated
db closed
started
delay cleared
Measurement Tool
Zoom:
2
Days
Alignment
0
1D
Mon...
Baltimor...
Anne...
Princ...
Balti...
Ha...
U...
... even harder!

TreeVersity

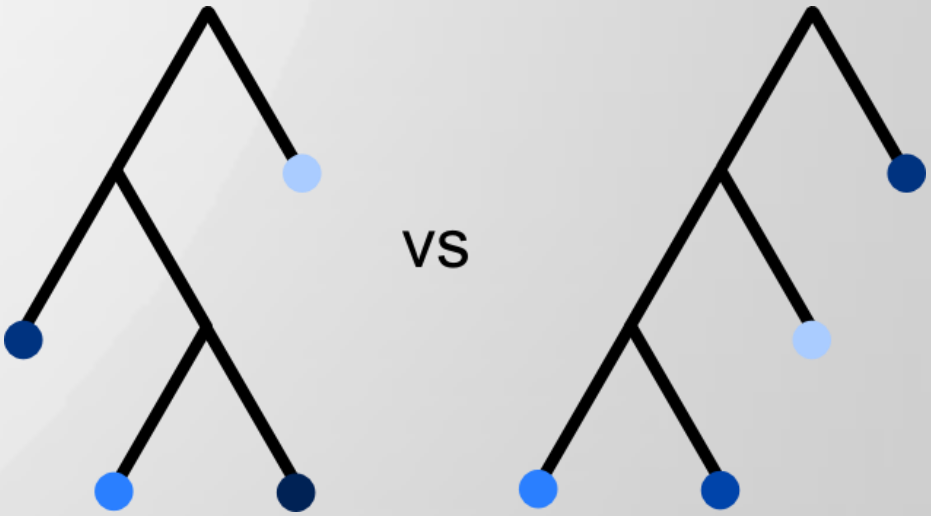
Compares Tree structures by changes in node attribute values and topology

Types of Comparison

- Values on the leaves only



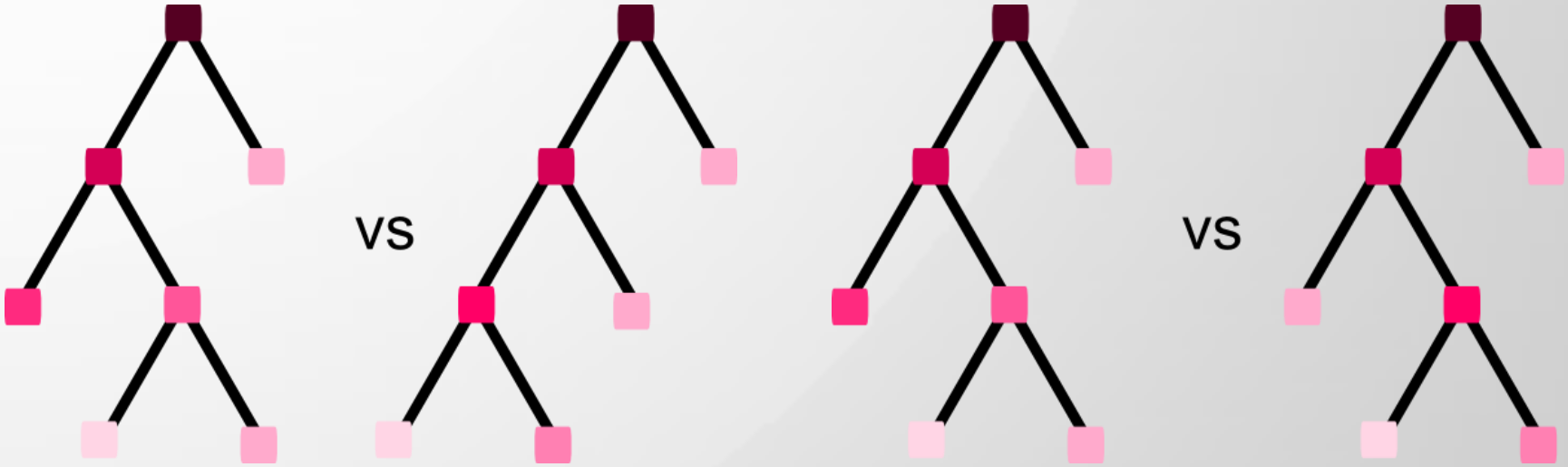
Same Topology



Different Topology

Types of Comparison (II)

- Values on all the nodes



Same Topology

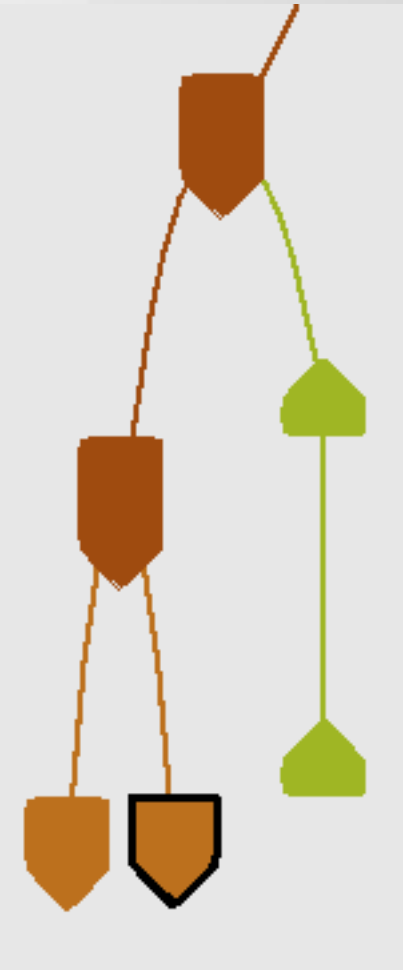
Different Topology

Type of Differences

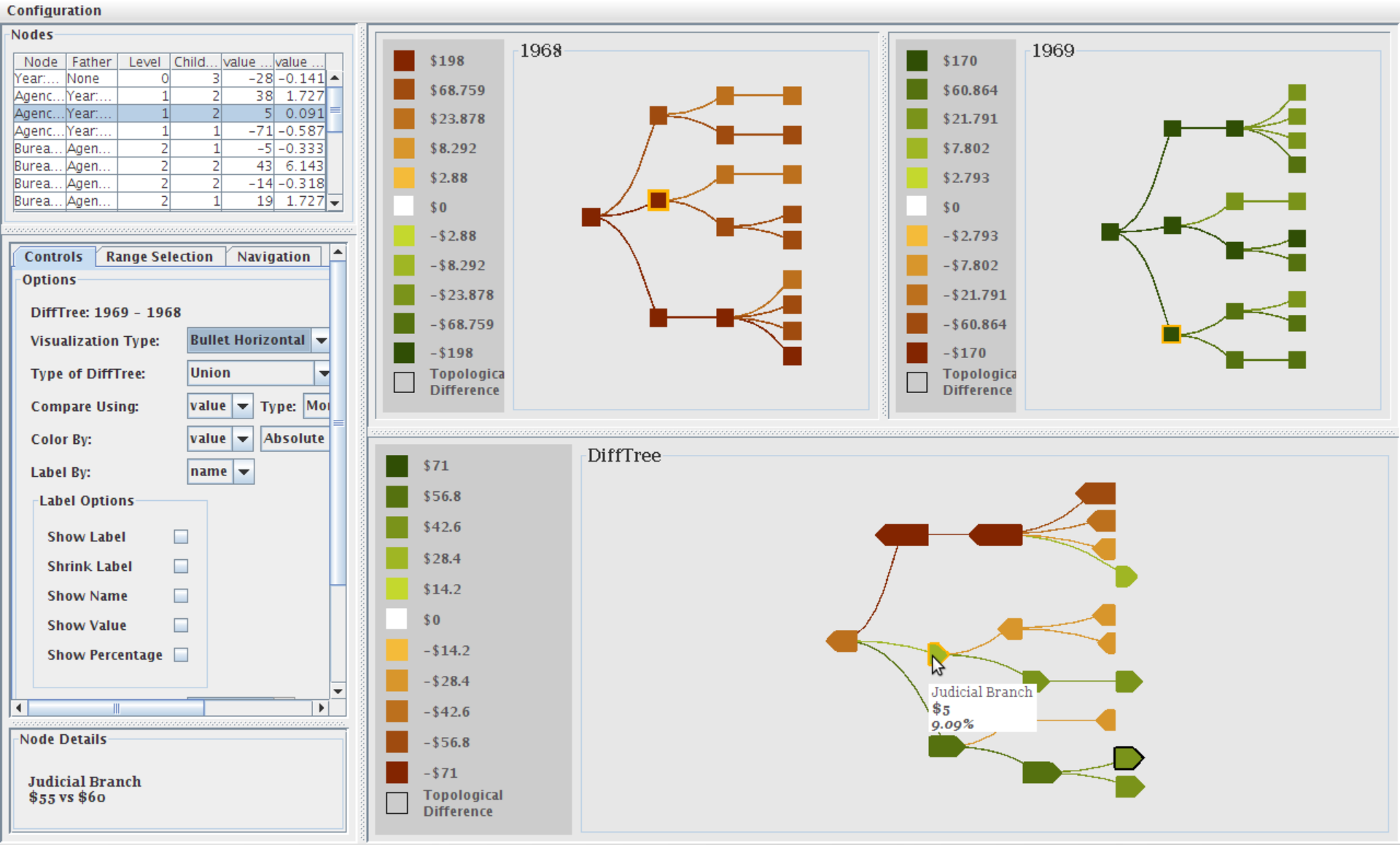
- Positive vs Negative.
- Absolute vs Relative.
- Leaves only vs Interior Nodes.
- Topological Differences.
- Change of a node compared to its siblings.
- Change of a node compared to the rest of the tree.

The Bullet

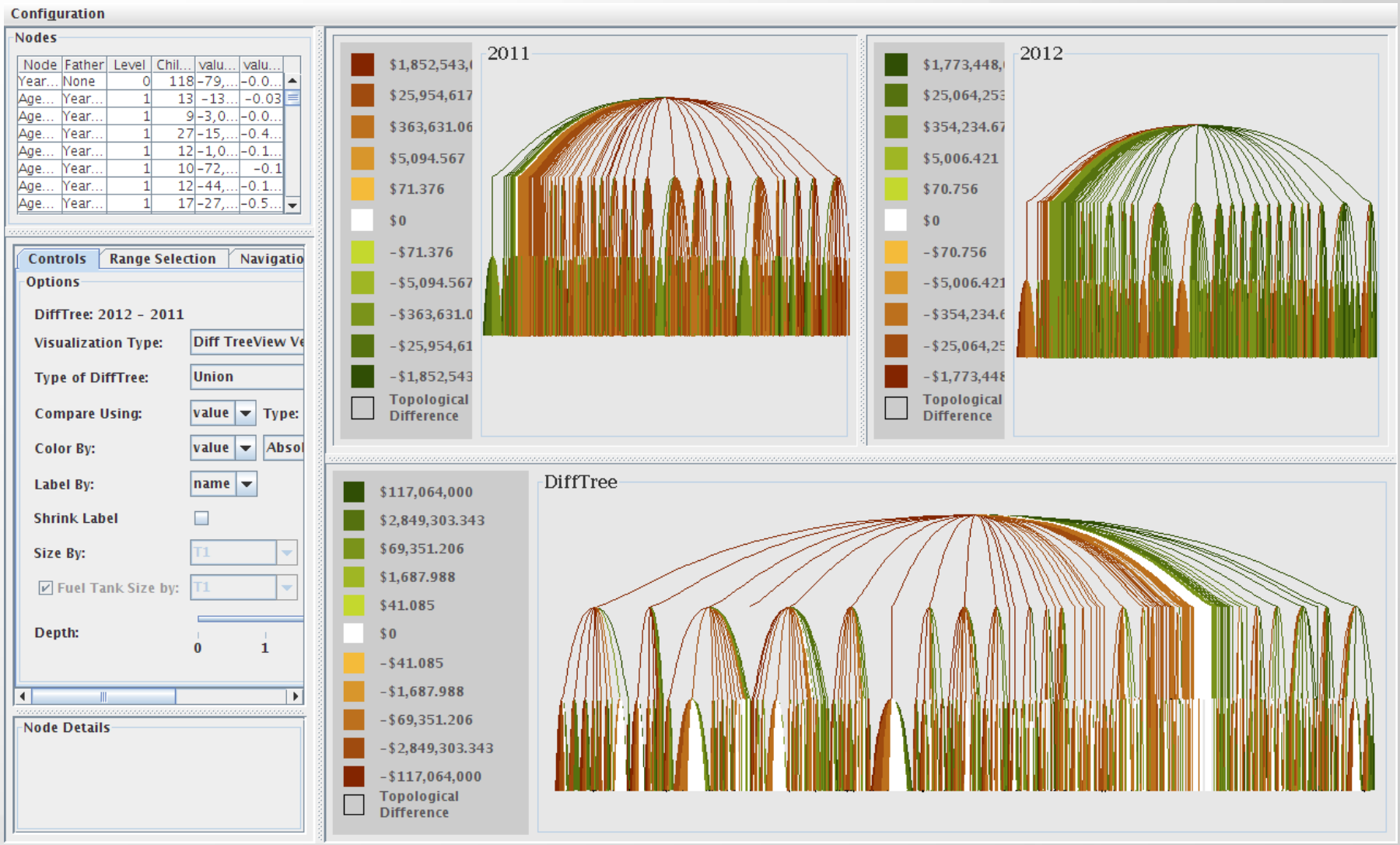
- Node Link Based
- Represents:
  - Cardinality
  - Relative or Absolute Value
  - Amount of change compared with the rest of the tree
  - Topological Changes
  - Values of interior nodes
  - Structure of the Tree



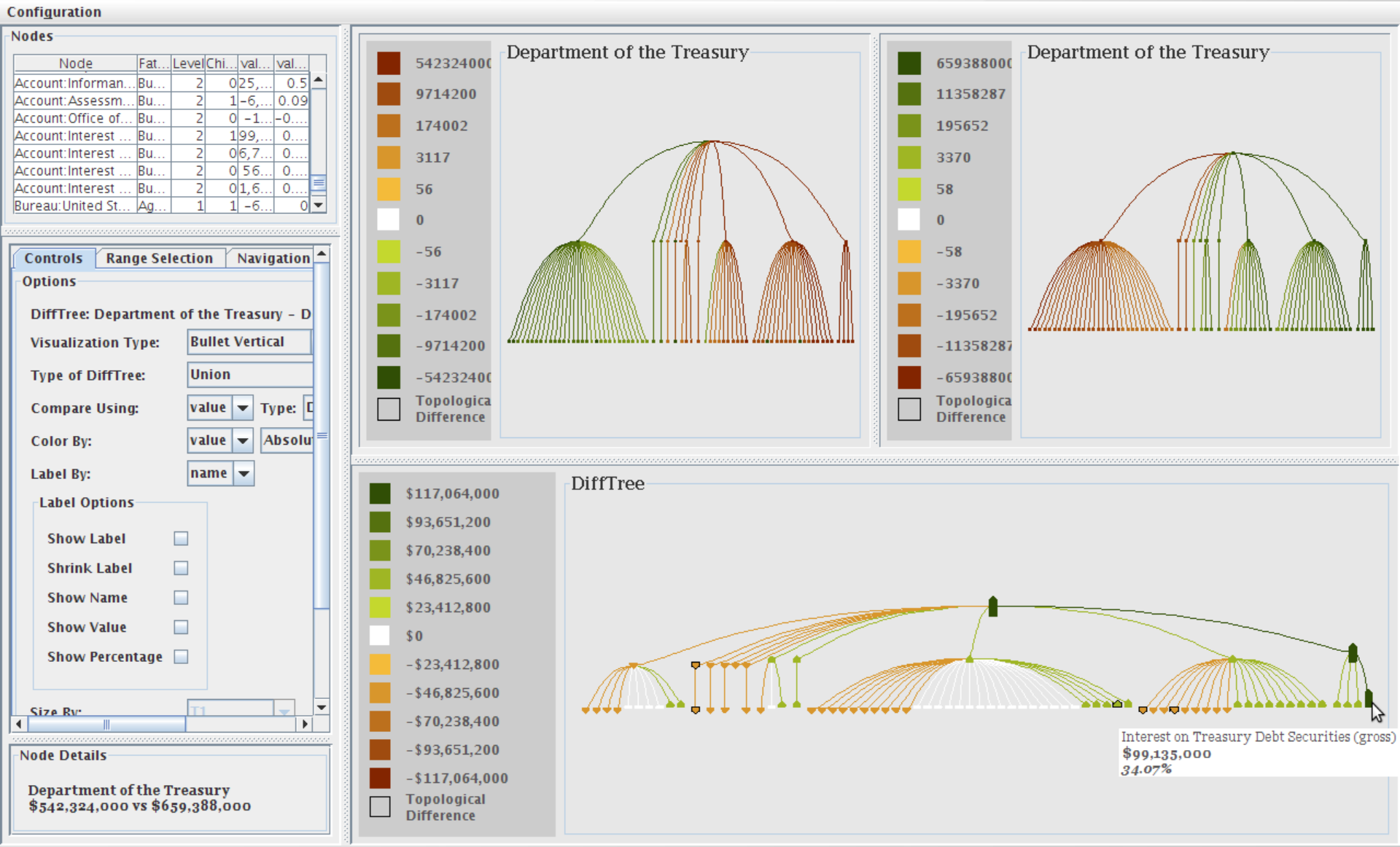
The Bullet (II)



Overview

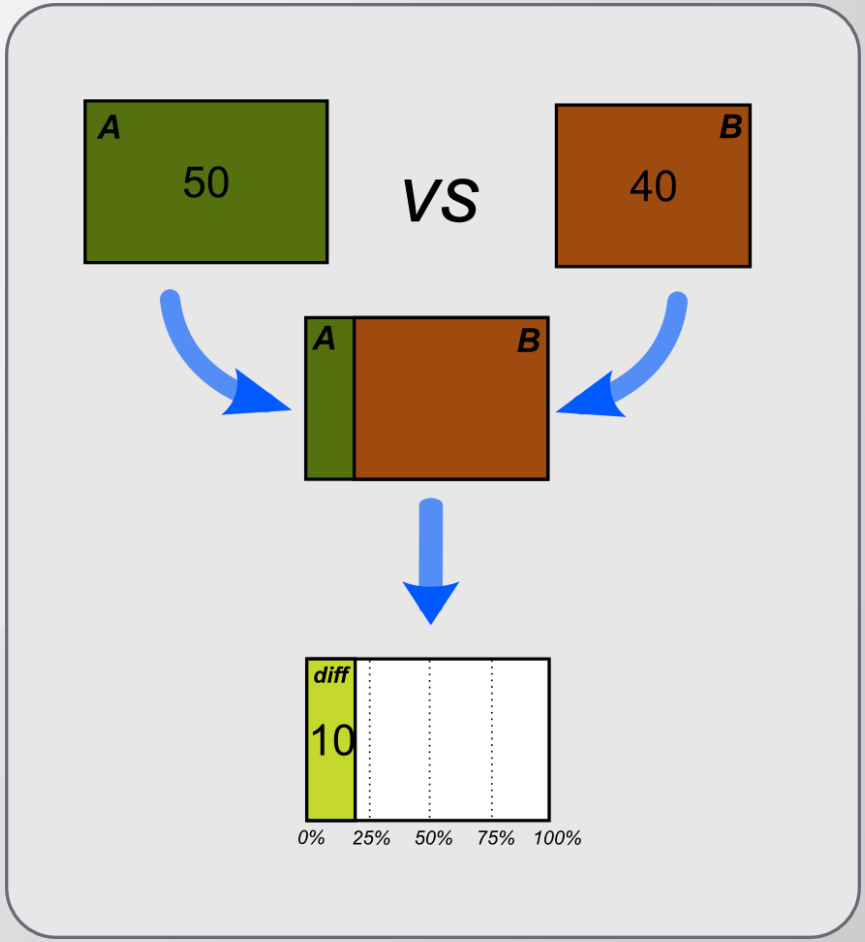

Configuration
Nodes
Controls
Range Selection
Navigatio
Options
DiffTree: 2012 - 2011
Visualization Type:
Diff TreeView Ve
Type of DiffTree:
Union
Compare Using:
value
Type:
Color By:
value
Absol
Label By:
name
Shrink Label
Size By:
T1
Fuel Tank Size by:
T1
Depth:
0
1
Node Details
2011
$1,852,543,
$25,954,617
$363,631.06
$5,094.567
$71.376
$0
-$71.376
-$5,094.567
-$363,631.0
-$25,954,61
-$1,852,543
Topological Difference
2012
$1,773,448,
$25,064,253
$354,234.67
$5,006.421
$70.756
$0
-$70.756
-$5,006.421
-$354,234.6
-$25,064,25
-$1,773,448
Topological Difference
DiffTree
$117,064,000
$2,849,303.343
$69,351.206
$1,687.988
$41.085
$0
-$41.085
-$1,687.988
-$69,351.206
-$2,849,303.343
-$117,064,000
Topological Difference

Details

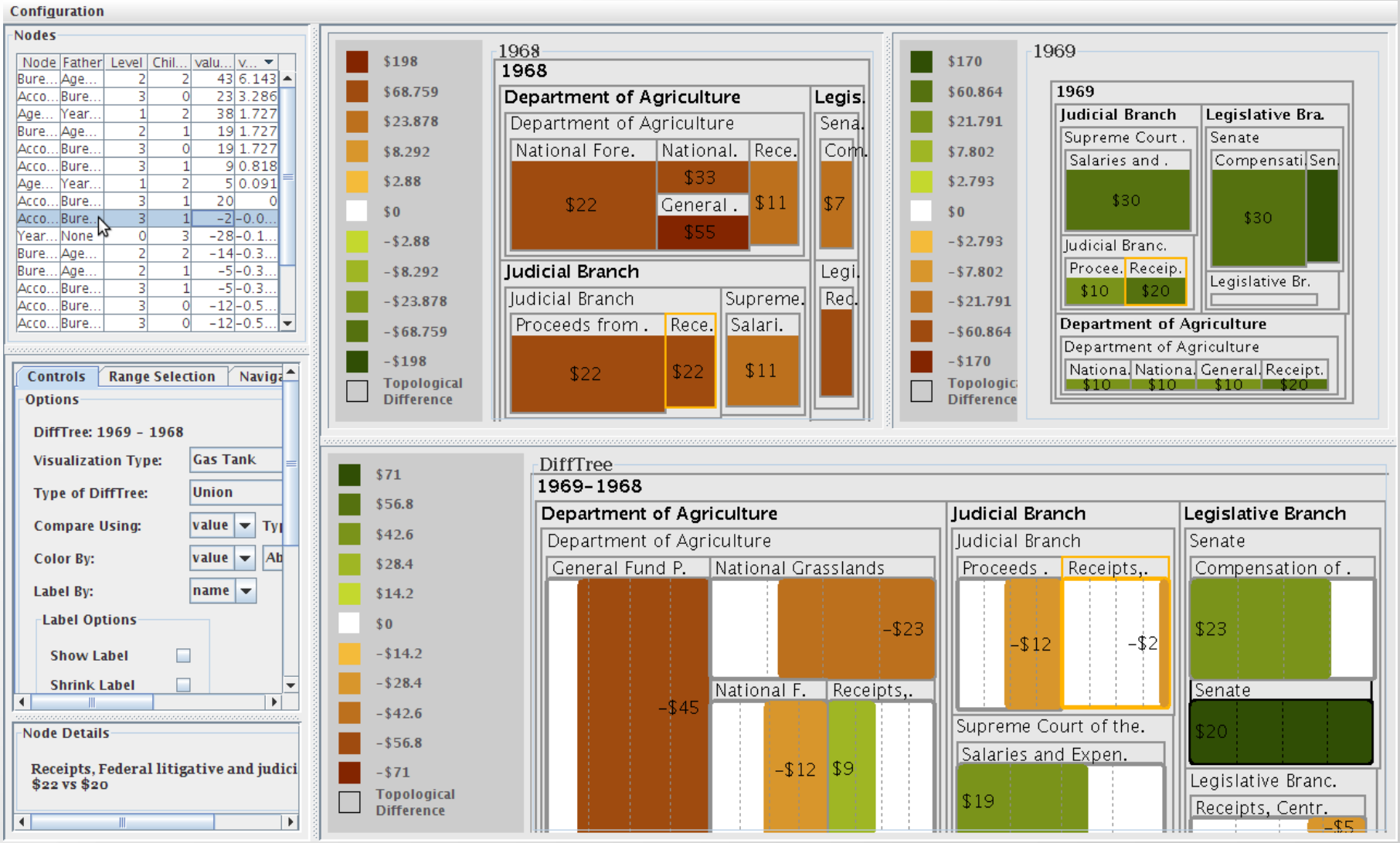

Configuration
Nodes
Node | Fat... | Level | Chi... | val... | val...
Account:Informan... | Bu... | 2 | 0 | 25,... | 0.5
Account:Assessm... | Bu... | 2 | 1 | -6,... | 0.09
Account:Office of... | Bu... | 2 | 0 | -1... | -0....
Account:Interest ... | Bu... | 2 | 1 | 99,... | 0....
Account:Interest ... | Bu... | 2 | 0 | 6,7... | 0....
Account:Interest ... | Bu... | 2 | 0 | 56... | 0....
Account:Interest ... | Bu... | 2 | 0 | 1,6... | 0....
Bureau:United St... | Ag... | 1 | 1 | -6... | 0
Controls
Range Selection
Navigation
Options
DiffTree: Department of the Treasury - D
Visualization Type:
Bullet Vertical
Type of DiffTree:
Union
Compare Using:
value
Type:
Color By:
value
Absolu
Label By:
name
Label Options
Show Label
Shrink Label
Show Name
Show Value
Show Percentage
Size By:
Node Details
Department of the Treasury
$542,324,000 vs $659,388,000
Department of the Treasury
9714200
174002
3117
56
0
-56
-3117
-174002
-9714200
Topological Difference
Department of the Treasury
11358287
195652
3370
58
0
-58
-3370
-195652
Topological Difference
$117,064,000
$93,651,200
$70,238,400
$46,825,600
$23,412,800
$0
-$23,412,800
-$46,825,600
-$70,238,400
-$93,651,200
-$117,064,000
Topological Difference
DiffTree
Interest on Treasury Debt Securities (gross)
$99,135,000
34.07%

The Gas Tank

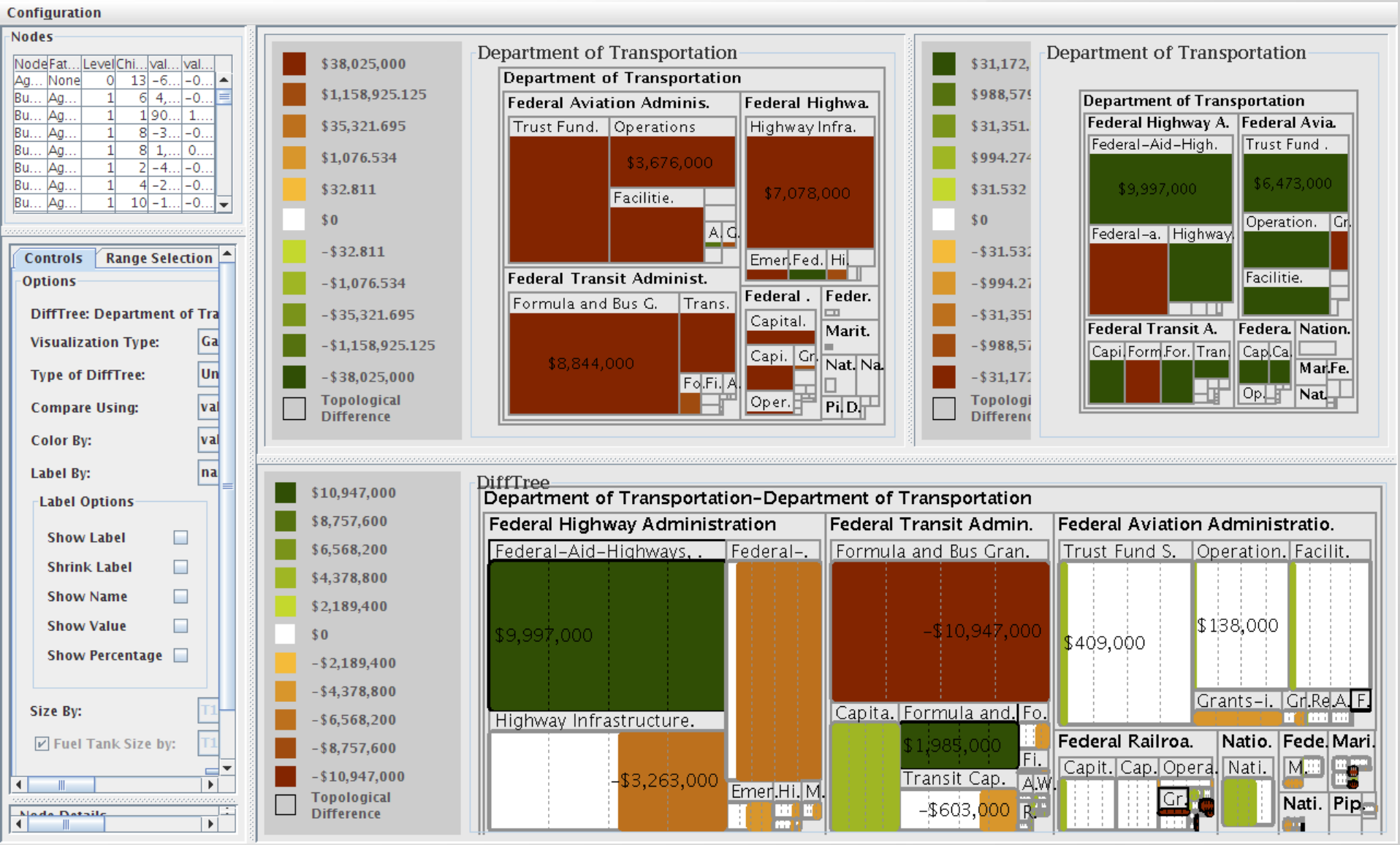
- Treemap based
- Represents:
  - Cardinality
  - Absolute and relative change
  - Amount of change compared with the rest of the leaves
  - Values of leaves



Examples


Configuration
Nodes
Controls
Range Selection
Options
DiffTree: 1969 - 1968
Visualization Type:
Gas Tank
Type of DiffTree:
Union
Compare Using:
value
Color By:
value
Label By:
name
Label Options
Show Label
Shrink Label
Node Details
Receipts, Federal litigative and judici
$22 vs $20
1968
Department of Agriculture
Judicial Branch
1969
Judicial Branch
Legislative Bra.
Department of Agriculture
DiffTree
1969-1968
Department of Agriculture
Judicial Branch
Legislative Branch
Topological Difference

Dept. Of Transportation Budget



Conclusions

- Visualization helps understanding our data.
- Provides overview
- Identify data quality issues
- Allows Comparison

Publications

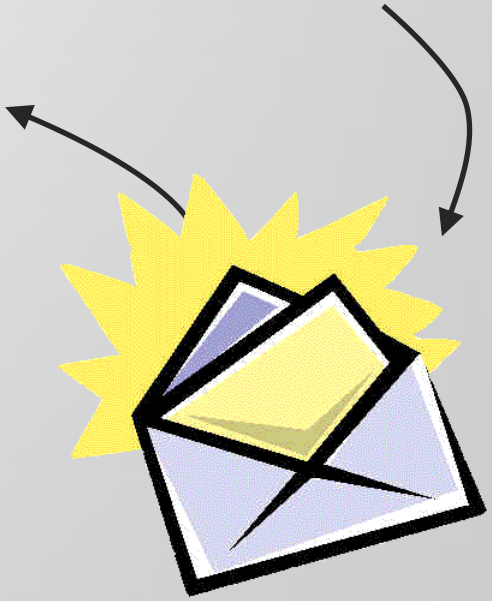
- Guerra Gómez, J., Wongsuphasawat, K., Wang, T., Pack, M., Plaisant, C.
  Analyzing Incident Management Event Sequences with Interactive Visualization
  To Appear in Transportation Research Board 90th Annual Meeting Compendium of Papers, 2011.
- Wongsuphasawat, K., Guerra Gómez, J., Plaisant, C., Wang, T., Taieb-Maimon, M., Shneiderman, B.
  LifeFlow: Visualizing an Overview of Event Sequences
  To Appear in Proc. ACM Conference of Human Factors in Computing (CHI) 2011

Thank YOU

Information visualization is a powerful way to explore temporal patterns ~

Many opportunities ~

You can work with us on case studies.



jguerrag@cs.umd.edu