Visualization of geospatio-temporal phenomena with spacetime maps

• Animated maps depict change through time.
• Can we do better? -- spacetime maps!
• Application: visualizing petroleum production from leases through time and space.
Spacetime maps: choosing area of interest

1. Select type of production

2. Click on counties or drag-out selection area

3. Go!
Spacetime maps: interaction

Two simple rules:

1. Navigation:

   Mouse-over this… \[\text{[Image]}\] ...yields this:

2. Right-click for pop-up menu:
   - Color editor
   - Filter by Formations
   - Time-Slicer
Spacetime maps: navigation controller

Head controller:
• slide lever up/down to look up/down.
• arrows rotate view while standing in place.

Moves up/down through time
Moves forwards/backwards through space
Slides left/right through space

Additional tips:
• Click and *pull away*: amount of pull affects rate of movement.
• Pull with a *twist* causes viewpoint to turn.
Spacetime maps: navigation controller

Head controller:
• slide lever up/down to look up/down.
• arrows rotate view while standing in place

Additional tips:
• Click and pull away: amount of pull affects rate of movement.
• Pull with a twist causes viewpoint to turn.
Spacetime maps: navigation controller

Head controller:
- slide lever up/down to look up/down.
- arrows rotate view while standing in place

Moves up/down through time
Moves forwards/backwards through space
Slides left/right through space

Additional tips:
- Click and *pull away*: amount of pull affects rate of movement.
- Pull with a *twist* causes viewpoint to turn.
Spacetime maps: navigation controller

Head controller:
• slide lever up/down to look up/down.
• arrows rotate view while standing in place

Moves up/down through time
Moves forwards/backwards through space
Slides left/right through space

Additional tips:
• Click and *pull away*: amount of pull affects rate of movement.
• Pull with a *twist* causes viewpoint to turn.
Spacetime maps: navigation controller

Head controller:
- slide lever up/down to look up/down.
- arrows rotate view while standing in place

Moves up/down through time

Moves forwards/backwards through space

Slides left/right through space

Additional tips:
- Click and pull away: amount of pull affects rate of movement.
- Pull with a twist causes viewpoint to turn.
Spacetime maps: Color Editor

- Data range, mean and std. dev.
- Histogram of data distribution
- Range and count for individual color cell (mouse-over cell to update)
Spacetime maps: Color Editor

- Define outliers in the data to remove extremes or highlight low/high values.
- Choose from a variety of color scales.
Spacetime maps: filter by producing zone

- Displays only leases producing from selected zone(s).
- Selecting system/stage/group selects all formations contained by that node.
- Shift-click semantics to select a range of zones.
- Control-click semantics to select a group of non-adjacent zones.
Spacetime maps: Time-Slicer

- Highlights data at a common interval of time, bounded by the red bands on the timewalls.
- Click and drag on red bands to adjust width of time slice.
- Click and drag on time wall to adjust position of time slice.
Spacetime maps: Map Slider

- Clicking anywhere on the map pops up Map Slider tool.
- Used to move map up/down through time axis, for better spatial reference.
- Right buttons move map and viewpoint (preserves viewer’s height above map).
- Left buttons move map only.
Spacetime maps: miscellaneous

- Mouse-over a lease shows production and number of wells at that point in time.
- Clicking on a lease launches web browser pointed to KGS web resources for that lease.
Spacetime maps: Evaluation!

• Please help assess utility of spacetime maps as a visualization technique:
  • Does this type of display assist in understanding the data? Does it assist in yielding new insights?
  • Are there features present that would be hard/impossible to observe by other visualization means?
• Tell us what features would serve to move this code from prototype stage to essential tool.
• Please send your feedback to Rick Brownrigg:
  brownrigg@sunflower.com; cc: lwatney@kgs.ku.edu