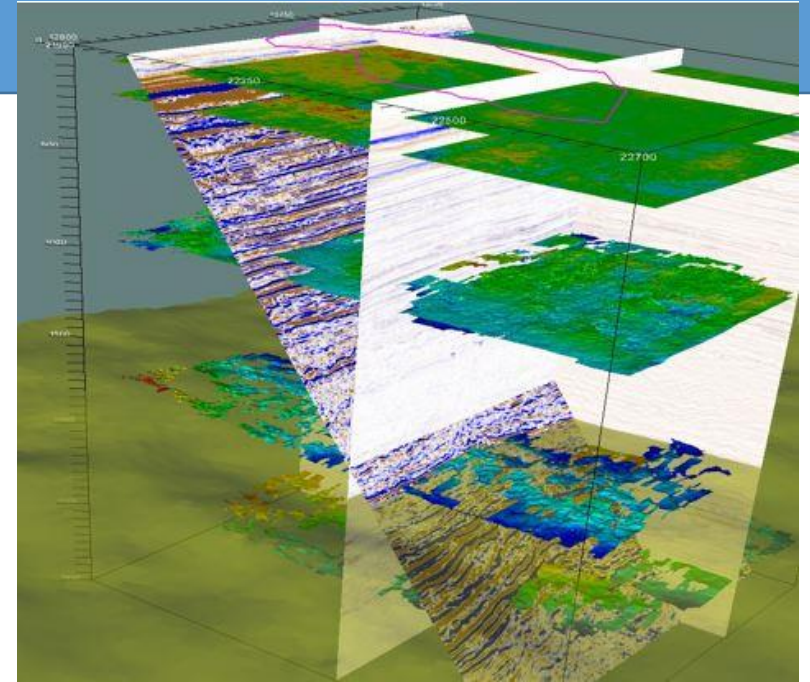


Geo-4D

Geoconsulting excellence



An overview of 3D Ground Modelling, Visualisation and Probabilistic Risk Analysis

Joe Durrant

Geocap

esri®

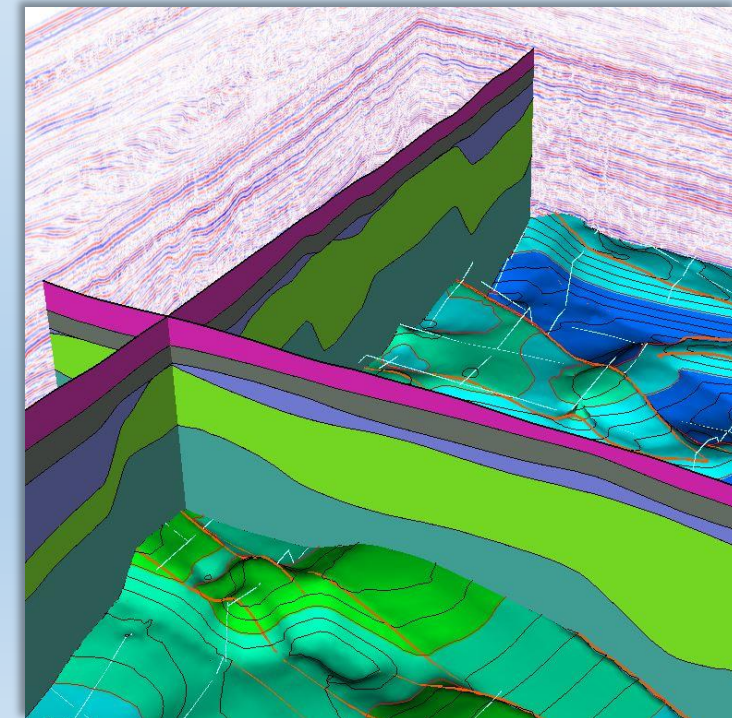
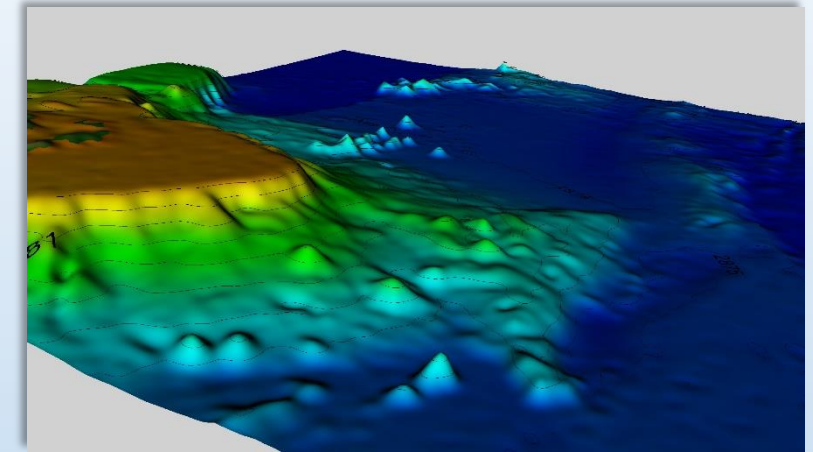
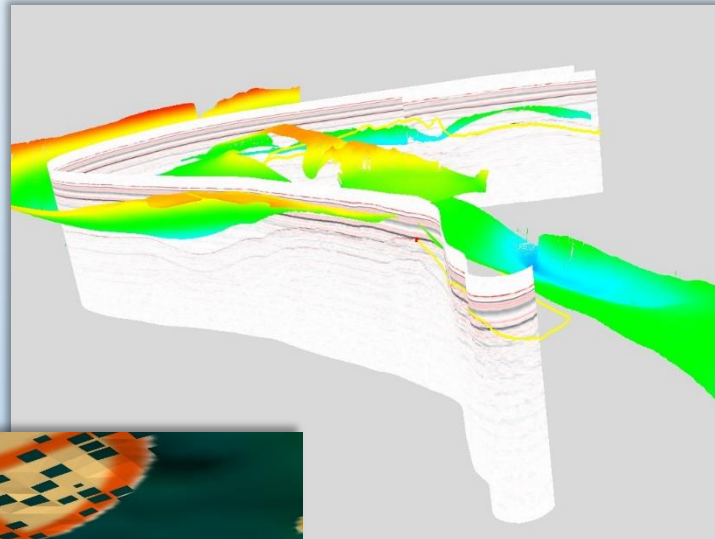
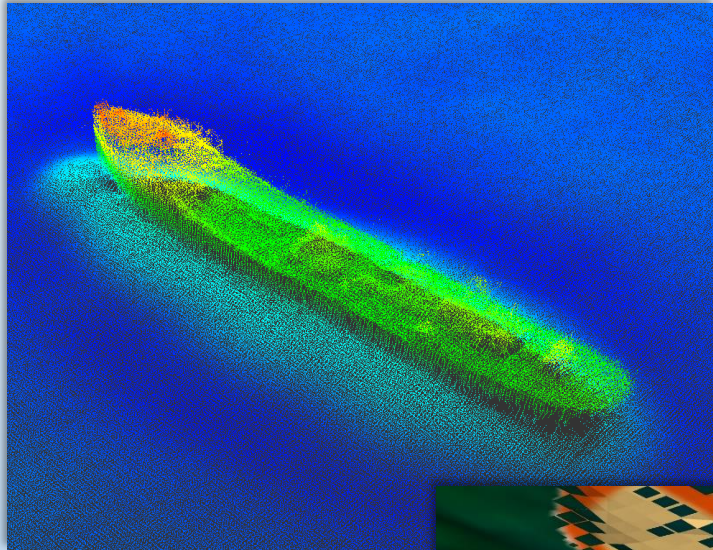
Geo-4D

GEOSOFTE
Oasis montaj

M-Files®

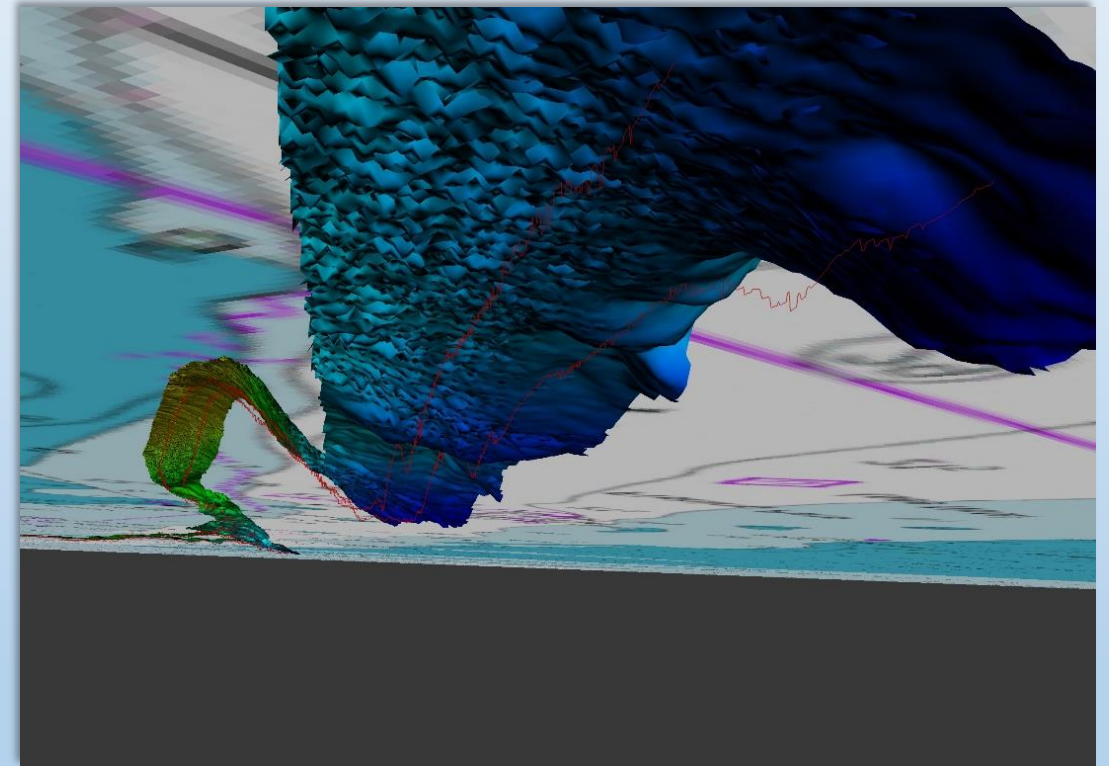
PIX4D

Ground Modelling in Geocap



Geo-4D Applications of Geocap

- Detailed seafloor analysis
- Cable burial assessments
- Modelling bed-form migration
From comparison of time series data
- Direct export to ArcGIS
- Probabilistic risk analysis – heat map deliverables

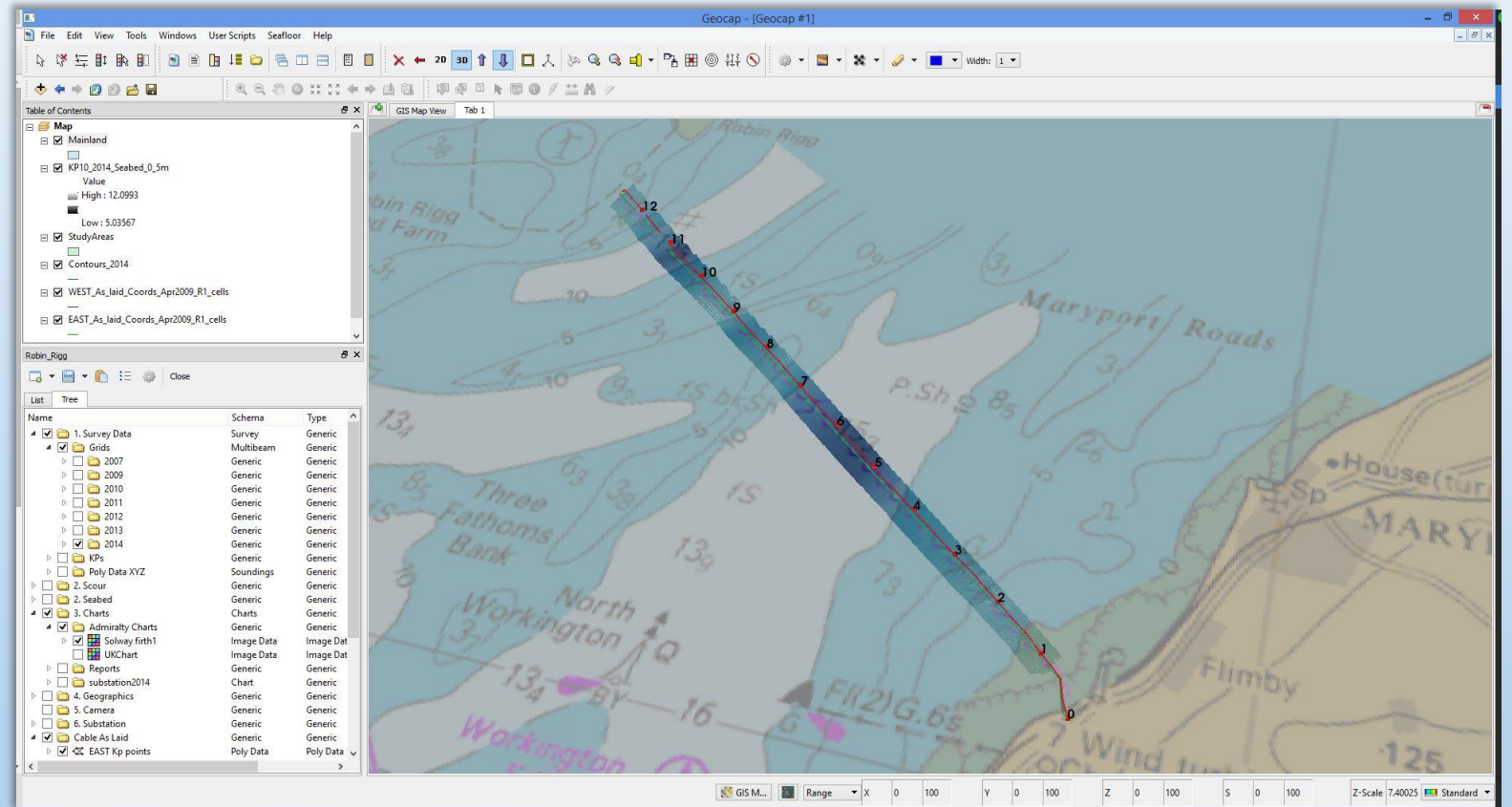


Data Assimilation and 3D Visualisation

- **Multiple features/data**
 - Bathymetry
 - Cable burial depth
 - KP markers
 - Admiralty Charts
 - Aerial photography
 - Sub bottom profiles

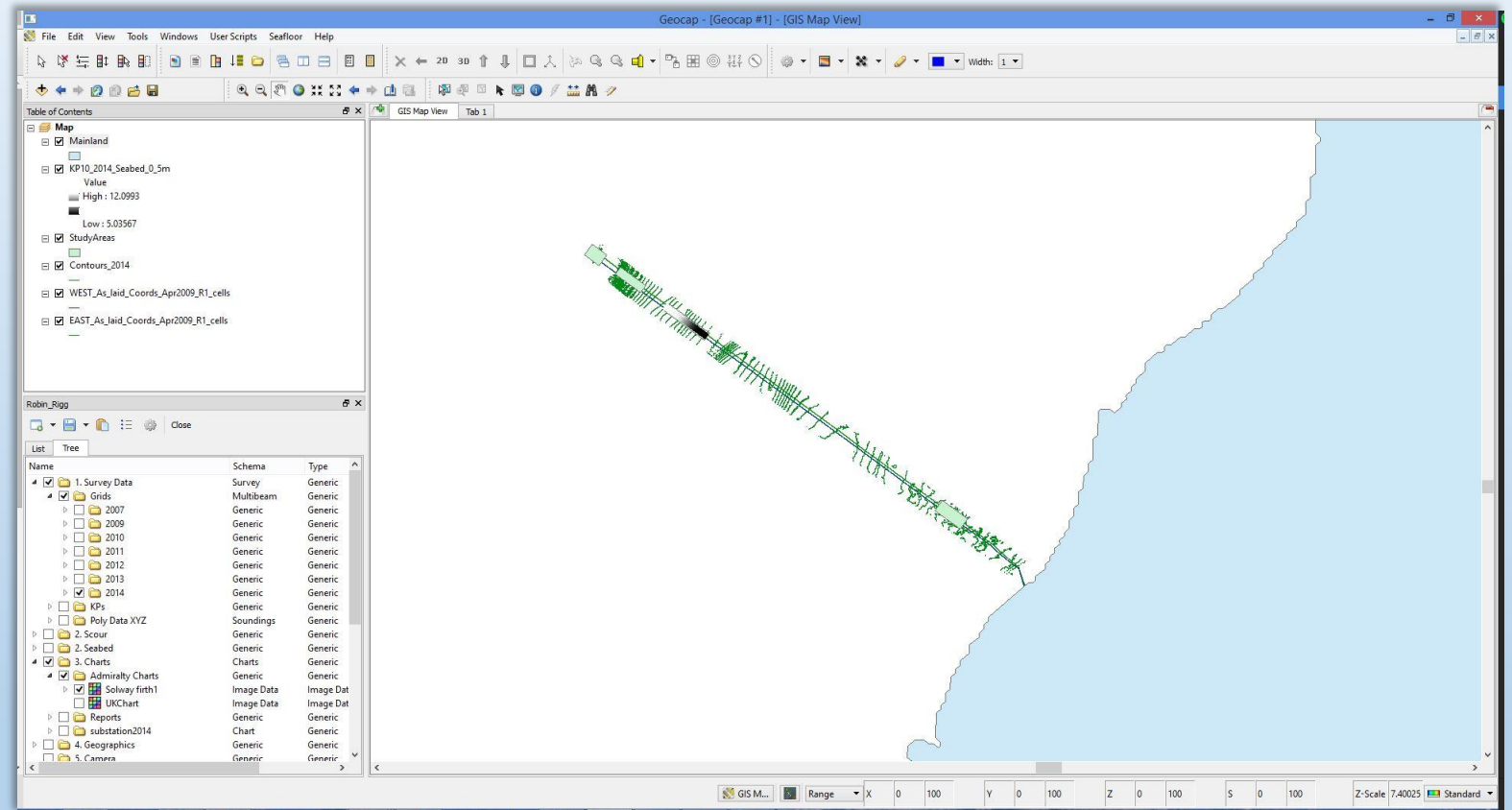
- **Time series analysis**
 - Scour/bedform migration plots

- **Slope Analysis**
 - UNCLOS



Native ArcGIS window in Geocap – Seamless data integration

- **ArcGIS Functionality**
 - Geodatabase creation
 - Feature class creation
 - Raster conversion
 - Simplified map layer organisation + visualisation
 - Dedicated Arc Toolbars
 - Export Shapefiles, tables etc..



Probabilistic Risk Assessment of Anchor drag and anchor drop.

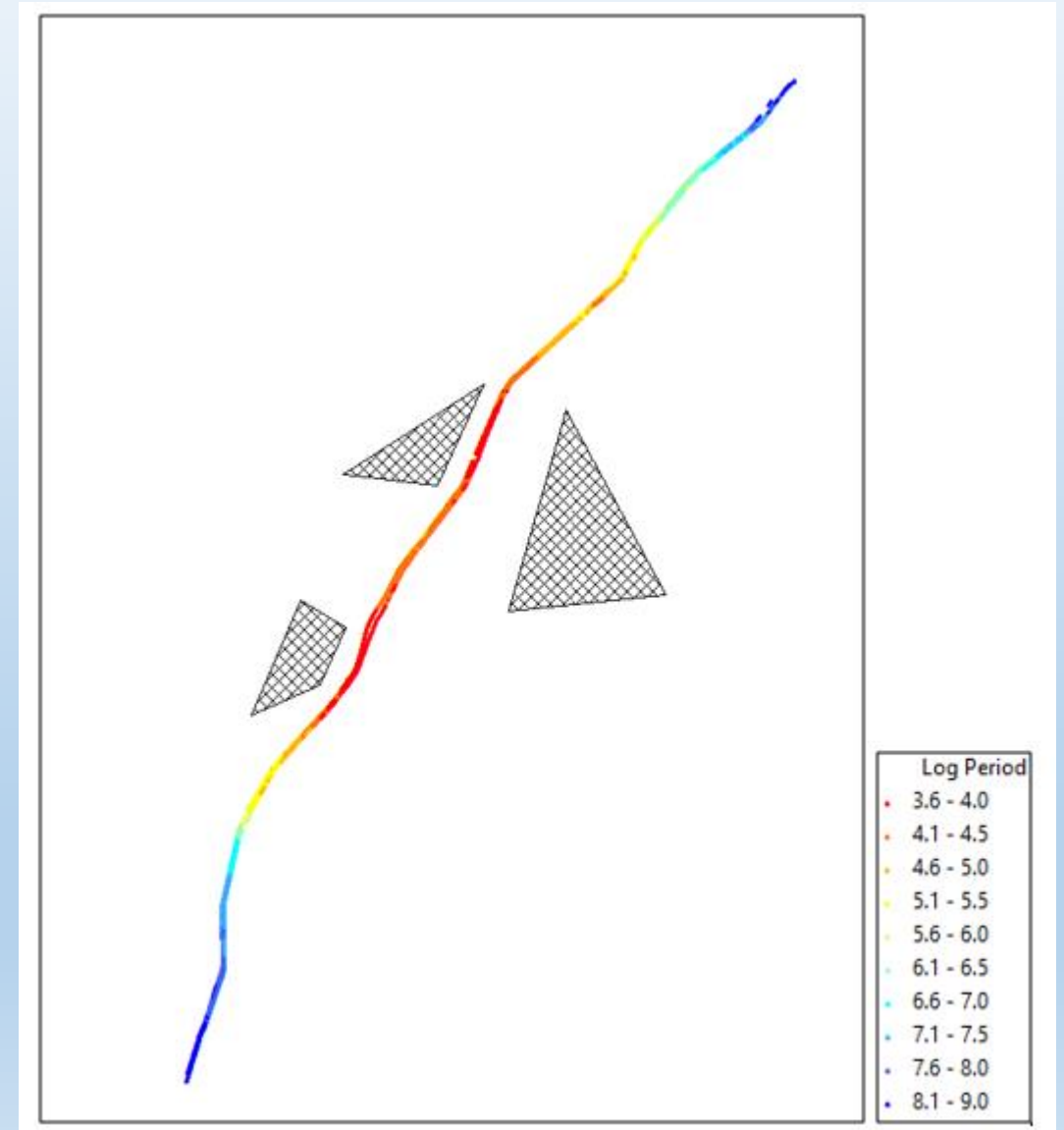
Anchor drag captures the chance that a vessel will drag its anchor from an anchorage, across the cable. The risk is primarily dependent on the vessel traffic density combined with wind strength and direction, the burial depth, and the anchor penetration.

Anchor drop captures the chance that a passing vessel will drop its anchor onto the cable. This is a much smaller risk than anchor drag.

Sediment mobility is also taken into account which modifies the burial depth in that area, which changes the risk profile.

It is possible to extend the model to take into account activities such as dredging and fishing.

Here is an example of a risk map from three anchorages. The period corresponds to the expected period, in years, between cable damage events. It uses burial depth information corrected for sediment mobility.



Probabilistic Analysis – Sneak peek

```
West cable
Cable: West
Parsing CSU data from 'input/WestCable.csv'
Parsed 41810 rows successfully.
Last KP is 46.756. Average depth is 2.195m
Parsing CSU data from 'input/wind.12.13.csv'
Parsed 469 rows successfully.
Parameters saved in 'out/2015-09-28-13-53-05/West/par.txt'
Started at 13:53:06 on 28-09-2015
Completed 72 of 100 simulations.

East cable
Cable: East
Parsing CSU data from 'input/EastCable.csv'
Parsed 42460 rows successfully.
Last KP is 47.468. Average depth is 2.197m
Parsing CSU data from 'input/wind.12.13.csv'
Parsed 469 rows successfully.
Parameters saved in 'out/2015-09-28-13-53-05/East/par.txt'
Started at 13:53:06 on 28-09-2015
Completed 77 of 100 simulations.
```

- Multiple Monte Carlo Simulations
- Typically 10,000 Simulations
- meter scale gridded results

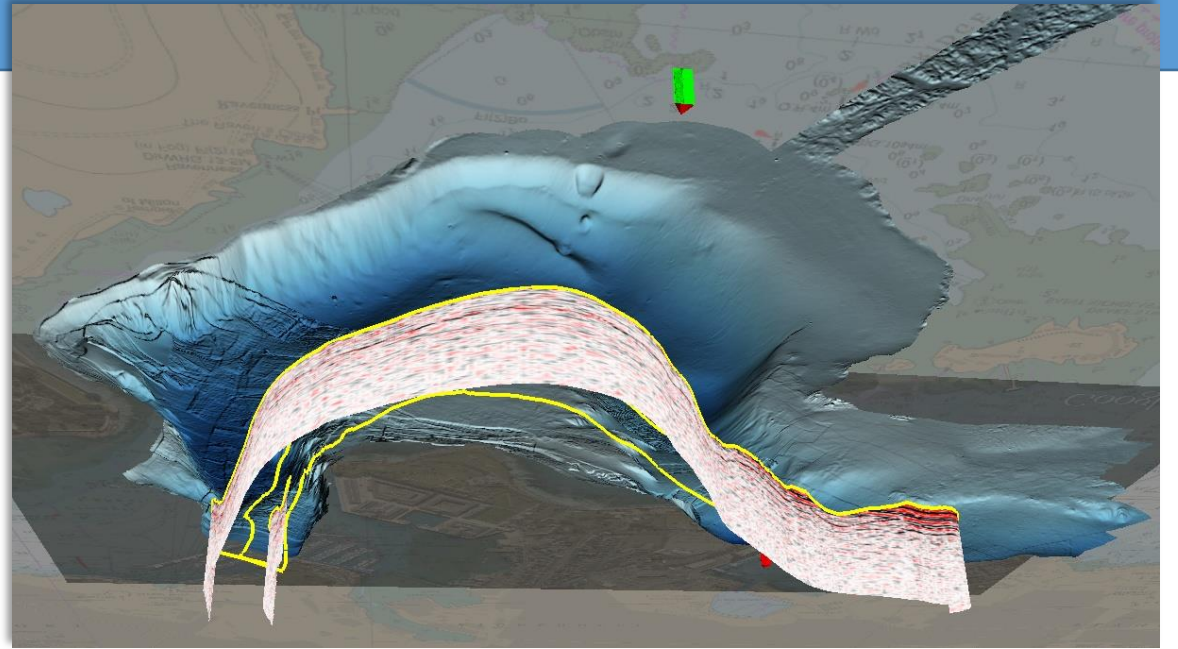
```
sum - Notepad
Completed 100 simulations.
Anchor drag:
Towards cable 42.0 times (42.0%). Period = 6.19 years.
Reached cable 3.7 times (3.701%). Period = 70.247 years.
Damaged cable 0.27 times (0.275%). Period = 946.71 years.
Anchor drop:
Dropped near cable 11315.37 times. Period = 3054.25 years.
Damaged cable 2774.24 times. Period = 12457.48 years.
```

```
cab - Notepad
File Edit Format View Help
X, Y, KP, Damage Period, Log Damage Period
315929.610, 5865228.070, 10.477, 456154.80166, 5.65911
315948.540, 5865248.820, 10.505, 306983.80515, 5.48712
315966.520, 5865268.160, 10.531, 441741.98199, 5.64517
315985.660, 5865287.340, 10.558, 880968.65324, 5.94496
316124.700, 5865428.470, 10.756, 5721934.14942, 6.75754
316146.040, 5865450.110, 10.787, 4838900.10712, 6.68475
316166.620, 5865471.410, 10.816, 3761470.47698, 6.57536
316542.260, 5865882.390, 11.372, 9018.77454, 3.95515
316560.430, 5865902.130, 11.399, 4207.57319, 3.62403
316576.660, 5865923.610, 11.426, 3216.3482, 3.50736
316593.370, 5865947.160, 11.455, 1663.10268, 3.22092
316610.010, 5865970.150, 11.483, 2430.60915, 3.38572
316625.900, 5865993.080, 11.512, 2430.83517, 3.38576
316642.310, 5866016.390, 11.541, 9683.94666, 3.98605
316690.890, 5866084.870, 11.625, 114976.20961, 5.06061
316707.120, 5866107.740, 11.653, 123644.07335, 5.09217
316722.920, 5866129.880, 11.680, 129302.14378, 5.11161
316738.900, 5866152.620, 11.708, 255290.77907, 5.40704
316770.500, 5866195.990, 11.761, 8749.87201, 3.942
316787.610, 5866216.940, 11.788, 5560.13122, 3.74509
316804.140, 5866237.770, 11.815, 7496.32476, 3.87485
316820.360, 5866258.420, 11.841, 15112.92563, 4.17935
316836.990, 5866279.070, 11.868, 2540450.33158, 6.40491
316854.390, 5866300.470, 11.895, 2176836.34709, 6.33783
316871.690, 5866321.620, 11.923, 2389231.93333, 6.37826
316888.920, 5866342.100, 11.949, 2479141.3846, 6.3943
316905.900, 5866362.580, 11.976, 2136784.59596, 6.32976
316922.300, 5866383.770, 12.003, 2707843.41728, 6.43262
316938.500, 5866406.470, 12.031, 4510753.0604, 6.65425
316954.460, 5866428.300, 12.058, 4265845.76798, 6.63001
316971.970, 5866452.240, 12.088, 7297.21143, 3.86316
316989.600, 5866476.130, 12.117, 5367.53192, 3.72977
317006.390, 5866499.210, 12.146, 5296.51146, 3.72399
317024.700, 5866524.470, 12.177, 119148.86548, 5.07609
317043.060, 5866549.890, 12.209, 123278.9037, 5.09089
317061.180, 5866574.880, 12.239, 107838.54692, 5.03277
```



Geo-4D

Geoconsulting excellence



Thank you