

Digital Geological Mapping

Digital Outcrop data extraction 1 Introduction to VRGS and Joint measurements

Matteo Massironi

matteo.massironi@unipd.it

VRGS software and Data set

- 18 Virtual desktops using VMware-Horizon Client
 - client: <https://vlab.vdi.ict.unipd.it/>; user and password are the same of your SSO.
 - VRGS floating license code: GN4H-Y5ST-4UEK-DXVR
 - Data sets: M_Merlo_quarry_base_data.zip in in E:\GEO\2G_22
- Your Own Laptop:
 - VRGS Installer at: <https://apps.vrgeoscience.com/index.html>
 - VRGS floating license code: GN4H-Y5ST-4UEK-DXVR Moodle
 - Data Sets for : M_Merlo_quarry_base_data.zip in Moodle

Practical activity sequence

- Importing DOM Meshes in VRGS
- Introduction to VRGS
- Joint attitude measurements on DOMs
- Importing Clino field move data in VRGS
- Comparison between field data and data extracted from DOMs
- Exporting data measurements from VRGS to Stereonet
- Visualizing data in Stereonet
- Importing DOM clouds in VRGS
- Clouds Tensor Analysis

Importing Meshes

- Import .obj or .ply

The screenshot displays the Virtual Reality Geological Studio interface. The main window shows a dark 3D environment. On the left, a 'Data' panel lists various data types, with 'Triangular Meshes' selected. A context menu is open over 'Triangular Meshes', showing options like 'New', 'Group', 'Ungroup', 'Export', 'Empty List', 'Fix Tie Points', 'Primitives', and 'Import'. The 'Import' option is further expanded to show 'Import From File' and 'Import From Sketchfab'. On the right, a 'Properties' panel shows settings for 'Triangular Meshes', including 'Bounding...', 'BBox Tex...', 'LOD Dist...', 'Tiepoint...', 'Minimum...', 'Wireframe', 'Displaye...', 'Use Com...', 'SDF Cuto...', 'Use Light...', 'Fixed Col...', 'Filter Bac...', and 'Backgrou...'. At the bottom, a 'Messages' panel displays system logs, including an error message: 'Error Writing project preferences: C:\Users\massmat95778\Documents\VRGS_analysis\Vrgs_projects\Merlo_Exercise Data\ProjectPrefs.vrprf' and a warning: 'SQL error: no such table: object'. The Windows taskbar at the bottom shows the system tray with the date '4/3/2022' and time '7:36 PM'.

Property	Value
Triangular Meshes	
Bounding...	<input checked="" type="checkbox"/>
BBox Tex...	1.000000
LOD Dist...	5000.000000
Tiepoint...	1.000000
Minimum...	0.000000
Wireframe	<input type="checkbox"/>
Displaye...	0
Use Com...	<input checked="" type="checkbox"/>
SDF Cuto...	50
Use Light...	<input checked="" type="checkbox"/>
Fixed Col...	<input type="checkbox"/>
Filter Bac...	<input type="checkbox"/>
Backgrou...	000000

```
Messages
Error Writing project preferences: C:\Users\massmat95778\Documents\VRGS_analysis\Vrgs_projects\Merlo_Exercise Data\ProjectPrefs.vrprf
Disk Info: Capacity : 1628434432
Disk Info: Available : 1608142648
Writing project
Writing database...
Opened DB : C:\Users\massmat95778\Documents\VRGS_analysis\Vrgs_projects\Merlo_Exercise Data\DATABASES\SQLDBv4.db
SQL error: no such table: object
SQL Command UPDATE object SET status= 1 where type = 5
Write project data completed at 19:33:26
Project saved 19:33:26
```

Joint measurements on DOM mesh

The screenshot displays the Virtual Reality Geological Studio interface. The main window shows a 3D model of a rock face with two green points placed on a vertical joint. A context menu is open over the 'Dip-Azimuth 3 Points' tool in the toolbar. The 'Messages' panel at the bottom left shows the following log:

```
Using Material : Mesh2  
OBJ importing ***** 33  
Mesh Mesh.obj loaded. 913252 Vertices, 1825121 triangles  
Building textures for: Mesh1 (1 of 3)  
Building textures for: Mesh1 (2 of 3)  
Building textures for: Mesh2 (3 of 3)  
Building textures completed  
FPS : 142.857143  
Task CompleteCloudPLY  
FPS : 1.785714
```

The Windows taskbar at the bottom shows the date and time as 4/3/2022, 5:55 PM, and the system temperature as 44°F. The taskbar also includes icons for various applications and the search bar.

Importing Field Data and grouping Field data and DOM measurements

The screenshot displays the Virtual Reality Geological Studio interface. The main window shows a 3D model of a rock face with various data points and measurement tools. The interface includes a file explorer, a toolbar with navigation and modeling tools, and a central 3D view area.

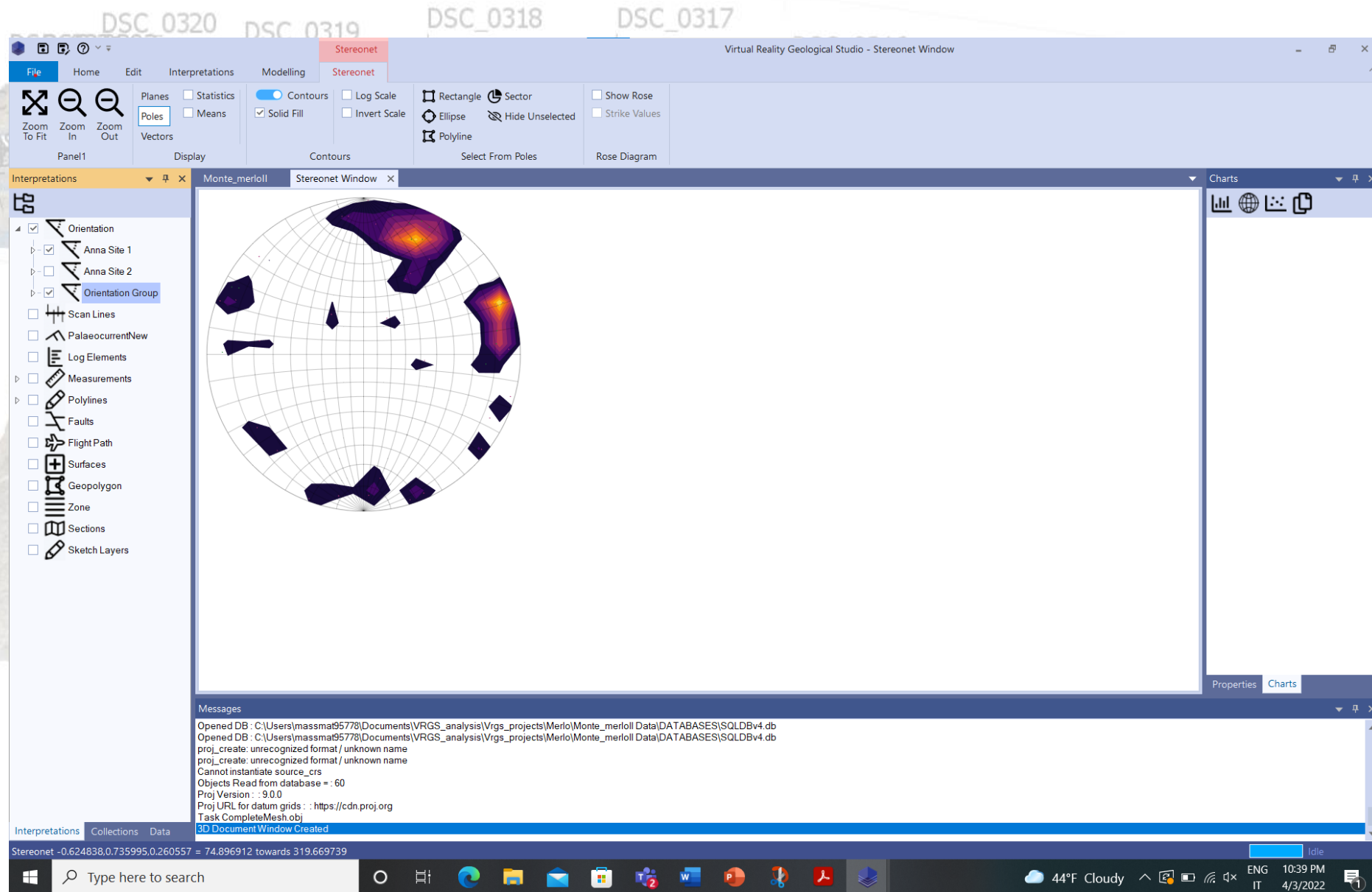
File Explorer: Shows the file structure for field measurements. The file list is as follows:

Name	Date modified	Type	Size
image	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
line	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
localities	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
note	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
plane	3/29/2022 7:17 PM	Microsoft Excel Co...	15 KB
stratocolumn	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB

Software Interface: The main window shows a 3D model of a rock face with various data points and measurement tools. The toolbar includes options for Navigation, Interpretations, Modelling, and Structure. The central 3D view area shows a rock face with various data points and measurement tools.

Messages: Reading Data 2 of 2: C:\Users\massma95778\Documents\VRGS_analysis\VRGS_projects\Merlo\Monte_merloll Data\Mesh.obj_0.tin
Opened DB: C:\Users\massma95778\Documents\VRGS_analysis\VRGS_projects\Merlo\Monte_merloll Data\DATABASES\SQLDBv4.db
Opened DB: C:\Users\massma95778\Documents\VRGS_analysis\VRGS_projects\Merlo\Monte_merloll Data\DATABASES\SQLDBv4.db
proj_create: unrecognized format / unknown name
proj_create: unrecognized format / unknown name
Cannot instantiate source_crs
Objects Read from database = : 60
Proj Version : : 9.0.0
Proj URL for datum gnd : https://cdn.proj.org
Task Complete\Mesh.obj

Field data vs DOM measurements



Export to Stereonet

Export Geobjects Dialog

This PC > Documents > VRGS_analysis > M_Merlo_quarry_base_data > Field measurements

Search Field measurements

Organize New folder

Name	Date modified	Type	Size
image	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
line	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
localities	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
note	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB
plane	3/29/2022 7:17 PM	Microsoft Excel Co...	15 KB
stratcolumn	3/29/2022 7:17 PM	Microsoft Excel Co...	1 KB

File name: Orientation Group

Save as type: Stereonet

Comma Separated Values (csv)
xml (ascii)
json (ascii)
Geodatabase (gdb)
Stereonet

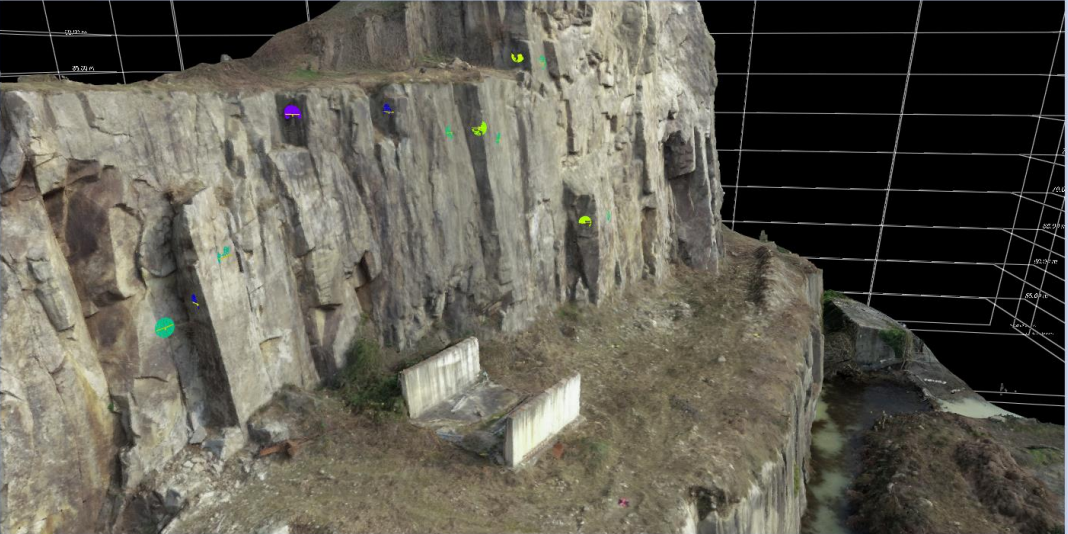
Virtual Reality Geological Studio - Monte_merloll

File Home Edit Interpretations Modelling

Navigation: Move, View From, Auto Properties

Active Descriptor: Unknown, Facies, Bedding Mode, Fractures Mode, Cleavage Mode, Dip, Azimuth, Digitise Fault, Digitise Polyline, Geo Polygon, Measure Vertical, Waypoint, Label, Billboard, GCP

Interpretations: Orientation, Anna Site 1, Anna Site 2, Orientation Group, Scan Lines, PalaeoocurrentNew, Log Elements, Measurements, Polylines, Faults, Flight Path, Surfaces, Geopolygon, Zone, Sections, Sketch Layers



Messages

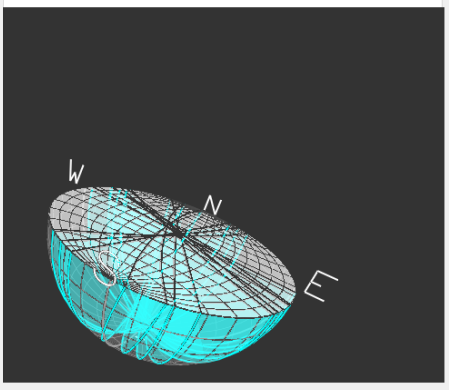
```
Reading Data 2 of 2 C:\Users\massmat95778\Documents\VRGS_analysis\VRgs_projects\Merlo\Monte_merloll\Data\Mesh.obj_0.in
Opened DB: C:\Users\massmat95778\Documents\VRGS_analysis\VRgs_projects\Merlo\Monte_merloll\Data\DATABASES\SQLDBv4.db
Opened DB: C:\Users\massmat95778\Documents\VRGS_analysis\VRgs_projects\Merlo\Monte_merloll\Data\DATABASES\SQLDBv4.db
proj_create: unrecognized format / unknown name
proj_create: unrecognized format / unknown name
Cannot instantiate source_crs
Objects Read from database - 60
Proj Version - 9.0.0
Proj URL for datum grids : https://cdn.proj.org
Task Completed\Mesh.obj
```

x=862.071920 y=377.999992 z=74.520793

Untitled 0

File Edit Data Calculations Plot View Window Help

Plot 3D View Details



Dataset Name	N	Type	Format
<input checked="" type="checkbox"/> Orientation Group_from VR...	13	Planes	AZ

New Dataset Delete

No.	Strike	Dip	Label
<input checked="" type="checkbox"/> 1	300.8	89.7	
<input checked="" type="checkbox"/> 2	175.2	80.0	
<input checked="" type="checkbox"/> 3	116.2	85.5	
<input checked="" type="checkbox"/> 4	196.7	89.9	
<input checked="" type="checkbox"/> 5	031.1	84.4	
<input checked="" type="checkbox"/> 6	110.4	89.6	
<input checked="" type="checkbox"/> 7	162.7	80.3	
<input checked="" type="checkbox"/> 8	289.2	84.9	
<input checked="" type="checkbox"/> 9	160.5	87.4	
<input checked="" type="checkbox"/> 10	123.6	84.0	
<input checked="" type="checkbox"/> 11	023.3	87.3	
<input checked="" type="checkbox"/> 12	152.4	89.5	
<input checked="" type="checkbox"/> 13	095.7	86.9	

-----4/3/2022 at 11:59 PM-----

Analysis of 13 planes from file "Orientation Group_from VRGS.txt"

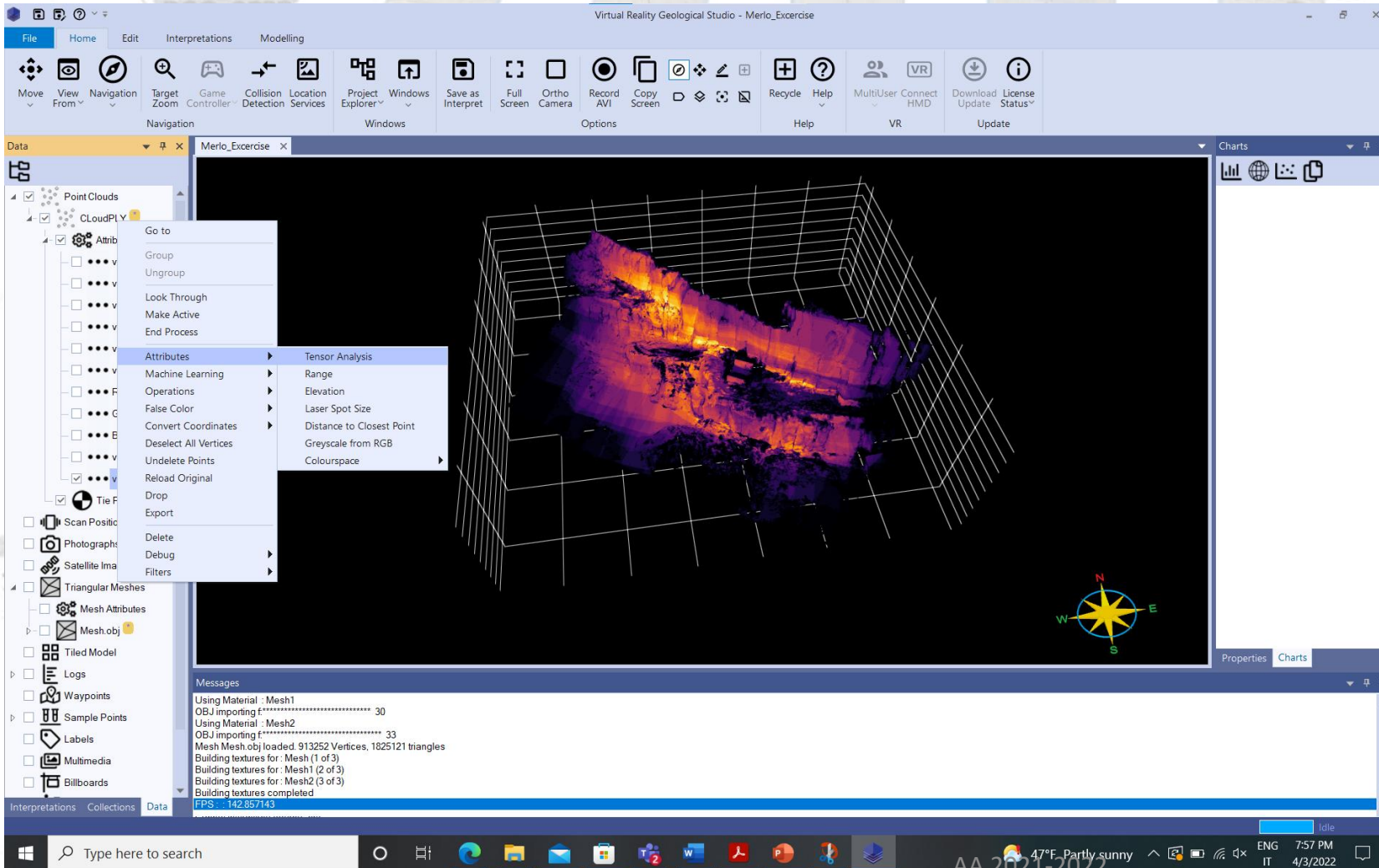
Add Datum Delete

Importing Clouds

- Import .ply

The screenshot displays the Virtual Reality Geological Studio (VRGS) interface. The 'Data' panel on the left contains a list of data types, with a context menu open over the 'Point Cloud' icon. The menu options are: New, Group, Ungroup, Import Item, Import Folder, Export, Remove Unlinked, Empty List, Batch Import, Artificial Data, and Sort By Name. The main 3D view is currently empty, showing a compass rose in the bottom right corner. The bottom status bar indicates the system is idle, with a temperature of 47°F, partly sunny weather, and the time is 7:49 PM on 4/3/2022. The Windows taskbar is visible at the bottom, showing various application icons and the search bar.

Tensor analysis



Tensor Analysis

Sphere

K Nearest Neighbours

Output

Minimum Moment of Inertia Dip Azimuth

Colinearity Coplanarity

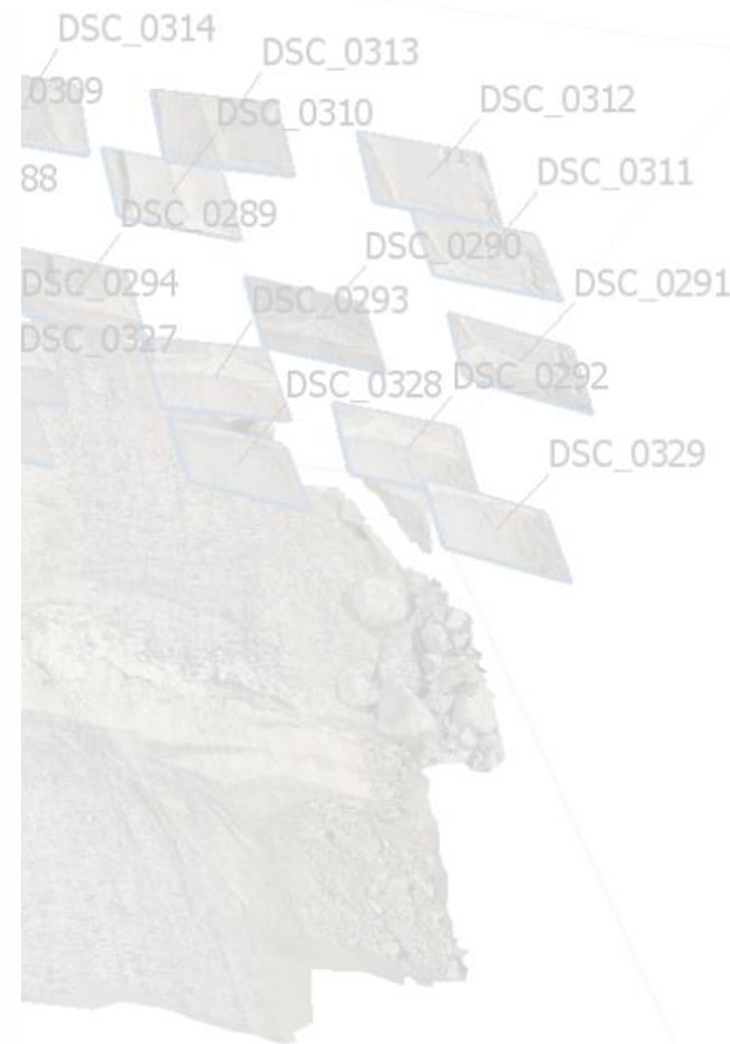
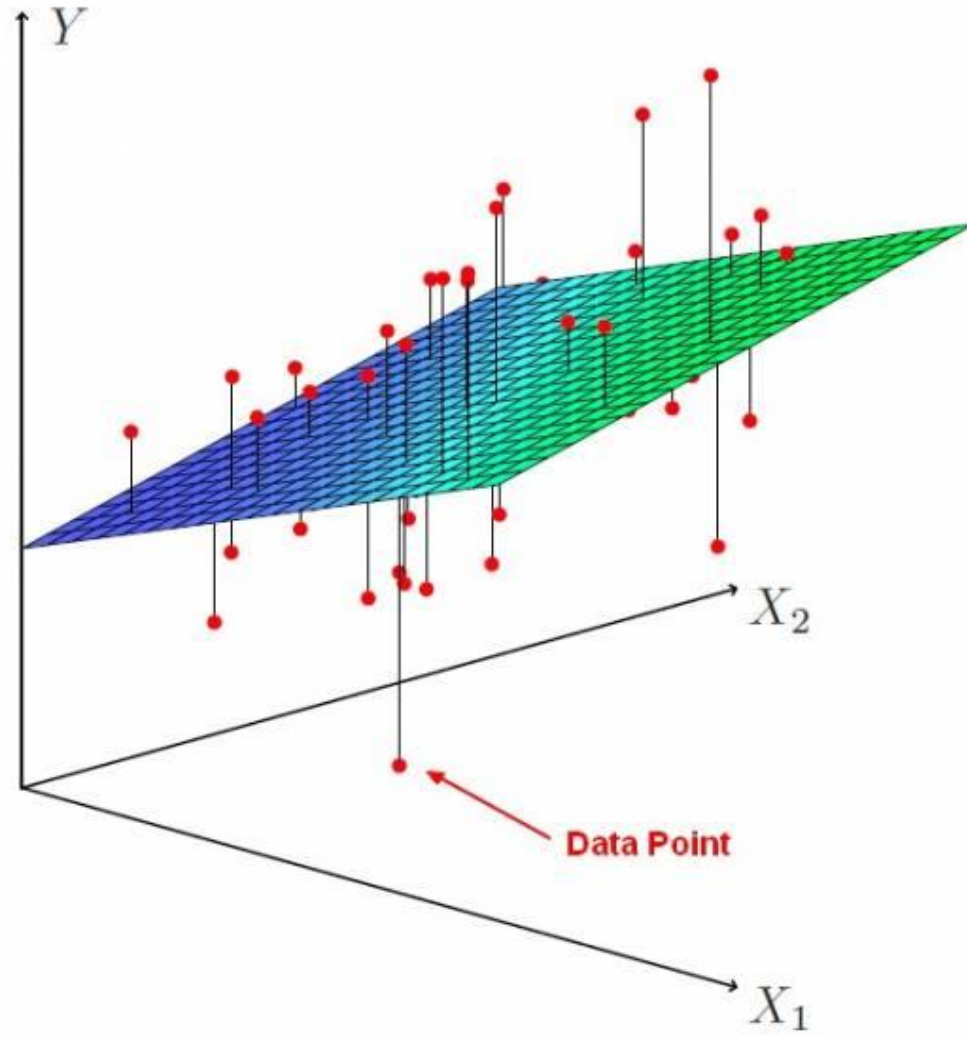
Eigen Values Number of Values Used

Octree

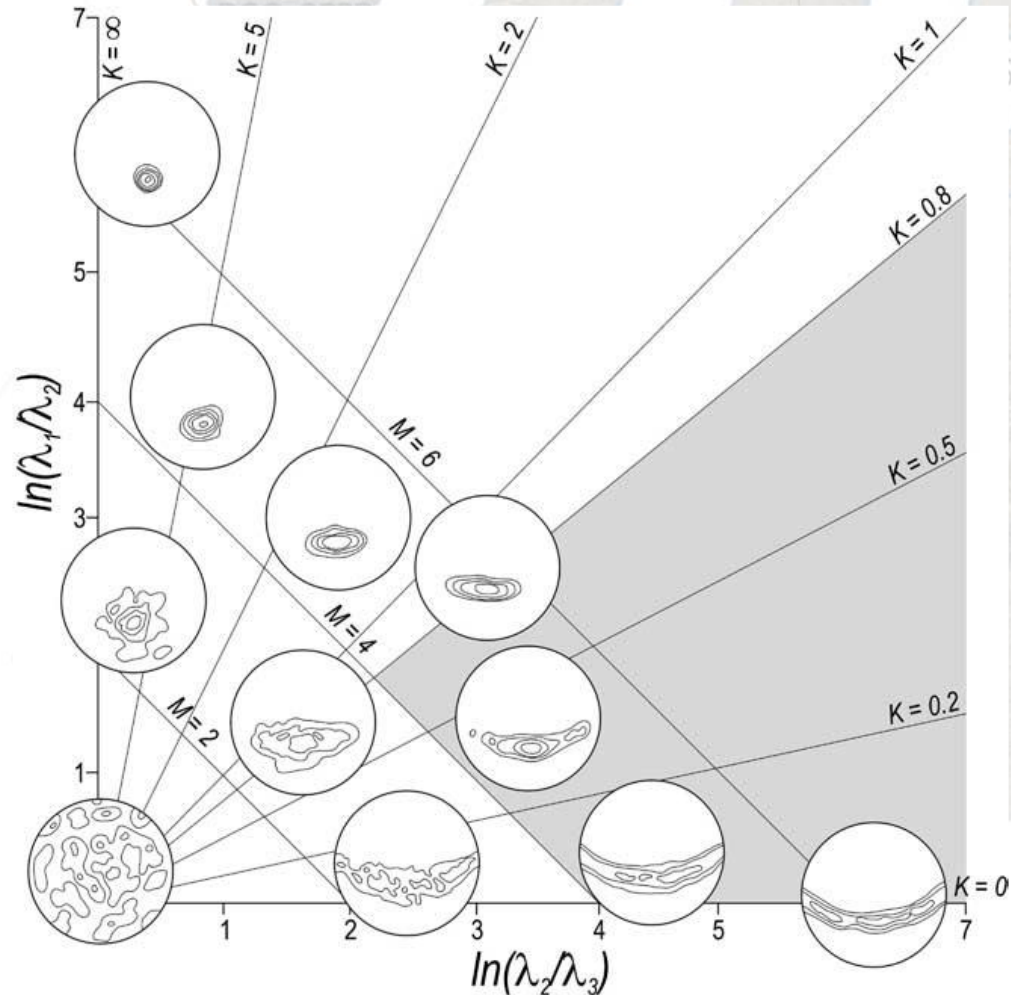
Levels

Points per Memory GB

Best Fit Plane-Multiple linear regression

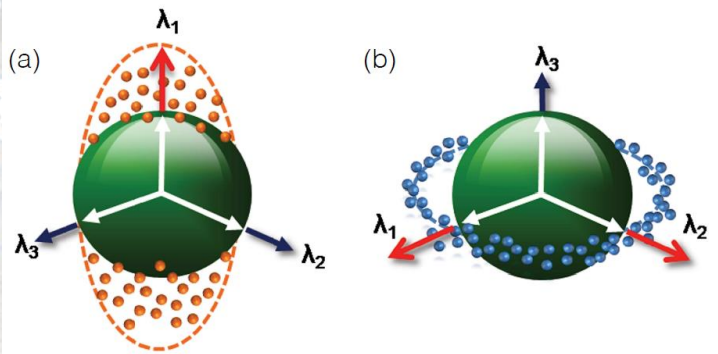


Moment of inertia



Fernandez 2005, JSG

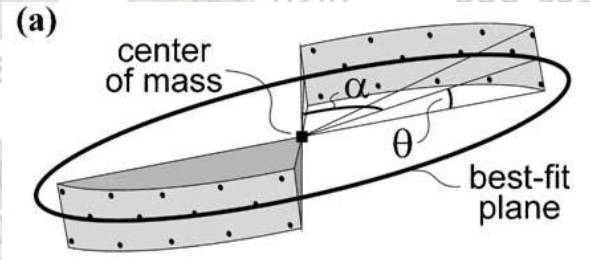
Baek and Kim, 2015, Nat. Haz. and Earth Syst. Sci,



Eigenvalue λ_3 and eigenvector v_3 correspond to the orientation with the minimum density of vectors and maximum moment of inertia, and therefore the pole to the best-fit plane of a girdle distribution.

$$M = \ln(\lambda_1/\lambda_3)$$

$$K = \ln(\lambda_1/\lambda_2) / \ln(\lambda_2/\lambda_3)$$



(b)

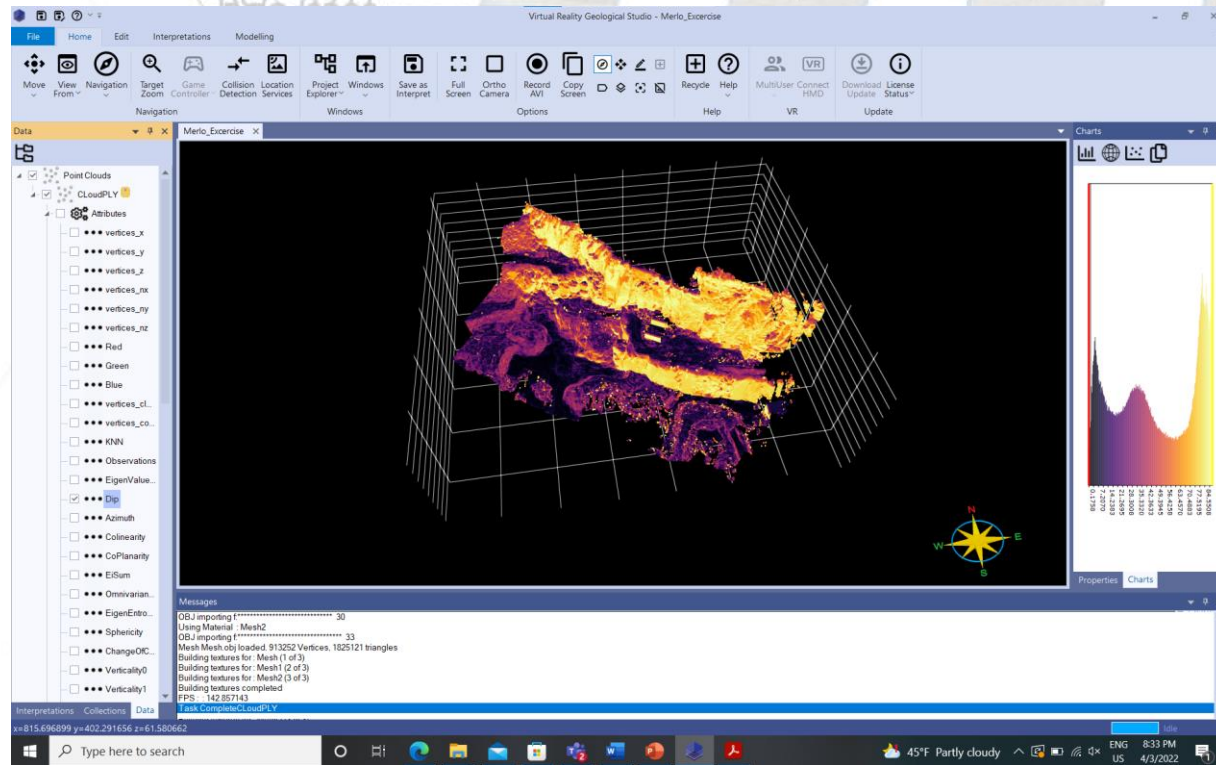
θ	M
1°	7.81
2°	6.42
3°	5.61
4°	5.03
5°	4.59
6°	4.22
7°	3.91
8°	3.64
9°	3.40
10°	3.18
15°	2.35

(c)

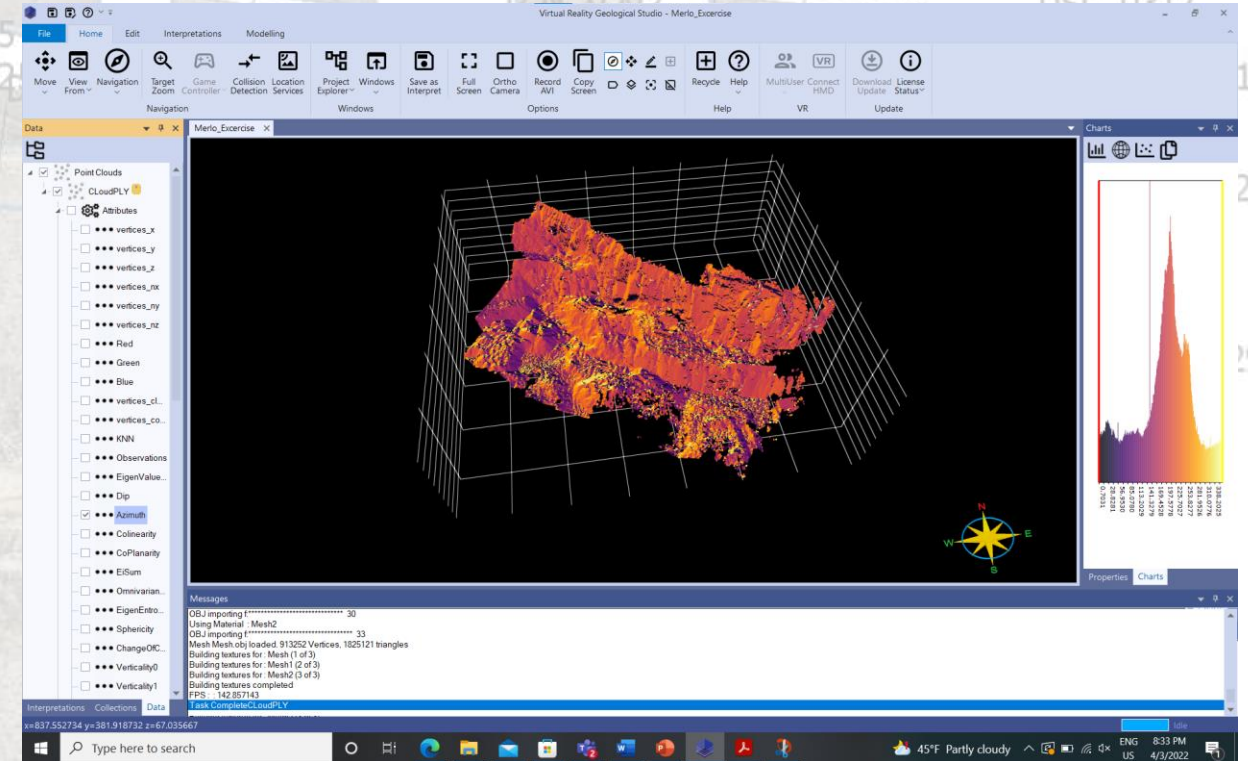
α	K
180°	3.1×10^{-4}
150°	2.9×10^{-2}
120°	0.10
90°	0.21
75°	0.28
60°	0.38
45°	0.52
30°	0.76
15°	1.33

Fernandez 2005, JSG

Dip and Azimuth

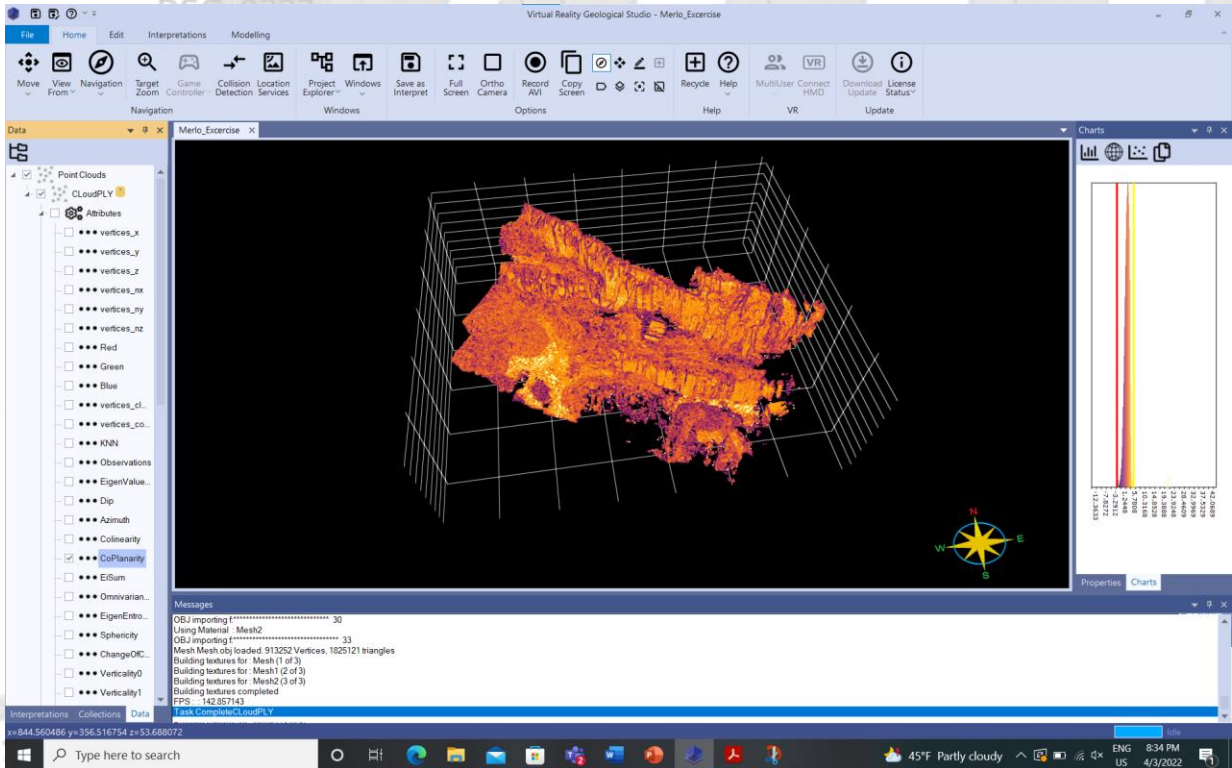


Dip

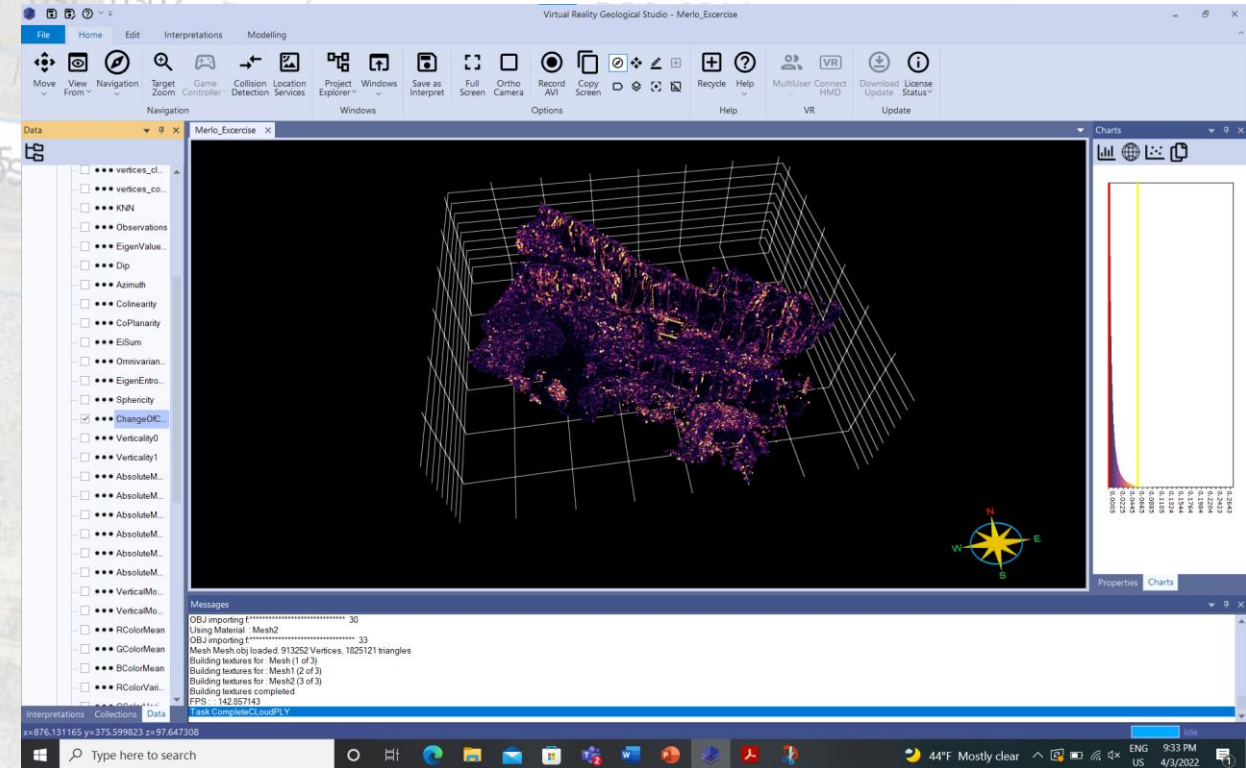


Azimuth

Coplanarity and Curvature



Coplanarity



Curvature