Oasis montaj How-To Guide

Induced Polarization - Import and Display 3D IP Data

Manual release date: April-17-12.

Please send comments or questions to info@geosoft.com

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Geosoft Incorporated
Queen's Quay Terminal
207 Queen's Quay West
Suite 810, PO Box 131
Toronto, Ontario
M5J 1A7
Canada
Tel: (416) 369-0111
Fax: (416) 369-9599

Website: www.geosoft.com
E-mail: info@geosoft.com

Support

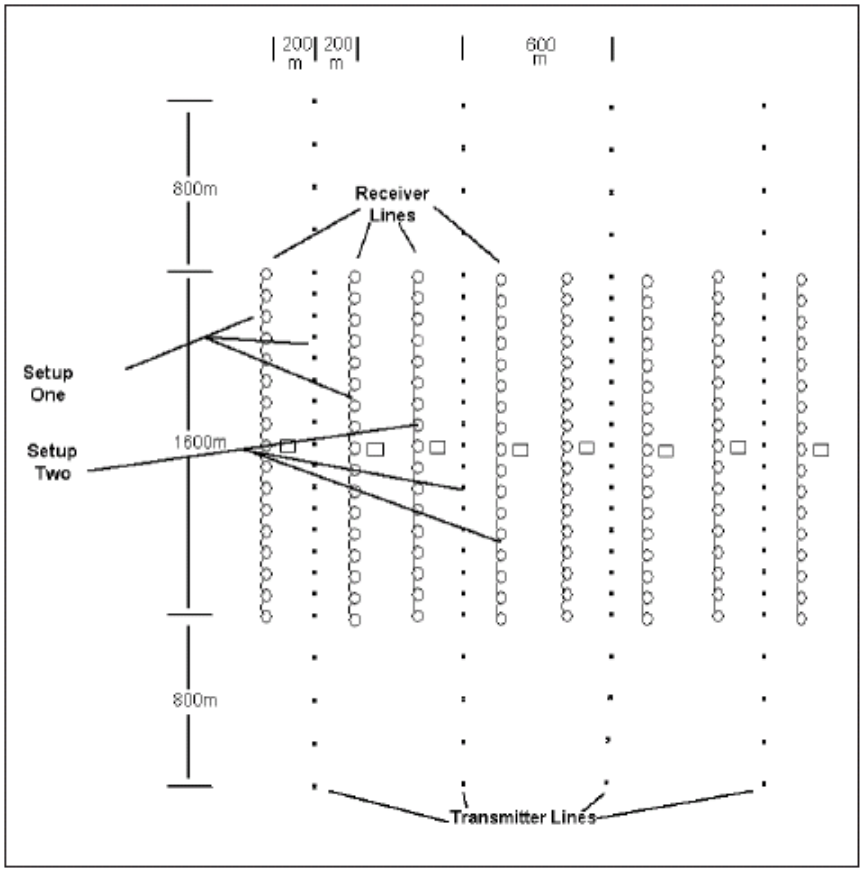
For obtaining technical support, email support@geosoft.com

If you wish to speak to a technical support representative in your region, please visit the Geosoft Support page at: www.geosoft.com/about-geosoft/contact-us/world-offices for contact information.

How to Import and Display 3D IP Data

The advent of **3D IP** inversion precipitated the use of offset Tx/Rx configurations. Most IP arrays are sensitive to offline sources as much as they are to sources at an equivalent depth. A 2D inversion may place such a lateral source at an equivalent depth. This emphasizes the necessity to collect 3D IP data and subject it to 3D inversion.

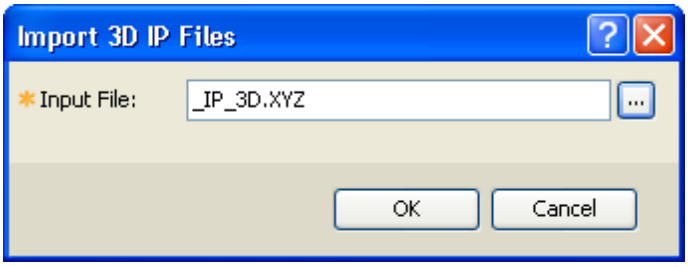
Electrode arrays can be designed to optimize target definition and data collection efficiency. All the receivers are normally placed in parallel lines, after which the transmitter is moved and activated in parallel lines in-between receiver lines.



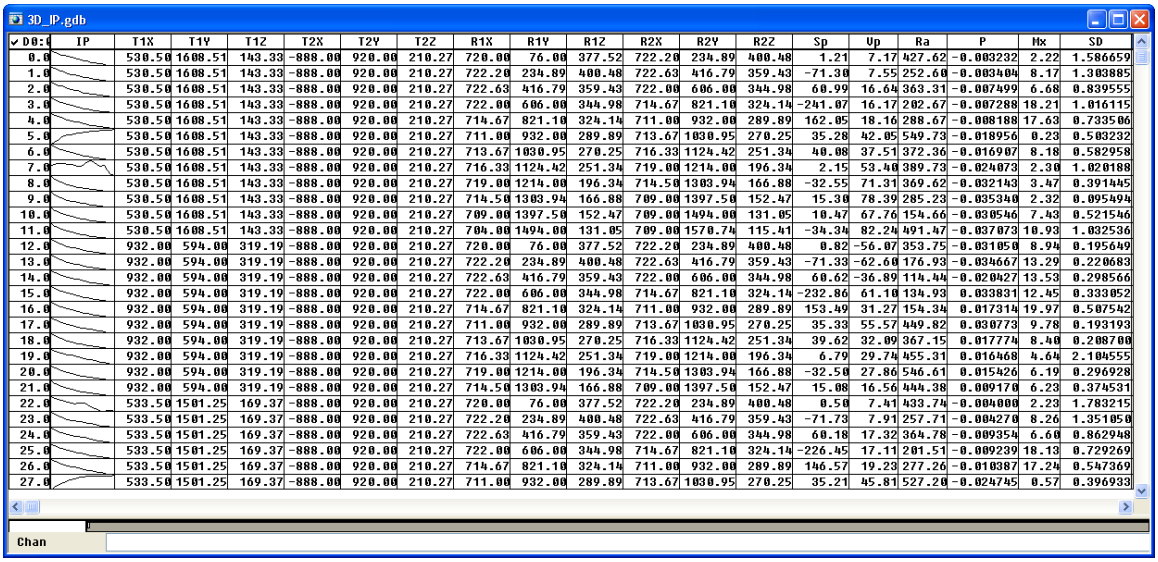
The practical configuration in common use is Offset Pole-Dipole. It is more efficient than the Dipole-Dipole configuration and it provides a better depth resolution and a more uniform lateral sensitivity. *White et al., 2003*[1] provides a comprehensive description of this configuration. The Pole-Dipole 3D configuration speeds data collection and reduces the effects of EM coupling.

To Import 3D IP Data

1. Load the IP menu.
2. From the *IP* menu, select **Import | 3D IP Format**. You will be prompted to either create a new database or import in the current database. Proceed to create a new database.
3. Navigate to the directory where your input data file is stored and select it.



4. Click **OK** and the 3D IP data will be loaded in the new database.



D0:0	IP	T1X	T1Y	T1Z	T2X	T2Y	T2Z	R1X	R1Y	R1Z	R2X	R2Y	R2Z	Sp	Up	Ra	P	Mx	SD
0.0		530.50	1608.51	143.33	-888.00	920.00	210.27	720.00	76.00	377.52	722.20	234.89	400.48	1.21	7.17	427.62	-0.003232	2.22	1.586659
1.0		530.50	1608.51	143.33	-888.00	920.00	210.27	722.20	234.89	400.48	722.63	416.79	359.43	-71.30	7.55	252.60	-0.003404	8.17	1.303885
2.0		530.50	1608.51	143.33	-888.00	920.00	210.27	722.63	416.79	359.43	722.00	606.00	344.98	60.99	16.64	363.31	-0.007499	6.68	0.839555
3.0		530.50	1608.51	143.33	-888.00	920.00	210.27	722.00	606.00	344.98	714.67	821.10	324.14	-241.07	16.17	202.67	-0.007288	18.21	1.016115
4.0		530.50	1608.51	143.33	-888.00	920.00	210.27	714.67	821.10	324.14	711.00	932.00	289.89	162.05	18.16	288.67	-0.008188	17.63	0.733506
5.0		530.50	1608.51	143.33	-888.00	920.00	210.27	711.00	932.00	289.89	713.67	1030.95	270.25	35.28	42.05	549.73	-0.018956	0.23	0.503232
6.0		530.50	1608.51	143.33	-888.00	920.00	210.27	713.67	1030.95	270.25	716.33	1124.42	251.34	40.08	37.51	372.36	-0.016907	8.18	0.582958
7.0		530.50	1608.51	143.33	-888.00	920.00	210.27	716.33	1124.42	251.34	719.00	1214.00	196.34	2.15	53.40	389.73	-0.024073	2.30	1.020188
8.0		530.50	1608.51	143.33	-888.00	920.00	210.27	719.00	1214.00	196.34	714.50	1303.94	166.88	-32.55	71.31	369.62	-0.032143	3.47	0.391445
9.0		530.50	1608.51	143.33	-888.00	920.00	210.27	714.50	1303.94	166.88	709.00	1397.50	152.47	15.30	78.39	285.23	-0.035340	2.32	0.095494
10.0		530.50	1608.51	143.33	-888.00	920.00	210.27	709.00	1397.50	152.47	709.00	1494.00	131.05	10.47	67.76	154.66	-0.030546	7.43	0.521546
11.0		530.50	1608.51	143.33	-888.00	920.00	210.27	704.00	1494.00	131.05	709.00	1570.74	115.41	-34.34	82.24	491.47	-0.037073	10.93	1.032536
12.0		932.00	594.00	319.19	-888.00	920.00	210.27	720.00	76.00	377.52	722.20	234.89	400.48	0.82	-56.07	353.75	-0.031050	8.94	0.195649
13.0		932.00	594.00	319.19	-888.00	920.00	210.27	722.20	234.89	400.48	722.63	416.79	359.43	-71.33	-62.60	176.93	-0.034667	13.29	0.220683
14.0		932.00	594.00	319.19	-888.00	920.00	210.27	722.63	416.79	359.43	722.00	606.00	344.98	60.62	-36.89	114.44	-0.020427	13.53	0.298566
15.0		932.00	594.00	319.19	-888.00	920.00	210.27	722.00	606.00	344.98	714.67	821.10	324.14	-232.86	61.10	134.93	0.033831	12.45	0.333052
16.0		932.00	594.00	319.19	-888.00	920.00	210.27	714.67	821.10	324.14	711.00	932.00	289.89	153.49	31.27	154.34	0.017314	19.97	0.507542
17.0		932.00	594.00	319.19	-888.00	920.00	210.27	711.00	932.00	289.89	713.67	1030.95	270.25	35.33	55.57	449.82	0.030773	9.78	0.193193
18.0		932.00	594.00	319.19	-888.00	920.00	210.27	713.67	1030.95	270.25	716.33	1124.42	251.34	39.62	32.09	367.15	0.017774	8.40	0.208700
19.0		932.00	594.00	319.19	-888.00	920.00	210.27	716.33	1124.42	251.34	719.00	1214.00	196.34	6.79	29.74	455.31	0.016468	4.64	2.104555
20.0		932.00	594.00	319.19	-888.00	920.00	210.27	719.00	1214.00	196.34	714.50	1303.94	166.88	-32.50	27.86	546.61	0.015426	6.19	0.296928
21.0		932.00	594.00	319.19	-888.00	920.00	210.27	714.50	1303.94	166.88	709.00	1397.50	152.47	15.08	16.56	444.38	0.009170	6.23	0.374531
22.0		533.50	1501.25	169.37	-888.00	920.00	210.27	720.00	76.00	377.52	722.20	234.89	400.48	0.50	7.41	433.74	-0.004000	2.23	1.783215
23.0		533.50	1501.25	169.37	-888.00	920.00	210.27	722.20	234.89	400.48	722.63	416.79	359.43	-71.73	7.91	257.71	-0.004270	8.26	1.351050
24.0		533.50	1501.25	169.37	-888.00	920.00	210.27	722.63	416.79	359.43	722.00	606.00	344.98	60.18	17.32	364.78	-0.009354	6.60	0.862948
25.0		533.50	1501.25	169.37	-888.00	920.00	210.27	722.00	606.00	344.98	714.67	821.10	324.14	-226.45	17.11	201.51	-0.009239	18.13	0.729269
26.0		533.50	1501.25	169.37	-888.00	920.00	210.27	714.67	821.10	324.14	711.00	932.00	289.89	146.57	19.23	277.26	-0.010387	17.24	0.547369
27.0		533.50	1501.25	169.37	-888.00	920.00	210.27	711.00	932.00	289.89	713.67	1030.95	270.25	35.21	45.81	527.20	-0.024745	0.57	0.396933

To Calculate the Pseudosection Points in 3D Space

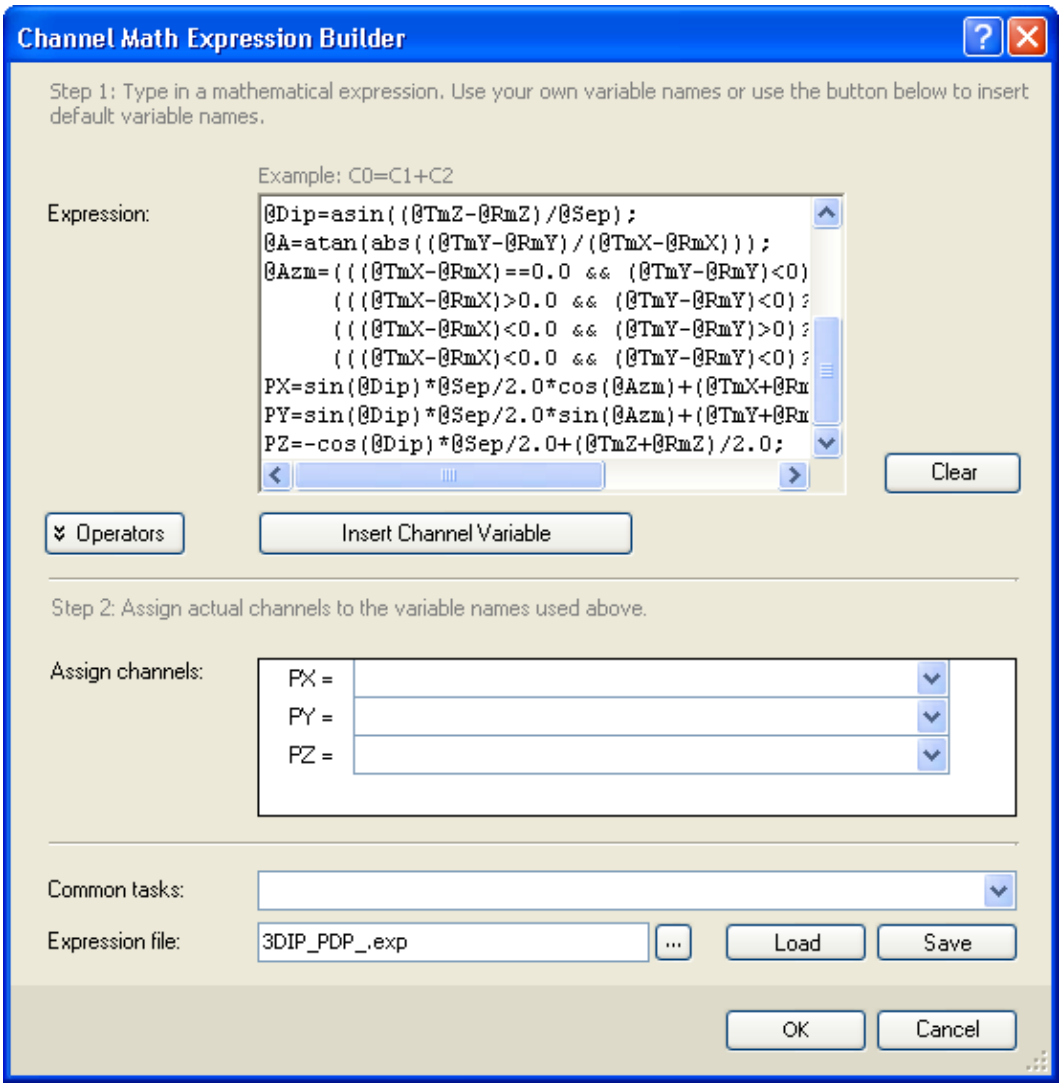
Two expression files are provided at the end of this document to calculate the pseudosection points in 3D space. Apply the appropriate one to your 3D IP database.

Note that the expression file assumes that the standard IP channel naming convention is in effect. If you are not using this naming convention, alter the expression file(s) to adapt it to your data. The provided formulas assume a 45° dip angle intersection between the transmitter mid-point (Dipole-Dipole) or near transmitter (Pole-Dipole) in 3D space and the midpoint of the corresponding receiver pair.

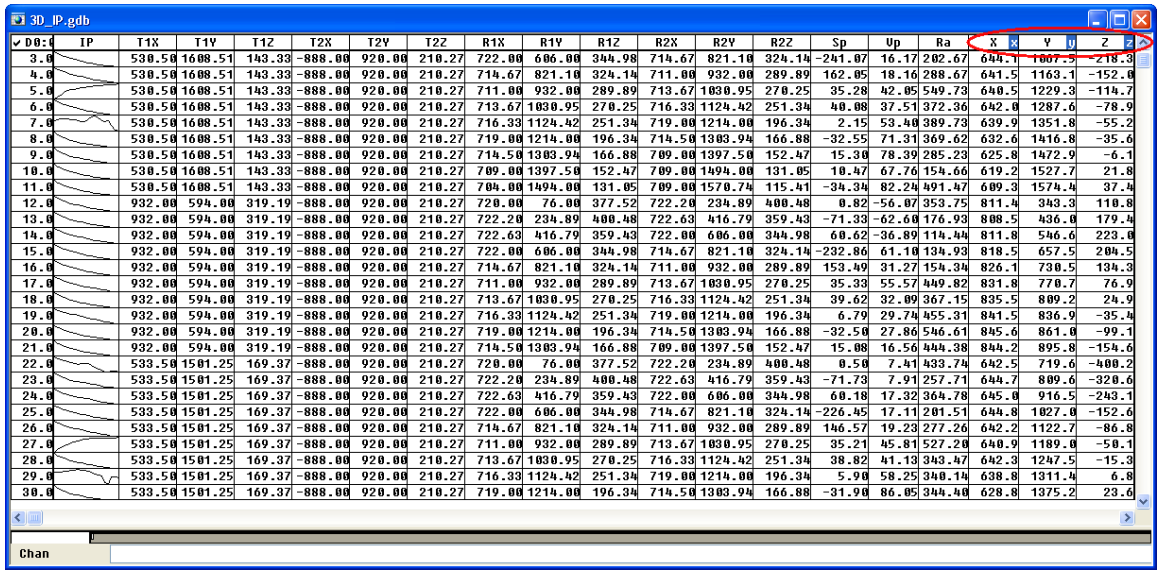
In this particular example, we are using a Pole-Dipole configuration. Save the appropriate expression in the file Geosoft\Oasis montaj\user\etc\3DIP_PDP.exp.

1. From the *Database Tools* menu, select **Channel Math**. At the bottom of the dialog, click the button and locate the expression file you just saved.

2. Click the **Load** button. This will load the expression file into the math dialog.



3. You will be prompted to provide the name of the Pseudosection X,Y,Z channels. Enter **X**, **Y**, **Z** .
4. Click **OK** and the new XYZ channels will be generated and saved in the database.



3D_IP.gdb

D0:0	IP	T1X	T1Y	T1Z	T2X	T2Y	T2Z	R1X	R1Y	R1Z	R2X	R2Y	R2Z	Sp	Up	Ra	X	Y	Z
3.0		530.50	1608.51	143.33	-888.00	920.00	210.27	722.00	606.00	344.98	714.67	821.10	324.14	-241.07	16.17	202.67	644.1	1007.5	-218.3
4.0		530.50	1608.51	143.33	-888.00	920.00	210.27	714.67	821.10	324.14	711.00	932.00	289.89	162.05	18.16	288.67	641.5	1163.1	-152.0
5.0		530.50	1608.51	143.33	-888.00	920.00	210.27	711.00	932.00	289.89	713.67	1030.95	270.25	35.28	42.05	549.73	640.5	1229.3	-114.7
6.0		530.50	1608.51	143.33	-888.00	920.00	210.27	713.67	1030.95	270.25	716.33	1124.42	251.34	40.08	37.51	372.36	642.0	1287.6	-78.9
7.0		530.50	1608.51	143.33	-888.00	920.00	210.27	716.33	1124.42	251.34	719.00	1214.00	196.34	2.15	53.40	389.73	639.9	1351.8	-55.2
8.0		530.50	1608.51	143.33	-888.00	920.00	210.27	719.00	1214.00	196.34	714.50	1303.94	166.88	-32.55	71.31	369.62	632.6	1416.8	-35.6
9.0		530.50	1608.51	143.33	-888.00	920.00	210.27	714.50	1303.94	166.88	709.00	1397.50	152.47	15.30	78.39	285.23	625.8	1472.9	-6.1
10.0		530.50	1608.51	143.33	-888.00	920.00	210.27	709.00	1397.50	152.47	709.00	1494.00	131.05	10.47	67.76	154.66	619.2	1527.7	21.8
11.0		530.50	1608.51	143.33	-888.00	920.00	210.27	704.00	1494.00	131.05	709.00	1570.74	115.41	-34.34	82.24	491.47	609.3	1574.4	37.4
12.0		932.00	594.00	319.19	-888.00	920.00	210.27	720.00	76.00	377.52	722.20	234.89	400.48	0.82	-56.07	353.75	811.4	343.3	110.8
13.0		932.00	594.00	319.19	-888.00	920.00	210.27	722.20	234.89	400.48	722.63	416.79	359.43	-71.33	-62.60	176.93	808.5	436.0	179.4
14.0		932.00	594.00	319.19	-888.00	920.00	210.27	722.63	416.79	359.43	722.00	606.00	344.98	60.62	-36.89	114.44	811.8	546.6	223.0
15.0		932.00	594.00	319.19	-888.00	920.00	210.27	722.00	606.00	344.98	714.67	821.10	324.14	-232.86	61.10	134.93	818.5	657.5	204.5
16.0		932.00	594.00	319.19	-888.00	920.00	210.27	714.67	821.10	324.14	711.00	932.00	289.89	153.49	31.27	154.34	826.1	730.5	134.3
17.0		932.00	594.00	319.19	-888.00	920.00	210.27	711.00	932.00	289.89	713.67	1030.95	270.25	35.33	55.57	449.82	831.8	770.7	76.9
18.0		932.00	594.00	319.19	-888.00	920.00	210.27	713.67	1030.95	270.25	716.33	1124.42	251.34	39.62	32.09	367.15	835.5	809.2	24.9
19.0		932.00	594.00	319.19	-888.00	920.00	210.27	716.33	1124.42	251.34	719.00	1214.00	196.34	6.79	29.74	455.31	841.5	836.9	-35.4
20.0		932.00	594.00	319.19	-888.00	920.00	210.27	719.00	1214.00	196.34	714.50	1303.94	166.88	-32.50	27.86	546.61	845.6	861.0	-99.1
21.0		932.00	594.00	319.19	-888.00	920.00	210.27	714.50	1303.94	166.88	709.00	1397.50	152.47	15.08	16.56	444.38	844.2	895.8	-154.6
22.0		533.50	1501.25	169.37	-888.00	920.00	210.27	720.00	76.00	377.52	722.20	234.89	400.48	0.50	7.41	433.74	642.5	719.6	-400.2
23.0		533.50	1501.25	169.37	-888.00	920.00	210.27	722.20	234.89	400.48	722.63	416.79	359.43	-71.73	7.91	257.71	644.7	809.6	-320.6
24.0		533.50	1501.25	169.37	-888.00	920.00	210.27	722.63	416.79	359.43	722.00	606.00	344.98	60.18	17.32	364.78	645.0	916.5	-243.1
25.0		533.50	1501.25	169.37	-888.00	920.00	210.27	722.00	606.00	344.98	714.67	821.10	324.14	-226.45	17.11	201.51	644.8	1027.0	-152.6
26.0		533.50	1501.25	169.37	-888.00	920.00	210.27	714.67	821.10	324.14	711.00	932.00	289.89	146.57	19.23	277.26	642.2	1122.7	-86.8
27.0		533.50	1501.25	169.37	-888.00	920.00	210.27	711.00	932.00	289.89	713.67	1030.95	270.25	35.21	45.81	527.20	640.9	1189.0	-50.1
28.0		533.50	1501.25	169.37	-888.00	920.00	210.27	713.67	1030.95	270.25	716.33	1124.42	251.34	38.82	41.13	343.47	642.3	1247.5	-15.3
29.0		533.50	1501.25	169.37	-888.00	920.00	210.27	716.33	1124.42	251.34	719.00	1214.00	196.34	5.90	58.25	340.14	638.8	1311.4	6.8
30.0		533.50	1501.25	169.37	-888.00	920.00	210.27	719.00	1214.00	196.34	714.50	1303.94	166.88	-31.90	86.05	344.40	628.8	1375.2	23.6

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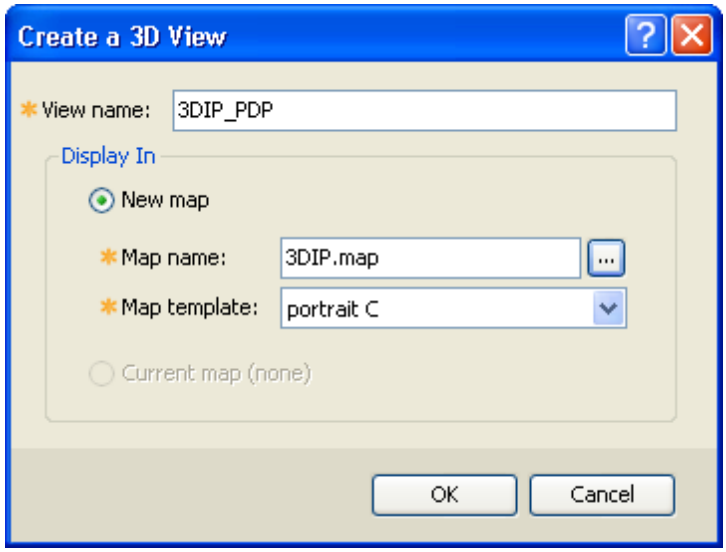
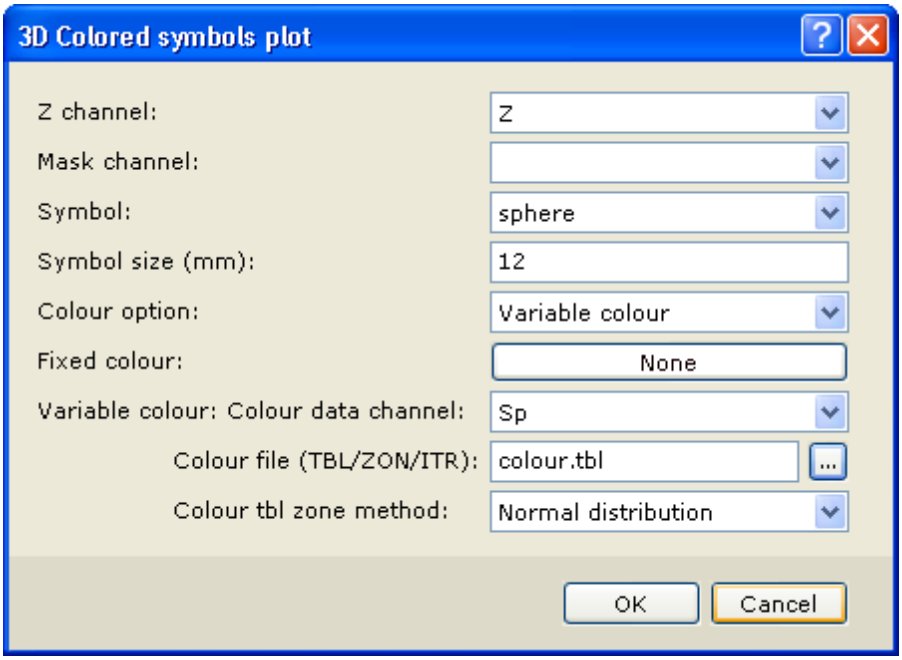
To Display the Pole-Dipole Data in 3D Space

The pseudosection surfaces can be displayed as variable colour symbols in a 3D view. In addition, the location of the transmitters and receivers can also be plotted as symbols on the same view.

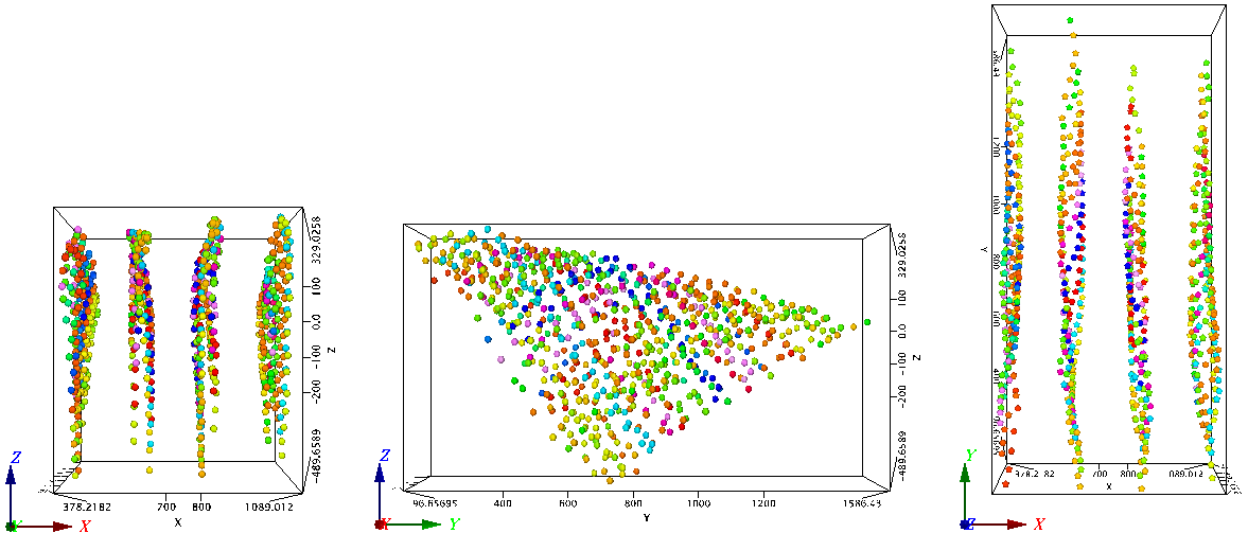
1. From the *3D* menu, select **Create a New 3D View**.
2. Name your View *3DIP_PDP* and your map *3DIP*. This will open a blank 3D viewer.



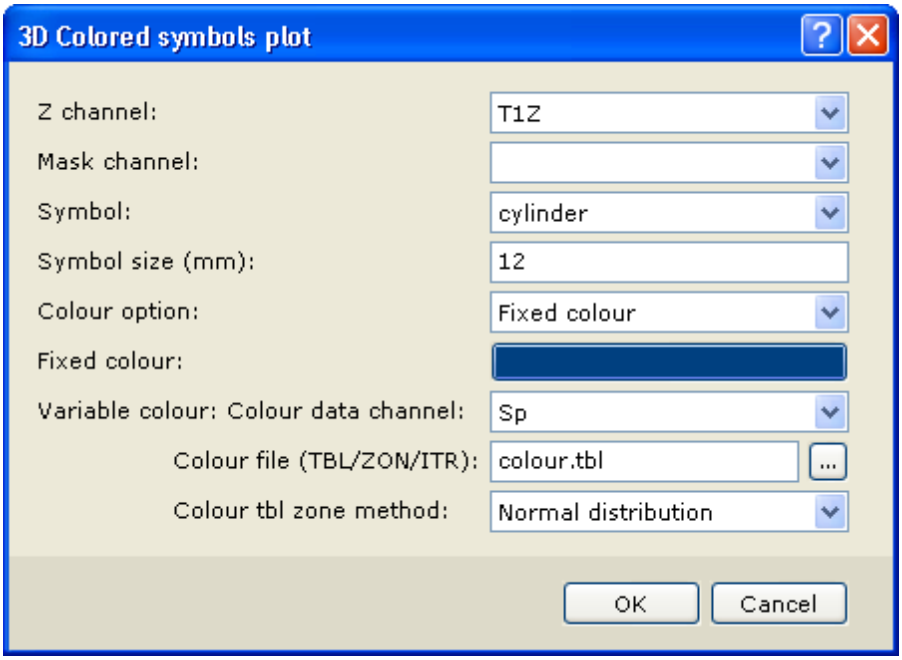
3. In the 3D Viewer, from the *Add to 3D* menu, select **3D Symbols**. Provide the Z channel as the vertical axis and display the self potential or any other desired channel with a variable colour table.



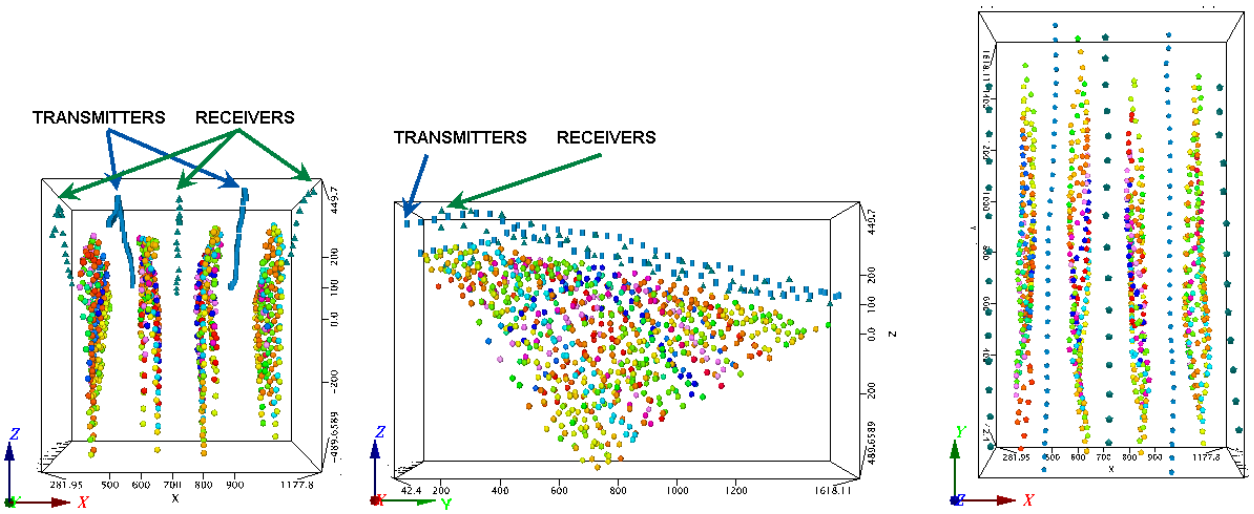
The X, Y, Z plan views are illustrated below.



4. To preserve this view, left click on the view name *SYMB_Z_Sp* to select it , then press **F2** and rename it *Pseudosection_Sp*.
5. Add the transmitter locations on the surface. To do so, from the *Coordinates* menu, select **Set current X,Y,Z coordinates** and change the X & Y channels to *T1X* & *T1Y*.
6. Go back to the 3D viewer and plot the transmitters as 3D symbols. Select a Fixed colour and a different symbol for the transmitters.



7. Proceed in the same manner to display the receivers in a different colour and symbol.



Expressions

Pole-Dipole configuration

- @TmX = T1X;
- @TmY = T1Y;
- @TmZ = T1Z;
- @RmX = (R1X+R2X)/2.0;
- @RmY = (R1Y+R2Y)/2.0;
- @RmZ = (R1Z+R2Z)/2.0;

- Sep=sqrt((@TmX-@RmX)**2+(@TmY-@RmY)**2+(@TmZ-@RmZ)**2);
- Dip=asin((@TmZ-@RmZ)/Sep);
- @A=atan(abs((@TmY-@RmY)/(@TmX-@RmX)));
- Azm=(((@TmX-@RmX)==0.0 && (@TmY-@RmY)<0)?3.141592654+@A:
- (((@TmX-@RmX)>0.0 && (@TmY-@RmY)<0)?2.0*3.141592654-@A:
- (((@TmX-@RmX)<0.0 && (@TmY-@RmY)>0)?3.141592654-@A:
- (((@TmX-@RmX)<0.0 && (@TmY-@RmY)<0)?3.141592654+@A:@A))));
- PX=sin(Dip)*Sep/2.0*cos(Azm)+(@TmX+@RmX)/2.0;
- PY=sin(Dip)*Sep/2.0*sin(Azm)+(@TmY+@RmY)/2.0;
- PZ=-cos(Dip)*Sep/2.0+(@TmZ+@RmZ)/2.0;

Dipole-Dipole configuration

- @TmX = (T1X+T2X)/2.0;
- @TmY = (T1Y+T2Y)/2.0;
- @TmZ = (T1Z+T2Z)/2.0;
- @RmX = (R1X+R2X)/2.0;
- @RmY = (R1Y+R2Y)/2.0;
- @RmZ = (R1Z+R2Z)/2.0;
- Sep=sqrt((@TmX-@RmX)**2+(@TmY-@RmY)**2+(@TmZ-@RmZ)**2);
- Dip=asin((@TmZ-@RmZ)/Sep);
- @A=atan(abs((@TmY-@RmY)/(@TmX-@RmX)));
- Azm=(((@TmX-@RmX)==0.0 && (@TmY-@RmY)<0)?3.141592654+@A:
- (((@TmX-@RmX)>0.0 && (@TmY-@RmY)<0)?2.0*3.141592654-@A:
- (((@TmX-@RmX)<0.0 && (@TmY-@RmY)>0)?3.141592654-@A:
- (((@TmX-@RmX)<0.0 && (@TmY-@RmY)<0)?3.141592654+@A:@A))));
- PX=sin(Dip)*Sep/2.0*cos(Azm)+(@TmX+@RmX)/2.0;
- PY=sin(Dip)*Sep/2.0*sin(Azm)+(@TmY+@RmY)/2.0;
- PZ=-cos(Dip)*Sep/2.0+(@TmZ+@RmZ)/2.0;

Reference

[1] White R.M.S, Collins S. Loke M.H, 2003, Resistivity and IP arrays, optimized for data collection andinversion, Exploration Geophysics 2003, Vol 34, pp. 229-232