

Efficiencies in 3D Design - Implementation and Operations

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and Yajaira Herrera



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- ✓ Equipment Demands
- ✓ Patch Movement
- ✓ “Zippered” Surveys
- ✓ Half-Patch Recording
- ✓ Variable Grids
- ✓ False Efficiencies

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Line Spacing

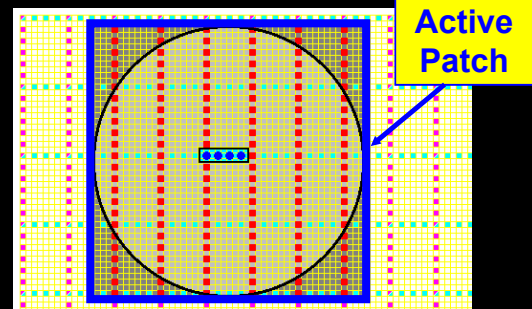
$$SL \times RL = \frac{\pi \times \text{Offset}_{\text{Max}}^2}{4 \times \text{Desired Fold}}$$

Avoid: SL / RL = 1.0
SL / RL > 2.0
SL / RL < 0.5



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The Fold Equation Assumes a Large Patch ...



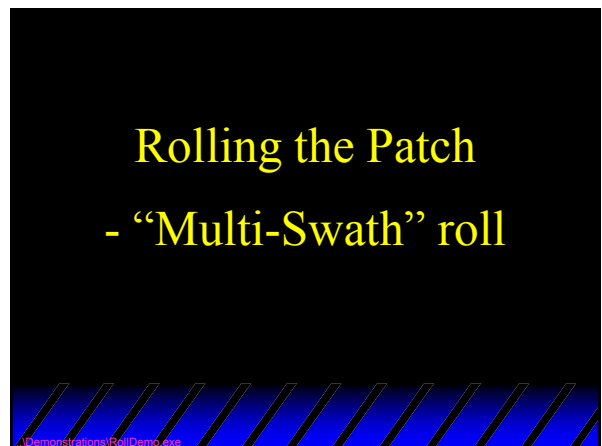
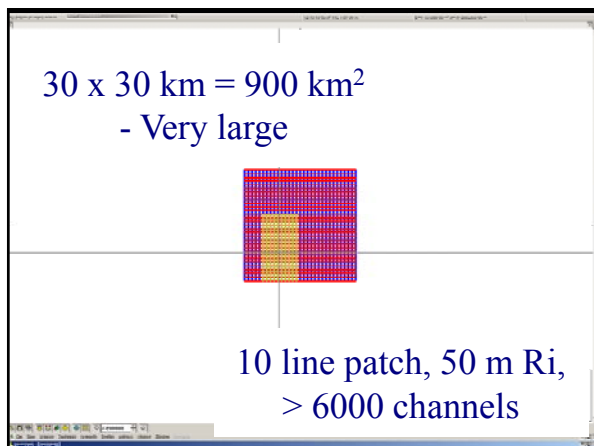
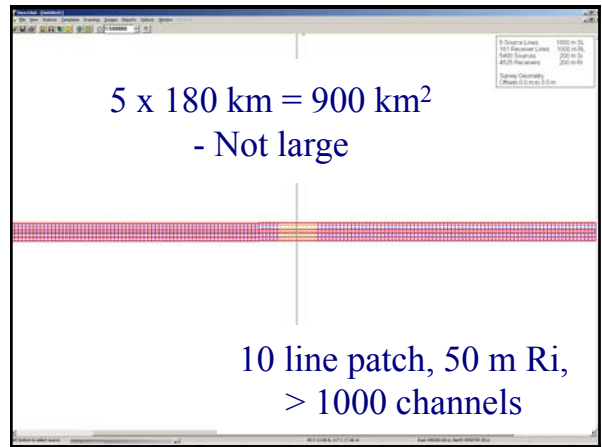
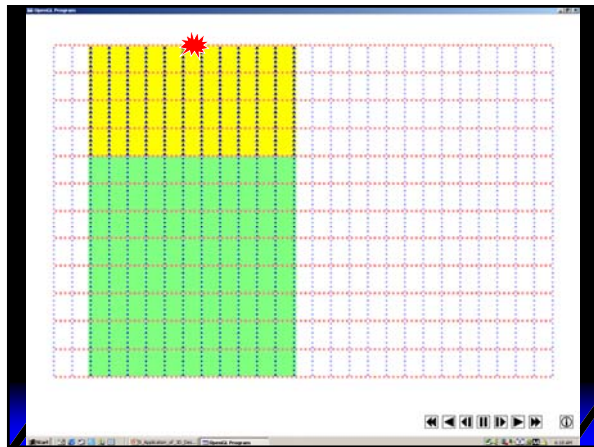
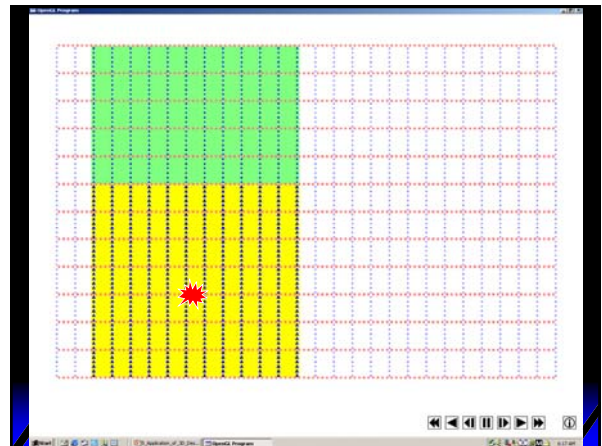
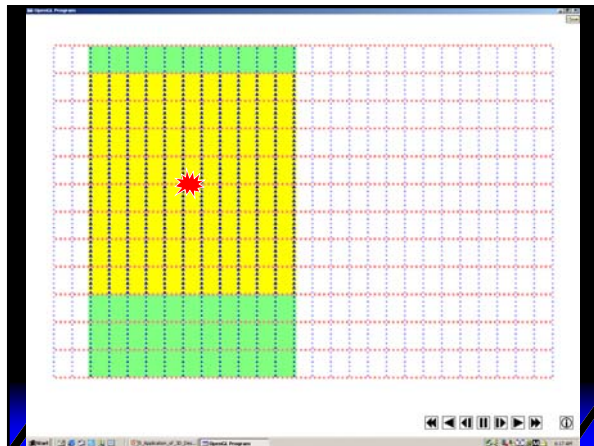
... Sufficient to record all useable offsets

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Rolling the Patch - “Normal” roll

\\Demonstrations\RollDemo.exe



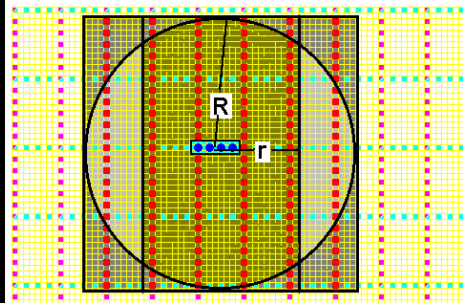


Rolling the Patch
- “Vibroseis” roll

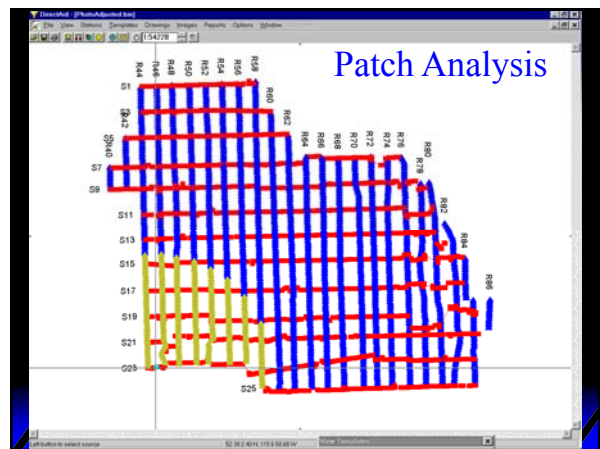
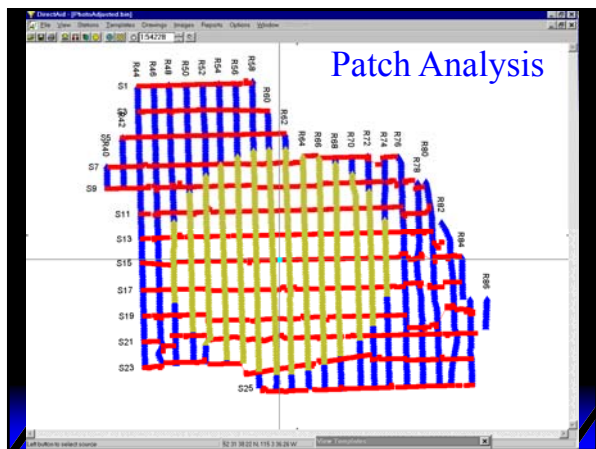
Rolling the Patch
“Vibroseis” roll
- Better

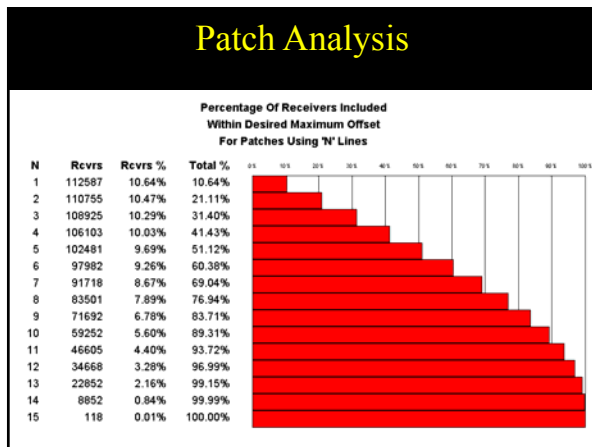
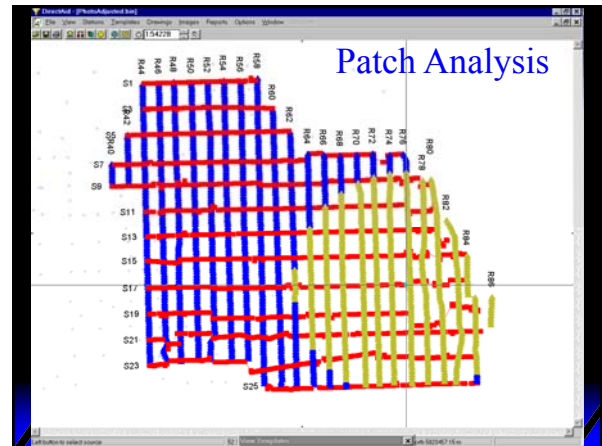
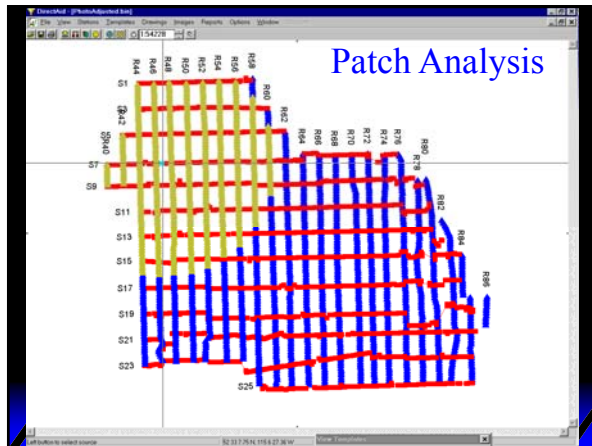
Patch Analysis

Sometimes, we are forced to use
Narrow Aperture Patches



... The patch width is not sufficient to record all useable traces



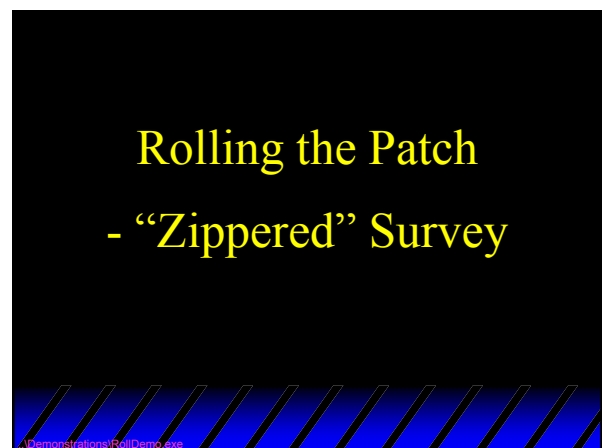


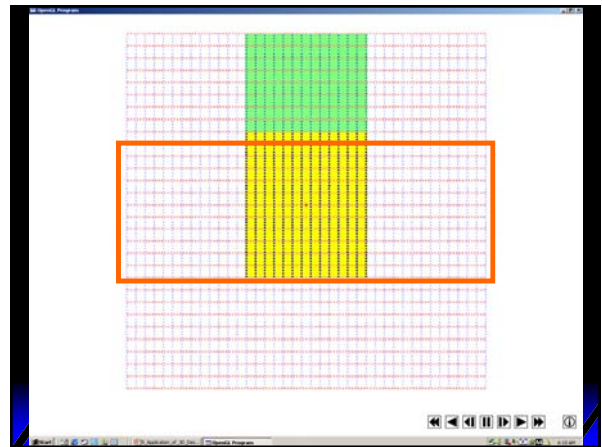
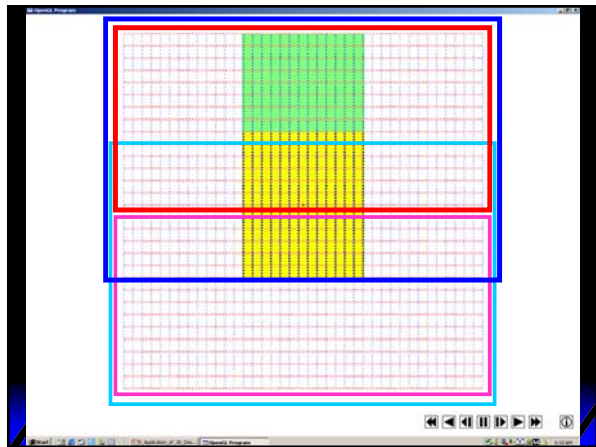
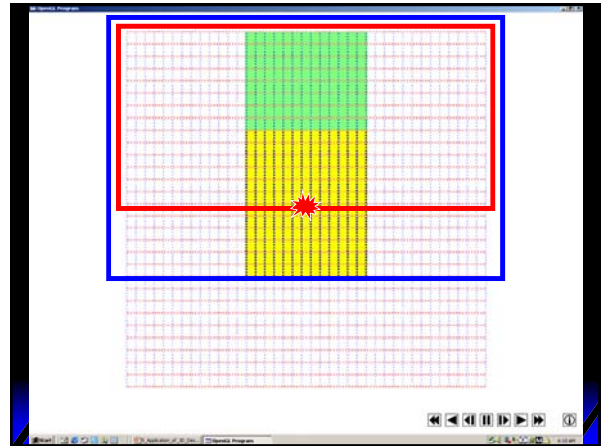
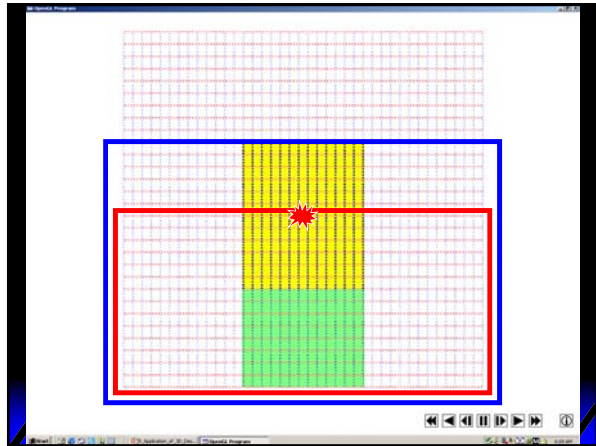
R-line	Start	End	Stations	Length km	Existing km	Newcut km	Water km
40	40136	40145	10	0.659	0.659	0.000	0.000
42	42123	42144	22	1.454	1.454	0.000	0.000
44	44102	44222	121	7.982	7.982	0.000	0.000
46	46102	46221	120	7.975	7.975	0.000	0.000
48	48101	48221	121	7.982	7.982	0.000	0.000
50	50102	50221	120	7.918	7.918	0.000	0.000
52	52102	52221	120	7.972	7.972	0.000	0.000
54	54101	54221	121	7.983	7.983	0.000	0.000
56	56102	56221	120	7.916	7.916	0.000	0.000
58	58101	58232	132	8.709	8.709	0.000	0.000
60	60114	60233	120	7.925	7.925	0.000	0.000
62	62124	62234	111	7.322	7.322	0.000	0.000
64	64135	64234	100	6.597	6.597	0.000	0.000
66	66134	66233	100	6.600	6.600	0.000	0.000
68	68135	68234	100	6.596	6.596	0.000	0.000
70	70135	70234	100	6.598	6.598	0.000	0.000
72	72134	72233	100	6.594	6.594	0.000	0.000
74	74135	74233	99	6.533	6.533	0.000	0.000
76	76135	76234	100	6.601	6.601	0.000	0.000
78	78146	78233	88	5.813	5.813	0.000	0.000
80	80146	80233	88	5.806	5.806	0.000	0.000
82	82163	82234	72	4.752	4.752	0.000	0.000
84	84179	84233	55	3.780	3.780	0.000	0.000
86	86196	86200	13	0.858	0.858	0.000	0.000
Total			2253	148.922	148.922	0.000	0.000
Min			10	0.659	0.659	0.000	0.000
Max			132	8.709	8.709	0.000	0.000
Avg			93.875	6.205	6.205	0.000	0.000

Line Summary - receivers

	17 lines	16 lines	15 lines	14 lines	13 lines	12 lines	11 lines	10 lines	9 lines	8 lines	7 lines
875	755	755	634	634	514	514	394	394	273	273	
1007	875	875	755	755	634	634	514	514	394	394	
1127	1007	1007	875	875	755	755	634	634	514	514	
1238	1127	1127	1007	1007	875	875	755	755	634	634	
1338	1238	1238	1127	1127	1007	1007	875	875	755	745	
1438	1338	1338	1238	1238	1127	1127	1007	1007	875	875	
1538	1438	1438	1338	1338	1238	1238	1127	1127	1007	1007	
1638	1538	1538	1438	1438	1338	1338	1238	1238	1127	1127	
1738	1638	1638	1538	1538	1438	1438	1338	1338	1238	1238	
1827	1738	1738	1638	1638	1538	1538	1438	1438	1338	1338	
1905	1827	1827	1738	1738	1638	1638	1538	1538	1438	1438	
1872	1784	1784	1664	1664	1544	1544	1424	1424	1304	1304	
1940	1752	1752	1631	1631	1511	1511	1391	1391	1271	1271	
1791	1719	1599	1511	1391	1303	1182	1062	1062	942	942	
1726	1671	1551	1479	1358	1270	1150	1062	1062	942	942	
1619	1606	1485	1430	1310	1230	1106	1018	1018	898	898	
1498	1498	1378	1365	1233	1178	1058	986	986	875	787	887
1378	1378	1246	1246	1126	1113	1002	947	847	775	675	
1246	1246	1126	1126	1015	1015	915	902	802	747	647	
1126	1126	1015	1015	915	915	815	815	715	702	602	
1015	1015	915	915	815	815	715	715	615	615	515	
915	915	815	815	715	715	615	615	515	515	416	
815	815	715	715	615	615	515	515	416	416	316	
715	715	615	615	515	515	416	416	316	316	228	
Total	33225	31727	30089	28470	26732	24993	23156	21297	19360	17380	15355
Min	715	715	615	515	416	316	316	216	116	273	228
Max	1905	1805	1706	1606	1506	1406	1306	1206	1095	975	854
Avg	1384	1322	1254	1186	1114	1041	965	887	807	724	640

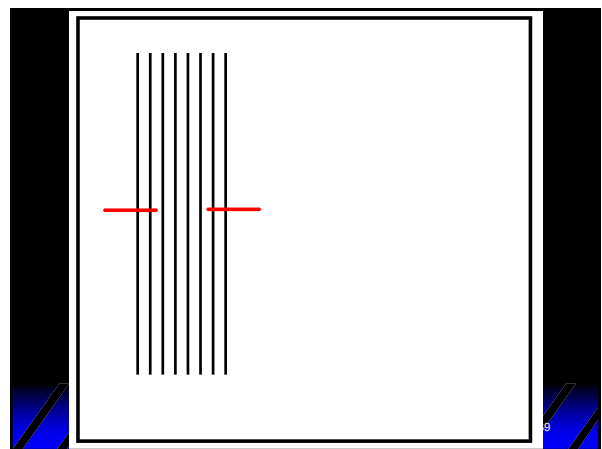
Crossline Channel Summary

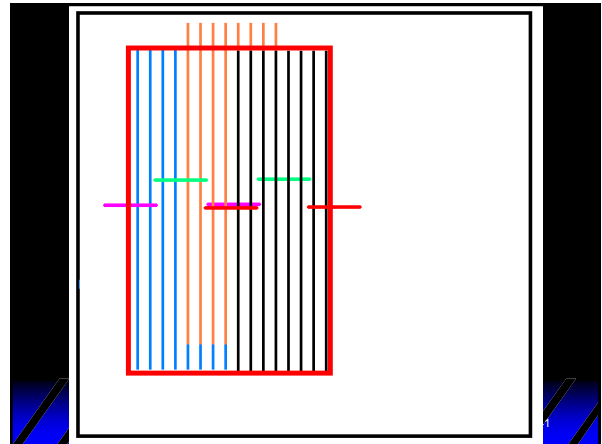
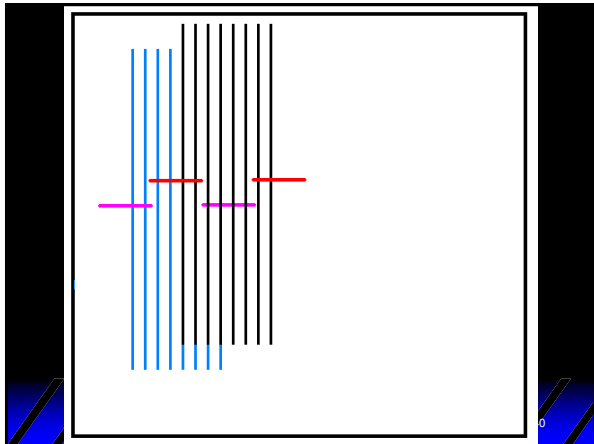




**“Half-Patch”
and “Ping-Pong”**

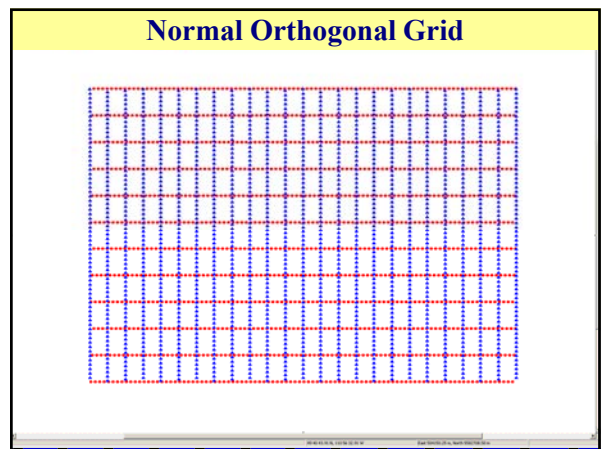
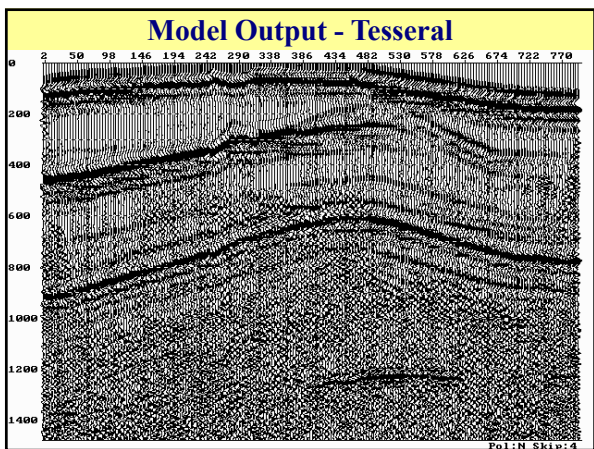
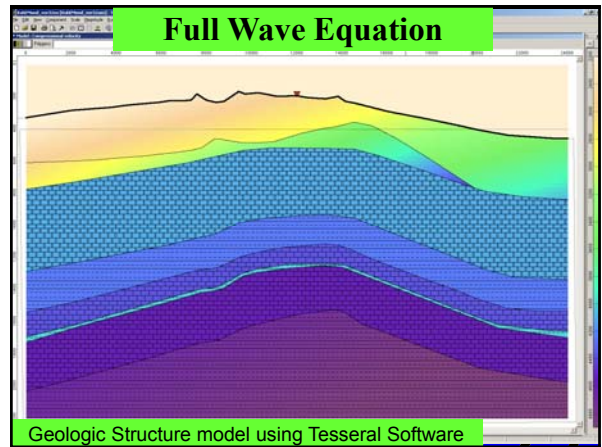
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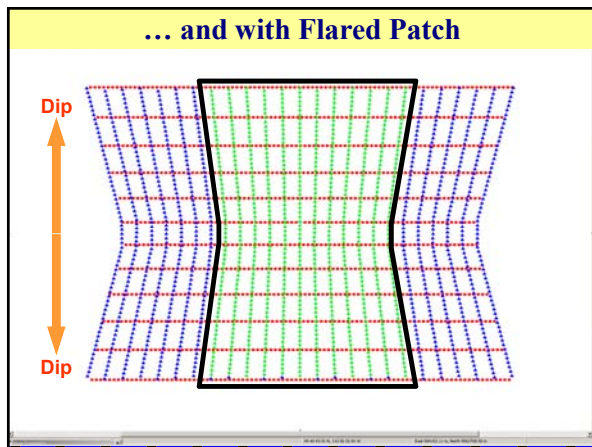
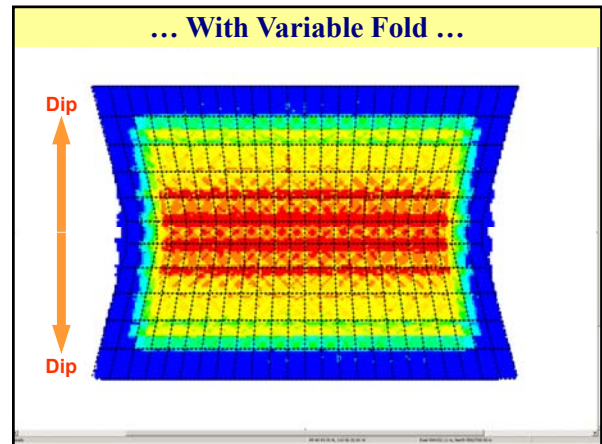
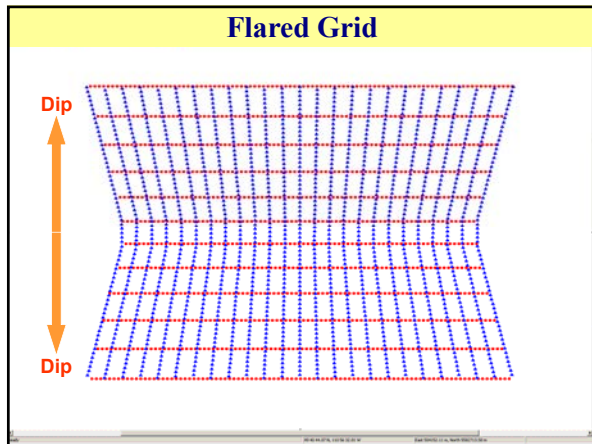




Variable Spacing Models

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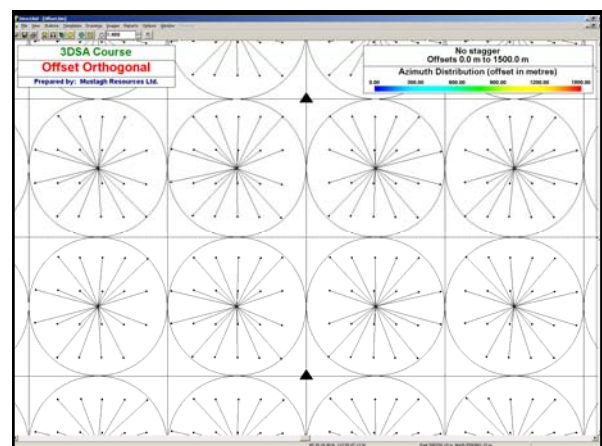
False Efficiencies

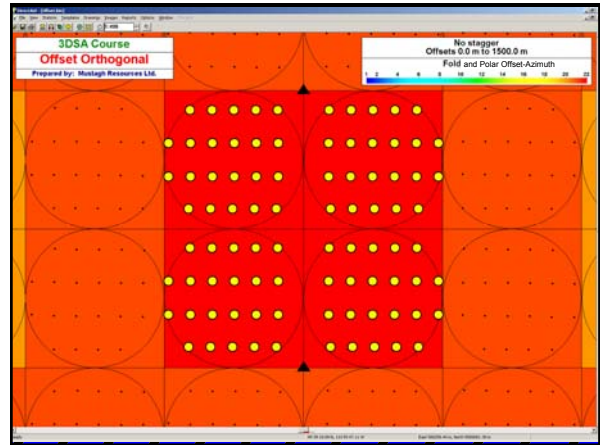
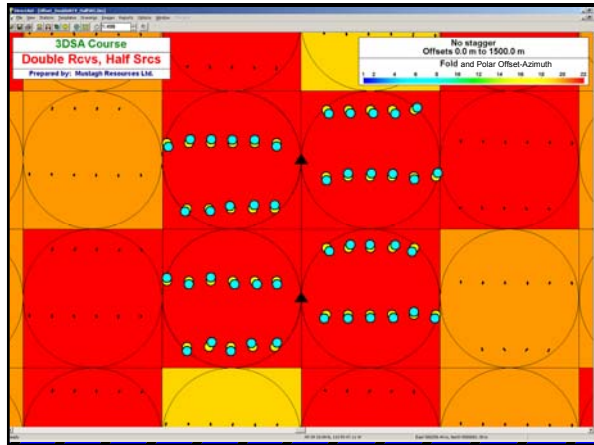
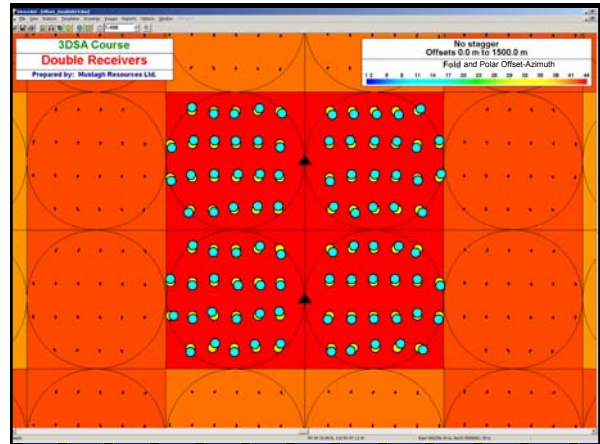
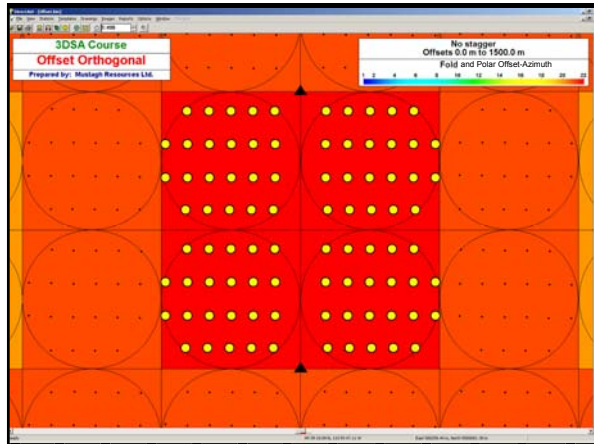
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False Efficiencies

- ◆ Double recorded traces by halving inexpensive receiver interval ...
- ◆ ... then halve recorded traces by doubling expensive source interval
- ◆ Net Fold (as gathered in original bins) will Remain the same !

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False Efficiencies

- ◆ Increase Fold by decreasing receiver interval and gathering in original bin size
- ◆ This generates non-diverse statistics within the over-sized bin as per the previous argument
- ◆ Fold is not our key consideration, **Sampling Diverse Statistics** within each bin is important

Cost Factors

Receiver line density	1.60	km per km ²
Source line density	1.08	km per km ²

Active patch lines 14

Receiver line density	1.60	km per km ²	Receiver point density	24.28	rcvs per km ²	approx. cost
Source line density	1.08	km per km ²	Source point density	13.88	srcs per km ²	\$10,251 per km ²

Most Important Factors:

- Preservation of the Wavefield
 - bin size, patch size
- Statistical Diversity
 - grid density, aspect ratio
- Robustness under Perturbation
 - model type
 - skidding and offsetting

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But Also :

- Minimize Costs**
- Optimize Operational Efficiency**
- Minimize Environmental Impact**

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If you desire more information or would like a copy of this tutorial, please contact Norm Cooper or Yajaira Herrera

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