Error Model Sub-Committee Update

Marc Willerth, H&P

Speaker Bio – Marc Willerth

H&P Global Research and Innovation Team (GRIT)

- Denver, Colorado
- Formerly MagVAR, SDI, SLB
- 10+ years in varying facets of Wellbore Positioning

Error Model Update Meeting

April 17th, 2023

- 42 people person, 12 additional attendees online

Agenda:

- Non-static survey check in
- Misalignment / XCL discussion
- Depth bias discussion
- Geomagnetic storms and survey errors

Topic 1: Non-static surveys check-in

- Error model status
  - Getting very close to alignment on error sources
  - Organizing a working group to standardize
  - Reach out to me if you're a vendor who would like to be involved

- Combined survey processes
  - Bigger task, will require more work
  - May be a larger issue around gyros as well

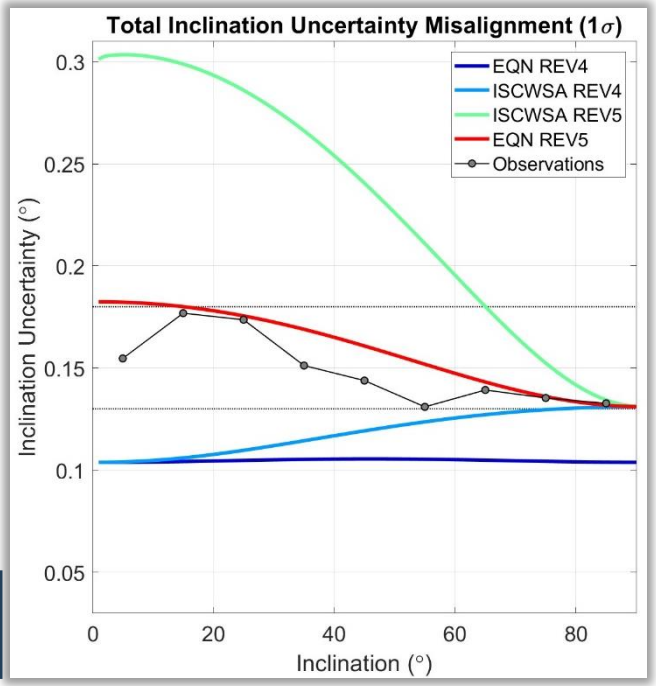
Topic 2: Misalignment and XCL Update

- Presentations from Marianne Houbiers & Jerry Codling
- New analysis supports further changes to RMIS terms
  - Possibly retaining a smaller random value and a small systematic
- Challenges with XCL – strict penalty makes adoption tricky
  - Even penalizes “proper” practices – no minimum course length
  - Minimum tortuosity may be pessimistic for vertical operation
- Discussions around EoU reduction from course length reduction

Low-angle misalignment – Inclination error terms

Error term	Propagation mode	Rev4 ISCWSA	Rev4 EQN (current)	Rev5 ISCWSA	Rev5 EQN (proposed)
Mis1	S	0.1	0.06	0.1	0.1
Mis2	S	0.1	0.06	0.1	0.1
Mis3	S	0.1	0.1	-	**0.1**
Mis4	S	0.1	0.1	-	**0.1**
Mis3r	R	-		0.3	**0.15**
Mis4r	R	-		0.3	**0.15**
Sag	S	0.08	0.08	-	0.08
Sage	S	-	-	0.08	

The proposed EQN Rev5 misalignment values fit with the observations. They result in slightly smaller error ellipses (larger SF) in the shallow tophole, compared to ISCWSA Rev5.



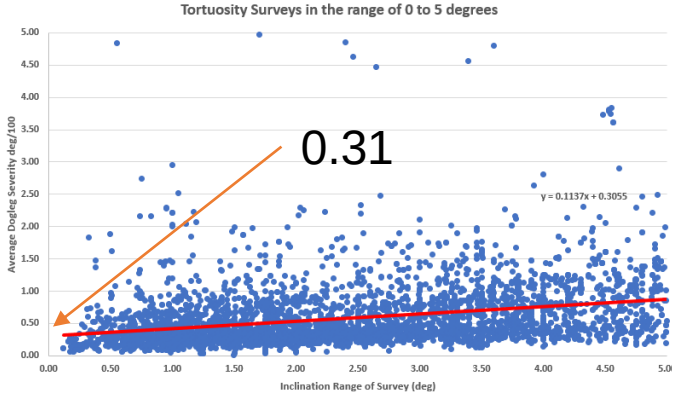
Plot showing the total single survey inclination error for the various models, as function of inclination

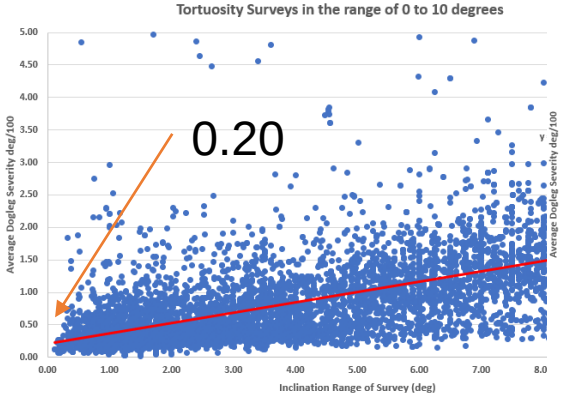
Inclination range (°)	Stddev/√2 (°)
0-10	0.15
10-20	0.18
20-30	0.17
30-40	0.15
40-50	0.14
50-60	0.13
60-70	0.14
70-80	0.14
80-90	0.13

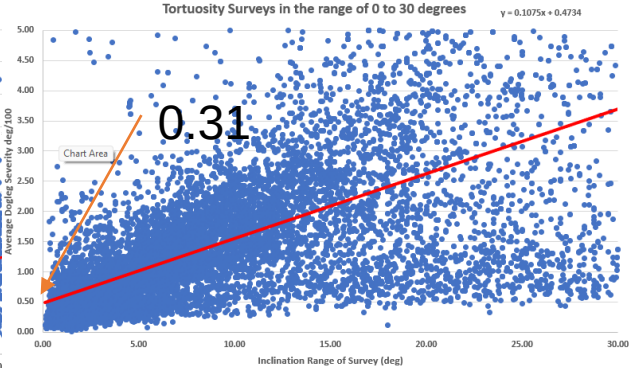
Observed inclination error per inclination range in line with proposed EQN Rev5 error terms

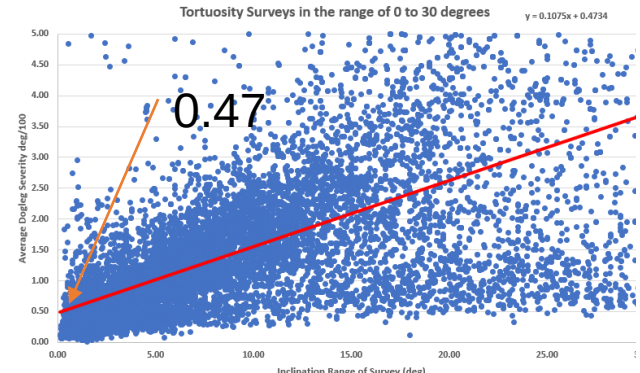
Tortuosity v. Inclination

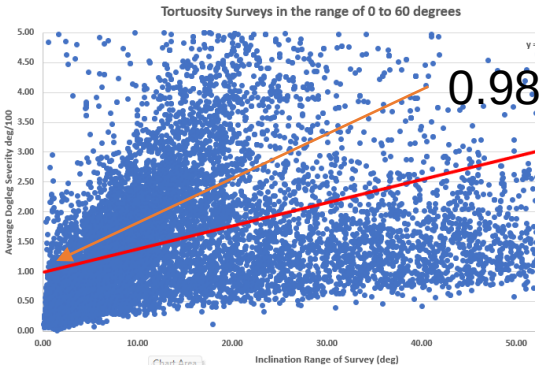
tort	n	n	-	0.00018	1.0
xcly	y	r	-	0.167	max(abs(din),tort*smd)
xclx	x	r	-	0.167	max(abs(sin(daz))*sin(inc),tort*smd)

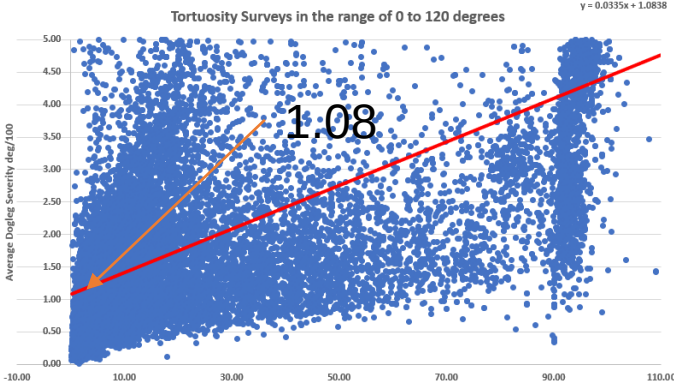












Topic 3: Utility Tool Code and Course Length

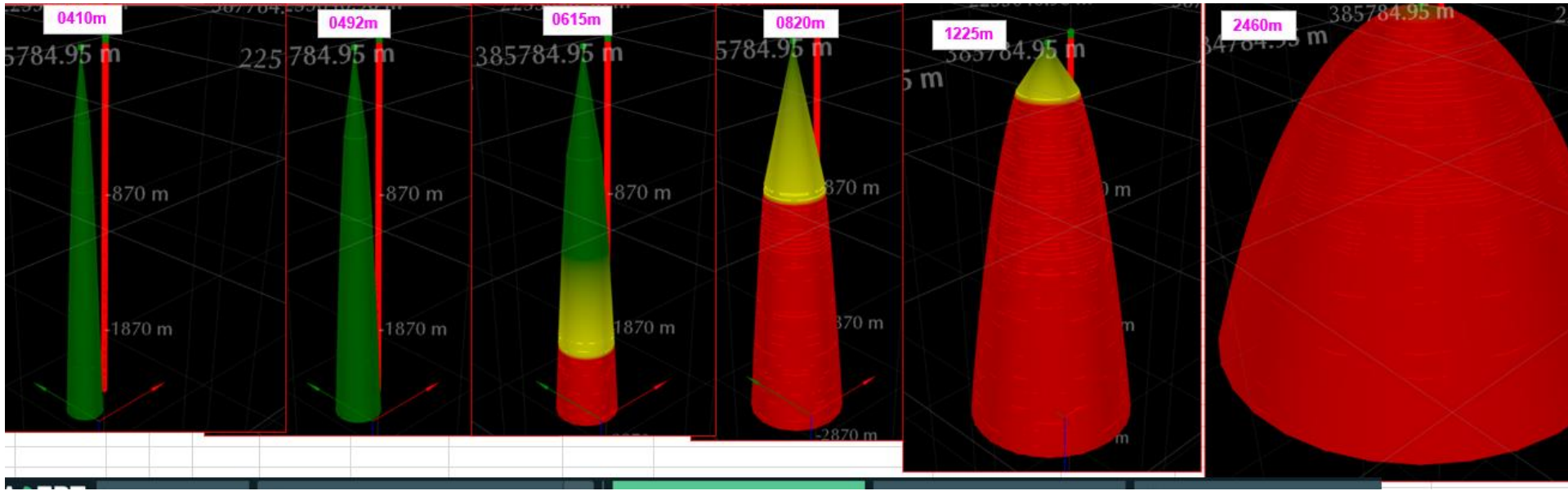
- Presentation from Hans Dresig

- Varying course length produces dramatically different Inc-only results
  - At times inc-only is more conservative than Blind!
  - No diagnostics for confirming utility tool code behavior
  - No guidance on when / how to use utility tool codes

- Broader conversation about use of “cone models”
  - Often done, often shared, but no guidance on creation and use
  - When is XCL appropriate, when should we switch to a utility?
    - Are there better/creative ways of handling these scenarios?

Topic 3: Utility Tool Code and Course Length

- Presentations from Hans Dresig
  - Varying course length produces dramatically different Inc-only results



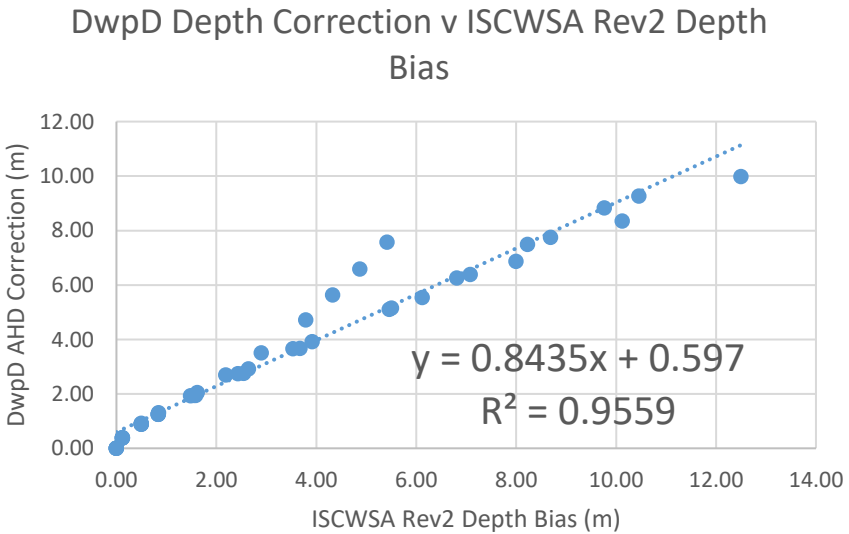
Topic 4: Depth and Depth Bias

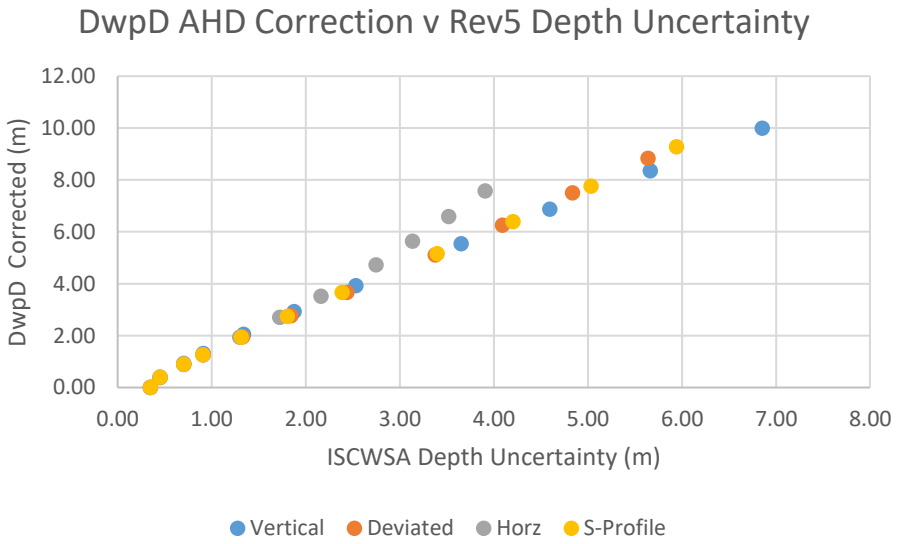
- Presentations from Andy McGregor and Harald Bolt

- Recurring requests (particularly from non-drillers) to include depth bias
  - Recent Revs of Error models have excluded this
  - Bias estimates appear reasonable when compared to corrections
  - Should we have this available as an option?

- Broader discussion around dynamic error model construction
  - Build your own Rev 5+bias

Topic 4: Depth and Depth Bias

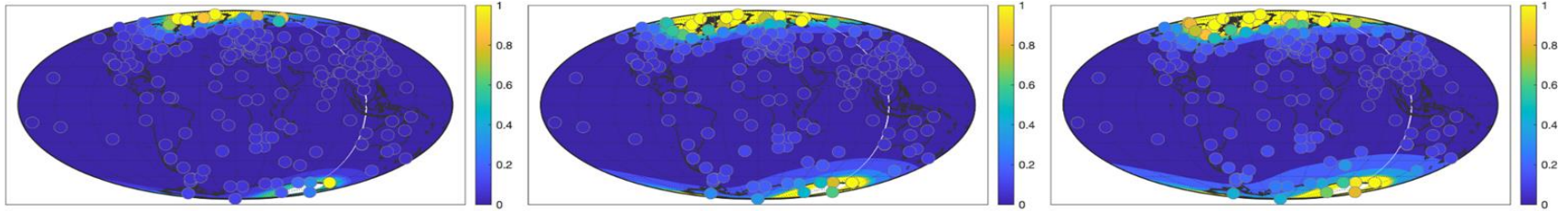




Topic 5: Geomagnetic Storms

- Presentations from Manoj Nair
- Approaching peak of Solar Cycle – Increasing geomagnetic activity
- NOAA has classification of solar events (K_p 0-9 or G 0 - 5)
- Looked at Historical data for K_p events vs. DECR term in Error Model
- Could provide this as a tool available to industry

Errors (1-sig) in Declination corresponding to G scales



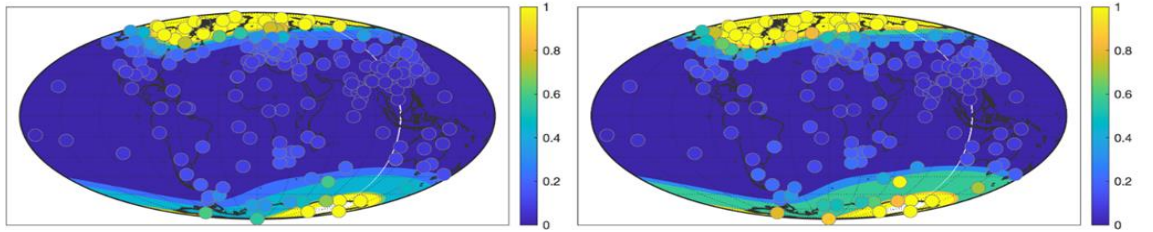
G0 (deg.)

G1 (deg.)

G2 (deg.)

G3

G4



(deg.)

(deg.)

Based on hourly geomagnetic data from 230 observatories 1960 - 2023.

Actions / Next Steps

New minimum tortuosity guidelines to be included in a Revision 6 proposal

Documents to be created for making Cone-based utility error models and adding depth bias terms to revision 5 error model

High-frequency survey providers to run analysis on downsampling vs. position

Workgroups to be formed

- Non-Static Survey Error Model
- Misalignment revision / Tortuosity review
- Utility error model usage / guidelines
- Dynamic Error Model Construction
- Email Marc.Willerth@hpinc.com if you are interested any of these!