ANDRILL 2006 SMS Mooring Velocity Profiles
Final Report

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Introduction

A current meter mooring was deployed on October 25, 2006 through the frozen surface ice of the Ross Sea in support of the ANtarctic geologic DRILLing (ANDRILL) project This report characterizes the horizontal currents at the 2006 ANDRILL SMS mooring site located in McMurdo Sound about 25 miles NNW of McMurdo Station. The details about the mooring deployment, the edited data, and the mooring design are can be found at http://www.whoi.edu/science/PO/ANDRILL_Mooring/. A schematic of the 2006 SMS mooring is shown below in Fig. 1.

The ANDRILL downward- looking ADCP velocity data at a depth of 25 -m were not good due to the formation of platelet ice surrounding the instrument during the deployment. The upward- looking ADCP located at a depth of 500 -m worked well, but this instrument had more instances of data dropouts than the AquaDopp current meters located at the intermediate depths. Therefore, in this report we will only use data acquired by the five5 AquaDopp current meters since these data were of high the best quality and covered the entire for the 42- day deployment.

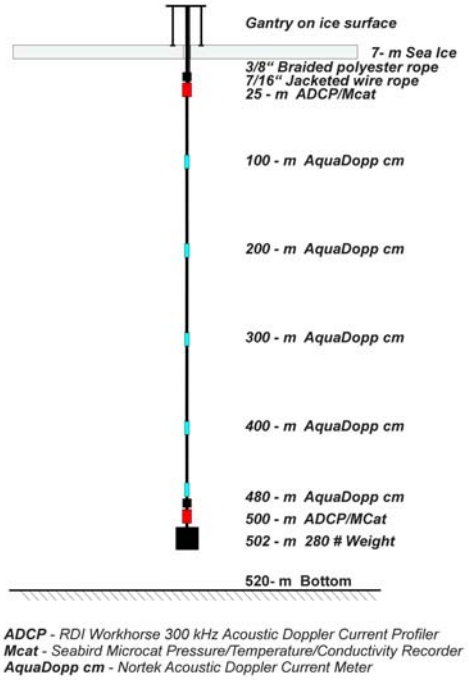

Fig. 1. ANDRILL 2006 SMS mooring design.

This report focuses on characterizing the strongest currents at the SMS site with the objective of ultimately using this data to design a drilling platform for coring the bottom sediments. We will provide two characteristic profiles of the ocean current at the SMS site, one profile from the data when the observed speed was a maximum and another profile from the data when the observed shear in the horizontal velocity was at a maximum. These two characteristic current profiles should provide adequate forcing to model the response of a drilling riser to the local forcing by the currents.

Maximum Speed Current

The first characteristic profile of the moored current in this report will be taken from the time when the measured speed was at a maximum at a depth of 300- m for about 4 hours on October 30, 2006 starting at about 0000z. In Fig. 2 the speed (top) and direction (bottom) with respect to true north from all five 5 AquaDopp current meters depths are shown for the entire deployment. Speeds above 40 cm/s were observed one time at a depth of 300 -m (green) and two other times for depths of 400 to 480 -m (blue and cyan). Generally the speed was bottom- intensified.

The variability in the Fig. 2 speed is primarily due to the tidal current, but there were times when the tidal current was less dominant such as on November 17-19, 2006 when the currents were toward the northwest at all levels and December 1-3, 2006 when the currents were generally toward the south at all levels.

Fig. ure 3 shows the speed at a depth of 300 -m for the entire deployment period (top), the speed for 36 hours centered on the time of the maximum speed measured for the deployment (middle), and the speeds of all the AquaDopps at the five current meter depths levels for 3 hours during the time of maximum speed. The October 29, 2007 maximum speed of over 40 cm/s at 300 -m lasted for about 4 hours and appears to be decorrelated from the currents at 200 -m and 400 -m. However, the speeds at depths of

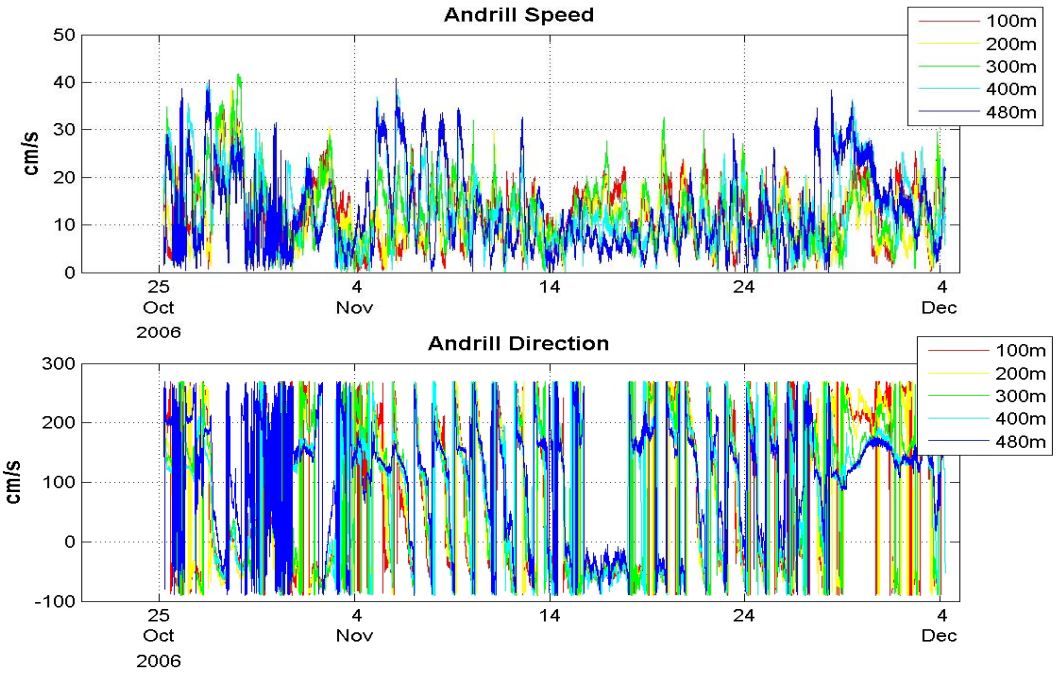

Fig. 2. Speed (top) and the direction the current flows toward with respect to true north (bottom) at the five AquaDopp current meter depths for the entire deployment period.

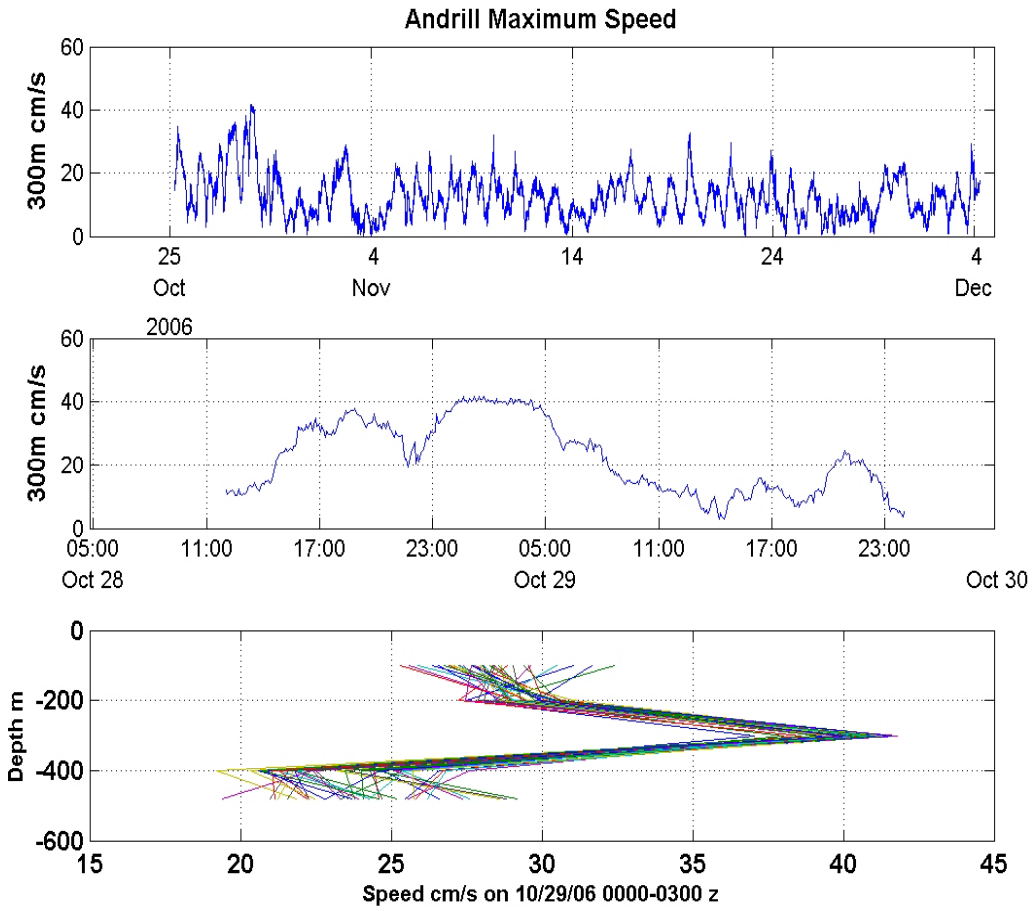

Fig. 3. Speed at a depth of 300 -m for the entire record (top), speed for 36 hours at 300 -m at the time of maximum speed (middle), and speed from all five depth levels at the time of maximum speed (bottom).

100--200 -m were greater than 25 cm/s and the speeds at 400-480 -m were greater than 20 cm/s.

Table 1 gives the east velocity, north velocity, speed and direction (with respect to true north) of the currents at the five depth levels at the time of maximum measured speed at a depth o0f 300 -m.

Depth m	East cm/s	North cm/s	Speed cm/s	Dir wrt North
100	-12.73	22.21	25.60	-29.82
200	-22.54	18.45	29.13	-50.70
300	-27.25	31.68	41.79	-40.70
400	-13.12	17.41	21.80	-37.00
480	11.05	21.23	23.93	27.51

Table 1. East velocity, north velocity, speed and direction (with respect to true north) for the current at the 5 AquaDopp depth levels during the time of maximum measured speed October 29, 2006 at 0127z.

Maximum Shear

Next we will characterize the currents by focusing on the times when the current shear is a maximum. The A complex velocity w is defined as

$$w=u+i*v,$$

where u is the east velocity, v is the north velocity and $i = \sqrt{-1}$. The complex shear is $d\Delta w/d\Delta z$ where Δw is the difference in w between two current meters and Δz is the vertical instrument separation. Fig. ure 4 (top) shows the shear from all instruments for the entire record. Note that there were two 2 times when the shear was greater than 0.006 $/sec^{-1}$. The first instance was on October 27, 2006 at 1457z and is shown in Fig. 4 (middle) at a depth between 400 -m and 480 -m. The shear angle shown in Fig. 4 (bottom) indicates there is little shear in the current speed, but the current direction changes more than 100° between at 400- m and 480- m.

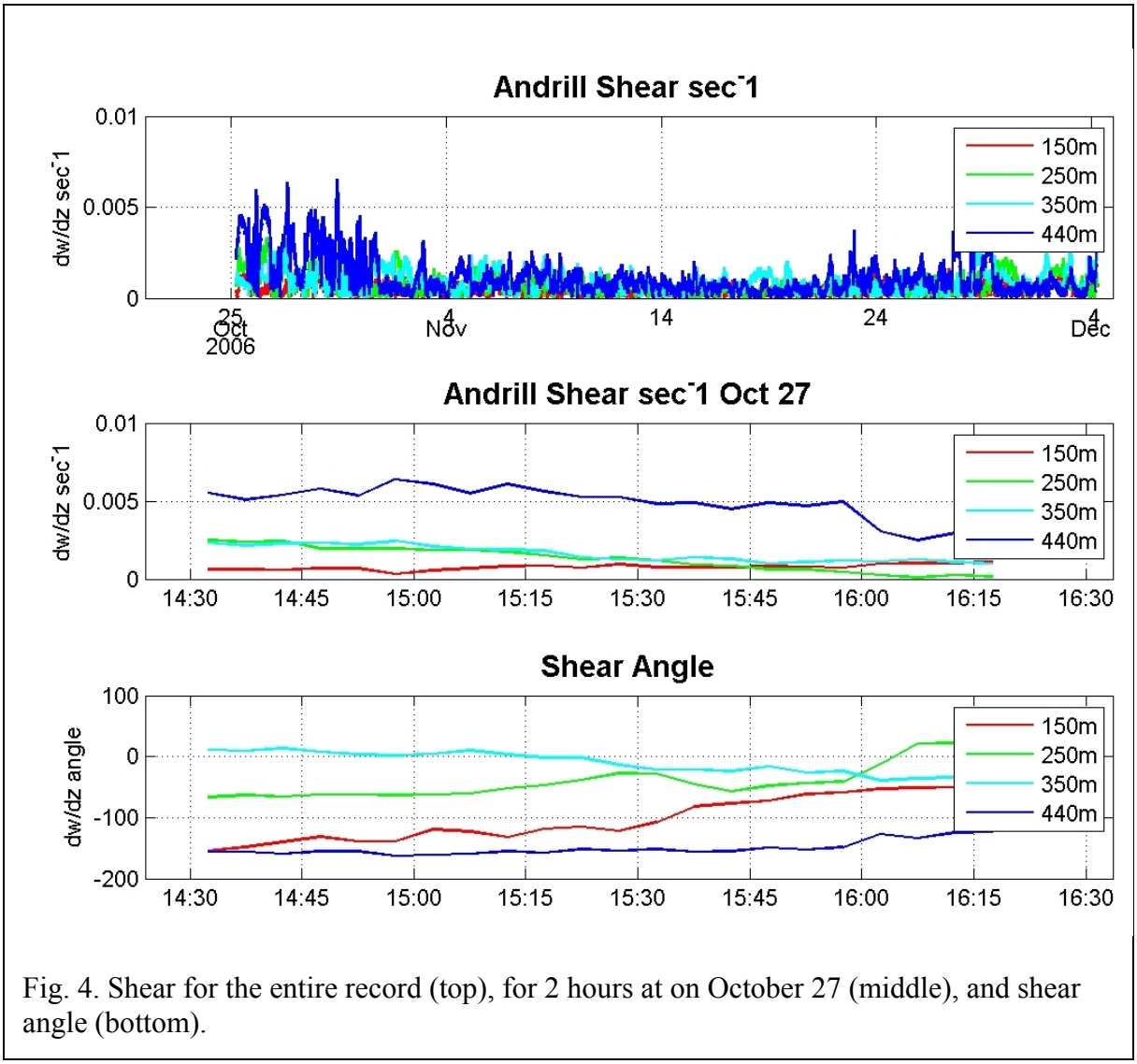

Fig. 4. Shear for the entire record (top), for 2 hours at on October 27 (middle), and shear angle (bottom).

Table 2 below gives the east velocity, north velocity, speed and direction (with respect to true north) of the currents at the five depth levels at the time of maximum measured shear on October 27, 2006 at 1457 z between 400 -m and 480 -m.

Depth m	East cm/s	North cm/s	Speed	Direction
100	1.57	5.56	5.78	15.73
200	-0.87	3.48	3.58	-14.01
300	7.91	-13.82	15.93	150.21
400	32.23	-13.03	34.76	112.01
480	-16.58	-28.02	32.55	210.61

Table 2. East velocity, north velocity, speed and direction (with respect to true north) of the currents at the five depth levels at the time of maximum measured shear on October 27, 2006 at 1457 z between 400- m and 480- m

Appendix 1 - Maximum speed profile interpolated every 10 m with a cubic spline.

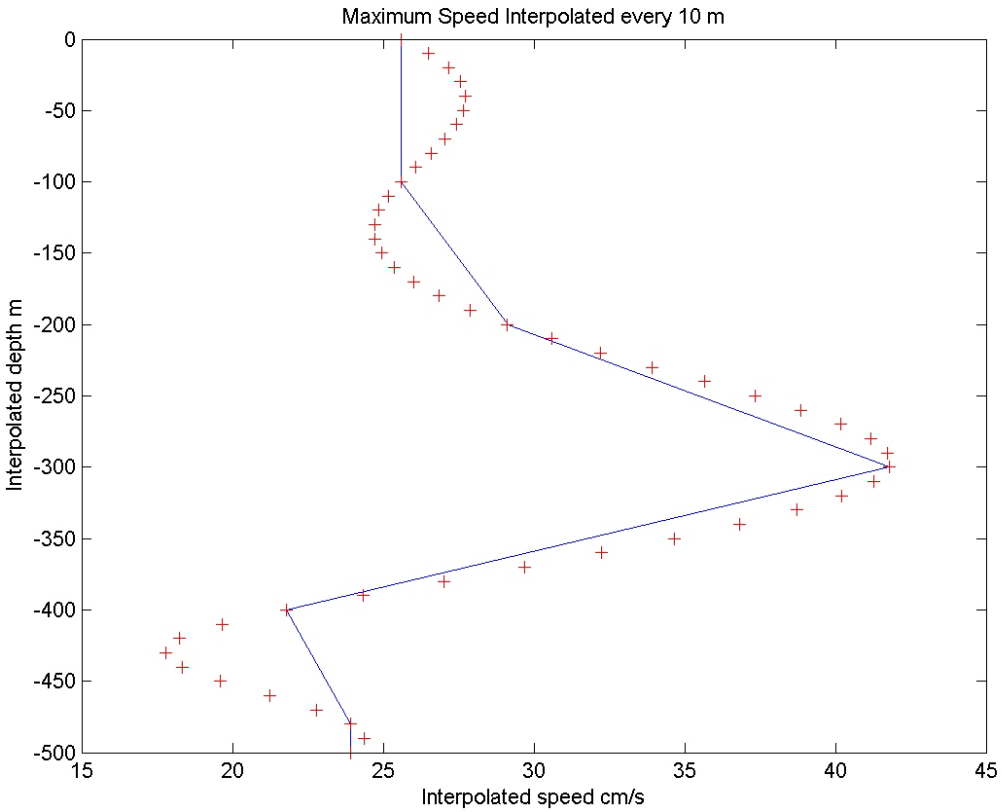

Fig. 5. Maximum speed profile interpolated every 10 m with a cubic spline.

Max speed interpolated data

Depth mM	East cm/s	North cm/s	Speed cm/s	Direction wrt north
0	-12.73	22.21	25.60	-29.82
-10.00	-11.83	23.71	26.50	-26.52
-20.00	-11.18	24.76	27.16	-24.30
-30.00	-10.75	25.39	27.57	-22.95
-40.00	-10.53	25.65	27.73	-22.32
-50.00	-10.51	25.60	27.67	-22.31
-60.00	-10.66	25.28	27.44	-22.86
-70.00	-10.97	24.73	27.06	-23.93
-80.00	-11.43	24.01	26.59	-25.47
-90.00	-12.03	23.15	26.09	-27.45
-100.00	-12.73	22.21	25.60	-29.82
-110.00	-13.53	21.23	25.18	-32.51
-120.00	-14.42	20.26	24.87	-35.43
-130.00	-15.37	19.35	24.71	-38.46
-140.00	-16.37	18.54	24.73	-41.45
-150.00	-17.41	17.88	24.95	-44.23
-160.00	-18.46	17.41	25.38	-46.67
-170.00	-19.52	17.19	26.01	-48.63
-180.00	-20.56	17.26	26.84	-49.99
-190.00	-21.57	17.66	27.88	-50.69
-200.00	-22.54	18.45	29.13	-50.70
-210.00	-23.45	19.64	30.59	-50.05
-220.00	-24.28	21.15	32.21	-48.94
-230.00	-25.04	22.88	33.92	-47.58
-240.00	-25.70	24.70	35.65	-46.14
-250.00	-26.27	26.52	37.33	-44.73
-260.00	-26.72	28.22	38.87	-43.44
-270.00	-27.06	29.70	40.18	-42.34
-280.00	-27.26	30.84	41.16	-41.48
-290.00	-27.33	31.54	41.73	-40.91
-300.00	-27.25	31.68	41.79	-40.70
-310.00	-27.01	31.20	41.26	-40.88
-320.00	-26.58	30.18	40.21	-41.37
-330.00	-25.93	28.74	38.71	-42.06
-340.00	-25.05	27.01	36.84	-42.84
-350.00	-23.90	25.11	34.66	-43.58
-360.00	-22.45	23.17	32.26	-44.09
-370.00	-20.67	21.30	29.68	-44.14
-380.00	-18.54	19.64	27.01	-43.36
-390.00	-16.04	18.30	24.33	-41.23
-400.00	-13.12	17.41	21.80	-37.00

-410.00	**-9.80**	**17.05**	**19.67**	**-29.89**
-420.00	**-6.22**	**17.16**	**18.25**	**-19.94**
-430.00	**-2.56**	**17.61**	**17.80**	**-8.26**
-440.00	**1.03**	**18.30**	**18.33**	**3.21**
-450.00	**4.35**	**19.12**	**19.61**	**12.82**
-460.00	**7.25**	**19.96**	**21.23**	**19.96**
-470.00	**9.54**	**20.70**	**22.79**	**24.74**
-480.00	**11.05**	**21.23**	**23.93**	**27.50**
-490.00	**11.61**	**21.44**	**24.39**	**28.43**
-500.00	**11.05**	**21.23**	**23.93**	**27.50**

Appendix 2 - Maximum shear October 27, 2006 - current profile interpolated every 10 m with cubic spline

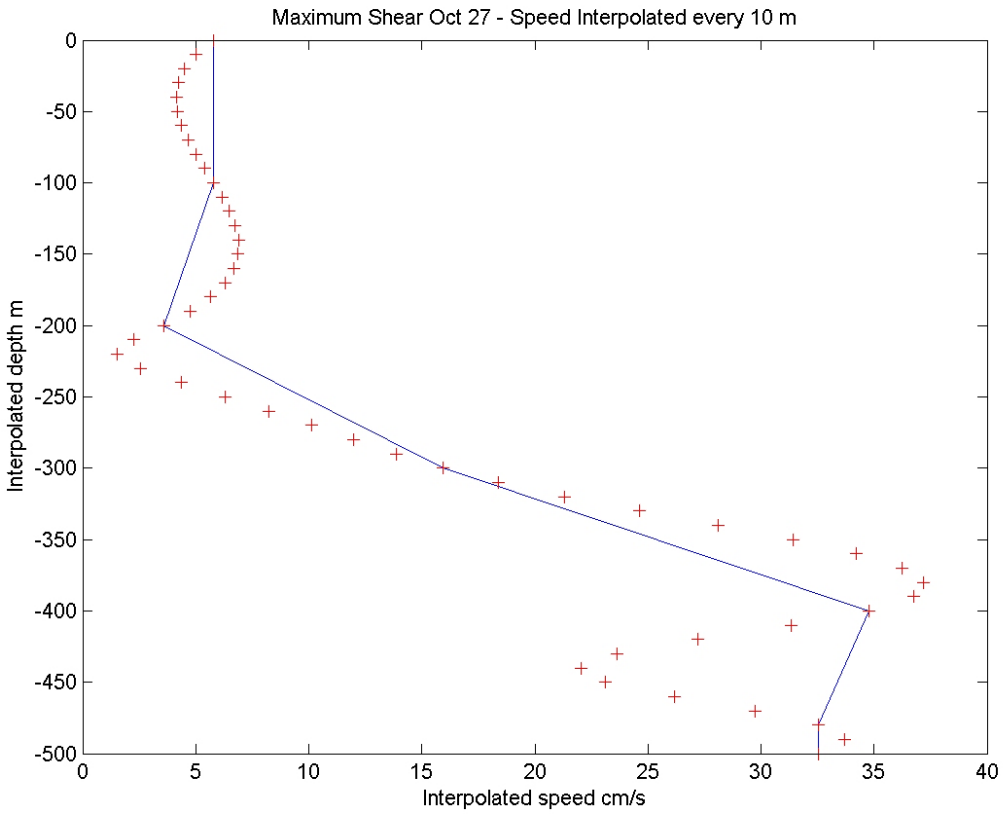

Fig. 6. Maximum shear October 27, 2006 - current profile interpolated every 10 m with cubic spline

Depth mM	East cm/s	North cm/s	Speed cm/s	Direction wrt north
0	1.57	5.56	5.78	15.77
-10.00	1.69	4.71	5.00	19.76
-20.00	1.79	4.14	4.51	23.35
-30.00	1.85	3.81	4.23	25.94
-40.00	1.89	3.69	4.15	27.13
-50.00	1.90	3.75	4.20	26.89
-60.00	1.89	3.95	4.38	25.51
-70.00	1.85	4.27	4.65	23.37
-80.00	1.78	4.67	4.99	20.87
-90.00	1.69	5.11	5.38	18.28
-100.00	1.57	5.56	5.78	15.77
-110.00	1.43	5.99	6.16	13.41
-120.00	1.26	6.37	6.49	11.22
-130.00	1.07	6.66	6.75	9.16
-140.00	0.86	6.83	6.89	7.20
-150.00	0.63	6.85	6.88	5.24
-160.00	0.37	6.68	6.69	3.18
-170.00	0.09	6.29	6.29	0.84
-180.00	-0.21	5.65	5.66	-2.10
-190.00	-0.53	4.73	4.76	-6.38
-200.00	-0.87	3.48	3.59	-14.04
-210.00	-1.22	1.90	2.26	-32.64
-220.00	-1.51	0.06	1.51	-87.76
-230.00	-1.66	-1.96	2.57	220.17
-240.00	-1.59	-4.08	4.37	201.27
-250.00	-1.22	-6.19	6.31	191.12
-260.00	-0.47	-8.23	8.24	183.26
-270.00	0.74	-10.10	10.12	175.82
-280.00	2.48	-11.71	11.97	168.03
-290.00	4.85	-12.98	13.86	159.52
-300.00	7.91	-13.82	15.92	150.21
-310.00	11.69	-14.18	18.37	140.50
-320.00	15.95	-14.13	21.31	131.55
-330.00	20.40	-13.80	24.63	124.08
-340.00	24.75	-13.30	28.10	118.25
-350.00	28.71	-12.74	31.40	113.92
-360.00	31.97	-12.23	34.23	110.93
-370.00	34.25	-11.89	36.25	109.15
-380.00	35.24	-11.83	37.18	108.56
-390.00	34.67	-12.18	36.75	109.35
-400.00	32.23	-13.03	34.76	112.01
-410.00	27.77	-14.46	31.31	117.51
-420.00	21.72	-16.36	27.19	126.98

-430.00	**14.63**	**-18.54**	**23.62**	**141.72**
-440.00	**7.08**	**-20.85**	**22.02**	**161.26**
-450.00	**-0.39**	**-23.12**	**23.13**	**180.96**
-460.00	**-7.19**	**-25.19**	**26.19**	**195.94**
-470.00	**-12.78**	**-26.87**	**29.76**	**205.43**
-480.00	**-16.58**	**-28.02**	**32.56**	**210.61**
-490.00	**-18.04**	**-28.46**	**33.69**	**212.36**
-500.00	**-16.58**	**-28.02**	**32.56**	**210.61**