REPORT FOR HYPERSPECTRAL ATMOSPHERIC CORRECTION

L40925 SYKE HySpex
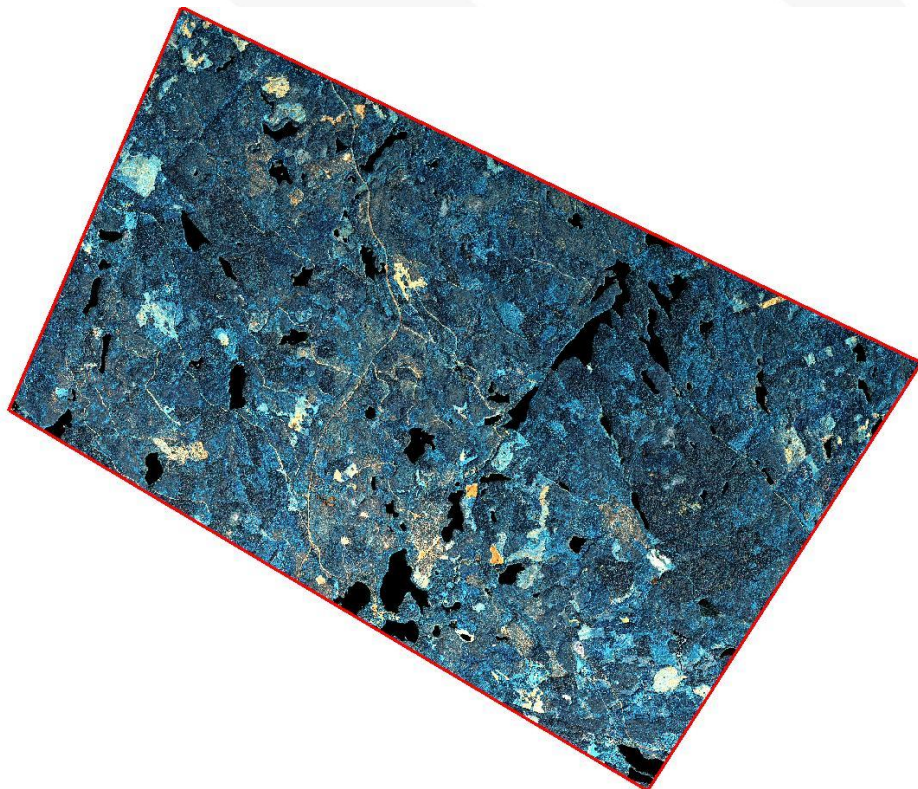

terratec

TABLE OF CONTENTS

Report prepared,

Oslo, Norway, 08.02.2019

Vetle Jonassen
Project manager

1 GENERAL PROJECT INFORMATION

1.1 Client

Name:	Blom Kartta OY
Address:	Esterinportti 2, 00240 Helsinki, Finland
Project manager:	Lasse Turunen
Project reference:	18068_AP

1.2 Project

Name:	SYKE HySpex
County:	Finland

1.3 Contractor

Name:	TerraTec AS
Address:	Vækerøveien 3, 0281 Oslo
Project manager:	Vetle Jonassen
Project reference:	10640

1.4 Project Content

The project included georeferenced and orthorectified atmospherically corrected hyperspectral image cubes with a resolution of 0.5 meters for the HySpex VNIR-1800 sensor and 1 meter for the HySpex SWIR-384 sensor. Ordered area to be atmospherically corrected was a total of 82.94 km^2. The atmospheric correction was specified to be done in the software ATCOR-4 from ReSe LLC.

1.5 Quality Checks

The delivery was based on a previously quality checked data capture. Please see original project report of Terratec project 8739 for details on the data capture and processing quality checks.

Quality checks on the resulting georeferencing and different spectra were carried out after atmospheric correction.

2 CALIBRATION

2.1 Factory Sensor Calibration

Calibration parameters of the hyperspectral sensors are given by Norsk Elektro Optikk AS. The calibration report and system parameter set were delivered along with the sensor. Factory calibration was also performed after repairs/upgrades and periodically according to service and maintenance plan.

An atmospheric correction is highly dependent on correct sensor calibrations, and thus the instrument spectral accuracy should not be underestimated.

2.2 Spectral Misregistration Calibration in ATCOR-4

Calibration of the sensor spectral misregistration (smile) effect was done in ATCOR-4 with a polynomial fit. This effect was generally low for the HySpex systems and thus the calibration for this in ATCOR-4 was also low. The polynomial coefficients applied to each band are found in Appendix B.

3 PROCESSING

3.1 Software

The software used for data processing and their functionality are listed in the table below:

Software/version	Provider	Function
ATCOR-4 7.3	ReSe	Atmospheric correction
Parge 3.4	ReSe	Mosaic generation
ENVI 5.5	Harris Geospatial Solutions	Tiling, file conversion and quality check

3.2 Atmospheric Correction of Hyperspectral Image Cubes

3.2.1 Background

The atmospheric correction of hyperspectral data through ATCOR-4 aimed to remove artefacts which contributed to reduced signal from the observed object. The result was a scale in percentage showing reflected light from the sun at the specified flight time under the specific light conditions at the time of data collection over the imaged object.

3.2.2 Limitations

The atmospheric correction which was done did not account for bidirectional reflectance distribution (BRDF) or shadows, and thus the results can best be described as atmospherically corrected radiance spectra. The following spectral bands were interpolated due to the great influence of water or oxygen absorption in the atmosphere, resulting in very low to no signal from the ground in these intervals:

720 nm
895 nm – 1000 nm
1081 nm – 1191 nm
1332 nm – 1469 nm
1780 nm – 2021 nm

3.2.3 Quality Assessment of Spectral Misregistration Calibration

A highly accurate calibration is needed to successfully derive an atmospherically corrected spectrum from hyperspectral data. Thus, in addition to the original laboratory calibrations from the camera manufacturer, an additional spectral misregistration detection and correction is done within the ATCOR-4 software. This leads to a small shift in band wavelengths as specified in Appendix B.

The accuracy of the acquired signal is neither constant in the spatial nor spectral direction of the image cube. Thus, the VNIR sensor is most accurate in the lower wavelengths, while the SWIR sensor is most accurate in the middle bands. This, combined with generally low to no signal from the higher wavelengths in the SWIR spectrum, leads to poor signal-to-noise levels over band 274, leading them to be masked out in the atmospheric correction.

3.2.4 Spectral Polishing

The SWIR spectrum was spectrally polished after finished atmospheric correction as recommended as standard processing procedure with the use of the ATCOR-4 software. This is due to noise becoming a proportionally higher part of the signal in dark bands near distinct atmospheric absorption features, such as water vapor. The polishing was done with a neighbor derivative over a total of seven bands, i.e. three on each side of the respective bands.

This additional spectral polishing was not carried out for the VNIR part of the spectrum as this part is less influenced by atmospheric absorption features.

3.3 Mosaicking and Tiling

The resulting hyperspectral data cubes were mosaicked using bilinear interpolation. Further, the mosaics were then tiled into 500 x 500-meter tiles for easier data handling.

4 DELIVERY

4.1 Delivery Content

The hyperspectral data tiles follow the naming:
*Sensor*_R*Tile_row_number*C*Tile_column_number*.tif

File format	Description
#.tif	Georeferenced, orthorectified and atmospherically corrected hyperspectral data
#.shp, #.shx, #.dbf, #.prj	Overview of the data tile borders
#.txt	Additional metadata file containing wavelengths after smile correction

All files have been compressed to zip format.

4.2 Tiling, Naming and File Storage

Delivery files have been mosaicked and tiled in TIFF format for each of the HySpex SWIR and VNIR data sets. Band wavelength information is not a defined header tag in the requested TIFF format used in this delivery. However, the wavelengths of the ascending bands can be found in the Appendix or in the TXT files.

Data has been shipped from Oslo, Norway to client on an external hard drive 08.02.2019.

APPENDIX

Following are new calculated wavelengths and coefficients for correction of the spectral misregistration effect in the HySpex VNIR and SWIR cameras.

VNIR Polynomial Spectral Misregistration Correction:

Band	Wavelength (nm)	Polynomial coefficients				
		b0	b1	b2	b3	b4
1	401.32798	-0.004437745	-7.02E-05	2.96E-07	-3.48E-10	1.20E-13
2	404.51794	-0.004428685	-7.02E-05	2.96E-07	-3.48E-10	1.20E-13
3	407.70793	-0.004420341	-7.02E-05	2.96E-07	-3.48E-10	1.20E-13
4	410.88798	-0.004446328	-7.02E-05	2.96E-07	-3.48E-10	1.20E-13
5	414.07798	-0.004437984	-7.02E-05	2.96E-07	-3.48E-10	1.20E-13
6	417.25797	-0.004433454	-7.02E-05	2.96E-07	-3.48E-10	1.20E-13
7	420.418	0.000521702	-9.86E-05	3.42E-07	-3.76E-10	1.26E-13
8	423.54158	0.01148554	-0.000161568	4.46E-07	-4.40E-10	1.39E-13
9	426.65531	0.022441579	-0.000224385	5.49E-07	-5.04E-10	1.52E-13
10	429.77883	0.033435824	-0.0002874	6.53E-07	-5.68E-10	1.65E-13
11	432.90232	0.044430665	-0.000350414	7.57E-07	-6.32E-10	1.78E-13
12	436.01607	0.055385982	-0.000413231	8.60E-07	-6.96E-10	1.90E-13
13	439.13962	0.066350451	-0.000476246	9.64E-07	-7.60E-10	2.03E-13
14	442.25334	0.077306363	-0.000539063	1.07E-06	-8.24E-10	2.16E-13
15	445.37686	0.088300701	-0.000602078	1.17E-06	-8.88E-10	2.29E-13
16	448.50038	0.099294906	-0.000665093	1.27E-06	-9.52E-10	2.42E-13
17	451.61417	0.11022051	-0.00072791	1.38E-06	-1.02E-09	2.55E-13
18	454.73766	0.12121536	-0.000790925	1.48E-06	-1.08E-09	2.68E-13
19	457.85138	0.13217131	-0.000853742	1.59E-06	-1.14E-09	2.81E-13
20	460.9749	0.14316542	-0.000916757	1.69E-06	-1.21E-09	2.94E-13
21	464.09848	0.15412927	-0.000979772	1.79E-06	-1.27E-09	3.07E-13
22	467.2122	0.16508532	-0.001042589	1.90E-06	-1.34E-09	3.20E-13
23	470.33569	0.17608012	-0.001105603	2.00E-06	-1.40E-09	3.33E-13
24	473.44942	0.18703612	-0.00116842	2.10E-06	-1.46E-09	3.46E-13
25	476.68215	0.1522353	-0.00095267	1.72E-06	-1.19E-09	2.82E-13
26	479.94989	0.10274911	-0.000647713	1.17E-06	-8.16E-10	1.93E-13
27	483.20732	0.053445419	-0.000343715	6.27E-07	-4.40E-10	1.04E-13
28	486.47497	0.003991412	-3.88E-05	8.21E-08	-6.24E-11	1.58E-14
29	489.73243	-0.04531352	0.000265236	-4.61E-07	3.14E-10	-7.26E-14
30	493.00014	-0.094798569	0.000570191	-1.01E-06	6.91E-10	-1.61E-13
31	496.26782	-0.14425358	0.000875145	-1.55E-06	1.07E-09	-2.50E-13
32	499.52522	-0.19355631	0.00117914	-2.09E-06	1.44E-09	-3.38E-13
33	502.79293	-0.2430127	0.001484097	-2.64E-06	1.82E-09	-4.27E-13
34	506.05033	-0.2923151	0.001788092	-3.18E-06	2.20E-09	-5.16E-13
35	509.3181	-0.34180256	0.002093052	-3.73E-06	2.57E-09	-6.04E-13
36	512.58581	-0.39128732	0.002398006	-4.27E-06	2.95E-09	-6.93E-13
37	515.77856	-0.37175868	0.002287373	-4.08E-06	2.82E-09	-6.62E-13

38	518.9469	-0.31549369	0.00195504	-3.49E-06	2.41E-09	-5.67E-13
39	522.10518	-0.25934959	0.001623756	-2.90E-06	2.00E-09	-4.72E-13
40	525.27358	-0.203085	0.001291416	-2.31E-06	1.60E-09	-3.77E-13
41	528.44192	-0.14682029	0.000959083	-1.72E-06	1.19E-09	-2.82E-13
42	531.60026	-0.090676391	0.000627793	-1.13E-06	7.85E-10	-1.88E-13
43	534.7686	-0.03441155	0.00029546	-5.43E-07	3.78E-10	-9.26E-14
44	537.93682	0.021913195	-3.69E-05	4.70E-08	-2.93E-11	2.41E-15
45	541.09529	0.077997221	-0.000368163	6.35E-07	-4.35E-10	9.71E-14
46	544.26363	0.13426204	-0.000700496	1.23E-06	-8.42E-10	1.92E-13
47	547.42197	0.19040584	-0.001031786	1.81E-06	-1.25E-09	2.87E-13
48	550.59031	0.24667092	-0.001364119	2.40E-06	-1.66E-09	3.82E-13
49	553.75865	0.30293562	-0.001696452	2.99E-06	-2.06E-09	4.77E-13
50	556.91699	0.35907962	-0.002027743	3.58E-06	-2.47E-09	5.71E-13
51	560.08533	0.41534424	-0.002360076	4.17E-06	-2.88E-09	6.66E-13
52	563.24367	0.47148826	-0.002691366	4.76E-06	-3.28E-09	7.61E-13
53	566.41201	0.52775338	-0.003023699	5.35E-06	-3.69E-09	8.56E-13
54	569.58036	0.58401829	-0.003356032	5.94E-06	-4.09E-09	9.51E-13
55	572.7387	0.64016162	-0.003687322	6.53E-06	-4.50E-09	1.05E-12
56	575.95084	0.65094479	-0.003766562	6.73E-06	-4.68E-09	1.10E-12
57	579.20715	0.60536121	-0.00353176	6.44E-06	-4.58E-09	1.10E-12
58	582.47376	0.55957675	-0.003296219	6.16E-06	-4.48E-09	1.09E-12
59	585.74038	0.5137933	-0.003060678	5.87E-06	-4.39E-09	1.09E-12
60	588.99668	0.46820892	-0.002825876	5.59E-06	-4.29E-09	1.09E-12
61	592.2633	0.42242526	-0.002590335	5.31E-06	-4.19E-09	1.09E-12
62	595.51961	0.37684137	-0.002355533	5.02E-06	-4.09E-09	1.09E-12
63	598.78622	0.33105764	-0.002119992	4.74E-06	-3.99E-09	1.08E-12
64	602.05284	0.28527388	-0.001884451	4.46E-06	-3.89E-09	1.08E-12
65	605.30915	0.23968961	-0.001649649	4.17E-06	-3.79E-09	1.08E-12
66	608.57576	0.19390579	-0.001414108	3.89E-06	-3.69E-09	1.08E-12
67	611.83207	0.14832142	-0.001179306	3.60E-06	-3.60E-09	1.08E-12
68	615.09868	0.10253796	-0.000943765	3.32E-06	-3.50E-09	1.07E-12
69	618.3653	0.056754083	-0.000708224	3.04E-06	-3.40E-09	1.07E-12
70	621.62161	0.011169714	-0.000473422	2.75E-06	-3.30E-09	1.07E-12
71	624.88822	-0.03461411	-0.000237881	2.47E-06	-3.20E-09	1.07E-12
72	628.14465	-0.080260304	-3.07E-06	2.18E-06	-3.10E-09	1.07E-12
73	631.41115	-0.1259821	0.000232462	1.90E-06	-3.00E-09	1.06E-12
74	634.67782	-0.17176798	0.000468008	1.62E-06	-2.90E-09	1.06E-12
75	637.93407	-0.21734968	0.000702805	1.33E-06	-2.81E-09	1.06E-12
76	641.20068	-0.26313364	0.000938346	1.05E-06	-2.71E-09	1.06E-12
77	644.46736	-0.30891948	0.001173892	7.63E-07	-2.61E-09	1.06E-12
78	647.72361	-0.35450176	0.001408689	4.79E-07	-2.51E-09	1.05E-12
79	650.99029	-0.40028769	0.001644235	1.95E-07	-2.41E-09	1.05E-12
80	654.24665	-0.44593118	0.001879036	-8.83E-08	-2.31E-09	1.05E-12
81	657.51315	-0.49165339	0.002114573	-3.73E-07	-2.21E-09	1.05E-12
82	660.77982	-0.53743919	0.002350119	-6.57E-07	-2.11E-09	1.05E-12
83	664.03607	-0.5830211	0.002584916	-9.40E-07	-2.01E-09	1.04E-12

84	667.30275	-0.62880705	0.002820462	-1.22E-06	-1.92E-09	1.04E-12
85	670.55912	-0.67445119	0.003055263	-1.51E-06	-1.82E-09	1.04E-12
86	673.82561	-0.72017266	0.0032908	-1.79E-06	-1.72E-09	1.04E-12
87	677.07034	-0.75639351	0.003481639	-2.04E-06	-1.61E-09	1.03E-12
88	680.1742	-0.73556455	0.003406045	-2.09E-06	-1.45E-09	9.62E-13
89	683.28802	-0.71472781	0.003330209	-2.13E-06	-1.29E-09	8.97E-13
90	686.39201	-0.6939592	0.003254613	-2.18E-06	-1.13E-09	8.32E-13
91	689.5057	-0.67306163	0.003178779	-2.22E-06	-9.71E-10	7.67E-13
92	692.61945	-0.65222397	0.003102945	-2.27E-06	-8.11E-10	7.02E-13
93	695.72332	-0.63139466	0.00302735	-2.31E-06	-6.51E-10	6.37E-13
94	698.83713	-0.61055787	0.002951515	-2.36E-06	-4.91E-10	5.71E-13
95	701.94112	-0.58978935	0.002875919	-2.40E-06	-3.31E-10	5.06E-13
96	705.05481	-0.56889178	0.002800085	-2.44E-06	-1.71E-10	4.41E-13
97	708.16857	-0.54805402	0.002724251	-2.49E-06	-1.07E-11	3.76E-13
98	711.27255	-0.52728533	0.002648655	-2.53E-06	1.49E-10	3.11E-13
99	714.38625	-0.50638785	0.002572821	-2.58E-06	3.09E-10	2.45E-13
100	717.49023	-0.48561937	0.002497225	-2.62E-06	4.69E-10	1.80E-13
101	720.60393	-0.46472185	0.002421391	-2.67E-06	6.29E-10	1.15E-13
102	723.71768	-0.44388417	0.002345557	-2.71E-06	7.89E-10	4.97E-14
103	726.82167	-0.42311575	0.002269961	-2.76E-06	9.49E-10	-1.54E-14
104	729.93536	-0.40221815	0.002194127	-2.80E-06	1.11E-09	-8.07E-14
105	733.03935	-0.38144976	0.002118531	-2.85E-06	1.27E-09	-1.46E-13
106	736.15304	-0.36055219	0.002042697	-2.89E-06	1.43E-09	-2.11E-13
107	739.26679	-0.33971455	0.001966863	-2.94E-06	1.59E-09	-2.76E-13
108	742.37084	-0.31894675	0.001891265	-2.98E-06	1.75E-09	-3.41E-13
109	745.48447	-0.2980483	0.001815433	-3.02E-06	1.91E-09	-4.07E-13
110	748.59823	-0.27721051	0.001739599	-3.07E-06	2.07E-09	-4.72E-13
111	751.70227	-0.25644311	0.001664001	-3.11E-06	2.23E-09	-5.37E-13
112	754.87181	-0.25218088	0.001649424	-3.15E-06	2.30E-09	-5.64E-13
113	758.07366	-0.26051805	0.001680989	-3.18E-06	2.31E-09	-5.63E-13
114	761.2854	-0.26881505	0.001712652	-3.21E-06	2.31E-09	-5.61E-13
115	764.49726	-0.27717298	0.001744316	-3.24E-06	2.32E-09	-5.60E-13
116	767.69911	-0.28551018	0.001775881	-3.27E-06	2.32E-09	-5.58E-13
117	770.91085	-0.29380692	0.001807545	-3.30E-06	2.33E-09	-5.57E-13
118	774.1127	-0.30214438	0.00183911	-3.33E-06	2.34E-09	-5.55E-13
119	777.32444	-0.31044102	0.001870773	-3.36E-06	2.34E-09	-5.54E-13
120	780.5363	-0.31879905	0.001902437	-3.38E-06	2.35E-09	-5.52E-13
121	783.73816	-0.32713637	0.001934003	-3.41E-06	2.35E-09	-5.51E-13
122	786.94989	-0.33543301	0.001965666	-3.44E-06	2.36E-09	-5.49E-13
123	790.15175	-0.34377031	0.001997231	-3.47E-06	2.36E-09	-5.48E-13
124	793.36361	-0.35212824	0.002028895	-3.50E-06	2.37E-09	-5.46E-13
125	796.57535	-0.36042525	0.002060559	-3.53E-06	2.37E-09	-5.45E-13
126	799.7772	-0.36876255	0.002092124	-3.56E-06	2.38E-09	-5.43E-13
127	802.98894	-0.37705919	0.002123787	-3.59E-06	2.39E-09	-5.42E-13
128	806.19079	-0.38539649	0.002155353	-3.62E-06	2.39E-09	-5.40E-13
129	809.40265	-0.39375406	0.002187016	-3.65E-06	2.40E-09	-5.39E-13

130	812.59975	-0.39893295	0.002205183	-3.66E-06	2.39E-09	-5.36E-13
131	815.77203	-0.40097083	0.002209479	-3.66E-06	2.38E-09	-5.32E-13
132	818.95411	-0.40294859	0.002213788	-3.65E-06	2.37E-09	-5.27E-13
133	822.12639	-0.40498662	0.002218084	-3.65E-06	2.36E-09	-5.23E-13
134	825.30859	-0.4070253	0.002222393	-3.64E-06	2.35E-09	-5.19E-13
135	828.49067	-0.40900318	0.002226702	-3.64E-06	2.34E-09	-5.14E-13
136	831.66295	-0.41104072	0.002230998	-3.63E-06	2.33E-09	-5.10E-13
137	834.84515	-0.41307954	0.002235307	-3.63E-06	2.32E-09	-5.06E-13
138	838.01731	-0.41505637	0.002239603	-3.62E-06	2.31E-09	-5.01E-13
139	841.19951	-0.41709531	0.002243912	-3.62E-06	2.29E-09	-4.97E-13
140	844.38158	-0.41907307	0.002248222	-3.61E-06	2.28E-09	-4.93E-13
141	847.55386	-0.4211111	0.002252517	-3.61E-06	2.27E-09	-4.88E-13
142	850.73606	-0.42314956	0.002256827	-3.60E-06	2.26E-09	-4.84E-13
143	853.9182	-0.425129	0.002261136	-3.60E-06	2.25E-09	-4.79E-13
144	857.09042	-0.42716507	0.002265432	-3.59E-06	2.24E-09	-4.75E-13
145	860.27256	-0.42914429	0.002269741	-3.59E-06	2.23E-09	-4.71E-13
146	863.44478	-0.43118085	0.002274037	-3.58E-06	2.22E-09	-4.66E-13
147	866.62698	-0.43321958	0.002278346	-3.58E-06	2.21E-09	-4.62E-13
148	869.80912	-0.43519902	0.002282655	-3.57E-06	2.19E-09	-4.58E-13
149	872.98134	-0.43723515	0.002286951	-3.57E-06	2.18E-09	-4.53E-13
150	876.1636	-0.43927551	0.00229126	-3.57E-06	2.17E-09	-4.49E-13
151	879.33569	-0.44125087	0.002295556	-3.56E-06	2.16E-09	-4.45E-13
152	882.51789	-0.44328933	0.002299865	-3.56E-06	2.15E-09	-4.40E-13
153	885.70003	-0.44526904	0.002304175	-3.55E-06	2.14E-09	-4.36E-13
154	888.87225	-0.44730554	0.00230847	-3.55E-06	2.13E-09	-4.32E-13
155	892.05451	-0.44934526	0.00231278	-3.54E-06	2.12E-09	-4.27E-13
156	895.22661	-0.45132089	0.002317075	-3.54E-06	2.11E-09	-4.23E-13
157	898.40887	-0.4533609	0.002321385	-3.53E-06	2.09E-09	-4.19E-13
158	901.59095	-0.45533886	0.002325694	-3.53E-06	2.08E-09	-4.14E-13
159	904.76317	-0.45737536	0.00232999	-3.52E-06	2.07E-09	-4.10E-13
160	907.94543	-0.45941535	0.002334299	-3.52E-06	2.06E-09	-4.06E-13
161	911.11752	-0.46139071	0.002338595	-3.51E-06	2.05E-09	-4.01E-13
162	914.29979	-0.46343092	0.002342904	-3.51E-06	2.04E-09	-3.97E-13
163	917.48199	-0.46546974	0.002347213	-3.50E-06	2.03E-09	-3.93E-13
164	920.65408	-0.46744537	0.002351509	-3.50E-06	2.02E-09	-3.88E-13
165	923.83634	-0.46948532	0.002355819	-3.49E-06	2.00E-09	-3.84E-13
166	927.00844	-0.47146073	0.002360114	-3.49E-06	1.99E-09	-3.80E-13
167	930.1907	-0.4735013	0.002364424	-3.48E-06	1.98E-09	-3.75E-13
168	933.3729	-0.47553976	0.002368733	-3.48E-06	1.97E-09	-3.71E-13
169	936.54977	-0.47628449	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
170	939.73986	-0.47630738	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
171	942.92976	-0.4762678	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
172	946.10984	-0.4762945	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
173	949.29986	-0.47631596	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
174	952.47982	-0.47628163	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
175	955.66985	-0.47630309	0.002370399	-3.48E-06	1.97E-09	-3.69E-13

176	958.85987	-0.47632454	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
177	962.03983	-0.47629021	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
178	965.22985	-0.47631167	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
179	968.40981	-0.47627734	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
180	971.59983	-0.4762988	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
181	974.78986	-0.47632025	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
182	977.96982	-0.47628592	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
183	981.15984	-0.47630738	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
184	984.3398	-0.47627305	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
185	987.52982	-0.4762945	0.002370399	-3.48E-06	1.97E-09	-3.69E-13
186	990.71985	-0.47631596	0.002370399	-3.48E-06	1.97E-09	-3.69E-13

SWIR Polynomial Spectral Misregistration Correction:

Band	Wavelength (nm)	Polynomial coefficients				
		b0	b1	b2	b3	b4
1	957.01414	0.22455513	-2.96E-03	1.13E-05	-1.64E-08	8.01E-12
2	962.47416	0.22455704	-2.96E-03	1.13E-05	-1.64E-08	8.01E-12
3	967.93418	0.22455894	-2.96E-03	1.13E-05	-1.64E-08	8.01E-12
4	973.40415	0.2245661	-2.96E-03	1.13E-05	-1.64E-08	8.01E-12
5	978.86417	0.224568	-2.96E-03	1.13E-05	-1.64E-08	8.01E-12
6	984.32413	0.22457134	-2.96E-03	1.13E-05	-1.64E-08	8.01E-12
7	989.79415	0.22457706	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
8	995.25411	0.2245804	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
9	1000.7141	0.22458374	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
10	1006.1741	0.22458565	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
11	1011.6441	0.22459137	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
12	1017.1041	0.22459328	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
13	1022.564	0.22459804	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
14	1028.0342	0.22454273	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
15	1033.4941	0.22460567	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
16	1038.9542	0.22454655	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
17	1044.424	0.22461616	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
18	1049.8841	0.22455704	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
19	1055.344	0.22461998	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
20	1060.8142	0.22456466	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
21	1066.274	0.22463047	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
22	1071.7341	0.22457134	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
23	1077.2042	0.22451603	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
24	1082.6641	0.22457897	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
25	1088.1243	0.22451984	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
26	1093.5841	0.22458565	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
27	1099.0542	0.22453033	-2.96E-03	1.13E-05	-1.64E-08	8.01E-12
28	1104.5141	0.22459328	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
29	1109.9742	0.22453415	-0.002955442	1.13E-05	-1.64E-08	8.01E-12
30	1115.4602	0.21764302	-0.002839977	1.08E-05	-1.56E-08	7.57E-12
31	1120.9385	0.20974921	-0.00271002	1.02E-05	-1.47E-08	7.07E-12
32	1126.4166	0.20197788	-0.002580066	9.64E-06	-1.37E-08	6.57E-12
33	1131.905	0.19407382	-0.002449871	9.08E-06	-1.28E-08	6.07E-12
34	1137.383	0.18630529	-0.00231992	8.52E-06	-1.19E-08	5.57E-12
35	1142.8613	0.17841141	-0.002189963	7.95E-06	-1.10E-08	5.07E-12
36	1148.3495	0.17062954	-0.002059771	7.39E-06	-1.01E-08	4.58E-12
37	1153.8278	0.16273584	-0.001929814	6.83E-06	-9.17E-09	4.08E-12
38	1159.3059	0.15496432	-0.00179986	6.27E-06	-8.26E-09	3.58E-12
39	1164.7942	0.14706318	-0.001669668	5.71E-06	-7.34E-09	3.08E-12
40	1170.2725	0.13916954	-0.001539711	5.15E-06	-6.43E-09	2.58E-12
41	1175.7506	0.13139809	-0.001409757	4.58E-06	-5.51E-09	2.08E-12
42	1181.2289	0.12350439	-0.0012798	4.02E-06	-4.60E-09	1.59E-12

43	1186.7169	0.11572541	-1.15E-03	3.46E-06	-3.68E-09	1.09E-12
44	1192.1953	0.10783172	-0.001019653	2.90E-06	-2.77E-09	5.89E-13
45	1197.6734	0.10006029	-0.000889699	2.34E-06	-1.86E-09	9.07E-14
46	1203.1618	0.092156016	-0.000759504	1.77E-06	-9.41E-10	-4.08E-13
47	1208.6397	0.084387603	-0.000629553	1.21E-06	-2.69E-11	-9.06E-13
48	1214.1181	0.076493936	-0.000499596	6.52E-07	8.87E-10	-1.40E-12
49	1219.6062	0.068711948	-0.000369404	8.93E-08	1.80E-09	-1.90E-12
50	1225.0846	0.060818258	-0.000239447	-4.72E-07	2.72E-09	-2.40E-12
51	1230.5625	0.053049866	-0.000109496	-1.03E-06	3.63E-09	-2.90E-12
52	1236.0509	0.045145629	2.07E-05	-1.60E-06	4.55E-09	-3.40E-12
53	1241.529	0.03737411	0.000150654	-2.16E-06	5.46E-09	-3.90E-12
54	1247.0073	0.029480424	0.000280611	-2.72E-06	6.38E-09	-4.39E-12
55	1252.4956	0.021579247	0.000410803	-3.28E-06	7.29E-09	-4.89E-12
56	1257.9737	0.013807713	0.000540757	-3.84E-06	8.21E-09	-5.39E-12
57	1263.452	0.005914058	0.000670714	-4.40E-06	9.12E-09	-5.89E-12
58	1268.9186	0.004423656	0.000681603	-4.42E-06	9.11E-09	-5.87E-12
59	1274.3932	0.004069948	0.000668668	-4.33E-06	8.93E-09	-5.75E-12
60	1279.8574	0.003837679	0.000655757	-4.24E-06	8.74E-09	-5.62E-12
61	1285.322	0.003480719	0.000642846	-4.16E-06	8.55E-09	-5.50E-12
62	1290.7963	0.003248967	0.000629911	-4.07E-06	8.36E-09	-5.37E-12
63	1296.2609	0.002891997	0.000617	-3.98E-06	8.17E-09	-5.25E-12
64	1301.7251	0.00265987	0.000604089	-3.89E-06	7.98E-09	-5.13E-12
65	1307.1996	0.00230603	0.000591154	-3.80E-06	7.79E-09	-5.00E-12
66	1312.6639	0.002071196	0.000578243	-3.71E-06	7.60E-09	-4.88E-12
67	1318.1285	0.001714056	0.000565332	-3.62E-06	7.41E-09	-4.75E-12
68	1323.6027	0.001485271	0.000552398	-3.53E-06	7.22E-09	-4.63E-12
69	1329.0673	0.001128194	0.000539486	-3.44E-06	7.04E-09	-4.51E-12
70	1334.5316	0.000893296	0.000526575	-3.35E-06	6.85E-09	-4.38E-12
71	1340.0062	0.000539457	5.14E-04	-3.26E-06	6.66E-09	-4.26E-12
72	1345.4706	0.000185257	0.000500729	-3.17E-06	6.47E-09	-4.14E-12
73	1350.9349	-4.96E-05	0.000487818	-3.08E-06	6.28E-09	-4.01E-12
74	1356.3995	-0.000406717	0.000474907	-2.99E-06	6.09E-09	-3.89E-12
75	1361.8738	-0.00063838	0.000461972	-2.91E-06	5.90E-09	-3.76E-12
76	1367.3384	-0.000995533	0.000449061	-2.82E-06	5.71E-09	-3.64E-12
77	1372.8025	-0.001227543	0.00043615	-2.73E-06	5.53E-09	-3.52E-12
78	1378.2771	-0.001581316	0.000423215	-2.64E-06	5.34E-09	-3.39E-12
79	1383.7414	-0.001816326	0.000410304	-2.55E-06	5.15E-09	-3.27E-12
80	1389.206	-0.002173291	0.000397393	-2.46E-06	4.96E-09	-3.14E-12
81	1394.6802	-0.002402175	0.000384459	-2.37E-06	4.77E-09	-3.02E-12
82	1400.1448	-0.002759172	0.000371547	-2.28E-06	4.58E-09	-2.90E-12
83	1405.6091	-0.002994149	0.000358636	-2.19E-06	4.39E-09	-2.77E-12
84	1411.0836	-0.003347955	0.000345701	-2.10E-06	4.20E-09	-2.65E-12
85	1416.5478	-0.003580031	0.000332791	-2.01E-06	4.01E-09	-2.53E-12
86	1422.0124	-0.003937085	0.000319879	-1.92E-06	3.83E-09	-2.40E-12
87	1427.487	-0.004290892	0.000306944	-1.83E-06	3.64E-09	-2.28E-12
88	1432.9513	-0.004525824	0.000294033	-1.74E-06	3.45E-09	-2.15E-12

89	1438.4157	-0.00488001	0.000281122	-1.66E-06	3.26E-09	-2.03E-12
90	1443.88	-0.005114941	0.000268211	-1.57E-06	3.07E-09	-1.91E-12
91	1449.3546	-0.005468731	0.000255276	-1.48E-06	2.88E-09	-1.78E-12
92	1454.8189	-0.005703715	0.000242365	-1.39E-06	2.69E-09	-1.66E-12
93	1460.2835	-0.006060774	0.000229454	-1.30E-06	2.50E-09	-1.53E-12
94	1465.7577	-0.006289609	0.00021652	-1.21E-06	2.31E-09	-1.41E-12
95	1471.2222	-0.006646623	0.000203608	-1.12E-06	2.13E-09	-1.29E-12
96	1476.6601	-0.016273364	0.000192864	-7.74E-07	1.35E-09	-8.14E-13
97	1482.1016	-0.028319923	0.000182627	-3.65E-07	4.33E-10	-2.57E-13
98	1487.5329	-0.04022288	0.000172409	4.32E-08	-4.83E-10	3.00E-13
99	1492.9645	-0.052251311	0.00016219	4.51E-07	-1.40E-09	8.57E-13
100	1498.4058	-0.064175525	0.000151953	8.60E-07	-2.32E-09	1.41E-12
101	1503.8374	-0.07620395	0.000141734	1.27E-06	-3.23E-09	1.97E-12
102	1509.2687	-0.088106869	0.000131516	1.68E-06	-4.15E-09	2.53E-12
103	1514.7103	-0.10015352	0.000121279	2.09E-06	-5.07E-09	3.09E-12
104	1520.1419	-0.11218192	0.00011106	2.49E-06	-5.98E-09	3.64E-12
105	1525.5732	-0.12408799	0.000100842	2.90E-06	-6.90E-09	4.20E-12
106	1531.0049	-0.13611652	9.06E-05	3.31E-06	-7.82E-09	4.76E-12
107	1536.4461	-0.14803753	8.04E-05	3.72E-06	-8.74E-09	5.31E-12
108	1541.8777	-0.16006587	7.02E-05	4.13E-06	-9.65E-09	5.87E-12
109	1547.3091	-0.17197204	5.99E-05	4.53E-06	-1.06E-08	6.43E-12
110	1552.7505	-0.18401541	4.97E-05	4.94E-06	-1.15E-08	6.99E-12
111	1558.1819	-0.19592158	3.95E-05	5.35E-06	-1.24E-08	7.54E-12
112	1563.6135	-0.2079501	2.93E-05	5.76E-06	-1.33E-08	8.10E-12
113	1569.0548	-0.2198742	1.90E-05	6.17E-06	-1.42E-08	8.66E-12
114	1574.4864	-0.23190272	8.82E-06	6.58E-06	-1.52E-08	9.21E-12
115	1579.9177	-0.24380556	-1.40E-06	6.98E-06	-1.61E-08	9.77E-12
116	1585.3592	-0.25585226	-1.16E-05	7.39E-06	-1.70E-08	1.03E-11
117	1590.7906	-0.267758	-2.19E-05	7.80E-06	-1.79E-08	1.09E-11
118	1596.2222	-0.2797867	-3.21E-05	8.21E-06	-1.88E-08	1.14E-11
119	1601.7039	-0.2760635	-4.56E-05	8.18E-06	-1.87E-08	1.14E-11
120	1607.1765	-0.27181439	-5.92E-05	8.14E-06	-1.86E-08	1.13E-11
121	1612.6494	-0.26768705	-7.28E-05	8.10E-06	-1.84E-08	1.12E-11
122	1618.122	-0.26343794	-8.64E-05	8.06E-06	-1.83E-08	1.11E-11
123	1623.6047	-0.25929661	-0.000100074	8.02E-06	-1.82E-08	1.10E-11
124	1629.0773	-0.25504714	-0.000113681	7.98E-06	-1.80E-08	1.09E-11
125	1634.5502	-0.25092006	-0.000127289	7.93E-06	-1.79E-08	1.08E-11
126	1640.0328	-0.24665948	-0.000140922	7.89E-06	-1.78E-08	1.07E-11
127	1645.5057	-0.24253214	-0.00015453	7.85E-06	-1.76E-08	1.07E-11
128	1650.9781	-0.23828051	-0.000168137	7.81E-06	-1.75E-08	1.06E-11
129	1656.461	-0.2341417	-0.00018177	7.77E-06	-1.73E-08	1.05E-11
130	1661.9336	-0.2298925	-0.000195377	7.73E-06	-1.72E-08	1.04E-11
131	1667.4065	-0.22576515	-0.000208985	7.69E-06	-1.71E-08	1.03E-11
132	1672.889	-0.22150205	-0.000222618	7.65E-06	-1.69E-08	1.02E-11
133	1678.3618	-0.21737458	-0.000236226	7.61E-06	-1.68E-08	1.01E-11
134	1683.8344	-0.2131256	-0.000249833	7.57E-06	-1.67E-08	1.00E-11

135	1689.3173	-0.20898668	-0.000263466	7.53E-06	-1.65E-08	9.93E-12
136	1694.79	-0.20485692	-0.000277074	7.48E-06	-1.64E-08	9.84E-12
137	1700.2626	-0.20060781	-0.000290681	7.44E-06	-1.63E-08	9.75E-12
138	1705.7355	-0.1964806	-0.000304289	7.40E-06	-1.61E-08	9.66E-12
139	1711.2181	-0.1922198	-0.000317922	7.36E-06	-1.60E-08	9.57E-12
140	1716.6908	-0.18809003	-0.000331529	7.32E-06	-1.59E-08	9.48E-12
141	1722.1634	-0.18384069	-0.000345137	7.28E-06	-1.57E-08	9.39E-12
142	1727.6463	-0.17970202	-0.00035877	7.24E-06	-1.56E-08	9.30E-12
143	1733.1189	-0.17545303	-0.000372377	7.20E-06	-1.54E-08	9.22E-12
144	1738.5917	-0.17132569	-0.000385985	7.16E-06	-1.53E-08	9.13E-12
145	1744.0742	-0.16706224	-0.000399618	7.12E-06	-1.52E-08	9.04E-12
146	1749.5471	-0.16293525	-0.000413226	7.07E-06	-1.50E-08	8.95E-12
147	1755.0197	-0.15868578	-0.000426833	7.03E-06	-1.49E-08	8.86E-12
148	1760.5024	-0.15454462	-0.000440466	6.99E-06	-1.48E-08	8.77E-12
149	1765.975	-0.15029534	-0.000454073	6.95E-06	-1.46E-08	8.68E-12
150	1771.4479	-0.14616813	-0.000467681	6.91E-06	-1.45E-08	8.59E-12
151	1776.9305	-0.14190745	-0.000481314	6.87E-06	-1.44E-08	8.50E-12
152	1782.4034	-0.13778016	-0.000494922	6.83E-06	-1.42E-08	8.41E-12
153	1787.8761	-0.13365035	-0.000508529	6.79E-06	-1.41E-08	8.32E-12
154	1793.3487	-0.12940122	-0.000522137	6.75E-06	-1.39E-08	8.23E-12
155	1798.8316	-0.12526251	-0.00053577	6.71E-06	-1.38E-08	8.14E-12
156	1804.3042	-0.1210132	-0.000549378	6.67E-06	-1.37E-08	8.05E-12
157	1809.7769	-0.11688326	-0.000562985	6.62E-06	-1.35E-08	7.96E-12
158	1815.2595	-0.11262278	-0.000576618	6.58E-06	-1.34E-08	7.87E-12
159	1820.7324	-0.10849542	-0.000590226	6.54E-06	-1.33E-08	7.78E-12
160	1826.205	-0.10424627	-0.000603833	6.50E-06	-1.31E-08	7.69E-12
161	1831.6877	-0.10010497	-0.000617466	6.46E-06	-1.30E-08	7.60E-12
162	1837.1603	-0.095855822	-0.000631073	6.42E-06	-1.29E-08	7.51E-12
163	1842.6332	-0.091728487	-0.000644681	6.38E-06	-1.27E-08	7.42E-12
164	1848.1158	-0.087467673	-0.000658314	6.34E-06	-1.26E-08	7.33E-12
165	1853.5886	-0.083340715	-0.000671922	6.30E-06	-1.24E-08	7.24E-12
166	1859.0611	-0.079088757	-0.000685529	6.26E-06	-1.23E-08	7.15E-12
167	1864.544	-0.074950023	-0.000699162	6.21E-06	-1.22E-08	7.06E-12
168	1870.0168	-0.070822868	-0.00071277	6.17E-06	-1.20E-08	6.97E-12
169	1875.4894	-0.066573715	-0.000726378	6.13E-06	-1.19E-08	6.88E-12
170	1880.9622	-0.062443706	-0.000739985	6.09E-06	-1.18E-08	6.79E-12
171	1886.4448	-0.058183137	-0.000753618	6.05E-06	-1.16E-08	6.70E-12
172	1891.9176	-0.054055934	-0.000767226	6.01E-06	-1.15E-08	6.61E-12
173	1897.3902	-0.049806622	-0.000780833	5.97E-06	-1.14E-08	6.52E-12
174	1902.873	-0.045665422	-0.000794466	5.93E-06	-1.12E-08	6.43E-12
175	1908.3456	-0.041416203	-0.000808073	5.89E-06	-1.11E-08	6.34E-12
176	1913.8184	-0.037288841	-0.000821681	5.85E-06	-1.09E-08	6.25E-12
177	1919.3011	-0.033028251	-0.000835314	5.80E-06	-1.08E-08	6.16E-12
178	1924.7738	-0.028898329	-0.000848922	5.76E-06	-1.07E-08	6.07E-12
179	1930.2464	-0.024649242	-0.000862529	5.72E-06	-1.05E-08	5.98E-12
180	1935.7293	-0.020510377	-0.000876162	5.68E-06	-1.04E-08	5.89E-12

181	1941.2019	-0.01626147	-0.00088977	5.64E-06	-1.03E-08	5.80E-12
182	1946.6747	-0.012134069	-0.000903378	5.60E-06	-1.01E-08	5.71E-12
183	1952.1572	-0.007870673	-0.00091701	5.56E-06	-1.00E-08	5.62E-12
184	1957.6301	-0.003743623	-0.000930618	5.52E-06	-9.86E-09	5.54E-12
185	1963.1029	0.000383713	-0.000944226	5.48E-06	-9.72E-09	5.45E-12
186	1968.5755	0.004632865	-0.000957833	5.44E-06	-9.59E-09	5.36E-12
187	1974.0583	0.008774225	-0.000971466	5.40E-06	-9.45E-09	5.27E-12
188	1979.5309	0.013023443	-0.000985074	5.35E-06	-9.32E-09	5.18E-12
189	1985.0037	0.017150647	-0.000998681	5.31E-06	-9.18E-09	5.09E-12
190	1990.4864	0.021411216	-0.001012314	5.27E-06	-9.04E-09	5.00E-12
191	1995.9591	0.025541186	-0.001025922	5.23E-06	-8.91E-09	4.91E-12
192	2001.4318	0.02978773	-0.00103953	5.19E-06	-8.77E-09	4.82E-12
193	2006.9144	0.033931785	-0.001053162	5.15E-06	-8.63E-09	4.73E-12
194	2012.3733	0.035717984	-0.001039661	5.01E-06	-8.33E-09	4.53E-12
195	2017.8276	0.03652211	-0.001016696	4.83E-06	-7.96E-09	4.30E-12
196	2023.2916	0.037453704	-0.00099369	4.66E-06	-7.60E-09	4.08E-12
197	2028.7459	0.038257989	-0.000970725	4.48E-06	-7.23E-09	3.85E-12
198	2034.2	0.039184101	-0.000947761	4.30E-06	-6.87E-09	3.62E-12
199	2039.6643	0.039993765	-0.000924755	4.13E-06	-6.50E-09	3.39E-12
200	2045.1183	0.040920069	-0.000901791	3.95E-06	-6.13E-09	3.16E-12
201	2050.5729	0.041602102	-0.000878826	3.78E-06	-5.77E-09	2.93E-12
202	2056.0267	0.042534006	-0.000855863	3.60E-06	-5.40E-09	2.70E-12
203	2061.4907	0.043465725	-0.000832857	3.42E-06	-5.04E-09	2.47E-12
204	2066.9615	0.032181947	-0.000705851	3.00E-06	-4.45E-09	2.18E-12
205	2072.4384	0.016591489	-0.000544226	2.48E-06	-3.78E-09	1.88E-12
206	2077.9248	0.001221498	-0.000382312	1.97E-06	-3.12E-09	1.57E-12
207	2083.4012	-0.014124133	-0.000220694	1.46E-06	-2.45E-09	1.27E-12
208	2088.8775	-0.029469717	-5.91E-05	9.47E-07	-1.79E-09	9.62E-13
209	2094.3644	-0.045084592	0.000102845	4.34E-07	-1.12E-09	6.57E-13
210	2099.8406	-0.060423769	0.000264455	-7.79E-08	-4.61E-10	3.52E-13
211	2105.3169	-0.075769375	0.000426073	-5.90E-07	2.03E-10	4.64E-14
212	2110.8033	-0.091139413	0.000587987	-1.10E-06	8.68E-10	-2.59E-13
213	2116.2802	-0.10672981	0.000749612	-1.61E-06	1.53E-09	-5.64E-13
214	2121.7566	-0.12207546	0.000911229	-2.13E-06	2.20E-09	-8.70E-13
215	2127.243	-0.13744549	0.001073143	-2.64E-06	2.86E-09	-1.18E-12
216	2132.7194	-0.15279104	0.001234761	-3.15E-06	3.53E-09	-1.48E-12
217	2138.1962	-0.1683815	0.001396386	-3.66E-06	4.19E-09	-1.79E-12
218	2143.6726	-0.18372718	0.001558004	-4.18E-06	4.85E-09	-2.09E-12
219	2149.1588	-0.19909074	0.00171991	-4.69E-06	5.52E-09	-2.40E-12
220	2154.6356	-0.21468111	0.001881535	-5.20E-06	6.18E-09	-2.70E-12
221	2160.112	-0.23002687	0.002043153	-5.71E-06	6.85E-09	-3.01E-12
222	2165.5984	-0.24539681	0.002205067	-6.22E-06	7.51E-09	-3.31E-12
223	2171.0748	-0.2607423	0.002366684	-6.74E-06	8.18E-09	-3.62E-12
224	2176.5516	-0.27633285	0.002528309	-7.25E-06	8.84E-09	-3.92E-12
225	2182.038	-0.29170288	0.002690223	-7.76E-06	9.50E-09	-4.23E-12
226	2187.5144	-0.30704851	0.002851841	-8.27E-06	1.02E-08	-4.53E-12

227	2192.9905	-0.32238771	0.003013451	-8.79E-06	1.08E-08	-4.84E-12
228	2198.4774	-0.33800243	0.003175373	-9.30E-06	1.15E-08	-5.14E-12
229	2203.9538	-0.35334806	0.00333699	-9.81E-06	1.22E-08	-5.45E-12
230	2209.4248	-0.34649993	0.003259775	-9.57E-06	1.18E-08	-5.29E-12
231	2214.9039	-0.33203676	0.003100644	-9.07E-06	1.12E-08	-4.98E-12
232	2220.3735	-0.31784735	0.002941798	-8.57E-06	1.05E-08	-4.66E-12
233	2225.8426	-0.30341431	0.002782958	-8.07E-06	9.87E-09	-4.34E-12
234	2231.3117	-0.28898131	0.002624119	-7.57E-06	9.22E-09	-4.03E-12
235	2236.7911	-0.27475649	0.002464989	-7.07E-06	8.56E-09	-3.71E-12
236	2242.2602	-0.26032335	0.002306149	-6.57E-06	7.91E-09	-3.40E-12
237	2247.7293	-0.24589049	0.00214731	-6.07E-06	7.25E-09	-3.08E-12
238	2253.2085	-0.23142731	0.00198818	-5.57E-06	6.59E-09	-2.77E-12
239	2258.6781	-0.21723763	0.001829333	-5.07E-06	5.94E-09	-2.45E-12
240	2264.1472	-0.20280471	0.001670494	-4.57E-06	5.28E-09	-2.13E-12
241	2269.6263	-0.18834153	0.001511363	-4.07E-06	4.62E-09	-1.82E-12
242	2275.0954	-0.17390843	0.001352524	-3.57E-06	3.97E-09	-1.50E-12
243	2280.565	-0.15971891	0.001193678	-3.07E-06	3.31E-09	-1.19E-12
244	2286.0439	-0.14525066	0.001034554	-2.57E-06	2.66E-09	-8.71E-13
245	2291.513	-0.13081768	0.000875715	-2.07E-06	2.00E-09	-5.55E-13
246	2296.9821	-0.11638457	0.000716876	-1.57E-06	1.34E-09	-2.39E-13
247	2302.4617	-0.10216492	0.000557738	-1.07E-06	6.88E-10	7.69E-14
248	2307.9309	-0.087731875	0.000398899	-5.66E-07	3.24E-11	3.93E-13
249	2313.4	-0.073298854	0.000240059	-6.65E-08	-6.23E-10	7.08E-13
250	2318.8444	-0.082639855	0.000345555	-4.22E-07	-1.68E-10	5.15E-13
251	2324.2854	-0.10397412	0.000588572	-1.22E-06	8.64E-10	5.68E-14
252	2329.7163	-0.12527298	0.000831145	-2.02E-06	1.90E-09	-4.00E-13
253	2335.147	-0.14656515	0.001073708	-2.82E-06	2.93E-09	-8.57E-13
254	2340.5884	-0.16814461	0.001316736	-3.62E-06	3.96E-09	-1.32E-12
255	2346.0194	-0.18944338	0.001559309	-4.42E-06	4.99E-09	-1.77E-12
256	2351.4503	-0.2107423	0.001801882	-5.22E-06	6.02E-09	-2.23E-12
257	2356.8913	-0.2320766	0.0020449	-6.02E-06	7.05E-09	-2.69E-12
258	2362.3227	-0.25362053	0.002287484	-6.82E-06	8.08E-09	-3.15E-12
259	2367.7537	-0.27491933	0.002530056	-7.62E-06	9.11E-09	-3.60E-12
260	2373.1946	-0.29625385	0.002773074	-8.42E-06	1.01E-08	-4.06E-12
261	2378.6253	-0.31754591	0.003015636	-9.21E-06	1.12E-08	-4.52E-12
262	2384.0567	-0.33909008	0.00325822	-1.00E-05	1.22E-08	-4.97E-12
263	2389.4977	-0.36042419	0.003501238	-1.08E-05	1.32E-08	-5.43E-12
264	2394.9286	-0.38172296	0.003743811	-1.16E-05	1.43E-08	-5.89E-12
265	2400.3596	-0.40302211	0.003986384	-1.24E-05	1.53E-08	-6.35E-12
266	2405.791	-0.42456573	0.004228967	-1.32E-05	1.63E-08	-6.80E-12
267	2411.2319	-0.44590031	0.004471985	-1.40E-05	1.74E-08	-7.26E-12
268	2416.6629	-0.46719912	0.004714558	-1.48E-05	1.84E-08	-7.72E-12
269	2422.1184	-0.47096871	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
270	2427.5881	-0.47089623	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
271	2433.048	-0.47083329	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
272	2438.5079	-0.47077035	0.004755306	-1.49E-05	1.86E-08	-7.80E-12

273	2443.9783	-0.47094773	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
274	2449.4382	-0.47088479	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
275	2454.8981	-0.47082185	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
276	2460.368	-0.47075509	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
277	2465.8283	-0.47093629	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
278	2471.288	-0.47086762	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
279	2476.7579	-0.47080087	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
280	2482.2178	-0.47073792	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
281	2487.6782	-0.47091912	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
282	2493.1381	-0.47085618	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
283	2498.608	-0.47078942	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
284	2504.0684	-0.47097062	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
285	2509.5283	-0.47090768	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
286	2514.9979	-0.4708352	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
287	2520.4578	-0.47077226	0.004755306	-1.49E-05	1.86E-08	-7.80E-12
288	2525.9182	-0.47095345	0.004755306	-1.49E-05	1.86E-08	-7.80E-12