C.1 Study Site FBG1 (non-tussock sedge, dwarf shrub, moss tundra)

I Location

Name	Location	Latitude	Longitude	Altitude
FBG1	Franklin Bluffs, Arctic North Slope,	69.674377°	-148,720972°	125 m
FBG1	Alaska, United States of America	09.074377	-140,720972	123 111

At an average elevation of 90 m, Franklin Bluffs is located in Subzone D about 1 km west of the Dalton Highway across from the pipeline access road APL/AMS 130 near green mile marker 375. This access road provides parking at the site. Three 10 x 10 m grids, designated dry, mesic, and wet, have been established at this location in 2002. The goniometer measurements have been carried out next to the moist / zonal site (FB_m/z). [Barreda et al., 2006]



Figure C.1-1: Location of study site FBG1 in Alaska, USA. Source: Google Earth, 2013



Figure C.1-2: Aerial photo of a 10 x 10 m zonal grid at the Franklin Bluffs study location near the FBG1 site. *Source:* [Barreda et al., 2006]

II Main Vegetation Description

The vegetation at the mesic Franklin Bluffs study location corresponds to the zonal vegetation in subzone D. The zonal plant community of bioclimate subzone D in northern Alaska is Dryado integrifoliae-Caricetum bigelowii [Walker et al., 2005], also called moist non-acidic tundra (MNT), or 'nontussock sedge, dwarf-shrub, moss tundra' [Walker et al., 2005]. It occurs on circumneutral to basic soils in association with silty loess that is blown from the major rivers in the eastern part of the Arctic Coastal Plain. The average soil pH of this plant community at Franklin Bluffs is 7.9; the average volumetric soil moisture of the top mineral horizon is 45 %, and average depth of thaw by late summer is 40 cm [Kade et al., 2005]. The dominant plants in MNT are sedges (Carex bigelowii, Eriophorum angustifolium ssp. triste, C. membranacea, C. scirpoidea, E. vaginatum), prostrate and hemi-prostrate evergreen dwarf shrubs (Dryas integrifolia, Cassiope tetragona), prostrate dwarf deciduous shrubs (Salix arctica, S. reticulata, Arctous rubra), scattered erect dwarf deciduous shrubs (Salix lanata, S. glauca), several forbs (Papaver macounii, Pedicularis lanata, Saussurea angustifolia, Senecio atropurpureus, Pedicularis capitata, Polygonum viviparum, Cardamine hyperborea, Astragalus umbellatus), mosses (Tomentypnum nitens, Hylocomium splendens, Aulacomnium turgidum, Rhytidium rugosum, Hypnum bambergeri, Distichium capillaceum, Ditrichum flexicaule), and lichens (Thamnolia subuliformis, Cetraria spp.).

An important component of the MNT is the abundant nonsorted circles, also called frost boils, which are small patterned ground features caused by soil frost heave [Walker et al., 2008; Washburn, 1980]. These features cover large parts of most MNT surfaces. The 10 x 10 m zonal grid at Franklin Bluffs has about 30 % cover of nonsorted circles. These features have drier plant communities than the mesic zonal plant communities between the circles, with high cover of lichens and bare soil.

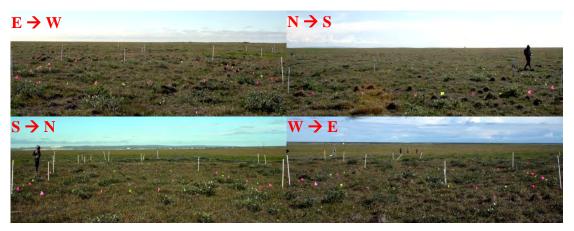


Figure C.1-3: Overview images of MNT tundra at the mesic Franklin Bluffs study location near the FBG1 site. *Source:* [*Buchhorn and Schwieder*, 2012]

III Vegetation Description of the FBG1 Site

The focus of the measurements at this goniometer site has been non-tussock sedges – dwarf shrub – moss tundra. The 1×1 m plot is homogeneously covered mainly with grass and sedges, but with forbs, mosses and lichens in the understory. Moreover, this plot correspond with the zonal plant community of Alaskan bioclimate subzone D (MNT vegetation).



Figure C.1-4: Overview images of the FBG1 vegetation from cardinal directions.



Figure C.1-5: Nadir image of the FBG1 vegetation (mainly grass and sedges).

IV Overview of the Spectro-Goniometer Measurements

Table C.1-1: Overview of the spectro-goniometer measurements at the FBG1 study site.

Name	Day	Starting Time	Duration	SAA	SZA	Sky
FBG1_01	2012-07-07	09:53:01	25 min	112°	59°	cirrostratus
FBG1_02	2012-07-07	11:47:17	21 min	143°	50°	cirrostratus
FBG1_03	2012-07-07	13:56:55	27 min	180°	47°	cirrostratus
FBG1_04	2012-07-07	15:49:41	19 min	217°	50°	clear
FBG1_05	2012-07-07	18:02:23	18 min	252°	59°	cirrostratus
FBG1_06	2012-07-07	19:52:40	19 min	278°	68°	cirrostratus

Table C.1-2: Spectro-directional data of the FBG1_01 spectro-goniometer measurement.

							15				4 444	1.1	1 A	44	-						
(SZA = 59°: SAA = 112°)	010	51180	51202.5	51225	51270	5 315	51337.5	Viewning Geometry (Viewning Zeintin Augle) Viewning Azimutin Augle) 5 510 512.5 5145 5190 51135 51157.5 101180 1	JIIIEUS (V 5122.5	5145	5190	51135	51157.5	101180	01190	101202.5	101225	101270	101315 1	101337.5	101350
HCRF EnMAP blue (479 nm)	4	0.0481	0.0557	0.0453	0.0441	0.0441	0.0460	وا	ı	0.0442	0.0513	ı			0.0533		0.0529	L			0.0423
HCRF EnMAP green (549 nm)		0.0781	0.0870	0.0715	0.0682	0.0693	0.0726												0.0740		0.0665
HCRF EnMAP rot (672 nm)		0.0882	0.1052	0.0859	0.0807	0.0842	0.0865												0.0874		0.0779
HCRF EnMAP NIR (864 nm)	0.3023	0.3138	0.3093	0.2741	0.2681	0.2720	0.2913	0.2958	0.2637	0.2724	0.3086	0.3090		0.3101	0.3277 (0.2806	0.2834	0.2854	0.2734
ANIF EnMAP rot (672 nm)	1.0000	0.9738	1.1610	0.9487	0.8913	0.9295	0.9546	0.8907	0.9433	0.9188	1.0683	1.0226	0.8903	1.0692	1.1235	1.1495	1.0986	0.9399	0.9647	0.8836	0.8594
ANIF EnMAP NIR (864 nm)	1.0000	1.0382	1.0232	0.9068	0.8871	0.8999	0.9638	0.9787		0.9012	1.0210		0.9055					0.9284	0.9376	0.9444	0.9046
Rel. Blue Absorption Depth		0.4207	0.4056	0.4074	0.3997	0.4078	0.4125			0.3814					0.3871 (0.4182	0.4112		0.3936
Rel. Red Absorption Depth	0.8805	0.9669	0.7656	0.8476	0.8748	0.8658	0.9082	0.9983	0.7982	0.8782	0.8364	0.9112			0.8660		0.8393	0.8607	0.8640		0.9468
NDVI (EnMAP)	0.5388	0.5611	0.4924	0.5226	0.5371	0.5272	0.5422	0.5714	0.5106	0.5319	0.5225	0.5387	0.5448	0.5240	0.5260 (0.5120	0.5156	0.5344	0.5286	0.5620	0.5567
Nadir Norm NDM (AWHRR)	1.0000	1.0266	0.9208	0.9792	0.9956	0.9882	1.0071	1.0600	0.9580	0.9978	0.9723	1.0043	1.0095	92.0	0.9811 (0.9618	0.9590	0.9832	0.9851	1.0384	1.0331
Nadir Norm NDM (MODIS)	1.0000	1.0278	0.9215	0.9795	0.9969	0.9888	1.0095	1.0615	0.9577	0.9975	0.9730	1.0052	1.0109	0.9782	0.9807	0.9616	0.9624	0.9846	0.9872	1.0418	1.0359
Nadir Norm NDM (EnMAP)	1.0000	1.0414	0.9140	0.9699	0.9969	0.9785	1.0063	1.0605	0.9476	0.9872	0.9698	0.9999	1.0111	0.9725	0.9764 (0.9570	0.9919	0.9811	1.0430	1.0333
(cont)																					
FBG1 01							Vie	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	metry (V	Tewing Z	enith Ang	Ile View	ing Azim	ith Angle							Γ
(SZA = 59°; SAA = 112°)	100	10 10	10 22.5	10 45	10 90	10 135	10 157.5	10 170	20 180	20 190 2	20 190 20 202.5 20 225	20 225	20 270	20 315 20 337.5	337.5	20 350	2010	20 10	20 22.5	20 45	20 90
HCRF EnMAP blue (479 nm)	0.0462	0.0456	0.0419	0.0446	0.0469	0.0480	0.0463	0.0495	0.0618	0.0583	0.0575		0.0471	0.0459	0.0380	0.0458	0.0462	0.0485	0.0470	0.0442	0.0552
HCRF EnMAP green (549 nm)		0.0698	0.0658	0.0684	0.0726	0.0764	0.0764												0.0734		0.0858
HCRF EnMAP rot (672 nm)		0.0874	0.0781	0.0831	0.0888	0.0900	0.0870								0.0673 (0.0911	0.0879		0.1031
HCRF EnMAP NIR (864 nm)	0.2747	0.2783	0.2771	0.2769	0.2908	0.3106	0.3138	0.3076					0.2948	0.2797		0.2913	0.2881		0.3053	0.2836	0.3257
ANIF EnMAP rot (672 nm)		0.9648	0.8618	0.9171	0.9797	0.9935	0.9607	1.0394		1.2126									0.9706		1.1378
ANIF EnMAP NIR (864 nm)		0.9208	0.9167	0.9162	0.9620	1.0274	1.0383	1.0178		1.1467								1.0369	1.0100		1.0774
Rel. Blue Absorption Depth		0.3912	0.4104	0.3782	0.3721	0.3850	0.4179												0.4045		0.3763
Rel. Red Absorption Depth		0.8367	0.9694	0.8978	0.8658	0.9328	0.9953												0.9407		0.8285
NDVI (EnMAP)		0.5220	0.5603	0.5385	0.5323	0.5506	0.5658											0.5494	0.5527		0.5191
Nadir Norm NDM (AWHRR)		0.9809	1.0452	1.0099	0.9950	1.0269	1.0449				0.9078	1.0187						1.0189	1.0263		0.9616
Nadir Norm NDM (MODIS)		0.9808	1.0466	1.0102	0.9945	1.0263	1.0466					1.0219						1.0217	1.0286		0.9627
Nadir Norm NDM (EnMAP)	0.9617	0.9688	1.0400	0.9994	0.9879	1.0219	1.0501	0.9861	0.8706	0.9626	0.8993	1.0216	1.0220	0.9867	1.1191	1.0367	0.9929	1.0197	1.0259	1.0250	0.9636
(cont.)																					
FBG1_01						Vie	wing Ge	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	iewing Za	enith Ang	ile View	ing Azim	uth Angle	5							
(SZA= 59°; SAA= 112°)		اء.	20 170	30 180		30 202.5	30 225	30 270		30 337.5	30 350	- 1		ᆈ	30 45	30 90	- 1	30 157.5	30 170		
HCRF EnMAP blue (479 nm)		0.0486	0.0570	0.0705		0.0588	0.0523									_			0.0616		
HCRF EnMAP green (549 nm)	0.0848	0.0804	0.0897	0.1121	0.1096	0.0968	0.0877	0.0808	0.0650	0.0652	0.0634	0.0672	0.0738	0.0706	0.0706	0.0877	0.0857	0.0944	0.0995		
HCRE FINAND NIR (864 nm)		0.3211	0.3296	0.3906	0.3935	0.3551	0.3337	0.0940											0.3481		
ANIF EnMAP rot (672 nm)		1.0131	1.2166	1.5087	1.3641	1.2385	1.0881	1.0443											1.3253		
ANIF EnMAP NIR (864 nm)	1.1261	1.0623	1.0906	1.2922	1.3019	1.1747	1.1041	0.9746		0.9290	0.9228	0.9262			0.9513	1.1054		1.1821	1.1518		
Rel. Blue Absorption Depth	0.4191	0.4234	0.3890	0.4091	0.4419	0.4383	0.4565	0.4150		0.4275	0.4271		0.3785		0.3739 (0.4106		
Rel. Red Absorption Depth	0.9517	0.9626	0.7867	0.7498	0.8676	0.8531	0.9351	0.8144		1.0875			0.8809						0.7523		
NDVI (EnMAP)	0.5507	0.5554	0.4988	0.4815	0.5220	0.5198	0.5439	0.5138		0.5902			0.5343						0.4871		
Nadir Norm NDM (AWHRR)	1.0183	1.0255	0.9307	0.8980	0.9596	0.9636	1.0017	0.9501	1.1019	1.0877	1.0840	1.0443	0.9958	1.0676	1.0236 (0.9642	0.9384	0.9984	0.9081		
Nadir Norm, NDVI (EnMAP)	1.0221	1.0309	0.9214	0.8938	0.9689	0.9647	1.0096	0.9537	1.1170	1.0953	1.0966		0.9916	1.0701					0.9041		
												1			1	1	1	1			

Table C.1-3: Spectro-directional data of the FBG1_02 spectro-goniometer measurement.

FBG1_02 /S7A = 50°: S4A = 143°)	ē	51180	51202 E	F1225	61270	5134E	Vie	wing Geo	ometry (V 51225	iewing Ze	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle) ה הוח הוסטה הואה הואה הואה הואה הואה הואה הואה או	le View	ving Azimu 51457 S	uth Angle	01490	101202 E	101225	101270	101345 4	401337.5	101350
UCDE EnM AD blue (470 mm)	250		2000		9900		2 2 2	١,	1	I,	I,			1			1	П	1		200
HOCKI EMMAP DIDE (4/9 mm)	0.0412	2000.0	1100.0	0.0480	0.000	0.0402	0.0492														0.0488
HCKI ENMAP green (549 nm)	0.0644	0.0839	0.0802	0.0/80	0.0849	0.0772	0.07 /6	0.0726	0.0724												0.0768
HCRF EnMAP rot (672 nm)	0.0764	0.1045	0.0956	0.0920	0.1052	0.0887	0.0920	0.0862	0.0875	0.0780	0.0856	0.0790	0.0926	0.0997	0.1015 0		0.1011	0.0931	0.0943 (0.0948 (0.0911
HCRF EnMAP NIR (864 nm)	0.2674	0.3071	0.3023	0.2889	0.2939	0.3067	0.3068	0.2901	0.2848	0.2747	0.2837	0.2908	0.2900	0.3152 (0.3076 (0.3098	0.3097	0.2882 (0.2882	0.3019 (0.2984
ANIF EnMAP rot (672 nm)	1.0000	1.3674	1.2514	1.2047	1.3769	1.1604	1.2039	1.1280	1.1449	1.0214	1.1202	1.0344	1.2122	1.3051	1.3280 1	1.3424	1.3237	1.2188	1.2339	1.2407	1.1930
ANIF EnMAP NIR (864 nm)	1.0000	1.1486	1.1305	1.0805	1.0992	1.1472	1.1472	1.0850	1.0652	1.0273	1.0608	1.0874	1.0844	1.1789	1.1502 1	1.1586	1.1582	1.0779	1.0777	1.1289	1.1160
Rel. Blue Absorption Depth	0.3748	0.3685	0.4022	0.4123	0.3906	0.4100	0.4143	0.4073	0.3797	0.3865	0.3881	0.4240	0.3762	0.3857 (0.4039 (0.4107	0.3995	0.4109 (0.3770	0.3945 (0.3875
Rel. Red Absorption Depth	0.9235	0.7587	0.8470	0.8147	0.7096	0.9303	0.8952	0.9046	0.8635	0.9334	0.8664	1.0051	0.8177	0.8299	0.8069	0.7912	0.8116 (0.8062 (0.7965	0.8440	0.8657
NDVI (EnMAP)	0.5556	0.4924	0.5194	0.5168	0.4729	0.5516	0.5387	0.5419	0.5301	0.5576	0.5364				0.5039			0.5117 (0.5070	0.5221	0.5321
Nadir Norm NDM (AWHRR)	1.0000	0.8972	0.9375	0.9271	0.8624	0.9873	0.9640	0.9776	0.9593	0.9972	0.9627		0.9341	0.9350	0.9150 (0.9089		0.9197 (0.9204	0.9440	0.9578
Nadir Norm NDM (MODIS)	1.0000	0.8961	0.9390	0.9273	0.8628	0.9891	0.9649	0.9784	0.9598		0.9626							0.9216 (0.9592
Nadir Norm NDVI (EnMAP)	1.0000	0.8863	0.9350	0.9303	0.8512	0.9928	0.9696	0.9755	0.9542	1.0036	0.9656	1.0306	0.9285	0.9349 (0.9070	0.9047	0.9139 (0.9210	0.9126 (0.9397	0.9577
l too)																					
FBG1 02							Vie	wing Geo	metry (V	iewing Ze	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	le View	ing Azim	ith Angle							Г
(SZA = 50°; SAA = 143°)	100	10 10	10 22.5	10 45	10 90	10 135	10 157.5	10 170	20 180	20 190 2	20 202.5 20 225	20 225	20 270	20 315 20 337.5	337.5	20 350	200	20 10 2	20 22.5	20 45	20 90
HCRF EnMAP blue (479 nm)	0.0461	0.0460	0.0428	0.0477	0.0502	0.0465	0.0530	0.0560	0.0574	0.0572	0.0579	0.0551	0.0572	0.0450 (0.0522 0	0.0466	0.0444	0.0462 (0.0441	0.0430 (0.0514
HCRF EnMAP green (549 nm)	0.0721	0.0717	0.0653	0.0727	0.0771	0.0767	0.0819	0.0875	0.0942		0.0937		0.0869	0.0707	0.0793 (0.0742	0.0694 (0.0726 (0.0675 (0.0673 (0.0781
HCRF EnMAP rot (672 nm)	0.0851	0.0852	0.0789	0.0893	0.0935	0.0869	0.1013	0.1064	0.1080	0.1107	0.1108	0.1007		0.0826 (0.0981	0.0854	0.0827	0.0852 (0.0805	0.0785 (0.0962
HCRF EnMAP NIR (864 nm)	0.2928	0.2855	0.2574	0.2835	0.2965	0.3058	0.2978	0.3141	0.3518	0.3454		0.3295	0.2967	0.2877 (0.3002	0.3109	0.2868 (0.2872 (0.2724	0.2784 (0.2891
ANIF EnMAP rot (672 nm)	1.1142	1.1150	1.0327	1.1693	1.2242	1.1374	1.3257	1.3929	1.4138	1.4488	1.4508	1.3175		1.0806		1.1179	1.0828	1.1152	1.0542	1.0269	1.2588
ANIF EnMAP NIR (864 nm)	1.0949	1.0677	0.9625	1.0604	1.1087	1.1436	1.1136	1.1745	1.3155	1.2918	1.2497	1.2323	1.1094			1.1628					1.0811
Rel. Blue Absorption Depth	0.4058	0.3935	0.3667	0.3633	0.3614	0.4161	0.3751	0.3935	0.4321	0.4287			0.3993	0.3938 (0.4117		0.3924 (0.3480
Rel. Red Absorption Depth	0.9314	0.8925	0.8591	0.8251	0.8216	0.9577	0.7533	0.7600	0.8794												0.7671
NDVI (EnMAP)	0.5495	0.5404	0.5307	0.5208	0.5204	0.5574	0.4924	0.4938	0.5302												0.5007
Nadir Norm NDM (AWHRR)	0.9898	0.9743	0.9600	0.9437	0.9401	0.9962	0.8925	0.8920	0.9474												0.9062
Nadir Norm NDM (MODIS)	0.9912	0.9742	0.9598	0.9431	0.9403	0.9985	0.8919		0.9485									0.9765 (0.9058
Nadir Norm. NDM (EnMAP)	0.9891	0.9727	0.9553	0.9375	0.9367	1.0034	0.8863	0.8889	0.9543	0.9264	0.9034	0.9576	0.8336	0.9973 (0.9136 1	1.0242	0.9941 (0.9763	0.9786	1.0085 (0.9013
(coat)																					
FBG1 02						Vie	wing Ge	ometry (V	iewing Z	enith Ang	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	ing Azim	ıth Angle						Γ		
(SZA = 50°; SĀA = 143°)	20 135	20 157.5	20 170	30 180	30 190	30 202.5	30 225	30 270	30 315	30 337.5 30 350	30 350	3010	30 10 3	122.5	30 45	30 90	30 135 3	30 157.5	30 170		
HCRF EnMAP blue (479 nm)	0.0525	0.0617	0.0581	0.0641		0.0663	0.0582		0.0457										0.0673		
HCRF EnMAP green (549 nm)	0.0856	0.0953	0.0946	0.1051	0.1079	0.1068	0.0983	0.0850	0.0734										0.1114		
HCKF ENMAP rot (6/2 nm)	0.0978	0.1189	0.1082	0.1193	0.1234	2/21.0	0.1053	0.0986	0.0850										0.1254		
ANIE ENMAN TOT (672 nm)	1 2795	0.32// 1.556/	1 4160	1 5615	1 6140	0.3005	0.3672	0.3249	0.3022	1 1 1 1 0 7	1 2037	0.2944	1,02.0	1 0004	1 0104	1 2468	0.3287	0.3422 (1 6408		
ANIF EnMAD NIR (864 nm)	1 2140	1 2255	1 2034	1 4242	4136	3708	13733	1 2152	1301	10031	1 1280								1 3045		
Rel Blue Absorption Denth	0.4121	0.3828	0.4224	0 4344	0.4267	0.4296	0.4671	0.4454	0.130										0.4351		
Rel. Red Absorption Depth	0.8973	0.7002	0.8660	0.8647	0.8122	0.7563	0.9513	0.8883	0.9672										0.7854		
NDVI (EnMAP)	0.5371	0.4675	0.5232	0.5229	0.5079	0.4847	0.5544	0.5345	0.5607										0.4968		
Nadir Norm NDVI (AVHRR)	0.9585	0.8491	0.9353	0.9326	0.9060	0.8727	0.9769	0.9602	1.0036		0.9583								0.8846		
Nadir Norm NDM (MODIS)	0.9611	0.8484	0.9383	0.9342	0.9088	0.8744	0.9825	0.9646	1.0076		0.9605								0.8870		
Nadir Norm NDVI (EnimAP)	0.9008	0.8415	0.9418	0.9413	0.9141	0.8720	0.8880	0.9621	1.0093	0.9849	0.8589	1.0360	0.9812	0.9923	9/10.1	0.9102	0.9226	0.8284	0.8943		

Table C.1-4: Spectro-directional data of the FBG1_03 spectro-goniometer measurement.

									1												
(SZA = 47°; SAA = 180°)	90	51180	51202.5	51225	51270	51315	VIE 5 337,5	Viewing Geometry (Viewing Zemin Angle) Viewing Azimuti Angle) 5 510 512.5 5145 5190 51135 51157.5 101180 1	ometry (v 5122.5	newing 2 5145	5190 5190	Jie view 51135	71119 AZIIII 51157.5	utn Angle 10180	01190	101202.5	101225	101270	10 315	101337.5	10 350
HCRF EnMAP blue (479 nm)	۵,	0.0510	0.0503	0.0536	0.0492	0.0501	0.0489	٥,		0.0468	0.0364	ı				0.0508	0.0577	0.0522	0.0477		0.0464
HCRF EnMAP green (549 nm)	0.0684	0.0812	0.0794	0.0821	0.0769	0.0770	0.0744			0.0724						0.0809	0.0880	0.0816	0.0731		0.0699
HCRF EnMAP rot (672 nm)		0.0962	0.0949	0.1030	0.0924	0.0953	0.0917			9680.0						0.0948	0.1103	0.0972	0.0885	0.0902	0.0851
HCRF EnMAP NIR (864 nm)	0.2681	0.3028	0.2988	0.2977	0.2939	0.2932	0.2837	0.2580	0.2725	0.2809	0.2536	0.2849		0.3135	0.2950	0.2986	0.3078	0.3002	0.2883	0.2780	0.2702
ANIF EnMAP rot (672 nm)	1.0000	1.1559	1.1400	1.2379	1.1103	1.1452	1.1015	0.9704	1.0309	1.0761	0.8108	1.0356	1.1026	1.2182	1.2205	1.1392	1.3256	1.1684	1.0635	1.0837	1.0223
ANIF EnMAP NIR (864 nm)	1.0000	1.1293	1.1144	1.1102	1.0962	1.0936	1.0580	0.9621	1.0162	1.0475	0.9459		1.0253	1.1691	1.1003	1.1135	1.1478	1.1197	1.0753	1.0366	1.0075
Rel. Blue Absorption Depth	0.3616	0.4208	0.4091	0.3922	0.4012	0.3925	0.3743		0.3663	0.3775	0.3953					0.4198	0.3854	0.3975	0.3862	0.3680	0.3554
Rel. Red Absorption Depth	0.8331	0.8249	0.8188	0.7342	0.8335	0.8047	0.8038	0.8271	0.8135	0.8121	1.0201	0.8813	0.7689		0.7321	0.8146	0.7045	0.8056	0.8563	0.7946	0.8273
NDVI (EnMAP)	0.5263	0.5178	0.5180	0.4858	0.5216	0.5094	0.5116			0.5165	0.5797						0.4722	0.5107	0.5302		0.5210
Nadir Norm NDM (AWHRR)	1.0000	0.9798	0.9809	0.9292	9066.0	0.9760	0.9768	1.0011	0.9947	0.9834	1.0915	1.0142	0.9518	0.9703	0.9299	0.9770	0.9083	0.9726	1.0124	0.9737	0.9956
Nadir Norm NDM (MODIS)	1.0000	0.9805	0.9814	0.9275	0.9912	0.9764	0.9764	1.0008	0.9930	0.9836	1.0930	1.0152	0.9516	0.9709	0.9298	0.9785	9906.0	0.9734	1.0130	0.9742	0.9961
Nadir Norm NDM (EnMAP)	1.0000	0.9839	0.9843	0.9231	0.9912	0.9679	0.9721	0.9941	0.9901	0.9814	1.1016	1.0176	0.9491	0.9714	0.9269	0.9843	0.8973	0.9704	1.0075	0.9691	0.9900
(coat)																					
FBG1 03							Vie	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	metry (V	fewing Z	enith Ang	ile View	ing Azim	uth Angle							Γ
(SZA = 47°; SĀA = 180°)	100	10 10	10 22.5	10 45	10 90	10 135	10 157.5	10 170	20 180	20 190	20 190 20 202.5 20 225	20 225	20 270	20 315 20 337.5	1337.5	20 350	200	20 10	20 22.5	20 45	20 90
HCRF EnMAP blue (479 nm)	0.0412	0.0440	0.0450	0.0444	0.0364	0.0480	0.0534	0.0512	0.0549	0.0597	0.0540	0.0546	0.0513	0.0471	0.0463	0.0423	0.0415	0.0405	0.0454	0.0446	0.0377
HCRF EnMAP green (549 nm)	0.0638	0.0668	0.0677	0.0682	0.0588	0.0744	0.0856	0.0800	0.0887	0.0935	0.0885	0.0855	0.0805	0.0750	0.0714	0.0658	0.0641	0.0622	0.0691	0.0677	0.0599
HCRF EnMAP rot (672 nm)	0.0766	0.0808	0.0849	0.0833	0.0672	0.0893	0.1032			0.1131	0.1008				0.0864	0.0778	0.0766	0.0735	0.0826	0.0816	0.0687
HCRF EnMAP NIR (864 nm)	0.2599	0.2683	0.2595	0.2684	0.2508	0.2786	0.3113			0.3345	0.3202					0.2741	0.2608	0.2570	0.2716		0.2431
ANIF EnMAP rot (672 nm)	0.9200	0.9711	1.0197	1.0010	0.8078	1.0733	1.2395	1.1728	1.2140	1.3594	1.2114		1.1430			0.9344	0.9200	0.8828	0.9924		0.8252
ANIF EnMAP NIR (864 nm)	0.9694	1.0004	0.9676	1.0008	0.9353	1.0390	1.1609	1.1055	1.2345	1.2476	1.1941					1.0222	0.9725	0.9585	1.0129	0.9933	0.9064
Rel. Blue Absorption Depth	0.3672	0.3555	0.3544	0.3624	0.3955	0.3775	0.4210			0.4132	0.4397					0.3828	0.3669	0.3662	0.3553	0.3516	0.3843
Rel. Red Absorption Depth	0.8963	0.8666	0.7726	0.8320	1.0086	0.8159	0.7912			0.7646	0.8278					0.9392	0.8965	0.9205	0.8513	0.8462	0.9400
NDVI (EnMAP)	0.5449	0.5369	0.5071	0.5262	0.5772	0.5144	0.5022			0.4946	0.5210					0.5580	0.5460	0.5554	0.5336	0.5309	0.5594
Nadir Norm NDM (AWHRR)	1.0361	1.0197	0.9693	0.9994	1.0870	0.9783	0.9562	0.9619		0.9411	0.9785		0.9892			1.0561	1.0359	1.0500	1.0076	1.0060	1.0515
Nadir Norm NDM (MODIS)	1.0365	1.0203	0.9674	0.9999	1.0888	0.9785	0.9576	0.9624		0.9420	0.9808		0.9904			1.0575	1.0369	1.0527	1.0085	1.0085	1.0544
Nadir Norm NDM (EnMAP)	1.0354	1.0203	0.9635	0.9999	1.0968	0.9775	0.9542	0.9588	1.0114	0.9398	0.9901	0.9218	0.9882	1.0610	0.9993	1.0603	1.0376	1.0553	1.0139	1.0087	1.0629
(cont.)																					
FBG1_03						Vie	wing Ge	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	iewing Z	enith Ang	yle View	ing Azim	uth Angle	5							
(SZA= 47°; SAA= 180°)	20 135		20 170	30 180		30 202.5	30 225	- 1	30 315 3	30 337.5 30 350	- 1	- 1		ᆈ	30 45	30 90	- 1	30 157.5	30 170		
HCRF EnMAP blue (479 nm)	0.0493	0.0544	0.0543	0.0640		0.0618	0.0557			0.0448							0.0564	0.0568	0.0639		
HCRF EnMAP green (549 nm)	0.0775	0.0874	0.0874	0.1059	0.1055	0.0991	0.0888	0.0797	0.0711	0.0679	0.0643	0.0600	0.0679	0.0621	0.0638	0.0621	0.0920	0.0937	0.1031		
HCRE FUMAP IOU (6/2 IIII)	0.0930	0.3209	0.324	0.1130	0.3736	0.1.00	0.1039			0.0010	0.0756					0.0746	0.3311	0.3336	0.1202		
ANIF EnMAP rot (672 nm)	1.1266	1.2538	1.2446	1.4367	1.4537	1.4035	1.2721			0.9737	0.8825					0.8969	1.2922	1.2762	1.4443		
ANIF EnMAP NIR (864 nm)	1.0693	1.1968	1.1986	1.3955	1.3933	1.2663	1.1553	1.1774	1.0926	1.0070	1.0314					0.8600	1.2347	1.2443	1.3228		
Rel. Blue Absorption Depth	0.3967	0.4158	0.4254	0.4445	0.4408	0.4254	0.4283	0.4110	0.3847	0.3545	0.3771	0.3778	0.3591	0.3503	0.3137	0.3772	0.4185	0.4319	0.4212		
Rel. Red Absorption Depth	0.7953	0.8034	0.8139	0.8255	0.8113	0.7471	0.7456		0.9165	0.8728	1.0205				0.7332	0.7935	0.8166	0.8268	0.7629		
NDVI (EnMAP)	0.5071	0.5093	0.5125	0.5157	0.5108	0.4881	0.4906		0.5521	0.5383	0.5803					0.5109	0.5096	0.5171	0.4938		
Nadir Norm NDVI (AVHRR)		0.9661	0.9712	0.9710	0.9613	0.9284	0.9331	1.0377	1.0459	1.0238	1.0910	1.0832	1.0160	1.0192	0.9460	0.9756	0.9642	0.9717	0.9335		
Nadir Norm, NDVI (MODIS)	0.9048	0.9677	0.9730	0.8700	0.9001	0.9318	0.9304	1.0422	1.0491	1.0262	1.0950	1.0887	1.0188				0.9677	0.9760	0.9373		
	1		3	3	3		7.00	1			11011		212	1	1	1	2000	0.00	2000		

Table C.1-5: Spectro-directional data of the FBG1_04 spectro-goniometer measurement.

20.00							7	S. Suirie	Amount A	Samina 7	Moudan Comment Moudan Zonish Angle Moudan Animath Angle)	1011	inc A-im	April April							
(SZA = 50°; SAA = 217°)	00	5 180	5 202.5	5 225	5 270	5 315	5 337.5	510 510	5 22.5	5 45	5190 5190	5 135	5 157.5	10 180	0 190	10 202.5	10 225	10 270	10 315 1	10 337.5	10 350
HCRF EnMAP blue (479 nm)	۵	0.0522	0.0572	0.0525	0.0454	0.0426	0.0410	0.0389	0.0441	0.0488	I۲	ı		ı				ı			0.0415
HCRF EnMAP green (549 nm)		0.0814	0.0852	0.0814	0.0695	0.0658	0.0631	0.0640	0.0662	0.0743	0.0754			0.0887					0.0675		0.0634
HCRF EnMAP rot (672 nm)		0.0944	0.1039	0.0988	0.0850	0.0784	0.0752	0.0712	0.0814	0.0880	0.0933	0.0960									0.0762
HCRF EnMAP NIR (864 nm)	0.2557	0.3022	0.3028	0.2944	0.2657	0.2542	0.2510	0.2658	0.2437	0.2742	0.2708	0.2986	0.2927	0.3198	0.3117	0.3245	0.3126		0.2659		0.2396
ANIF EnMAP rot (672 nm)	1.0000	1.1313	1.2462	1.1846	1.0192	0.9402	0.9017	0.8541	0.9759	1.0555	1.1184	1.1509	1.1430	1.2991	1.2293	1.2648	1.2684	1.2059	0.9694	0.9072	0.9133
ANIF EnMAP NIR (864 nm)	1.0000	1.1819	1.1843	1.1514	1.0389	0.9942	0.9817	1.0393	0.9531	1.0725	1.0592	1.1677	1.1447	1.2506	1.2189	1.2691	1.2225	1.1557	1.0399	0.9581	0.9369
Rel. Blue Absorption Depth	0.3624	0.3913	0.3591	0.3945	0.3725	0.3726	0.3752	0.4287	0.3574	0.3667		0.4115	0.4077	0.4005							0.3655
Rel. Red Absorption Depth	0.7948	0.8442	0.7506	0.7692	0.8189	0.8510	0.8926	1.0258	0.7538	0.8046	0.7405	0.8201	0.7998	0.7634		0.8142	0.7640	0.7526			0.8214
NDVI (EnMAP)	0.5081	0.5241	0.4889	0.4974	0.5151	0.5285	0.5389	0.5772	0.4993	0.5140	0.4876	0.5134	0.5086	0.4938	0.5049	0.5093	0.4943	0.4921	0.5337	0.5280	0.5175
Nadir Norm NDVI (AVHRR)	1.0000	1.0192	0.9630	0.9813	1.0174	1.0356	1.0585	1.1184	0.9845	1.0014	0.9621	0.9974	0.9974	0.9665	0.9931	1.0010	0.9756	9696.0	1.0487	1.0319	1.0175
Nadir Norm NDVI (MODIS)	1.0000	1.0217	0.9623	0.9816	1.0177	1.0375	1.0598	1.1216	0.9848	1.0026	0.9630	0.9998	0.9979	0.9673	0.9944	1.0023	0.9764	0.9700	1.0499	1.0346	1.0186
Nadir Norm NDM (EnMAP)	1.0000	1.0316	0.9623	0.9791	1.0139	1.0402	1.0607	1.1361	0.9827	1.0116	0.9598	1.0105	1.0011	0.9719	0.9938	1.0025	0.9728	0.9686	1.0503	1.0393	1.0185
(cont)																					
FBG1 04							Vie	wing Ge	ometry (V	fewing Z	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	le View	ing Azim	uth Angle	3						Γ
(SZA = 50°; SAA = 217°)	100	10 10	10 22.5	10 45	10 90	10 135	10 157.5	10 170	20 180	20 190	20 202.5 20 225	20 225	20 270	20 315 20 337.5	1337.5	20 350	200	20 10	20 22.5	20 45	20 90
HCRF EnMAP blue (479 nm)	0.0401	0.0368	0.0359	0.0352	0.0393	0.0519	0.0507	0.0548	0.0619	0.0648	0.0599	0.0547	0.0529	0.0428	0.0415	0.0387	0.0397	0.0379	0.0380	0.0351	0.0434
HCRF EnMAP green (549 nm)	0.0618	0.0573	0.0574	0.0559	0.0622	0.0846	0.0800	0.0836	0.0962	0.0979		0.0876	0.0817	0.0659			0.0599		0.0591		0.0703
HCRF EnMAP rot (672 nm)		0.0679	0.0665	0.0632	0.0717	0.0968	0.0944	0.1025	0.1174	0.1236		0.1002				0.0693			0.0705		0.0781
HCRF EnMAP NIR (864 nm)	0.2399	0.2310	0.2416	0.2366	0.2478	0.3161	0.2972	0.2919	0.3189	0.3179	0.3267	0.3282	0.3090			0.2314			0.2415		0.2695
ANIF EnMAP rot (672 nm)		0.8142	0.7972	0.7581	0.8600	1.1610	1.1322	1.2286	1.4070	1.4819	1.3916	1.2016	1.1819								0.9369
ANIF EnMAP NIR (864 nm)		0.9034	0.9449	0.9254	0.9692	1.2360	1.1624	1.1415	1.2470	1.2431	1.2777	1.2834	1.2086						0.9443		1.0542
Rel. Blue Absorption Depth		0.3740	0.3978	0.3845	0.3975	0.4406	0.4094	0.3875	0.3997	0.3898		0.4107	0.3917	0.3660							0.4165
Rel. Red Absorption Depth		0.8985	0.9864	1.0114	0.9249	0.8719	0.8242	0.7182	0.6787	0.6319		0.8732	0.8295	0.9035							0.9265
NDVI (EnMAP)	0.5256	0.5456	0.5684	0.5783	0.5511	0.5309	0.5178	0.4803	0.4619	0.4401		0.5321	0.5163	0.5438			0.5363	0.5301	0.5480		0.5505
Nadir Norm NDM (AWHRR)	1.0326	1.0687	1.1074	1.1187	1.0697	1.0316	1.0094	0.9438	0.9091	0.8749	0.9414	1.0339	1.0143	1.0582		1.0504	1.0475	1.0364	1.0711	1.0395	1.0567
Nadir Norm NDM (MODIS)	1.0336	1.0694	1.1100	1.1216	1.0733	1.0353	1.0107	0.9442	0.9102	0.8754	0.9420	1.0364	1.0166	1.0608		1.0533	1.0507	1.0375	1.0731	1.0416	1.0623
Nadir Norm NDM (EnMAP)	1.0346	1.0739	1.1187	1.1381	1.0847	1.0450	1.0191	0.9454	0.9092	0.8661	0.9363	1.0473	1.0162	1.0702	1.0799	1.0612	1.0556	1.0433	1.0785	1.0530	1.0835
(cost)																					
FBG1 04						Vie	wing Ge	ometry (V	Tewing Z	enith And	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	ing Azim	uth Angle	2							
(SZA = 50°; SĀA = 217°)	20 135 2	20 157.5	20 170	30 180	30 190	30 202.5	30 225	30 270	30 315	30 337.5 30 350	30 350	3010	30 10	30 122.5	30 45	30 90	30 135	30 157.5	30 170		
HCRF EnMAP blue (479 nm)	0.0519	0.0568	0.0615	0.0679	0.0662	0.0637	0.0586	0.0575	0.0494	0.0418	0.0407	0.0403	0.0417	0.0401		0.0491	0.0555	0.0640	0.0654		
HCRF EnMAP green (549 nm)		0.0931	0.0983	0.1091	0.1071	0.1015	0.0960	0.0874	0.0749	0.0643		0.0587	0.0622						0.1042		
HCRF EnMAP rot (672 nm)	0.0954	0.1037	0.1136	0.1279	0.1272	0.1201	0.1096	0.1060	0.0871	0.0747		0.0700	0.0736	0.0693			0.1019		0.1221		
HCRF EnMAP NIR (864 nm)	0.2977	0.3291	0.3319	0.3597	0.3634	0.3466	0.3567	0.3141	0.2841	0.2528		0.2179		0.2330			0.3333		0.3415		
ANIF EnMAP rot (672 nm)	1.1440	1.2431	1.3625	1.5335	1.5255	1.4404	1.3143	1.2703	1.0449	0.8957		0.8390				1.0564	1.2219		1.4643		
ANIF EnMAP NIR (864 nm)	1.1644	1.2869	1.2980	1.4067	1.4213	1.3556	1.3949	1.2285	1.1110	0.9887		0.8522							1.3357		
Rel. Blue Absorption Depth	0.4143	0.4440	0.4218	0.4344	0.4402	0.4185	0.4297	0.3673	0.3601	0.3672		0.3228							0.4211		
Rel. Red Absorption Depth	0.8138	0.8303	0.7404	0.7184	0.7401	0.7481	0.8796	0.7589	0.8730	0.9010		0.7954	0.8350						0.7046		
NDVI (EnMAP)	0.5146	0.5208	0.4899	0.4754	0.4814	0.4852	0.5298	0.4956	0.5305	0.5438		0.5139	0.5254						0.4732		
Nadir Norm NDM (MODIS)	0.9930	0.9996	0.9491	0.9264	0.9445	0.9488	1.0266	0.9734	1.0330	1.0613	1.0166	1.0005	1.0215	1.0483	1.0907	1.0234	1.0261	0.9655	0.9211		
Nadir Norm, NDV (EnMAP)	1 0128	1 0251	0.9642	0.9357	0.9474	0.9550	1 0428	0.9754	10441	1 0703	1 0249	10114	1 0341	1.0661	1 1126	1 0472			0.9343		
																	ı	ı			

Table C.1-6: Spectro-directional data of the FBG1_05 spectro-goniometer measurement.

PDC4 06							1/10	og ouim	A tout	Tomino 7	Moudes Commentar Moudes Zonith Apolo Moudes Azimuth Apolo	In Mon	ing Azim	oloup 44							
(SZA = 59°; SAA = 252°)	00	5 180	5 202.5	5 225	5 270	5 315	5 337.5	510 510	5 22.5	5 45	5190	5 135 (5 157.5	10 180	01190	10 202.5 1	10 225 1	10 270 1	10 315 10	10 337.5 1	10 350
HCRF EnMAP blue (479 nm)	0.0351	0.0483	0.0486	0.0503	0.0414	0.0384	0.0363	0.0323	0.0385	0.0413	0.0411	0.0482	0.0521	0.0549 (0.0502	0.0486	0.0514	0.0425 0	0.0384 0	0.0329	0.0342
HCRF EnMAP green (549 nm)	0.0552	0.0783	0.0776	0.0806	0.0656	0.0604	0.0571	0.0516	0.0599	0.0647									0.0609		0.0548
HCRF EnMAP rot (672 nm)	0.0631	0.0872	0.0906	0.0941	0.0756	0.0684	0.0671	0.0588	0.0692	0.0730		0.0920	0.0967	0.0996	0.0932	0.0922	0.0955 (0.0691 0	0.0598	0.0616
HCRF EnMAP NIR (864 nm)	0.2284	0.3017	0.2992	0.3090	0.2667	0.2393	0.2356	0.2207	0.2401	0.2538	0.2574	0.3024	0.3039 (0.2976 (0.3004	0.2992 0	0.3010	0.2515 0	0.2463 0	0.2295 (0.2263
ANIF EnMAP rot (672 nm)	1.0000	1.3820	1.4355	1.4909	1.1984	1.0843	1.0643	0.9314	1.0967	1.1575	1.1835	1.4577	1.5331	1.5795	1.4774	1.4622 1	1.5131 1	1.2058 1	1.0946 0	0.9484 (9926.0
ANIF EnMAP NIR (864 nm)	1.0000	1.3210	1.3097	1.3528	1.1677	1.0478	1.0313	0.9663	1.0512	1.1111	1.1270		1.3305	1.3031	1.3152 1	1.3100 1		1.1013 1		1.0048 (0.9905
Rel. Blue Absorption Depth	0.3876	0.4210	0.4229	0.4122	0.3987	0.3829	0.3809	0.3918	0.3718	0.3885				0.3893 (0.4095
Rel. Red Absorption Depth	0.9795	0.9494	0.8980	0.8856	0.9790	0.9510	0.9524	1.0274	0.9350	0.9272	0.9322	0.8855	0.8441 (0.7726 (0.8689	0.8780	0.8497 (0.8959 0	0.9803 1	1.0582 1	1.0024
NDVI (EnMAP)	0.5672	0.5517	0.5353	0.5333	0.5583	0.5554	0.5564	0.5795	0.5526	0.5531	0.5503			0.4984 (0.5264 (0.5287 0		0.5356 0	0.5621 0	0.5864 (0.5719
Nadir Norm NDM (AWHRR)	1.0000	0.9692	0.9486	0.9471	0.9904	0.9795	0.9845	1.0214	0.9720	0.9622	0.9636	0.9485	0.9191 (0.8813 (0.9340	0.9387 0	0.9241	0.9517 0	0.9882 1	1.0312	1.0021
Nadir Norm NDM (MODIS)	1.0000	0.9720	0.9493	0.9470	0.9908	0.9806	0.9835	1.0222	0.9722	0.9644	0.9657		0.9191 (0.8817 (0.9345 (0.9386 (0.9231 (0.9512 0	0.9898 1	1.0329 1	1.0048
Nadir Norm NDM (EnMAP)	1.0000	0.9727	0.9437	0.9403	0.9844	0.9793	0.9810	1.0218	0.9744	0.9753	0.9703	0.9409	0.9118 (0.8787 (0.9282 (0.9322 0	0.9141 (0.9444 0	0.9910 1	1.0340 1	1.0084
(coat)																					
FBG1 05							Vie	wing Geo	ometry (V	lewing Z	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	le View	ing Azim	th Angle							Γ
(SZA = 59°; SAA = 252°)	100	10 10	10 22.5	10 45	10 90	10 135	10 157.5	10 170	20 180	20 190	20 202.5 20 225	20 225	20 270	20 315 20 337.5	337.5	20 350	200	20 10 2	20 22.5	20 45	20 90
HCRF EnMAP blue (479 nm)	0.0340	0.0396	0.0415	0.0435	0.0409	0.0538	0.0543	0.0523	0.0591	0.0584	0.0542	0.0550	0.0394 (0.0372 (0.0337	0.0368	0.0312	0.0368 0	0.0406 0	0.0462 (0.0408
HCRF EnMAP green (549 nm)	0.0547	0.0603	0.0645	0.0678	0.0670	0.0863	0.0860	0.0808	0.0983	0.0958	0.0871	0.0871	0.0629		0.0531	0.0556 (0.0491		0.0619 0	0.0743 (0.0677
HCRF EnMAP rot (672 nm)	0.0616	0.0715	0.0737	0.0803	0.0731	0.1025	0.1004	0.0957	0.1077	0.1087	0.1024	0.1046	0.0698	0.0667		0.0670		0.0669 0	0.0721 0		0.0745
HCRF EnMAP NIR (864 nm)	0.2328	0.2346	0.2631	0.2611	0.2760	0.3248	0.3258	0.2879	0.3569	0.3575	0.3352	0.3317	0.2619 (0.2536 (0.2210			0.2426 0		0.2841
ANIF EnMAP rot (672 nm)	0.9759	1.1331	1.1688	1.2726	1.1593	1.6245	1.5922	1.5172	1.7075	1.7227											1.1811
ANIF EnMAP NIR (864 nm)	1.0194	1.0272	1.1518	1.1431	1.2085	1.4218	1.4263	1.2604	1.5624	1.5650											1.2437
Rel. Blue Absorption Depth	0.4022	0.3661	0.3788	0.3932	0.4341	0.4291	0.4037	0.3833	0.4437	0.4329											0.4454
Rel. Red Absorption Depth	1.0331	0.8571	0.9604	0.8635	1.0397	0.8508	0.8766	0.7846	0.9068	0.9072											1.0670
NDVI (EnMAP)	0.5818	0.5330	0.5622	0.5296	0.5811	0.5202	0.5287	0.5010	0.5363	0.5337				_							0.5844
Nadir Norm NDM (AWHRR)	1.0209	0.9398	0.9810	0.9347	1.0122	0.9174	0.9347	0.8902	0.9368	0.9414		0.9267									1.0207
Nadir Norm NDM (MODIS)	1.0223	0.9403	0.9829	0.9363	1.0154	0.9190	0.9353	0.8905	0.9397	0.9436		0.9269									1.0239
Nadir Norm NDM (EnMAP)	1.0257	0.9397	0.9912	0.9339	1.0246	0.9173	0.9321	0.8833	0.9456	0.9411	0.9382	0.9179	1.0207	1.0293	1.0102	0.9433 1	1.0293 (0.9631 0	0.9552 0	0.9616 1	1.0304
(cost)																					
FBG1 05						Ņ	wing Ge	ometry (V	Jewing Z	enith And	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	ing Azim	uth Angle	_					Г		
(SZA = 59°; SĀA = 252°)	20 135 2	20 157.5	20 170	30 180	30 190	30 202.5	30 225	30 270	30 315	30 337.5 30 350	30 350	3010	30 10 3	1122.5	30 45	30 90	30 135 30	30 157.5 3	30 170		
HCRF EnMAP blue (479 nm)	0.0541	0.0565	0.0581	0.0633	0.0700	0.0652	0.0651	0.0477	0.0436	0.0386									0.0617		
HCRF EnMAP green (549 nm)	0.0860	0.0907	0.0957	0.1101	0.1131	0.1037	0.1026	0.0734	0.0641	0.0612									0.1074		
HCRF EnMAP rot (672 nm)	0.1017	0.1080	0.1110	0.1173	0.1322	0.1239	0.1233	0.0844	0.0746	0.0672									0.1167		
HCRF EnMAP NIR (864 nm)	0.3145	0.3260	0.3485	0.4050	0.3960	0.3818	0.3650	0.2735	0.2451	0.2618									0.3913		
ANIF ENMAP rot (672 nm)	1.612/	1./114	1.7588	1.8594	2.0960	1.963/	1.9546	1.3384	1.1820	1.0646									1.8491		
ANIF EnMAP NIR (864 nm)	1.3768	1.42/4	1.5256	1.7730	1.7336	1.6714	1.5982	1.1975	1.0730	1.1461									1.7132		
Rei. Blue Absorption Deptin	0.4241	0.4209	0.4417	0.4772	0.4233	0.4130	0.3979	0.3097	0.3255	0.3873									0.4800		
Kel. Ked Absorption Depth	0.8235	0.7958	0.84/3	0.9731	0.8040	0.8286	0.7931	0.8/49	0.8646	1.08/5	0.9756	0.97.26	0.9463 (0.9627	1.0585	1.1346	0.80/1	0.8208	0.9260		
Nadir Norm NDVI (AVHRR)	0.9058	0.9024	0.0170	0.000	0.8852	0.0100	0.4330	0.0202	0.9355	1 0326									0.940		
Nadir Norm NDM (MODIS)	0.9074	0.8910	0.9154	0.9619	0.8867	0.9040	0.8842	0.9365	0.9379	1.0364				•					0.9451		
Nadir Norm NDM (EnMAP)	0.9012	0.8859	0.9115	0.9711	0.8804	0.8992	0.8728	0.9314	0.9405	1.0432	0.9981	0.9991	0.9898	1.0027	1.0335 1	1.0497	0.8879	0.8953 0	0.9534		

Table C.1-7: Spectro-directional data of the FBG1_06 spectro-goniometer measurement.

30.70							78.0	Series Co.	A vent	Tourist 7	anith And	1 1/1011	Inc. Anima	olena dt.	-						
(SZA = 68°; SAA = 278°)	000	51180	51202.5	51225	51270	51315	51337.5	90 GEW	5122.5	5145	Viewning Geometry (Viewning Zeintri Augle) viewning Azimuti Augle) 5 510 512.5 5145 5190 51135 51157.5 101180 1	5I135	51157.5	10/180 .	01190	10 202.5	101225	101270	101315 1	101337.5	101350
HCRF EnMAP blue (479 nm)	_ا ا	I.	0.0419	0.0368	Ι.	0.0370	0.0396	2	0.0425	۱"	۱"	ı		ı				ı			0.0388
HCRF EnMAP green (549 nm)		0.0749	0.0660	0.0571		0.0586	0.0644	0.0697	0.0662										0.0600		0.0612
HCRF EnMAP rot (672 nm)	0.0518	0.0870	0.0751	0.0657	0.0507	0.0665	0.0723	0.0810	0.0797	0.0652	0.0753	0.0838	0.0662	0.0824 (0.0773	0.0719	0.0642		0.0664	0.0741	0.0695
HCRF EnMAP NIR (864 nm)	0.1888	0.2684	0.2546	0.2258	0.1911	0.2334	0.2675	0.2802	0.2614	0.2361	0.2514	0.2568	0.2184	0.2709	0.2477 (0.2442	0.2294	0.2128	0.2446	0.2436	0.2595
ANIF EnMAP rot (672 nm)	1.0000	1.6772	1.4490	1.2671	0.9782	1.2818	1.3944	1.5619	1.5379	1.2573	1.4519	1.6162	1.2776	1.5901	1.4902	1.3872	1.2382	1.1604	1.2807	1.4291	1.3400
ANIF EnMAP NIR (864 nm)	1.0000	1.4215	1.3484	1.1955	1.0118	1.2361	1.4163	1.4839	1.3844	1.2501	1.3310	1.3601	1.1564	1.4345		1.2932	1.2149		1.2952		1.3744
Rel. Blue Absorption Depth		0.4026	0.3879	0.3738	0.3596	0.3999	0.4164	0.3985	0.3922	0.3990	0.4114					0.4047			0.4070		0.3934
Rel. Red Absorption Depth	0.9947	0.8309	0.9507	0.9522	1.0411	0.9414	1.0237	0.9414	0.8693	0.9915	0.8921		0.8804	0.9013 (0.9326		0.9636	1.0107		1.0152
NDVI (EnMAP)		0.5106	0.5444	0.5492	0.5805	0.5568	0.5744	0.5516	0.5326	0.5672									0.5730		0.5777
Nadir Norm NDM (AWHRR)	1.0000	0.9091	0.9711	0.9795	1.0231	0.9810	1.0138	0.9777	0.9519	1.0025	0.9560	0.9132	0.9422	0.9472 (0.9402 (0.9689	0.9974	0.9867	1.0095	0.9483	1.0219
Nadir Norm NDVI (MODIS)	1.0000	0.9110	90.6	9626.0	1.0232	0.9835	1.0153	0.9790	0.9528	1.0049	0.9585	0.9139	0.9451	0.9491 (0.9399	0.9699	0.9981	0.9884	1.0124	0.9490	1.0230
Nadir Norm NDVI (EnMAP)	1.0000	0.8972	0.9564	0.9649	1.0199	0.9782	1.0092	0.9691	0.9357	0.9966	0.9471	0.8926	0.9392	0.9371	0.9214 (0.9575 (0.9887	0.9824	1.0066	0.9374	1.0149
(taos)																					
FBG1 06							Vie	wing Geo	metry (V	Tewing Z	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	le View	ing Azim	ıth Angle							Γ
(SZA = 68°; SAA = 278°)	100	10 10	10 22.5	10 45	10 90	10 135	10 157.5	10 170	20 180	20 190	20 202.5 20 225	20 225	20 270	20 315 20 337.5	337.5	20 350	2010	20 10	20 22.5	20 45	20 90
HCRF EnMAP blue (479 nm)	0.0396	0.0442	0.0420	0.0416	0.0405	0.0462	0.0419	0.0457	0.0433	0.0504	0.0461	0.0438	0.0357	0.0345 (0.0324 (0.0381	0.0411	0.0385	0.0427	0.0391	0.0394
HCRF EnMAP green (549 nm)	0.0648	0.0703	0.0663	0.0670		0.0720	0.0660	0.0710	0.0704	0.0806									0.0682		0.0630
HCRF EnMAP rot (672 nm)	0.0719	0.0830	0.0790	0.0747	0.0723	0.0825	0.0744	0.0833	0.0793	0.0934									0.0780		0.0699
HCRF EnMAP NIR (864 nm)		0.2782	0.2727	0.2674	0.2338	0.2557	0.2439	0.2565	0.2589	0.2918									0.2875		0.2550
ANIF EnMAP rot (672 nm)		1.6006	1.5241	1.4418	1.3936	1.5911	1.4346	1.6061	1.5298	1.8023								1.3448	1.5046		1.3474
ANIF EnMAP NIR (864 nm)		1.4734	1.4443	1.4163	1.2382	1.3539	1.2914	1.3583	1.3711	1.5454								1.4435	1.5225		1.3501
Rel. Blue Absorption Depth		0.4117	0.3966	0.4220	0.3866	0.3905	0.3969	0.3902	0.4204	0.4152							0.3910	0.4341	0.4065		0.4219
Rel. Red Absorption Depth		0.9106	0.9308	0.9922	0.8526	0.8304	0.8770	0.8237	0.8959	0.8565							0.9794	1.1037	1.0284		1.0206
NDVI (EnMAP)		0.5405	0.5507	0.5631	0.5279	0.5121	0.5326	0.5098	0.5310	0.5149				_			0.5644	0.5926	0.5732		0.5699
Nadir Norm NDM (AWHRR)		0.9679	0.9822	0.9931	0.9354	0.9064	0.9450	0.9102	0.9454				0.9888				0.9963	1.0443	1.0200	1.0219	1.0104
Nadir Norm NDVI (MODIS)		0.9694	0.9825	0.9954	0.9364	0.9080	0.9464	0.9100	0.9462								0.9994	1.0476	1.0215	1.0242	1.0130
Nadir Norm NDM (EnMAP)	1.0278	0.9497	9.9676	0.9893	0.9274	0.8997	0.9357	0.8957	0.9330	0.9047	0.9085	0.9266	0.9864	1.0398	1.0607	1.0224	0.9916	1.0412	1.0070	1.0168	1.0012
(cont)																					
FBG1 06						Vie	wing Ge	ometry (V	lewing Z	enith Ang	Viewing Geometry (Viewing Zenith Angle Viewing Azimuth Angle)	ing Azim	uth Angle								
(SZA= 68°; SĀA= 278°)	20 135 20 157.5		20 170	30 180	30 190	30 202.5	30 225	30 270	30 315	30 337.5 30 350	30 350	3010	30 10 3	30/122.5	30 45	- 1	30 135 3	30 157.5	30 170		
HCRF EnMAP blue (479 nm)	0.0485	0.0481	0.0427	0.0497		0.0530	0.0491	0.0438	0.0383	0.0370									0.0520		
HCRF EnMAP green (549 nm)	0.0780	0.0808	0.0695	0.0811		0.0843	0.0771	0.0678	0.0622	0.0564				_					0.0860		
HCRF EnMAP FOT (672 nm)	0.0881	0.0800	0.0780	0.0962	0.1020	2001.0	0.0880	0.0770	0.0084	0.0008	0.0020	0.0000	0.0088	0.0733	0.0084	0.0747	0.1020		0.0993		
ANIE EDM AD rot (672 pm)		1,6700	1 5161	1 8546	1 9787	1 9331	1 7064	1 4960	13187	1 2880								0.3337	1 9149		
ANIF EnMAP NIR (864 nm)	1 4663	1 6162	1 4575	1.5473	1,6836	1.5371	14054	13784	14166	1 2272	13184								1 6593		
Rel. Blue Absorption Depth		0.4467	0.4161	0.4233	0.4321	0.4078	0.3869	0.3803	0.4142	0.3640									0.4408		
Rel. Red Absorption Depth		0.9986	0.9824	0.8239	0.8607	0.7904	0.8152	0.9138	1.0784	0.9172									0.8673		
NDVI (EnMAP)		0.5580	0.5557	0.5048	0.5121	0.4867	0.5000	0.5408	0.5929	0.5524									0.5188		
Nadir Norm NDM (AWHRR)		0.9856	0.9829	0.9133	0.9172	0.8695	0.8934	0.9537	1.0411	0.9862	1.0521	1.0419					0.9142		0.9281		
Nadir Norm NDV (MODIS)	0.9155	0.9885	0.9831	0.9114	7/16.0	0.8693	0.8955	0.9556	1.0447	0.9867	1.0543	1.0452	1.0486	1.0006	1.08/1	1.0136	0.9143	0.8831	0.9269		
	1	8	3				5	10000			1	2	1	1	1	1	1	1	2		

V Main Spectral Characteristics

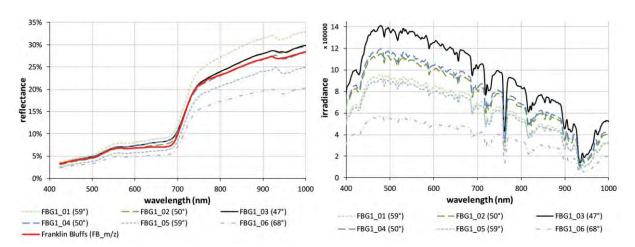


Figure C.1-6: Nadir reflectances and irradiance profiles of the FBG1 site at different sun zenith angles. Left: Comparison of the nadir reflectance signatures with the average zonal vegetation (MNT). Right: Comparison of the total irradiance profiles.

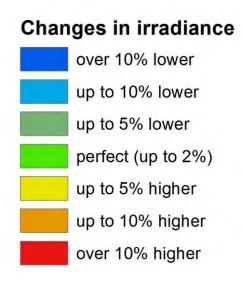


Figure C.1-7: Legend of the outlier indicator graphics shown in Figure C.1-9, C.1-10, and C.1-13

VI HCRF Visualization

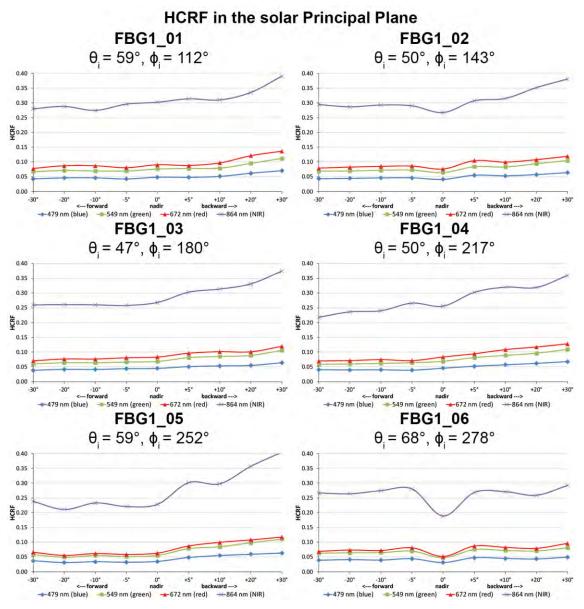


Figure C.1-8: Comparison of the HCRF values at 479 nm (blue), 549 nm (green), 672 nm (red), and 864 nm (NIR) in the solar principal plane of the FBG1 site at different sun zenith angles.

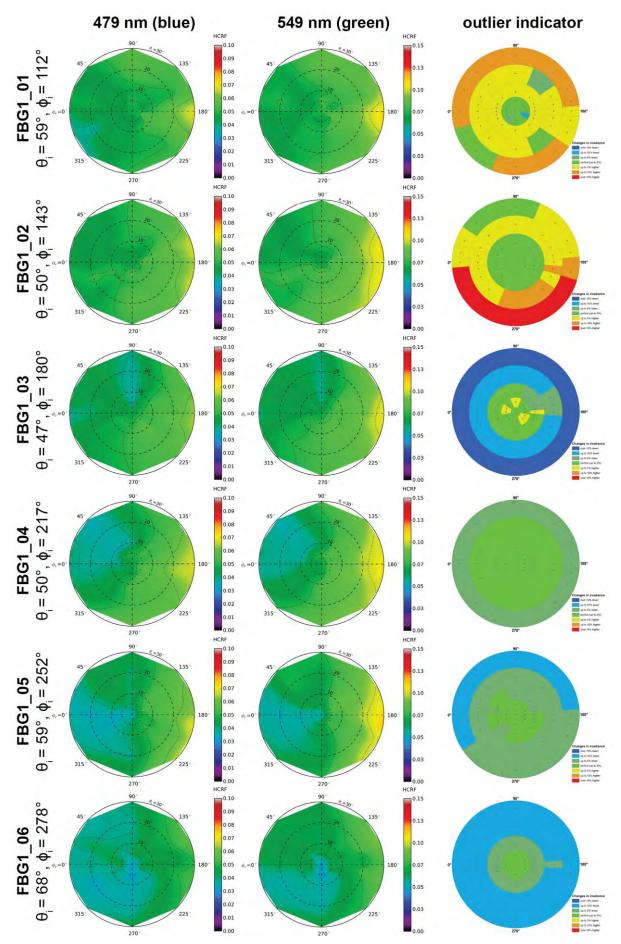


Figure C.1-9: HCRF visualization at 479 nm and 549 nm of the FBG1 site.

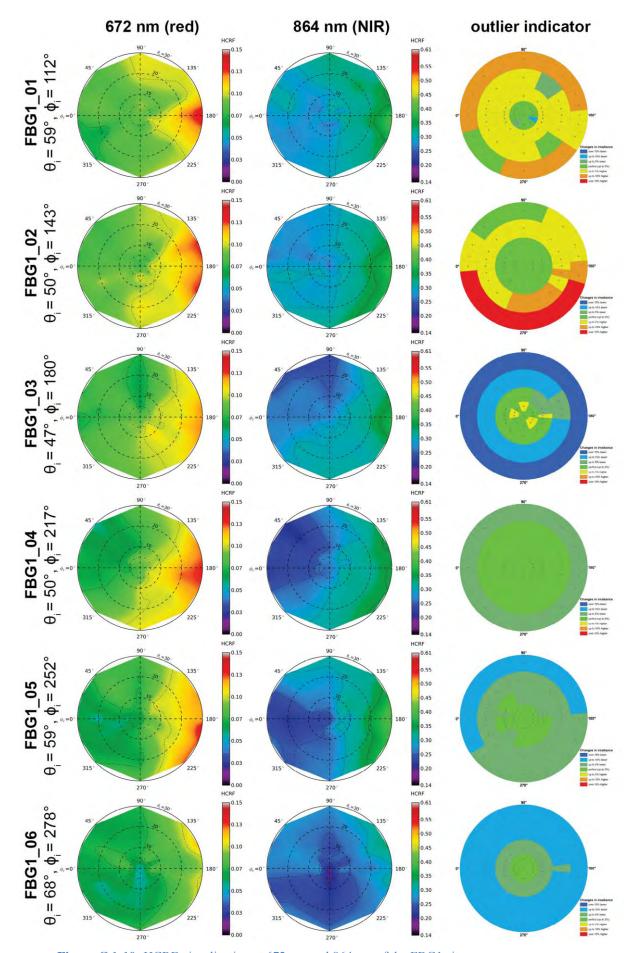


Figure C.1-10: HCRF visualization at 672 nm and 864 nm of the FBG1 site.

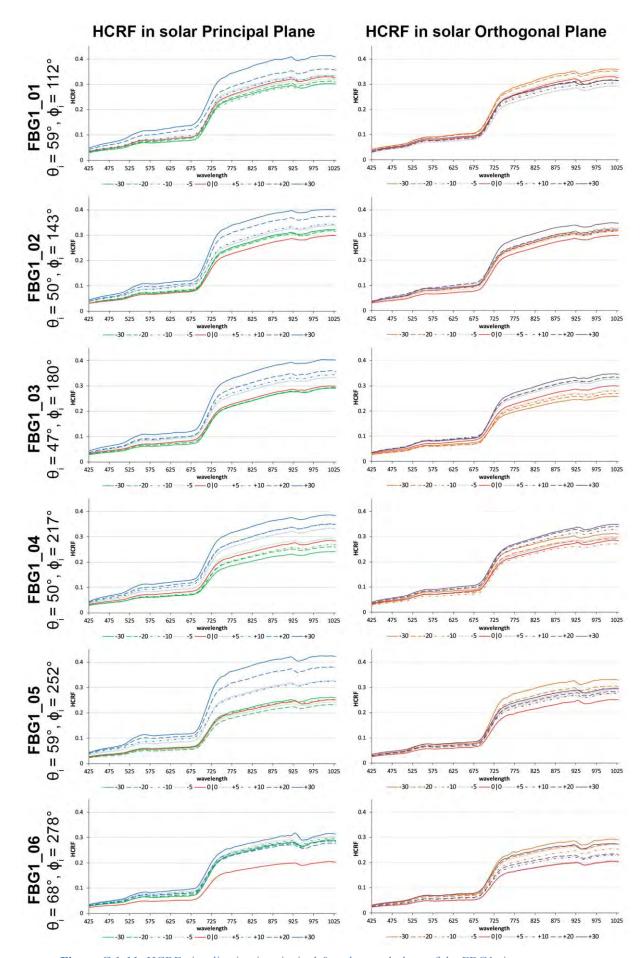


Figure C.1-11: HCRF visualization in principal & orthogonal plane of the FBG1 site.

VII ANIF Visualization

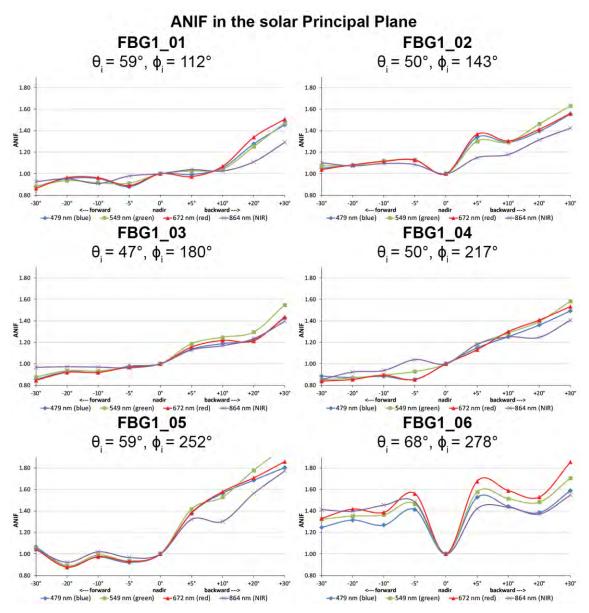


Figure C.1-12: Comparison of the ANIF values at 479 nm (blue), 549 nm (green), 672 nm (red), and 864 nm (NIR) in the solar principal plane of the FBG1 site at different sun zenith angles.

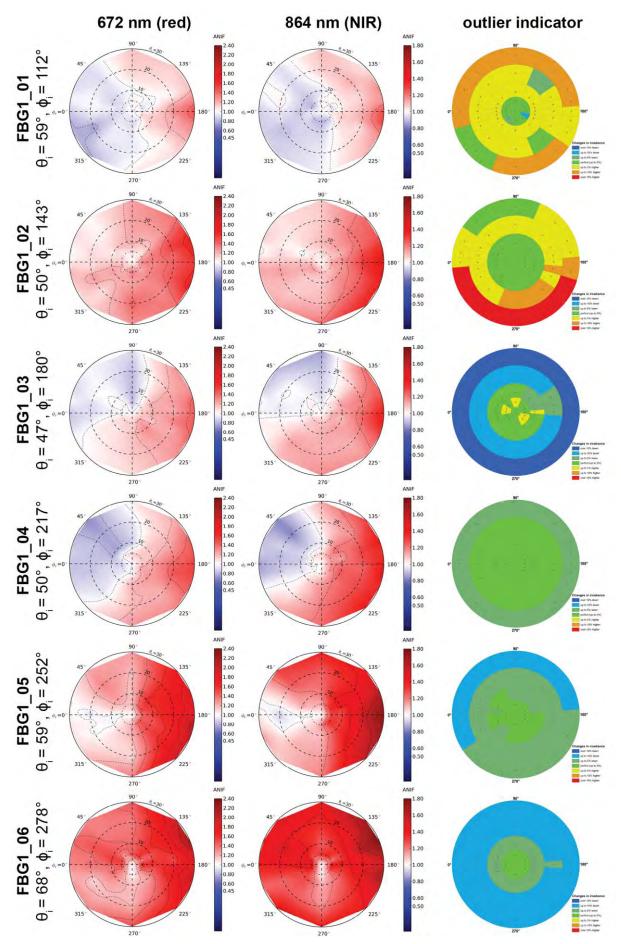


Figure C.1-13: ANIF visualization at 672 nm and 864 nm of the FBG1 site.

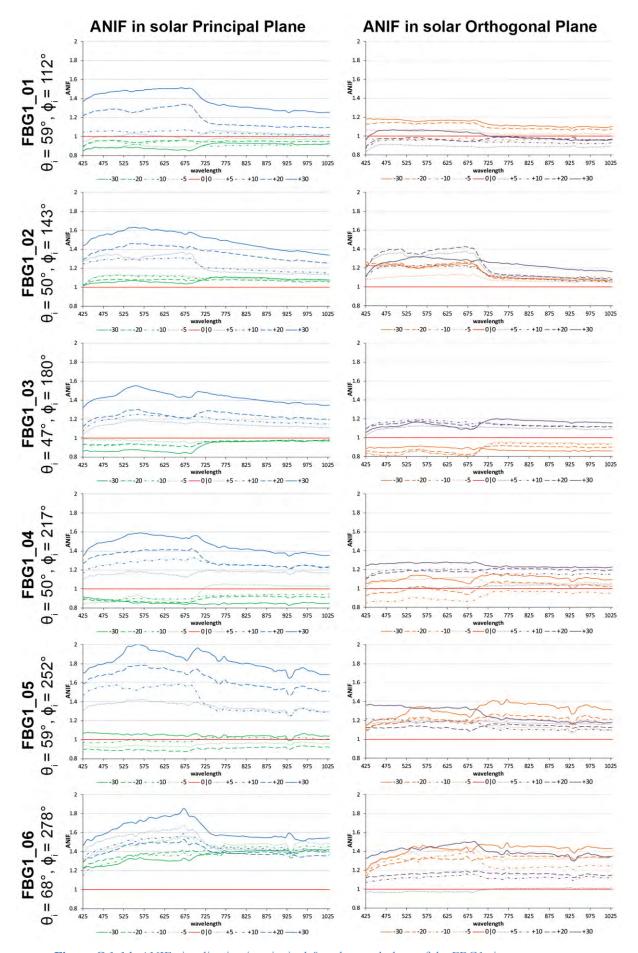
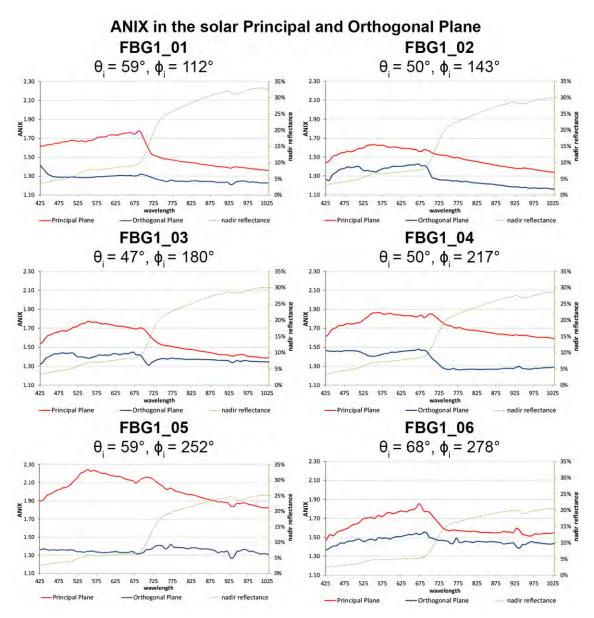


Figure C.1-14: ANIF visualization in principal & orthogonal plane of the FBG1 site.

VIII ANIX Visualization



FigureC.1-15: Comparison of the ANIX in the solar principal and orthogonal plane with the nadir reflectance of the FBG1 site at different sun zenith angles.

IX NDVI and Relative Absorption Depth Visualization

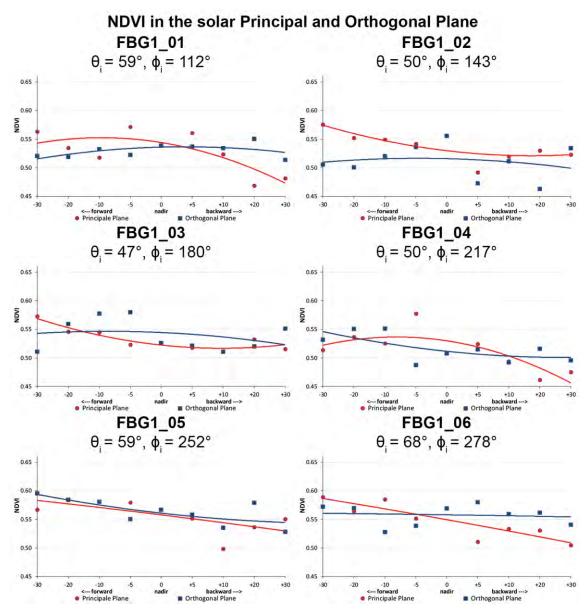


Figure C.1-16: Comparison of the NDVI in the solar principal and orthogonal plane of the FBG1 site at different sun zenith angles.

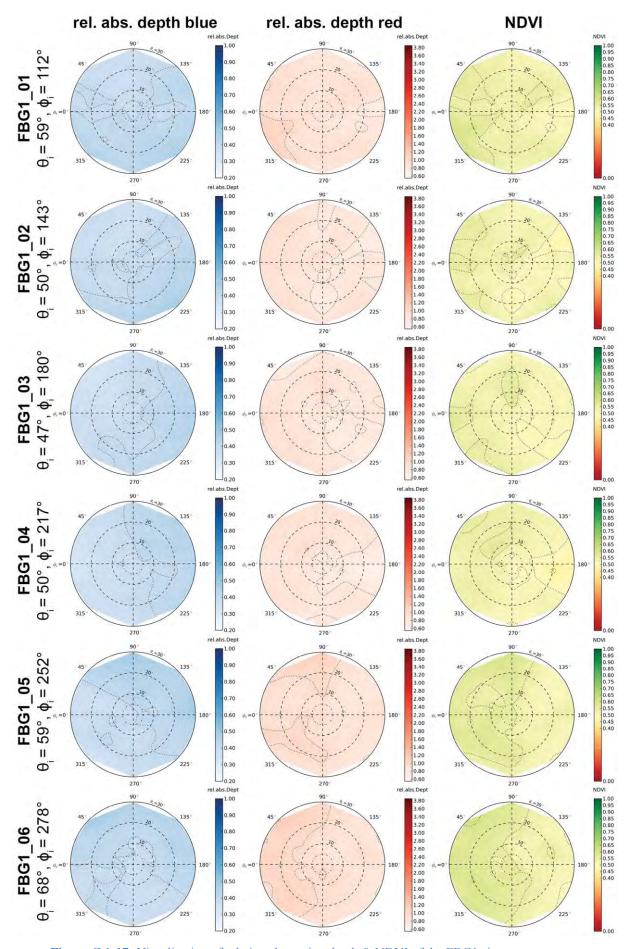


Figure C.1-17: Visualization of relative absorption depth & NDVI of the FBG1 site.

X NDVI Comparison of Different Sensors

Table C.1-8: Center wavelengths and band widths of the broadband and narrowband NDVIs, based on the spectral response curves of the AVHRR, MODIS and EnMAP sensors.

NDVI	Sensor	Sensor band	Center wavelength (nm)	band width (nm)
NDVI _{AVHRR}	AVHRR/3	red: band 1	630	100
[broadband]		NIR: band 2	865	275
NDVI _{MODIS}	MODIS	red: band 1	645	50
[broadband]		NIR: band 2	859	35
NDVI _{EnMAP}	EnMAP	red: band 47	672	6.5
[narrowband]		NIR: band 73	864	8

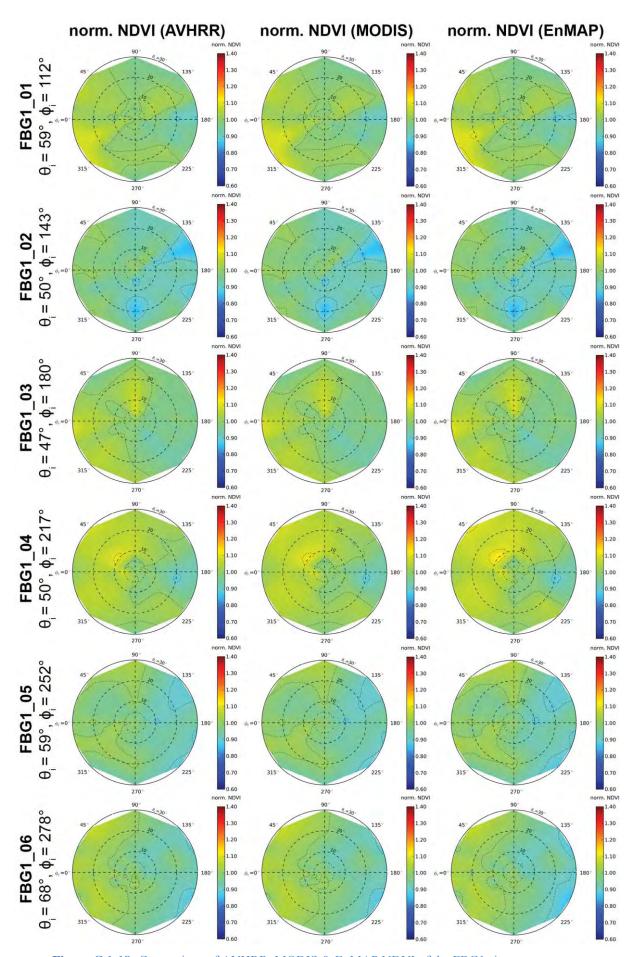


Figure C.1-18: Comparison of AVHRR, MODIS & EnMAP NDVI of the FBG1 site.