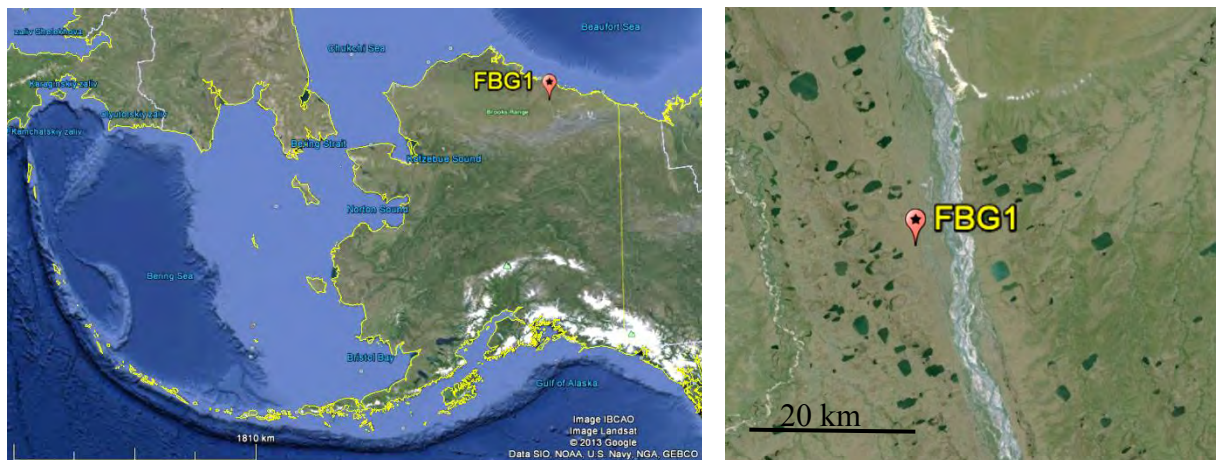


## C.1 Study Site FBG1 (non-tussock sedge, dwarf shrub, moss tundra)

### I Location

Name	Location	Latitude	Longitude	Altitude
<b>FBG1</b>	Franklin Bluffs, Arctic North Slope, Alaska, United States of America	69.674377°	-148,720972°	125 m

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

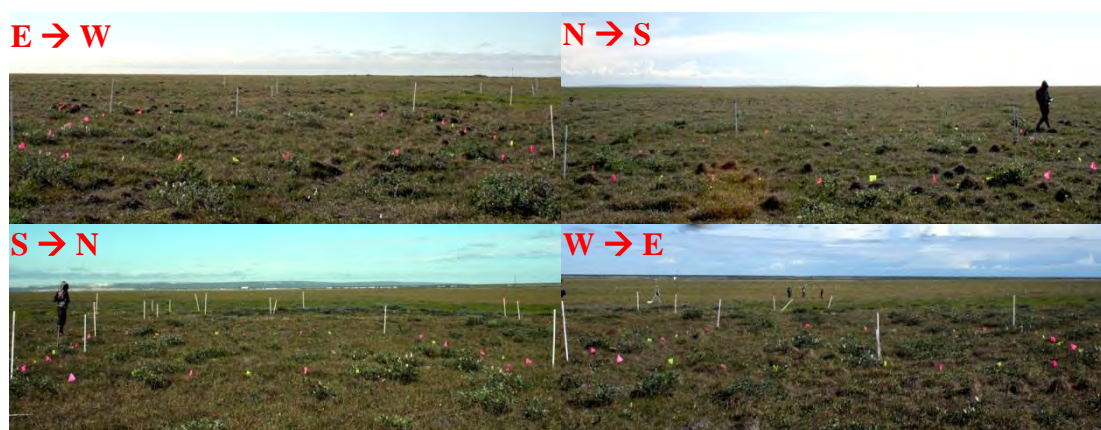


**Figure C.1-2:** Aerial photo of a 10 x 10 m zonal grid at the Franklin Bluffs study location near the FBG1 site. *Source:* [Barreda *et al.*, 2006]

## 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 x 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







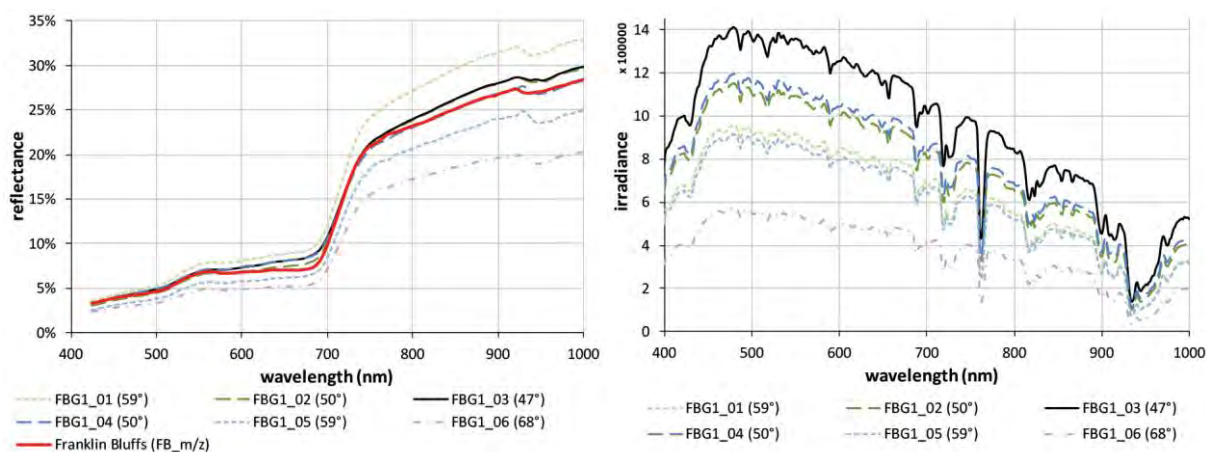








## V Main Spectral Characteristics



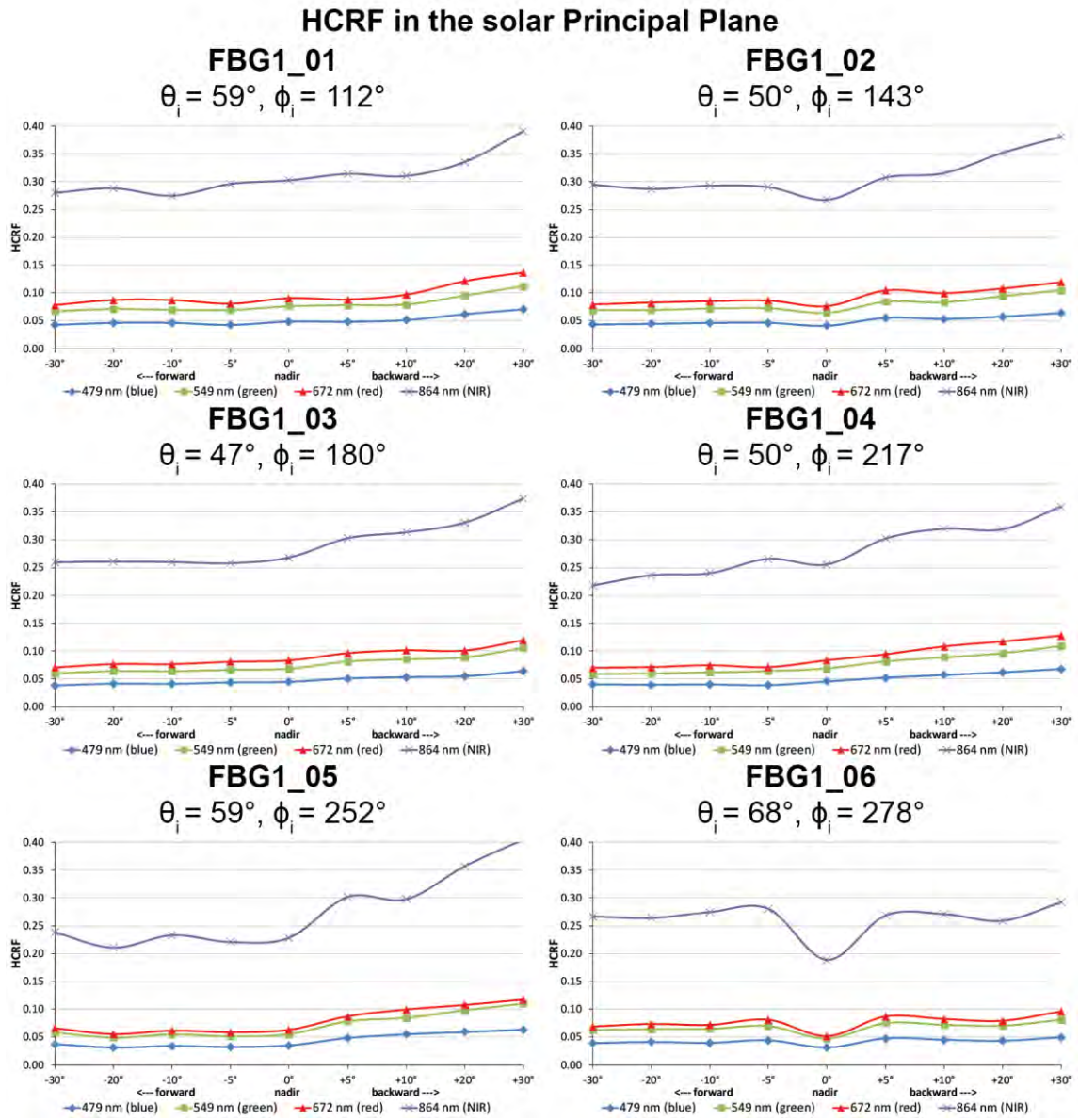
**Figure C.1-6:** Nadir reflectances and irradiance profiles of the FBG1 site at different sun zenith angles. Left: Comparison of the nadir reflectance signatures with the average zonal vegetation (MNT). Right: Comparison of the total irradiance profiles.

### Changes in irradiance



**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.

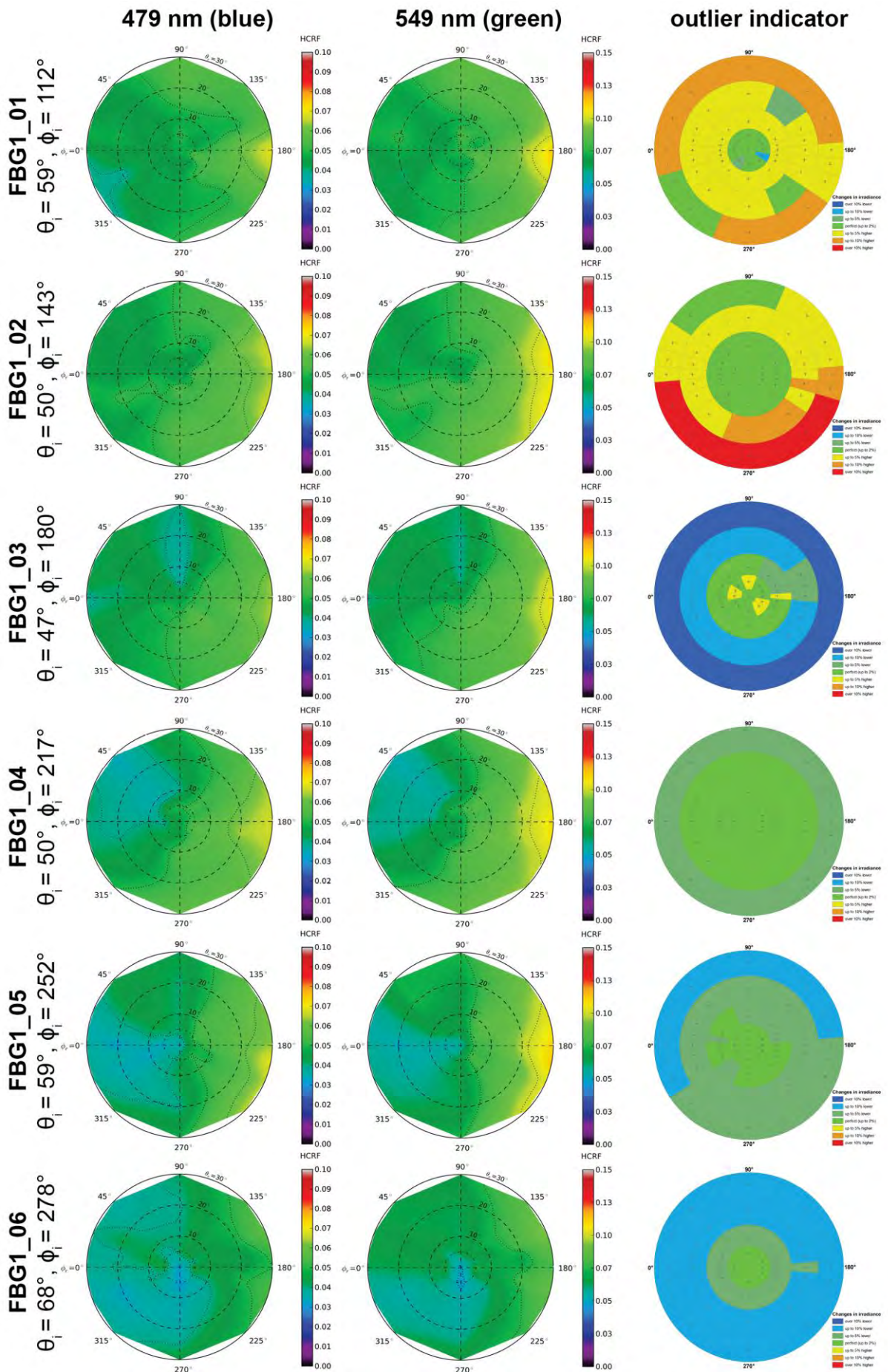


Figure C.1-9: HCRF visualization at 479 nm and 549 nm of the FBG1 site.

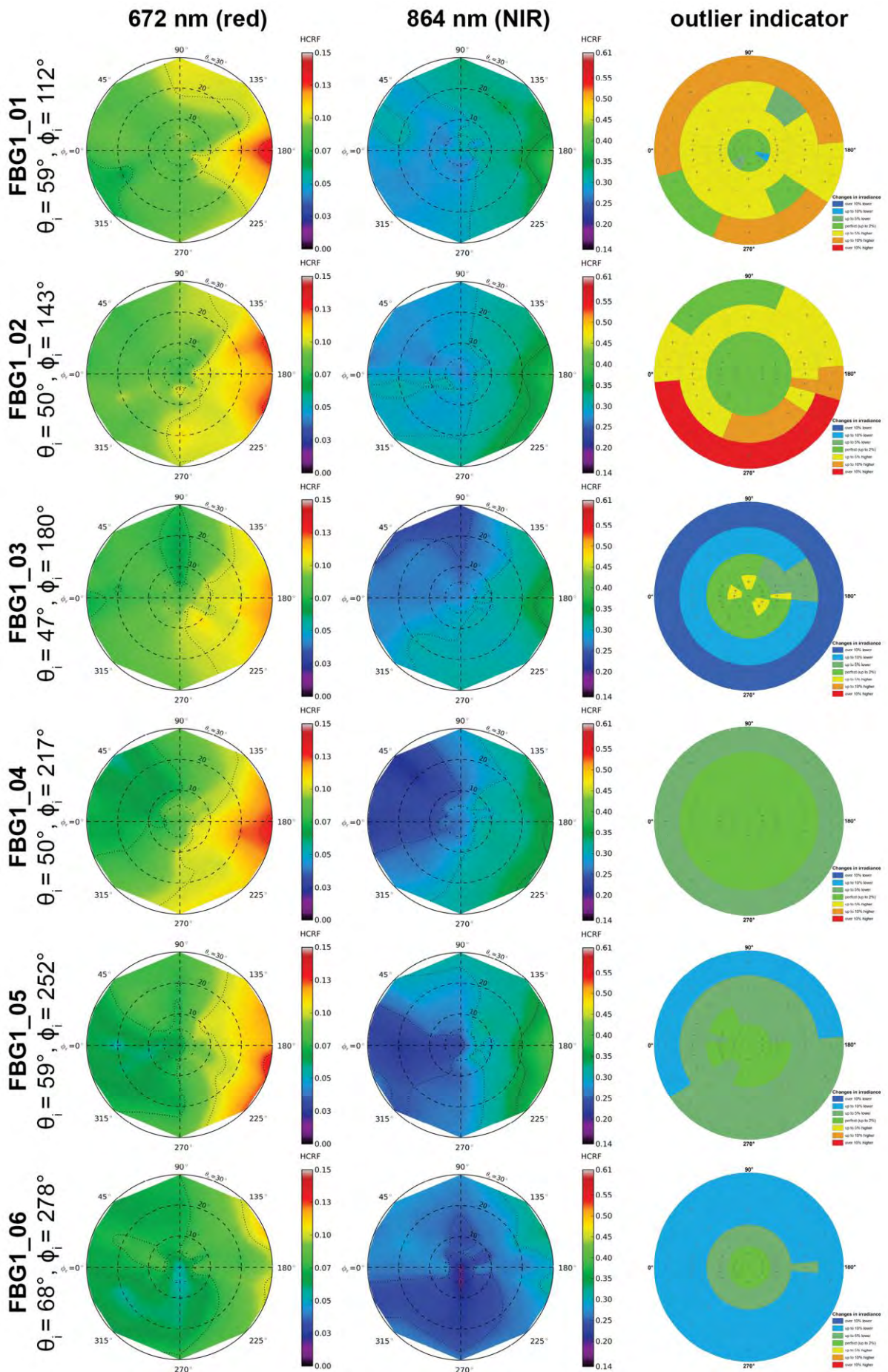


Figure C.1-10: HCRF visualization at 672 nm and 864 nm of the FBG1 site.

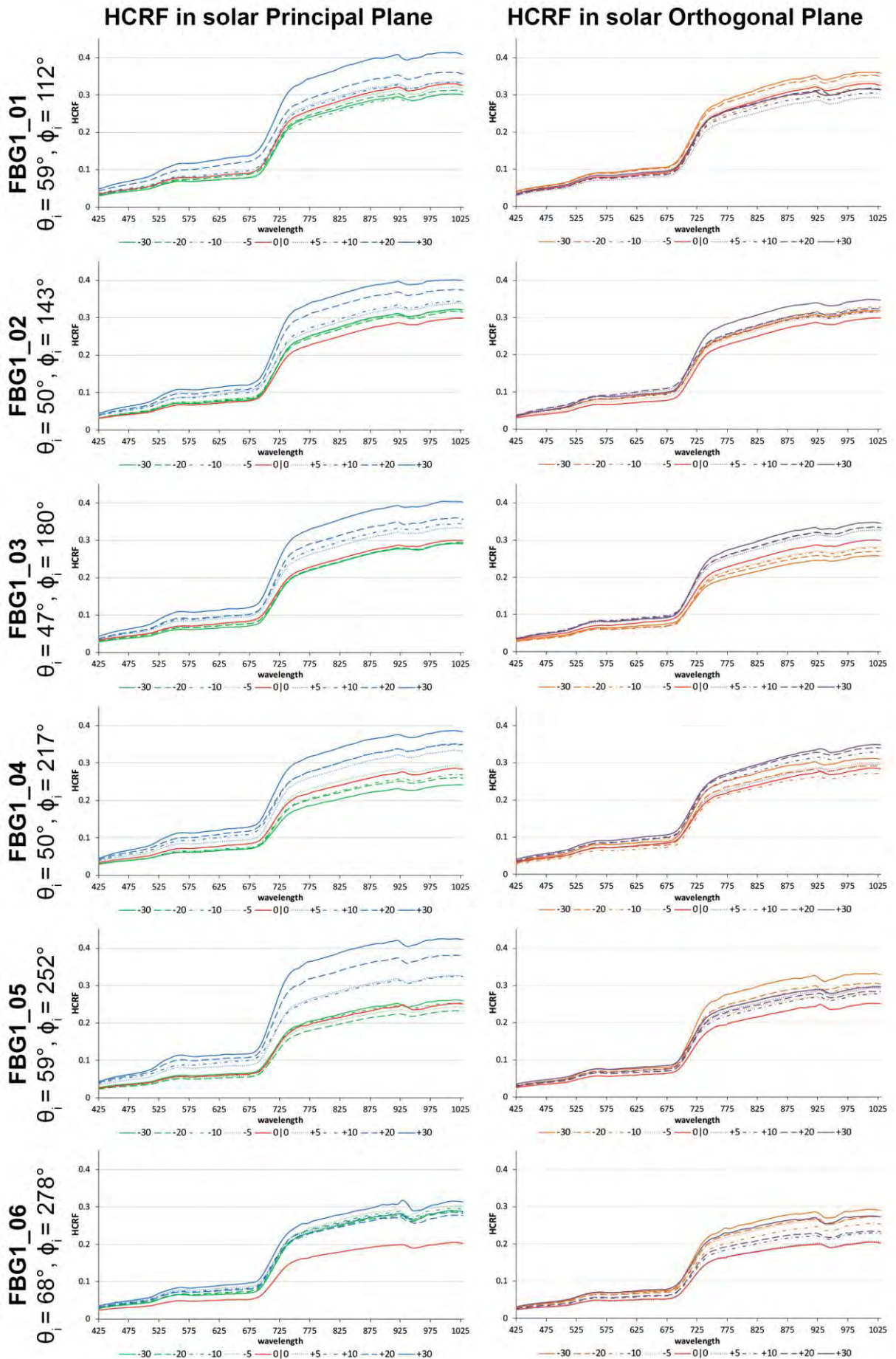
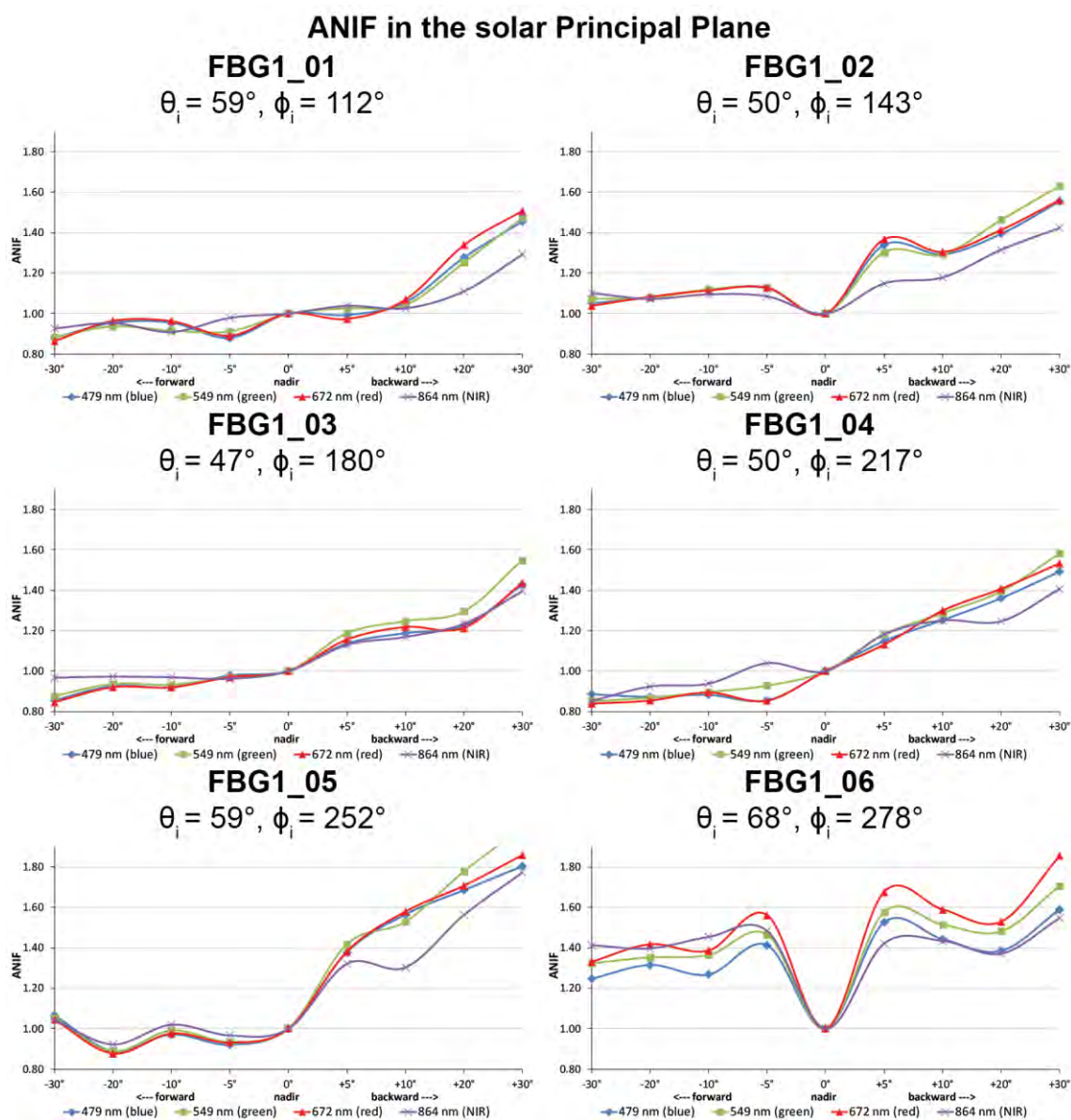


Figure C.1-11: HCRF visualization in principal & orthogonal plane of the FBG1 site.

## 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.

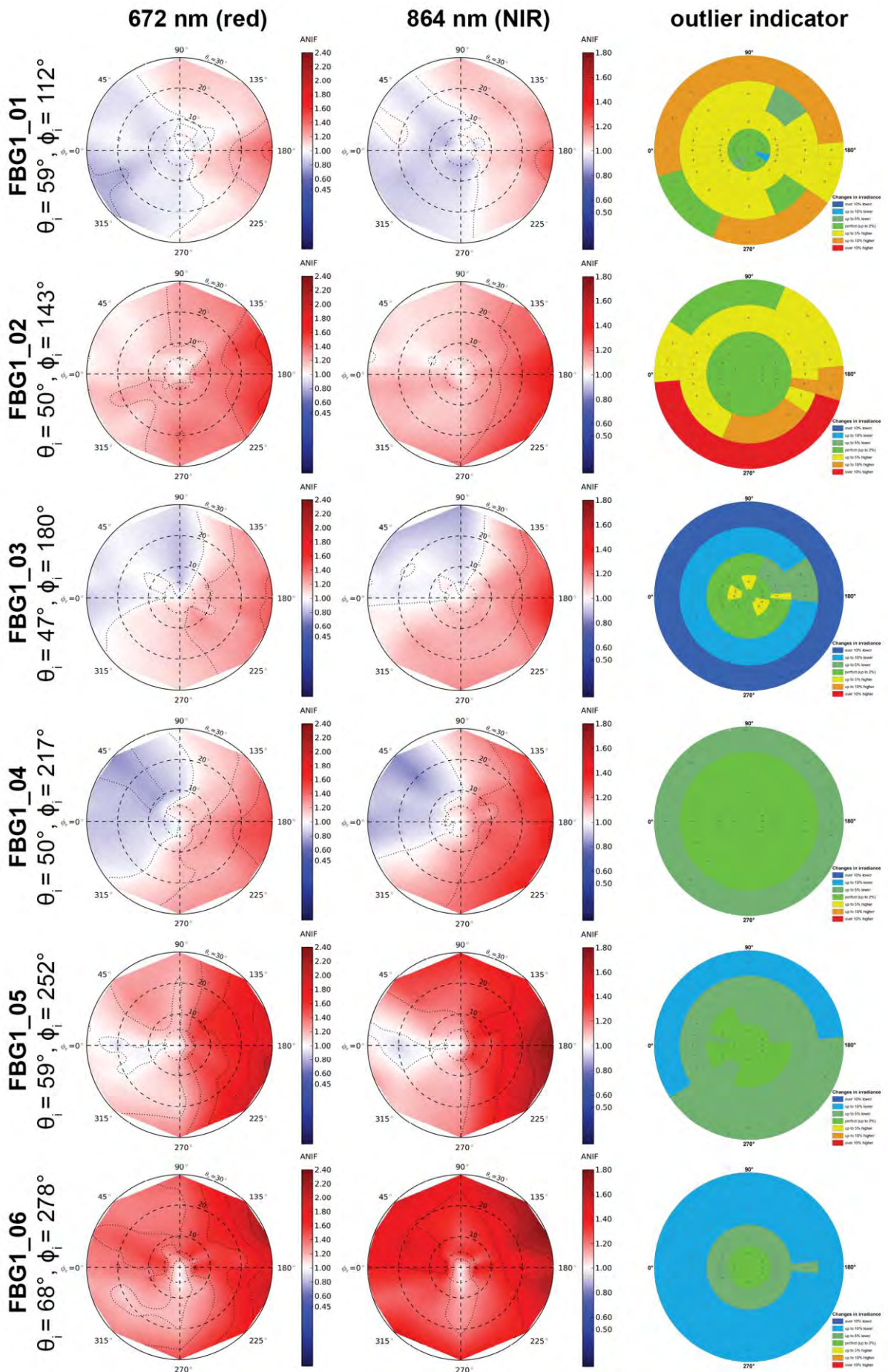


Figure C.1-13: ANIF visualization at 672 nm and 864 nm of the FBG1 site.



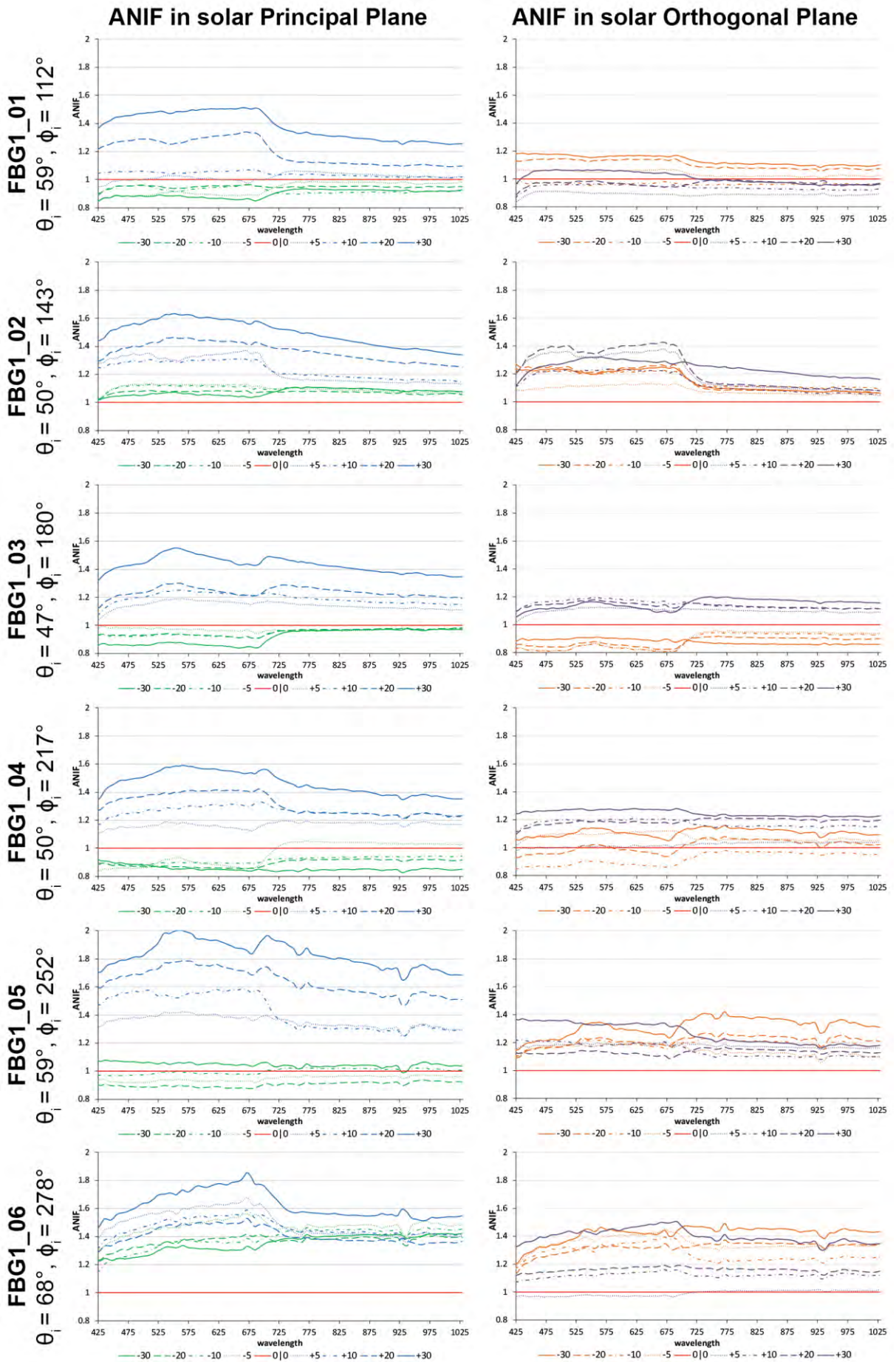
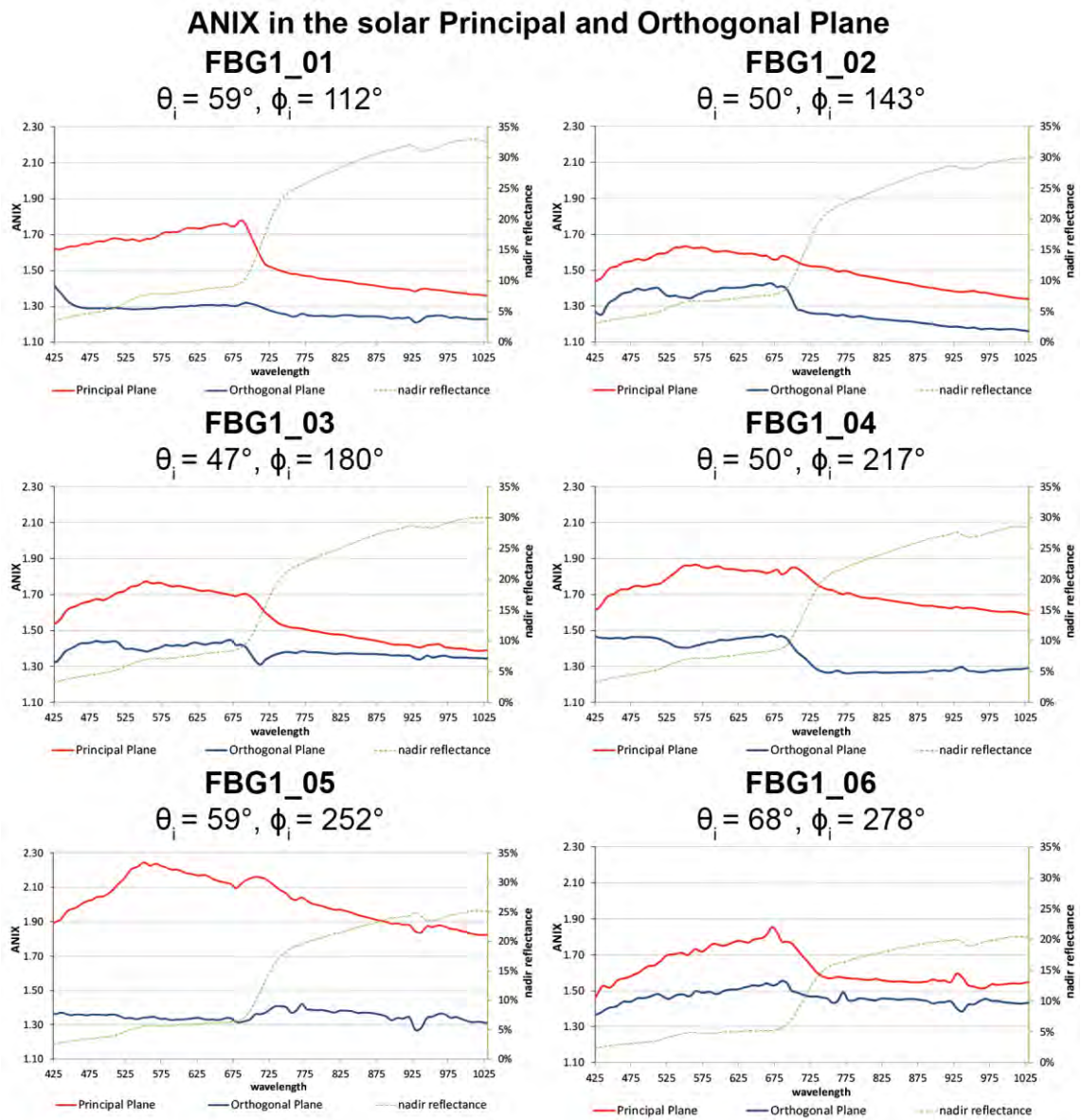


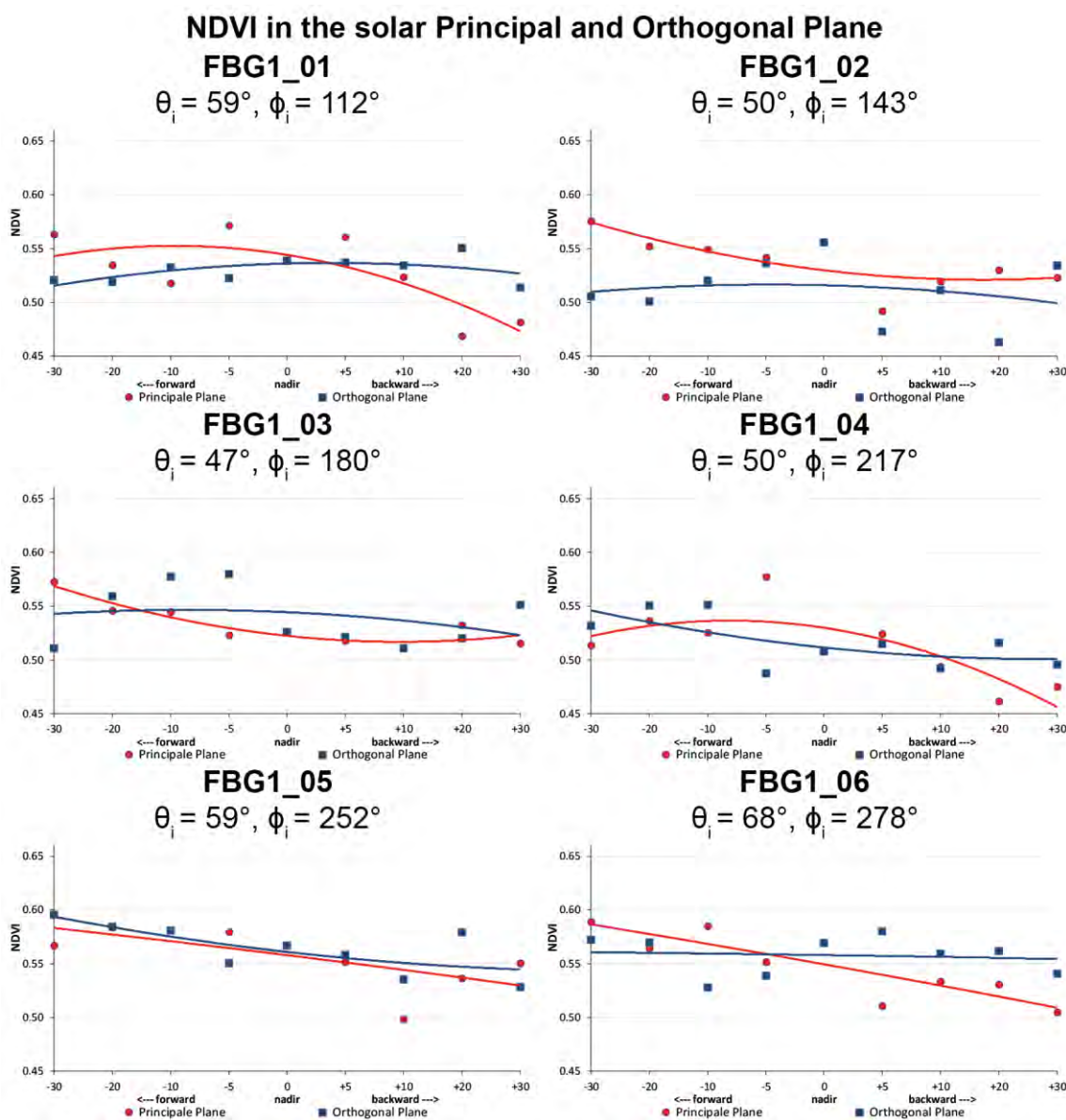
Figure C.1-14: ANIF visualization in principal & orthogonal plane of the FBG1 site.

## 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.

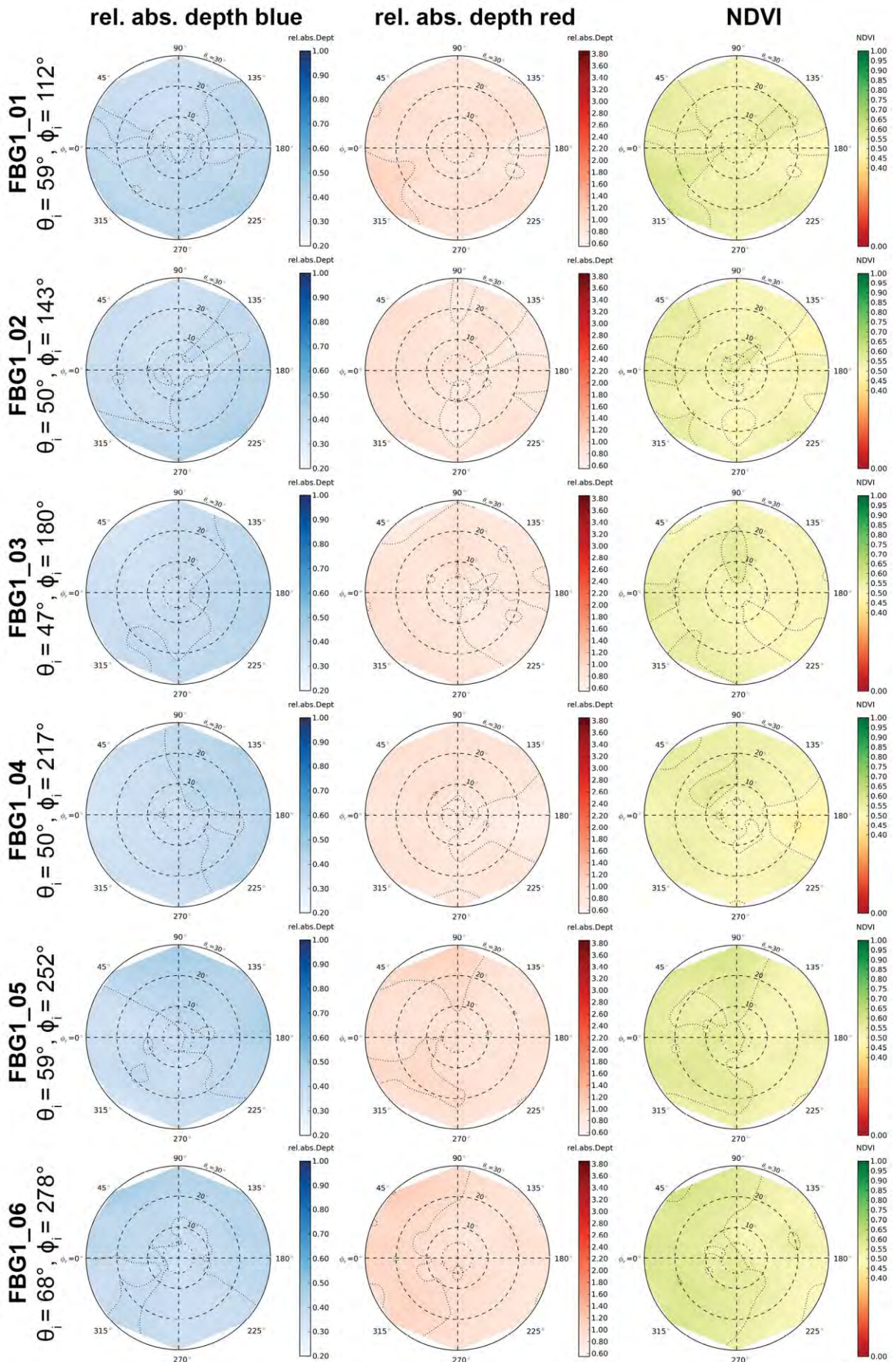


Figure C.1-17: Visualization of relative absorption depth & NDVI of the FBG1 site.

## 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.

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

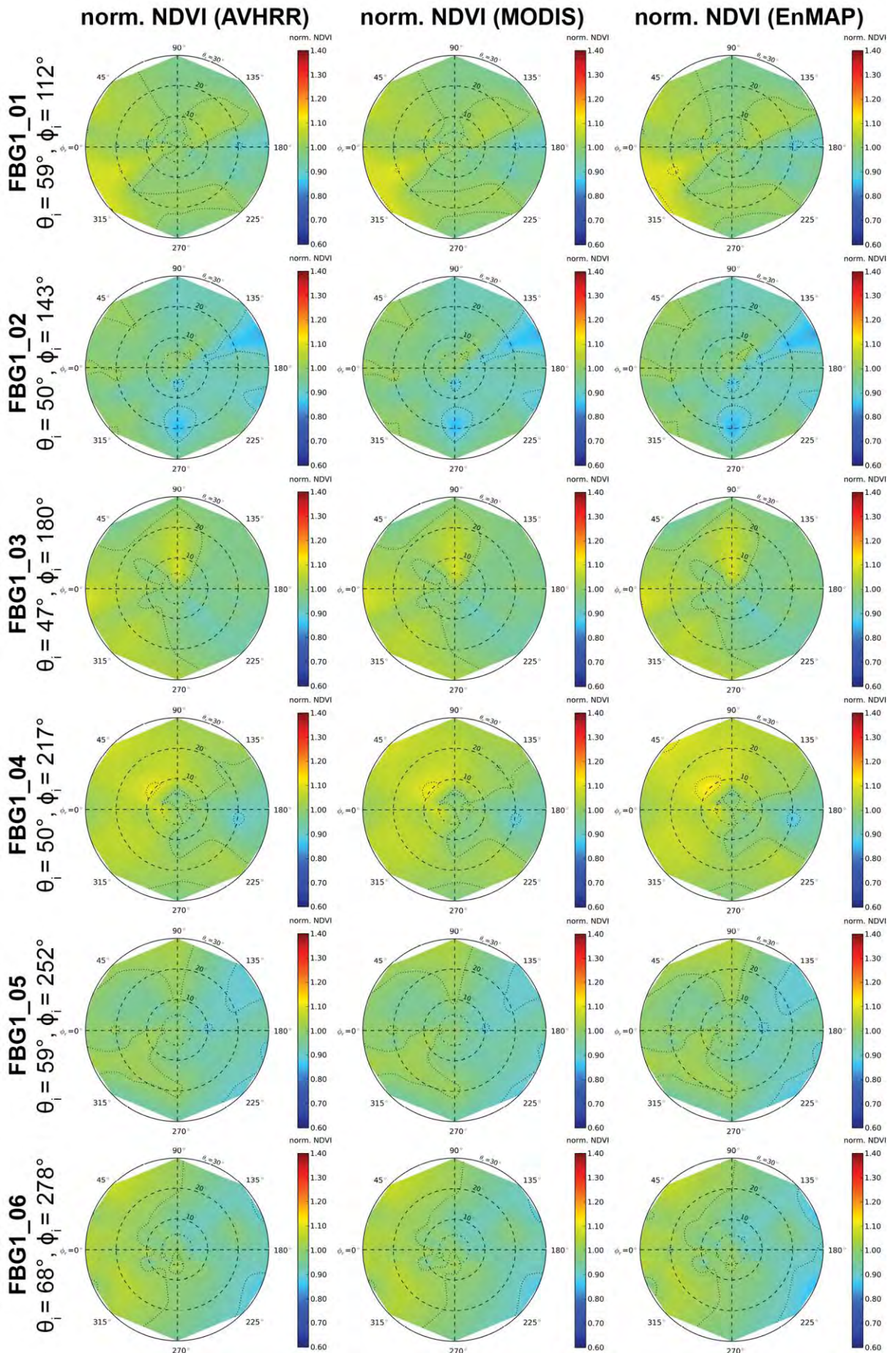


Figure C.1-18: Comparison of AVHRR, MODIS & EnMAP NDVI of the FBG1 site.