

Supplementary Materials: Zero Deforestation Agreement Assessment at Farm Level in Colombia Using ALOS PALSAR. *Remote Sensing* 2018, 9, remotesensing-342327

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2. Materials and Methods

2.2. Data Processing

2.2.2. Fine Beam Dual ALOS PALSAR Imagery Preprocessing

Zero deforestation agreement assessments require a change analysis to estimate forest extent at the time of the MSCR agreement (2010) with respect to the target year of assessment (2016). ALOS PALSAR imagery was used to classify forest and nonforest cover, and to estimate deforestation extent at farm level for the five regions under analysis. ALOSPALSAR Fine Beam Dual (FBD) imagery was obtained through the Kyoto & Carbon Initiative as part of the collaborative research between The Nature Conservancy and the Japanese Aerospace Exploration Agency (JAXA). Data was accessed through the ALOS User Interface Gateway. A total of 125 SLC (Level 1.1) ALOS-1 and ALOS-2 FBD images were used, covering years 2010 (ALOS-1) and 2016 (ALOS-2) (Supplementary Material, Table S1).

Multiple routines were implemented to convert single look complex (SLC) images into geocoded gamma naught (γ_0) backscatter intensity images through: multilooking, radiometric, geocoding, and geometric/radiometric correction procedures (Figure). Multilooking was performed to SLC imagery complex data to produce multilook intensity imagery, using four range and one azimuth looks as parameters. Radiometric calibration of multilook imagery was applied using different calibration factor for ALOS-1 (−115 dB) and ALOS-2 (−83 dB) [35] for the normalization reference area correction to multilooking gamma naught imagery at a 15 m pixel resolution. Shuttle Radar Topography Terrain Mission (SRTM) 30 m digital elevation model was used for terrain correction and geocoding; additionally, a fine registration is implemented where SAR image is simulated based on the digital elevation model and used to determine the fine registration using a cross correlation analysis. Geocoded, radiometric, and geometric corrected products for ALOS PALSAR imagery products were obtained after preprocessing procedures performed using Gamma software® [36], which provides Synthetic Aperture Radar (SAR) preprocessing routines. Functions and parameters implemented through the software are detailed in Supplementary Material Figure S1.

Table S1. ALOS-1 and ALOS-2 Fine Beam Dual imagery used for forest change mapping.

Region	Scene ID	Satellite Name	Operation Mode	Observation Date	Orbit Direction	Off Nadir Angle	Polarization
Bajo Magdalena	ALPSRP079220190	ALOS-1	FBD	2007/07/21	Ascending	34.3	HH + HV
Bajo Magdalena	ALPSRP079220200	ALOS-1	FBD	2007/07/21	Ascending	34.3	HH + HV
Bajo Magdalena	ALPSRP081700190	ALOS-1	FBD	2007/08/07	Ascending	34.3	HH + HV

Region	Scene ID	Satellite Name	Operation Mode	Observation Date	Orbit Direction	Off Nadir Angle	Polarization
Bajo Magdalen a	ALPSRP081700200	ALOS-1	FBD	2007/08/07	Ascending	34.3	HH + HV
Bajo Magdalen a	ALPSRP240260190	ALOS-1	FBD	2010/07/29	Ascending	34.3	HH + HV
Bajo Magdalen a	ALPSRP240260200	ALOS-1	FBD	2010/07/29	Ascending	34.3	HH + HV
Bajo Magdalen a	ALPSRP242740190	ALOS-1	FBD	2010/08/15	Ascending	34.3	HH + HV
Bajo Magdalen a	ALPSRP242740200	ALOS-1	FBD	2010/08/15	Ascending	34.3	HH + HV
Bajo Magdalen a	ALOS2091390200-160201	ALOS-2	FBD	2016/02/01	Ascending	28.2	HH + HV
Bajo Magdalen a	ALOS2110020200-160606	ALOS-2	FBD	2016/06/06	Ascending	32.5	HH + HV
Cesar River Valley	ALPSRP080970170	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP080970180	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP080970190	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP080970200	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP082720190	ALOS-1	FBD	2007/08/14	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP082720200	ALOS-1	FBD	2007/08/14	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP082720210	ALOS-1	FBD	2007/08/14	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP083450170	ALOS-1	FBD	2007/08/19	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP083450180	ALOS-1	FBD	2007/08/19	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP083450190	ALOS-1	FBD	2007/08/19	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP085200170	ALOS-1	FBD	2007/08/31	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP085200180	ALOS-1	FBD	2007/08/31	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP085200190	ALOS-1	FBD	2007/08/31	Ascending	34.3	HH + HV

Region	Scene ID	Satellite Name	Operation Mode	Observation Date	Orbit Direction	Off Nadir Angle	Polarization
Cesar River Valley	ALPSRP085200200	ALOS-1	FBD	2007/08/31	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP239530170	ALOS-1	FBD	2010/07/24	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP239530180	ALOS-1	FBD	2010/07/24	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP239530190	ALOS-1	FBD	2010/07/24	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP239530200	ALOS-1	FBD	2010/07/24	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP242010170	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP242010180	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP242010190	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP242010200	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP243760190	ALOS-1	FBD	2010/08/22	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP243760200	ALOS-1	FBD	2010/08/22	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP243760210	ALOS-1	FBD	2010/08/22	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP244490170	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP244490180	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Cesar River Valley	ALPSRP244490190	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Cesar River Valley	ALOS2089320170-160118	ALOS-2	FBD	2016/01/18	Ascending	36.2	HH + HV
Cesar River Valley	ALOS2089320180-160118	ALOS-2	FBD	2016/01/18	Ascending	36.2	HH + HV
Cesar River Valley	ALOS2092720180-160210	ALOS-2	FBD	2016/02/10	Ascending	28.2	HH + HV
Cesar River Valley	ALOS2092720190-160210	ALOS-2	FBD	2016/02/10	Ascending	28.2	HH + HV
Cesar River Valley	ALOS2092720200-160210	ALOS-2	FBD	2016/02/10	Ascending	28.2	HH + HV

Region	Scene ID	Satellite Name	Operation Mode	Observation Date	Orbit Direction	Off Nadir Angle	Polarization
Cesar River Valley	ALOS209479 0190-160224	ALOS-2	FBD	2016/02/24	Ascending	32.5	HH + HV
Cesar River Valley	ALOS209479 0200-160224	ALOS-2	FBD	2016/02/24	Ascending	32.5	HH + HV
Cesar River Valley	ALOS212791 0210-161005	ALOS-2	FBD	2016/10/05	Ascending	32.5	HH + HV
Cesar River Valley	ALOS214447 0210-170125	ALOS-2	FBD	2017/01/25	Ascending	36.2	HH + HV
Cesar River Valley	ALOS214654 0179-170208	ALOS-2	FBD	2017/02/08	Ascending	28.2	HH + HV
Cesar River Valley	ALOS214654 0190-170208	ALOS-2	FBD	2017/02/08	Ascending	28.2	HH + HV
Cesar River Valley	ALOS214654 0201-170208	ALOS-2	FBD	2017/02/08	Ascending	28.1	HH + HV
Cesar River Valley	ALOS214861 0190-170222	ALOS-2	FBD	2017/02/22	Ascending	32.5	HH + HV
Cesar River Valley	ALOS214861 0201-170222	ALOS-2	FBD	2017/02/22	Ascending	32.5	HH + HV
Meta Foothills	ALPSRP076 740060	ALOS-1	FBD	2007/07/04	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP079 220060	ALOS-1	FBD	2007/07/21	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP080 970050	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP080 970060	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP081 700050	ALOS-1	FBD	2007/08/07	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP081 700060	ALOS-1	FBD	2007/08/07	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP083 450050	ALOS-1	FBD	2007/08/19	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP085 930050	ALOS-1	FBD	2007/09/05	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP238 510060	ALOS-1	FBD	2010/07/17	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP240 260050	ALOS-1	FBD	2010/07/29	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP240 260060	ALOS-1	FBD	2010/07/29	Ascending	34.3	HH + HV

Region	Scene ID	Satellite Name	Operation Mode	Observation Date	Orbit Direction	Off Nadir Angle	Polarization
Meta Foothills	ALPSRP242 010060	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP242 740050	ALOS-1	FBD	2010/08/15	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP242 740060	ALOS-1	FBD	2010/08/15	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP242 740070	ALOS-1	FBD	2010/08/15	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP244 490050	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Meta Foothills	ALPSRP244 490060	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Meta Foothills	ALOS208932 0050-160118	ALOS-2	FBD	2016/01/18	Ascending	36.2	HH + HV
Meta Foothills	ALOS208932 0060-160118	ALOS-2	FBD	2016/01/18	Ascending	36.2	HH + HV
Meta Foothills	ALOS209006 0060-160123	ALOS-2	FBD	2016/01/23	Ascending	36.2	HH + HV
Meta Foothills	ALOS209139 0050-160201	ALOS-2	FBD	2016/02/01	Ascending	28.2	HH + HV
Meta Foothills	ALOS209139 0060-160201	ALOS-2	FBD	2016/02/01	Ascending	28.2	HH + HV
Meta Foothills	ALOS209139 0070-160201	ALOS-2	FBD	2016/02/01	Ascending	28.2	HH + HV
Meta Foothills	ALOS211002 0060-160606	ALOS-2	FBD	2016/02/01	Ascending	32.5	HH + HV
Meta Foothills	ALOS211002 0070-160606	ALOS-2	FBD	2016/06/06	Ascending	32.5	HH + HV
Meta Foothills	ALOS212244 0050-160829	ALOS-2	FBD	2016/08/29	Ascending	36.2	HH + HV
Meta Foothills	ALOS212244 0060-160829	ALOS-2	FBD	2016/08/29	Ascending	36.2	HH + HV
Coffee Ecoregion	ALPSRP073 240070	ALOS-1	FBD	2007/06/10	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP073 970060	ALOS-1	FBD	2007/06/15	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP079 950080	ALOS-1	FBD	2007/07/26	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP079 950090	ALOS-1	FBD	2007/07/26	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP082 430070	ALOS-1	FBD	2007/08/12	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP082 430080	ALOS-1	FBD	2007/08/12	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP082 430090	ALOS-1	FBD	2007/08/12	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP084 180080	ALOS-1	FBD	2007/08/24	Ascending	34.3	HH + HV

Region	Scene ID	Satellite Name	Operation Mode	Observation Date	Orbit Direction	Off Nadir Angle	Polarization
Coffee Ecoregion	ALPSRP084 910060	ALOS-1	FBD	2007/08/29	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP084 910070	ALOS-1	FBD	2007/08/29	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP084 910080	ALOS-1	FBD	2007/08/29	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP238 510070	ALOS-1	FBD	2010/07/17	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP238 510080	ALOS-1	FBD	2010/07/17	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP240 990070	ALOS-1	FBD	2010/08/03	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP240 990080	ALOS-1	FBD	2010/08/03	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP240 990090	ALOS-1	FBD	2010/08/03	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP241 720060	ALOS-1	FBD	2010/08/08	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP243 470070	ALOS-1	FBD	2010/08/20	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP243 470080	ALOS-1	FBD	2010/08/20	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP243 470090	ALOS-1	FBD	2010/08/20	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP245 950060	ALOS-1	FBD	2010/09/06	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP245 950070	ALOS-1	FBD	2010/09/06	Ascending	34.3	HH + HV
Coffee Ecoregion	ALPSRP245 950080	ALOS-1	FBD	2010/09/06	Ascending	34.3	HH + HV
Coffee Ecoregion	ALOS209006 0080-160123	ALOS-2	FBD	2016/01/23	Ascending	36.2	HH + HV
Coffee Ecoregion	ALOS209080 0062-160128	ALOS-2	FBD	2016/01/28	Ascending	36.2	HH + HV
Coffee Ecoregion	ALOS209213 0069-160206	ALOS-2	FBD	2016/02/06	Ascending	28.2	HH + HV
Coffee Ecoregion	ALOS209420 0075-160220	ALOS-2	FBD	2016/02/20	Ascending	32.5	HH + HV
Coffee Ecoregion	ALOS209420 0086-160220	ALOS-2	FBD	2016/02/20	Ascending	32.5	HH + HV

Region	Scene ID	Satellite Name	Operation Mode	Observation Date	Orbit Direction	Off Nadir Angle	Polarization
Coffee Ecoregion	ALOS214388 0079-170121	ALOS-2	FBD	2017/01/21	Ascending	36.2	HH + HV
Coffee Ecoregion	ALOS214595 0080-170204	ALOS-2	FBD	2017/02/04	Ascending	28.2	HH + HV
Coffee Ecoregion	ALOS214802 0075-170218	ALOS-2	FBD	2017/02/18	Ascending	32.5	HH + HV
Boyacá-Santander	ALPSRP080 970090	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP080 970100	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP080 970110	ALOS-1	FBD	2007/08/02	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP083 450090	ALOS-1	FBD	2007/08/19	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP083 450100	ALOS-1	FBD	2007/08/19	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP083 450110	ALOS-1	FBD	2007/08/19	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP242 010090	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP242 010100	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP242 010110	ALOS-1	FBD	2010/08/10	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP244 490090	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP244 490100	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Boyacá-Santander	ALPSRP244 490110	ALOS-1	FBD	2010/08/27	Ascending	34.3	HH + HV
Boyacá-Santander	ALOS208932 0098-160118	ALOS-2	FBD	2016/01/18	Ascending	36.2	HH + HV
Boyacá-Santander	ALOS208932 0108-160118	ALOS-2	FBD	2016/01/18	Ascending	36.2	HH + HV
Boyacá-Santander	ALOS209272 0110-160210	ALOS-2	FBD	2016/02/10	Ascending	28.2	HH + HV

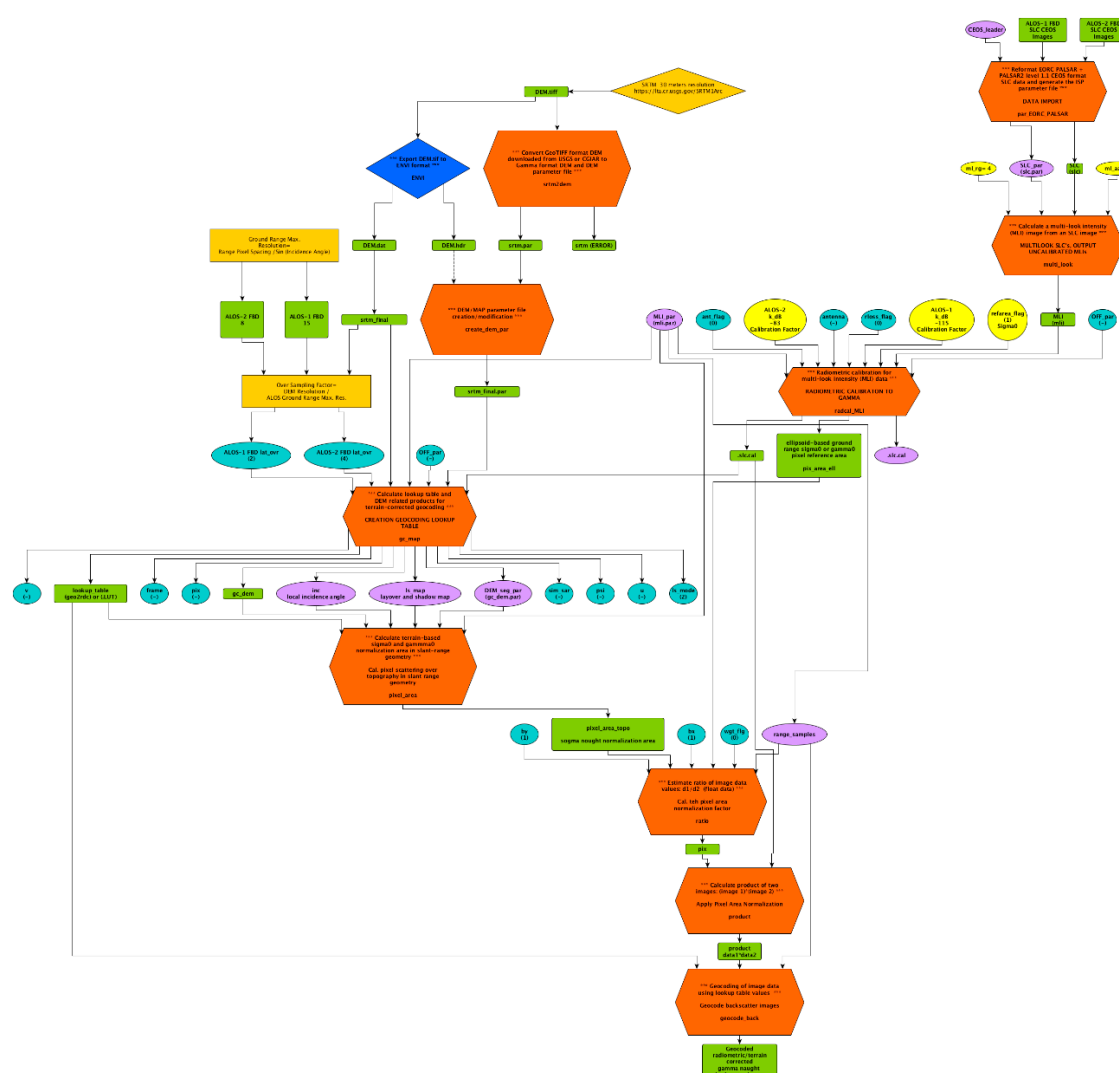


Figure S1. ALOS-1 and ALOS-2 Fine Beam Dual imagery preprocessing workflow implemented in Gamma® software.



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