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Abstract

Earth observations from Synthetic Aperture Radar (SAR) can provide unique information related to forest structure and condition. Despite the many advantages of SAR, particularly where clouds impede optical observations, a knowledge gap has prevented the applied remote sensing community from harnessing its full potential. Here, we discuss the results of a collaboration between SERVIR, a joint program between NASA and the U.S. Agency for International Development (USAID), and SilvaCarbon, the United States' contribution to the Global Forest Observation Initiative, to build global capacity in using SAR for forest monitoring and biomass estimation. This includes primarily the creation of 1) The **SAR** Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation, 2) a series of international hands-on trainings and training materials, 3) quick-reference guides illustrating SAR concepts, and 4) animated videos explaining how SAR works.

The SERVIR-Global community joined efforts to develop a hands-on guide to support decision-makers in the forestry community to leverage the power of SAR technology to better protect and manage forest resources. We worked with world-renowned SAR experts to provide targeted trainings and develop the **SAR Handbook**. This handbook consists of approachable theoretical background and applied content that contributes to filling the knowledge gap in the applied use of SAR technology for forestry applications. We hope that forest managers and remote sensing specialists will use these materials to benefit from currently available SAR datasets, as well as prepare for future SAR missions, such as NISAR and BIOMASS. Since its release on April 11, 2019, the SAR Handbook materials have been accessed more than 320,000 times, demonstrating the remote sensing community's urgent need and interest to learn and use SAR.

Objectives

- BUILD CAPACITY to monitor forests and estimate biomass using freely available SAR datasets
- PREPARE the remote sensing community to use existing and future SAR datasets, including NISAR and BIOMASS
- PRODUCE TRAINING MATERIALS on standard SAR processing techniques to monitor forests and estimate biomass using open source resources
- DETERMINE IMPROVEMENT AREAS for future SAR capacity building initiatives

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PA23A-1151: Leveraging the Power of SAR **Observations for Forest Monitoring Systems**

Methodology

Products



SAR & Av	Da vail	ta A abili	ccess ty	A quick refi missions a check out t for Forest 1 associated	erence to Synthetic nd where to obtain he SAR Handbook: Monitoring and Bior training materials a	Aperture Radar - data. For more i Comprehensive I mass Estimation It SERVIRgloba	collecting- nformation, Methodologies and 1.net
SENSOR	LIFETIME	WAVELENGTH/ FREQUENCY	POLARIZATION	RESOLUTION	FRAME SIZE	REPEAT CYCLE	ACCESS
ieasat	1978	L-band λ = 24.6cm	н	Ac: 25m Rg: 25m	100km		Free & open
IRS-1	1991-2001	C-band λ=05.6cm	w	A2: 6-30m RG: 26m	100km	35 days	Restrained
ERS-1	1995-1998	L-band λ = 24.6om	н	Az. 18m Rg. 18m	75km	44 days	Restrained
IRS-2	1995-2011	C-band λ=05.6cm	W	Az: 6-30m Rg: 26m	100km	35 days	Restrained
INVISAT	2002-2012	C-band λ=05.6cm	HH, W, W/HH, HH/HY, W/VH	Az: 28m Rg: 28m	100km	35 days	Restrained
4L05-1	2006-2011	L-band λ = 24.6cm	FBS: HH, W FBD: HH/HV, HH/VH FD: HH/HV NH /W ScarSAR: HH, W	FBS: 10x10m FBD: 20x10m PUR: 30x10m ScanSAR: 100m	F85: 70km F8D: 70km PUR: 30km ScanSAR: 250-350km	45 days	Free & open
kadarsat-1	1995-2013	C-band λ=05.6cm	нн	Standard: 25x28m Fine: 9x9m Wide1: 35x28m Wide2: 35x28m Scan5AR: 50x50-100x100m	Standard: 100km Fine: 45km Wide1: 165km Wide2:150km ScarSAR: 305-510km	24 days	1995-2008: Restrained 2008-2013: Commercial
lerraSAR-X lanDEM-X	2007- 2010-	X-band λ = 03.5cm	Single: IHH, W Dual: HH/W, HH/HV, W/VH Twin: HH/W, HH/VH, W/VH	Spetlight: 0.2x1.0-1.7x3.5m Stripmap: 3x3m ScanSAR: 18-40m	Spotlight: 3-10km Stripmap: 50:30km ScartSAR: 150:100- 200:200km	11 days	Application- dependent; restrained scientific, commercial
ladarsat-2	2007-	C-band λ = 05.6cm	Single: IIH, W, HV, VH Dual: HH/HV, W/VH Quad: HH/HV/VH/VV	Spotlight: -1.5m Stripmap: -3x3-25x25m ScarSAR: 35x35-100x100m	Spotlight: 18x8km Stripmap: 20-170m ScartSAR: 300x300- 500x500km	24 days	Commercial
COSMO- ikyMed	2007-	X-band λ=03.5cm	Single: IIH, W, HV, VH Duat: HIK/HV, IHK/VV, W/VH	Spotlight: s1m Stripmap: 3-15m ScanSAR: 30-100m	Spotlight: 10x10km Stripmap: 40x40km ScanSAR: 100x100 - 200x200km	Satellite: 16 days Constellation: -hrs	Commercial; limited proposal- based scientific
NLOS-2 PALSAR-2	2014-	L-band λ=24.6cm	Single: HH, W, HV, VH Dual: HH/HV, W/VH Quad: HH/HV/NH/VV	Spatlight: 1x3m Stripmap: 3-10m ScanSAR: 25-100m	Spotlight: 25x25km Stripmap: 55x70- 70x70km ScanSAR: 355x355km	14 days	Commercial; limited proposal- based scientific
ientinel-1	2014-	C-band λ = 05.6cm	Single: HH, W Dual: HH/HV, W/VH	Stripmap: SxSm Interferometric Wide Swath (TW): Sx20m Extra Wide Swath (EW): 20-40m	Stripmap: 375km IVI: 250km EVI: 400km	Satellite: 12 days Constellation: E-days	Free & open
AOCOM	2018-	L-band λ = 24.6cm	Single: HH, W Dual: HH/HV, W/VH Quad: HH/HV/VH/VV	Stripmap: 10x10m TopSAR: 100x100m	Stripmap: >65km TopSAR: 320km	Satellite: 16 days Constellation: 8 days	TRD
AZ SAR	2018-	3-band 1=03.5m	"See TerraSAR/ TuroDDM.v	"See TerraSAR/ TarrDEM.x	*See TenaSAW TanDEM-x	11 days	Commercial



FSH METHOD 1: Backscatter	
As a general rule, as Forest Stand Height (FSN) increases, the number of scatterets—and therefore, backscatter power—increases.	Empirically-derived FSH equation
This relationship allows us to derive an empirical relationship between in situ FSH data and backscatter power.	For the first sector of th
FSH METHOD 2: INSAR	
Interferometric SAR, or InSAR, uses the geometric relationship between two different SAR observations to calculate tree top elevation . <i>FBH = inSAR-derived Elevation -</i> <i>Surface Elevation</i>	DSM: Digital Surface Model DTM: Digital Terrain Model
FSH METHOD 3: Temporal Decorrelation	
As a general rule, the tailer the 581, the more movement exists between two 584 observations. This movement, or TD, cas be calculated from repeat-pass InSAR.	Empirically-derived PSN equation
We can thus derive an empirical (C) relationship between in situ FSH data and temporal discoveration	itemboorg





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AGU FALL MEETING

San Francisco, CA | 9–13 December 2019

QUESTIONS? Contact kelsey.e.herndon@nasa.gov

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