NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

BIOMASS RETRIEVAL FROM INTERFEROMETRIC SAR

Svein Solberg

NIBIO, Norway

1st CCI BIOMASS WORKSHOP
25-26 SEPTEMBER 2018, PARIS

IDEA

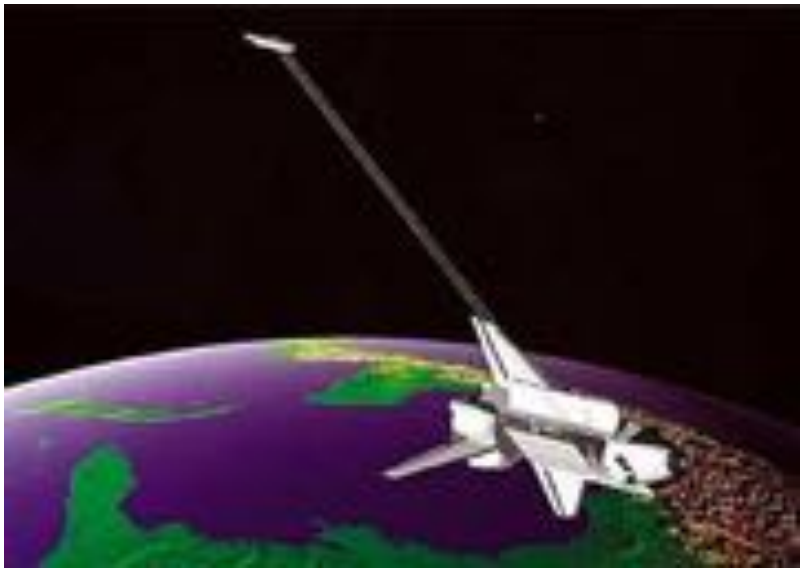
- Utilize SRTM DEM and TDX WorldDEM to derive height and biomass changes at a near-global scale

- InSAR limitations
  - Steep terrain
  - Different penetration X- and C-band
  - Curvilinear relationship InSAR height and biomass
  - Lack of field inventory data for modelling
  - Effects of frost and weather
  - Effects of leaf-off leaf-on

Near-global coverage SRTM DEM and TDX WorldDEM

Study areas srtm

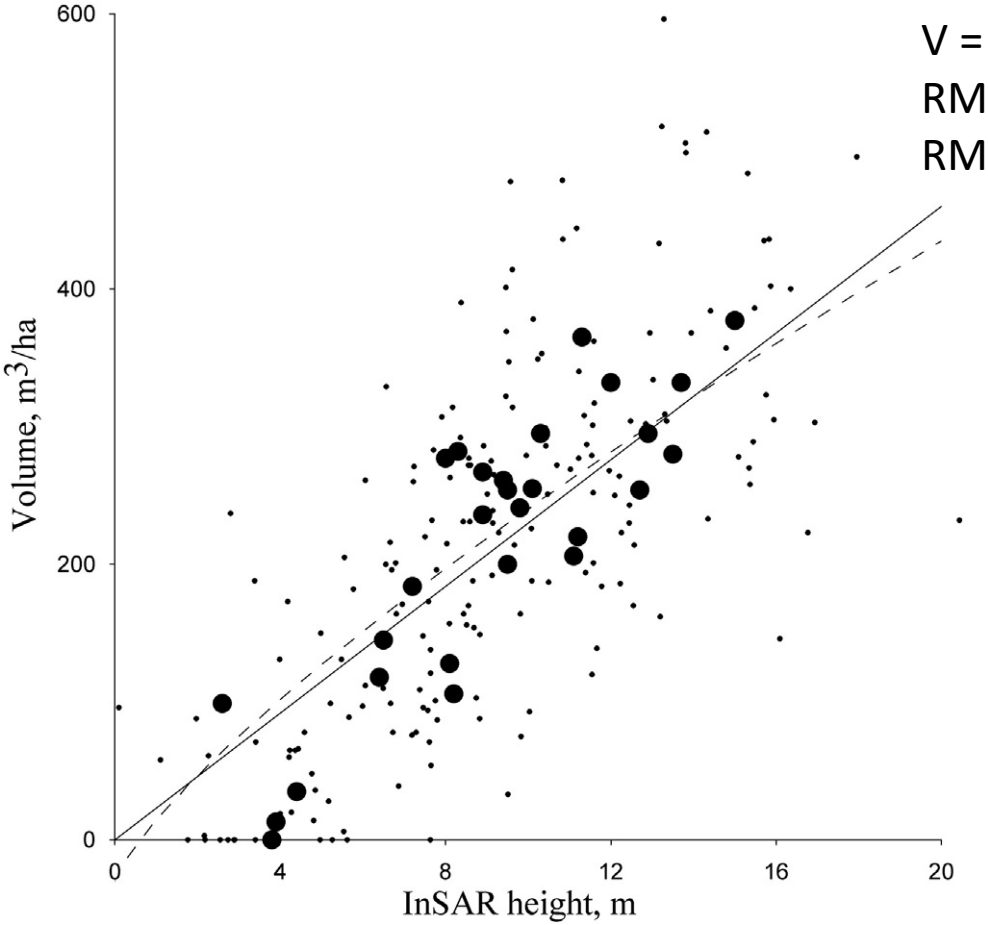
InSAR DEM data



2000: SRTM C and partly X

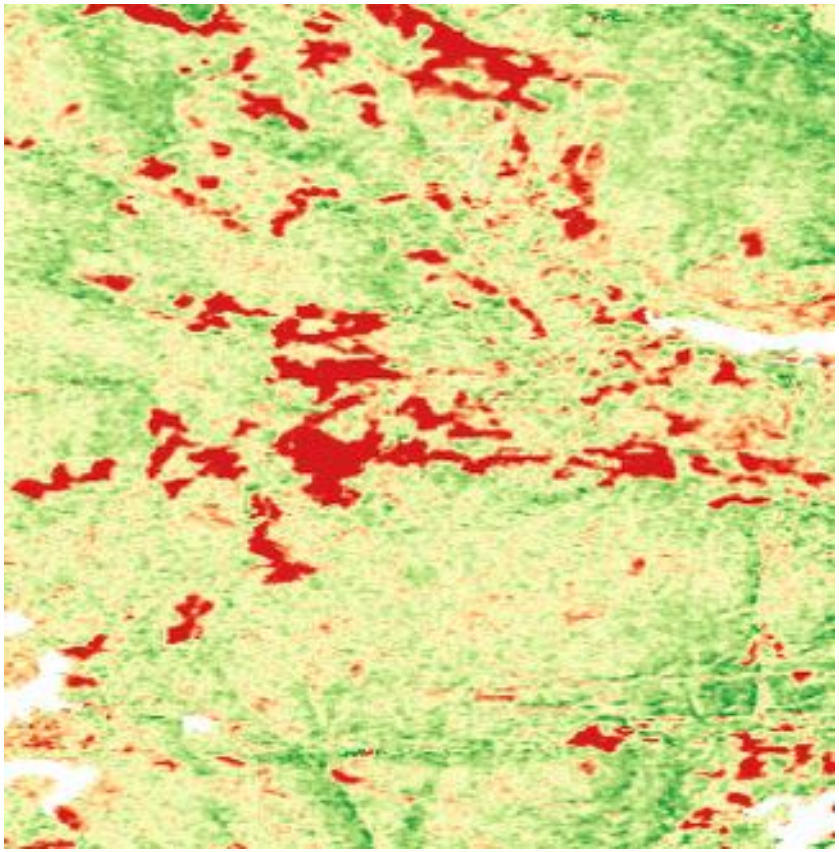
~2012: TanDEM-X WorldDEM

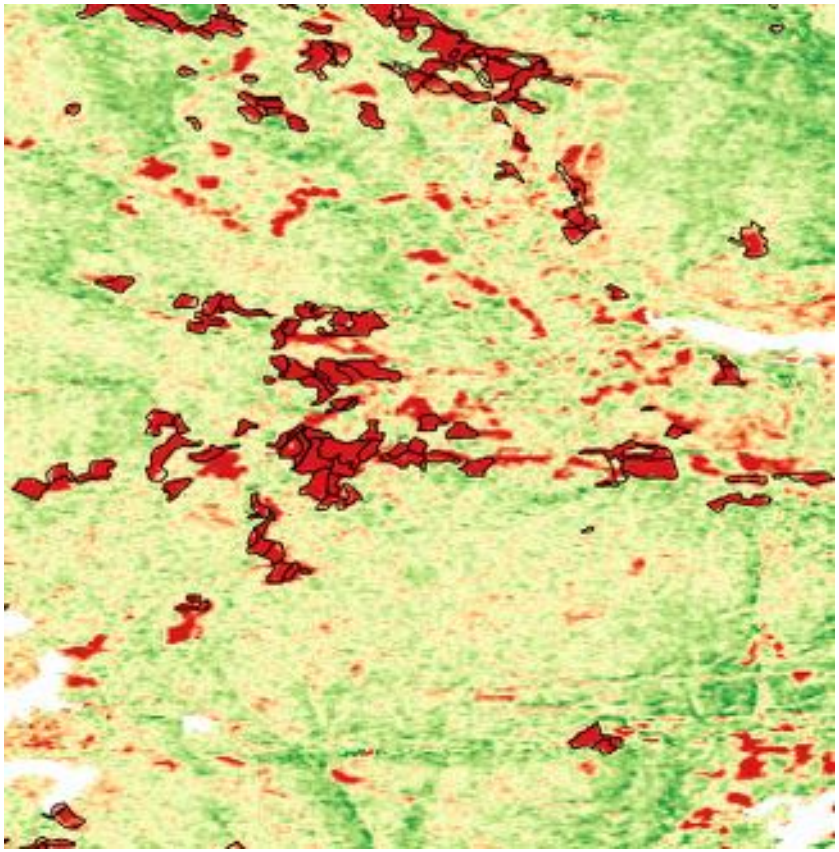
TEST AREA NORWEGIAN FOREST ESTATE
ESTIMATING VOLUME (GROWING STOCK)



V = 23*H
RMSE plot = 94m3/ha
RMSE stand = 44

12 YEAR CHANGE IN INSAR HEIGHT FOR LOGGED AREAS





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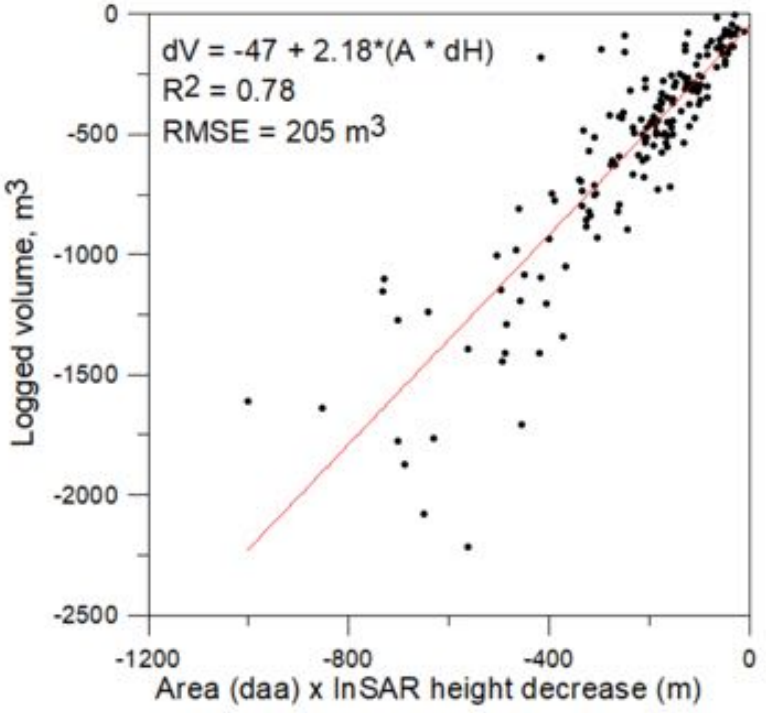
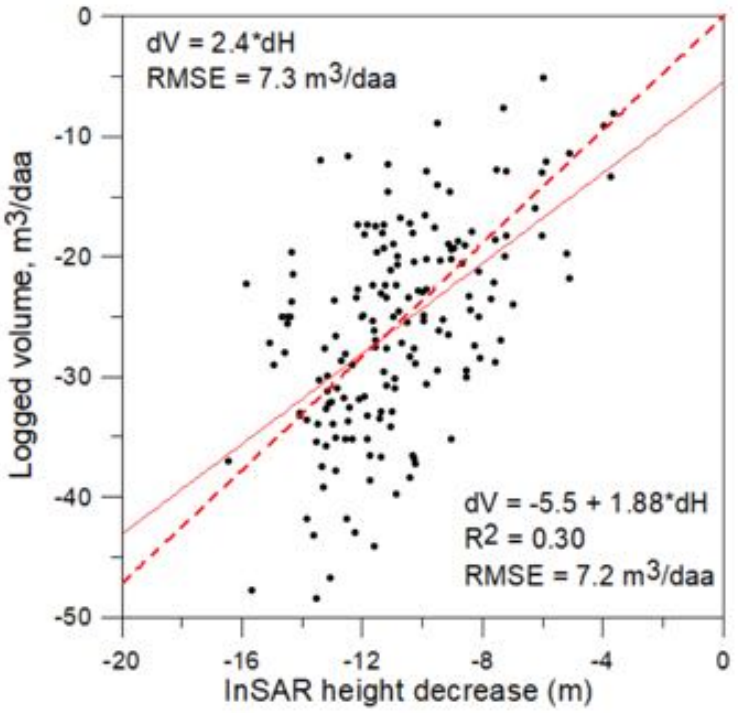
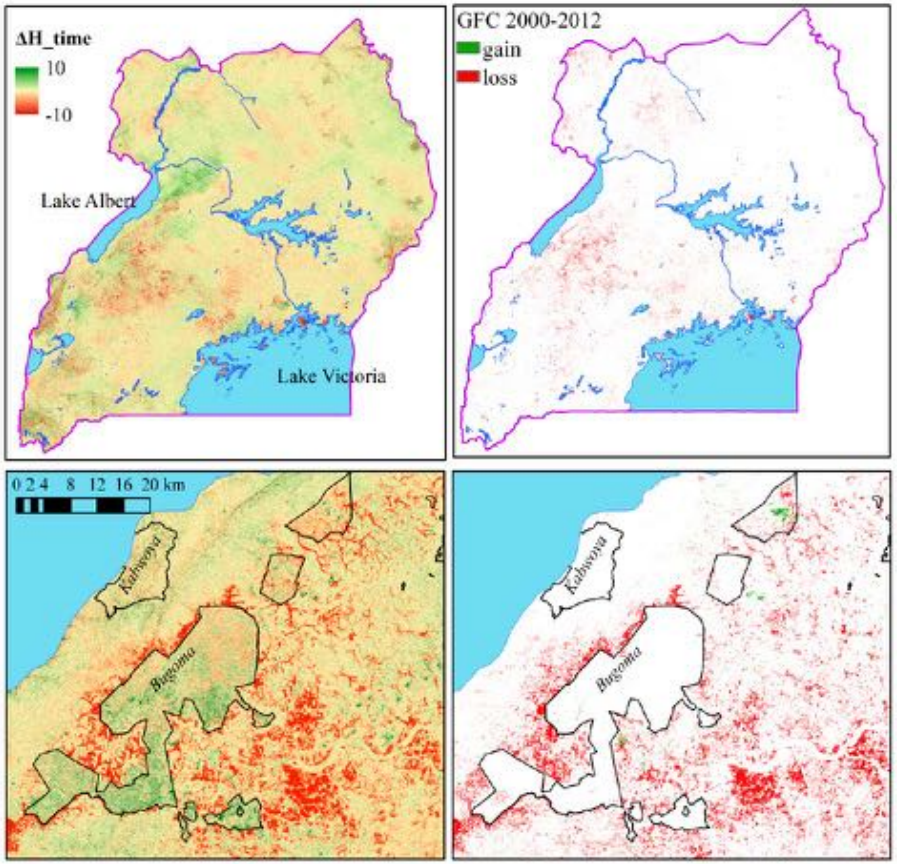




Forest change 2000-2012 based on InSAR and Landsat

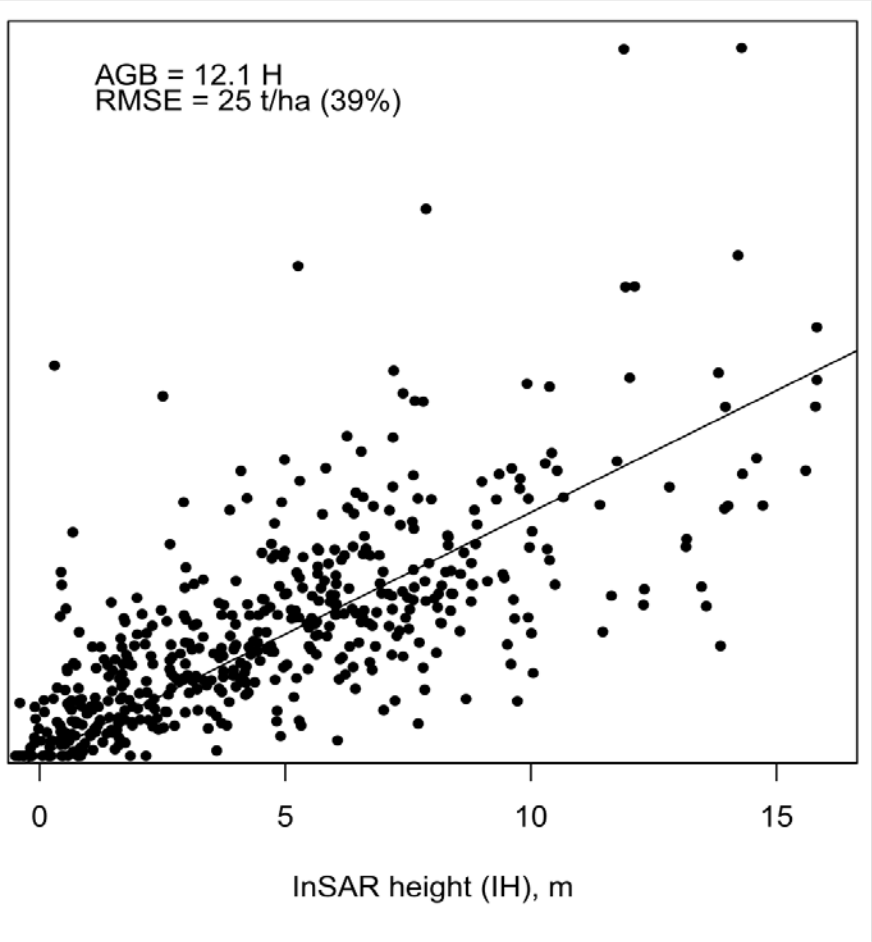
Changes in forest height based on InSAR DEMs (SRTM and TanDEM-X)

Changes in forest cover based on Landsat



Svein Solberg, Johannes May, Wiley Bogren, Johannes Breidenbach, Torfinn Torp and Belachew Gizachew. 2018. Interferometric SAR DEMs for Forest Change in Uganda 2000–2012. Remote Sensing 10, 228; doi:10.3390/rs10020228.

MODELING AGB ~INSAR HEIGHT
TANDEM-X WORLD DEM – TERRAIN HEIGHT

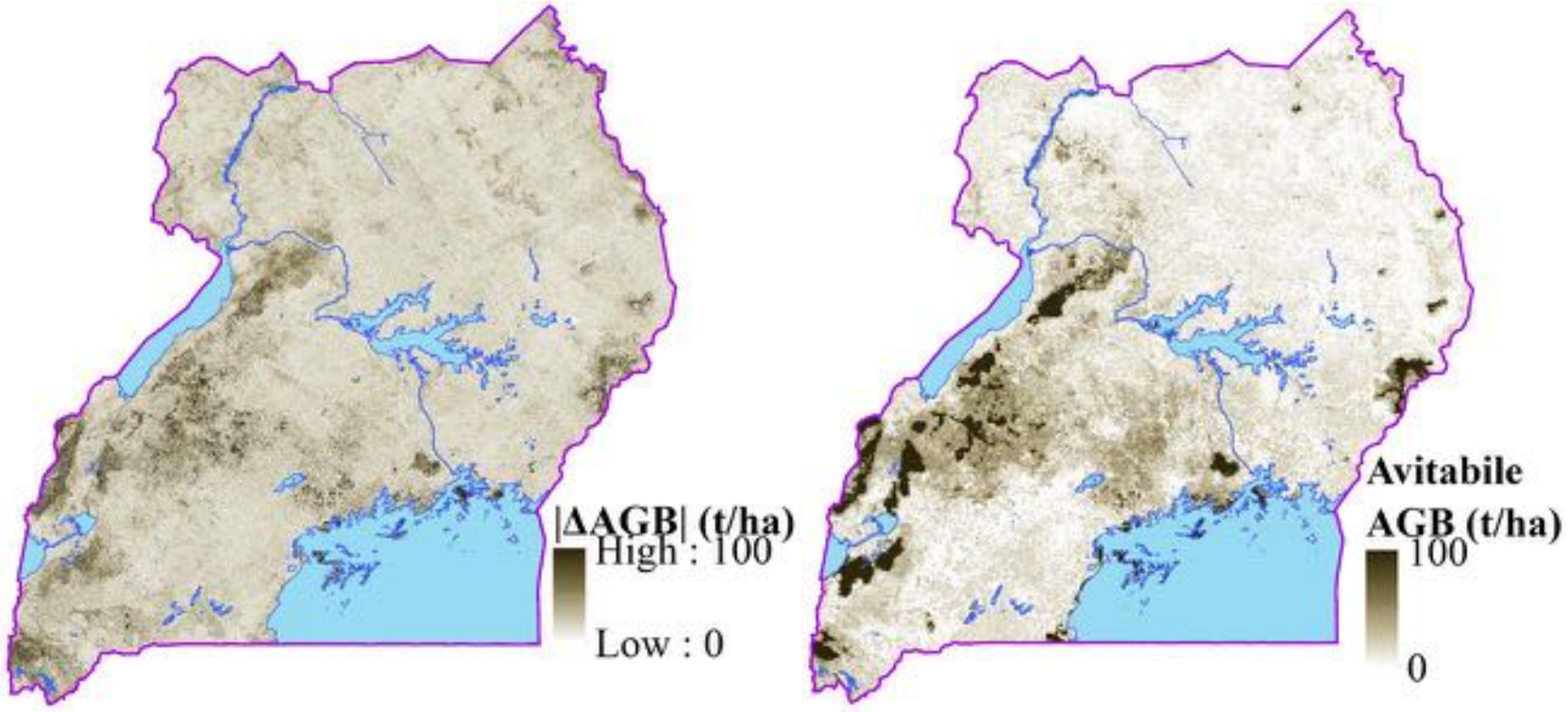


Puliti, et al. (in review) Modelling above ground biomass in Tanzanian miombo woodlands using TanDEM-X WorldDEM and field data

INSAR CHANGES VERSUS LANDSAT CHANGES UGANDA 2000-2012

	ΔH, m			ΔAGB, t/ha		
MODIS Land cover type	loss	no change	gain	loss	no change	gain
Evergreen broadleaf forest	-8.8	-1.0	0.6	-161.7	-19.1	10.1
Woody savanna	-3.7	-0.1	0.7	-51.5	-1.6	9.4
Savanna	-1.2	-0.3	1.8	-17.5	-3.7	25.4
Grassland	-2.2	-0.1	-0.4	-31.4	-1.0	-4.9
Permanent wetlands	-3.6	0.1	-0.1	-50.1	1.3	-1.7
Croplands	-1.4	-0.1	0.8	-19.7	-0.8	11.3
Cropland and natural vegetation mosaic	-3.5	-0.3	1.2	-49.6	-3.8	17.5
Others	-3.6	0.4	1.4	-51.0	5.8	20.2

UGANDA: COMPARING MAX CHANGE AND MAX STOCK



UGANDA: COMPARING MAX CHANGE AND MAX STOCK

Land cover type	Max AGB change (99-%tile) InSAR	Max AGB stock (99-%tile) Avitabile	Saatchi	Baccini
Evergreen Broadleaf Forest	335	498	290	353
Permanent Wetlands	185	186	151	255
Woody Savanna	125	161	196	179
Cropland/Natural Vegetatio	108	59	153	113
Croplands	84	33	79	95
Grasslands	77	42	85	112
Savannas	71	29	82	86

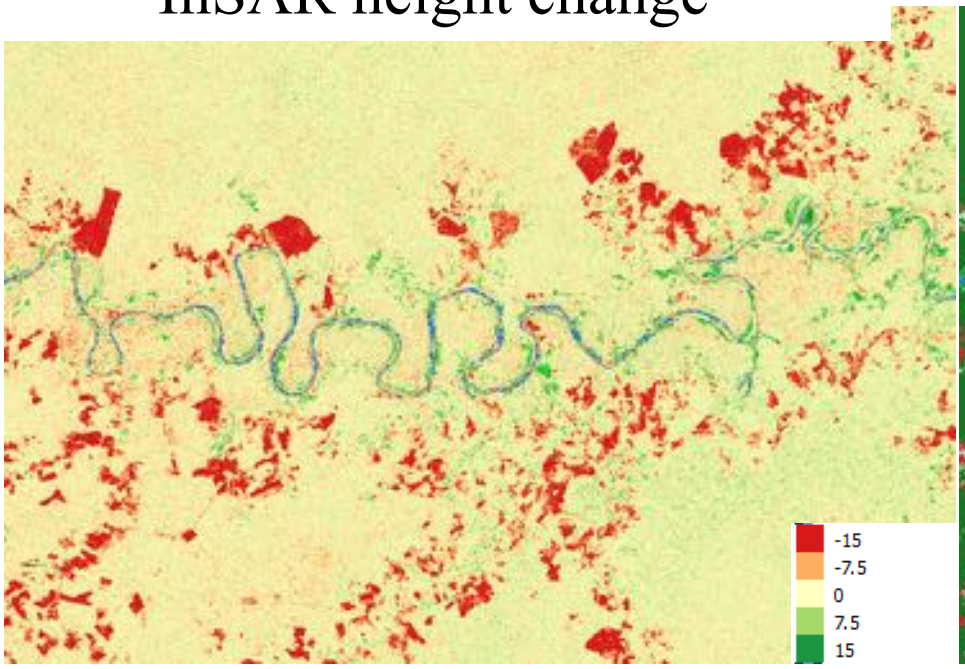
Avitabile, Valerio, Alessandro Baccini, Mark A. Friedl, and Christiane Schmullius. "Capabilities and Limitations of Landsat and Land Cover Data for Aboveground Woody Biomass Estimation of Uganda." Remote Sensing of Environment 117 (2012): 366-80.

Saatchi, S. S., N. L. Harris, S. Brown, M. Lefsky, E. T. A. Mitchard, W. Salas, B. R. Zutta, W. Buermann, S. L. Lewis, S. Hagen, S. Petrova, L. White, M. Silman, and A. Morel. "Benchmark Map of Forest Carbon Stocks in Tropical Regions across Three Continents." Proceedings of the National Academy of Sciences of the United States of America 108, no. 24 (2011): 9899-904.

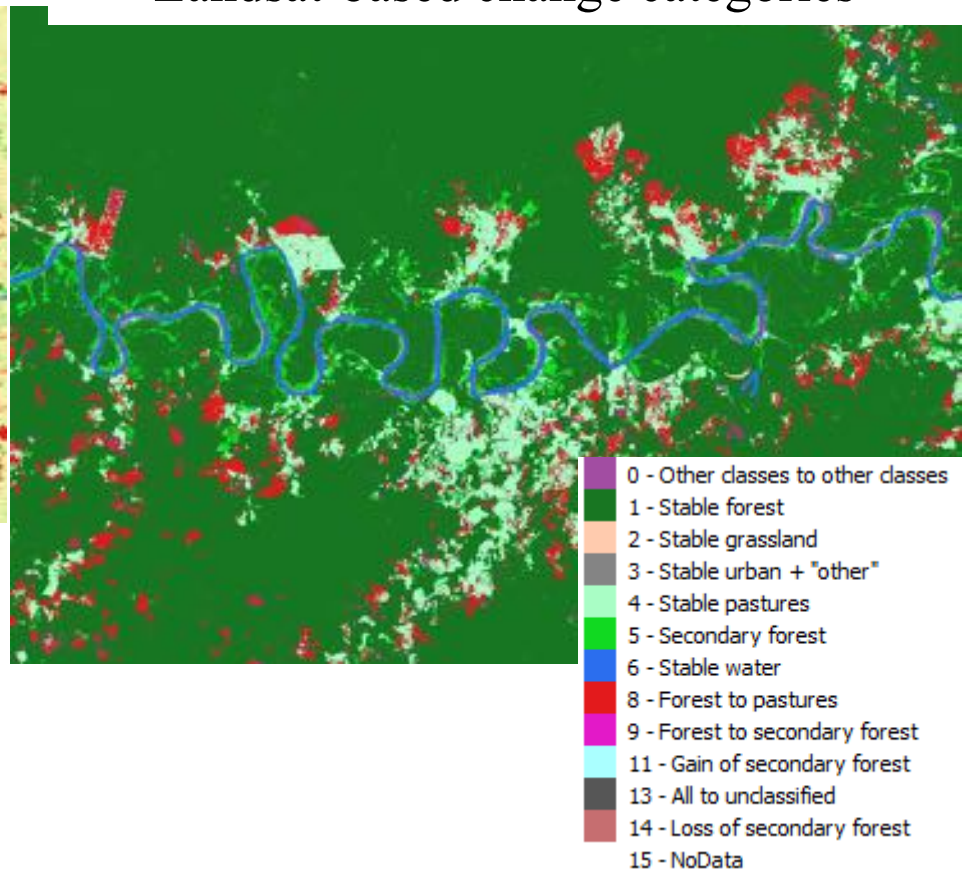
Baccini, A., S. J. Goetz, W. S. Walker, N. T. Laporte, M. Sun, D. Sulla-Menashe, J. Hackler, P. S. A. Beck, R. Dubayah, M. A. Friedl, S. Samanta, and R. A. Houghton. "Estimated Carbon Dioxide Emissions from Tropical Deforestation Improved by Carbon-Density Maps." Nature Climate Change 2, no. 3 (2012): 182-85.

TEST AREA COLOMBIA:
CHANGES 2000 –2012

InSAR height change



Landsat-based change categories



Prepared by Olofsson & Arevalo Orduz

COLOMBIA INSAR HEIGHT CHANGE FOR LANDSAT CHANGE CATEGORIES 2000-2012

Landsat based categories	No of pixels	Mean change, m
Forest to pastures	3 442 520	-11.7
Forest to secondary forest	426 392	-7.1
Loss of secondary forest	581 620	-4.6
Other classes to other classes	1 231 020	-3.5
Stable water	721 828	-0.6
Stable forest	59 373 900	-0.3
Stable pastures	18 627 300	-0.3
Stable grassland	3 904 950	0.5
Secondary forest	2 390 060	0.7
Stable urban + "other"	82 430	0.7
Gain of secondary forest	186 224	1.3

CONCLUSION

- The geography of gain and loss appear to be OK
- The magnitude of changes correspond to independent data sets
- A number of limitations currently
- Has potential to provide unique understanding of forest biomass dynamics, i.e. geography and magnitude