



Multi-Temporal Pixel Trajectories of Synthetic Aperture Radar Backscatter and Coherence in Tropical Forest

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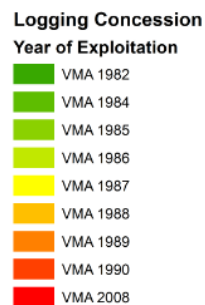
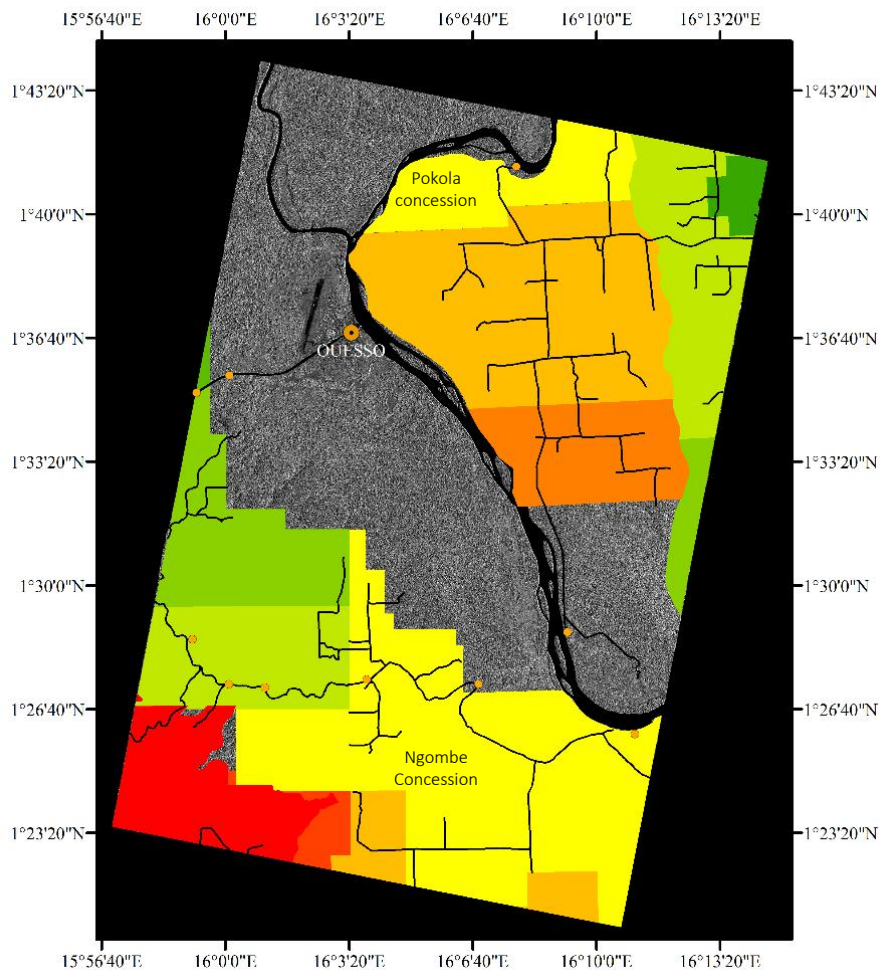


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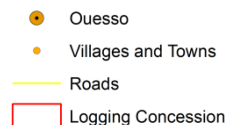
Study Site

- Dense humid evergreen forest and swamp forest.
- Intensive disturbance patterns around Ouesso and Mboko.
- Extensive area of secondary forest and agriculture around urban centers.
- Presence of currently inactive logging concessions (Ngombe and Pokola) (1985-2008).

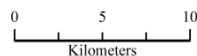


Dates	Rainfall (mm)*
1. 05/12/2012	0
2. 14/03/2013	0.587
3. 15/05/2013	20.657
4. 25/12/2013	7.603
5. 03/04/2014	29.843
6. 06/05/2014	12.382

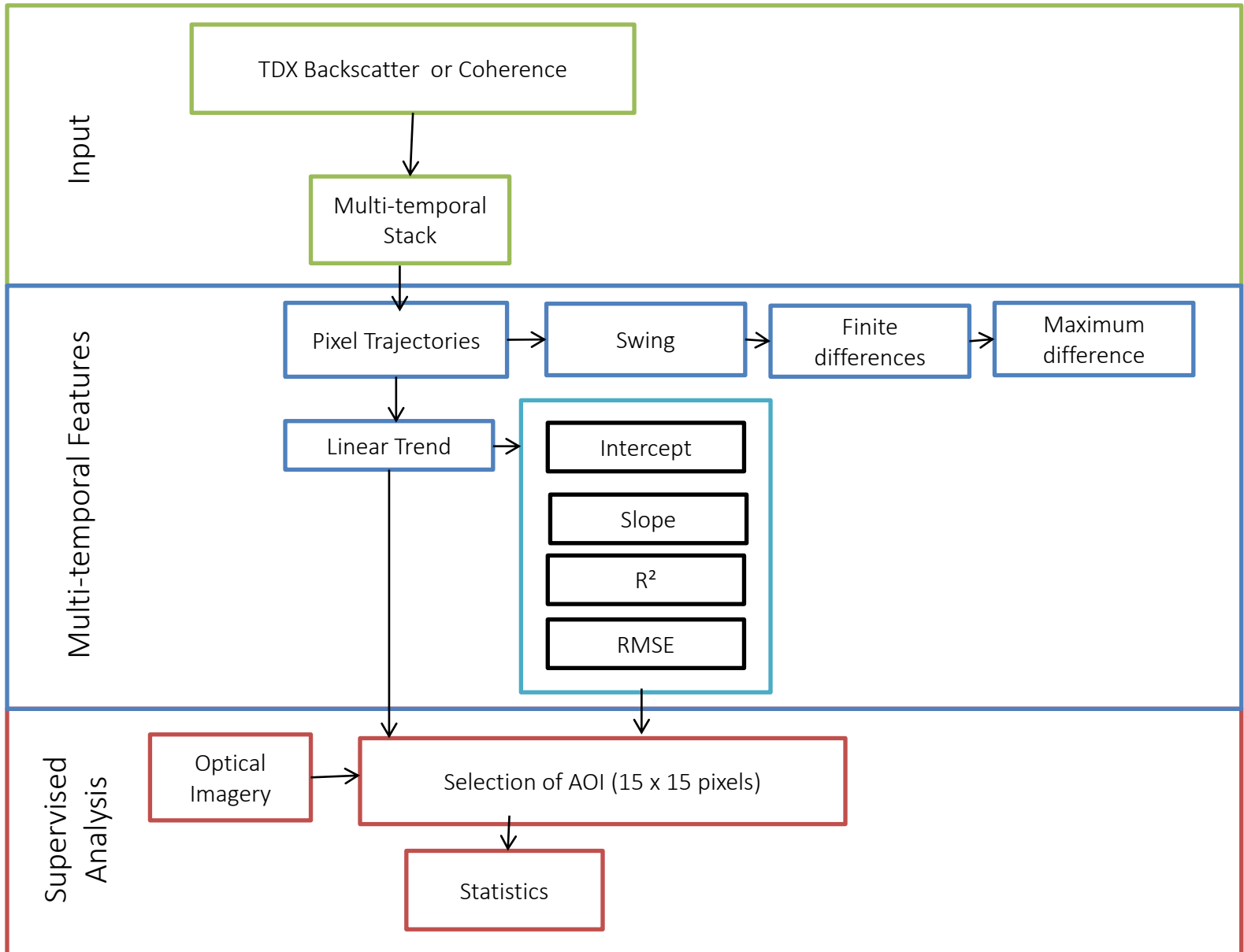
*based on TRMM data 48 h accumulated precipitation before data acquisition



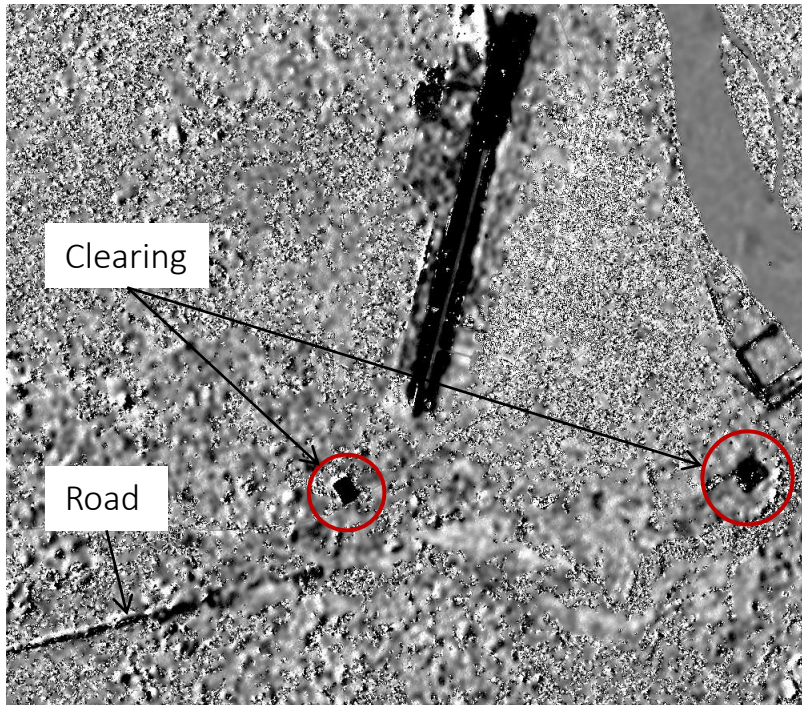
TanDEM-X (HH), 47°
slant range pixel size= 3.69 x 3.73 m



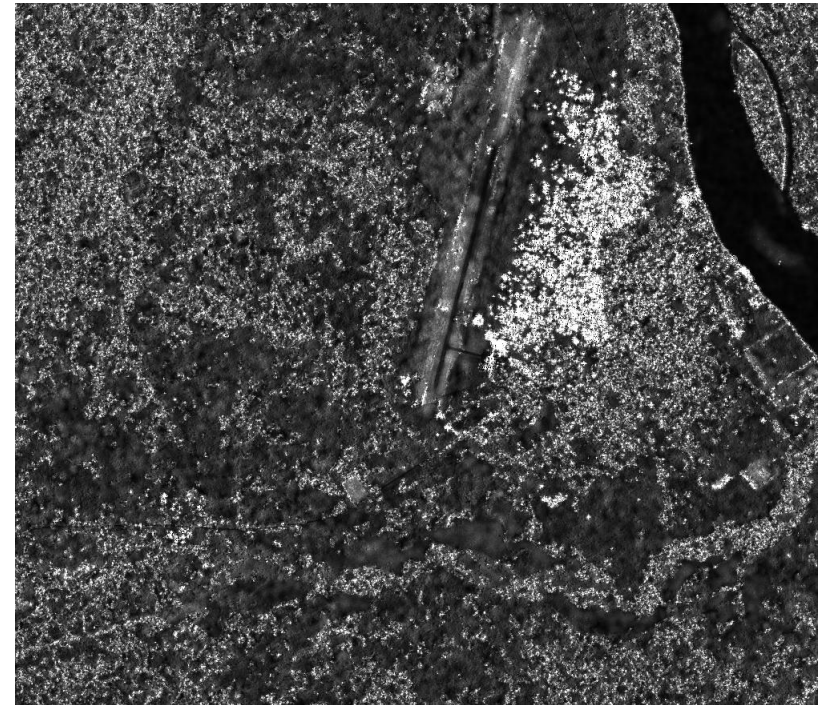
Methods



Multi-temporal Features



Slope



RMSE



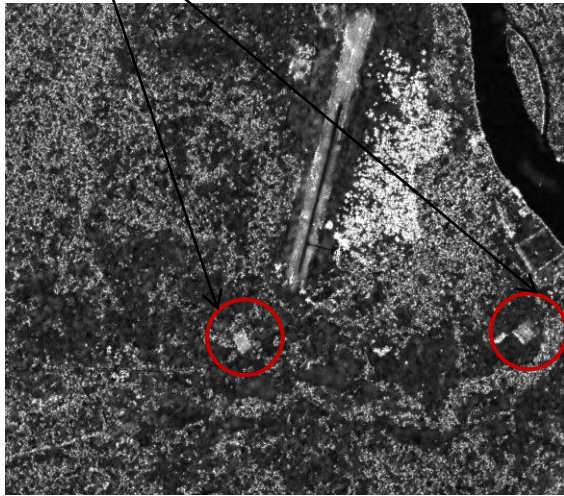
Low

High

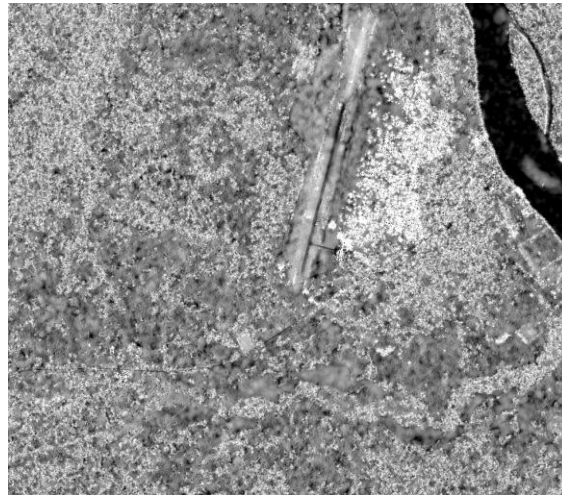
Ouesso

Multi-temporal Features

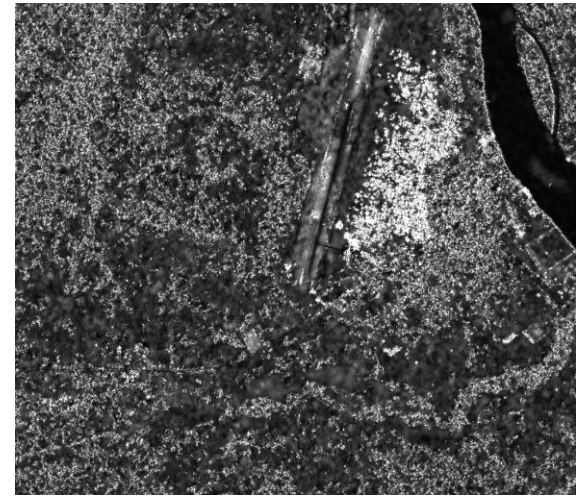
Clearing



Swing



Variance



Intermittency



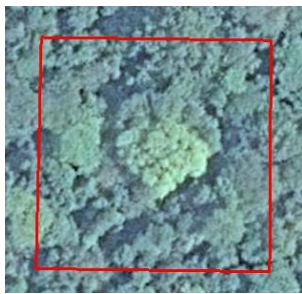
High

Low

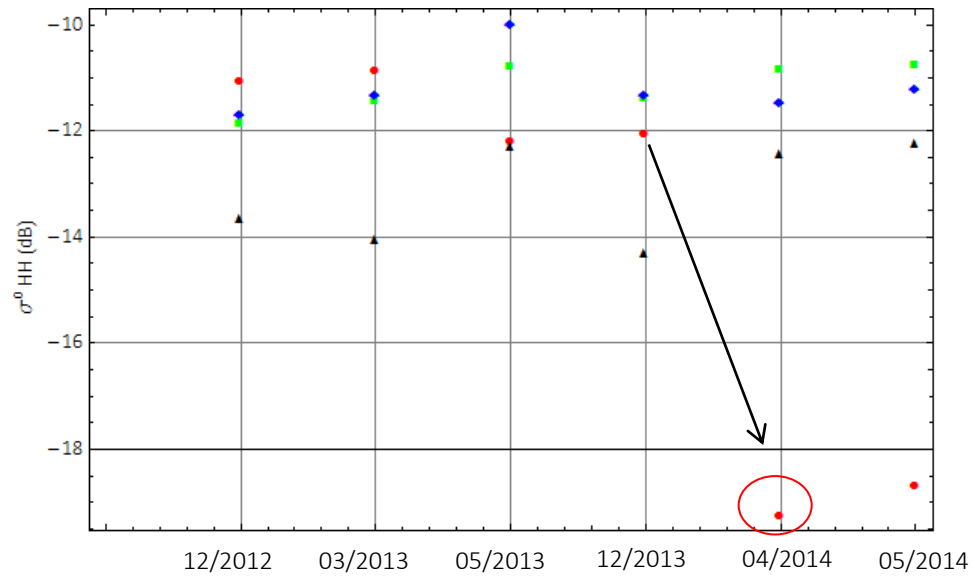
Backscatter Trajectories



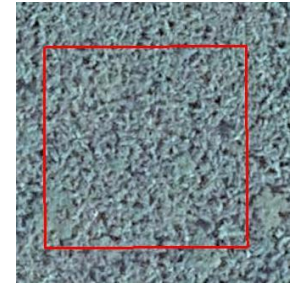
Agriculture



Lowland Forest



- Agriculture
- Lowland Forest
- Swamp Forest
- Grassland



Swamp Forest

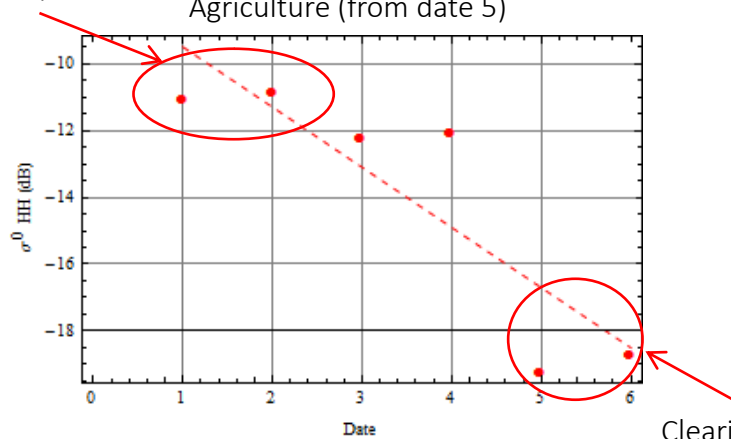


Grassland

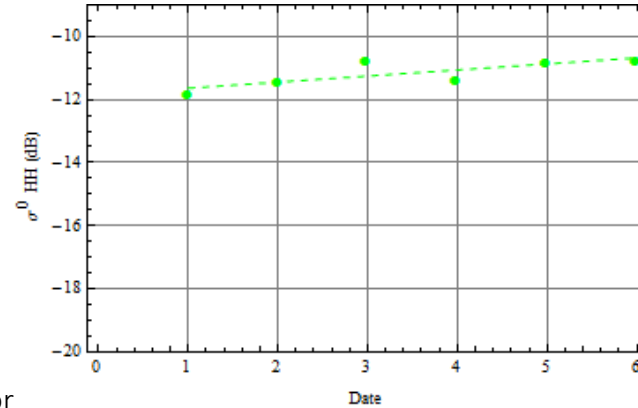
* Optical imagery: Google Earth (12/2013)

Backscatter Trajectories

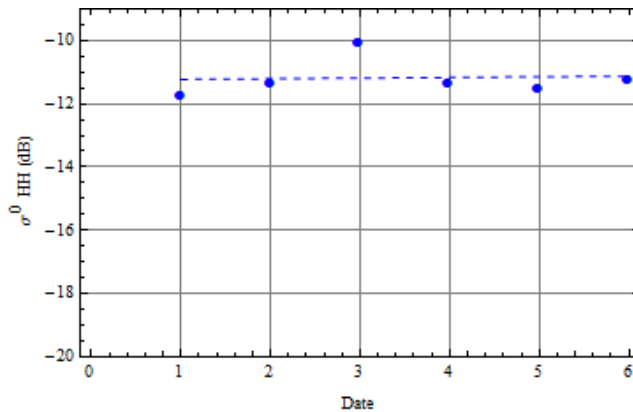
Secondary Forest



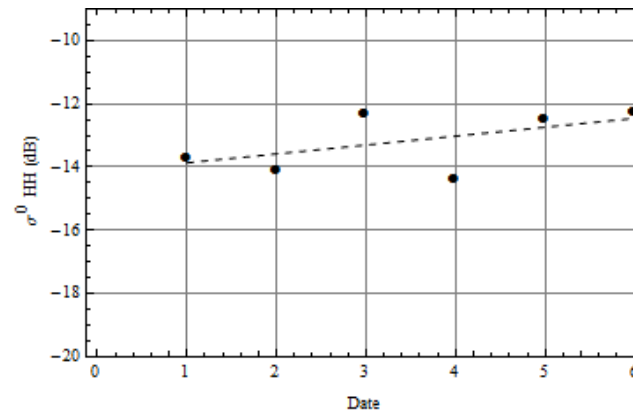
Lowland Forest



Swamp Forest

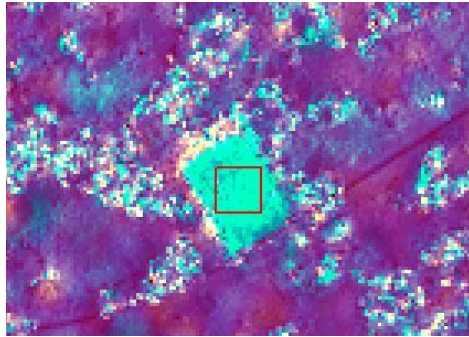


Grassland

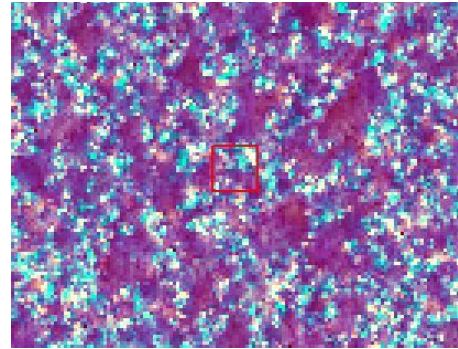


Class	Swing	Relative Swing (%)	Slope	RMSE	Variance	Intermittency
Agriculture	8.3	59.8	-60.9	1.7	10.5	29.0
Lowland Forest	1.1	9.9	10.9	0.2	0.2	0.5
Swamp Forest	1.6	15.1	1.1	0.5	0.9	1.7
Grassland	2.0	15.7	15.7	0.7	2.6	5.2

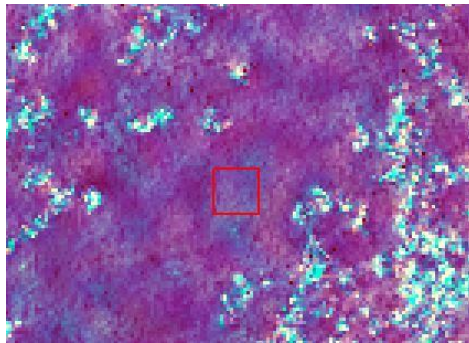
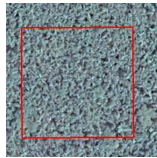
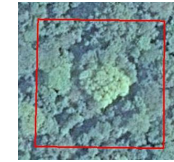
Multi-temporal Features (Backscatter)



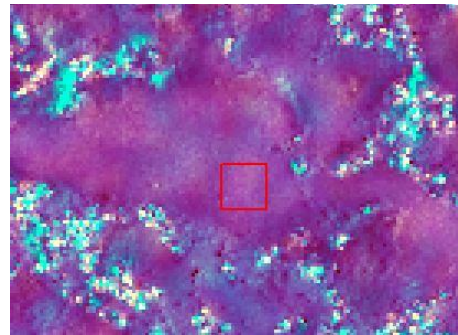
(A) Agriculture



(B) Humid Evergreen Forest



(C) Swamp Forest

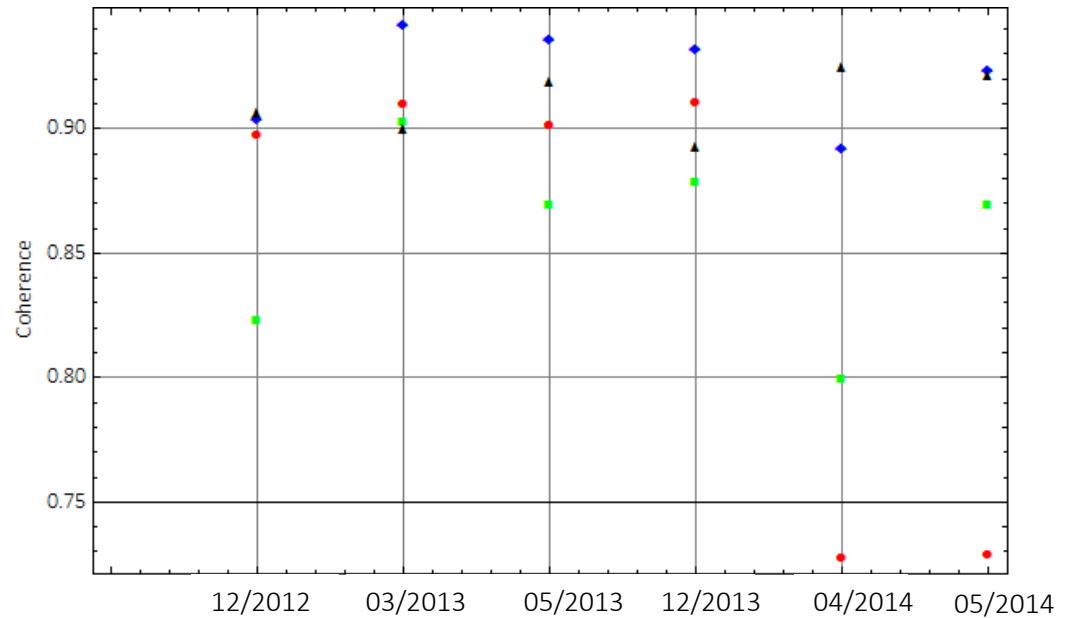
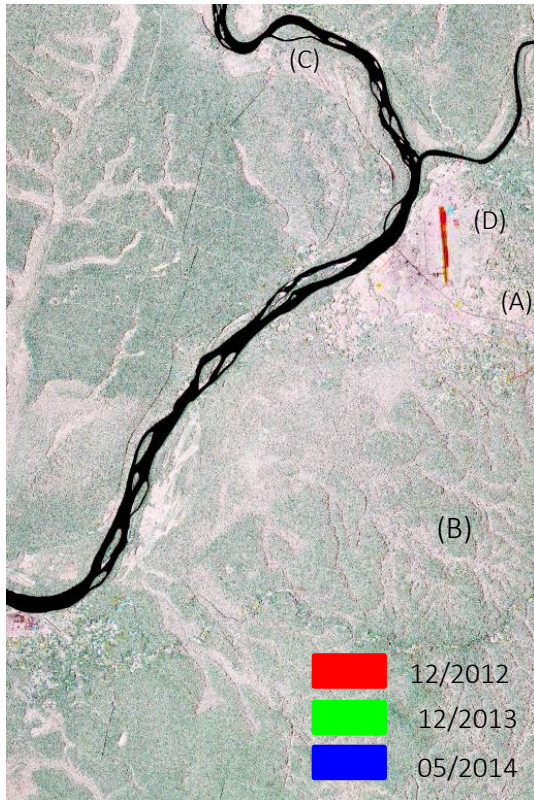


(D) Grassland



15 x 15 pixels

Coherence Trajectories

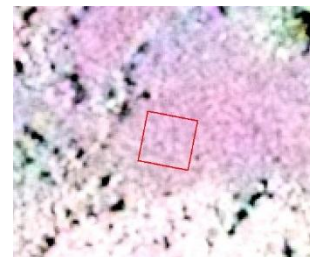
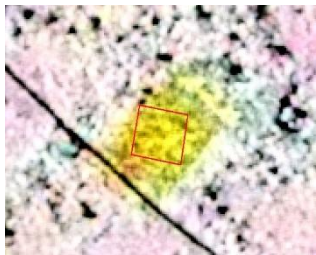


(A) Agriculture

(B) Lowland Forest

(C) Swamp Forest

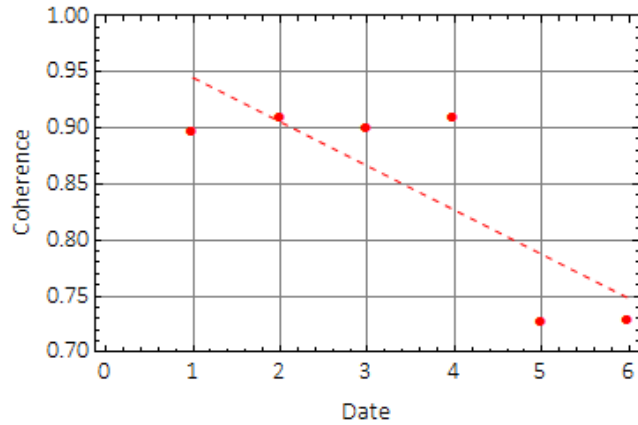
(D) Grassland



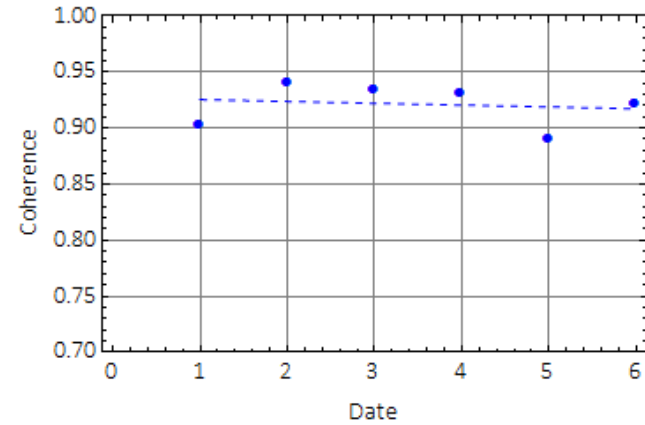
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Coherence Trajectories

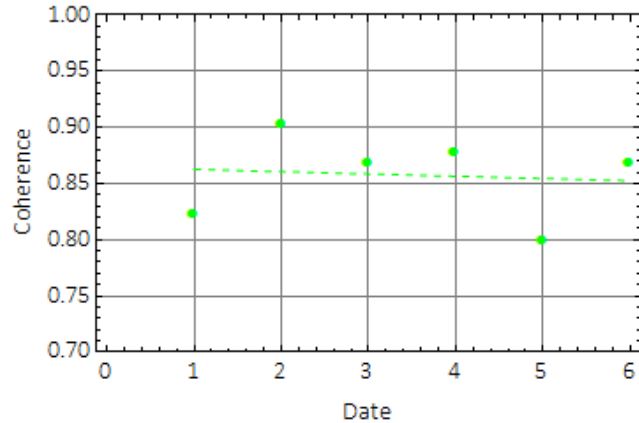
Agriculture



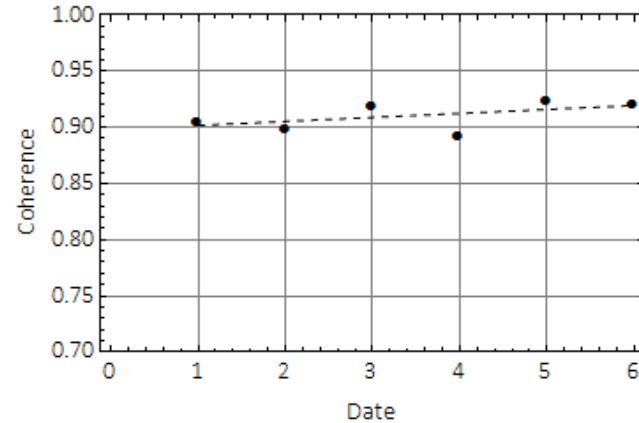
Lowland Forest



Swamp Forest



Grassland



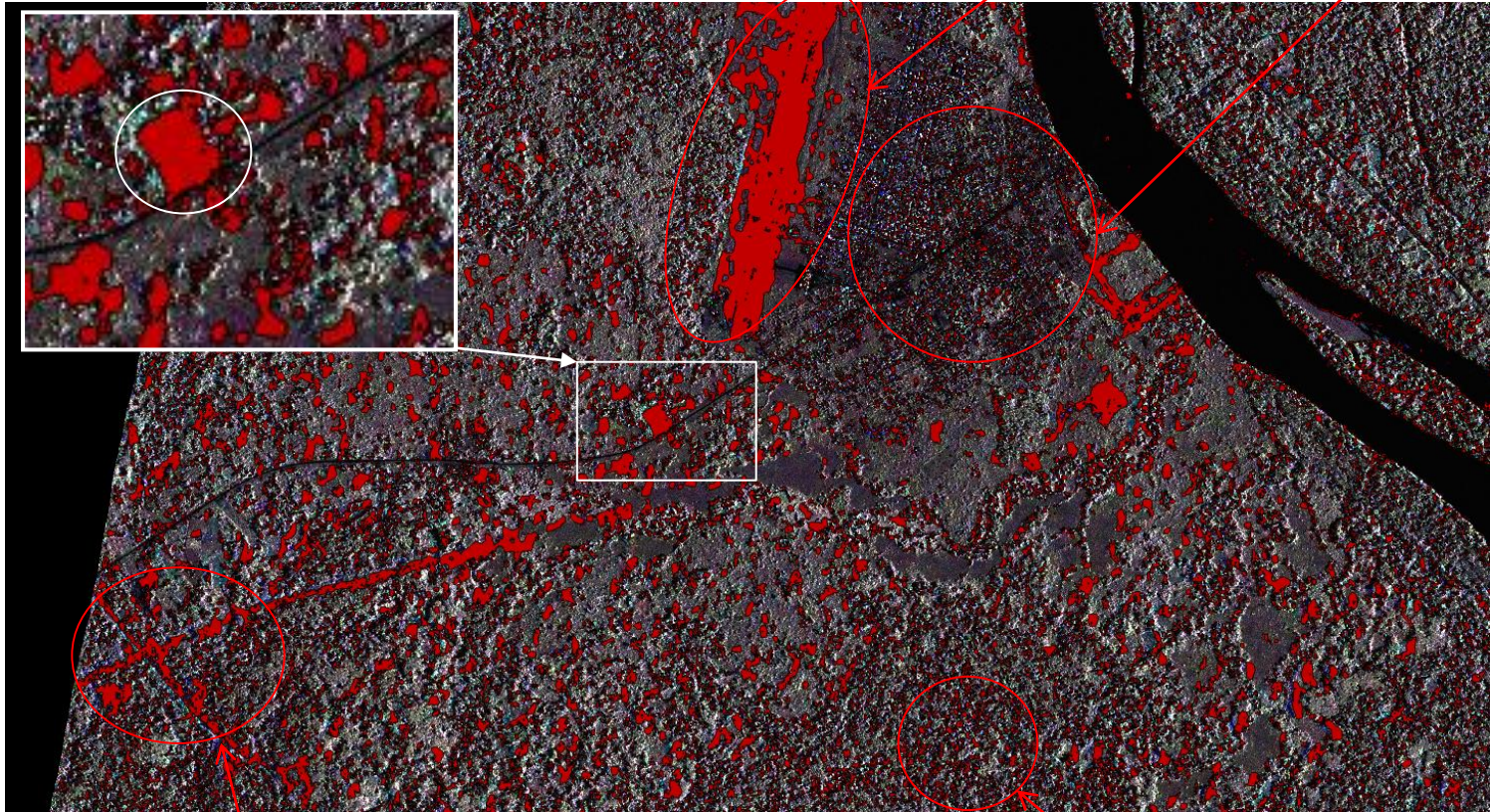
Class	Swing	Slope	RMSE	Variance	Intermittency
Agriculture	0.18	-2.25	0.049	0.0069	0.0204
Lowland Forest	0.10	-0.11	0.034	0.0046	0.0067
Swamp Forest	0.049	-0.09	0.017	0.0009	0.0015
Grassland	0.031	0.20	0.010	0.0005	0.0009

Future Work

Clearing for agriculture (> 1 ha)

Airport runway

Ouesso



Secondary forest cleared for road development



$-79 < \text{slope} < -1$

Changes possibly due to noise and/or temporal and environmental conditions

Final Remarks

- Multi-temporal features were extracted from TDX backscatter and coherence for 4 AOI.
- Multi-temporal features can be used to detect changes due to anthropogenic forest disturbance (e.g. clearing for agriculture).
- Slope of the linear trend fit gives a good indication of change (to be investigated in future work).