



S2 BOA reflectance in the context of tropical rainforest: preliminary illustration of the challenges for the extraction of vegetation properties

Jean-Baptiste Féret & Nicolas Barbier

S2 BOA reflectance in the context of tropical rainforest

- **Introduction & contexte**
- **Image dataset**
- **Methods**
- **Results**
- **Conclusions**

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S2 BOA reflectance in the context of tropical rainforest

- **Enjeux pour la zone forestière d'Afrique centrale (bassin du Congo)**
 - **Zone géostratégique**: rôle fondamental pour avenir Biosphère et Humanité
 - 6% des surfaces forestières mondiales ; 2,5 millions de km² sur 6 pays
 - Région essentielle pour le devenir du climat global et de la biodiversité
 - **Zone en mutation**: croissance démographique, développement urbain, activités agricoles, infrastructures / transport et énergie, activités minières extractives, etc.
 - **Zone d'émergence** de maladies infectieuses
 - **Manque de données & besoin d'observations long terme**: cycle de l'eau, cycles biogéochimiques, dynamique forestière, biodiversité, émissions GES, services écosystémiques, etc.

?

Comment concilier développement & préservation d'écosystèmes majeurs à biodiversité très riche en contexte de réchauffement climatique, de forte croissance démographique et d'occupation des terres accrue.

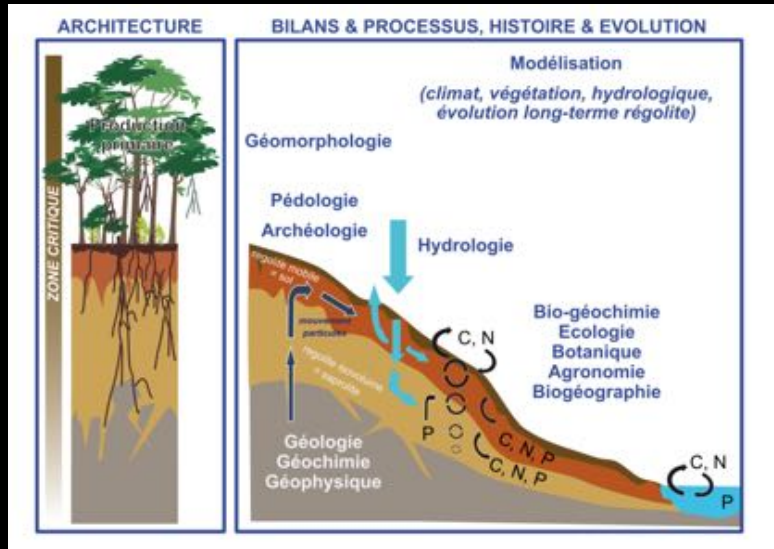
- **Laboratoire Mixte International (LMI) Dycofac :**

Dynamique des écosystèmes forestiers d'Afrique centrale en contexte de changements globaux

→ Liens entre climat et occupation des sols au travers de la dynamique du couvert végétal et des cycles biogéochimiques

S2 BOA reflectance in the context of tropical rainforest

- **Zone Critique et ressource en eau**



ZC : de la base atmosphère à la lithosphère non altérée par l'eau

ZC est critique car elle est caractérisée par le Vivant et concentre la plupart des activités humaines (Anthropocène)

Nombreuses interfaces : entre milieux physiques et entre milieux physiques et Vivant

Lieu de réactions bio-physico-chimiques complexes et interdépendantes, sur des échelles de temps très variables (géologiques => journalières),

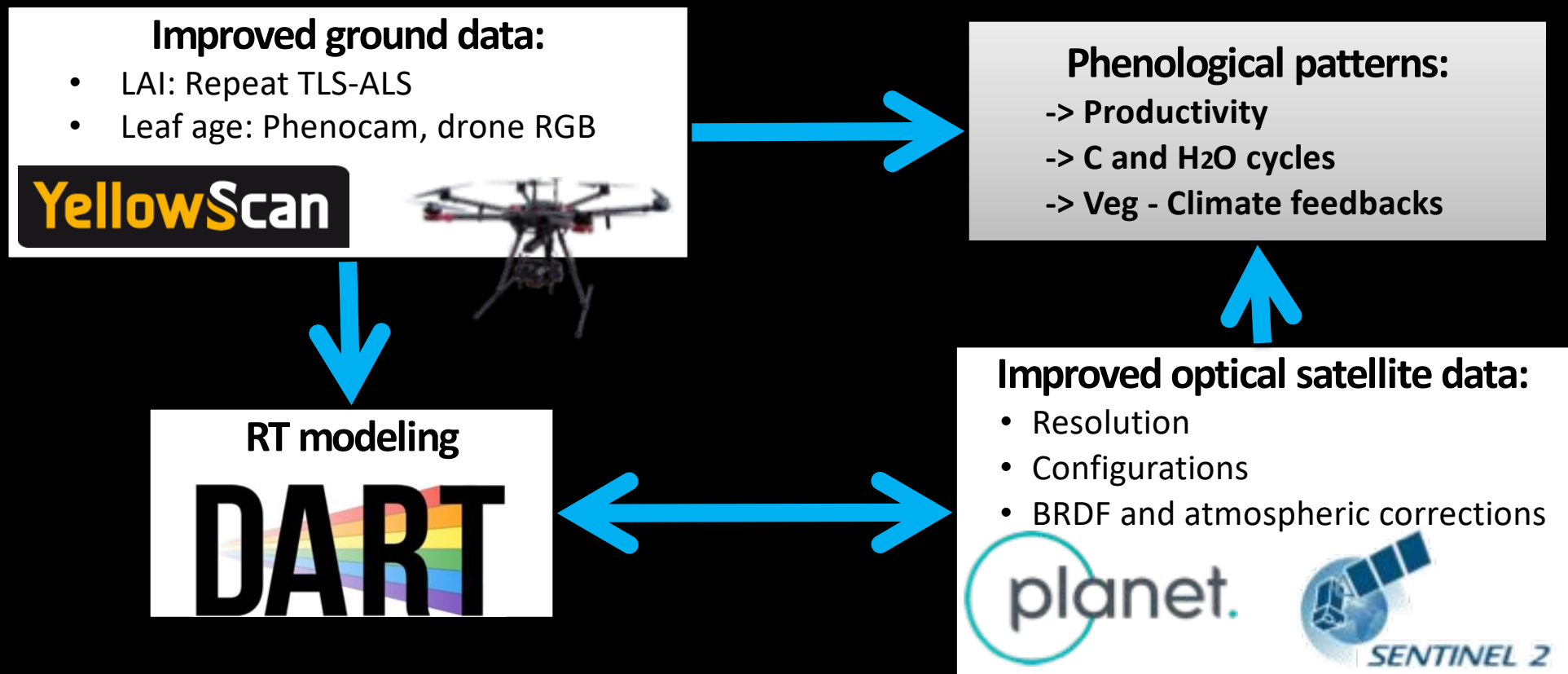
Lieu principal des ressources biologiques, hydrologiques et géologiques : ZC soumise à des problèmes de risques et d'impacts

Fonctionnement intégré de la ZC : approche « bassin versant » au cœur d'une démarche « multi-échelles » + réseau pertinent d'observatoires environnement

S2 BOA reflectance in the context of tropical rainforest

- **Comment les données Sentinel-2 peuvent-elles contribuer ?**
 - **Diversité du couvert végétal (fonction, composition)** : rôle sur les flux biogéochimiques aux échelles de temps courtes (saisonniers, annuels, décennaux) et sensibilité au climat,
 - **Dynamique de la végétation** : intégration dans **modèles d'altération chimique des continents** en contexte de changement climatique

- **Projet PhenoScan**

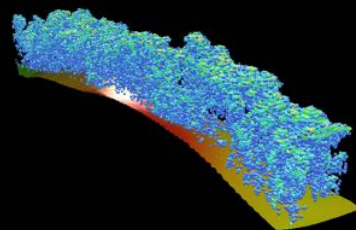
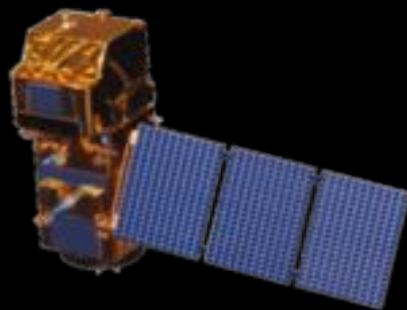
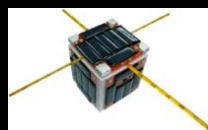


PhenoScan project

(Q3) Can dedicated space platforms and imagery correction algorithms be designed to maximize the signal of foliage dynamics?

(Q2) How do foliage dynamics impact radiometric signatures at plant and stand levels?

(Q1) Can we monitor detailed 3D foliage dynamics in complex tropical forests?



WP4: Towards a CubeSat constellation

- T4.1 Phase 0: mission identification
- T4.2 Phase A: feasibility

WP3: Comparing simulations to actual signal dynamics

- T3.1 Atmospheric correction
- T3.2 compare to simulations

WP2: Radiative transfer modeling

- T2.1 Upscaling from leaves to crown
- T2.2 Simulating temporal variations

WP1: Proximal measurements

- T1.1 Leaf area, wood volume, ...
- T1.2 Leaf age dynamics

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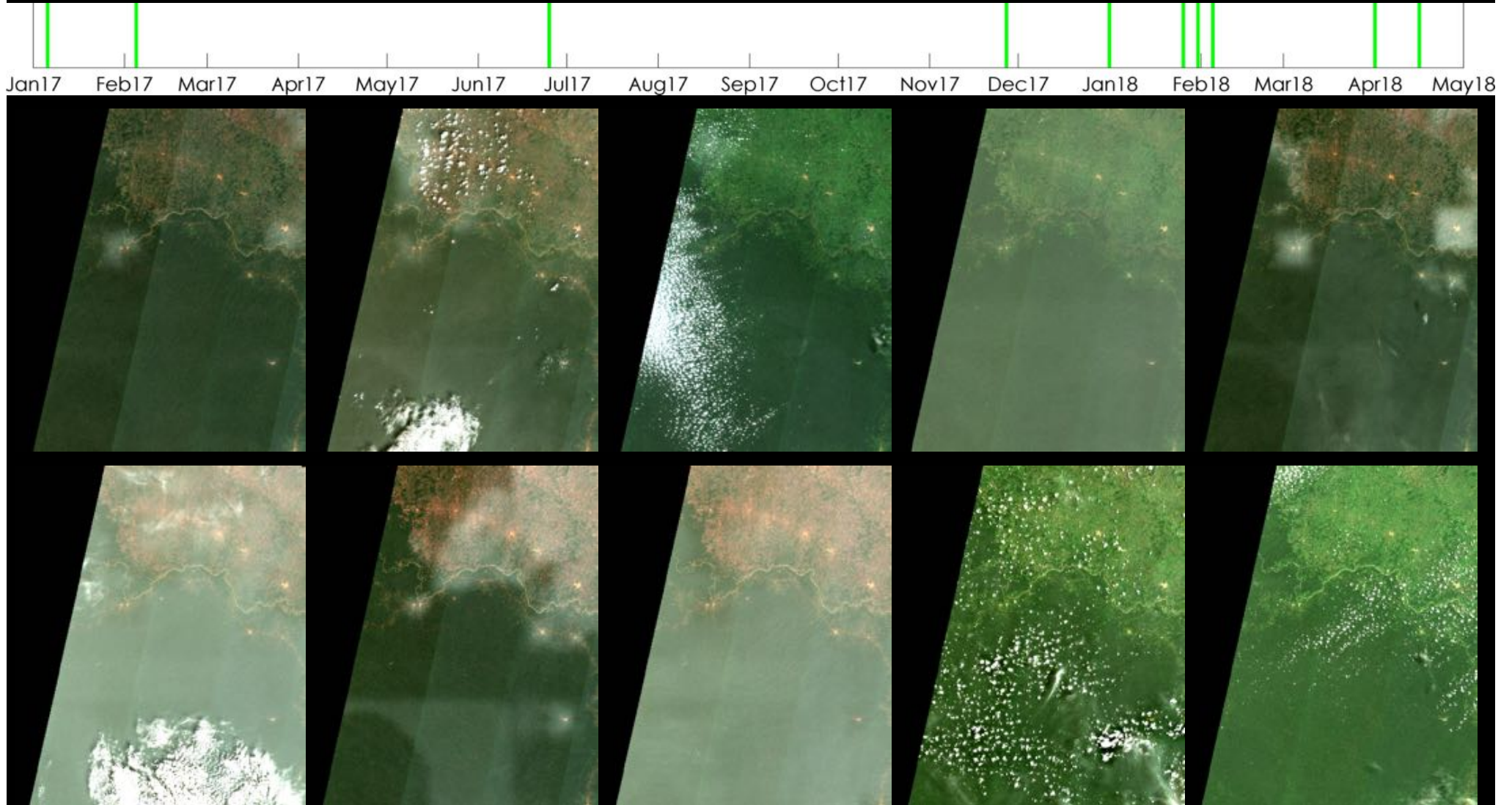
- **Methods**

- **Results**

- **Conclusions**

Image dataset

- **10 images selected from THEIA, Tile 33NVE**
 - Same image from PEPS → Sen2Cor with DEM correction
 - Same image from OverLand →

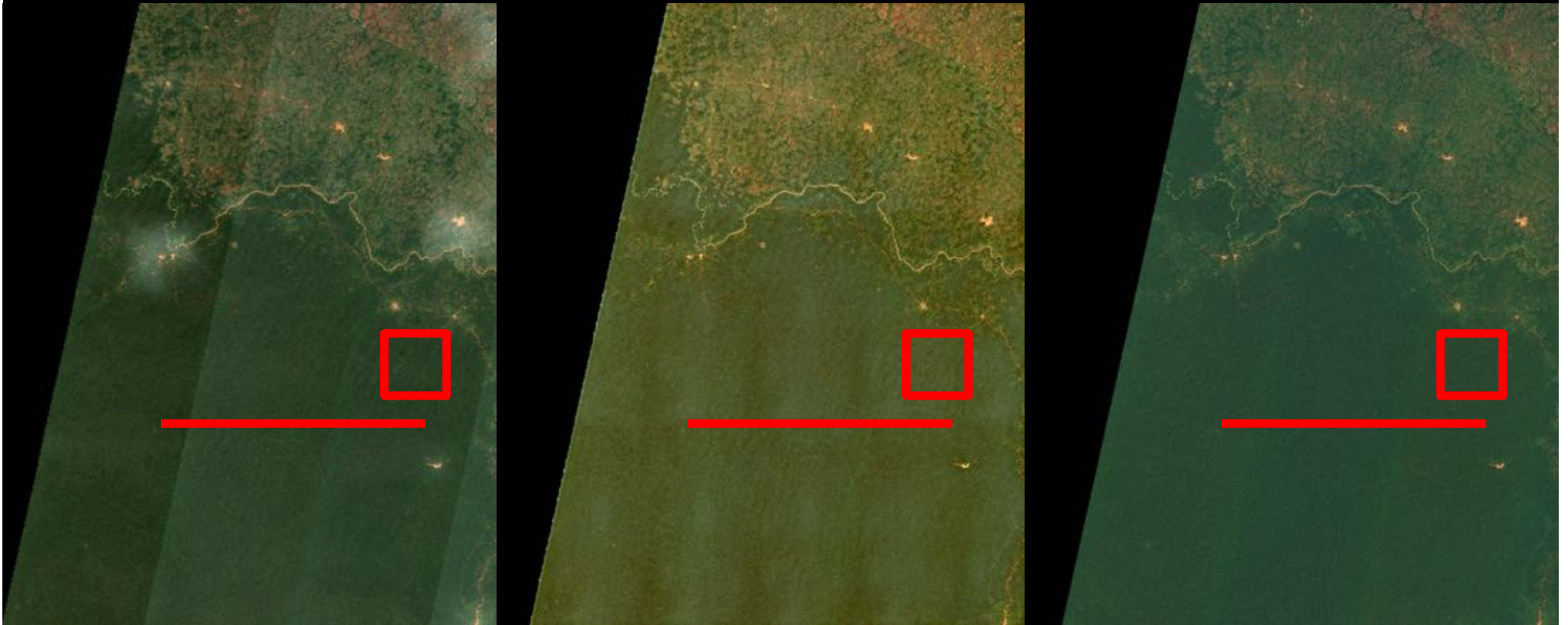


S2 BOA reflectance in the context of tropical rainforest

- **Introduction**
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- **“Method”**
- **Results**
- **Conclusions**

Comparison across images and preprocessing techniques

- **1 or 2 dates**
 - Comparison among data sources for all bands
- **Time series (10 images)**
 - Horizontal sampling transect (~50 km) across the image
 - Square sampling area (100 km²)
 - Comparison for native 10 m bands



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- **Results**
 - 1 / 2 dates
 - Time series: Transect & Square area
- **Conclusions**

Comparison among data sources for one image

THEIA

PEPS

OVERLAND

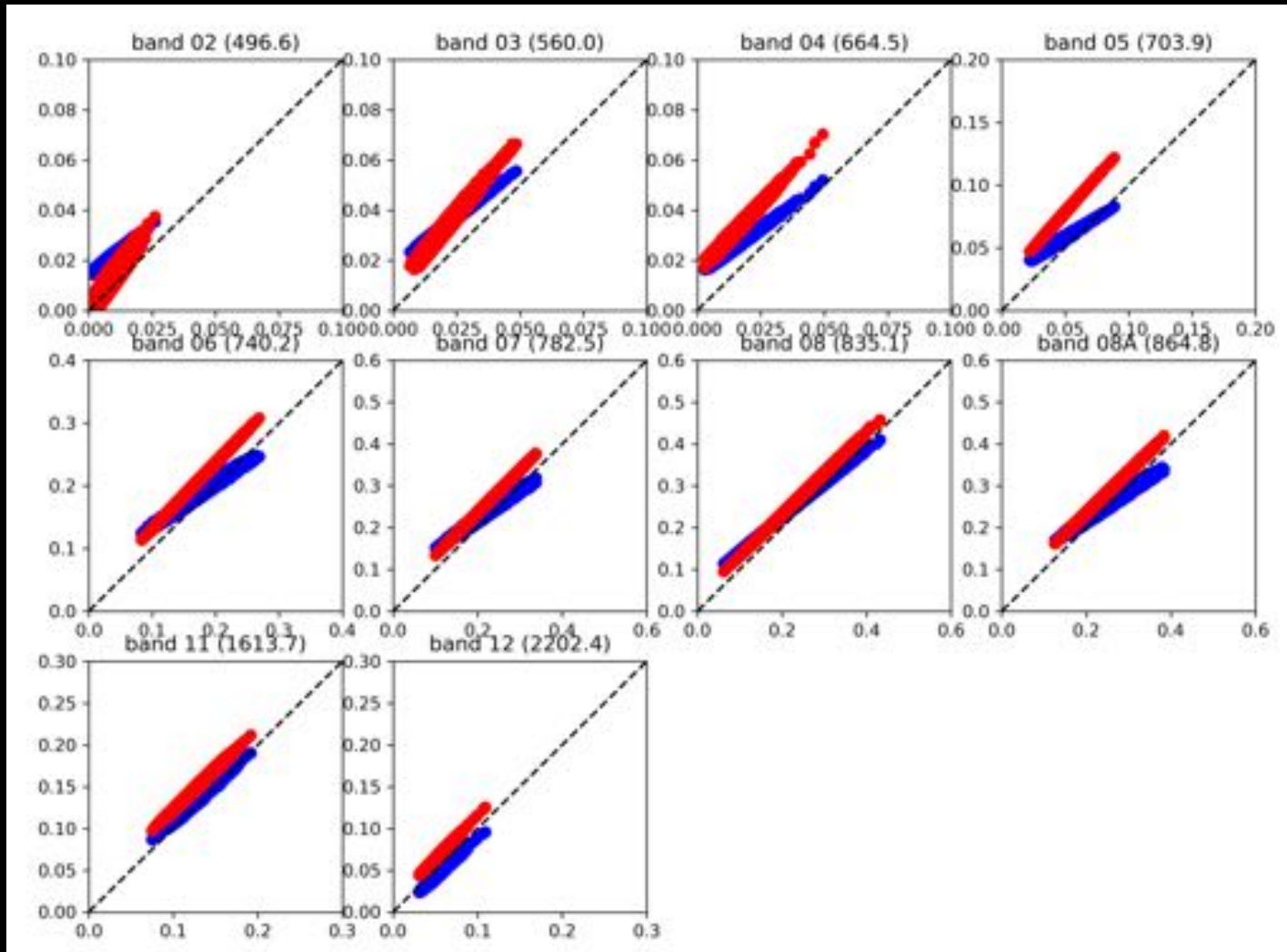


Comparison among data sources for one image

Jan. 6th, 2017

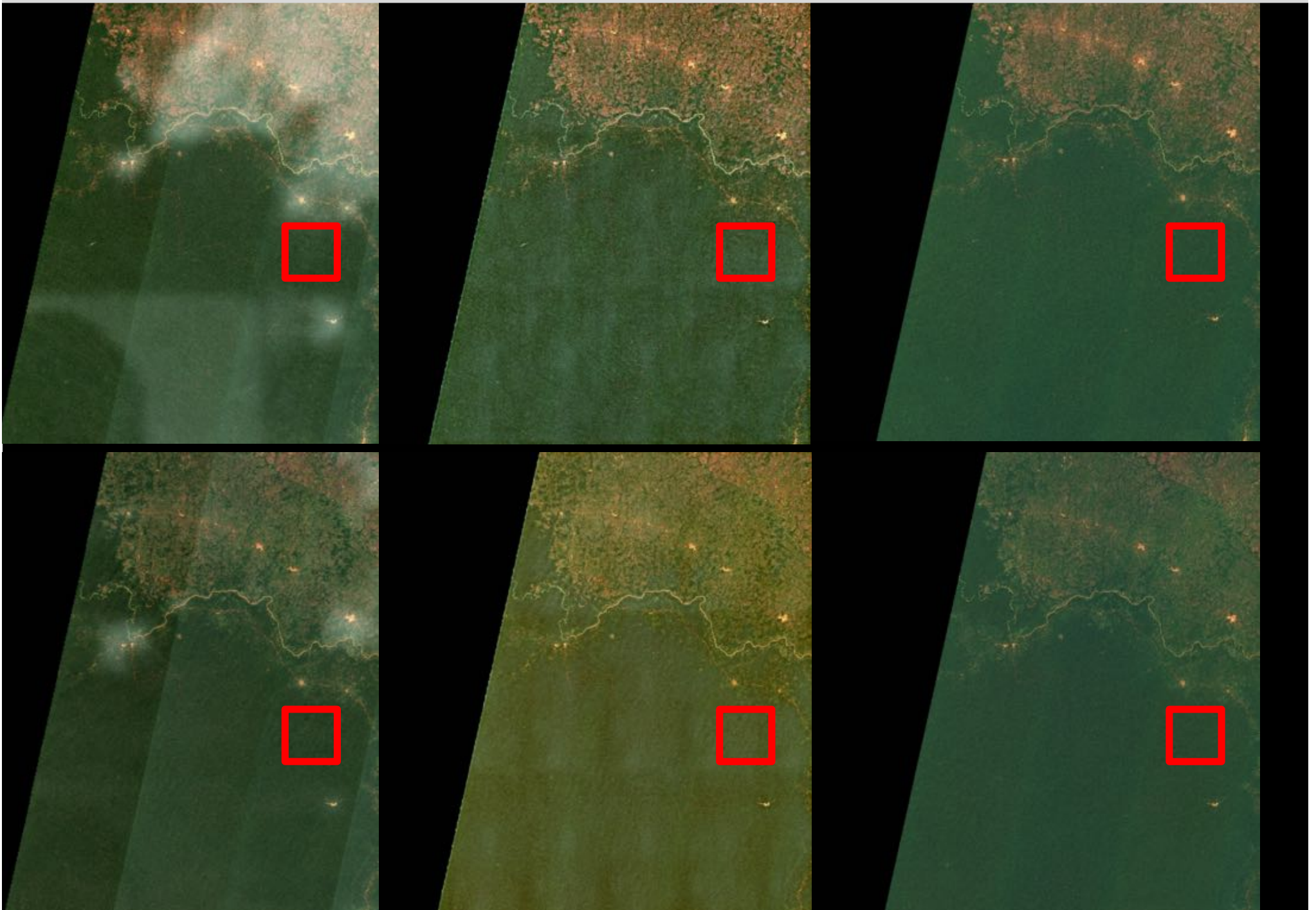
OVERLAND

PEPS

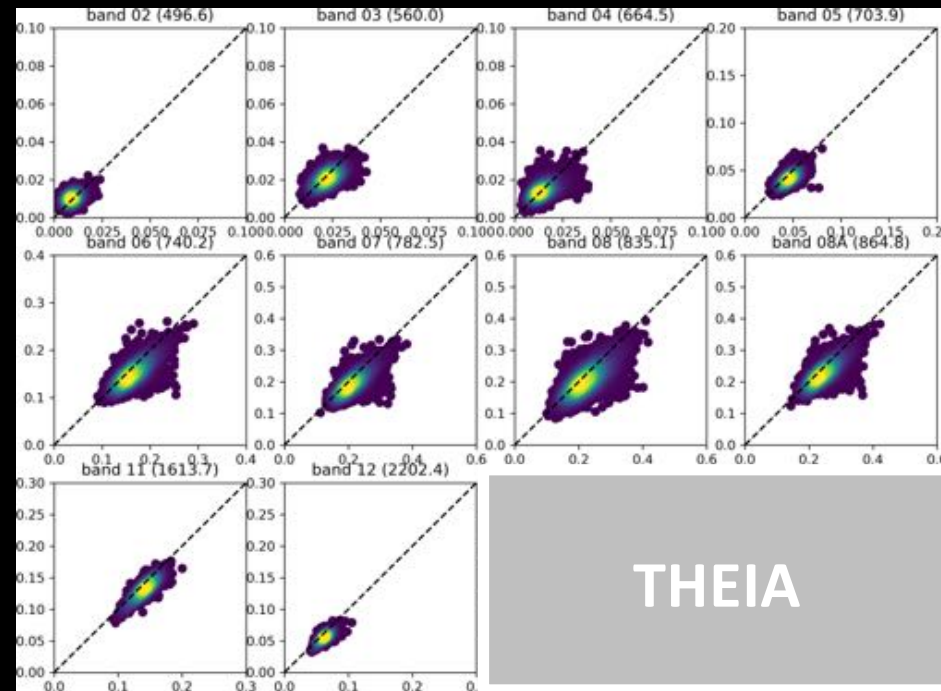
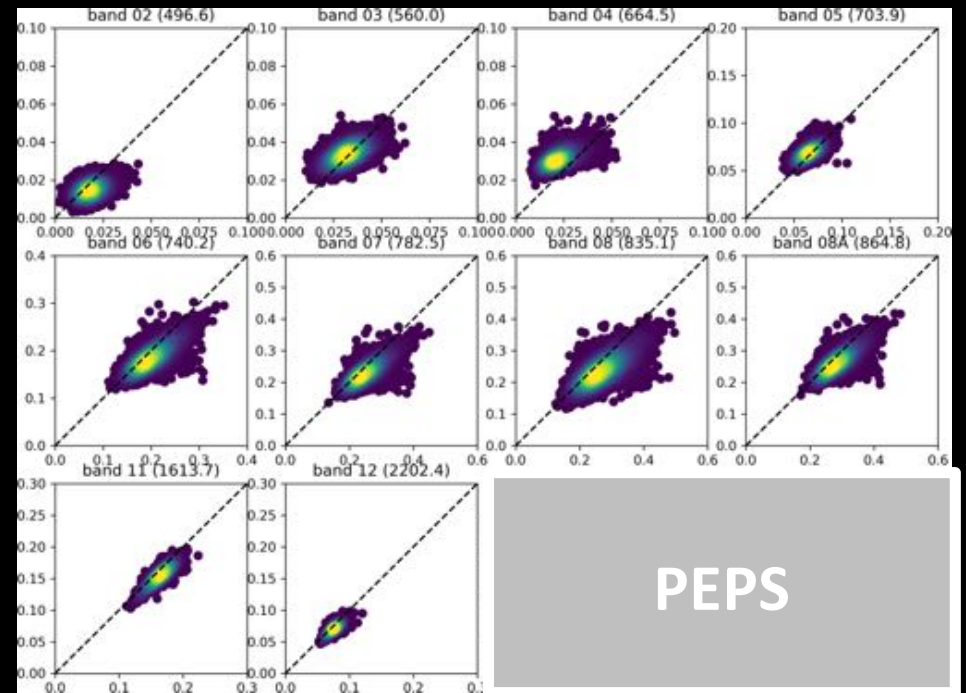
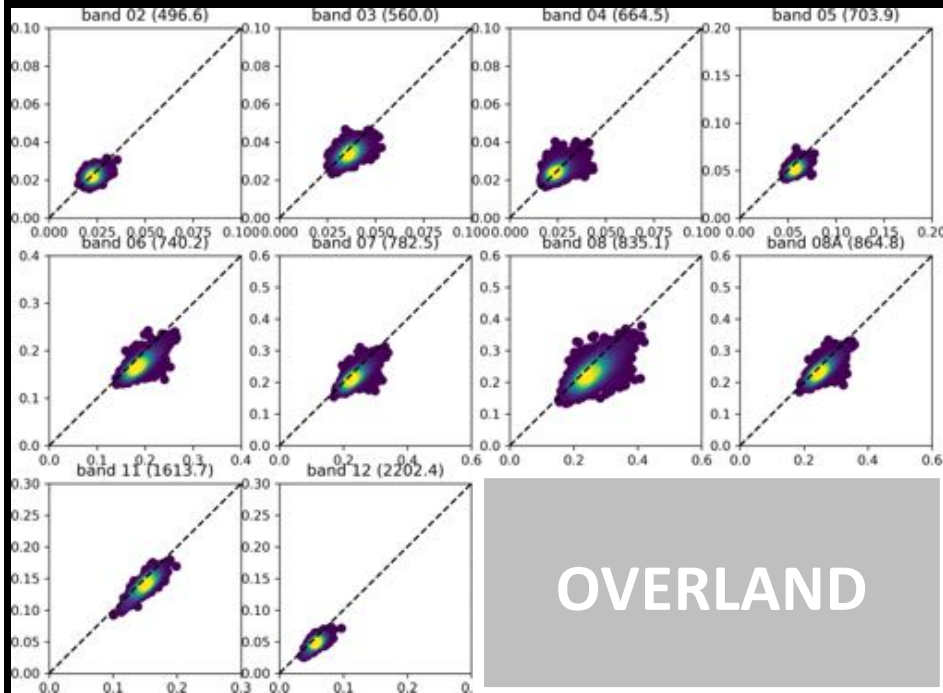


THEIA

Comparison between Jan. 6th, 2017 and Jan. 31st, 2018



Comparison between Jan. 6th, 2017 and Jan. 31st, 2018



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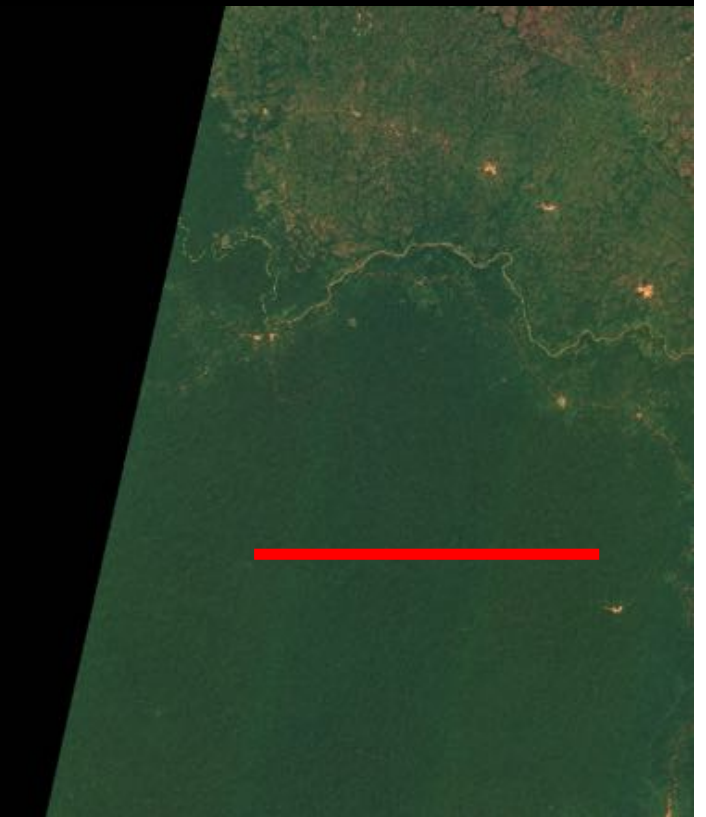
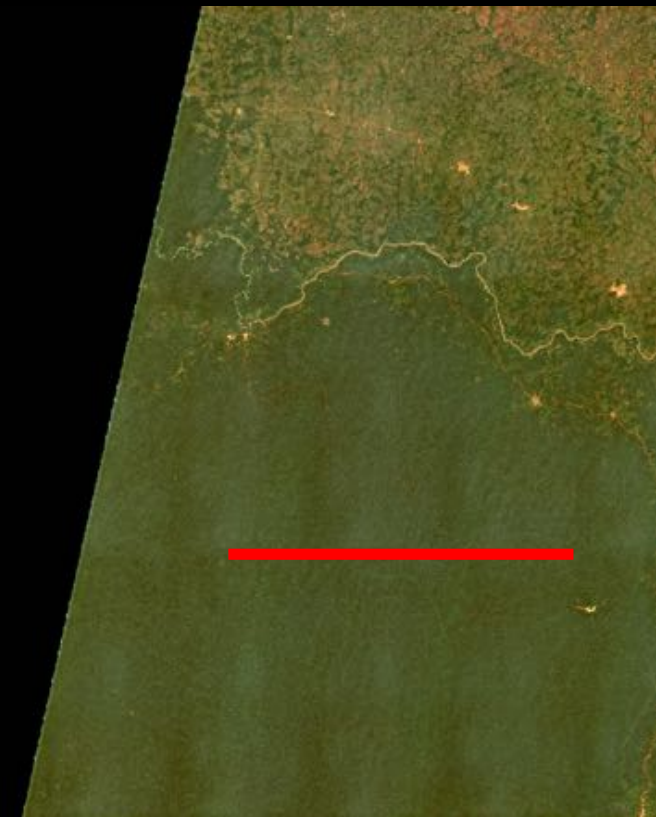
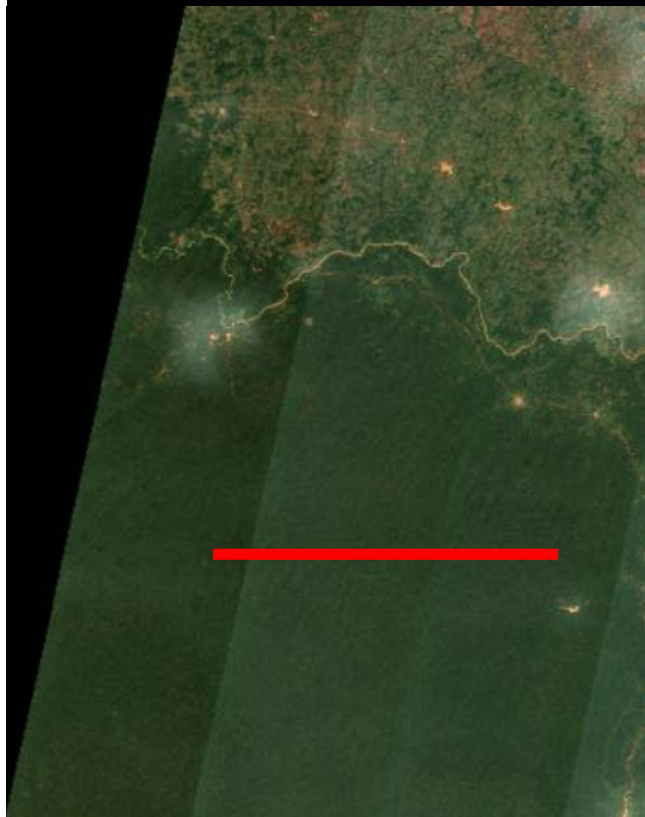
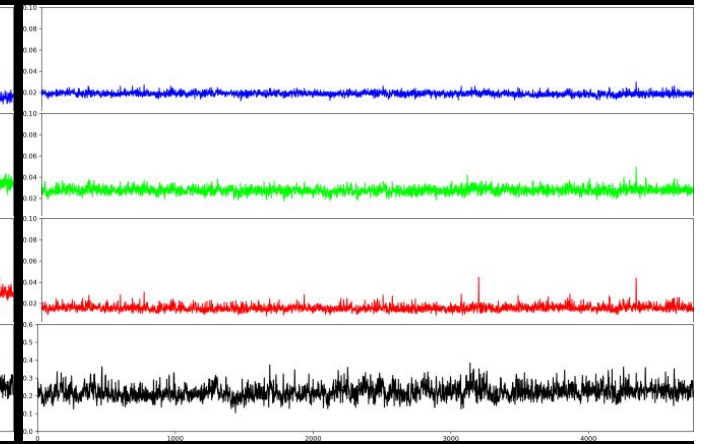
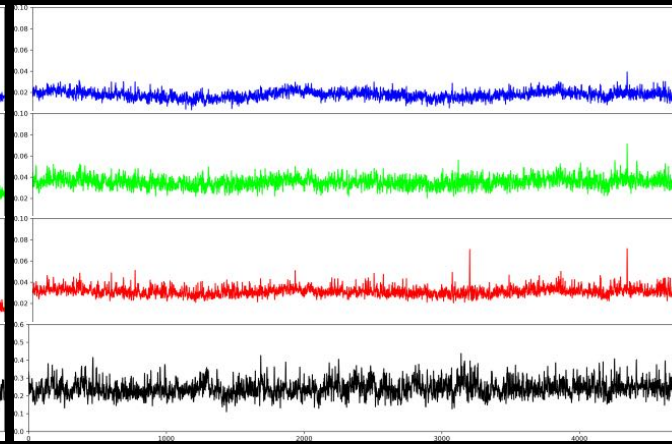
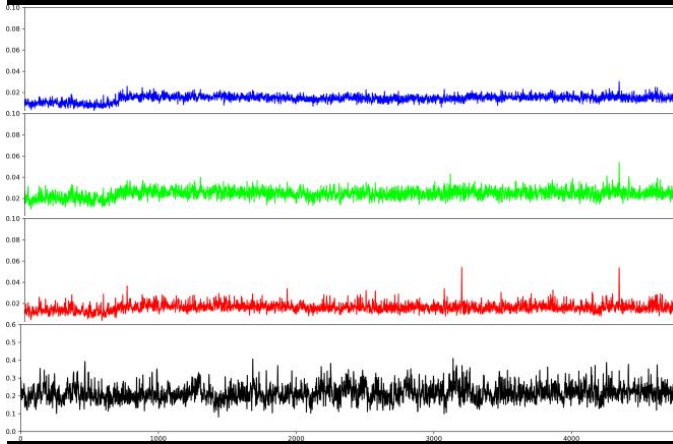
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Jan. 6th, 2017

THEIA

PEPS

OVERLAND

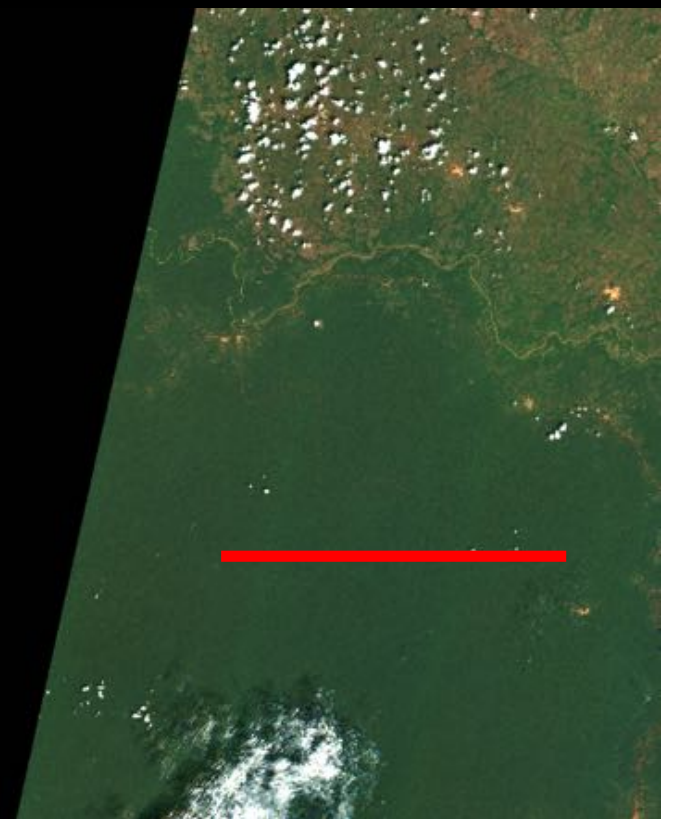
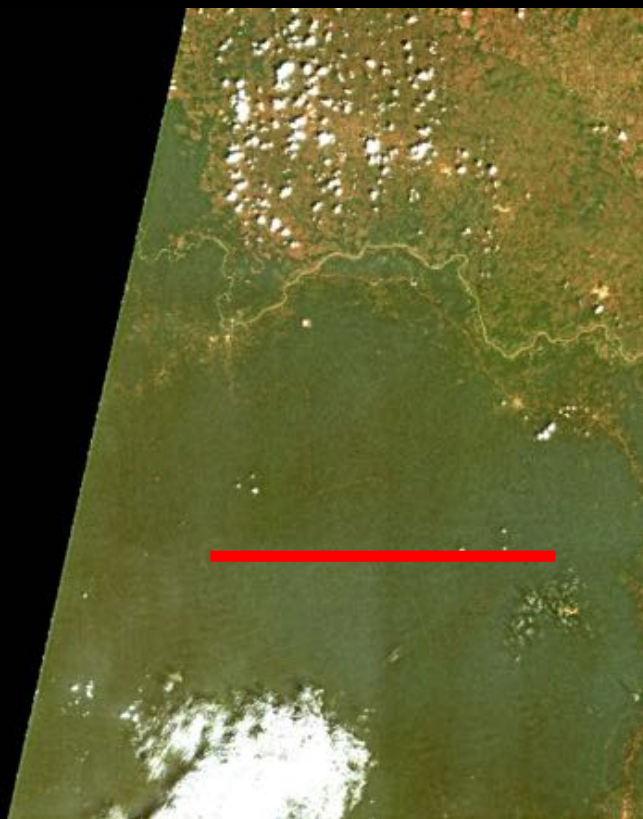
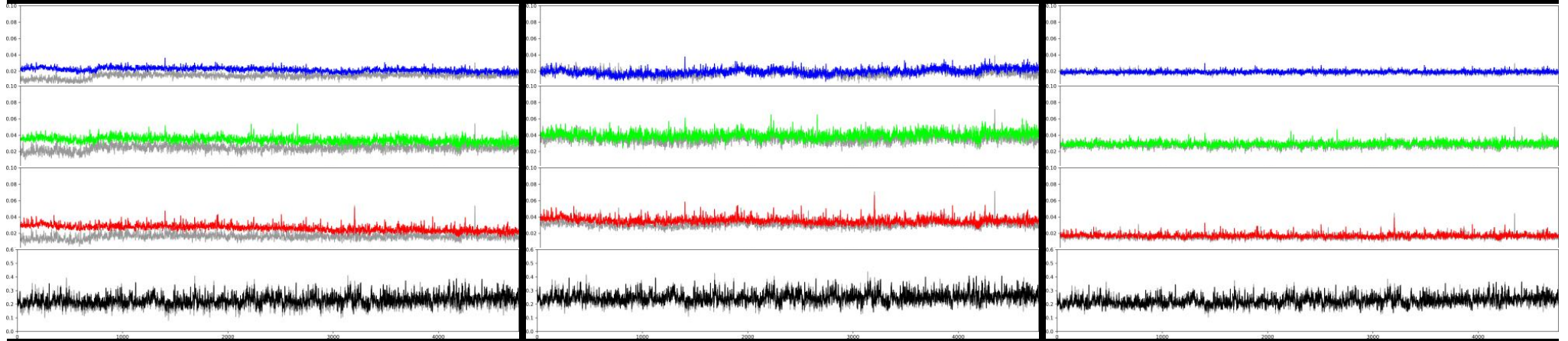


Feb. 5th, 2017

THEIA

PEPS

OVERLAND

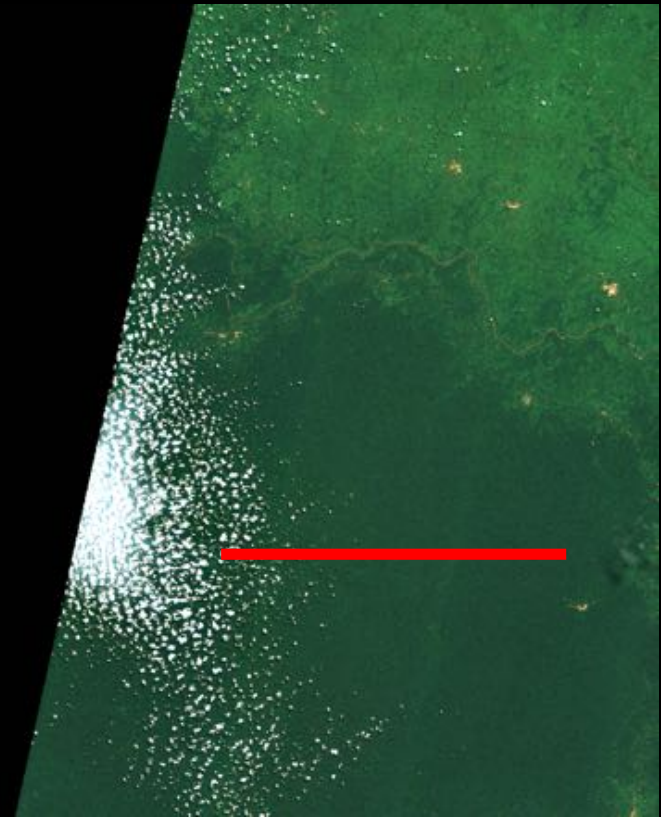
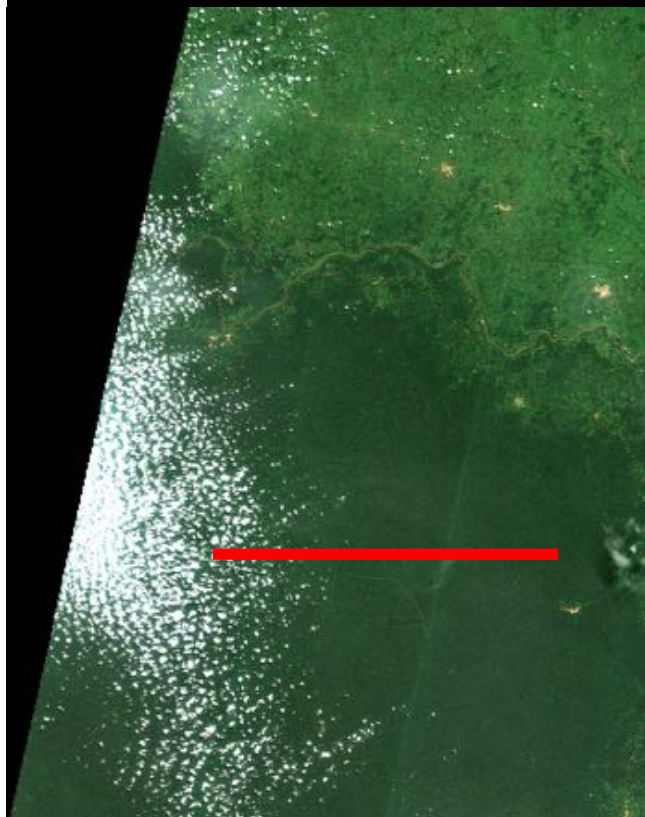
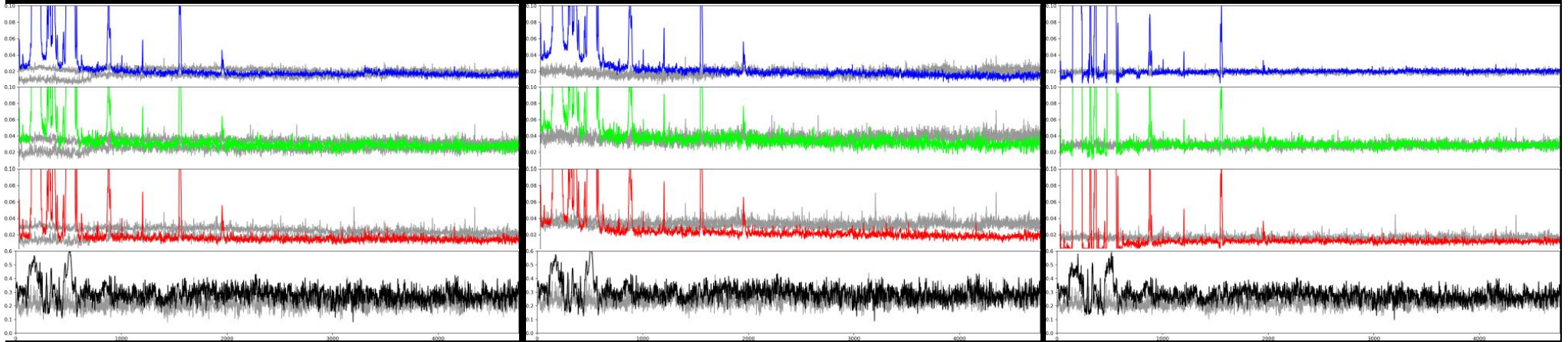


June 25th, 2017

THEIA

PEPS

OVERLAND

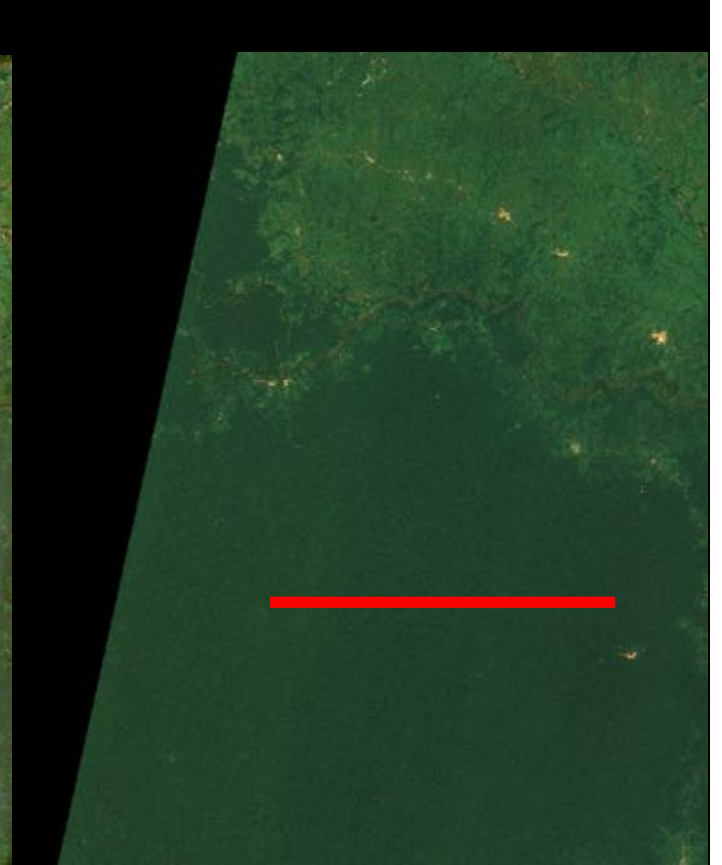
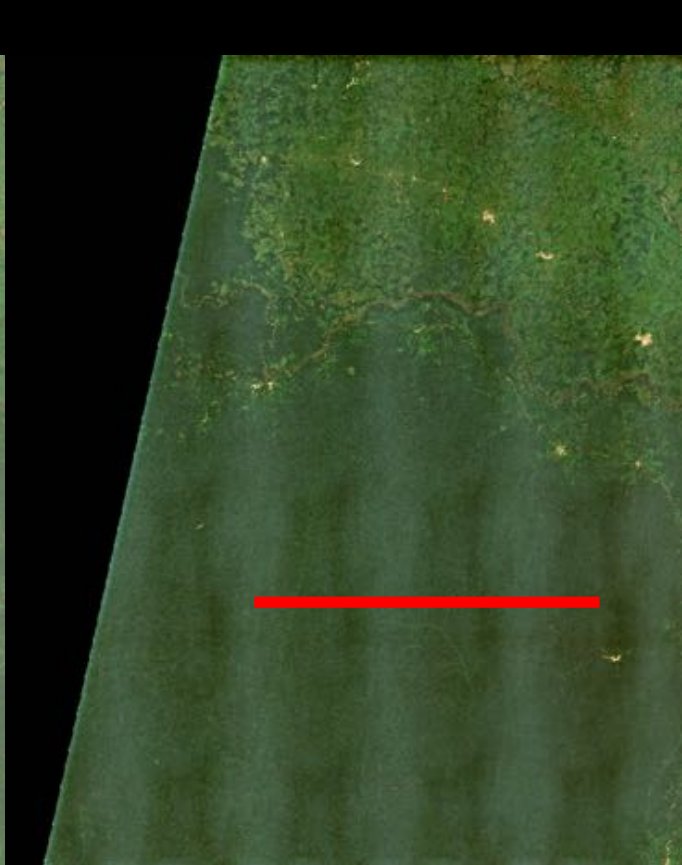
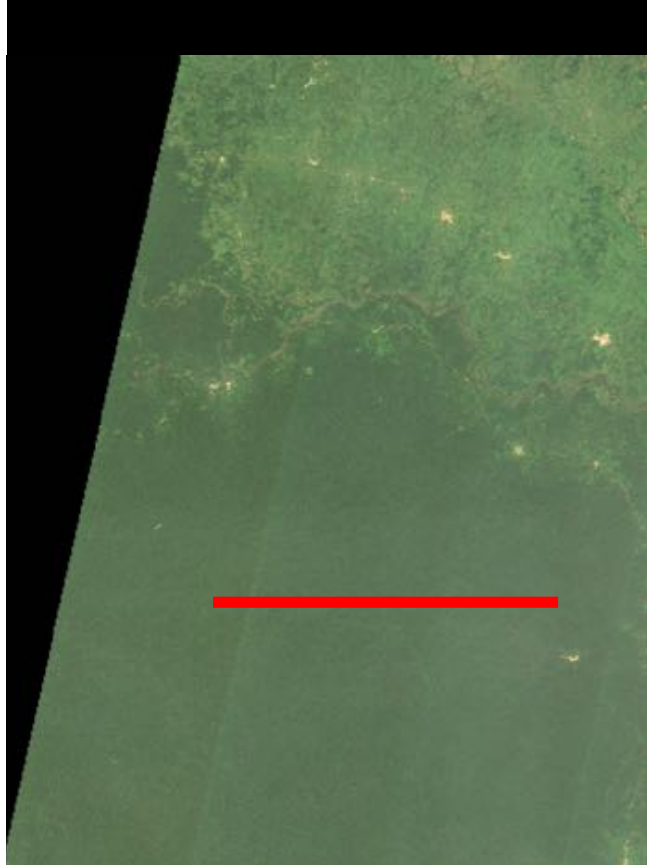
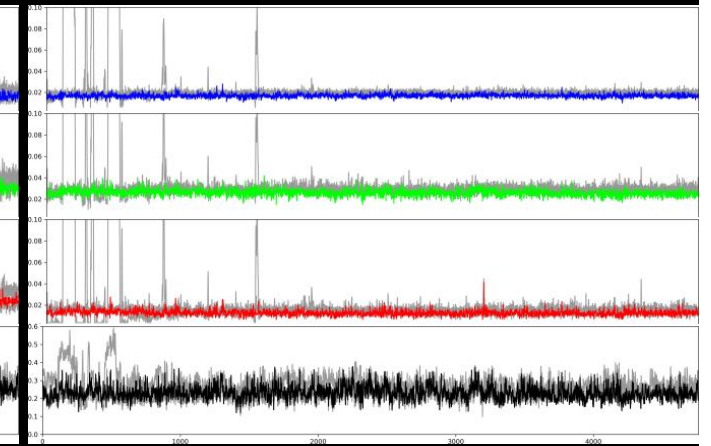
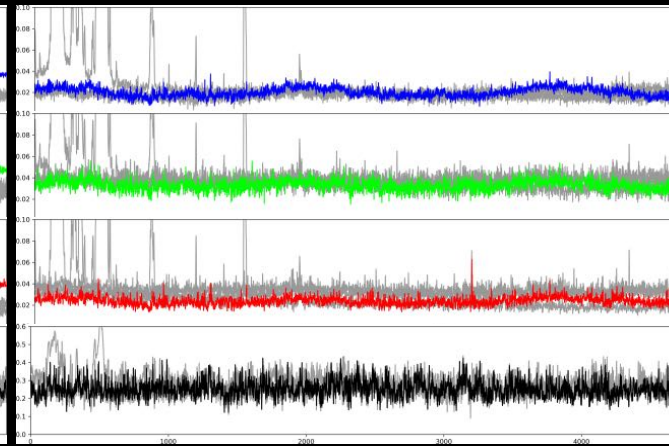
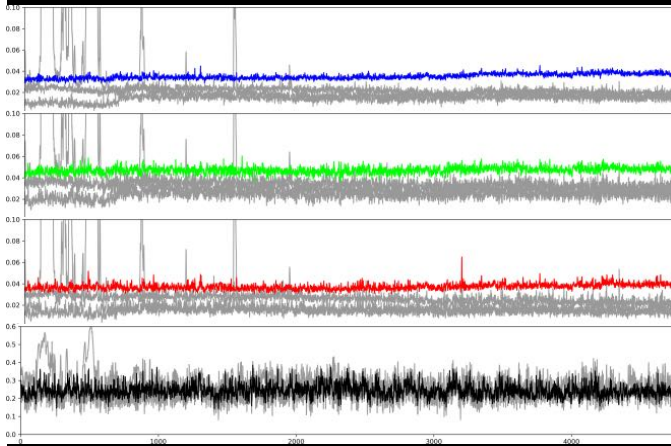


Nov. 27th, 2017

THEIA

PEPS

OVERLAND

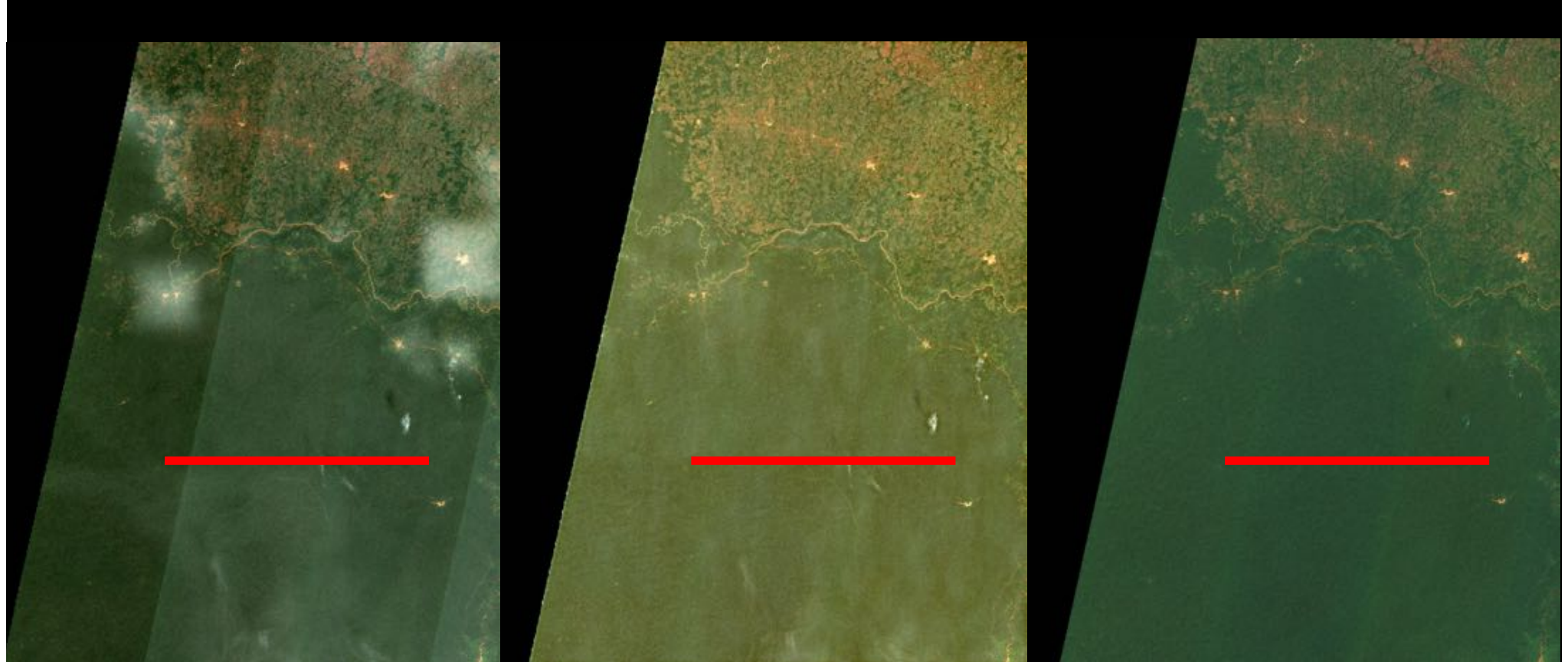
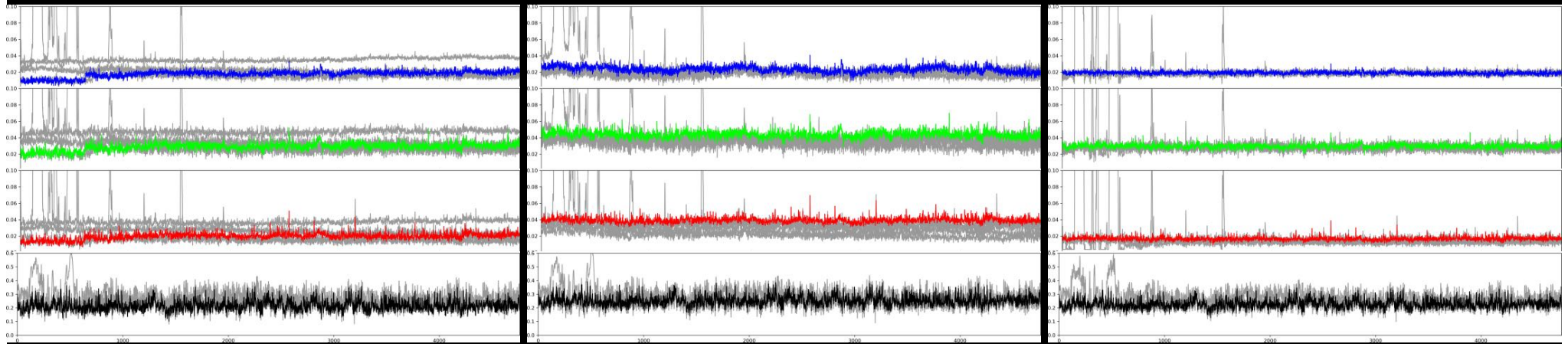


Jan. 1st, 2018

THEIA

PEPS

OVERLAND

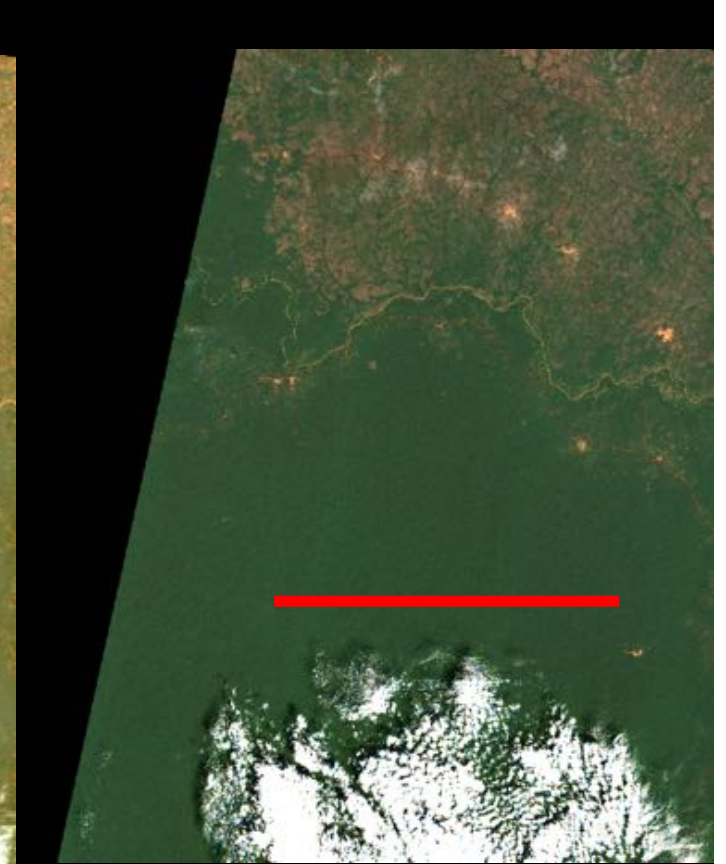
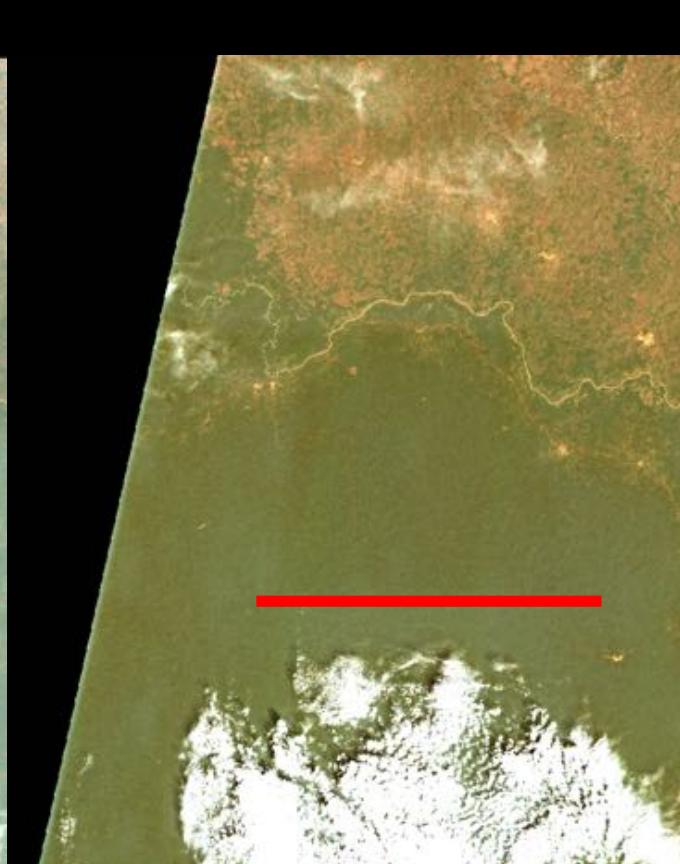
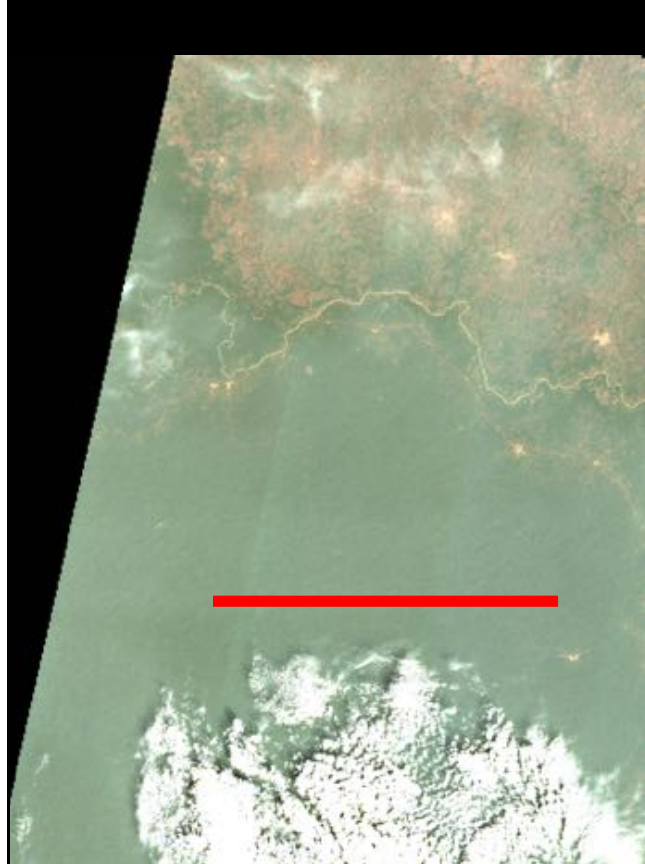
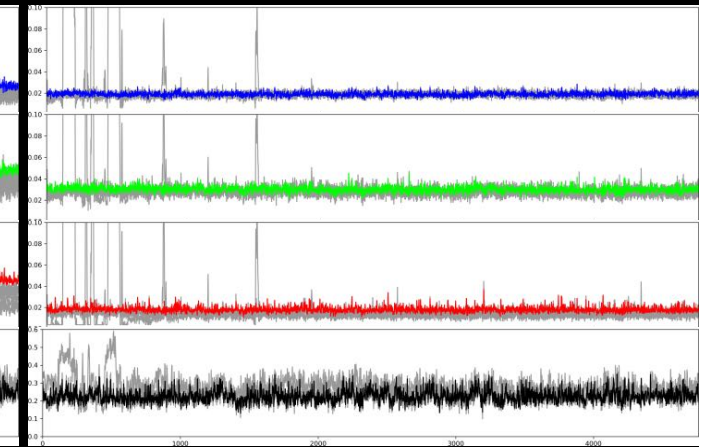
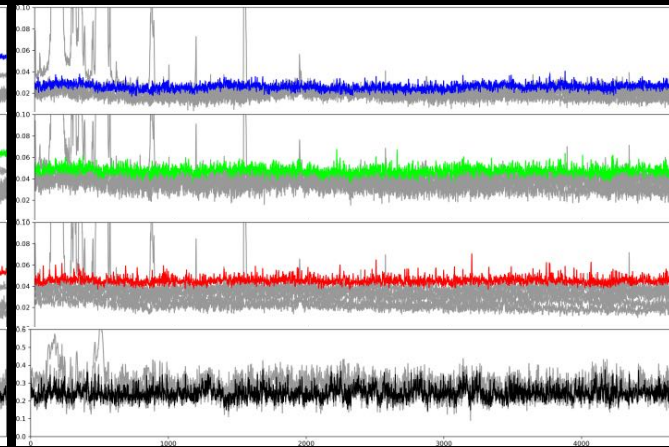
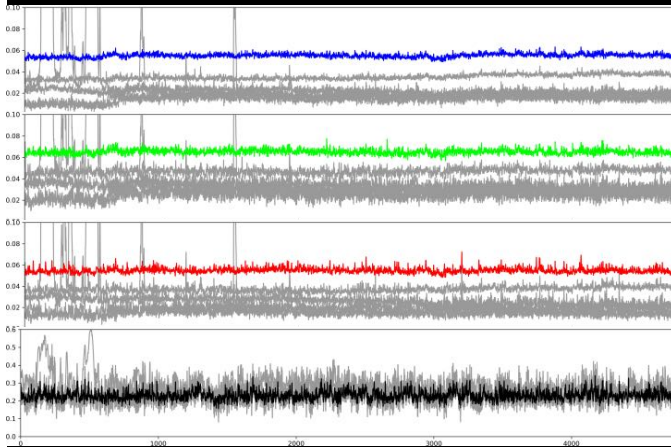


Jan. 26th, 2018

THEIA

PEPS

OVERLAND

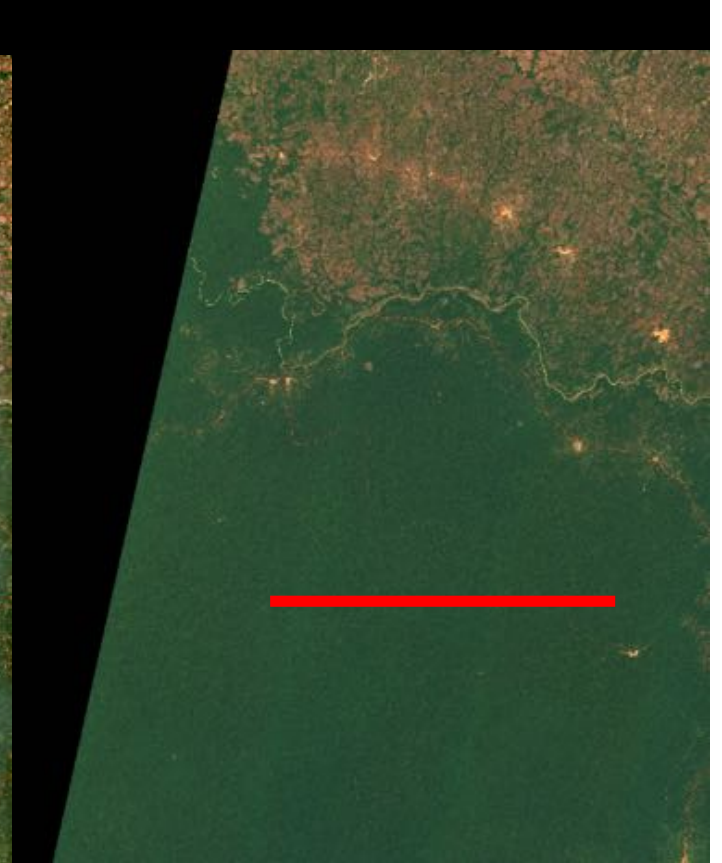
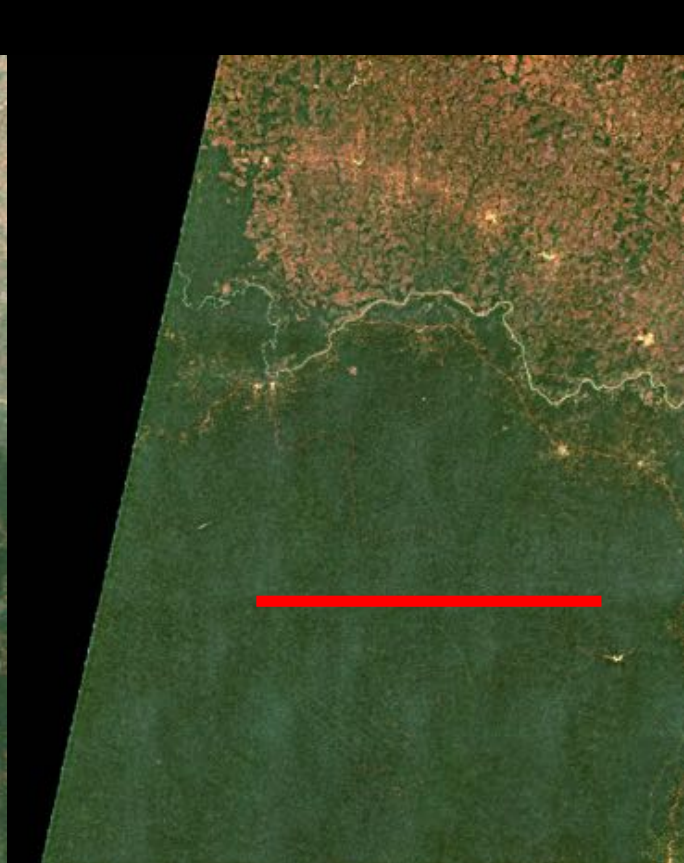
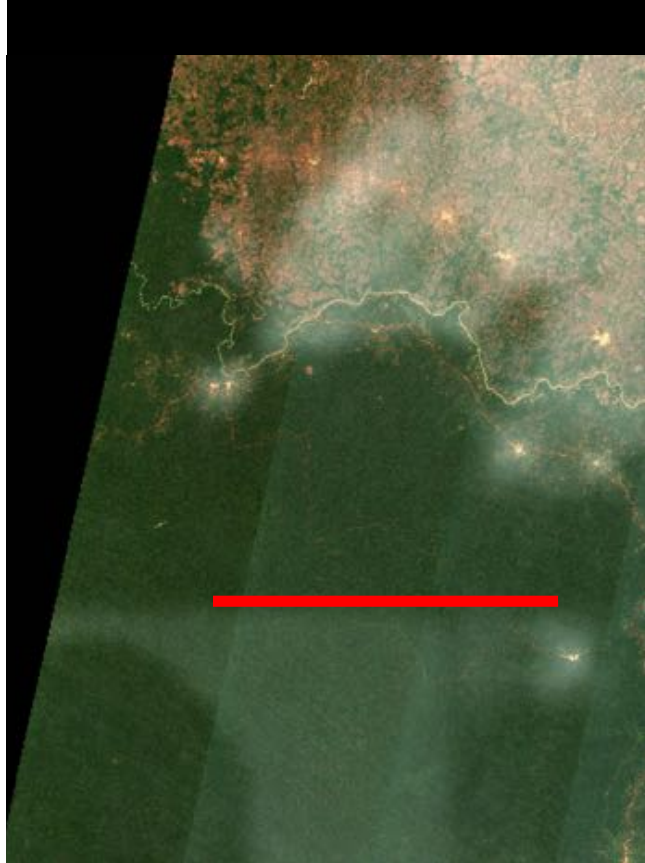
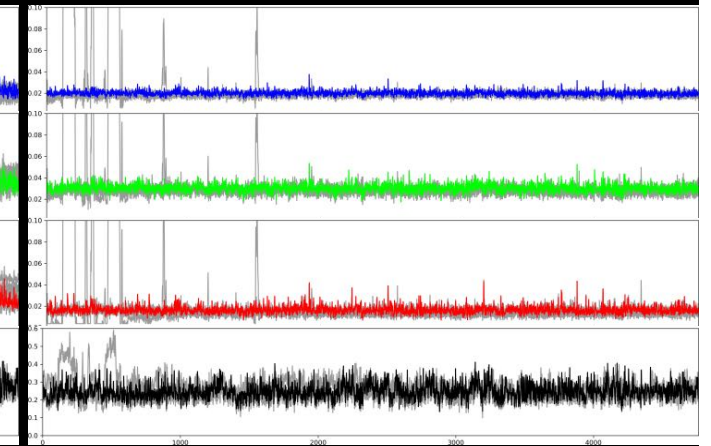
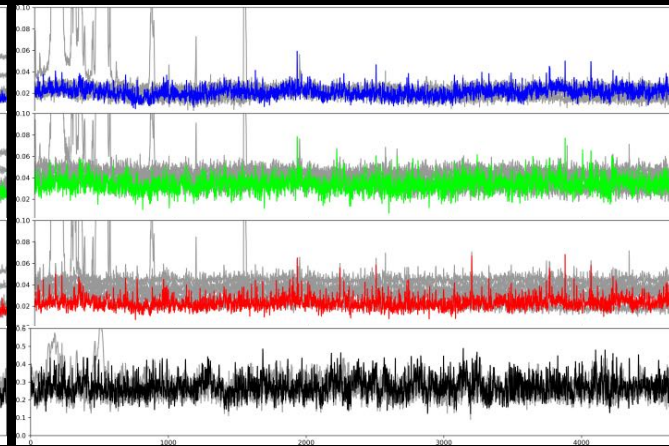
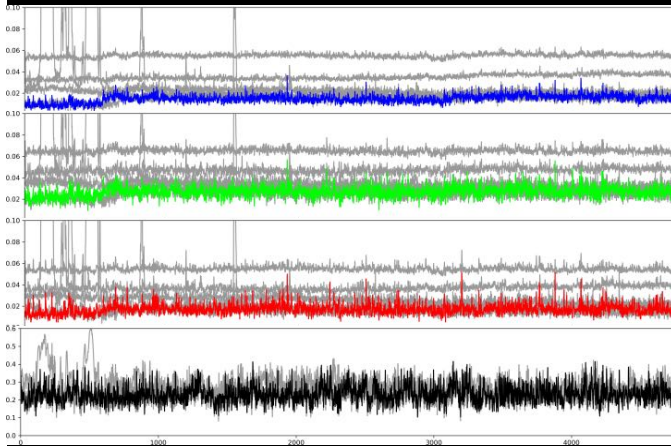


Jan. 31st, 2018

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PEPS

OVERLAND

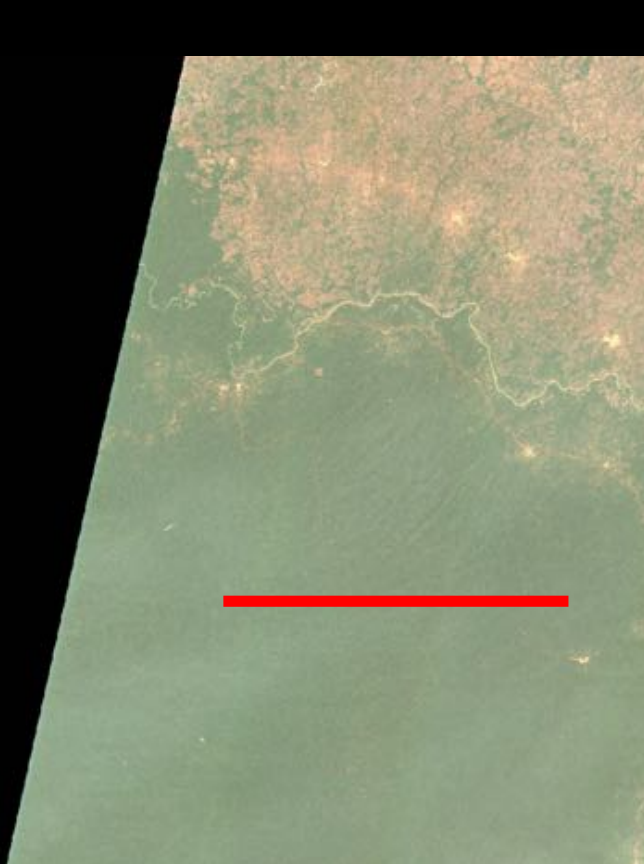
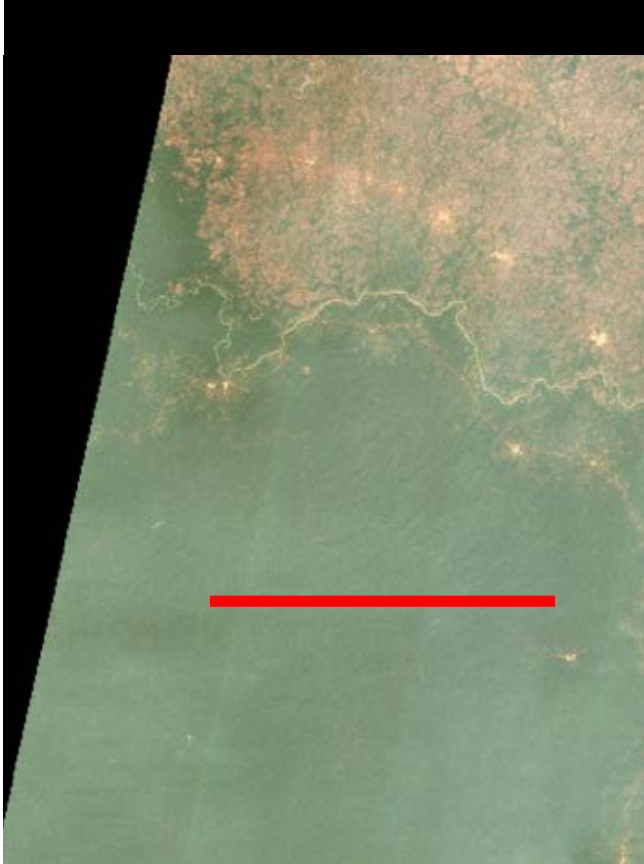
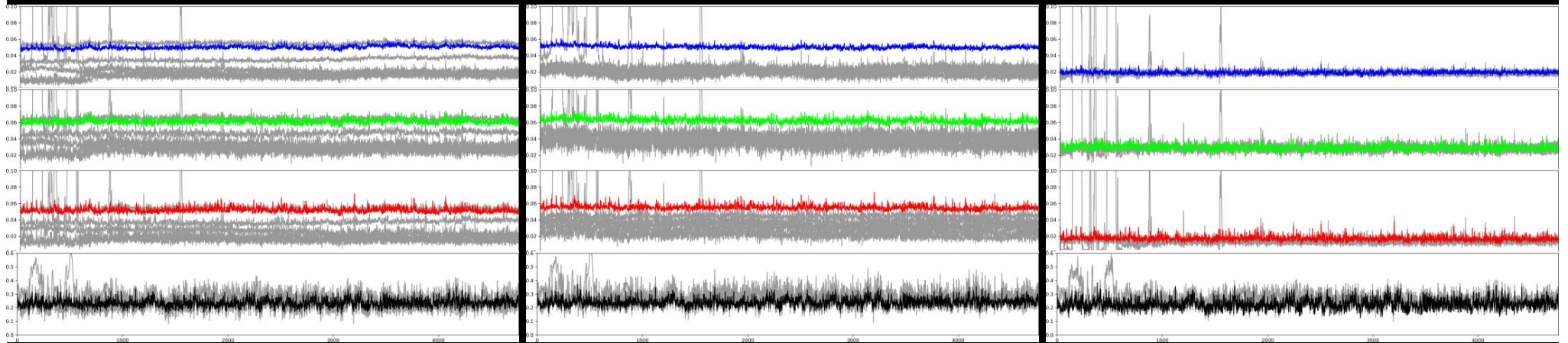


Feb. 5th, 2018

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PEPS

OVERLAND

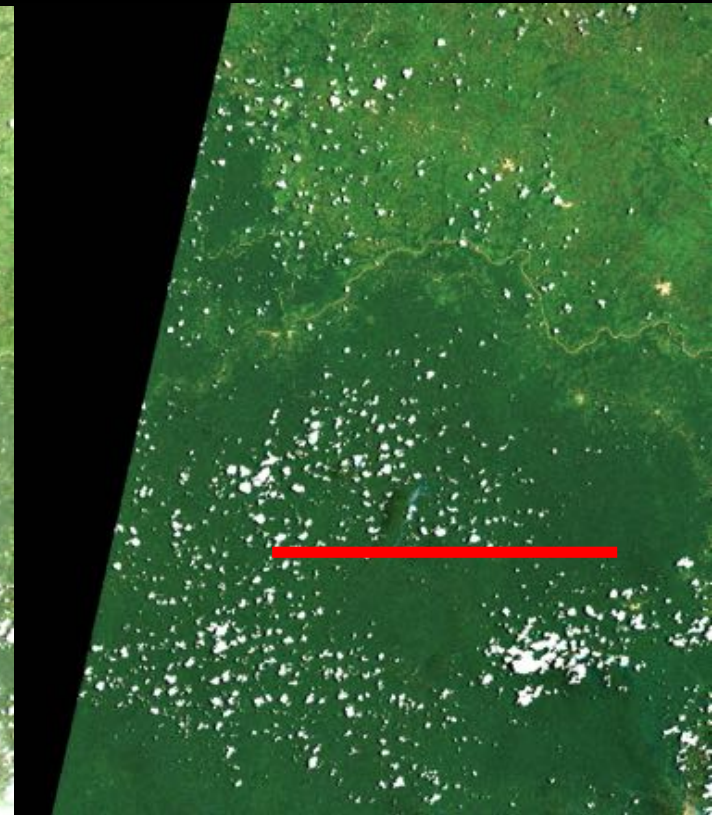
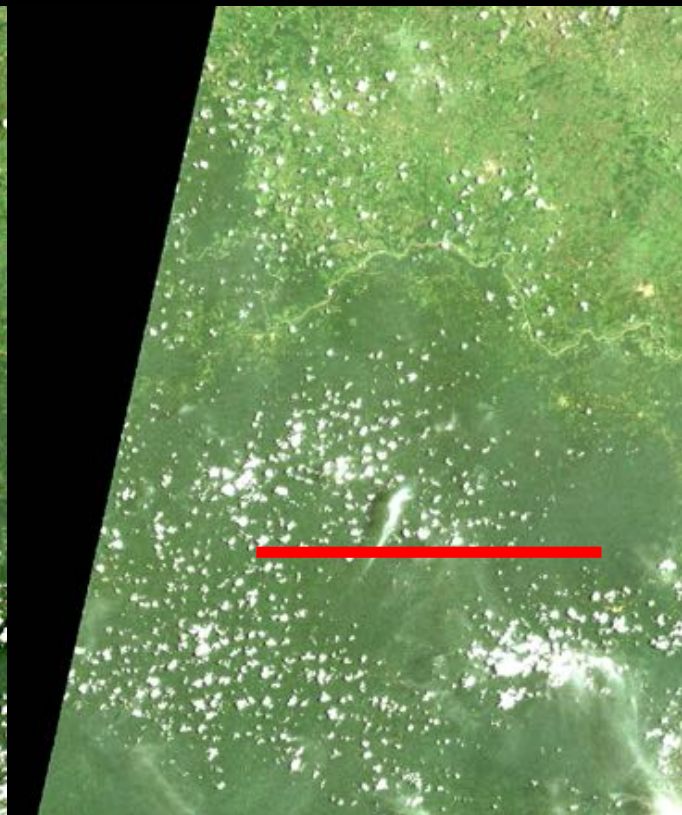
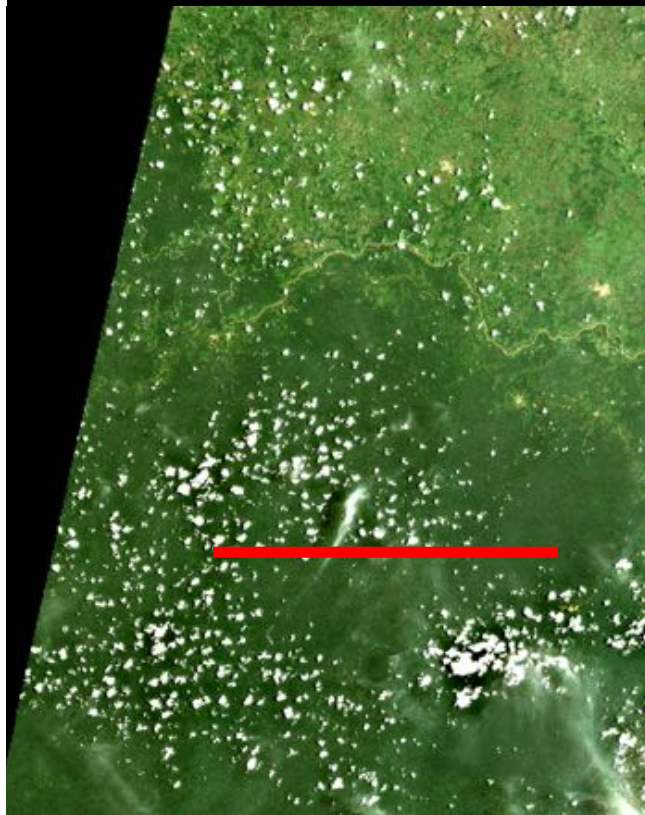
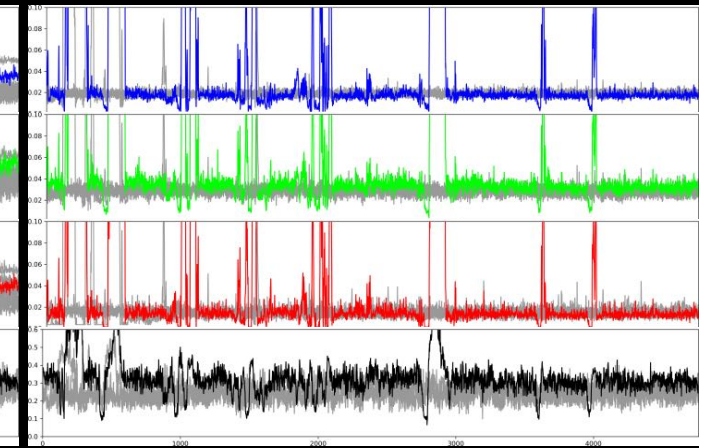
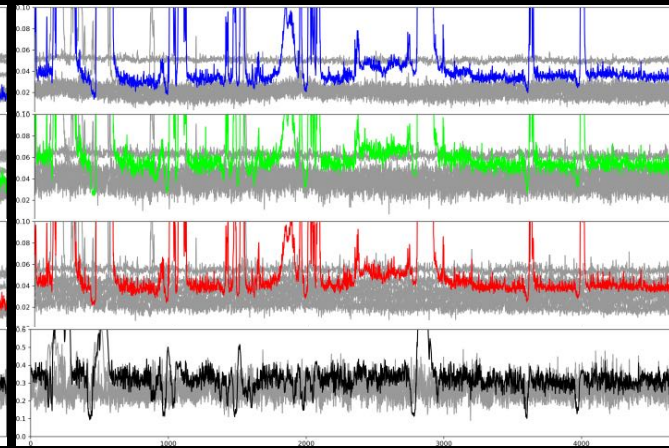
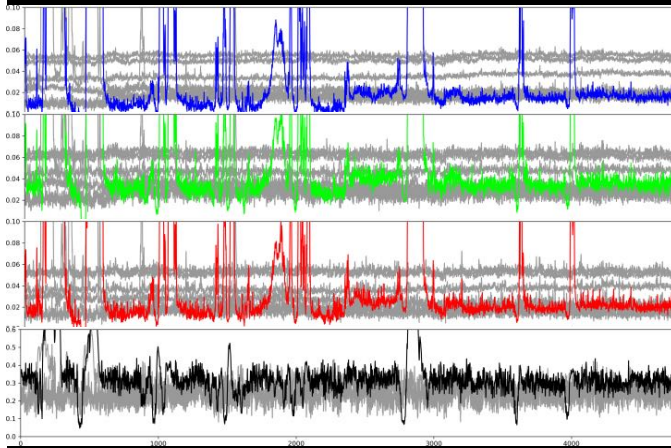


Apr. 1st 2018

THEIA

PEPS

OVERLAND

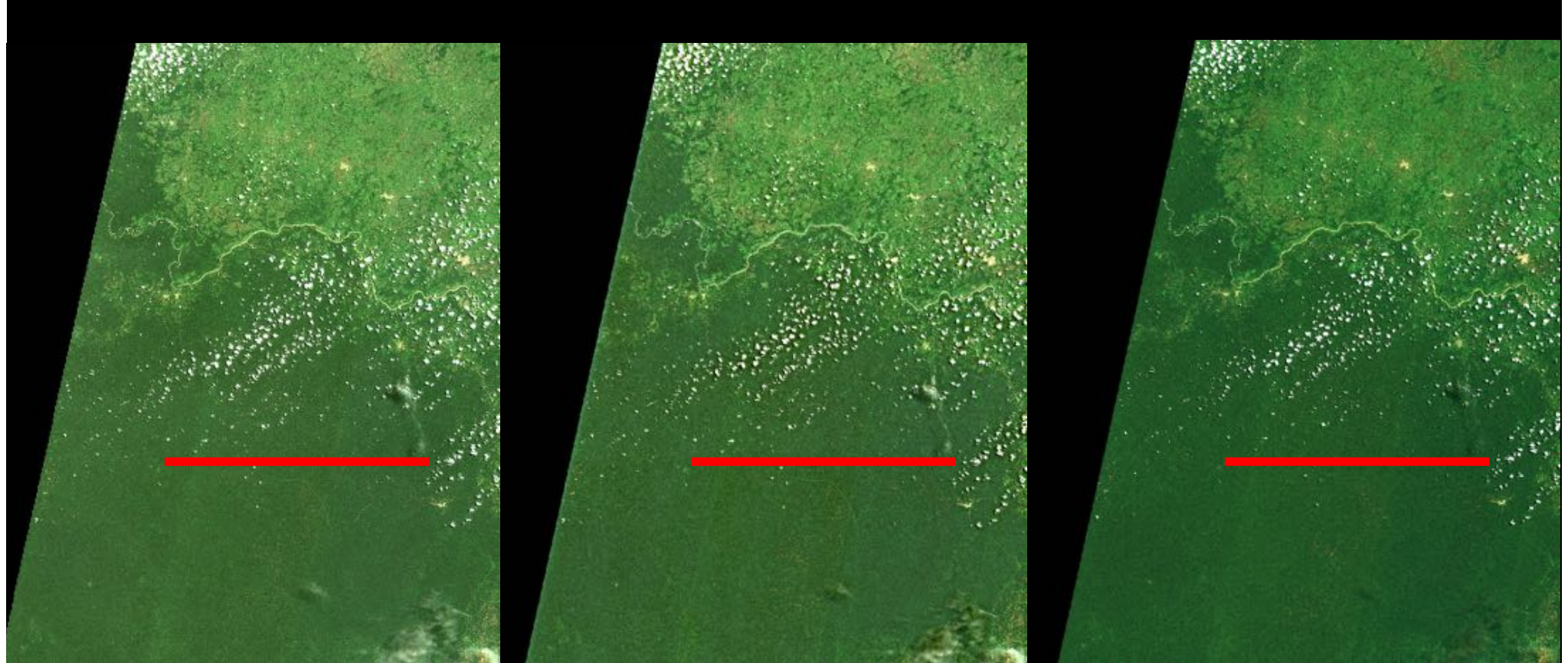
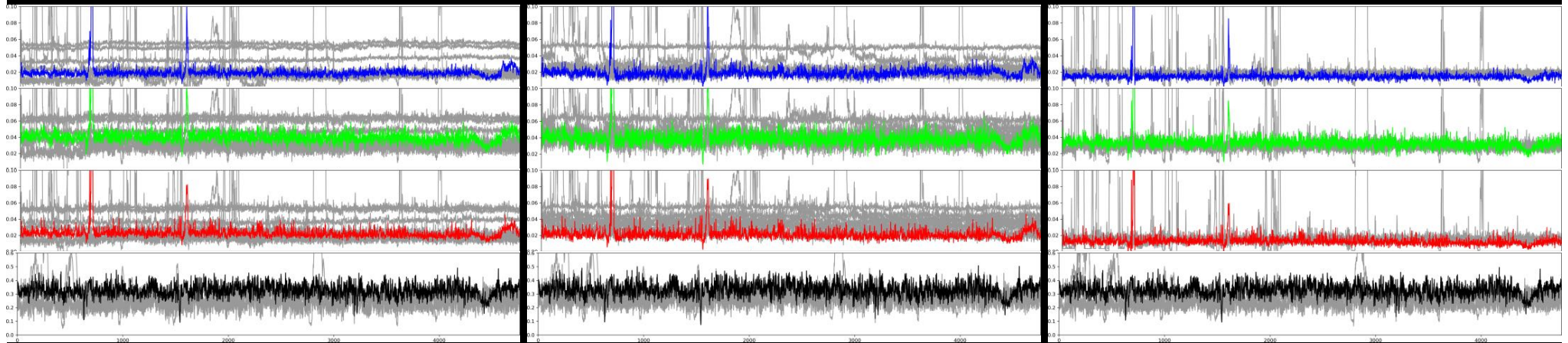


Apr. 16th, 2018

THEIA

PEPS

OVERLAND

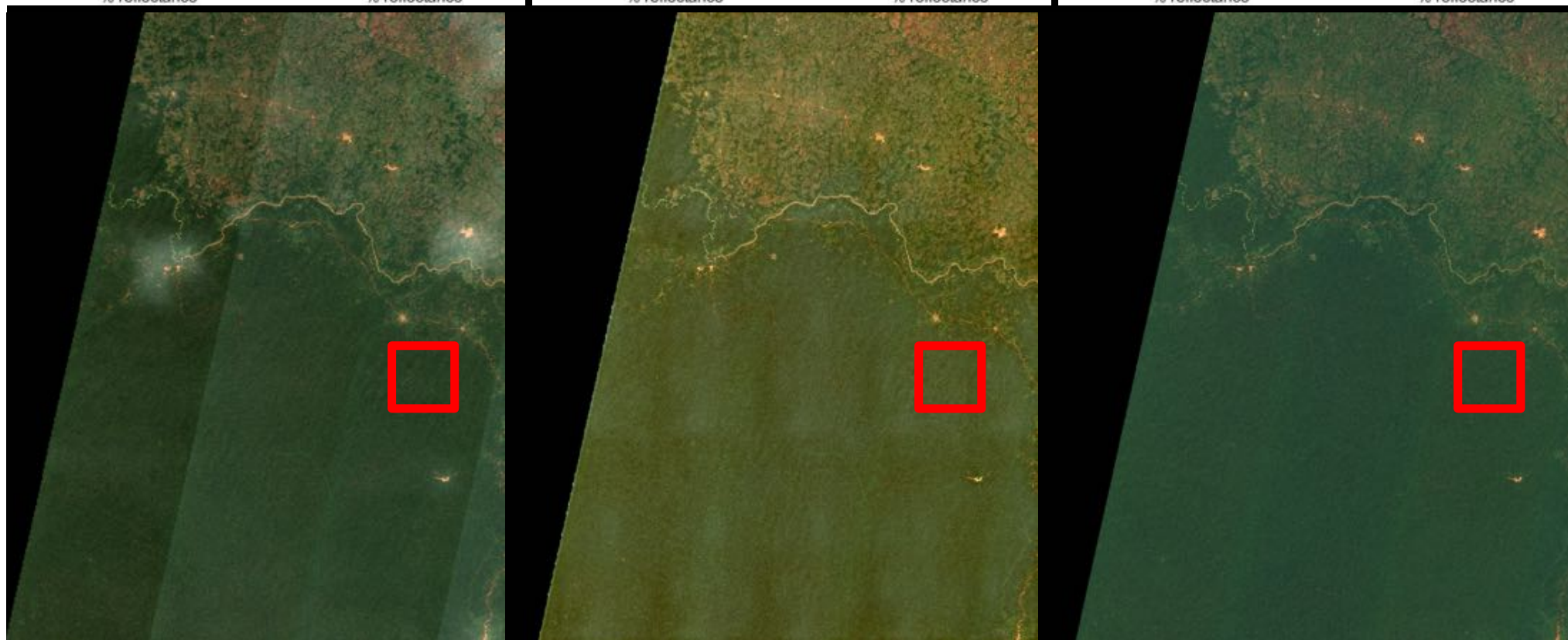
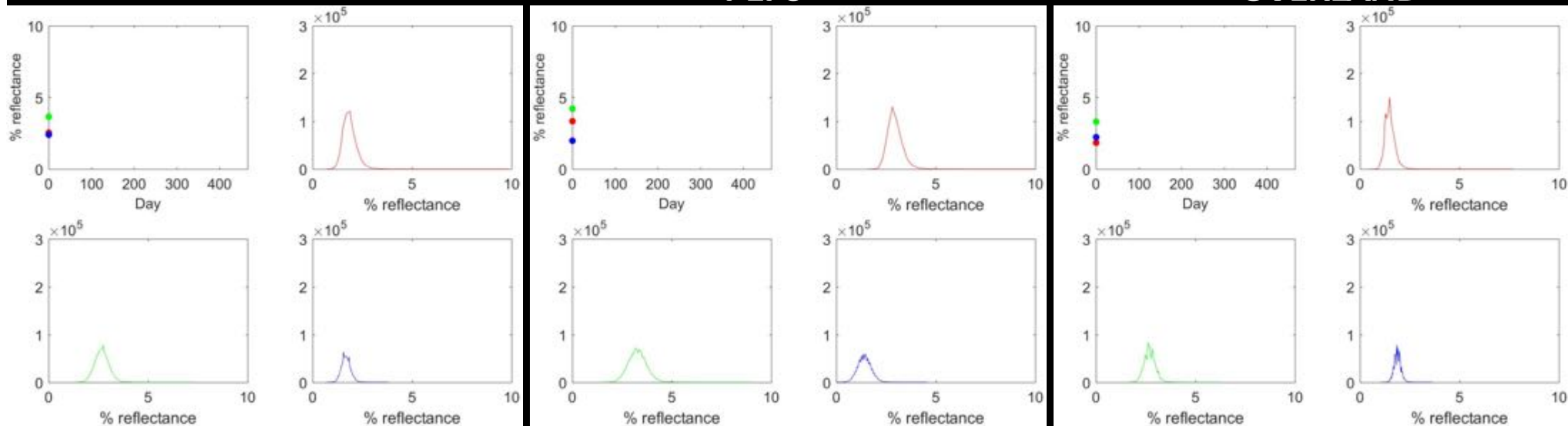


Jan. 6th, 2017

THEIA

PEPS

OVERLAND

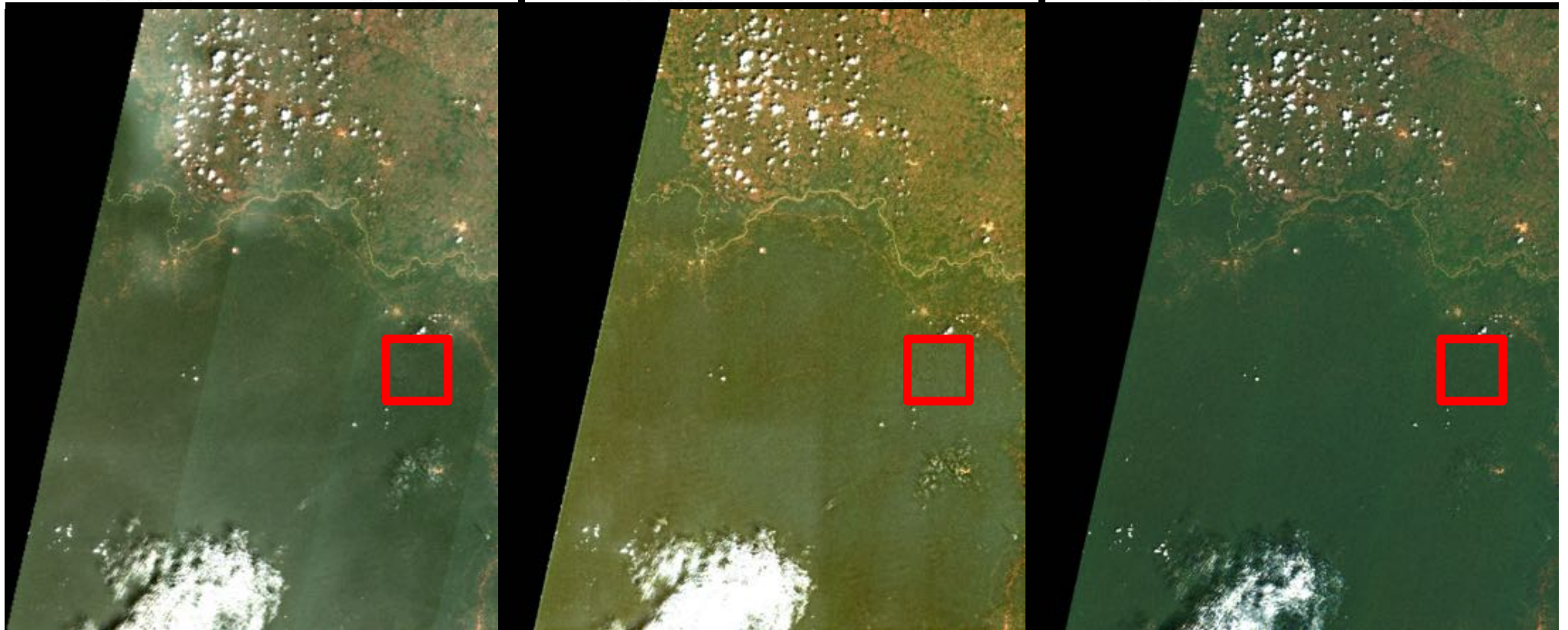
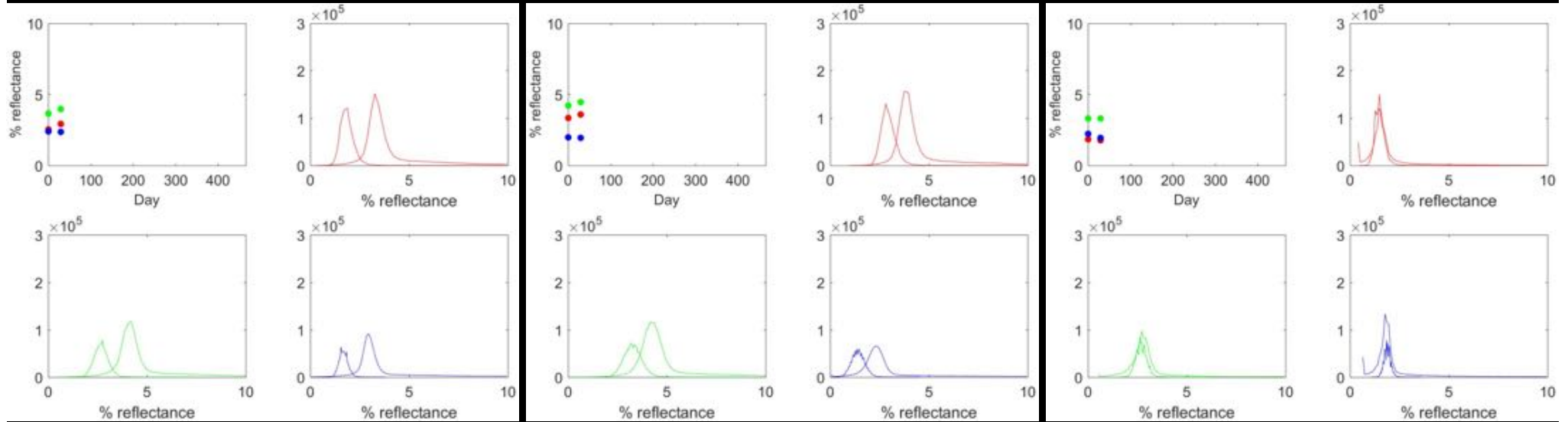


Feb. 5th, 2017

THEIA

PEPS

OVERLAND

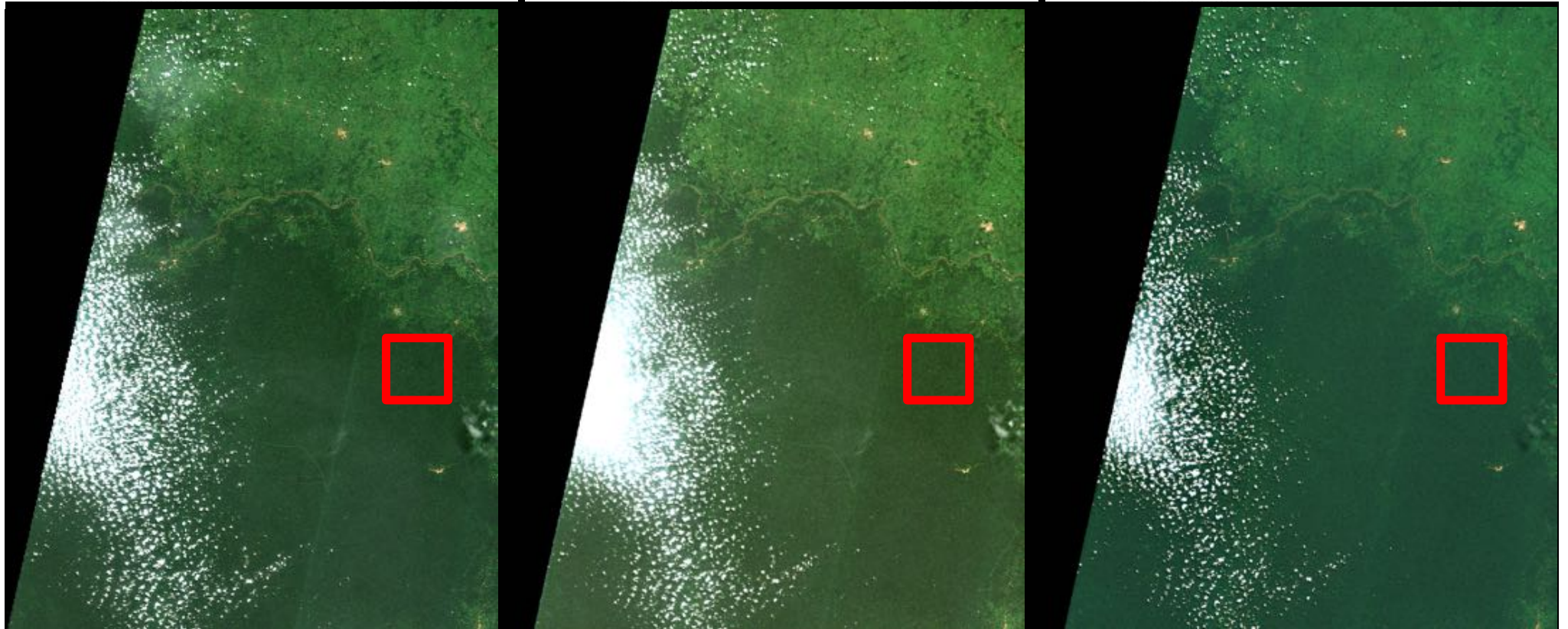
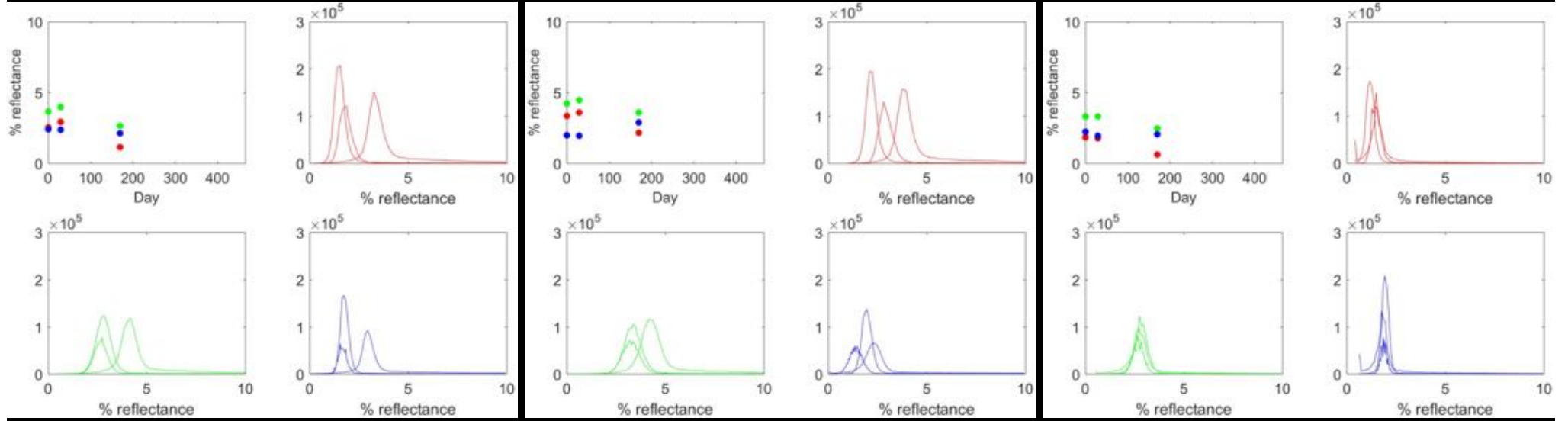


June 25th, 2017

THEIA

PEPS

OVERLAND

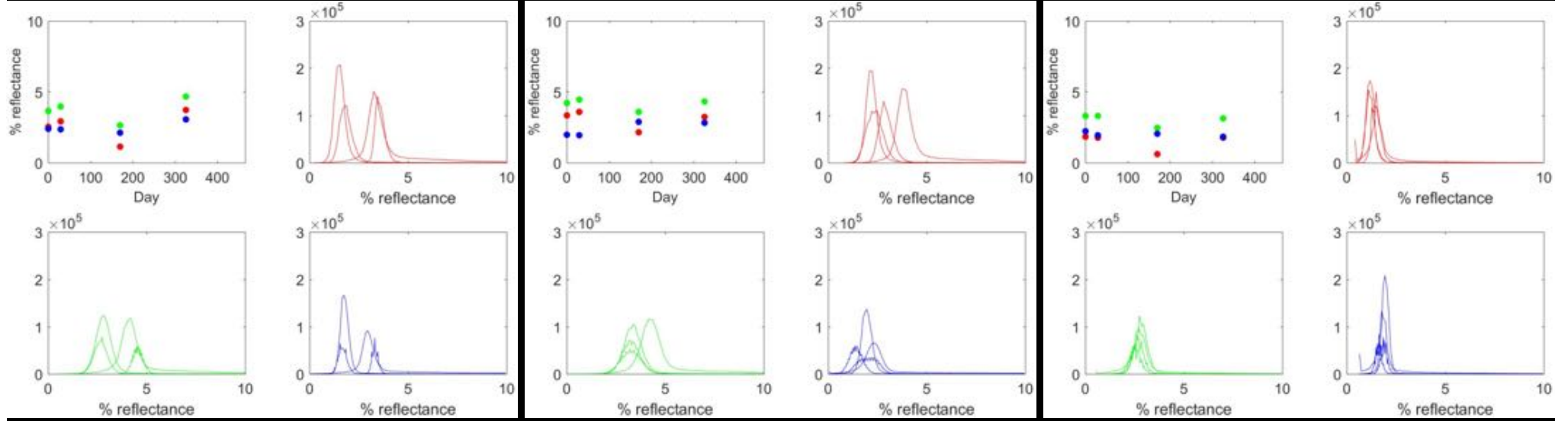


Nov. 27th, 2017

THEIA

PEPS

OVERLAND

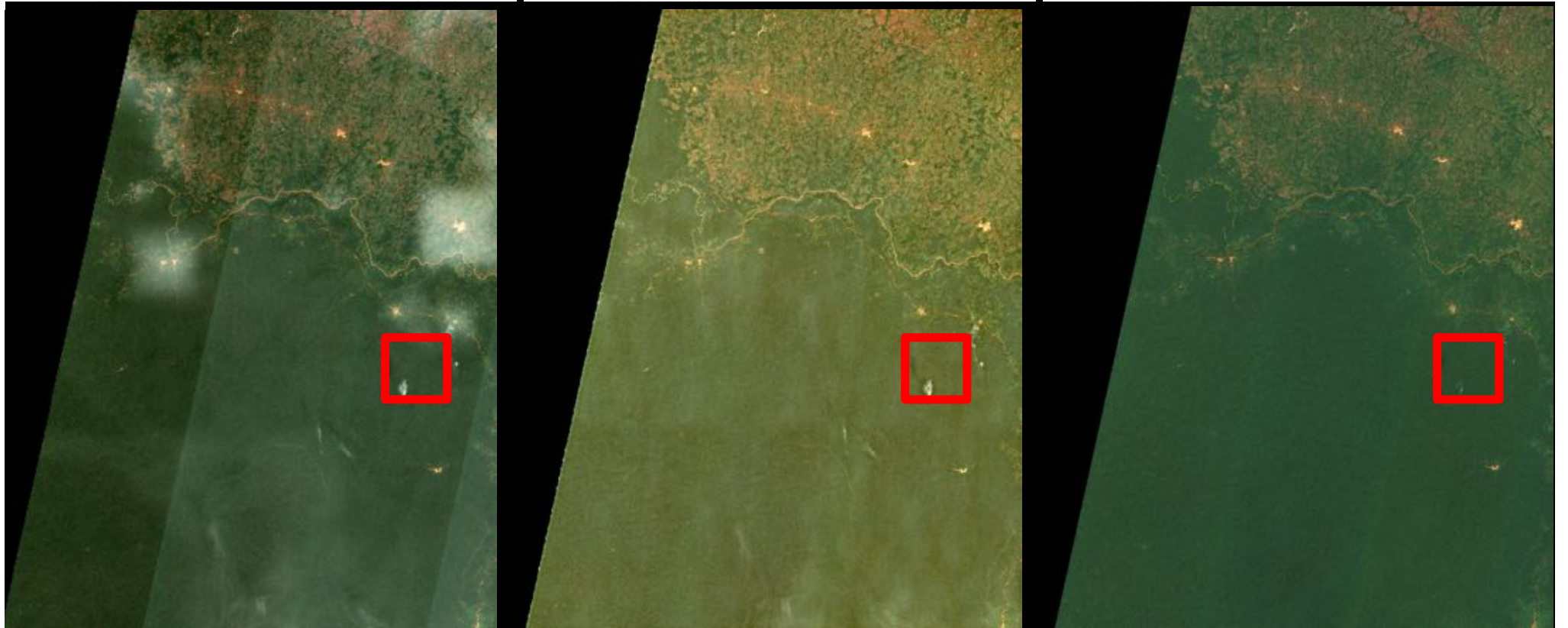
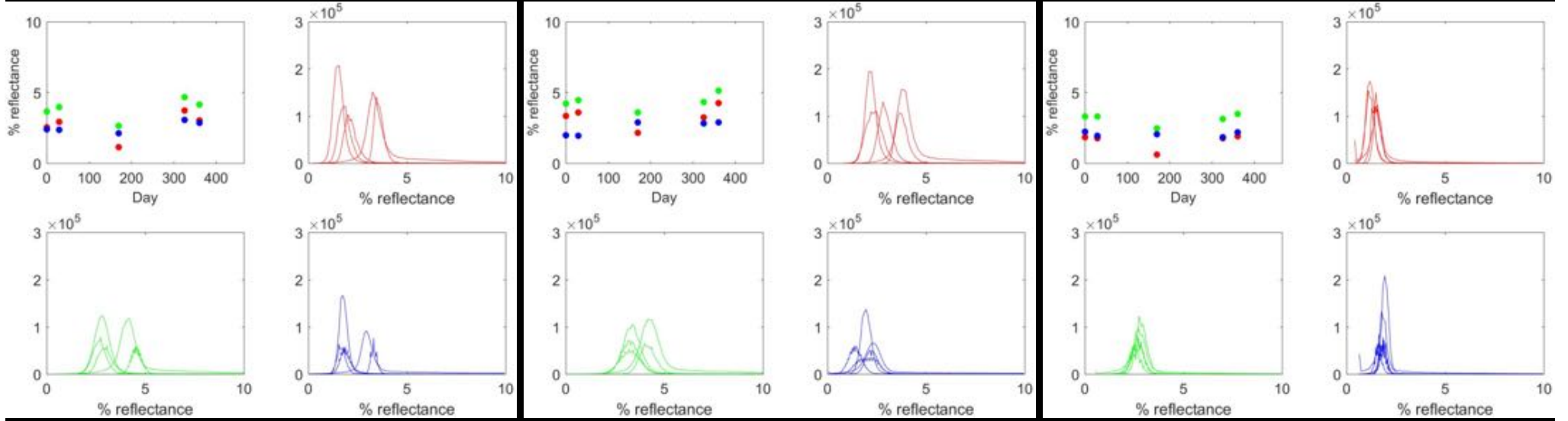


Jan. 1st, 2018

THEIA

PEPS

OVERLAND

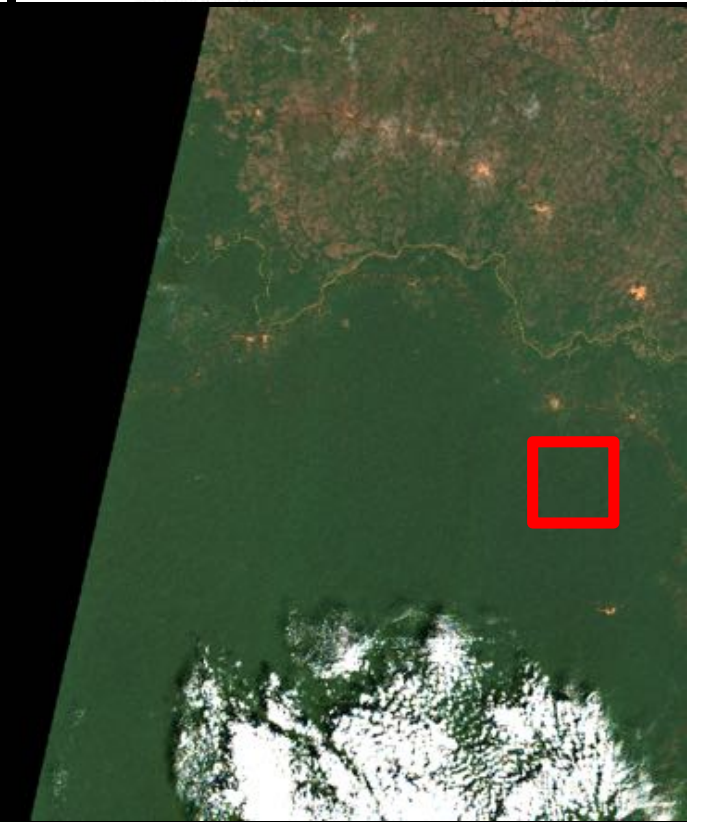
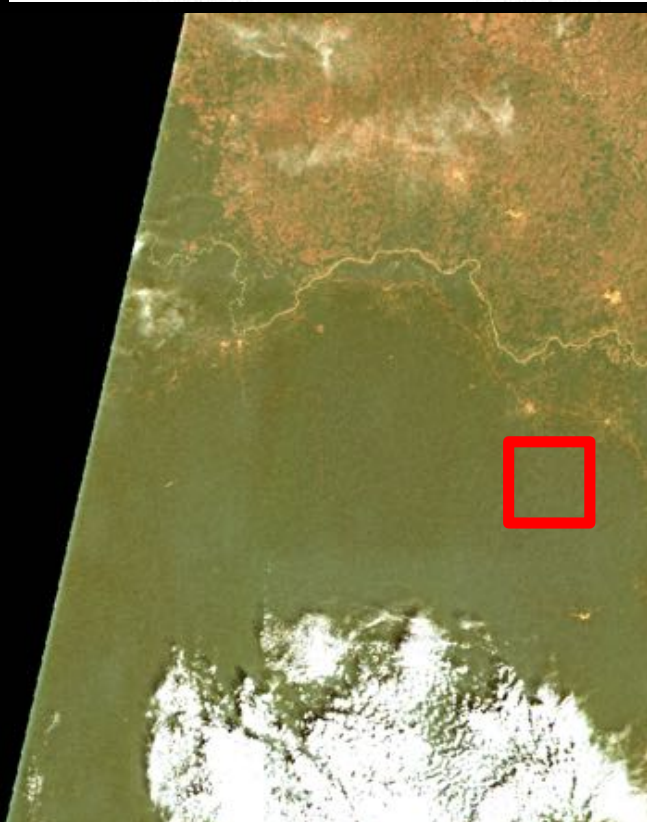
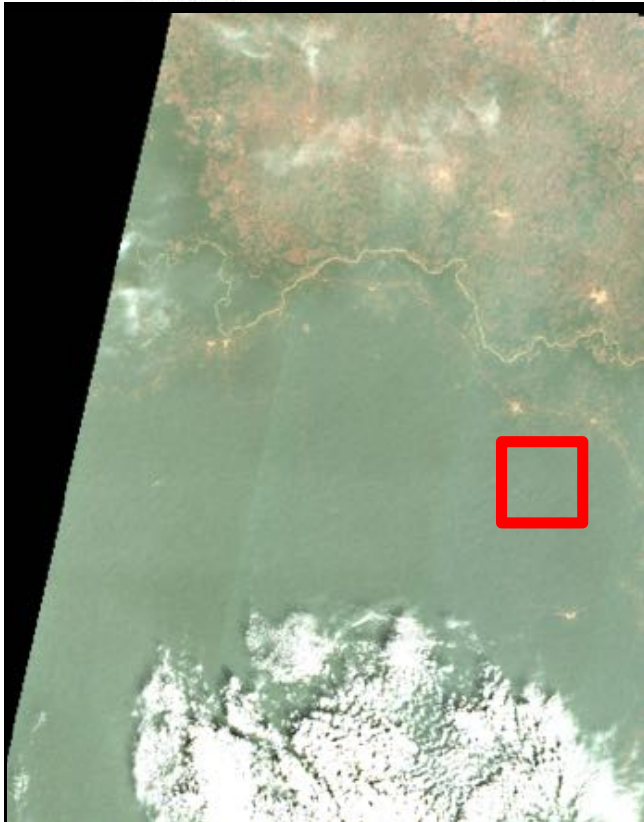
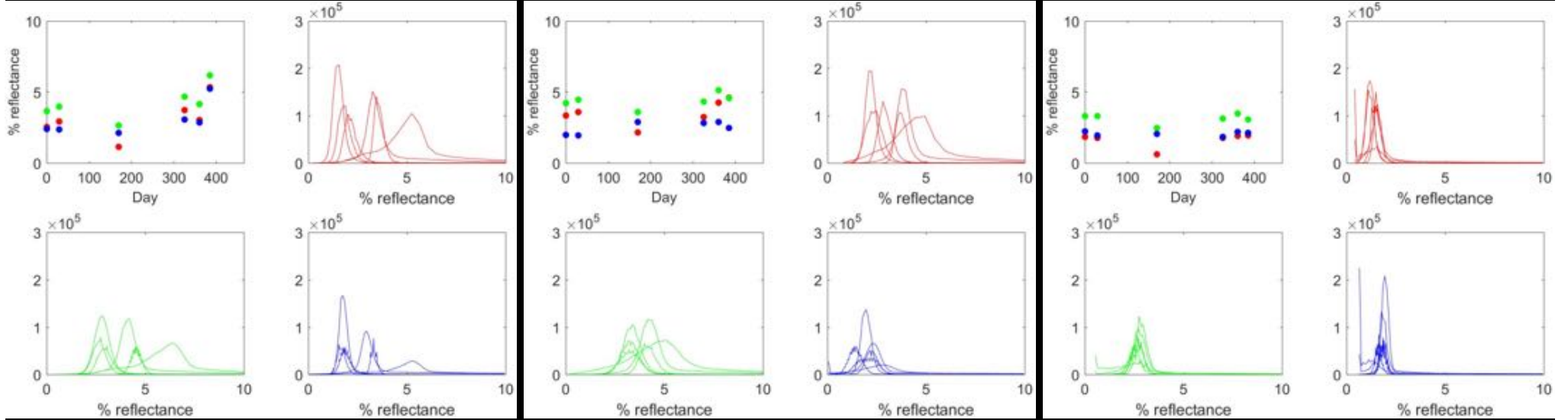


Jan. 26th, 2018

THEIA

PEPS

OVERLAND

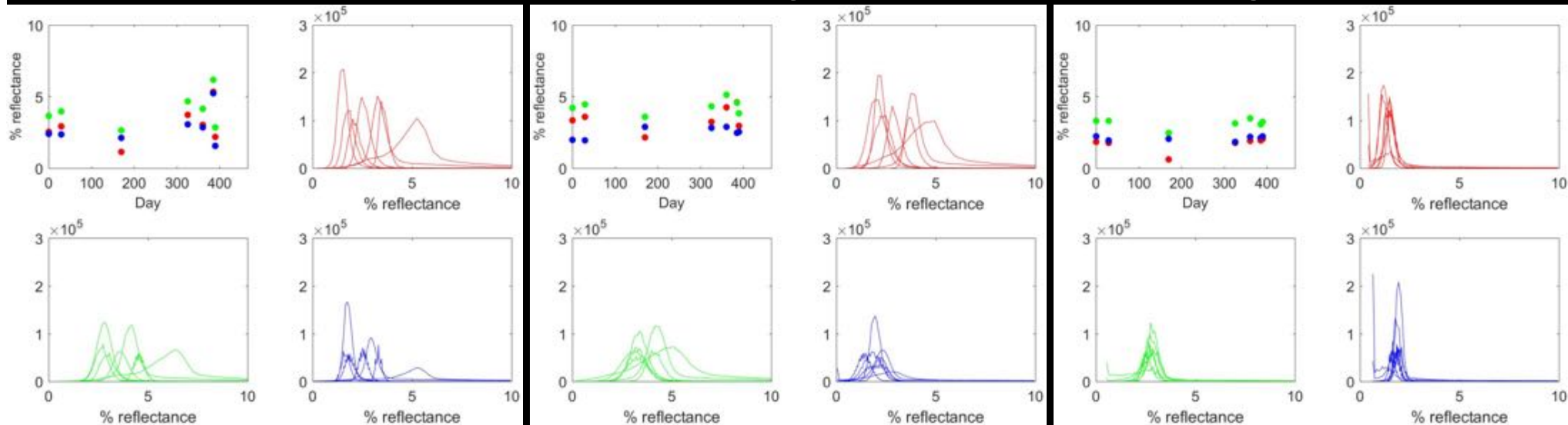


Jan. 31st, 2018

THEIA

PEPS

OVERLAND

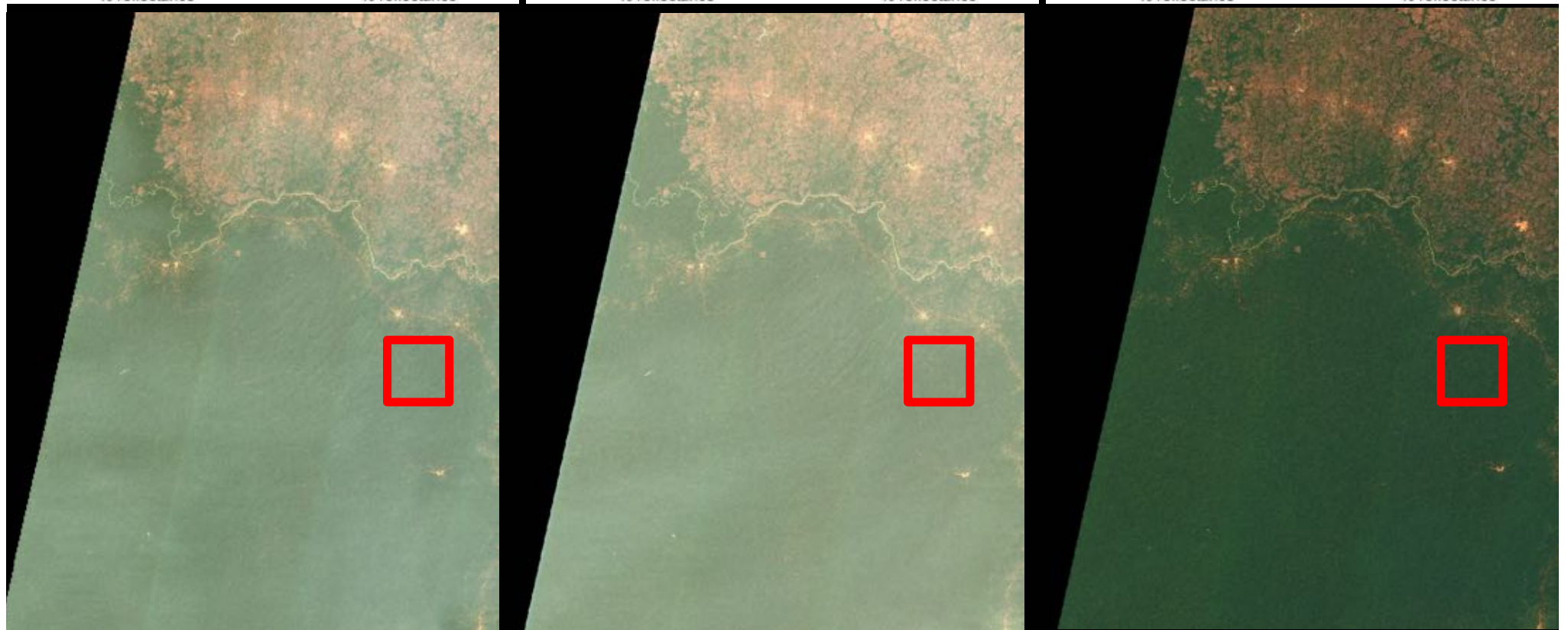
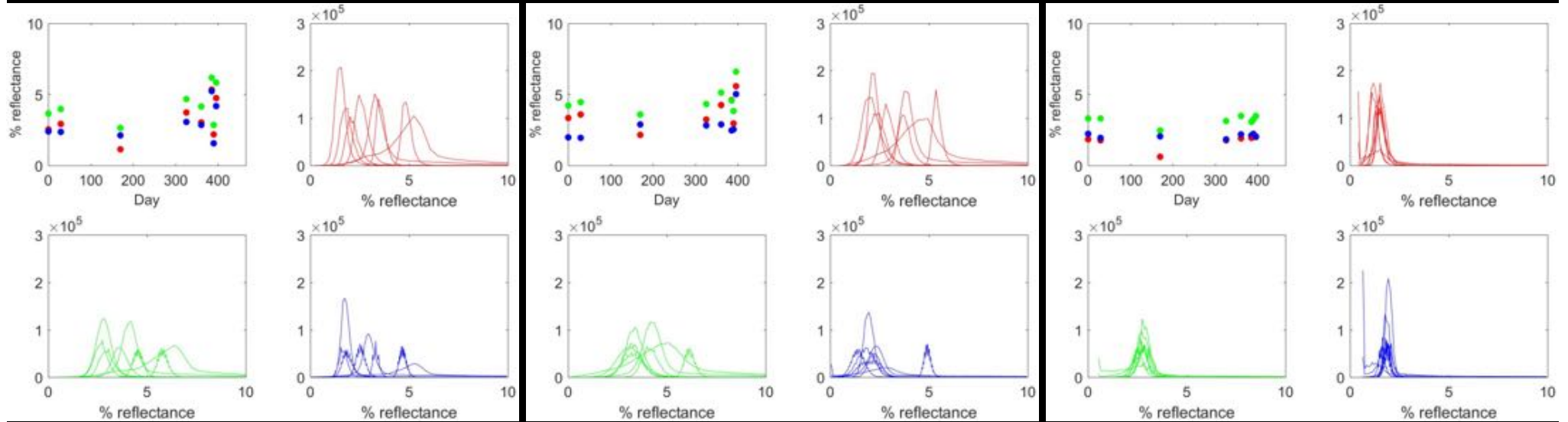


Feb. 5th, 2018

THEIA

PEPS

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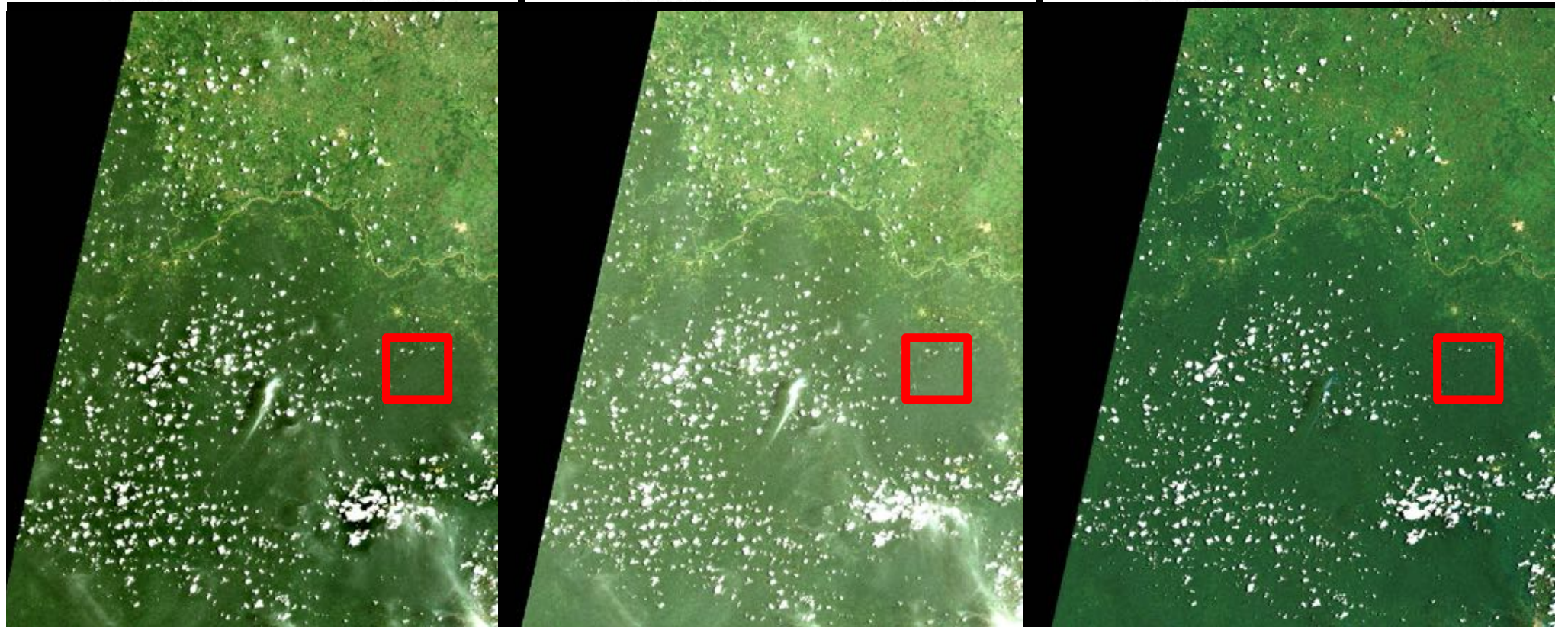
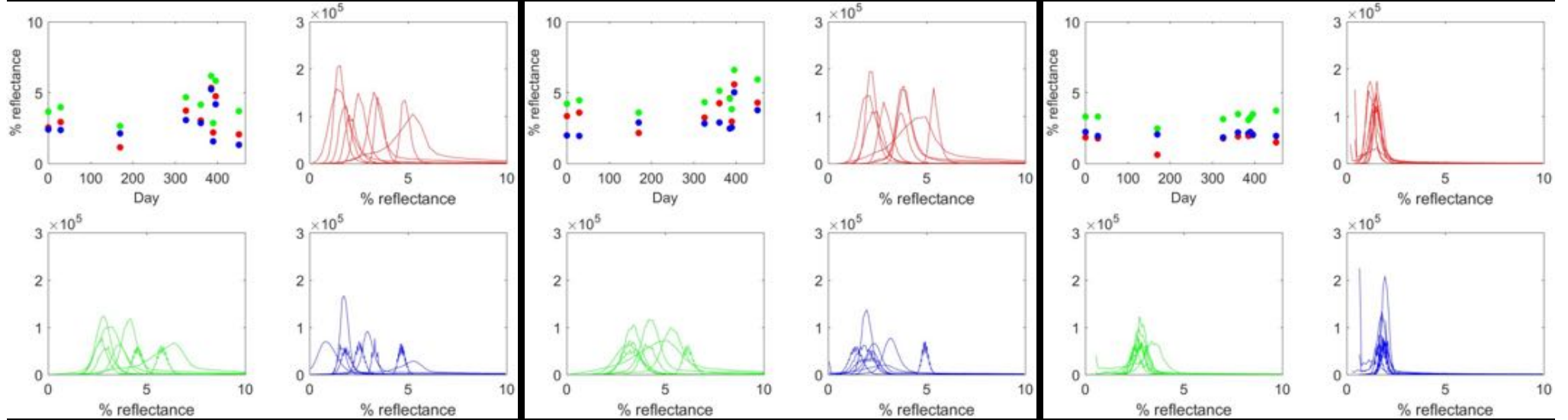


Apr. 1st 2018

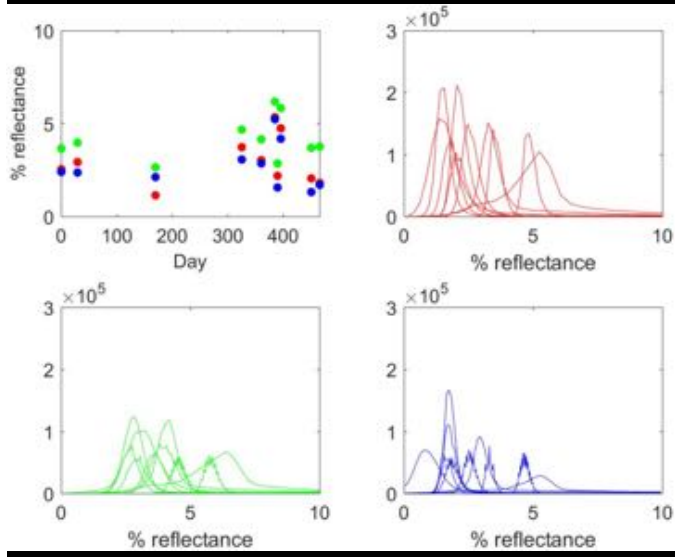
THEIA

PEPS

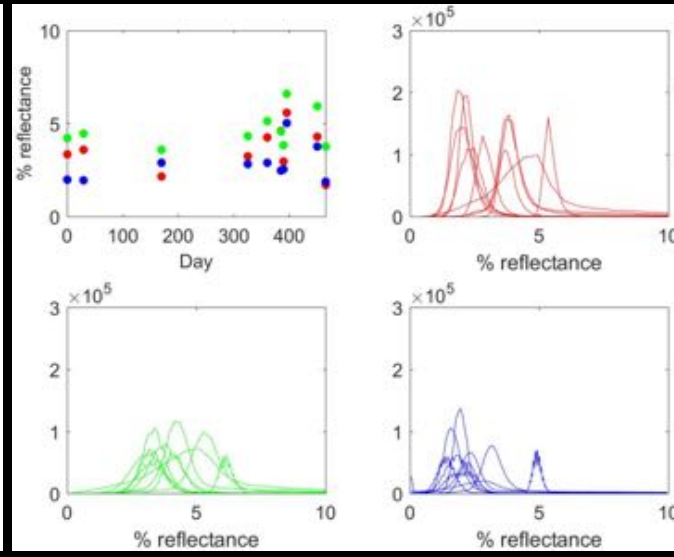
OVERLAND



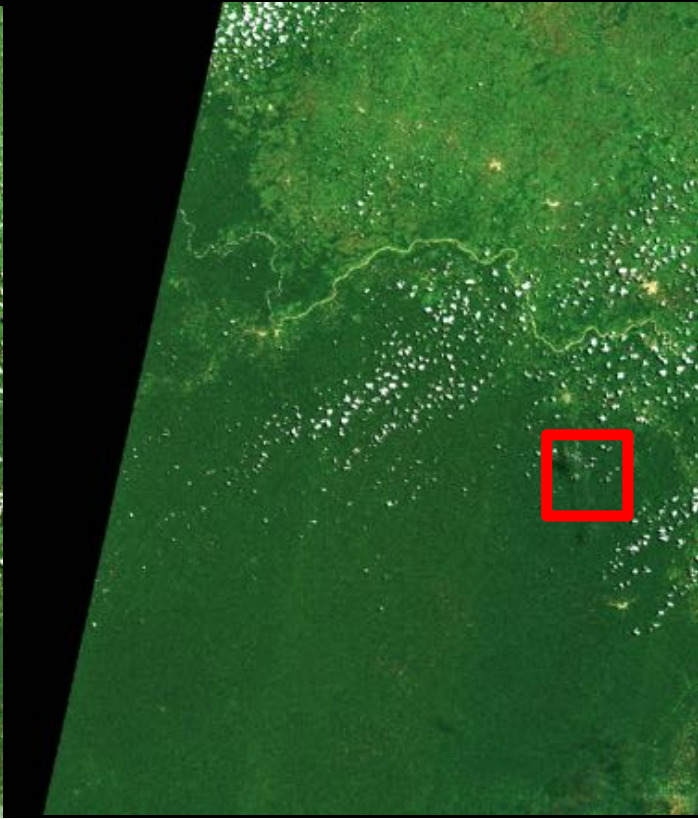
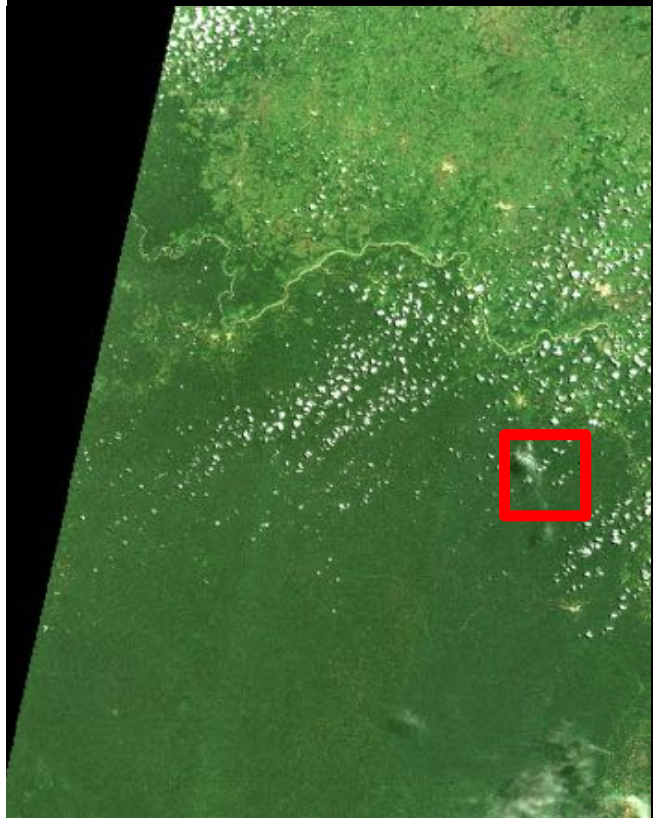
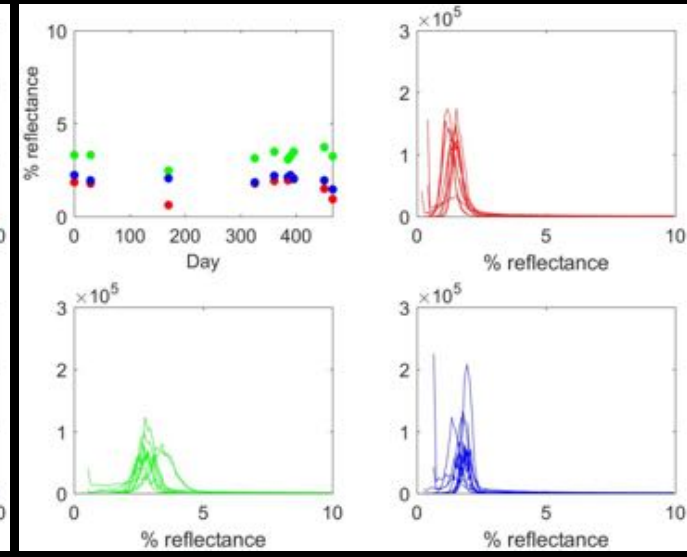
THEIA



PEPS



OVERLAND



S2 BOA reflectance in the context of tropical rainforest

- **Introduction & contexte**
- **Image dataset**
- **Methods**
- **Results**
- **Conclusions**

Conclusions: S2 BOA reflectance in the context of tropical rainforest

- **Very preliminary study comparison of three data sources for the preparation of time series dedicated to tropical vegetation monitoring**
 - **THEIA, PEPS + Sen2Cor, OverLand (Airbus)**
- **Strong effect due to haze**
 - **Difficulties expected for the estimation of vegetation properties**
 - **Possibility to correct haze based on mono-date algorithm**
 - **Additional environmental effects**
 - **Integrated in OverLand processing chain (Airbus patented)**
 - **Integration of equivalent solutions in MAJA and Sen2cor ?**

Thank you!
Questions?

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Hervé Poilvé & ADS (OverLand S2 preprocessing)

Lea Tresch (THEIA & PEPS preprocessing chain)