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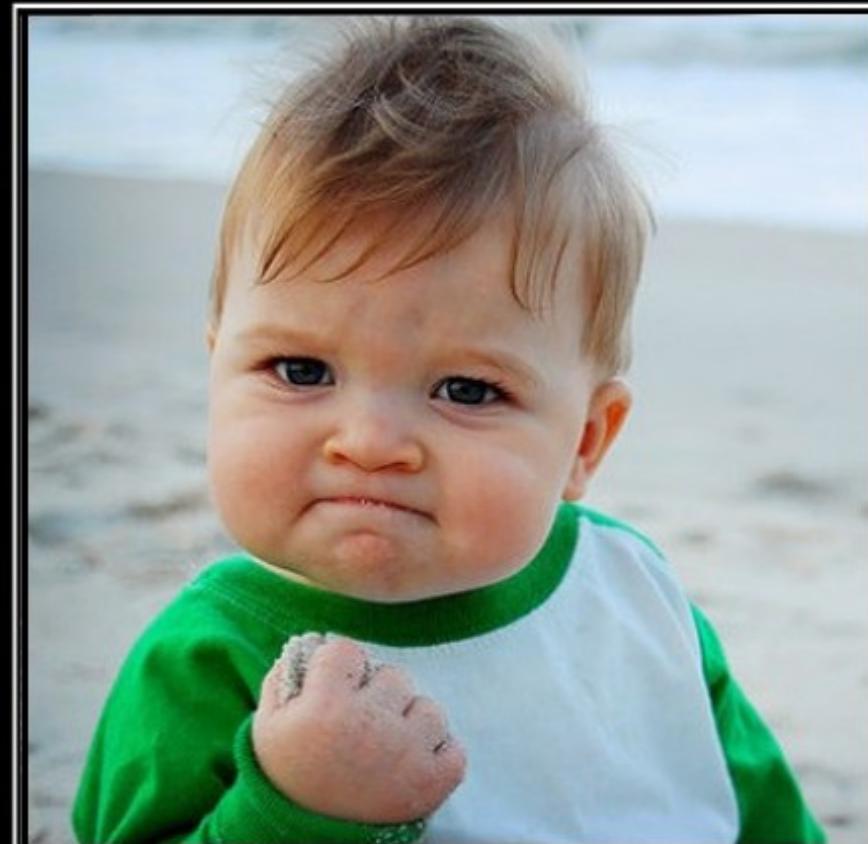
Image Processing and GIS Lab (LAPIG/UFG)
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Bobby Braswell
Applied Geosolutions
www.appliedgeosolutions.com

Presentation Outline

- Context and background...
- How big is our problem ?
- Solution blocks...
- Preliminary results
- Next steps

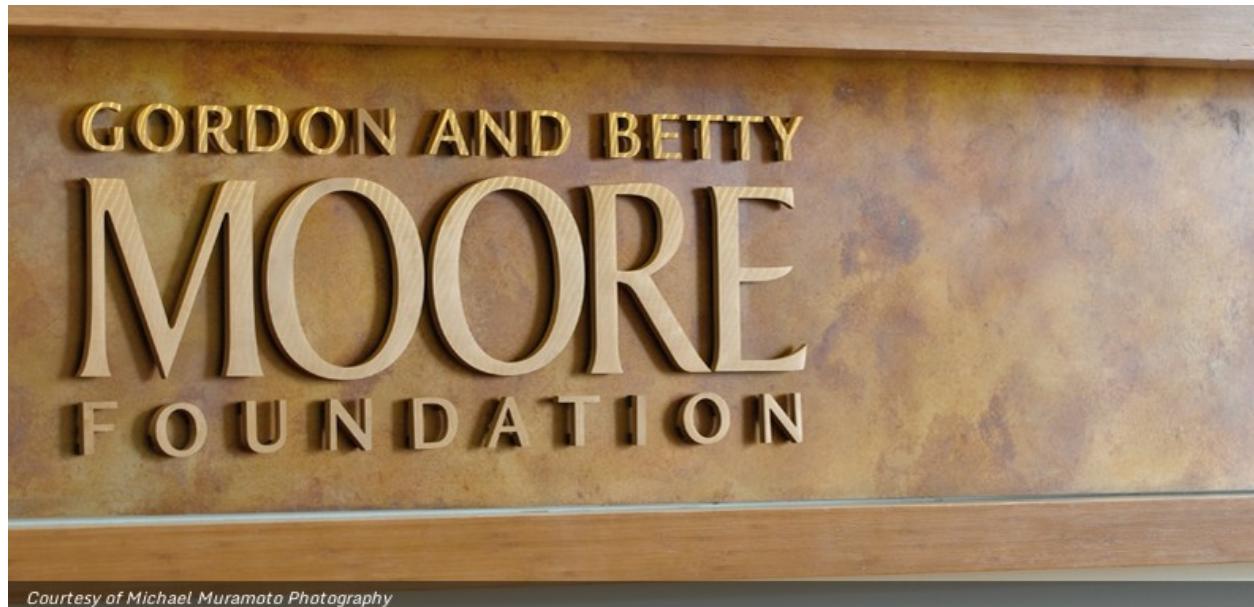
Context and background...



EXPLANATION

I demand one

Context and background



Courtesy of Michael Muramoto Photography

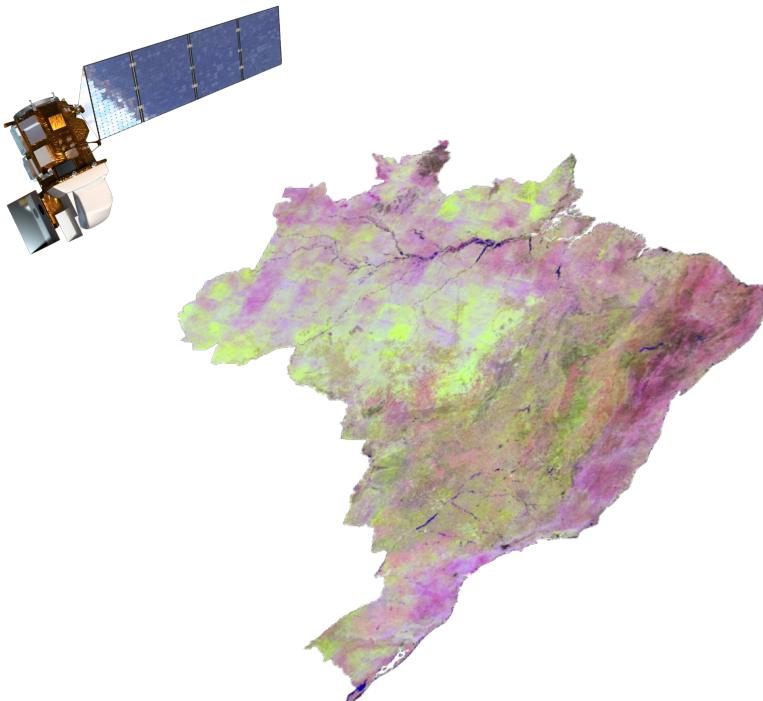
Universidade Federal de
Goiás

Spatial metrics and baselines of degradation patterns and provision of ecosystem services by pastures in Brazil

In support of the measurement, validation and accurate mapping of pasture degradation, productivity, and provision of related ecosystem services in Brazil.

Context and background

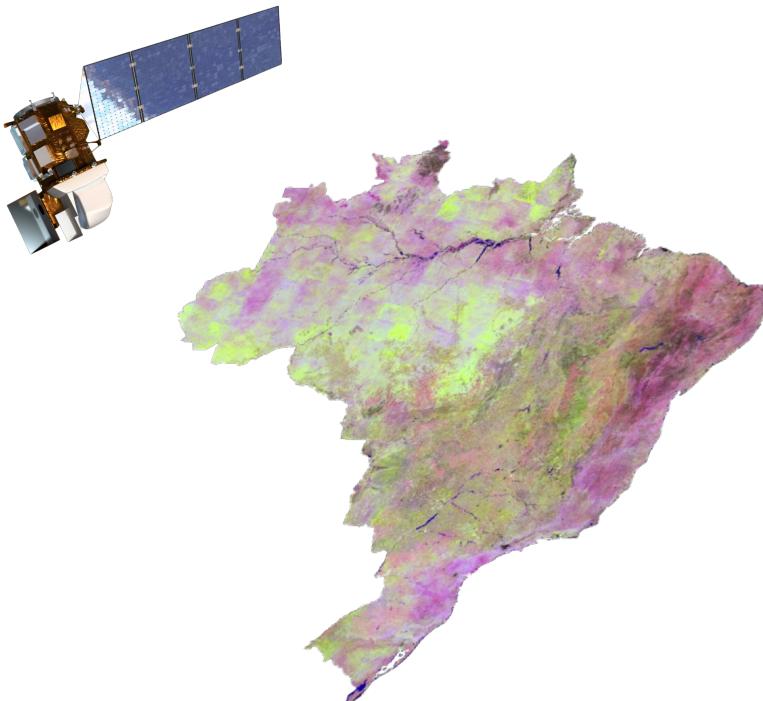
Spatial metrics and baselines of degradation patterns and provision of ecosystem services by pastures in Brazil



		Baseline Conditions	
Output		Current	Projected
Updated and refined pasture map for Brazil		<i>Spatially explicit pasture information</i>	
Pasture degradation map		Brazil: PROBIO 2002 / 1:250.000 Amazon Forest TerraClass 2010 / 1:250.000 Cerrado TerraClass 2013 / 1:250.000	2014 integrated, updated, and refined pasture map for the entire Brazilian territory (> 1:250.000)
Estimation of pasture environmental impacts and ecosystem services		<i>Pasture degradation trends</i>	
Pasture degradation and productivity trends		Indirect pasture degradation estimations based on the 2006 IBGE census data (cattle occupation rates at municipality level)	2015 satellite-based degradation estimations (@ 250m spatial resolution) calibrated to ground biophysical / management information
<i>Pasture carbon and water fluxes</i>		Estimation of carbon and water fluxes variations as a function of pasture conditions and management practices	
<i>long-term pasture responses to grazing and management</i>		None	

Context and background

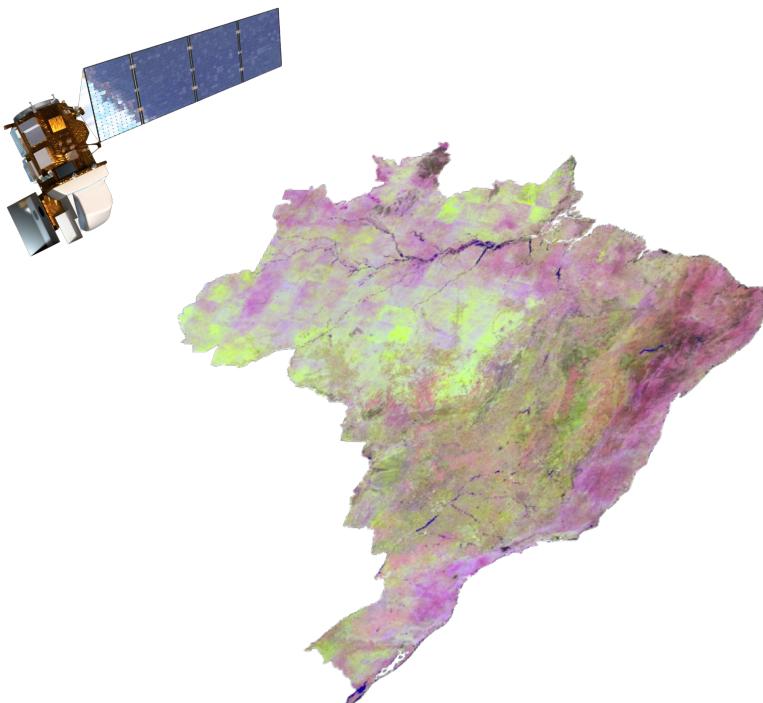
Spatial metrics and baselines of degradation patterns and provision of ecosystem services by pastures in Brazil



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<i>Pasture carbon and water fluxes</i>			
None		Estimation of carbon and water fluxes variations as a function of pasture conditions and management practices	
<i>long-term pasture responses to grazing and management</i>			
None		Identification, on a per-pixel basis, of pasture response to investments, intensification, etc. Improved strategies regarding cattle and resources allocation	

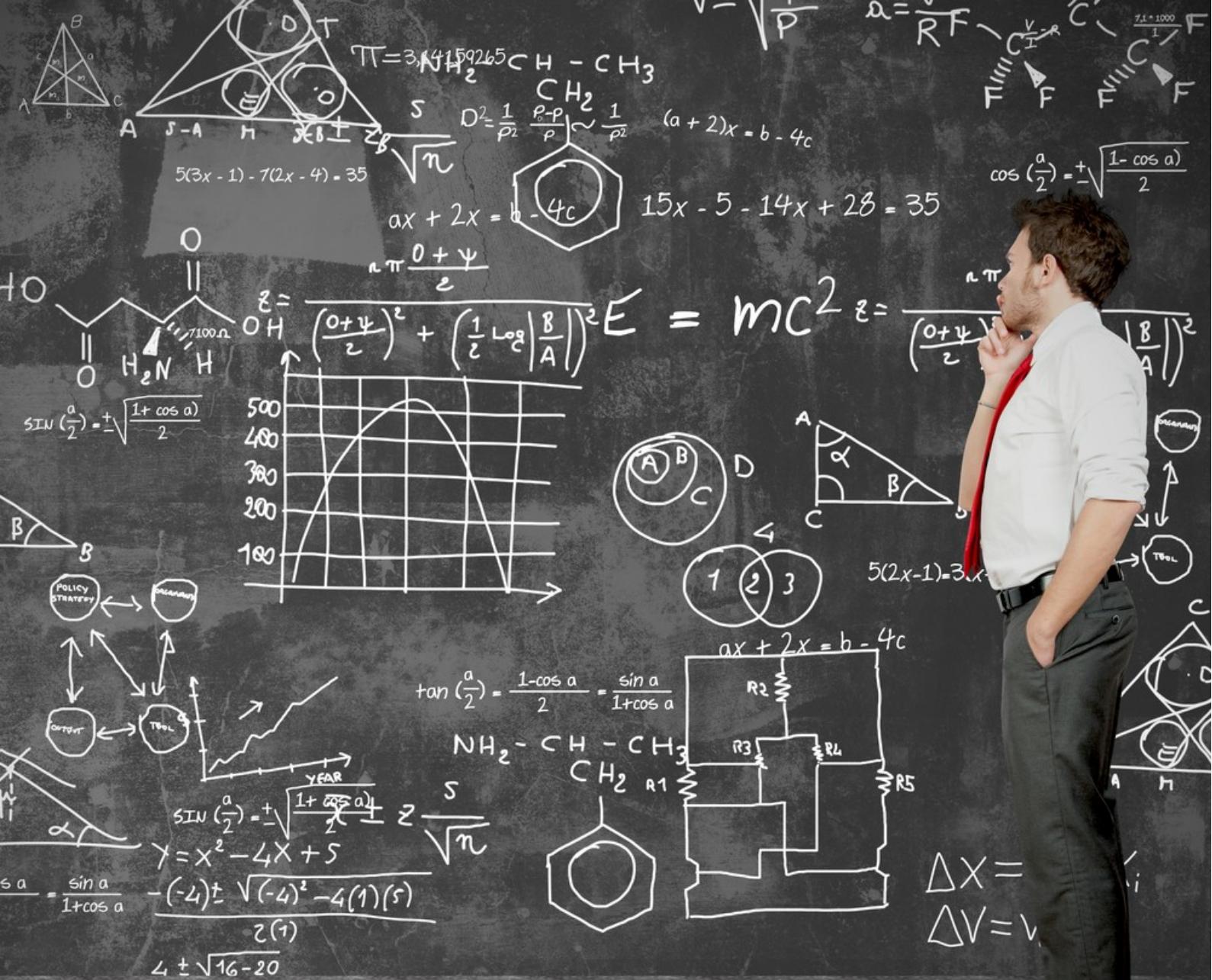
Context and background

Spatial metrics and baselines of degradation patterns and provision of ecosystem services by pastures in Brazil

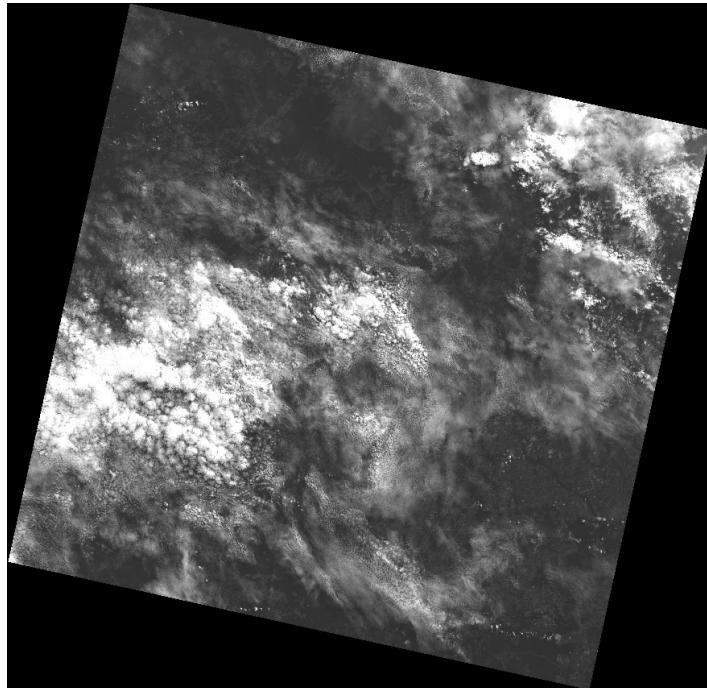


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How big is our problem ?



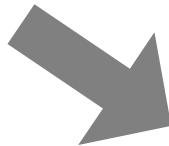
How big is our problem ?



7.341 pixels

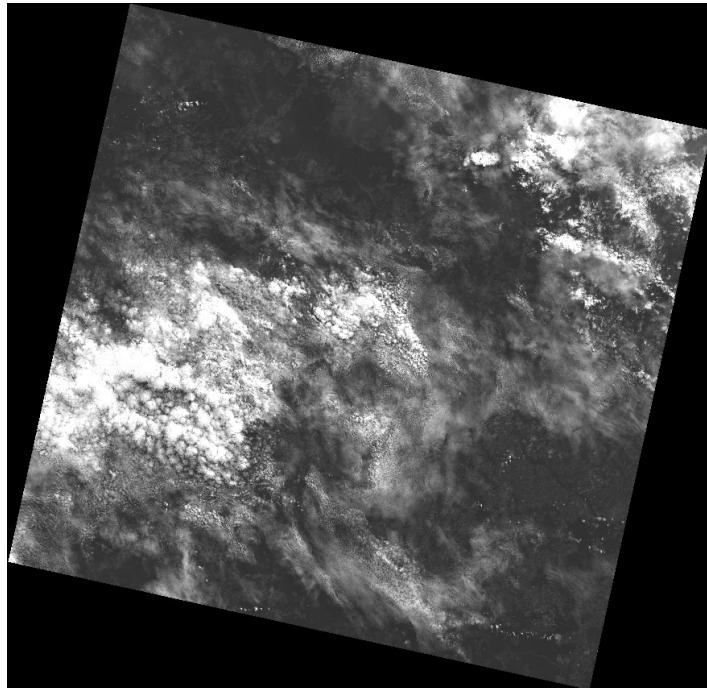


7.541 pixels



55.358.481
pixels per tile

How big is our problem ?

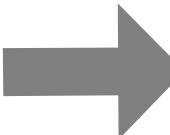


7.341 pixels

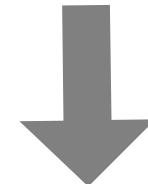
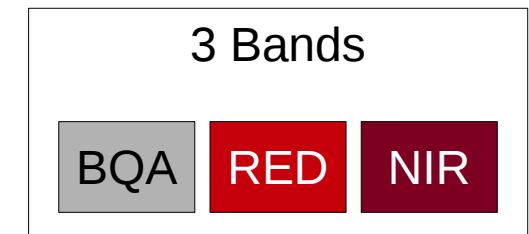
7.541 pixels



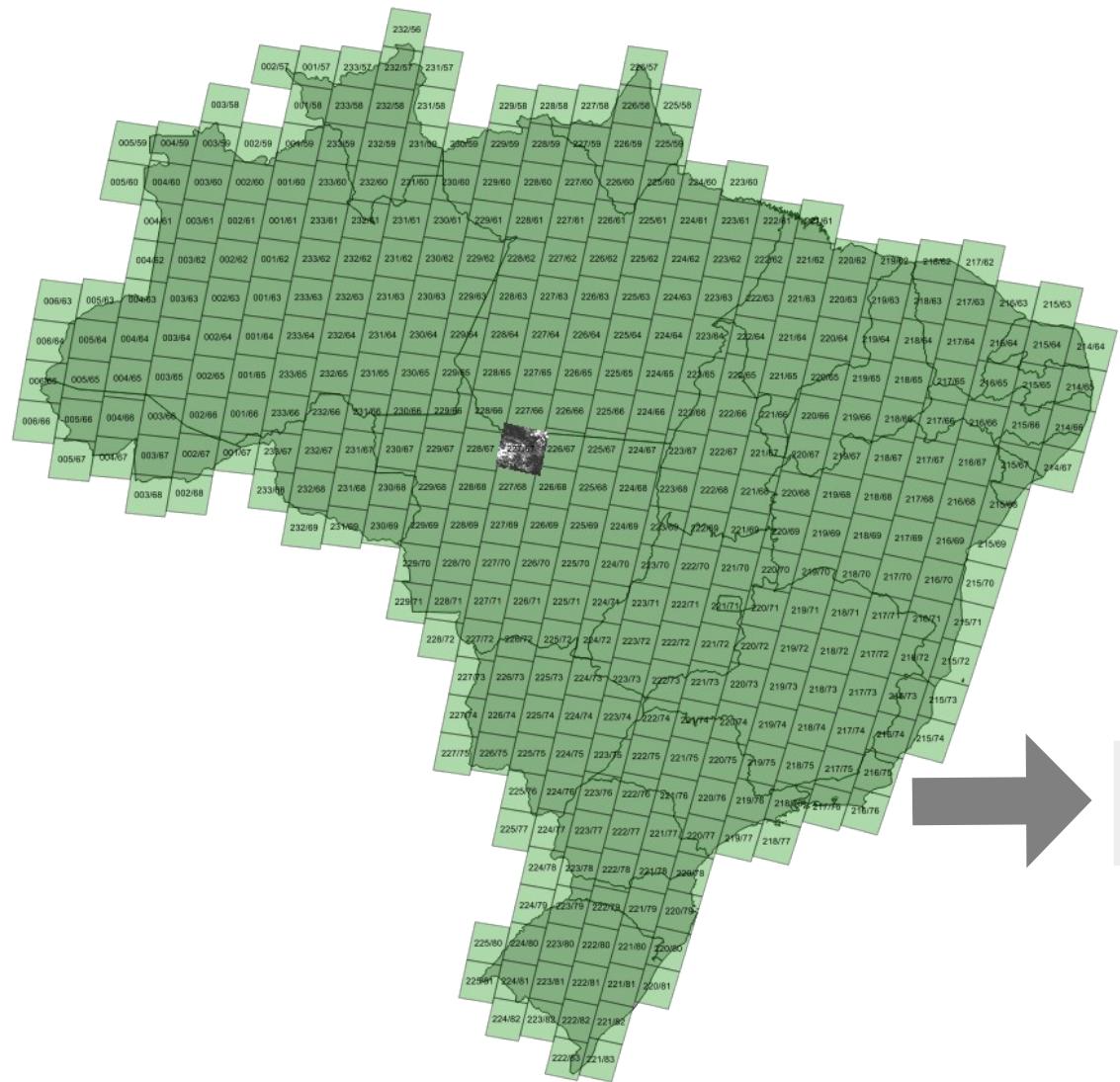
55.358.481
pixels per tile



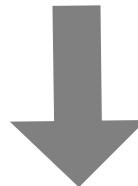
166.075.443
pixels per tile



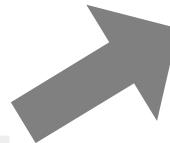
How big is our problem ?



166.075.443
pixels per tile

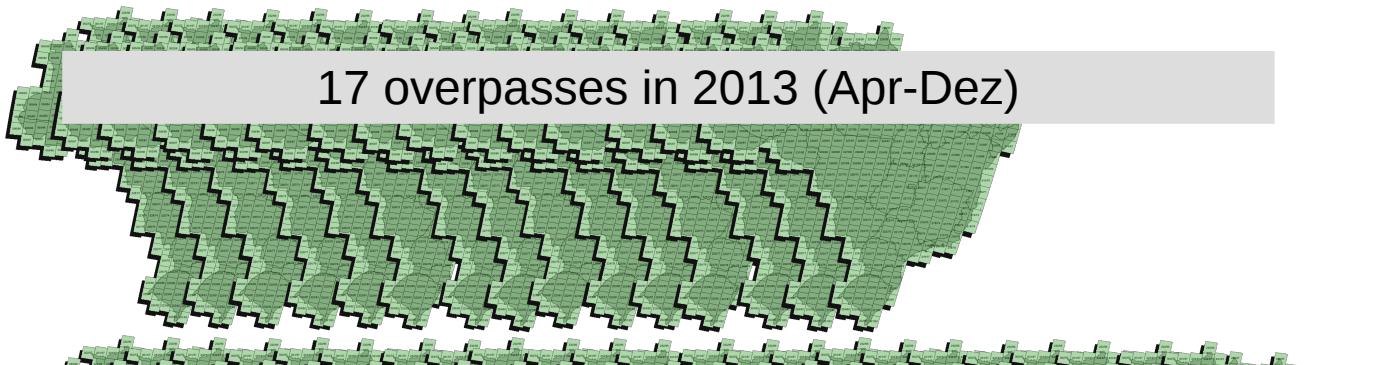


63.108.668.340
“Brazilian” pixels

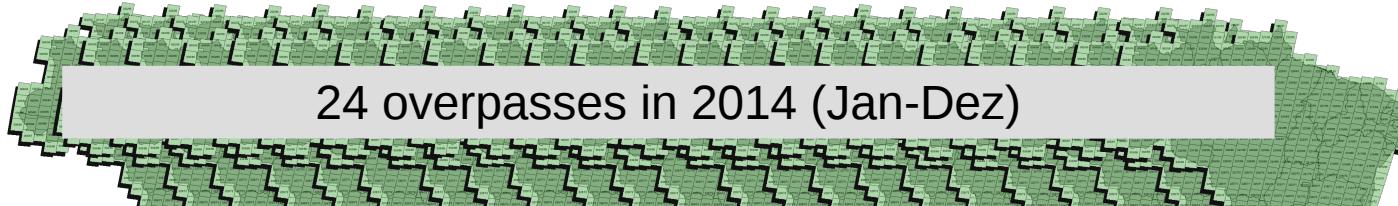


380
tiles

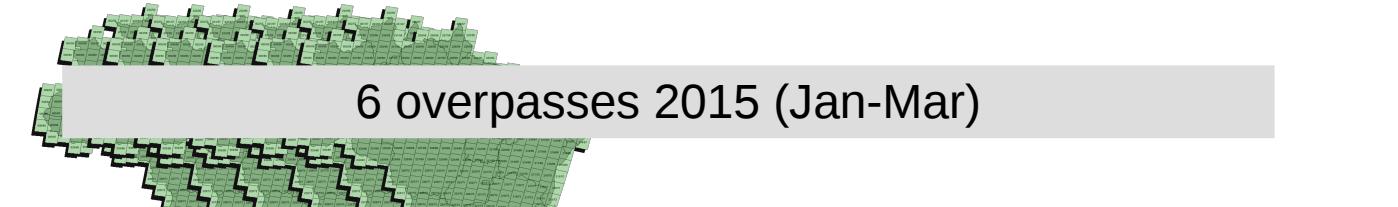
How big is our problem ?



17 overpasses in 2013 (Apr-Dec)

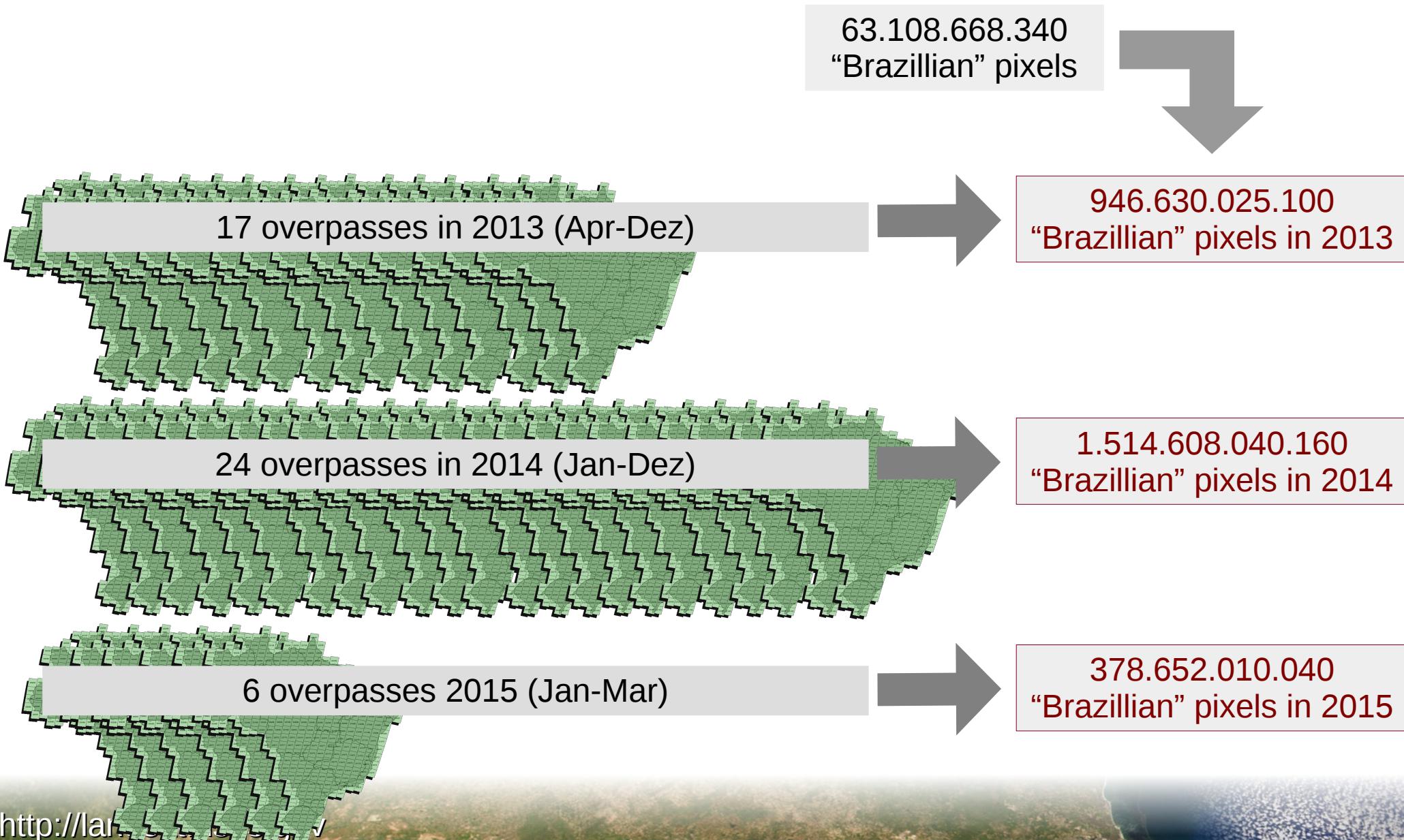


24 overpasses in 2014 (Jan-Dec)



6 overpasses 2015 (Jan-Mar)

How big is our problem ?



How big is our problem ?

2.966.107.411.980

“Brazillian” pixels in (may,2013 – mar,2015)

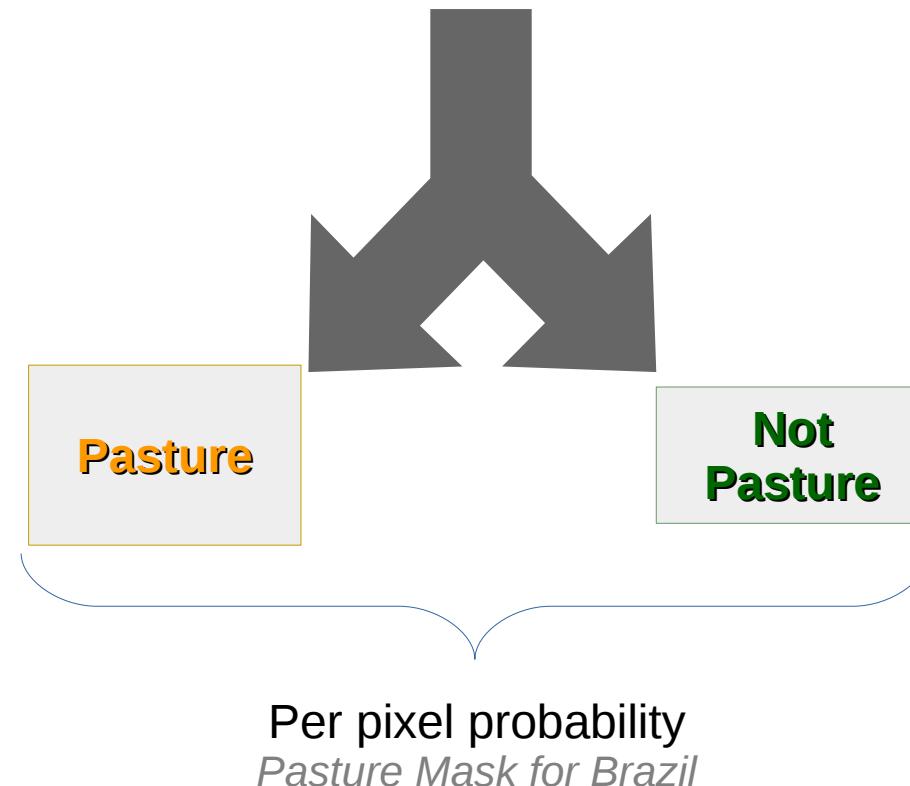
Two trillion nine hundred sixty-six billion one hundred seven million four hundred eleven thousand nine hundred eighty

How big is our problem ?

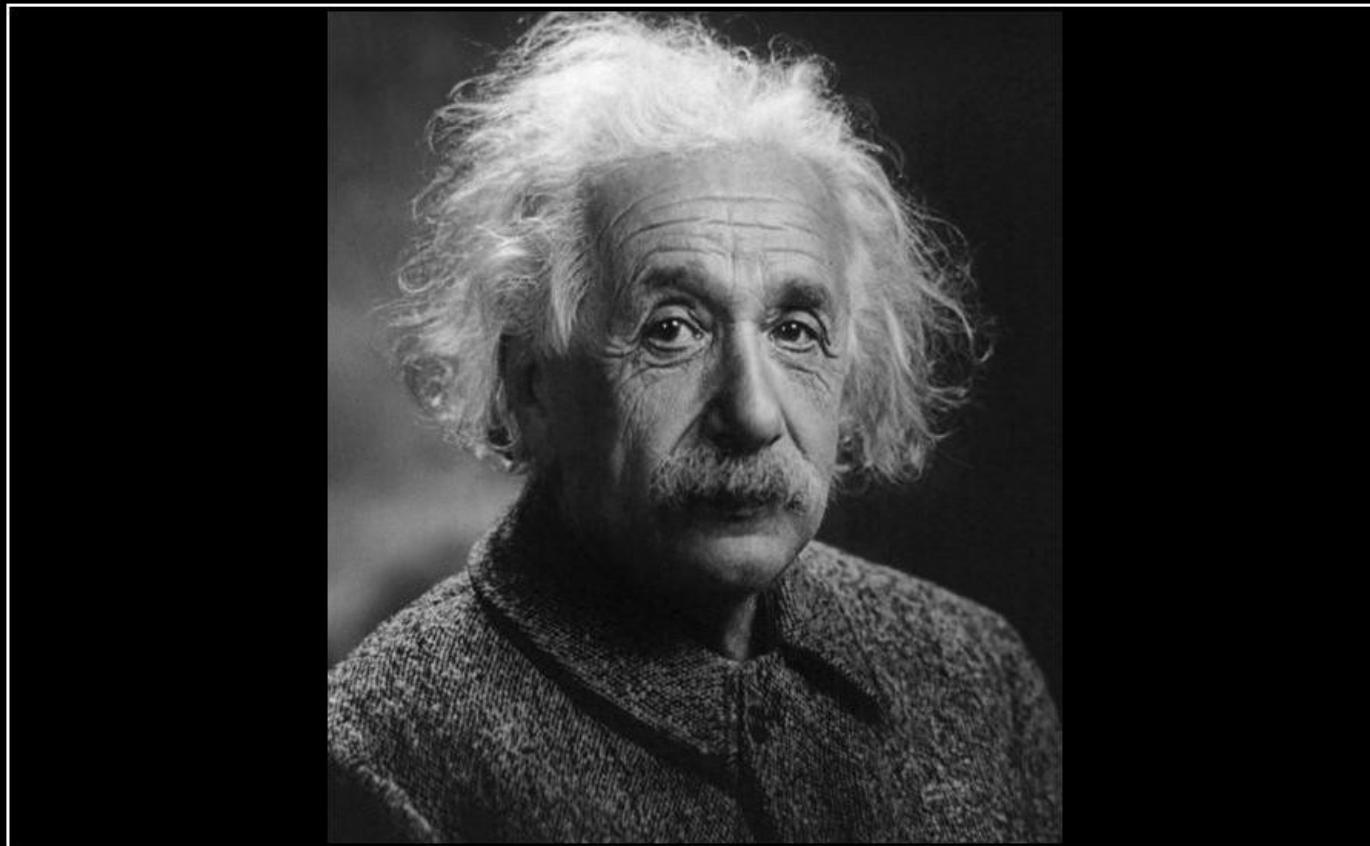
2.966.107.411.980

“Brazillian” pixels in (may,2013 – mar,2015)

Two trillion nine hundred sixty-six billion one hundred seven million four hundred eleven thousand nine hundred eighty



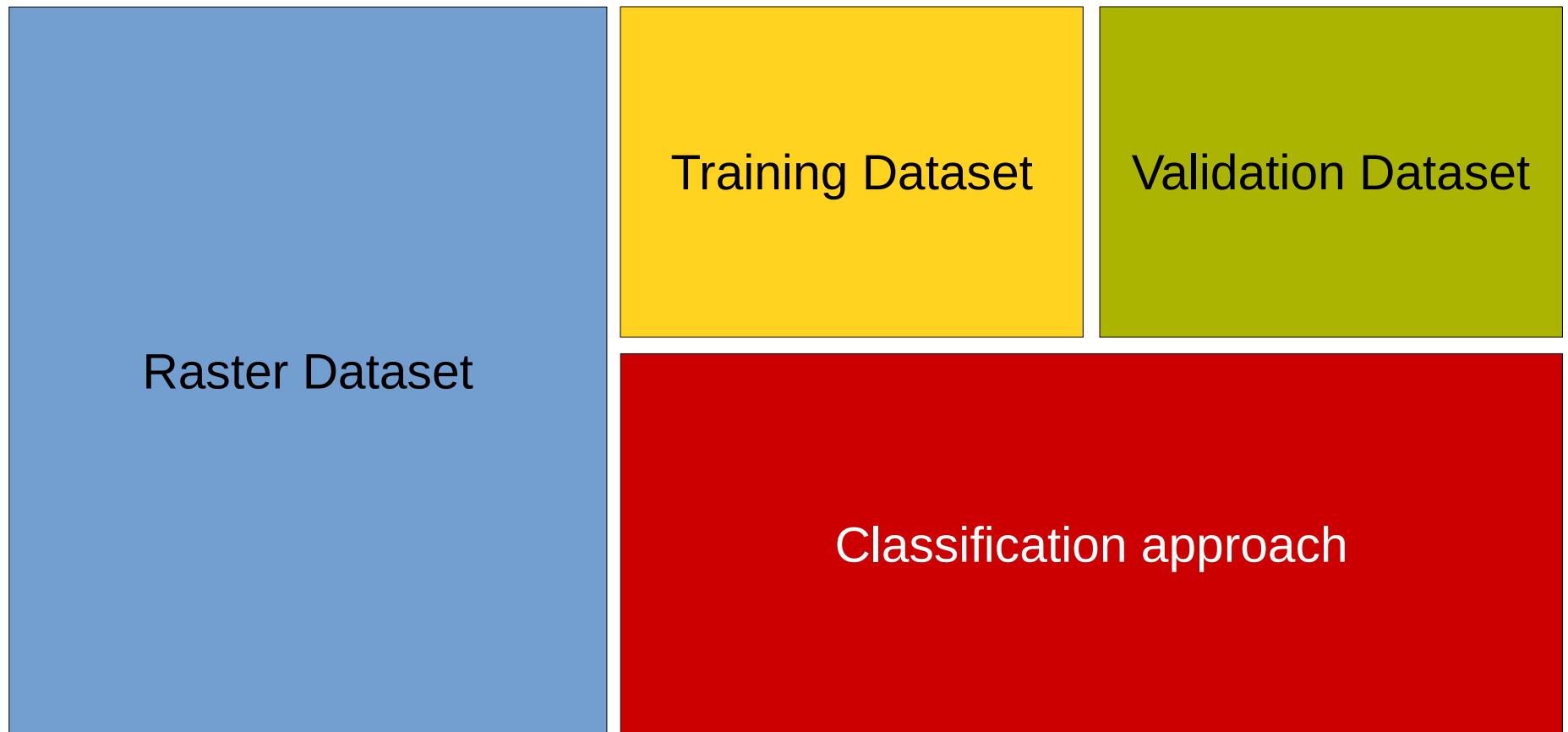
What are our solution blocks ?



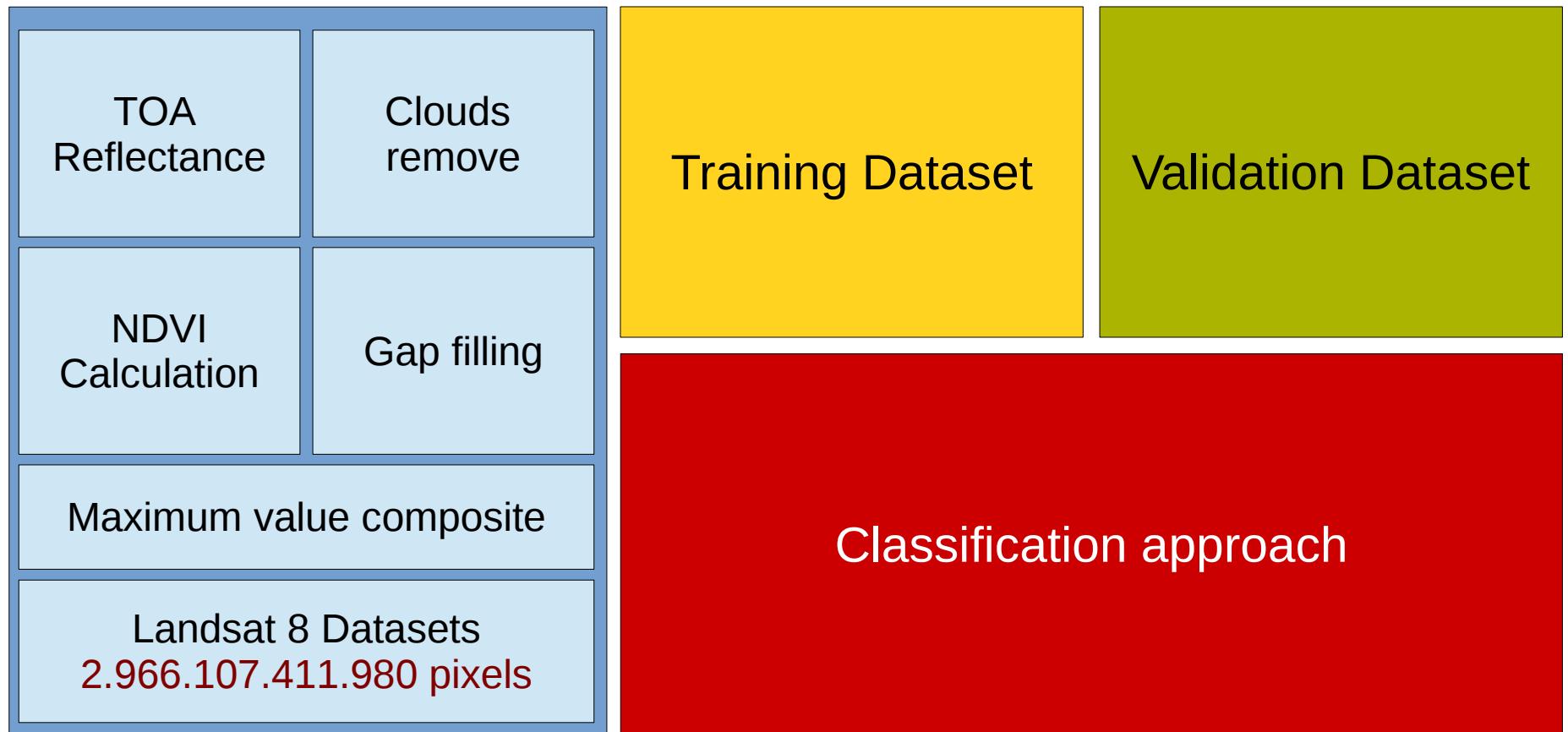
Problem Solving Requires New Approaches

"We can't solve problems by using the same kind of thinking we used when we created them." – Albert Einstein

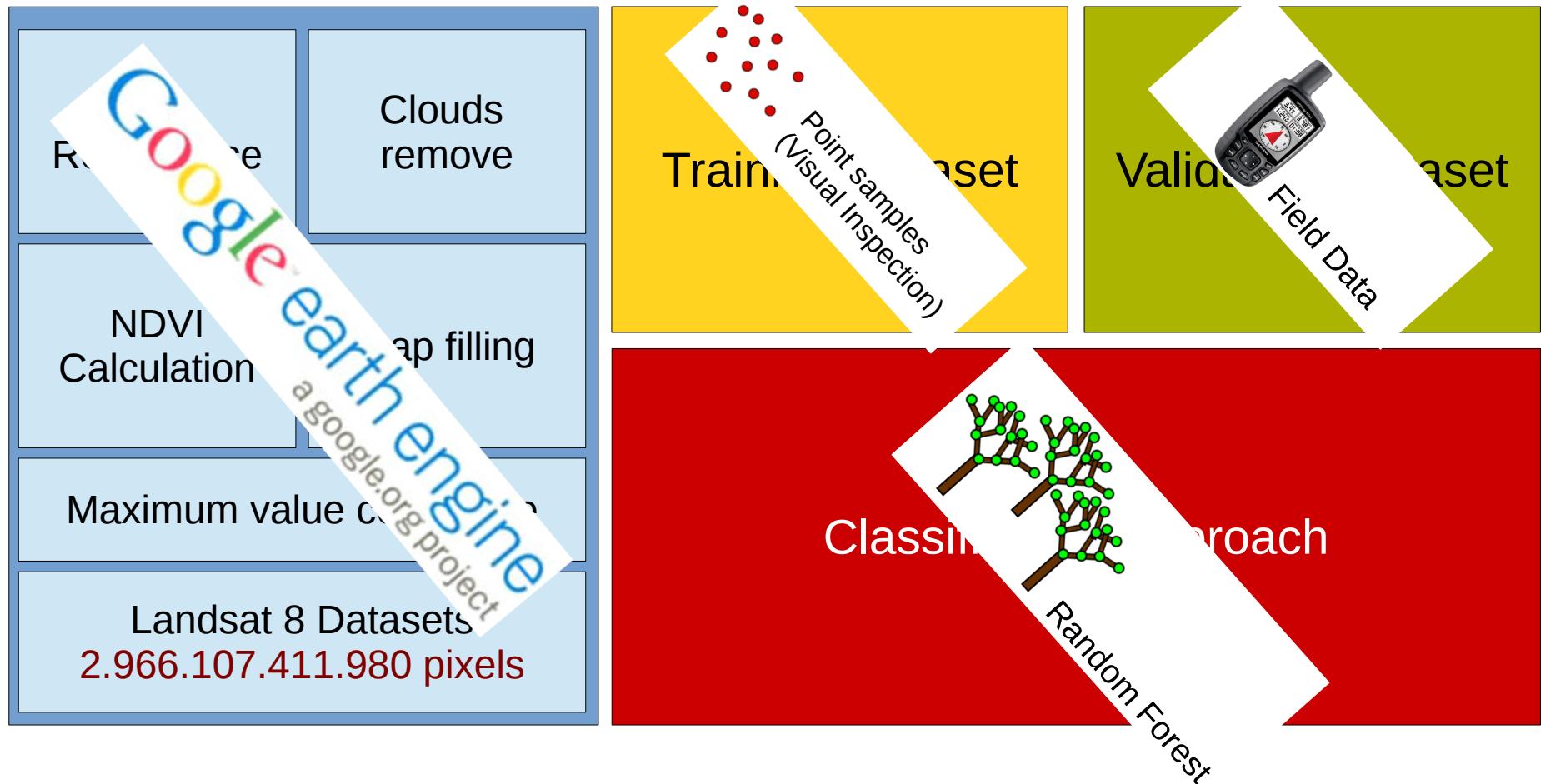
Solution blocks



Solution blocks



Solution blocks

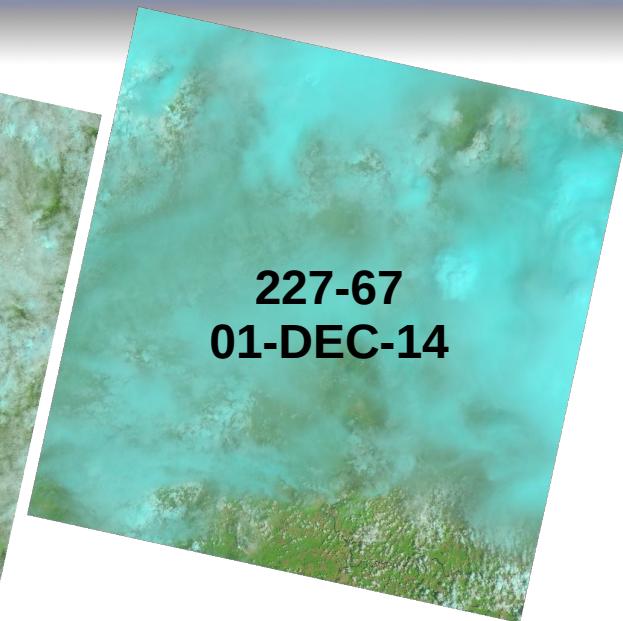
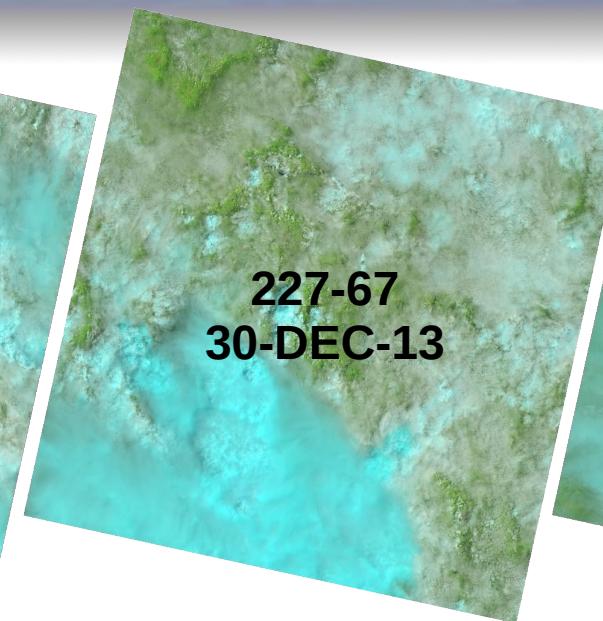
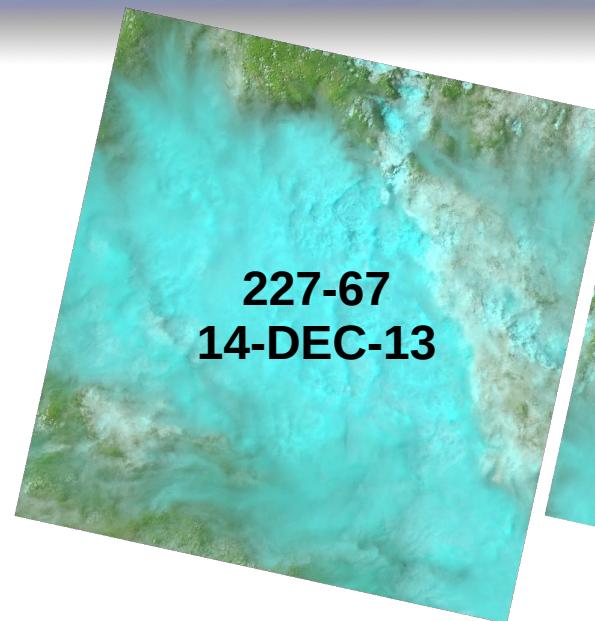


Landsat 8 Datasets

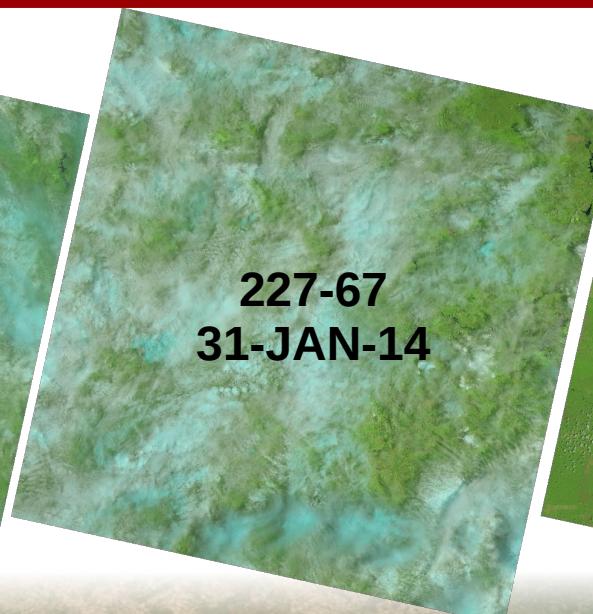
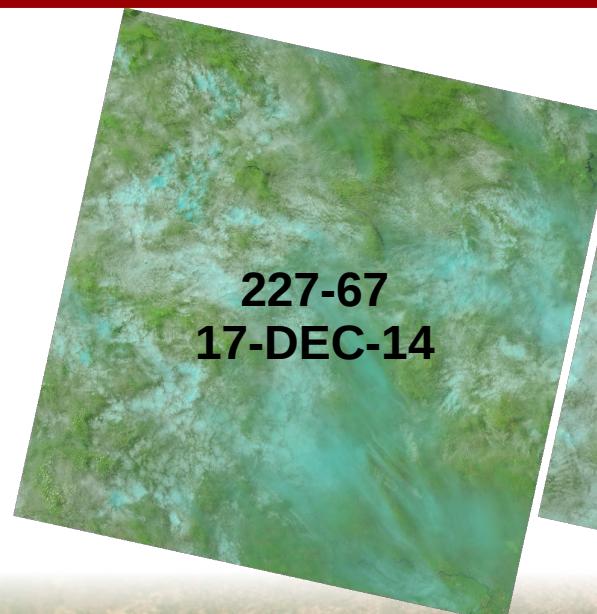
- Data Type Level 1:
 - **L1G (Systematic Correction):** provides systematic radiometric and geometric accuracy, which is derived from data collected by the sensor and spacecraft
 - **L1T (Standard Terrain Correction):** provides systematic radiometric and geometric accuracy by incorporating ground control points while employing a Digital Elevation Model (DEM) for topographic accuracy.

Landsat 8 Datasets

L1G



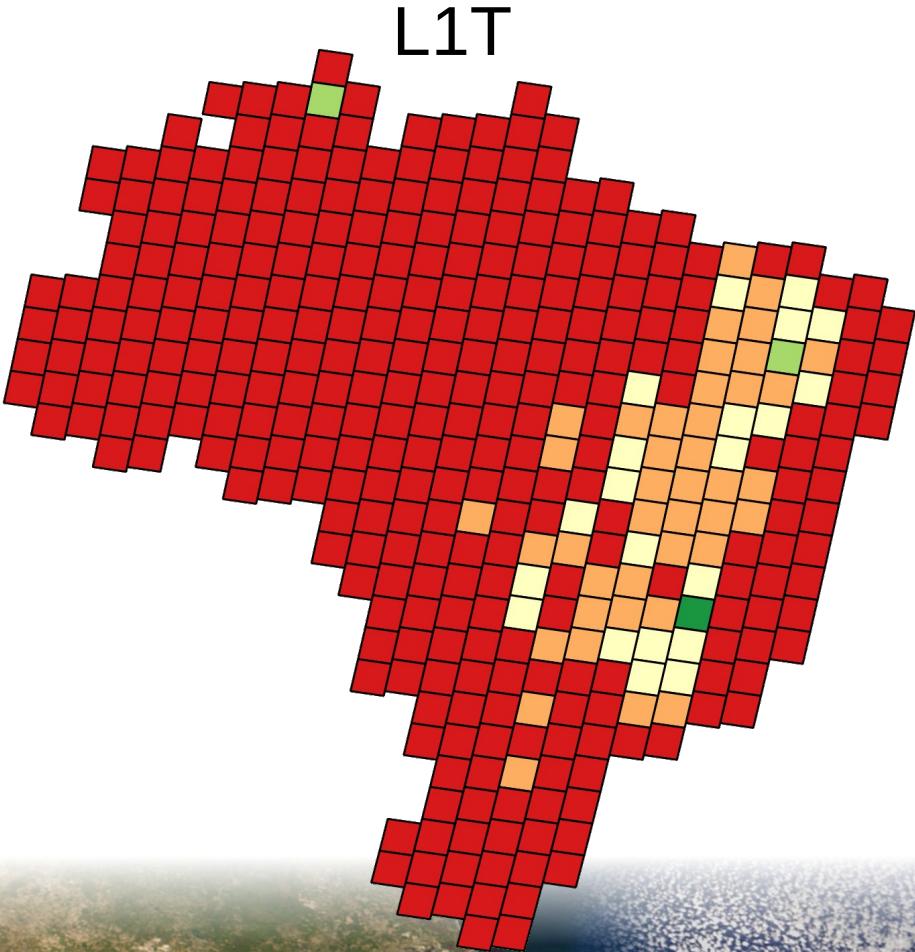
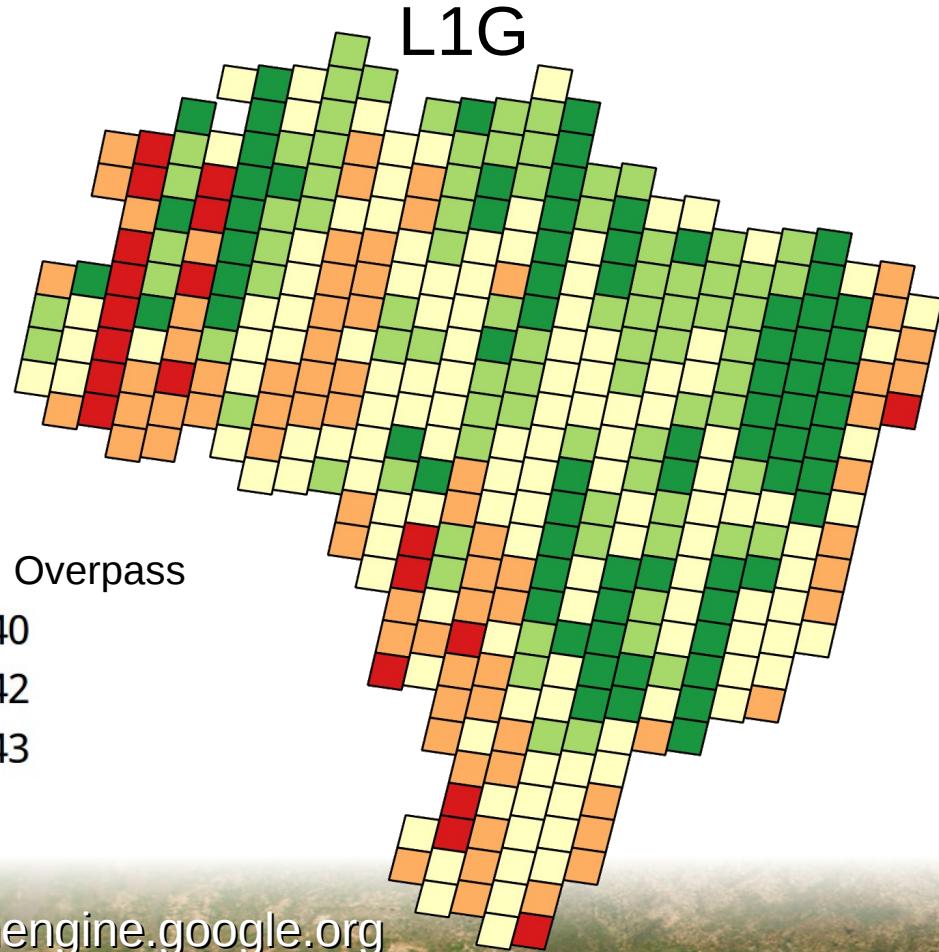
L1T



Landsat 8 Datasets

Landsat 8: Available tiles and overpasses for Brazil
Apr,2013 until Mar,2015

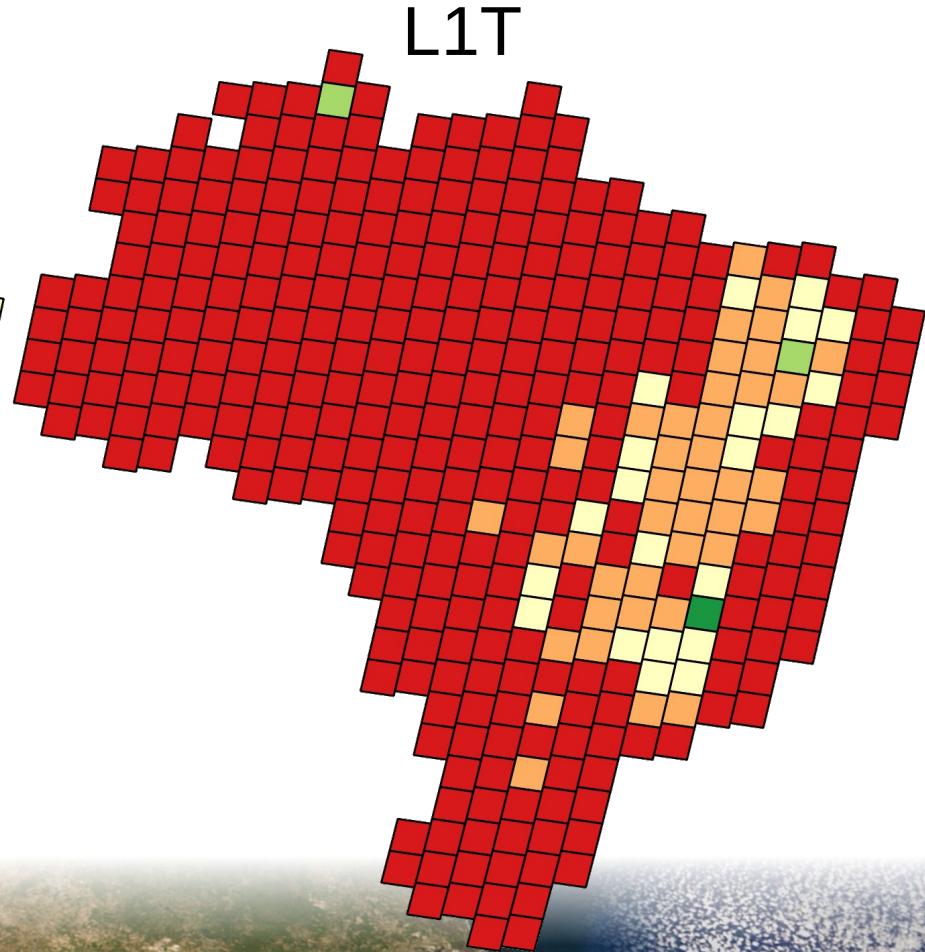
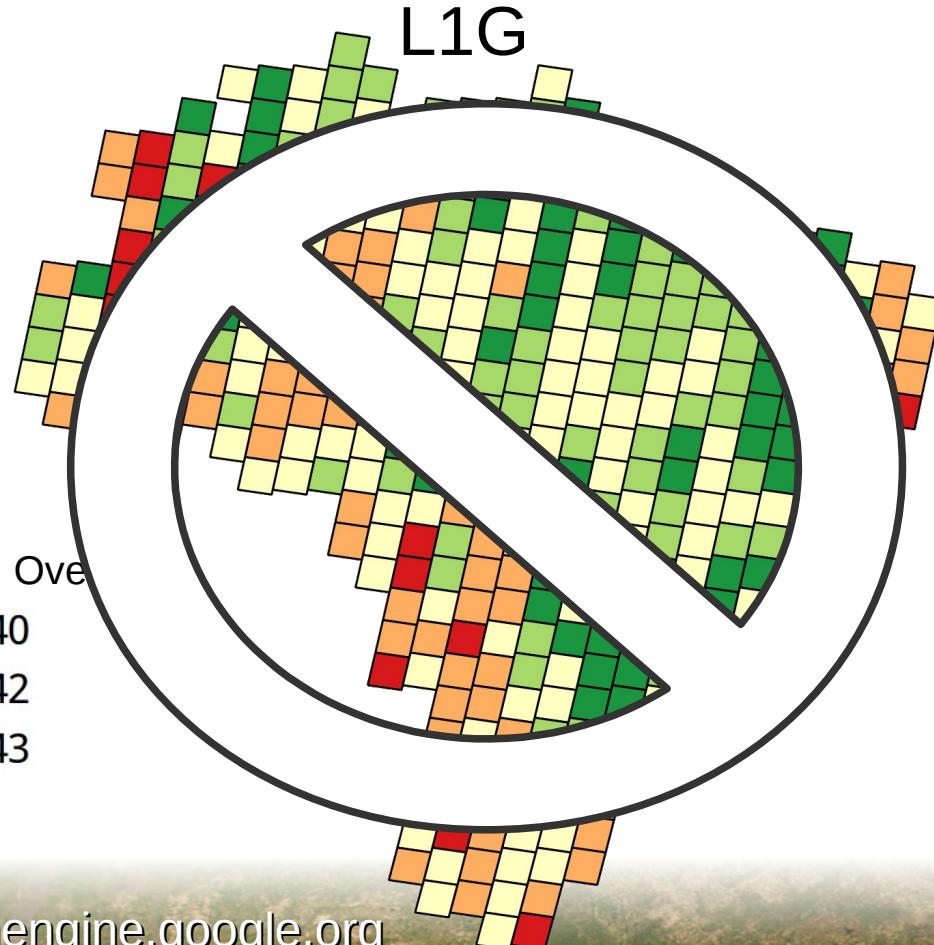
Maximum possible overpasses: 47



Landsat 8 Datasets

Landsat 8: Available tiles and overpasses for Brazil
Apr,2013 until Mar,2015

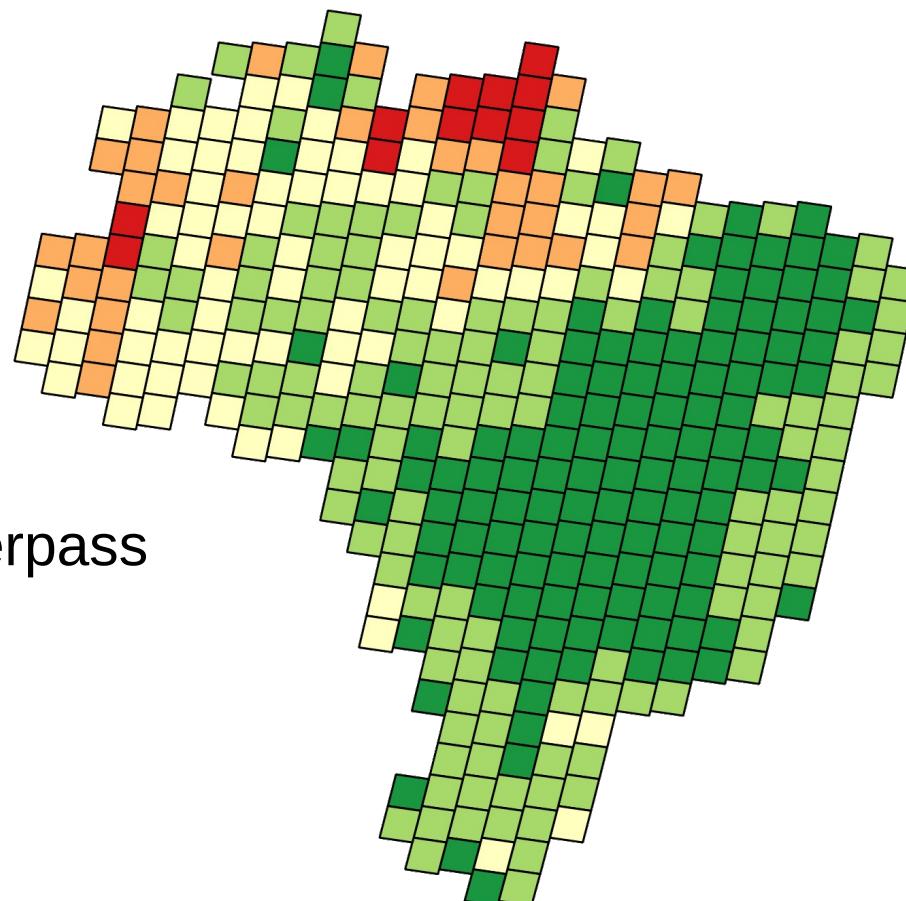
Maximum possible overpasses: 47



Landsat 8 Datasets

Landsat 8 - LT1: Available tiles and overpasses for Brazil
Apr,2013 until Mar,2015

Maximum possible overpasses: 47



Legend

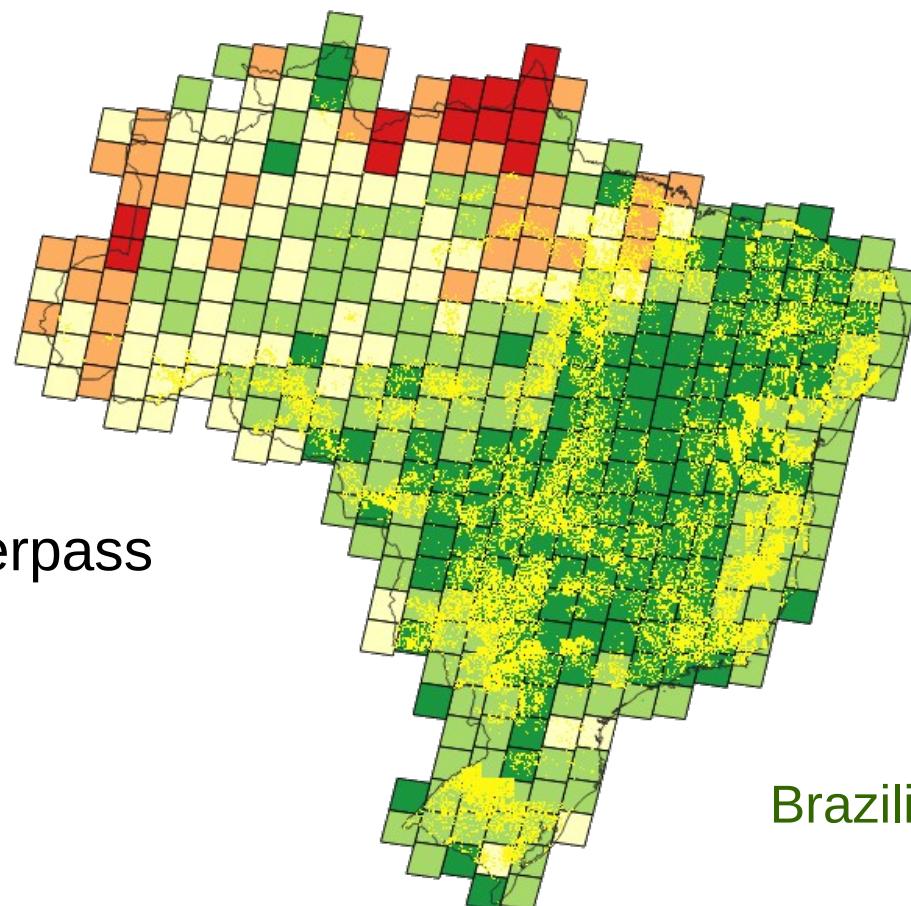
- <= 10 Overpass
- 10 - 21
- 21 - 29
- 29 - 35
- > 35

Landsat 8 Datasets

Landsat 8 - LT1: Available tiles and overpasses for Brazil
Apr,2013 until Mar,2015

Legend

- █ <= 10 Overpass
- █ 10 - 21
- █ 21 - 29
- █ 29 - 35
- █ > 35



Compiled pasture mask
e.g: PROBIO, TerraClass

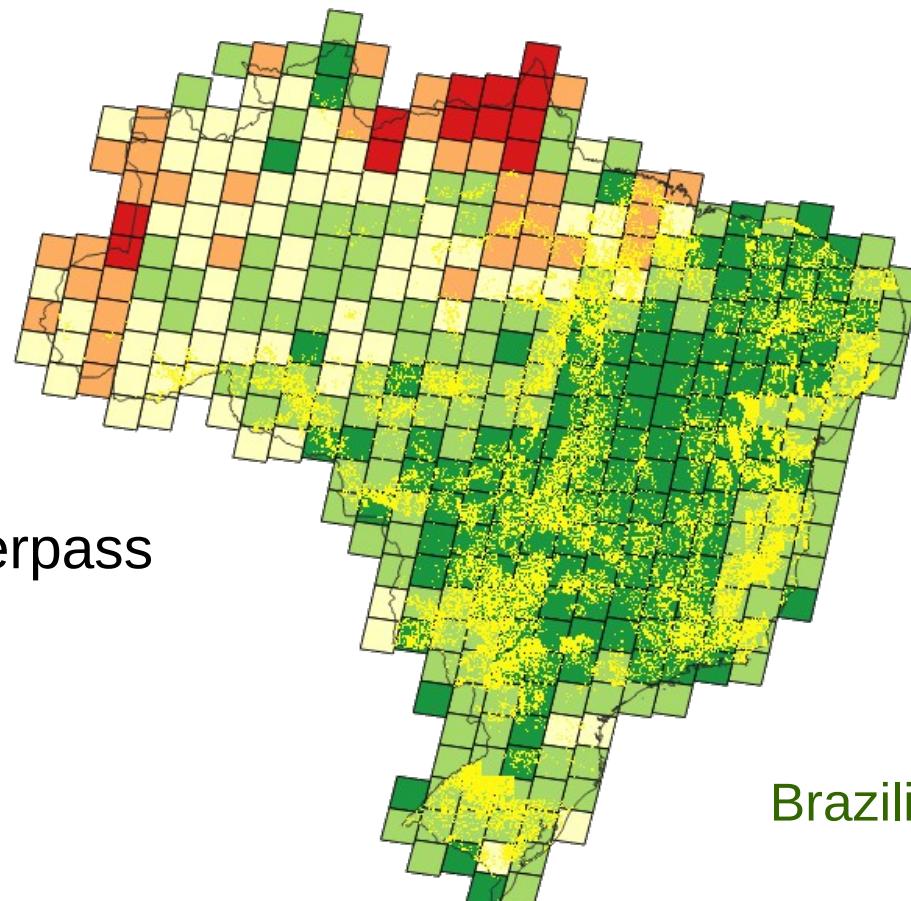


Brazilian Pasture Assessment Project
www.pastagem.org

Landsat 8 Datasets

Landsat 8 - LT1: Available tiles and overpasses for Brazil
Apr,2013 until Mar,2015

172 Million hectares
of pastures



Legend

- █ <= 10 Overpass
- █ 10 - 21
- █ 21 - 29
- █ 29 - 35
- █ > 35

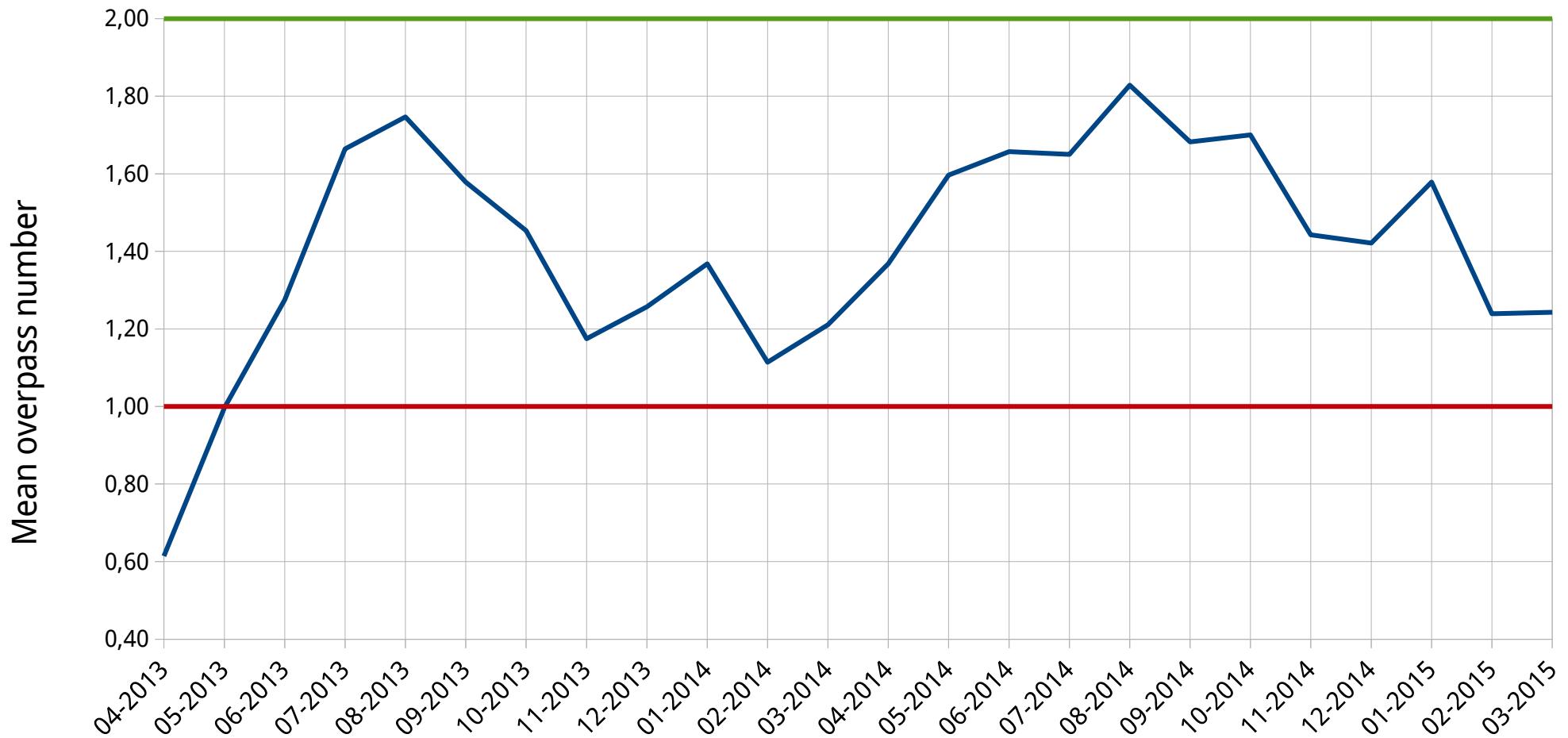
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e.g: PROBIO, TerraClass



Brazilian Pasture Assessment Project
www.pastagem.org

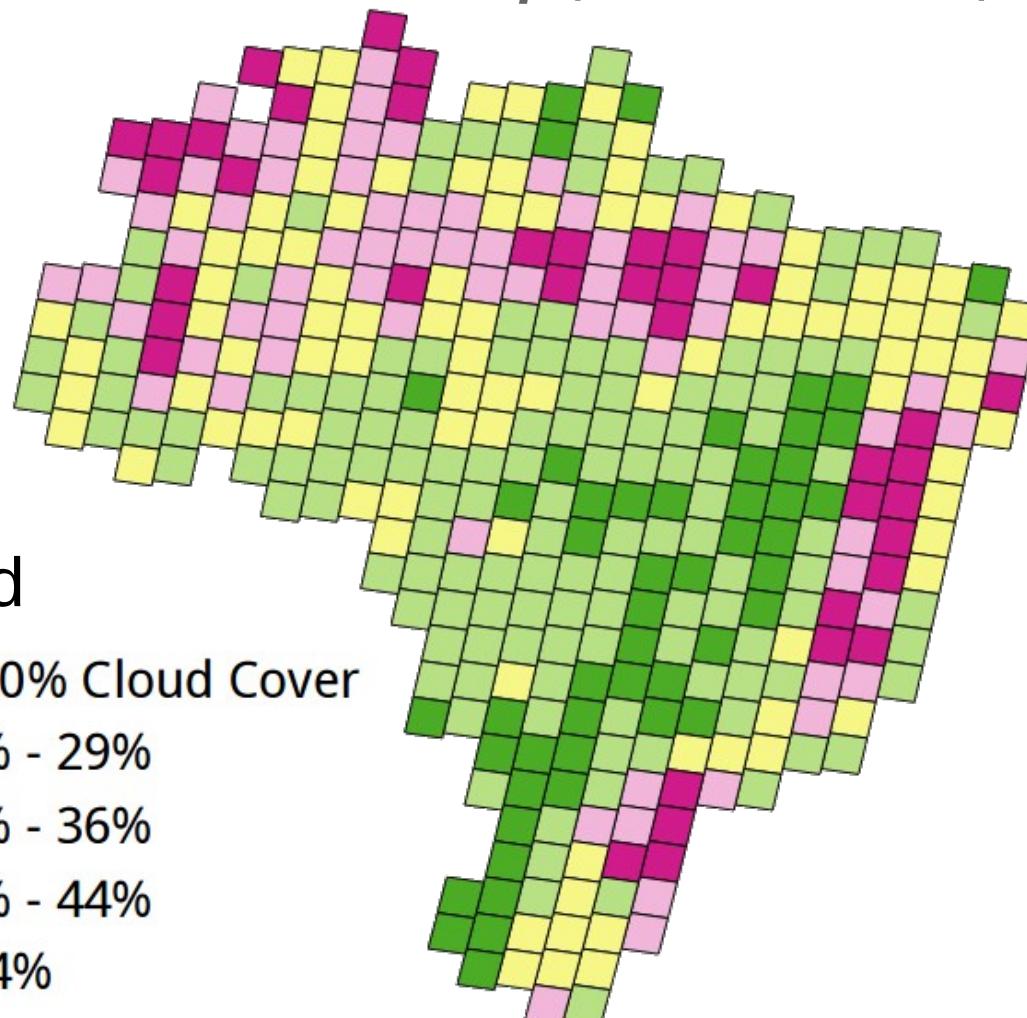
Landsat 8 Datasets

Landsat 8 - L1T: Mean overpass number for tiles with pasture
Apr,2013 until Mar,2015



Landsat 8 Datasets

Landsat 8 - L1T: Mean cloud cover (per tile)
Apr,2013 until Mar,2015

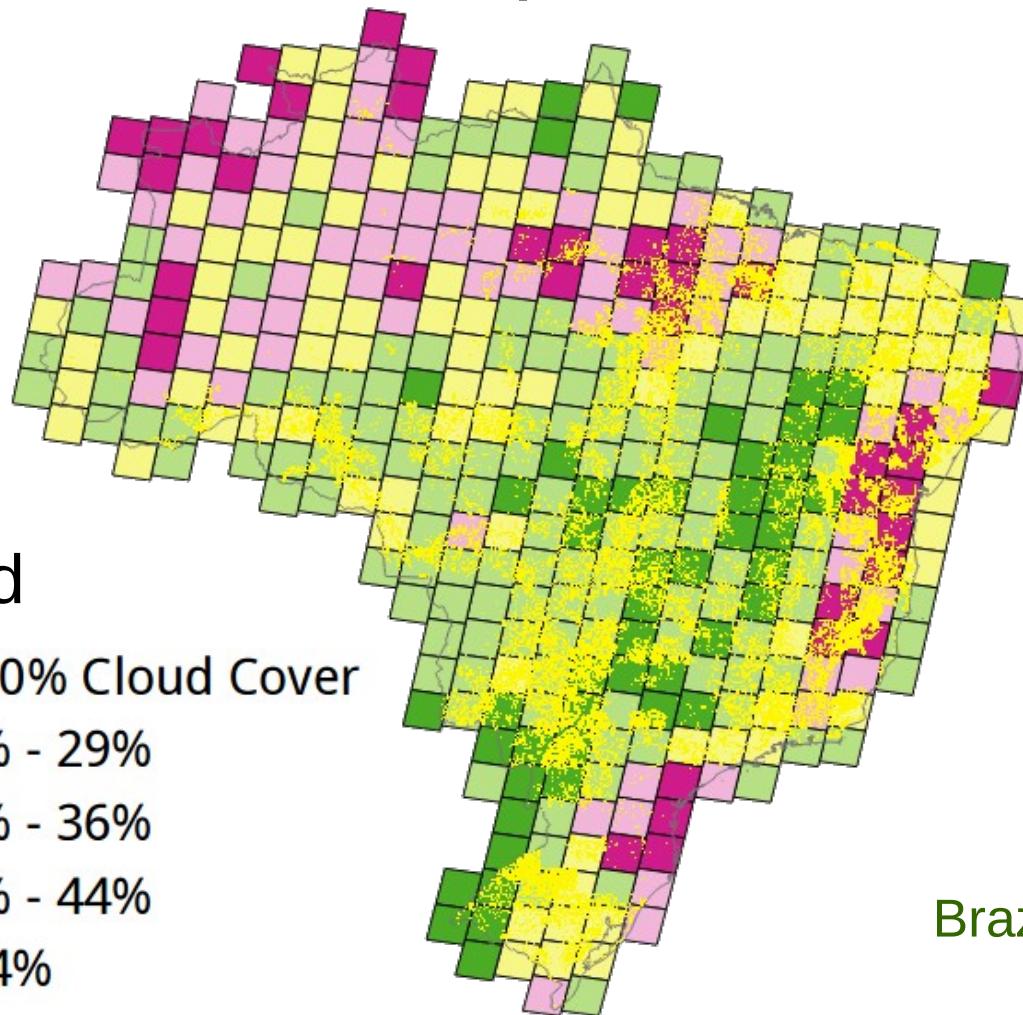


Legend

- [Dark Green] <= 20% Cloud Cover
- [Light Green] 20% - 29%
- [Yellow] 29% - 36%
- [Pink] 36% - 44%
- [Magenta] > 44%

Landsat 8 Datasets

Landsat 8 - L1T: Mean cloud cover (per tile)
Apr,2013 until Mar,2015



Legend

- █ <= 20% Cloud Cover
- █ 20% - 29%
- █ 29% - 36%
- █ 36% - 44%
- █ > 44%

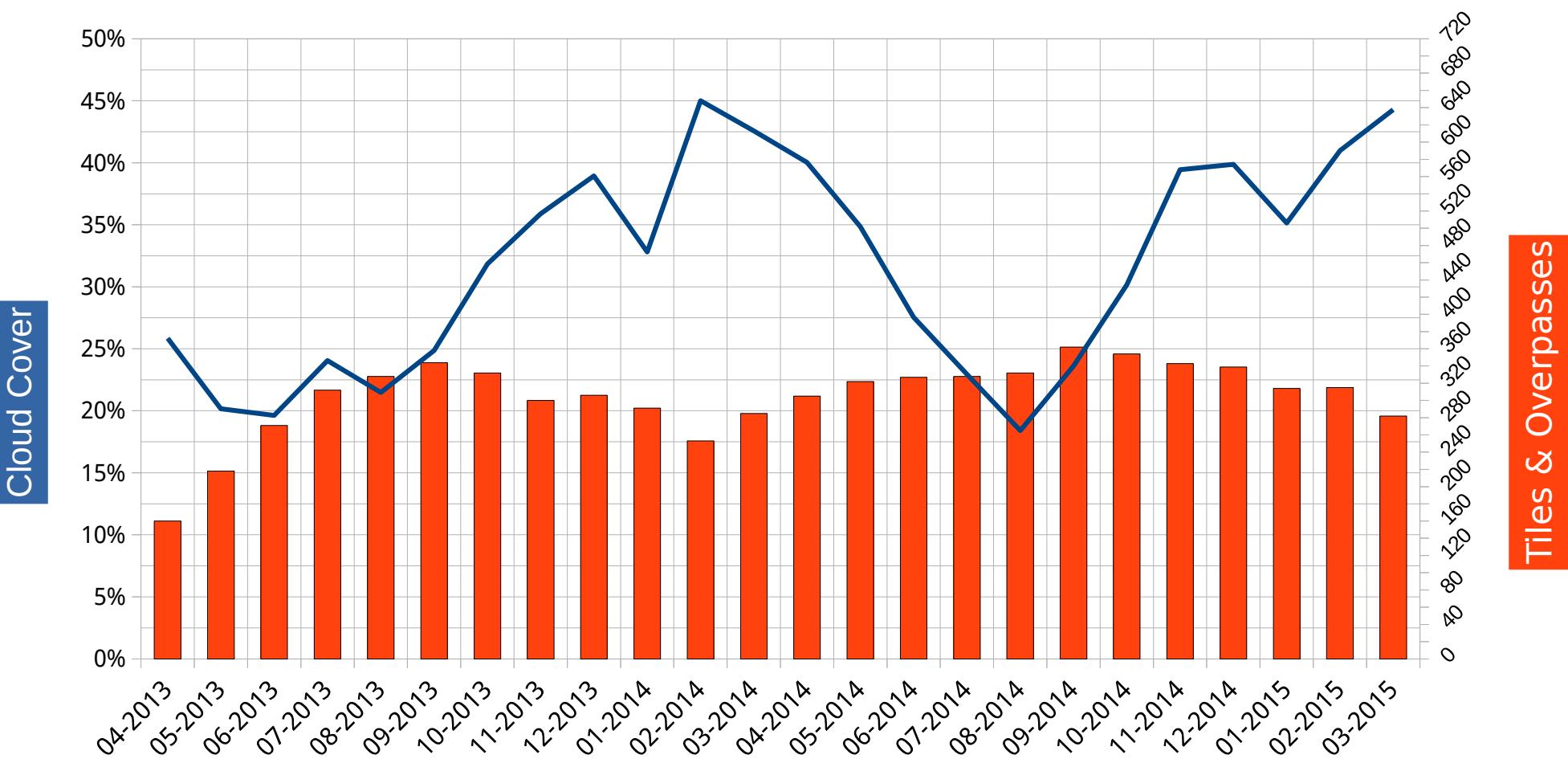
Compiled pasture mask
e.g: PROBIO, TerraClass



Brazilian Pasture Assessment Project
www.pastagem.org

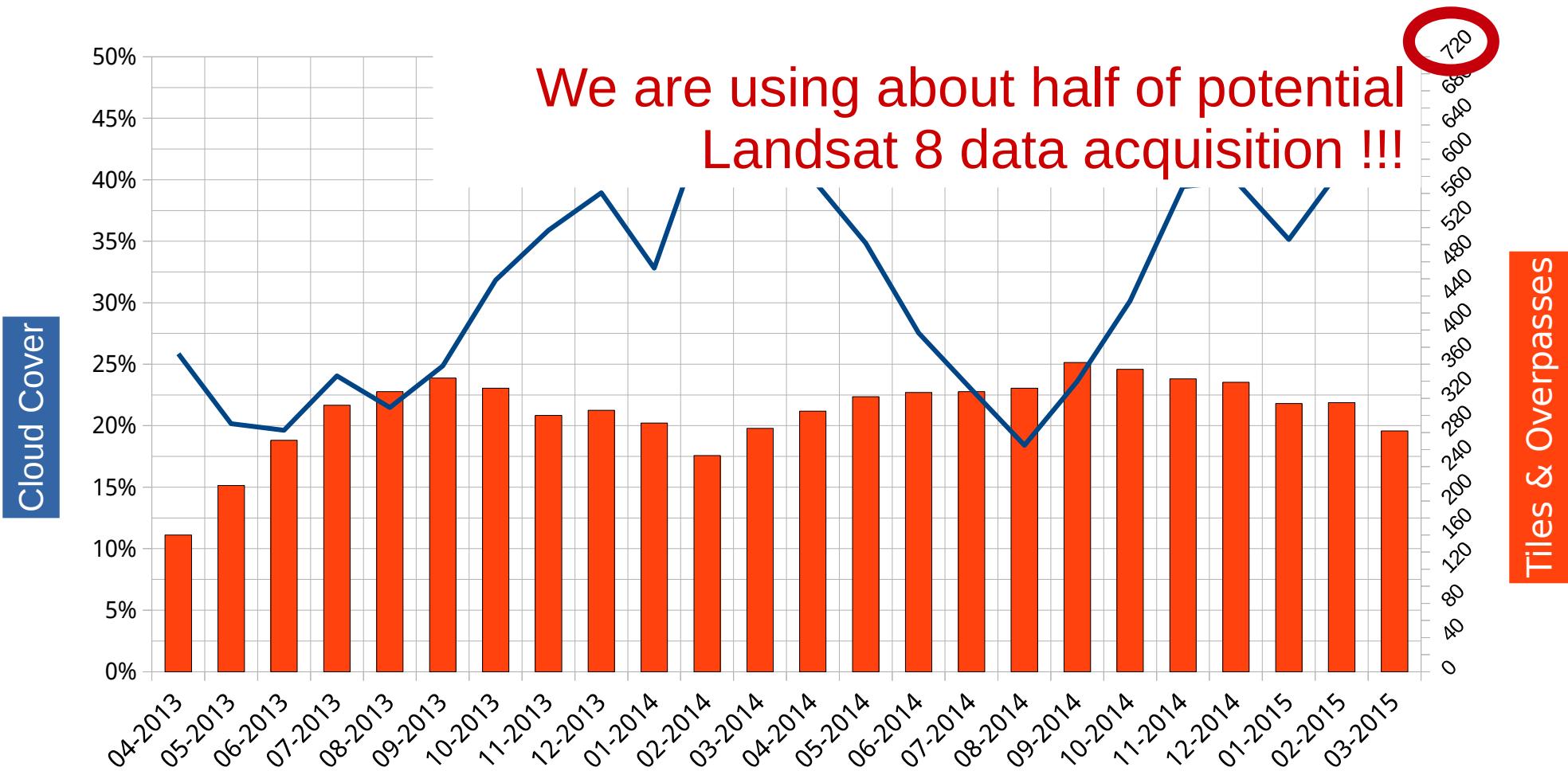
Landsat 8 Datasets

Landsat 8 L1T: Mean cloud cover for Brazil
Apr,2013 until Mar,2015



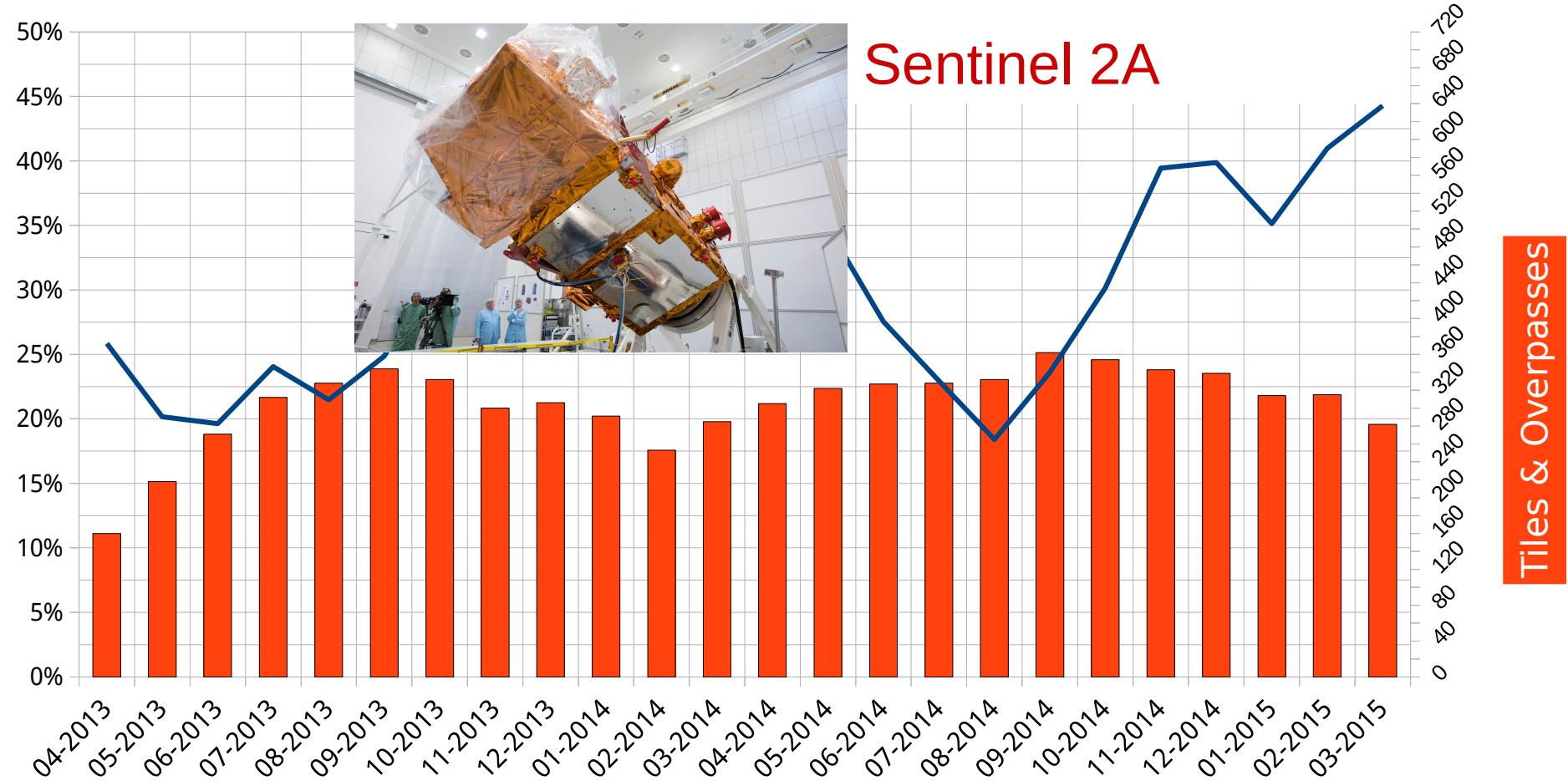
Landsat 8 Datasets

Landsat 8 L1T: Mean cloud cover for Brazil
Apr,2013 until Mar,2015



Landsat 8 Datasets

Landsat 8 L1T: Mean cloud cover for Brazil
Apr,2013 until Mar,2015

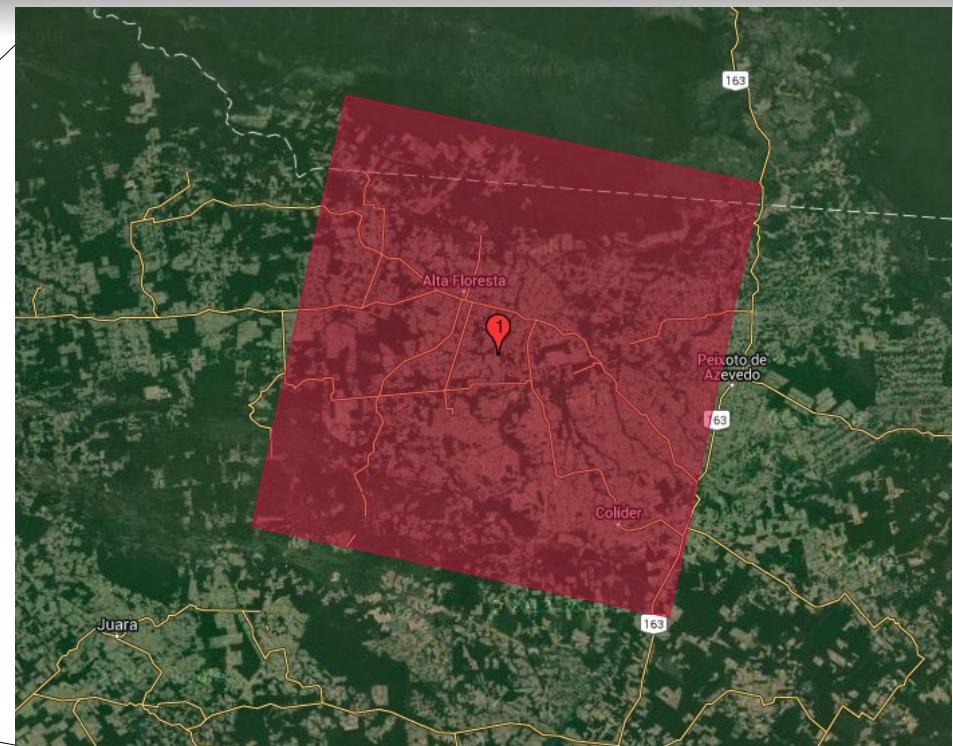


Cloud Screening

- **Landsat 8 Quality Assessment Band (BQA):** Per pixel cloud contamination
- **SimpleCloudScore (EE):** Computes a simple cloud-likelihood score in the range [0,100] using a combination of brightness, temperature, and NDSI.

Cloud Screening

Path: 227 Row: 67



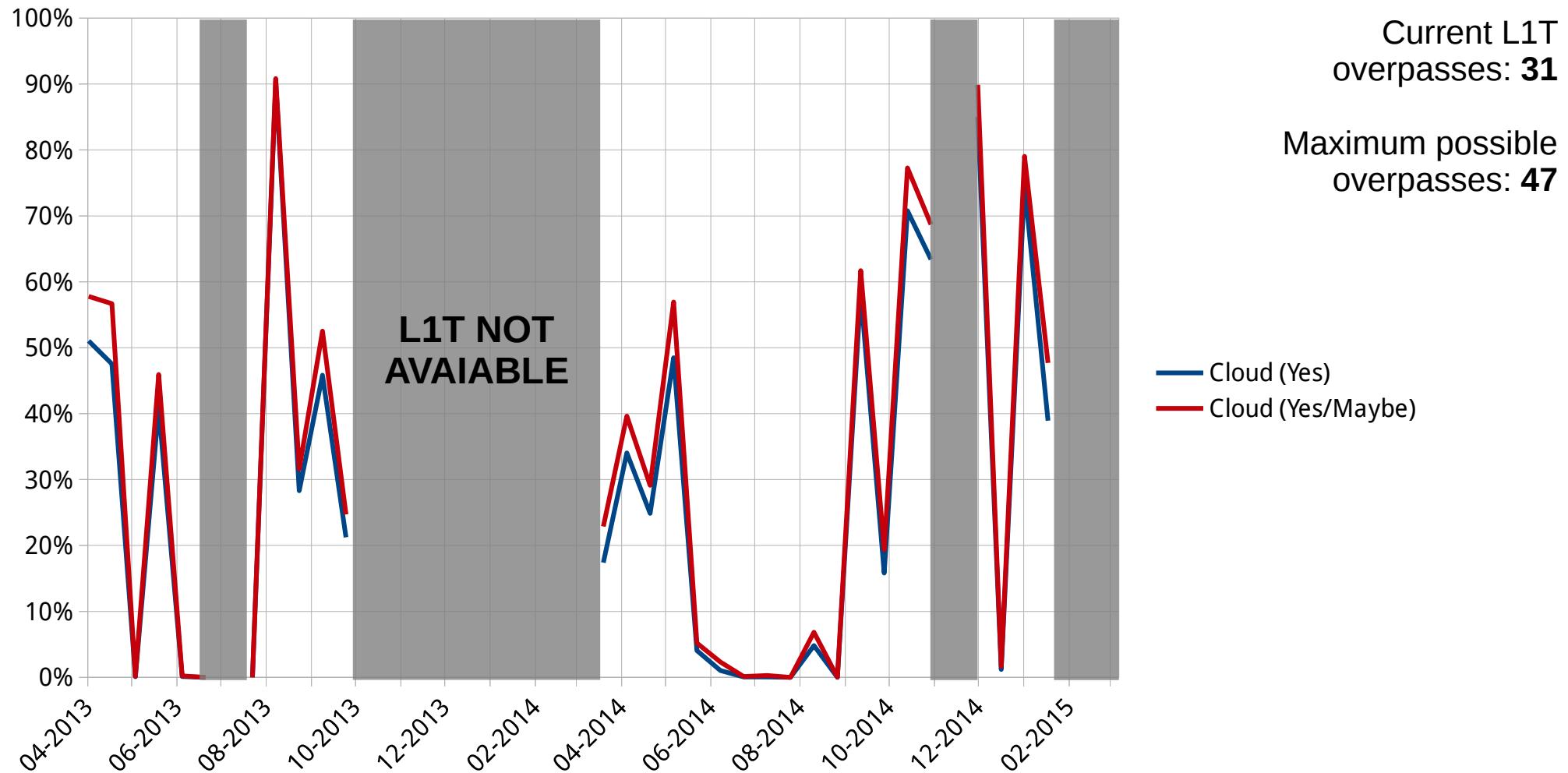
Cloud Screening

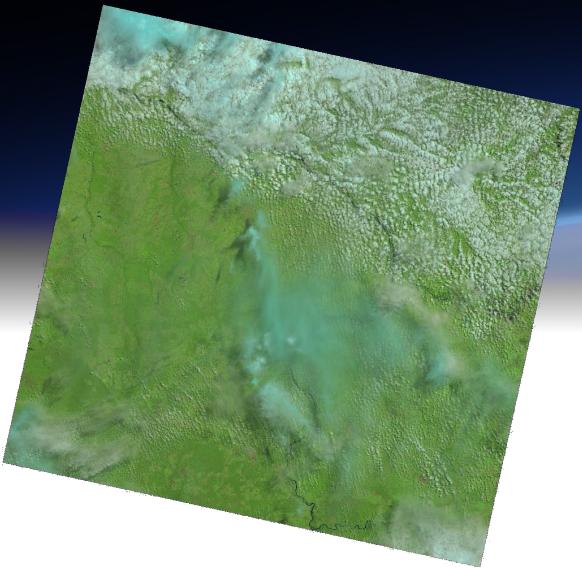
- **Landsat 8 Quality Assessment Band**
 - Tile percentage cloud cover considers only “Yes” values

Pixel Value	Cloud
61440	Yes
59424	Yes
57344	Yes
56320	Yes
53248	Yes
39936	Maybe
36896	Maybe
36864	Maybe

Cloud Screening

L1T: Cloud cover for Landsat 8 tile 227-67 *Apr,2013 until Mar,2015*

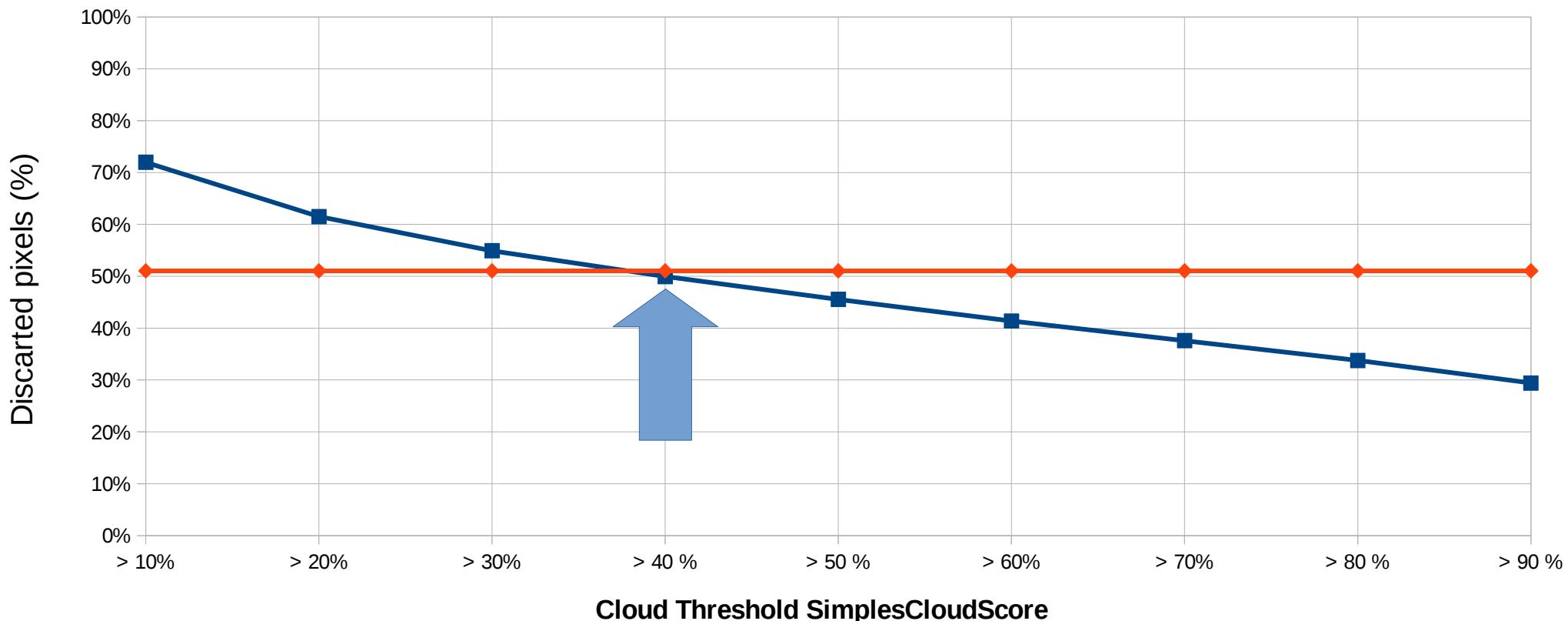




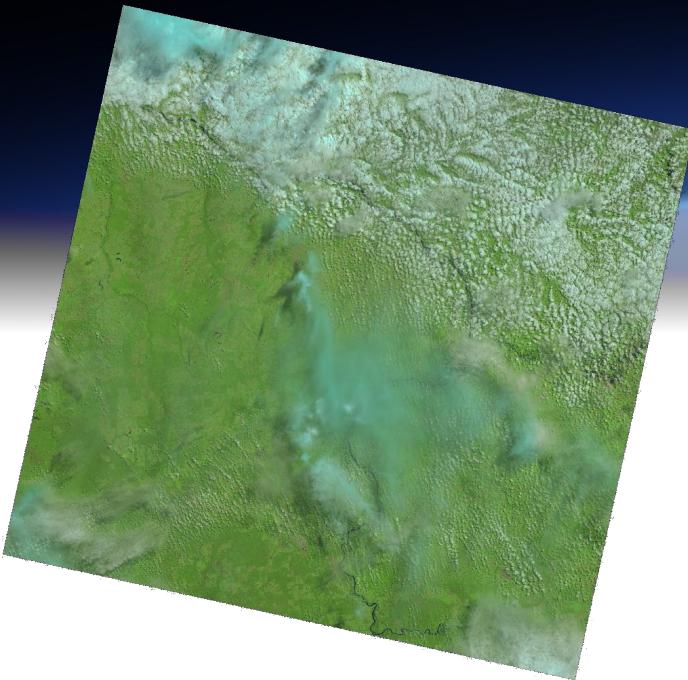
Cloud Screening

SimpleCloudScore Threshold
LC82270672013108LGN01 (May,13)

■ SimpleCloudScore (EE) ◆ Cloud_Cover (LC8)



Cloud Screening



LC82270672013108LGN01 (May,13)



Cloud (Yes)

Cloud (Yes/Maybe)



10%



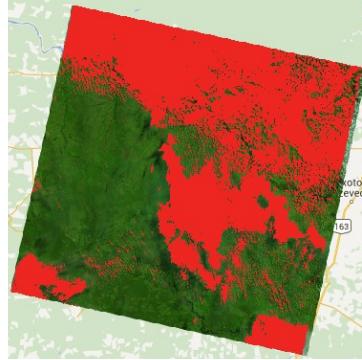
40%



70%



20%



50%



80%



30%

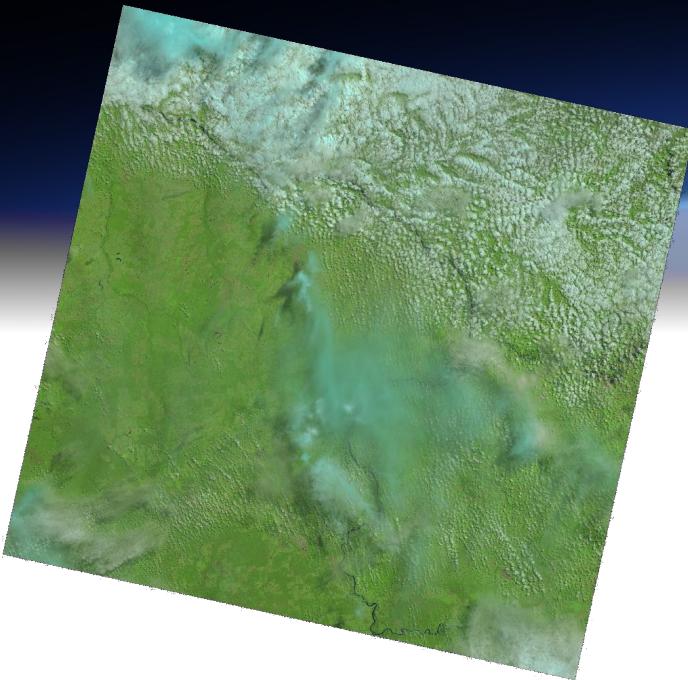


60%

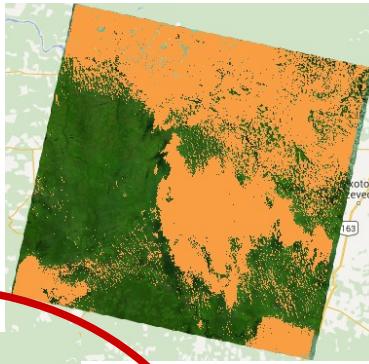
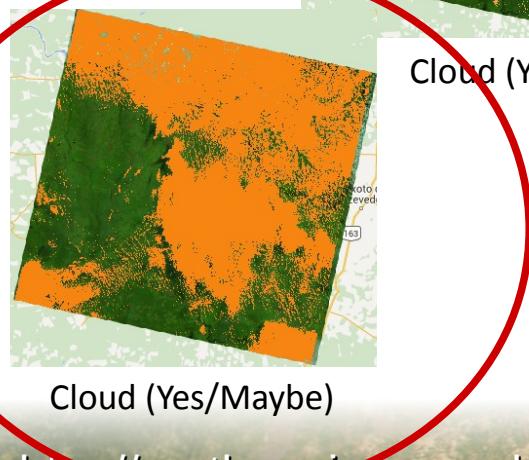


90%

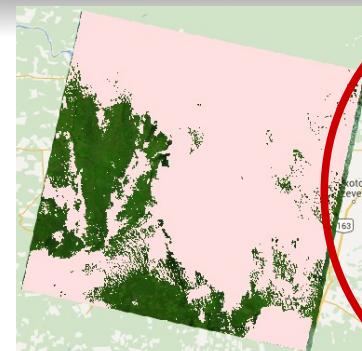
Cloud Screening



LC82270672013108LGN01 (May,13)



Cloud (Yes)



10%



40%



70%



20%



50%



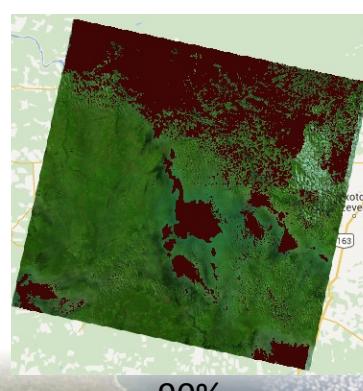
80%



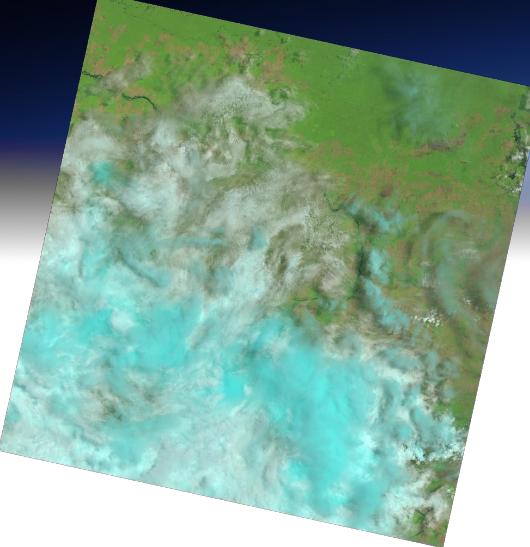
30%



60%



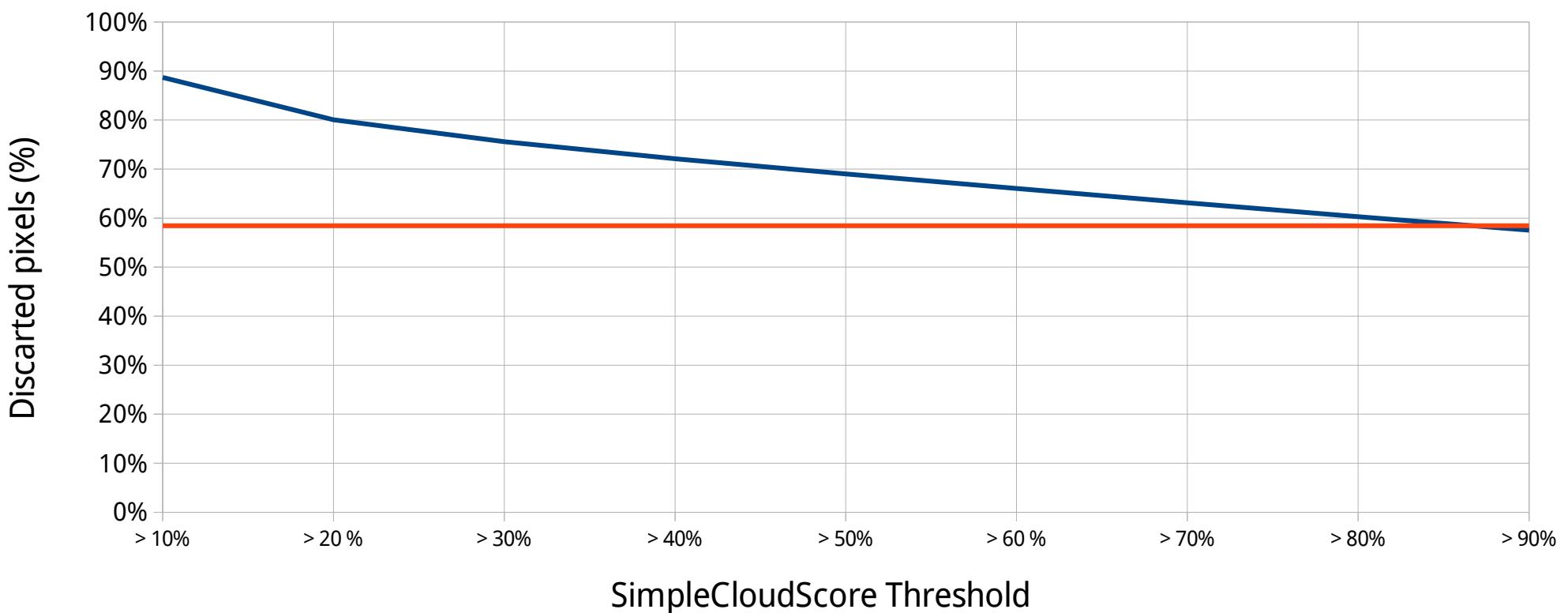
90%



Cloud Screening

SimplesCloudScore Threshold
LC82270672014271LGN00 (Sep,14)

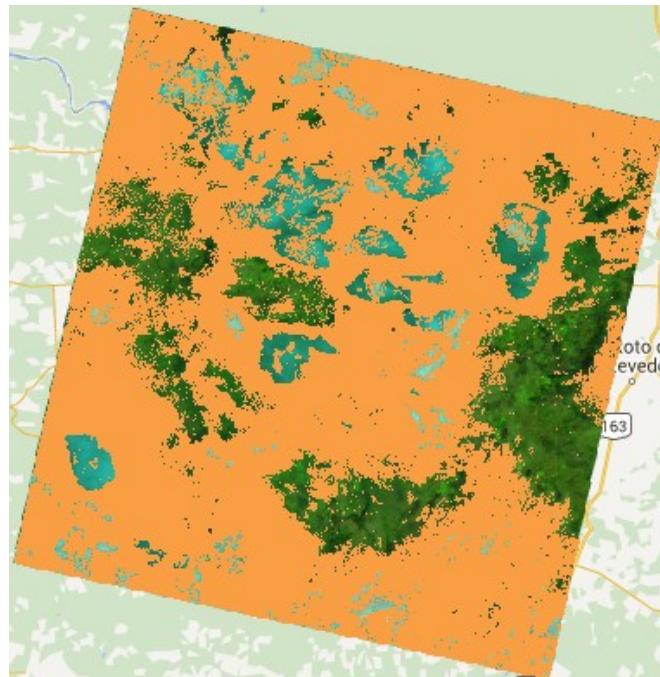
— SimpleCloudScore (ee) — Cloud Cover (BQA)



SimpleCloudScore Threshold

Cloud Screening

- **SimplesCloudScore** didn't run for any 2015 Landsat 8 LT1 datasets



LC82270672015018LGN00 (Jan,15)

Cloud Screening

▼ January 21, 2015 – Landsat 8 Thermal Infrared (TIRS) data are still being collected but product generation remains suspended.

The Flight Operations Team and subject matter experts have conducted numerous tests in an effort to determine the cause of the current anomaly associated with the TIRS scan select mirror (SSM) encoder.

As investigations and testing continue, several options for returning to normal operations are under consideration. These include:

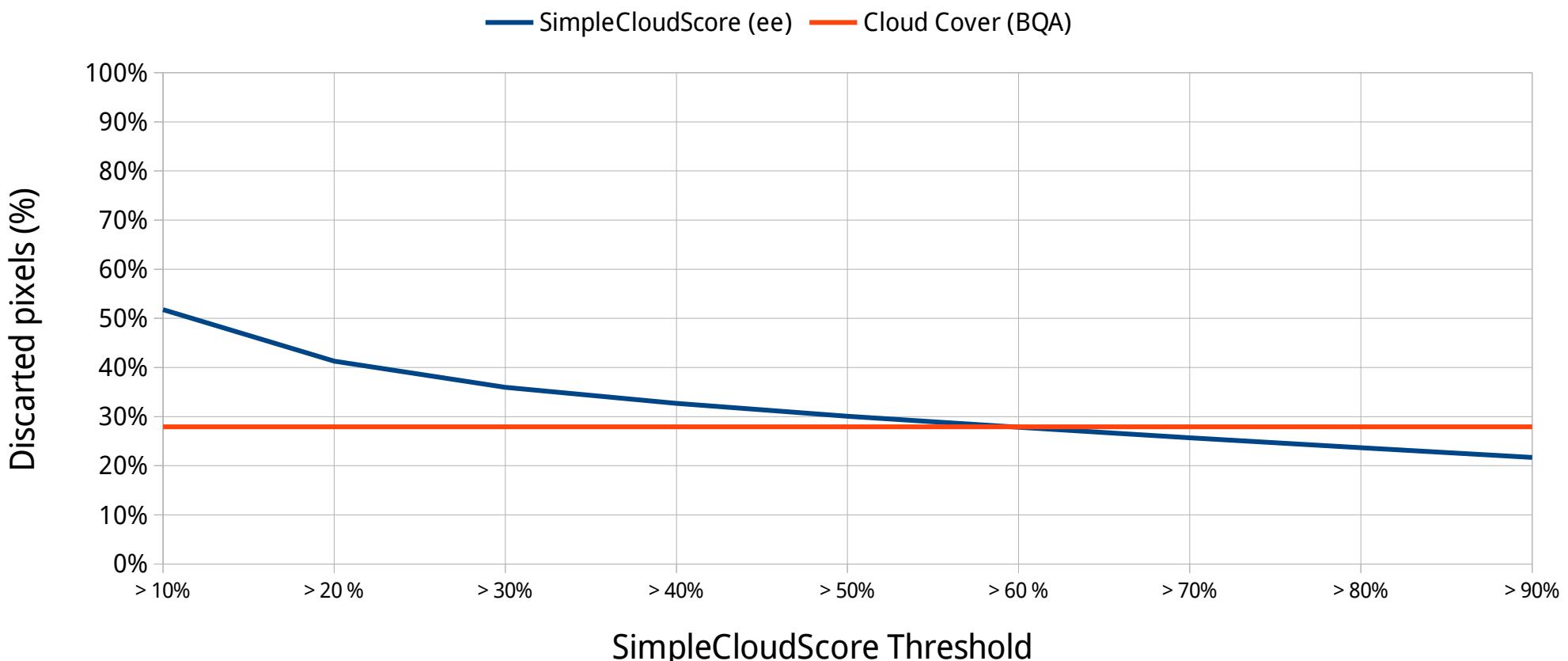
- A) Resume operating with the A-side electronic using a modified operations concept
- B) Switch to the B-side electronics and resume the standard operations concept
- C) Resume standard operations using the B-side electronics with the understanding that if the current anomaly is detected on the B-side that a return to the A-side is done to fully implement an alternative operations concept

There is a goal to return to normal imaging early in the 2015 northern hemisphere growing season. However, the specific timing for the return to normal imaging is still being evaluated.

Plans are also being developed to process the TIRS imagery acquired since mid-December. More information will be posted on a weekly basis.

Cloud Screening

Mean SimpleCloudScore Threshold *Apr,2013 until Dez,2014*



Cloud Screening & Filtering



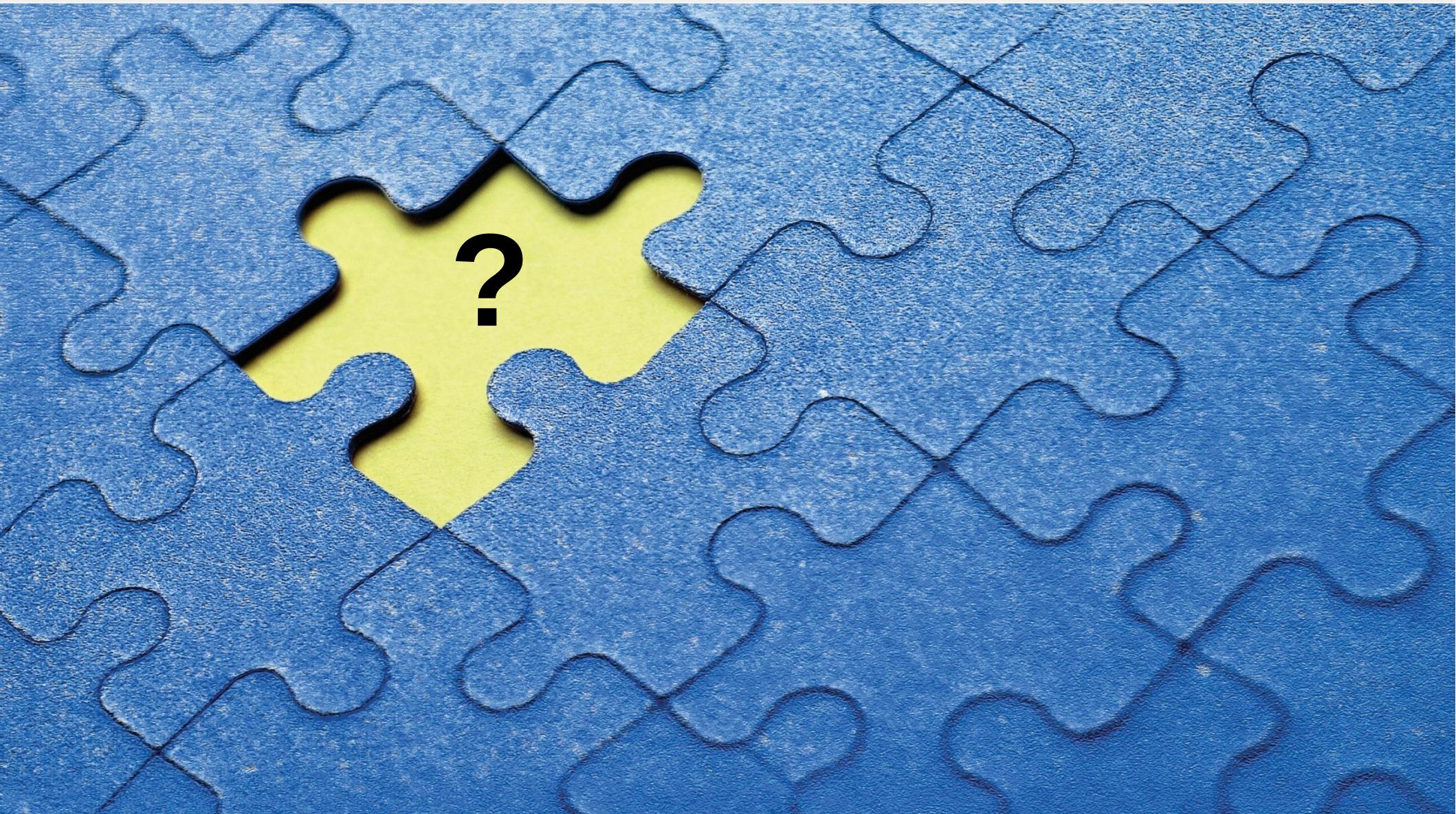
Yes

(Cloud Cover BQA)

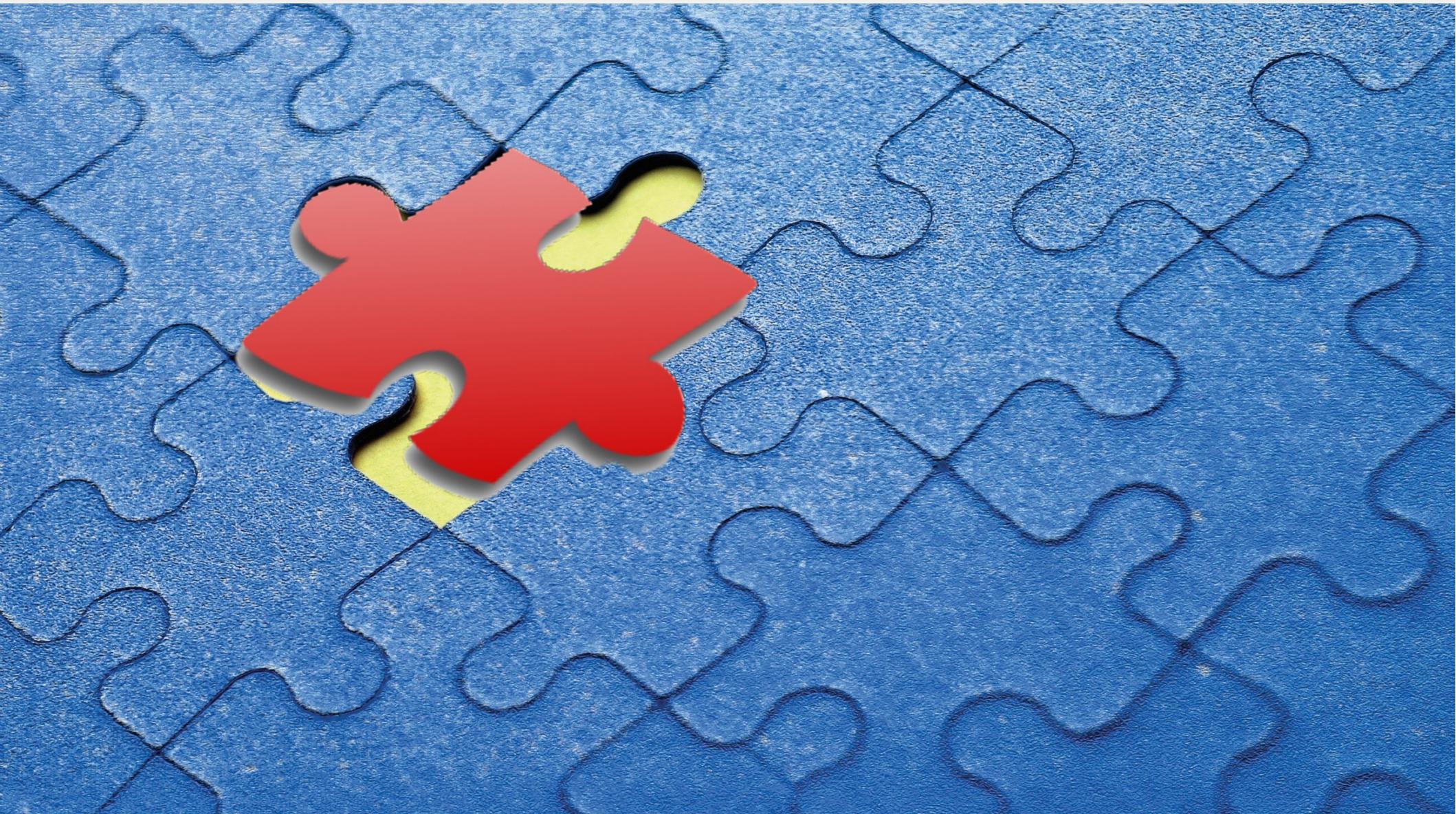
40 %

(SimpleCloudScore)

Gap Filling

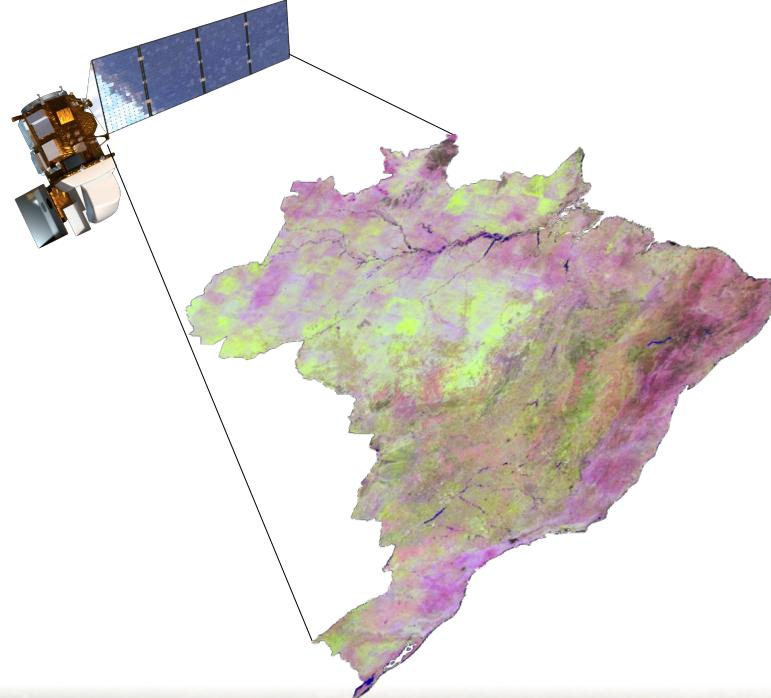
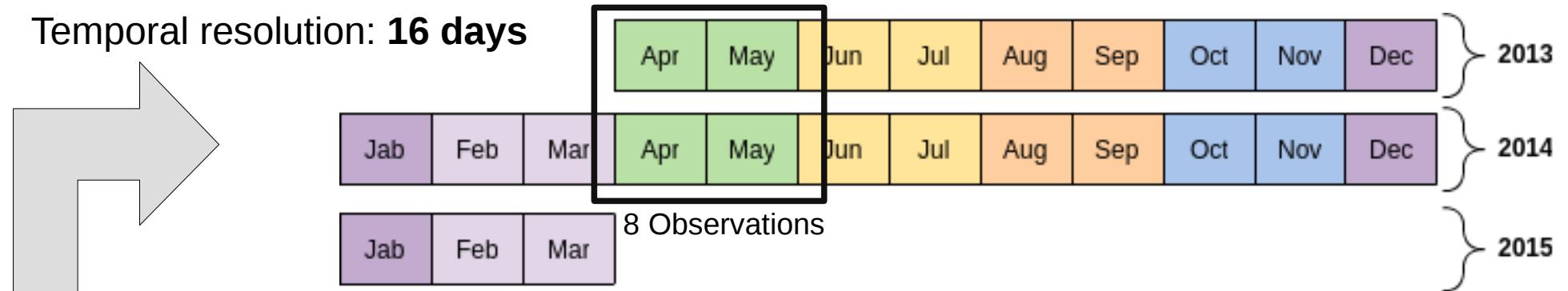


Gap Filling



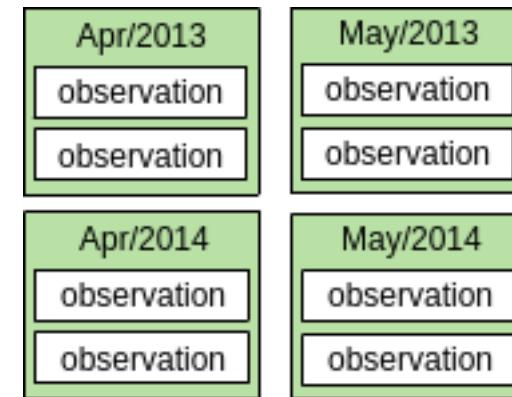
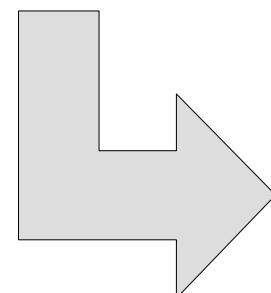
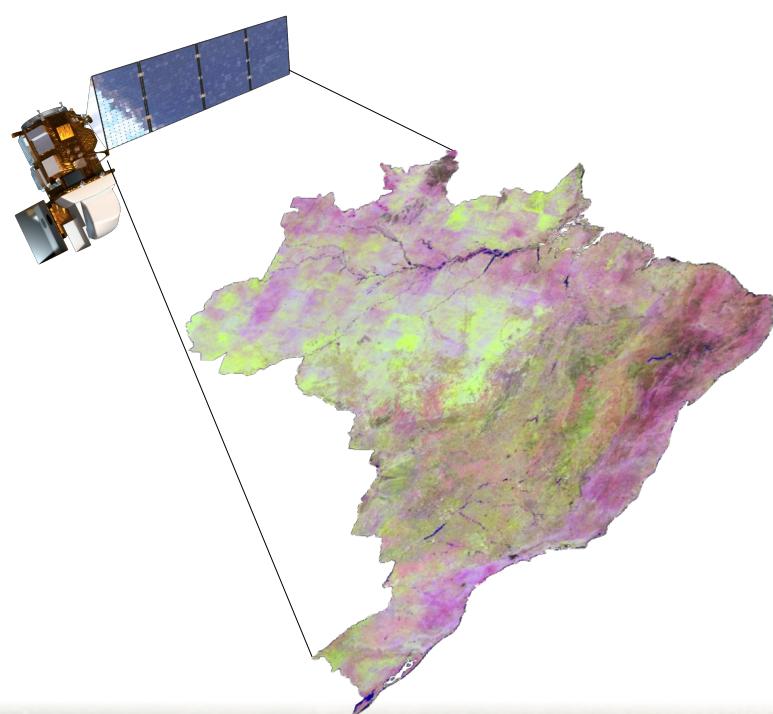
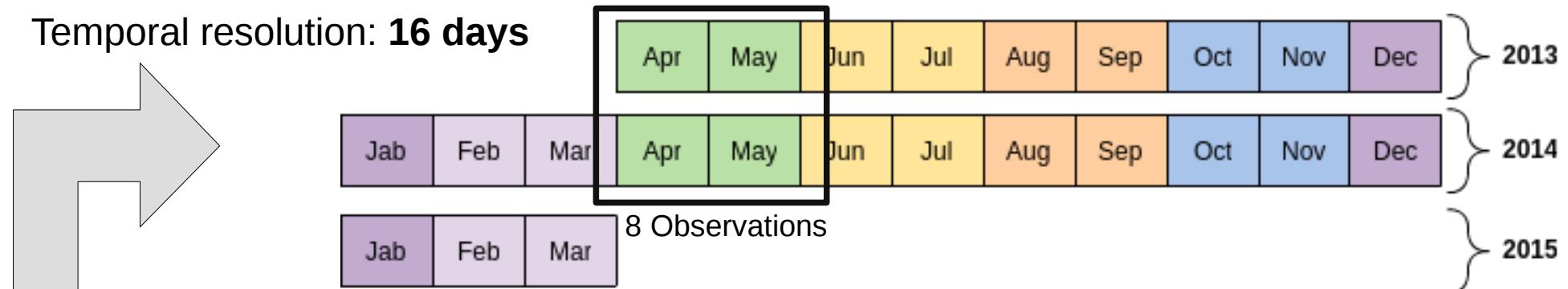
Maximum value composite (NDVI)

Temporal resolution: **16 days**

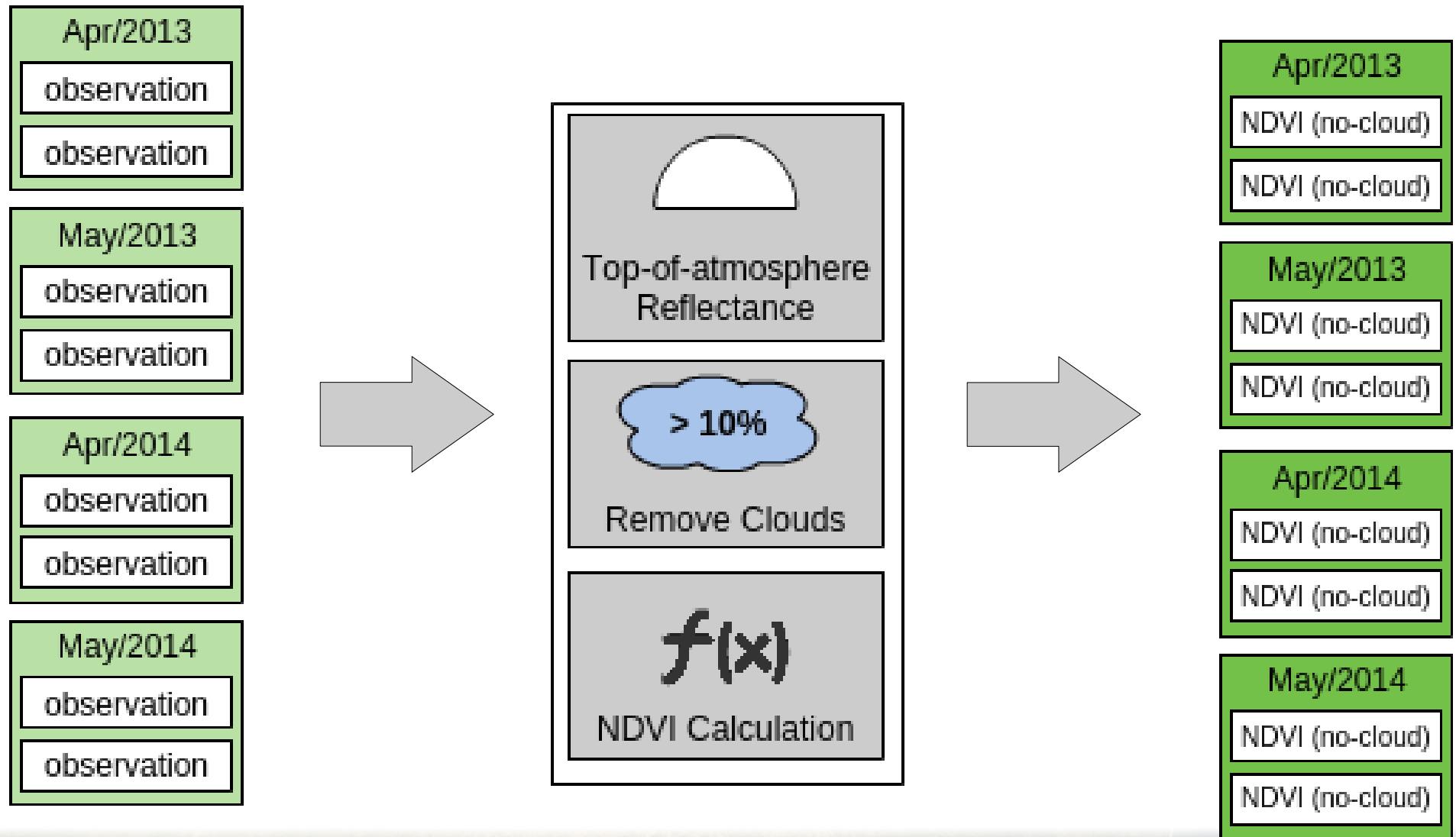


Maximum value composite (NDVI)

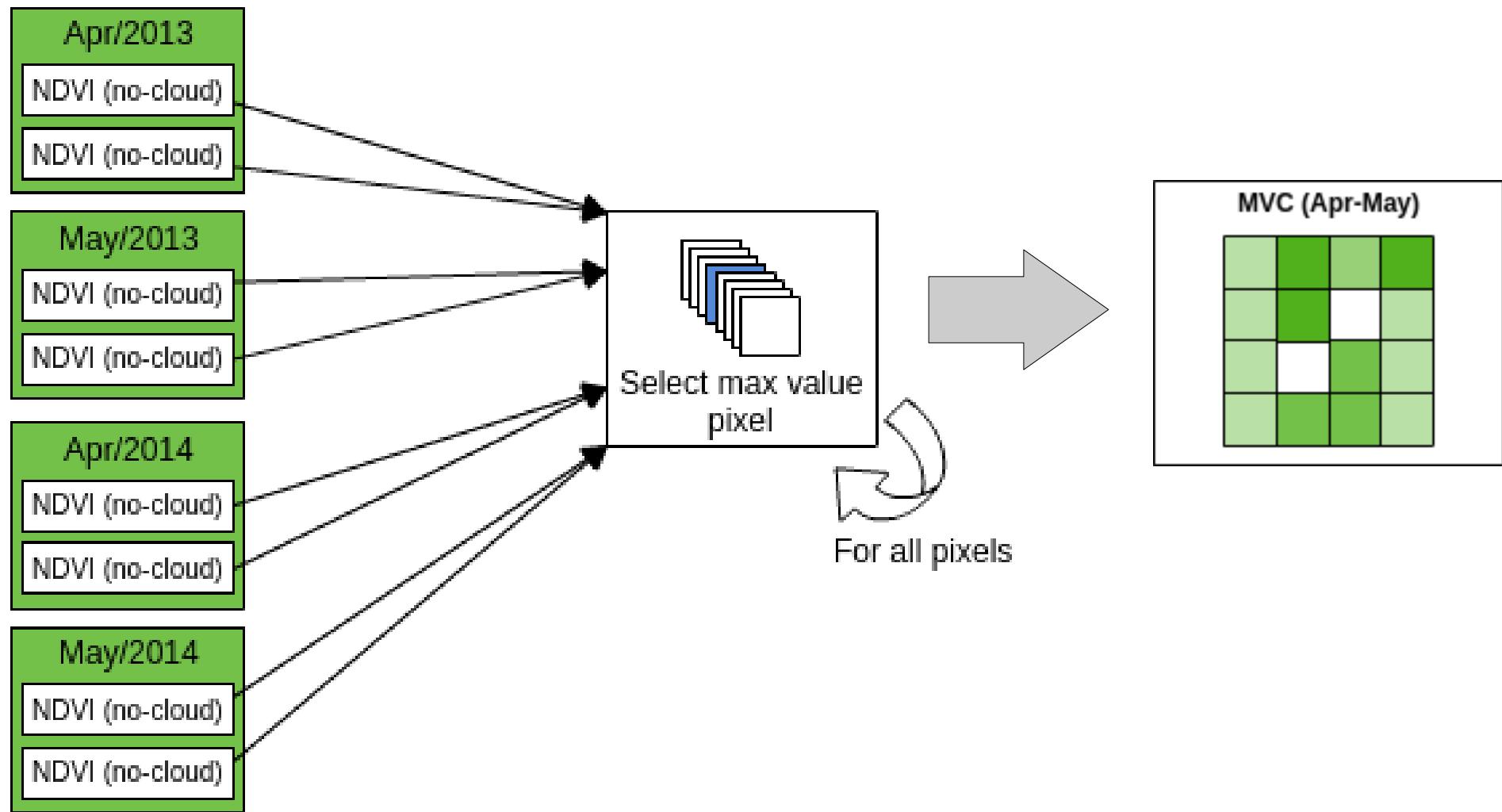
Temporal resolution: **16 days**



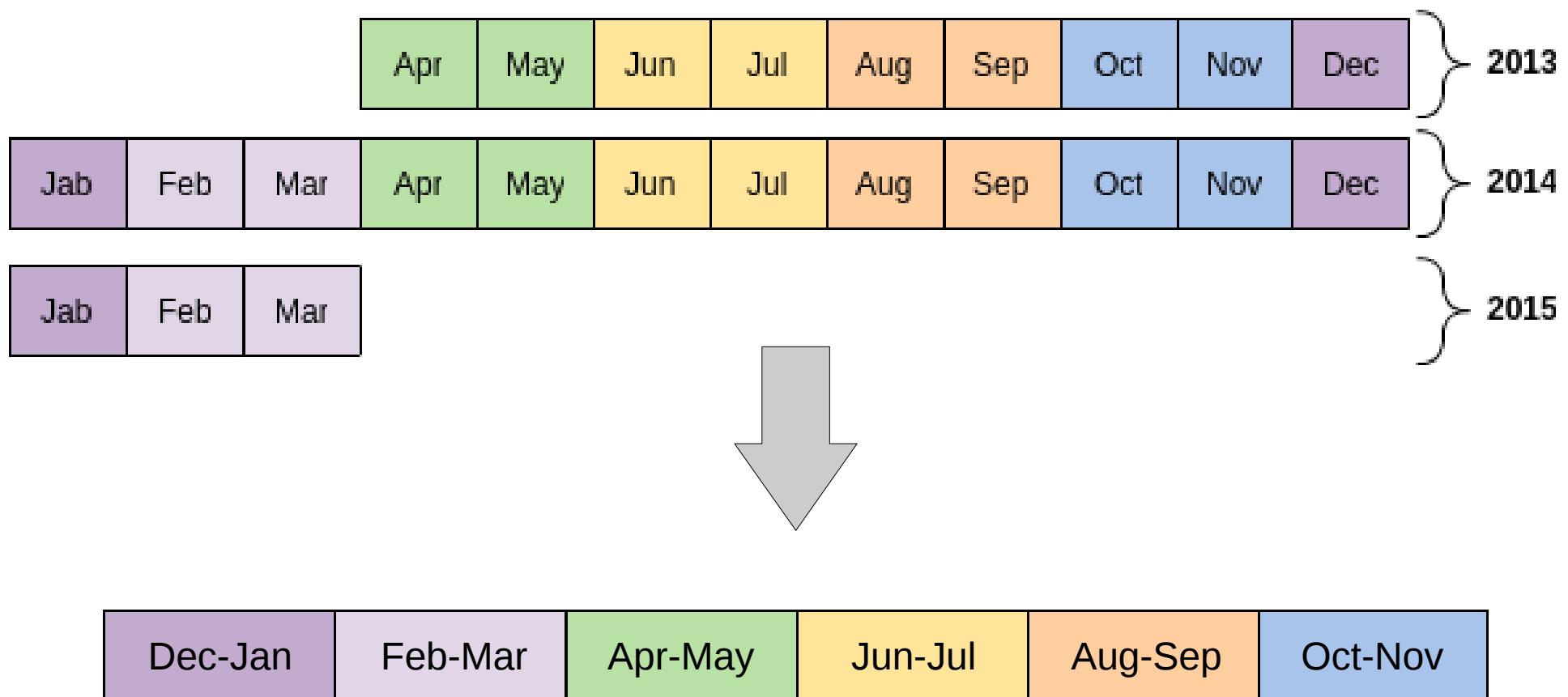
Maximum value composite (NDVI)



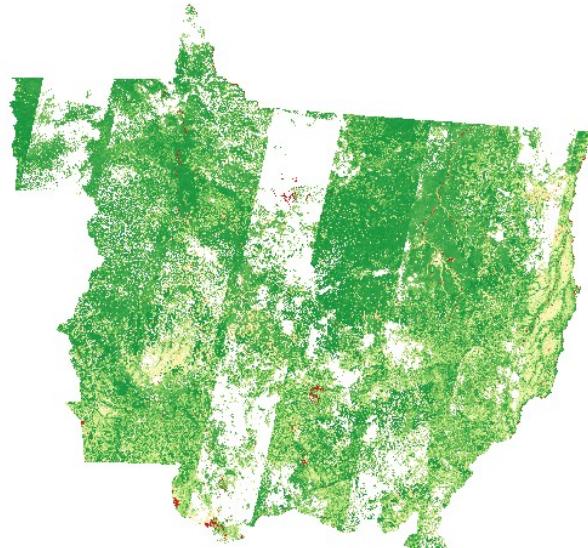
Maximum value composite (NDVI)



Maximum value composite (NDVI)



Maximum value composite (NDVI)



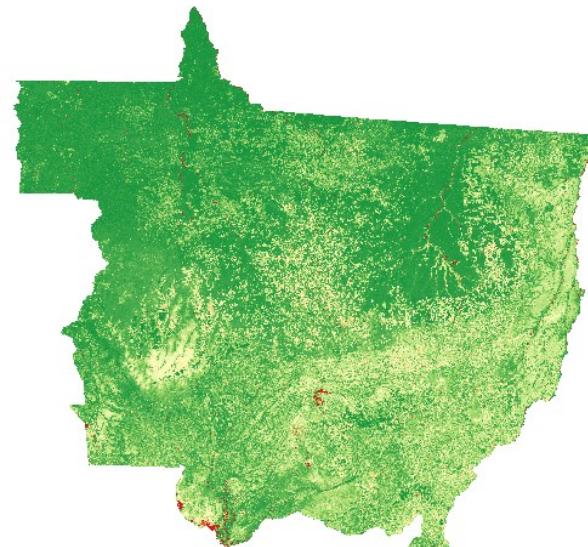
Dec-Jan



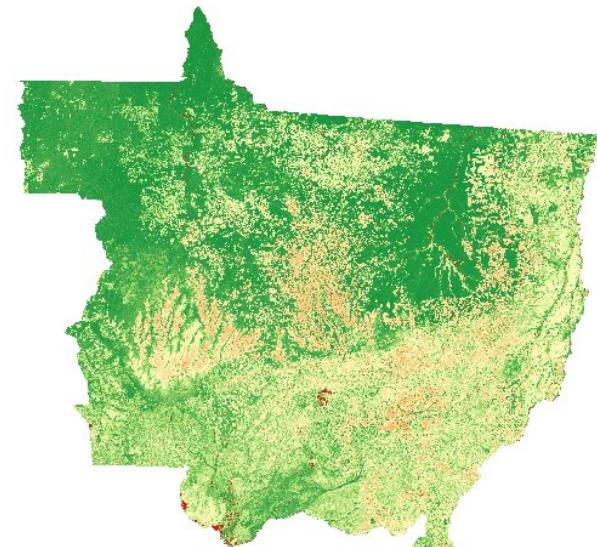
Feb-Mar



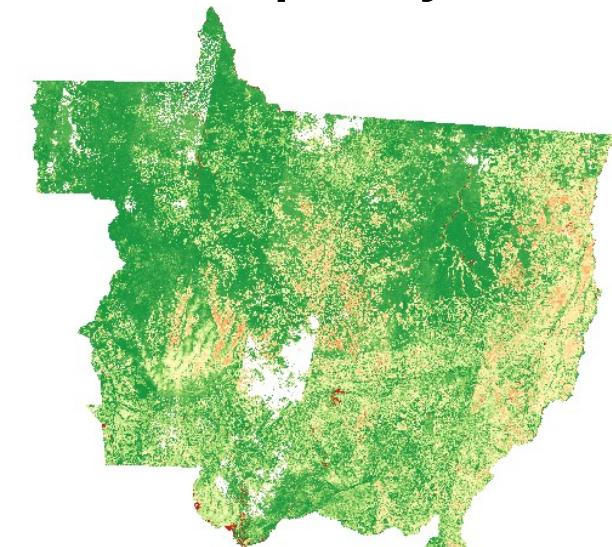
Apr-May



Jun-Jul



Aug-Sep

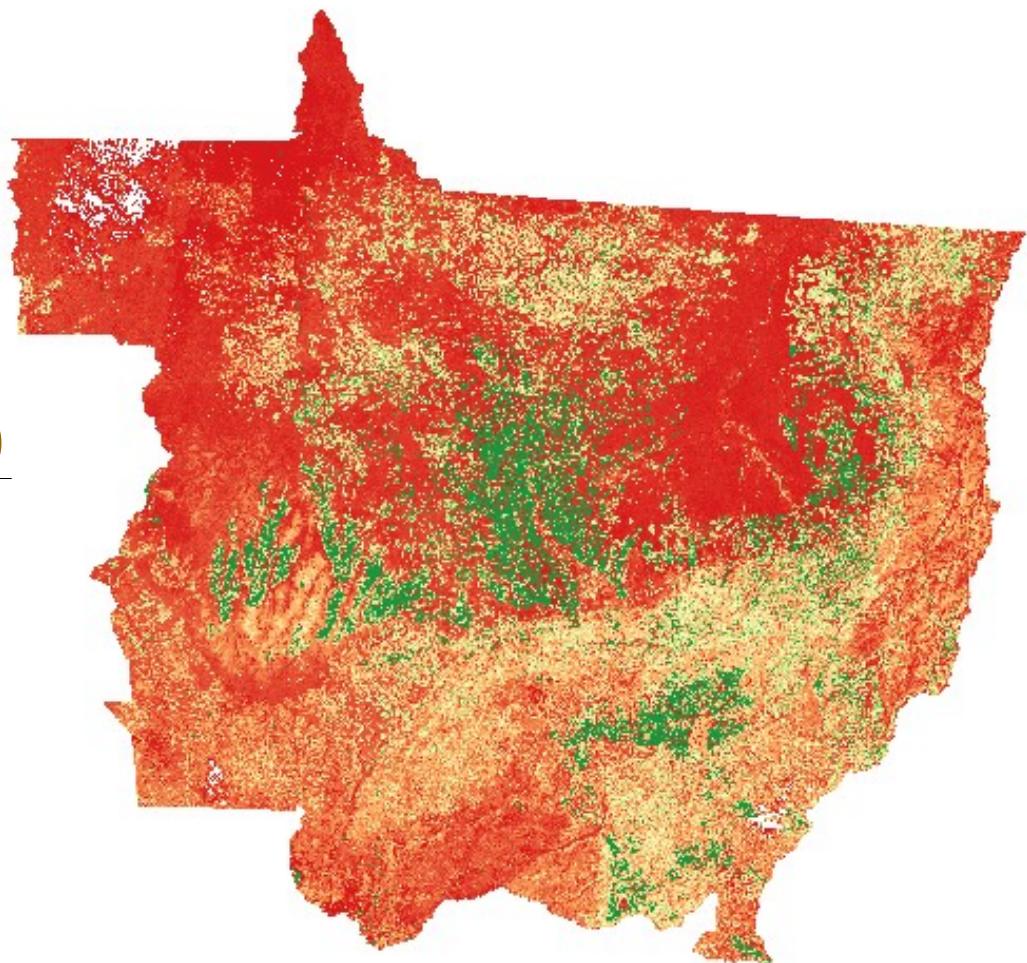


Oct-Nov

Maximum value composite (NDVI)

- Derivative images
 - Seasonal Contrast 1

$$CS1 = \frac{(Abr-May) - (Aug-Sep)}{(Aug-Sep)}$$



Maximum value composite (NDVI)

- Derivative images
 - Seasonal Contrast 2

$$CS2 = \frac{(Dez-Jan) - (Out-Nov)}{(Out-Nov)}$$

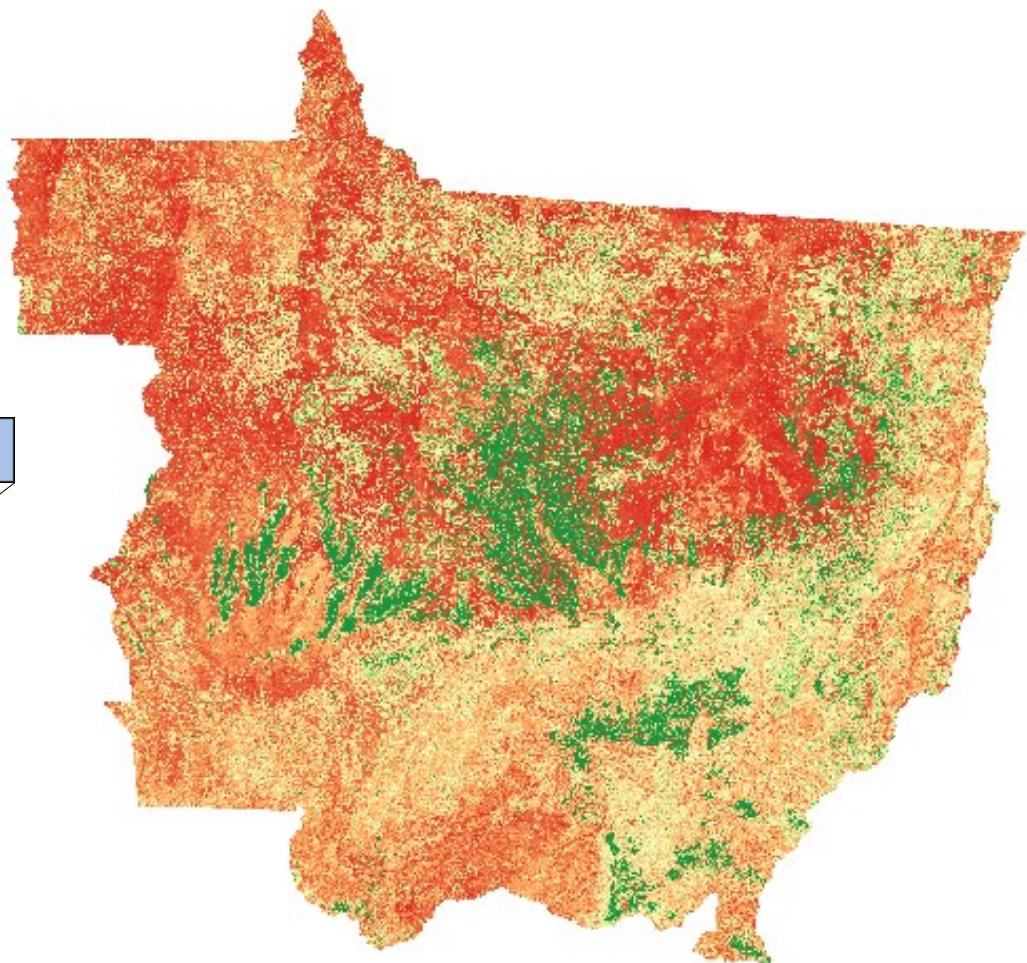


Maximum value composite (NDVI)

- Derivative images
 - Standard Variation

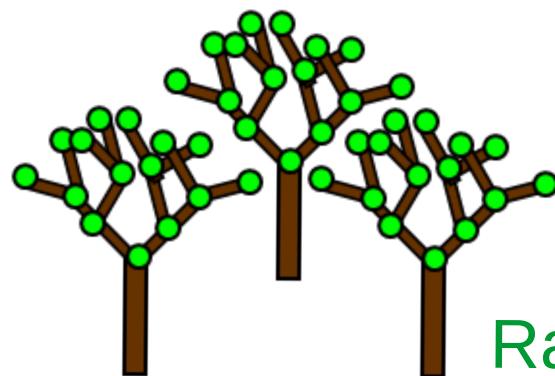
Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Oct-Nov
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Classification approach

- GARSeCT: General Automated Remote Sensing Classification Tool



Random Forest

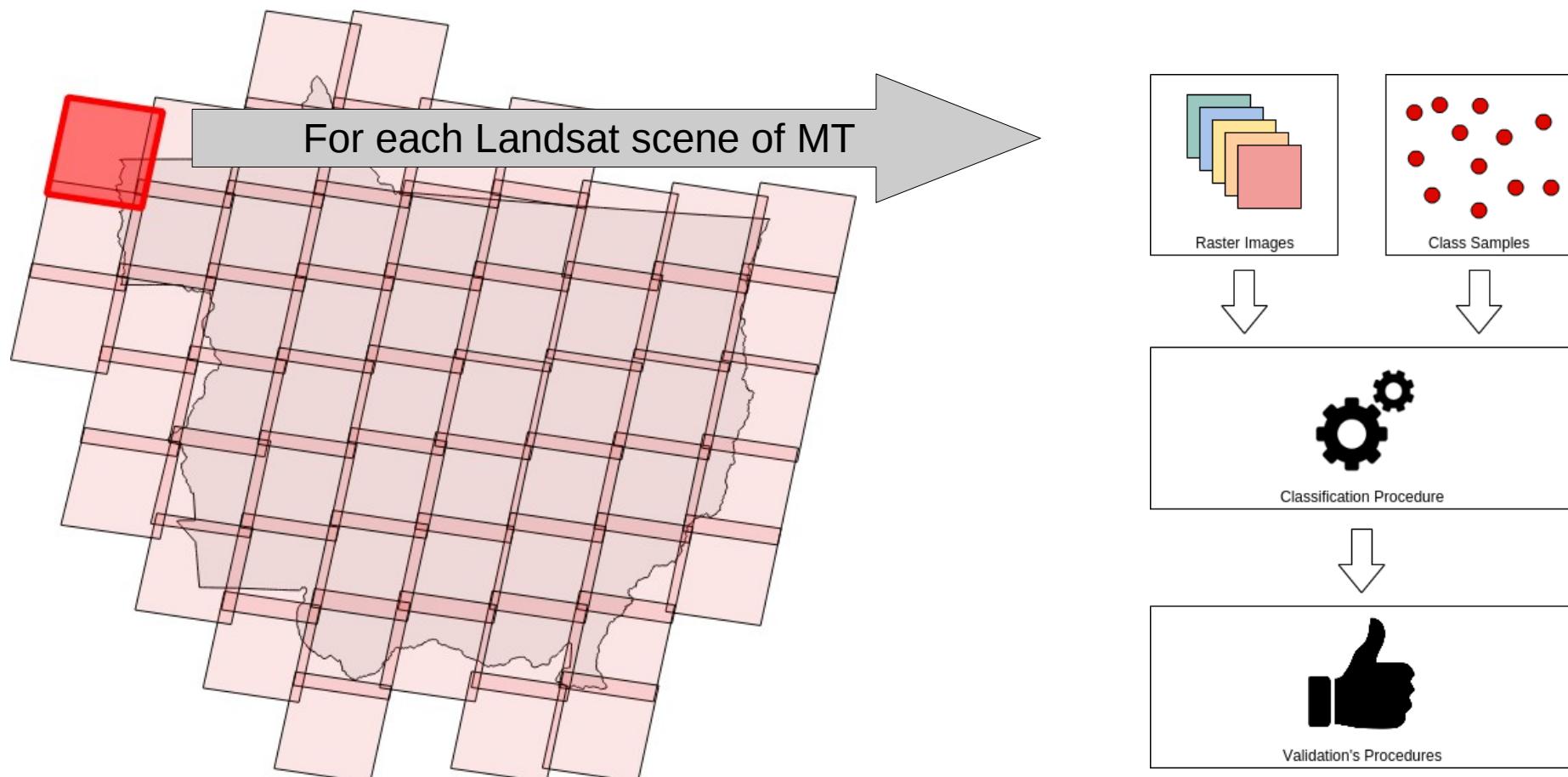


Probabilistic Result

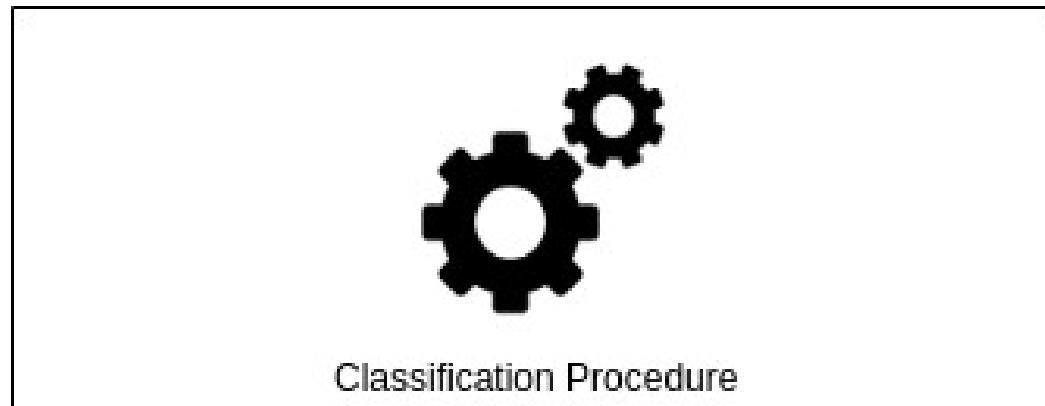
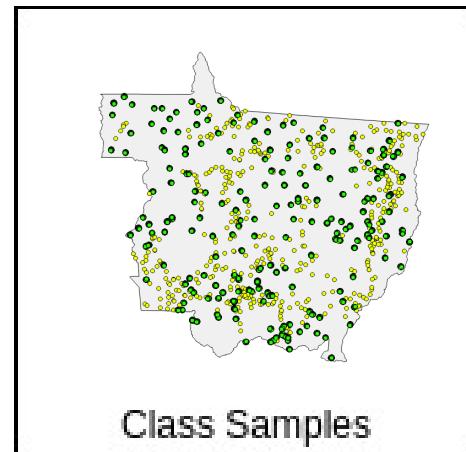
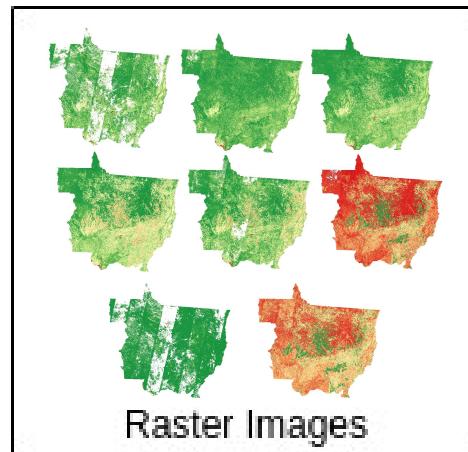
Preliminary results

Preliminary results

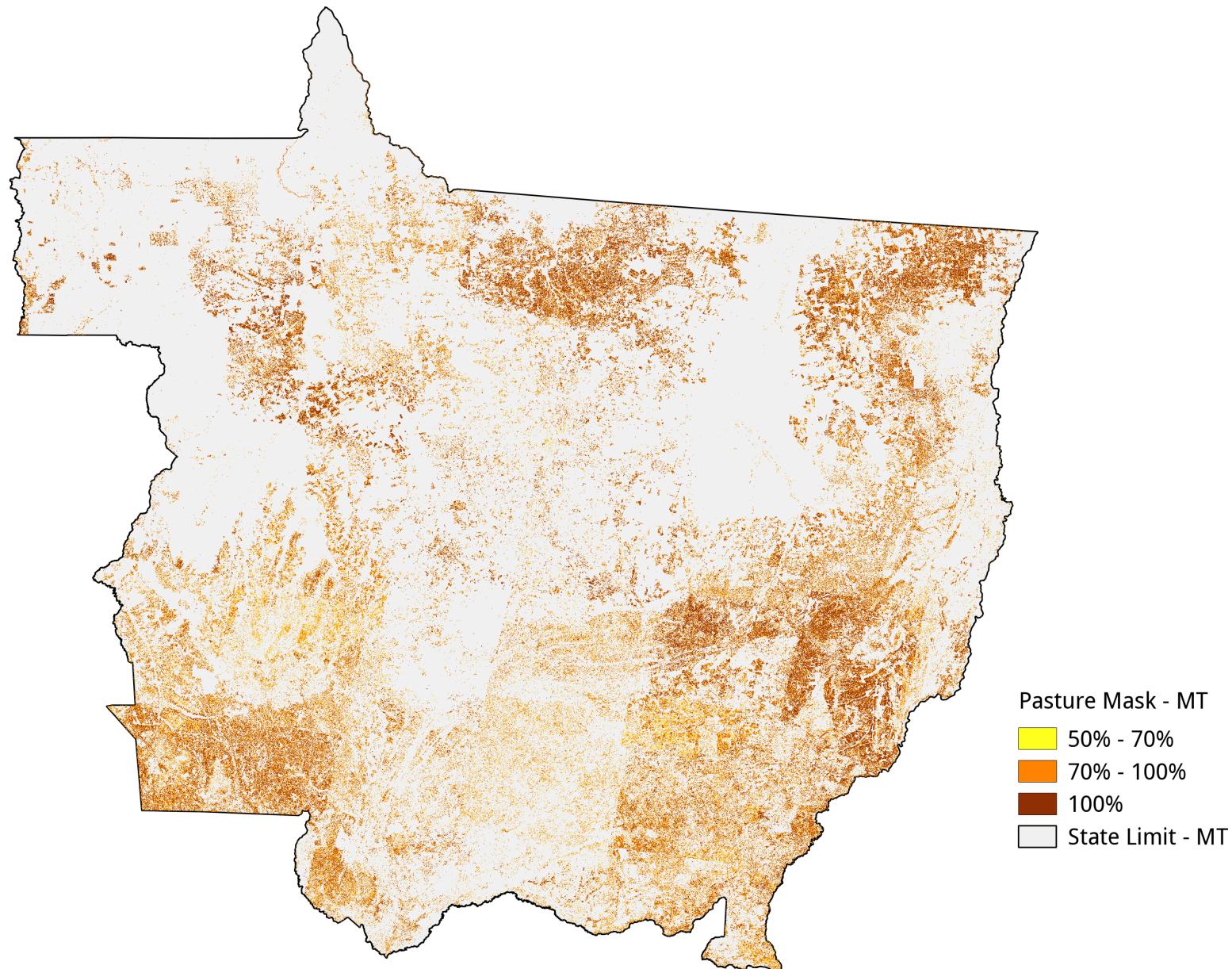
- We didn't classify the all area at once !!!



Preliminary results

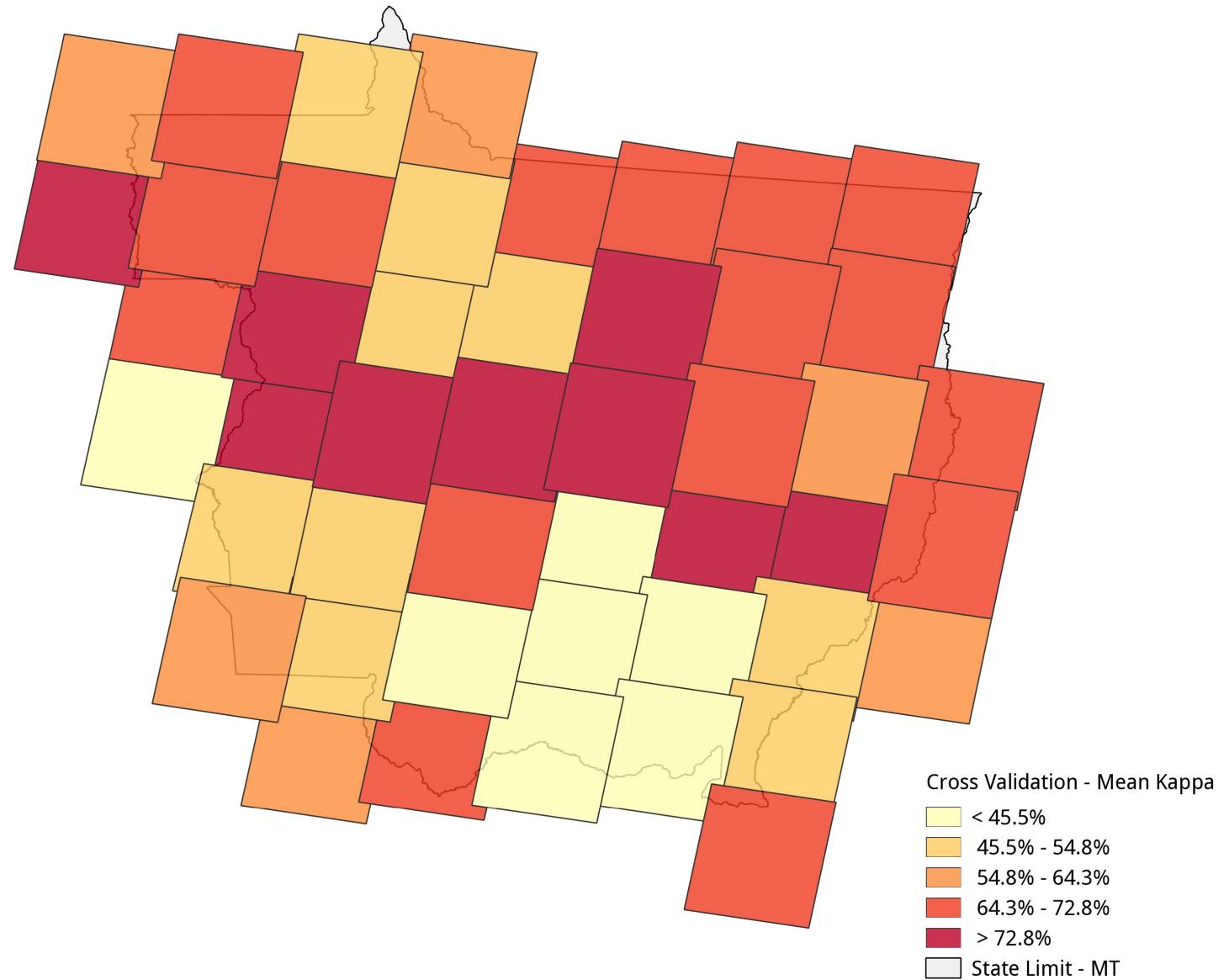


Preliminary results



Preliminary results

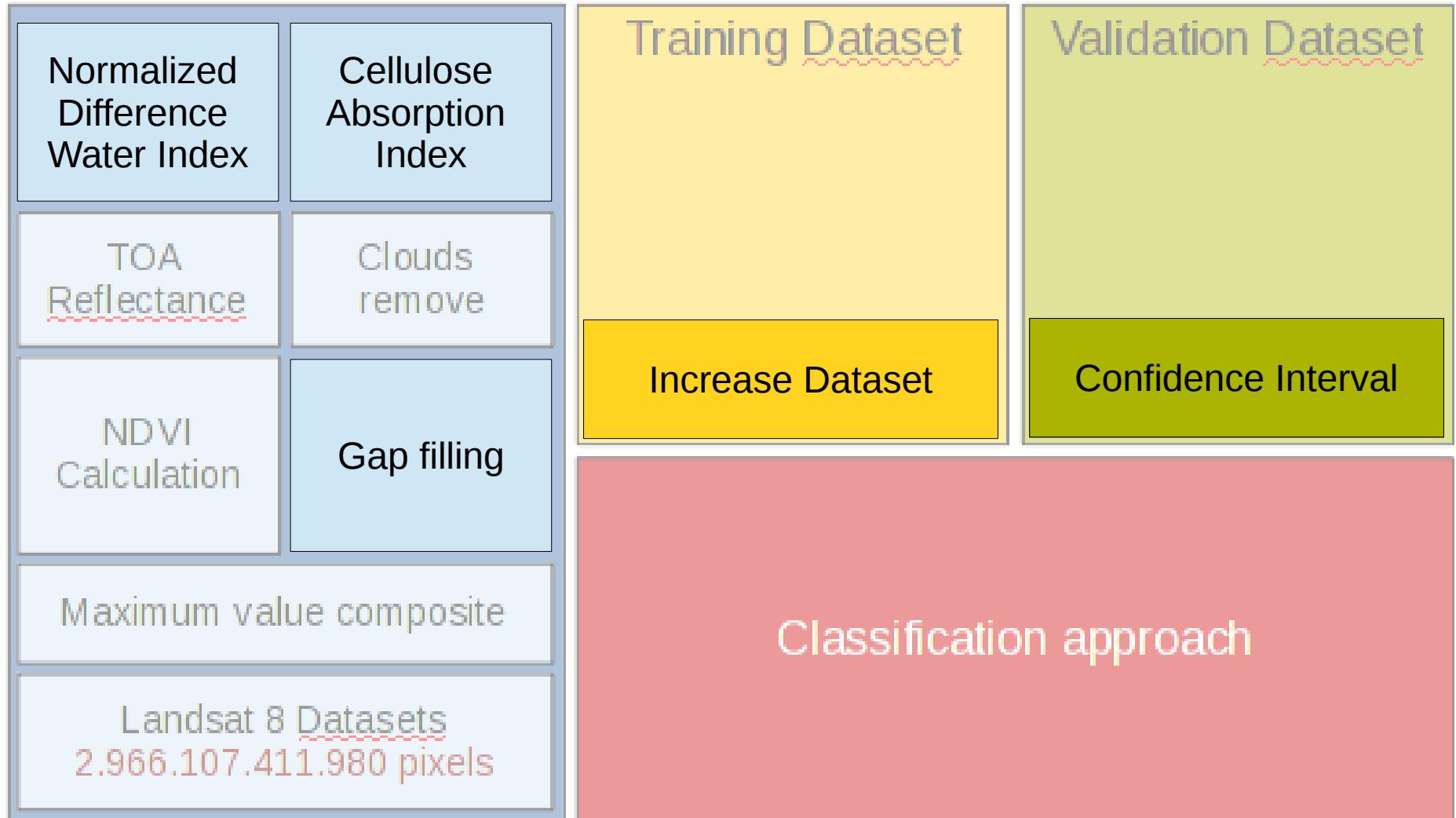
Cross validation



A black and white photograph showing a person's legs and feet walking away from the viewer on a paved surface. The person is wearing dark trousers and shoes. Several dark footprints are visible in the asphalt ahead of them.

Next Steps

Next Steps



GRACIAS
SPASSIBO
NUHUN
CHALTU
WABEEJA
DHARVABAD
AINHIA
ATTO
MAAKE
LAH
GRAZIE
MEHRBANI
PALDIES
TINGKI
BİYAN
SHUKRIA

ARIGATO
TAVTAPUCH
MEDAWAGSE
BANKA
TASHAKKUR ATU
SNACHALHYA
MERASTAWHY
SANCIO
GAEJTHO
KOMAPSUMNIDA
FAKAUE

SHUKURIA

JUSPAXAR

TASHAKKUR ATU

YAQHANELAY

MAAKE

GOZAIMASHITA

EFCHARISTO

KOMAPSUMNIDA

LAH

GRAZIE

MEHRBANI

PALDIES

TINGKI

BİYAN

SHUKRIA

THANK

YOU

BOLZİN

MERCI