STAR Algorithm and Data Products (ADP) Beta Review

Suomi NPP Surface Type EDR Product

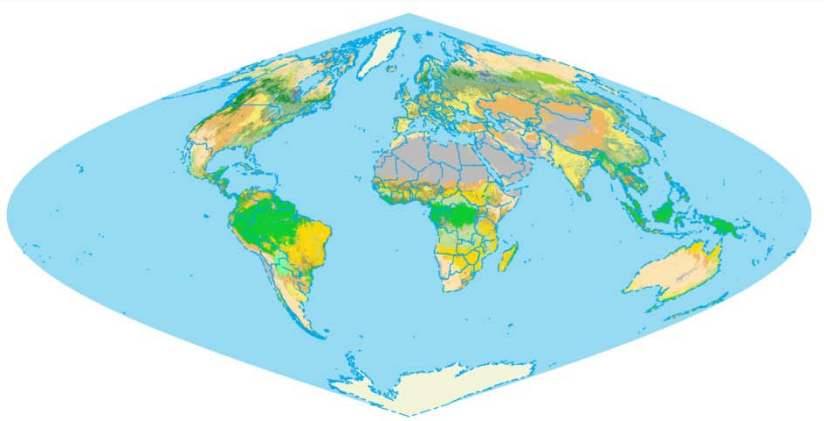
Xiwu Zhan
Surface Type EDR Lead
2/20/2013

VIIRS Surface Type EDR Team Goals

- Xiwu Zhan (NOAA/NESDIS/STAR)
  - Surface Type EDR lead, User outreach
- Chengquan Huang (UMD/Geography)
  - Algorithm development lead
- Kuan Song (UMD/Geography)
  - Algorithm development
  - QST Product generation
  - User readiness
- Mark Friedl (Boston University)
  - Cal/Val lead
- Damien Sulla-Menashe (Boston University)
  - Ground truth data development
  - Product validation
  - MODIS land cover products as QST IP seed

Science Needs for Surface Type Products

- Modeling studies
  - Land surface parameterization for GCM
  - Biogeochemical cycles
  - Hydrological processes
- Carbon and ecosystem studies
  - Carbon stock, fluxes
  - Biodiversity
- Feed to other VIIRS products
  - BRDF/Albedo
  - Land surface temperature (LST)
- Surface type change monitoring
  - Burned areas
  - Snow covers
  - Flooding/deforestation/etc (TBD)



L1RD Requirements

Table 4.5.4.2 - Surface Type (VIIRS)		
EDR Attribute	**Threshold**	**Objective**
SURF Applicable Conditions: 1. Both clear and partly cloudy sky conditions		
a. Horizontal Cell Size	1 km at Nadir	1 km at Edge of Scan
b. Mapping Uncertainty, 3 Sigma	5 km	1 km
c. Measurement Range	17 IGBP classes specified in Table 4.5.4.1	17 IGBP classes
d. Measurement Precision*	10%	0.1%
e. Measurement Accuracy *	70% correct for 17 types	2%
f. Refresh	At least 90% coverage of the globe every 24 hours (monthly average)	3 hrs.
		v2.0, 9/23/12

** Current IDP product was designed to meet heritage NPOESS requirements. Beta evaluation is done against those heritage requirements. Precision and accuracy numbers are to be corrected in the JPSS L1RD.*

Overview of VIIRS Surface Type EDR

- Describes surface condition at time of each VIIRS overpass
- Produced for every VIIRS swath/granule
  - Same geometry as any VIIRS 750m granule
- Two major components
  - Gridded Quarterly Surface Type (QST) IP mapped to the swath/granule space
    - VIIRS QST IP not available yet (requires one full year of data, VIIRS gridding just turned on)
    - Currently use MODIS land cover (LC) as QST IP seed
  - Includes flags to indicate snow and fire based on
    - Active fire Application Related Product (ARP)
    - Snow EDR

History of ST EDR Related DRs

Date	DR #	Reason	Status
11/18/2011	4452	ST rename vegetation fraction	NDE provides separate GVF product in future
11/18/2011	4458	C5 Decision tree replacement	UMD to upgrade QST IP algorithm with SVM in future
11/18/2011	4459	QST IP goes to annual	To be approved in future
05/22/2012	4707	Update QST IP seed data	Completed with MODIS C5 LC
09/12/2012	4900	Remove new QST IP Seed fill values	Completed with update MODIS C5 LC
01/14/2013	7002	VIIRS ST EDR Beta review	In progress

What to look for in this review

- Verify current MODIS C5 Land Cover product used as QST IP seed
- Snow flags in Snow EDR copied to ST EDR properly
- Fire flags in Fire ARP copied to ST EDR properly
- Thematic accuracy not assessed at this time.

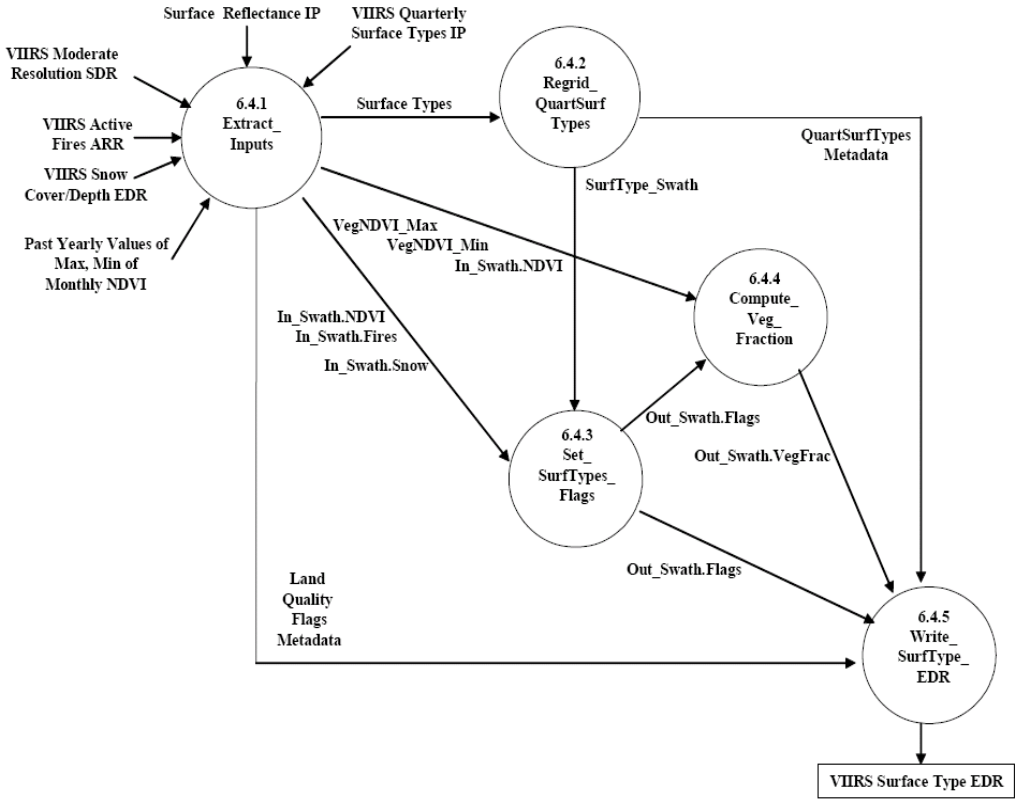
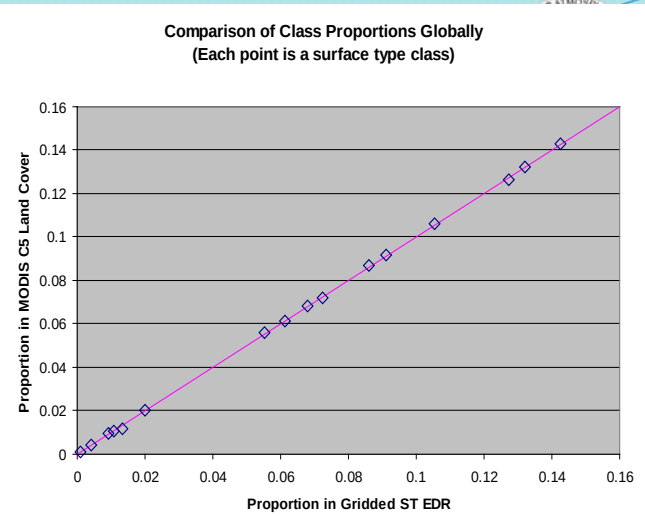


Figure 6. Flow diagram showing the processing chain for the VIIRS Surface Type EDR.

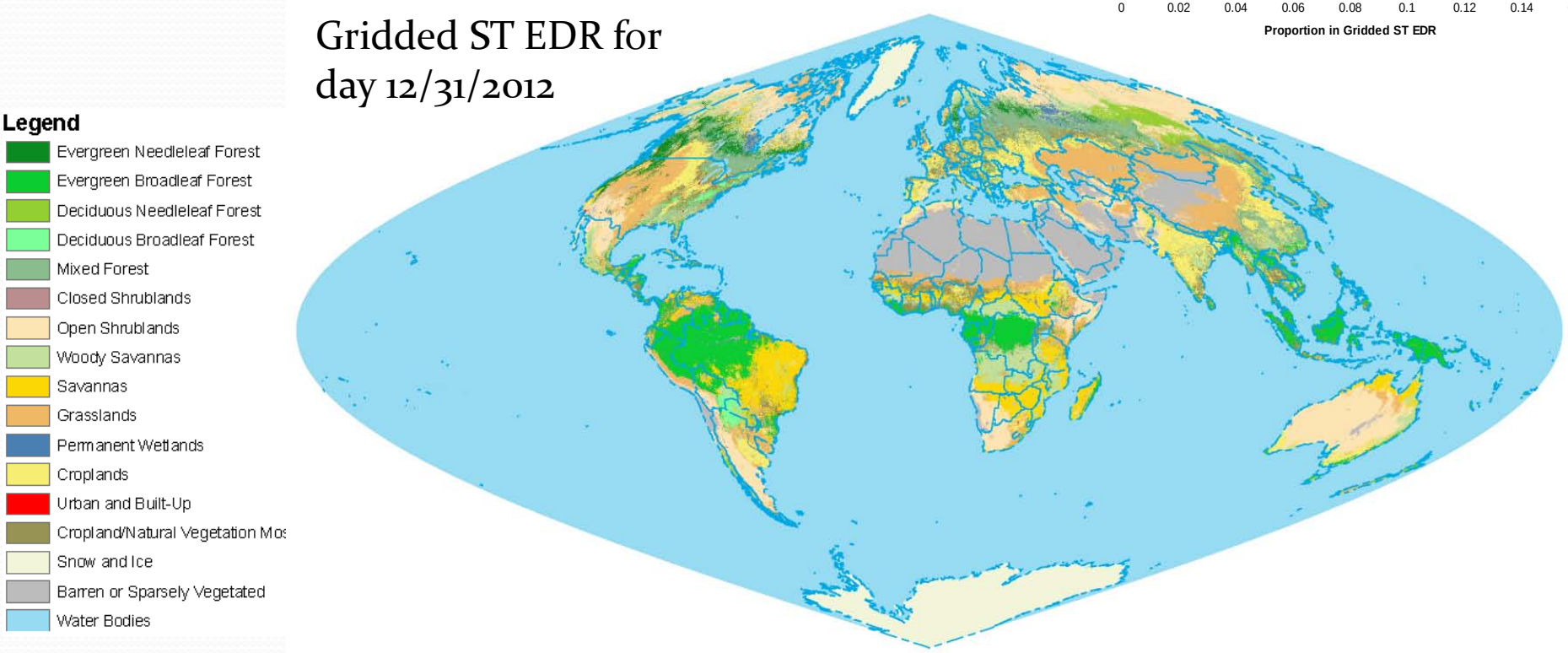
Comparison of ST EDR and MODIS C5 LC

- Verify current IDPS QST IP seed is consistent with MODIS C5 LC product
- MODIS C5 LC
  - 1KM
  - Gridded: Sinusoidal
  - Delivered to IDPS by BU
- ST EDR
  - 750 M @ nadir, larger off nadir
  - Swath/granule
  - From LPEATE's IDPS copy
- Data preparation for comparison
  - Convert the ST EDR from swath to the gridded space using LPEATE gridding tool
- Known limitations:
  - Resampling in map conversion is known to cause 1-2 pixel shifts. Small surface type patches may get dropped off.
  - MODIS LC is resampled once (gridded space to swath space) when used to create ST EDR
  - The ST EDR is resampled again (swath space to gridded space) before it is compared with MODIS C5 data
  - Hence, ST EDR will be similar but not identical to MODIS C5 LC in the following comparisons.

Global Mosaic of Gridded ST EDR Matches MODIS C5 Product



Gridded ST EDR for day 12/31/2012

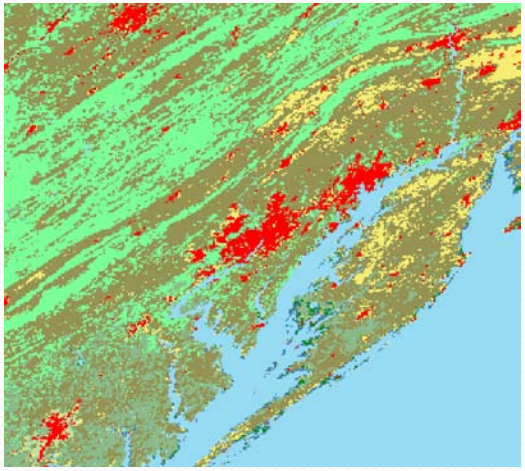


Note: Small differences are due to resampling in map conversion between gridded space and swath space.

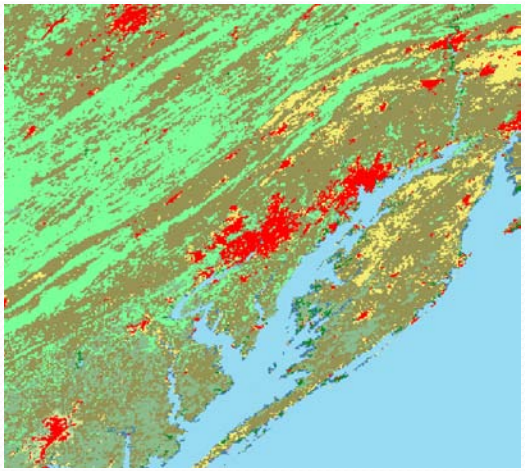
Zoom-in Comparison of ST EDR and MODIS C5 LC

US eastern coast, red pixels in the middle are the Baltimore-Washington area

MODIS C5 LC

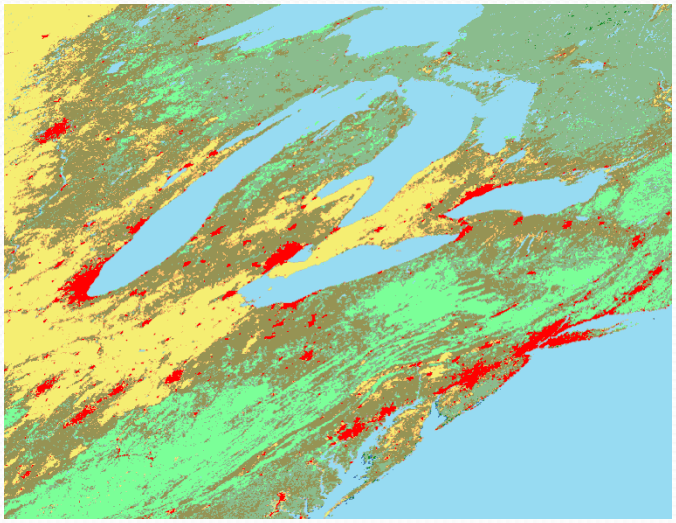


ST EDR

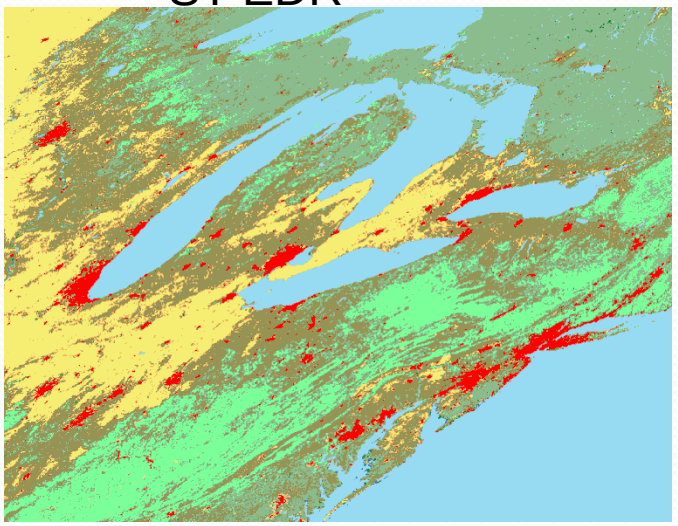


Great Lakes and NE US

MODIS C5 LC



ST EDR

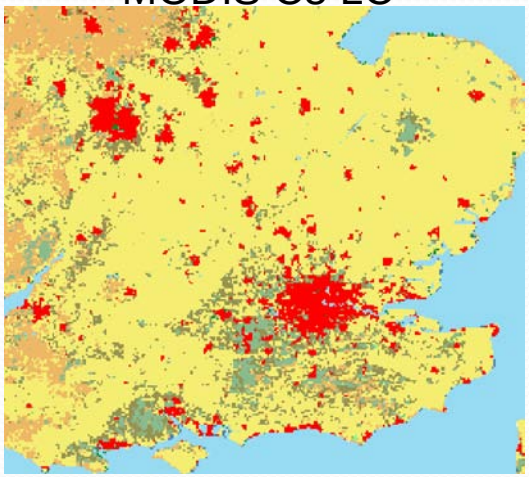


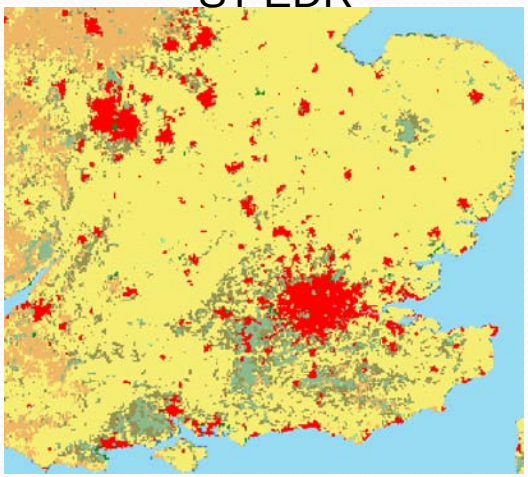
More Comparison of ST EDR and MODIS C5 LC

MODIS C5 LC

ST EDR

London and SE England

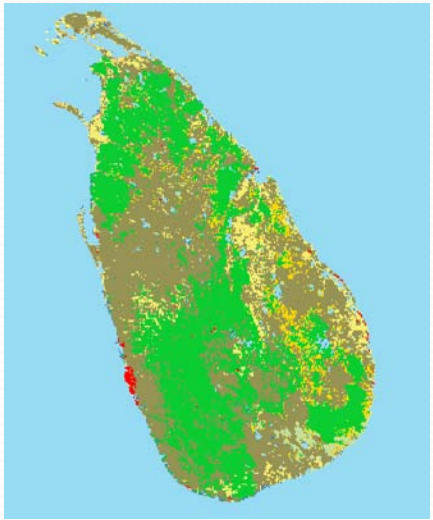


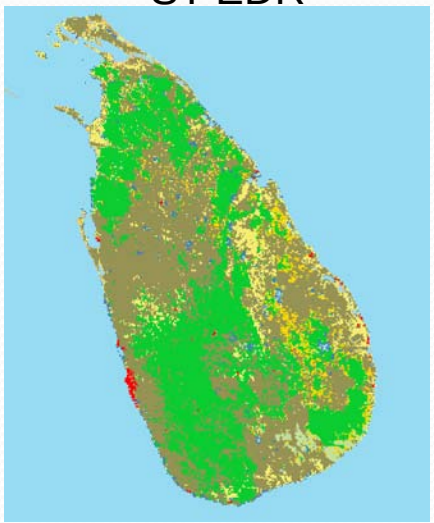


MODIS C5 LC

ST EDR

Sri Lanka



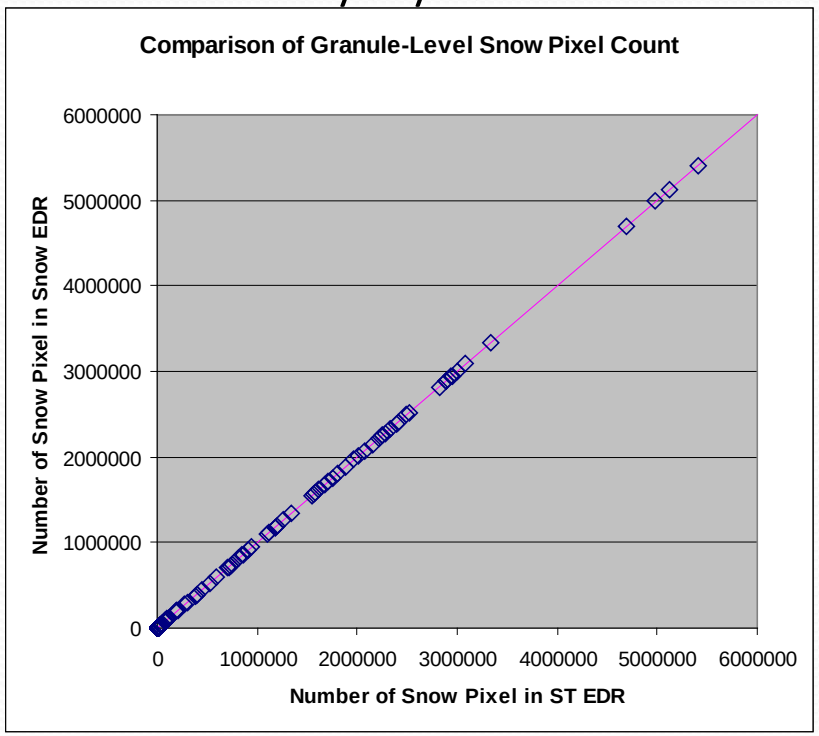


Comparison of Snow EDR and Snow QC flag in ST EDR

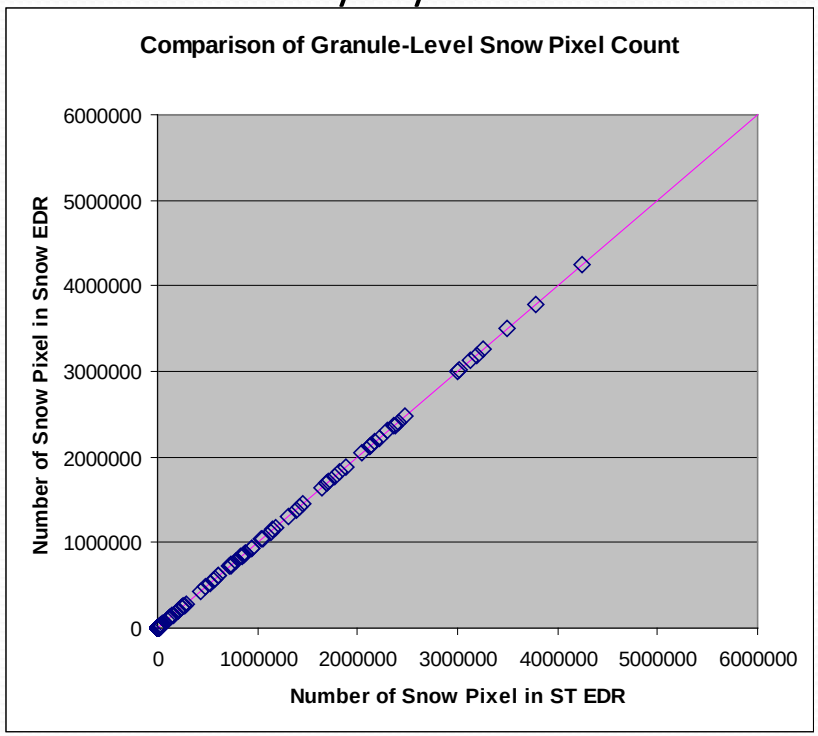
- ST EDR
  - Swath, 750 m @ nadir
  - Snow pixels has value of 1 in QC flag
  - From LPEATE's IDPS copy
- Snow EDR
  - Swath, 375 m @ nadir
  - From LPEATE's IDPS copy
- Data processing for comparison
  - Every 2 x 2 snow EDR pixels aggregated to match ST EDR pixels
  - If > 2 pixels in the 2x2 snow EDR window are snow, flag snow in the ST EDR
  - To avoid impact of resampling, comparison made in swath space

Granule-Level Snow Pixel Counts Near Identical in ST EDR and Snow EDR

All Granules Acquired on 12/31/2012



All Granules Acquired on 02/05/2013



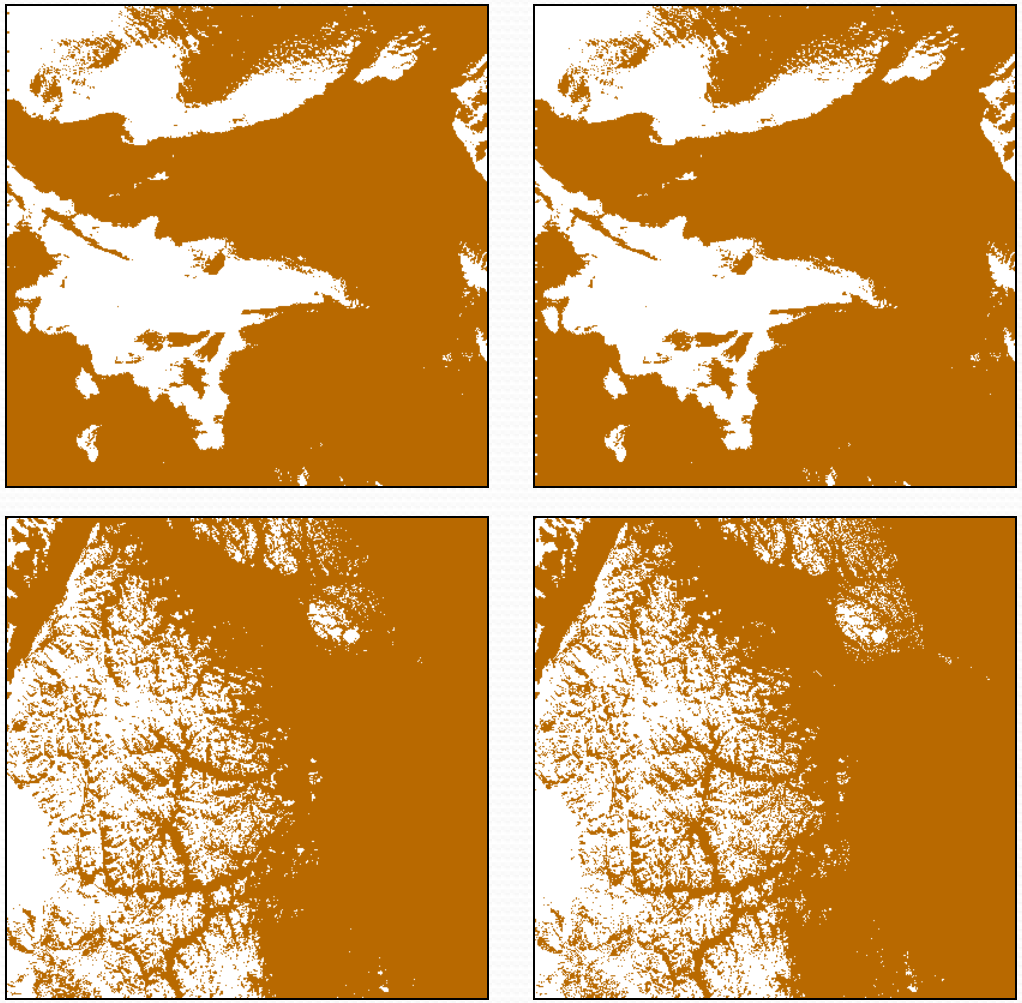
Each point represent one VIIRS granule

Detailed Comparison of Snow Flags in ST EDR and VIIRS Snow EDR

Snow in Snow EDR | Snow in ST EDR

North Antarctica
Acquired @ 08:50
on 12/31/2012

Eastern Siberia
Acquired @ 21:15
on 12/31/2012



Legend

Snow

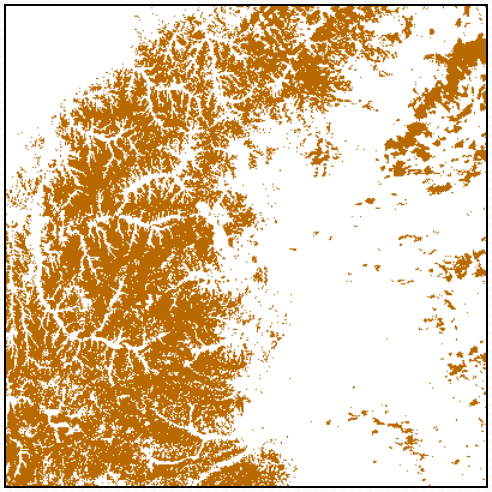
Non-snow

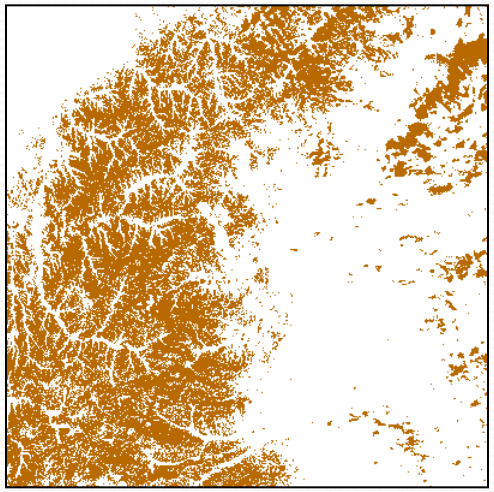
More Comparison of Snow Flags in ST EDR and VIIRS Snow EDR

Snow in Snow EDR

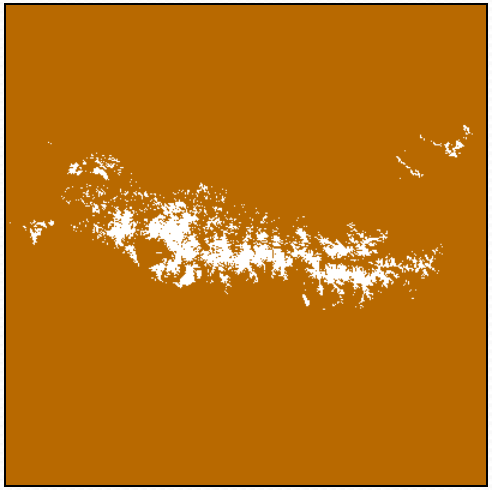
Snow in ST EDR

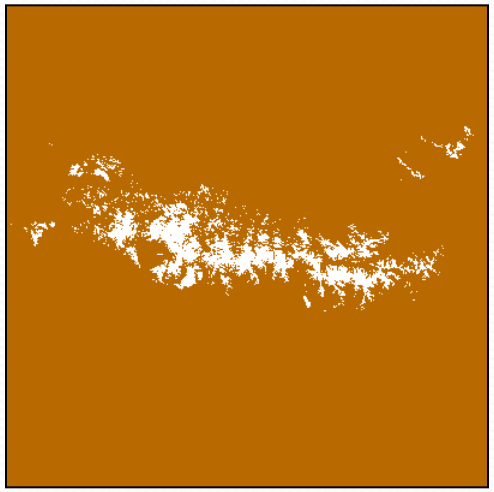
North of Baikal
Russia
Acquired @ 04:45
on 02/05/2013





North Spain
Acquired @ 13:10
on 02/05/2013



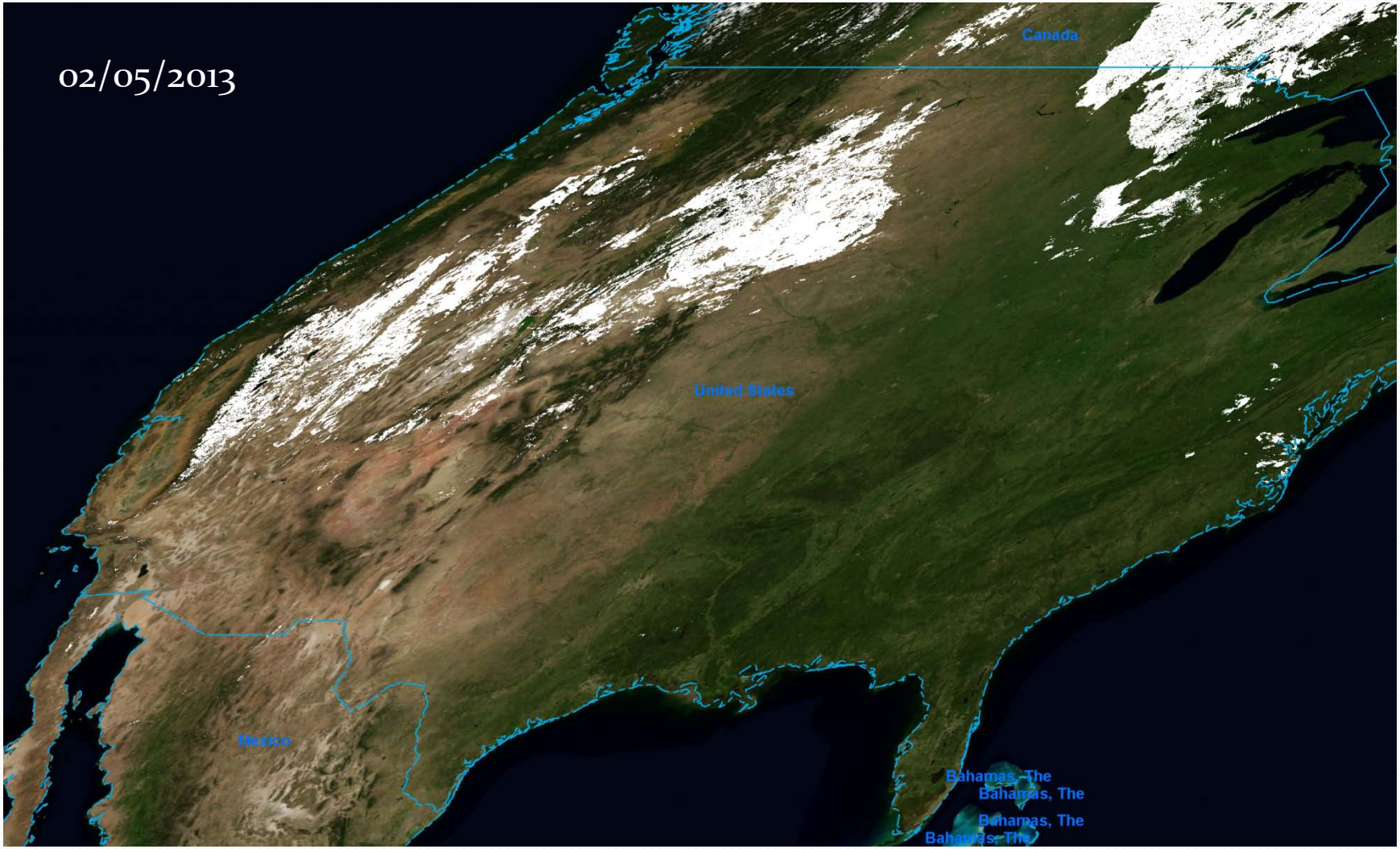


Legend

Snow

Non-snow

Gridded Snow in ST EDR for US



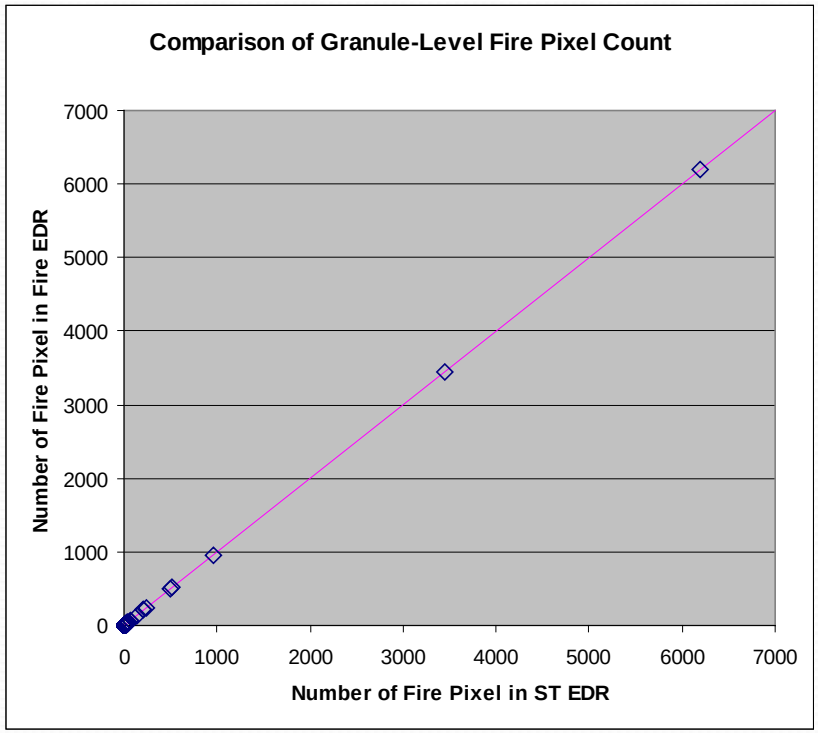
Background: Microsoft Bing Map

Comparison of Fire ARP and Fire QC flag in ST EDR

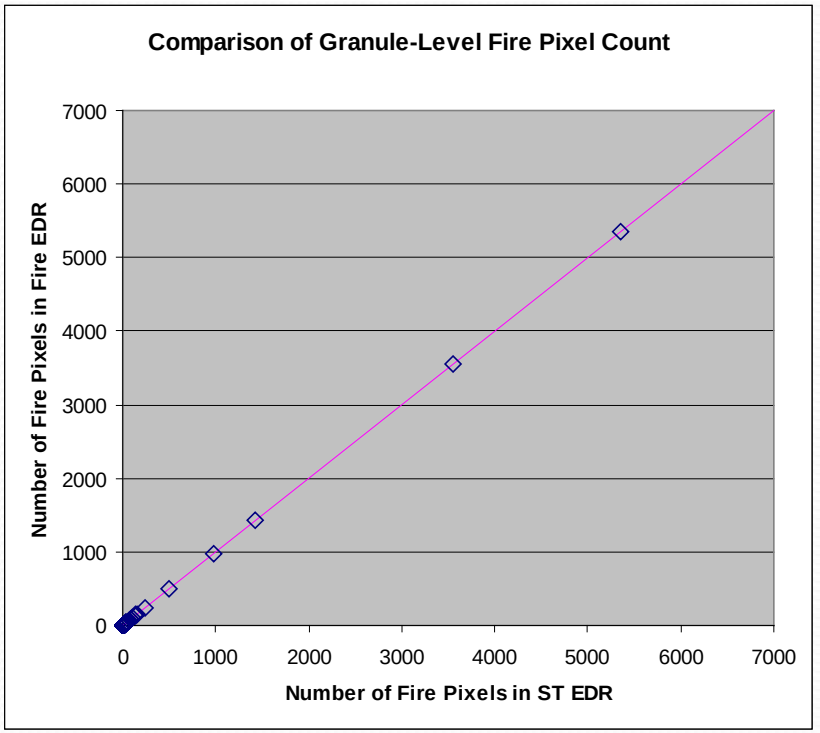
- ST EDR
  - Swath, 750 m @ nadir
  - Fire pixels has value of 1 in QC flag
  - From LPEATE's IDPS copy
- Fire ARP
  - Vector format showing location of fire pixels, no imagery product
  - From LPEATE's IDPS copy
- Data preparation for comparison
  - Convert Fire ARP vector file to imagery product (used in the following comparison)
  - Compare Fire ARP with fire flag in ST EDR

Granule Fire Pixel Counts Identical in ST EDR and Fire EDR

All Granules Acquired on 12/31/2012

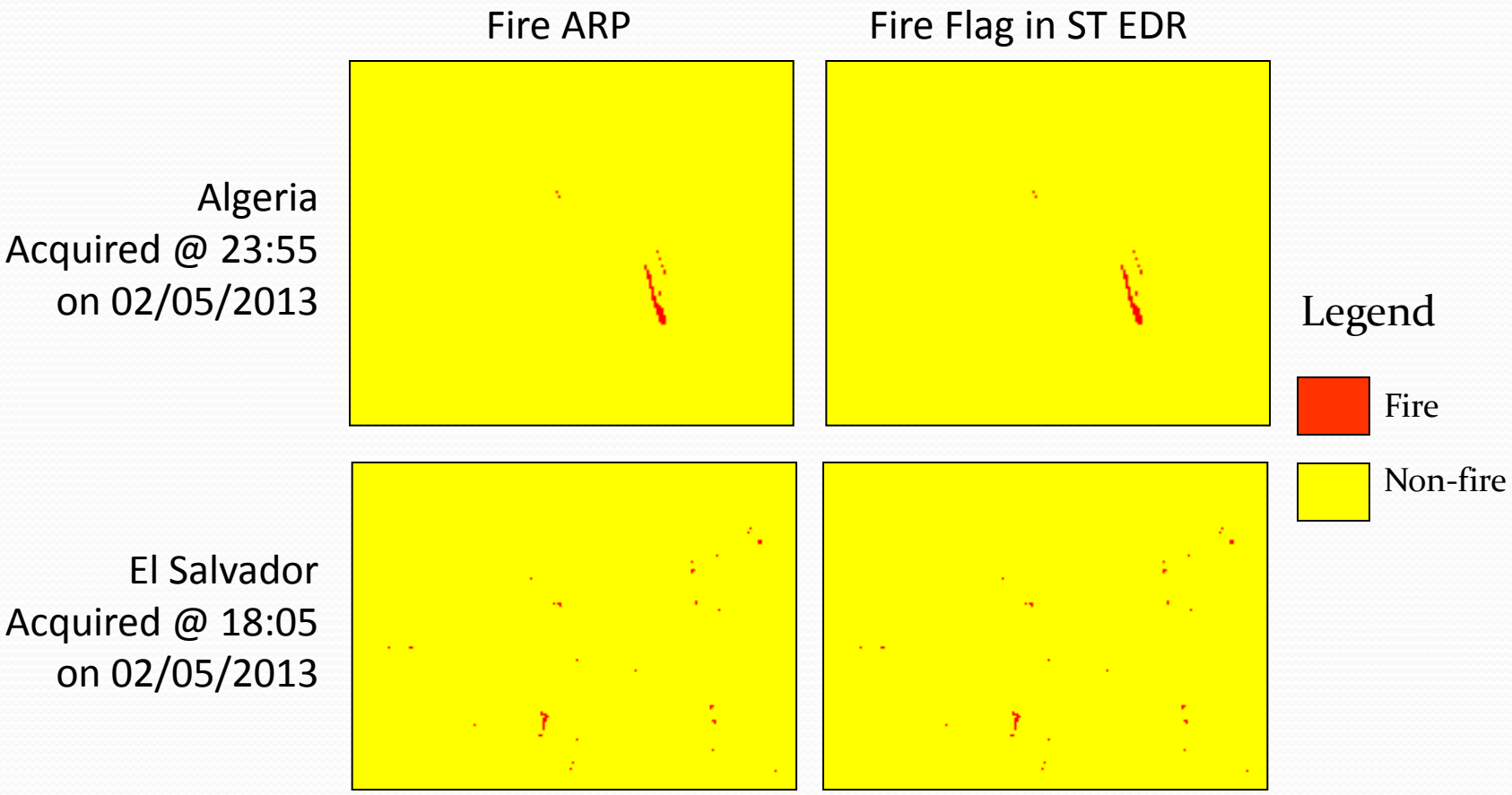


All Granules Acquired on 02/05/2013

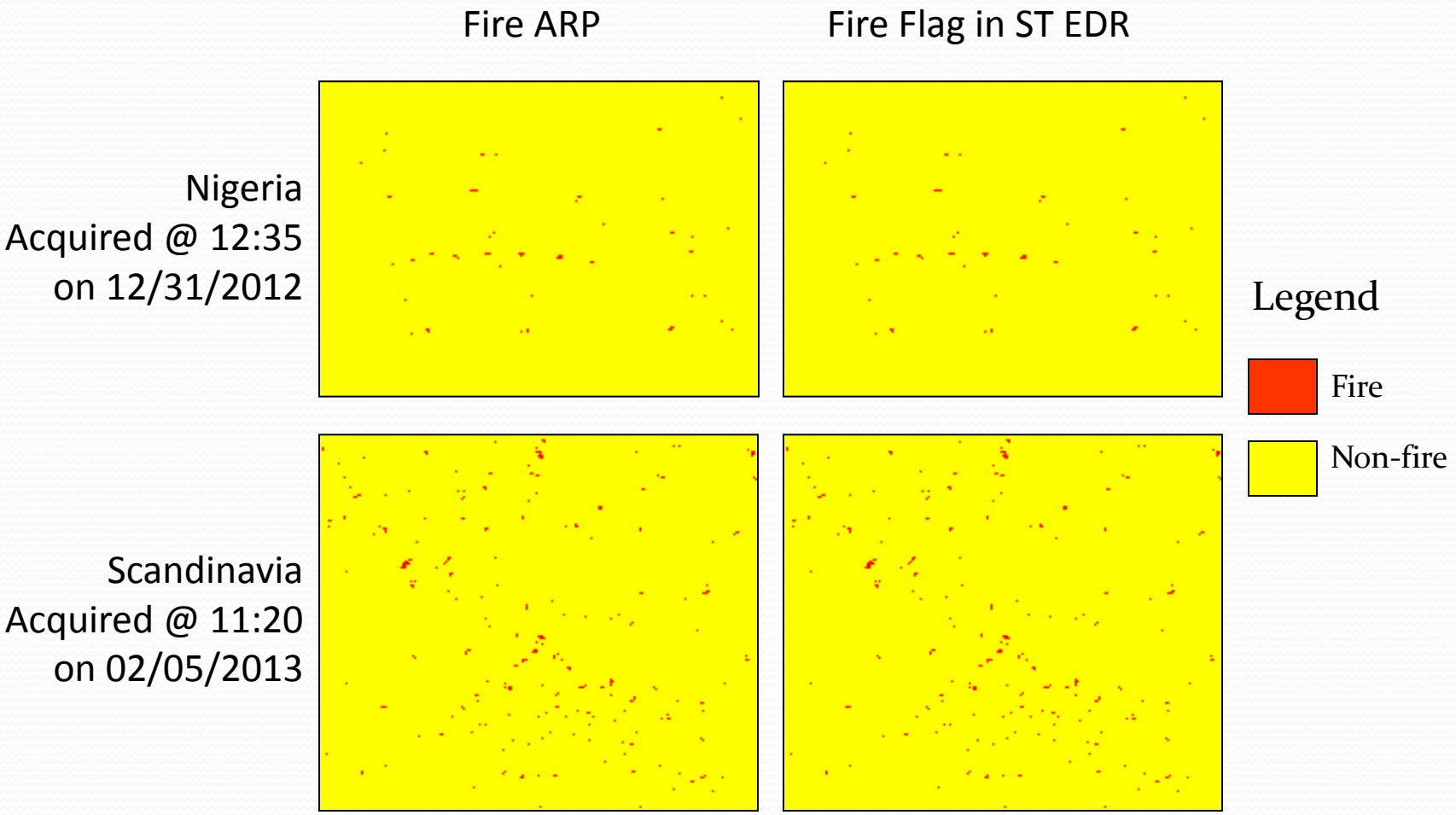


Each point represent one VIIRS granule

Zoom-in Comparison of Fire Flags

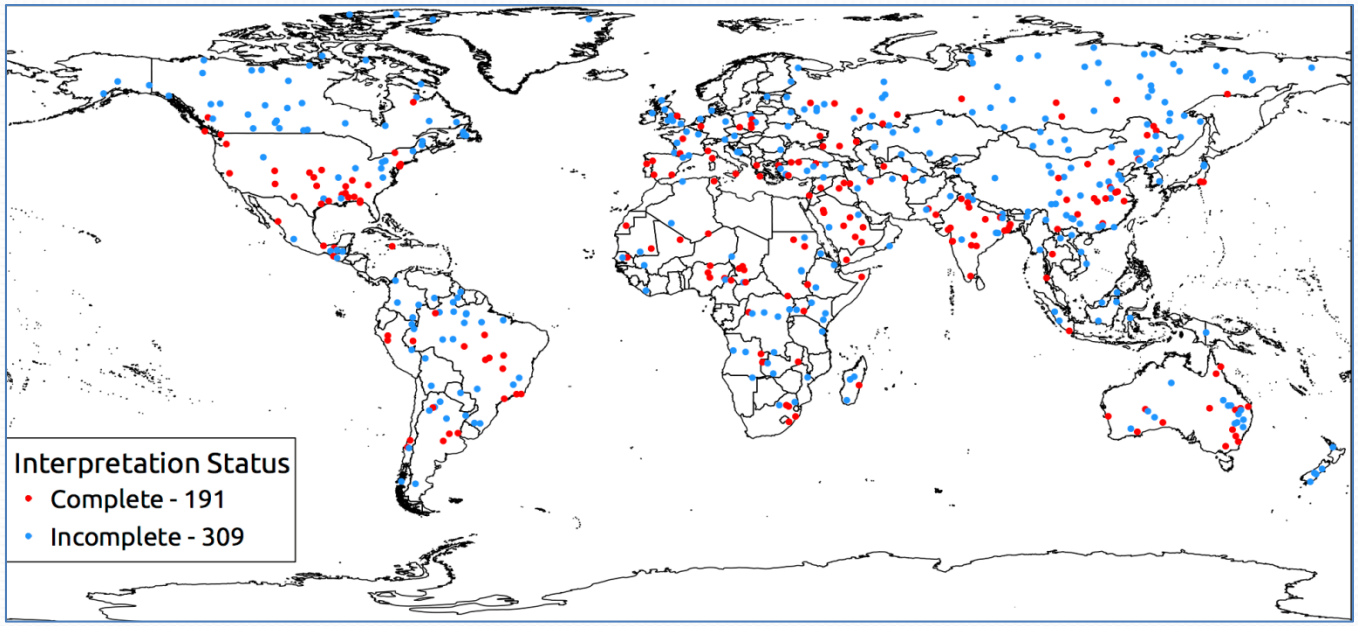


Zoom-in Comparison of Fire Flags



Surface Type Validation Preparation

- Response and analysis design essentially complete
- Majority of effort focused on building site data base (by manual interpretation, supervised classification)



Beta Consideration and Remaining Issues

- **Surface Type EDR Algorithm Functions as Designed**
  - MODIS C5 land cover product used as QST IP seed
    - Small differences between MODIS C5 and ST EDR due to map conversion
  - Fire flag in ST EDR updated properly using Fire ARP
  - Snow flag in ST EDR updated properly using Snow EDR
- Generating **VIIRS QST IP** is **in progress**
- Explicit **validation** remains **crucial**

Future Plans

- Near Term:
  - Complete validation data development by Summer 2013
  - Generate and validate VIIRS QST IP before May 2013
  - Deliver new VIIRS QST IP to IDPS from June 2013
- Longer Term:
  - Upgrade QST IP algorithm for improved accuracy
  - Upgrade ST EDR algorithm for more surface type change monitoring
  - Validate QST IP and ST EDR with validation data