National Aeronautics and Space Administration

# Landsat & Sentinel-2 Synergy

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**April 3, 2012**
**LCLUC Meeting**

LDCM
LANDSAT

data continuity mission

# Land Cover Project Science Office

The Land Cover Satellite Project Science Office (LcPSO) at GSFC maintains and enhances the quality of data used by the NASA land cover science community.

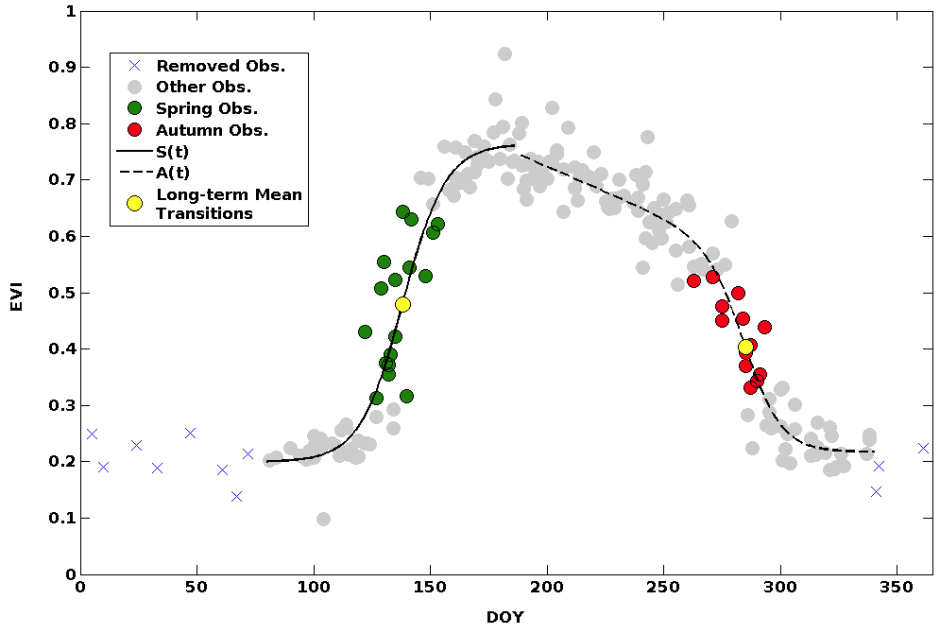
Previous activities have focused on

- Landsat calibration (operational, historic)
- Landsat data quality (e.g. scan-line corrector anomaly; image artifacts)
- Cross-calibration among EOS, commercial, and international sensors
- Support for new data products (GLS, 30-m surface temperature)
- Landsat-7 Long-Term Acquisition Plan (LTAP)
- Education and Outreach

# Moderate-Resolution Time Series

Since the opening of the USGS Landsat archive, there has been increased interest in ***intra-annual*** time series applications at 30m resolution

- Agricultural monitoring (e.g. GEO-GLAM)
- Vegetation biophysics (LAI, fPAR, productivity)
- Phenology and climate linkages
- WELD data products

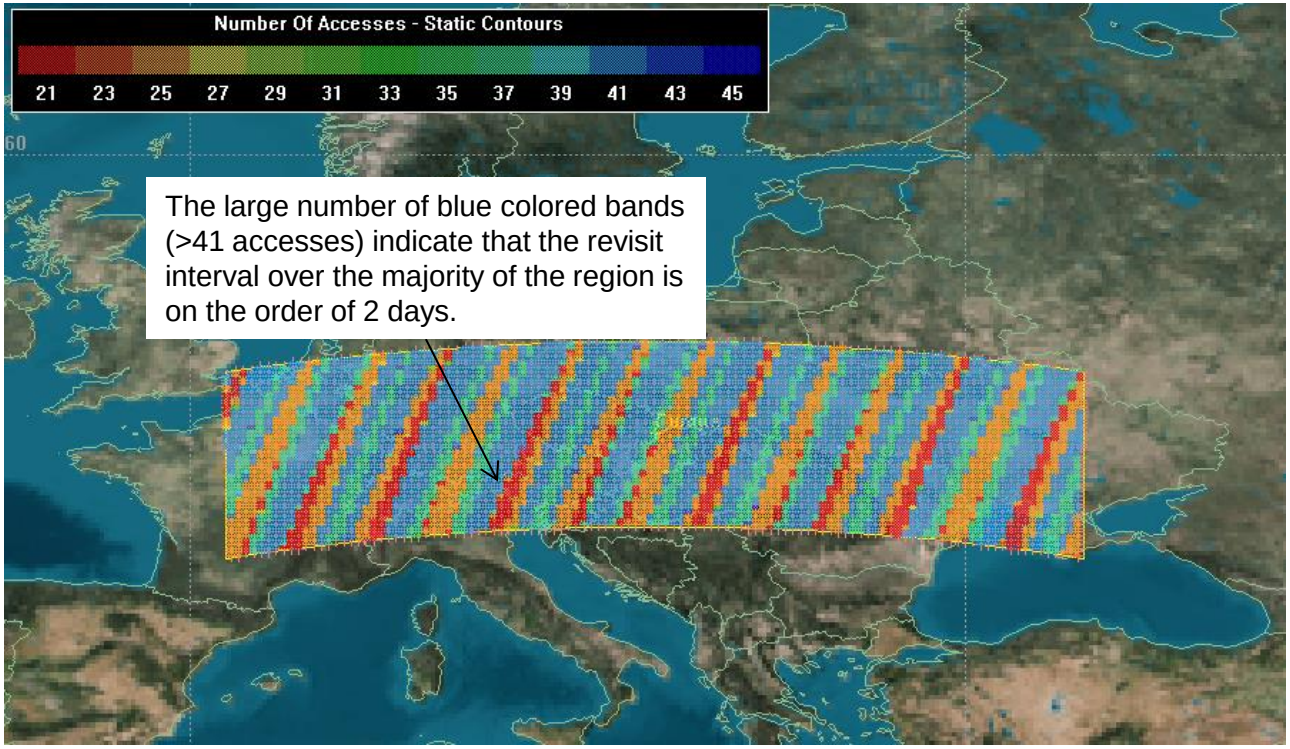



Example: New England forest phenology from multi-annual Landsat observations, courtesy Mark Friedl (BU)

# Sentinel-2 and Landsat Fusion

**Merging Sentinel-2 and Landsat data streams could provide < 5-day coverage required for Ag monitoring**

- Both sensors have 10-30m coverage in VNIR-SWIR
- S-2a launch in mid-2014; S-2b launch late-2015

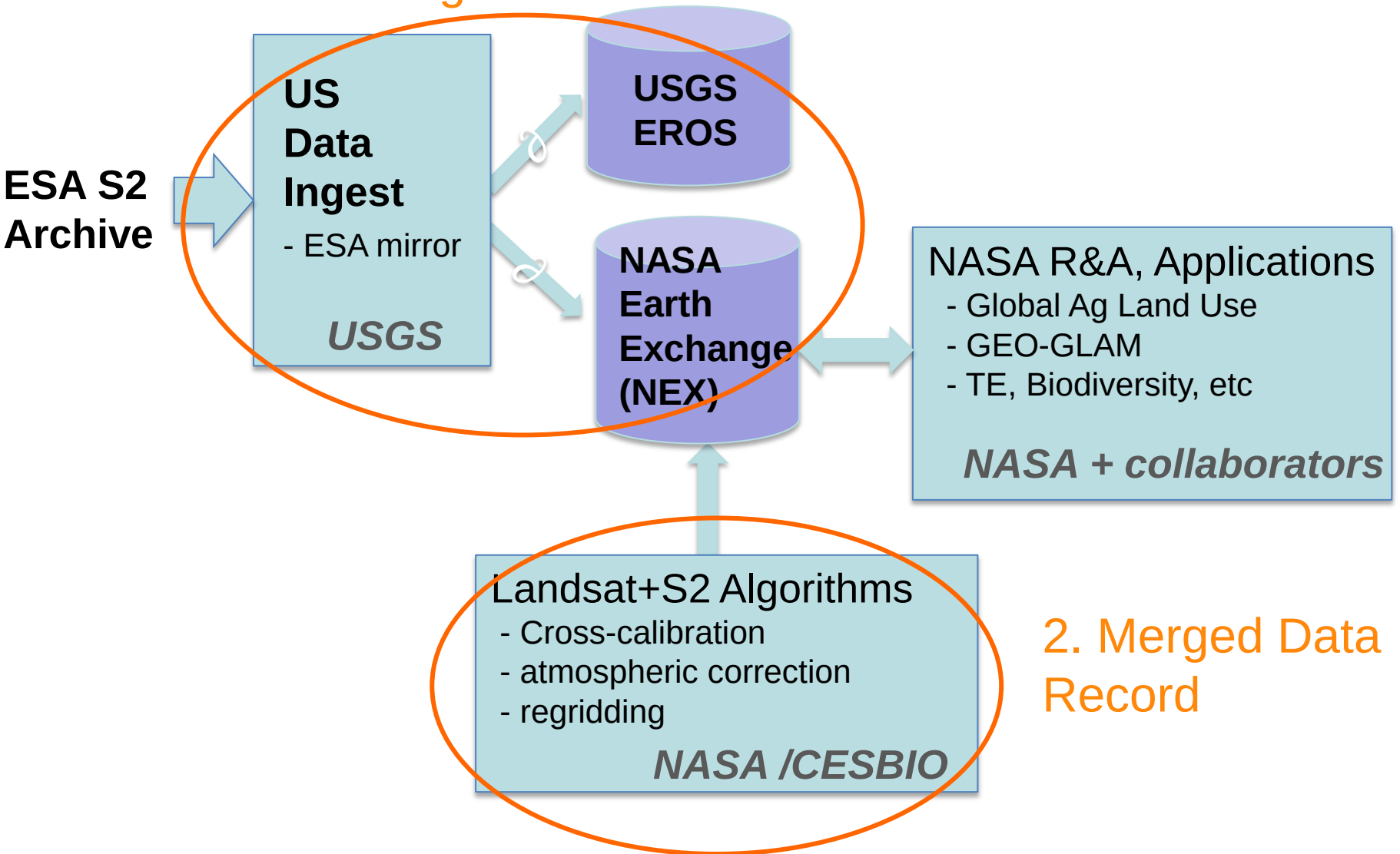



Number of times LDCM and the Sentinel 2 satellites accessed areas on the ground over an 80 day period of time.

- 21 accesses indicates a maximum revisit interval of ~3 days 19 hours
- 46 accesses indicates a minimum revisit interval of ~1 day 18 hours

# Proposed Sentinel-2 / Landsat Architecture

## 1. Data Provisioning

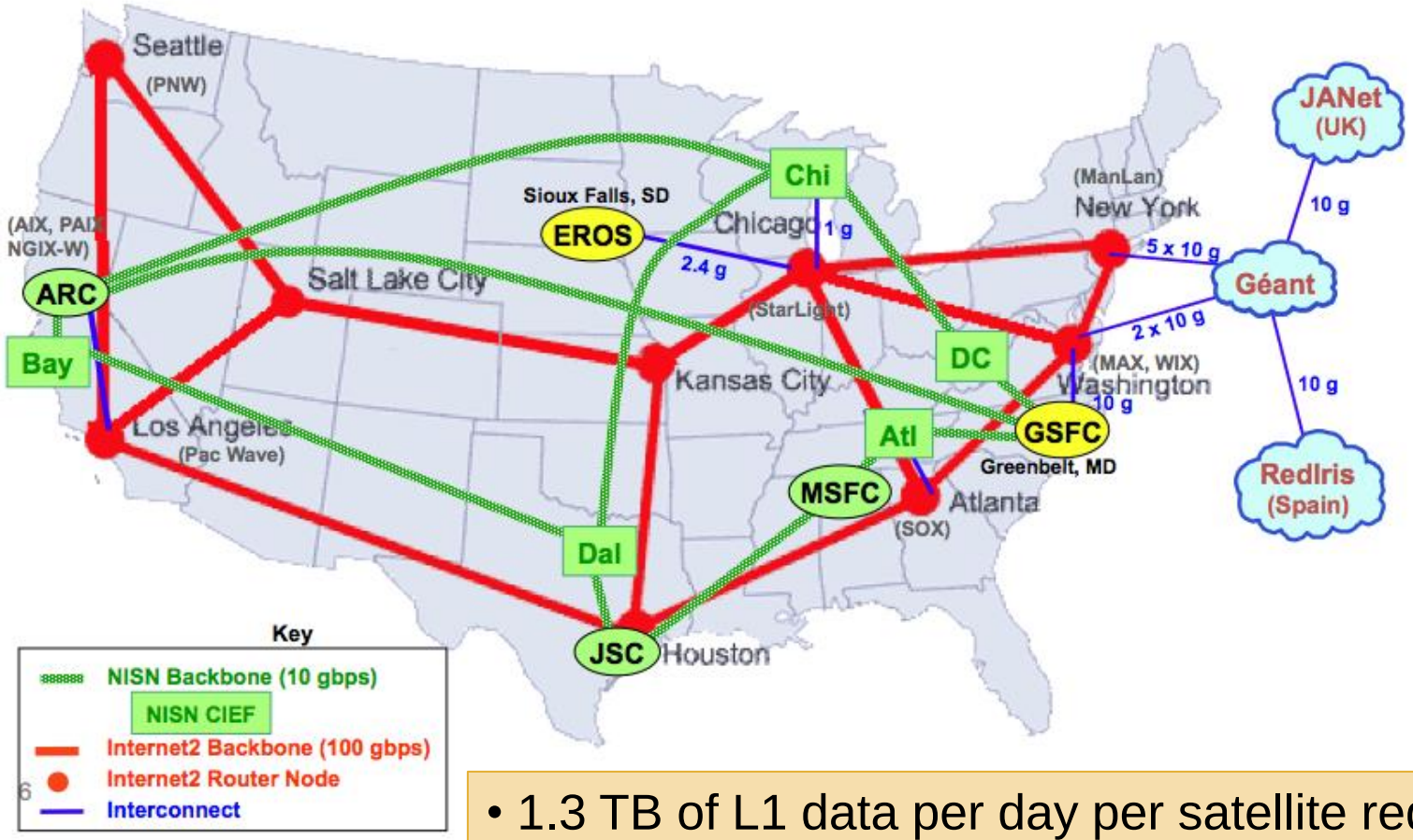



## 2. Merged Data Record

# 1. Data Access

- The USGS is interested in hosting mirror archives of Sentinel-2 data
  - Initially will focus on Level-1c products (100 Km by 100 Km granules) as soon as they are made available from the PACs
  - Ensure synchronization of U.S. and ESA inventories
    - US would serve as a “hot back-up”
  - May investigate Level-1b products
    - To enable generation of larger Level-1c granules conforming to Landsat WRS-2 scenes or WELD tiles
    - To enable the generation of high-level geophysical and biophysical parameters
- USGS also investigating direct downlink options for S2
- US requirements communicated to ESA Fall 2012

# EOS - Géant Connectivity



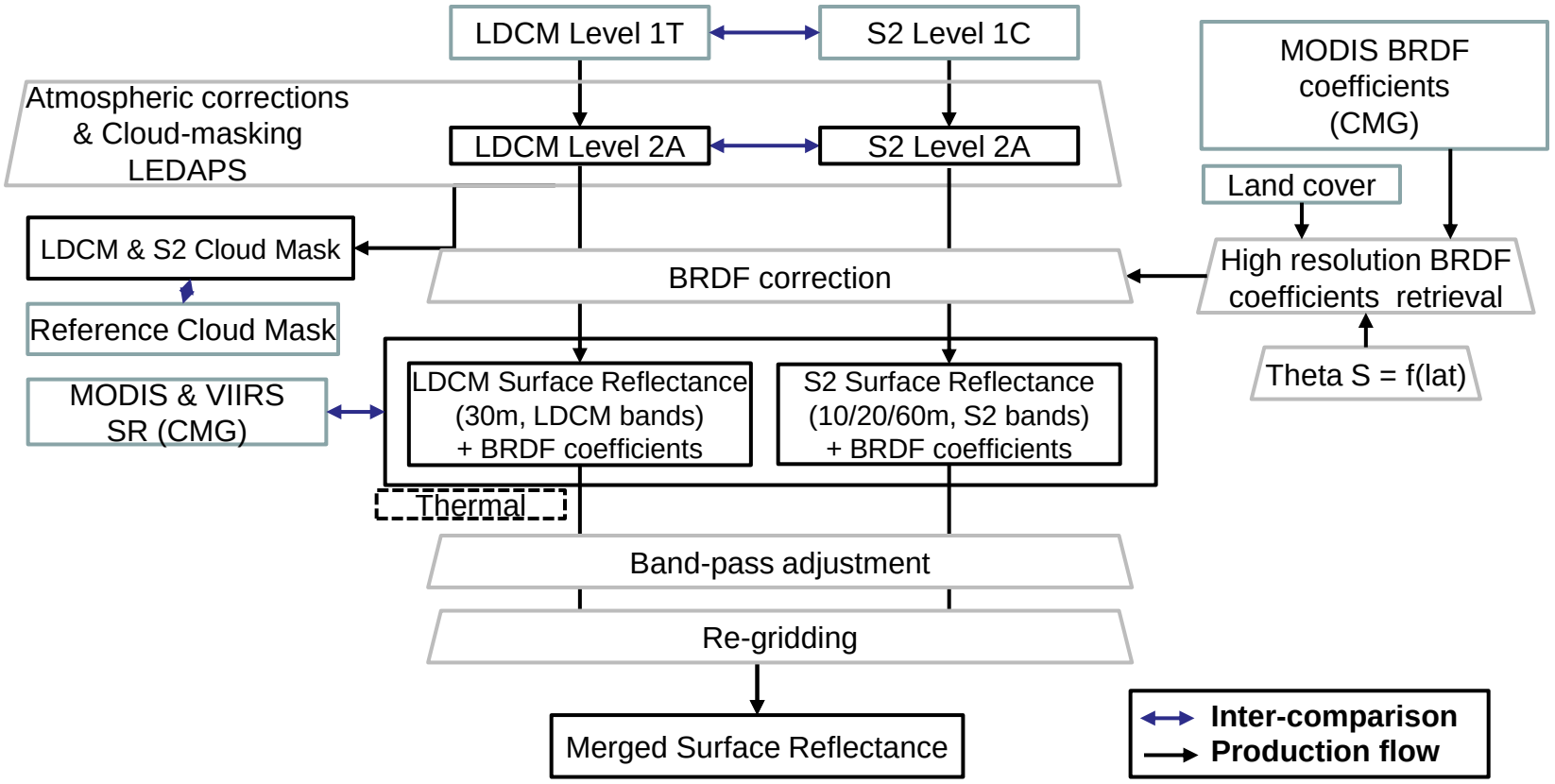

- 1.3 TB of L1 data per day per satellite required.
- Data delivery will be within a 24 hour period
- 400 Mbps of bandwidth meets the requirements.

*Courtesy Andrew Germain, GSFC*

# 2. Merged Radiometric Record

- Collaboration with UMD, CNES/CESBIO, GSFC, ARC, USGS
- Goal: “seamless” surface reflectance product with <5 day repeat to support GEO-GLAM
- Radiometric Adjustments
  - Cross-calibration
  - Atmospheric correction (6S, MACC)
  - BRDF correction to nadir & constant SZA
  - Bandpass correction
  - Regridding and compositing
- Initial prototyping using SPOT-4 and L7 data (Spring 2013)
- Implementation of processing algrorithms on NEX

# LDCM / Sentinel-2 Fusion

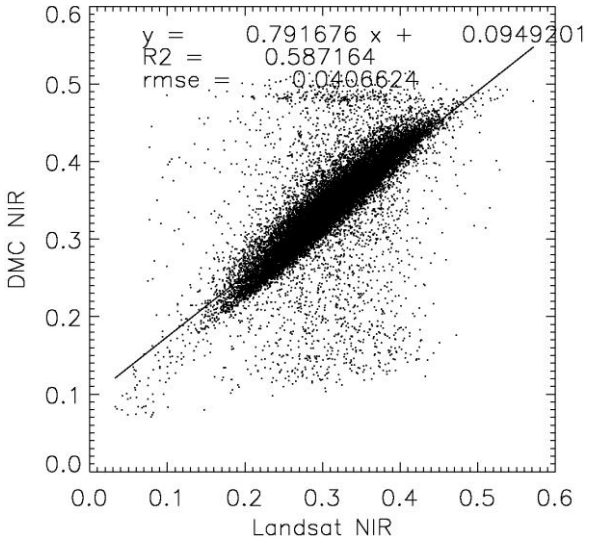


# Prototyping Before Sentinel

- CNES SPOT-4 “Take 5” Experiment

- USDA DMC (Deimos, UK-DMC2) coverage
  - 3 band, 22m imagery (green, red, NIR)
  - ~ weekly coverage for US agricultural regions
  - cross-calibrated with Landsat-7 via PICS sites

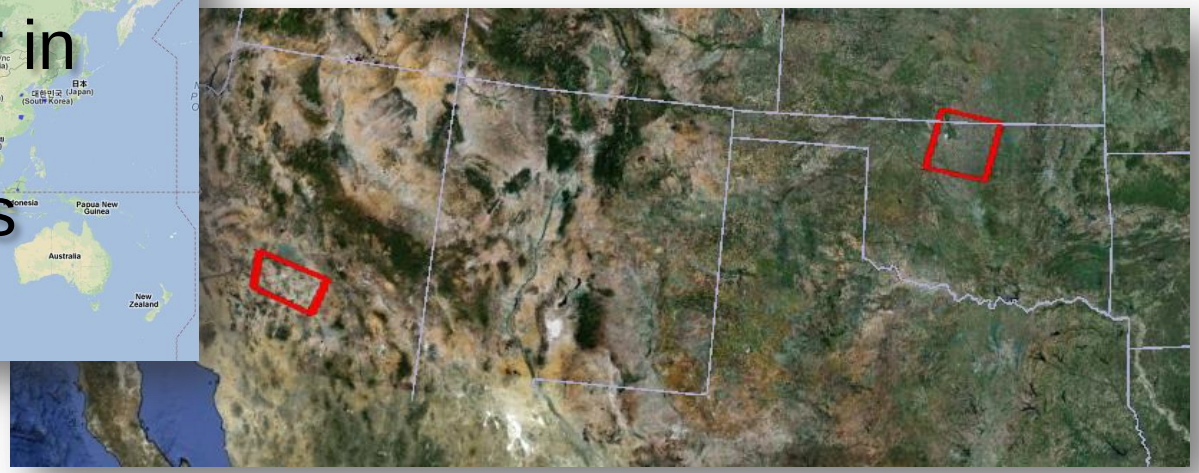
*Bondville, IL: NIR TOA at 100m: DMC June 29, 2011 vs Landsat7 June 28, 2011.*



# SPOT-4 Take five

- CNES end-of-life experiment
- Data every 5th day
- Constant View Angle
- 4 spectral bands (b, g, r, nir)
- 5 months: February – June

- 42 sites (worldwide, mostly in France)
- 2 US Ag sites funded by NASA:
  - Southern Great Plains (OK, USA)
  - Maricopa (AZ, USA)
- All data free

# Sentinel-2a & LDCM Cross Calibration

- Winter 2012-13 joint ESA/NASA pre-launch cross-calibration activity (funded through LDCM Project)

- Radiance sources (integrating spheres) compared at Astrium facility

- Analysis ongoing

# Conclusions

- Combining Sentinel-2 and Landsat observations can provide a new resource for intra-annual land science

- USGS, ESA, and NASA are establishing a framework for…
  - US access to Sentinel-2 data
  - Processing approaches for creating a harmonized data stream
  - Improved LCLUC and agricultural monitoring

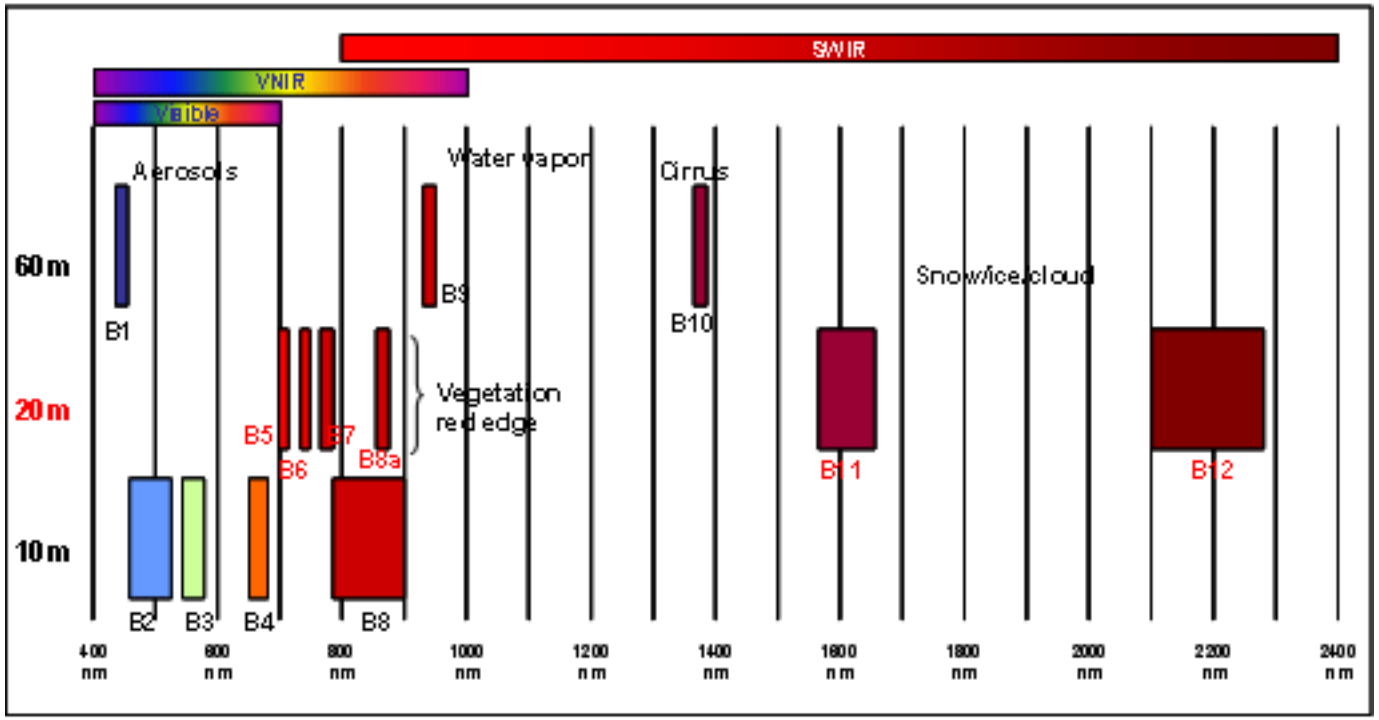
- Possibility of expanding activity to include additional international sensing systems (e.g. ISRO ResourceSat-2)

# Backup

# 2. Sentinel-2 Data Access: Background

- Sentinel-2 data will be transmitted via X-band to four ground stations
  - Alaska, Svalbard, Matera, and Maspalomas
  - No processing capabilities will be hosted at these ground stations
- Mission data will be sent to Processing and Archive Centers (PACs)
  - United Kingdom
  - Spain
- PACs will process and distribute Level-1b (radiometrically corrected) and Level-1c (precision/terrain corrected) products

# Sentinel-2 Bands




- 2 satellites (Sentinel 2a and 2b)
- 290 km swath width
- 7-year design life
- Polar, sun-synchronous orbit