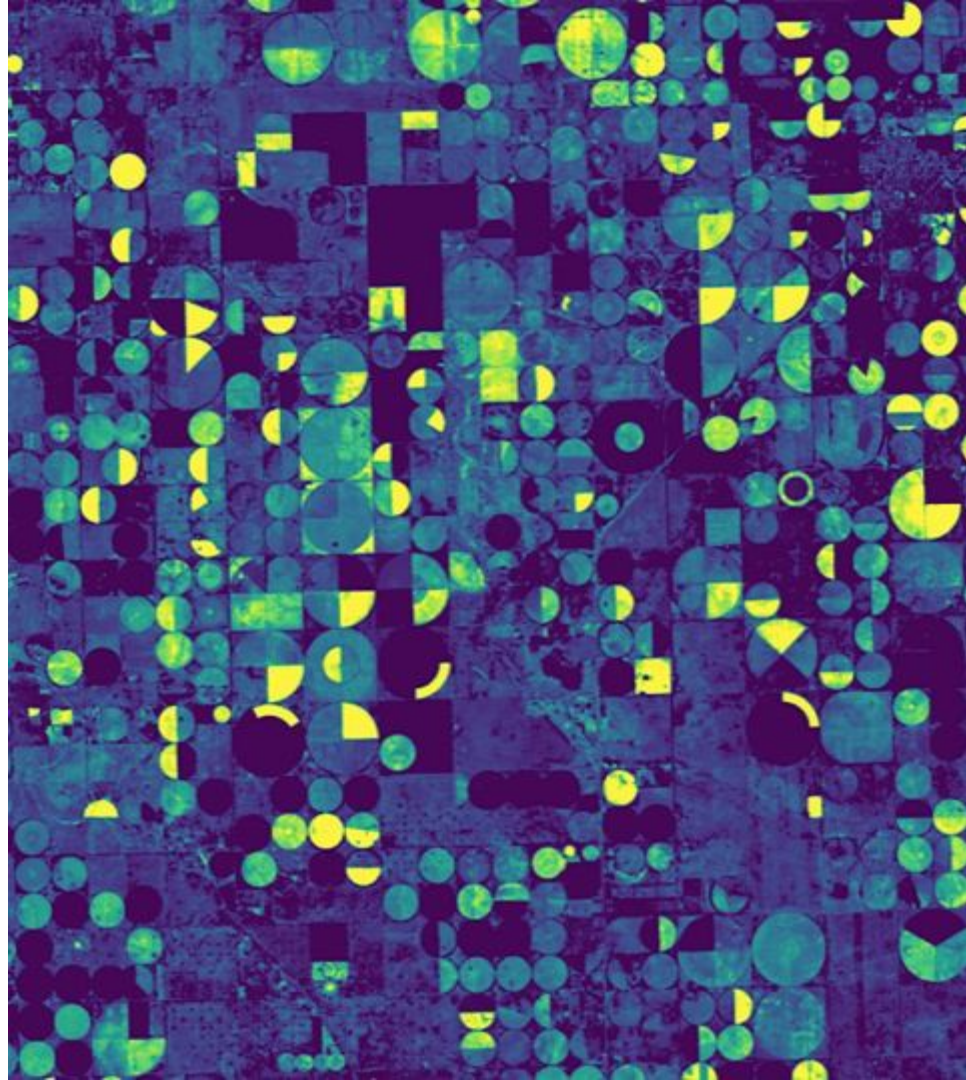


# Understanding World Food Economy with Satellite Images

Aleksandra Kudriashova,  
Astro Digital

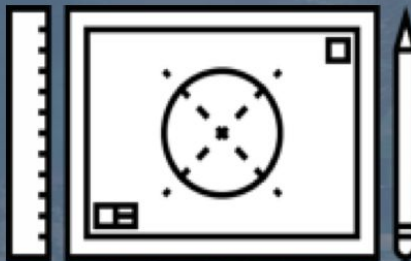


# INFRASTRUCTURE FOR DATA ANALYTICS



## 1. MONITOR

**Scalable** infrastructure and **multi-sensor** data for **targeted** and **recurrent** areas of interest



## 2. MEASURE

**Pattern** detection, trending and alert system for human and natural **activity analysis**



## 3. MANAGE

Business process integration:  
timely, informed and accurate





# LANDMAPPER-BC, LANDSAT 8, SENTINEL-2

**DAILY MULTI-SPECTRAL** IMAGING  
OF ENTIRE LANDMASS WITH **10-30 M** GSD.

170 KM

220 KM

OPEN SOURCE SATELLITE IMAGERY



# LANDSAT 8

ARCHIVE: MARCH, 2013

SPECTRAL RESOLUTION: 30 M

TEMPORAL RESOLUTION: 16 DAYS

9 SPECTRAL BANDS



A satellite image of a river delta, likely the Amazon, showing a complex network of water channels and land. The image uses false color overlays: red for vegetation, green for water, and blue for land. The text 'OPEN SOURCE SATELLITE IMAGERY' is in the top left corner.

OPEN SOURCE SATELLITE IMAGERY

# SENTINEL-2A/2B

ARCHIVE: JULY, 2015

SPECTRAL RESOLUTION: 10-60 M

TEMPORAL RESOLUTION: 10 DAYS

12 SPECTRAL BANDS

**healthy  
tomatoes**



# Farmlands in California



but it's more than just visual analysis

# going beyond pretty pictures





# How to design satellites to address industrial applications?

## User applications for corn

- Plant detection
- Biomass monitoring
- Variable rate analysis





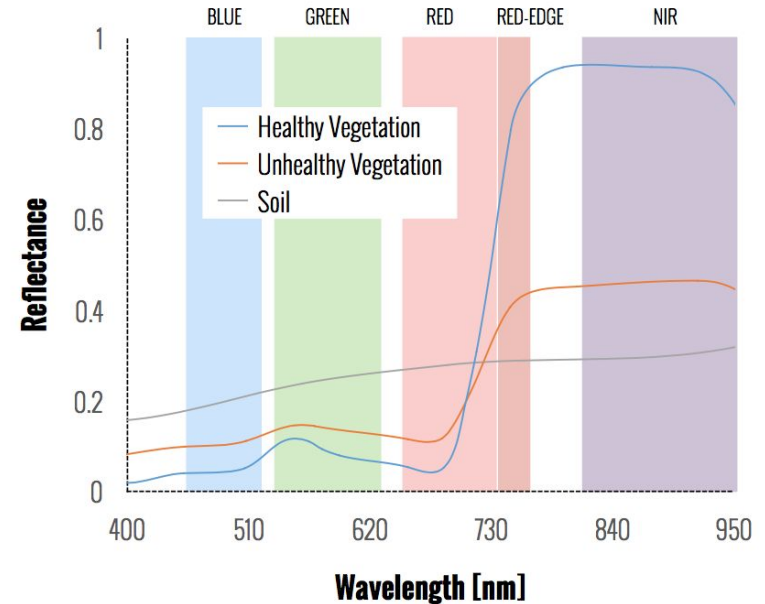
# Landmapper for variable rate analysis



## SPECTRAL BANDS

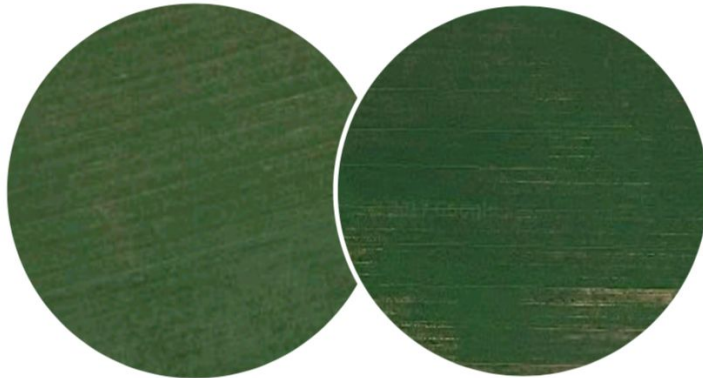
**Landmapper-BC:** Green, Red, NIR (ETM+ 2, 3, 4)

**Landmapper-HD:** Blue, Green, Red, Red Edge, NIR



# Using NDVI for crop classification

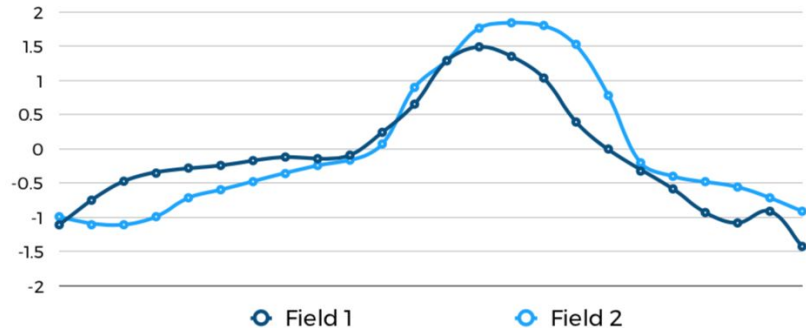
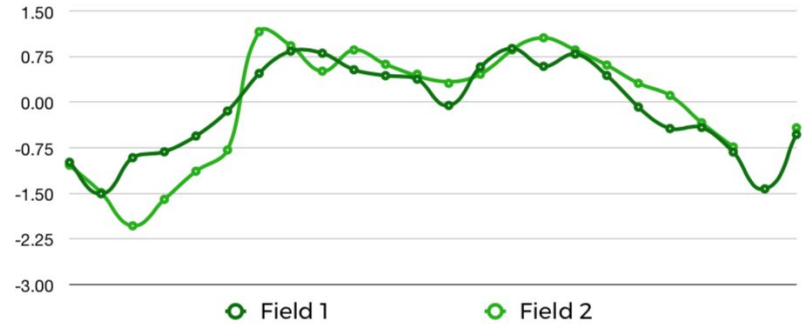
Individual images of fields don't contain enough detail required for identification of crop types.



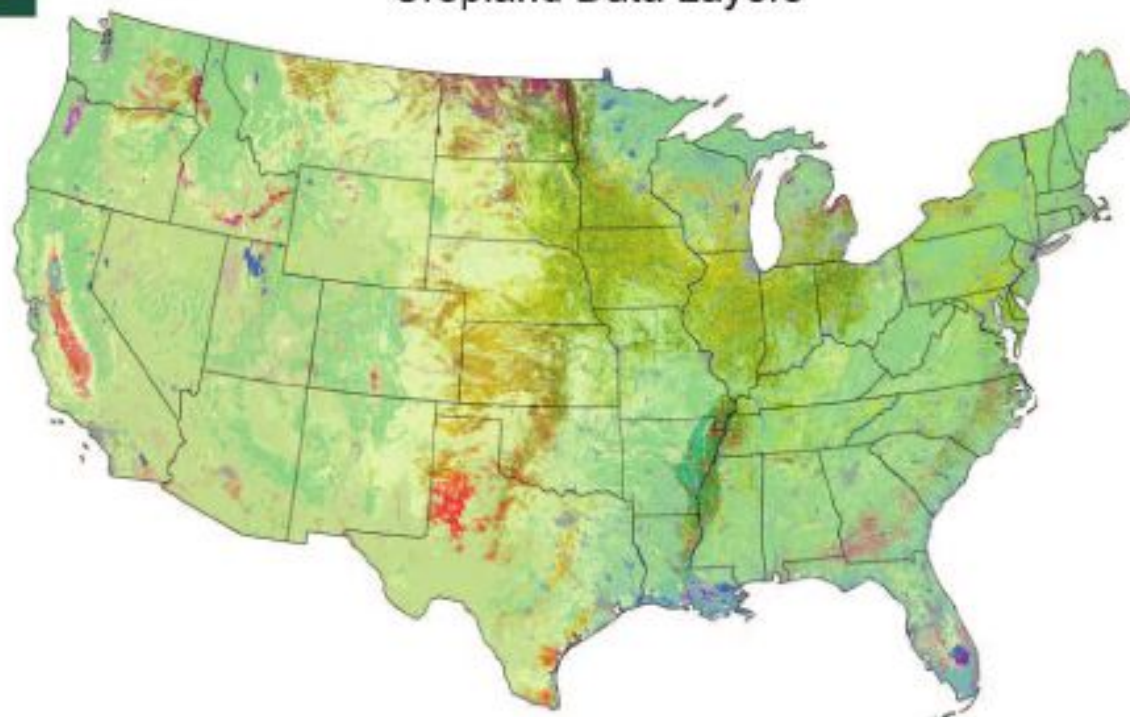
ALFALFA

SOYBEAN

## VEGETATION INDEX OF ALFALFA AND SOYBEANS THROUGHOUT THE SEASON







## Major Land Cover Categories

### Agriculture

Pasture/Grass  
Corn  
Soybeans  
All Wheat  
Other Hay

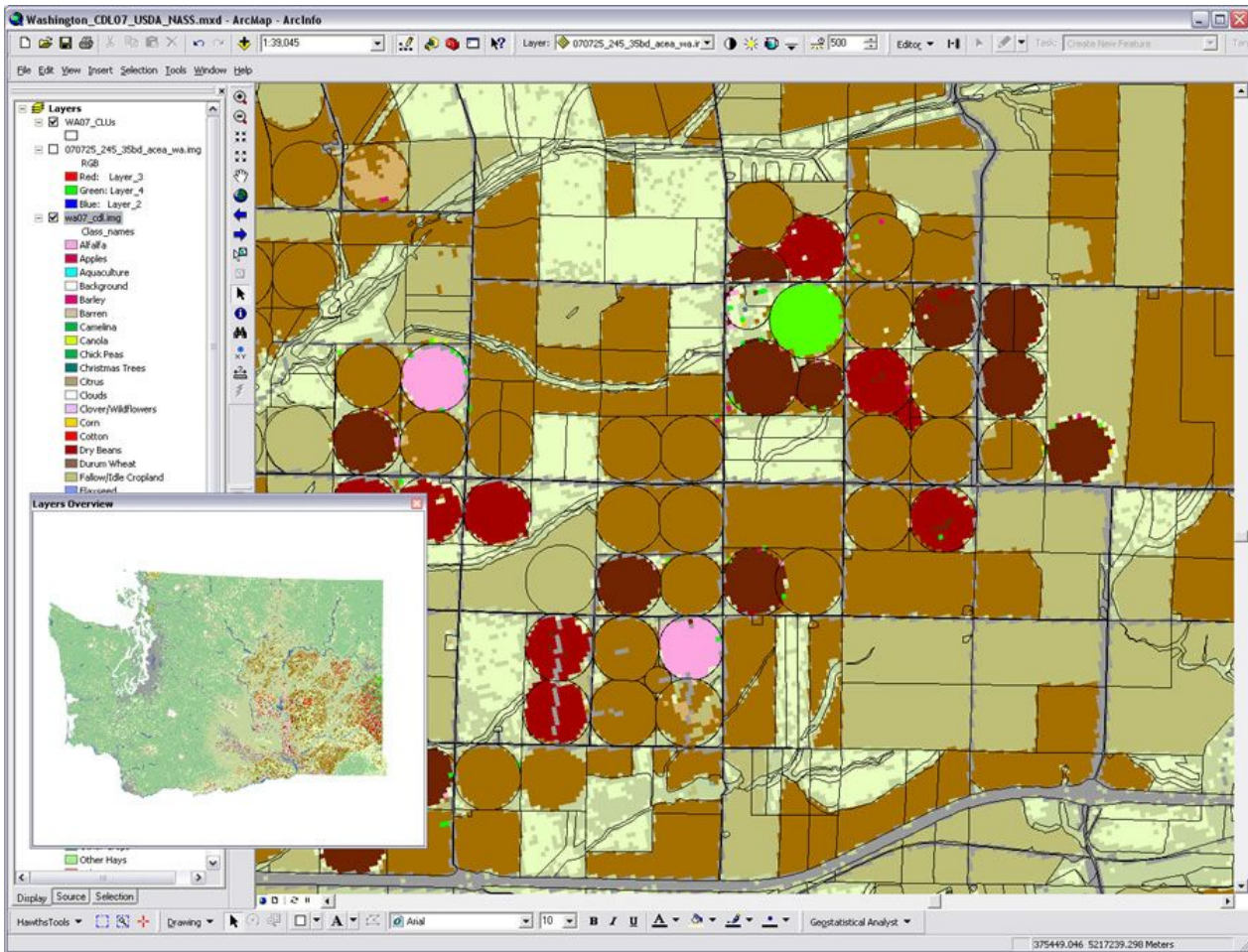
Fallow/Idle Cropland  
Alfalfa  
Cotton  
Other Crops  
Vegetables/Fruits/Nuts

Sorghum  
Other Small Grains  
Rice

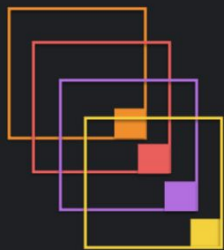
### Non-Agriculture

Woodland  
Shrubland  
Urban/Developed  
Wetlands  
Water

Barren  
Perennial Ice/Snow







stacks of pixels  
Landsat 8



NASS Cropland  
map

**x**

over  
**2 mln**  
farms

**recurrent neural network**

# Processing all data on a personal computer

3 spectral bands: **Red, Green, NIR**

**15M** images per day

**210M** pixels per image

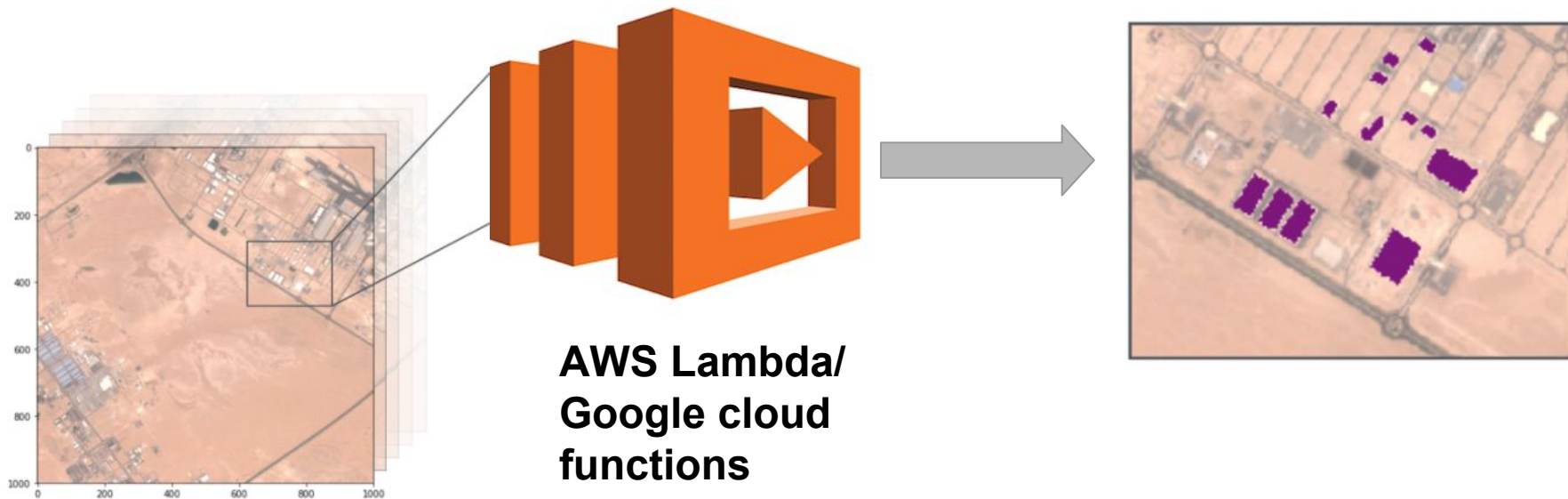
Time for processing of 1 scene - **30 seconds**

Time for processing daily archive - **17 years**

**And less than 1% of this data is actually used!**



# Implementation - Function as a Service



<https://github.com/ryfeus/lambda-packs>

<https://github.com/ryfeus/gcf-packs>

# Implementation - Advantages

- capacity for parallelization - 40000 calls per datacenter
- Cost model - pay per invocation (not pay per hour)
- Quick deployment
- Traceability

# Demo time

1. Data sources - Landsat 8 and Sentinel-2 on AWS and GCP
  - a. <https://registry.opendata.aws/landsat-8/>
  - b. <http://sentinel-pds.s3-website.eu-central-1.amazonaws.com/>
  - c. <https://cloud.google.com/storage/docs/public-datasets/landsat>
  - d. <https://cloud.google.com/storage/docs/public-datasets/sentinel-2>
2. Working with images in QGIS <https://qgis.org/>
3. Working with images in rasterio <https://github.com/mapbox/rasterio>



Questions??

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