Field-level crop identification and condition monitoring
- current status and research issue

Eugene G. Yu

Liping Di

Center for Spatial Information Science and Systems

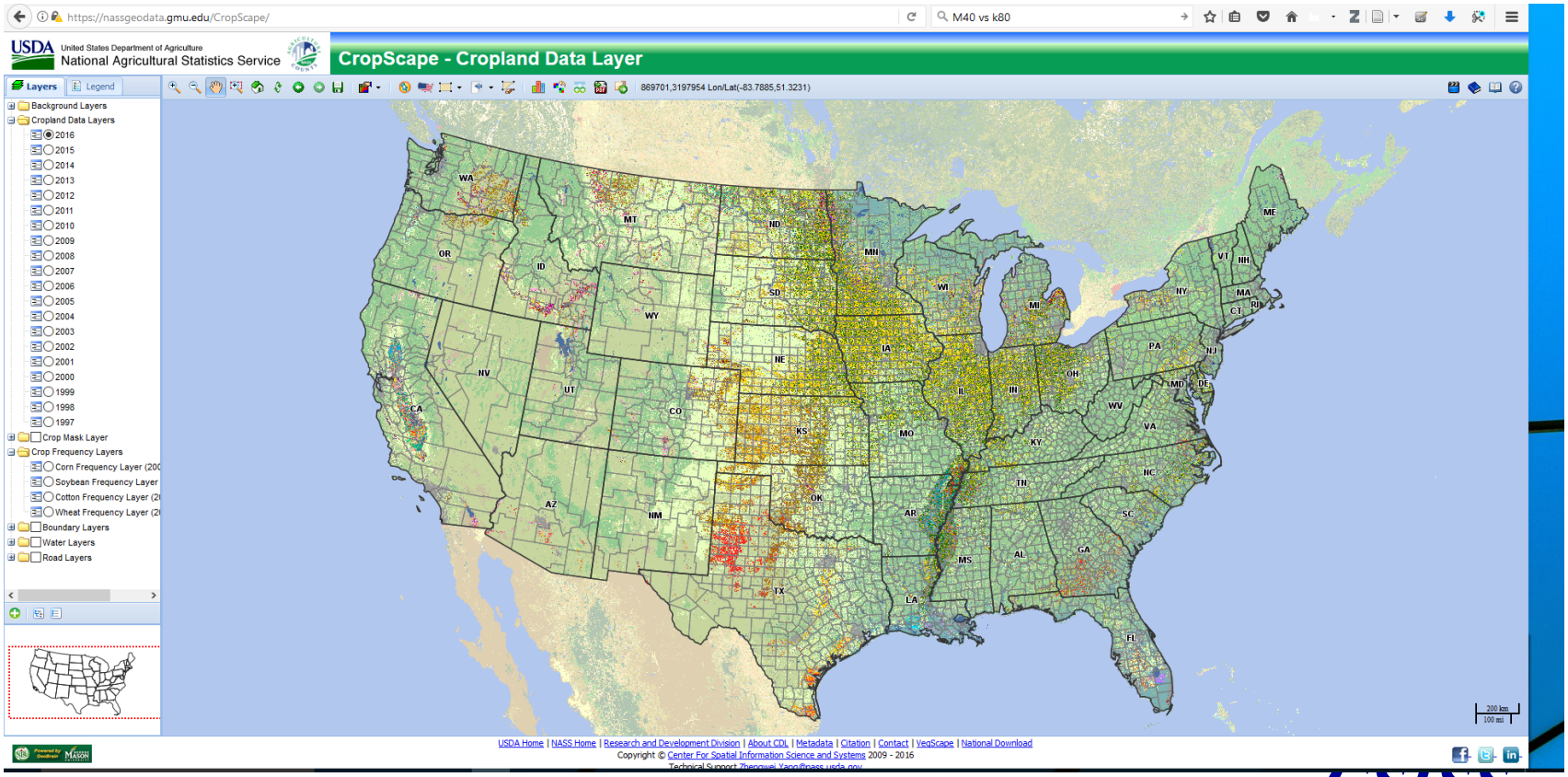
George Mason University

Cropland Data Layer

- Produced by USDA NASS
- Satellite remote sensing data source include Landsat OLI/TM/ETM, Resourcesat-1 AWiFS, UK-DMC-2
- Decision-tree-based classification scheme trained with substantial number of June survey results, Farm Service Agency (FSA) Form 578, Common Land Unit (CLU)
- Primarily 30-meter spatial resolution
- Completely annual coverage of CONUS since 2008
- Distributed through CropScape
- Accuracy is close to 95%
- Release to public in January next year.

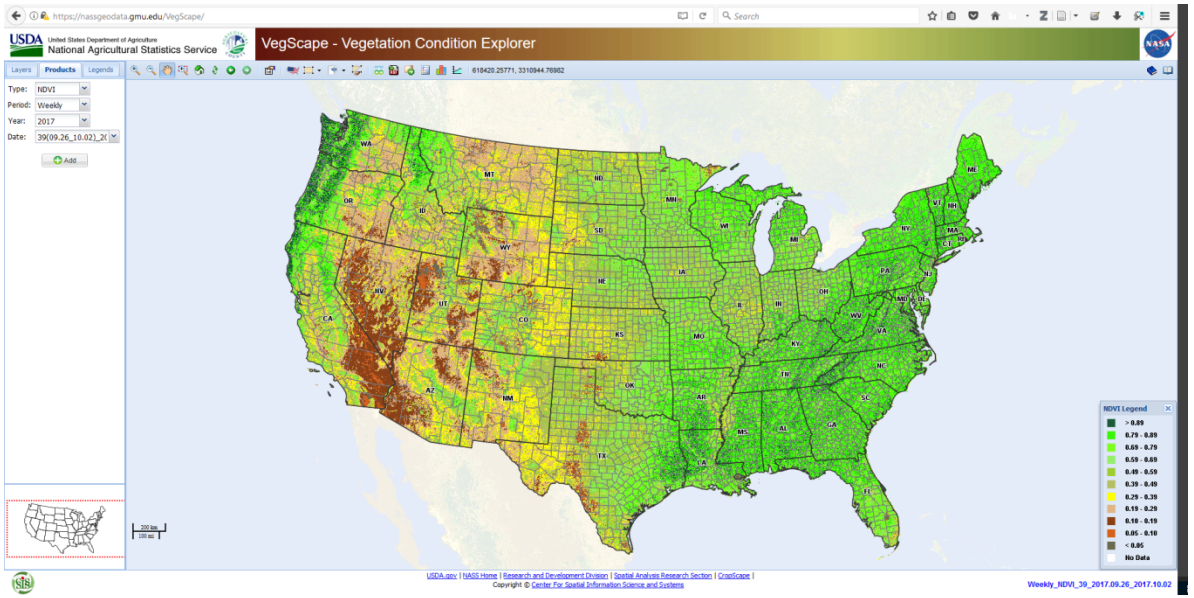
CropScape

- Standard Web Services
  - Rendering
  - Accessing



Crop Condition

- Crop conditions
  - NDVI
  - VCI
  - RVCI
  - RMVCI



The Challenges

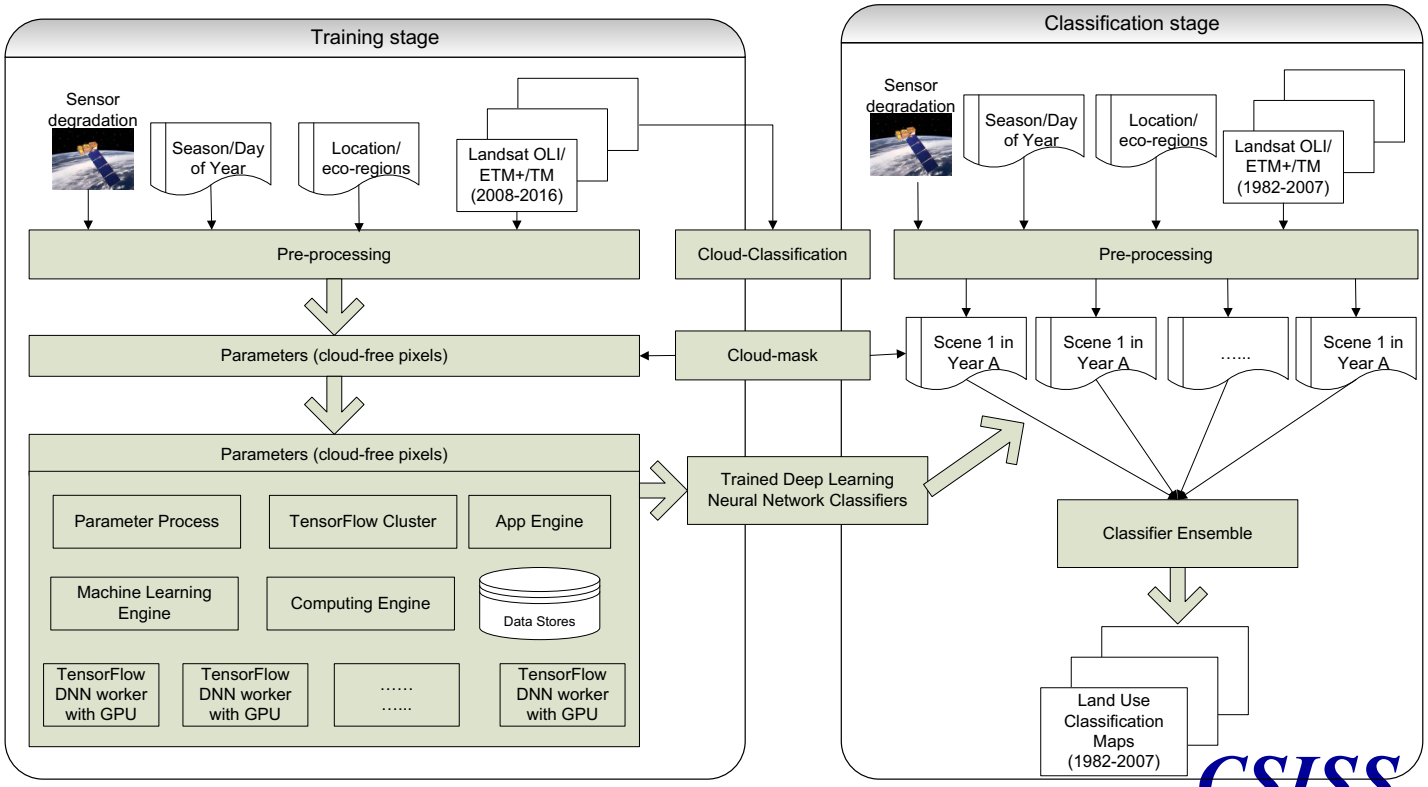
- Current CDL production relies on surveys from Farm Agency
- Release to public use after the growing season – January the following year, although the internal use may be as early as mid to late growing season.
- The complete coverage of CONUS is only available since 2008 – the time series may not be long enough to support temporally-based modeling.
- Big data challeges
  - Volume: nearly petabyte of data needs to be analyzed and mined
  - Variety: multiple sensors, multiple forms of data
  - Veracity: uncertainty of CDL and trained data

The Trend

- Using multiple sensors and multiple source of data (Waldner et al. 2017)
- High temporal/spatial resolution data (Planet Labs)
- Deep learning in cloud computing environment (Warren et al. 2015)
- Improved crop classification using crop knowledge of previous years (Hao et al. 2016)

The Roadmap to meet cropland classification requirements

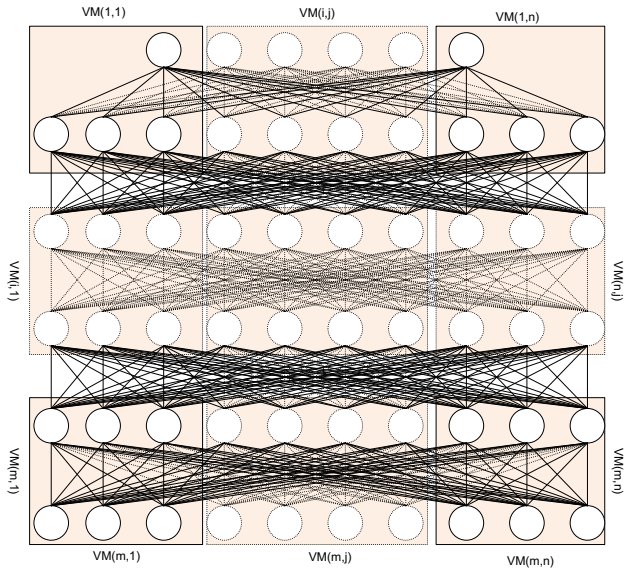
- Learn from massive data
- Classify/predict the crop types



Increase the speed of computation through parallelism

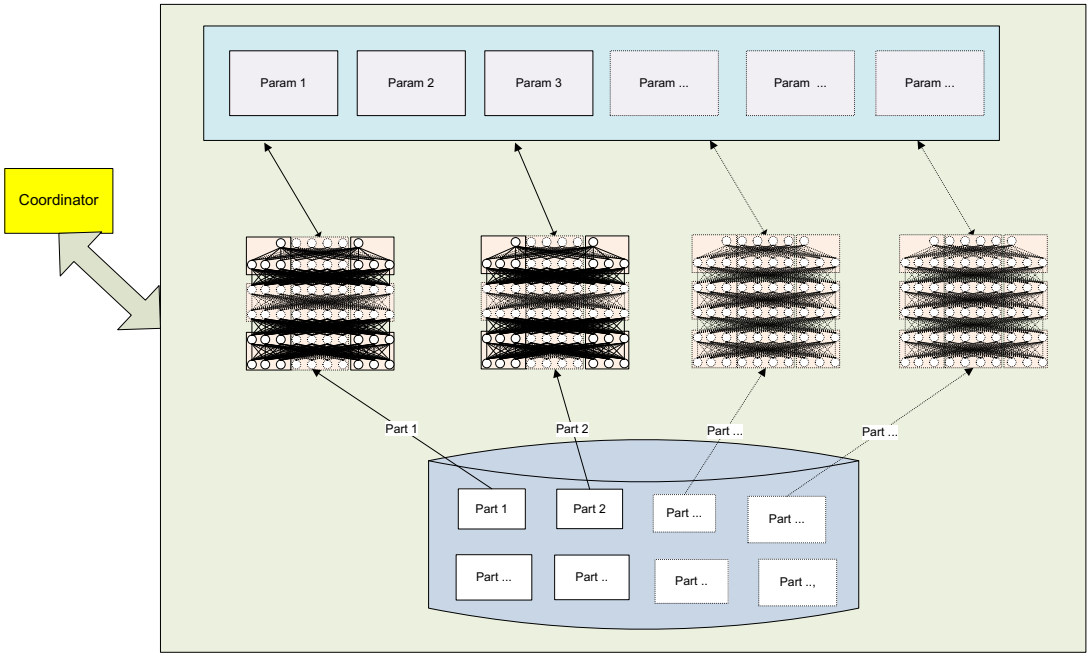
- Model parallelism
- Data parallelism

Model Parallelism



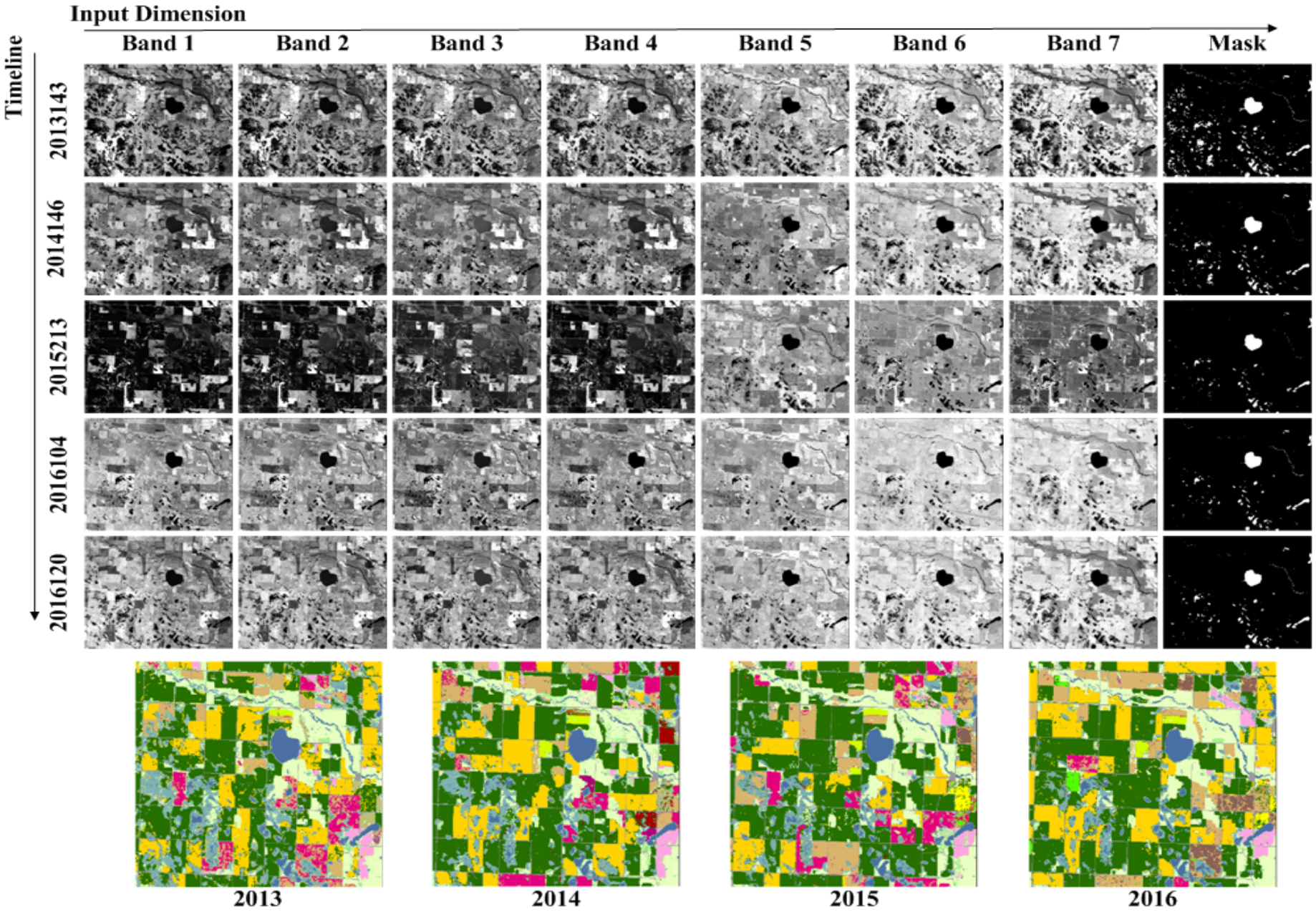
(Split into m x n partitions, where i={1,m}, j={1,n})

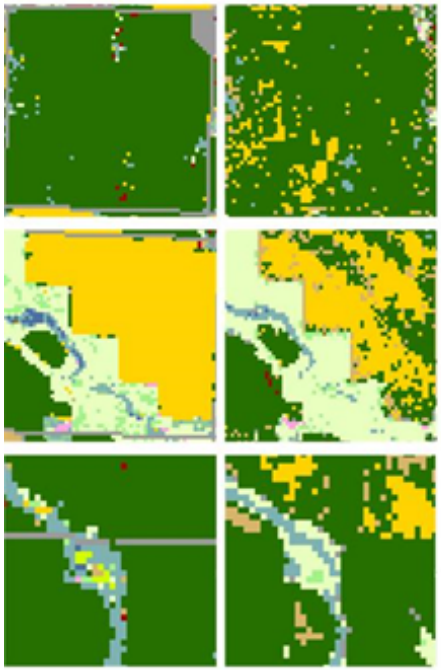
Data Parallelism



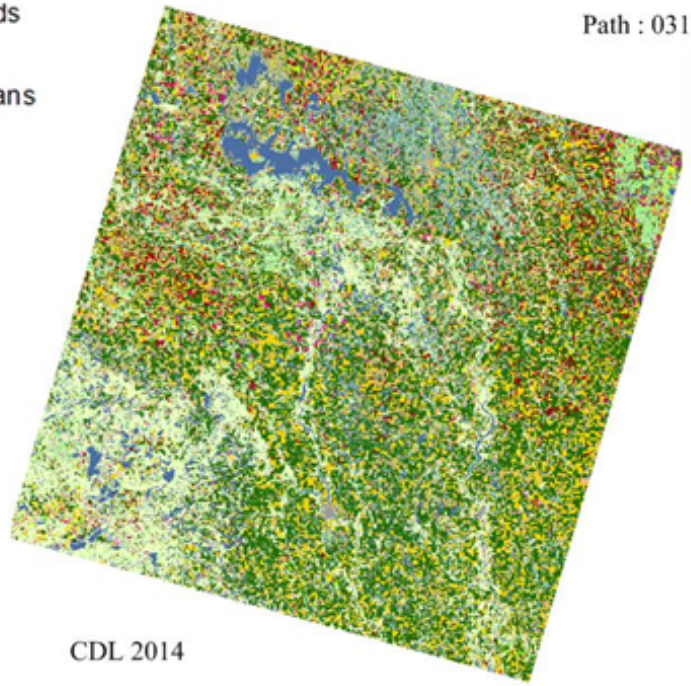
Experiment

- Experiment RNN with multiple years of Landsat data sources
- Trained with multiple years ofCDL


Input Dimension
Timeline
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Mask
2013143
2014146
2015213
2016104
2016120
2013
2014
2015
2016

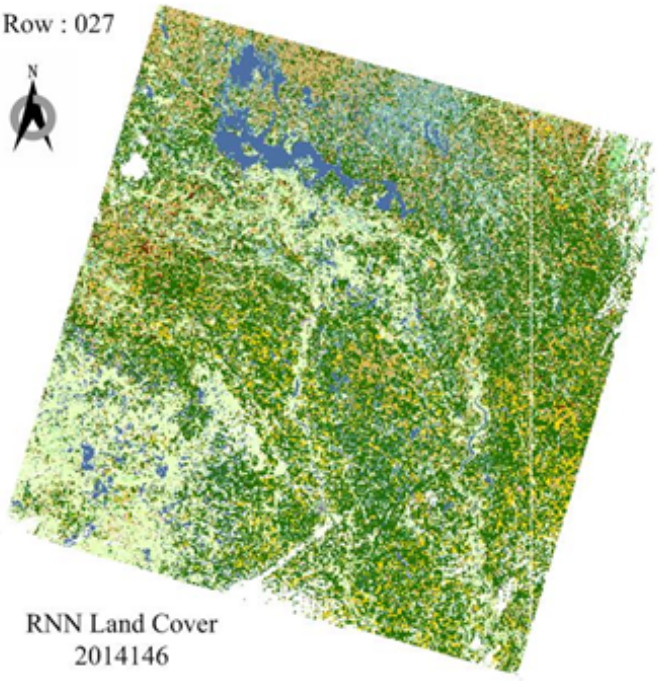


Detailed Comparison
(Left: CDL; Right: RNN)



CDL 2014

Path : 031 Row : 027



RNN Land Cover
2014146

CDL 2013

RNN Land Cover 2013143

What's next?

- Continue on experimenting the alternative deep learning approaches to enhance the filed crop classification
- Collecting and incorporating more data sources
- Extracting features for crop classification
- Leverage both cloud computing, GPU-enhanced computing, and deep learning to learn from big data (multiple sensor data, historical data, and other data)