

Satellite Imagery

Lecture 29: CSE 490c

TECHNOLOGY

Can Satellites Learn to 'See' Poverty?

A new team improves on the old "Earth at night" technique.

ROBINSON MEYER AUG 24, 2016



The International Space Station passes over the glowing Earth at night. (NASA)

Topics

- Data Science for Development
- AI for Social Good

- Today
 - Satellite Imagery

Announcements

- Programming Assignment 4 Due December 11
- You have received the teaching evaluation link.
Complete evaluations by December 9

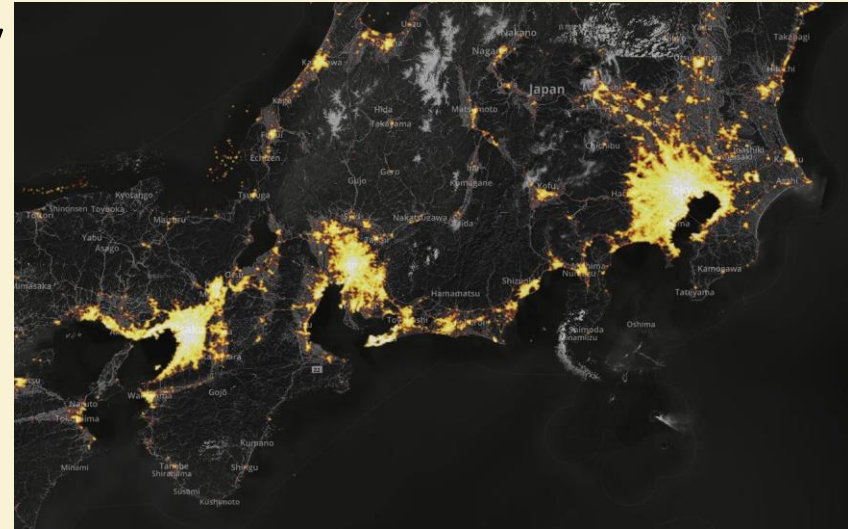
A high response rate is very important for meaningful results. We will send reminder emails to non-responders during the evaluation period. In addition, studies show that instructor involvement can increase response rates as much as 15-20%.

Satellite Images

- Satellite Imagery much easier to get than CDRs
 - Public data sets
 - Medium quality data available from free
 - High quality data requires paying commercial fees or being a spy agency

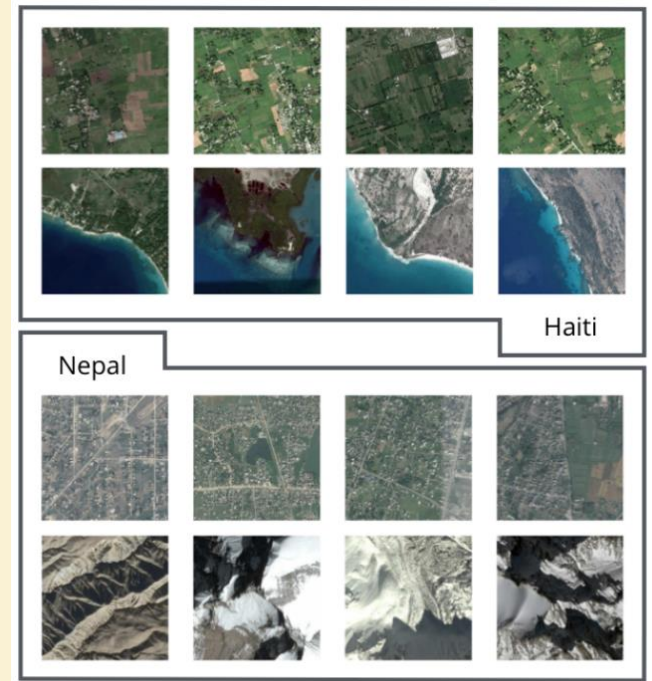
Night light imagery

- Relatively easy to pre-process
 - But some details, such as removing gas flares
- Basic question: how well does light correlate with economic activity
 - Population
 - Economic level
 - Quality of electrical grid



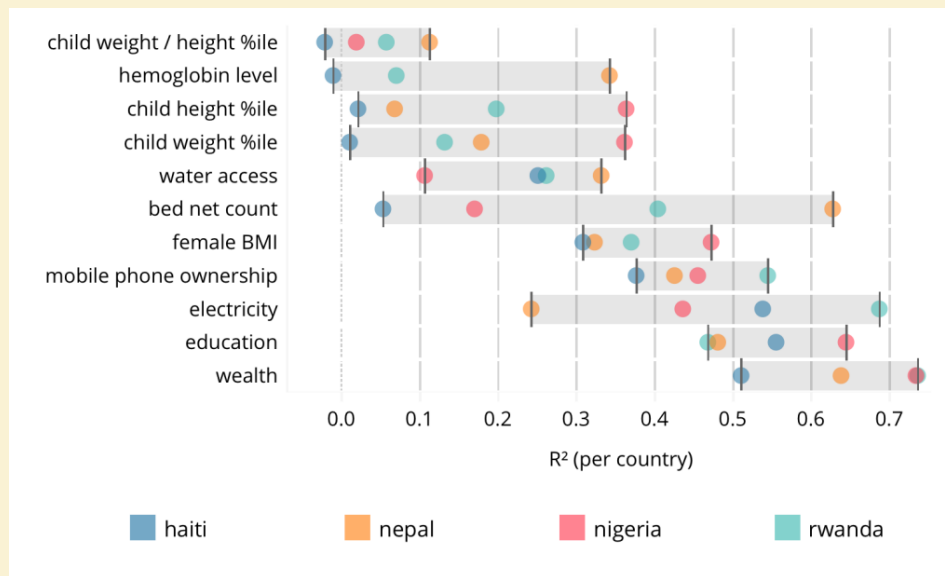
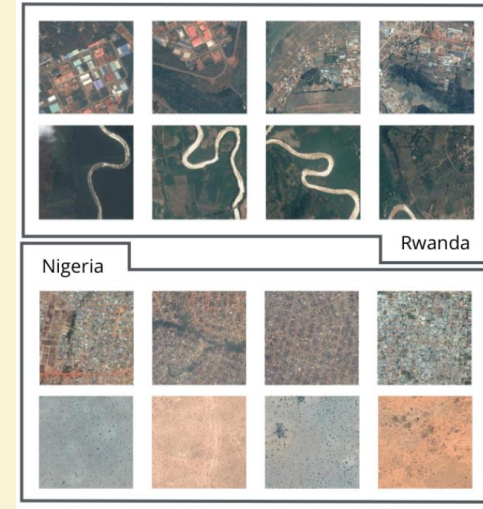
Can Human Development be Measured with Satellite Imagery

- Demographic Health Surveys
 - Wealth
 - Education
 - Access to Water
 - Health Indices
 - Anthropometric Indices
 - Electricity and Phones



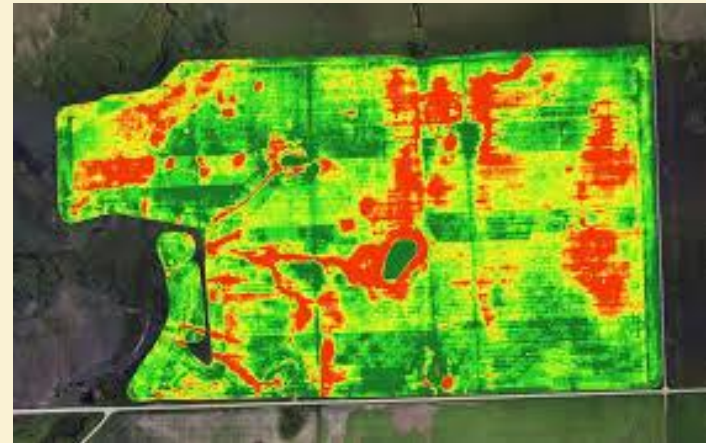
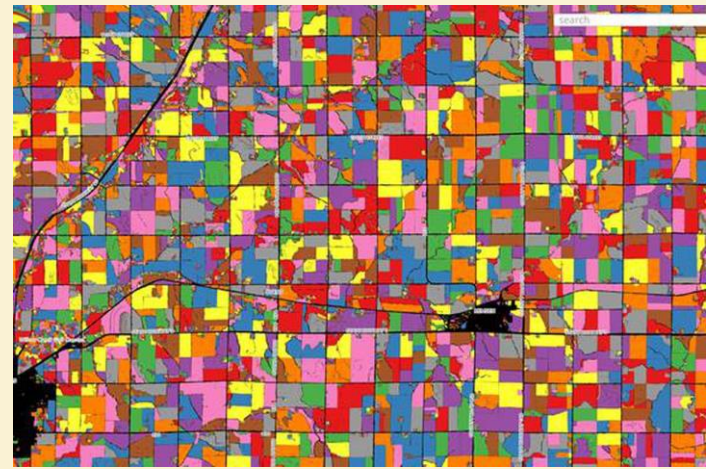
Demographic Prediction

- Transfer learning
- Methodology
 - Train Neural Network (CNN) on Geographic Features to predict Night Light
 - Extract model from CNN
 - Build regression model for development indicators using model and image features
- Separate training for four countries



Crop Imaging

- Wide range of problems
- Crop identification
- Yield Prediction
- Field Assessment
- Technical issues
 - Different forms of imaging
 - Image filtering: vegetation indices
 - Image segmentation and machine learning



Agriculture Problems



- Technology to support agriculture is big business (including satellite imaging)
- Most benefits go to rich country agribusiness
- How are applications different for poor countries?
 - Technology transfer versus appropriate technology
- System wide interventions, e.g., predicting crop productions is obvious
 - What about cases where farmers can intervene?



Crop Insurance

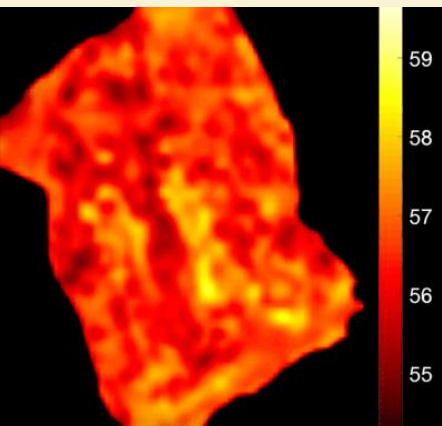


- Crop insurance is important for developed world agriculture
 - Insure against crop loss
 - Insure against price changes
 - Allows greater risk with high value crops
- Insurance rarely available in developing countries
 - High cost of administration, low value of crops
 - Difficulty in assessing loss
- Startups offering crop insurance in developing countries
 - Image based assessment of crops for verification and loss inspection

Farm Beats



- Microsoft project for Intelligent Agriculture
- Sensor and image based analysis
- Use of balloons for collecting crop images
- Identification of problems in fields that farmers can address
 - Pools of water, dry areas, weed infestations, cow poop



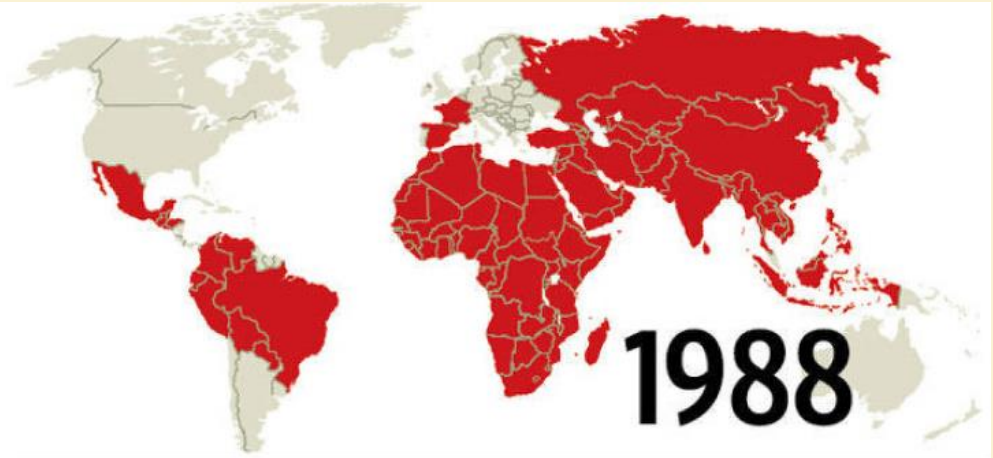
Polio Elimination

The polio endgame

Since 1988, when the WHO resolved to eradicate polio, its footprint has shrunk dramatically. It is only considered endemic in Afghanistan, Pakistan and Nigeria (which hasn't seen a case since 2016). Last year there were only 22 new cases reported.

	1988	2017
■ Endemic countries	125	3

SOURCE: World Health Organization
TORONTO STAR GRAPHIC

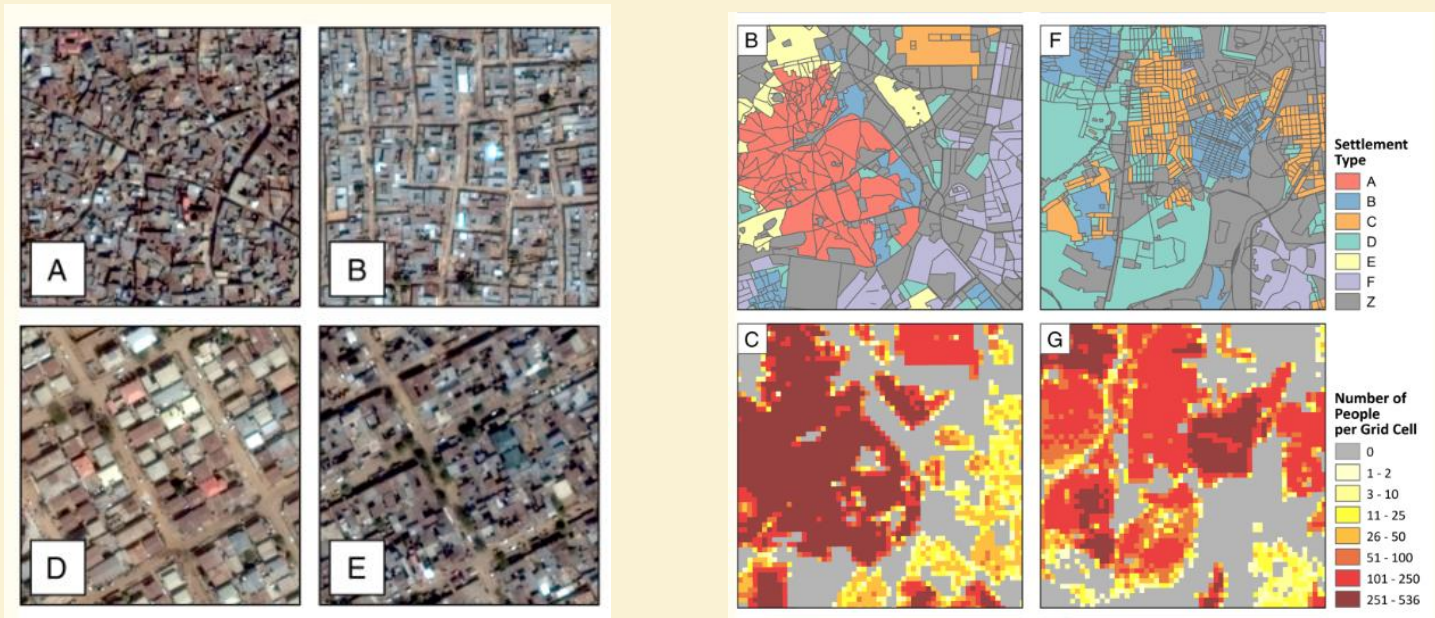


Elimination Process

- Global Polio Immunization
- Intensive monitoring for suspected cases
- Immunization campaigns
- Identifying the population is a challenge
 - Poor census data
 - No maps

Population mapping in Northern Nigeria

- Identify population and settlements
- Difficult area
 - But good for imaging – flat and few trees



Malaria Follow up



- Indoor residual spraying
 - Spray all households in area of a malaria case
- Challenge is mapping and tracking houses
- MSpray application (developed by Ona)
 - House identification for aerial photographs

