Global Analysis of Snow Cover Changes Using MODIS and Google Earth Engine

By: Jim Coll
Importance of This Project

• To establish whether or not Google Earth Engine is a viable platform for this type of “big data” analysis

• Depending on the time of year, snow coverage represents a significant portion of the high albedo land surface, which dictates global energy balances

• Snow melt is a significant source of drinking water for as much as 1/6\textsuperscript{th} of the world's population

• Snow melt from mountainous regions plays a supportive role in maintaining flow for lower stream and river reaches

• The winter tourism industry is a 12.2 billion dollar industry and represents a significant portion of several states yearly revenue
What is Google Earth Engine?

Google Earth Engine is a massive data warehouse (2+ petabytes) of remote sensing imagery including all past Landsat and MODIS data. The platform supports JavaScript and Python analysis of these data, and performs the calculations across their servers, eliminating the need for the end user to manage those details.
Project Details

The Questions

• Can this analysis be preformed in a timely manner?
• Where and how is snow cover frequency changing across the globe?
• Are there patterns to those changes?

Past Research

• Many longer term, localized studies, primarily based on Landsat or weather station data
  • Some stations data go back to the 1960’s
• Few continent-scale studies
  • Most focus on extent
• Painter et al have mapped snow using a custom MODIS data set, but performed calculations at a large watershed scale and were focused on percent minimum exposed snow and ice
• None have approached the spatial resolution or global scope that MODIS provides
Previous Results

“The standardized SCE time series vary and trend coherently over Eurasia and North America, with evidence of a poleward amplification of decreasing SCE trends during spring.”

- Dery and Brown
The Method

Creating A More Useful Dataset

- Using MODIS Terra as the basal layer
- Cloud cover interference represents the greatest loss of potential observations
- Terra and Aqua pass over the equator ~ 3 hours apart, catching new land surface as clouds move
- By combining both satellites and applying a temporal filter, a virtually cloud free land cover classification can be created
Preliminary Results:

Mann-Kendall significant (P < 0.05) Trend
Questions?

Google Earth Engine

Future analysis

• Monthly changes
• Snow cover extent, snow cover duration, snow cover onset
• Snowfall event detection
• Comparison and collaboration with other major snow monitoring labs

Acknowledgements:

Huge thank you to Google for providing the funding and computational power of the Google Earth Engine to perform this research.