Comparing Vegetation Phenology, Temperature, and Precipitation Data in Bhutan | Alabama -Marshall

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Introduction

Bhutan is a small country situated between India and the Tibet Autonomous Region of China, located in the fragile Eastern Himalayan Region. In addition to the increased population and rapid development, climate change poses a threat to the environment and to the sustainable development and the livelihood of the people. The study analyzed following bio-climatic variables:

1. Phenology: The scientific study of cyclic time like a season (Zhang et al., 2003). For this project, we focused solely on season 1, which is the time from the beginning of significant vegetation growth to end of significant vegetation growth.

2. Temperature: A physical quantity that expresses the hot and/or cold of a system (Agrawal et al., 2014).

3. Precipitation: A form of water from the atmosphere (Agrawal et al., 2014). We did a trend analysis on precipitation and rainfall on a daily basis.

Objective

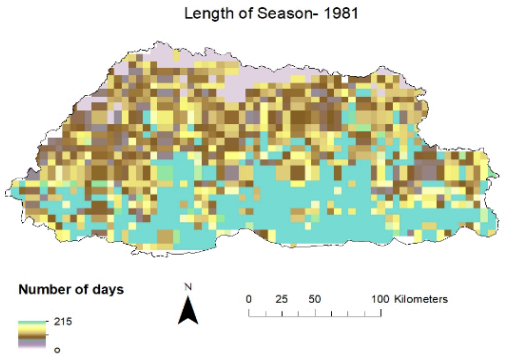
This project will help raise climate change awareness and expand on educational outreach. This research will aid UWICER to strengthen the efforts in better understanding how climate is changing across Bhutan and show these changes for the last 40 years (1981-2020) regarding phenology and climatology.

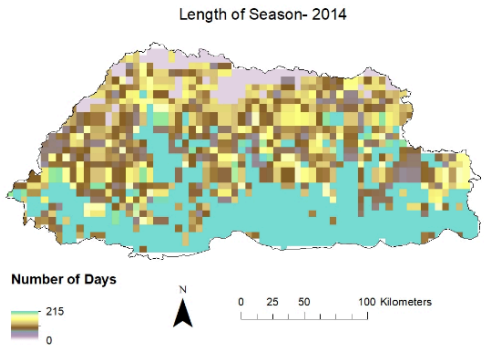
Method

VIP Phenology data which uses MODIS and AVHRR were collected and uploaded to Google Earth Engine (GEE) to assess phenology variables. The data were clipped to the country boundary in QGIS. Precipitation and Temperature data were processed in GEE. Height Above Nearest Drainage (HAND) was applied to all the datasets to mask out higher elevations and narrow to the region of interest. The phenology, temperature, and precipitation data were then viewed and mapped in ArcGIS Pro to create visual representations. All data was analyzed in Microsoft Excel and Minitab to see trends in phenology, temperature, and precipitation.

Result

While comparing the length of season pixels for 1981 and 2014 in the data collected, the teal color represents longer seasons and as the color band changes from teal to brown, it shows the shortening of seasons. The purple color represents areas experiencing fewer to no change in length of season. Season 1 has gotten slightly longer by about 23.5 days in the past 32 years.





Conclusion

Seasonal and climatic variability has had major effects in Bhutan. Satellite-derived and modeled data like CHIRPS, FLDAS, and MODIS were used to assess trends in precipitation, temperature, and phenology in the country of Bhutan. The entire country was our focus region with high elevation points and snowcaps masked out, using HAND in Google Earth Engine, as opposed to the previous work that was only focused on 3 districts. If needed, our prototype can be used to focus on specific regions. We saw a gradual increase in the temperature over the past 40 years by 0.9 degrees Celsius and while comparing ground data to satellite data, we saw they had a strong correlation with the R-value of 0.903.

There was also an overall increase in annual rainfall by 68.8mm and we saw the correlation for ground data and satellite data was 0.8519 for precipitation. Based on the results acquired from analyzing the datasets, we saw an upward trend for temperature, phenology, and precipitation, which indicates that temperature has been gradually increasing and season 1 (beginning and end of significant vegetation growth) has been experiencing longer seasons by approx. 23.5 *days*. Based on the phenology results, we saw that there was an upward and increasing trend for the Day of Peak and start of season which indicates that the seasons were pushed back meaning it started later than usual.