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Climate Data Collection and Analysis Workshop

February 26, 2024

Welcome!

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Today's Schedule

Day 1: Satellite Data Processing with Open-Source Tools

09:30 – 10:00 Introduction and Computer Setup

10:00 – 10:30 Overview of Satellite Climate Data, with a focus on Hydrological Data

10:30 – 10:45 Tea/Coffee Break

10:45 – 11:15 Introduction to Google Earth Engine for free online data processing

11:15 – 12:30 Practical Example – Collecting Climate Data for Specific Locations

12:30 – 13:30 Lunch Break

13:30 – 14:30 Practical Example – Integrating Watershed Data and Mapping Climate Trends

14:30 – 14:45 Tea/Coffee Break

14:45 – 15:45 Practical Example – Creating Useful Visualizations and Consistent Reports

15:45 – 16:00 Wrap Up and Further Resources

Workshop Goals

1. Provide background knowledge on climate and climate change in the Himalaya

2. Explain how remote sensing and satellite tools can help understand the environment

3. Gain hands-on experience with online data processing tools

4. Learn about open-source hardware and how to build custom environmental sensors

5. Discuss ongoing research in High Mountain Asia related to water resources

Workshop Materials

All materials and data can be found online:

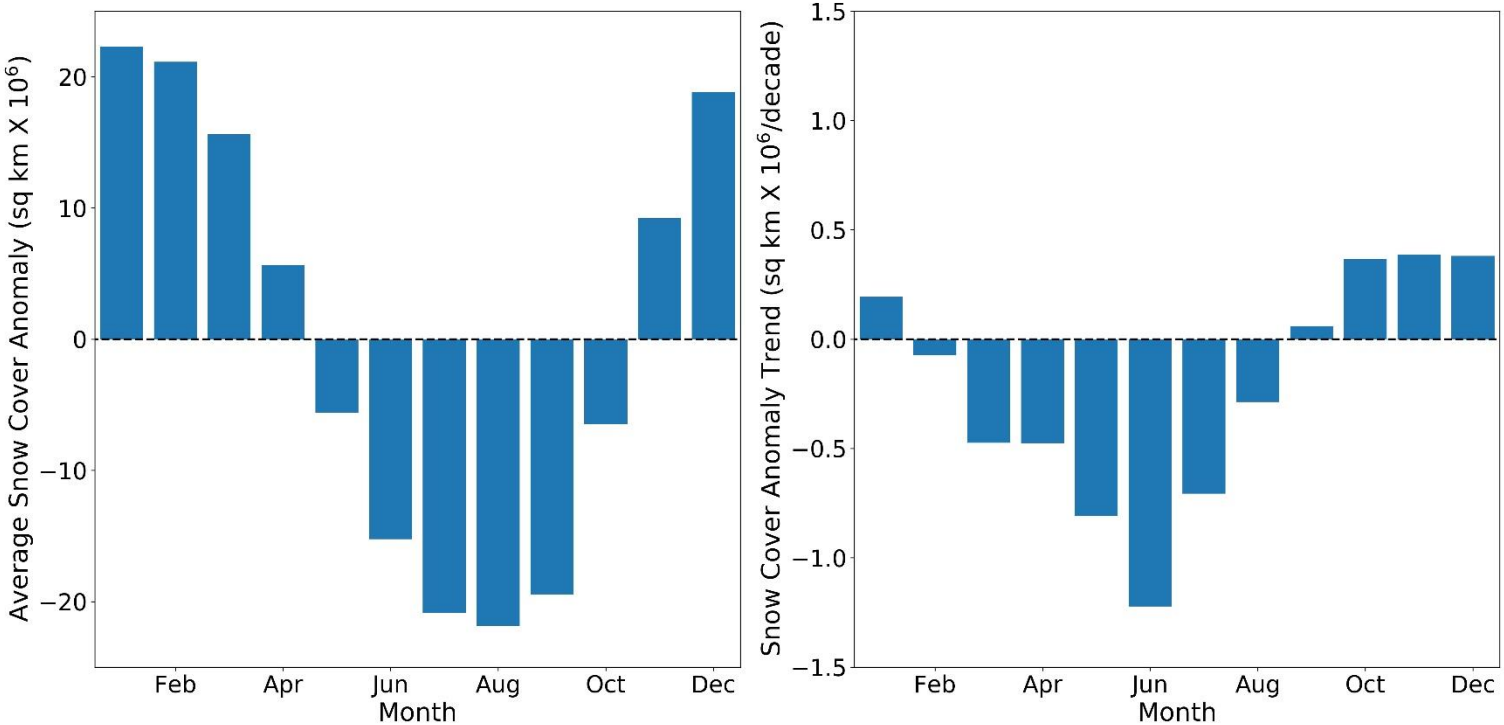
https://github.com/tasmi/Workshop_Kathmandu_Feb2024

Computer Setup

Please let us know if you had trouble with any set up!

Introduction to Snow Remote Sensing

Recent Snow Cover Trends



What are the impacts of higher air temperatures on snow?

- The atmosphere can store more water vapor
- Precipitation could shift from snow to rain
- Snow persistence could decrease
- The frequency of rain-on-snow events may increase

Data: NOAA, 2018

The Importance of Frozen Water

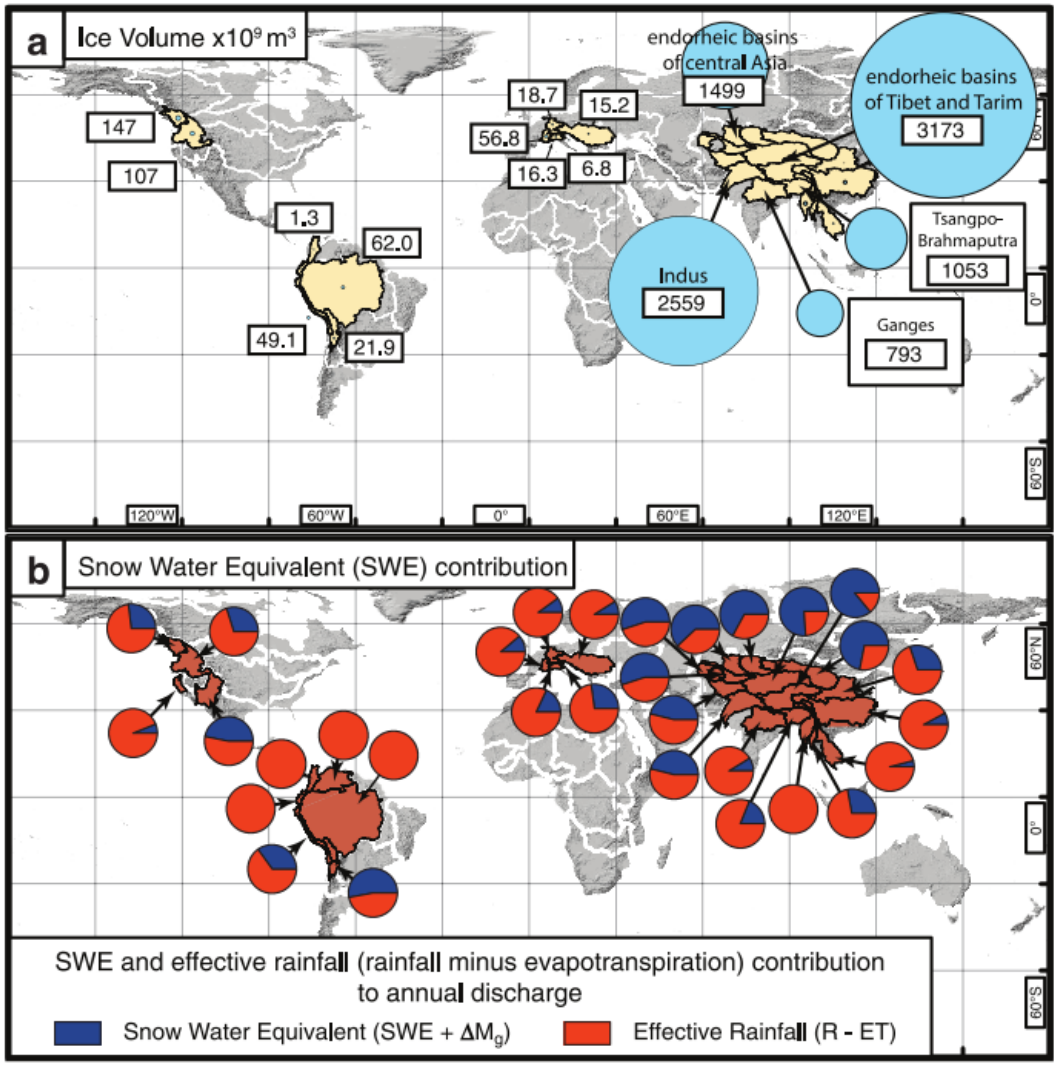
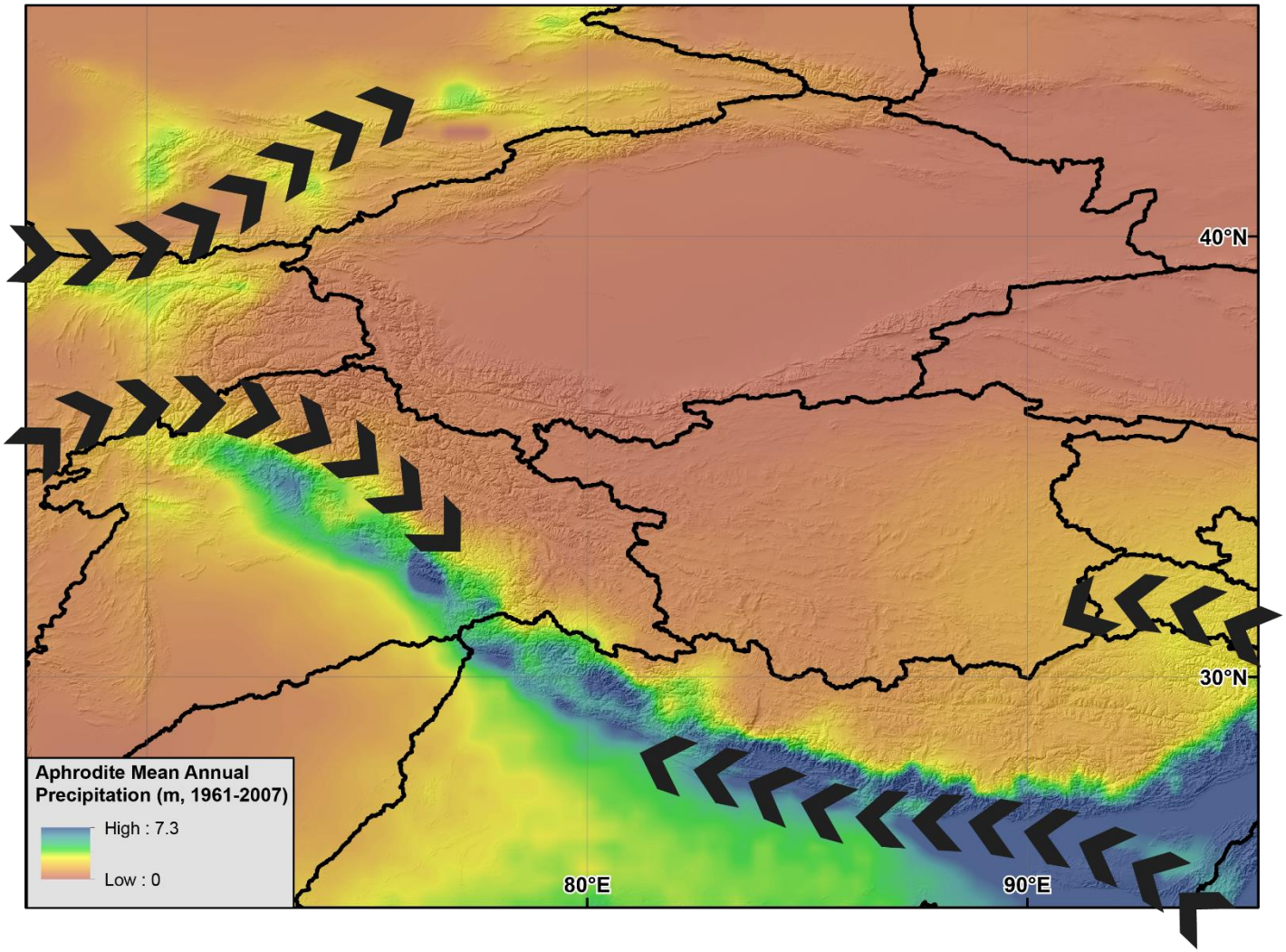
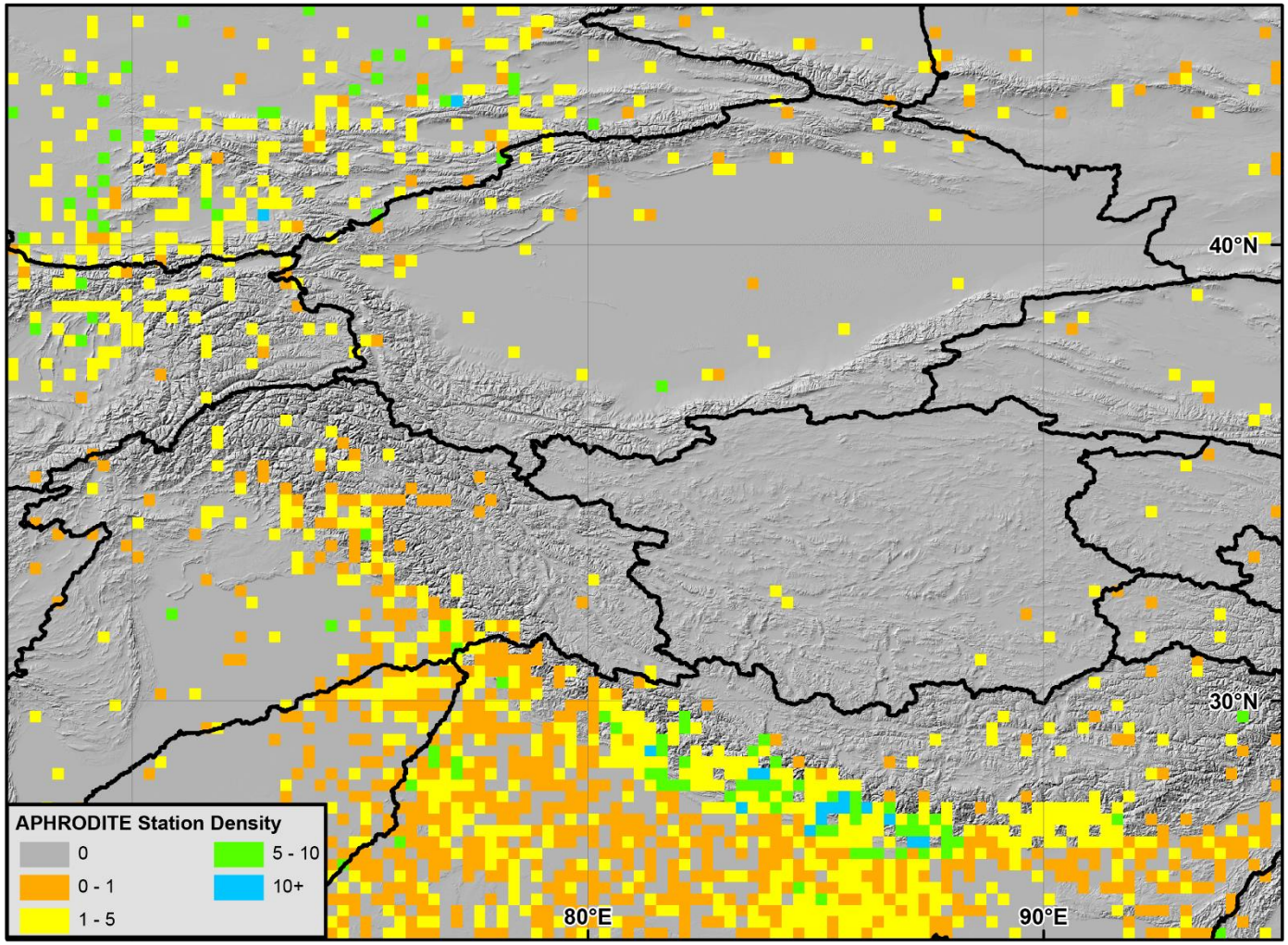


Image Credit: Huss et al., 2017

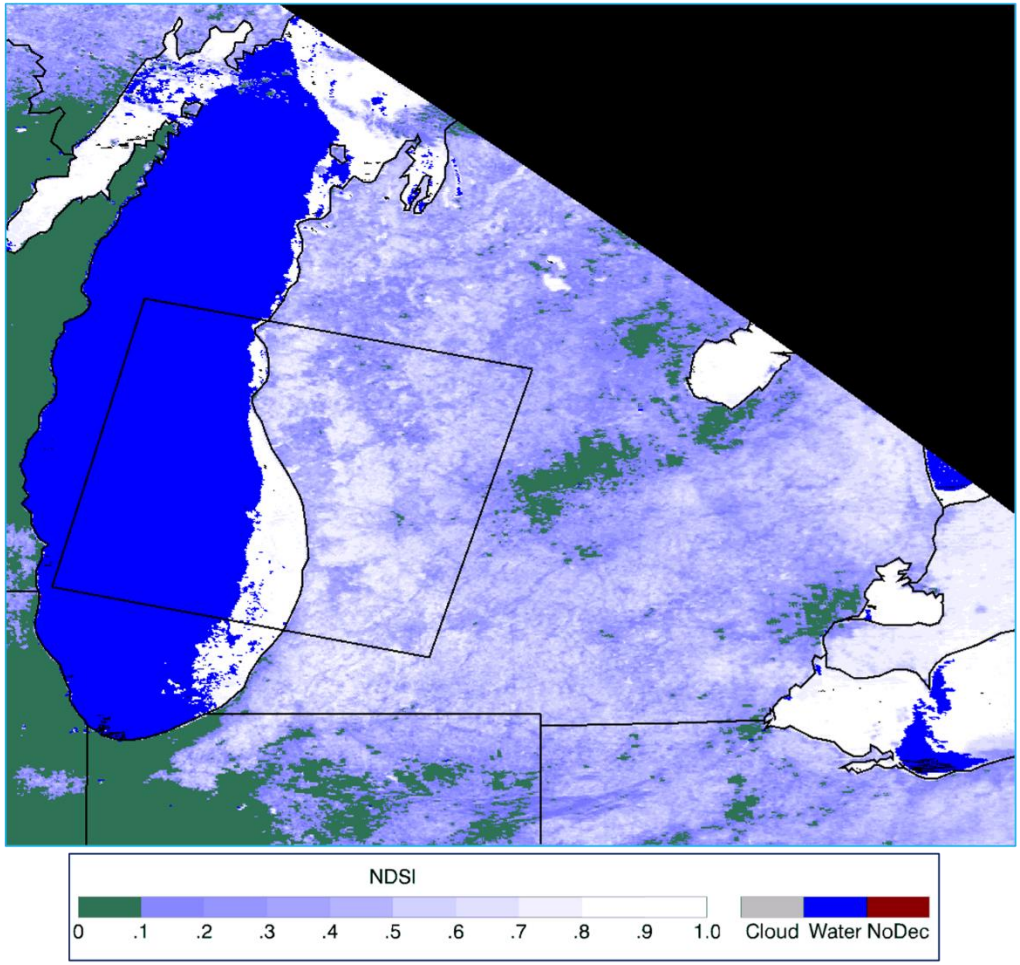
Annual Precipitation



Climate Station Density



Mapping Snow Cover



Via: https://modis-snow-ice.gsfc.nasa.gov/

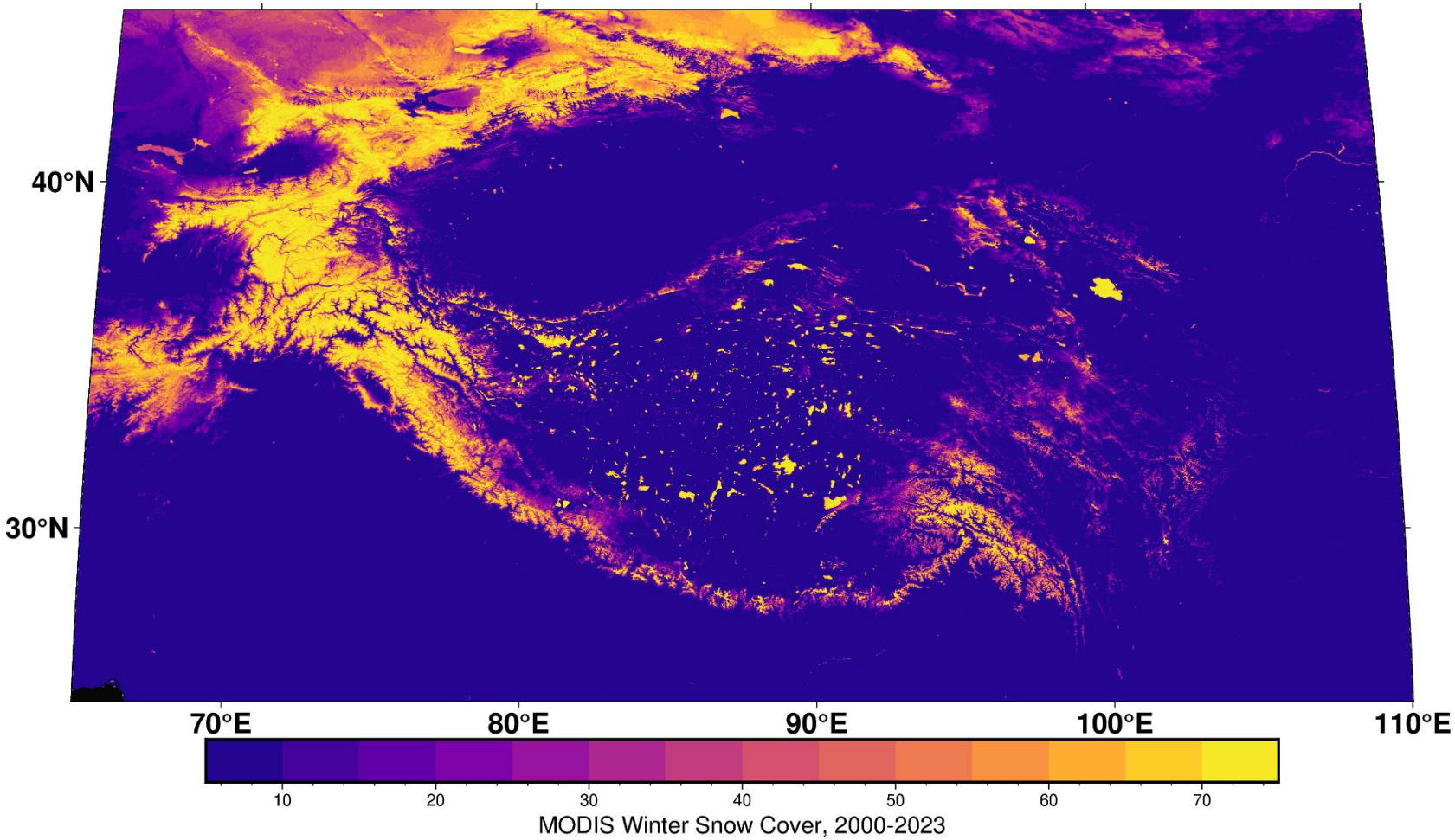
Snow cover mapping relies on visible light

This means that it cannot work under cloud cover or at night

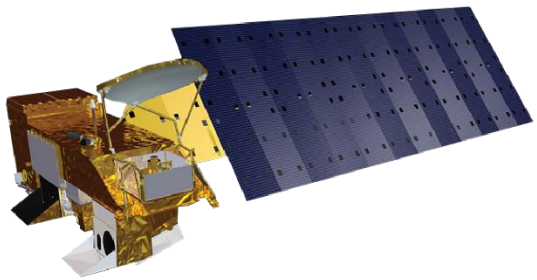
There are products ranging from 10 m to 10 km

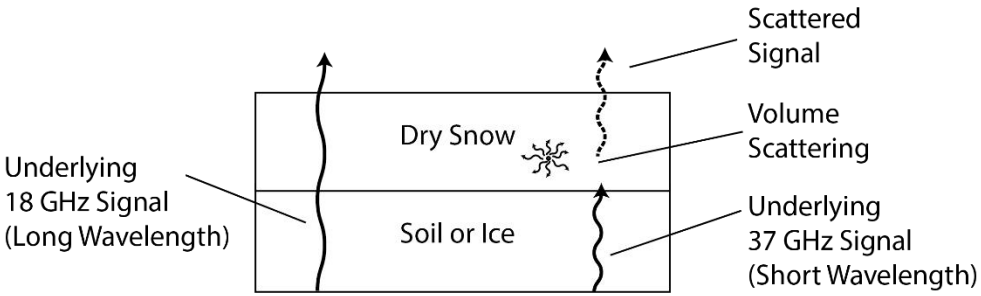
Time resolution from daily to monthly

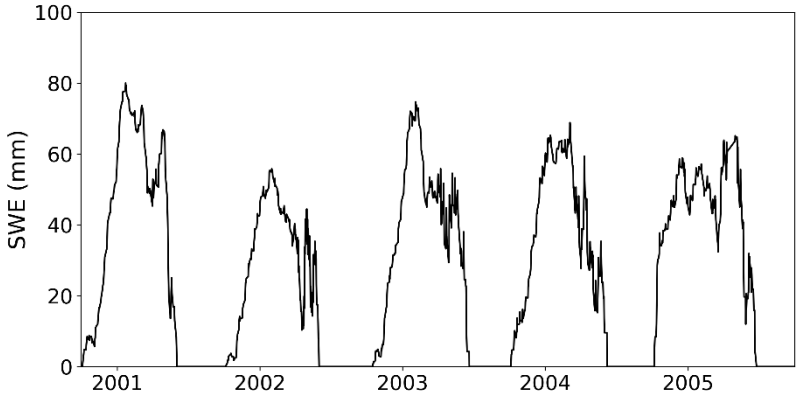
MODIS Average Winter SCA

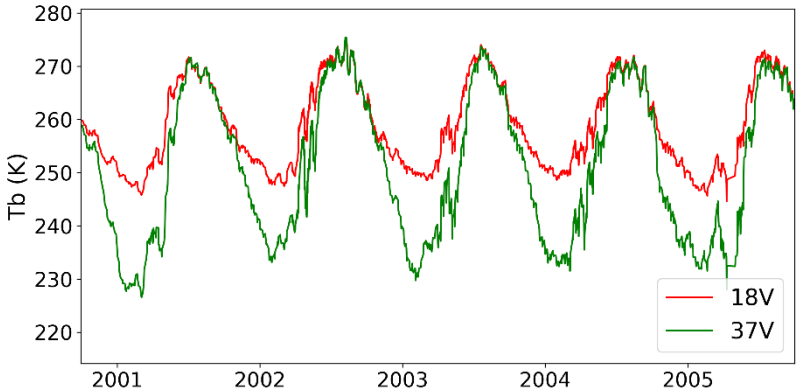


Snow Water Equivalent Calculation









This relationship was used to develop the initial snow-water equivalent algorithm:

$$\text{Snow Depth} = 1.59 * (Tb_{18V} - Tb_{37V})$$

$$\text{Snow Water Equivalent (SWE)} = \text{Snow Depth} * \text{Snow Density}$$

Annual Trends

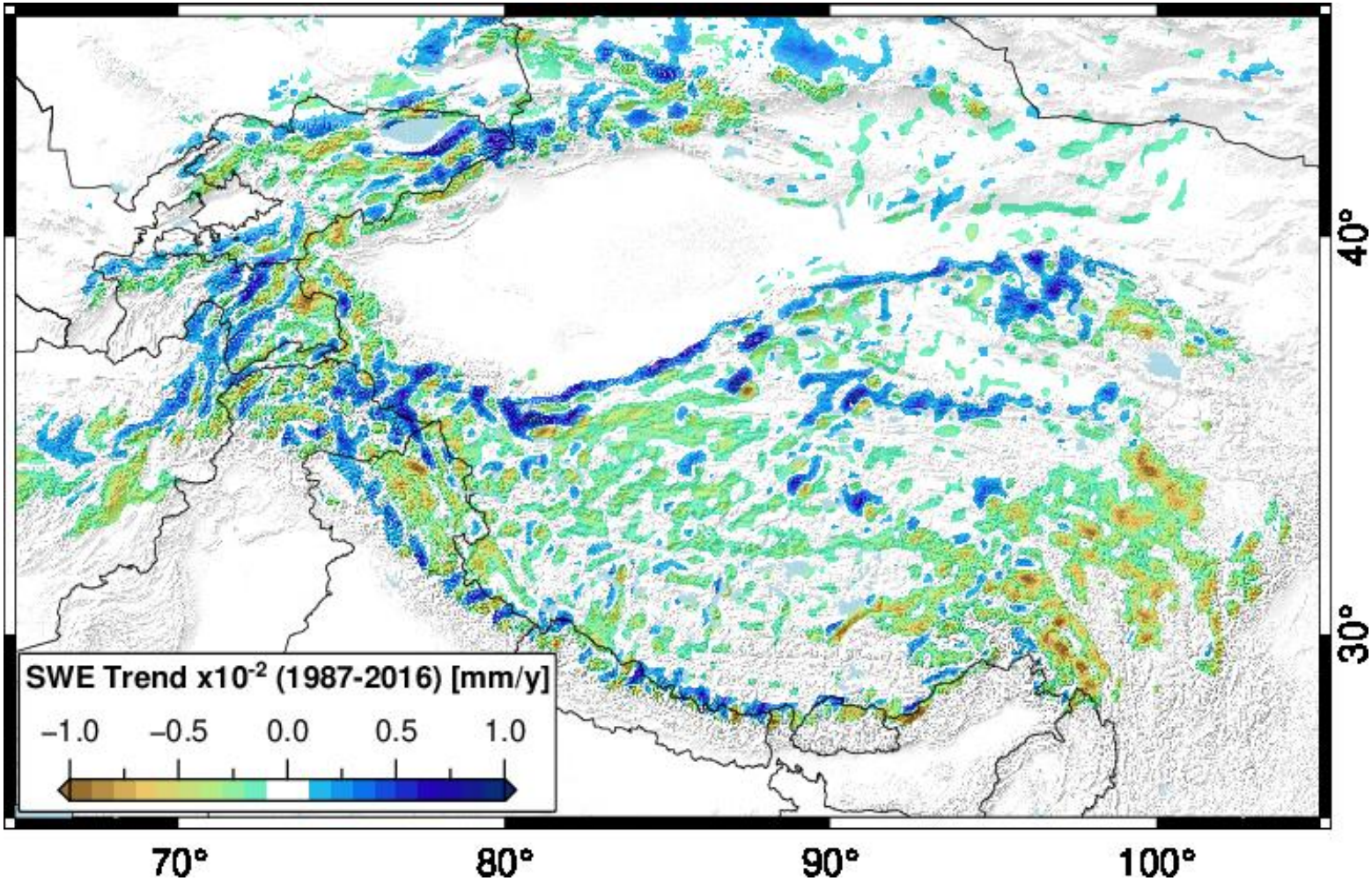


Image: Smith and Bookhagen, 2020

Seasonal Trends

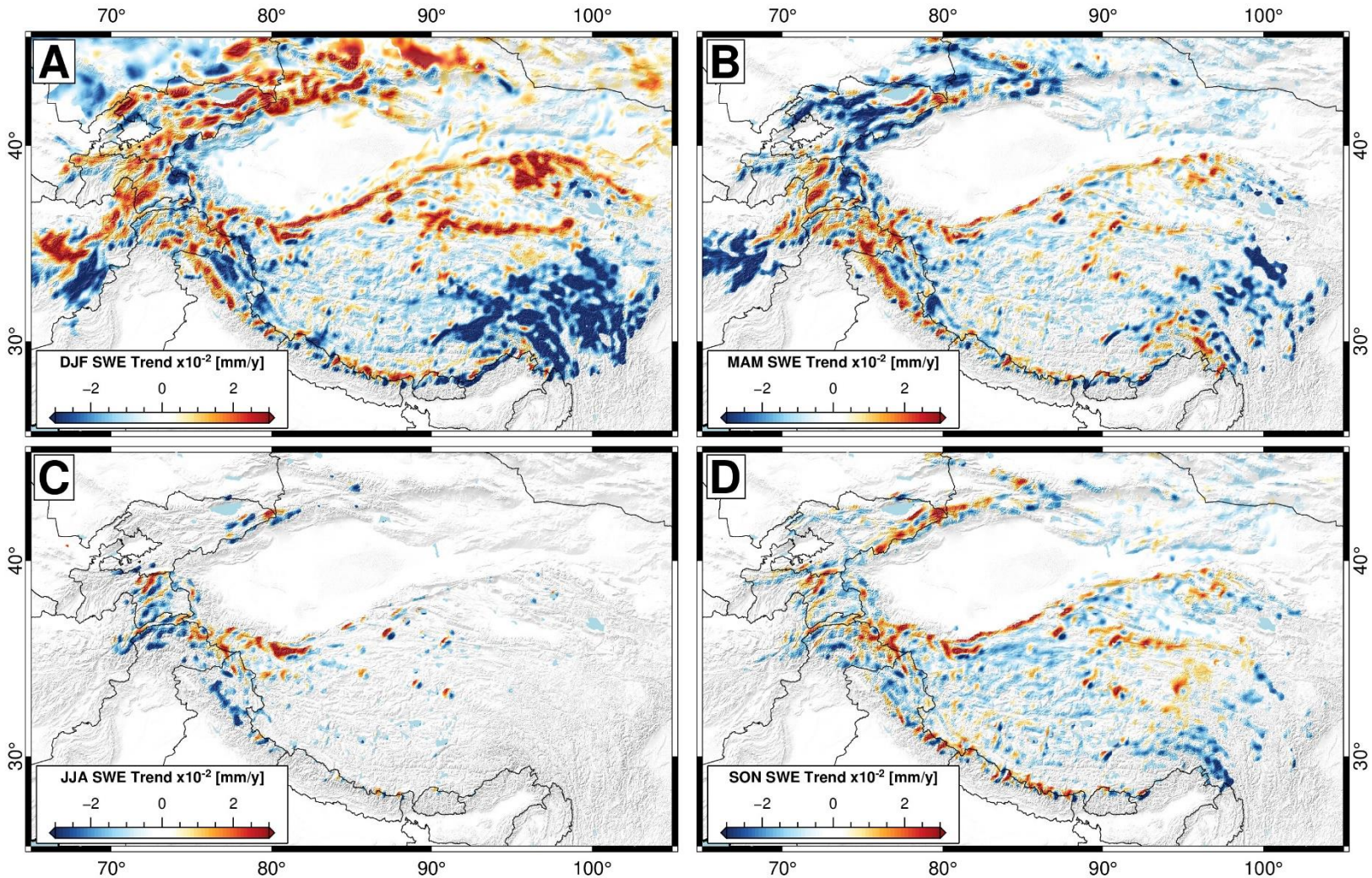
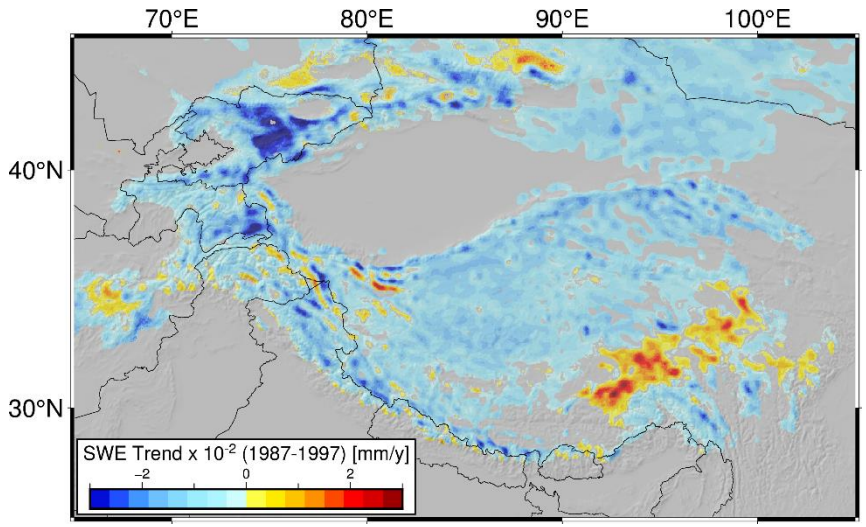


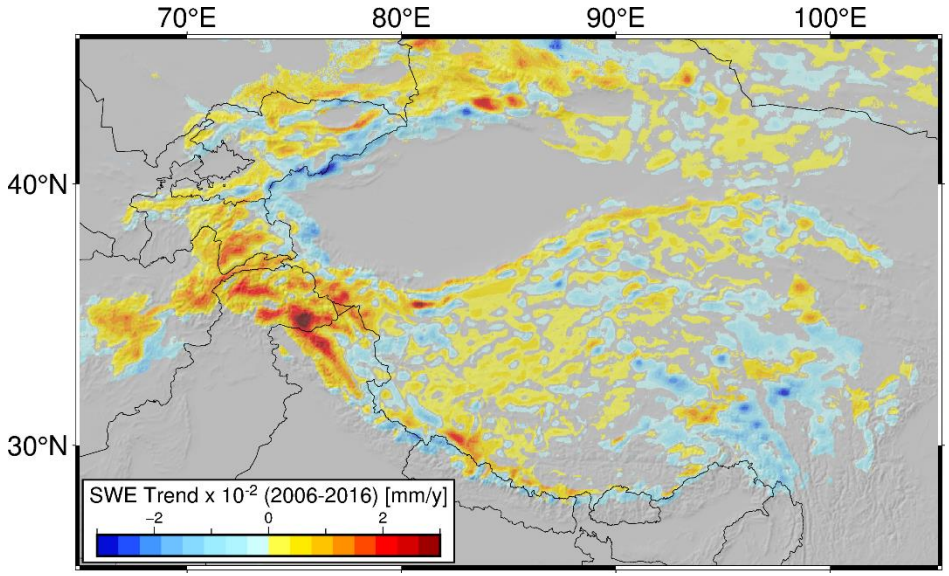
Image: Smith and Bookhagen, 2020

Changes in Trend Magnitude



1980s Trends

2000s Trends



Open Questions

There remain many data gaps in snow measurement from space

Spatial and temporal resolution are still lacking

Data remains very useful for long-term trends