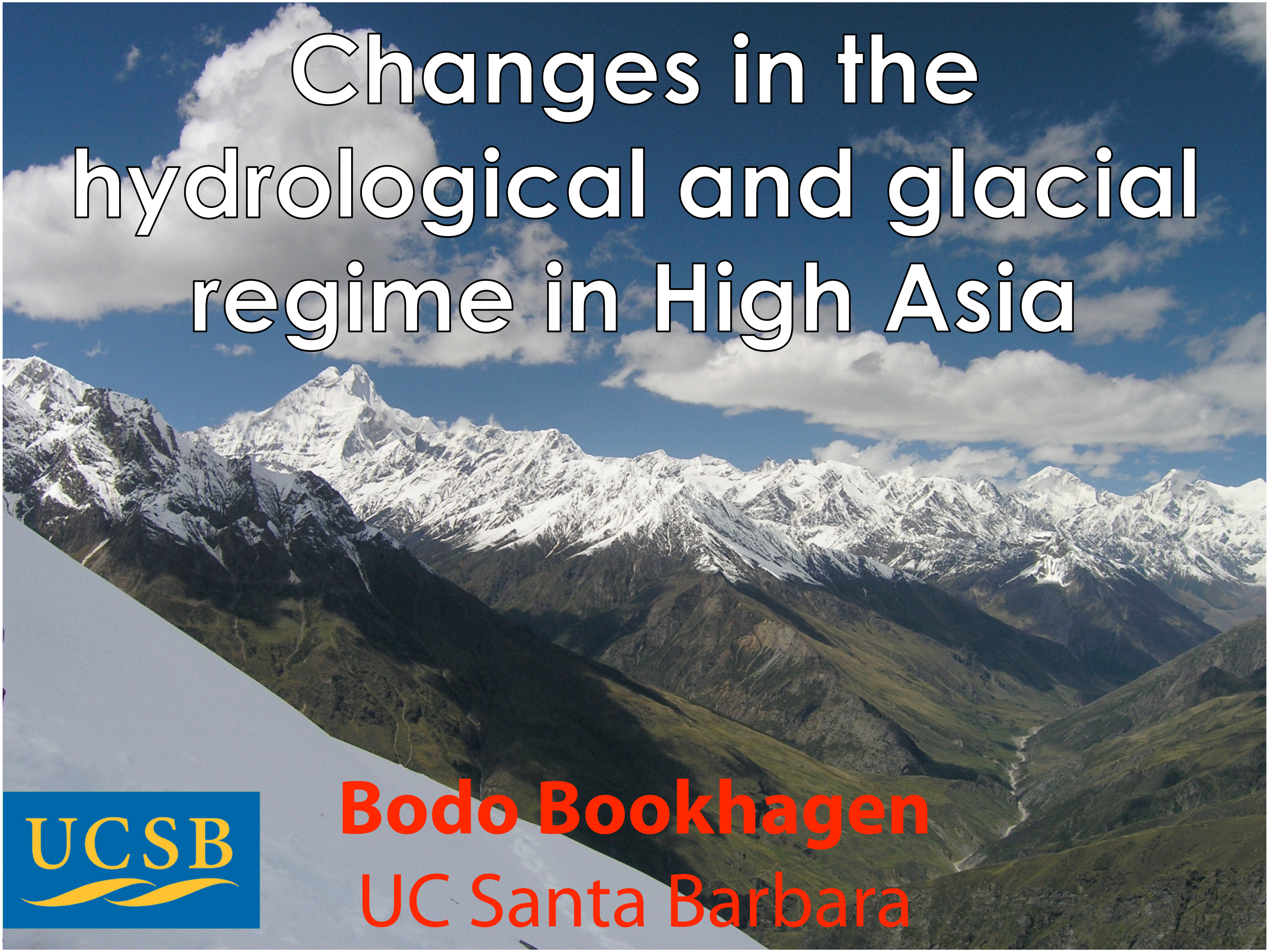


Changes in the hydrological and glacial regime in High Asia

UCSB

Bodo Bookhagen

UC Santa Barbara

U.N. Panel's Glacier Warning Is Criticized as Exaggerated

Subel Bhandari/Agence France-Presse — Getty Images

The Khumbu Glacier in northeastern Nepal. Millions rely on ice and snow melt from Himalayan glaciers for water supply.

By ELISABETH ROSENTHAL
Published: January 18, 2010

SIGN IN TO

World-wide media coverage criticizing the UN Environmental Program (UNEP) and Intergovernmental Panel on Climate Change (IPCC) findings on Himalayan glacial retreat

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Geneva, 20 January 2010

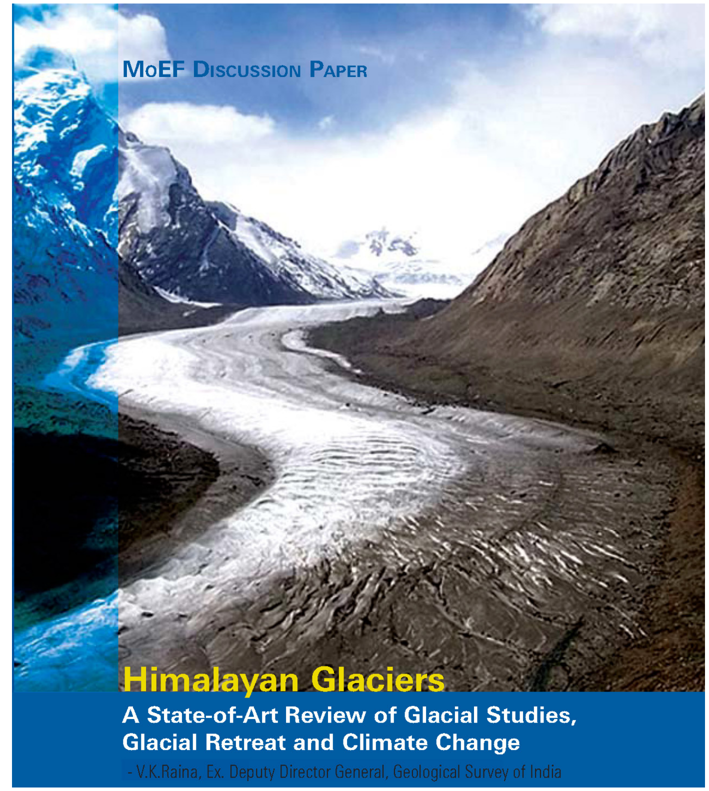
IPCC statement on the melting of Himalayan glaciers[1]

The Synthesis Report, the concluding document of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (page 49) stated: “Climate change is expected to exacerbate current stresses on water resources from population growth and economic and land-use change, including urbanisation. On a regional scale, mountain snow pack, glaciers and small ice caps play a crucial role in freshwater availability. Widespread mass losses from glaciers and reductions in snow cover over recent decades are projected to accelerate throughout the 21st century, reducing water availability, hydropower potential, and changing seasonality of flows in regions supplied by meltwater from major mountain ranges (e.g. Hindu-Kush, Himalaya, Andes), where more than one-sixth of the world population currently lives.”

This conclusion is robust, appropriate, and entirely consistent with the underlying science and the broader IPCC assessment.

It has, however, recently come to our attention that a paragraph in the 938-page Working Group II contribution to the underlying assessment[2] refers to poorly substantiated estimates of rate of recession and date for the disappearance of Himalayan glaciers. In drafting the paragraph in question, the clear and well-established standards of evidence, required by the IPCC procedures, were not applied properly.

The Chair, Vice-Chairs, and Co-chairs of the IPCC regret the poor application of well-established IPCC procedures in this instance. This episode demonstrates that the quality of the assessment depends on absolute adherence to the IPCC standards, including thorough review of “the quality and validity of each source before incorporating results from the source into an IPCC Report”[3]. We reaffirm our strong commitment to ensuring this level of performance.



NEWS OF THE WEEK

CLIMATE CHANGE

No Sign Yet of Himalayan Meltdown, Indian Report Finds

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WMO UNEP

Problems in Estimating Hydrological Budget and Glacier Retreat in High Asia

1. **Remoteness of High Asia**
   - nearly no continuous, in-situ observation

2. **There are no 'typical' Himalayan Glaciers (spatial extent)**
   - two interfering climatic gradients and local climatic signals result in a complex glacial-retreat signal (and also hydrological signal)
   - only a few index glaciers provided estimates for IPCC report

3. **Insufficient glacial mass-balance measurements (both in space and time)**
   - most retreat rates are based on frontal changes and *not* on mass-balance studies (i.e., thickness, width, ice properties)
   - Lack of knowledge: What are the effects of changes in debris coverage, temperature, precipitation, and solar radiation on glaciers? What are the glacial response times?

Importance of the Hydrological Budget and Glacial Regime in High Asia

1. Half of the Earth’s population depends on discharge mainly derived from **rain**, **snow** and **glacial melting** in Asia.

2. If monsoonal rainfall weakens, role of **solid-water storage** (snow and glacial melting) becomes more important.

3. **Seasonal component** of snow- and glacial melting is crucial: spring discharge is mostly derived from snow and ice melt.

What we need: Identifying mountainous hydrological regimes

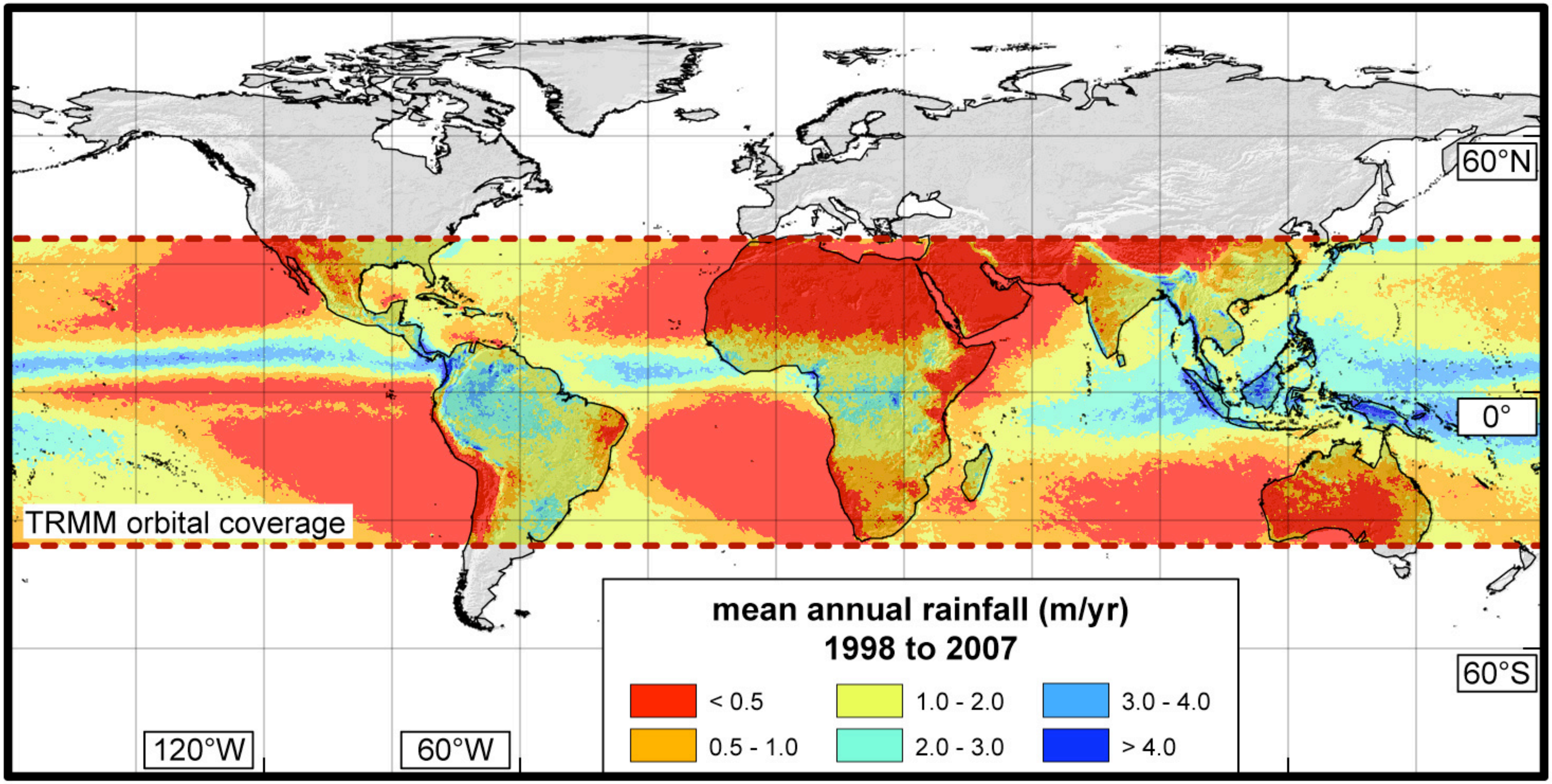
1. Continuous rainfall observation (including storm events).

2. Mass-balance glacial measurements (volumetric changes).

3. Long timeseries of glacial mass-balance measurements covering several decades (~1950's until today).

4. High temporal resolution (ideally sub-seasonal).

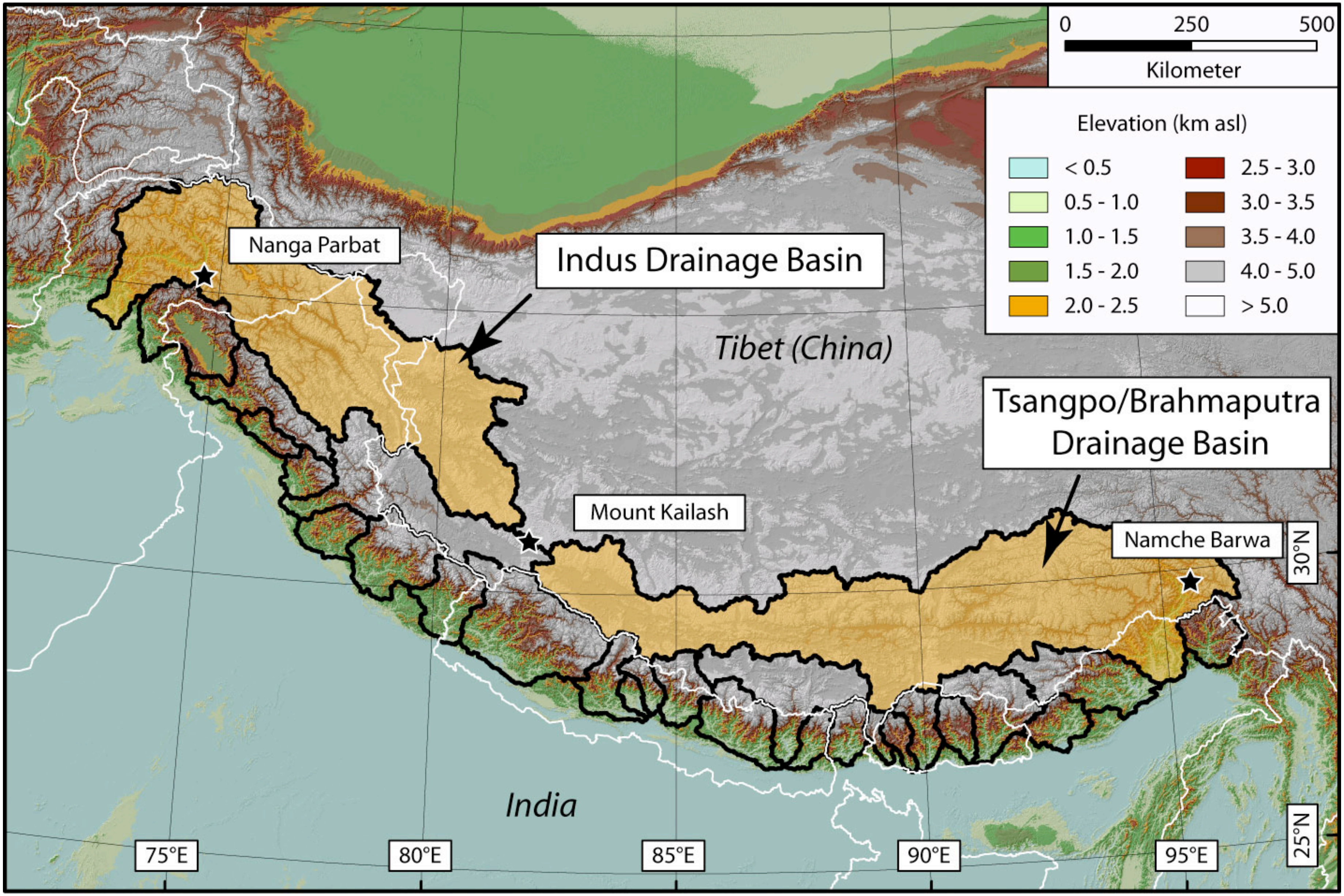
TRMM – high spatial resolution



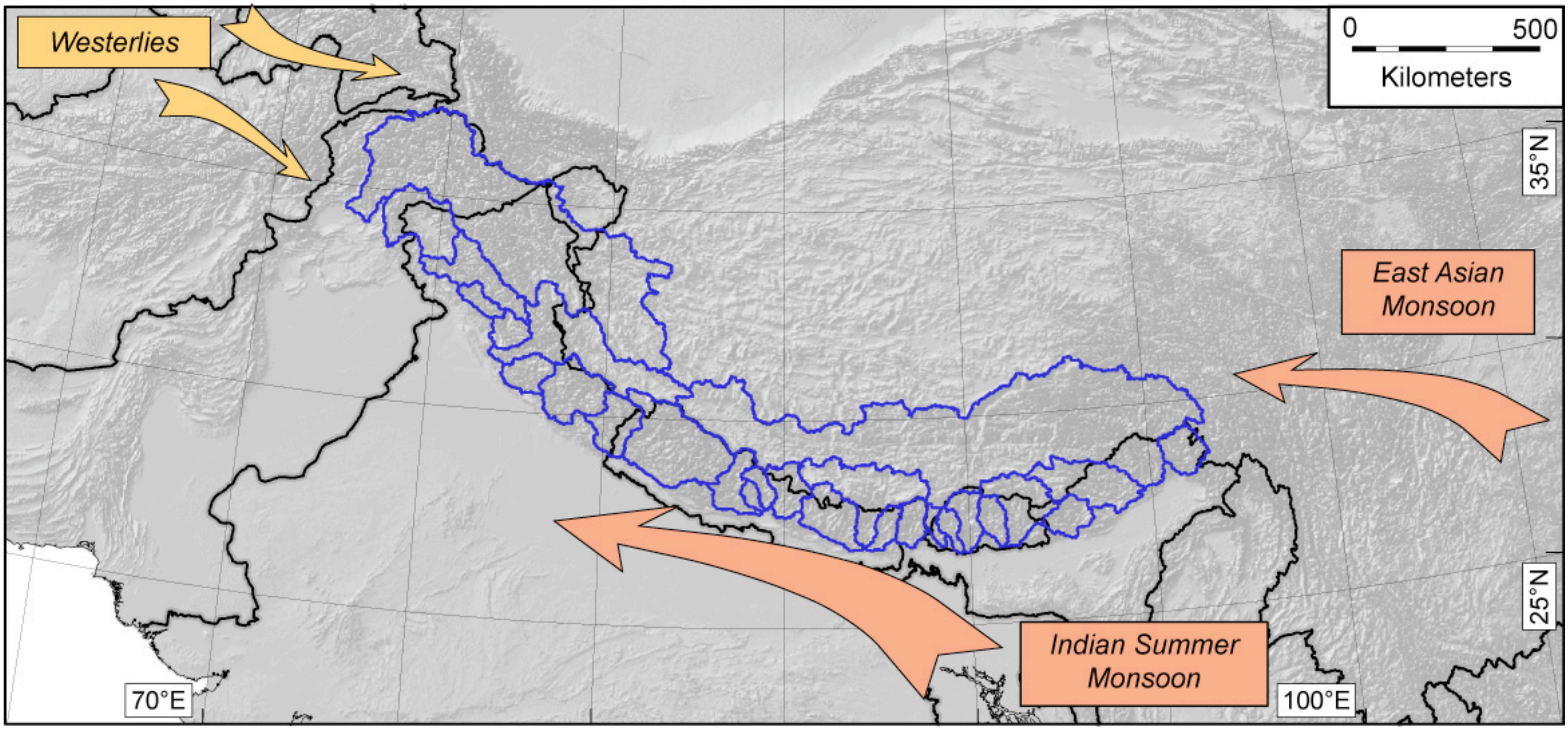
The entire time-series data of 2B31 (global) will be available for download soon. Email me (bodo@icess.ucsb.edu) or check http://www.geog.ucsb.edu/~bodo/ for updates.

TRMM (http://trmm.gsfc.nasa.gov)

High Asian Topography and Himalayan River Catchments

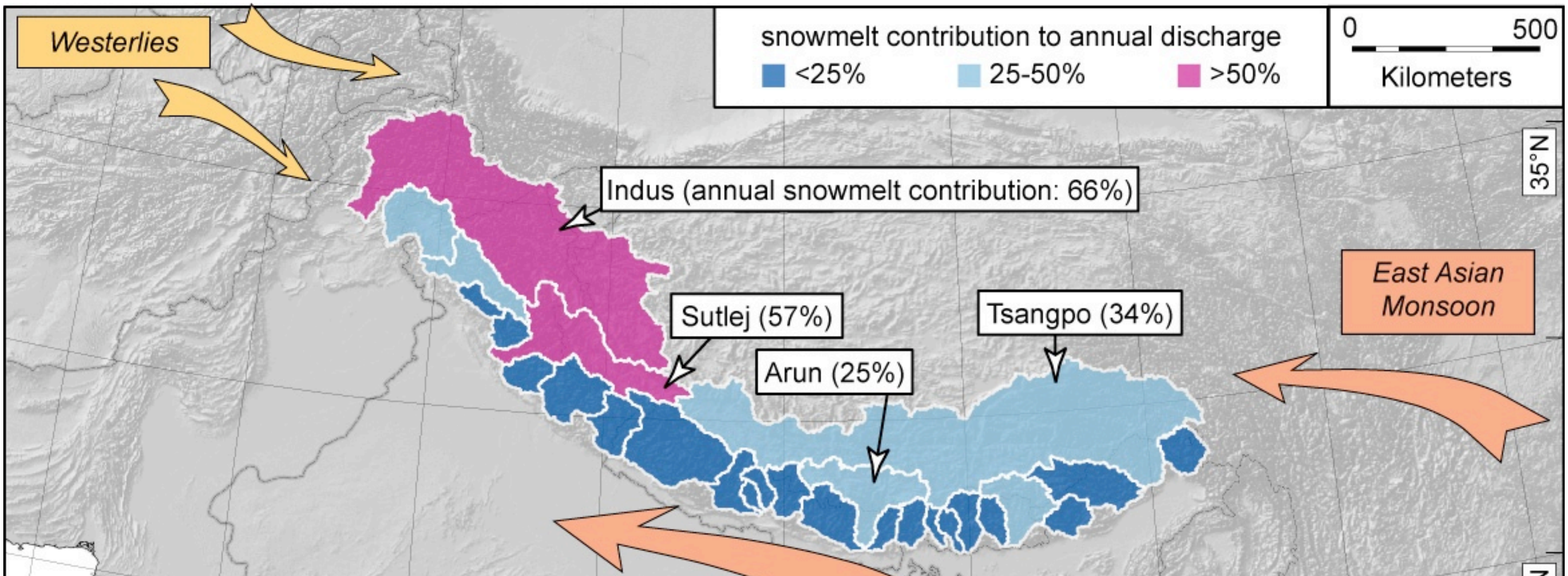


General Atmospheric Circulation Patterns



Bookhagen and Burbank, in press

Predicting River Discharge in the Himalaya – Rainfall and Snowmelt Contribution



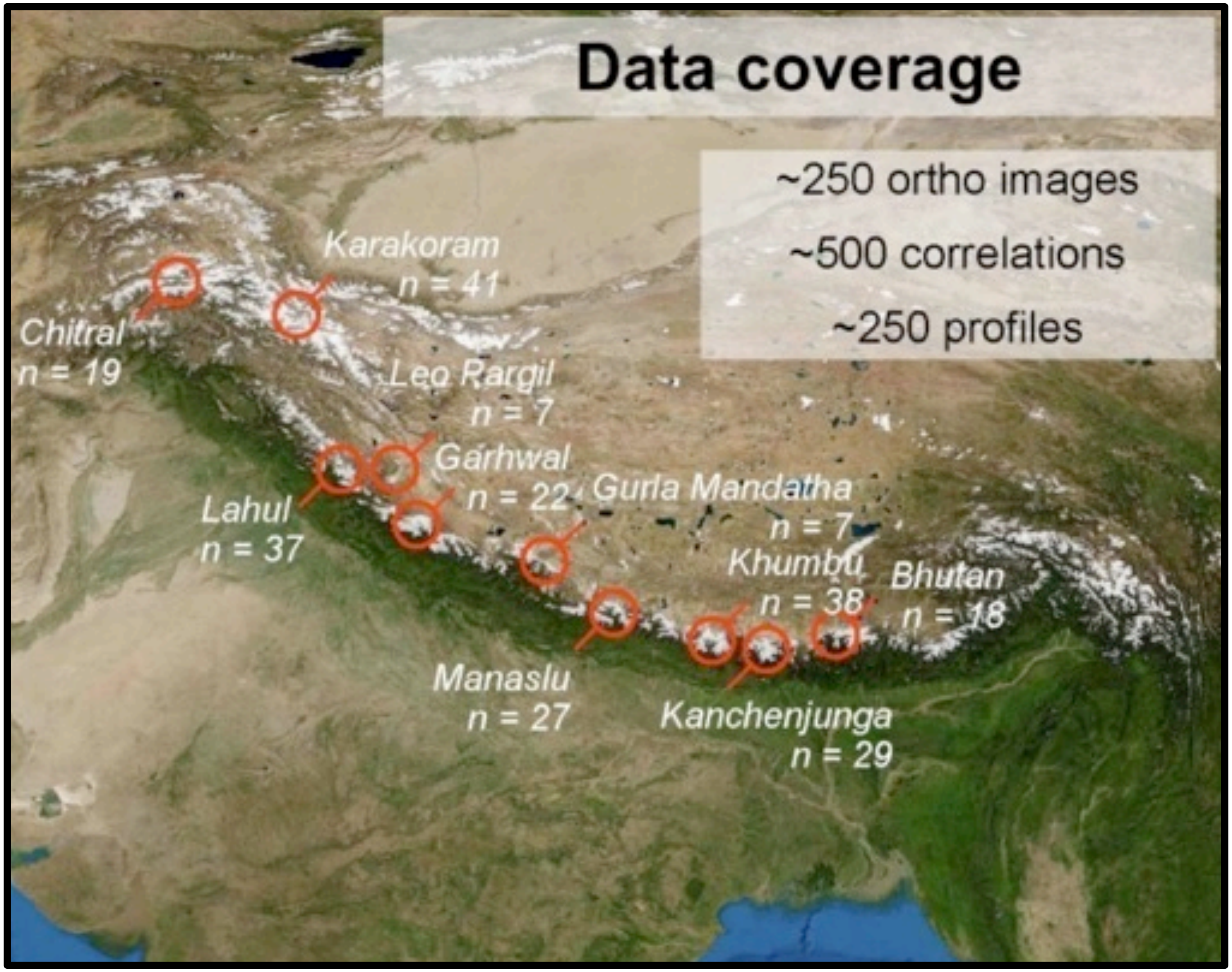
Discharge in the pre-monsoon season (March-May) for all Himalayan catchments significantly depends on transiently stored moisture (snow- and glacial melting, permafrost and soil moisture)!

- *Discharge is calculated by accounting for rainfall, snowmelt, and evapotranspiration*
- *Validated with 13 daily river-gauge stations throughout the Himalaya (Nash-Sutcliffe coefficient between 0.7 and 0.9)*

Bookhagen and Burbank, in press

Characterizing the Highly Dynamic (and very Important) Glacial Regime

Glacial Characteristics Determined by ASTER Optical Satellite Imagery



Scherler et al. (in review); Bookhagen and Scherler (2010)

Factors Controlling Hydrological Regime and Glacial Behavior and proposed work

I. Seasonal snow- and ice melting is the dominant discharge contribution in western High Asia.

- Combine daily observation, fractional snow cover estimates and ice/snow coverage with advanced hydrologic model [*NEED: better spatial and temporal resolution*]
- Use airborne gravimetric and/or GPR approaches to estimate water storage

Factors Controlling Hydrological Regime and Glacial Behavior and proposed work

I. **Seasonal snow- and ice melting is the dominant discharge contribution in western High Asia.**

II. **Debris cover and snow avalanches significantly influence glacial retreat/advance.**

- Use combination of glacial velocities and optical imagery to classify and to distinguish between debris cover, in-situ bedrock, and re-transported snow [at annual, intra-annual and seasonal time steps]
- gravimetric or GPR approaches

Factors Controlling Hydrological Regime and Glacial Behavior and proposed work

I. **Seasonal snow- and ice melting is the dominant discharge contribution in western High Asia.**

II. **Debris cover and snow avalanches significantly influence glacial retreat/advance.**

III. **Glacial-mass balances and their dynamics**

- Estimate volumetric changes with stereo images, orthophotos, and digital elevation models
- Extend timeseries by several decades into the past with aerial photographies and declassified imagery [*NEED: algorithm and data management improvement*]
- Future: Use gravimetric or GPR