Karakoram cryosphere response to climate change: Anomalies and Research Efforts



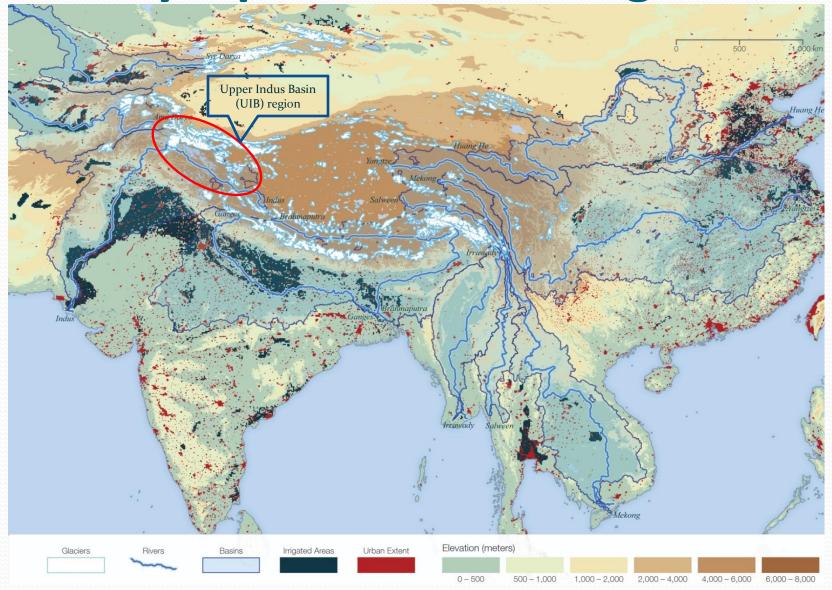
Dr. Muhammad Zia ur Rahman Hashmi Qurat ul Ain Ghazanfer Ali

Ev-K2-CNR Scientific Conference Karakoram Resources and Climate Change: Glacier, Water and Ecosystem 10th September, 2013, National Art Gallery, Islamabad, Pakistan

Outline

- Cryosphere of HKH region
- HKH Glaciers under changing climate
- The "Karakoram Anomaly"
- Research Activities under GCISC-EV-K2-CNR Collaboration
- Conclusions

Cryosphere of HKH region

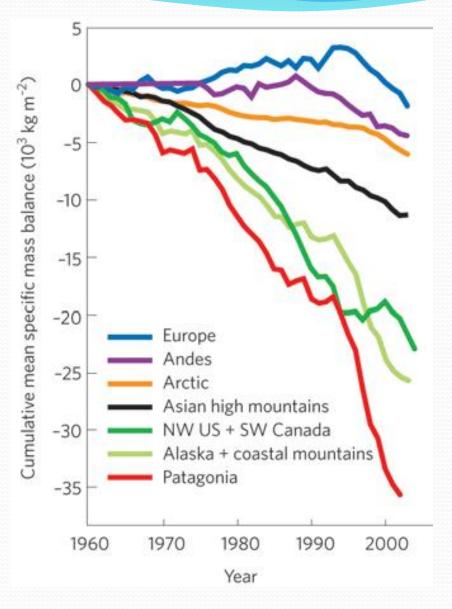


Some facts related to cryosphere of UIB

```
    Total Glacial Area... = 15061.74 sq.km
    Est. total Ice Reserves... = 2,174 Km<sup>3</sup>
    Total number of Glaciers... = 11,413
    Largest glacier area... = 925.93 Km<sup>2</sup>
```

Source: ICIMOD (2011)

Inman (2010) has noted, "According to a 2006 review by Cogley and others, the Himalayas are in the middle of the pack ("Himalayan glaciers are losing mass faster than European glaciers but slower than those in Alaska.")



Source: Inman (2010)

...Cont

HKH Glaciers under changing climate

Source	Finding
World Glacier Monitoring Service	Measurements taken over the last century clearly reveal a general shrinkage of mountain glaciers on a global scale
Mason Inman (2010) In Nature reports-climate change	"The remote glaciers of the Himalayan mountains have been a subject of much controversy, yet little research" (Out of about 12000 to 15000 glaciers in Himalaya and around 5000 in Karakorum, very few have been measured on the ground to see if they are losing or gaining mass) "It is pretty clear that Himalayan glaciers have been losing mass, with markedly greater loss in the past decade than earlier" Graham Cogley, Geographer, Trent University Ontario
Dirk Scherler et al. (2011) In Nature Geoscience (Effect of Debris cover)	Out of 42 studied glaciers in Karakoram region, 58% advancing/stable and 42% retreating. In all other regions (Himalaya, Hindukush, West Kunlun Shan), the studied glaciers are mostly retreating. Study has found that the debris cover has a significant influence on glacier terminus dynamics.

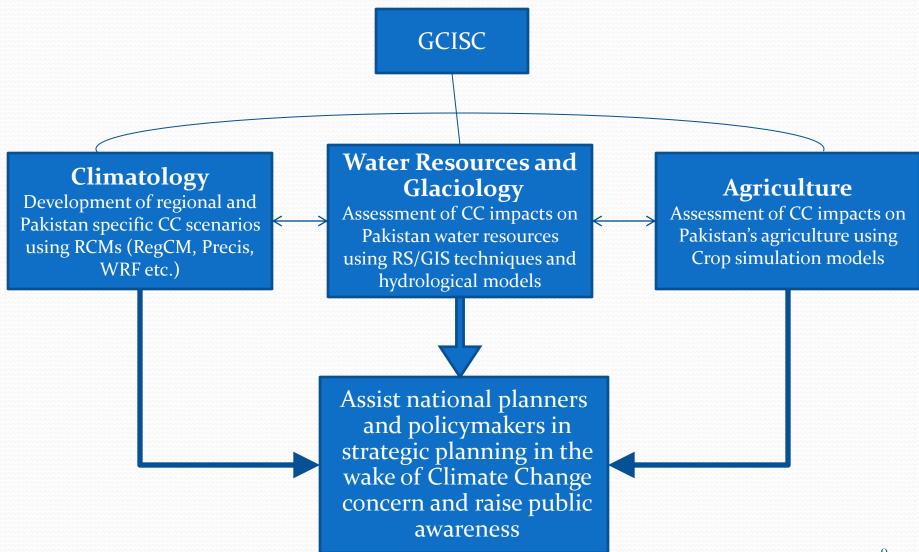
Karakoram cryosphere under changing climate "Karakoram Anomaly"

Source	Finding
Hewitt, 2005	
Bishop et al., 2008	
Hewitt, 2011	
Copland et al., 2011	
Dirk Scherler et al. (2011)	Stable/slightly advancing glaciers
Gardelle et al., 2012	
Sarikaya et al., 2012	
Kääb et al., 2012	
Janes and Bush 2012	
Wiltshire, 2013	
Cogley (2012) in Nature	"No ice lost in the Karakoram"
Geoscience	

Analysis of Climate data supporting the slow response of Karakoram Glaciers to changing climate

Source	Finding
Elisa Palazzi (ISAC CNR) et al. (2013)	 Analysis of last ~60 years of northern Pakistan data from Pakistan Met Deptt show; Decreasing trend in JJAS minimum temperatures Increasing trend in DJFMA maximum temperatures Increasing trend in DJFMA precipitation
Bocchiola and Diolaiuti (2013) (Italians)	PMD's "hill stations" monthly data for 1980–2009 in the upper Karakoram, Northern Pakistan; "Slightly decreased Summer temperatures, and increased Winter Prec., possibly leading to increasing snow covered area at thaw"

Cliamte Change Research at GCISC



Major Collaborating International Partners

• APN	Asia Pacific Network for Global Change Research, Japa
-------	---

• ASICTP Abdus Salam Int. Centre for Theoretical Physics, Italy;

• IIASA Int. Inst. for Applied Systems Analysis, Austria;

NCAR National Centre for Atmospheric Research, USA;

GECAFS Global Environment Change and Food System, UK;

• ICIMOD International Centre for Integrated Mountain Development, Nepal;

• UNC University of Newcastle, UK

• Ev-K2-CNR, Italy Recently signed an MoU

Research Activities under GCISC-EV-K2-CNR Collaboration

SUMMER FIELD CAMPAIGN ON GLACIOLOGICAL, HYDROLOGICAL AND ATMOSPHERIC MONITORING ACTIVITIES ON BALTORO GLACIER, KARAKORAM, PAKISTAN 2013

Objectives of the Activity

- Assessment of current status of Karakorum Glaciers under changing climate by carrying out GLACIOLOGICAL, HYDROLOGICAL AND ATMOSPHERIC MONITORING in Baltoro glacier, that includes;
 - Glacier snout positions measurement
 - Stakes measurements (position and coordinates) of previously installed stakes (year 2011) at different position along with Baltoro glacier
 - Installation and maintenance of stakes up to Concordia
 - **Snow pit measurements** (snow depth profile, temperature and density measurement of different layers of snow)
 - Radar profile measurements to evaluate the ice depth in Baltoro glacier region.

Field Team

- Scientific expedition was consisting of total 10 members from Europe and Pakistan.
- European Participants:
- Chris Mayer (Group Leader, German)
- Astrid Lambrecht (Researcher, German)
- 3. Umberto Minnora (PhD Student, Milano University, Italian)
- 4. Luigi Bonetti (Researcher, Italian)
- 5. Roberto Ambrosini (PhD Student, Italian)
- Daniele Bernasconi (Italian Guide)
- Stepheno (Generalist, Italian)
- Pakistani (GCISC) Participants:
- 1. Ms. Qurat ul Ain Ahmad (Scientific Officer, GCISC)
- 2. Mr. Shahbaz Mehmood (Scientific Officer, GCISC)
- 3. Mr. Muhammad Amjad (Scientific Officer, GCISC)

Benefits of the Activity

- Capacity building of GCISC scientists in;
 - Stake drilling, monitoring and maintenance procedure
 - Snow depth profile for measuring temperature and density of different snow layers
- (The most difficult) First step towards long lasting Research Collaboration between GCISC and Ev-K2-CNR scientists



Glimpses of some Field Activities











The Alpine Summer School 2013

- The Alpine Summer School was arranged by Institute of Atmospheric Sciences and Climate of the National Research Council (ISAC CNR), Italy, in collaboration with EV-K2-CNR, at Valsavarenche, Aosta valley, Italy
- The participants came from all over the globe including Pakistan (GCISC), India, Nepal, Canada, America, France, Italy, Denmark, Malaysia, Turkey, Israel, and Philistine





The School consisted of;

A series of lectures/seminars

Field Expedition/Hiking





Lectures on following main Themes;

- Theme 1: Atmospheric dynamics in mountain regions
- Theme 2: Hydrological cycle in the mountains
- Theme 3: Ecosystems and biodiversity
- Theme 4: Past climate variations in mountain regions
- Theme 5: Climate modelling in mountain regions



Current activities of WR&G section of GCISC

- Statistical downscaling of meteorological data for use in hydrologic studies using Weather generators and Regression-based techniques
- Analysis of extreme hydro-meteorological events under changing climate
- Assessing future flows in UIB under different SRES scenarios using downscaled data in hydrological models to investigate;
 - Water availability in the near future (first few decades) and far future
 - Changes in the Intra-Annual pattern of river flows
 - Uncertainties
- Assessing CC impacts on mangrove forests in the Indus Basin delta
- Frequency of GLOF events and vulnerability of communities living up in the Northern region of Pakistan

Conclusions

- Climate change has serious implications for Pakistan's water resources due to dependence on glaciers
- Need for exploring new dimensions of research apart from glacier mass balance studies to assess climate change impacts on Karakoram cryosphere
- GCISC has an important role in building country's resilience against climate change but lacks data as well as technical capacity in some areas e.g.
 - Glacier mass balance studies for Pakistan through field measurements and use of advanced RS/GIS tools and techniques
 - Advanced glacio-hydrological modelling
- "No matter what accomplishments you make, somebody helped you." —Althea Gibson

Thank you



