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Questions

Webinar staff to everyone

Welcome to "How Wildfire Smoke Impacts the Quality of Wine" with Associate Professor of Enology Elizabeth Tomasino of Oregon State University. This ACS Webinar is moderated by Gavin Sacks of Cornell University and co-produced with the ACS Division of Agricultural & Food Chemistry. Say "hello" to Elizabeth and Gavin in the questions window and tell us where you are joining us from today.

Webinar staff to everyone

Q: Hello! I'm from Oshkosh, Wisconsin

A: Glad you could join us!
1:54 PM

Webinar staff to everyone

Q: Good afternoon! I'm joining from Murfreesboro, TN.

A: Good to see you here.
1:54 PM

Webinar staff to everyone

Q: Hello! Doug here, Redding California.

A: Good to see you here Doug!
1:54 PM



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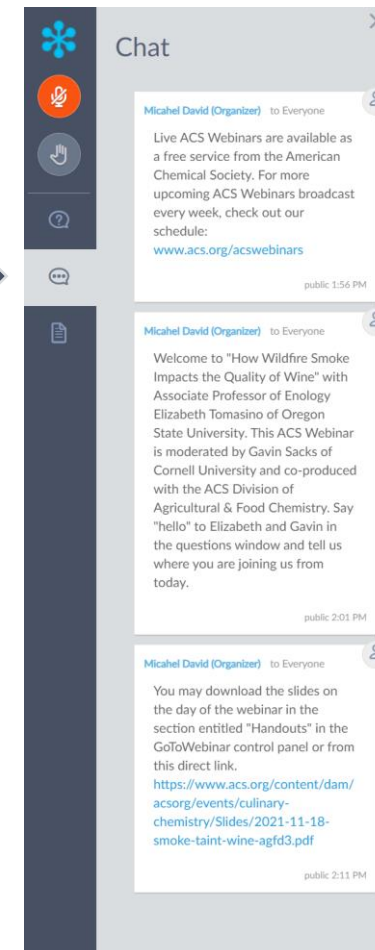
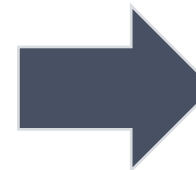
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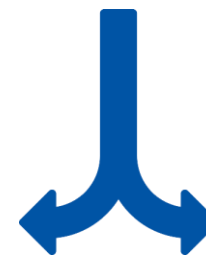


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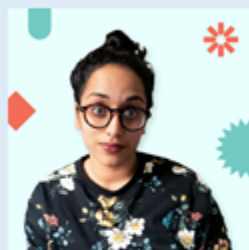
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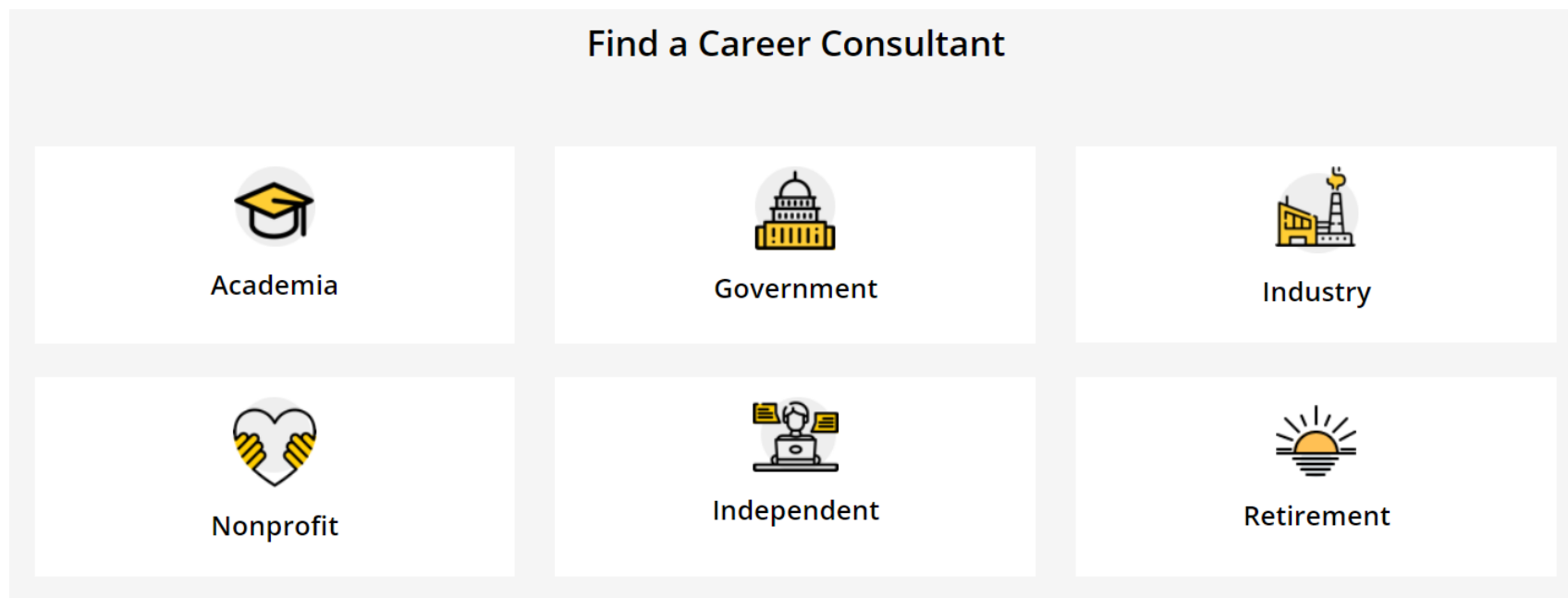
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(Chemical-biological Engineering, Computer Science & Molecular Biology)

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4
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Is Grad School Right for Me?

August 4, 2022

1
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Leadership and Soft Skills Development – What You Need to Advance in Your Career

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OCT

Skydiving into Retirement

October 6, 2022

3
NOV

Finding and Securing an Internship

November 3, 2022

1
DEC

Careers in Academia

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Thurs., July 21, 2022 | 2:00pm–3:00pm ET

How the Evolution of Science Transformed the Art of Cooking

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NEXT WEEK!



Thurs., July 28, 2022 | 2:00pm–3:15pm ET

Starting a Company: How to Set Up Essential Business Contracts

Co-produced with ACS Division of Small Chemical Businesses and ACS Division of Business Development & Management



Thurs., Aug. 4, 2022 | 2:00pm–3:00pm ET

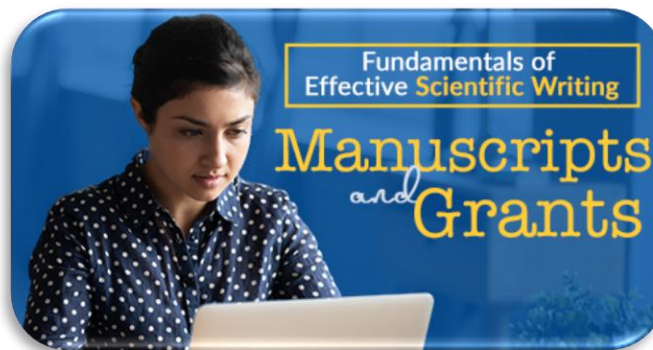
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The Himalayas in the 21st Century: Ecology, Environment, and Geopolitics



Dr. Shailesh Nayak, PhD

Director, National Institute of
Advanced Studies, Indian Institute of
Science Campus, Bengaluru



Dr. Kunal Gupta, PhD, MS

Outreach Manager, ACS Membership,
American Chemical Society

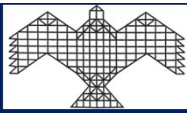
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The Himalaya in the 21st Century – Ecology, Environment and Geopolitics

Shailesh Nayak

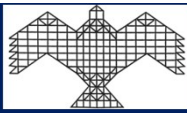
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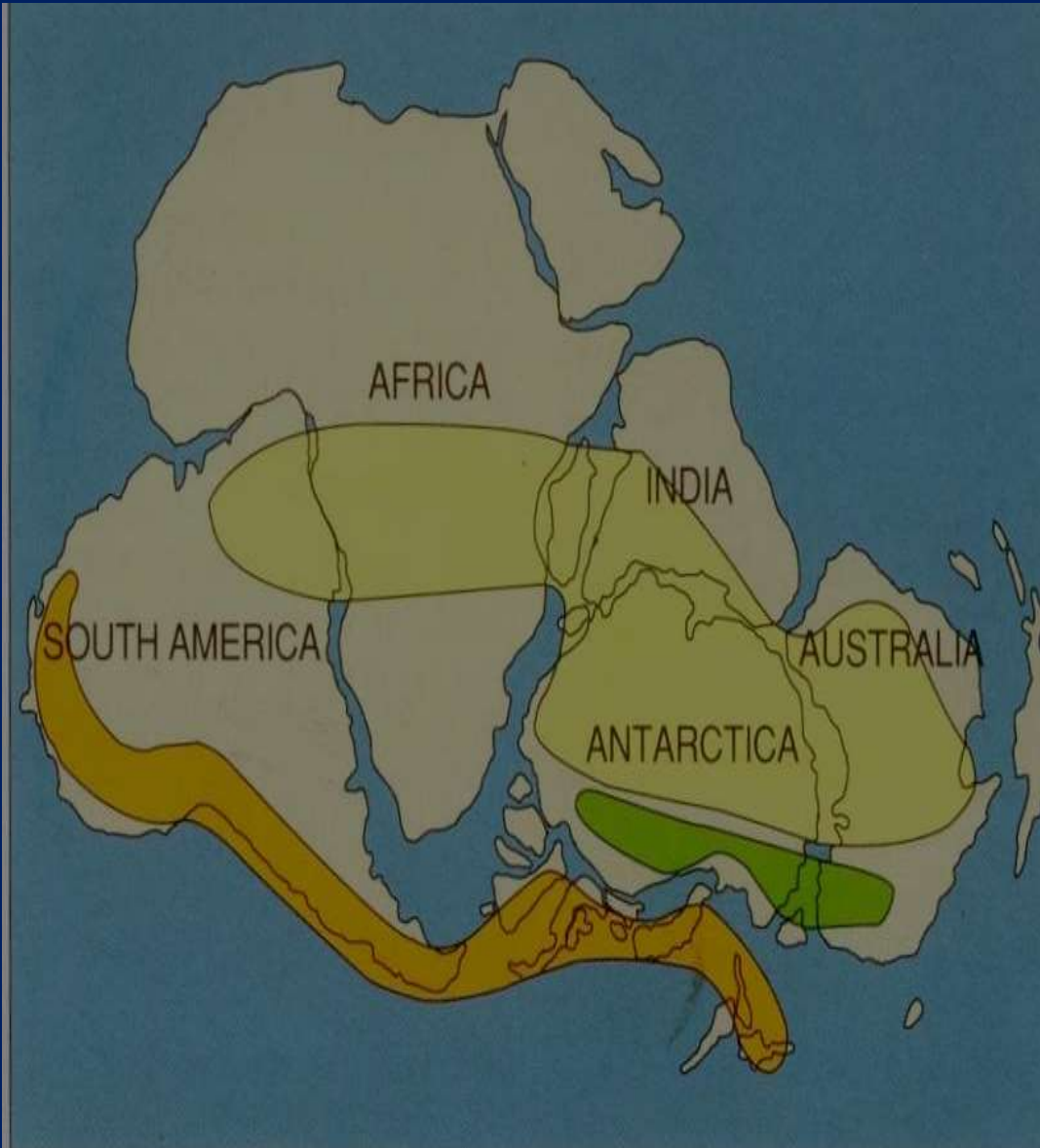


Third Pole -The Himalayas

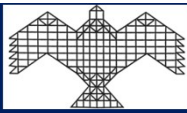
- Plays vital role in global weather and climate, Asian Monsoon. Warming faster than rest of the globe.
- Large rivers viz. Indus, Ganges, Brahmaputra, Irravady, Salween, Mekong, Yangtze and Yellow rivers originate.
- These rivers provide much of the freshwater to 1.4 billion people in Asia. Their river plains provide food to almost 40 % of the World's population.
- Largest concentration of snow and ice outside polar regions. The high albedo of snow & ice surface of Himalaya has a cooling effect on mountains but warming effect over Persian Gulf and Arabian Peninsula (Bush, 2000).
- Holds large reserves of trapped carbon in permafrost and wetlands.
- Prone to natural hazards, earthquakes and landslides.
- Limited mineral resources.
- Himalayan grasslands. Unique biodiversity.
- Profound impact on social, economic, cultural aspects and demography of India, Bhutan, Tibet China, Nepal, Pakistan.
- Significant impact on Myanmar, Afghanistan, Bangladesh, Laos, Thailand and Vietnam.



Evolution of the Himalaya



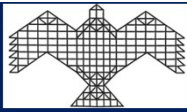
- The evolution of the Indian subcontinent and Himalaya is linked to the fragmentation and dispersal of the Gondwanaland Supercontinent (~133 million years ago).
- The study of this fragmentation process is one of the most challenging areas.
- The permanent station, 'Bharati' at Larsemann hills, provides opportunities to study this process.



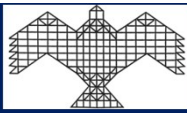
Evolution of the Indian Subcontinent



- The journey from the southern hemisphere to the northern hemisphere started 83 million years ago.
- India zoomed at speed of 18-20 cm per year.
- The Indian plate collided with the Eurasian plate and in place of the Tethys Sea, Himalaya mountain gradually rose and continue to rise.
- The Himalaya had attained its current elevation by 10-5 Ma (Wang et al. 2014).



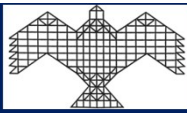
Geosphere



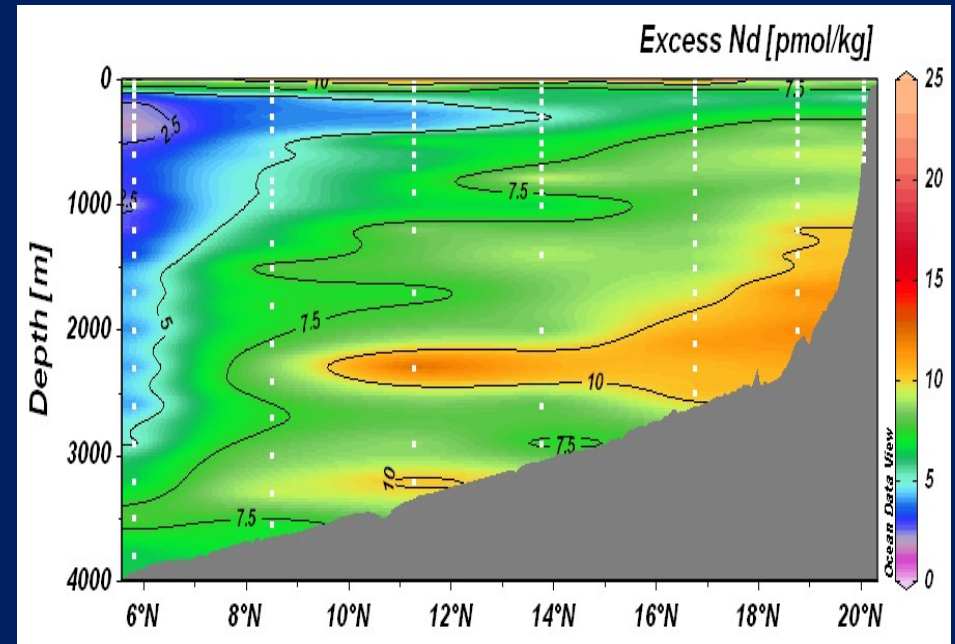
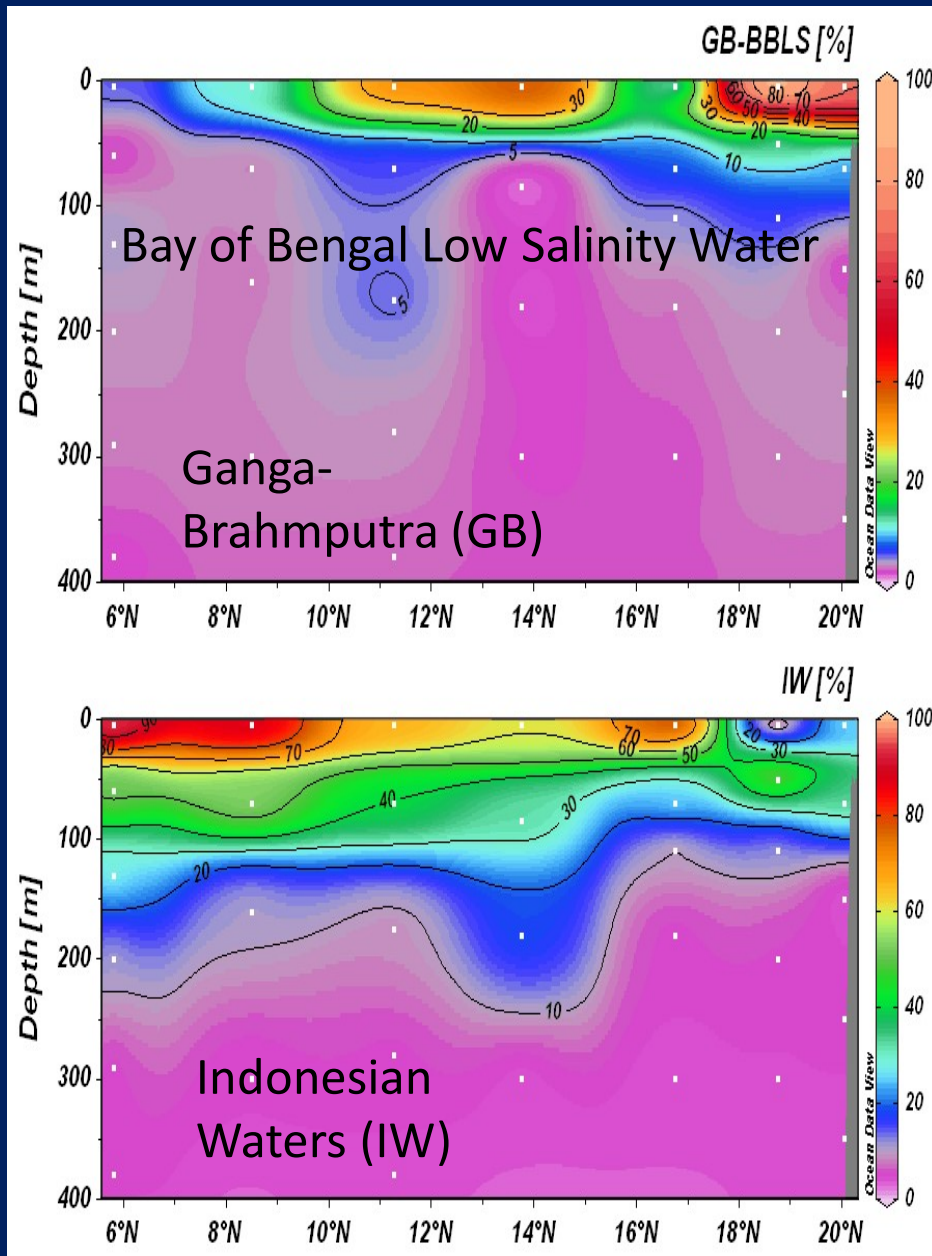
Evolution of Himalaya and Origin of Monsoon



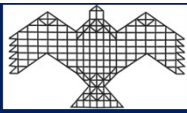
- Strong coupling between surface uplift of Himalaya and evolution of SAM.
- Himalaya as an orographic barrier is more important for SAM circulation than elevation and extent of Tibetan Plateau (Boos and Kuantan, 2010).
- Drilling platforms - JOIDES Resolution (USA): Drilling was carried out at two sites up to 1.1 km in the Arabian Sea during April-May 2015.
- Recent analysis of cores provided an evidence that SAM intensification took place at c.3.2-2.8 Ma. The modern strength of SAM was achieved around c. 1 Ma (Tripathi et al. 2017)
- Coincides with the Mid-Pliocene, period of Global warmth, with CO₂ levels, 400 ppmv, similar to present day.
- High-resolution & continuous records (40 Ma years) provided insight into evolution of Himalaya and climatic transitions.



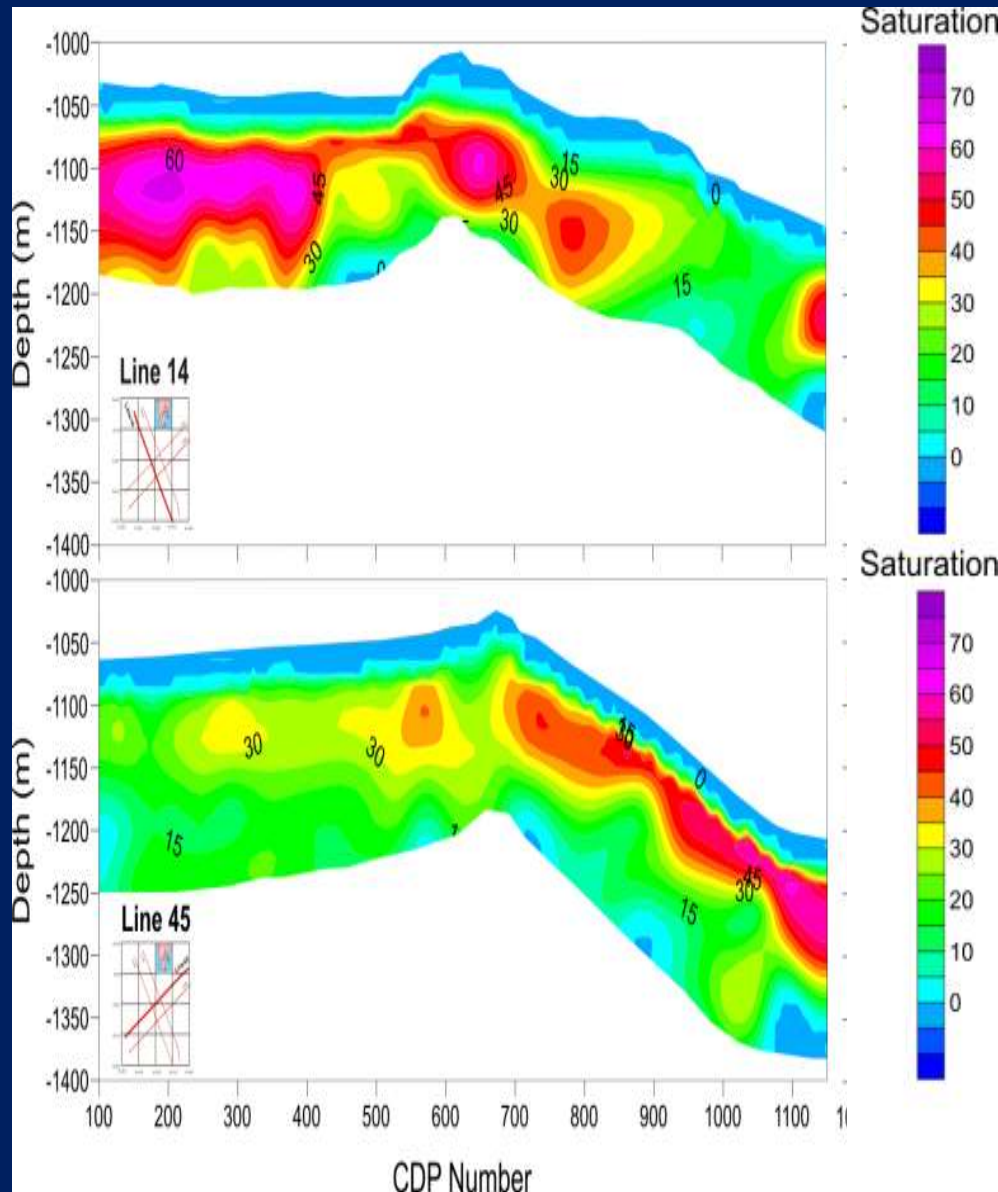
Trace Elements and Biogeochemistry



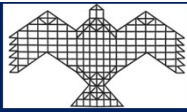
- The Bay of Bengal surface water is composed primarily from freshwater influx and particulate matter from the Ganga-Brahmputra waters.
- Excess Nd in BoB (decreasing from N to S) is derived from sinking detrital material or slope sediments derived from the Himalaya (Singh et al. 2012)



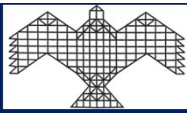
Gas Hydrates



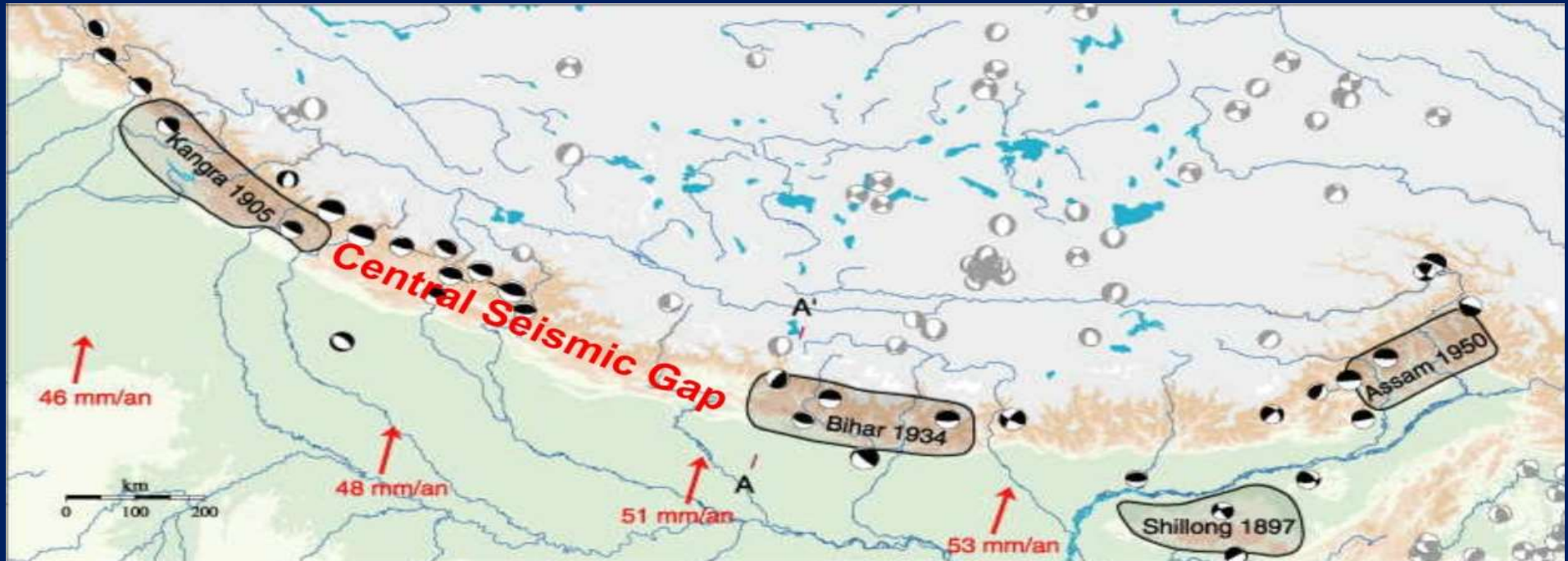
- Ice-like crystalline form of methane and water are considered future hydrocarbon energy resources. Occurs in shallow sediments along continental margins of India.
- The total volume estimated is 1900 T CM. 10 % recovery can provide energy for 100 years (Sain and Gupta, 2012).
- CSIR-NIO & CSIR-NGRI have generated database on geological and geophysical information, and characterized gas-hydrate reservoirs and identification of prospective zones in Krishna, Godavari, Mahanadi basins & Andaman Offshore region.
- Two distinct gas hydrate accumulations have been identified at the depth of 2200 m by ONGC.



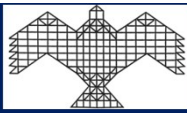
Natural Hazards



Earthquake Research

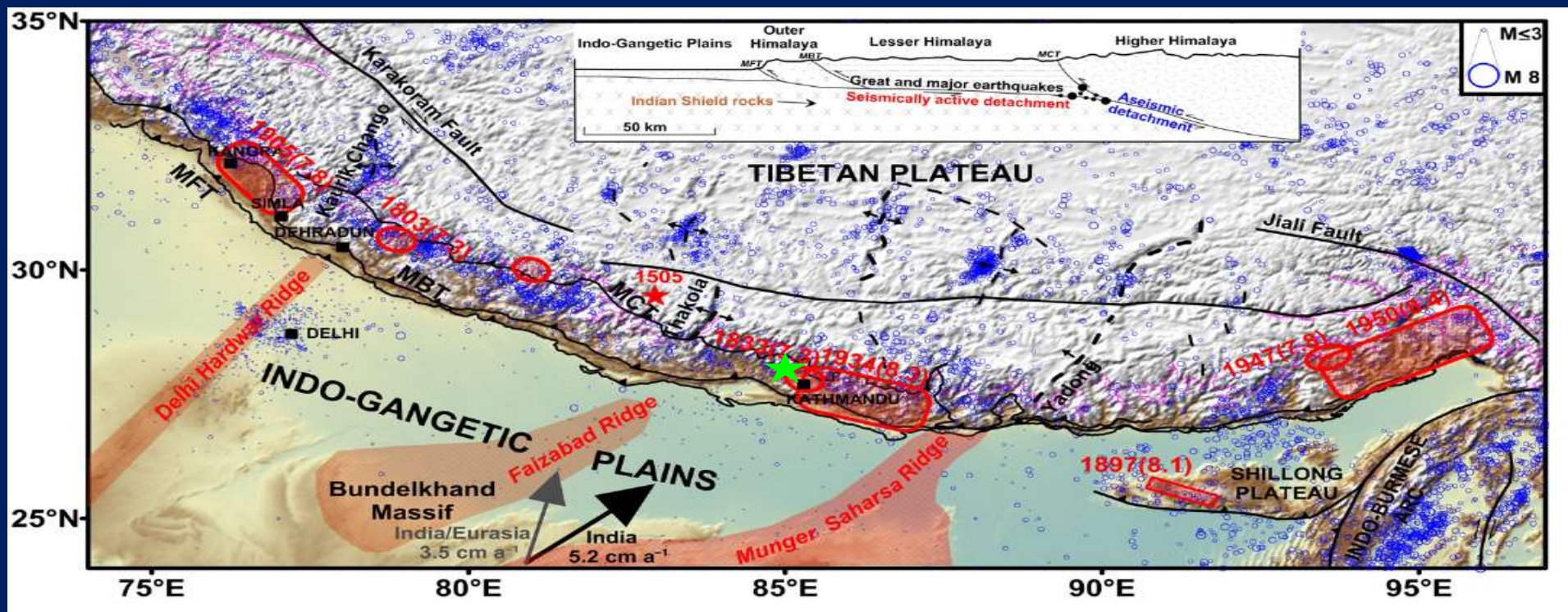


- Continued northward movement of the Indian plate and its under-thrusting beneath Eurasian plate resulted accumulation of strain energy. Himalaya are rising about 5 mm per year.
- GPS measurements provided evidence of strain accumulation in the region (Bilham, 2014).
- Last 200 years, less than 50 % of the Himalayan Arc has been ruptured (Bilham, 2014). Seismic gaps (HP, UK) are considered as potential areas of future earthquakes.
- A coordinated program to understand earthquake processes with neighbouring countries is required. Assessment of long-term earthquake rates to be carried out to facilitate probabilistic forecasting.



A Mega Earthquake in Uttarakhand?

- High Potential for the Occurrence of Earthquake of M 8 in Central Seismic Gap
- High Plate convergence rate (~18 mm/year)
- Evidence of presence of fault under the Himalaya
- Long seismic quiescence (No M8 in at least last 200 years)
- Low Potential for the Occurrence of Earthquake of M 9 in Himalaya
- M 9 earthquake required rupture length of around 1000 km and width of 200 km
- Such lengths and width are not available in Himalaya as Himalayan arc is segmented by transverse ridges running across it.





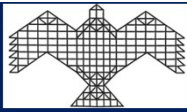
Audience Survey Question

ANSWER THE QUESTION ON THE INTERACTIVE SCREEN IN ONE MOMENT

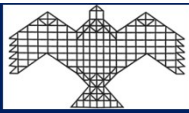
Which of the following do NOT form the Himalayan cryosphere?

- Snow and Glaciers
- Moraine-Dammed Lakes
- Plateau
- Vegetation

* If your answer differs greatly from the choices above **tell us in the chat!**

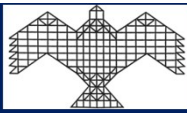


Cryosphere

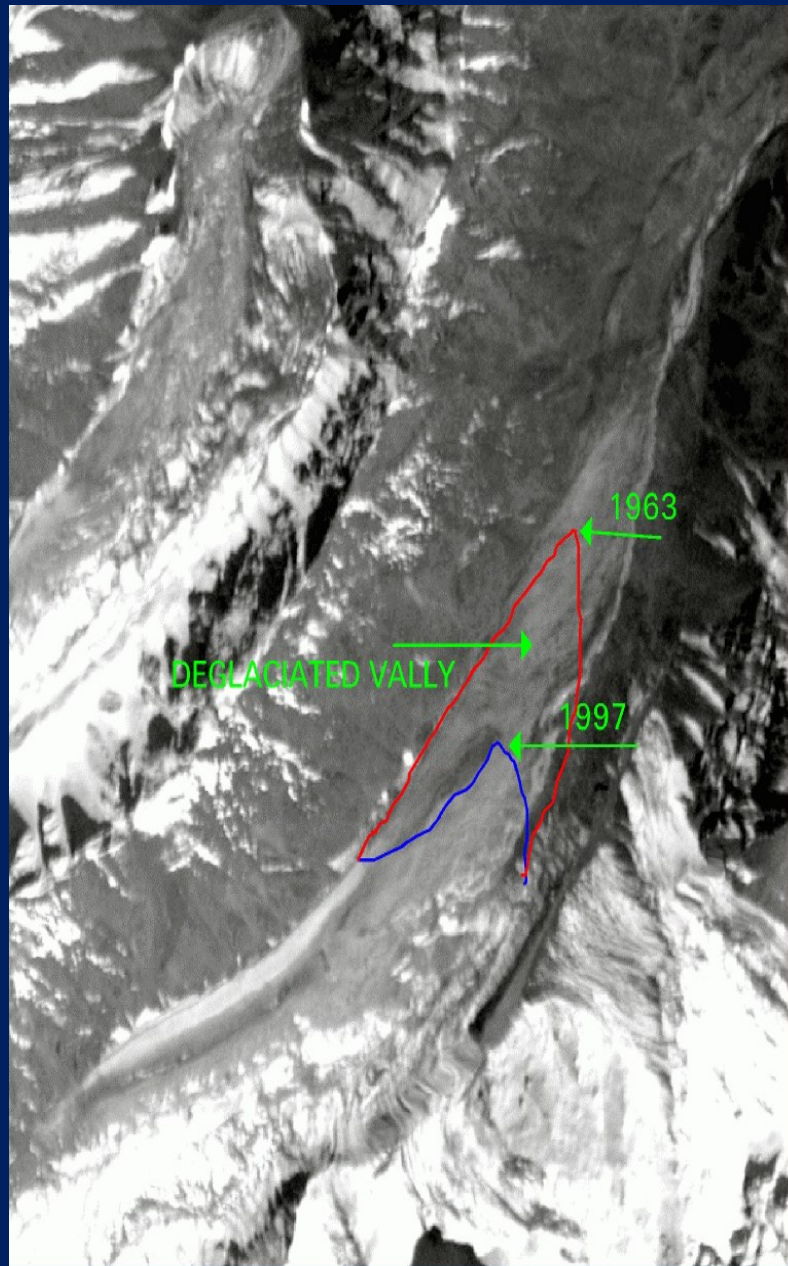


Snow and Glaciers

- Himalaya has largest cryospheric surface outside poles. Plays important role in influencing earth system processes. Glaciers cover 33,000 sq km area in Himalaya.
- The ice cores provide an evidence of growth and decay of large ice fields at lower latitudes are asynchronous with high latitude glaciation and deglaciation that occur on Milankovitch time-scales (Thompson, et al. 2005).
- The first inventory of Himalayan glaciers was based on satellite data of 1987 and was prepared at SAC/ISRO (Kulkarni and Buch, 1991).
- GSI carried out survey based on aerial photos of 1962-63 (Sangewar and Shukla, 2009).

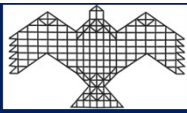


Snow and Glaciers



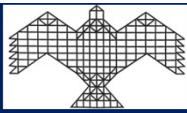
JANAPA GLACIER, BASPA BASIN, H.P.

- Most glaciers have been retreating, 1-60 m per year. Overall loss was about 16-17 % due to faster retreat of smaller glaciers and fragmentation (Kulkarni et al. 2011). The loss in Chinese Himalayas is 16 % (Qui, 2010). More than 50 % glaciers are advancing or stable in Karakoram (Scherler et al. 2011).
- Glaciers in Western Himalayas are retreating slowly, while monsoon-dominated Central and Eastern Himalaya retreating at faster rates (Pant et al. 2018).
- Mass balance studies are available for few glaciers only. GRACE data showed mass loss of about 4 billion tons of ice annually (Jacob et al. 2012).
- Based on CMPI5 modelling, it has been estimated that 10.6 and 27 % of glaciers may disappear under low and high emission scenarios (Chaturvedi et al. 2014).
- Geodetic network for studying fragmentation of glaciers.
- The understanding of solid earth response to deformation associated glacio-isostatic adjustment need to be developed.



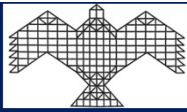
Moraine-Dammed Lakes

- Many moraine-dammed lakes form as a consequence of retreat of glaciers.
- Total lakes are 20,200 as per ICIMOD survey.
- The increase in volume since 1970 is 26 %, leading to increasing threat of Glacial Lake Outburst Floods (GLOF).
- The risk of flooding is likely to increase in future.
- A model for formation of such glacial lakes and their expansion has been developed (Maanya et al. 2016).
- International network is required to monitor such lakes and develop an early warning system.

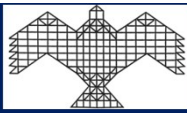


Tibetan Plateau

- Large store of ice and vast expanse of permafrost (1.6 M sq km).
- China had launched an International Third Pole Environment (TPE) Project.
- Tibet has 46,000 glaciers. China had documented characteristics of 24,300 glaciers. The total surface decreased by 17 %, more or less similar as Indian Himalaya.
- Black-carbon levels in ice cores has been increasing due to the rapid industrial growth. This has increased snow and ice melting.
- The release of carbon (methane gas) in permafrost can further enhance global warming.

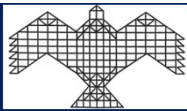


Hydrosphere

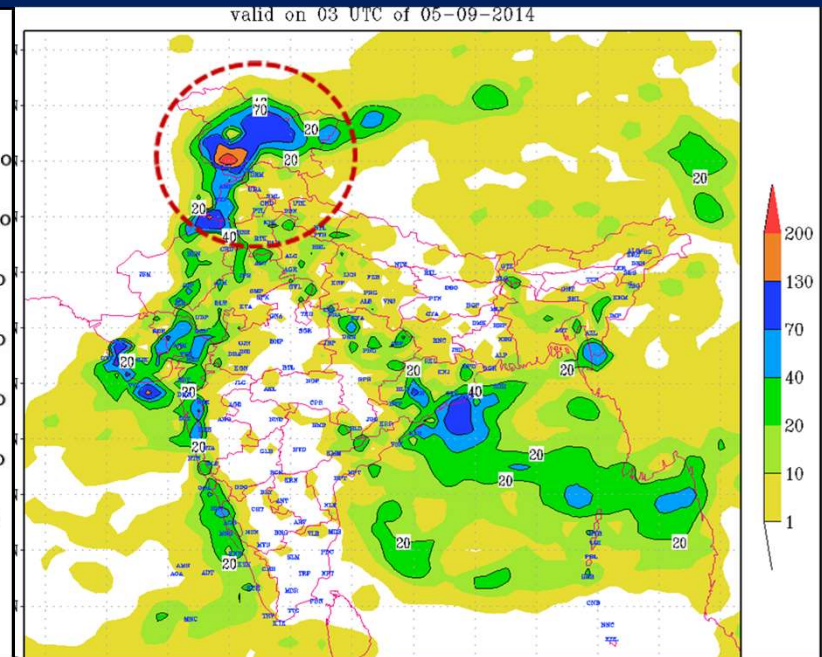
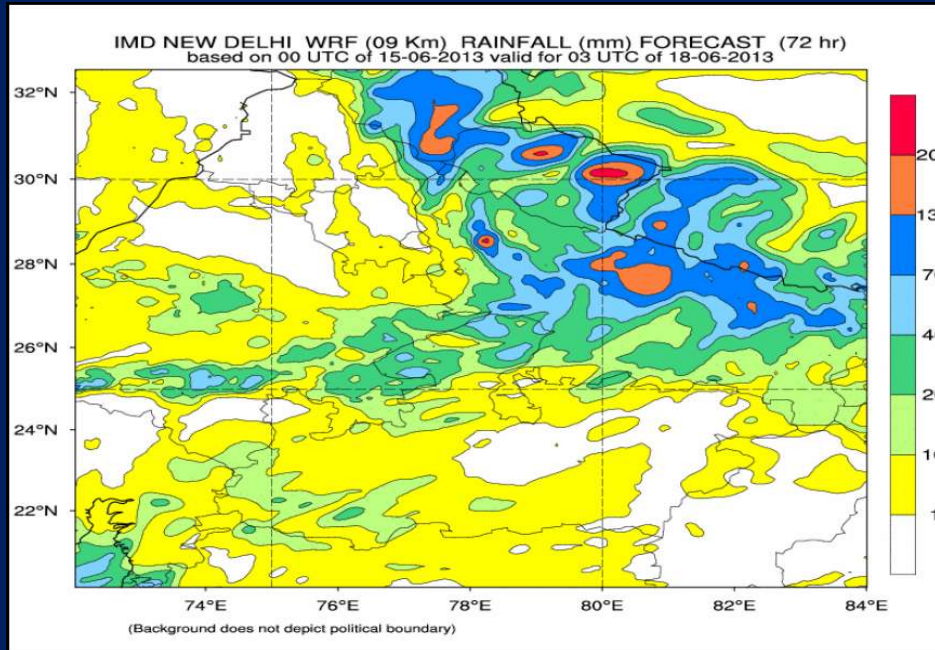


Himalayan Rivers

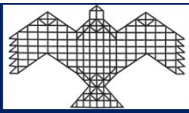
- The rivers originating from Himalaya depend on snow and glacier melt. **Western Region: Snowfall-specific accumulation in Feb.-Mar and post-monsoon. Central region: Winter snowfall and monsoon rainfall. Eastern region: Rainfall and snowfall seasons are close together (Munagapati and Tiwari, 2021).**
- The average volume of snow in the Indus, Ganges and the Brahmaputra basins estimated to be 55, 9 and 15 billion cubic meters, resp.
- The decreasing trend of snow cover can modify the water cycle and sustainable supply of water is doubtful. In Bhutan, snow cover shows decreasing trend at the rate of 3 % (Gurung et al. 2010). Decreasing trend was observed in Arunachal Pradesh also (Chiphang et al. 2017).
- The Indus basin mainly depends on snow and ice melt for water flow support most of the food production in Pakistan and about 25 % in India (RBI, 2011; Khan et al. 2010).



Floods in NW Himalaya

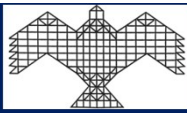


The frequency of heavy precipitation events has increased over most land areas consistent with warming and observed increase of atmospheric water vapor.

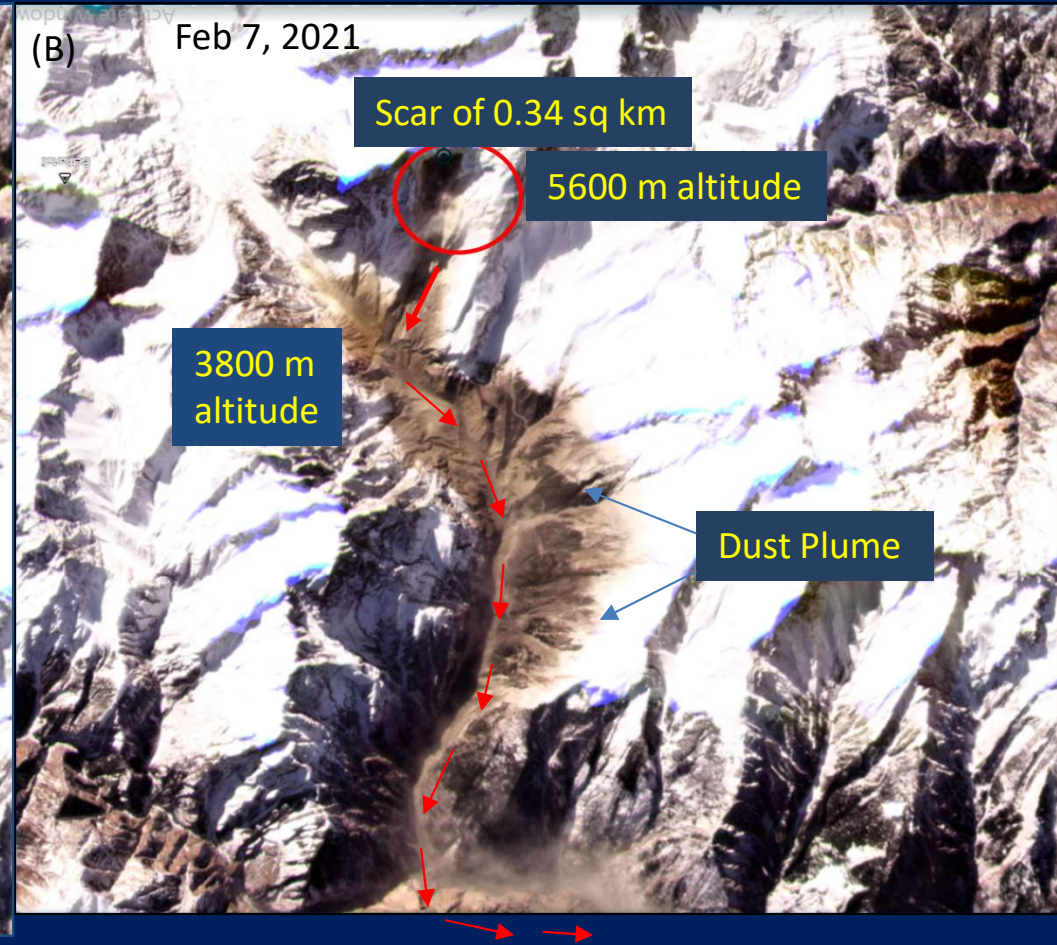


Floods in NW Himalaya

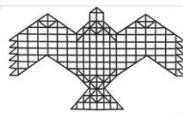
- Five major flood events during last 10 years or so.
- Uttarakhand Floods: Human casualty 4000. Estimates of economic loss between US \$ 500 to 2000 million.
- Pakistan Floods: 2000 people died. Economic loss US \$ 40 billion.
- Improved observations & modelling and development of warning system.



Uttarakhand - Rishigangga Floods



Landslide & Avalanche Zone

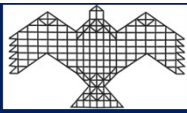


Site of Rockslide/ Snow Avalanche In Rishiganga Sub-basin



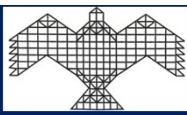
Pre & Post satellite images depicting probable rockslide / avalanche in Trishul glacier

Courtesy: IIRS/ISRO

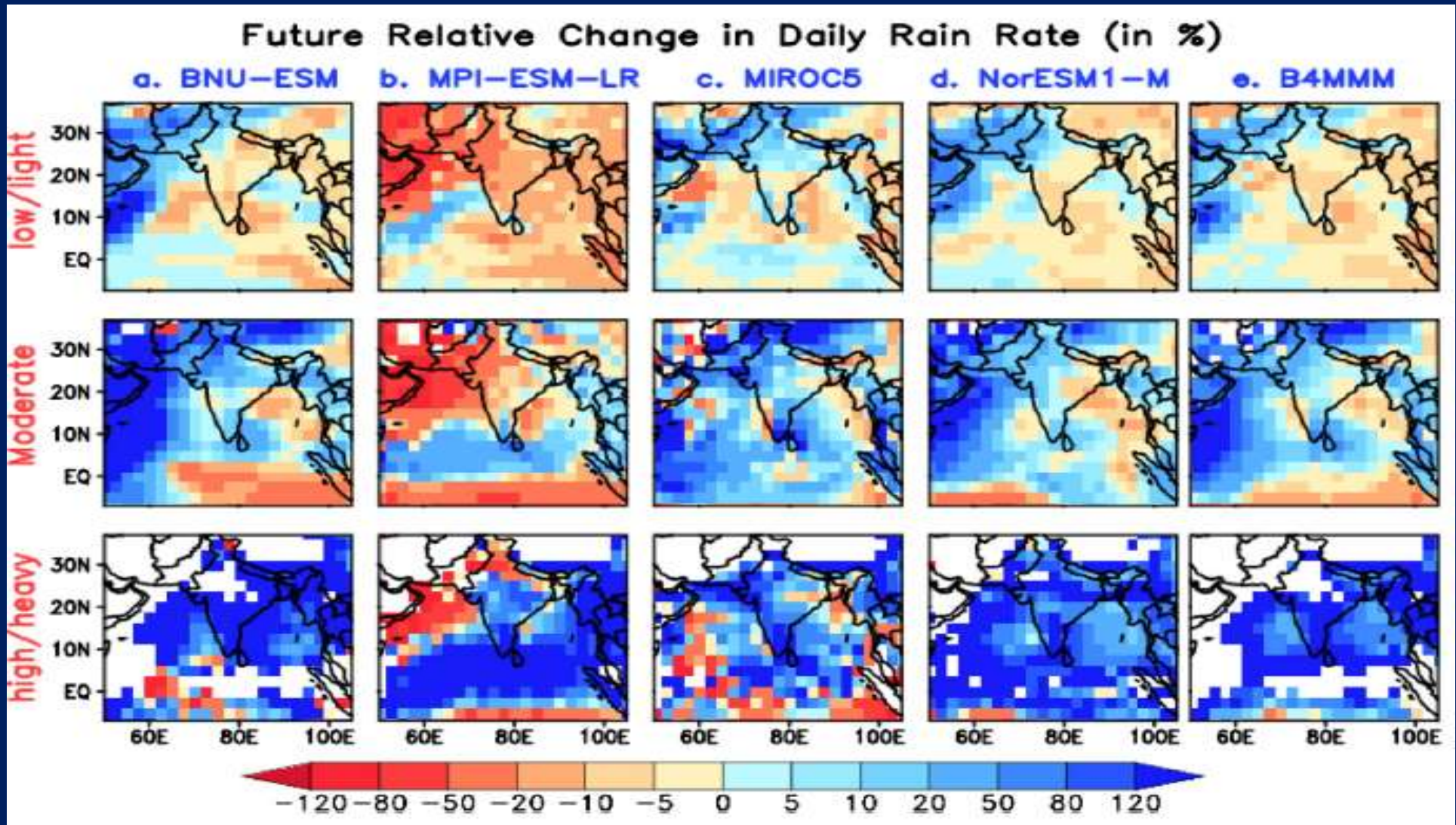


Tapovan Project Site, Rishi Ganga, Uttarakhand

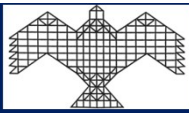




Future Change in Precipitation Rate

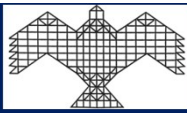


- Models suggest a decrease in light rain (10 mm) and increase in heavy (> 40 mm) precipitation.
- A rising trend of western disturbances has been observed during last few decades and will continue in 21st century (Krishnan et al. 2020)

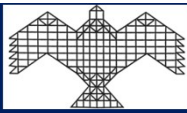


Water Resources and Energy

- All Himalayan states have built large and small dams for hydropower generation. According to ICIMOD (international Centre for Integrated Mountain Development), there are about 550 hydropower projects either built or under construction or planned in all Himalayan states.
- The inclusion of hydropower within international “*Clean Development Mechanism (CDM)*.” This scheme subsidised as “carbon offsets,” though large dams do cause hydrological and ecological damage.
- Micro and Mini hydropower generation to be encouraged to support local communities.
- Many scholars have suggested that future wars may be fought on *water*.
- The developmental activities have affected hydrological cycle and affected local ecosystem and people.

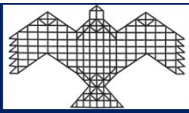


Himalayan Environment



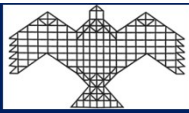
Forest and Biodiversity

- About 1500 people depend on each sq km of agriculture land on mountains compare about 500 persons on plains.
- The forest cover in Nepal has reduced from ~ 33 to 25 %. Bhutan has maintained its forest cover around 64 %. There is an increase from 19.44 to 21.71 % in forest cover from 1991-2021 in India.
- Loss of forest cover has increased incidences of landslides, soil erosion, especially in Nepal.
- Optimum forest cover is vital for preserving biodiversity.
- More than 40 % of forest is susceptible to forest fire.



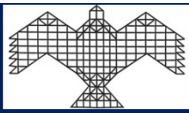
Transformation of Himalaya

- The region is under stress due to border conflicts between Pakistan, India and China. The military presence on permafrost and glaciers have led to increased avalanches and landslides.
- In addition, urbanisation, large-scale infrastructure projects, construction of roads, railways, tunnels, airfields, have been undertaken to support defence as well as developmental needs (hydropower generation and dam building) by all Himalayan States.
- Tourism is one of the major industries, especially in Nepal and Bhutan. Tourism is growing on both sides of Himalaya. Tourists' impact on such as Mt. Everest, Gangotri has led to litter, soot pollution on ice and glaciers.
- India, China and Pakistan are making decisions about Himalaya primarily based on their mutual enmity.
- The environmental issues are placed as secondary to state security and development.
- Himalaya have to be looked from how political decisions and anthropogenic activities interplay with the Himalayan environment, climate change, natural hazards.
- Requires an interdisciplinary approach and mechanism to understand Himalayan environment, its role in earth system vis-à-vis international politics.



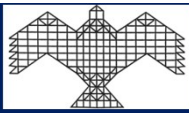
Global Engagements

- It is very difficult for single country to generate knowledge on the Himalaya.
- International partnership required to improve understanding of the earth system processes and developing numerical weather prediction models to meet national and regional needs.
- Convert knowledge into products and services for weather, climate, hazards for the country and neighboring region, viz. BIMSTEC, etc.
- ICIMOD have provided limited scientific knowledge on Himalaya.
- Issues of indigenous people inhabiting hazardous terrain.
- A knowledge-based society to sustain planet earth.
- An effective collaboration to build observational systems, data standards and exchange, prediction system, networking of required services, and preparing human communities is crucial to improve quality of life.



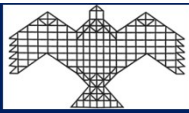
Existing Cooperation Mechanism

- SAARC would have been ideal mechanism, however, it is dysfunctional.
- BBIN (Bangladesh, Bhutan, India, Nepal), addresses issues related to water resources management, connectivity of power, transport and infrastructure. Leaves out China and Pakistan.
- BIMSTEC (Bay of Bengal Initiative for Multi-sectoral Technical and Economic Cooperation) though leaves out Pakistan and China, addresses issues related to “Environment and Disaster management.”
- India and China have cooperated in green- focus confidence building measures. Breakdown of waterflow data sharing agreement after Doklam crisis.
- MoES did have an MoU with Chinese Earthquake Administration, but no joint projects were undertaken.



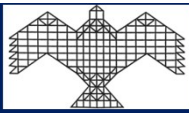
Himalayan Science Council (HSC)

- The idea of the HSC was mooted in March 2013 to address all Scientific issues which are common to all Himalayan nations as well as neighboring states. However, it could not move forward.
- This issue was again revived in May 2015.
- It was felt that China and Pakistan may not support this idea and it was decided to form HSC under BIMSTEC.
- The First Meeting of the BIMSTEC National Security Chiefs held in New Delhi in March 2017 decided to prepare a Concept Paper on HSC and Plan of Action.
- The Expert Group met in December 2019 in Goa and recommended that HSC be established to promote scientific cooperation, establish HSC Secretariat to coordinate activities, and place a proposal for financial mechanism to the Council to the BIMSTEC Permanent Working Committee.



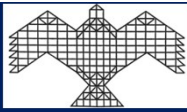
A way Forward

- Augment systematic, continuous, automated, long-term observations of atmospheric, hydrological, geological and geophysical parameters to understand patterns and trends of earth system processes and model the same.
- Future research to focus on ice dynamics, mass balance and evolution of cryosphere to understand fate of glaciers and driving forces and modelling of Glacial Lake Outburst Flooding (GLOF).
- Reliable estimates of snowmelt contributions in Himalayan river basins are crucial for forecasting regional water availability.
- Understanding of earthquake processes, landslide and avalanches.
- Collaborations with research institutes in understanding of the Himalayan system to develop strategies to provide resilience to large populations.



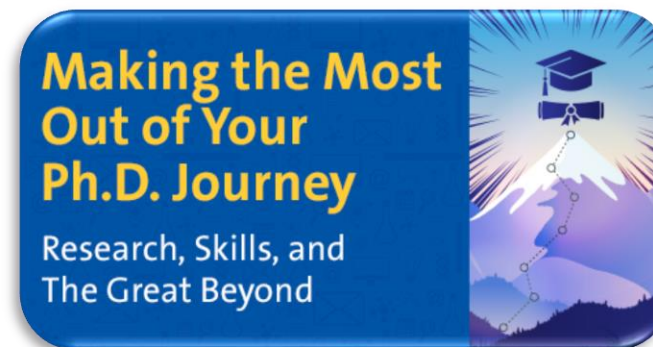
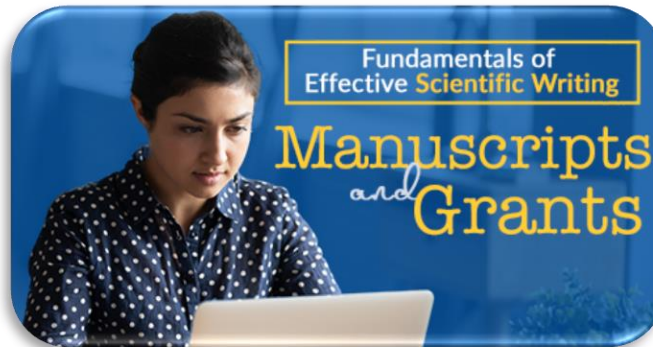
A way Forward

- The Himalaya lies beyond sovereign control of one nation. HSC should strive to involve China and Pakistan.
- Participation of all Himalayan States along with local people is needed to mitigate effects of climate change.
- To identify earth system processes having influence on the Himalayan system and in turn influence by them.
- Water crisis especially in Pakistan, India and China is likely to arise in future.
- Networking of scientific institutions
- Forum for Young Himalayan Researchers.
- Himalaya should be treated as a unique ecological system. The degradation of this system likely to affect population living in plains.
- A Polar Ambassador may be appointed to promote scientific work related to Himalaya along with Arctic and Antarctica.



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