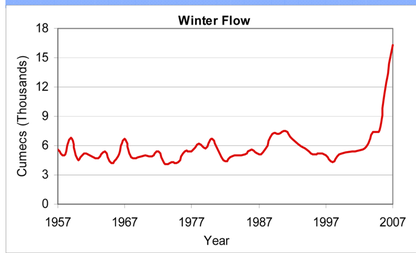
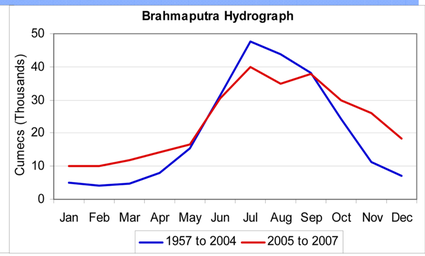
Changing Nature of Brahmaputra Hydrograph

Dinesh Prashar
Civil and Environmental Engineering, Tufts University, MA, USA.

Tufts UNIVERSITY
School of Engineering
GIS Expo 2010

Context

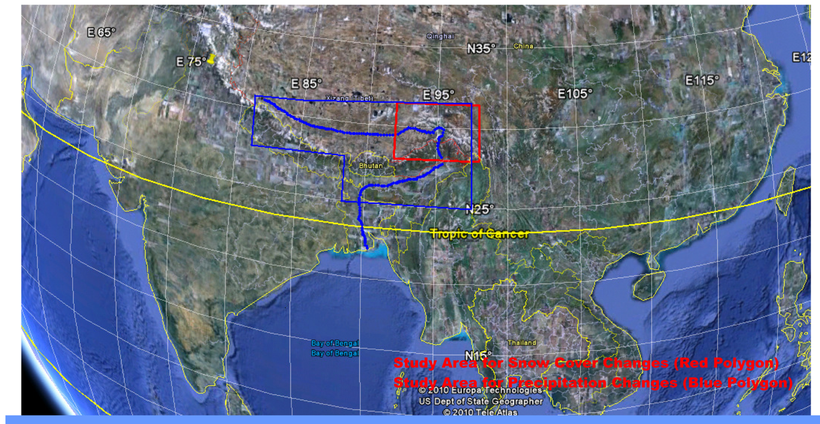




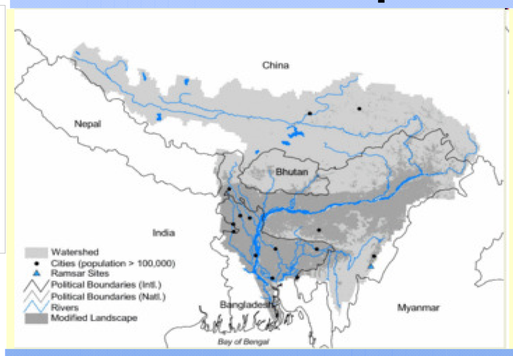
- **Brahmaputra is one of the largest rivers in the world in terms of discharge.**
- **Drainage area of 530,000 sq km extends into China (50.5%), India (33.6%), Bhutan (7.8%), and Bangladesh (7.8%).**
- **90% of the precipitation and flow occurs in the four monsoon months (Jul—Oct).**
- **Winters (Nov-Mar) correspond to low flow months.**
- **Last decade has seen a significant rise in winter flow.**

Study Logistics

- **Moisture sources for Brahmaputra**
  Q = R + M
  Q = Flow in Brahmaputra
  R = Rainfall Runoff
  M = Snowmelt Water
- **Likely causes of the change**
  Increase in winter precipitation
  Increase in temperature
- **Increased precipitation will immediately show up in the river.**
- **Effects of temperature rise**
  Increasing snowmelt
  rain instead of snow

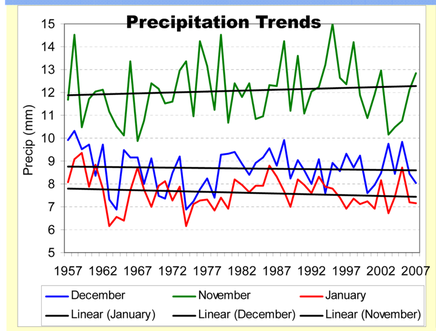


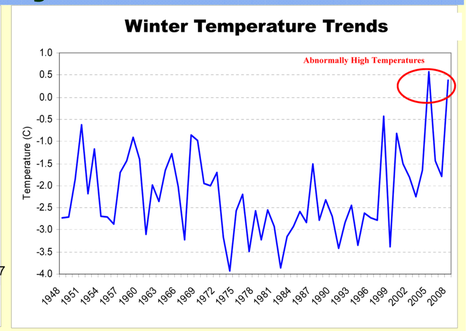
Brahmaputra Watershed



Basin Area	651,334 sq.Km
Population density	174 per sq.km
Large Cities	14
Wetlands	Sunderbans (21%)
Cropland	29%
Irrigated Cropland	47%
Lost forest area	73%
Grassland	29%
Shrub	16%
Major dams	None

Analysis

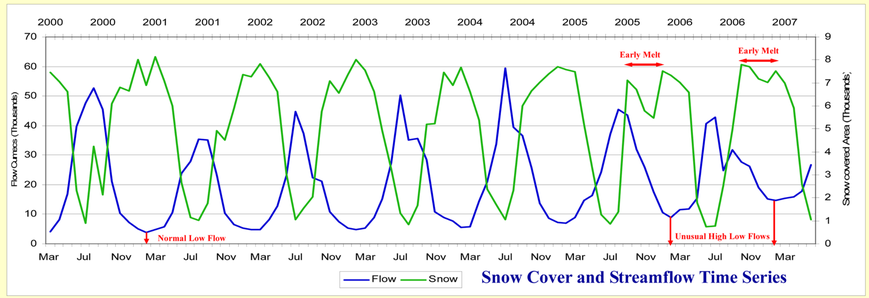




- **Winter precipitation over the watershed shows no increase.**
- **Temperature Shows a definite increasing trend after 1998.**
- **Four of five warmest years on record occurred after 1998.**
- **Average winter temperature exceeded freezing point for the first time in 2005 and again in 2007.**

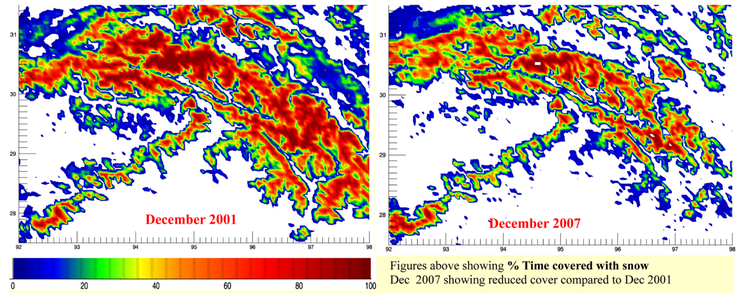
Remote Sensing

- **Used to establish a link between warming and snow melt.**
- **Overcomes the lack of data sharing by riparian countries.**
- **Inaccessible areas in The Himalayas make ground measurements difficult.**
- **Large study area and high albedo of snow make this an ideal avenue for application of remote sensing.**
- **MODIS snow products were used to obtain the snow covered areas in the region.**

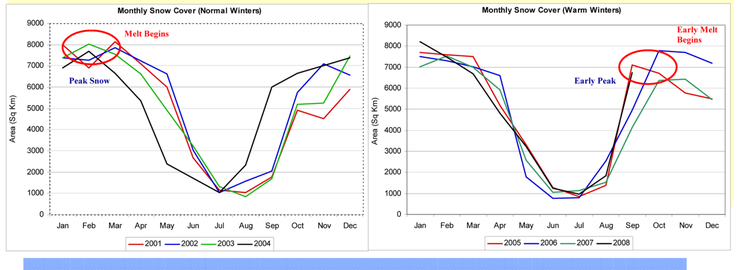


Snow Cover

- **Peak snow cover now occurs in Sep-Dec instead of Feb-Mar.**
- **Snowmelt historically began in Feb-Mar but now it begins around Nov.**
- **Resulting melt water is causing an increase in Brahmaputra flow in winters.**



Figures above showing **% Time covered with snow**
Dec 2007 showing reduced cover compared to Dec 2001



Summary

- **Increased winter flow in Brahmaputra can be attributed to snowmelt induced due to increased temperature.**
- **Remote sensing data affirms the above conclusion as it indicates that snowmelt is starting earlier in the Himalayas compared to earlier years.**
- **Remote sensing proved to be a useful tool in the absence of ground data and a lack of cooperation among political entities in the Brahmaputra basin on data sharing.**

Limitations and Future Work

- **Snow Water Equivalent and snow depth are important factors on which runoff depends.**
- **Future work must take into account these two factors to obtain a more accurate assessment of the impacts of warming in the region.**

Acknowledgements: I am thankful to Dr. Eman Ghoneim for her guidance and my colleague Mr. Antarpreet Jutla for his support on this project.