

Giriraj Amarnath

Nationality Indian
 Year of birth 22nd April 1977

KEY QUALIFICATIONS

Dr. Giriraj Amarnath is a remote sensing researcher specialized in the application of Remote Sensing and Geographic Information Systems in the study of risk assessment across a wide range of natural hazards and monitoring land and water resources in Asia and Africa. He has over 13 years' experience in research including 3 years in academic at University of Bayreuth, Germany. He has conducted research on the: (i) mapping flood inundation extent in south Asia and south-east Asia, (ii) global flood hotspots assessment for climate risk studies, (iii) piloting operational flood mapping and modeling in Eastern Sudan, (iv) snow cover mapping and monitoring in the Hindu-Kush Himalayas, (v) vegetation cover change and biodiversity assessment in Western Ghats (India), Sagarmatha National Park (Nepal), (vi) species niche modeling for endangered plants species in Western Ghats (India), (vii) environmental impact assessment using RS/GIS and (viii) relationship between upstream-downstream linkages in Indo-Gangetic plain and the possible causes of climate change impacts in this region.

In recent years he has become interested in studying the relationship between land cover/use changes, hydrology, impact of flooding on food security and livelihood. He is applying his expertise in geospatial technology in a recent project that assesses south Asia exposure and vulnerability towards climate hazards. Giriraj's academic and professional work have given him substantial experience including time living and working in India, Nepal, Germany, South Asia, Southeast Asia and Eastern Africa.

EDUCATION

| Year | Qualification and details |
|------|--|
| 2004 | Ph.D. Remote Sensing, National Remote Sensing Centre (ISRO), Hyderabad, India |
| 2006 | M.Sc., Geoinformatics, Indian Institute of Tropical Ecology, Sikkim Manipal Univ., India |
| 2001 | M.Sc., Botany, Madras Christian College, University of Madras, India |
| 1999 | B.Sc., Botany, Madras Christian College, University of Madras, India |

LANGUAGE SKILLS

| Language | Level of Proficiency (Mother tongue, Excellent, good, fair, poor) | | |
|----------|---|-----------|-----------|
| | Speaking | Reading | Writing |
| English | Excellent | Excellent | Excellent |
| Telugu | Mother tongue | Poor | Poor |
| Tamil | Good | Good | Good |
| Hindi | Fair | Poor | Poor |

SELECT PROFESSIONAL EXPERIENCE

May 2011 – Present | Researcher, Remote Sensing and GIS – Sri Lanka | International Water Management Institute (IWMI)

Responsible for flood risk mapping and flood early warning system using multi-scale satellite data, climate hazard mapping in south Asia and vulnerability analysis, prototype drought risk mapping

Giriraj Amarnath, November 2013

1

development, capacity building programme in Asia and Africa and outreach project to identify investment opportunities to unlock the potential for flood risk products in flood insurance industry. Below describes specific job responsibilities:

- Responsibilities in coordination of flood research in Asia and Africa region;
- Managing climate change impacts in Asia and Africa using geospatial tools; mapping and assessing flood risks; identifying global flood hotspots for flood mitigation measures;
- Mapping and modeling current and future flood estimates in South Asia and South East Asia using multi-resolution satellite, hydrologic and hydraulic modeling system
- Development of operational flood forecasting early warning system for Sudan using hydrological and hydrodynamic model;
- Developed approach for bias-correction in satellite rainfall estimates (SRE) for its use in flood modeling research;
- Organize and conduct training courses/seminars/workshops in the application of flood mapping and modeling for flood mitigation studies in Asia and Africa region;
- Rapid Emergency Response Mapping for catastrophic flood events in Asia and Africa through Sentinel Asia and UN-SPIDER mechanism and delivery of geospatial flood products to relevant stakeholders;
- Develop training curricula, training manuals and other necessary materials for the training courses/seminars/workshops in the flood mapping and modeling research;

Jan 2008 to April 2011 | Remote Sensing Specialist – Nepal | International Centre for Integrated Mountain Development (ICIMOD)

Responsible for modeling land cover change in Sagarmatha National Park, Nepal; regional-scale mapping and monitoring of snow cover in the HKH region; coordinate disaster thematic areas including monitoring of forest fires in Himalayas, rapid emergency response mapping in HKH region and play significant role for the 2010 floods in Pakistan. Several capacity building programs and organizing DRR workshop for the member countries of ICIMOD.

Jan 2006 to Jan 2008 | Research Associate – Germany | University of Bayreuth

Conducted research related to forest fire ecology, tropical forest fragmentation assessment using landscape metrics, Species niche modeling and satellite data assimilation in vegetation dynamics studies. Conduct academic course on “Remote Sensing for Biodiversity” for M.Sc., Global Change Ecology.

March 2004 to Dec 2005 | Post-Doctoral Researcher – India | French Institute of Pondicherry (IFP)

Responsible in landscape characterization and conservation planning in tropical ecosystems of Western Ghats, forest fire mapping in India using (A)ATSR satellite data, species niche modeling for the endemic and endangered plants using bioclimate conditions for conservation prioritization.

CURRENT / ONGOING PROJECTS:

Synthesis of global flood occurrence for hotspot analysis and large-scale flood inundation mapping for risk assessment in South Asia

Donor: CCAFS/ CGIAR | Duration: 18 Months / Ongoing

- To analyze, using literature and on-line sources, the global state-of- the-art in estimating and spatial mapping of flood-related parameters (hydromorphometric, climatic and land cover variables)

Giriraj Amarnath, November 2013

2

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- To develop the methodology for global and basin-wide mapping of the above parameters using statistical approach
- To estimate and map the above parameters in a basin case study and globally
- To map flood inundated areas for the last 10 years in Ganges basin/Sri Lanka using MODIS data for the monsoon seasons

Sub-National Scale Assessment of Current and Future Flood Risk to changing Climatic Conditions in South Asia Region

Donor: CCAFS/CGIAR / Ongoing | Duration: 12 months

- Enhanced understanding of flood intensity and duration, spatial extent, and potential impact will be identified with the coupled climate, hydrology and biophysical factors;
- Study will identify areas which are more frequent in flooding with changing climate factors for future flood mitigation activities;
- Enhanced understanding on the increases in frequency and magnitude of floods in response to climate change will be identified;
- Online repository and dissemination of flood information to users;

Mapping floods in South-east Asia using multi-scale satellite data for UTFI assessment

Donor: WLE/CGIAR | Duration: 2013 – Ongoing

- Synthesis of large-scale global flood events and identification of flood risks hotspots at basin scale for detail flood characteristics
- Establishing the typologies of the major river basins of Asia that have high flood risk and most favour the development of UTF systems
- Quantify the potential for UTF in greater spatio-temporal detail in two or more prospective hydrologic basins identified from objective 2
- Establish and monitor a pilot system in a sub-basin or watershed with high UTF potential that is of sufficient scale to create demonstrable impact to test the technical, environmental and socio-economic feasibility and replicability of the technology and benefits to flood managers and smallholder farming communities.
- Develop guidelines and strategies that foster the uptake of UTF where the conditions are suitable.

Smart-ICT for climate and weather information and advice to smallholders in Africa

Donors: IFAD and IWMI | Duration: 2012 – Ongoing

- To have an innovative approach of quantifying accurately flood prediction and forecast on a 3 hourly and daily time step using hydrological and hydrodynamic model;
- To implement HEC HMS and HEC RAS models for the selected region that includes river routing, sensitivity analysis (model calibration and validation) for effective flood risk management;
- To develop flood inundation mapping that uses multi-resolution remote-sensing data that provides daily/weekly flood extent, flood duration that address flood flows and maximizing returns in flood-based farming;
- To enhance the decision making capacity of farmers/water user associations and their service institutions to use rainfall estimation from remotely-sensed data and rainfall forecast to ensure near real-time stream flow information using ICT;

Fine-scale climate hazard mapping and vulnerability analysis in South Asia

Donor: CCAFS/CGIAR | Duration: 2014 – Ongoing

- To identify which sub-national areas/units (regions, provinces or districts, depending on the availability of the data) of South Asia countries (Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka) are the

most vulnerable to multiple hazards (flood, drought, sea level rise, glacial melting, intense precipitation zones)

- To develop socio-economic indicators (poverty, infrastructure, literacy, energy use, irrigation development etc.) for vulnerability assessment
- To show these vulnerable areas in a map for ease of reference of interested parties

AWARDS:

- Received prestigious **Rufford-Whitely Award** from UK Conservation Grant for 2003 & 2004
- Received Prestigious Grant in 2006 from American Rhododendron Society for mapping and monitoring Rhododendron distribution in Western Ghats
- Received **Young Scientist Award** Competitor Award in 2003 from Indian Science Congress Association, India
- Received **Best Poster Award** in 2004 from Indian Science Congress Association, India
- Received **Best Paper Award** in National Conference on Space Technology and Geographical Research Application held at Hyderabad, India
- Received Travel Grant Award from International Human Dimension Programme, Germany
- Central Scientific Industrial Research (CSIR, India) supported travel to attend ISRSE Symposium in Hawaii, USA in 2003

PUBLICATIONS AND TECHNICAL REPORTS:

1. **Amarnath G.**, Murthy M.S.R., Britto S.J., Rajashekar G. & Dutt C.B.S. 2003. Diagnostic analysis of conservation zones using remote sensing and GIS techniques in wet evergreen forests of Western Ghats – An ecological hotspot, Tamil Nadu, India. *Biodiversity and Conservation* 12: 2331-2359.
2. Murthy, M.S.R., **Giriraj A.** & Dutt C.B.S. 2003. Geoinformatics for Biodiversity Assessments. *Biological Letters* 40: 75-100.
3. Murthy, M.S.R., Pujar G.S. & **Giriraj A.** 2006. Geoinformatics based management of biodiversity from landscape to species scale – An Indian Perspective. *Current Science* 91: 1477-1485.
4. Irfan-Ullah M, **Giriraj A.**, Murthy M.S.R. & Peterson A.T. 2007. Mapping the Geographic Distribution of *Aglaia bourdillonii* Gamble (Meliaceae), an Endemic and Threatened Plant, using Ecological Niche Modeling. *Biodiversity and Conservation* 16:1917-1925.
5. **Giriraj A.**, Irfan-Ullah M., Murthy M.S.R. & Carl Beierkuhnlein. 2008. Modelling the spatial and temporal patterns of forest cover change (1973 - 2020): A case study from South Western Ghats (India). *Sensors* 8: 6132-6153.
6. **Giriraj A.**, Karunakaran P.V., Irfan-Ullah M., Ramesh B.R. & Murthy M.S.R. 2008. Mapping the Potential Distribution of *Rhododendron arboreum* ssp. *nilagiricum* (Zenker) Tagg (Ericaceae), an Endemic plant using Ecological Niche Modeling. *Current Science* 94 (12): 1605- 1612.
7. **Giriraj A.**, Murthy M.S.R. & Ramesh B.R. 2008. Vegetation Composition, Structure and Diversity Pattern: A case study from Tropical Wet Evergreen Forests of Western Ghats, India. *Edinburgh Journal of Botany* 65 (3): 1-22.
8. Roy P.S. & **Giriraj A.** 2008. Land use and Land cover analysis in Indian Context. *Journal of Applied Sciences* 8 (8): 1346-1353.
9. **Giriraj A.**, Babar S. & Reddy C.S. 2008. Monitoring of Forest Cover Change in Pranahita Wildlife Sanctuary, Andhra Pradesh, India Using Remote Sensing and GIS. *Journal of Environmental Science and Technology* 1 (2): 73-79.
10. Reddy C.S., Babar S., **Giriraj A.**, Reddy K. N. & ThulsiRao K. 2008. Structure and Floristic Composition

Giriraj Amarnath, November 2013

4

of Tree diversity in Tropical Dry Deciduous Forest of Eastern Ghats, Southern Andhra Pradesh, India. *Asian Journal of Scientific Research* 1 (1): 57-64.

11. **Giriraj A.**, Murthy M.S.R. & Beierkuhlein C. 2009. Evaluating forest fragmentation and its tree-community composition in the tropical rain forest of Southern Western Ghats (India) from 1973 – 2004. *Environmental Monitoring and Assessment* 161: 29-44.
12. **Giriraj A.**, Murthy M.S.R., Ramesh B.R. & Dutt C.B.S. 2009. A method for assessing evergreen habitats using phytodiversity and geospatial techniques in tropical rain forests of Southern Western Ghats (India). *Journal of Ecological Research* 24 (4): 749-760.
13. Prasad R.C., Sringswara A. N., Reddy C.S., Nagabhatla N., Rajan K.S., **Giriraj A.**, Murthy M.S.R., Raza S.H. & Dutt C.B.S. 2009. Assessment of Forest Fragmentation and Species Diversity in North Andaman Islands (India) – A Geospatial Approach. *International Journal of Ecology and Development*, Vol.14 No. FO9, 33-46.
14. Shrestha A.B., **A. Giriraj** & Kumar R. 2009. Snow and glacier melt runoff modelling in the Himalayas. *Current Science* 97 (7): 985.
15. **Giriraj A.**, Reddy C.S., Babar S., Ugle P., Sudhakar S. 2010. Assessment of Fragmentation and Disturbance patterns in Eastern Ghats: A case study in R.V. Nagar Range, Visakhapatnam district, Andhra Pradesh, India. *Indian Society of Remote Sensing* 38, 4: 633-639.
16. **Giriraj A.**, Babar S., Jentsch A., Sudhakar S., & Murthy M.S.R. 2010. Tracking Fires in India Using Advanced Along Track Scanning Radiometer (A)ATSR Data. *Remote Sensing* 2(2):591-610.
17. Brown M.E., Ouyang H., Habib S., Shrestha B., Shrestha M., Panday P., Tzortziou M., Pollicelli F., Artan G., **Giriraj A.**, Bajracharya S. & Racovinteanu A. 2010. HIMALA: Climate Impacts on Glaciers, Snow and Hydrology in the Himalayan Region. *Mountain Research and Development* 30 (4): 401-404.
18. Konz M., Finger D., Bürgi C., Normand S., Immerzeel W., Merz J., **Giriraj A.** & Burlando, P. 2010. Calibration of a distributed hydrological model for simulations of remote glacierized Himalayan catchments using MODIS snow cover data. *LAHS-AISH Publication* 340: 465-473.
19. Joshi, A. K., Pant, P., Kumar, P., **Giriraj, A.**, & Joshi, P.K. 2011. National Forest Policy in India: Critique of Targets and Implementation. *Small-Scale Forestry* 10: 83-96. 10.1007/s11842-010-9133-z.
20. Reddy C.S., Babar S., **Giriraj A.** & Pattanaik C. 2011. Structure and floristic composition of tree stand in tropical forest in the Eastern Ghats of northern Andhra Pradesh, India. *Journal of Forestry Research* 22 (4): 491-500. 10.1007/s11676-011-0193-5
21. Gurung D.R., Kulkarni A.V., **Giriraj A.**, Aung K.S. & Shrestha B. 2011. Monitoring of seasonal snow cover in Bhutan using remote sensing technique. *Current Sciences* 101 (10):
22. Gurung D.R., Kulkarni A.V., **Giriraj A.**, Aung K.S., Shrestha B. & Srinivasan J. 2011. Changes in seasonal snow cover in Hindu Kush-Himalayan region. *Cryosphere Discussion*, 5, 755–777.
23. **Giriraj A.**, Bajracharya B, Shrestha B. 2010. Modelling land cover dynamics using remote sensing and GIS - A case study in Sagarmatha National Park, Nepal. *Journal of Geographical Sciences* (in review)
24. Babar, S., **Amarnath, G.**, Reddy, C. S., Jentsch, A., & Sudhakar, S. (2012). Species distribution models : ecological explanation and prediction of an endemic and endangered plant species (*Pterocarpus santalinus* L . f .). *Current Science*, 102(8), 1157–1165.

25. **Amarnath, G.**, Bajracharya, B., & Shrestha, B. (2012). Geoinformatics for Landscape Ecology and Biodiversity Research. *Asian Journal of Geoinformatics*, 12(1).
26. Uddin, K., Gurung, D. R., **Giriraj, A.**, & Shrestha, B. (2013). Application of Remote Sensing and GIS for Flood Hazard Management : A Case Study from Sindh Province , Pakistan. *American Journal of Geographic Information System*, 2(September 1988), 1–5. doi:10.5923/j.ajgis.20130201.01
27. Tang, B.-H.; Shrestha, B.; Li, Z.-L.; Liu, G.; Ouyang, H.; Gurung, D. R.; **Amarnath, Giriraj**; Aung, K. S. (2013). Determination of snow cover from MODIS data for the Tibetan Plateau Region. *International Journal of Applied Earth Observation and Geoinformation*, 21:356-365.
28. Amarnath, **Giriraj**. (2013). An algorithm for rapid flood inundation mapping from optical data using a reflectance differencing technique. *Journal of Flood Risk Management*, 12p. DOI: 10.1111/jfr3.12045

Articles in Pipeline

1. Giriraj Amarnath; Ameer Rajah; Vladimir Smakhtin, Pramod Aggarwal. Global flood hotspots: Identification, assessment and monitoring for climate mitigation measures – *Natural Hazards Journal* (In Preparation)
2. Giriraj Amarnath; Ameer Rajah; Vladimir Smakhtin, Pramod Aggarwal. Spatio-temporal flood mapping analysis for South Asia using MODIS imagery – *Journal of Applied Remote Sensing* (In Prep.)
3. Giriraj Amarnath; Ameer Rajah; Vladimir Smakhtin. Comparison of flood affected area derived from MODIS and ALOS imagery. *Current Science* (In Prep.)
4. Giriraj Amarnath, Bharat Sharma, Yasir Mohammed, Younis Gismalla. Role of remote sensing data in flood-based farming for the Gash River Catchment (In Prep.)
5. Giriraj Amarnath, Deoraj Gurung, Panday Prajjwal, Basanta Shrestha. Seasonal distribution of snow cover in the Himalayan region using MODIS satellite data.

Book chapters

1. **Giriraj** Amarnath & Bharat Sharma (2013) “Droughts and Floods: Issues and Coping Strategies” in *Indian Water Policy at the Cross-roads: resources, technology and reforms* by Narayanamoorthy A.
2. Giriraj Amarnath et al., (2013) Remote Sensing of inundated areas - book chapters in *Hydrometeorological Disasters and Climate Change*, edited by Giriraj A., Joshi P.K., Singh T.P. and Ravan S., published by Taylor and Francis **Giriraj**, Amarnath. 2012. ***Large-scale flood event: global and regional assessment.*** In Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP). International Training Course: Application of Space Technology for Disaster Risk Reduction. Lecture notes. Dehradun, India: Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP). pp.187-202.
3. **Giriraj**, Amarnath; Murthy, M. S. R.; Shrestha, B. 2011. ***Evaluating biodiversity and spatial simulation of land-cover change in the tropical region of western Ghats, India.*** In Pavlinov, I. Y. (Ed.). *Research in biodiversity - models and applications*. Rijeka, Croatia: InTech. pp.115-144.
4. Joshi, P. K.; Priyanka, N.; **Giriraj**, Amarnath. 2011. ***Geospatial tools to assess forest ecosystems under climate change trajectories.*** In Joshi, P. K.; Singh, T. P. (Eds.). *Geoinformatics for climate change studies*. New Delhi, India: The Energy and Resources Institute (TERI) pp.129-176.
5. **Giriraj A.**, Joshi P.K., Babar S., Wegmann M., Conrad C., Sudhakar S., Beierkuhnlein C. 2009. Systematic

assessment of forest cover change and forest fragmentation in Indian sub-continent using multi-scale satellite remote sensing inputs. In Joshi, P. K.; Singh, T. P. (Eds.). Geoinformation for Natural Resource Management, Nova Publishers, New York. Pp 1-23.

6. Hawksworth, D. L., & Bull, A. T. (2007). Plant conservation and biodiversity. Dordrecht, the Netherlands, Springer.

Proceedings / Training Manual / Report

1. Amarnath, **Giriraj**; Sharma, Bharat. 2013. Manual of the Training on *Application of Remote Sensing and GIS in Flood Inundation Mapping for Spate Irrigation Assessment in Sudan*, jointly organized by IWMI, the Hydraulic Research Institute (HRS), Sudan, and the International Fund for Agricultural Development (IFAD), held at Wad Medani, Sudan, 15-17 January 2013. Colombo, Sri Lanka: International Water Management Institute (IWMI). 96p.
2. Amarnath, **Giriraj**; Rajah, Ameer. 2013. Manual of the Training on *Flood Inundation Mapping and Modeling: Case Study of Bangladesh*, held at the Bangladesh Space Research and Remote Sensing Organization, Dhaka, Bangladesh, 12 - 16 May 2013. Colombo, Sri Lanka: International Water Management Institute (IWMI). 119p.
3. **Giriraj**, Amarnath; Ameer, Mohamed; Aggarwal, Pramod; Smakhtin, Vladimir. 2012. *Detecting spatio-temporal changes in the extent of seasonal and annual flooding in South Asia using multi-resolution satellite data*. In Civco, D. L.; Ehlers, M.; Habib, S.; Maltese, A.; Messinger, D.; Michel, U.; Nikolakopoulos, K. G.; Schulz, K. (Eds.). Earth resources and environmental remote sensing/GIS applications III: proceedings of the International Society for Optics and Photonics (SPIE), Vol.8538, Amsterdam, Netherland, 1-6 July 2012. Bellingham, WA, USA: International Society for Optics and Photonics (SPIE). 11p.
4. Amarnath, **Giriraj**; Pavelic, Paul; Smakhtin, Vladimir. 2013. *Analysis of trends in extreme flood events and mitigation strategies in South East Asia*. [Abstract only]. In German Aerospace Center (DLR); Germany. Federal Ministry of Education and Research (BMBF). Mekong Environmental Symposium, Ho Chi Minh City, Vietnam, 5-7 March 2013. Abstract volume, Topic 06 - Hazards and disaster risk reduction in the Mekong Basin. Wessling, Germany: German Aerospace Center (DLR); Bonn, Germany: Federal Ministry of Education and Research (BMBF). pp.46.
5. Sharma, Bharat; Rebelo, Lisa-Maria; Amarnath, **Giriraj**; Miltenburg, I. 2013. *Launching next generation ICT for weather and water information and advice to smallholders in Africa* [Abstract only]. Paper presented at the Mobile Services that Empower Vulnerable Communities, Catholic Relief Services (CRS) 5th Conference on Information and Communications Technologies for Development (ICT4D), Accra, Ghana, 19-21 March 2013. 1p
6. Amarnath, **Giriraj**. 2012. *Large-scale flood event: global and regional assessment*. In Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP). International Training Course: Application of Space Technology for Disaster Risk Reduction. Lecture notes. Dehradun, India: Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP). pp.187-202.
7. **Giriraj**, Amarnath; Ameer, Mohamed; Aggarwal, Pramod; Smakhtin, Vladimir. 2012. *An algorithm for rapid flood inundation mapping from optical data using reflectance differencing technique [Abstract only]*. In de Silva, R. P; Kumar, N.; Mehmood, H. (Eds.). GIT4NDM - reduce exposure to reduce risk: proceedings of the 4th International Conference on Geo-information Technology for Natural Disaster Management (GIT4NDM), Colombo, Sri Lanka, 7-8 November 2012. Pathumthani, Thailand: Geoinformatics International. pp.19.
8. Gurung D.R., **Giriraj A.**, Shrestha B., Jürg L. 2010. Inter-comparability of MERIS GLOBCOVER and ASTER Land Cover Product for the Sagarmatha National Park, Nepal. Proceedings in the Living Planet Symposium, Norway
9. Tang B.H., Shrestha B., Li Z.L., Gaohuan Liu G., Ouyang H., Gurung D.R., **Giriraj A.**, Aung K.S. 2010. Improvement of MODIS Snow Cover Algorithm for the Hindu Kush-Himalayan Region. IGARSS 2010. IEEE International Geoscience and Remote Sensing Symposium, in Proc. IGARSS, 2010, pp.1737-1740.
10. **Giriraj A.** 2010. GIS Methods for Forest Fire Monitoring. ESRI User Conference, California, USA
11. **Giriraj A.** (ICIMOD) and WFP. Drought and Forest Fires. 2009. Report on Crop and Food Security 2008/09. United Nations World Food Programme publications Pp 38

12. Cyril B., **Giriraj A.** 2010. Incorporating Remote Sensing Data in Modelling Hydrology for the Himalayan Catchment. ICIMOD Technical Report Pp 44
13. **Giriraj A.** and ICIMOD. 2010. Regional framework on space-based information for disaster preparedness and risk management in the Hindu Kush-Himalayan region. ICIMOD Technical Draft Report
14. **Giriraj A.** and Shrestha B. 2010. “Regional forest fires in the Hindu-Kush Himalayan region” , International symposium on “Benefitting from Earth Observation – Bridging the Data Gap for Adaptation to Climate Change in the HKH Region, Kathmandu
15. **Giriraj A.** and Shrestha B. 2010. “Rapid Response Mapping and Damage Assessment for Pakistan Floods”, International symposium on “Benefitting from Earth Observation – Bridging the Data Gap for Adaptation to Climate Change in the HKH Region, Kathmandu