Overview of SERVIR-Himalaya and Science Applications

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United Nations/Pakistan International Workshop on Integrated Use of Space Technologies for Food and Water Security
Special Session: SERVIR-Himalaya
Enhancing Use of Earth Observation and Geospatial Technologies in the HKH Region
International Centre for Integrated Mountain Development (ICIMOD)

- Member countries - Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan

- A regional mountain knowledge, learning and enabling centre devoted to sustainable mountain development

- Information and knowledge are prime commodities of the Centre

The Hindu Kush-Himalayan Region
Extends over 3500 km from Afghanistan to Myanmar and Home to 200 million People
SERVIR Initiative at NASA

SERVIR ~ to serve

To improve environmental management and resilience to climate change by strengthening capacity of governments and key stakeholders to integrate EO and geospatial technologies into decision making for sustainable development.
Contributing to GEOSS vision

THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS

INFORMATION FOR THE BENEFIT OF SOCIETY

SERVIR Initiative at NASA
Matching Demand & Supply

Demand:
- cultivate use of better information
  - Users engaged to define needs and opportunities
  - Capacity building and training delivered
  - Outreach and communications conducted

Supply:
- Access to high quality, user-tailored tools & information services
  - Improved access through a functioning One-Stop platform
  - Data quality and coverage improved
  - Tools, models, and applications co-developed

Matching Demand & Supply

Demand & Supply
**Goal:** Improved environmental management and resilience to climate change

**Objective:** Strengthen capacity of governments and other key stakeholders to integrate earth observation information and geospatial technologies into development decision-making

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**Intermediate Results**

- **IR1. Demand:** Use of better information cultivated
- **IR2. Supply:** Access to high quality, user-tailored tools and information services
- **IR3. Regional hubs and networks established and functioning**

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**Sub-Intermediate Results**

- **1.1 Users engaged to define needs and opportunities**
- **1.2 Capacity building and training delivered**
- **1.3 Outreach and communications conducted**
- **3.1 Existing hubs strengthened**
- **3.2 SERVIR Communities-of-Practice developed**
- **3.3 Additional hubs and/or smaller nodes established**
- **2.1 Improved access through a functioning One-Stop platform**
- **2.2 Data quality and coverage improved**
- **2.3 Tools, models, and applications co-developed**

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**Indicative activities/projects**

- 1. Regional needs and opportunities assessments
- 2. Workshops conducted to engage stakeholders
- 3. Training courses developed
- 4. Public awareness events and materials developed

- 1. Strengthen existing regional hubs
- 2. Identify, establish future hubs and smaller nodes
- 3. Develop regional partnerships and networks
- 4. South-South Collaboration and exchange
- 5. SERVIR liaisons to ministries

- 1. Establish web-based one-stop platform
- 2. Acquire, harmonize, provide access to data layers
- 3. Co-develop terrestrial carbon, adaptation, disaster management and other products and applications
- 4. Develop new remote sensing products
Identifying the Needs

- Regional experience
- Meetings & RMC consultations
- GEOSS priority areas
- Priority themes
- Technical innovations
- ICIMOD’s ongoing programs

Priority themes:
- Regional experience
- Meetings & RMC consultations
- GEOSS priority areas
- Technical innovations
- ICIMOD’s ongoing programs
Identifying the Needs

- Cryosphere & Water
- Ecosystem & Biodiversity
- Air & Atmosphere
- Climate Change Adaptation and Mountain Development
- Disaster & Natural Hazards
- Agriculture & Food Security
Ecosystem & Biodiversity

- Land cover change and GHGs
- Multi scale biomass modeling
- Phobjiaka habitat conservation
- Forest change proneness model

Product design verification

Field data support

Forest Resources Assessment
REDD Cell, WWF-Nepal
Dept Forest & Park Services, Bhutan
ICIMOD Regional Programs

Product use & application

Tools adoption

Forest cover reporting systems

REDD MRV framework

RAMSAR site monitoring system
Multi-scale Biomass Modeling
REDD MRV Framework

- Develop multi resolution satellite data based biomass models for baseline carbon assessment and monitoring
- REDD Project areas of ICIMOD
- Spatial biomass models tested, under calibration
  - Landsat TM Seasonal Multispectral Reflectance
  - GeoEye based Stand level canopy Morphology
  - GeoEye based Species level canopy projected area
- MRV Spatial frame work being worked out
Tree Crown Size Analysis

Tree Crown Size 2002
- <50
- 50-100
- 100-150
- 150-200
- 200-250
- >250

Tree Crown Size 2009
- <50
- 50-100
- 100-150
- 150-200
- 200-250
- 250-300
- 300-350
- >350

2002:

2009:
Land Cover Change – Forest Carbon Fluxes Estimation

- To develop improved forest carbon flux estimation using improved databases and quantification methods
- Landsat TM based Land cover change database 1990-2000-2010 under ground verification
- Emission factor data at Tier-II/III level across Veg-Alt based strata collected
- Design for integrating activity and emission factor data developed
Decadal Land Cover Change

• District-wise land cover statistics and trend
• Visualization of land cover change – tables, graphs, maps and swipe tool
Disaster & Natural Hazards

- Forest fire detection & monitoring
- Flood early warning system

DoF, REDD Communities, Nepal
DoF, DDM, Bhutan
CEGIS, FWC, Bangladesh
HYCOS Program, ICIMOD

Product design & verification
Ancillary data
Near real time fire reporting system
Flood early warning system
Product use & application
Tools adoption
MODIS Forest Fire Detection and Monitoring System, Nepal

Acquisition

- Global active fire text file
  - Download, generate shapefile and clip to Nepal boundary
  - Nepal active fire shapefile
  - Attach important information (district, VDC, ward, protected area, etc.) to fire data and load to database

Analysis and Storage

- Forest Fire Database
  - SMS notification
  - Email notification
  - Web mapping application

Dissemination
• Provide daily SMS and email fire alerts to the concerned individuals
• Currently, there are 380 subscribers (200 SMS and 180 email subscribers)
Flash Flood Early Warning Wireless Sensor Network System

- Consist of - a water level sensing node, a data concentrator and an alarm node
- Individual nodes form a peer-to-peer mesh network to communicate between themselves
- Features an advanced sleep mode - entire network goes to a low power consumption state during periods of inactivity
- Capacity building of local community to respond to flash flood

Source: Synapse Wireless Inc.
Agriculture & Food Security

In season crop monitoring
Crop production assessment

DoA, DoI, DHM, NARC, Nepal Koshi River Basin & HICAP Programs, ICIMOD

Product design & verification

Historical data

Agriculture
Drought Warning system

Crop Planning management

Product use & application

Tools adoption
Crop Growth Monitoring and Production Assessment

- MODIS based in season crop growth monitoring and crop production assessment
- Rice and Wheat crops - Terai Region, Nepal
- Preparation of fortnightly reference VI (250 m) data using decadal historical database
- Spatial and temporal VI anomalies detection and products
- Peak season VI based production modeling
- Integration with climate, soil and soil moisture and process models
Crop Growth Monitoring and Production Assessment

Agriculture Monitoring to Support Food Security in Nepal

NDVI

District: Banke

Latest Year (2010)

View Graphs

Graphs

Banke 2010

NCVI

Day

Year 2010 Long Term Anomaly

Base Layers

Country Outline
District
Airport
Settlement
Road
Agriculture

Legends

Matured and Gravelled
Others
Railway
Agriculture
Crop in Slope
Irrigated Agriculture
Mixed Agriculture
Orchards
Rainfed Agriculture
Cryosphere & Water
Automated snow cover product
CREST run off modeling

DHM, Nepal
DHMS, Bhutan
Cryosphere Program, ICIMOD

Product use & application
Tools adoption

Product design
verification

Ancillary data

SCA feed to Snow Melt Runoff Models

Basin level water management
MODIS based automated snow cover monitoring
Automated Aerosol Monitoring Validation of MODIS Aerosol Data Air Quality and Health

Male’ Declaration MoEST, Nepal Health Research Council, EvK2CNR Black Carbon Program, ICIMOD

Satellite based air quality reporting system

Product design verification

Ancillary data

Product use & application

Tools adoption
Air Quality Monitoring

Atmospheric Haze Monitoring in the HKH

Dec 31, 2012 [Mean of aqua & Terra]
Access to Information

The Mountain GeoPortal provides a gateway for geo-information and knowledge resources to support mountain development policies and practices in the Hindu Kush Himalayan region.

Regional status of glaciers
Comprehensive glacier inventory and status of the entire Hindu Kush Himalayan region

Forest fire monitoring
MODIS based active fire detection and monitoring system in Nepal with SMS and email alerts

Land cover dynamics
Statistics on the harmonised land cover database of Bhutan for 1990, 2000 and 2010

Regional Database
A comprehensive catalogue of GIS and satellite data featuring data discovery, access, and use of ICIMOD and its partners. This data explorer application uses open source geoweb management system with the ability to harvest metadata from network of partners.

Latest MODIS images from ICIMOD Receiving Station
Access to Information

Featured Maps & Applications from ICIMOD's Mountain GeoPortal

ICIMOD Data Explorer
Atmospheric Haze Monitoring in the HKH
Earthquake Emergency Management and Glacial Lakes in the HKH Region

Make a Map »
Create a map that can be viewed in a browser, desktop or mobile device. Share it on a blog, via email, or embed it in a website.

ArcGIS Online for Developers »
Build custom web and mobile applications that incorporate your maps and data.
Outreach & Capacity Building

• Symposium
• Workshops/Training
• Youth Forum
• Science Applications Showcase
Other Opportunities and Linkages

• MyCOE/SERVIR for capacity building of young professionals
• NASA Develop – student internship program
<table>
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<tr>
<th>Project Title</th>
<th>Region</th>
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<tr>
<td>Forest carbon assessment for REDD in the East Africa SERVIR region</td>
<td>East Africa</td>
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<td>Interdisciplinary science applications to glacier and alpine hazards in relation to development and habitation in the Hindu Kush-Himalaya: SERVIR Science Team project</td>
<td>Hindu Kush-Himalaya</td>
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<td>A Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa</td>
<td>East Africa</td>
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<td>Using Earth Observation Data to Improve REDD+ Policy in Mesoamerica and the Dominican Republic</td>
<td>Mesoamerica</td>
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<td>Applications of Satellite Products for Air Quality Monitoring, Analysis, Forecasting, and Visualization in the SERVIR Mesoamerica and Himalaya Regions</td>
<td>Mesoamerica, Hindu Kush-Himalaya</td>
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<td>Leveraging CMIP5 and NASA / GMAO Coupled Modeling Capacity for SERVIR East Africa Climate Projections</td>
<td>East Africa/Hindu Kush-Himalaya</td>
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<td>East Africa Drought and Agricultural Productivity Assessment and Prediction System</td>
<td>East Africa</td>
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<td>SERVIR Water Africa-Arizona Team (SWAAT)</td>
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<td>Landslide Hazard Assessment and Forecasting System using near real-time remote sensing information over SERVIR-Mesoamerica</td>
<td>Mesoamerica</td>
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<td>Development and Implementation of Flood Risk Mapping, Water Bodies Monitoring and Climate Information for Disaster Management and Human Health (integration within SERVIR)</td>
<td>East Africa</td>
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• a new International Space Station camera developed by SERVIR
• ISERV is a pathfinder system, designed to help scientists gain expertise in providing ISS-based imagery for developing nations to help monitor natural disasters and environmental concerns.
Way Ahead

- Institutional mechanisms for operationalizing science applications
- Creating a global network of regional partners and a platform for collaboration and cross-agency coordination, international partnerships
- Capacity building at different levels – individuals, institutions and enabling environments
- Realizing the vision of “Linking from Space to Village”
Thank You