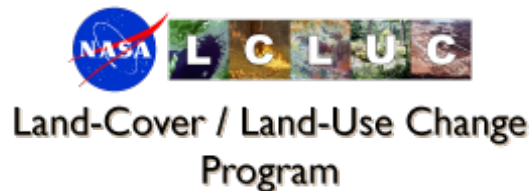
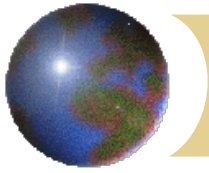


# The South/Southeast Asia Research Initiative (SARI)

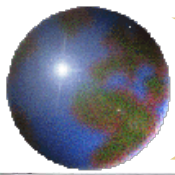
Krishna Prasad Vadrevu  
University of Maryland College Park  
USA  
and  
SARI Organizational Committee





## Presentation topics

- **Background to the SARI initiative**
- **SARI Science Rationale**
- **SARI Program coordination and next steps**
- **Regional science issues from the Burma meeting**



## How it started - strong interest in a SARI from local scientists



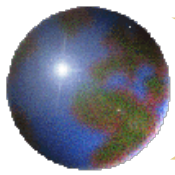
**Jan-10-13th, 2013-Regional Science Meeting, Coimbatore**

**Total participants =120**

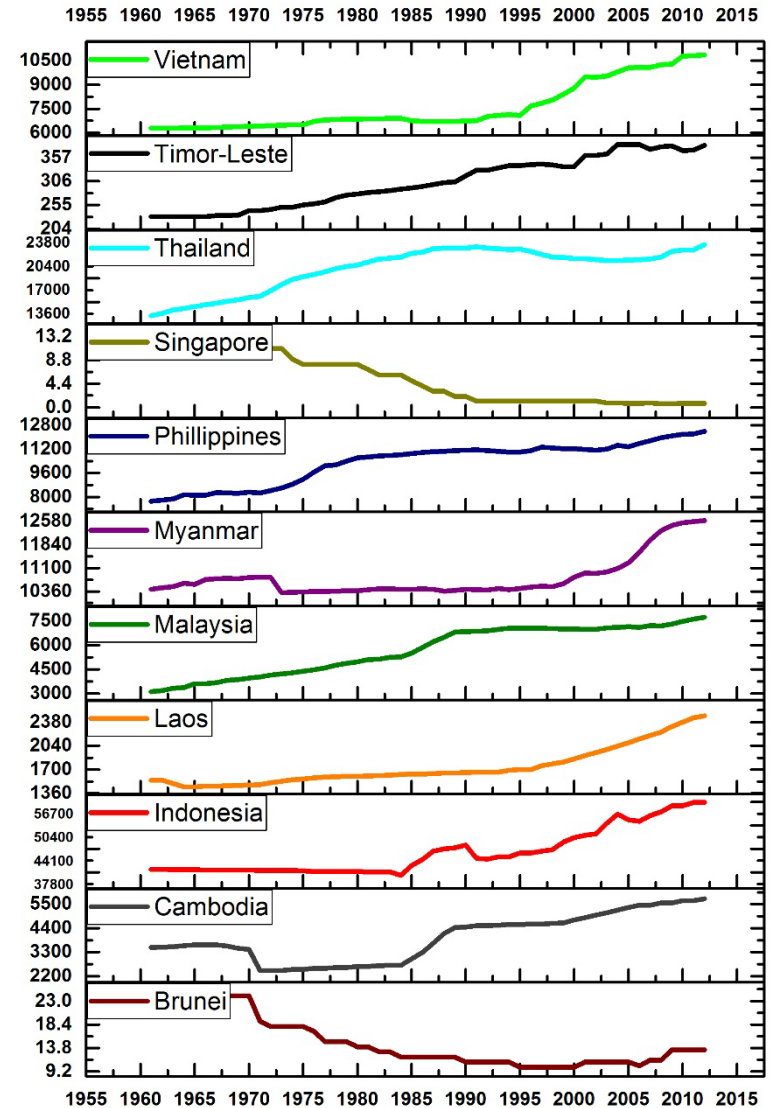
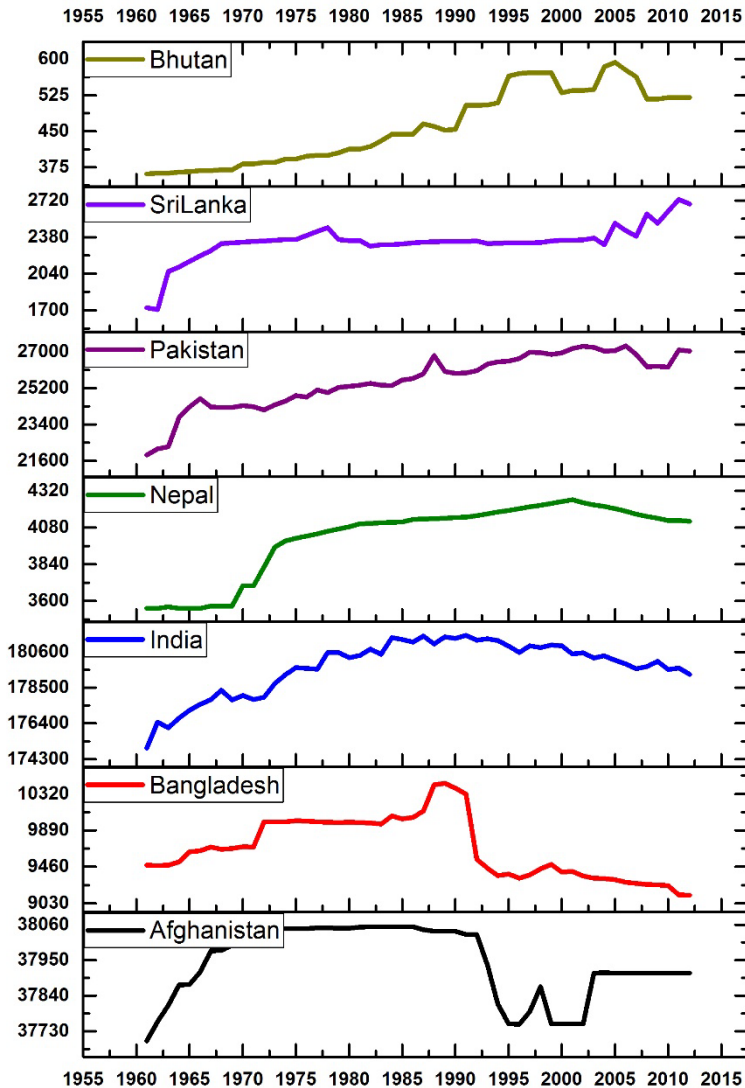
**US – 18 researchers**

**Nepal-3; Srilanka-2; Myanmar-1; Afghanistan, Myanmar, Bangladesh-1 each  
Pakistan, China invited but could not attend – Visa issues**

**India – University Researchers, Government, Non-Government, NGO's**



# Agricultural land use in South/SE Asia

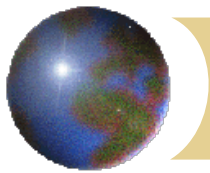


Significant increase in Agricultural Land Area (x 1000ha) in Several South and Southeast Asian Countries

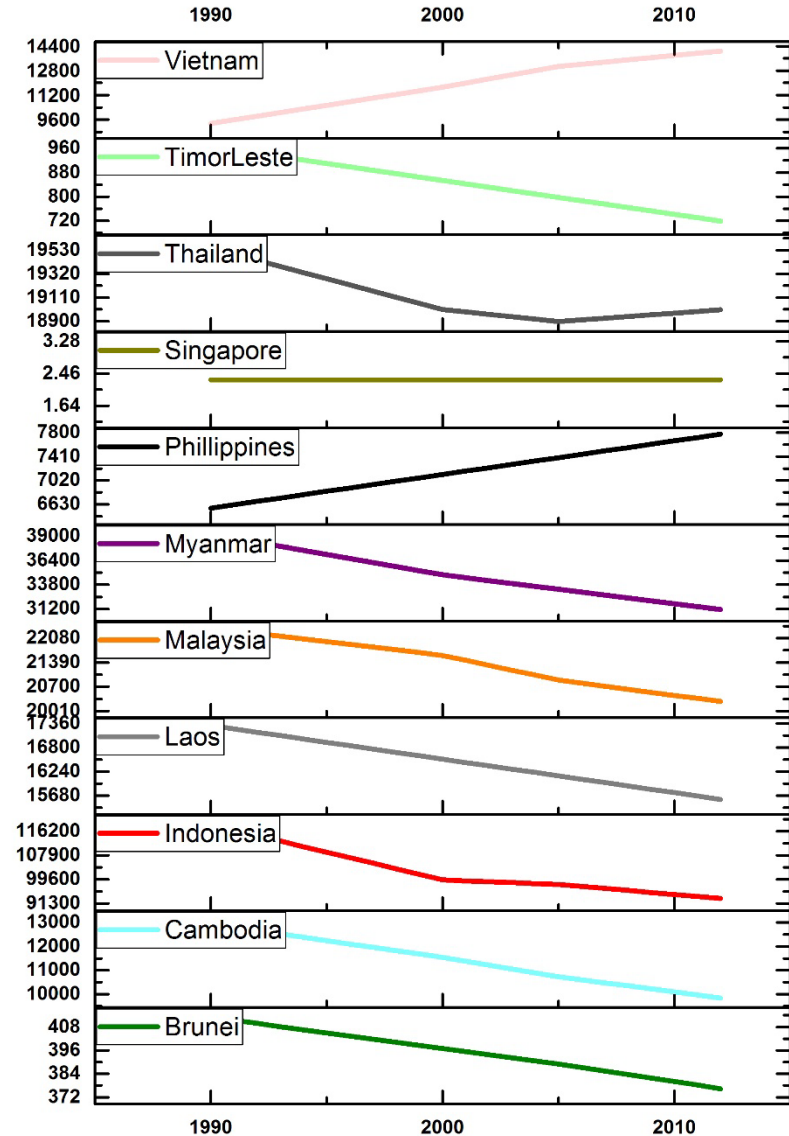
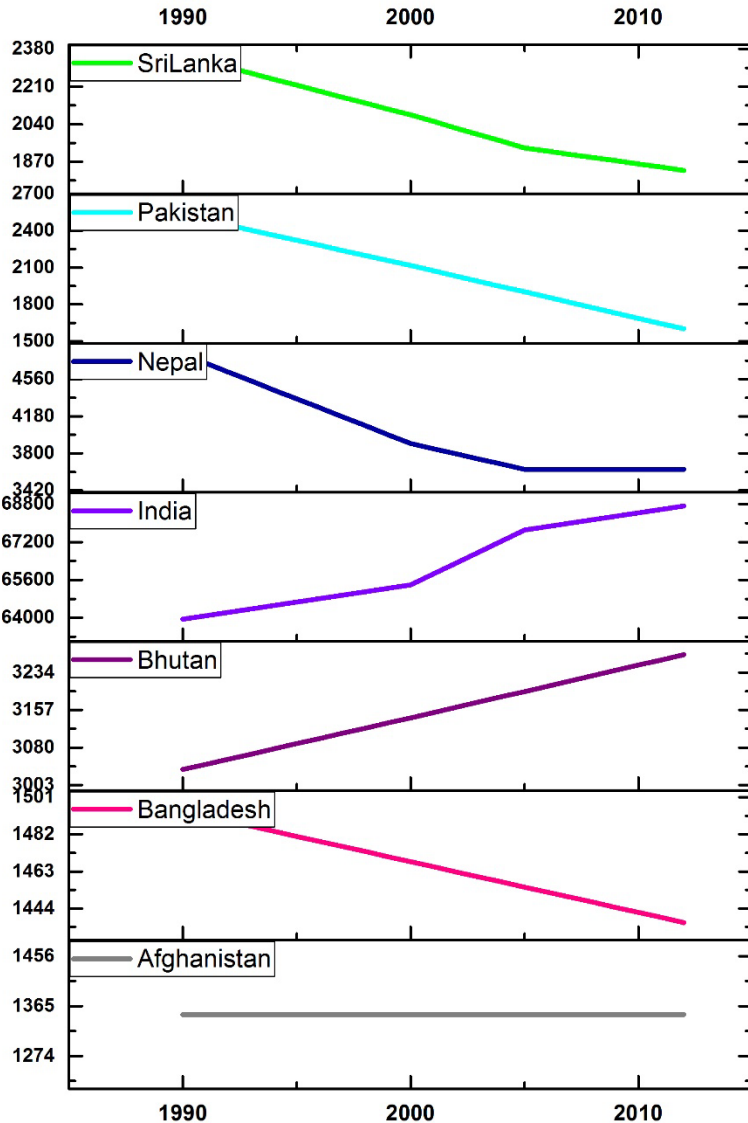
Vadrevu et al., 2016, ERL (in press)

Data Source: FAO, 2015





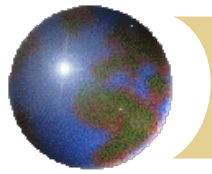
# Forest Area in South/SE Asia



Significant decrease in Forest Area (x 1000ha) in Several South and Southeast Asian Countries

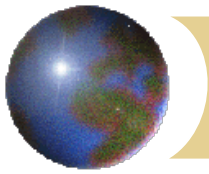
Vadrevu et al., 2015, ERL (in Press)

Data Source: FAO, 2015



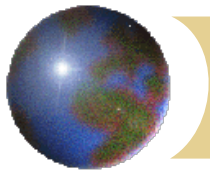
## Background to SARI Initiative

- The South/Southeast Asia region is undergoing rapid land cover/land use changes due to population growth and economic development with implications for greenhouse gas emissions, hydrology, biodiversity, land atmosphere interactions, human livelihood.
- Satellite data are used widely by regional scientists (NASA and ISRO data) for land use/cover change studies.
- Much of the research using satellite data has societal relevance with a developing country perspective.
- Good collaboration exists between NASA LCLUC and Regional Scientists from South/Southeast Asia (recently collaborations with Myanmar scientists started).



## Background

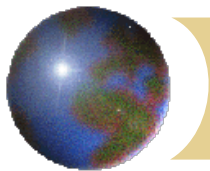
- **Precedents for NASA initiated Regional Integrated Science Initiatives**
  - **TE – ISLSCP** (International Satellite Land Surface Climatology Project; **Boreas**, **LBA** (Large Scale Biosphere-Atmosphere-Experiment in Amazonia), **ABOVE** (Arctic Boreal Vulnerability Experiment))
  - **SAFARI (2000-2005)**
  - **NEESPI - Northern Eurasia Earth Science Partnership Initiative (2006-2015)**
  - **MAIRS – Monsoon Asia Integrated Regional Study (2006 – 2014) - initiated by China, implemented by START, supported by LCLUC**



## Regional Priorities – Workshop Panel Summary

- Unanimous agreement for the development and need for SARI.
- International programs such as GOFC-GOLD, START, MAIRS, GEO-GLAM, etc. should be engaged as a means to strengthen SARI.
- A series of SARI planning workshops needed to converge on a science plan, identify, prioritize and address regional scale questions.
- SARI to aid in:
  - Developing and strengthening bilateral science collaborations among SARI + US and other countries.
  - Enable data collection and sharing mechanisms.
  - Assist in capacity building activities.
- Funding mechanisms needs to be explored through national/regional as well as international sources through Regional Scientists involvement.





# Meeting Summary-The Earth Observer

24

meeting/workshop summaries

The Earth Observer

March - April 2013

Volume 25, Issue 2

## Summary of the 2013 NASA Land Cover/Land Use Change Regional Science Meeting, South India

Krishna Prasad Vadrevu, University of Maryland, College Park, [krishna@hermes.geog.umd.edu](mailto:krishna@hermes.geog.umd.edu)  
Chris Justice, University of Maryland, College Park, [justice@hermes.geog.umd.edu](mailto:justice@hermes.geog.umd.edu)  
Prasad Thenkabail, United States Geological Survey, [pthenkabail@usgs.gov](mailto:pthenkabail@usgs.gov)  
Garik Gutman, NASA Headquarters, [ggutman@nasa.gov](mailto:ggutman@nasa.gov)

### Introduction

The 2013 NASA Land Cover/Land Use Change (LCLUC) Regional Science Meeting was held in South India and had three components:

- a focused workshop on water resources at the Centre for Water Resources Development and Management (CWRDM), held in Kozhikode, Kerala in India, from January 7-8, and a Land Use (LU) Transect Study from Kozhikode, Kerala, to Coimbatore, Tamil Nadu, in India<sup>1</sup>, on January 9;
- a NASA international regional meeting, held January 10-13, at Karunya University in Coimbatore, Tamil Nadu; and
- a training workshop titled *Remote Sensing and Geospatial Technologies for Land Cover and Land Use Change Studies and Applications*, held January 14 at Karunya University.

The goal of the meeting was to discuss land cover/land use change (LCLUC) issues and impacts in the South Asia region. The meeting was organized around eight technical sessions:

1. Agricultural land-use change;
2. LCLUC-related Earth observations (missions, data, and products);
3. Atmosphere/land-use interactions (aerosols, greenhouse gases);

<sup>1</sup> Kerala and Tamil Nadu are two of the 28 states in India.



Water resource-focused workshop participants. Images Credit: All photos in this article were taken by author or other members of the LCLUC team.

4. LCLUC and the carbon cycle;
5. Forests and LCLUC in mountainous areas;
6. Coastal zones and water resources;
7. Urban LCLUC; and
8. Working towards a Regional Global Observation for Forest and Land Cover Dynamics (GOF-C-GOLD) South Asia Regional Information Network (SARIN) (including prospects, opportunities, and challenges).

The meeting was a joint effort of the NASA LCLUC Program; GOF-C-GOLD Program; International System for Analysis Research and Training (START) Program; Monsoon Asia Integrated Regional Studies Program (MAIRS); University of Maryland College Park (UMD); Centre for Water Resources Development and Management (CWRDM) in Kozhikode, Kerala; and Karunya University, in Coimbatore, Tamil Nadu.

### NASA LCLUC Workshop on Water Resources and Land Use Transect

Thirty top-level delegates from different institutes and universities in India attended the meeting in addition to twelve researchers from the U.S. **Narasimha Prasad** (CWRDM), welcomed the participants and highlighted the CWRDM water research activities.

After the welcome, **Garik Gutman** [NASA Headquarters] addressed the workshop's participants, presenting an overview of LCLUC issues in South Asia, with focus on agricultural land-cover conversion.

The Earth Observer

March - April 2013

Volume 25, Issue 2

25

meeting/workshop summaries



*Rhizophora mangle*, known as the "red mangrove," near Kadalundi bird sanctuary in Kerala.

forest-cover loss, increasing urbanization, and air pollution. **Chris Justice** [UMD] stressed that much needs to be done in terms of the underpinning science of LCLUC and the linkages with global climate change in South Asia.

Some highlights from the workshop are summarized here:

- The most important LCLUC issue impacting agriculture in south India is *paddy fields* (wetlands) being converted to urban areas and/or left abandoned, with the attendant deficit in rice production.
- This *paddy conversion* is complex, and crosses economic, ecological, sociocultural, structural, and class dimensions.
- Economic return from paddy cultivation does not tend to encourage conservation—due to labor costs.
- At present, land is seen only as real estate needed for residence status, and is the safest and best investment to maximize profits.
- Coconut farming is shrinking due to the unavailability of skilled labor.
- Pollution and sedimentation from *anthropogenic* activities seriously affects aquatic systems/wetlands in South India. This requires more-stringent regulations and greater wetland protection.
- The roles of coastal vegetation and mangroves in protecting lives and property require more research to address contamination—possibly due to saline water intrusion, likely from inadequate drainage systems and poor maintenance of the well surroundings.

The CWRDM arranged several field visits to highlight local LCLUC issues and responses, including urban green park and wetlands conservation, mangrove conservation, and coastal and riparian land use management.

On January 9, participants departed for a Land Use Transect Study from Kozhikode, Kerala, to Coimbatore, Tamil Nadu, involving local scientists. The processes of urban expansion and forest degradation were quite evident during the transect study. During the transect, the participants observed forest fires in the mountains, 50 km (~31 mi) away from Coimbatore.



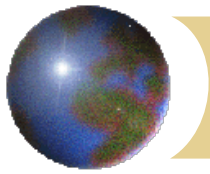
Coconut, arecanut, banana, and yam plantations, Kozhikode, Kerala.



Smoke from forest fires, Palakkad, Western Ghats, Kerala.

March/April 2013

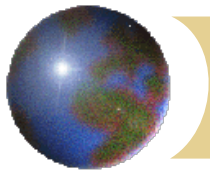
[http://eosps0.gsfc.nasa.gov/eos\\_homepage/for\\_scientists/earth\\_observer.php](http://eosps0.gsfc.nasa.gov/eos_homepage/for_scientists/earth_observer.php)



# SARI – Core Team

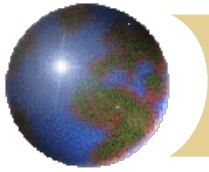


*Discussions at the meeting by some LCLUC principal players raised the desirability and opportunity for a research initiative*



## SARI - Goal

To develop an innovative research, education, and capacity building program involving state-of-the-art remote sensing, natural sciences, engineering and social sciences to enrich LCLUC science in South/Southeast Asia.



# **SARI Science Rationale**



**SOUTH ASIA REGIONAL-SCIENCE INITIATIVE (SARI)-  
A RESPONSE TO REGIONAL NEEDS IN LAND COVER/LAND USE CHANGE  
(LCLUC) SCIENCE AND EDUCATION**

**Krishna Prasad Vadrevu**

Dept. of Geographical Sciences, University of Maryland College Park, USA  
Email: krisvkp@umd.edu

**Rama Nemani**

NASA AMES Research Center, NASA Ames research center, California, USA  
Email: rama.nemani@nasa.gov

**Abstract**

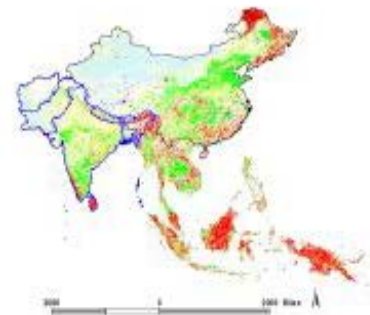
The goal of this initiative is to develop an innovative regional research, education, and capacity building program involving state-of-the-art remote sensing, natural sciences, engineering and social sciences to enrich LCLUC science in South Asia. Our objectives are twofold. First, we aim to advance LCLUC science in the region. Second, we endeavor to strengthen existing and build new collaborations between US and South Asia researchers in the areas of LCLUC research. The impetus for such an initiative came from the LCLUC science team meeting held in Coimbatore, India, January 19-23, 2013.

To address LCLUC science, this initiative will utilize a systems approach to problem-solving that examines both biophysical and socioeconomic aspects of land systems, including the interactions between land use and climate and the interrelationships among policy, governance, and land use. A central component of this initiative will be the use of geospatial data from both remotely sensed and *in situ* sources and models. To strengthen the theoretical underpinnings of LCLUC science in the South Asian region, SARI will facilitate: a) new partnerships with space agencies, universities and non-government organizations; b) novel and regionally-appropriate methodologies and algorithms for LCLUC products; c) data sharing mechanisms; d) leadership training; e) international workshops to identify regional priorities, discuss and share scientific findings; f) capacity building programs; and g) international student/researcher exchanges, including among LCLUC scientists in the region. SARI will serve as a facilitator and catalyst for LCLUC research in South Asia. The outputs will be beneficial to the U.S., South Asia and international researchers and will serve as a model for interdisciplinary research that links LCLUC science with NASA assets.



**Background Document**

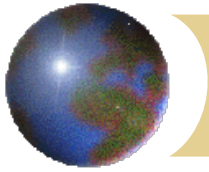
**South Asia Research Initiative**



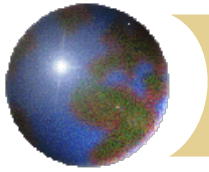
2015





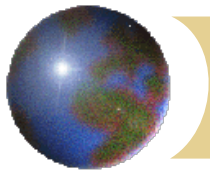


# Coordination and on-going activities



## **SARI Updates and Next Steps**

- **Phase-I. Design Phase - Completed**
  - **Organizational Committee with Co-leads and Task Force members formed**
  - **Science plan prepared highlighting the need for SARI and Action Plan.**
- **Phase-II Implementation – On going**
  - **Burma Meeting, January, 2016 – Official Regional launch of SARI;**
  - **Identifying regional experts to be part of SARI;**



# Project Office Tasks

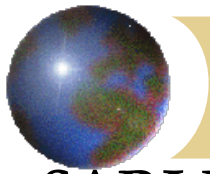
**Task-2:** *Serve as a Liaison* between SARI and the NASA LCLUC program. SARI project office will help in building collaborations/partnerships between the US and regional scientists.

**Task-3:** *Facilitate NASA LCLUC Science Team meetings in South/Southeast Asia.* SARI website for updates.

**Task-4:** *Capacity building and training activities.* Co-funding for some of the meetings secured through JAXA-National Institute of environmental Studies (NIES), Japan.

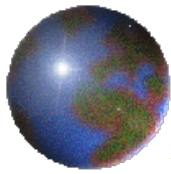
**Task-5:** *Promotion of NASA products + regional datasets*

**Task-6:** *Publications, journal special issues, books, brochures.*



## SARI Next Steps

- SARI NASA LCLUC Projects (South Asia Focus - LCLUC ROSES 2015 call – Step-1 done); SARI NASA LCLUC projects (Southeast Asia Focus - LCLUC ROSES 2016 call (forthcoming))
- In addition, bring together existing national and regional projects
- Exploring new non-NASA LCLUC funding sources for SARI
  - International (Belmont Forum, USAID, NASA SERVIR, etc.
  - National – Dept. of Science and Technology (India); Private Companies, etc.
  - *NIES, Japan – committed funding for 3 years to cost-share meetings + trainings in the SARI region).*
- SARI international endorsements in consideration
  - Global Land Project (GLP) and Future Earth

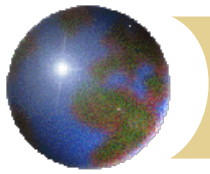


# LCLUC Regional Meeting, Myanmar, January, 2016



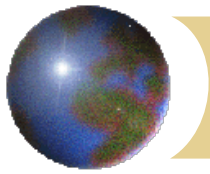
**Total Meeting Participants = 150**  
**Training Participants = 60**





## Regional Issues Identified – Myanmar, 2016

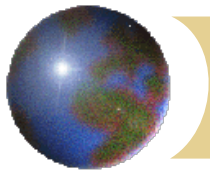
- ✦ **Not just mapping - relating outputs to issues that people care about, for example, land-use change impacts on food, water, livelihoods, human well-being and environment is important.**
- ✦ **The need to move towards big /time series data processing for understanding fine-scale changes is important, in addition to improving the access to the fine-resolution earth observation data.**



## Regional Issues Identified – Myanmar, 2016

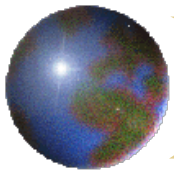
✦ Focus on generating relevant scientific information in support of policy in the following areas was stressed:

- a) Forest Cover and Change;
- b) Agricultural Land Use and Change;
- c) Urban Cover and Change;
- d) Water Resources and Quality;
- e) Land Atmosphere Interactions;
- f) Land-use impacts on Ecosystem Services;
- g). Land-Use and Disaster Management.



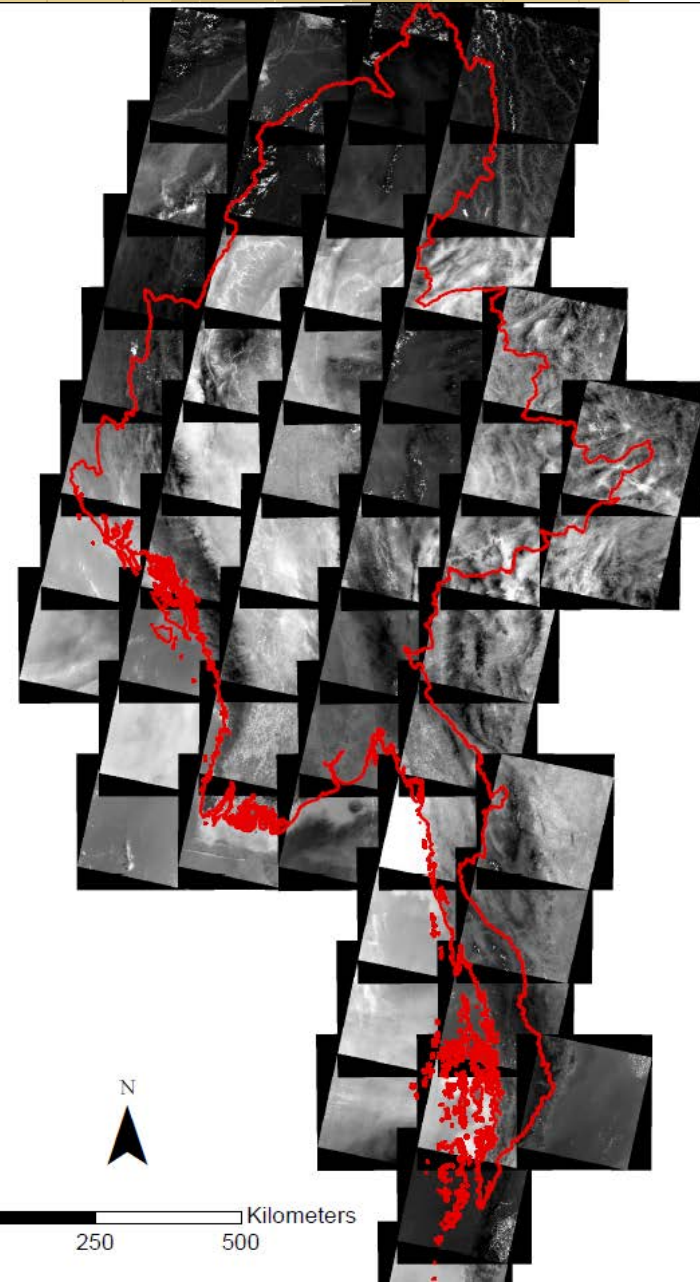
## Regional Issues Identified – Myanmar, 2016

- ✦ **Reducing Emissions from Deforestation and Degradation (REDD+, MRV) and Post-Paris Implementation**
  - ✦ **Forest Cover Change; Fire Emissions**
  - ✦ **Agricultural Land Use**
- ✦ **Standard definitions on what constitutes a ‘forest’ and harmonization of different land-use classification systems are also needed.**
- ✦ **Need for collaborations and urgent need for capacity building and training activities in the region.**
- ✦ **Internet still seems an issue on data downloading!**



# FREE LANDSAT-8 DATA

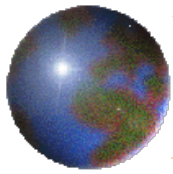
**Landsat images for the whole country of Myanmar Images from Landsat 8 for the period of January-March, 2015.**



global change SysTEm for Analysis, Research & Training

**LANDSAT-8 – 2015 – CLOUD FREE IMAGES**





# SARI meetings - 4 already funded by NIES, Japan and local partners



International Workshop on Air Quality in Asia, Hanoi, Vietnam

June 24th-26th, 2014



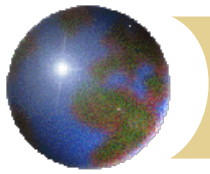
Local Host



VNU UNIVERSITY OF ENGINEERING AND TECHNOLOGY

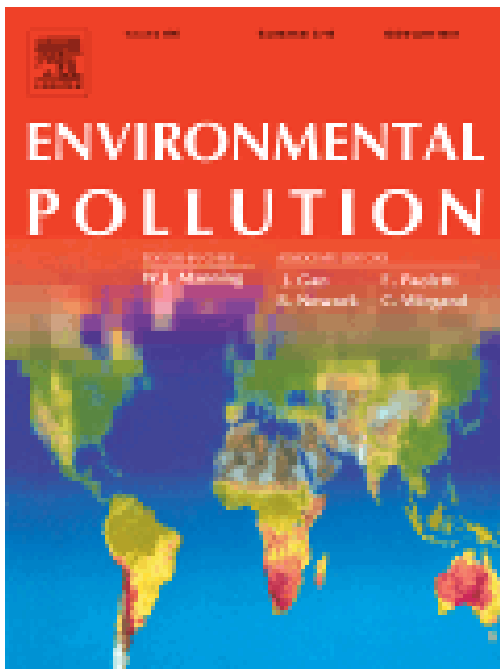
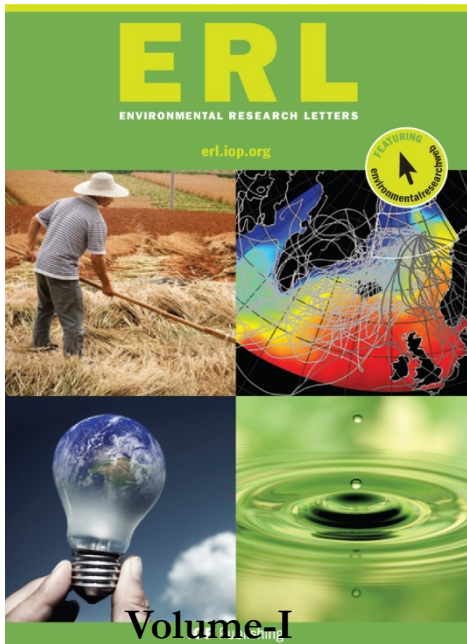






## **SARI forthcoming meetings (2016-2018)**

- ✿ **October 2016 – Ho Chi Min City (Saigon) Vietnam**
  - ✦ **Meeting Focus: Agriculture, Forests and Other Land Use Emissions**
  - ✦ **Dates: October 16-22<sup>nd</sup> October (LCLUC field trip + meeting + training)**
  
- ✿ **2017 - SARI LCLUC regional meeting in India and training in Nepal**
  - ✦ **Meeting Focus: TBD**
  - ✦ **Dates: TBD**
  
- ✿ **2018 - SARI LCLUC regional meeting in Laos**
  - ✦ **Meeting Focus: TBD**
  - ✦ **Dates: TBD**



International Workshop on Air Quality in Asia, Hanoi, Vietnam

June 24th-26th, 2014

1886-87

Local Host

WU UNIVERSITY OF ENGINEERING AND TECHNOLOGY

Springer **springer.com**

**Land-Atmospheric Interactions in Asia**  
 Book Series: Springer Remote Sensing/Photogrammetry  
 Editors: Krishna Prasad Vadrevu, Toshimasa Ohara, Chris Justice

**Forthcoming, Summer 2016**

- Maximizes reader insights into the quantification of land cover/land use changes (LC/LUC) and greenhouse gas emissions in Asia.
- Focuses on large spatial scales integrating satellite remote sensing and ground-based approaches.
- Broadens understanding on integrated approaches combining top-down and bottom-up methodologies including modeling for characterizing LC/LUC and emissions.
- Explores the causative factors and impacts of LC/LUC and emissions due to population growth, industrial activities and energy demand in Asia.

In Asia, high population growth together with rapid economic development are causing immense pressure to convert land from natural and agricultural areas to residential and urban uses with significant impact on emissions and ecosystem services. This edited volume sheds new light on the causative factors and impacts of LC/LUC on the greenhouse gas (G-G) and aerosols in Asia. The volume will also focus on the use of remote sensing, geospatial technologies, and integrated approaches to characterize LC/LUC and emissions.

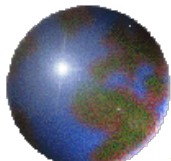
Articles are invited from international researchers working on remote sensing of LC/LUC, fires, GHG emission inventories, aerosols, and land-atmospheric interactions in Asia.

Submission Deadline: December 31<sup>st</sup>, 2015  
 Email: [erl@springer.com](mailto:erl@springer.com)

Dr. Krishna Prasad Vadrevu ([krpv@umd.edu](mailto:krpv@umd.edu)), Associate Research Professor, Department of Geographical Sciences, University of Maryland, College Park, USA.

Dr. Toshimasa Ohara ([tohara@nies.go.jp](mailto:tohara@nies.go.jp)), Researcher, National Institute of Environmental Studies (NIES), Japan.

Dr. Chris Justice ([cjustice@umd.edu](mailto:cjustice@umd.edu)), Head, Department of Geographical Sciences, University of Maryland, College Park, USA.



# Myanmar meeting outputs – “Remote Sensing” journal special issue solicitation



Title / Keyword  Journal **Remote Sensing** Volume  Page   
 Author  Section -- Issue  Number   
 Article Type **all** Special Issue **Mapping, Monitoring :**



## Remote Sensing

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Vol  Issue

- Forthcoming Issue
- Current Issue**
- Vol. 8 (2016)
- Vol. 7 (2015)
- Vol. 6 (2014)
- Vol. 5 (2013)
- Vol. 4 (2012)

## Special Issue "Mapping, Monitoring and Impact Assessment of Land Cover/Land Use Changes in South and South East Asia"

### Quicklinks

- Special Issue Editors
- Special Issue Information
- Published Papers

A special issue of *Remote Sensing* (ISSN 2072-4292).

Deadline for manuscript submissions: **30 July 2016**

### Special Issue Editors

*Guest Editor*

**Dr. Krishna Prasad Vadrevu**

Department of Geographical Sciences, University of Maryland, College Park, MD 20742, USA

Website: <http://geog.umd.edu/facultyprofile/Vadrevu/Krishna>

**Interests:** satellite remote sensing of land use/cover changes; land atmospheric interactions; remote sensing of fires; biogeochemical cycling; agroecosystems

*Guest Editor*

**Dr. Rama Nemani**

Ecological Forecasting Laboratory, NASA Ames Research Center, MS 242-4, Moffett Field, CA 94035, USA

Website: <http://ecocast.arc.nasa.gov/peop/rama.php>

**Interests:** ecological forecasting; collaborative computing; big-data analysis

*Guest Editor*

**Prof. Chris Justice**

Dept. of Geographical Sciences, University of Maryland, College Park, MD 20742, USA

Website: <http://geog.umd.edu/facultyprofile/Justice/Christopher>

**Interests:** global change research; land use/cover change; satellite based agriculture monitoring; satellite based fire monitoring; terrestrial observing





# SARI

South/Southeast Asia Research Initiative

[Home](#) [Core Team](#) [Participants](#) [Projects](#) [Partners](#) [Meetings](#) [Resources](#) [News](#) [Contact](#)



## Welcome to SARI

The goal of SARI is to develop an innovative regional research, education, and capacity building program involving state-of-the-art remote sensing, natural sciences, engineering and social sciences to enrich Land Cover/Land Use Change (LCLUC) science in South Asia. Our objectives are twofold. First, we aim to advance LCLUC science in the region. Second, we endeavor to strengthen existing and build new collaborations between US and South Asia researchers in the areas of LCLUC research. To address LCLUC science, SARI will utilize a systems approach to problem-solving that examines both biophysical and socioeconomic aspects of land systems, including the interactions between land use and climate and the interrelationships among policy, governance, and land use. A central component of this initiative will be the use of geospatial data from both remotely sensed and in situ sources and models. To strengthen the theoretical underpinnings of LCLUC science in the South Asian region, SARI will facilitate:

- a) new partnerships with space agencies, universities and non-government organizations;
- b) novel and regionally-appropriate methodologies and algorithms for LCLUC products;
- c) data sharing mechanisms;
- d) leadership training;
- e) international workshops to identify regional priorities, discuss and share scientific findings;
- f) capacity building programs; and
- g) international student/researcher exchanges, including among LCLUC scientists in the region.

SARI will serve as a facilitator and catalyst for LCLUC research in South Asia. The outputs will be beneficial to the U.S., South Asia and international researchers and will serve as a model for interdisciplinary research that links LCLUC science with NASA assets.

# SARI website

# www.sari.umd.edu