The South/Southeast Asia Research Initiative (SARI)

Krishna Prasad Vadrevu
NASA SARI Lead
University of Maryland College Park, USA
and
SARI Core Team

Land-Cover / Land-Use Change Program

NIES JAPAN

UNIVERSITY OF MARYLAND

GOFC-GOLD
GLOBAL OBSERVATION FOR FOREST AND LAND COVER DYNAMICS

NASA

Presentation topics

- Background to the SARI initiative
- SARI Science Rationale
- SARI Program Coordination and Current Activities
- Next Steps

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 (Myanmar – just started).**

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

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) – transition to Future Earth..**
  - **MAIRS – Monsoon Asia Integrated Regional Study (2006 – 2014) - initiated by China, implemented by START, supported by LCLUC - transition to Future Earth..**

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

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
Chris Justice, University of Maryland, College Park, justice@hermes.geog.umd.edu
Prasad Thenkabail, United States Geological Survey, pthenkabail@usgs.gov
Garik Gutman, NASA Headquarters, 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[1], 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);
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 (GOFC–GOLD) South Asia Regional Information Network (SARIN) (including prospects, opportunities, and challenges).

[1] Kerala and Tamil Nadu are two of the 28 states in India.

The meeting was a joint effort of the NASA LCLUC Program; GOFC–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,

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

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.

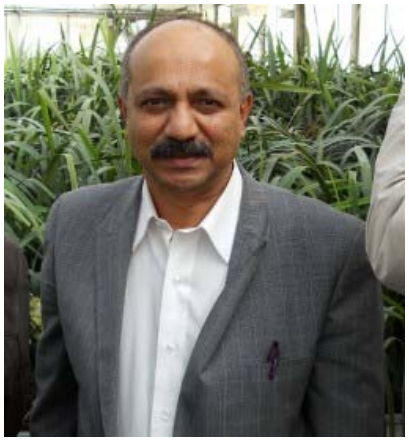
Smoke from forest fires, Palakkad, Western Ghats, Kerala.

March/April 2013

http://eospso.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 Objectives

To strengthen the theoretical underpinnings of LCLUC science in the Asian region. SARI will help in:

- **Developing new science partnerships between space agencies, research agencies, universities and non-government organizations;**
- **Developing integrated methodologies for regional scale LCLUC products; enhancing data sharing mechanisms;**
- **Organizing international workshops to exchange science results and formulate new research projects;**
- **Conducting capacity building programs, facilitating leadership training and experience;**
- **Facilitating international student/researcher exchange.**

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

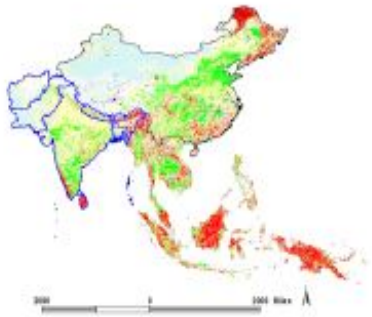
Abstract

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.

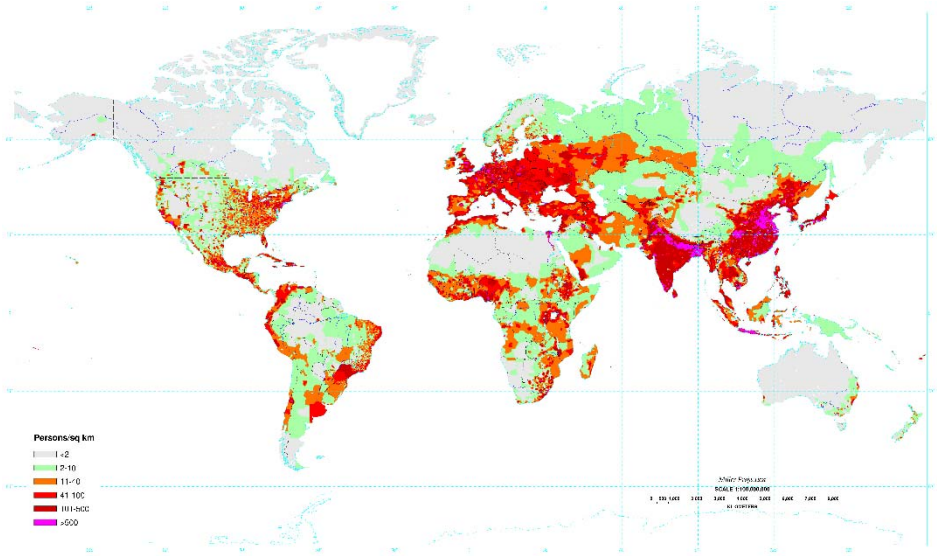
Background Document

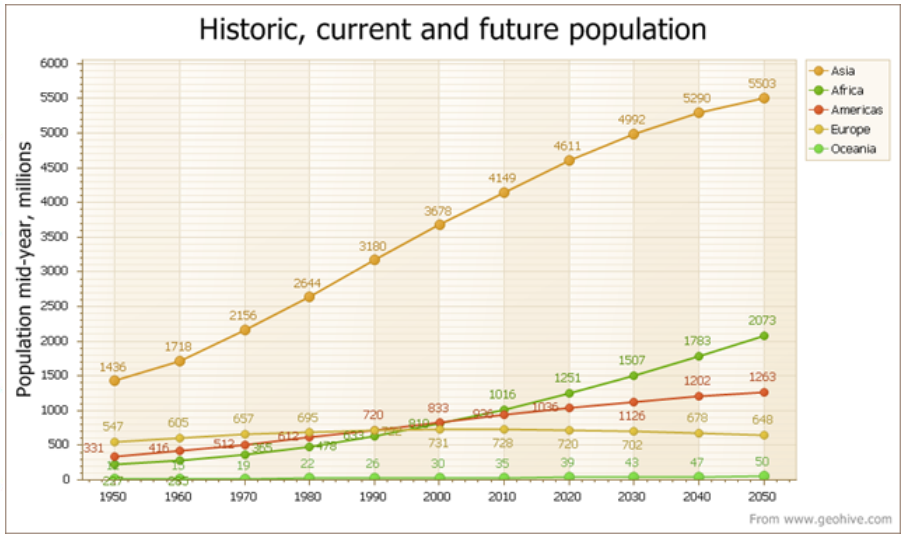
South Asia Research Initiative



2015

Population





- ***Nearly 60% of worlds population is in Asia (4.5 billion people); of which South/Southeast Asia accounts for ~70%.***
- ***Nearly 2/3rd of world population growth is in Asia***
- ***Nearly 50 million people are being added every year!***

Agricultural LCLUC

- In recent years, Croplands in the region are have been decreasing rapidly due to increasing urbanization and industrialization.

- To meet the demands of the growing population, more than 80% of the increase in production will have to come from yield increase, since there is very little scope for expansion of agricultural lands.

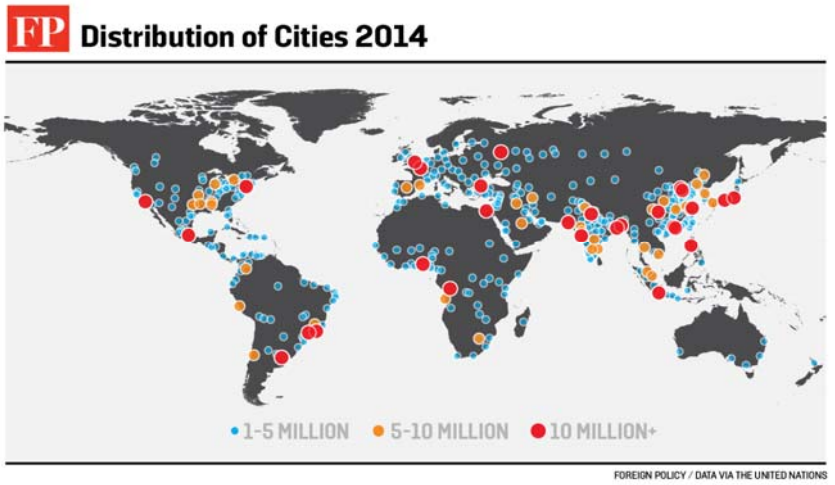
- Increasing extreme events are negatively affecting agricultural production

Understanding cropland changes and the impact of intensive agricultural practices on ecosystem services require integrated approaches.

Urbanization and LCLUC

- Urbanization is occurring rapidly at the cost of agriculture and forest lands.

- Currently, 28.33% of South/Southeast Asian population lives in urban areas and it is estimated that by 2030, more than 55% of the population will be urban.

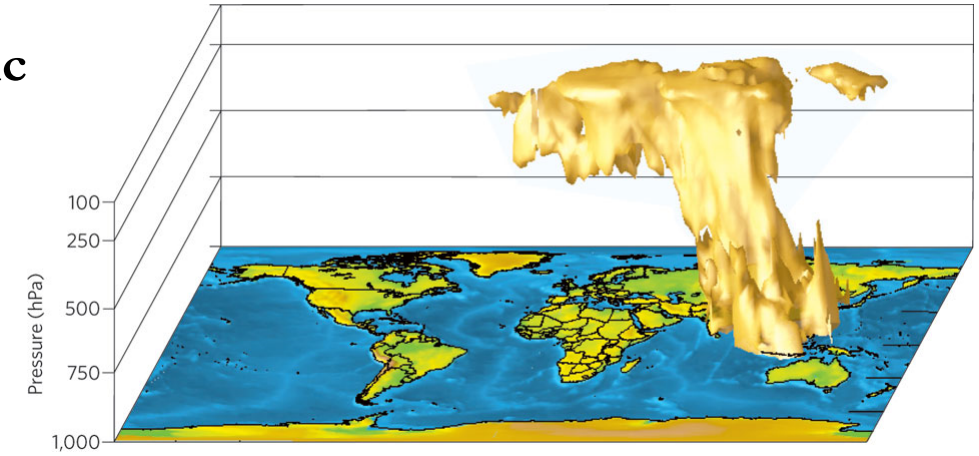


- Urban sprawl has been increasing in different cities at the cost of agricultural lands, ecologically sensitive and natural areas.
- Increasing Urbanization is resulting in air, water and solid waste pollution problems in most cities.

- *LCLUC interactions in urban environments are poorly understood and need immediate attention.*

LCLUC and Atmospheric Interactions

- Increasing industrialization is a major cause of Atmospheric pollution.
- Region is well known for Atmospheric brown clouds (ABC) (AOD>0.3 and percentage of absorbing aerosols exceeds >10%.
- Increasing amounts of soot, sulphates and other aerosol components in ABC are causing major threats to the air, water and food security in Asia.



CO plumes from Air Pollution in South Asia (Lawrence et al., 2013)

- ABC pollutants were shown to have resulted in surface dimming, atmospheric solar heating and soot deposition in the Hindu Kush-Himalayan-Tibetan (HKHT) glaciers and snow packs.

Linking standing LCLUC and atmospheric interactions impacts on regional climate is one of the priority areas of research.

Region with high extreme events

- **Floods: Although a natural calamity, poor land use planning and unplanned development in the hill areas through road construction, buildings, hydro-power projects and mining the river beds aggravating the havoc.**

- **Droughts: The South Asian countries have been among the perennially drought-prone regions of the world. For example, Afghanistan, India, Pakistan and Sri Lanka have reported droughts at least once in three years in the past five decades (SAARC, 2012).**

- **Landslides: Several mountain regions of Pakistan, Afghanistan, India and Myanmar are impacted by landslides.**

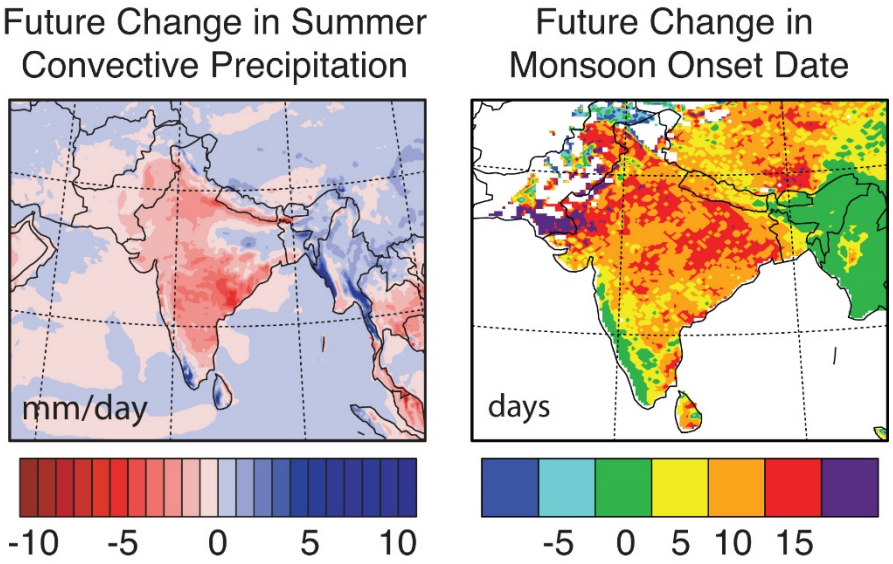
Understanding the linkages between LCLUC and extreme events such as fires, floods, tsunamis, droughts, etc., is important to aid mitigation efforts.

Climate Change Issues

- The projected warming due to the combined effect of greenhouse gas and sulfate aerosols over Asia is estimated to increase 2.7-3.7 degree C by the 2050's (AR-5).

- Rainfall more extreme near the center of tropical belts making landfall in South Asia.

- Increased surface temperatures can have drastic effect on:
  - Glacier melts; Ag. Yield loss; Severe droughts in some regions; Decrease water availability



Ashfaq et al., (2009)

In the Asian countries, Adaptive capacity of humans is low and vulnerability is high.

Research Focus Areas

- Characterize the nature, magnitude, drivers and impacts of LCLUC in South Asia.
- Assist in the development of regional scale land surface and socioeconomic products useful for LCLUC research.
- Address LCLUC interactions on climate, water resources, biodiversity, atmosphere, etc.
- Address the vulnerability, impacts and adaptation issues associated with LCLUC.
- Develop regional scale land cover change models useful for decision support.
- Develop an understanding of LCLUC dynamics through facilitating systematic and integrated case studies.

Coordination and on-going activities

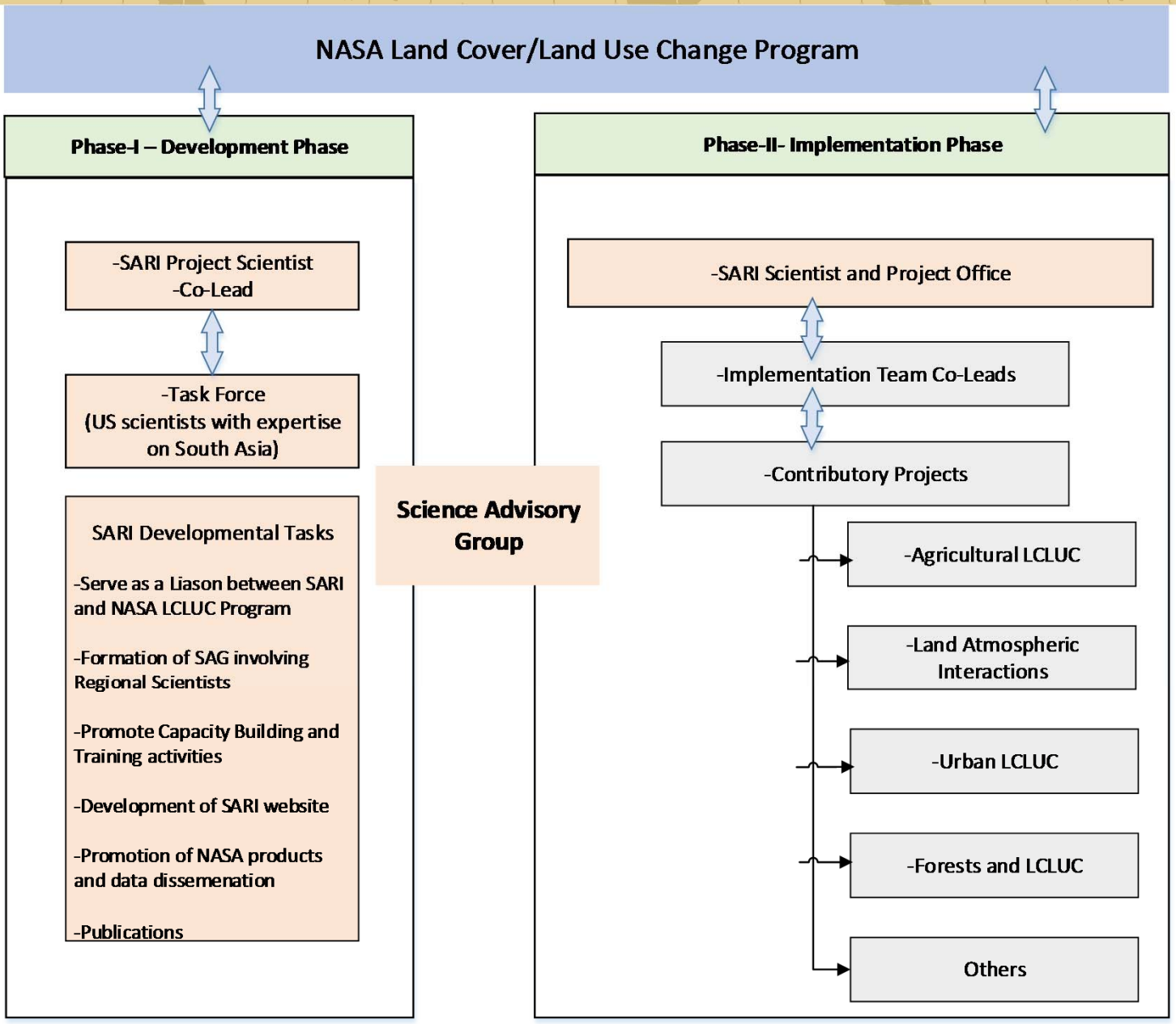
SARI Update and Next Steps

- Phase-I. Design Phase - Completed
  - Organizational Committee with Co-leads and Task Force members formed
    - SARI Formulation Leads: Krishna Vadrevu and Rama Nemani
    - Task-Force leads: Ruth DeFries, Karen Seto, Dan Brown, Chris Justice, Thenkabail Prasad (USGS), Ivan Csiszar (NOAA),
    - Regional leads: In formation
- Science plan prepared highlighting the need for SARI and Action Plan.
- Initial Projects funded through LCLUC ROSES

SARI Update and Next Steps

- **Phase-II Implementation – On going**
  - **Project Office established;**
  - **Burma Meeting, January, 2016 – Official Regional launch of SARI;**
  - **Regional Review/Feedback on draft science plan in South Asia planned;**
  - **Organizing internationally sponsored regional workshops to bring researchers together and identify priority areas.**

Project Office Task-1: Development of Science Advisory Group Involving Regional Scientists and Implementation Teams



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

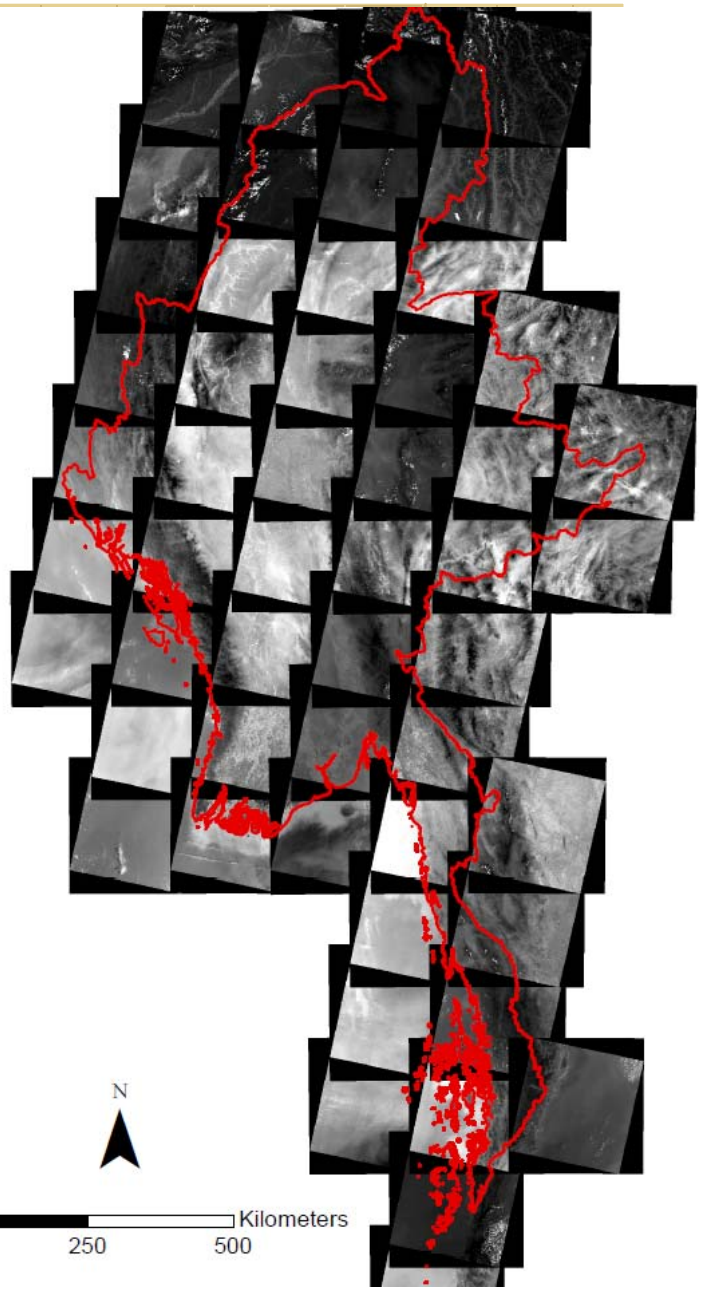
Task-5: Promotion of NASA products + regional datasets

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

FREE LANDSAT-8 DATA

Landsat images for the whole country of Myanmar Images from new Landsat sensor L8 for the period of January-March, 2015.

Contact: Sumalika Biswas



LANDSAT-8 – 2015 – CLOUD FREE IMAGES

START
global change SysTem for Analysis, Research & Training

Previous LCLUC projects in SARI region

- Jefferson Fox – East West Center, Hawaii -Twenty-Five Years of Community Forestry: Mapping Forest Dynamics in the Middle Hills of Nepal – 2015-2018

- Atul Jain, University of Illinois at Urbana Champaign - Land Cover and Land Use Changes and Their Effects on Carbon Dynamics in South and South East Asia: A Synthesis Study – 2014-2017

- Jinwei Dong – Oklahoma State University-Mapping Industrial Forest Plantations in tropical Monsoon Asia Through Integration of Landsat and PALSAR Imagery – 2014-2017

- Ruth DeFries- Columbia University - Multi-sensor Fusion to Determine Climate Sensitivity of Agricultural Intensification in South Asia-2011-2014

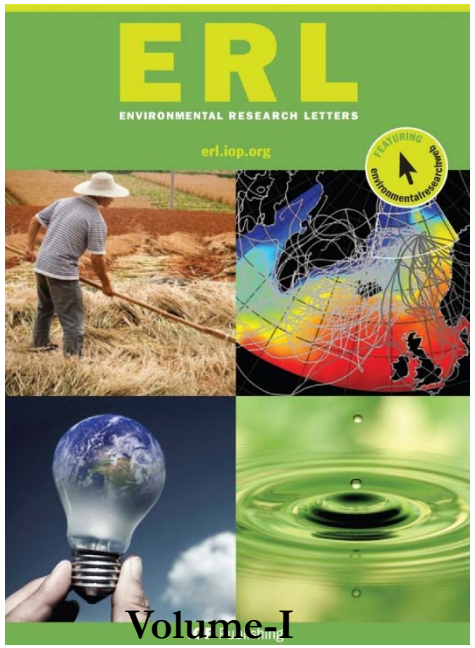
- Karen Seto – Yale University - Multi-Scale and Multi-Sensor Analysis of Urban Cluster Development and Agricultural Land Loss in China and India - 2011-2014

Phase II – Implementation Phase

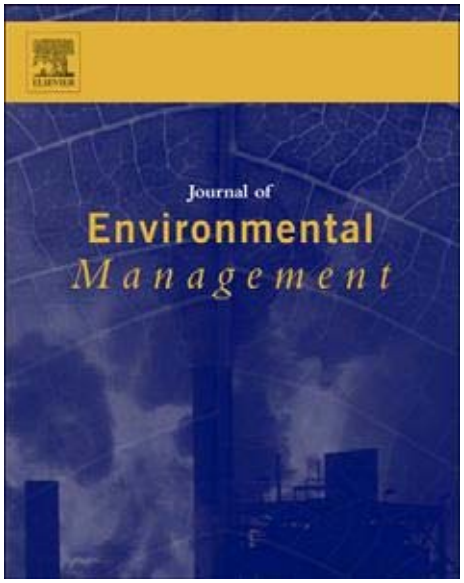
- Additional NASA LCLUC projects (LCLUC ROSES 2015 call)
- Bring together existing national and regional projects
- Exploring new non-NASA funding sources for SARI
  - International (Belmont Forum, USAID, NIES, Japan, etc.)
  - National – Dept. of Science and Technology (India); Private Companies, etc.

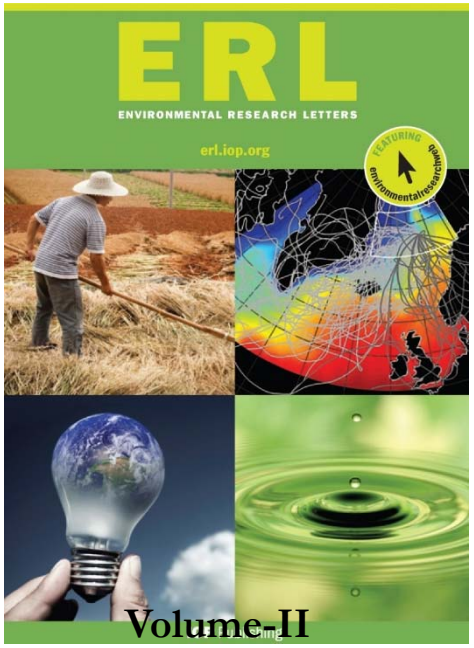
Inclusion of SEA Countries in SARI underway

(4 Regional Workshops already funded by NIES Japan and Regional partners)



Volume-I





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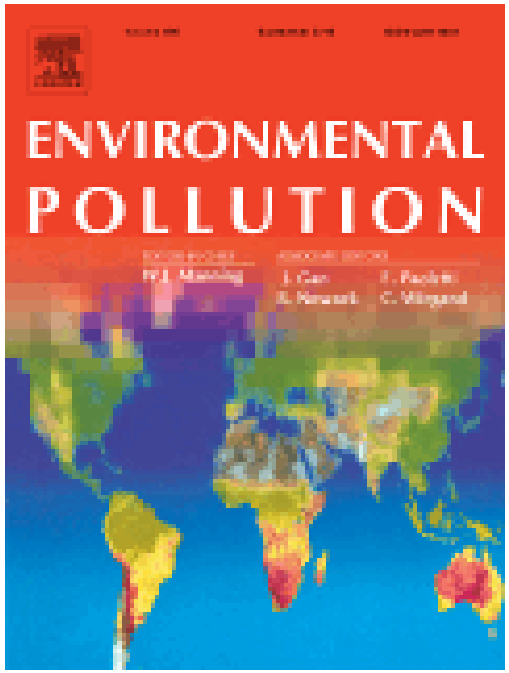

This meeting outputs – "Remote Sensing" journal special issue solicitation

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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).

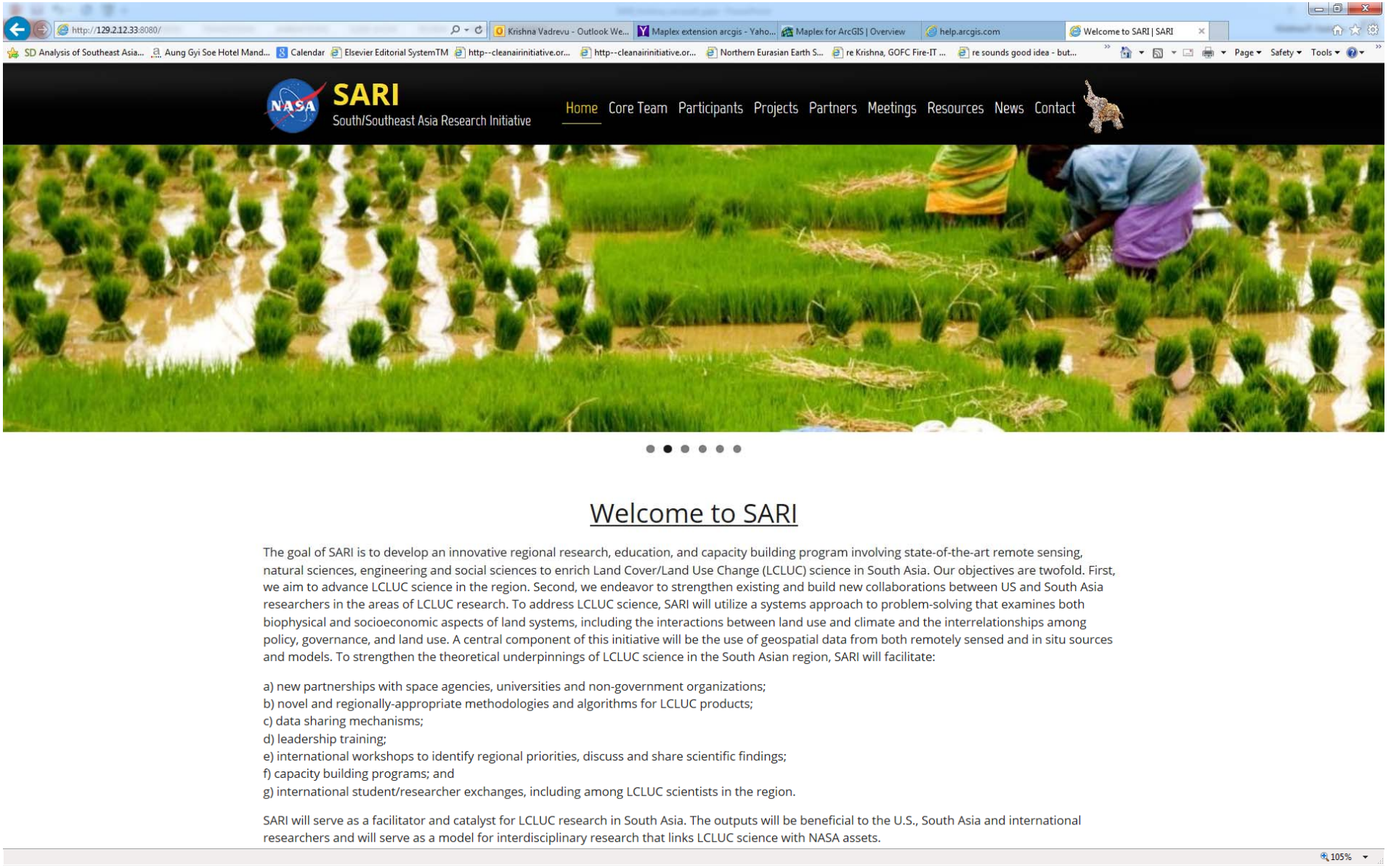
Deadline for manuscript submissions: **30 July 2016**

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 website

www.sari.umd.edu