

ARCP2010-07CMY-BAI

# Asian Coastal Ecosystems: An Integrated Database and Information Management System (DIMS) for Assessing Impact of Climate Change and its Appraisal

Ramani Bai V.<sup>1</sup>, Mohan S., Raju D. and French J.

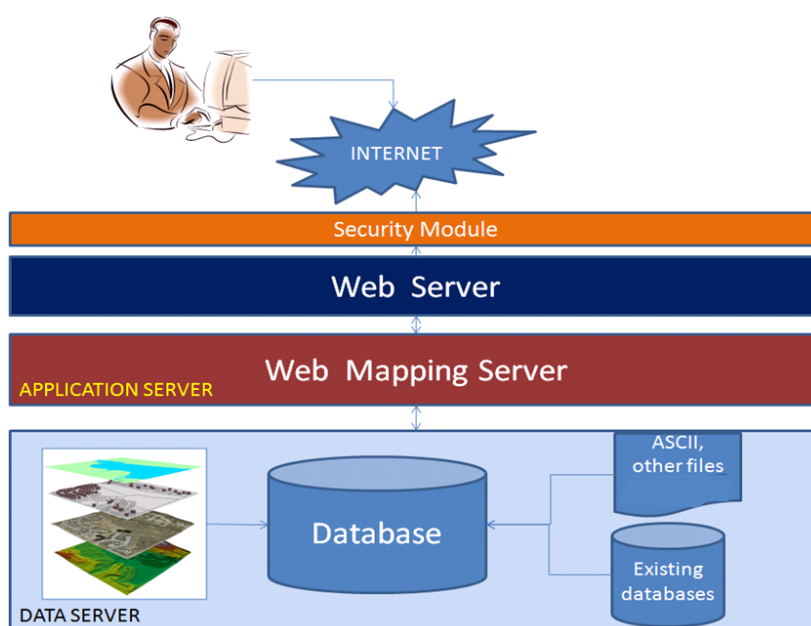
<sup>1</sup>Corresponding author

Department of Civil Engineering, University of Nottingham Malaysia Campus

Email: vramanibai@gmail.com

**ABSTRACT:** The new Database and Information Management System (DIMS) is a web-GIS-based online resource that facilitates the study of climate change impacts, sea-level rise, coastal ecosystems, floods, water quality and other related phenomena in the earth sciences. DIMS consists of two parts: (a) A spatial database of the study area in Asia; namely Malaysia, Singapore and India; and (b) A simple set of software that provides users with basic querying, updating, reporting and data-acquiring capabilities and techniques. DIMS hosts a data inventory on sea level records, temperature, climatic and weather parameters, geologic, ecologic, biologic (both quality and quantity) information and spatial data on the website [www.globalclimate-engine.org](http://www.globalclimate-engine.org). The website also hosts new software for flood prediction and water quality. DIMS is designed to be used by two broad groups: regular end-users (e.g., scientists and project leaders) and system administrators. The new DIMS for Climate Change Studies was awarded the Double Gold British Invention of the Year Award at the British Invention Show 2011.

**KEYWORDS:** DIMS, database, information management system, climate change



**Figure 1.** DIMS-GIS System Architecture

## Introduction

Climate change poses a serious threat to human security due to increasing disasters in the region. While more research is being conducted on climate change, it is essential to ensure that the data needed to conduct such research is freely and readily accessible to all. Although many global climate models (GCMs) have been developed and provided for worldwide use; access has been limited because of a lack of data. For this reason, the project team of researchers from Malaysia, India, Singapore and England, embarked on developing an Integrated Database and Information Management System (DIMS), as an easily accessible data and information outlet for interested parties in the region.

The main objectives were to: i) Create country-wide compliant metadata to serve as a means of documenting data sets that could be distributed online and searchable; ii) Plan, develop and demonstrate the technology at a regional workshop; and iii) Evaluate DIMS by assessing the impacts of climate change in selected coastal regions in participating countries of India, Malaysia and Singapore.

The primary goal of the project was to develop a comprehensive set of hydrologic, geologic, biologic, and spatial information

for onshore and offshore ecosystems through a database driven Internet system (DIMS) for the selected countries in the Asia-Pacific region.

## Methodology

The design and implementation of a data-driven website and relational database consisting of climatic, geologic, ecologic, biologic (both quality and quantity) information and spatial data was carried out (Liu 2009; Baker and Michael 2006). For proper development and use of the geodatabase, an accompanying data management plan was developed that addressed important issues such as server configuration, user access, security, workflow, data location, etc. The flow of work in creating the DIMS-GIS is shown in Figure 1. In order to store, manage and analyze all the information available, a relational structure should be chosen (Ramani Bai *et al.*, 2012).

## Results and Discussion

Geographic information system (GIS) and remote sensing (RS) technologies are very important tools for planning, management and monitoring natural resources. The DIMS project was pursued with the

**Figure 2.** A list of previously entered metadata in the metadata update page ([http://dims.globalclimate-engine.org/Metadata\\_UNM/Edit](http://dims.globalclimate-engine.org/Metadata_UNM/Edit))

Record Title	Abstract	edit	delete
1 India_Coastline	[ 1 ] Coastline of India (2007) [ ... ]	edit	delete
2 India_Coastboundary	[ 1 ] Boundaries of India (2007) [ ... ]	edit	delete
3 India_Majorcities	[ 1 ] Major cities represent the location of the Major cities in India [ ... ]	edit	delete
4 India_Landcover	[ 1 ] Shows the Land cover details of India. Its classified into 6 categories like, Water, Forest, Grass Land, Crop Land, Bare Land and Urban and Built-up [ ... ]	edit	delete
5 India_Stateboundary	[ 1 ] Administrative Units represents the boundaries for the lowest administrative units of the world [ ... ]	edit	delete
6 India_Elevation	[ 1 ] NASA Shuttle Radar Topographic Mission (SRTM) has provided digital elevation data (DEM) for over 80% of the globe. This data is currently at resolution of 30m by 30m and is available for download from the National Map Information Center, Distribution System, of the USGS for data. The SRTM data is available as 3 arc second approx. 30m resolution DEMs. The vertical error of the DEMs is reported to be less than 16m [ ... ]	edit	delete
7 Malaysia_Coastline	[ 1 ] Coastline of Malaysia (2007) [ ... ]	edit	delete
8 Malaysia_Coastboundary	[ 1 ] Boundaries of Malaysia (2007) [ ... ]	edit	delete
9 Malaysia_Majorcities	[ 1 ] Major cities represent the location of the Major cities in Malaysia [ ... ]	edit	delete
10 Malaysia_Stateboundary	[ 1 ] Administrative Units represents the boundaries for the lowest administrative units of the world [ ... ]	edit	delete
11 Malaysia_Landcover	[ 1 ] Shows the Land cover details of Malaysia. Its classified into 6 categories like, Water, Forest, Grass Land, Crop Land, Bare Land and Urban and Built-up [ ... ]	edit	delete
12 Malaysia_Elevation	[ 1 ] NASA Shuttle Radar Topographic Mission (SRTM) has provided digital elevation data (DEM) for over 80% of the globe. This data is currently at resolution of 30m by 30m and is available for download from the National Map Information Center, Distribution System, of the USGS for data. The SRTM data is available as 3 arc second approx. 30m resolution DEMs. The vertical error of the DEMs is reported to be less than 16m [ ... ]	edit	delete
13 Singapore_Coastline	[ 1 ] Coastline of Singapore (2007) [ ... ]	edit	delete
14 Singapore_Coastboundary	[ 1 ] Boundaries of Singapore (2007) [ ... ]	edit	delete

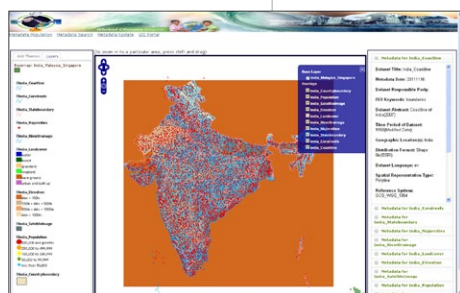


objective of rehabilitating a country's capacity to alleviate the impacts of climate change. DIMS is to be viewed as an opportunity for environmental and science communities to advance in land-use and coastal zone management in light of climate change.

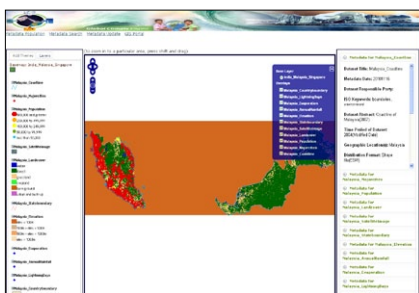
DIMS technology is an important tool for projects charged with managing, improving and preserving a country's climate and its environment, especially in the Asian region. The coastal zone-DIMS concept has generated keen interest that warrants further development. Selected sites from the collaborating countries have been used to evaluate the database (DIMS) created by modelling climate change and coastal mapping. The studies have provided an understanding of climate change, its impact and the sensitiveness of coasts for potential changes in climate. The sample metadata page and the database hosted on the Internet are shown in Figures 2, 3, 4 and 5, respectively (Ramani Bai and Andy Chan, 2010). In conclusion, the use of DIMS in coastal zone management and in climate change studies are both interesting and stimulating.

## Conclusions

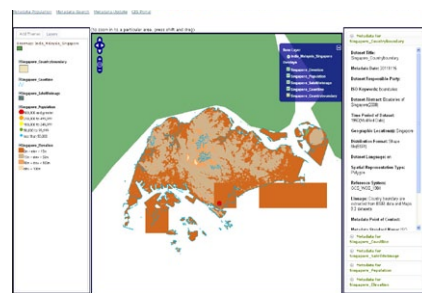
Climate change and its impact assessment is an inter-disciplinary area that cuts across physics, chemistry, biology, earth sciences, hydrology, agriculture, economics, technology development and many other fields. Therefore, multiple data sets are required even to simulate the current situations by different models in Climate science. Many studies on climate impact assessments utilizing models have been developed in other countries. But there is an urgent need to develop a climate change model for each region as the rainfall and monsoon conditions are entirely different in different countries. Thus there is an immediate need to get data on climate, natural ecosystems, soil, water from different sources, agricultural productivity and socio-economic parameters, amongst others, in order to get a reliable prediction. In this context, it is essential to have accessibility to databases that reflect national and regional concerns. DIMS is paying one such way to scientists, engineers and all interested individuals in climate science and related studies. Efforts



**Figure 3.** GIS portal for India with metadata



**Figure 4.** GIS portal for Malaysia



**Figure 5.** GIS Portal for Singapore



should be taken to establish an effective mechanism for sharing and accessing this data in required formats that can be easily deciphered.

## References

- Ramani Bai V., Mohan S. and Reza Kabiri. 2012. "Towards a Database for an Information Management System for Climate Change: An Online resource." Climate Change and the Sustainable Management of Water Resources: Climate Change Management, Walter Leal Filho (Eds.) Springer-Verlag, Berlin., 61–67.
- Ramani Bai V., and Andy Chan. 2010. "Climate Change and DIMS Technology." Proc., of the year 2010 Asia-Pacific Network for Global Change Research workshop, Kuala Lumpur, 1–466.

- Liu, J. 2009. "A GIS-based tool for modeling large-scale crop-water relations." J. Environmental Modeling & Software, 24, 411–422.

- Baker Jr., Michael. 2006. Updated GIS Database Design: Geodatabase Model, City of Suffolk, Virginia. Virginia Beach, Virginia.

## Acknowledgments

Our Project team is most thankful for the evaluation panel of APN-ARCP who approved this project to allow it to progress to the stage it is today.

### ARCP2010-07CMY-BAI

#### PROJECT TITLE

**Asian Coastal Ecosystems: An Integrated Database and Information Management System (DIMS) for Assessing Impact of Climate Change and its Appraisal**

#### PROJECT LEADER

Assoc. Prof. Dr. Ramani Bai V.  
School of Civil Engineering  
University of Nottingham Malaysia  
Campus  
Jalan Broga, Semenyih,  
43500 Selangor, Malaysia

Tel: +60 3 8924 8604



#### PROJECT DURATION

2 years

Email:  
ramani-bai.v@nottingham.edu.my

#### APN FUNDING

US\$ 80,000

Website: [www.globalclimate-engine.org](http://www.globalclimate-engine.org)