MRC Workshop, Vientiane, Lao PDR, 21 – 22 October 2008

1. Monitoring land use change with remote sensing data: Application to sediment yield modeling

2. Remote sensing of turbidity and suspended sediment

---

**Monitoring land use change with remote sensing data: Application to sediment yield modeling**

LIEW Soo Chin  
CRISP, National University of Singapore

Avijit GUPTA  
CRISP, National University of Singapore  
School of Geography, University of Leeds

---

**Some factors affecting sediment yield**

- Loss of vegetation cover
- Soil type
- Precipitation: when, where, how much
- Slope gradient

---

**Use of remote sensing data**

- Vegetation cover  
  - Relatively easy to map using vegetation indices
- Soil type  
  - Not easy
- Precipitation  
  - Spaceborne radar instrument  
    - E.g. TRMM (Tropical rainfall monitoring mission)
- Slope gradient  
  - SRTM (Shuttle radar terrain mission) provides DEM at 90 m postings, available for free  
  - Generate DEM using stereo pairs of high resolution satellite images

---

**Seasonal variations**

*Date: Feb 18, 1998*  
Dry season: exposed rocks, sand bars in river channel. Exposed bare land on slopes

*Date: Oct 28, 1998*  
Wet season: rocks, sand bars covered by rising water level. Vegetation growth on previously exposed slopes

---

1. SC Liew and A Gupta, CRISP, National University of Singapore
2. SC Liew, CRISP
1. Monitoring land use change with remote sensing data: Application to sediment yield modeling

1. SC Liew and A Gupta, CRISP, National University of Singapore

2. Remote sensing of turbidity and suspended sediment

Mapping Parameters

- Land cover change, change in vegetation cover
- Slope of land where vegetation loss occurred
- River channel width, change in time
- Sediment in river channel
- Sand bars in river channel

Observations

- More vegetation depletion area observed in the Feb 1998 image.
- A large proportion (24.2%) of the cleared land has steep to very steep slopes (>25°).
- Vegetation depletion was observed mainly in the eastern side, but new vegetation began to regenerate in the southern and middle part of the image.

Observations

- Growth of bars in the Mekong river channel was observed.
- Land clearing on steep slope is vulnerable to erosion and sediment transfer during the wet monsoon periods. The sediments will eventually reach the Mekong river channel.
1. Monitoring land use change with remote sensing data: Application to sediment yield modeling
2. Remote sensing of turbidity and suspended sediment

1. SC Liew and A Gupta, CRISP, National University of Singapore
2. SC Liew, CRISP
1. Monitoring land use change with remote sensing data: Application to sediment yield modeling
2. Remote sensing of turbidity and suspended sediment

Remote Sensing of Water Turbidity and Suspended Sediment

LIEW Soo Chin
Centre for Remote Imaging, Sensing and Processing (CRISP)
National University of Singapore

Forward Modeling

Water Optical Properties → Forward Model → Water Reflectance

Computed reflectance spectrum
\[ R(\lambda) \]

Inverse Modeling

Measured reflectance spectrum
\[ R(\lambda) \]

Spectral fitting method

Water Optical Properties → Forward Model → Computed Water Reflectance

Adjust parameters → Measured Water Reflectance

Small difference → No
Yes → Stop, input parameters are the solution

Typical Coastal Waters Reflectance Spectra

(A) Chl-a = 17.4 mg/m³, TSS = 74.1 g/m³
(B) Chl-a = 3.8 mg/m³, TSS = 2.3 g/m³

1. SC Liew and A Gupta, CRISP, National University of Singapore
2. SC Liew, CRISP
1. Monitoring land use change with remote sensing data: Application to sediment yield modeling
2. Remote sensing of turbidity and suspended sediment

Retrieval of Seawater Absorption Coefficient

Correlation of retrieved phytoplankton absorption at 440nm ($P_0$) with measured Chl-a

Correlation of retrieved Chlorophyll Fluorescence at 685nm (F) with measured Chl-a

In-situ measurements

Remote sensing reflectance of typical Singapore coastal waters

Retrieval of absorption coefficient from reflectance

1. SC Liew and A Gupta, CRISP, National University of Singapore
2. SC Liew, CRISP
1. Monitoring land use change with remote sensing data: Application to sediment yield modeling
2. Remote sensing of turbidity and suspended sediment

1. SC Liew and A Gupta, CRISP, National University of Singapore
2. SC Liew, CRISP
1. Monitoring land use change with remote sensing data: Application to sediment yield modeling
2. Remote sensing of turbidity and suspended sediment

Turbidity measurement

Reflectance spectra of water with different turbidity

Relation between Turbidity (NTU) and Backscattering Coefficient

1. SC Liew and A Gupta, CRISP, National University of Singapore
2. SC Liew, CRISP
1. Monitoring land use change with remote sensing data: Application to sediment yield modeling
2. Remote sensing of turbidity and suspended sediment

1. SC Liew and A Gupta, CRISP, National University of Singapore
2. SC Liew, CRISP