Abstract ID- 0780

Variability Analysis of Land Surface Albedo Associated with Different Land Cover Types in India

P K Saritha, V Keerthi, R N Anjani, C.V Rao , B. GopalaKrishna

National Remote Sensing Centre, ISRO, Balanagar, Hyderabad 500 625

Introduction

Land Surface Albedo (LSA), defined as the ratio of upwelling to the incoming solar radiation at Earth's surface, has significant influence on surface energy budget used in climate studies. It is highly variable, both spatially and temporally. Significant changes in LSA are accompanied by variations in land cover and surface conditions, such as snow, vegetation cover, urbanization, soil moisture, atmospheric cloud and aerosol properties.

In this study, time series Oceansat2 Ocean color monitor(OCM) broad band albedo product were used to study the variation of LSA of different land cover types over Indian territory.

Objectives

The purpose of this study is to investigate the impact of seasonal changes associated with forest and environment on surface radiative transfer, particularly on LSA. Further we have attempted to correlate the variation of albedo with Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST) and Sun Zenith Angle (SZA).

Data Used

Albedo: Oceansat 2 Ocean Color Monitor (OCM) snow free land surface broad band (0.3 – 3.0 µm) albedo products. They are fortnightly products @ 360 m.
(http://bhuvan.nrsc.gov.in/data/download/index.php)

NDVI: OCM2 fortnightly NDVI products @ 360 m.

LST: MODIS LST products (MOD11) @ 1 km . Daily LST were composited using averaging criteria for a fortnight

SZA: Computed from Level2 OCM georef. product

Land cover Map (LC): 1:100,000 LULC map

Methodology & Study Area

- LULC map (2011) resampled to 360 m was used to extract region of interest(ROIs) of the below mentioned land cover types from thematic layers of LSA, LST, NDVI, SZA for a period of four year from 2013-2016.
- Land cover class studied includes
  1. Urban Areas
  2. Desert Soil
  3. Cropland
  4. Grass Land
  5. Semi evergreen forest
  6. Wet ever green forest
  7. Subtropical broad leaf
  8. Dry deciduous forest

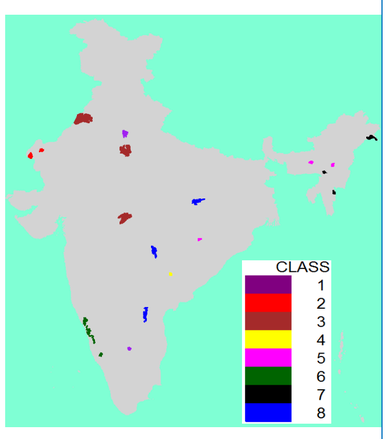


Fig. 1 Location of LC types studied

- In order to analyze the inter and intra annual variation of surface albedo (fortnightly) associated with each land cover classes mean(µ) and standard deviation (σ) LSA associated with the particular class is achieved by averaging LSA values as

$$\mu_j = \frac{1}{n_j}\sum_{i=1}^{n_j}\alpha_{j,i} \qquad \sigma = \sqrt{\frac{1}{n_j}\sum_{i=1}^{n_j}\left(X_{j,i}-\mu_j\right)^2}$$

where j is a specific land cover type; μ_j is average value of surface albedo for the jth land cover type; n_j is the total number of pixels falling in the jth land cover type.

- LSA outliers were excluded from computation of mean by eliminating LSA values greater than two σ from the mean. µ and σ were subsequently recalculated.
- Fortnightly mean of LST , NDVI and SZA for each class are also calculated by aforementioned way.

Results

Intra-annual variation in LSA exhibited a flat Gaussian distribution for all land cover type studied expect for desert and urban areas. The intra annual variation of LSA on a fortnightly basis are plotted in figures below. Annual mean and SD of LSA are displayed in table

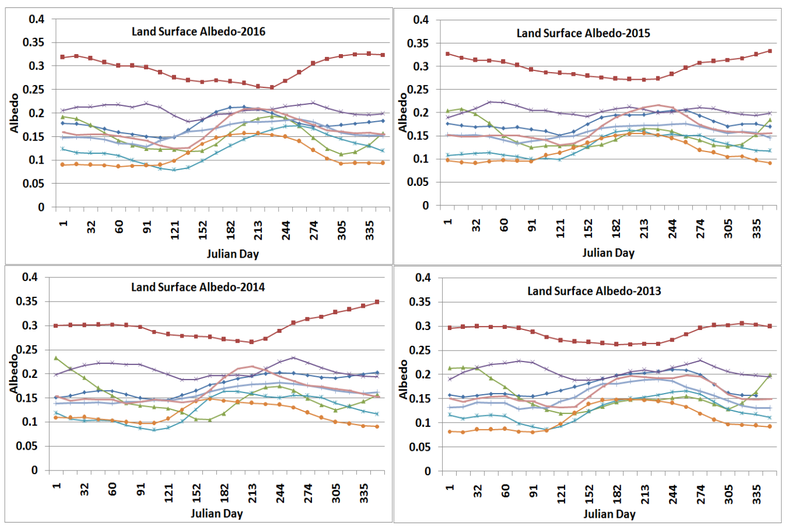


Fig 2. Intra annual variation of LSA from 2016 - 2013

Land cover type	Land Surface Albedo(LSA)			
	2016	2015	2014	2013
Build up/Urban	0.178±0.019	0.179±0.015	0.177±0.021	0.175±0.021
Desert	0.293±0.025	0.299±0.020	0.298±0.023	0.285±0.016
Crop Land	0.150±0.028	0.152±0.026	0.150±0.031	0.156±0.030
Grass Land	0.205±0.010	0.204±0.009	0.207±0.013	0.207±0.013
Semi Ever Green	0.126±0.029	0.128±0.022	0.126±0.027	0.126±0.024
Wet Ever Green	0.113±0.027	0.117±0.023	0.116±0.019	0.110±0.026
Sub Tropical Broad leaf	0.160±0.018	0.157±0.013	0.158±0.016	0.153±0.021
Dry Deciduous	0.164±0.025	0.165±0.025	0.165±0.024	0.163±0.023

Desert albedos were found to be the highest followed by grass lands and urban features. Cropland, deciduous and sub tropical broad leaf forest had medium albedo values and semi ever green and wet ever green forest were having the lowest albedo values. Influence of vegetation growth and land surface temperature on variation of albedo was also studied. The results obtained for 5 land cover classes with different range of albedo values depicted in plots below.

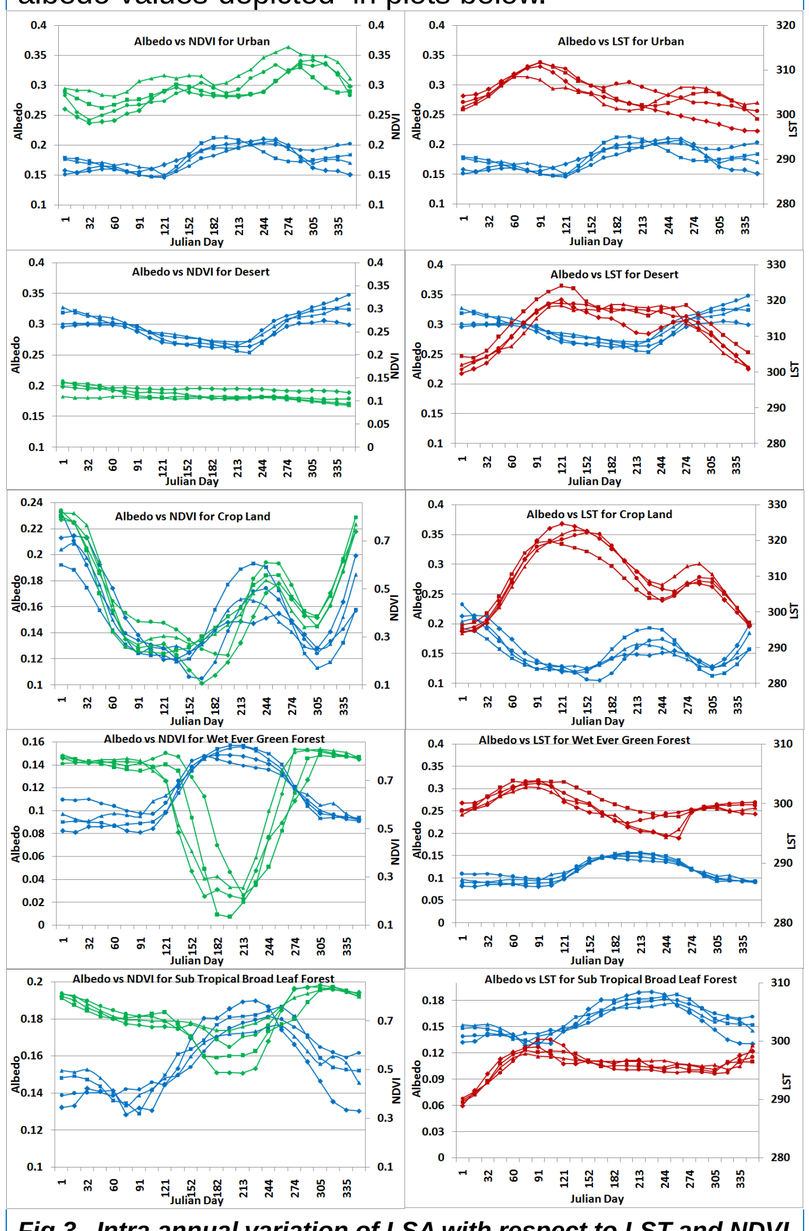
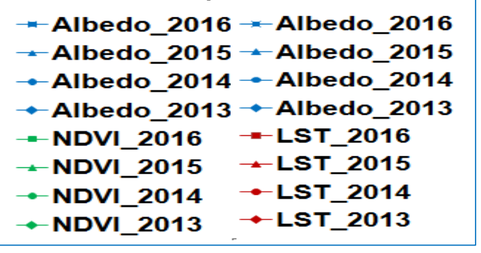


Fig.3. Intra annual variation of LSA with respect to LST and NDVI

In general both NDVI and LST were found to be negatively correlated with the variation of LSA values.



The influence of solar altitude on the variation of LSA, albedo were studied. The results obtained are demonstrated in figure below values for land cover features falling in different latitudes

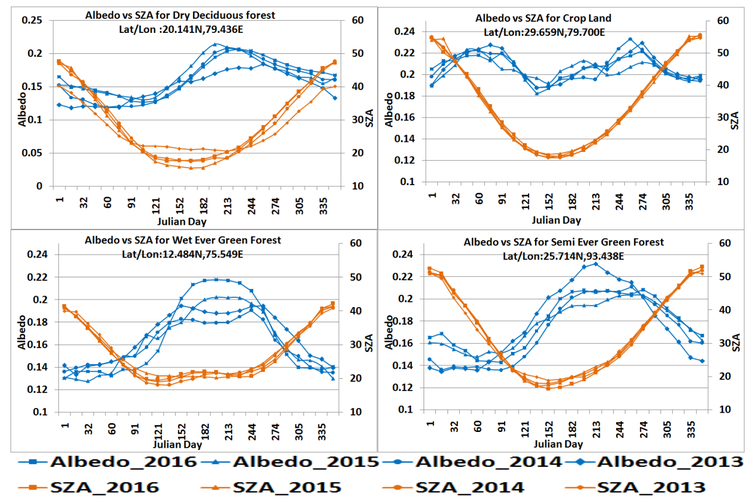


Fig 4. Intra annual variation of LSA with respect to SZA

Conclusions

The analysis of OCM BB albedo shows that there is significant difference in the range of albedo values for the various classes studied. Inter annual variation in albedo values were very minimal for the period studied. The albedo values for most land cover types showed some rapid increase in albedo values around the Julian day 90-105 in each year. The albedo had peak value around 195-220 and thereafter albedo values had a fall and reached lower values around the Julian day 270-280. Crop land albedo showed a bimodal variation for the period under study.

The vegetation density variability is inversely related to that of BB albedo especially for the forest cover studied. For the crop land the variation had a positive trend. LST was negatively correlated with LSA of all land cover types analyzed. The variation in LSA were seen to have a flat Gaussian near equator where there is lower variation in SZA values as compared for higher latitudes which have more steeper intra annual variation in SZA.The research can be extended to more temporal data to better understand the interaction between the variables studied.

Acknowledgements & References

○ We sincerely thank F&E Group , NRSC for providing forest cover LULC maps. We also thank Director, NRSC for his support and encouragement.

- Beans, N., 2014 Estimation of land surface albedo time series and trends based on MODIS data. *Proceedings Volume 9239, Remote Sensing for Agriculture, Ecosystems, and Hydrology XVI; 92390Q (2014); doi: 10.1117/12.2066473.*
- Tao He., et. al. 2014 Analysis of global land surface albedo climatology and spatial-temporal variation during 1981–2010 from multiple satellite products. *Journal of Geophys. Res. Atmos., Vol.119,pp10,281-10,298*.
- Rahman. S et.al., 2007 Study on the seasonal changes of land cover and their impact on surface albedo in the northwestern part of Bangladesh using remote sensing. *International Journal of Remote Sensing. Vol.28, No.5,pp 1001-1022.*
- Senthil Kumar A., et.al., 2014 Generation of Vegetation Fraction and Surface Albedo Products Over India from Ocean Colour Monitor (OCM) Data Onboard Oceansat-2. *Journal of the Indian Society of Remote Sensing, December 2014, Vol. 42, Issue 4, pp 701–709*
- Zhengjia Liu et.al.2014. Intra-annual variability of satellite observed surface albedo associated with typical land cover types in China. *Journal of Geographical Sciences February 2015, Vol.25, Issue 1, pp 35–44*

38th Asian Conference on Remote Sensing
on
Space Applications: Touching Human Lives

October 23-27, 2017
New Delhi (India)