Evaluation of QuikSCAT Data for Regional Monitoring of Vegetation Phenology

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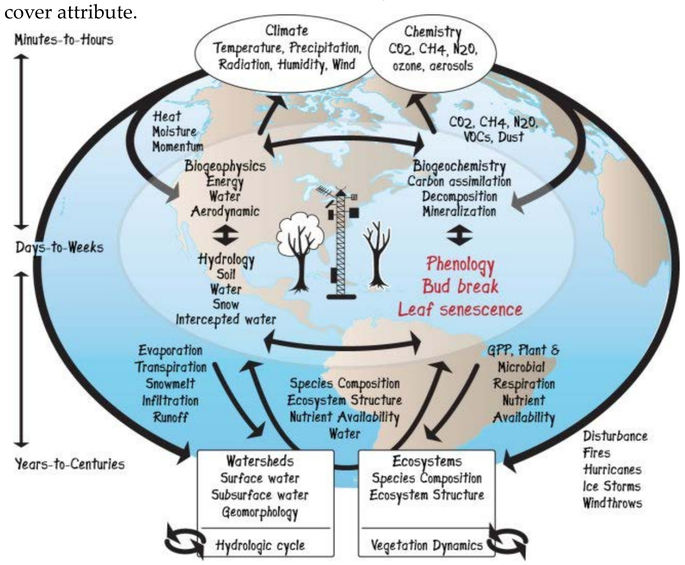
Abstract

The periodic plant cycle or vegetation phenology is controlled by various factors depending on the region. Those factors could be water availability or precipitation and temperature. Since vegetation phenology are sensitive to soil moisture and weather patterns, then phenology stages and duration are essential indicators for monitoring climate change and weather patterns.

The vegetation characteristics such as: Vegetation Optical Depth (VOD), Normalized Difference Vegetation Index (NDVI) and Leaf area Index (LAI) derived from VIS/IR remote sensing are used for monitoring vegetation phenology.

Microwave remote sensing observations shows great potential in assessing biomass, since it is unaffected by cloud cover or low solar zenith angles. Microwave observations of land surfaces are influenced by dielectric and structural surface and land cover attribute.



Source: http://wwwpaztcn.wr.usgs.gov

Introduction

Phenology is the study of periodic plant and animal life cycle events that are influenced by environmental changes especially seasonal variations in temperature and precipitation driven by weather and climate. Important phenophases include the timing of leafing, flowering, and fruiting in plants, agricultural crop stages, insect emergence, and animal migration. Phenology, representing the seasonal cycle on Earth, is a far reaching component of environmental science.

Variations in phenophase affect the abundance and diversity of organisms, their inter-specific interactions, their ecological functions, and their effects on fluxes in water, energy, and chemical elements at various scales.

With sufficient observations and understanding, phenology can be used as a predictor for other processes and variables of importance at local to global scales like climate change, and could drive a variety of ecological forecast models with both scientific and practical applications.

Objective

Satellite based monitoring of vegetation activity at optical and near-infrared wavelengths is compromised by cloud cover, smoke, aerosol contamination and is limit by seasonal snow cover and low solar illumination over large part the globe.

Microwave radar remote sensing instruments illuminate the land surface independent of solar radiation, and are largely insensitive to cloud cover, smoke and other atmospheric aerosols. Satellite radar remote sensing has the potential for nearly continuous global monitoring, day or night and under virtually all weather conditions, with monitoring capabilities constrained primarily by sensor design and orbital geometry.

The objective of this study is to evaluate vegetation phenology data based on VIS/IR monitoring and correlate with corresponding data based on microwave radar remote sensing.

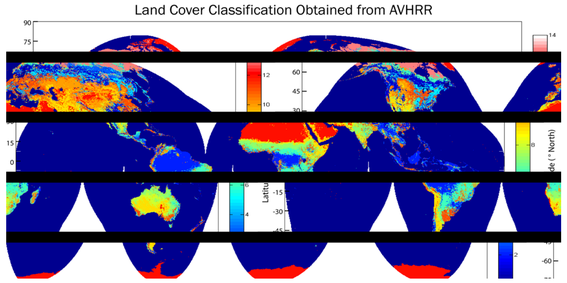
The relationship between QuikSCAT backscatter, NDVI and LAI will be analyzed across a wide range of global vegetation types and geographical locations. The NDVI and LAI product from MODIS will be used in this study to understand the effect of seasonality.

Materials and Methods

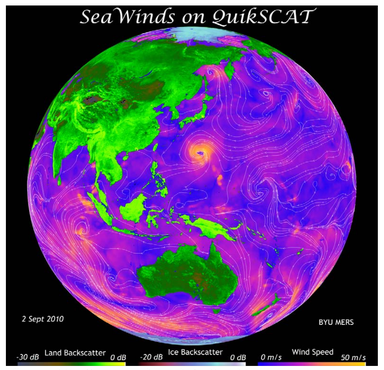
Global and regional data from years 2002 to 2009 will be analyze. Land Cover classification data was obtained from Advanced Very High Resolution Radiometer (AVHRR) were values range from 0 to 13 varies from water to urban build. For each classified region on the map we will analyze the correlation between Ku-band radar backscatter measurements from the SeaWinds-on-QuikSCAT use to determine canopy phenology as well as Microwave Polarization Difference Index (MPDI) and the corresponding data from Leaf Area Index (LAI) and NDVI from MODIS as well as VOD derived from AMSR-E. SMEX (Soil Moisture Experiments) data will be use to validate VOD derived from AMSR-E.

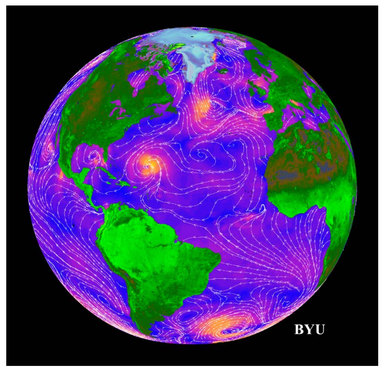
Data Sets		Period	Resolution
QuikSCAT	Daily	2002-2009	12.5 km
MODIS-NDVI	8 days	2002-2009	0.25 km
MODIS-LAI	8 days	2002-2009	0.25km
AMSR-E-VWC	Daily	2002-2009	56km
AMSR-E-VOD	Daily	2002-2009	56km
AMSR-E-MPDI	Daily	2002-2009	56km
Land Cover Classification-AVHRR	Static	2002-2009	8km
SMEX	Static		Field observations

Land Cover Classification Obtained from AVHRR



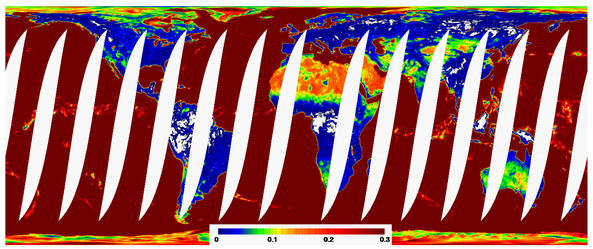
Value	Label
0	Water
1	Evergreen Needleleaf Forest
2	Evergreen Broadleaf Forest
3	Deciduous Needleleaf Forest
4	Deciduous Broadleaf Forest
5	Mixed Forest
6	Woodland
7	Wooded Grassland
8	Closed Shrubland
9	Open Shrubland
10	Grassland
11	Cropland
12	Bare Ground
13	Urban and Built



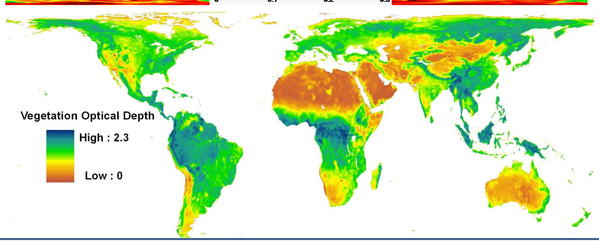


Source: http://www.scp.byu.edu/gallery.htm

The image derived from QuikSCAT data shows the land areas are shows higher backscatter values in tropical vegetation to lower values in the deserts.

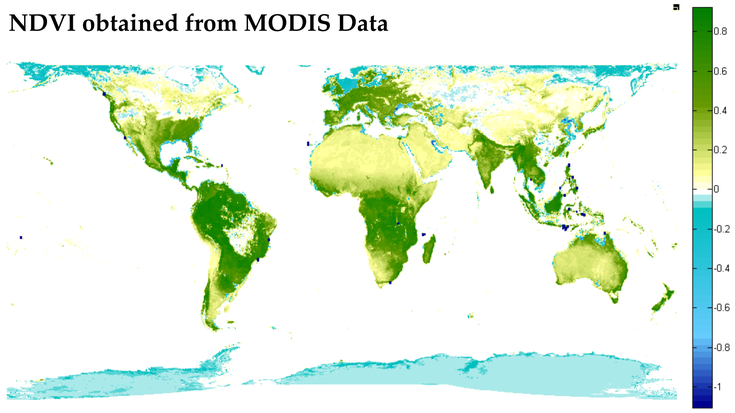


MPDI from AMSR-E
Source: Ronny Schroeder

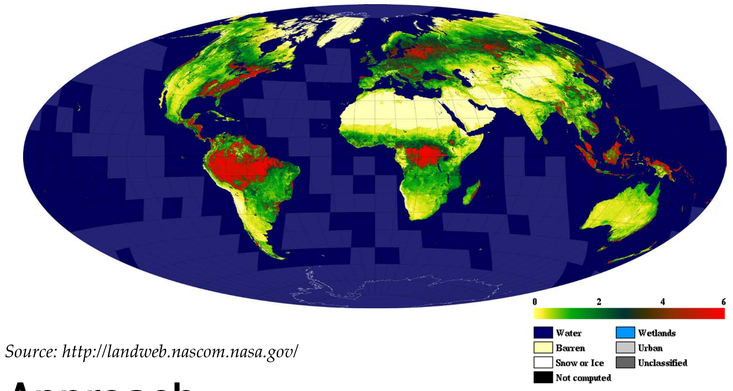


VOD from AMSR-E
Source: Enhanced Global Vegetation Phenology Monitoring USing Microwave and Optical-Infrared Satellite Remote Sensing.

NDVI obtained from MODIS Data



Leaf Area Index (LAI) from MODIS Data



Source: http://landweb.nascom.nasa.gov/

Approach

The study will be carried out based on following approach :

- Using the vegetation land cover data select 27 sites that contains relatively homogeneous vegetation and each one of the 13 vegetation classes will be represent by at least two sites.
- Determine the correlations between the different sources of active and passive microwave remote sensing observations (QuikSCAT, AMSR-E based MPDI)
- Analyze the relationship between NDVI, and LAI generated based on VIS/IR data.
- Study the association between microwave remote sensing observations (QuikSCAT, AMSR-E based MPDI) and VIS/IR observations (NDVI and LAI). A time series analysis will be performed.
- Seasonal variations of vegetation will be studied and inter-comparisons will be made between the seasons. Inter-comparisons will be made for 13 vegetation classes.
- For each site the association between SeaWinds backscatter and MODIS-derived LAI during non-frozen periods from 2002 to 2009 will be study.
- Classify growing season parameters from 2002 to 2009 using daily Ku-band backscatter measurements from SeaWinds-on-QuikSCAT.

Acknowledgments

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