Development and application of settlement Index of Forest pests and Diseases for Large Areas through Using modis-ndvi Data

Sun fuyang1, Wang jianhe3, Fu wei4, Li xiaosong2
1 Collegeof Forestry,Northeast forestry University,Harbin 150040, ,
2 Institute of Remote Sensing and Digitalearth,Chinese Academy of Sciences, beijing 100101, in-
3 Forestry Working station in Inner Mongolia, Huhehot 010010, in-
4 Inner Mongolia Branch, PICC ,huhehot 010010, in -

Abstract: settlement to forest pests and diseases to Large areas is one of Most pressing challenges For the 
" Development of Forest insurance. This Study , taking , forestareas of of East Inner Mongolia, developed A 
settlement index to forest pests and diseases at the County scale to Large areas, based on MODIS - NDVI 
Data , Field surveydata , Successfully applied It to East Inner Mongolia to The year of 2016. The results Show [] This Proposed settlement Index has the Advantage in being simple in Calculation, wide coverage and ? - space 
continuity, Could monitor The serious Damage , even , moderate Damage for Conifer For est effectively. therefore , The settlement Index of Forest pests and diseases could provide Reference and support for forest Insurance.

Keywords: MODIS - NDVI , Forest pests and diseases, settlement index Receipt Date : 2017-11-02 To fix the 
date : 2017-11-30

Introduction to authors : Sun Fuyang (1993-), men , Inner Mongolia chifeng people , reading Master , Research Direction Forestry remote sensing . Email:897134158@qq.com Communications author : Li Xiaosong (1981-), men , Inner Mongolia chifeng people , Associate researcher , Dr , Research direction for ecological remote sensing . Email:lixs@Radi.ac.cn

missing leaves caused by forest pests , Tree Death is global sen The main factors of the forest disturbances 
are _ . According to statistics of forest diseases and insect pests cause great harm to our forests , frequency and 
subject to disaster area is on the rise every year,. annual due to disease and pest death tree up 4 many million 
strains ,cause economic loss up to 1 - Billion , eco-service loss 856.1 billion . to achieve our country Forestry 
Sustainability , policy Forest Insurance on a nationwide scale to wide launch , Up to 2013 covers an area up to at 
the end of 1. billion HM 2 , National Forest insurance coverage rate reached 19%.2013 year To complete the 
claim 166 up , Pay Amount 4. $ billion 2 , forest Insurance in the rapid development of the same time also faces 
many problems : 1 ) cover protect area large , Survey Difficulty high , claims-less aging , when using a 
manual face survey when surveying forest pests , restricted on fixed-selected samples , Lines and limited 
manpower , survey real Poor time , not accurate , Quickly reflect the quality of the forest in real

Remote Sensing | 1
not wide ,Survey Incomplete , Because it is not comprehensive In time to control the disaster , easy to miss the best time to survey , forward The passive situation occurred after the disaster survey is not timely ; 3) Pest Infestation type more , disaster loss assessment difficulty Big . so , How to develop and applied by , Advanced claims method for forest pest and disease compensate for , is an urgent problem .

Remote Sensing technology has a ground survey for forest pest monitoring damage Unmatched Advantage , The principle of all forms of pest Damage will eventually result in tree growth. , canopy spectrum in change , and these spectral changes can be recorded by satellite . The spectral characteristics of the are identified by . Medium-High resolution satellite data , Landsat (+m) has been widely used in the afternoon poison moth (Gypsy moth,) Mountain Pine size Stupid (dendroctonus _ ponderosae )/ Jackson Color volume Moth (choristoneura _ Pinus ), deciduous pine moth ( _piree mothetc) Pest monitoring . due to Landsat etc Sensor time resolution rate Low , It's difficult to get multiple periods of valid data during growth period , to Quarter section-marked diseases and pests cannot be monitored effectively . High resolution operator data acquisition capability for multi-temporal phases , but The High cost of restricts its application at the regional scale , low resolution data , such as novv AVHRR ( > 4km ) also used with wide range of forest pests and diseases caused by leaf loss monitoring , The result Provide reference for the discovery of forest-affected areas at the macro scale ,but its the smallest unit is approximately dozens of square kilometres of spatial resolution , cannot meet the demand for precision claims . MODIS sensor with ? m Space Resolution , Daily Time resolution , in forest pests harm monitoring shows better potential B Ten , successfully passed health Green blade discoloration or loss implements dynamic monitoring of forest diseases and pests Test . is worth noting , existing MODIS monitoring results are targeted at special Set Pest type , specific Region , Its methods to promote in other regions Be very cautious , and need to go through the ground real pests and diseases data enter row demarcation . Even so , take advantage of MODISNDVI Monitored forests blade discoloration or loss as an indication of the severity of ground pest and disease instructions agreed . thus , using MODIS NDVI build - the claim relative scale on the reflect area , Forest Pest claim indices , Yes .

This article takes the eastern Inner Mongolia region as the test area , analyzes Inner Mongolia The characteristics of common pests and diseases in eastern forests ,development based on time series MODIS NDVI assessment model for forest pest loss type , combined with the actual disaster characteristics of ground pest and severity letter - rest , building large area forest disease and pest claims in county scale number , calculated 2016 year East Inner Mongolia Forest claims index , and compare to local forest pest disaster data to verify its Apply Effects .

1. Research Overview

Research area includes Inner Mongolia Holonburyr , Xing an union , Cylinder Gol Union , Tongliao , Chifeng , wulanchabu city . Area Existing sen forest area close to 2 000 Universal HM2 . in recent years , Inner Mongolia annual occurrence Forest Pest rodent area up to € million HM2, disaster Kind has 109 more species One , not only for ecological , The economy causes very serious direct danger harm , further affect the green barrier ecological safety in north China .

2. Research Methods

2.1 Remote sensing data and preprocessing

Normalized difference vegetation index ( NDVI ) is the most commonly used to refer to the "" vegetation Index for vegetation changes " . This research uses MODIS TER RA NDVI Products (MOD Q 1) , Space Resolution , m, Time resolution to D . Data covers time range 2010-2016 year , every year period . data is downloaded from the U.S. Address Bureau Web site . with MODIS MRT tool extract from NDVI Wave paragraph , and then tif format , Original SIN projection to Albers projection . use filter processing on time domain (S - G filter ) log

2 | Remote Sensing
to refactor, to reduce noise levels.

2.2 Feature Data

Forest distribution data comes from National Ecological 10-year assessment Land Cover classification data A. The dataset is made in China satellite HJ Primary Data source, data processing based on Super platform method, automatic sorting work, and after a massive ground investigation point’s revision, the final classification precision is higher than 85%.

2.3 Ground Survey

2016 Year in Chifeng with Tongliaoj Forest disease Pest Ground sample survey, to correct forest based on remote sensing parameters Pest and disease disaster provides data support. The investigation principle is as follows: 1 with small The class is the unit, and has an area of at least 6. HM2 (+ mu) above, coordinates as much as possible in the central location, not on edge position. 2) Culvert The main diseases and insect pests in the eastern part of Inner Mongolia, specific survey standard parameters See forest pest occurrence and disaster criteria M; 3) Sample Space- The cloth needs to have. Fixed representation.

2.4 Remote Sensing monitoring model for forest diseases and pests

through ground surveys and literature studies, occurs in the test area of disease-causing leaf discoloration or deciduous conditions in a growing season Green or grow less likely. hence, If occurrence sen Forest Pest, 7-8 months NDVI will definitely receive an impact reduction. other, Conventional forest disease outbreaks usually persist 1~3 year around, so, relative to 2016 Year, in 2010-2015 Year 7-8 Month time series NDVI There will always be a year or years of healthy NDVI values can be used as references.

Follow these guidelines, Reference Jepsen proposed methods such as, to pilot Zone forest area 2010-2015 year 7-8 of the month 4 period time series NDVI data for image-by-pixel analysis, Select of the decimal point NDVI as a reference to a healthy forest NDVI, Yes after, use 2016 for the corresponding period of the year NDVI value With reference value contrast, Sustainability considerations from Pest effects, if 3 continuously d NDVI pixels with a value lower than the reference value can determine that the This is the area affected by forest disease collection. last, pair OK to sen image of forest pest effects, calculation 2016 year 7-8 Month 4 period NDVI reduction of data and reference values, Add and build a forest disease pest Hazard degree parameter.

combined with the ground forest Pest survey data, analyze varying degrees of forest Pest and Disease hazard Remote Sensing parameter, OK The threshold values the extent of forest pests and diseases as.

2.5 claims index design

taking into account the forest Insurance Administration Regulations, in flag counties, Set Forest Pest and disease claims index for forest pest disaster area ratio Example, The proportions of the affected area to the total insured forest area, to the macro View the reference to insurance company claims.

3. Results and Analysis

3.1 parameter analysis of hazard degree of forest pests

to map forest pest hazard parameters to ground survey For analysis,, broad leaved Forest Mild disaster, Moderate Disaster sample corresponds to the forest pest and disease degree parameters for are all invalid values, Show this study mentioned out based on MODIS - NDVI time series analysis model cannot Light for broad-leaved forests, Moderate disaster effective recognition, and broad-leaved Forest the degree of forest pests and diseases corresponding to the severity of the disaster the parameters are all have the value, average of -85%, It is proved that the model can effectively monitor the severe pest and disease disaster of deciduous broad-leaved forest;. coniferous forest mildly affected the forest pest and disease degree parameter is invalid value, indicates that The model cannot be effectively identified for minor disaster in coniferous forests, for coniferous forests; Severe disaster-prone, Forest Pest hazard process Degree parameters are valid values, average is -45%, Moderate and severe parameter overlap between due to disease and pest type, so
no to differentiate between, so, for broad-leaved forest select mean minus standard deviation to threshold to identify pests and diseases severe disaster, threshold is -50%; for pins leaf Forest Select Average minus standard deviation as a threshold to identify the bug, ., Severe disaster, threshold is -30%.

3.2 spatial analysis of forest pest infestation

According to the threshold of the broad-leaved and coniferous forests, to 2016 year test area Forest Pest Infestation estimates, results in Figure 1 shows, statistics show, overall disaster area 5 252km2, close, million HM2. where the affected area is over 1 Universal HM 2 with Flag County, is Elunchunqi, Yakeshi, Jalaid Qi, Keerqin right front flag, Jarud Qi, Eerguna, Zalantun, Aershan, A Ron, Moliqi, Ewenkizu Zizhiqi, Bairin Zuqiqi, Horqin Youyi Zhongqi; affected area in 1 HM 2 has Flag County, is Hexigten Qi, Bar forest right flag Liangcheng County , Ar Horqin Qi, Genhe, Linxi County, Black Blue Hot City, songshan District, Aohanqi, Xi Ujimqin Qi, Tuquan County, Ongniud Qi, Zhenglanqi, Harqin Qi, Xinghe County, Ningcheng County. affected by disaster area less than 1 HM 2 has Flag County.

3.3 claims index and validation

uses a well-designed index to 2016 year Inner Mongolia East Forest region Forest Pest Claim results are calculated and plotted in the diagram (Chart 2), sets the claim result to 6 class: is the same as 1%, >1% ~2% for , >2%-3%, >3%-5%, >5%-10%, >10%. claims index 1% has Seven flags County, >1%!2% with flag County, >2%!13% has tenflag counties, >3%!5% with @ Flag County, >5%!10% has 9 flag counties, is mainly distributed in Tongliao with Chifeng North, >10% has 2 Flag County.

This study collects the 2016 year Inner Mongolia Autonomous Region 9 Flag County Forest Pest Insurance Data, Hexigten Qi, Teeth Keshi city, Arongqi, Elunchunqi, Kulunqi, Naimanqi, A Baga, Fengzhen and Shangdou County. Then, Take advantage of this item compensation Index and forest pest disaster area and insured forest area ratio case Analysis, to verify the feasibility of the project claim index application. related analysis results as shown 3 „You can see the reason” highly linear correlation between the escalation ratio. The decision factor can be to reach 0.911 3. This shows that the claims index has a better application effect fruit. Taking into account the enormous workload of ground surveys, based on time series.

4. Epilogue

This article uses the time series MODIS NDVI data, combined face actual survey data, Forest diseases and insect pests based on time series data occurrences feature, Forest Pest hazard path reflecting loss of leaf rate is designed degree parameters, building large area forest diseases and pests with flag County as unit claims index, The validation results are in good correlation with the actual reported disaster situation. sex, provides important support for forest insurance claims work. then and, affected by spatial resolution and forest pests and diseases and spectral response Miscellaneous effects, The method proposed in this study cannot be used for mildly forested Pest Effective identification, for broad-leaved forests and even moderate disaster Law reflection, future needs to be further refined.

Reference

2. multicast, Autumn, Zhao Rong, , and so on. Research on the design innovation of policy forest insurance system J]. Forestry Economy, 2016 (2): 27-32.


