Mapping land cover and insect outbreaks at test sites in East Siberia

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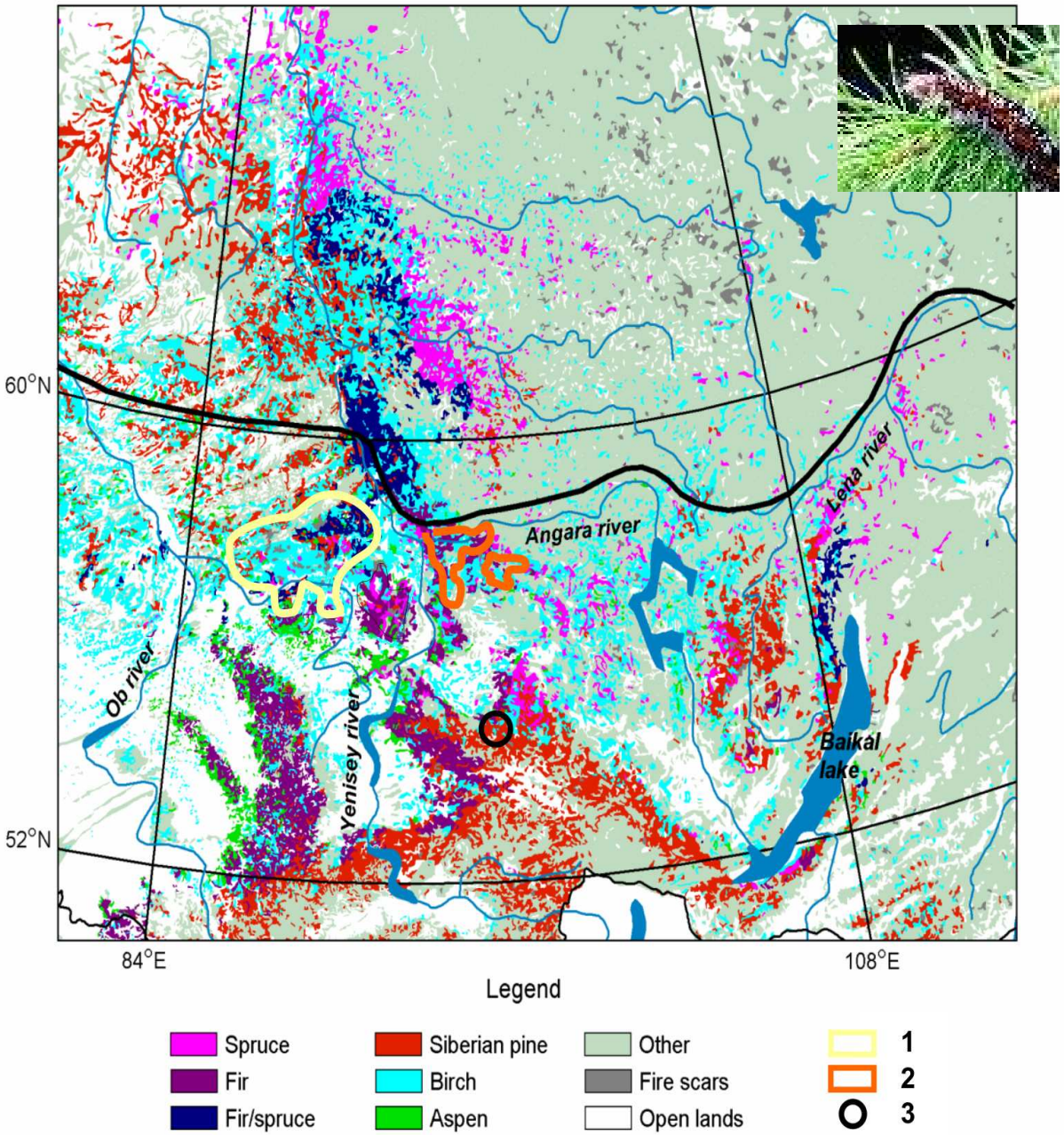
Insect outbreaks are one of the primary factors of Siberian forests dynamics, determining species composition and carbon balance.

This table lists the main insect species which caused outbreaks in Siberian taiga

	Insect species	Main food source tree species	Max. outbreak area, thousand hectares
1.	Dendrolimus superans sibiricus Tschetw.*	fir, pine, larch, spruce	> 1000
2.	Lymantria dispar*	larch, broadleaf	300
3.	Orgyia antiqua	larch, birch	40
4.	Dasychira abietis	spruce, fir, pine, larch	1000
5.	Leucoma salicis*	aspen, willow	100
6.	Lymantria monacha*	pine, spruce	5
7.	Ectropis bistortata*	spruce	400
8.	Bupalus piniarius*	pine	50
9.	Semiothisa signaria*	spruce, fir	10
10.	Simiothisa continuaria	larch	5
11.	Erranis jacobsoni*	larch	50
12.	Biston betularius	birch	50
13.	Phalera bucephala	birch	50
14.	Clostera anastomosis*	aspen, willow	10
15.	Zeiraphera rufimitrana	fir	100
16.	Coleophera dahurica	larch	100
17.	Zeiraphera griseana	larch	>1000

The most dangerous species is the Siberian silkmoth (*Dendrolimus superans sibiricus* Tschetw.).
This insect causes forest damage and mortality up to >1 mln ha per outbreak



The map of actual and potential Siberian silkmoth food base

Outbreak areas:
1 (yellow line) – of 1950s;
2 (red line) - of 1990s,
3 (black circle) - of 21st century;

The temporal trend
in outbreak periodicity
is observing:
25 yr, 25yr, 12 yr, and 8 yr.

Solid line:
northern limit of outbreak zone.
Under the impact of climate change this border will shift northward.

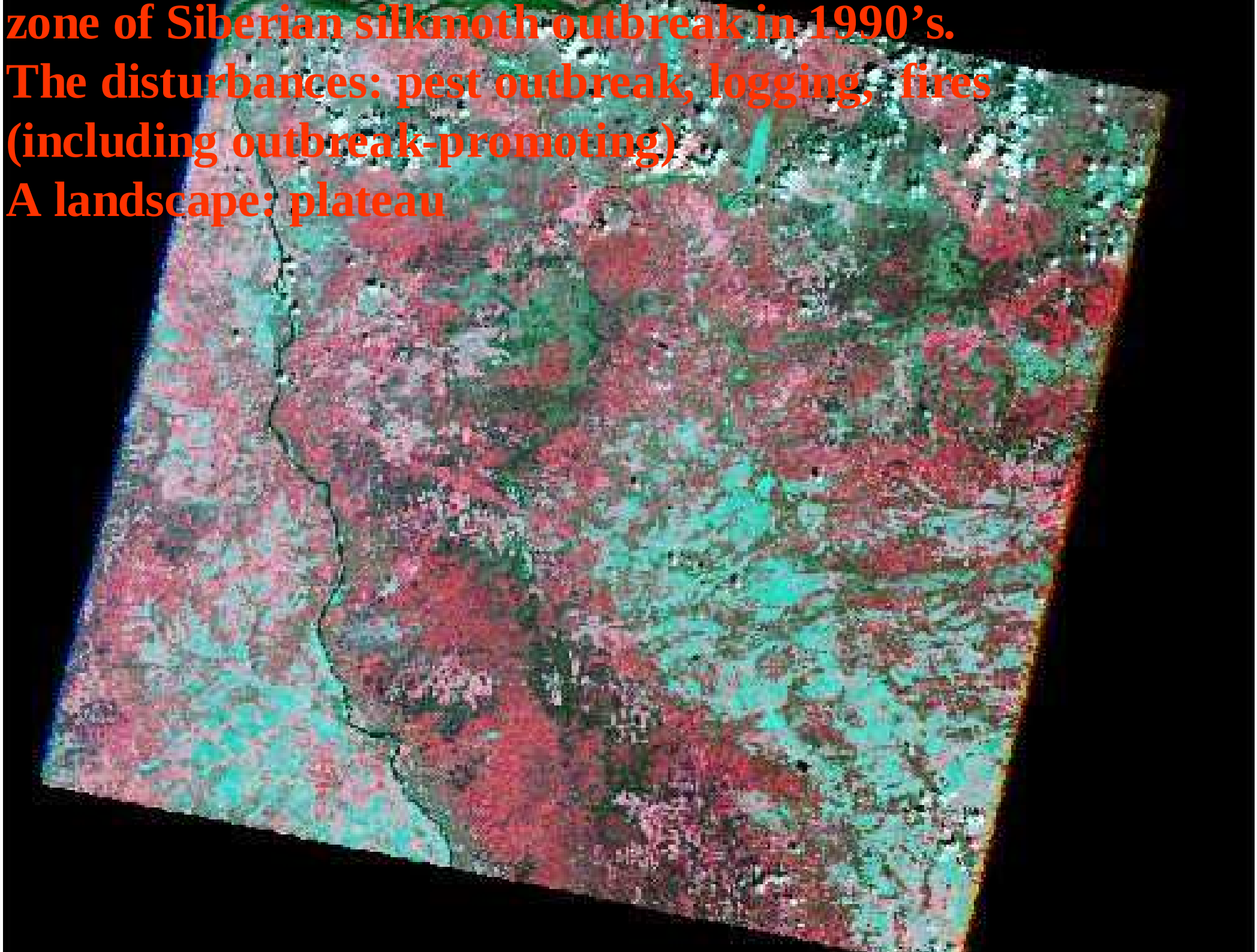
Secondary pests (bark beetles) attacked stands weakened by Siberian silkmoth

Insect-killed stands becomes a “firewood” for the periodic follow-on fires

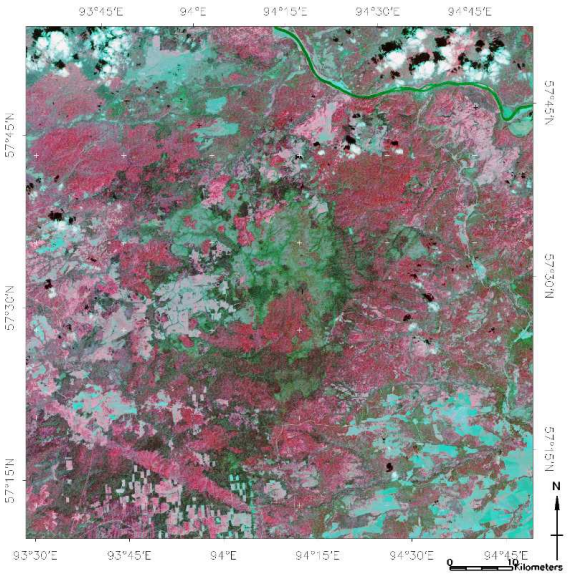
The catastrophic scale of outbreaks requires adequate methods of detection and mapping.

The purpose of this study is evaluation of Terra/MODIS and SPOTVegetation data for detection of Siberian silkmoth outbreaks.

zone of Siberian silkmoth outbreak in 1990's.
The disturbances: pest outbreak, logging, fires (including outbreak-promoting)
A landscape: plateau

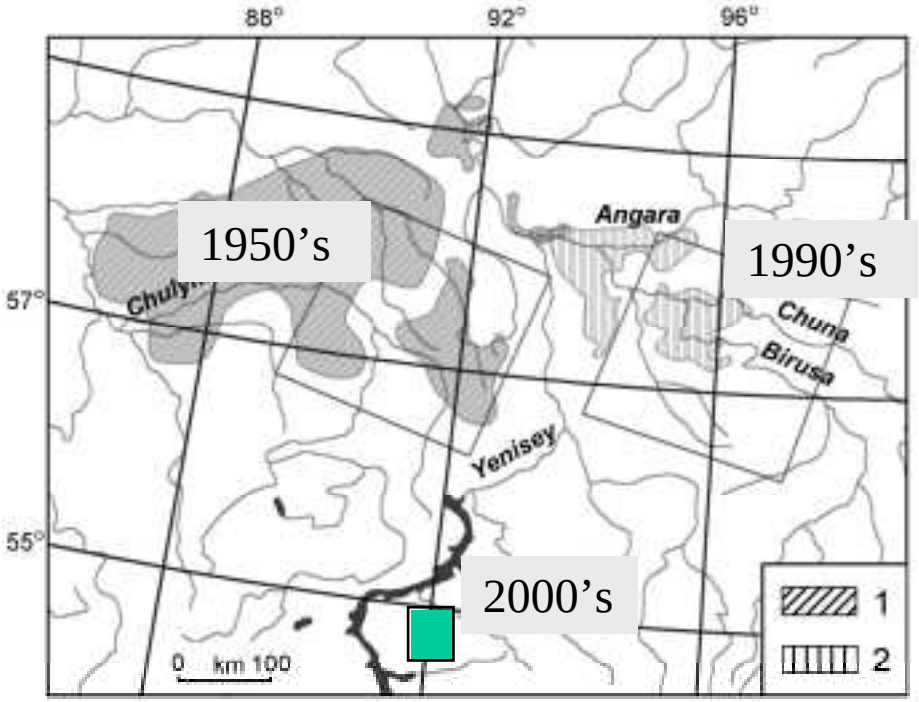


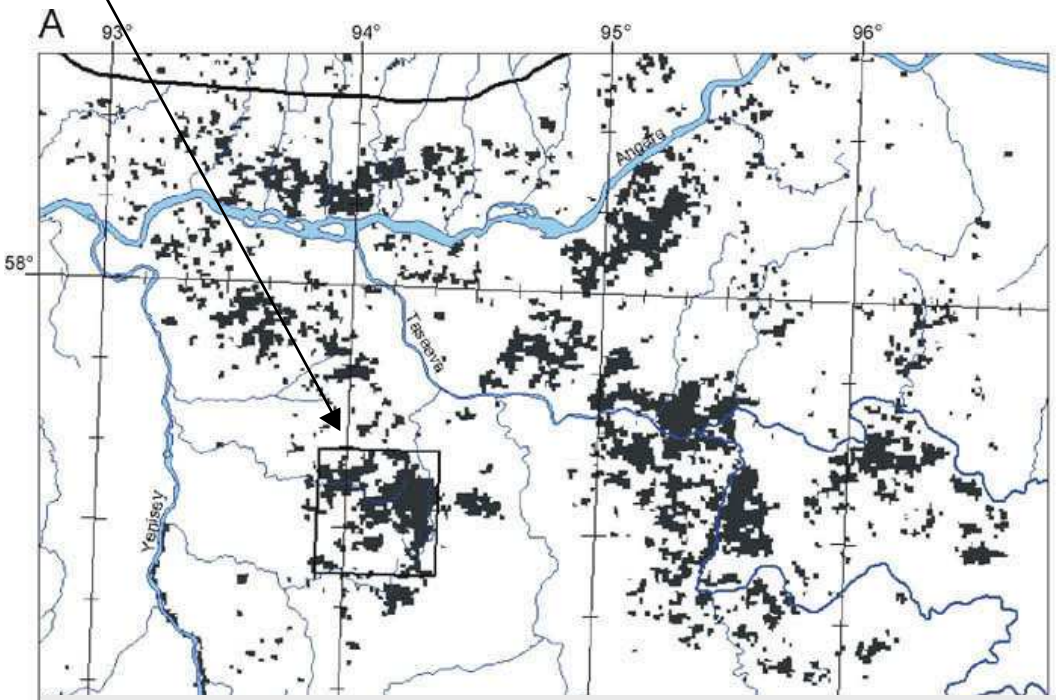
Insect outbreaks in Central Siberia

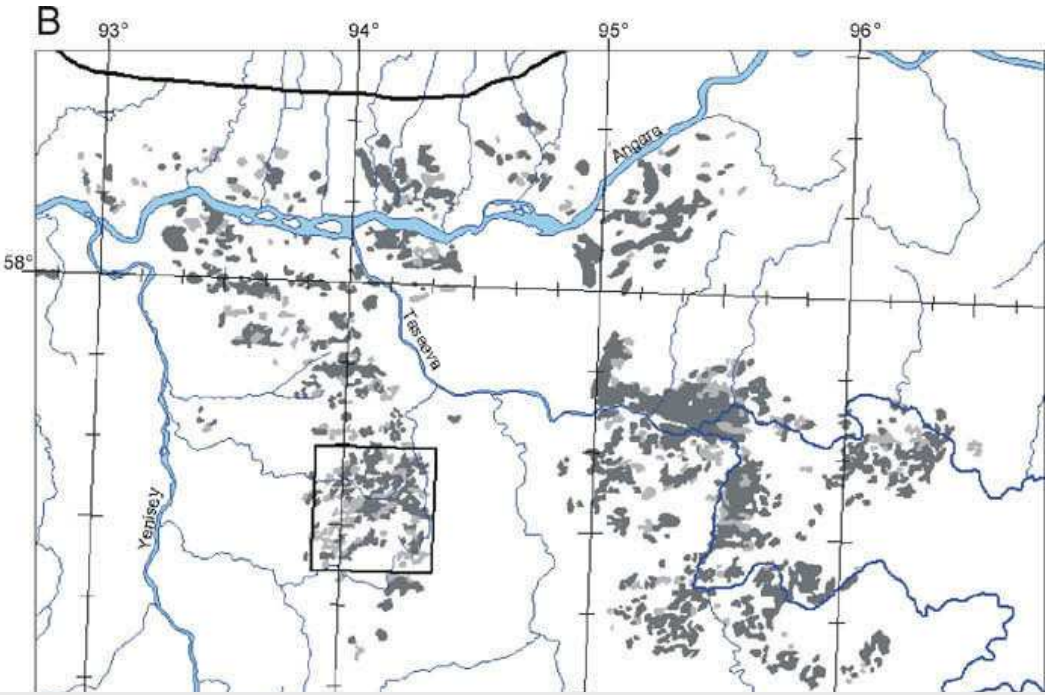


Landsat 7 image

Insect outbreak areas

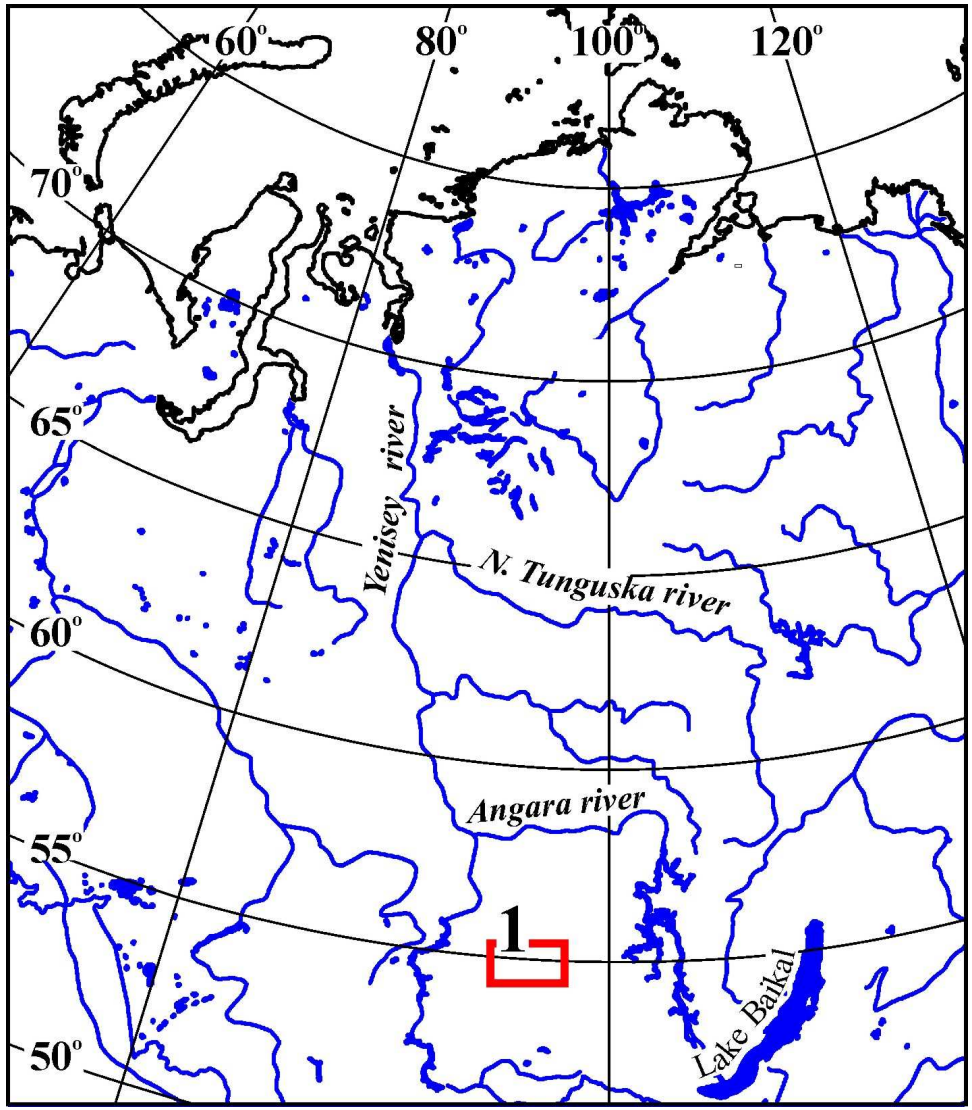


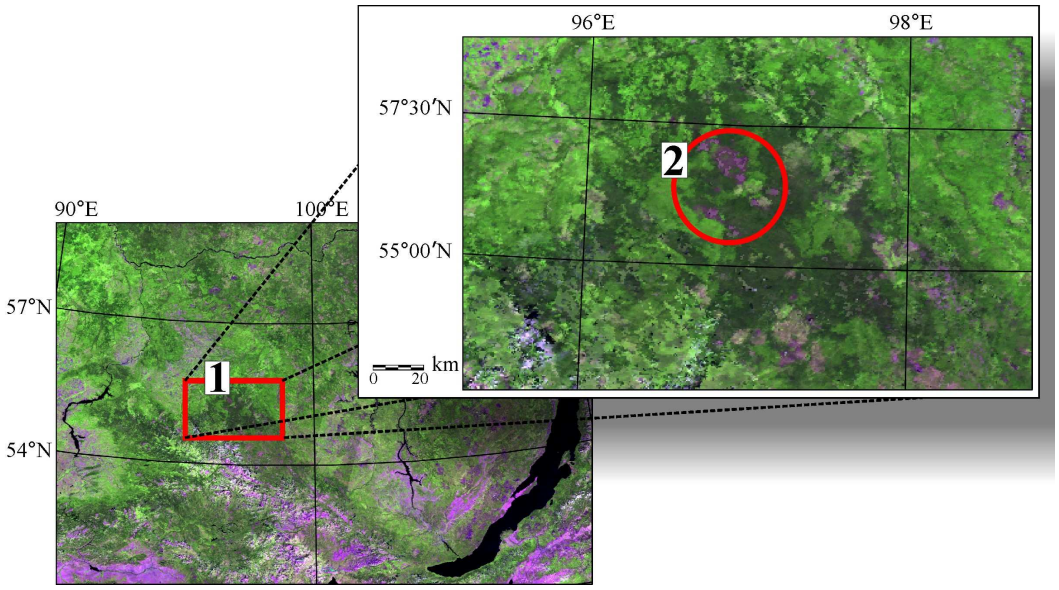




AVHRR derived and conventional mapping insect damage

Area of investigations _2:
zone of Siberian silkmoth outbreak in 2000's.
The disturbances: pest outbreak, logging, fires SPOT Veg Image
A landscape: mountains

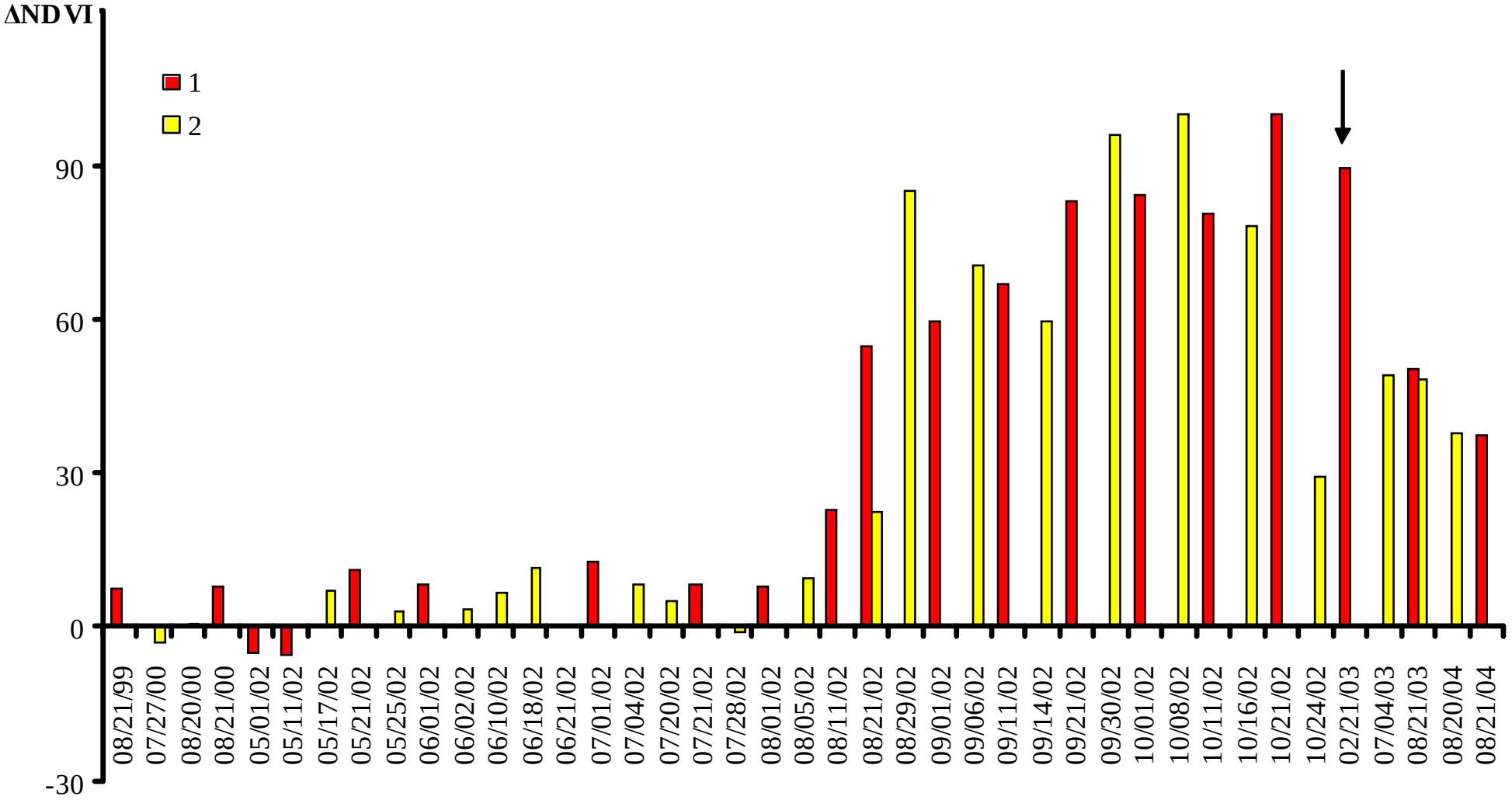




1. The outbreak zone.
2. The main outbreak spot.

NDVI difference dynamics between healthy and damaged stands

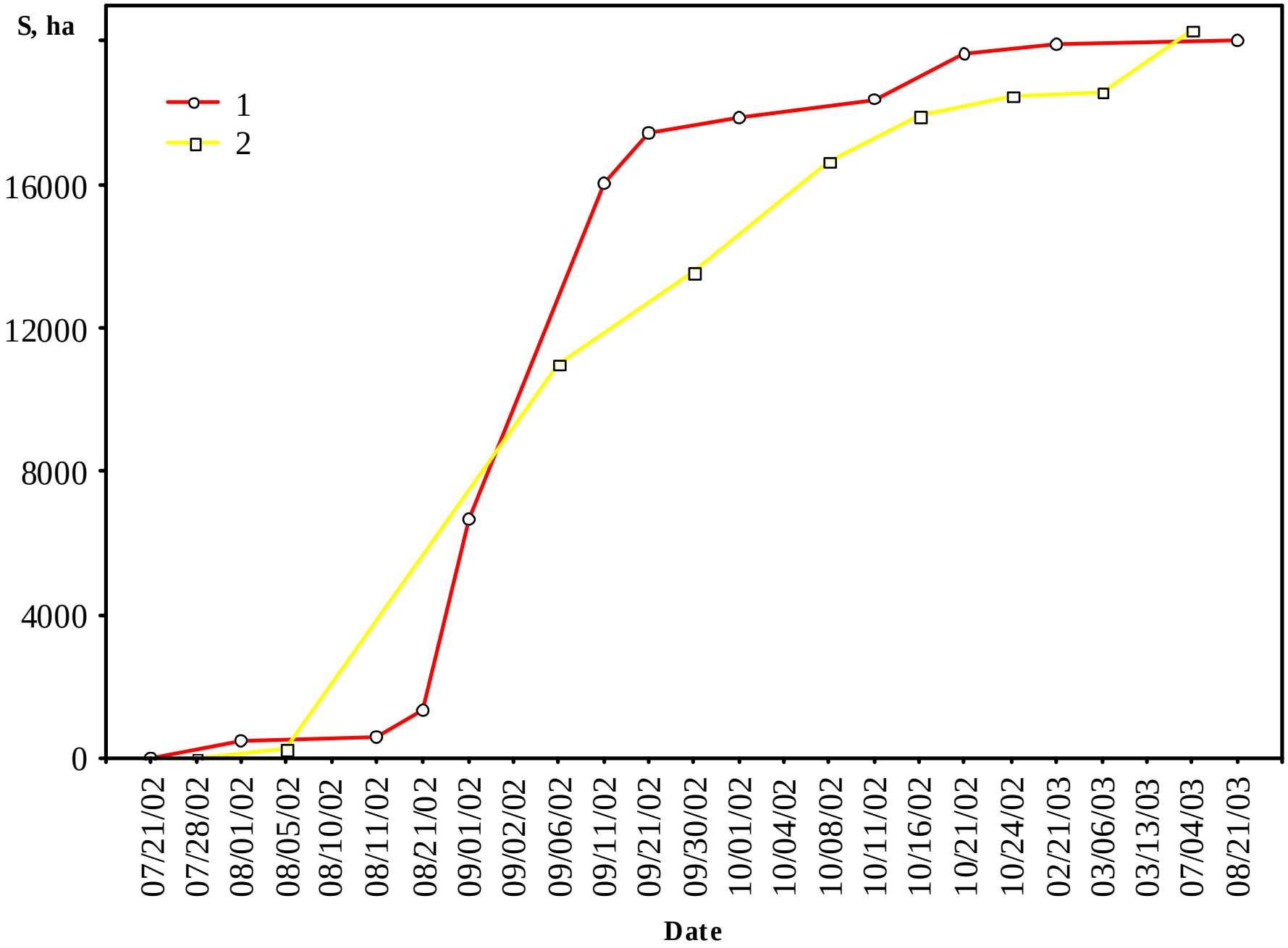
(normalized data)



1 – SPOTVeg

2 – TERRA/MODIS

Damaged stands area dynamics

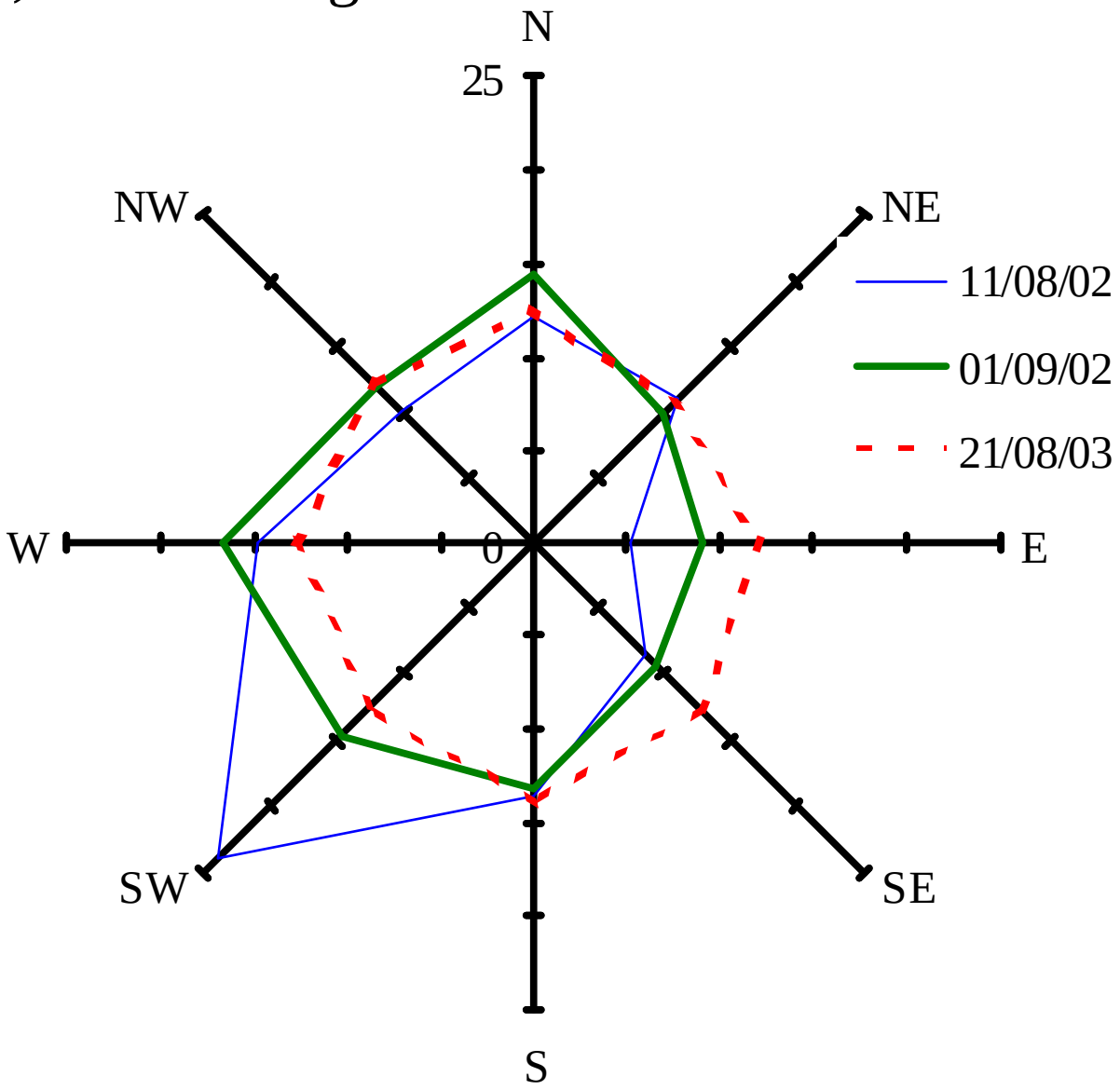


1 – SPOT-Vegetation; 2 – Terra\MODIS

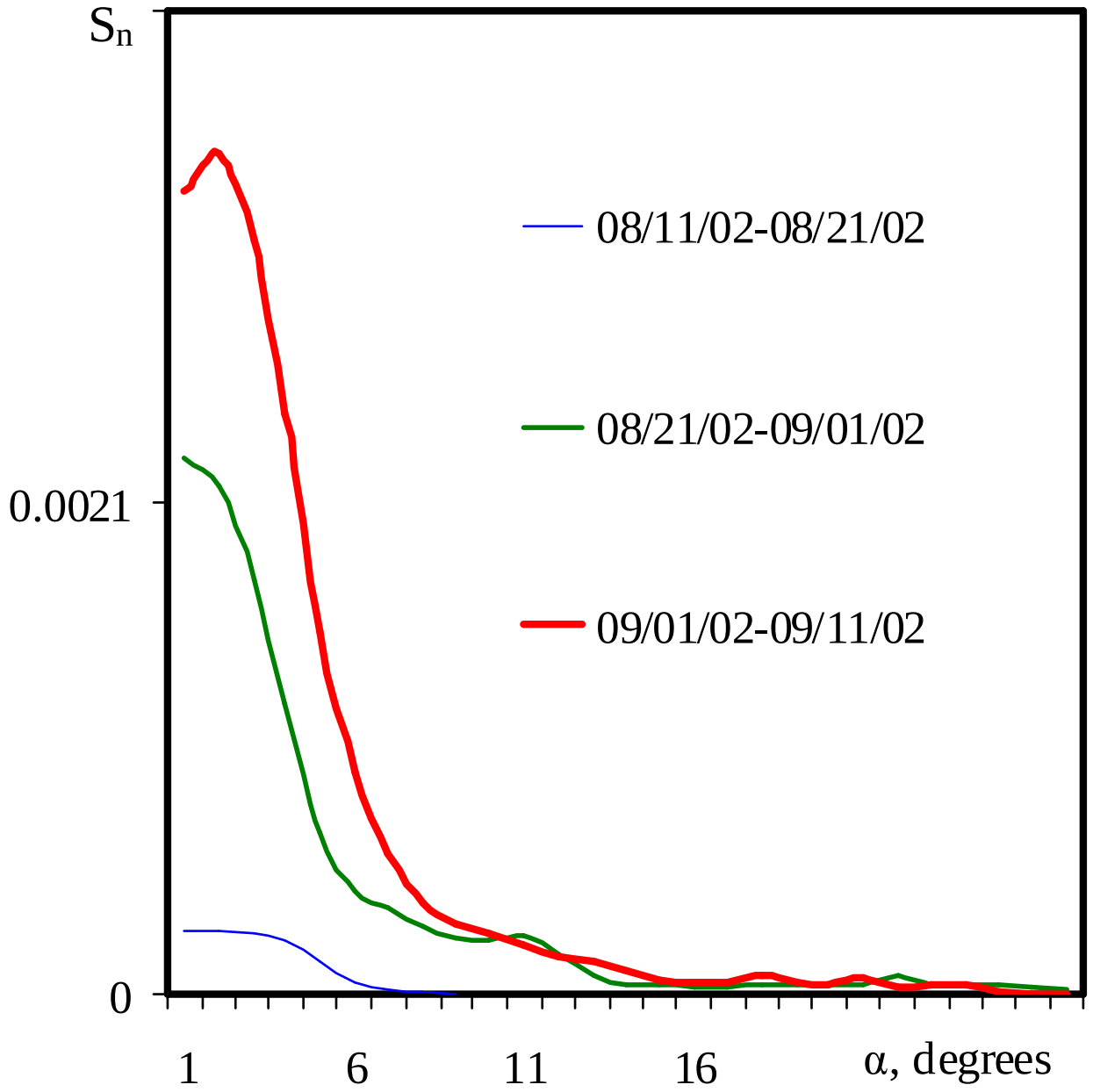
Is the initial outbreak phase related to landscape features (aspect, slope steepness, and elevation)?

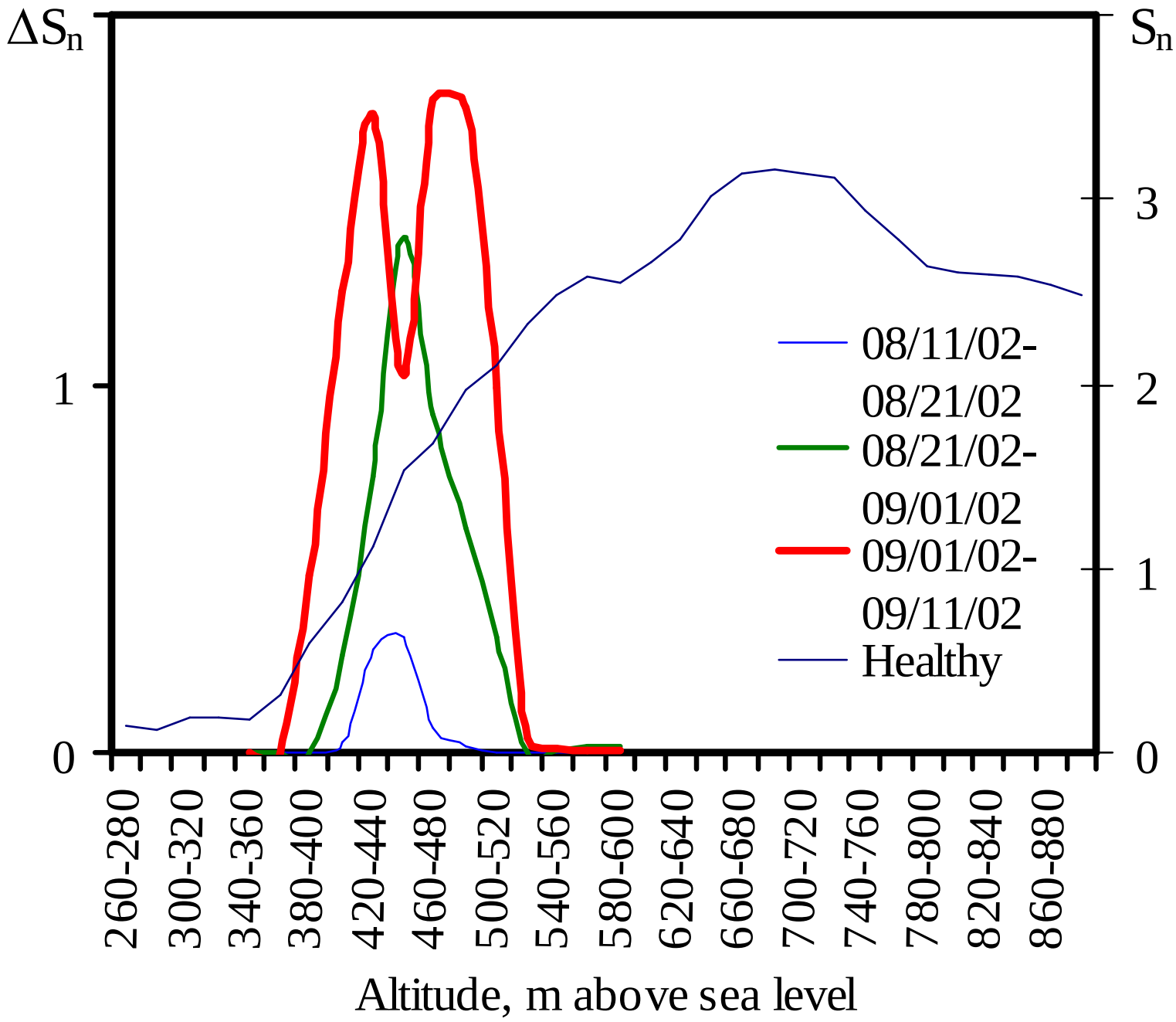
To answer this question, we used high resolution 3D model

Damaged stands area increment dynamics (with respect to aspect)



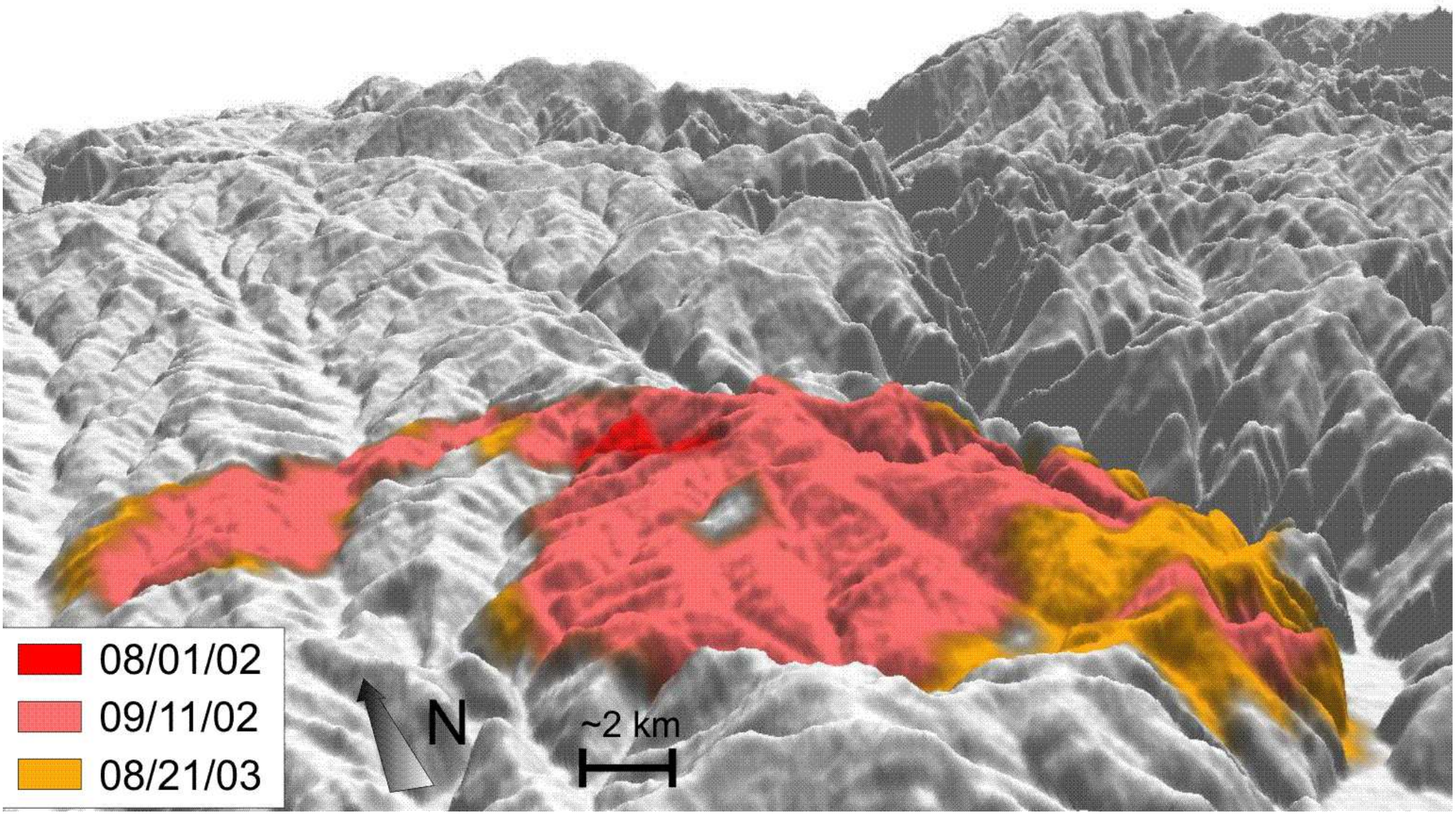
Damaged stands area increment dynamics (with respect to slope steepness)



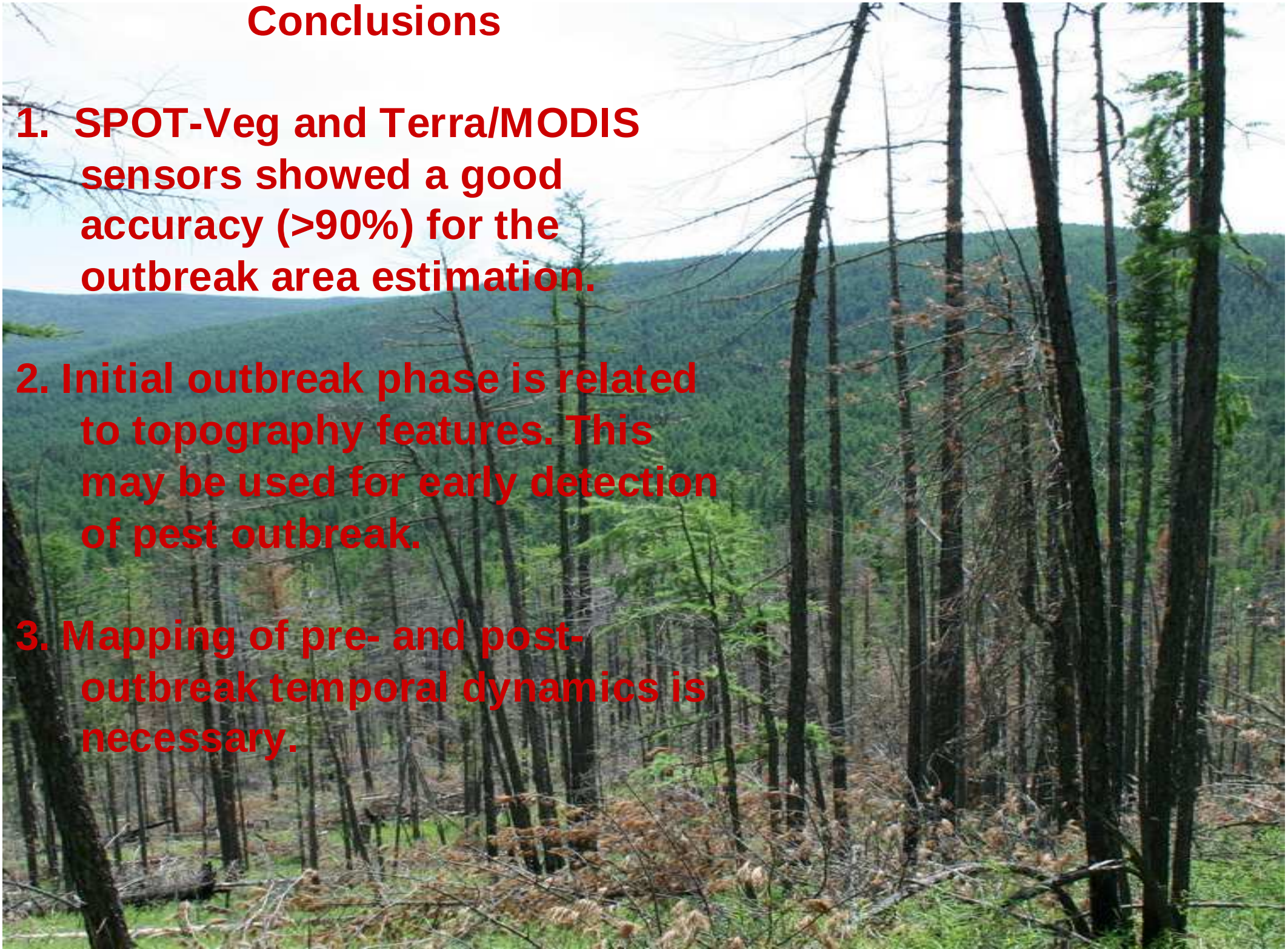


Increment dynamics of normalized damaged stands (ΔSn) with respect to altitude (Sn – normalized area of healthy stands)

3d view (not a map!) on areas damaged pests



Conclusions



1. SPOT-Veg and Terra/MODIS sensors showed a good accuracy (>90%) for the outbreak area estimation.

2. Initial outbreak phase is related to topography features. This may be used for early detection of pest outbreak.

3. Mapping of pre- and post-outbreak temporal dynamics is necessary.

ACKNOWLEDGMENTS

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СПАСИБО!
THANK YOU!