Michigan Tech Research Institute

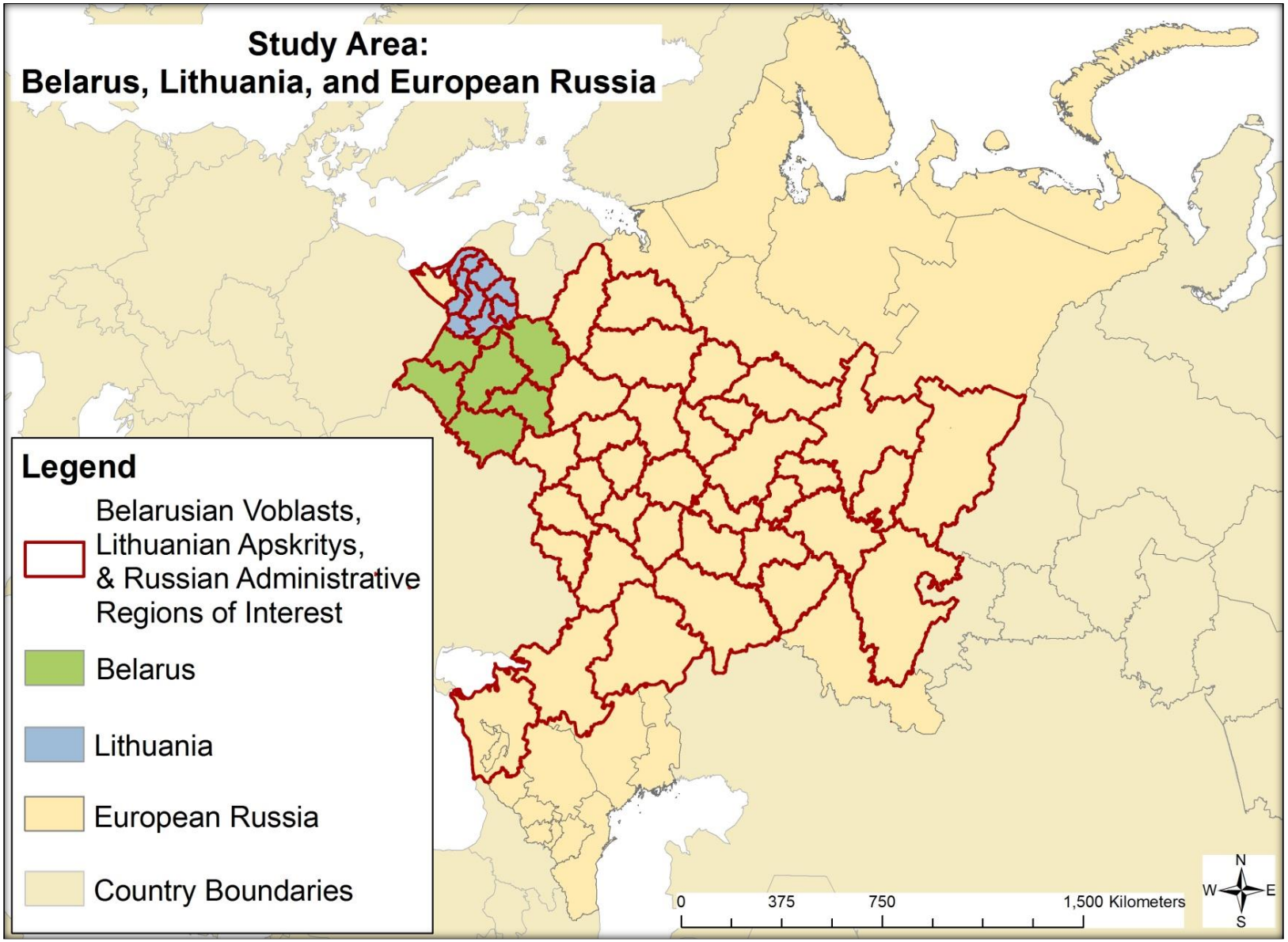
Environmental, Socioeconomic, and Institutional Impacts on Fire

Third Year Activities of

"The role of environmental, socioeconomic, institutional, and land-cover/ land-use change factors to explain the pattern and drivers of anthropogenic fires in post-Soviet Eastern Europe: a case study comparison of Belarus, European Russia, and Lithuania"

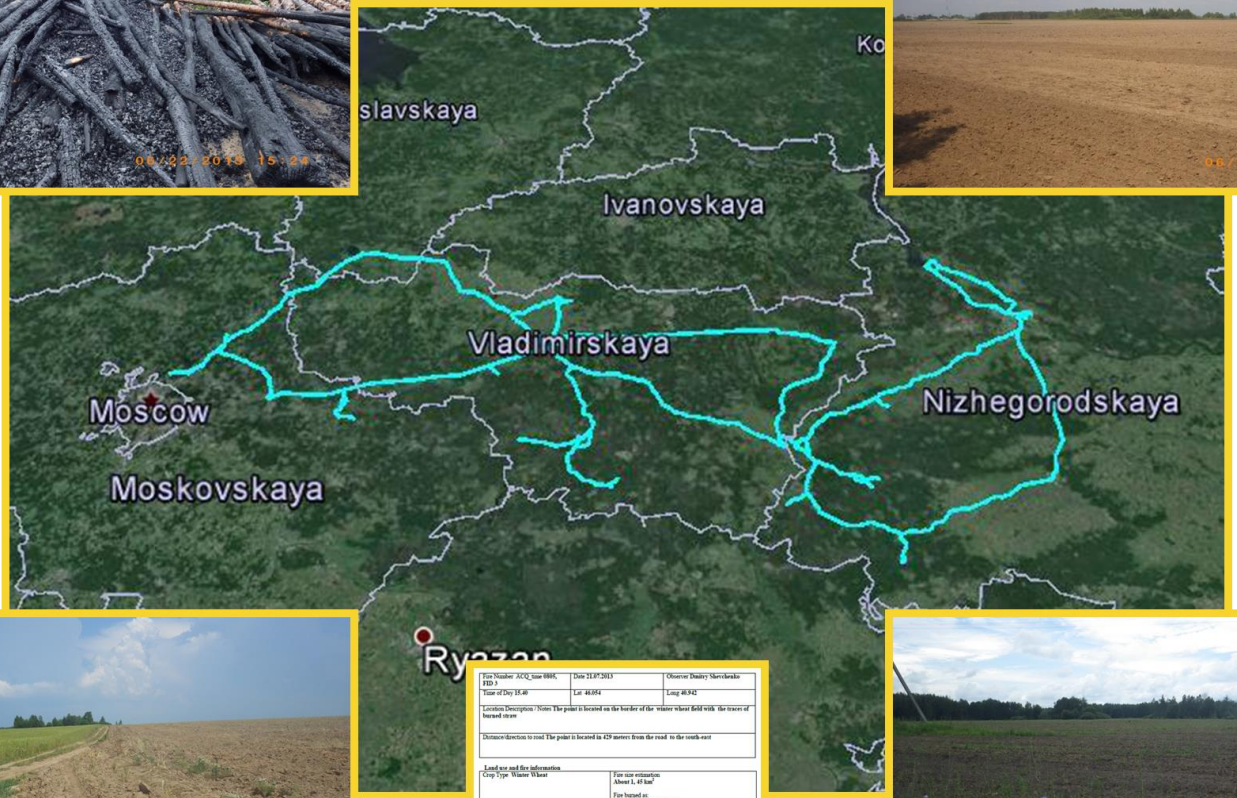
Team

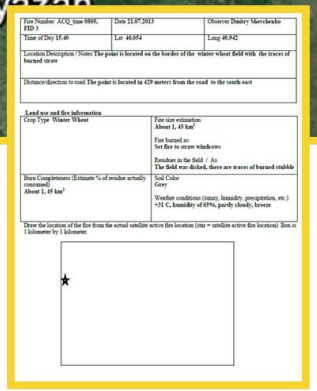
Team


Study Area:
Belarus, Lithuania, and European Russia
Legend
Belarusian Voblasts, Lithuanian Apskritys, & Russian Administrative Regions of Interest
Belarus
Lithuania
European Russia
Country Boundaries
0
375
750
1,500 Kilometers
N
W
E
S

Field Collects

2013 Field Collects





Fire Number: ACQ_time 0805, FID 3	Date 21.07.2013	Observer Dmitry Shevchenko
Time of Day 15.40	Lat 46.054	Long 40.942

Location Description / Notes The point is located on the border of the winter wheat field with the traces of burned straw

Distance/direction to road The point is located in 429 meters from the road to the south-east

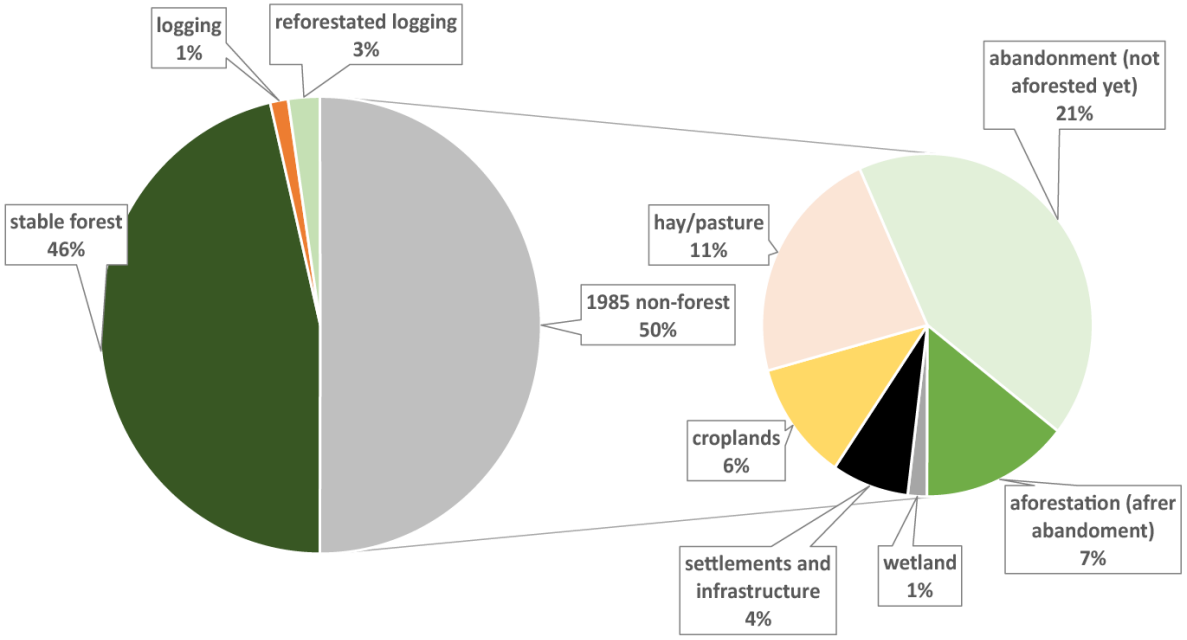
Land use and fire information

Crop Type Winter Wheat	Fire size estimation: About 1, 45 km²
	Fire burned as: Set fire to straw windrows
	Residues in the field / At: The field was disked, there are traces of burned stubble
Burn Completeness (Estimate % of residue actually consumed): About 1, 45 km²	Soil Color: Grey
	Weather conditions (sunny, humidity, precipitation, etc.): +31 C, humidity of 65%, partly cloudy, breeze

Draw the location of the fire from the actual satellite active fire location (star = satellite active fire location). Box is 1 kilometer by 1 kilometer.

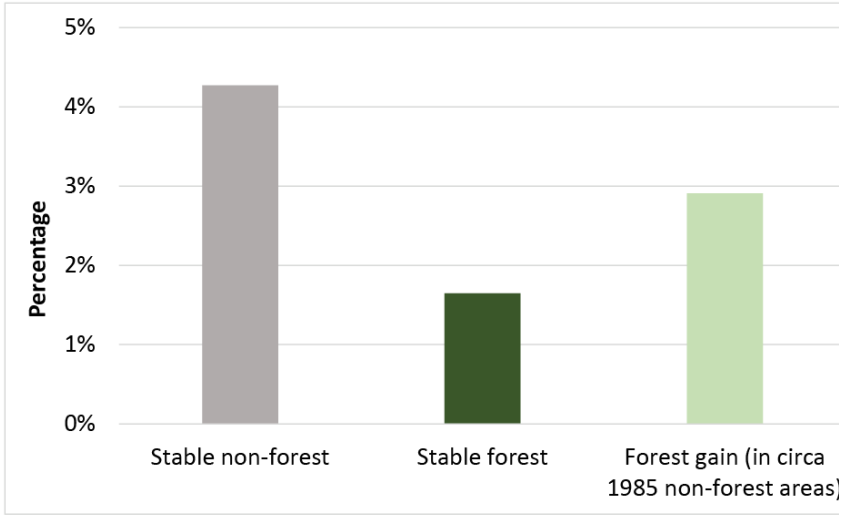
2014 Field Collects

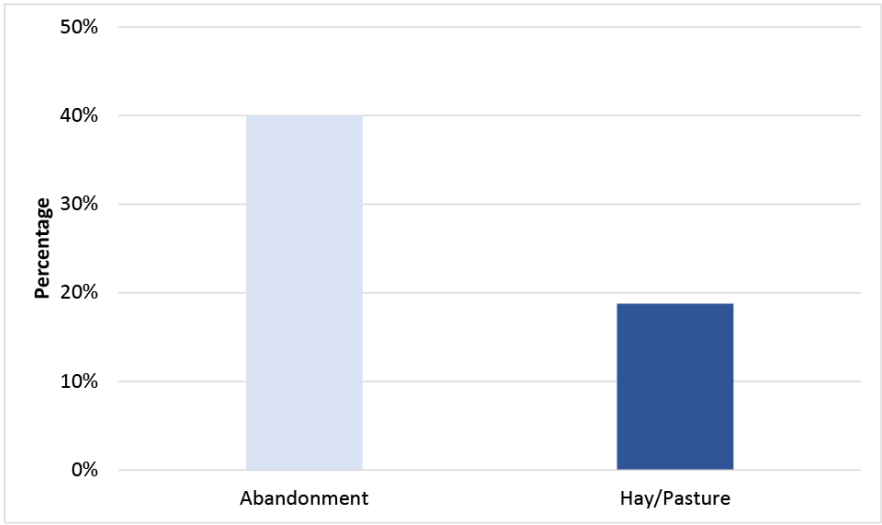
Fire regime and land abandonment in European Russia: Case Study of Smolensk Oblast



Estimation of current land use

Estimation of fire regime on abandonment and managed land: Smolensk Oblast

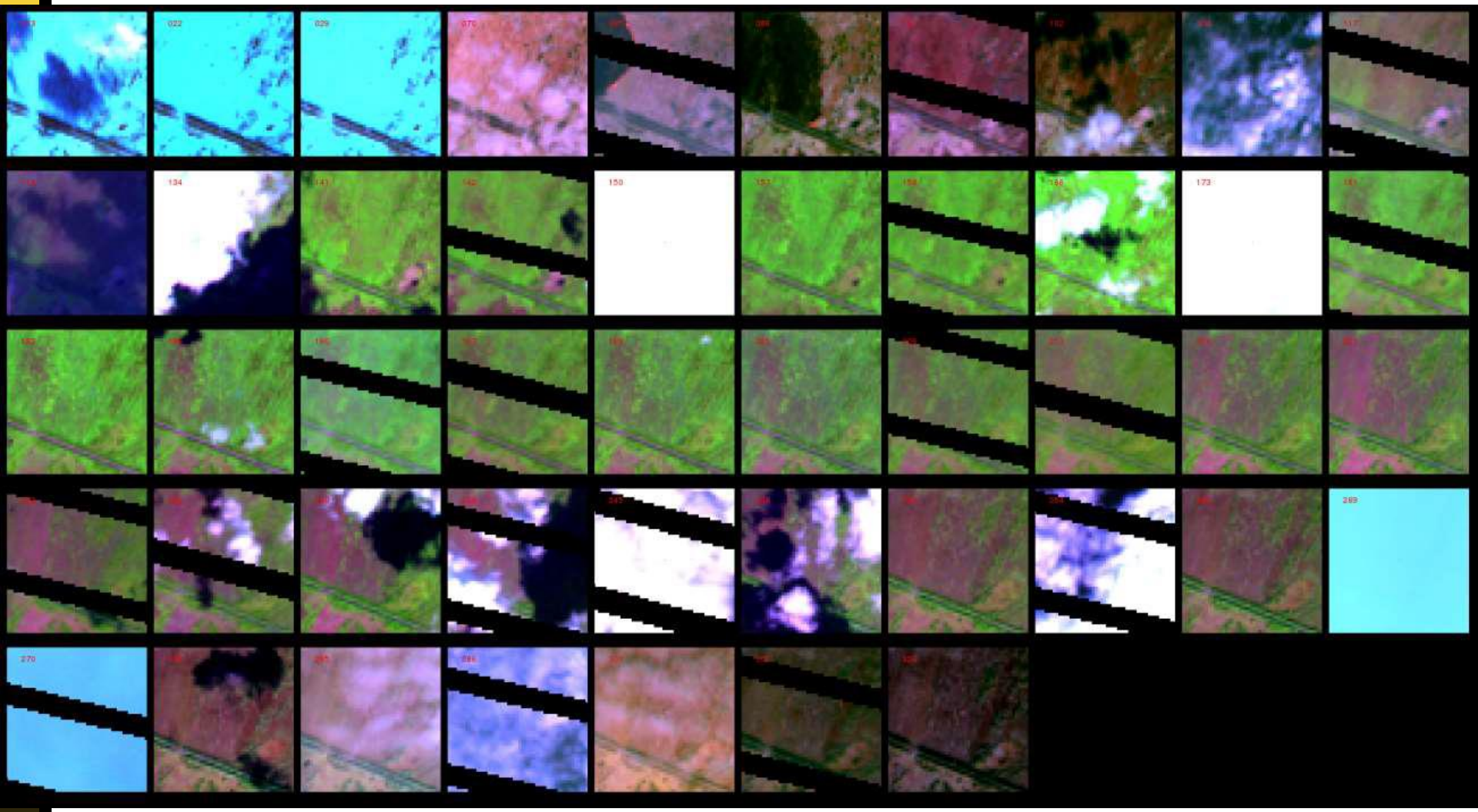




Annual burned area estimation from MODIS active fire

Annual burned area estimation from Landsat OLI Burn Scars

Landsat 7 and 8 True Color Time Series, Smolensk Oblast from 2014013 to 2014326



Environmental Research Letters

Environmental Research Letters > Volume 9 > Number 10
Alexander Krylov *et al* 2014 *Environ. Res. Lett.* **9** 105007 doi:10.1088/1748-9326/9/10/105007

Remote sensing estimates of stand-replacement fires in Russia, 2002–2011

OPEN ACCESS FOCUS ON NORTHERN EURASIA IN THE GLOBAL EARTH SYSTEM: CHANGES AND INTERACTIONS

Alexander Krylov[1], Jessica L McCarty[2], Peter Potapov[1], Tatiana Loboda[1], Alexandra Tyukavina[1], Svetlana Turubanova[1] and Matthew C Hansen[1]
Show affiliations

Tag this article PDF (1.09 MB) View article

Abstract References Metrics

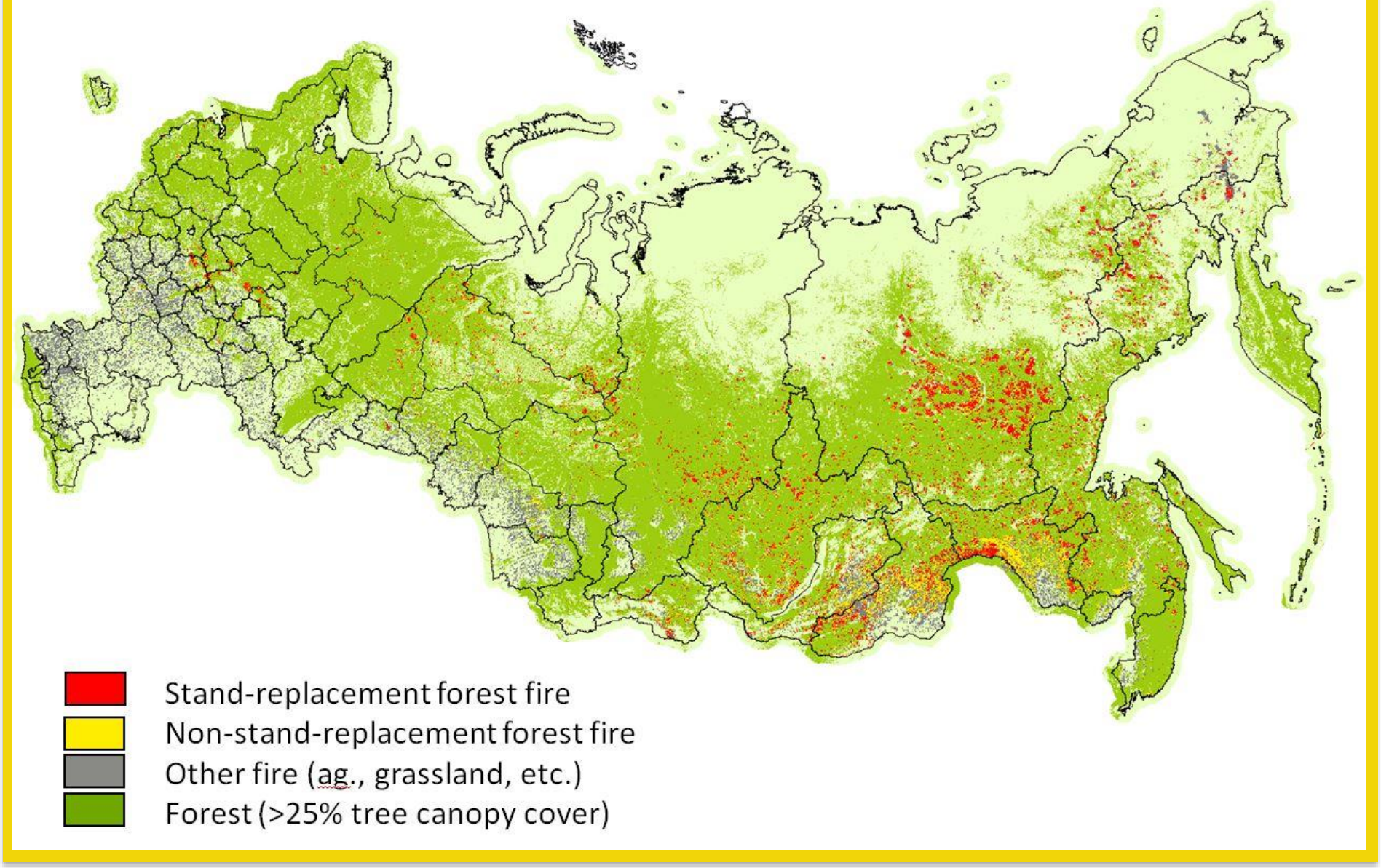
Paper

Part of Focus on Northern Eurasia in the Global Earth System: Changes and Interactions

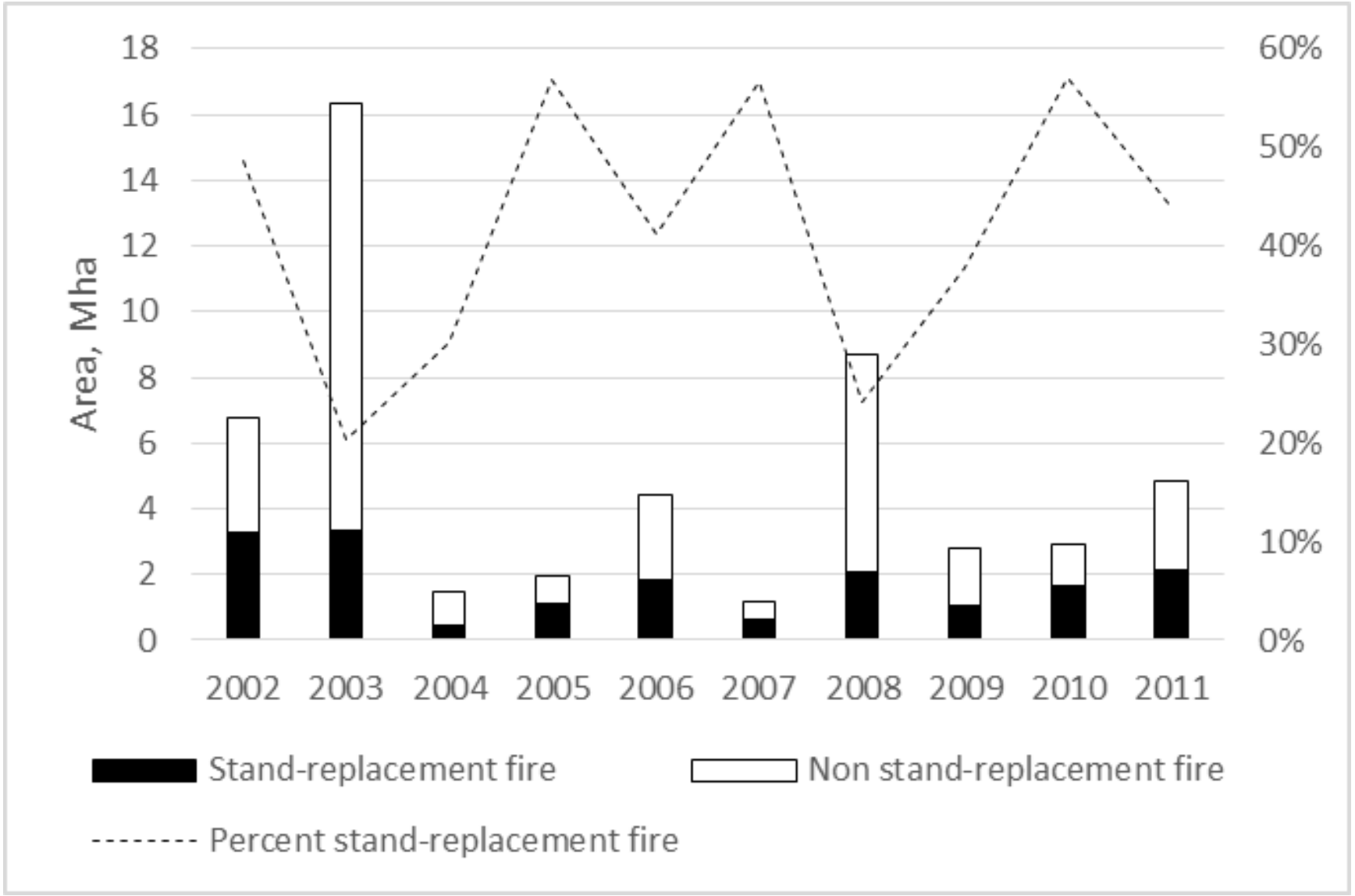
The presented study quantifies the proportion of stand-replacement fires in Russian forests through the integrated analysis of Landsat and Moderate Resolution Imaging Spectroradiometer (MODIS) data products. We employed 30 m Landsat Enhanced Thematic Mapper Plus derived tree canopy cover and decadal (2001–2012) forest cover loss (Hansen *et al* 2013 High-resolution global maps of 21st-century forest cover change *Science* **342** 850–53) to identify forest extent and disturbance. These data were overlaid with 1 km MODIS active fire (earthdata.nasa.gov/data/near-real-time-data/firms) and 500 m regional burned area data (Loboda *et al* 2007 Regionally adaptable dNBR-based algorithm for burned area mapping from MODIS data *Remote Sens. Environ.* **109** 429–42 and Loboda *et al* 2011 Mapping burned area in Alaska using MODIS data: a data limitations-driven modification to the regional burned area algorithm *Int. J. Wildl. Fire* **20** 487–96) to differentiate stand-replacement disturbances due to fire versus other causes. Total stand replacement forest fire area within the Russian Federation from 2002 to 2011 was estimated to be 17.6 million ha (Mha). The smallest stand-replacement fire loss occurred in 2004 (0.4 Mha) and the largest annual loss in 2003 (3.3 Mha). Of total burned area within forests, 33.6% resulted in stand-replacement. Light conifer stands comprised 65% of all non-stand-replacement and 79% of all stand-replacement fire in Russia. Stand-replacement area for the study period is estimated to be two times higher than the reported logging area. Results of this analysis can be used with historical fire regime estimations to develop effective fire management policy, increase accuracy of carbon calculations, and improve fire behavior and climate change modeling efforts.

PACS
93.85.Pq Remote sensing in exploration geophysics
93.30.Db Asia
89.60.Ec Environmental safety
89.60.Gg Impact of natural and man-made disasters

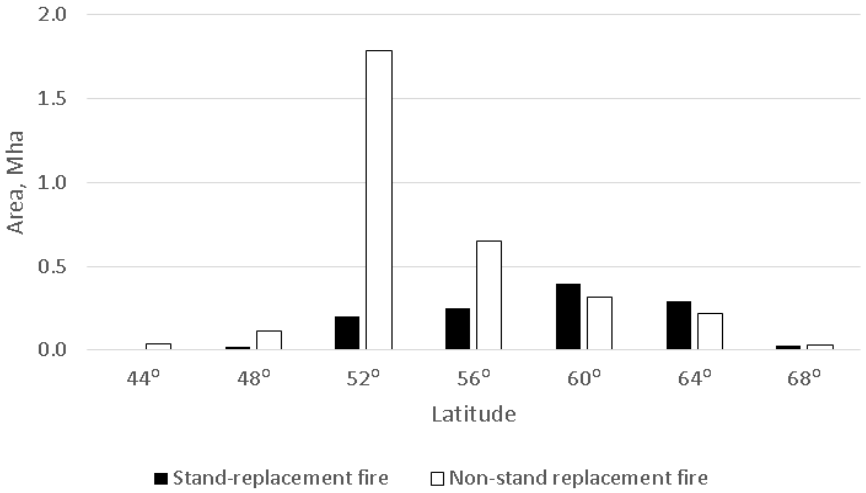
Burned area in Russia 2002-2011



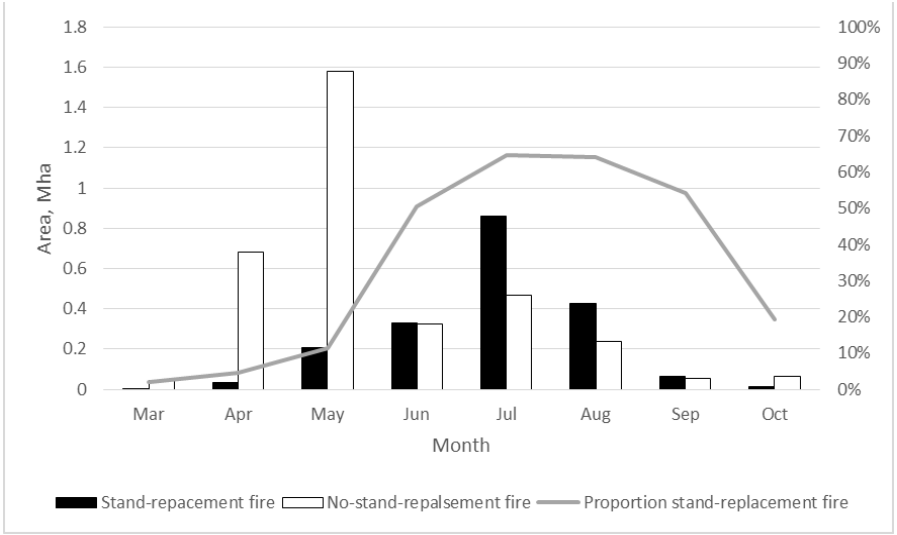
Remote sensing estimates of stand-replacement forest fires in Russia, 2002-2011



Seasonal and latitudinal dynamics of stand-replacement forest fires in Russia, 2002-2011



Stand-replacement fire proportion vs. latitude



Seasonal dynamic stand- and non-stand-replacement fire.

Land-Cover / Land-Use Change Program

Leibniz Institute of Agricultural Development in Transition Economies

Determinants of spatial patterns of non-forest (agricultural) fires in temperate European Russia: Ryazan province case study

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Alex Gittelson
Jessica L. McCarty
Alexander Krylov
Daniel Müller

*alpr@ign.ku.dk;
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"Celebrating ten years of Northern Eurasia Earth Science Partnership Initiative Research: Synthesis and Future Plans ", April 9-12, 2015, Prague, Czech Republic

Background

- Human-induced wildfires are widespread in Russia, cause economic losses, danger for humans and biodiversity, carbon emissions
- So far, there was focus on impacts of forest and peatland fires, and little is known about the determinants of anthropogenic fires on agricultural lands
- It is also unclear if massive agricultural land abandonment in Russia contributes to the spread of fires

Wildfires in Ryazan province in 2010

Source: Savostjanov http://photopolygon.com/user/1813

Burned villages in Ryazan in 2010

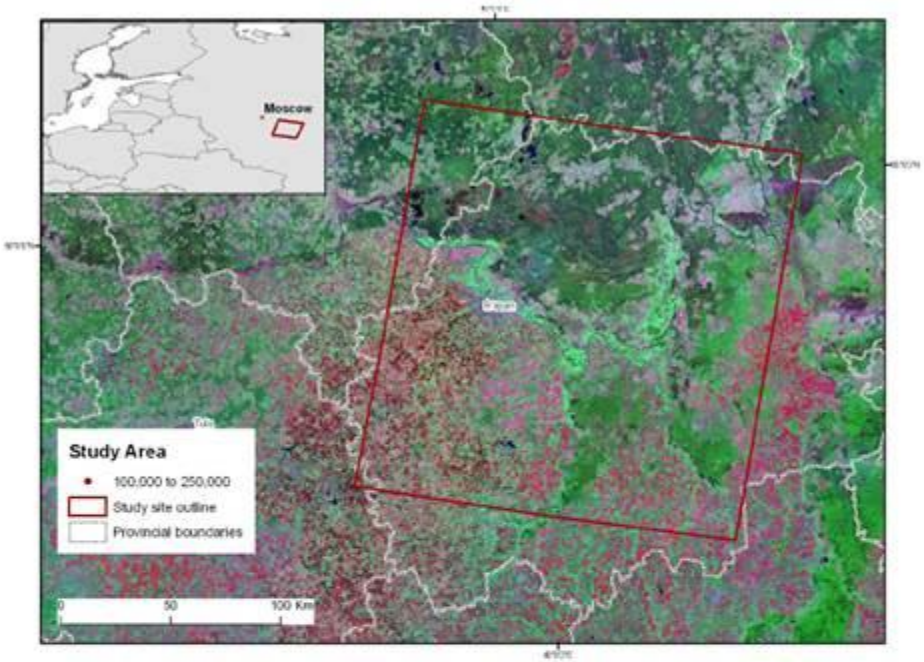
Source: drugoi.livejournal.com

Rjazan case-study

- Temperate European Russia, Ryazan province (oblast) ,forest-steppe transition zone
- ~30% forest-covered
- Rural population density

  5-31 people/km2 (1990)
- Grain yields 1.0-2.4 tones/ hectare (1987-1990)
- Number of livestock decline ~60% (1990-2000)
- Arable lands decline

  ~40% (1990-2000)
- Ongoing agricultural abandonment and re-cultivation (2000-2010)



Abandoned agricultural lands

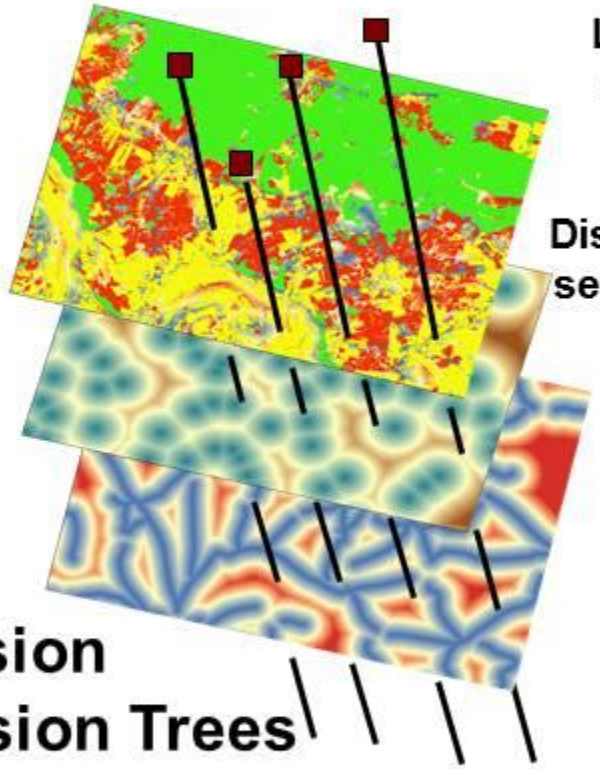
Recent re-cultivation of abandoned lands

Source: Prishchepov, A.

Input

- Remote sensing data of agricultural land-cover change (1990-2000-2010)
- MODIS-based 1-km fire product (2001-2010)
- Detailed socio-economic and environmental data

Sampling for spatially-explicit models



Modeling approach

- Spatially explicit **logistic regression modeling** and **Boosted Regression Trees**
  - Account for spatial autocorrelation and robustness to sampling
  - Dependent variable: Fires-"1", No-fires-"0" for each study period

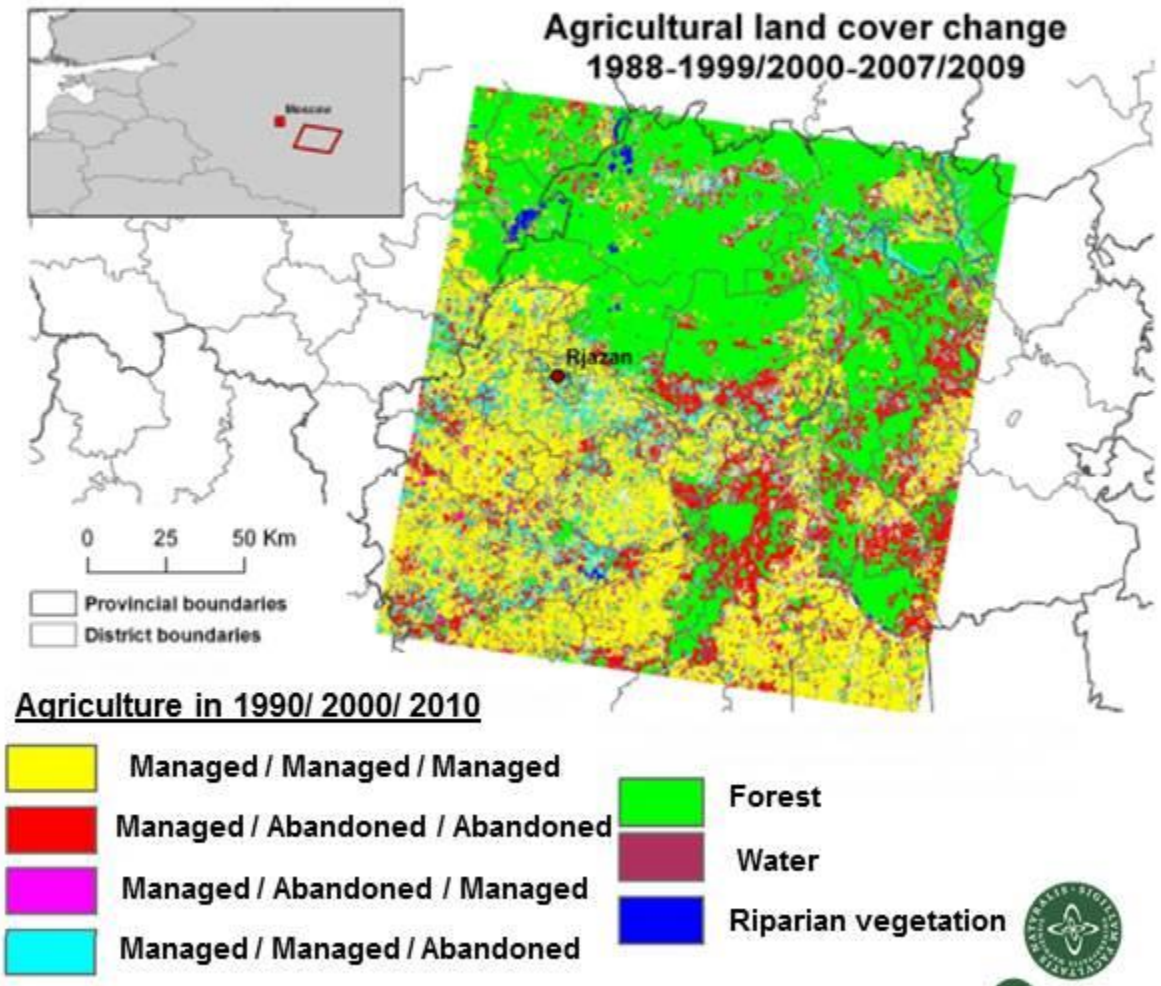
Mapping agricultural land-cover change in Rjazan

1990-2000

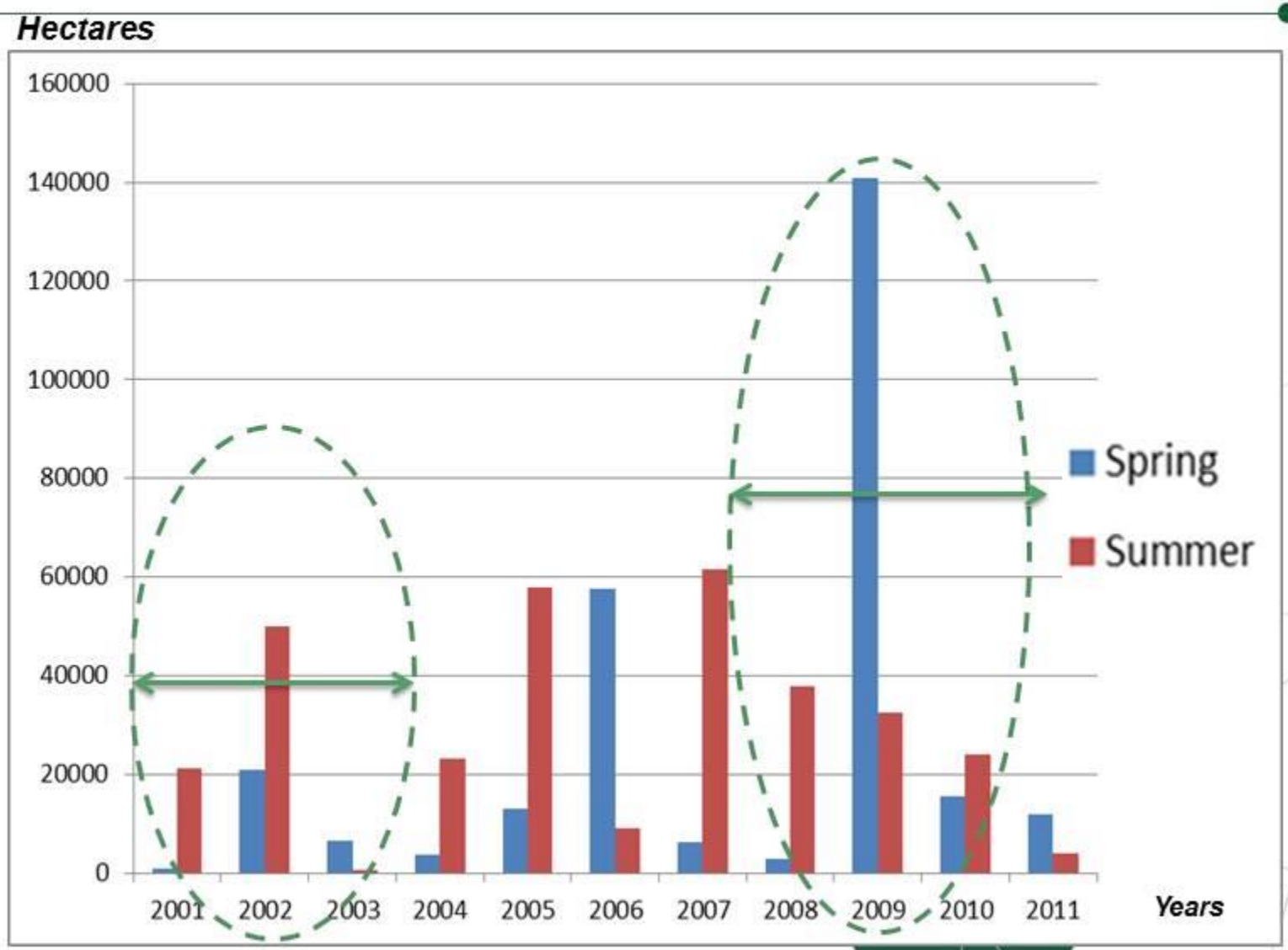
- 28% of agricultural lands (~403'000 ha), managed in 1990 were abandoned by 2000.

2000-2010

- 43% of agricultural lands(~626'100 ha),managed in 1990 were abandoned by 2010
- Only 1,7% of abandoned agricultural lands from 1990 by 2000 (~26'800 ha) were recultivated by 2010.



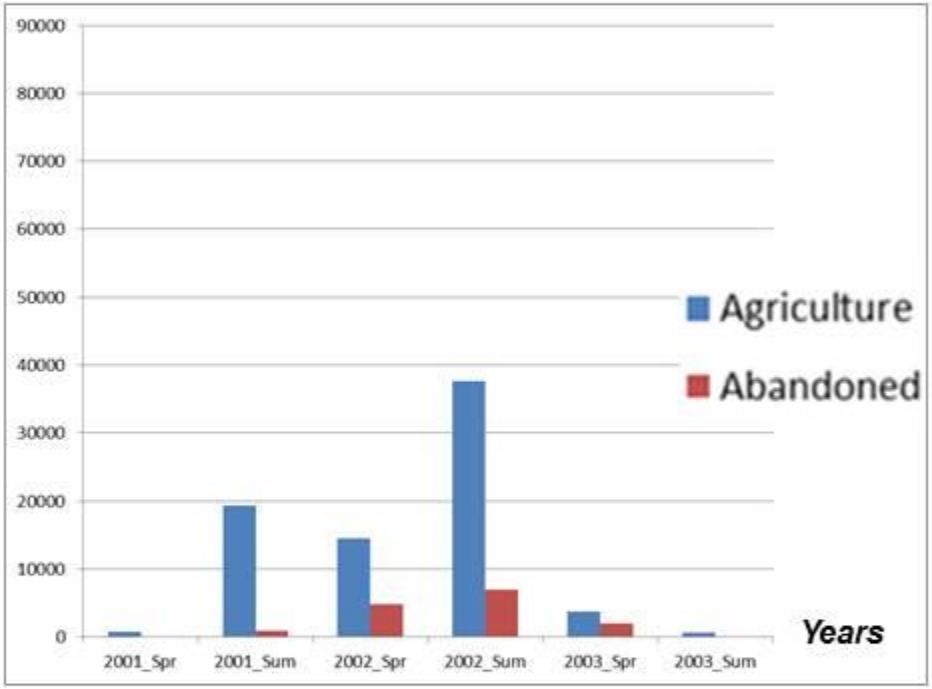
Dynamics of burned areas, 2001-2011



Contribution of abandonment to spread of fires

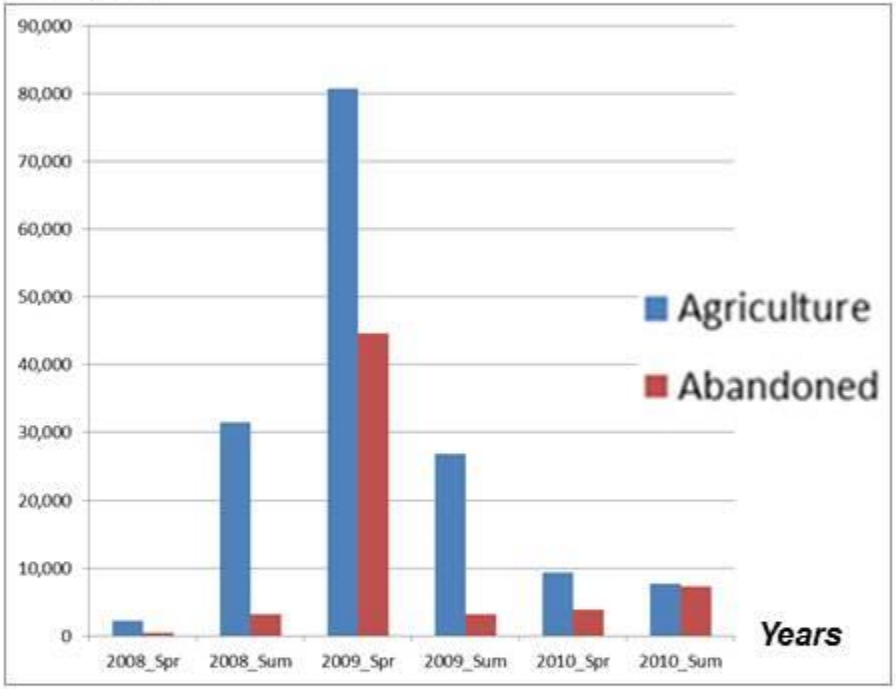
2002

Hectares



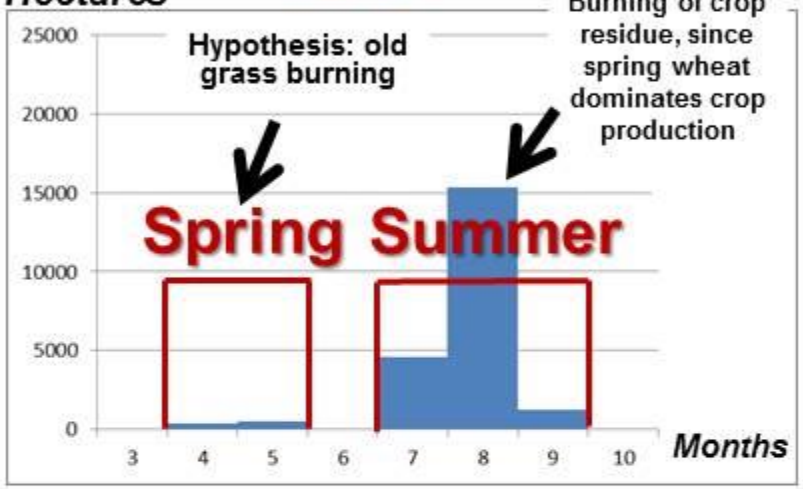
2009

Hectares

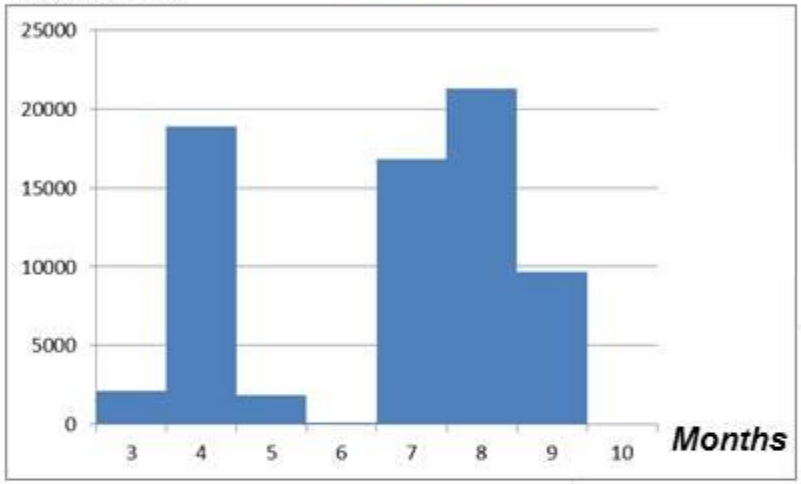


Strong seasonality of fires

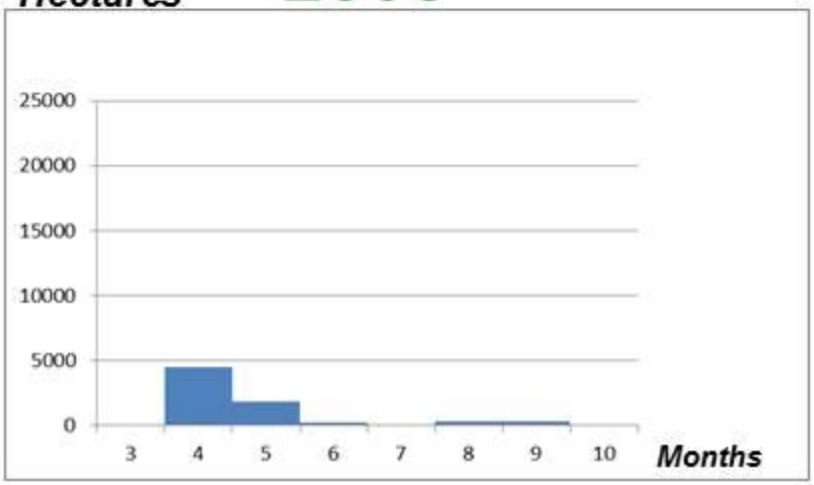
2001



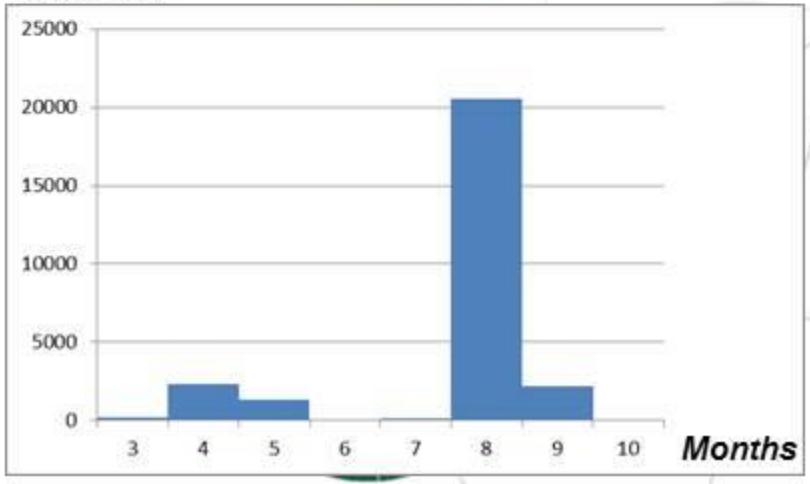
2002



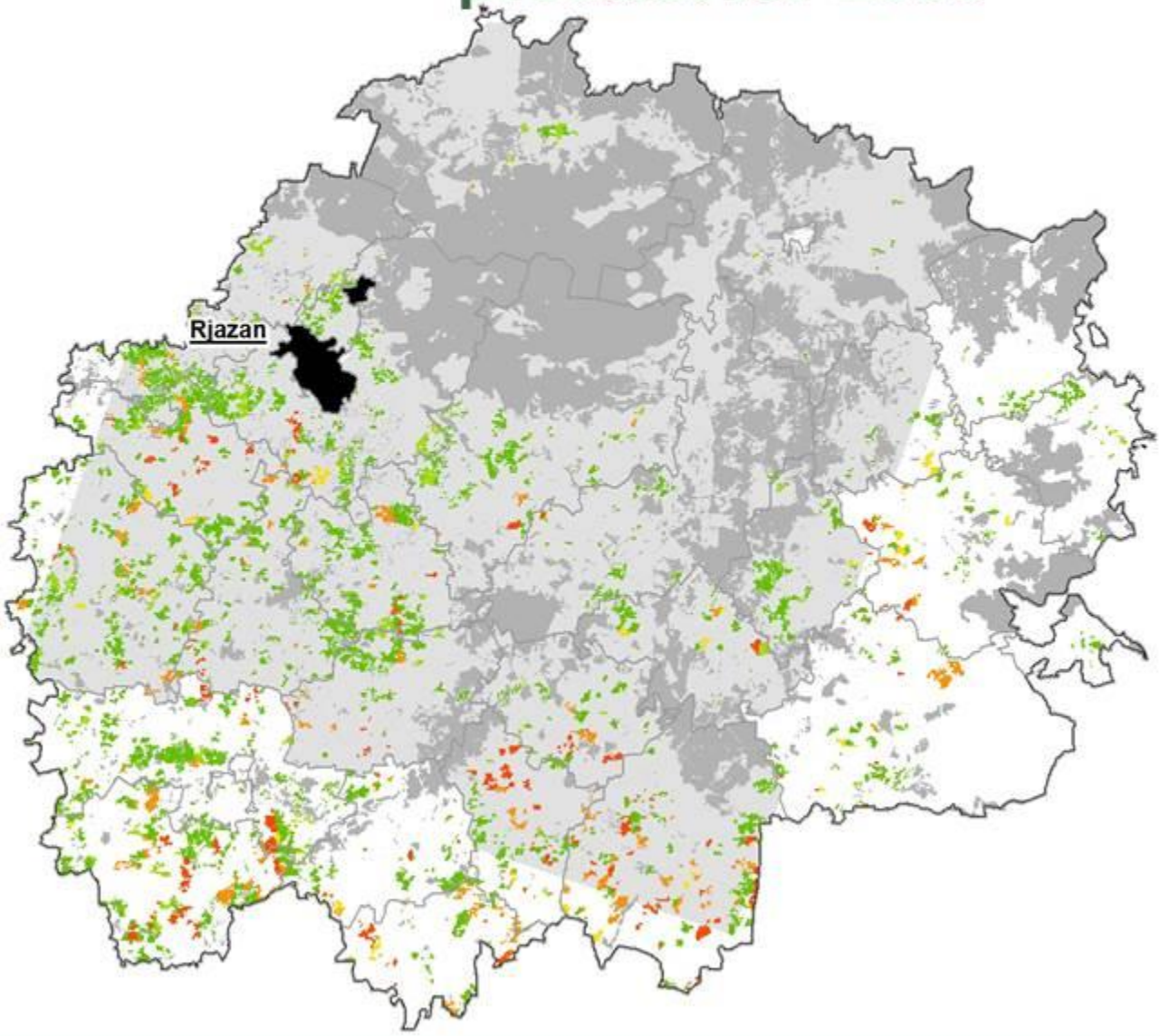
2003



2004



Example of 1-km non-forest burned area product for 2009



Assumptions

Spring fire season

- Burning on non-forested areas can be strongly associated with removal of old grass
- Burning on agricultural and fallow fields can be considered as the cheapest option of managing fields
- In spring burning of old grasses is expected to be close to settlements, in close vicinity to abandoned fields, on poorer soils, and on lands with lower yields

Assumptions

Summer fire season

- During Summer burning on non-forested areas should be strongly associated with removal of crop residue
- Burning patterns are associated with the cheapest option of managing fields, when income from agricultural activity is not sufficient to implement other measures of clearing the fields
- Burning is expected to be far from the settlements, far away of abandoned fields, on poorer soils, on lands with lower yields and lower agricultural machinery density (*if production is highly profitable, farmer would be motivated to invest in additional operations on fields*)

Variables selected after checking for multicollinearity

LULCC

- Abandoned/non-abandoned fields- 900 m2 pixel level
- Distance to abandoned plots- 900 m2 pixel level

Infrastructure

- Proximity to the settlements-900 m2 pixel level
- Proximity to the roads- 900 m2 pixel level

Demography

- Interpolated population counts- 900 m2 pixel level (1990/2000/2010)
- Share of retired people-district level
- Share of unemployed-district level
- Birth crude rate- district level

Crime

- Rate of crime-district level

Agro-environmental characteristics

- Slope- 900 m2 pixel level
- Elevation-900 m2 pixel level
- Soil types-900 m2 pixel level (categories)
- Precipitation-900 m2 pixel level
- Distance to forest edge-900 m2 pixel level (categories)

Economic performance of agriculture

- Yields-district level
- Application of mineral fertilizers-district level
- Tractors density-district level
- Livestock density-district level

Selected variables

Abbreviation	Variables
Soils	Soils, ranked 1 (worst) to 7 (best)
Pcpe	Potential evapotranspiration, mm
Fdist	Distance to forest edge, km
Gry_01/08	Average grain yields around 2001, 2008, centners/ha
GryCh_9001/0108	Average grain yields change from 1990 to 2001/ from 2001 to 2008, centners/ha
AgAb_9000/9010	Abandoned (coded "1")/ non-abandoned fields (coded "0") from 1990 to 2000/ from 1990 to 2010
DAb_9000/9010/0210	Distance to plots abandoned from 1990 to 2000/ from 1990 to 2010/ from 2000 to 2010, km
Idwp_02/10	Interpolated population densities from settlements based on Census 2002, 2010, people/ km2
IdwpCh_8802/0210	Interpolated population densities change from 1988 to 2002, from 2002 to 2010, people/ km2
Dsettl_02/10	Distance to settlements populated in 2002, 2010, km
D500_02/10	Distance to settlements >=500 people in 2002, 2010, km

Results: spring non-forest burned areas

Abbreviation	2002	2009
Adj. R2	0.135	0.174
AUC	0.688	0.698
Soils	+	
Pcpe	+	
Fdist	+	
Gry_01/08		+
GryCh_9001/0108	+	+
AgAb_9000/9010	-	-
DAb_9000/9010/0010	-	-
ldwp_02/10		-
ldwpCh_8802/0210	+	
Dsettl_02/10	+	
D500_02/10		

Results: summer non-forest burned areas

Abbreviation	2002	2009
Adj. R2	0.135	0.414
AUC	0.688	0.828
Soils	+	+
Pcpe		+
Fdist	+	+
Gry_01/08	+	+
GryCh_9000/0108		+
AgAb_9000/9010	-	-
DAb_9000/9010/0010	+	+
ldwp_02/10	-	-
ldwpCh_8802/0210	+	
Dsettl_02/10	+	
D500_02/10		

Spring fires were strongly associated with:

2002

Human activity

- Close to still populated settlements and maintained fields (better soils)
- On lands with good lands with better agricultural endowment. Prishchepov et al. 2013 Land Use Policy showed that lands with poorer soils were predominately abandoned

Marginalization of agriculture

- In areas with yields and population decline and in close proximity to abandoned fields

2009

Human activity

- Close to settlements with high population density
- On better soils, on managed fields with higher yields
- In close proximity to recently abandoned fields (from 2000 to 2010)

Summer fires were strongly associated with:

2002

Crop production activity

- On lands with higher yields and with better soils, further away of settlements (spatial allocation of fields for large-scale farming), further away of abandoned fields and forest edge, and with low population density

Social marginalization

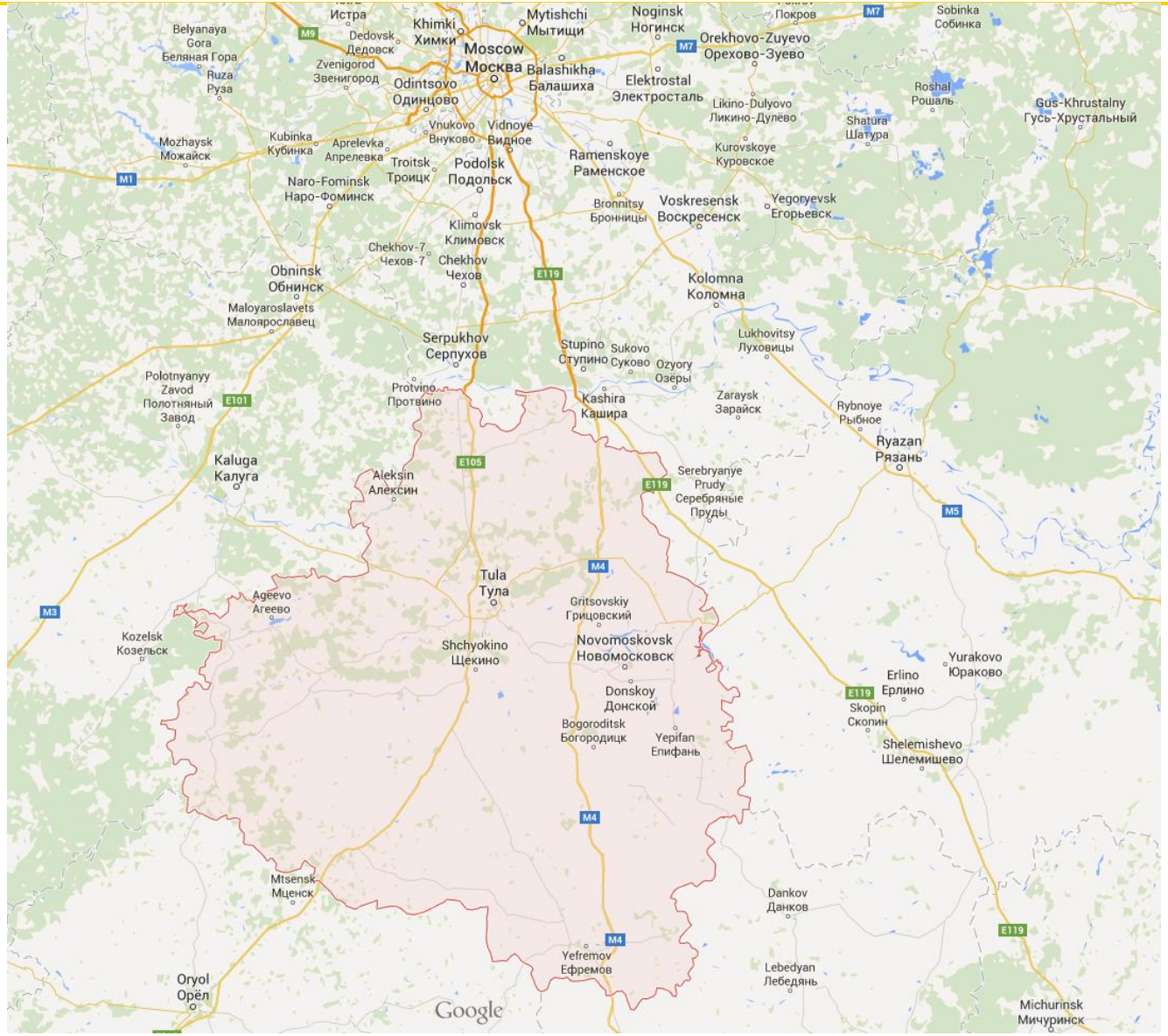
- In areas, which experienced decline in population density

2009

Crop production activity

- On lands with higher yields and with increased yields since 2000, on better soils, further away of settlements (spatial allocation of fields for large-scale farming), further away from abandoned fields and forest edge, and where population density was lower

Farmer Outreach in Tula, February 2014

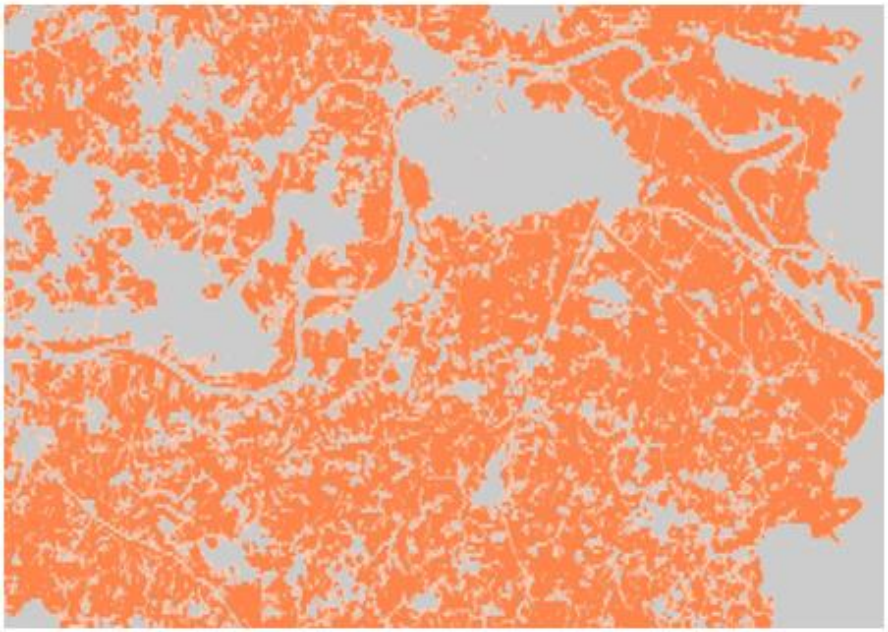


CLIMATE AND CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

BELLONA

Farmer Input vs. Remote sensing data

- 80+ farmers insisted fire detections were small scale fields at dachas
- Shared MODIS active fires on high resolution field boundary maps – 70% of fields had fire detections



Map based on field boundaries

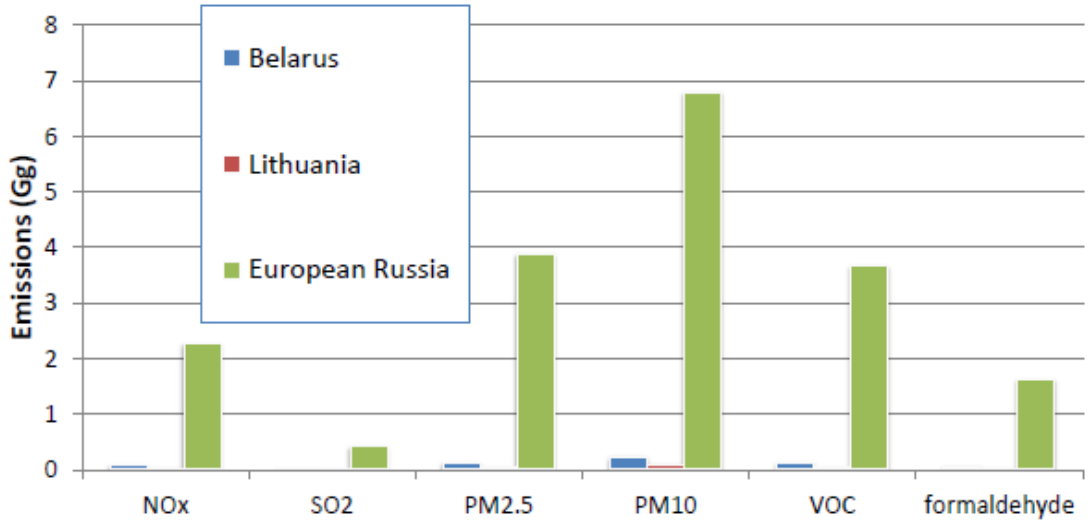
Why Burn The Residues?

Wheat field in Volovo, Tula Oblast, Russia

Picture by Ekaterina Sotova: https://www.flickr.com/photos/27484170@N04/5993625404

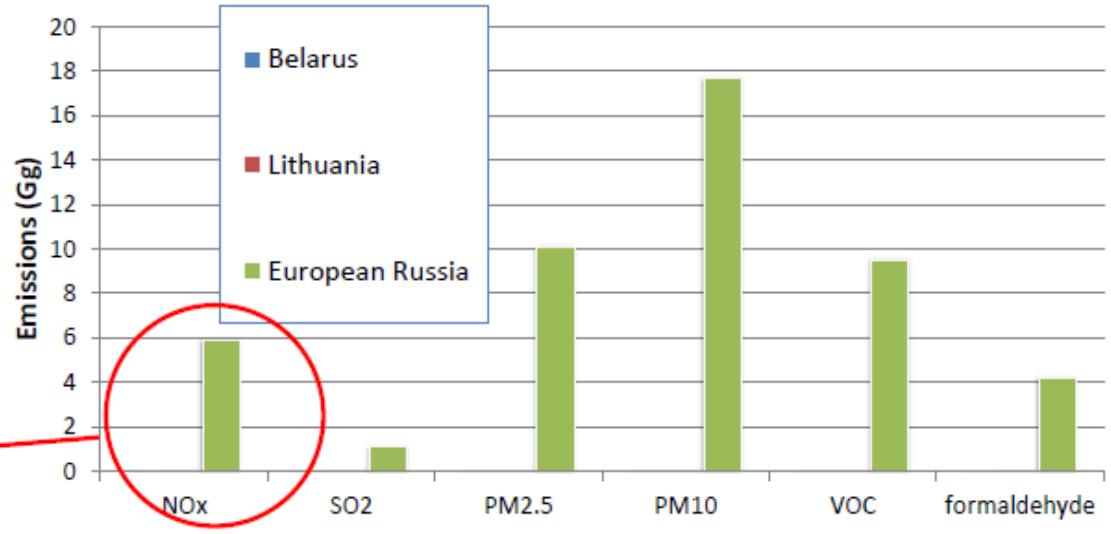
- Very good harvest of grains
- Very thick stubble
- Narrow window for sowing

Russia is main source of cropland fire emissions.



Selected emissions (NOx, SO2, PM, VOC, and formaldehyde) from cropland burning (LC = 12 in IGBP classification schema) as quantified from1 km MCD14ML collection 5 MODIS active fire data; all emissions in Gg.

Selected emissions (NOx, SO2, PM, VOC, and formaldehyde) from cropland burning (LC = 12 in IGBP classification schema) as quantified from 500 m MCD45A1 collection 5.1 MODIS burned area product; all emissions in Gg.



*Equivalent to **10% of NOx** emissions **from all sectors in Lithuania** (source: European Environment Agency, http://bit.ly/1CkF72l)*

Air Quality: Smolensk Oblast

	Fire Data Source	Burned Area (ha)	CO2	CH4	CO	NOx	SO2	PM2.5	PM10
Spring	MODIS Active Fire Cropland Burning	22,275	59	0.07	1.95	0.08	0.02	0.14	0.25
	MODIS Active Fire Grassland/Pasture Burning	4,950	185	1.04	16.14	0.09	0.04	1.77	3.45
	Landsat/Field Validated Pasture Burn Scars	169,000	6,318	35.6	550.98	3.06	1.31	60.4	117.95
Fall	MODIS Active Fire Cropland Burning	1,825	4.84	0.01	0.16	0.01	1.27E-03	0.01	0.02
	MODIS Active Fire Grassland/Pasture Burning	325	12.15	0.07	1.06	0.01	2.51E-03	0.12	0.23
	Landsat/Field Validated Pasture Burn Scars	1,440	53.83	0.30	4.69	0.03	0.01	0.51	1.01

Thank you!
Спасибо!