APPLICATION OF REMOTELY SENSED DATA TO THE MANAGEMENT OF FIRE EVENTS IN POLAND

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MOTIVATION

Statistics provided by the European Join Research Centre (JRC) show that Poland is a third European country after Portugal and Spain in number of fires reported annually. The National Forest Fire Information System (KSIPL) functioning currently in Poland is based explicitly on the ground data collection. The Earth Observation data, which is recognized as valuable source of information about fire event is not included into the existing system.

DATA

- MODIS Active Fire and Burned area
- AVHRR/NOAA and ATSR/Envisat
- Fire Radiative Power (FRP) from MODIS Terra/Aqua
- FRP SEVIRI / Meteosat Second Generation (MSG)
- Fire ground data from the National Forest Fire Information System

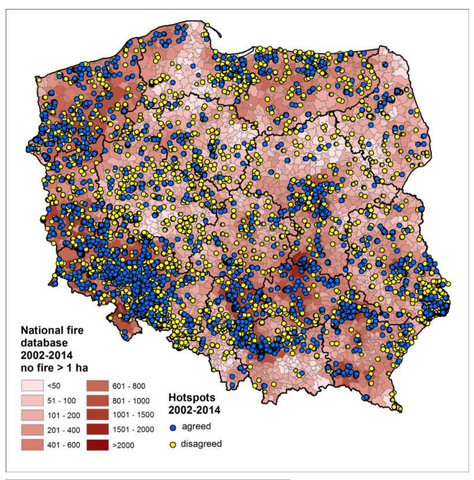
AIMS & OBJECTIVES

The main aim of this study was to examine and assess the suitability of remotely detected fires for providing additional information on the fire regime in Poland.

Research objectives :

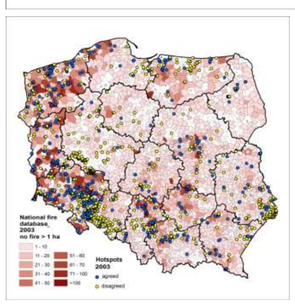
1) detection of fires using active fire products
2) validation of hotspots against ground-based fires reported in the National Forest Fire Information System (KSIPL),
3) dynamics of post-fire vegetation regrowth
4) assessment of fire intensity based on MODIS Fire Radiative Power (FRP)
5) calculation of amount of biomass consumed by wildland fire of wetlands using 'top-down' and 'bottom-up' approach
6) calculation of emissions from burning biomass

VALIDATION OF HOTSPOTS AGAINST NATIONAL GROUND DATA

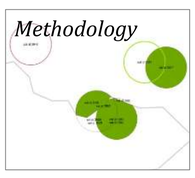


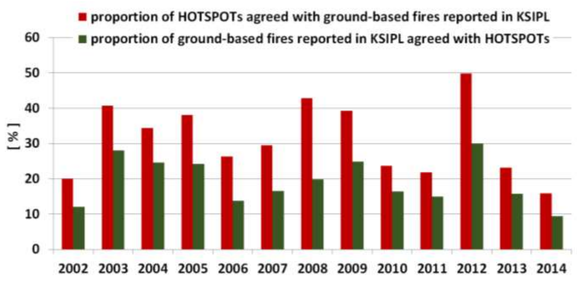
On average **32,3%** of the remotely detected fires were recorded in the ground-based fire database over the period 2002-2014.
Avg. **20,2%** of the fires > 1ha recorded in the national ground database were detected by satellites.
Avg. **68%** of detected hotspots was not reported in the ground database - high commission error.

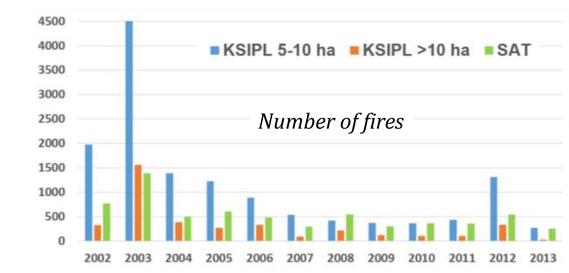
The satellites has missed the vast majority of vegetation fires.

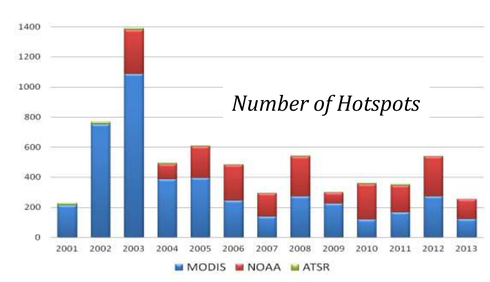


Omission & Commission errors







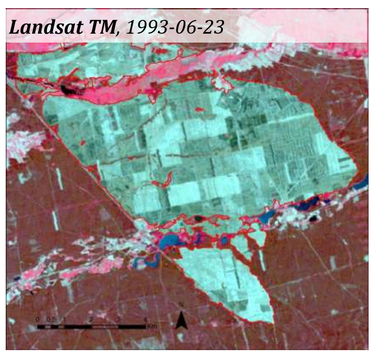


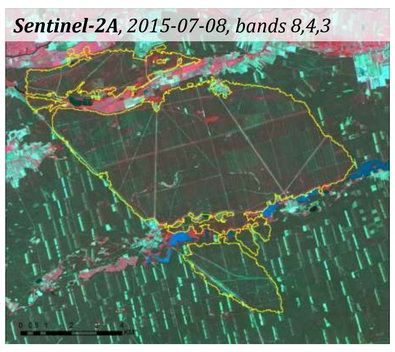
Challenges

1) The high commission error is more likely to be related to the accuracy and completeness of the national fire database.
2) Lack of the precise information on the position of fires (X, Y) on the ground influence reliability of validation - comparison was performed on the bases of administrative divisions NUTS3 taking into account the information on the time of fire alarm, time of intervention and the duration of a fire.
3) The high omission error is mainly due to the limitation of remote detection of fires caused by cloud, smoke and small fire size dominate in Poland.
4) The national fire database requires standardization of the procedure of fires reporting to avoid further error propagation.

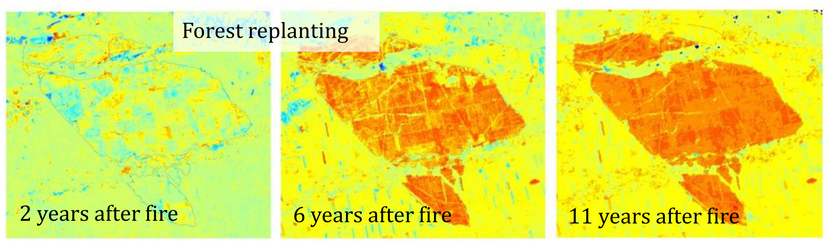
BA MAPPING & POST-FIRE VEGETATION RE-GROWTH

Puszcza Notecka
Forest fire 10.08.1992
BA= 5662 ha (based on dNBR)



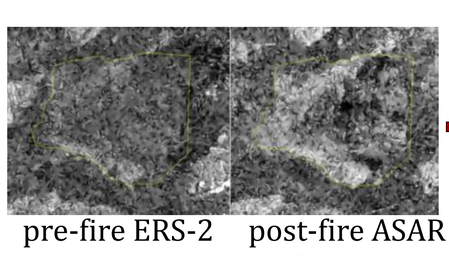


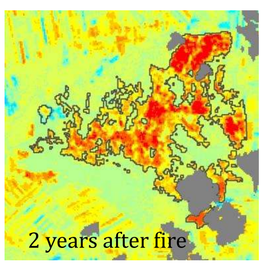
Post-fire re-growth: *Percentile Rank Order Differentiation* (PROD) method based on Normalized Difference Vegetation Index (NDVI)

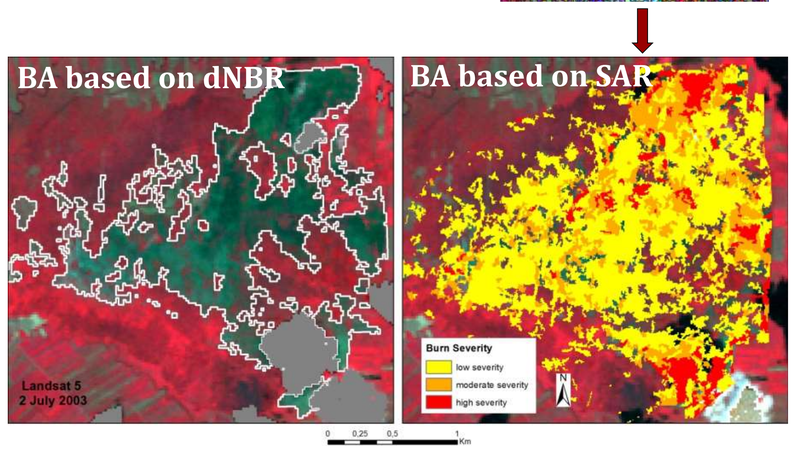


Forest fire near Kadzidło
24.05.2014 BA= 90 ha

Biele Suchowolskie
wetlands fire 28.08-12.09.2002
BA= 1130 ha (based on dNBR)







FIRE INTENSITY AND BIOMASS CONSUMPTION

Fire Radiative Power (FRP) provides information on the measured radiant heat output of detected fires. The amount of radiant heat energy liberated per unit time is thought to be related to the rate at which fuel is being consumed (*Wooster 2005*).
FRP is measured in MW (MegaWatts).

Fire Radiative Energy (FRE) for the burned area (hotspot cluster) was calculated by summing the FRP values multiplied by the time difference between acquisitions.

$$FRE_{s,c}(T2) = \sum_{i=0}^{N} \frac{(FRP_{s,c,t_{s,i}} + FRP_{s,c,t_{s,i+1}})(t_{s,i+1} - t_{s,i})}{2}$$

Where, $FRP_{s,c,t} = \sum_{x \in c} FRP_{s,x,t}$

($t_{s,i+1} - t_{s,i}$) – time difference between satellite acquisition
S – Terra and Aqua

BIOMASS consumption

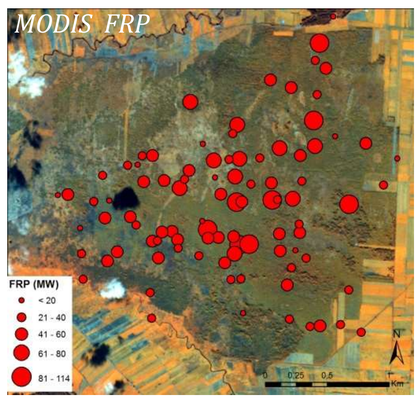
Top-down approach: the dry biomass consumption from fire was estimated using an FRE-based combustion factor 0.368 kg/MJ (*Wooster et al.*, 2005) and 0.60 kg/MJ *(Konovalov et al. , 2014).*

Bottom-up approach: M=BA x FL x CC
BA – burned area [m2]
FL – Fuel load [kg (biomasy) / m^2]
CC - combustion completness [kg (burned fuel) / kg (available fuel)]

MODIS FRP by land cover type (2001-2013)

LC type	No of cases	Mean	Sum	SD	Min	Max	Q25	Median	Q75
Discontinuous urban area	399	27,6	11029	30,0	4,4	344,4	10,9	18,3	32,1
Arable land	2471	27,9	68954	31,1	4,9	437,3	12,4	19,2	31,2
Grassland	658	36,3	23859	39,4	4,9	505,2	15,9	24,8	40,9
Heterogeneous agricultural area	215	30,9	6644	31,5	5,7	240,4	14,2	21,5	33,2
Forest	511	35,1	17932	35,4	6,0	299,8	14,2	23,4	40,4
Wetlands	142	45,1	6407	30,7	8,1	231,8	24,7	39,7	53,8

FIRE in wetlands



Carbon losses from above ground biomass and from burning peat soil
BA = 1130 hectares
Avg. peat depth burned away = 30 cm
Bulk density – avg. 0,175 [g/m3]

Carbon loss

	Top-down		Bottom-up		
	Woostr et al. 2005	Konovalov et al. 2014	Aboveground biomass	Belowground biomass	Total
Carbon loss (ton)	44891	73191	34742	110433	145176

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