Research at the Institute of Geodesy and Cartography (Warsaw) and at the Geospatial Sciences Center of Excellence (GSCE), South Dakota State University (USA)

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Remote Sensing Center
Institute of Geodesy and Cartography
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- **Remote Sensing Centre** has a long tradition of using Earth Observation data starting in 1976.
- Activities cover the broad range of research and application-oriented works related to the use of various satellite images and products for deriving information on environmental aspects, including…

AGRICULTURE: yield forecasting; drought detection; crop mapping & status; estimates of land-atmosphere exchanges; soil moisture monitoring

WETLANDS: hydrology and status

BIOENERGY: assessment & monitoring of resource base

NATURAL HAZARDS: floods, forest fires, landslides

LAND COVER / LAND USE: mapping and dynamics

IGiK

ESA PECS Project 1: “Application of remotely sensed data for transboundary water resource management” (Water project No. 98098)

To develop the method supporting the management of surface waters by integrating Earth Observation using land cover / land use data into specialized water quality and agri-economical models.

ESA PECS

Plan for European Cooperating States

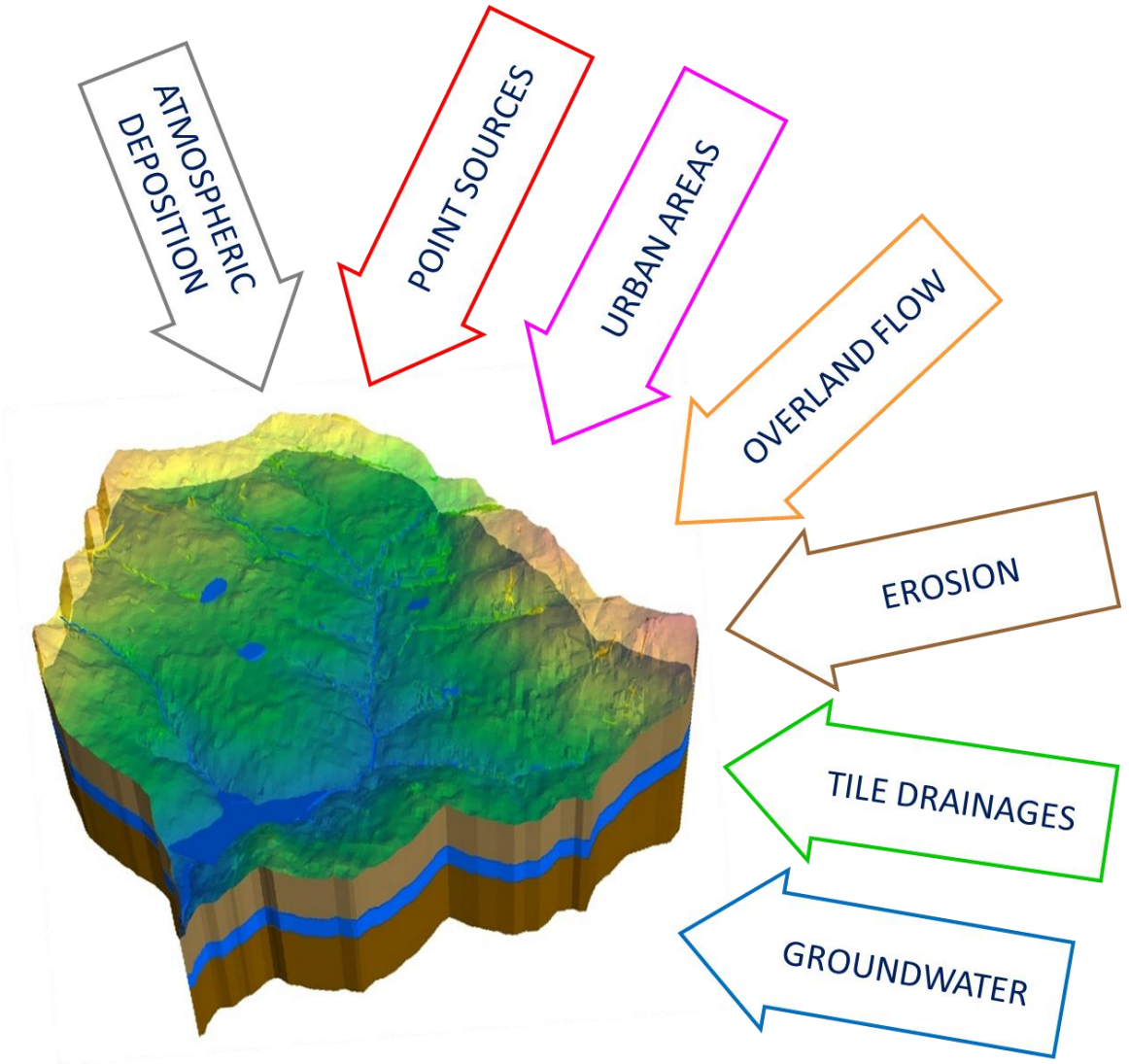
esa

Modelling Nutrient Emissions in River Systems

Nutrient emission model (Nitrogen and Phosphorous) addressed to studies of water quality in a catchment scale.

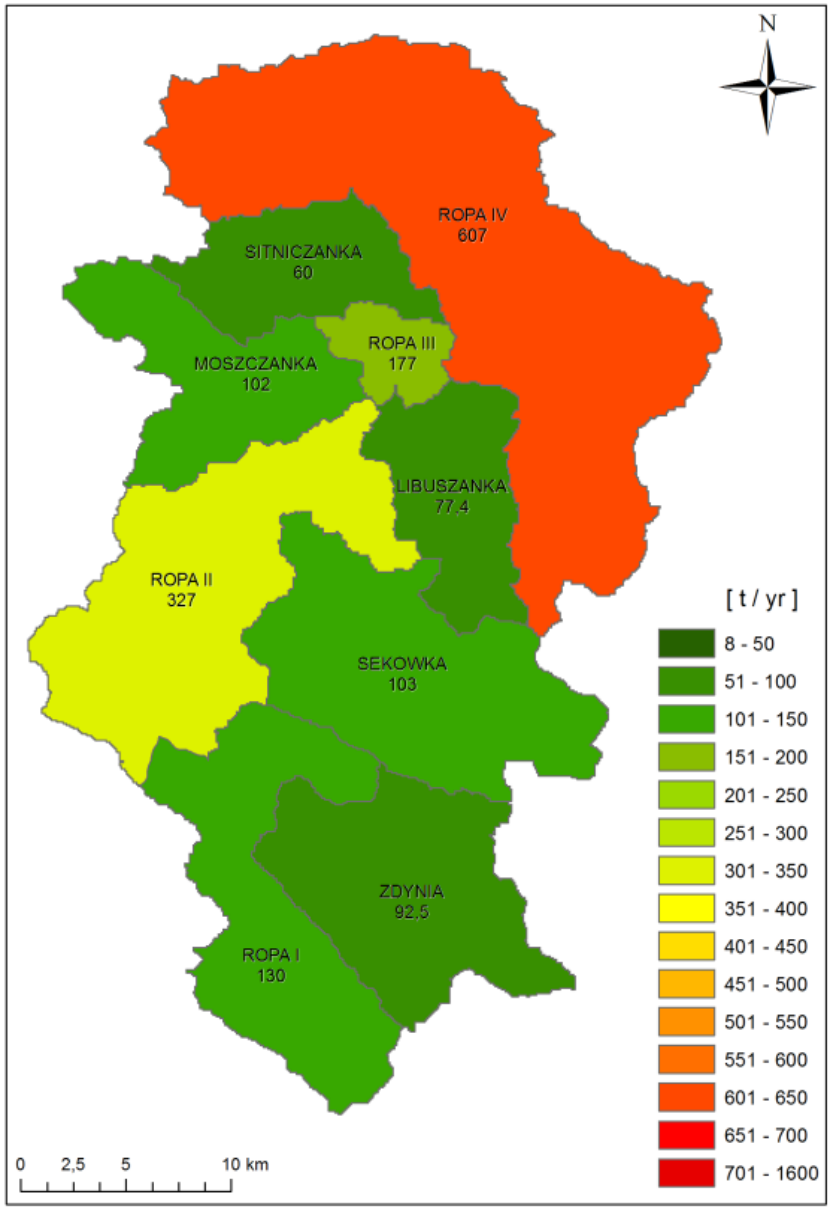
Main goals of MONERIS:

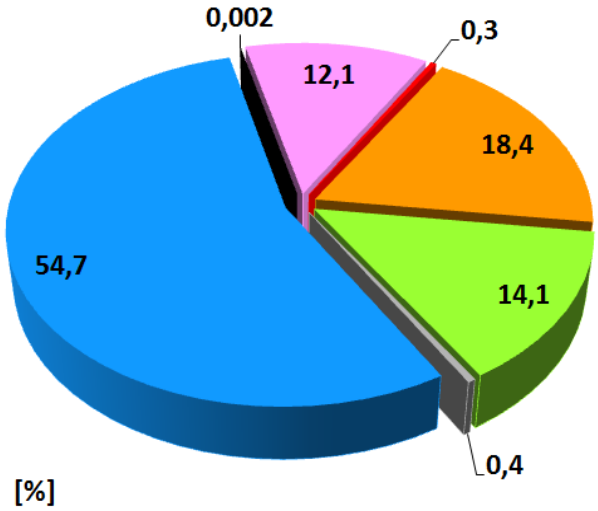
- **Identify the sources and pathways** of nutrient emissions (loads in: t/yr, t/ha·yr^{-1}, %)
- Analyze of **transport & retention** of nutrients in river system
- **Simulate scenarios** as framework for development of management alternatives

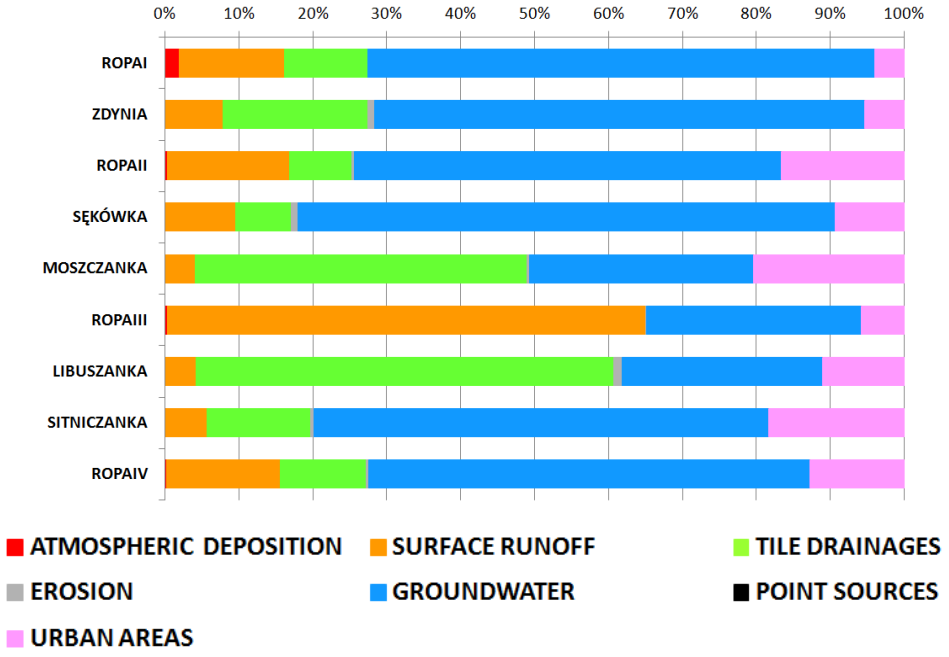


7 PATHWAYS FOR NUTRIENT EMISSION INTO SURFACE WATERS

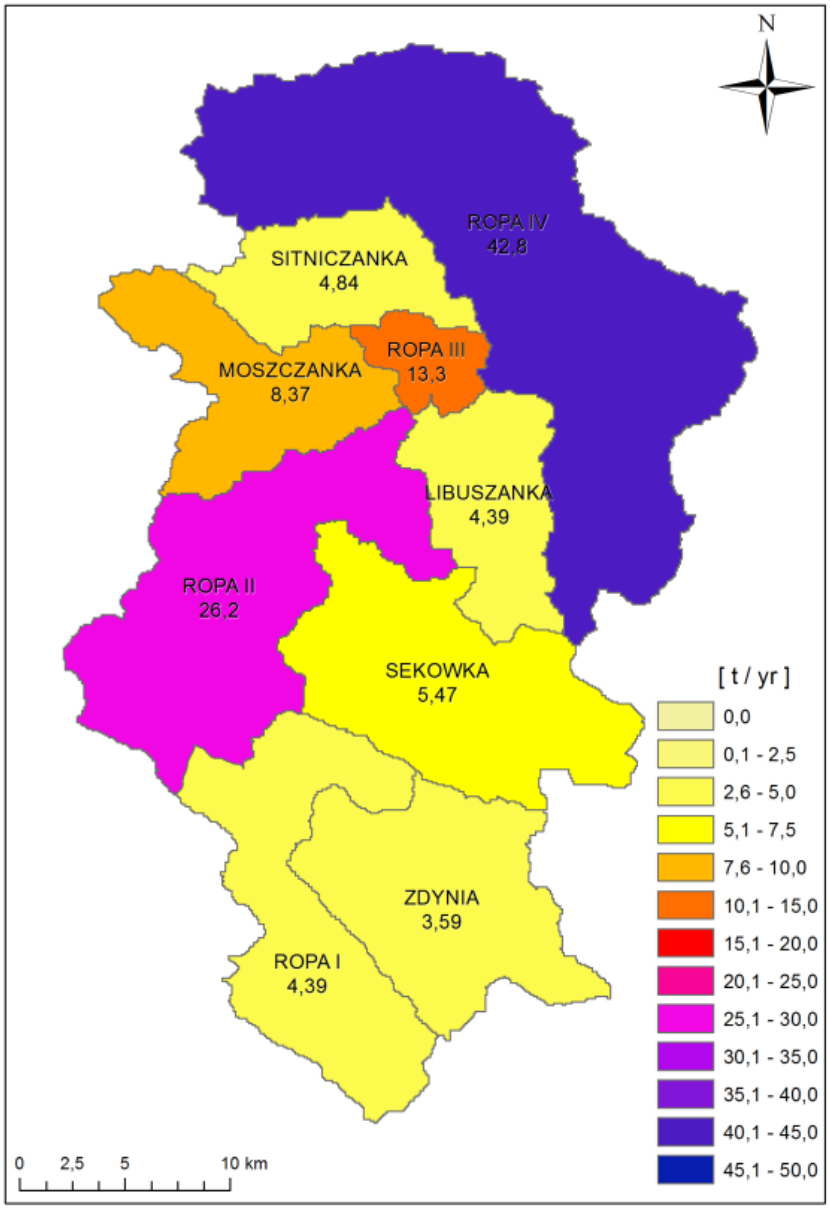
- NITROGEN -

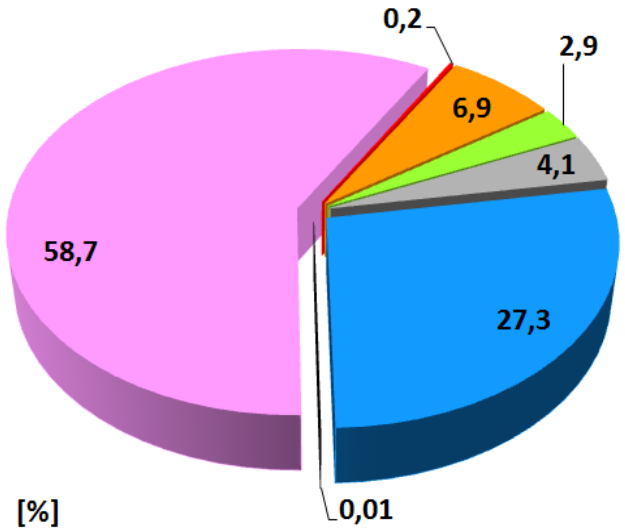

N
ROPA IV
607
SITNICZANKA
60
ROPA III
177
MOSZCZANKA
102
LIBUSZANKA
77,4
ROPA II
327
SEKOWKA
103
ZDYNIA
92,5
ROPA I
130
0
2,5
5
10 km
[t / yr]
8 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 1600

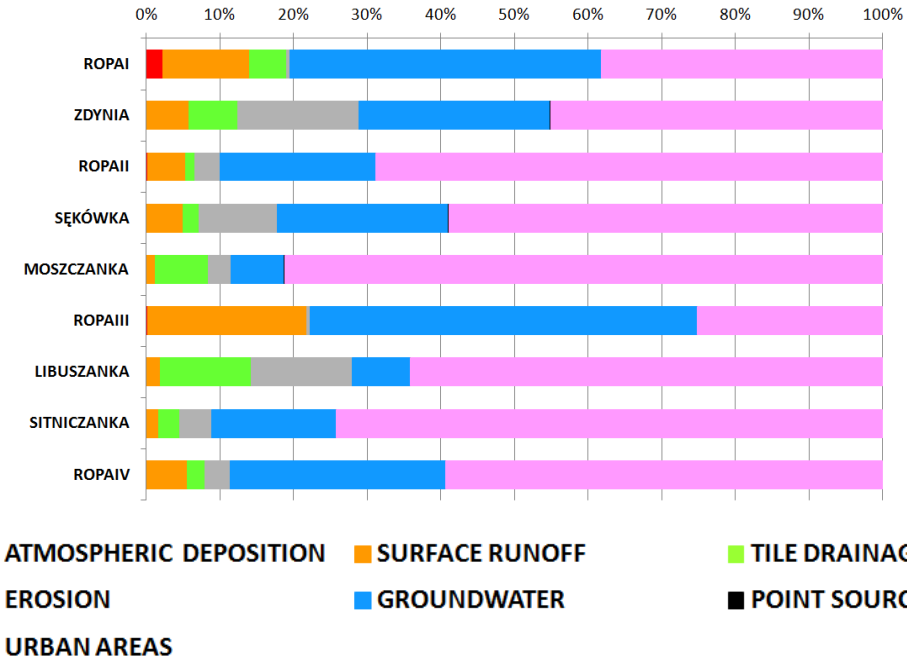

0,002
0,3
12,1
18,4
54,7
14,1
0,4
[%]


0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
ROPAI
ZDYNIA
ROPAII
SĘKÓWKA
MOSZCZANKA
ROPAIII
LIBUSZANKA
SITNICZANKA
ROPAIV
ATMOSPHERIC DEPOSITION
SURFACE RUNOFF
TILE DRAINAGES
EROSION
GROUNDWATER
POINT SOURCES
URBAN AREAS

- PHOSPHORUS -


N
ROPA IV
42,8
SITNICZANKA
4,84
ROPA III
13,3
MOSZCZANKA
8,37
LIBUSZANKA
4,39
ROPA II
26,2
SEKOWKA
5,47
ZDYNIA
3,59
ROPA I
4,39
0
2,5
5
10 km
[t / yr]
0,0
0,1 - 2,5
2,6 - 5,0
5,1 - 7,5
7,6 - 10,0
10,1 - 15,0
15,1 - 20,0
20,1 - 25,0
25,1 - 30,0
30,1 - 35,0
35,1 - 40,0
40,1 - 45,0
45,1 - 50,0


0,2
2,9
6,9
4,1
58,7
27,3
0,01
[%]


0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
ROPAI
ZDYNIA
ROPAII
SĘKÓWKA
MOSZCZANKA
ROPAIII
LIBUSZANKA
SITNICZANKA
ROPAIV
ATMOSPHERIC DEPOSITION
SURFACE RUNOFF
TILE DRAINAGES
EROSION
GROUNDWATER
POINT SOURCES
URBAN AREAS

- MONERIS is effective for monitoring water quality & nutrients in catchment
- Comprehensive database enables multi-criteria analyses at decision and operational level, including prevention and mitigation activities
- MONERIS can use geospatial data, such as high-resolution satellite images and processed soil or climatic information
- MONERIS can be driven by other models, such as SWAT, which is important in ungauged catchments
- MONERIS model in conjunction other models is effective tool for evaluating water quality and identifying sensitive factors. It can also generate water quality scenarios for decisionmaking.

ESA PECS Project 2: “Study and implement remote sensing techniques for the assessment of carbon balances for different biomasses and soil moistures within various ecosystems”

ESA PECS CARBON Project assessed carbon balance with regard to land use, biomass, soil moisture, meteorological conditions, and the influence of land use on carbon release and sequestration dynamics.

- Land use mapping with special attention to bio-energy species and wetland areas
- Soil moisture measurement by applying L- band radiometer & TDR measurements to validate ASAR and PALSAR data
- Measurement of variations in carbon fluxes in areas of heterogeneous vegetation

Ongoing projects:

GIO Land Monitoring – CORINE Land Cover 2012; Verification and Enhancement of High Resolution Layers for Poland.

FINEGRASS - Effect of climatic changes on grassland growth, its water conditions and biomass

WICLAP - Ecosystem stress from the combined effects of winter climate change and air pollution - how do the impacts differ between biomes - The main objective is to elucidate the impacts of recent winter warming events and air pollution on northern European ecosystems

- **ASAP** - Application of space-based products and services for agriculture for specific national, regional, and local needs. The assessment of crops conditions before winter, based on analyses of biomass, temperature and NDVI. The above conditions determine the amount of fertilizers required. Precise yield prognosis.

- **SERENE** - Bioenergy as key to regional economic growth - EO Based Service Supporting Energy Crops Cultivation.

  The actual energy crops plantations' location and cover. The areas having the potential for energy crops cultivation and indication of energy plants cultivation in these areas. The estimations of several factors such as: potential biomass yield, energy production from it's utilization and profits.

Geospatial Sciences Center of Excellence
South Dakota State University
Brookings, South Dakota, USA

22/06/2013 – 22/12/2013

Working with Professor Geoffrey M. Henebry as part of a NASA Interdisciplinary Science project, I investigated the variability of MODIS middle infrared radiance as influenced by seasonality, land cover, and viewing geometry.

Middle infrared (MIR) region (wavelengths 3-5 microns) is the mixing zone of emitted terrestrial radiation and reflected solar radiation.

Green vegetation and open water appear “dark” in MIR due to absorption by water. Soils and dried vegetation appear “bright” and urban surfaces (roofs and roads) appear an intermediate “grey”.

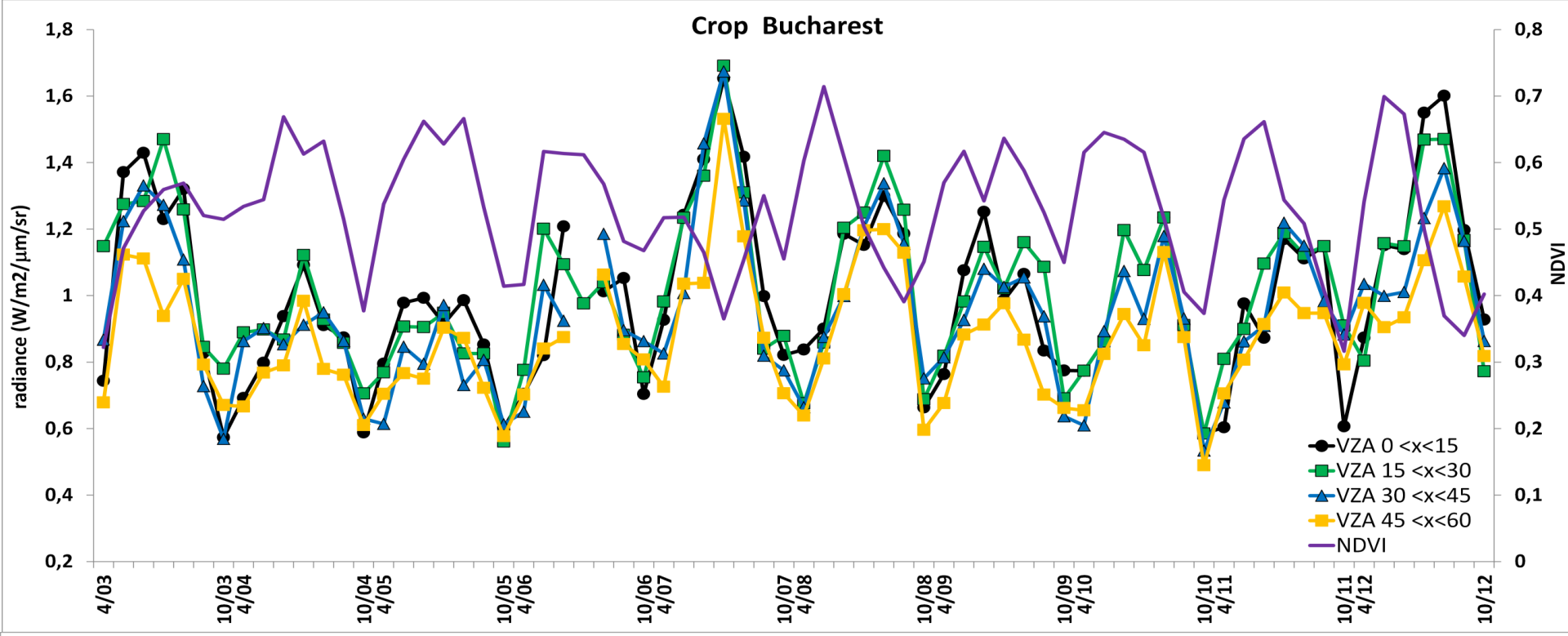
MODIS band 23 (~4 microns) can “see through” urban atmospheric haze and pollution ($PM_{2.5}$).

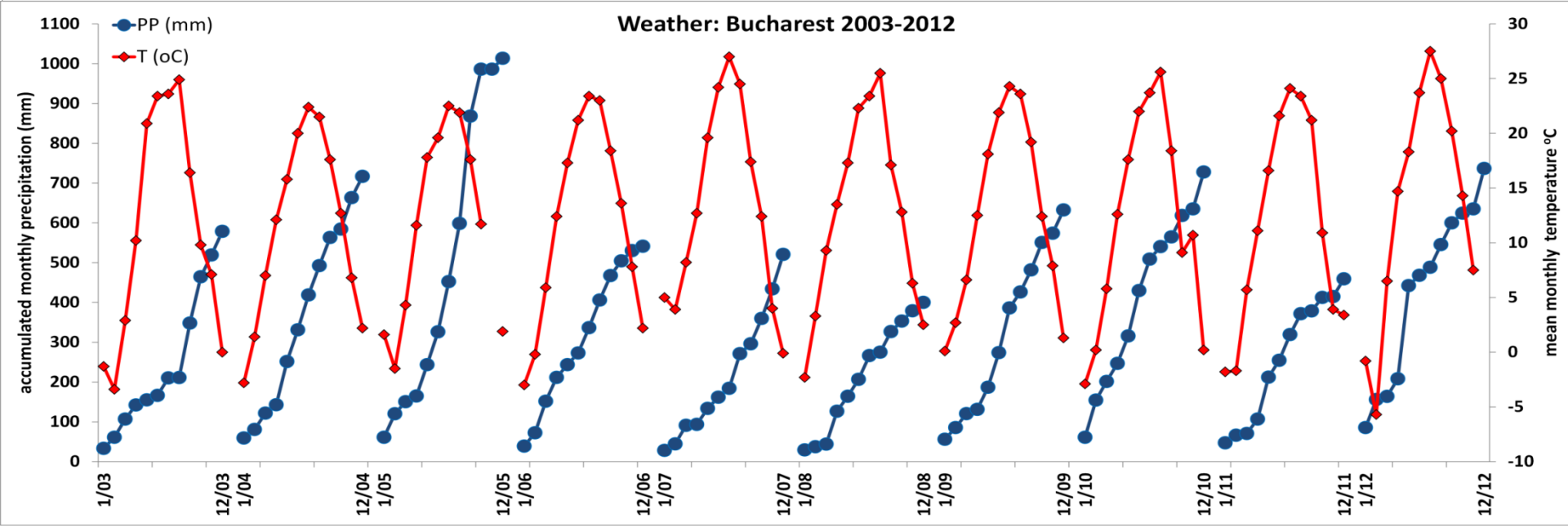
I focused on three “post-socialist” Central European cities:

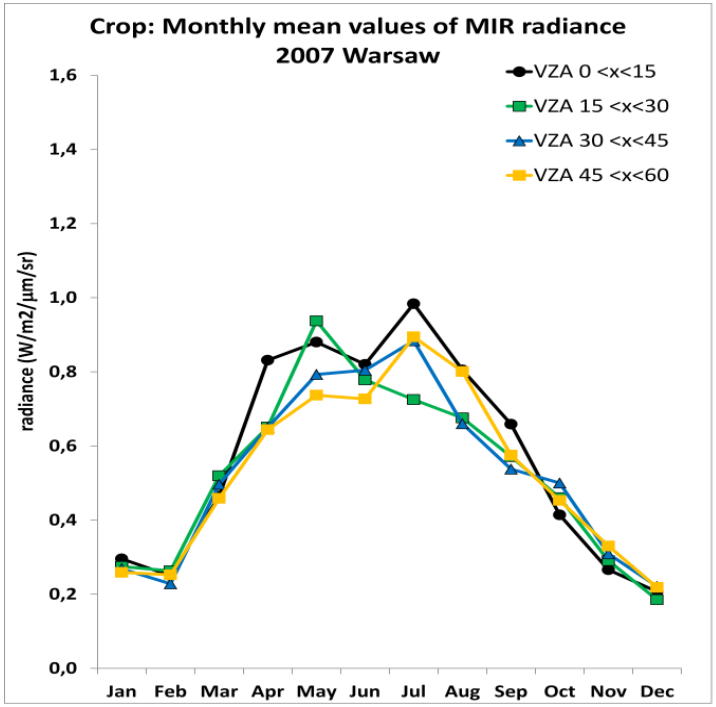
Bucharest, Romania
Budapest, Hungary
Warsaw, Poland

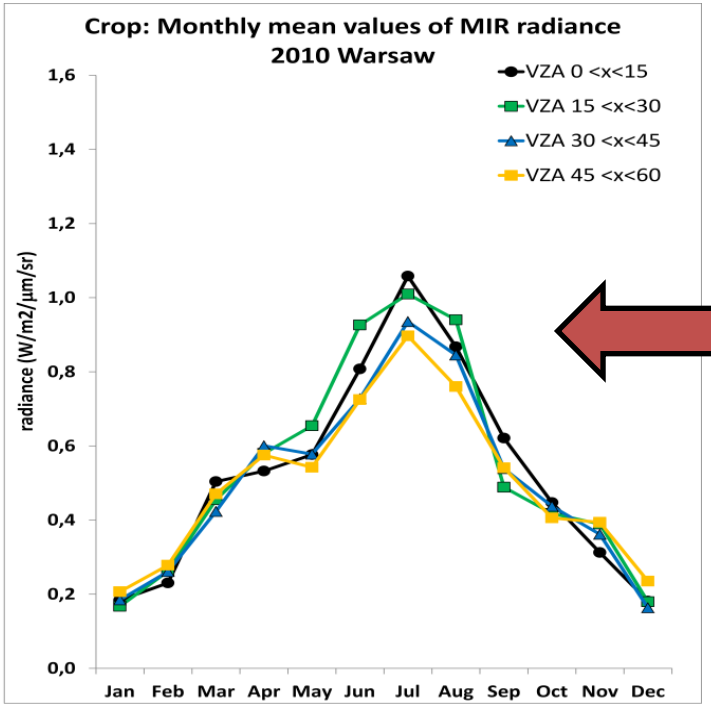
Period: April-October 2003-2012
Additional information: MODIS NBAR NDVI

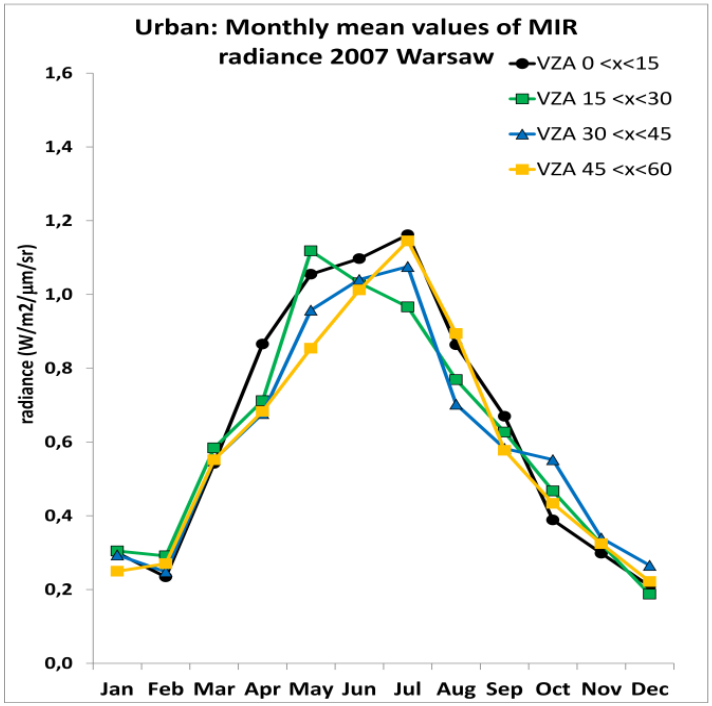
Selected representative pixels of urban, crop, crop/natural, forest, and water

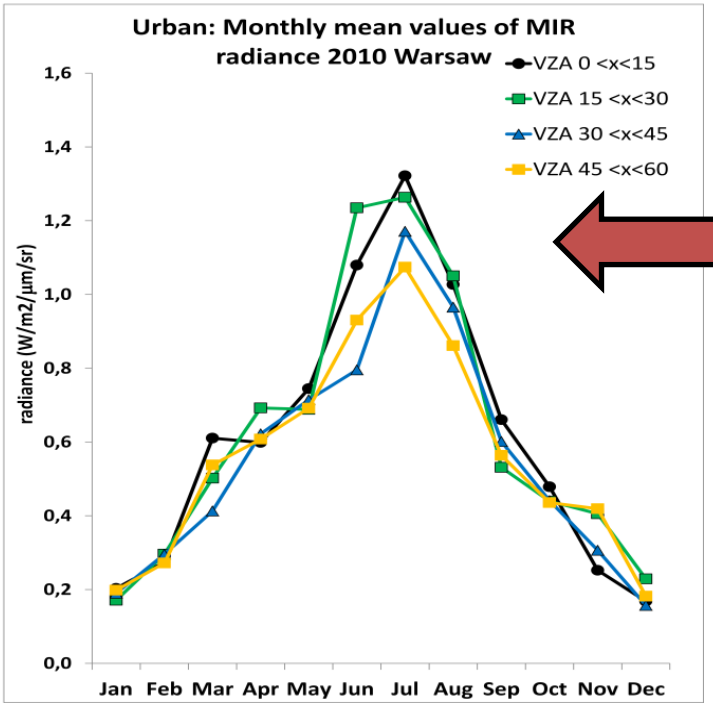

Crop Bucharest
radiance (W/m2/µm/sr)
NDVI
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0,7
0,5
0,3
0,1
0
VZA 0 <x<15
VZA 15 <x<30
VZA 30 <x<45
VZA 45 <x<60
NDVI
4/03
10/03 4/04
10/04 4/05
10/05 4/06
10/06 4/07
10/07 4/08
10/08 4/09
10/09 4/10
10/10 4/11
10/11 4/12
10/12


Weather: Bucharest 2003-2012
PP (mm)
T (oC)
accumulated monthly precipitation (mm)
mean monthly temperature °C
1100
1000
900
800
700
600
500
400
300
200
100
0
30
25
20
15
10
5
0
-5
-10
1/03
12/03 1/04
12/04 1/05
12/05 1/06
12/06 1/07
12/07 1/08
12/08 1/09
12/09 1/10
12/10 1/11
12/11 1/12
12/12









Spikes in MIR in July due to 2010 heatwave

MIR seasonality of three cities was similar, especially in urban areas.

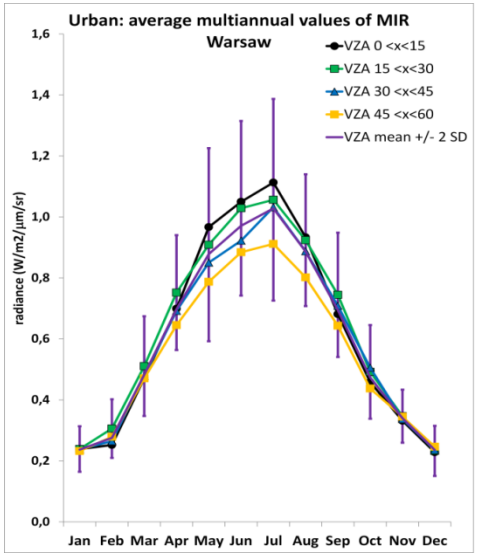
MIR dynamic range varied by latitude and climate. Highest in Bucharest where average air temperatures were highest; lowest in Warsaw where irradiance is lower and climate cooler and moister.

Evident relationship between MIR radiance and NDVI with NDVI leading MIR radiance in most years.

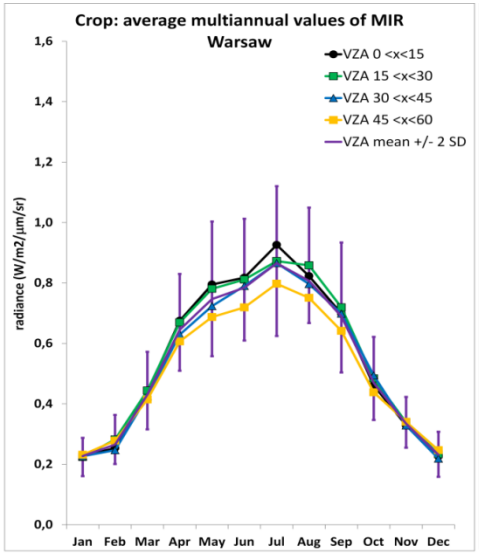
Spikes in MIR radiance evident midyear during seasons affected by heatwaves and/or drought.

WARSAW: Average MIR radiance for 2003-2012

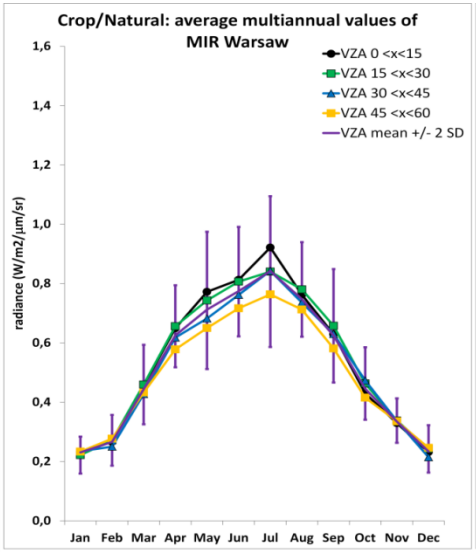
Urban



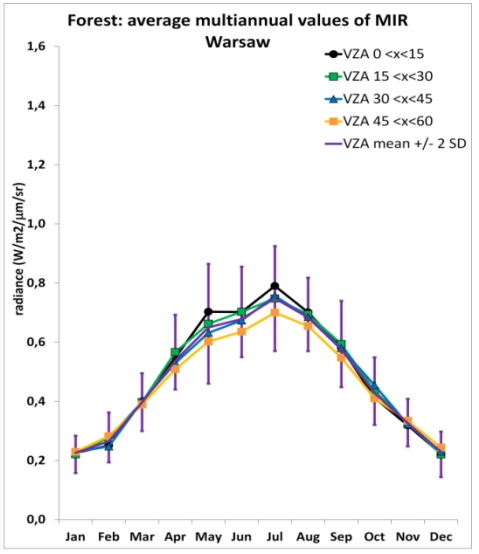
Crop



Crop/Natural Veg



Forest



Highest seasonal variation in MIR radiance appeared in **urban** areas.

Lowest seasonal variation in MIR radiance appeared in **forest** areas.

Urban averages are nearly symmetrical, but amplitude varied by view angle. In forests, there is little view angle effect. In croplands, a hysteresis is evident resulting from influence of vegetation phenology.

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