ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ УЧРЕЖДЕНИЕ НАУКИ
ИНСТИТУТ МОНИТОРИНГА КЛИМАТИЧЕСКИХ И ЭКОЛОГИЧЕСКИХ СИСТЕМ
СИБИРСКОГО ОТДЕЛЕНИЯ РОССИЙСКОЙ АКАДЕМИИ НАУК

Features of NDVI changes in the West Siberian Plain in the context of climate change

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Enviromis-2020

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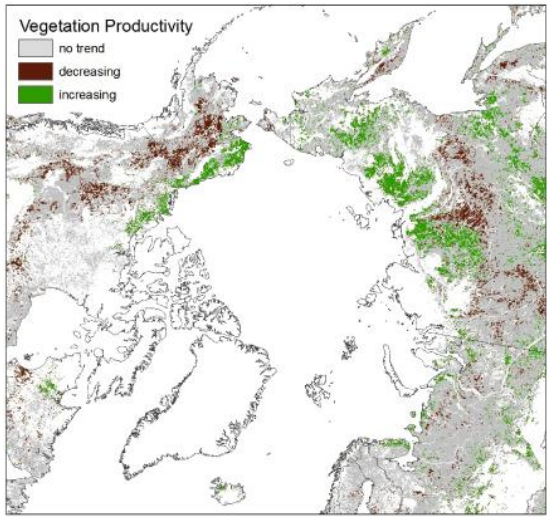
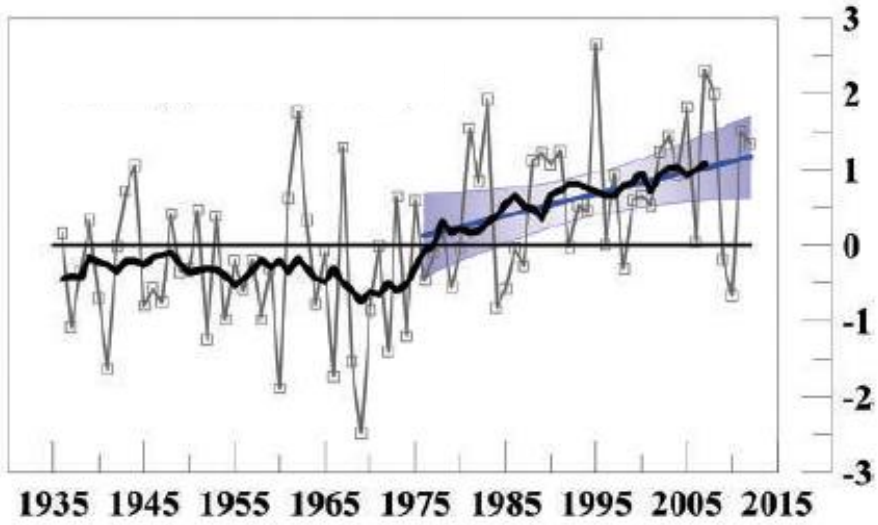
MOTIVATION

Vegetation productivity trends 1982-2008[1]



Air temperature anomalies in Western Siberia[2]



NDVI (Normalized Difference Vegetation Index) – a widely used indicator of the amount of photosynthetically active biomass.

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

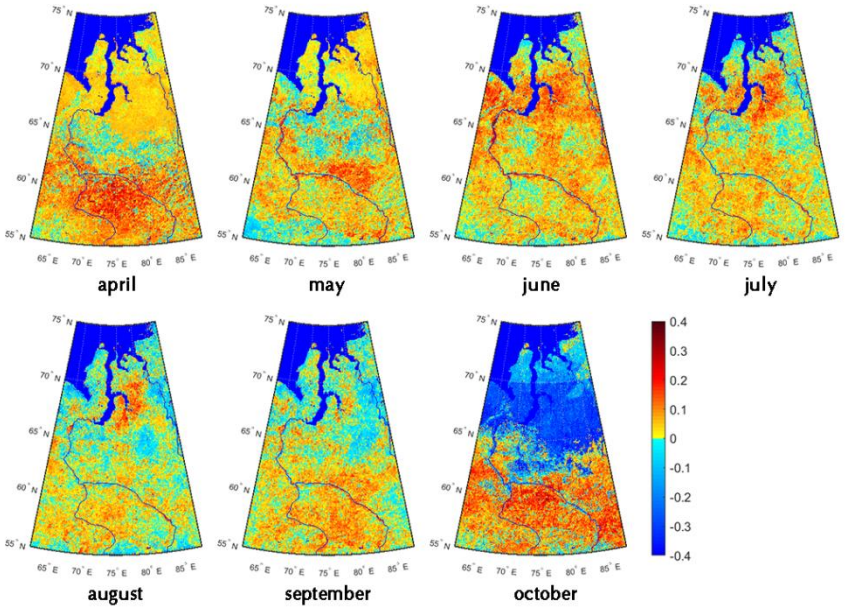
NIR and **RED** - reflection in the near infrared and red regions of the spectrum

[1]Beck, P.S.A., Goetz S.J. Satellite observations of high northern latitude vegetation productivity changes between 1982 and 2008: ecological variability and regional differences // Environmental Research Letters. 2011. V. 6. 045501.

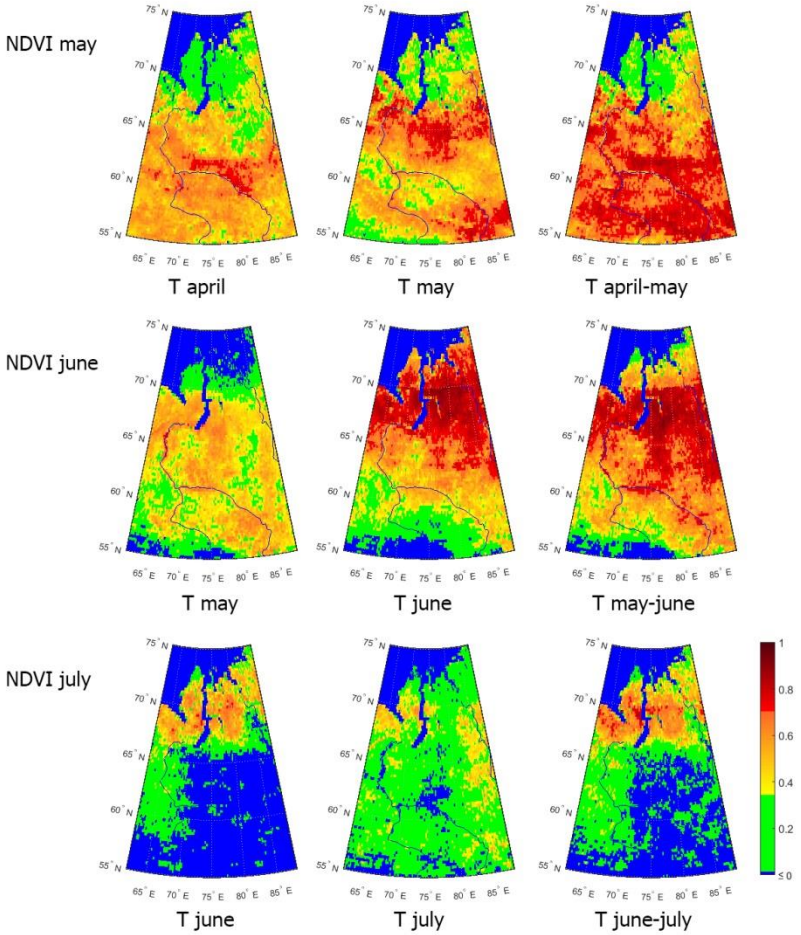
[2]The Second Roshydromet Assessment Report on Climate Change and its Consequences in the Russian Federation. Roshydromet, 2014. 1009 p.

PREVIOUS STUDIES

Trends of NDVI[1]



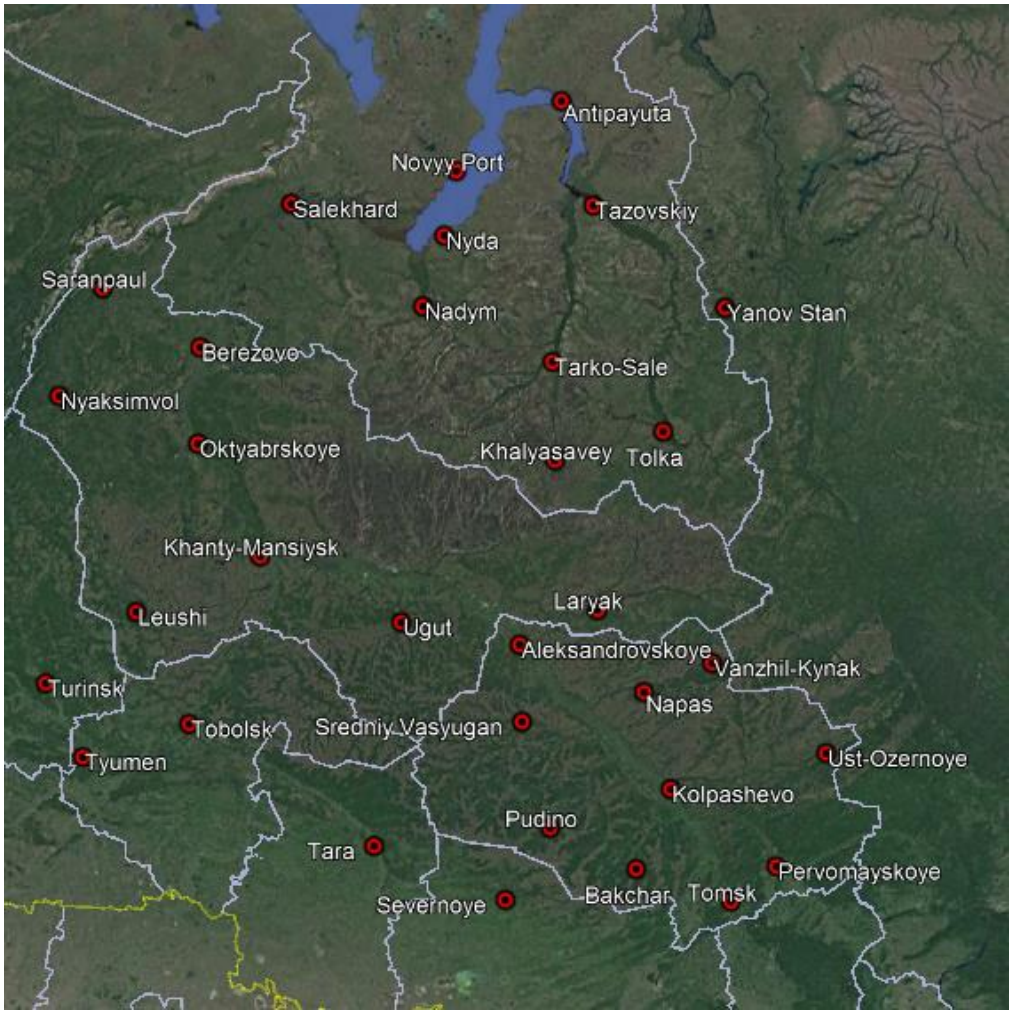
Correlation coefficients of NDVI and air temperature[1]



[1]*V.V. Zuev, E.M. Korotkova, A.V. Pavlinsky.* Climate-Related Changes in the Vegetation Cover of the Taiga and Tundra of Western Siberia in 1982–2015 According to Satellite Observations // Issledovanie Zemli iz kosmosa. 2019. № 6. P. 66-76.

DATA

Weather stations taken for analysis



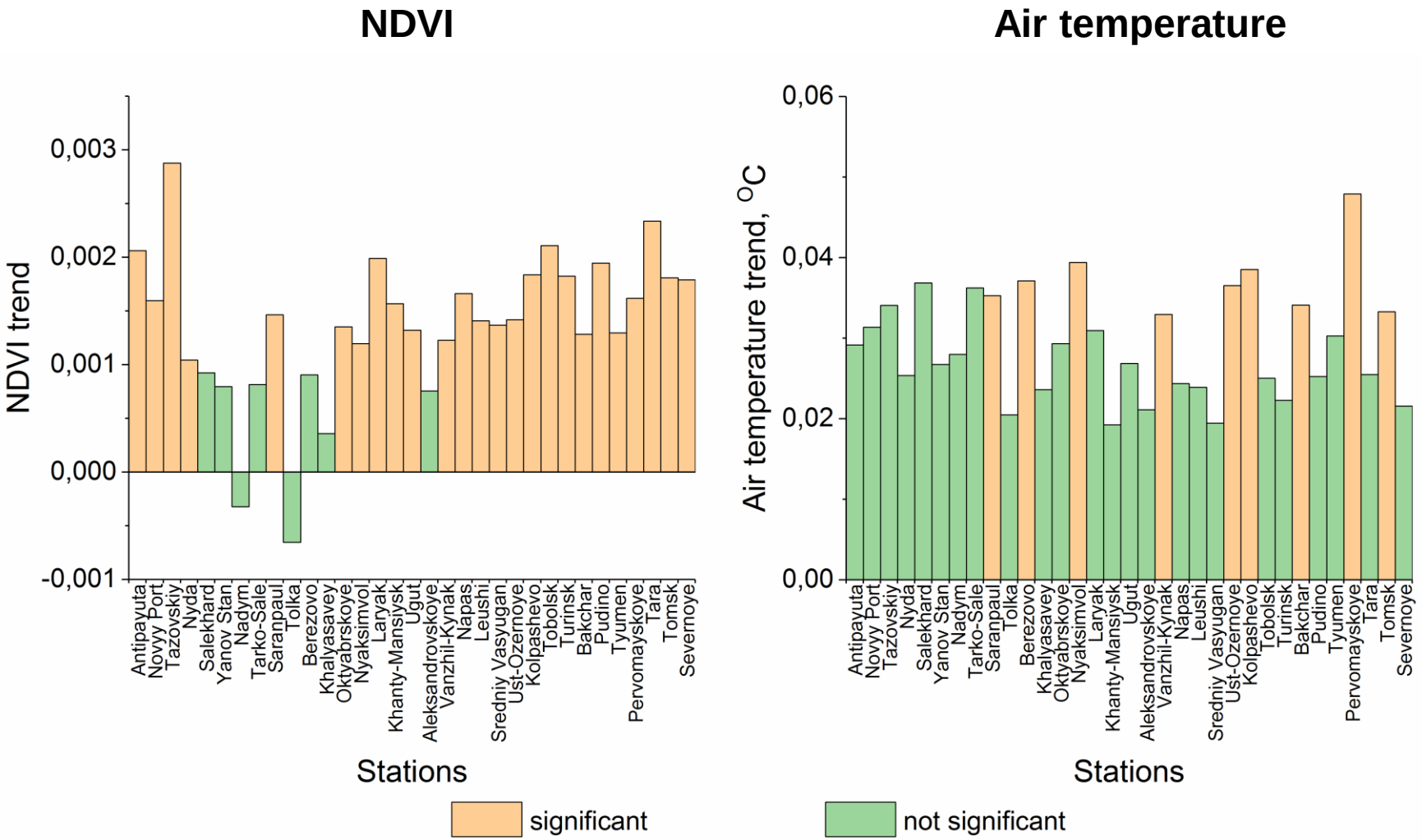
- **NDVI data – NDVI GIMMS set (AVHRR, NOAA), period: 1982-2015, resolution: 1/12*1/12°. The averaged NDVI value was taken for a square area of 0,5*0,5° for every station on the territory with maximum possible homogeneous vegetation and the minimum possible number of burns and anthropogenic objects.**

- **Air temperature at weather stations according to Roshydromet data.**

NATURAL ZONES AND WARM PERIOD FOR STATIONS

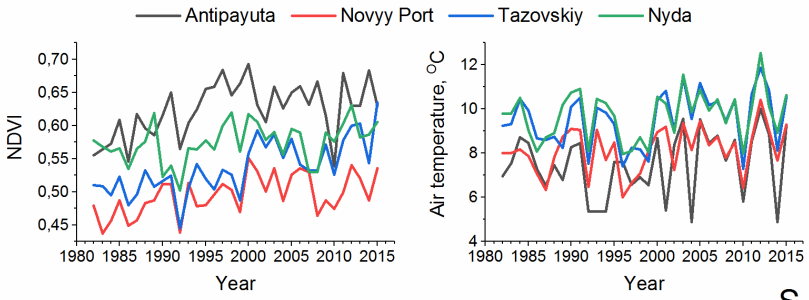
Natural zone	Station	Warm period (season)
Tundra	Antipayuta, Novyy Port, Tazovskiy, Nyda	June-September
Forest tundra	Salekhard, Yanov Stan, Nadym, Tarko-Sale	May-September
Northern taiga	Saranpaul, Tolka, Berezovo, Khalyasavey	May-September
Middle taiga	Oktyabrskoye, Nyaksimvol, Laryak, Khanty-Mansiysk, Ugut, Aleksandrovskoye, Vanzhil-Kynak, Napas, Leushi, Sredniy Vasyugan	May-September
Southern taiga	Ust-Ozernoye, Kolpashevo, Tobolsk, Turinsk, Bakchar, Pudino	April-October
Sub-taiga	Tyumen, Pervomayskoye, Tara, Tomsk, Severnoye	April-October

SEASONAL NDVI AND AIR TEMPERATURE TRENDS BY STATIONS, 1982-2015

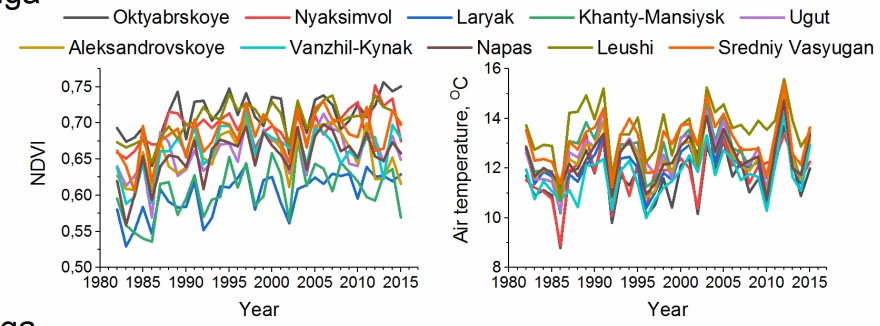


NDVI AND AIR TEMPERATURE DYNAMICS AT STATIONS

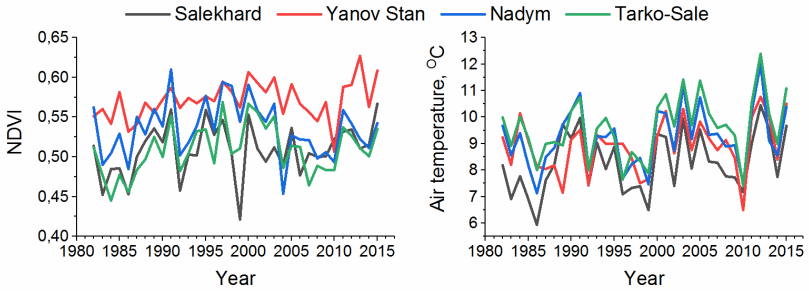
Tundra



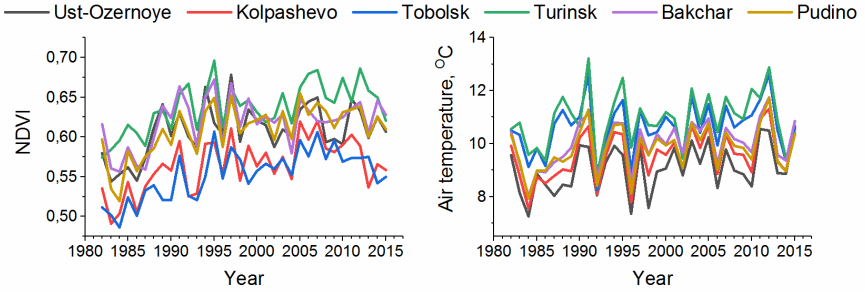
M. taiga



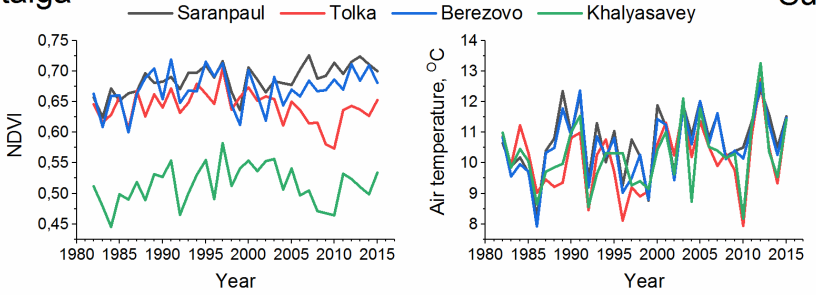
Forest tundra



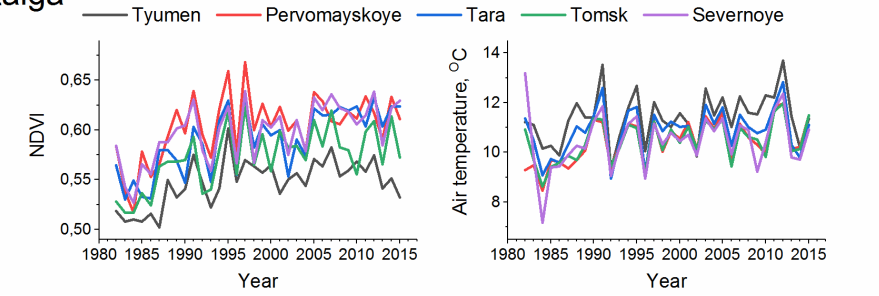
S. taiga



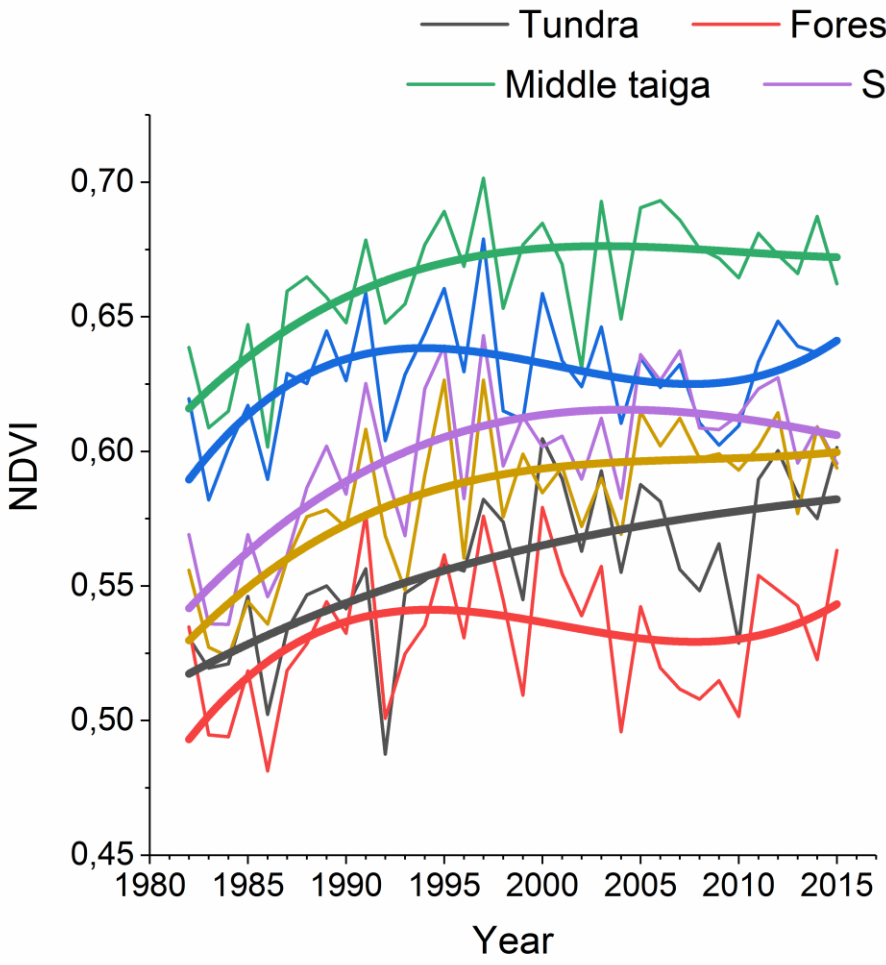
N. taiga

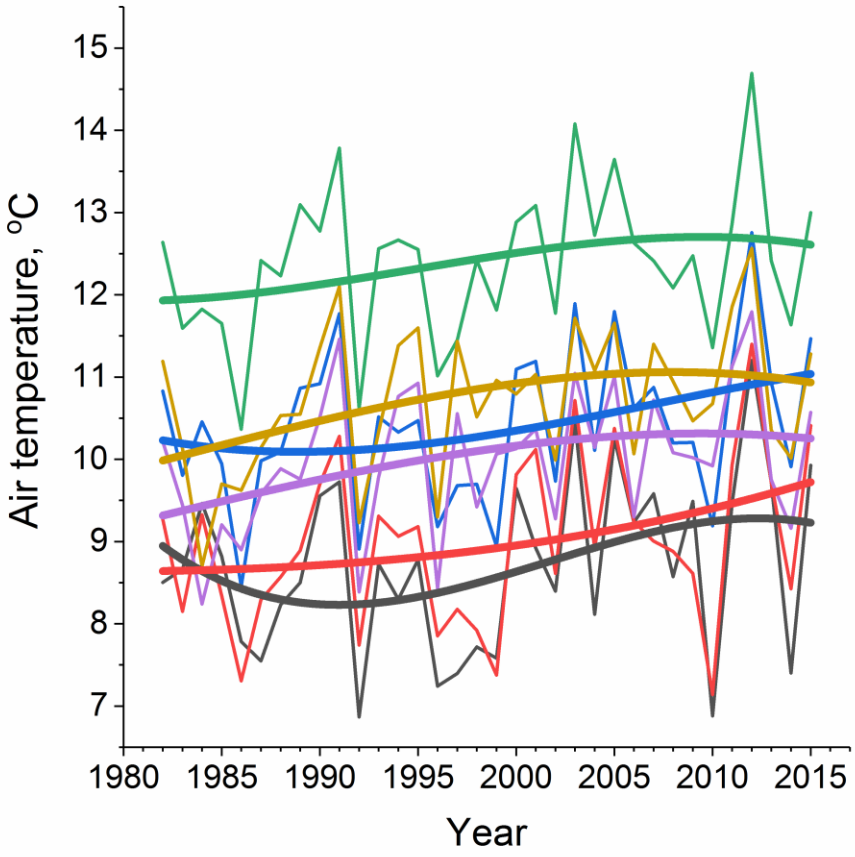


Sub-taiga



NDVI AND AIR TEMPERATURE DYNAMICS IN NATURAL ZONES

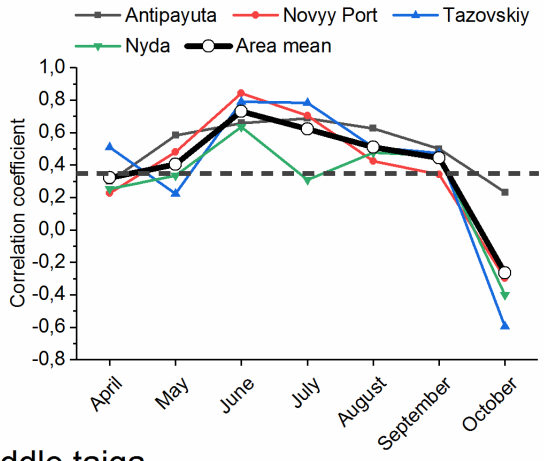




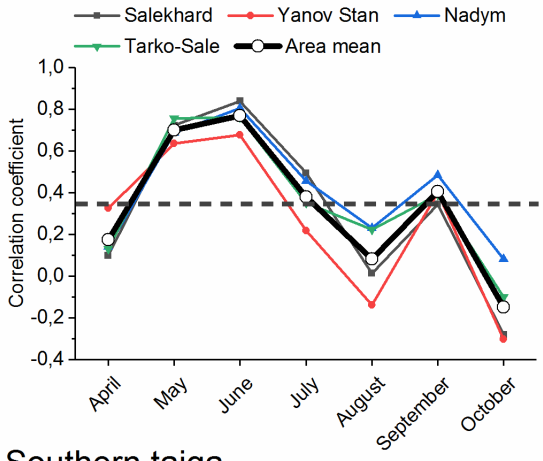
SEASONAL AND MONTHLY NDVI CORRELATIONS

$r_{critical} = 0,34$

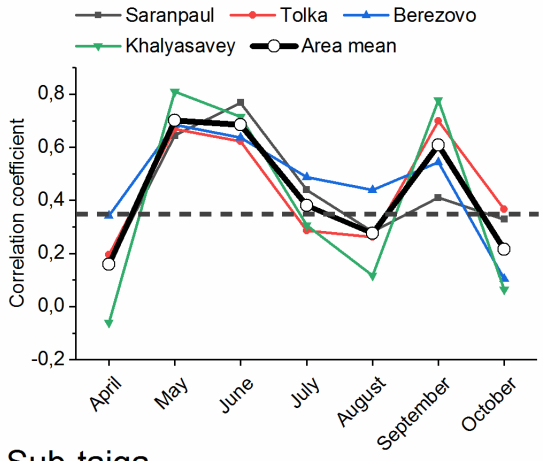
Tundra



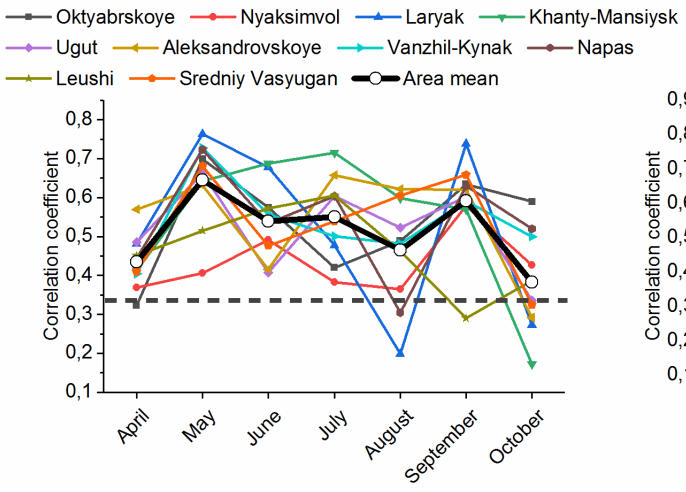
Forest tundra



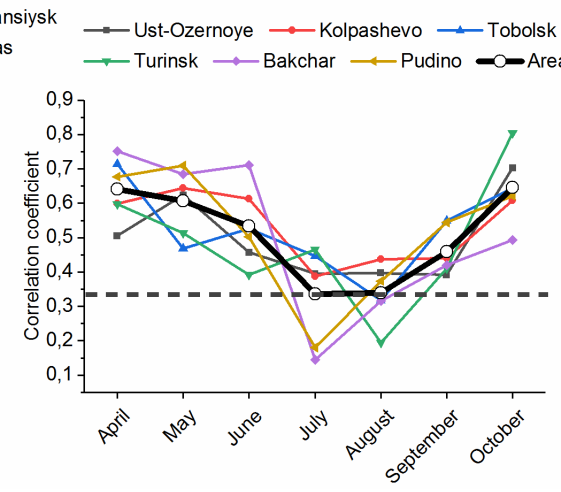
Northern taiga



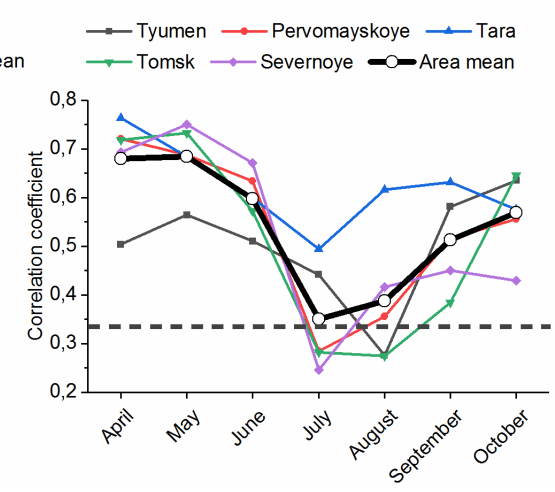
Middle taiga



Southern taiga



Sub-taiga



TRENDS OF SERIES OF MOVING CORRELATION COEFFICIENTS. METHOD

1. 20-year moving correlation was calculated for all stations by the following cases:

		Air temperature									
		March	April	May	June	August	September	October	March-April	April-May	May-June
NDVI	April	r	r								
	May		r	r							
	June			r	r						
	September					r	r				
	October						r	r			
	April-May	r	r	r					r	r	
	May-June		r	r	r					r	r

2. Linear trend was calculated for all of the resulting series of 20-year moving correlation coefficients

3. Maximum value of linear trend was founded for all of these series

MAXIMUM TRENDS OF 20-YEAR MOVING SERIES OF NDVI AND AIR TEMPERATURE CORRELATION COEFFICIENTS

Natural zone	Station	Months, determining season NDVI dynamics	20-year moving correlation coefficient trends					
			NDVI june - T may	NDVI may - T apr	NDVI apr - T mar	NDVI sep - T aug	NDVI oct - T sep	NDVI oct - T oct
Tundra	Antipayuta	june, july	*0,030*					
	Novyy Port	june, july	*0,021*					
	Tazovskiy	june, july	*0,035*					
	Nyda	june	*0,031*			0,012		
Forest tundra	Salekhard	may, june	*0,013*			0,011		
	Yanov Stan	may, june	*0,050*			**0,050**		
	Nadym	may, june	*0,016*			**0,025**		
	Tarko-Sale	may, june	*0,023*			**0,024**		
Northern taiga	Saranpaul	may, june, september		*0,016*		*0,026*		
	Tolka	may, june, september	*0,038*			*0,039*		
	Berezovo	may, june, september		*0,021*		*0,030*		
	Khalyasavey	may, june, september	*0,013*			*0,034*		
Middle taiga	Oktyabrskoye	may, september		*0,036*		**0,035**		
	Nyaksimvol	june, september		0,034		**0,045**		
	Laryak	may, september		*0,021*			**0,030**	
	Khanty-Mansiysk	july		**0,012**		**0,055**		
	Ugut	may, september		*0,026*				**0,022**
	Aleksandrovskoye	may, july, september	**0,024**					**0,028**
	Vanzhil-Kynak	may, september	0,012					**0,030**
	Napas	may, september		*0,009*			**0,049**	
	Leushi	july		**0,036**		**0,050**		
	Sredniy Vasyugan	june	**0,017**				**0,046**	
South taiga	Ust-Ozernoye	may, october	0,012				*0,028*	
	Kolpashevo	april, may, june, october			*0,029*		*0,034*	
	Tobolsk	april, october			*0,028*	**0,036**		
	Turinsk	april, october			*0,041*	**0,044**		
	Bakchar	april, october			*0,018*	**0,035**		
	Pudino	april, may, october			*0,031*		**0,046**	
Sub-taiga	Tyumen	april, october			*0,019*	**0,034**		
	Pervomayskoye	april, october			*0,018*	**0,029**		
	Tara	april, september			*0,042*	*0,013*		
	Tomsk	april, may, october			*0,010*	**0,022**	*0,021*	
	Severnoye	april, may, october			*0,029*		*0,025*	

Significant (α = 0,05) values shown in **Bold**

The month determining season NDVI dynamics is the same as the month having maximum trend of 20-year moving correlation coefficient series

0,10-0,24 weak changes

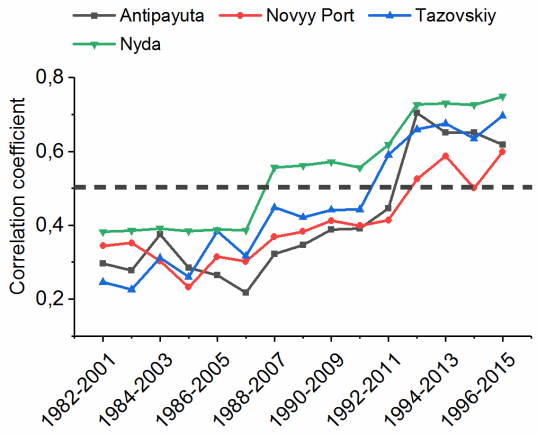
0,25-0,39 moderate changes

0,40-0,55 strong changes

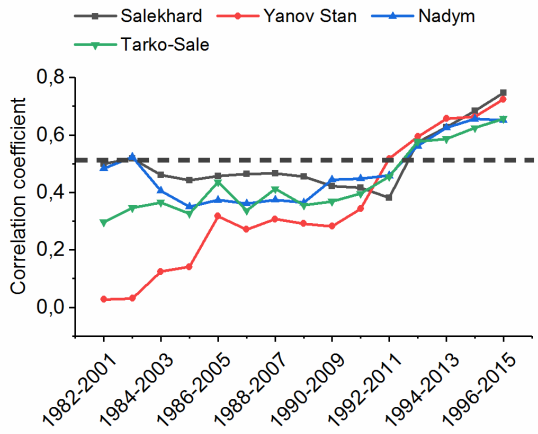
DYNAMICS OF 20-YEAR MOVING CORRELATION COEFFICIENTS OF NDVI AND AIR TEMPERATURE

$r_{critical} = 0,51$

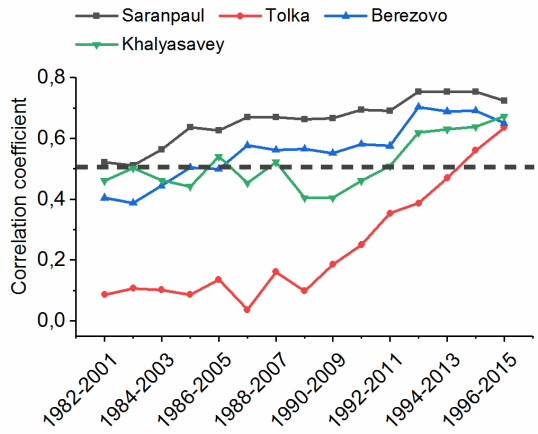
Tundra



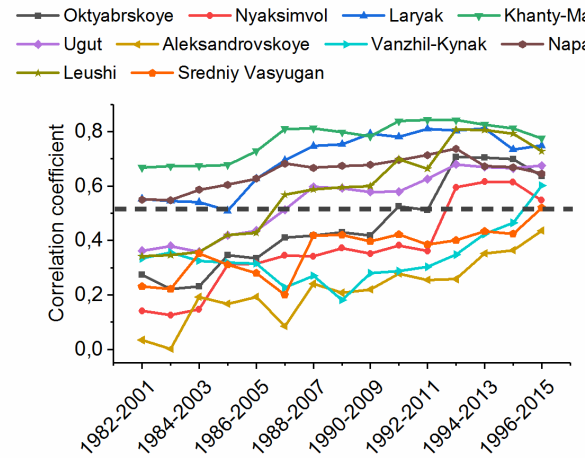
Forest tundra



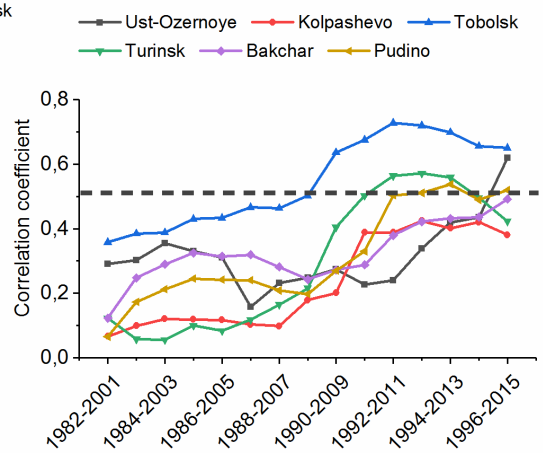
Northern taiga



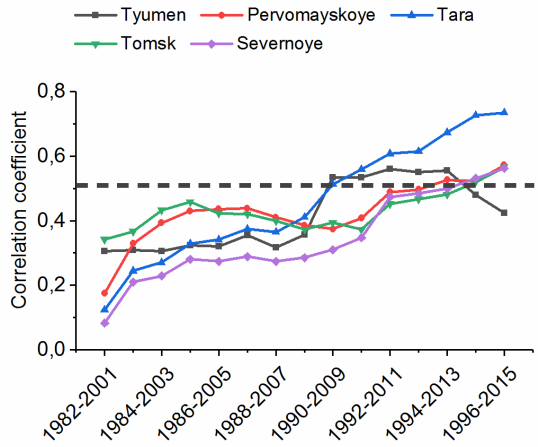
Middle taiga



Southern taiga



Sub-taiga



CONCLUSIONS

- A significant increase in NDVI during the growing season is typical for almost all areas of the West Siberian Plain, except for the highly swampy areas of the forest-tundra and northern taiga;

- The dynamics of the seasonal development of vegetation in Western Siberia is largely determined by its dynamics in the spring and autumn months;

- A constant increase in NDVI in the period 1982-2015 was observed only at stations of the tundra; for stations of other natural zones in the 2000s a stabilization or decline in NDVI is observed.

- The patterns of the NDVI response in different regions of Western Siberia are probably determined by the type of landscape. The identification of characteristic responses of different types of landscape requires further analysis.

THANK YOU FOR YOUR ATTENTION!