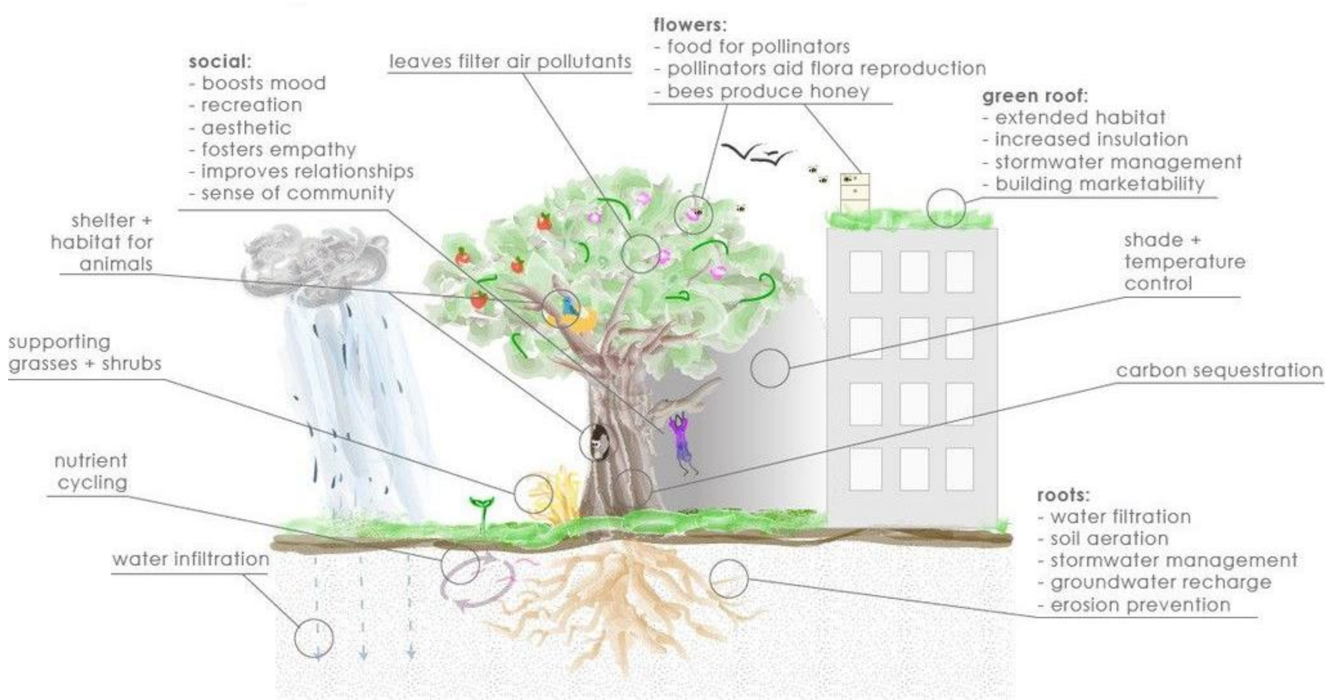
Ecosystem services approach for landscaping project: the case of Metropolia Residential Complex



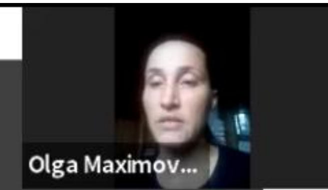
Victor Matasov

Post-Doc, Smart Urban Nature Laboratory, RUDN university
Faculty of Geography, Lomonosov MSU
matasov_vm@pfur.ru

Matasov V., Yaroslavtsev A., Bukin S., Konstantinov P., Vasenev V., Grigoreva V., Romzaykina O., Dvornikov Yu., Sayanov A., Maximova O.

19.04.2021

SMART URBAN NATURE

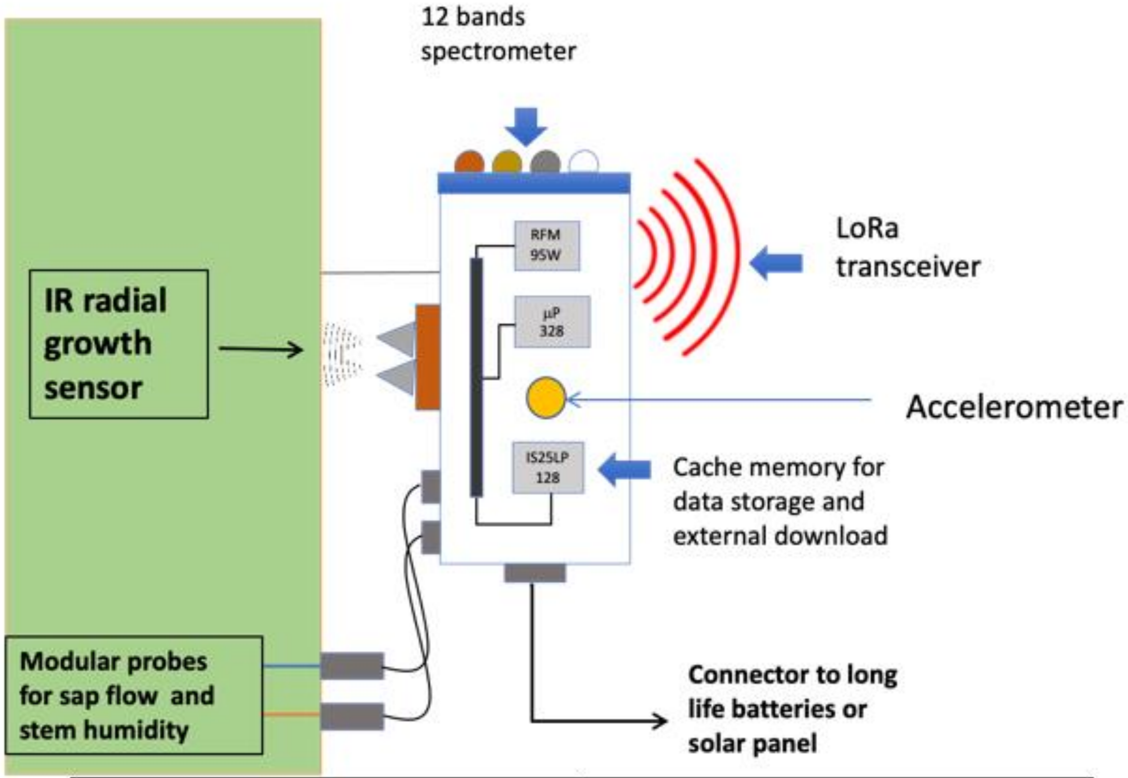


Urban Ecology
Cycle of discussions and lectures

- **Theory to practice.** Round table. 29/04/2020
- **Ecological framework.** Round table. 13/05/2020
- **Microclimate management.** Lectures. 27/05/2020
- **Stormwater management.** Lectures. 10/06/2020
- **Ecosystem services.** Lectures. 25/06/2020

Round Table 2. Ecosystem services assessment for sustainable landscape architecture: from science to practice

https://www.facebook.com/anastasia.v.konstantinova/videos/2507397662697268



Sensor	Range	Accuracy
Accelerometer	0-360° (0-8g)	± 0.01°
Diameter growth sensor	0-1 cm	±200 µm
Temperature probes	-40 ÷ +40 °C	±0.1 °C
Stem humidity probe	0 – 100%	± 2% v/v (Resolution, Accuracy under investigation)
Visible Spectrometer	400-700 nm	± 5 nm peak ± 20 nm Half Bandwith (450,500,550,570,600,650 nm)
Near-Infrared Spectrometer	700- 900 nm	± 5 nm peak ± 10 nm HBW (610,680,730,760,810,860 nm)
Air and humidity sensor	-10 ÷ +85 0-100%	± 1 °C ± 5%

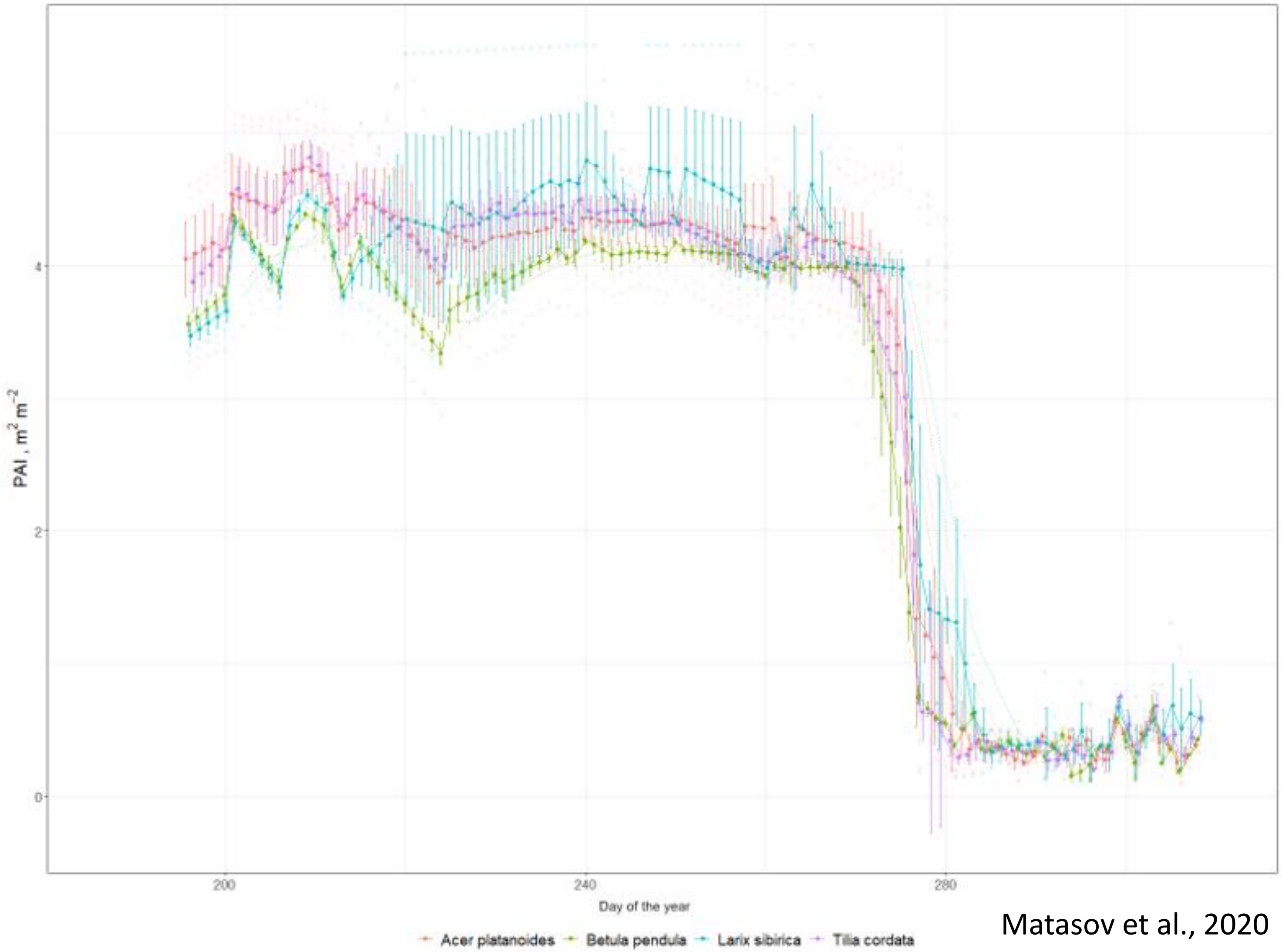
(Belelli Marchesini et al., 2020; Valentini, 2020; Valentini et al., 2019)
Nature4 Benefit Corporation (www.nature4.org)

From tree functioning to Ecosystem services indicators

ES group	Type of ES	Indicator	Sensor	Type of equation	Units	Key references
Global Climate regulation	Carbon sequestration	Tree growth rate	IR growth sensor	Indirect *Biomass expansion factors*	kg C	[45–47]
Local Climate regulation	Climate comfort regulation	Air temperature	Thermo-hygrometer sensor	Direct	C degrees	[48–50]
		Wind velocity	Spectrometer	Indirect *LAI*	m s^{-1}	[51–53]
	Energy balance regulation	Latent energy via transpiration	Sap flow sensors	Direct	W m^{-2}	[54–57],
Water regulation	Run-off mitigation	Transpiration	Sap flow sensors	Direct	1 hr^{-1} or mm	[58–61]
		Rain buffer	Spectrometer	Indirect *LAI*	%	[62–64]
Air quality regulation	Particulate adsorption	PM removal	Spectrometer	Indirect *LAI*	g m^{-2}	[18,44,65,66]
	Gas regulation	Gaseous pollutants removal	Spectrometer	Indirect *LAI*	g m^{-2}	

Matasov et al., 2020

Leaf Area Index



Matasov et al., 2020

Average LAI for all trees was 3.77 with less variation in *Betula pendula* (3.5-3.7) and *Larix sibirica* (3.6-3.9) and higher variation for *Acer platanoides* (3.2-4.3) and *Tilia cordata* (3.4-4.3).

ГЕНЕРАЛЬНЫЙ ПЛАН

въезд спецтранспорта

пешеходный вход

забор

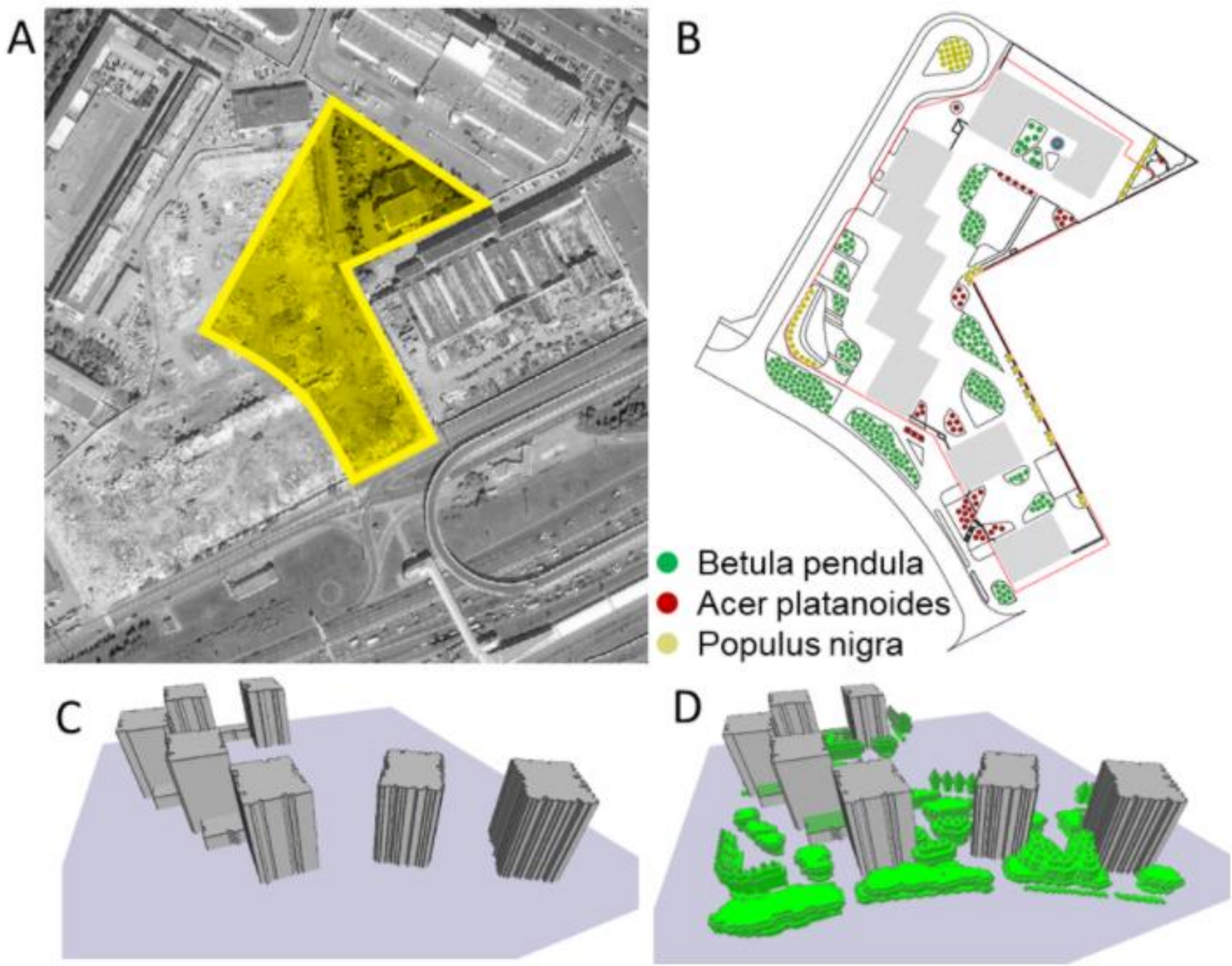
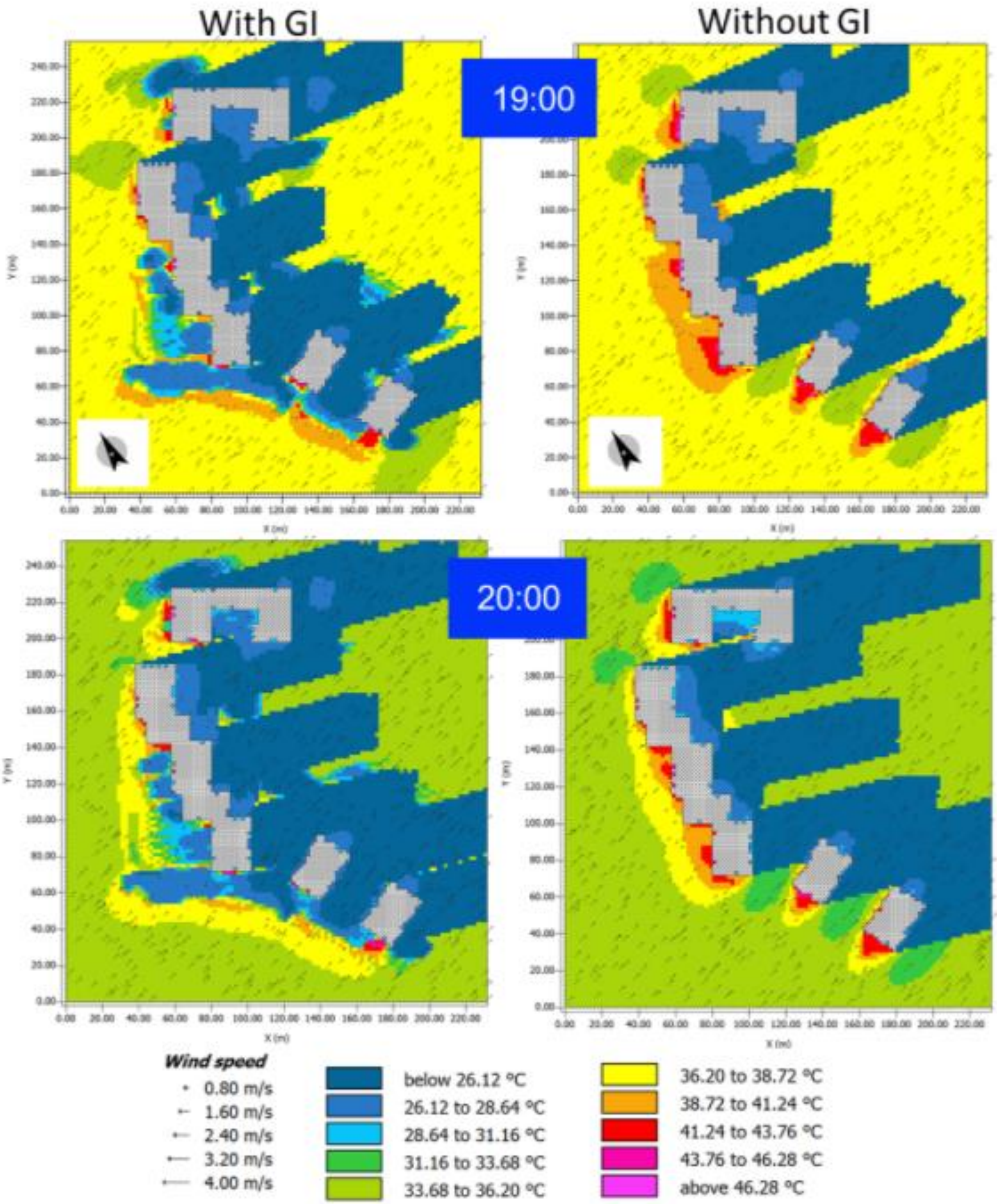


Fig. 1. Study area: A) industrial surroundings B) planting project C) “without GI” scenario D) “with GI” scenario 3D models.

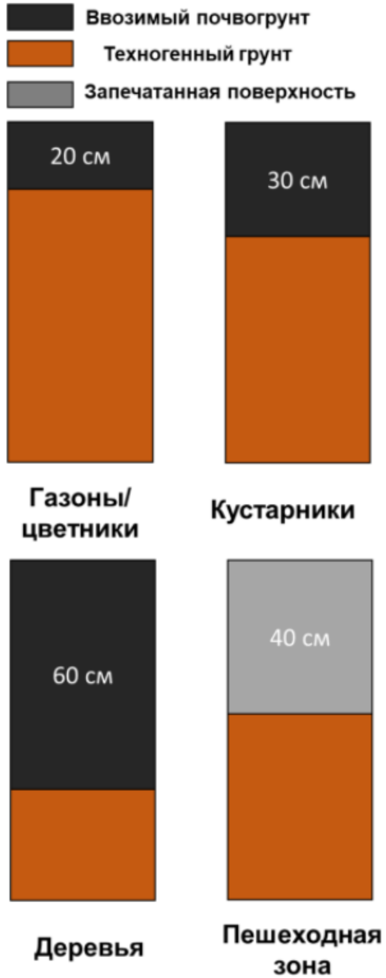
	Period 1 (planting)			Period 2 (adulthood)		
Species	*Betula p endula*	*Populus nigra*	*Acer pla tanoides*	*Betula p endula*	*Populus nigra*	*Acer pla tanoides*
Number items	134	32	29	134	32	29
Height, m	6	10	6	18	22	20
DBH, cm	11,15	15,92	12,74	22,29	27,07	28,66
Basal area, m^2	0,0098	0,0066	0,0042	0,013	0,0192	0,0215
Canopy area, m^2	7	15	10	15	30	25
BCEF	0,8	0,85	1,1	0,8	0,85	1,1
R/S ratio	0,2	0,3	0,3	0,2	0,3	0,3
Sap Flux (l/h - daily mean)	1	2,5	1,3	1,5	4	2
LAI (leaf area index) m m^{-2}	3	4	3,5	4	6	4
WAI (wood area index) m m^{-2}	0,35	0,4	0,4	0,45	0,5	0,45
PAI (plant area index) m m^{-2}	3,35	4,4	3,9	4,45	6,5	4,45
Carbon biomass, kg	9,3	12,2	6,1	37,4	77,6	102,3
Carbon increment, kg	1,4	3,3	4,8	1,4	3,3	4,8
Particle adsorption, g	4,23	11,66	6,97	11,81	33,5	19,69
Transpiration, l	3840	9600	4992	5760	15360	7680
Transpiration, mm per canopy area	548,6	640	499,2	384	512	307,2
Energy, kWh	2415,7	6039,2	3140,4	3623,5	9662,7	4831,4



	Air temperature, °C		Thermal stress (PET) °C	
Time	With GI	Without GI	With GI	Without GI
15:00	30	30,1	42,3	44,4
19:00	28	28,1	32,7	34,2
20:00	27,2	27,4	29,2	29,6

- Органо-минеральная смесь с долей торфа < 30% и содержанием $C_{орг}$ 4% (Вариант 1)
- Наиболее распространенные для Москвы почвогрунты с долей торфа >30% и средним содержанием $C_{орг}$ 10% (Вариант 2)
- Почвогрунт, соответствующий максимальным разрешенным значениям в соответствии с ПП-514 - содержанием $C_{орг}$ 20% для газонов, деревьев и кустарников и 25% - для цветников (Вариант 3)

	Soil construction type	**Area type**				
		Pedestrian area	Flower beds	Shrubs	Lawns	Trees
Specific stock (kg C/m2)	Option 1	7,2	14,4	16	14,4	19,2
	Option 2	7,2	21,6	26	21,6	40,8
	Option 3	7,2	39,6	44	33,6	76,8
Total stock, t C	Option 1	95,3	0,9	7,4	3,2	54,6
	Option 2	95,3	1,3	13	4,7	116
	Option 3	95,3	2,4	21	7,4	219
Life span under normal conditions, years	Option 1	n\a	102	74	102	45,3
	Option 2	n\a	45,8	37	45,8	28,9
	Option 3	n\a	21	16	17,8	13,6
Life span under hot and wet conditions, years	Option 1	n\a	3,1	17	11,2	64,4
	Option 2	n\a	1,1	7,3	4,2	34,2
	Option 3	n\a	0,4	2,5	1,3	12,9



Conclusion

- Recommendations given on where to plant and how to make sustainable ecosystems based on soil-plant-climate interaction
- Interesting for architects, but not pretty clear due to the absence of “real” mechanisms to implement in practice
- Before-project investigation and past-project control or monitoring

- GOST on ecosystem services evaluation (RuGBC)
- Expert interviews