Urban Forests, Heat and Dust stress in oasis cities in Xinjiang

城市森林、新疆城市的热岛效应和沙尘问题



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Background/背景与动机

The high-speed growth of China‘s economy brought rapid urbanization in China and extensive modernization of China’s cities
中国经济的快速发展加速了中国的城市化，即城市现代化过程。

The concept of modernization was used as an *Instrument for urban beautification* („city cosmetic“) over the last 30 years. It was implemented independently of local cultural and natural conditions.
近30年的城市现代化过程中，不顾各地的自然条件和社会文化差异，过于提倡城市美化，即“城市化妆运动“ (Yu Kongjian 2013) 。

The idea to consider the **city as a ecosystem** is still relatively young in China.
在中国，城市看作为一种“符合生态系统”的理念还比较薄弱或年轻。

Urban greening in China 中国的城市绿化

Repräsentation ist viel stärker betont als Multifunktionalität
强调展示性, 为视觉形式美而设计，为参观者或观众而美化

but the urban green, especially urban forests with its multi-functionality (ESS/ESF) as an important component of urban infrastructure are fully recognized 作为城市生态基础设施——城市绿地特别是城市森林及其多种生态服务功能已得到市民的充分认可。

- Provide shade 提供阴凉
- Contribute to air quality 净化空气
- Positiv effects on microclimate 对小气候的正面效果
- Provide shelter 提供庇护
- Noise control 抑制噪音
- Wildlife and biodiversity 野生动植物及生物多样性
- ……

Air pollution poses a long-term threat to human health and life quality of urban residents. In particular, dust pollution in oasis cities located in arid areas is associated with reduced life expectancy

What we have done? 我们做了哪些工作？

Halik, Ü. (2003): Stadtbegrünung im ariden Milieu: Das Beispiel der Oasenstädte des südlichen Xinjiang/VR China, unter besonderer Berücksichtigung ökologischer, sozioökonomischer und kulturhistorischer Aspekte. Diss., in: Berliner Beiträge zu Umwelt und Entwicklung, Bd. 20: 343
玉米提·哈力克(2003): 干旱区城市绿化研究：中国新疆南部绿洲城市为例。柏林工业大学博士论文, 343页。

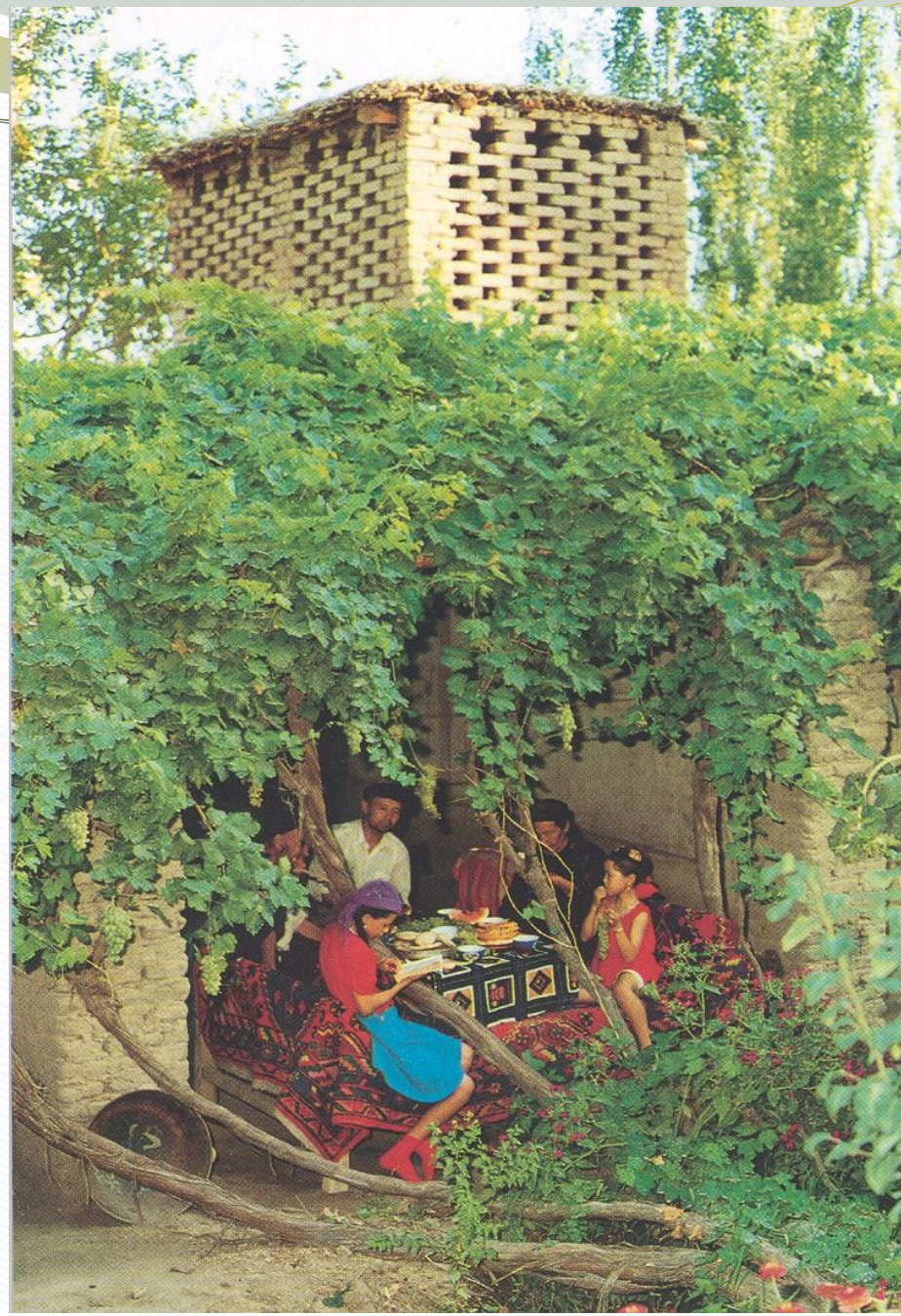
BMBF-SuMaRiO WP4.3: ESS/ESF of urban and peri-urban oasis vegetation (2011-2016), (Grant NO.: 01LL0918C)
德国科研部SuMaRiO项目子课题4.3：绿洲城市和城郊植被生态系统服务与功能(2011-2016), (项目编号: 01LL0918C)

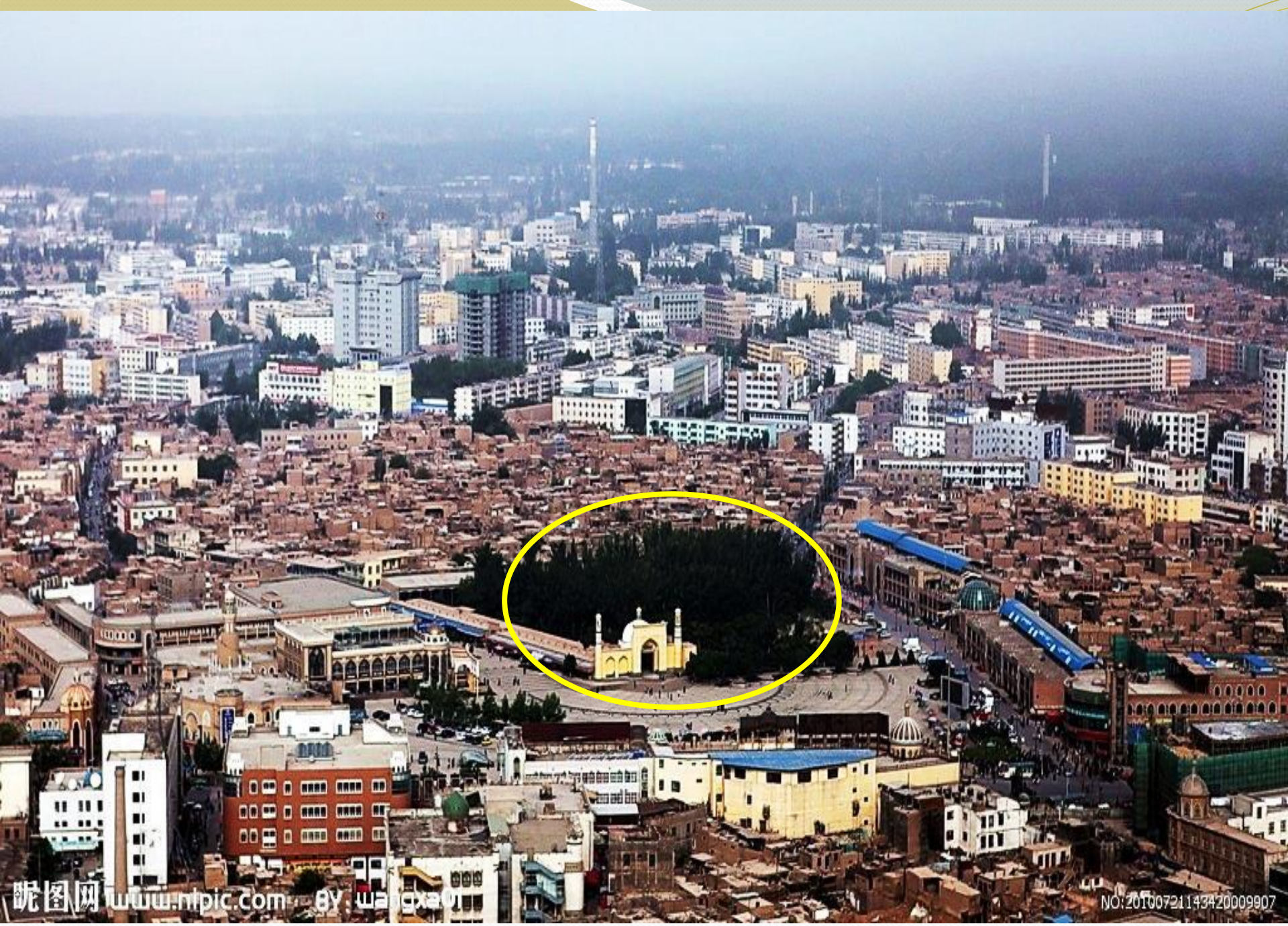
NSFC-Project: Dust Retention Effects and Resistance Mechanism of Urban Trees in Arid Land Oasis Cities (2013-2016), Funded by National Natural Science Foundation of China (2013-2016), (Grant NO.: 31270742)
国家自然科学基金面向项目：干旱区绿洲城市园林树种滞尘效应及耐尘机制研究 (2013-2016), (项目编号: 31270742)

2. Modernization process of oasis cities in Southern Xinjiang
南疆绿洲城市的现代化历程

- Pre-industrial city (before 1950)
  前工业城市（1950年之前）
- Early industrial city (1950 – 1980)
- 工业早期的城市（1950至1980年）
- The city as an industry and service center (1980 – now)
  城市作为一个产业和服务中心（1980年后）

Kashgar 100 years ago
100年前的喀什

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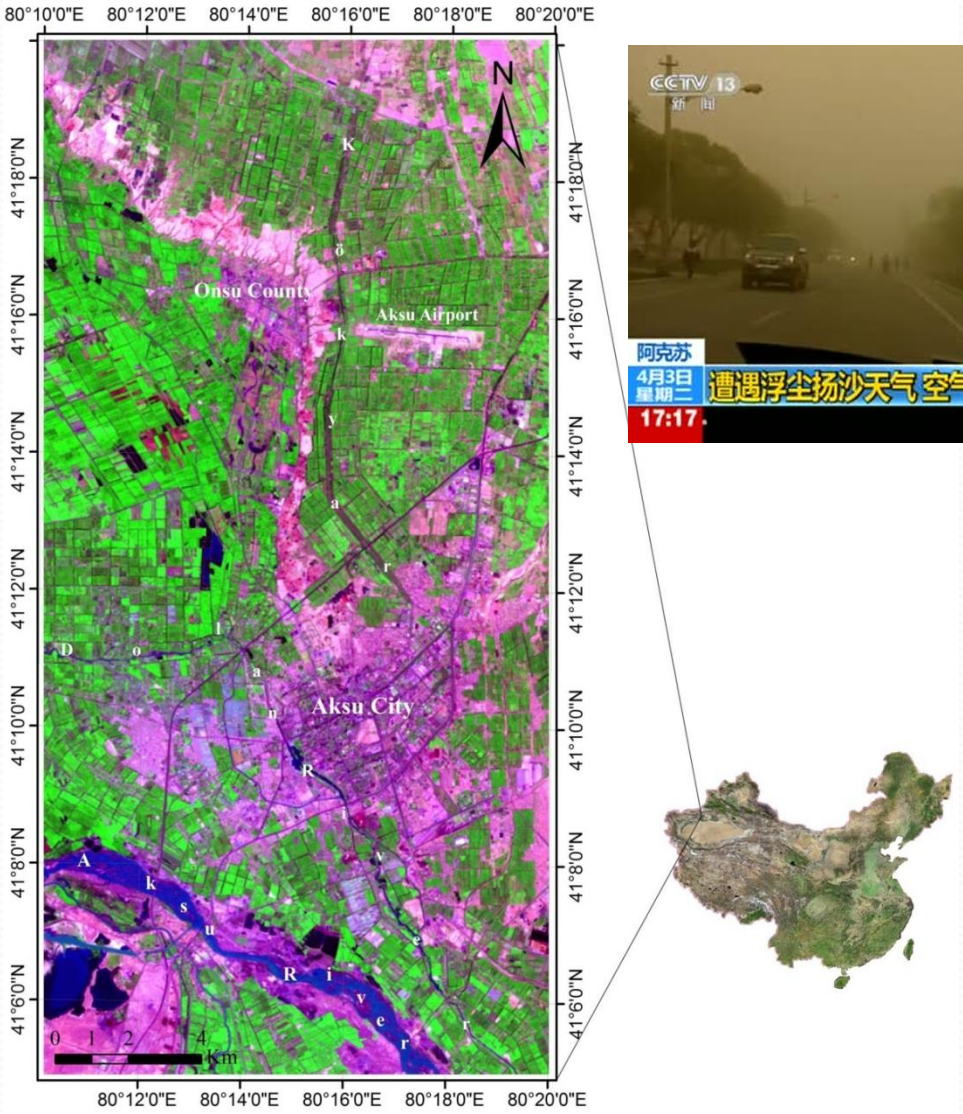
Ürümqi is the fastest growing metropolis in Xinjiang, but has no traces of old culture

Possible reasons for the missing public consciousness about the water wastage:

- Missing understanding for hydrological context and missing data for the use of ground water and the meaning of glacier water makes people think that there is enough water.
- Thesis: „The urban water consumption is neglectable in view of the extensive water use in agriculture“.

Case study in Aksu 研究案例：阿克苏



Aksu City is located at the north fringe of the Taklamakan Desert, NW China. The local climate is characterized by large temperature variations and extreme aridity with about 65 mm precipitation and of about 2000 mm evaporation per year (Halik, 2003).

阿克苏城市位于塔克拉玛干沙漠的北缘。当地的气候特点是温差大和极端干旱，年均降水约为65mm和蒸发量约为2000mm（Halik, 2003）。

Research topics / 研究重点

Dissertation Project 1 (Abdulla Abliz, KUE/XJU/HNEE):

Urban and Peri-urban Forests and Heat Island Effect in the Oasis City of Aksu 阿克苏市城市森林与城市热岛效应

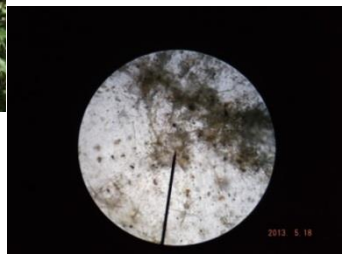
Dissertation Project 2 (Dr. Aliya Baidourela, XJU):

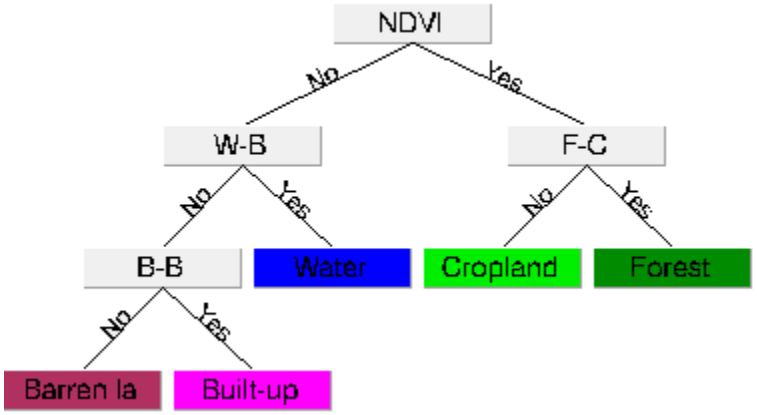
Quantification of water use efficiency and dust retention capacity of urban trees in Aksu 阿克苏市园林树种水分利用效率及滞尘能力

Air pollution poses a long-term threat to human health and life quality of urban residents. In particular, dust pollution in oasis cities located in arid areas is associated with reduced life expectancy

Methodology

- Archive analysis and interviews
- Field measurement and Lab. analysis
- Remote Sensing and GIS analysis





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Datasets/数据获取:

1)Field Data Collection

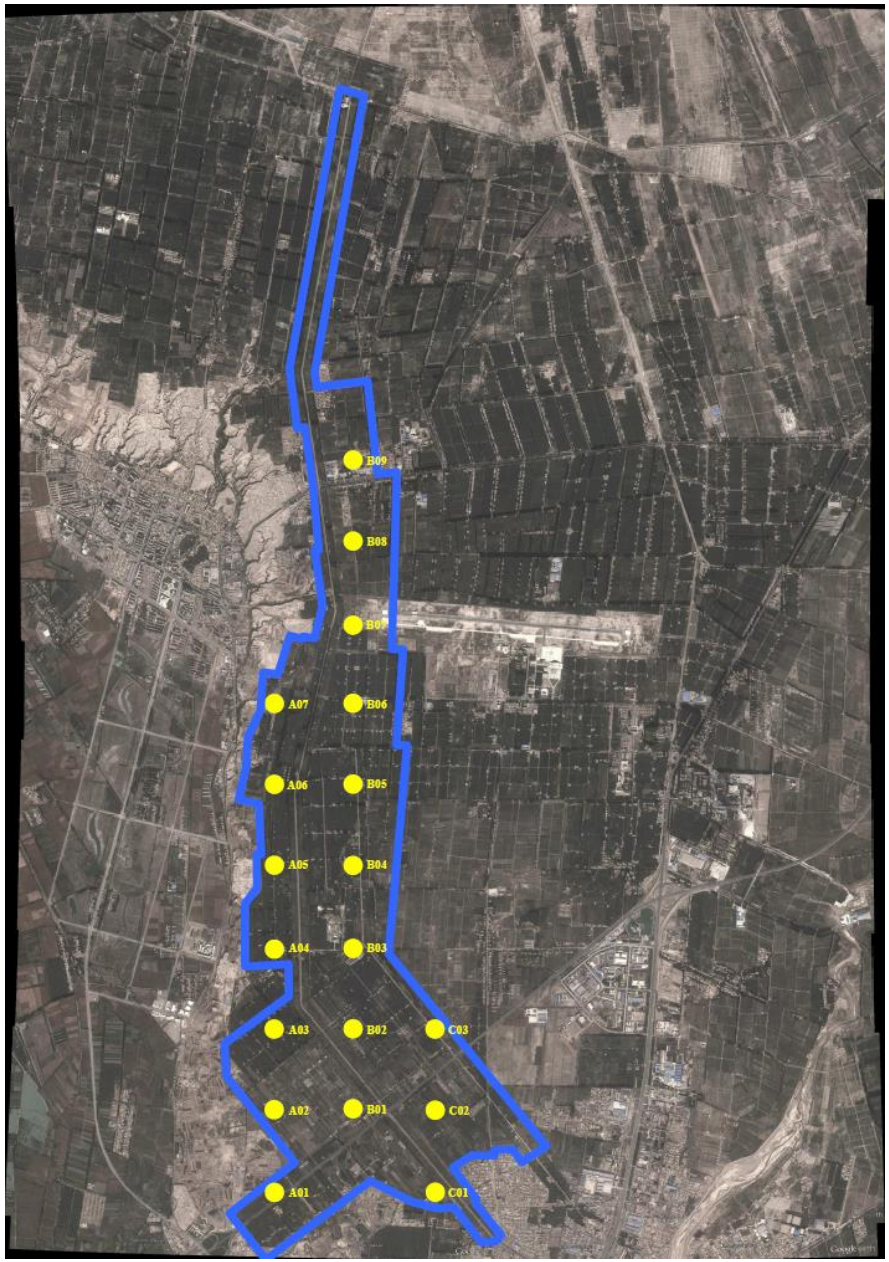
2)local archives and legal documents on urban greening of Aksu provided by the Municipal Government of Aksu, the Aksu Prefecture Bureau of Forestry and the Aksu Municipal Bureau of Forestry.

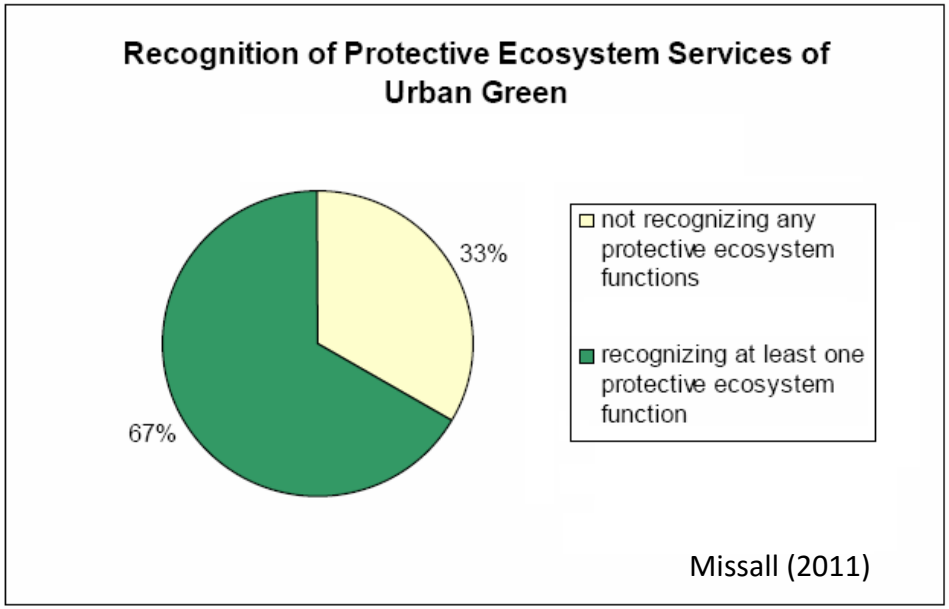
3)Urban green space indices including the total area, green coverage area as percentage of urban built up area obtained from the **statistical yearbook** of cities (1985-2012).

4)cloud-free Landsat images of the research area are obtained from the USGS website (http://glovis.usgs.gov).

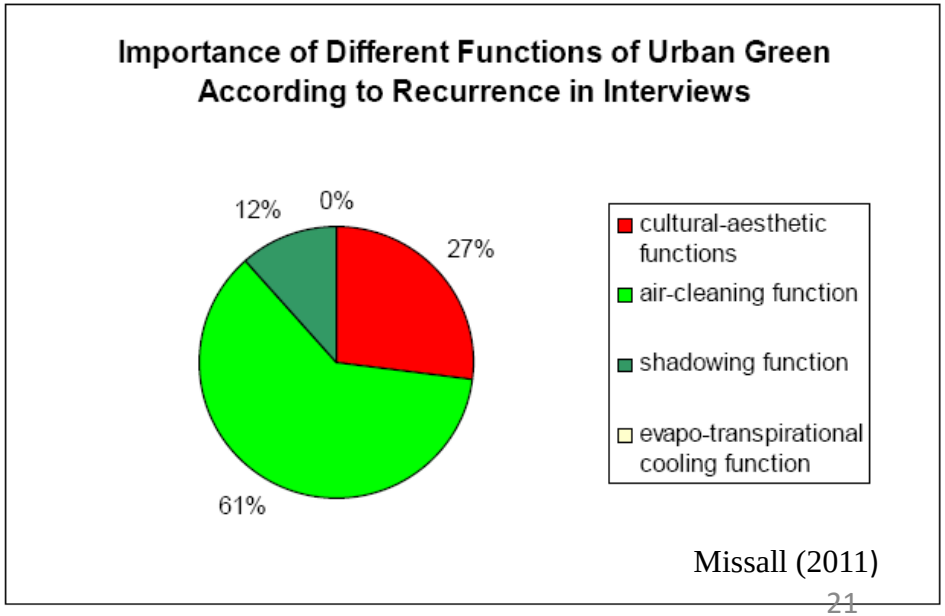
5)Interviews with local experts and officials from the Forestry Bureau of Aksu took place in 2011-2012 in Aksu and Urumqi. Field investigation on urban parks and different urban green spaces is simultaneously carried out with the interviews in Aksu.

Plot Interviews in Aksu



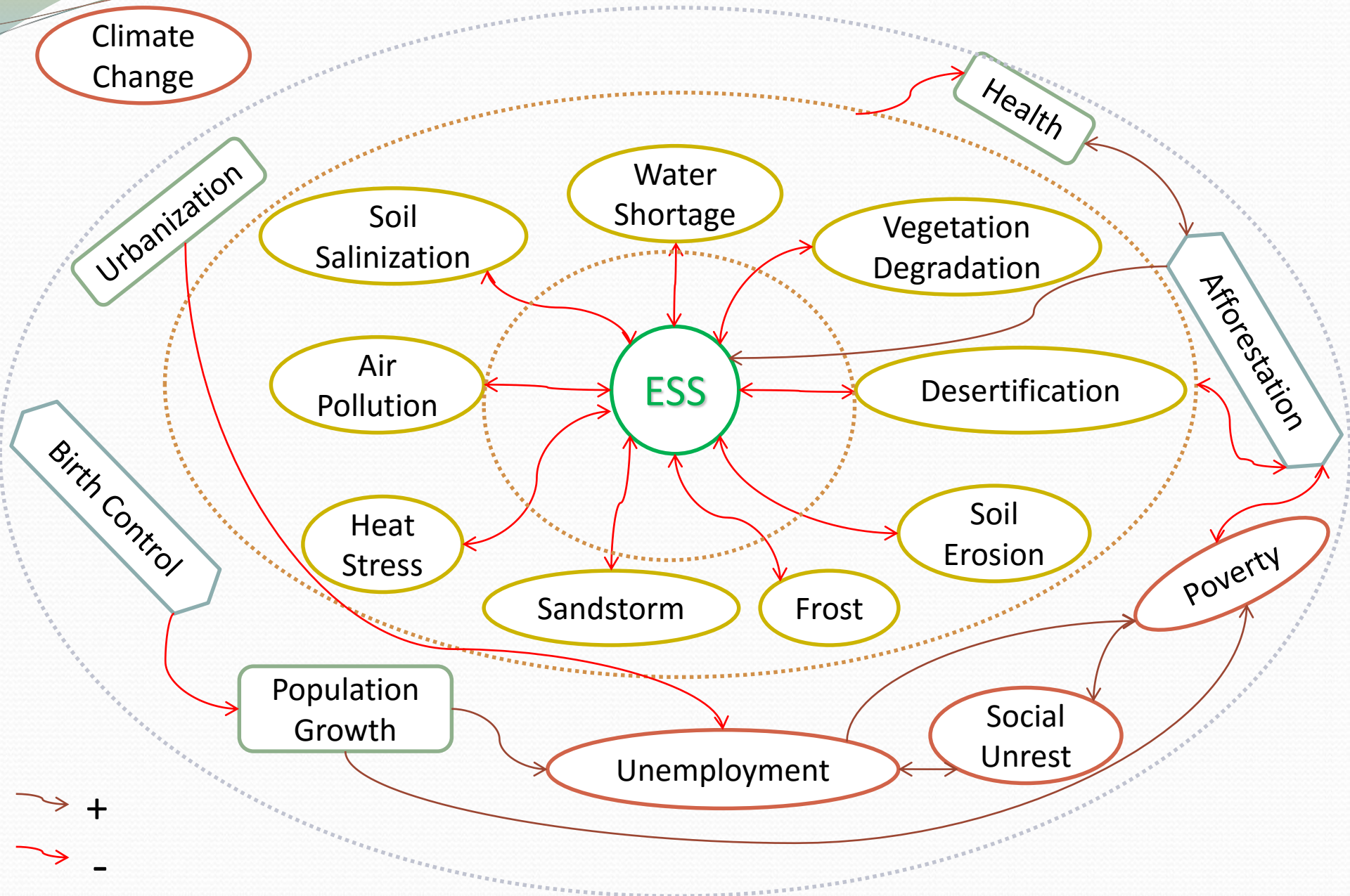


Missall (2011)

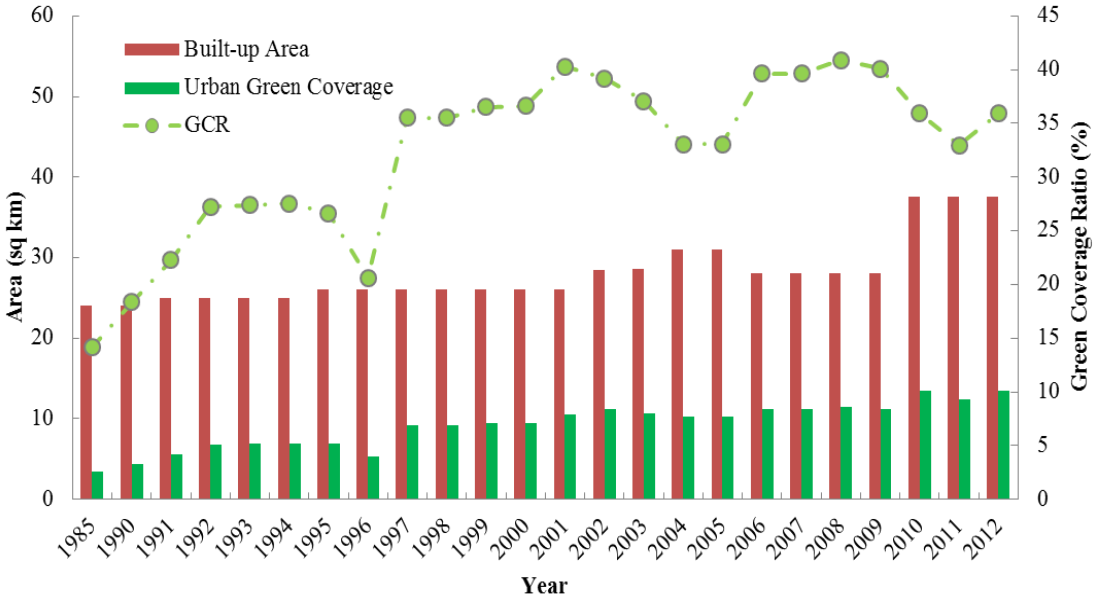


Missall (2011)

Interaction Analysis



Urban forests of Aksu



Area of urban green spaces within the built-up area of Aksu

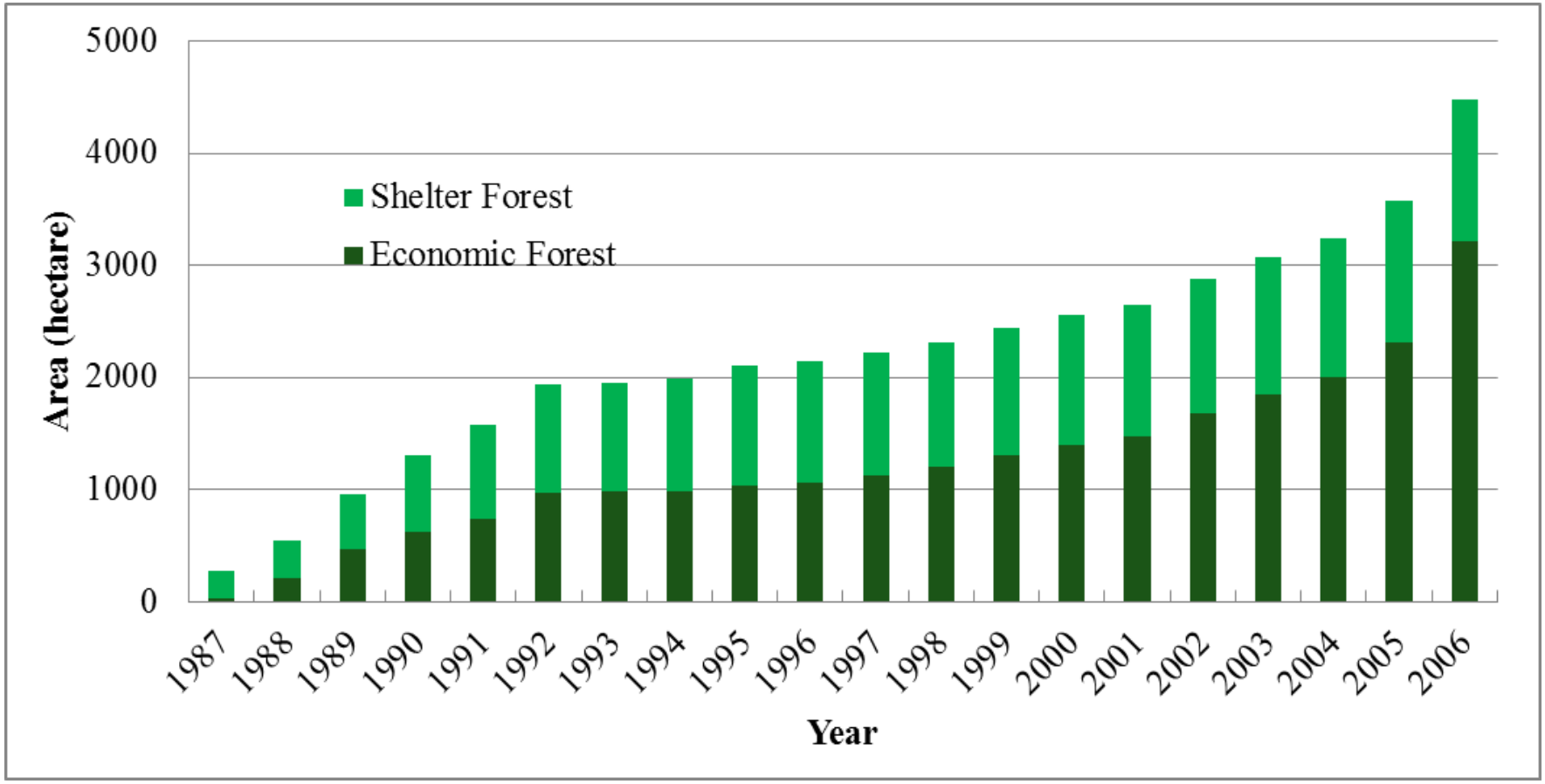
Green spaces	Area (hectare)	Per capita green space (sq. m)	Green ratio (%)
Public green space	202.9	8.9	7.22
Productive Park	42.29	1.85	1.50
Green buffer	284.86	12.49	10.14
Attached green space	578.31	25.36	20.58
Total	1042.13	45.71	**37.09**

Source: declaration data for creating state forest city of Aksu, 2007

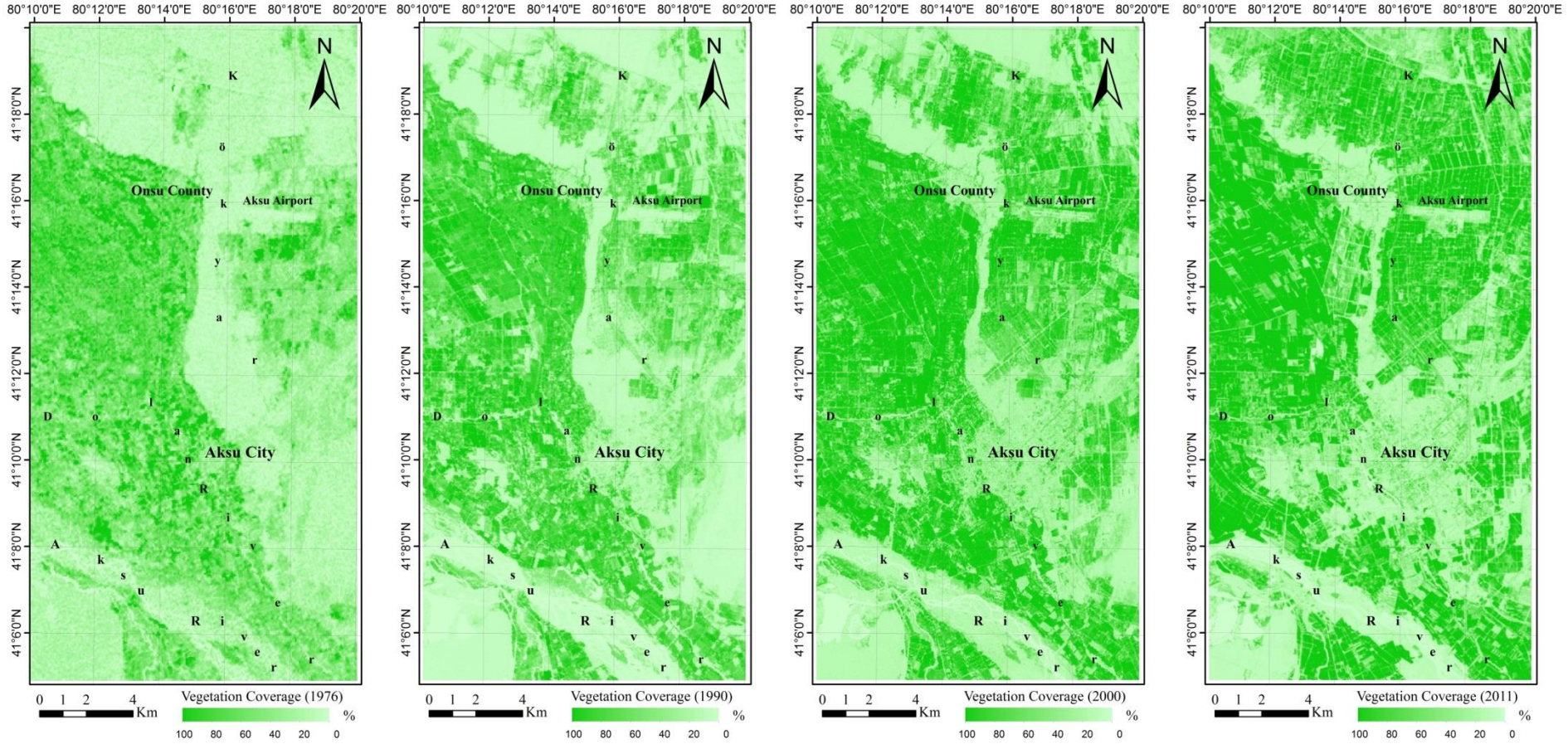
Peri-urban afforestation: Kökyar shelterbelt project

- Beginning in early 80ies
- Initial municipal support, „Community effort“
- Maintenance on the basis of private contract horticulture

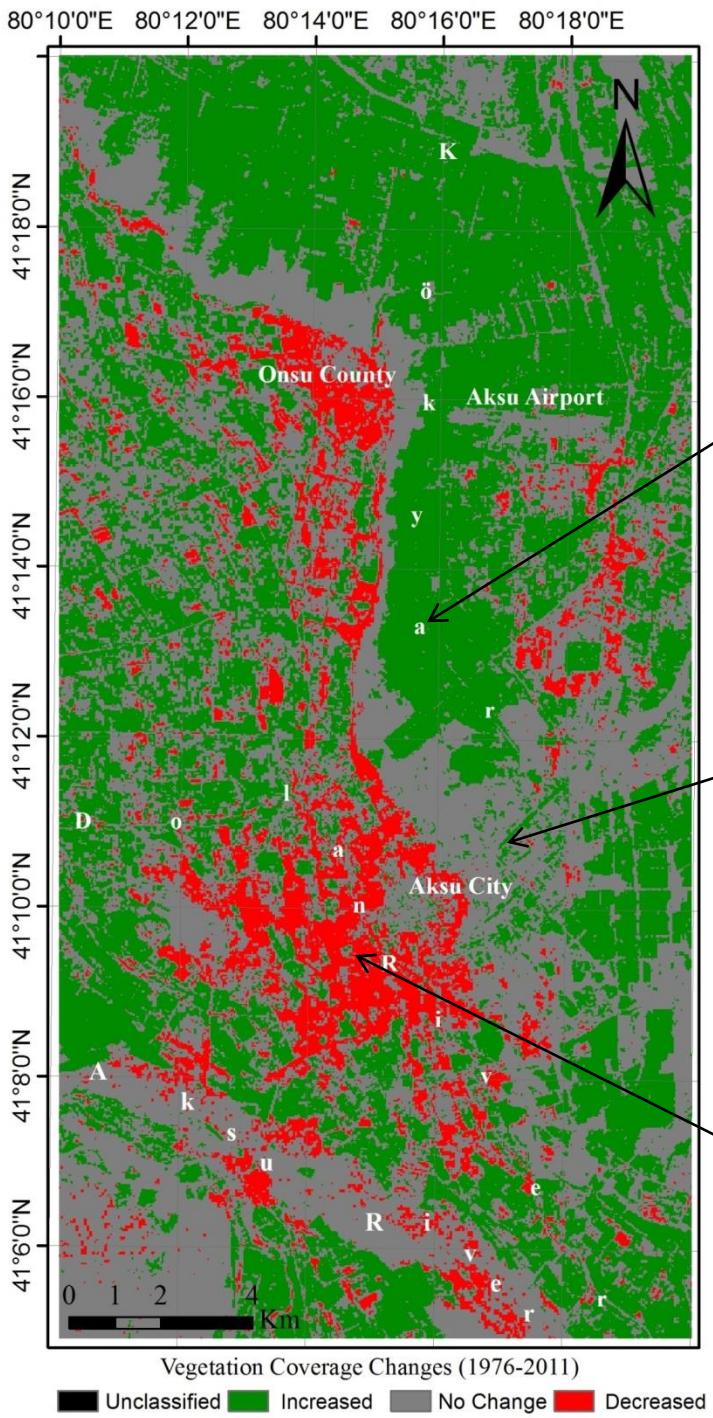
Forest area changes of Kökyar shelterbelt

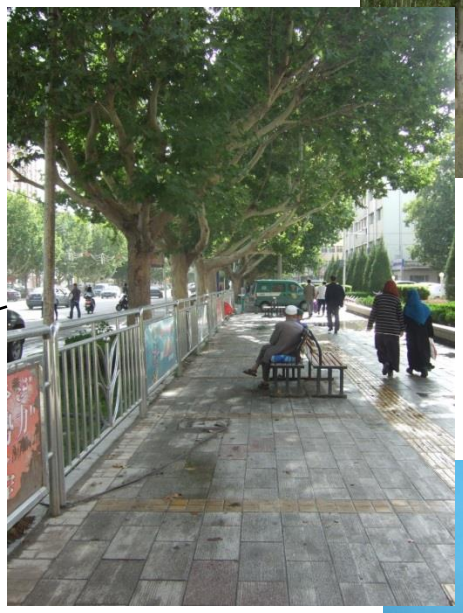


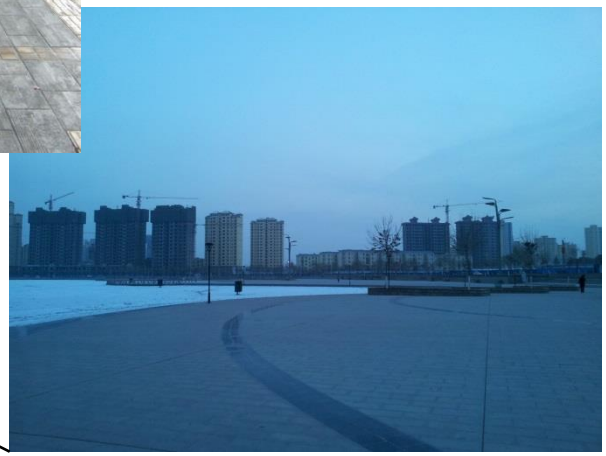
Changes in Urban & peri-urban vegetation coverage (1976, 1990, 2000, 2011)



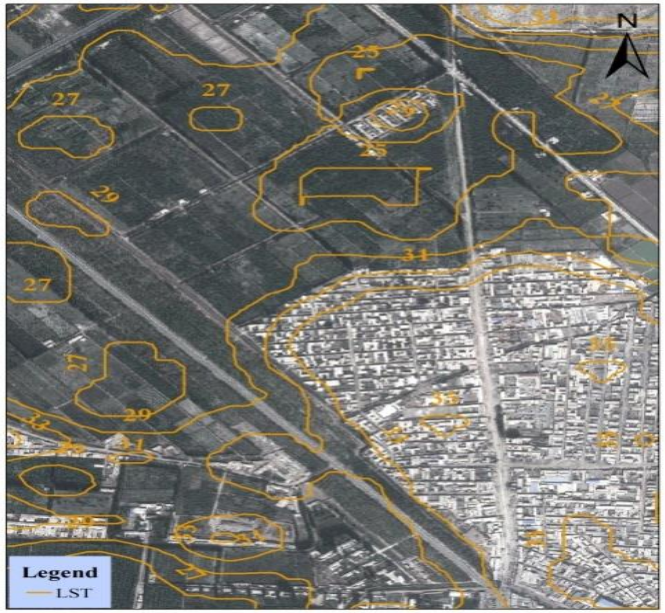
Changes in vegetation coverage

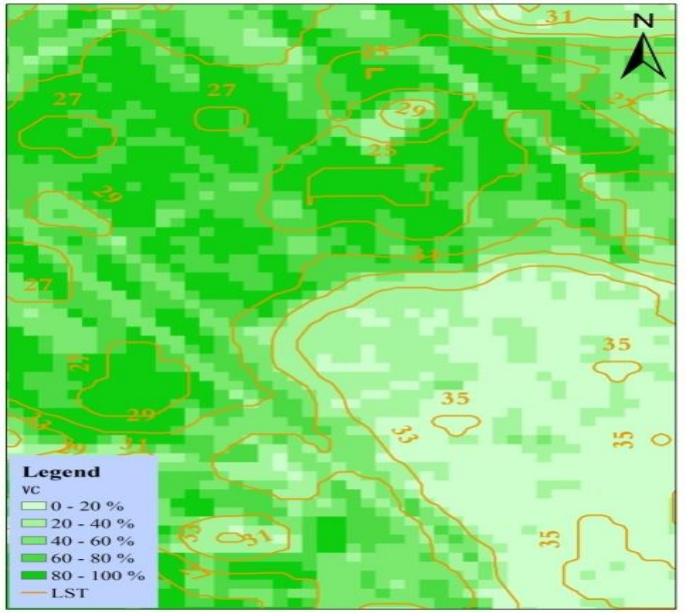


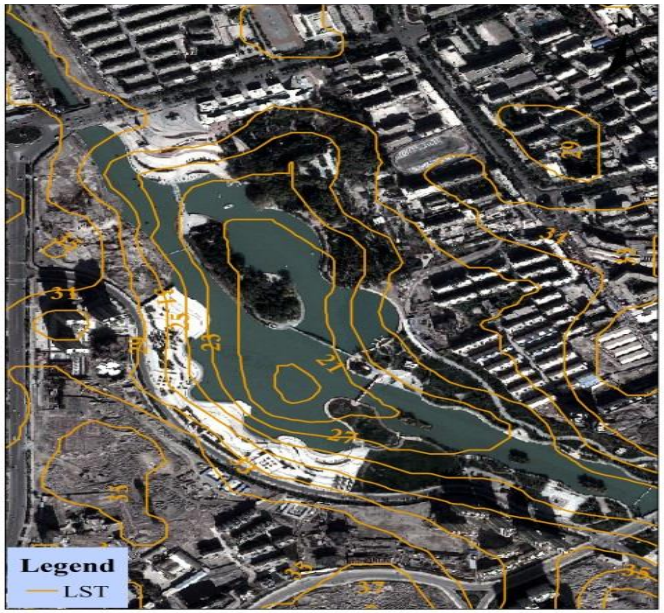


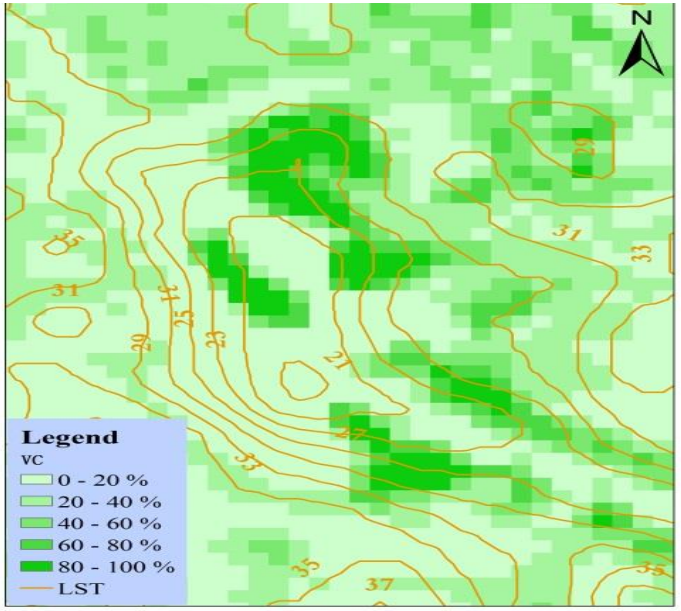


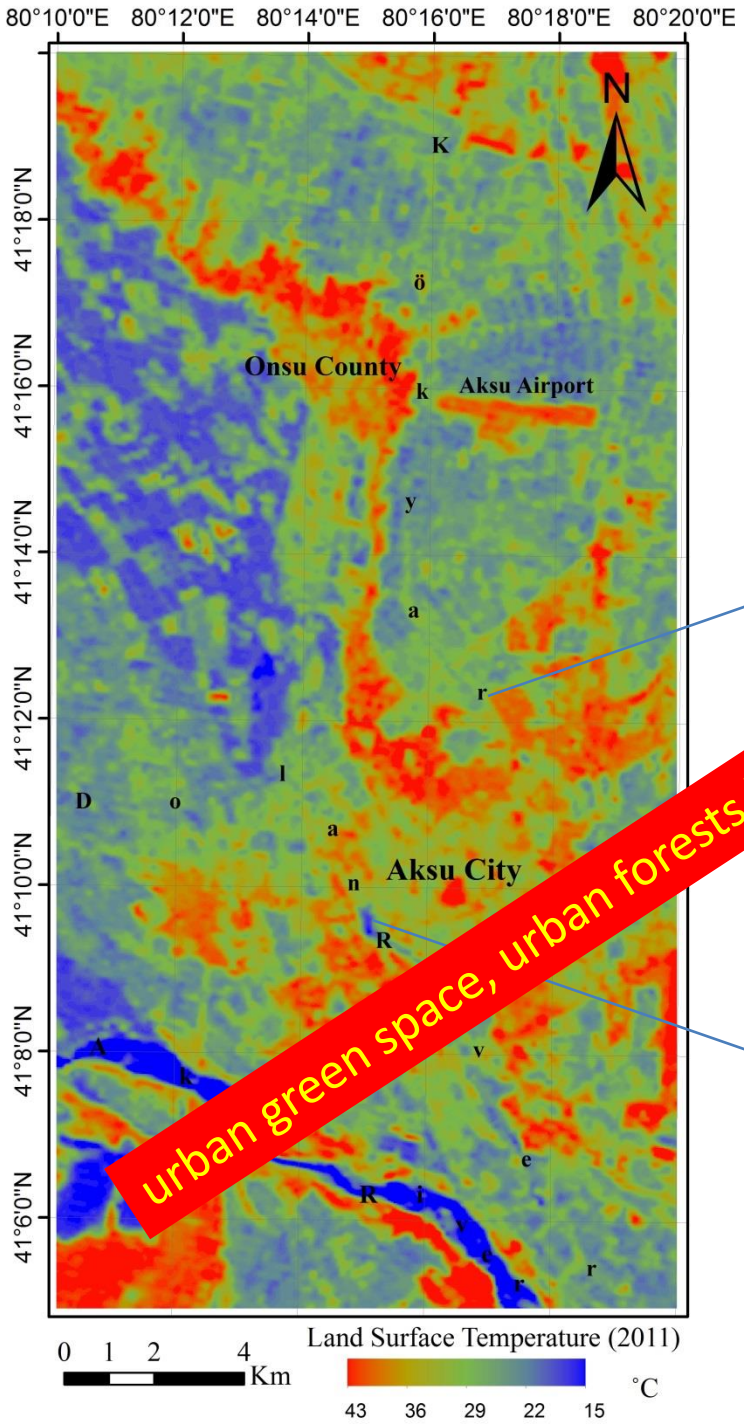
城市森林覆盖与热岛效应 Forest coverage & urban heat islands



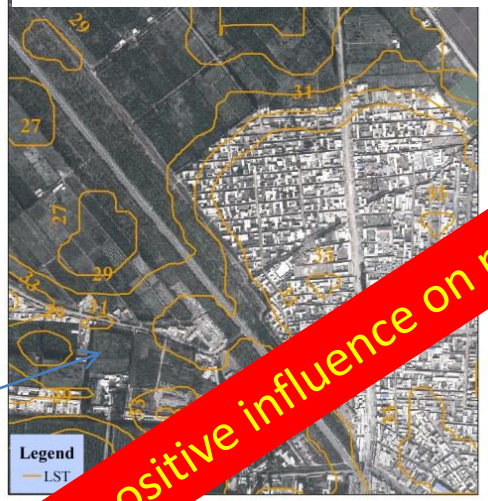


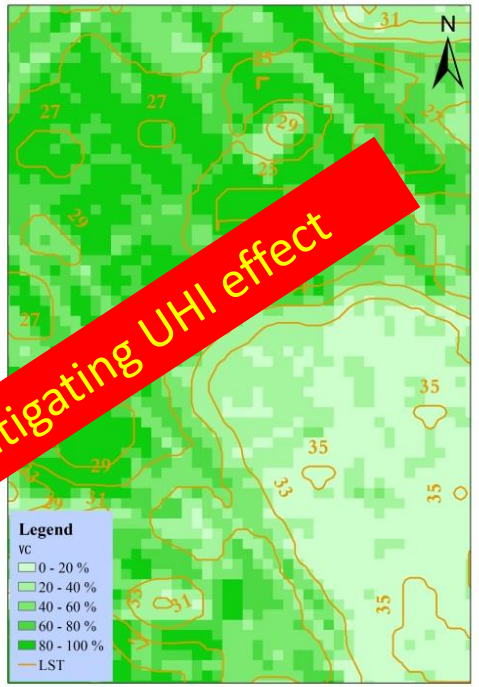


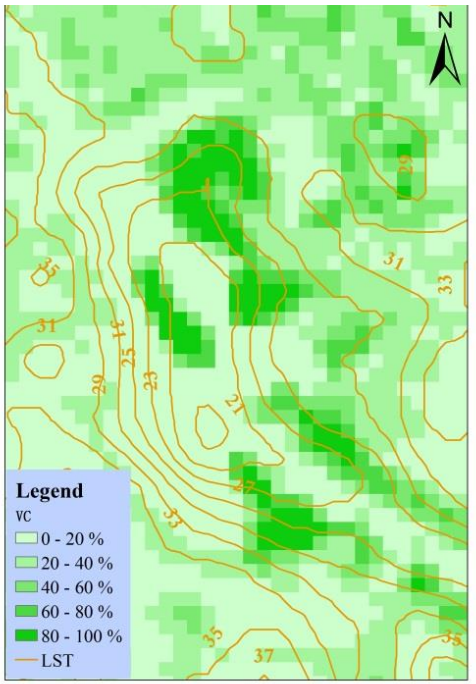




Spatial distribution of vegetation coverage & urban heat island

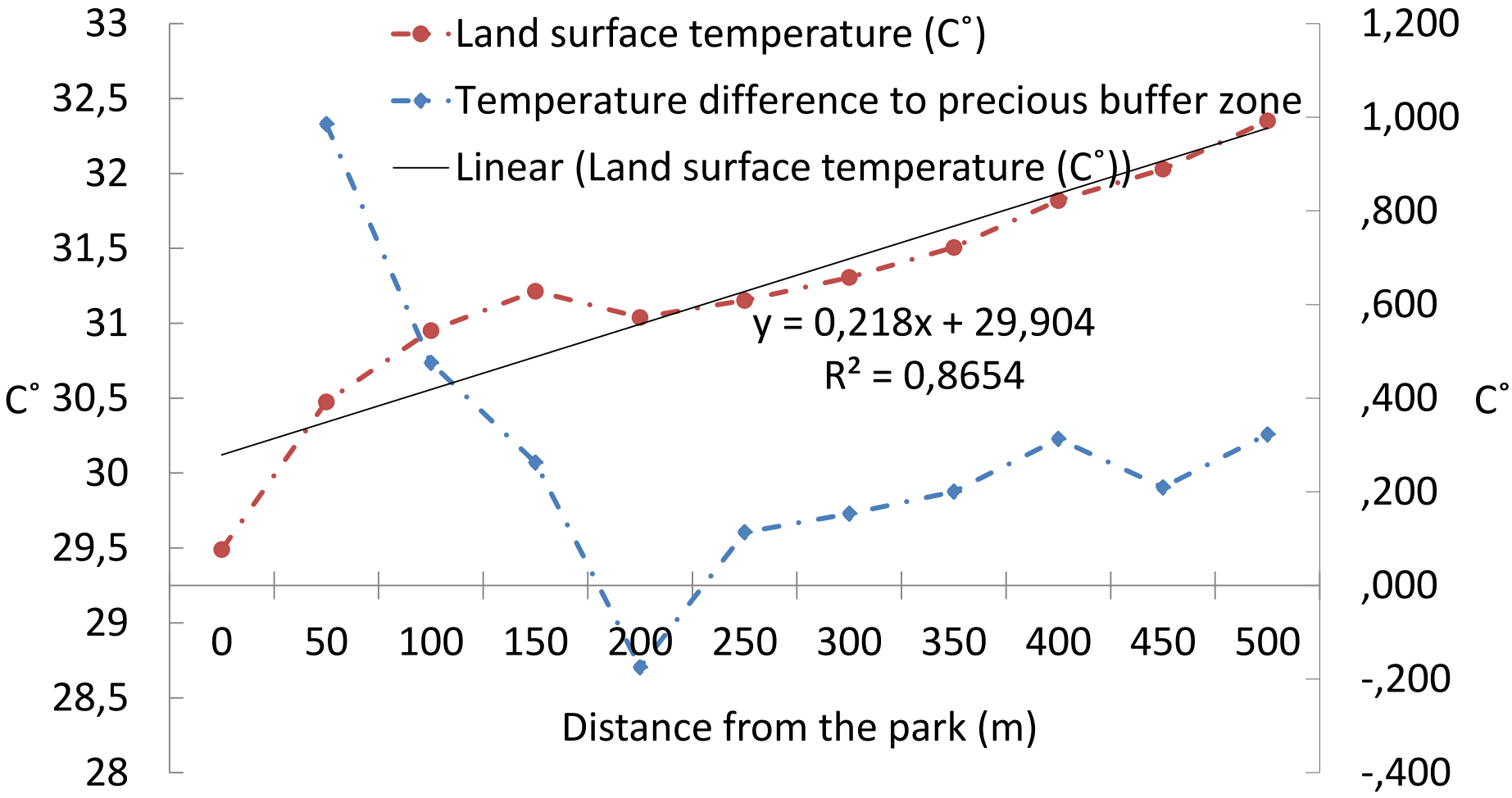






urban green space, urban forests have positive influence on mitigating UHI effect

Cooling effect of park forest



Average land surface temperature variations of buffer zones (primary vertical axis) and temperature difference to previous buffer zone (secondary vertical axis)

Conclusion & Outlook / 结论与展望

- UHI effect is strengthening the environmental pressure on the life quality of local residents. However, larger area of and abundant urban forest means increase in evapo-transpiration, and further enhance water use stresses in this particular arid city. Therefore, locally adapted, drought-resistant species should be given the priority in urban greening. 城市热岛效应严重影响着当地居民的生活质量。然而，增加城市森林的面积意味着更大的蒸散量并进一步加强城市的用水压力。因此，**适应本地和抗旱的树种在城市林业中应给予优先。**

- Urban forests need to be placed foremost and carefully planned in the future urban development in order to mitigate expected intensification of UHI effects and environmental problems owing to climate change and ongoing urbanization in the oasis cities. 在未来城市发展规划中，城市与城郊森林应放在最重要首要地位并需精心策划，以便减轻因气候变化和城市发展导致的城市热岛效应和环境问题。

- Well-managed urban forests with high water use efficiency, proper vertical structure and in reasonable size could effectively ease the UHI effects. Therefore, optimizing the configuration of urban green space seems to be more practical than increasing green coverage. 水分利用效率高、具有适当的垂直结构和合理面积大小的城市森林可以有效缓解热岛效应。因此，**优化城市绿地的配置比增加森林面积似乎更实用。**

Published papers:

1. Aliya Baidourela, Umut Halik, Tajiang Aishan. 2015: Dust Retention Capacity of Urban Trees in Arid Land Oasis Cities, Northwest China. *SCIENTIA SILVAE SINICAE* , 51(03): 57-64
2. Aliya Baidourela, Umut Halik, Tajiang Aishan, Martin Welp. 2015: Dust Retention Capacities of Urban Trees And The Influencing Factors in Aksu, Xinjiang China. *Journal of Desert Research*. 35(02): 322-329
3. Aliya Baidourela, Umut Halik, Tajiang Aishan. 2015: Dust retention effect of *Populus alba* var. *pramidalis*-A case study of Aksu, Northwest China. *Fresenius Environmental Bulletin*. 24(1b): 285-29
4. Aliya Baidourela and Kahaer Zhayimu. 2015: Patterns of Dust Retention by Urban Trees in Oasis Cities, *Nature Environment and Pollution Technology*. 14(1): 53-57
5. ——————————

Establishing a Green-GIS-Aksu / 建立一个阿克苏绿地系统GIS系统

Public participation is a prerequisite for succesful urban forestry

“公众参与”是城市森林建设的必要前提

„*Guide to Sustainable Urban Green Management in arid North west China*“ in prep.

正在准备一本“干旱区城市绿化可持续管理”维汉手册，之将为市民免费使用。


ROBIN
EH10

谢谢各位聆听！

Thank you for your attention!

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