沈阳生态所在城市天空开阔度估算方法研究中获进展

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本文原地址：https://www.iikx.com/news/progress/7879.html

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天空开阔度是一个几何概念，指一个平面从天空接收（或发射）的辐射与整个半球辐射环境发射（或接收）的辐射之比，用无量纲值来描述城市街谷可见天空或开放峡谷空间的比例。天空开阔度是影响城市地表热平衡、微尺度空气循环、大气污染物扩散的关键因素，在城市微气候研究中起着重要作用。天空开阔度的估算方法种类多样。而目前并没有相关论文系统总结各种方法的估算原理、准确性、计算效率、应用范围等。

中国科学院沈阳应用生态研究所科研人员将天空开阔度的估算方法分为数学几何分析法、鱼眼镜头照片法（digitals solution, Fish-eye Image Processing, BMSky view software, RayMan, CCL method）、全球定位系统法、模型估算法（3DSky View, Arc-View SVF extension, SOLWEIG, SkyHelio model, SVFEngine, Munoz ’ s method）和街景图像法五种（表1）。提出方法选择要考虑的因素有研究尺度、城市街谷环境的复杂性、准确性、输入输出的数据类型、研究高度、计算能力和时间等。鱼眼镜头照片法的图示信息直观，估算的准确度高，可用于检验计算机技术估算结果的准确性。基于deep learning model的街景图像法可以获得与鱼眼照相方法几乎相同的估计精度。未来研究应该集中于模型模拟以及街景图像法在不规则街谷和复杂城市环境中的应用，同时还要考虑不同季节行道树和太阳路径差异对天空开阔度估算的影响。

该研究综述不同空间尺度天空开阔度的估算需求，可为学者在城市气候学和城市热岛研究中提供方法选择。该研究以*Review of methods used to estimate the sky view factor in urban street canyons* 为题发表于期刊*Building and Environment*。城市生态学研究组博士后苗纯萍为第一作者，研究员陈玮为通讯作者。该研究得到国家自然科学基金重点项目、青年项目，中国博士后科学基金面上项目等的支持。

文章链接

表1 五种天空开阔度估算方法比较

Methods		Input requirements	Output relevance	Strengths	Weaknesses
Geometric methods		Stereo angle	The position of given point	Gives a theoretical framework; accuracy	Can only be applied in simple and regular street canyons; time-consuming; neglects the effects of trees
Fish-eye photographic methods	SKYVIEW	Digital fish-eye images	Image resolutions; pixel size	High accuracy; includes the effect of trees	Time-consuming; manual work required
	Fisheye Image Processing	Digital fish-eye images in JPEG			
	BMSky view	Fish-eye images			
	CCL method	High resolution fish-eye images			
	RayMan	Fish-eye images; 3D building models; plant models			
Global Positioning System methods		Satellite visibility data with a GPS receiver	Regression equations; GPS system	Real-time calculation	Low processing accuracy; the evaluation formula varies with GPS equipment
Simulation methods	3DSky view	GIS-based 3D building database	Spatial resolution of database; database types; transformations algorithm	Advantageous in large sets of computations; raster-based methods gained in efficiency and low computing cost, while vector-based methods showed high accuracy	The accuracy depends on the spatial resolution of the database used; some are limited in support for 3D interactions and customization
	ArcView SVF extension	Vector-based 3D building database			
	SOLWEIG	Digital elevation model			
	SkyHelios	Fish-eye images; 3D building models;			
	SVFEngine	3D city model			
	Munoz's method	3D city model			
Big data approaches		Street view images	Geometric transformations; seasonal variation of vegetation	Advantageous in estimation on a large scale; freely available data sources; without manual fieldwork	Height of street view images is limited to about 2 m; SVFs are influenced by seasonal variation of vegetation

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