

## 著作类成果

# 蒸散发尺度效应与 时空尺度拓展

### 【创新性】

本书采用试验观测与理论分析相结合的方法，揭示了蒸散发的尺度效应，构建了蒸散发时空尺度扩展与提升方法，建立了不同尺度的蒸散发估算模型，开展了基于蒸散发尺度效应的农业用水效率与效益评价研究。取得的主要创新性成果包括：揭示并阐释了华北地区主要农作物生长期蒸散发的尺度变异规律与变化趋势，科学辨识出影响蒸散发尺度效应的各类主控因子，为实现蒸散发时空尺度扩展与提升以及合理评价农业用水效率与效益奠定了可靠的基础；系统阐述了从瞬时到日、再到全生育期的蒸散发时间尺度扩展机制与方法，创新融合叶片截获辐射的空间差异与气孔导度对辐射的非线性响应特征，构建了典型作物从叶片到农田的蒸散发空间尺度提升半理论模型，为蒸散发的多时空耦合关联转换提供了理论方法；建立起适用于任意时间尺度的水热耦合平衡方程，构建了基于蒸散发互补相关理论的非线性函数模型，统一了蒸散发研究中对实际与潜在蒸散发之间关系的认识，发展和丰富了水热耦合平衡原理和蒸散发互补相关理论的内容；提出了基于蒸散发尺度效应的农业用水效率与效益综合评价方法及其评价指标体系，模拟评价了不同空间尺度的水分利用效率变化规律，为农业高效用水提供了综合评估方法。

主要完成人：许迪、刘钰、杨大文、张宝忠、韩松俊  
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### 【影响力】

国际灌排委员会前主席 Luis S. Pereira 认为“该成果拓展了人们对蒸散发在多时空维度的认知，对蒸散发理论体系构建做出了重要贡献”。美国工程院院士 Brutsaert 教授对提出的蒸散互补方法高度认可，且被多国学者广泛采用。茆智院士、康绍忠院士也对本专著给予高度评价。

# EVAPOTRANSPIRATION SCALE EFFECT AND TEMPORAL-SPATIAL SCALE EXPANSION

### 【Innovation】

Based on test observation and theoretical analysis, this book reveals the scale effect of evapotranspiration, establishes evapotranspiration temporal-spatial scale expansion and lifting methods, sets up evapotranspiration estimation models on different scales, and conducts a research of agricultural water efficiency and benefit evaluation based on evapotranspiration scale effect. Innovative achievements include: it reveals and expounds the evapotranspiration scale variation law of main crops in growing period in North China, scientifically identifies main control factors that affect evapotranspiration scale effect, and lays a reliable foundation for expanding and lifting the spatial-temporal scale of evapotranspiration and rationally assessing agricultural water efficiency and benefit; systematically expounds the mechanism and method for expanding evapotranspiration temporal scale from transient to day and then to whole growth period, establishes a semi-theoretical model of evapotranspiration spatial upscaling for typical crops from leaf to farmland through innovatively combining

the spatial difference in leaf's interception of radiation and the characteristics of stomatal conductance's non-linear response to radiation, and provides theoretical methodology for the multi-space coupling, connecting and switch of evapotranspiration; establishes a hydro-thermal coupling equilibrium equation applicable to any temporal scale and a nonlinear function model based on evapotranspiration complementation theories, unifies the knowledge about the relations between actual and potential evapotranspiration in evapotranspiration studies, and develops and enriches the content of hydro-thermal coupling equilibrium theory and evapotranspiration complementation theory; proposes agricultural water efficiency and benefit comprehensive assessment method based on evapotranspiration scale effect and its indicator system, simulates and assesses the variation law of water use efficiency on different spatial scales, and provides comprehensive assessment methodology for efficient water use in agriculture.

### 【Influence】

Former President Luis S. Pereira of the International Commission on Irrigation & Discharge (ICID) deems "this achievement expands the recognition of evapotranspiration on multiple spatial scales, and makes an important contribution to the establishment of the theoretical system of evapotranspiration". Academician Prof. Brutsaert

of the U.S. National Academy of Engineering (NAE) highly affirms the evapotranspiration complementation method presented in this book, and it has been widely used by scholars in various countries. In addition, Academicians Mao Zhi and Kang Shaozhong also speak highly of this book.

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