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翻译

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产业生态学中关于气候变化文献的文本挖掘分析

作者：Fazle Rabbi Dayeen, Abhinav S. Sharma, Sybil Derrible

关键字： 学术出版，气候变化，产业生态学，弹性，文本挖掘，主题建模

摘要：
自 1990 年以来，与气候变化研究相关的文献有了巨大的发展。本研究的目的是使用文本挖掘评述气候变化文献并研究其主要趋势的演进。首先从《产业生态学杂志》的“关于气候变化适应性和弹性的产业生态学”专刊发表的文章中选择特定关键词。然后从 Web of Science 下载了 1990-2018 年发表的包含这些关键词的 35000 多种出版物的详细信息，分析了出版物的数量和共现关键字。此外，隐狄利克雷分配（LDA）是一种概率方法，可以从大型非结构化的文本文档中检索主题，该方法被应用于摘要以揭示自然产生的主要主题（由新术语组成）。随后基于主题的相对频率分析一些新兴主题的重要性随时间的演变情况。总体而言，研究显示气候变化出版物数量迅速增长。诸如“气候变化适应性”之类的术语出现上升趋势，而“污染”之类的其他术语呈现下降趋势。此外，“气候变化适应性”和“弹性”等术语经常同时出现。本研究收集的数据库和基于 Python 开发的 LiTCoF（文献主题共现和频率）工具可以公开访问。本文符合 http://jie.click/badges 中所述的 JIE 数据开放徽章的要求。

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A text mining analysis of the climate change literature in industrial ecology

Fazle Rabbi Dayeen, Abhinav S. Sharma, Sybil Derrible

Keywords: academic publishing, climate change, industrial ecology, resilience, text mining, topic modeling

Summary:
The literature on climate change research has evolved tremendously since the 1990s. The goal of this study is to use text mining to review the climate change literature and study the evolution of the main trends over time. Specific keywords from articles published in the special issue “ Industrial Ecology for Climate Change Adaptation and Resilience” in the Journal of Industrial Ecology are first selected. Details of over 35,000 publications containing these keywords are downloaded from the Web of Science from 1990 to 2018. The number of publications and co-occurrence of keywords are analyzed. Moreover, latent Dirichlet allocation (LDA)—a probabilistic approach that can retrieve topics from large and unstructured text documents—is applied on the abstracts to uncover the main topics (consisting of new terms) that naturally emerge from them. The evolution in time of the importance of some emerging topics is then analyzed on the basis of their relative frequency. Overall, a rapid growth in climate change publications is observed. Terms such as “climate change adaptation” appear on the rise, whereas other terms are declining such as “pollution.” Moreover, several terms tend to co-occur frequently, such as “climate change adaptation” and “resilience.” The database collected and the LiTCoF (Literature Topic Co-occurrence and Frequency) Python-based tool developed for this study are also made openly accessible. This article met the requirements for a gold – gold JIE data openness badge described http://jie.click/badges.

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产业生态学、气候适应和财务风险

作者：Timo Busch

关键字： 适应性、碳排放、气候变化、环境影响评价、产业生态学概念、产业生态学工具、风险管理

摘要：
适应气候变化已成为公司风险管理的重要主题。在此背景下，本文研究了产业生态学工具和概念对此主题的意义。结论是，产业生态学已有的工具和概念，其设计本意并不是协助管理人员应对气候适应和相关的财务风险。但是，这些工具和概念提供了许多有助于评估和管理气候风险的功能。产业生态学工具主要为管理、决策过程提供指导，尤其是在数据处理方面。产业生态学概念可以作为构建新的气候风险管理框架的起点。

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Industrial ecology, climate adaptation, and financial risk

Timo Busch

Keywords: adaptation, carbon emissions, climate change, environmental impact assessment, IE concepts, IE tools, risk management

Summary:
Climate adaptation has become an important topic for risk management in companies. This article investigates the usefulness of Industrial Ecology tools and concepts in this context. The conclusion is that the established tools and concepts were not designed with the purpose of assisting managers in the climate adaptation and related financial risk context. Nevertheless, the tools and concepts offer plenty of aspects and features that are helpful for the assessment and management of climate risks. The tools primarily provide guidance for the managerial decision-making process, notably in terms of data handling. The concepts can be used as a starting point for developing new climate risk management frameworks.

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气候变化适应与韧性视角下的矿产资源管理

作者： Raimund Bleischwitz

关键字： 循环经济、气候变化、经济分析、物质效率、方法、资源管理

摘要：
适应气候变化是应对气候变化的策略之一，而现有矿产资源管理研究大多立足于气候变化减缓。气候变化适应与矿产资源的关联在于：适应气候变化会导致新的矿产资源需求，而矿产资源的开发与利用对反过来影响气候变化。本文以该关联为核心论点，从气候变化适应的角度对矿产资源管理中的供应短缺、风险与不确定性、资源要素间的耦合等问题进行了系统梳理。在此基础上，本文对产业生态学各工具的适用性进行了初步评价，并指出相应的研究与改进方向。例如，基础设施在气候适应过程中将面临哪些风险与挑战？如何考虑物理和虚拟基础设施在增强气候韧性过程中所起到的作用？如何确保相关矿产资源的循环利用和可持续供给？本文还评估了产业生态学与其他相关学科领域的结合潜力，以期在适应气候变化的同时，帮助实现联合国可持续发展目标中的一系列子目标。

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Mineral resources in the age of climate adaptation and resilience

Raimund Bleischwitz

Keywords: circular economy, climate change, economic analysis, materials efficiency, methods, resource management

Summary:
This article discusses issues on resources availability to achieve climate adaptation and resilience for cities and infrastructures. In the age of climate change, there could be cascading failures through a range of infrastructure breakdowns. Direct and indirect damage costs could exceed what had been estimated in traditional risk assessments. This could be exacerbated through abrupt price peaks in international supply chains of minerals, and through events happening in remote parts of the world that affect extraction and vulnerable industries. The core argument made here is one of feedbacks: climate adaptation has significant resource implications, and how resources are being used will have implications on climate strategies. Industrial Ecology has a role to play assessing those interactions and providing a better grasp of the spatial dimension of material flows, partly to track those flows and align them to specific actors, and partly to address interlinkages across different flows and their stocks ('the resource nexus'). Methodological novelties are needed to better understand the resource base and the socio-economic dimension, especially on innovations and transitions that can help to cope with the challenges ahead. Altogether this would enable research to establish an evidence base on sustainable materials to deliver parts of the UN Sustainable Development Goals (SDGs) and to reassess infrastructure assets and the mineral resources in the age of climate adaptation and resilience.

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从城市代谢到城市免疫系统

作者：David N. Bristow, Eugene A. Mohareb

关键字： 产业生态学，物质流分析，气候变化恢复与适应，可持续城市系统，城市免疫系统，城市代谢

摘要：
城市地区面临着越来越多的风险。城市奉行多种策略来抵制、恢复及适应各种冲击和压力，但是人们对这些方法在整个城市范围内的关系以及城市在能力方面的比较了解甚少。解决这些差距的部分挑战是，通常要着重研究一种或几种危害或通过单一部门的视角来研究城市风险。本文提出了一个“城市免疫系统（UIS）”的框架，以合并和扩展关于城市风险管理的产业生态学研究。与城市代谢（UM）作为城市环境可持续的统一框架一样，城市免疫系统也可以是城市恢复力（尤其是与气候变化有关）的统一框架。本文定义了城市免疫系统，剖析了其功能。本文的结论是通过研究城市免疫系统与气候变化之间的关系，确定城市免疫系统在气候变化下日益重要的属性。

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From the urban metabolism to the urban immune system

David N. Bristow, Eugene A. Mohareb

Keywords: industrial ecology, material flow analysis (MFA), resilience and adaptation to climate change, sustainable urban systems, urban immune system, urban metabolism

Summary:
Urban areas face mounting risks from many sources. Cities pursue myriad tactics to resist, recover from and adapt to shocks and stresses, but little is known about how these approaches relate across the scales of a city nor how cities compare in their abilities. Part of the challenge in addressing these gaps is that the risk to cities is typically studied with an emphasis on one or a few hazards or through the lens of a singular sector. This paper proposes a framework, dubbed the Urban Immune System (UIS) to coalesce and expand industrial ecology research on urban risk management. In the same way that Urban Metabolism (UM) is a unifying framework for urban environmental sustainability, UIS can be a unifying framework for urban resilience, especially related to climate change. Herein, UIS is defined, its many capabilities are dissected and linked to disparate studies; and opportunities for application of the concept are provided. The paper concludes by examining the relationship between UIS and climate change and by identifying those attributes of the UIS that are expected to be of increasing importance under climate change.

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产业生态学在粮食和农业适应气候变化中的作用

作者：Alissa Kendall, Edward S. Spang

关键字： 循环流，效率，产业生态学，生命周期评估（LCA），物质流分析（MFA），弹性

摘要：
粮食和农业部门对气候变化有显著贡献，但也特别容易受到气候变化的影响。产业生态学已经致力于研究这些部门对气候变化的贡献，但没有解读它们面对气候变化的脆弱性。我们必须通过制定气候变化适应和恢复战略来解决气候变化脆弱性。但是，产业生态学的主要目标（效率、循环流和污染预防）与气候变化适应和弹性所需的目标之间不相匹配。我们在此开发两种可能的方法，可以克服（或在其中解决）这种问题，并将产业生态学的工具与适应气候变化的学科和方法相结合。第一种思路是在气候变化适应策略之上的产业生态学工具，例如人们可以比较不同适应策略对环境的影响。另一种思路将气候变化适应性嵌入产业生态工具中，例如，通过重新定义生命周期评估（LCA）中的功能单元以包括适应性功能。在这两种方法中，产业生态学都通过提供环境好坏的定量指标，为气候变化适应和恢复决策提供信息。鉴于粮食和农业对减缓温室气体排放的重大贡献和潜力，产业生态的这一作用至关重要。但是，这表明产业生态在气候适应中的作用将是作为适应战略的评估者，而不是发起者。

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The role of industrial ecology in food and agriculture's adaptation to climate change

Alissa Kendall, Edward S. Spang

Keywords: cyclic flows, efficiency, industrial ecology, life cycle assessment (LCA), mitigation, resilience

Summary:
The food and agriculture sectors contribute significantly to climate change, but are also particularly vulnerable to its effects. Industrial ecology has robustly addressed these sectors' contributions to climate change, but not their vulnerability to climate change. Climate change vulnerability must be addressed through development of climate change adaptation and resiliency strategies. However, there is a fundamental tension between the primary objectives of industrial ecology (efficiency, cyclic flows, and pollution prevention) and what is needed for climate change adaptation and resiliency. We develop here two potential ways through which the field can overcome (or work within) this tension and combine the tools and methods of industrial ecology with the science and process of climate change adaptation. The first layers industrial ecology tools on top of climate change adaptation strategies, allowing one to, for example, compare the environmental impacts of different adaptation strategies. The other embeds climate change adaptation and resiliency within industrial ecology tools, for example, by redefining the functional unit in life cycle assessment (LCA) to include functions of resiliency. In both, industrial ecology plays a somewhat narrow role, informing climate change adaptation and resilience decision-making by providing quantitative indicators of environmental performance. This role for industrial ecology is important given the significant contributions and potential for mitigation of greenhouse gas emissions from food and agriculture. However, it suggests that industrial ecology's role in climate adaptation will be as an evaluator of adaptation strategies, rather than an originator.

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迈向可持续的气候变化适应

作者：Yi Yang, Beibei Liu, Peng Wang, Wei-Qiang Chen, Timothy M. Smith

关键字： 气候变化适应，气候韧性，气候智能型农业，生命周期评价，低碳基础设施，物质流分析

摘要：
产业生态学以其全生命周期系统的思想和扎实分析方法，例如生命周期评价、物质流分析和环境投入产出分析等，为缓解气候变化研究做出了巨大贡献。然而，它对适应气候变化的潜在贡献尚不清楚。在持续变化的气候中，适应气候变化已变得越来越紧迫，特别是在发展中国家。据估计，这些国家将饱受气候变化带来的损害。在简要回顾气候变化影响及适应的文献的基础上，我们认为产业生态学可以在以下两个方面发挥重要作用。首先，从系统的角度来看，产业生态学可以帮助我们确定气候变化如何与社会经济系统相互作用，以及这些相互作用可能如何加重(或减轻)其直接影响，或者它们是否会将负担转移到其他环境影响上。其次，产业生态学方法可以帮助我们量化适应活动对环境的直接和间接影响，寻求缓解气候变化影响的机会，并达到可持续的适应。更重要的是，我们发现需要大量投资来提高发展中国家基础设施(如交通、能源和供水)与农业的抗灾能力。由于这些部门也是环境退化的主要驱动因素，因此需要在未来的产业生态学研究中特别关注如何在发展中国家实现基础设施和农业的可持续气候韧性。总之，产业生态学的思想和方法在气候变化适应的研究和政策问题上有很大的潜力，对这一不断发展的领域的探索也将促进产业生态学的前进。

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Toward sustainable climate change adaptation

Yi Yang, Beibei Liu, Peng Wang, Wei-Qiang Chen, Timothy M. Smith

Keywords: climate change adaptation, climate resilience, climate-smart agriculture, life cycle assessment (LCA), low-carbon infrastructure, material flow analysis

Summary:
Industrial ecology (IE) has made great contributions to climate change mitigation research, in terms of its systems thinking and solid methodologies such as life cycle assessment, material flow analysis, and environmentally extended input–output analysis. However, its potential contribution to climate change adaptation is unclear. Adaptation has become increasingly urgent in a continuously changing climate, especially in developing countries, which are projected to bear the brunt of climate-change-related damages. On the basis of a brief review of climate change impacts and adaptation literature, we suggest that IE can play an important role in the following two aspects. First, with the emphasis on a systems perspective, IE can help us determine how climate change interacts with our socio-economic system and how the interactions may aggravate (or moderate) its direct impacts or whether they may shift burden to other environmental impacts. Second, IE methodologies can help us quantify the direct and indirect environmental impacts of adaptation activities, identify mitigation opportunities, and achieve sustainable adaptation. Further, we find that substantial investment is needed to increase the resilience of infrastructure (e.g., transport, energy, and water supply) and agriculture in developing countries. Because these sectors are also the main drivers of environmental degradation, how to achieve sustainable climate-resilient infrastructure and agriculture in developing countries deserves special attention in future IE studies. Overall, IE thinking and methodologies have great potential to contribute to climate change adaptation research and policy questions, and exploring this growing field will, in turn, inspire IE development.

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有关气候移民需要研究的十个问题

作者：Clinton J. Andrews

关键字： 适应，城市，气候变化，决策，治理，移民

摘要：
气候变化是人类必须适应的许多压力因素之一。环境问题通常与贫困、种族冲突或治理不善等其他因素结合在一起，成为需要采取有力行动的严峻问题。而迁移离开受影响地区是一种久经考验的对策。通过研究不同收入水平的国家的移民流动，考察它们在不同情境下的变化、对基础设施和住房的影响、对住房和服务需求的短期和长期影响，本文提出了聚焦移民的产业生态学研究议程。该议程的内容包括：理解分散的移民决策；为移民相关问题开发基于社会生态学的解决方案；以及以城市为重点增强基础设施适应性，让城市更具弹性，更加公平。

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Toward a research agenda on climate-related migration

Clinton J. Andrews

Keywords: adaptation, cities, climate change, decision-making, governance, migration

Summary:
Climate change is one of the many stressors to which humans must adapt. Environmental concerns usually combine with other factors such as poverty, ethnic strife, or poor governance to become serious enough problems to warrant strong action. Migration away from affected areas is one time-tested response. This article proposes a migration-oriented research agenda for industrial ecology based on an examination of migration flows and ways of thinking about them, variations across contexts, implications for infrastructure and housing, the framing of climate-related migration, and short-term and longer-term fluctuations in the demand for shelter and services in high and low income countries. Elements of this agenda include understanding decentralized migration decisions, developing socio-ecologically based solutions for migration-related problems, and embracing an urban focus that makes infrastructures more adaptable and makes cities more resilient and equitable.

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气候变化对沥青路面建设和维护的影响:美国弗吉尼亚州适应措施的经济生命周期评估

作者：Yaning Qiao, Joao Santos, Anne M.K. Stoner, Gerardo Flinstch

关键字： 适应，气候变化，气候模型降尺度，柔性路面，生命周期成本分析，维护效果

摘要：
路面设计和管理实践必须适应未来的气候变化。尽管许多研究试图确定不同的方法来使路面适应未来的气候条件，但这些适应措施的潜在经济影响仍然很大程度上无法量化。本研究介绍了一项全面的生命周期成本分析(LCCA)的结果，该分析旨在量化气候适应方法的潜在经济影响，在该方法中，在柔性路面部分的施工和维护中使用一种升级的沥青结合料(性能等级为 PG76 - 22)代替原始结合料(PG70 - 22)，以提高耐高温性能。对于弗吉尼亚州交通部(VDOT)三个具有不同气候的主要地区中的每一个，都考虑了由典型的州际、主要和次要路面部分组成的三个案例研究。LCCA 通过明确考虑未来气候预测、路面寿命周期性能、维护效果和工作区用户延误，计算了路面寿命周期中混合料生产、维护和使用阶段的成本。该研究得出结论，在预期的未来气候条件下(2020–2039 年)，与使用原始粘合剂的路面相比，使用升级粘合剂的路面不仅性能更好，而且在经济上也更有利。

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Climate change impacts on asphalt road pavement construction and maintenance: An economic life cycle assessment of adaptation measures in the state of Virginia, United States

Yaning Qiao, Joao Santos, Anne M.K. Stoner, Gerardo Flinstch

Keywords: adaptation, climate change, climate model downscaling, flexible pavement, life-cycle cost analysis, maintenance effects

Summary:
Pavement design and management practices must be adapted in response to future climate change. While many studies have attempted to identify different methods to adapt pavements to future climate conditions, the potential economic impacts of the adaptations still remain largely unquantified. This study presents the results of a comprehensive life-cycle cost analysis (LCCA) aimed at quantifying the potential economic impacts of a climate adaptation method, in which an upgraded asphalt binder (Performance Grade PG 76-22) is used in the construction and maintenance of flexible pavement sections in lieu of the original binder (PG 70-22) for improved resistance against high temperatures. For each of three major Virginia Department of Transportation (VDOT) districts with different climates, three case studies consisting of typical interstate, primary, and secondary pavement sections were considered. The LCCA accounted for the costs incurred during the mixture's production, maintenance, and use phases of the pavement life cycle by explicitly considering future climate projections, pavement life-cycle performance, maintenance effects, and work zone user delays. The study concludes that pavements using the upgraded binder not only perform better over time but are also economically advantageous compared to those with the original binder under the conditions of the anticipated future climate conditions (2020–2039).

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将气候变化影响纳入基础设施生命周期评价：以路面使用寿命性能为例

作者： Geoffrey Guest, Jieying Zhang, Omran Maadani, Hamidreza Shirkhani

关键字： 适应，气候变化，柔性路面，框架，产业生态学，生命周期评价

摘要：
预计气候变化将影响道路、桥梁和建筑物等基础设施的运行和结构性能。然而，之前大多数生命周期评价的研究没有考虑气候变化将如何影响基础设施的运行/结构性能。本研究的目标是开发一个将气候变化影响纳入基础设施系统的生命周期评价的框架。为说明这一框架，本文对一段柔性路面进行了案例研究，对气候变化情景和多个时间范围的生命周期环境影响进行了比较。该模型考虑了施工和维护/修复的使用材料和行为活动、相对表面反照率的变化以及交通造成的影响，使用机械-经验路面设计方法（MEPDG）来捕捉每个路面性能场景的结构性能，将性能破坏作为路面生命周期评价模型的输入。案例研究的结果表明，在本世纪后半叶可能要对路面性能提出基于气候变化的适应性设计要求，而在中短期，国际平整度指数（IRI）和总车辙退化曲线将非常接近历史水平。尽管包含以气候变化数据作为输入的机械性能模型给基于基础设施的生命周期评价带来了新的不确定性，但研究进行了敏感性分析以更好地理解结果。通过进一步的基础设施案例研究，可简化该框架进而更好地适应特定的基础设施，即只对气候变化最敏感的基础设施组件使用机械-经验建模程序进行明确建模。

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Incorporating the impacts of climate change into infrastructure life cycle assessments: A case study of pavement service life performance

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Keywords: adaptation, climate change, flexible pavement, framework, industrial ecology, life cycle assessment

Summary:
Climate change is expected to impact both the operational and structural performance of infrastructures such as roads, bridges, and buildings. However, most past life cycle assessment (LCA) studies do not consider how the operational/structural performance of infrastructure will be affected by a changing climate. The goal of this research was to develop a framework for integrating climate change impacts into LCA of infrastructure systems. To illustrate this framework, a flexible pavement case study was considered where life-cycle environmental impacts were compared across a climate change scenario and several time horizons. The Mechanistic-Empirical Pavement Design Guide (MEPDG) was utilized to capture the structural performance of each pavement performance scenario and performance distresses were used as inputs into a pavement LCA model that considered construction and maintenance/rehabilitation materials and activities, change in relative surface albedo, and impacts due to traffic. The results from the case study suggest that climate change will likely call for adaptive design requirements in the latter half of this century but in the near-to-mid term, the international roughness index (IRI) and total rutting degradation profile was very close to the historical climate run. While the inclusion of mechanistic performance models with climate change data as input introduces new uncertainties to infrastructure-based LCA, sensitivity analyses runs were performed to better understand a comprehensive range of result outcomes. Through further infrastructure cases the framework could be streamlined to better suit specific infrastructures where only the infrastructure components with the greatest sensitivity to climate change are explicitly modeled using mechanistic-empirical modeling routines.

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岛屿的重量：利用格林纳达岛的材料存量来适应气候变化

作者：Rob Symmes, Tomer Fishman, John N. Telesford, Simron J. Singh, Su-Yin Tan, Kristen De Kroon

关键字： 建筑材料，地理信息系统（GIS），格林纳达，物质流分析（MFA），自然灾害，小岛屿发展中国家（SIDS）

摘要：
建筑存量的维护和扩建消耗大量的资源，灾害事件导致的大规模迅速重建只会加速此进程。近期研究表明了材料存量（MS）在灾害风险规划中的应用潜力。本研究中，我们提出了一种分析建筑材料存量对气候变化引起的极端天气事件和海平面上升（SLR）的脆弱性的方法。文章以加勒比地区的一个小岛屿发展中国家（SIDS）- 格林纳达为例进行案例分析。本文基于地理信息系统（GIS）自下而上地测算建筑骨料、木材、混凝土和钢铁的存量。2014 年建筑材料存量为 11.9 Mt，人均为 112 t。1993- 2009 年，存量增量（GAS）为 6.8 Mt，同期人均年增长平均值为 4.0 t。在伊凡飓风（2004）之后的一年里，人均木材 GAS 增长了 172%，金属材料则增长了 103%（分别与 1993-2009 年间的平均增长率 11%和 8%相比）。我们还构建了“伊凡-II”情景并计算建筑库存中木材假设损失量为 135-216 Kt。在 SLR 增长 2 m 情景下，将有 1.6 Mt 建筑材料存量面临损失风险。我们认为，空间物质存量核算在弹性规划中具有重要的应用，并有利于揭示自然灾害修复和资源使用模式之间的联系。

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The weight of islands: Leveraging Grenada's material stocks to adapt to climate change

Rob Symmes, Tomer Fishman, John N. Telesford, Simron J. Singh, Su-Yin Tan, Kristen De Kroon

Keywords: construction materials, geographical information system (GIS), Grenada, material flow analysis (MFA), natural disasters, small island developing state (SIDS)

Summary:
The building stock consumes large amounts of resources for maintenance and expansion which is only exacerbated by disaster events where large-scale reconstruction must occur quickly. Recent research has shown the potential for application of material stock (MS) accounts for informing disaster risk planning. In this research, we present a methodological approach to analyze the vulnerability of the material stock in buildings to extreme weather events and sea-level rise (SLR) due to climate change. The main island of Grenada, a Small Island Developing State (SIDS) in the Caribbean region, was used as a case study. A bottom-up approach based on a geographic information system (GIS) is used to calculate the total MS of aggregate, timber, concrete, and steel in buildings. The total MS in buildings in 2014 was calculated to be 11.9 million tonnes (Mt), which is equivalent to 112 tonnes per capita. Material gross addition to stock (GAS) between 1993 to 2009 was 6.8 Mt and the average value over the time period was 4.0 tonnes per capita per year. In the year following Hurricane Ivan (2004), the per capita GAS for timber increased by 172%, while for other metals, GAS spiked by 103% (compared to average growth rates of 11% and 8%, respectively, between 1993 and 2009). We also ran a future “Ivan-II” scenario and estimated a hypothetical loss of between 135 and 216 kilotonnes (kt) of timber from the building stock. The potential impact of SLR is also assessed, with an estimated 1.6 Mt of building material stock exposed under a 2-m scenario. We argue that spatial material stock accounts have an important application in planning for resilience and provide indication of the link between natural disaster recovery and resource use patterns.

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克服适应气候变化的障碍：美国不同人口群体的饮食对食物、能量和水的影响研究

作者：Joe F. Bozeman III, Rayne Bozeman, Thomas L. Theis

关键字： 气候变化适应，人口统计，饮食与环境，食物-能量-水，产业生态学，生命周期评价（LCA）

摘要：
有效适应气候变化需要克服来自社会系统和生态系统的障碍。本研究使用一个三阶段（“理解-规划-管理”）适应性框架提出相应策略，来克服实现粮食-能源-水（FEW）耦合的社会生态障碍。论文对美国主要人口群体（非裔、拉丁裔和白人）食物消费带来的从摇篮到农场的土地、温室气体（GHG）和水的影响进行了分析和区分。结果表明，白人食物消费量的人均温室气体排放（680 kg CO2 当量/年）和水影响（328600 L/年）最高；非裔食物消费带来的对土地的影响最高（1770 m2/年）。我们的发现表明，获取意在争取在不同社会人口统计群体间达成共识的数据，可以克服理解阶段的障碍，有利于增加许多规划和管理阶段流程的社会接受度。具体而言，我们发现，识别和培养具有认知能力和人际关系管理能力、可以管理许多变量和利益相关方的领导者，是在规划阶段评估和选择适应性方案的关键。我们还建议使用政府规划来鼓励环境友好的食品购买行为。论文进一步讨论了在管理阶段如何将我们的建议用于适应策略的可行性评估活动。总而言之，本研究的发现有利于达成气候变化适应性框架中的理解阶段，建立解决社会生态问题的跨学科方法，并能为 FEW 耦合和气候变化研究者提供有用的 FEW 影响数据，这些都将促进气候变化适应性的改善和政策制定。

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Overcoming climate change adaptation barriers: A study on food–energy–water impacts of the average American diet by demographic group

Joe F. Bozeman III, Rayne Bozeman, Thomas L. Theis

Keywords: climate change adaptation, demographics, diet and environment, food–energy–water (FEW), industrial ecology, life cycle assessment (LCA)

Summary:
Effectively adapting to climate change involves overcoming social and ecological system barriers. The present study uses a three-phase adaptation framework to propose adaptation strategies aimed at overcoming socioecological barriers of the food–energy–water (FEW) nexus. Cradle-to-farm-gate land, greenhouse gas (GHG), and water impacts—that derive from food consumption in the United States—are analyzed and differentiated by major demographic groups (Black, Latinx, and White). Results indicate that the White demographic yields the highest per capita GHG (680 kg of CO2 eq·year−1) and water impacts (328,600 L·year−1) from food consumption, whereas the Black demographic yields the highest per capita land impacts (1,770 m2·year−1) from food consumption. Our findings suggest that obtaining data with the intention of building consensus across sociodemographic lines overcomes barriers in the understanding phase, leading to increased social receptivity for many planning and managing phase processes. Specifically, we find that identifying and developing leaders who possess the cognitive and interpersonal capacity to manage many variables and stakeholders is key to assessing and selecting adaptation options in the planning phase. We also propose using government programming to encourage environmentally friendly food purchasing behavior. Then, we discuss how our proposals could be used in adaptation feasibility and evaluation activities in the managing phase. In all, these findings facilitate the development of improved climate change adaptation and policy by satisfying the understanding phase of the climate change adaptation framework, establishing a cross-disciplinary methodological approach to addressing socioecological problems, and providing useful FEW impact data for FEW nexus and climate change researchers.

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为适应气候变化注入活力

作者：Frank Stadler, Luke Houghton

关键字： 生物适应，生物灵感设计，气候变化适应，进化，产业生态学

摘要：
进化生物学和生物适应性的探索可以为气候变化的社会适应提供信息，特别是相关机制，如表型可塑性、表观遗传学和水平基因转移。从无计划的自主生物适应中学习可能被认为是不可取的，也与人类情形不相容。然而，有人认为有计划的适应不一定比自主适应更可取，而适应机制的效力及其提高社会对当前和未来影响的恢复能力才是重要的。此外，产业生态学有很大的空间为气候变化适应提供方法，生成系统模型和基线数据，为决策提供信息。选择了“不确定性”问题作为生物系统、产业生态和气候变化适应共同面临的挑战的一个例子，以显示生物适应如何有助于解决问题。最后，使用了沿海气候适应决策支持工具以展示产业生态和生物适应方法如何成为气候变化适应规划和实践的主流。总之，进化生物学和产业生态学在概念上有密切的联系。整合生物适应思维可以丰富产业生态学，为气候变化适应科学增添新的视角，并支持产业生态学与气候变化适应相结合。产业生态学家与气候变化适应研究群体的合作不应有较多障碍，但生物适应解决方案的主流化在很大程度上取决于成功的知识转移和开放和明智的适应性问题利益攸关方的参与。

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Breathing life into climate change adaptation

Frank Stadler, Luke Houghton

Keywords: biological adaptation, biologically inspired design, climate change adaptation, evolution, industrial ecology

Summary:
The exploration of evolutionary biology and biological adaptation can inform society's adaptation to climate change, particularly the mechanisms that bring about adaptability, such as phenotypic plasticity, epigenetics, and horizontal gene transfer. Learning from unplanned autonomous biological adaptation may be considered undesirable and incompatible with human endeavor. However, it is argued that there is no need for agency, and planned adaptation is not necessarily preferable over autonomous adaptation. What matters is the efficacy of adaptive mechanisms and their capacity to increase societal resilience to current and future impacts. In addition, there is great scope for industrial ecology (IE) to contribute approaches to climate change adaptation that generate system models and baseline data to inform decision making. The problem of “uncertainty” was chosen as an example of a challenge that is shared by biological systems, IE, and climate change adaptation to show how biological adaptation might contribute solutions. Finally, the Coastal Climate Adaptation Decision Support tool was used to demonstrate how IE and biological adaptation approaches may be mainstreamed in climate change adaptation planning and practice. In conclusion, there is close conceptual alignment between evolutionary biology and IE. The integration of biological adaptation thinking can enrich IE, add new perspectives to climate change adaptation science, and support IE's engagement with climate change adaptation. There should be no major obstacles regarding the collaboration of industrial ecologists with the climate change adaptation community, but mainstreaming of biological adaptation solutions depends greatly on successful knowledge transfer and the engagement of open-minded and informed adaptation stakeholders.

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将城市热岛效应及其缓解措施引入生命周期评估

作者：Tiziana Susca, Francesco Pomponi

关键字： 热岛，产业生态学，制定政策，城市热岛缓解，城市生命周期评估，城市居住区

摘要：
城市化通常会导致城市温度相比周边乡村有所上升，即城市热岛效应（UHI）。这样的温度升高会引发污染物的形成，从而使城市空气质量恶化。较差的空气质量和城市热岛效应共同影响生态系统和人类健康。为了减轻对人口和环境的影响，设计有效的城市热岛效应缓解措施至关重要。生命周期评估（LCA）是一种可以捕获城市居住区的复杂性并量化其影响的评估工具。然而，按照目前的实现方法，LCA 忽略了建筑环境与当地气候之间的相互作用，进而忽略了由此带来的影响。本研究回顾了现有文献，表明缺少有机地纳入 LCA 中建筑环境与当地气候之间相互作用的研究。这构成了识别当前 LCA 框架不适合全面捕获城市住区影响的研究基础。为了克服这一局限性，本研究提供了一种扩展 LCA 方法的途径，表明有必要（a）将 LCA 方法与量化局部气候和建筑环境之间相互作用的气候模型或物理关系相结合；（b）在 LCA 中包括新颖的影响类别，以解决此类相互作用；（c）使用现有的或临时开发的特征因子来评估与城市热岛效应相关的影响。LCA 研究者可以在本文提供的参考框架的基础上克服 LCA 的当前局限性，并使其可用于全面评估城市热岛效应的影响及其缓解措施。

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Heat island effects in urban life cycle assessment: Novel insights to include the effects of the urban heat island and UHI-mitigation measures in LCA for effective policy making

Tiziana Susca, Francesco Pomponi

Keywords: heat island, industrial ecology, policy making, urban heat island mitigation, urban LCA, urban settlement

Summary:
Urbanization often entails a surge in urban temperature compared to the rural surroundings: the Urban Heat Island (UHI) effect. Such a temperature increase triggers the formation of pollutants worsening the urban air quality. Jointly, bad air quality and UHI affect ecosystems and human health. To alleviate the impacts on the population and the environment, it is crucial to design effective UHI-mitigation measures. Life Cycle Assessment (LCA) is an assessment tool able to capture the complexity of urban settlements and quantify their impact. Yet, as currently implemented, LCA neglects the interactions between the built environment and the local climate, omitting the resulting impacts. This study reviews the existing literature, showing the lack of studies that organically include interactions between the built environment and local climate in LCA. This forms the basis to identify the unsuitability of the current LCA framework for comprehensively capturing the impact of urban settlements. To overcome this limitation, this research offers a pathway to expand the LCA methodology, indicating the necessity to (a) couple the LCA methodology with climate models or physical relations that quantify the interactions between the local climate and the built environment; (b) include novel impact categories in LCA to address such interactions; and (c) use existing or ad hoc developed characterization factors to assess the impacts related to the UHI effect. The LCA community can build on the frame of reference offered by this research to overcome the current limitations of LCA and enable its use for a comprehensive assessment of the impacts of UHI and its mitigation measures.

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房地产市场应对沿海洪水的集成模型

作者：Handi Chandra-Putra, Clinton J. Andrews

关键字： 适应，基于主体建模（ABM），沿海洪水，住房市场，弹性，空间特征

摘要：
理解和改善人类如何适应气候变化是需要优先考虑的议题，沿海居民区是研究适应性问题的合适地区。严重的风暴事件和海平面上升正威胁着洪水泛滥的沿海社区。由于沿海资产为私人或公共所有，因此个人财产所有者和公务人员都须采取适应性措施。本文介绍了一种基于主体和特征价格的集成定价模型系统，用于模拟在受飓风事件影响的非平衡状况下沿海房地产市场的表现。该模型系统用于政策分析，并已根据美国新泽西州蒙茅斯县两个城镇的情况进行了校准，这些城镇在 2012 年遭到飓风“桑迪”的严重破坏。主要结果有：（a）沿海房地产市场将洪水风险资本化为财产价值，但随着风暴事件后时间的流逝，这种折价迅速减少；（b）在设计公共政策以减少沿海洪水给社会带来的成本时，存在着公平与效率之间的冲突。严格的建筑规范管理减少了洪水的破坏，但驱赶了贫困的购房者和业主，而信息和激励型政策则相对来说更加公平，但效果较差。使用基于市场的非干预措施撤离风险地区社会成本高，但是在易受灾害事件影响地区也允许不太富裕的人留在海岸上。有管理的撤离应着力使沿海娱乐设施的使用更加便利，并且不鼓励人们在那里定居。

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An integrated model of real estate market responses to coastal flooding

Handi Chandra-Putra, Clinton J. Andrews

Keywords: adaptation, agent-based modeling, coastal flooding, housing market, resilience, spatial hedonic

Summary:
Understanding and improving how humans adapt to climate change are priorities in our research community, and coastal settlements are good places to study adaptation. Severe storm events and sea-level rise are threatening coastal communities with increasing levels of flood damage. Because ownership of coastal assets is distributed among many private and public actors, both individual property owners and public officials must take adaptive actions. This paper introduces an integrated agent-based and hedonic pricing modeling system to simulate coastal real estate market performance under non-equilibrium conditions that reflect the effects of storm events. The modeling system, which is used for policy analysis, is calibrated to conditions in two towns in Monmouth County, New Jersey, USA, which were badly damaged by Hurricane Sandy in 2012. The key findings are that (a) coastal real estate markets capitalize flood risk into property values but this discount diminishes rapidly as time passes between storm events, and (b) there is a distinct equity versus efficiency tradeoff in designing public policies to reduce the cost to society of coastal flooding. Stringent regulation of building practices reduces flood damage but drives away poorer home buyers and owners, whereas informational and incentive-based policies are fairer but less effective. Hands-off, market-based retreat from risky areas is socially costly but allows less wealthy people to remain at the shore, albeit in vulnerable situations. Managed retreat should emphasize improved recreational access to coastal amenities while discouraging people from living there.