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2016ICM Problem E我们正在 走向一个缺水的星球吗?



2016ICM Problem E Are we heading towards a thirsty planet?

- Will the world run out of clean water? According to the United Nations, 1.6 billion people (one quarter of the world's population) experience water scarcity. Water use has been growing at twice the rate of population over the last century. Humans require water resources for industrial, agricultural, and residential purposes.
- 世界上的水会用完殆尽吗?根据联合国统计, 16 亿人民(世界人民的四分之一)正处于缺水状态。在过去一个世纪, 用水量的增长速度是人口增长速度的两倍。工业、农业、居民的日常都需要水的支持。



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- There are two primary causes for water scarcity: physical scarcity and economic scarcity. Physical scarcity is where there is inadequate water in a region to meet demand.
- 目前有两种缺水的原因：物理性缺水和经济型缺水。物理性缺水指的是该地区没有充足的水来满足用水需求。



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- Economic scarcity is where water exists but poor management and lack of infrastructure limits the availability of clean water. Many scientists see this water scarcity problem becoming exacerbated with climate change and population increase.
- 经济型缺水指的是，该地区的水并未明显缺乏，但是缺乏合理的管理和基础设施的建设，这限制了干净水的获取。许多科学家说缺水问题在气候变化和人口增加的情况下更加趋向恶化。



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- The fact that water use is increasing at twice the rate of population suggests that there is another cause of scarcity – is it increasing rates of personal consumption, or increasing rates of industrial consumption, or increasing pollution which depletes the supply of fresh water, or what? **
- 水的使用正以人口两倍的速度增长这个事实提示我们还存在另外一个缺水的原因:是个人消费率的增长, 还是工业消费率的增长, 还是日益严重的污染耗尽了淡水的供应, 还是别的什么原因?



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- Is it possible to provide clean fresh water to all? The supply of water must take into account the physical availability of water (e.g., natural water source, technological advances such as desalination plants or rainwater harvesting techniques). Understanding water availability is an inherently interdisciplinary problem. One must not only understand the environmental constraints on water supply, but also how social factors influence availability and distribution of clean water.
- 有可能为所有人提供干净的淡水吗?水的供应必须考虑到水的实际可用性(例如,天然水源、技术进步,例如脱盐厂或雨水收集技术)。理解水的可用性是一个跨学科问题。你不仅需要理解环境对水供给的限制,还要理解社会因素是如何影响干净水源的分布和获取的。



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- For example, lack of adequate sanitation can cause a decrease in water quality. Human population increase also places increased burden on the water supply within a region. When analyzing issues of water scarcity, the following types of questions must be considered.
- 比方说，差的卫生条件会限制水的供给，人口的增长会给地区水供给带来压力。当你在分析一个地区的缺水问题时，以下的问题是你必须考虑的。



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- How have humans historically exacerbated or alleviated water scarcity? What are the geological, topographical, and ecological reasons for water scarcity, and how can we accurately predict future water availability? What is the potential for new or alternate sources of water (for example, desalinization plants, water harvesting techniques or undiscovered aquifers)? What are the demographic and health related problems tied to water scarcity?
- 历史上人们是如何恶化或者缓解了这个问题?地理、地质、生态是怎么影响水供给的?我们如何准确的预测未来水的可获取性?如何评估新水源或者替代水源的潜力(比如海水淡化技术、雨水收集技术或者未发现的地下水)?与缺水有关的人口和健康问题是什么?



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- Problem Statement The International Clean water Movement (ICM) wants your team to help them solve the world's water problems. Can you help improve access to clean, fresh water?
- 提出该问题国际清洁水运动(ICM)希望您的团队帮助他们解决世界水问题。你能帮助改善清洁、淡水的获取吗？



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- Task 1: Develop a model that provides a measure of the ability of a region to provide clean water to meet the needs of its population. You may need to consider the dynamic nature of the factors that affect both supply and demand in your modeling process.
- 任务1: 建立一种模式, 衡量一个地区提供清洁水以满足其人口需求的能力。在你建模的过程中, 你可能需要考虑影响供需的动态因素。



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- Task 2: Using the UN water scarcity map (<http://www.unep.org/dewa/vitalwater/jpg/0222-waterstress-overuse-EN.jpg>) pick one country or region where water is either heavily or moderately overloaded. Explain why and how water is scarce in that region. Make sure to explain both the social and environmental drivers by addressing physical and/or economic scarcity.
- 任务2:使用联合国的缺水分布地图。选择一个水资源严重或中度超载的国家或地区。解释为何、如何该地区的水陷入了缺乏的境地。一定要通过处理物理型和经济型缺水来解释社会和环境的双重驱动因素。



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- Task 3: In your chosen region from Task 2, use your model from Task 1 to show what the water situation will be in 15 years. How does this situation impact the lives of citizens of this region? Be sure to incorporate the environmental drivers' effects on the model components.
- 任务3:在你任务2中选择的地区中, 使用你任务1中的模型来预测该地区15年后水供给的情况是怎么样的?这种情况如何影响该地区公民的生活?要在模型中包含环境驱动的影响。



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- Task 4: For your chosen region, design an intervention plan taking all the drivers of water scarcity into account. Any intervention plan will inevitably impact the surrounding areas, as well as the entire water ecosystem. Discuss this impact and the overall strengths and weaknesses of the plan in this larger context. How does your plan mitigate water scarcity?
- 任务4: 针对你选择的地区, 设计一个干预计划, 将所有导致缺水因素都考虑在内。任何的干预措施都会不可避免的影响到周围的环境和整个的生态系统。讨论这些影响, 以及这个方案的整体优缺点。最后, 你的方案是如何缓解这个问题的?



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- Task 5: Use the intervention you designed in Task 4 and your model to project water availability into the future. Can your chosen region become less susceptible to water scarcity? Will water become a critical issue in the future? If so, when will this scarcity occur?
- 任务5:使用你在任务4中设计的调节方案和模型来预测未来水的可获取性。你选择的地区在缺水问题上能变得轻松一些吗?水问题会变成未来的关键议题吗?如果这样,水缺乏什么时候会出现?



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- Task 6: Write a 20-page report (the one-page summary sheet does not count in the 20 pages) that explains your model, water scarcity in your region with no intervention, your intervention, and the effect of your intervention on your region's and the surrounding area's water availability.
- 任务6:写一个20面的报告（不包括摘要页）来解释你的模型:你选择地区的在没有调节情况下的水缺乏状况、你的调节措施、你的调节措施对该地区及周边地区水供给的效果。



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- Be sure to detail the strengths and weaknesses of your model. The ICM will use your report to help with its mission to produce plans to provide access to clean water for all citizens of the world. Good luck in your modeling work!
- 一定要明确模型的优缺点。ICM会用你的模型来帮助别人。



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- FAO Water Resources.
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- The State of the World's Land and Water Resources for food and agriculture. 2011.
- (<http://www.fao.org/docrep/017/i1688e/i1688e00.htm>).
- GrowingBlue: Water. Economics. Life. (<http://growingblue.com>). World Resources Institute. www.wri.org. **



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- Note that the 2013 Mathematical Competition in Modeling (Problem B) and the 2009 High School Modeling Competition in Modeling (Problem A) were related to modeling different aspects of water scarcity. Your ICM submission should consist of a 1 page Summary Sheet and your solution cannot exceed 20 pages for a maximum of 21 pages.
- Note: The appendix and references do not count toward the 20 page limit.
- 请注意，2013年数学建模竞赛(问题B)和2009年高中建模竞赛(问题A)与水资源短缺的不同方面建模有关。你的ICM提交应该包括一个1页的摘要页，你的解决方案不能超过20页，最多21页。
- 注意：附录和参考文献不计入20页的限制。



2017 ICM Problem E: Sustainable Cities Needed! 需要可持续城市!



2017 ICM Problem E: Sustainable Cities Needed!需要可持续城市!

Background: Many communities are implementing smart growth initiatives in an effort to consider long range, sustainable planning goals. “Smart growth is about helping every town and city become a more economically prosperous, socially equitable, and environmentally sustainable place to live.”[2] Smart growth focuses on building cities that embrace the E’s of sustainability—Economically prosperous, socially Equitable, and Environmentally Sustainable

- 许多社区正在实施智能增长计划，以考虑长期、可持续的规划目标。“智能增长是关于帮助每个城镇和城市变成一个经济更繁荣、社会更公平、环境更可持续发展的生活地方。”[2]智能增长致力于建设可持续发展的城市——经济繁荣、社会公平、环境可持续发展（这三个短语英文开头字母都是E）。



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This task is more important than ever because the world is rapidly urbanizing. It is projected that by 2050, 66 percent of the world's population will be urban—this will result in a projected 2.5 billion people being added to the urban population.[3] Consequently, urban planning has become increasingly important and necessary to ensure that people have access to equitable and sustainable homes, resources and jobs.

- 由于世界正在迅速城市化，这个任务比以往任何时候都重要。预计到2050年，世界人口的66%将是城市人口——这将导致25亿人口被纳入城市人口。[3]因此，城市规划变得越来越重要和必要，是为了确保人们获得公平和可持续的家园、资源和就业机会。



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- Smart growth is an urban planning theory that originated in 1990's as a means to curb continued urban sprawl and reduce the loss of farmland surrounding urban centers.
- 智能增长是一种起源于1990的城市规划理论，是一种抑制城市持续扩张和减少城市周边农田流失的方法。



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- The ten principles for smart growth are[4]智能增长的十个原则是：
 1. Mix land uses混合土地利用
 2. Take advantage of compact building design设计紧凑型建筑
 3. Create a range of housing opportunities and choices 创造一系列住房机会和选择
 4. Create walkable neighborhoods 创造适于步行的街区
 5. Foster distinctive, attractive communities with a strong sense of place 培养具有鲜明的地方感的独特的，有吸引力的社区



2017 ICM Problem E: Sustainable Cities Needed! 需要可持续城市!

- 6. Preserve open space, farmland, natural beauty, and critical environmental areas 保护开放空间, 农田, 自然美景和关键环境区
- 7. Strengthen and direct development towards existing communities 加强和指导现有社区的发展
- 8. Provide a variety of transportation choices 提供多种交通选择
- 9. Make development decisions predictable, fair, and cost effective 使开发决策具有可预测性、公平性和成本效益



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- 10. Encourage community and stakeholder collaboration in development decisions 鼓励社区和利益相关者合作发展决策
- These broad principles must be tailored to a community's unique needs to be effective. Thus, any measure of success must incorporate the demographics, growth needs, and geographical conditions of a city as well as the goal to adhere to the three E's. 这些宽泛的原则必须针对一个社区的独特需求才能有效。因此，任何成功的措施必须结合人口、增长需要、一个城市的地理条件、坚持三E目标（经济繁荣、社会公平、环境可持续发展）。



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- **Tasks: 任务:**
- The International City Management Group (ICM) needs your help implementing smart growth theories into city design around the world. Select two mid-sized cities (any city with a population of between 100,000 and 500,000 persons), on two different continents.
- 国际城市管理集团（ICM）需要你的帮助，将智能增长理论应用到世界各地的城市设计中。选择两个在两个不同的大洲的、中等大小的城市（任何一个人口介于100000到500000人之间的城市）。



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- 1. Define a metric to measure the success of smart growth of a city. It should consider the three E's of sustainability and/or the 10 principles of smart growth.
- 1. 定义衡量一个城市智能增长的度量标准。它应该考虑可持续发展的三个E和/或智能增长的10个原则。
- 2. Research the current growth plan of the selected cities. Measure and discuss how the current growth plan of each city meets the smart growth principles. How successful are the current plans according to your metric?
- 2、研究当前选定城市的增长计划。制定和讨论每个城市当前的增长计划符合智能增长原则。根据你的标准，目前的计划有多成功？



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- 3. Using smart growth principles develop a growth plan for both cities over the next few decades. Support why you chose the components and initiatives of your plans based on the geography, expected growth rates, and economic opportunities of your cities. Use your metric to evaluate the success of your smart growth plans.
- 3. 利用智能增长原则在未来几十年内制定两个城市的增长计划。依据地理因素、预期增长率和经济机会，给出你制定计划的理由。用你的度量标准（第一问中的）来评估你的智能增长计划是否成功。



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- 4. Also using your metric, rank the individual initiatives within your redesigned smartgrowth plan as the most potential to the least potential. Compare and contrast the initiatives and their ranking between the two cities.
- 4. 同样使用你的度量标准，在你重新设计的智能增长计划中，将每个单独的计划按照潜力从大到小进行排序。比较两个城市的倡议和排名。



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- 5. Suppose the population of each city will increase by an additional 50% by 2050, explain in what way(s) your plan supports this level of growth?
- 5. 假设到2050年，每个城市的人口将增加50%，说明你的计划以什么样的方式支持这一水平的增长？



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- Your ICM submission should consist of a 1 page Summary Sheet and your solution cannot exceed 20 pages for a maximum of 21 pages. Note: The appendix and references do not count toward the 20 page limit.
- 你的ICM提交包括1页摘要页，您的解决方案不能超过20页，总共最多21页。注意：附录和参考文献不计入20页限制。
- **References: 参考文献**
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- [2] EPA, “This is Smart Growth.” 2016
- <https://www.epa.gov/smartgrowth/smart-growth-publication>[3] World Urbanization Prospects. United Nations. 2014. <https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf>
- [4] EPA, “Smart Growth: A Guide to Developing and Implementing Greenhouse Gas Reductions Programs.” 2011. http://www.sustainablecitiesinstitute.org/Documents/SCI/Report_Guide/Guide_EPA_SmartGrowthGHGReduction_2011.pdf
- [5] Duany, Andres, Jeff Speck and Mike Lydon. The Smart Growth Manual. McGraw-Hill. 2010.



2018 ICM Problem E: 气候变化如何影响地区不稳定?



2018 ICM Problem E: How does climate change influence regional instability? 气候变化如何影响地区不稳定?

- The effects of Climate Change, to include increased droughts, shrinking glaciers, changing animal and plant ranges, and sea level rise, are already being realized and vary from region to region. The Intergovernmental Panel on Climate Change suggests that the net damage costs of climate change are likely to be significant. Many of these effects will alter the way humans live, and may have the potential to cause the weakening and breakdown of social and governmental structures. Consequently, destabilized governments could result in fragile states.
- 气候变化的影响，包括干旱的增加、冰川的缩小、动植物活动范围的变化以及海平面的上升，已经被人们认识到，并且在不同的地区有所不同。政府间气候变化专门委员会认为，气候变化的净损害成本可能很大。这些影响中的许多会改变人类的生活方式，并有可能导致社会和政府结构的弱化和崩溃。因此，不稳定的政府可能会导致国家变得脆弱。



2018 ICM Problem E: 气候变化如何影响地区不稳定？

- A fragile state is one where the state government is not able to, or chooses not to, provide the basic essentials to its people. For the purpose of this problem “state” refers to a sovereign state or country. Being a fragile state increases the vulnerability of a country’s population to the impact of such climate shocks as natural disasters, decreasing arable land, unpredictable weather, and increasing temperatures.
- 脆弱国家是指国家政府不能或选择不向其人民提供基本必需品的国家。就此问题而言，“国家”是指一个独立国或国家。作为一个脆弱的国家，一个国家的人口更容易受到自然灾害、可耕地减少、天气变化无常和气温升高等气候冲击的影响。



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- Non-sustainable environmental practices, migration, and resource shortages, which are common in developing states, may further aggravate states with weak governance (Schwartz and Randall, 2003; Theisen, Gleditsch, and Buhaug, 2013). Arguably, drought in both Syria and Yemen further exacerbated already fragile states.
- 发展中国家普遍存在的，不可可持续发展的环境、移民和资源短缺可能会使治理薄弱的国家进一步恶化（Schwartz and Randall, 2003; Theisen, Gleditsch和Buhaug, 2013）。可以说，叙利亚和也门的干旱进一步使已经脆弱的国家更加脆弱。



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- Environmental stress alone does not necessarily trigger violent conflict, but evidence suggests that it enables violent conflict when it combines with weak governance and social fragmentation. This confluence can enhance a spiral of violence, typically along latent ethnic and political divisions (Krakowka, HeimeI, and Galgano 2012).
- 环境压力本身并不一定会引发暴力冲突，但有证据表明，当它与薄弱的政府管理和社会零碎化相结合的时候，它就会导致暴力冲突。这种融合可以加剧暴力的螺旋式增长，典型表现的是潜在的种族和政治分歧（Krakowka, HeimeI和Galgano，2012）。



2018 ICM Problem E: 气候变化如何影响地区不稳定？

- Your tasks are the following:
- **Task 1:** Develop a model that determines a country's fragility and simultaneously measures the impact of climate change. Your model should identify when a state is fragile, vulnerable, or stable. It should also identify how climate change increases fragility through direct means or indirectly as it influences other factors and indicators.
- 你的任务如下：
- 任务1：建立受气候变化影响的国家脆弱性模型。你的模型应该确定一个国家的状态是脆弱的，易受伤害的还是稳定的。它还应查明气候变化如何通过直接手段或间接手段，在影响其他因素和指标增加脆弱性。



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- **Task 2:** Select one of the top 10 most fragile states as determined by the Fragile State Index (<http://fundforpeace.org/fsi/data/>) and determine how climate change may have increased fragility of that country. Use your model to show in what way(s) the state may be less fragile without these effects.
- **任务2:** 根据脆弱状态指数 (Fragile State Index) 确定的十大最脆弱国家之一 (<http://fundforpeace.org> FSI 数据) 并确定气候变化如何增加该国的脆弱性。使用您的模型来显示在没有这些影响的情况下, 状态可能会以何种方式变得不那么脆弱。



2018 ICM Problem E: 气候变化如何影响地区不稳定?

- **Task 3:** Use your model on another state not in the top 10 list to measure its fragility, and see in what way and when climate change may push it to become more fragile. Identify any definitive indicators. How do you define a tipping point and predict when a country may reach it?
- 任务3: 在不在前十名单的另一个国家使用你的模型来衡量其脆弱性, 看看气候变化如何以及何时使它变得更加脆弱。确定所有明确的指标。你如何定义一个临界点, 并预测一个国家何时可以达到临界点?
- **Task 4:** Use your model to show which state driven interventions could mitigate the risk of climate change and prevent a country from becoming a fragile state. Explain the effect of human intervention and predict the total cost of intervention for this country.
- 任务4: 使用你的模型来展示哪些国家驱动的干预措施可以减轻气候变化的风险, 并防止一个国家成为一个脆弱的国家。解释人为干预的效果, 预测国家干预的总成本。



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- **Task 5:** Will your model work on smaller “states” (such as cities) or larger “states” (such as continents)? If not, how would you modify your model?
- 任务5: 你的模型可以在较小的“州”(比如城市)或者更大的“州”(比如大洲)上使用吗? 如果不行, 你将如何修改你的模型?
- Your submission should consist of:
 - One-page Summary Sheet,
 - Your solution of no more than 20 pages, for a maximum of 21 pages with your summary.
 - Note: Reference list and any appendices do not count toward the 21-page limit and should appear after your completed solution.
- 您的提交应该包括:
 - 一页总结表,
 - 您的解决方案不超过20页, 最多21页与您的摘要。
 - 注意: 参考列表和任何附录不计入21页的限制, 应在完成的解决方案后出现。



2018 ICM Problem E: 气候变化如何影响地区不稳定？

- **References: 参考文献**

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<http://eesc.columbia.edu/courses/v1003/readings/Pentagon.pdf>
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- **Helpful Links:**

- Fragile States Index: <http://fundforpeace.org/fsi/>
- The World Bank: <http://www>.



2019 ICM Problem E:环境退化成本是多少?



2019 ICM Problem E: What is the Cost of Environmental Degradation? 环境退化成本是多少?

- Economic theory often disregards the impact of its decisions on the *biosphere* or assumes unlimited resources or capacity for its needs. There is a flaw in this viewpoint, and the environment is now facing the consequences. The biosphere provides many natural processes to maintain a healthy and sustainable environment for human life, which are known as *ecosystem services*. Examples include turning waste into food, water filtration, growing food, pollinating plants, and converting carbon dioxide into oxygen.
- 经济理论往往忽视其决策对生物圈的影响，或假设其资源或能力是无限的。这种观点存在缺陷，现在环境面临着严重的后果。生物圈提供了许多条件来维持自身健康和人类生活环境，这被称为生态系统服务。例如，将废物转化为食物、过滤水、种植食物、为植物授粉，以及将二氧化碳转化为氧气。



2019 ICM Problem E:环境退化成本是多少？

- However, whenever humans alter the ecosystem, we potentially limit or remove ecosystem services. The impact of local small-scale changes in land use, such as building a few roads, sewers, bridges, houses, or factories may seem negligible. Add to these small projects, large-scale projects such as building or relocating a large corporate headquarters, building a pipeline across the country, or expanding or altering waterways for extended commercial use. Now think about the impact of many of these projects across a region, country, and the world. While individually these activities may seem inconsequential to the total ability of the biosphere's functioning potential, cumulatively they are directly impacting the *biodiversity* and causing *environmental degradation*.
- 然而，每当人类改变生态系统时，我们可能会限制或破坏生态系统服务。当地小规模土地利用变化，例如建设一些道路，下水道，桥梁，房屋或工厂，可能看起来微不足道。除了这些小项目外，还有一些大型项目，比如建设或搬迁大型企业总部，在全国修建管道，或扩建或改造水道，以扩大商业用途。现在想想这些项目对一个地区、国家和世界的影响。虽然这些活动单独看来对生物圈的全部功能潜力似乎无关紧要，但它们累积起来直接影响生物多样性并造成环境退化。



2019 ICM Problem E:环境退化成本是多少？

- Traditionally, most land use projects do not consider the impact of, or account for changes to, ecosystem services. The economic costs to *mitigate* negative results of land use changes: polluted rivers, poor air quality, hazardous waste sites, poorly treated waste water, climate changes, etc., are often not included in the plan. Is it possible to put a value on the environmental cost of land use development projects? How would environmental degradation be accounted for in these project costs? Once ecosystem services are accounted for in the cost-benefit ratio of a project, then the true and comprehensive *valuation* of the project can be determined and assessed.
- 传统上，大多数土地利用项目都没有考虑生态系统服务的影响或变化。减轻土地利用负面变化结果的经济成本：污染的河流，空气质量差，危险废物场所，处理不当的废水，气候变化等，往往不包括在计划中。是否能对土地利用开发项目的环境成本进行评估？如何在这些项目成本中考虑环境退化？一旦将生态系统服务计入项目的成本效益比，就可以确定和评估项目的真实和全面估值。



2019 ICM Problem E:环境退化成本是多少？

- Your ICM team has been hired to create an ecological services valuation model to understand the true economic costs of land use projects when ecosystem services are considered. Use your model to perform a cost benefit analysis of land use development projects of varying sizes, from small community-based projects to large national projects. Evaluate the effectiveness of your model based on your analyses and model design. What are the implications of your modeling on land use project planners and managers? How might your model need to change over time?
- 您的ICM团队已被聘请创建生态服务评估模型，以了解考虑生态系统服务时土地利用项目的真实经济成本。使用您的模型对不同规模的土地利用开发项目进行成本效益分析，从小型社区项目到大型国家项目。根据分析和模型设计来评估模型的有效性。您的模型对土地利用项目规划者和管理者有什么影响？随着时间的推移，您的模型需要如何更改？



2019 ICM Problem E:环境退化成本是多少？

Your submission should consist of:

- One-page Summary Sheet,
- Your solution of no more than 20 pages, for a maximum of 21 pages with your summary.
- Judges expect a complete list of references with in-text citations, but may not consider appendices in the judging process.
- Note: Reference list and any appendices do not count toward the 21-page limit and should appear after your completed solution.
- 您的提交应包括：
 - 一页摘要表，
 - 您的解决方案不超过20页，最多21页与您的摘要。
 - 评委希望提供完整的参考文献列表，其中包含文本引文，但可能不会在评审过程中考虑附录。
- 注意：参考列表和任何附录不计入21页限制，应在完成解决方案后显示。



2019 ICM Problem E:环境退化成本是多少？

- **References: 参考文献**

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2019 ICM Problem E:环境退化成本是多少?

- **Data sources: 数据源**

- US based data: <https://www.data.gov/ecosystems/> 美国数据
- Satellite data: <https://www.ncdc.noaa.gov/data-access/satellite-data/satellite-data-access-datasets> 卫星数据

- **Glossary:**

- **Biodiversity** - refers to the variety of life in an ecosystem; all of the living organisms within a given area.
- **Biosphere** - the part of the Earth that is occupied by living organisms and generally includes the interaction between these organisms and their physical environment.
- 名词解释:
- 生物多样性 - 指生态系统中的各种生物;特定区域内的所有生物。
- 生物圈 - 地球上被生物体占据的部分, 通常包括这些生物与其物理环境之间的相互作用。



2019 ICM Problem E:环境退化成本是多少？

- **Ecosystem** - a subset of the biosphere that primarily focuses on the interaction between living things and their physical environment.
- **Ecosystem Services** – the many benefits and assets that humans receive freely from our natural environment and a fully functioning ecosystem.
- **Environmental Degradation** – the deterioration or compromise of the natural environment through consumption of assets either by natural processes or human activities.
- **Mitigate** – to make less severe, painful, or impactful.
- **Valuation** - refers to the estimating or determining the current worth of something
- 生态系统 – 生物圈的一个子集，主要关注生物与其物理环境之间的相互作用。
- 生态系统服务 – 人类从我们的自然环境和充分运作的生态系统中自由获得的诸多益处和资产。
- 环境退化 – 通过自然过程或人类活动消耗资产来改变或妥协自然环境。
- 缓解 – 减轻严重，痛苦或有影响力。
- 估价 – 指估算或确定某物的当前价值。