

2020 年美国大学生数学建模竞赛(MCM/ICM) F 题

中英版



微信搜一搜

数学模型

中文赛题：我称为家的地方

背景：研究人员已经确认马尔代夫，图瓦卢，基里巴斯和马绍尔群岛等几个岛国由于海平面上升而处于完全消失的危险中。当岛国的土地消失后，岛上的人口会发生什么或应该发生什么？当岛国的土地消失后，岛上的人口会发生什么或应该发生什么变化？这些因为环境而流离失所的人（EDPs）不仅需要搬迁，而且还面临失去独特文化，语言和生活方式的风险。在这个问题上，我们请您从安置人员并保护文化的角度来仔细研究这个问题。有许多需要考虑的注意事项和问题，包括：这些 EDPs 会去哪里？什么国家会接受它们？从历史和现在来看，各国产生的温室气体并不均衡，这些温室气体加速了与海平面上升相关的气候变化，那么，产生温室气体最多的国家是否有更大的义务来解决这些问题呢？而且，谁有发言权决定这些失去国家的 EDPs 在何处安家？是像联合国这样的政府间组织，还是吸收这些人的各国政府？关于这些问题的更详细的解释在第3页开始的问题文件中给出。

由于联合国最近的一项裁决打开了对 EDPs 作为难民的理论认可的大门，因此国际气候迁移基金会（ICM-F）聘请您为联合国提供咨询意见，方法是建立模型并利用它来分析联合国何时、为何以及如何发挥作用以应对 EPS 日益增加的挑战这一多层面的问题。ICM-F 计划向联合国简要介绍有关联合国应如何对 EDPs 做出系统反应的指南，尤其是考虑到保护文化遗产的要求。您的任务是开发一个（或一组）模型，并使用您的模型提供分析以支持此简介。ICM-F 对了解 EDPs 问题的范围特别感兴趣。例如，目前有多少人有成为 EDPs 的风险 [1]；高危国家文化的价值是什么？这些答案可能会随着时间变化吗？外，世界应如何制定一项国际政策，专门侧重于保护那些国家因为气候变化消失的人的权利，同时还以保护文化为目标？根据你的分析，你可以就这个问题提出什么建议？接受或拒绝你的建议有什么影响？

这个问题非常复杂。我们了解到，您的提交内容将无法完全考虑第 3 页开始的论文中描述的所有方面。然而，考虑到你所涉及的各个方面，综合你的工作，形成对 ICM-F 的一个有凝聚力的回答，作为向联合国的建议。您的团队的论文至少应包括：

- 从面临危险的人数和文化丧失的风险方面分析问题的范围；
- 在人权（能够新的家园中重新定居并充分参与生活）和文化保护方面处理 EDPs 的拟议政策；
- 描述用于测量拟议政策的潜在影响模型的开发过程；
- 解释如何使用您的模型来设计和/或改进您提出的策略；
- 根据您的分析，解释实施您所提议的政策的重要性

ICM-F 由包括数学家、气候科学家和难民移民专家在内的跨学科评审组成，他们将对您的工作进行评审。因此，您的论文应面向具有科学素养却又多元化的读者

您提交的作品应该包括：

- 一页摘要表
- 目录
- 您的解决方案不超过 20 页，加上您的摘要、目录最多 22 页，
- 注意：参考文献和任何附录不计入页面限制，应位于完成解决方案后。您不应该使用未经授权的图像和材料，其使用受到版权法的限制。确保您在报告中引用了您的观点和材料。

专业名词

Environmentally displaced persons (EDPs): 由于气候变化事件家园变得无法居住而必须搬迁的人。

Cultural heritage: 世代相传的群体或社会的生活方式，包括风俗，习俗，艺术和价值观。

ICM F 题发表论文

正如问题陈述中所指出的，由于海平面上升，几个岛国处于完全消失的危险中[1]。这个问题很复杂。这不仅仅是一个确定如何在全球范围内转移一定数量的人的问题，而且还要认识到这些人是有权利的人，是其独特文化的最后代表。在这篇论文中，我们强调了构建这

一问题的三个基本概念:涉及人权、民族国家责任和个人选择的搬迁决定;作为安置和文化保护的一部分,同化和住宿之间的紧张关系;和时间因素,例如国家消失的速度,这些损失的发生时间与全球民族主义的上升相吻合,以及难以对这一问题的规模做出正确的预测。

搬迁决定:人权,民族国家责任和个人选择 考虑到搬迁问题,您可能会认为这种EDP与其他联合国认可的难民具有相似的权利,但联合国难民事务高级专员公署 (UNHCR) 委员会和广泛采用 1967 协议历来只提供由于政治权利相关的安全问题而流离失所的人,如种族和宗教迫害。但是,在最近的裁决中,联合国承认了这个问题,并认识到某些 EDPs 可能有资格成为难民。[2] 尽管现在已经作出了裁决,但对于随着这些局势的规模和频率的增加,国际社会应如何应对尚无一个构想。[3]

给予这些难民的权利包括工作的权利、行动的自由和东道国政府的保护。此外,难民专员办事处与其他援助组织合作,努力向难民提供援助和援助,直到他们被重新安置在另一个国家,被东道国归化,或被遣返原籍国。现在,有了这项新的裁决,失踪国家的前居民可能有资格获得其中的一些权利或援助,但由于土地本身已经消失,遣返是没有希望的。

即使EDP有资格在其他地方享有权利,也不清楚这个新家在哪里,或由谁来负责该决定。在个人和国际上,应考虑是否由个人选择新的长期居住地,或者选择是由各国单独制定的移民政策还是由联合国单独制定或作为联合国协调的合作努力的一部分而做出的选择。可能的移民政策可以考虑新国家吸收这些新移民的财政能力,但是也有人讨论根据国家对环境条件的相对贡献(污染)建立责任分担制度,这种环境条件导致了这些国家的损失。换句话说,国际社会可能会向污染记录高的国家施加压力,以公平的方式为 EDPs 的重新安置做出更大的贡献。

移民和文化保护:同化与和解 就文化保护问题而言,受威胁最大的国家可以说是世界上最具文化特色的国家之一,它们的语言、音乐、艺术、舞蹈、社会规范和生活方式可能因岛屿而异,即使是在同一岛链内也是如此。因此,失去其中一个国家可能代表重大的文化损失。虽然流离失所的居民可能能够保存他们文化的某些方面,但有些是地理上特定的。例如,在马绍尔群岛使用的传统海洋捕鱼技术不太可能继续被居住在阿尔卑斯山的家庭所采用。再举一个例子,也许语言可以被保留下来,但这这就要求居住国对这些特殊的新居民的同化要求更宽容,不那么严格,而这些新居民可能正试图在一个新的土地上保存他们的文化。例如,法国目前要求在该国定居的难民学习法语,但如果有国际压力,也许法国会放弃对试图保留失落文化的 EDPs 团体的这一要求。

这导致了和解和同化之间的紧张关系,因为其他国家自愿吸收前国家的人口。需要指出的是,正是由于缺乏联合国处理 EDPs 的议定书,其他国家才被迫自愿安置并使受影响的人入籍。事实上,一个国家的灭亡落在几个联合国机构之间的无人区:联合国难民事务高级专员办事处 (UNHCR)、世界文化保护组织 (UNESCO)、联合国教育、科学及文化组织

(UNESCO)、联合国人道主义事务协调办公室 (UNOCHA)。虽然少数小岛国的居民可能相对容易被志愿国吸收,但事实是,气候变化已经引发了一波更频繁、更严重的环境灾难。想象一下,一场巨大的海啸摧毁了一座核电站,并造成了足够多的其他重大破坏,让一个人口更密集的国家变得无法居住;或者一个地方被多次重复的严重风暴袭击,以至于重建被

认为是不明智的；或者是一个气候变化使一个曾经盛产粮食的国家无法养活人民的地方。联合国应该在什么时候介入，扮演什么角色？

时间因素：汹涌的浪潮，汹涌的大海和民族主义的崛起 如果一个国家因为迅速的灾难性事件，如海啸或飓风，而被摧毁，那么即使这个国家知道他们面临着这样的风险，也没有时间去准备。当一个国家由于海平面缓慢上升而下沉时，就会出现一个问题，即如何协调和计划移民，甚至如何通过有或没有国际支持的处于危险中的国家采取的保护土地的措施来减轻损失。目前还不清楚损失的时间范围将如何影响或应该如何影响必须作出的关于移民安置、保护其人权和保护其文化的最终决定。

此外，由于解决这一问题的紧迫性实际上随海平面上升，世界也在经历民族主义的崛起，因此今天的全球反应可能与全球主义可能在历史上其他时期的反应截然不同。比民族主义更受青睐。如果政策或缺乏政策最终将 EDPs 推向一部分欢迎国家，那么这些国家可能会变得不知所措，而对回应的欢迎程度就会降低。因此，不断变化的全球政治气氛也可能是需要考虑的重要因素。最后，所有这些挑战使得这个问题的规模极其难以预测。可信的研究预测，到 2050 年，EDP 将达到 1.4 亿至 10 亿个。[4,5]

摘要 总而言之，随着一个国家的消失，目前尚不清楚是否应采取国际合作与协调的努力来解决房屋的丧失，安置的需要和文化的保护。这个问题很复杂，没有任何模型或报告能够充分解决每个问题方面，但优秀的报告需要了解这些不同方面以及它们之间的相互关系。人权的某些方面现已在理论上得到承认，但从未在实践中得到应用。个人选择与政策驱动的迁移之间存在平衡。另一个方面是确定公平的负担分担，这可由各国吸收新居民和/或由于对气候变化的贡献而承担的义务的能力来驱动；具体来说，对气候变化贡献最大的国家是否有任何道德义务承担更大的援助气候难民负担。另一个方面是同化与住宿之间的平衡，因为新居民保留了自己的文化和/或融入了新的家园。一些国家可能会慢慢消失，例如在海平面上升下沉或丧失生产食物的能力，而其他国家则可能在灾难性灾难中丧生。在这些情况下，即时需求和针对长期需求进行规划的能力是不同的。此外，随着气候变化的发展以及我们看到全球民族主义的抬头，情况正在随着时间而发展。

最后，所有这些复杂性使得难以衡量问题或预测问题升级的速度。

参考文献

请注意，这些内容作为引用提供，以支持问题文件中的主张。我们已经为您从这些资源中提取了重要的想法，因此，尽管您的团队可以使用这些资源，但不需要访问这些资源。相反，鼓励您的团队寻找其他来源来支持您的主张。

[1] Letman, J. (2018, November 19). Rising seas give island nation a stark choice: relocate or elevate. National Geographic. Retrieved from <https://www.nationalgeographic.com/environment/2018/11/rising-seas-force-marshall-islands-relocate-elevate-artificial-islands/>.

[2] Young, M. (2019, December 9). Climate Refugees Refused UN Protection & Denied Rights Under International Law. Retrieved from <http://www.ipsnews.net/2019/12/climate-refugees-refused-un-protection-denied-rights-international-law/>.

[3] Su, Y. (2020, January 29). UN ruling on climate refugees could be gamechanger for climate action. Retrieved from <https://www.climatechangenews.com/2020/01/29/un-ruling-climate-refugees-gamechanger-climate-action/>.

[4] The World Bank Report. (2018, March 19). Climate Change Could Force Over 140-Million to Migration Within Countries by 2050. Retrieved from <https://www.worldbank.org/en/news/press-release/2018/03/19/climate-change-could-force-over-140-million-to-migrate-within-countries-by-2050-world-bank-report>.

[5] Kamal, B. (2017, August 21). Climate Migrants Might Reach One Billion by 2050. Retrieved from <http://www.ipsnews.net/2017/08/climate-migrants-might-reach-one-billion-by-2050/>.

英文赛题：The Place I Called Home...

Background: Researchers have identified several island nations, such as The Maldives, Tuvalu, Kiribati, and The Marshall Islands, as being at risk of completely disappearing due to rising sea levels. What happens, or what should happen, to an island's population when its nation's land disappears? Not only do these environmentally displaced persons (EDPs) need to relocate, but there is also risk of losing a unique culture, language, and way of life. In this problem, we ask you to look more closely at this issue, in terms of both the need to relocate people and the protection of culture. There are many considerations and questions to address, to include: Where will these EDPs go? What countries will take them? Given various nations' disproportionate contributions to the green-house gasses both historically and currently that have accelerated climate change linked to the rising seas, should the worst offenders have a higher obligation to address these issues? And, who gets a say in deciding where these nationless EDPs make a new home – the individuals, an intergovernmental organization like the United Nations (UN), or the individual governments of the states absorbing these persons? A more detailed explanation of these issues is given in the Issue Paper beginning on page 3.

As a result of a recent UN ruling that opened the door to the theoretical recognition of EDPs as refugees, the International Climate Migration Foundation (ICM-F) has hired you to advise the UN by developing a model and using it to analyze this multifaceted issue of when, why, and how the UN should step into a role of addressing the increasing challenge of EDPs. The ICM-F plans to brief the UN on guidance for how the UN should generate a systemized response for EDPs, especially in consideration of the desire to preserve cultural heritage. Your assignment

is to develop a model (or set of models) and use your model(s) to provide the analysis to support this briefing. The ICM-F is especially interested in understanding the scope of the issue of EDPs. For example, how many people are currently at risk of becoming EDPs [1]; what is the value of the cultures of at-risk nations; how are those answers likely to change over time? Furthermore, how should the world respond with an international policy that specifically focuses on protecting the rights of persons whose nations have disappeared in the face of climate change while also aiming to preserve culture? Based on your analysis, what recommendations can you offer on this matter, and what are the implications of accepting or rejecting your recommendations?

This problem is extremely complex. We understand that your submission will not be able to fully consider all of the aspects described in the Issue Paper beginning on page 3. However, considering the aspects that you address, synthesize your work into a cohesive answer to the ICM-F as they advise the UN. At a minimum, your team's paper should include:

- An analysis of the scope of the issue in terms of both the number of people at risk and the risk of loss of culture;
- Proposed policies to address EDPs in terms of both human rights (being able to resettle and participate fully in life in their new home) and cultural preservation;
- A description of the development of a model used to measure the potential impact of proposed policies;
- An explanation of how your model was used to design and/or improve your proposed policies;
- An explanation, backed by your analysis, of the importance of implementing your proposed policies.

The ICM-F consists of interdisciplinary judges including mathematicians, climate scientists, and experts in refugee migration to review your work. Therefore, your paper should be written for a scientifically literate yet diverse audience. Your submission should consist of:

- One-page Summary Sheet
- Table of Contents
- Your solution of no more than 20 pages, for a maximum of 22 pages with your summary and table of contents.
- NOTE:Reference List and any appendices do not count toward the page limit and should appear after your completed solution. You should not make use of unauthorized images

and materials whose use is restricted by copyright laws. Ensure you cite the sources for your ideas and the materials used in your report.

Glossary

Environmentally displaced persons (EDPs): people who must relocate as their homeland becomes uninhabitable due to climate change events

Cultural heritage: the ways of living of a group or society passed through generations to include customs, practices, art, and values.

ICM Problem F Issue Paper

As noted in the problem statement, several island nations are at risk of completely disappearing due to rising sea levels.[1] The issue is quite complex. It is not simply a matter of identifying how to move a certain number of people around the globe – it is also about recognizing that these people are human beings who have rights and who are the last living representatives of their unique culture. In this Issue Paper, we highlight three of the essential ideas that frame this problem: relocation decisions as they relate to human rights, nation-state responsibility, and individual choice; the tension between assimilation and accommodation as part of resettlement and cultural preservation; and time factors such as the rate of the nation disappearing, the timing of these losses aligning with a global rise in nationalism, and the difficulty in making sound predictions about the size of this issue.

Relocation Decisions: Human Rights, Nation-State Responsibility, and Individual Choice

Considering the relocation issue, you might think that such EDPs would have similar rights as other UN-recognized refugees, but the United Nations High Commission on Refugees (UNHCR) and the widely adopted 1967 protocol has historically only afforded rights to those who are displaced due to politically related security issues, such as ethnic or religious persecution. However, in a very recent ruling, the UN has acknowledged this issue and recognized that some EDPs might qualify as refugees.[2] Although a ruling has now been made, there is not yet a vision on how the international community should respond as these situations increase in magnitude and frequency.[3]

Rights awarded to these refugees include right to work, freedom of movement, and protection by host governments. Additionally, the UNHCR, in collaboration with other aid organizations, work to provide aid and assistance to refugees until they are resettled in another country, become naturalized by their host state, or repatriate to their country of origin. Now, with this

new ruling, the former inhabitants of the disappeared nation may be eligible for some of those rights or aid, but there is no hope of repatriation as the land itself is gone.

Even if EDPs are eligible for rights somewhere else, it is not clear where this new home would be or who would be responsible for making that decision. There are individual and international considerations related to whether the selection of a new long-term residence is made by individuals or if the choices are made or swayed by immigration policies developed by nations in isolation or as part of a cooperative effort coordinated by the United Nations. Possible migration policies could consider the financial ability of the new nation to absorb these new individuals, but there is also discussion of setting up burden-sharing based on nations' relative contributions (pollution) to the environmental conditions that is leading to the loss of these nations. In other words, the international community may press nations with high pollution records to contribute more to the resettlement of EDPs in some equitable manner.

Resettlement and Cultural Preservation: Assimilation versus Accommodation In terms of the cultural preservation issues, the nations that are most at risk are arguably some of the most culturally distinct in the world with languages, music, art, dances, social norms, and ways of life that can be different from island to island even within the same island chain. As a result, the loss of one of these nations could represent a significant cultural loss. While the displaced inhabitants may be able to preserve some aspects of their culture, some are geographically specific. For example, traditional ocean fishing techniques used in The Marshall Islands are unlikely to continue to be practiced by families who settle in the Alps. As another example, perhaps the language could be preserved, but this would require host nations to be more accommodating and less strict on the assimilation requirements of these special new residents who may be trying to preserve their culture in a new land. For example, France currently requires refugees who resettle there to learn French, but if there were international pressure, perhaps France would waive this requirement for groups of EDPs who are trying to preserve a lost culture.

This leads to a tension between accommodation and assimilation as other nations volunteer to absorb the populations of the former nations. It is important to note that it is the lack of a UN protocol for dealing with EDPs that forces other nations to volunteer to settle and naturalize those affected. In fact, the loss of a nation falls into the no-man's land between several UN charges – the care of refugees (UNHCR), the protection of world culture (United Nations Educational, Scientific, and Cultural Organization (UNESCO)), and emergency aid response (United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA)). And while the residents of a handful of small island nations might be absorbed relatively easily by volunteer nations, the fact is that climate change has been ushering a literal wave of more frequent and more intense environmental disasters. Imagine a major tsunami taking out a nuclear power plant and causing enough other significant damage that a more heavily

inhabited nation may become uninhabitable; or a place being hit by so many repeated severe storms that rebuilding was deemed unwise; or a place where climate change is making it impossible for a nation that was formerly flush with crops to provide for its people. At what point should the UN step in, and in what role?

Time Factors: Raging Waves, Rising Seas, and Rising Nationalism If a nation is wiped out as a result of a rapid catastrophic event, such as a tsunami or hurricane, then there is no time to prepare, even if the country knew they were at risk of such an event. When a nation is sinking as a result of slowly rising sea levels, then there are issues about how a migration could be coordinated and planned, or even how the loss could be mitigated through land-preserving measures taken by the at-risk nation with or without international support. It is not clear how the timescale of the loss would impact, or should impact, the ultimate decisions that need to be made concerning the resettlement of a population, the protection of their human rights, and the preservation of their culture.

Additionally, as the urgency to address this issue is literally rising with the sea level, the world is also experiencing a rise of nationalism, so the global response today may be very different than it would have been at other periods in history where globalism may have been more in favor than nationalism. If policies, or a lack of policies, end up pushing EDPs towards a subset of welcoming nations, then those countries may get overwhelmed and become less welcoming in response. Therefore, the changing global political climate may also be an important factor to consider.

Lastly, all of these challenges make the size of this problem extremely difficult to predict. Credible studies have predicted anywhere from 140 million to one billion EDPs by 2050.[4,5]

Summary: In summary, as a nation disappears, it is not clear if an international cooperative and coordinated effort should be adopted to address the loss of homes, the need to resettle, and the preservation of culture. This issue is complex, and no model or report would be able to adequately address every aspect in detail, but excellent reports need to be aware of these different aspects and how they are interrelated. There is the aspect of human rights, which are now recognized in theory, but have never been applied in practice. There is the balance of individual choice versus policy-driven migration. Another aspect is defining equitable burden sharing which could be driven by the capacity for nations to absorb new residents and/or obligations due to contributions to climate change; specifically, whether the nations with the largest contributions to climate change have any ethical obligations to take on a higher burden in assisting climate refugees. Yet another aspect is a balance between assimilation and accommodation, as new residents preserve their culture and/or blend into their new home. Some nations may disappear slowly, such as sinking under rising sea levels or loss of the ability to produce food, while other nations may be wiped out in a catastrophic disaster; and the immediate needs and ability to plan for the long-term needs in these situations are

different. Furthermore, the situation is evolving over time as climate change advances and as we see a global rise in nationalism. Lastly, all of this complexity has made it difficult to even measure the problem or predict how quickly it will escalate.

Cited References

Note that these are provided as citations to support claims in the Issue Paper. We have already pulled the important ideas from these resources for you, so although your team may use these sources, access to these is not required. Instead your team is encouraged to look for other sources to support your claims.

[1] Letman, J. (2018, November 19). Rising seas give island nation a stark choice: relocate or elevate. National Geographic. Retrieved from <https://www.nationalgeographic.com/environment/2018/11/rising-seas-force-marshall-islands-relocate-elevate-artificial-islands/>.

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[3] Su, Y. (2020, January 29). UN ruling on climate refugees could be gamechanger for climate action. Retrieved from <https://www.climatechangenews.com/2020/01/29/un-ruling-climate-refugees-gamechanger-climate-action/>.

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[5] Kamal, B. (2017, August 21). Climate Migrants Might Reach One Billion by 2050. Retrieved from <http://www.ipsnews.net/2017/08/climate-migrants-might-reach-one-billion-by-2050/>.