

A mathematical model may give more efficient climate talks

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Achieving consensus among countries in global climate negotiations is a long and complicated process. Researchers at Linköping University have developed a mathematical model that describes the achievement of the

2015 Paris Agreement and that may contribute to more efficient negotiations when striving for unanimity.

Global climate targets have been in focus this autumn as world leaders met at COP26 in Glasgow. The intention was that countries would negotiate how to work together to keep the global temperature rise below two degrees Celsius, and preferably below 1.5 degrees.

Climate agreements need unanimity, and achieving unanimity takes time, commitment, and a good organization structure. The Paris Agreement in 2015, for example, was the result of complex diplomatic negotiations that took more than a decade to complete. And the time aspect is something that researchers at Linköping University have examined in depth.

"Our [model](#) investigates how the negotiations should be organized in order to achieve unanimity, and what factors can slow down or speed up convergence," says Claudio Altafini, professor in the Division for Automatic Control, Department of Electrical Engineering, at Linköping University.

The results have been published in the scientific journal *Science Advances*.

Based on observed data

The model is dynamical and based on observed data from the documents and the minutes of nearly 300 UN-sponsored climate conferences in the period 2001-2015, leading to the Paris Agreement. The documents have enabled the LiU researchers to investigate, among other things, the pattern according to which countries participated and expressed their opinions in the sequence of meetings.

The model shows how countries influence each other as time passes. Consensus, in the form of the Paris Agreement, was reached after more than a decade of negotiations, and is also predicted by the model on a similar time scale.

"Our model shows that a key to achieving unanimity is that all parties are involved in the negotiations at some stage. Plenary sessions like COP are crucial in this respect, everyone participates and receives an up-to-date summary of the discussions. On the other hand, plenary sessions are very dispersive and time-consuming, which is why it is often more reasonable to use a structure that keeps everybody informed without using plenary sessions per se. This is one aspect that a model such as the one we have developed can help to understand."

The model also has a certain predictive value. The key actors in the negotiation process that have been identified by the model are highly consistent with those mentioned in the media and in the scientific literature, explains Claudio Altafini:

"For example, the EU played a leading role, especially in the early years. As 2015 approached, countries like China and India increased their [negotiation](#) power, which we can see in our model. This validates its underlying principles," says Claudio Altafini

Other questions that the model can help answer are how often countries should meet, and which parties should participate in which meetings to give maximum probability that unanimity is reached.

However, there is always a risk of over-simplification, explains Claudio Altafini.

"Our description of the Paris Agreement can only capture the formal part of the negotiations presented in the minutes of the various meetings,

not all the informal discussions that take place behind closed doors."

Applicable in other fields

The model has been developed to analyze the structure of the negotiations for the Paris Agreement, but it can also be used in other complex negotiations. One example comes from the business world, when unanimity is required among the board directors to conclude a deal.

One important feature of the research is that the model is not an abstract mathematical construction, but based on concrete problems.

"What happens most often in this [research field](#) is that there is a gap between the [mathematical model](#) and the real world. In contrast, we have taken a real-life problem and built a model around it."

The work belongs to a line of research that tries to model opinion dynamics. The basic task is to understand the mechanisms that are encoded when individuals, parties or national delegations interact with each other. The task is also to analyze how this influences the collective behavior, which determines whether [agreement](#) can be reached, or if instead the parties become polarized, or cluster into groups of distinct opinions.

The research has been carried out in collaboration between researchers at Linköping University and in Italy, China and Australia.

More information: Carmela Bernardo et al, Achieving consensus in multilateral international negotiations: The case study of the 2015 Paris Agreement on climate change, *Science Advances* (2021). [DOI: 10.1126/sciadv.abg8068](#)

Provided by Linköping University

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