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Controlling Global Warming Through Awareness-Based Epidemic Modelling

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Abstract
Global warming presents a major environmental challenge due to persistent greenhouse gas emissions driven by human activities. Beyond technological interventions, human awareness plays a critical role in shaping sustainable behavior. This article develops an awareness-based epidemic model to investigate how information diffusion influences emission trajectories. A compartmental model linking awareness dynamics to emission reduction is introduced, analyzed, and simulated. Results demonstrate that rapid growth in awareness can reduce harmful emissions over time, suggesting that communication-driven strategies may support climate stabilization efforts.

1. Introduction
Climate change and global warming are significant global concerns, characterized by increasing global surface temperatures, melting ice sheets, rising sea levels, and an increase in extreme weather events. These changes are primarily attributed to anthropogenic greenhouse gas emissions, particularly carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). While technological advancements such as renewable energy and carbon capture are vital, behavioral and societal responses remain equally influential. Awareness concerning climate change encourages adoption of sustainable behaviors including reduced fossil fuel consumption, recycling, and support for environmentally favorable policies[1].

Mathematical modelling provides a structured framework for studying the complex interplay between emissions, human behavior, and policy interventions. Traditional climate models focus on physical processes, whereas epidemiological models focus on transmission dynamics. Epidemic models have recently been applied to social contagion processes such as information spreading, rumor propagation, and behavior adoption[2]. In this context, awareness spread mimics infection spread: individuals become informed and influence others. This analogy makes epidemic modelling suitable for evaluating awareness-driven climate mitigation strategies.

2. Model Framework and Equations
The population is divided into three awareness-related compartments: Unaware (U), Aware (A), and Resistant (R). Unaware individuals contribute to emissions due to lack of climate-conscious behavior, while aware individuals adopt emission-reducing behaviors. Resistant individuals are informed but inactive, either due to socioeconomic barriers, lack of motivation, or misinformation.

The model is defined as follows[3]:

$$dU/dt = -\beta U A + \omega R$$
$$dA/dt = \beta U A - \gamma A$$
$$dR/dt = \gamma A - \omega R$$
$$dE/dt = \lambda U - \delta A$$

Here, β represents the awareness transmission rate through social or media influence, γ represents the rate at which aware individuals lose interest or motivation, ω represents the rate at which resistant individuals revert to being unaware, λ denotes emission intensity from unaware individuals, and δ denotes emission reduction due to awareness.

3. Analysis
In the absence of awareness ($A = 0$), emission dynamics are dominated by λU, leading to continuous growth in emissions. Conversely, awareness growth decreases the size of U and increases A, thereby enhancing δA which reduces emissions. The dynamics exhibit threshold behavior analogous to epidemiology. An effective reproduction factor may be defined as:

$$R\_eff = (\beta \lambda) / (\gamma \delta)$$

If R_eff < 1, the model suggests awareness spreads sufficiently to counteract emission growth, stabilizing or reducing E(t). If R_eff > 1, emissions continue to rise due to insufficient awareness spread.

4. Simulation Setup

To illustrate the model behavior, numerical simulations were performed using a deterministic Euler method. Initial conditions assume a mostly unaware population with moderate emission levels. Parameter values were selected to represent relatively fast awareness diffusion and moderate emission reduction.
Initial conditions: U(0)=0.9, A(0)=0.1, R(0)=0.0, E(0)=1.0

The simulation was executed over a time horizon of 100 units with $\Delta t=0.1$. The resulting compartment and emission trajectories are shown in Figures 1 and 2.

5. Results and Discussion

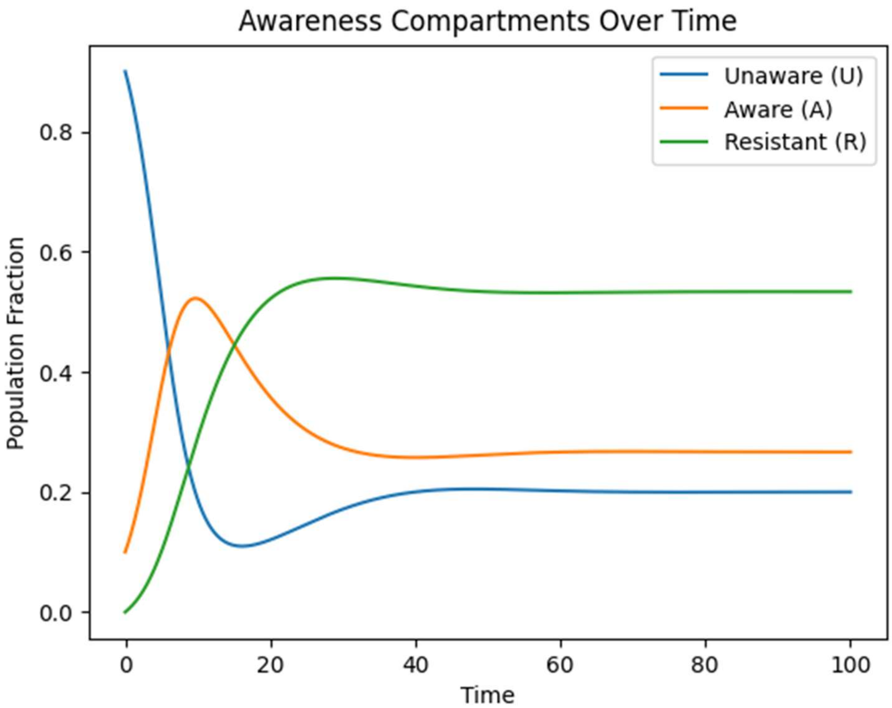

Figure 1: Awareness Compartments Over Time

Figure 1 shows that the aware population increases rapidly during the early stages of simulation due to high β. As awareness rises, the unaware population declines. Over time, resistance grows as some aware individuals lose interest. The equilibrium state comprises nonzero fractions of all three compartments.

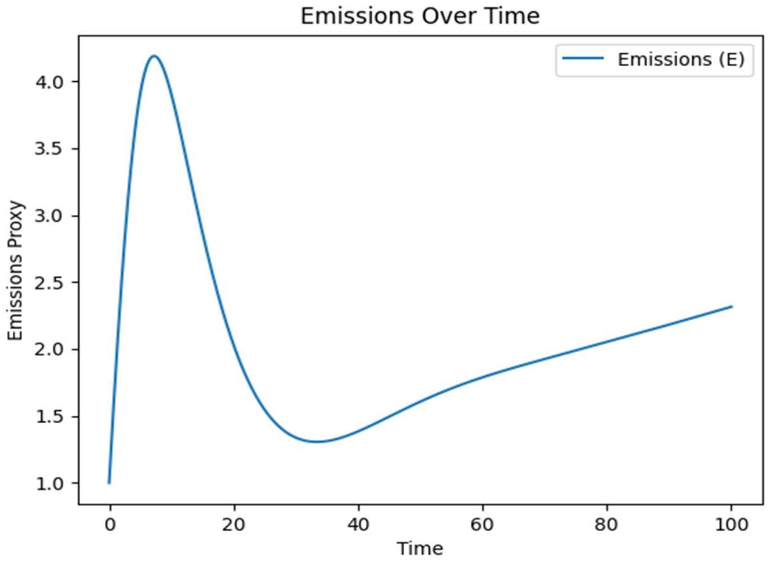

Figure 2: Emissions Over Time

Figure 2 demonstrates that emissions initially rise due to a large unaware population but begin to decline as awareness peaks. At long times, emissions stabilize due to the balance between U and A. These observations indicate that awareness campaigns can delay or suppress emission growth.

6. Conclusion

This study demonstrates that epidemic-inspired awareness models provide a valuable framework for exploring behavioral influences on global warming. Simulation results suggest that awareness diffusion can reduce harmful emissions when transmission rates are sufficiently high. Such modeling highlights the importance of educational campaigns, media influence, and social advocacy in climate mitigation strategies. Future research could extend this framework to include economic constraints, misinformation effects, policy interventions, or multi-layer social networks.

References

1. Agaba G.O., Kyrychko Y.N., Blyuss K.B., Mathematical model for the impact of awareness on infectious disease dynamics.
2. Wang Z., Bauch C.T., et al., Analysis of epidemic models with awareness programs on networks.
3. Kermack W.O., McKendrick A.G., Contributions to the mathematical theory of epidemics.

