Reward-Based Participant Management for Crowdsourcing Rainfall Monitoring: An Agent-Based Model Simulation

Background/objective

High-resolution rainfall data are needed for a variety of agricultural applications — including assessment of water availability, land suitability, and biomass productivity for food and energy crops. Crowdsourcing has been identified as a promising option for gathering local-scale data using low-cost sensors. However, unpredictable volunteer participation has been a drawback of such methods. Here, we investigated the potential of carefully designed reward allocation to actively manage crowdsourcing participation and obtain local-scale rainfall intensity data.

Approach

- ❖ An agent-based model integrating reward allocation and rainfall simulation was developed to investigate performance of different reward allocation policies.
- ❖ Reward allocation policies were designed based on different principles of rainfall monitoring: maximum participants, maximum information, and minimum redundancy.
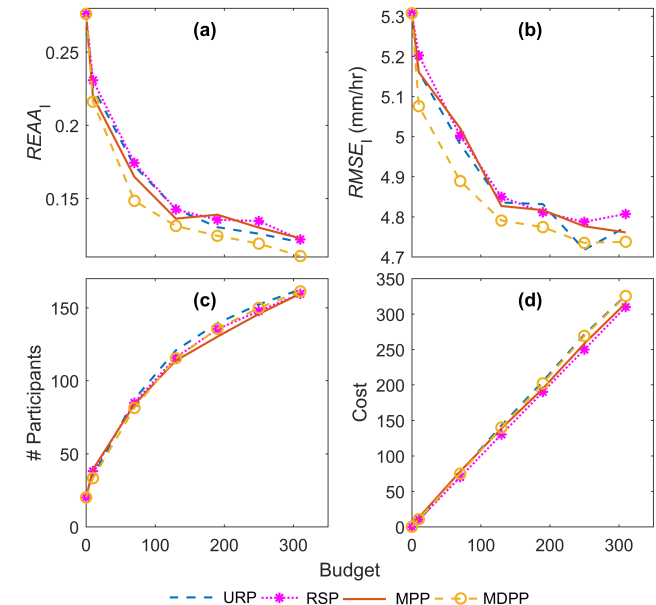
Results

- ❖ The minimum redundancy policy, which considers population distribution, resulted in the best performance among the compared policies.
- ❖ Factors influencing policy performance included budget, citizen environmental awareness, and population distribution.

Significance

Numerous studies have explored the use of marginal land for cultivation of bioenergy crops. Water availability from rainfall is a critical factor for land productivity. This study provides insight into factors to consider when implementing crowdsourcing to collect rainfall data to assess land for bioenergy crop suitability.

Impact of reward budget on (a) areal average error, (b) root mean square error, (c) number of participants, and (d) actual cost of each reward allocation policy