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Numerical Ocean and Atmospheric Forecast Models in Search and Rescue: Benefits, Challenges and Possible Improvements in the Future

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Maritime search and rescue (SAR) operations entail locating distressed or lost persons and crafts at sea, then using search and rescue assets (i.e. helicopters) to retrieve them safely and in a timely manner from the dangers of the perilous sea environment.

It is essential for SAR marine effectiveness to possess a deep understanding of the local oceanographic and atmospheric dynamics, knowledge of the drifting object - how it is influenced by the relative exposure to the air and water, and proficiency in the use of advanced tools that integrate these dominant factors to plan and search efficiently.

The United States Coast Guard (USCG) employs the Search And Rescue Optimal Planning System (SAROPS) for search and rescue (SAR) and planning (USCG Addendum, 2022). It consists of two distinct but integrated and sophisticated systems: the simulator and the planner.

The SAROPS simulator takes into account uncertainties in the initial time and location of the search object and in the forcing fields. SAROPS accesses ocean and atmospheric models' forecasts of surface currents and winds through the Environmental Data Server (EDS) for drift modeling. The simulator employs a Monte Carlo method to account for the uncertainties, and performs thousands of simulations, generating probability maps of the most likely locations of the endangered individuals and/or vessels over time.

The SAROPS planner combines the probability distribution information with the availability of search units to provide guidance on where the search effort should be expended, producing operationally feasible and optimized search plans that maximize the probability of success.

For successful and efficient SAR, it is essential to access the best high-quality and reliable global and regional winds and surface currents data, derived from the latest state-of-the-art forecast modeling systems available and from observational networks. To that effect, CG-SAR is continually researching, evaluating and incorporating new products into SAROPS. As of 2024, SAROPS accesses 134 different ocean (81) and meteorological models (53) developed and run by academia and various international and national government agencies that conform to the recommendations and requirements needed for SAR [Forbes, 2022].

In this presentation the importance of understanding oceanographic and atmospheric factors and the vital role of accurate global and regional numerical ocean and weather prediction models in SAR will be described. They are a crucial input to drift models, like SAROPS, and vital components for successful maritime SAR missions.

CG-SAR is currently exploring and collaborating with academic developers to determine if and how the incorporation of machine learning, artificial intelligence and relocatable models could assist in the accurate prediction of the drift of mariners and crafts at sea, targeted SAR operations and planning and narrowing of search areas in the marine environment.

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References

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