Smart control of the climate resilience
in European coastal cities

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Policy Brief

Under Pressure: Climate Change, Flood Dynamics, and Resilience in the Kızılırmak Basin

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Context and Importance

The Kızılırmak Delta, a Ramsar-protected wetland located in the Samsun province of Türkiye, is a vital ecological and agricultural region facing increasing flood risk due to climate change. Floods-already among the most damaging natural hazards-are expected to intensify in frequency and severity, with direct consequences for local communities, infrastructure, and food security. This brief highlights the results of a recent HEC-RAS 2D modeling study that simulates flood risk under historical data and future climate scenarios, offering key insights for evidence-based planning in the Bafra Plain.

Introduction

Flooding is one of the most frequent and destructive natural disasters, and its severity is intensifying in many regions due to climate change. The Bafra Plain, located in the Kızılırmak Delta of Türkiye's Samsun province, is highly vulnerable to these risks due to its low elevation, ecological sensitivity, and intense agricultural activity. With changing precipitation patterns and the increasing likelihood of extreme weather events, the region faces complex flood dynamics that threaten livelihoods, biodiversity, and critical infrastructure.

This policy brief presents key findings from a HEC-RAS 2D flood modeling study that integrates both historical data and future climate projections under RCP 4.5 and RCP 8.5 scenarios. The study provides valuable insights for climate adaptation planning by simulating flood extent, water depth, and flow velocity under different scenarios, highlighting areas at greatest risk and identifying pathways to strengthen resilience (Fig.1).

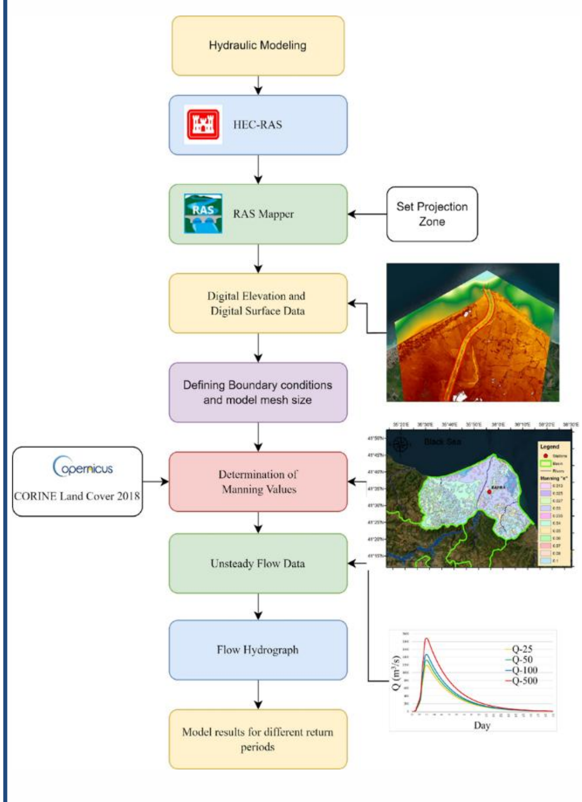

Figure 1. Methodological framework

Key Findings

Historical flood modeling (1963–2005) showed flood-prone areas ranging from 8.96 km² (Q_{25}) to 12.70 km² (Q_{500}), with low average velocities (~0.13–0.14 m/s), indicating slow, widespread inundation.
Under RCP 4.5, flood extents decrease (Q_{500}: 7.49 km²), but velocities increase (up to 0.38 m/s), suggesting stronger floods in narrower areas.
RCP 8.5 results show wider flood areas (Q_{500}: 10.71 km²) with moderate velocities, posing cumulative risks to rural zones.
Both scenarios reveal a shift of flood risk toward low-lying rural areas, especially in Q_{100} and Q_{500} events (Fig.2-4).
Despite lower projected precipitation, flash flood risk rises due to intense summer rainfall, threatening agriculture and ecosystems in the Bafra Plain.

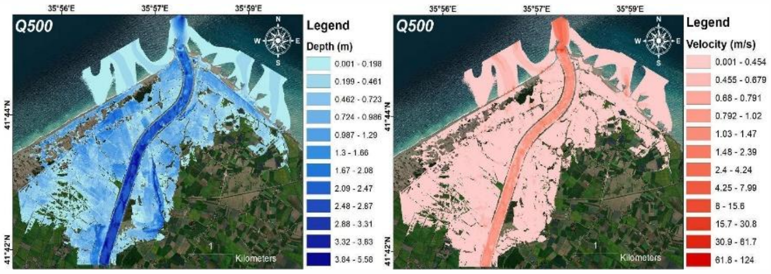

Figure 2. Historical flood propagation and water velocity maps for Q_{500}

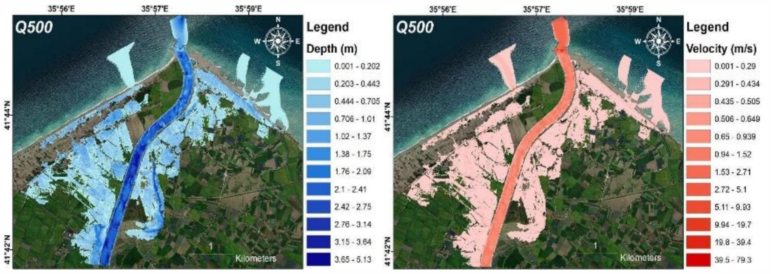

Figure 3. Flood propagation and water velocity maps for Q_{500} periods (RCP 4.5)

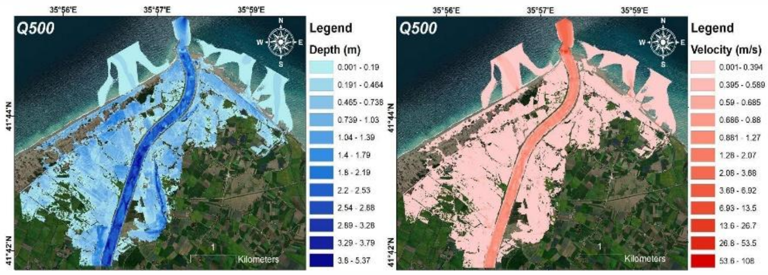

Figure 4. Flood propagation and water velocity maps for Q_{500} periods (RCP8.5)

Policy Implications

- Incorporate long-term climate projections into flood forecasting tools to enable rapid response and disaster preparedness.
- Resilient Infrastructure and Zoning
- Avoid new construction in high-risk flood zones; reinforce existing infrastructure, particularly around agricultural lands and transport routes.
- Ecosystem-Based Approaches (EBAs)
- Protect and restore wetlands and natural floodplains to absorb excess water and reduce peak flows.
- Climate-Sensitive Urban Planning
- Integrate updated flood risk maps into development strategies; prioritize green infrastructure and permeable surfaces in urban design.
- Strengthen Early Warning Systems

Expected Outputs

- Flood Risk Maps for different return periods (Q25, Q50, Q100, Q500) under historical and future climate scenarios (RCP 4.5 and RCP 8.5), supporting evidence-based spatial planning.
- Scenario-based Flood Velocity and Depth Analysis, identifying zones of high-energy flow and potential infrastructure vulnerability.
- Policy Recommendations for flood resilience, including nature-based solutions, zoning adjustments, and early warning systems.
- Data-driven Decision Support for local authorities in Samsun, enhancing disaster preparedness and climate adaptation capacity.

Conclusions

- The Kızılırmak Basin, and particularly the Bafra Plain, faces a dynamic and uncertain flood future.
- Scientific modeling reveals clear shifts in flood behavior under climate change scenarios, calling for urgent, adaptive, and ecosystem-based flood management policies.
- Local authorities, planners, and community stakeholders must collaborate to build a resilient Samsun, safeguarding both its people and its environment.

References

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About SCORE
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