Flood Risk Assessment on two Greek island ports under the impact of rising sea levels

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Introduction

Ports Importance

- **Crucial nodes** in the supply network
- **80 %** of merchandise trade globally (UNCTAD, 2022)
- Critical infrastructures at small islands **(lifelines)** (Monioudi et al, 2018)

Ports exposure to marine hazards

- **Harbor functionality**
- **Terminal and vessel damaging**
- **Constraints on vessel handling and berthing**
- **Disruptions on supply chains**

Under CV & C exposure is projected to increase (Camus et al, 2019)

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Introduction

Extreme Sea Levels (ESLs) equal to the summation of:

- **Rising Mean Sea Level** (RMSL)
- **Astronomical Tide**
- **Meteorological tide** (storm surge)
- **Wave set up** (approximated as 0.2 of H_s)

RCP4.5 (moderate) & **RCP8.5** (pessimistic) scenarios from **IPCC**

2 Reference Years: **2050 & 2100**

(Vousdoukas et al, 2018*)*

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Objective

Study the exposure to flood risk under the impact of CV & C at two island ports of the NE Aegean Sea

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Study Area

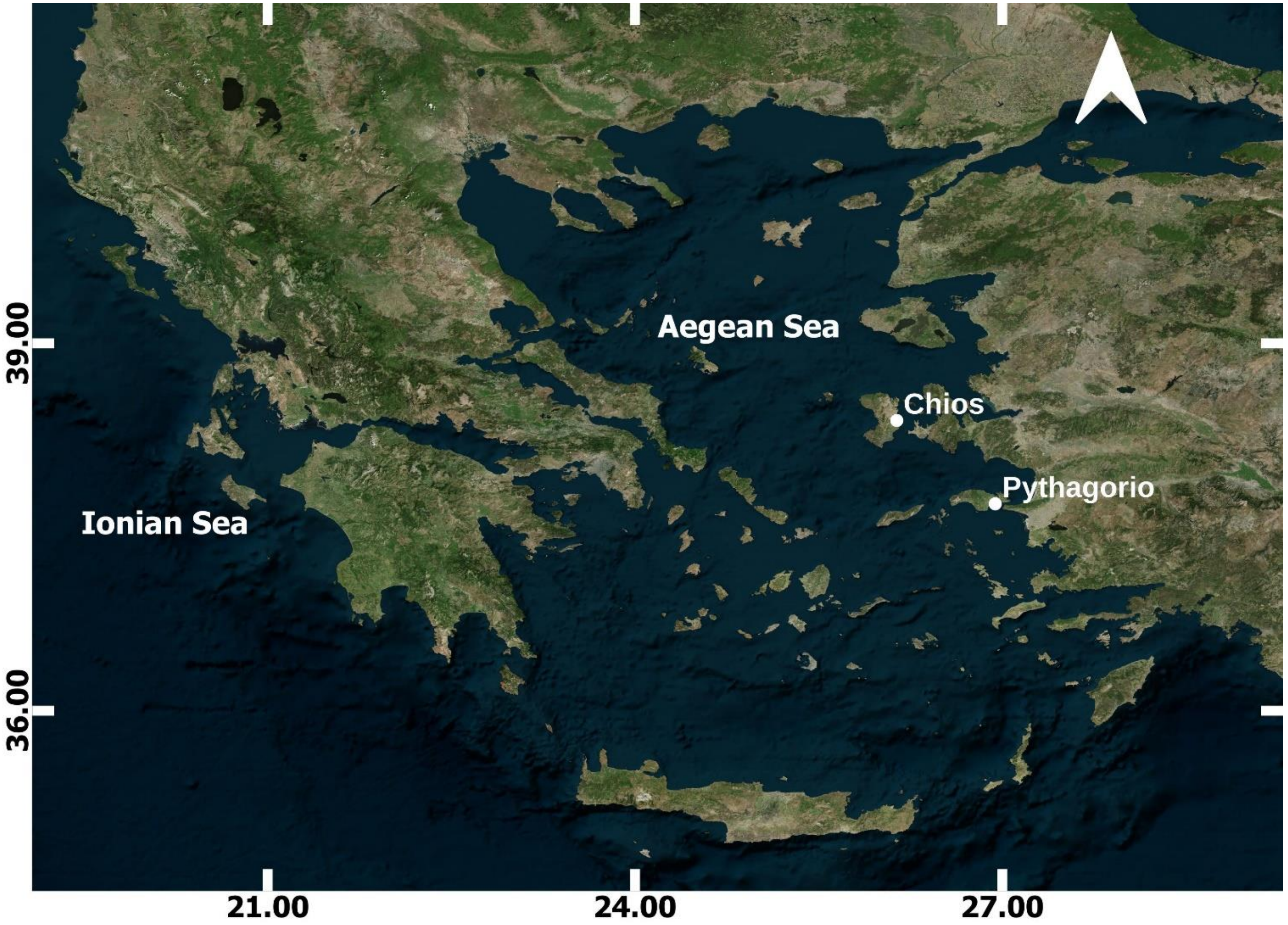
- **Chios Port**

~150000 arrivals

- **Pythagorio Port, Samos**

~ 17000 departures

(*Papaioannou et al*, 2022)



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Methodology

- **Hydrodynamic modelling:**

LISFLOOD-FP (*Bates & de Roo*, 2000)

2-D simulations on structured grid

Used in coastal flood risk applications and port inundation estimation (e.g *Bove et al*, 2020)

- **Hydrodynamic forcing at boundaries:**

ESL = 1.2 m (2050) and 1.65 m (2100), 1-100 yr event

- **Storm duration** set to 10 hours
- **High Resolution** (2x2) **DEM** from Greek Cadastre
- **Manning friction coefficient** from Coastal Zone Land Use/Land Cover layer from https://land.copernicus.eu/en/products/coastal-zones

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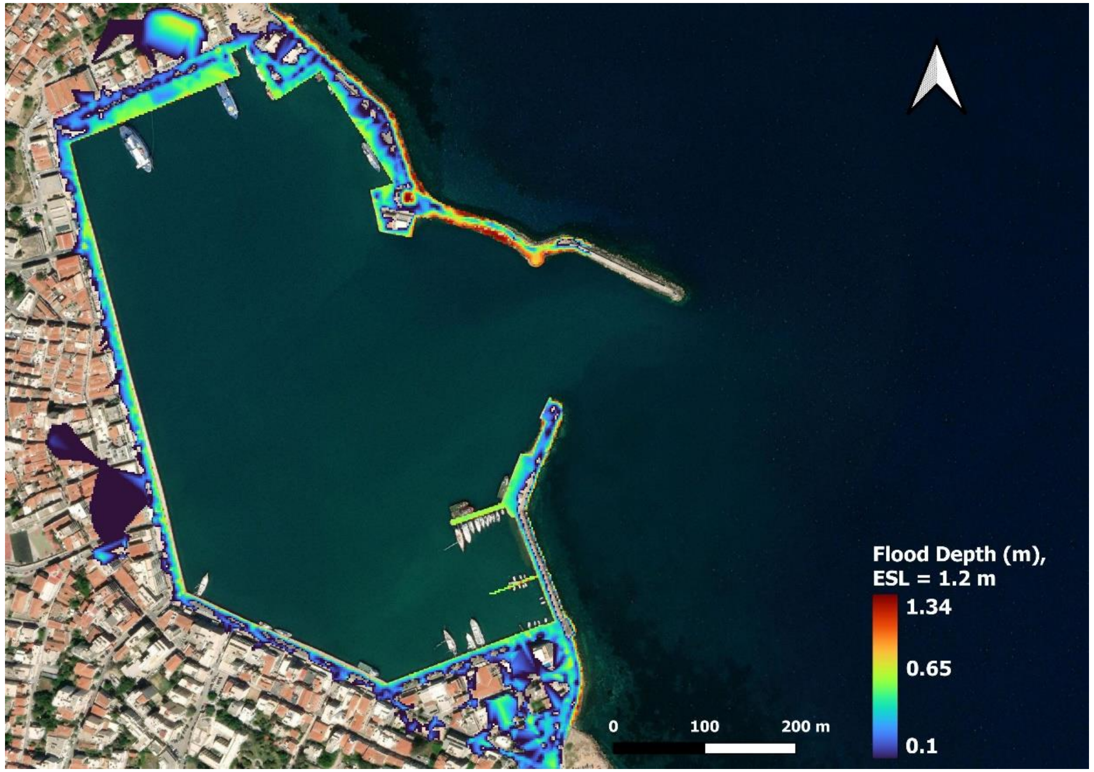
Results: Chios Port

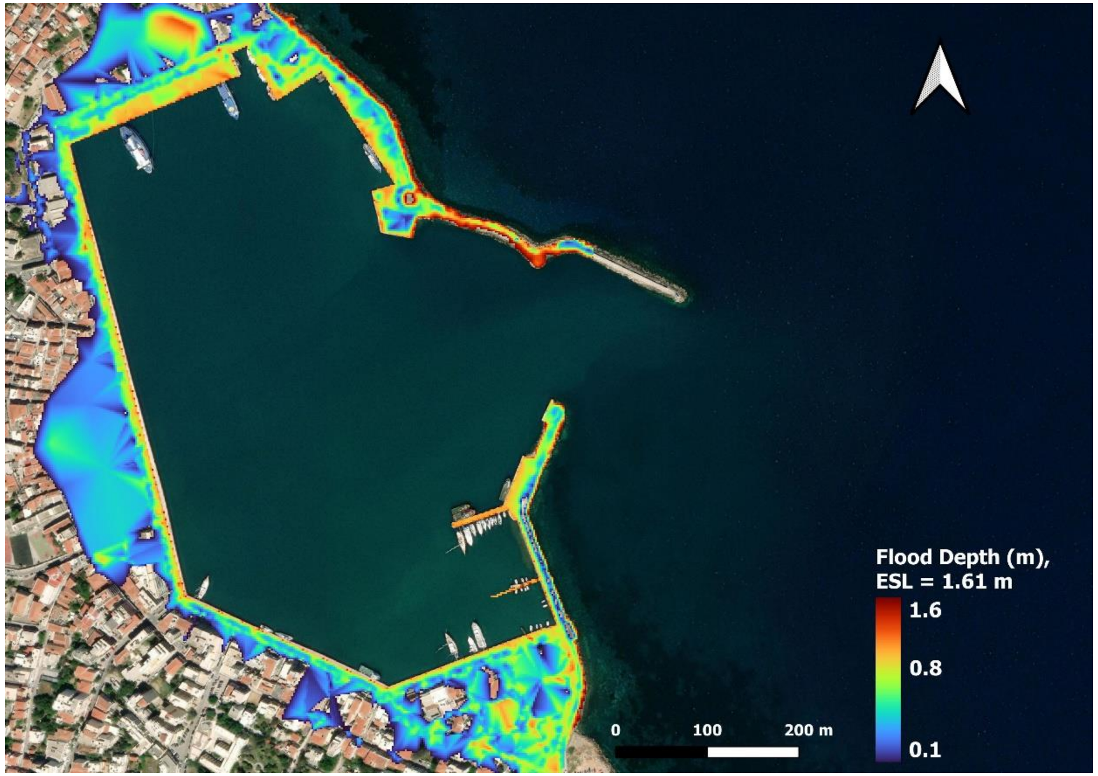
2050 : 60300 m^2 inundated,

Max flood extent = 165 m



2100: 107000 m^2 inundated,

Max flood Extent = 180 m



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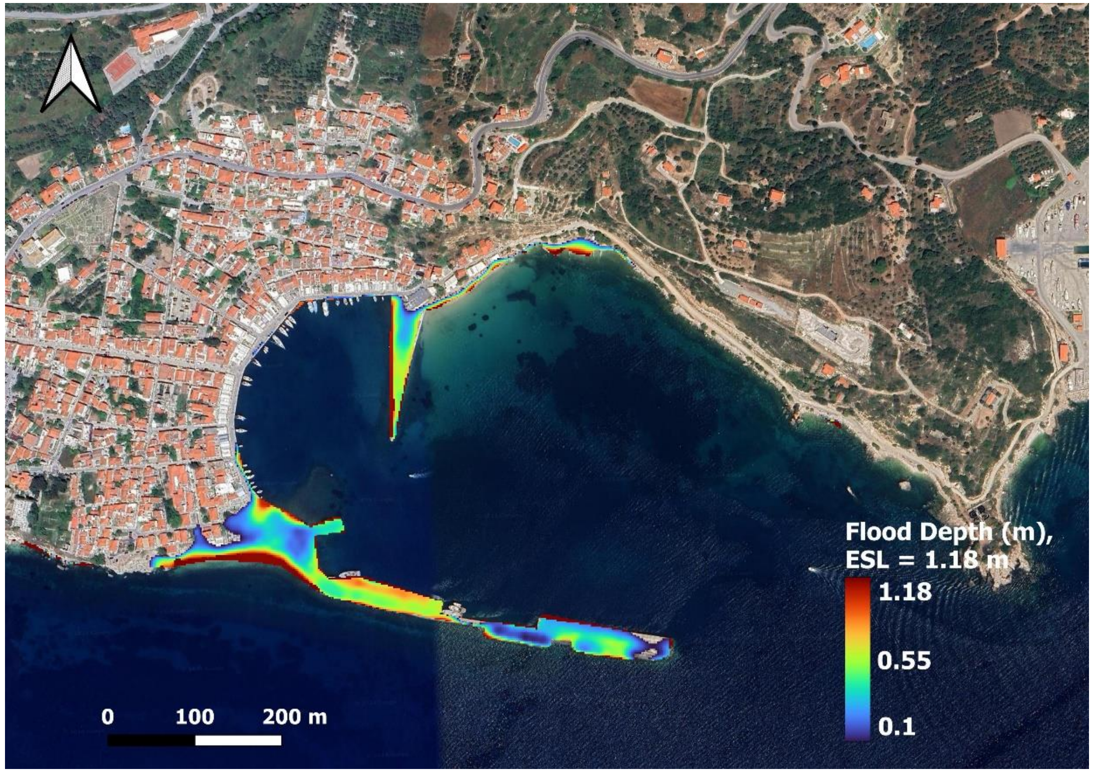
Results: Pythagorio

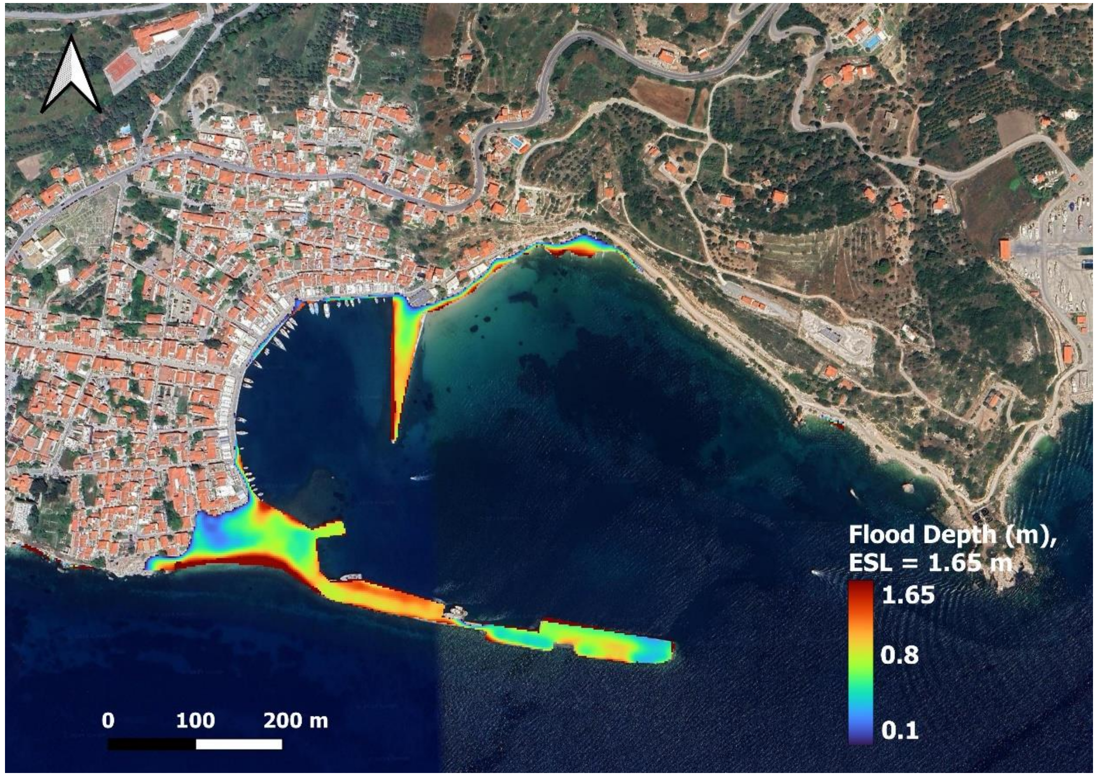
2050: Entire harbor are inundated

Max flood extent: 55 m



2100: Max flood extent 65 m

Coastal road inundation



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Conclusions

- High Resolution topographic data crucial on detailed flood modelling
- LISFLOOD-FP can support flood risk assessment on ports
- Both ports are highly exposed to flood risk with adverse consequences also for the local communities
- Urgency for adaptation measures and enhancement of port resiliency

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References

Bates, Paul D., De Roo, A.P.J., 2000. A simple raster-based model for flood inundation simulation. J. Hydrology 236, 54-77 doi.org/10.1016/S0022-1694(00)00278-X

Camus P, et al 2019 Probabilistic assessment of port operation downtimes under climate change. Coastal Engineering 147:12–24. https://doi.org/10.1016/j.coastaleng.2019.01.007

Monioudi IN et al 2018. Climate change impacts on critical international transportation assets of Caribbean Small Island Developing States (SIDS): the case of Jamaica and Saint Lucia. Reg Environ Change 18. https://doi.org/10.1007/s10113-018-1360-4

Papaioannou, G., et al 2023. Analyzing the Passenger Traffic Demand Patterns of Greek Ferry Terminals. Transportation Research Procedia 72, 2920-2927 https://doi.org/10.1016/j.trpro.2023.11.838

UNCTAD, 2022. Review of Maritime Transport. UNCTAD/RMT/2022. United Nations Publications, New York, USA. https://unctad.org/publication/review-maritime-transport-2022. Accessed 18 Jan 2024

Vousdoukas MI, et al 2018. Global probabilistic projections of extreme sea levels show intensification of coastal flood hazard. Nat Commun 9:2360. https://doi.org/10.1038/s41467-018-04692-w

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Thank you for your attention

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