CoSMoS – Adapt:
Assessing coastal risks and risk reduction strategies in California

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American Shore & Beach Preservation Association

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CALIFORNIA'S FIFTH CLIMATE CHANGE ASSESSMENT

OUR VOICES WILL DEFINE THE CENTURY

Coastal Risks & Engineering @ UCSC

Coastal Climate Hazards

Risks and impacts to people and infrastructure

Adaptation and nature-based infrastructure

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Project goals

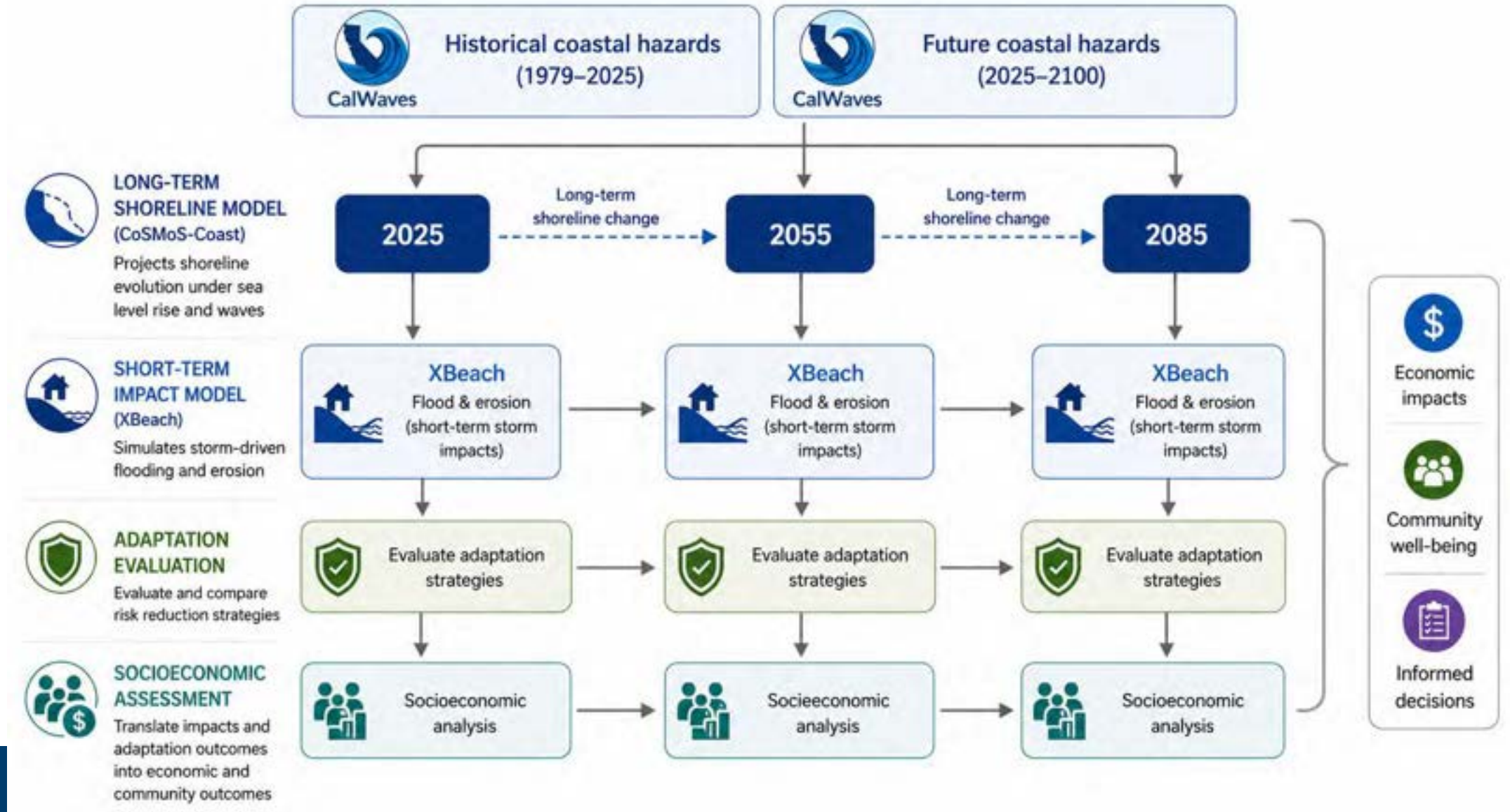
1. Advance the characterization of coastal risks over time, including tipping points.

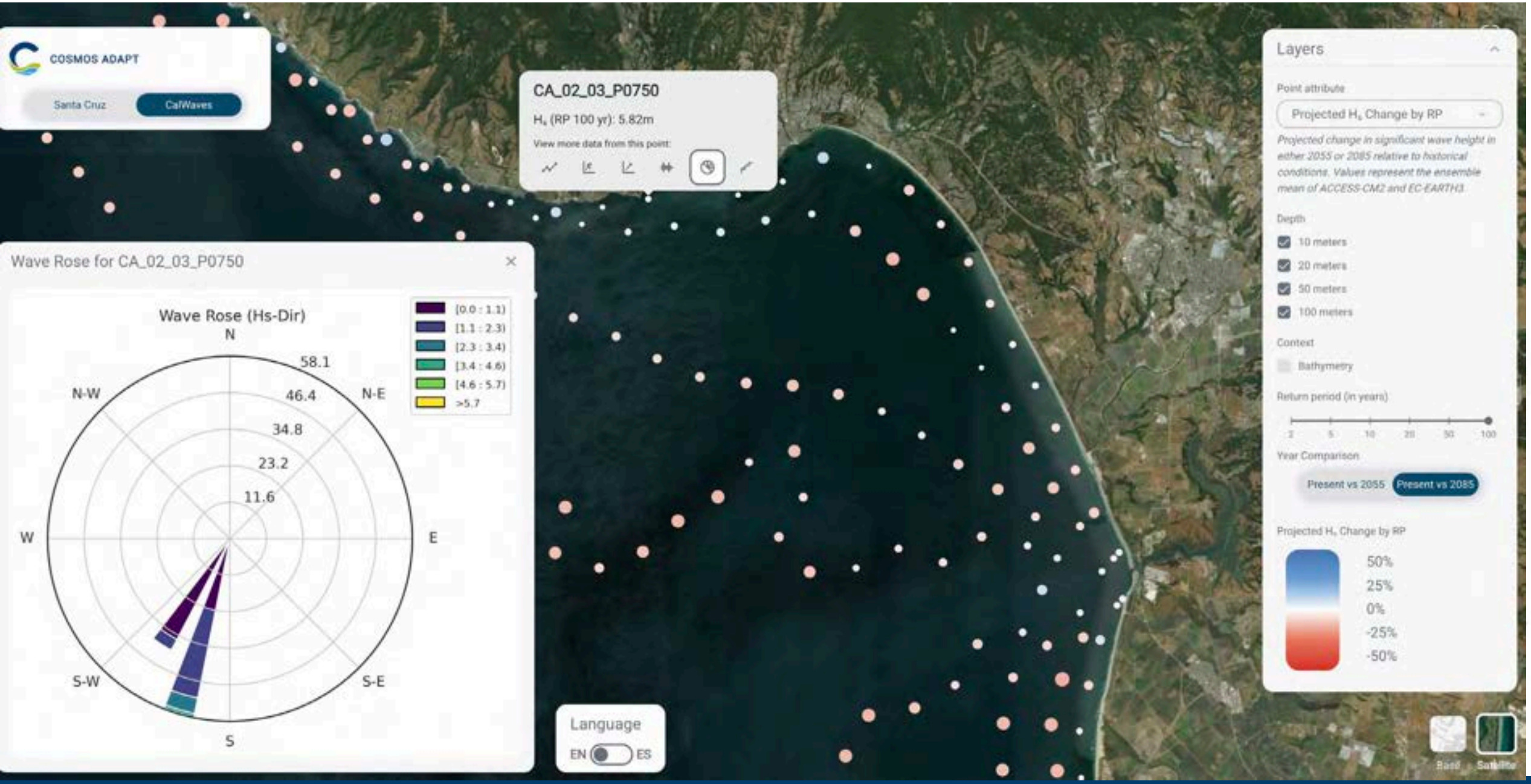
2. Quantitative evaluation of adaptation strategies, costs-benefit analysis, and their spatial distributions.

Pilot phase.
Applied in 7 municipalities.

Summary of Modeling

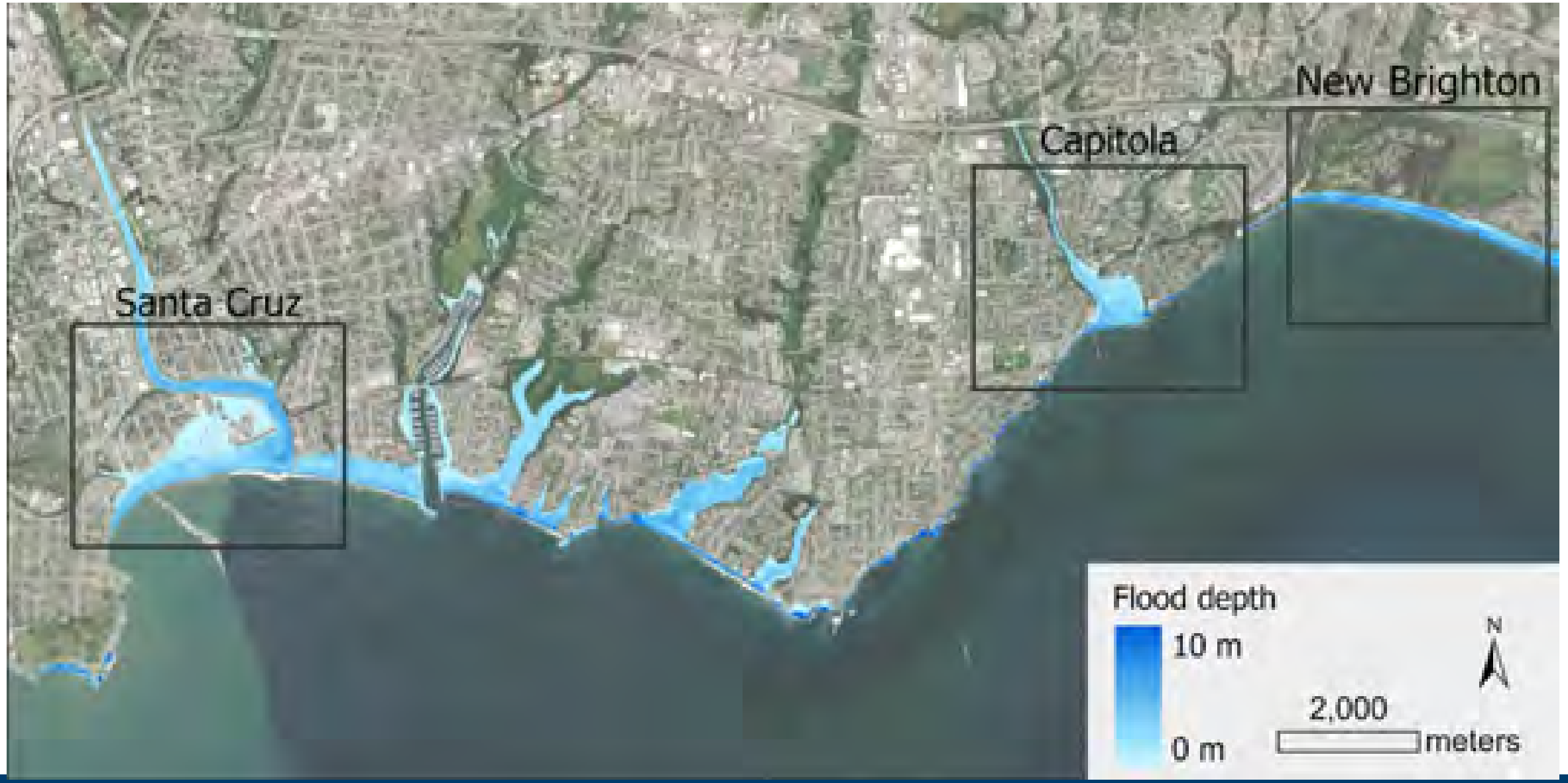
Risk across short (storms) and long-term (decadal) scales



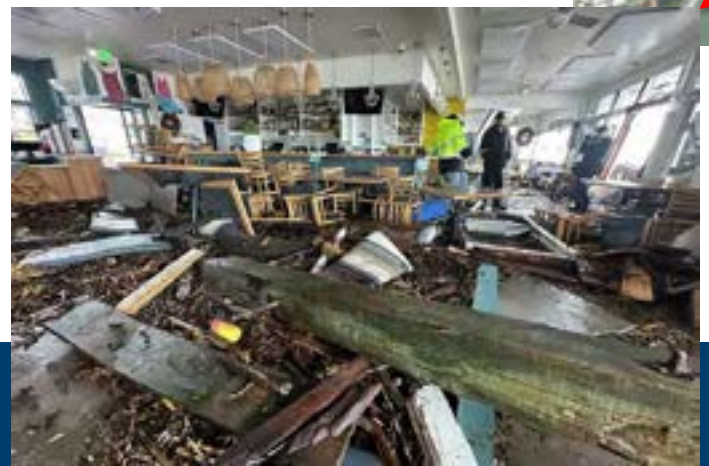


Draft results - Under review – Not for distribution

Results: flood hazard maps (HR)



Validation and comparison against January 2023 bomb swells benchmarks



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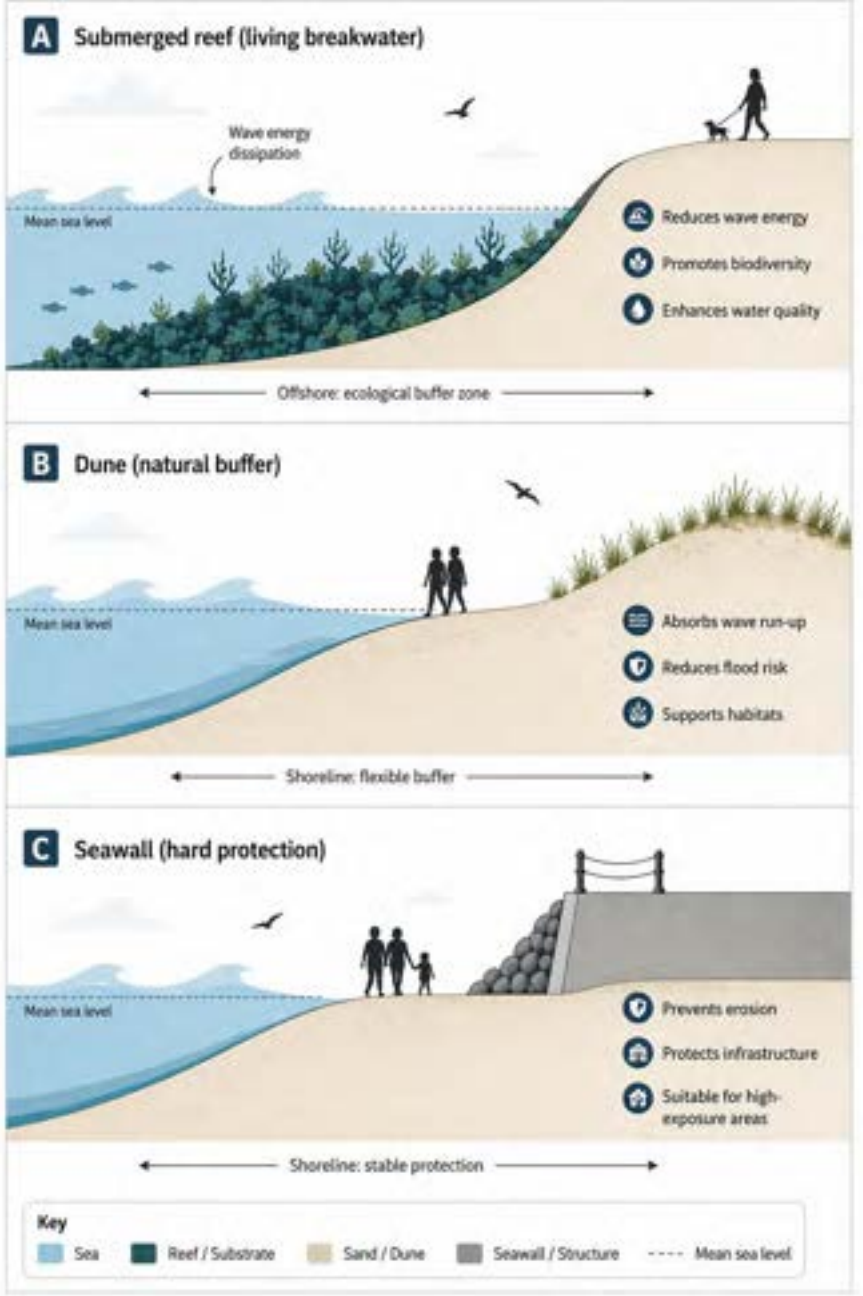
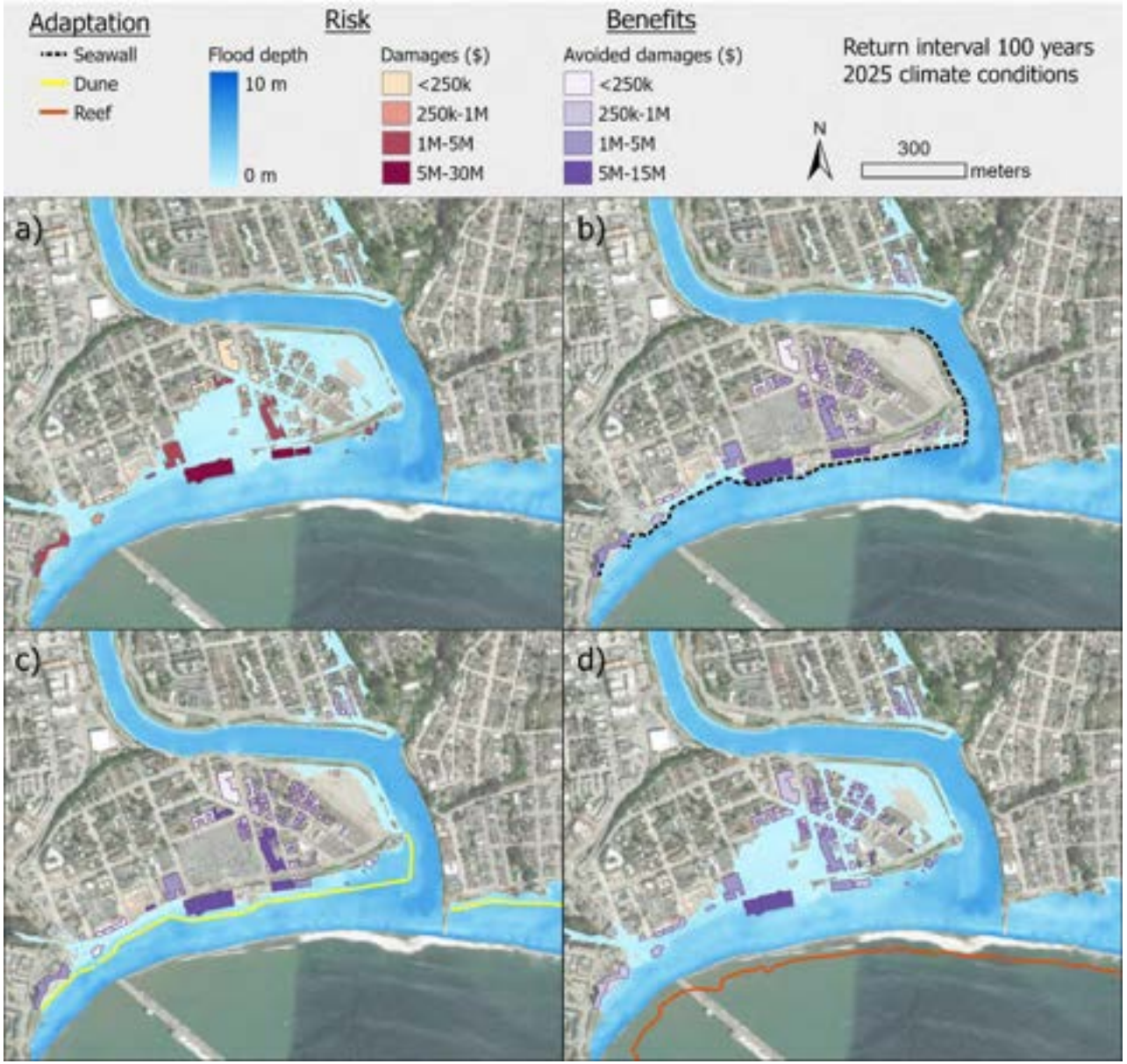
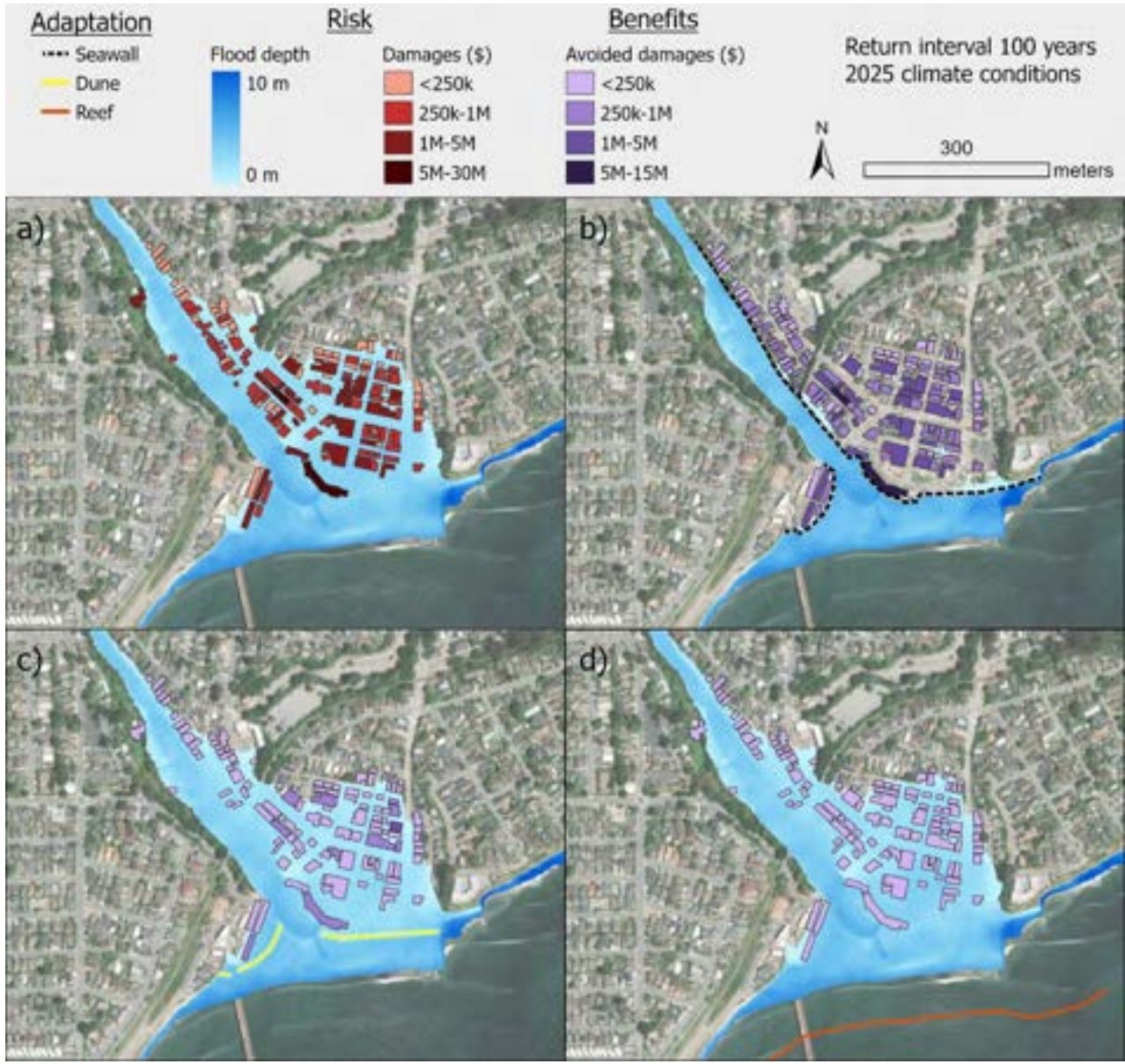
Examining Adaptation Options



Adaptation Options included: dunes; reefs (submerged defenses); seawalls; shoreline protection





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Effects of adaptation options on present-day risk in Main Beach, Santa Cruz area

Effects of adaptation options on present-day risk in Capitola

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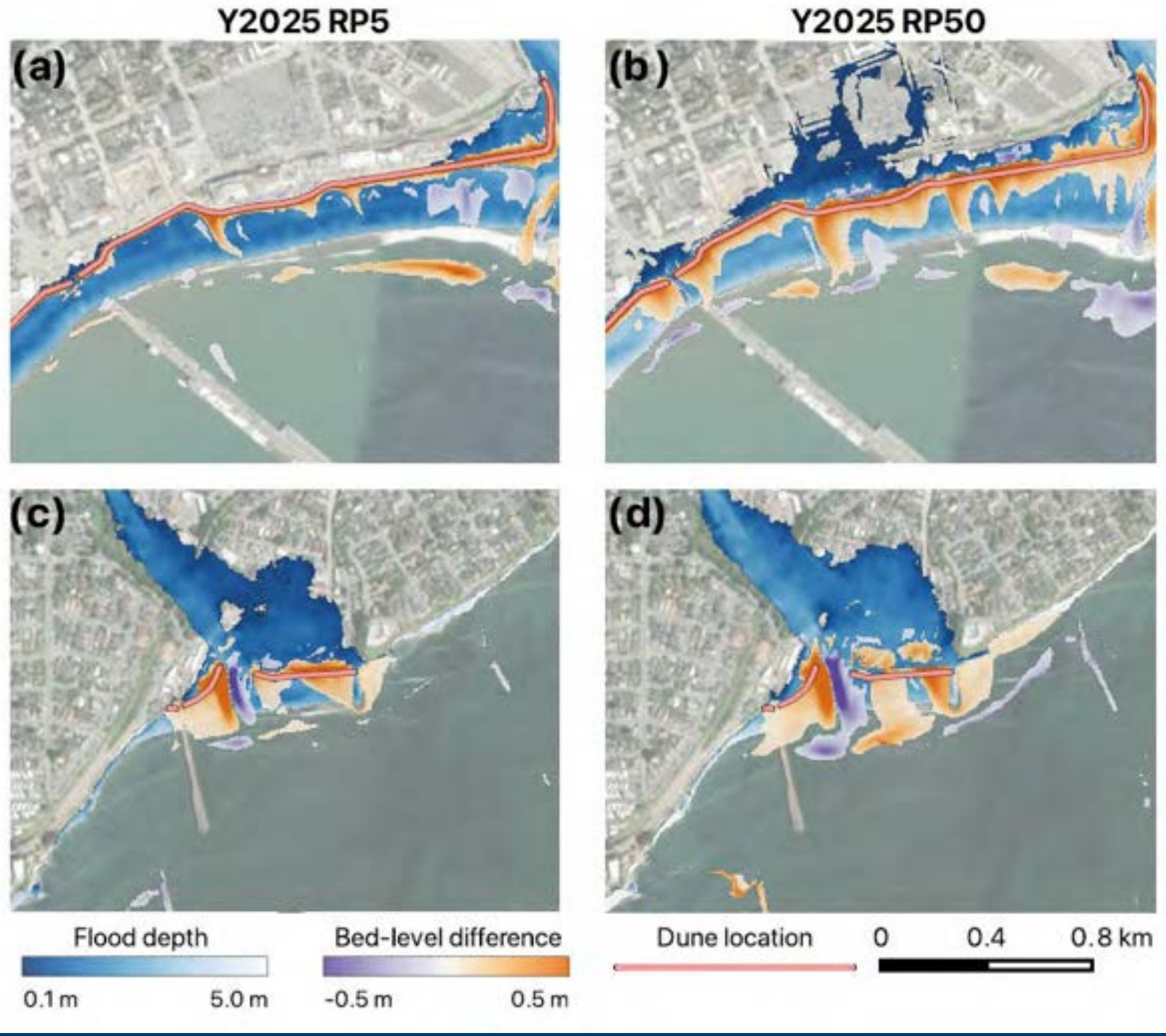
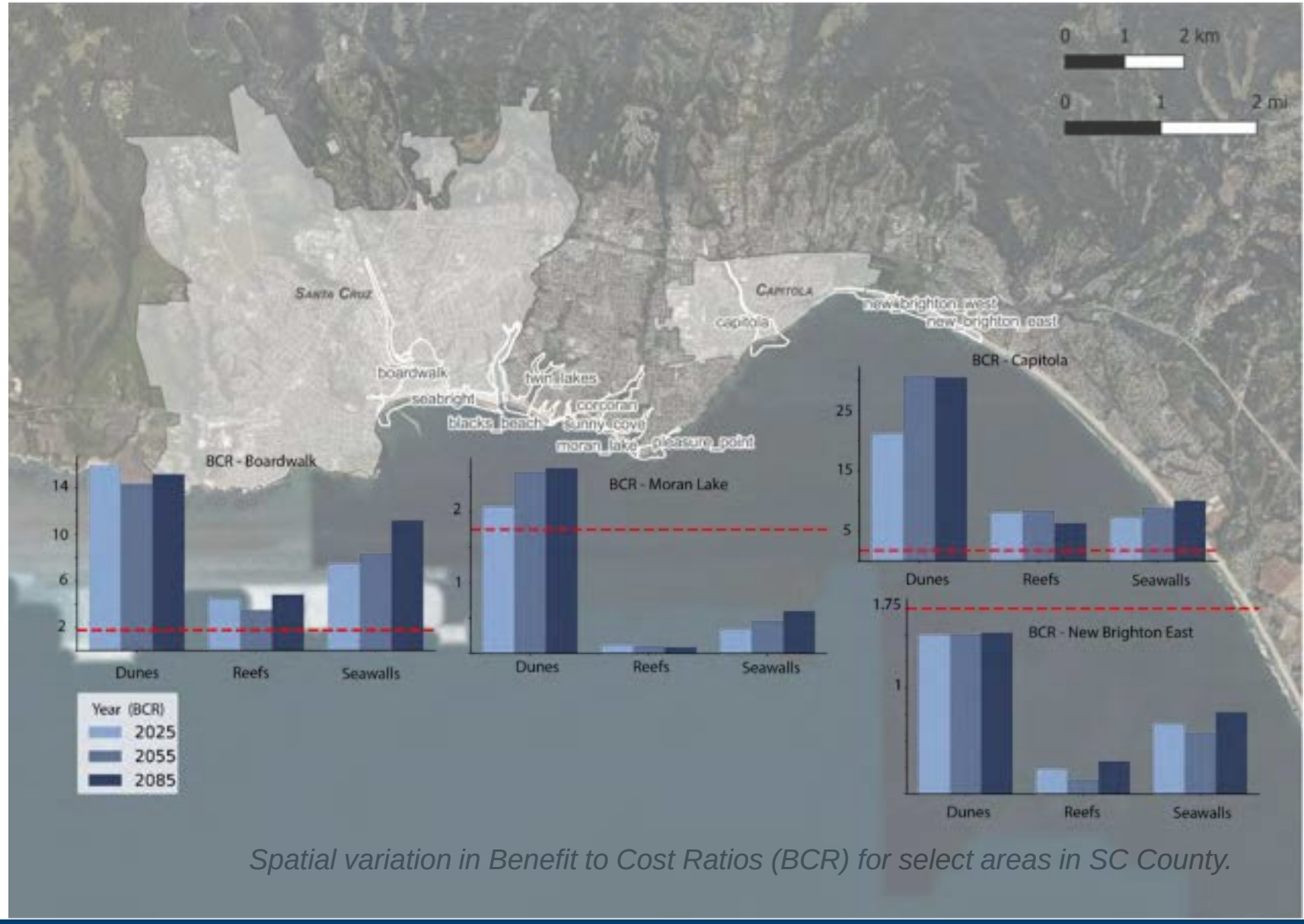
Are Morphodynamic relevant for risks?

- Morphodynamic feedbacks **reduce coastal flood extent** by up to 32%
- Dune performance: 60% flood mitigation at present, drops below 5% by 2085 (overwashed)
- **Static vs. erodible dune** models diverge up to 54% for storm intensity
- **Dune performance is site-specific, driven by geomorphic setting**



Cost Benefit Analysis

- **Adaptation solutions can significantly lower risks**
- **Dunes and seawalls can be highly effective**
  - Dunes reduce risk 34 - 41%; very cost-effective.
  - Seawalls reduce risk 46 - 96%; at high cost economically (before social costs considered)
- **Cost effectiveness varies by location**



Spatial variation in Benefit to Cost Ratios (BCR) for select areas in SC County.

CoSMoS Adapts: Online Tool – Coming Soon

Conclusions

CoSMoS Adapt Pilot Phase

- New datasets for CA-wide application in coastal projects
- High-fidelity models assess structural & nature-based features
- Non-linear risk changes detected
- Large variability in intervention cost-effectiveness

Regional Risk and Adaptation Analysis

- Viable deployment at county-wide scales (~15–20 km shoreline) and statewide
- Models incorporate structural and nature-based features
- Pinpoint benefits to individual communities and assets

Next steps:

- Cliff erosion & Rip-rap stability
- Co-benefits (e.g. recreation)
- Analysis of effects on various infrastructure assets and beneficiaries (e.g. public vs residential infrastructure)

Thank you

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