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From Model Outputs to Planning Layers

Connecting environmental evidence with spatial planning choices

A planning support workflow for coastal adaptation in Dalian, China

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Dalian's coastal growth setting

- **Coastal metropolitan region**

  Approximately 13,400 km² in northeast China

- **Coastal development pressure**

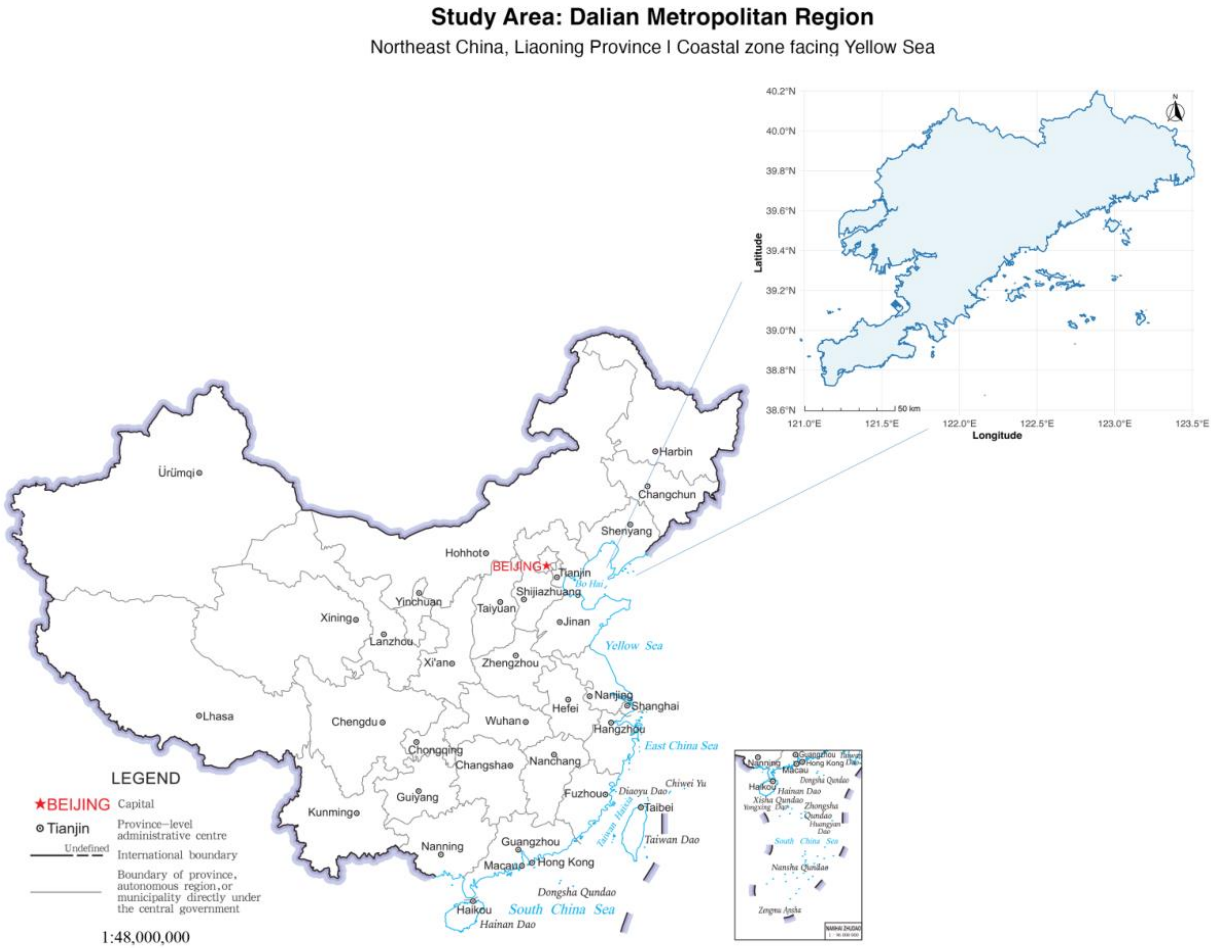
  Modeled growth is concentrated near the shoreline

- **Port context**

  Port proximity is explored as a proxy for differentiated commercial treatment

- **2050 planning horizon**

  SSP2-4.5 inputs with an exploratory flood exposure layer



Guiding future growth in coastal Dalian

EARLIER WORK

- Combined LEAM with coastal flood screening under sea level rise.
- Tested how wetland protection and blue–green corridors change future growth through spatial development rules.

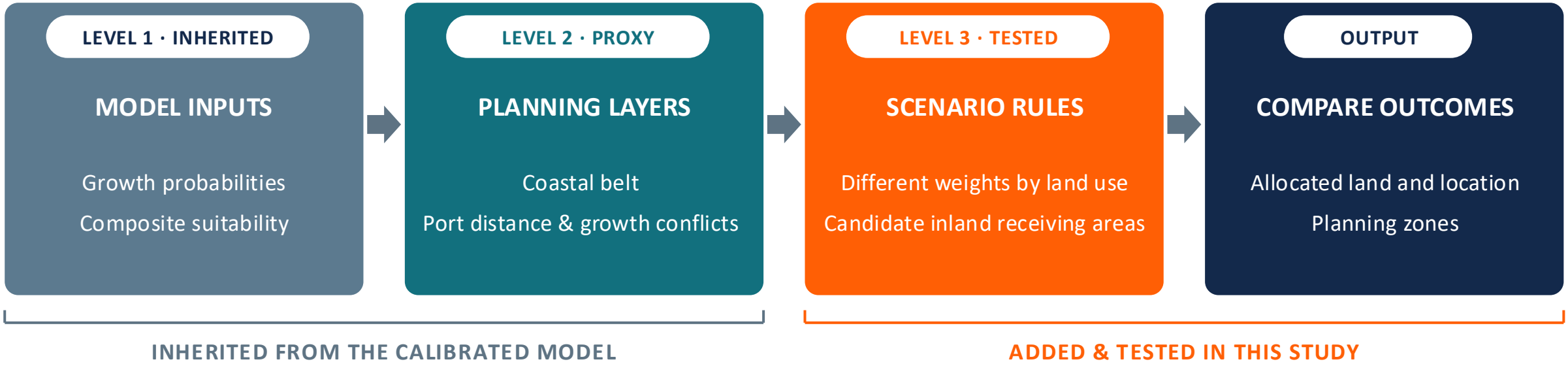
WHAT THE BASELINE SHOWS

- 97.7% of projected urban growth falls on highly suitable land.
- New residential growth remains within 5 km of the coast.

Pang, B., & Deal, B. (2025). Integrating Land-Use Modeling with Coastal Landscape Interventions: A Framework for Climate Adaptation Planning in Dalian, China. *Sustainability*, *18*(1), 370.

Workflow

From inherited evidence to scenario comparison



This study

Can different rules for residential and commercial development guide new housing inland while retaining space for commercial growth?

Research behind the selective adaptation rules

Research	Idea we drew on	What we added to the model
Wolff et al. (2023)	Coastal setbacks can reduce the exposure of new development.	A coastal planning belt extending 5 km from the shoreline.
Mach & Siders (2021)	Retreat can work alongside other adaptation responses.	Different coastal rules for residential and commercial growth.
Druckenmiller et al. (2024)	Removing development incentives can discourage coastal growth.	Within the coastal belt, residential allocation scores ×0.50 and commercial scores ×0.90.
Notteboom et al. (2022)	Port facilities support clusters of related economic activities.	Within the coastal belt, restore the commercial multiplier to 1.00 within 5 km of a mapped port.
Haasnoot et al. (2021)	Planning ahead includes identifying alternative development locations.	In candidate inland receiving areas, residential scores ×1.20 and commercial scores ×1.05.

Three scenarios, shared demand inputs

BAU

Business as usual

Growth under existing planning constraints

SA

Selective adaptation

- Stronger restraint on coastal residential growth
- Conditional commercial retention near ports

SC

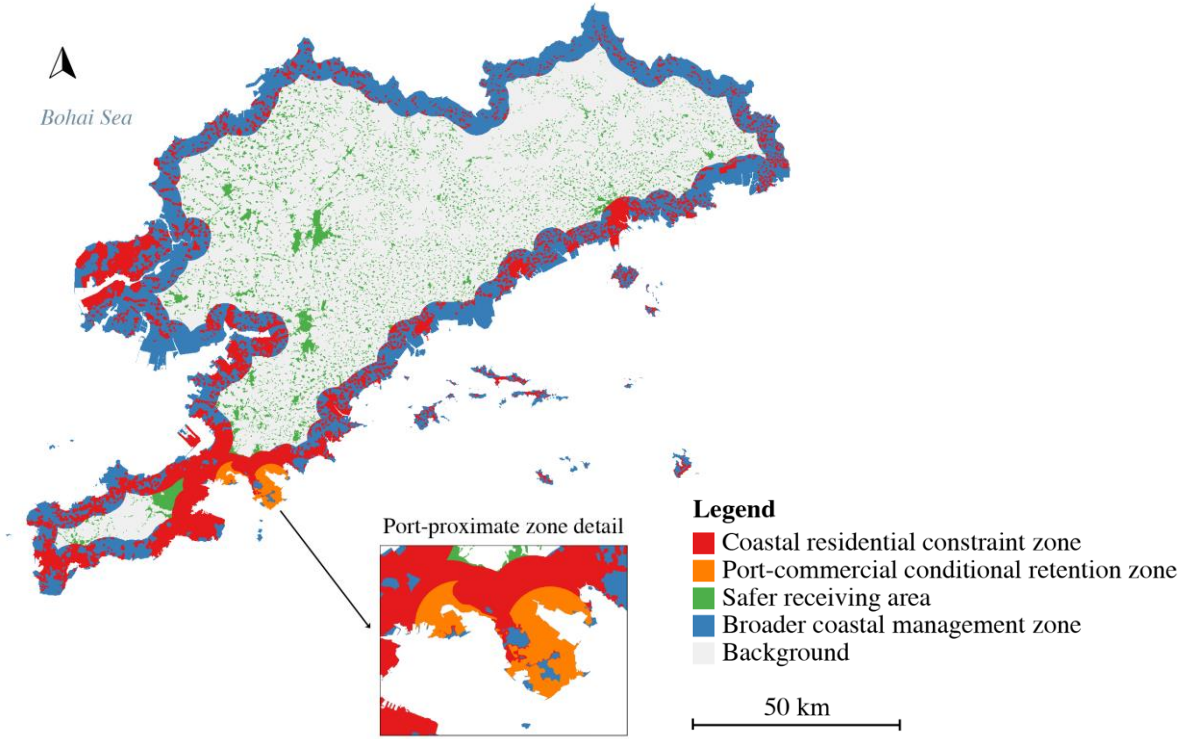
Strong conservation benchmark

wetland protection and ***blue–green corridor*** constraints.

How much growth can each approach accommodate, and where?

From model outputs to planning zones

Five planning categories for screening and discussion



Coastal residential constraint

Where should new residential growth be discouraged?

Conditional commercial retention

Which activities require coastal access, and under what conditions?

Candidate inland receiving area

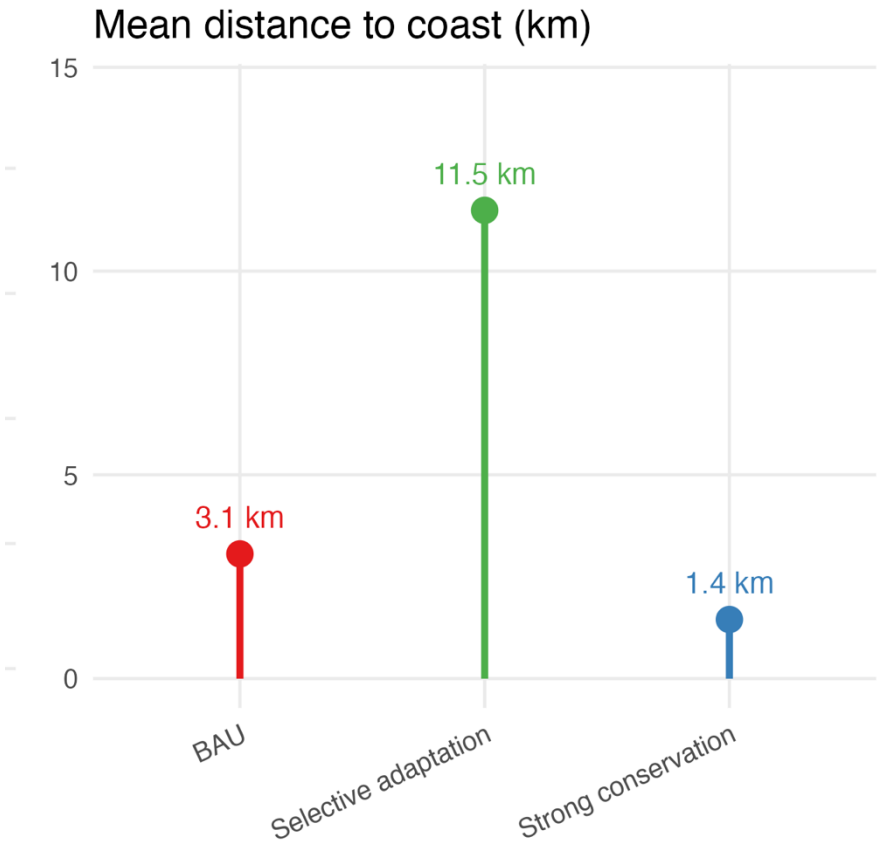
Can infrastructure and ecological conditions support new growth?

- **Red — coastal residential constraint.** The shoreline cells where new housing pressure is high and should be discouraged.
- **Orange — port-commercial conditional retention.** The tiny sliver where commercial growth is allowed to stay because it genuinely needs port access.
- **Green — (safer) receiving area.** Inland places where redirected growth is steered *to*.

Selective adaptation directs new residential growth inland

All three scenarios meet the same residential land demand.

Scenario	Residential share within 5 km belt	Mean residential distance to coast	Commercial cells allocated	Commercial Change vs BAU
BAU	100%	3.06 km	3,541	Reference
Selective adaptation	0%	11.49 km	2,360	−33.4%
Strong conservation benchmark	100%	1.45 km	8	−99.8%



A candidate planning option with less commercial land allocated

Commercial change is relative to BAU allocation. Coast distance describes location, not flood risk.

What this case suggests for planning and design

1 **Connecting evidence with planning choices**
Combine model outputs with planning rules informed by research, then test their effects.

2 **A starting point for planning and design**
Compare alternatives and identify areas for closer site investigation.

How could we further connect environmental evidence and planning design?

I study how environmental evidence informs landscape design and land-use decisions for climate adaptation.

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