Methods for identifying what kind of sea level rise information users need: experiences from the INSeaPTION project

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INSeaPTION

Needs stated by users

- Needs are subjective and socially constructed
- Needs for SLR information expressed by users may not serve the purpose of adapting well
  - Needs may be culturally determined or legally prescribed
  - Needs may be opportunistic: A large body of social science literature shows how opportunistic behaviour and individual interests hamper organisations to pursue their organisational goals (e.g., Levine & Forrence, 1990)
- Remarkably little empirical research on this in the climate domain
  - Existing studies ‘ask users’ what they need:
    - Coastal domain (Madsen et al. 2018)
    - Climate decision-support tools (e.g. ClimateADAPT, UNEP Provia)

Three perspective on decision-making

Decision-analytical	Empirical	Transdisciplinary
Prescriptive	Descriptive	Normative
How to make the “best” decision, given some criteria?	How are decisions actually made and why?	How to design a fair, inclusive and effective decision making process?
• Compute the “best” option • Formalisation of decisions and subjective preference	• Systematic cognitive biases (Tversky and Kahneman, 1972) • Power, regulatory capture, opportunistic behaviour (Levine & Forrence, 1990)	• Avoid power: powerless discourse (Habermas 1981), deliberative democracy” (Besette 1980, Dryzek 2000)

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Needs from a decision-analytical perspective

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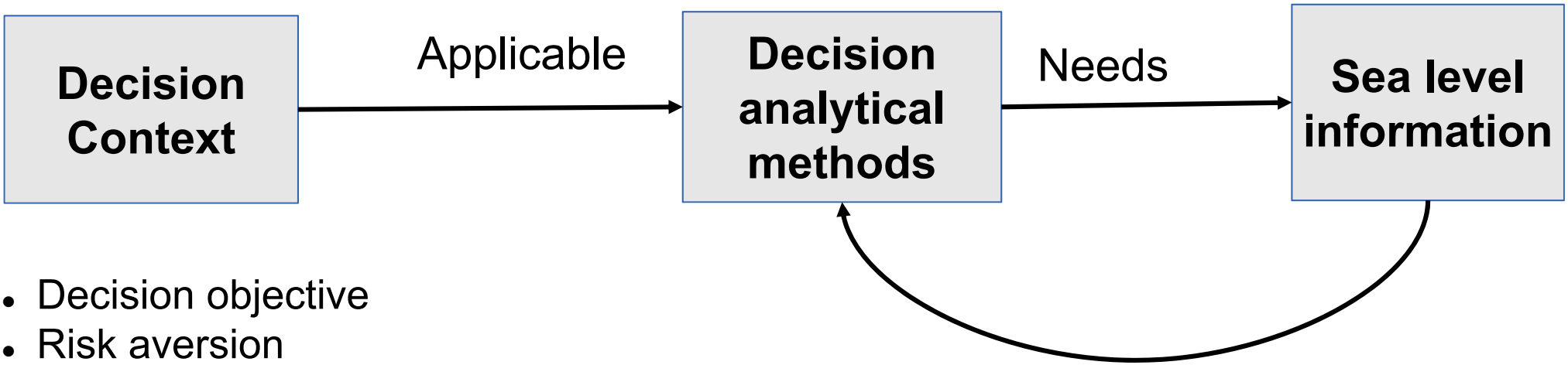
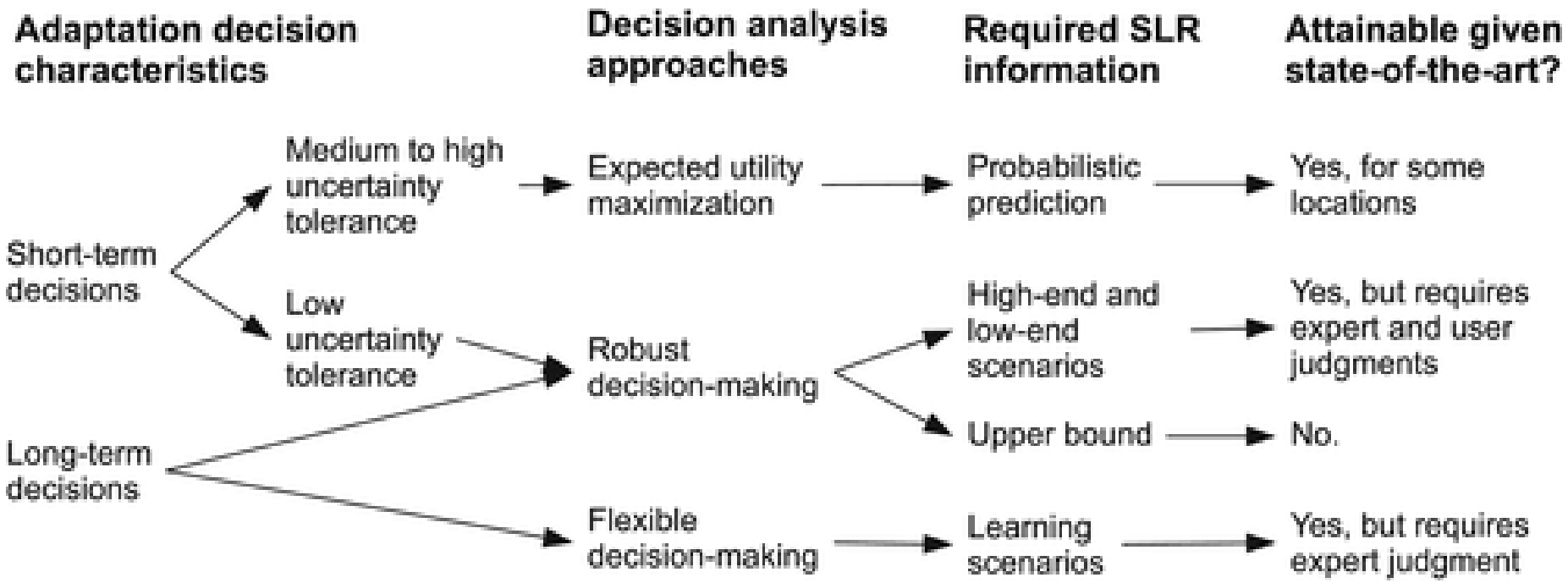


- Decision objective
- Risk aversion
- Time horizon
- Individual vs social
- Etc.



Hinkel et al. (2019)

An example from the Maldives

Land reclamation in the Maldives

→ Purposes: Residential, airports, tourism, waste management, industry

→ Land extensions levelled at existing island height to avoid drainage problems

→ Current Guideline 1.50 -1.75 m above current MSL for new projects

Limitations:

1. No differentiation to account for local differences in flood probabilities or exposure for planned land use
2. Ad hoc “allowance” for SLR does not address robustness
3. Flood-proof versus risk-based heights of reclaimed land
4. Options to increase flexibility & future lock-ins not considered

- Hulhumalé II

- Komandoo

- Hoarafushi

- Vilufushi

- Reethi Rah

- Thilafushi II

Decision	Methods	Information needs	Limitations
1. Choose uniform design height policy for new land	Adaptation tipping points	MSL scenarios and extreme sea-level distributions Long-term regional SLR scenarios	- Does not account for local variation, e.g. in wave set-up - Does not account for exposure
2. Choose hazard-based design height strategy for new land	Adaptation tipping points	Same as above. + changes in waves + bathymetry	- Does not account for exposure - Modelling deep SLR uncertainty
3. Choose risk-based design height policy for new land	Cost-benefit analysis	Same as above. + exposure data (e.g. area, population, asset values, etc.) + Model effectiveness of adaptation options	- Computational intensive - Modelling deep SLR uncertainty

Decision-analysis methods

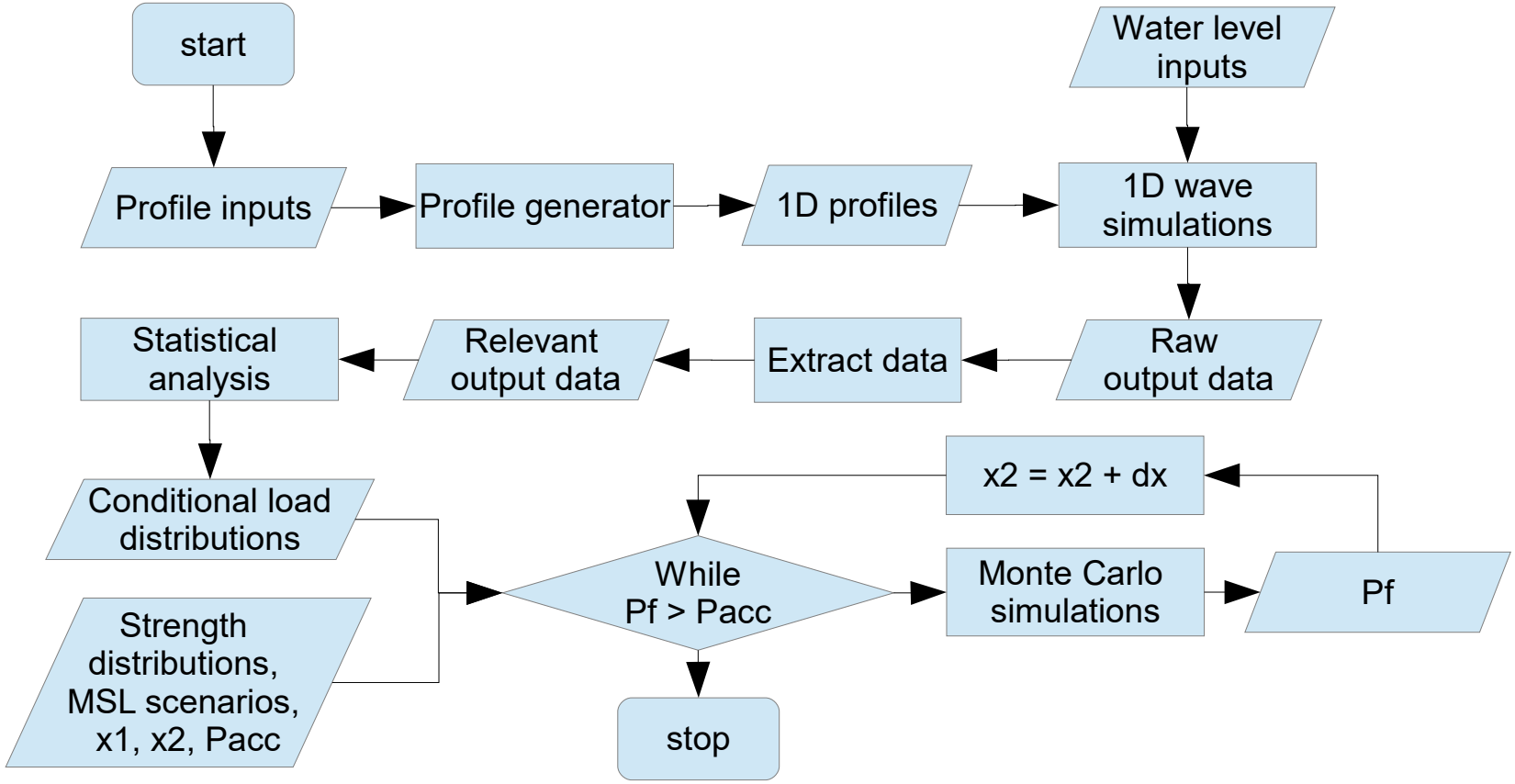
Hazard analysis (tipping points):

- Adapted version of simple reliability analysis (van der Meer et al. 2009; Dupuits et al., 2017):
  - Land reclamation context
  - Simulation-optimisation approach for hazard-based island heights for a given maximum flood probability
  - Risk intolerance

Cost-benefit analysis

- Risk-based land reclamation not previously studied
- Setting resembles extensively studied risk-based flood defence height problems (van Dantzig 1956; Eijgenraam et al. 2017; Dupuits et al. 2017; Zwaneveld et al. 2018)

Hazard analysis: solution method



Conclusions

→Hazard-proof island heights without additional adaptations are very uncertain due to SLR uncertainty beyond 2050

→Hazard method can inform site selection:

- →Local flood hazard greatly differs across locations in the Maldives
- →Key drivers: swell exposure; distance to the reef, reef water depths

→Method is relatively lightweight in terms of data requirements and computations:

- →Requires 1 bathymetric data and design alternatives
- →All other hazard inputs available in the literature

More broadly → Different decision context require different decision-making methods, which in turn require different kinds of sea-level information:

- Probabilist forecasts for the short term
- Worst case scenarios for the longer-term and the risk averse
- In both cases: Information on what we will know in the future

Thanks!

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