# Groundwater Dynamics in Kaituna, Bay of Plenty, New Zealand: Assessing RSLR Impacts on Groundwater Shoaling

## From National to Local: Refining RSLR Impact Assessment in Kaituna, Bay of Plenty

**Patrick Durney**

**Komanawa Solutions Ltd**

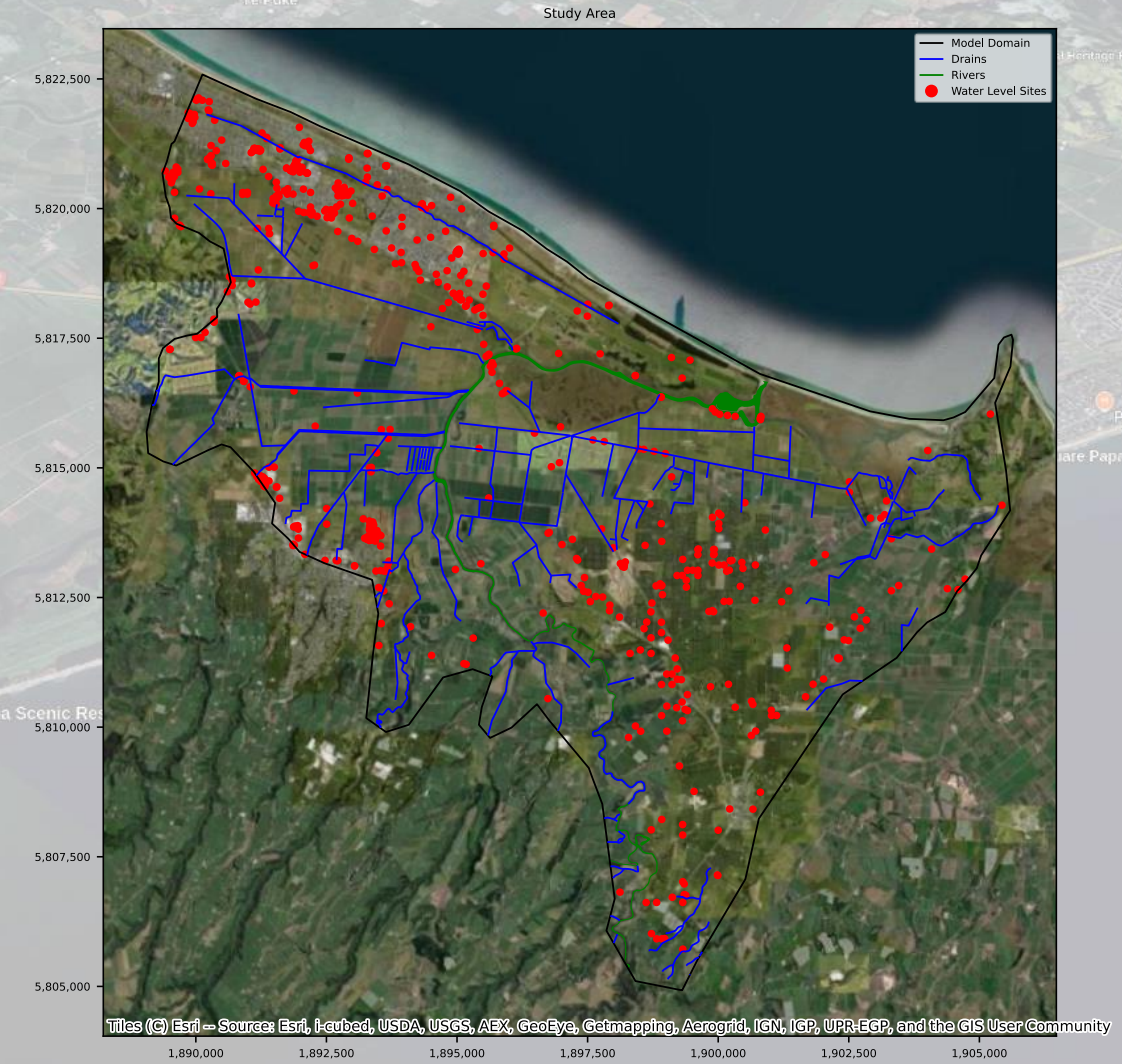
**Breda Savoldelli**

**Bay of Plenty Regional Council**

# Study Area Characteristics

## Understanding the Managed System in Kaituna, Bay of Plenty

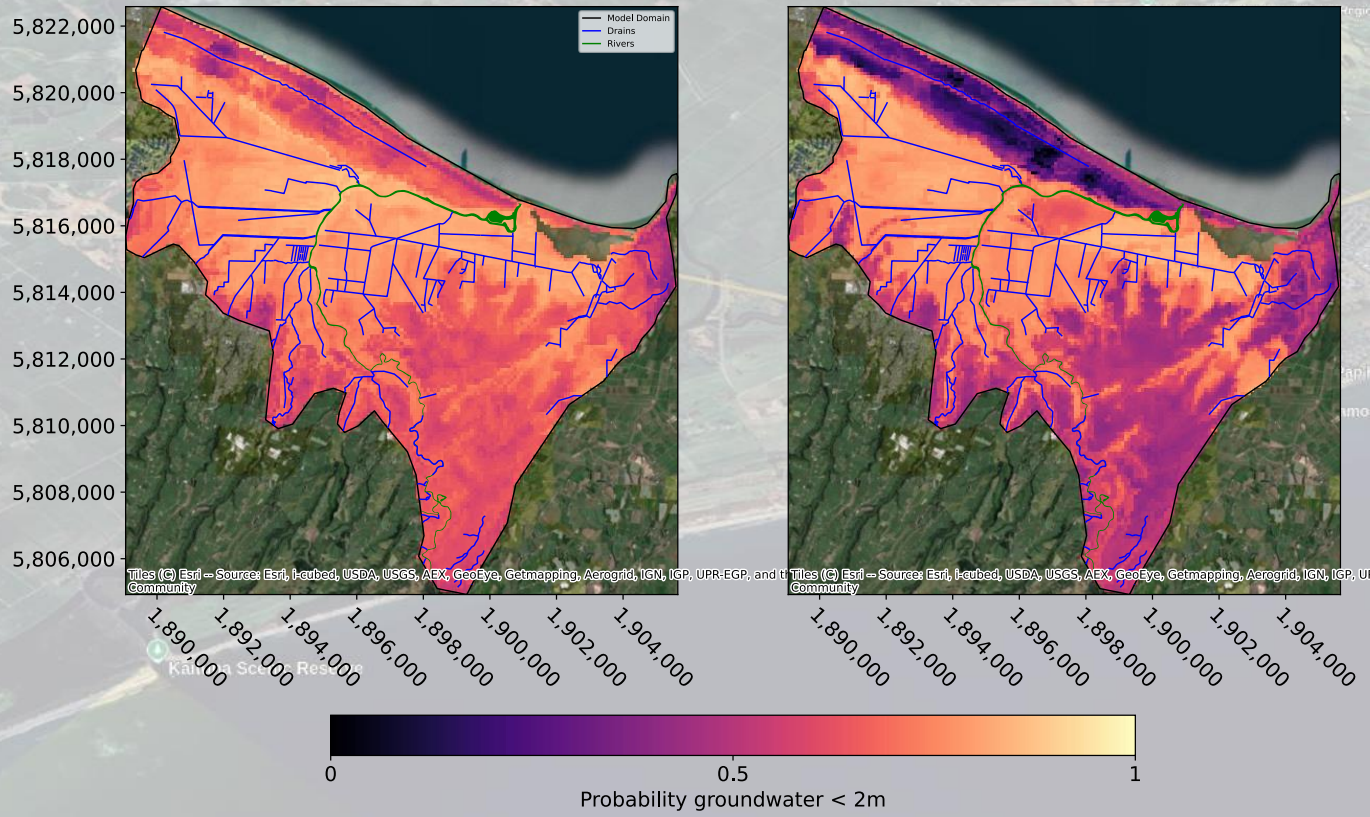
- Coastal characteristics and managed hydrological systems
- Importance of localised assessments due to specific environmental factors



## Statistical Model Refinement

Refining National Models for Local Decision-Making

- Limitations of national-scale models for local applications
- Added local data: drain network elevations, river stages, local groundwater observations



# Bridging to Numerical Modelling

## Statistical Approach

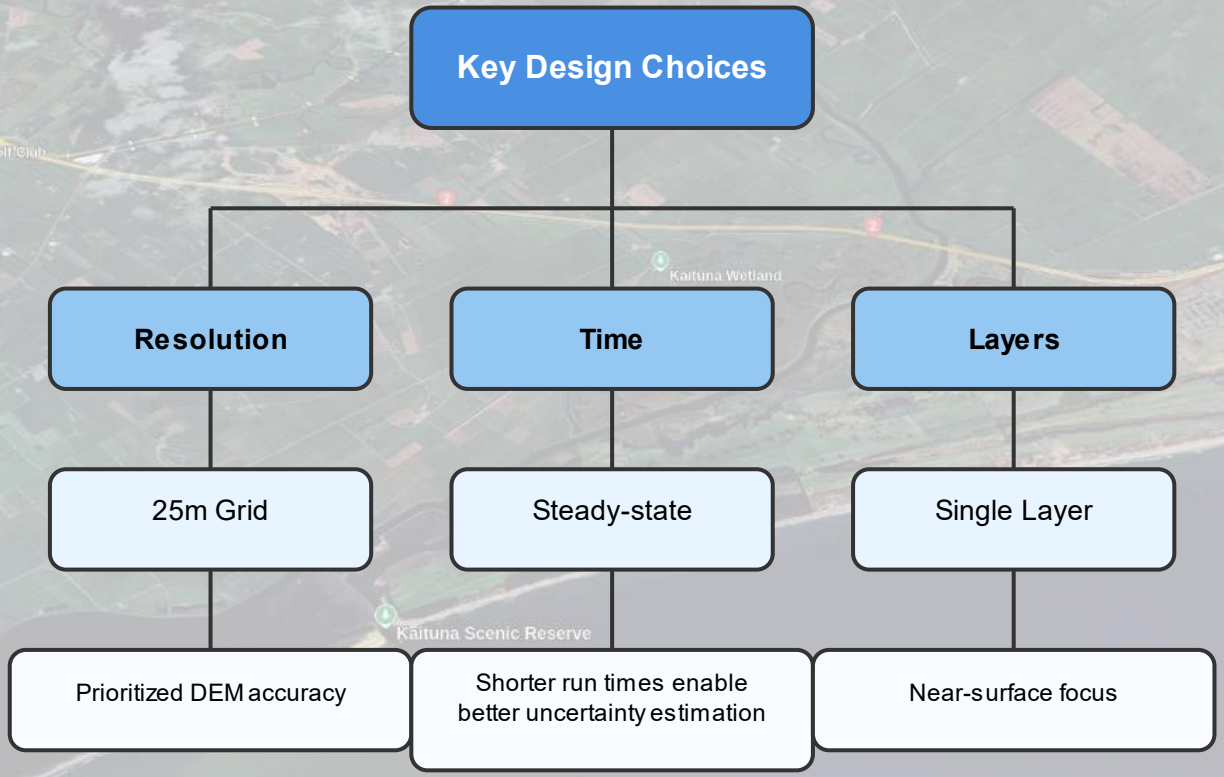
Random Forest | 100m Resolution

- Limited to trained conditions
- Cannot predict new processes
- No physical process coupling
- Simplistic future predictions

## Numerical Approach

MODFLOW 6 | 25m Resolution | Python/FloPy

- Physics-based predictions
- Adapts to new conditions
- Complex process coupling
- Surface water interactions
- Infrastructure impacts


Key Design Choices
Resolution
Time
Layers
25m Grid
Steady-state
Single Layer
Prioritized DEM accuracy
Shorter run times enable better uncertainty estimation
Near-surface focus

# Addressing equifinality

Historical Data

Parameter Space

Multiple parameter sets can produce equally valid matches to data (Equifinality)

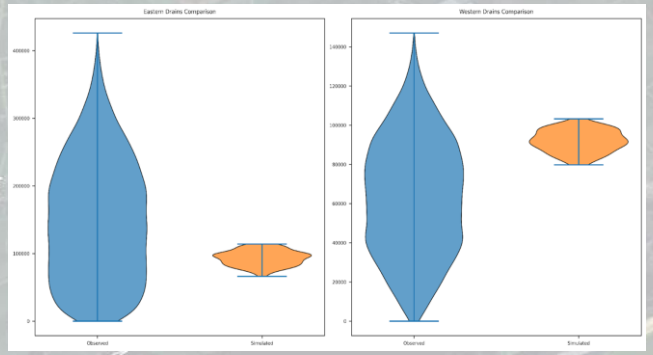
DREAM-ZS Algorithm

Parameter Set 1

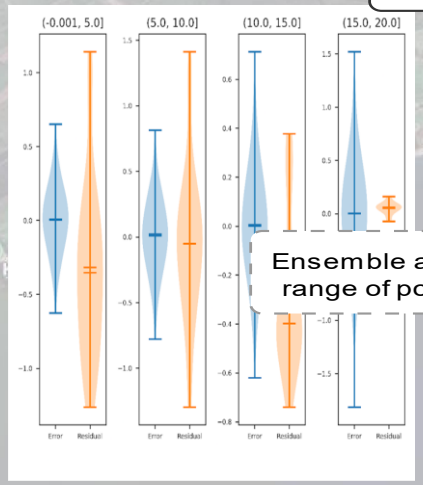
Parameter Set 2

Parameter Set n

Model Ensemble



Violin plots of prior and posterior drain flux estimates for drainage schemes on each bank of the Kaituna River




Violin plots of prior and posterior drain flux estimates for drainage schemes on each bank of the Kaituna River

Ensemble approach captures range of possible outcomes

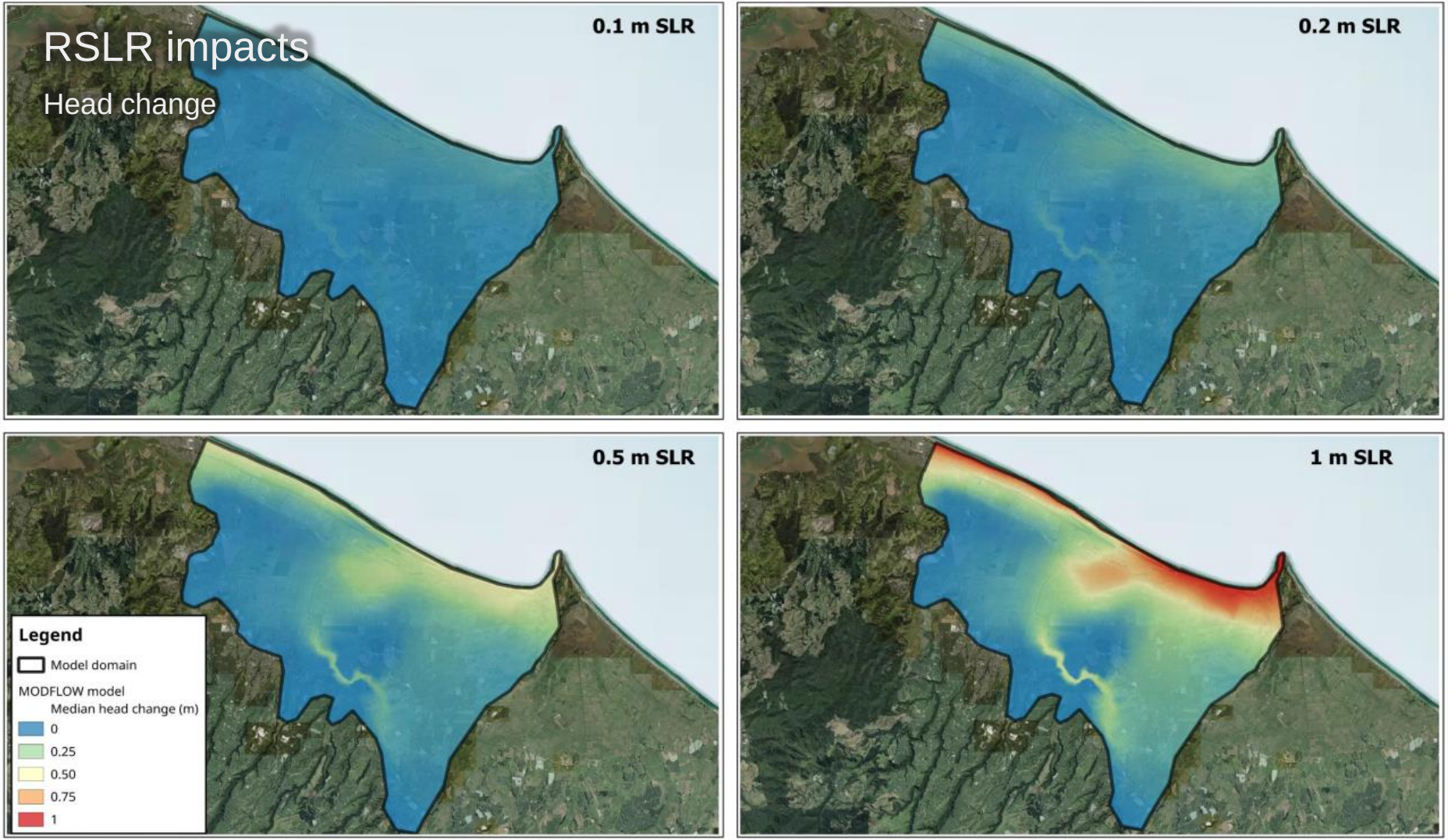
Uncertainty Analysis

- Probability Distributions
- Confidence Intervals
- Sensitivity Analysis

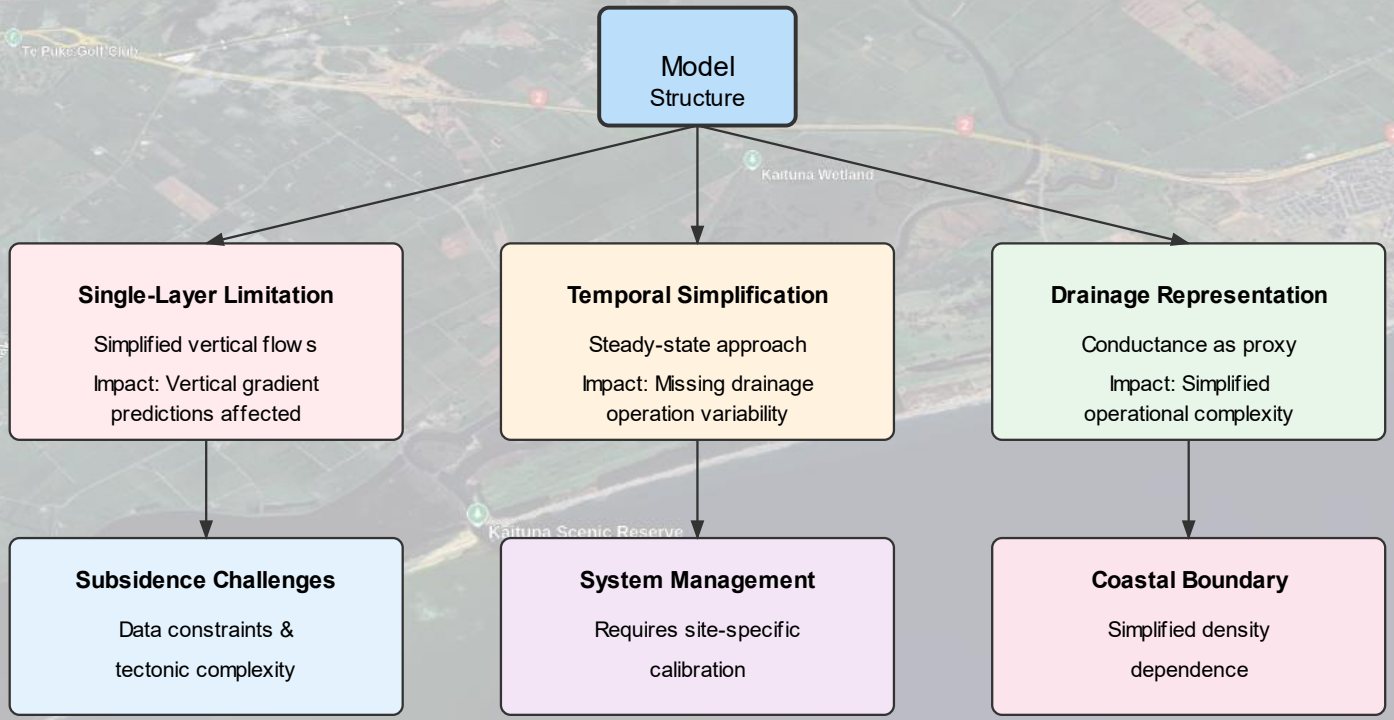
Risk-Based Decision Making

# RSLR impacts

## Head change



# Key Model Limitations



# Three Fundamental Findings from this Work

## Finding 1

**Progressive Refinement from National to Local Scale:**

- Critical process understanding
- Statistical Model:
  Identified vulnerable areas
- Numerical Model:
  Management implications
  82% increase in Eastern drain flows under 1m RSLR

## Finding 2

**Uncertainty Quantification:**

- Essential for adaptation planning
- Ensemble Approach shows:
  - Confident in patterns
  - Uncertain in magnitudes
- Uncertainty is key information for robust decision-making

## Finding 3

**Practical Limitations:**

- Complexity of managed systems
- Focus on drainage infrastructure

Future refinement paths:

1. Density-dependent transport
2. Improved drainage
3. Targeted monitoring

# This is the END

- Thank you and what are your questions?

# Salinity data - review