

# Modelling Symposium

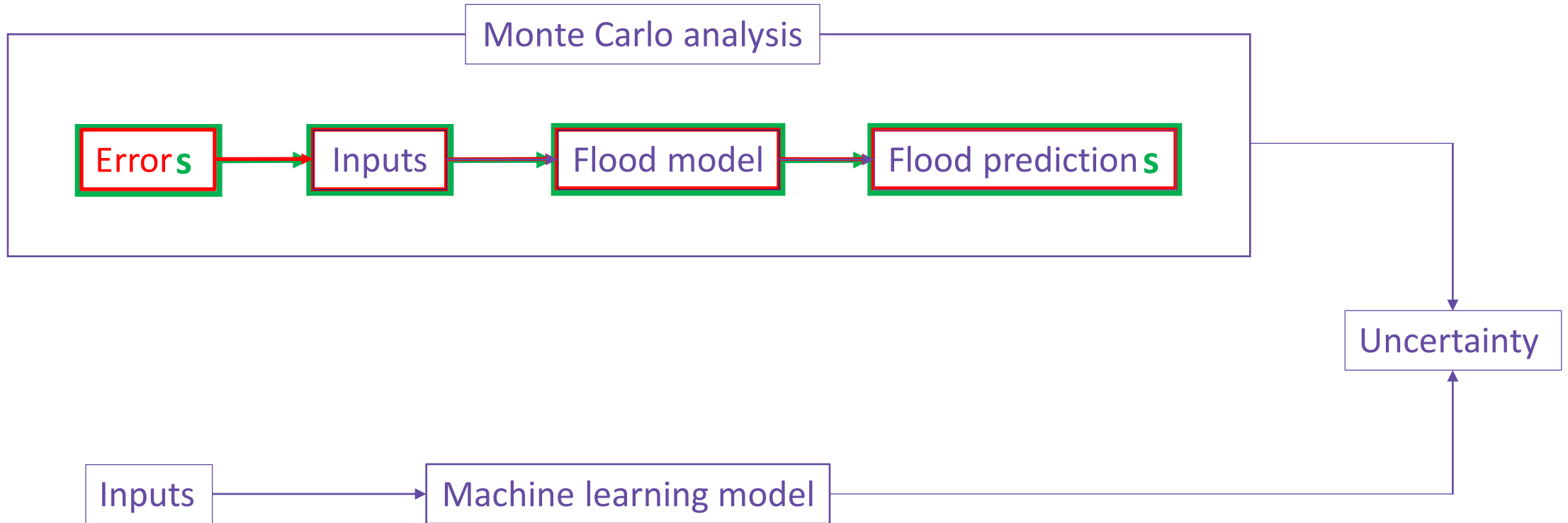
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## Estimating uncertainty in flood model outputs using machine learning informed by Monte Carlo analysis

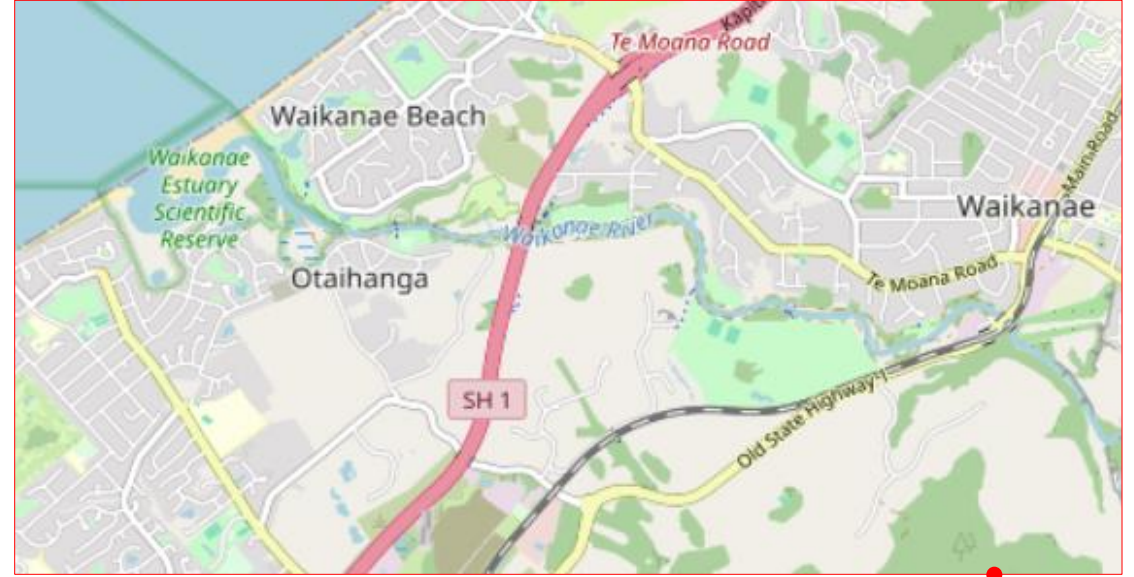
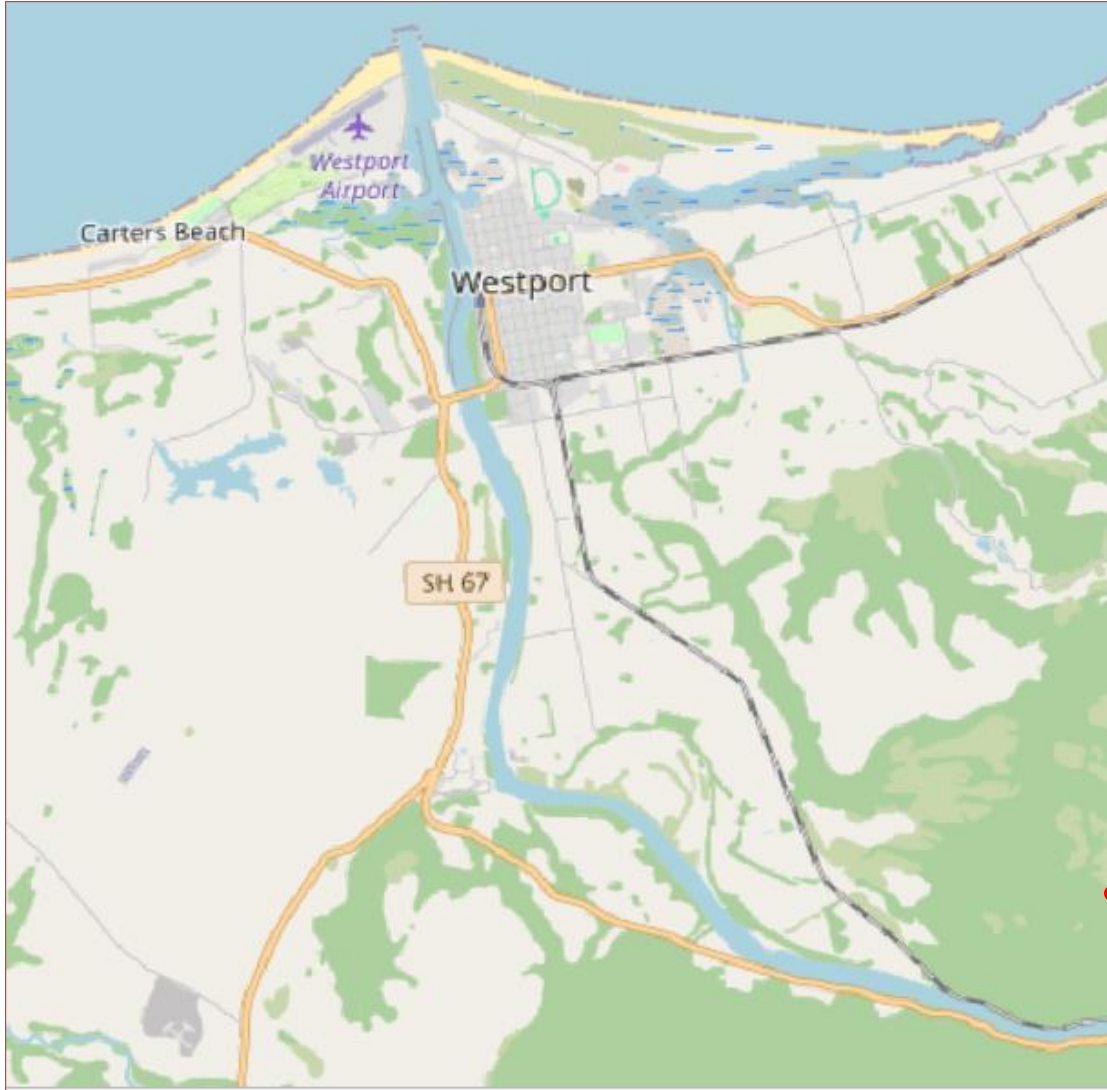
Presented by  
Martin Nguyen | PhD student at UC

*Prof. Matthew Wilson, Dr. Emily Lane, Prof. James Brasington, Dr. Rose Pearson*

# INTRODUCTION

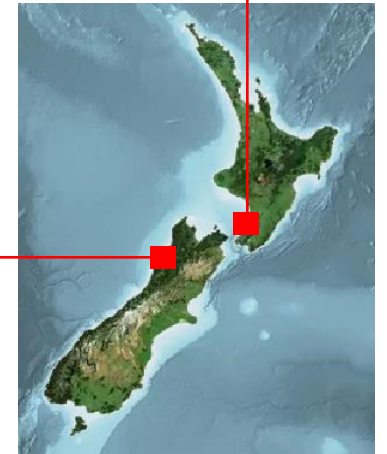


# Sites



**Waikanae River, Wellington**  
*training dataset*

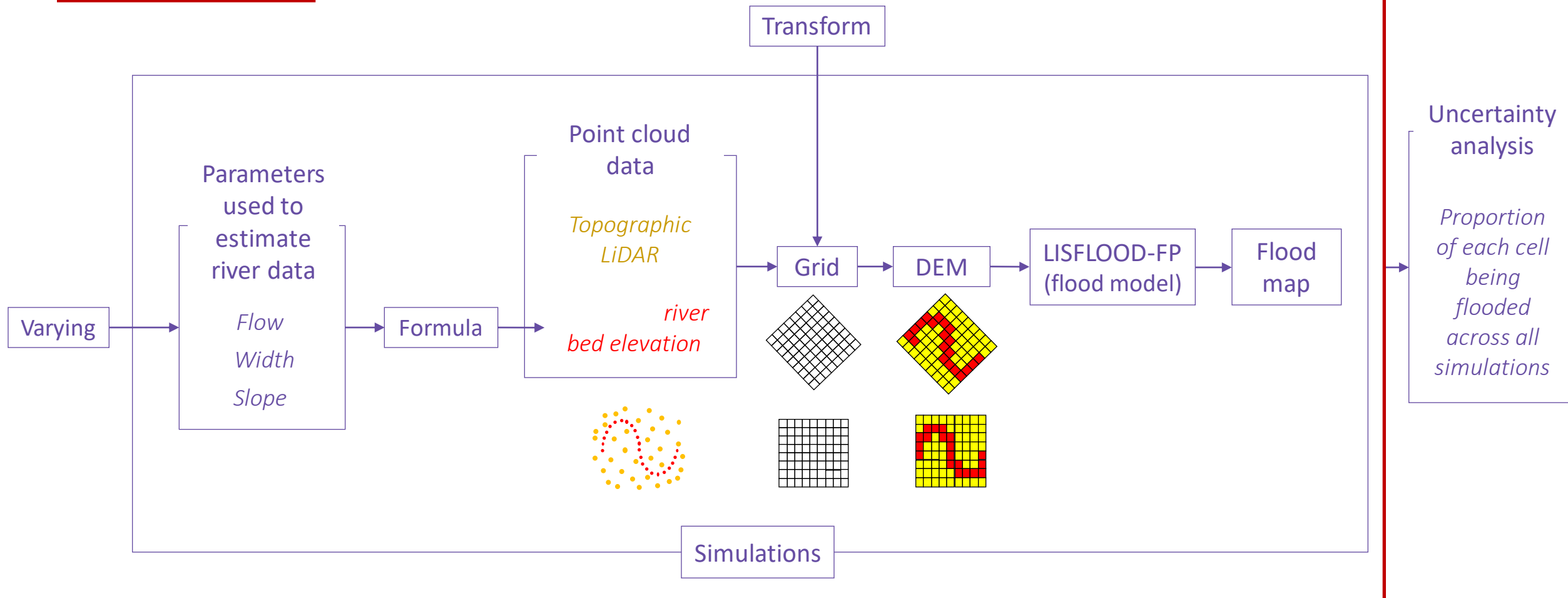
**Buller River, Westport**  
*testing dataset*





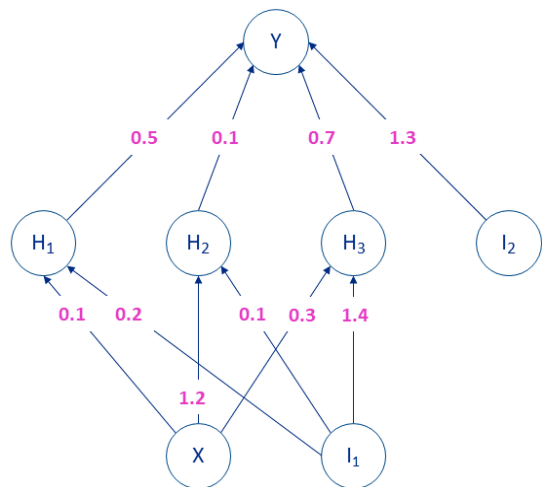
# Methodology – uncertainty

## Monte Carlo analysis



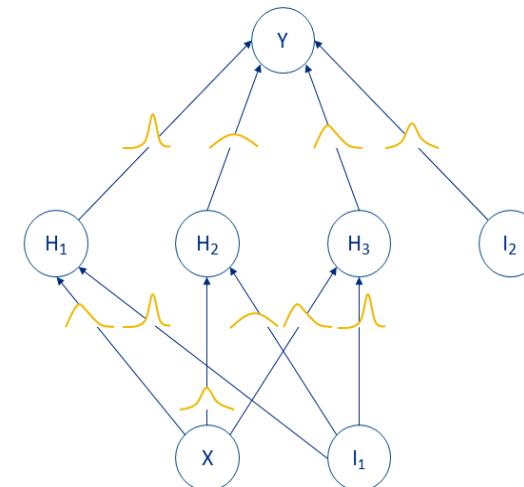
# Methodology – machine learning model

Standard Fully Connected Network (**FCN**)

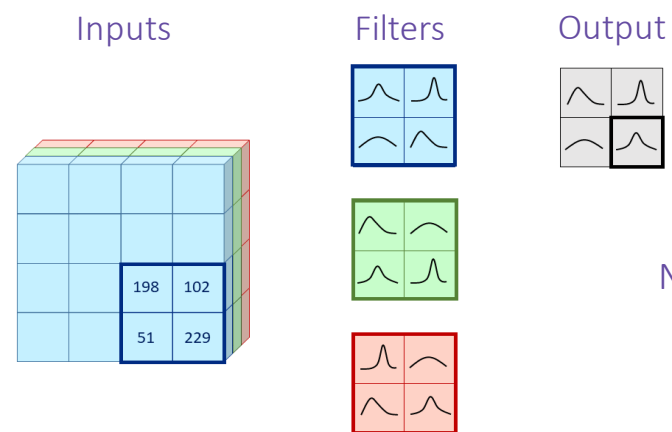
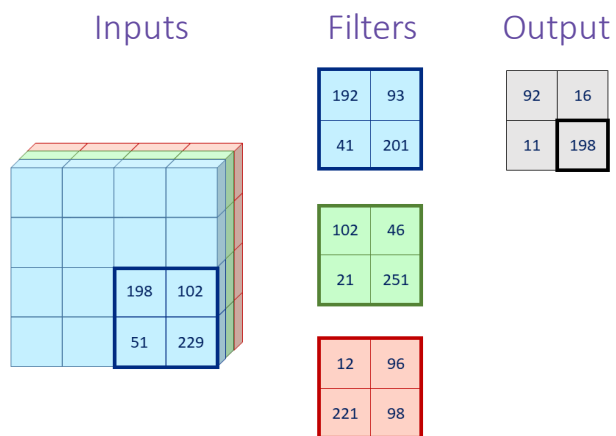


Y : Output  
 H : Hidden nodes  
 I : Biases  
 X : Input

Bayes Fully Connected Network



Standard Convolutional Neural Network (**CNN**)

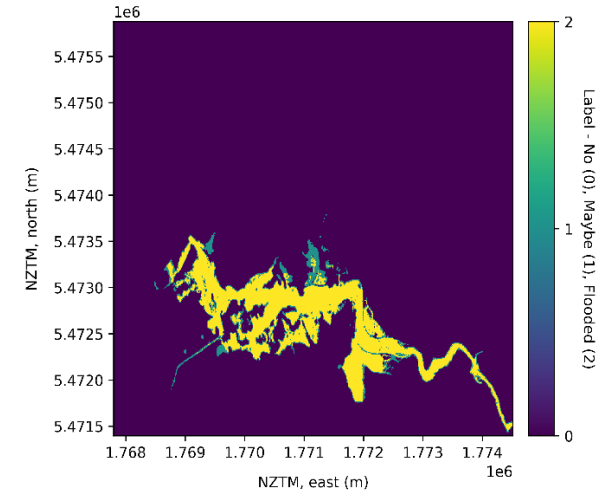
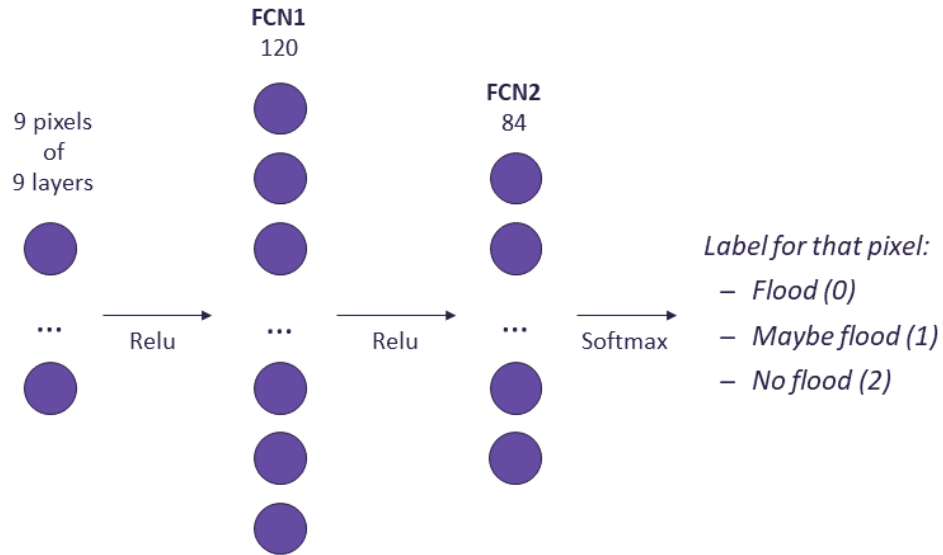


Bayes Convolutional Neural Network

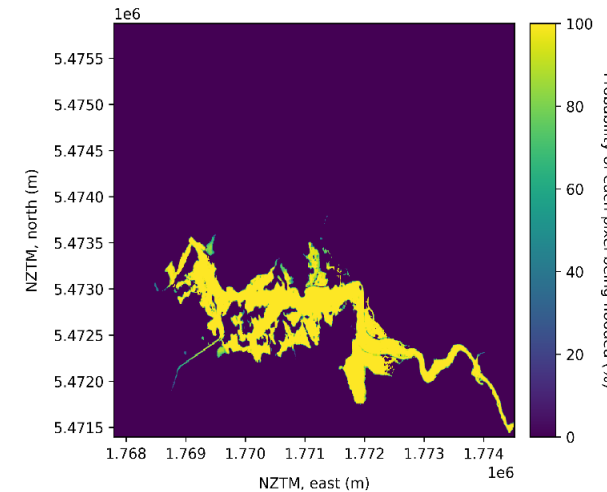
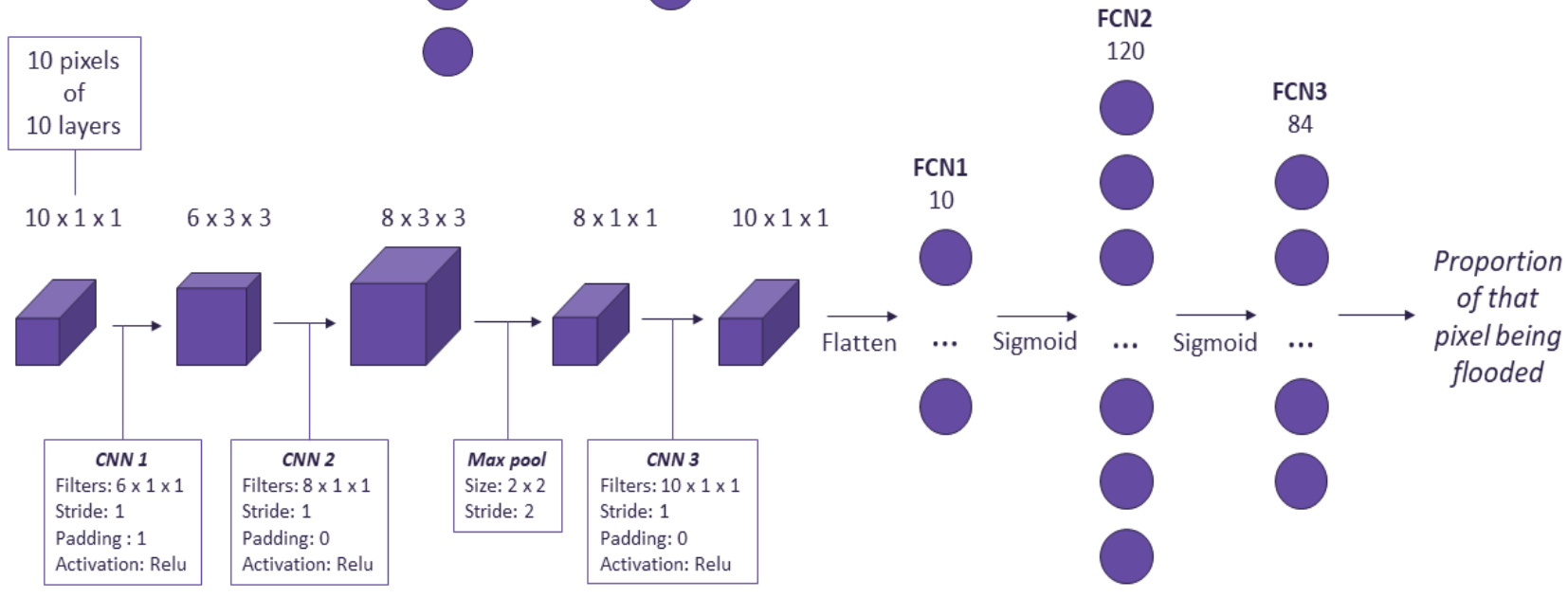
**References:** Blundell, C., Cornebise, J., Kavukcuoglu, K., & Wierstra, D. (2015, June). Weight uncertainty in neural network. In *International conference on machine learning* (pp. 1613-1622). PMLR  
 Shridhar, K., Laumann, F., & Liwicki, M. (2019). A comprehensive guide to bayesian convolutional neural network with variational inference. *arXiv preprint arXiv:1901.02731*.

# Methodology – machine learning models

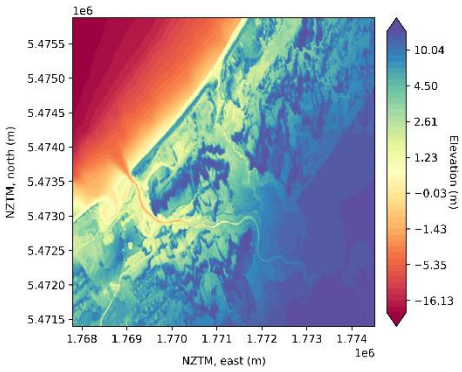
Classification model



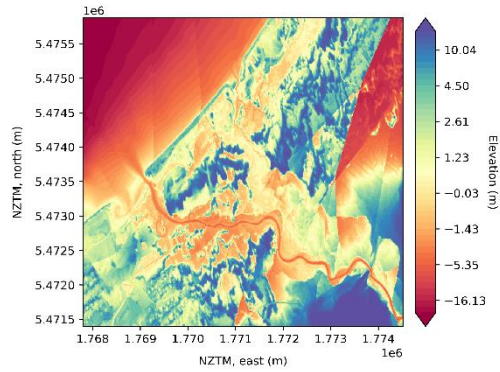
Regression model



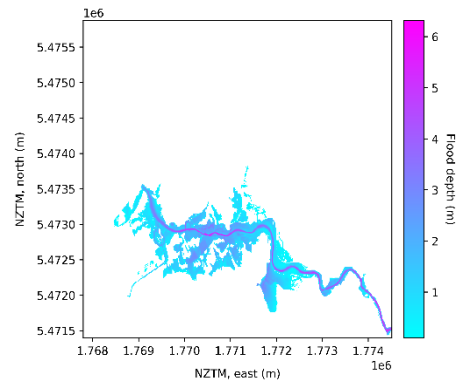
# Methodology – inputs – Waikanae River examples



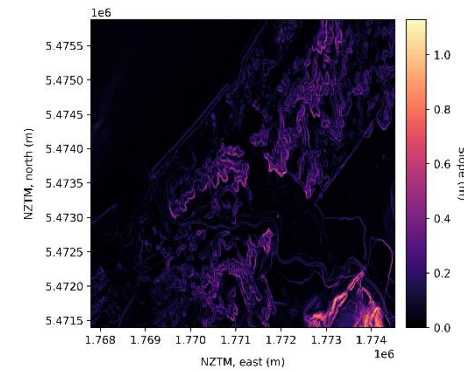
Elevation (DEM)



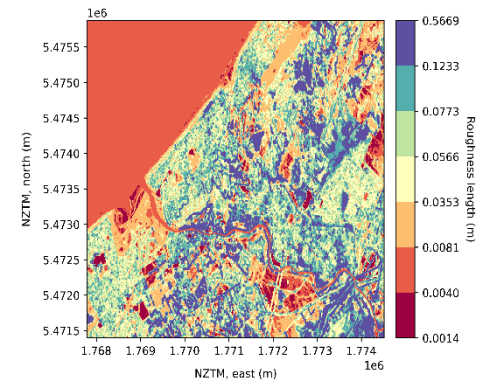
Height above nearest flood



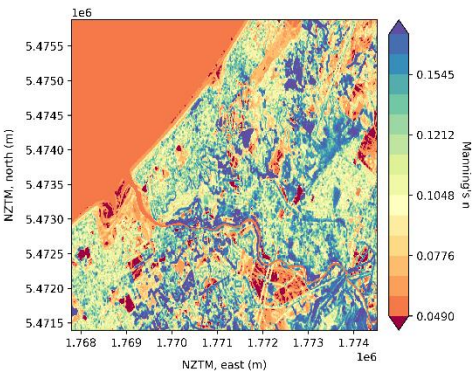
Flood depth



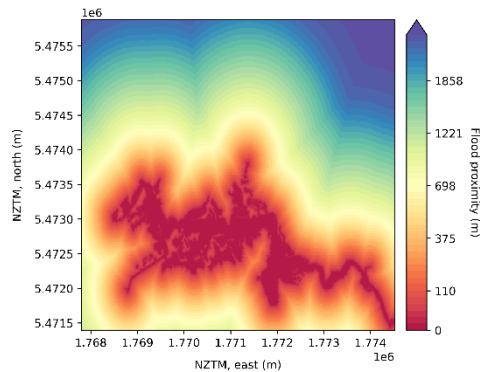
Slope



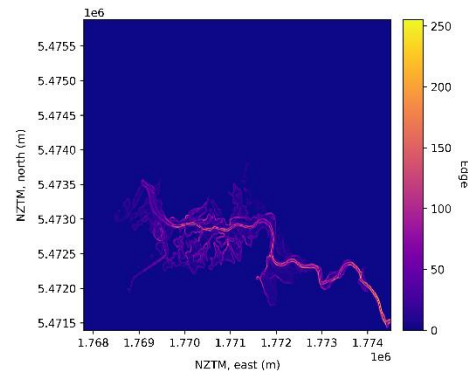
Roughness length



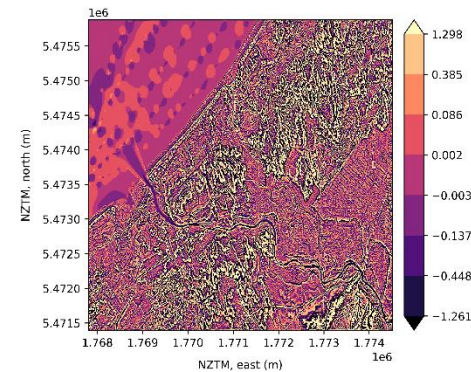
Manning's n



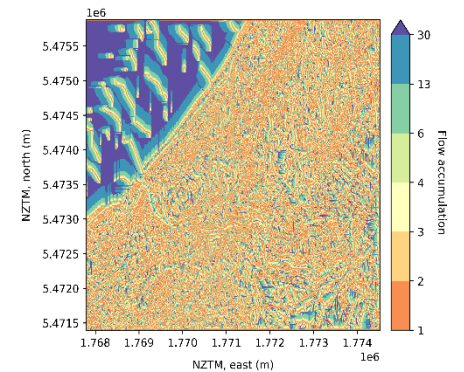
Flood proximity



Sobel edge of flood depth



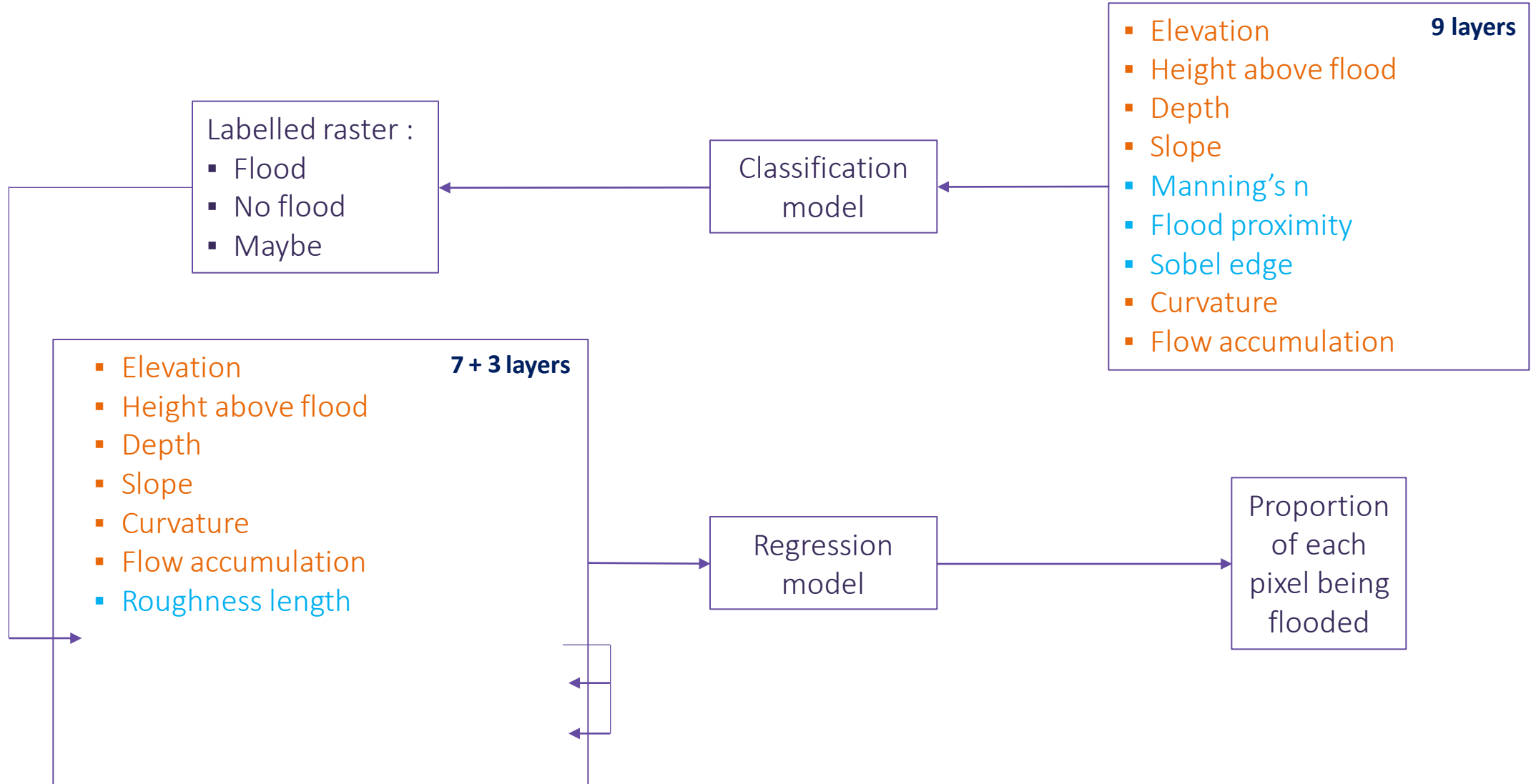
Curvature



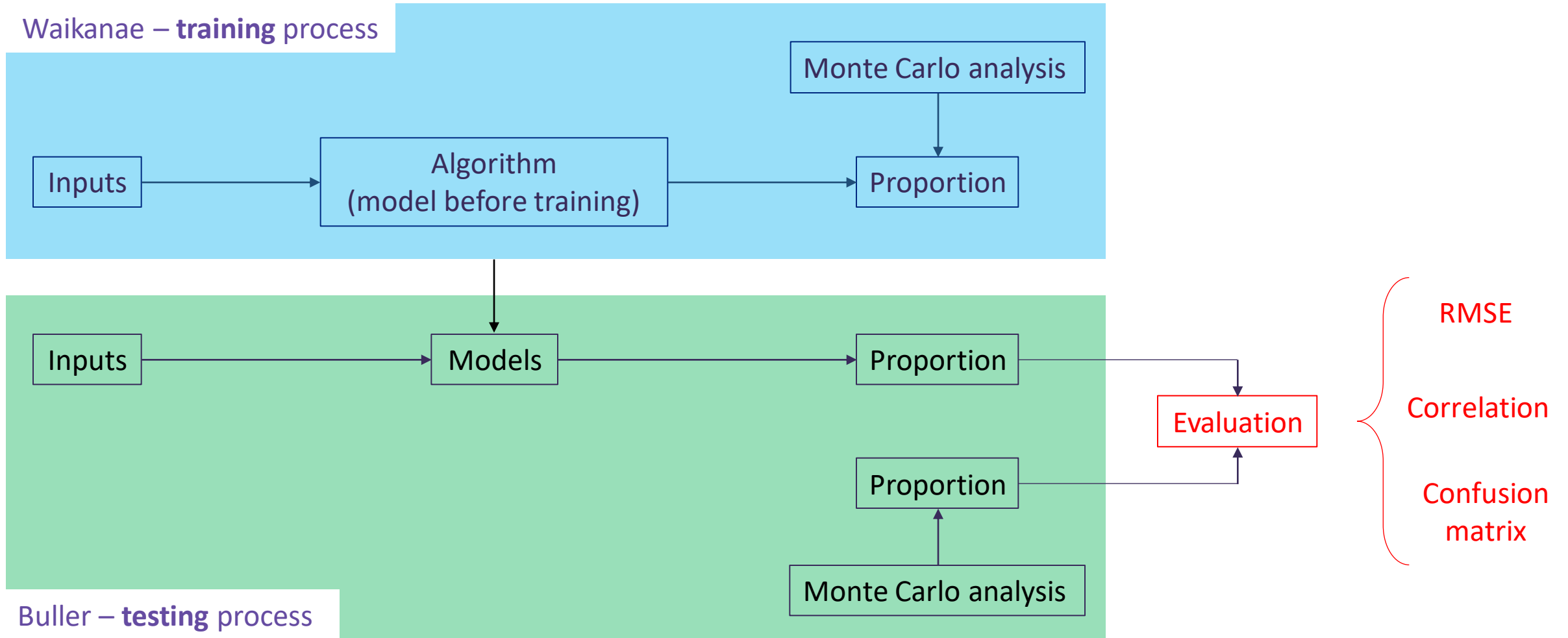
Flow accumulation



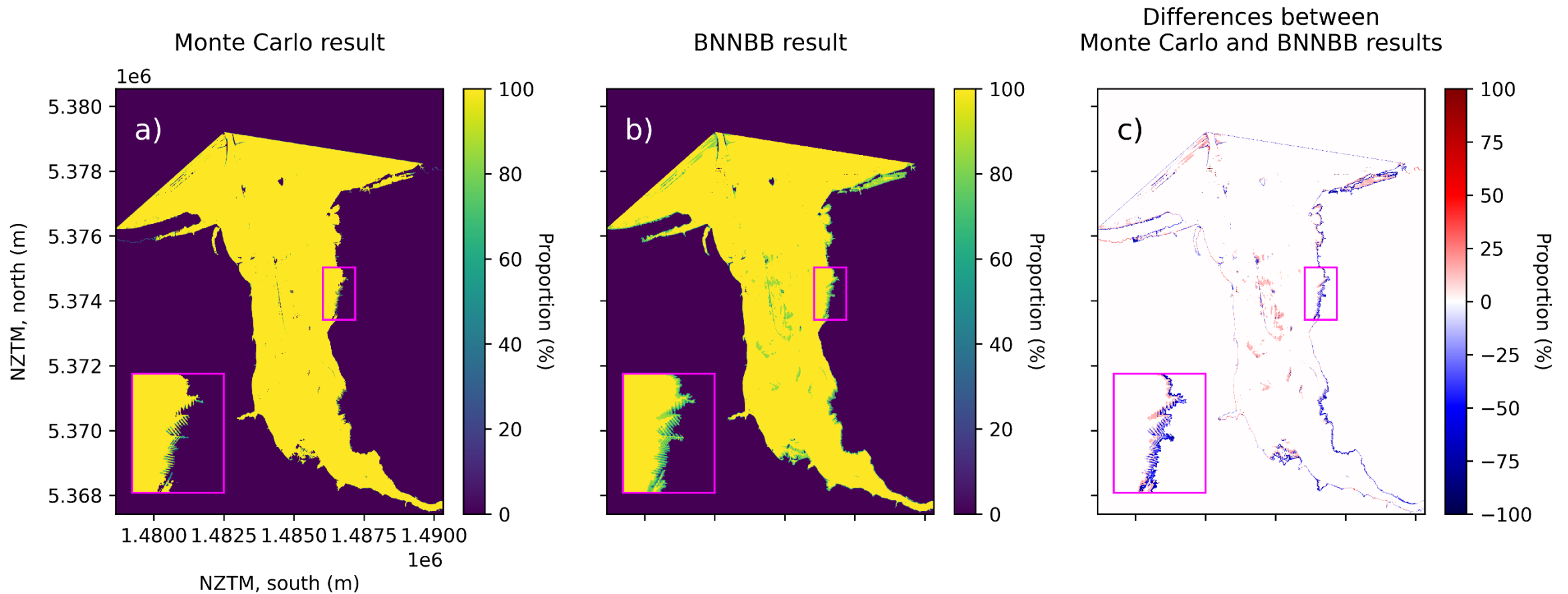
# Methodology – inputs



# Methodology – Whole process



# Results



All values    Excluding 0% and 100%

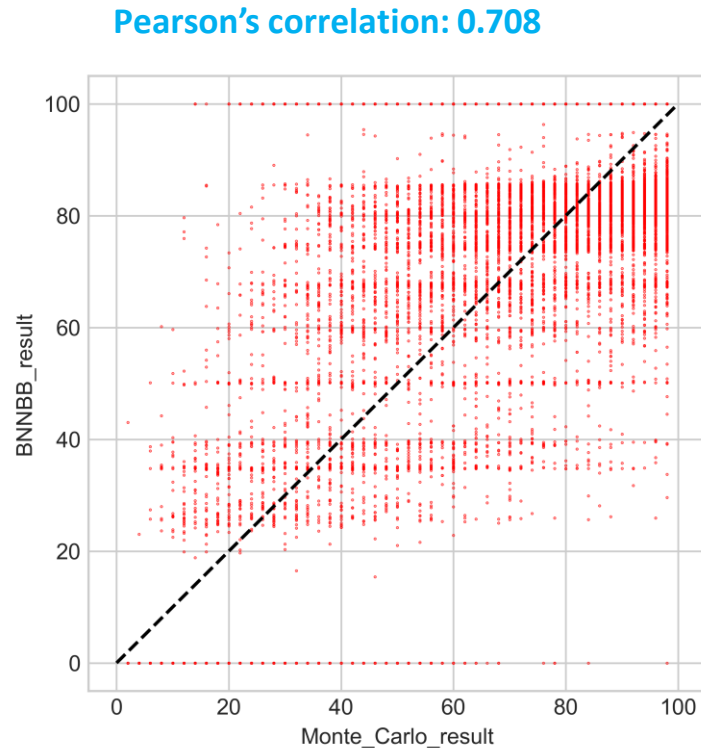
RMSE

5.694

19.614

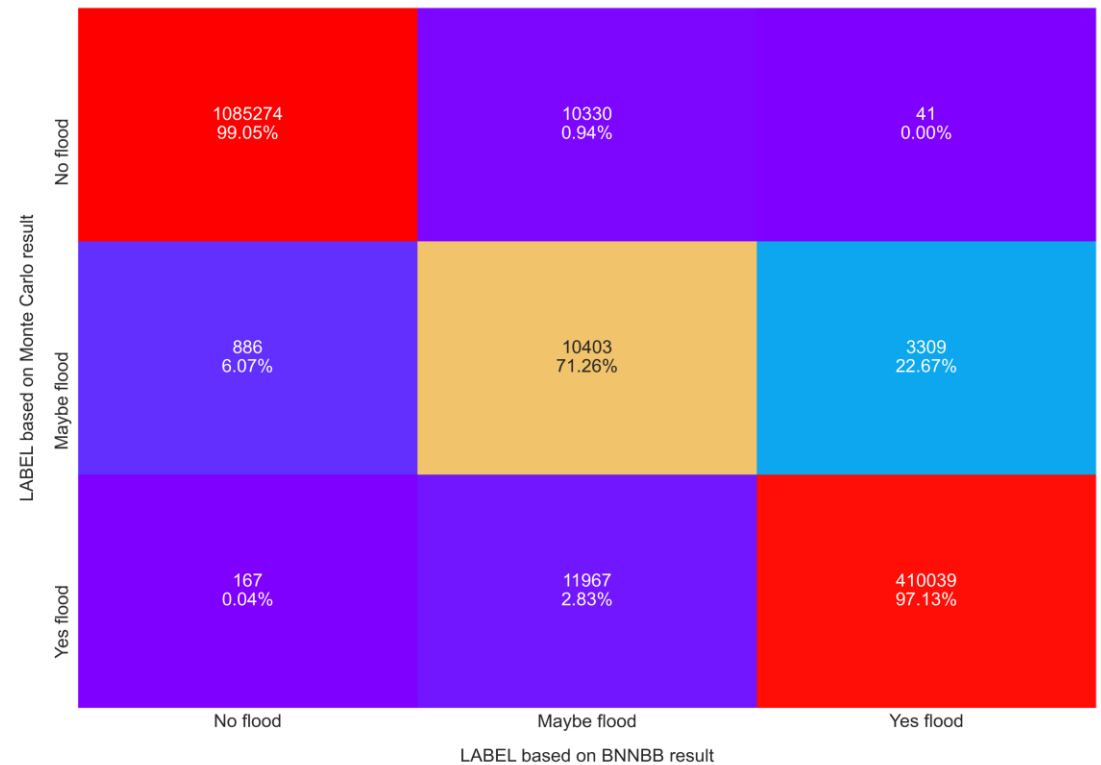
# Results

Correlation excluding values 0% and 100%



- Uncertainties were **well detected** (despite including some instances of 'flood' and 'no flood')
- Their values were **moderately predicted**

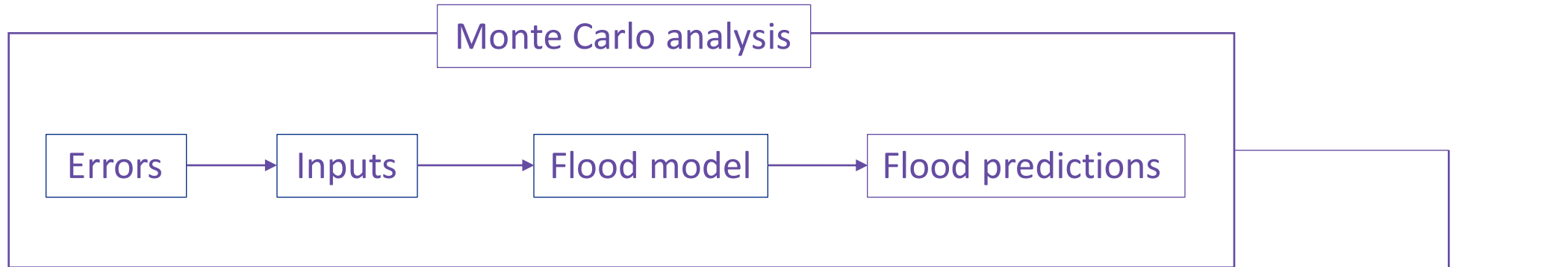
Converting predicted proportions to label



	No	Maybe	Flooded
Precision	0.999	0.318	0.992
Recall	0.991	0.713	0.971

# Summary

≈ 20 hours  
+  
Complexity



≈ 30 minutes  
+  
Less  
complexity



# Modelling Symposium

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Thank you!  
Questions? Patai?