Ollscoil Teicneolaíochta an Oirdheiscirt

South East Technological University

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

A framework for modelling groundwater floods and its applications for forecasting and assessing the impact of climate change in groundwater systems

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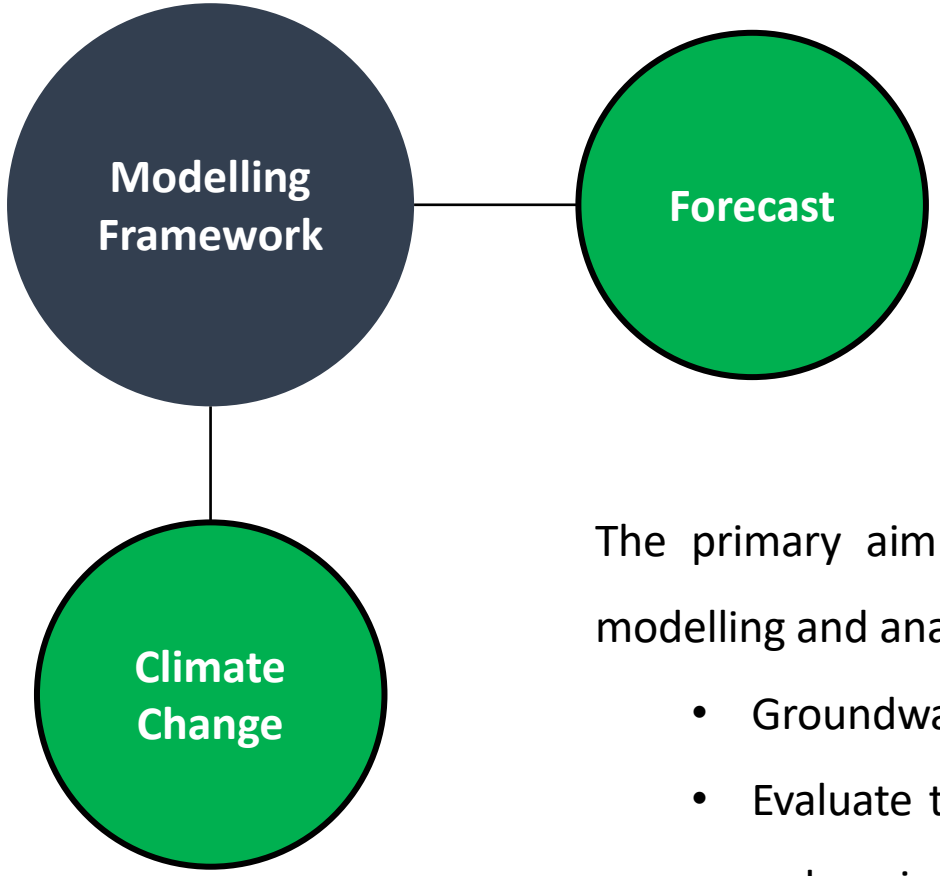
Motivation



The primary aim of this research project is to develop a modelling and analysis framework that will enable:

- Groundwater flood forecasting
- Evaluate the vulnerability of groundwater systems to a changing climate in Ireland

Groundwater Floods Modelling Framework

Summary

Inputs

Meteorological data

- Precipitation
- Evapotranspiration

Groundwater levels

- Datalogger
- SAR hydrographs

DTM

- Stage – Volume conversion

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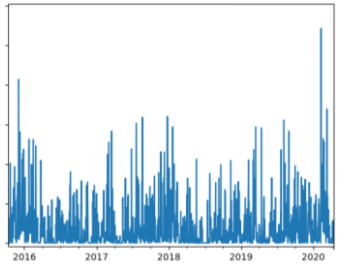
Automated calibration process following a Bayesian approach

Models

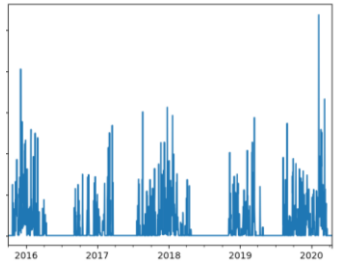
Transfer Function
- Gamma distribution

Conceptual
- Reservoir Model

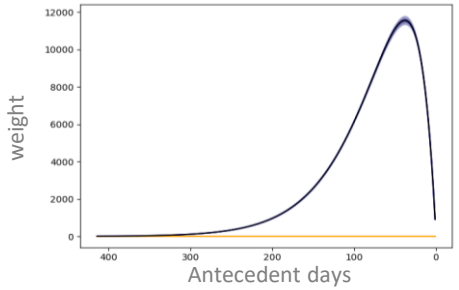
Rain



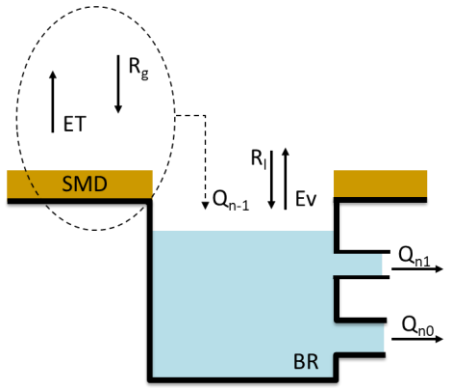
Effective Rain (ET, SMD)



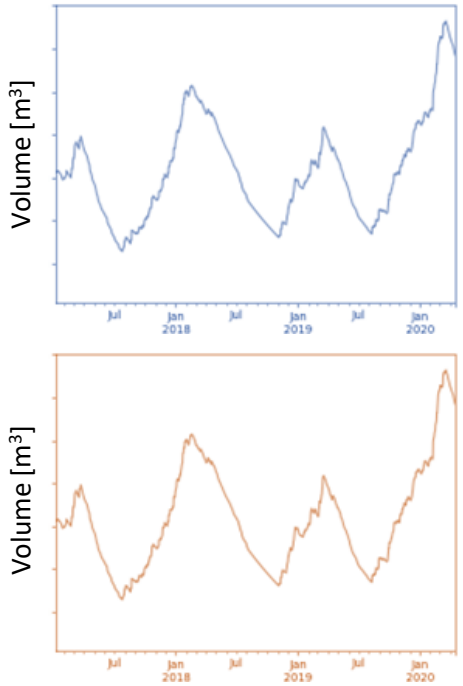
Transfer Function



Reservoir Model



Time series (volume / stage)



ET: Evapotranspiration
SMD: Soil Moisture Deficit

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Outputs

Outputs
- Stage and volume time series
- Model parameters estimation
- Uncertainties

Transfer Function
- Recession time
- Time delay for flood reaction

Reservoir Model
- Recharge
- Discharge

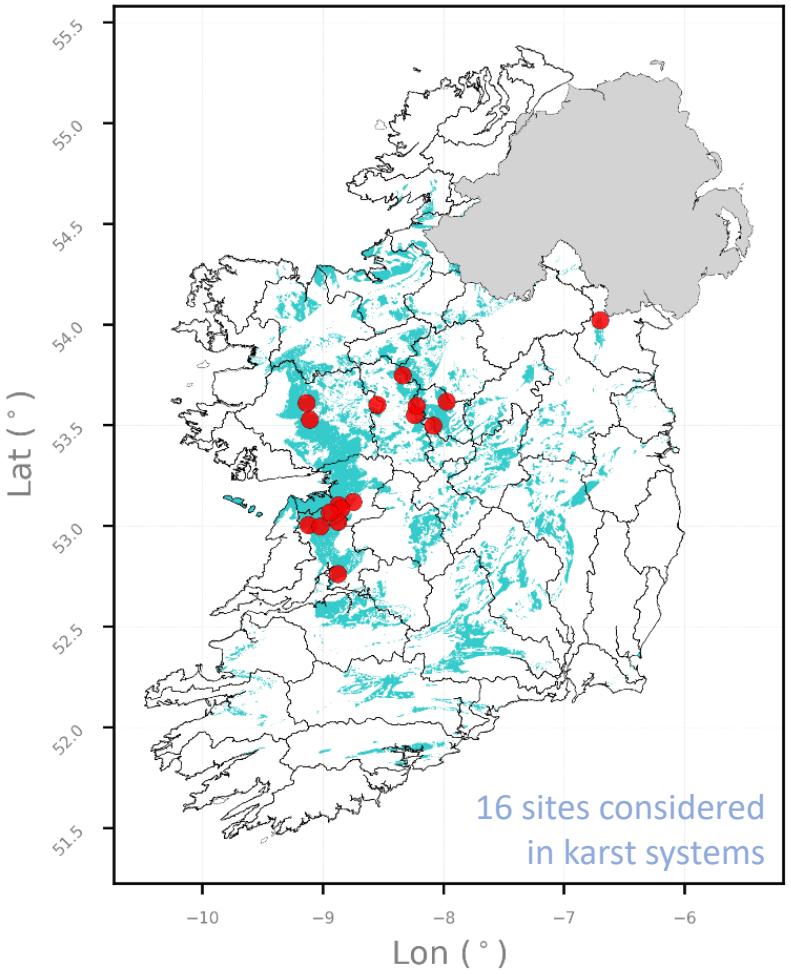
Potential additions (site specific)

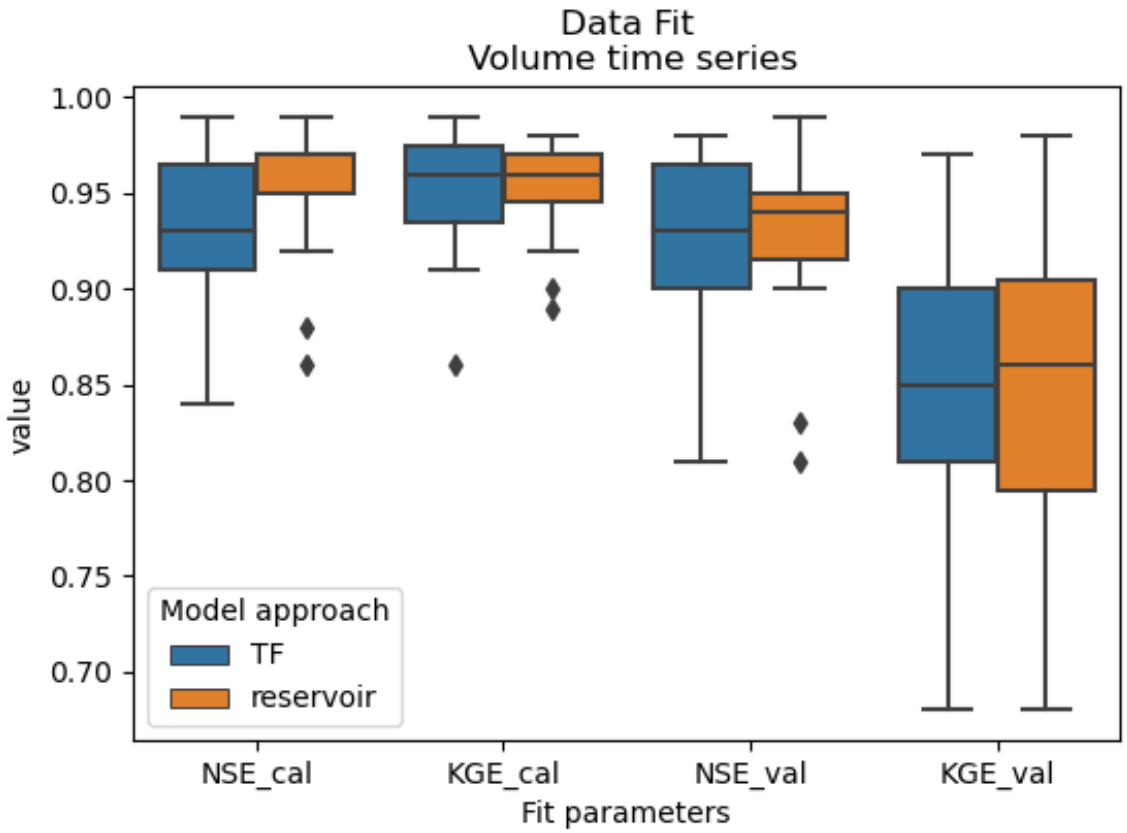
Transfer Functions
- Additional functions

Reservoir Model
- Additional inflows and outflows
- Changes in catchment area

Numerical Modelling

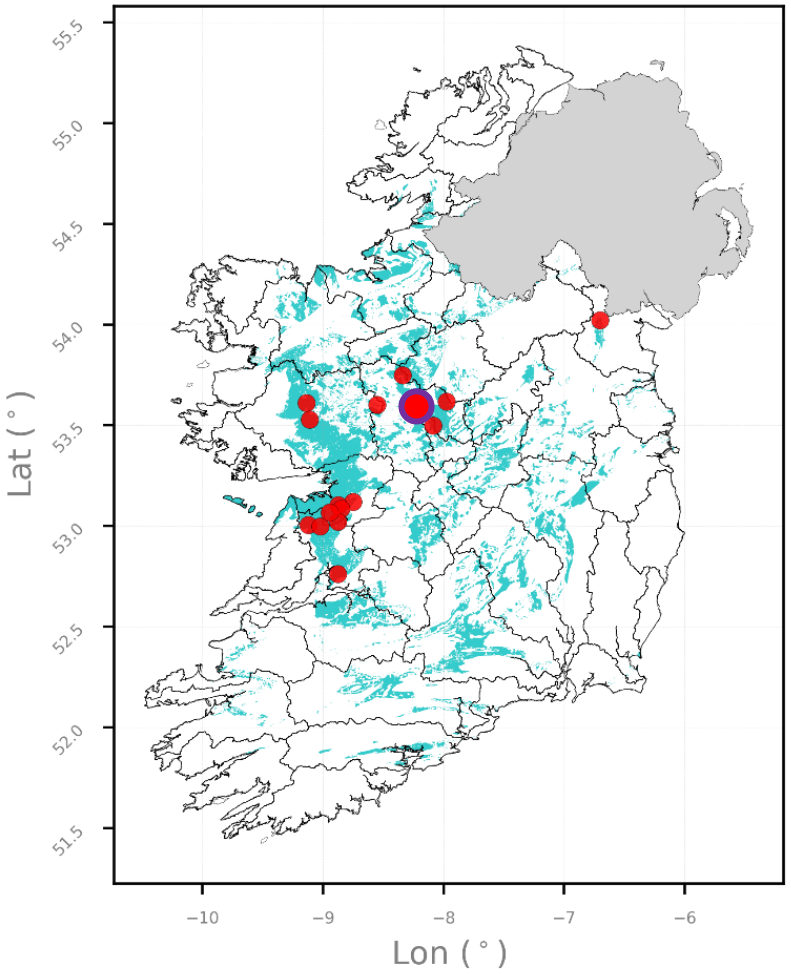
Evaluation



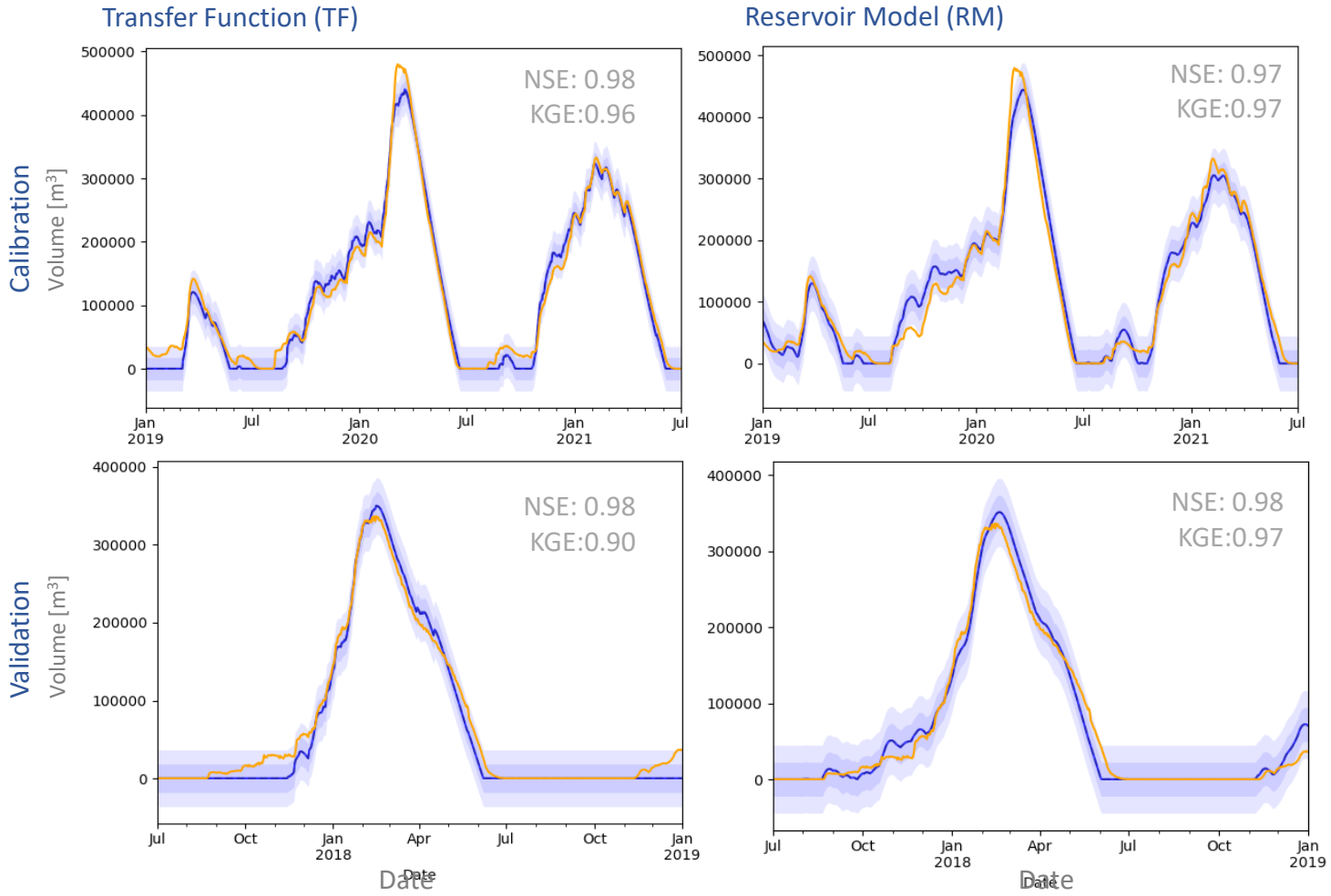


Numerical Modelling

Evaluation

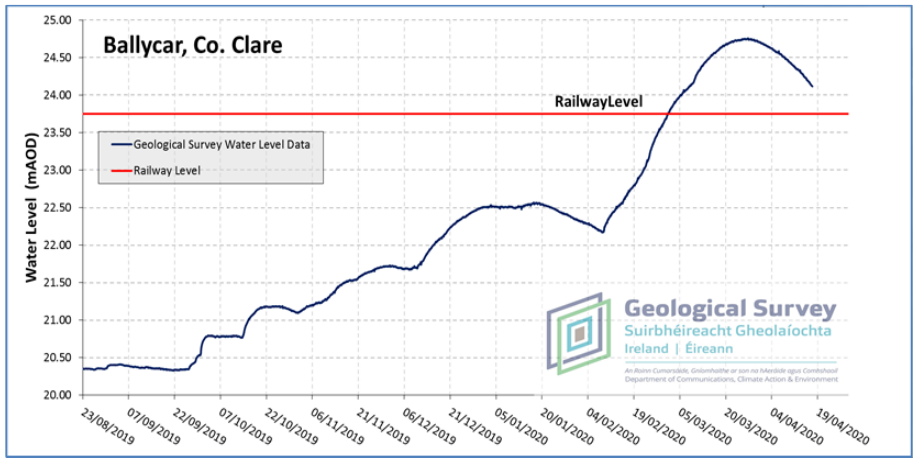


Ballygalda Turlough

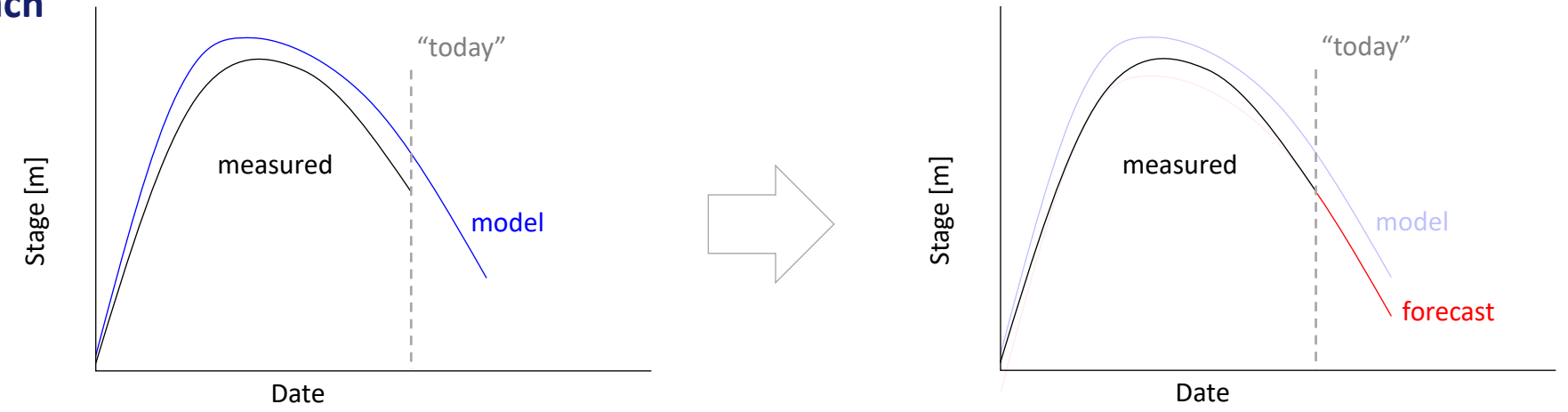


Applications

Groundwater Flood Forecasting

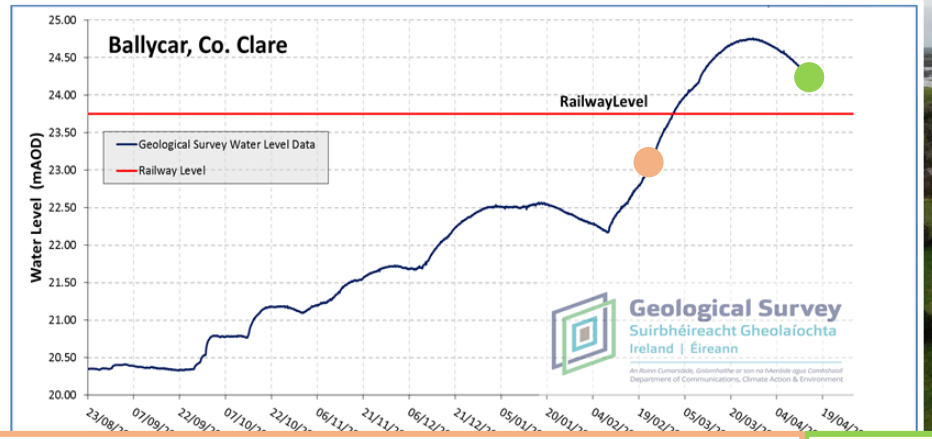


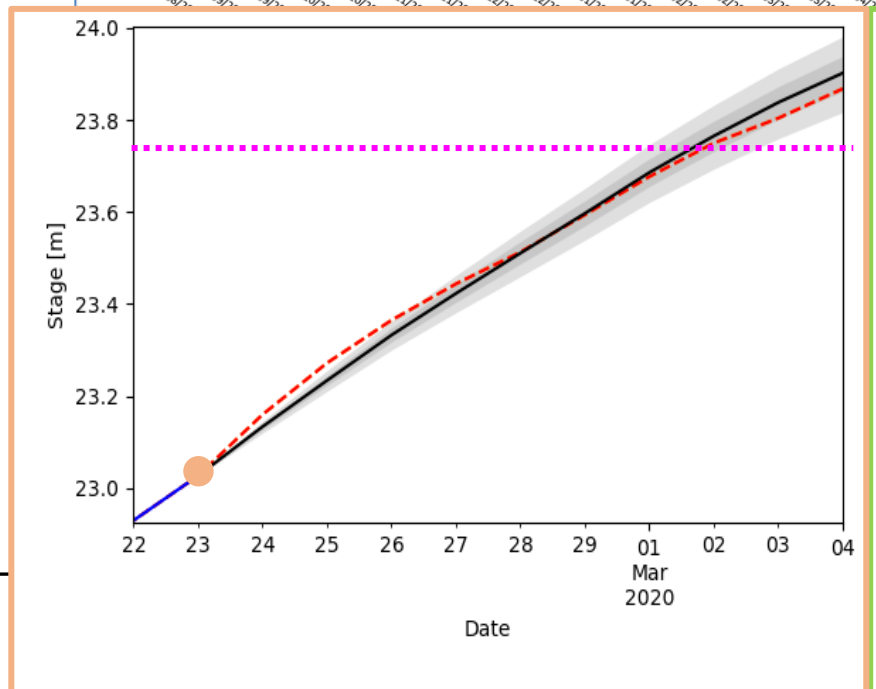
Approach

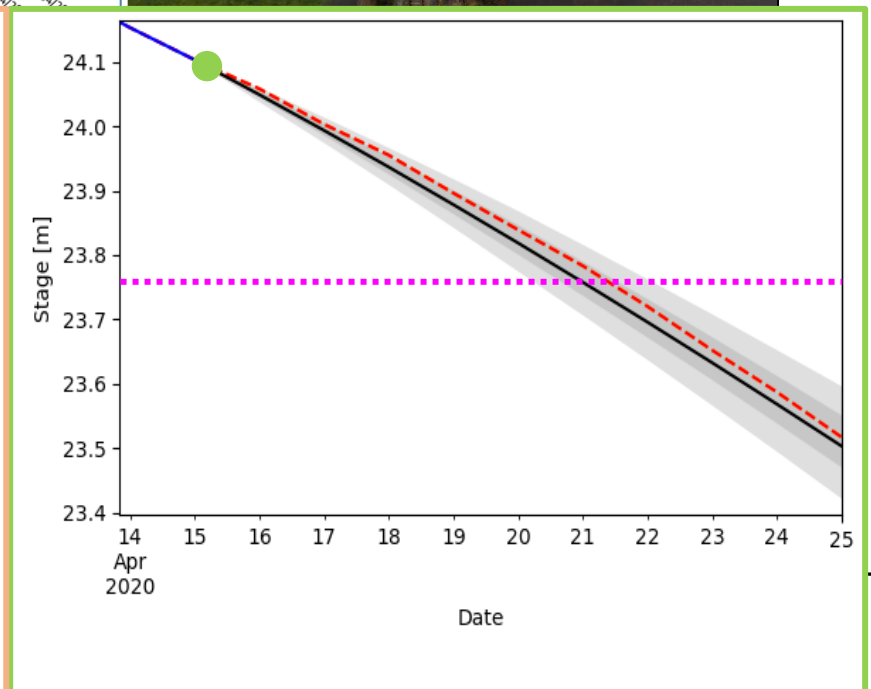


Applications

Groundwater Flood Forecasting







Measured up to forecast day

Measured after forecast day

Forecast

Railway Level

Applications

Climate Change

Climate change predictions for Ireland:

- Rainfall to increase during winter and autumn and decrease during summer

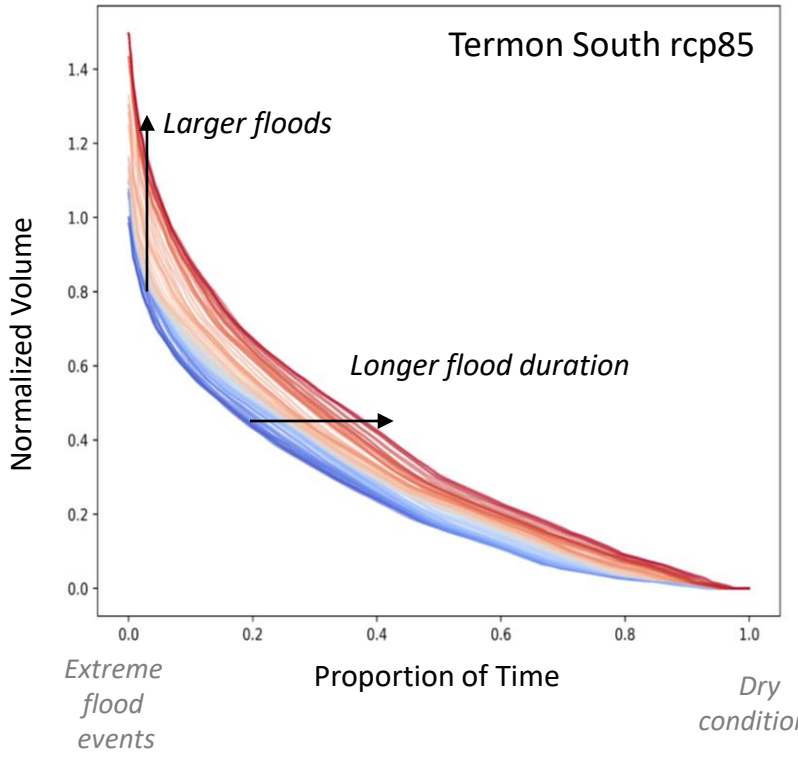
Climate change scenario (RCP45 & RCP85)

- Scenario Led
  - MIROC5
  - MPI-ESM-LR
  - CNRM-CM5
  - EC-EARTH
  - HadGEM2-ES
- Scenario Neutral

Quantify impact on groundwater

- Potential changes in **Flood duration**, **Frequency, Seasonality, Annual maxima**

Impact on Flood duration (ensemble - mean)



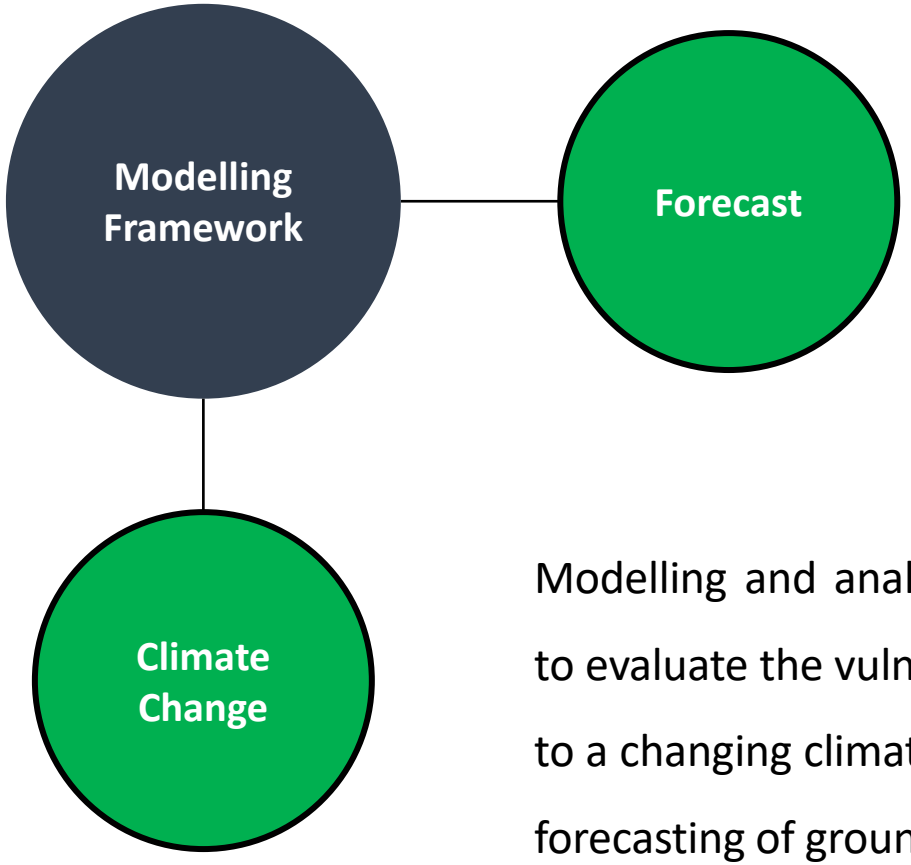
Flood duration Proportion of time that a particular volume (normalized) was equaled or exceeded

Normalized volume

- **1** - Maximum volume during the reference period
- **0** - Minimum volume during the reference period
- **Reference period** - from 1980/09/01 to 2010/09/01

Work in progress

Thank you for your attention



Modelling and analysis Framework that will enable to evaluate the vulnerability of groundwater systems to a changing climate in Ireland at national scale and forecasting of groundwater floods.

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