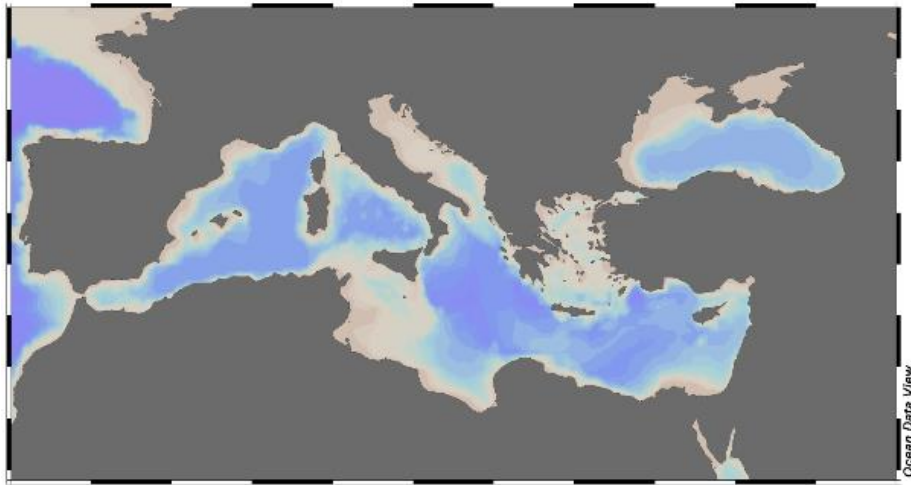RSES Data Surgery

Box Models and Uncertainty

Jessica Amies

Why use box models?
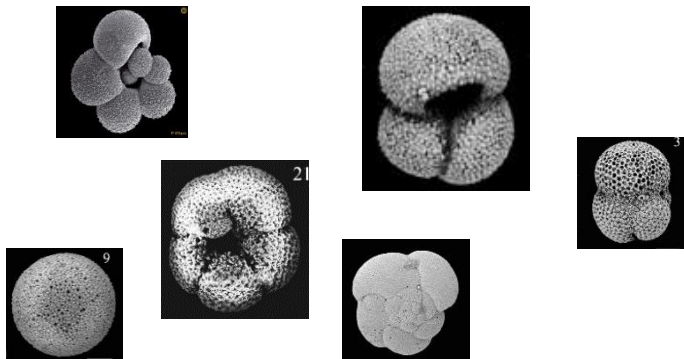

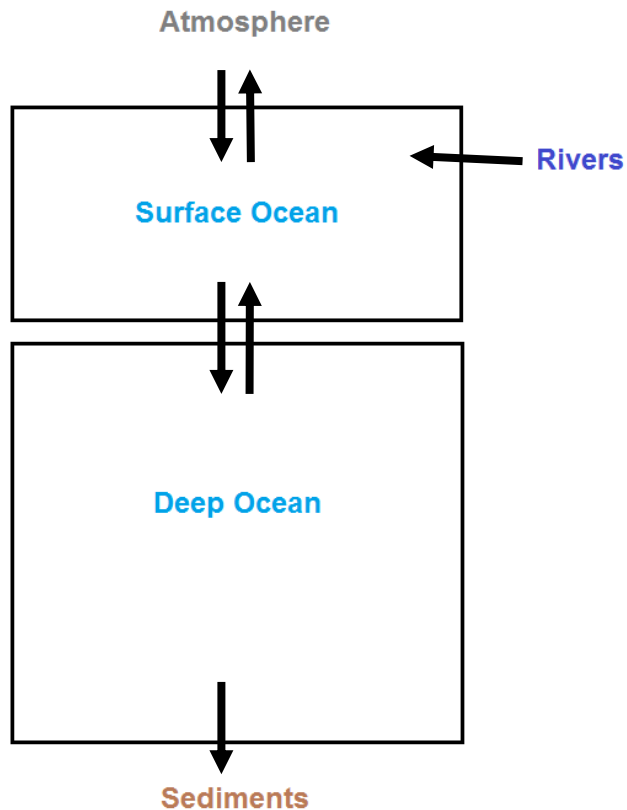Ocean Data View

Foram δ^{18}O reflects seawater δ^{18}O

Seawater δ^{18}O controlled by:
➢ Ice volume
➢ Temperature
➢ Freshwater influx

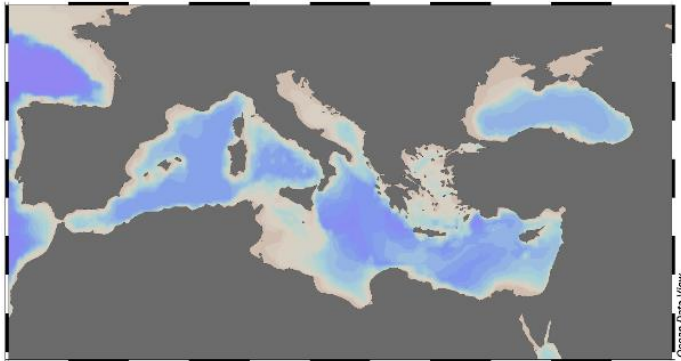To explore this further I am using a box model
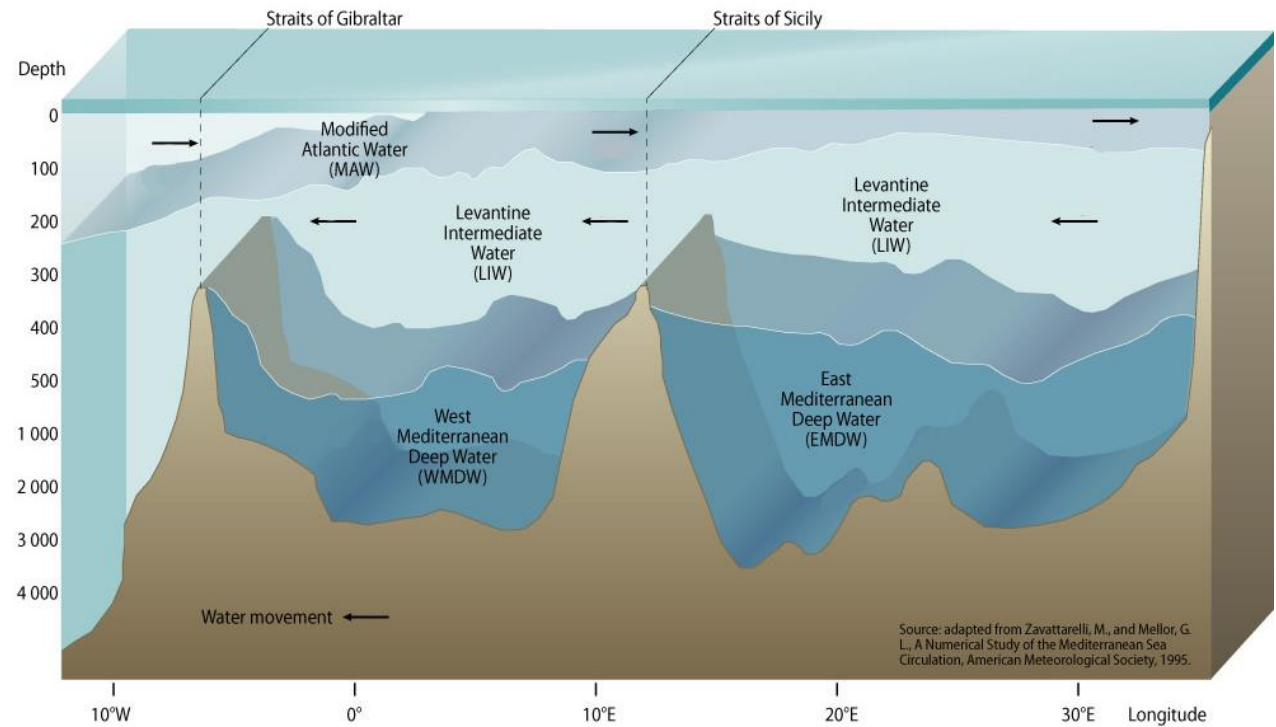
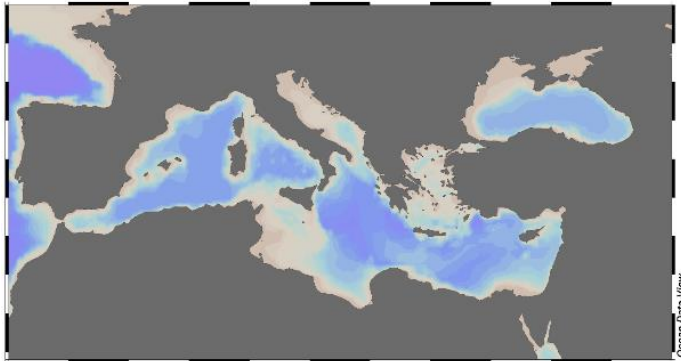# What is a box model?

Simple representation of the ocean

➢ Boxes represent different water masses
➢ Fluxes in, out, and between boxes

Simple, but quick to run and easy to change different parameters
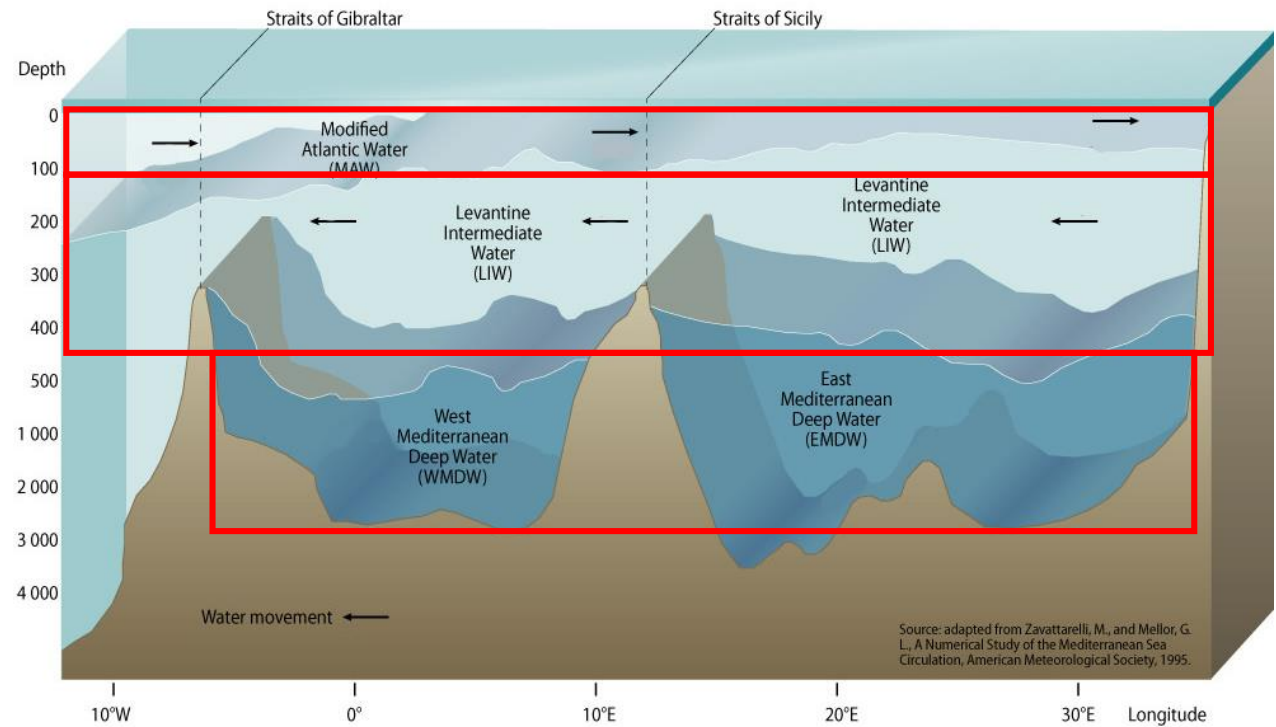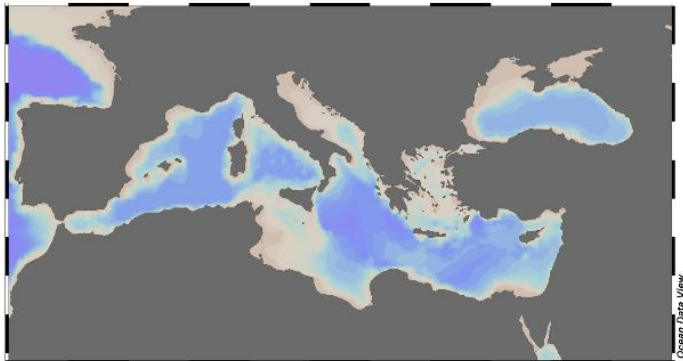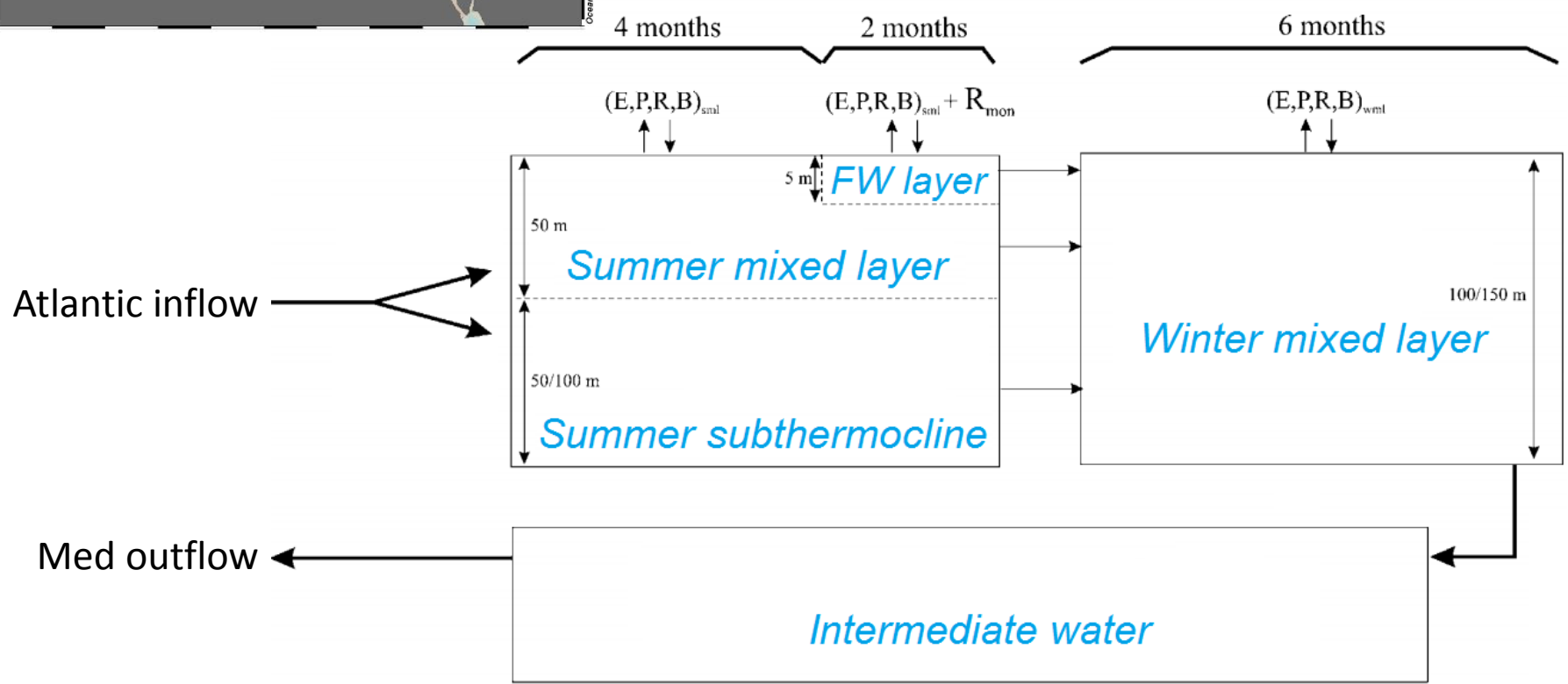
Mediterranean box model

Source: adapted from Zavattarelli, M., and Mellor, G. L., A Numerical Study of the Mediterranean Sea Circulation, American Meteorological Society, 1995.

Mediterranean box model

Mediterranean box model
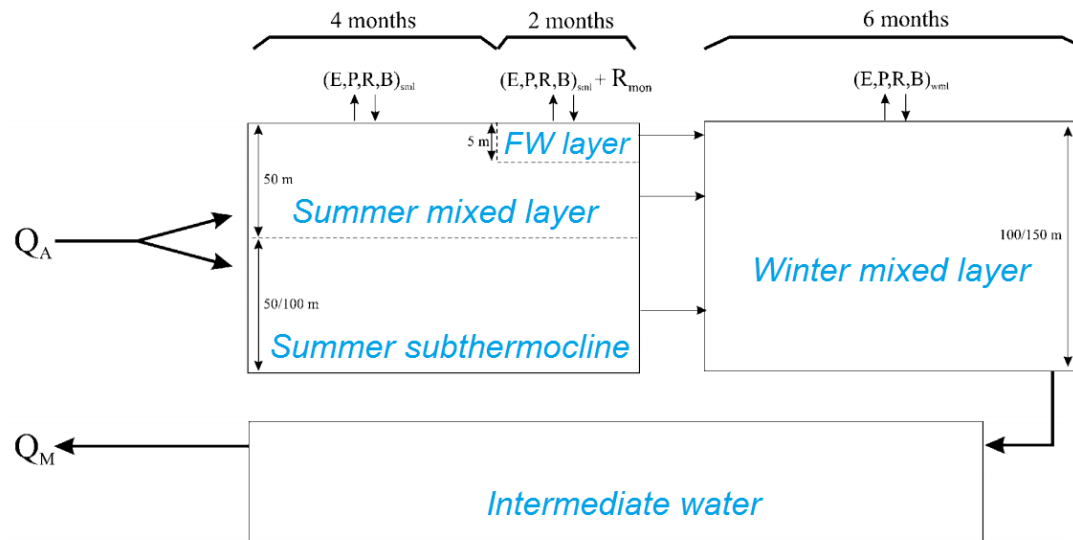
Inputs

Parameters observed in modern day ocean
> e.g. precipitation amount, wind speed, etc.

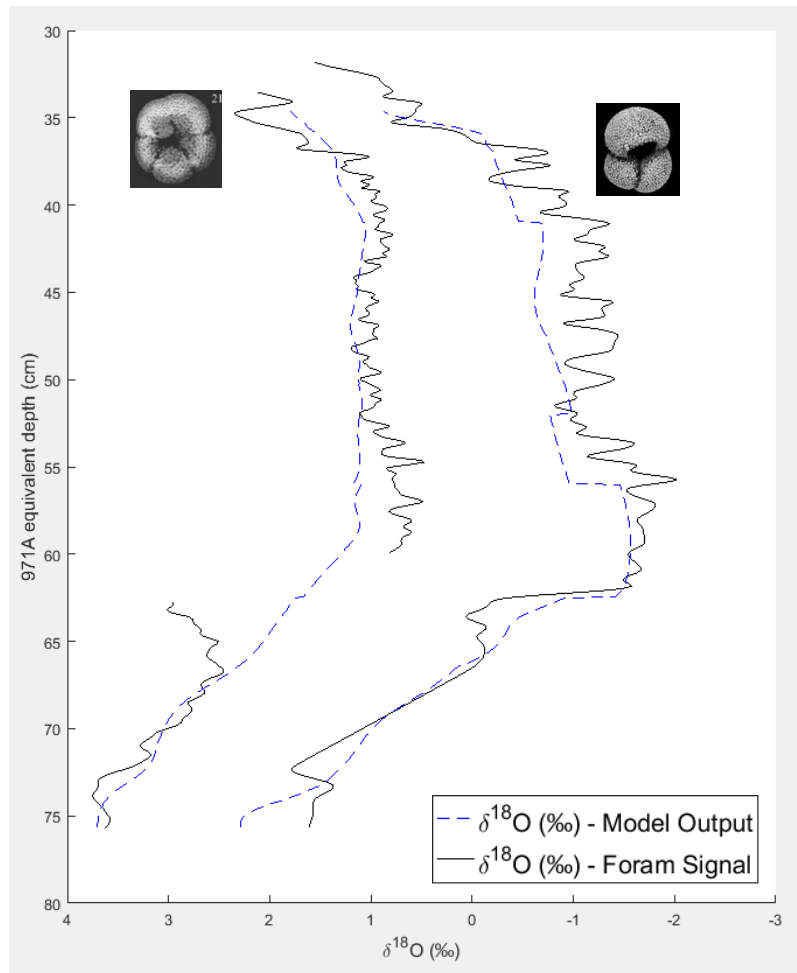**Time-dependant parameters from palaeo-records**
> Sea level and SSTs

Poorly constrained parameters
> Freshwater runoff from African monsoon (d18O and volume)

Outputs

Output = expected properties for the different water masses

Uncertainties

All input parameters have uncertainties

Parameters observed in modern day ocean
measurement errors + potential variability over time

Time-dependant parameters: Sea level and SSTs
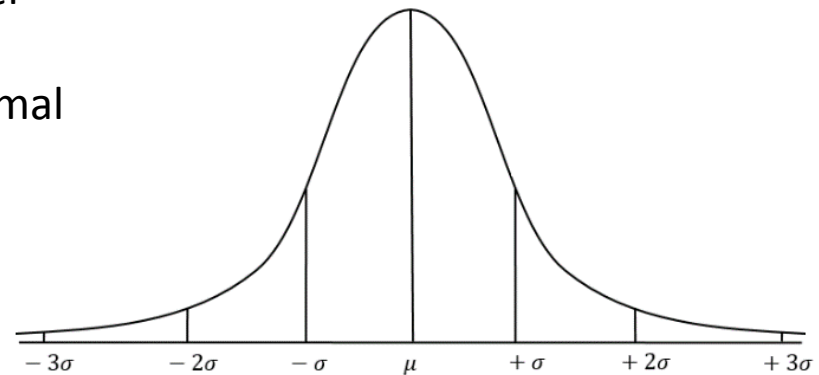uncertainties associated with records

Poorly constrained parameters: Freshwater runoff (d18O and volume)
not fully quantified, only have a range of possibilities!

All the uncertainties need to be accounted for in the model

Propagating uncertainty through model

➢ Introduce an error to each input parameter

➢ The error is randomly selected from a normal distribution
  ➢ SD is equal to the uncertainty

➢ Monte-carlo style approach
  ➢ run the model thousands of times

➢ Result is thousands of outputs

My questions...

With all these uncertainties in my model inputs, how are these propagated through the model, and what does this mean for my outputs?

Is there a way I can see what inputs are having the greatest effect on my outputs?