

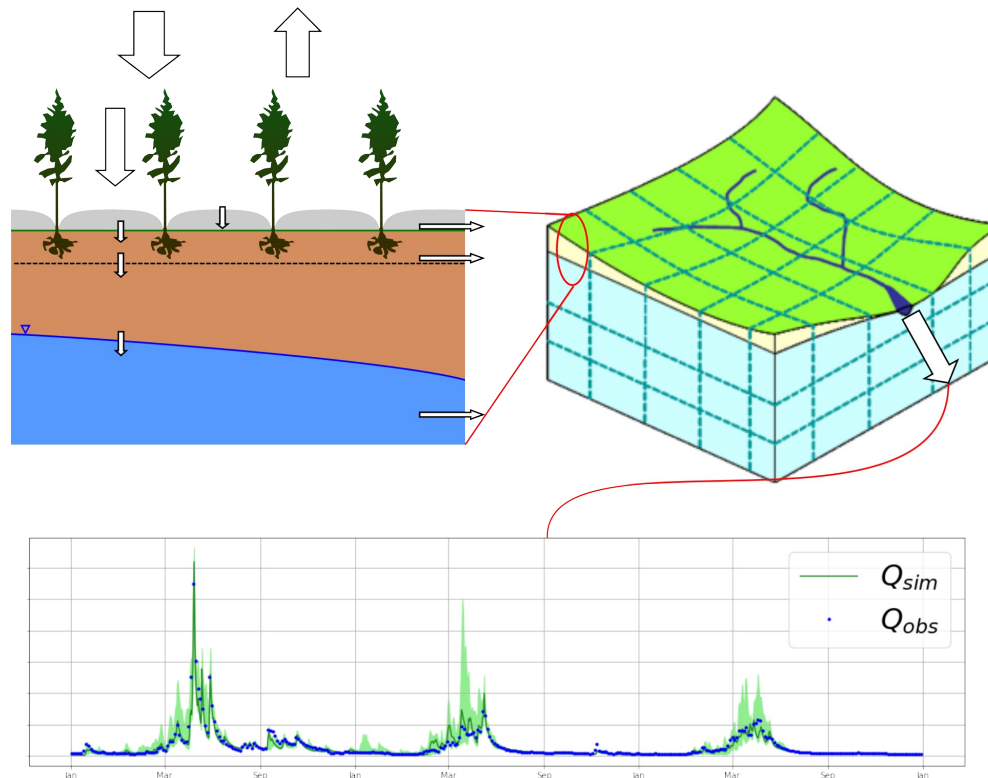
Hydrological modelling with python



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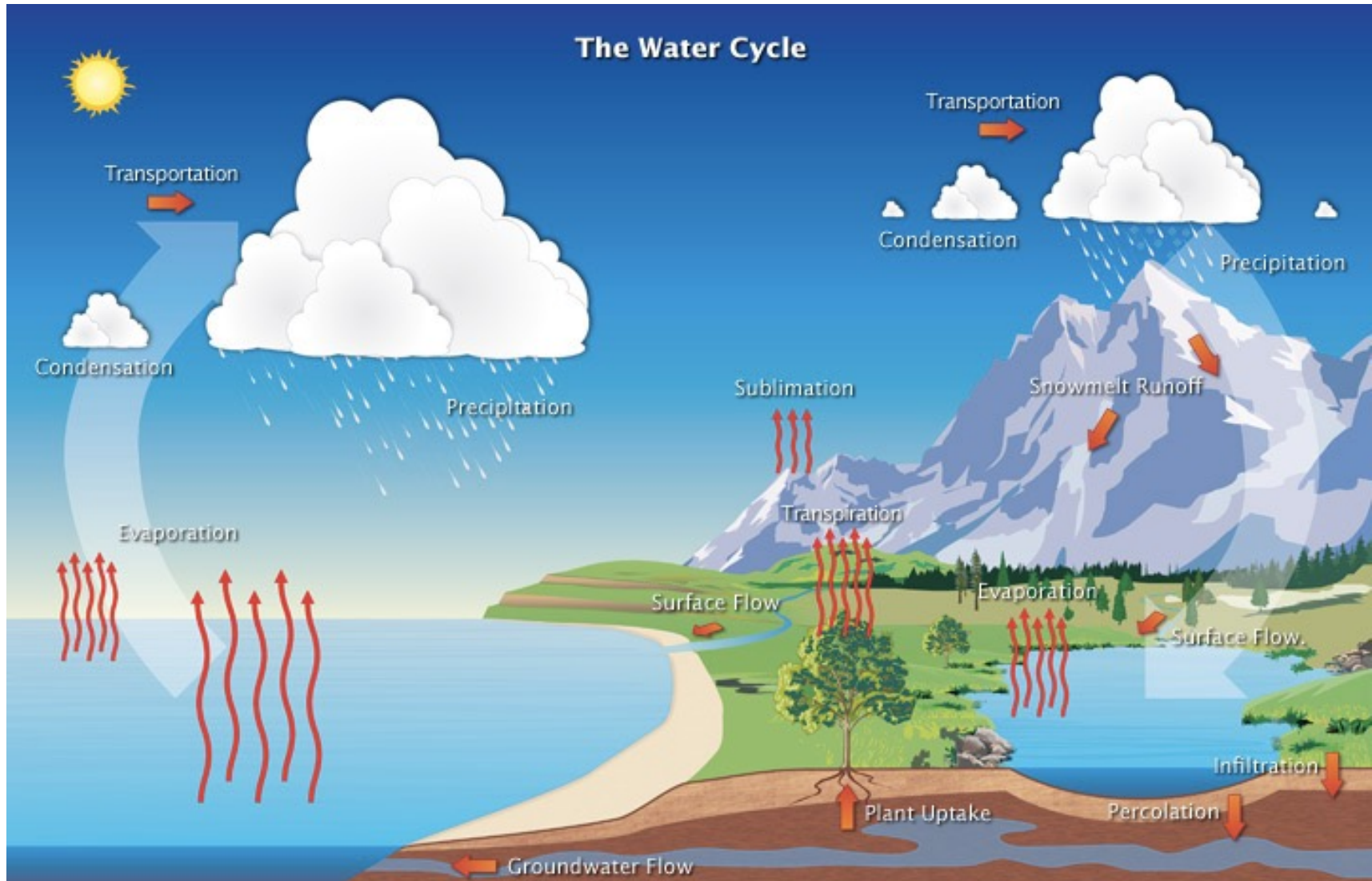
A webinar for the BUET Alumni Association of Alberta

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Today's learning objectives

- Review **what problems can be addressed** by hydrological modelling
- Understand the **opportunities** that the **open-source** python language provides
- Know where to get **python packages** and how to get started with the **jupyter notebook**
- Appreciate the steps involved in **writing a simple hydrological model**
- Experience **a modelling case-studies** with python models
- Have clear direction about how to proceed on your own – **breakdown the barriers to entry**

The natural hydrological cycle



Why do we need hydrological models?

- We can't measure everything we would like to know
- What we can measure, we measure imperfectly
- We therefore use models to extract useful information from imperfect and incomplete data.



Typically with a hydrological model, we are looking to **predict what will happen in the future**, due to patterns of climate or modifications to the land surface













For example, to predict flood occurrence and magnitude.

How are models useful?

1. Predictive modelling

Operations:

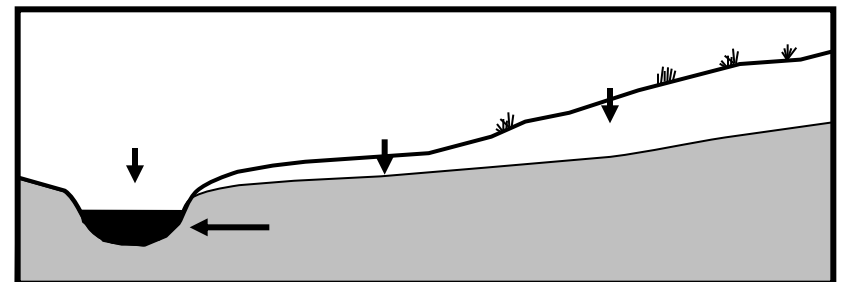
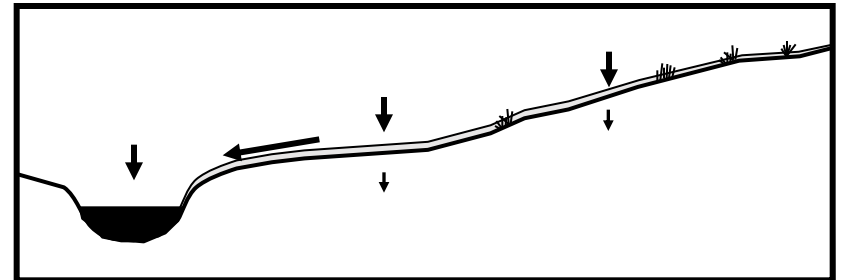
Model outputs as sources of information for decision making

Forecast					Hourly Forecast	Air Quality	Alerts	Jet Stream
	Sat 19 Mar	Sun 20 Mar	Mon 21 Mar	Tue 22 Mar	Wed 23 Mar	Thu 24 Mar		
	 2°C Mainly sunny	 1°C 60% Chance of showers	 1°C Periods of snow	 3°C Sunny	 8°C Sunny	 5°C A mix of sun and cloud		
Tonight	Night	Night	Night	Night	Night			
 -10°C A few clouds	 -5°C Partly cloudy	 -2°C Snow	 -9°C Clear	 -4°C Clear	 1°C Cloudy periods			

2. Explanatory modelling

Basic research:

Models as working hypotheses that can be used to investigate how a system work.

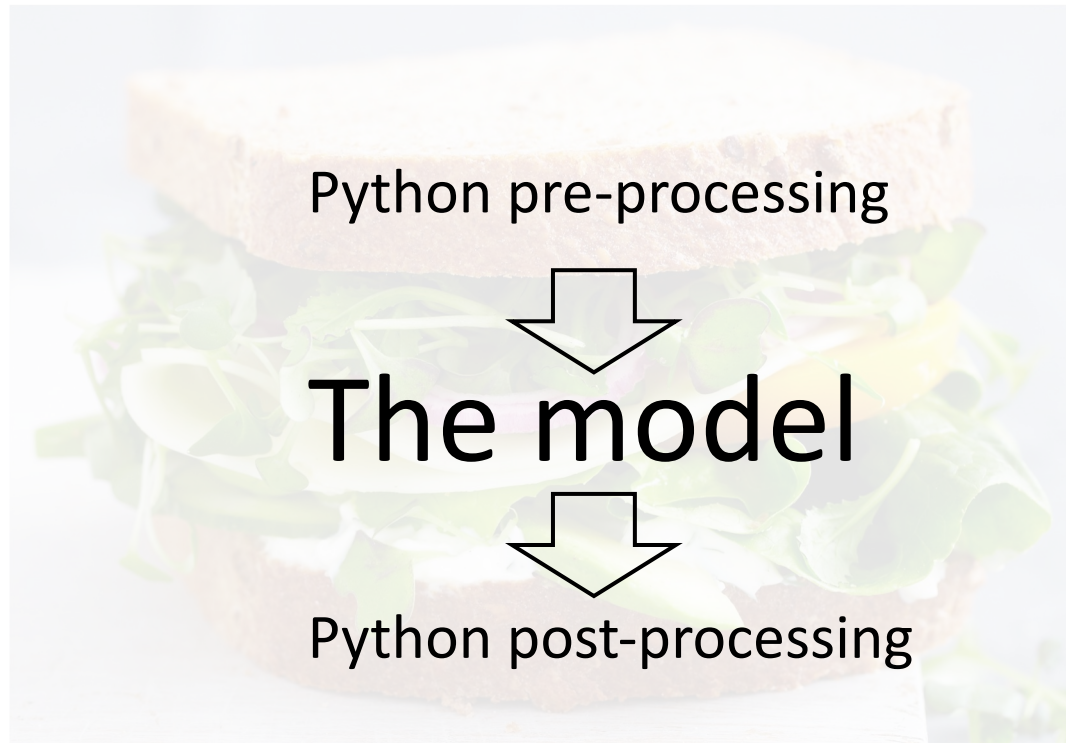


Why python?

- Coding is an essential skill in the job market/academia
- Reproducibility crisis – all analysis needs to be scripted
- Big data – beyond the capabilities of spreadsheets
- Python is open source – freely available to anyone on any computer platform;
- Python is relatively easy to learn
- Python is extremely powerful and has excellent packages for different types of analysis (e.g. GIS, numerical methods, data visualization)
- However – you don't have to use python. MATLAB and R are also excellent, and coding skills are transferable from one language to another

The python-model sandwich

For most people, most of the time, the best use case of python will be as a data pre- and/or post- processor for any given model:



For this reason – when you first learn python you should focus on learning how to manipulate and plot data (*numpy, pandas, matplotlib*)

Modelling in python

For some people, some of the time, it will be useful to write models in python from scratch.

Why?

- To learn how models work (students);
- To customize what the model does – e.g. to test out new ideas (researchers);

Today we will focus on this topic.