Surface Water Dynamics

Surface Water - Surface water is any body of water found on the Earth's surface, including both the saltwater in the ocean and the freshwater in rivers, streams, and lakes. A body of surface water can persist all year long or for only part of the year.

Method

1. Identify suitable data sources
2. Image Pre Processing - Cloud Masking
3. Water Body Extraction - Indices based; time-series
4. Post-processing - filters to remote isolated pixels, raster to vectors
5. Data visualization and plot surface water changes

Categorization of surface water delineation techniques

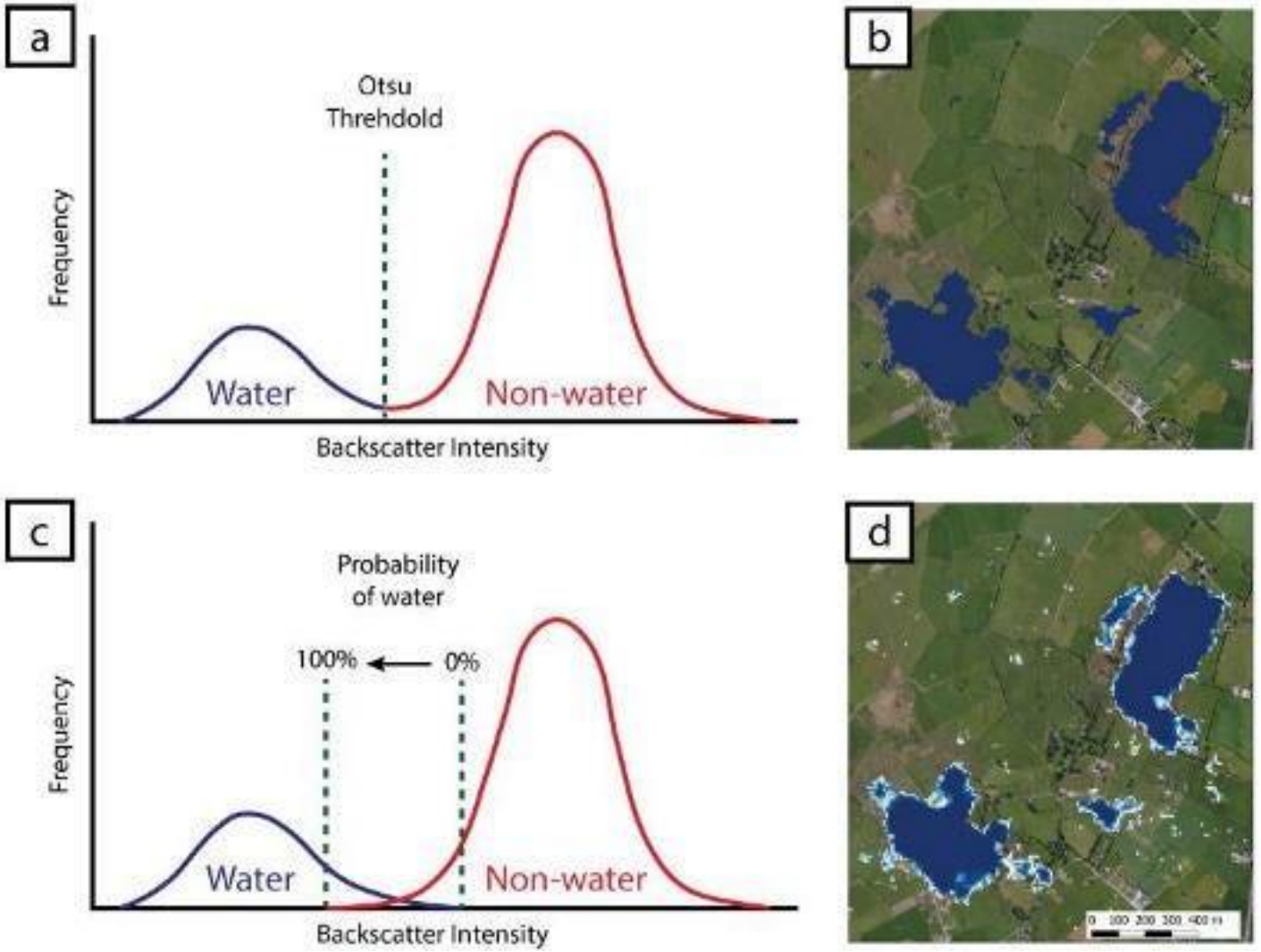
1. single band based methods
2. spectral index based methods
3. machine learning/ deep learning based methods

Single Band Based Methods

- make use of just one band for the detection and delineation of water bodies
- the near infra-red (NIR) region in the EM spectrum has been proved to be the best suitable frequency region.
- radiation within the NIR region is absorbed almost completely by water and water appears dark in an NIR image
- simple slicing or thresholding on the digital numbers of the pixel values can detect and delineate the water bodies.

Categories**:** Intensity thresholding and histogram based thresholding

Issues**:** The major sources of error found in classification are the **shadows of mountains and clouds.**


a
Otsu
Threhdold
Frequency
Water
Non-water
Backscatter Intensity
b
c
Probability
of water
100%
0%
Frequency
Water
Non-water
Backscatter Intensity
d

Spectral Index based methods

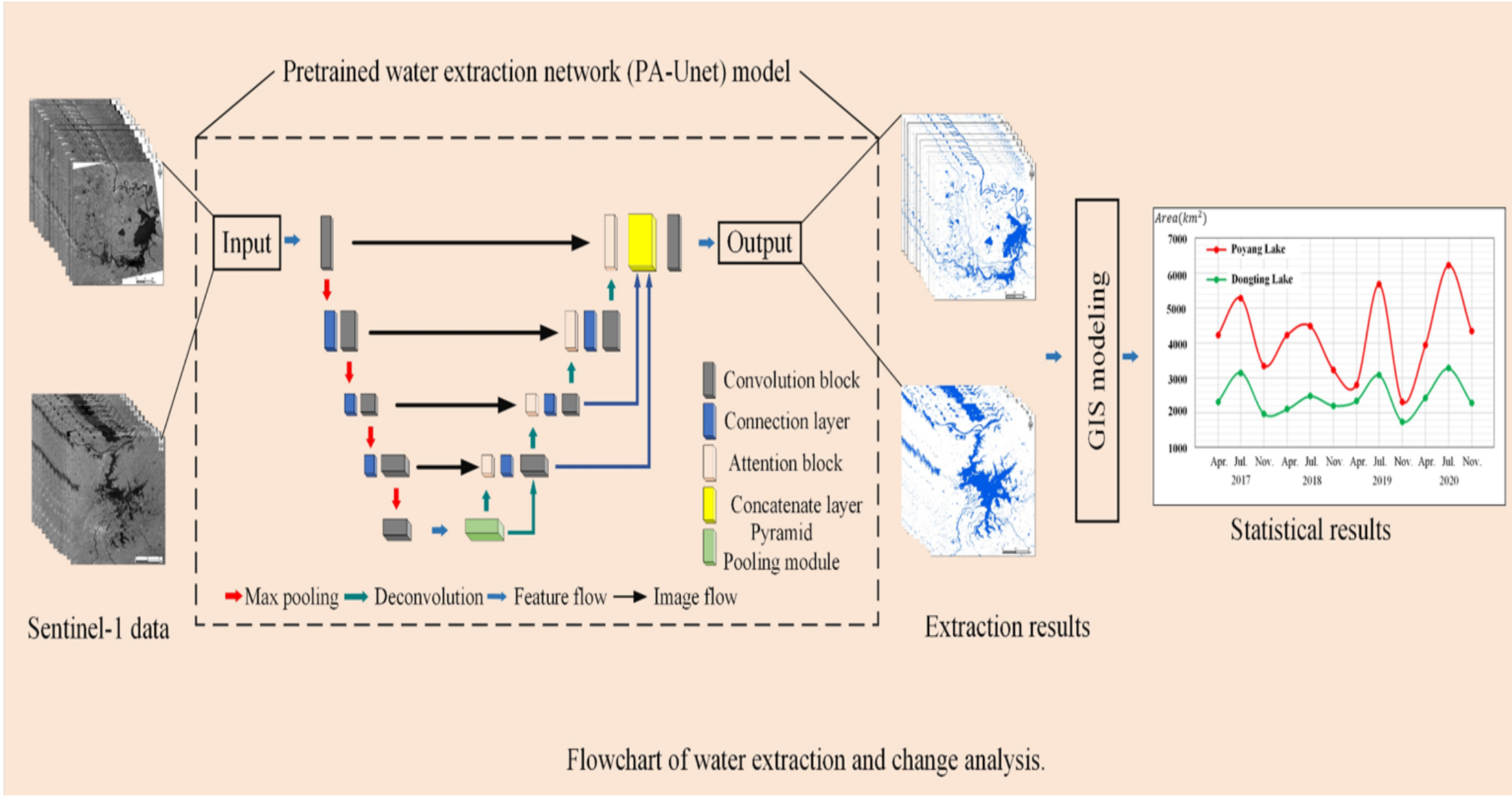
- An obvious improvement on the single band based methods is to use the band ratios instead of directly using the single band pixel values.
- Using band ratios can normalize the effect of some unwanted information in the pixels like that of clouds and shadows.
- Several techniques utilizing complex ratios of multiple bands were proposed.

Most commonly used spectral indices: NDVI, EVI, NDWI, EWI, MNDWI etc.

Machine Learning based Methods

- Primarily using regression and classification algorithms for detections.
- Regression algorithms basically try to predict the output value based on the inputs whereas classification algorithms try to group the input data into different classes.
- Classification Algorithms falls in two categories: supervised and unsupervised algorithms.
- Example of supervised ML algorithms are ANN (artificial neural network), SVM (support vector machine), minimum distance classification, maximum likelihood classification, regression tree based algorithms
- Example of unsupervised ML algorithms are **K-means clustering and ISODATA**

Deep Learning based water extraction



Flowchart of water extraction and change analysis.