University of British Columbia, Okanagan Campus | Earth and Environmental Sciences

Remote sensing techniques to classify and monitor wetlands in the Okanagan Valley using LiDAR and earth observation satellite data

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Concerns

- Wetland loss of 98% near urban centers[1]
- Existing maps are insufficient for long-term monitoring purposes

Objectives

- Create a replicable model to identify and classify wetlands in the Okanagan using remote sensing data
- Explore secondary studies such as biodiversity and connectivity

Goals for the Okanagan[2]

- No net loss of wetlands by 2025
- Net gain within areas rated as high value for biodiversity and habitat connectivity by 2030

Background

Wetlands are considered one of Earth's most productive ecosystems and provide important services such as:

- Flood mitigation
- Groundwater recharge
- Water purification
- Nutrient cycling
- Erosion control
- Carbon sequestering
- Habitat for a variety of species

The Canadian Federal Policy on Wetland Conservation estimated that economic value of these services to be over **$10 billion** annually[3], giving us strong incentive to protect wetlands. Nation-wide and local inventories are patchy or incomplete and do not account for terrain morphology at relevant scales. Recent advances in remote sensing technologies have improved the opportunities available for creating comprehensive wetland inventories. The ability to identify and differentiate wetland types using earth observation satellite and LiDAR data combined holds great promise for conserving wetlands at scales relevant to ecological processes, including wetland connectivity and biodiversity, and for informing resource management.

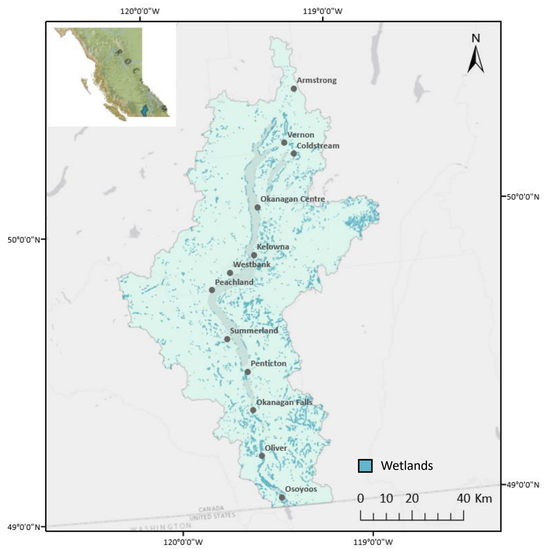


Figure 1. Study area map of the Okanagan Basin
Produced in ArcGIS by Tina Deenik using the Okanagan Wetland Database provided by Ecoscape Environmental Consultants[4].

Approach

The Canadian Wetland Classification System has identified five main classes of wetlands: bog, fen, marsh, shallow water and swamp. Each of these different classes has specific attributes relating to hydraulic regimes and vegetation communities. Remote sensing techniques can pick up on these attributes to acquire spatial and temporal information about wetlands.

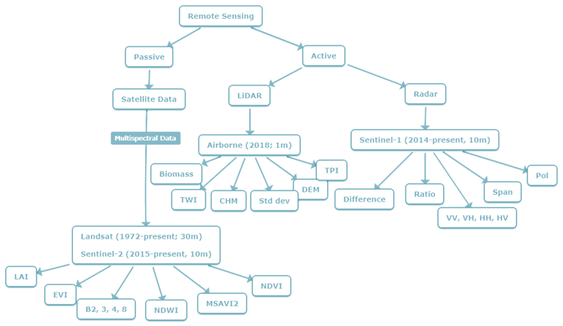


Figure 2. Derived parameters for the model
Produced by Tina Deenik

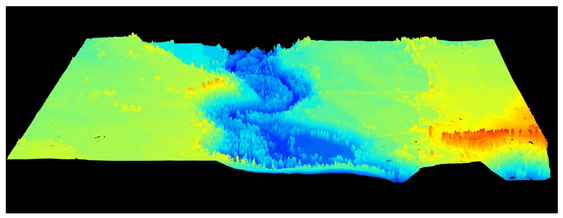


Figure 3. LiDAR section Mill Creek, Okanagan, BC
Image captured by Tina Deenik from 2018 LiDAR data provided by the Okanagan Basin Water Board.

Building the model

Google Earth Engine (GEE) is a free service that allows anyone to access the processing power of Google Earth's servers through the cloud. The following steps will take place:

1. Stack parameters using GEE
2. Train model using random forest machine learning to pick up on the relationships and interactions between parameters for known wetlands
3. Test the model's accuracy using the wetland inventory and refine it
4. Predict probability of wetland occurrence across the entire Okanagan

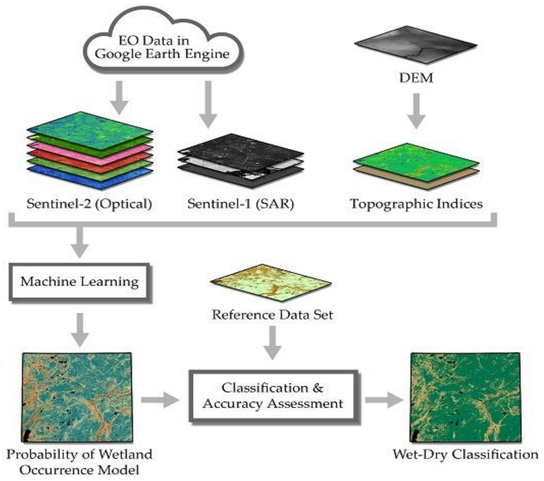


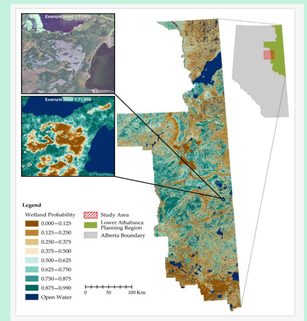
Figure 4. Schema showing data processing flow
Produced by Hird et al. (2017) in Remote Sensing[5].

Deliverables

- Map showing probability of wetland occurrences throughout the Okanagan basin
- Map showing wetland classifications (bog, swamp, marsh, fen, shallow open water) associated with the identified wetlands above
- Map showing functionally connected wetlands and biodiversity hot spots

Applications

- Land-use planning
- Wetland evaluation
- Monitoring
- Conservation
- Flood mitigation
- Restoration



Map produced by Hird et al. (2017) in the journal Remote Sensing[5]

References

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2. Nadeau, C. and H. Hamilton. (2019). Okanagan Wetlands Action Plan A Resource for Local Government and Communities. Prepared by: Associated Environmental. Prepared for: Okanagan Basin Water Board.
3. Environment Canada. (1991). The federal policy on wetland conservation. Environment Canada.
4. Patterson A., D. Drieschner, R. Wagner, and K. Hawes. 2014. Okanagan Wetlands Strategy: Phase 1: Outreach, Data Collection, Prioritization, and Mapping. Prepared By: Ecoscape Environmental Consultants Ltd. Prepared For: Okanagan Basin Water Board. Ecoscape File No. 13-1159.
5. Hird, J. N., DeLancey, E. R., McDermid, G. J., & Kariyeva, J. (2017). Google Earth Engine, open-access satellite data, and machine learning in support of large-area probabilistic wetland mapping. Remote Sensing, 9(12), 1315.

Acknowledgement

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