Abstract:

In the last few years, there has been a significant change in the sea level of Alaska by the melting of glaciers due to which the flora and fauna in the coastal region have been endangered. Accurate prediction and analysis of change in sea level is crucial for the policymakers and protective agencies to take proper measures against the change. Existing studies don’t provide a proper prediction about the changes in the glacier mass, glacier health or the changes in the sea level. The main problem lies in the unavailability of data. This research provides a deep analysis of glacier mass change from 1985-2021 extracted from a remote sensing timelapse video and it predicts the changes in glacier health and sea level from 2021-2026. This solution uses various image processing techniques to extract data from the image sequence from the video and it also uses the LSTM and RNN models ensembled together to predict future changes with an accuracy of 80%. This prediction provides a solution for various policy-building organizations to be ready for a change in habitat.

Introduction:

Recent global warming has triggered the deterioration of glaciers throughout Alaska resulting in substantial increases in water levels along the coast and threatening native sea-based vegetation and animal species. Ecosystems depend on glaciers for the conservation of ecological equilibrium because glaciers control freshwater access while shaping weather patterns. The fast degeneration of glacier mass caused by increasing global temperatures produces unsettling impacts which harm both marine and coastal ecosystems. Good sea-level rise prediction allows policy makers along with protective agencies to create sustainable protection methods. Studies face a barrier in forecasting glacier amounts and health as well as resulting sea-level changes due to insufficient reliable and continuous datasets, as studied.

A global glacier mass loss of approximately −331.68 ± 59.07 Gt/yr was estimated from 2019 to 2023, which can be equivalated to a sea level rise of 0.916 ± 0.163 mm/yr. Conversely, the southern Canadian Arctic, Alaska, and the southern Greenland Periphery consistently displayed more negative specific-mass change rates, indicating a relatively substantial thinning rate of up to −1 m w.e/yr.[1] Glacier mass loss in Alaska has implications for global sea level rise, fresh water input into the Gulf of Alaska and terrestrial freshwater resources. The glacier area shrunk by 543±123km2 (12±3%) between 1986 and 2016. The region-wide mass-balance rate between 2005 and 2014 was −0.94±0.12mw.e.a−1 (−3.84± 0.50 Gt a−1), which is almost twice as negative than found for earlier periods in previous studies indicating an acceleration in glacier mass loss in this region.[3]

The study aims to address the lack of data about glacier mass alterations across 1985 to 2021 by performing thorough assessments. The research uses remote sensing time-lapse video data extraction as a distinctive methodology to track glaciers through detailed continuous observations. The research uses superior image processing methods to accurately measure glacier mass fluctuations from which scientists can obtain essential data about melting rates and patterns. The analyzed data contributes to historical analysis together with its capability to develop predictions about glacier health together with sea-level changes in the future.

This study uses a combination of Long Short-Term Memory (LSTM) with Recurrent Neural Network (RNN) to improve prediction accuracy in an ensembled form. This deep learning technology excels at managing sequential information through dependency detection which leads to its successful application in studying glacier mass modifications while predicting potential future changes. Using an ensemble of LSTM together with RNN the model generated forecasts for glacier health and sea-level trends from 2021 to 2026. The predictive accuracy reaches important levels due to its ability to deliver reliable data enabling public officials to anticipate environmental shifts after implementing proactive measures. This research presents a beneficial solution which allows different policy-building organizations to develop preparation strategies for potential habitat alterations driven by rising sea levels. Coastal protection agencies together with environmental researchers and local governments could utilize this projected data to develop adaptation measures for protecting biodiversity and human settlements. This study fosters climate science development alongside sustainable environmental management through its data-based strategies which address both glacier melting and rising sea levels.