Current Science Reports

Iceberg Tracking in the Antarctic

Content-based image classification

Image: Tanya Patrick via Wikimedia

Icebergs in the Antarctic region can help us monitor climate change. To monitor such changes, icebergs in remote sensing images are annotated with information about latitude, longitude and time. But the process is slow, challenging and not very reliable. Can we automate the process?

Rajakumar Krishnan and team from the Vellore Institute of Technology recently collaborated with researchers from the Space Applications Centre, Ahmedabad to develop automatic iceberg detection in remote sensing images of the Antarctic ocean.

They collected synthetic aperture radar image data over the Antarctic region from the Sentinel-1 satellite. The data contained speckle noise due to the reflection and interference of signals from multiple surfaces. This affects image quality. The noise was reduced using the frost filter algorithm.

The researchers divided the processed image data into 64 × 64 pixels and applied two-level feature extraction. In the first level, they detected and classified icebergs, sea ice and land melting from the image texture using the convolutional neural network, a classifier algorithm. In the second level, they eliminated false predictions of icebergs by using a filter algorithm. The movements of icebergs were extracted from the temporal images using pixel latitude and longitude information. This two-level method had a precision of 79%, the highest among existing methods.

'We now have to devise ways to detect smaller icebergs of less than 64 × 64 pixels,' says Arundhati Misra, Space Application Centre, ISRO, Ahmedabad.

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Chhota Shigri Glacier

Factors affecting melting

In summer, Chhota Shigri, located on a northern slope in the Pir Panjal ranges, does not melt as rapidly as glaciers on the southern slopes. But, lately, the glacier has been losing its mass drastically. What are the factors contributing to the snow cover imbalance at the Chhota Shigri glacier?

Researchers from different institutes across India collaborated to analyse snow-surface energy balance, an energy parameter, to determine the rate of glacier melting. The energy exchange between the earth's surface and the atmosphere involves processes like the absorption and emission of electromagnetic radiation, ground thermal conduction and the turbulent heat energy of the atmosphere which leads to glacial sublimation – evaporation into atmospheric water vapour without melting. They quantified the relationships between these variables that affect snow depletion into an energy equation.

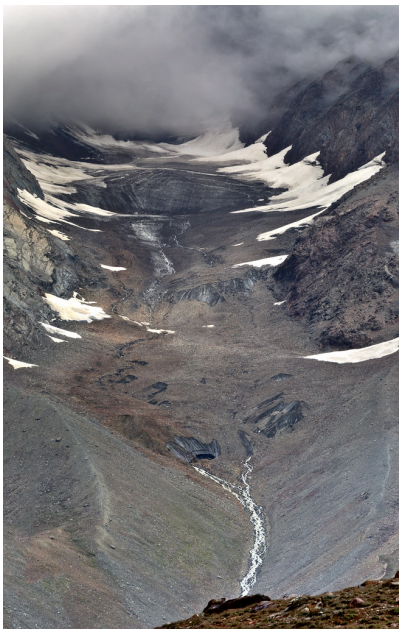

Image: Amritash, Flickr

Based on meteorological data from an automatic weather system at Chhota Shigri which recorded temperature, humidity, wind speed and solar radiation between 2009 and 2020, they noted that glacier sublimation varies on a temporal scale across the 11-year period.

The team found that meteorological variables in sublimation, such as wind speed, humidity, surface temperature and incoming radiation, play a major role in changing glacier balance.

The researchers noticed that the sublimation rate was almost three times higher in clear-sky conditions. Cloud cover affects the stability of the atmosphere. Strong winds were often observed in overcast conditions with high cloud cover. And clouds also controlled the temperature and moisture gradient over the Chhota Shigri glacier.

The researchers say that, though temperature affects the rate of glacial melting, other meteorological drivers like wind speed, humidity and cloud cover directly affect the loss of glacial mass in Chhota Shigri.

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Dengue Biomarker

Protease-activated receptor

There has been a rise in dengue cases across Northern India. While dengue infections are self-limiting, some patients develop complications such as inflammation and internal bleeding. Some go into shock and die due to these complications.

Is there a way to identify the onset of these dengue fever complications early enough to treat patients at higher risk?

Researchers from the Government Medical College, Patiala and Chitkara University, Punjab identified protease-activated receptor 1 as a potential biological marker in dengue patients. This receptor protein is involved in regulating coagulation-inflammation responses, aggravating haemorrhaging and inflammation.

The team examined 60 dengue patients aged between 15 and 65 in Patiala Hospital. The RT-PCR tests for dengue viral serotypes showed more patients were infected by the dengue virus-2 serotype than by the dengue virus-3 serotype. Dengue virus-2 serotype is more virulent and creates more complications.

The researchers categorised the patients based on the dengue symptoms. Thirty patients suffered from non-severe dengue, nineteen patients reached the severe dengue stage, and eleven were affected by dengue shock syndrome. Standard blood tests showed very low platelets and red blood cells in severe dengue and dengue shock patients, confirming that the patients had developed complications. Enzymes such as alanine transaminase and alkaline phosphatase were found in the blood and urine of patients with severe dengue, suggesting immune-mediated injury of the liver.

The more severe the complications, the higher the levels of protease-activated receptor-1. The levels were also correlated with various haematological and inflammatory complications. There was also a very strong correlation between the protease-activated receptor and pro-inflammatory cytokines, besides the biomarkers of liver injury.

The researchers tried correlating the protease-activated receptor-1 levels with other biological markers in dengue patients. The receptor levels did not seem to affect platelet count in dengue patients. But the red blood cell count was directly influenced by the levels of the receptor in serum. This signified the role of the protease-activated receptor 1 in clotting and in other severe symptoms.

Pathology labs in dengue-affected areas need to acquire the test kits for measuring the protease-activated receptor 1 levels to help clinicians predict the severity of individual cases and to take timely steps for treating the complications.

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Monitoring Epilepsy

Using a smartwatch

For epilepsy patients and their families, the most stressful aspect is the uncertainty of seizure occurrence. Electroencephalogram signals can help predict seizures reliably. But patients cannot live their lives wearing the headgear for monitoring electroencephalogram signals.

Smartwatches can be worn day and night without inconvenience. Moreover, they can also be fitted with sensors to detect rapid seizure motions and disturbances in the nervous system. Can these smartwatches be used for monitoring epilepsy patients?

Epilepto, a medical research start-up from IIT Ropar, used a smartwatch to observe eleven patients with epilepsy. The smartwatch had an electrodermal and temperature sensor which detects surges in skin conductance, an indicator of disturbances in the nervous system triggered during an epileptic attack. It could detect blood volume pressure. It also had an accelerometer sensor, to detect rapid seizure movements.

The start-up collaborated with Dayanand Medical College and Hospital, Ludhiana, and monitored nineteen seizure events. The electrical signals of the patients were captured with an electroencephalogram and the smartwatch monitored the other factors.

The researchers then used combinations of machine learning algorithms to segregate the seizure data into pre-seizure, seizure and non-seizure events. The algorithms fared well in specificity and sensitivity to detect seizures. The prediction accuracy to detect different seizure events was around 84%.

The researchers say that their dataset is small and claim that, with more data to train more complex algorithms, accuracy can be improved further.

The start-up now plans to produce a smartwatch with the sensors as well as the algorithms to predict seizures. In India, an estimated 12 million people suffer from epileptic seizures. Constant monitoring to predict the onset can help patients and caregivers.

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Gallbladder Cancer

Reducing misdiagnosis

Gallbladder cancer has a low survival rate. Surgically removing the gallbladder is the best treatment option. But it is not easy to distinguish benign tumours from malignant cancers of the gall bladder. So there is a risk of overdiagnosing the cancer. In high-incidence regions like North India, what is the rate of misdiagnosis?

Recently, surgeons from the Postgraduate Institute of Medical Education and Research, Chandigarh, acquired data on gallbladder cancer patients from a tertiary care centre in North India. Of the 61 who underwent complete surgical removal of the gallbladder, 25% had benign tumours, according to tissue examination. Gall bladder infections or tuberculosis accounted for the misdiagnosis of benign tumours as malignant.

How can we reduce the chances of unnecessary surgical procedures in suspected gallbladder cancer? To find out, the team analysed blood sample data, computer tomography scans and the histopathology reports of patients who had undergone radical surgery. They identified the difference between benign and malignant diseases. Weight loss and anorexia were significantly associated with malignancy.

Before recommending surgery, clinicians diagnosing gallbladder cancer can avoid misdiagnosis by distinguishing between benign and malignant cases based on these signs.

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