APPLICATION STORY

RENOWNED RUSSIAN RESEARCH INSTITUTE RELIES ON FLIR TO MONITOR TEMPERATURES IN SIBERIAN PERMAFROST.

Permafrost is a land condition where the soil is at or below the freezing point of water (0°C/32°F) for two or more years. China, Siberia, northern Canada, Alaska and Greenland all have permafrost areas. It is very hard to develop any human activity in permafrost areas. Constructions like buildings, roads or pipelines need to be built with dedicated techniques. Next to other sensing devices, thermal imaging cameras are used more and more for permafrost research and for the design and monitoring of roads and railways.

The Sergeev Institute of Environmental Geoscience, based in Moscow, Russia, is a true authority in the field of permafrost research. Since its inauguration in 1996, the institute has been carrying out fundamental and applied research in environmental geoscience, engineering geology, hydrogeology, and seismology. The institute also coordinates these studies within the scope of federal, academic, and municipal programs. For extensive permafrost research and field work in the Russian Northern Transbaikal region, the Sergeev Institute of Environmental Geoscience relied on a FLIR T400 thermal imaging camera, provided by Russian distributor Pergam Engineering.

The FLIR T400-Series cameras are extremely flexible and ergonomic handheld cameras. They have rotating optical block points up and down 120 degrees and are extremely easy to aim, focus, and use. The T400-Series also has FLIR's MSX® technology which enhances thermal images with recognizable details from the visible camera like numbers, labels, and other key features to better orient you to problem areas.

"The use of thermal imaging cameras for permafrost research is certainly interesting in many ways," says Julia Stanilovskaya from the Sergeev Institute's Permafrost Laboratory. "Thermal cameras allow us to see temperature contrasts in the surface of various landscapes. They also allow us to assess the average surface temperature areas where contact measurement is difficult or impossible."

MAN-MADE INFRASTRUCTURE IN PERMAFROST AREAS

Infrastructure works in permafrost areas have their own issues. For example, the process of clearing vegetation and constructing roadway embankments is one that often produces local warming of the ground surface. The warming, in turn, interferes with the thermal state of the underlying permafrost, which causes thawing. If the permafrost has a high amount of ice content, then the thawing will result in settlement (usually referred to as thaw settlement) and damage to above-ground structures. For example for highway construction, thawing permafrost will cause roadways to become distorted or damaged.

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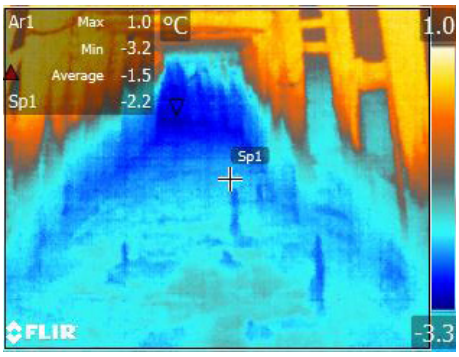
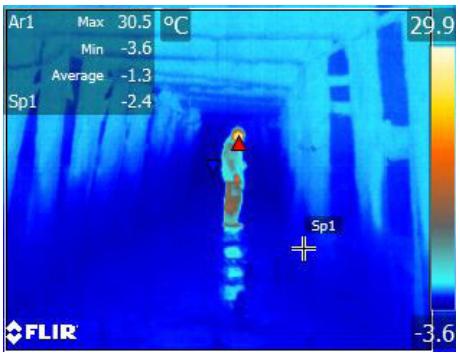
MONITORING ROAD AND RAILWAY INFRASTRUCTURE

Over the years, a number of innovative solutions have been developed to help overcome the difficulties that harsh climatic permafrost conditions can cause to man-made infrastructure such as roads,

buildings, railways, or pipelines. One well-known example is that of the Trans-Alaska oil pipeline, which employs a system of thermosyphon cooling devices that keep the vertical support structures permanently frozen into the permafrost.

"Thermal imaging can be used to see whether these cooling devices are working effectively," says Julia Stanilovskaya. "These cameras can also be mounted on drones to perform aerial thermography on pipelines, railways or road infrastructure."





Thermal imaging can also be used in support of mining and tunnel construction works in permafrost areas. (Udokan Ridge tunnel works, similar to the Kodar tunnel works)

One example is the Baikal–Amur Mainline (BAM), a 4,324 km long railway traversing Eastern Siberia and the Russian Far East. Since 2000 already, BAM experts of the railway's permafrost station have been using aerial thermography to determine the performance of cooling piles and artificial structures along this railway line.

MINING AND TUNNEL CONSTRUCTION

Thermal imaging can also be used in support of mining and tunnel construction works in permafrost areas. In the year 1984, a rockfall occurred during railway tunneling works in the Kodar mountain ridge in Siberia. This accident could probably have been avoided with regular thermal measurement of the rock temperature around the perimeter of the tunnel. Using thermograms on time could have helped to avoid the rock collapse and to take the necessary measures to maintain the temperature and mounting arch.

PERMAFROST RESEARCH

The possibilities of thermal imaging cameras for permafrost research are numerous and the types of phenomena that can be detected quite varied. Even very cold objects, such as ground ice, emit thermal radiation. That's why thermal imaging cameras can reliably detect ice wedges at the distance of 400 to 500m and measure the temperature of ground ice in local areas. The study of ground ice and icy sediments aims at identifying problem areas and possible solutions for infrastructure works in permafrost areas. Thaw subsidence may occur both on man-made objects and in natural conditions.

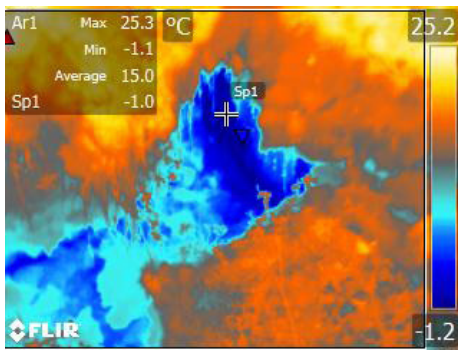
Geologists are interested in temperature regimes of rock landscapes and also try to integrate this data into statistic models. Temperature measurements give geologists more information about how landscapes are formed. The application of thermal cameras in the study of mining and rock landscapes (in particular the kurums or so-called stone rivers: coarse debris areas with underground ice) shows a clear contrast in surface temperature between the mountain slopes with vegetation and those with coarse stone debris. Interestingly, the thermogram shows that kurums are warmer than their surrounding territory, although they have a cooling effect. This has to do with convective air flows, which can also be detected with FLIR's thermal imaging cameras.

THE PERENNIAL SNOW FIELDS OF YUZHNO-SAKHALINSK

Storage of large amounts of contaminated snow masses harvested from the streets of the city of Yuzhno-Sakhalinsk, on the Russian Sakhalinsk island, resulted in the formation of perennial snowfields on the outskirts of the city. These snowfields are categorized as waste and have lead to the formation of a non-natural permafrost area. However, should these snowfields melt, then the contamination of neighboring properties and water areas would be severe. Luckily, thermal imaging cameras are able to see when the snow is melting. This way, the direction of the contaminated melt water flow can be determined and predictions about possible contaminations can be made. Normally, the temperatures during summer are not high enough in order to change the state of the snow. But with thermal imaging camera, the people of Yuzhno- Sakhalinsk can be 100% sure about the condition of their perennial snow heaps.

ERGONOMIC SOLUTION

"In our field research in the Northern Transbaikal area, we were in need of an ergonomic camera solution that allowed us to monitor large areas at once," says Julia Stanilovskaya. "That's exactly what the FLIR T400 offered us. In particular, we were looking for homogenous icy or cold places without temperature anomalies where it was possible to drill. With the FLIR T400 camera, that was easy to find. In fact, the camera saved us a lot of time and money, because it reduced our search time significantly. In addition, the FLIR T400 is easy to use, lightweight and can easily withstand cold, humid and windy permafrost conditions."



Natural thaw subsidence along ice wedges on the terraces of Chara river (August 2013)

For more information
www.flir.com

The images displayed may not be representative of the actual resolution of the camera shown. Images for illustrative purposes only.