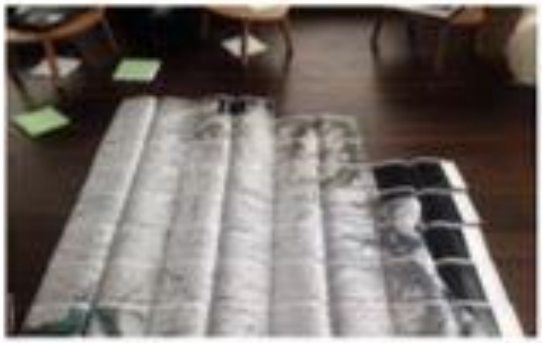
To prepare for the expedition, a SPOT6/7 mosaic was produced with more than 17 images acquired in the spring and summer of 2014 and 2015. The mosaic was printed out on waterproofed pages to provide the adventurers with day by day guidance, even in foggy conditions with no visual reference points. With this set of maps, bad weather cannot stop the skiers from advancing.



The 1.5m resolution enables them to identify the types of ice, the slopes and the crevasses and thus plan for the next day's journey. A grid on each map gives the positions which are then verified with a GPS. The next day's route is thus adjusted on the basis of a double geographical information system. This mosaic covers the entire icecap so that if the explorers get into difficulties they will be able to locate an exit valley.

The icefield of Mounts Wrangell and Saint-Elias is divided between Alaska and Canada, and is the world's largest non-polar icefield, covering a total of 31,700 km² and with a thickness of up to 1 kilometre.

At 5,489 m, Mount-Saint Elias dominates the numerous peaks which surround this vast expanse of snow. Animal life is abundant and the icy terrain is home to goats, mouflons, caribous, bears and wolves. A US and Canadian International Park manages this spectacular sweep of glaciers and snow.

The IceLegacy project initiated by the two explorers, aims to mobilise efforts to fight glacier retreat. The goal is to cross 20 of the world's largest glaciers on skis. This epic 10-year journey will take them from Russia to Alaska and from Patagonia to Pakistan.

A SPOT 6/7 mosaic of Mounts Wrangell and Saint-Elias Glaciers used to analyse & track the IceLegacy expedition.

The journey made by the IceLegacy expedition on the glaciers of Mounts Wrangell and Saint-Elias in Alaska, is analysed daily using a SPOT 6/7 mosaic by the explorers Børge Ousland and Vincent Colliard. This is the third time Airbus Defence and Space has supported the awareness-raising actions of IceLegacy concerning glacier retreat and dwindling fresh water resources.

Over a 6 week period, the Norwegian polar explorer Børge Ousland and Vincent Colliard from France will cross the icefields of Mounts Wrangell and Saint-Elias in Alaska, on skis. Along with their equipment, they were transported to the starting point in the Novatak zone by helicopter, on 21st April 2016. They will then cover 430 km on skis, pulling their sleds, sometimes with the assistance of a snowkite.

The public can track the expedition's progress daily on the SPOT6/7 mosaic, via the http://icelegacy.com website. The explorers upload their position every day, with a photo and update describing their day on the glaciers.

After crossing the main glacier of Spitzbergen Island in 2014, and then the Stikine icecap in southern Alaska in 2015, the adventurers will be taking on the world's largest icefield in 2016, classified as a UNESCO world heritage site and an International Biosphere Reserve.

a SPOT6/7 Mosaic

Related pages

- www.icelegacy.com
- SPOT 6/7 Satellite Imagery
- Polar Expedition to the Main Glacier on Spitsbergen Island
- Expedition to the Stikine Icecap in Alaska

Image Gallery

SPOT 6/7 is on an expedition with the IceLegacy team to the Stikine Icecap in Alaska

The second IceLegacy expedition will be exploring the Stikine Icecap in Alaska for three weeks starting on May 8th, 2015 . Web users can follow the explorers' progress with a SPOT 6/7 mosaic, produced by Airbus Defence and Space.

The Norwegian explorer Børge Ousland and his French colleague Vincent Colliard are skiing off again, this time to explore the Stikine Icecap in Alaska, which is ranked the 17th-largest icecap at 7,100 km². Starting on May 8, 2015, web users will be able to follow the three-week expedition of a SPOT 6/7 mosaic via the web site **www.icelegacy.com.**

The IceLegacy team will ski across 20 of the largest glaciers in the world to report on the effects of climate change. This epic 10-year journey will take them from Russia to Alaska, and from Patagonia to Pakistan.

Stikine is the second glacier to be explored after Spitzbergen island. Airbus Defence and Space is once again accompanying the IceLegacy team with a mosaic of SPOT 6/7 images acquired in the summers of 2013 and 2014. Geo-referenced on a Reference3D DEM, the mosaic offers a geometric accuracy of less than 6 metres.

View the SPOT 6/7 mosaic Stikine Icecap in Alaska, between Canada to the east and the Pacific Ocean to the west, dotted by peaks reaching over 3,000m in height

The explorers also use the SPOT 6/7 mosaic for their route plan which crosses the icecap from north to south. Data extracted from the image is particularly useful for the approach by boat and then by dinghy. The explorers will ascend along the glacier, avoiding the cracked areas andmarking theirorientation on an icecap, with major differences in altitude and types of ice.

With over 60kg of equipment that each explorer will carry, including a sleigh and a dinghy, the map is a valuable tool for viewing the terrain, anticipating efforts and for planning stages. Once they reach the foot of the southern glacier, the IceLegacy team will row their way to the Pacific Ocean.

Vincent Colliard and Børge Ousland

IceLegacy - Stikine Icecap

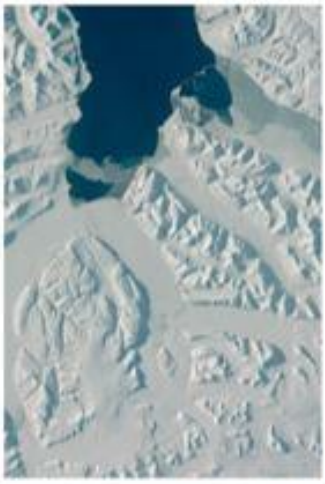
Related pages

- www.icelegacy.com
- SPOT 6/7 Satellite Imagery

Image Gallery

SPOT 6 on a Polar Expedition to the Main Glacier on Spitsbergen Island

With a SPOT 6 mosaic, Airbus Defence and Space supported the first of the IceLegacy expeditions: the main glacier of Spitsbergen Island. From 4th to 12th August 2014, the explorers Børge Ousland and Vincent Colliard crossed the 180 km of the main glacier of the Norwegian island, on skis. Web users followed their progress live on the SPOT 6 mosaic.



In supporting the first IceLegacy expedition, Airbus Defence and Space is helping to raise public awareness of the retreat of the polar glaciers and dwindling fresh water resources. The SPOT 6 mosaic accompanied the famous Norwegian explorer Børge Ousland and his partner, the Frenchman Vincent Colliard, on the main glacier of Spitsbergen Island, the world's 13th largest ice field.

On the **www.icelegacy.com** website, web users monitored the progress of the explorers. Texts and photos about each stage in the expedition were accessible from the SPOT 6 mosaic placed on a geo-referenced background. Airbus Defence and Space supplied this mosaic, consisting of six SPOT 6 images acquired in the winter of 2013.

The climb of the highest glacier in the Arctic began on 4th August 2014 in the north of Spitsbergen Island. On the way, the two adventurers scaled the 1713 m Mount Newton, the highest mountain in the Svalbard archipelago. They left the glacier after covering 180 km on skis, on 12th August 2014.

See the SPOT 6 mosaic of the main glacier of Spitsbergen Island, Svalbard Archipelago, Norway

The goal of the IceLegacy project conceived by our two explorers is to promote efforts to combat glacier retreat. Their aim is to cross the world's 20 largest glaciers on skis. This epic 10-year journey will take them from Russia to Alaska and from Patagonia to Pakistan. The next expedition will be to the Severnaya Zemlya archipelago in Russia or Ellesmere Island in Canada.

A photo presentation of the Vincent Colliard and Børge Ousland IceLegacy expedition to the Spitsbergen Island glacier

"As far as we know no one has done this route crossing main Spitsbergen icecap and exiting down the Von Post glacier leg, but the satellite photos and waypoints were perfect. No major problems for us with the fantastic weather we had, but for the glacier it is a losing game. The glacier has retreated several hundred metresers in a few decades"

Børge Ousland and Vincent Colliard
Explorers, First IceLegacy Expedition

IceLegacy - Spitsbergen Island

Related pages
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Image Gallery

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Polar legend Børge Ousland and young adventurer Vincent Colliard have just completed the first glacier (Main Spitsbergen, 13th largest on earth) of the IceLegacy project. *"Thank you to Airbus Defence and Space for their support !"*

Børge Ousland and Vincent Colliard partnered for the first time together – back in 2010 – while sailing the first circumnavigation of the North Pole and its Arctic ocean in one season. Today they unite their strength again for the IceLegacy project – crossing the 20 world largest glaciers on skis.

Alone in the polar vastness

"It was minus 8 degrees last night and the whole day we had a hard surface with very good glide. Sun from a blue sky and sometimes we skied in T-shirts, no wind at all. We did 36 km. It is being one of the most beautiful summer ski expeditions I have been on. Today again we met some crevasses areas but they were all snowed in and with the hard surface they were easy to cross. Even got some suntan today!" words by Børge Ousland.

At the summit of Mount Newton

It is 4.00 pm. Right after pitching the tent on Veteran glacier, Børge and Vincent leave the camp in order to reach the top of Newton mountain. A few hours later – on the photo – they ski the last metres before the summit at 1713 metres. From the summit: "Today has been great, sunny and calm, after a successful climb to Newton, the highest peak on Svalbard. Great view! Mountains and glaciers all around, we could even see Nordaustlandet island in the distance" affirms Børge Ousland.

On the glacier moraine

"We started about nine as usual, at 600 metress, just under the cloud cover. But also today the sun shone through. We followed the moraine all the way down. It was heavy going across the uneven ice in the melted zone with lots of small streams to cross, but we found good routes" says Vincent Colliard.

Adrift on an iceberg

"Doctor Ice feels at home as soon as he has a piece of ice under his feet, he is like a polar bear!" declares Vincent Colliard about his partner and hero Børge Ousland.

The end of the fjord

On our way to the North, captain Nick anchored sailing boat SkyDancer in a sheltered fjord of the western part of Svalbard. Just time for the two adventurers to go ashore, stretch their legs and enjoy the beautiful scenery ...

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Main Glacier on Spitsbergen island

Minimising the environmental impact of Arctic exploration

The search for hydrocarbons in the Arctic region is controversial. The environment is fragile, ice coverage is decreasing and fears of oil production in such frontier locations are shaping how oil companies and environmental NGOs are reacting to the shifting landscape. While significant hydrocarbon resources are thought to lie beneath the Arctic seafloor, the region presents one of the most challenging locations for oil and gas exploration. The technical difficulties of working in this remote area and the associated risks and harsh conditions are coupled with environmental concerns for the sensitive habitat and geo-political uncertainty.

Falling oil prices have resulted in a general scaling back of activity in the Arctic region. In order for any future exploration, development and production to be conducted responsibly, the latest technologies will need to be deployed to minimise disturbance to the environment and local populations. The application of observational data acquired by satellites and associated products and services, specifically designed for these conditions, are key tools to assist in addressing these environmental concerns and technical challenges.

Exploration has been ongoing in the Arctic since the 1970s, with most activity seen in Alaska and Greenland. Since these early days, sea ice has presented a significant hazard to offshore operations including ship traffic and offshore facilities. One of the most significant early applications of remote sensing in the Arctic region was the monitoring of sea ice. By monitoring sea ice conditions and tracking the position of icebergs, hazardous areas can be avoided or mitigation strategies can be put in place.

Sea ice monitoring brings together a range of observation techniques including in-situ observations. Remote sensing has historically been achieved through using Synthetic Aperture Radar (SAR) technology from fixed wing aircraft, although more recently this has largely transitioned to satellite-based SAR, as it offers a wider choice of suitable sensors and acquisition advantages. Active radar sensors are well suited to arctic conditions as they have the ability to acquire data independent of lighting and cloud cover. The Airbus Defence and Space satellite constellation comprises both optical and radar sensors and offers the technology to support a reduction in environmental impact throughout the oil and gas production lifecycle in a number of ways.

A SPOT 6 Mosaic image of the Stikine Icecap , Alaska/British Columbia border

Satellite images to monitor change

Firstly, an extensive imagery archive enables the determination of environmental baseline conditions before exploration and the identification of environmentally vulnerable locations, which can assist with the development of an effective spill response plan. The establishment of baseline conditions is also important for distinguishing between those impacts triggered by exploration and those caused by other sources.

Secondly, the potential to regularly acquire new imagery datasets allows the detection of changes, which have occurred due to the operation of a site. By utilising the frequent revisit times and prompt delivery of processed datasets from the satellite constellation, any surface impact such as an oil spill can be identified and responded to rapidly.

Mapping offshore oil seeps from space

Over the last 20 years Airbus Defence and Space has developed a continually updated worldwide database of offshore natural oil slicks (Global Seeps) based on the interpretation of satellite radar data. This database allows the presence of a working hydrocarbon system to be established, and helps target surveys such as seismic acquisition, potentially reducing the level of vessel activity. Areas covered in and around the Arctic region include the Barents, Kara, Bering and Chukchi Seas, offshore Greenland including Baffin Bay and Newfoundland and Labrador. When exploration is initiated in a frontier area it is important to understand the location and extent of natural oil seeps in order to be able to rapidly differentiate any spill related to exploration and production, by establishing baseline oil presence on the sea surface.

Safer, more effective ice charting

With the use of the TerraSAR-X satellite, Airbus Defence and Space has been involved with sea ice charting in Arctic waters to reduce the risk of infrastructure damage during

provide near-real time delivery of satellite imagery (down to 15 minutes of acquisition) in order to ensure up-to- date intelligence in an area with quickly changing sea ice conditions. Space-borne remote sensing allows ice charting and the ability to classify information on different ice types while documenting temporal or time-related change. Increasingly, semi-automatic approaches are being employed to allow a rapid detection of icebergs in order to assure the safe operation of offshore production installations. From space-borne sensors ice can be detected in various physical states but depending on the target and the application, a range of acquisition parameters need to be considered in order to achieve the required derived product. Information on sea ice topography is also important in order to determine navigation constraints for vessels operating in the Arctic Sea. Furthermore, ice ridging is a risk for infrastructure located in the arctic regions (e.g. oil platforms and pipelines). The determination of ice ridges using cloud and light independent radar data has been demonstrated and under certain circumstances stereo photogrammetric processing of optical data can be considered.

The challenges of onshore Arctic development

Any onshore development in the Arctic including facilities, pipelines and roads or other related infrastructure requires considered planning to minimise potential environmental impacts during construction and operation. Both optical and radar imagery, together with derived elevation models, can contribute to this planning process by developing an understanding of surface and terrain conditions. Following construction the partial thawing of permafrost can result in ice beneath the ground surface becoming unstable, resulting in cavities and surface subsidence. Any infrastructure mounted on this surface can be affected by this subsidence. It's possible to detect these effects at an early stage, enabling remediation planning, by the utilisation of radar and its capability to identify subsidence and tilting of infrastructure with a millimetric precision using interferometry, based on repeat coverage over the area of interest. The remote nature of the region means that satellite monitoring approaches can make a significant contribution.

Environmental intelligence

The potential for oil spills in the Arctic is of great concern, due to the sensitive nature of the environment and complications of spill clean-up for areas with sea ice. However in the event of a spill, oil can be readily detected using radar satellite imagery due to the dampening effect that oil has on sea surface wave amplitude. Radar based monitoring of offshore oil production facilities for occurrence of oil spills is common practice and this approach can be applied to the Arctic environment. Nevertheless, some difficulties can be expected for the determination of oil spills if there is ice present around the infrastructure to be monitored. Several studies are currently ongoing in order to assess these difficulties and to develop appropriate technologies to overcome them.

Remote support throughout the project's lifecycle

During the decommissioning phases of an onshore project, satellite data can assist in establishing areas requiring remediation and documenting remediation over time with regular image acquisition.

In order to minimise the environmental impact of oil and gas exploration inthe Arctic, the application of the latest technology is required throughout the workflow from exploration and development to production and decommissioning. Satellite imagery and associated derived products and services have a contribution to make in supporting planning,

Picturing Glaciers

With a SPOT 6 mosaic (composite image), Airbus Defence and Space supported the first of the IceLegacy expeditions, a journey to highlight the importance of glaciers to the world. The first outing took the explorers to the main glacier of Spitsbergen Island in early August 2014. Explorers Barge Ousland from Norway and Frenchman Vincent Colland crossed the 160km of the larger glacier on the Norwegian island of Spitsbergen on skis.

On the www.icelegacy.com website, web users monitored the progress of the explorers. Texts and photos about each stage of the expedition were accessible from the SPOT 6 mosaic placed on a geo-referenced background. Airbus Defence and Space supplied this mosaic, consisting of six SPOT 6 images acquired in the winter of 2013.

The climb of the highest glacier in the Arctic began in August 2014 in the north of Spitsbergen Island. On the way, the two adventurers scaled the 1,713m Mount Newton, the highest mountain in the Svalbard archipelago. They left the glacier after covering 180km on skis in just eight days.

The goal of the IceLegacy project conceived by the two explorers is to promote efforts to combat glacier retreat. Their aim is to cross the world's 20 largest glaciers on skis. This epic 10-year journey will take them from Russia to Alaska and from Patagonia to Pakistan.

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