

Canadian Rocky Mountain Parks

Sentinel-1 CSAR IW acquired on **16 February 2017** from 01:37:14 to 01:38:04 UTC
Sentinel-3 OLCI FR acquired on **27 May 2017** from 18:34:48 to 18:37:48 UTC
Sentinel-3 SLSTR RBT acquired on **25 July 2017** from 18:04:53 to 18:07:53 UTC
Sentinel-2 MSI acquired on **19 June 2018** at 18:49:19 UTC
Sentinel-3 SRAL LAND acquired on **27 March 2019** at 05:02:06 UTC

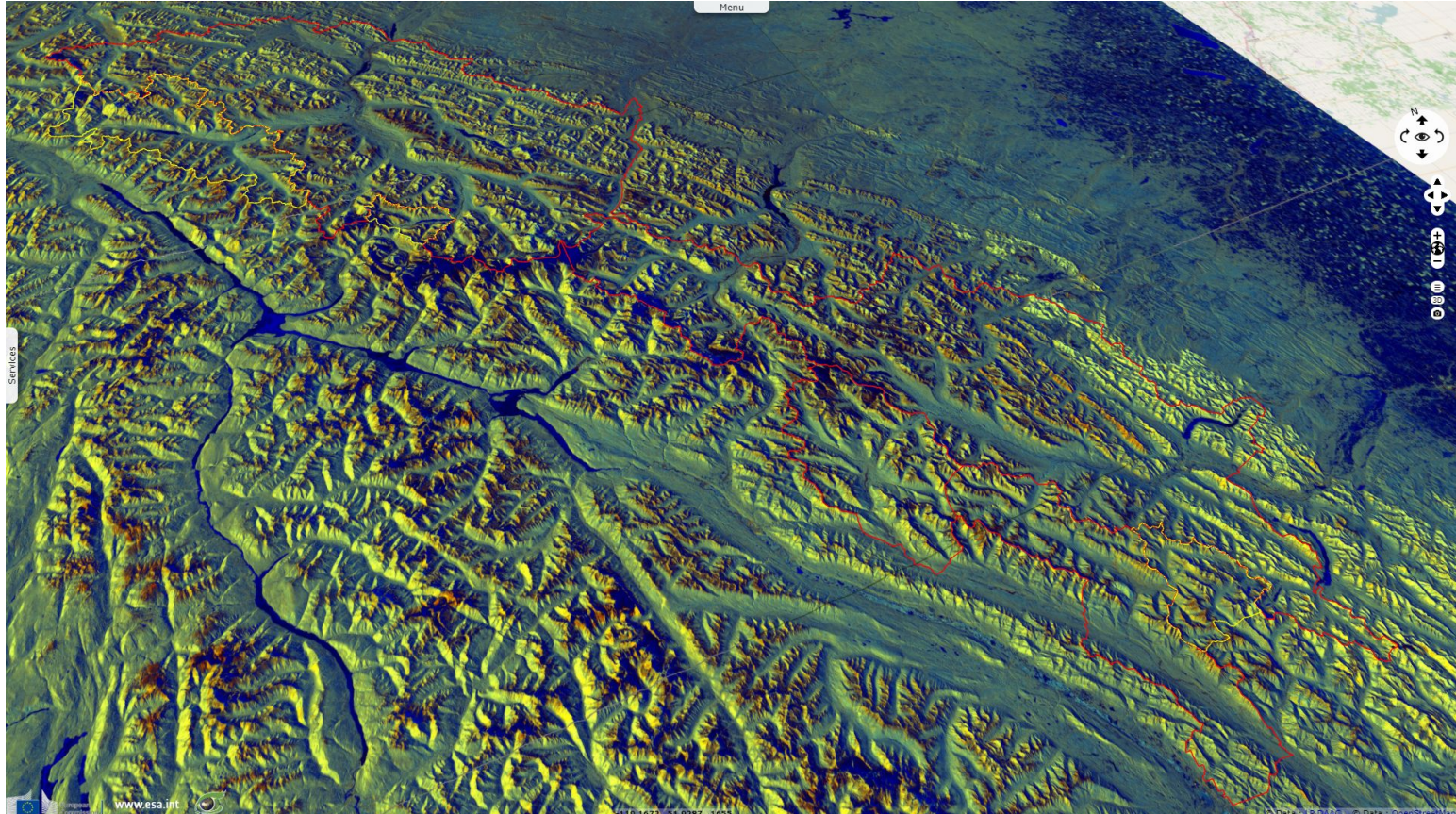
Author(s): Sentinel Vision team, VisioTerra, France - svp@visioterra.fr

Keyword(s): Land, range, cryosphere, glacier, icefield, snow, national parks, UNESCO World Heritage, Canada, Pacific ring of fire

[3D Layerstack](#)

Fig. 1 - S1 (10 & 15.09.2018) - vv,vh,ndi(vh,vv) colour composite - Canadian Rocky Mountain Parks in mid-September.

[3D view](#)



The origin of the Rocky Mountains is [explained](#) by the Canadian Encyclopedia as such: "During the Precambrian age, 1 billion years ago, the mountains that make up Canadian Rocky Mountain Parks did not exist. The entire Rocky Mountain System, stretching from the Gulf of Mexico to the Arctic Ocean, was flat."

The Canadian Geographic [adds](#): "Between 120 million and 190 million years ago, the convergence of tectonic plates forced land masses of igneous origin from the west to attach to the much older rocks of North America - some 300 million to 1.8 billion years old - as the continent merged with offshore volcanic islands."

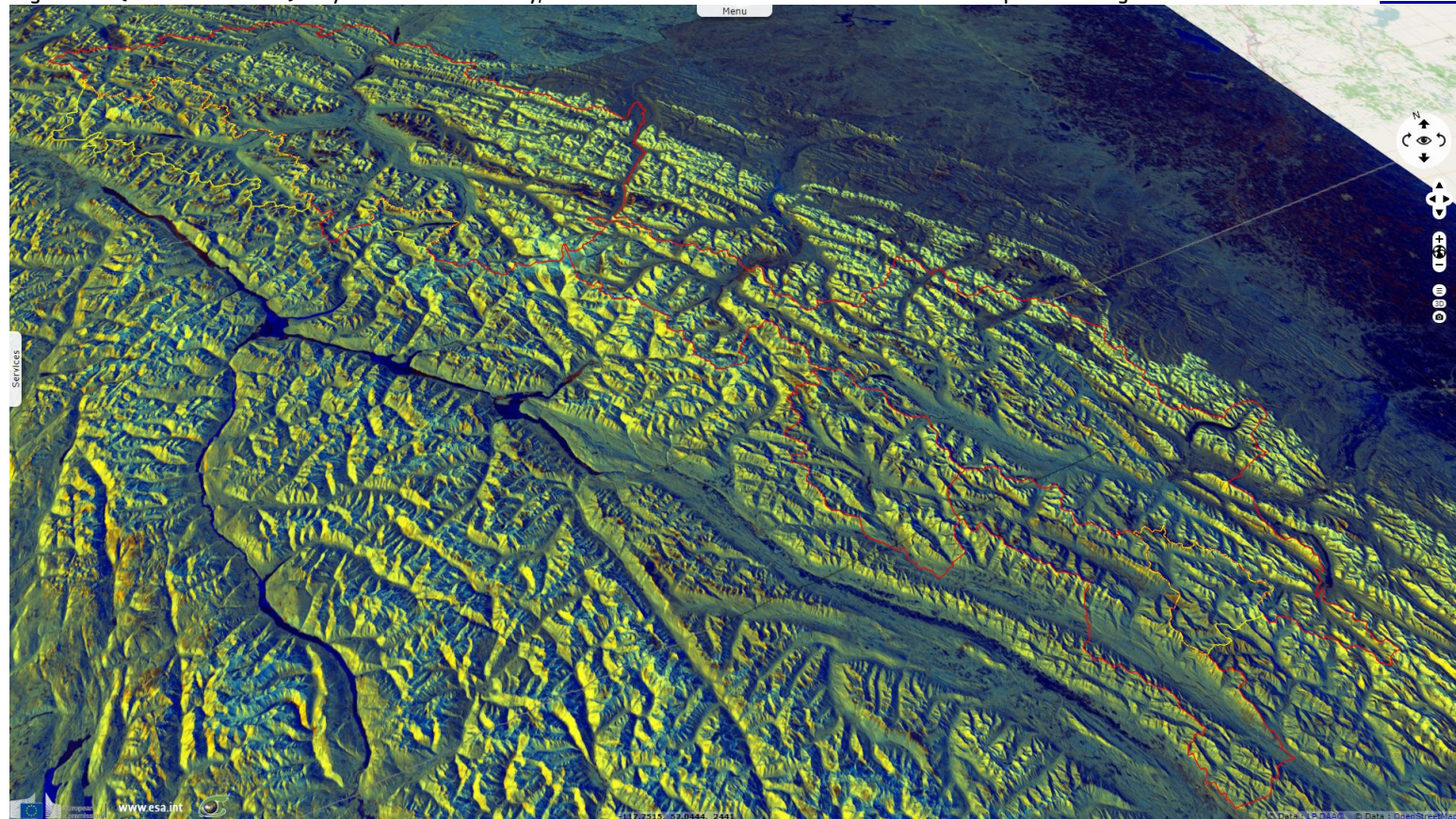


River in Yoho National Park near natural bridge site - Source: [The Canadian Encyclopedia](#).

Right: Canadian Rocky Mountain Parks - Source: [Ko Hon Chiu Vincent](#)

Fig. 2 - S1 [16 & 23.02.2017] - By the end of February, snow & ice covers the treeless summits and replenish the glaciers.

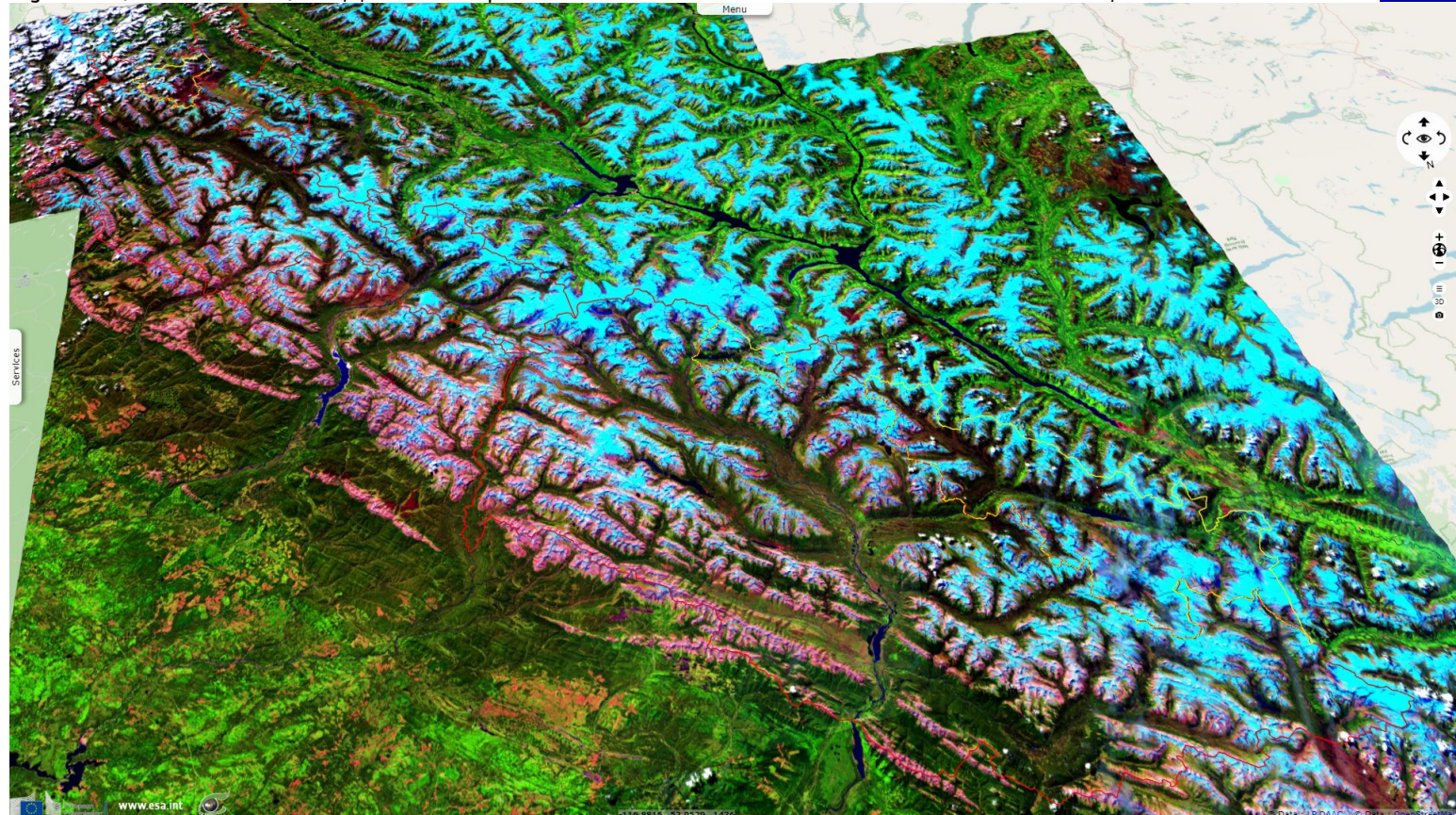
[3D view](#)



The Canadian Encyclopedia [completes](#): "Gradually, this area began to sink below sea level and fill with sea water. Over millions of years sediments such as mud, silt and sand were deposited into this inland sea from nearby rivers. As more and more sediment was added, the bottom of the sea continued to sink, creating layers of sediment thousands of metres deep." "About 75 million years ago, forces within the Earth pushed the sediment above sea level, compressing the rocks so that they folded, buckled and broke, forming the Rocky Mountain System. Erosion, from forces such as rain, running water and glaciers, continued to shape the mountains into their current formations."

Fig. 3 - S2 [17 & 19.06.2018] - 11,8,2 colour composite - Land cover varies with altitude: forests until the treeline, bare rock and then ice.

[3D view](#)



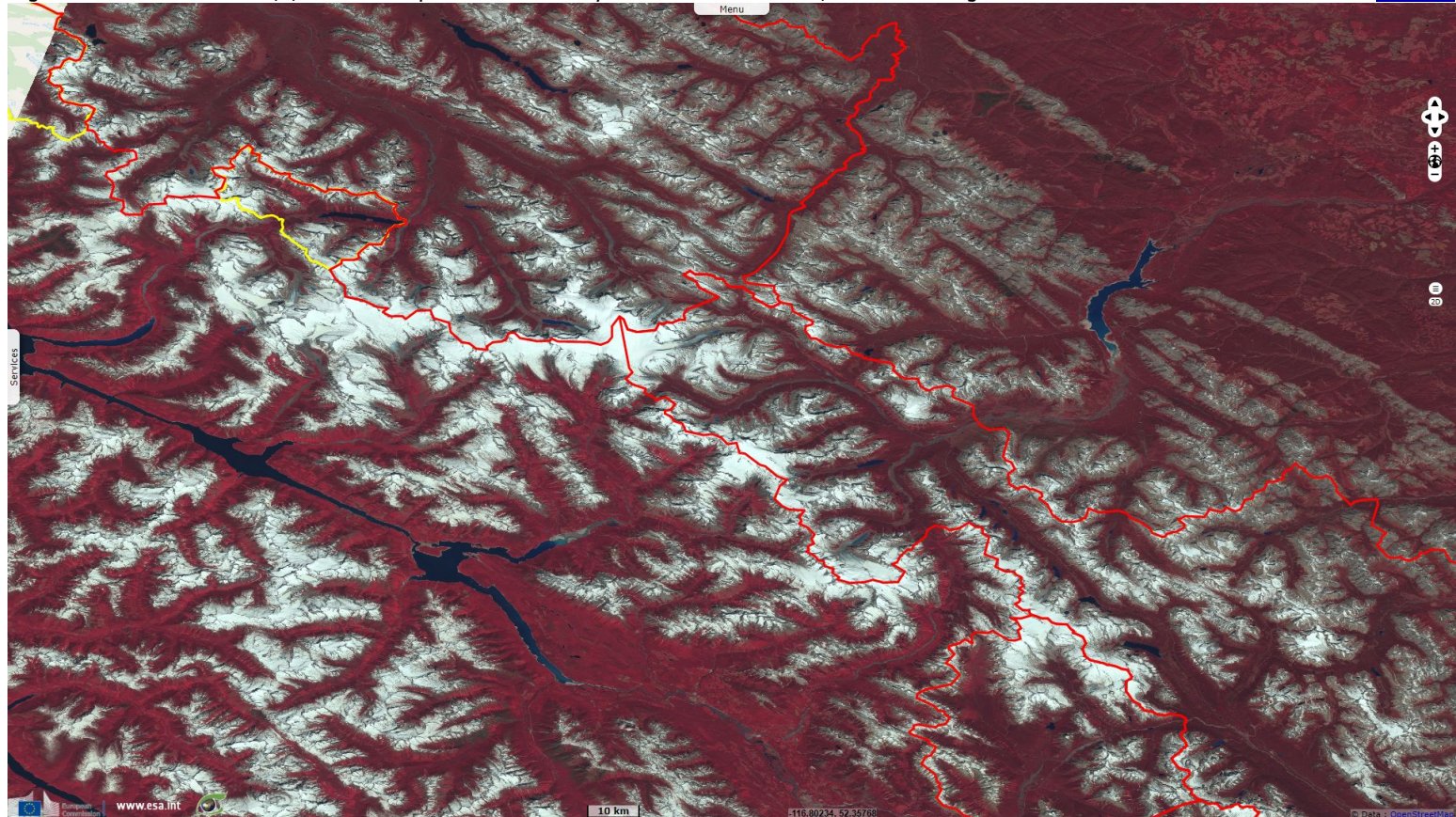
The Canadian Rocky Mountain Parks were added to UNESCO World heritage sites on 1984, they are [described](#) as follows: "Renowned for their scenic splendor, the Canadian Rocky Mountain Parks are comprised of Banff, Jasper, Kootenay and Yoho national parks and Mount Robson, Mount Assiniboine and Hamber provincial parks. Together, they exemplify the outstanding physical features of the Rocky Mountain Biogeographical Province. Classic illustrations of glacial geological processes – including icefields, remnant valley glaciers, canyons and exceptional examples of erosion and deposition – are found throughout the area."



Pyramid Lake in Jasper National Park - Source: Ian Chris Graham | [Dreamstime.com](#)
Canadian Rocky Mountain Parks - [Kelly J. Martens](#)

Fig. 4 - S2 (19.06.2018) - 8,4,3 colour composite - With many summits over 3000 m, ice fields and glaciers are still numerous in June.

2D view



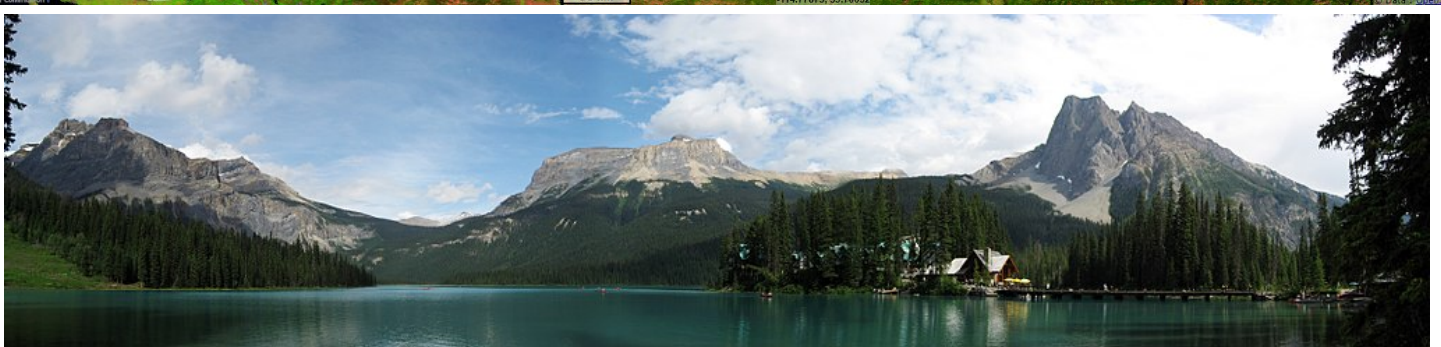
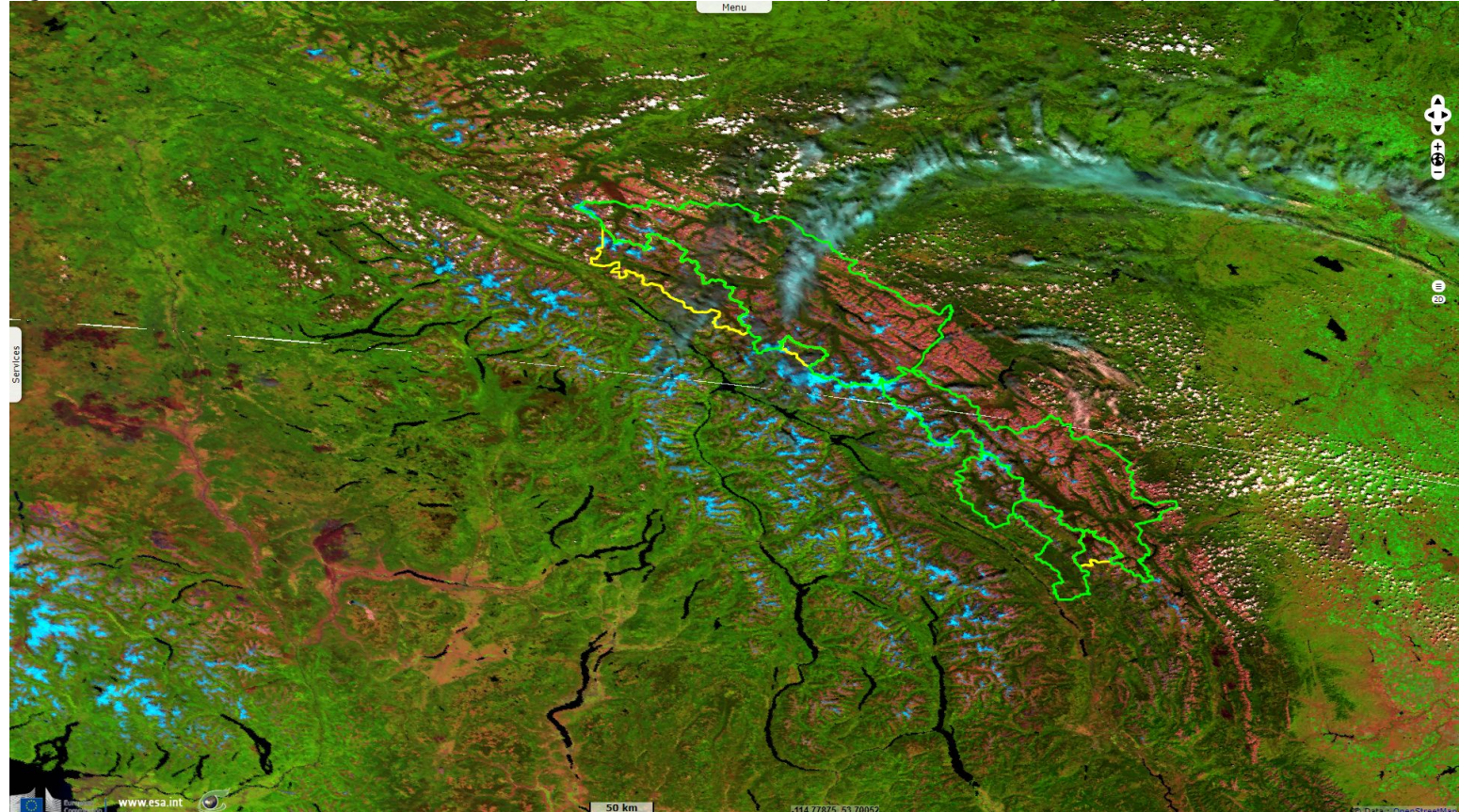
Left: Moraine Lake in Banff National Park, 2012. Source: Rick Schwartz/justenoughfocus.com
Right: Canadian Rocky Mountain Parks - Source: [Ko Hon Chiu Vincent](#)

"The seven parks of the Canadian Rockies form a striking mountain landscape. With rugged mountain peaks, icefields and glaciers, alpine meadows, lakes, waterfalls, extensive karst cave systems and deeply incised canyons, the Canadian Rocky Mountain Parks possess exceptional natural beauty, attracting millions of visitors annually." "The seven parks of the Canadian Rockies are a classic representation of significant and on-going glacial processes along the continental divide on highly faulted, folded and uplifted sedimentary rocks."

Fig. 5 - S2 (19.06.2018) - 4,3,2 colour composite - Beneath glaciers, Lake Moraine & Lake Louise owe their cyan colour to silted glacial flour. [3D view](#)



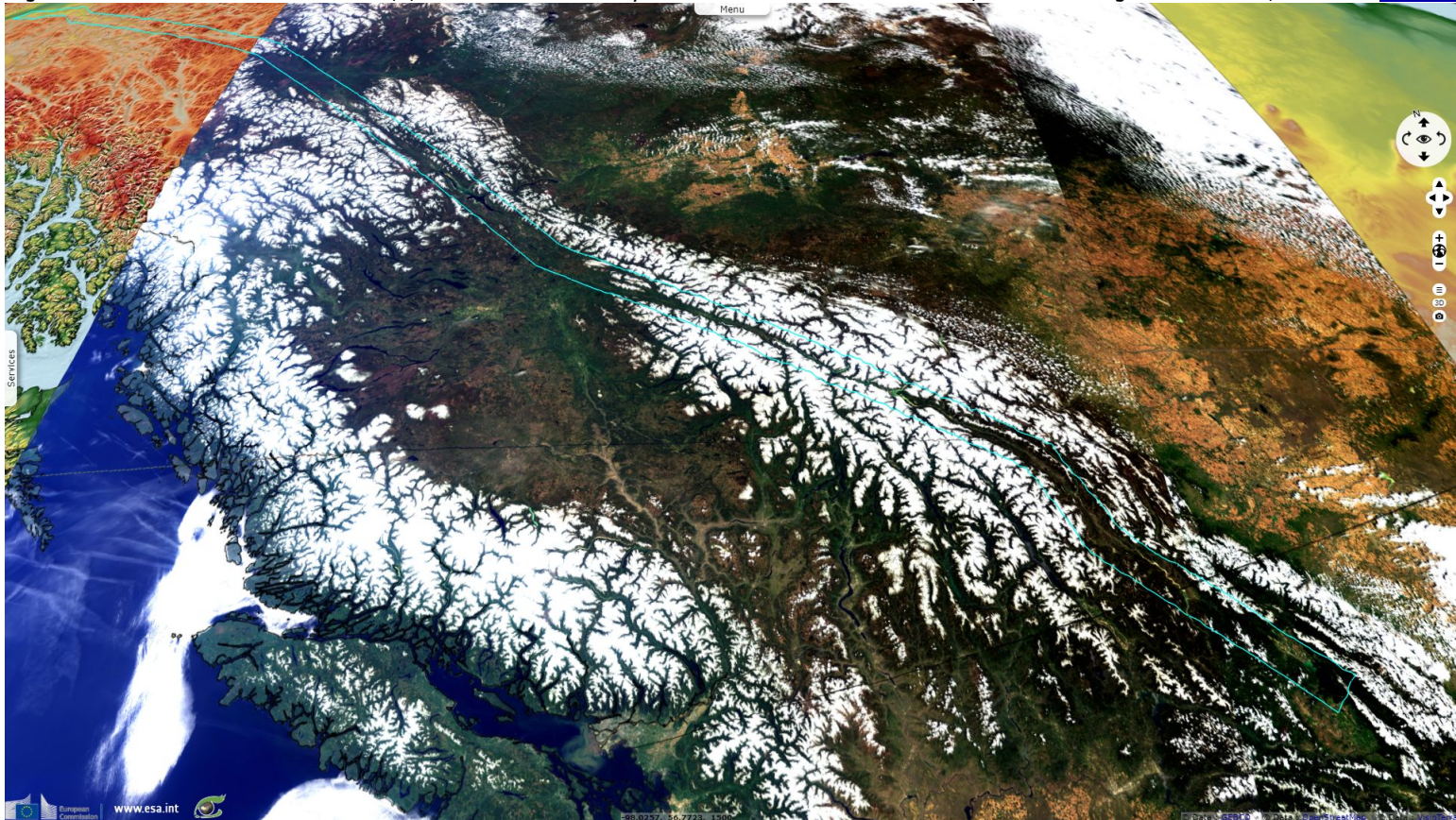
Fig. 6 - S3 SLSTR (25.07.2017) - S5,S3,S2 colour composite - Wildfires occur naturally in the summer and rejuvenate part of the vegetation. [2D view](#)



Emerald Lake panorama with Michael Peak, Wapta Mountain, and Mount Burgess - [Source](#)

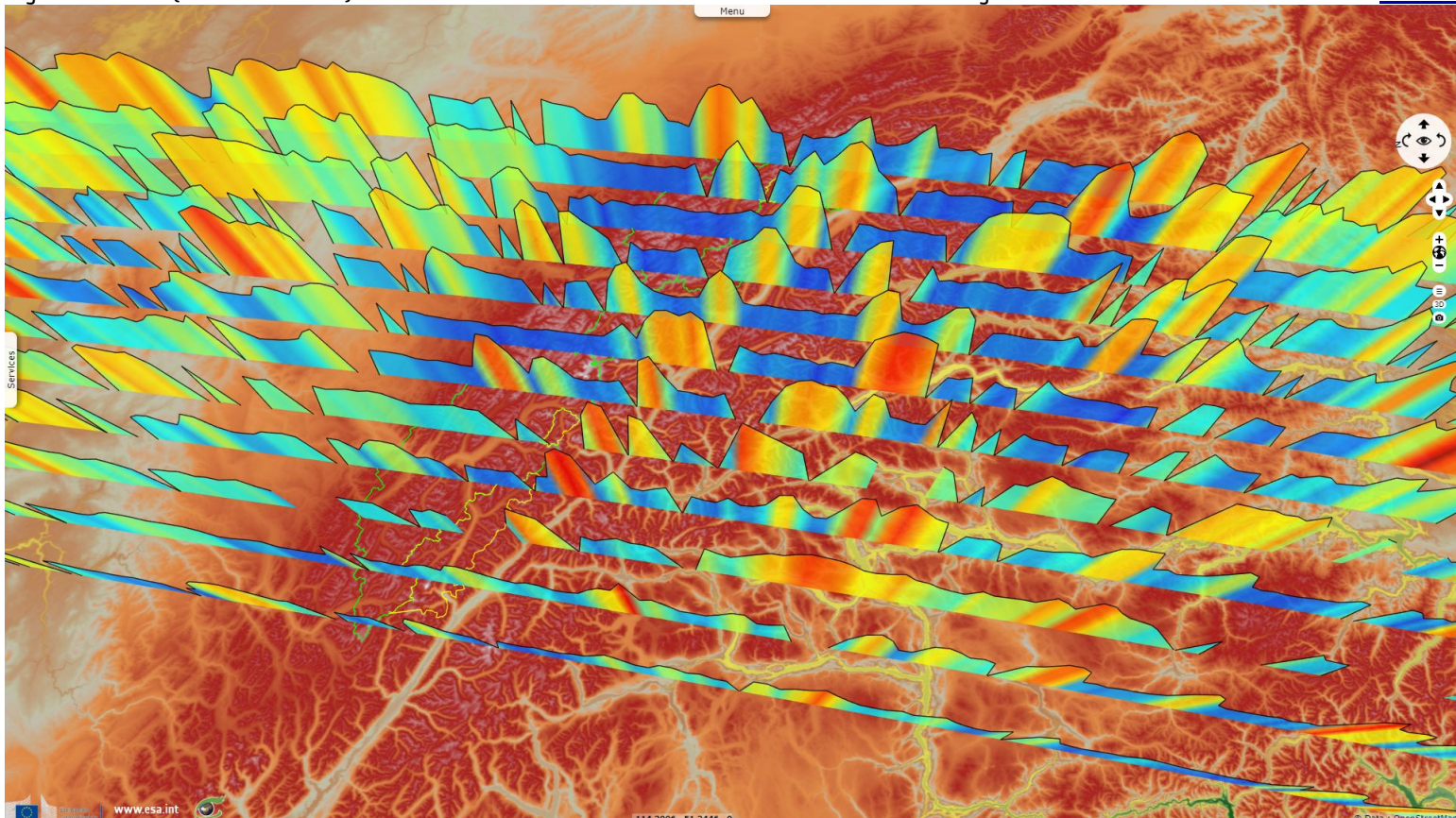
A singular feature is these parks, the Burgess Shale, deserved a World heritage site on its own: *"The Burgess Shale is one of the most significant fossil areas in the world. Exquisitely preserved fossils record a diverse, abundant marine community dominated by soft-bodied organisms. Originating soon after the rapid unfolding of animal life about 540 million years ago, the Burgess Shale fossils provide key evidence of the history and early evolution of most animal groups known today, and yield a more complete view of life in the sea than any other site for that time period."*

Fig. 7 - S3 OLCI (27 & 28.05.2017) - 10,6,3 natural colour - Rocky Mountain Trench & Tintina Trench, a fault running from Montana, to Alaska [3D view](#)



Along the 1600 km of the Rocky Mountain Trench are nested many rivers in the trench: From south to north: Kootenay, Colombia, Canoe, Fraser, Parsnip, Finlay, Ketchika and Liard rivers.

Fig. 8 - S3 SRAL (01 to 25.03.2019) - Corrected ocean backscatter coefficient C-band 1Hz - Descending orbits [3D view](#)

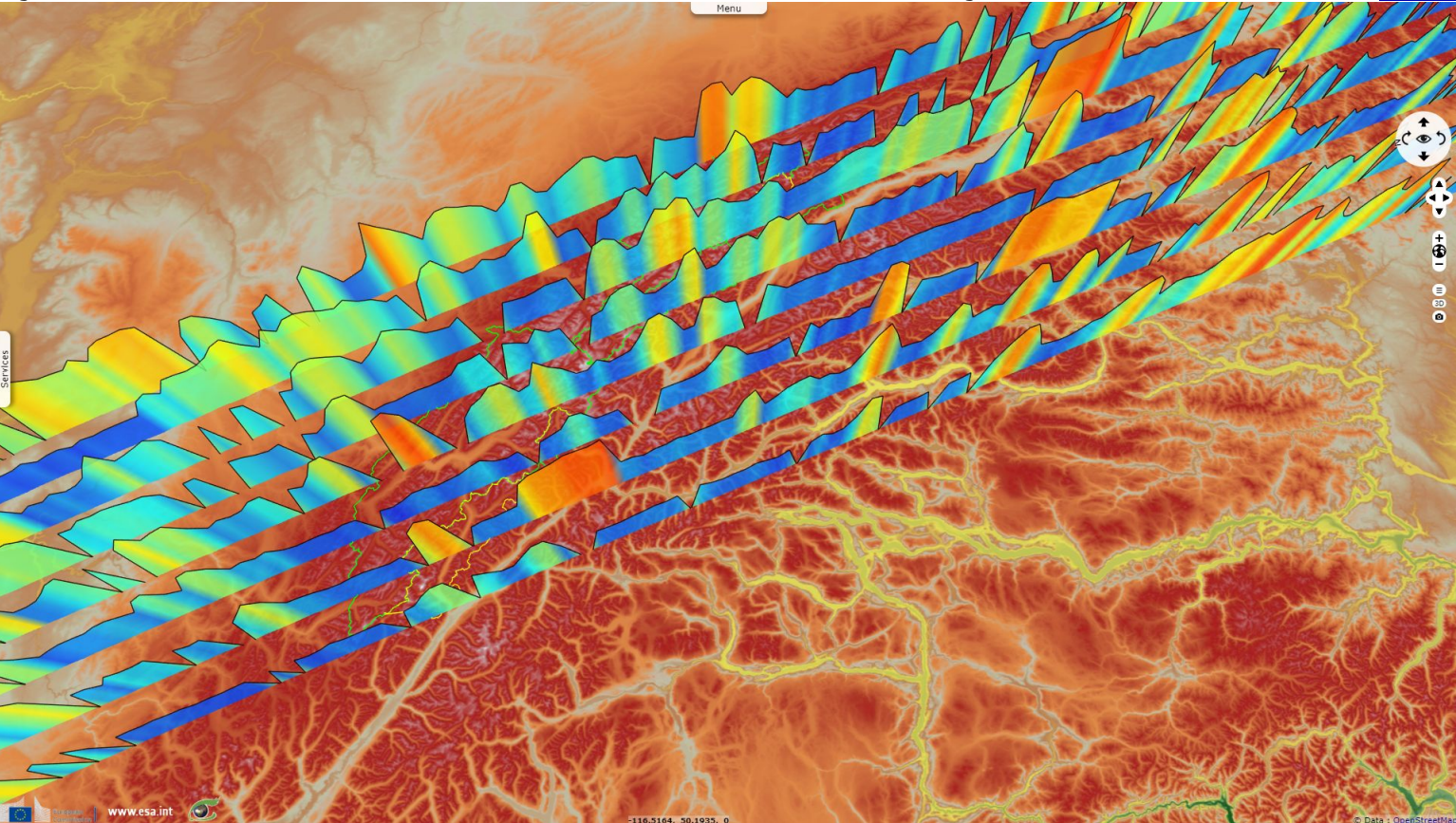


The Canadian Encyclopedia [provides](#) additional details: *"Burgess Shale is an area of layered rock featuring fossils from the Cambrian period (540 – 485 million years ago). In Canada, sites featuring Burgess Shale fossils are found in Yoho and Kootenay national parks. The fossils in Burgess Shale capture the end of the Cambrian Explosion, when, over millions of years, most major animal groups appeared in the fossil record. While there are sites around the world that feature fossils from the Cambrian period, these sites mainly include hard-bodied organisms such as shellfish. By*

comparison, Burgess Shale is primarily made-up of rarely preserved soft-bodied organisms, providing scientists with the world's clearest record of Cambrian marine life."

Fig. 9 - S3 SRAL (04 to 27.03.2019) - Corrected ocean backscatter coefficient C-band 1Hz - Ascending orbits.

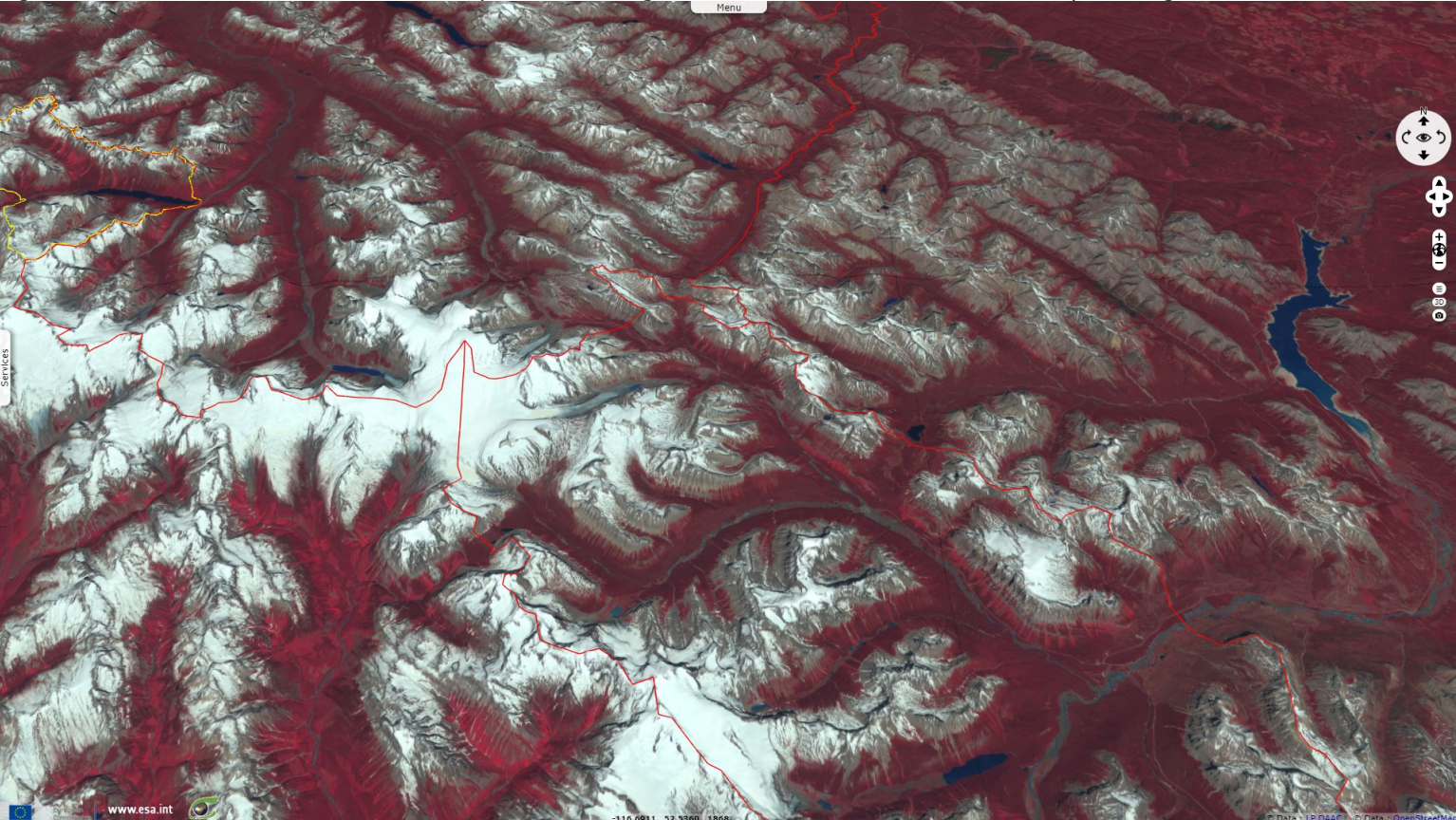
[3D view](#)



"These organisms lived in the sea that once covered the location of the Rocky Mountains. Sediment flowing into the sea buried both dead and living animals. As more and more sediment accumulated, the organisms were compressed and fossilized. As this process was repeated the layers of fossils now found in the Burgess Shale were created."

Fig. 10 - S2 (17 & 19.06.2018) - 8,4,3 colour composite - Bordering 3 watersheds, Snowdome is surrounded by several glaciers.

[3D view](#)

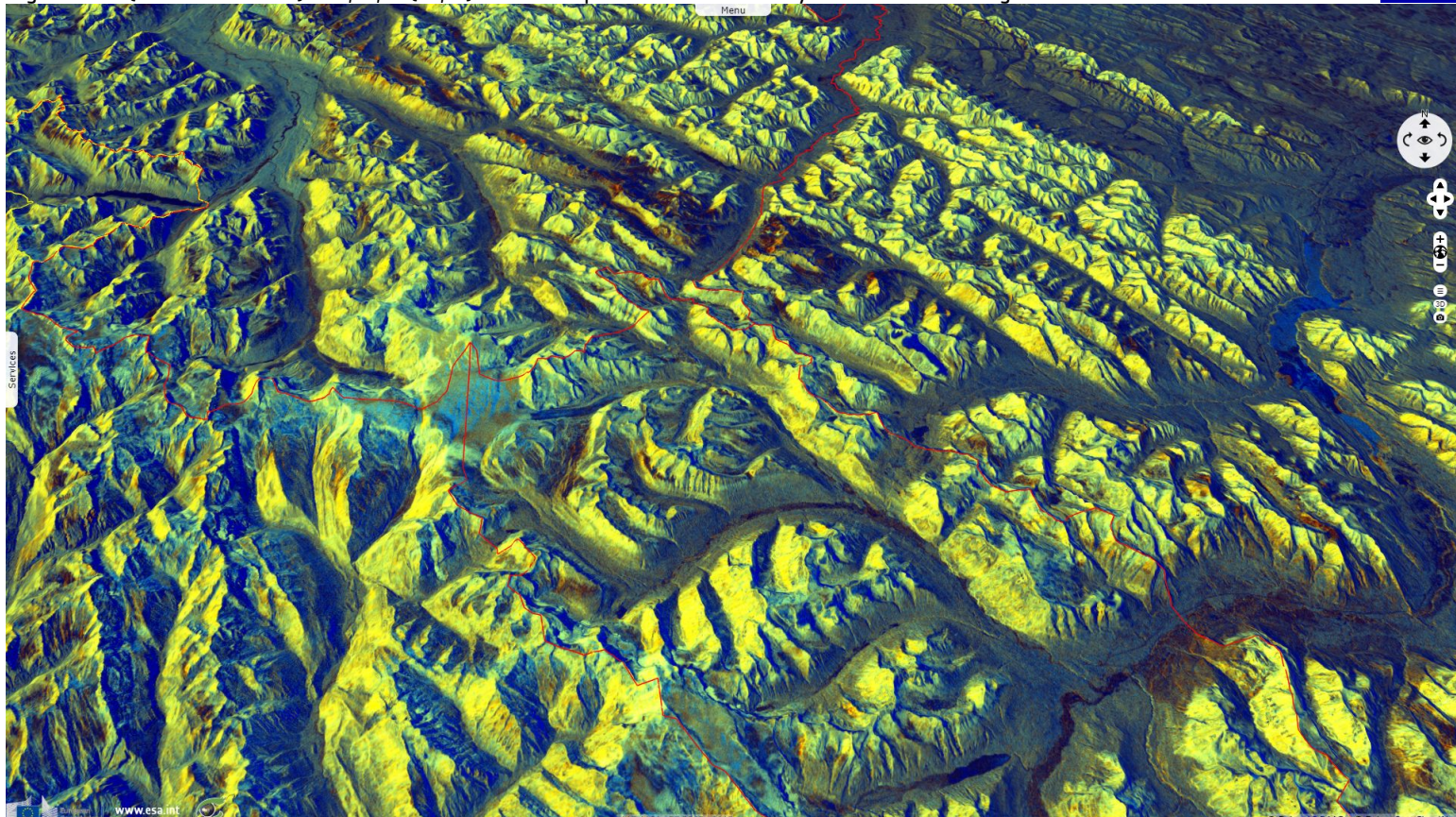


Canadian Rocky Mountain Parks are a place of unique contrasts, from icy mountain rivers to steamy hot springs. According to the Canadian Encyclopedia, vegetation is spectacularly varied, from cactus to wet-belt western red cedar and from alpine tundra to forests of Douglas fir. Large mammals found in the park include mountain goat, bighorn sheep, elk, moose, white-tailed and mule deer, wapiti, woodland caribou and the American Bison (which is being reintroduced in Banff) as well as numerous smaller mammals such as the badger, golden-mantled ground squirrel, hoary marmot, pika. Carnivorous animals include American black bear and grizzly, wolverine, coyote, timber wolf, cougar, lynx.



The relationship between fire, bison, and people shaped this area for thousands of years. Grazers, like bison, are attracted to the fresh grass that emerges after a fire. As they focus on the nutrient-rich new growth, older vegetation gets a break from grazing before it gets burned and grazed again. Over time, this creates a mosaic landscape that supports a diversity of plants and wildlife - Source: [Banff National Park Bison blog](#).

Fig. 11 - S1 (16 & 23.02.2017) - vv,vh,ndi(vh,vv) colour composite - The 3 rivers systems below these glaciers feed 3 different oceans. [3D view](#)



Birdlife is varied, over 300 species of birds, including the golden eagle, rufous hummingbird, white-tailed ptarmigan, bald eagles, red-tailed hawk osprey and the gray jay.

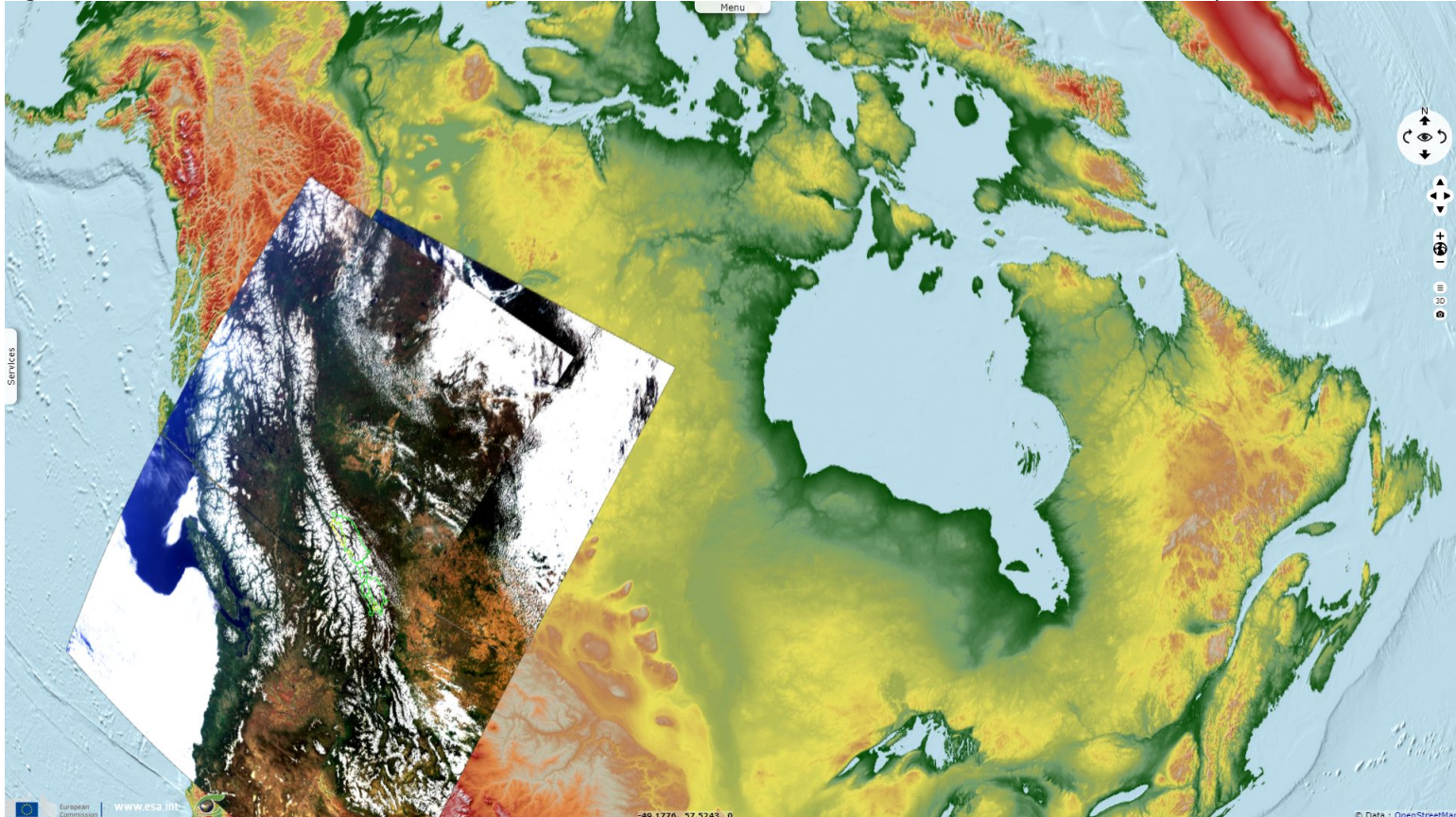
The harsh winters are unsuitable for reptiles and amphibians, but the park is home to one species of toad, three species of frog, one species of salamander and two species of snakes. The Banff Springs Snail is currently listed as an endangered species, while the woodland caribou is a threatened species.

High altitude streams often contain too much silt to be habitable for fish; however streams and rivers in the lower valley include trout as well as mountain whitefish and some northern pikeminnow. Some lakes are home to a variety of trout, including bull, lake, speckled, and cutthroat. There are 16 species and subspecies of fish native to the park, including the longnose sucker, burbot and spoonhead sculpin.



Mount Athabasca in Jasper National Park in summer (2013) - Source: [Ryan Schroeder](#).

Fig. 12 - S3 OLCI (27 & 28.05.2017) - 10,6,3 natural colour - Snow dome divides the Pacific, Arctic & Atlantic (via Hudson Bay) watersheds. [3D view](#)



The Canadian website [bivouac.com](#) highlights the significance of the Snowdome as a point dividing 3 oceanic watersheds: "Located on the Columbia Icefield, at the head of the Athabasca, Saskatchewan and Columbia Glaciers. Snowdome is the "triple point" where the continental divide between the Atlantic and Pacific oceans splits into two divides: the Arctic-Pacific Divide (between the Arctic Ocean and Pacific Ocean), and the Arctic-Hudson's Bay Divide, between Hudson's Bay and the Arctic Ocean. The three main glaciers that drain from the peak go to the Athabasca River (Arctic Ocean), the Saskatchewan River (Hudson's Bay) and the Columbia River (Pacific Ocean)."

South of the Arctic Circle, Hudson Bay shares most of its water with the Atlantic Ocean. It implies it is one of the only summits on Earth where 3 raindrops falling on 3 different faces will end up in 3 different oceans.

More on European Commission space:						
More on ESA:				S-1 website	S-2 website	S-3 website
More on Copernicus program:				Scihub portal	Cophub portal	Inthub portal Colhub portal
More on VisioTerra:				Sentinel Vision Portal	Envisat+ERS portal	Swarm+GOCE portal CryoSat portal