Topic 2e - Inland water

Inland waters, whether they are lakes or reservoirs, are a very special feature in the landscape. They are beautiful and attract people for tourism, recreation, fishing, and at the same time they are maybe our most precious natural resource, providing clean water-- if you're lucky-- or at least the source of irrigation for crops. They come in many, many different shapes and sizes and globally we can count, maybe, over 100 million lakes.

Some of these lakes will be dark, such as lakes in the north, which are fed by water from forests. Some of them will be green, full of algae, some very, very small, some large, such as the Great Lakes in the US and Canada. Deep lakes, very shallow lakes, lakes exposed to their surrounding landscape washing sediments, soil, and dissolved matter into these waters. Others pristine, deep, and full of fish.

All of these lakes are part of our most precious natural resource, clean water. And it is not to be taken for granted that everybody has access to clean water. So this motivates us to monitor the quality of these water bodies very carefully. And this is possible now. Since the start of this century we've had space borne observations capable of deserving quite a wide variety of inland water bodies.

And with the launch of recent Sentinel-2 and 3 this legacy will continue for quite some time. Bringing us both the detailed information at the very finest resolution, so that we can observe small water bodies, such as this, with Sentinel-2. Sentinel-3, continuing the legacy of the MERIS sensor on Envisat that allows us to even discern diagnostic features of lakes, such as which particular group of algae or cyanobacteria are present in a lake. And all of these give us cues to the environmental state, or the health of these water bodies.

Now for this particular reservoir we are very happy that the water is as clear as it is. But what that means is that from space we will see a very dark water surface. There is very little in the water to reflect light back towards the sensor. What that means is that we're looking at a small dark target surrounded by land, which is reflecting a lot of light. And this is one of the particular challenges that we face when looking at inland water compared to coastal, or ocean waters. If we add to do this a bucket of sand, some algae, some humic acids-- that absorb a lot of blue light-- we can change the face of this water body completely. And then the challenge becomes, how do we tell what is what?

So to face that challenge what we need for inland waters is not only to be able to observe them with a fine spatial resolution, but also to be able to look at the spectrum of reflected light in such a way that we can pull apart all these different optically active components. We may have wave bands on a satellite band that targets specifically the absorption by a pigment, or several pigments, so we can say what's in the water. We may need other wave bands in that same sensor to tell us how much light is being absorbed by dissolved matter. So we need to have a very, very sophisticated sensor. And we're just now getting there to the point that we can do this for a large, large number of inland water bodies.

Since the 70s it's been known that a lot of our water bodies have been suffering from nutrient enrichment. Becoming more productive, turning from relatively clear waters into productive systems, dominated by phytoplankton rather than submerged plants-- which grow from the bottom. This is a regime that is not easy to reverse.

So the problem, eutrophication, the addition of nutrients into a water body, is one of the main drivers why we are monitoring lakes and reservoirs very closely. And in inland waters we can really find

some extreme situations where phytoplankton have completely taken over, up to the point that you could grab the substance from the water as if it were a green soup.

To observe inland water bodies from space, ideally we'd have it all. We'd have a space borne sensor with a very fine spatial footprint to observe small water bodies, we wanted to have many wavebands so that we can diagnostically see what is growing in the water, and we want it to be highly sensitive--because water bodies are generally dark compared to the land that surrounds them. They only reflect 1% of the sunlight that reaches them.

And from this signal we'd still want to make out whether increased absorption by a pigment means steady growth of algae or a fast developing algal bloom with a potential health risk.