Topic 5a - Part 3: Future innovations - Future satellite missions in depth

So tell me about the satellites of the future. So there's this continual chain, it seems, of these amazing satellites coming out. What are the next few things in the chain?

So for EUMETSAT, the first two major ones to mention is Meteostat Third Generation, which will be a dual-satellite system. It will have an infrared sounder. It will have a better imager. But it will also have a UVN instrument and also a lightning mapper. So that is really quite exciting. The lightning mapper, combining that with these kind of animations of clouds we see here, will just be a killer.

And when will that go up?

It'll go up in 2021. And the other one following that is our next-generation polar orbiting system satellite, the EPS-- Second Generation. And that will continue the current suite of instruments that we have onboard. But it will also come with some new, exciting instruments. We will have an ice cloud imager, which we will really focus on the ice clouds. It will have a 3MI imager, which is really important, for instance, for aerosol observations, so really quite exciting.

Then in addition, we are working together with the European Commission and ESA on Sentinel 7, which is a carbon observatory. Then we will have Sentinel 5, which is part of the flying on the EUMETSAT EPS-- Second Generation Satellite and the UVN instrument I mentioned for MTG, Sentinel 4. So these are all very exciting. We also will have the new generations for observing altimetry with adjacent continuity service satellite.

So Sentinel 5 and 7, for example, what will they be able to do?

So sentinel 7 is really dedicated towards monitoring carbon. And it will give us an observation of carbon at roughly one parts per million or two parts per million accuracy. And that is basically half a percent of the 400 ppm level we have today. And with that, we can also we can see what are the relative contributions from different regions.

And we would like to break that down into looking at country level emissions, but also to hotspot emissions. And most importantly, what we are trying to do with this system is to understand how efficient those systems are to reduce the emissions. Just saying we will reduce emissions and nobody monitors what is happening, that doesn't help. So we have to monitor the effectiveness of the measures we take, just like we did with the Montreal Protocol for ozone.

So we're getting better and better at watching ourselves. This is all these different details, aren't there? And there's more and more satellites coming out. How do you see this changing our view of our civilization? 50 years ago, every globe was built by deduction. People

measured and they said it must look like this. And then you put up an earth observation satellite and you can see. How are these new satellites going to change our perspective on our society?

Well, I think it's we will get a very consistent view of the globe. Not only Europe is improving its instrumentation, but so is the US, so is China, Japan, India. Everybody's putting more and better instruments up in space. I think one of the most exciting things which is now happening, is we'll get an integrated view of the world. It's not any more atmosphere and ocean. It is a coupled system. It's earth observation, everything in one.

Your SAF is going to be very busy over the next few years. Tell me a little bit about the new satellites that are coming along and how they will change the data that's available.

The first one is there's a resolution issue, because now we have a satellite in order of tens of kilometers. Like GOME-2, we have a 40 by 80 kilometers ground pixel size. But the TROPOMI, it's already three and a half times seven kilometers. So the resolution is absolutely wonderful. And also, the signal-to-noise ratio is much better. Of course, we have difficulties with a huge amount of data. So how to handle that data? What are the requirements for processing and archiving? So there's two points. There's positive side of weather data. And then there's difficulties with the data amount.

So everyone wants more data, but then you have to put it somewhere.

Yeah. Yeah, that's true. And then with EPS-- Second Generation, with Sentinel 5 and Sentinel 4, for example. The situation needs to say and we will have better data, better spatial resolution, but the amount of data is increasing all the time.

There's going to be more data in the future. There's going to be more need in the future. How are things going to change?

I think the big game changer will come with some satellite instruments, in particular observing the earth from the geostationary orbit. So this will give very high spatial and temporal resolution. And it's key for air quality. For instance, what we don't do today is to provide real-time emissions because the emissions we have are precomputed.

But with the future sensors, like Sentinel 4, we'll be able to have, within 15 minutes or half an hour, information about emissions. Which means that if there's something exceptional, even a traffic jam, an accident, we'll see immediately that reflected into the emissions. And the emissions will be information that is extremely useful for decision making. So in a way, the service we provide today, which are the concentration in the air, are very useful.

But in terms of decision making, probably the emissions is something which is most useful. I'm speaking of air quality, but also this applies to greenhouse gases. And if we think in the

context of the big international treaties and COP 21, our incapability to assess fresh emission of CO2-- maybe not on a daily basis, more monthly or yearly basis-- that will be a very big support to knowing whether the efforts to reduce emissions are verified in the atmosphere.

To that point about the geostationary satellites, because of the way your models run here, we have information for the whole globe. But that comes from satellites in low-polar orbit kind of measuring in stripes. And what you're talking about is having a satellite that basically looks at one point all the time. And so you can see these tiny changes. And that's a different way of looking at the planet.

Yes, exactly. And we are fortunate that actually our North American and Asian colleagues are also thinking the same. And there are projects for launching geostationary satellites over the three parts of the globe. So in the end, we are thinking 5 to 10 years ahead. We'll have an observing capability which will be combining the low-earth orbit that gives the global picture with zooms over the areas where the main emissions are. So that would be a really complete game changer for cancer, for other initiatives worldwide.

Well, the potential and the need is to have an observing system which is fit for purpose, which means that we measure at an adequate spatial sampling and temporal resolution. So we need geostationary satellites where clouds change, where things are changing fast. We need to measure, say, once every 20 minutes. And we think geostationary is very good for this. And this is coming at the Sentinel 4 program, which was originally based on the idea of Geo-SCIA, Geostationary SCIAMACHY.

Then, we also have the Sentinel 5 coming, which is improving the spatial resolution. And we have a Sentinel 5 precursor experiment, which is showing the power of going to higher spatial resolution. But this is still a resolution which for us is too large. We want to get to the 500 meter, 1 kilometer scale, which means we can then really identify different parts of a city which are polluting, and much better, in terms of the troposphere, much better estimates of the emissions, the sources and sinks of these key pollutant gases and the greenhouse gases.

So the future is higher spatial resolution, more sampling. And possibly, in this context, we are now in the research area looking towards smaller satellites and having maybe swarms of these things in the future. But in the first case, we're pleased that Europe is going to move forward to have a LEO and a GEO system.

But it's possible in, shall we say, the 2040 period that this system is replaced by swarms of smaller satellites. This is a great future for two reasons. It's very exciting science. It's very exciting engineering. But it's also addressing a societally relevant problem which needs to be solved this century.