Ocean Extras: The people managing ocean monitoring satellites at EUMETSAT

We're in a very exciting room here. It says up there, on the wall, Copernicus Sentinel-3 Mission Control Centre. Tell me what your role is in all of this.

Well, I'm the System Operations Manager at EUMETSAT. So I'm responsible for making sure end-to-end operations work in this control room and in the other control rooms as well. From this control room, we're controlling the Sentinel-3 suite of satellites. So we've got Sentinel-3a is now operational. The flight operations are already running from here. We launched in February. And we're flying the satellite from here and we're doing the data processing from here. If everything is going right, we're just monitoring.

Most of the things are done in an automatic way, because we have very little contact with the satellite. So we schedule everything in advance. We plan the commanding in advance. We send it up to the satellite when we have the contact periods. And then we monitor that the satellite is working as expected, the data comes down as expected, and then the major part of the control room is to actually make sure we're generating the products and distributing them as expected.

So the satellite is orbiting continuously. Let's talk about Sentinel-3a. But you clearly-- oh, we can see where it is! Is that what we can see there?

Yep, exactly.

You can see it coming down--

That's 3A a little bit towards the bottom, yeah.

So you know it's down there, but you can't talk to it directly all the time.

Nope.

Tell me about when you can contact the satellite.

Right. We have an orbit which is about 105 minutes. And every 105 minutes, we have a contact period with the satellite. The contact period is about 15 minutes.

Sentinel is different to some of our other programmes, in that we actually only have commanding capability twice a day. So we load up all the commands for the next 24 hours in those two passes. They're usually daytime passes, but we have two contact periods for that.

For the mission data, for the instrument data that we get down to actually generate all the products, we have a pass every pass. So, for every orbit, after 105 minutes, we then get a contact of about 15 minutes, where it downloads all the data. Which then gets passed here and we then do the product processing.

We have two ground stations that we use. They're up near the North Pole, so that we have very good contact, because, obviously, it's flying over the Earth, so you need to make sure that you have the contact periods. We use Svalbard, which is very close to the North Pole, for the data reception. And we use Kiruna, which is an ESA station for the S-band data, which is the satellite housekeeping. That's the data that gives us the knowledge that the satellite is safe and healthy. Basically, if you look right up the top, you see the little stations at the top of the picture.

Oh, yes, right.

That's Kiruna and Svalbard. So those are the two stations we use. And down the bottom is where the satellite is at the moment. It's going round through the Antarctic. It will come back up the other side, and then at that point we'll have the contact. If you look up there, that tells you the next upcoming orbit is in another 57 minutes.

So the people sitting in this room have got what is right there on the screen. They've got-- They're following this tiny, tiny little thing going around the Earth, and talking to it when they can. And it's recording data continuously pretty much--

Absolutely.

But then you're only getting the data in packets.

Yeah, we get the data in one large dump. It gets passed down to the ground station and then the ground station passes through a comms network to us here.

What sorts of things happen on the days when it's not nice and quiet? What can need doing to a satellite? So what can you do because it's all the way up there, right, you're down here.

Right. Well, I mean, assuming even if it's working normally, we do make improvements to the algorithms, to the calibrations, to improve the data we get back from the satellite. So even when things are working, we may, in advance, plan some activities for the satellite to calibrate. Next week, we have a manoeuvre of the satellite. So we're just going to move by a little bit to get a better positioning on the ground track. So these are things we could do normally.

If we get some data down from on-board to say that there was an anomaly on-board the satellite, then the first thing we will do is investigate what that anomaly is and maybe have to make some corrective action. We can request additional passes if we need to-- if we need to talk to the satellite. But normally we would do that in the normal passes.

For the data processing, we've got a number of environments. We start in a development environment, where we just generate the new algorithms and things. We then go into a validation environment, or a reference environment, where we actually spend a lot of time using the operational data from the satellite, pushing it through the systems, making sure that the algorithms are solid-- that they produce an improved product or a new product or whatever, before we even consider putting it into operations.

As I mentioned earlier, it's not like a car, where you can park it by the roadside and get it fixed. You have one chance and if you send the wrong commands to the satellite, you can actually damage the satellite or put it in a safe mode which could lose days of data. Or you could affect an instrument. So we have a simulator as well. We test everything before we put it on-board.

That's a lot of responsibility. Are you used to that now? Or do you ever worry about that?

It's a team effort. It really is. I mean, there are experts on all the facilities. And they're the ones you trust to make sure that it goes well. My job is really the coordination to make sure that we keep it operational. And they know their systems. They know-- they know how to write the procedures. They know how to maintain it. And, although to a certain extent, they're learning, they actually do know how to keep it running.

So this is the control room.

So this is the Meteosat control room. So this is the geostationary satellites. Here, we control all the geostationary satellites-- so the first generation and second generation satellites. This set of consoles controls Meteosat-7, the last of our first generation of satellites. And that was launched in 1997, and will be re-orbited early next year. So almost 20 years of operations.

So it's got pedigree, this.

Yeah. It taught us how to do operations-- or taught EUMETSAT how to do operations. And all the lessons we learned from doing operations with the first generation, we took the best of it and put it into the second generation. And we'll also do the same for the third generation.

So the second generation is controlled from down there, then?

Yeah.

Let's go down and have a look.

So here we have the spacecraft control for the second generation of satellites. So this is-- we've got four satellites now. So the last one was launched in 2015. And this should keep us in satellites until, at least, the start of the generation-- next generation, Meteosat third generation. But actually this will-- the satellites we'll launch will probably last until 2030.

So we're talking about geostationary satellites. It's the little-- the ones close to the Earth, the low-Earth orbit ones. Like the Sentinel system, are all controlled downstairs and they're orbiting very, very quickly. And this is a separate system, which is much further out.

Yeah, this is 36,000 kilometres out. And each of the satellites, basically, is in such a distance that it is permanently over one place around the equator. So the zero degrees. So we have permanent visibility of the spacecraft, which is a difference from downstairs, where you only see it every now and again, every hour or so. So here we can see permanently the satellite, permanently see how it's going along, how the spacecraft is reacting. Any anomalies we are aware of straight away, so we can react far quicker than we can actually downstairs.

And so even though you can't touch these satellites ever again, basically, you can do quite a lot of things, in terms of what they're doing. What are you controlling in this control room?

So what we do here in the control centre-- so the controllers are here for analysing problems on the spacecraft, analysing problems on the ground stations, on the ground segments, on the data processing. We're happy when there's no alarms. But a lot of the time, it's not so much reacting to problems as actually maintaining the system. We have to upgrade it, entire systems, every five years. We have to bring in new requirements that we get from users.

Some of the things-- so doing rapid scanning. We do full-Earth disks. When we first started with Meteosat. It was full-Earth disc. And then we thought, OK, we can actually-- if you do quicker scans, we can observe phenomena even quickly. So you get clouds which bubble up. We can observe those quite quickly now. And this is very useful in the Alps, for example, we see lots of summer storms coming up. We can actually see these.

This meant we had to do different things differently. And we had to evolve the systems. We have to take that into account. We have to design the control centre to be able to look after these new satellites, new systems, new requirements. It's constantly evolving. So the controller is actually here to make sure that we don't mess up and we do things properly without jeopardising getting data to the users, which is our prime focus in life, so--

And so I can see some pictures. Is that data coming in over there?

This is data coming in. So we have-- The prime reason we have this is the full-Earth scan. So we scan from bottom to top every 15 minutes. So this is why we build Meteosat to provide these constant observations. But then we have this rapid scanning as well. So we can see-- we can do it every five minutes and this looks more at the European-- Northern Africa, European scale. So there we get more and more data.

What we did with this-- Because we thought it was such a great idea, with this third generation, we actually basically designed this into the concept for the third generation. So when we have the full complement of satellites, we'll have the full-Earth scan, we'll have a very, very quick rapid scan-- it will be 2.5 minutes-- but we'll also have a sounder as well. So we've taken the lessons learned, the users found this incredibly useful, so we're going to build it into the next generation of satellites.

And there's a lot of coordination here, because, obviously you've got quite a few satellites. Other people-- there's a lot of other satellites up there. And you've got to not bump into each other and not overlap jobs too much. So-- and you've got to think ahead. Tell me a little bit about that thinking ahead.

Obviously, as you see, these programmes last a long, long time. The same happens in NOAA and JMA, in China, in India, in Russia. We actually meet every year. We have a group called the Coordination Group for Meterological Satellites. And we do this long-term planning to make sure exactly that we don't overlap, but also that we complement each other. So not only in the geostationary ring, but in the low-Earth orbit. And we make sure that we cover with the best instruments, the best resolution, to make sure that we're providing the users globally a consistent set of measurements. So this takes a lot of planning, it takes a lot of patience to get this in place.

But it works very, very well and-- The example being, of course, the Indian Ocean. Where we're moving a satellite across to provide observations, we're also working in partnerships with China, with

India, and Russia, who also have meteorological satellites there to provide a really robust sensor across the Indian Ocean, right over, and then round again to the Pacific, and back to us. So we have-- we do work with each other quite a lot.

So on-site here, you control the satellites themselves. The frequencies they're working at, exactly where they are, and then the data that comes back also passes through here and goes through some processing before it goes out to the user. So you've got everything on one site.

This is one of the things that EUMETSAT does very, very well. Is basically we focus everything in one place. So we take the data, we control the ground stations remotely-- so we do that from here, the controller looks after those. We process the data and we disseminate the data. We do all the things around this that help to do this--so, calibrations and so on. It's all done here. And so we don't have to really interface with too many other entities. And that's one of the advantages where we can react very quickly, both to long-term needs to short-term needs from the users-- answer their queries very quickly.

It looks very static, looks very quiet. But, in fact, behind, in the background, we're preparing and doing a lot of work to actually make it a bit more future-proof.

So there's an amazing mixture in your job, because you're both looking 10, 20, 30 years ahead to which satellites we're going to need, how do we manage the data in the systems now, so they still work in 10 years time, in 20 years time. And, on the other hand, you've got these little things whizzing around the Earth now. And you've got to deal with them now, today.

Exactly. It's planning versus fire-fighting. So my days bounce between the two. So, a lot of the time, I'm planning for the future, planning the resources, planning how we do-- change the systems, planning all sorts of things for the future. But, on the other hand, there may be a problem in a ground station. There was a serious antenna problem, for example. I have to drop all that, and work on that. So every day is different. Every day is a challenge. And every day is unique, which is great, which is why I love the job.