This is SISS, Science on the ISS, the International Space Station – and today's episode is *Overview*.

From a purely objective and empirical view, having a science laboratory in space is not all that useful. After all, a laboratory on Earth can reproduce the vacuum, the intense cold, the short wavelength radiation and even the cosmic rays. What is special about the ISS is that it's a laboratory in microgravity – no one has managed to reproduce that on Earth, apart from short periods in descending aircraft.

But there is one aspect of being in space that does make doing science on the ISS a bit special. You can look out the window – and I don't mean up, but down. The ISS orbits the only confirmed life-bearing planet in the Universe. Indeed it orbits the only confirmed planet with an intelligent civilisation – and it does this at an altitude of only 350 kilometres.

Since it began orbiting in 2000, all the photographs taken from ISS account for almost one half of all Earth photographs taken from manned spacecraft. That's all the Mercury, Gemini, Apollo and subsequent Space Shuttle missions put together – as well as the scant images shared by other space-faring nations, like Russia and China.

But of course that's just manned spacecraft. There are a myriad of unmanned spacecraft with automated cameras on precision-engineered mounts, instead of shaky human hands. Those cameras can take continuous images across more wavelengths than just optical light.

Most of these unmanned spacecraft are in what we call sun-synchronous orbits – generally polar orbits which can cover 100% percent of the Earth's surface. If such a satellite passes over one spot on the equator at 2pm then about two hours later, it will pass over another spot further east on the equator, where it will also be 2pm. In other words it keeps pace with the movement of the Sun in Earth's sky. So, these satellites will always see the same spots of ground at the same times of day, which is useful if you are tracking something – for scientific or spying purposes – since you will always see the same location under the same lighting conditions.

The ISS does something quite different. It orbits Earth at an angle of 52 degrees to the equator. So, having crossed the equator once, its next orbit crosses the equator about 23 degrees to the east and so on. Each orbit takes about 90 minutes to complete so that the ISS ends up doing about 16 Earth orbits every day. It more or less retraces its tracks about once every 3 days, but it is passing over those same points at a totally different time of day (or night) from its last pass 3 days earlier. So despite the repetition, you get quite a different perspective of the same points on Earth due to the different lighting and shadowing in those areas.

The ISS's shifting, tilted orbit misses both poles – never straying further north than 52 degrees, which is approximately the latitude of London, England – and never straying further south than 52 degrees, which is approximately the latitude of Tierra Del Fuego. So, it only covers 90% of the Earth's surface. This is an unusual orbit for a satellite, but a necessary one to allow for fuel-efficient rendezvous from both US and Russian launch sites.

So, as an Earth observation facility, the ISS has its limitations. It also has strengths though, including orbiting at less than 400 kilometres altitude, while most Earth-observation satellites orbit at more than 800 kilometres altitude. This is because those unmanned satellites lack the ability to intermittently recover their altitude through rocket burns and so must orbit higher up to avoid atmospheric drag. Secondly, the ISS's massive solar arrays provide substantial electrical power to run more sophisticated imaging systems than could be operated from a smaller robot satellite. Thirdly, the ISS is a manned laboratory - having people around to tighten a few bolts and tweak a few dials can sometimes be useful.

Now you might have been thinking that having humans take the photos would be a plus - and for the first few decades of space flight that was certainly true. But these days the robots have the advantage. There are a growing number of automated cameras on the ISS can capture regularly-updated wide angle images and they generally have a team of ground personnel who can scan for the best images at their leisure. So, the astronauts are starting to take a back seat.

For example, there's WORF, the Window Observational Research Facility, which really is named after the fictional Lieutenant Commander Worf and is a box of gadgets that fits over a very expensive window in the Destiny module. The glass in that window transmits better than 95% of the visible spectrum and over 90% of the infrared spectrum – which for glass thick enough to withstand the equivalent of sea level atmospheric pressure against a vacuum, is pretty good going.

NASA makes much of WORF's modular design – although it's got to be said again, it really is just a box of gadgets that fits over a window. The modular design is a part of NASA's EXpedite the PRocessing of Experiments to the Space Station - or EXPRESS program – where any infrastructure set up to support ISS science experiments must have a set of standard inputs, standard outputs and some standard clips and fasteners. So anyone planning to do science on the ISS can begin building their payload for a future launch, already knowing the size of the box it has to fit in, the power and data connections it needs and the types of clips and fasteners that will lock it in place.

For example, something that has already been built for WORF is ISERV, the ISS environmental research and visualisation system, which is a joint NASA and USAID initiative. It's a remotely-controlled camera attached to Schmidt-Cassegrain telescope on an automated mount. This keeps the telescope pointed at the ground and it can slew and track things on the ground for the brief period that they stay in the window's field of view. The ease at which an off-the-shelf telescope and camera can be fitted into the WORF facility is some indication of the value of using generic specs and connections in ISS research facilities.

ISERV will test the capacity of a low-cost automated imaging system, which will hopefully give developing nations the capacity to monitor environmental changes on Earth, including the impact of natural disasters. When ISERV is running, it captures three images per second. And hey, it's a cheap telescope! Well OK, maybe it cost a few thousand bucks - but for space, that's cheap.

If you are looking for something more expensive, try UrtheCast, operated by a commercial Canadian outfit, which had space-walking astronauts set up its cameras on the *outside* of the ISS in January 2014. UrtheCast is expected to provide streaming HD video of the ISS's passage over Earth sometime later this year, after ironing out a few bugs. How many people will get to see the UrtheCast video in all its glory will somewhat depend on internet bandwidth, latency and buffering, but it's a technology that we can reasonably expect to unfold over the next decade, with more and more resolution being delivered to a larger and larger audience, keen to engage in this whole-of-humanity selfie.

And is this science? No, not really. But it is a supreme level of social engagement in technology that the world has never really seen before. Of course, it's a supreme level of engagement has crept up on us in such small increments that we will all just go – *oh sure, live streaming video from space? We all knew that was coming*.

But on the bright, once we've all got it, we might not want to give it up. And so, hopefully, science on the ISS will continue.

(outro)