Question 1:

Dear Cheap Astronomy – How far does the impact of solar flares extend?

Firstly, the strict definition of a solar flare is a flash of light, associated with the acceleration of charged particles. Remembering light is electromagnetic radiation, it's not surprising to get such flashes associated with all the dynamic electromagnetic activity of the Sun – or perhaps electromagnetic uproars would be a better description to distinguish flare events from the general broiling activity that goes on. A flare is an energetic event comprising not only visible light, but shorter wavelength higher energy ultraviolet and x-rays. Such high energy radiation will affect planetary atmospheres, including Earth's, where the X and UV rays will ionize gases in so-named ionosphere, which can have affect shortwave radio transmission. Radiation that does penetrate the atmosphere adds some heating to it also.

Of course, there's more to this story than just problems with short-wave radio, where most people associate solar flares with everything else that happens around a solar electromagnetic outburst, such as a coronal mass ejection or smaller scale solar particle events.

These are what cause most of the trouble commonly associated with solar flares, where high energy charged particles are blasted outwards from the Sun. Effects range from the aurora we see around both poles to induced currents in terrestrial wire networks, which could short out power grids. There is also potential to disrupt satellite functions. Solar flares are also problematic for satellites by heating the atmosphere, so that it expands, creating drag and hence degrading the orbits of satellites, particularly low Earth orbiting ones.

The effect of solar particle outbursts extends well past Earth's orbit. On Mars, our rovers have detected solar flares and Martian auroras arising from them. Jupiter gets x-ray auroras, as does Mercury, for that matter – though through some different physics. Uranus gets weird wobbles in its weird magnetosphere remembering that it is tilted over and rotates on its side, with one or other pole facing the Sun. for much of its orbit. Then there's Neptune, which is known to develop more of its wispy white clouds just after solar maximum – which is when flares are most frequent = whether its due to heating from the flares or electromagnetic disturbances from more particle flux – or both, is not yet clear.

From there the effect of flares continues, right out to the heliopause– the boundary at which the Sun's output of solar wind is balanced by the pressure of the interstellar wind, the general background of photons and charged particles that exists between stellar systems.

Again, strictly defined solar flares, which are bursts of electromagnetic radiation do not have much effect on the heliopause specifically. But coronal mass ejections sure do. These are fast-moving particles with both mass and charge, which essentially represent a large gust against the normal background solar wind, such gusts pushing the heliopause outwards as they arrive. But that is the end of their journey, the gust doesn't get through it just pushes the boundary outwards until its runs out of puff.

What does get through though is the actual solar flare, the burst of electromagnetic radiation that's brighter than the background radiation output of the Sun. With the right technology, aliens from across the galaxy should be able to see the light from our Sun and also the faint flashes of flares, particularly around the solar maxima. After all, we can readily see flares from other stars. So the extent of solar flares impact is essentially infinite. Intergalactic aliens might struggle to distinguish our star from the general glow of the billions of other stars in the Milky Way, but it will be a part of it nonetheless.

Question 2:

Dear Cheap Astronomy – How stupid is it to deliberately crash asteroids on the Moon.

If you ask an AI search engine about crashing asteroids on the Moon it will tell you it's stupid, as would a lot of humans. Such an impact is going to throw up debris, which could exceed the escape velocity of the Moon and hence become a risk to Earth or it could go into orbit around the Moon becoming a risk to spacecraft wanting to land or it might just throw up ejecta that might fall back onto a growing lunar colony. Clearly the whole idea is daft.

If you ask an AI engine how many people have died on Earth from tailing dam collapses it will tell you that between 1961 and 2019, an estimated 2,375 people died over that nearly 60-year period. So, that's some measure of the accepted risk of mining on Earth. If you ask an AI engine if mining on Earth is stupid it will tell you that well it is environmentally destructive, but that's probably necessary to power a sustainable future. You gotta break some eggs to make an omelette

It's not clear how big an asteroid hitting the Moon would have to be to throw ejecta high enough to achieve escape velocity, since it somewhat depends on its speed, composition and the angle of approach. A colliding object approaching one kilometre in diameter will almost inevitably produce such ejecta and it could happen with smaller ones under the right conditions

There are meteorites on Earth that clearly have come from the Moon, around 300 documented ones, though it's thought they only be the result of maybe 30 lunar impact events since some are clearly bits of the same rock. Most are estimated to have been ejected from the Moon in the last 100,000 years, presumably because anything older has since been buried, eroded or washed away. Anyhow, that's at least twenty lunar impacts events sufficient to produce ejecta in the last 100,000 years – so one every 5,000 years or so on average. Most were almost certainly well less than 1 kilometre, since we think Earth only gets hit by something that big every half million years or so and Earth is a bigger target.

So, if there was a deliberate program to crash asteroids in the sub one kilometre range on the Moon sure there's a minute risk of someone on Earth getting hit on the head by a big rock, or have their house wrecked by one, but we are just talking big rocks, nothing in the mass extinction or even Tunguska range.

Then there are the risks of putting ejecta into lunar orbit or on a parabolic trajectory to somewhere else on the lunar surface. Although, the chance of putting something on the exact trajectory and velocity need to achieve orbit is slim – it's a lot more likely the ejecta would either achieve escape velocity or fall back down. In any case Earth is currently surrounded by orbiting debris of our own making. An increasing number of spacecraft still get through that OK – we just have to keep track of all the orbiting junk. So, the risk of falling ejecta is probably the most tangible risk, at least to a lunar colony.

It's then worth thinking why we are going to have a lunar colony anyway. Are we seriously going to mine what's on the Moon now, because there isn't all that much. Are we seriously going to just do science? That might be possible to the extent that lots of countries have bases in Antarctica, that do science, though perhaps partly because other countries have bases there and we're all waiting to see if anyone figures out something lucrative to do there. And that is the trick with the Moon, we have to figure out something lucrative to do there. So, if we are going to mine asteroids anyway, why not bring them to the Moon and make it our great orbiting quarry in the sky. We'd then have to establish lunar colonies deep underground out of harm's way, but that's probably what we'd do anyway because of radiation and the natural micrometeorite falls.

So… is it stupid to deliberately crash asteroids on the Moon? Maybe, but just how stupid are all the other plans we have at the moment? Go ask an AI engine.