Air pollution has a serious impact on the environment and people’s health, but the causes are multiple and complex. A key research report last year by the Grantham Institute – Climate Change and the Environment in collaboration with the Energy Futures Lab and Institute of Global Health Innovation identifies some of the key pollutants for global and regional climate change, and aims to set new standards for tools to measure the impact of emissions worldwide.

The report found that the impacts of short-lived pollutant emissions on air quality and climate change vary greatly depending on both the region where emissions occur and the location of the affected region.

For example, sulfate aerosols can cool the atmosphere, which offsets some global warming, but they also degrade air quality and in many regions they are a contributing cause of drought.

The Imperial researchers quantified the effect that global sulfate emissions had on rainfall levels in India in 2000 at the time of one of the country’s worst ever droughts – affecting more than 130 million people. The north-west of India experienced an unprecedented 40% drop in precipitation during the vital monsoon season, caused by industrial area in the northern hemisphere. Europe’s emissions alone caused reductions of up to 10% in the north-west and south-west region.

Dilshad Shawki, a PhD student at the Grantham Institute, said: “In recent decades rising pollution levels and increases in global surface temperatures have influenced atmospheric circulation patterns in the tropics, in turn affecting monsoon rainfall patterns. The challenge for scientists, including myself, is to gain a better appreciation of these relationships in order to build more accurate forecasts.”
The advent of laser technology in the late 1950s has had a truly transformative impact on modern society and industry – from entertainment, to medicine and surgery through to communications and scientific research.

Now masers (which can be thought of as microwave lasers) promise to be just as revolutionary in the 21st Century.

Unlike lasers, masers are much less widely used at present because in order to function they must normally be cooled to temperatures close to absolute zero (-273°C).

Following years of research, Imperial researchers Professor Neil Alford, Dr Jon Breeze and Dr Juna Sathian (Department of Materials) together with UCL collaborators, have developed a maser that can act continuously at room temperature. Key to the team’s technique is the use of a synthetic diamond grown in a nitrogen-rich atmosphere. Their work has been reported several times in the journal *Nature* – featuring on the cover in March 2018.

Maser technology of this kind could find a range of applications in medical imaging, airport security scanning to remotely detect bombs, deep space communication and radio astronomy.

Masers could also prove instrumental in enabling powerful quantum computers that far surpass the power and ability of current processors.
Over the past five years, Imperial has consolidated its long-standing expertise in research and innovation related to the data revolution – with the launch of the Data Science Institute as well as through centres and networks of excellence such as the Centre for Cryptocurrency Research and Engineering.

This has allowed Imperial to respond to the very latest trends in the field, for example in Financial Technology (FinTech). Coupled with a supportive ecosystem for aspiring staff and student entrepreneurs this has led to some major innovations.

While students at Imperial, Alan Vey (Computing) and Annika Monari (Physics) formed Aventus – a blockchain-based platform that aims to combat uncontrolled resale and counterfeit event tickets, while improving the transparency and security of ticket sales.

A blockchain is a public ledger of all cryptocurrency transactions that have ever been executed – and was the topic of Alan’s Master’s thesis. Through Aventus, each ticket has a unique identifier on the blockchain. Due to the transparency of the blockchain, any user can check the validity of a ticket immediately, eliminating the risk of counterfeits.

By ensuring that all ticket sales and resales occur through the Aventus system, it means that event organisers can reliably enforce maximum resale prices, and even receive a portion of resale revenue. This would work in two ways. Firstly, tickets would have an identity associated with them upon purchase – whether it be customer’s name, credit card number, or photograph, which would be checked upon arrival at the event. Secondly, those selling their tickets wouldn’t know who specifically they were selling them to – rather buyers and sellers would be anonymously matched through the platform. This would prevent off-chain transactions taking place to circumvent the system.

Aventus raised the equivalent of $20 million of investment through an Initial Coin Offering (ICO) in September 2017.
Antimicrobial resistance (AMR) is growing year on year. In January 2018, the WHO’s first release of surveillance data revealed widespread antibiotic resistance among 500,000 people across 22 high- and low-income countries.

A key part of the UK government’s response to the issue is through the work of two national centres of excellence at Imperial and the University of Oxford – the NIHR Health Protection Research Units in Healthcare Associated Infections and Antimicrobial Resistance.

In 2015, Imperial consolidated its long-standing expertise in the area by establishing the Antimicrobial Research Collaborative (ARC), gathering multidisciplinary expertise from across the College. The ARC is now having real impact through innovative projects such as the Point Of Care Antimicrobial Stewardship Tool (POCAST).

Most antibiotics are prescribed in the community and research has shown that providing doctors with data on prescribing can improve care and optimise the use of antibiotics. Currently, when a GP wants to prescribe an antibiotic, and they wish to refer to the Public Health England (PHE) guidance, they must sift through a 20-page document in a PDF format.

To make that process easier, a dedicated website, POCAST was developed by a team of pharmacists, GPs, nurses and microbiologists led by Professor Alison Holmes (Director of the ARC). POCAST is now being trialled in five Clinical Commissioning Groups (CCGs) in North West London, which covers approximately 247 general practices and 1.4 million patients.

In another recent project under the ARC initiative, a team of researchers have been able to switch on and study the mechanism some bacteria use to inject toxins into rival bacteria. This breakthrough could enable scientists to make disease causing bacteria more susceptible to attack by the immune system or by other bacteria.