Weather Monitoring & Climate Change

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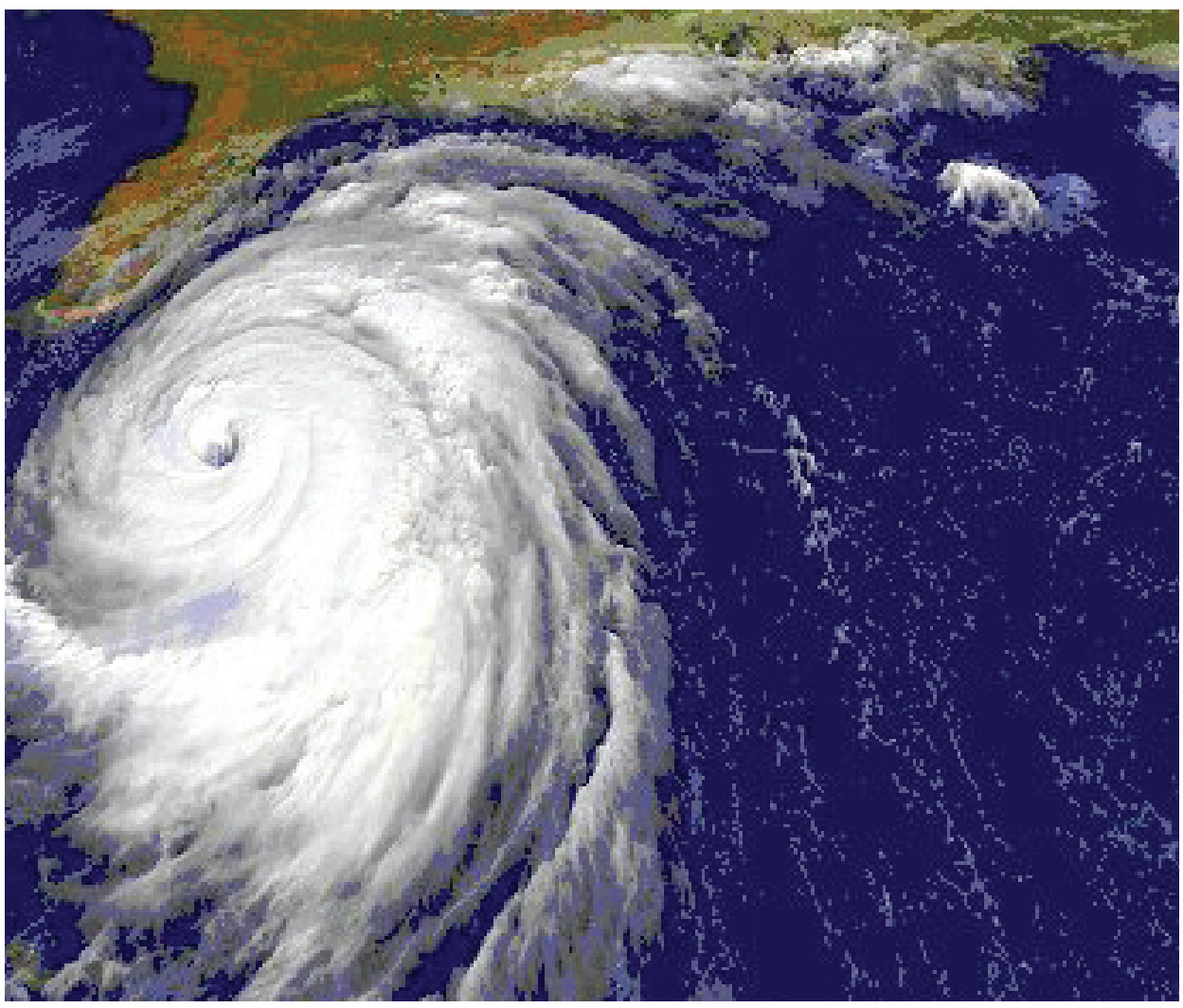
In 1981, Gary graduated from Exeter University with a degree in Zoology. He then spent ten years as a customer service manager for a controlled atmosphere storage equipment manufacturer. Gary started working for Casella in 1991 as Technical Sales Engineer, based in the South East, selling a complete range of environmental and personal monitoring equipment. In 2001, he moved to the position of Product Manager based at Casella's headquarters in Bedford. Gary is now responsible for all new product development and marketing strategies for the Casella range of personal monitoring, meteorological, and ambient monitoring equipment. Gary is a Fellow of the Royal Institute of Public Health & Hygiene (FRSH), and an active participant at BOHS conferences. He has extensive knowledge of Noise & Vibration, Occupational Health Monitoring & Sampling for toxic substances and meteorology. Gary is married, has 2 children, 9 hens, 4 ducks, 3 cats and lives in Cambridgeshire.

Climate change has become one of the most important global environmental issues. Politicians, scientists, academics and environmentalists continually discuss how humans and our industrialised processes continue to damage our physical environment. Developing countries such as Asia are very vulnerable to extreme climate events such as typhoons, droughts and floods. Climate change here increases these vulnerabilities. This damage has been building up over hundreds of years and a key affect of this is the extremes of weather experienced throughout the world.



The devastation in the US after hurricane Katrina, following on from the droughts in Niger, and the Malaysian Tsunami only enforce the belief that global warming, which is the increase over time of the average temperature of the earth's atmosphere and oceans, is becoming more prevalent and severe every day.

Economic

Accurate forecasting of the weather, in particular, the arrival of the monsoon season is critical for the people of Asia. This allows farmers to decide when it would be best to plant crops in order to take advantage of the rains. Too much or too little rain can have disastrous results on the economy. The impact of global warming on monsoons is not yet fully understood but this calls for an increase in scientific research to determine the affects, which have huge implications for the economy, health and agriculture, not just for the people of Asia but also on a global scale. In addition, extremes of seasonal climate, from monsoon floods to dry periods and drought, ensures that water resource issues will remain critical.

Physical vulnerability

The term El Niño is nowadays used to refer to the periods of strong and prolonged warm weather, which influence the climate worldwide. The periods of the warm waters in eastern Pacific (El Niño) and periods of cooler waters (La Niña) are accompanied by changes of air pressure in the east and west Pacific: these are called the Southern Oscillation. Large year–to-year fluctuations of natural disasters, some of which can be explained by El Niño, are described as the El Niño disaster cycle.

El Niño is associated with death and disease, most of which result from weather-related disasters such as floods and droughts. For example, in 1997 Central Ecuador and Peru suffered rainfall more than 10 times normal, which caused flooding, extensive erosion and mudslides with loss of lives, destruction of homes and food supplies. During the 1997 El Niño droughts hit Malaysia, Indonesia and Brazil, exacerbating the huge forest fires. Smoke inhalation from these fires was a major public health problem in these countries, with countless people visiting health facilities with respiratory problems.

In the Asia-Pacific region, the number of people killed, injured or made homeless by natural disasters is increasing alarmingly. This is partly due to population growth and the concentration of population in high-risk areas like coastal zones and cities. Their vulnerability to extreme weather conditions is also increasing.

For example:

- Large shanty towns with flimsy habitations are often located on land subject to frequent flooding.
- In many areas the only places available to poor communities may be marginal land with few natural defences against weather extremes.

Air pollution

In August 2005, a smoky haze shrouded parts of Southeast Asia forcing schools and business to close. This is one element of an air pollution problem that kills thousands of people in the region each year. According to the World Health Organisation, Air pollution in major Southeast Asian and Chinese cities ranks among the worst in the world and contributes to the deaths of about 500,000 people each year.

Many cities in the far east already have issues with pollution, and the major cause of this is traffic exhaust emissions. Levels of SO_2, Ozone, Oxides of Nitrogen and PM_{10} particulate levels are now routinely monitored in many towns and cities, with large nationwide networks of monitoring stations (AQMS's) being set up to look at local and national effects of pollutants. Localised monitoring of weather parameters on these systems is also very important, as local geography will affect the transportation of the pollutants.

With the growth of the Asian economies will come the inevitable growth in car usage and this will contribute more to the air pollution problem. There will need to be considerable growth in networks of gas and meteorological monitoring stations to keep a close monitor on these factors.

Natural disasters & weather pattern changes

Every year, there are natural disasters which cause millions of pounds of damage, and result in thousands of deaths. It is a fact that the number of directly weather related catastrophes has risen 3 times faster than non-weather related over the past years.

Flooding and droughts now appear to be more prevalent, destroying crops, property, livestock and causing death and starvation to thousands of people. Pest and infestations are also very dependent upon the local weather conditions. In Africa, it is essential

to monitor the rainfall levels, however small, as the locust swarms usually follow these. Even the might of the USA is not immune to the effects of the weather, and the ripples from any disaster spread far and wide.

Socio-economic effects

In South East Asia, crop production and aquaculture is threatened by thermal and water stresses, sea-level rises, increased flooding, and strong winds associated with intense tropical cyclones. Acute water shortages combined with thermal stress adversely affect wheat, and more severely, rice productivity. Along with an increasing population and limited availability of land, agricultural productivity needs continuously increase to meet growing demand even though the negative impacts of climate changes continue.

At a recent conference at the UK Met Office, presenters said that a major factor to take into consideration is that of social changes. It is estimated that there could be 150 million refugees by 2050 caused by dramatic weather and flooding effects. This has again been seen after the tsunami and hurricane Katrina.

Global changes in weather patterns

Until very recently, scientists and meteorologists thought that changes in the global weather trends were slow and gradual, but now there has been a sea change in these thoughts. Firstly, it is believed that humans may now be responsible for causing significant changes in climate. Secondly, it is now known that these changes have occurred more rapidly than had at one time been thought; namely over less than a century rather than over several hundred years.

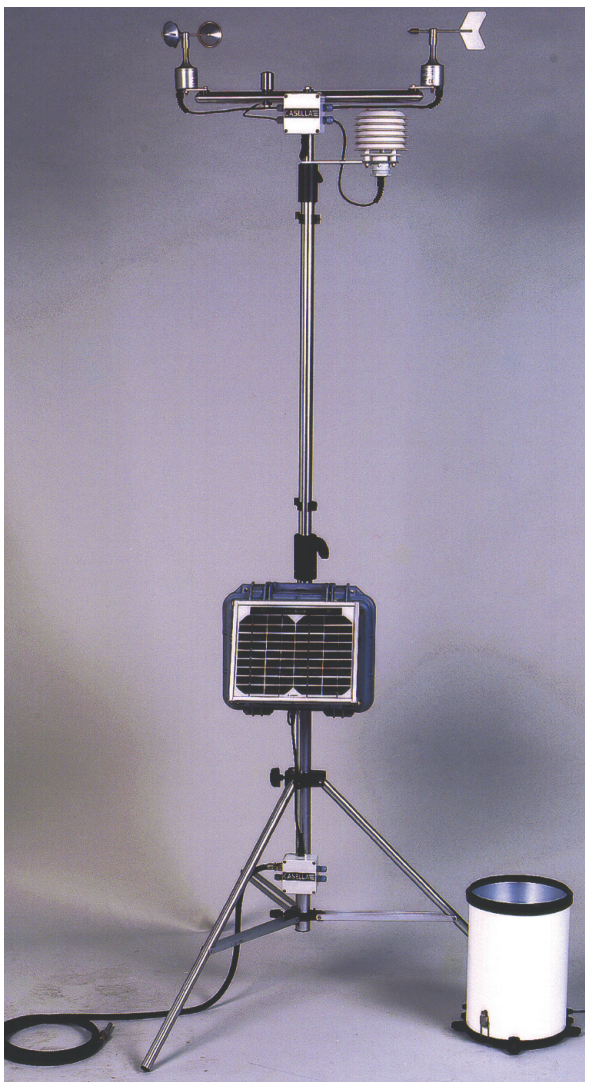
Global temperatures have risen by over 0.7C in the last 300 years - climate change is therefore already taking place. However 0.5C of this warming has occurred during the 20th century. The main factors that contribute to Global warming are general atmospheric pollution from vehicles and manufacturing, deforestation and forest fires.

One of the first indicators of these climate changes is an increase in the global sea temperature which in turn affects the polar ice caps. The sea ice coverage has started to diminish by some 10-15% and the sea ice itself is already thinning by 40%. The ramifications of this will be a rise in sea levels, which have the potential to cause flooding in many low lying countries such as Bangladesh and coastal areas in Asia, potentially causing millions of deaths and corresponding demographic changes. Fish stocks will also continue to decline if the ocean temperatures continue to rise as it effects the sea fertility rate.

Global dimming

This is a phenomenon caused by other by-product gases from combustion of fossil fuels. What these pollutants do is build up in the atmosphere and reflect more sunlight back, preventing it from reaching the earth. More of the sun's heat and energy is therefore reflected back into space. It is now thought that as this makes the oceans cooler, this has had a major global effect on rainfall which in turn has lead to massive famines due to the loss of annual rainfall levels. If similar effects are caused to the Asian monsoon patterns, 3 billion people will be affected.

It is essential for climatologists to measure and monitor these weather patterns in order to study the interactive, local and global,



effects of the weather. Global warming and dimming are inextricably linked and the two sides of the global warming equation should be studied together.

Legislation

In February 2005 the 1997 Kyoto Protocol became international law. The protocol is officially the first global legally binding contract to reduce greenhouse gases. All nations who sign up are legally bound to reduce their emissions of six greenhouse gases by an average of 5.2% below their 1990 levels by the period 2008 - 2012. These gases are; Carbon Dioxide, Methane, Nitrous oxide, Ozone, Water Vapour and Halocarbons. The EU and Japan have already promised to reduce to pollution by 8% from their respective 1990 levels. The Kyoto Protocol also tries to address the needs of the 'poor and developing' countries who may suffer the most from severe weather events.

Equipment for monitoring the weather

For hundreds of years now, equipment has been available to monitor the weather and other meteorological conditions. Originally, simple manual equipment was used and some of this equipment continues to be the backdrop for modern meteorological monitoring networks worldwide. These instruments include simple thermometers, soil thermometers, hygrometers, thermohygrographs, barometers and simple raingauges, to name but a few. They are generally used in traditional meteorological instrument enclosures (Stevenson Screens).

Data collection using manual instruments are being slowly replaced with automatic weather stations (AWS's) which allow data to be accessed remotely via radio, GSM or satellite telemetry systems and allows systems to be deployed in the remotest areas on earth. Many systems in Asia by definition and geographical location, require remote data collection via radio or GSM. An example of this was a remote station located on Batum, a small Indonesian island which required data monitoring of the only natural water reservoir for water conservation research.

Most government ministries now set up and run whole networks of ground stations. The data from these can be accessed, then used and analysed by powerful computers to devise "climate models". The first step in any modeled projection of climate change is to first simulate the present climate and compare it to observations. It is therefore vital to have an extensive network of simple stations to validate the modeled data.

Most countries also still extensively use radio-sondes for upper atmosphere monitoring applications. These are small transmitters with sensors which are sent up to high altitudes via meteorological balloons. Data from all the ground and upper air systems can then be processed centrally and disseminated to all relevant bodies. With the internet, this data can now be accessed in "real-time". This is critical data which can provide instant displays of extreme weather events either locally or available via live satellite images of earth from space.

There is also an extensive global network of hydrological, oceanographic and polar ice cap monitoring equipment and stations, and these help to monitor the effects on rainfall, sea levels, currents and the condition of the ice caps, and it is the damage and changes to these that will have the greatest consequence and potential threat to human life. Here the effects of global warming will have the most obvious damage in the long run. Water is the most valuable resource on earth and by measuring its distribution and patterns, the effects of urbanization, deforestation and other global effects can be monitored. The increase in hydrological monitoring networks is one of the fastest growing sectors in our market at the present time.

"Weather" systems are really local "environmental monitoring systems" and the data can be incorporated to give global pictures, but more and more applications such as industrial processes now have requirements to monitor local conditions to help monitor emissions of pollutants, or chemical spills from their site boundaries.

There are many other applications where meteorological systems can be used, One area is for use at hazmat type incidents, where there will be a requirement to monitor the weather conditions at a chemical or terrorist type incident, in order to ascertain where the potential pollutant may go, so that evacuations can be made.

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Conclusion

Everything we do is dictated by the weather and industrialised societies have undoubtedly had an effect on the environment which in turn has affected our weather patterns and trends. We now have the technology to monitor the weather conditions to very exact detail and with extensive modeling packages, try to help predict what may happen in the future. This equipment is becoming more affordable, even for the poorest countries of the world. Every element of monitoring helps assess the overall picture and allows for vital steps of action to be taken.

We cannot control the weather or the outcomes of weather related events. We can control and have an influence on the damage we cause to our environment. This in turn will start to have a cumulative restorative effect. It is the responsibility of every tier of government body right down to the private individual to affect these changes for the better. We all live inside the same global envelope and action to make changes to our environment, even at a local level, will have global implications. In Asia with 3 billion inhabitants, the cumulative effects of these small contributions will be huge.

Sources of information:

http://timesofindia.indiatimes.com/articleshow/1206555.cms
http://www.who.int/mediacentre/factsheets/fs192/en/
http://www.grida.no/climate/ipcc_tar/wg2/041.htm
http://www.bbc.co.uk/weather/features/understanding/monsoon.shtml
http://www.unep.org/dpdl/indiaworkshop/backobje.htm
http://www.reliefweb.int/rw/