Environmental emergency response: WMO activities*

Photo: Getty Images

For many nations, the human and material losses caused by disasters are a major obstacle to sustainable development. While WMO aims at reducing average fatalities for natural disasters of meteorological, hydrological and climatic origin, it also aims at reducing the risk of environmental emergencies through better meteorological support in prevention, preparedness, response, and recovery.

Introduction

Disasters can strike in many ways. In addition to natural disasters that are associated with natural phenomena, there is also an important area of risk of disasters, sometimes referred to as technological disasters, which fall into the domain of "environmental emergencies". Frequently used examples are a nuclear power plant accident or a transportation accident that involves the release of a chemical to the atmosphere. These potential disasters are induced by, or occur as a consequence of, human activities. Of course, natural hazards can also trigger technological disasters.

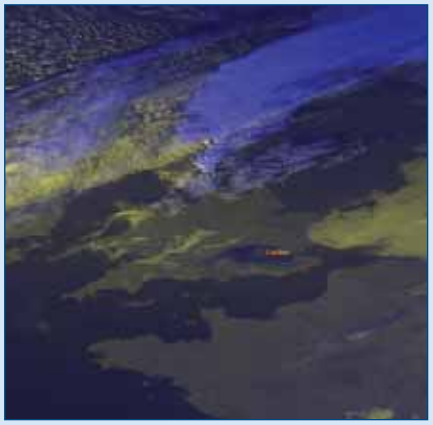
Meteorology could potentially play an important controlling factor in the behaviour of both the hazardous material suddenly released to the environment, into the air and into water bodies, while the effective protection of life and property often depends critically on reliable information on current and future environmental conditions. In managing the risk of environmental emergencies, therefore, meteorological data, information and forecasts are important in two main ways:

- Meteorological information such as weather forecasts support local and regional emergency response operations; and

- Specialized numerical modelling systems can assess and predict the movement and spread of air- and water-borne hazardous substances from the location of sudden release.

WMO's programme Emergency Response Activities includes in general terms the broad area of the application of specialized atmospheric dispersion-modelling techniques to track and predict the spread of airborne hazardous substances in the event of an environmental emergency. This kind of specialized application depends directly on the operational infrastructure of the numerical weather prediction systems that are implemented and maintained at many of WMO's World Weather Watch system of global, regional and national meteorological centres.

A smoke emergency



A massive fire broke out after a series of explosions at a fuel depot in Hemel Hempstead, north of London, England, on 11 December 2005, sending smoke hundreds of metres into the sky (see also photo, left). The fire raged for three days. Some 2 000 people had to evacuate the area and schools were closed.

A huge, dense black cloud spread out east, west and southwards, towards France and Belgium. Eventually, the wind changed direction and blew the smoke towards the open Atlantic. The METEOSAT-8 image shows the cloud enveloping the London area on 12 December (image courtesy of EUMETSAT).

* A contribution from the WMO Secretariat

Volcanic ash warnings for international civil aviation

The International Civil Aviation Organization (ICAO) is responsible for coordinating the efforts of seven international organizations, including WMO, and ICAO Contracting States, which comprise the International Airways Volcano Watch (IAVW). This work is undertaken with the assistance of the International Airways Volcano Watch (IAVW) Operations Group established in 2003, to coordinate and oversee the global development of the IAVW.

The IAVW is made up of two main components:

- The observing component comprises various observing sources, including international ground-based networks, global satellite systems and in-flight air reports, in order to observe or detect volcanic eruptions and ash cloud and pass the information quickly to appropriate air traffic services units and Meteorological Watch Offices (MWO);
- The warning component provides the necessary warnings to aircraft through SIGMET messages issued by MWOs, and air-route closures or diversionary instructions in appropriate aeronautical messages. The messages are based on advisory information supplied by nine Volcanic Ash Advisory Centres (VAACs) designated upon advice from WMO. Their areas of responsibility cover all the major air-traffic flows. The designated VAACs are located in Anchorage, Buenos Aires, Darwin, London, Montreal, Tokyo, Toulouse, Washington and Wellington.

Volcanic ash is a direct safety threat to jet transport aircraft, primarily because the melting point of ash (mostly silicates) is around 1100°C, while the operating temperatures of high by-pass jet engines are around 1400°C. The ash, therefore, does not simply blow through the engines as dust/sand tends to do, but melts in the hot section and then fuses on fuel nozzle guide vanes and turbine blades. With sufficient exposure to volcanic ash, jet engines flame out. Since 1982, there have been four cases in which jet engines have flamed out as a result of an encounter with volcanic ash.

Aside from the safety threat, the abrasive nature of volcanic ash involves annually important costs to airlines arising from aircraft maintenance and resulting delaying or re-routeing.

In any one week, at least two or three volcanoes erupt sufficiently near international air routes to trigger the IAVW.

In the framework described above, WMO plays an important role in the support of safety and efficiency of international civil aviation through the development of methods for detection and forecast of the movement of volcanic ash in the atmosphere and subsequent provision of advisory information to MWOs tasked with issuing the warnings.

WMO's programme of Emergency Response Activities was established to assist National Meteorological and Hydrological Services, their respective national agencies, as well as relevant international organizations, to respond effectively to environmental emergencies with large-scale dispersion of airborne hazardous substances. Following the Chernobyl nuclear power plant accident in 1986, the programme has focused its operational arrangements and support on nuclear facility accidents. In addition, where possible, the programme has also included meteorological support in emergency response to the dispersion of smoke from large fires, ash and other emissions from volcanic eruptions, and chemical releases from industrial accidents.

Meteorological data and information, while they can be integrated into emergency preparedness and response systems, could also be effective in reducing the risk of incidents and emergencies if they are introduced into environmental emergency prevention programmes.

While the focus of WMO's Natural Disaster Prevention and Mitigation programme is on natural disasters, operational services of the meteorological community are important for the reduction of loss and risks in the mitigation of all kinds of disasters. As well, naturally occurring extreme

events are disruptive and could trigger many kinds of accidents which can, in turn, result in spills and releases of hazardous substances to air and water, adding to the burden of emergency response to protect and secure endangered populations and contaminated environments.

What are "environmental emergencies"?

Environmental emergencies can be defined as an uncontrolled, unplanned, or accidental release of a hazardous substance into the environment that could have immediate adverse affect on human and animal life or the environment. These releases are primarily the result of accidents, system failures due to improper maintenance or human error in activities, such as those associated with industries.

Environmental emergencies could also refer to a broader area of the sudden and acute release of hazardous substances into the environment, including those that are of natural origins. The important element is the immediate threat which such substances poses to humans and the environment. In this definition, this area includes smoke from large wildland fires, volcanic ash from volcanic eruptions, out-gassing from deep lakes, and dust- or sandstorms.

Nuclear accidents and radiological emergencies

WMO has in place operational international arrangements with the International Atomic Energy Agency (IAEA) to trigger specialized meteorological support to environmental emergency response related to nuclear accidents and radiological emergencies, when needed. WMO plays an important role in this connection through its unique numerical weather prediction capability for simulating and predicting the movement and dispersal of radioactive materials in the atmosphere.

WMO has implemented and maintains a system of eight specialized numerical modelling centres called Regional Specialized Meteorological Centres (RSMCs) which are prepared at all times to provide highly specialized computer-based simulations of the atmosphere that predicts the long-range movement of airborne radioactivity. These specialized centres, representing complete global coverage 24 hours a day, every day, are located in National Meteorological Centres at Exeter (United Kingdom), Toulouse (France), Melbourne (Australia), Montreal (Canada), Washington (USA), Beijing (China), Obninsk (Russian Federation) and Tokyo (Japan). The system also includes a telecommunication gateway at Offenbach (Germany) to provide the notification and real-time information linkage between the Incident and Emergency Centre of IAEA and WMO. When requested, these centres will provide the specialized products within three hours to National Meteorological Centres, and the IAEA.

WMO centres participate in numerous exercises that are designed to simulate an accident or failure at a nuclear power plant. The potential risks to populations from a nuclear accident are extremely complex and the protection of the population and the environment implicate many national and international organizations. Under the international Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, an exercise programme

Nuclear emergencies

Good planning in advance of an emergency can substantially improve the response.

To this end, the Joint Radiation Emergency Management Plan of the International Organizations was developed. It is maintained by the International Atomic Energy Agency (IAEA); the international organizations which are party to the International Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; and some international organizations that participate in the activities of the Interagency Committee on Response to Nuclear Accidents.

WMO is a party to these Conventions and participates in the regular review and maintenance of the Joint Plan, including the Convention Exercise Programme.

called a "convention exercise" (or "ConvEx") has been put in place.

In May 2005, a major worldwide ConvEx-3 exercise was conducted, where the accident scenario involved an accident at a nuclear power plant in a given country. During the first hours of the two-day exercise, after the notification of a serious accident, IAEA, the Meteorological Service of the accident State, as well as several neighbouring States, requested the WMO RSMCs at Exeter and Toulouse to provide the specialized simulation products to assist in the assessment and decision for protective actions. Through the period of the exercise, updated products were provided, based on new meteorological and accident information, through the use of protected Web-based facilities, e-mail and facsimile transmissions.

Chemical incidents and emergencies

WMO is expanding the scope and capabilities of its programme of Emergency Response Activities from its present operational arrangements for nuclear emergencies to include non-nuclear environmental emergencies—the area of chemical incidents and emergencies is one under exploration and development. Many National Meteorological and Hydrological Services have a national responsibility to provide meteorological support to chemical accident emergency response. The services range from weather observations, forecasts and warnings provided to field operations, to the provision of specialized products and expert advice on the atmospheric dispersal of pollutants. Some governments are investing and cooperating in science and technology and reviewing operational arrangements to enhance their respective level of security measures, including in the areas of environmental monitoring in complex environments and numerical modelling and simulations for detection, assessment and prediction of atmospheric transport of hazardous materials. All these aspects contribute to the management of risk in the context of disaster prevention and mitigation.

Partnership with other international organizations

WMO works with UN system organizations such as the International Atomic Energy Agency, the International Civil Aviation Organization, the World Health Organization, the United Nations Environment Pro-

Wildfires in South-East Asia

Fire, climate and human actions are highly interactive. South-East Asia witnessed one of the worst smoke and haze episodes in autumn 1997 due to forest fires that were exacerbated by the El Niño-related drought. It was estimated that the over two million hectares of forests burned in Kalimantan, and Sumatra emitted the same level of carbon dioxide as a whole year of emissions over Europe. Economic losses were estimated at US$ 9.3 billion. Civil aviation operations, maritime shipping, agricultural production and the tourist industry were especially hard hit. The fires also affected the health of the population in the region. As a consequence, the members of the Association of South-East Asian Nations (ASEAN) agreed to implement a Regional Haze Action Plan to address the problem of recurring forest fires and the resulting transboundary smoke and haze pollution.

WMO joined with ASEAN to establish the ASEAN Regional Specialized Meteorological Centre in Singapore. This Centre provides smoke/haze information and forecasts to NMHSs to assist in environmental emergency situations. It also displays weather and hot spots using satellite images on its Website, which is open to the public. Satellite imagery can provide information on the dryness of vegetation, location and size of major fires and smoke plumes, energy released by fires, and air pollutants in the smoke plumes. WMO, the World Health Organization and the United Nations Environment Programme have also developed a joint report that provides comprehensive guidelines for governments and responsible authorities on actions to be taken when the population is exposed to smoke from fires.

Meteorology of environmental emergencies

The sudden introduction of a toxic or radioactive material into the environment could immediately present a risk of disastrous consequences.

The importance of meteorological factors is their influence on the spread, dispersion and dilution of the substance, as well as, in some cases, on the transformation and interaction of the substance with other constituents of the environment.

Some of the more important factors are wind speed and direction, turbulence, stability layers, humidity, cloudiness, precipitation and topographical features.

The potential hazardous zones depend on the quantity and type of substances released and the environmental conditions into which the substances have been released and persist. In many cases, only local conditions are critical, whereas in other situations, long-range transport processes are in important.

Meteorological aspects are factored into many decisions around protective actions, both for communities and for operations such as air traffic control.

gramme, the United Nations Office for the Coordination of Humanitarian Affairs, the United Nations International Strategy for Disaster Reduction and the Intergovernmental Oceanographic Commission of UNESCO. Each, in its respective domain, has responsibilities for promoting and coordinating emergency planning and programmes, and implementing emergency preparedness and response measures. Some also have round-the-clock operations to monitor emergency situations, and coordinate and facilitate emergency assistance as needed, in all regions of the world.

Meteorological data and information support both preventive and restorative measures, as well as emergency preparedness and response. International organizations have different leading interests or authority, depending on the hazard and disaster situation. Coordination and planning between WMO and other international organizations ensure that the meteorological requirements during emergency situations are well understood and that the necessary products and services are ready and delivered efficiently and effectively by WMO's network of NMHSs and specialized meteorological centres.

WMO is the leading and authoritative international organization on meteorological and hydrological hazards. In addition, many other natural hazards or hazards which are the result of human activities are controlled in varying degrees by meteorological and hydrological factors, such as gases and ash from volcanic eruptions, floods, industrial spills or fires, or locust outbreaks. Moreover, a meteorological hazard, such as a tropical cyclone, could trigger a secondary hazard, such as a fire at an industrial plant. Each potential hazard could require international consultations and coordination, for emergency response actions, deployment of supplies or assistance. Building meteorological aspects into the arrangements implemented and coordinated by other international organizations to enhance emergency preparedness and response is an effective approach to assuring specialized meteorological support and assistance to decision-makers having the ultimate responsibility to protect populations and the environment at risk.