

## ATMOSPHERIC HAZARDS: SEVERE STORMS

More property is insured against storms and other weather-related damage than any other form of environmental hazard. It has been estimated (Housner, 1987) that windstorm-related hazards cause an average of 30,000 deaths and \$2.3 billion in damage worldwide each year. The greatest property losses exist in the Developed Countries and the highest damage potential lies along the Gulf of Mexico and the Atlantic coastline of the USA.

Many countries have "all risk" policies on building structures and contents, as well as motor vehicles, which contain cover for a variety of "storm" losses including wind, hail and lightning. Because of these package policies, it is difficult to identify the role of individual weather perils. In Britain, the total insurance claim payments for property losses due to crime, fire and severe weather amount to about £2 billion (at 1987 prices) in a typical year (Parry and Read, 1988).

Farmers in developed countries often insure crops against storm-related losses. Hail insurance is fairly common in North America. Thus, in 1975 the premiums written by all companies for crop-hail insurance in the USA totalled about \$311 million, representing insured crop values approaching \$8.2 billion at 1975 prices. Even so, it is likely that only about one in six farms in the nation are covered by commercial crop insurance and that less than one-fifth of the total-crop value in the US is insured. Crop-hail insurance is only a minor part of the US insurance market. It is widely spread through more than 200 companies, although about 80% of the business is concentrated in some 50 firms. For most of these, crop-hail insurance amounts to less than 5% of their total activity. It is estimated that, in an average year, a valid claim is made on 20-25% of all hail insurance policies. These claims amount to about 60% of the value of the premium paid.

Major storm-related disasters, especially from hurricanes in the USA, have the ability to cause great strain within the commercial insurance industry. The projected losses in the coastal counties of Texas alone are between \$1 billion and \$1.5 billion (Cross & Thornton, 1983). In 1985, the Gulf and Atlantic coastlines were hit by six different hurricanes causing aggregate insurance losses of about \$1.4 billion. In 1992, Hurricane Andrew devastated southern Florida and parts of Louisiana, producing the most expensive catastrophe in history.

It was believed that, because of the large concentrations of property along these coasts, individual storms causing insured losses of up to \$7 billion were possible (AIRAC,1986). In a simulation exercise, where two hypothetical hurricanes of this magnitude were assumed to have struck the US mainland in the summer of 1984, the finite limits of the insurance system were thought to have been exposed. Although the burden would have been spread worldwide through reinsurance arrangements, the losses would have created serious market dislocations. No fewer than 28 companies (6 US, 22 overseas), according to the simulation, could have become insolvent in the absence of large transfusions of new capital from their affiliates or other sources.

Hurricane Andrew, however, showed that a hurricane costing upwards of \$15billion and ensuing East coast storms costing \$650 million closed only six Florida-based insurers and showed the insurance industry, as a whole, to be remarkably resilient to a claim of this magnitude.

## T R O P I C A L C Y C L O N E S

Tropical cyclones are severe storms of marine origin. They create coastal hazards because most of the storms decay rapidly over land areas. However, some remain dangerous for thousands of kilometres with sufficient energy to cross mid-latitude oceans. Tropical storms bring multiple problems associated with high windspeeds, heavy rainfall and sea surges. The term "tropical cyclone" is used in the Indian Ocean, Bay of Bengal and Australian waters, whilst the same storms are called "hurricanes" in the Caribbean, Gulf of Mexico and the Atlantic Ocean. In the region of greatest frequency, which is the North-West Pacific in the vicinity of the Philippines and Japan, they are known as "typhoons".

The minimum speed threshold for hurricane winds is set at  $33\text{ms}^{-1}$ . The storm's severity can be classified according to either the central pressure, windspeed or ocean surge on the Saffir/Simpson scale:

SCALE NUMBER	CENTRAL PRESSURE (mb)	WINDSPEED (m/s)	SURGE (m)	DAMAGE
1	>980	33-42	1.2-1.6	Minimal
2	965-979	43-49	1.7-2.5	Moderate
3	945-964	50-58	2.6-3.8	Extensive
4	920-944	59-69	3.9-5.5	Extreme
5	<920	>69	>5.5	Catastrophic

With scale 4 or 5, the system releases more power in one day than the USA uses in a year. Category 5 storms are comparatively rare, the only recent ones to affect the Caribbean being "Camille" in 1969 and "Gilbert" in 1988.

The Atlantic produces ten "named" tropical cyclones a year, of which an average of six reach hurricane strength. Hurricane frequency data between 1886 and 1980 show that the number of hurricanes peak in September and, of the six a year, 1.6 (average) reach the US coast.

[see **The Financial Impact: Hurricanes**]

### **SUMMER STORMS:**

**TORNADOES** A tornado is a violently rotating narrow column of air, which averages about 100m in diameter, and extends to the ground from a cumuloform cloud. The United States leads the world in tornado hazard but, when an adjustment is made for size of the country, it has been claimed that the tornado frequency in Italy and some mid-latitude countries is similar to that of the USA. An important difference seems to be that the USA suffers from very large and intense events. The damage potential from these storms is highly skewed. For example, only some 3% of the 900 tornadoes which occur in the US each year are responsible for most of the \$200 million annual property loss. For example, the Kalamazoo tornado of 1980, alone, caused total property damage estimated at \$50 million.

The tornado hazard is highly concentrated in time and space. Over half of all US tornadoes develop in the spring and there is a marked decrease after the summer solstice. Annually, the maximum tornado frequency is located in central Oklahoma, which experiences approximately ten tornadoes per year, although the most destructive storms tend to occur north and east of this area. In Canada, which experiences 20-50 events per year, tornadoes reach maximum frequency later in the season than the USA.

**HAILSTORMS** International comparisons of hail-related losses are notoriously difficult but, for small areas (<1500km<sup>2</sup>) there is some evidence that the greatest impact is suffered in the Province of Asti, northern Italy, where the major crop is high-value wine grapes.

Comparisons of hail hazard are difficult because the key characteristic of hail is its enormous variability in size, time and space. Most places in the US experience only two or three hailstorms per year and only one in ten or

twenty of these may ever produce seriously damaging hail.

## **S E V E R E      W I N T E R      S T O R M S**

**SEVERE WINDSTORMS** Severe windstorms, frequently accompanied by heavy rain, are usually associated with deep mid-latitude depressions. The greatest damage is sustained in coastal areas where wind-driven waves encroach upon the shoreline eroding sea-defences and other structures. For example, in the winter of 1977-78 a combination of strong waves, local storm surges and high tides caused an \$18 million loss along the coast of California. Even greater losses were recorded in 1982-83 when beaches were eroded with consequent losses to shoreline properties. Some major world cities, such as Venice and London, are subject to increasing storm surge hazard because of long-term subsidence and rising sea levels resulting from projected global warming.

For Britain, it has been estimated that an average of about 20,000 buildings are damaged by windstorms each year at a direct cost of at least £13 million in annual repair and replacement. Nearly 85% of the damage, which is suffered mainly by domestic properties, occurs between November and March.

In October 1987, a small depression deepened very rapidly in the Bay of Biscay and then moved over seven European nations from Portugal to Scandinavia. The storm created most losses in southern England, most damage to infrastructure being caused by falling trees. The total insurance bill was estimated at £1 billion to £2 billion. In January 1990, a similar storm struck more widely across England. Despite being well forecast, estimates suggest that insurance losses would exceed those paid out for the October 1987 storm, much of it to motorists.

### **HYDROLOGIC HAZARDS: FLOODING**

Flooding is the most common of all environmental hazards. The reason lies in the widespread geographical distribution of river valleys and low-lying coasts, together with their long-standing attractions for human settlement.

The nature and scale of flood risk varies greatly, even within the Developed Countries. Thus, in the US, river flooding (including mud and debris flows) accounted for nearly two-thirds of all federally declared disasters between 1965 and 1985.

In an international comparison of flood risk in selected Developed Countries, it was concluded (Handmer, 1987) that less than 2% of the population of England and Wales, and in Australia, was exposed to flooding compared with almost 10% of people in the USA. Risk exposure show little relationship to overall population density because flood risk is highly concentrated in built-up areas. Thus, though New Zealand has a low population density, nearly 70% of New Zealand towns and cities with populations in excess of 20,000 have a river flood problem.

Before the 1961, flood cover was typically excluded for buildings in the UK but, following major floods in the 1960s, flood cover became part of standard comprehensive insurance policies.

A major weakness of commercial insurance is that not all flood-prone households elect to take cover and many of those that do will be underinsured. Premiums paid by private householders rarely take into account hazard exposure.

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