What is a flood?
Defining flood loss occurrences for reinsurance purposes
Background

The August 2002 floods in central Europe showed once more that the loss occurrence clauses currently used in the market do not provide a clear definition of flood for underwriting purposes. Primary insurers and reinsurers are often divided on where the line should be drawn between different flood loss occurrences and the number of occurrences involved in a particular case. Geoscientists and meteorologists analyse the complex atmospheric conditions in an attempt to define the individual loss occurrences using meteorological parameters such as low-pressure systems. However, where flood is concerned the uncertainties remain.

Consequently, Munich Re has drafted a loss occurrence clause for the flood peril designed to avoid such situations to a large extent at least, if not entirely. The primary concern here was to establish legal certainty between insurers and reinsurers. Compared with the current position, the difference is that the contracting parties will be in agreement as to how the issue of flood loss occurrence is to be resolved for underwriting purposes from the time the contract is concluded.
Even historical monuments did not escape the August floodwaters. Here, the Zwinger Palace and the Semper Opera in Dresden.
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From cause to flood to loss occurrence – A problem of definition

Cause – Loss occurrence: What is the missing link?

The most common loss occurrence clauses, particularly in catastrophe covers, are hours clauses, for example the different versions of the LPO 98a or, in the United States, the NMA 2244 a), b) and c).

The loss occurrence is derived from each of the individual losses directly occasioned by one and the same catastrophe. The hours clauses explain neither the precise meaning of the expression “one catastrophe” nor how a loss occurrence as such should be defined and circumscribed. In practice, it is generally accepted that catastrophes can be defined in terms of the losses resulting from such perils as windstorm or earthquake, since they can often be traced back to a single cause such as a low-pressure system. In addition to that, the loss occurrence is limited by the hours clause.

There is a broad consensus that these clauses are not an ideal way to define loss occurrences as they tend to be vague, particularly where flood is concerned.

The clauses do not treat flood as a separate peril, loss occurrences attributable to flood being dealt with under the collective 168-hours rule (“168 consecutive hours ... whatever nature ... not mentioned in ... above”).

However, floods can be caused by a number of weather systems. If there is a series of bad weather fronts, it is often difficult to distinguish between the individual low-pressure areas. Consequently, the hours clauses in themselves are not a particularly useful way of defining loss occurrences.

Scientific causal chain: Is it sufficient?

Other loss occurrence clauses go further and aim to define the occurrence in terms of the common cause (causal chain), time period and place, focussing on the scientific perspective. This approach takes the definition of loss occurrence a stage further and is, as such, a positive development. However, applying such clauses to occurrences caused by flood remains problematical since it is not always possible to establish a conclusive link between the scientific perspective and the loss occurrence.

Meteorological cause: Is it practicable?

Initially, Munich Re sought to define the flood loss occurrence in terms of a common meteorological cause. However, as we see below, this proved not to be a satisfactory solution.

Water damage results from floods triggered, as a rule, directly or indirectly by precipitation and/or snowmelt, which in turn result from high-pressure or low-pressure systems. However, when atmospheric conditions are complex, with low-pressure systems following one another in rapid succession, it is difficult to distinguish between individual loss occurrences and determine precisely how many there are. Furthermore the condition of the ground is crucial, and in particular its moisture content. How do we decide which low-pressure system triggered the flood? Was it the one which caused only the first flood damage but caused the ground to be waterlogged or the one which ultimately caused the river or lake to burst its banks?
In the year 2000 two low-pressure systems, Oratia and Nicole, follow one another in rapid succession causing floods in the UK. Complex atmospheric conditions of this kind make it difficult to draw the line between loss occurrences since it is often not possible to determine conclusively which low-pressure system is responsible for a particular flood loss.

Another problem is that low-pressure systems move, causing flood losses over extensive areas. Indeed, in some cases river flood waves can cause damage days if not weeks after precipitation has fallen, and at an entirely different location. Similarly, two separate low-pressure systems could cause a rise in the levels of two rivers which converge at some point along their course, with resulting floods downstream of the confluence. Does that constitute one loss occurrence or two?
New approach to a flood loss occurrence definition

The causes and effects of the flood peril are so diverse (complex atmospheric conditions, flash floods, snowmelt, etc.) that it is difficult to formulate a definition of loss occurrence which caters for all eventualities.

Thus, we wanted to find a solution that would include most if not all flood scenarios, but would still not be too complex and could be included in international contracts. In the interests of simplification, the flood extension was designed to be incorporated into existing occurrence clauses. We have taken the LPO 98a, which is widely used and accepted in Europe, as an example.

Essentially, the idea is to aggregate all flood losses occurring in a specific geographical area over a given period of time. The sum of the flood losses within those limits constitutes the aggregate loss and is deemed in the clause to be the loss occurrence.

The clause in detail
[see in particular page 7, item d]

- A loss occurrence comprises any water loss whatsoever due to a natural cause such as precipitation or snowmelt. However, it does not include water damage directly occasioned by unnatural causes, such as the bursting of a dam or pipe. Where applicable, such damage would be covered as before under the 168-hours rule (item f). If a dam or dyke were breached due to flood, the resulting losses would be dealt with under the new item (d).

- The natural event triggering the flood loss is no longer relevant. Losses occasioned by all floods occurring within a given period of time and within a prescribed area can be aggregated to form a single loss occurrence.

- Only water losses are included in the aggregation, and not losses due to storm surge. Losses due to a combination of flood and other perils, such as windstorm, continue to be dealt with under item (e), the 72-hours clause, and not under the new flood occurrence definition. Item (e) applies only if the loss occurrence is due to a combination of at least two of the perils named under a) to d), hence the inclusion of the words “two or more”.


**Definition of Loss Occurrence: LPO 98A amended for flood**

The term “loss occurrence” shall mean all individual losses arising out of and directly occasioned by one catastrophe. However, the duration and extent of any “loss occurrence” so defined shall be limited to:

a) 72 consecutive hours as regards a hurricane, a typhoon, windstorm, hailstorm and/or tornado

b) 72 consecutive hours as regards earthquake, seakeak, tidal wave and/or volcanic eruption

c) 72 consecutive hours and within the limits of one City, Town or Village as regards riots, civil commotions and malicious damage

d) As regards flood the term “loss occurrence” shall be considered as the sum of all individual losses arising out of and directly occasioned by all instances of inundation occurring during one of the below-mentioned time periods and within one of the corresponding areas (as defined below), due to natural perils, provided such instances are not due to or otherwise caused by storm surge or by any of the perils mentioned in a) to c) above.

- 168 consecutive hours and within one category 1 river basin area; the geographical areas of category 1 river basins are defined in Appendix No. 1*

- 504 consecutive hours and within one category 2 river basin area; the geographical areas of category 2 river basins are defined in Appendix No. 1*

- 168 consecutive hours and within any remaining area of one country; the “remaining area of one country” shall mean the area which does not belong to a category 1 or 2 river basin area. Such an area shall be restricted to the national territory of one country.

e) 72 consecutive hours as regards any “loss occurrence” which includes individual loss or losses from any of the perils mentioned in two or more of (a), (b), (c) and (d) above.

f) 168 consecutive hours of any “loss occurrence” of whatsoever nature which does not include individual loss or losses from any of the perils mentioned in (a), (b), (c) and (d) above.

and no individual loss from whatever insured peril, which occurs outside these periods or areas, shall be included in that “loss occurrence”.

The Company may choose the date and time when any such period of consecutive hours commences and if any catastrophe is of greater duration than the above-mentioned periods, the Company may divide that catastrophe into two or more “loss occurrences”, provided no two periods overlap and provided no period commences earlier than the date and time of the happening of the first recorded individual loss to the Company in that catastrophe.

* Appendix 1 lists all Category 1 and 2 river basin areas. Their geographical extent is based on data supplied by the GRDC (Global Runoff Data Centre) and published on its website http://grdc.bafg.de. The GRDC operates under the auspices of the World Metereological Organization (WMO) at the German Federal Institute of Hydrology (BfG). Munich Re has converted the geographically defined river basin areas into loss accumulation zones. These are binding for the purpose of this clause and are also listed on the website: www.munichre.com/floodevent.
Definition of geographical and time limits

- The loss occurrence produced by adding together the individual losses is subject to temporal and geographical limits.

- These are divided into three categories. Different time limits apply, depending on the size of the area. A distinction is drawn between medium-sized and large river basins and remaining areas.

- The data on river basins around the world and their geographical limits were compiled by the Global Runoff Data Centre (GRDC) and are available on their website (http://grdc.bafg.de). The GRDC operates under the auspices of the World Meteorological Organization (WMO) at the German Federal Institute of Hydrology (BfG). The basins are named after the main river.

- The river basins concerned are those with an area of more than 30,000 km², whose main river discharges into the sea or into a lake.

- They fall into one of two categories: medium-sized, i.e. 30,000–100,000 km², such as the Po and Garonne, and large, i.e. in excess of 100,000 km², for instance the Rhine and the Danube. Losses that belong to neither category are deemed to have occurred in remaining areas. Such areas are restricted to the national territory of the country. A remaining area can cover an entire country, even if the flooded areas are not contiguous.

- There is a relatively high correlation between the flow length of the main river and the size of the basin. The flow lengths of the rivers in the respective categories were compared with the typical flood wave speed in order to establish time limits for the loss occurrences. Using the well-known hours periods in the market as a model, the time limits laid down for aggregating flood losses were defined as follows: 168 hours for medium-sized river basins, 504 hours for large ones and 168 hours for remaining areas.

The novel aspect of this clause is that the natural event triggering the loss is no longer relevant as far as the definition of loss occurrence is concerned. This is now determined by finding the sum total of flood losses which occur within the predefined geographical and temporal limits.

<table>
<thead>
<tr>
<th>Limit</th>
<th>Geographical</th>
<th>Temporal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
<td>Medium-sized river basins approx. 30,000–100,000 km²</td>
<td>168 hours</td>
</tr>
<tr>
<td>Category 2</td>
<td>Large river basins &gt; approx. 100,000 km²</td>
<td>504 hours</td>
</tr>
<tr>
<td>Category 3</td>
<td>Remaining areas National territory</td>
<td>168 hours</td>
</tr>
</tbody>
</table>
Munich Re, What is a flood?

New approach to a flood loss occurrence definition

Examples showing how the clause applies

a) Under the new clause, the floods in the Elbe (Category 2) and Danube (Category 2) river basins on 12–20 August 2002 are treated as two loss occurrences, although caused by a single low-pressure system (Ilse). Flooding in southwest Rumania on 11 August is not a separate occurrence since it also occurred in the Danube river basin within the prescribed 504-hour period.

b) There were simultaneous floods in southeast England and Scotland in the period 9–11 October 2000. The Thames river basin was also affected but, being less than 30,000 km² in area, it does not meet the criteria applicable to either category of river basin. Thus, each of the losses occurred in a remaining area which extends as far as the national boundaries of Great Britain. Although geographically separate areas were affected, the floods must be ascribed to one occurrence. The total damage is subject to the 168-hours’ rule.

c) The floods which began in the United Kingdom on 28 October 2000 constitute a new event. They were caused by two low-pressure systems, Oratia and Nicole, but this is irrelevant as far as the new definition of loss occurrence is concerned. The next low-pressure system, Rebecca, extended the period of uninterrupted flooding to 10 November. Thus, there were two events, the first lasting from 28 October to 3 November (168 hours) and the second commencing on 4 November.

d) At the beginning of March 1999, torrential rain in eastern Hungary caused substantial damage along the Tisza and the Danube. A few days later, a sudden snowmelt in Germany caused flooding on the upper reaches of the Danube. All the affected areas were situated in the basin of the river Danube (Category 2) and the losses occurred within a 504-hour period. This then constitutes one loss occurrence and the losses can be aggregated.

e) In January 1995, there were floods in Germany, France, Luxembourg, Belgium and the Netherlands. In addition to the river basins of the Rhine and Danube, areas of the Netherlands and Belgium were affected which drain into neither river. Although only one major weather pattern was responsible for the flood, it results in at least four insurance losses: the Rhine (504 hours), the Danube (504 hours) and the remaining areas of Belgium (168 hours) and the Netherlands (168 hours).
Advantages of the enhanced loss occurrence definition

- As long as the current uncertainties persist regarding the definition of loss occurrence, flood losses will inevitably entail protracted discussions between insurers and reinsurers, the outcome of which will not always be satisfactory to all concerned. The advantage of the loss occurrence definition extended to include flood compared with the current LPO 98a definition is that the flood peril is clearly named and defined.

- The new clause gives insurers and reinsurers objective limits by which to determine the extent of loss occurrences caused by the flood peril, leaving no room for different interpretations.

- The clause is based on river basin areas or remaining areas which simultaneously constitute loss accumulation zones. This approach facilitates accumulation assessment and loss scenario modelling for insurers and reinsurers.

- Neither insurer nor reinsurer finds itself at a disadvantage. Whether the clause operates in favour of one or other depends on the prevailing atmospheric conditions and the geographical distribution of the insurance portfolio concerned.

Thus, in scenario 1, the insurers can aggregate a number of water losses, provided they fall within the prescribed temporal and geographical limits. In scenario 2, the individual losses can no longer be added together to constitute a single loss occurrence because they involve several river basins and remaining areas.

- The clause is suitable for inclusion not only in regional but also in international contracts.

- National boundaries are used to precisely delimit the remaining areas. The main river basin database is administered by a neutral, independent and internationally recognised organisation.

Effects on reinsurance demand and structure

Essentially, the effects of applying the clause further developed by Munich Re would appear to be threefold:

- It enhances the accuracy of insurers’ PML calculations. This may influence priority levels and increase demand for catastrophe coverage.

- In view of the extended time periods and geographical limits, insurers and reinsurers will have to reach agreement on the number of reinstatements.

- Insurers will be called upon to supply additional information on losses. Precise locations and times will be required so that the individual losses can be allocated to the appropriate temporal and geographical categories.

Implementing the clause

- The extent of the river basin is essentially based on GIS data published by the GRDC. For insurance and reinsurance purposes, Munich Re has, to date, converted the European data into accumulation zone data.

- The river basins will be defined by means of the geographical grid used to record windstorm and earthquake exposure data, e.g. CRESTA or postcode zones. The resulting data can be used to produce models and to precisely allocate losses to an occurrence.

- The loss accumulation zones allocated to the individual river basins are listed in the appendix to the clause and are binding. To ensure the database is available in the long term and on an independent basis, the clause and appendix will also be published at www.munichre.com/floodevent.

Summary

Munich Re’s objective is to remove existing uncertainties. Europe presents the greatest difficulty due to the large number of river basins, and this is where insurers and reinsurers alike stand to benefit most from the new concept. However, the clause can also be included in international contracts. Munich Re, with its extensive knowledge of data generation and data conversion, has the necessary expertise to divide the river basins into loss accumulation zones, thus providing support in exposure assessment. Our intention is to make this service available to our clients and to the market as a whole. A further service currently offered to clients is the provision of Flood-PML calculations for Germany and the UK.

If you would like to find out more about our approach to the issue, we will be pleased to discuss its implications for reinsurance structures and data requirements with you and give you appropriate guidance.
New approach to a flood loss occurrence definition.

The graphic shows the Rhine-Meuse river basin together with their Cresta or postcode zones, depending on which system is used for accumulation assessment in the country concerned. The zones located in the Rhine-Meuse area are summarised in the following table.

<table>
<thead>
<tr>
<th>Switzerland</th>
<th>Austria</th>
<th>Liechtenstein</th>
<th>France</th>
<th>Germany</th>
<th>Luxembourg</th>
<th>Belgium</th>
<th>Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cresta</td>
<td>Postcode zone</td>
<td>Cresta</td>
<td>whole country</td>
<td>Cresta</td>
<td>Postcode zone</td>
<td>whole country</td>
<td>Cresta</td>
</tr>
<tr>
<td>1–7</td>
<td>6700</td>
<td>8</td>
<td>33098</td>
<td>3–6</td>
<td>10–12</td>
<td>20–36</td>
<td>39–42</td>
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<td>67</td>
<td>33102</td>
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</table>
List of river basins
The allocation to loss accumulation zones is not shown

The data on river basins around the world and their geographical limits were compiled by the Global Runoff Data Centre (GRDC). The GRDC operates under the auspices of the World Meteorological Organization (WMO) at the German Federal Institute of Hydrology (BfG).

Europe

Category 1 (30,000–100,000 km²)
1 Guadalquivir
2 Guadiana
3 Tejo
4 Douro
5 Ebro
6 Garonne
8 Seine
9 Rhone
10 Po
12 Weser
17 Neman
18 Western Dvina (Daugava)
19 Narva
21 Dniestr
22 Southern Bug
23 Sakarya
24 Kizilirmak
25 Kuban
31 Vuoksi
32 Kymijoki
33 Glomma
34 Vaennern-Goeta

Category 2 (> 100,000 km²)
7 Loire
11 Rhine-Maas
13 Elbe
14 Oder
15 Danube
16 Wisla
20 Dniepr
26 Don
27 Ural
28 Volga
29 Northern Dvina (Severnaya Dvina)
30 Neva
Africa

Category 1 (30,000–100,000 km²)

2 Gambia 15 Tugela 16 Maputo 17 Incomati

Category 2 (> 100,000 km²)

1 Senegal 3 Niger 4 Volta 5 Sanaga 6 Lake Chad 7 Nile 8 Shebelle 9 Rufiji 10 Congo 11 Ogooue 12 Zambezi 13 Okavango 14 Orange 18 Limpopo 19 Save
Asia and Australia

Category 1 (30,000–100,000 km²)

Asia
10 Luan He
19 Mahi River
20 Narmada
21 Tapti River
24 Cauvery River
27 Brahmani River (Brahmani)
31 Sittang River
37 Bei Jiang (Pearl R. North)
38 Dong Jiang (Pearl R. East)

Category 2 (> 100,000 km²)

Asia
1 Tigris & Euphrates
2 Pechora
3 Ob
4 Pur
5 Yenisei
6 Lena
8 Amur
9 Liao He
11 Yongding He
12 Huang He (Yellow River)
13 Huai He
14 Chang Jiang (Yangtze River)
15 Tarim
16 Aral Sea
17 Indus
18 Ganges
22 Godavari
23 Krishna
26 Mahanadi
29 Brahmaputra
30 Irrawaddy
32 Salween
33 Chao Phraya
34 Mekong
35 Hong (Red River)
36 Xi Jiang (Pearl R. West)

Australia
39 Burdekin
40 Fitzroy
41 Murray
North America

Category 1 (30,000–100,000 km²)

2 Skeena River  31 Churchill, Fleuve (Labrador)
8 Klamath River  32 George River
9 Sacramento River  34 Aux Melezes
10 San Joaquin River  35 Feuilles (Riviere Aux)
12 Yaqui  36 Arnaud
17 Trinity River (Texas)  38 Eastmain
20 Apalachicola River  42 Attawapiskat River
21 Altamaha River  44 Severn River
22 Santee River  (Trib. Hudson Bay)
23 Pee Dee River
24 Potomac River
25 Susquehanna River
26 Hudson River
28 Saint John River
29 Saguenay (Riviere)
30 Manicouagan (Riviere)

Category 2 (> 100,000 km²)

1 Yukon River
3 Fraser River
4 Mackenzie River
5 Churchill River
6 Nelson River
7 Columbia River
11 Colorado River (Pacific Ocean)
14 Bravo
15 Colorado River (Caribbean Sea)
16 Brazos River
18 Mississippi River
19 Alabama River & Tombigbee
27 St. Lawrence
33 Caniapiscau
37 Grande Riviere
39 Nottaway
40 Moose River (Trib. Hudson Bay)
41 Albany River
43 Winisk River
45 Hayes River (Trib. Hudson Bay)
South America

Category 1 (30,000–100,000 km²)

3 Cuyuni
4 Essequibo
5 Corantijn
6 Maroni
7 Rio Araguaí
10 Rio Capim
11 Rio Gurupi
12 Rio Pindare
13 Rio Mearim
14 Rio Itacuru
16 Rio Jaguariibe
18 Rio Itapicuru
19 Rio Paraguacu
20 Rio De Contas
21 Rio Prado
22 Jequitinhonha
23 Rio Doce
24 Paraiba Do Sul

Category 2 (> 100,000 km²)

1 Magdalena
2 Orinoco
8 Amazonas
9 Tocantins
15 Rio Parnaíba
17 Sao Francisco
25 Parana
26 Uruguay
27 Salado
28 Colorado (Argentina)
29 Negro (Argentina)
30 Chubut