
FTS Summary on STARDEX Deliverable 9**"Summary of the analysis of extremes, their causes and damages"**

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1. Analysed types of extremes

FTS concentrated on the following European extremes:

1. Severe winter storms in Western, Central and Northern Europe
2. River flooding in Southwest and Western Germany and the neighbouring Benelux countries.
3. Summer river flooding in Central and Eastern Europe (Odra 1997, Wisla 2001, and the dramatic Elbe 2002 flood.
4. River flooding , flash floods, landslides in the Southern Alpine region.

The summary of the results are given in Tab. 1 (File: FTS_D9_summary.xls). The sum of the economic losses of the major extremes with more than US \$ 1 billion per extreme, are exceeding **90 billion US \$**.

2. Causes of the extremes

The analysis of the extremes revealed that different atmospheric circulation patterns (CP) are associated with the extremes in the different European regions. These causing CPs are called "critical" CPs for European extremes.

2.1 Zonal circulation in winter and extremes in Western and Central Europe

The severe winter storms (Tab. 2) in Western, Central and Northern Europe of the last 50 years as well as most of the major river floodings (see Tab. 3) in Southwest and Western Germany during the last 80 years were linked to zonal circulations. Using the subjective classified CP indices of the "Großwetterlagen Europas" it was found that most of the severe winter storms and river floodings happened during long lasting periods of CP type "**West cyclonic (Wz)**". But also the zonal types wW (winkelförmige Westlage) and Ws (südliche Westlage) are contributing to these extremes to some extend. Therefore the CP types **Wz, Ws** and **wW** are "**critical CPs**" for these extremes. All the major river floodings in this region were caused by long lasting heavy rainfall covering large areas during December till February. The severe storms were observed from late autumn (Oct.) till February. Therefore the zonal circulation types (Wz, Ws and wW) are most critical during winter.

2.2 Circulation type V b in summer and extremes in Central and Eastern Europe

The Dutch meteorologist **van Bebbber** (1841-1909) classified the tracks of Atlantic low pressure systems from I a to VI b. One of the most important track is circulation type **V b**. Track V b starts in the North Atlantic, crosses Southern France and moves to Northern Italy. Low pressure systems of V b often have a tendency to turn north after crossing the Adriatic Sea. From here they often move on very slow or stay stationary. By crossing the Mediterranean Sea which has relatively high SST, the Vb-low pressure systems are taking up a lot of moisture. In the slow moving area the Vb-low with warm and moist air from the Mediterranean Sea meets cold air from the North. These contrasts of air masses often produce long lasting heavy precipitation and these are leading to river flooding in the Elbe, Odra,

Wisla and Danube basins. The heavy rainfalls of Vb were the causes of 3 major flood events during the last 5 years. During the Odra flood in July 1997, the region with the highest areal precipitation was in Northern Czech Rep. and Southwestern Poland. During the Wisla flood in July 2001 the highest precipitation amounts were observed in Northern Slovakia and Southern Poland. During recent Elbe Vlatava and Danube flood in August 2002 precipitation amounts was very high in Bohemia, in the Southeast of Eastern Germany, in Northwest Austria and Southeast Bavaria. Highest precipitation amount was observed on August 12, 2002 at station Zinnwald near Dresden with 312 mm in 24 hours. As Tab. 4 shows, this extreme events caused dramatic economic losses of more than 18.6 billion EUR in Europe. About EUR 9.2 billion losses were summarized for Eastern Germany and Bavaria, about EUR 3 billion for Austria, EUR 2.3 billion for the Czech Republik. Additionally Northern and Central Italy had damages, Slovakia and Hungary to a lesser extend.

It is obvious that despite the fact that different major river basins were affected by the 1997, 2001 and 2002 flood events the causing atmospheric circulation pattern was similar. It was type Vb in all cases. The difference of the events was that the center of the more or less stationary lows and by this of the areas with the highest precipitation amounts was shifted to some extend more to the East or West.

2.3 Southern circulation in summer and autumn and extremes in the southern Alpine region

During summer and autumn (July - Nov.) long lasting southern circulation types like Sa (Südlage antizyklonal = southern circulation, anticyclonic), TB (Tief Britische Inseln = Low across the British Isles) and TrW (Trog Westeuropa Western European trough) are taking up a lot of moisture by crossing the Mediterranean Sea which has relatively high SST at that time of the year. When these warm and moist air masses are directed towards the orographic barrier of the Alps they are lifted. During this lifting process they are cooling down and loose most of their moisture in form of very intensive long lasting precipitation. Highest precipitation amount was observed on October 13, 2000 at station Bognanco in the Ticino river basin 402 mm in 24 hours [Munich Re, 2001]. Typically these events happen during Sept. till November. These circulation types are causing river flooding, flash floods and landslides in Northern Italy and parts southern of the Alp barrier of Switzerland, France and Austria. As Tab. 5 shows, the extreme event of October 2000 caused economic losses in northern Italy and Switzerland of US \$ 8.5 billion.

3. Damages

The damages of the analysed extremes are summarized in Tab. 2 to Tab. 5. The damages are mostly taken from the Munich Re CD "World of Natural Hazards" [Munich Re, 2000], the Munich Re annual reviews on natural catastrophes [Munich Re, 2001, 2002, 2003], and from the Munich Re NatCat Service. The damages are given as economic losses, insured losses and fatalities. The tables also give the periods and types of the subjective classified CPs, which were associated with the observed extremes. The CPs are taken from DWD [2002].

4. References

- Bundesanstalt für Gewässerkunde (BfG), 2002: Das Augusthochwasser im Elbegebiet. Koblenz, pp. 49 (available as pdf (4.9 MB) from www.bafg.de).
- Bundesministerium des Innern (BMI), 2002: Bundesregierung zieht vorläufige Schadensbilanz der Hochwasserkatastrophe. Pressemitteilung des BMI v. 06.11.2002.
- Caspary, H. J., 2001: Zusammenhang zwischen der Verschärfung des Hochwasserrisikos in Südwestdeutschland seit Mitte der siebziger Jahre und einem veränderten Winterklima. *GAIA - Ecological Perspectives in Science, Humanities, and Economics* 10, No. 4, pp. 286-293.

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- Caspary, H. J., 2002: Major river floods and severe winter storms linked to changes of the atmospheric circulation across Europe. *XXVII General Assembly of the European Geophysical Society (EGS)*, Nice, France, 22-26 April 2002.
- Deutscher Wetterdienst (DWD), 2002: Extreme precipitation amounts in central Europe from 1.-13. August 2002, pp. 7, (available as pdf (1 MB) from www.dwd.de/en/FundE/Klima/KLIS/prod/spezial/regen/index.htm)
- Deutscher Wetterdienst (DWD), 2002: Die Großwetterlagen Europas. Monatliche Publikation, Selbstverlag des DWD, Offenbach. Seit 01.01.2002 unter www.dwd.de/
- Fuchs, T., Rapp, J., 1998: Two spells of unusual heavy rainfall caused the flooding of the Odra river 1997. DWD Klimastatusbericht 1997. pp. 24-27. (available as pdf (200 KB) from www.dwd.de/en/FundE/Klima/KLIS/prod/spezial/regen/index.htm).
- Fuchs, T., 2000: Heavy precipitation during autumn 2000 in Europe. Global Precipitation Climatology Center (GPCC) at the DWD, pp. 4, (available as pdf (640 KB) from www.dwd.de/en/FundE/Klima/KLIS/prod/spezial/regen/index.htm).
- Fuchs, T., Rudolf, B., 2001: Analysis of precipitation leading to the flooding of the Wisla river in July 2001 in comparison to the flooding of the Odra river in 1997. pp. 4. (available as pdf (380 KB) from www.dwd.de/en/FundE/Klima/KLIS/prod/spezial/regen/index.htm)
- Munich Re, 1999: Topics 2000 - natural catastrophes - the current position, Munich, pp. 126. (available as pdf (12 MB) from www.munichre.com).
- Munich Re, 2000: World of natural hazards. CD-ROM, Munich.
- Munich Re, 2001: Topics - Jahresrückblick Naturkatastrophen 2000. München, 56 S.
- Munich Re, 2002: Winter storms in Europe (II) - Analysis of 1999 losses and loss potentials, Munich, pp. 72. (available as pdf (2.8 MB) from www.munichre.com).
- Munich Re, 2002: Topics - Annual review: natural catastrophes 2001. Munich, pp. 44, (available as pdf (2.8 MB) from www.munichre.com).
- Munich Re, 2002: Flooding in central and eastern Europe August 2002. MRNatCat poster 31, Munich, Dec. 2002, (available as pdf (1.0 MB) from www.munichre.com).
- Munich Re, 2002: Gale Jeanett: Western/Central Europe, 27th/28th Oct. 2002. MRNatCat poster 34, Munich, (available as pdf (600 kB) from www.munichre.com).
- Munich Re, 2003: Topics - Annual review: natural catastrophes 2002. Munich, pp. 48, (available as pdf (3.8 MB) from www.munichre.com).

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