European Severe Storms Laboratory

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Using the European Severe Weather Database for climatological analyses

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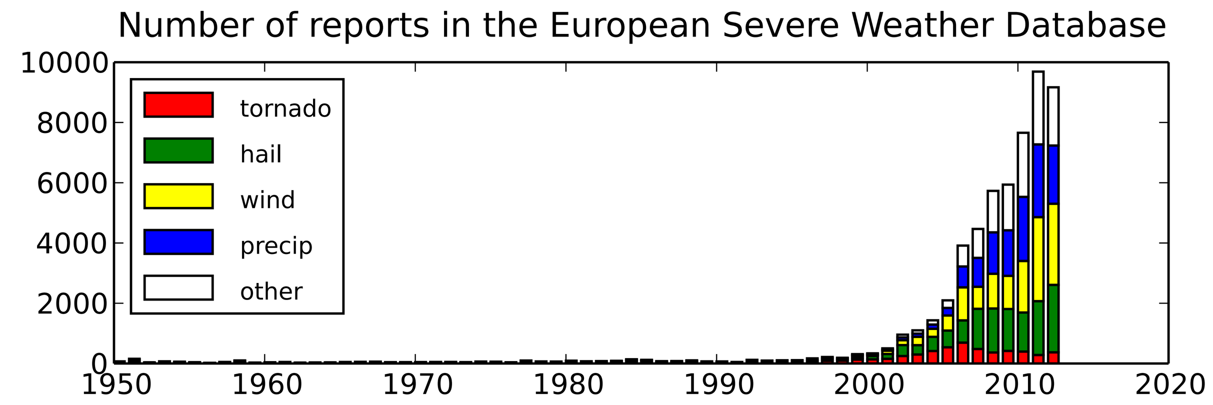
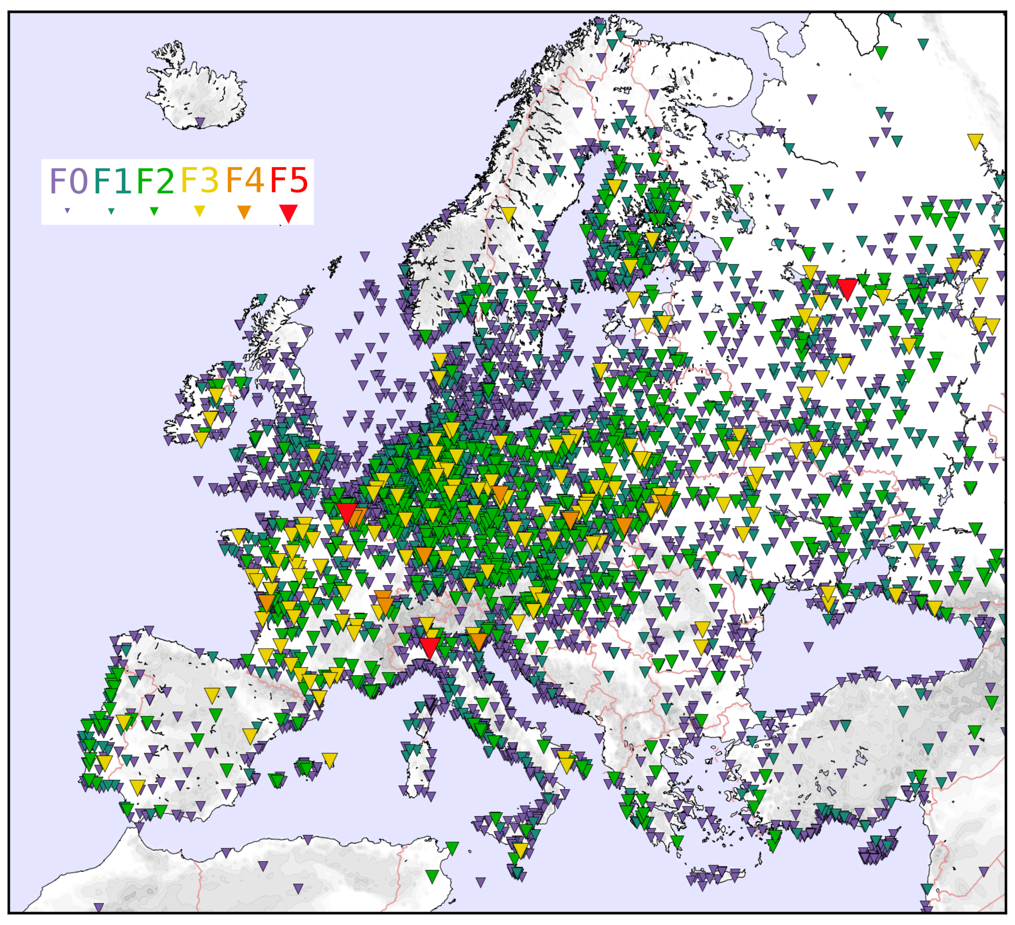
The database and its limitations

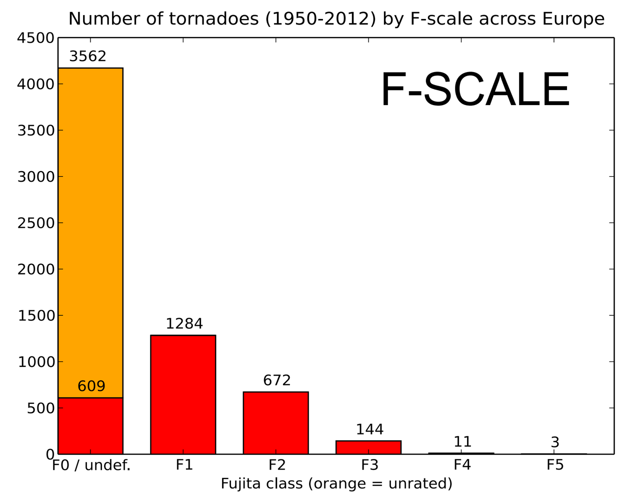
Maintaining and developing the European Severe Weather Database (ESWD) is one of the primary objectives of the European Severe Storms Laboratory since its foundation in 2006. The ESWD contains an increasing number of reports of severe weather phenomena across Europe (defined as WMO Region VI). These reports are collected with help of networks of voluntary observers and National (Hydro-)Meteorological Services throughout Europe.

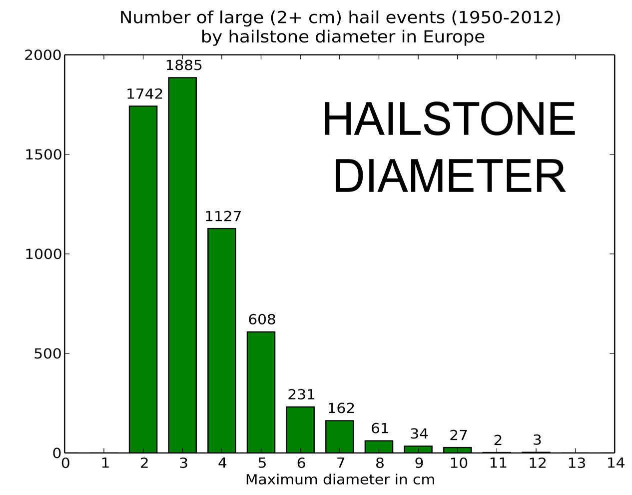


Changes in reporting rates of severe weather over time (above) and regional differences (right) are clearly visible in the data set. We set out to find what climatological analyses are possible and how.

Tornadoes (1950-2012) in the European Severe Weather Database

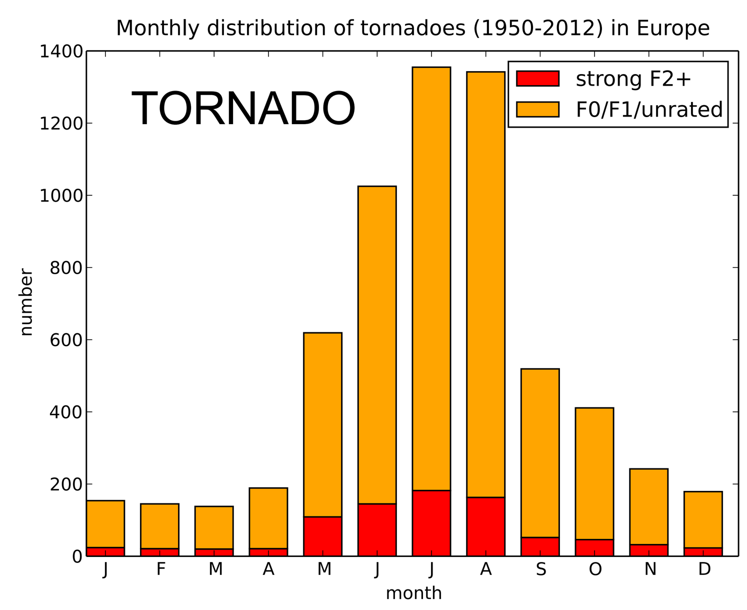


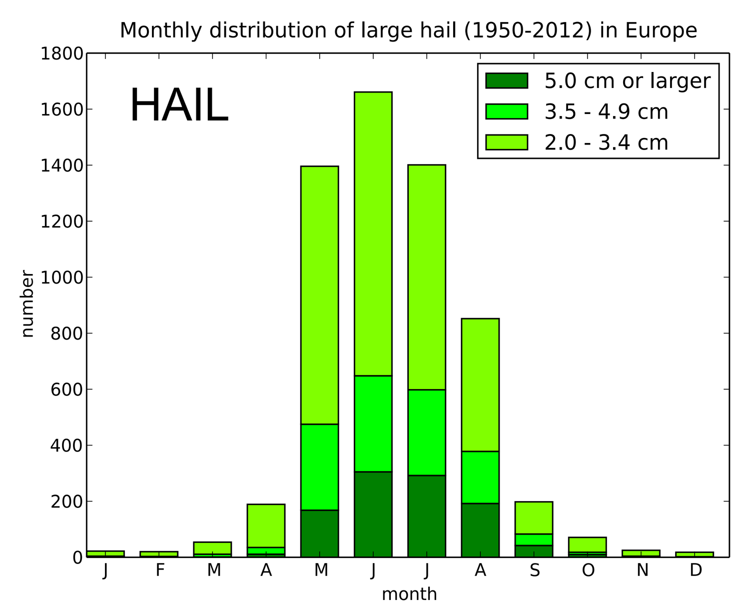




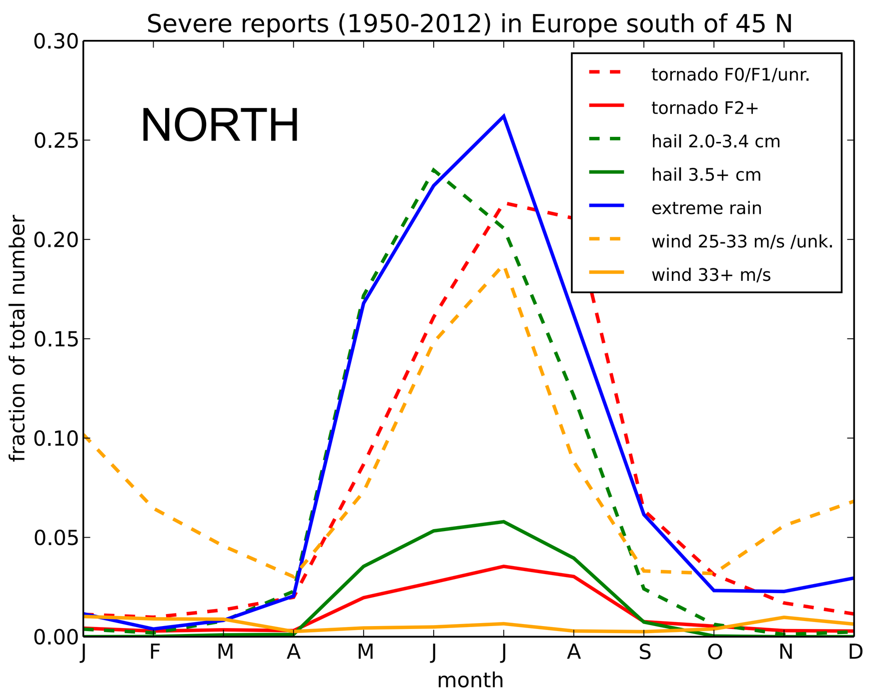
Intensity distributions are sensitive to secular effects: the more intense an event, the more likely that it will be reported. But, with better reporting infrastructure more weak events are reported, too. The differences in reporting practices among countries are evident from the tornado map above.

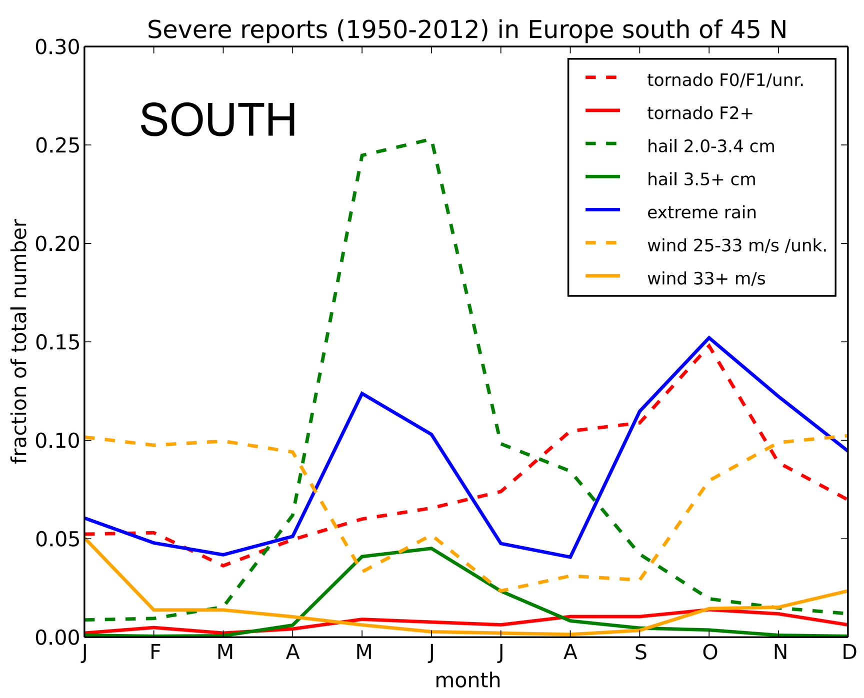
Annual cycles

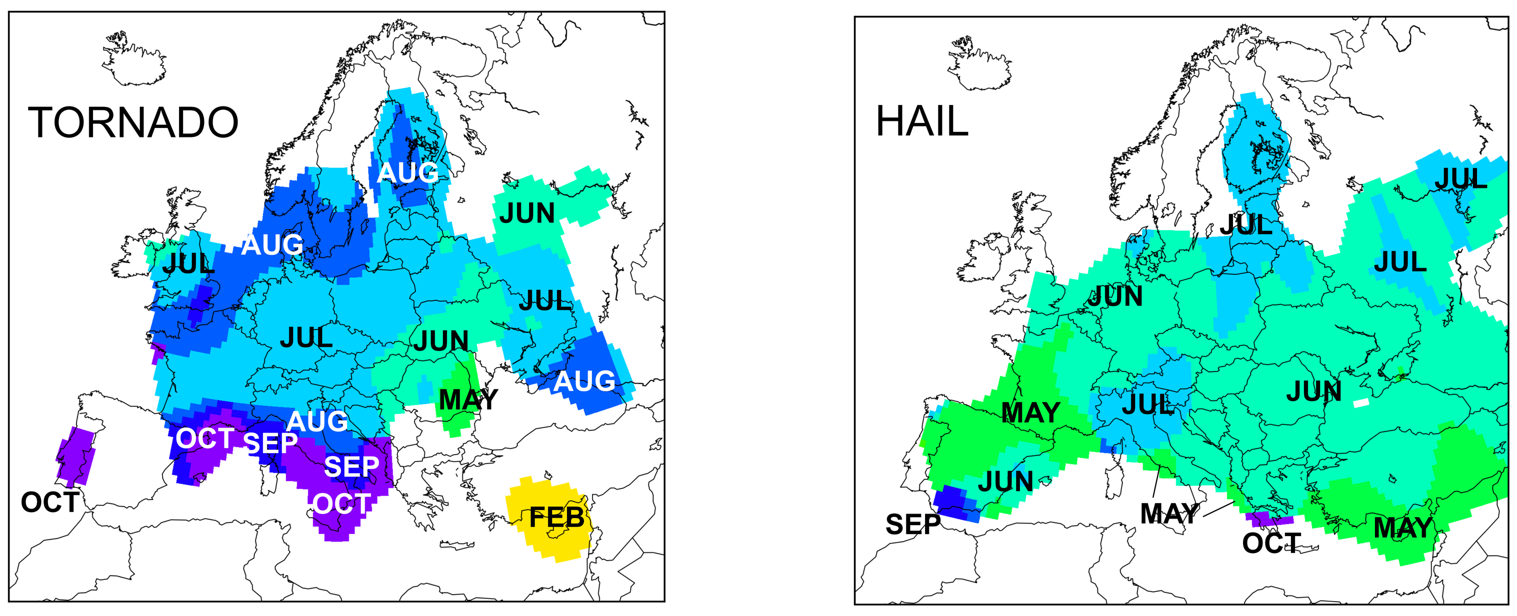




Even annual cycles for Europe as a whole (top) are biased towards areas with higher reporting rates. In Europe, reporting efficiency is likely much higher north of 45 N latitude, and differences in annual cycle only become evident when distinguishing between these areas (below).







Months with maximum number of tornado (left) and hail reports (right)

The maps above were produced by counting the number of severe weather events in each 0.25 bin every month. The resulting monthly fields were smoothed by a Gaussian kernel with 10 degrees of latitude standard deviation and a three-point filter in time (0.25/0.5/0.25). For each location, the month with highest value is shown.

A number of climatological conclusions can be drawn:

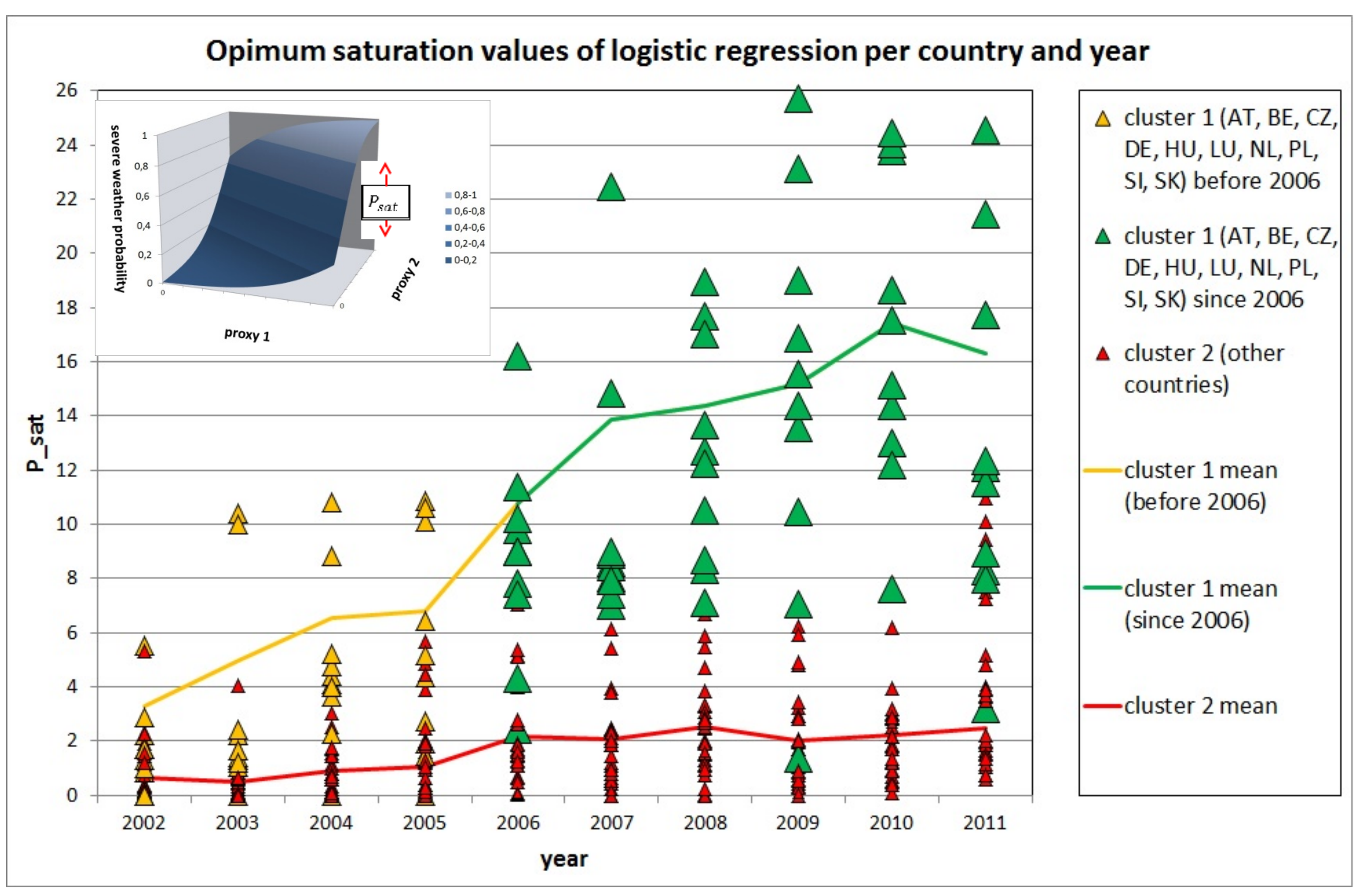
1. The Mediterranean has two maxima of convective activity, one in later spring and one in autumn. Hailfall occurs mostly during the spring maximum, tornadoes primarily in the autumn, and rainfall with both.

2. Further north, the convective season peaks in summer. The hailfall maximum occurs a bit earlier in the season than that of heavy rain and wind, while tornadoes peak last.

3. The larger hail classes go to zero in winter in northern areas.

4. Wind events have a maximum in winter. In northern areas, a clear summer maximum exists as well.

Periods and regions of relative homogenity



The observations themselves have limited use for climatological analyses because the reporting rate of severe weather events varies in space and time. Such inhomogenities can be mitigated by using a set of modelled parameters (CAPE, shear, ...) as a proxy for severe weather occurrence.

Such a proxy must be calibrated to observations in a period and region with a relatively homogeneous reporting rate. To find such a region and period, we first performed a logistic regression of the severe weather probability ***P*** as a function of sqrt(CAPE) and deep-layer shear (left top inset). Second, the saturation values of ***P*** were optimized for each country and year individually. Last, the resulting values were grouped into 2 clusters representing countries with a "high" and a "low" reporting rate (left). Our results show:

- The best spatial discrimination is between 10 Central European countries and the rest
- The mean of cluster with "high" reporting rate rises most notably between 2005 and 2006
- A quasi-homogeneous subset of data is thus formed by the reports from Austria, Belgium, Czech Republic, Germany, Hungary, Luxemburg, Netherlands, Poland, Slovenia, and Slovakia since 2006

Acknowledgements

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