



## Severe weather and psychology – Analysis of international survey data

Alexander Keul (1), Bernhard Brunner (1), Melanie Korff (1), Sanjay Sharma (2), Partha Roy (2), John Allen (3), Katie A. Bowden (4), Mat Said Aini (5), Abu Bakar Elistina (5), Mohd Zainal Abidin Ab Kadir (5), Chandima Gomes (5), and Mateusz Taszarek (6)

(1) Psychology Dept., University of Salzburg, Austria, Europe (alexander.keul@sbg.ac.at), (2) Dept. of Physics, Kohima Science College, Jotsoma, Nagaland, India, (3) International Research Institute for Climate and Society, Lamont-Doherty Earth Observatory, Palisades, New York, USA, (4) University of Oklahoma, Norman, Oklahoma, USA, (5) Universiti Putra Malaysia, UPM Serdang, Selangor, Malaysia, (6) Institute of Physical Geography and Environmental Planning, Dept. of Climatology, Adam Mickiewicz University, Poznan, Poland

Organizations including WMO, AMS, EMS and ESSL underline the importance of severe weather knowledge and preparedness of the general public. The progress in severe weather forecasting, nowcasting, and warning has to make its way into media coverage, and to get to the attention of endangered lay populations. The range and efficiency of warnings about meteorological risks are modified by economic, cultural, and psychological factors. Many factors shape the severe weather interest and preparedness of lay populations. These factors include: elementary meteorological knowledge, subjective risk assessment, access to fast media (e.g. radio, television, internet), personal exposition, and sociodemography. Previous surveys focused on the lay usage of media weather reports, with respect to frequency, interest, legibility, and trust (Germany 2006, Great Britain 2007–2009, USA 2008, Australia 2010, and Canada 2011).

### The International Severe Weather Survey

In 2012–2013, severe weather social data were sampled in Germany, Poland, USA, Australia, Brazil, India, and Malaysia for a comparative survey. 717 laypersons (mean age 36.2 years, age range 18–90 years, N=80–129/sample) in seven countries were field-interviewed with identical questionnaires written in five languages about their meteorological knowledge and interest, exposition and damage, risk assessment, severe weather anxiety, fast media access, preparedness (total 20 items), and sociodemographic variables (11 items). Also, ten lightning knowledge items were asked as a special topic not further discussed here.

### Results

After a presentation of first results from three countries (Brazil, India, and Germany) at ECSS2013, the full dataset was analyzed with the following key findings:

1. General - Country sample differences were highly significant (Chi square) for meteorological knowledge (Germany first, and India last) and weather interest (USA highest, and India lowest), damage experiences (Malaysia, Brazil and Australia most frequent), total weather risk assessment score (Brazil highest, and India lowest), severe weather anxiety (Malaysia highest, and Germany lowest), fast media access (USA, Poland, Australia highest, and India lowest), and preparedness (USA highest, and Malaysia lowest). Also, education levels and housing types showed significant country differences. The education level in the overall sample had no significant gender dependency. Detached house occupants reported higher flood/storm exposition, higher preparedness and less anxiety than other housing types.
2. Meteorological knowledge and weather report interest – For the whole survey sample (N=717), elementary meteorological knowledge did not depend on age or gender, but showed a highly significant education effect ( $r=-.249$ ,  $p<.001$ ; better educated know more). It significantly correlated with higher weather report interest, lower anxiety, and more preparedness. Weather report interest was not gender-dependent, but had a highly significant relation with age ( $r=-.276$ ,  $p<.001$  – older report higher interest), education ( $r=-.093$ ,  $p=.013$  – better educated more interest), and higher preparedness ( $r=.307$ ,  $p<.001$ ).
3. Previous damage and risk assessment - Respondents were asked about previous lightning, flood and storm damage to their homes. 15.2% reported lightning damage (1.3% severe, 13.9% minor), 27.0% flood damage (2.5% severe, 24.5% minor), and 44.7% storm damage (8.6% severe, 36.1% minor). The three damage categories showed high intercorrelations. As expected, previous damage did not depend on age, gender or education. Subjective lightning risk did not correlate with experienced lightning damage. Subjective flood risk was significantly linked with experienced flood damage ( $r=.250$ ,  $p<.001$ ) and tornado risk with experienced storm damage ( $r=.199$ ,  $p<.001$ ). Paradoxically, lightning damage ( $r=-.080$ ,  $p=.034$ ) and flood damage ( $r=-.188$ ,  $p<.001$ ) also meant lower preparedness. Previous storm damage had no preparedness effect for affected people.

Based on a Likert scale of 0–10 (0=low .. 10=high), main subjective weather risks were tornadoes (USA mean 9.23; Germany 8.12), floods (Brazil 9.10), heat (Malaysia 7.95), landslides (India 7.60), severe storms (Poland 7.32) and wildfires (Australia 7.23). Brazil had the highest cumulative weather risk score (69.30), while India had the lowest (44.98). The risk assessment score showed no gender, age or education dependency.

The subjective risk assessment values were compared with the Centre for Research on the Epidemiology of Disasters objective risk database EMDAT and with the Glocal Climate Risk Index (CRI). Main country risk assessments coincided with the EMDAT natural disaster statistics, with the exception of dread risks (e.g. tornadoes in Germany) and main risks due to the local climatology of the survey area (landslides in Nagaland, India; tornadoes in Oklahoma, USA). The Global CRI 1992–2011 highest weather-related death toll ranks were found for Myanmar (CRI 11.00) and India (CRI 41.17). Nevertheless, Nagaland, India had the lowest subjective cumulative risk score in our survey.

The US sample was collected in Norman, Oklahoma, shortly after an EF5 tornado hit Moore, Oklahoma on 20 May 2013. 22% reported their families as affected. The affected respondents showed higher property damage than the unaffected respondents, but both groups had identical social weather parameters.

4. Severe weather anxiety - 29% reported high severe weather anxiety, 55% sometimes, 16% no anxiety. Anxiety had no age dependency, but a highly significant correlation with gender (Chisquare=34.950,  $p<.001$  – women expressed more fear), and education (Chisquare=.132,  $p<.001$  – less educated were more afraid). Anxiety linked significantly with weather knowledge ( $r=-.298$ ,  $p<.001$ ) and the risk score ( $r=-.188$ ,  $p<.001$ ) – more knowledge resulted in less anxiety, and less anxiety resulted in a lower subjective risk assessment. The correlation anxiety – preparedness was negative ( $r=-.093$ ,  $p=.021$ ), i.e. anxiety did not stimulate precautions.

5. Fast media access - 85% of the respondents had access to fast media weather information both in normal and in severe weather conditions. Fast media access in danger showed no age, gender or education dependency. It was not different for high anxiety, but significantly higher for the weather-interested and the better-prepared.

Additional questions dealt with weather report speed and legibility, local weather access, and interest in media-issued precautions. Appropriate weather report speed was found by 45%, not always by 38%, and never by 17%. Good local weather access was reported by 58%, by 32% as not always, and by 10% as never. Interest in media-issued precautions was reported as always by 34%, only in case of severe danger by 58%, and never by 8%. Appropriate report speed and good local weather access were significantly interrelated ( $r=.352$ ,  $p<.001$ ). The better prepared needed less precautions ( $r=-.158$ ,  $p=.003$ ) whereas the less educated wanted more precautions ( $r=.111$ ,  $p=.003$ ). Women coped better with weather report speed (Chisquare=12.299,  $p=.002$ ) and in obtaining local weather reports (Chisquare=5.774,  $p=.056$ ).

6. Preparedness - 30% felt well prepared for severe weather risks, 47% partly, and 23% were unprepared. 22% reported they were well insured, 26% partly, and 52% were uninsured. Severe weather preparedness had no gender and no education dependency, but correlated with age ( $r=-.086$ ,  $p=.023$  – older people were more prepared). Preparedness was linked with weather interest ( $r=.307$ ,  $p<.001$ ), meteorological knowledge ( $r=.208$ ,  $p<.001$ ), and anxiety ( $r=-.093$ ,  $p=.021$  – better prepared people were less afraid). The better prepared reported higher fast media access each day and when in danger. Detached house owners were better prepared ( $r=.126$ ,  $p=.001$ ). As discussed, previous lightning and flood damage even correlated with lower preparedness, and storm damage showed no preparedness effect.

#### Outlook

This low-budget project obtained no representative random, but urban street samples. It offers benchmarks for the planning of future educational efforts. Previous lay media weather report usage surveys are enhanced by data on meteorological knowledge, experienced damage and preparedness. The authors suggest a continuation of the international lay user research for future risk development. Continued efforts will provide a more detailed understanding of high-risk groups, allow monitoring of public education, and assess media and forecasting innovations such as mobile phone warning applications.