# $7^{th}$ European Conference on Severe Storms ECSS 2013

# Abstracts

## Paper 2:

## MODELING AND QUANTIFICATION OF SEVERE HAILSTORM RISK IN SPAIN FROM RE/INSURANCE PERSPECTIVES

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Spain is the European country with the greatest agricultural losses caused by severe hailstorms. While there are a few studies on regional severe hail climatology in Spain based on regional hailpad measuring networks and a number of studies on the meteorological conditions and climatological interpretation of individual severe hailstorms in some regions of Spain, there has been a lack of severe hail reports for studies and investigations on the severe hail climatology in Spain at the national level. Severe hailstorm risk is a significant issue for the insurance industry. Therefore, Re/insurance companies need reliable models to analyze and quantify severe hailstorm risk in Spain.

After reviewing the quality of available Spain hail data required for simulation of severe hailstorm risks, historical hailstorm reports from 2005 through 2010 from the European Severe Storm Laboratory (ESSL) European Severe Weather Database (ESWD) are used to model the severe hailstorm risk in Spain. Monte Carlo technique is conducted to simulate the stochastic severe hailstorms using the compiled ESWD historical hail data.

To allow companies to assess their reinsurance needs at a portfolio level, the concept of severe hail event is introduced and defined as a congregation of individual hailstorms occurring within a 72-hour timeframe across Spain. The simulation process starts with simulating the probable number of severe hail events in a simulation year by sampling from the Poisson distribution fitted by the historical annual number of hailstorm events. The number of hailstorms in a hail event is modeled by an exponential distribution. The starting date of a stochastic hail event is modeled by a Weibull distribution derived based on the temporal variations of ESWD historical hail events in Spain. A two-dimensional (latitude and longitude) Gaussian kernel density smoother with the bandwidth is employed to achieve the maximum likelihood of the ESWD historical hail storm genesis locations in Spain. The optimal bandwidth for Gaussian kernel density estimation is determined using Jackknife out-of-sample likelihood maximization procedure. Physical parameters of a stochastic hailstorm, including storm path length, width, orientation, and intensity, are then simulated using different statistical distributions fitted by historical hailstorm data. The same simulation process repeats for all stochastic hailstorms to simulate up to 1,000,000-year worth of future possible severe hailstorm events in Spain.

Comparisons show that the simulated climatology of severe hailstorm risk matches reasonably well with the ESWD historical data. The severe hailstorm model developed in this study provides a reasonable quantification of the severe hailstorm risk in Spain from Re/insurance perspectives.

## Paper 184:

# Tornado and waterspout climatological risk for Greece

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Tornado and waterspouts are extreme weather events, which though rare, however can be hazardous in many aspects including economic losses for damage to infrastructure and property and a serious threat for injures and fatalities. Estimating probabilities of occurrence and risk levels is crucial for research and forecasting, damage prevention and life protection. Background tornado and waterspout data for Greece are based on an updated 14-year database. The climatological probability of tornado and waterspout days for the various Greek regions and regional unities (prefectures) is estimated and spatial and temporal threat patterns are identified. Western Greece islands and coasts exhibit the greatest tornado risk, with maxima in Elias area, northwest Peloponnesus and Corfu Island, in the Ionian Sea. Waterspout peak threat is located over north offshore of Crete Island, in the southern Aegean Sea. The annual risk cycle is different for the various parts of Greece. Northern Greece faces maximum tornado threat during summer, while southern Greece during winter. Western Greece exhibits a longer tornado seasonality, from autumn up to spring. Waterspouts develop in almost all seas with seasonal maxima in autumn.

A principal component analysis (PCA) was applied on tornado and waterspout day frequency distributions for the various Greek regional unities (prefectures). The results indicated the first component (PC1) grouping regions of western Greece, the Ionian Islands and the southern Aegean, and the second component (PC2) regions of north-central Greece. Waterspout frequency PCA analysis indicated the first component (PC1) including the north Ionian Sea and north offshore of Crete Island and the second component (PC2) areas of the north-central Aegean Sea. The total risk analysis permitted an identification of the most tornado and waterspout prone areas in Greece. Determining of tornado alleys and waterspout high risk spatial patterns indicated a large seasonal influence and differentiation.

## Paper 185:

# Floods in Southeastern Brazil- Observations, Simulation, Projection and Uncertainties

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Cases of floods in Southeastern Brazil are analyzed, discussing the associated synoptic features and the convection in the systems shown in satellite images. Cases of heavy precipitation in this region are identified in a climate simulation of present time and in a climate projection under global warming using the Regional Eta Model. The synoptic and mesoscale conditions, associated with heavy precipitation, simulated by the model are analyzed. The frequencies and intensities of extreme precipitation cases are obtained from four members of the simulations and projections, and an uncertainty analysis is performed with the results. One of the extreme precipitation cases is illustrated: the case that happened in Southeastern Brazil (Rio de Janeiro) from 31st December 2009 to 1st January 2010. There were several landslides in the region, one of which destroyed a beach hotel killing many people. The satellite image showed the influence of several synoptic systems in the region, as the Bolivian High displaced from its normal position, the upper level cyclonic vortex close to Northeastern Brazil coast and a frontal system extending from the region towards the ocean. The synoptic condition, with low level wind confluence over the region, high relative humidity above 80% and strong divergence at high levels favored by the displacement of the Bolivian High southeastward contributed to the heavy precipitation associated with the

oceanic squall line embedded in the frontal system. A simulation of this case with high resolution of Eta Model shows the ability of the model in representing the extreme precipitation.

## Paper 186:

# Climate-driven increase in the variability and multi-year mean level of severe thunderstorm-related losses and thunderstorm forcing environments in the U.S. since 1970

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A substantial increase in the variability of normalised direct economic and insured severe thunderstorm-related losses in the U.S. east of the Rocky Mountains over the period 1970-2009 (March – September) has been detected. Besides variability, also the multi-year mean level of losses has strongly increased. Analysed are sizeable severe thunderstorm events causing at least US$ 250 million in normalized economic losses. The high threshold guarantees homogeneity over time, because such events regularly covered several states and thus are very unlikely to have been missed at any time due to reporting variability.

To shed light on the question whether the strong increase was driven by an external climate driver, the time series of normalized losses (annual counts and annual loss aggregate) was correlated with the time series of thunderstorm forcing environments. The latter were inferred from NCEP/NCAR reanalysis data and comprise 6-hourly CAPE and vertical wind shear data combined to form the variable Thunderstorm Severity Potential (TSP). From the notable correlation found between the time series of normalized losses and meteorological thunderstorm forcing environments (TSP) it could be inferred that climate was the dominant driver for the increase in variability and average level of thunderstorm-related losses in the period 1970-2009. An important factor in the rise of TSP over time could be identified in CAPE, as we found a substantial rise in the annual number of exceedances of a high CAPE threshold in the reanalysis data.

Recent studies imply that the changes observed in our study, particularly regarding an increase in high-level CAPE environments, are consistent with the modelled effects of anthropogenic climate change. The physical chain of climate change-driven increasing levels of specific humidity leading to rising levels of CAPE as one of the preconditions of more severe thunderstorm forcing environments has already been established by measurements and climate model experiments.

## Paper 187:

# CAPS Storm-scale ensemble forecasting for the NOAA HWT 2013 Spring Experiment

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The Center for Analysis and Prediction of Storms at the University of Oklahoma continues to produce realtime storm-scale ensemble forecast (SSEF) for the NOAA 2013 Hazardous Weather Testbed (HWT) Spring Experiment. The CAPS SSEF will consist of 25 members from three NWP model systems (WRF-ARW, COAMPS, and ARPS), covering the full continental United States with convection-allowing resolution at 4-km horizontal grid pacing. SSEF members are