Preface

This special issue of BGTA is based on some of the papers presented during the 2017 GNGTS session entitled "Science, Technology and Communication to support seismic prevention". Indeed, Science, Technology and Communication are the three pillars on which actions for seismic prevention should be based. Many virtuous examples of studies and actions to reduce seismic risk were presented, leading to a multifaceted representation of seismic risk and associated activities, aimed at improving its knowledge, evaluating consequences and increasing awareness to promote mitigation.

Part of the studies presented at GNGTS 2017 are now proposed in this special issue, to provide examples of the wide spectrum of activities linked by a common subject, summarised by the word 'risk'.

The consequences of past earthquakes in terms of physical damage provide an immediate perspective of what seismic risk can produce, and dramatically emphasise the urgent need for its mitigation. Italy has an ample collection of building damage data from recent earthquakes, representing a precious source of knowledge about the real seismic behaviour of buildings all over Italy. The need to enhance the reliability of prevention models and more effectively support strategic decision-making has prompted the Italian Civil Protection Department to undertake a specific project aimed at storing and sharing data from major post-earthquake damage campaigns. The paper "Observed damage database of past Italian earthquakes: the Da.D.O. WebGIS" (Dolce *et al*., 2019b) describes the goals, contents and capabilities of the Italian web-GIS platform named Da.D.O. (Observed Damage Database). It includes data sets on nine seismic events occurring from 1976 (Friuli earthquake) to 2012 (Emilia earthquake), for a total of 300,000 damage inspection forms of as many dwelling buildings. This database is an inestimable scientific heritage, useful for calibrating vulnerability models for seismic risk assessment and formulating damage scenarios.

The long seismic sequence that struck central Italy in 2016-2017, still not included in Da.D.O., has produced considerable damage to different buildings and structures, besides residential ones, such as school buildings and architectural heritage. Two papers are devoted to the survey of the physical damage of these two assets.

The paper "Cumulative damage on school buildings following the 2016 central Italy earthquake sequence" (Ludovico *et al*., 2019) focuses on the behaviour of school buildings struck by several earthquakes during the seismic sequence. The effects of the seismic sequence are discussed considering age of construction and design methods, structural types (i.e. RC and masonry), and peak ground acceleration experienced during the sequence. Relationships between damage and

repair costs are used to evaluate the incidence of the damage produced by the seismic sequence in terms of direct economic loss.

The paper "First analysis of data concerning damage occurred to churches of the Marche region following the 2016 central Italy earthquakes" (Carbonari *et al*., 2019) presents a methodology to process inspection data of churches in the Marche region. In addition, the global damage index of each church is correlated with the relevant highest pseudo spectral acceleration at period 0.3 s. Relationships between the seismic intensity and the observed damage are then derived. Finally, the observed damage is compared to that estimated through empirical models.

Seismic risk prevention requires specific seismic design, sometimes using advanced construction technologies that rely upon the concept of passive control. One example is reported in the paper "ADAS dampers for the hazard protection of multi-story buildings with glazing envelopes: a feasibility study" (Bedon and Amadio, 2019), where the authors analyse the behaviour under extreme actions (seismic and explosive) of multi-story buildings with glass *façades* designed as distributed-tuned mass damper, using finite element models. The global and local effects and the possible benefits deriving from additional vibration control systems are numerically analysed. Careful consideration is paid to elasto-plastic vibration control systems.

The consequences of earthquakes can be forecasted through probabilistic tools that allow physical damage and losses to be suitably represented and, therefore, understood by decision makers. A representation of risk that can be understood by stakeholders is the main topic of the paper "Municipal expected annual loss as an indicator to develop seismic risk maps in Italy" (Zanini *et al*., 2019). The authors present a risk-targeted indicator for residential buildings, where a quantitative estimation of the seismic risk on a municipal scale, named MEAL, can easily be understood by different stakeholders.

A different analysis of seismic risk aimed at reducing it by increasing the local resilience during a seismic emergency is carried out for a specific urban system of civil protection interest, in the paper "Structural operational efficiency indices for Emergency Limit Condition (I.OPà.CLE): experimental results" (Dolce *et al*., 2019a). The authors describe the probabilistic method named I.OPà.CLE (Indices for evaluation of Operational efficiency of Limit Condition of Emergency) devoted to assessing the operational efficiency of a municipal contingency plan in case of earthquakes. If the physical elements of this system are not able to resist the earthquake, the whole emergency management can be seriously hindered. The method relies on the formulation of synthetic indices to express the probability of the emergency system and its relevant components, preserving the operational capability for seismic scenario events with different return periods. The paper also shows the results of an experimental application on a sample of 30 municipalities.

Earthquake consequences can increase greatly if one of the risk's primary components, such as hazard, is not adequately evaluated. This can occur, for instance, when important site effects are not taken into account. Such is the case shown in the paper "The local seismic response and the effects of the 2016 central Italy earthquake on the buildings of L'Aquila downtown" (Mannella *et al*., 2019), which examines the seismic behaviour of buildings with seismic isolation systems, built in L'Aquila after the 2009 earthquake, during the 2016 earthquakes. The authors highlight the importance of the morphological and geological conditions on the site seismic response and the soil-building interaction. They also focus on the seismic response analysis from the design perspective of seismically isolated buildings, with reference to the Italian building code as well as the evaluation of the effectiveness of 1D and 2D modelling to predict site amplification.

Seismic microzonation studies are intended to evaluate site effects on a local scale. They have been and are being carried out extensively in almost half of the Italian municipalities, and their full exploitation to improve hazard and risk assessment is explored in the paper "Maps for land management: from geology to seismic hazard" (Naso *et al*., 2019). The authors describe a procedure to investigate and represent the site seismic hazard starting from geology. In addition, they propose a new integral parameter, named H_{SM}, derived from the seismic motion expected at the surface, taking into account both reference seismic hazard and site effects. H_{SM} allows the local seismic hazard to be more accurately compared among different areas, on every scale, providing a classification of the territory that is more consistent with the actual hazard. This is important for a more realistic assessment of seismic risk and makes it possible for the national and Regional authorities to make more informed choices to implement strategies and policies for risk mitigation.

Risk mitigation, on the other hand, strongly depends on its knowledge and perception by the wider public and stakeholders. That is why a correct and extended communication of risk in general, and of the seismic risk in particular, is of paramount importance to promote prevention activities, as discussed in the paper "Seismic risk communication: an opportunity for prevention" (Musacchio and Solarino, 2019). The authors, considering the risk communication an important opportunity to turn scientific knowledge into preventative actions, scan nine research projects, funded by major European programs over the time span 2010-2017. Three parameters are analysed: the public, crucial to foster prevention, the approach used to reach it and the interaction with recipients. The results show that academia rates schools as the most responsive audience for raising awareness towards preventative actions; face-to-face is chosen as the most efficient approach to trigger preventative actions; the acknowledgment of recipients' needs contributes to better tailor communication campaigns.

The importance of considering a more structured point of view on risk communication and introducing methods and techniques of the behavioural sciences is highlighted in two papers. They consider a behavioural approach fundamental to understand possible cognitive biases and risk misperception, which can cause mistakes, indecisions, and wrong choices.

The paper "A behavioural approach for seismic risk mitigation" (Speranza *et al*., 2019), starting from the fact that earthquakes are neither predictable nor avoidable and that knowledge, preparation, and prevention are the best weapons to mitigate seismic risk, approaches the theme of seismic risk mitigation through the tools of behavioural sciences. Human behaviour becomes extremely relevant and there are two main actors: the population and the policy-makers. The authors focus on Italy, a country with a high seismic risk and significant skills on seismic risk reduction strategies.

The paper "Deciding (or not) on the acceptable level of seismic risk: first behavioural considerations on the L'Aquila trial" (Di Bucci *et al*., 2019) analyses the issue of the acceptable risk level with a behavioural perspective. The authors emphasise that it is political decision-makers who are in charge of the choice of the acceptable risk level for their community, but they often do not establish it. From this viewpoint, the work proposes some preliminary reasoning on the L'Aquila trial, which involved scientists and Civil Protection officers after the 2009 Abruzzo earthquake.

Furthermore, managing risk is in itself a risky activity for those involved in disaster risk management, due to the considerable related responsibilities. This aspect is shared by many risks

related to different hazards. The topic is deeply investigated, also from a legal point of view, in the paper "The INGV Tsunami Alert Center: analysis of the responsibility profiles, procedures and risk communication issues" (Valbonesi *et al*., 2019). The authors illustrate the role and activities of the Italian Tsunami Warning Center (Centro Allerta Tsunami, CAT) of INGV and discuss the responsibilities of the CAT-INGV operators in light of the Italian regulations. The authors describe the critical aspect of the surveillance and release of alert messages and try to delineate useful tools to limit legal problems for the operators in case of damaging events or false alarms.

To conclude this overview, it is worth underlying that scientific institutions and decision-making authorities are using a holistic approach (of which this special issue is in our opinion an interesting example) to deal with seismic risk, and many others, at national and supranational scale. In such a way, it might be possible to gather a full understanding of the risks in order to reduce them and to get all the possible stakeholders on board, to accomplish this difficult task together.

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M. Dolce[1] and L. Martelli[2]

[1] Dipartimento della Protezione Civile della Presidenza del Consiglio dei Ministri, Roma, Italy
[2] Servizio Geologico, Sismico e dei Suoli, Regione Emilia-Romagna, Bologna, Italy