Wind Risk Assessment in Urban Environments: The Case of Falling Trees During Windstorm Events in Lisbon

A. Lopes, S. Oliveira, M. Fragoso, J.A. Andrade and P. Pedro

Keywords Strong winds · Trees in urban streets · Urban environment · Lisbon

Introduction

Planting trees brings many benefits to the urban environment (Fabião 1996; Jim and Liu 1997; Nilsson et al. 2000; Saebe et al. 2003; Soares and Castel-Branco 2007). Trees have a moderating effect on the urban microclimate and improve the physical, biological and chemical aspects of the urban environment, namely by reducing the urban 'heat island' effect (Alcoforado 1992), by acting as a barrier against strong wind channelling (Lopes 2003), by protecting urban surfaces from direct sunlight (McPherson and Muchnick 2005), by capturing air pollutants and dust in urban areas (Freer-Smith et al. 2004) and by increasing the biodiversity, providing habitat for birds and small mammals (Clergeau 1996). Trees also protect urban surfaces by reducing the impact of rainwater, while their roots remove nutrients that can be harmful to the water in urban soils, hence improving urban hydrology and controlling erosion. In addition, trees in urban settings sequester carbon, providing a helpful hand to combat climate change, reduce the energetic demand of the city, influence thermal and mechanic comfort and foster citizens' wellbeing (e.g. affecting physical and mental health, aesthetic and socio-economic values, common heritage, recreation benefits, etc.). A 1999 World Health Organization report revealed that in three European countries (Austria, France and Switzerland), more people died prematurely due to the effects of pollution from vehicle emissions than due to car accidents. Since a large proportion of the population is expected to continue living in urban areas, where current EU standards for PM and long-term average nitrogen dioxide are exceeded, owing mainly to road-traffic emissions (Krzyzanowski et al. 2005), the plantation of trees in these areas must be strongly encouraged. However, excessive plantation of trees and obstructive 'green masses' in ventilation paths should be avoided, because it can reduce mean wind speed and deplete dispersion conditions (Lopes 2003; Alcoforado et al. 2005).

On the other hand, trees' benefits for the urban environment are frequently accompanied by hazards caused to the human population and infrastructure, particularly during strong wind events, due to total or partial tree falls in public and private open spaces. This is one of the major causes of human injuries (and, sometimes, death) during extreme events. For example, the extreme windstorms of 26–28 December 1999 were directly responsible for killing 95 people, injuring 11 and affecting approximately 3,400,000 people in France; killing 15 in Germany; 11 in Switzerland; 11 in the United Kingdom and 5 in Spain. The total cost of the disaster was estimated at more than USD 10 billion (EM-DAT: the OFDA/CRED International Disaster Database). During this event, wind speed exceeded 160 km/h in many places along the French coast and along the 49°N parallel. Near Paris, in Versailles, more than 4000 trees were windthrown as a result of the storm and the French *Office National des Forêts* reported that an estimated 1,300,000 trees were blown away

A. Lopes (✉)
Centre of Geographical Studies, University of Lisbon, 1600-214 Lisbon, Portugal
e-mail: antlopes@fl.ul.pt

K. Strelcová et al. (eds.), *Bioclimatology and Natural Hazards*,
DOI 10.1007/978-1-4020-8876-6_5,