Planning the adaptation to climate change in cities: An introduction

Maurizio Tiepolo[1] and Elena Cristofori[2]

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1.1 Climate Change in Subtropical and Tropical Cities

Very heavy rains, the early start and end of the rain season, river floods, sea level rise (SLR), high temperatures and drought have been reported in subtropical and tropical cities for many years now. These phenomena regard a "change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (IPCC WGII, AR5 2014: 5) known as climate change (CC).

In large subtropical cities the impact of CC is important, due to the higher population densities and a higher concentration of goods and services relative to elsewhere. In these large tropical cities the impact is devastating due to size, the concentration of industrial and tertiary activities of an entire country localized within them, and because often there are not the resources to prepare for catastrophe or to rebuild.

The availability of long term data on daily rainfall, recorded by weather stations or by satellites, and of daily discharge of larger rivers has led to the characterization of CC in cities mainly in terms of pluvial and river floods and, sometimes, in terms of SLR. Heat waves, dust storms, and alteration of aquifers are less known components of CC due to the lack of complete and sufficiently long term databases to evaluate the change. They are less evident hazards but nonetheless considered as having serious impact, especially on human health (respiratory and gastrointestinal diseases, death).

Moreover, it is by now recognised that the urban form (land cover, texture and building density) has an impact on the microclimate. This is changing in all tropical and subtropical contexts. Consequently, we can expect it to influence local CC. Apart from some general studies (Alcoforado and Matzarakis 2010, Stone *et al.* 2010), the consequences of urban form on CC vulnerability are still only investigated in few cases (Tiepolo and Braccio 2015).

Climatic analysis methodologies, which are now widely represented in the literature, are not practiced often in the local climate plans adopted for subtropical and tropical cities.

1 Maurizio Tiepolo, associate professor of Urban and regional planning at DIST-Politecnico and University of Turin, is author of 1.2 and 1.3 paragraphs, maurizio.tiepolo@polito.it

2 Elena Cristofori, PhD student at Politecnico di Torino, is author of paragraph 1.1, elena.cristofori@polito.it.

Although some cities have been careful to reduce GHG emissions for over a decade now in order to help reduce global warming and, therefore, CC, it has only been in the last three years that "climate plans" have sharply increased in subtropical and tropical cities.

1.2 Planning the Adaptation of Cities to Climate Change

Adaptation to CC is "the process of adjustment to actual or expected climate and its effects" (IPCC 2014: 1). Adaptation can be realised before, during or after a climatic disaster (flood, heat wave, drought, etc.) through individual measures, plans, strategies and policies.

These tools may be directed at reducing GHC emissions that are considered responsible for global warming and, therefore, CC (e.g., mitigation plans), aimed at reducing impact (adaptation plans), and preparing for and managing emergencies in the event of catastrophes (emergency plans) or a mix of the first and second types (mitigation and adaptation plans).

Some cities have chosen, instead, to mainstream individual adaptation measures within the existing tools (master plans, local development plans) without producing other plans specific to CC.

Following the initial reviews on CC adaptation planning in the urban ambit (Perkins *et al.* 2007; Füssell 2007; Moser *et al.* 2008, Wheeler 2008), the literature has multiplied.

Among the books, some deal with cities from very heterogeneous climatic zones (Davoudi *et al.* 2009; OECD 2010; UN-Habitat 2011; Hoornweg *et al.* 2011; Hammer *et al.* 2011; Ford and Berrang Ford 2011; Otto-Zimmermann 2012), while others focus on mega-cities (World Bank 2010; Krellenberger 2014), macro-regions or large countries (Birkmann *et al.* 2009; Tanner *et al.* 2009; Sharma and Tomar 2010; World Bank 2010; Macchi and Tiepolo 2014; Krellenberg *et al.* 2014). For some years now, adaptation guidelines have been published by UN-Habitat and the World Bank (Hoornweg *et al.* 2012; Dodman 2012; World Bank 2013; Ingram *et al.* 2014), and many national guides to adaptation by cities are available (Buendía 2010; LGASA 2012; MDC 2013, to name but a few).

Despite this wide production and the latest, monumental fifth assessment report of the working group II of the IPCC (2014), gaps in understanding adaptation planning are still present in at least four aspects. Firstly, the comparison of similar cities. The adaptation measures depend on the hazard (therefore, the climatic zone), and on the way the city expands (formal/informal) and carries out specific functions (coastal port, internal interexchange point, etc.). A comparison of adaptation planning should be done on similar case studies.

Secondly, the consideration of the city and its surrounding area. Our understanding of hazards and risks in metropolitan belts and in the nearby rural surroundings

from which, in the event of natural disaster, (climatic) migrations move towards the city, is still quite poor.

Thirdly, the integration of climate analysis and planning. The coincidental hazards in urban settlements are rarely characterised and do not determine specific adaptation measures.

Fourthly, analysis and planning methodologies that address the needs of local governments. In the case of scant information on hazards and hazard prone areas, local governments with low capacities and budgets often need snapshot methodologies for the identification of hot spots and decision-making instead developing a new information system for detailed risk assessments.

This book contributes to understanding these aspects.

1.3 Structure of the Book

This book is a collection of case studies in subtropical and tropical zones and considers different types of cities: large (over 1 million population), intermediate (0.1–1 million population), secondary (less than 0.1 million population).

The book is divided into three sections: hazard, adaptation planning, best practices.

Different chapters could have taken another position, as they deal with specific aspects in several sections.

The first section brings together the chapters on the characterisation of the hazard in climate plans (Tiepolo and Cristofori), heavy rainfall and SLR (Sakai *et al.*), atmospheric drought (Pezzoli and Ponte), flood hazard (Bacci), alteration of aquifers due to sea water intrusion (Sappa and Luciani), marine aerosol transport towards shore (Piazzola *et al.*).

The second section includes the chapters on flood early warning (Cristofori *et al.*), flood risk preliminary mapping on the urban and regional scale as a support to decision making (Tiepolo and Braccio), drought risk (Bacci and Tarchiani), community-based adaptation measures in water sector (Biconne), CC vulnerability on the local scale (Giri), adaptation and contingency planning (Ponte) and the mainstreaming of adaptation measures in other tools (Macchi and Ricci; Shemdoe *et al.*).

The third section includes the chapters on some European best practices that are of interest for subtropical and tropical contexts such as hazard monitoring and risk assessment at regional (Prohom and Puig; Franzi *et al.*) and city level (Ronco *et al.*).

Overall, 12 contexts are explored: large cities (Dar es Salaam, Niamey), intermediate cities (Caraguatatuba, Tabarre, Zurich), secondary cities (Mekhé, Pragatinagar, Nawalparasi) and regions (Catalonia, Chaco, Gaza province, Piedmont, Réunion, Tillabéri). With the exception of Zurich, the case studies are divided equally between subtropical and tropical zones according the Koppen-Geiger classification after the

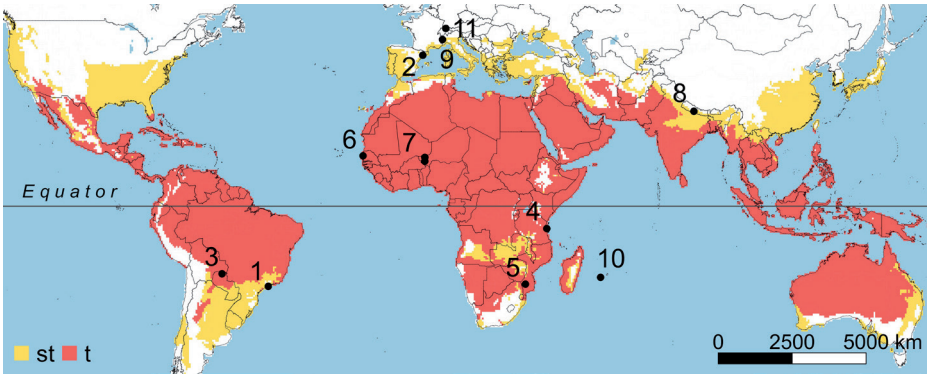

Figure 1.1: Subtropical (st) and tropical (t) zones and the twelve case studies: 1 Caraguatatuba, 2 Catalonia, 3 Paraguayan Chaco, 4 Dar es Salaam, 5 Gaza province, 6 Mekhé, 7 Niamey and Tillabéri region, 8 Pragatinegar and Nawalparasi, 9 Piedmont, 10 Réunion Island, 11 Zurich (by S. Braccio).

categories and subcategories re-unification of Trewartha (Rubel and Kottok 2010, Belda *et al.* 2014) (Figure 1.1).

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