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### **A contribution to the study of the economic causes and consequences of climate change:**

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## Summary

The present doctoral thesis is a collection of interrelated works on the economic causes and consequences of climate change. Throughout its chapters, a variety of methods used for investigating fundamental questions regarding climate change and its economic impacts are critically analyzed and new methodological contributions are offered. As a whole, this thesis represents an interdisciplinary effort to advance in the understanding and modelling of the Economics of Climate Change.

Climate change is one of the most important environmental problems that humanity will face this century. It is larger, more complex and more uncertain than any other and it is commonly defined as the largest market failure in the history of mankind (Tol, 2009; Stern, 2006). Describing this phenomenon as a market failure implies that it is the product of an externality unquestionably due to human activity and that its physical and economic impacts are reasonably known (or knowable) and distinguishable from those of an otherwise unforced climate. Therefore, this description of the problem presupposes our capacity to satisfactorily detect, separate and attribute the contribution of natural and anthropogenic factors, to adequately model and project future climate, economic growth and technological change at a wide variety of temporal and spatial scales, as well as to be able to estimate climate impacts in the present, short- and long-term horizons. Furthermore, it implies that the estimated impacts can be translated to economic terms in a meaningful way.

As such, the Economics of Climate Change is inescapably fraught with large epistemic uncertainty, methodological problems and gaps as well as important data limitations. The challenges for its study are substantial, even though significant advances in the understanding of both the physical and socioeconomic dimensions of climate change have occurred during the last decades (e.g., IPCC, 2013a,b). The objective of this doctoral thesis is to address some of the fundamental questions regarding the economic causes and consequences of climate change. Through its different chapters, methodological contributions are proposed and policy-relevant information is provided regarding the attribution of climate change as well as its past and future economic impacts at local, regional and global scales. I strongly believe that the boundaries

between Economic and Natural Sciences need to be blurred if we are to address this type of complex problems in a meaningful way. This is the spirit and intention of the present doctoral thesis. What is presented here rests on an integrated and interdisciplinary approach combining Economics, Statistics and Atmospheric Sciences.

Part I is composed of chapters 2 to 4 and addresses the detection and attribution of climate change through statistical methods. This part of the thesis reviews the methodologies and results found in the literature and proposes new approaches to study the attribution of climate change. In Part II, the economic impacts of climate change and the widely used Integrated Assessment Models are studied. Through chapters 5 to 8, the impact functions in these models are examined and methodological improvements are proposed. Part III focuses in different aspects of the estimation of regional and local impacts of climate change. Chapters 9 to 15 investigate aspects relevant for projecting and understanding climate change impacts at these spatial scales. Methods for testing for the existence of a warming trend in extreme events, to model uncertainty and risk and to downscale climate scenarios are discussed and new approaches proposed. This section also includes a critical analysis of the common practice of supporting policy relevant documents on non peer-review, grey literature. Chapter 16 presents the conclusions of this thesis and discusses its implications for policy making. Future research, limitations and some extensions of what is presented here are also discussed.