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Changing travel patterns in China and 'carbon footprint' implications for a domestic tourist destination

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HIGHLIGHTS

- Explored the effect of changing travel patterns on the tourism transportation carbon emissions at the destination level in China.
- The tourism transportatiom carbon emissions in the itinerary are represented by emissions broken down into transport modes, emissions per visitor and shared emission for stop-overs.
- Findings are discussed with regard to the potential for domestic destinations to reduce emissions from transport by mitigation policies.

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ABSTRACT

Mitigating tourism's emissions, in particular related to transportation is critical, to achieve the broader national emission reduction targets in developing countries. To gain a better understanding of the carbon emissions related to one of Chinese top destinations, and assess changes over time, this article analyses the travel patterns of both domestic and international visitors to Zhangjiajie, Hunan province. Two points in time are examined, namely 2009 and 2015. The results show that despite some contraction towards closer and shorter trips, the overall growth (a near doubling in arrivals) led to a substantial increase in carbon emissions. The increasing role of the private car and high-speed rail has been noted in particular. The average transportation carbon footprint of visitors to Zhangjiajie changed from 94.55 kg CO_2 in 2009 to 82.97 kg in 2015 per trip, and 18.87 kg in 2009 to 16.46 kg in 2015 per visitor day.

1. Introduction

Tourism in China has grown exponentially and now dwarfs international arrivals by a factor of three. In 2015, there were 4 billion domestic tourists and 133 million international tourists in China (China National Tourism Administration [CNTA, 2016a]). In comparison, the United Nations World Tourism Organisation recorded 1.24 billion international arrivals globally in 2016 (UNWTO, 2017). Domestic tourism in China has become a major activity that contributes to multiple political and economic goals, including regional development, employment, and well-being of citizens (Weaver et al., 2015). However, at the same time such growth does not remain without negative impacts. One key effect of travel is the demand for fossil fuels and associated greenhouse gas (GHG) emissions. China has now become the major driver of global emissions (Liu, 2015) and is therefore at the core of global mitigation efforts. This prominent role is also of high relevance to China's tourism sector.

Tourism has been known as a carbon-intensive industry for over a decade. However, previous analyses have failed to take into account the dynamics of fast growing emerging tourism economies. China in particular is the new growth pole of global tourism, not only because of the size of its market but also the speed with which it develops – with major implications for travel-related GHG emissions (Becken, 2015). Thus, whilst Scott et al. (2008) projected a doubling in tourism's GHG emissions by 2035 under a business-*as*-usual scenario, it is likely that the actual growth is considerably larger. It is therefore imminently important to study the dynamics

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of travel behaviours in tourism economies such as China.

From a geographical point of view, tourism is the voluntary short-term movement of people through time and space, either between home places and destinations or within destinations (Coles, Duval, & Hall, 2004; McKercher & Lew, 2004). As already suggested by Leiper in 1995, transit routes link the tourist-generating region and the tourist-receiving destination as an integral component of the tourist product (Kuo & Chen, 2009), but they have also been identified as the largest contributor to tourists' GHG emissions or so-called 'carbon footprint'[1] (e.g. Filimonau, Dickinson, & Robbins, 2014). Therefore, an analysis of tourists' itineraries is a crucial step towards assessing tourism's carbon footprint. Itineraries can be single destination (possibly with a 'daisy' pattern of day trips) or multi-destination (Becken, Simmons, & Frampton, 2003). Tourist itineraries often correspond to particular market segments. Oppermann (1992) noted that tourists who travel further away from home are more likely to engage in a multi-destination trip to fit in a maximum of sights within a limited time. Elsewhere, Becken (2005a) questioned the sustainability of multi-destination coach tours (in particular North American and Asian tours) in New Zealand because of their carbon intensity. Very little is known about travel itineraries in China.

Analysis of the carbon intensity of multi-destination trips is relevant for the development of regional carbon accounts, which are increasingly relevant for tourism planning and marketing (e.g. Gössling, 2009). Walz et al. (2008), for example, undertook a detailed regional carbon dioxide assessment for the Alpine tourist region of Davos in Switzerland, including carbon sources and sinks. However, as acknowledged by the authors, the narrow scope of 'tourist mobility' that only considered transport within the geographic boundaries of the region, poses a limitation. The integration of destination-based carbon analyses with transit corridor assessments is therefore the next important step, implying that the identification of meaningful metrics and system boundaries is critical.

Destinations evolve over time, and so do travel patterns by their visitors. However, most carbon footprint analyses in the tourism literature have been static and failed to take into account changes in market composition, transport modes and itineraries. Thus, this paper aims to examine the GHG emissions associated with travel to a popular destination in China. Considering that much of the global tourism growth occurs within and out of China, adding to the emerging body of literature on carbon footprint in China is important. In particular, however, this research investigates changes in transport patterns over the course of six years based on primary data and using four different carbon metrics. Such a longitudinal approach is unique and will be beneficial in capturing the rapid changes in Chinese tourism. This represents a major contribution and should be of interest not only to tourism academics who focus on tourism and climate change but also to international organisations, such as the UNWTO, who at this point in time still rely on dated carbon estimates going back to 2005 (Scott et al., 2008). We argue that even a short period of time of six years, as investigated in this study, can be characterized by profound changes in travel patterns and carbon emissions. Understanding these dynamics is important for management and policy making, not only in China.

This paper undertakes an analysis of tourist travel to Zhangjiajie, Hunan province, for two points in time, namely 2009 and 2015. The reason for the choice of Zhangjiajie was three-fold. Firstly, Zhangjiajie is a United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site and one of the most popular scenic spots in China. Secondly, the case study destination represents a mid-range distance away from major population centres that is relatively easily accessible. Thirdly, the destination has experienced changes in its transportation network, most notably through better connectivity with the high-speed rail system. Potential visitors now have the choice of air transport, rail and road. As such, Zhangjiajie offers a suitable case study to examine changes in travel patterns. Whilst the site is relatively representative of other key destinations (including 14 other natural World Heritage sites), it is also acknowledged that each destination in China has unique characteristics and is likely to experience and idiosyncratic micro-changes in addition to more generic trends.

The objectives of this paper are to (1) examine key markets and tourist itineraries to Zhangjiajie, taking into account different transport choices and the structure of itineraries, (2) analyse changes over time in terms of four carbon-relevant metrics, namely total destination GHG emissions, emissions broken down into transport modes, emissions per visitor and emissions per visitor-day, and (3) attribute GHG emissions to stop-overs that formed part of the overall itinerary.

2. Literature review

2.1. Greenhouse gas accounting in tourism

As a result of the ratification of the Paris Agreement, the measurement and accounting of GHG emissions has become more important than ever. This is highly relevant for the global tourism industry that seeks to understand its position in national and global carbon reduction efforts (World Travel and Tourism Council, 2016). At present, however, understanding tourism's role is hampered by two key issues. One is the lack of carbon reporting and disclosure by tourism companies (Becken & Bobes, 2016), and the other one is the fact that tourism is not a traditional sector in the System of National Accounts, and as a result countries lack detailed information on the GHG emissions associated with tourism. Several attempts have been made to enhance standard accounts with a 'newly created' tourism sector to then assess and compare tourism's emissions with those of other economic sectors (Becken & Patterson, 2006; Dwyer, Forsyth, Spurr, & Hoque, 2010).

This top-down approach relies on the existence of robust and publicly available data for both environmental conditions and tourism activity at the macro level. Several studies completed such analysis at the national level, using for example Input-Output analysis or Computable General Equilibrium Modelling (Dwyer et al., 2010; Fay, Treloar, & Iyer-Raniga, 2000; Zhong et al., 2015). In addition, there has been interest in developing carbon footprints of tourism for regional economies (Jones & Munday, 2007; Sun, 2014; Turner, Munday, McGregor, & Swales, 2012; Walz et al., 2008). Other top-down studies investigated the carbon intensity of a particular tourism sub-sector (e.g. hotels, see Rosenblum, Horvath, & Hendrickson, 2000), or market segments (Lundie Dwyer, & Forsyth, 2007). To date, such analyses are mainly driven by academic interests, or maybe by marketers who seek to promote low-carbon forms of tourism (including low-carbon destinations).

There are no official Tourism Satellite Accounts in China, and a macro-economic approach to tourism's GHG emissions is therefore not possible. Instead, a bottom-up analysis can be pursued that involves collecting data from either industry or tourists, or both. Bottom-up analyses are somewhat more labour intensive, but they offer the advantage of more detailed information on tourist

[1] Note that 'carbon emissions' is used in this article interchangeably with greenhouse gas emissions, because it is common practice to account for non-carbon emissions through the metric of carbon-equivalent (carbon-e) but still refer to it as carbon. The term carbon dioxide is used to highlight the specific analysis of carbon dioxide (CO_2), excluding other GHG gases.