

---

**Dmitry A. Ruban**  
Southern Federal University

**Tatyana K. Molchanova**  
Southern Federal University

**Natalia N. Yashalova**  
Cherepovets State University

---

### **Three rising tourism directions and climate change: Conceptualizing new opportunities**

Geological, archaeological, and industrial tourism can serve efficiently for the communication of climate change knowledge to the public, which is a literacy function. Importantly, each of these directions deals with information on a particular time slice, and thus, taking these tourism directions together delivers climate change knowledge very logically. Thematic, climate change-oriented parks (e.g., on the basis of geoparks) can combine geological, archaeological, and industrial tourism activities in order to sufficiently increase public awareness and to correct the public perception of climate change. Correct interpretation and availability of trained interpreters are the main challenges.

---

Key words: geotourism, archaeology, industrial heritage, public awareness, interpretation

Dmitry A. Ruban  
Department of Business in Hospitality Sphere  
Higher School of Business  
Southern Federal University  
23-ja linija Street 43  
Rostov-na-Donu 344019  
Russian Federation  
Phone: 7 903 463 4344  
Email: [ruban-d@mail.ru](mailto:ruban-d@mail.ru)

Tatyana K. Molchanova  
Department of Business in Hospitality Sphere  
Higher School of Business  
Southern Federal University  
23-ja linija Street 43  
Rostov-na-Donu 344019  
Russian Federation  
Phone: 7 961 404 8824  
Email: [tkm\\_stud@mail.ru](mailto:tkm_stud@mail.ru)

Natalia N. Yashalova  
Department of Economics and Management  
Business School  
Cherepovets State University  
Sovetskiy Avenue 10

Cherepovets, Vologda Region 162600  
Russian Federation  
Phone: 7 921 132 4155  
Email: [natalij2005@mail.ru](mailto:natalij2005@mail.ru)

Dmitry A. Ruban is an associate professor at the Southern Federal University with an interest in geosciences, tourism, and hospitality, and economics and management. A significant part of his current research focuses on geotourism. He has published > 100 papers in major international journals and several books, he is an editorial board member of five journals, and he has reviewed dozens of papers for various scientific media.

Tatyana K. Molchanova is a bachelor student at the Southern Federal University with an interest in hospitality and economics. Her current research focuses on industrial tourism and quality management in the hospitality industry. She has published several papers in major international and national journals.

Natalia N. Yashalova is a full professor and department head at the Cherepovets State University. Her research focuses on ecological economics. She has published numerous papers in major international and national journals. For her outstanding research, she has been awarded by D.Sci. degree from the Moscow State University.

## Introduction

Tourism is a weather- and climate-dependent industry (Craig and Feng, 2018). Its relevance to climate change has remained popular and, at the same time, a contested research issue in science for three decades. The first contributions appeared in the early 1990s (Smith, 1990; Wall, Badke, 1994), and among the most cited works are those published by Elsasser and Burki (2002), Amelung et al. (2007), and Hamilton et al. (2005). It has also been established that climate change was a complex factor for tourism in the historical past (Weir, 2017).

Despite the evident diversity of *tourism versus climate change* research, four major subjects can be outlined, namely

- negative effects of climate change on tourism (Smith, 1990; Elsasser and Burki, 2002; Buzinde et al., 2010; Hall et al., 2015; Damm et al., 2017; Zhang and Zhang, 2018) and relevant tourism adaptation (Njoroge, 2014);
- positive (more or less) effects of climate change on tourism (Rossello-Nadal, 2014; Shani and Arad, 2014; Grillakis et al., 2016a,b; Amelung et al., 2017);
- tourism effects on climate changes (Buckley, 2011; Korstanje and George, 2012a,b; Peters and Eijgelaar, 2014; Gössling and Peeters, 2015; Gössling et al., 2015; Hall et al., 2015; Michailidou et al., 2016);
- climate change awareness (Wall and Badke, 1994; Gaita and Both, 2008; Becken et al., 2015) and perception by tourists and tourism managers (Becken, 2004; Saarinen and Tervo, 2006; Wyss et al., 2014; Martin et al., 2017).

Disputes on these subjects and the relevant state-of-the-art interpretations have become very common in professional journals (not only tourism-focused or climate-focused) (Becken, 2013), although some research gaps still exist (e.g., Hewer and Gough, 2018). Generally, the theme of *tourism versus climate change* has gradually become an old message

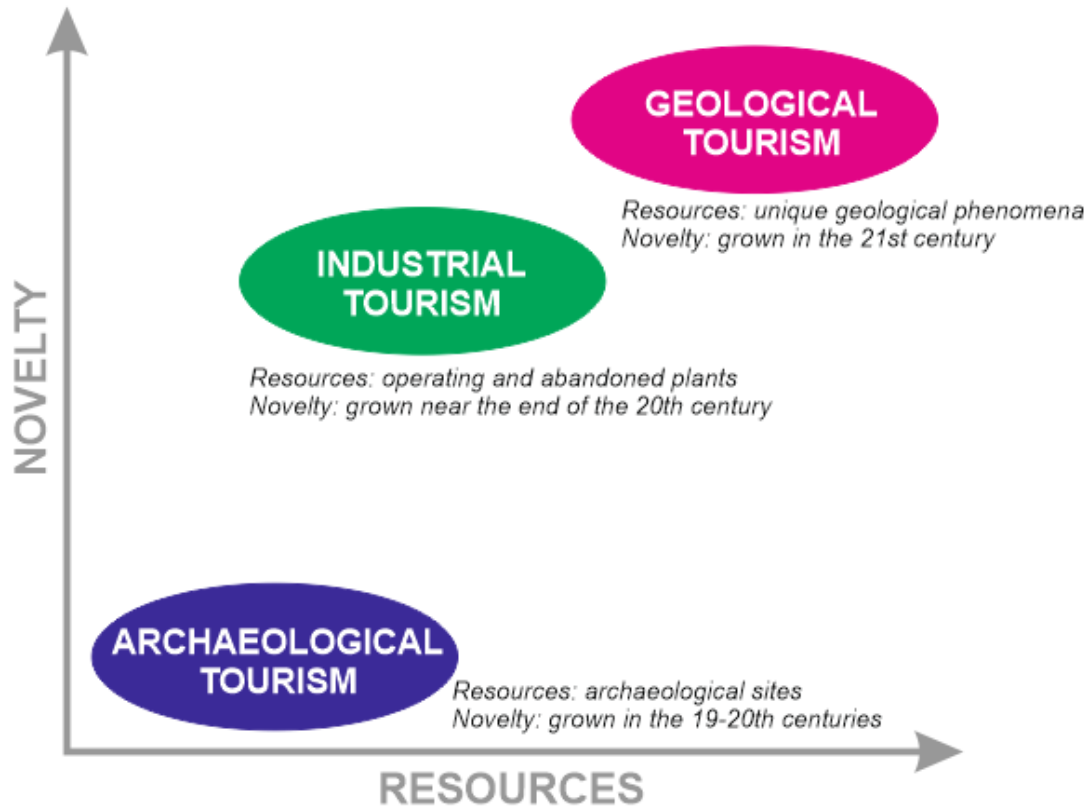
(note that "old" never means "outdated" or "insignificant") linked to the "classical" understanding of the climate change (and "global warming" as a popular label) and its consequences (DiMento and Doughman, 2007; Houghton, 2009; Graves, 2017; Shukla et al., 2017). If so, the finding of new ways of thinking about the noted theme seems to be important. For instance, the educational component expands for modern tourism, and why not to use this educational potential for better delivery of climate change knowledge to the broader public?

In this brief paper, the authors intend to turn the attention of the research community to the appearance of some new ideas in tourism science that permit significant extension of discussions and interpretations relevant to the theme of *tourism versus climate change*. The main purpose of this paper is to emphasize three relatively new directions for tourism that can distribute climate change knowledge efficiently, and thus contribute to climate change mitigation. In other words, this paper is a contribution to the modern tourism research agenda, which should be extended because of the new opportunities provided by geological, archaeological, and industrial tourism. Attempting doing this, the authors rely on their own research experience and review the main findings as reflected in the literature. Methodologically, this paper is essentially a kind of conceptualization of tourism directions relevance to climate changes, and it also offers theoretical analysis of education potential of these directions that can increase the public awareness of the past, present, and future climate changes.

### **Tourism directions related to the distribution of the climate change knowledge**

Geological, archaeological, and industrial tourism have either started to grow or continued to expand at the beginning of the 21<sup>st</sup> century (Fig. 1). Indeed, these activities existed (in different forms) far before the last decade, but they have been conceptualized and

studied in-depth only very recently, together with their global rise. Importantly, all these directions can be related to the idea of climate change, which is explained below.



**Figure 1: A conceptual representation of the relative importance of three directions of tourism considered in this paper**

*Geological tourism* (geotourism) can be defined as a public activity aimed at learning about interesting, unusual, and spectacular geological features either in the field or in a museum. In other words, this tourism direction involves the "exploitation" of unique geological phenomena for tourism purposes (Dowling, 2011; Hose, 2012; Henriques and Brilha, 2017; Ruban, 2015, 2017; Habibi et al., 2018; Ólafsdóttir and Tverijonaite, 2018). Single manifestations of spectacular geological phenomena (e.g., unusual rocks or fossil-rich deposits) termed as "geosites" can be arranged to attract visitors. Similarly popular is the creation of geoparks. These are thematic parks displaying a diversity of unique features and

geological landscapes; in other words, geoparks are territorial establishments emphasizing geological heritage and providing infrastructure for the relevant learning and recreation activities (cf. Habibi et al., 2018). Finally, unique mineral, rock, and fossil specimens can be preserved in museum collections open to visitors. As the climate of the Earth changed through geological history and the climate belts also shifted, some (if not many) geological objects bear important information about climate changes (including extreme and catastrophic changes) in the "Deep Past". In doing so, these objects support the concept of modern climate change and its possible consequences. The involvement of such objects in tourism programs is important for the communication of climate change knowledge to the public. This approach has been suggested, particularly, by Gnezdilova et al. (2015). For instance, a geosite in Europe representing rocks and fossils of the Eocene Epoch (~45 mln yr ago) provides sharp evidence of extreme warm conditions on a territory where the modern climate is temperate. Similarly, if it is known that the ongoing human-induced global warming can return the planet to the "greenhouse" Cretaceous world (~100 mln yr ago) (Hay, 2011), then localities of Cretaceous rocks and fossils can be used to demonstrate the reality of such significant climate shifts. The possible geotourism contribution to public awareness of climate change was also considered by Rutherford et al. (2015) in the case of Rottneest Island (Australia) and Muda (2016) in the case of Northern Sabah (Malaysia). More general ideas on this issue were also expressed by Prosser (2013) and Gill (2017). Additionally, Ansari et al. (2016) proposed that the UNESCO World Heritage Sites can be employed for purposes of demonstrating the geological activity of humans, i.e., their real ability to influence Earth-related processes including climate change.

*Archaeological tourism* (Ross et al., 2017) can be defined as a public activity aimed at learning about notable archaeological discoveries directly at archaeological sites (also excavations) or in museum exhibitions. This tourism direction can also be expanded with the

involvement of a creative component (Ross et al., 2017). It offers visitors of archaeological sites a vision of past societies, but it also puts these societies into an environmental context. For instance, one can learn about the ancient peoples of Sahara, realizing that the world of these peoples was less hostile than today with wetter conditions. In some other cases, archaeological sites make possible an explanation for the end of civilization by climate change; the "classical" example is the collapse of the Maya society linked to extraordinary climate drying (Haug et al., 2003; Douglas et al., 2016; Marx et al., 2017). Even if the climatic trigger for this societal collapse is disputed by some specialists (Aimers, 2012), the very possibility of such discussions permits an emphasis on links between climate change and humankind development. Archaeological touristic experiences and climate change learning have been coupled in the case of the Mimisbrunnr Climate Park 246 (Norway) where visitors have a unique chance to learn about ice melting, as well as about Norse archaeology and mythology (Vistad et al., 2016).

Finally, *industrial tourism* can be defined broadly as the visitation of operating plants, and it supports the sustainable development of former industrial areas with closed and abandoned plants and related infrastructural objects (Jonsen-Verbeke, 1999; Otgaar, 2012; Yashalova et al., 2017). This direction of tourism can be realized in different ways, ranging from obvious excursions (to open or closed enterprises) to the creation of industrial museums and the redesign of industrial environments into creative spaces. Typical examples can be found in the German region of Ruhr (e.g., Copic et al., 2014). With regard to climate change, industrial tourism facilitates direct perceptions of voluminous human greenhouse gases emission (in the case of excursions to operating plants), as well as technologies to prevent (or to minimize) this and other human influences on the environment. Additionally, industrial tourism may promote renewable energy resources (Beer et al., 2018).

Two principal approaches of communication of the climate change-related knowledge

to geological, archaeological, and industrial tourists are

- explanation of the reality of past, present, and future climatic changes with the given example of geological, archaeological, and industrial heritage on specially installed information panels or in the course of guided excursions;
- provision of the climate change experience with the given heritage through interactive tools (e.g., demonstration of a melting glacier or sea-level rise that leave sharp and well-visible geological marks).

Good examples of such approaches can be found, particularly, in the Mimisbrunnr Climate Park 246 in Norway (Vistad et al., 2016).

From the three tourism directions characterized above, geotourism has one significant advantage. As shown by modern assessments of the relevant research (Ruban, 2015; Ólafsdóttir and Tverijonaite, 2018), geotourism develops actively in such countries as China and Brazil, as well as in some countries of Africa. Industrial growth in these countries leads to significant emission of greenhouse gases that facilitate climate change. In such a case, the distribution of climate change knowledge is especially urgent for these countries. The rise of geological tourism there, which provides a vision of the reality of such changes in the past and their far-going consequences (see above), can help in the potential achievement of this goal.

### **Climate change literacy functions**

Each of the above-mentioned tourism directions taken alone can potentially contribute to better public awareness and can correct public perceptions of climate change. This contribution can be termed a *climate change literacy function*. Each direction provides its function of this type (Fig. 2). The latter is realized *via* three approaches, namely

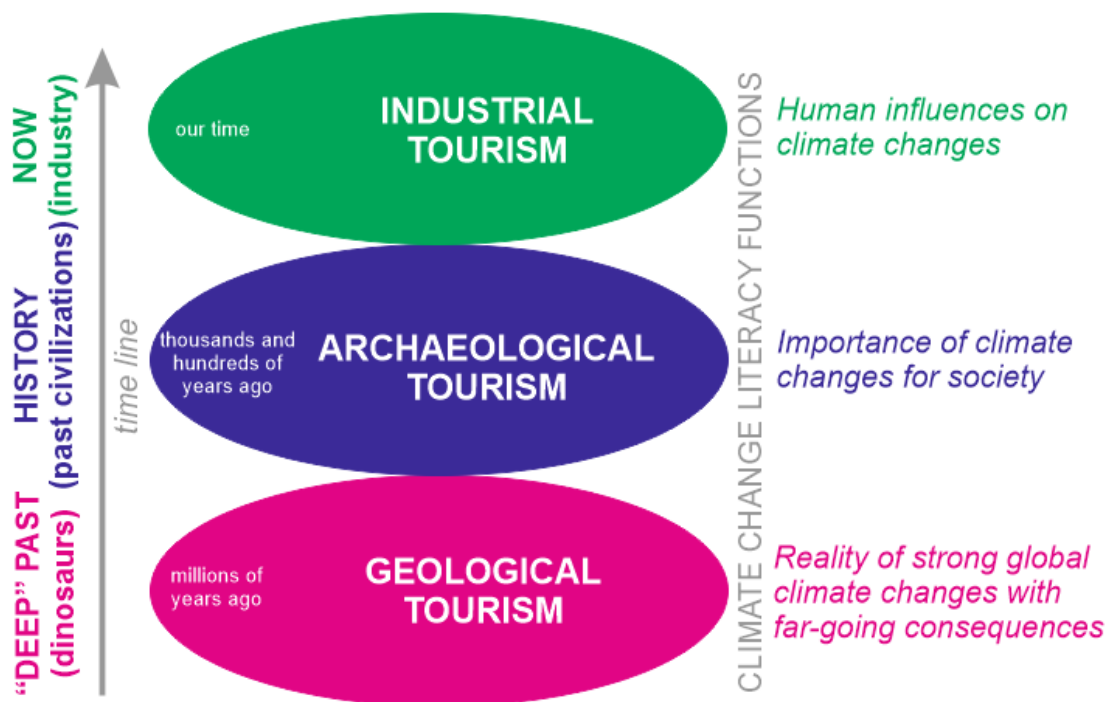
- tourist attraction (*general functional approach*);
- general geological/archaeological/industrial (technological) education (*essential*



*functional approach*);

- climate change-focused interpretation (*specific functional approach*).

The two first approaches are necessary for the development of a given tourism attraction or program. The third approach is required because climate change is difficult both to perceive directly (this is a slow process measured by years, decades, and longer time intervals) and to relate features displayed on-site to those of climate change. "Simple" observation of a Cretaceous rock outcrop is not sufficient to understand its relevance to both past and future greenhouse conditions, and visiting the ruins of Maya towns is not sufficient to visualize a drought-induced civilization collapse. Such relationships should be *explained* by professional guides or demonstrated on panels and exhibits.



**Figure 2: Climate change literacy functions of three rising tourism directions**

A strong requirement of special tourism *interpretation* in such cases was also noted by other specialists (Gnezdilova et al., 2015; Rutherford et al., 2015; Muda, 2016; Powell et

al., 2017). The approaches and challenges of interpretations were addressed for the case of geological heritage by Moreira (2012), Pacheco and Brilha (2014), You et al. (2014), Gordon (2018), and Santos et al. (2018), for the case of archaeological heritage by Jameson (2010) and Ababneh (2018), and for the case of industrial heritage by Goodall (1993), Uzzell (1996), Hale (2001), and Jelen and Kucera (2017). Moreover, the entire tourist attraction site can be designed to communicate climate change knowledge efficiently, which is shown by the example of the Mimisbrunnr Climate Park 246 in Norway (Vistad et al., 2016). As shown in the cited literature sources, there are a variety of possibilities that offer appropriate interpretations of the noted heritage types for the efficient education of tourists. The same possibilities are possible for interpretations focused on climate change.

The utility of a specific functional approach can be demonstrated by the example of an outcrop of Cretaceous rocks with dinosaur bones (such localities are ideal geological heritage sites employed for geotourism). Interpretation of such a site should start from a basic explanation of what is available at the locality. Tourists often do not have detailed knowledge to realize this themselves. This is why it is necessary to explain that the rocks were formed in the Cretaceous Period, i.e., about 100 mln yr ago, and that the "strange objects" in them are bones that belonged to "beasts of the past." The next portion of interpretation would be an explanation that these rocks and fossils represent an ancient environment that differed by its extreme warmth, with no analogues in the modern world. It is very important to stress that this is not a hypothesis, but a fact – the climate really can be so hot. The final interpretation should be to introduce the visitor to the following idea: *if this is possible in the past, this will be possible in the future*. The two main purposes of the entire interpretation are to introduce tourists to the reality of climate changes in the past and to relate those past changes to expected future changes.

The central problem is the lack of *professional interpreters*. Individuals who are able

to explain how geological, archaeological, and industrial heritages are linked to climate changes are few. Indeed, training programs can be developed (Powell et al., 2017). Others, such as enthusiastic middle-school teachers with perfect knowledge (McNeal et al., 2017), can be involved, and the tourism-related eco-pedagogy techniques (e.g., Nakagawa, 2018) can be employed. However, only a general shift toward a more environmentally-oriented education for future specialists of the tourism industry will lead to a resolution of this problem.

Separate functioning of geological, archaeological, and industrial tourism is less important than their joint contribution. These tourism directions offer logical and time-sequenced promotion of climate change knowledge (Fig. 2). Indeed, the combined impact of their global development can be outstanding. Their literacy functions complement one another and also bring into order climate change knowledge so that it can be delivered to the public. This conclusion has two implications:

- the ongoing growth of geological, archaeological, and industrial tourism should be supported on local, national, and international levels because it contributes to climate change mitigation;
- different opportunities for combining these tourism directions within the same destinations has to be considered.

Apparently, the best opportunity for combining the discussed tourism directions is the creation of thematic parks like geoparks (Henriques and Brilha, 2017), archaeological parks (e.g., Alazaizeh et al., 2016), industrial parks (e.g., Xu, 2012), or even special climate change parks (Vistad et al., 2016). This practice shows that these can serve efficiently not only for their direct purpose but also for the desired combination of activities (Moroni et al., 2015; Vistad et al., 2016; Ramsay, 2017). The main advantage of thematic parks is the availability of an interpretation infrastructure that permits the efficient realization of climate change

knowledge.

It is essential to note that the interests and the needs of environmental protection in general and climate change mitigation, in particular, are not the same (cf. Ingold, 2000; Giddens, 2011). Although such paradoxes of the climate change perception and awareness are difficult to avoid, it remains very important to explain the true essence of this phenomenon. The discussed triad, namely the geological, archaeological, and industrial tourism can achieve this important task because these offer not only abstract explanation but a kind of *real-world demonstration* of the climate changes and their possible mechanisms.

### **Further inferences**

*Ecological tourism* (ecotourism) is the very important direction of tourism, which is tied closely to the both geotourism (Dowling, 2011; Koizumi and Chakraborty, 2016; Hakim and Soemarno, 2017) and the climate change awareness (Aldous, 2013; Hornoiu, 2015). Undoubtedly, it plays the same or even more important role in the promotion of climate change knowledge than the directions considered in this paper. However, it does this differently. Geological and archaeological tourism offer a historical vision of the climate changes and, thus, ensure in their reality. Industrial tourism demonstrates the factors of ongoing climate changes. In contrast, ecotourism appeals to the nature fragility and sensitivity of ecosystems to the climate changes. In other words, it provides examples of climate change *consequences*, not direct evidence. However, this inference is very tentative and needs further investigation.

The other tourism direction that should be discussed together with climate change is *post-disaster tourism*. The latter term generally describes tourist activities on sites experienced devastation by any natural or human-triggered disaster. This tourism direction has risen recently (Tucker et al., 2017; Liu et al., 2018; Zhang et al., 2018). On the one

hand, this can also contribute to climate change awareness, because it displays consequences of catastrophes that can be induced (potentially) by these changes. However, this requires very careful attachment of a given natural disaster to climate change, which may be a serious challenge even for professionals. On the other hand, geological and archaeological tourism can also be seen as representatives of post-disaster tourism because these demonstrate the effects of some past climate changes. If so, experience with post-disaster tourism of some people can facilitate their climate change education *via* participation in geological, archaeological, and industrial tourism initiatives.

## **Conclusion**

The main conclusion of this research note is that three rising tourism directions can contribute systematically, and thus significantly, to climate change mitigation *via* climate change education (in the form of special interpretation). The coherent and combined use of the various climate change literacy functions of geological, archaeological, and industrial tourism can lead toward this goal.

The four major subjects of *tourism versus climate change research* (see above) do not include considerations of the potential of the rising tourism directions for climate change mitigation through public education, although the potential for the relevant studies is demonstrated in this paper. If so, a research gap is revealed. Filling this gap is an urgent task for further investigations, and some general recommendations are possible to formulate:

- the idea of climate change literacy function should be fully conceptualized;
- the climate change literacy function of different directions of tourism (not only those three considered in this paper) has to be examined;
- interpretation approaches that are valuable for climate change mitigation and education need to be characterized, and the costs of their implementation should be

estimated;

- it is necessary to understand how the climate change literacy function of different directions of tourism may contribute to the climate change adaptation (see complexities of this process in Giddens (2011) and Simpson et al. (2018)) – for instance, can such an education help to affect prevailing commercial interests and cultural values of capitalism?

Finding a new idea in the theme of *tourism versus climate change* is highly important for tourism policy-makers and practitioners, including those in developing countries and countries responsible for voluminous greenhouse gases emissions. Geological, archaeological, and industrial tourism should be promoted actively, jointly, and on the state level because of their potential contribution to climate change mitigation.

### **Acknowledgments**

The authors gratefully thank the editor and the both, anonymous reviewers for their suggestions and support, as well as C.P. Conrad (Norway) for his linguistic improvements. The reported study was funded by RFBR according to the research project № 18-010-00549.

## References

- Ababneh, A. (2018). Tour guides and heritage interpretation: guides' interpretation of the past at the archaeological site of Jarash, Jordan. *Journal of Heritage Tourism*, 13, 257-272.
- Aimers, J.J. (2012). Environment and agency in the ancient Maya collapse. *Geophysical Monograph Series*, 198, 27-33.
- Alazaizeh, M.M., Hallo, J.C., Backman, S.J., Norman, W.C., & Vogel, M.A. (2016). Value orientations and heritage tourism management at Petra Archaeological Park, Jordan. *Tourism Management*, 57, 149-158.
- Aldous, D.E. (2013). Effects of green tourism on sustainable development. *Acta Horticulturae*, 999, 171-178.
- Amelung, B., Nicholls, S., & Viner, D. (2007). Implications of global climate change for tourism flows and seasonality. *Journal of Travel Research*, 45, 285-296.
- Ansari, M.K., Moroni, A., Ruban, D.A., Zorina, S.O., Aloia, A., Ahmad, M., Panikarskaja, N.I., Radchenko, E.G., Singh, T.N., & Statsenko, A.A. (2016). Geological activity of humans represented in the World Heritage Sites of India, Italy, and Russia: Evidence of the Anthropocene. *Geološki anali Balkonskoga poluostrva*, 77, 55-71.
- Becken, S. (2004). How tourists and tourism experts perceive climate change and carbon-offsetting schemes. *Journal of Sustainable Tourism*, 12, 332-345.
- Becken, S. (2013). A review of tourism and climate change as an evolving knowledge domain. *Tourism Management Perspectives*, 6, 53-62.
- Becken, S., Zammit, C., & Hendriks, J. (2015). Developing Climate Change Maps for Tourism: Essential Information or Awareness Raising? *Journal of Travel Research*, 54, 430-441.
- Beer, M., Rybar, R., & Kalavsky, M. (2018). Renewable energy sources as an attractive element of industrial tourism. *Current Issues in Tourism*, 21, 2139-2151.
- Buckley, R. (2011). 20 answers: Reconciling air travel and climate change. *Annals of Tourism Research*, 38, 1178-1181.
- Buzinde, C.N., Manuel-Navarrete, D., Kerstetter, D., & Redclift, M. (2010). Representations and adaptation to climate change. *Annals of Tourism Research*, 37, 581-603.
- Copic, S., Dordevic, J., Lukic, T., Stojanovic, V., Dukicin, S., Besermenji, S., Stamenkovic, I., & Tumaric, A. (2014). Transformation of industrial heritage -an example of tourism industry development in the Ruhr area (Germany). *Geographica Pannonica*, 18, 43-50.
- Craig, C.A., & Feng, S. (2018). A temporal and spatial analysis of climate change, weather events, and tourism businesses. *Tourism Management*, 67, 351-361.
- Damm, A., Greuell, W., Landgren, O., & Prettenthaler, F. (2017). Impacts of +2 °C global warming on winter tourism demand in Europe. *Climate Services*, 7, 31-46.
- DiMento, J.F.C., & Doughman, P. (Eds.) (2007). *Climate Change. What It Means for Us, Our Children, and Our Grandchildren*. Cambridge: Massachusetts Institute of Technology - MIT Press.
- Douglas, P.M.J., Demarest, A.A., Brenner, M., & Canuto, M.A. (2016). Impacts of Climate Change on the Collapse of Lowland Maya Civilization. *Annual Review of Earth and Planetary Sciences*, 44, 613-645.
- Dowling, R. (2011). Geotourism's Global Growth. *Geoheritage*, 3, 1-13.
- Elsasser, H., & Burki, R. (2002). Climate change as a threat to tourism in the Alps. *Climate Research*, 20, 253-257.

- Gaita, R., & Both, M. (2008). Climate change and local awareness: A comparative study on tourism stakeholders in Zandvoort (NL) and Costa del Sol (ES). *WIT Transactions on Ecology and the Environment*, 115, 175-184.
- Giddens, A. (2011). *The Politics of Climate Change*. Chichester: Wiley.
- Gill, J.C. (2017). Geology and the Sustainable Development Goals. *Episodes*, 40, 70-76.
- Gnezdilova, V.V., Ruban, D.A., Bruno, D.E., Perrotta, P., Crowley, B.E., Oheim, K.B., & Zayats, P.P. (2015). Geoheritage sites with palaeogeographical value: some geotourism perspectives with examples from Mountainous Adygeja (Russia). *Geološki anali Balkonskoga poluostrva*, 76, 93-104.
- Goodall, B. (1993). Industrial heritage and tourism. *Built Environment*, 19, 92-146.
- Gordon, J.E. (2018). Geoheritage, geotourism and the cultural landscape: Enhancing the visitor experience and promoting geoconservation. *Geosciences*, 8, 136.
- Gössling, S., & Peeters, P. (2015). Assessing tourism's global environmental impact 1900–2050. *Journal of Sustainable Tourism*, 23, 639-659.
- Gössling, S., Scott, D., & Hall, C.M. (2013). Inter-market variability in CO2 emission-intensities in tourism: Implications for destination marketing and carbon management. *Tourism Management*, 46, 203-212.
- Graves, P.E. (2017). Implications for global warming: Two eras. *World Development Perspectives*, 7-8, 9-14.
- Grillakis, M.G., Koutroulis, A.G., & Tsanis, I.K. (2016a). The 2 °C global warming effect on summer European tourism through different indices. *International Journal of Biometeorology*, 60, 1205-1215.
- Grillakis, M.G., Koutroulis, A.G., Seiradakis, K.D., & Tsanis, I.K. (2016b). Implications of 2 °C global warming in European summer tourism. *Climate Services*, 1, 30-38.
- Habibi, T., Ponedelnik, A.A., Yashalova, N.N., & Ruban, D.A. (2018). Urban geoheritage complexity: Evidence of a unique natural resource from Shiraz city in Iran. *Resources Policy*, 59, 85-94.
- Hakim, L., & Soemarno, M. (2017). Biodiversity conservation, community development and geotourism development in Bromo-Tengger-Semeru-Arjuno biosphere reserve, East Java. *GeoJournal of Tourism and Geosites*, 20, 220-230.
- Hale, A. (2001). Representing the Cornish: Contesting heritage interpretation in Cornwall. *Tourist Studies*, 1, 185-196.
- Hall, C.M., Amelung, B., Cohen, C., & Eijgelaar, E., et al. (2015). No time for smokescreen skepticism: A rejoinder to Shani and Arad. *Tourism Management*, 47, 341-347.
- Hamilton, J.M., Maddison, D.J., & Tol, R.S.J. (2005). Climate change and international tourism: A simulation study. *Global Environmental Change*, 15, 253-266.
- Haug, G.H., Gunther, D., Peterson, L.C., Sigman, D.M., Hughen, K.A., & Aeschlimann, B. (2003). Climate and the collapse of Maya civilization. *Science*, 299, 1731-1735.
- Hay, W.W. (2011). Can humans force a return to a "Cretaceous" climate? *Sedimentary Geology*, 235, 5-26.
- Henriques, M.H., & Brilha, J. (2017). UNESCO Global Geoparks: a strategy towards global understanding and sustainability. *Episodes*, 40, 349-355.
- Hewer, M.J., & Gough, W.A. (2018). Thirty years of assessing the impacts of climate change on outdoor recreation and tourism in Canada. *Tourism Management Perspectives*, 26, 179-192.
- Hornoiu, R.-I. (2015). Assessing climate change perception of ecotourism stakeholders from protected areas. *Quality - Access to Success*, 16, 68-70.
- Hose, T.A. (2012). 3G's for Modern Geotourism. *Geoheritage*, 4, 7-24.
- Houghton, J. (2009). *Global Warming. The Complete Briefing*. Cambridge: Cambridge University Press.



- Ingold, T. (2000). *The Perception of the Environment: Essays on livelihood, dwelling and skill*. London: Routledge.
- Jameson, J.H. (2010). Interpretation of archaeology for the public. *Encyclopedia of Archaeology*, 1529-1543.
- Jelen, J., & Kucera, Z. (2017). Approaches to identification and interpretation of mining heritage: The case of the Jáchymovsko area, Ore Mountains, Czechia. *Hungarian Geographical Bulletin*, 66, 321-336.
- Jonsen-Verbeke, M. (1999). Industrial heritage: A nexus for sustainable tourism development. *Tourism Geographies*, 1, 70-85.
- Koizumi, T., & Chakraborty, A. (2016). Geocotourism and environmental conservation education: insights from Japan. *GeoJournal*, 81, 737-750.
- Korstanje, M.E., & George, B. (2012a). Global warming and tourism: Chronicles of apocalypse? *Worldwide Hospitality and Tourism Themes*, 4, 332-355.
- Korstanje, M.E., & George, B. (2012b). Sustainable tourism and global warming: Panacea, excuse, or just an accidental connection? *Worldwide Hospitality and Tourism Themes*, 4, 383-394.
- Liu, S., Cheung, L.T.O., Lo, A.Y., & Fang, W. (2018). Livelihood benefits from post-earthquake nature-based tourism development: A survey of local residents in rural China. *Sustainability (Switzerland)*, 10, 699.
- Martin, Ma.B.G., Lopez, X.A.A., & Iglesias, M.C. (2017). Climate change perception and local adaptation responses: Rural tourism as a case study. *Cuadernos de Turismo*, 39, 651-654.
- Marx, W., Haunschild, R., & Bornmann, L. (2017). The role of climate in the collapse of the Maya civilization: A bibliometric analysis of the scientific discourse. *Climate*, 5, 88.
- McNeal, P., Petcovic, H., & Reeves, P. (2017). What is motivating middle-school science teachers to teach climate change? *International Journal of Science Education*, 39, 1069-1088.
- Michailidou, A.V., Vlachokostas, C., & Moussiopoulos, N. (2016). Interactions between climate change and the tourism sector: Multiple-criteria decision analysis to assess mitigation and adaptation options in tourism areas. *Tourism Management*, 55, 1-12.
- Moreira, J.C. (2012). Interpretative Panels About the Geological Heritage-a Case Study at the Iguassu Falls National Park (Brazil). *Geoheritage*, 4, 127-137.
- Moroni, A., Gnezdilova, V.V., & Ruban, D.A. (2015). Geological heritage in archaeological sites: case examples from Italy and Russia. *Proceedings of the Geologists' Association*, 126, 244-251.
- Muda, J. (2016). Geological indicators of sea-level changes at Northern Sabah, Malaysia: Tools for instilling public awareness on global climate changes. *Bulletin of the Geological Society of Malaysia*, 62, 31-35.
- Nakagawa, Y. (2018). EscapeScape: Simulating ecopedagogy for the tourist. *Journal of Environmental Education*, 49, 164-176.
- Njoroge, J.M. (2014). An enhanced framework for regional tourism sustainable adaptation to climate change. *Tourism Management Perspectives*, 12, 23-30.
- Ólafsdóttir, R., & Tverijonaite, E. (2018). Geotourism: A Systematic Literature Review. *Geosciences*, 8, 234.
- Otgaard, A. (2012). Towards a common agenda for the development of industrial tourism. *Tourism Management Perspectives*, 4, 86-91.
- Pacheco, J., & Brilha, J. (2014). The importance of interpretation for the diffusion of geoheritage: A review. *Comunicacoes Geologicas*, 101, 101-107.
- Peters, P.M., & Eijgelaar, E. (2014). Tourism's climate mitigation dilemma: Flying between rich and poor countries. *Tourism Management*, 40, 15-26.

- Powell, R.B., Depper, G.L., & Wright, B.A. (2017). Interpretation Training Needs in the 21st Century: A Needs Assessment of Interpreters in the National Park Service. *Journal of Interpretation Research*, 22, URL: [https://www.interpnet.com/NAI/nai/\\_publications/JIR\\_v22n2\\_Powell.aspx](https://www.interpnet.com/NAI/nai/_publications/JIR_v22n2_Powell.aspx).
- Prosser, C.D. (2013). Our rich and varied geoconservation portfolio: The foundation for the future. *Proceedings of the Geologists' Association*, 124, 568-580.
- Ramsay, T. (2017). Fforest Fawr Geopark—a UNESCO Global Geopark distinguished by its geological, industrial and cultural heritage. *Proceedings of the Geologists' Association*, 128, 500-509.
- Ross, D., Saxena, G., Correia, F., & Deutz, P. (2017). Archaeological tourism: A creative approach. *Annals of Tourism Research*, 67, 37-47.
- Rossello-Nadal, J. (2014). How to evaluate the effects of climate change on tourism. *Tourism Management*, 42, 334-340.
- Ruban, D.A. (2015). Geotourism - A geographical review of the literature. *Tourism Management Perspectives*, 15, 1-15.
- Ruban, D.A. (2017). Geodiversity as a precious national resource: A note on the role of geoparks. *Resources Policy*, 53, 103-108.
- Rutherford, J., Newsome, D., & Kobryn, H. (2015). Interpretation as a vital ingredient of geotourism in coastal environments: The geology of sea level change, Rottneest Island, Western Australia. *Tourism in Marine Environments*, 11, 55-72.
- Saarinen, J., & Tervo, K. (2006). Perceptions and adaptation strategies of the tourism industry to climate change: The case of Finnish nature-based tourism entrepreneurs. *International Journal of Innovation and Sustainable Development*, 1, 214-228.
- Santos, I., Henriques, R., Mariano, G., & Pereira, D.I. (2018). Methodologies to Represent and Promote the Geoheritage Using Unmanned Aerial Vehicles, Multimedia Technologies, and Augmented Reality. *Geoheritage*, 10, 143-155.
- Shani, A., & Arad, B. (2014). Climate change and tourism: Time for environmental skepticism. *Tourism Management*, 44, 82-85.
- Shukla, J.B., Verma, M., & Misra, A.K. (2017). Effect of global warming on sea level rise: A modeling study. *Ecological Complexity*, 32, 99-110.
- Simpson, M.C., Gössling, S., Scott, D., Hall, C.M., & Gladin, E. (2008). *Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices*. Paris: UNEP.
- Smith, K. (1990). Tourism and climate change. *Land Use Policy*, 7, 176-180.
- Tucker, H., Shelton, E.J., & Bae, H. (2017). Post-disaster tourism: Towards a tourism of transition. *Tourist Studies*, 17, 306-327.
- Uzzell, D.L. (1996). Creating place identity through heritage interpretation. *International Journal of Heritage Studies*, 1, 219-228.
- Vistad, O.I., Wold, L.C., Daugstad, K., & Haukeland, J.V. (2016). Mimisbrunnr Climate Park – A network for heritage learning, tourism development, and climate consciousness. *Journal of Heritage Tourism*, 11, 43-57.
- Wall, G., & Badke, C. (1994). Tourism and climate change: An international perspective. *Journal of Sustainable Tourism*, 2, 193-203.
- Weir, B. (2017). Climate change and tourism – Are we forgetting lessons from the past? *Journal of Hospitality and Tourism Management*, 32, 108-114.
- Wyss, R., Abegg, B., & Luthe, T. (2014). Perceptions of climate change in a tourism governance context. *Tourism Management Perspectives*, 11, 69-76.
- Xu, F. (2012). The studies of the concept plan of the Fengcheng industrial park towards the circular economy. *Advanced Materials Research*, 598, 220-223.
- Yashalova, N.N., Akimova, M.A., Ruban, D.A., Boiko, S.V., Usova, A.V., & Mustafaeva,

- E.R. (2017). Prospects for Regional Development of Industrial Tourism in View of the Analysis of the Main Economic Indicators of Russian Tourism Industry. *Economic and social changes: facts, trends, forecast*, 10, 195-213.
- You, Y., Tian, M., Yang, Y., & Gao, L. (2014). Construction of geoparks' interpretation system based on geoheritage protection. *WIT Transactions on Ecology and the Environment*, 189, 863-870.
- Zhang, J.K., & Zhang, Y. (2018). Carbon tax, tourism CO2 emissions and economic welfare. *Annals of Tourism Research*, 69, 18-30.
- Zhang, Y., Coghlan, A., & Knox, K. (2018). Understanding the depersonalisation process in post-disaster sites. *Tourism Recreation Research*, 43, 497-510.