Part C

WATER JOINT PROGRAMMING INITIATIVE

WATER CHALLENGES FOR A CHANGING WORLD

2018 JOINT CALL
Closing the Water Cycle Gap

“Simulating tourism water consumption with stakeholders”

“SIMTWIST”

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1. EXCELLENCE

1.1. Introduction

Tourism is one of the world's largest sectors, accounting for around 10% of GDP and employment world-wide. Tourism is also growing fast: annual international tourist arrivals increased from 500 million 1995, to 1 billion in 2012 and 1.3 billion in 2017. Water is an essential resource for tourism: in the form of drinking water, as an important determinant of landscapes, and as a setting for tourism activities. At first glance, tourism appears to have a negligible impact on water resources, as global figures suggest that international tourism accounts for less than one per cent of national water use in the majority of countries[1]. However, tourism tends to be concentrated in dry and warm places and seasons, coinciding with high demand from nature and agriculture, and limited precipitation. As a result, tourism's share in water consumption can be nationally and regionally significant[2]. In nineteen countries, tourism's estimated share in domestic water consumption exceeds 5%; in six of those (including France and Spain) this share exceeds 10%[3]. On the regional level, the case of the major Spanish tourism resort town of Benidorm is well-documented.[4] Every year, about ten million cubic meters, or approximately half of the total water supplied in the Marina Baja region, is consumed in Benidorm. Of this consumption, 64% is dedicated to tourist, recreational, and commercial activities, while around 30% is for permanent residents, 30% of whom are foreigners. Directly and indirectly, tourism clearly dominates urban water consumption in Benidorm and in many other tourism town.

In tourist destinations around the world, the tourism sector is increasingly adding to local and pressures on water supply systems[5], in particular in coastal regions where water use intensities are already high[6]. Coastal tourism is the largest segment of international tourism and one of its hotspots is the Mediterranean, the world's most visited tourism region with 300 million arrivals per year. In the Mediterranean region, tourism puts substantial pressure on water supplies and competes with local users[7], and this has been the case for decades already. Already forty years ago, in 1978, Benidorm faced an acute water crisis. After an extended period of drought, the town was unable to meet tourism water demand and narrowly escaped a complete shut-down[8]. Water crises like this have large impacts on economy and society and over the last five years, they have consistently featured in the top five of most likely and impactful future risks in the World Economic Forum's Global Risk Reports[9]. Decision-makers face difficult choices, with far-reaching consequences, about prioritizing water uses and allocating scarce water resources among the various sectors. A World Bank study for Murcia (Spain) for example, observes that it may be necessary to reinforce the legal priority of domestic water supply and reduce irrigation's impact on the region's water availability[10]. Strategic questions for tourism include how tourism operators can contribute to responsible water management at the site level, and whether the tourism industry should actually be engaged in water management planning and water efficiency measures. Such broader considerations of tourism's resource use, however, are largely absent from the academic literature and so far mostly limited to industry-relevant publications and reports.

Tourism development in the Mediterranean region has been characterised by large-scale urbanisation. Around the world, rapid urbanization and growth of cities have put pressure on dwindling resources[10]. Over the last 60 years, domestic water use – which includes water use by tourism – has almost quadrupled. Within the next three decades, the demand for residential water in cities is projected to grow by an additional 50 percent[11]. Some of this projected growth relates to behavioural adaptation to climate change, but most of it results from socio-economic

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[1] Lavanchy G.T. (2017). When wells run dry: Water and tourism in Nicaragua. *Annals of Tourism Research* 64:37-50.
[2] Cole S. (2017). Tourism and water. Journal of Sustainable Tourism 22(1): 89-106.
[3] Gössling S. et al. (2012). Tourism and water use: Supply, demand, and security. *Tourism Management* 30(1): 1-15.
[4] Yoon, H. et al. (2018). Shifting Scarcities? *Sustainability* 10(3), 824.
[5] Becken S. (2014). Water equity – Contrasting tourism water use with that of the local community. *Water Resources and Industry* 7-8: 9-22.
[6] Flörke M. et al. (2013). Domestic and industrial water uses of the past 60 years as a mirror of socio-economic development: A global simulation study. *Global Environmental Change 23*: 144-156.
[7] Rico A.M., Olcina J., Baños C.J. (2014). Competition for water use in the province of Alicante (Spain): management experiences for harmonizing tourist and agricultural uses. *Documents d'Anàlisi Geogràfica* 3: 523-548.
[8] Martínez-Ibarra E. (2015). Climate, water and tourism: Causes and effects of droughts associated with urban development and tourism in Benidorm (Spain*). International Journal of Biometeorology* 59(5): 487-501.
[9] World Economic Forum (2018). The Global Risks Report 2018, 13th Edition. World Economic Forum, Geneva.
[10] World Bank (2018). *Water Scarce Cities: Thriving in a Finite World*. World Bank, Washington, DC.
[11] Luck M. et al. (2015). *Aqueduct Water Stress Projections: Decadal Projections of Water Supply and Demand Using CMIP5 GCMs*. Technical Note. Washington, D.C.: World Resources Institute.

development[12], which in many Mediterranean destinations centres on tourism. Tourism's contribution to water consumption is expected to increase sharply as a result of increasing numbers of tourists, rising hotel standards and tourism activities' growing water intensity[3].

While water demand is projected to increase, water availability will likely decrease, at least in the Mediterranean region. The simultaneous phenomena of climate change and tourism growth pose challenges to both the water utilities and the tourism industry. The challenges are particularly great in the dry summer season, when the demand is maximum and the water availability is minimum[13]. To meet these challenges, scenarios for future supply and demand are essential. The water utilities needs such scenarios to inform investment decisions on capacity, whereas the tourism industry needs them to evaluate the risk and implications of water shortages, and the options to reduce their own water consumption. First of all, however, information is needed on past and current water consumption by tourism, as there are no specific water use databases and statistics for tourism[3]. As Flörke et al. rhetorically ask: "How can we constructively think about future developments of water-related sectors if we do not know how water was used in the past?"[6]

1.2. State-of-the-art and relation to the work programme

Without water, tourism amenities such as swimming pools, golf courses, aquatic parks and gardens would be unavailable. No wonder that international tour operators carefully look at water supply. Tourist destinations that do not comply with stringent standards in this respect run the risk of losing clientele[14]. Climate change will likely exacerbate water scarcity problems, as dry regions are getting drier, and the frequency and intensity of floods and droughts change[15]. Tourism destinations that are already water scarce are advised to manage water proactively[3]. Effective management is difficult, however, without basic information about tourism's water footprint. The literature on the impact of touristic variables on urban water demand, for example, is limited, and at sub-annual scale almost non-existent[16].

Recent publications have made headway in putting some basic information together, for example by providing a global overview of tourism's water consumption[3]; a set of performance indicators[17]; knowledge on the combined impacts of climatic and touristic factors on monthly urban water demand[16]; and an account of the direct and indirect water footprint of tourism in Spain[18] and the Eastern Mediterranean[19]. Through the presence of international tourists, Spain and other Mediterranean countries are exporters of large amounts of 'virtual' water[18]. Efforts to reduce water scarcity can be directed at increasing supply, redistributing supply and reducing demand[20]. Most studies have focused on increasing supply, for example through desalination. Options for reducing demand have been under-researched[21], but the limited available evidence suggests the potential is large. Tourism is known to be a water-intensive sector that has long attached a low priority to saving water, and therefore also lacks indicators to monitor consumption and identify options for reduction[22]. Very few studies have attempted to study water supply and tourism water demand in an integrated way, although the need for such studies has recently been emphasised[23].

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[12] Parkinson, S. et al. (2016). Climate and human development impacts on municipal water demand: A spatially-explicit global modelling framework. *Environmental Modelling & Software* 85: 266–278.
[13] EEA (2010). *The European Environment State and Outlook 2010. Water resources: quantity and flows*. EEA, Copenhagen.
[14] Gabarda A. et al. (2017). Mass tourism and water efficiency in the hotel industry: A case study. *International Journal of Hospitality Management* 61: 82-93.
[15] Wolff E. et al. (2014): Climate Change: Evidence and Causes, National Academy of Sciences, Washington, D.C.
[16] Toth E. et al. (2018). Assessing the significance of tourism and climate on residential water demand: Panel-data analysis and non-linear modelling of monthly water consumptions. *Environmental Modelling & Software* 103: 52-61.
[17] Gössling S. (2015). New performance indicators for water management in tourism. *Tourism Management* 46: 233-244.
[18] Cazcarro I. et al. (2014). The water footprint of tourism in Spain. *Tourism Management* 40: 90-101.
[19] Hadjikakou M. et al. (2013). Estimating the direct and indirect water use of tourism in the eastern Mediterranean. *Journal of Environmental Management* 114: 548-556.
[20] Rico A.M. et al. (2013). Beyond Megaprojects? Water alternatives for mass tourism in Coastal Mediterranean Spain. *Water Resources Management* 27(2): 553-565.
[21] Cashman A., Moore, W. (2012). A market-based proposal for encouraging water use efficiency in a tourism-based economy. *International Journal of Hospitality Management* 31(1): 286-294.
[22] Gössling S. (2015). New performance indicators for water management in tourism. *Tourism Management* 46: 233-244.
[23] Enríquez et al. 2017. Sustainable Water Management in the Tourism Economy: Linking the Mediterranean's Traditional Rainwater Cisterns to Modern Needs. *Water* 9(11): 868.

Studies of water problems have become increasingly interdisciplinary. Water studies were initially dominated by natural scientists and engineers, who conceptualised the flows of water with the 'hydrologic cycle', a diagram describing the natural circulation of water in the environment. To take account of humanity's increasing interference in the natural flow of water, the concept of the 'urban water cycle' was developed, which expands the notion of the 'hydrologic cycle' by integrating the natural and managed pathways that water follows in an urban ecosystem[24]. In recent years, it has become evident that only taking account of humanity's physical interference does not suffice, as water challenges are also strongly shaped by social aspects, such as power relations, institutions and human behaviour. The emerging field of *hydrosocial* cycle analysis deliberately attends to water's social, political and cultural nature, representing water's broader social dimensions in combination with environmental issues.

The hydrosocial cycle can be defined as "a socio-natural process by which water and society make and remake each other over space and time."[25] Water scarcity or changes in water availability (which can be related to seasonality, quantity and quality) give rise to water management or governance, which in turn affects water availability, leading to governance adjustments, and so on. Water governance measures are politically charged: they are taken in a context of social power relations and can also change those relations. According to the hydrosocial cycle literature, different water governance arrangements produce different 'kinds' of water in a social sense. Hydrosocial cycle analysis offers analytical insights into the social construction and production of water. The approach has so far hardly been applied to analyse water challenges in coastal mass tourism destinations.

Assessments of water supply require strong input from hydrology and other natural sciences, whereas assessments of water demand require the social sciences. The hydrosocial cycle framework provides a natural interdisciplinary platform to integrate these two academic branches. It also constitutes a bridge to transdisciplinarity, which has been defined as "is a reflexive, integrative, method-driven scientific principle aiming at the solution or transition of societal problems and concurrently of related scientific problems by differentiating and integrating knowledge from various scientific and societal bodies of knowledge." [26] Stakeholder participation must be centre-stage in this project, not only because stakeholders are a vital source of practical information, but also because transitions towards more sustainable water use systems can be greatly accelerated with their support and collaboration; they may not even be achievable without. Social learning with and among stakeholders is therefore essential to accelerate the learning cycle and produce action. The key challenge of the action is to connect water scarcity, a macro-level problem, with the micro-level behaviour of individual stakeholders. Stakeholders do not necessarily 'feel' the high-level problem, but their combined behaviour does contribute to it. In addition, solutions eventually have to be incorporated or reflected in the behaviour of individuals. This challenge requires platforms for stakeholders and researchers from a variety of disciplines to discuss and integrate knowledge and insights. Companion modelling and agent-based modelling, which are at the heart of our proposal, are particularly well suited to meet this challenge, in combination with hydrosocial cycle analysis.

1.3. Objectives and overview of the proposal

The proposal's general objective is to improve the understanding of the tourism water footprint and to help reduce tourism stakeholders' contributions to water scarcity in tourism destinations by informing public and private decision-makers about the effectiveness of different types of interventions. The emphasis on water scarcity necessitates the consideration of both water supply and demand. This action endeavours to connect water scarcity, a macro-level problem, with the micro-level behaviour of individual tourism stakeholders. The stakeholders addressed by the project include tourists, tourism accommodations and other tourism-related businesses, water utilities, and policy makers. The project's objective can only be achieved through transdisciplinary research, i.e. research that integrates insights from different disciplines and puts stakeholder participation centre-stage. Transdisciplinary research is challenging, but over the years a set of principles has emerged that can guide project design.[28] These principles relate to the proper execution of three phases: 1) collaboratively framing the problem, to make sure that the problem addressed is societally relevant; 2) co-producing solution-oriented knowledge, to enable mutual learning; and 3) transferring the produced knowledge to other applications in societal practice as well as science. Our proposal

[24] Ridolfi E. (2014). Exploring the urban hydrosocial cycle in tourist environments. *Investigaciones Geográficas* 61: 17-38.
[25] Linton J., Budds J. (2014). The hydrosocial cycle. *Geoforum* 57: 170-180.
[26] Lang, D.J. et al. (2012). Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustainability Science* 7 (SUPPL 1): 25-43.

has been designed with these design principles in mind. The issue of tourism-related water consumption that this project addresses is of great relevance and concern to the project's study areas, as exemplified by the long-term research collaborations that the University of Alicante and the University of Bologna have established on this issue with local stakeholders. Core methodologies in the proposal, in particular Companion Modelling, have been specifically designed to facilitate knowledge co-production. Given the similarity of water issues (e.g. scarcity, seasonality) in Mediterranean tourism destinations, results and methods can be easily scaled-up and transferred.

The action's specific objectives are:

1. To assess the water availability conditions in each of the case study areas by means of hydrological modelling and/or information on reservoirs management and withdrawals from other local water sources;
2. To estimate current tourism-related water consumption in each of the case studies and the main natural and anthropogenic factors that govern it;
3. To explore the prospects of water scarcity in the case study areas with the help of exploratory scenarios of supply and demand;
4. To examine the interactions between water, social power and infrastructure in the two case studies through hydrosocial cycle analysis;
5. To determine the key behavioural rules that guide water consumption by tourism business in each of the case study areas, paying attention to e.g. water efficiency campaigns, water and energy prices, financial resources, environmental attitude, shared knowledge, cultural background;
6. To test the effectiveness of various public and private intervention options as potential tools to monitor and reduce water consumption, through agent-based model simulations.

Based on the case study results, the project hopes to inspire a new kind of approach to urban water security in coastal mass-tourism destinations. This approach fully acknowledges that human activities and natural water systems in tourism destinations co-evolve and that effective action to induce high water-use efficiencies and lower water consumptions require public-private coordination at the regional and local scales.

1.4. Research methodology and approach

The main purpose of **objective 1** is to establish a baseline of water availability. This requires a careful understanding of the water supply system in each of the case studies. These systems are very different. In the case of Rimini, the Ridracoli reservoir plays a pivotal role, as it feeds half the volumes for the Romagna region. For this reservoir, a detailed model is available that provides estimates of available water volumes, and may be used to assess various climate change scenarios. For the other water sources (groundwater and surface water withdrawals) we rely on aggregated available volumes, and their possible evolution in the next decades, provided by the water supplier and other studies. For Benidorm, our dependence on secondary data and analyses is even greater, because data from local water agencies and managers are discontinuous. Fortunately, given the highly developed water arrangements that are in place, the water system is well-understood and statistics about it abundant.

Achieving **objective 2** requires the identification of the main drivers of water demand. Urban water demand is guided by complex interactions between human and natural system variables at multiple spatial and temporal scales and understanding the dominant drivers is a necessary prerequisite for improving the demand models. Accounting for intra-annual variations in demand is crucial, given the strong seasonality of coastal tourism in the Mediterranean. We will study the combined effects of climatic factors and tourist fluxes on annual and intra-annual urban water consumption for the two case study cities. The first step of the analysis consists of setting up a database containing time-series of measures of water consumption and climatic and tourism variables. A set of smart meters will be installed in Rimini to monitor a number of representative water users. These meters will provide insights into the consumption patterns of the main user typologies (hotels, holiday homes, bathing establishments, restaurants etc.) at sub-annual scale (monthly, but possibly up to daily and sub-daily), which are currently available in Benidorm but not in Rimini. Correlation analysis between water demand and the seasonally varying predictors will identify the most influential variables. These variables will feed into different modelling approaches (linear and non-linear), aimed at estimating and predicting the urban water demand for individual user types and aggregated at district/city level. The demand models developed by the University of Bologna will first be run with historical meteorological data to establish a baseline for both Rimini and Benidorm.

To evaluate the effects of climate change (**objective 3**) the models will be driven by climate projections. Such climatic scenarios, resulting from regional climate models are already available for the case-study areas (such as the COSMO–CLM driven by CMCC–CM for Rimini and the regional scenarios Escenarios PNACC as well as the RCM projections provided by EURO-CORDEX and MED-CORDEX for the Alicante region). Scenarios for future tourism development will be produced based on the Shared Socioeconomic Pathways (SSPs). The SSPs were developed to be used alongside the IPCC's Representative Concentration Pathways (RCPs) in a Scenario Matrix Architecture. The tourism scenarios will include narratives that provide a consistent logic of the main causal relationships and trends, including those which are traditionally difficult to capture by models. In addition, data from local meteorological stations will be analysed and compared with regional models, to inform the specific climatic scenario for each case study.

Hydrosocial Cycle analysis (HSC) will be used to uncover the interactions between water, social power and infrastructure **(objective 4)**. HSC is an approach integrating the macro-level processes of (urban) hydrology and climate change with the micro/actor-level of social behaviour and power relations. Cause-effect relationships in the articulation of water resource availability and social demands will be analysed combining political ecology and human geography approaches. Questionnaires (targeted at end-users) and semi-structured interviews (targeted at managers) are used to explore questions such as "how do tourists' socioeconomic background and cultural perspective influence their perception of water consumption and their willingness to change it?" and "is water scarcity a key issue when deciding on water resource use?" The resulting qualitative and quantitative data information will be used in the configuration and application of the ABM in each case study. The HSC will offer a critical approach that prompts us to consider how water internalizes and reflects tourism sector demands that might be otherwise remain invisible for end-users and managers. In addition, HSC will provide insights into patterns of support of and resistance against possible interventions.

To elicit the behaviour rules guiding water consumption by the tourism sector, including key stakeholders and end-users (**objective 5**), we will use Companion Modelling (ComMod), an iterative approach to stakeholder engagement and simulation/model co-development[27], in which stakeholders, researchers and technical experts can participate. The ComMod process that we apply has three steps: desk study and individual interviews, simulation development, and simulation sessions. Desk study and individual interviews with key stakeholders (step 1) will result in a first overview of the main elements and processes of the water system at hand, and the stakeholders' perspectives on them. During the simulation development step (step 2), stakeholders will combine various pieces of information about the water system, so that a system's representation results that the stakeholders recognize. Based on the insights from the simulation development process, the research team will develop a first version of a serious game, which captures the main stakeholder types with their resources and interests. The game will be further improved based on stakeholder feedback. During the simulations sessions (step 4), participants are given different roles and go through different game rounds and scenarios. Simulation sessions enable the research team to test the information about human agency, heterogeneities, and feedbacks provided by individual interviews, in a dynamic group setting. Simulation sessions enable participants to perform their unique strategies within the system. They are thus a means of understanding and enabling human agency and social learning.

The simulation sessions provide a wealth of qualitative (and some quantitative) insights into stakeholder behaviour in a complex and changing environment. To evaluate the effectiveness of potential intervention options (**objective 6**) in such complex environments, agent-based models (ABMs) will be developed. ABMs can explore the effects of a wide range of assumptions, future scenarios and possible (policy) interventions, in this case aimed at achieving local adaptation measures on climate change and water efficiency. The project's Agent-Based Models (ABMs) will be composed of: (1) various types of actors, including individual tourists, managers and decision-makers; (2) interrelated and weighted variables; (3) attitudes and profiles from urban water demand; (4) scenarios and decision-making heuristics; and (5) learning rules and guidelines to identify water and social variables involved in coastal mass-tourism destinations. Achieving objective 6 requires the integration of information about water availability, consumption and scarcity (obj. 1, 2,,3), social (power) relations (obj. 4) and behaviour (obj. 5). The Agent-Based Model will be set up in such a way that various types of policies can be evaluated, including qualitative and quantitative restrictions, conditions and rules, taxes and levies. These policies are modelled as exogenous factors, represented by buttons and levers in the model interface. Policy effectiveness will be measured in terms that are

[27] Etienne M (2014). Companion modelling: A participatory approach to support sustainable development. Springer.

meaningful to stakeholders. These terms will be further specified in consultation with the stakeholders during the project, but likely candidates include water consumption, water efficiency (water consumption per tourist/room/unit of income/unit of energy used/etc.) and water scarcity. Rather than providing point estimates, the model simulations will produce distributions of potential outcomes, reflecting the large inherent uncertainties in complex systems.

Case studies

Benidorm (Spain) and Rimini (Italy) are the project's two case study areas. **Benidorm** has been considered a costal mass-tourism resort since the 1960s. Today, Benidorm is the fourth most visited tourism destination in Spain after Barcelona, Madrid and the Canary Islands, annually attracting around 2 million visitors with 16 million overnight stays. With over 130 hotels and nearly 5,000 tourist apartments, Benidorm has a capacity of over 41,000 rooms. Tourism activities make Benidorm a large consumer of water and energy. One of the most distinctive features of the urban water cycle in Benidorm is the use of non-conventional flows based on the agreements between several agricultural communities and the water authorities of the region in order to ensure water availability for residential and tourism activities. Given their importance in economic, social, and environmental terms, an accurate assessment of water-tourism interrelationships has been conducted by HIDRAQUA and the Marina Baja Water Consortium, the main retail water company and water manager in the Benidorm area.

Rimini is the biggest beach resort on the entire Adriatic Sea, attracting almost 16 million tourists in 2017. With over 2,100 hotels and 7% of the total Italian hotel capacity, Rimini belongs to the top five of European regions in terms of hotel accommodation, and has the highest concentration of hotels in Europe[28]. Rimini has a long history of tourism development, being one of the first mass tourism destinations at the beginning of the 20th century and reaching a mature stage already in the 1960s. The massive tourist development resulted in indiscriminate exploitation of natural resources, including water. Recently, the city of Rimini has played a pro-active role in analysing and proposing sustainable forms of coastal tourism (see also UE LIFE Project MED-COAST S-T). RomagnaAcque – Società delle Fonti is the regional water supplier and it provides wholesale water to HERA SpA, the main retail water company in Rimini.

1.5. Originality and innovative aspects of the research (ambition)

The proposal is novel in various ways. First of all, the proposal focuses on tourism. Water research and water policies tend to overlook tourism, despite its significance in many water-scarce coastal regions in Europe. Secondly, the proposal goes beyond the traditional system-level statistical relationships between tourism water consumption and determinants such as accommodations' numbers of rooms, quality levels and amenities provided. It dives deeper, taking account of perceptions, attitudes, cultural backgrounds, and other individual and social drivers that, in combination with climatic factors, influence individual actors' water use behaviour. To this end, the project uses the novel hydrosocial cycle approach, which connects the physical sphere of water flows with the social spheres of power and institutions. Information about tourist behaviour, put in its social and institutional context, allows companies to design and implement green practices that fit with tourist expectations. Thirdly, the proposal applies transdisciplinary modelling approaches that are built around and facilitate stakeholders' participation. ComMod is an approach that has specifically been developed to support stakeholder participation in transdisciplinary research on complex societal issues. ABM complements ComMod. It has the same systemic, stakeholder-based orientation, but due to its reliance on computer simulation, allows for the exploration of a wide set of scenarios, and the experimentation with a range of potential policy measures to test their effectiveness. Finally, the same modelling approaches also facilitate the integration of knowledge from a range of disciplines, including hydrology, economics and social sciences. In summary, the SIMTWIST project includes a network of integrated tools, methodologies and approaches that a) are focused on the strategic role of water and energy consumption in Mediterranean coastal mass-tourism destinations; b) combine and integrate quantitative and qualitative data; c) are developed to take into account social, technical and institutional issues combined with climate data; d) are able to include and promote strong cross-border links between end-users, stakeholders, and decision makers; and e) make use of different scenarios in order to provide guidelines and recommendations to be included in multiscale policies and common action programs.

[28] Unioncamere Emilia-Romagna (2011). "Governance e marketing territoriale nel turismo. Rapporto 2010". Maggioli Editore, Rimini, Italy.

1.6. Clarity and quality of transfer of knowledge for the development of the consortium partners in light of the proposal objectives

The University of Bologna Research Unit (UB-RU) will, through the project, gain new knowledge on the interface between hydrological and tourism science, from the sociological and economic perspectives. Such knowledge will allow the UB-RU to better understand the expected tourism demand scenarios and incentive structures that have a crucial impact on the development of water demand and on the success of water management projects. In addition, the project will finance the collection of additional data on water demand, at fine temporal and spatial scales, that will allow to better understand the water consumption patterns at sub-annual scale. This kind of consumption data is new for Rimini. The project activities will also further strengthen UB-RU's relationships with the water utilities (both Romagna Acque and HERA SpA), and increase the research unit's knowledge of the Rimini water distribution system. Finally, the comparison with the Benidorm case study will potentially yield key factors for understanding and improving the Rimini water resources management of Rimini and other Italian coastal cities.

The Interuniversity Institute of Geography, in combination with the Department of Geography of the University of Alicante (UA), will gain new knowledge on the interplay between climate change impacts, urban water consumption and key behavioural rules for tourism-related water consumption in mass-tourism destinations. The UA will be able to increase its knowledge on how technical, natural and social sciences can work together in order to offer a complete and transversal analysis of the complexity involved in the water-society nexus. As geographers, the UA project members are not fully familiar with questions related to using future climate change projections for developing combined scenarios for water resources availability and demand, nor with the development of ABMs. Through this project, the UA will become much more familiar with these methods and approaches, thereby strengthening its position in interdisciplinary and transdisciplinary research.

The Environmental Systems Analysis group at Wageningen University (ESA) will broaden its knowledge of the intricate relationships between tourism and environmental change, building on its expertise in the field of climate change and tourism. The project will also strengthen ESA's position as a leader in the emerging community of researchers using agent-based modelling techniques in tourism research. Furthermore, ESA will also greatly benefit from the collaboration with two very strong research teams in Alicante and Bologna and their well-established connections to the tourism sector in two of the world's leading tourism destinations. With this project, ESA intends to lay the groundwork for more joint research projects on tourism in these destinations. Finally, the project will reinforce ESA's strong reputation as an interdisciplinary research group, by playing a key role in the combination and integration of insights from the natural, technical and social sciences.

1.7. Quality of the consortium partners and collaborative arrangements. Capacity of the consortium to reinforce a position of leadership in the proposed research field

The Consortium is well balanced in terms of different roles and complementary competencies. The University of Bologna is strongly rooted in the natural sciences, specialising in hydrology and hydrological engineering. The University of Alicante has a strong emphasis on social sciences, specialising in hydrosocial cycle analysis and the behavioural side of tourism. The University of Wageningen is strong in interdisciplinary and transdisciplinary research, clearly targeted at solving critical societal issues. All the partners are characterized by an outstanding scientific profile and have an internationally recognised leadership role in the respective fields. The topics and activities proposed by the partners are consistent with their skills and experience. All three partners have ample experience with interdisciplinary research and have internalised the required academic flexibility and openness.

The University of Bologna (UB) has extensive experience in two fields: hydrological modelling and water resource management on one hand, and urban water supply systems on the other hand. UB has worked extensively with the main stakeholders to be involved in Rimini: the regional wholesale water supplier, RomagnaAcque – Società delle Fonti SpA (with whom UB has a 5-years research contract for developing water supply and water demand modelling) and HERA SpA (with whom UB has worked in the water distribution systems characterisation and modelling for many years).

The University of Alicante (UA) has a recognized experience in two fields: hydrosocial cycle analysis of water scarce areas confronted with high water demands; and daily monitoring of a range of climatic variables by the research institute's climate laboratory. Just like the Italian partner, UA has closely worked with local stakeholders and end users involved in the management of water resources in Benidorm, including the Marina Baja Water

Consortium, HIDRAQUA and Aguas de Alicante Corporations, HOSBEC Hoteliers Association, municipalities, and wastewater management plants. All of them have collaborated (or collaborate nowadays) in different research projects conducted by the University of Alicante research group and focused on 1) finding out how to increase water efficiency in urban water systems and 2) identifying and constructing tourist profiles regarding water consumption in water scarcity areas.

The Environmental Systems Analysis group is a leading group in environmental systems analysis, which is a multidisciplinary research field aimed at analysing, interpreting, simulating and communicating complex environmental problems from different perspectives. Members of the group have been actively shaping the international sustainability program Future Earth, the integrated assessment model IMAGE, the Millennium Ecosystem Assessment, and The Economics of Ecosystems and Biodiversity (TEEB) studies on nature's contribution to society. The group's extensive experience with systems analysis methods, in particular modelling, has in recent years been applied to the analysis of environmental issues in relation to tourism. Wageningen University as a whole is one of the world's leading universities in the fields of food and agriculture, and environmental sciences, as shown by its top position in those fields in the QS World University Rankings and the National Taiwan Ranking.

2. IMPACT

2.1. Impact of the proposal

The project aims to increase the overall coherence and efficiency of the use of European water resources and valorising know-how on water solutions as part of the expected impacts listed in the H2020 Societal Challenge 5. In addition, UN SDG 6 and 13 will be addressed by producing new knowledge and innovative solutions with bottom-up modelling. Our proposal focuses on improving our understanding of water consumption by tourism actors so that effective measures to reduce this consumption can be developed and water scarcity can be reduced. This clearly addresses the UN SDG 6 target that states: "By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity". In addition, our proposal is future-oriented, incorporating the implications of climate change into simulation games and computer simulations. One of the primary goals of using simulation games is to foster social learning, which can be seen as a type of informal education. Key goals of using computer simulations are to provide early warnings of potential future threats, and to provide a virtual context for policy experimentation, strengthening the institutional capacity for climate change adaptation. As a result, the proposal also addresses the UN SDG 13 target that states: "improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning".

The proposal targets water consumption by individual actors, addressing the decisions they make and the trade-offs they face. Rather than using a 'typical' or 'average' consumer approach, it pays full attention to the heterogeneity among actors and contexts. Sub-theme 2.3, "connecting science to society" is therefore at the core of the proposal. Based on the findings about the individuals' water use behaviour, the proposal goes on to explore the effectiveness of a variety of possible policy and management interventions, including labelling and information provisioning, but also pricing strategies and economic incentives. As a result, sub-theme 2.1, "integrating economic and social analyses into decision-making processes" is also squarely in the proposal's crosshairs. Finally, the proposal's aim to link micro-level (water use) behaviour to macro-level (water scarcity) challenges also relates to theme 1, "enabling sustainable management of water resources" as it contributes to "mitigating water stress in coastal zones and urbanized deltas", i.e. sub-theme 1.3.

The project aims to have impact in two distinct ways: through the knowledge that will be produced and through the methodologies that will be developed and refined. With respect to knowledge: the tourism industry and water utilities in the case study areas will benefit substantially from the new insights into how high tourism-related water consumption is, what its main components are what influence institutions and economic and social incentives have on water consumption behaviour. In addition, policy-makers in the case study areas will benefit from the model simulations regarding policy effectiveness. Some of this knowledge, for example regarding the influence of institutions and incentive structures, will likely be of direct relevance for stakeholders in other tourism destinations in the Mediterranean and beyond. The new practices that may thus emerge can be shared with stakeholders in other destinations as 'best practices', either in written form or through stakeholder conferences.

With respect to the methodologies produced: the project makes use of innovative methodologies, including demand modelling, hydrosocial cycle analysis, companion modelling, serious games and agent-based modelling. These methodologies may have some case-specific details, but the approaches are generic enough to be applied in other tourism destinations as well. Rather than having to start from scratch, destinations around the Mediterranean and elsewhere will be able to build on the project's experience with applying the various methods in Rimini and Benidorm and on the suit of actual tools and models developed. We expect the project's impact through the transfer and sharing of methodologies, tools and models to be even larger than its impact via the direct transfer of insights.

2.2. Expected outputs

The transdisciplinary nature of the project necessitates the production of outputs directed at a variety of audiences: policy makers and water utilities, stakeholders in the tourism industry, and academia.

Expected outputs directed at policy-makers and water utilities include:

- Policy briefs with information on the quantity and structure of tourism-related water consumption;
- Policy briefs about tourism's current and expected contribution to regional water scarcity;
- Policy briefs with the main conclusions from the simulation-based policy evaluations;
- An agent-based model with which the effects of policies can be evaluated;
- Guidelines on how to analyse hydrosocial cycles in coastal mass-tourism destinations based on tested experiences in Spain and Italy;
- Guidelines on how to design and execute companion modelling processes aimed at the co-production of knowledge on tourism-related water consumption in tourism destinations;
- A workshop on tourism sector behavioural modelling in coastal mass-tourism destinations
- Proceedings of the results of participatory processes, including social learning sessions.

Expected outputs directed at stakeholders in the tourism industry include:

- A report on best-practices with regard to reducing water consumption and increasing water efficiency in the tourism industry;
- A list of tracking indicators to be used by the stakeholders and end-users of coastal mass-tourism destinations;
- A stakeholder meeting (to which also policy-makers and water utilities are invited) at the beginning of the project, to raise awareness and stimulate further ownership of the project among tourism stakeholders.
- A stakeholder meeting at the end of the project to discuss the project's results and to collectively draw up the collaborative research agenda for the years after the project.
- Proceedings of the results of participatory processes, including social learning sessions.

Expected output directed at academia include:

- At least five peer-reviewed articles in renowned journals: 1) Tourism's share in residential water consumption: the cases of Benidorm and Rimini; 2) Current and future water scarcity in Mediterranean tourism centres: an exploratory scenario analysis for Rimini and Benidorm; 3) Understanding water consumption in tourism: eliciting the behavioural rules with companion modelling; 4) How to reduce tourism water consumption? Exploring policy effectiveness with agent-based modelling; 5) Tourism, climate change and the hydrosocial cycle in Benidorm and Rimini: the intricate relationship between water, power and institutions in two Mediterranean megaresorts.
- Incorporation of results and methods in teaching programmes, such as in the courses Environment&Tourism and Tourism Systems Analysis of Wageningen University's BSc Tourism programme.
- Papers in the proceedings of conferences and workshops related to various disciplines and transdisciplinary fields, including hydrology, tourism, participatory processes, complex adaptive systems.

2.3. Exploitation and communication activities (measures to maximise impact)

Stakeholder participation and social learning is at the heart of the proposal. Stakeholders will themselves co-produce the new knowledge about tourism water consumption and ways to reduce it, greatly enhancing the chances for effective internalisation of the knowledge and for behavioural change. To a significant degree, the dissemination of knowledge will therefore be automatic and informal. Nevertheless, more formal ways of knowledge dissemination are important for broader groups of stakeholders: local stakeholders who were not involved in the project, stakeholders in other destination, national and European policy-makers, etc. Local stakeholders will be tended to with dedicated workshops and news items in the local media. Stakeholders in other destinations will be targeted with a concise project website offering best practices, both in terms of reducing water consumption and in terms of facilitating social learning processes. Digital tools such as social media platforms (TEDx, accounts on Twitter, Facebook, Instagram and LinkedIn) will be also be used for the exchange of experiences between the research community, professionals and key stakeholders (managers, decision-makers). Replicating such processes in many different destinations is crucial to capture the huge heterogeneity among destinations and stakeholder dynamics. Regional, national and European policy-makers will be targeted with policy briefs, supported by academic publications. Dissemination tasks will also include short notes and published reports in the context of the World Water Day (March 22th) and the International Tourism Day (September 27th) and participation in tourism sector conferences, such as the World Conference on Smart Destinations or the International Conference on Sustainable Tourism Management. Tailored dissemination will be conducted at case study level, for example there will be regular meetings and public conferences in the office of HOSBEC, which represents the Benidorm hotel industry.

2.4. Market knowledge and economic advantages/return of investment

Our project does not have a direct commercial aim, in the sense of developing products or services that have commercial value and can be sold in the marketplace. Rather, our project is aimed at developing innovations with a societal return on investment. The new knowledge on tourism water consumption and behavioural analysis (ABM software, HSC matrix, stakeholders and end-users narratives, and statistical results) obtained during the project, will become available to end-users and stakeholders (tourism sector) in tourism destinations in the Mediterranean, Europe and the rest of the world, as a starting point for tracking, predicting and reducing tourism-related water consumption in coastal mass-tourism destinations. Water utilities may decide to adopt our models and develop water and tourism services based on that

3. IMPLEMENTATION

3.1. Overall coherence and effectiveness of the work plan

SIMTWIST is organized into seven WPs (WP0-WP6), as illustrated by the following Table and Figure 1. This structure allows for an efficient interaction among scientists of different disciplines, as it is based on the project's key components, while facilitating and stimulating feedbacks between WPs and associated models.

WP0	WP1	WP2	WP3	WP4	WP5	WP6
Project management	Supply, demand and water scarcity	Climate scenarios and policy intervention	Companion Modelling and behavioural rules	Hydrosocial Cycle and stakeholders' profile in case studies	Agent-Based modelling and policy simulation	Communication and dissemination
Month 1-36	Month 1-36	Month 1-9	Month 6-30	Month 3-24	Month 18-36	Month 13-36

WP0 (WUR, UB, UA) "Project management" encompasses project management, centred on good communication, flexibility and a clear distribution of responsibilities among all partners. The project promotes connecting science to society and an efficient implementation plan ensures that results and outputs of the project will be shared with the stakeholders, other target groups and the general public in a timely and effective manner.

WP1 (UB, UA) "Supply, demand and water scarcity" focuses on the physical side of water, including supply, demand and the resulting scarcity, both at present and in the future under a number of climate change scenarios..

WP2 (WUR, UB, UA) "Climate scenarios and policy intervention" is aimed at producing the scenarios and policy/intervention options used in the other work packages. Whereas the necessary climate scenarios in terms of radiative forcing and impacts are readily available as RCP scenarios, scenarios for the development of tourism are not. These will be developed based on the IPCC's Shared Socioeconomic Pathways (SSPs), so that they are consistent with the physical RCP scenarios. This WP will further entail a comprehensive and detailed review of well-established and innovative policy/intervention options to reduce tourism-related water consumption or improve water efficiencies, through laws, economic incentives, social and emotional incentives or otherwise. All categories of options will be described and documented, and a selection of options will be made for inclusion in the project's models. A detailed description will be provided of how these policy options can be represented in the models.

WP3 (WUR, UA, UB) "Companion modelling and behavioural rules" addresses the social side of water demand, exploring and modelling the decision-making processes among tourists and tourism companies regarding water consumption. The central methodological approach towards understanding the behaviour of tourism stakeholders is Companion Modelling (ComMod). ComMod is an interactive process facilitated by role-playing games and simulation models used as mediating tools to support dialogue, shared learning & collective decision-making[27]. The activities are driven by end users interest. This WP pays explicit attention to the water-energy nexus, since energy prices are known to be key determinants of water use.

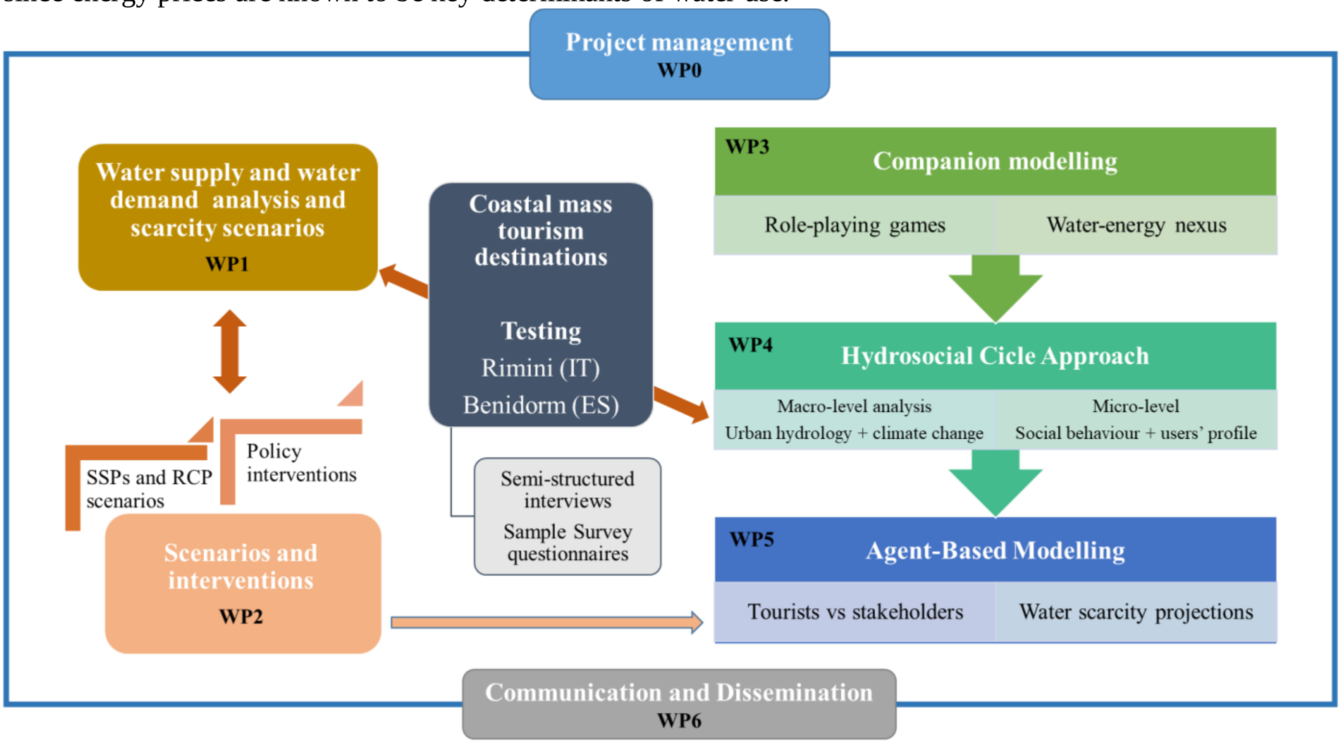


Figure 1: Project structure

WP4 (UA, WUR, UB) "Hydrosocial Cycle and stakeholders' profile in tested case studies" develops the Hydrosocial cycle (HSC), an approach integrating the macro-level processes of (urban) hydrology and climate change with the micro/actor-level of social behaviour and power relations (tourist sector). For each case study (Benidorm and Rimini), in-depth analyses on social power relationships between water resources availability, tourist sector demands and regional climate change scenarios will be conducted. Survey questionnaires and semi-structured interviews will be used in order to address current and future challenges on coupled natural human systems such as coastal mass-tourism destinations. Qualitative and quantitative data will be analysed using qualitative analysis (MAXQDA©) and statistical software (SPSS©). Furthermore, survey and interview data will be used as a data sources for Agent-based modelling (WP5).

WP5 (WUR, UA, UB) "Agent-Based modelling and policy simulation" explores the effectiveness of possible policy measures to reduce the water consumption by tourists and tourism stakeholders. These measures may range from information provisioning to water or energy pricing policies and to the imposition of efficiency standards, banning of wasteful technologies or other command-and-control measures. ABM models consist of an environment and agents, whose behaviour is described by rules. The environment is the hydrological system in each of the two case study areas, the dynamics of which will be based on the hydrological and water availability scenarios resulting from WP1. The actors are of two main types: tourists and tourism stakeholders according to WP4. The rules driving the behaviour of these types of actors will be based on the results from WP3. In combination with the scenarios and policy options produced by WP2, the ABM model will be used to make projections for the future development of the water scarcity issues around tourism, and to test the effects of a variety of policy options on the main indicators: water consumption, water efficiency and water scarcity.

WP6 (WUR, UB, UA) will ensure that the project's results are widely promoted and disseminated, and knowledge produced within the project is effectively shared with external stakeholders in the Mediterranean and beyond. The WP contains a series of dissemination and communication tasks aimed at generating a valuable information flow and publicity of the project's results in a wide network of stakeholders, including the research community, tourism businesses, national and regional authorities, and the general public.

3.2. Appropriateness of the management structure and procedures, including quality management

The Consortium Coordinator is responsible for the project's internal management and external representation. He will submit all the project deliverables to the Call Steering Committee in a timely manner, including the Final Technical Report, the Mid-term Progress Report and the Final Report. The Consortium Coordinator will also attend the kick-off, mid-term and final review meetings organised by the Water JPI, to ensure compliance with the overall Water JPI and to identify options for cross-fertilization with other projects. Each of the partners must comply with the requirements of its respective FPO, which includes the budget. Each of the PIs therefore take personal responsibility to manage their own national budget, including outlays related to training and dissemination activities. Each institution's support staff will assist the PI with the financial management.

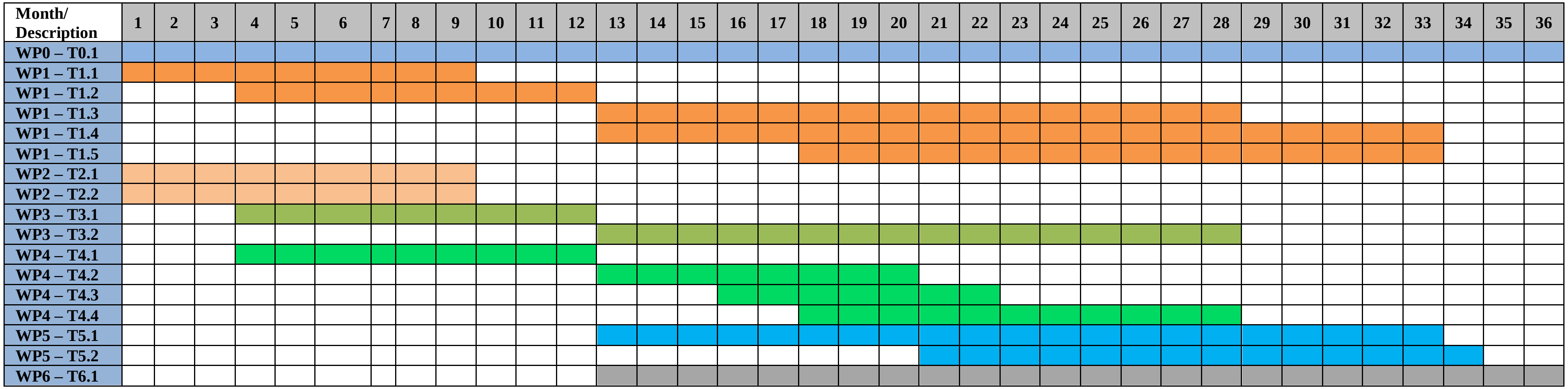
The consortium's small size allows for a light and lean internal management structure. Much of the communication, knowledge exchange, and combination and integration of skills that are essential for the project's success will therefore occur informally. Nevertheless, a formal structure is also required to make sure the project stays on track, and to resolve any problems that might arise. The consortium partners will sign a Consortium Agreement (CA) that will set out the project structure and management (i.e. bodies, decision making procedures, role and responsibilities of the partnership, financial issues), publishing rules, handling of conflicts, confidentiality issues and the approach to be taken regarding any intellectual property that may arise from the research activities.

The Project Management Board is the decision-making and executive body of the project and it is composed of all the three Principal Investigators (PI) of the involved partners. The Board will see to the implementation of the activities, according to the schedule outlined in the Gantt chart and the project's budget, by ensuring the progress alignment among partners and handling any problem or delay that may occur. The Board will meet in person during the kick-off meeting and then once per year. In between, it will review progress and preliminary results at least once a month, using video or telephone conference technologies.

To facilitate the exchange of data, approaches and procedures among the partners, the project will make use of a Data Exchange platform, to which all members of the project team have access. The Data Exchange platform will support work package activities by providing a central repository of project files; it will also support project management by providing an overview of where the project stands. Each of the partners will organize one of the three annual general project meetings, during which the past period's accomplishments and problems will be discussed and a concrete plan for the subsequent plan will be developed and agreed upon.

Within the project's overall framework, the various Work Packages (WPs) will have considerable autonomy in achieving the project's goals. All partners are fully aware that the interdisciplinary nature of the project requires an open mind towards new combinations of approaches and methods, and the three PIs will actively pursue such research environment. Each of the WP leaders will produce concise quarterly internal progress reports for discussion by the Project Management Board.

Gantt chart



List of Tasks

T0.1: Coordination and internal communication

T1.1: Collection of available data sets (water supply and demand) and information on existing measures and policies; state of the art on tourism footprint in coastal areas (scientific review); analysis and validation of existing climate scenarios in the case study areas.

T1.2: Design of water metering campaigns

T1.3: Smart monitoring (water metering)

T1.4: Development and validation of the water demand models

T1.5: Analysis of future water demand evolution, using the (above) models under future scenarios and assessment of expected water scarcity conditions

T2.1: Development of scenarios (narratives and quantitative indicators) for tourism development that are consistent with the climate change scenarios used

T2.2: Identification and description of intervention options

T3.1: Design of the survey/interviews campaigns.

T3.2: Companion modelling process, including interviews and simulation sessions

T4.1: Design of the interview campaign

T4.2: Interview/surveys with stakeholders and consumer profiling

T4.3: HSC approach applied to Rimini and Benidorm case studies

T4.4: Analysis of power relationships between key stakeholders and water-tourism nexus managers

T5.1: ABM in current scenario (using historical data)
T5.2: Analyses of effectiveness of intervention options.
T6.1: Dissemination

List of main milestones
M1.1: Validation of available data sets on water supply and demand (Month 13)
M1.2: Checkpoint to test smart monitoring (Month 16)
M2.1: Evaluation of scenarios and interventions (Month 10)
M3.1: Evaluation of stakeholder and end-users (tourists)' involvement from sample survey (Month 10)
M3.2: Validation of Companion modelling process (Month 20)
M4.1: Checkpoint to apply HSC in each case study (Month 6)
M5.1: Checkpoint to validate the ABM (Month 20)
M5.2: Checkpoint to test the ABM in each case study (Month 30)
M6.1: Evaluation of dissemination capacity during the social-learning process (Month 24)

List of deliverables
D1.1: Policy briefs with information on the quantity and structure of tourism-related water consumption in Rimini and Benidorm (Month 10);
D1.2: A list of tracking indicators to be used by the stakeholders and end-users of coastal mass-tourism destinations (Month 12);
D1.3: Policy briefs about tourism's projected future water consumption contribution to regional water scarcity in Rimini and Benidorm (Month 34);
D3.1: A workshop on tourism sector behavioural modelling in coastal mass-tourism destinations (Month 20)
D3.2: Guidelines on how to design and execute companion modelling processes aimed at the co-production of knowledge on tourism-related water consumption (Month 30);
D4.1: Guidelines on how to analyse hydrosocial cycles in coastal mass-tourism destinations based on tested experiences in Spain and Italy (Month 24);
D5.1: Guidelines for developing and Agent-Based Model focused on water resources in coastal mass-tourism destinations (Month 30).
D5.2: An agent-based model with which the effects of policies can be evaluated (Month 36)
D5.3: Policy briefs with the main conclusions from the simulation-based policy evaluations (Month 36);
D6.1: A stakeholder meeting at the beginning of the project, to raise awareness and stimulate further ownership of the project among tourism stakeholders (Month 3).
D6.2 Website and social media report (Month 3-36)
D6.3 Stakeholders and end-users dissemination report (open forums) (Month 24)
D6.4: A stakeholder meeting at the end of the project to discuss the project's results and to collectively draw up a future collaborative research agenda (Month 34);
D6.5: A report on best-practices with regard to reducing water consumption and increasing water efficiency in the tourism industry (Month 36);
DX.1 Academic publications with the main results obtained from interviews and sample survey from stakeholders and end-users' consultancy (Month 18-36).

3.3. Risk management

Top-down and bottom-up contingency mechanisms are foreseen to solve problems or conflict at decision-making levels as close as possible to the problem source:

- Top-down mechanism: the Project Management Team (PMT) approves major decisions. Decisions cascade to Work package Teams in a formal contractual structure.
- Bottom-up mechanism: A possible problem/conflict has to be managed first at Work package level. If needed, the problem will be raised at the PMT.

Different areas of risk have been identified: project management risks, data management risks and scientific risks. Plans of action will be elaborated for each of these areas. Any risks identified will be managed (and shared between partners) using the Risk Register. The identified risks will be monitored throughout the project and discussed during the project meetings. Each identified risk will be assigned to a partner responsible for monitoring it. The Project Management Team will help assess risks and facilitate their mitigation. Mitigation and contingency plans will be defined jointly with the Project Coordinator. This procedure entails the identification and prioritisation of risks and the application of necessary resources to mitigate the risks' impacts. The Consortium Agreement regulates the process in case of serious problems concerning a partner or team member.

With respect to scientific risk, the event with the largest impact would be low participation of end-users and other stakeholders. Stakeholder participation is at the heart of the project, so low participation would certainly endanger reaching project objectives. Among other things, it would delay the collection of data on water consumption and the elicitation of behavioural rules needed to develop the agent-based models. Perhaps even more importantly, low stakeholder participation would potentially severely limit the societal uptake of the project's results. Fortunately, the likelihood of low participation is low. The Universities of Alicante and Bologna both have long-standing collaborations with key stakeholders, characterised by high levels of trust. As a result, the project can build on the considerable amount of social capital that is already present. Research agendas in Alicante and Bologna are partly shaped by the frequent interaction with stakeholders, so that the gap between the academic and stakeholder 'worlds' is small. In addition, stakeholders can reap strategic benefits from participating in a practice-oriented project on water use, a topic of large strategic importance.

Other events may be more likely, but less critical to the project's success. First, privacy issues may arise when gathering information characterising the users. If such issues arise, we will work with aggregated rather than individual data. Second, acquiring existing data on water use from water utilities may cause delays, as the utilities need to employ their workforce in order to deliver the data to us in a suitable format, which may not be a priority. To minimise this risk, we will involve the data-owner/utilities from the beginning, identifying a suitable contact person. Third, there is a risk of problems and delays related to the acquisition, installation and implementation of smart-meter installations, which are required for fine water use monitoring. If the acquisition of meters is problematic, we may lease them.

3.4. Potential and commitment of the consortium to realise the project

A key factor for the project's success is stakeholder involvement, as stakeholders play a central role in the project. One of the consortium's great strengths is its well-established and excellent ties to the key stakeholders in the case study areas. The project can therefore greatly benefit from the high level of trust that already exists between researchers and stakeholders. The complementary knowledge and skills of the consortium partners further nourish the networks and provide strong incentives for both stakeholders and academics to participate.

The University of Bologna has a long-lasting collaboration with end-user organisations, including water utilities and local and regional policy-makers. The end-user organisations are keen on continuing and intensifying this collaboration to incorporate the additional information on the tourism-related and social determinants of water use, retrievable through the project. The University of Alicante has a long history of collaboration with the main tourism and water stakeholders in Benidorm and Alicante. This project promises to bring substantial value to the Spanish stakeholders involved, by shedding light on the future of water availability - a key resource for tourism development - and on the best options for adaptation. The project will also help define new water efficiency policies at the local level, and maximise the chances that public administration and private investors will integrate the results into their daily operations and conform to SDGs and circular economy principles.

4. DESCRIPTION OF THE PARTICIPATING RESEARCHERS

Partner Number, according to Part A	Research Team Members (for personnel include name, position and affiliation)	General Description
Partner 1 (Bas Amelung)	Jillian Student	Experienced in companion modelling, i.e. developing and applying models together with stakeholders, and also in agent-based modelling. Student, J.et al. (2016). *Journal of Sustainable Tourism* 24(3): 412-429. Student, J. et al. (2016). Vulnerability Is Dynamic! Conceptualising a Dynamic Approach to Coastal Tourism Destinations' Vulnerability. In: Leal Filho, W. (Ed.) Innovation in Climate Change Adaptation. Springer International Publishing. Pp. 31-42.
Partner 2 (Antonio Rico)	María Hernández	Experienced in urban water demand analysis and the use of non-conventional water resources as climate change adaptation measure.
	Sandra Ricart	Experienced in water governance and modelling qualitative data from stakeholders' attitudes and perceptions (interviews and sample surveys).
	Jorge Olcina	Experienced in climate change projection and modelling at regional scale (Alicante), and in promoting local measures for end-user adaptation.
	Rubén Villar/Ana Arahuetes	Experienced in databases configuration and residential water consumption analysis in coastal tourism areas, applying statistical models and hydrosocial cycle assessment.
Partner 3 (Elena Toth)	Cristiana Bragalli	More than 20 years of research on water supply and distribution networks: reduction of water losses; smart technologies; indicators for assessment of the technical quality of distribution systems, tariff setting methodologies for urban water services. Participation in many European and National projects on urban water scarcity and innovative water management/services, such as H2020-SWAMP – Smart Water Management Platform (2017-2020). LIFE08 WATACLIC - Water against climate change. Sustainable water management in urban areas (2010-2012).

5. CAPACITY OF THE CONSORTIUM ORGANISATIONS

Partner Number (Organisation Name)		General Description
Partner 1 (Wageningen University & Research)	**Role and main responsibilities in the project**	Project leader. Companion modelling. Agent-based modelling.
	Key research facilities, infrastructure, equipment	The Environmental Systems Analysis chair group of Wageningen University will grant the research team all the necessary infrastructures and equipment for the activities of the researcher (shared office with her own desk space; a PC; use of printers; software; telephone; internet access; library access).
	Relevant publications and/or research/innovation products	Amelung, B. et al. (2016). *Current Opinion in Environmental Sustainability* 23: 46-53. Parkinson, S., Van Vliet, M. et al. (2016). *Environmental Modelling & Software* 85: 266–278.
Partner 2 (University of Alicante)	**Role and main responsibilities in the project**	Project partner. Coordination of the Benidorm case study analysis. Hydrosocial analysis.
	Key research facilities, infrastructure, equipment	The Interuniversity Institute of Geography at the University of Alicante will offer its infrastructure (office, library and databases, secretariat and technical support services) and equipment (PCs, software, internet access) to project members.
	Relevant publications and/or research/innovation products	Ricart, S. et al. (2018). *International Journal of Water Resources Development* (in press). Olcina, J. et al. (2014). *Environmental Management* 53(1):181 Arahuetes, A., Villar, R. & Hernández, M. (2016). *Revista de geografía Norte Grande* 65: 109
Partner 3 (University of Bologna)	**Role and main responsibilities in the project**	Project partner. Coordination of the Rimini case study analysis. Hydrological analysis.
	Key research facilities, infrastructure, equipment	The Department of Civil, Chemical, Environmental, and Materials Engineering at the University of Bologna will offer infrastructures and research equipment (office space, access to library and databases, secretariat and technical support services, software). The Hydraulic Engineering laboratory may provide support for the monitoring campaign.
	Relevant publications and/or research/innovation products	Toth E. et al. (2018). *Environmental Modelling & Software* 103: 52-61. Bragalli, C. et al (2016). *Water Resources Management* 30(11): 3689-3706. Bragalli, C. et al. (2007). Assessment of water shortage in urban areas. In: Methods and tools for drought analysis and management. Springer.