Horizon 2020 Societal challenge 5: Climate action, environment, resource efficiency and raw materials

BINGO

Bringing INnovation to onGOing water management – a better future under climate change

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Short Summary of results (<250 words)

Deliverable 7.9 – Proceeding of the Final Conference was developed by SPI within Task 7.3 of WP7 - Dissemination, communication and exploitation. It contains the summary of BINGO's representation in the 4th European Climate Change Adaptation Conference – ECCA 2019, where the final conference of the project was embedded. It includes the abstracts and presentations of all the BINGO sessions and the materials produced for the dissemination of BINGO's results in the conference, as well as the activities that took place at the BINGO booth in ECCA 2019.

Evidence of accomplishment

Report

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1. INTRODUCTION

This document is developed as part of the BINGO (Bringing INnovation to onGOing water management – a better future under climate change) project, which has received funding from the European Union's Horizon 2020 Research and Innovation programme, under the Grant Agreement number 641739. The **Proceedings of the Final Conference** represents Deliverable 7.9 of Work Package 7 (WP7) – Dissemination, communication and exploitation.

WP7 has three main objectives: **(i)** to disseminate and communicate project related information to the different target groups; **(ii)** to ensure that the results of the project are exploited and have a lasting impact in Europe; and **(iii)** to empower stakeholders to take up the project results. The specific objectives of this WP are to:

- Develop and update a Dissemination and Communication Plan, which will ensure an effective communication within and outside the project;
- Develop dissemination and communication materials and tools;
- Organise workshops to disseminate the project results and activities;
- Contribute to long term and sustainable engagement of stakeholders, maximizing the impact of the project;
- Create synergies with other projects and initiatives, contributing to an effective use of resources;
- Ensure an effective exploitation of the project results.

This document serves to provide an overview of the participation of BINGO in the ECCA 2019, where its Final Conference was embedded. It describes the activities developed in the BINGO booth, the prizes distributed and the presentations of the project's results across ECCA 2019 sessions.

After this Introduction, this document is organised in the following sections: 2. ECCA 2019; 3. BINGO Presentations; 4. BINGO booth and activities; 5. BINGO Promotional Materials; and 6. Impact.

2. ECCA 2019

The 4th European Climate Change Adaptation (ECCA) Conference took place at Centro Cultural de Belém, in Lisbon, Portugal, from the 28th to the 31st of May 2019 with over 1100 delegates from all over the world.

The Organisation Committee of the Conference consisted of the coordinators and selected members of three EU-funded adaptation research projects: BINGO, PLACARD and RESCCUE.

Building on past conferences that took place in Hamburg (2013), Copenhagen (2015) and Glasgow (2017), ECCA 2019 aimed at promoting the communication and knowledge exchange between researchers, policymakers and practitioners in order to find integrated solutions and inspire action.

ECCA 2019 was organised around six main themes:

1. Data, methods and approaches in climate change adaptation and disaster risk reduction
2. Co-production of knowledge, solutions and services
3. Communication, data-sharing and decision support
4. Institutions, governance, citizens and social justice
5. Global climate challenges
6. Climate risk management and resilience

Three plenaries were held in ECCA. The opening plenary (28 May) with the title “Europe is at risk: adapting to extremes” focused on the urgency to take action and present what is being done in Lisbon, Portugal and Europe, and included high-level keynote speakers:

- João Pedro Matos Fernandes | Portuguese Minister of Environment and Energy Transition
- Fernando Medina | Mayor of Lisbon City Hall
- Christos Stylianides | European Commissioner for Humanitarian Aid and Crisis Management, European Commission
- Daniela Jacob | Climate Service Center Germany – GERICS
- Yvon Slingenberg | Director of International, Mainstreaming and Policy Coordination, Directorate-General for Climate Action (DG CLIMA), European Commission

The second plenary (29 May) “Adapting businesses to climate change: risks and opportunities” brought on the discussion on the role of the private sector, including speakers from international companies and organisations:

- Cláudia Coelho | Sustainable Business Solutions Director of PWC Portugal
- Alexandre Relvas Jr. | Managing Director, Casa Relvas
- Diane D’Arras | President of International Water Association
- Paul Fleming | Corporate Water Program Manager for Microsoft
- Kirsten Dunlop | Chief Executive Officer, EIT Climate-KIC

The third plenary: “The road ahead” focused on discussing solutions and setting the path for the next decade to achieve the goals and targets of the three international agreements for 2030, with the intervention of:

- Jean-Eric Paquet | Director-General, Directorate-General for Research and Innovation (DG RTD), European Commission
- Jian Liu | Chief Scientist at UN Environment
- Paola Albrito | Chief of the Regional Office for Europe of the UN Office for Disaster Risk Reduction
- Virginia Murray | Head of Global Disaster Risk Reduction, Public Health England
- Marko Maver | Slovenian Secretary of State for the Environment

Additionally, 96 Science-Practice and Science parallel sessions were organised by the scientific and practice communities to present the current state-of-the-art knowledge and inspired action, as well as a range of innovative tools in the context of climate change adaptation and disaster risk reduction.

The key messages gathered during the conference will be used to inform Horizon Europe by providing an update on each of the six ECCA themes. The update will provide an overview of what is the current state of knowledge of each theme, which interesting highlights have come from ECCA and, most importantly, which knowledge gaps can be identified. An overall analysis will describe how especially these knowledge gaps link to Horizon Europe.

The BINGO representation at ECCA 2019 consisted of:

- 44 BINGO partners, with invitation cards for the BINGO booth
- BINGO booth with prizes (250 hats and 250 t-shirts), games, videos and activities;
- BINGO brochure in every ECCA 2019 gift bag
- BINGO presentations mapping flyer in every ECCA 2019 gift bag
- BINGO poster/oral presentations

There were a total of 27 presentations, among oral presentations, sessions and posters, covering all of the themes of the conference, as the image below displays.


Tuesday 28 May
BINGO
a better future under
CLIMATE CHANGE
11:15 - 13:00
Strengths and weaknesses in climate change adaptation governance - a comparison across six European regions
S13
Guidelines designed for win-win collaboration between Researchers and Non-Researchers Stakeholders
S16
Lunch
Thematic character: Farmer
14:00 - 15:45
Developing Adaptation Strategies Using Science and Stakeholders
S16
Observed and modelled effects of the temporal variability of rainfall on evapotranspiration and runoff in semi-arid environments
S9
Afternoon coffee break
Bingo Game
16:15 - 18:00
BINGO PROJECT: Selection of effective adaptation measures to weather extremes - Reducing flood risk in Wuppertal, Germany
S11
Hazard and risk assessment related to CSOs in bathing waters in a context of climate change.
Socio-economic potential impacts of climate change due to urban pluvial floods in Badalona (Spain). The BINGO project
BINGO PROJECT: Impacts of Climate Change on Water Cycle's Groundwater Component - Tagus basin case-study
S9
Posters - 28 May 18:00 - 19:00
Calibration of a one-way coupled atmospheric-hydrologic model for the study of extreme events over Cyprus
PS2
Canvas exercise applied to exploitation - methodology for collectively defining exploitable results
PS6
Sub-hourly precipitation over a Mediterranean catchment in a high-resolution climate model
PS1
Will inundation hazard by storm surges change in the near-future? The upper Tagus estuary case.
PS3
Irrigation in Portugal and climate change
PS18
Evaluating climate change adaptation measures for a Mediterranean Watershed with stakeholder engagement
PS17
Numerical assessment of the saltwater propagation in the upper Tagus estuary during droughts
PS2
Themes
1 - Data, methods and approaches in Climate Change Adaptation and Disaster Risk Reduction
2 - Co-production of knowledge, solutions and services
3 - Communication, data sharing and decision support
4 - Institutions, governance, citizens and social justice
5 - Global climate challenges
6 - Climate risk management and resilience
Visit the ECCA tool-shed, in room 15, and check out BINGO Online Portfolio of Adaptation Measures on May 30!

Figure 1 - Mapping of BINGO at ECCA 2019 (printed in flyer)

3. BINGO PRESENTATIONS

The BINGO presentations and posters at ECCA 2019 are listed below, with clickable hyperlinks that redirect to the abstract in this document:

Theme 1: Data, methods and approaches in Climate Change Adaptation and Disaster Risk Reduction

- ORAL PRESENTATIONS
    - Observed and modelled effects of the temporal variability of rainfall on evapotranspiration and runoff in semi-arid environments
    - BINGO PROJECT: Selection of effective adaptation measures to weather extremes – Reducing flood risk in Wuppertal, Germany
    - Hazard and risk assessment related to CSOs in bathing waters in a context of climate change
    - Socio-economic potential impacts of climate change due to urban pluvial floods in Badalona (Spain). The BINGO project
    - BINGO PROJECT: Impacts of Climate Change on Water Cycle's Groundwater Component – Tagus basin case-study
    - Decadal predictions for hydrological extremes assessment in Europe
    - Assessment of climate change scenarios combined with anthropogenic influences at the Große Dhünn Reservoir, Germany
    - BINGO PROJECT: Impacts of Climate Change on the Urban Water System – a case study from Bergen

    - Effects of climate change in an agricultural area in the Tagus estuary (Portugal)
    - Making decadal predictions and climate scenario simulations usable for the Wupper association's water management challenges
- E-POSTERS
    - Calibration of a one-way coupled atmospheric-hydrologic model for the study of extreme events over Cyprus
    - Sub-hourly precipitation over a Mediterranean catchment in a high-resolution climate model
    - Will inundation hazard by storm surges change in the near-future? The upper Tagus estuary case
    - Numerical assessment of the saltwater propagation in the upper Tagus estuary during droughts

Theme 2: Co-production of knowledge, solutions and services

- ORAL PRESENTATIONS
    - Developing Adaptation Strategies Using Science and Stakeholders
    - BINGO – A Dynamic Framework for Creating Knowledge Co-production
    - Stakeholders' involvement in defining climate change adaptation strategies. The case study of Badalona in BINGO project

Theme 3: Communication, data sharing and decision support

- ORAL PRESENTATIONS
    - Guidelines designed for win-win collaboration between Researchers and Non-Researchers Stakeholders
- SCIENCE PRACTICE SESSIONS
    - Exploitation in CCA & DDR – clustering and discussion

- BINGO project's exploitable results and exploitation plan

- POSTERS
  - Canvas exercise applied to exploitation – methodology for collectively defining exploitable results

Theme 4: Institutions, governance, citizens and social justice

- ORAL PRESENTATIONS
  - Strengths and weaknesses in climate change adaptation governance – a comparison across six European regions
  - Strategic groundwater management as an adaptation measure
  - Advice in Collaborative Management in Climate Change Adaptation
- POSTERS
  - Evaluating climate change adaptation measures for a Mediterranean Watershed with stakeholder engagement

Theme 5: Global climate challenges

- POSTERS
  - Irrigation in Portugal and climate change

Theme 6: Climate risk management and resilience

- ORAL PRESENTATIONS
  - This abstract was not presented at ECCA 2019, but the abstract was available *in the Conference's App and website.*
  - Towards sustainable drinking water abstraction: an assessment framework to support local adaptation planning

This section gathers the abstracts and posters from the participation of BINGO at ECCA 2019.

Theme 1: Data, methods and approaches in Climate Change Adaptation and Disaster Risk Reduction

ORAL PRESENTATIONS

Observed and modelled effects of the temporal variability of rainfall on evapotranspiration and runoff in semi-arid environments

Marinos Eliades[1]; Adriana Bruggeman[1]; Hakan Djuma[1]; Corrado Camera[2]

1 - The Cyprus institute; 2 - Universita Degli Studi Di Milano

May 28 | 14:00-15:45

The temporal variability and unpredictability of the magnitude of rainfall due to climate change is expected to cause changes both in runoff and evapotranspiration processes. These changes are difficult to model in semi-arid watersheds. . The objectives of this study are (i) to observe the water balance components of a Pinus brutia forest during three hydrologically contrasting years (2015-2017) and (ii) to improve the representation of the observed evapotranspiration patterns and streamflow characteristics of semi-arid watersheds in a conceptual, four-parameter rainfall-runoff model (GR4J). The water balance components were measured with through fall gauges and soil moisture and sap flow sensors at the Agia Marina Xyliatou forest site, situated at the northern foothills of the Troodos mountains in Cyprus. GR4J was applied in the midstream and upstream areas of the adjacent Peristerona watershed. To reduce model complexity, the streamflow-groundwater exchange parameter was set to zero, while maintaining a good fit. Exponents of the routing store outflow and evapotranspiration equations were made tuneable. The models were evaluated against four different Nash-Shutcliffe efficiency criteria (standard, root squared, logarithmic, and inverse) and Bias for daily streamflow. We evaluated the model with the same criteria for monthly evapotranspiration.

The results from three years (2015-2017) of monitoring show a seasonal pattern of transpiration. Even though rainfall was significantly higher in 2016 (359 mm) than in 2017 (220 mm), transpiration was lower in 2016 (107 mm) than in 2017 (166 mm). This was due to the temporal distribution of rainfall during the year and the rain in fall 2016, which recharged the fractured bedrock. The trees were found to take up water from the fractured bed rock. On average, rainfall during the driest months (July-September) was 2% of the annual rain while tree transpiration was about 7% of rain. The new GR5J-dry showed better results than the original GR4J model during the calibration period (01/01/2015 - 30/09/2016), as it captured the monthly distribution of the observed evapotranspiration with an NSE of 41%. Also, GR5J-dry simulated zero streamflow during the dry period and had a higher standard NSE for streamflow (88%). During the validation period (1/10/2016 -31/12/2017), both models had a lower performance, indicating that a longer observation record is needed to capture the effects of the large

rainfall variabilities between years. The results show the importance of long-term observations and of hydrologic model improvements for understanding the effects of climate change in semi-arid environments.

BINGO PROJECT: Selection of effective adaptation measures to weather extremes – Reducing flood risk in Wuppertal, Germany

Clemens Strehl[1]; Fabian Vollmer[1]; Andreas Hein[1]; Juliane Koti[1]; Marc Scheibel[2]; Paula Lorza[2]; Daniel Heinenberg[2]; Robert Mittelstädt[3]; Eduard Interwies[4]; Stefan Görlitz[4]

1 - IWW Rheinisch-Westfälisches Institut für Wasserforschung gGmbH; 2 - Wupperverband; 3 - Hydrotec Ingenieurgesellschaft für Wasser und Umwelt mbH; 4 - InterSus - Sustainability Services

May 28 | 16:15-18:00

Growing risk of flooding is a global threat. Their expected aggravation by climate change is scientific consensus. Still there is a demand for smart adaptation strategies, methods to define best fitting measures for risk reduction and their case study application to collect evidence. The BINGO PROJECT covers research on methods to manage and treat risks from hydrological weather extremes, including the application of the risk management process in case studies.

The German BINGO research-site studies fluvial flood risks at the Mirke creek in the urban area of the city Wuppertal. The municipality and the regional water board (Wupperverband) aim to implement measures to reduce urban flood risk around the creek. Most recently (May/June 2018) flood events caused severe tangible damage, empathizing urgency of stakeholders to act. The aim of the current work at the research site is to establish and test a method to select cost-effective risk reduction measures. This includes a risk assessment, prioritizing so-called spatial hotspots by their different magnitude of expected damage from future floods. A scenario approach is followed to estimate potential aggravation of the flood risk level under near-future climate change. The scenarios used build on simulations of a regional climate model (MiKlip), which delivers decadal predictions of weather patterns. In terms of risk treatment, alternative measures for each hotspot will be evaluated. This evaluation will cover several key indicators per measure, like:

- costs,
- monetary benefits (reduction of expected damage, i.e. saved damage costs to properties),

- non-monetary benefits (reduced inhabitants at risk and reduced critical infrastructures like kindergartens endangered by flood water).

All measures will be ranked by costs in relation to their benefits to take action where it is most needed at first and to use financial resources efficiently. In addition, the case studies approach integrates cooperative decision making of stakeholders involved. A customized approach, in dependence of the analytical hierarchy method, was used to reach consensus in weighting the importance of different non-monetary risk reduction goals.

The expected result of the case is a better informed risk management by the involved stakeholders. The planned outcome is a list, prioritizing which measures to implement at which hotspot, ordered by their cost-effectiveness. Climate change's uncertainty is dealt with using not one but a range of possible climate change scenarios for calculations. The method developed and tested may serve as pattern to other cases in the future, facing similar risks and adaptation needs.

Hazard and risk assessment related to CSOs in bathing waters in a context of climate change

Luca Locatelli[1]; Beniamino Russo[1]; Montse Martinez[1]

1 – AQUATEC

May 28 | 16:15-18:00

Combined sewer overflows affect the water quality of the receiving water bodies and climate change is influencing future scenarios. As part of the BINGO project (European H2020) AQUATEC quantified people health hazard due to poor bathing water quality and the effect of a climate change scenario in Badalona. Badalona is a city that faces the Mediterranean Sea and its beaches host over a million visitants per year. The Bathing Water Directive (Directive 2006/7/EC) safeguards public health and protects the aquatic environment in coastal and inland areas from pollution recommending monitoring of two bacteria, Escherichia coli and intestinal enterococci.

AQUATEC developed an urban drainage model to quantify combined sewer volume and spills; then bacteria measurements were used to estimate the concentrations of CSOs and, finally, a 3D marine model was developed to simulate spreading of the

bacteria in the sea in front of Badalona. Both models were calibrated using field data and were combined to run continuous simulations for different periods of 10 years.

Hazard and risk for bathers were assessed based on two simulated indicators: the average number of days where the sea water quality is considered poor and the time necessary to recover to an acceptable water quality after CSOs. Finally it was quantified how a future climate change scenario based on decadal predictions affect the people hazard.

Socio-economic potential impacts of climate change due to urban pluvial floods in Badalona (Spain). The BINGO project

Eduardo Martínez-Gomariz[1]; Luca Locatelli[2]; Beniamino Russo[2]; Montse Martínez[2]

1 - Cetaqua, Water Technology Centre; 2 - AQUATEC, Water Advanced Solutions

May 28 | 16:15-18:00

One of the effects of climate change within the water cycle is the disorder of the rainfall patterns. It means that heavy rainfalls are expected to be more frequent and, therefore, an increase of both urban floods and their related potential damages has to be faced. In Badalona (Spain), rainfall intensities are likely to be higher than the actual ones in the future period 2050-2100 according to CORDEX projections (RCP 2.6 and 8.5), thereby producing an increase of the future potential flood damages.

The historic-future variation percentages in rainfall intensities have been applied on the historic-observed RIDF curves in order to obtain the future ones and, therefore, future design storms have been performed. These design storms, for different return periods (i.e. 2, 5, 10, 100, and 500 years), have been used as input for a detailed 1D/2D coupled hydrodynamic model, in order to obtain their corresponding floods parameters (i.e. water depths and velocities) in Badalona. Based on these outputs (i.e. floods in Badalona), a comprehensive damage assessment has been conducted focusing on vehicles and buildings, the urban elements traditionally more affected by floods.

In order to assess the damages for vehicles and buildings, two GIS-based methodologies have been proposed. To both, depth damage curves are required; in case of vehicles the ones proposed by the US Army Corp of Engineers (2009) have been selected as the most comprehensively developed within the ones found in the

literature; and tailored curves for buildings in Badalona have been performed based on a fieldwork.

Once the damage assessment is conducted for both, buildings and vehicles, and for the different return periods (current and future scenarios), a unique (i.e. including vehicles and buildings damages) Expected Annual Damage (EAD) is calculated as a benchmark, in order to compare the present with the future in terms of potential direct damages due to urban floods in Badalona.

BINGO PROJECT: Impacts of Climate Change on Water Cycle's Groundwater Component – Tagus basin case-study

Maria Novo[1]; Manuel Oliveira[1]; Tiago Martins[1]; Maria José Henriques[1]

1 – LNEC

May 28 | 16:15-18:00

Climate change studies usually have long term time horizons (2050 or 2100) while decision-makers define policies under short term frameworks. To help decision-makers set up adaptation policies, BINGO project analysed the impacts of climate change, including extreme events, on the water cycle for time horizon 2024. Climate change impacts on groundwater for 3 large aquifers in Tagus Basin (Aluvi›es do Tejo, Tejo-Margem Direita & Tejo-Sado/Margem Esquerda) were analysed in BINGO Portuguese case-study. For each of the 10 climate realizations and the ensemble of these realizations, generated by regional climate model MiKlip developed by FUB, aquifer recharge scenarios were determined using BALSEQ_MOD (a sequential daily water budget developed in LNEC). Of these 11 recharge scenarios 3 were chosen – ensemble (R1_R10), maximum (R1), minimum recharge (R3) – and fed into the 3D aquifer flow model (FEFLOW) which generated the piezometric surfaces for each of these scenarios.

Drought impacts were also analysed, under transient state. This methodology can be used anywhere as long as recharge values obtained from climate projections and robust data to build the flow model (for porous aquifer) exist. Results show the piezometry for ensemble scenario does not change significantly from present day values. R1 scenario shows piezometry rises of <2 m up to 5 m in general with several flooded areas. R3 scenario shows piezometry declines of <2 up to 10 m in general and no flooded areas. Multiannual drought scenarios (5 year drought) show a piezometry

decline of 2 to 3 m in general. From the results, impacts seem mild for the short term time horizon of 2024, in particular for droughts, pointing to a much required paradigm shift of policy-makers concerning adaptation policies. Instead of looking and acting for the near future, policy-makers must start now create adaptation policies based also on long term projections.

Decadal predictions for hydrological extremes assessment in Europe

Tim Aus Der Beek[1]; Adriana Bruggeman[2]; Rui Rodrigues[3]; Beniamino Russo[4,5]; Tone Muthanna[6]; Marc Scheibel[7]; Marjolein Van Huijgevoort[8]

1 - IWW Water Centre; 2 - The Cyprus Institute; 3 - Laboratório Nacional de Engenharia Civil; 4 - Aquatec; 5 - SUEZ Advanced Solutions; 6 - Norwegian University of Science and Technology; 7 - Wupperverband; 8 – KWR

May 29 | 16:15-18:00

The Horizon2020 research project BINGO has investigated the impact of climate change on multiple water related problems at 15 research sites in six European countries. More than 20 hydrological models have been applied, driven with climatic decadal predictions from 2015 to 2024. The model applications focus on different water compartments and scales, such as flooding by combined sewer overflows in Badalona (Spain) and Bergen (Norway), changes in groundwater recharge for drinking water abstraction in the Veluwe, (the Netherlands), altered reservoir management in the Wupper river basin (Germany) and in Bergen (Norway), flooding in Cyprus, and increasing salinization in Portugal. Furthermore, consistent land- and water use scenarios have been developed in order to analyse and assess their impact on the water cycle.

The model results show that the impacts of climate and socio-economic change vary between geographical regions and water compartments affected (i.e. groundwater or surface water). For example, at the Norwegian reservoir an increase of inflow is predicted, while the German reservoir is predicted to remain stable or even decrease. The groundwater levels at the Dutch and Portuguese site are both showing effects of not returning to the same antecedent conditions (reference period) or even featuring decreases. The combined sewer overflows at the Spanish and Norwegian sites both feature increasing trends. The comparison of the impacts of land-use and water use changes as well as extremal episodes also provides an indifferent picture. For

example, land-use changes are predicted to further increase flood peaks in Cyprus, while no changes in the hydrographs of the German sites have been observed.

The results are used by stakeholders, such as water providers and managers, local authorities, and others in order to be prepared for and to cope with near time climate change effects. Stakeholders have been included in Communities of Practice right from the project start and have influenced the modelling goals and protocols. Some of the models are implemented by stakeholders and are used operationally. Further, the model results have been used to conduct case sensitive risk analysis. The combined bottom-up (stakeholder, water managers, local problems) and top-down (modelling framework, decadal predictions, socio-economic scenarios) approach has shown to be a very promising way ahead to tackle multiple water problems at multiple sites and countries at the same time.

Assessment of climate change scenarios combined with anthropogenic influences at the Große Dhünn Reservoir, Germany

Marc Scheibel[1]; Paula Lorza[1]; Eleni Teneketzi[1]; Tim Aus Der Beek[2]; Rike Becker[2]; Corinna Wilmers[2]

1 - Wupperverband; 2 – IWW

May 29 | 16:15-18:00

The occurrence of flooding and dry periods on the Wupper catchment has increased in the last decades together with the precipitation regime shifting. In the frame of the Horizon 2020 project BINGO (Bringing INnovation to onGOing water management), the effects of climate change in combination with land and water use scenarios on the water cycle in the Wupper River Basin are investigated. Special focus is given to identifying historical and future trends and extreme events.

Past hydro-meteorological extreme dry periods are evaluated based on historical meteorological data. Indices like SPI and SPEI are estimated for different time scales to determine if they were abnormally dry or wet. These indices are also estimated for medium-term climate predictions (MiKlip, time frame 2015-2024) and long-term climate projections (RCPs scenarios, time-frame 2006-2100). Thus, future abnormal dry periods can be identified, and results from MiKlip and RCPs scenarios can be compared within the next decade. Simulations of storage volume at GDT are performed for past and future conditions, using the water-balance, reservoir-oriented

hydrological model. For past conditions, the model is driven with ground data and different water use scenarios. For future conditions, simulations are carried out with different climate change and predicted land and water use scenarios. The resulting simulated storage is correlated with the calculated indices (for past and future conditions). Estimation of different indices has proven to be a robust method for comparison between different data sets. This approach can be applied to other research sites worldwide, serving as a tool which supports decision making processes for reservoir management.

The methodology is validated based on observed volume. For validation and uncertainty assessment of future climate scenarios, the Soil & Water Assessment Tool (SWAT) was setup to simulate inflow rates to GDT. The results are compared with TALSIM simulations at the reservoir inlet. Thus, potential model uncertainties can be identified and more reliable predictions can be made.

Results indicate an increment in variability of annual inflow rates. A shift of dry summer months from early to late summer with decreasing inflow rates is expected; winter months in turn are likely to show increased inflow. Consequently, effectively managing the GDT will become more complex.

Uncertainties in climate data predictions are one of the greatest challenges. The strength of this study is the comparison of different data sets with statistical methods to test the significance of predicted climate change impacts and likelihood of occurrence of extreme events.

BINGO PROJECT: Impacts of Climate Change on the Urban Water System – a case study from Bergen

Tone Muthanna[1]; Erle Kristvik[1]; Sveinung Sægrov[1]; Magnar Sekse [2]

1 - Norwegian University of Science and Technology (NTNU); 2 - Bergen Municipality

May 29 | 16:15-18:00

Climate change will impact the urban water systems' service level. The key issues in Bergen include sea level rise, flooding, variations in ground water level, and maintenance of sewer systems. The impacted sectors are tourism and waste water systems. In order to make plans that will add resilience to performance of the urban

water system it is necessary to have both the long and medium short term in mind. Usually climate change studies run for a 50 or 100 years period, which can make it difficult for decision-makers to prioritize the urgency of the actions they need to take.

The BINGO project attempted to overcome this by analysing the impacts of climate change on the water cycle for the short range (time horizon 2025), including those of extreme events, as well as for longer term series. In the Bergen case we have focused on two specific areas:

- the drinking water supply;
- the risk of combined sewer overflows.

This paper will focus on the second part, where three specific tasks have been performed:

- Sewer systems modelling for impact of CSO today and in the near future;
- The possibility to use urban streets as floodways to avoid CSOs;
- Using rain gardens and nature based solutions to mitigate downstream CSOs.

The results showcase the vulnerability to CSOs in the Damsgaard research site, and the mitigation needs. The flood way study showed potential, but also important aspects that need further evaluation. The use of nature based solutions in connection with the combined sewer can provide contributions to reduce the CSOs.

Effects of climate change in an agricultural area in the Tagus estuary (Portugal)

Paula Freire[1]; Marta Rodrigues[1]; André B. Fortunato[1]

1 - Laboratório Nacional de Engenharia Civil

May 29 | 16:15-18:00

Agriculture is one of the most relevant economic activities in the Tagus estuary upper region, where a public irrigation perimeter (Lezíria Grande de Vila Franca de Xira) covering about 13,400 ha of low-elevation estuarine marginal terrains protected by a dyke is located. Two main natural hazards with potential to increase with climate change affect this area. First, during very low Tagus river discharges, salinity can propagate upstream and reach the main water abstraction station, limiting the availability of water with quality for irrigation (salinity below 1).

Secondly, estuarine high water levels forced by spring tides and severe storm surges can overflow and damage dykes leading to the inundation of agricultural lands inundation. This presentation discusses the level of risk associated with these two hazards and the possible effects of climate change. The water salinity and the inundation are assessed for different scenarios through numerical modelling and the likelihood is estimated based on relevant historical data and/or probability forecasts.

The consequences evaluated are: the percentage of time per week during which the salinity of the abstracted water is adequate for irrigation; the percentage of the area inundated and the percentage of the dyke length overflown. A consequence / probability matrix approach is used for the risk analysis. For the salinity concentration of the water, results show that consequences with very high severity (>50% of time with water inadequate for irrigation) have a very low likelihood with return periods over 100 years. An event similar to the worst recent drought that occurred in 2005 (10-50 years of estimated return period) has consequences with high severity (>25 to 50% of time with water inadequate for irrigation). These consequences may be exacerbated by sea level rise and more severe droughts in the future. Independently of the likelihood, the severity of the inundated area consequence is always low (≤5% of inundated area). However, for the dyke overflown consequence, medium severity (>10 to 30% of overflown dyke length) can be reached for very low likelihood scenarios (return period over 100 years). If a sea level rise of 0.5 m is considered, the severity of both consequences is high (>10 to 30% of inundated area/ overflown dyke length).

Making decadal predictions and climate scenario simulations usable for the Wupper association's water management challenges

Edmund Meredith[1]; Henning Rust[1]; Uwe Ulbrich[1]; Paula Lorza[2]; Marc Scheibel[2]

1 - Freie Universität Berlin; 2 – Wupperverband

May 30 | 9:00-10:45

Hydrological modelling requires high-resolution climate data [O(1 km)] at the catchment scale because of small-scale water system related structures. The scales of available numerical simulation results for climate change and decadal predictions are thus not suitable for a direct application. Thus, the practitioners require a workflow which provides them with suitable input data for the region of their responsibility.

A particular challenge are extreme events, as the observations are typically sparse, and climate change both on the decadal and the centennial scale may produce events of an intensity not observed before. Here, dynamical downscaling down to 2 km is applied in order to be able to generate physically possible cases from the large scale conditions. Such dynamical downscaling is, however, extremely costly in terms of computing time, so that long downscaling simulations of multiple large-scale input series are not feasible. Within the framework of the H2020 project BINGO (Bringing INnovation in onGOing water management; <www.projectbingo.eu>), a flexible classification algorithm was developed for the identification of days with enhanced likelihood of extreme local rainfall events. It is based on the available knowledge of observed extreme local precipitation over the catchment. Large-scale weather patterns are classified, and those associated with these dates are identified using ERA-Interim reanalysis. Additional parameters determining the occurrence of extremes are used for further discrimination.

For the resulting potential extreme days (PEDs), high resolution, convection-resolving simulations are performed and the changing risk for such events is assessed, including a comparison with observed historical data.

Results are used for an improvement of targeted investments for disaster risk reduction with adequate cost-benefit relationship. Knowledge of the potential small-scale impacts under specific large-scale weather conditions will also help to develop suitable contingency plans. The methodology can operationally be applied to forthcoming predictions.

E-POSTERS

Calibration of a one-way coupled atmospheric-hydrologic model for the study of extreme events over Cyprus

Corrado Camera[1]; Georgios Zittis[2]; Adriana Bruggeman[2]; Ioannis Sofokleous[2]

1 - Dipartimento di Scienze della Terra - Università degli Studi di Milano; 2 - Energy Environment and Water Research Center - The Cyprus Institute

Coupled atmospheric-hydrologic simulations are a very promising tool to investigate hydrologic processes and manage water resources under climate change. The WRF hydrological extension (WRF-Hydro) represents a complete model environment for the analysis of atmospheric-hydrologic processes. The study's objectives were to calibrate the one-way coupled WRF-hydro model for simulating extreme events in Cyprus from observed precipitation, and evaluate the model performance when forced with WRF downscaled (1 x 1 km2) re-analysis precipitation data. The focus was on January 1989 and November 1994. For both events, 15 days were modelled over 22 watersheds. Both observed and WRF-modelled precipitation were fed to the model with a 1-hour time step. The model version adopted allows spatially distributed values for model factors controlling rainfall partitioning, saturated hydraulic conductivity, and deep drainage. Optional routines (lake/reservoir and baseflow) were activated too. Calibration was performed manually, following a trial and error procedure, on four parameters (the rainfall partitioning coefficient, the reference hydraulic conductivity parameter, the retention-depth routing factor, and the overland-roughness routing factor). The performance of WRF-Hydro was evaluated on daily streamflow. The factor controlling rainfall partitioning (REFKDT) was found to be the most sensitive parameter. In five watersheds (Xeros, Peristerona, Akaki, Agios Onoufrious and Pedieos), Nash-Sutcliffe Efficiency Coefficient (NSE) values larger than 0.4 were obtained for both events. However, REFKDT values leading to the best NSEs were usually different, for the same watershed, under the wet conditions of January 1989 and the dry conditions of November 1994. The WRF-modelled rainfall, evaluated on daily data, showed a NSE of 0.71 and 0.42 for the events of 1989 and 1994, respectively. Nevertheless, simulations of the two events with the calibrated WRF-Hydro and the modelled rainfall returned negative NSE values on all watersheds. However, the streamflow volumes for simulations forced with the observed and with the modelled rainfall are comparable. This result indicates that the modelled chain is reliable and could be used to predict streamflow resulting from modelled future extreme rainfall events.

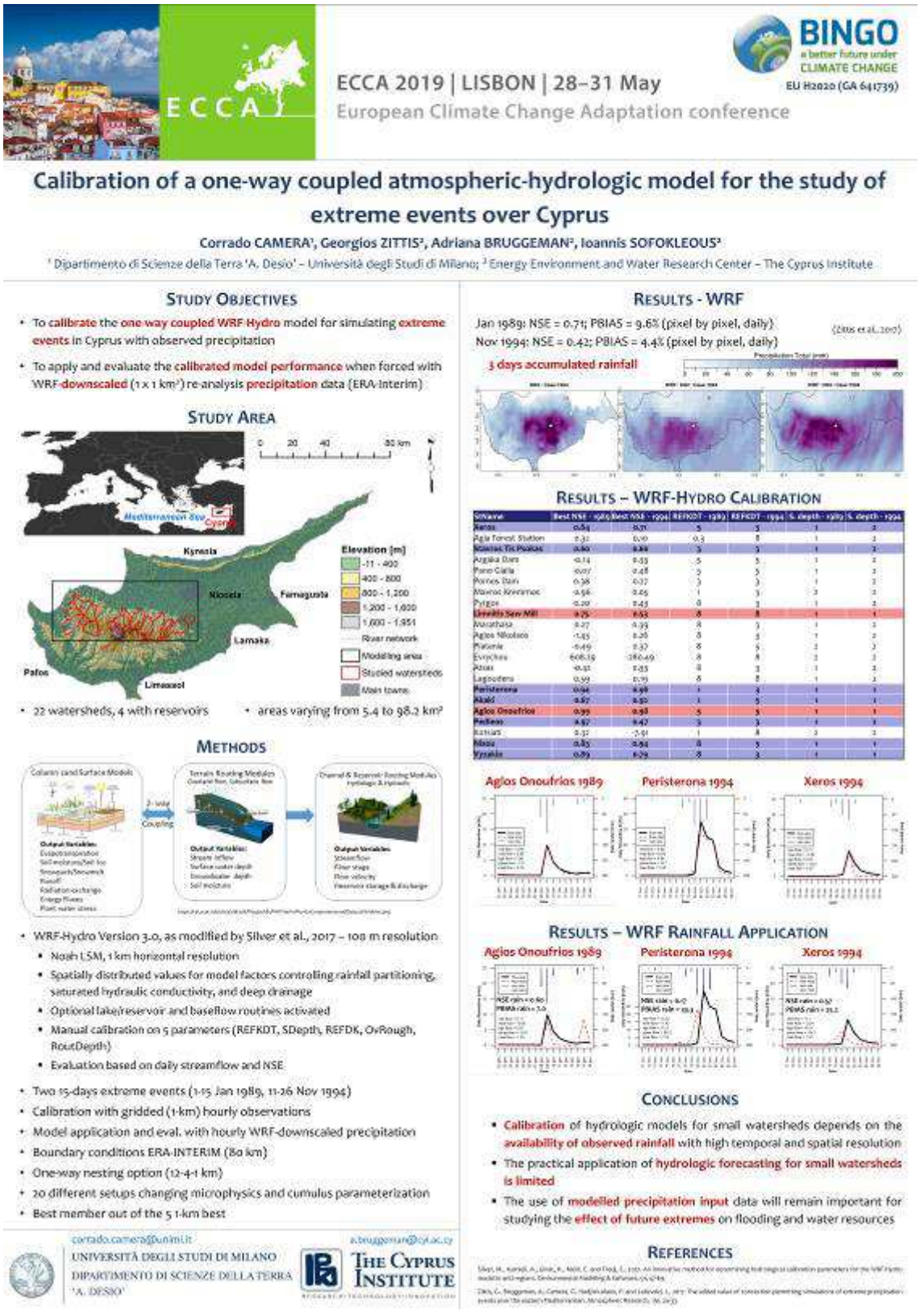

Figure 2 - Poster "Calibration of a one-way coupled atmospheric-hydrologic model for the study of extreme events over Cyprus"

Sub-hourly precipitation over a Mediterranean catchment in a high-resolution climate model

Edmund Meredith[1]; Uwe Ulbrich[1]; Henning Rust[1]

1 - Freie Universität Berlin

Convection-permitting atmospheric models [O (1 km)] add value to lower-resolution models for the simulation of extreme precipitation, in particular for short-duration (i.e. sub-daily) extremes of a convective nature. Such events are the main cause of flash flooding, an acute risk in many regions. Accurate modelling of short-duration rainfall events in the present climate is thus key for having confidence in future projections of how the flash-flooding risk may change. As such, evaluation of short-duration (extreme) precipitation in convection-permitting models is an important endeavour. Owing to a lack of observational datasets at both high spatial and temporal resolution, however, most evaluations of convection-permitting models have to date been at the hourly (or longer) temporal scale. The validation of precipitation in convection-permitting models at the sub-hourly scale has thus been identified as an important challenge for climate science (e.g. Chan et al., 2016).

Using a unique regional micro-gauge network from the Mediterranean city of Barcelona, with 5-minute precipitation observations spanning on average 20 years, we analyse the performance of the COSMO-CLM climate model at 2 km resolution in simulating the characteristics – both mean and extreme – of observed precipitation during this period. Results indicate that the model simulates 5-minute and sub-hourly precipitation with comparable realism to that found at the hourly scale, suggesting that convection-permitting models can be a valuable tool for the study of sub-hourly precipitation extremes.

Our results offer useful guidance to researchers on working with and interpreting high-resolution (temporal and spatial) modelled precipitation, or planning related experiments.

References: Chan, SC, EJ Kendon, NM Roberts, HJ Fowler and S Blenkinsop (2016). The characteristics of summer sub-hourly rainfall over the southern UK in a high-resolution convective permitting model. Environmental Research Letters, 11(9): 094024.

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Sub-hourly Precipitation over a Mediterranean Catchment in a high-resolution Climate Model

EP Meredith, U Ulbrich, HW Rust
Institut für Meteorologie, Freie Universität Berlin
Freie Universität Berlin
edmund.meredith@met.fu-berlin.de

1. Motivation and Experiment

While convection-permitting models (CPMs) are known to add value for the simulation of hourly rainfall (e.g. Kendon et al., 2012), the representation of sub-hourly rainfall in CPMs has been less studied, partly due to a lack of suitable observations. Using a unique rain-gauge network for Barcelona, with 5-minute measurements spanning 1994-2016, we assess the realism of sub-hourly rainfall in the COSMO-CLM model run at 0.02° resolution (~2.2 km).

We focus on the months of August-October, in which the most intense short-duration events are typically found for our study region (Fig. 1). We perform convection-permitting time-slice simulations (Fig. 2a) from July-October each year, downscaling 0.11° EURO-CORDEX evaluation runs (ERA-Interim driven), with July discarded for spinup. Simulated precipitation is compared with gauges (Fig 2b). We compare the realism of 5-minute modelled precipitation with that of hourly precipitation, with a focus on extremes.

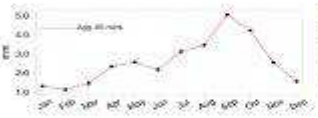


Fig. 1. Annual cycle of intense 5-minute events in Barcelona region. Median of monthly maxima across all rain gauges in dataset. The most intense events are found in the August-October period, which is the focus of our analyses.

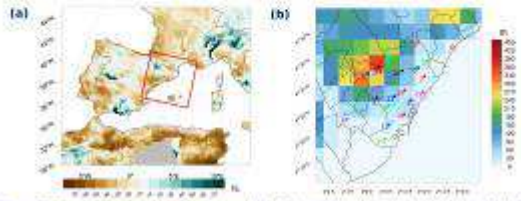


Figure 2. Simulation domain and gauges. (a) 0.02° simulation domain marked in red (241x241). Barcelona is marked with a red 'x'. Shading shows the mean precipitation bias of the 0.11° CCLM EURO-CORDEX simulations (Aug.-Oct.) wrt. E-OBS. Note that the parent domain covers the whole EURO-CORDEX region. **(b)** Zoom-in over the Barcelona region. Shading shows 0.02° model orography, while the gauge locations and IDs are also marked.

2. Results - Full Distribution - QQ Plots

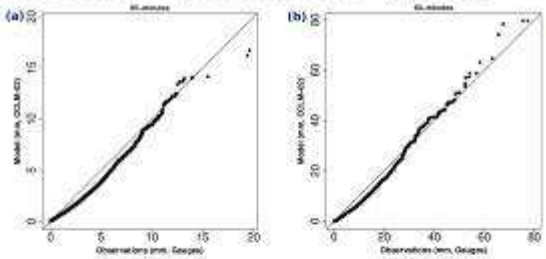


Figure 3. QQ Plots. QQ plots of simulated precipitation (CCLM, 2.2-km) against observations (gauges) for all gauges. **(a)** 5-minute, **(b)** 60-minute. CCLM overestimates the strongest events at 60-minute aggregation, while underestimating them at 5-minute aggregation.

3. Results - Moderate/Heavy Events

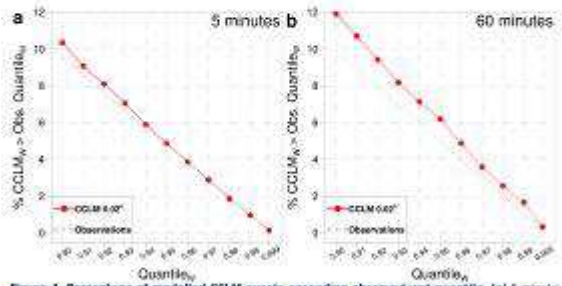


Figure 4. Percentage of modelled CCLM events exceeding observed wet quantile. (a) 5-minute aggregation. **(b)** 60-minute aggregation. By this metric, the CCLM performs better at 5-minute aggregation. Note that the 5-minute results are quite sensitive to the wet period definition.

Acknowledgements and References

The BINGO project has received funding from the European Union's Horizon 2020 research and innovation programme, under the Grant Agreement number 641739.

4. Results - Temperature Scaling of Extremes

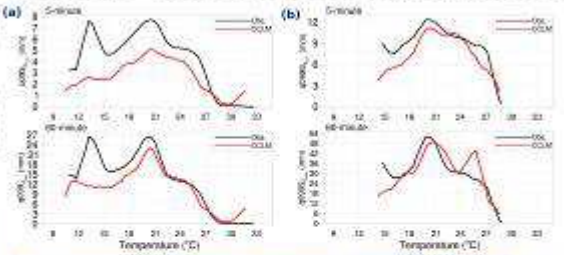


Figure 5. Temperature scaling of extreme precipitation. (a) 0.99- (b) 0.999-quantile. CCLM performs comparably at 5- (top) and 60-minute (bottom) aggregations. Precipitation quantiles are for daily maxima of the respective aggregation length.

5. Results - Wet-period Frequency

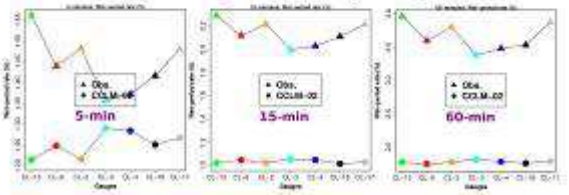


Figure 6. Wet-period frequency (selected gauges). Rate of occurrence of wet periods for aggregations of 5-, 15- and 60-minutes. CCLM clearly underestimates the wet-period frequency, though this underestimation decreases for smaller accumulation periods. Wet-period threshold is 0.1 mm.

6. Results - Spatial Structure of Precipitation

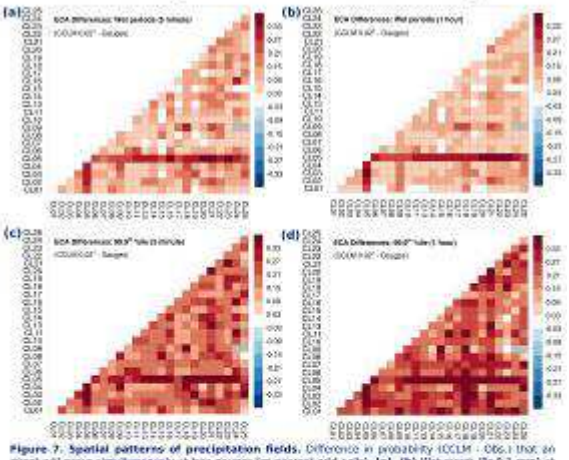


Figure 7. Spatial patterns of precipitation fields. Difference in probability (CCLM - Obs.) that an event will occur simultaneously at two gauges (or nearest grid cells). **(a), (b)** Wet event (P>0.1 mm) at 5- and 60-min. aggregation. **(c), (d)** 0.999 quantile exceedance at 5- and 60-min. aggregation. The conditional probabilities are computed via the R-package "CoinCalc", where the method is termed "Event Coincidence Analysis" (Siegmund et al. 2016).

The positive probability bias in CCLM suggests that modelled events are still too spatially widespread at 0.02° resolution, though this affects 5- and 60-minute aggregations equally.

7. Summary and Conclusions

→ CCLM-02 underestimates bulk of the sub-hourly distribution, though improves for extremes (Fig. 3)

→ Heavy to extreme events are better simulated at 5-min. resolution (Fig. 4)

→ Temperature-scaling of extremes is captured with similar realism at 5- and 60-min. aggregations (Fig. 5)

→ CCLM-02 tends to underestimate the wet-period frequency (Fig. 6), though this decreases for shorter accumulation times

→ The spatial precipitation fields, both wet (P > 0.1 mm) and extreme, are too widespread in CCLM-02 (Fig. 7). This problem is common to 5- and 60-minute aggregations.

→ Take-home message: 5-minute modelled precipitation in CCLM at 0.02° appears to be at least as realistic as 60-minute modelled precipitation in the same model.

Figure 3 - Poster "Sub-hourly precipitation over a Mediterranean catchment in a high-resolution climate model"

Will inundation hazard by storm surges change in the near-future? The upper Tagus estuary case

André B. Fortunato[1]; Marta Rodrigues[1]; Paula Freire[1]; Edmund Meredith[2]; Xavier Bertin[3]; Juan Ferreira[4]; Margarida L.R. Liberato[5]

1 - National Laboratory for Civil Engineering; 2 - Institut fur Meteorologie; 3 - UMR 7266 LIENSs, CNRS - Université de La Rochelle; 4 - Escola de Ciências e Tecnologia, Universidade de Trás-os-Montes e Alto Douro; 5 - Escola de Ciências e Tecnologia, Universidade de Trás-os-Montes e Alto Douro, and Instituto Dom Luiz

Like in most large estuaries, the Tagus' margins are intensively occupied, thus vulnerable to inundations due to extreme sea levels. The present inundation hazard in the Tagus estuary is assessed through numerical modelling of the water levels due to tides, surges and waves for the most severe storm of the 20th century (the February 15, 1941 storm). Several scenarios are simulated with an atmospheric model (WRF), a large-scale wave model (WW3), a regional tide-surge model (SCHISM) and a coupled circulation and wave model (SCHISM-WWM). Results reveal the overtopping of dykes and the extensive inundation of agricultural lands. Changes of the hazard from the present (1980-2015) to the 'near-future' (2021-2024) are then evaluated by forcing the regional tide-surge model with atmospheric reanalyses (ERA-INTERIN) and decadal predictions (MIKLIP). Changes in storminess in this period are shown to be negligible in the Atlantic Iberian coast. As a result, the growth in extreme sea levels will be dominated by sea level rise.

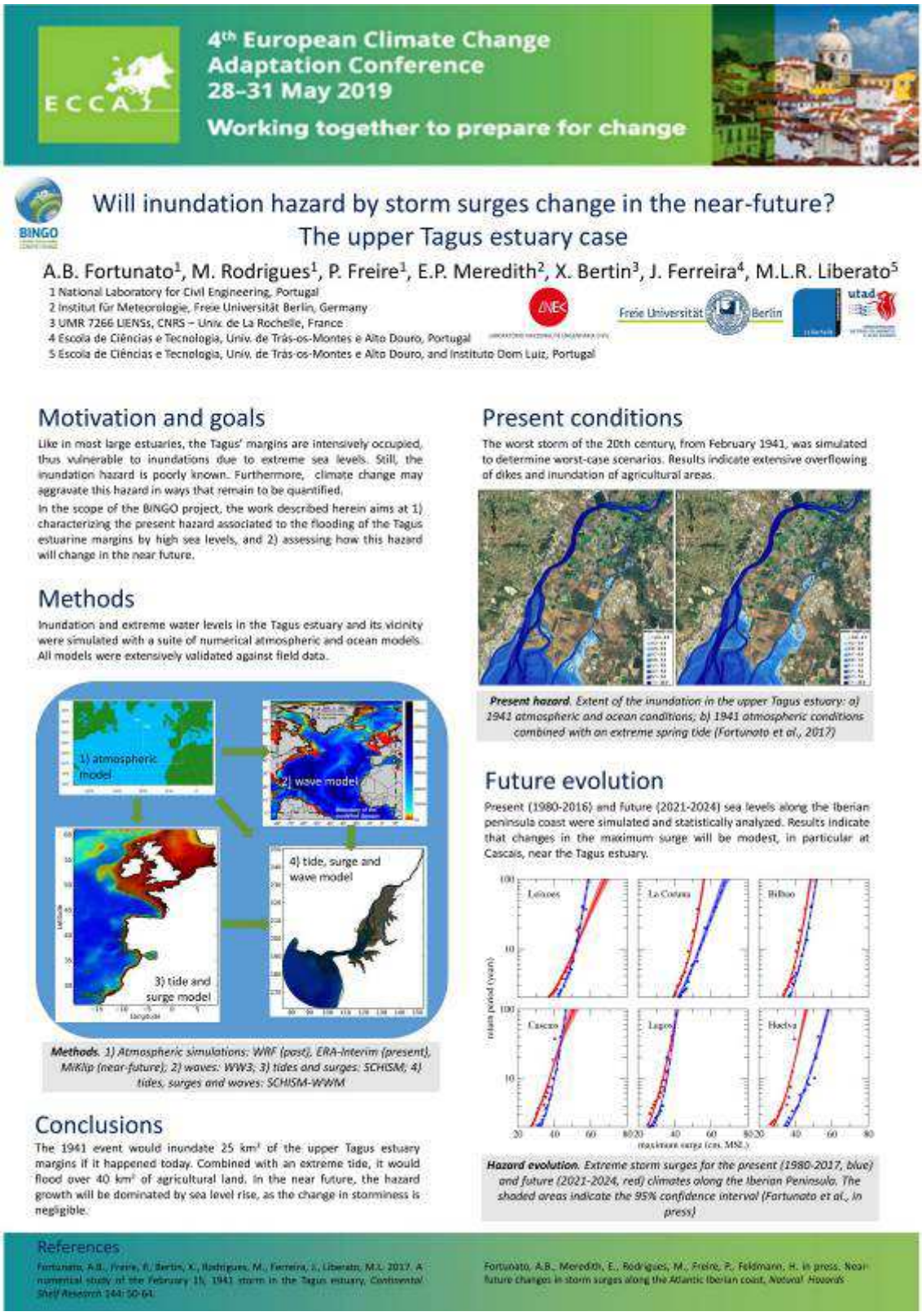


Figure 4 - Poster "Will inundation hazard by storm surges change in the near-future? The upper Tagus estuary case"

Numerical assessment of the saltwater propagation in the upper Tagus estuary during droughts

Marta Rodrigues[1]; André B. Fortunato[1]; Paula Freire[1]

1 - Laboratório Nacional de Engenharia Civil

Estuarine uses and activities may be negatively affected by climatic variability and climate change. Numerical modelling approaches, combining climate, hydrological and oceanographic scenarios, can support decision-making regarding climate change adaptation. This study uses a numerical modelling approach to assess the salinity dynamics in the Tagus estuary resulting from changes in river flow and sea level rise.

The upper Tagus estuary left margin, in particular, includes an important agricultural area (Lezíria Grande de Vila Franca de Xira Public Irrigation Perimeter – LGVFX PIP), which main water abstraction is located in the estuary close to the salinity propagation limit. A reduction of the Tagus river flow or the sea level rise may foster saltwater intrusion and impact negatively agricultural activities in this area. During the most recent droughts (2005 and 2012) several emergency measures were undertaken to minimize the negative impacts in the LGVFX PIP.

A three-dimensional hydrodynamic model is validated and the sensitivity of the saltwater intrusion to the river flow is discussed. Errors in the river flow data used to specify the boundary conditions constitute a major source of uncertainty in the model results. To evaluate the influence of low freshwater discharge and of sea level rise in the salinity intrusion, five scenarios are then established. Results suggest that the salinity does not reach the water abstraction of the LGVFX PIP for the climatological river discharge. For the remaining scenarios, salinity reaches concentrations that are inadequate for irrigation during some periods and these effects are exacerbated by sea level rise. Salinity intrusion also increases with the duration of the droughts.

The results achieved herein demonstrate the applicability of the approach followed and are further used to evaluate the risk and discuss the effects of climate change in the LGVFX PIP, presented in a companion communication.

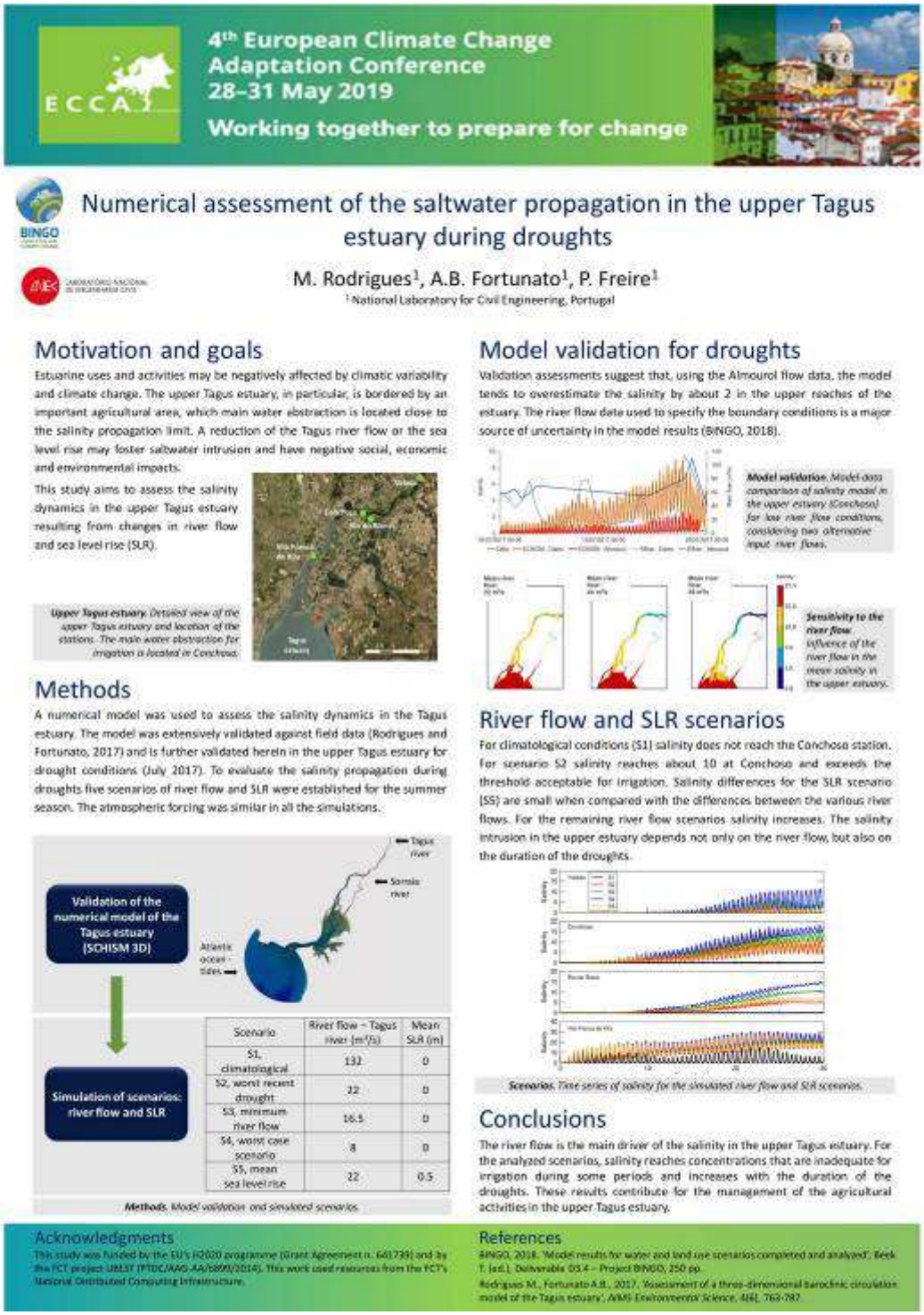


Figure 5 - Poster "Numerical assessment of the saltwater propagation in the upper Tagus estuary during droughts"

Theme 2: Co-production of knowledge, solutions and services

ORAL PRESENTATIONS

Developing Adaptation Strategies Using Science and Stakeholders

Henk-Jan Van Alphen[1]; Eduard Interwies[2]; Stefan Görlitz[2]

1 - KWR; 2 – Intersus

May 28 | 14:00-15:45

The Horizon 2020 BINGO research project aims to provide more insight into the regional impacts of climate change on the water cycle across Europe and develop tailored adaptation strategies to address these impacts. An innovative research approach was used, combining technical and social scientific analyses with structural stakeholder involvement to assess regional climate risks and develop appropriate regional adaptation strategies

This contribution describes and reflects on the research approach applied within BINGO as well as its results. Scientific analyses followed a stepwise method where climate predictions were scaled down to six European case study sites (Badalona city in Spain, Bergen city in Norway, nature area the Veluwe in the Netherlands, the Troodos Mountains in Cyprus, the Wupper River Basin in Germany and the Lower Tagus basin in Portugal), the hydrological impacts were studied, local-level risks were identified, existing governance contexts were analysed and adaptation measures were assembled and assessed on their governance needs and socio-economic impacts.

Parallel to these scientific analyses, Communities of Practice (CoPs) were organized at each research site, which allowed regional stakeholders to reflect on the outcomes of the scientific analyses and put them to use in their regional contexts. All CoPs followed a similar structure. Stakeholders started out with mapping stakeholder objectives regarding climate change adaptation, which they used as input to assess climate risks and select relevant adaptation measures.

Following this approach, adaptation strategies were developed for each research site within the BINGO project, which consist of a select set of measures linked to identified area risks, taking into account the stakeholder objectives, governance needs and socio-economic costs and benefits connected to the selected adaptation measures. For

each measure, building blocks for implementation have been identified. In this way strategic questions can be answered such as when to implement a measure (based in risk analysis), what governance arrangement is needed for implementing the measure (policy/governance analysis) and what the socio economic impact of the measure will be (socio economic analysis).

We will discuss both the differences in governance context as well as in concrete adaptation strategies and the paths towards those strategies. Insights will be given on how do different regions respond to similar challenges and how can we understand these differences, esp. regarding stakeholder involvement.

Finally we discuss some insights for strategy development beyond the research sites, mainly in terms of process, bringing together science and stakeholders in order to put science into practice.

BINGO – A Dynamic Framework for Creating Knowledge Co-production

Maria João Freitas1; Sægrov Sveinung2; Tonne Muthanna2

1 - LNEC; 2 – NTNU

May 29 | 16:15-18:00

In the BINGO Project one of the main outcomes were to contribute to more effective tools, improved use of data and a deeper understanding of the issues at hand through a particular process based on Communities of Practice (CoPs). The CoPs are aimed to cross the usual engagement interactive chain constraints typically known and to stress Knowledge Alliances based on co-production between researchers (hydrologists and climatologists) and non-researchers (stakeholders and decision makers). In BINGO the aim was to go deeper in exploring and experimenting with collaborative and interactive processes. The processes focused on sharing experiences based on the human factor, face-to-face collaborative and co-productive moments. This enables a deeper focus on what really happens and matters for each site.

The added-value was cross-cutting and helped in reducing the barriers between data production and action through knowledge co-production. By doing so, the process enabled adaptation proxies to explore the exposure specificities of the climate challenges in each site and testing and exploring how it could be achieved. What the BINGO CoP experience intended to show was that if you are able to reach and engage

different stakeholders and combine their interactions in a circular and interactive way, awareness and perceptions processes (based on quantitative and qualitative co-productions and outputs) will start to occur. With these common experiences (based on comprehensive tools for risk assessment, co-production of consequent strategic roadmaps and recommendations) it is possible to launch an actionable process enabling real adaptive actions.

Along the BINGO experience we learned that the marriage between information outputs and CoP process was not a spontaneous one neither just a smooth linear consequence of sequential well defined research tasks. Instead, it was an adventure quite alive, dynamic, restless, and uncertain, with ups and downs, more settle in commitments than in consensus, and running along different rhythmic balances at the different sites. However, the important message is that it was possible! The BINGO Dynamic Framework is supported by some key BINGO Exploitable Results. The Dynamic Framework results in more robust involvement of key stakeholders, which in return creates sustained decision making for implementation. Bringing it all the way to implementation is a key step, as that is where climate change adaption needs to end up – in implemented actions.

Stakeholders' involvement in defining climate change adaptation strategies. The case study of Badalona in BINGO project

Montse Martinez[1]; Beniamino Russo[1]; Luca Locatelli[1]; Josep Montes[2]; Albert Pérez[3]; Esther Suárez[4]; Eduardo Martinez[5]

1 - Aquatec; 2 - Ajuntament de Badalona; 3 - Aigües de Barcelona; 4 - àrea Metropolitana de Barcelona; 5 – CETaqua

May 29 | 16:15-18:00

The Horizon 2020 project BINGO: Bringing INnovation to onGOing water management-a better future under climate change aims at providing practical knowledge and tools to end-users, water managers, decision and policy-makers affected by climate change to better cope with all climate projections, including droughts and floods.

Badalona (located along Catalonia's northeast coast) is one of the 6 case studies of BINGO project, whose main objective is to increase the urban resilience of the city towards floods and Combined Sewer Overflows (CSOs) problems in a context of climate change.

Climate change adaptation can be approached at different spatial scales, from national to local. However, as adaptation decisions are context-specific, local and regional stakeholders are particularly relevant when defining optimal and realistic adaptation strategies.

Key elements to construct a solid climate change adaptation strategy include: availability of sound knowledge and information to support decision-making processes; commitment of cities to take climate action; existence of a good governance, competences and authority to regulate climate-relevant issues and availability of economic resources to reach adaptation strategy.

Analysing such elements at Badalona scale we can conclude that:

- BINGO project has provided a solid knowledge basis (and tools to reach) climate change impacts assessment, including an estimation of direct and indirect damages on citizens, buildings, vehicles and bathing waters which has contributed to raise awareness on potential climate change impacts at local scale
- Badalona city has a clear commitment towards climate action due to its accession to the Covenant of Mayors for Climate Change Adaptation
- Regarding governance and competences, several stakeholders are involved in adaptation decisions concerning the urban water cycle, these include: the Badalona city Council, the regional administration of Metropolitan Area of Barcelona (AMB), the water managers (Aigües de Barcelona), the Catalan Water agency, and some others.
- Finally, one of the main constraints to develop such adaptation strategies is clearly the availability of economic resources to put into practice the adaptation strategies.

For each one of the case studies of BINGO project, an innovative methodology, the Communities of Practices (CoP) have been created as a tool to exchange information and to involve stakeholders in decision-making processes such as the definition of the adaptation strategies.

One of the results of this CoP in Badalona is the definition of 5 adaptation measures, agreed by all the key stakeholders together with a realistic roadmap to implement them, including the identification of responsibilities, pros and cons, action plan or cost.

Theme 3: Communication, data sharing and decision support

ORAL PRESENTATIONS

Guidelines designed for win-win collaboration between Researchers and Non-Researchers Stakeholders

Adriana Bruggeman[1]; Maria João Freitas [2,3]; Tone Merete Muthanna[4]

1 - The Cyprus Institute; 2 - LNEC,; 3 - Collaborative Consulting; 4 - Norwegian University of Science and Technology

May 28 | 11:15-13:00

The Horizon 2020 project BINGO: Bringing INnovation to onGOing water management – a better future under climate change (2015-2019) aimed at providing practical knowledge and tools to end users, water managers, decision – and policy makers affected by climate change in order to enable them to better cope with all climate projections, including droughts and floods. In the BINGO project, the centre point for the coproduction of knowledge has been the Community of Practice (CoP) at the six research sites:

Badalona (ES), Bergen (NO), Peristerona River Basin (CY), Tagus River Basin (PT), Veluwe (NL) and Wupper River Basin (DE).

A CoP is defined as a group of significant and diverse stakeholders who are connected to an issue and will share and join experiences, skills, ideas, resources, and actions to further embrace shared collective and societal challenges. During the project a shared roadmap was implemented for local interactions (workshops) in each site: #1 – Setting the Scene; #2 – Are we prepared?; #3 – Yes we are! (prepared); #4 – Solving the unsolvable; #5 – Sharing; #6 – Up the CoP. Based on the researcher and stakeholder interactions in the BINGO project, we aim to share a set of learning guidelines for creating win-win collaboration :

1. Designing a double-sided communication strategy;
2. Designate a CoP facilitator and Design a roadmap;
3. Built a solid and diverse base for CoP development;
4. Design a storyboard for each interaction animation and facilitation;
5. Make everyone aware and comfortable with the ethics code;

6. Create a collaborative environment and make room for informal interactions;
7. Create a vision and set expectations and common outcomes;
8. Engage everyone in co-productions and make room for side-concerns debate and/or detailed side debates;
9. Evaluate and celebrate each step's achievements;
10. Take care of co-productions register, feed-back, and technical reports;
11. Follow-up CoP other initiatives and developments (i.e. inputs X learning X actions);
12. Prepare community for the long haul.

A large set of animation tools have been used in the BINGO project CoPs, illustrating some key dynamic phases used in this process, such as Icebreaking and Networking; Inspiring and Setting the Scene; Defining and Scope and Ideating phases. We encourage everyone to actively share and coproduce knowledge through CoPs.

SCIENCE PRACTICE SESSIONS

Exploitation in CCA & DDR – clustering and discussion

Rita Andrade[2]; Marco Hartman[1]; Elena Lopez-Gunn[3]; Marta Rica[3]; Andrea Geyer-Scholz[4]; Frederik Accoe[5]; Laura Palomo Rios[5]

1 - BRIGAID project; 2 - BINGO project; 3 - NAIAD project; 4 - CLARITY project; 5 - EASME

May 29 | 11:15-13:00

Research and innovation in Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) is a growing field, with an increasingly number of projects dedicated to understanding the impacts of climate change and developing solutions to either adapt to or mitigate these impacts. However, one of the most demanding challenges in research and innovation in these (and many other) areas is ensuring the sustainability of the results after the projects' completion.

How can we extract as much value (ideas, methodologies, products, services) from these results as possible? How to make them self-sustaining? Can they be monetised, further developed, used in other research? How do we reach the end-users?

Exploitation strategies aim to answer these questions by defining the results which are truly exploitable, and not specific for the context of the project itself.

This means identifying and clustering target audiences and their needs and designing structured action plans that involve transforming the results into outputs adapted to the audience it is aimed for (guidelines, workshops, technical factsheets, portfolio, business plan, etc) and disseminating them through the appropriate channels.

Consequently, the exploitation has taken a significant position in research and innovation, as investments on such projects aim to maximise and proliferate the value created through the work developed.

Establishing synergies between researchers and other stakeholders is crucial, not only to be aware of the exploitation strategies of other projects and how they can be of use to different projects, but also to understand how one project's results can be complemented with another project's results.

This session aims to put together projects in a clustering and discussion space where different results are clustered and exploitation strategies discussed.

The objective is to present both achieved and desired results and the strategies for the exploitation of such results from projects which have similar topics in CCA & DRR. Through these presentations, synergies in exploitation could be discussed and established and the visibility of a CCA & DRR landscape ignited.

The expected outcomes are:

- To recognise and raise awareness of existing and planned results among the public;
- To create new synergies between the projects and the audience, (i.e. among investors, companies, SMEs, policy makers, decision makers, researchers);
- To encourage public and collective reflection on a pertinence of results for the end-users;
- To discuss exploitation strategies and their approaches in sustainability (scalability, replication, adapting and replication to other projects);
- To cluster results and discuss and plan possible joint exploitation actions.

Target audience

- Researchers and technical staff in the area of Climate Change Adaptation and Disaster Risk Reduction
- Investors

- SMEs and other private companies who could develop/monetise/use some of the work produced by the projects
- Consultants for spatial planning, project development
- Policy makers and decision makers who want to understand results and what tools could be available for their activities

Format for the session.

- Introduction and presentation of the projects, focusing on exploitation

  4 speakers, 5 minutes each (20 min)

- World café session – 4 tables hosted by each of the authors with 4 exploitation approaches (approaches to be defined)
- There will be 2 sessions of 15 minutes for each table, allowing participants to move around tables and address different topics. (30 minutes total)
  - Exploitation by users – Bingo (Rita)
  - Commercial exploitation – Brigaid (Marco)
  - Networks and markets – Clarity (Andrea)
  - Policy impact – Naiad (Elena)
- Authors will present 3 key messages from each table
  3 messages per table (10 minutes)
- EASME views and experience
  (5-10 minutes)
- Open discussion, led by EASME
  (25-30 minutes)
- Wrap up and closure by EASME
  (5 minutes)

BINGO PRESENTATION UNDER THIS SESSION:

BINGO project's exploitable results and exploitation plan

1. Rita Andrade, Sociedade Portuguesa de Inovação (SPI) –

The BINGO project has been dedicated to understanding the impacts of climate change in water resources based on decadal predictions. To achieve this, it developed several methodologies, from collaborative management methodology to guidance on the use of hydro models. These BINGO methodologies are the fundamental exploitable output of the project and can be transferred to different types of stakeholders. BINGO's exploitation strategy is focused on exploiting and spreading the project results so they can be used in diverse contexts and situations by relevant stakeholders, who will turn the project results into research activities and promote them to local, regional, national or international stakeholders. The current approach to the exploitation strategy was defined through consultation with all the partners, which concluded that the strategy would not be focused on developing a 'business-focused' approach. Thus, the main aim of BINGO exploitation strategy is to spread the project outputs and results to the relevant stakeholders so that the knowledge that is generated by the project has a long running impact beyond the research sites and can be used in different activities and circumstances.

Canvas exercise applied to exploitation – methodology for collectively defining exploitable results

Rita Andrade[1]; Douglas Thompson[1]

1 - SPI - Sociedade Portuguesa de Inovação

The BINGO project has produced several outputs from the work of different teams. Some of these results are limited to the project itself and/or served to solve issues relating to the research sites, and thus not the target for potential exploitation due to their local specificities. However, among the many results, there were some which could be used by other entities and, thus, exploited.

Finding the exploitable results might not be easy and some of them might not even be that explicit and require a more profound look to the work of each team. This deeper look sometimes is hard to be achieved by the team members who have produced the results themselves, and, thus, an external perspective is sometimes valuable.

As such, WP7, together with WP5 and WP6, has developed an exercise to promote the discussion among project members from different teams to define exploitable results for each WP. This exercise consisted of using a 'business model canvas' as the basis for the discussion.

For the 'canvas exercise' there was one person selected for each WP to lead the conversation within the groups. The partners were then divided into 6 groups, one per WP (excluding WP7), and discussed for 25 minutes, followed by a short presentation of the results per group.

Their objective was to look at all the results from that WP and, from that, defining the major exploitable result and then answering the following questions:

- Customer segments for the product/service (choose combinations of the sectors and types of stakeholders)
- What may be the added value to the costumer segment of the product/service?
- What kind of activities may be provided?
- Which would be the best channels to deliver the product/service?
- Who would be the best/main partners to engage in the product/service development

This result is not sector-specific. As such, it could be useful for innovation, scientific and technological projects which have different teams producing different results. The Horizon 2020 projects and other consortium-based projects are good candidates for implementing this methodology.

This exercise has had benefits for the definition of the exploitable results:

- Gathering different perspectives on the several outputs of BINGO
- Involving all the partners in the exploitation discussion
- More comprehensive definition of the exploitable results and how different target audiences could use them.

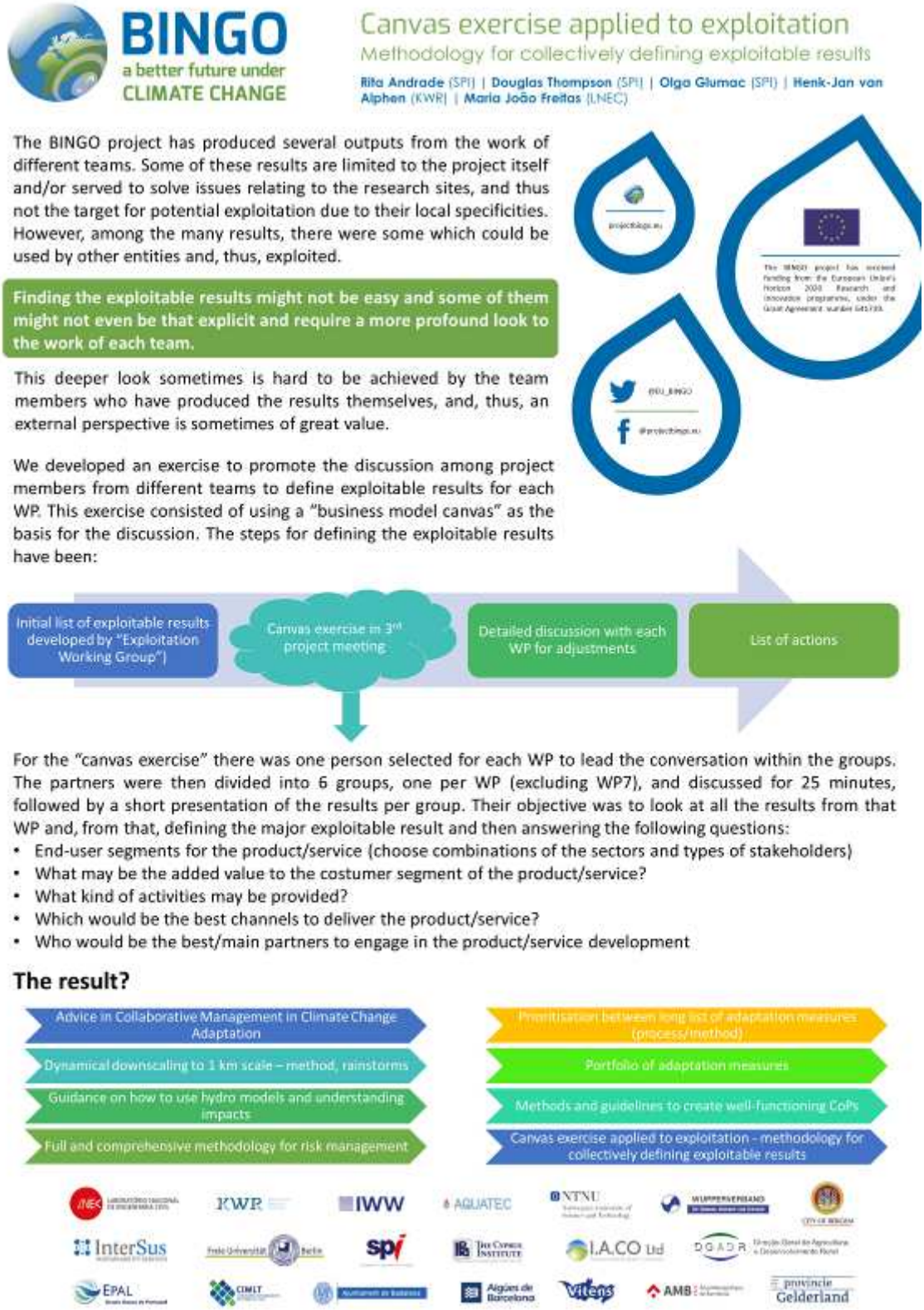


Figure 6 - Poster "Canvas exercise applied to exploitation – methodology for collectively defining exploitable results"

Theme 4: Institutions, governance, citizens and social justice

ORAL PRESENTATIONS

Strengths and weaknesses in climate change adaptation governance – a comparison across six European regions

Henk-Jan Van Alphen[1]; Eduard Interwies[2]; Stefan Görlitz[2]

1 - KWR; 2 – Intersus

May 28 | 11:15-13:00

In Europe, environmental and climate governance traditionally belongs to the domain of the state, where governmental programs are set up to protect valuable environmental resources and provide safety against environmental hazards. Issues like nature conservation and flood defence have always been seen as public goods, which should be provided by the state as the guardian of the public interest.

Today, these governmentally-led policy approaches seem to reach their limits in a changing hydrological and political climate. Hydrological climate change asks for a renewed investment in environmental adaptation policies to continue to ensure environmental protection and safety. However, in the current political climate, climate change adaptation is increasingly moved to the private domain, with private actors held responsible for preparing and adapting to climatic changes. For example, floods are increasingly seen as a problem caused by the human development of floodplains, and floodplain occupants are increasingly held responsible for protecting their properties against floods.

In this context, policy approaches to environmental governance are shifting. Climate adaptation in Europe is characterized by a mix of policy instruments, ranging from traditional (infrastructural) governmental programs to new behavioural and regulatory policies.

This presentation comparatively analyses the policy and governance contexts of six European regions that are affected by different hydrological impacts of climate change, drawing on the results of the BINGO project. The results demonstrate that major governance strength across regions lies in the organization of management capacities to deal with the present day and near future water-related risks. Weaknesses are

identified in focusing more on historical risks, and not integrating near future hydrological developments, and in a high degree of governmental fragmentation in managing hydrological issues and risks, i.e. different sub-domains of water management are dealt with under separate policies and are governed by different responsible agencies. Consequently, information about current performance of the water system is scattered and coordinative efforts, which are key to developing adaptation strategies, are hampered.

In this comparative assessment of governance strengths and weaknesses for climate change adaptation in the six BINGO research sites, three main governance challenges are identified. These are illustrated with the main climate change adaptation strategies planned and/or implemented in the sites, based on several European databases for climate change adaptation measures such as PREPARED, Climate-ADAPT and BINGO.

Strategic groundwater management as an adaptation measure

Henk-Jan Van Alphen[1]; Marjolein Van Huijgevoort[1]; Teun Spek[2]; Jolijn Van Engelenburg[3]; Flip Witte[1]; Bernard Voortman[4]

1 - KWR; 2 - Provincie Gelderland; 3 - Vitens; 4 - Moisture Matters

May 28 | 11:15-13:00

In this presentation we analyse the potential role of groundwater in adaptation strategies aimed at securing a sufficient freshwater supply in a changing climate. Based on a case study of the Veluwe, the largest groundwater reserve in the Netherlands, we ask: To what extent and how can groundwater resources help to mitigate the short-term and long-term hydrological impacts of climate change at the Veluwe, and what management strategies are needed to utilize this potential?

The data underlying this analysis is both quantitative (climate impacts) and qualitative (management strategies), bringing forward an interdisciplinary perspective on climate change adaptation. Climate data shows that the Veluwe will face shifting precipitation patterns in the coming decade. This will have an effect on groundwater levels as well as on available water for brooks and streams that rely on the groundwater and the impact of water abstractions. Groundwater recharge is determined by precipitation and evapotranspiration, therefore, land use strongly affects the recharge. The analysis shows that both changing precipitation patterns and changes in land use have impact

on groundwater levels and the available water for brooks and streams and groundwater abstraction. Based on this analysis, measures have been developed to increase the groundwater availability.

Although there are strong linkages between groundwater levels, surface water availability, land use and groundwater abstraction, the governance of these domains is often divided between different private and public organizations. In this case study we have brought these different organisations together in assessing the risks of climate change and identifying and analysing potential adaptation measures.

Based on the case study research, we conclude that groundwater could play a more leading role in adaptation strategies for freshwater supply, depending on local and regional conditions. We also conclude that these resources need to be carefully managed in order for these adaptation strategies to be sustainable. More precisely, we argue that these management strategies should take into account both the specific, long-term geo-hydrological characteristics of groundwater systems as well as the needs of different actors and sectors dependent on groundwater resources. For that to be the case, the governance of adaptation should reflect the physical interlinkages between different water and land resources.

Advice in Collaborative Management in Climate Change Adaptation

Rafaela Matos[1], Ana Estela Barbosa[1], Paul Fleming[2]

1 – LNEC; 2 – Microsoft

May 28 | 11:15-13:00

The H2020 BINGO project is being developed since 2015, by a consortium of 20 organizations from 6 European countries and a team of around 80 water related professionals. The project undertook climate change modelling, followed by water cycle modelling and evaluation of impacts and risks of future climate to representative activities and end users of water. BINGO engaged individual farmers in Cyprus and large water management organizations in Germany; water utilities in Portugal and Norway and municipalities in Spain. Soil moisture and wildlife protection were addressed in The Netherlands and specific field equipment designed and installed for onsite measurements. Cyprus followed the methodology and equipment used in order to better assesses droughts. These are a few examples of the rich diversity of climate, land uses, identities, legal and institutional frameworks, different personnel

backgrounds & organisations and levels of commitments/ roles within BINGO. The project delivers to society a portfolio of climate change adaptation strategies to be used by different stakeholders and outside the geographic context of the project.

Beyond the stakeholders from the BINGO consortium, Communities of Practice (CoPs) were created at the 6 countries, engaging water users and other sectors of the society all along the project, following a predefined roadmap. It is our belief that the experience of coordination such a variety of people, knowledges, interests and perspectives enables the authors to share and provide guidelines into Collaborative Management in Climate Change Adaptation. Among others, key aspects may be summarized as follows:

- Engage actively everyone in a common goal, guiding and valuing all contributions;
- Get started in planning by ensuring commitment and acceptance of managerial principles and structure;
- Promote good communication and acknowledgment of different perspectives;
- Face difficulties from the start, enhancing collaborative problem solving, and coordination across different sectors and levels;

POSTERS

Evaluating climate change adaptation measures for a Mediterranean Watershed with stakeholder engagement

Elias Giannakis[1]; Christos Zoumides[1]; Adriana Bruggeman[2]; Marios Mouskountis[3]; Ayis Iacovides[4,5]

1 - Associate Research Scientist; 2 - Associate Professor; 3 - Geologist, Environmental Hydrogeologist; 4 - Civil / Environmental Engineer; 5 - Environmental Management Expert

Climate change projections estimate an increase in water scarcity and drought episodes in the Mediterranean region. This study aims to identify and evaluate adaptation measures for minimizing climate-related water supply risks and reducing vulnerabilities of rural communities in semi-arid regions. Within the framework of the BINGO (Bringing INnovation to onGOing water management) project, a climate risk management process was undertaken with local and national stakeholders in

Peristerona Watershed, Cyprus. The analysis focuses on the two main water uses, namely, domestic water supply and irrigation.

The main hazards for both sectors are the reduced stream flows and the resulting decrease in groundwater recharge, caused by the reduction and increased variability of precipitation. Risk treatment measures were formulated in cooperation with the risk owners for the domestic water supply and agricultural sectors, i.e., the community councils and irrigation associations, with support from government officers, through two participatory workshops. The adaptation measures to ensure the continuity of water supply to rural households for domestic use include: (a) the expansion of the water desalination distribution pipeline network, and (b) the proper maintenance of groundwater recharge check dams.

The risk treatment options for matching irrigation water demand with available water supply and reduce water losses for the agricultural sector include: (a) the adoption of irrigation scheduling decision support technologies, and (b) the use of treated sewage water for irrigation. A combination of cost-effectiveness and multi-criteria approaches will analyse the economic and societal impact of the selected measures. The cost-effectiveness will provide valuable information to risk owners and decision makers whether a measure is disproportionately costly or expensive, thus resulting in a better informed risk management, while the multi-criteria analysis will link stakeholders' knowledge about the watershed with their preferences for measures to adapt water resources management to future conditions.

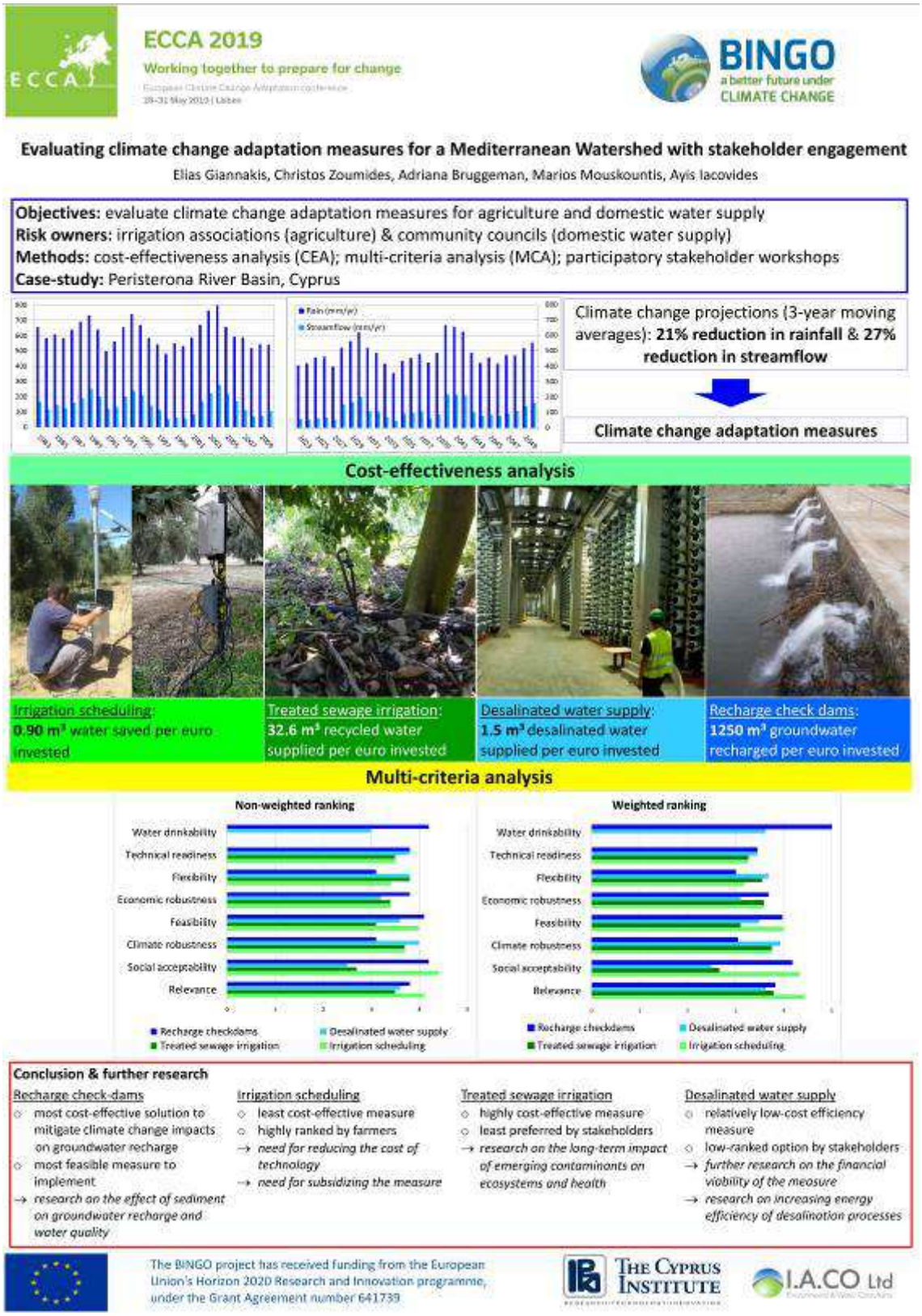


Figure 7 - Poster "Evaluating climate change adaptation measures for a Mediterranean Watershed with stakeholder engagement"

Theme 5: Global climate challenges

POSTERS

Irrigation in Portugal and climate change

Alberto Freitas[1]; Cláudia Brandão[1]; António Campeã Da Mota[1]

1 - Direção-Geral de Agricultura e Desenvolvimento Rural

Currently, the global demand for water is estimated to be around 4 600 km3/year, and it is estimated that this will increase from 20% to 30%, reaching a volume between 6 000 and 5 500 km3/year by 2050 (World Water Development Report, WWDR, 2018).

World water use has increased has increased by six times over the past 100 years and continues to grow steadily, with world demand for agricultural output expected to increase by about 60% by 2025 (WWDR, 2018). Considering the prevailing management practices, the intensification of production will involve increasing mechanical interventions on the ground and the use of agrochemicals, energy and water. These factors will contribute to the reduction of terrestrial biodiversity. This impact and the need for more land and more water can be largely avoided if the intensification of production involves the improvement of environmental services.

Global climate change is one of the challenges of the 21st century that consists in the development of a planet in a sustainable way, which considers the existence of finite and sensitive natural resources. It is therefore essential to be able to adapt to the new climate paradigm, reducing its impact on the environment and avoiding the reduction of areas with habitable conditions.

In Portugal the impact of climate change will likely increase the need for irrigation of crops and reduce water availability, due to the change of hydro-meteorological regime. In this context, has been progressively adjusting the binomial demand-supply in the agricultural sector, with a significant reduction in water use (-48%): 6,54 to 3,3 km3/year (PNA, 2002, 2016).

It will therefore be essential to continue to increase the water storage capacity and promote efficient water management, reducing losses in irrigation network (management and distribution) and an optimization of the use of water (farmer). In

order to reduce water consumption, Portugal is implementing the National Irrigation Program, which includes the modernization and rehabilitation of existing public agricultural facilities exploitations and the construction of new dams, and the promotion of capacity-building for the use of efficient production processes, suitable with environmental services.

Simultaneously, the supply guarantees of the hydraulics agricultural infrastructures are being reassessed, since the assumptions supporting its design have been changed, namely the existence of new and other consumptive uses and the probable decrease in water availability, forcing to implement measures to mitigate the potential losses. This evaluation is being carried out, and it is possible to present some results.

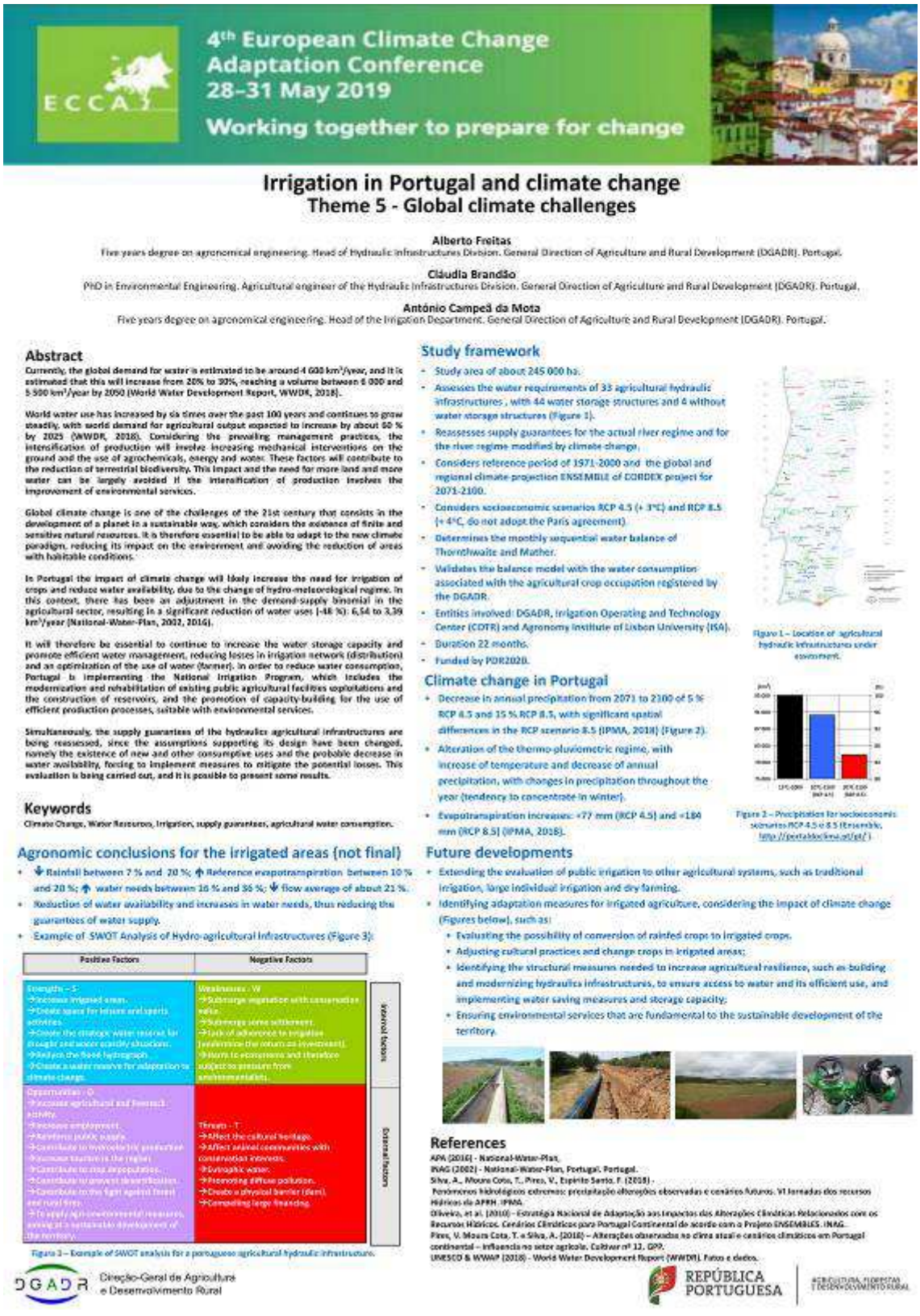


Figure 8 - Poster "Irrigation in Portugal and climate change"

Theme 6: Climate risk management and resilience

ORAL PRESENTATIONS

This abstract was not presented at ECCA 2019, but the abstract was available in the Conference's App and website.

Towards sustainable drinking water abstraction: an assessment framework to support local adaptation planning

Jolijn Van Engelenburg[1]; Erik Van Slobbe[2]; Petra Hellegers[3]

1 - Vitens 2 - Water Systems and Global Change Group 3 - Water Resources Management Group

May 29 | 11:15-13:00

Sustainable Development Goal 6: Clean water and sanitation, aims at safe and affordable drinking water, sustainable drinking water supply, improving water quality, integrated water resources management, and protection of water-related ecosystems. To reach these global targets, it is important to understand current and future sustainability challenges in drinking water abstraction on a local scale and how to adapt to these challenges. Vitens, a Dutch drinking water company, made an effort to operationalize sustainability for local drinking water abstraction, using Multi-Criteria Analysis to identify the risks climate change and other future developments pose to their local drinking water abstractions, and to compose an adaptation agenda. In this research we aim to develop an integrated assessment framework to identify the sustainability challenges and adaptation options for a local drinking water abstraction, using lessons learned from this current practice.

We studied the Vitens case and combined the lessons learned from this current practice with scientific knowledge on sustainability, to define sustainable local drinking water abstraction. To develop an integrated assessment framework for adaptation planning, we identified scenarios with main future developments that affect the sustainability of local drinking water abstractions, and adaptation options and their impact to sustainability. Finally we applied the framework to a number of local drinking water abstractions to test the framework.

The definition of sustainable local drinking water abstraction includes characteristics from the socioeconomic, physical and technical system. Relevant future developments

for local drinking water abstraction are: growing water demand, water saving, land use change, climate change, and energy transition. In the assessment framework, the current sustainability of a local drinking water abstraction is combined with scenarios for the future to identify the sustainability challenges. Adaptation options can improve supply security and resilience, mitigate or reduce the impact of abstraction, or protect and restore raw water quality.

From our research, we conclude that the assessment framework helps to understand the complexity of sustainable local drinking water abstraction and can support the adaptation planning process. Because local drinking water abstractions are strongly embedded in their environment, all relevant stakeholders should be involved in the planning process. The impact of the adaptation options that protect and restore water quality to the sustainability of a local drinking water abstraction, may only be noticeable after a long period of time. There are sustainability challenges where no adaptation options are available, such as the vulnerability of the abstraction.

4. BINGO BOOTH AND ACTIVITIES

During ECCA 2019, the BINGO booth was the rendezvous of all BINGO partners. At all times, there were at least 2 BINGO partners in charge of the booth, welcoming delegates, answering questions and distributing gifts. In order for this to be implemented, a schedule was produced beforehand, with rotations of 2 volunteers every 1h45. During coffee-breaks and activities, a group of BINGO partners would be at the booth, calling people to visit the booth and attend the activities.

Figure 9 - BINGO Partner from LNEC giving at the BINGO booth, giving gifts to an ECCA 2019 delegate

In order to mobilise the delegates to visit the booth, the following activities were implemented:

- BINGO game
- Kahoot game
- Thematic performances
    - Young farmer
    - Politicians

BINGO GAME

The BINGO team has developed a game of bingo about the BINGO project. The game is played by following these instructions:

1) Each player has a card with 9 answers, each answer corresponding to a number;
2) The host of the game would take a question out of the cup and ask, also saying the number of the answer;

Figure 10 - Host of BINGO (partner from LNEC) game asking a question

3) The person who had the number of the answer would read the answer out loud;

Figure 11 - Participant reading an answer

4) Once a player would complete their whole card, they would say “BINGO”;
5) The host would finish the game and offer a prize to the winner.

This game was held twice in the BINGO booth, with over 10 participants each time.

The questions and answers were the following:

What is BINGO?
BINGO is a EU 2020 Research Project on Climate Change and Water Systems Management
What does BINGO mean?
BINGO means: Bringing INnovation to onGOing water management
What is the main BINGO vision?
A better future under climate change
Which countries does BINGO involve?
Cyprus, Germany, The Netherlands, Norway, Portugal and Spain
How many partners have been directly involved in BINGO activities?
BINGO directly engaged 20 partners in its activities
How can I learn more about BINGO?
I can follow BINGO at http://projectbingo.eu/ and in Facebook at https://www.facebook.com/projectbingo.eu/
BINGO focuses its activities in 6 Research Sites. In which RS did BINGO focus its activities in Germany?
Wupper River Basin (Germany Research Site)
BINGO focuses its activities in 6 Research Sites. In which RS did BINGO focus its activities in Cyprus?
Troodos Mountains (Cyprus Research Site)
BINGO focuses its activities in 6 Research Sites. In which RS did BINGO focus its activities in Spain?
Badalona (Spain Research Site)
BINGO focuses its activities in 6 Research Sites. In which RS did BINGO focus its activities in Netherland?
The Veluwe (The Netherlands Research Site)
BINGO focuses its activities in 6 Research Sites. In which RS did BINGO focus

its activities in Norway?

Bergen (Norway Research Site)

BINGO focuses its activities in 6 Research Sites. In which RS did BINGO focus its activities in Portugal?

Tagus Basin (Portugal Research Site)

How can climate change be relevant to water systems management?

Climate Change is of utmost relevance to water systems management as floods and droughts are more and more severe and frequent and a shift may be expected in average water availability

What kind of relevant results did BINGO produce?

BINGO produced relevant results in terms of climate predictions, hydrologic models, risk assessment, adaptation measures and stakeholders' engagement and collaboration

How do BINGO climate projections differ from other projections?

BINGO climate projections are not projections! They are predictions made for narrow time and space scales (decadal and local zooms)

Why Hydrologic Models are relevant?

Hydrologic Models are relevant to identify climate predictions impacts to water systems management, *in situ*

What does BINGO Risk Assessment shows?

BINGO Risk Assessment shows how relevant is to invest in preventive board actions to cope with uncertainty and severeness of climate events

What BINGO Adaptation Measures stresses?

BINGO Adaptation Measures underlines how climate change collaborative governance is a key issue (but also a challenge!) to engage all different actors to prepare active roadmaps.

How did BINGO involve all the different partners and local stakeholders?

BINGO settled and facilitated a Community of Practice (CoP) in each site, involving researchers, technicians, decision makers and community organisations

How did BINGO CoP made the difference to the project development?

Involving partners and local stakeholders in each research site since the beginning and all along the project development. Also giving everyone a voice to address water

issues and to connect results to action

What did the different BINGO Research Sites show to have in common?

BINGO Research Sites showed how different water uses needs conflict in very practical ways and must to be addressed through a collective awareness and perception and a collaborative multilevel taskforce

What did the different BINGO CoPs show to have in common?

BINGO CoP experience showed how learning together with each other makes everyone stronger to address climate change and to be implicated in individual and collective actions

What main results on climate prediction and hydrologic models tell us?

Climate predictions may provide a large spectrum of values. But even if in short time there may be no significant changes, severeness and uncertain events may stress quick actions

Take the Tagus river research site as an example. What do the climate predictions tell us?

Climate predictions for Tagus tell us that we have a range of equally probable results, between lower to higher precipitation averages in relation to past. So adaptation plans must take these different possible realities into account.

What main results on risk assessment tell us?

Risks are not only connected to water scarcity and/or floods, but also to water needs for the different uses: i.e. how water uses conflicts are anticipated and managed?; how water systems decisions are made and integrated at different multi-level decision scales?

What do the main results on adaptive measures tell us?

Adaptation measures do not only have a risk reduction effect but also broader influence on society and the environment.

What are the main governance challenges to climate adaptation across Europe?

Effectively integrate climate change adaptation in existing policy and governance frameworks. And make it a primary objective with sufficient resources devoted to it.

What can I do for a better future under climate change?

My example and action is relevant and I shouldn't give up of being proactive, even if I feel my action is yet a little drop in the ocean

KAHOOT GAME

The Kahoot game is an online game of questions with multiple answers that people can play through their smartphones. Similar to the BINGO game, Kahoot had several questions relating to BINGO, water and climate change.

The Kahoot game was played once in the BINGO booth, due to technical difficulties. However, the game had a good number of engaged participants.

Figure 12 - Kahoot game at the BINGO booth

The questions and answers were the following:

Question	Correct answer	Incorrect option 1	Incorrect option 2
What was the key to project BINGO's success?	Collaboration	Working independently	Focus only on the scientific outputs
One of the major transferable results of BINGO was the Advice on…	Collaborative Management in Climate Change Adaptation	How To Make A Great Game For A Conference	Independent Management in Climate Change Mitigation
Is the BINGO climate data available to everyone?	Yes, all info at the BINGO website	No	Yes, if you pay, all info at the BINGO website
What does BINO downscaling methodology reduce in climate simulation models?	Computational expense, by 90%	Resolution, by 45%	Simulation accuracy, by 10%
Did BINGO hydro models apply to every research site?	Yes, after tailoring, set-up, calibration and validation to local characteristics	No	Yes
How did BINGO hydro models adapt to each research site?	By directly involving stakeholders in the model set-up and application	By trial and error approach	By working with the scientific team to try to
What type of activities did BINGO focus on?	Water dependent socio-economic activities	Climate change impacted activities	Water sports
What did the risk assessment methodology in BINGO address?	The key questions to better cope with impact of climate change	The risks to the surf industry	The impact of climate change on agriculture
Where is the BINGO portfolio of adaptation measures?	Online	In our hearts	In a library in Brussels

Can anyone use the portfolio of adaptation measures?	Yes	No, only decision-makers	Yes, if you visit the library in Brussels
How did BINGO helped identify appropriate measures for the climate change risks?	Socio-economic cost benefit analysis and governance analysis	Lengthy analysis of the overall context of the local economies	With an app
According to BINGO's methodology, who must the prioritisation between long list of adaptation measures involve?	All relevant stakeholders in all relevant sectors	The policy makers	People who agree with each other
What does CoP mean in BINGO?	Communities of Practice	Collaboration of People	Coordinated own Project
Which one is a key aspect of a functioning CoP?	Designate a CoP facilitator & design a roadmap	Allow everyone to lead and go with the flow	Lead and make a strict work plan
How many exploitable results did BINGO produced?	8	2	6
How did BINGO identify the exploitable results?	Through a collaborative canvas exercise, involving all project members	Through a vox-pop	Through the hard-work of one person

THEMATIC PERFORMANCES

As a new way to communicate the project's results, the BINGO team has developed 2 thematic performances involving very different types of stakeholders:

- **Farmer** – tells a story of a young farmer who started having issues with the irrigation of her olives, until she was introduced to the BINGO project by her grandfather and decided to create a Community of Practice in her own village.

Figure 13 - Performance from the Farmer at the BINGO booth

- **Two politicians** – a conversation between 2 politicians, one who is up for elections soon but is sceptic about climate change and another who knows about the BINGO project and explains the benefits of having the BINGO approach to climate change in their area.

Figure 14 - Performance of the politicians at the BINGO booth

These thematic performances were done once each, during lunch time.

5. BINGO PROMOTIONAL MATERIALS

In order to disseminate the BINGO project at ECCA 2019, several promotional materials were produced and distributed among the participants. The promotional materials were distributed in different formats, in order to reach the maximum amount of people and have an increased impact.

Every participant in ECCA 2019 was given a gift bag at the moment of registration. Inside of this gift bag, there were 2 BINGO promotional materials:

- **Brochure**, briefly explaining the project and listing the exploitable results

Figure 15 - BINGO at ECCA trifold brochure

- **Flyer with the mapping of all BINGO presentations**, posters and activities during ECCA 2019

Figure 16 - Flyer with mapping of BINGO's activities at ECCA 2019

These materials were also available at the BINGO Booth. In total, there were 2000 of each of the materials, 1200 of them were in the gift bags and the remaining 800 were at the BINGO booth or taken to the presentations by the BINGO partners.

Not all of the 800 were distributed, but the remaining trifold brochures will be used in further events.

Additionally, each BINGO partner was given **invitation cards**, which they should give to other participants of the conference inviting them to the activities happening in the BINGO booth.

Figure 17 - BINGO invitation cards

In the BINGO booth, the people who approached and participated in the activities were given 2 gifts:

- **Hats**

Figure 18 - Jean-Eric Paquet and Rafaela Matos wearing BINGO hats

- **T-shirts**

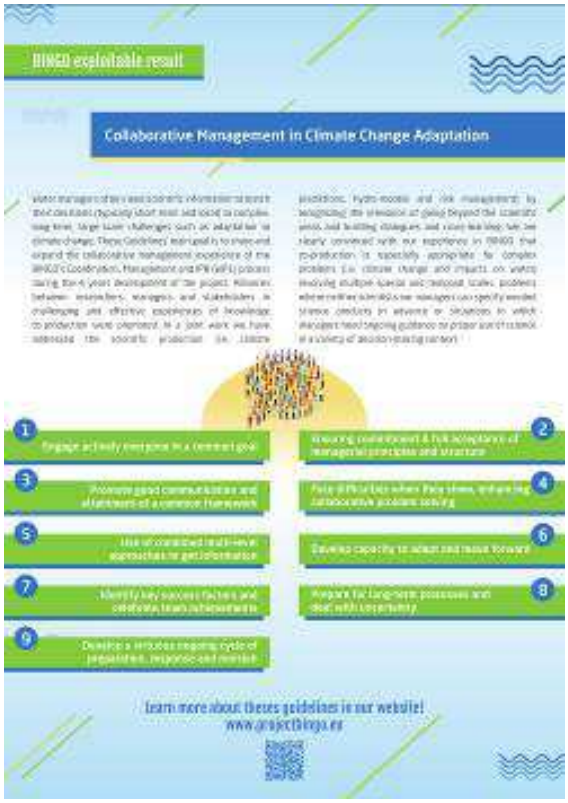
Figure 19 - BINGO partner from FUB presenting with the BINGO t-shirt

There were a total of 250 hats and 250 T-shirts available at the BINGO booth, all of which were distributed.

At the booth there was a black board where the “BINGO menu of the day” was written every day, containing that day’s BINGO presentations.

Figure 20 - BINGO partners updating the "BINGO menu of the day"

Moreover, there were 8 plasticised sheets available at the booth, which described the guidelines produced by the partners, as well as an overview of the key achievements from BINGO at the 6 research sites. Each one of them had a QR code that people could scan and would be redirected to the respective guideline online.




BINGO exploitable result
Application of hydro models
Hydro models are generally used to represent and predict water fluxes in the past, present and future, from near real time to long term modelling, e.g. until 2100. The choice of the model is based on the type of water flux to be investigated/predicted. After setting up the model it needs to be calibrated and validated with observed data in order to assess its suitability to represent all relevant natural, anthropogenic and technical processes that drive the water fluxes. Once the model performance is considered to well represent past and present conditions, it can be applied for predicting future water fluxes. Usually, depending on the temporal horizon of the prediction, different climate scenarios/predictions can be used to drive the model, e.g. from nearly/fully forecasts to decadal predictions or RCPs (Representative Concentration Pathways) and the end of the century.
1 Analysis of the water system and/or water problems
2 Selection of applicable model
3 Model set-up
4 Model calibration and validation
5 Selection of climate scenarios
6 Modelling the impact of climate change
7 Selection of socio-economic scenarios
8 Modelling the impact of socio-economic change
9 Combined modelling of climate and socio-economic impacts
10 Assessment of risks and measures
Learn more about theses guidelines in our website!
www.projectbingo.eu


BINGO exploitable result
Performing risk assessment
The evolution of climate changes still presents a large amount of uncertainty. Water is the central resource in BINGO and how its excess or deficit affects key socio-economic services is the key issue addressed in the project. Adaptation strategies require decision under uncertainty, which is a difficult task for people in charge, no matter its role (policy makers, regulation entities, service provider, entities, citizens).
Adoption of an adaptation strategy requires knowledge about a large diversity of information regarding natural or environmental phenomena, conditioning factors influencing the adaptation objectives (political, social, economic, technological, organizational) affecting the socio-economic key activities, relevant actors, perception of risk, etc.
A risk management approach is a suitable methodology to link all this information and structure it in a way able of providing support to decision making.
BINGO has provided guidelines to develop the most relevant steps of a risk assessment process, based on ISO 31000, referring to BINGO experience and their limitations and successes. It aims at being useful to any type of entity performing the first attempt of a risk management process.
1 Communicate and consult
2 Establish the context for the risk management process (RMP)
3 Risk identification
4 Risk analysis
5 Risk evaluation
Learn more about theses guidelines in our website!
www.projectbingo.eu


BINGO exploitable result
Prioritisation between adaptation measures
BINGO has produced a practical guideline to collecting and analysing measures for adaptation to climate change. One of the goals of the BINGO project is to select and analyse adaptation measures as part of an adaptation strategy. We have, thus, applied a stepwise approach to prioritise between these and other measures, using different approaches to elicit stakeholder knowledge and expert analysis. This allowed the different research sites in BINGO to select suitable adaptation measures, supported by stakeholders and grounded in research, and effective on a broad range of socio-economic criteria.
In this guideline, the stepwise approach is laid out that was followed in the BINGO project to select and analyse adaptation measures.
1 Create portfolio of potential adaptation measures
2 Select relevant measures based on risk analysis and stakeholder preferences
3 Multi-Criteria-Analysis (1): Develop a set of socio-economic indicators to assess the selected measures
4 Multi-Criteria-Analysis (2): Score selected measures on socio-economic criteria
5 Analyse adaptation measures on social justice
6 Analyse adaptation measures for governance challenging the three-layer framework
Learn more about theses guidelines in our website!
www.projectbingo.eu


BINGO exploitable result
BINGO Online Portfolio of Adaptation Measures
BINGO developed an online portfolio of adaptation measures that have been collected and analysed in the BINGO project.
The information is focused on stakeholders, decision makers and policy makers in different sectors such as water resources management, urban drainage, public water supply and agriculture. The information in the database is primarily focus on governance aspects of the measures, using the three-layer framework that has also been used in BINGO.
We want to inspire all other regions in Europe to find a fitting adaptation measure for their issues!
Visit our website and explore the Online portfolio here:
Learn more about theses guidelines in our website!
www.projectbingo.eu

Figure 21 - ECCA 2019 cards on the Guidelines for Exploitable Results

Finally, the booth had an LCD screen where the BINGO videos were playing on loop with subtitles. The videos played were the ones which are available in our YouTube Channel: https://www.youtube.com/channel/UC3sCquq-qkvauD9LVbUJoWw .

6. IMPACT

As the Final Conference from BINGO, the participation of the project in ECCA 2019 was extensively strategically planned. The objective was to engage as many delegates from ECCA 2019 as possible in many different formats: scientifically through the presentations and posters; directly through person-to-person contact with the invitation cards; indirectly through the flyers and brochures in the gift bags; passively through our booth, where people could approach if interested, providing rewards when they did; actively through the games at the booth; and in informal, fun moments with our thematic performances, where we actively engaged the stakeholders around the booth.

With around 1200 participants, ECCA 2019 was the largest platform where BINGO has been able to be disseminated. The response from the audiences present at the Conference was positive, but not necessarily measurable. The numbers that can provide a small overview of BINGO's impact are: the Twitter account, which had >20 new followers and the website also saw 500 new visitors.

All of the hats and t-shirts were distributed among the delegates, the BINGO booth had a consistent amount of visitors throughout the days, mostly concentrated in the coffee and lunch breaks. The participation in BINGO's activities was partially successful, failing only due to the surrounding noise. However, overall, the activities were fun and people who participated enjoyed them. People also regularly approached the booth with questions about the project, after seeing one of BINGO's presentations. Because there were always BINGO partners around, we were always able to provide satisfactory answers and/or forward them to the key people in the project.

BINGO's presentations and posters were the key piece to the project's participation strategy, providing solid scientific basis to the findings and results. The participation in BINGO's presentations and posters was high and provided a platform for people to further engage in the project's activities in the Conference.