

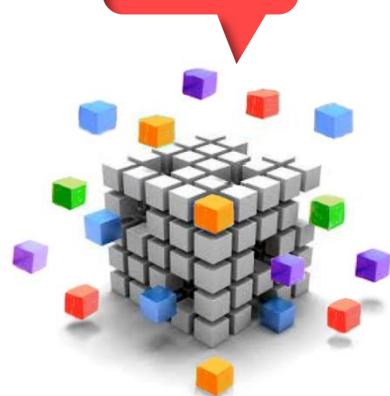


FEEDBACK REPORT

DECEMBER 2019

CD-INTERACTION & ANNUAL MEETING

WP1



~~WATER~~

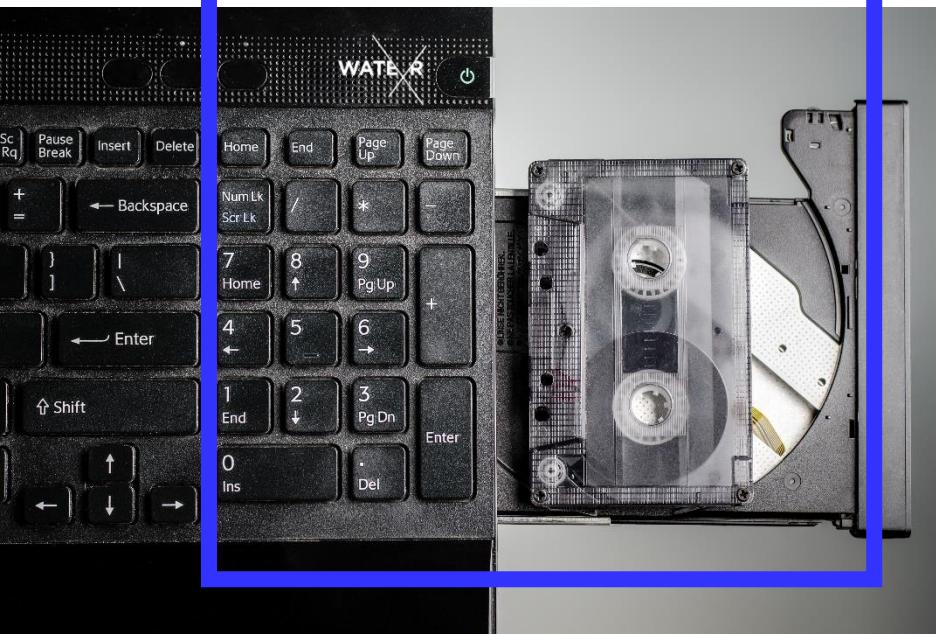
CONTENTS

1. INTRO
2. A GLOBAL PERSPECTIVE FROM CD-INTERACTION
3. ANNUAL MEETING & CD-INTERACTION RESULTS

1

INTRO

OUR “CD-MISSION”



After some months working on co-development we have launched the CD-interaction as a main task for Fall 2019. It was also connected to the Annual meeting in Ireland. Its main lines of action within co-development process were:



THE PERSONAL PERSPECTIVE

- Co-development process
- Interaction dynamics
- Participants (developer & stakeholder) expectations



THE TECHNICAL PERSPECTIVE

- Promote the development of the different plug-ins (case studies)
- “Serious playing” with the layout combined version (developer & stakeholder) for all case studies
- Learn by doing and match the “simulated” results with stakeholder expectations/needs in the tool
- Synergies detection and bottleneck prevention

IDENTIFY
EXPECTATIONS OF THE
PARTICIPANTS
(RESEARCHERS &
STAKEHOLDERS)

PROMOTE AN OPEN,
CLEAR AND EFFECTIVE
COMMUNICATION

OUR ESSENTIALS

DETECT
SYNERGIES,
ANTICIPATE
INEFFICIENCIES
AND BOOST
PROBLEM
RESOLUTION

ASSESS THE CO-
DEVELOPMENT PROCESS
AND MAKE IT MORE
TRACEABLE

Additionally, all steps in this interaction also considered our **essential goals** for the co-development process planning (WP1)*

*See the Albirem introduction document about WP1 & the record of the zoom introduction meeting (22th February 2019) for more details

2

A GLOBAL PERSPECTIVE FROM CD-INTERACTION

2. A GLOBAL PERSPECTIVE

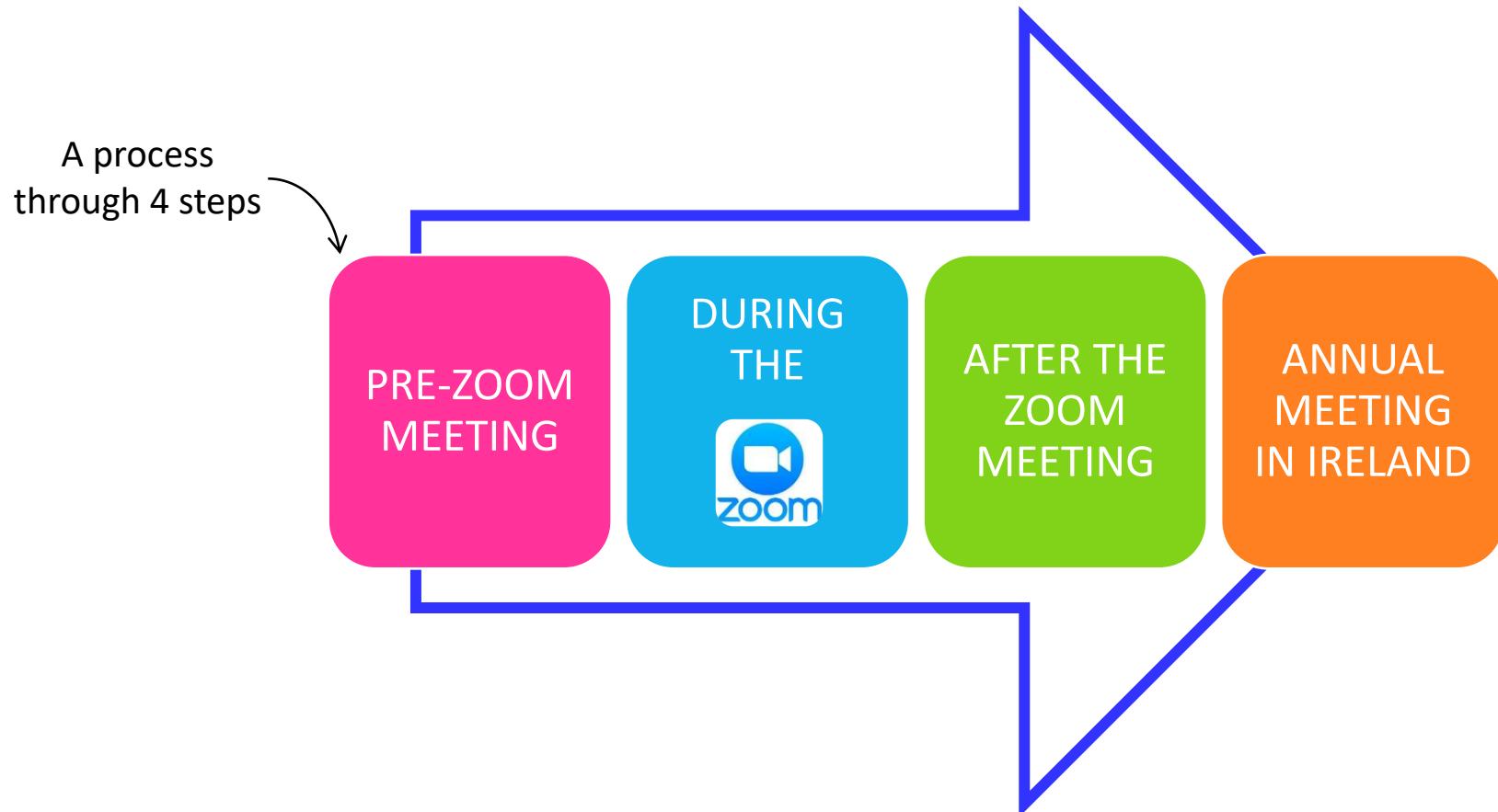
CD

INTERACTION

"PRE-IRELAND" MEETING



- The “CD interaction” had an individualized Zoom session and it was devoted to work on the plug-in status this early Fall. It also included a conceptual simulation exercise that has culminated with the Ireland Annual Meeting 2019



2. A GLOBAL PERSPECTIVE



INTERACTION

"PRE-IRELAND" MEETING



goals

- Promote the development of the different plug-ins (case studies)
- "Serious playing" with the layout combined version (developer & stakeholder) for all case studies
- Learn by doing and match with stakeholder expectations/needs in the tools

participants

- We wanted to interact with at least 2 representatives of each case study (developer & stakeholder)
- 7 independent zoom meetings (1 zoom meeting per case study)
- Our colleagues from University of Cantabria were aware of the interaction and exercise

PRE-ZOOM MEETING



TO-DO LIST



TIMELAPSE



RESOURCES

DURING THE ZOOM

AFTER THE ZOOM

ANNUAL MEETING IRL

- ZOOM MEETING DATE: Choose a day
- YOUR OPINION ABOUT B-interaction: (if necessary)
- SIMULATION EXERCISE: Select an extreme climatic episode (stakeholder) and draw a possible layout for the episode (developer)

- ZOOM MEETING: Share your results and opinions with the call participants (developer & stakeholder)

- NEXT STEPS: Think about the conclusions and lessons learnt from the exercise
- WE'LL BE THERE FOR YOU: If you need anything

- ANNUAL MEETING: Think about what's coming up in Ireland

- ZOOM MEETING: 30 min approximately of virtual interaction per case study (developers, stakeholders & us)

- INTEGRATED FEEDBACK: We'll work on it to share it with you

- NEXT STEPS: We are yet preparing everything for the Annual Meeting! You'll get the detailed Agenda soon

- ZOOM MEETING:
 - Meeting agenda
 - Link to the zoom meeting for your Case Study (email)

- NEXT STEPS: There are different channels available to interact (email, Zoom, Mattermost, etc.)

- WATExR Co-development: We'll share with you the conclusions of the simulation exercise...and there will be much more!

3. PRE-MEETING

SIMULATION EXERCISE

INTRO

- We conducted a theoretical exercise to “simulate” how the tool layout could be useful in a “known” episode of interest for the stakeholder
- At this point, we are convinced that this exercise boosts the tool development, as potential difficulties and synergies may arise

GOALS

- Our aim was to focus on layout of the tool and the results offered to the stakeholder from a theoretical / conceptual perspective
- Qualitatively “test” the current version of the layout and making a transversal exercise within the WATExR project, to:
 - Think about an extreme climatic episode and assess the potential output in the context of the project (limits of the probabilistic seasonal forecast, missing info, new stakeholder needs, potential limits for the model, etc.)
 - Realize whether the information in the layout may be useful in a “real episode”

PARTICIPANTS

- **Stakeholders** → They established a past climatic extreme episode of interest, based on their background
- **Developers** → They drew a hypothetical layout result for the chosen extreme climatic episode
- **Climatologists (University of Cantabria)** → They knew about the suggested episodes and were aware about the development of the exercise
- **Albirem** → They guided the exercise as an opportunity to interact and improve co-development of the WATExR project

INFO FOR:

SCIENTISTS



STAKEHOLDERS





**KEEP
CALM**

3. PRE-MEETING

“SIMULATION” EXERCISE

This should not be
taken literally !!!

WHAT DID WE MEAN BY SIMULATION

- A beta-version of the plug-in should be achieved by the end of the project (2020). Therefore, **there is no need to run a real simulation for this exercise!**
- We have designed the exercise in a way that **all case studies are able to participate** (there are **no requirements in terms of model running or code programming**). It's about teamworking, system thinking and drawing!
- We think that this “theoretical exercise” may set the basis for a complete simulation experiment (running the model with real data for several case studies to “validate” the WATExR approach) that could be of interest to publish by the end of the project. Like this, we suggest you to go one step further to the point achieved in the last Santander workshop (conducted by University of Cantabria)



2. A GLOBAL PERSPECTIVE

SIMULATION EXERCISE

CD

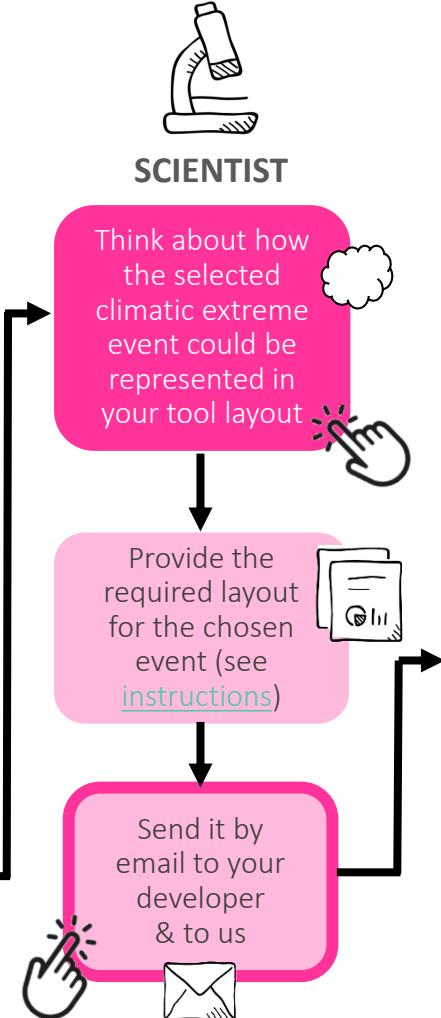
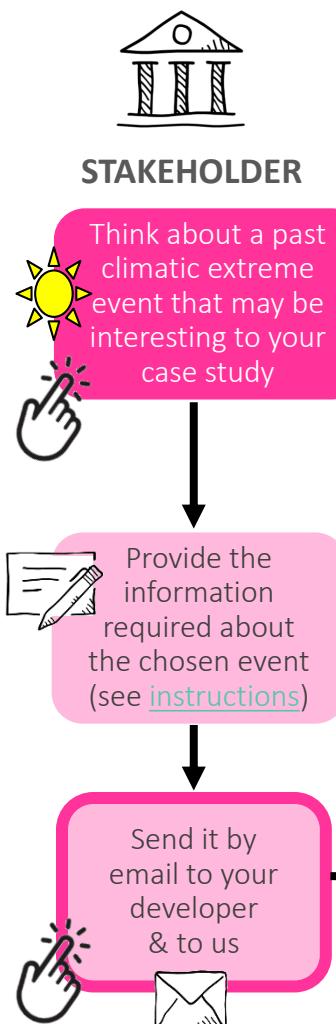
INTERACTION

"PRE-IRELAND" MEETING



3. PRE-MEETING

GENERAL SCHEME



The CD-interaction materials included specific instructions for scientists and stakeholders

We thought about the results and analyzed the CD-interaction from a global perspective

AFTER THE ZOOM

ANNUAL MEETING IRL

We shared and commented some conclusions arising from the exercise

2. A GLOBAL PERSPECTIVE



INTERACTION

"PRE-IRELAND" MEETING



3. PRE-MEETING

SIMULATION EXERCISE

WHAT WAS INTERESTING FOR STAKEHOLDERS?

- There are different stakeholder perspectives in the WATExR project
- Different stakeholders had different expectations
- How will the simulation exercise match with the purpose of the tools and audience?
- Synergies and new expectations may appear



Case study	Stakeholder	Developer	Purpose of tool and audience
(AUS) Mt Bold reservoir	South Australian Water	Marine Institute (MI) / Dundalk Institute for Technology (DKIT)	Predicting water quality / quantity for reservoir managers
(IRL) Burrishoole catchment	Marine Institute (MI)	Marine Institute (MI) / Dundalk Institute for Technology (DKIT)	Predicting fish migration to aid fish stock assessments / monitoring
(ESP) Sau reservoir	Aigües Ter - Llobregat (ATLL)	Catalan Institute of Water Research (ICRA)	Predicting water quality / quantity for reservoir managers in line with WFD
(DNK) Lake Filso / Lake Arreskov	Ministry of Environment and Food	Aarhus University (AU)	Predicting water quality, ecological impacts and explaining extreme ecological / aquatic phenomena to the public
(NOR) Vansjø-Hobol catchment	Morsa river basin management authority	Norwegian Institute for Water Research (NIVA)	Predicting water quality parameters and WFD status for water supply
(DEU) Wupper reservoir	Wupperverband	Wupperverband / Helmholtz Centre for Environmental Research	Predicting water quality parameters and WFD status for water based recreation
(SWE) Lake Erken	Stockholm Vatten	University of Uppsala (UU)	Support education by providing simplified output of lake models from meteorology (historic ; projected seasonal / climate)

2. A GLOBAL PERSPECTIVE

CD

INTERACTION

"PRE-IRELAND" MEETING



4. DURING THE MEETING



MEETING AGENDA

WELCOME!

- CO-DEVELOPMENT: Up to date (After all, there's always something new under the sun...)

2. SIMULATION EXERCISE

PRE-MEETING

- CASE STUDY:

- How did you feel with this exercise?
- DEVELOPERS: Resulting layout description
- STAKEHOLDER: How this layout may have been **useful for you**? Based on it, which would have been your **decisions**? What about your **expectations**? Are there **new needs**?
- How does your approach take **uncertainty** into account?
- DEVELOPERS: What about **probabilistic forecasts**? How do you work on the limits within the exercise? Which new **difficulties** may arise?
- Assessment of your **needs** from a global perspective

- WATExR APPROACH:

- How may your experience with this exercise **contribute to the other groups**?

3. ANNUAL MEETING "IN SIGHT"

3

ANNUAL MEETING & CD-INTERACTION RESULTS

CONTENTS & AGENDA

1. Intro (5')
2. Co-development results “up to date” (15')
3. Simulation results (120')
 1. Individual feedback from each case study & internal discussion (100')
 2. Aggregated perspective & conclusions (10')
 3. Global implications for WATExR (10')
4. Connecting with WP4... (30')
5. Recommendations from the co-development (5')
6. Next steps (5')
7. Questions & discussion? (OPEN)

3.1

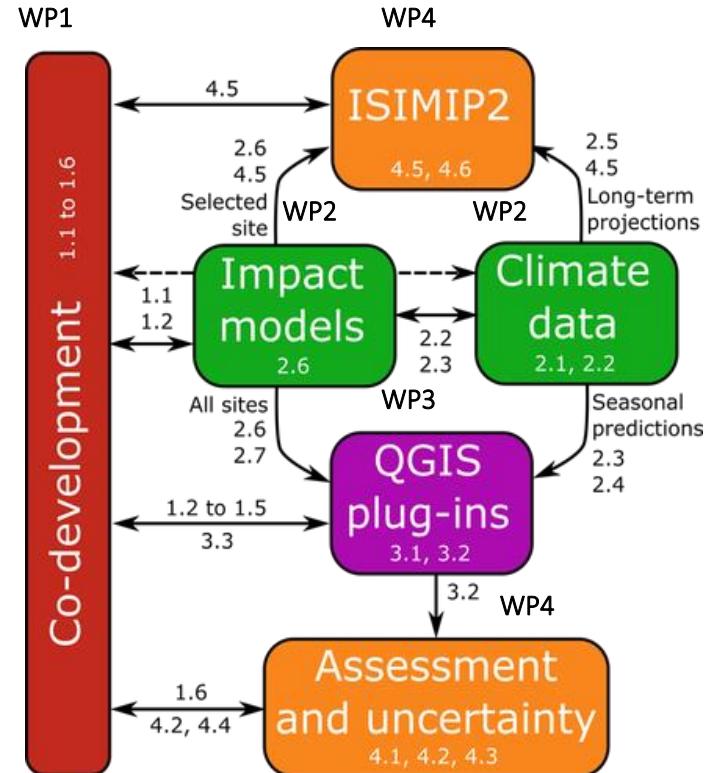
INTRO

FIRST OF ALL...

Thank you all!

Since you joined
ALL our activities
during 2019 and
made it happen

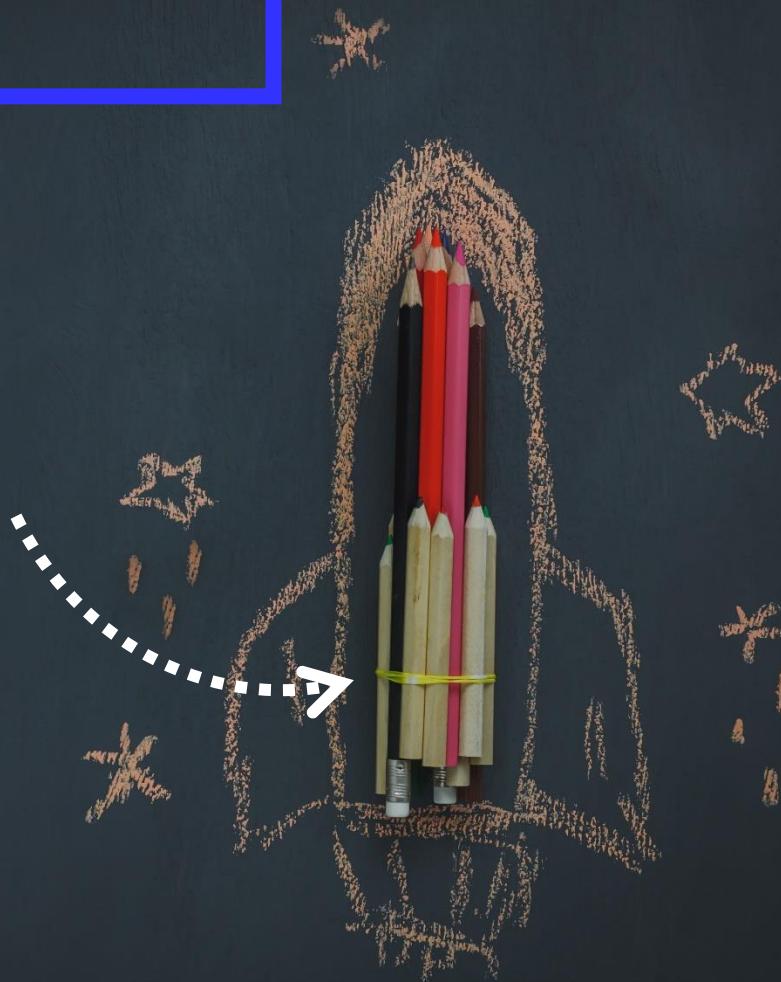
AN INTEGRATED CO-DEVELOPMENT FRAMEWORK



- WP1 requires to promote the interaction and cooperation of international experts, climate modelers and managers to analyze the case studies of 7 countries (Denmark, Ireland, Norway, Sweden, Germany, Australia and Spain)

OUR MISSION FOR 2019

To be a catalyst in the relationship between all the participants of the project, accompanying in the process of research, modeling, development and implementation of the predictive tools for the management of water resources



1

IDENTIFY EXPECTATIONS
OF THE PARTICIPANTS
(RESEARCHERS &
STAKEHOLDERS)

2

PROMOTE AN OPEN,
CLEAR AND EFFECTIVE
COMMUNICATION

3

DETECT
SYNERGIES,
ANTICIPATE
INEFFICIENCIES
AND BOOST
PROBLEM
RESOLUTION

4

ASSESS THE CO-
DEVELOPMENT PROCESS
AND MAKE IT MORE
TRACEABLE



CO-DEVELOPMENT
LINES OF ACTION

~~WATER~~

3.2

CO-DEVELOPMENT
RESULTS “UP TO DATE”

2. CO-DEVELOPMENT RESULTS "UP TO DATE"

ANNUAL MEETING 2019



1

IDENTIFY EXPECTATIONS OF THE PARTICIPANTS (RESEARCHERS & STAKEHOLDERS)

2

PROMOTE AN OPEN, CLEAR AND EFFECTIVE COMMUNICATION

3

DETECT SYNERGIES, ANTICIPATE INEFFICIENCIES AND BOOST PROBLEM RESOLUTION

4

ASSESS THE CO-DEVELOPMENT PROCESS AND MAKE IT MORE TRACEABLE

- Group interactions
- Individual interactions
- Online questionnaires
- Global check, engagement and satisfaction assessment
- Other participative dynamics

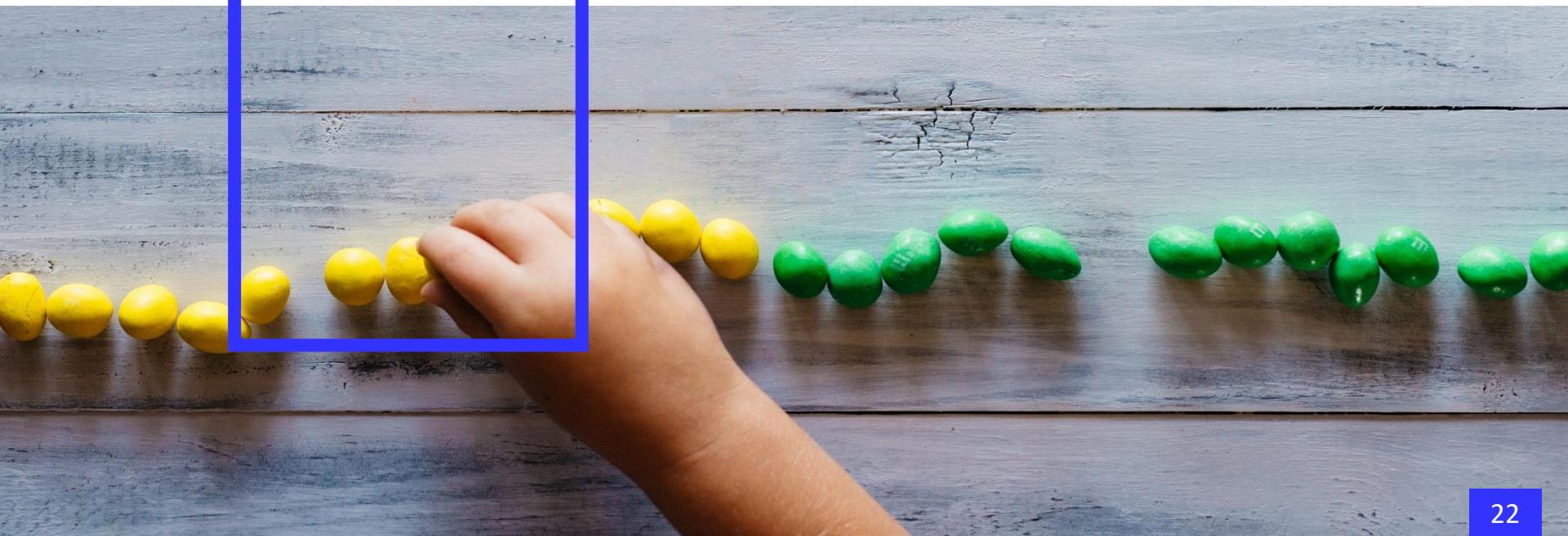
- Group interactions
- Individual interactions
- Proactive management
- Open access to data and information
- Other participative dynamics

- Intra case study communication
- Inter-case studies communication dynamics
- Tests and user recommendations
- Feedback that may be useful to other WP of the project

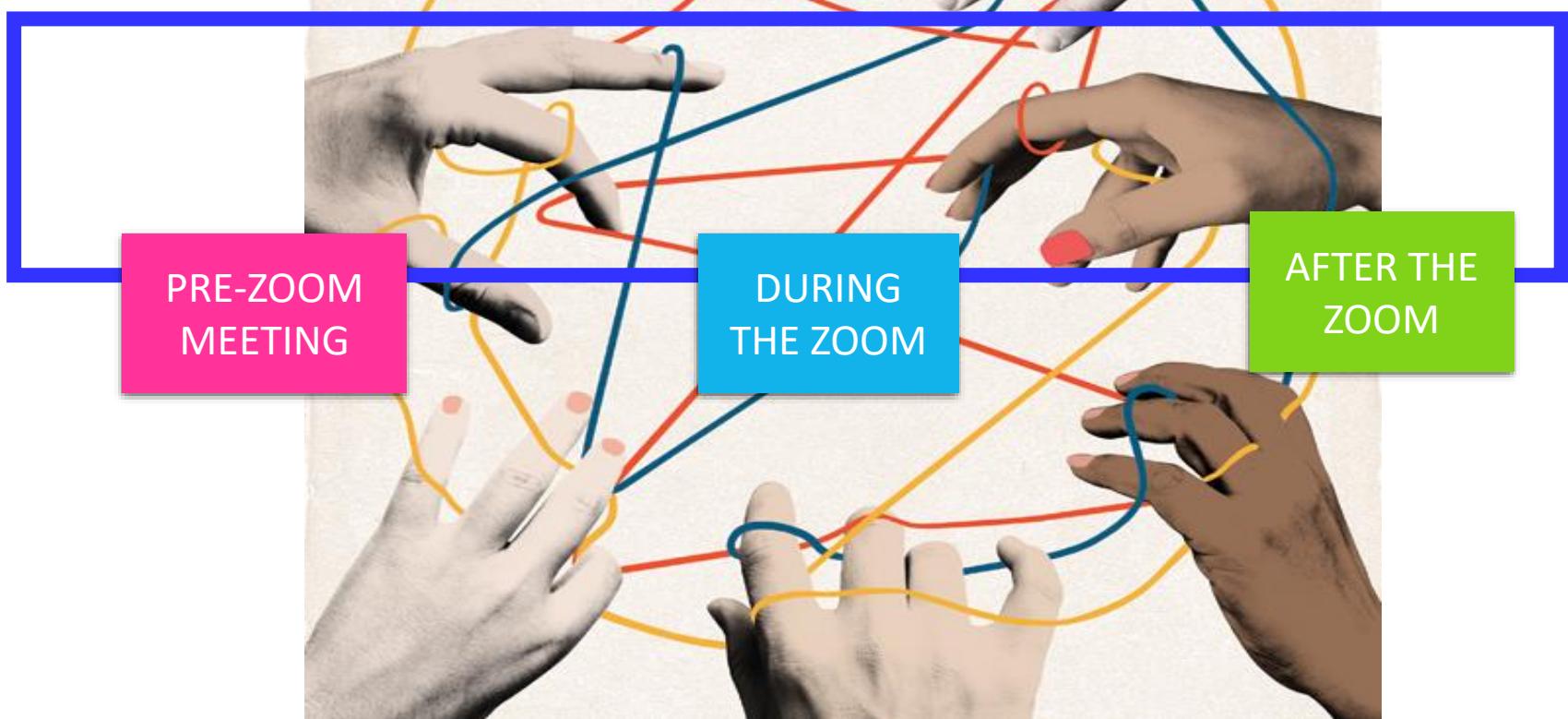
- Development and use of indicators (intensity, frequency of interaction, information management, plug-in development, project results, satisfaction, etc.)

THE PROCESS
HAS BEEN
ITSELF A
RESULT

- The process has been **an opportunity** for the different agents to **interact** during the co-development, with the **coordination** and **dynamisation** carried out
- Thus, the **monitoring of the project** and **access to information** has been enhanced at all times



A VIRTUAL
INTERACTIONS
“MODUS
OPERANDI”





Where are we now?

Introduction
Zoom
meeting

B-interaction
questionnaire
& exercises

B-interaction
Zoom &
conclusions

Mid-term
Feedback
report
(JUL'19)

CD-interaction
• Simulation
exercise
• Zoom
• Conclusions



Annual
meeting



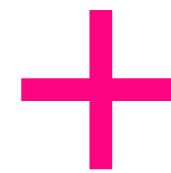
How do you
feel from
April on?

ON-LINE QUESTIONNAIRE

We launched
two on-line
questionnaires
last April



STAKEHOLDERS



SCIENTISTS



2. CO-DEVELOPMENT RESULTS "UP TO DATE"

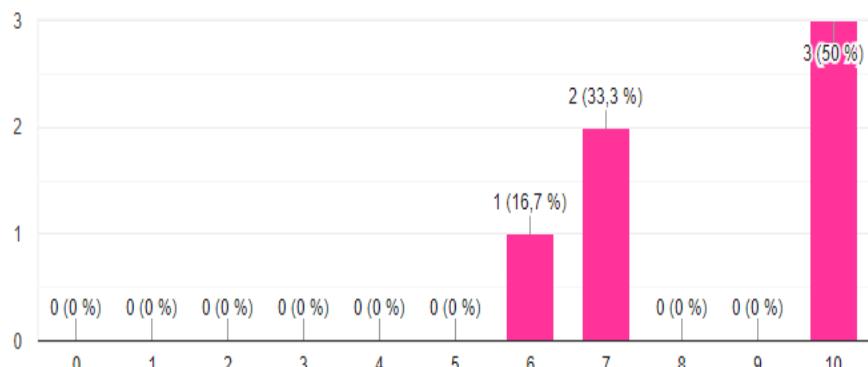
ANNUAL MEETING 2019



STAKEHOLDERS



How approachable do you consider your developer?

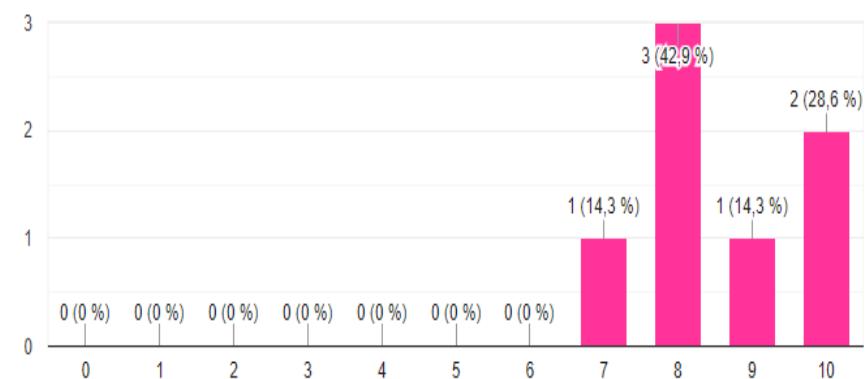


PART 1: ABOUT CO-DEVELOPMENT

SCIENTISTS



How approachable do you consider your stakeholder?



- In general everybody perceives their partners as approachable within the WATExR project
- However, stakeholders perceive a little distance with developers sometimes

✓ The co-development atmosphere is good in the project but sometimes a little more approachability would be desirable. It is hard sometimes to manage with busy agendas but it is worth doing it to find new opportunities



...partners
look more
approachable?

2. CO-DEVELOPMENT RESULTS "UP TO DATE"

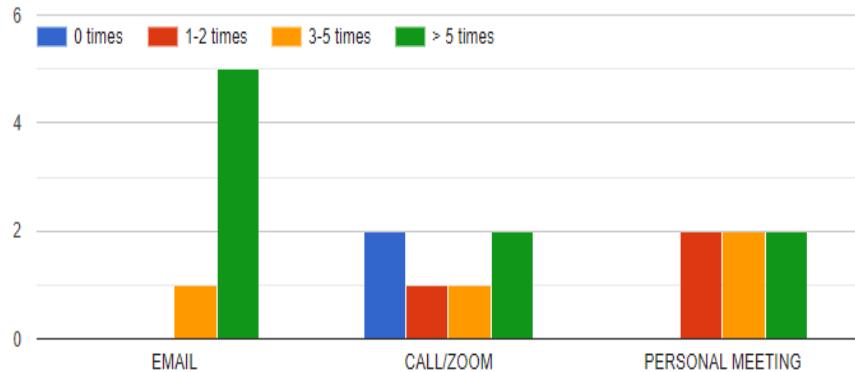
ANNUAL MEETING 2019



STAKEHOLDERS



How often did you interact with your case-study developer last year?

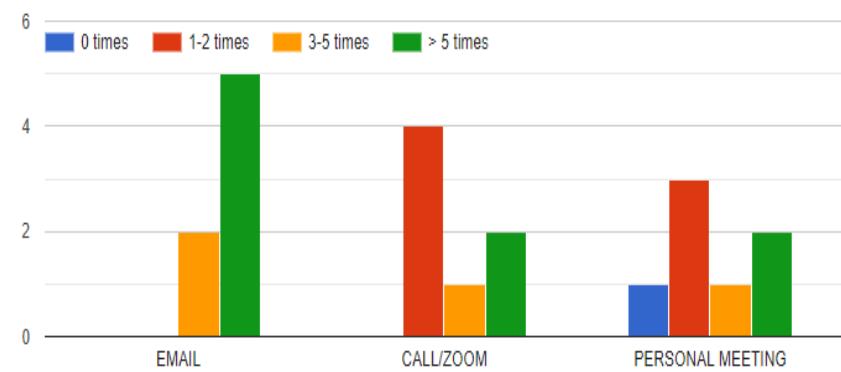


PART 1: ABOUT CO-DEVELOPMENT

SCIENTISTS



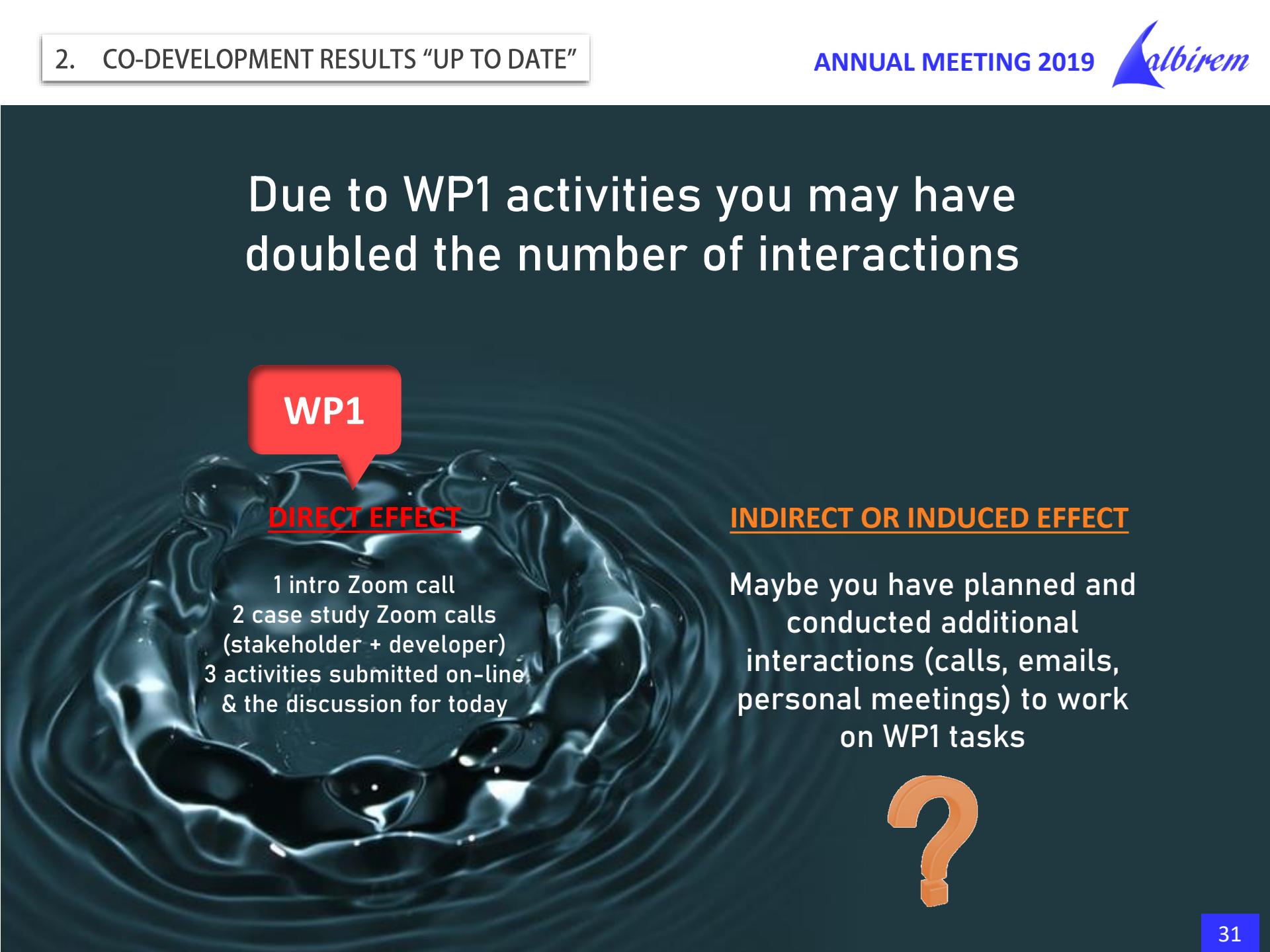
How often did you interact with your case-study stakeholder last year?



- Results on interaction are coherent and in general show a good level of interaction between the different work groups
- Apart from e-mail, zooms are a good channel to meet, but groups tend to meet F2F more than once a year

✓ The level of interaction is adequate and it may also fluctuate depending on the different working phases. WP1 also expects to contribute to increase the frequency of interactions through different channels

Due to WP1 activities you may have doubled the number of interactions



WP1

DIRECT EFFECT

- 1 intro Zoom call
- 2 case study Zoom calls
(stakeholder + developer)
- 3 activities submitted on-line
& the discussion for today

INDIRECT OR INDUCED EFFECT

Maybe you have planned and conducted additional interactions (calls, emails, personal meetings) to work on WP1 tasks



2. CO-DEVELOPMENT RESULTS "UP TO DATE"

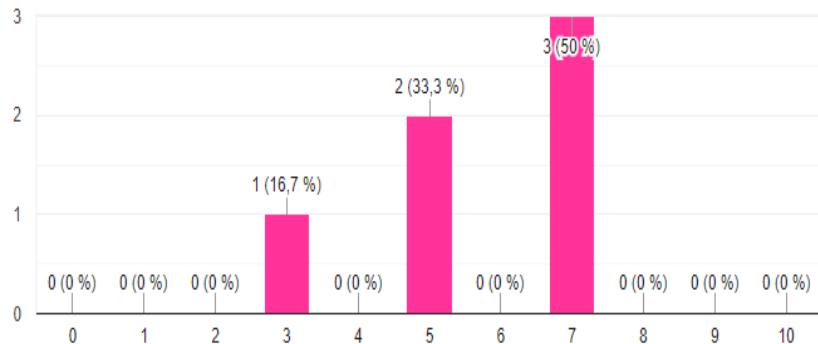
ANNUAL MEETING 2019



STAKEHOLDERS



How often do you share information about this project with other colleagues in your institution (not your case-study developers)?

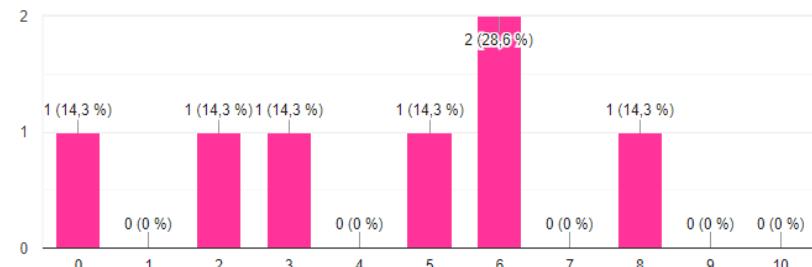


PART 1: ABOUT CO-DEVELOPMENT

SCIENTISTS



How often do you share experiences/doubts about the project with other Case Study members (apart from your own Case Study)?



- Stakeholders tend to share information a little more than developers, but both are more or less in the same situation

✓ Its is also difficult to find opportunities to comment with your colleagues about the project, but it is also relevant to get new inputs / ideas to internally promote the project in your institution, etc.

2. CO-DEVELOPMENT RESULTS "UP TO DATE"

Have you
shared
internally the
WATExR
project with
any colleague?



SCIENTISTS

PART 1: ABOUT CO-DEVELOPMENT



When we ask scientists what do they expect from the co-development in the project...

- They mainly tell us that they expect the co-development to ensure that the final tools will match stakeholder expectations
- And to guide them to produce a useful tool for seasonal forecasting



- ✓ You're aligned! That sounds great for the next steps 😊
- ✓ This will also guide us in WP1 to match your expectations within WATExR project

STAKEHOLDERS

PART 2: CASE STUDY UP TO DATE



When we ask stakeholders to what extent does the tool match their expectations ...



An 80% tell us that it matches their expectations in a 10/10!!!

- ✓ That's a good indicator that you're moving in the right direction!

Do you think
that now we
are even
closer to
stakeholder's
expectations?



STAKEHOLDERS



- Stakeholders mainly think about discussion, about how to implement the results of the tools, how to connect them with other existing models or how to review the results...

PART 3: THE FUTURE "IN SIGHT"

When we ask you all if there is anything in the project/case study that could be improved in order to achieve our goals...

SCIENTISTS



- Scientists are more diverse in their answers...
 - Not now...maybe later on
 - To cooperate more to ensure the tool adjustment to stakeholder needs
 - And some of them put the emphasis on additional resources: time, more code sharing, or even more budget :P

✓ According to that, it's great to notice that everybody has answered that they can be useful to others within the project! Let's create the conditions to do so



So we
have
focused
on...



...promoting
discussion,
cooperation,
connecting ideas,
identifying new
needs or problems
and to also ways to
solve them...

...and our discussion today is another key milestone to complete!



3.3

SIMULATION RESULTS

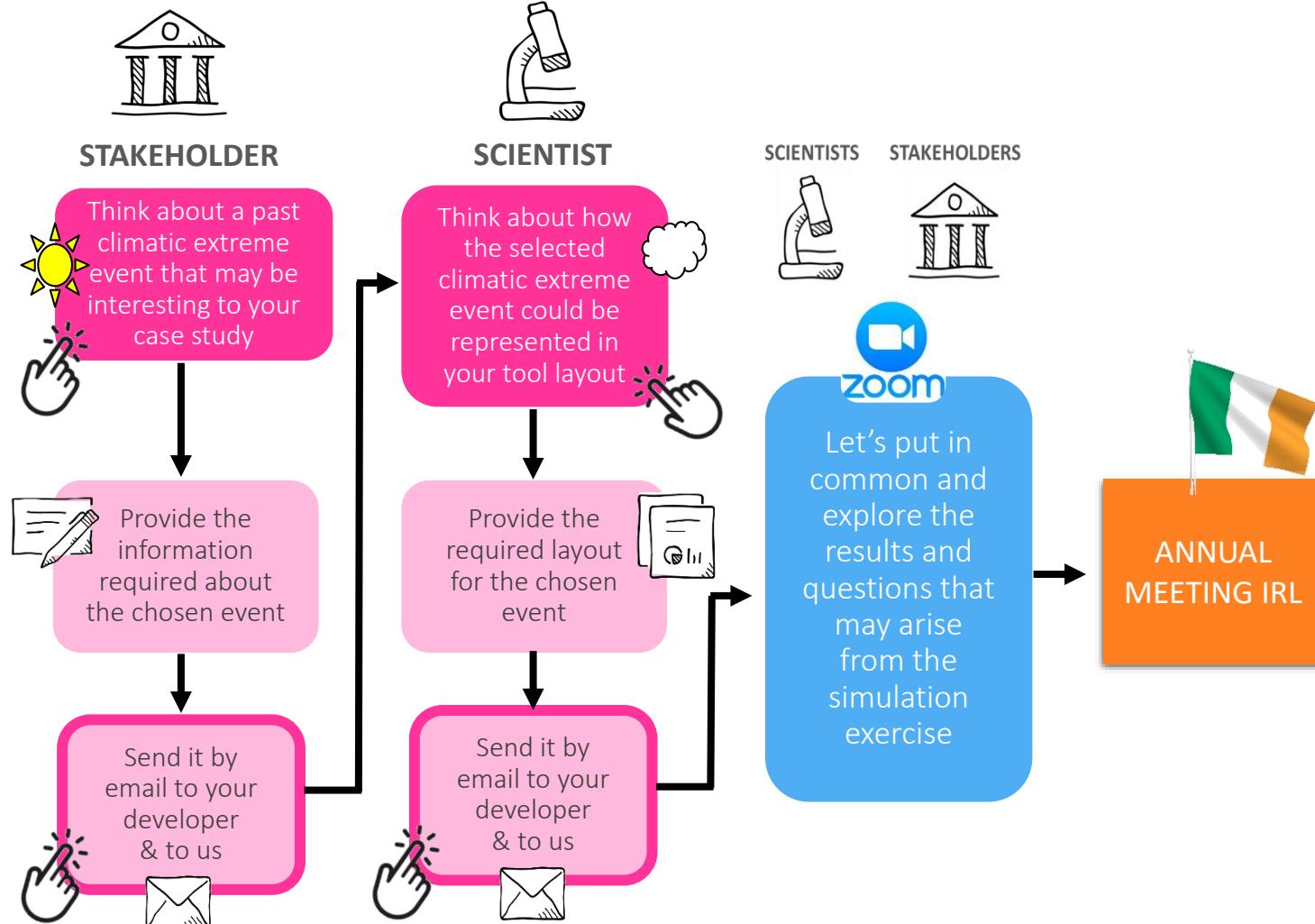
3. SIMULATION RESULTS

ANNUAL MEETING 2019



SIMULATION EXERCISE

GENERAL SCHEME





"SIMULATION" EXERCISE

This should not be
taken literally !!!

WHAT DO WE MEAN BY SIMULATION

- A beta-version of the plug-in should be achieved by the end of the project (2020) and there was no need to run a real simulation for this exercise!



INFO FOR:

SCIENTISTS

STAKEHOLDERS



**What about
the other
case studies?**

**Let's share
and explore!**

3. SIMULATION RESULTS



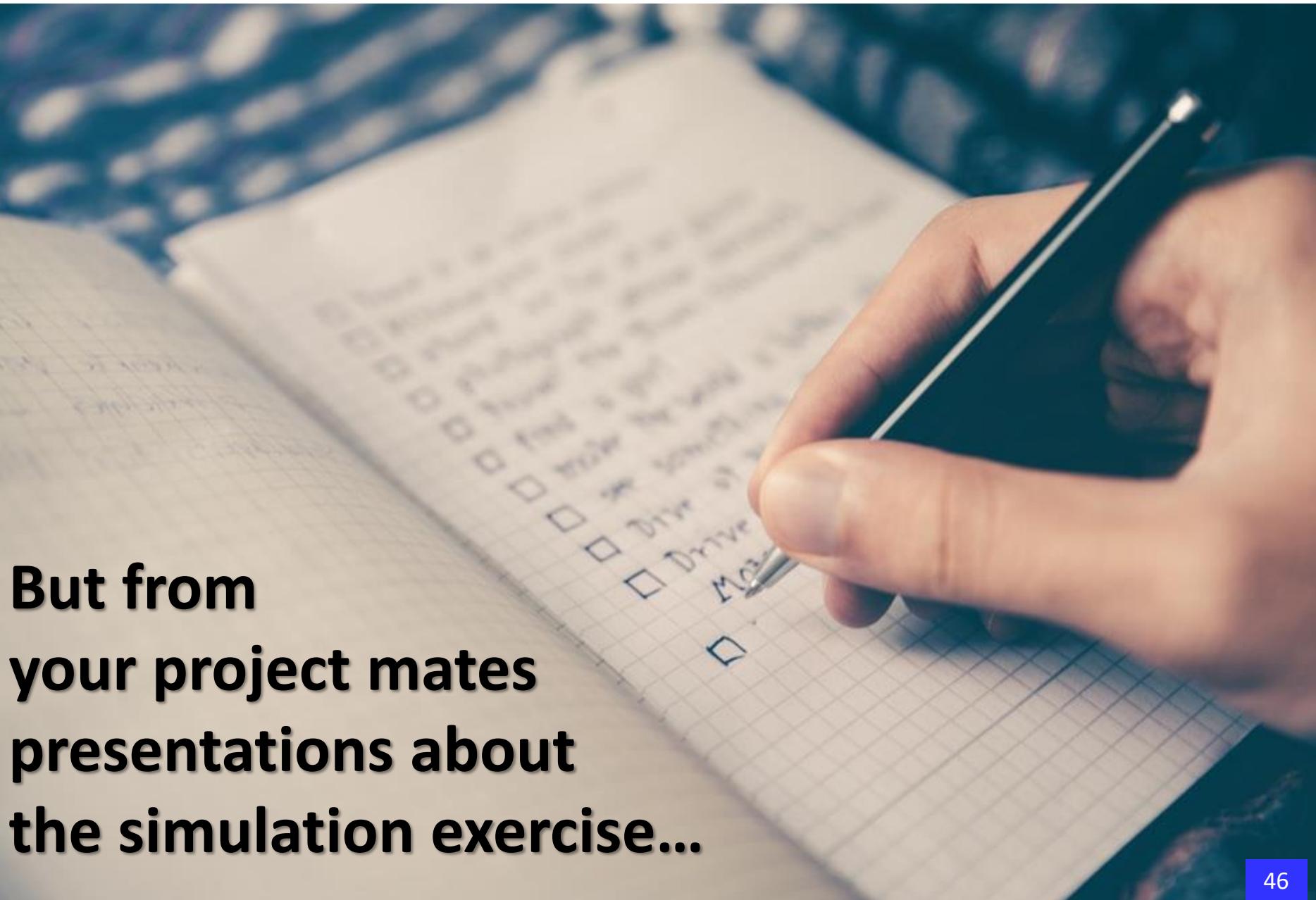
ANNUAL MEETING 2019



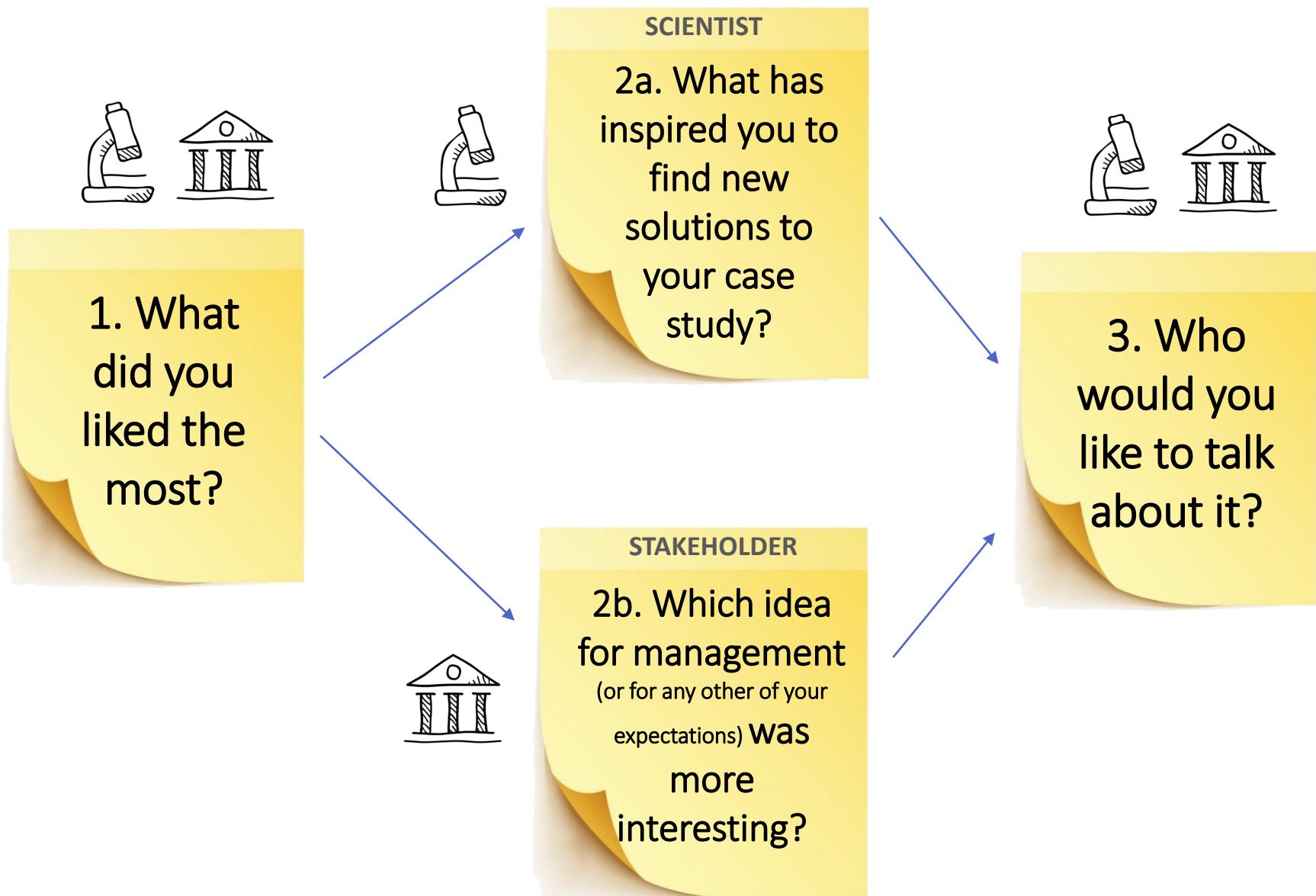
**NOW WE
WANT YOU TO
LOOK FOR
SIGNS...**

Well, not this one...





**But from
your project mates
presentations about
the simulation exercise...**



3.3.1

INDIVIDUAL FEEDBACK FROM EACH
CASE STUDY & INTERNAL DISCUSSION

3. SIMULATION RESULTS

ANNUAL MEETING 2019



Suggested order of appearance...

CASE STUDY	STAKEHOLDER	DEVELOPER	PURPOSE OF TOOL AND AUDIENCE
1 (IRL) Burrishoole catchment	Marine Institute (MI)	Marine Institute (MI) / Dundalk Institute for Technology (DkIT)	Predicting fish migration to aid fish stock assessments / monitoring
2 (DEU) Wupper reservoir	Wupperverband	Wupperverband / Helmholtz Centre for Environmental Research	Predicting water quality parameters and WFD status for water based recreation
3 (ESP) Sau reservoir	Aigües Ter - Llobregat (ATLL)	Catalan Institute of Water Research (ICRA)	Predicting water quality / quantity for reservoir managers in line with WFD
4 (DNK) Lake Arreskov	Ministry of Environment and Food	Aarhus University (AU)	Predicting water quality, ecological impacts and explaining extreme ecological / aquatic phenomena to the public
5 (NOR) Vansjo-Hobol catchment	Morsa river basin management authority	Norwegian Institute for Water Research (NIVA)	Predicting water quality parameters and WFD status for water supply
6 (AUS) Mt Bold reservoir	South Australian Water	Marine Institute (MI) / Dundalk Institute for Technology (DkIT)	Predicting water quality / quantity for reservoir managers
7 (SWE) Lake Erken	Stockholm Vatten	University of Uppsala (UU)	Support education by providing simplified output of lake models from meteorology (historic ; projected seasonal / climate)

CASE STUDY



IRELAND (IRL)

Burrishoole catchment

5. ANNUAL MEETING IRL



CD INTERACTION



SIMULATION EXERCISE → climatic episode description



1. DEFINE THE EPISODE

- Winter of 2009/2010 through to Spring 2010 – very cold and dry

2. EPISODE DESCRIPTION

- very cold and dry, low water levels in spring

3. RELEVANCE FOR YOU

- Salmon smolt (juveniles going to sea) run was late – was this due to temperature or water level?

4. IMPACT

- Late timing of smolt migration to sea. Potential for knock-on survival of sea run fish – effects not yet quantified.

SLIDE FOR:

STAKEHOLDERS



1 of 4

- Based on the information that you already sent to us, just describe the event to share with other groups during the Ireland meeting
- You can add some pictures or a newspaper link if you want to illustrate the episode or its effects / impact

SIMULATION EXERCISE → LAYOUT DRAWING 

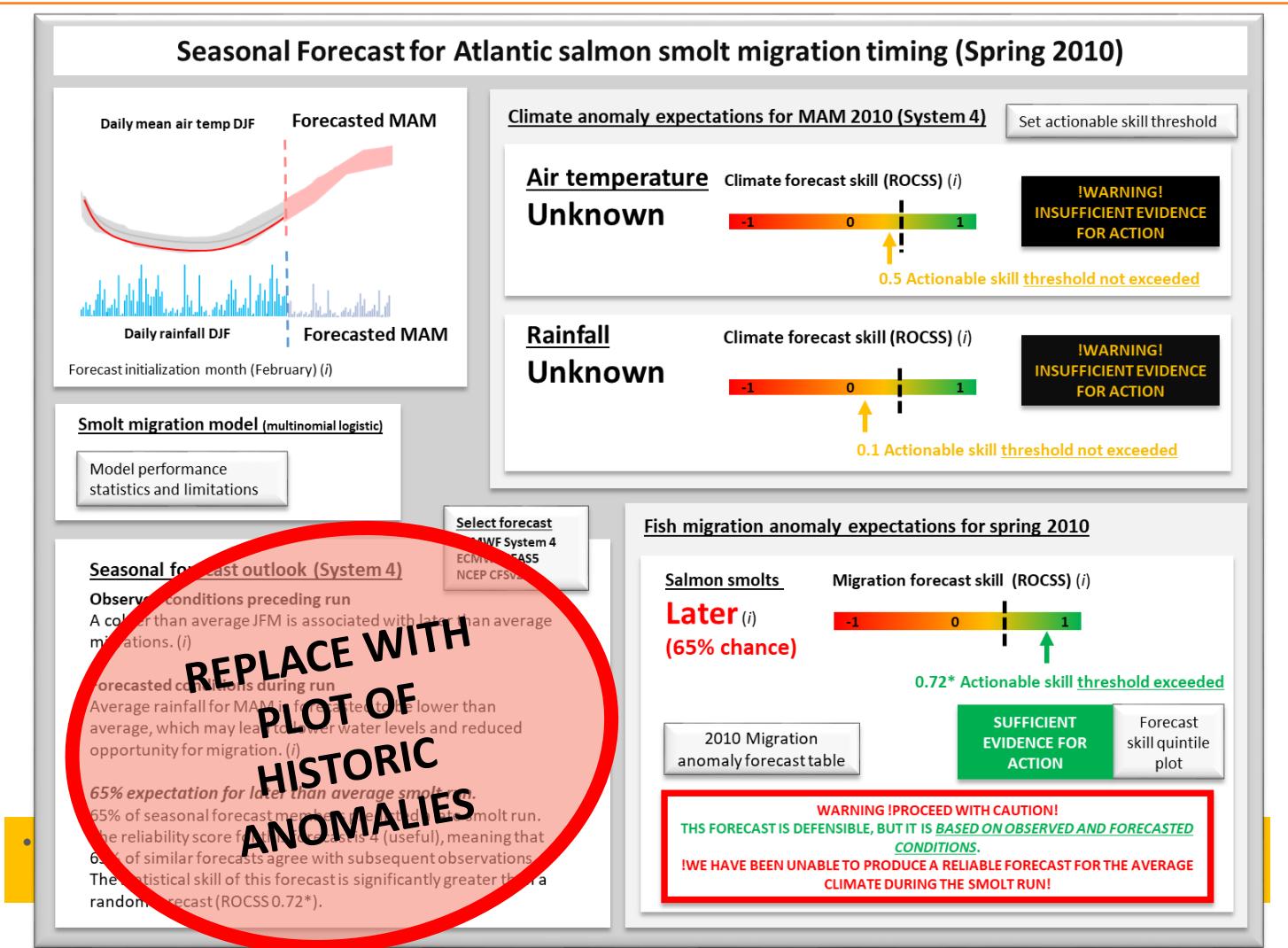
COPY YOUR LAYOUT DRAW HERE

SLIDE FOR:

SCIENTISTS



2 of 4



SIMULATION EXERCISE → Main conclusions from STAKEHOLDERS

- Presentation of the forecast template was excellent.
Suggested that the text description in lwr LHS box should have an accompanying visual output display.
- Need a view of what the threshold level means in the field data of run timing – how late is late, early is early? And this would feed into how to translate the forecast time into the required management action and its timing.
- Level of risk in the prediction, and consequences for getting it wrong?
- Visualize the main forecast, and indicate the other anomalies alongside to inform risk decision making.

SLIDE FOR:

STAKEHOLDERS



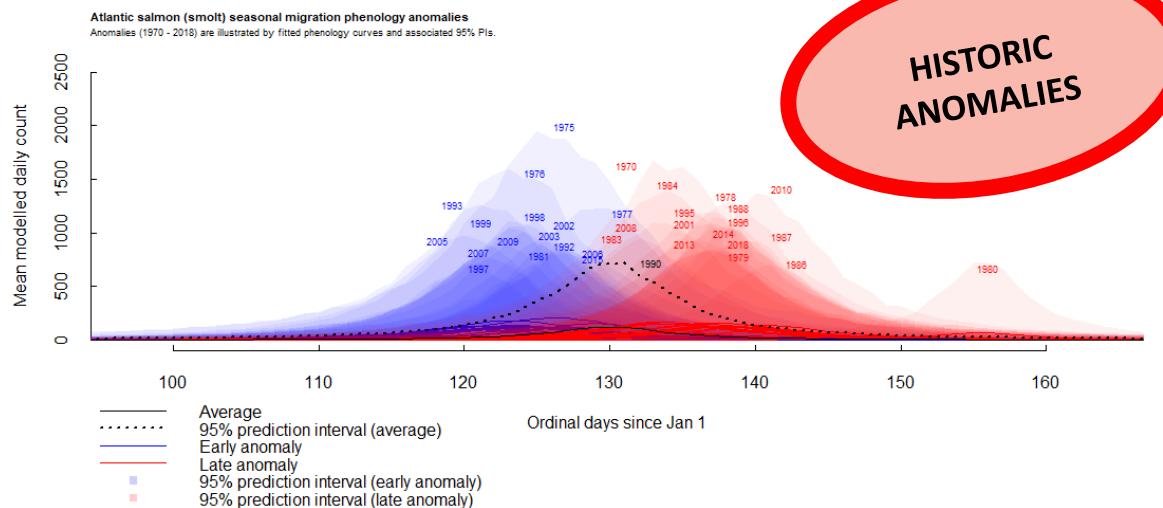
3 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES: The layout could have been useful in your chosen past event?
Expectations?
New needs? etc.



SIMULATION EXERCISE → Main conclusions from DEVELOPERS

- Useful exercise to identify essential outputs
- Identified additional information to provide context of forecasts to stakeholder



SLIDE FOR:

SCIENTISTS



4 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES:
Strengths, main difficulties, lessons learnt for the WATExR project, etc.

Minimise number of “clicks”/“windows” necessary to reach forecast summary window.

CASE STUDY



GERMANY (DEU)

Wupper reservoir



SIMULATION EXERCISE → climatic episode description



1. DEFINE THE EPISODE

- The episode covers the year 2003. It represents a drought period and a heat wave.

2. EPISODE DESCRIPTION

- The year 2003 was characterized by low rainfall and high temperatures throughout Europe.

3. RELEVANCE FOR YOU

- Low reservoir levels in the Wupper Reservoir and constant nutrient loads from the upstream catchment area are principally associated with eutrophication and thus failure to meet the objectives of the Water Framework Directive.

4. IMPACT

- Remarkable is the year 2003 due to the fact that since then, a fundamental change also occurred in the structure of the phytoplankton summer species, which could lead to the potential development of harmful cyanobacteria and further to the limitation in the recreational use of the reservoir.

SLIDE FOR:

STAKEHOLDERS



1 of 4

- Based on the information that you already sent to us, just describe the event to share with other groups during the Ireland meeting
- You can add some pictures or a newspaper link if you want to illustrate the episode or its effects / impact

5. ANNUAL MEETING IRL

CASE STUDY



GERMANY (DEU)

Wupper reservoir

CD

INTERACTION



SIMULATION EXERCISE → LAYOUT DRAWING

SLIDE FOR:

SCIENTISTS



2 of 4

Old Design

plugin input

Start and End date of the simulation

 simulation start date
 simulation end date

Inflow source

 modeled discharges measured discharges

Select lake model

 CEQUAL-W2 GLM

CEQUAL-W2 Configuration

Wind sheltering coefficient

Shading coefficient

Light extinction coefficient

GLM Configuration

Kw

subdaily True

Meteorological data source

- Seasonal Forecast
- Reanalysis
- DWD

Select output data

- Water level dynamics
- Nutrients concentrations
- Temperature
- Ecology

RUN

Results

Water Level

Depth

Date

Surface Temperature

Surface temperature

Date

5. ANNUAL MEETING IRL

CASE STUDY GERMANY (DEU)



Wupper reservoir

CD

INTERACTION



SIMULATION EXERCISE → LAYOUT DRAWING



New Design after stakeholders CD meeting

SLIDE FOR:

SCIENTISTS



2 of 4



SIMULATION EXERCISE → Main conclusions from STAKEHOLDERS

- **Layout** - Plugin options and result visualisation:
- Modell and simulation settings (entire window)

Select workflow (Nowcast/Seasonal Forecasting/Hindcast) –

Hindcast only offline

Set forecasting start date T0

Select warm or cold start

The model will be configured beforehand (Delft-FEWS)

- Result visualisation (entire window)

The output will be configured beforehand (Delft-FEWS)

Seasonal (probabilistic) forecasting: all members should be

visualised including an extra plot with the probability distribution
(quantiles)

- Further future functions – configuration settings:

Set water level / reservoir storage volume thresholds/warning levels

Set water quality parameter thresholds

Set measures (change model configuration)

Export possibilities (e.g. time series, graphs, pdf report etc.)

SLIDE FOR:

STAKEHOLDERS



3 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES: The layout could have been useful in your chosen past event?
Expectations?
New needs? etc.

SIMULATION EXERCISE → Main conclusions from DEVELOPERS

1. 1. The main goal of the stakeholders is to empower them with a management controlling interface for dynamic decision making to respond to such events.
2. The design should allow different management strategies and possibilities for alternative scenario-building
3. Determining a set of important variables to be displayed for the stakeholder that are based on prior selection.
4. The plugin should have a warning sign for water quality variables below certain thresholds.

SLIDE FOR:

SCIENTISTS



4 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES:
Strengths, main difficulties, lessons learnt for the WATExR project, etc.

CASE STUDY

SPAIN (ESP)



Sau reservoir

5. ANNUAL MEETING IRL

CASE STUDY

SPAIN (ESP)



Sau reservoir

CD

INTERACTION



SIMULATION EXERCISE → climatic episode description



1. DEFINE THE EPISODE

- Flooding occurred in 16th October 2018, affecting the water quality variables in the reservoir for the rest of the season (autumn 2018).

2. EPISODE DESCRIPTION

- There was an unpredicted large water input from the Ter River basin due to heavy rainfall. The days before it had been having dry conditions, so it was saving and storing water in Sau. When the torrential arrived it was necessary to release good quality water downstream, and the reservoir received low quality water. There was then an increase in the organic matter content that could lead to an increase in the treatment cost.

3. RELEVANCE FOR YOU

- The management becomes very difficult and we had to take reactive decisions day by day according to the behaviour of the reservoir and expert knowledge.

4. IMPACT

- Increase in the cost of water treatment

SLIDE FOR:

STAKEHOLDERS



1 of 4

- Based on the information that you already sent to us, just describe the event to share with other groups during the Ireland meeting
- You can add some pictures or a newspaper link if you want to illustrate the episode or its effects / impact



SIMULATION EXERCISE → LAYOUT DRAWING

COPY YOUR LAYOUT DRAW HERE

SLIDE FOR:

SCIENTISTS



2 of 4

Seasonal forecast system for Sau Reservoir

Autumn 2018

Prediction

Streamflow (Q)

High Q values are predicted for the Ter River



Temperature (T)

Low T values are predicted for III, low values for II and high values for I

Organic Matter (OM)

Low OM values are predicted for III, high values for II and low values for I

Oxygen (O)

Low O values are predicted for III, high values for II and low values for I

Chlorophyll a (Ch)

Low Ch values are predicted for III, high values for II and low values for I



Significant prediction

Terciles

above
normal
below

X Non-significant tercile

✓ Significant tercile

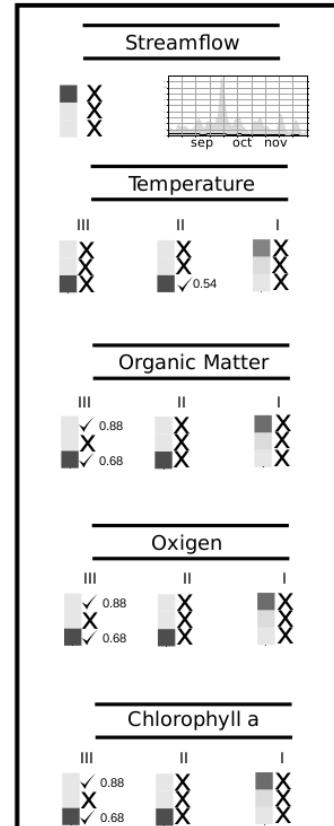
III: gate 3

II: gate 2

I: gate 1

Confidence
Low 0.45 High 1.00

How to use?





SIMULATION EXERCISE → Main conclusions from STAKEHOLDERS

- According to past meetings and a basic explanation from the developers, we were able to understand the analysis, results and legends in the report. Additionally, we agreed the format and the presentation of the report.
- We found the report useful for us because, even if we continue to make the decisions based on expert knowledge, it could help us to technically support the management in the reservoirs.
- We suggested some changes, especially in the analysis of the results. We think some adjustments are required in the way the sentences are written in the analysis because we could take more advantages of the tool (report). We also agreed with the developers to create at the end of the project two reports for each reservoir (Sau and Susqueda), which will be the output from the QGIS plugin.

SLIDE FOR:

STAKEHOLDERS



3 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES: The layout could have been useful in your chosen past event?
Expectations?
New needs? etc.



SIMULATION EXERCISE → Main conclusions from DEVELOPERS

1. In general, it was clearly understood by the stakeholders, but it requires some adjustments to clarify the results and analysis.

2. According to the stakeholder's suggestions we should:

-Improve the language used in the analysis of the results (first box on the left side) to avoid discarding useful information. For instance, even if a particular tercile was not significant in the hindcast (past), but most of the members support this particular tercile, the stakeholder could still use this information. We could use a sentence like this "You could use this prediction for this tercile but there is no confidence in the result"

-Complete the "How to use?" box, change the ATL logo

3. We will generate 2 reports for Sau and Susqueda, with 3 and 4 scenarios, respectively. This is based on the number of gates and water level.

4. We will create approximately 5 automatic results analysis (first box in the left side) according to the multiple results with could obtain from the tercile plots.

SLIDE FOR:

SCIENTISTS



4 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES:
Strengths, main difficulties, lessons learnt for the WATExR project, etc.

CASE STUDY

DENMARK (DNK)



Lake Arreskov

5. ANNUAL MEETING IRL

CASE STUDY

DENMARK (DNK)



Lake Arreskov

CD

INTERACTION



SIMULATION EXERCISE → climatic episode description



SLIDE FOR:

STAKEHOLDERS



1 of 4

1. DEFINE THE EPISODE

- Heat wave: The summer heat wave of 2018 had unprecedented warm temperatures during May-July.

2. EPISODE DESCRIPTION

- Air temperatures were roughly 3 degrees warmer than normal (median change relative to a five year period). In addition, there was drought during this period, resulting in agricultural production losses.

3. RELEVANCE FOR YOU

- This period is interesting as it has had impact on the productivity of lakes in Denmark, and the effects may even extend into the following years (e.g. by reduced macrophyte coverage). This means that during such a year, and potentially the years to come, it is even more difficult to comply with the Water Framework Directive.

4. IMPACT

- The impacts were likely degraded water quality. It is important that we understand, and is able to communicate (e.g. through website), the mechanisms causing such degradation.

- Based on the information that you already sent to us, just describe the event to share with other groups during the Ireland meeting
- You can add some pictures or a newspaper link if you want to illustrate the episode or its effects / impact

INDLAND

Røde flag på strandene: Alger kan gøre dig syg

Både mennesker og dyr skal passe på med at tage en dukkert, hvis der er hejst rødt flag på stranden eller ved badesøen.



Ved Stilling Strand ved Solbjerg Sø i Skanderborg Kommune har der efterhånden i mange dage været advarsel mod at bade på grund af alger. (Foto: Kim Haugaard © Scanpix)

AF NIKOLINE VESTERGAARD
26. JULI 2018 KL. 08.31 BEMÆRK: ARTIKLEN ER MERE END 30 DAGE GAMMEL

LÆS OP

Beware: the algae is coming!

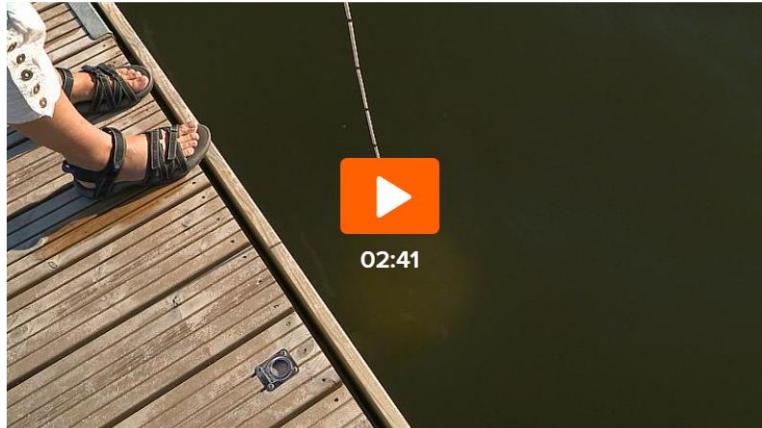
Algerne kommer! Nu er det ikke

tv2ostjylland.dk/artikel/algerne-kommer-nu-er-det-ikke-kun-i-skanderborg-der-er-badeforbud

TV2 ØSTJYLLAND° Din kommune TV Tip os Søg Menu

Algerne kommer! Nu er det ikke kun i Skanderborg, der er badeforbud

I Silkeborg er der nu så mange alger, at kommunen fraråder badning i to søer. Aarhus og Skanderborg slås også med algerne



VIDEO: Her fortæller biolog Maibritt Langfeldt Sørensen om situationen i Silkeborg. Hun viser også, hvordan kommunen måler sigtbarheden i vandet.

© 19. jul 2018, kl. 08:09
Bemærk: Artiklen er mere end 30 dage gammel

Silkeborg Skanderborg Miljø

Del artiklen

f e s

Sten Brøgger

For to dage siden måtte Skanderborg Kommune kapitulere og indføre badeforbud ved Stilling Strand, og nu er den også gal i Silkeborg. I Aarhus er der også problemer med alger flere steder.

10:11 PM DAN 2019-11-19

5. ANNUAL MEETING IRL

CASE STUDY

DENMARK (DNK)



Lake Arreskov

CD

INTERACTION



SIMULATION EXERCISE → LAYOUT DRAWING

COPY YOUR LAYOUT DRAW HERE

SLIDE FOR:

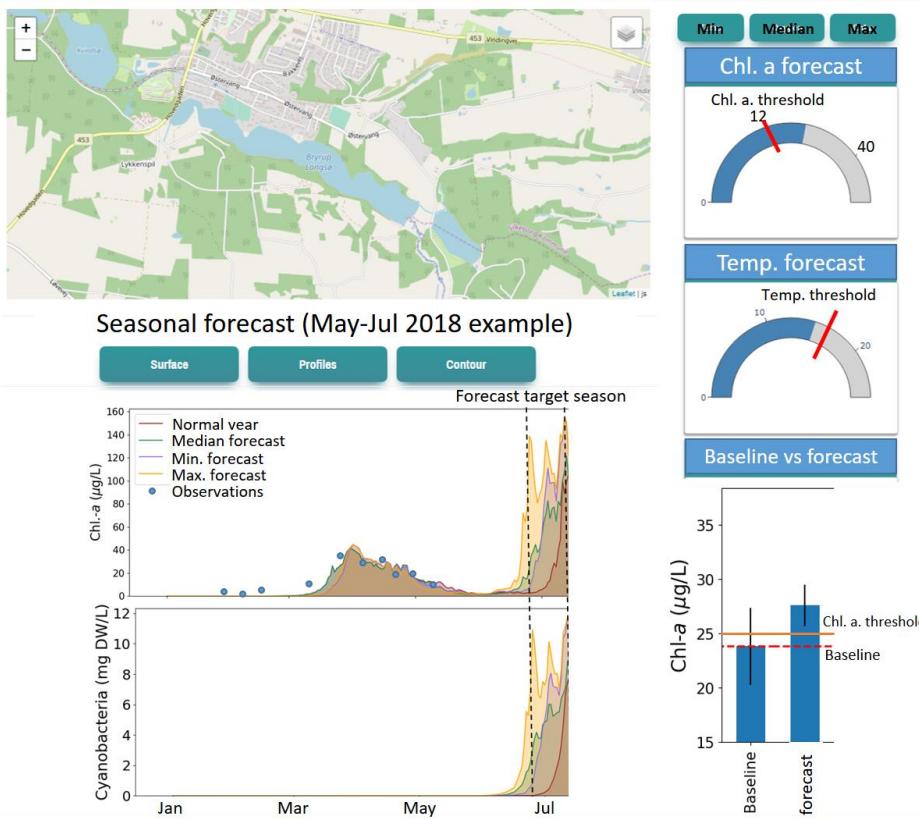
SCIENTISTS



2 of 4

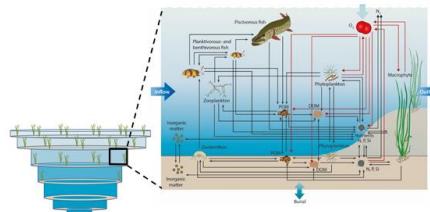
Front-end (LAYOUT example)

- An example to be used as a basis for discussion
- Could allow end-user interactions (e.g. could be through a web portal, where end-user can set custom warning levels)



Model application back-end

- Acquisition and formatting of weather forecast data
- Execution of model-chain
- Post-processing



- Paste the layout that you have produced for the selected climatic extreme event that your stakeholder has suggested

SIMULATION EXERCISE → Main conclusions from STAKEHOLDERS

- Danish stakeholder/co-developer (MFE) is particularly interested in ensuring that the models and tools developed in WATExR may also be relevant for water action planning beyond a seasonal forecast (e.g. also being able to look some years into the future, and not only a few months).
- MFE is mainly interested in the insights that a model analysis can provide, and not all the technical details on how to apply the model and acquire and format data to enable seasonal forecasting.
- If a seasonal forecast system is available and reliable, the MFE could use it, however, to plan ad hoc sampling campaigns (for example to document impacts of weather extremes).
- Also, the MFE would like to be able to explain to the public the mechanisms of an extreme event (for example, which factors have contributed to a massive fish kill).

SLIDE FOR:

STAKEHOLDERS



3 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES: The layout could have been useful in your chosen past event?
Expectations?
New needs? etc.

SIMULATION EXERCISE → Main conclusions from DEVELOPERS

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SLIDE FOR:

SCIENTISTS



4 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES:
Strengths, main difficulties, lessons learnt for the WATExR project, etc.

CASE STUDY



AUSTRALIA (AUS)

Mt Bold reservoir

5. ANNUAL MEETING IRL



CD INTERACTION



SIMULATION EXERCISE → climatic episode description ☀

1. DEFINE THE EPISODE

- The selected episode is a big flood in the lake Vansjø, that started the 23. of October year 2000, and it lasted until December 2000. Write here

2. EPISODE DESCRIPTION

The flood lasted for more than 3 months, and had big consequences for the infrastructure and the environment. The flood lead to leakage of nutrients and organic material to the water from both sewage and agriculture.

3. RELEVANCE FOR YOU

The flood had major consequences for the water quality of the lake – several years after the flood. The algae bloom after the flood caused “bathing ban” in the western parts of Vansjø from August 2001 until August 2007.

4. IMPACT

Lake Vansjø is regulated for power production. The outlet is naturally narrow, which means the lake is vulnerable for flooding. If we can get a prediction about possible flooding episodes, maybe the power plant can release more water in advance to be prepared.

SLIDE FOR:

STAKEHOLDERS

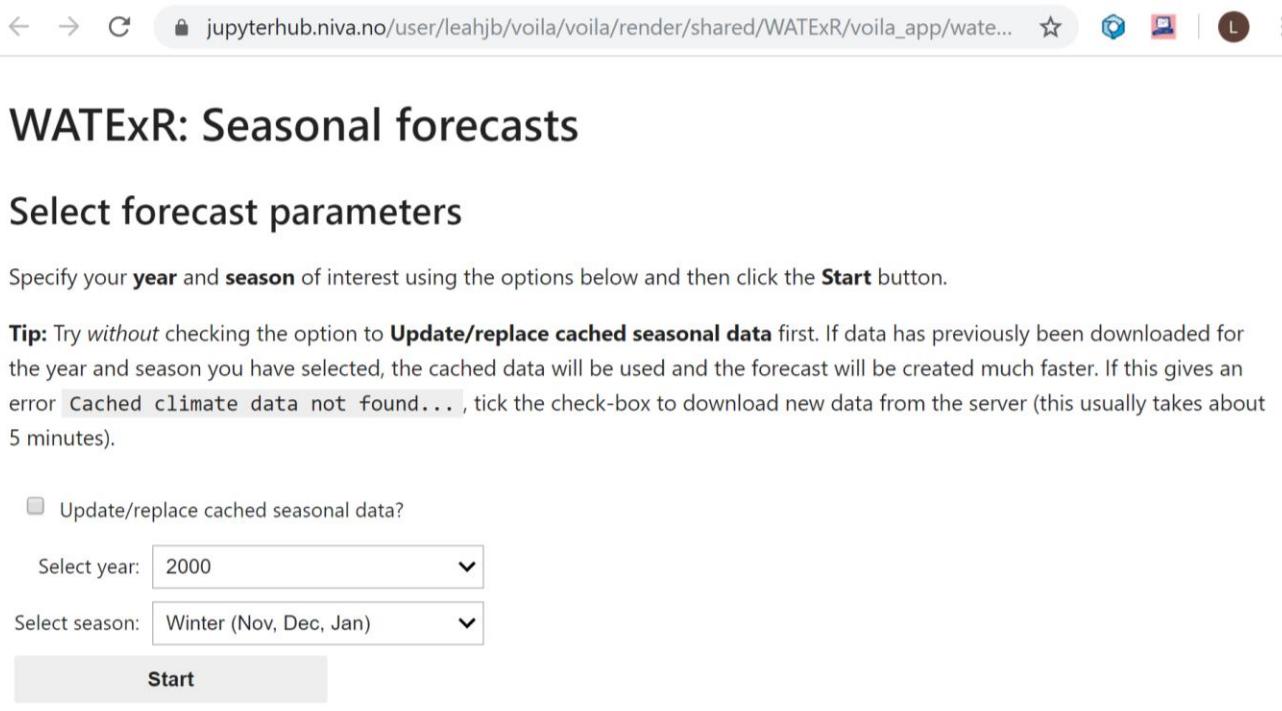


1 of 4

- Based on the information that you already sent to us, just describe the event to share with other groups during the Ireland meeting
- You can add some pictures or a newspaper link if you want to illustrate the episode or its effects / impact

SIMULATION EXERCISE → LAYOUT DRAWING

Home page, where the season of interest is selected:



The screenshot shows a web browser window with the URL jupyterhub.niva.no/user/leahjb/voila/voila/render/shared/WATExR/voila_app/wate.... The main content area is titled "WATExR: Seasonal forecasts" and contains the heading "Select forecast parameters". Below this, a tip message reads: "Specify your **year** and **season** of interest using the options below and then click the **Start** button." A tip message follows: "Tip: Try without checking the option to **Update/replace cached seasonal data** first. If data has previously been downloaded for the year and season you have selected, the cached data will be used and the forecast will be created much faster. If this gives an error `Cached climate data not found...`, tick the check-box to download new data from the server (this usually takes about 5 minutes)." There are three input fields: a checkbox for "Update/replace cached seasonal data?", a dropdown menu for "Select year" set to "2000", and a dropdown menu for "Select season" set to "Winter (Nov, Dec, Jan)". A large "Start" button is at the bottom.

SLIDE FOR:

SCIENTISTS



1 of 5

SIMULATION EXERCISE → LAYOUT DRAWING

Returns: (1) Introduction to the forecast

Seasonal forecast of weather and lake water quality

Forecast for Lake Vansjø for November 2000 – January 2001. Forecast issued 10th October 2000

This page shows temperature, rainfall and wind conditions expected for south-eastern Norway during the next 3 months. For summer (May-Oct), lake water quality forecasts for the western basin of Lake Vansjø are also produced, where the aim is to predict ecological status according to the Water Framework Directive.

Forecasts are issued four times a year, as follows:

Issued	Forecast season	Months in forecast
April	Early summer	May - July
July	Late summer	August - October
October	Early winter	November - January
January	Late winter	February - April

Weather forecasts are generated using an ensemble of bias-corrected seasonal climate forecasts (15 members) provided by the ECMWF System 4. Lake ecological status forecasts are based on statistical modelling ([link](#) for further information).

SLIDE FOR:

SCIENTISTS



2 of 5

SIMULATION EXERCISE → LAYOUT DRAWING

Returns: (2) Seasonal weather forecast summary

Weather forecast for November 2000 – January 2001

	Prediction for the coming season (compared to the 1981 - 2010 average)	Risk of extremes	Forecast reliability (historic performance)
Temperature	Above normal	Not extreme	Low (0.31)
Precipitation	Below normal	Not extreme	None (-0.19)
Wind	Above normal	Extreme high	Low (0.25)

Colour intensity represents **forecast probability***

 High (> 75% agreement)	 Low (35 - 50% agreement)
 Medium (50 - 75% agreement)	 Less than low (< 35% agreement)

*percentage of seasonal forecast ensemble members within each class

SLIDE FOR:

SCIENTISTS



3 of 5

- No skill in forecasting precipitation
- The large flood of winter 2000 was not predicted

SIMULATION EXERCISE → LAYOUT DRAWING

Returns: (3) Seasonal lake quality forecast summary

Lake water quality forecast for May 2001 – July 2001

	Predicted ecological status class	Classification	Forecast skill*
Total phosphorus	Upper Moderate or better Lower Moderate or worse	Lower Moderate (90% chance)	70%
Chl-a	Good or better Moderate or worse	Moderate or worse (60% chance)	63%
Cyanobacteria	Good or better Moderate or worse	Moderate or worse (75% chance)	60%

* Percentage of time the model classified correctly during hindcast runs

SLIDE FOR:

SCIENTISTS


4 of 5

- Expect higher skill in forecasting lake water quality, as historic (observed) factors are key drivers. E.g. winter rain

SIMULATION EXERCISE → Main conclusions from STAKEHOLDERS

- Temperature and precipitation are the most interesting themes from the weather forecast.
- If we can get predictions about flooding episodes that will appear the next season, the power plant might will be able to adjust the water level in the lake in advance.
- This can help reduce the flooding in the lake, which will have positive effects for the farmers, the infrastructure and the water quality.
- The reliability of the forecast is important for us to use the data in the mangament.

SLIDE FOR:

STAKEHOLDERS



3 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES: The layout could have been useful in your chosen past event?
Expectations?
New needs? etc.

SIMULATION EXERCISE → Main conclusions from DEVELOPERS

- Very useful exercise for us – started the process of thinking about how to present results clearly, which we hope will be an iterative process with our co-developer
- Unsurprising but disappointing lack of ability to forecast an extremely important weather event for the catchment.

Next steps:

- Gather detailed feedback on design and presentation, and inspiration from other case studies
- Add text summary of any “trustworthy” results that could be acted on (need to decide on acceptable levels of uncertainty)
- Should we just exclude unreliable forecast output?

SLIDE FOR:

SCIENTISTS



5 of 5

CASE STUDY



AUSTRALIA (AUS)

Mt Bold reservoir

5. ANNUAL MEETING IRL

CASE STUDY



AUSTRALIA (AUS)

Mt Bold reservoir

CD

INTERACTION



SIMULATION EXERCISE → climatic episode description



SLIDE FOR:

STAKEHOLDERS



1. DEFINE THE EPISODE

- The Millennium Drought – a multi-year drought event
- Below average rainfall accumulations over 10 years
- Elevated demand on supply – mitigated by demand reduction strategies
- Lower reservoir level at beginning of 'pumping season'

2. EPISODE DESCRIPTION

- Mt Bold Reservoir is supplied by winter rainfall and inter-basin transfers from the River Murray. In drought, there is a much higher dependency on the Murray. Our pumping is designed to meet water security storage targets, while minimizing energy costs.

3. RELEVANCE FOR YOU

- In droughts, we incur higher pumping costs of water and low reservoir levels may result in some water quality problems. We are currently in a period of low rainfall. See figures on following page.

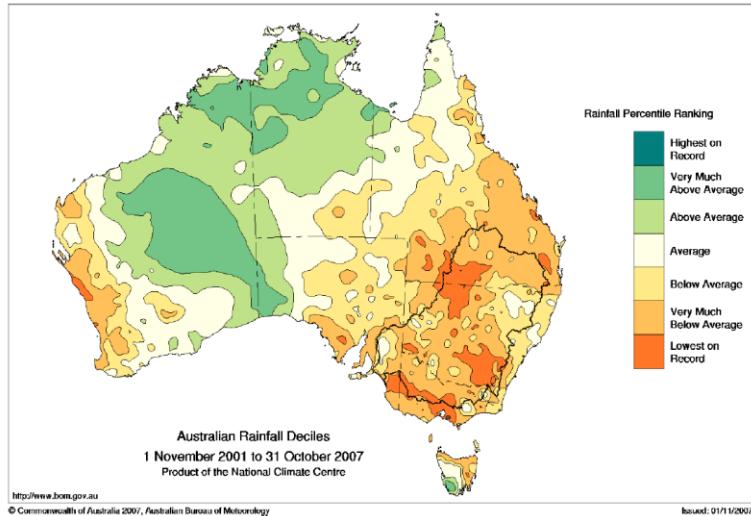
4. IMPACT

- The Millennium drought resulted in a number of impacts on us and our customers.

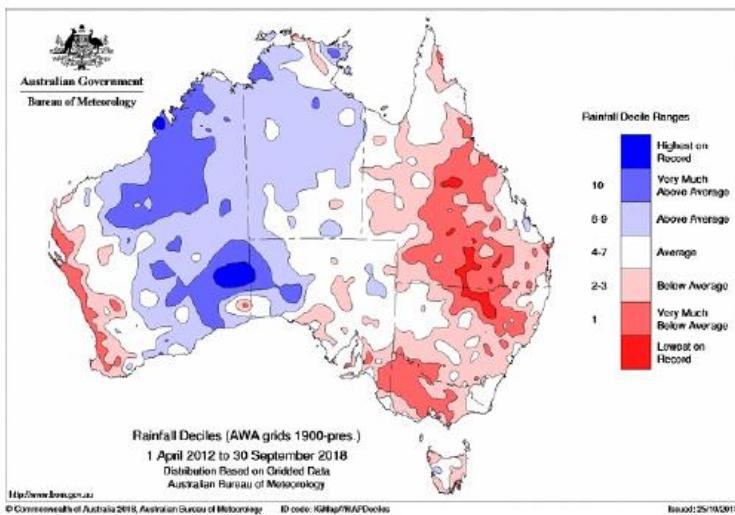
1 of 4

- Based on the information that you already sent to us, just describe the event to share with other groups during the Ireland meeting
- You can add some pictures or a newspaper link if you want to illustrate the episode or its effects / impact

Precipitation anomalies in the Millennium drought and now



Millennium Drought



Current Drought

5. ANNUAL MEETING IRL

CASE STUDY



AUSTRALIA (AUS)

Mt Bold reservoir

CD

INTERACTION



SIMULATION EXERCISE → LAYOUT DRAWING

COPY YOUR LAYOUT DRAW HERE

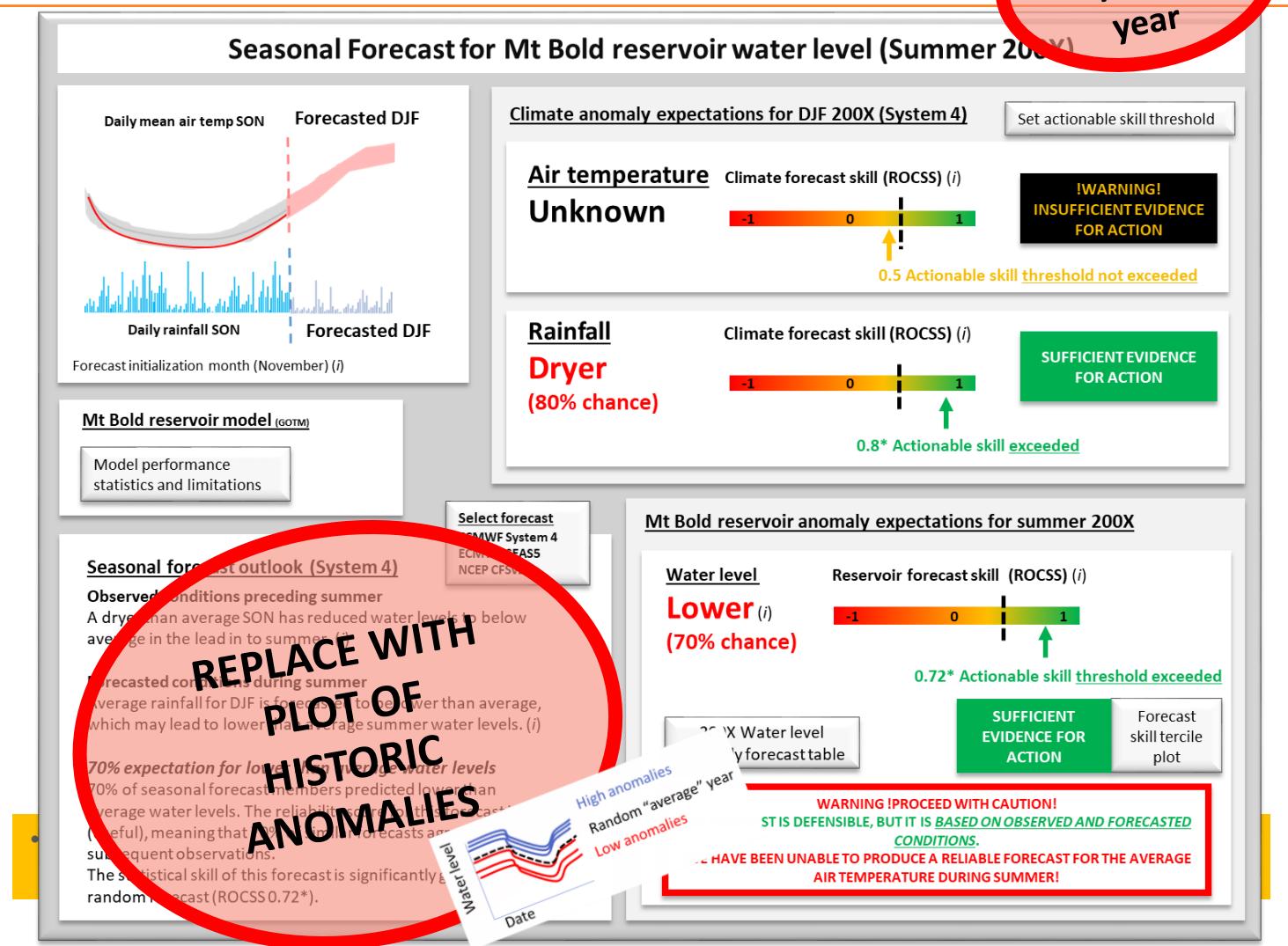
Choose a specific year

SLIDE FOR:

SCIENTISTS



2 of 4





SIMULATION EXERCISE → Main conclusions from STAKEHOLDERS

- Communication with the decision-makers has historically been a key challenge.
- Potentially we may need a second simpler portal / dashboard for communicating with some internals
- We need to consider political (+/- desalination) and market drivers (water, energy). Perhaps as scenarios within the seasonal forecasts.
- Hopefully, seasonal forecasts will allow us to anticipate pumping requirements and therefore define target amounts for periodic pumping plans.

SLIDE FOR:

STAKEHOLDERS

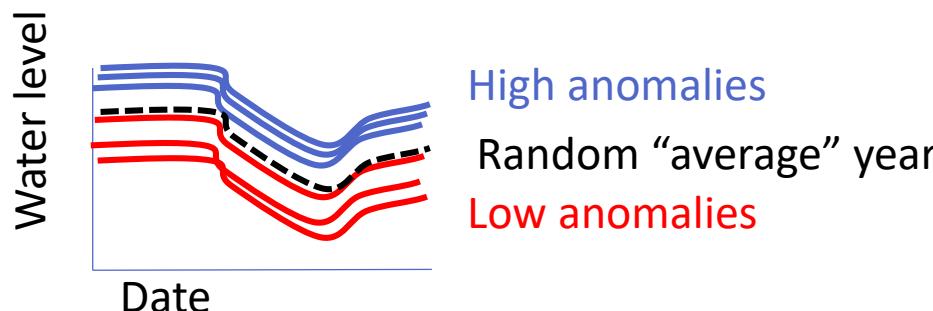


3 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES: The layout could have been useful in your chosen past event? Expectations? New needs? etc.

SIMULATION EXERCISE → Main conclusions from DEVELOPERS

- More background to definition of actionable threshold is worth discussion.
- Add more seasonal climate variable anomaly forecasts.
- There is potential for empirical relationships between water level and probability of algal blooms/ P flux to downstream reservoir (assuming biogeochem model not implemented).
- Provide plot of historic anomalies to give context probabilistic prediction...e.g., :



SLIDE FOR:

SCIENTISTS



4 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES:
Strengths, main difficulties, lessons learnt for the WATExR project, etc.

CASE STUDY

SWEDEN (SWE)



Lake Erken



SIMULATION EXERCISE → climatic episode description



SLIDE FOR:

STAKEHOLDERS



1 of 4

1. DEFINE THE EPISODE

- Simulation of Lake Water Temperature as Part of the 2019 Lake Erken Research school

2. EPISODE DESCRIPTION

- Simulation of 1) Historical Lake Erken Water Temperatures 2)Comparative simulation of water temperatures from other lakes participating in the ISIMIP lake sector 2)Future climate simulations of the same lakes

3. RELEVANCE FOR YOU

- These simulations were useful for describing the mechanisms and effects of thermal stratification., and allowing students to see how thermal stratification can vary between lakes with different climates, and geographical locations

4. IMPACT

- The modeling tools that was tested during the 2019 Research school allowed student to gain a deep understanding patterns and seasonality of thermal stratification in both Lake Erken and other lakes participating in the ISIMIP lake sector.

- Based on the information that you already sent to us, just describe the event to share with other groups during the Ireland meeting

- You can add some pictures or a newspaper link if you want to illustrate the episode or its effects / impact

5. ANNUAL MEETING IRL

CASE STUDY



SWEDEN (SWE)

Lake Erken

CD

INTERACTION



SIMULATION EXERCISE → LAYOUT DRAWING

COPY YOUR LAYOUT DRAW HERE

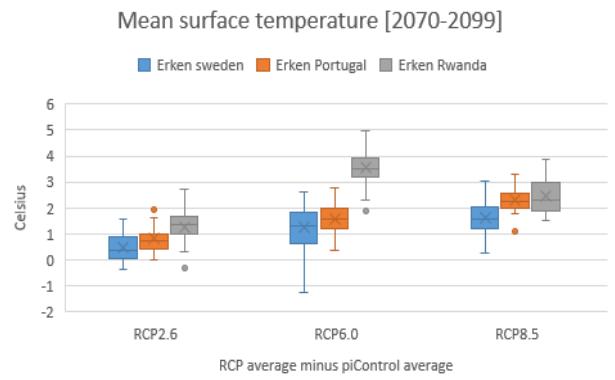
SLIDE FOR:

SCIENTISTS

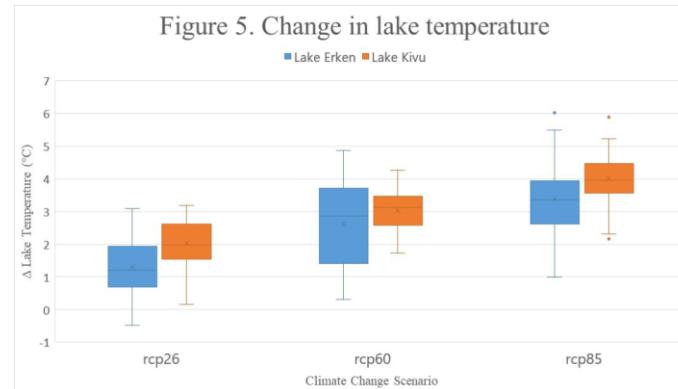


2 of 4

Results from Project by Elin_Linnea



Results from Project by Raynice Waker and Melvin Blackhammar



- Paste the layout that you have produced for the selected climatic extreme event that your stakeholder has suggested

5. ANNUAL MEETING IRL



CD INTERACTION



SIMULATION EXERCISE → Main conclusions from STAKEHOLDERS

- Preliminary tests of the modeling tool were successful. Use of the tool was appreciated by the students.
- Work will continue on the tool during 2019

SLIDE FOR:

STAKEHOLDERS



3 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES: The layout could have been useful in your chosen past event?
Expectations?
New needs? etc.

SIMULATION EXERCISE → Main conclusions from DEVELOPERS

- Use of a modeling interface to allow students to simulate lake water temperature with relative ease was an effective teaching tool
- Research projects that allowed students to make real climate change simulations of lakes both increase their understanding of the role of thermal stratification on the ecology of lakes and the effects of climate change on patterns of seasonal stratification.
- The modelling interface made model simulation accessible, overcoming multiple technical difficulties associated with running lake models. This allow student to focus on the result of the modeling and also encouraged them to consider future studies that involve modeling.

SLIDE FOR:

SCIENTISTS



4 of 4

- Based on your experience with the simulation exercise add some bullet points
- EXAMPLES:
Strengths, main difficulties, lessons learnt for the WATExR project, etc.

3.2

AGGREGATED PERSPECTIVE & CONCLUSIONS

From your preliminary feedback after the Zoom we found out that...

- CASE STUDY:

How did you feel with this exercise? **6/7 case studies said it was useful**



DEVELOPERS: Good to progress, although in some cases the “simulation” may have been a challenging or stressful experience :P



STAKEHOLDERS: Interesting to go on and to have a preliminary view of the potential of the tool

From your preliminary feedback after the Zoom we found out that...

- CASE STUDY:
 - How this layout may have been **useful for you?** Based on it, which would have been your **decisions?**

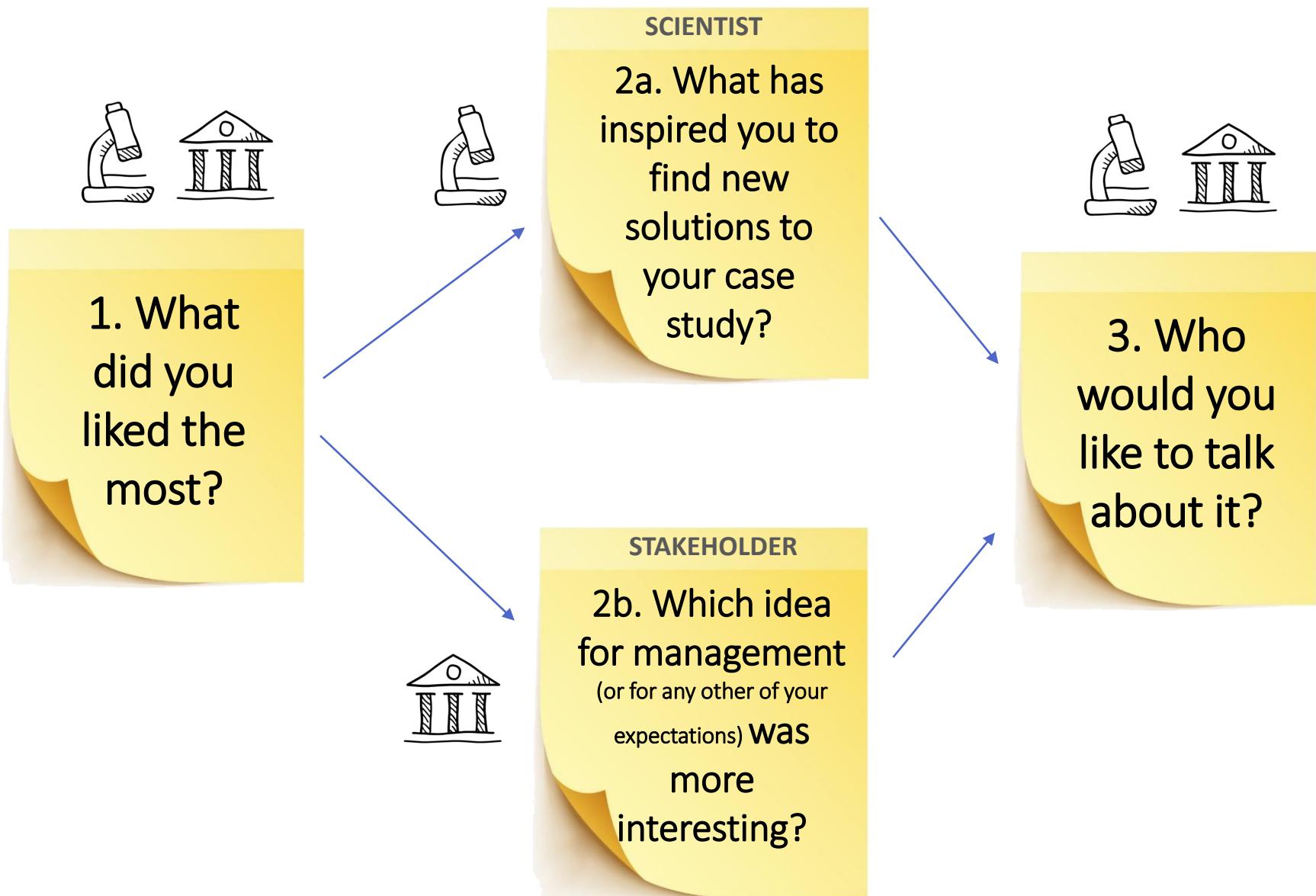


STAKEHOLDERS: They found it a useful tool that might have guided their decisions. In some cases:

- As a complement to expert judgement
- Maybe it would have been better with additional parameters still not implemented (water quantity vs quality)

3.3.3

GLOBAL IMPLICATIONS FOR WATExR



3.4

CONNECTING WITH WP4

*visualising forecast
uncertainty*



Leah Jackson-Blake

3.5

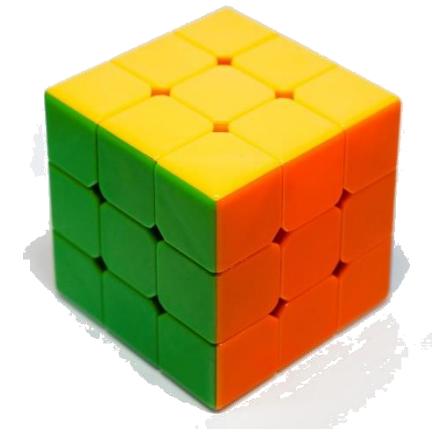
RECOMENDATIONS FROM THE CO-DEVELOPMENT



After a year of co-development we would like to share some recommendations with you...

Handling uncertainty: Uncertainty is a key factor to accurately understand and use the results of the models developed in WATExR project. Bearing this in mind, it is important from the co-development perspective to:

- Emphasize uncertainty management on every occasion, even by promoting direct interaction with the stakeholders
- Find new ways for developers to express (plot, represent, etc.) uncertainty
- Improve the way that uncertainty and its implications can be transmitted to stakeholders
- Promote the discussion of stakeholders about the implications of uncertainty and share their opinions about its effects on management/planning
- Provide individualized recommendations on each case study related to the preliminary results observed



CONNECTING WITH WP4

*visualising forecast
uncertainty*

□ **Time series:** It is worth mentioning, that some stakeholders are used to work with time series from the water quantity perspective (sometimes at short-term: weeks, days, etc. to manage flooding).

- It is a challenge to use water quality forecasting in a timeframe further (or closer) than a season or a year, and a “time-series” approach may not be strictly feasible with WATExR-type data.
- It is also relevant to see how probabilistic forecast can be considered for management (as it is not easy to handle).



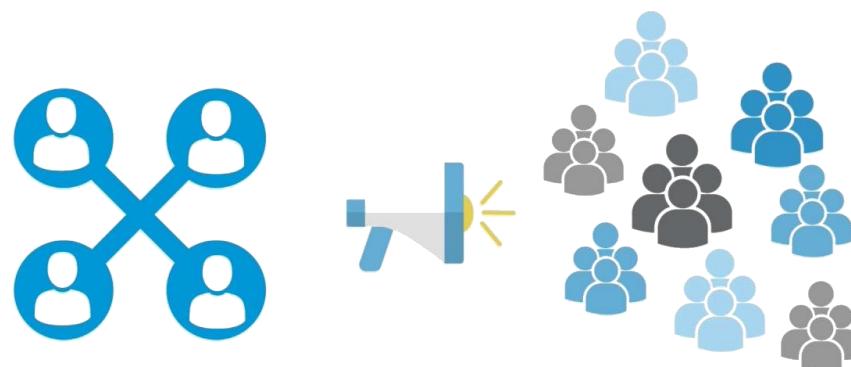
❑ MEET OTHERS: Daily tasks are intense, but it is important to find opportunities to interact with others in your team / case study.

- It could also be valuable to talk about the project internally in your institution (not only in the research center but also in the stakeholder institution), outside your team members.
- It is time-spending, but sometimes can be a source of ideas and opportunities (or a way to meet new people with other or similar interests, difficulties, etc.).



DISSEMINATION TO NON-EXPERT: We recommend this topic to be taken into account from a global WATExR perspective, as it can contribute to generate synergies with other case studies, managers, etc.

- We suggest the possibility of representing, in a friendly way (i.e. colours, traffic lights, etc.), the results of the report to make this information easier to understand and handle by non-expert people
- However an specific approach should be reached in order to strategically plan and implement outreach and dissemination to different targets



3.6

NEXT STEPS

SCIENTISTS

PART 2: CASE STUDY UP TO DATE



When we ask scientists which are the most challenging matters (or issues) that they have to deal with at this stage...

They mainly tell us that they are very concentrated in the workflow...trying to embed pieces of model into other models, managing technical details, calibrating or trying to fix problems with R code for the QGIS...

- ✓ You're going on although some steps may be a little chaotic and stressful sometimes...but do not surrender! There are hints in your way and all the people in the project may help you. Just let us know if we can do anything...



WATER

What will you focus on
for 2020?

STAKEHOLDERS



PART 3: THE FUTURE "IN SIGHT"

SCIENTISTS



And the final question...how feasible is to have a beta-version of the plug-in at the end of the project?

- Stakeholders on average consider it...

8 / 10!

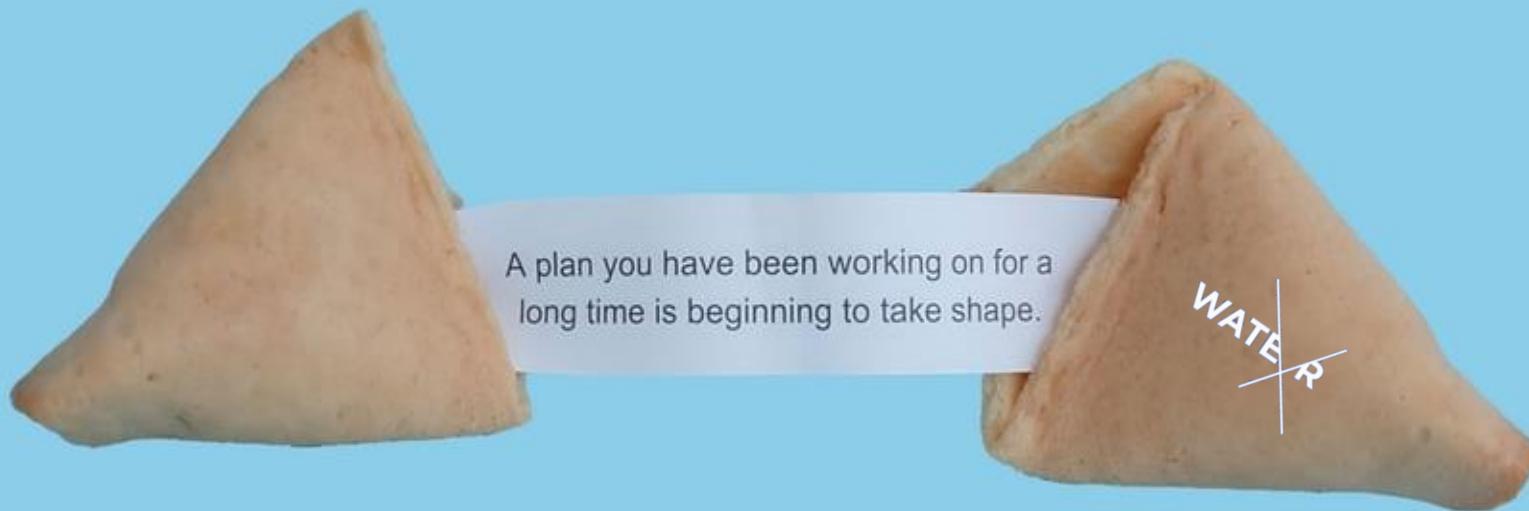


- Scientists on average consider it...

9 / 10!

✓ Great expectations! Just go on working to make this a reality!

How feasible do you see the beta-version by the end?



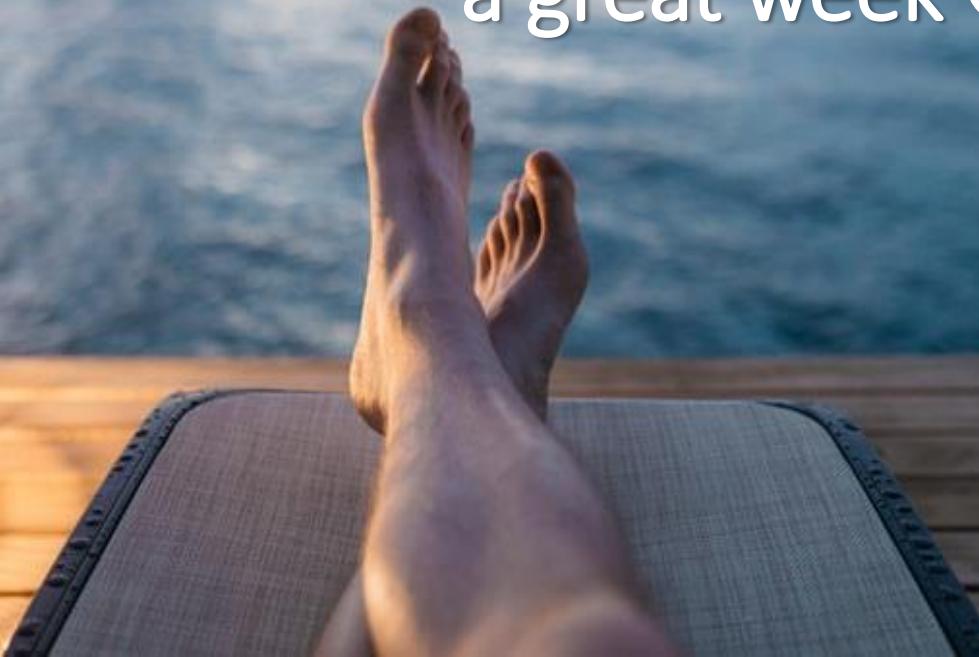
3.7

QUESTIONS & DISCUSSION?

**Any other
question
or
something
else to
discuss
about?**



We all the Albirem team thank you
for your participation and wish you
a great week ☺



~~WATER~~

albirem



THANK YOU
VERY MUCH!



STRATEGIC SOLUTIONS WITH SUSTAINABILITY IN SIGHT



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