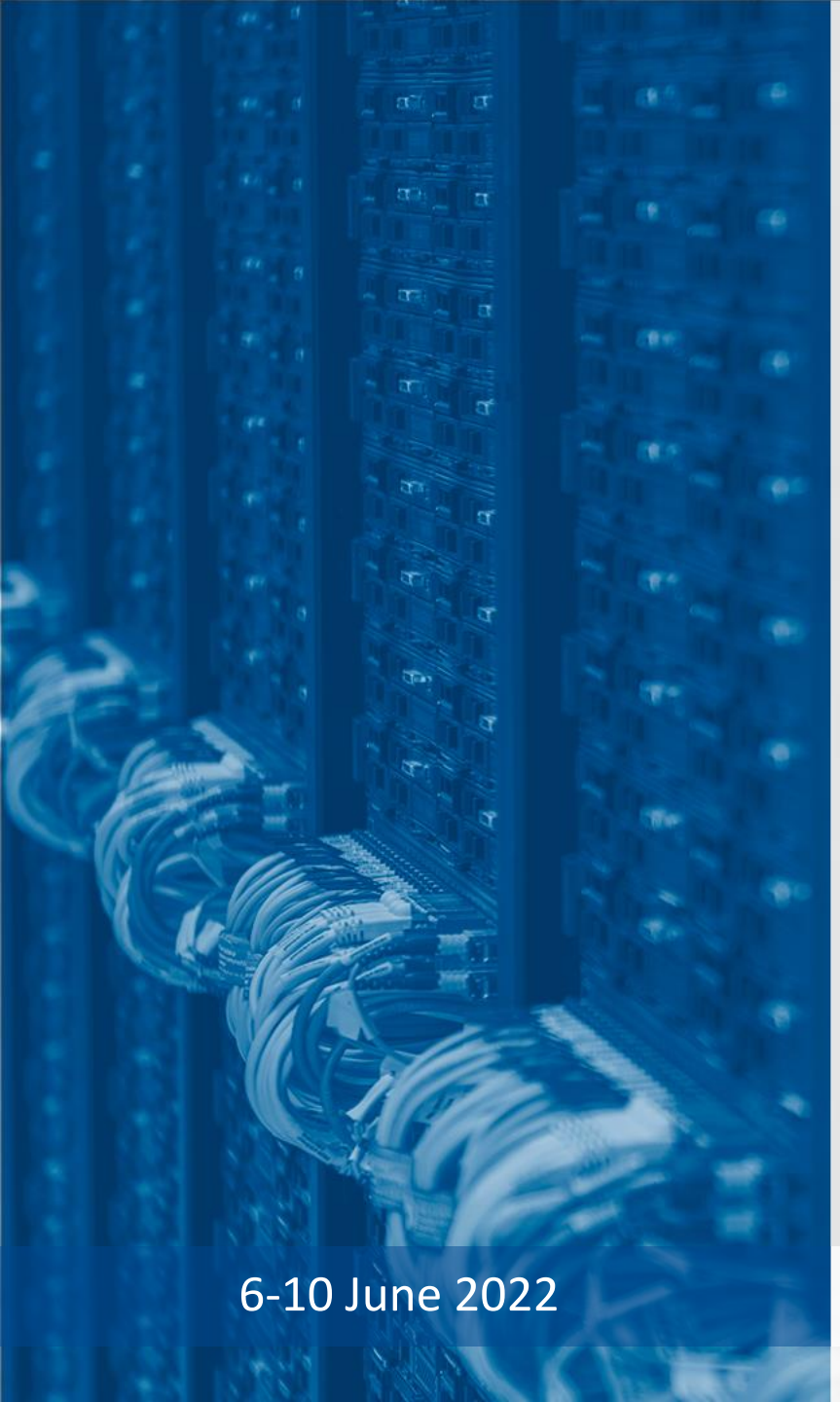

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Decision-making II
Success story from the agriculture sector

Marta Terrado & colleagues in the Earth System Services group at BSC

6-10 June 2022

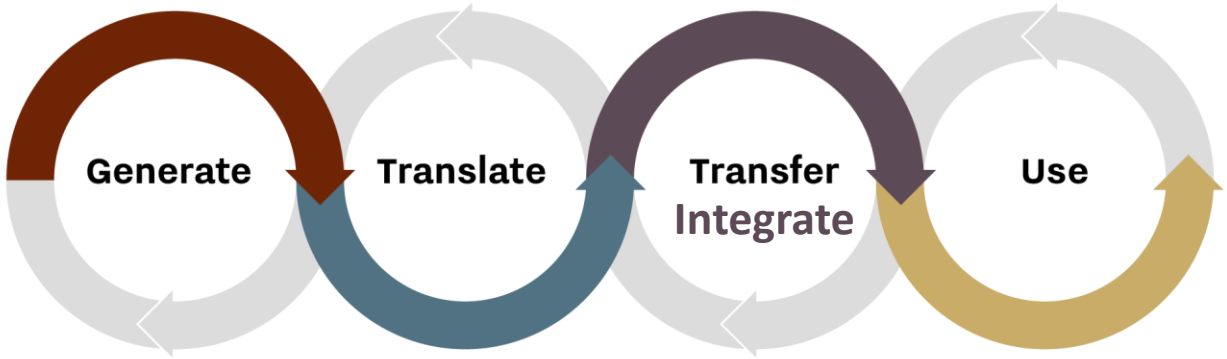
MPE CDT Virtual Summer School on Attribution, Causality, and Decision-Making

Earth System Services

Closing the gap between science & society

■ Generate climate information and knowledge - learn from the past, monitor the present, forecast the future.

■ Transfer the translated information to the appropriate beneficiaries, in formats and media most useful to their operations

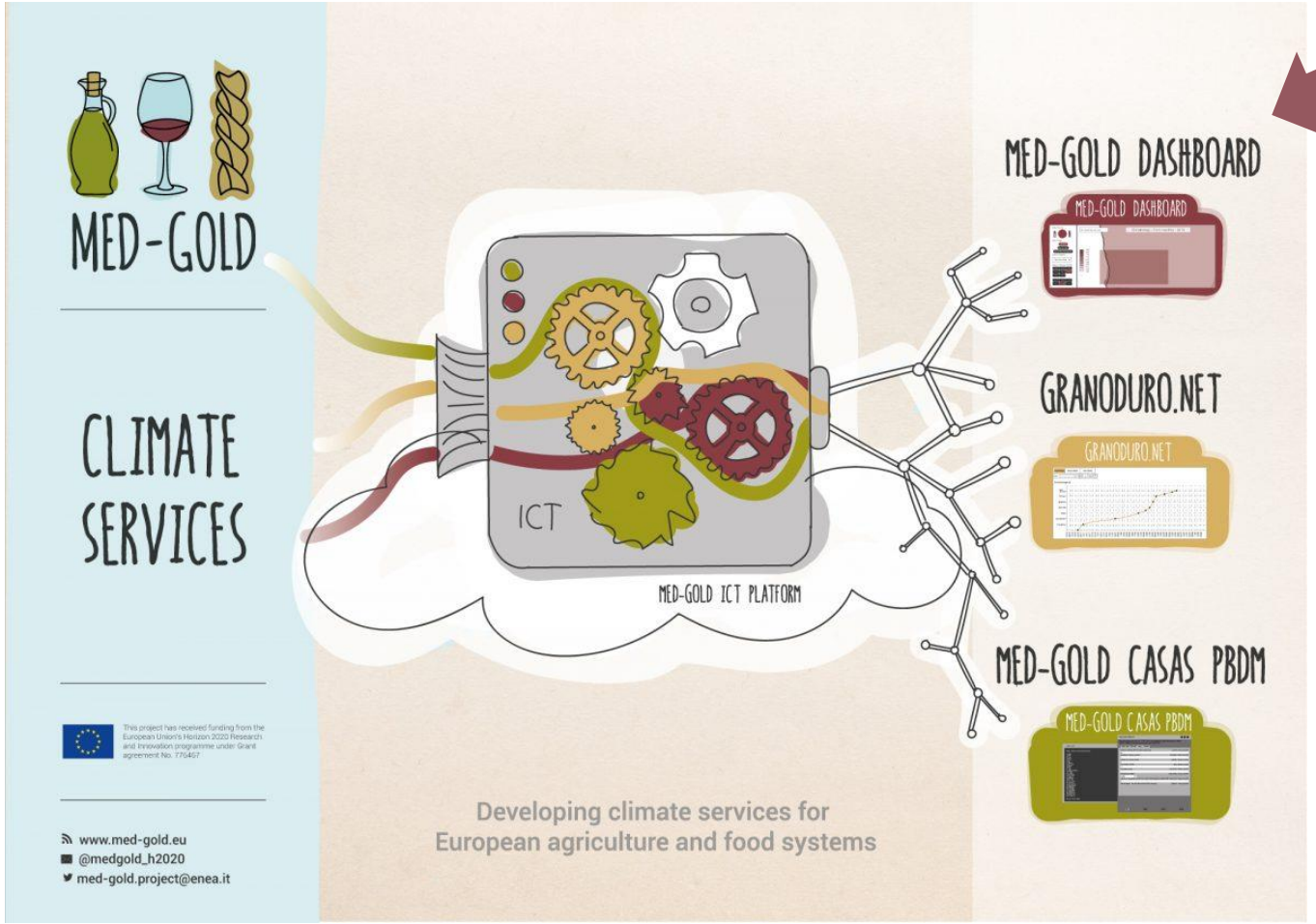


■ Translate the climate knowledge into Information that is relevant to agriculture, public health and other target sectors.

■ Put the translated and transferred climate knowledge to use in operational decision processes, policies and plans. Learn what works and what doesn't.

Vogel et al. (2019) Climate Services
Adapted from IRI

Success story: climate services for agriculture

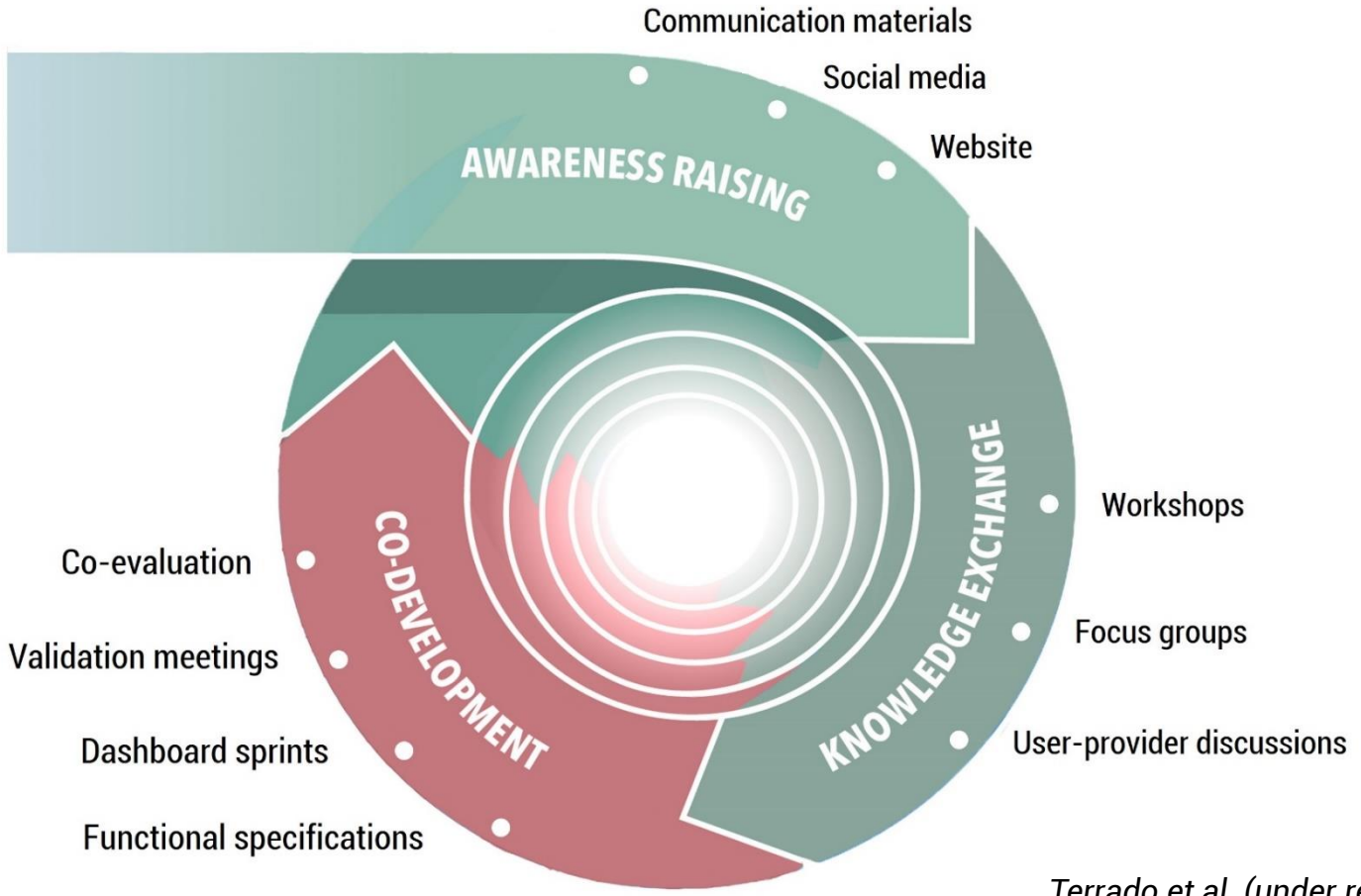


Make European agriculture and food systems more resilient, sustainable and efficient in the face of climate change

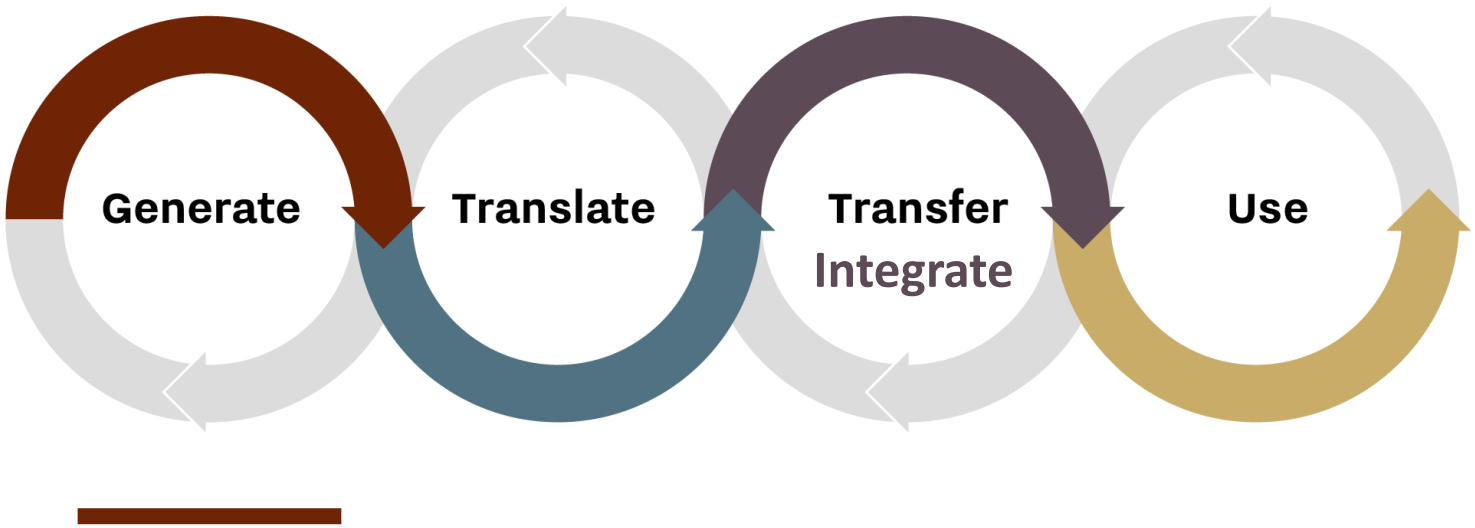
- **Proof-of-concept** for climate services in the agriculture sector
- **Co-design** pilot services involving suppliers and users from 3 Mediterranean food systems: grape/wine, olives/olive oil, durum wheat/pasta
- **Identify key decisions** that can benefit from climate-related information at different timescales

Success story: climate services for agriculture

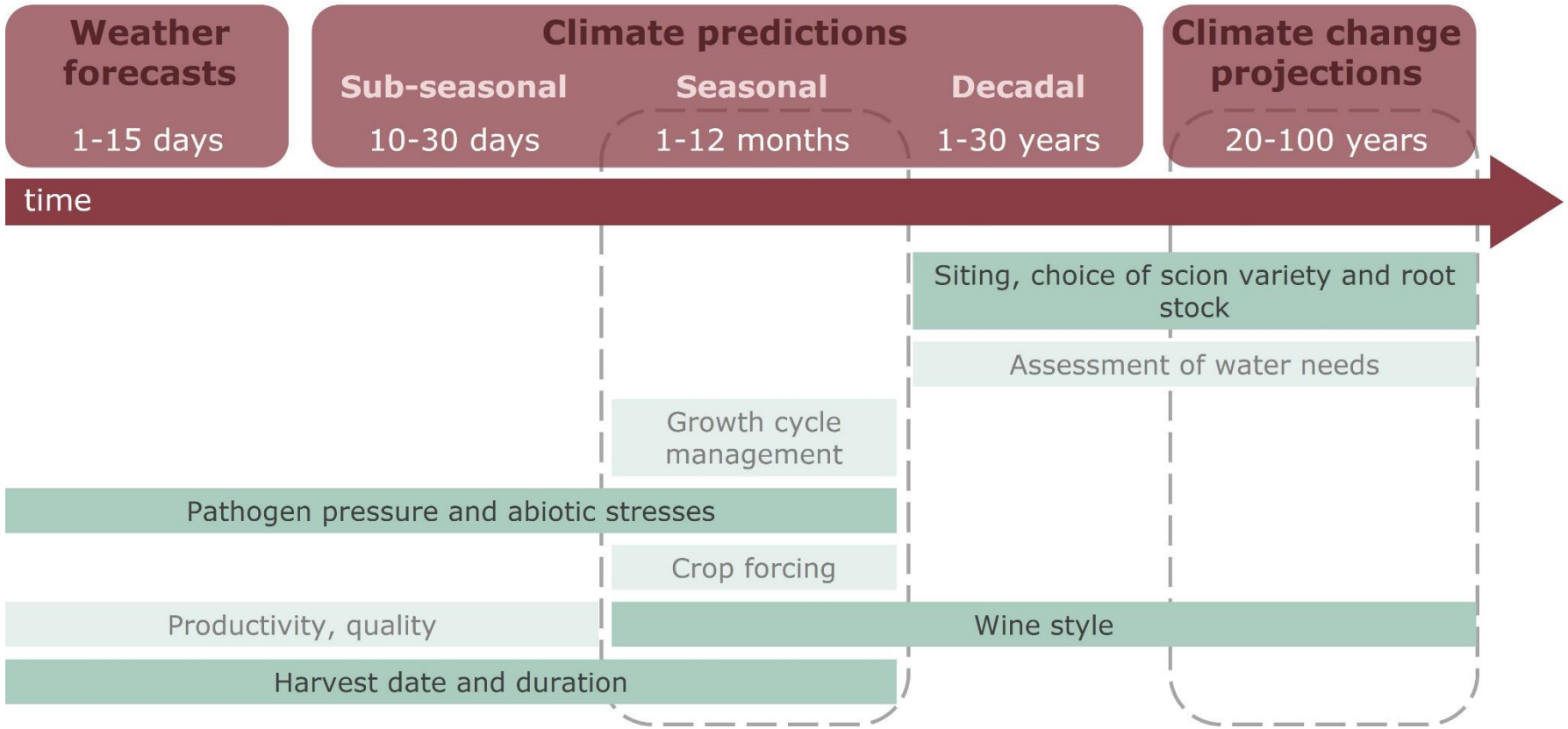
Co-production of a climate service for the wine sector



Terrado et al. (under review). Adapted from Bojovic et al. (2021) Global Environ. Change


Generate
Translate
Transfer
Integrate
Use

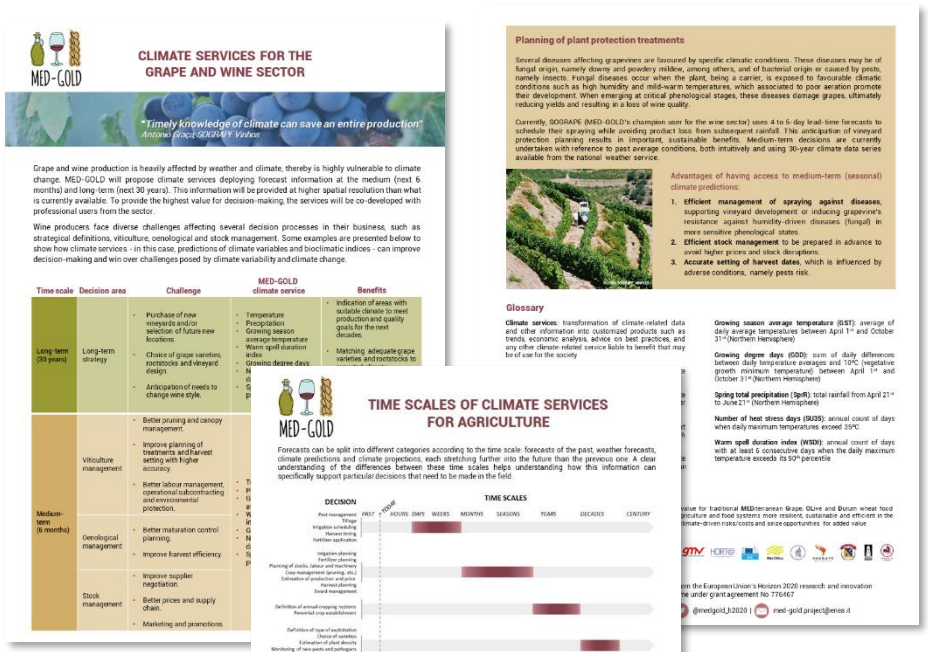
Generate: needs from the wine sector



Adapted from Gishen et al. (2016)

Generate: needs from the wine sector

Infosheets



Type of questions answered by each temporal scale?

Weather forecasts

Temperature in Porto in the next few days in absolute values (ºC)

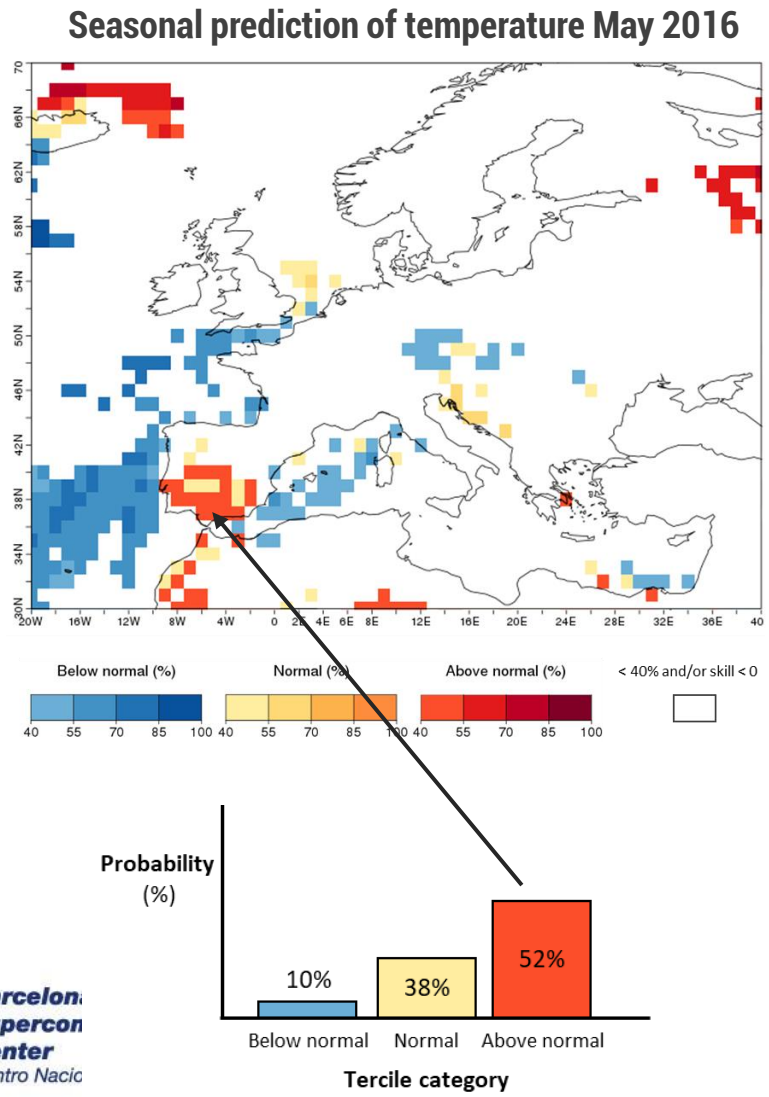
Climate predictions

Most likely category for next spring temperature in Porto in relative values or anomalies (either below normal, normal or above normal)

Climate projections

Variation of temperature expected in Porto during this century (ºC change)

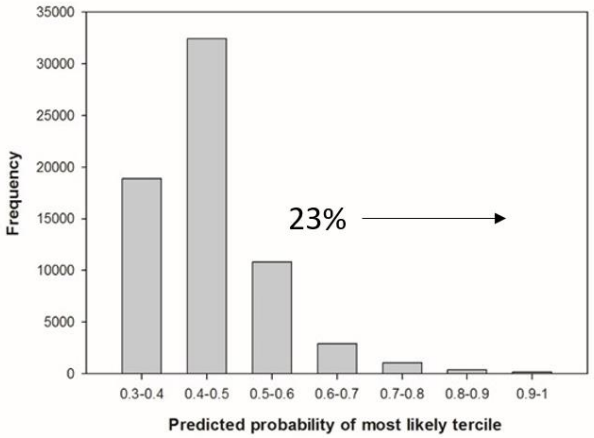
Generate: needs from the wine sector



Barriers for the uptake of climate predictions by decision-makers

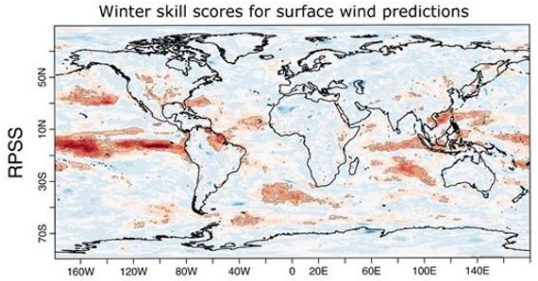
Decision uncertainty

Users request high predicted probabilities



Forecast uncertainty

Scientific community calculates different metrics, such as skill scores (forecast quality)



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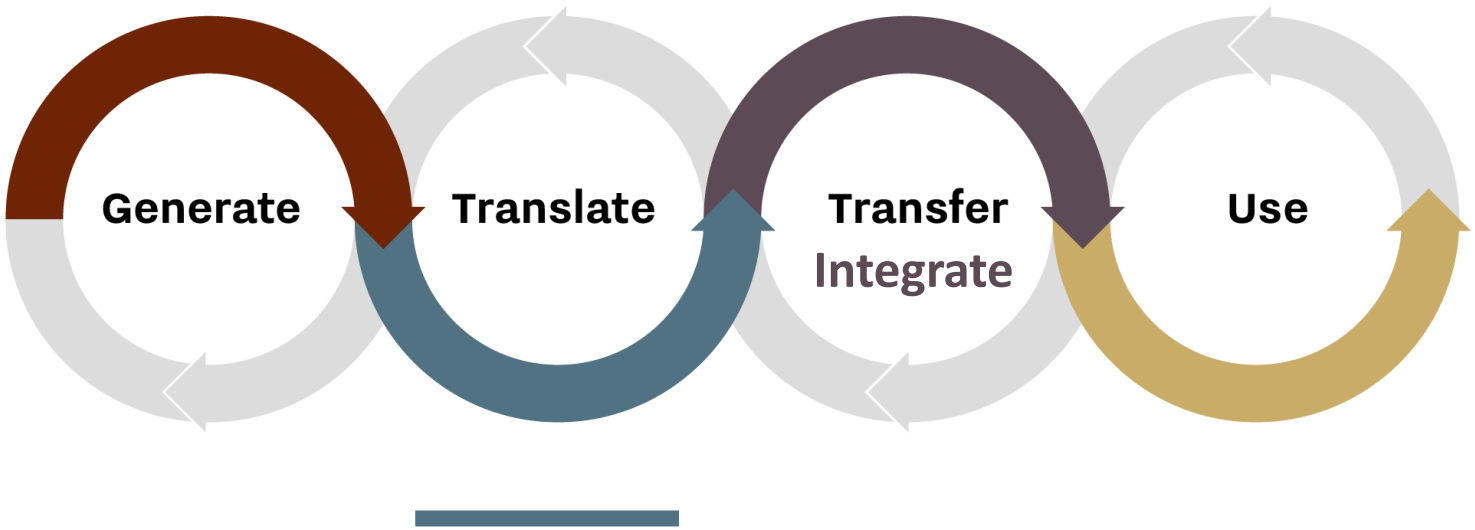
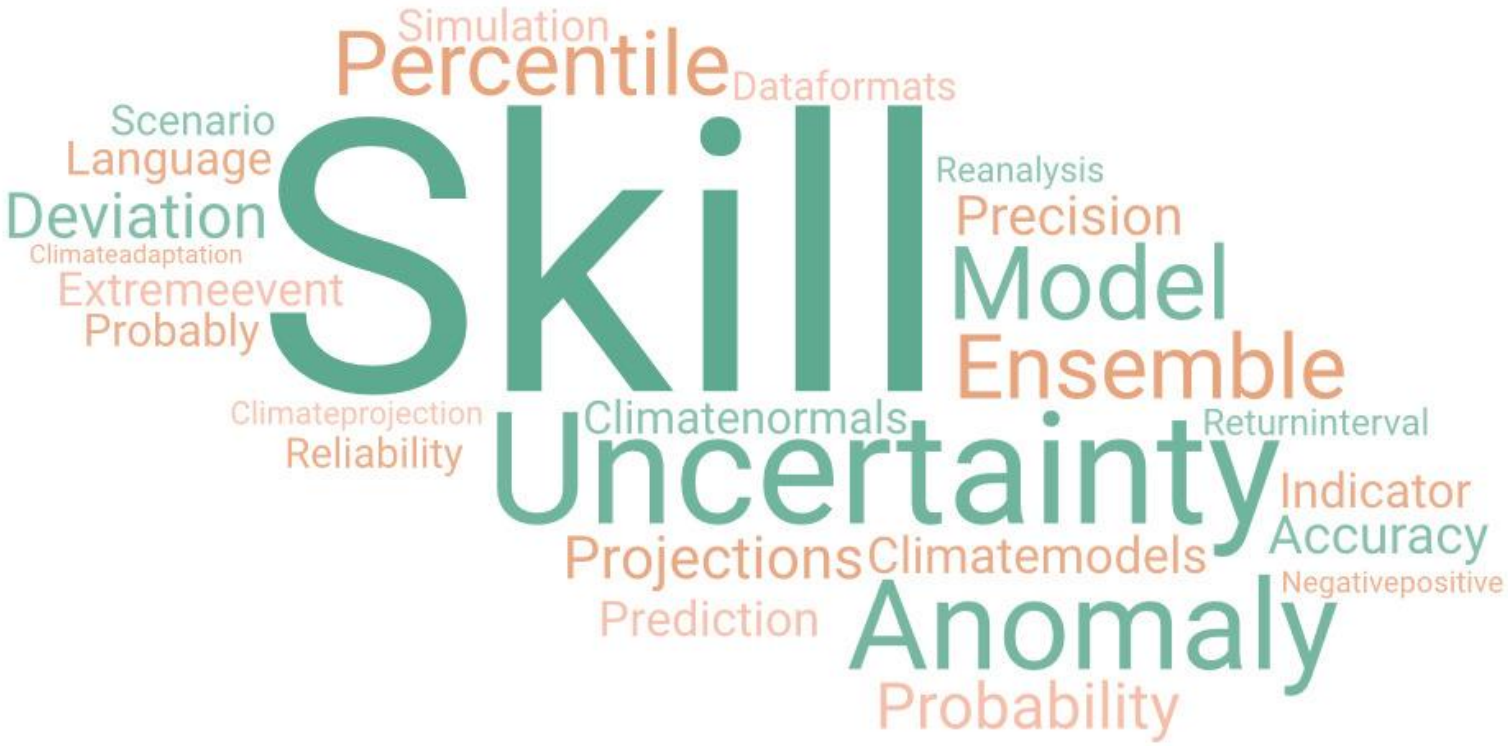

Generate
Translate
Transfer
Integrate
Use

Translate



Terrado et al. (2022) BAMS

Translate: from data to economic value

The Weather Roulette

- **Communication and engagement tool** that shows the potential benefits of climate predictions over climatology in the long term
- Based on the approach of Hagedorn & Smith (2009)
- Addressed to the wind energy sector
- https://weatherroulette.earth.bsc.es

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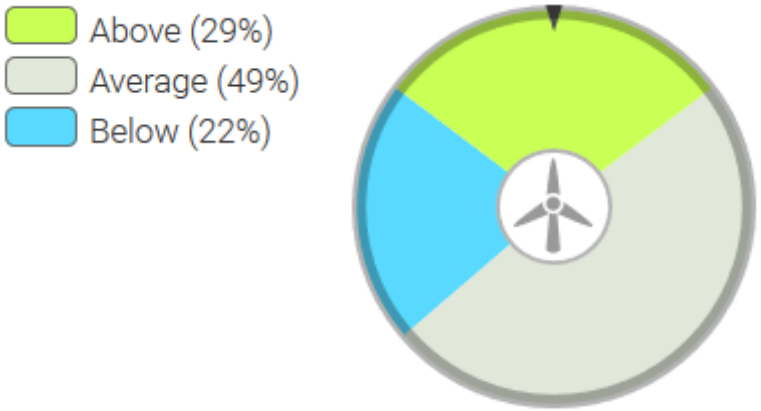
EUPORIAS
European Provision Of Regional Impacts Assessments on Seasonal and Decadal Timescales

S2S4E
Climate Services for Clean Energy

Translate: from data to value

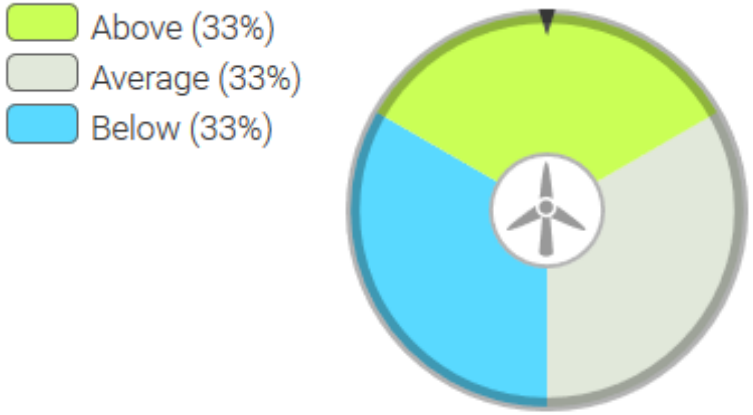
2 playing options

OPTION 1
CLIMATE PREDICTIONS



Calibrated ECMWF System 4 prediction system
Seasonal predictions of wind speed

OPTION 2
CLIMATOLOGY



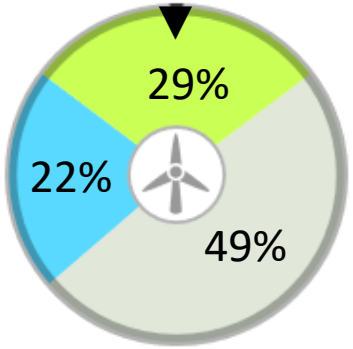
Historical wind speed observations

Terrado et al. (2019) BAMS

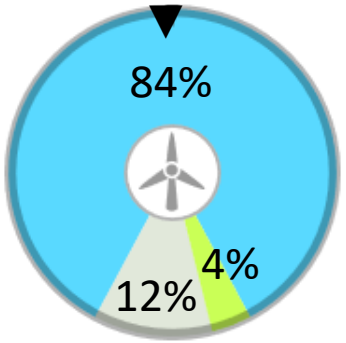
Translate: from data to value

betting scheme

OPTION 1
CLIMATE PREDICTIONS



Year t



Year t+1

10€

2.9€
4.9€
2.2€

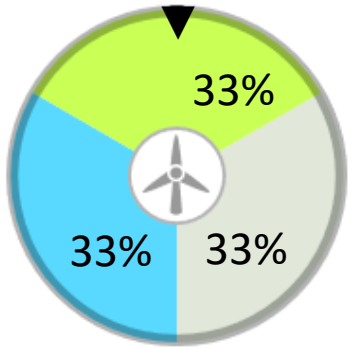
2.9€ x 3 =8.7€

0.4€
1€
7.3€

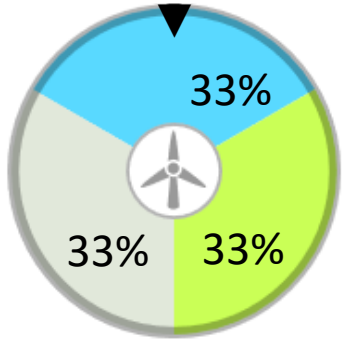
7.3€ x 3 =21.9€

Year t+…

OPTION 2
CLIMATOLOGY



Year t



Year t+1

10€

3.3€
3.3€
3.3€

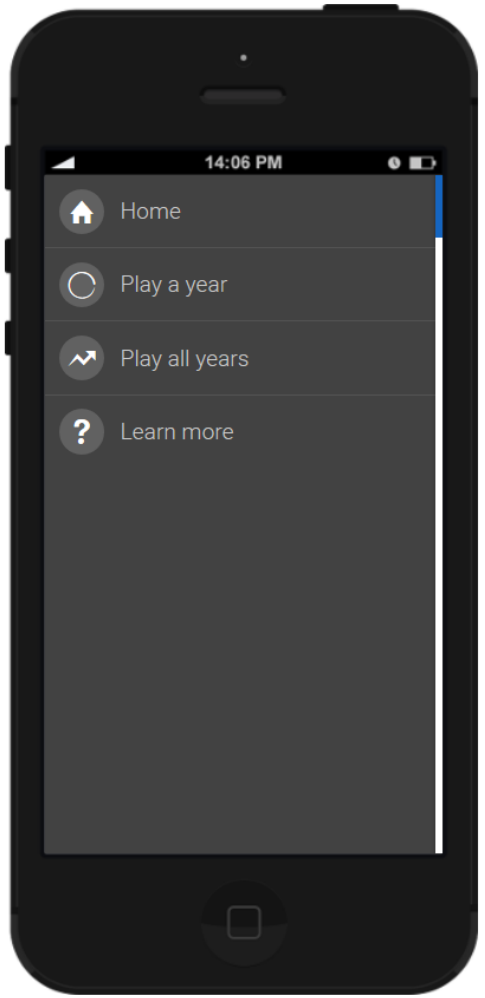
3.3€ x 3 =10€

3.3€
3.3€
3.3€

3.3€ x 3 =10€

Translate: from data to value

How to play?

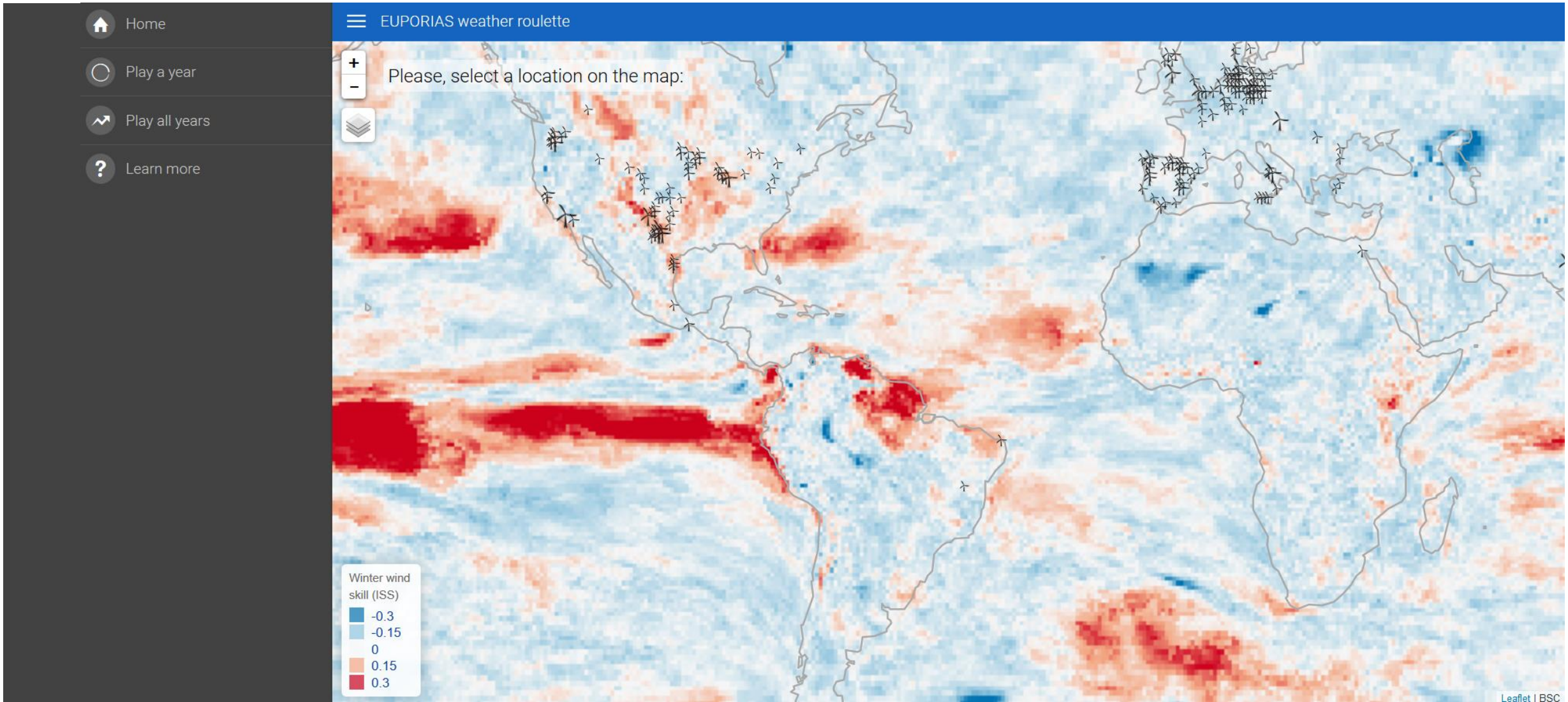


- Possibility to play the roulette **1 year**
- Possibility to play the roulette for **the whole period of 33 years** (1981-2013)

Translate: from data to value

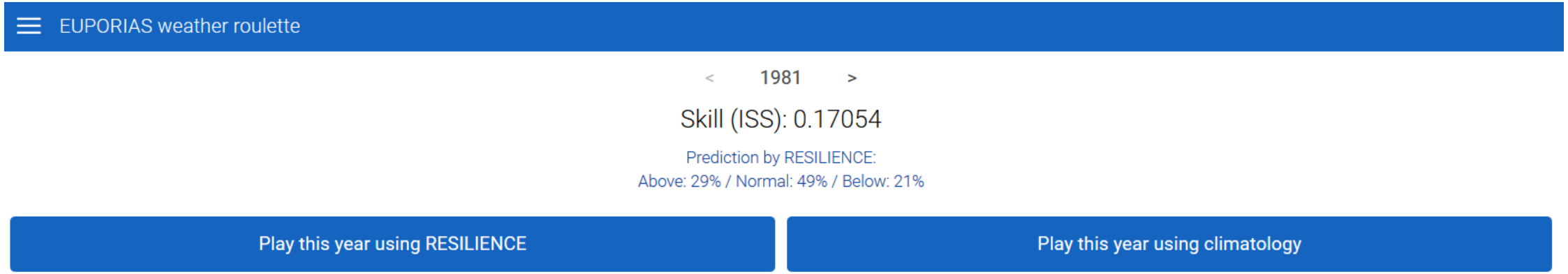
Play 1 year

Map of skill. The player can select a location according to the level of skill ▼



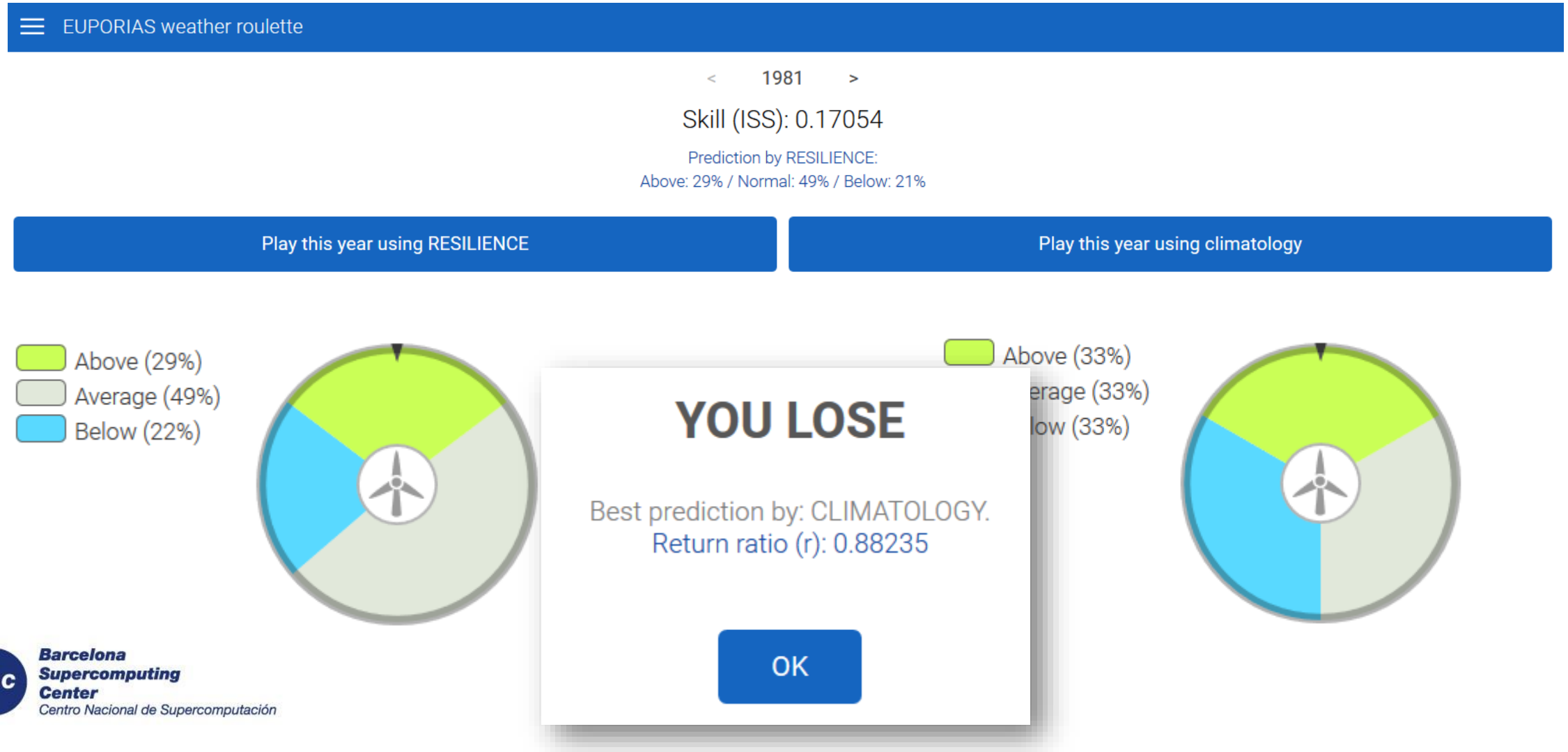
Translate: from data to value

Play 1 year



Translate: from data to value

Play 1 year



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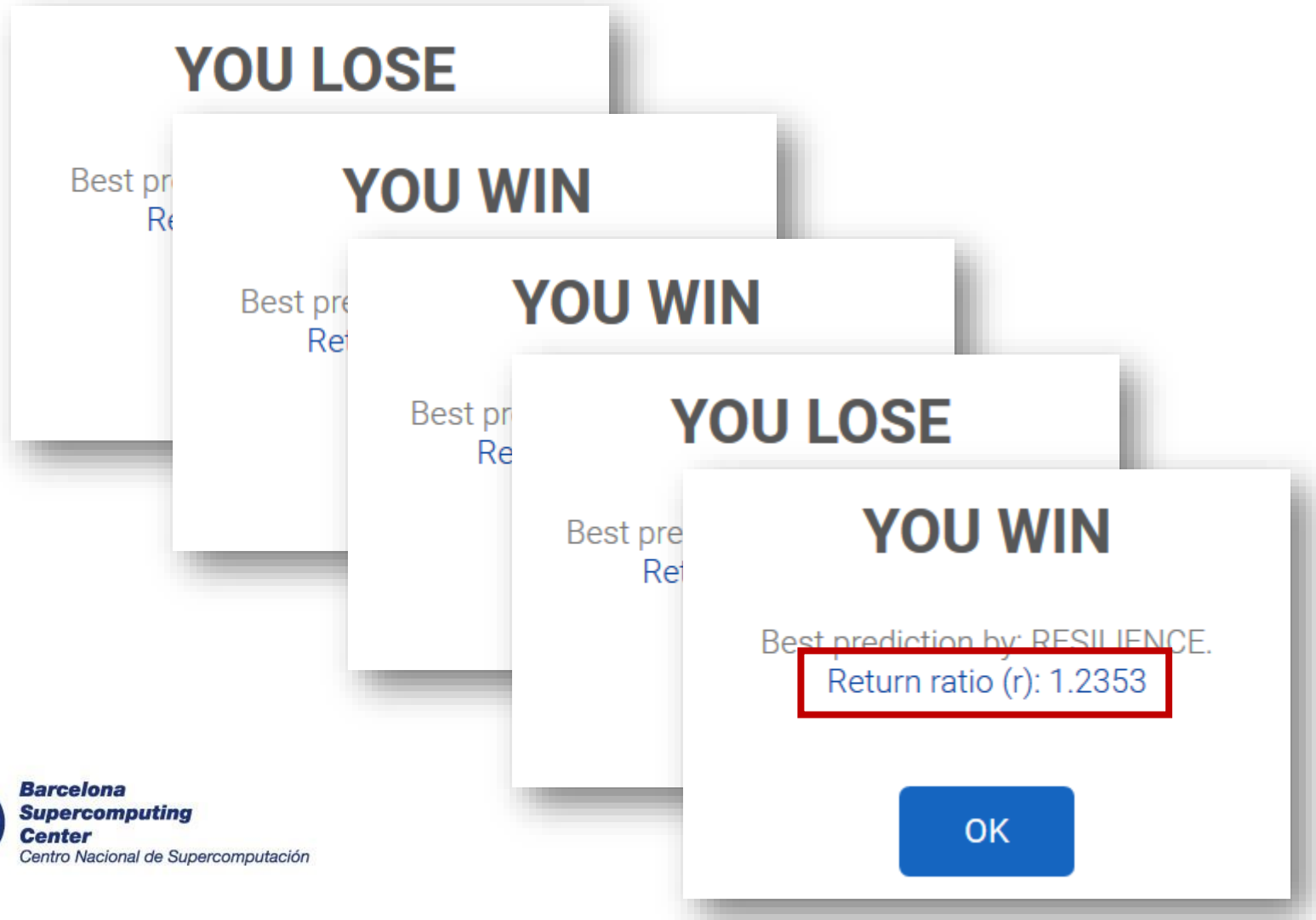
Translate: from data to value

Play 1 year



- Helps users understand the uncertainty of probabilistic outcomes
- When playing for individual years, resulting return ratios can indistinctly be found above or below 1 (win or loose)

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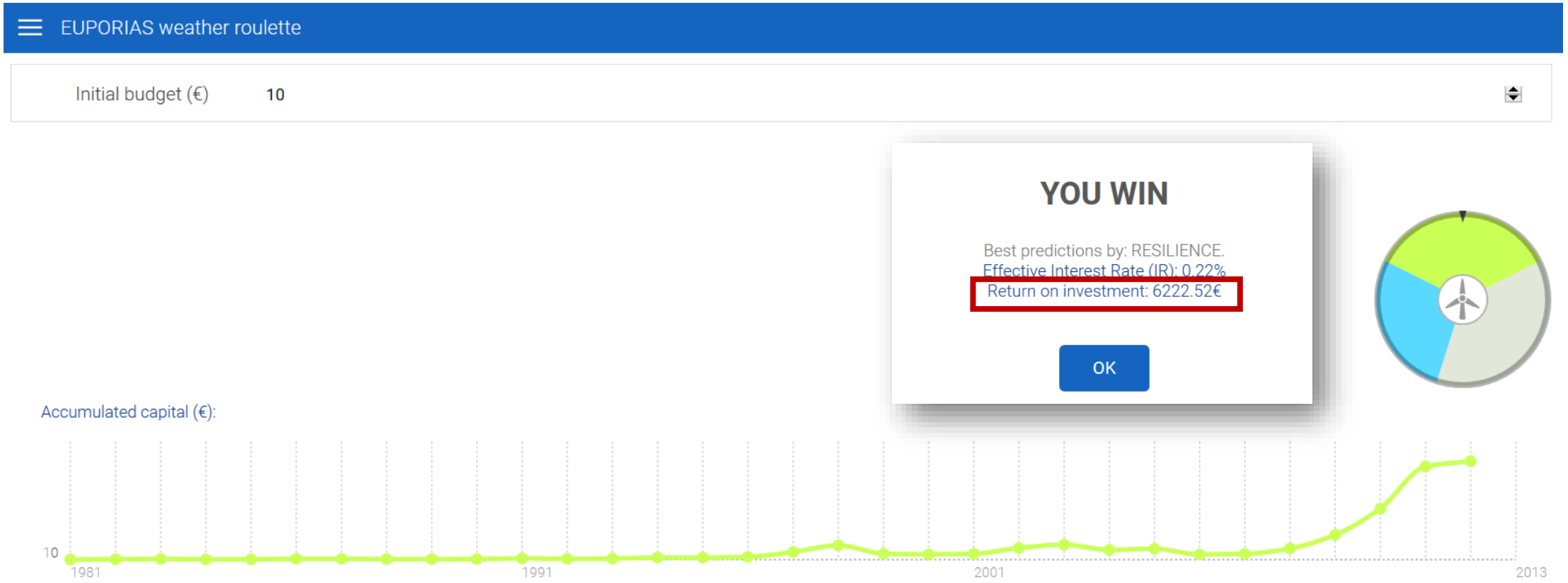
Translate: from data to value

What happens when we play all years?

Skill (ISS) : 0.18



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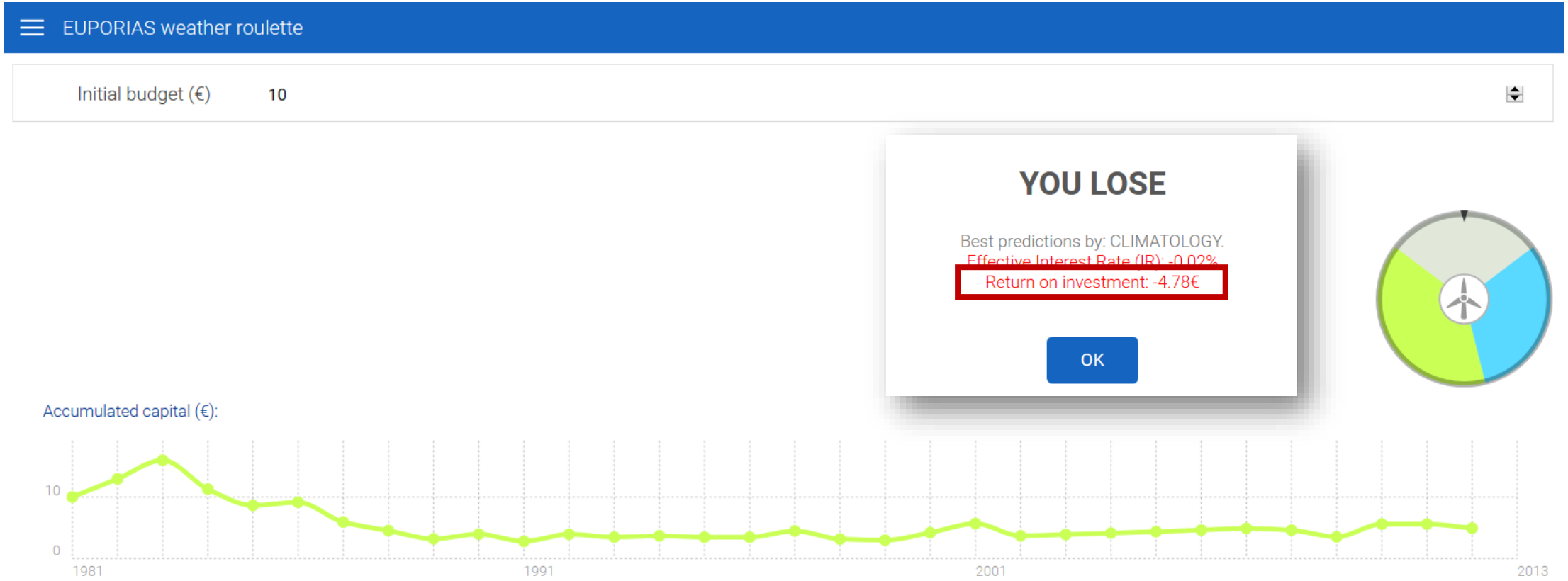
- Playing all years helps users understand that in areas with skill benefits are seen in the long term
- Translation of technical concepts into economic value (ROI): (Cn-Co)/Co

Translate: from data to value

What happens when we play all years?

Skill (ISS) : -0,02



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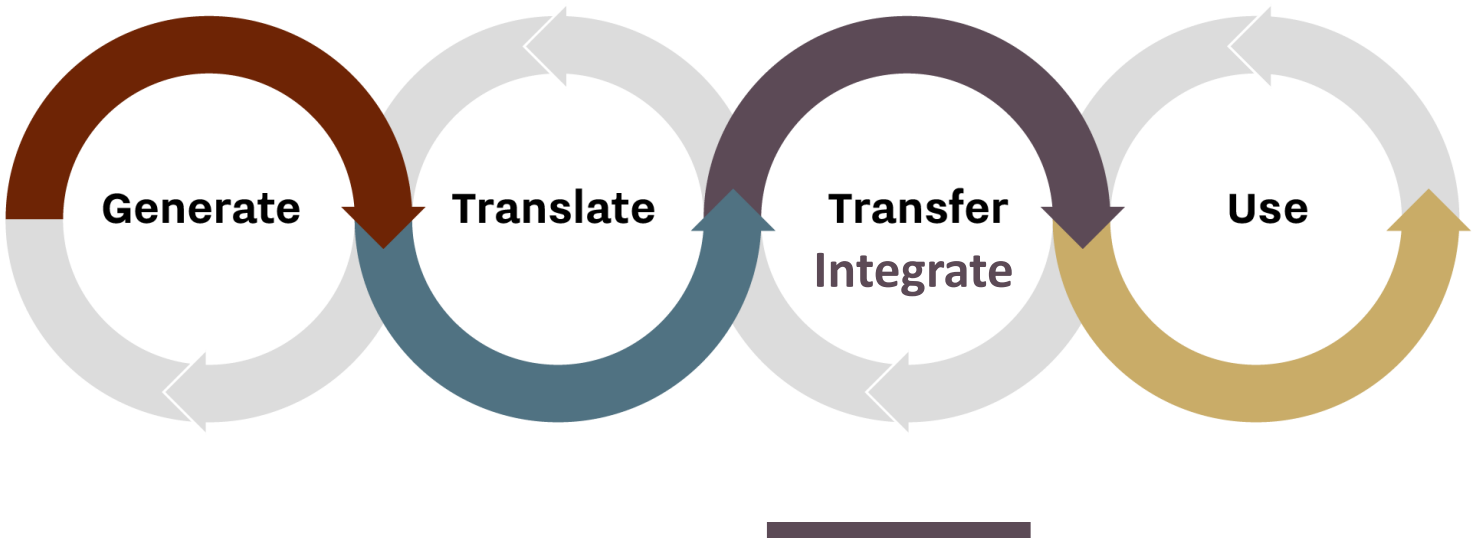
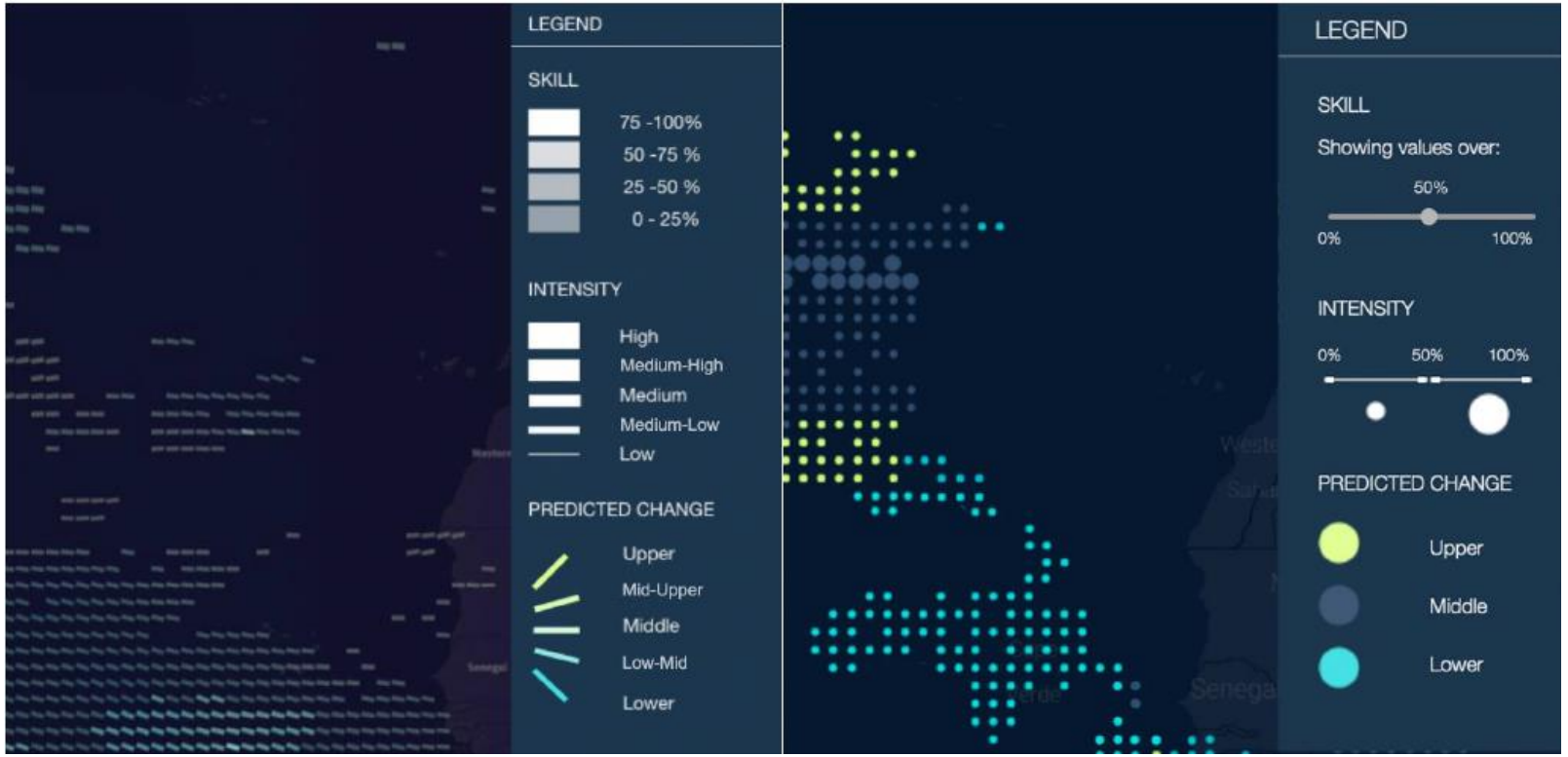
- Helps users understand that no benefits are obtained in the long term in areas without skill


Generate
Translate
Transfer
Integrate
Use

Integrate

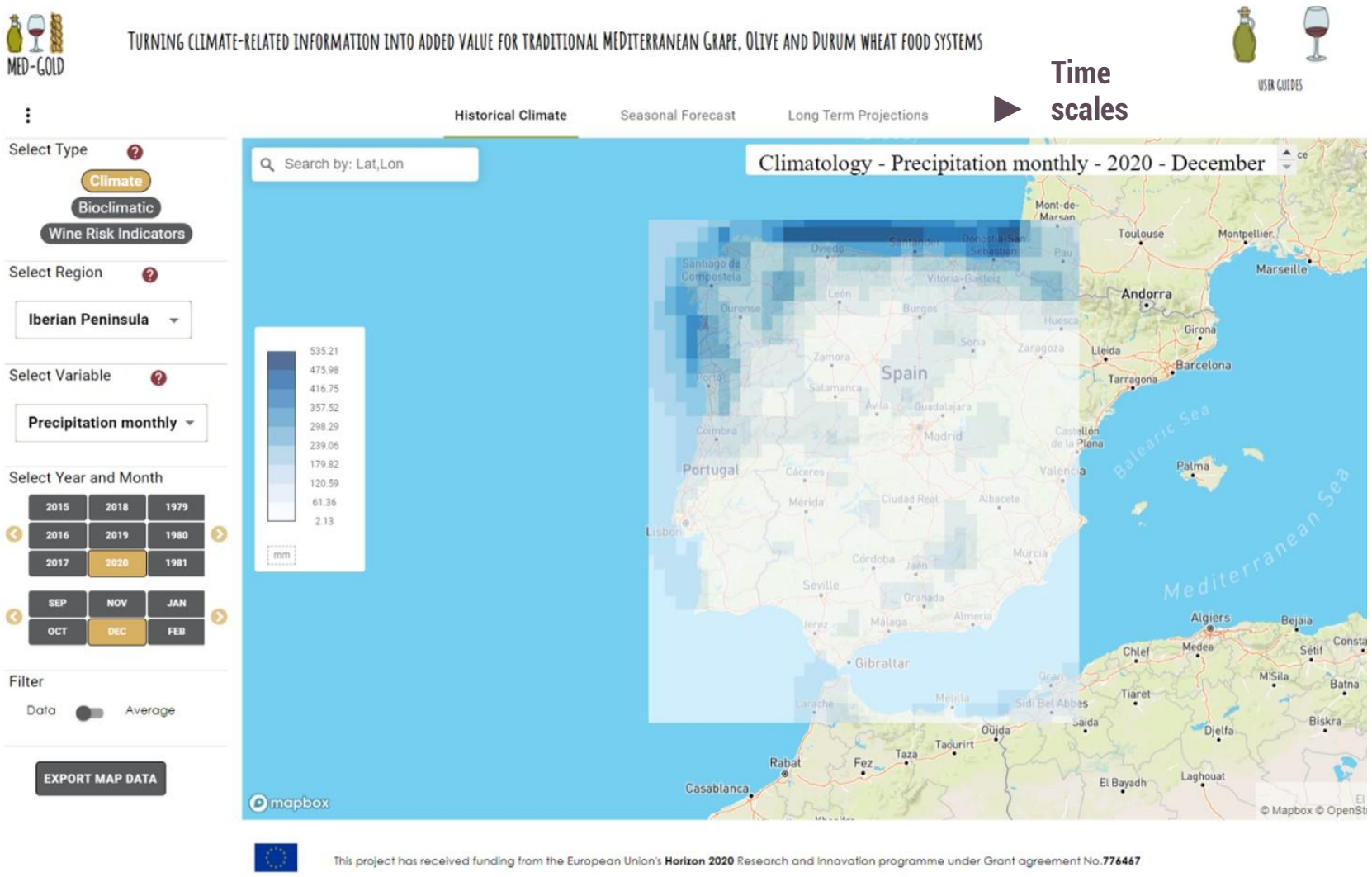
Importance of visualisations to reduce users' cognitive load and highlight salient information for decision-making



Calvo et al. (2021) BAMS

Integrate: MED-GOLD Dashboard

Type of information ▶



Time scales ▶

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant agreement No.776467

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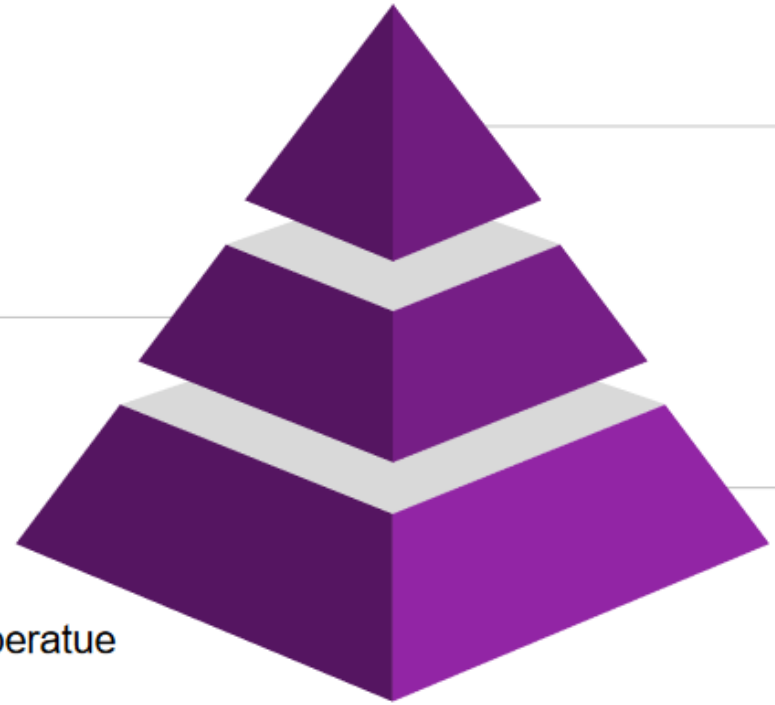
https://dashboard.med-gold.eu

Integrate: MED-GOLD Dashboard

Type of information
Different levels of complexity



3. Risk Indices

- Heat-related risk index
- Sanitary risk index

2. Climate-related indicators

- Spring Rainfall
- Growing Degree Days
- Number of heat stress days
- Warm Spell Duration
- Growing Season mean Temperatue
- Others

1. Essential Climate Variables

- Temperature
- Rainfall
- Others

Integrate: MED-GOLD Dashboard

Test the service with users

#	Comment (# mentions)
1	When choosing options to visualise from the dropdown menus, a short caption explaining their meaning should pop-up as the cursor hovers over each option (especially abbreviations and acronyms). The same should happen when hovering above tab names (historical, seasonal and long-term) or type of data (7)
2	Navigation is overall easy and intuitive; map updating is quick enough (3)
3	The parameter panel needs to be better organised; it wastes too much space which would be better used to have more space for map viewing (2)
4	Having the dashboard in English slows down [the process] and makes interpretation sometimes difficult. It would be much better if it was in Portuguese (2)
5	Maps often take extremely long to load or do not load at all. There is a lot to be done in terms of susceptibility to user handling of the tool. It seems overly sensitive to movements or clicks on the map while loading. When zooming in, sometimes data colours disappear altogether and will not reappear when zooming out, especially in seasonal forecasts (3)
6	Export GeoJSON and, particularly NetCDF, do not know what they are and how to use them. They should be available for those requiring them, but in a less prominent way than JPEG, PNG and other user-familiar formats (3)
7	Many features and possibilities of the tool remain undiscoverable because of insufficient on-screen guidance (e.g. the chart that opens if a spot is clicked in the map). On-screen guidance must be everywhere (2)
8	The map data-box that pops when a map grid cell is clicked is sometimes hard to close, requiring many clicks. It won't disappear when visualisation parameters are changed, creating wrong readings from the part of users (2)
9	If in long term projections anomaly is reported in %, the legend caption needs to be changed [to reflect that] (2)
10	The base map should not be displayed before all needed choices are made. After visualising a map, if choices are changed, the base map should redisplay again only after loading the visual data. Maintaining the map when parameters are changed is misleading (2)

Terrado et al. (under review)

Integrate: MED-GOLD Dashboard

Co-explore potential applications: long-term projections

USE CASE 1

Your wine company is concerned about the impact that climate change will have on your top-selling iconic wine. The grape variety used has an optimal growth of 16-19°C. If your vineyard sees higher temperatures in the future, you will need to look for alternative sites to maintain your production.

Is the quality of your iconic wine threatened by future climate change?

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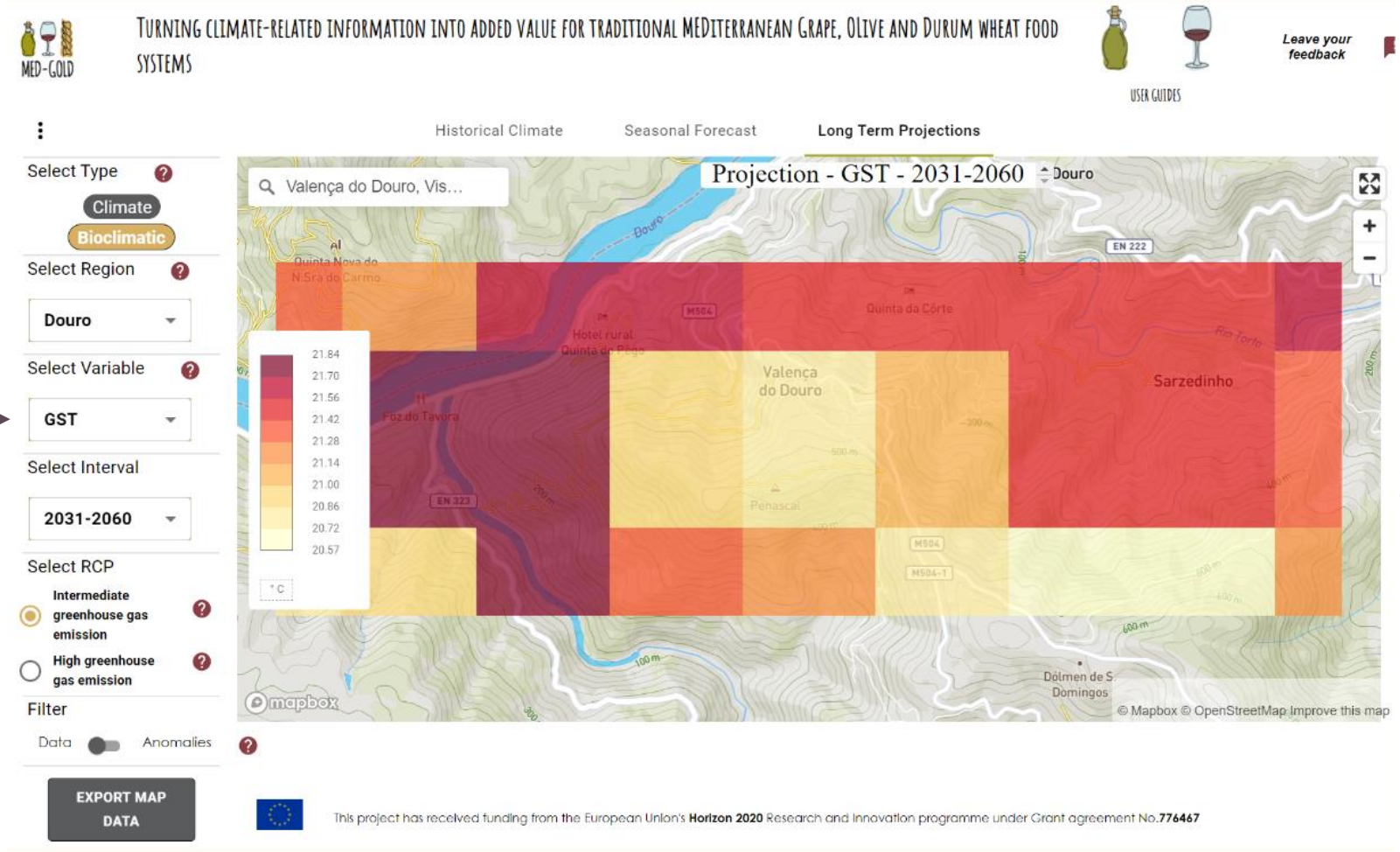
Integrate: MED-GOLD Dashboard

Co-explore potential applications: long-term projections

Growing season temperature



Average growing season temperature in the area is expected to be above 20 degrees Celsius, outside the range of your grape variety

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Integrate: MED-GOLD Dashboard

Co-explore potential applications: seasonal forecasts

USE CASE 2

You are a viticulturist. It's March, and you need to decide how much stock of plant protection products to buy this season. Rainy and warm springs can favour pest outbreaks in vines.

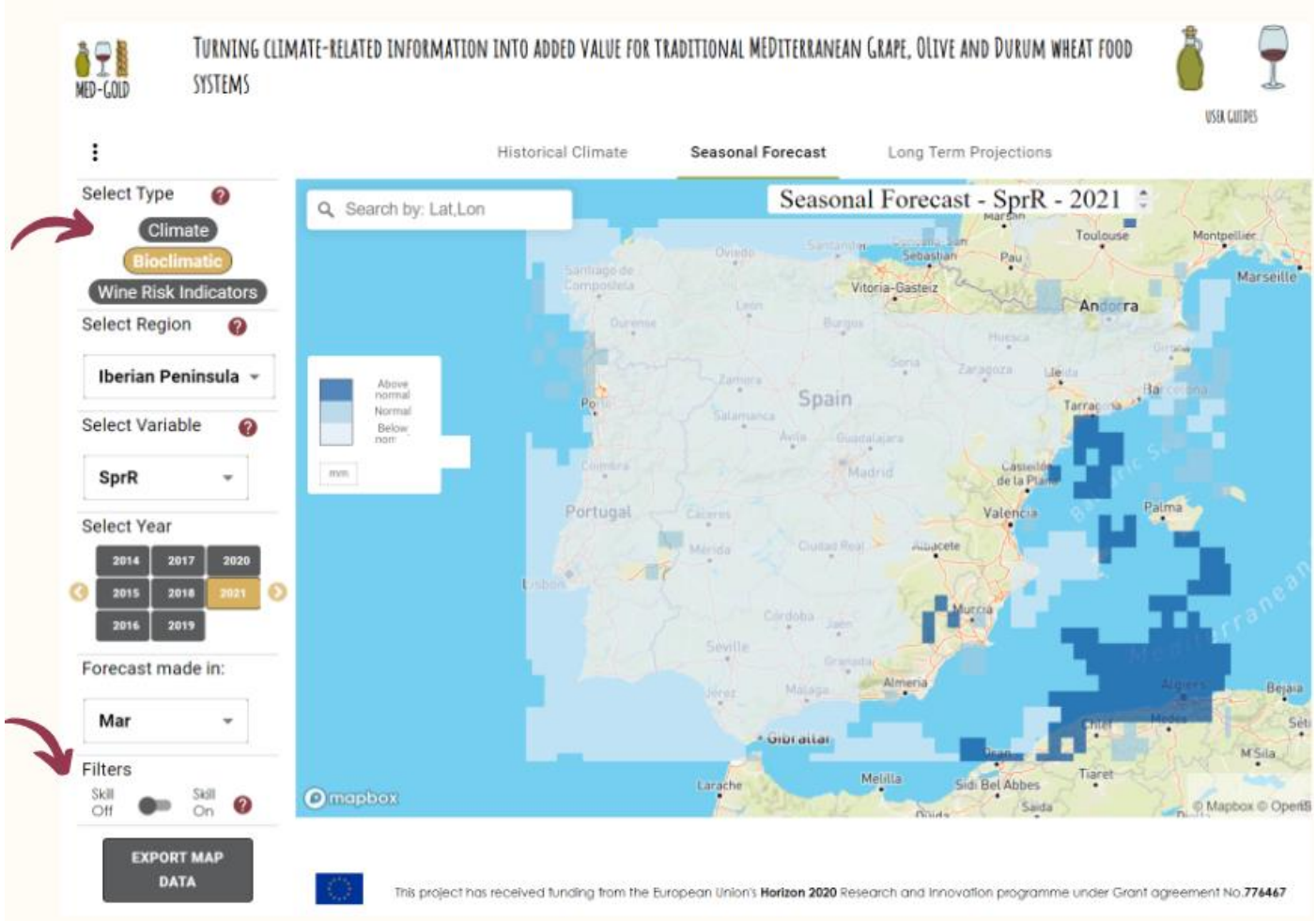
Is this spring going to be particularly dry or wet?

Integrate: MED-GOLD Dashboard

Co-explore potential applications: seasonal forecasts

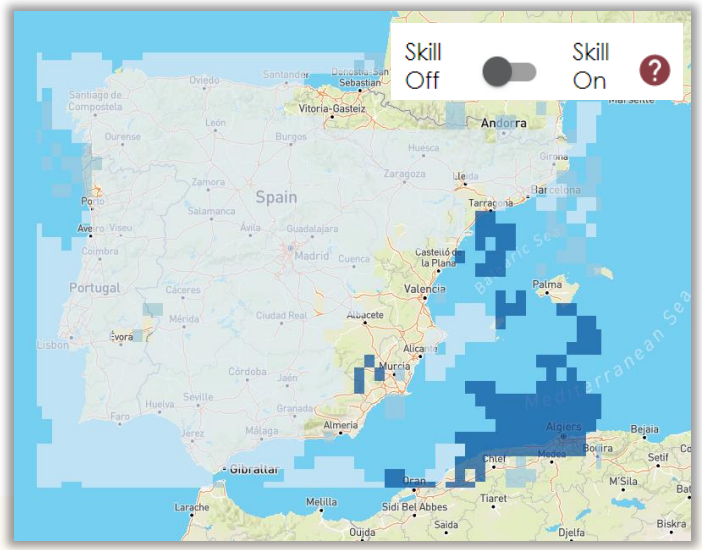
Risk of pests and diseases?
Check the bioclimatic indicator Spring Rain (SprR)

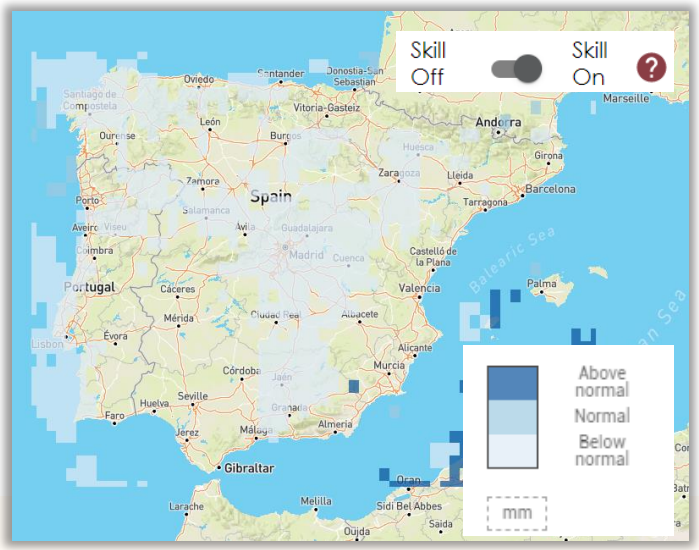
How accurate is the prediction?
Turn on the 'skill' filter option to hide areas where the prediction is not reliable enough for decision making



Integrate: MED-GOLD Dashboard

Seasonal forecasts

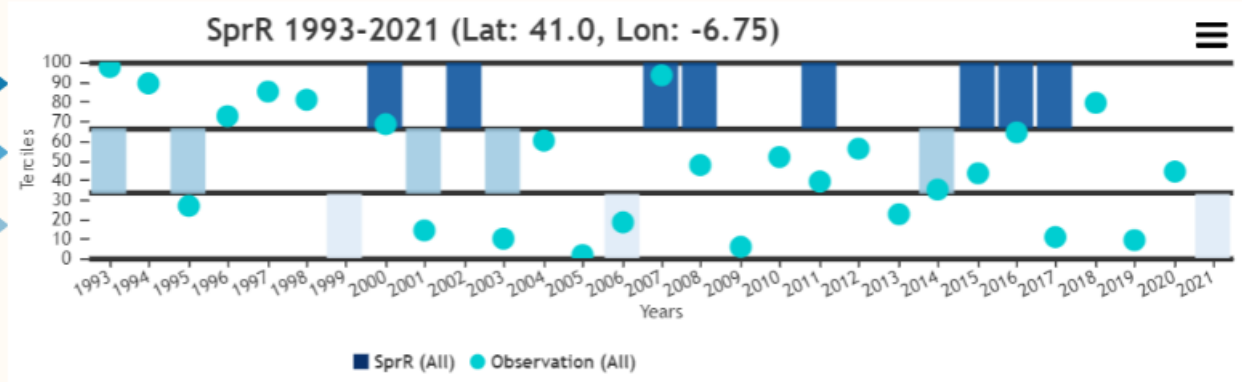




Wetter than normal
(upper tercile, 66.7-100)

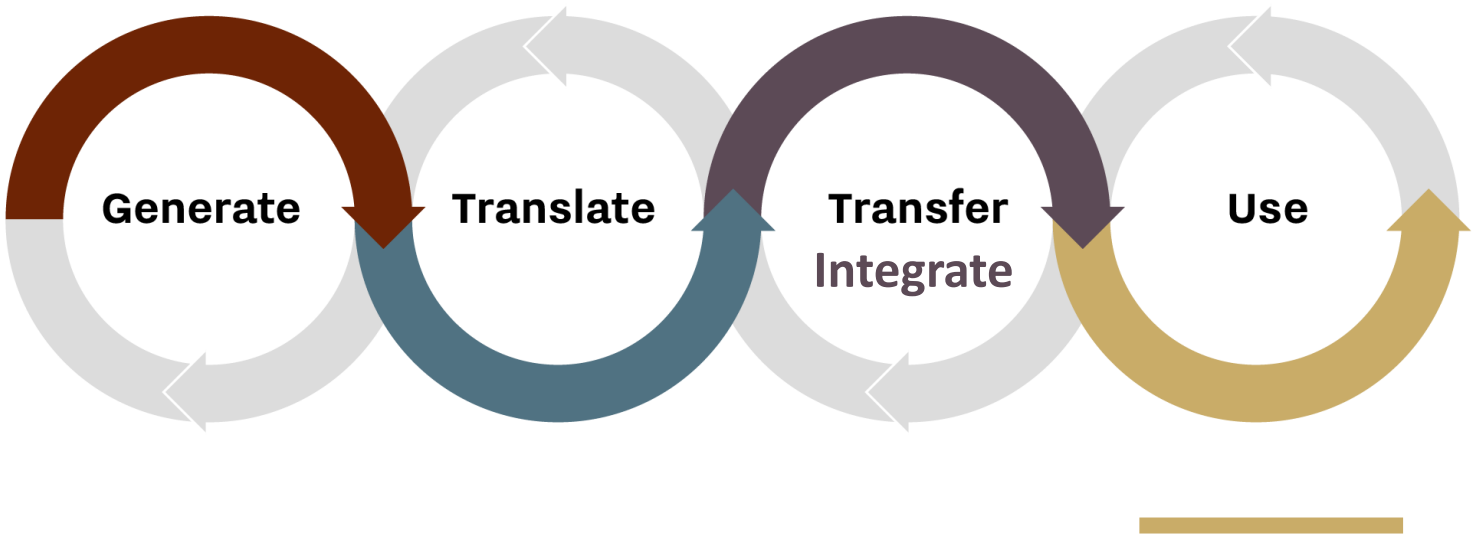
Normal
(medium tercile, 33.3-66.7)

Drier than normal
(lower tercile, 0-33.3)



HOW WELL WAS SPRING RAIN PREDICTED IN THE PAST?

By clicking on the map, a chart will appear where circles correspond to values of spring rain observed in past years, and squares show model predictions (*above normal, normal and below normal terciles*).

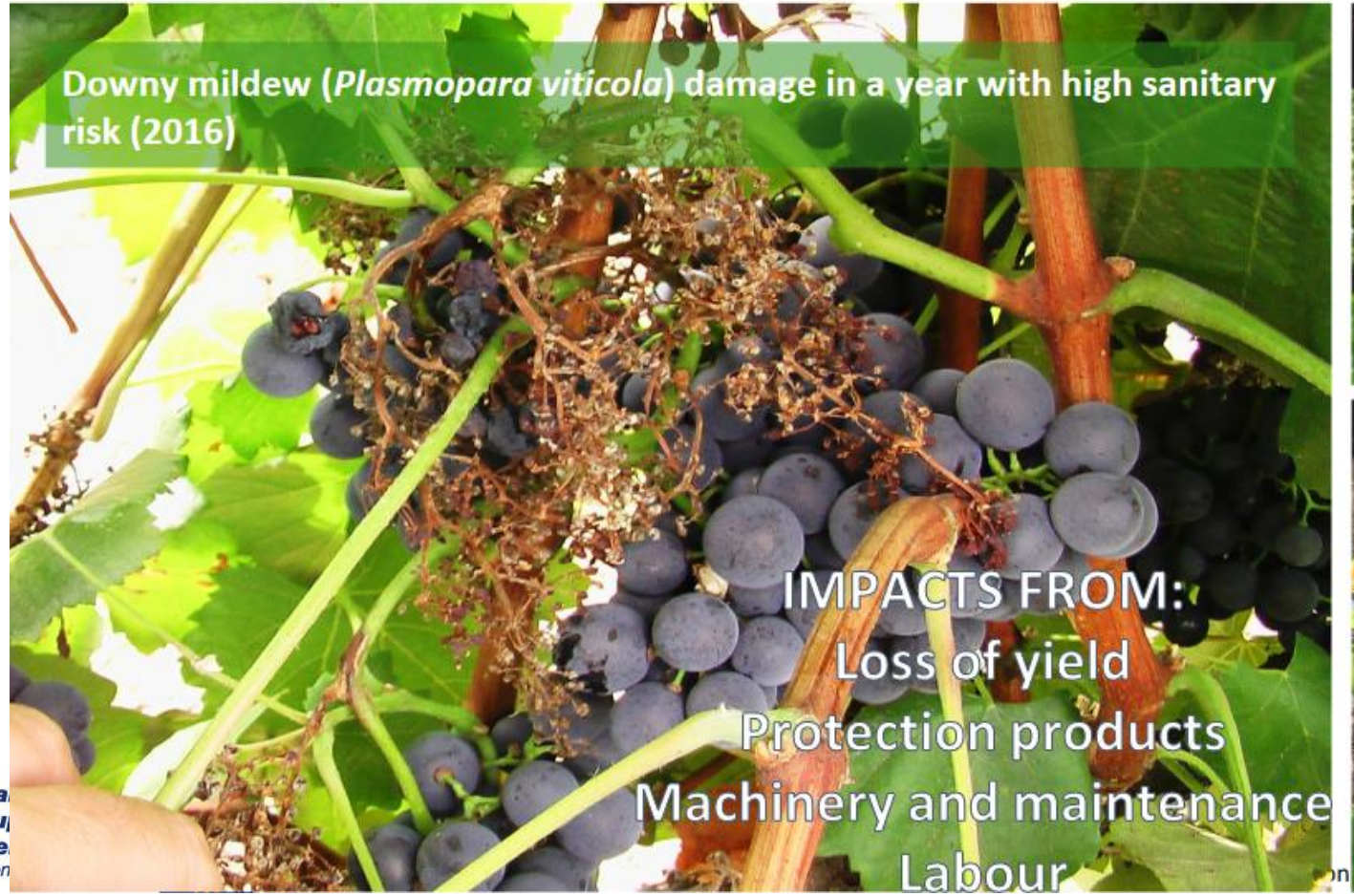

Generate
Translate
Transfer
Integrate
Use

Use: Decision-making

Spring rain and temperature: risk of fungal disease

SOGRAPE
ORIGINAL LEGACY WINES

Challenge



Related user decisions

Use: Decision-making

Business as usual strategy (BaU)

- Vineyard manager applies same strategy independently of climatic conditions
- January: purchasing department orders plant protection products and plans contracting labour

Scenario (Action;Observation)	Cost plant protection products (€/ha)	Cost canopy management (€/ha)	Revenue Yield (€/ha)	Payoff (€/ha)
N;AN (=BaU)	315	495	1400	590
N;N (=BaU)	315	495	2000	1190
N;BN (=BaU)	315	495	2000	1190

▶ Underspending translates in yield losses

▶ Waste of plant protection products. Validity of 12 months

Vigo et al. (under review)

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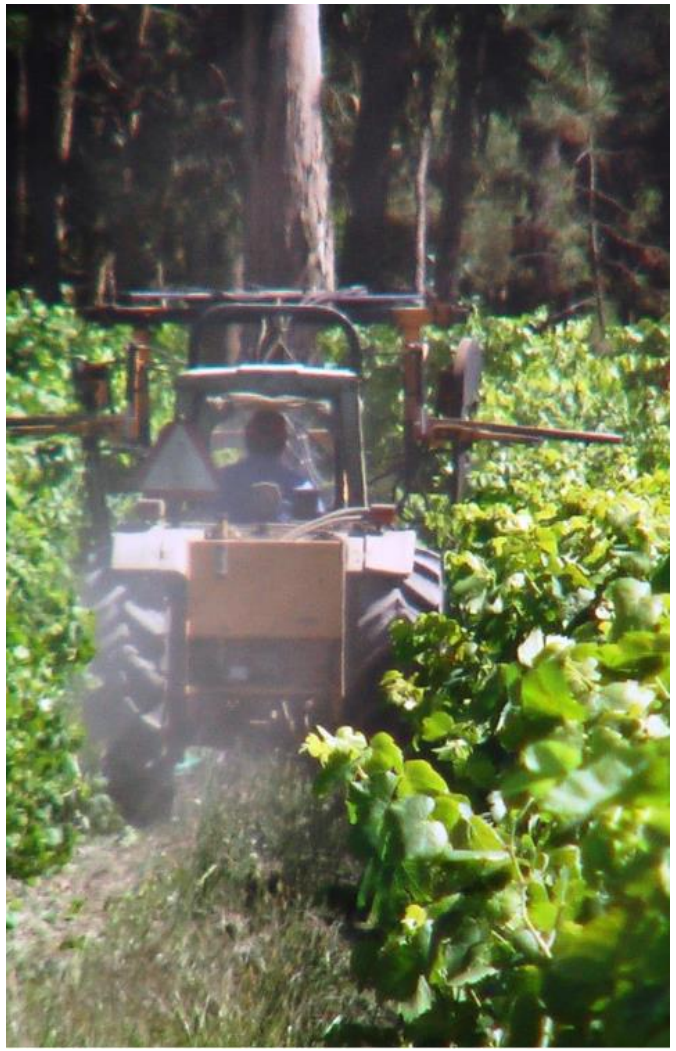
SOGRAPE
ORIGINAL LEGACY WINES

Use: Decision-making



Methodology

Decision Theory (Rubas et al, 2006)

- Climate service (CS) user has to make a **decision**
- With the goal of **maximising an objective** (Payoff = Π)
- **CS' Value** = $\Pi_{wcs} - \Pi_{wocs}$

Π_{wocs} = Π decision without CS
Π_{wcs} = Π decision with CS

Vigo et al. (under review)

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SOGRAPE
ORIGINAL LEGACY WINES

Use: Decision-making

Climate prediction strategy

Scenario (Action;Observation)	Cost plant protection products (€/ha)	Cost canopy management (€/ha)	Revenue Yield (€/ha)	Payoff (€/ha)
AN;AN	410	520	2000	1070
AN;N	410	520	2000	1070
AN;BN	410	520	2000	1070
N;AN (=BaU)	315	495	1400	590
N;N (=BaU)	315	495	2000	1190
N;BN (=BaU)	315	495	2000	1190
BN;AN	220	495	1000	285
BN;N	535	495	2000	970
BN;BN	220	495	2000	1285

- No yield losses
- Losses due to inefficient purchase and contracting

- Yield losses
- Protection products supply shock

- Higher savings and sustainability

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Vigo et al. (under review)

$$\text{Payoff } (\Pi) = €Y - Cpp - Ccm$$

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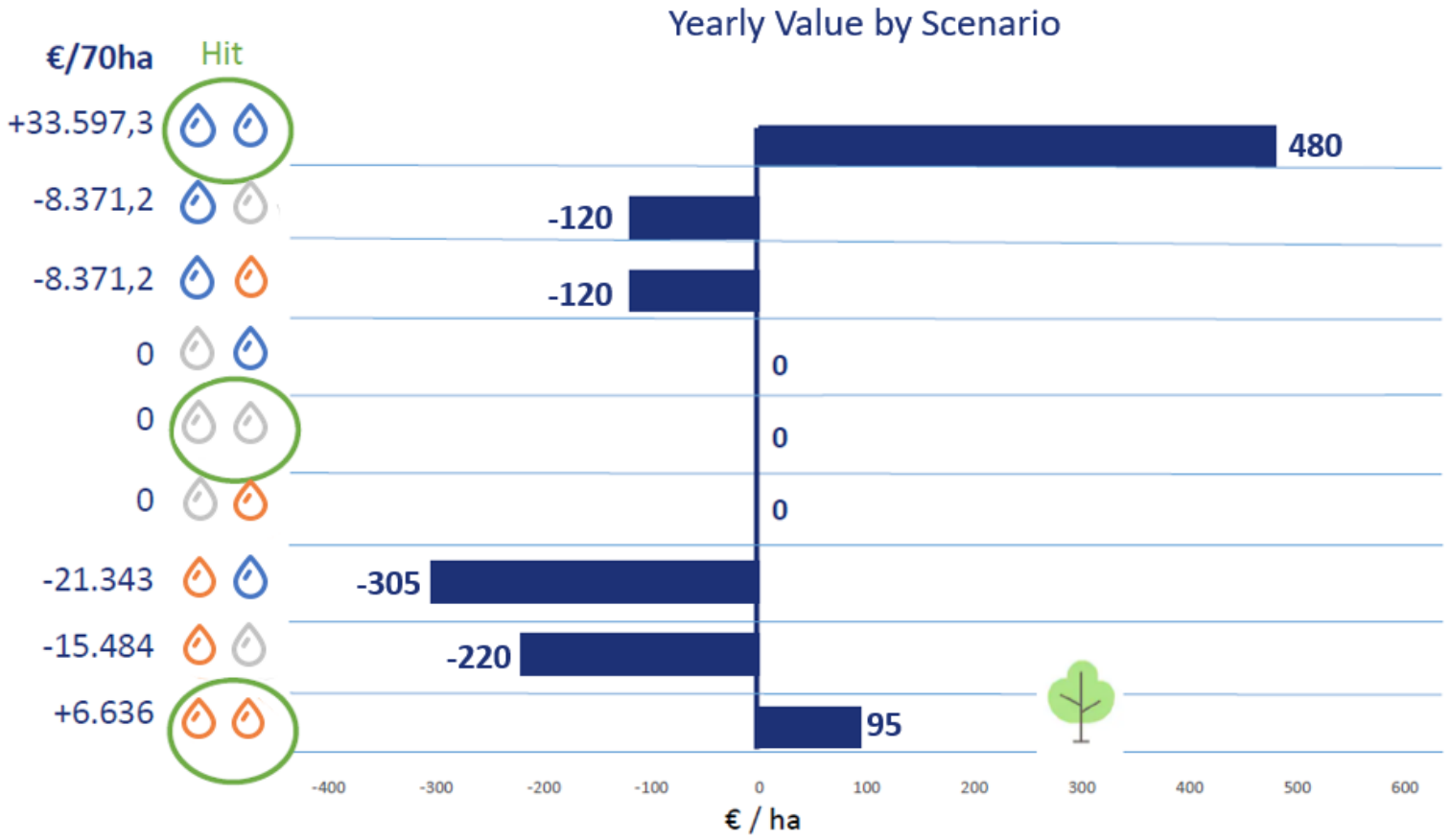
ORIGINAL LEGACY WINES

Use: Decision-making

Seasonal climate service value



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SOGRAPE
ORIGINAL LEGACY WINES

Conclusions

- Climate data is a key part of a climate service but it needs to be **transformed into information** that can support the decision-making of users
- **Generate:** apply a co-production framework to climate services, involving users through awareness raising, knowledge exchange and co-development
- **Translate:** explain research findings in a way that is easily understood by users and that allows them to connect with the meaning of the information provided
- **Integrate:** deliver and exchange information in a suitable and tailored way. Visualisations can be effective to reduce the users' cognitive load and better highlight salient information for them
- **Use:** demonstrate the application of the climate service in the user's decision making context to boost uptake

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