



Climate change and European aquatic RESources

Socio-political scenarios for the fishery and aquaculture sectors in Europe

Short-, medium- and long-term developments in governance, social, technological and economic drivers may be just as important to fisheries and aquaculture as climate-driven changes in habitats and species.

Here we propose a suite of exploratory, future socio-political scenarios that will be used throughout the CERES project in modelling exercises and serve as the basis for discussions or engagement with the wider stakeholder community.



- Scenarios are imagined 'futures'.
- They do not come individually, as a forecast would, but in sets of alternatives.
- They describe both optimistic and problematic futures.
- For scenarios to be a useful tool, they must all be possible, plausible and credible.

Why do we need scenarios?

1. Without scenarios it can be very difficult **to constrain the number of possible combinations** of climate vs economic vs political legislation storylines and hence we need a coherent framework.
2. To **make the most of work that has been done by others**, e.g. the IPCC, UNEP etc.
3. So that we are **all speaking the same language** and we have a similar concept of the different storylines.
4. So that we can **share quantitative outputs** to inform each other's modelling.
5. So that we have **a similar framework and starting point for fisheries and aquaculture** where regional differences in flavour and detail can be added (e.g. from the Arctic to Mediterranean Seas and inland waters).



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PESTLE analysis

PESTLE is a concept used by companies and also in the CERES project to consider factors impacting upon businesses or markets.

PESTLE is a mnemonic which in its expanded form denotes:

- P** for **Political**
- E** for **Economic**
- S** for **Social**
- T** for **Technological**
- L** for **Legal**
- E** for **Environmental**.

Key questions when constructing scenarios:

- What is the political situation of the country and how can it affect the industry?
- What are the prevalent economic factors?
- How much importance does culture have in the market and what are its determinants?
- What technological innovations are likely to become apparent and affect the market structure?
- What current legislation regulates the industry and are future legislative changes expected?
- What are the environmental concerns for the industry?



IPCC Scenarios

CERES will aim to make a significant contribution in the next assessment report of the **Intergovernmental Panel on Climate Change (IPCC)** in 2020.

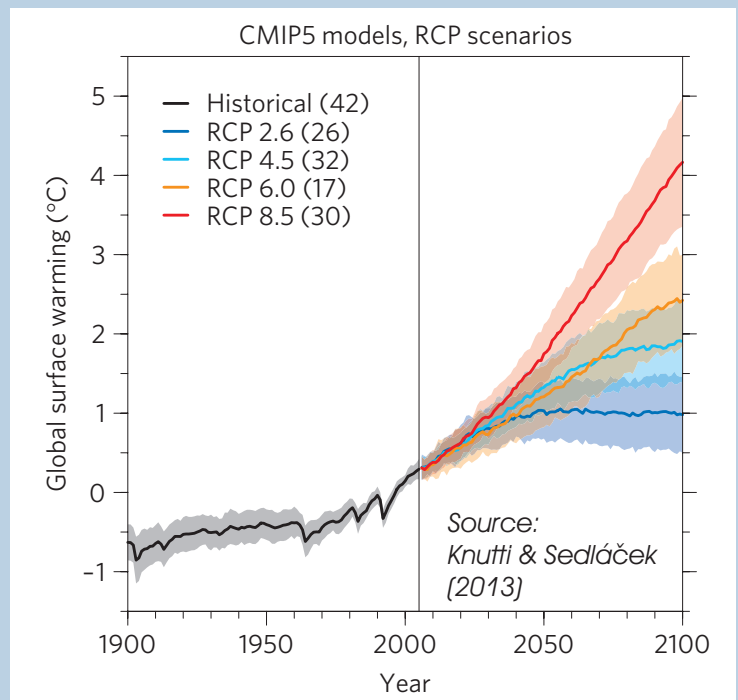
In order to do this, CERES participants must use climate change scenarios and socio-economic **storylines that are compatible** with those of the IPCC.

Representative Concentration Pathways (RCPs) are four greenhouse gas concentration (not emission) trajectories adopted by the IPCC for its Fifth Assessment Report (AR5) in 2014.

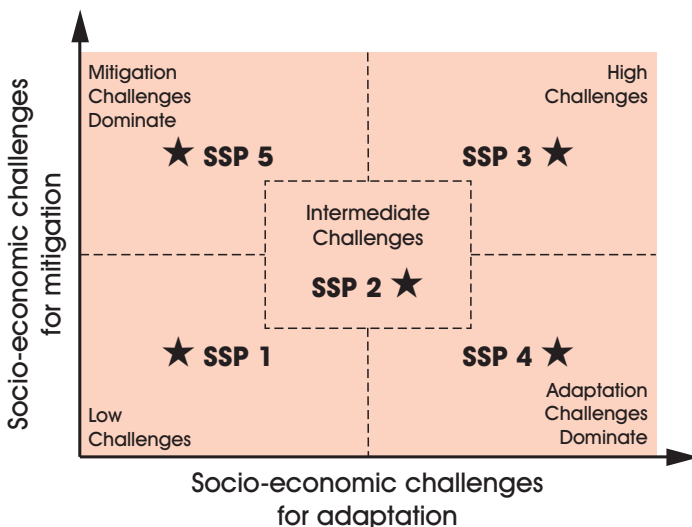
The pathways describe **four possible climate futures**, all of which are considered possible depending on how much greenhouse gases are emitted in the years to come.

In **CERES task 1.1** modellers will create spatially and temporally detailed projections of future marine and freshwater conditions under **RCP 8.5** and **RCP 4.5**.

Global warming (in °C) expected under each RCP



Shared Socio-economic Pathways (SSPs)



Shared Socio-economic Pathways (SSPs) have been designed by the IPCC to be **used alongside** the Representative Concentration Pathways (RCPs) to analyse **feedbacks between climate change and socioeconomic factors**, such as world population growth, economic development and technological progress.

The new SSPs are arranged along two major development axes: the intensity of climate policies that will be necessary in the future, either to prevent a certain level of climate change (**MITIGATION on the vertical axis**), and/or to cope with a certain level of climate change (**ADAPTATION on the horizontal axis**).

How do the old and new IPCC scenarios compare?

Based on detailed quantitative analyses, van Vuuren & Carter (2014) provided a suggestion for mapping the previous generation of IPCC SRES (Special Report on Emission Scenarios) storylines onto the new framework of representative concentration pathways (RCPs) and shared socio-economic pathways (SSPs).

According to these authors:

- (i) an SRES **A2 (National Enterprise) world** broadly corresponds with the combination RCP 8.5 and SSP3,
- (ii) an SRES **B2 or A1B (Local Stewardship) world** corresponds with the combination RCP 6.0 and SSP2,
- (iii) an SRES **B1 (Global Sustainability) world** corresponds with the combination RCP 4.5 and SSP1, and
- (iv) an SRES **A1FI (World Markets) world** corresponds with the combination RCP 8.5 and SSP5.



The four CERES Socio-political Scenarios

World Markets – RCP 8.5 and SSP5 (A1F1)

- People aspire to personal independence, material wealth and greater mobility, all of which have a negative effect on wider societal and environmental goals.
- Pressure grows to reduce taxes and strip away regulation. More public services are privatized or privately managed.
- Consumerism.
- High fossil fuel dependency.
- Highly engineered infrastructure and ecosystems.

National Enterprise – RCP 8.5 and SSP3 (A2)

- Increased national isolation and independence.
- Long-term economic growth limited by government policies, that limit international competition and protect national industries.
- Conservation and the environment are not a main priority.
- High resource intensity and fossil fuel dependency.
- Low investments in technology development and education.
- Weak international governance and local institutions.

Global Sustainability – RCP 4.5 and SSP1 (B1)

- People aspire to high levels of welfare and a healthy environment. The best way to achieve this is through international cooperation.
- People see their personal interests as being connected to a strong and cooperative society.
- Policies are coordinated at the European Union and international level.
- Decreasing income inequality.
- Low resource intensity and fossil fuel dependency.
- Environmentalism.

Local Stewardship – RCP 6.0 and SSP2 (B2)

- Public policies aim to promote economic activities that are small scale and regional.
- An important focus is on using technology and new ideas to make the best use of local and regional resources.
- Global environmental problems receive less attention.
- Moderate population growth.
- Slowly converging incomes between industrialized and developing countries.
- A rich mosaic of local strategies to manage ecosystems and ecosystem services.

For the following elements, IPCC quantifications are available: population by age, sex and education; urbanization; and economic development (GDP).

Many existing scenario exercises have chosen similar criteria to define their 'possibility-space', with an axis representing '**local to global**' and an axis representing '**community to consumerism**'.

The same basic scenario architecture was used in [the UN Millennium Ecosystem Assessment](#) as well as many previous EU research projects focussed on the marine environment (see Groeneveld *et al.* 2016).

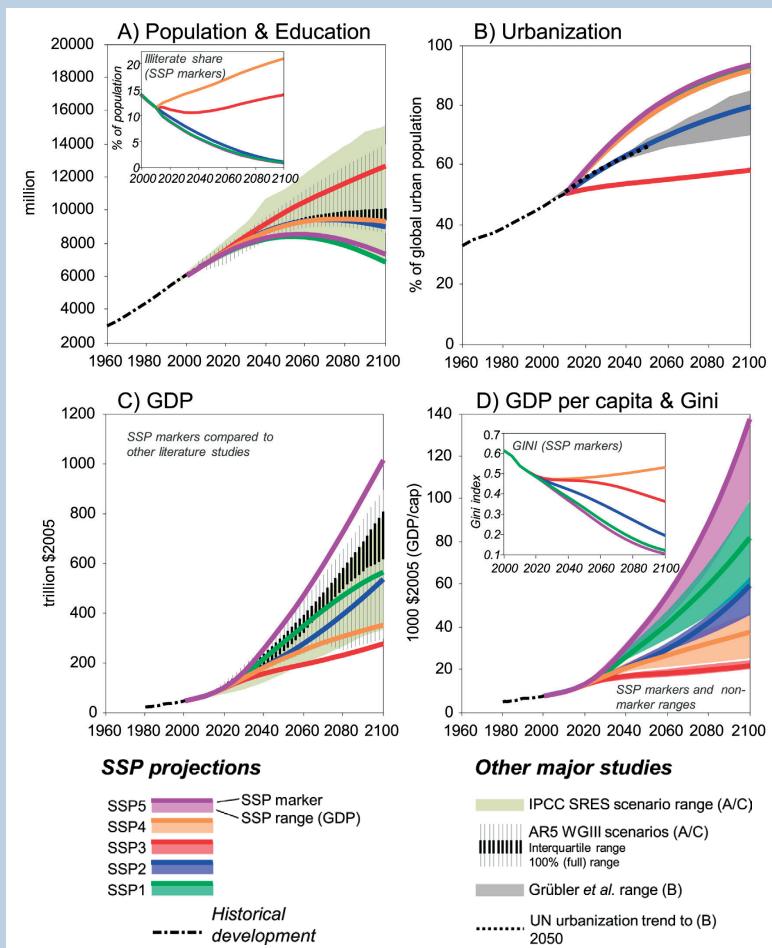
The EU Project [ELME \(European Lifestyles and Marine Ecosystems\)](#) provided holistic scenarios for each European Sea including the Northeast Atlantic, Black Sea, Baltic Sea and Mediterranean using this same common framework.

General economic outlook

Certain model outputs are available 'off the shelf' for each IPCC SSP. These can be used directly in CERES.

- The quantitative outputs presented (right and below) are described in detail in a special issue of Global Environmental Change (2016), www.sciencedirect.com/science/article/pii/S0959378015000060
- For more information at the individual country level see <https://tntcat.iiasa.ac.at/SspDb/>

Projections of global:
 (A) population, (B) urbanization,
 (C) economic growth, and
 (D) GDP per capita and the Gini index
 (income distribution).
 Source: Riahi et al. (2016)



What could this mean for Europe?

Western and Eastern Europe (36 countries)

‡ based on global estimates

World Markets – RCP 8.5 and SSP5 (A1F1)

	2010	2050	2100
Population (millions)	609	748	846
Urban population (%)	72.7	89.5	96.2
Education (number yrs)	12.0	13.7	14.5
GDP per capita (1000 US\$)	25.4	57.8	152.9
Renewable energy (%)‡	15.8	7.7	16.7

National Enterprise – RCP 8.5 and SSP3 (A2)

	2010	2050	2100
Population (millions)	609	606	493
Urban population (%)	72.7	77.9	80.1
Education (number yrs)	12.0	13.0	12.8
GDP per capita (1000 US\$)	25.4	39.3	53.4
Renewable energy (%)‡	15.8	20.5	18.0

Global Sustainability – RCP 4.5 and SSP1 (B1)

	2010	2050	2100
Population (millions)	609	679	600
Urban population (%)	72.7	89.4	96.1
Education (number yrs)	12.0	13.7	14.5
GDP per capita (1000 US\$)	25.4	50.0	96.9
Renewable energy (%)‡	15.8	23.5	46.7

Local Stewardship – RCP 6.0 and SSP2 (B2)

	2010	2050	2100
Population (millions)	609	672	630
Urban population (%)	72.7	84.5	91.8
Education (number yrs)	12.0	13.5	14.1
GDP per capita (1000 US\$)	25.4	45.9	91.5
Renewable energy (%)‡	15.8	16.2	22.8



Demand for fish and shellfish in Europe (EU-27)

- **World Markets** – RCP 8.5 and SSP5, 13.7 million tonnes in 2050, 17.2 million tonnes in 2100
- **Global Sustainability** – RCP 4.5 and SSP1, 12.2 million tonnes in 2050, 11.5 million tonnes in 2100
- **National Enterprise** – RCP 8.5 and SSP3, 10.0 million tonnes in 2050, 6.9 million tonnes in 2100
- **Local Stewardship** – RCP 6.0 and SSP2, 11.8 million tonnes in 2050, 11.6 million tonnes in 2100

What could it mean for European Fisheries?

These draft socio-political storylines were elaborated by CERES partners and stakeholders

World Markets – RCP 8.5 and SSP5 (A1F1)

- Fish obtained from the cheapest sources
- Decommissioning subsidies reduced
- Few legal and technical restrictions
- Only a few high-tech boats
- Sequentially depleted fish stocks
- More competition for resources globally
- Low taxes, strong private sector
- Europe outcompeted by Asia/China
- Use of cheap immigrant labour



Global Sustainability – RCP 4.5 and SSP1 (B1)

- Fish from sustainable sources worldwide
- Equitable and ethical are important
- EU/international marine strategy
- Lower meat and fish consumption per capita
- Ecolabel certification schemes
- EIA required for new fisheries
- Traceability and quality standards
- Fisheries displaced by windfarms and MPAs
- Sustainable, low impact fishing gears

National Enterprise – RCP 8.5 and SSP3 (A2)

- Maintaining national supply important
- Frequent 'cod wars'
- Decline in fish imports (import tariffs)
- Sport fisheries 'squeezed out'
- Higher fish prices and taxes
- Little new technology
- Food security more important than MPAs
- Individual Transferable Quotas (ITQs)
- Increased disparity – rich and poor countries



Local Stewardship – RCP 6.0 and SSP2 (B2)

- 'Bottom up' local/regional governance
- Self sufficiency viewed as important
- Large number of small/traditional vessels
- Improved opportunities for 'sport fisheries'
- Mosaic of different management measures
- Not worried about downstream impacts
- Equity and ownership are important
- Traceability standards important
- Individual Transferable Quotas (ITQs)

What could it mean for European Aquaculture?

These draft socio-political storylines were elaborated by CERES partners and stakeholders



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National Enterprise – RCP 8.5 and SSP3 (A2)

- High seafood prices, high energy prices
- Less technology, more labour
- Regional production with public subsidies
- Genetic engineering of aquaculture species
- Aquaculture to feed domestic tastes
- Some countries adopt new tech., others not
- Local certification and marketing schemes
- Food security dominates over environment

World Markets – RCP 8.5 and SSP5 (A1F1)

- Huge expansion of offshore fish farming
- Luxury product vs anonymous fish protein
- Pangasius dominated aquaculture markets
- Extensive use of cheap immigrant labour
- Big businesses strive for value-for-money
- Frequent fish kills due to pathogens & jellyfish
- Global trading of aquaculture products
- Technology/automation important
- Low seafood prices, low energy prices

Local Stewardship – RCP 6.0 and SSP2 (B2)

- Local/regional governance – high autonomy
- Self sufficiency viewed as important
- Small scale, low-impact fish farming
- EIA required for all new farms
- Quality and traceability important
- Sale/marketing of locally produced products
- Greater variety of organisms farmed
- Strong incentives to recycle waste materials

Global Sustainability – RCP 4.5 and SSP1 (B1)

- Tight regulation of inputs and outputs
- EIA required for new farms
- Traceability and quality standards
- Organic and fair-trade ecolabel schemes
- Technology transfer to poorer countries
- Carbon footprint considered
- Inland, closed systems more common
- Renewable energy powering most farms
- Expansion of offshore production



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Scenarios are not predictions!

- Scenarios are neither predictions nor forecasts of future conditions.
- No single scenario will ever come true in its entirety, in reality the future will comprise a mixture of attributes from several of the suggested storylines.
- The true purpose of a set of scenarios is to illuminate uncertainty, as they help in determining the possible ramifications of an issue along one or more plausible paths.
- Scenarios go beyond a single best estimate, or a 'high' and 'low' projection, and encourage us to explore a number of different, logically-coherent pathways.

What is CERES?

A 4-year EU Horizon 2020 project, coordinated by Prof. Myron Peck (University of Hamburg) with 26 partners.

CERES will provide tools and develop adaptive strategies allowing fisheries and aquaculture sectors to anticipate and prepare for adverse changes or future benefits of climate change.

Further Information

Further details about the work of CERES can be found at www.ceresproject.eu.

The CERES Project Office can be contacted at University of Hamburg, Phone: +49 40 42838 9891, e-mail: contact@ceresproject.eu

Source Documents

- Groeneveld *et al.* (2016) Estuarine, Coastal and Shelf Science doi: 10.1016/j.ecss.2015.10.020
- Knutti, R. & Sedláček, J. (2013) Nature Climate Change, 3: 369-373.
- Riahi, K. *et al.* (2016) Global Environmental Change doi:10.1016/j.gloenvcha.2016.05.
- van Vuuren, D.P. & Carter, T.R. (2014) Climatic Change, 122: 415-429

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CERES Partners



Your Feedback

Readers are encouraged to consider how each future storyline might play out for their particular sector and region. Comments and suggestions should be submitted to: marine.climate@cefas.co.uk.