Integrating Climate Model Projections into Environmental Risk Assessment (ERA): a Probabilistic Modeling Approach

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Background

- Future climate model projections have clear signals but also high uncertainty (Fig. 1).
- Traditional ERA frameworks do not routinely incoroporate climate-related uncertainty (Fig. 2).
- A SETAC Pellston workshop was organised in Oslo (June 2022) to address this mismatch [3].
- The special series was published in IEAM (March 2024): "*Integrating Global Climate Change into Ecological Risk Assessment: Strategies, Methods and Examples*".

Climate model projections

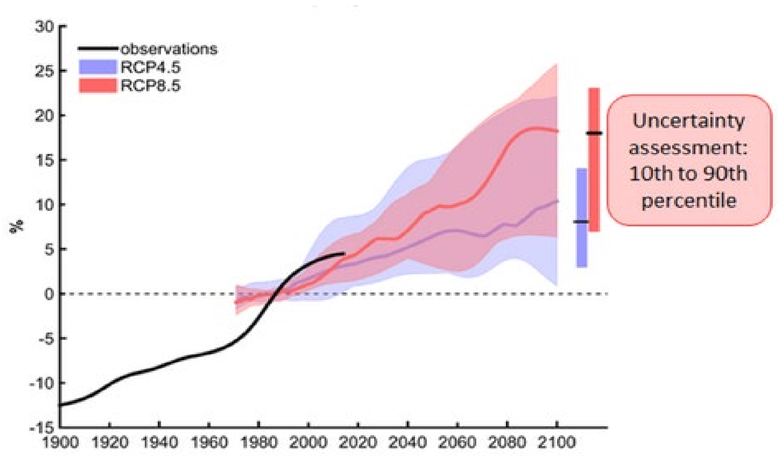

Figure 1. Example of projections with uncertainty assessment: annual precipitation over Norway as % deviation from years 1971 to 2000. After [1].

Traditional ERA

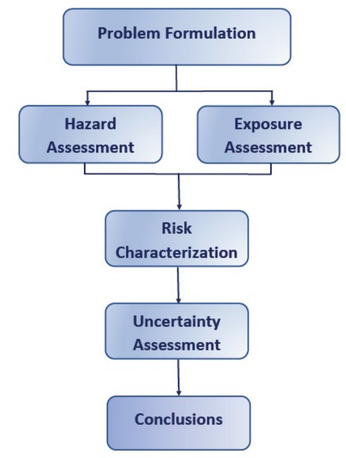

Figure 2. How the different components of an ERA relate to one another. From [2].

Workshop: case studies and workflow

We used three case studies for exploring how ERA can incorporate climate change projections (Fig. 3).

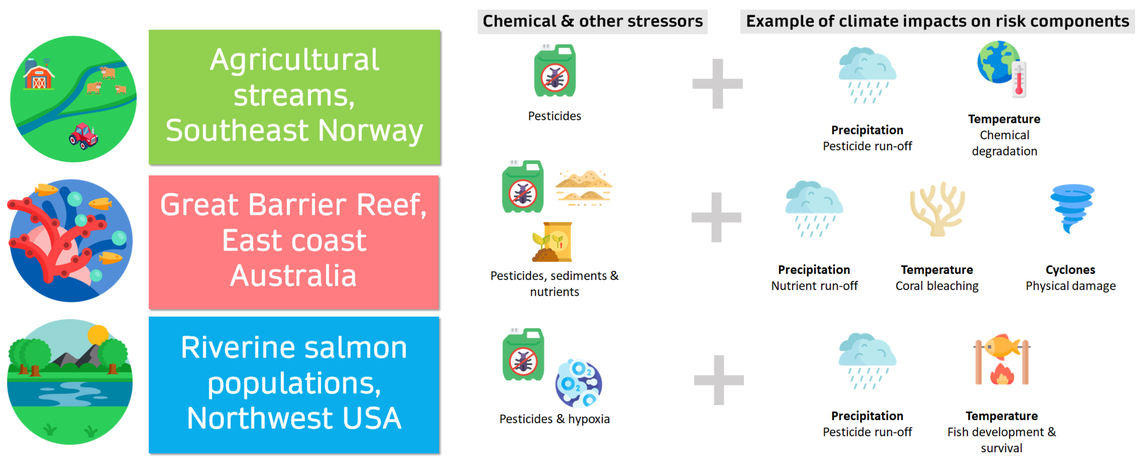

Figure 3. Overview of case studies from Norway [4], Australia [5] and USA [6].

We used a common workflow:
from global climate models via local processes to ecological assessment endpoints (Fig. 4).

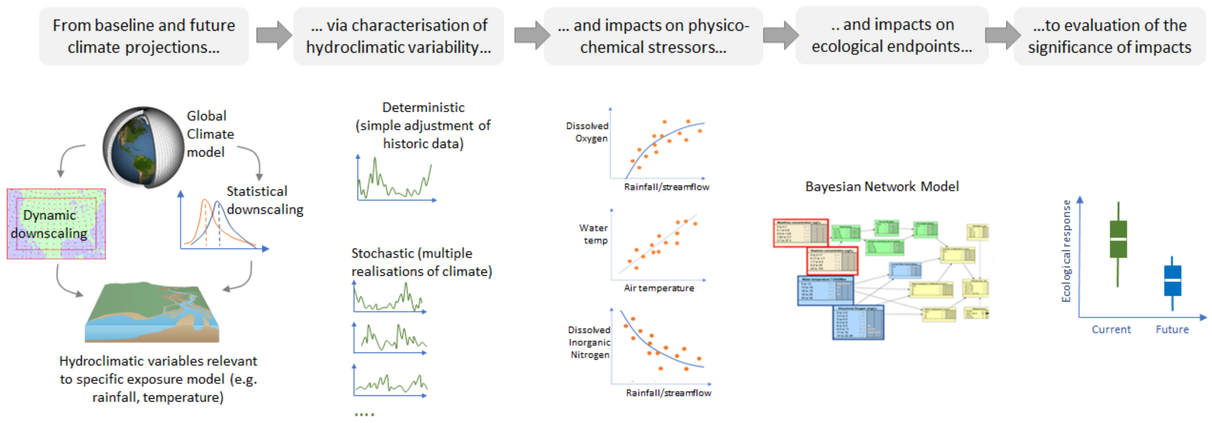

Figure 4. Schematic illustration and example of work flow for integrating climate model projections with risk characterization, as exemplified by the three case studies. After [7].

Proposed modeling approach: 3 pillars

We recommend considering (Fig. 5):

(1) Climate information: use statistical properties of climate model projections as relevant and robust climate information.

(2) Climate-induced vulnerability: how climate change can modify the sensitivity of individuals to chemicals in an ecosystem.

(3) Probabilistic modeling: exemplified by Bayesian networks (BNs) as a probabilistic and potentially causal modeling method.

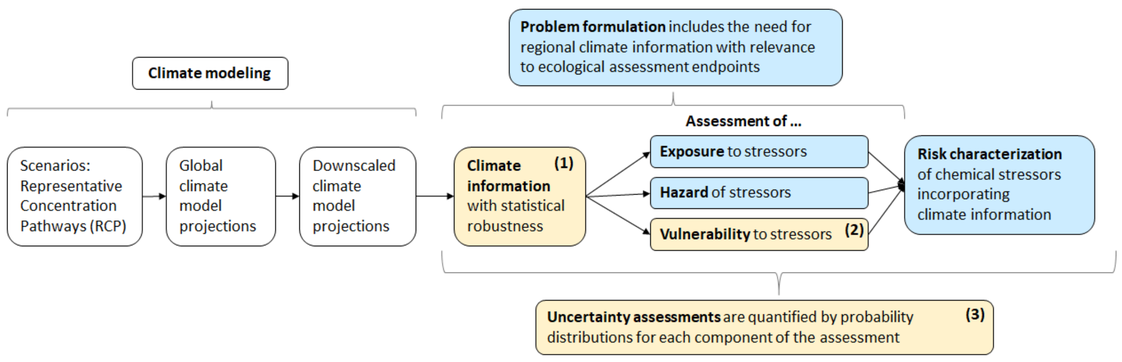

Figure 5. Proposed modeling approach for integration of climate model projections into ERA of chemical stressors. The novel aspects ("pillars") are identified by numbers 1-3. After [7].

How can a Bayesian network model support ERA of pollutants under climate change?

Explored with the three case studies (Fig. 3):

- Represent **causal relationships**
  - e.g. from AOP models.
- **Integrate information** from other models
  - by conditional probability distributions.
- **Predict risk**
  - as the probability of a given outcome (Fig. 6).
- Evaluate **knowledge needs**
  - by sensitivity or value-of-information analysis.

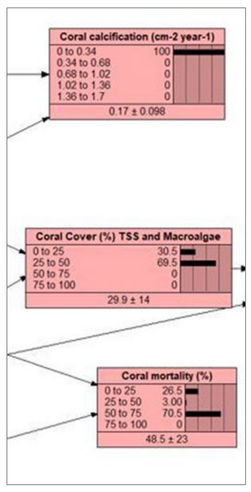

Figure. 6. Extract of BN model [5]: predicted risk to coral assessment endpoints

References

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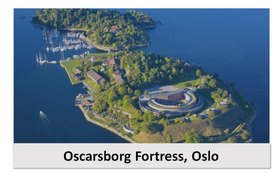
Acknowledgments

The workshop was supported by: (1) BHP, (2) Chevron, (3) Corteva Agrisciences, (4) CSIRO, (5) International Copper Association, (6) NiPERA, (7) NIVA's Computational Toxicology Program, (8) Research Council of Norway, (9) Rio Tinto, (10) SETAC, (11) Shell, (12) Teck Resources, (13) US EPA.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