Probabilistic assessment of adaptation options from an ensemble of crop models: a case study in the Mediterranean.

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INTRODUCTION & OBJECTIVE

- Effective adaptation of agricultural systems to climate change has to
  - Consider local specificities
  - Provide sound and practical information
  - Deal with the uncertainty
- We present a methodology for assessing different aspects of adaptation
- Our study case is adaptation of winter wheat in the Mediterranean

METHODOLOGY

- An ensemble of 17 wheat simulation models was run in Lleida, Spain
- Crop yield for 2030 and 2050 under A1B scenario was evaluated for
  - 2 soil types
  - 3 CO2 levels
  - **Adaptations:** 3 sowing dates, 3 cycle lengths, 3 water/irrigation options, spring variety
- Impact Response Surfaces (IRS)
  - Surfaces showing the response of an impact variable (e.g. yield) to changes in two explanatory variables (precipitation P and temperature T).
- Adaptation Response Surfaces
  - Surfaces showing the response of an adaptation variable (e.g. change in yield) to potential changes of P and T when an adaptation option is simulated.
  - It is the difference of two IRS, with and without adaptation (Fig. 1)

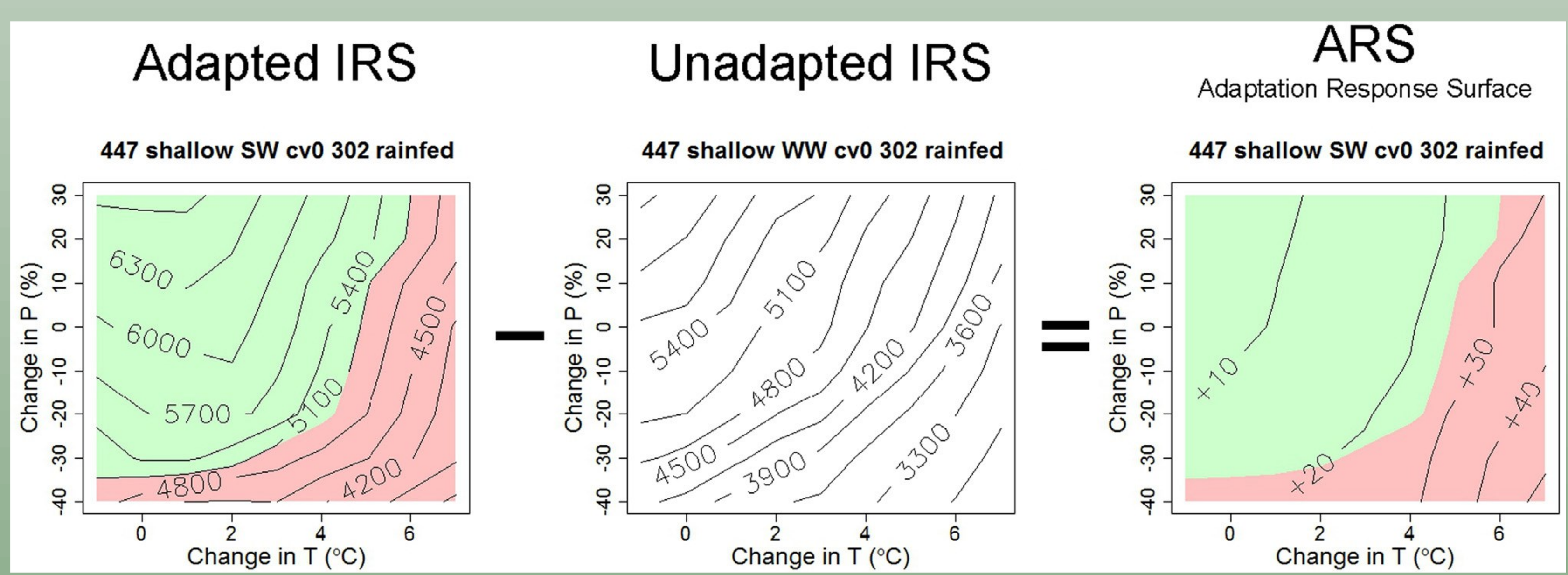

Fig. 1. Example of IRS and ARS. Adaptation evaluated is switching to a spring wheat variety. Green areas are above the current yields, while red areas are below. (Ruiz-Ramos et al., 2016)

- We overimposed probabilistic climate change projections, of the same explanatory variables used for creating ARSs, to estimate distributions of the effect and likelihoods (Fig. 2)

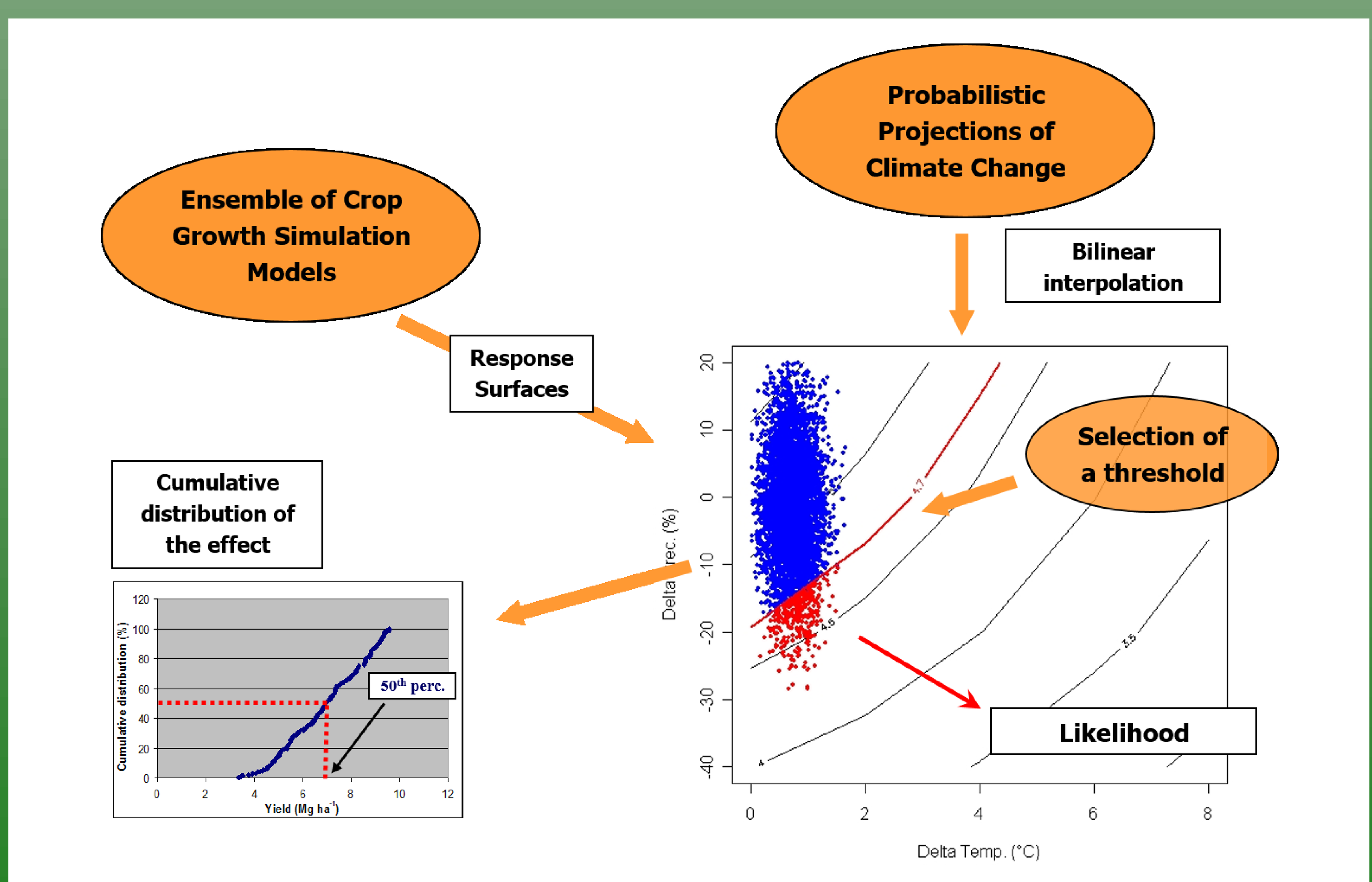

Fig. 2. Framework for coupling ARSs and probabilistic climate projections. Overimposing probabilistic projections on ARSs permits to estimate the cumulative distribution of the effect of the adaptation. Further, by setting a threshold, the probability (likelihood) of being above or below it can be calculated.

RESULTS

1. Many options with adaptation potential were identified using ARS (some examples in Fig. 3).

- Most promising were based on a combination of spring wheat, longer growing cycle, advanced sowing date and supplementary irrigation.
- Other feasible strategies were also found for winter wheat with supplementary irrigation and for spring wheat under rainfed.

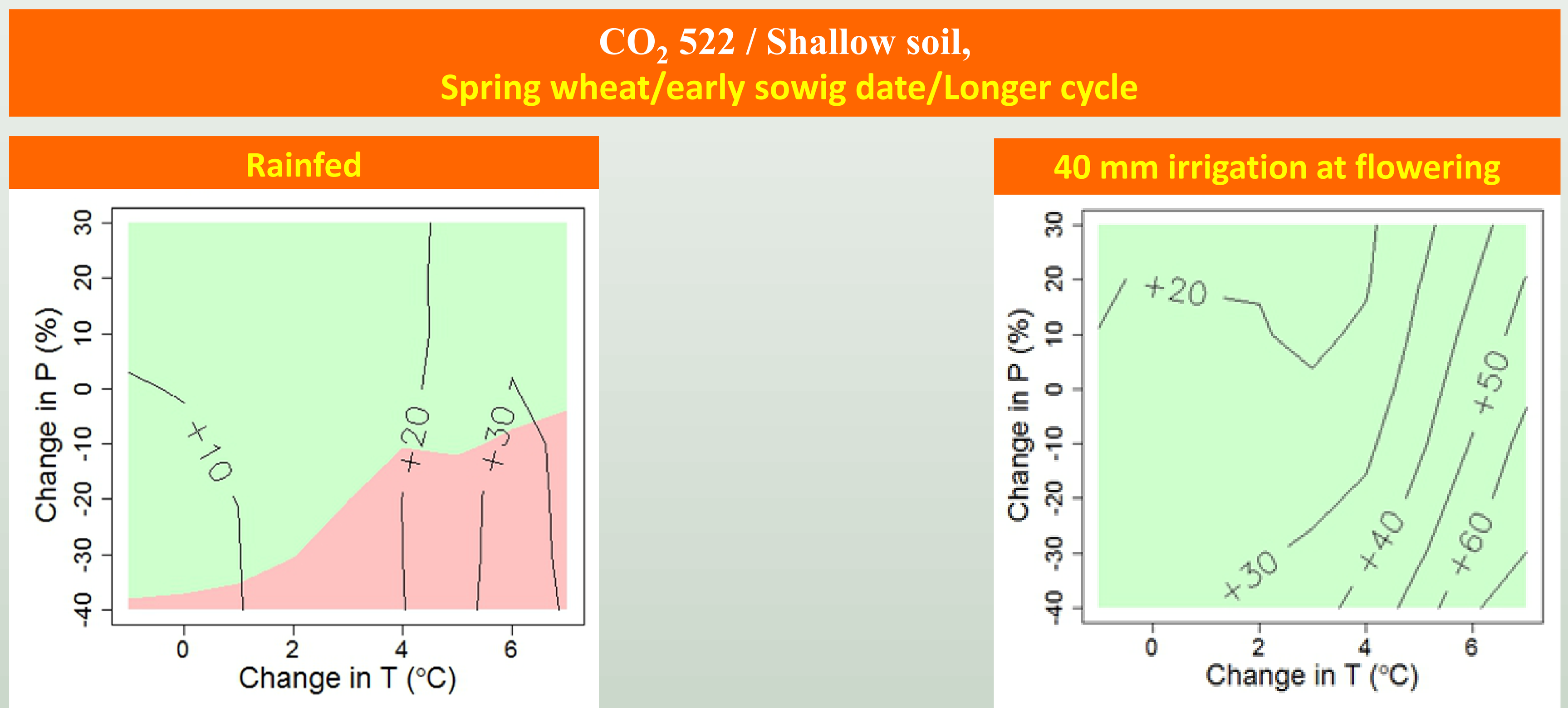

Fig. 3. ARS showing the change in yield when winter wheat is sonw erlier, with a longer cultivar without vernalisation requirements, under a) rainfed, b) supplementary irrigation

2. Most promising options show a virtually certain positive adaptation response and recovery of current yields (an example is shown in Fig. 4)

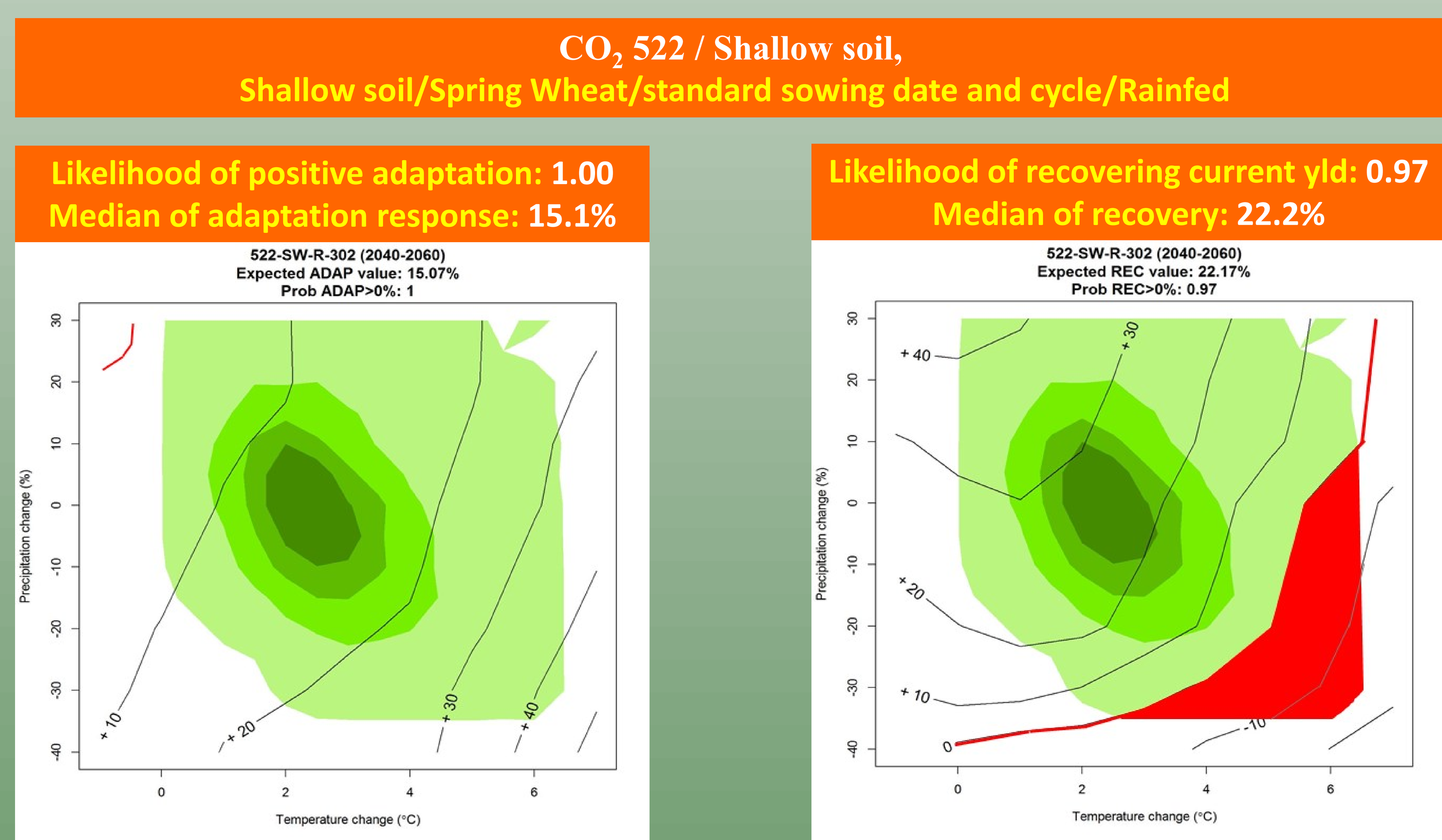

Fig. 4: Likelihoods of reaching positive adaptation (left plot) and to recover current yields (right plot) of an adaptation option based on rainfed spring wheat with standard sowing date and cycle (Ferrise et al., 2017). Green cloud are the probabilistic climate change projections (Harris et al., 2012). The darker the region an isoline crosses is, the more likely the isoline is.

CONCLUSIONS

- A wide scope for adaptation exists when considering combined adaptation options
- Our methodology enables comprehensive assessment of adaptation effectiveness and uncertainty by providing:
  - Qualitative information, by identifying options with adaptation potential
  - Quantitative information, such as median of adaptation's response or likelihood of a specific effect (e.g. recovery of current yields)

REFERENCES

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