How to develop mitigation and adaptation measures

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Agriculture's challenges

– Double food production by 2050 (FAO 2008)

Other products (eg: biofuels, new materials)

– Provide Ecosystems Services (ES)

How much land can we spare for nature?

– **How to develop mitigation and adaptation measures to climate change?**

Sequence

- Challenges for adaptation and mitigation
- Climate change and agro-ecosystems
  - The need for field work and modelling
  - The problem of scale
  - The need to assess uncertainties
- Conclusions

Challenges for adaptation and mitigation

- Good projections of likely climate changes
- Need these with a timescale

  PRUDENCE FP5 2070-2100

  ENSEMBLES FP6 1950- 2050/2100

- Build existing genetic possibilities into agricultural production systems that can provide optimum combinations of adaptation and mitigation, in an early future

Challenges for adaptation and mitigation

- **Systems analysis** :

  look at systems as a whole and at multiple outcomes that can meet the production and conservation requirements by establishing new production technologies (adaptation) while reducing, as possible, the GHG contributions of agriculture (mitigation)
- **Avoid pursuing single issues** that do not meet this requirement

Productivity is the key

1. Provide food, fiber, fuel, new materials
2. Not individual crops but systems (rotations, basin)
3. Intensification: need for inputs and control of pests and diseases (role for breeding, biotech)
4. Save land for nature/designing the landscape

Challenges for adaptation and mitigation

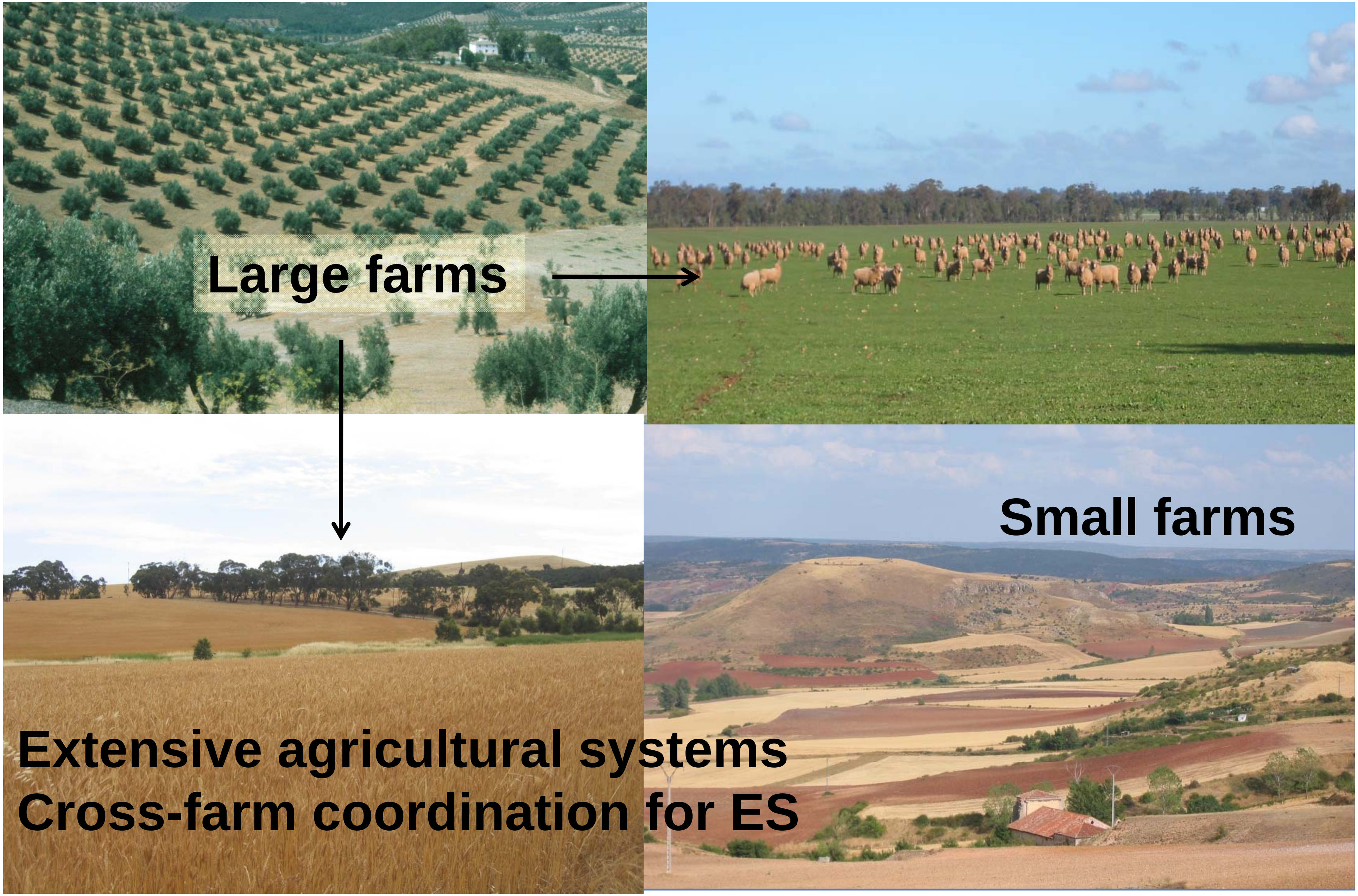
– Biotech is not the only solution. Plenty of diversity in current cultivars (importance for pest/disease control)

  "Genes cannot solve the major problems of crop production without appropriate management systems in which they can express their benefits" (Nature, 2008)

– Beware of complex solutions e.g. excessive pressure on multifunctional agriculture. All is multifunctional but degree is important

– How much land will be spared for nature in 2050

Intensive agricultural systems
Cross-farm coordination for ES


Large farms
Small farms
Extensive agricultural systems
Cross-farm coordination for ES

Climate change and agro-ecosystems

1 –The need for field work and modelling
Linking with productivity and ES

2 – The problem of scale
The need to assess uncertainties of impact projections

1- The need for field work and modelling

Management solutions and options for strategic or representative agro-ecosystems

Tailoring production: developing , implementing specific solutions at the systems level

Development of new technologies

See CC- WG Standing Committee for Agricultural Research SCAR

Focus on the field and farm of representative/strategic agro-ecosystems

1

Models for many purposes (incl. decision makers)

Long-term field experiments and observations linked to simulation models are the only way to establish best techniques for meeting the goals of sustainability, mitigation and adaptation

(sufficient produce, environmentally sensitive, economically feasible, etc.)

Mínguez, X ESA, 2008)

Focus on the field and farm of representative/strategic agro-ecosystems

1

Measurements to assist farmers:

★ Present technologies as 'tool boxes' for optimum management of land/soil, water, nitrogen, C sequestration, emissions of GHG, for specific cases: i.e. farms or farm types within a region

Mínguez, X ESA, 2008)

2- Scale and uncertainties

- **The case of biofuel potential from olive groves**
- **C sequestration in the Dehesas**

- Modelling chains used for impact projections
  [AOGCM-RCM-Cropping option]

Biomass production in plantations (C sequestration ?)

- **Biomass potential: crop residues**
  - Agencia Andaluza de Energía

    Olive pruning: **3t /ha year**

  - iPAR and RUE: **0.9 t/ha year**

    avge Rs: 16. 5 MJ/m^2 day

    25% iPAR; RUE 1 g/MJ

    Olive: Annual Δ Biomass (Villalobos, pers. comm.)

    50 % : fruits and 12.5% : annual pruning

Estimation of C sequestration

- Estimations derived from "Mapas de Cultivos y Aprove-chamientos" and SigPac can differ by a factor of 2
- Agriforestry systems (dehesas) are considered forestry systems; 1996, 2006 guidelines for National Greenhouse Inventories are applied

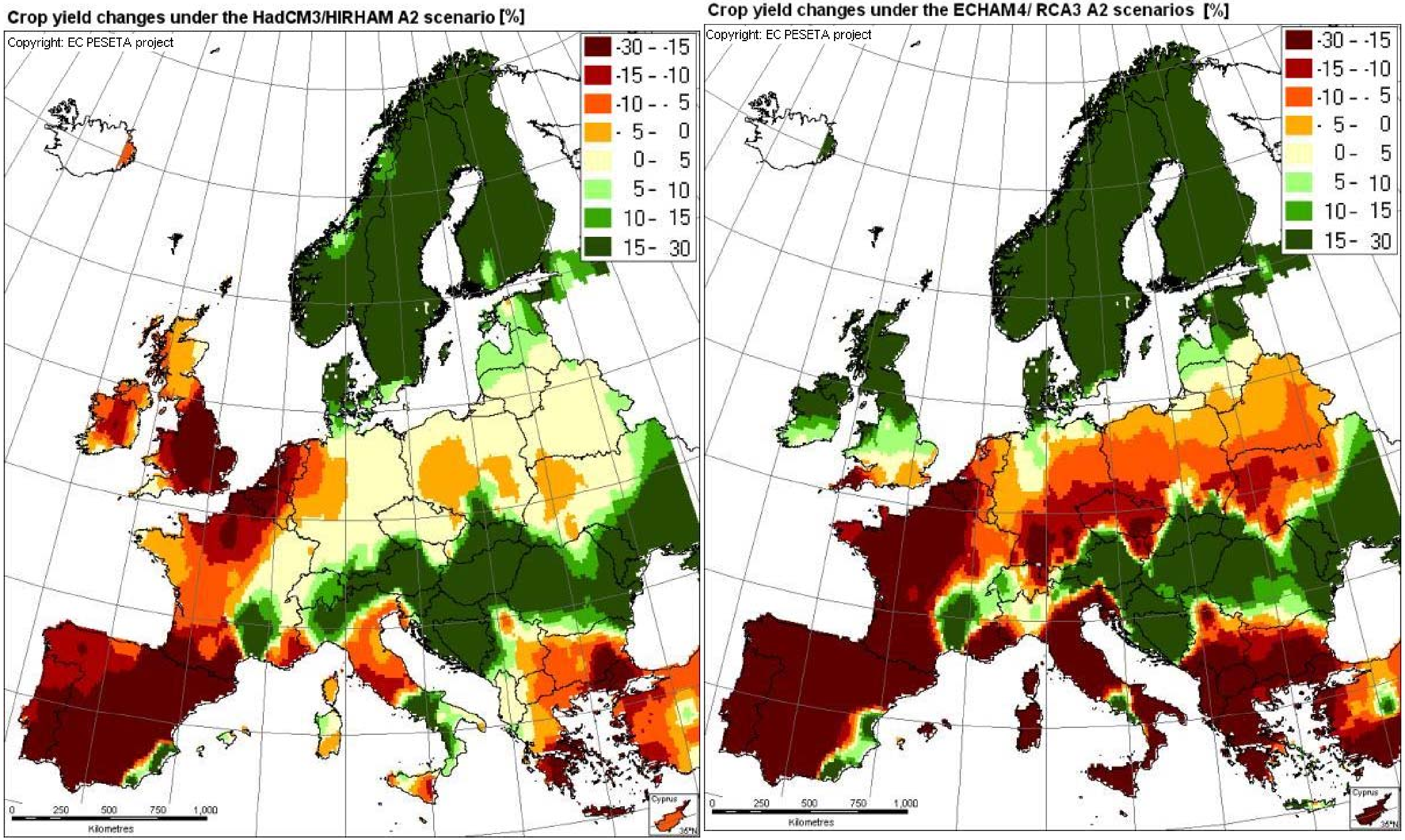
(Fuertes, 2009)

2- Scale and uncertainties

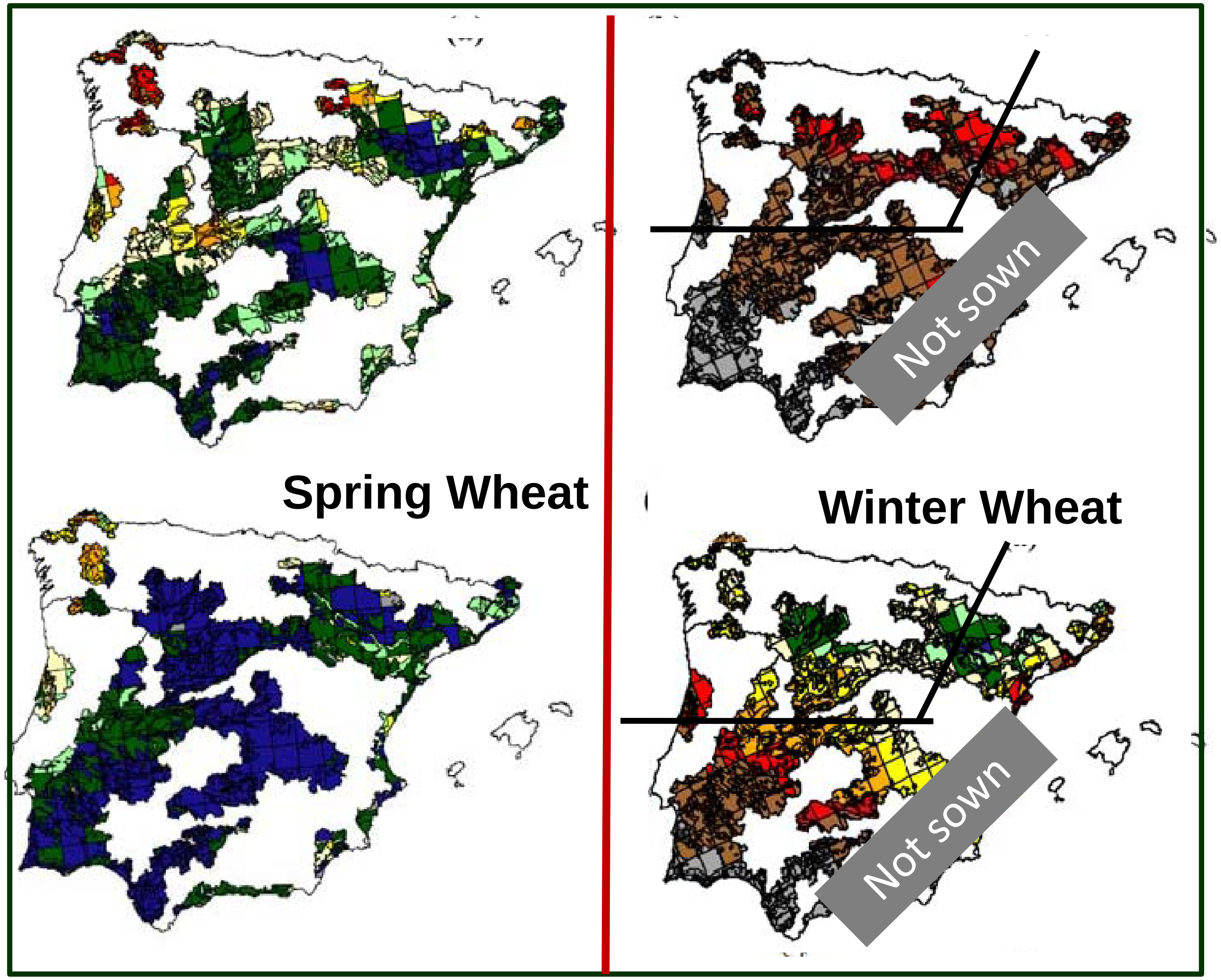
- The case of biofuel potential from olive groves
- C sequestration in the Dehesas

- **Modelling chains used for impact projections [AOGCM-RCM-Cropping option]**

EC JRC IPTS, 2007. EU Project PESETA, http://peseta.jrc.ec.europa.eu/



Crop yield changes (A2/Control) with the modelling chains:
HadCM3-HIRHAM and **ECHAM-RCA**



2

EU Project PRUDENCE

A2/control relative yield of **autumn-sown SW and WW**

A2/current Relative Yield (%)
- < 50
- 50 - 70
- 70 - 90
- 90 - 110
- 110 - 130
- 130 - 150
- 150 - 200
- > 200
- Crop failures

[HadAM3H-REMO-SW]
[HadAM3H-PROMES-SW]
[ECHAM/OPYC4-RCAO-WW]
[HadAM3H-RCAO-WW]

(adap. Minguez et al. 2007, Climatic Change)

AgSystems

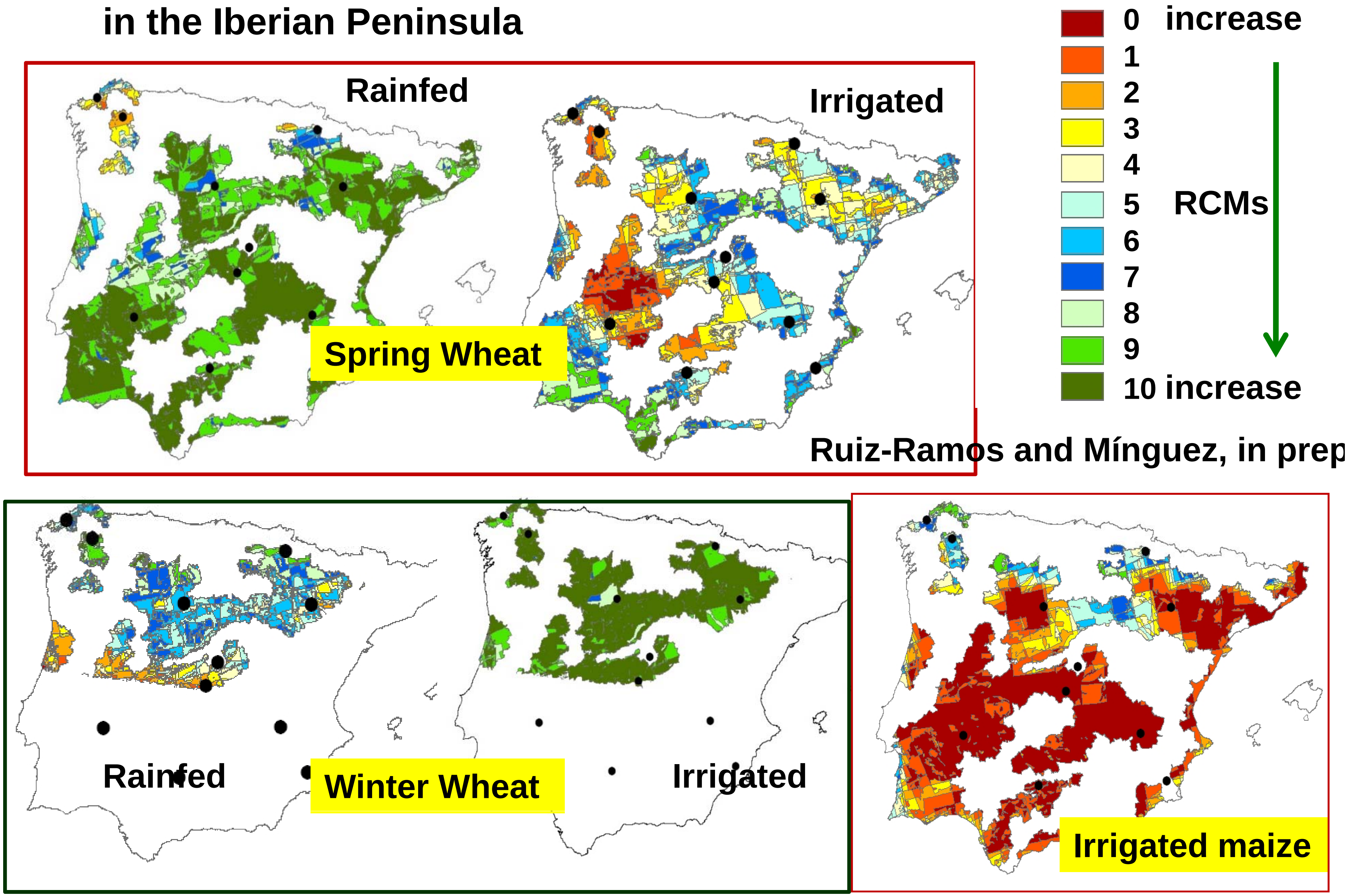
Uncertainties

- Uncertainties are incorporated in all steps of the modelling chain

  [AOGCM-RCM-Cropping option]

- Three main sources: climate modelling, crop modelling, and the connections between the two
- Several ways to evaluate uncertainties

Maps of coincidences of the projected impact on crop yield in the Iberian Peninsula



Conclusions
Challenges for adaptation and mitigation

– Climate modelling: projections, weather forecasts

– Systems analysis

representative/strategic agro-ecosystems

co-innovation with farmers

– New technologies (eg robotics)

– New gene technologies

How much land can we spare for nature by 2050?

Thank you

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