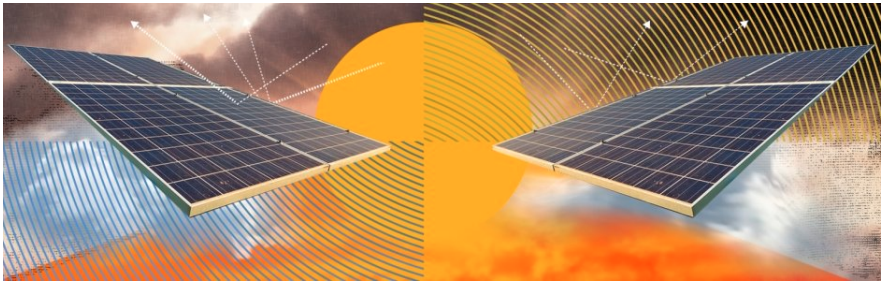
EPhysLab

Universidade Vigo

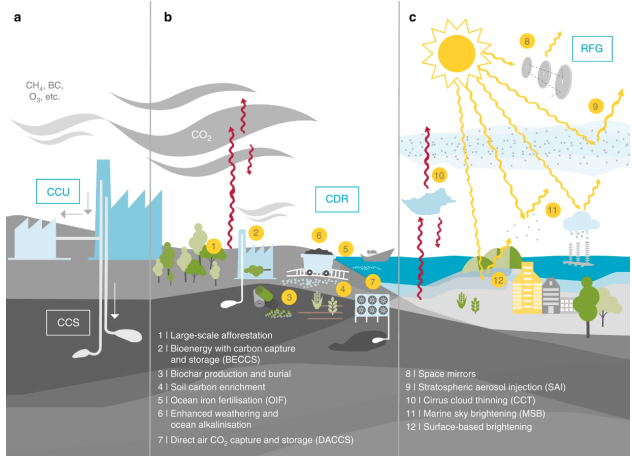


La energía fotovoltaica en la península ibérica bajo escenarios de inyección de aerosoles de azufre en la estratosfera

S. BAYO-BESTEIRO, C. PÉREZ-SOUTO, J. C. ANTUÑA-MARRERO, L. DE LA TORRE, J.A. AÑEL

Funding


Partners



Lawrence et al. (2018) Nat. Commun.

Motivation

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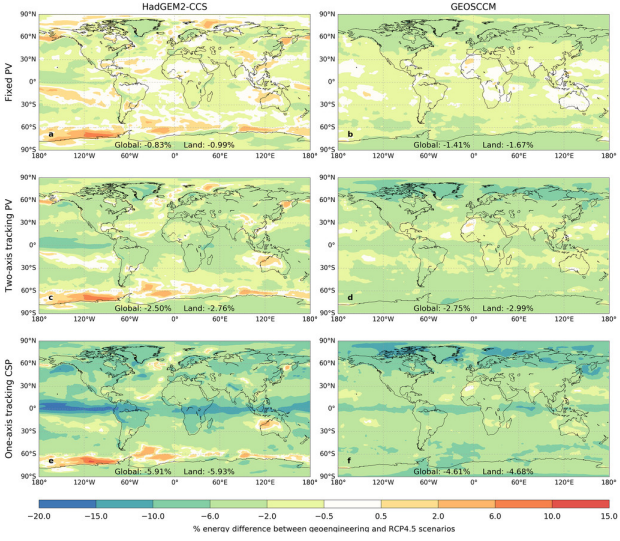
- Stratospheric Sulfate Aerosol Injection (SAI) is among the top solutions proposed.
- SAI is about decreasing solar radiation coming into the troposphere.
- Therefore, SAI could be a risk for solar power production and energy security.
- Despite it, little work has been done on this.

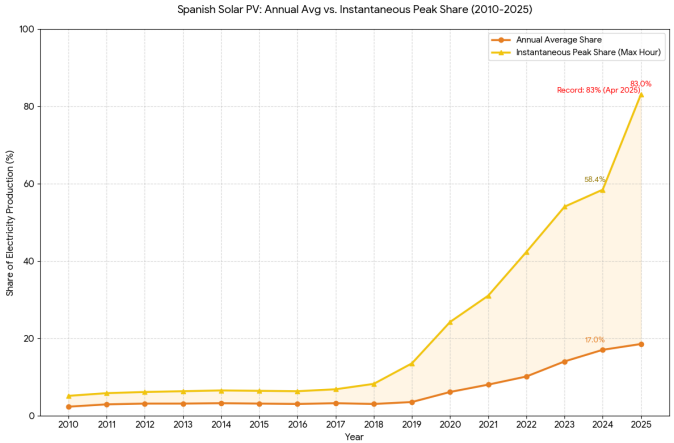
2040-2059 SAI vs 1980-2005
RCP4.5 + SAI (10 Tg/year (left) and 5 Tg/year (right)) at tropics



Smith et al. (2017) J. Appl. Meteorol. Climatol.

What does it mean for Spain and who cares?

Motivation



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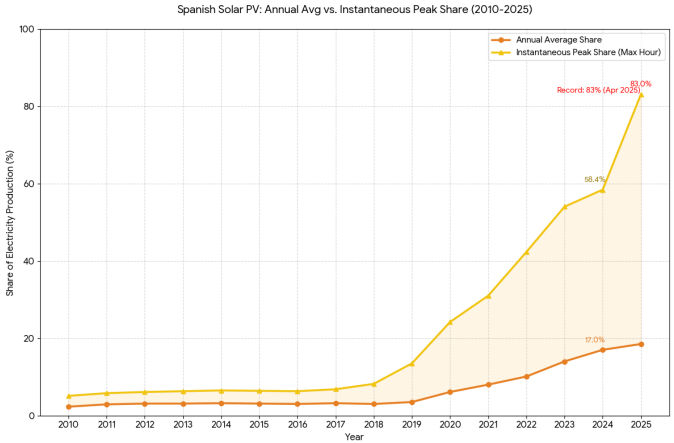

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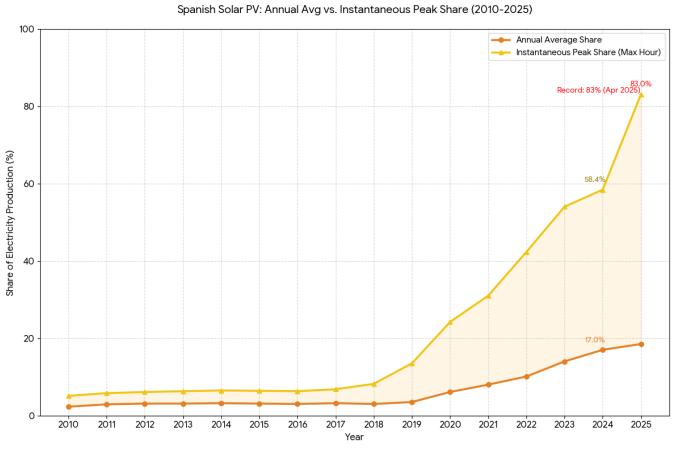

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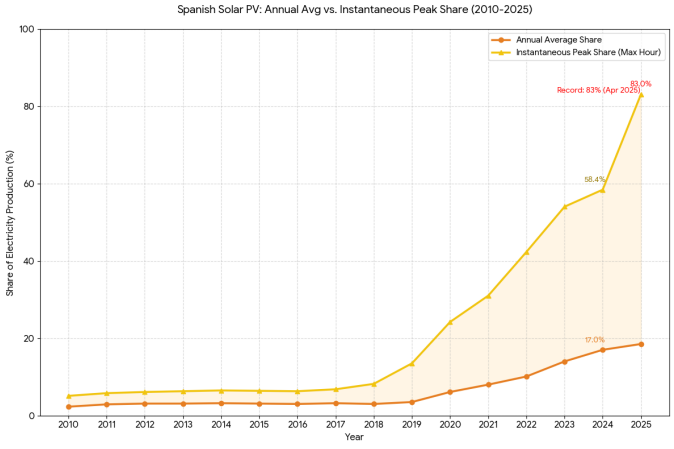

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- **Socioeconomical:**
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  - SAI could impact future ability to export energy, electricity and green hydrogen.
- **Scientific/gaps:**
  - Little previous research on the topic (one paper, few models, one member...).
  - Previous work is global, not regional.
  - Information available only up to 2050.
  - Low top models.
  - RCP4.5 scenario.
  - 1 single point injection.
  - PV output reported with assumptions, not the resource.
  - Comparisons to a world that is not counterfactual.

Methodology

Data

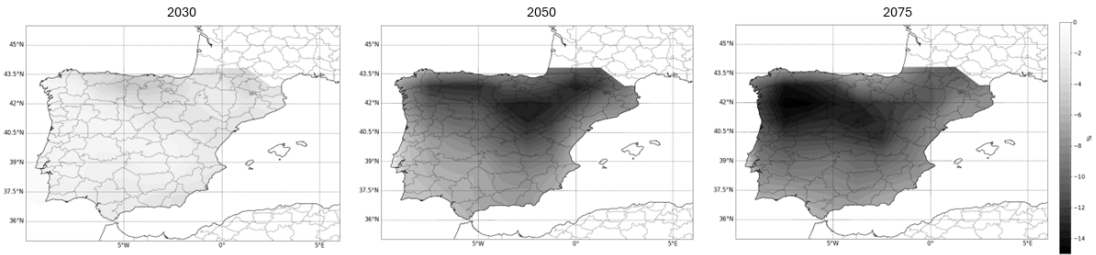
- GLENS data (Tilmes et al., 2018).
- WACCM4 - high top model.
- 21 ensemble members.
- Realistic and dynamic SAI to keep 2020 conditions.
- Maintain interhemispheric and equator-to-pole surface temperature gradients.
- RCP8.5.
- 4 points injection (15° and 30°).
- Simulations up to 2099.

PV_{res} computation (Jerez et al., 2015)

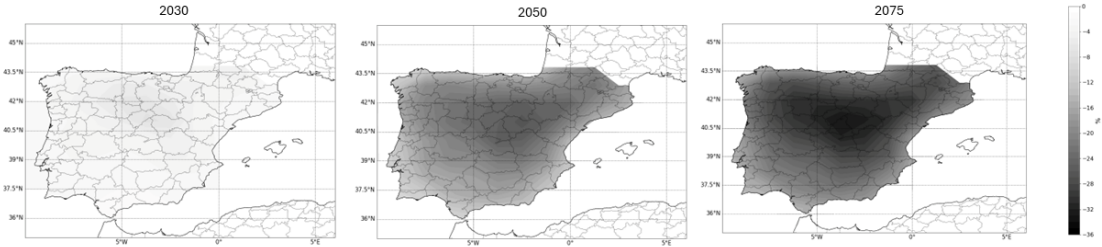
$$\text{PVpot}=\alpha_1\ \text{RSDS} + \alpha_2\ \text{RSDS}^2 + \alpha_3\ \text{RSDS} \cdot \text{TAS} + \alpha_4\ \text{RSDS} \cdot \text{scfWind}$$

Comparing each year with its counterfactual year without SAI

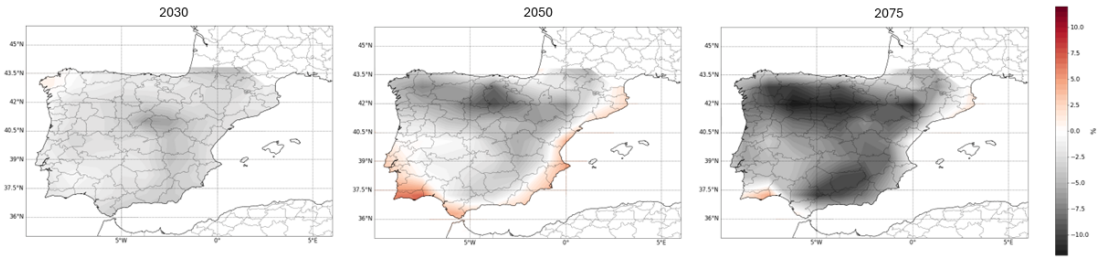
ΔRSDS (%)



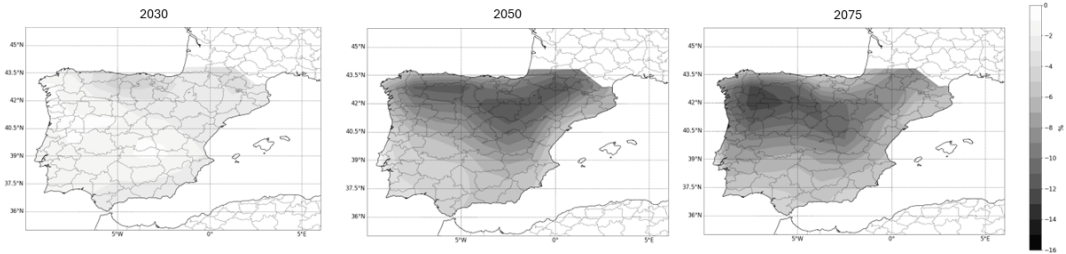
ΔTAS(%)

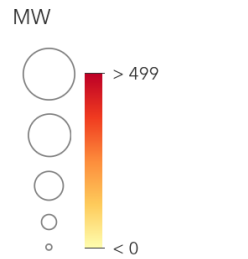


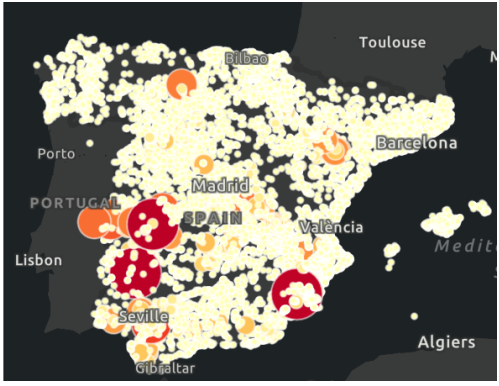
ΔWind(%)



ΔPVres(%)







Summary of impacts

	2030	2050	2075
ΔPVres (%)	-2.11	-6.70	-6.65
ΔTAS (%)	-3.04	-15.94	-21.32
ΔWind (%)	-2.23	-0.77	-4.48
ΔRSDS (%)	-2.32	-7.73	-8.64
Contribution of changes in TAS to ΔPVres (%)	-12.67	-16.85	-28.77
Contribution of changes in Wind to ΔPVres (%)	3.03	1.9	1.41
Contribution of changes in RSDS to ΔPVres (%)	84.30	81.25	69.82

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What is the role of clouds?

ΔPVres clear sky(%)

Conclusions

- Under SAI (GLENS experiments) changes in irradiance continue to be the main driver for PV_{res}.
- Considerable lost happens even for the near-term (2030).
- Lost of up to 7% for the mid and long-term.
- The cloud coverage under SAI scenarios has a negative impact on PVres that accounts for between 30% and 50% of the change.
- Northern regions are the most affected.
- Critical locations with large PV installations are some of the ones suffering "lower" changes.
- On average the results agree with previous ones by Smith et al. (2017).