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Agrovoltaic plants and optimisation of energy production from cultivated fields

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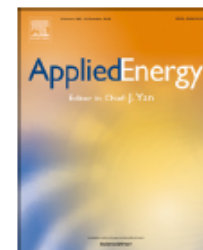


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Agrivoltaic systems to optimise land use for electric energy production

Stefano Amaducci^{a,*}, Xinyou Yin^b, Michele Colauzzi^a

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^b Centre for Crop Systems Analysis, Department of Plant Sciences, Wageningen University & Research, Droevendaalsesteeg 1, Wageningen, The Netherlands



HIGHLIGHTS

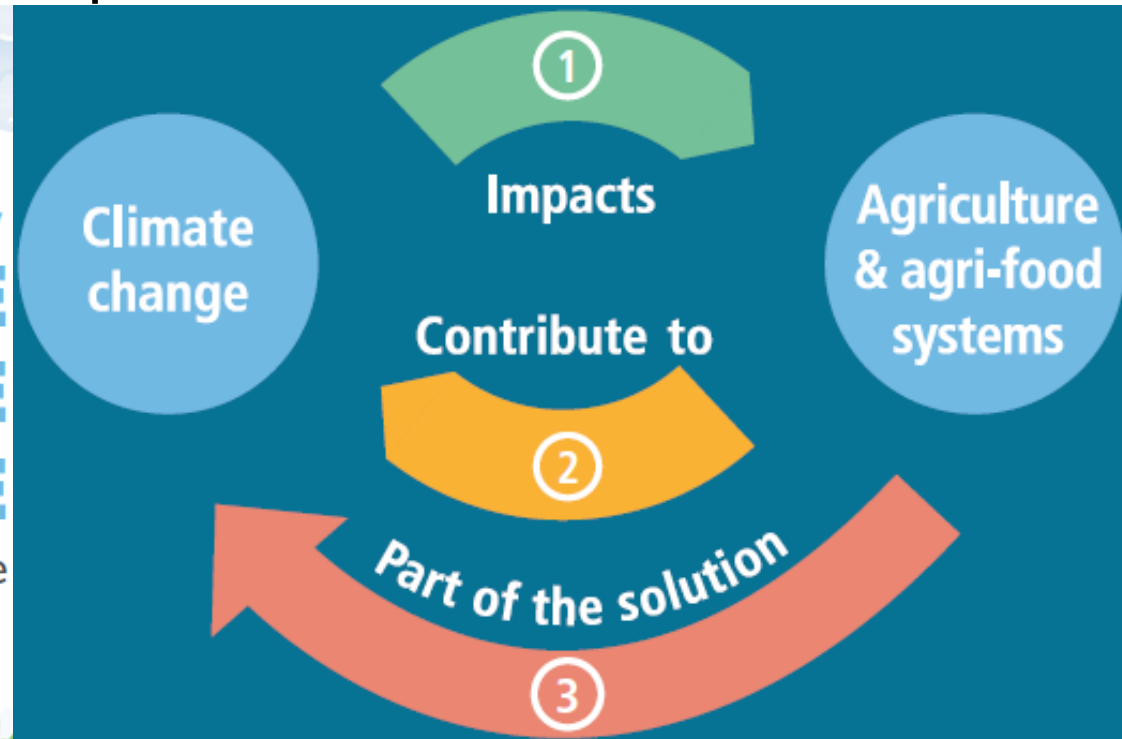
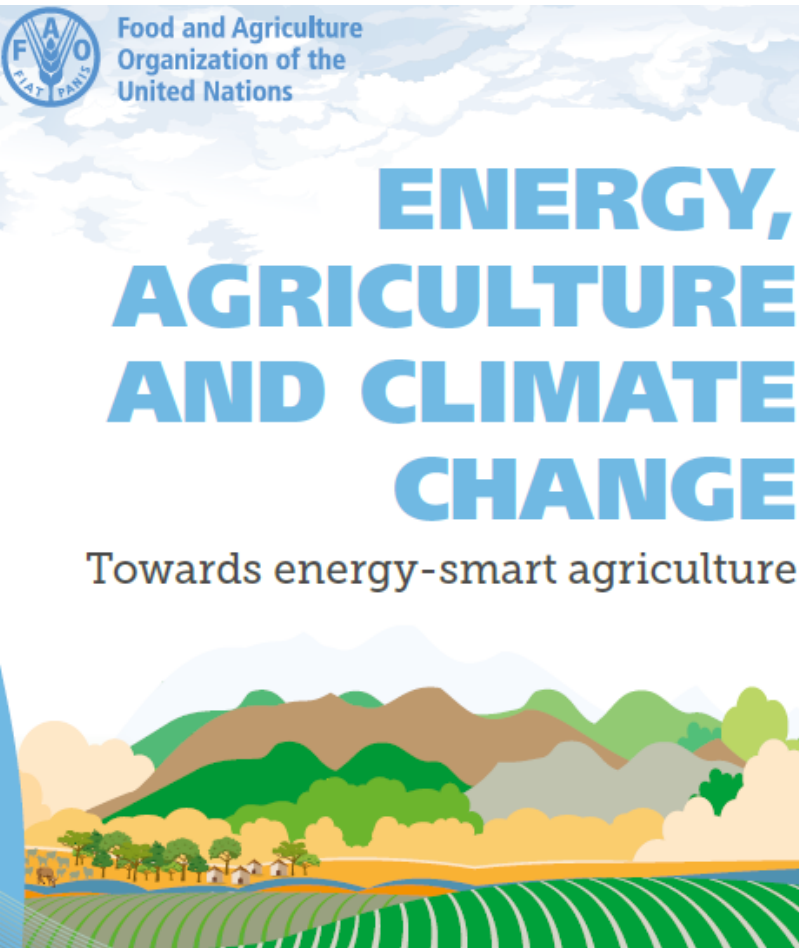
- A simulation platform to simulate crops under agrivoltaic was developed.
- Shading under agrivoltaic improves soil water balance and increases water saving.
- Agrivoltaic conditions increased and stabilized yield of rainfed maize.
- Agrivoltaic doubled renewable energy land productivity.



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Agriculture and climatic change: the triple connection





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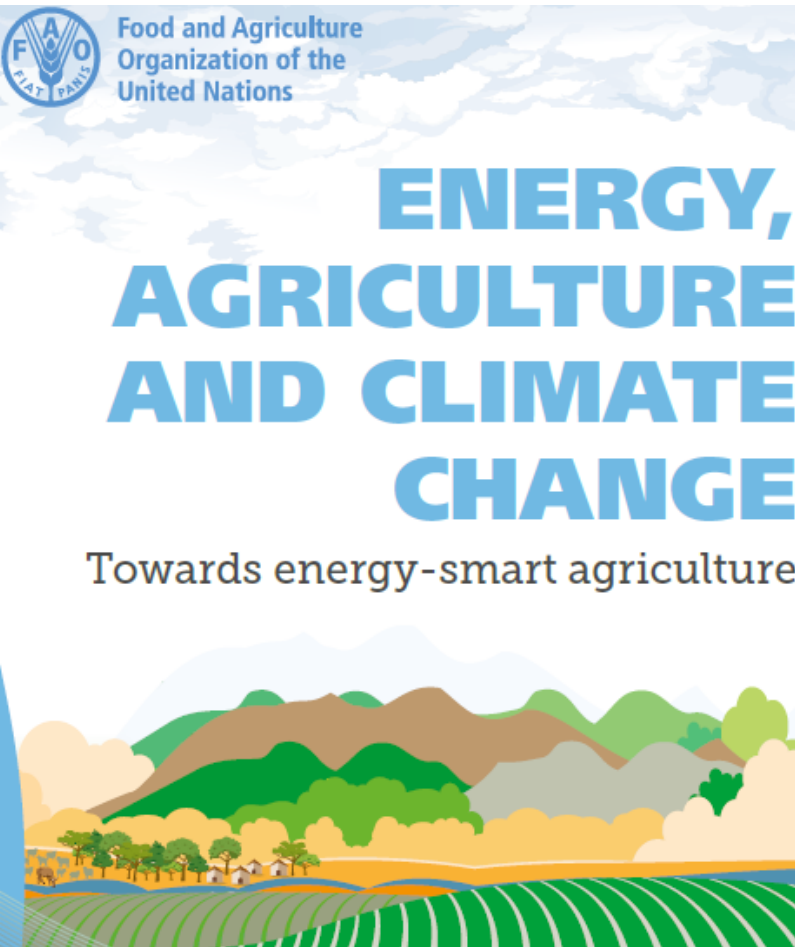
Agriculture and energy

Improve energy efficiency

- Optimise fertilizer use
- Optimise water use
- Conservative agriculture
- Precision agriculture

Renewable energy production

- Biogas
- Biomass plants
- Biofuels
- Wind energy, Photovoltaics





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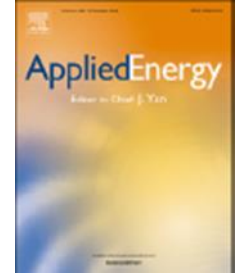
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Agrivoltaic systems to optimise land use for electric energy production

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Goals

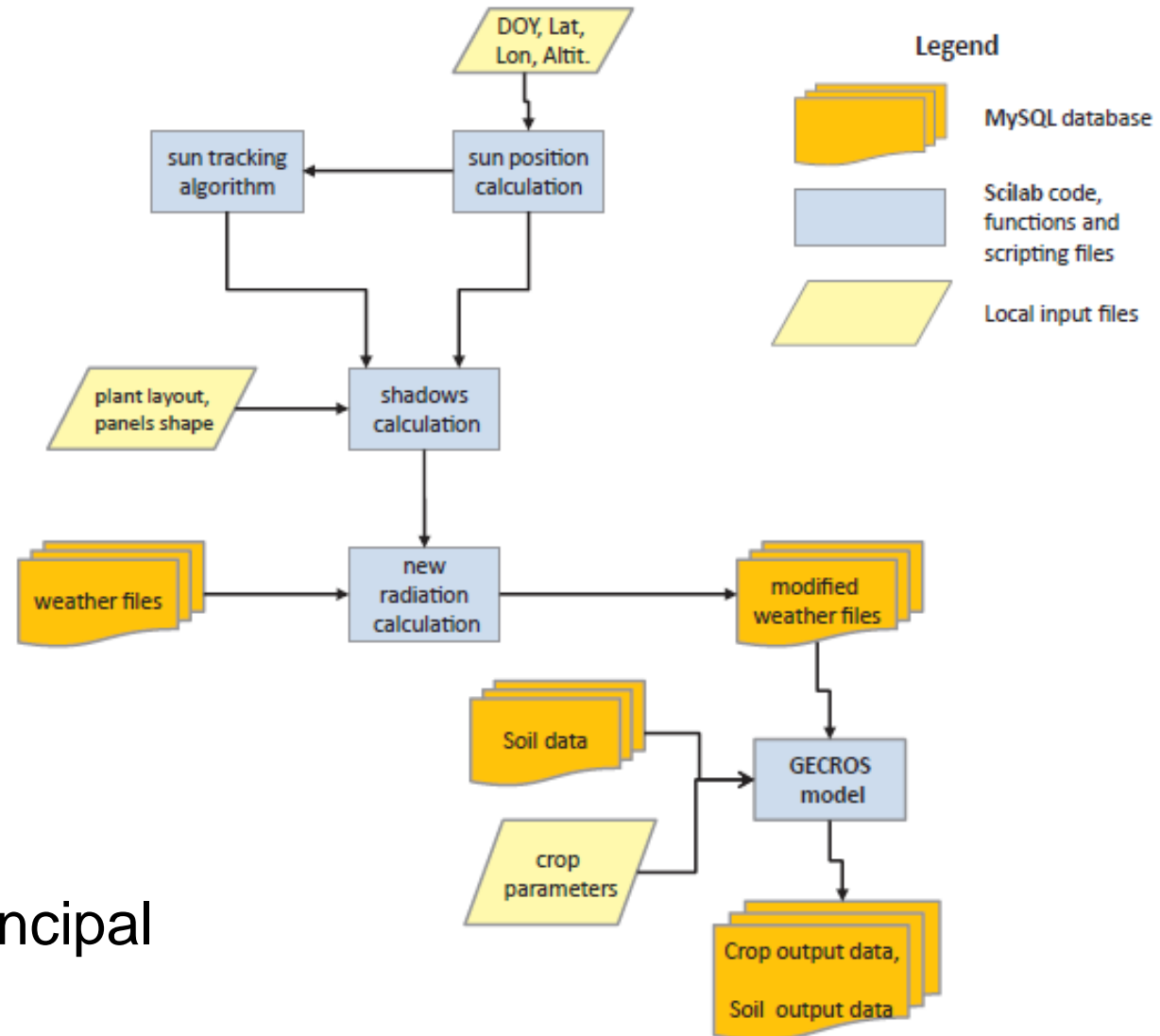
1. To realise a simulation platform to optimise vegetable and energy production under Agrovoltaico[®];
2. To simulate maize yield in Agrovoltaico[®] scenarios;
3. To compare the efficiency in land use of existent system (biogas from maize and ground PV) and Agrovoltaico[®] for energy production.



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Goal 1



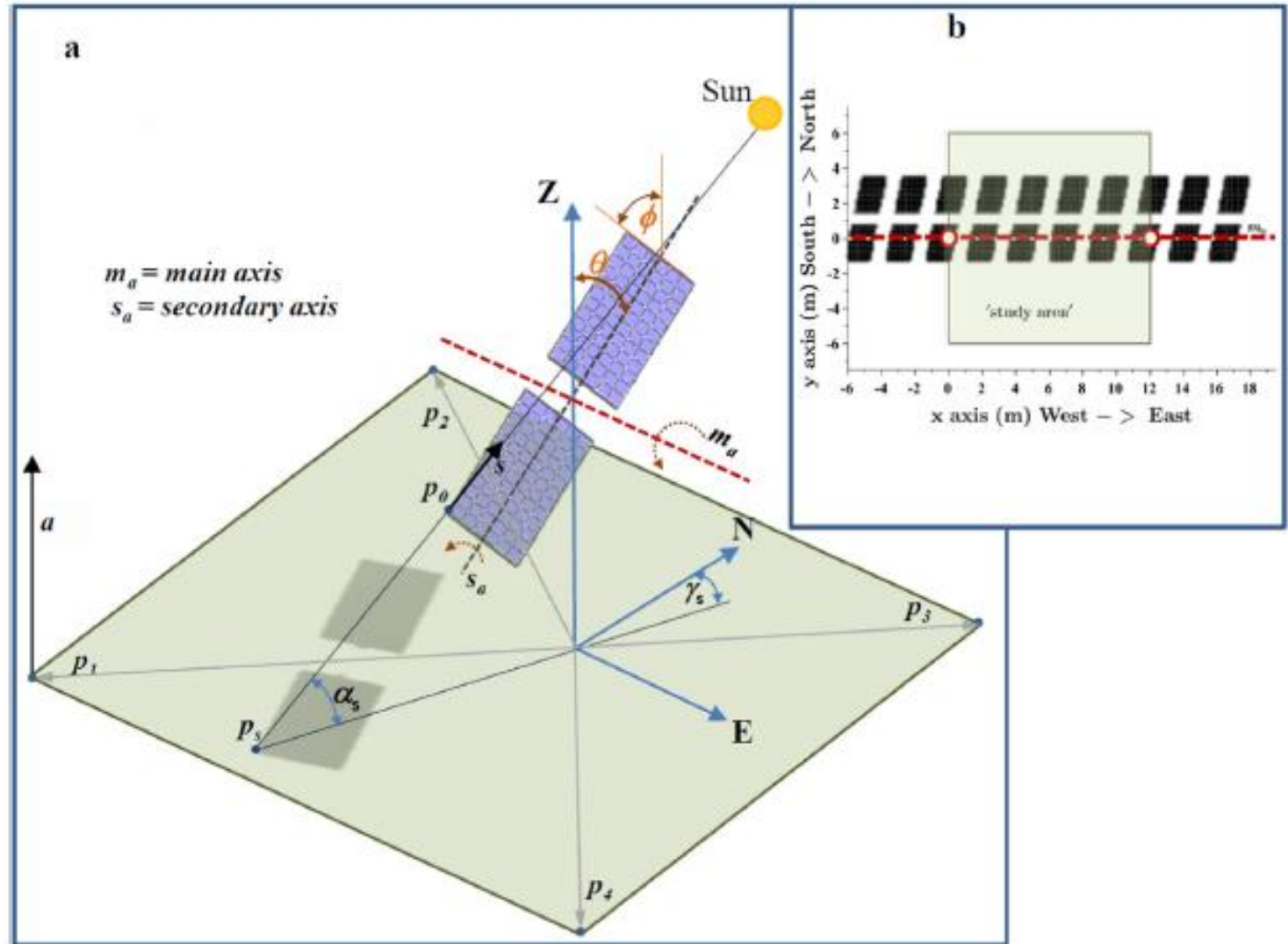
Simulation platform principal
elements diagram



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Goal 1

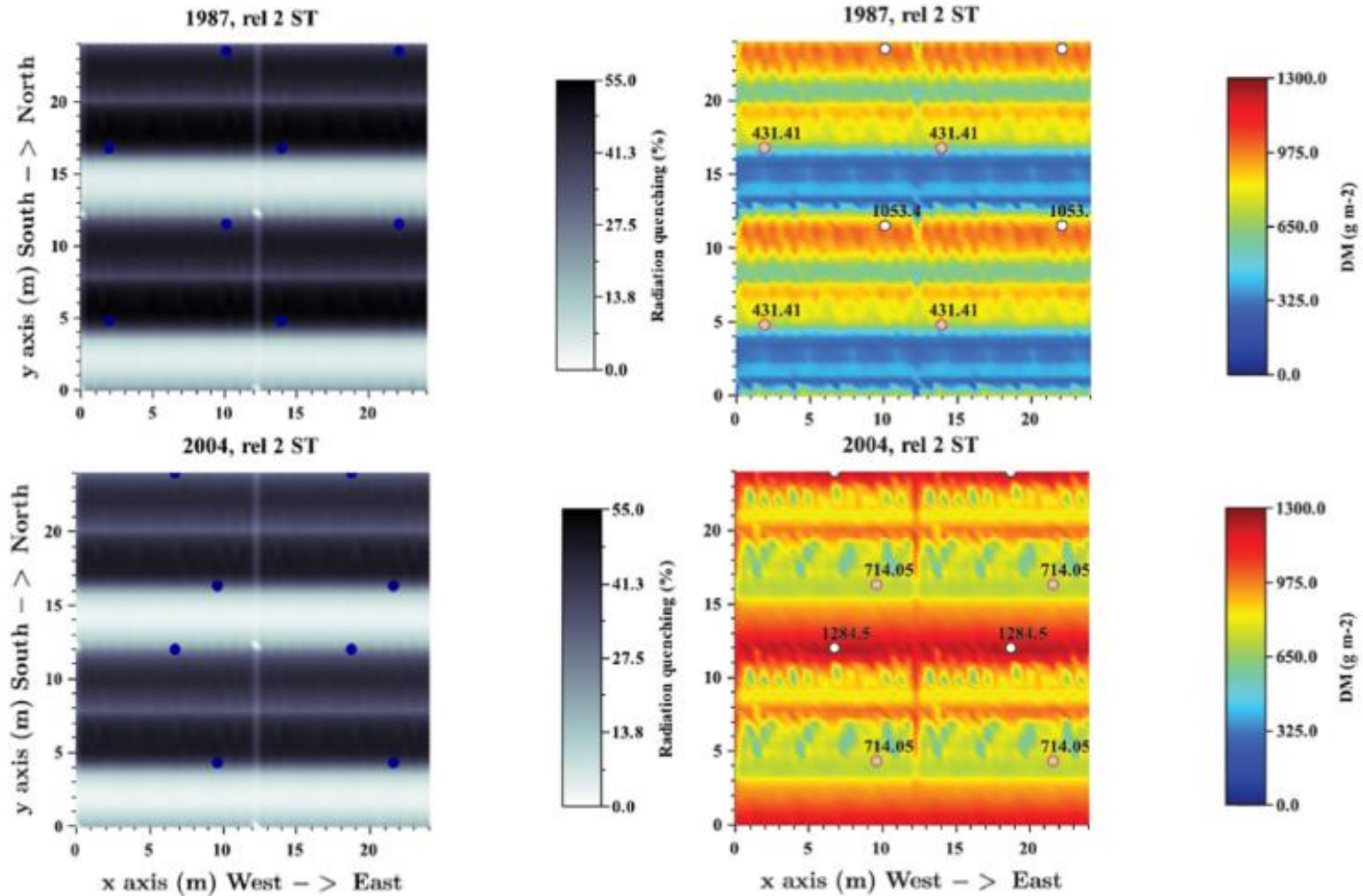




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Goal 1

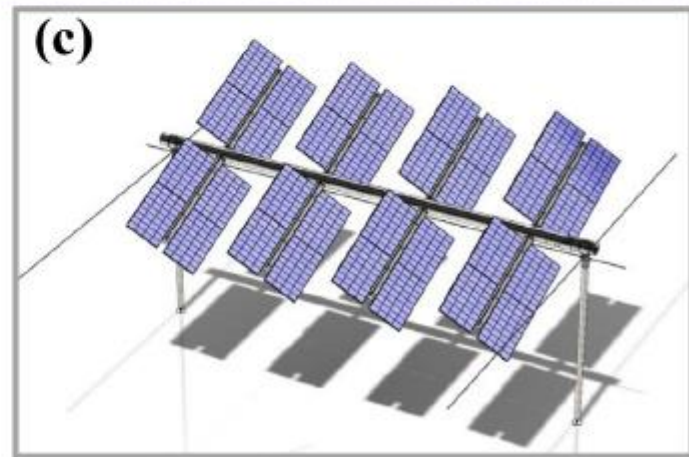
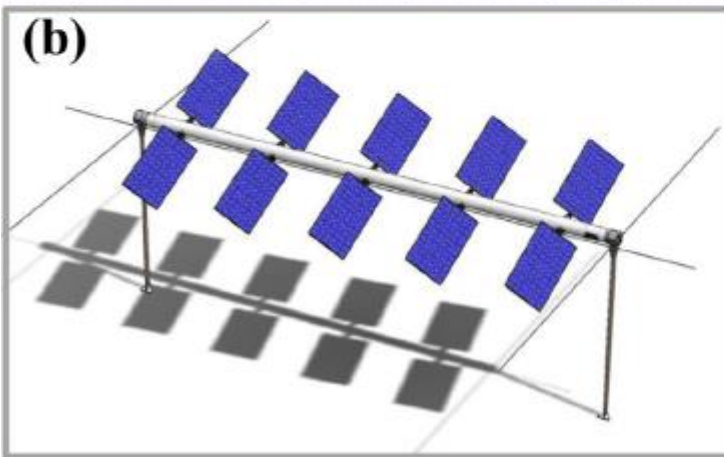




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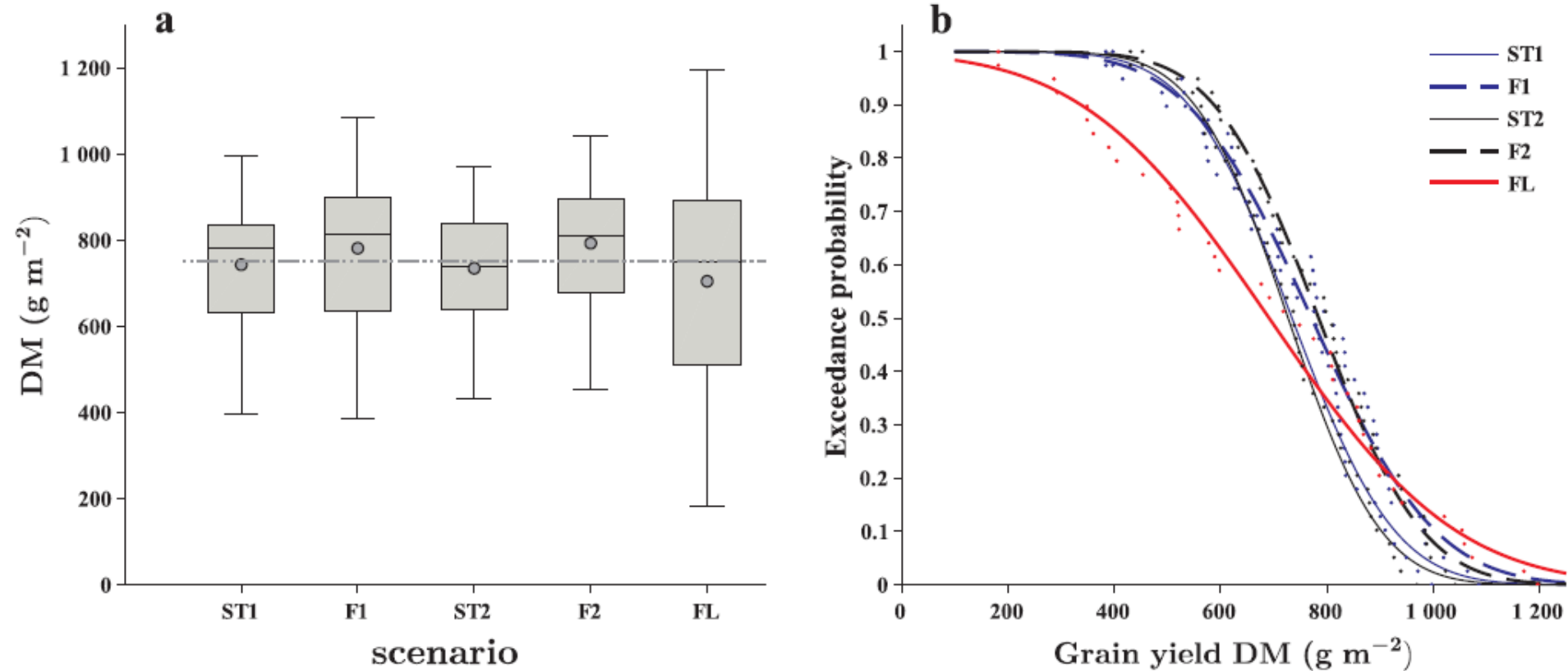
Agrovoltaic plants and optimisation of energy production from cultivated fields

Goal 2 To simulate maize yield in Agrovoltaico® scenarios





Goal 2 To simulate maize yield in Agrovoltaico® scenarios





Obiettivo 3 Produzione di energia elettrica sotto Agrovoltaico vs Biogas e Fotovoltaico

Resa mais sotto Agrovoltaico

Elettricità Agrovoltaico

$$LER_{sn} = \frac{Y_{crop.agv_{sn}}}{Y_{crop.FL}} + \frac{Y_{kWh.agv_{sn}}}{Y_{kWh.PV}}$$

Resa mais Pieno campo

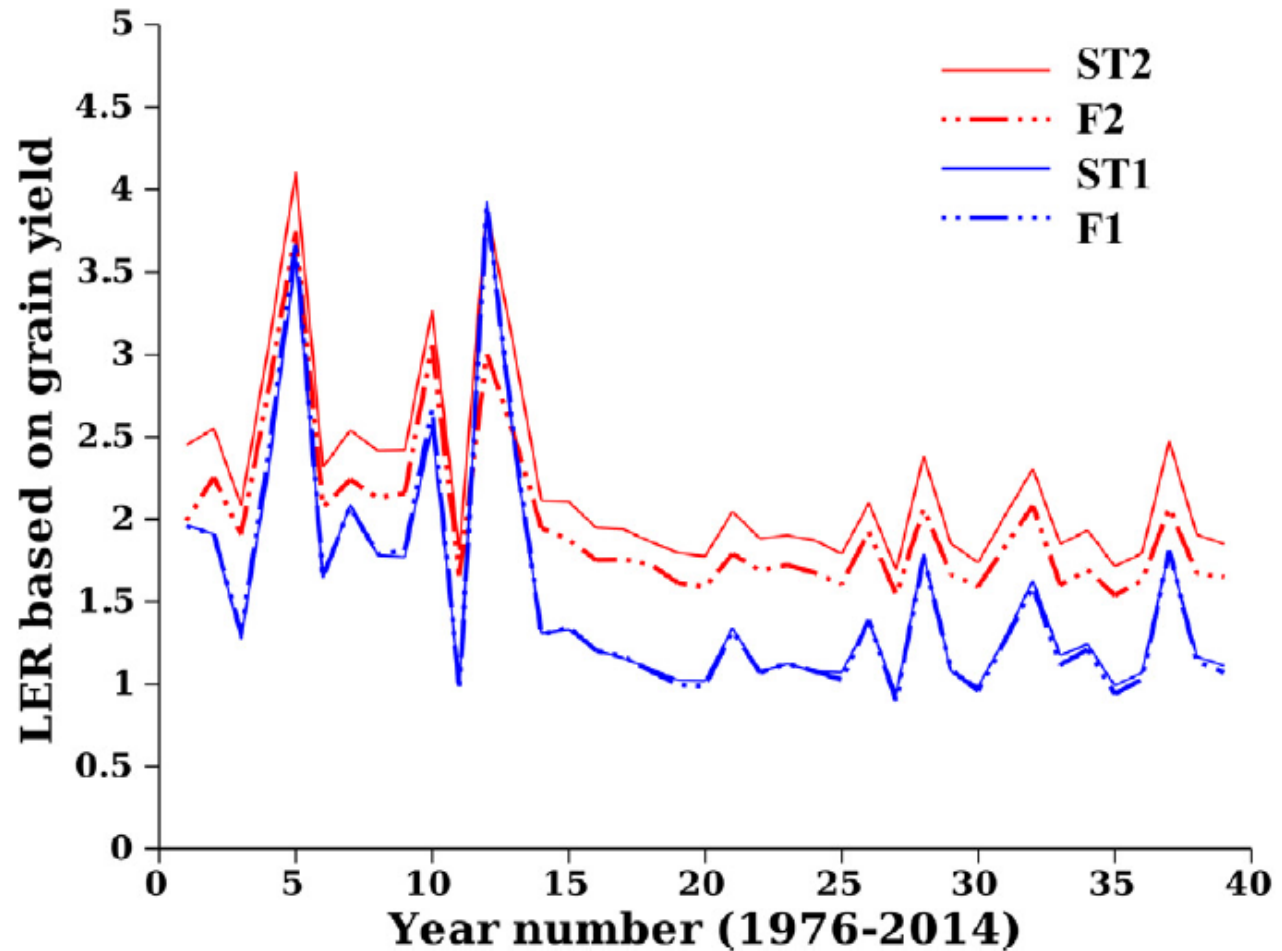
Elettricità Fotovoltaico a terra



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Goal 3 Electric energy production under Agrovoltaico vs Biogas vs photovoltaics





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Piacenza Province



134 ha => 75.4 GWh



1400 ha => 36.44 GWh



123 ha

**PV electric energy
64.0 kWh·m⁻²**

**Biogas electric energy
2.5 kWh·m⁻²**



Conclusions

- Simulation platform has been realised;
- Mais with no irrigation has higher and stable yields under Agrovoltaico than in full light;
- Land use for energy production is much more efficient with Agrovoltaico than with biogas or ground PV

Outlook

- To validate the results obtained (2018);
- To do an economical-environmental analysis;
- To optimise the Agrovoltaico system (agronomic technics – panel orientation)



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Thank you for your attention



UCSC Field Crops Group

Developing sustainable solutions for healthy agroecosystems



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