NETWAT - *West African Mineral Dust:* a key in the NExus ClimaTe – WATer – Energy

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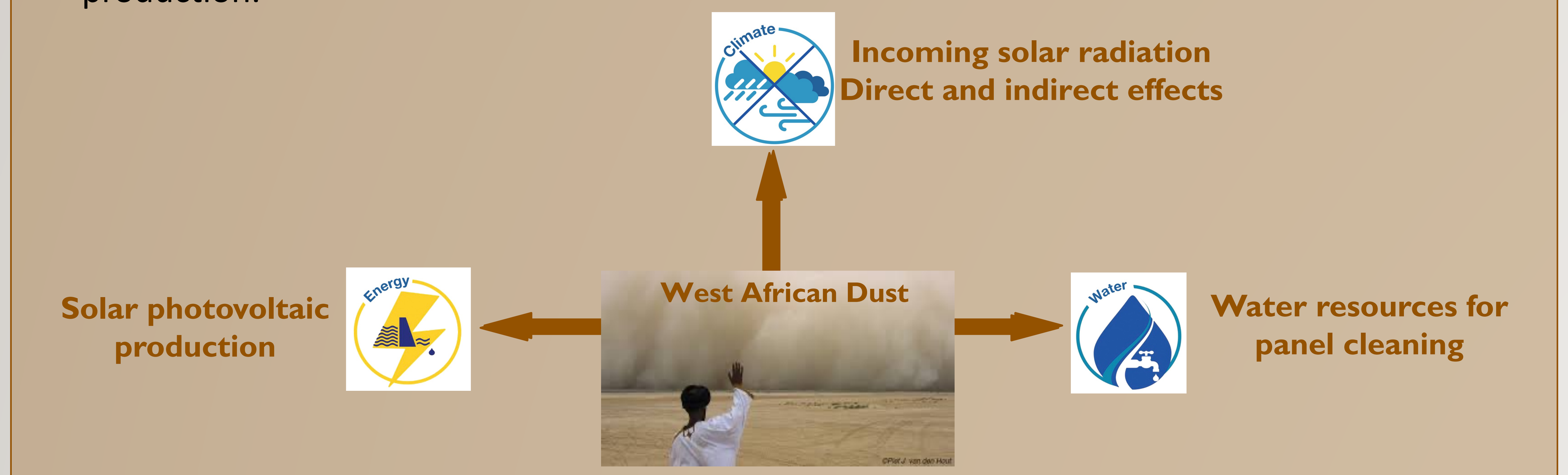
Context

Dust has **direct** (solar irradiance) and **indirect** (cloud interaction) **radiative effects** that **impact the renewable resources**. **Dust deposit** on solar panel can lead to significant **power production losses**. The **use of water to wash off dust** deposited on panels **adds new pressure** on an already scarce resource, threatening system sustainability. This is particularly critical for **West Africa**, poised for a fast development of renewable energy production.



Annual dust deposition flux

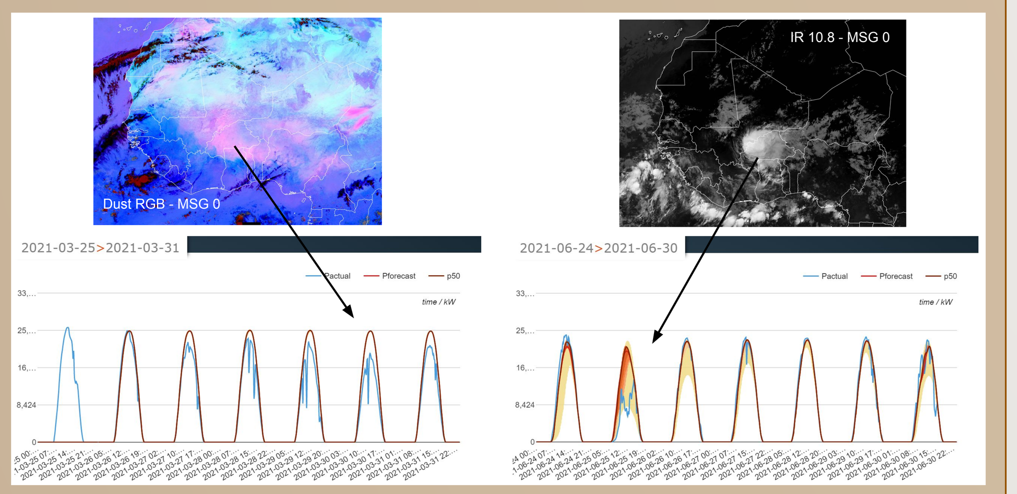
West Africa records the highest atmospheric dust load.

Dust monitoring is monitored by the **AERONET network** of sun spectro-photometers that measure **Aerosol Optical Depth.** In situ dust concentration and deposition have been measured since 2006 in the Sahel by the French National Service for Observation (**SNO**) **INDAAF**.

Deposition fluxes (in g m^{-2} yr^{-1}) measured by passive deposition collectors inside and close to the north of Africa (adapted from Marticorena et al., 2017) and predominant transport paths of Saharan dust (yellow arrows).

Solar production forecasting at the Zagtouli solar farm

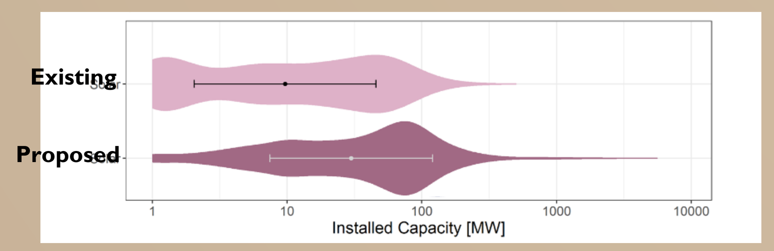
Numerical weather forecast fails to properly predict PV production (misrepresentation of the dust cycle, difficulty to simulate small scale meteorological events (mesoscale convective systems)).



Solar production forecasts at the Zagtouli solar farm (©Steadysun)

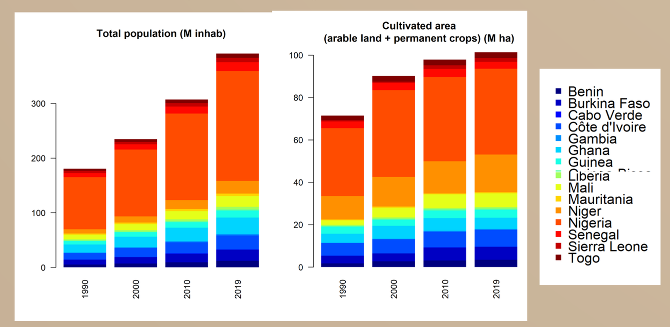
In addition, global chemistry and transport models **fail to simulate the global pattern of dust deposition**.

Water footprint in a context of solar farm development



Distribution of Solar Power Plant data entries and status for solar power (database from Peters et al. 2023)

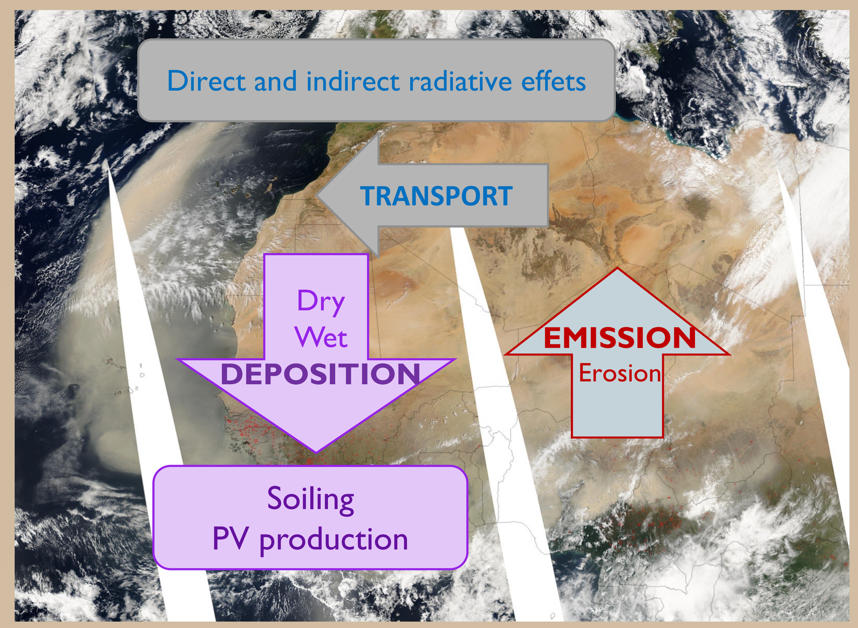
Decision support tools are needed to ensure a maintenance of solar PV farms that is:
(a) effective in terms of energy production
(b) sustainable in terms of water use.
Such tools should account for available **current** and **future** water **resources** and water **uses** (domestic, agriculture, industry)



Total population (domestic uses) and cultivated area (potential uses for agriculture) from 1990 to 2019 (data source: AQUASTAT, FAO)

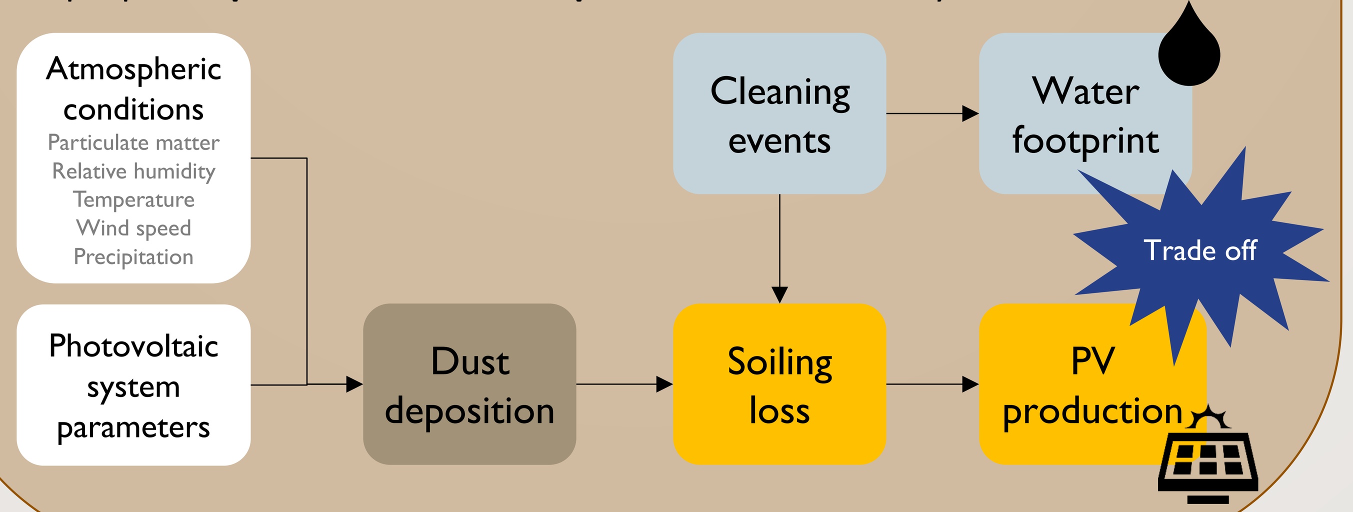
Main objectives

To improve our understanding of the **West-African dust cycle** and its **direct/indirect effects on solar resource and production**.



To account for dust effects in a power production forecasting chain and build reliable and efficient decision-making tools to optimize power grid management and solar production.

To address the issue of the **water footprint of solar farms**.
To propose **optimal maintenance plans** based on dust dynamics.



More information

https://netwat.osug.fr/

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Funds and Support

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References

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Work organisation

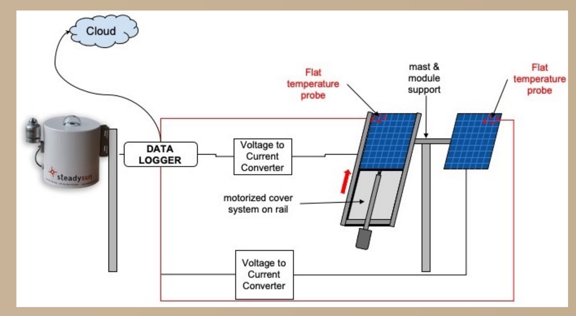
Two pilot sites

Ten Merina (Senegal)
92 000 panels, 46 ha
30 MW
(**4% of Senegal** today's consumption)

Zagtouli (Burkina-Faso (BF))
130 000 panels, 60 ha
34 MW
(**4% of BF** today's consumption)

Aerosols cycle and solar production
☞ Measurement of dust deposit on panels
☞ Link between deposition and power loss
☞ Innovative experimental setup

Total (left) and wet (right) deposition collectors deployed in the INDAAF network.



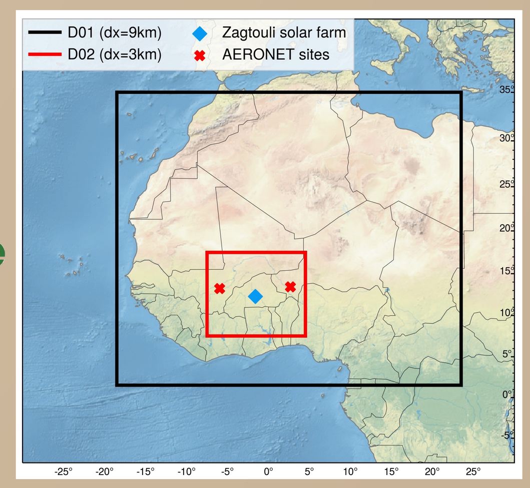
Steadysun soiling measurement system.

Forecasting chain
☞ CHIMERE deposition model
☞ Forecasting models (WRF; WRF-CHIMERE)

What are the direct and the indirect effects on cloud formation ? How to improve the solar production forecasts based on data assimilation techniques ? What are the best data to assimilate ?

Sustainable management
☞ Maintenance decision support tool
☞ Water demand assessment

When should I clean my solar panels to minimize PV production loss? Which scenario allows me to minimize my water footprint?



One-way nesting domains for WRF-CHIMERE simulations. Black domain forced by ERA5

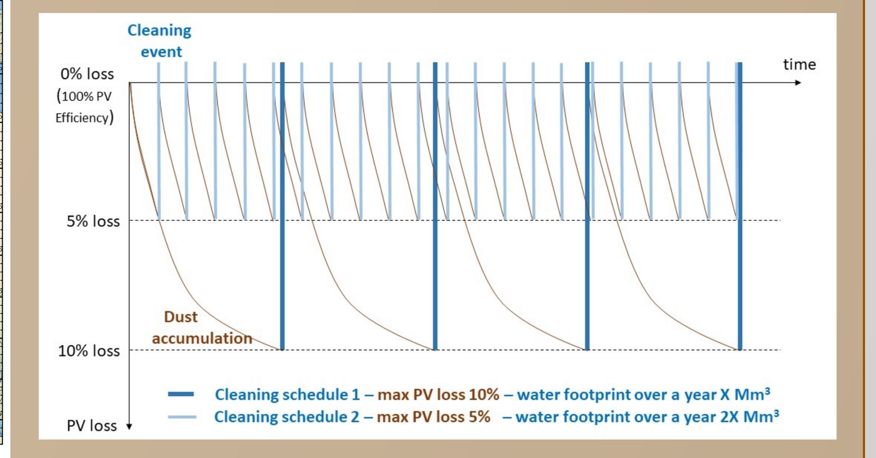
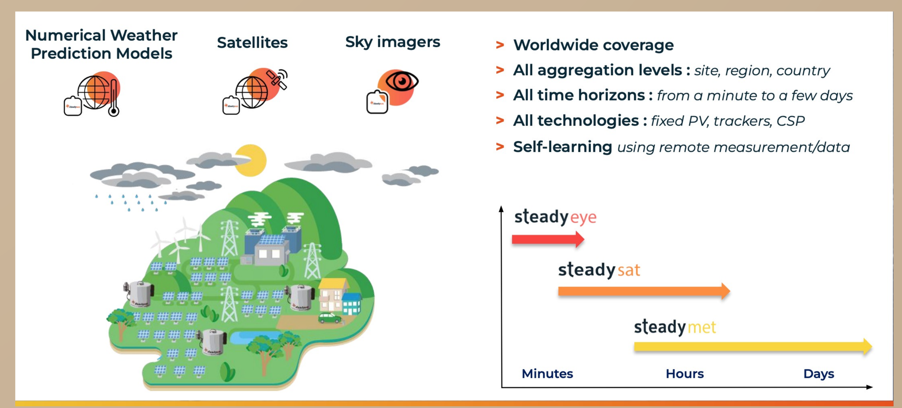


Illustration of 2 cleaning schedules and their influence on the PV loss and water footprint.



Steadysun's forecasting chain.