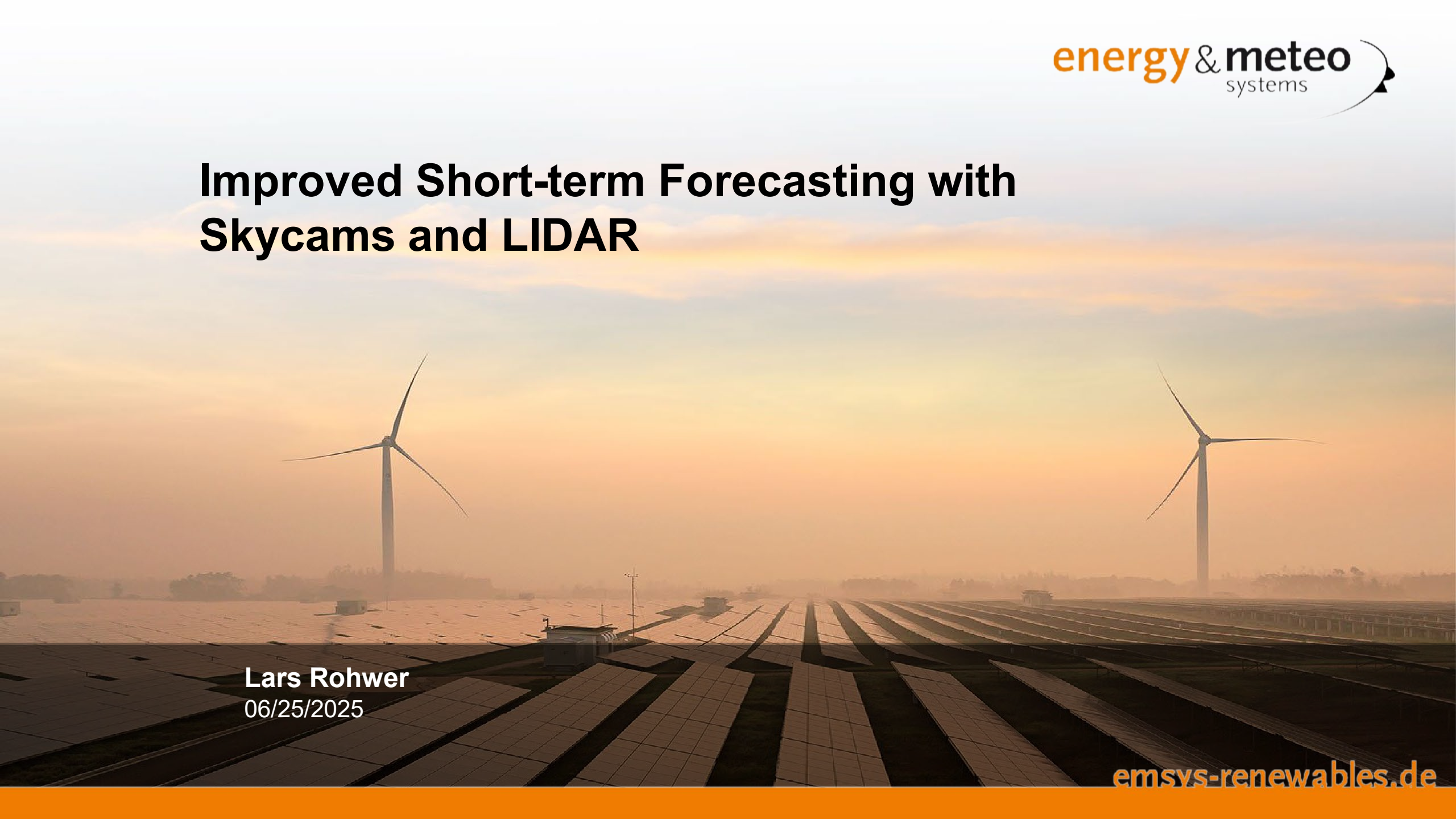
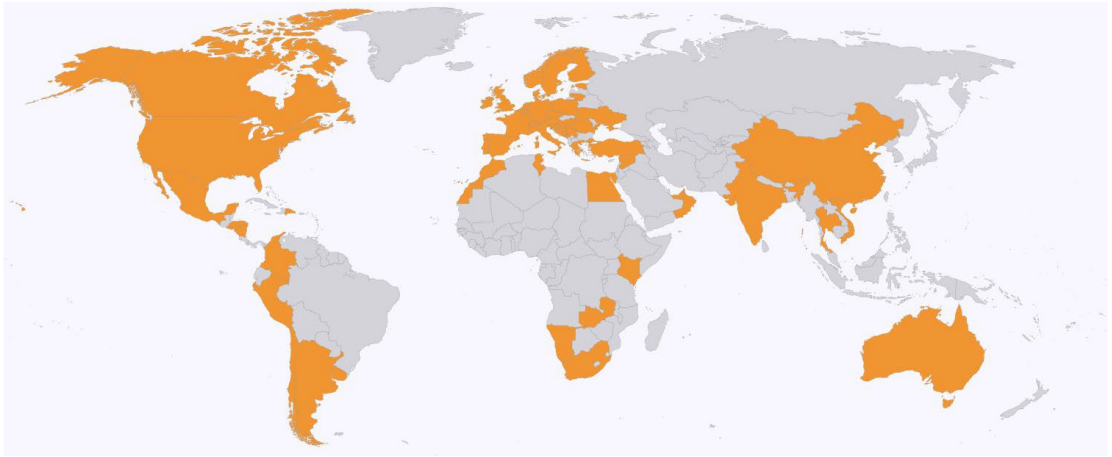
Improved Short-term Forecasting with Skycams and LIDAR



Lars Rohwer
06/25/2025

Three companies, one goal: 100% renewable energy!

- Headquarters in Oldenburg, Germany
- Approx. 250 employees
- Operations on all continents
- Over 20 years of experience



emsys grid services

- Grid Operation
- Network Platform

energy & meteo systems

- Wind & Solar Forecasts
- Consulting

emsys vpp

- Virtual Power Plant
- Balancing Power Services

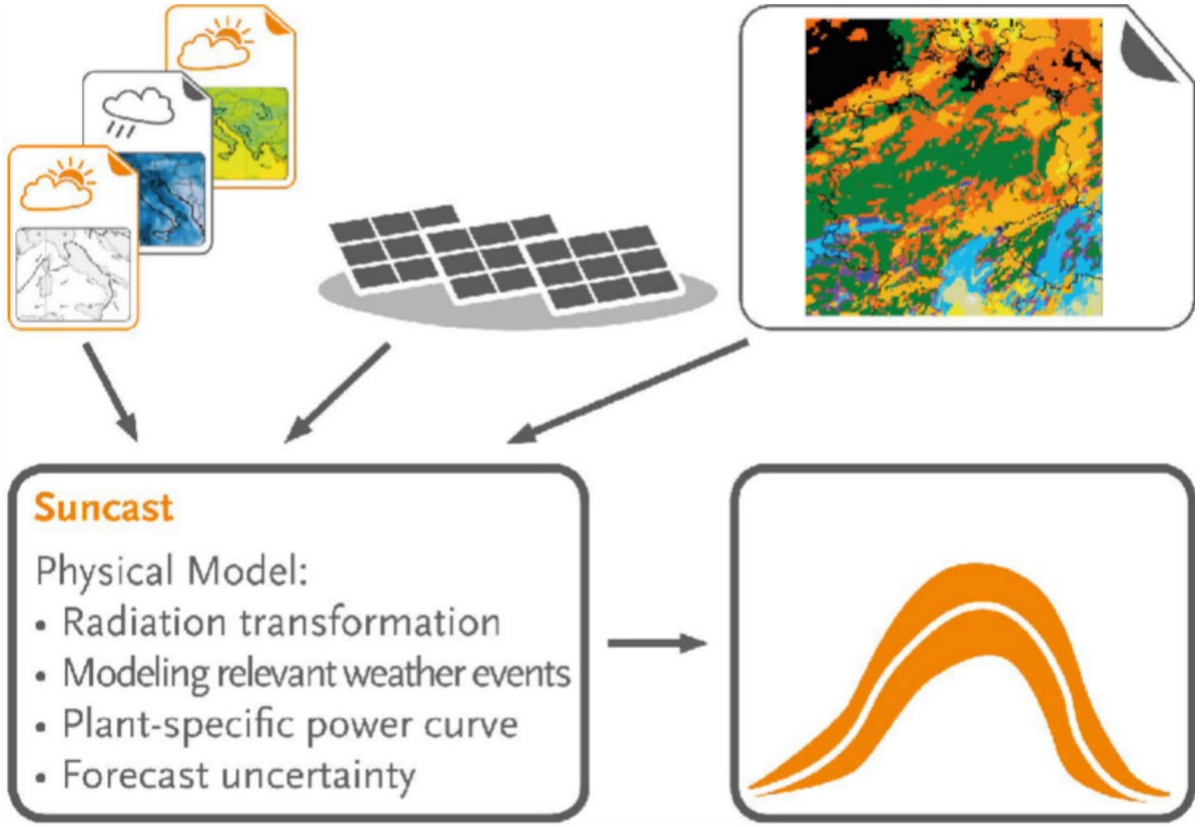
Skycams - motivation

- Weather conditions with convection and broken clouds lead to highly volatile PV production
- The goal is to better predict the max and min values
- A side effect could be an estimation of potential production (e.g. during curtailments)

Solar power prediction

Already used:
- Multiple NWP data
- Satellite images
- Real-time power data

Now possible:
- Skycams also known as All Sky Imagers (ASI)



Skycams

- Idea: Use single SkyCams or network of Skycams to improve shortest term prediction of solar power
- Produce irradiance maps (ghi and dni)
- Temporal resolution: 30s
- irradiation data reprocessed and provided by third party provider

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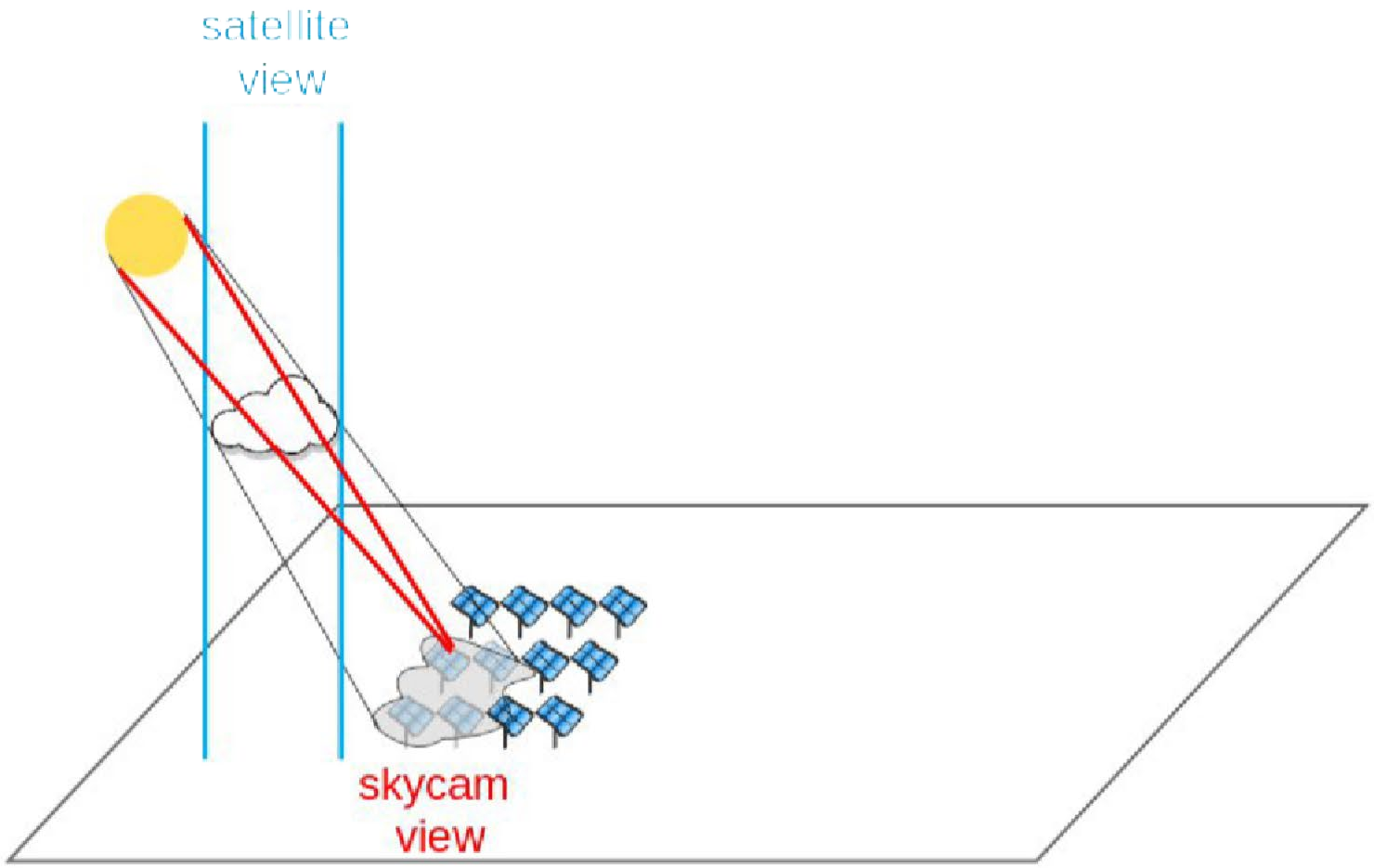
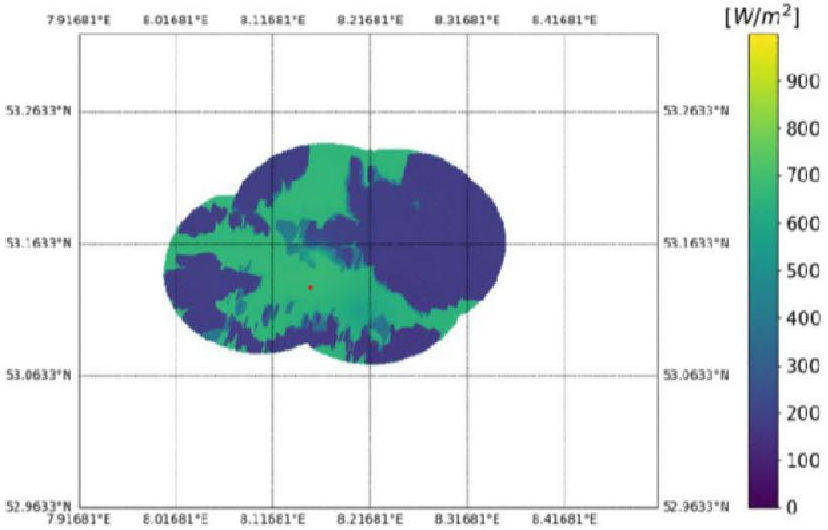
Skycams vs Satellites

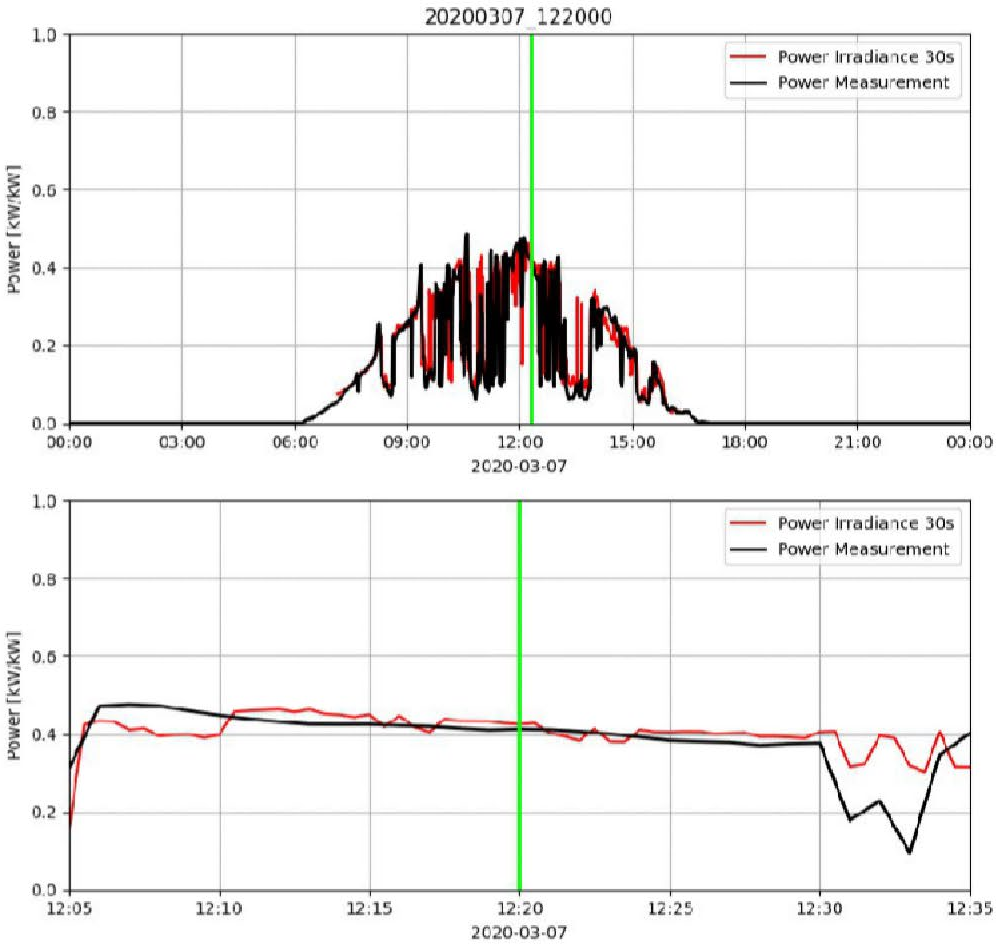


- **Satellite**: View of the clouds / PV plants from above
- **Skycam**: Detects and tracks clouds from the perspective of the solar plant
- **Skycam**: Propagate cloud shadows in space to look into the future

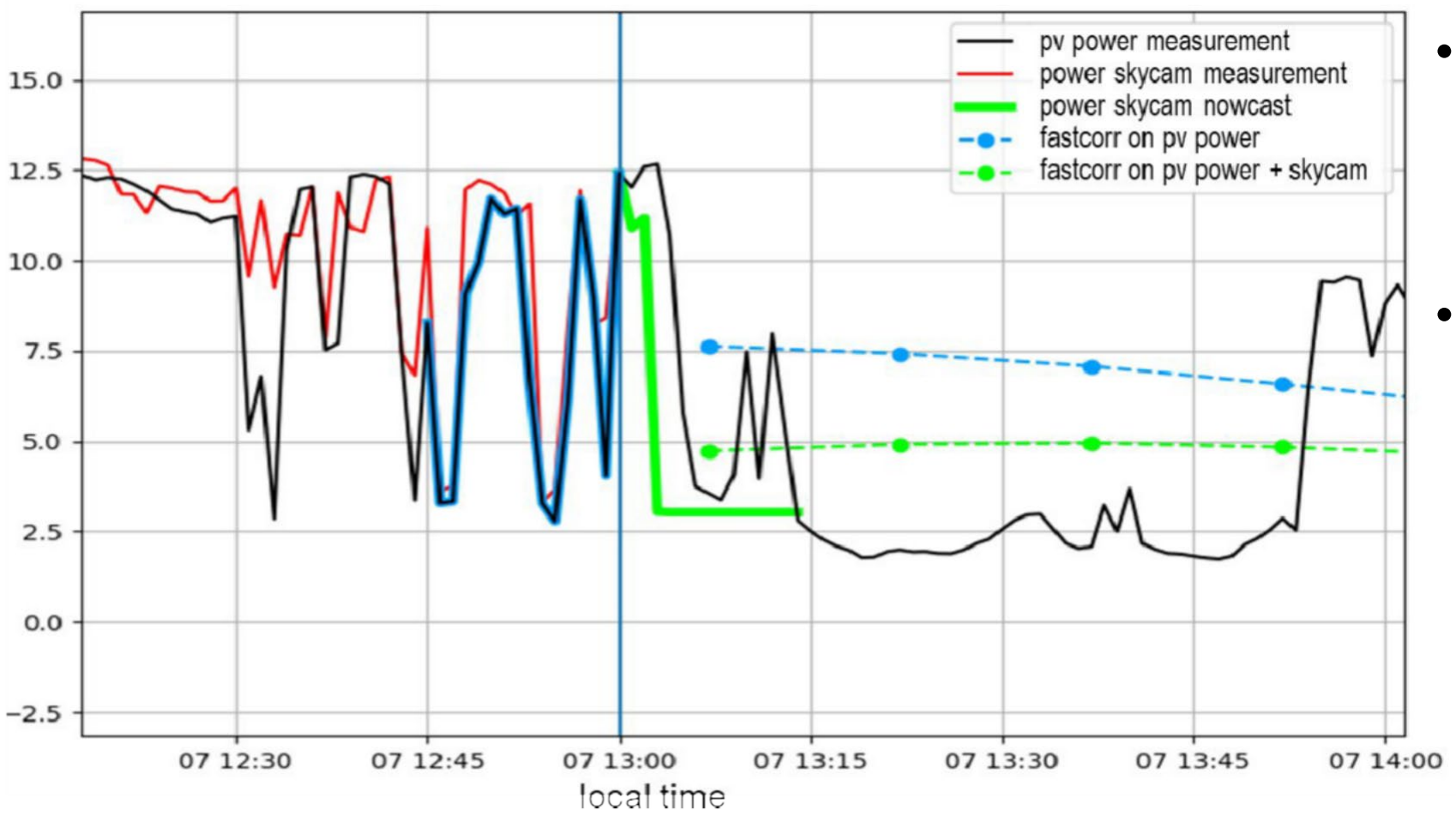
Integration of Skycam data into shortest-term solar prediction

- The data produced with the help of the Skycam correspond well with the measured values





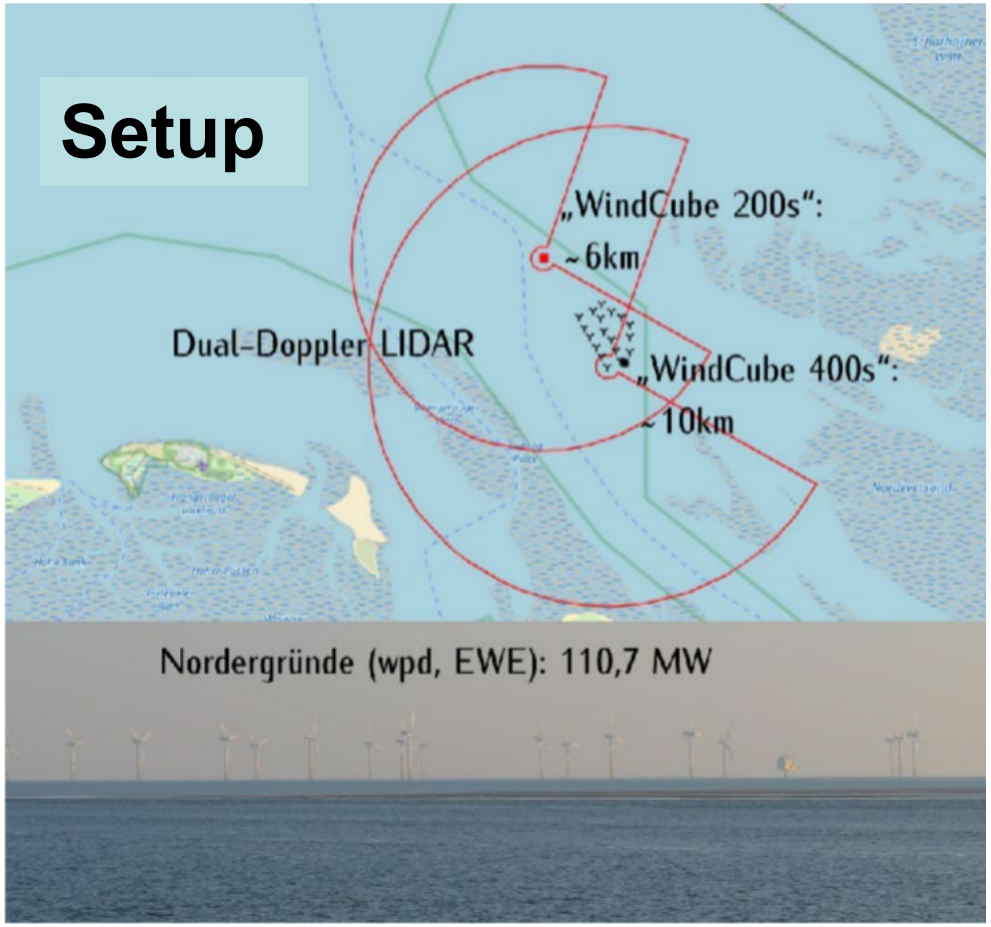
Integration of Skycam data into shortest-term solar prediction



- Skycam data gives valuable additional information over next 15-30 minutes
- Strong improvements achieved over evaluation period: on average 20% RMSE reduction, on days with broken clouds up to 40%

Windramp – Project Overview

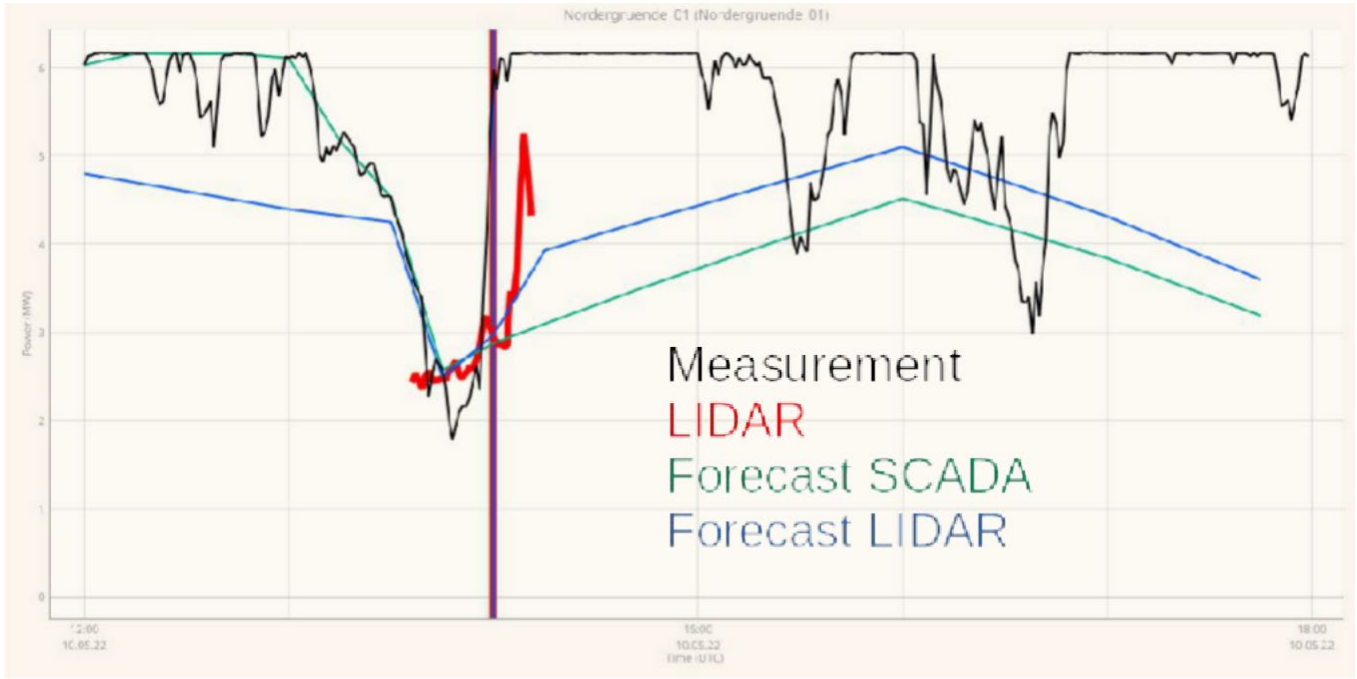
- Research project with diverse project partners
- Mission: Enhance offshore wind power forecasts to improve balancing capabilities for grid operators and energy traders
- Focus on wind ramp events: hard to forecast, can create massive imbalance
- Integration of LIDAR and SCADA measurements into shortest-term power predictions

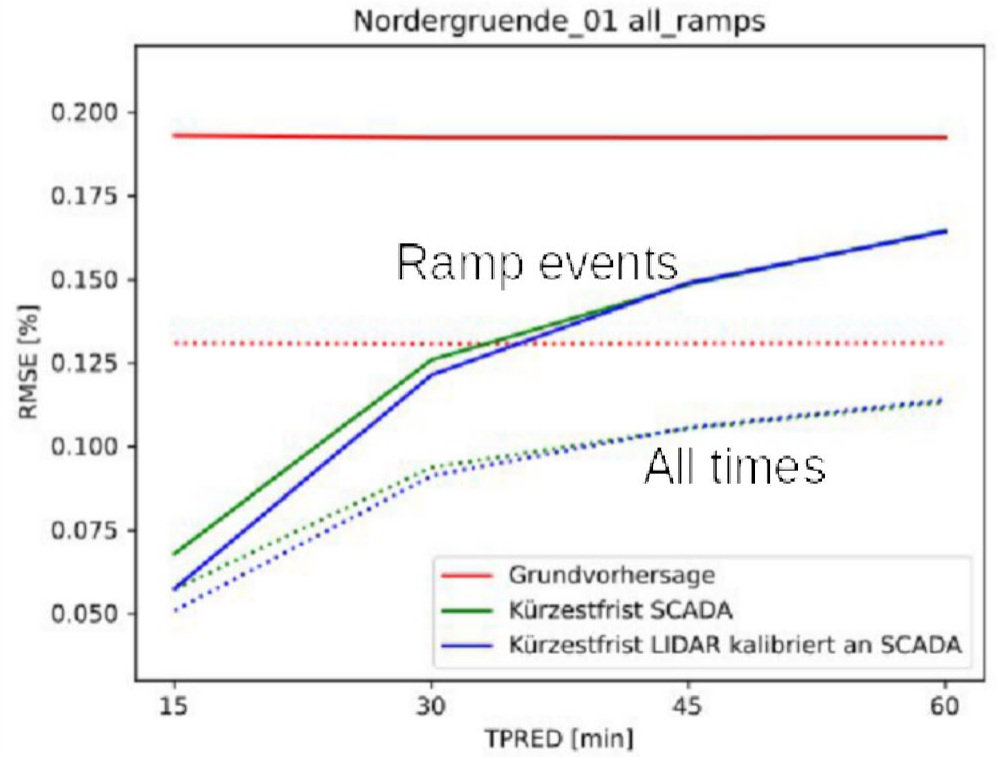


Windramp – our contributions

- Enhance shortest-term wind power forecasts by integrating SCADA and LIDAR measurements into power forecasts
- Evaluate the benefit of using LIDAR wind propagation data to enrich forecasts
- Statistical evaluation of ramp events
- Analyze typical and extreme ramp events with meteorological expertise
- Create situational awareness for grid operators and traders

Windramp – improvement of shortest-term forecast



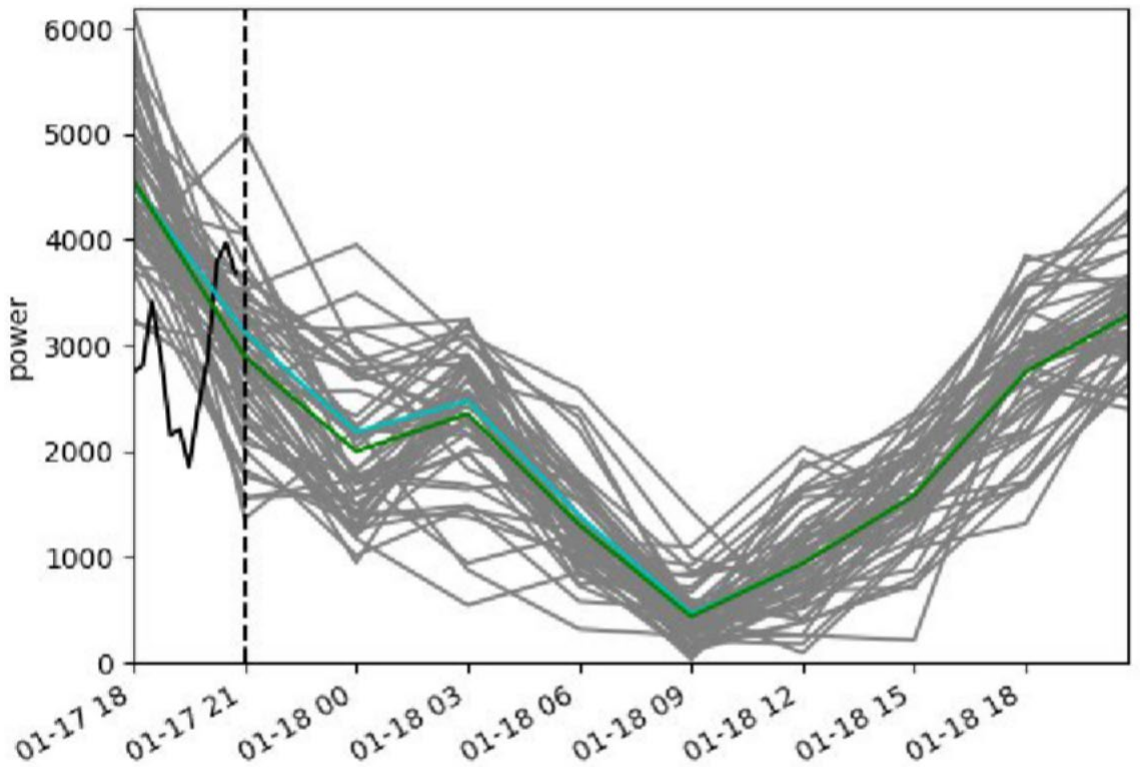


- LIDAR-assimilated forecasts perform better in shortest-term, especially during ramp events

Windramp – Ensemble

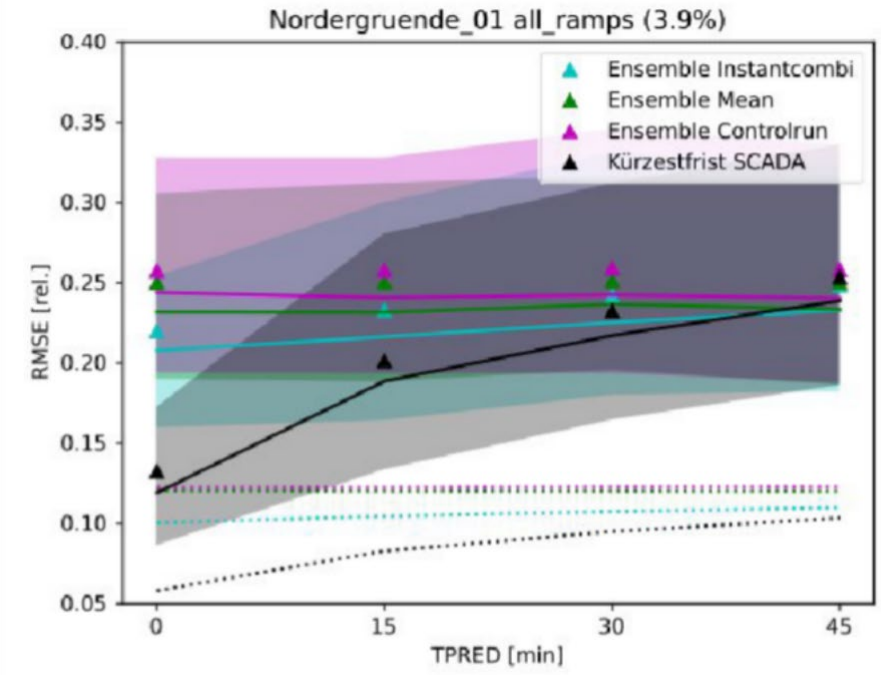
Idea:

- weighted ensemble mean according to agreement with measurements
- resolution: 3h
- 50 ensemble members + 1 control run

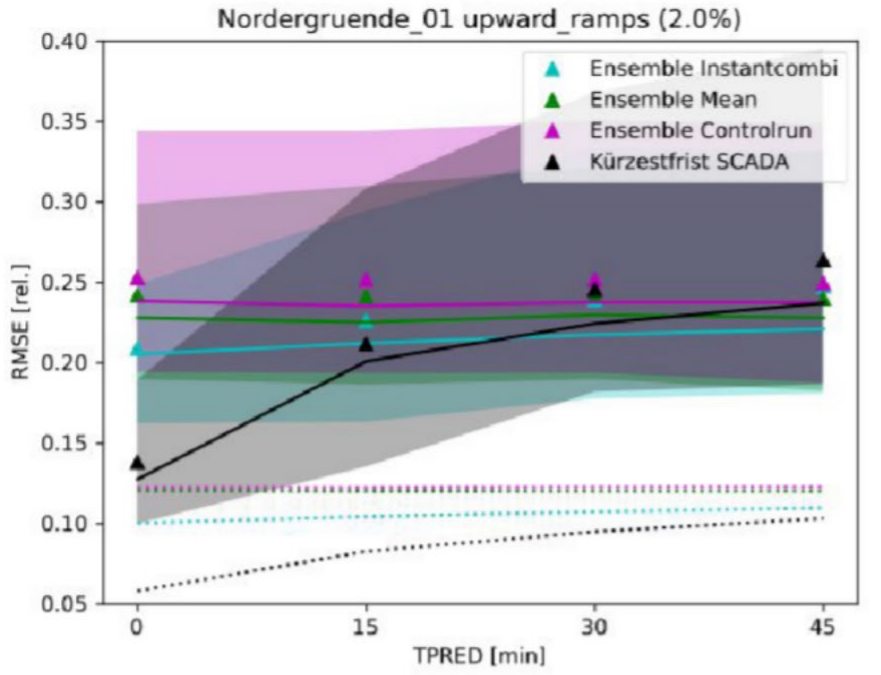


Windramp – Ensemble

all ramps



upward ramps



- Improvement over single runs and ensemble mean
- Standard short-term correction better for very short horizons

Thanks for your attention!