# The Changing Face of the Sky: Insights into Cloud Variability and Solar Irradiance through High-Resolution Sky Images

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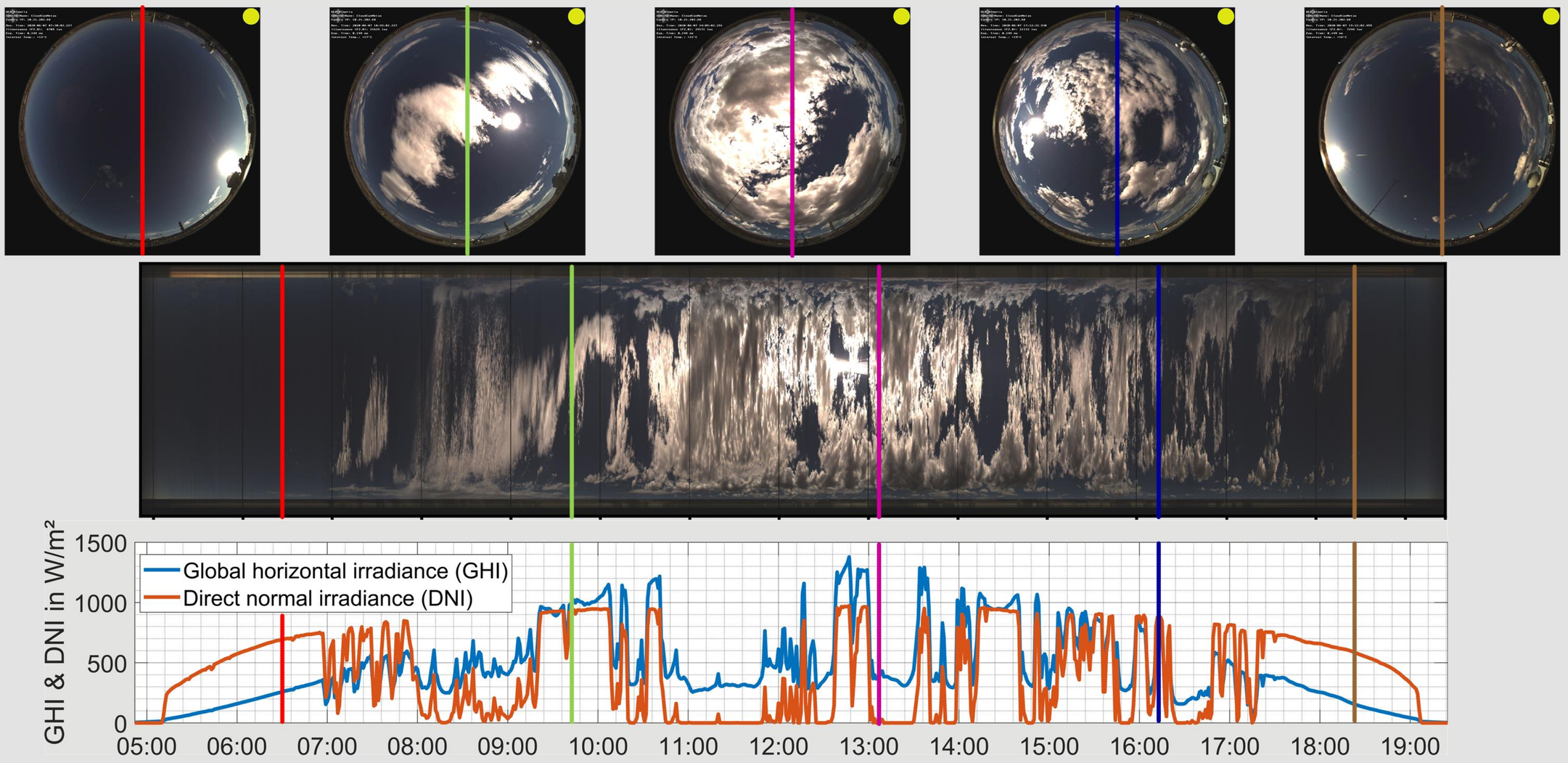
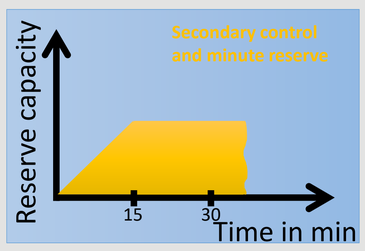


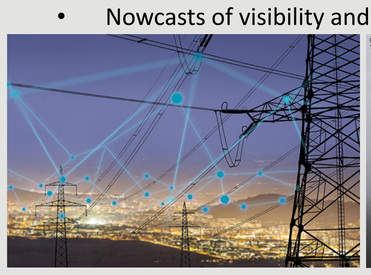

## Motivation

- Power plant control applications e.g.:
  - CSP: process optimization [1]
  - PV: ramp rate mitigation [2]

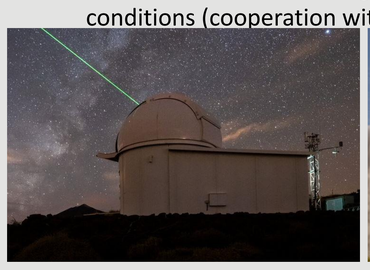

- Balancing and trading applications e.g.:
  - Nowcasts of PV balancing energy potential
  - Energy trading: Improved PV power nowcasts



- Improved situational awareness e.g.:
  - Electrical smart grids
  - Nowcasts of visibility and fog: automated driving




- Space applications e.g.:
  - Nowcasts communication signal availability: Direct space to earth laser communication (cooperation with DLR RB)
  - Microlauncher: Monitoring and nowcasting critical conditions (cooperation with DLR RS)




## Objectives

- Highly resolved cloud and solar irradiance forecasts [3, 4]
- Regional forecast → Eye2Sky [5] (DLR VE)

## Results

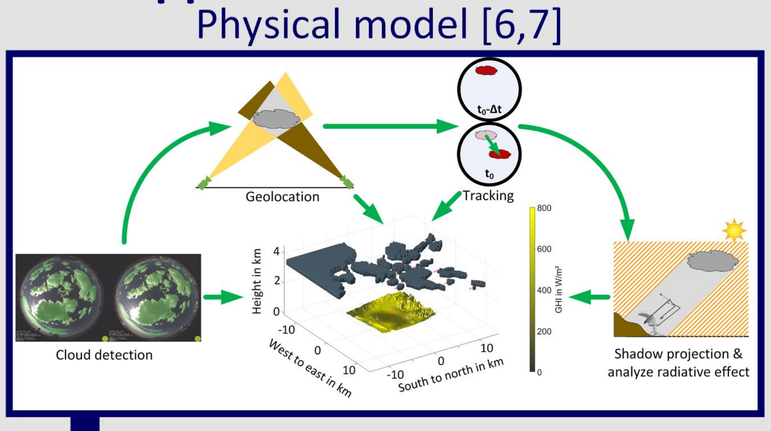
- Simulations revealed potential for substantial CSP and PV power plant control optimizations [1, 2]
- The DLR system outperformed all participants of the IEA PVPS Task benchmark [8]

## Summary & Outlook

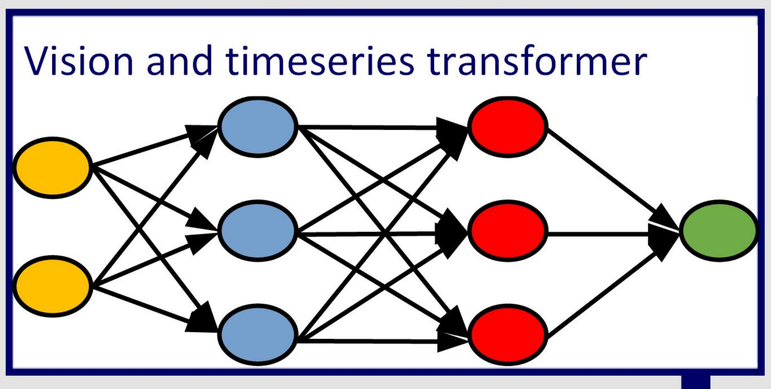
- Operational sky camera forecasting system partially licensed
- Highly resolved irradiance maps via stereo photography
  - High accuracy compared to recent literature and benchmark participants
  - Applicability is being demonstrated at commercial power plants
- Deep learning approaches are investigated e.g.:
  - Cloud formation, dissipation and shape changes
  - Cloud classification
  - Combined sky camera + satellite approaches
- Sky cameras as radiometers [9]
  - Support forecasting
  - Monitoring of power plants

## Approach & Method: Solar irradiance forecasts hybrid model

### Physical model [6,7]

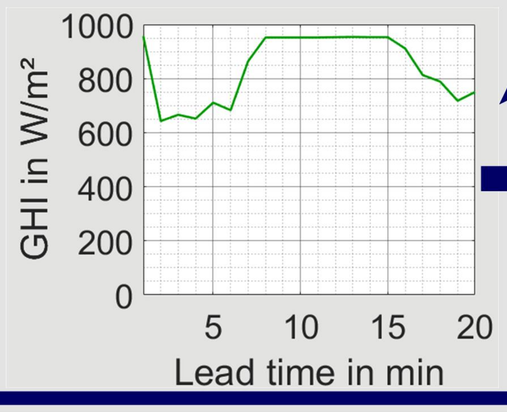



### Data driven model



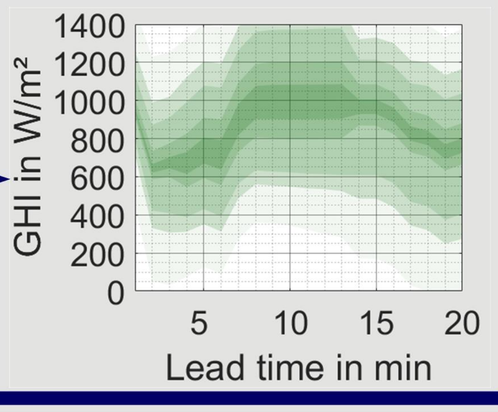

Real-time accuracy weighting [3]

### Deterministic forecast

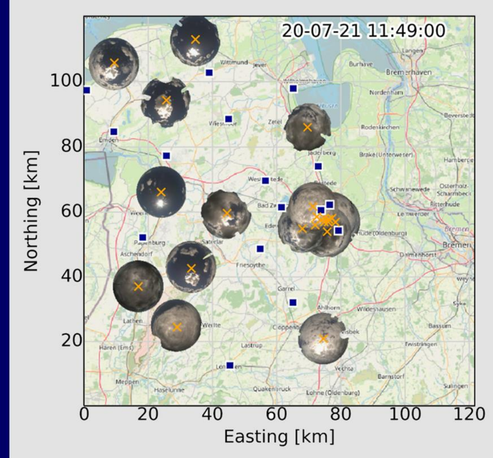


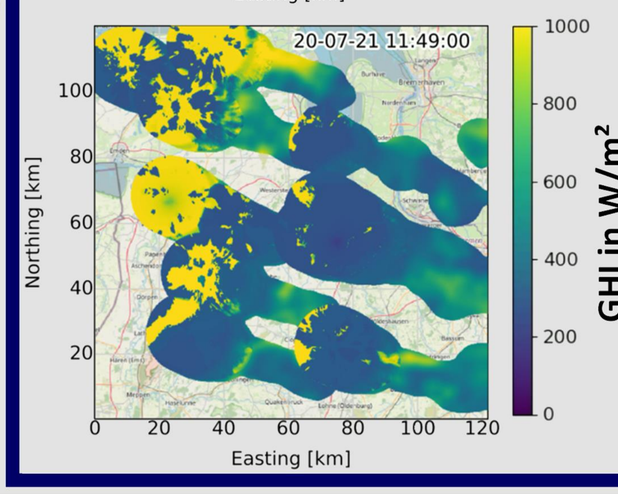

quantile analysis [4]

### Probabilistic forecast




## Merging observations from Eye2Sky network [5]




**References**

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**Supported by:**

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Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
Federal Ministry for Economic Affairs and Climate Action

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