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Operational wind & solar power forecasting

Optimized Wind and Solar Power Forecasts for India

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Overspeed: 30 Years of Experience

- Core: Consulting for investors, banks, project developers

- R&D as background
- System development

- Main areas:

Dr. Hans-Peter Waldl

Thomas Pahlke

Wind energy Consulting

Assessments

System and Software Development

Wind and Solar Power Predictions

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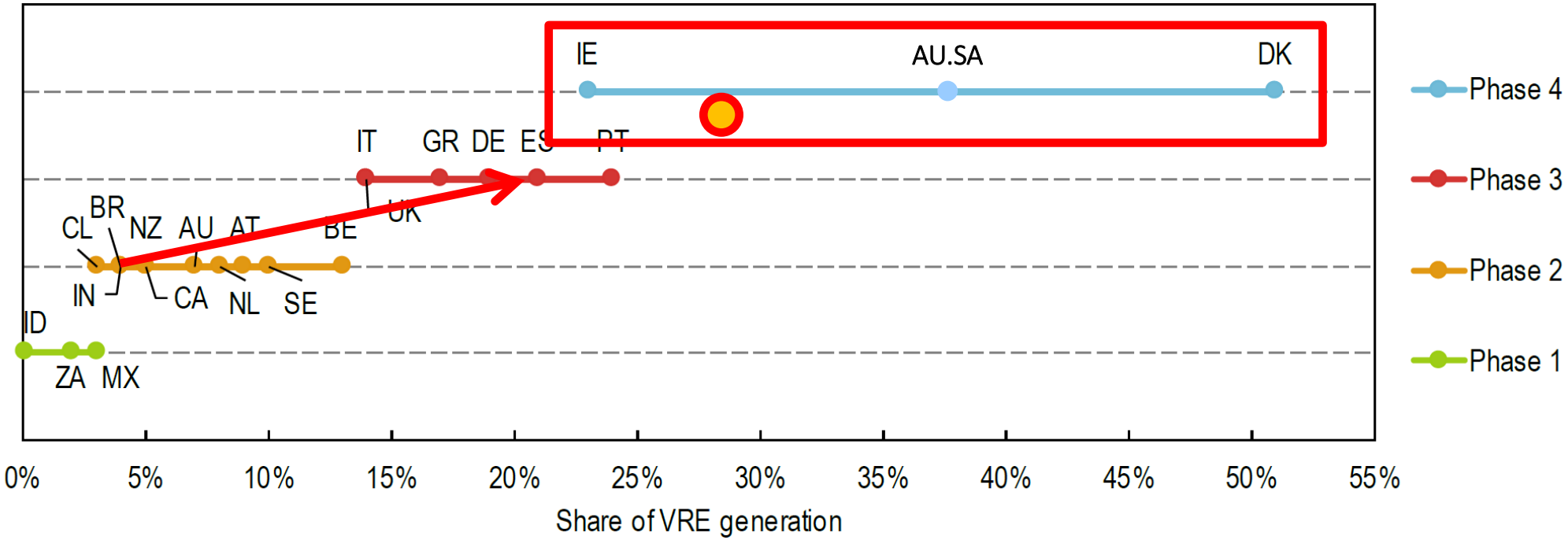
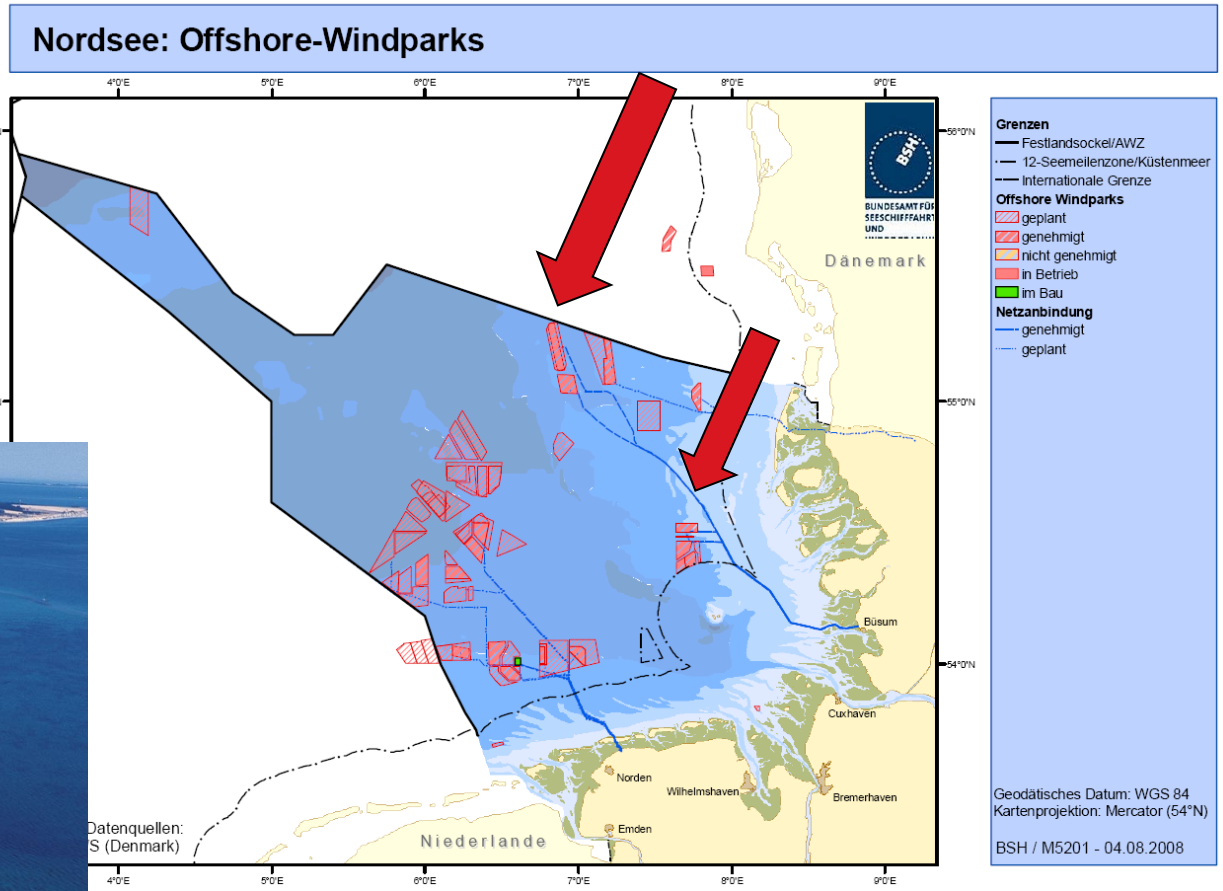
Anemos predictions: What is Anemos?

- Leading edge research and development

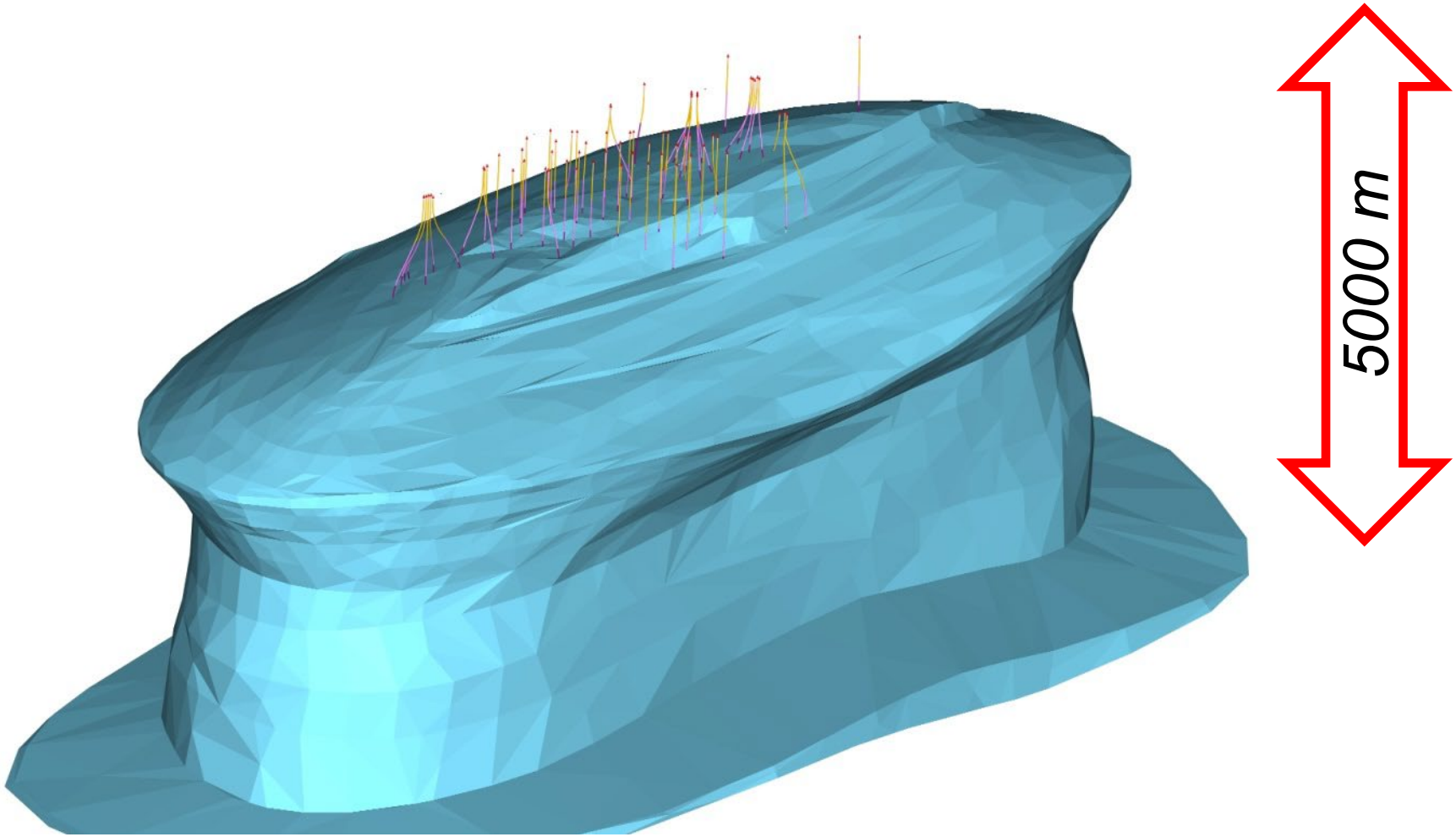


Source: Adapted from IEA (2016d), *Medium-Term Renewable Energy Market Report 2016*

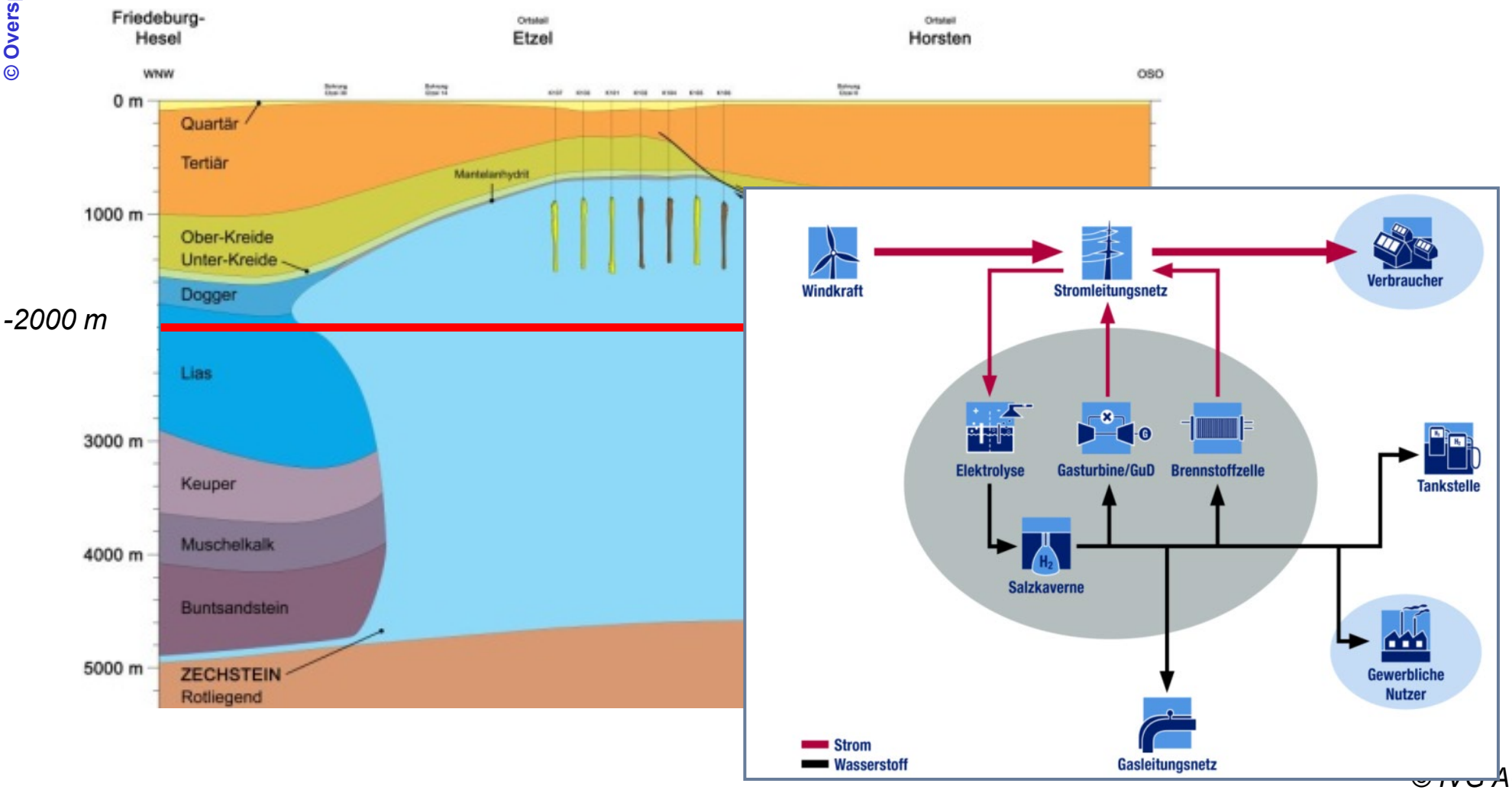
Offshore wind farm development Sandbank 24



Underground storage for hydrogen: Salt dome

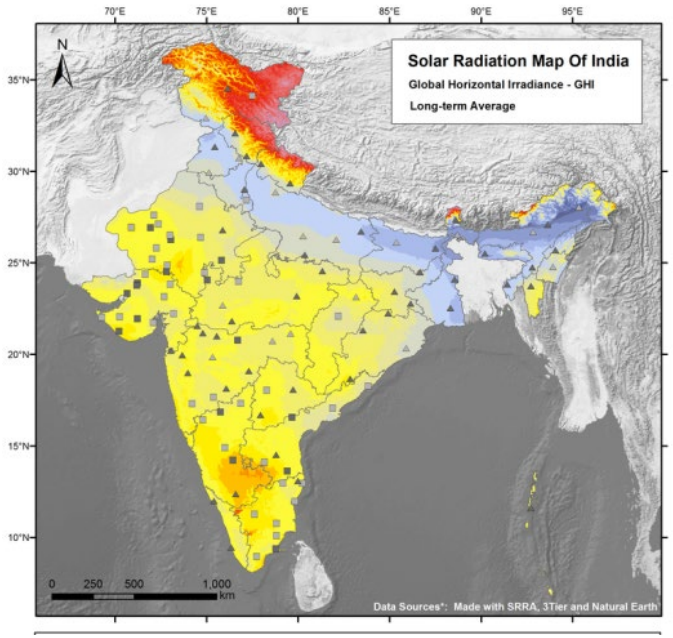


Hydrogen (P2X) long-term storage



Activities in India

- REMC advice
- Wind and solar power predictions
- Satellite-based very short-term predictions



- Training for NIWE team (GIZ): Indigenous solar power prediction system for India

- Training for REMC operators (GIZ)

High/low Wind Seasons and Model Tuning

Daily patterns and the atmosphere

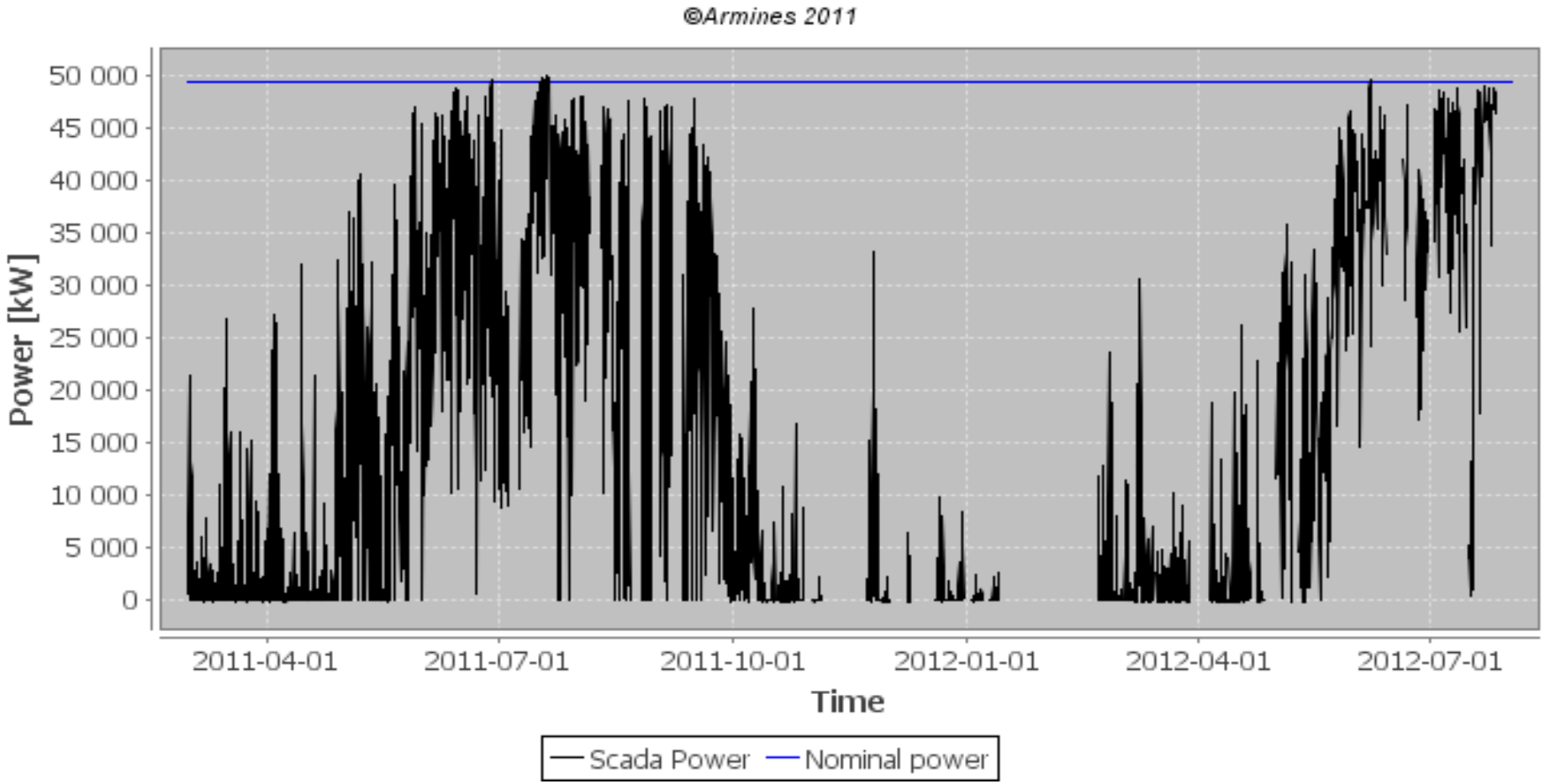
Curtailment and unavailability

Solar power: Soiling of PV panels

Solar power: Sat-based forecasting methods

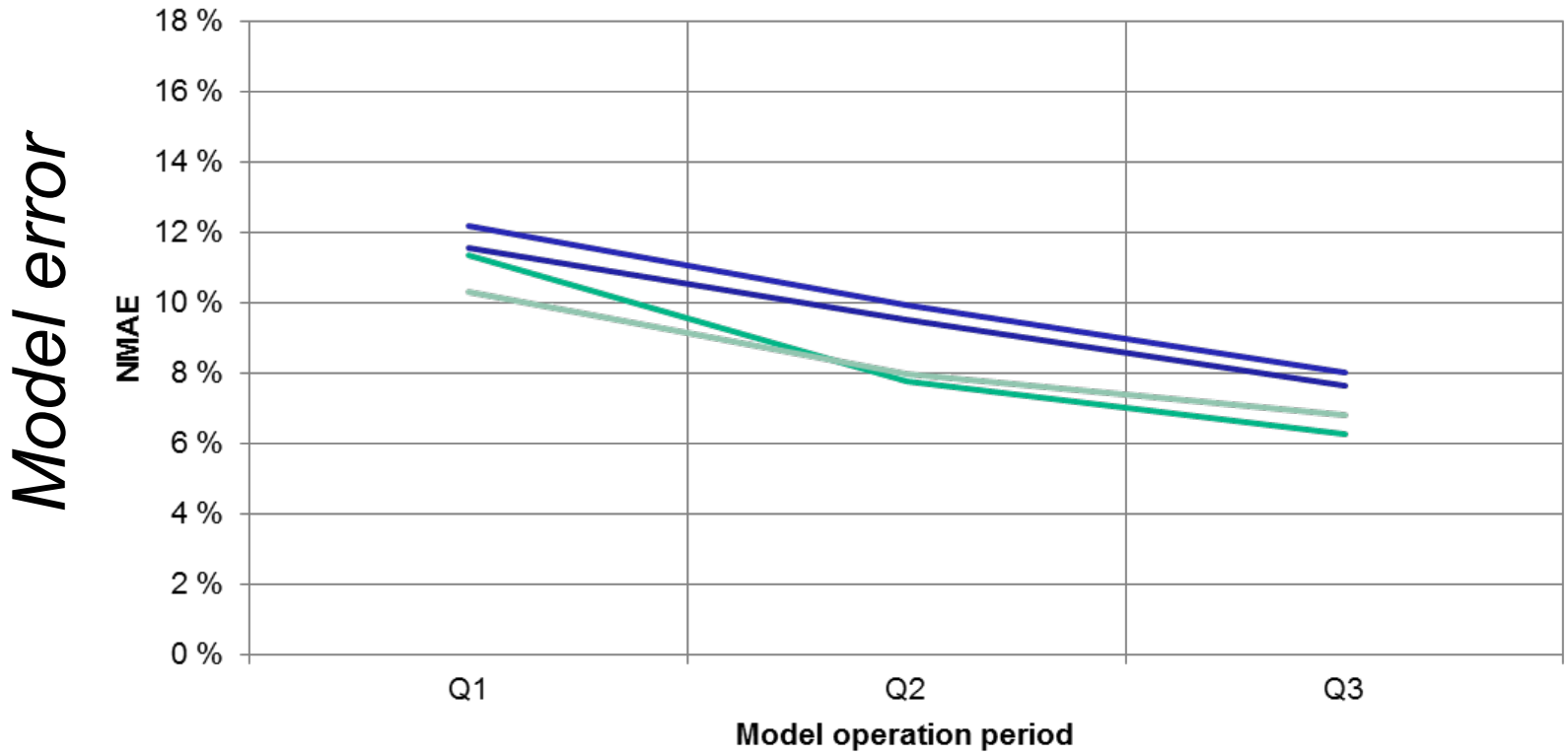
High/low Wind Seasons and Model Tuning

Tuning affected by high/low wind period

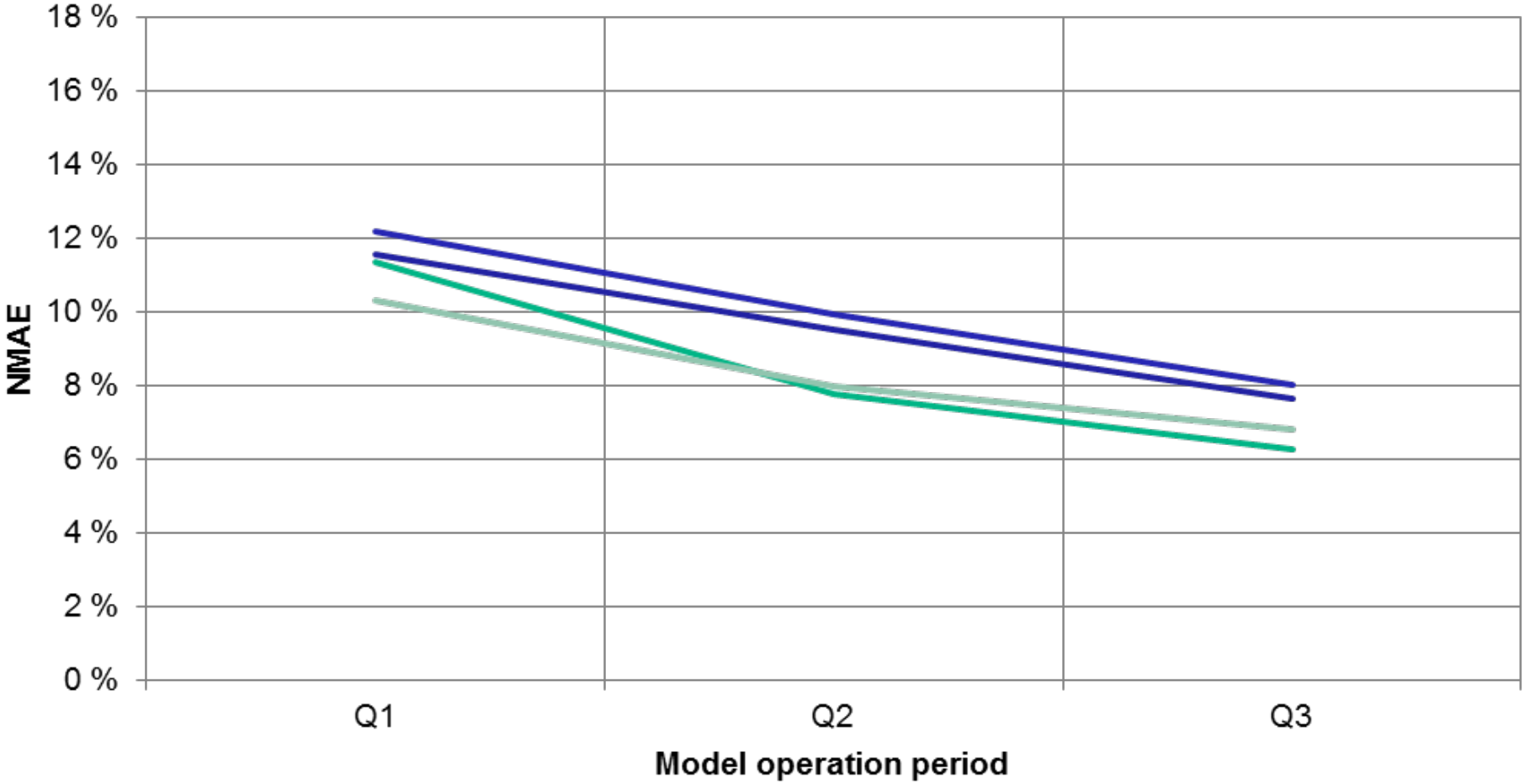


Models and adaptive tuning

- Adaptive model tuning improves forecasts over time
- Includes some „forgetting factor“

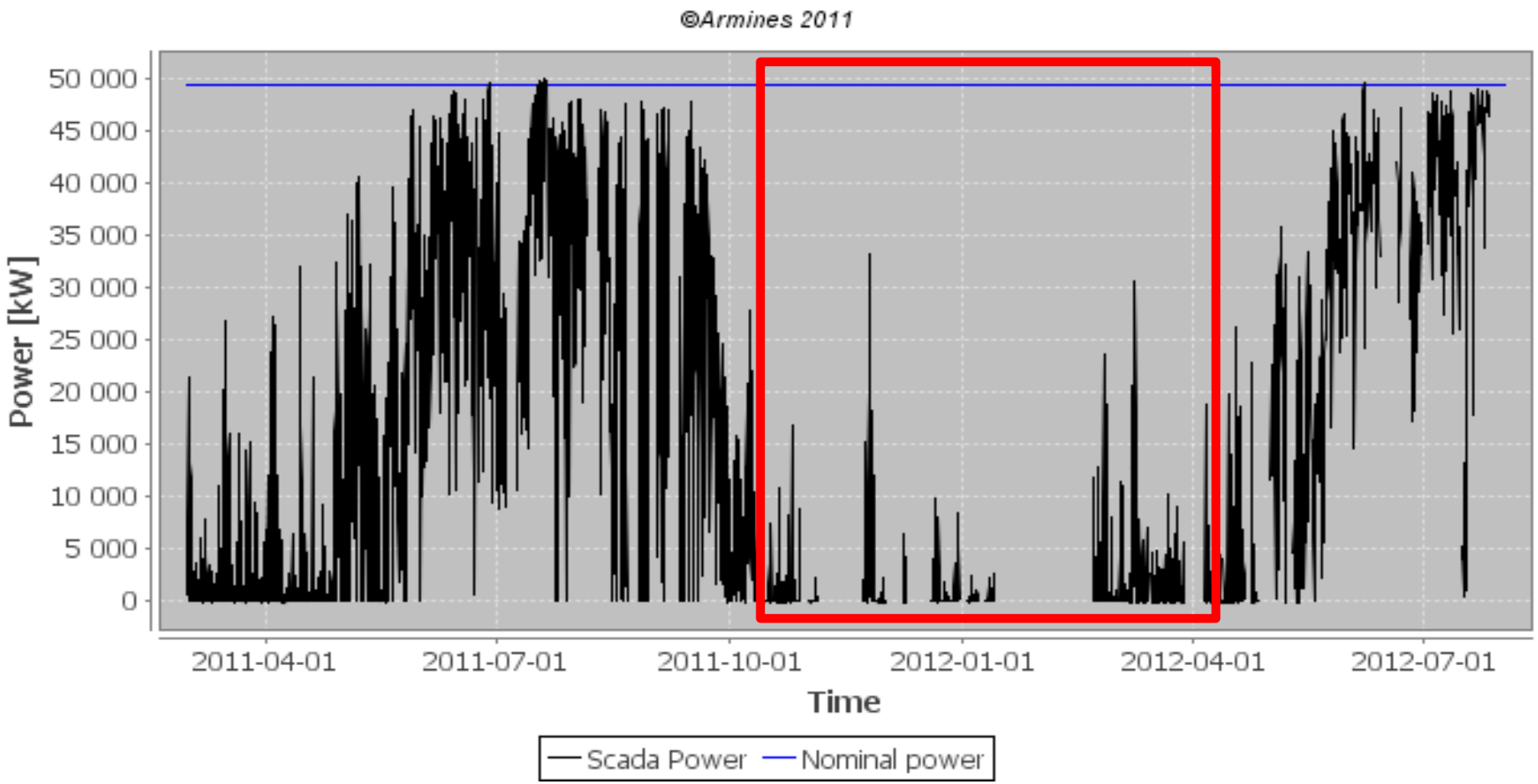


Auto-adaptive model improvement



Model error improvement over 6 month

Tuning affected by high/low wind period



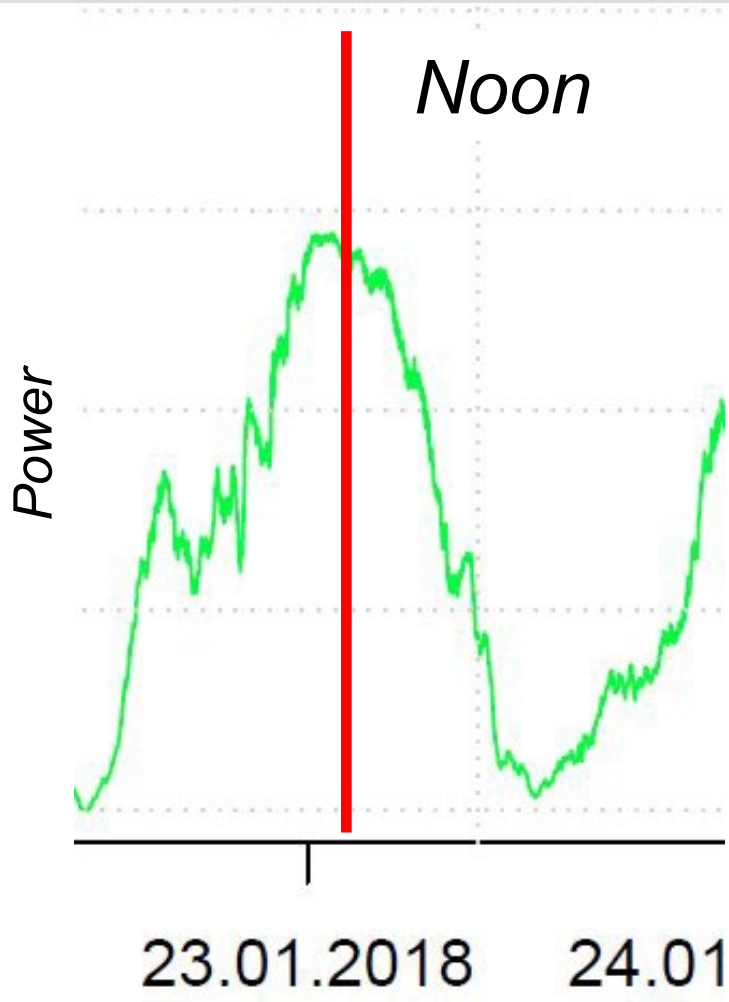
Models and adaptive tuning

- Adaptive model tuning improves forecasts over time
- Includes some „forgetting factor“

- **Discarding of old observations from the process must take into account seasonality**

Thermal status of the atmosphere

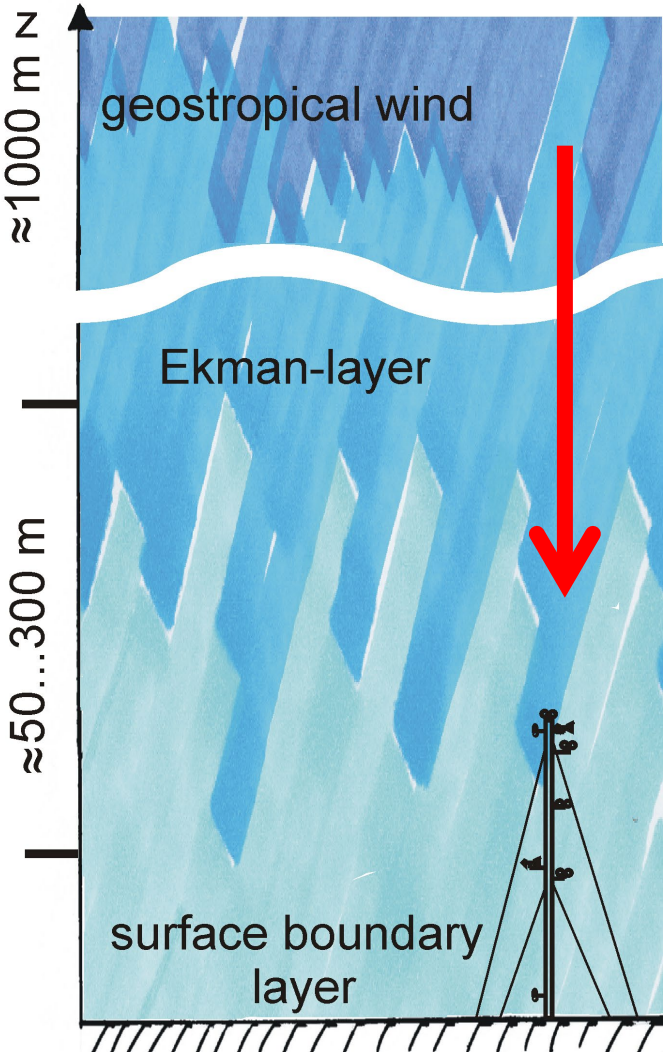
Strong thermal influences

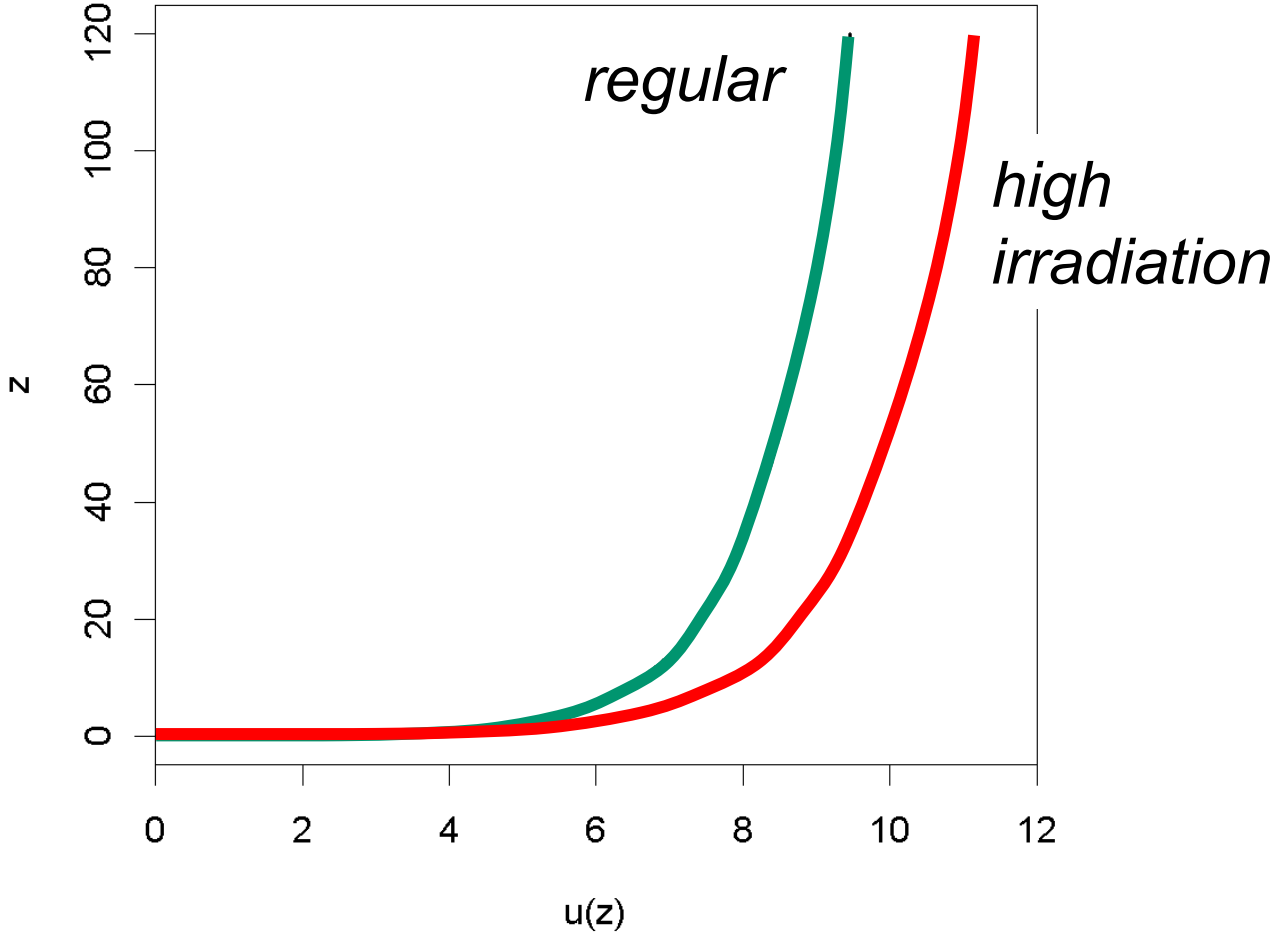


Strong daily pattern.

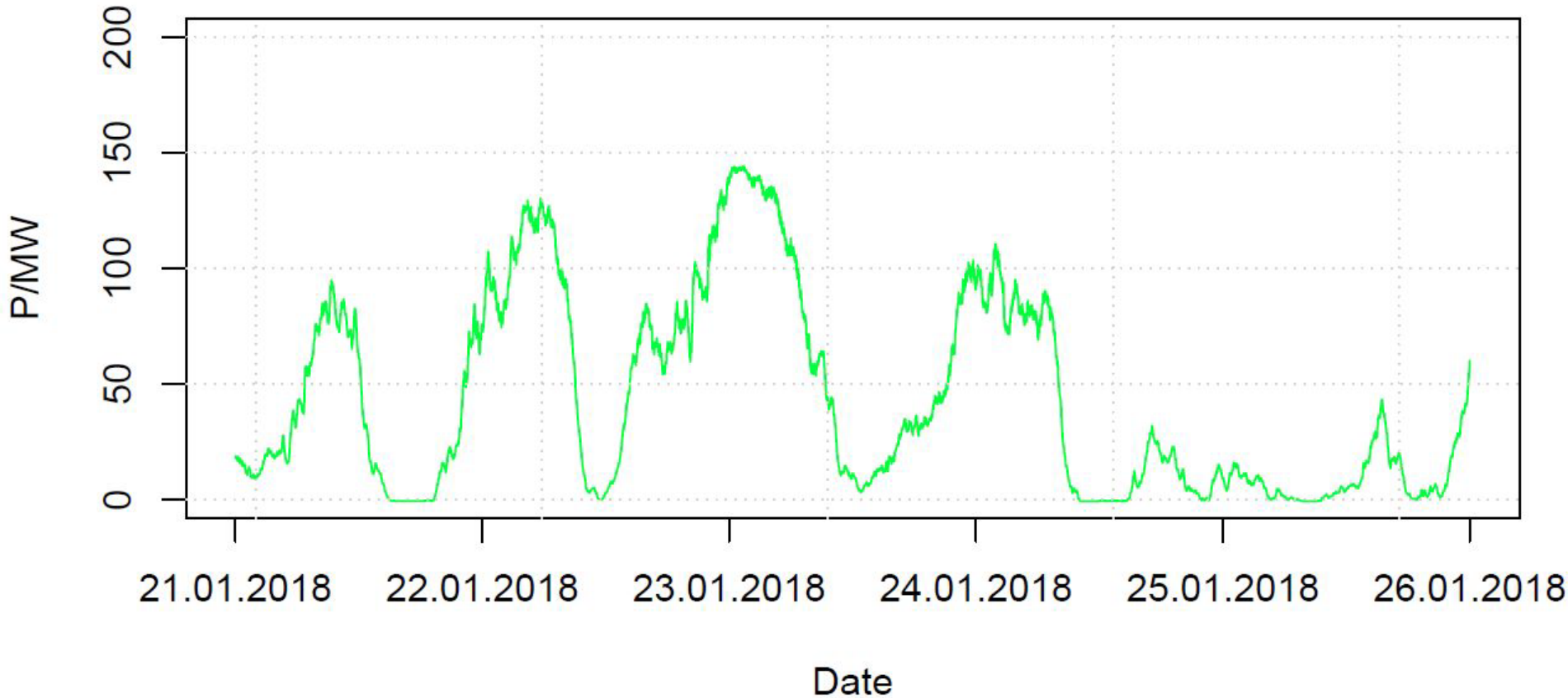
That‘s a wind farm, not solar!

Vertical wind speed profile





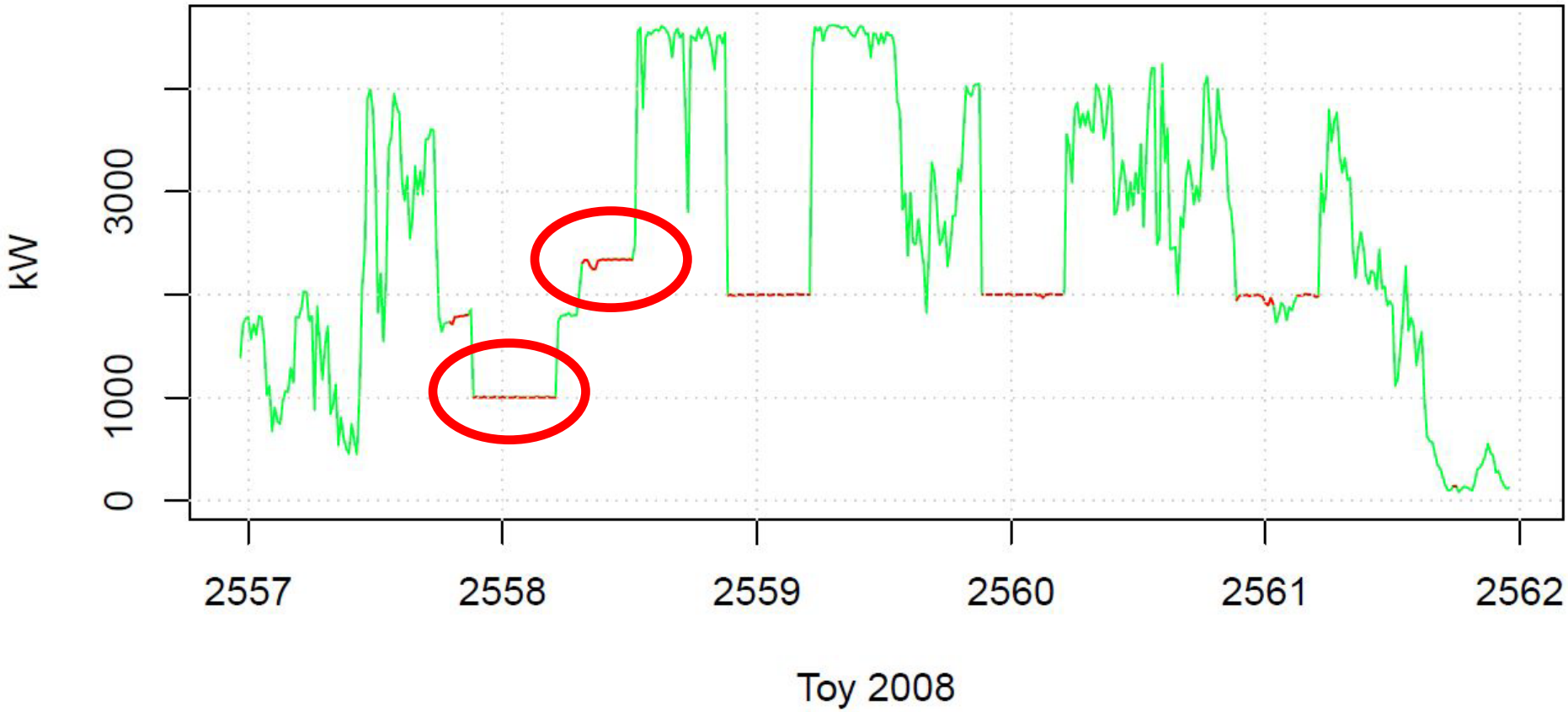
Wind farm with strong thermal influences



Appropriate modelling of the atmosphere is crucial

Power Data: Curtailment and unavailability

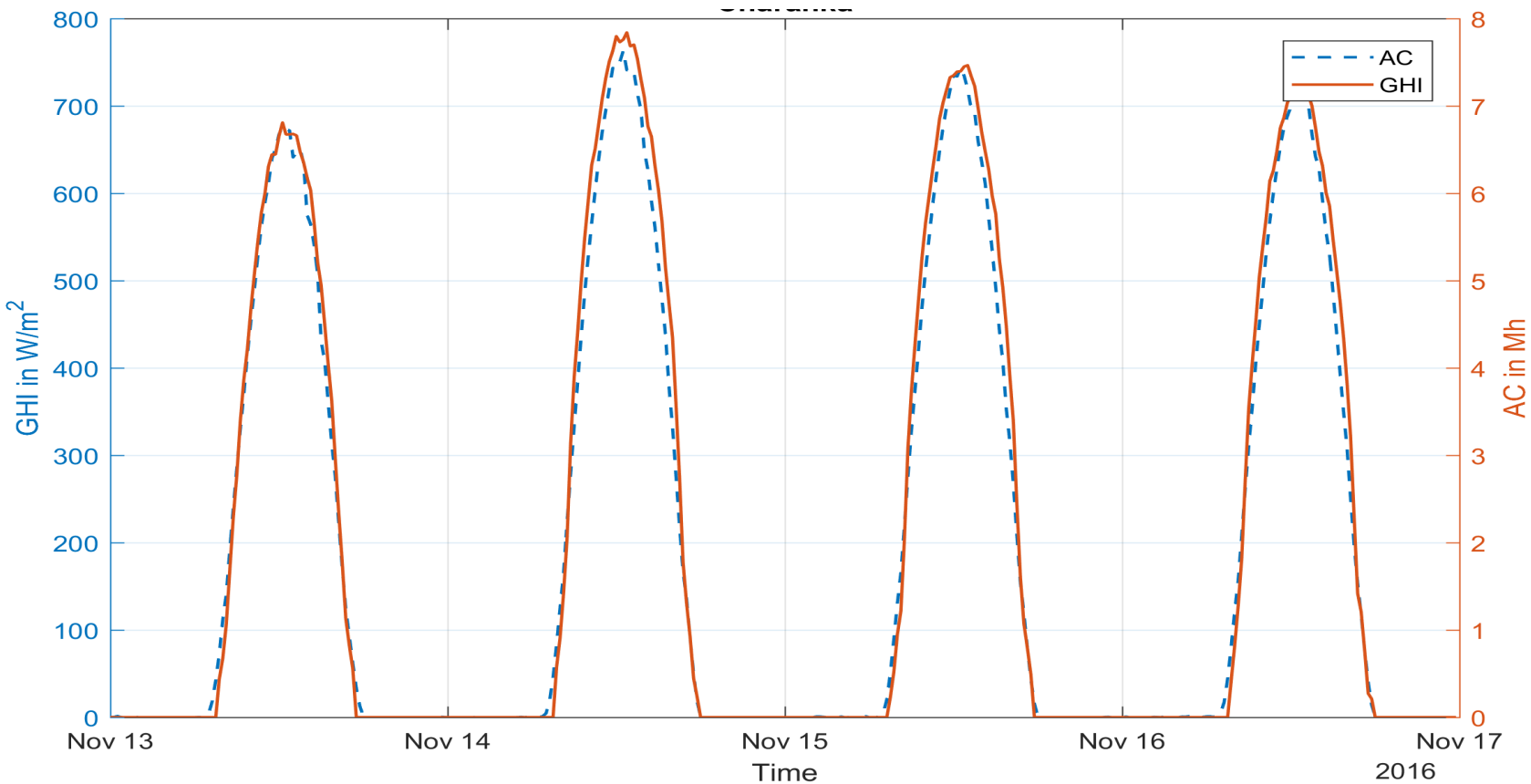
Curtailment and unavailability



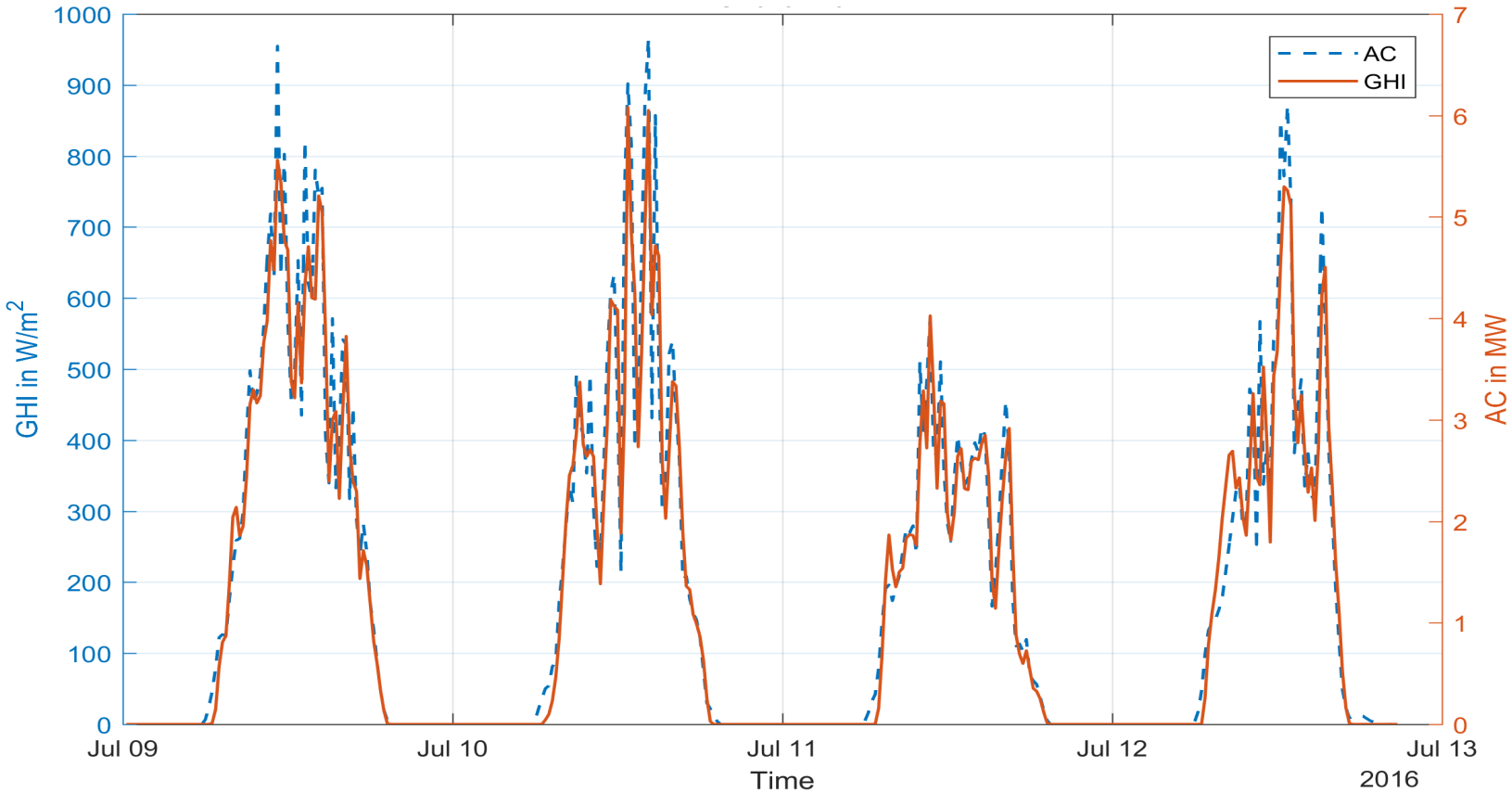
Auto-detection helps for better tuning and forecasts

Solar power: Seasons

PV Power Production, clear sky



PV Power Production, broken clouds



As for wind: Model tuning algorithms must be optimised

Solar power: Soiling of PV panels

Losses due to soiling

- Soiling could reduce the PV output up to 15 % or more
- Cleaning routine in place in most farms
- Rain has high impact on the effect
- Local measurements help

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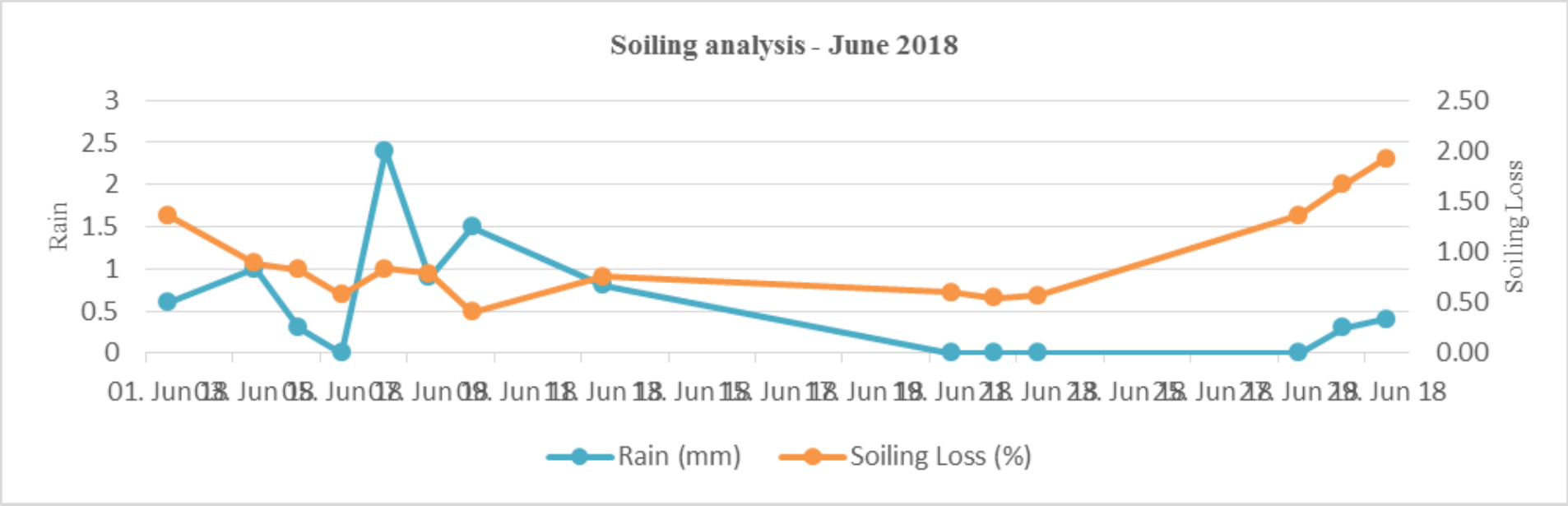
Soiling experiment

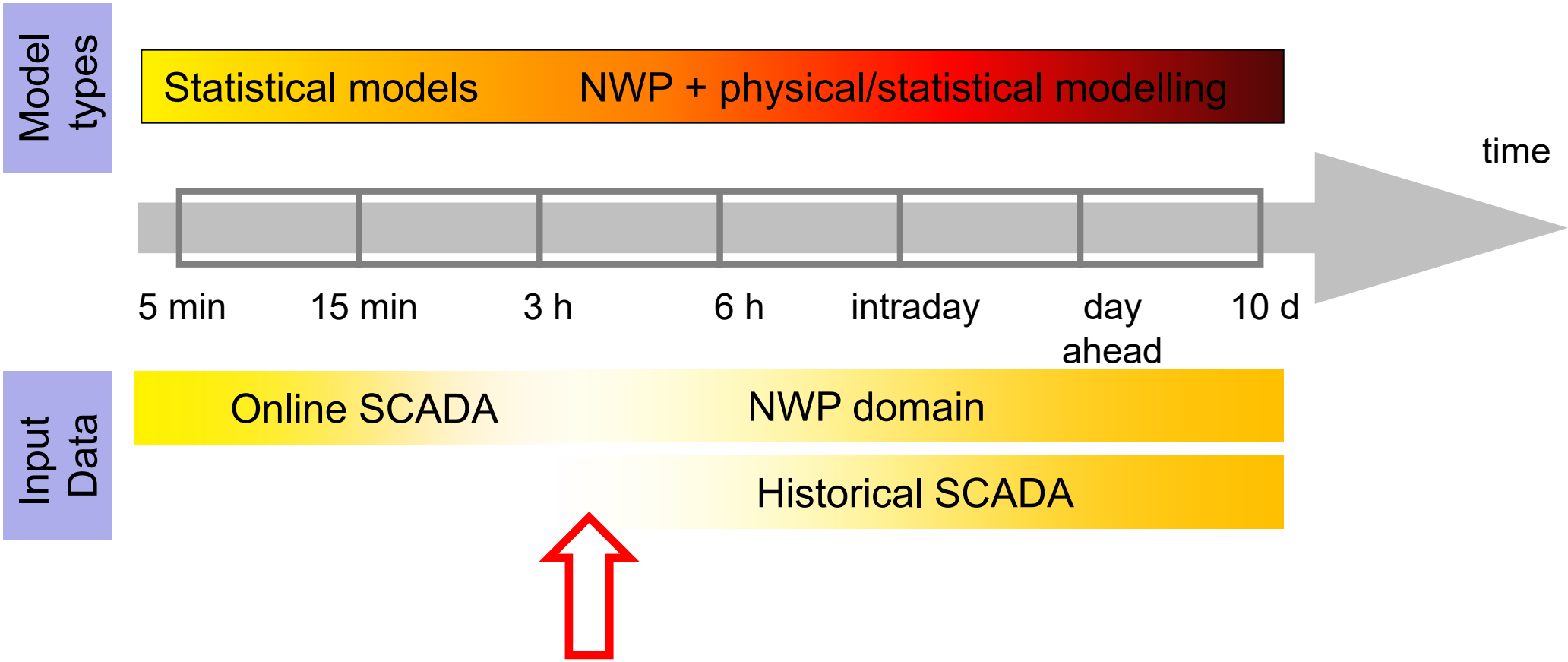


NIWE/overspeed/Uni Oldenburg:

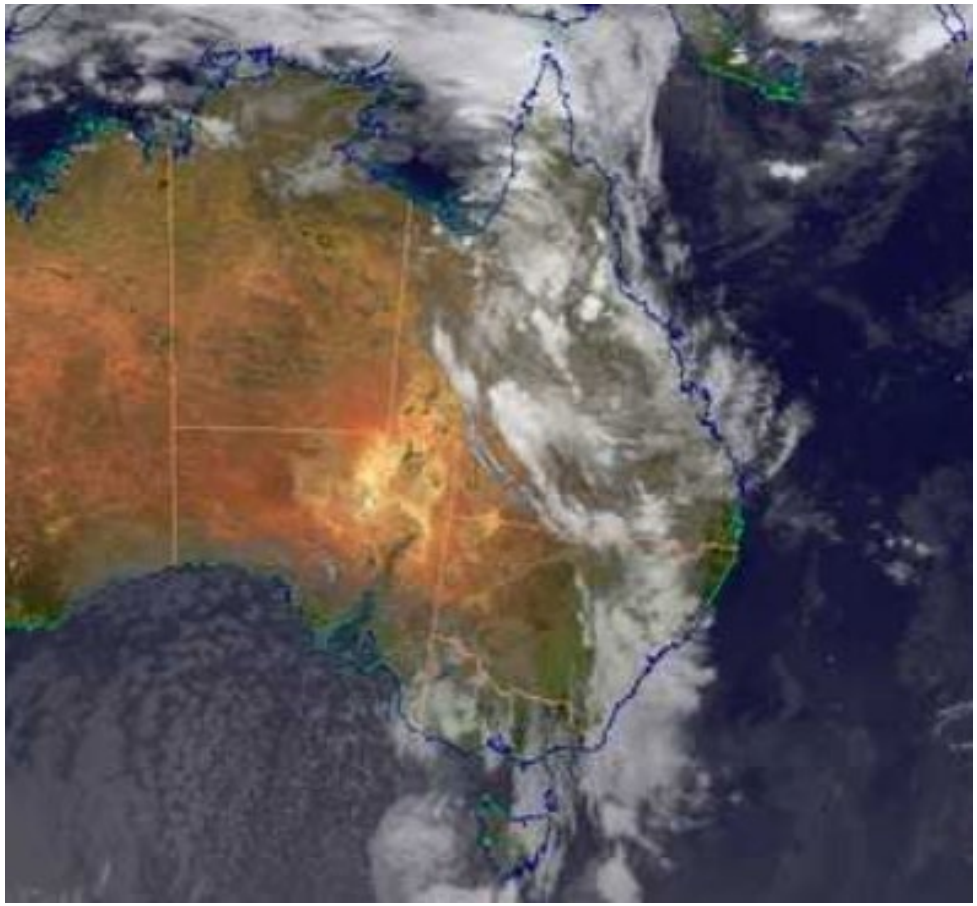
First long-term soiling experiment in India (Sahana L., this conference)

Solar power: Sat-based forecasting methods

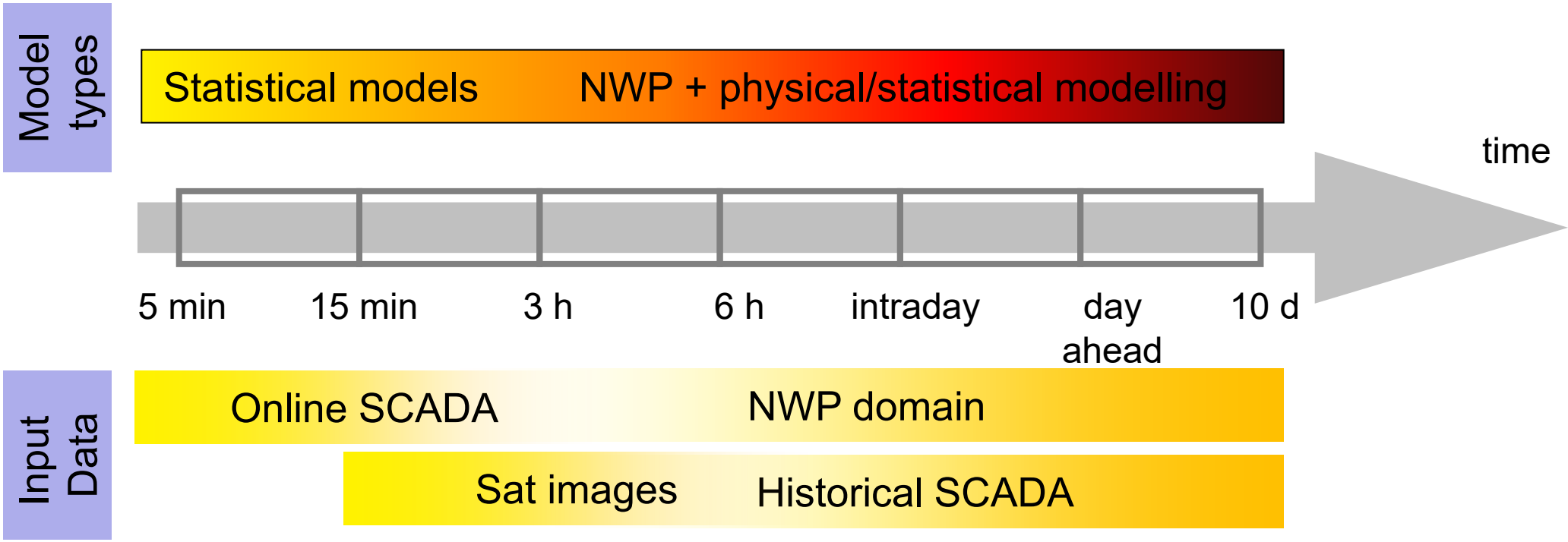
Prediction Principles: Short-term

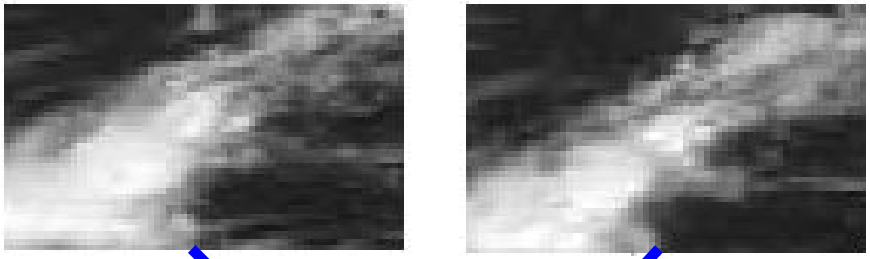


Big cloud field over south-east Australia

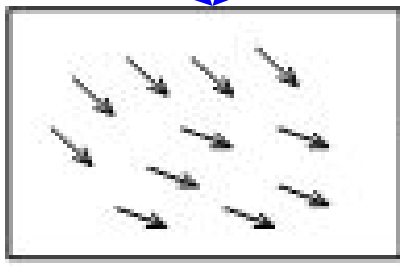


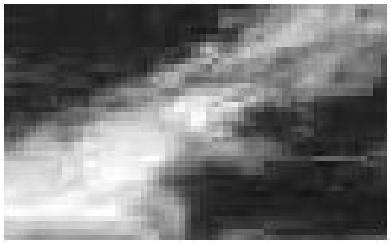
Prediction Principles: Short-term





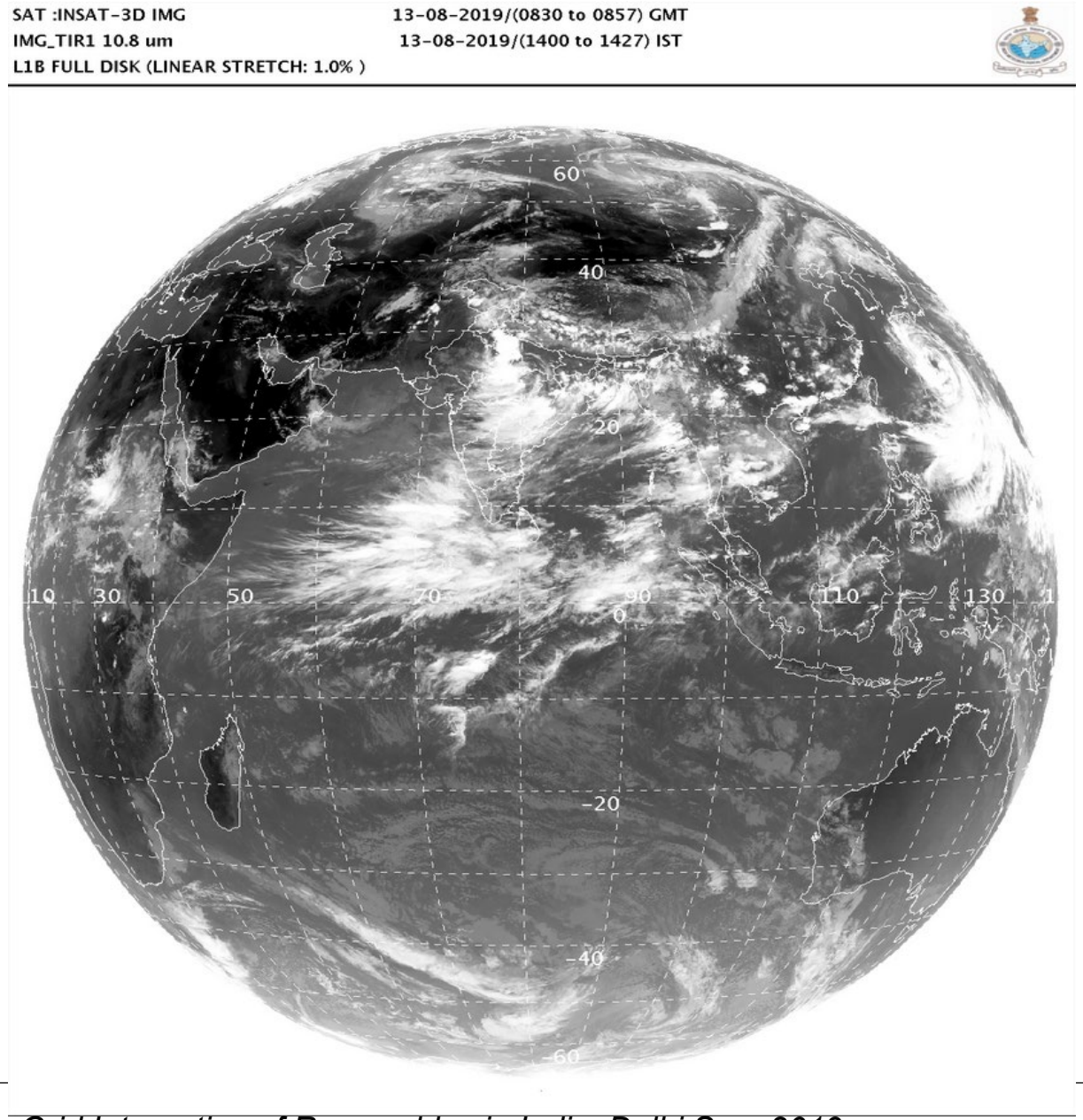
Consecutive satellite images

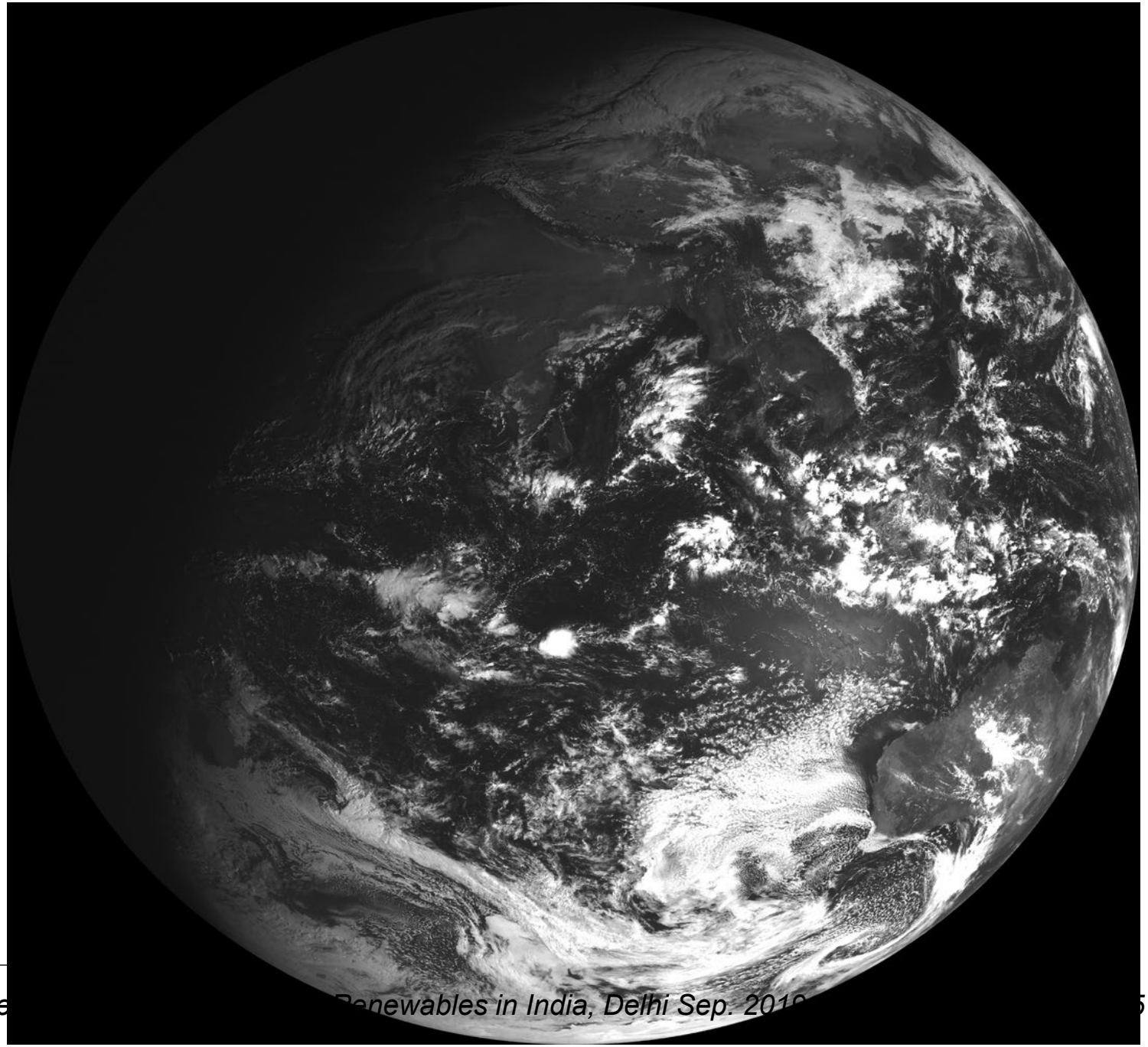


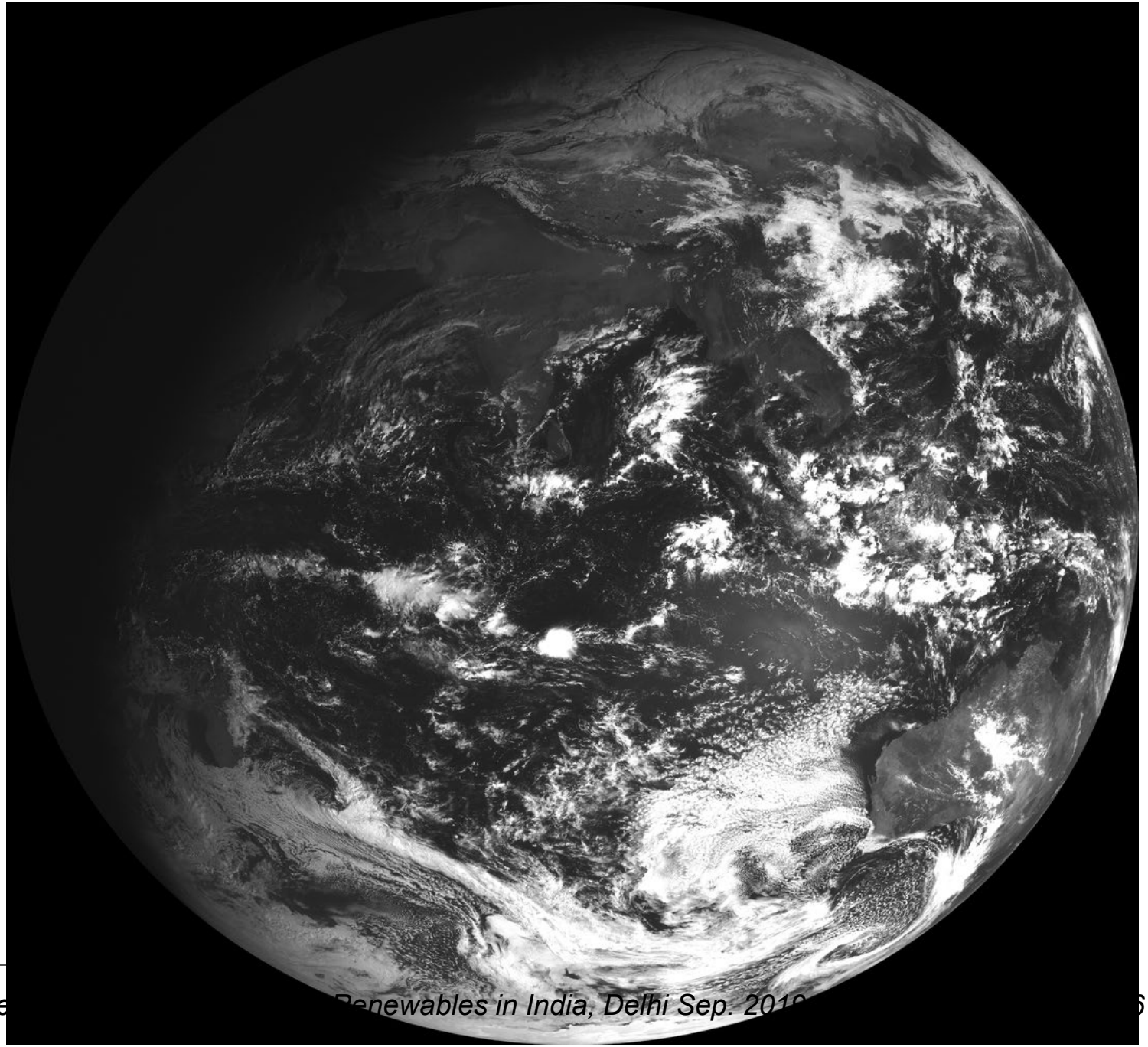


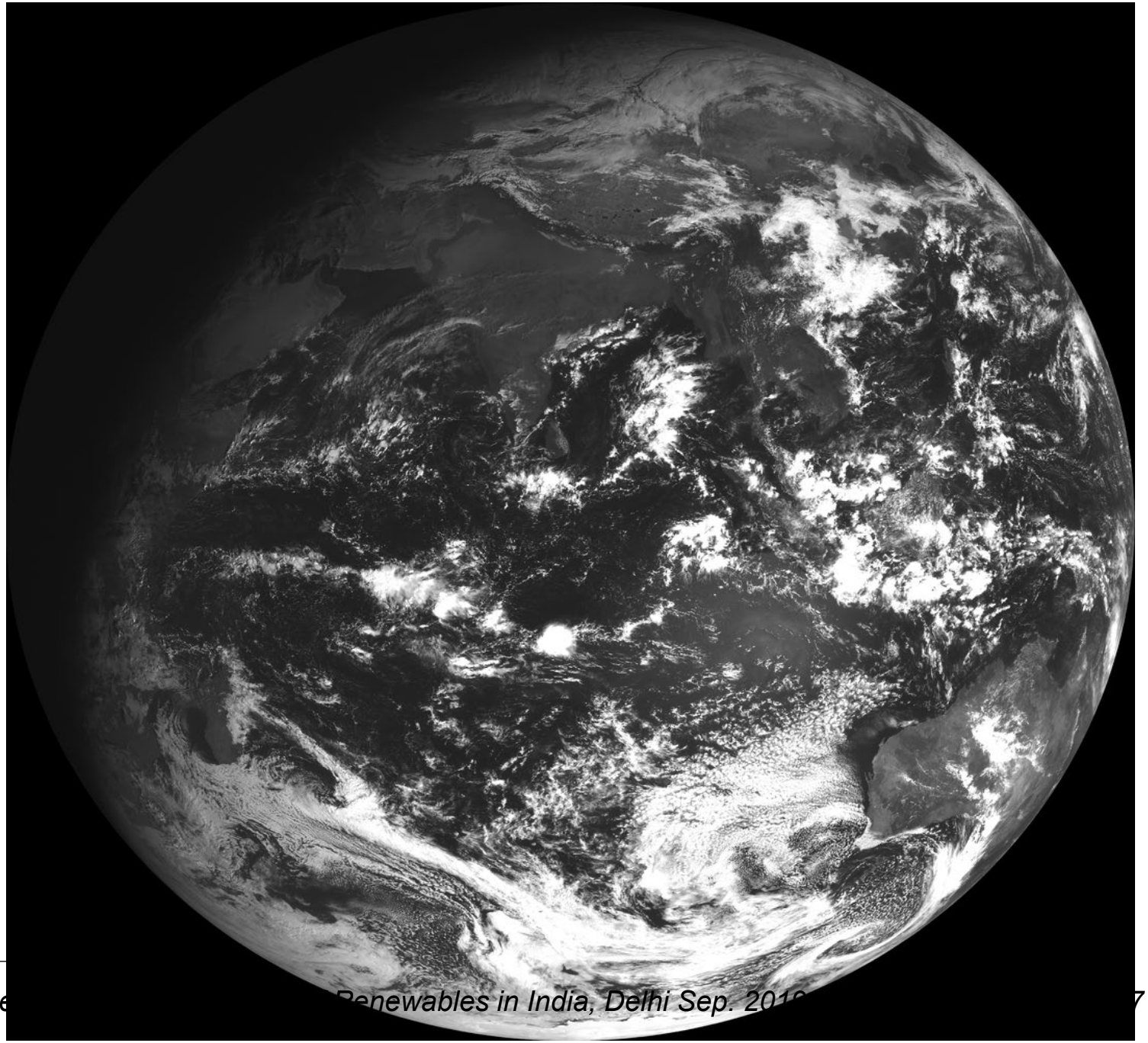
Motion Vector Field

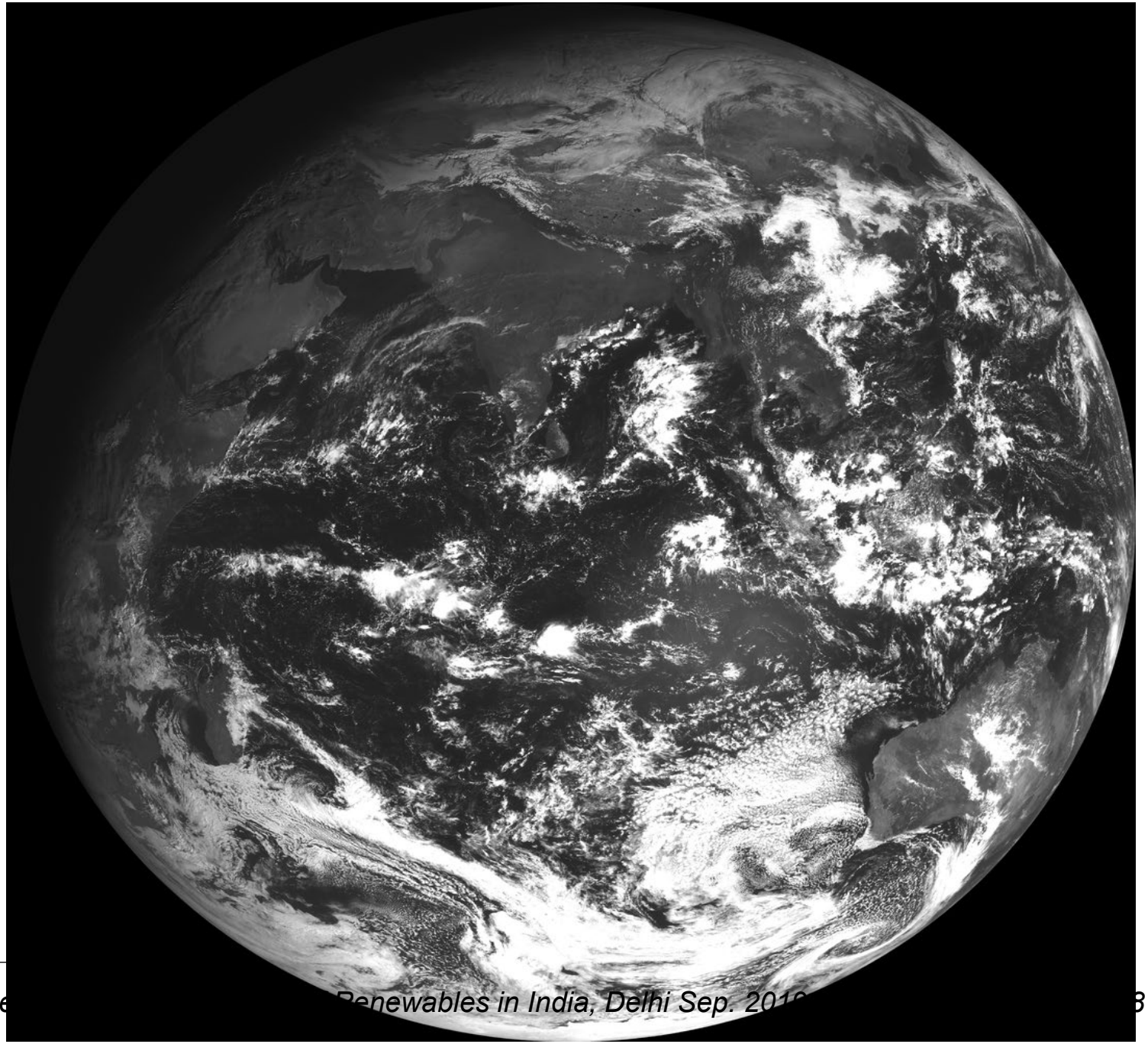
Cloud prediction
→ Irradiation

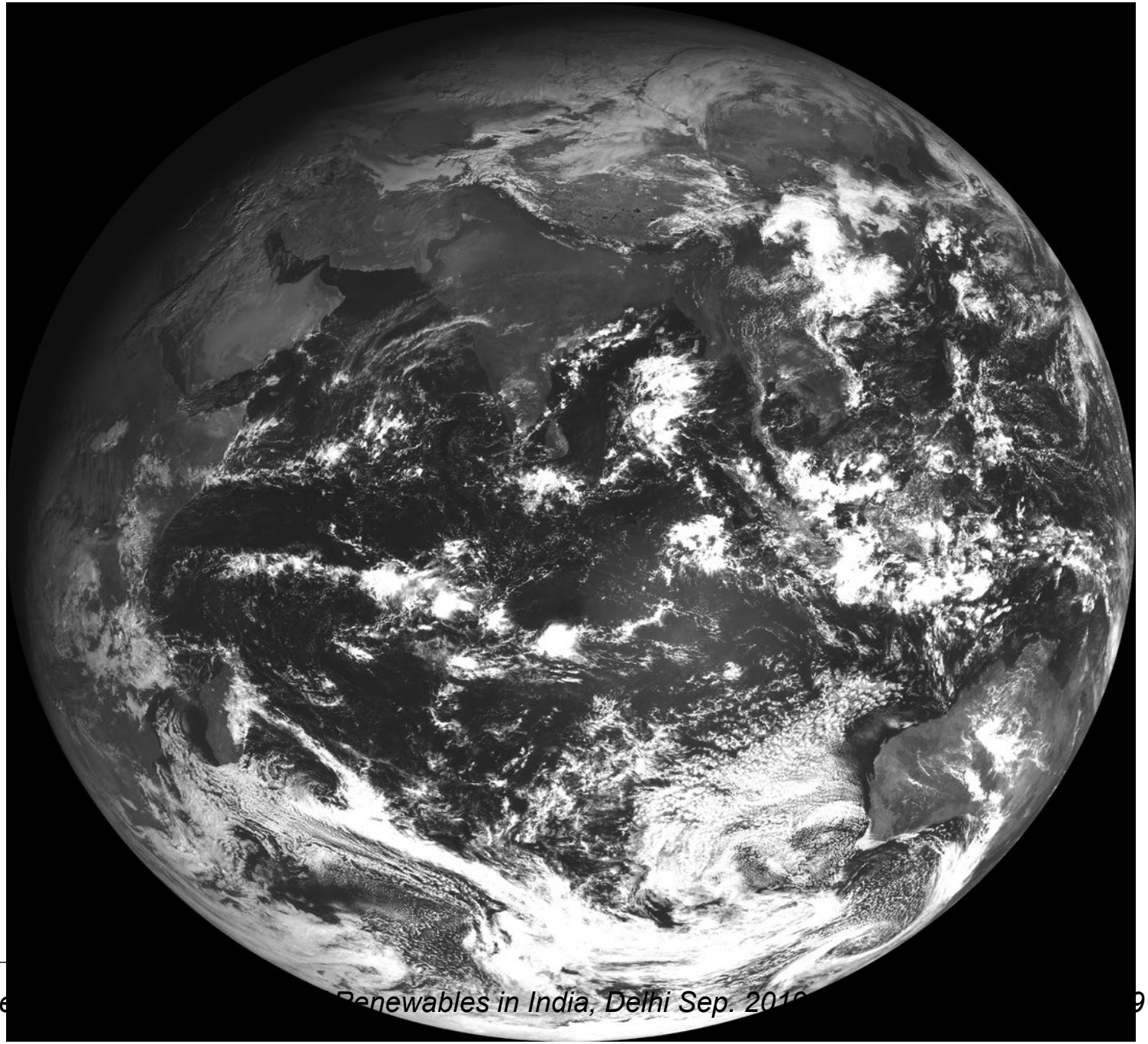


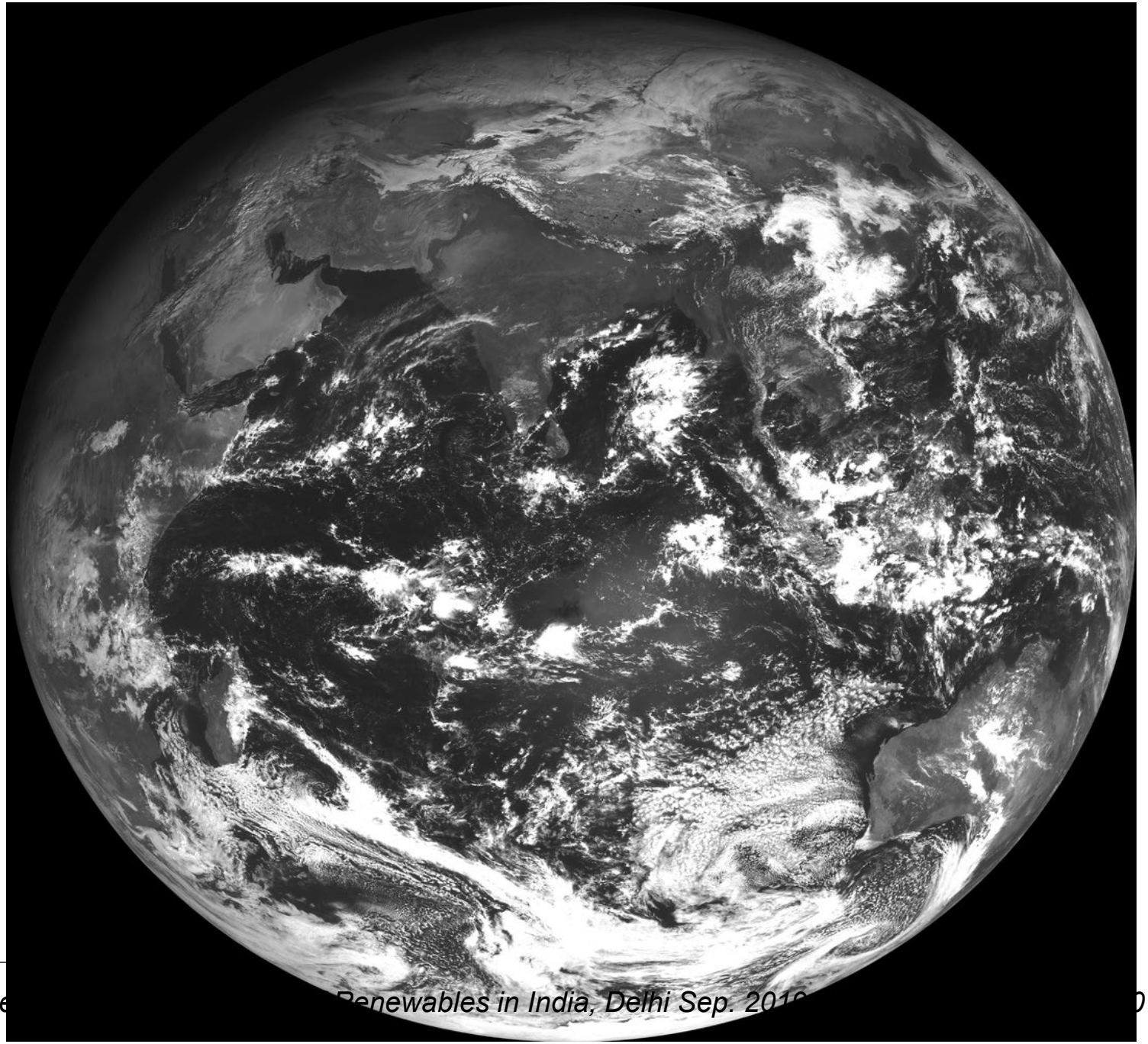


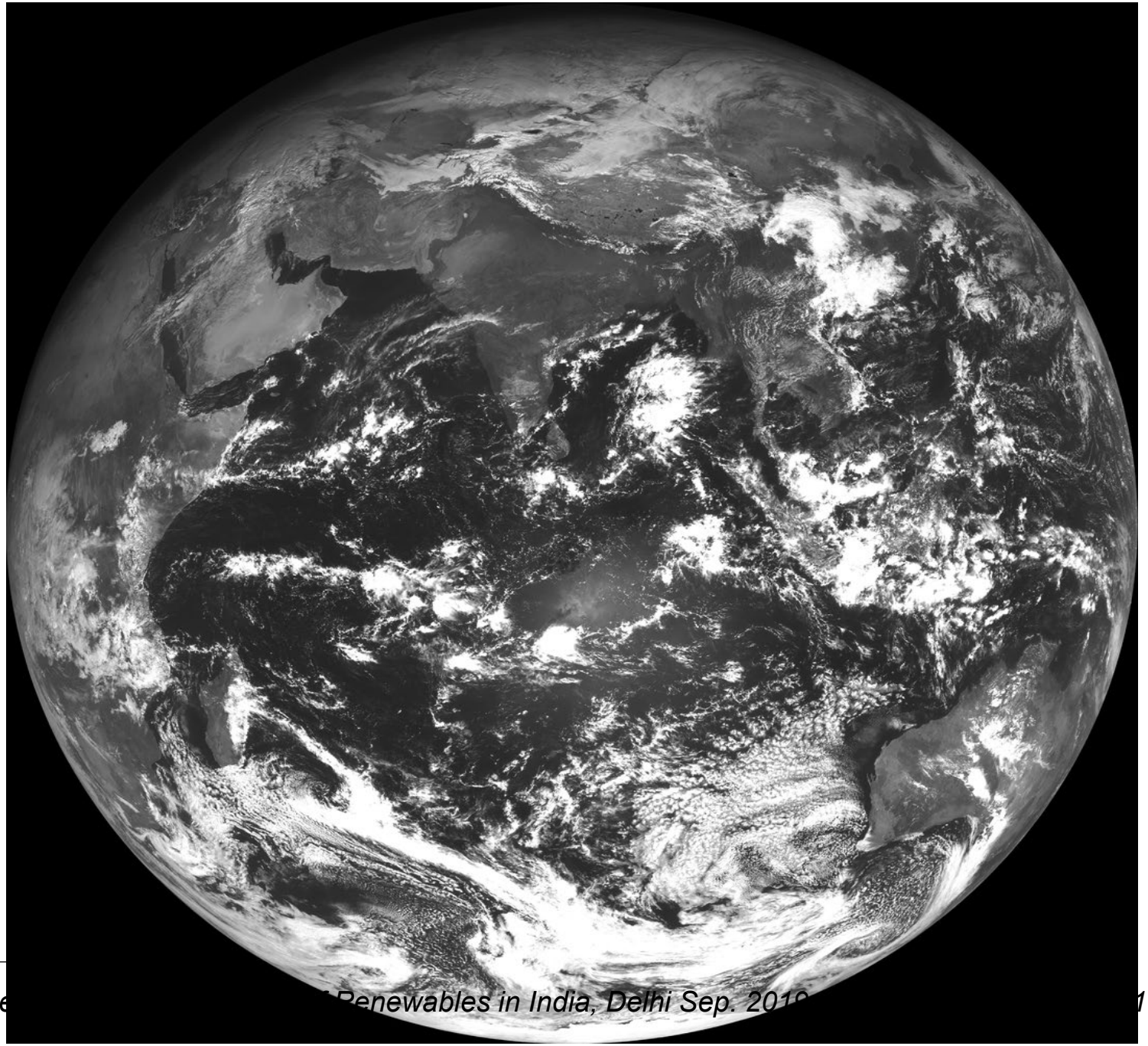


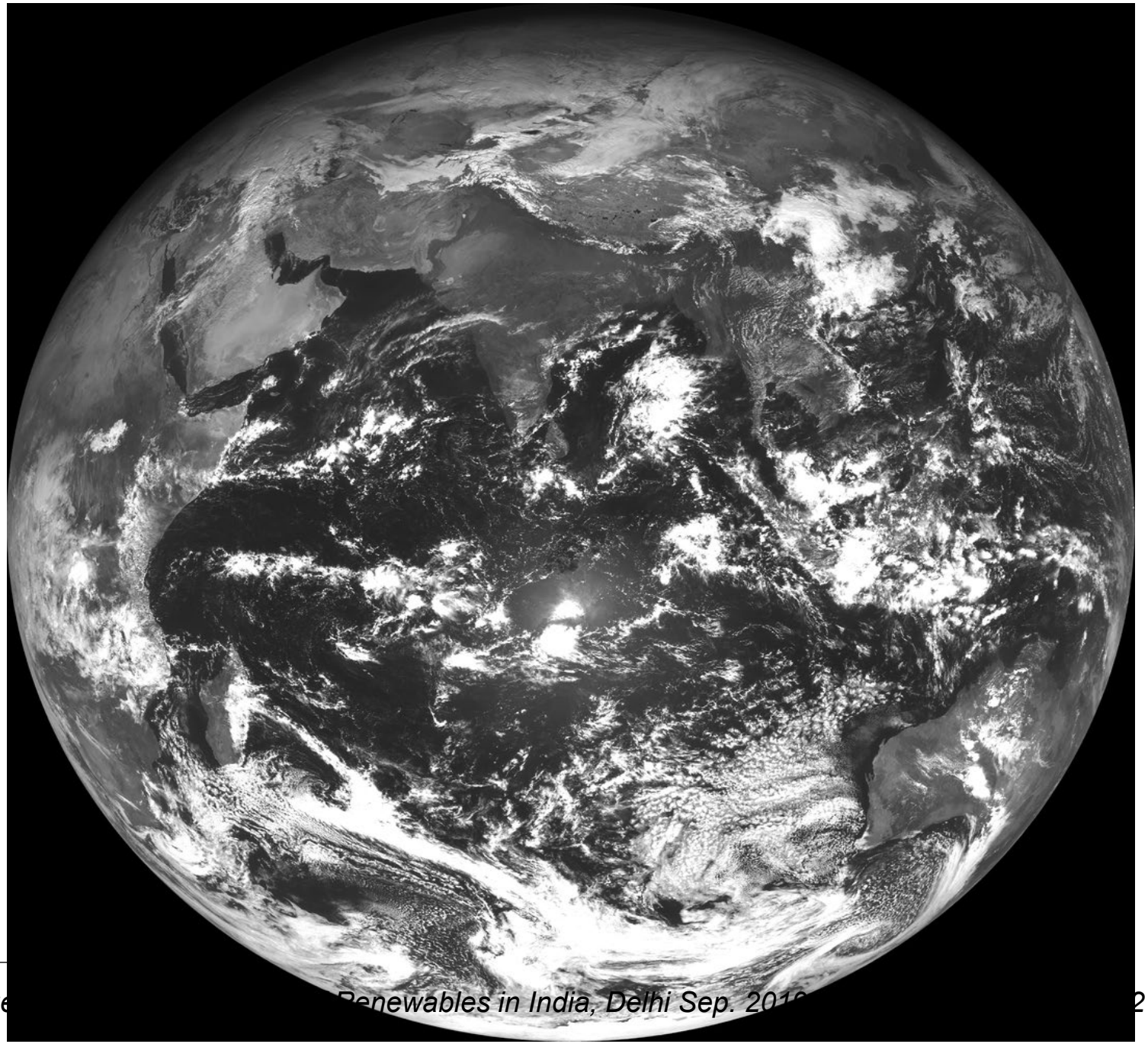


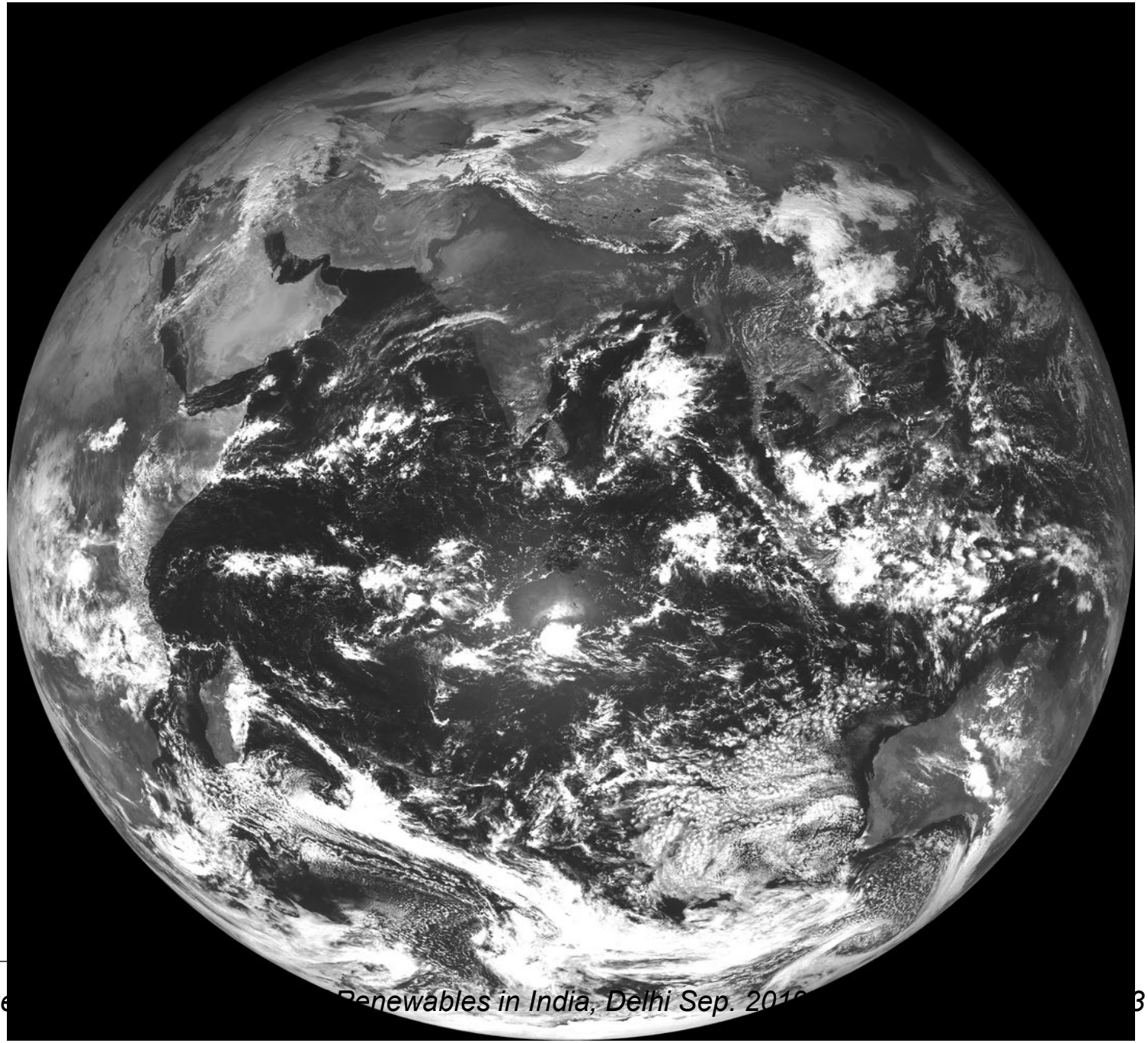


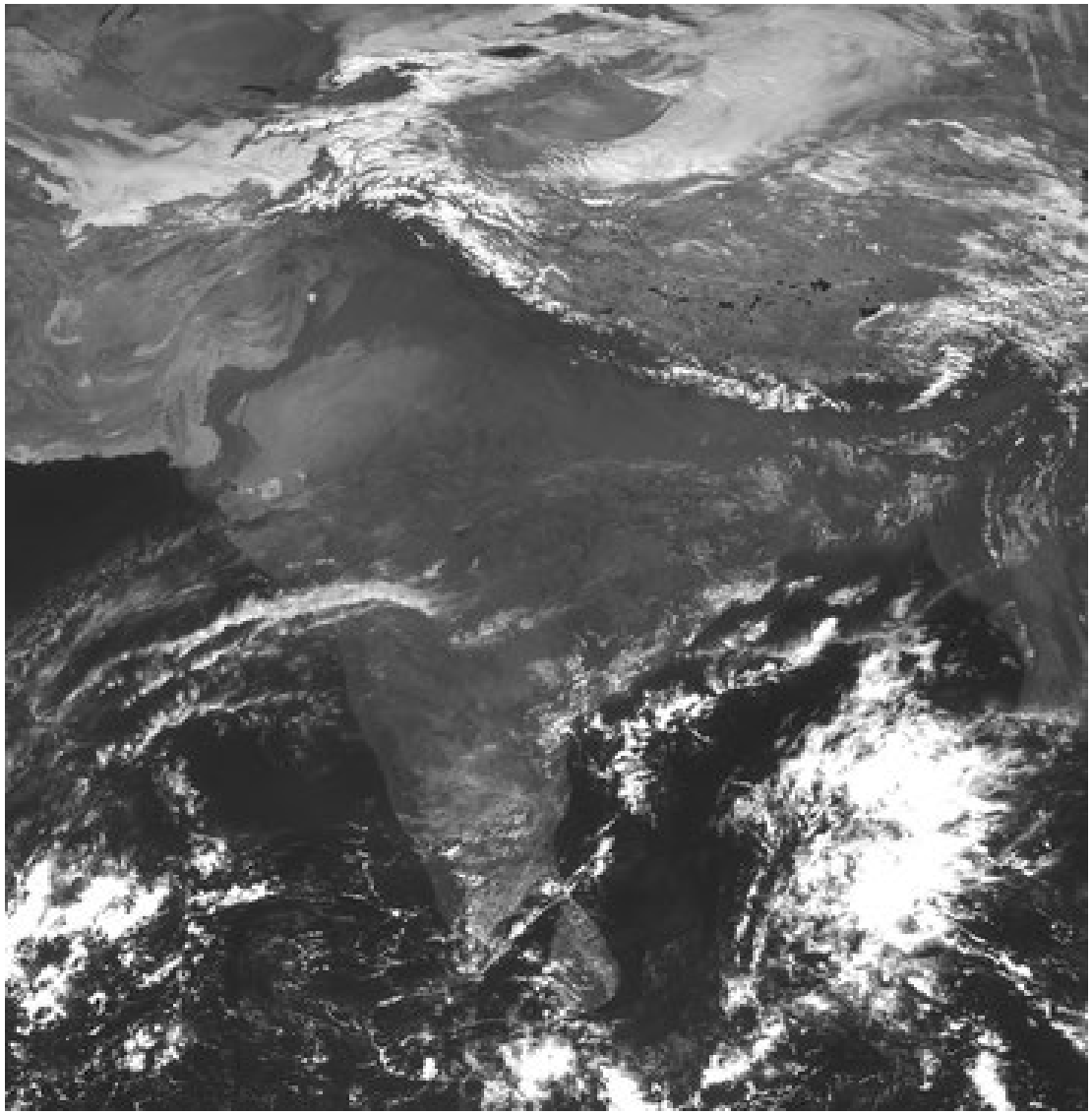


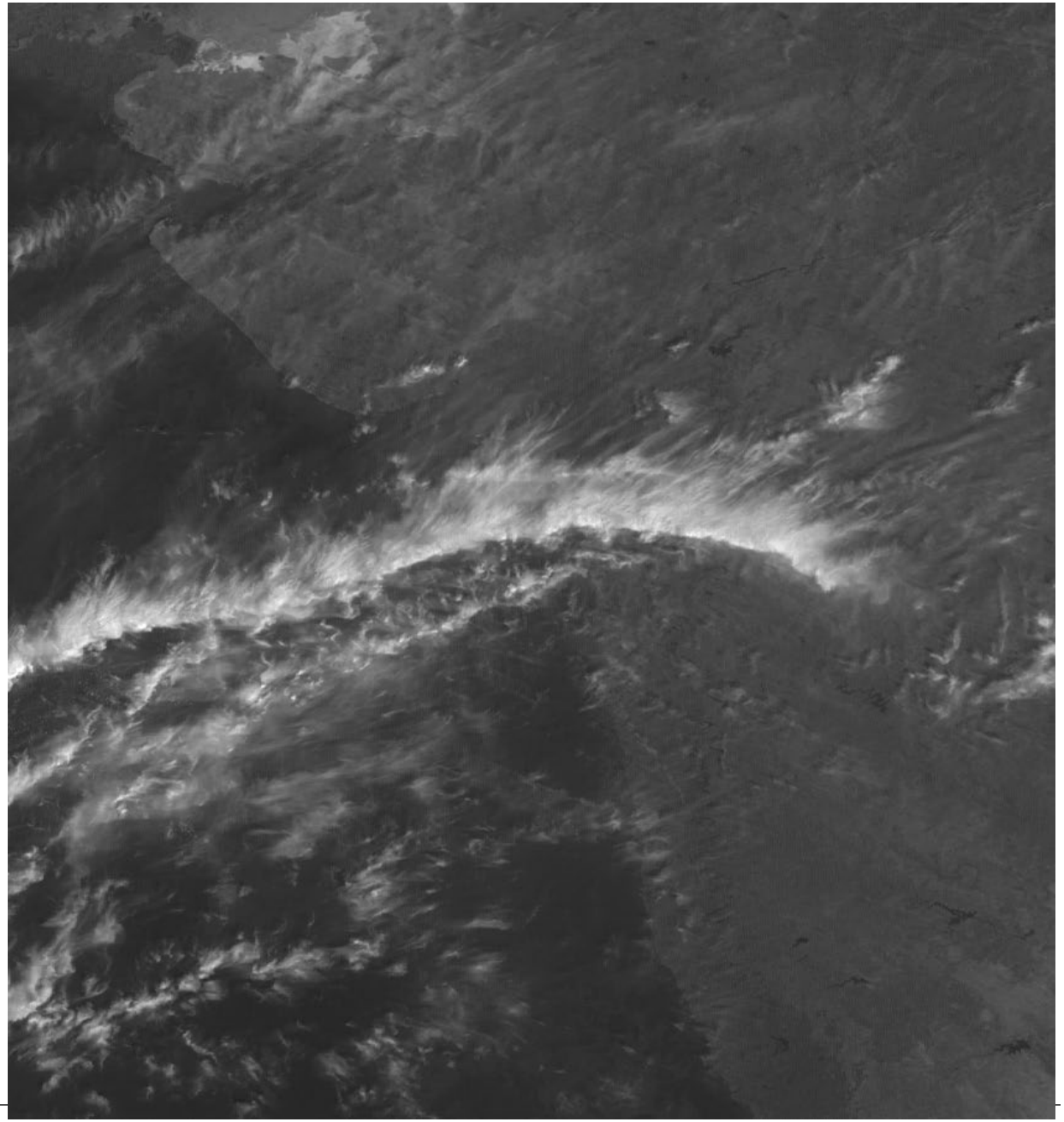


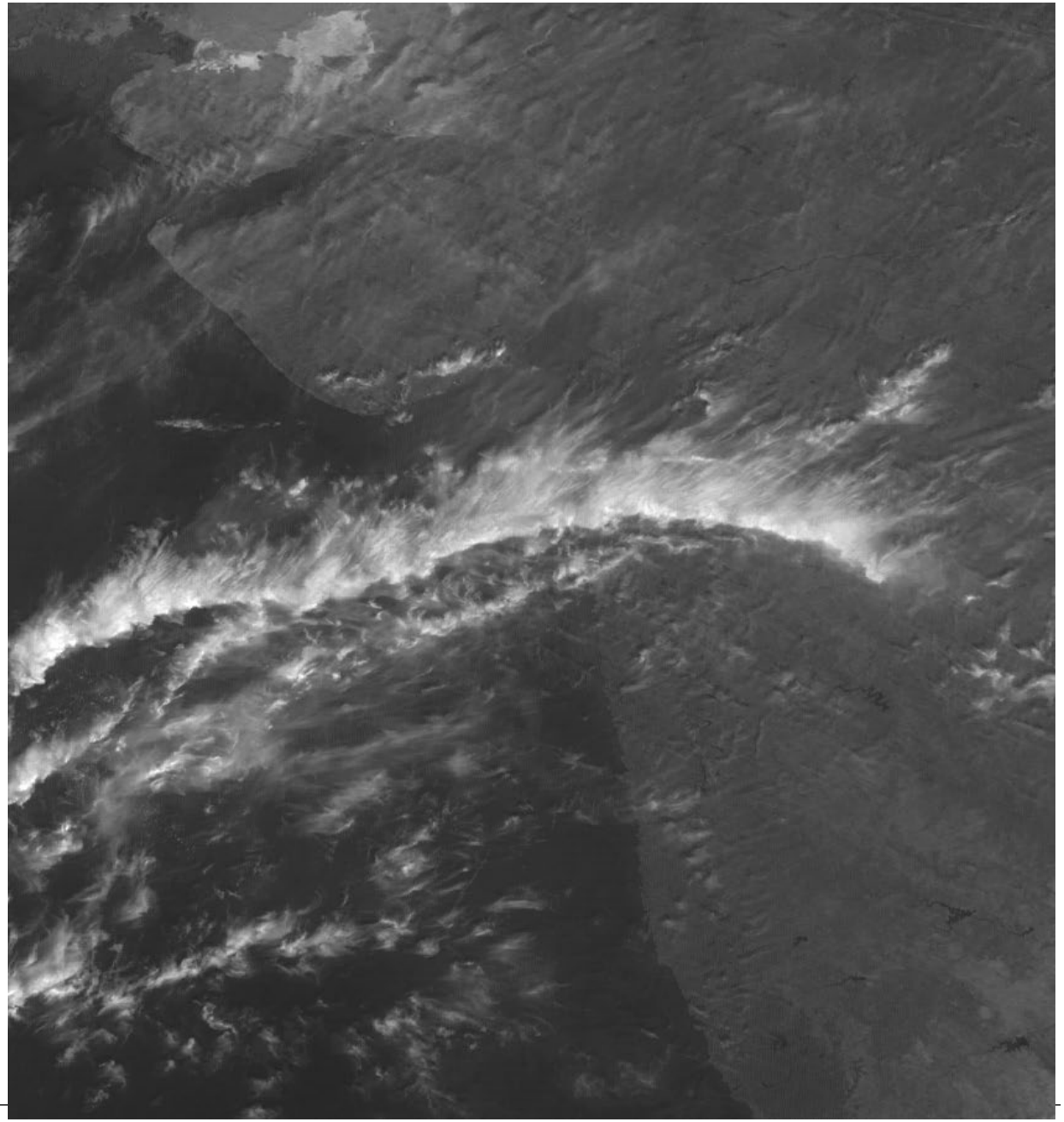


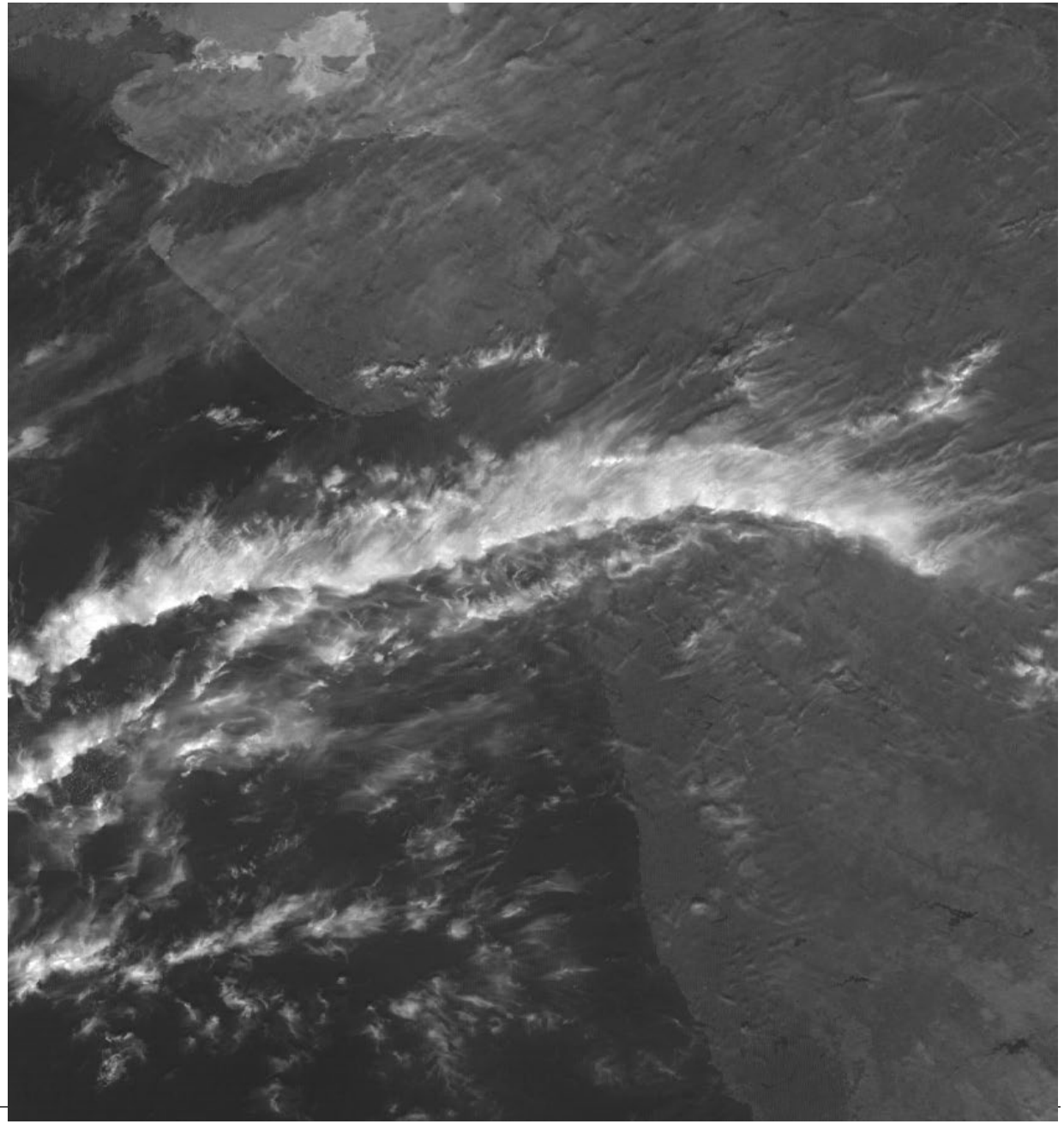


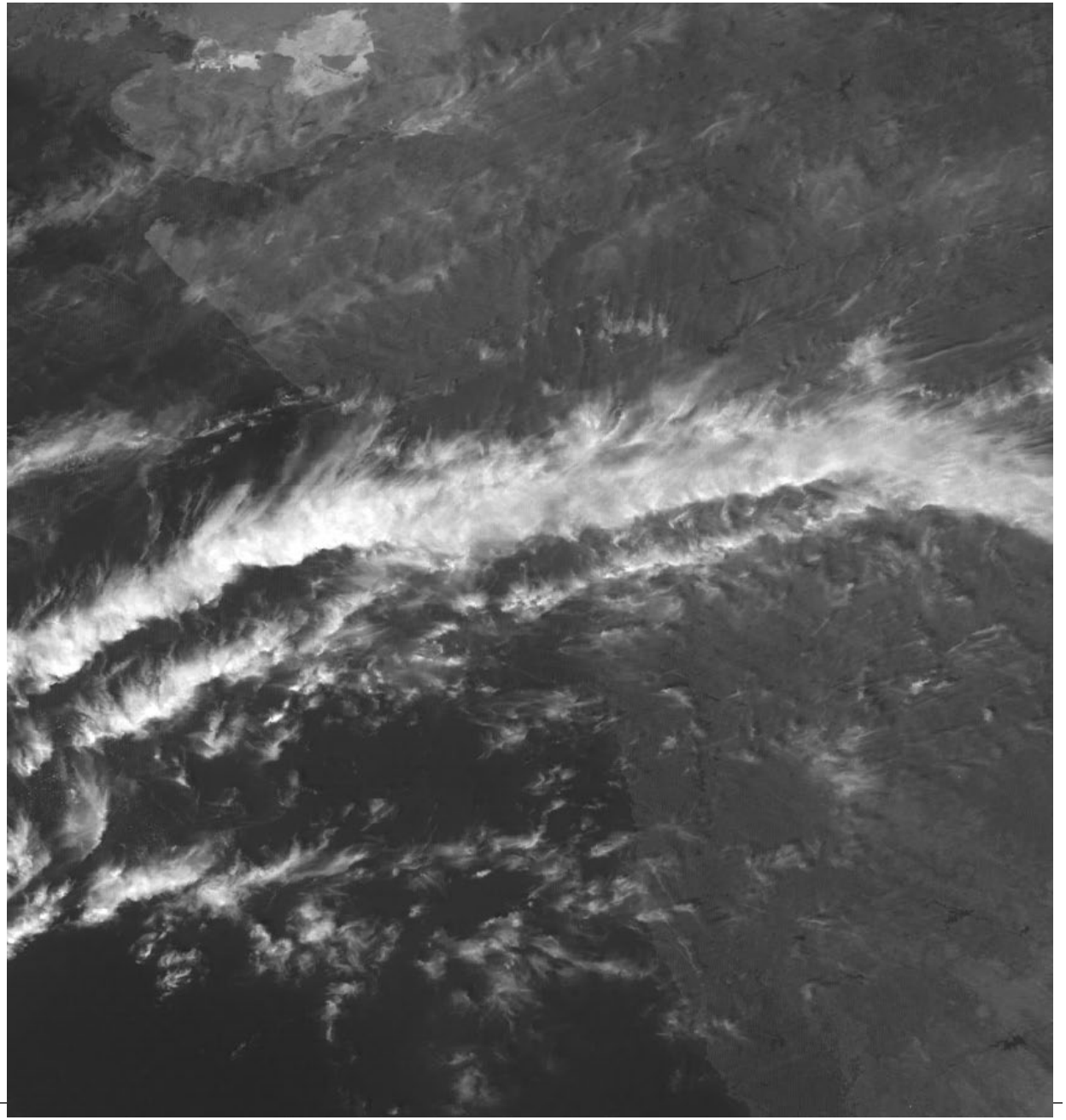




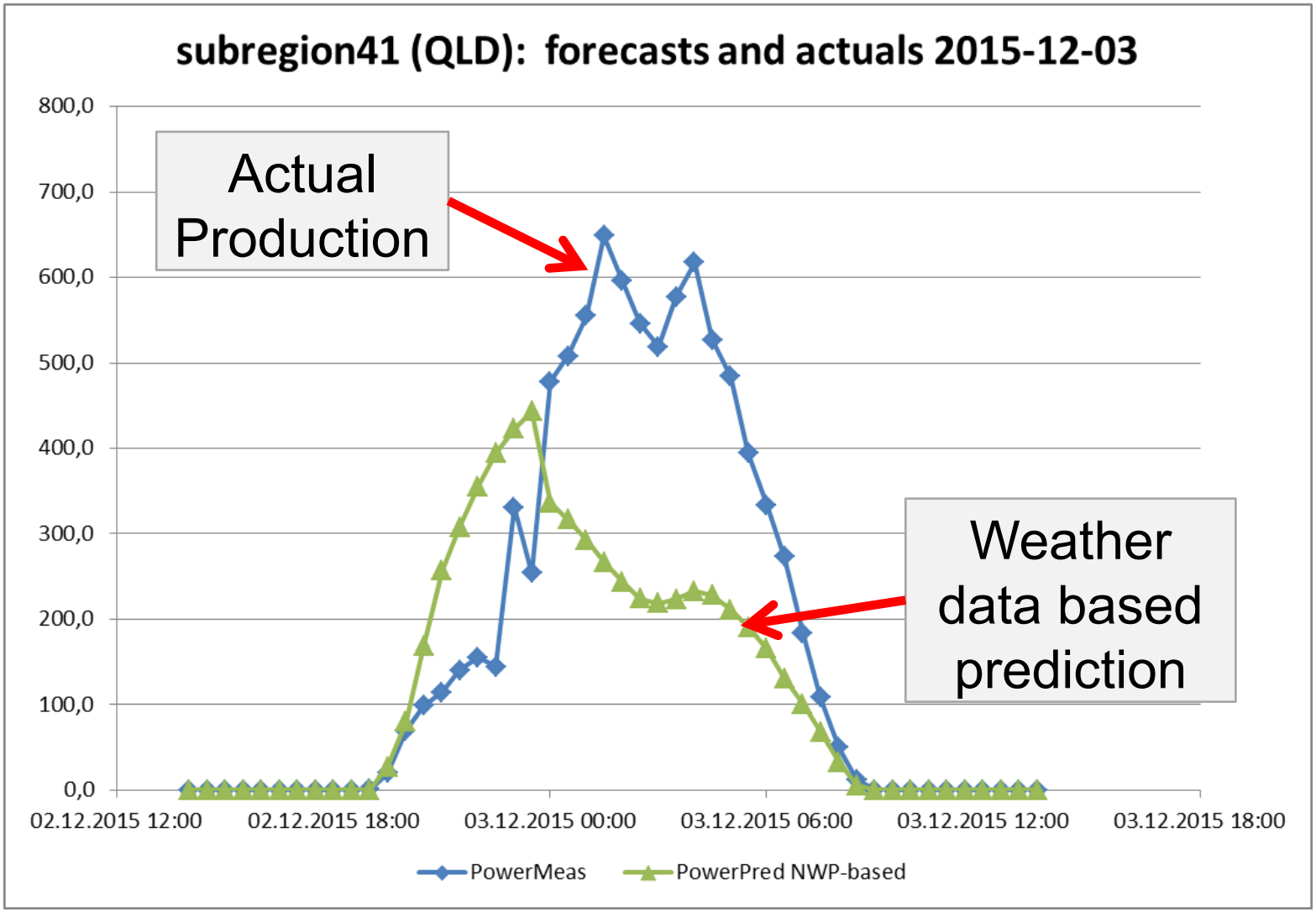




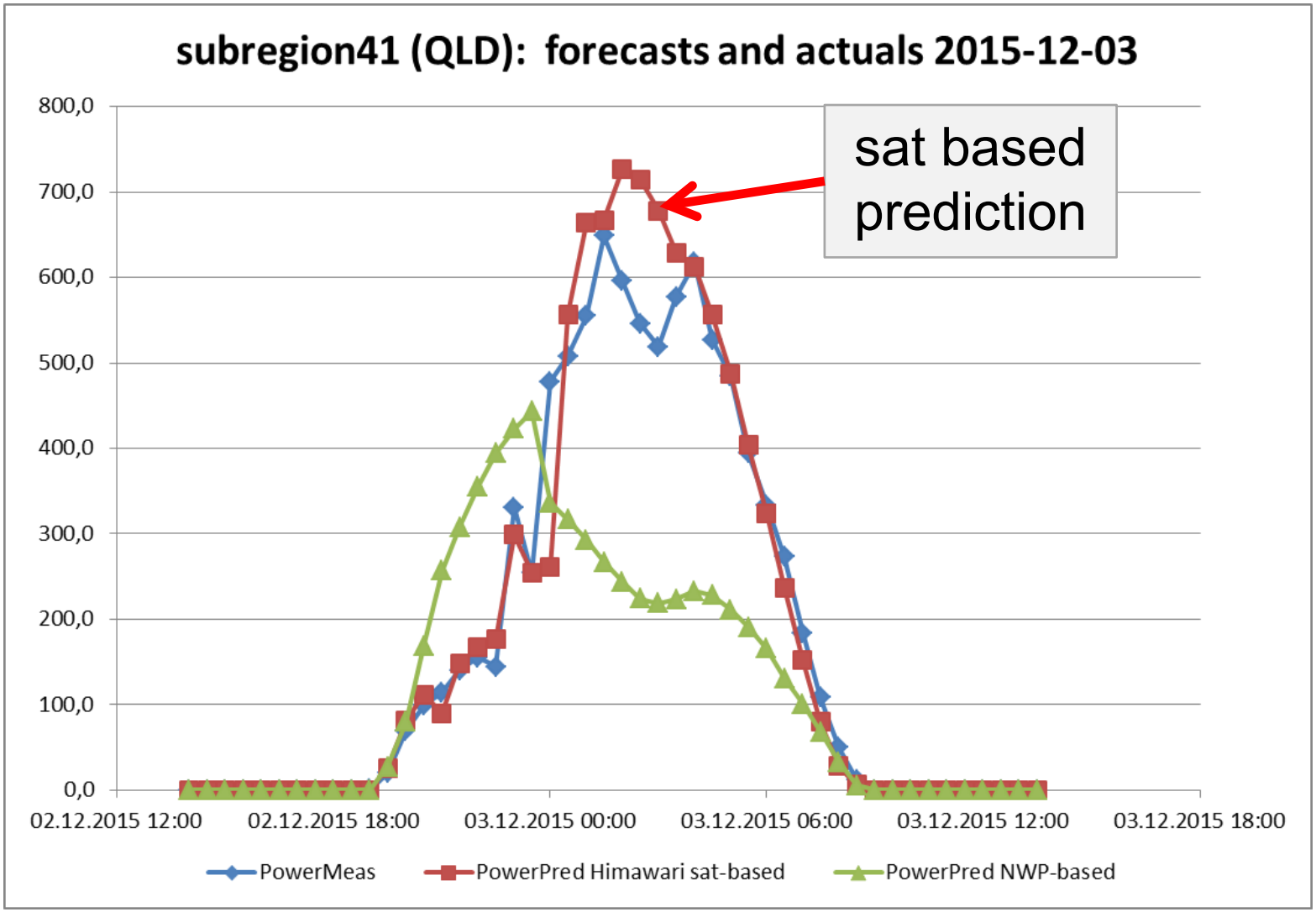




Example roof-top, NWP-based, Brisbane



Example roof-top, sat-based, 1 hour ahead



Prediction Principles: Extreme Short-term

Model types

Statistical models | NWP + physical/statistical modelling

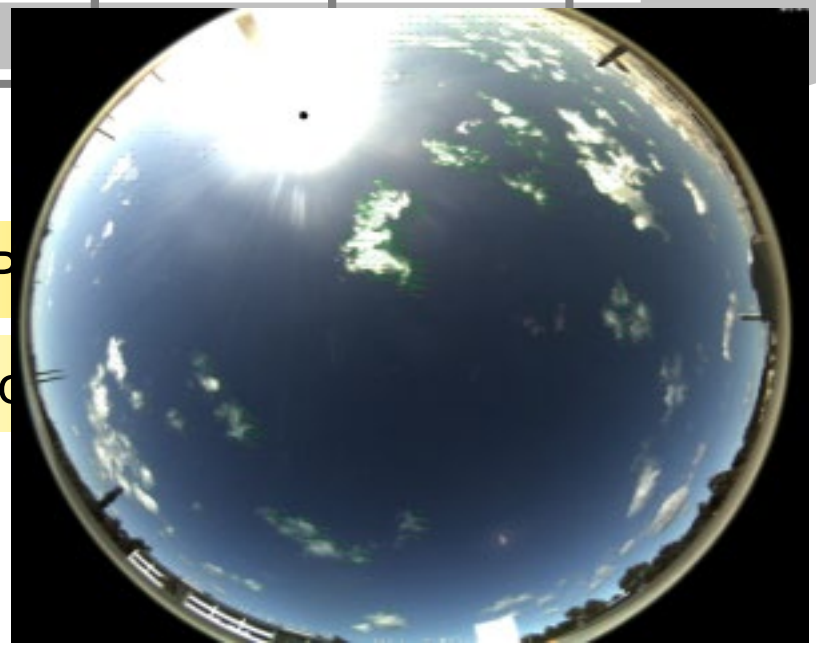
time

5 min | 15 min | 3 h | 6 h

Input Data

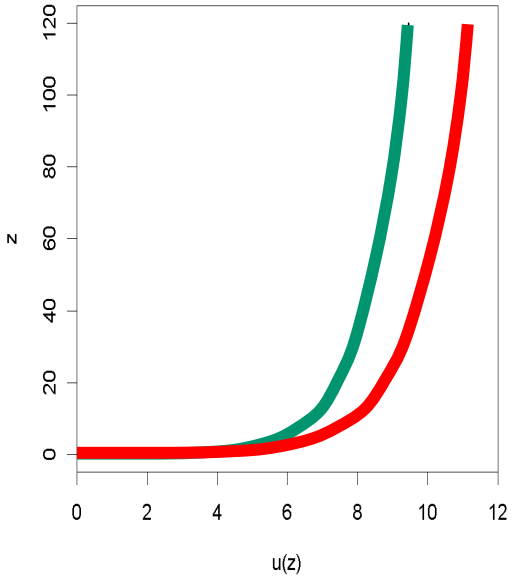
Online SCADA | NWP

Sky cams | Sat images | Histo



India is a challenging environment!

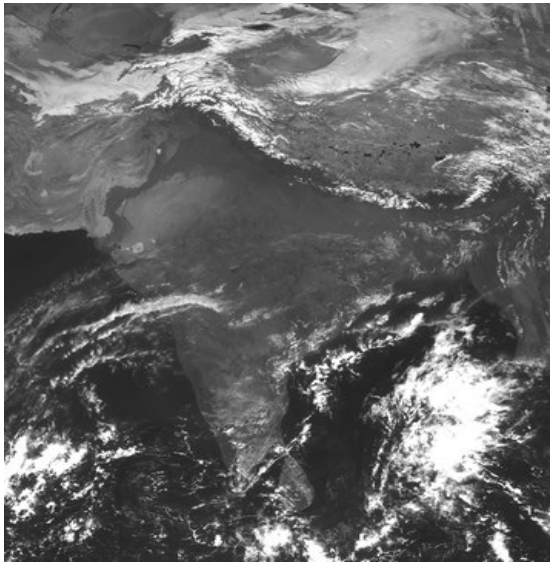
- Strong seasonal effects
- Strong thermal influences
- SCADA data influenced by no-availability



- Aerosoles and humidity play a big role
- Soiling has to be taken into account

India is a challenging environment!

- Very-shert-term forecasting with Indian satellite
- Fine tuning of models and processes improves predictions significantly



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