Monday, 8 December 2025 - Wednesday, 10 December 2025

Vrije Universiteit Brussels (VUB)

Programme

Mon 08/12

08:00

Welcome & Setup
U-Residence, Vrije Universiteit Brussels (VUB) 08:30 - 09:20

09:00

Welcome address *Prof. Lesley De Cruz et al.*
U-Residence, Vrije Universiteit Brussels (VUB) 09:20 - 09:30

Forecasting at a Transmission System Operator: applications & challenges within TenneT *Wouter Tromp*
U-Residence, Vrije Universiteit Brussels (VUB) 09:30 - 10:20

10:00

Renewable energy forecasting at the Royal Meteorological Institute of Belgium *Joris Van den Bergh*
U-Residence, Vrije Universiteit Brussels (VUB) 10:20 - 10:45

Current Status of Numerical Weather Prediction *Piet Termonia*
U-Residence, Vrije Universiteit Brussels (VUB) 10:45 - 11:10

11:00

Coffee break
U-Residence, Vrije Universiteit Brussels (VUB) 11:10 - 11:50

From Extreme Weather Detection to Energy Forecasts: The On-Demand Extremes Digital Twin Renewables Model
Kristian Pagh Nielsen

12:00

Evaluating the Prediction of Wind Power Ramping Events in the Belgian Offshore Zone *Ruoke Meng*
U-Residence, Vrije Universiteit Brussels (VUB) 12:15 - 12:40

Lunch break
U-Residence, Vrije Universiteit Brussels (VUB) 12:40 - 13:40

13:00

Forecasting Belgium's Solar Future: Climate Change Impact on PV Energy Output *Mr Richard de Jong*
U-Residence, Vrije Universiteit Brussels (VUB) 13:40 - 14:05

HireNext: HIgh Resolution forecasts for Next Generation Dynamic Line Rating computation *Tomas Van Oyen*
U-Residence, Vrije Universiteit Brussels (VUB) 14:05 - 14:30

14:00

Coffee break
U-Residence, Vrije Universiteit Brussels (VUB) 14:30 - 15:10

Identifying hotspots of adverse weather for Austrian energy infrastructure *Dr Irene Schicker*
U-Residence, Vrije Universiteit Brussels (VUB) 15:10 - 15:35

15:00

Machine-learning informed stochastic control of a hybrid wind-battery plant operating under time-dependent grid const…
Stijn Ally

16:00

Renewable forecasts as an enabler for Elia's operations *FREDERIK VANMAELE*

U-Residence, Vrije Universiteit Brussels (VUB) 16:00 - 16:50

17:00

Ice Breaker

18:00

19:00

20:00

't Complex 17:00 - 20:30

Tue 09/12

09:00

User-Informed Post-Processing: Designing Around Decision-making Requirements *Alice Lake*

U-Residence, Vrije Universiteit Brussels (VUB) 09:00 - 09:50

Probabilistic forecasting of spatially aggregated wind power production using Bernstein Quantile Networks.

10:00 *John Bjørnar Bremnes*

Coffee break

U-Residence, Vrije Universiteit Brussels (VUB) 10:20 - 11:00

11:00

The Zero Degree of Freedom Non-Central Chi Squared Distribution for Postprocessing of Precipitation Forecasts

Annette Möller

ENTSO-E API Python Package: Streamlining Access to European Electricity Market Data *Dr Jonathan Berrisch*

U-Residence, Vrije Universiteit Brussels (VUB) 11:30 - 12:00

12:00

Joint lead time precipitation forecast post-processing using deep generative models *Peter Mlakar*

U-Residence, Vrije Universiteit Brussels (VUB) 12:00 - 12:30

Lunch break

13:00

U-Residence, Vrije Universiteit Brussels (VUB) 12:30 - 14:00

14:00

Adaptive Bayesian Nowcasting of Wind Power Based on the Generalised Logit Transformation *Tao SHEN*

U-Residence, Vrije Universiteit Brussels (VUB) 14:00 - 14:25

RUSH: Seamless Shift from Obs Extrapolation to AIFS Guidance *Simon De Kock*

U-Residence, Vrije Universiteit Brussels (VUB) 14:25 - 14:50

Coffee break

15:00

U-Residence, Vrije Universiteit Brussels (VUB) 14:50 - 15:20

User requirements for nowcasting, forecasting, and observations

U-Residence, Vrije Universiteit Brussels (VUB) 15:20 - 16:10

16:00

Panel discussion *Jonathan Demaeyer*

U-Residence, Vrije Universiteit Brussels (VUB) 16:10 - 16:50

17:00

17:00

18:00

Workshop social dinner

19:00

20:00

21:00

Fox Food Market 18:30 - 22:00

22:00

Wed 10/12

09:00

Modeling the impact of gigawatt-scale offshore wind farm clusters on regional wind and weather conditions *Wim Munters*

U-Residence, Vrije Universiteit Brussels (VUB) 09:00 - 09:50

Day-ahead wind power forecasting with gradient boosting trees *Max Bruninx*

10:00

U-Residence, Vrije Universiteit Brussels (VUB) 09:50 - 10:15

Development of a multi-layer atmospheric perturbation model *Theo Delvaux*

U-Residence, Vrije Universiteit Brussels (VUB) 10:15 - 10:40

Coffee break

U-Residence, Vrije Universiteit Brussels (VUB) 10:40 - 11:00

11:00

Advancing Wind Power Forecasting with AI Weather Models *Sebastian Lerch*

U-Residence, Vrije Universiteit Brussels (VUB) 11:00 - 11:25

Adapting Machine Learning Weather Forecasting Architectures for Wind Power Prediction *Aaron Van Poecke*

U-Residence, Vrije Universiteit Brussels (VUB) 11:25 - 11:50

A fast blockage-correction model for wind-farm power calculation *Koen Devesse*

12:00

U-Residence, Vrije Universiteit Brussels (VUB) 11:50 - 12:15

Wind Energy Ramp Events: On the meteorological events causing sudden changes in wind energy generation
Vaughan Jones

Lunch break

13:00

U-Residence, Vrije Universiteit Brussels (VUB) 12:40 - 14:00

14:00

Satellite-based Solar Energy Nowcasting across Europe *Angela Meyer*

U-Residence, Vrije Universiteit Brussels (VUB) 14:00 - 14:50

Practice on forecasting wind and solar power *Yong Wang*

15:00

U-Residence, Vrije Universiteit Brussels (VUB) 14:50 - 15:15

Translating Weather Forecasts into Actionable Flexibility: The Meteorological Core of EngagePrivFlex *Irene Schicker*

U-Residence, Vrije Universiteit Brussels (VUB) 15:15 - 15:40

Concluding remarks *Prof. Lesley De Cruz et al.*

U-Residence, Vrije Universiteit Brussels (VUB) 15:40 - 15:50

Table of contents

Monday, 8 December 2025

Welcome & Setup - U-Residence (08:30 - 09:20)

Welcome address - U-Residence (09:20 - 09:30)

- Presenters: DE CRUZ, Lesley (RMI - VUB); DEMAEYER, Jonathan (Royal Meteorological Institute of Belgium); VAN DEN BERGH, Joris (Royal Meteorological Institute of Belgium); VANNITSEM, Stéphane (Royal Meteorological Institute of Belgium); SCHICKER, Irene (GeoSphere Austria)

Operational forecasting application: Operational forecasting application - U-Residence (8 Dec 2025, 09:30 - 12:40)

-Conveners: Demaeyer, Jonathan (Royal Meteorological Institute of Belgium)

Forecasting at a Transmission System Operator: applications & challenges within TenneT (09:30, 50 minutes)

Presenter: TROMP, Wouter (TenneT)
Running a high-voltage transmission grid is work in the shadows: it rarely goes wrong. Yet, a lot of challenges are faced every day. Reliable forecasting is at the heart of this challenge. A good understanding of weather will lead to better forecasts, yet the landscape is changing fast. Having accurate solar and wind forecasts is not enough; better insights in market dynamics and new technological developments are on the horizon. Within this keynote an overview will be given in the developments we have faced over the last few years, and the challenges we will face for the next few years.

Renewable energy forecasting at the Royal Meteorological Institute of Belgium (10:20, 25 minutes)

Presenter: VAN DEN BERGH, Joris (Royal Meteorological Institute Belgium)
In recent years, the Royal Meteorological Institute of Belgium (RMI) has positioned itself strongly in the field of renewable energy forecasting and its applications. This was made possible by leveraging scientific collaboration within various projects. In this presentation, we give an overview of applications such as the RMI Storm Forecast Tool developed for the Belgian TSO (Elia), and research and development performed in the context of the projects E-TREND (funded by Belspo), BeFORECAST, InStaFlex and STORM (FOD Economy through the Energy Transition Fund), renewable energy impact models within Destination Earth (ECMWF), and the Destination Earth Pilot Service on Dynamic Line Rating (ECMWF). We present the main results, ongoing work, and future plans within these projects.

Current Status of Numerical Weather Prediction (10:45, 25 minutes)

Presenter: TERMONIA, Piet (Royal Meteorological Institute of Belgium)
Over more than half a century, Numerical Weather Prediction (NWP) has achieved remarkable progress. This advancement results from the use of increasingly dense observational data types, progress in high-performance computing, and steady improvements in numerical modeling. This long-standing progress faces new challenges, with standard technologies approaching their physical limits, and models reaching resolutions where global high-resolution datasets are lacking. To address these challenges a threefold strategy is being pursued. Limited-area models are being used to further increase resolution toward the hectometric scale. Existing models are being refactored to enhance their flexibility and efficiency on emerging computing architectures. Machine learning techniques are being integrated with traditional numerical approaches to develop Machine-Learning NWP. This talk will explore these three directions, highlighting their implementation within major international initiatives.

From Extreme Weather Detection to Energy Forecasts: The On-Demand Extremes Digital Twin Renewables Model (11:50, 25 minutes)

Presenter: NIELSEN, Kristian Pagh (DMI)
The on-demand Extremes Digital Twin Renewables models, developed by the Destination Earth team, provide a configurable workflow linking the detection of adverse weather, hectometric and sub-hourly NWP simulations, and impact models for wind and solar energy. Targeted forecasts of renewable energy production under extreme conditions are generated through dynamic triggering based on meteorological detection algorithms. For wind and solar energy, post-processing combines NWP data (including a wind-farm parametrization) with machine-learning methods to refine the power output predictions, while satellite-driven nowcasting of global radiation complements the forecasts. Together, these components enhance the forecasting precision, uncertainty quantification, and user-tailored information to support grid operators, TSOs, DSOs, and energy traders in operational decision-making during extreme events.

Evaluating the Prediction of Wind Power Ramping Events in the Belgian Offshore Zone (12:15, 25 minutes)

Presenter: MENG, Ruoke (Royal Meteorological Institute of Belgium)

We present evaluations for the prediction of wind power ramping events in the Belgian Offshore Zone. We verify two models from Royal Meteorological Institute of Belgium: the operational ALARO-4km and its version with Wind Farm Parameterization (WFP). Power predictions are generated with power curves and machine learning (ML). As standard metrics like MAE are insufficient for evaluating ramps, our proposed framework incorporates time and power buffers for a flexible assessment by tolerating minor errors. Results show that WFP models improve ramping prediction skill, with ML achieving more balanced forecasts between reducing misses and false alarms. We also introduce a Ramp Alignment Score to quantify temporal errors by forecast lead time and confirm the averaged smaller timing errors of WFP models. Finally, the framework helps to understand that severe precipitation is a strong indicator of large, predictable ramps, while lighter precipitation is associated with more forecast errors.

time	title	presenter
11:10	Coffee break (40 minutes)	

Lunch break - U-Residence (12:40 - 13:40)

Operation & Decision-making - U-Residence (8 Dec 2025, 13:40 - 16:50)

-Conveners: Van den Bergh, Joris (Royal Meteorological Institute of Belgium)

Forecasting Belgium's Solar Future: Climate Change Impact on PV Energy Output (13:40, 25 minutes)

Presenter: DE JONG, Richard (imec)

This study investigates how climate change could affect the energy output of solar panels in Belgium, with projections extending to the year 2100. It offers a long-term perspective by starting with weather data from 1950 and building on future climate models developed by the Royal Meteorological Institute (RMI). By analysing multiple climate scenarios, the study examines potential shifts in photovoltaic (PV) system performance over time. The methodological framework is based on a bottom-up, multi-physics energy yield model developed by imec. This advanced model uses a wide range of weather variables to produce a clear and realistic estimate of how solar panels perform under different climate conditions.

HireNext: HIgh Resolution forecasts for Next Generation Dynamic Line Rating computation (14:05, 25 minutes)

Presenter: VAN OYEN, Tomas (PropheSea B.V.)

The HIRENEXT project aims to co-design and implement a Pilot Service tailored to dynamic line rating (DLR) computations for electricity transmission. This service leverages innovative research from the Destination Earth On-Demand Extremes Digital Twin contract (DE_330), which provides access to unprecedented high-resolution weather predictions. Through a user-centric co-design approach, conducted in close collaboration with a Transmission System Operator (TSO), the project seeks to demonstrate how accurate, high-resolution weather data can be operationalized to enhance overhead line ratings—both in real-time grid operations and long-term planning. By focusing on demonstrable outcomes and clear communication of expected benefits, the contract is positioned to showcase the tangible value of DestinE services, thereby driving significant user engagement and adoption of the Destination Earth (DestinE) platform.

Identifying hotspots of adverse weather for Austrian energy infrastructure (15:10, 25 minutes)

Presenter: SCHICKER, Irene (GeoSphere Austria)

EnergyProtect aims to identify present and future risk hotspots, defined as sites of renewable energy infrastructure with elevated exposure to potentially disruptive meteorological conditions. We i) use physics-informed ML to detect patterns of adverse weather, ii) dynamically downscale ensemble time slices to convection permitting resolutions, and iii) estimate uncertainties, return periods and changes in intensity. These datasets are then overlaid with renewable energy infrastructure to identify current and future risk hotspots. We present preliminary results for different severity levels of wind speed ramping and high wind events, that have potential to cause turbine cut-outs, reduced efficiency, or grid balance destabilization. We map the average annual occurrence of such risk events using multiple meteorological datasets (hourly, 1–30 km resolution), thereby identifying key hotspots in Austria and quantifying related uncertainties.

Machine-learning informed stochastic control of a hybrid wind-battery plant operating under time-dependent grid constraints (15:35, 25 minutes)

Presenter: ALLY, Stijn (VUB)

Offshore wind farms play an important role in the transition toward carbon-free energy production, but their variable and uncertain power output, depending on the wind conditions, presents significant operational challenges. To mitigate fluctuations in the grid, transmission system operators and regulatory authorities may impose various constraints on the power injection into the grid. Complying with these requirements may necessitate the integration of a battery energy storage system (BESS) together with advanced supervisory control. In this talk, a stochastic control strategy is presented for a hybrid wind-battery plant operating under time-dependent grid constraints, motivated by a real-world use case. The proposed approach maximizes the economic value of the plant, while ensuring compliance with both operational limitations and grid constraints. It is demonstrated that combining machine-learning-based wind farm power forecasts with a stochastic model predictive control (SMPC) framework can substantially improve the profitability of the hybrid renewable energy plant.

Renewable forecasts as an enabler for Elia's operations (16:00, 50 minutes)

Presenter: VANMAELE, FREDERIK

Elia Transmission Belgium operates a grid with a high penetration of PV-production capacity, offshore wind parks, DC cables and a particular geographical position, between the biggest consumers of the European grid – Germany and France. The exploitation happens parallel to one of the most challenging infrastructure portfolios in the whole of Europe, implying many outages happening at any given time. The first topic is the use of forecasts in the congestion management domain. Elia has designed several

processes to balance the need of outages while limiting the impact on the market. In these processes, a particular role is played by the renewable forecasts. In a second part, Predico will be highlighted, an innovative platform designed by the Elia Group Innovation Department, that aims at improving the forecast Elia uses internally and publishes as well. It lowers the entry barriers for forecasting companies and drives innovation, by rewarding forecasters based on their performance.

time	title	presenter
14:30	Coffee break (40 minutes)	

Ice Breaker (17:00 - 20:30)

Tuesday, 9 December 2025

Postprocessing - U-Residence (9 Dec 2025, 09:00 - 12:30)

-Conveners: Vannitsem, Stéphane (Royal Meteorological Institute of Belgium)

User-Informed Post-Processing: Designing Around Decision-making Requirements (09:00, 50 minutes)

Presenter: LAKE, Alice (Met Office (UK))

As the Met Office retires legacy deterministic data feeds and moves towards ensemble forecasting, a challenge arises in maintaining delivery of spot forecast products, including those supporting renewable energy applications. Rather than replicating existing data feeds, a new project is taking a fresh approach to understand requirements. Starting with plain-English questions to understand how each product supports decision-making and what behaviour it aims to capture, key scientific characteristics (such as inter-parameter consistency, temporal consistency, and accuracy metrics) were identified. These characteristics inform the design of modular post-processing components, which will be deployed in cloud-based pipelines to deliver forecasts tailored to user needs. This method enables more flexible, purposeful forecasting and supports the transition to modern, scalable systems. Examples will be presented to illustrate the approach and its benefits.

Probabilistic forecasting of spatially aggregated wind power production using Bernstein Quantile Networks. (09:50, 30 minutes)

Presenter: BREMNES, John Bjørnar (Norwegian Meteorological Institute)

Accurate forecasts of regional wind power production are crucial for power system operation and planning. Total generation in the coming hours and days depends strongly on both weather forecasts and time-varying production capacity. We propose a probabilistic forecasting approach based on Bernstein Quantile Networks (BQN) to predict aggregated power production from multiple wind farms without access to individual farm data. The model uses ensemble forecasts of several meteorological variables at each wind farm, combined with time-dependent capacity information. Its architecture exploits the structured input through (i) learnable wind farm embeddings, (ii) mappings to power output, (iii) spatial aggregation across farms, and (iv) permutation-invariant layers capturing distributional features. The BQN framework produces full predictive distributions via quantile functions represented by Bernstein polynomials.

The Zero Degree of Freedom Non-Central Chi Squared Distribution for Postprocessing of Precipitation Forecasts (11:00, 30 minutes)

Presenter: MÖLLER, Annette

In this work we introduce and investigate the zero degree of freedom non-central Chi Squared distribution for ensemble postprocessing. It has a point mass at zero by definition and is thus particularly suited for postprocessing weather variables naturally exhibiting large numbers of zeros, such as precipitation, solar radiation or lightnings. Due to the properties of the distribution, no additional truncation or censoring is required to obtain a positive probability at zero. The presented study investigates its performance compared to that of the censored generalized extreme value distribution (GEV0) and the censored and shifted gamma distribution (CSG0) for postprocessing 24h accumulated precipitation at 31 stations in Germany using an Ensemble Model Output Statistics (EMOS) approach with a rolling training period. The case study shows that the Chi Squared distribution is highly competitive to state-of-the-art distributions, specifically when predicting extreme precipitation events.

ENTSO-E API Python Package: Streamlining Access to European Electricity Market Data (11:30, 30 minutes)

Presenter: BERRISCH, Jonathan (University of Duisburg-Essen, House of Energy, Climate & Finance)

The ENTSO-E Transparency Platform provides comprehensive European electricity market data essential for renewable energy forecasting and operations. We present entsoe-apy, an open-source Python library enabling access to all ENTSO-E RESTful API endpoints with seamless data retrieval. The package features automatic request splitting for large queries, intelligent retries, and consistent error handling. Its structure mirrors the official API documentation, making it intuitive for users. Built on Pydantic models, entsoe-apy offers type-safe, validated data structures with runtime checks, improving reliability. The library preserves complete API responses while providing flexible outputs: users can extract data as JSON or pandas DataFrames. Designed for operational and research use, entsoe-apy enables stakeholders to efficiently integrate ENTSO-E data into forecasting models, validate predictions, and support data-driven decisions for improved renewable energy integration across Europe.

Joint lead time precipitation forecast post-processing using deep generative models (12:00, 30 minutes)

Presenter: MLAKAR, Peter (Slovenian Environment Agency)

Accurate weather forecasting plays an increasingly important role in today's society, with implications in hydrological modelling, renewable energy production, and civil service operations. To improve the reliability of ensemble weather forecasts, post-processing of said forecasts is frequently employed. However, many variables of interest, such as precipitation or wind

speed, exhibit highly skewed distributions, making them challenging to model. We investigate the application of normalizing flows and flow matching to facilitate skewed distribution modelling, focusing on precipitation forecast post-processing. We show that both methods improve the reliability of the underlying forecast while post-processing the entire lead time at once, jointly.

time	title	presenter
10:20	Coffee break (40 minutes)	

Lunch break - U-Residence (12:30 - 14:00)

Nowcasting - U-Residence (9 Dec 2025, 14:00 - 16:10)

-Conveners: Schicker, Irene (GeoSphere Austria)

Adaptive Bayesian Nowcasting of Wind Power Based on the Generalised Logit Transformation (14:00, 25 minutes)

Presenter: SHEN, Tao (University of Glasgow)

Wind power central to the energy transition, yet its variability challenges accurate forecasting. This work introduces an adaptive nowcasting method for probabilistic forecasting method combining the generalised logit transformation with a Bayesian framework. The transformation maps double-bounded wind power data to an unbounded domain, enabling Bayesian inference, while an adaptive mechanism updates the shape parameter using representative samples. Four adaptive methods are compared in a case study of over 100 wind farms in Great Britain over four years, focusing on one-step-ahead 30-minute forecasts. Performance is assessed with the Continuous Ranked Probability Score and functional reliability diagrams. Results show the proposed Bayesian method consistently improves forecast accuracy and reliability, supporting robust grid integration and decision-making.

RUSH: Seamless Shift from Obs Extrapolation to AIFS Guidance (14:25, 25 minutes)

Presenter: DE KOCK, Simon (Electronics and Informatics (ETRO), Vrije Universiteit Brussel, Brussels, Belgium. Royal Meteorological Institute, Brussels, Belgium)

RUSH (Rapid Update Short-term High-resolution) is an AI-native, rapid-update nowcasting framework that turns heterogeneous inputs into probabilistic 0–24 h forecasts at 30-min steps on a 1-km grid over Belgium. Methodologically, RUSH couples two ingredients: (i) observation-led evolution learned from 30-min radar accumulations and 15-min SEVIRI channels, and (ii) large-scale dynamical context from ECMWF's AIFS. A latent-diffusion sequence-to-sequence model performs conditioning and super-resolution in latent space, avoiding manual blending and enabling seamless transition from nowcasting to short-range guidance. The system is designed for fast cycling as new observations arrive and exposes uncertainty via ensembles. We will present the framework design, training/ingestion pipeline and provide an update on current work which now includes longer forecast times and large-scale predictions downscaling.

time	title	presenter
14:50	Coffee break (30 minutes)	
15:20	User requirements for nowcasting, forecasting, and observations (50 minutes)	

Panel discussion - U-Residence (16:10 - 16:50)

- **Presenter: DEMAEYER, Jonathan (Royal Meteorological Institute of Belgium)**

Workshop social dinner (18:30 - 22:00)

Wednesday, 10 December 2025

Wind energy application: Wind energy application - U-Residence (10 Dec 2025, 09:00 - 12:40)

-Conveners: Tabari, Hossein (RMI / UAntwerpen)

Modeling the impact of gigawatt-scale offshore wind farm clusters on regional wind and weather conditions (09:00, 50 minutes)

Presenter: MUNTERS, Wim (von Karman Institute for Fluid Dynamics)

With offshore wind farms increasing in size and number, their interaction with regional wind and weather patterns plays an increasingly important role. Wind turbines extract energy from the boundary layer, resulting in downstream wakes with reduced wind speeds. When clustering many turbines together, wakes coalesce and can persist for tens of kilometers, affecting neighboring farms and regional conditions. We study the impact of a gigawatt-scale cluster on regional weather using multi-year high-resolution mesoscale simulations. We focus on the Belgian–Dutch cluster, the largest offshore cluster to date with an installed capacity of over 3.7 GW. Modeled wake effects are validated against lidar and satellite data, and potential impacts on precipitation and sea surface waves are explored. This work provides a first long-duration assessment of the accuracy of this setup, paving the way for broader use of mesoscale wind farm parameterizations in different phases of wind farm projects.

Day-ahead wind power forecasting with gradient boosting trees (09:50, 25 minutes)

Presenter: BRUNINX, Max (Vrije Universiteit Brussel)

Accurate day-ahead wind power forecasts are essential for wind farm operation strategies and grid capacity planning. This presentation demonstrates probabilistic day-ahead wind power forecasting using gradient boosting trees. We compare three probabilistic prediction methods - conformalised quantile regression, natural gradient boosting and conditional diffusion models - combined with tree-based machine learning. Validated with four years of data from all wind farms in the Belgian offshore zone, we find that these methods outperform deterministic engineering approaches (power curve or analytical wake model), with an improved point forecast accuracy of around 3.7 % of installed capacity compared to the analytical wake model. Considering the three probabilistic prediction methods, the conditional diffusion model is found to yield the best overall probabilistic and point estimate of wind power generation.

Development of a multi-layer atmospheric perturbation model (10:15, 25 minutes)

Presenter: DELVAUX, Theo (KU Leuven)

Recent research has pointed out that wind farms can interact with the atmosphere at scales much larger than the turbine size. Although these large-scale effects are significant, they cannot be captured by the widely used engineering wake models. To bridge this gap, Allaerts & Meyers [1] developed an Atmospheric Perturbation Model (APM) that accounts for both turbine-scale and mesoscale effects on power predictions. The original model represents the atmospheric boundary layer as two sub-layers topped by the free atmosphere. This work aims to generalize the APM to a user-defined number of sub-layers, and to inform a simple physics-based procedure to define them. Preliminary results have shown that the improved model allows to study a wider range of atmospheric conditions. The current focus is placed on testing the performance of the model for realistic conditions provided by RMI (ECMWF data of the Belgian offshore zone). [1] Allaerts & Meyers 2019, J. Fluid. Mech vol 862

Advancing Wind Power Forecasting with AI Weather Models (11:00, 25 minutes)

Presenter: LERCH, Sebastian (University of Marburg, Germany)

AI-driven Weather Prediction Models (AIWPMs) are revolutionizing weather forecasting and surpassing traditional numerical weather models in both accuracy and computational efficiency. With weather conditions impacting numerous sectors, such as renewable energy generation, this has far-reaching implications. AIWPMs could enable improved forecasts for renewable energy generation, such as wind power, ensuring that appropriate actions are taken to maintain grid stability and cope with volatile generation. Traditionally, such renewable energy forecasts have been generated with separate models in a model-chain approach, considering weather predictions as important inputs. We explore novel strategies for utilizing AIWPMs for wind energy prediction, including parameter-efficient fine-tuning methods, which have been successfully employed to adapt large models to new tasks without excessive computational cost in the machine learning community.

Adapting Machine Learning Weather Forecasting Architectures for Wind Power Prediction (11:25, 25 minutes)

Presenter: VAN POECKE, Aaron (University of Antwerp)

This study investigates the application of Encoder–Processor–Decoder architectures, which have been successfully employed in large machine learning–based weather forecasting models, for wind power prediction. Using the Anemoi framework from the European Centre for Medium-Range Weather Forecasts (ECMWF), we evaluate graph-based neural networks over a domain

covering Belgium and the Belgian Offshore Zone (BOZ) with a forecast horizon of up to 48 hours. These models are trained to forecast key meteorological variables, including wind speed, wind direction, and temperature, derived from the Copernicus Regional Reanalysis for Europe (CERRA). Wind power is treated as a diagnostic variable, and verification is performed using publicly available production data from the European Network of Transmission System Operators for Electricity (ENTSO-E). We assess how both input feature selection and network architecture affect prediction accuracy.

A fast blockage-correction model for wind-farm power calculation (11:50, 25 minutes)

Presenter: DEVESSE, Koen (KU Leuven)

As offshore wind-farms grow in size, atmospheric gravity waves and blockage can affect their operation and performance [1]. Since conventional wake models cannot capture these effects on their own, they need to be coupled to other models that simulate the mesoscale interaction between wind farms and the atmosphere. However, this raises the computational cost of the wake model by several orders of magnitude. To address this, we present a new method of speeding up the coupling with an atmospheric perturbation model [2]. The resulting combined model can calculate farm power output in just a few seconds per case, and has been validated using prior LES results [1]. Furthermore, we will show how the combined model can be used for estimating annual losses due to flow blockage, and compare its predictions against operational data from the Belgian-Dutch offshore wind cluster. [1] Lanzilao & Meyers 2024, J. Fluid Mech., vol 979 [2] Devesse et al. 2024, J. of Physics: Conf. Series, vol 2767

Wind Energy Ramp Events: On the meteorological events causing sudden changes in wind energy generation (12:15, 25 minutes)

Presenter: JONES, Vaughan

This study investigates the meteorological drivers responsible for sudden wind power fluctuations (ramps) at the Belgian offshore wind farm cluster. These ramps can cause grid management challenges. Using power generation and meteorological data, 221 unique ramps are identified across 154 days in 4 years time. Each ramp is manually linked to synoptic conditions via a custom dashboard integrating weather charts and power data. Ramp types are categorised into slow-large ($\geq$1000 Mw in $\leq$60 min), fast-small ($\geq$500 Mw in $\leq$15 min) and fast-large ramps (both criteria). Most events (171) can be associated to synoptic scale events, which might suggest that the Belgian cluster is somewhat insensitive to mesoscale features (often fast ramps). To explore this further, ramp extraction (with scaled thresholds) of hypothetical sub-clusters shows that larger clusters ramp less frequently, but when they do, the events are more severe (larger and longer).

time	title	presenter
10:40	Coffee break (20 minutes)	

Lunch break - U-Residence (12:40 - 14:00)

PV energy application: PV energy application - U-Residence (10 Dec 2025, 14:00 - 15:40)

-Conveners: De Cruz, Lesley (RMI - VUB)

Satellite-based Solar Energy Nowcasting across Europe (14:00, 50 minutes)

Presenter: MEYER, Angela (BFH, TU Delft)

Solar energy forms an important pillar of climate change mitigation. Short-term forecasts of surface solar irradiance (SSI) are gaining more importance for power grid operators seeking to balance supply and demand in a secure and economical way. Regional-scale SSI forecasts are essential since most solar power is provided by decentralized PV plants. Solar nowcast models offer SSI predictions at forecast lead times of minutes to hours. I will provide an introduction to spatiotemporal forecasting of solar energy as applicable across Europe and other global regions and will introduce the first two regional-scale solar nowcast models, SolarSTEPS and SHADECast, which provide probabilistic satellite-based solar forecasts for minutes to hours, enabling uncertainty quantification for regions of dozens to thousands of kilometers in size. I will also present a first intercomparison of probabilistic solar forecast models and how they perform for national-scale PV forecasting.

Practice on forecasting wind and solar power (14:50, 25 minutes)

Presenter: WANG, Yong (Nanjing University of Information Science and Technology)

Post-processing methods are implemented at wind/solar farm for the power forecast. We propose two forecasting frameworks based on EMOS and neural network (NN). Boosting technique is applied for selection of the variables in the EMOS approach. The NN approach uses a multilayer perceptron model, where the training process is specifically tailored to the limited dataset size of one year by utilizing a similarity-based custom validation set. The power forecasts are customer-oriented evaluated, and compared with the commercialized product. The results will be shown at the workshop.

Translating Weather Forecasts into Actionable Flexibility: The Meteorological Core of EngagePrivFlex (15:15, 25 minutes)

Presenter: SCHICKER, Irene (GeoSphere Austria)

Increasing shares of distributed PV generation plus increased wind energy being fed into the grid challenge local grids through rising variability and peak loads, requiring accurate, high-resolution forecasts for grid flexibility. EngagePrivFlex addresses this by exploring how private households can provide flexible generation & consumption to support grid stability. The meteorological component develops post-processing and ML tools to improve weather-driven forecasts for PV and wind energy production &flexibility planning. This is done using ensemble calibration, site-specific temporal disaggregation, and conversion to per-substation aggregated power production predictions to represent local variability relevant for demand response. Meteo-forecasts are coupled with grid and consumption data to predict short-term flexibility potential, demonstrating how tailored post-processing and AI methods can translate NWP outputs into insights for smart-grid operation and renewable integration.

Concluding remarks - U-Residence (15:40 - 15:50)

- Presenters: DE CRUZ, Lesley (RMI - VUB); DEMAEYER, Jonathan (Royal Meteorological Institute of Belgium); VAN DEN BERGH, Joris (Royal Meteorological Institute of Belgium); VANNITSEM, Stéphane (Royal Meteorological Institute of Belgium); SCHICKER, Irene (GeoSphere Austria)