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Editorial: Climate change challenge-a wind energy perspective

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Editorial on the Research Topic
Climate change challenge-a wind energy perspective

1 Introduction

The ongoing effects of climate change have significant consequences on ecosystems, healthcare systems, and the overall economy in the next decades. Several studies have investigated various impacts of the climate change (Nardone et al., 2010; Tol, 2018; Mikhaylov et al., 2020). Although some impacts are not direct, they can have long lasting influences and alter the future the planet earth. Tackling the climate change issues has been a major topic in the last few decades. Therefore, prioritizing the advancement, implementation, and integration of renewable energy sources is crucial.

Wind energy has become the main part in human life and one of the major player in reducing the climate impacts due to carbon emission. Some of the main drivers for massive developments in wind energy technologies are the constant depletion of fossil fuels, fear of the energy crisis, price volatility, and people's awareness of cleaner and greener sources of energy (Bangga, 2022a). These factors have driven a rapid development and massive demand in wind productions over the time, and wind energy has been observed as one of the most prominent solutions to produce clean energy without leaving noticeable carbon footprints (Bangga, 2022b).

For this purpose, the Research Topic collection series "Climate Change Challenge" aim to foster collaborative scientific decision-making and work toward a more sustainable future for the next-generation. The objective is to explore solutions and challenges in energy research, particularly from the perspective of Wind Energy. The present editorial article will provide a brief overview of recent research progress and highlights some key takeaway from the studies.

2 Research outcomes and key takeaway

The Research Topic "Climate Change Challenge - A Wind Energy Perspective" has collected articles from different perspectives in wind energy technologies and assessments. These range from forecasting, wind farm control and optimization, to load estimations.

To properly evaluate wind turbine performance, low to high order prediction tools may be used (Bangga, 2022b). They will provide different levels of fidelity and reliability. One of the main consideration when using high order prediction tool is the computational speed, which becomes the limiting factor in forecasting the energy production in real time. To accommodate these shortcomings, state-of-the art statistical approaches are now commonly used for various aspects to enhance the accuracy of low order models.

Su et al. proposed a method to improve short-term power forecasting based on secondary decomposition technique and grey wolf optimizer (GWO). The simulation results indicate that the forecasting model outperforms other forecasting models in terms of accuracy. Another application of data processing technique in wind energy is to estimate the acting blade pitch loads based solely on SCADA (supervisory control and data acquisition) data as carried out by Li et al. The main implication and usage of the studies might be directed for condition monitoring of wind turbines (Wang et al., 2014). The outcome can also be useful to improve the understanding of large turbine behavior in operation and also during strong wind gust or turbulence. This might be also beneficial to reconstruct the wind field in combination with the data-driven technique proposed by Geibel and Bangga (Geibel and Bangga, 2022). The reconstructed datasets together with the processed SCADA data may serve as an input for a digital twin technologies when combined with a dedicated calculation tool such as blade-element theory.

The energy generated by the turbine will affect the grid and determine the characteristics of other turbines within the wind farm. Several studies have reviewed the optimization of a wind farm based on the layout and control perspectives (Bossanyi, 2000; Bossanyi, 2018; Bossanyi, 2022; Chen et al. Desalegn et al.), for instance as documented by Desalegn et al. which covers some recent trend in wind farm control models. Bossanyi (Bossanyi, 2022) and Chen et al. both adopted a surrogate model for wind farm applications. This highlights the possible application of surrogate models for fast prediction tool. However, in many cases, the short-term effects will not be captured by surrogate models, but the general characteristics are commonly well estimated, e.g., when comparing time domain load fluctuations.

Based on the above discussion, it can be seen that progress has been made in wind energy research in various aspects. It is evident that statistical approaches play an increasingly crucial role in wind energy assessment and predictions. In the future, it is highly possible to see the integration of digital twin technologies with wind energy systems, allowing various aspects of wind technology to be incorporated.

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Galih Bangga: Writing–original draft, Writing–review and editing.

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Conflict of interest

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