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Global warming impact on the wind energy resources and ramps in Japan

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This study investigated about the impact of global warming on the resource of wind power generations by using the large ensemble simulation of the global warming experiments named d4PDF dataset. The d4PDF consists of outputs from general circulation models and dynamically downscaled for the Japanese region using a 20-km regional climate model for historical and +4-K future climate projections. The climatological capacity factor under the future and present climate is estimated from an idealized power curve based on hourly near-surface wind speeds. The 20-km climate simulations capture the behavior and variability of current wind energy indices, even though some differences exist when compared with that in reanalysis. +4K warming future climate projections show significant changes of the wind energy generation on annual mean that are substantially stronger in seasonal terms. The changes in wind energy varies from region to region and season to season. From winter to spring, the wind energy potential is projected to slightly increase especially over northern part of Japan. However, that in summer to autumn may experience a decrease in most parts of Japan. Frequency of wind ramp events are also decreased in these seasons.
To investigate about the relationship to the synoptic weathers, self-organizing maps (SOMs) is employed on atmospheric variables derived from the d4PDF over the region, whereby weather patterns (WPs) in present and future +4-K climate were classified for a two-dimensional lattice. Future probabilistic projection of WPs under the global warming scenario show the increase/decrease in occurrence frequency of the WPs which has advantages/dis advantages for the wind power generations are corresponding with the changes in the future changes in the climatological capacity factor in Japan.