天气尺度环流对中国气温、风速和日照时数的影响

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关键字：可再生能源，环流分型，气温，风速，日照时数，中国

未来，电力系统中风能和太阳能所占比重将大幅提升，以构建以新能源为主体的新型电力系统，实现碳达峰碳中和目标。本研究基于台站观测数据和ERA5再分析数据，研究了1979—2021年冬季环流型对中国地区与可再生能源相关的气象变量（温度、风速和日照时长）逐日变化的影响。首先，利用Self-Organizing Map（SOM）方法对逐日的大气环流进行分类，共分为六种类型，包含三对相反的环流模态：两个西北-东南偶极子模态、两个控制中国东北部的单极子模态和两个控制整个中国的单极子模态。

研究发现，温度距平和环流距平的位置有很好的对应关系，正的风速距平通常位于气旋的南部或西部，而正的日照时数距平与气旋西部的偏北气流和减少的云量有关。因此，这些变量的空间分布与环流的分布有密切联系。

如果只考虑温度负距平的情况，在东北气旋控制的环流条件下，中国地区的风能和太阳能发电气象条件是最佳的，在西北（正距平）-东南（负距平）偶极子环流条件控制下，云贵高原地区的风力和光伏发电气象条件比较差。

最后，利用多元线性回归方法，基于1979-2021年42个冬季的环流型和气温、风速和日照时数建立模型，并模拟2021/2022年冬季的气温、风速和日照时数。我们发现，随着环流模态数量增加，该模型的技巧不断提高。具体来说，由56个模态建立的多元线性回归模型可以解释2021/2022年冬季84.10%的温度、60.80%的风速和55.65%的日照时数变化，并且很好地再现了这些变量的逐日变化和趋势，但低估了极端值的情况。

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