EMS Annual Meeting Abstracts
Vol. 16, EMS2019-841, 2019

Cloud properties and associated impact on solar irradiance by means of satellite and ground-based remote sensing

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Clouds play a dynamic role in the weather and climate system of the Earth. It is essential to continuously monitor clouds for a better understanding of their radiative impact. A combination of satellite-based remote sensing and ground-based remote sensing approaches allow one to detect and monitor clouds accurately, which thereafter facilitates the understanding of impact of clouds on solar irradiance on the surface of the Earth.
In this study, we present a two-year (2017-2018) analysis of cloud physical properties (CPP) observed over the west coast of Ireland. We make use of the Spinning Enhanced Visible and Infra Red Imager (SEVIRI) based CPP and a combination of active and passive ground-based remote sensing instruments to understand the similarities/differences between the various observations. The ground-based remote sensing instruments used are a 35.5 GHz cloud radar, a ceilometer operating at 1064 nm and a microwave radiometer located at the Atmospheric Research Station Mace Head (53.31 °N, 9.9 °E). The focus of this study is cloud top height, cloud optical thickness, and cloud effective radii. It is observed that CPP from SEVIRI and ground-based remote sensing instruments have a varying degree of agreement that depends on seasons, and type of clouds, among other reasons. For instance, the correlation coefficient for cloud top height varied from .33 to .83 for statistically significant cases. Additionally, the shortwave solar irradiance (SWS) estimated from the SEVIRI observations is compared against the SWS measured by a pyranometer at Mace Head. The impact of clouds on SWS is discussed. A seasonal trend analysis of SWS with respect to the clouds is also performed.