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A 34-year climatology and trends of CM SAF CLARA-A2 global cloud cover and comparison with ISCCP

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Clouds are vital for the Earth's shortwave, longwave radiation and energy budgets, and thus for global climate. However, despite the great progress in their observation during the last two decades, there is still considerable uncertainty even about their basic properties such as their fractional cloud cover (CC). More specifically, uncertainties related to their long-term changes hinder their inclusion in assessments of ongoing and future climate changes. To this aim, continued efforts to improve capabilities of observing CC and its inter-annual variability and trends are necessary, with remote sensing playing a key role and assisting in creating relevant long-term uniform global databases.
The Cloud Albedo Radiation, AVHRR-based, edition 2 (CLARA-A2) data record has been created using measurements of the Advanced Very High Resolution Radiometer (AVHRR) instrument onboard the polar orbiting NOAA and the EUMETSAT METOP satellites. In the present study the global distribution, variability and trends of CC over the period 1982 – 2015 are analyzed using monthly averages of CLARA-A2 data on a spatial resolution of $2.5^\circ \times 2.5^\circ$ latitude-longitude. Furthermore, a comparison of CLARA-A2 is attempted against the International Satellite Cloud Climatology Project (ISCCP-D2) over their common period 1984-2009. CLARA-A2 has the advantage of enabling a longer temporal coverage (34 against 26 years) while ensuring complete spatial coverage, also including the polar areas which are often missing in ISCCP-D2.
The analysis for the common 26-year common period shows that both CLARA-A2 and ISCCP-D2 reproduce well-known global CC patterns, such as the increased values of high-level CC (up to 80 %) along the Intertropical Convergence Zone (ITCZ) and the extended low-level cloud decks off the western coasts of South America and southern Africa (coverage up to 60 %). The computed 26-year global mean total CC is equal to 62.3 and 65.6 % according to CLARA-A2 and ISCCP-D2, respectively. The corresponding global mean values of CLARA-A2 low-, mid- and high-level cloud cover are equal to 19.8, 17.4 and 24.1 %, respectively, while those for ISCCP-D2 are 22.9, 20.1 and 22.6 %, i.e. CLARA-A2 underestimates low and middle and overestimates high-level CC with respect to ISCCP-D2. The 34-year time series of CLARA-A2 global mean total CC reveal an overall linear decrease equal to -2 %, arising from a stronger decrease of mid-level CC (-2.9 %) and weak increases of low- and high-level CC (0.4 and 0.3 %, respectively). A more detailed analysis indicates decadal-scale increases and decreases of total CC, consisting in slight modifications up to mid-90s, a subsequent prolonged decrease through to the end of 2000s and a following increase in the 2010s. Such long-term changes of cloud cover are very important in the context of ongoing climate change, but need to be further assessed and evaluated given the inhomogeneity issues in their time series. In this context, a comparison of CLARA-A2 with the latest release of ISCCP -H series will be made, while CLARA-A2 CC data shall be used in a detailed radiative transfer model in order to estimate the 34-year global cloud radiative effects and the associated radiation budget.