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Coupled global sea surface temperature-total cloud cover patterns associated to Pacific climate modes

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Clouds represent a critical component of the climate system, with a profound influence on the Earth's radiation budget through their associated feedbacks. Investigations of cloud processes are constrained by the limited temporal extension of measurements and by the imperfections of available data. Furthermore, global climate sensitivity is essentially linked to Pacific sea surface temperature and clouds variations. Here, we apply a variety of statistical methods on two corrected versions of observed total cloud cover datasets, the International Satellite Cloud Climatology Project and the Pathfinder Atmospheres–Extended projects, in order to 1) identify dominant modes of total cloud cover variability, 2) identify and remove the anthropogenic footprint on total cloud cover, and 3) identify the impact of Eastern Pacific El Niño – Southern Oscillation, Central Pacific El Niño – Southern Oscillation and Pacific decadal sea surface temperature variability on total cloud cover.

We find that the two flavors of El-Niño explain over 30 % of the global total cloud cover variability on interannual time scales. The associated total cloud cover footprints are found to be robust across the choice of dataset and statistical method. The positive correlation between sea surface temperature and total cloud cover in the Pacific basin indicate that convection plays a dominant role in mediating the influence of the associated sea surface anomalies on the total cloud cover field.

The physical relevance of the identified total cloud cover footprints is supported by the consistency of the associated total precipitation rate, sea level pressure/wind patterns and indicates that the satellite cloud data contain valuable information related to Pacific climate variability.