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GEWEX assessment of global cloud climatologies: cloud properties and their variation

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Satellite observations provide a continuous survey of the state of the atmosphere over the whole globe. One GEWEX activity is to assess the quality and reliability of available global cloud data sets for climate studies (http://climserv.ipsl.polytechnique.fr/gewexca). GEWEX cloud products are provided by the International Satellite Cloud Climatology Project (ISCCP), using data from a combination of polar orbiting and geostationary imagers. There are two cloud analyses (HIRS-NOAA and TOVS Path-B) using TIROS-N Operational Vertical Sounder Operational (TOVS) observations onboard the NOAA polar orbiting satellites. The relatively high spectral resolution of these instruments provides reliable cirrus identification, day and night. Recently, the NOAA PATMOS-x project has reanalyzed the Advanced Very High Resolution Radiometer (AVHRR) data onboard the same satellites. Cloud occurrence climatologies using sun occultation measurements from the Stratospheric Aerosol and Gas Experiment (SAGE) and from surface observations also participate in the assessment, as well as analyses using the second generation instruments MODIS (Moderate Resolution Imaging Spectroradiometer), MISR (Multi-angle Imaging SpectroRadiometer) and AIRS (Atmospheric Infrared Sounder) aboard the NASA the Earth Observing System (EOS). Since summer 2006 data are available from two active instruments aboard the A-Train: the lidar of the CALIPSO mission and the CloudSat radar, giving for the first time a global insight on cloud layering. Recently, also cloud climatologies from PARASOL and ATSR (Along-Track-Scanning Radiometer) joined this project.

Climatological averages of cloud properties, their regional, seasonal and diurnal variations as well as time series of these climatologies are presented.

One outcome of this study was, that the different datasets compared better when high, midlevel and lowlevel cloud amount were scaled by total cloud amount. This approach might also be useful for comparisons with climate models. One should also remember that passive remote sensing gives only information on the uppermost cloud layer. About 40% of all clouds are high clouds (with a cloud pressure smaller than 440 hPa) and about 40% of all clouds are single-layer lowlevel clouds (with a cloud pressure larger than 680 hPa). Differences in relative high cloud amount (scaled by total cloud amount) can be mostly understood by different instrument sensitivities: the active lidar CALIPSO as well as limb sounding SAGE are the most sensitive instruments to very thin cirrus. The relatively high spectral resolution of IR sounders (TOVS/HIRS and AIRS) makes them the passive instruments most sensitive to cirrus. They only miss 10% and 5% of all high clouds in the tropics and midlatitudes, respectively (being subvisible cirrus). ISCCP misses further 15% and 10% of high clouds in the tropics and midlatitudes, respectively. These thin cirrus (often above lower clouds) are misidentified as midlevel clouds. The MODIS Science Team algorithm misidentifies some thin cirrus as lowlevel clouds. The seasonal cycles of the different cloud properties, however, agree very well.