Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 2881-2891, 2007
www.atmos-chem-phys.net/7/2881/2007/

Technical Note: The effect of sensor resolution on the number of cloud-free observations from space

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Abstract. Air quality and surface emission inversions are likely to be focal points for future satellite missions on atmospheric composition. Most important for these applications is sensitivity to the atmospheric composition in the lowest few kilometers of the troposphere. Reduced sensitivity by clouds needs to be minimized. In this study we have quantified the increase in number of useful footprints, i.e. footprints which are sufficient cloud-free, as a function of sensor resolution (footprint area). High resolution (1 km×1 km) MODIS TERRA cloud mask observations are aggregated to lower resolutions. Statistics for different thresholds on cloudiness are applied. For each month in 2004 four days of MODIS data are analyzed. Globally the fraction of cloud-free observations drops from 16% at 100 km^2 resolution to only 3% at 10 000 km^2 if not a single MODIS observation within a footprint is allowed to be cloudy. If up to 5% or 20% of a footprint is allowed to be cloudy, the fraction of cloud-free observations is 9% or 17%, respectively, at 10 000 km^2 resolution. The probability of finding cloud-free observations for different sensor resolutions is also quantified as a function of geolocation and season, showing examples over Europe and northern South America (ITCZ).

Final Revised Paper (PDF, 414 KB) Discussion Paper (ACPD)

Citation: Krijger, J. M., van Weele, M., Aben, I., and Frey, R.: Technical Note: The effect of sensor resolution on the number of cloud-free observations from space, Atmos. Chem. Phys., 7, 2881-2891, 2007. Bibtex EndNote Reference Manager