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Comment on "A multi-data comparison of shortwave climate forcing changes" by Pallé et al.

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[1] In the paper "A multi-data comparison of shortwave climate forcing changes", published in GRL (32), November 2005, and presented at the AGU Fall meeting 2005, Pallé et al. make highly relevant points regarding the importance of the Earth's reflectivity for climate and climate change, and emphasize the need for stronger observational constraints on climate models. However, *Pallé et al.* [2005] argue against the assumption that the Earth's reflectance, that is, the global albedo, is roughly constant at about 30%, by referring to seven different data sets "related to the Earth's reflectance". Although some of the shortcomings of the different data sets are mentioned, the authors fail to recognize that the data presented are insufficient as a basis for any general conclusions regarding long-term trends of the global albedo.

[2] According to *Pallé et al.* [2005] "there are five major ways to measure or derive estimates of the Earth's shortwave reflectance", namely satellite-based radiometry, earthshine measurements, groundbased radiometry, derivations (by models) from cloud-estimates and derivations (by analogy) from satellite on-board temperatures. However, of the data sets originating from these five methods, used by *Pallé et al.* [2005] to show global albedo trends, only one is a truly global measure of the Earth's reflected shortwave radiation, including the effects of all atmospheric and surface properties. This is the broadband (0.3–5.0 μm) CERES satellite data, for 2000 through 2003 [see *Wielicki et al.*, 2005]. The other satellite radiometry estimate used, from ERBE, does not give global coverage for the whole period studied, and *Pallé et al.* [2005] only consider tropical ERBE data. The remaining data sets are, for reasons presented below, not measurements of the global albedo. As pointed out by *Pallé et al.* [2005] satellite observations are not free from limitations either. The measurements are not direct and must rely on models and assumptions, and they suffer from difficulties related to long-term calibration. Also, in their sun-synchronous orbits the satellites can only sample each point of the Earth twice per day.

[3] The earthshine method, although it is a more direct measurement of reflectivity, does not give a global albedo-estimate. It covers about one third of the Earth at each observation occasion and certain areas can never be "seen" from the measurement site. Furthermore the measurements are sparsely sampled in time, and are only made in a narrow wavelength band (0.4–0.7 μm). Before the period of actual earthshine measurements (beginning in 2000 as given by *Pallé et al.* [2005]), the so called earthshine albedo reconstruction is calculated as a linear combination of three ISCCP-estimated cloud parameters over the respective earthshine areas [*Pallé et al.*, 2004], and can hence only detect changes in these parameters.

[4] The S_{SRBN} data set, derived from measurements of solar radiation incident at the Earth's surface [*Wild et al.*, 2005], has the advantage of high temporal resolution, but the spatial sampling is very poor. *Pallé et al.* [2005] refer to the mean of the annual mean time series at eight individual sites, all over land, which may or may not be representative of the Earth as a whole. Also, measuring shortwave radiation incident at the surface differs from measuring reflected radiation at the top of the atmosphere in that no surface effects can be taken into account, and that no distinction can be made between reflection and absorption in the atmosphere.

[5] The use of satellite on-board temperatures as a proxy measurement of changes in Earth's climate is a method "tentatively proposed" by *Casadio et al.* [2005]. While *Casadio et al.* [2005] call for confirmation of their preliminary analysis of the measurement method, *Pallé et al.* [2005] refer to it as one of the "five major ways to measure or derive estimates of the Earth's shortwave reflectance", only briefly mentioning the facts that Earth's longwave radiation might influence the measurements, and that these anomalies are given in a different unit (K) than the other data are (Wm^{-2}).

[6] Finally, the so called S_{mod} data set is a model calculation of the quantity measured in the S_{SRBN} data set, that is, incident solar radiation at the Earth's surface [*Pinker et al.*, 2005]. The calculations are based on global ISCCP data, and are carried out globally. Still they are actually not an estimate of the global reflectivity, but of how clouds affect the amount of radiation reaching the Earth's surface, although the model used by *Pinker et al.* [2005] does allow for calculation of upward surface fluxes as well as TOA net shortwave fluxes.

[7] Given the differences between the data sets and their different inherent weaknesses, the conclusion of *Pallé et al.* [2005] that "There is a consistent picture among all data sets by which the Earth's albedo has decreased over the 1985–2000 interval." is not properly founded. A statement of this kind should be based on data sets that measure the same quantity, and must be accompanied by appropriate error estimates.

[8] Independent measurements and methodologies for estimating the Earth's reflectance are essential, and uncon-

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ventional methods must be welcomed. But the data sets need to be taken for what they are, and conclusions need to be drawn with caution.

References

Casadio, S., A. di Sarra, and G. Pisacane (2005), Satellite on-board temperatures: Proxy measurements of Earth's climate changes?, *Geophys. Res. Lett.*, *32*, L06704, doi:10.1029/2004GL022138.

Pallé, E., P. R. Goode, P. Montañés-Rodriguez, and S. E. Koonin (2004), Changes in Earth's reflectance over the past two decades, *Science*, *304*, 1299–1301, doi:10.1126/science.1094070.

Pallé, E., P. Montañés-Rodriguez, P. R. Goode, S. E. Koonin, M. Wild, and S. Casadio (2005), A multi-data comparison of shortwave climate forcing changes, *Geophys. Res. Lett.*, *32*, L21702, doi:10.1029/2005GL023847.

Pinker, R. T., B. Zhang, and E. G. Dutton (2005), Do satellites detect trends in surface solar radiation?, *Science*, *308*, 850–854, doi:10.1126/science.1103159.

Wielicki, B. A., T. Wong, N. Loeb, P. Minnis, K. Priestly, and R. Kandel (2005), Changes in Earth's albedo measured by satellite, *Science*, *308*, 825, doi:10.1126/science.1106484.

Wild, M., H. Gilgen, A. Roesch, A. Ohmura, C. N. Long, E. G. Dutton, B. Forgan, A. Kallis, V. Russak, and A. Tsvetkov (2005), From dimming to brightening: Decadal changes in solar radiation at Earth's surface, *Science*, *308*, 847–850, doi:10.1126/science.1103215.

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