Arguments against a physical long-term trend in global ISCCP cloud amounts

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Introduction

The International Satellite Cloud Climatology Project (ISCCP) multi-decadal record of cloudiness exhibits a well-known global decrease in cloud amounts.

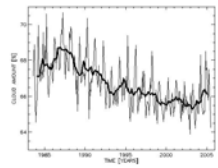
Here we show that trends observed in the ISCCP data are satellite viewing geometry artifacts and are not related to physical changes in the atmosphere.

Satellite Zenith Angle: The angle between nadir (looking up from the surface of the Earth) and the satellite sensor

Mu: The cosine of the satellite zenith angle, 1/mu is proportional to the path length a photon will travel from the surface of the Earth to the satellite sensor

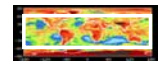
Limb darkening: Water vapor emission at low *mu* values which make the surface appear cool

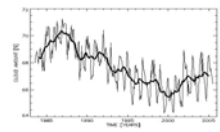
A time series of global mean (IR) total cloud cover



This time series shows the iconic decrease is global cloud amounts from the mid-1980s through the early 2000s. These cloud amounts are generated from a single (IR) channel retrieval.

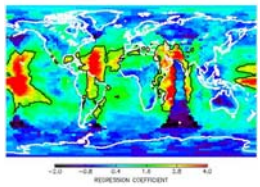
Time series without polar data from the NOAA satellites





Data from the AVHRR is used at the poles to supplement the geostationary record. By only looking at the time series for 60S–60N (above plot) we can better isolate the pattern of cloudiness from the geostationary based instruments

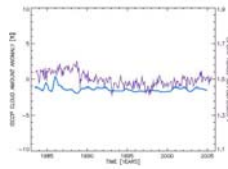
Identifying regions that contribute to the low frequency variability



We identify areas that contribute the greatest to the low frequency variability in the ISCCP cloud time series by linearly regressing the global maps of IR cloud amounts against the smoothed time series of mean 60S–60N cloudiness (thick black line from plot in previous panel).

The regions with the strongest (positive and negative) regression coefficients are areas at the limbs of the geostationary satellites

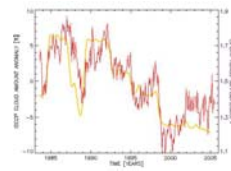
Time series of regions that contribute little to the low frequency global variability



The blue line is a time series of cloud amounts in regions where the regression of cloudiness onto the low frequency cloudiness variability is weak (areas not bounded by the black contours in map from previous panel). The smooth light blue line is a time series of 1/mu for those same regions.

This cloudiness series is for around 80% of the Earth's surface and exhibits little long term variability.

Time series of regions that contribute strongly to the low frequency global variability

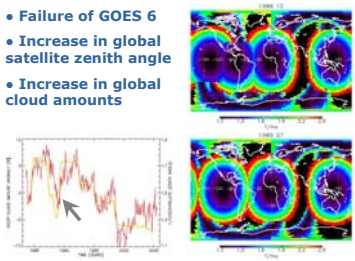


The red line is a time series of cloud amounts in regions where the regression of cloudiness onto the low frequency cloudiness variability is strong. The smooth yellow line is a time series of 1/mu for those same regions.

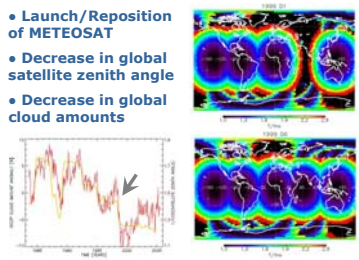
This cloudiness series exhibits several discrete and dramatic changes in cloudiness that are well correlated with 1/mu. Via limb darkening, the surface appears cooler than it does at nadir, leading to false cloud detection.

A few events that shape global ISCCP cloud amounts

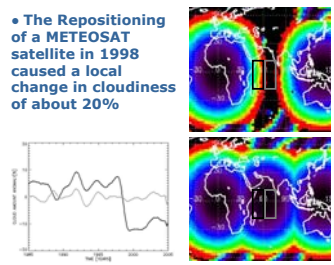
- Failure of GOES 6
- Increase in global satellite zenith angle
- Increase in global cloud amounts



- Launch/Reposition of METEOSAT
- Decrease in global satellite zenith angle
- Decrease in global cloud amounts

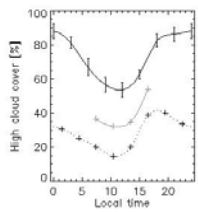


- The Repositioning of a METEOSAT satellite in 1998 caused a local change in cloudiness of about 20%



What's next?

We are developing new techniques to create a 3-hourly record of global cloud amounts based on data from the AVHRR. Preliminary work suggests that this new cloud data may be suitable for climatological studies since it exhibits no long-term, systematic biases.



This plot shows the diurnal cycle of high clouds (JAN 1998, Amazon Basin) for ISCCP IR (dotted line) and IR+VIS (gray line), and our new AVHRR-based cloud data set (black line).

Further information

Evan, A. T., A. K. Heidinger & D. J. Vimont (2007) Arguments against a physical long-term trend in global ISCCP cloud amounts. *Geophys. Res. Lett.*, 34, L04701, doi:10.1029/2006GL028083.

Evan, A. T., A. K. Heidinger & H. Corrada-Bravo (2007) Generation of a global 3-hourly cloud cover data set from polar orbiting platforms. *J. Appl. Met. Clim., to be submitted.*