Boundary Layers,Transport and Mixing

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The influence of clouds in climate

Scientists have discovered that the Earth’s climate is driven by the exchanges of radiant energy between the earth and outer space. Over a period of a year, the amount of sunlight entering the Earth system equals the amount of radiant energy reflected and emitted back through the top of the atmosphere .The sun beams an average of 340 watts per square meter to the Earth and our world reflects 100 watts per square meter back up to space. The remaining solar energy is stored as heat within the air, oceans and land surface and, gradually is emitted back up through the atmosphere to space. Furthermore an important role for the radiation balance in the earth play the clouds, thus influence the climate of an area.

I mentioned before that the study of clouds and their characteristics is significant as they play a key role in the understanding of climate change.In low altitude, thick clouds mainly reflect solar radiation and cool the surface of the Earth. In high altitude, thin clouds primarily transmit incoming solar radiation.Meanwhile, they trap some of the outgoing infrared radiation emitted by the Earth and radiate it back downward, thereby warming the surface of the Earth.Whether a given cloud will heat or cool the surface depends on several factors, including the cloud's altitude, its size, and the make-up of the particles that form the cloud.All this situation it makes many scientists to explain different phenomenon with the help of the clouds.A significant example is the infrared iris effect which lead to many disagreements among the scientists.

Many researchers have made observations and analyses of water vapor and clouds in the Tropics over the past period which show that the boundary between regions of high and low free–tropospheric relative humidity is precisely, and that upper–level cirrus and high free–tropospheric relative humidity tend to coincide. Most current studies of atmospheric climate feedbacks have focused on such quantities as clear sky humidity,average humidity,or differences between regions of high and low humidity,but the data suggest that another possible feedback might consist of changes in the relative areas of high and low humidity and cloudiness. Moreover it has been found that the area of cirrus cloud coverage normalized by a measure of the area of cumulus coverage decreases per degree Celsius significantly lead to an increase in the surface temperature of the cloudy region.A number of possible interpretations of this result are examined and a plausible one is found to be that cirrus detrainment from cumulus convection diminishes with increasing temperature.

A well-known interpretation is the infrared iris effect from the Richard Lindzen.His idea depends on the iris of the human eye, which is responsible for controlling the diameter and size of the [pupil](https://en.wikipedia.org/wiki/Pupil) and as a result the amount of light reaching the [retina](https://en.wikipedia.org/wiki/Retina" \o "Retina).So according to this process Richard Lindzen suggested in 2001 that the area covered by high cirrus clouds contracts to allow more heat to escape into outer space from a very warm environment.This new mechanism would, in effect,develope an adaptive infrared iris that opens and closes in order to control the Outgoing Longwave Radiation in response to changes in surface temperature in a way similar to the way in which an eye's iris opens and closes in response to changing light levels.

To be more specific an increase in sea surface temperature in the tropics would result in reduced cirrus clouds  and as a result more infrared radiation is released from Earth's atmosphere.Lindzen’s study of observed changes in cloud coverage and modeled effects on infrared radiation released to space as a result supported the hypothesis.This suggested infrared radiation leakage was hypothesized to be a negative feedback in which an initial warming would result in an overall cooling of the surface. The consensus view is that increased sea surface temperature would result in increased cirrus clouds and reduced infrared radiation leakage and therefore a positive feedback.

On the other hand there were many researchers who disagreed with the iris explanation by Lindsen.One of them was the Dennis Hartmann and Marc Michelsen. They analysed the same sea surface temperature and cloud data as Lindsen, but they concluded that the changes could not be attributed to an iris effect.They supported that the Lindsen assume that the coldest clouds are representative at the convective cores that feed smithy clouds. They followed different procedure and they showed that the deep convective cores are separated by long distance from the clouds that have relationship with most of the variation in cloud-weighted sea surface temperature(SST).They gave a different explanation for the relationship between cloud-weighted SST and cloud area.This is that there is a shift in the latitude or longtitude of the cloudiness and not a change between deep convective and correlated tropical anvil cloud amounts.Moreover it is important to mention that they displayed that these latitudes and longtitudes movements are related with meteorological and not SST forcing.They considered that these meteorological forcings seem to originate in the extratropics and they are probably unrelated to tropical SSTs.

In addition it is essential that there are disagreements for the iris effect. Various research groups approach with different way this explanation.They try to show that there are errors in this theory from different angle.This situation leads to have distinct opinion among them.For example there are reports that try to prove that the approach Hartmann-Michelsen is wrong.One of them is the report of Ming-Dah Chou and Arthur Y. Hou. They support that a number of points of Hartmann-Michelsen are irrelevant to iris effect(ex. their discussion about the meteorological origin of various systems.Also they consider that other assumptions do not have a basis such as the allegation that the cloud cover over latitudes around 20° originates from cumulus convection over 1000 km away.

Finally I desire to express my opinion about the iris effect. In my point of view this explanation is crucial for the situation in the tropics.Furthermore I think that this theory has a deficit because there are not evidences which can confirm the theory. Generally physics depends on theory and experiments which make stronger an view.Moreover I think that is good that there are disagreements about the iris effect because it shows that the scientific community does not have common