Increasing rainfall may affect winds: study

February 24 2012, by Lin Edwards

Image: Wikipedia.

(PhysOrg.com) -- Falling raindrops produce friction as they drop through the atmosphere to the ground, and this dissipates the kinetic energy, converting it into diffuse heat. Now researchers in the US have used recently-obtained satellite data to calculate the energy dissipation, and they have discovered it is a surprisingly major component of the atmosphere's overall energy system.

Mathematicians Olivier Pauluis of New York University, and Juliana Dias of the National Oceanic and Atmospheric Administration (NOAA) in Colorado, USA, used radar data provided by the Tropical Rainfall Measurement Mission (TRMM) jointly run by the US National Aeronautics and Space Administration (NASA) and Japan's counterpart, the Japan Aerospace Exploration Agency (JAXA). They used the data to compute the kinetic energy dissipation rate, which turns out to be on average 1.8 watts per square meter in the tropical regions between latitudes 30 degrees South and 30 degrees North.

They based their calculations on the energy a single raindrop dissipates, which was already known, and TRMM figures on total rainfall. The satellite data also provided height details, which were important because raindrops falling from a greater height dissipate more kinetic energy through friction.

The researchers found that energy dissipation produced by raindrops was around the same as dissipation caused by turbulence in the atmosphere, such as in storms and trade winds. Pauluis said that this result, despite seeming to be surprising, fits well with previous modeling.

Pauluis and Dias also calculated that rain-induced dissipation is stronger for continental convection than maritime convection. They conclude that changes in hydrologic (water) cycles could affect the amount of kinetic energy dissipated in the atmosphere and affect the amount of energy remaining to produce winds.

Hydrologic cycles are changing rapidly, and if these changes and increased evaporation result in greater rainfall (and rain falling from a greater height, as it does when the atmosphere is warmer), this would dissipate more kinetic energy and could thus result in slightly weaker air circulation by winds.

The paper was published in the journal *Science*. Climate scientist Dargan M.W. Frierson of the University of Washington, in a related Perspective, said that more research is needed to determine how likely a weakening of atmospheric circulation is, and what impact, if any, this effect would have on individual weather systems.

Any changes are unlikely to affect large storm systems such as hurricanes, since they are governed much more by sea temperatures than the energy available in the atmosphere.

More information: Satellite Estimates of Precipitation-Induced Dissipation in the Atmosphere, *Science* 24 February 2012: Vol. 335 no. 6071 pp. 953-956. DOI: 10.1126/science.1215869

ABSTRACT

A substantial amount of frictional dissipation in the atmosphere occurs in the microphysical shear zones surrounding falling precipitation. The dissipation rate is computed here from recently available satellite retrieval from the Tropical Rainfall Measurement Missions and is found to average 1.8 watts per square meter between 30°S and 30°N. The geographical distribution of the precipitation-induced dissipation is closely tied to that of precipitation but also reveals a stronger dissipation rate for continental convection than for maritime convection. Because the precipitation-induced dissipation is of the same magnitude as the turbulent dissipation of the kinetic energy in the atmosphere, changes in the hydrological cycle could potentially have a direct impact on the amount of kinetic energy generated and dissipated by the atmospheric circulation.