Short description of the proposal

Tropical cyclones can cause considerable damage and disruption when they hit land. The Fourth IPCC report quoted evidence for an increase in intense tropical cyclone activity in the North Atlantic since about 1970, correlated with increases of tropical sea surface temperatures. However, there is no clear trend in the annual numbers of tropical cyclones. The 2005 hurricane season in the Atlantic was the most intense on record, with 15 out of 28 recorded tropical storms reaching hurricane intensity. The number of hurricanes forecasted in 2006 was similar to the one in 2005. However, only 10 tropical storms with 5 reaching hurricane strength were recorded. An analysis of the 2006 vs. 2005 Atlantic hurricane season revealed that the atmospheric dust loading was higher in 2006. A higher atmospheric dust loading would lead to a drier mid troposphere and colder sea surface temperatures, both of which could influence the circulation, e.g., increase the wind shear and thus would reduce tropical cyclone activity.

In this project we will use the ECHAM6 general circulation model (GCM) with a two-moment cloud microphysics scheme that predicts the mass and number concentrations of cloud droplets and ice crystals in T213 horizontal resolution with 31 vertical levels. The two-moment cloud microphysics will be coupled to a climatology of aerosol optical depth and cloud condensation nuclei (CCN).

In this proposal, we will address the following questions:

1. Is there a universal relationship between the amount of dust and the track, strength or frequency of tropical cyclones?

2. Does a change in dust amount in a future climate affect the frequency, track or strength of tropical cyclones?

3. Can anthropogenic CCN affect the intensity, the track and the lifetime of tropical cyclones?

Expected output:

1. Answering the question if dust reduces the track, strength or frequency of tropical cyclones by warming and drying the mid troposphere

2. Answering the question if seeding a tropical cyclone with CCN could indeed be used as a means to reduce the strength of tropical cyclones or if the effects of increased CCN concentrations on tropical cyclones that are seen in individual case studies are rather due to small changes in the meteorology?