

# ***Twelve Plus One Lectures: A Climate System View of Clouds & Convection***

**Bjorn Stevens (MPI-M)**

1. Cloud climatologies (Maps, Regimes, ISCCP Histograms, Conceptualizations)
2. Precipitation climatologies (Maps, Relationships)
3. The energy budget (Radiative convective equilibrium the role of Clouds)
4. Cloud radiative effects and climate susceptibility
5. Energy balance models: climate forcing, feedback, and adjustment
6. Clouds in large-scale models (an overview)
7. Clouds feedbacks and adjustments
8. Cloud aerosol interaction
9. Changes in the hydrological cycle
10. Cloud land-surface interactions
11. Remote effects of tropical convection
12. Clouds and polar climate (change)
13. ...

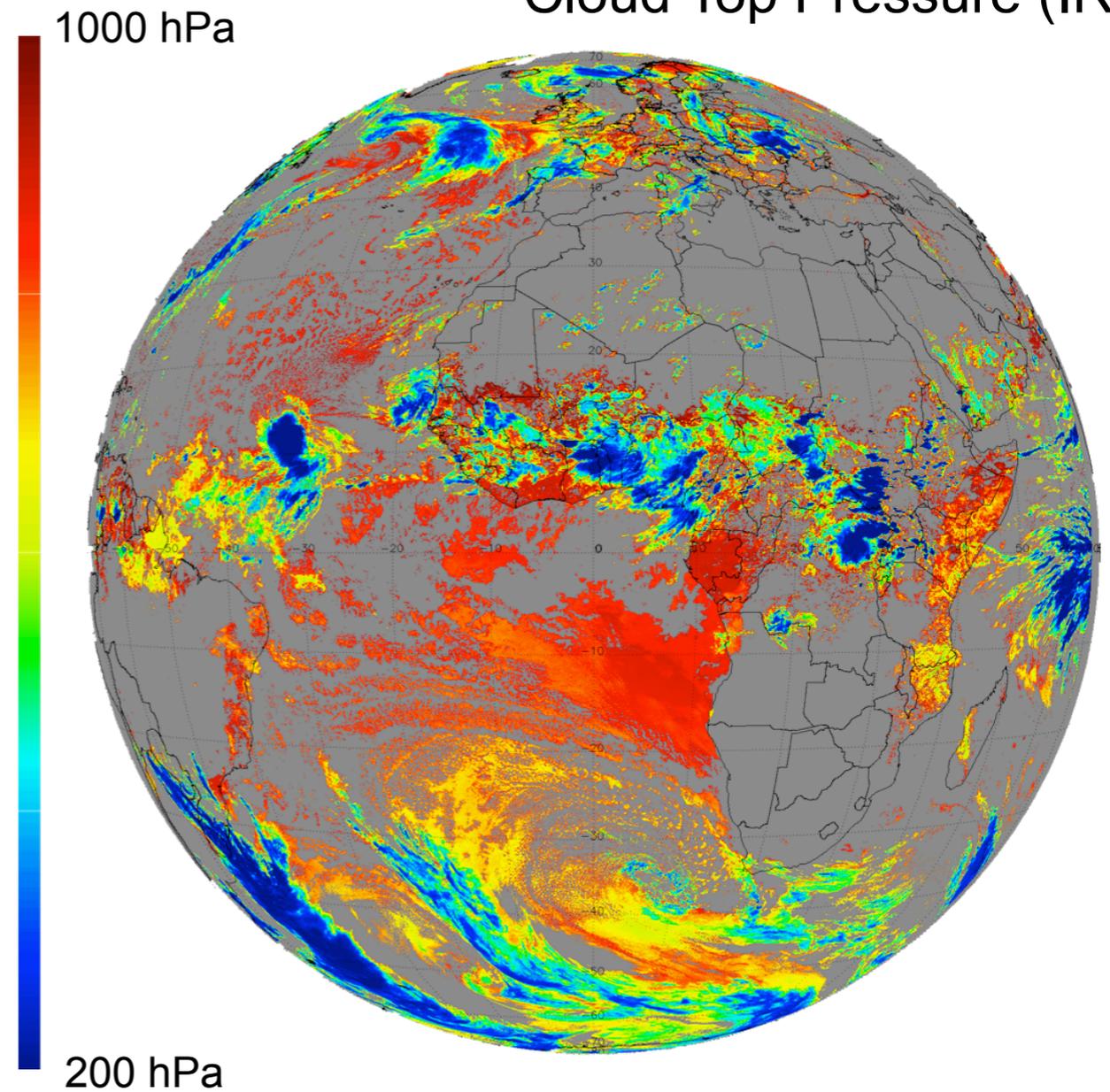


# Radiation

Reflectance (Vis)



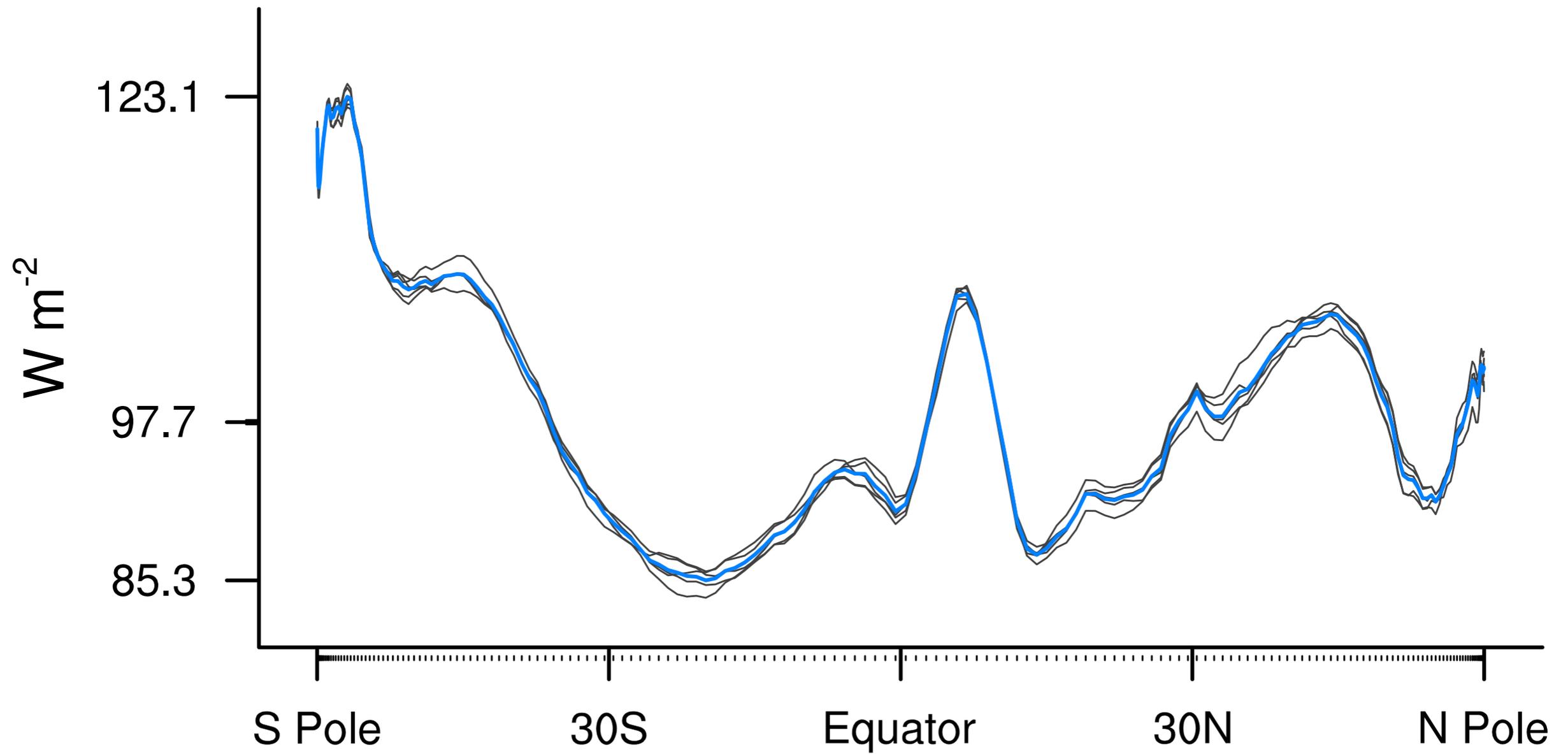
Cloud Top Pressure (IR)



$$S_0(1-\alpha) - 4\varepsilon\sigma T^4 = J$$



# Large-scale Order (i)



# Cloud & Climate

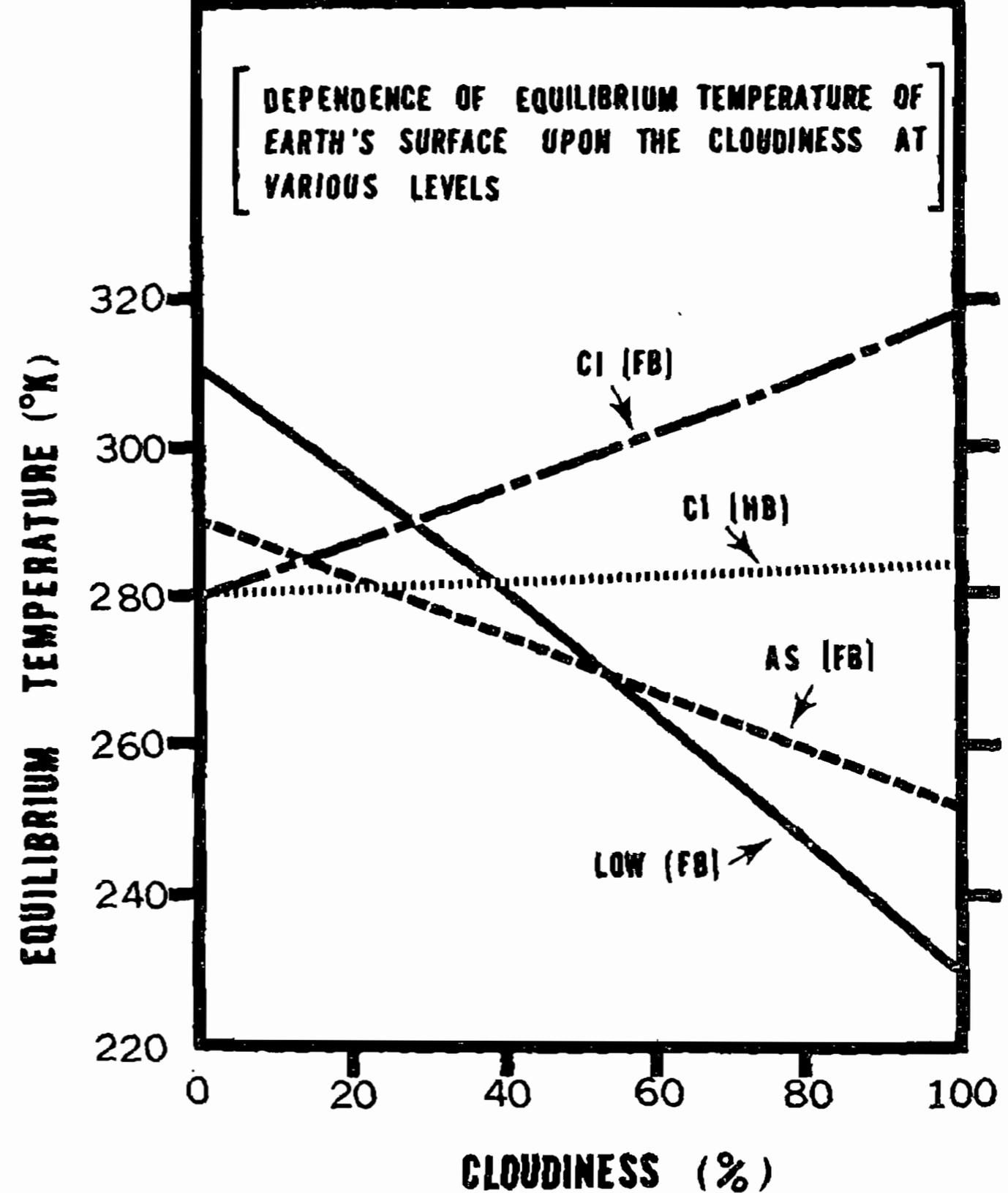


FIG. 20. Radiative convective equilibrium temperature at the earth's surface as a function of cloudiness (cirrus, altostratus, low cloud). FB and HB refer to full black and half black, respectively.

# Its rationalization

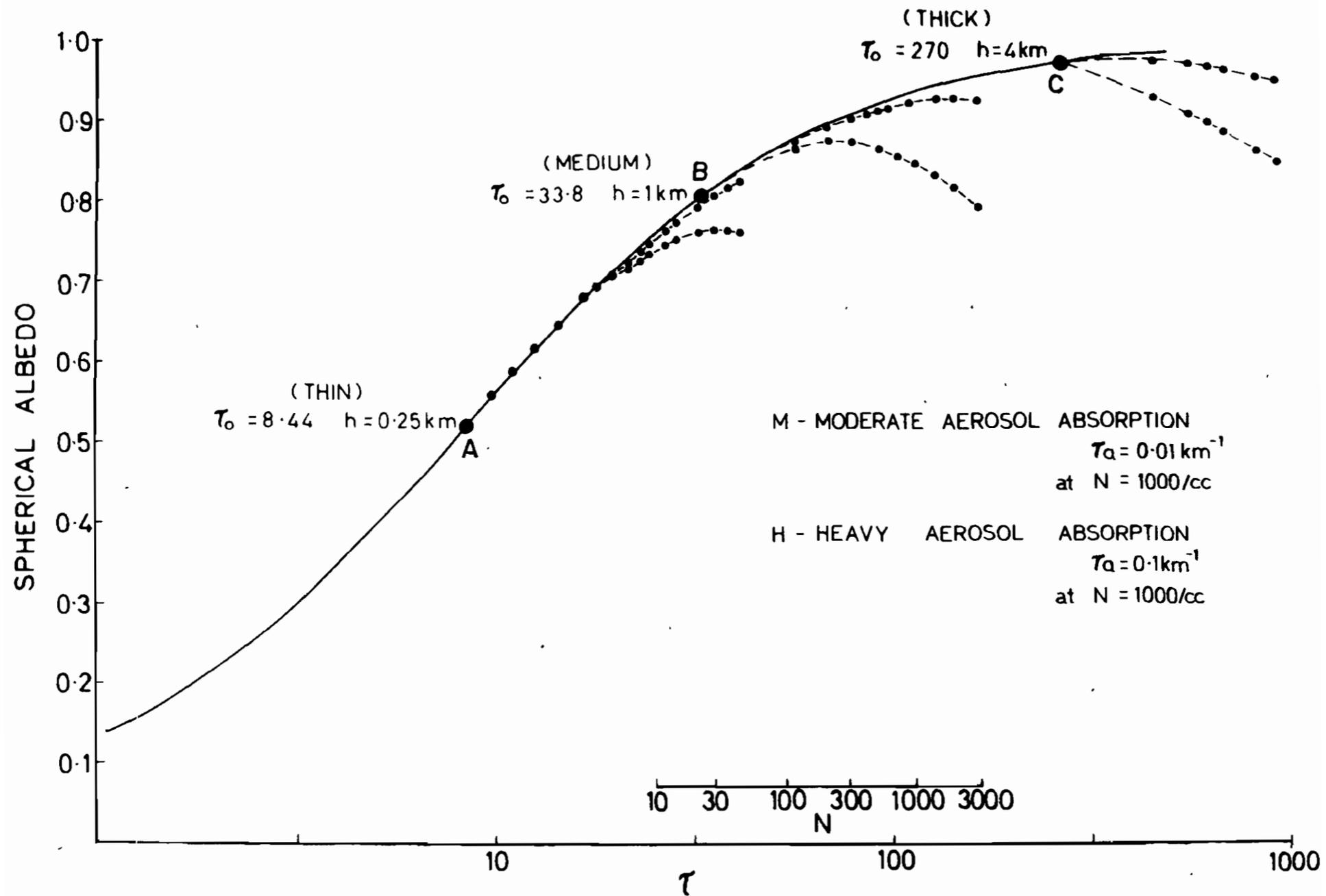
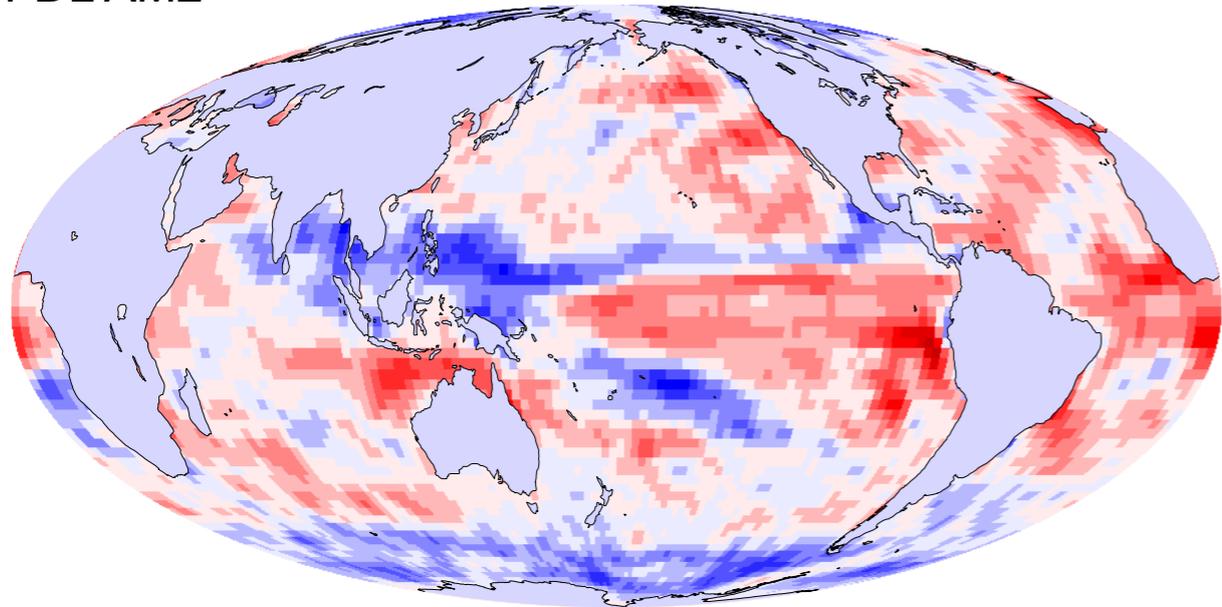


FIG. 3. Numerically computed trajectories corresponding to the schematic curves in Fig. 2, for the change of spherical albedo with increasing pollution for thin, moderate and thick clouds.

# Clouds and Climate

GFDL AM2

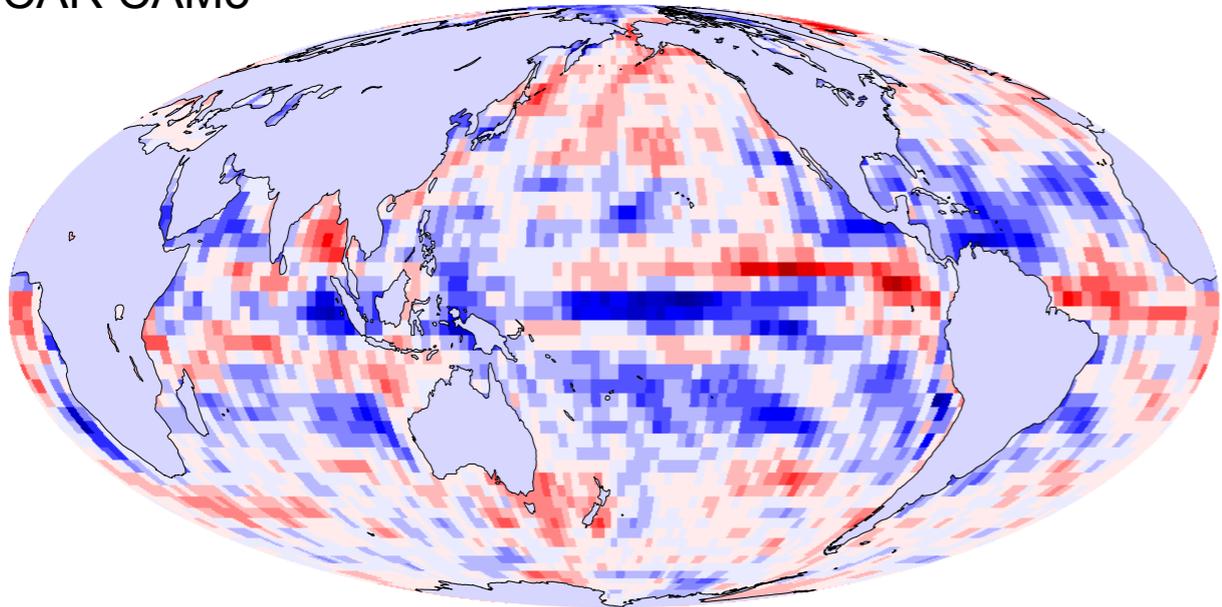


clouds act to enhance the warming (positive effect)

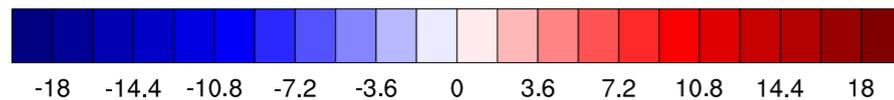
clouds act to mitigate the warming (negative effect)

*positive* cloud effect, larger climate sensitivity

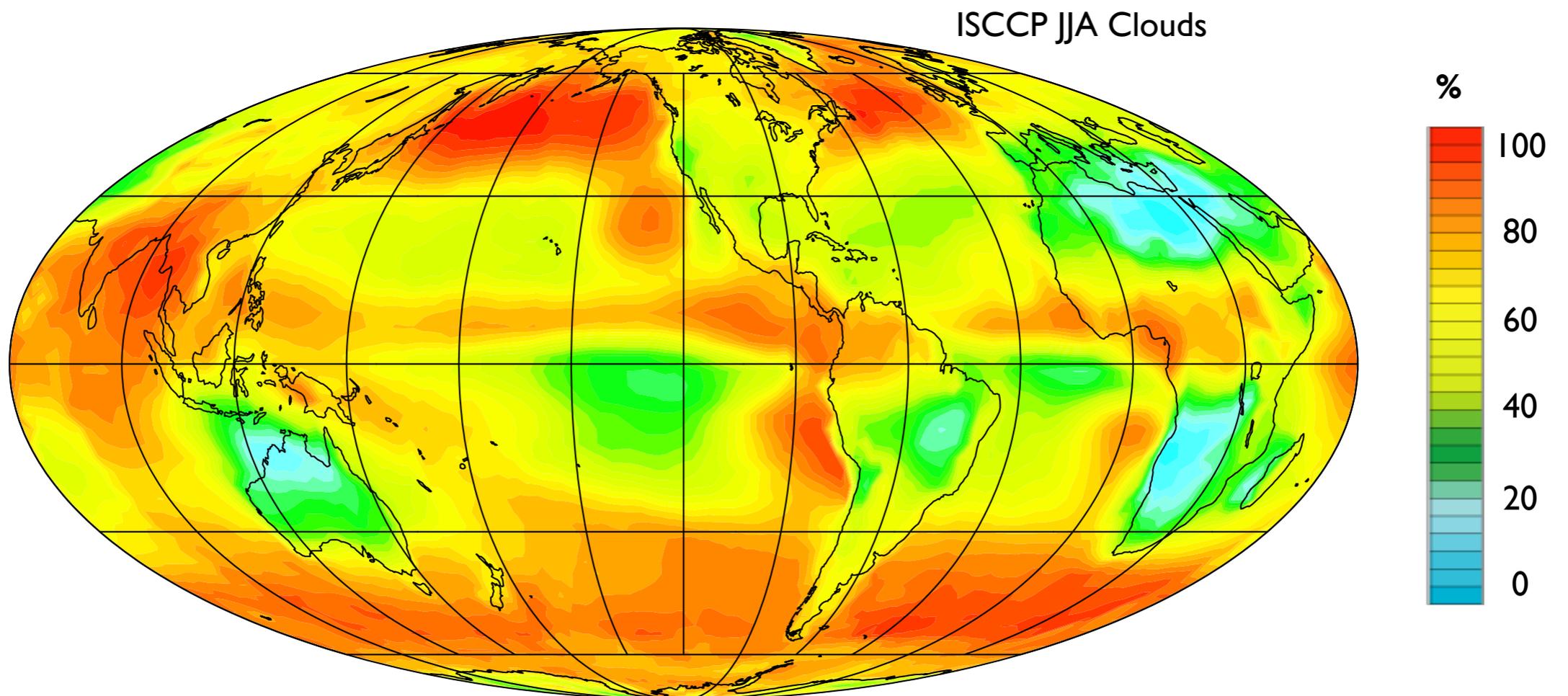
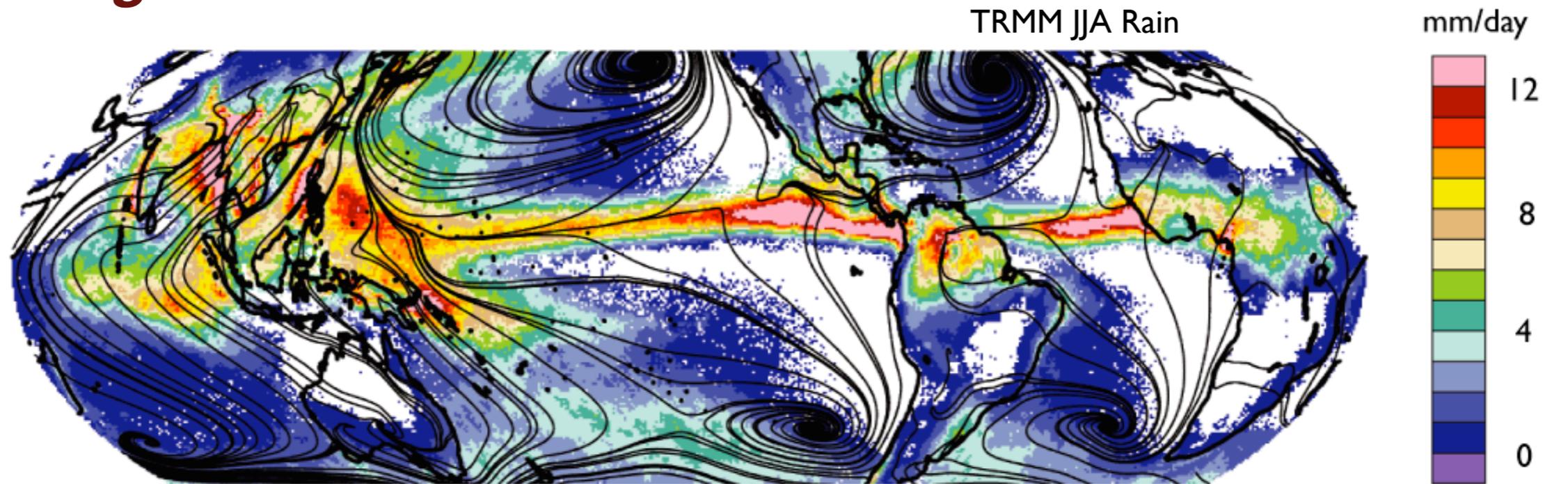
NCAR CAM3



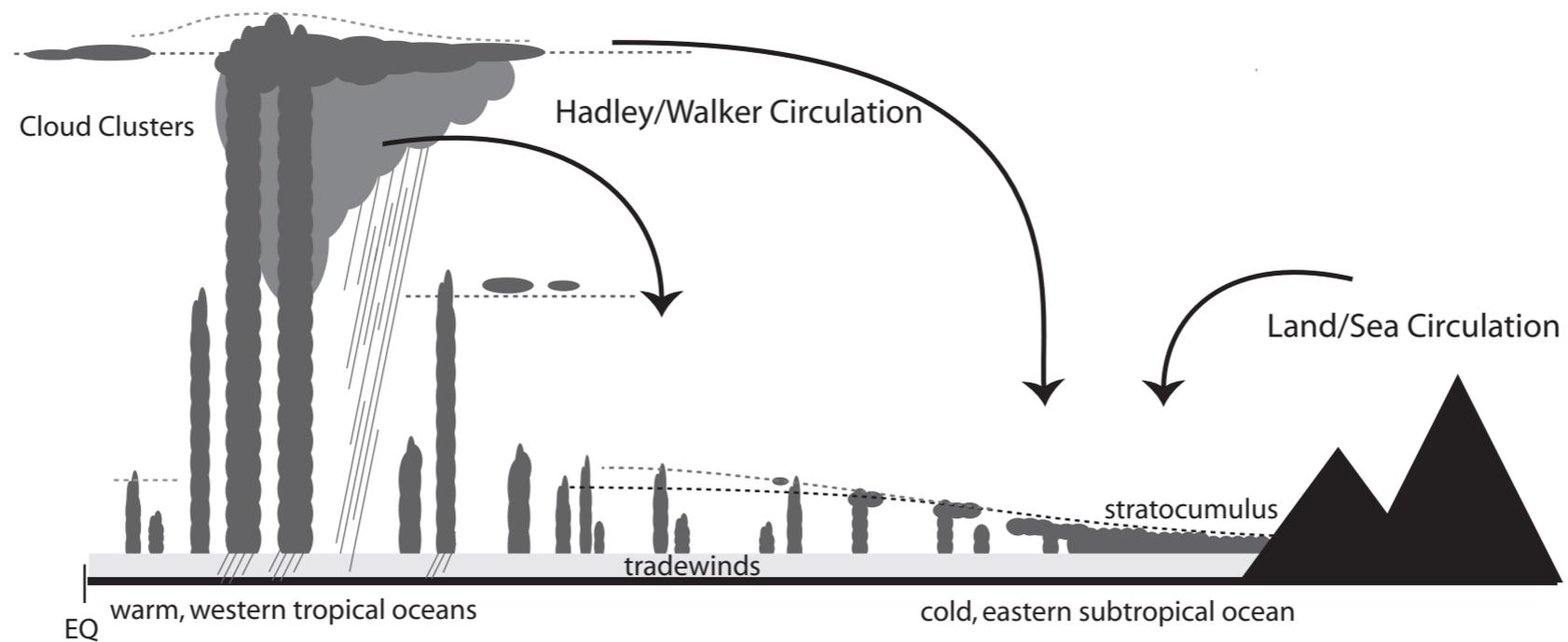
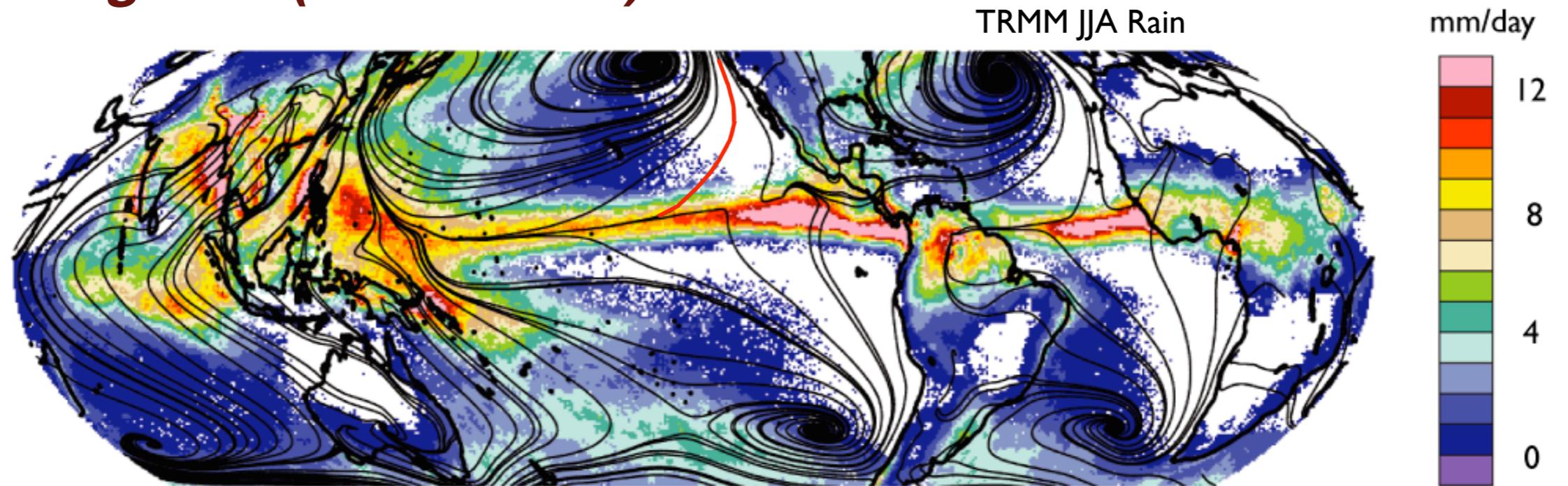
*negative* cloud effect, smaller climate sensitivity



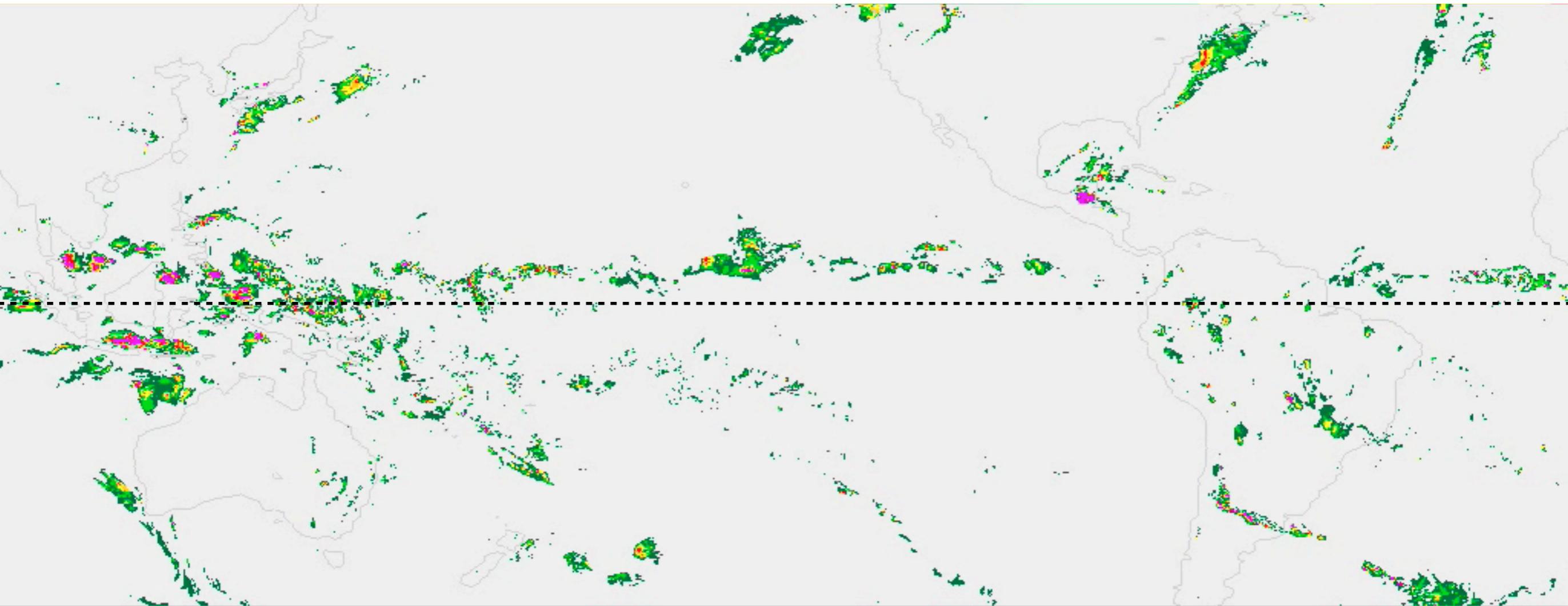
# cloud regimes

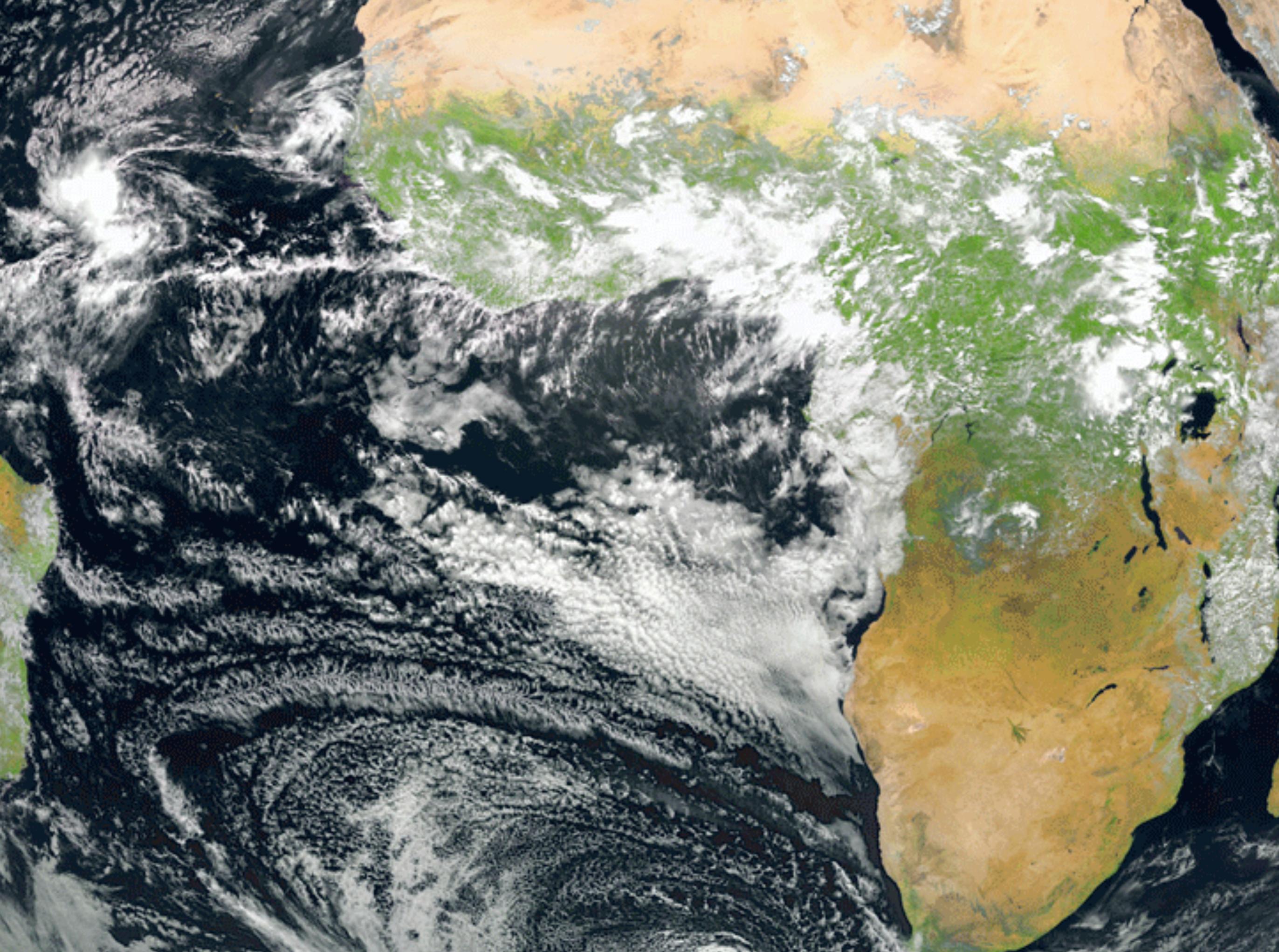


# cloud regimes (the cartoon)

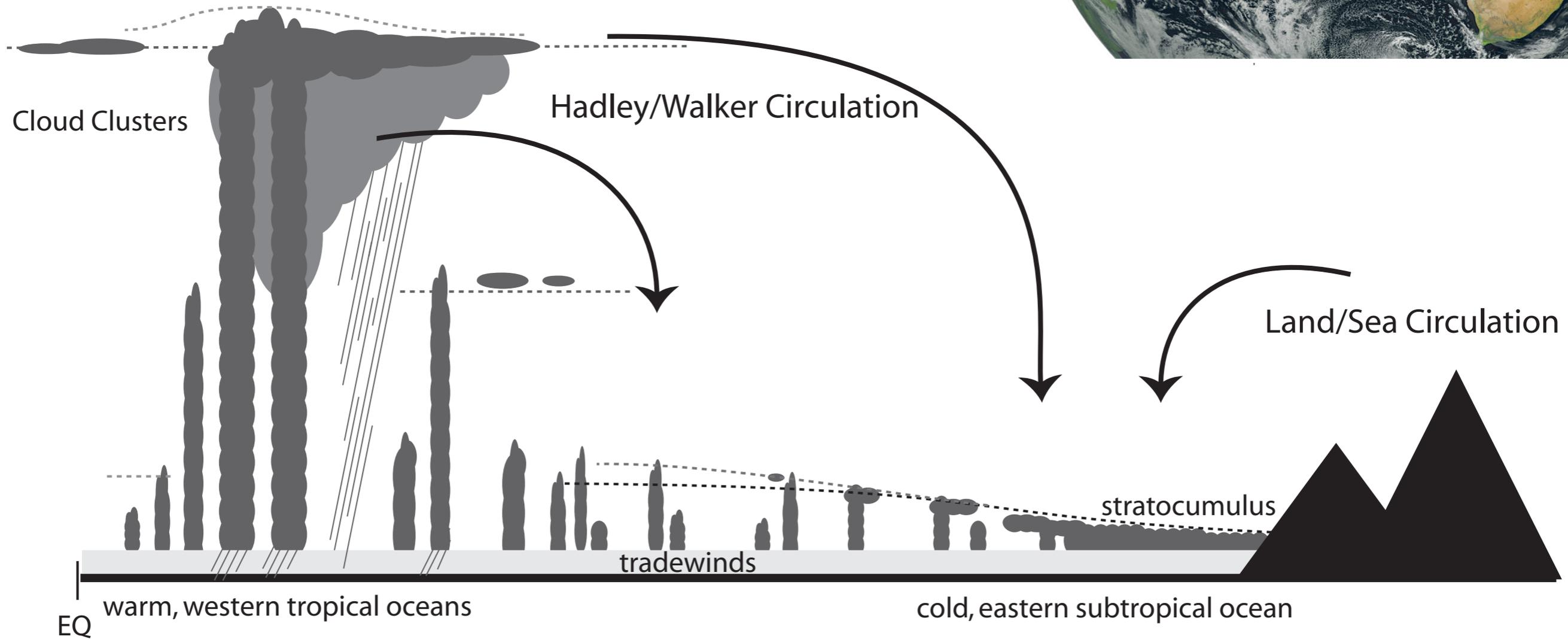
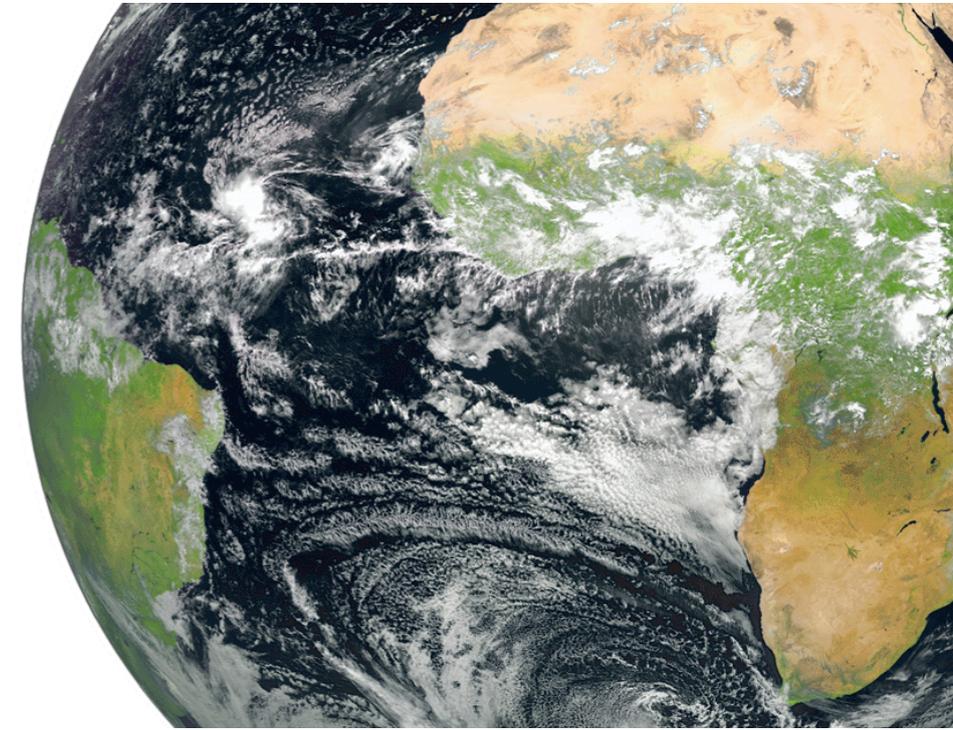


# Precipitation





# Large-scale Order (ii)



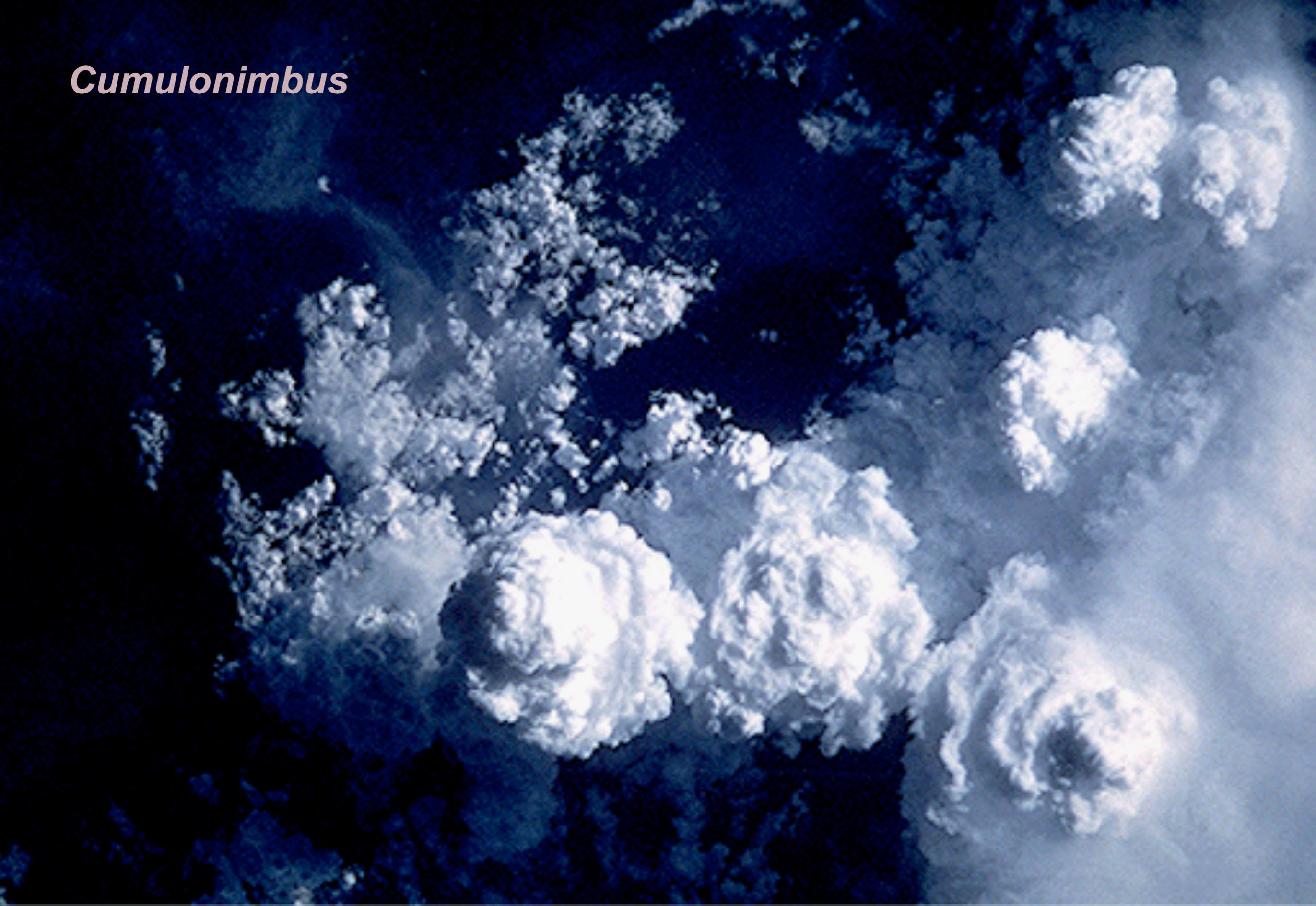
# *Stratocumulus*



# *Trade Cumulus*

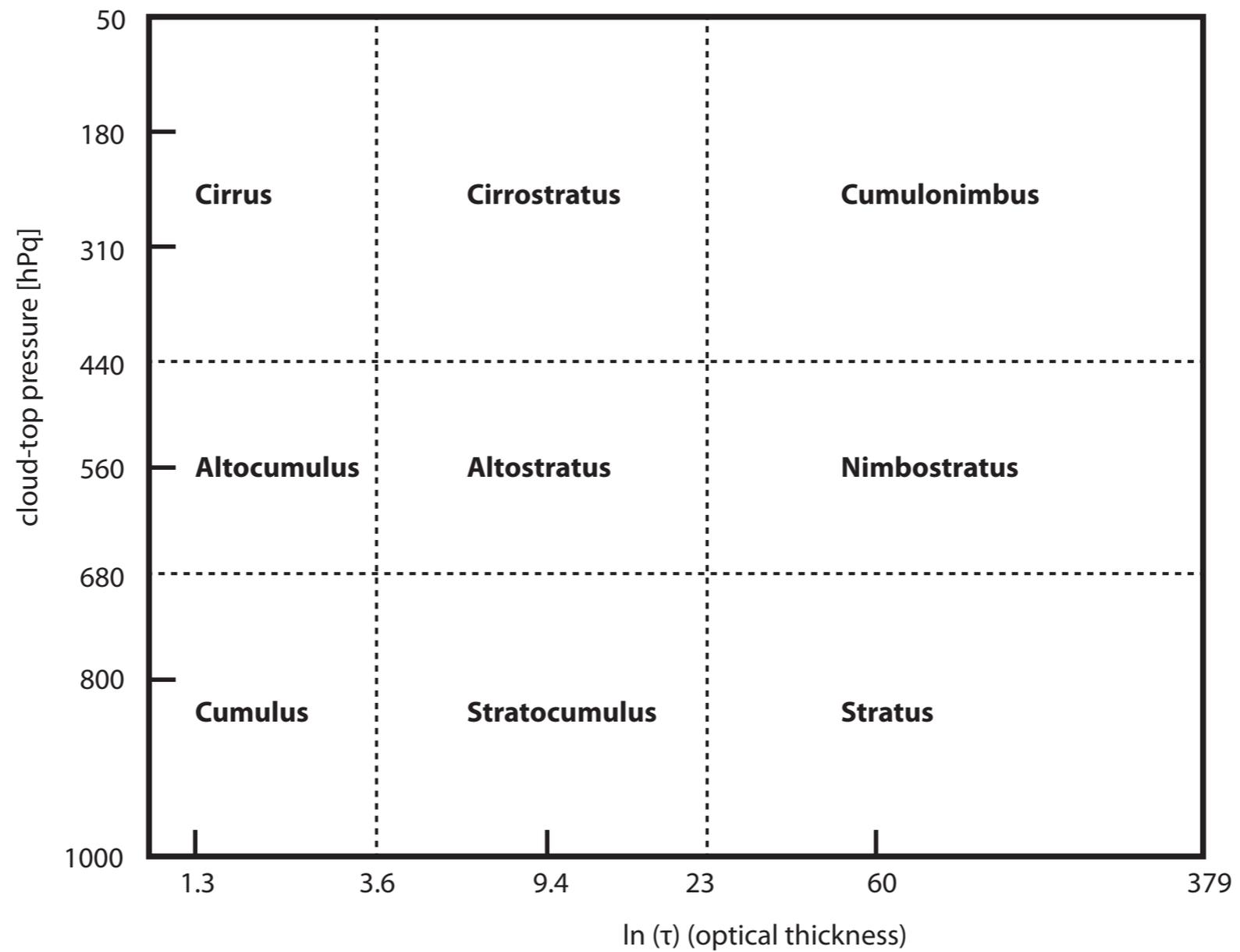


# *Cumulonimbus*



Max-Planck-Institut  
für Meteorologie

# ISCCP Histograms



# Slide Title

