

Anthropogenic Influence and Their Impacts on Global Climate

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Outline

- Introduction
- Land Use
- Land Cover
- Physical Response of Species to Climate
- Tropical Cyclones
- Ground Water Modeling

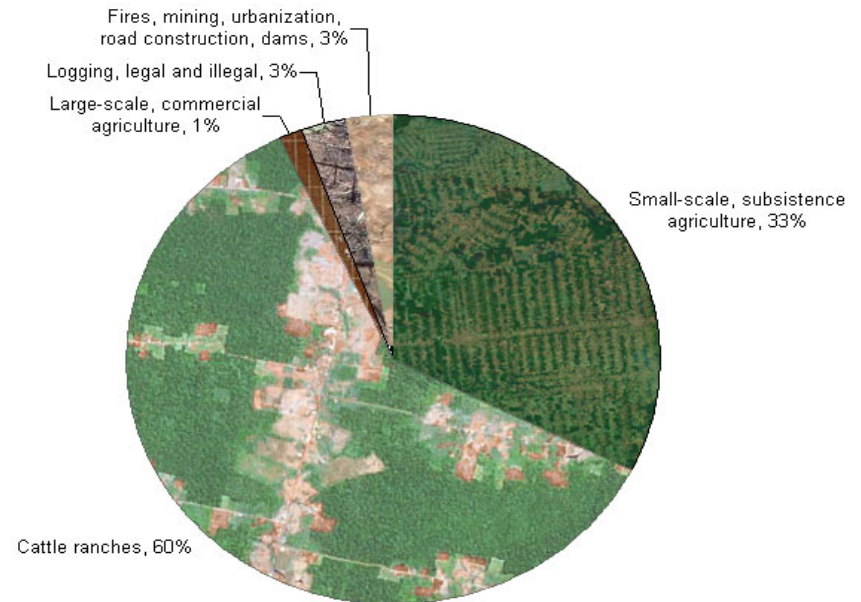
- Anthropogenic activities are one of the primary causes of global warming
- Climate temperature has been rising which affects
 - Biogeochemical
 - Biogeophysical
 - Ecological
 - Biological

Land Use

- Deforestation
 - One of the leading causes of the increase of carbon dioxide
 - Due to agriculture, urbanization, logging, and failure to preserve land



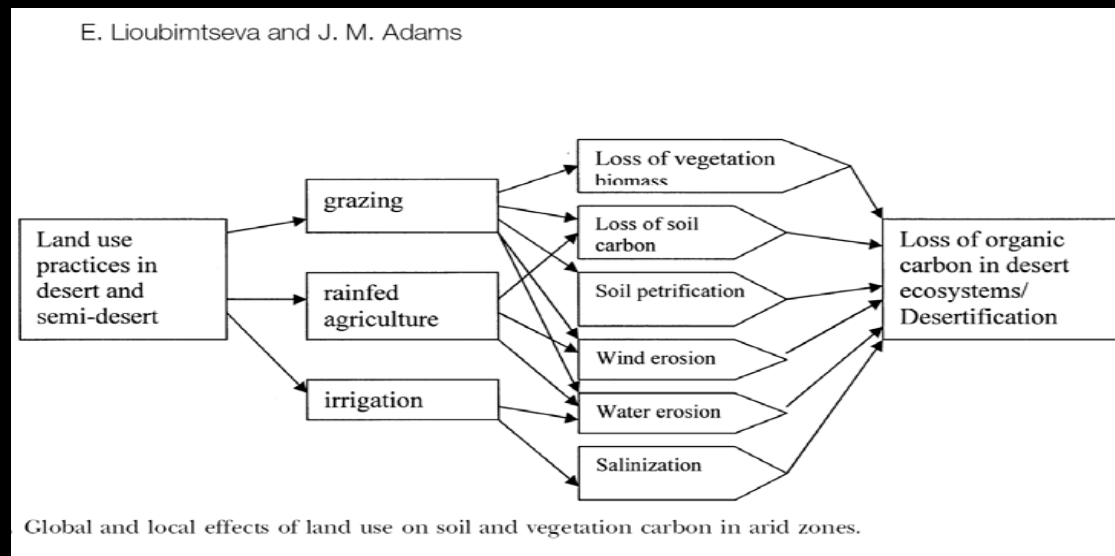
Causes of Deforestation in the Amazon, 2000-2005



<http://www.mongabay.com>

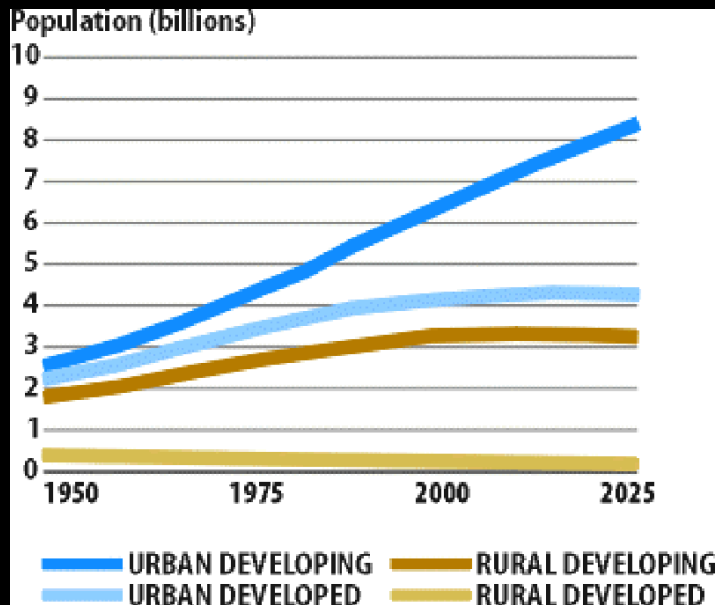
Land Use

- Desert ecosystems
 - Climate change, precipitation, and distribution of temperature can change in the desert areas
 - Global warming may have a positive effect in the desert regions but a drier negative outcome will be experienced in other parts of the world



Land Use

- Urbanization
 - Growing population have a global negative impact such as rising sea level, drought, urban heat island, depletion of groundwater, enhance or decrease in precipitation, rising temperature, and greater catastrophic hurricanes



Greenleapforward.com/2008/03/26

Land Cover

- Tropical deforestation
 - Using Atmospheric General Circulations, it is found that altered land cover in Amazonia significantly increase and decrease in evapotranspiration due to deforestation
 - Decline of evapotranspiration will result into an overall surface temperature increase, dryer planetary boundary layer and atmosphere and decrease in precipitation due to the reduced water cycle

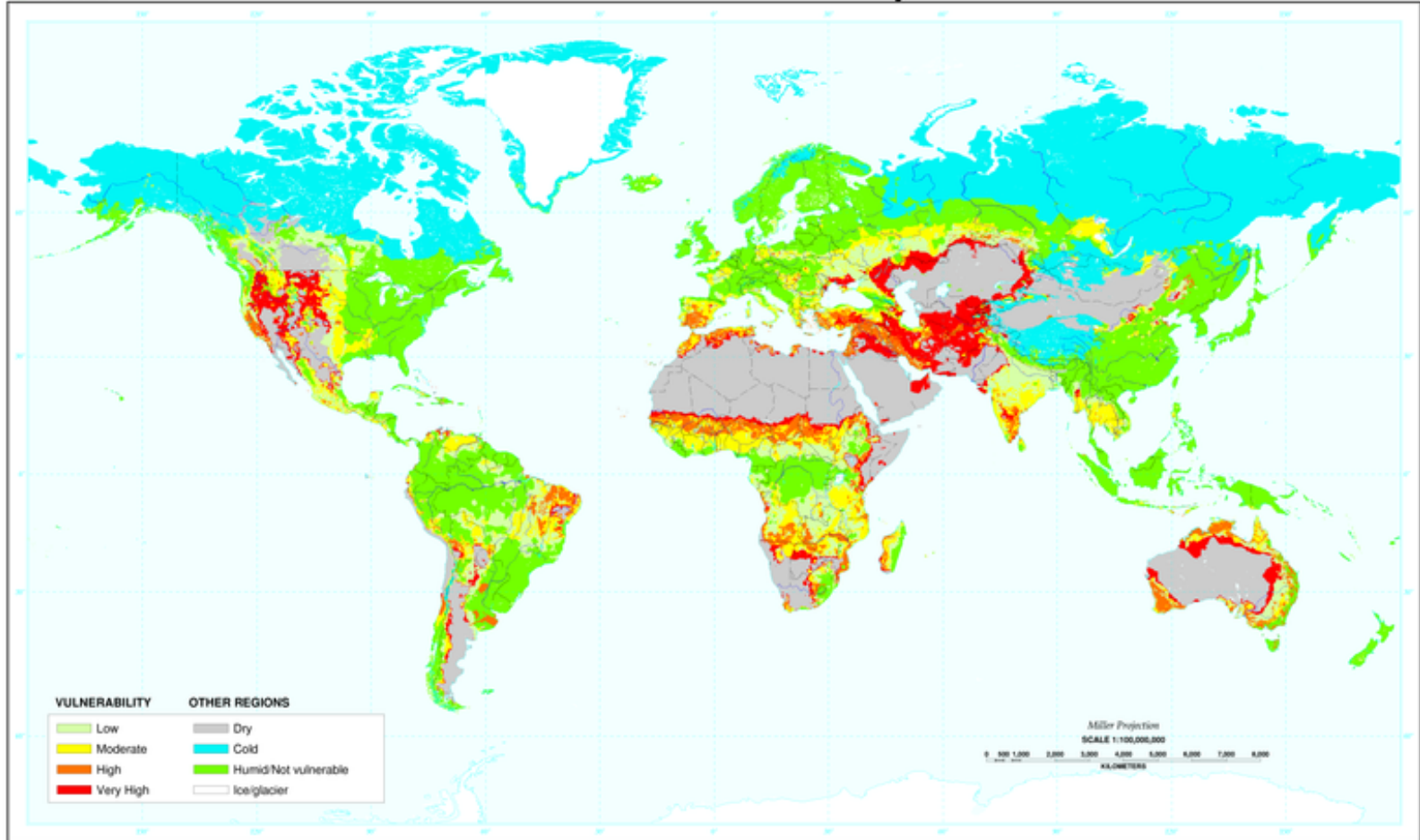
Land Cover

- **Boreal deforestation**
 - Biome removal have the largest signal of global temperature
 - It affects the climate systems through water balance while the vegetation alter the surface radiation balance
 - Removal of vegetation revealed snow cover which resulted in an increase of albedo as well as a strong reduction in net radiation, surface, and precipitation

Land Cover

- **Desertification**
 - Due to humans such as overgrazing and overcultivation
 - Other factors are its regional characteristics such as sandy and non vegetated soil that maintains thermal equilibrium in which explains the extensive drought that most desert experience

Desertification Vulnerability

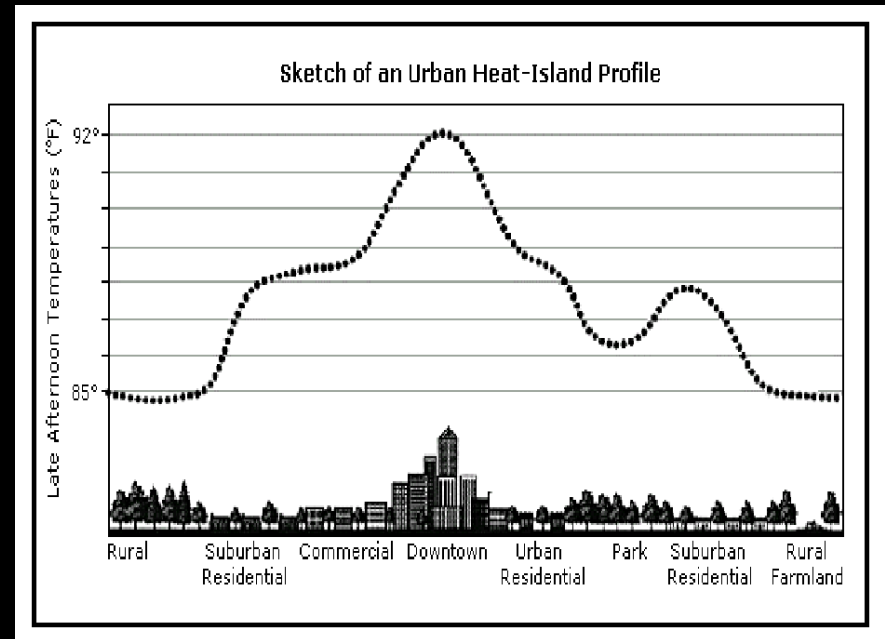


Land Cover

- **Urban Heat Island**

- Due to the growing population around the world
- Regional areas are being replaced by concrete and building in which creates the heat island

- Caused by heating-ventilation-air conditioning systems, energy emissions from industrial processes



rsd.gsfc.nasa.gov

Physical Response of Species to Climate

- Species migration
 - Around 24 bird species are influence by the increase of temperature
 - Along with climate change, food availabilities is another factor that determines species migration
- Sex ratio
 - Studies have shown that a 2°C increase in temperature have drastically skewed sex determination to females in most reptile species

Physical Response of Species to Climate

- **Reproduction**
 - Due to the rise and abrupt change in temperature, some species has had a 10 day shift to an earlier laying behavior or have a difficulty in adapting to the weather conditions



Tropical Cyclones

- Duration

- With the use of global modeling to predict Hurricanes, scientist discovered that the North Atlantic Ocean has increased in frequency trend and duration by 99% due to global warming

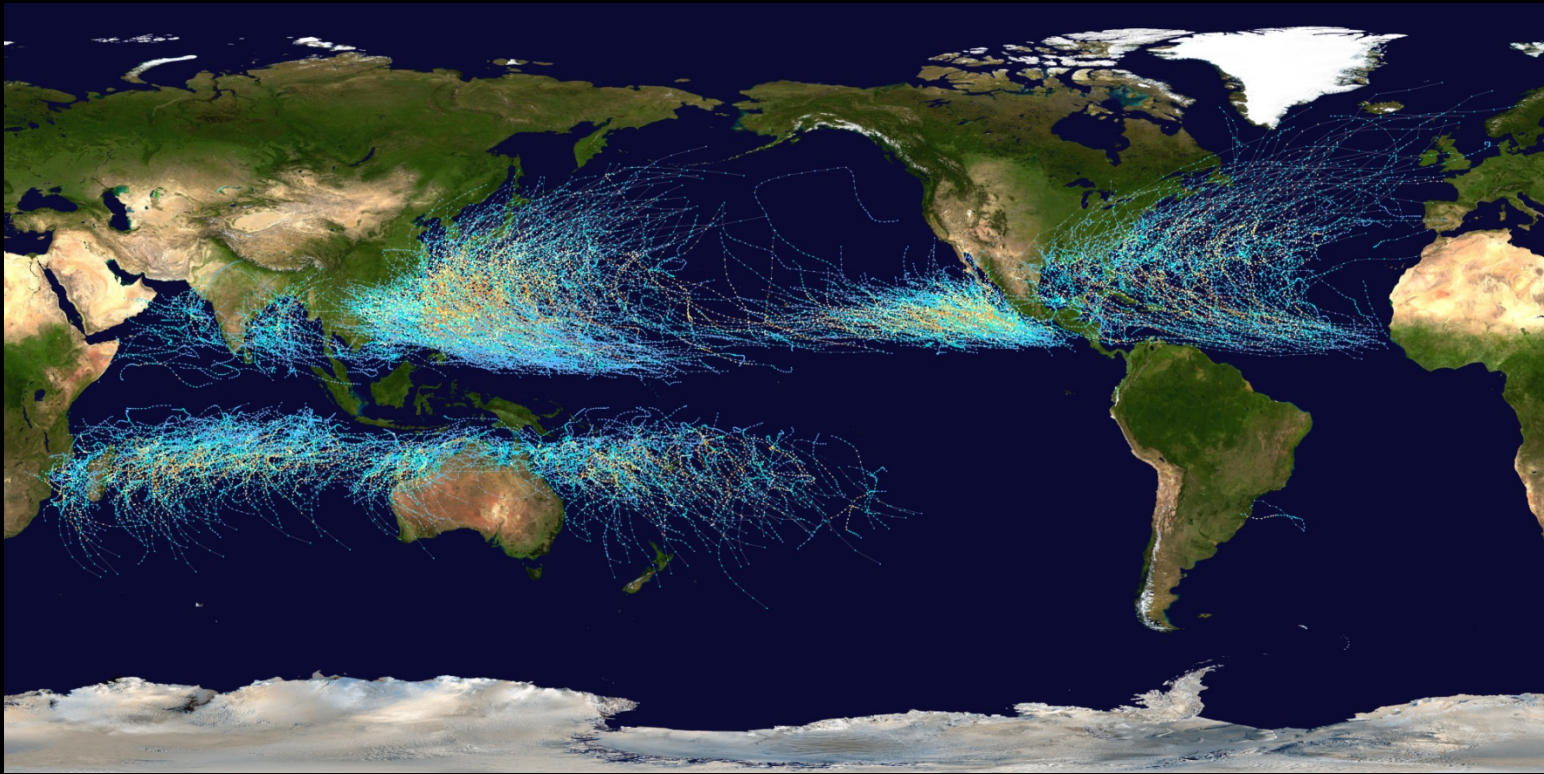
- Intensity

- Using the ocean-atmosphere climate model, researchers discovered that areas with high-CO₂ has more intense wind speeds

- Destructiveness

- Is based on the total dissipation of power as well as the overall lifetime

Tropical Cyclones



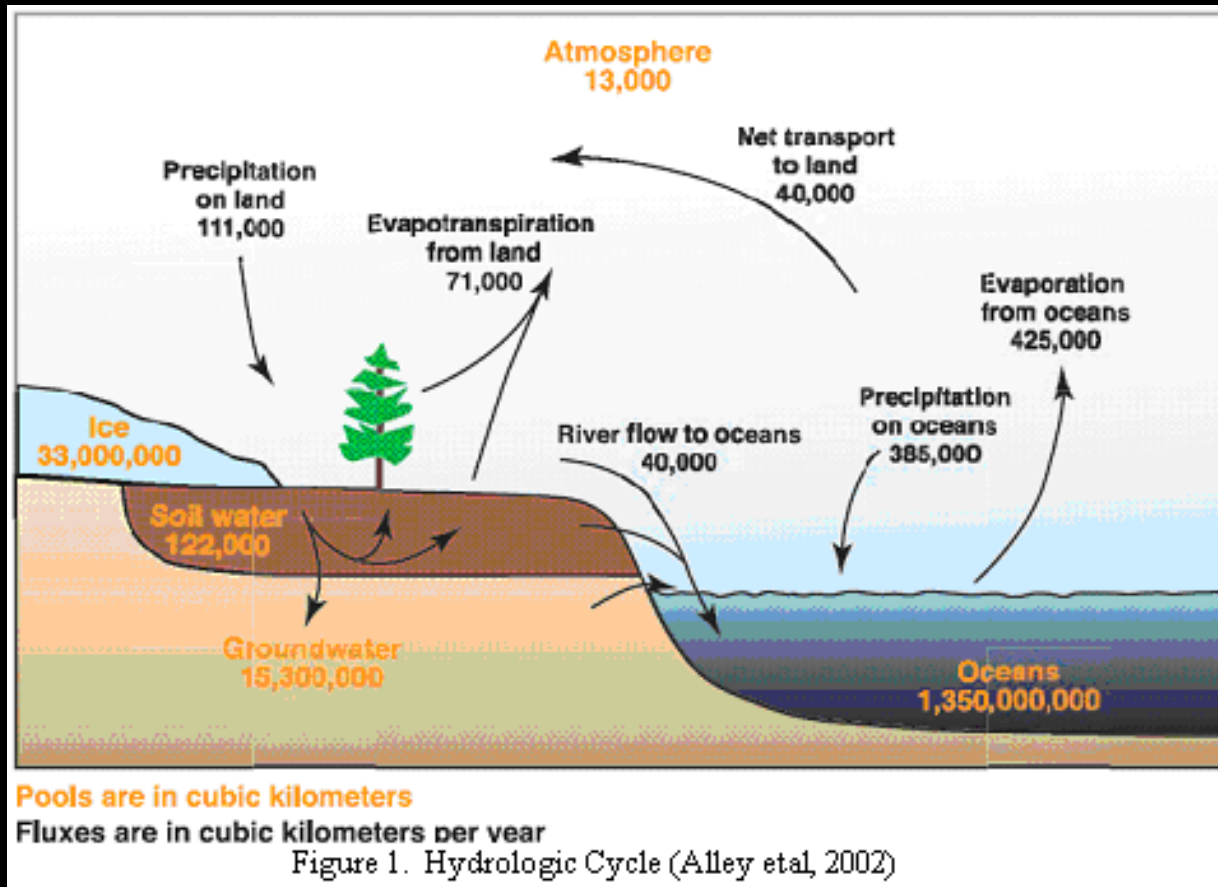
This map shows the tracks of all tropical cyclones which formed worldwide from 1985 to 2005. The points show the locations of the storms at six-hourly intervals

nihongo.wunderground.com

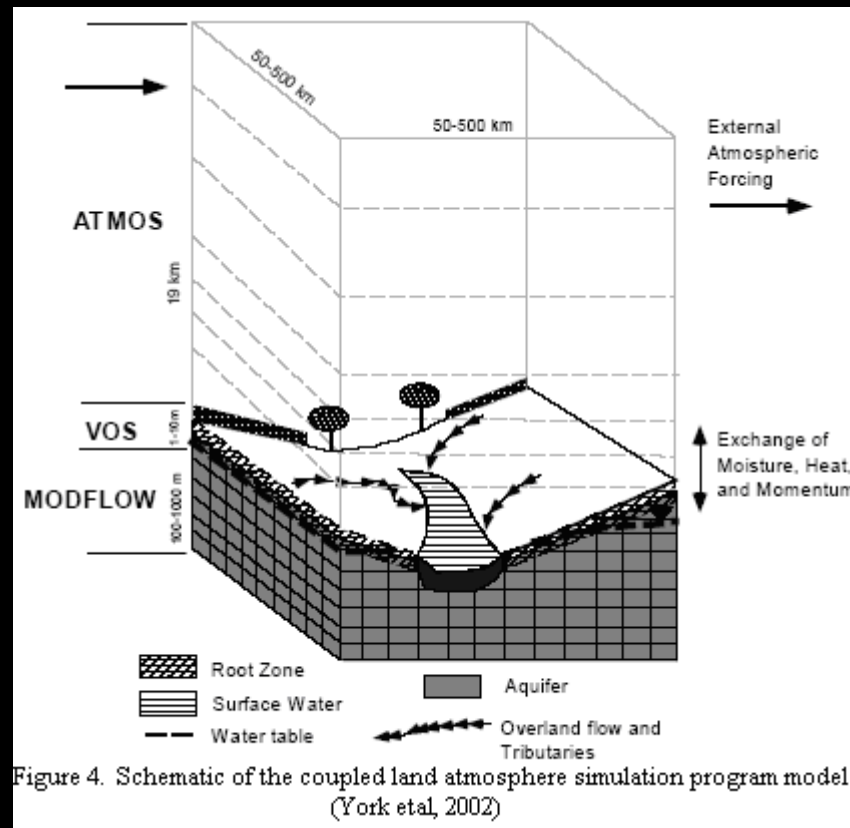
Groundwater

- **Water availability**
 - Groundwater dependency
 - Depletion of above groundwater
- **Correlation between groundwater and climate using three different types of modeling**
 - Hydrological cycle- which includes precipitation, evaporation, transpiration sublimation, runoff, infiltration recharge, and base flow
 - Three-layer variable infiltration capacity model- simulates the effect of different types of vegetation on water energy budget
 - Soil hydrological model- which recognizes the impact of groundwater as a soil water source as well as the water exchange between unsaturated zone and groundwater

Hydrological Cycle



Three-layer variable infiltration capacity model-



Soil Hydrological model

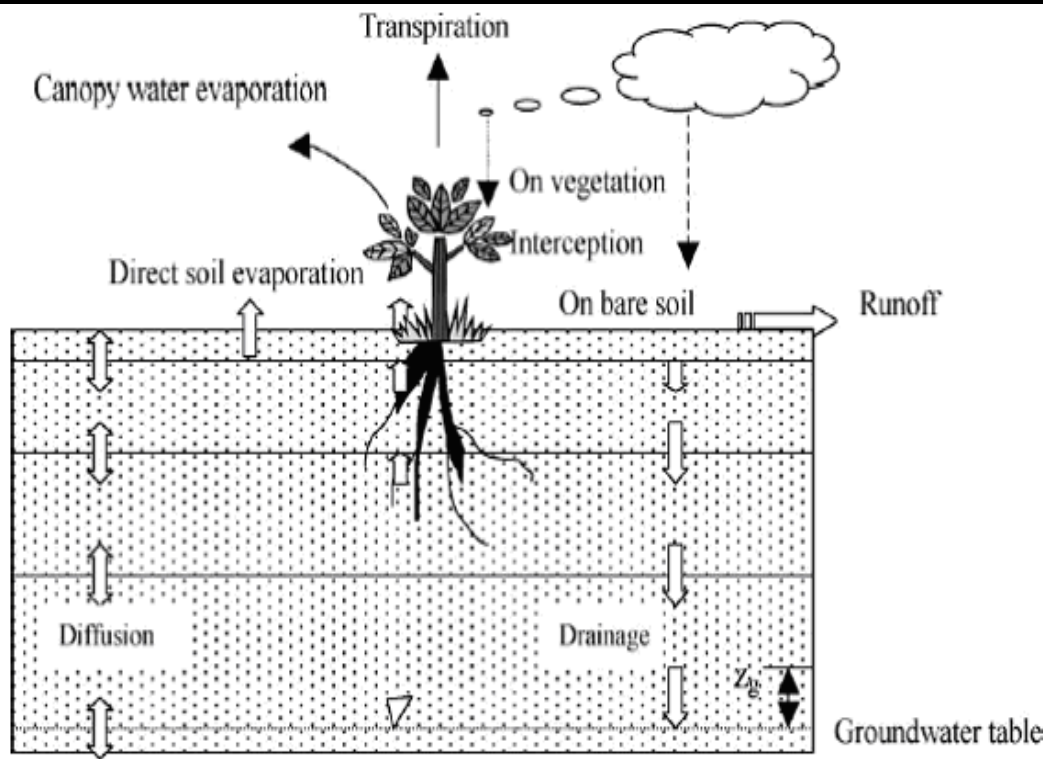


Figure 6. A Schematic of the multiplayer soil hydrological model.
(Chen and Hu, 2004)

- Due to the various vertical distribution of saturated hydraulic conductivity, Richard's equation is included to calculate the soil moisture and consider the four soil

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z} \left(D \frac{\partial \theta}{\partial z} \right) + \frac{\partial K}{\partial z} + F(t, \theta),$$

Equation 1. Richard's Equation.
(Chen and Hu, 2004)

Conclusion

- It is significant for scientist to understand the factors the influence global warming and its effects to the environment
- Creating various types of models assist researchers to understand the scientific process of global warming
- The simulations are beneficial for scientist to create hypothesis, which in turn help educate the world and motivate people to live a more sustainable lifestyle