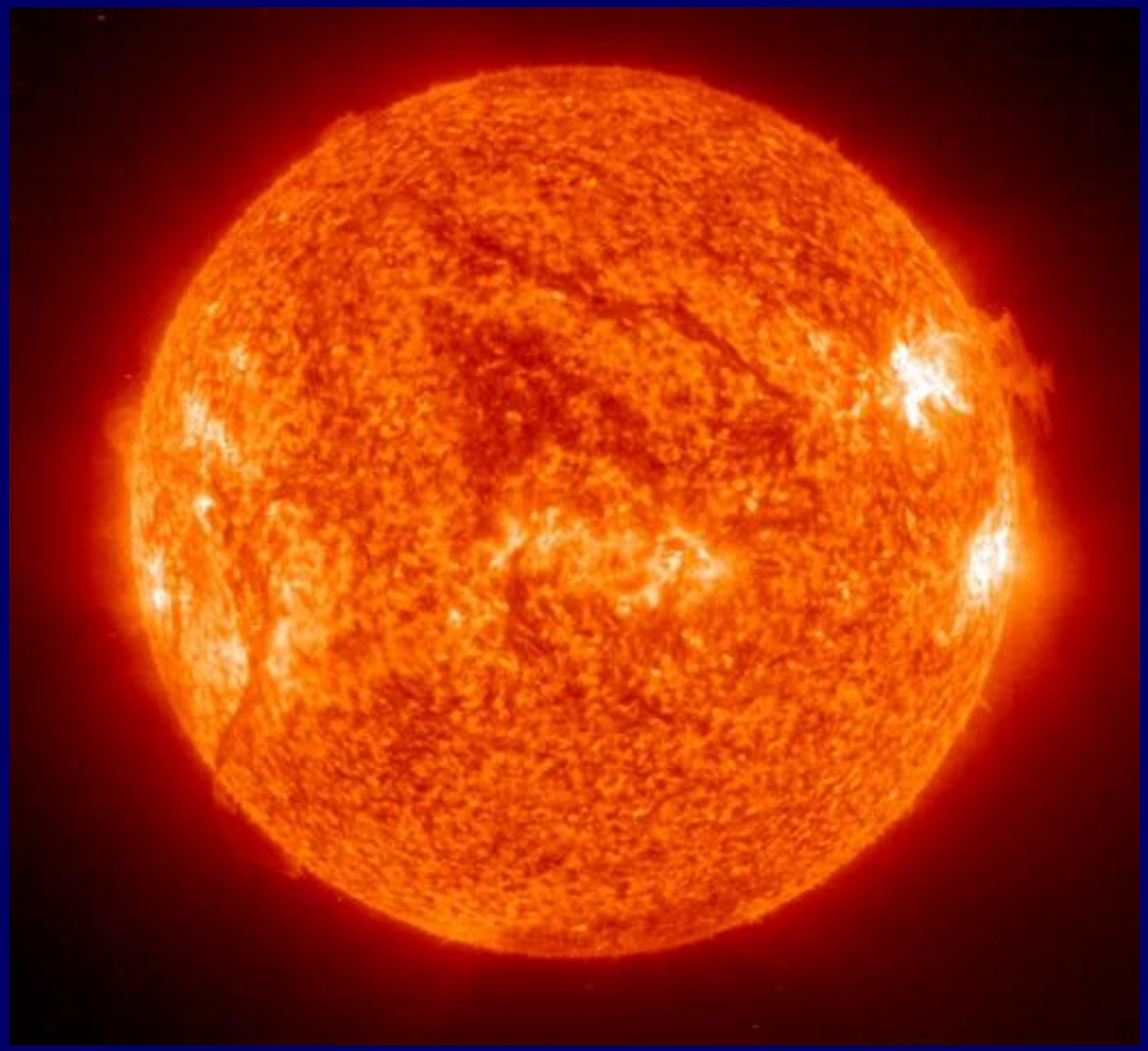
Topic # 11
HOW CLIMATE WORKS – PART I

A "Primer" on
How the Energy Balance Drives
Atmospheric & Oceanic Circulation,
Natural Climatic Processes

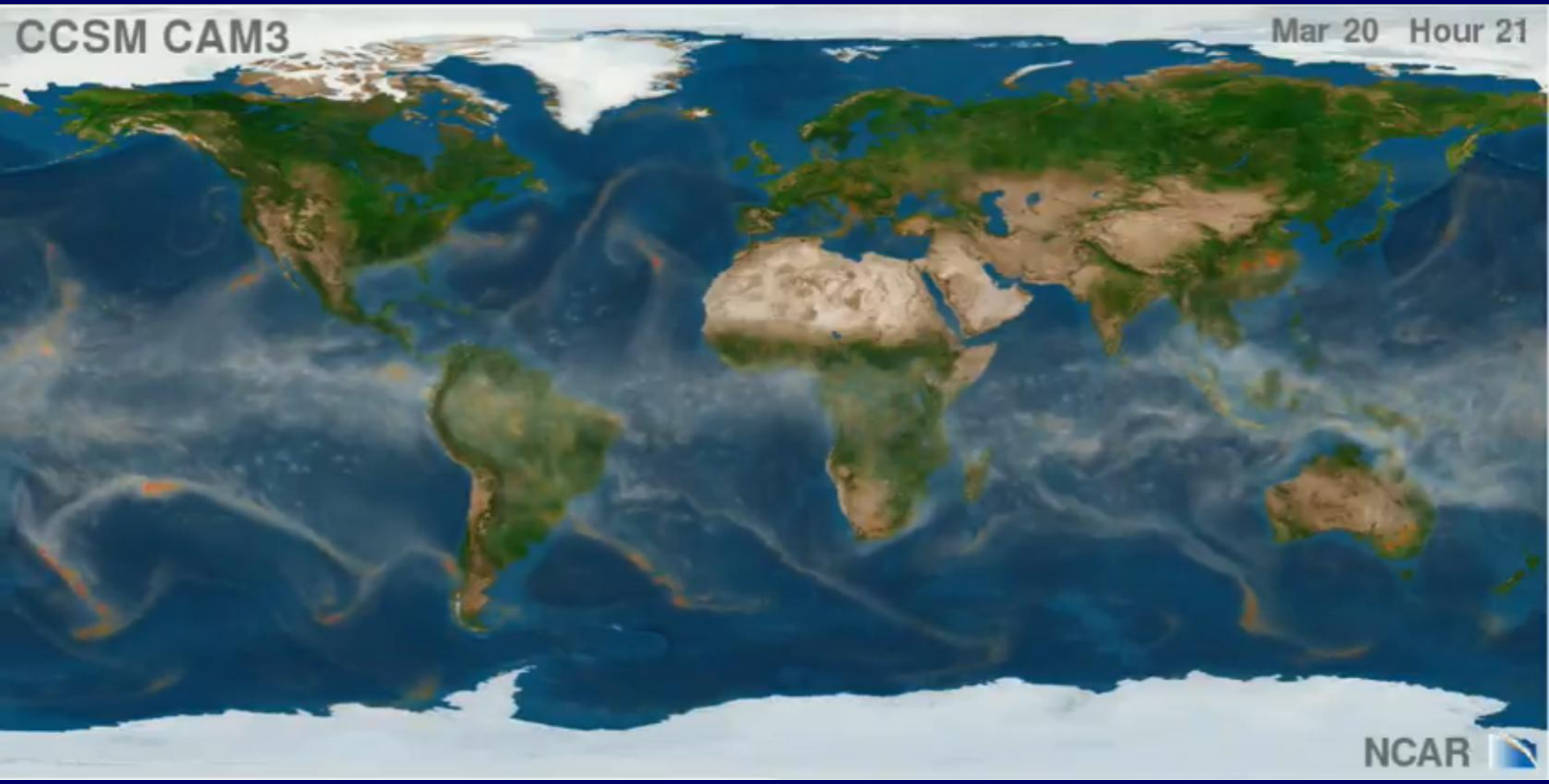
pp 61-67 in Class Notes

How do we get energy from this . . . .



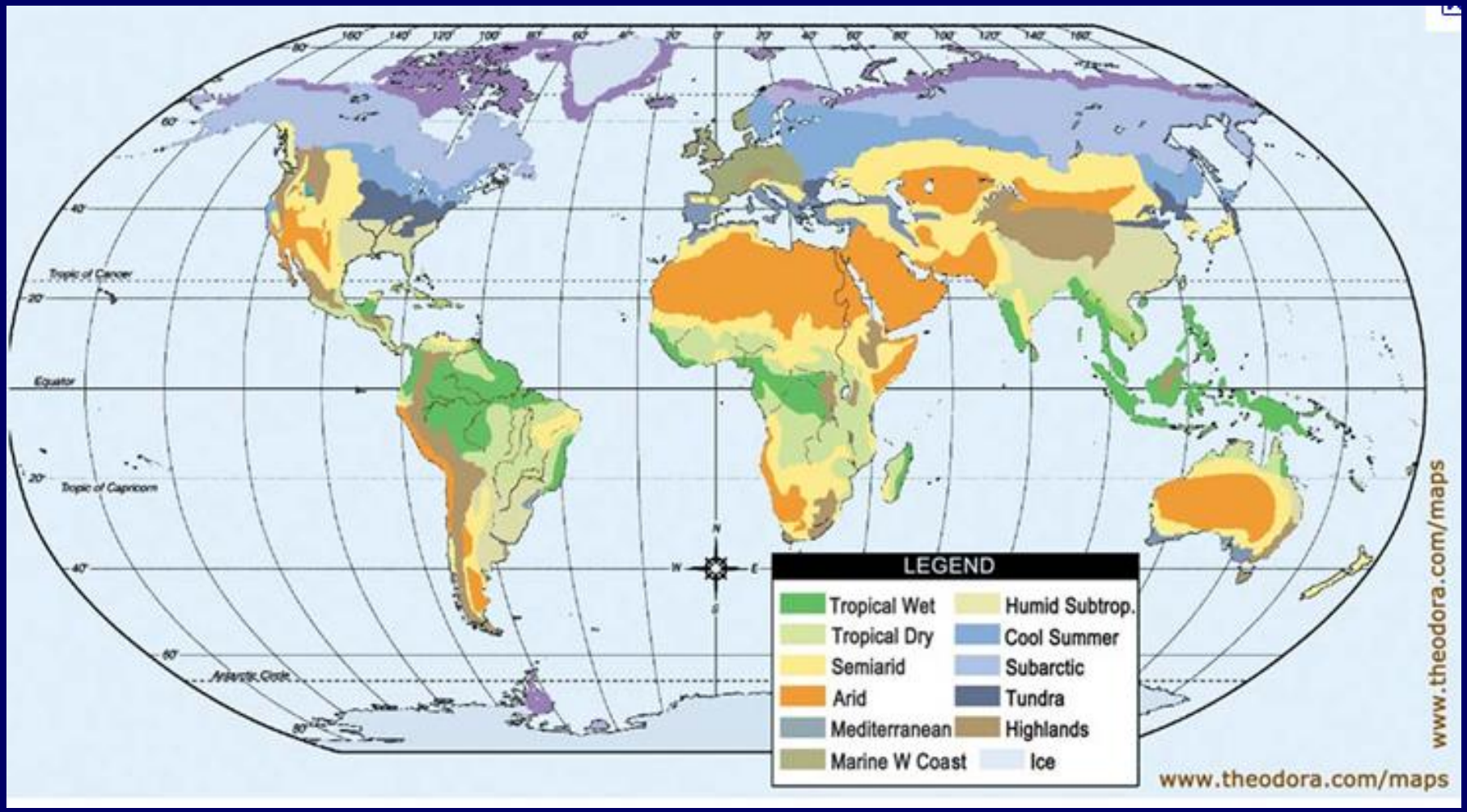
. . . . to drive this ?

. . . . or this ?



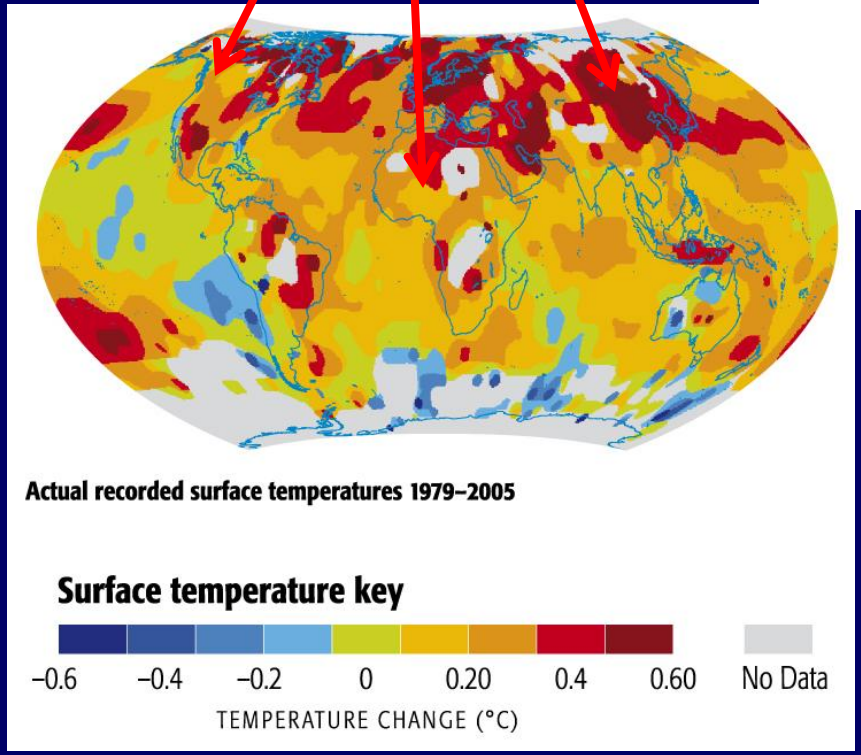
http://www.vets.ucar.edu/vg/T341/index.shtml

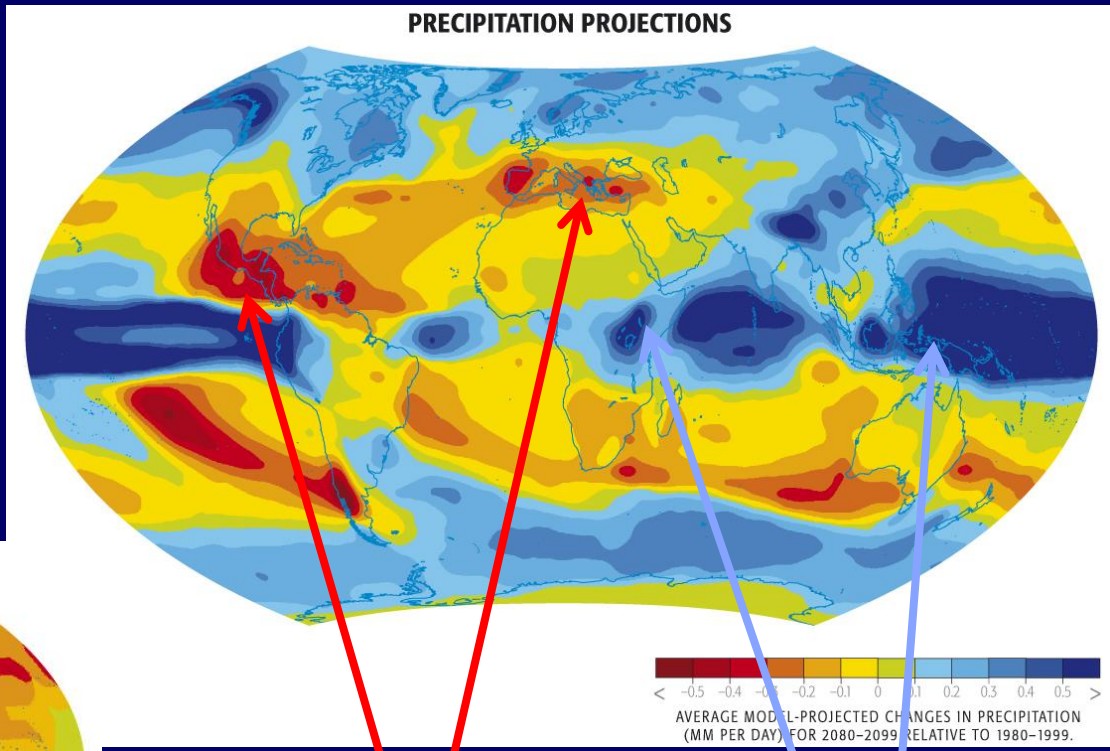
. . . .which leads to Global Climatic Regions:



. . . .and CHANGES in these regions!

Hotter!



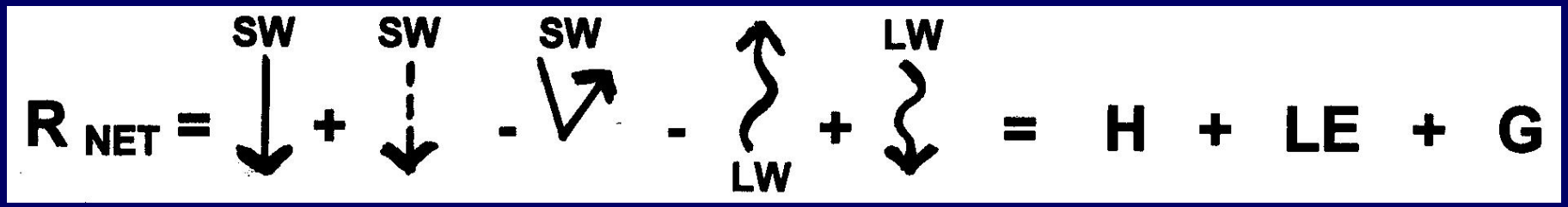


Drier!

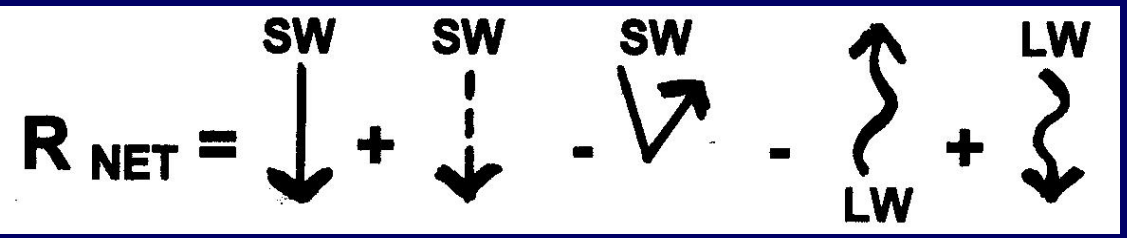
Wetter!

from *Dire Predictions* text

It all happens because of changes in the RADIATION / ENERGY BALANCE !



"Radiation Balance" part



All components are referring to electromagnetic radiation

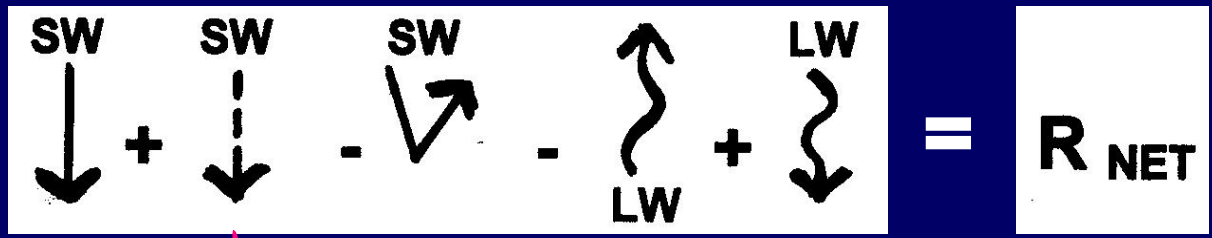
All components are referring to modes of heat energy transfer or heat energy storage involving matter

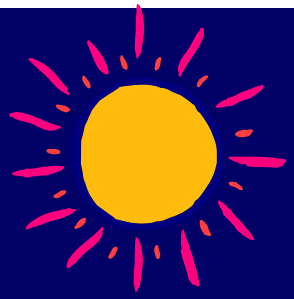
"Energy Balance" part

$$R_{NET} = H + LE + G$$

Start out here, with energy from the SUN radiated to Earth and so forth . . .

"Radiation Balance" part





The R_{NET} is then able to be used in thermal energy "heat transfer" processes which manifest themselves as weather & climate!

"Energy Balance" part

$$R_{NET} = H + LE + G$$

Thermal Energy Review

Heat **(def) = the thermal energy that is *transferred* from one body to another because of a temperature difference.**

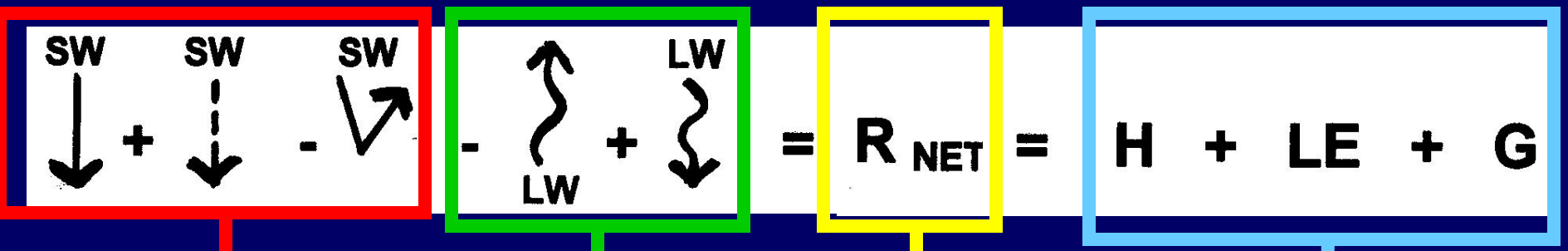
- **Sensible Heat transfer (H)**
- **Latent Heat transfer (LE)**

plus (after transfer) thermal energy can be STORED (G)

H + LE + G

Review

ENERGY IN THE EARTH-ATMOSPHERE SYSTEM



Ultimate source of energy is the SUN (SW)

After absorption of SW, LW energy is radiated in & out by EARTH & Atmosphere

Any NET (leftover) energy

Goes into the HEAT TRANSFER processes that drive **WEATHER & CLIMATE !**

The Earth [as viewed from space] . . .

has the organized,
self-contained look
of a live creature,
full of information,
marvelously skilled
in handling
the sun.

- Lewis Thomas

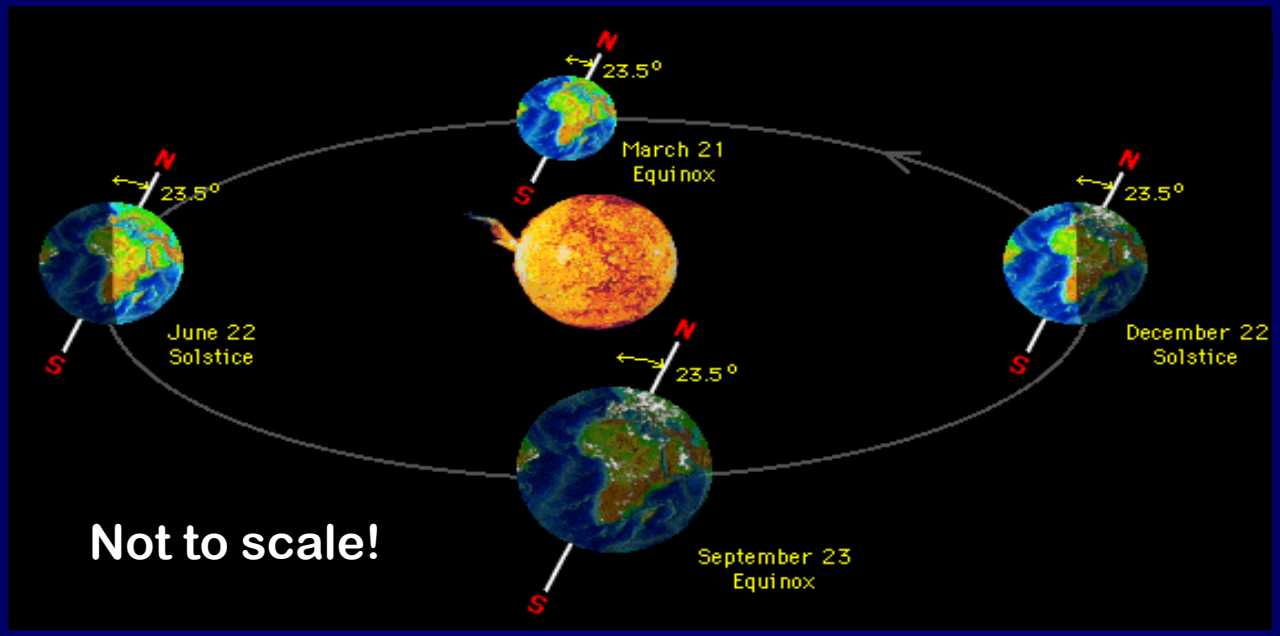
LINKING THE ENERGY BALANCE TO ATMOSPHERIC CIRCULATION . . .

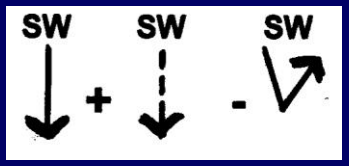
We'll start with the SUN (SOLAR INSOLATION)

IN – SOL- ATION =

Amount of incoming solar energy received by a point on Earth's surface

To drive the circulation, the initial source of energy is from the Sun:





EARTH-SUN Relationships

4 Things to Know about Earth-Sun Relationships:

1) **Earth orbits Sun in one year**
2) **Orbit is not a perfect circle** (= an ellipse)
3) **Earth's orbit around Sun can be "traced" on a plane**
   ("**Plane of the Ecliptic**" – plane passes thru the center of Sun & Earth)
4) **Earth's axis tilts 23.5 ° from a ⊥ to the "Plane of The Ecliptic"**

http://mesoscale.agron.iastate.edu/agron206/animations/01_EarthSun.html

These 4 Earth-Sun Properties lead to: the 2 factors that determine the AMOUNT OF SOLAR INSOLATION as the seasons progress:

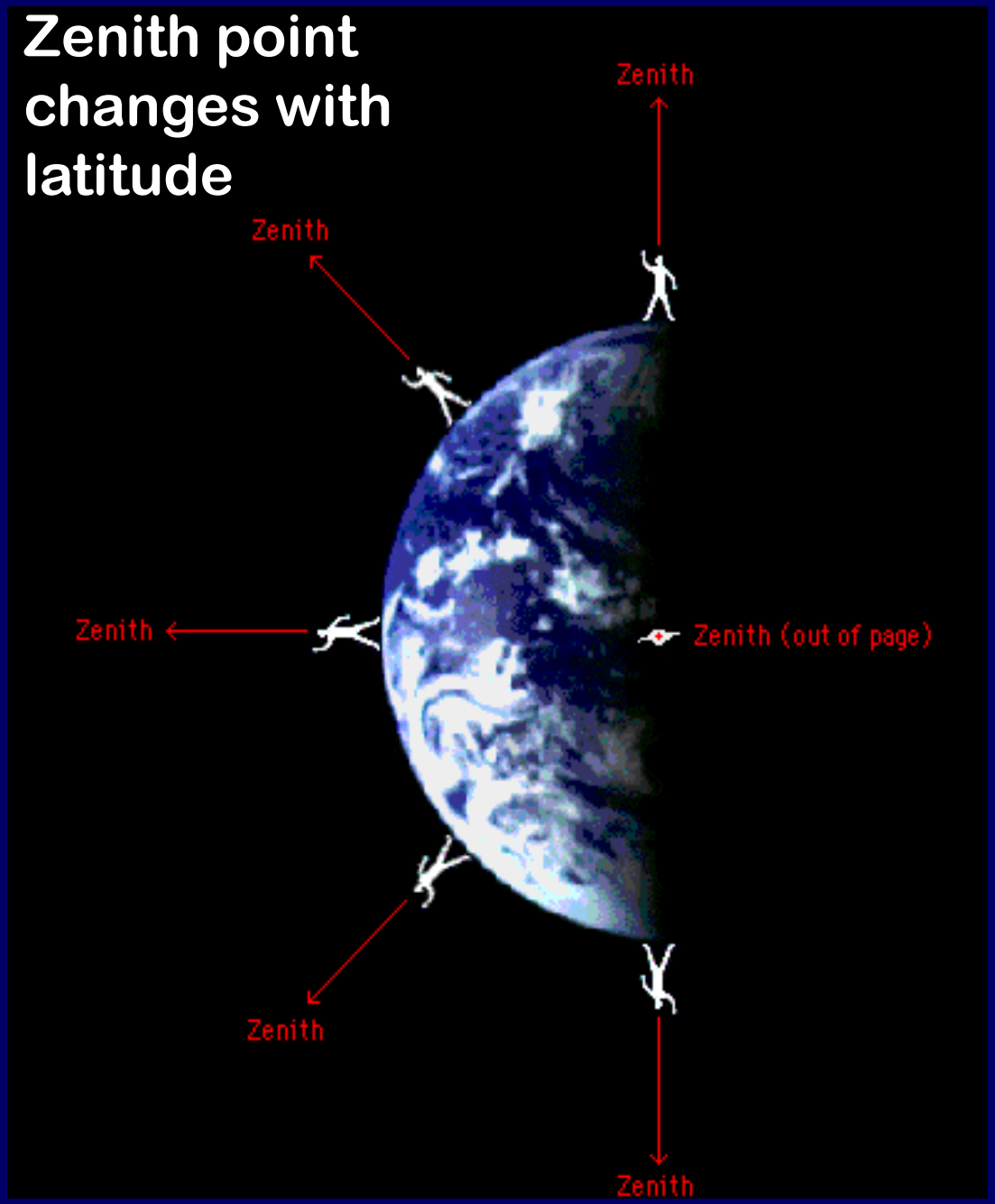
(1) **INTENSITY** of sun's rays

(perpendicular to surface = more intense)

(2) **DURATION** of daily insolation

(longer day length = more insolation)

Zenith point changes with latitude

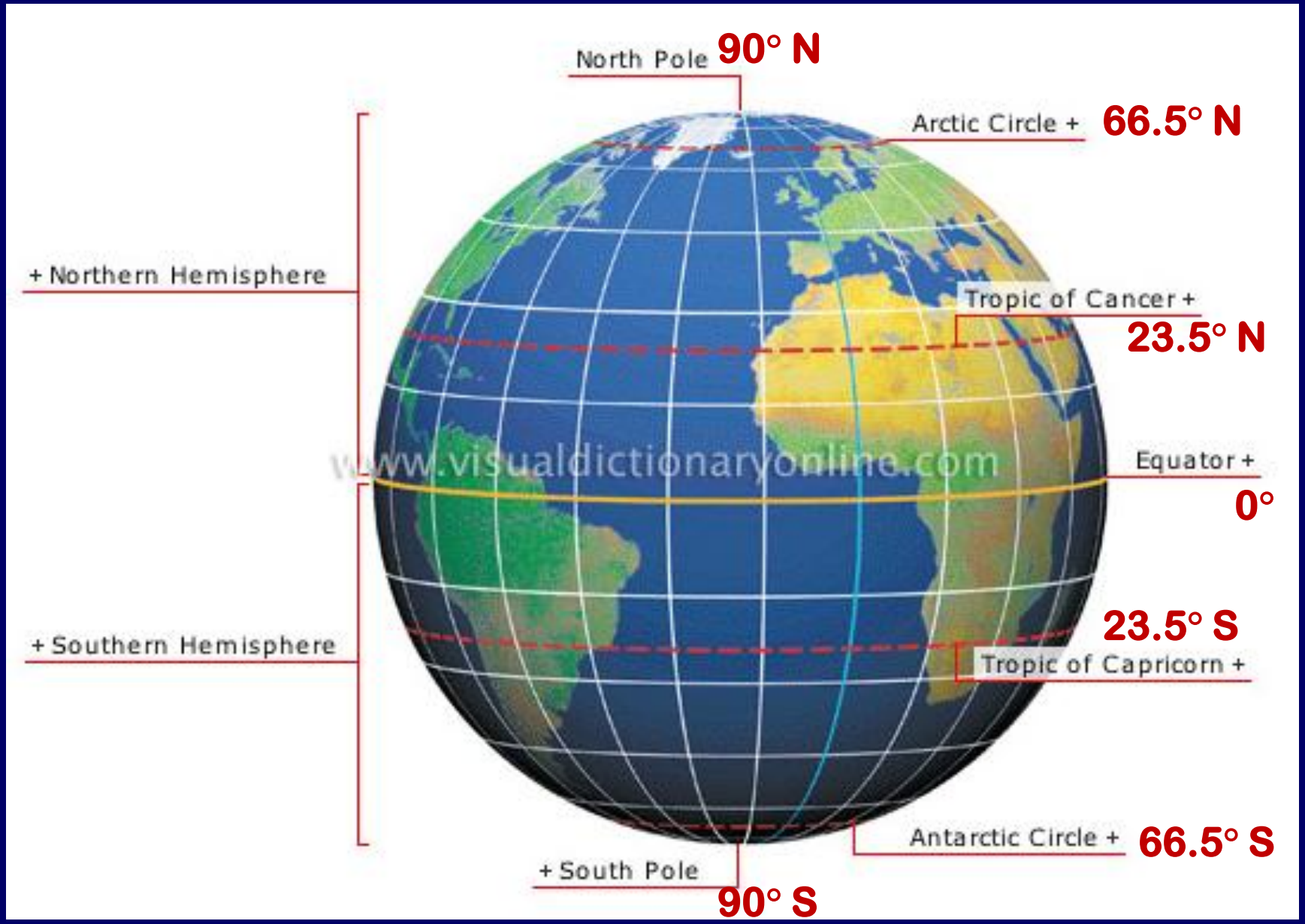


A useful term:

ZENITH =
The point directly overhead

INTENSITY is greatest at any spot on Earth when sun is closest to the ZENITH!

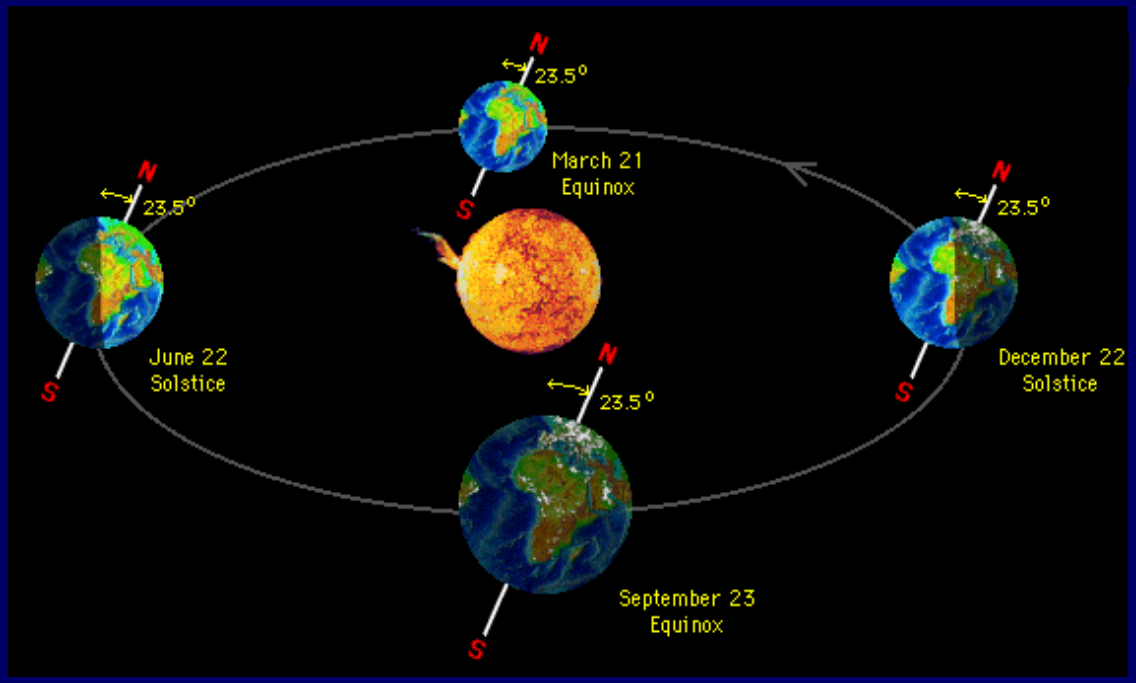
QUICKIE LATITUDE REVIEW:



EARTH-SUN RELATIONSHIPS & The SEASONS:

VIEW THE ANIMATION:

http://mesoscale.agron.iastate.edu/agron206/animations/01_EarthSun.html



To Be Continued . . . .