CHAPTER 7: Introduction to the Atmosphere

(j). Global Heat Balance: Introduction to Heat Fluxes

Figure 7j-1 illustrates the annual values of net shortwave and net longwave radiation from the South Pole to the North Pole. On closer examination of this graph one notes that the lines representing ***incoming*** and ***outgoing radiation*** do not have the same values. From 0 - 35 ° latitude North and South incoming solar radiation exceeds outgoing terrestrial radiation and a surplus of energy exists. The reverse holds true from 35 - 90° latitude North and South and these regions have a deficit of energy. Surplus energy at low latitudes and a deficit at high latitudes results in energy transfer from the equator to the poles. It is this **meridional transport** of energy that causes atmospheric and oceanic circulation. If there were no energy transfer the poles would be 25° Celsius cooler, and the equator 14° Celsius warmer!

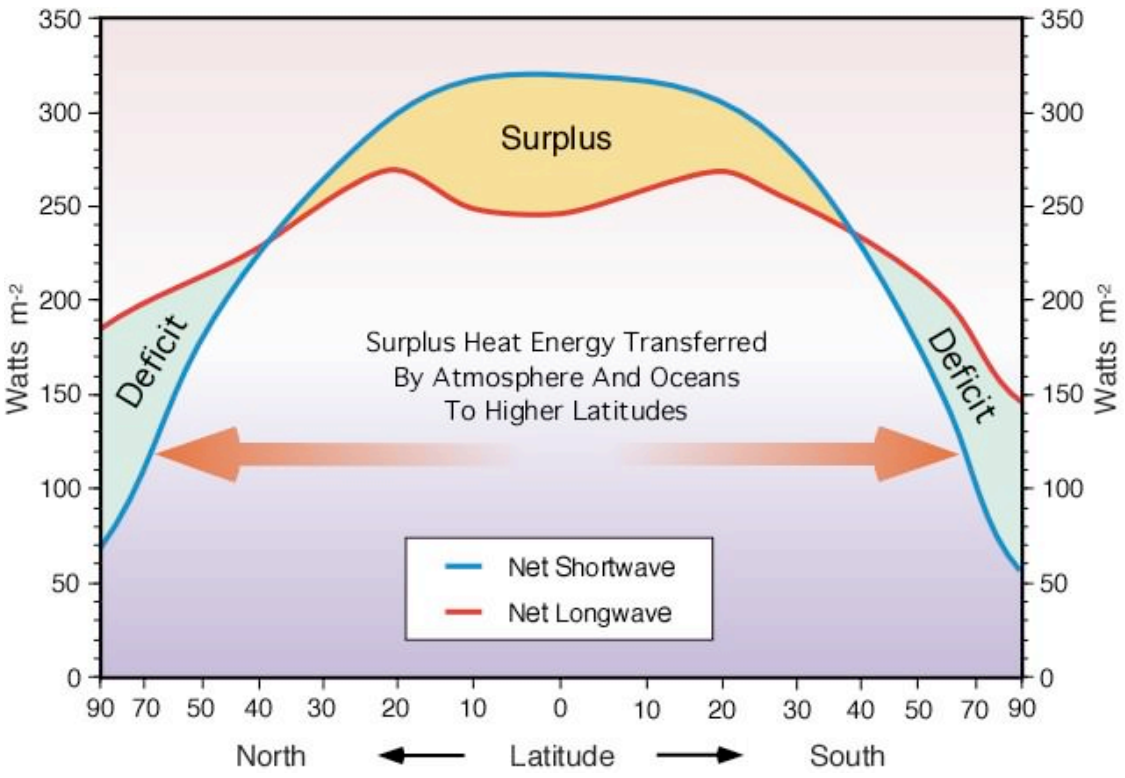

Figure 7j-1: Balance between average net

shortwave and longwave radiation from 90° North to 90° South.

The redistribution of energy across the Earth's surface is accomplished primarily through three processes: **sensible heat flux**, **latent heat flux**, and **surface heat flux** into oceans. **Sensible heat flux** is the process where heat energy is transferred from the Earth's surface to the atmosphere by **conduction** and **convection**. This energy is then moved from the tropics to the poles by **advection**, creating atmospheric circulation. As a result, atmospheric circulation moves warm tropical air to the polar regions and cold air from the poles to the equator. **Latent heat flux** moves energy globally when solid and liquid water is converted into vapor. This vapor is often moved by atmospheric circulation vertically and horizontally to cooler locations where it is **condensed** as rain or is **deposited** as snow releasing the heat energy stored within it. Finally, large quantities of radiation energy are transferred into the Earth's tropical oceans. The energy enters these water bodies at the surface when absorbed radiation is converted into heat energy. The warmed surface water is then transferred downward into the water column by conduction and convection. Horizontal transfer of this heat energy from the equator to the poles is accomplished by **ocean currents**.

The following equation describes the partitioning of heat energy at the Earth's surface:

Q* = **H** (**Sensible heat**) + **L** (**Latent heat**) + **S** (**Surface heat flux** into soil or water)

The actual amount of net radiation being partitioned into each one of these components is a function of the following factors:

- Presence or absence of water in liquid and solid forms at the surface.
- **Specific heat** of the surface receiving the **net radiation**.
- **Convective** and **conductive** characteristics of the receiving surface.
- **Diffusion** characteristics of the surface's overlying atmosphere.

Study Guide

Additional Readings

Internet Weblinks

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