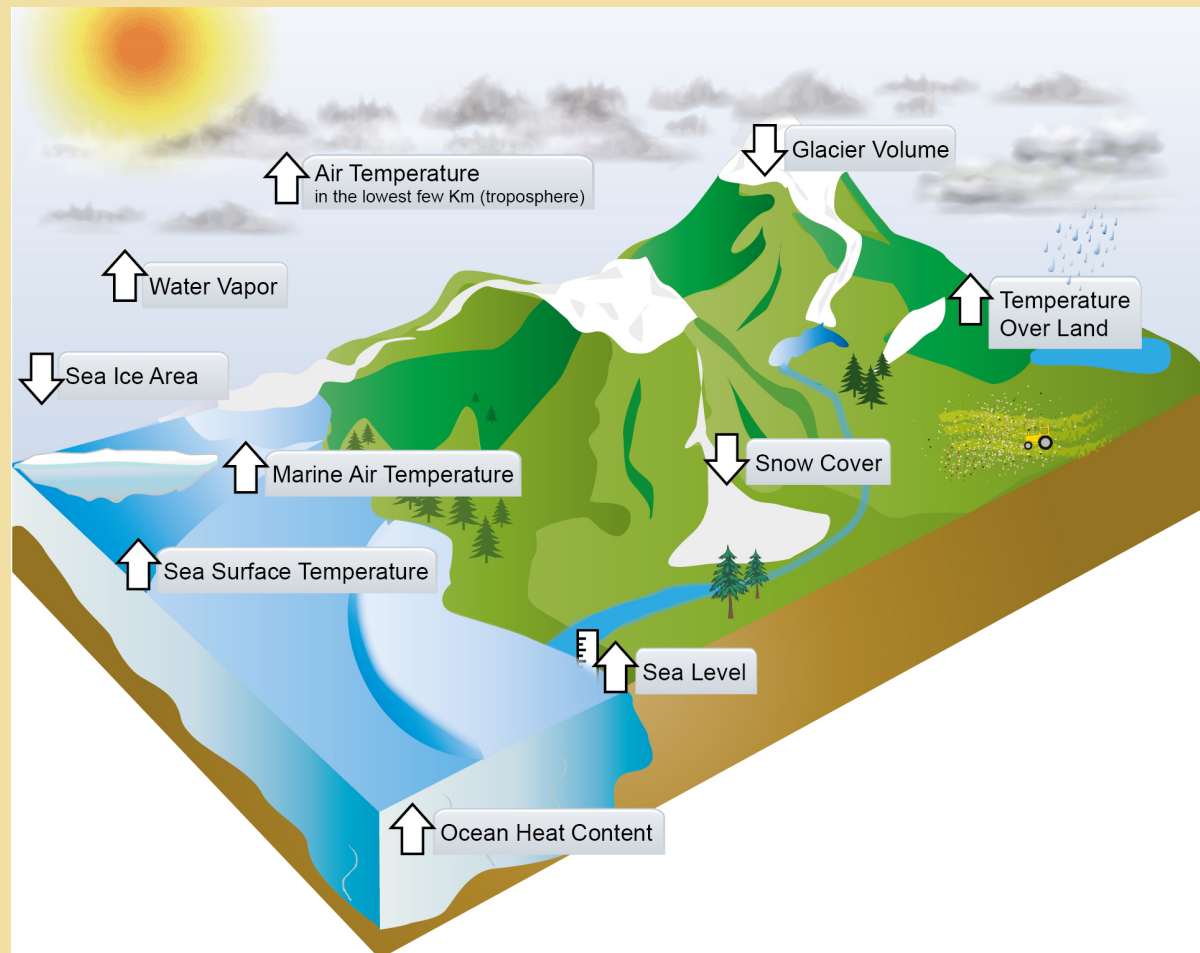


Climate Change and Society

GEOL-G490

Lecture 3: Observations: Atmosphere and Surface



1. Changes in Atmospheric Composition

2. Changes in Radiation Budgets

3. Changes in Temperature

4. Changes in Hydrological Cycle

5. Changes in Extreme Events

6. Changes in Atmospheric Circulation

2. Changes in Radiation Budgets

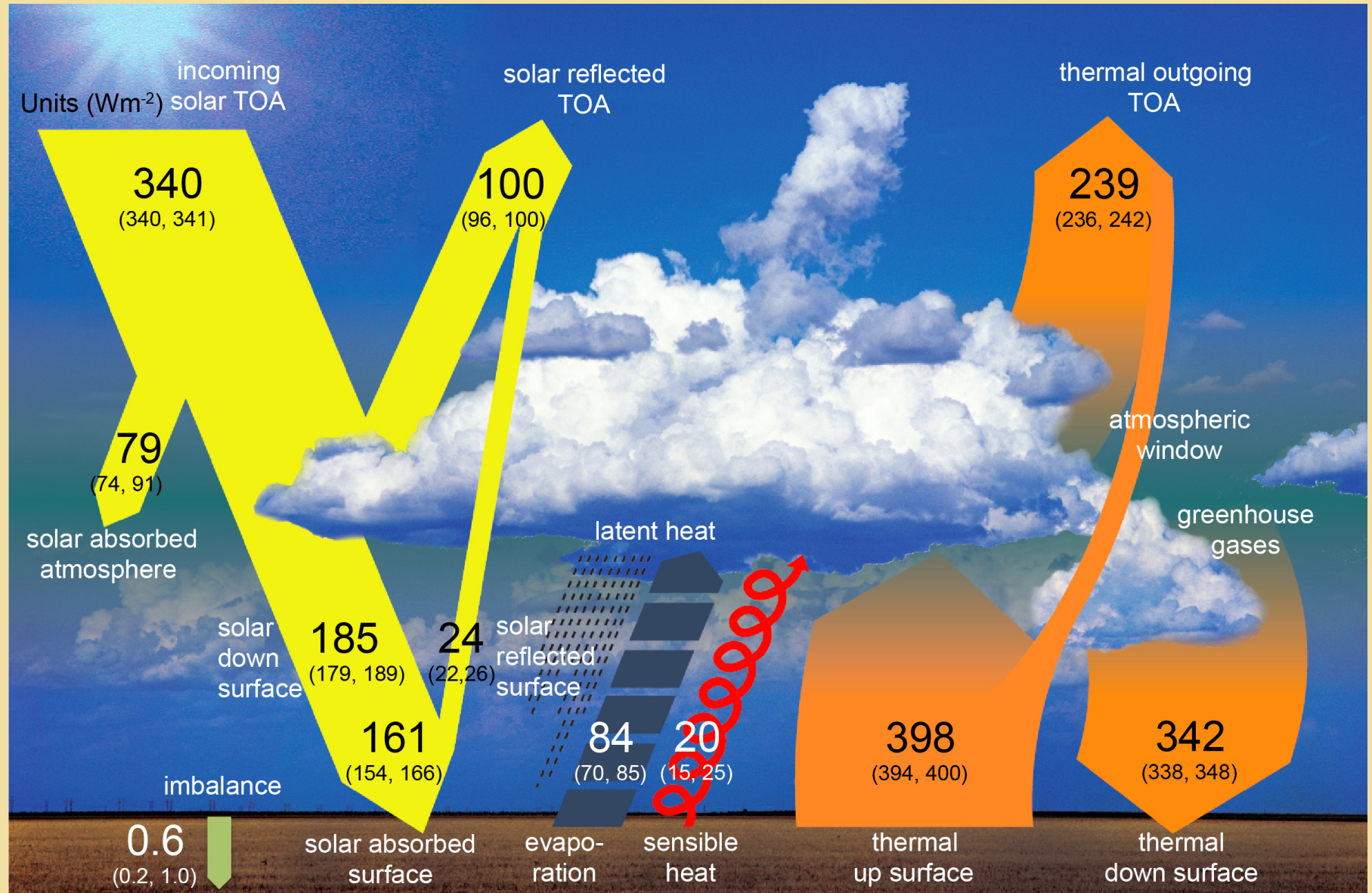
Radiation energy is the energy of electromagnetic waves.

Top of Atmosphere (TOA) Radiation Budget

The Surface Radiation Budget { The Surface Solar Radiation (SSR)
The Surface Thermal Radiation

2. Changes in in Radiation Budgets

Global Mean Radiation Budget



Exercise

- ✧ How many years does this imbalance energy can power a typical U.S. family. In 2016, the average annual electricity consumption for a U.S. residential utility customer was 10,766 kilowatthours (kWh).

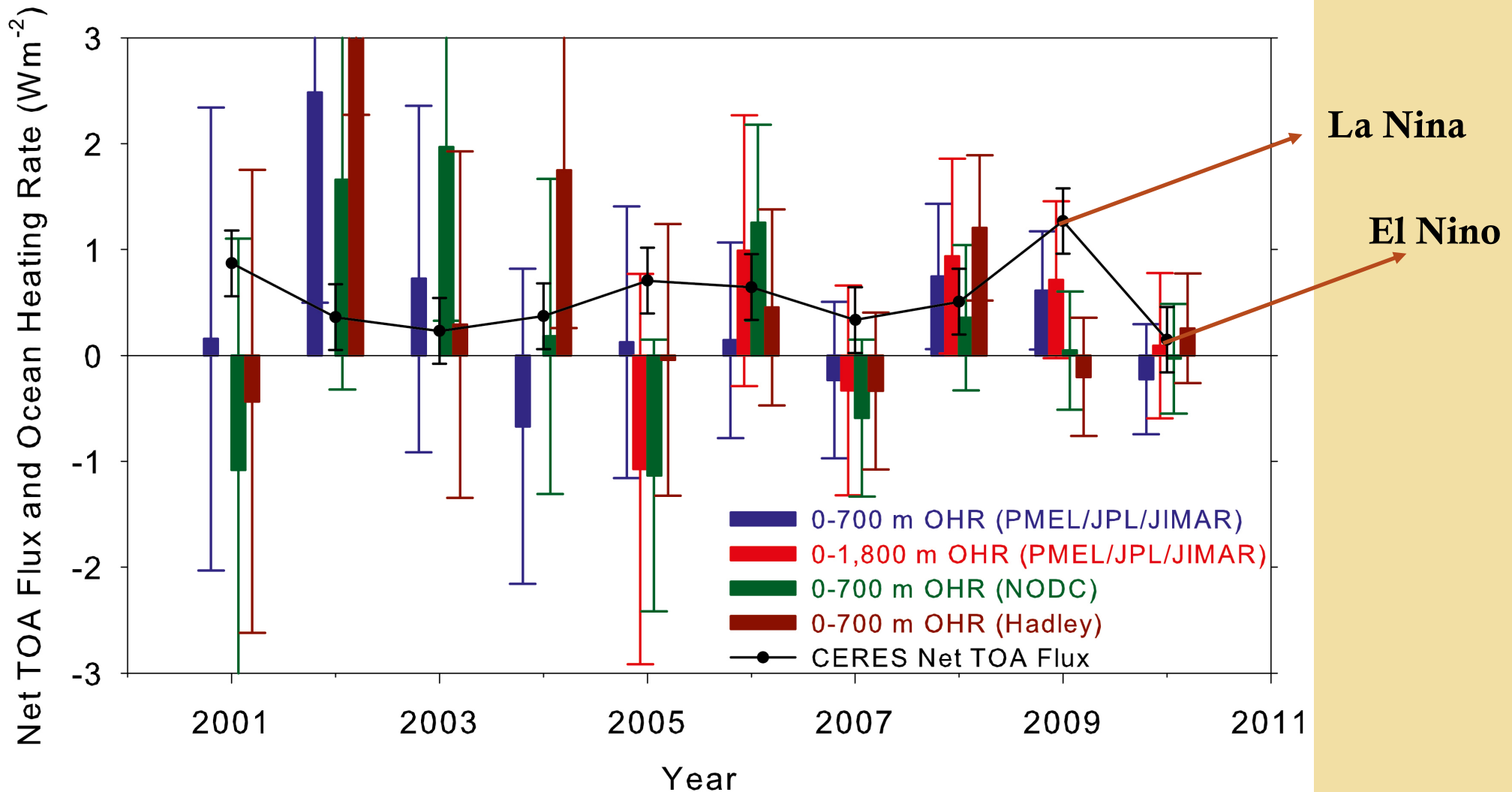
Hints: 1) Energy Use (Wh) = Power (W) x Time of Power Use (h)
2) Earth surface area: 510.1 trillion m²

Annual family electricity consumption (W) = Energy Use (Wh)
/Time of Power Use (h) = $10766 \times 1000 / 24 / 365 \text{ W year}^{-1}$

Time of Power Use (years) = Imbalanced Power / Annual family
consumption = $(0.6 \times 510.1 \times 10^{12}) / (10766 \times 10^3) \times 24 \times 365 = 249$
billion years

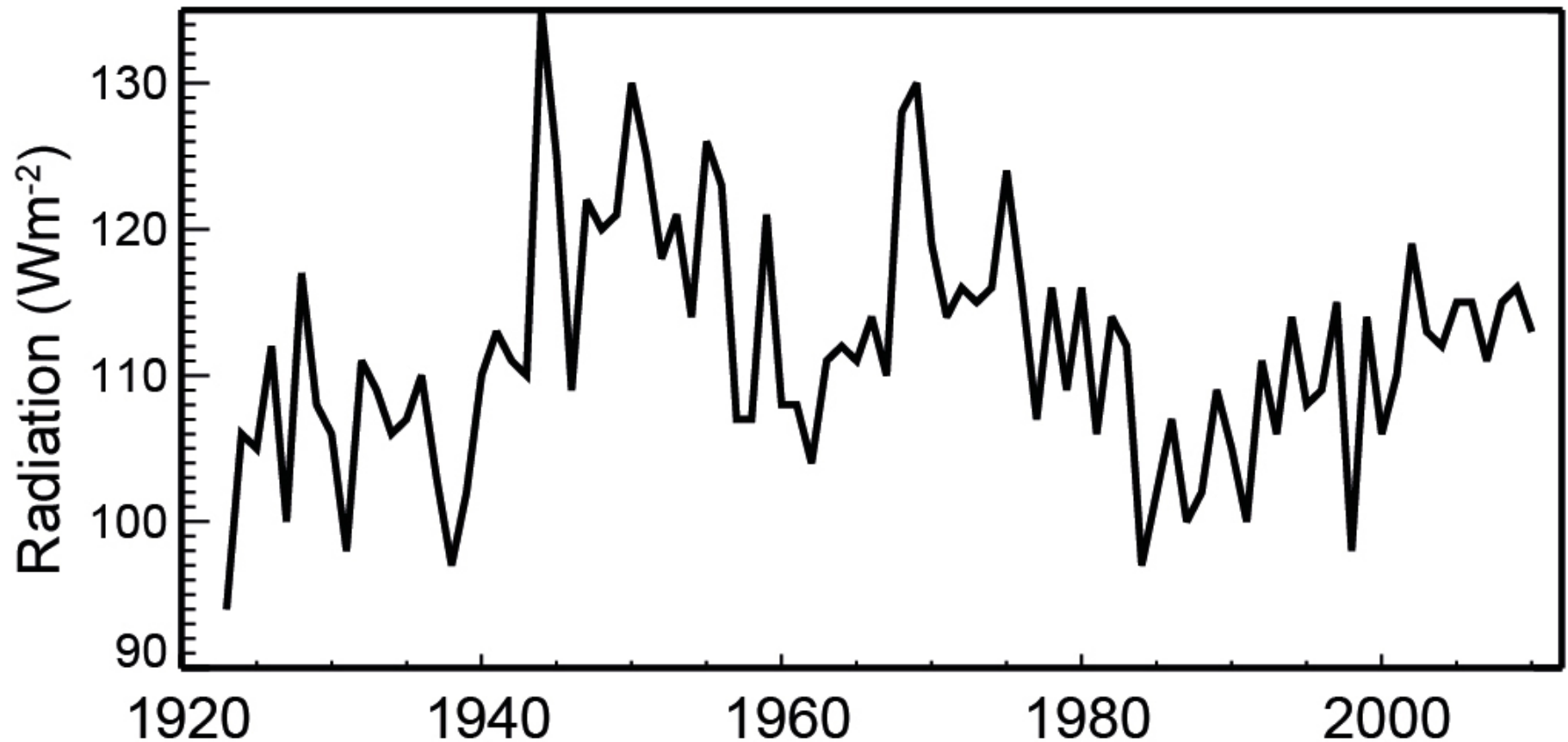
2. Changes in in Radiation Budgets

TOA (Top of Atmosphere) Radiation Budget



2. Changes in in Radiation Budgets

Surface Solar Radiation (SSR)



2. Changes in in Radiation Budgets

Surface Thermal Radiation

$\sim 2 \text{ W m}^{-2}$ increase per decade

Reading Assignment

WG1AR5_Chapter02_FINAL