EAE3132 – Future Climates

Lecture 1 – Introduction

Unit overview

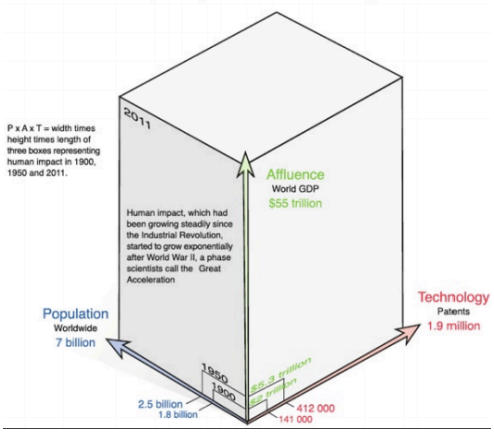
- Section 1 – Introduction and the physical science basis
- Section 2 – Models, Scenarios and Emission Projections
- Section 3 – Observed Climate Change
- Section 4 – Climate Projections and Impacts
- Section 5 – International Policy Considerations
- Section 6 – Approaches to Climate Change Mitigation
- Section 7 – Sectoral Approaches to Climate Adaptation
- Section 8 – Case Study: Climate Adaptation in Australian Cities

Anthropocene

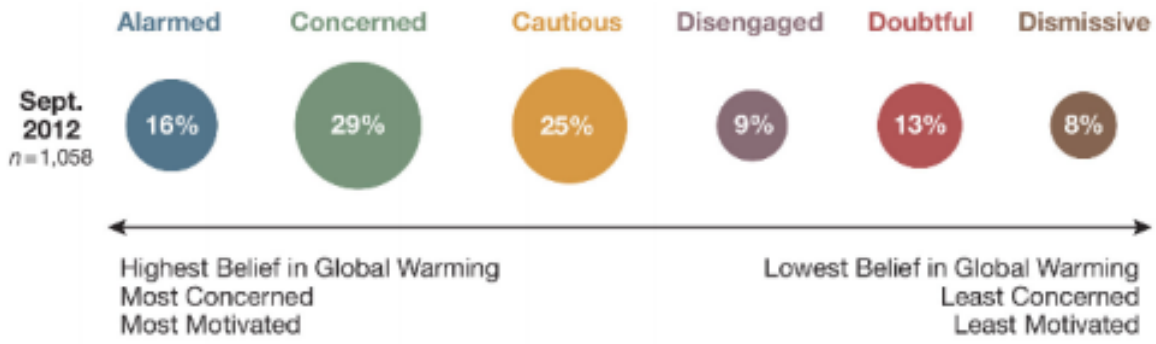
- "Great acceleration" – exponential increase in human impacts after WWII
    - Population, consumption, transport, tourism, land clearing

Impact equation

- Impact = Population X Affluence X Technology
- Human impact is driven by –
    - Population – 7 billion (only 2.5 billion in 1950)
    - Affluence – World GDP $55 trillion ($5.3 trillion in 1950)
    - Technology – 2 million patents (400,000 in 1950)



It is hard to communicate a consistent message to a sceptical public



Lecture 2 – Physical Science: Radiation Laws and Characteristics, the Global Energy Balance and Recent Trends in Greenhouse Gases

The nature of energy in the Earth-Atmosphere System

- Energy = the capacity for doing work
- Energy comes from outside the system (sun)
    - *Radiant Energy* is energy associated with electromagnetic waves propagating through space
        - Initial energy source that fuels nearly all processes in atmosphere
    - *Thermal Energy* is energy associated with the ability of one body or substance to raise the temperature of a cooler one
    - *Potential Energy* is energy due to position
        - e.g. moisture in a cloud about to fall as rain
    - *Kinetic Energy* is energy due to motion, e.g. air in motion

Energy is only transferred in three ways –

- **Radiation** of electromagnetic waves propagated through space
- **Conduction** or transfer of energy in a substance by means of molecular excitation without any net external motion
- **Convection** or the transfer of energy by mass motions within a fluid or gas, resulting in actual transport of energy
    - Advection = horizontal motion

Energy flow through a simple climate system

- **First Law of Thermodynamics** states that energy can neither be created nor destroyed. This leaves only two possibilities; either
    - Energy input = energy output OR
    - Energy input = energy output +/- energy storage change

Electromagnetic Radiation

- Radiation is the transfer of energy by rapid oscillations of electromagnetic fields
- The most important general characteristic is its wavelength (crest-to-crest distance)

All bodies that possess energy (temperature above 0 Kelvin) emit radiation at different wavelengths based on their temperature

- Efficiency of emission is dependent on its emissivity ($\in$)
- Where a body emits the maximum radiation for its temperature it is called a **black body**