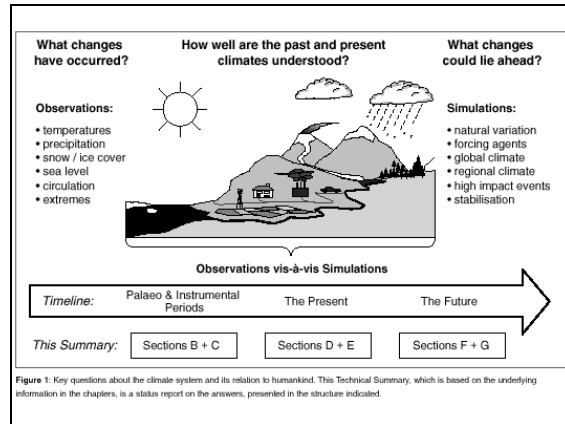


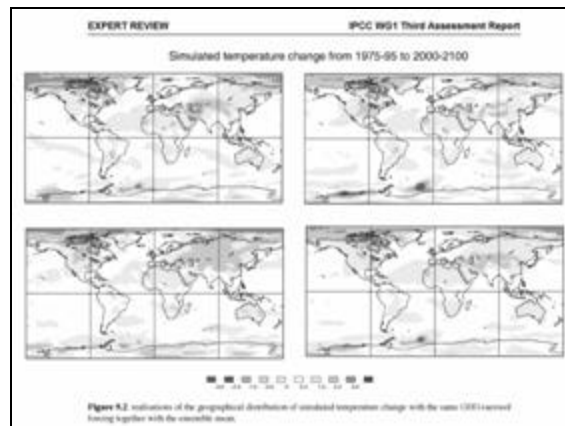
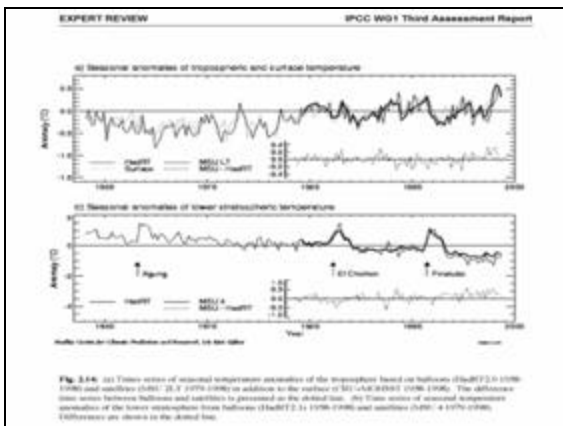
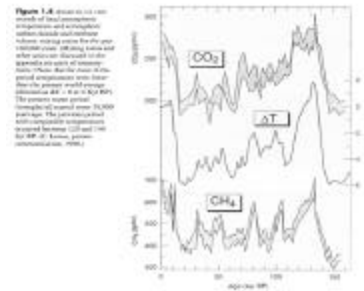
Global Impacts of Climate Change



Global Climate Changes

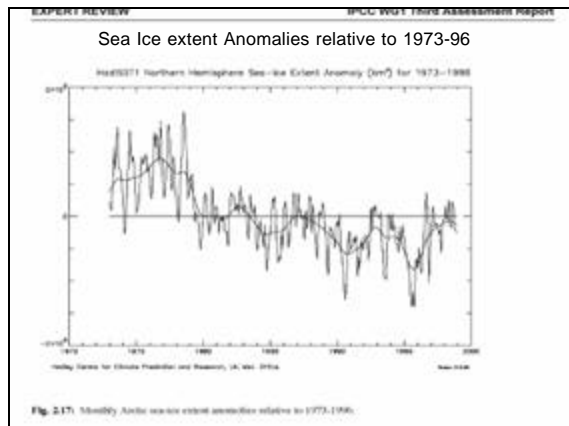
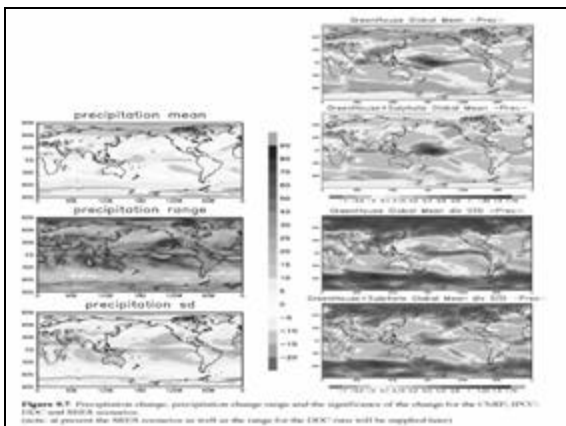
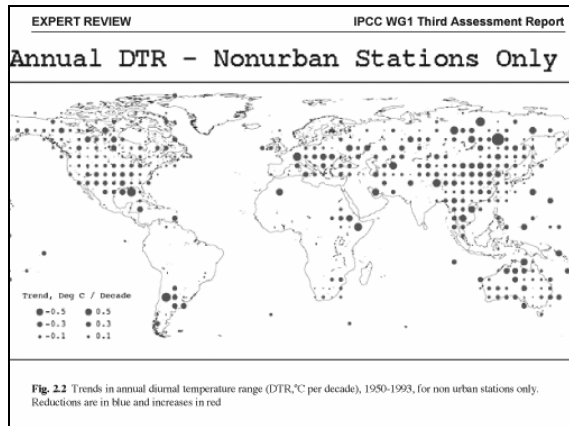
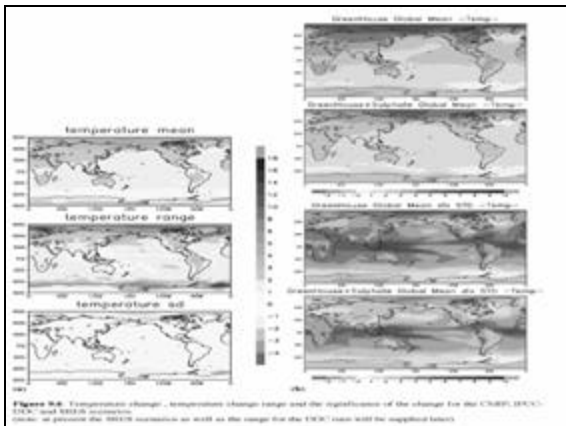
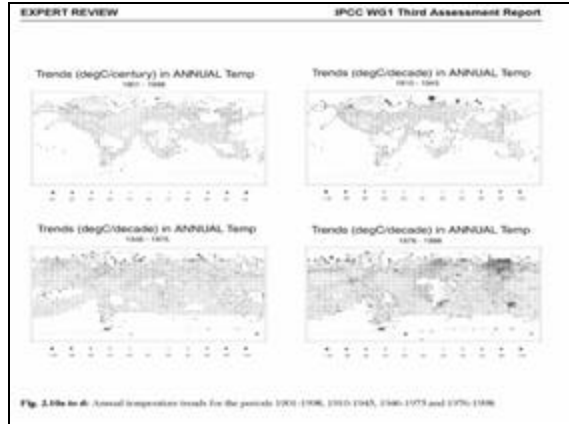
- Past: Reconstruction and observations
- Future: Model Projections
 - models
 - GHG increase
 - results
 - Comparisons

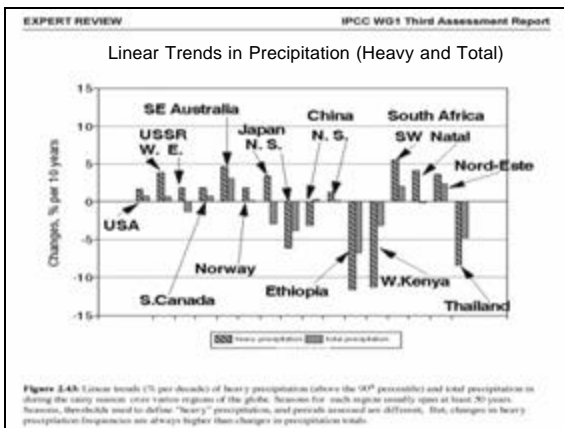
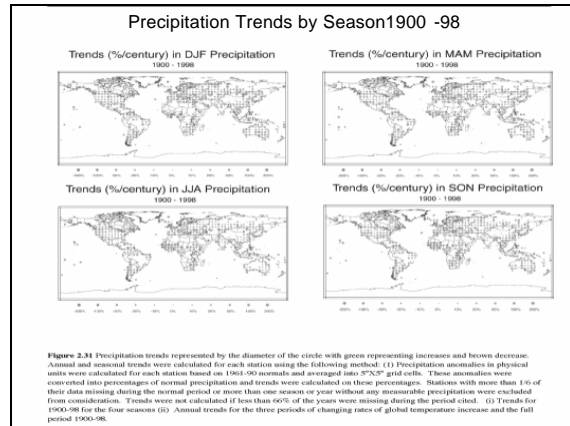
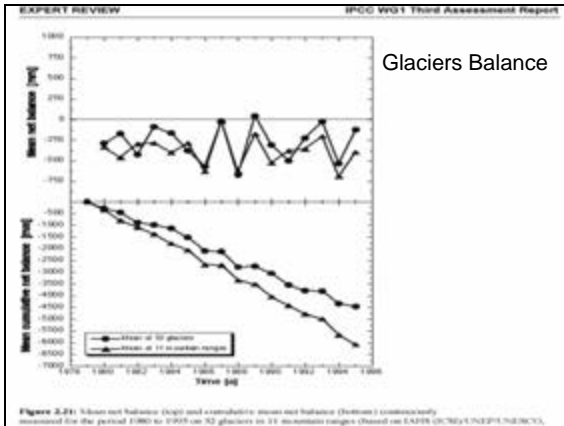
CO₂, T and CH₄ concentration change over last 150,000 y



Climate Change

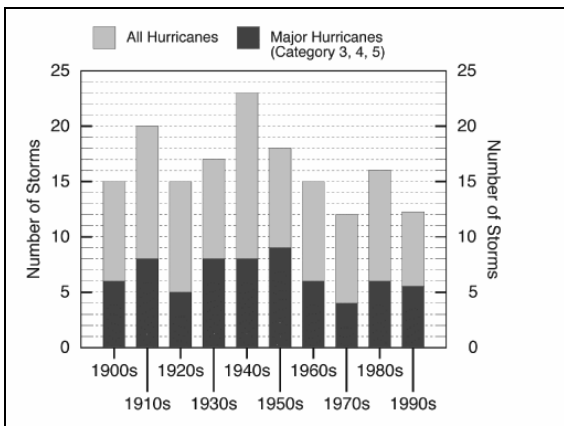
- Regional Climate Change
 - Greater surface warming over land than oceans
 - Minimum warming around Antarctica and N Atlantic
 - Maximum warming in northern latitude in winter (reduced snow)
 - Reduction in diurnal temperature range
 - Enhanced hydrological cycle





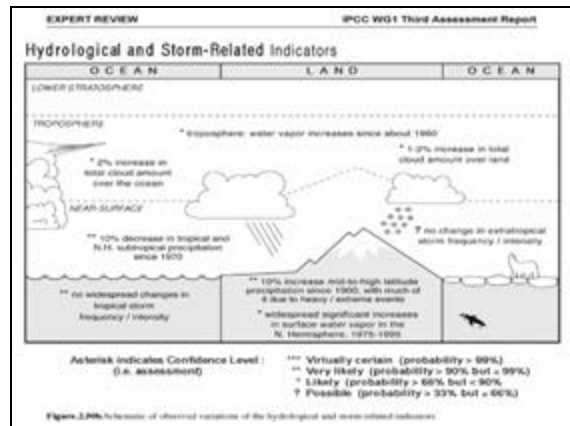
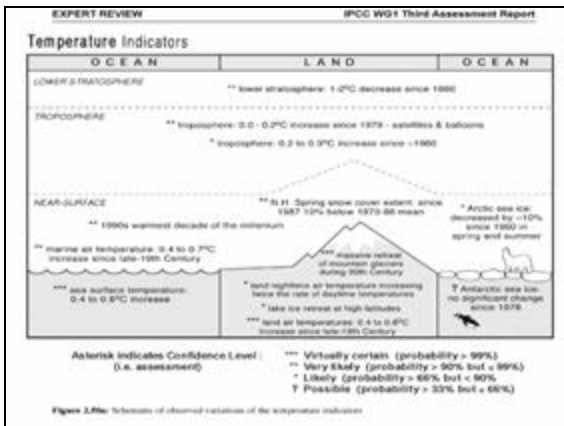
Climate Change

- Changes in Climate Extremes
 - Importance of extremes
 - Large increase in warm days and decrease in cold
 - More intense hydrological cycle
 - Likelihood of draughts and increased evaporation
 - Increase number of heavy precipitation days
 - Hurricanes and typhoons?
- Other factors
 - incoming solar radiation
 - volcanic eruptions (impact lasts for several years)



Impacts of Climate Change

- A complex network of changes
 - Impacts vary from place to place
 - Positive (increase length of growing season) and negative impacts
 - Rate at which changes may occur=> high costs
 - Adaptation easy for some difficult for others
 - Complex assessment



Impacts of Climate Change: Sea level

- How much?
- Evidence of historical changes:
 - 120,000 y ago 5 - 6 m > than now
 - 18,000 y ago 100 m < than now
- Large changes associated with ice-lock ups
- Shorter term changes main effect not melting
 - glaciers & ice caps (16cm),
 - Greenland (6cm)
 - thermal expansion (28cm)
- Ice sheets
 - Competing effects: snowfall and melting
 - Western Antarctic - grounded below sea level - dynamic

Impacts of Sea level Rise

- Human
 - Half humanity lives in coastal regions (most fertile)
 - 7% habitable land < 1m above Sea level
 - Impacts of weather events (storms, hurricanes)
 - impact on agriculture: intrusion of salt water
- Possible responses
 - Relocation of fishing industries ? May be
 - Relocation or adaptation of agriculture areas? - no
 - management

Impacts of Sea level Rise

- Countries affected
 - Bangladesh
 - Nile river and other deltas (e.g., Mississippi)
 - Netherlands
 - Low lying islands
 - Wetlands, mangroves swamps (biodiversity, biological productivity, Methane)
- 1/2 m rise => substantial adverse effects

Impacts on Fresh Water Resources

- Global water cycle
- Key substance for mankind (drinking, food production, health, industry, transport)
- Water availability strongly varies with countries
- Demand increasing with population and standard of living
- Water resources are shared (Danube, Nile, Ganges...)
- Availability expected to change with GW

Impacts on Fresh Water Resources

- Evaporation increase and reduced precip in some regions
- Increased precip in others=> greater run-off (e.g., Sacramento river: 20% Precip up => 20 -50% run-off up)
- Change in extreme conditions=> river floodings, drought effects felt over longer time
- Watersheds vulnerability: storage vs flow, demand vs supply, groundwater used vs. replenishment, variability of stream and river flow)
- Link between rainfall and landuse

Impact on agriculture and food supply

- Agriculture decisions strongly linked to climate
- Capacity of adaptation: detailed knowledge of requirements of species and genetic manipulation OK for 1 - 2 y crops (e.g. adaptation in Peru to El Niño predictions)
- Importance of water variability
- Modeling studies suggest with adaptation small effects. Issue is effect of extremes
- Future: Need for technical advances in develop. countries and management of water

Impact on Natural Ecosystems

- 10% land cultivated and 30% natural forests
- Variety of plants and animals sensitive to climate
- Distribution of vegetation has changed over time
- Climate changes alter suitability for species
- Past ecosystems changes over thousands of years, projected changes over decades ecosystem cannot respond that fast
- Natural ecosystems unmatched to their environment: diseases, fertilization

Impact on Natural Ecosystems

- Trees cannot adapt easily=> most vulnerable
 - Long- lived
 - Take time to reproduce
 - Sensitive to average climate (niches)
 - Conditions will become unsuitable for boreal forests=> pests, death, forest fires
- Recent decline in forests health
 - Acid rain and pollution
 - Succession of warmer winters and drier summers
 - Concurrence of climate change and pollution

Impact on Natural Ecosystems

- Forests
 - large storage of carbon (80% above, 40% below)
 - deforestation => 1-2 Gt C in atmosphere
 - Boreal forest stress => release of C => potential positive feedback
 - Diversity of species contained in forests
- Marine ecosystems
 - Fish migration and disappearance
 - Toxicity in fish linked to global pollution

Impact on Human Health

- Environmental factors affecting health:
 - Atmospheric pollution
 - Polluted or inadequate water supplies
 - Poor soil
 - Extreme events: floods and droughts
- Direct effects:
 - Heat stress and heat waves
 - Spreading of diseases (e.g., by mosquitoes: Malaria, viral encephalitis)