

## Global Climate Change and Kyoto Protocol

### Climate Change: What do the observations show?

#### **The Earth is warming**

- 1990 likely the warmest decade in instrumental record [temperature\\_change\\_7\\_time\\_scale.ppt](#)
- Ice records show Temperature (and other) changes over centuries to millennia and succession of glacial and interglacial periods [ice\\_records\\_of\\_climate.ppt](#)
- Rate of change increased since human activities started [temperature\\_change.ppt](#)

### Climate Change: What do the observations show?

#### **Atmospheric GHG concentration is increasing**

- Carbon dioxide CO<sub>2</sub> [CO2\\_T&CH4.ppt](#)
- Methane CH<sub>4</sub>
- Nitrous oxide N<sub>2</sub>O
- Tropospheric ozone O<sub>3</sub> [www.met.rdg.ac.uk/climate\\_change.ppt](#)

### Climate Change: What do the observations show?

#### **Global Pollution (aerosols) is increasing**

- SO<sub>2</sub> aerosol concentration is increasing in industrial areas [so2\\_and\\_aerosols.ppt](#)
- Biomass burning aerosols concentration is increasing in forests areas [biomass\\_burning\\_effects.ppt](#)
- Black Carbon particle concentration is increasing in urban areas [black\\_carbon\\_effects.ppt](#)
- Mineral aerosol concentration is increasing due to land use changes

### Climate Change: What do the observations show?

#### **Snow cover and ice extent are decreasing**

- Sea ice cover in Arctic is decreasing and ice is thinning [ice\\_thinning.ppt](#)
- Glaciers are melting [glaciers.ppt](#)

### Climate Change: What do the observations show?

#### **Global sea level is rising**

- [sea\\_level\\_changes.ppt](#)

#### **Ocean heat content is increasing**

- [ocean\\_heat\\_content\\_increase.ppt](#)

## How do we make sense of observations of change?

- Scientific understanding
  - Increase in GHG induces increase in near-surface warming (GH effect) [GH effect ppt.pdf](#)
  - Concept of radiative forcing [radiative forcing.pdf](#)
  - Concept of feedback (positive and negative) [feedback.pdf](#)

## How do we make sense of observations of change?

- Scientific modeling
  - Representation of climate system
  - Description and Quantification of forcing (natural vs anthropogenic)
  - Representation and quantification of feedbacks
  - Quantification of response (long-term predictions)
  - What if scenarios

## Consequences of rising GHG emissions in the future

- All scenarios project **increase CO<sub>2</sub> concentration** [IPCC Special Report Emission Scenarios \(SRES\).pdf](#)
- All scenarios predict **increase in globally averaged surface Temperature** 1.4 – 5.8 C
- **Globally averaged annual precipitation** projected to **increase**
- **Glaciers** projected to continue **melting**
- **Global sea level** projected to **rise** by 0.0 – 0.88 m

## Consequences of rising GHG emissions

- Effects on environmental and socio-economic
  - Overall climate change is predicted to increase threats to **human health** particularly to the poorer populations in the tropics
  - **Ecological productivity and biodiversity** will be altered and sea level rise will increase risk of **extinction** of vulnerable species
  - Climate change will **exacerbate water shortages** in water scarce areas
  - **Risk** for population of small and **low-lying islands**

## Consequences of rising GHG emissions

- Adaptation has the potential to reduce adverse effects
  - Numerous options exist but will incur costs
  - Greater and more rapid changes will pose greater adaptation challenges

## Extent and timing of emissions reduction

- Projected rate and magnitude of temperature and sea level increase can be lessened by reducing GHG emissions [CO2 stabilization levels.pdf](#)
- Reducing emissions would delay and reduce damages caused by climate change [uncertain warming.pdf](#)
- Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts

## Why should we be concerned

- Earth in the Balance (e.g., human and ecosystems)
- Historically: Earth exploitation - little thought to consequences
- Choices:
  - “Back to nature” (primitive lifestyle, human creativity)
  - Technical Fix (possibilities, implications, sustainability)
- Steward of the Earth (on behalf of humanity and future generations)
- Environmental values (what to preserve, foster, improve; conservation of Earth and resources)
- The will to act

## Understanding within framework of large uncertainties

- Natural climate variability vs anthropogenic effects
- Relationship between regional trends and anthropogenic climate change?
- Assumptions of emissions scenarios
- Model predictions: climate sensitivity, climate forcing and feedbacks
- Inertia in system
- Potential large-scale abrupt changes

## Weighing the Uncertainty

- The scientific uncertainty
- The IPCC assessment
- Narrowing the uncertainty
- Sustainable development
- Why not wait and see
- The precautionary principle
- Global economics

## A strategy for Action

- Climate convention
  - UN Framework on Climate Change signed Rio 1992
  - Goal: slow and stabilize climate change
  - Means: Stabilization of emissions
- Montreal Protocol (Ozone layer protection)
- Realizing the climate convention objectives = Kyoto protocol