Unit 4 Environment and climate

Main studies includes GIS

Climate international treaty case studies

🌍 1. Human-Caused Climate Change – Key Case Studies

a) Industrial & Fossil Fuel Emissions

Belchatow Power Station – Poland

- **Date**: Ongoing (commissioned in 1988)
- **Details**: Largest coal-fired power plant in Europe; emits **38 million tonnes of CO_2 annually**.
- **Cause**: Lignite (brown coal) combustion.
- **Effect**: Accelerated global warming and severe air pollution.

Baogang Steel Plant – Inner Mongolia, China

- **Date**: Ongoing; emissions data from 2023
- **Details**: Emits **27.7 million tonnes of CO_2 annually** due to coal-based steelmaking.
- **Cause**: Heavy industrial fossil fuel use.
- **Effect**: Air quality decline and greenhouse gas increase.

🔥 2. Land Use Change & Ecosystem Emissions

Indonesian Peatland Degradation

- **Date**: 2000–Present
- **Details**: Over **2.1 gigatons of CO_2** released due to drainage and burning for palm oil plantations.
- **Effect**: Biodiversity loss, toxic haze, and long-term carbon emissions.

Livestock Methane Emissions – Global

- **Date**: Ongoing; 2023 emissions latest recorded

- **Details**: Industrial livestock emit **115 million metric tons/year** of methane (28x stronger than CO_2).
- **Effect**: Potent greenhouse gas buildup, climate warming.

🌇 3. Urban Climate Impacts

Urban Heat Island – Tokyo & Phoenix

- **Date**: Tokyo (2001–present); Phoenix (measured since early 2000s)
- **Details**: +2.5°C in Tokyo, +4°C in Phoenix due to heat-retaining infrastructure.
- **Effect**: Heatwaves, higher energy use, health emergencies.
- **Tokyo UHI Measures**: Green roofing ordinance (2001), expansion in 2010s.

Climate Gentrification – Little Haiti, Miami

- **Location**: Little Haiti, Miami, Florida, USA
- **Timeframe**: Mid-2010s – Present
- **Issue**: Climate gentrification caused by sea-level rise and urban development pressures

🧭 Cause of the Challenge:

- **Sea-level rise in South Florida** has increased flooding and property risks in low-lying, coastal areas like Miami Beach.
- In contrast, **higher-elevation neighborhoods** like **Little Haiti** (approx. 7–10 feet above sea level) are **less vulnerable to flooding**.
- This elevation made Little Haiti **attractive to developers** and wealthier buyers, prompting increased investment and redevelopment.
- This process is driven by **climate resilience real estate speculation**, where developers seek “climate-safe” land.

🔄 Climate Change Link:

- Miami is facing **chronic tidal flooding** and **saltwater intrusion** due to **rising sea levels** linked to global warming.
- As insurance rates climb and flooding risks increase, residents and businesses in waterfront properties are moving inland.

🎯 Effects:

- **Displacement**: Long-term, lower-income residents (many of Haitian descent) are priced out due to rising rents and property values.
- **Cultural erosion**: As wealthier residents and new businesses move in, **Haitian cultural identity** is diluted.
- **Social tensions**: Protests have emerged in response to rapid gentrification and perceived lack of support for vulnerable communities.

🛠️ Responses and Solutions:

- **Community resistance movements** like **"Haitian Voices Count"** and **"Little Haiti Is Not for Sale"** advocate for affordable housing protections and cultural preservation.
- Miami-Dade County is working on **resilient urban planning**, but affordable housing strategies remain underdeveloped.

🌊 4. Climate Change Adaptation – Policies & Infrastructure

Tuvalu Coastal Adaptation Project (TCAP)

✅ Overview:

- **Location**: Tuvalu – a small island nation in the South Pacific
- **Project Start Date**: 2017
- **Implemented by**: Tuvaluan Government, funded by the Green Climate Fund & UNDP

🧭 Cause of the Challenge:

- Tuvalu is one of the **most vulnerable nations to climate change** due to:
  - **Sea-level rise** (average elevation only 2 meters above sea level)
  - **Erosion and saltwater intrusion** into freshwater supplies
  - **Increasing storm surges and cyclones**
- Climate change threatens to make large parts of Tuvalu **uninhabitable within decades**.

🔄 Climate Change Link:

- Global sea-level rise, driven by **melting polar ice caps and thermal expansion**, is affecting **low-lying atolls** like Tuvalu.
- Tuvalu has already experienced **flooded homes, schools, and crop loss** due to saline soil and rising tides.

🎯 Effects:

- **Livelihood disruption**: Saltwater affects agriculture and fishing—the nation's main sources of food and income.
- **Displacement risk**: There are increasing discussions about **climate refugees** from Tuvalu needing to migrate to countries like New Zealand.
- **Threat to sovereignty**: As the land disappears, so does Tuvalu's political and cultural identity.

🛠️ TCAP: Solutions Implemented:

- **Shoreline protection works**: Construction of **seawalls** and **revetments** to protect key infrastructure such as schools, hospitals, and homes.
- **Land reclamation and elevation projects**: Some areas are being raised to counter future sea-level projections.
- **Ecosystem-based adaptation**: Includes **mangrove planting** to act as a natural buffer.
- **Community involvement**: Local people are engaged in planning and monitoring progress to ensure long-term resilience.

Debt-for-Climate Resilience Swap – Barbados

- **Date**: 2024
- **Details**: Converted **$165 million of national debt** into climate adaptation funding.
- **Goal**: Improve sewage treatment, food security, and water infrastructure.

Uganda – Health Adaptation Plan

- **Date**: 2024
- **Details**: Africa's first national health-focused climate plan.
- **Includes**: Healthcare infrastructure resilience and training for workers.

Delta Works Flood System – Netherlands

- **Date**: Construction from 1958 to 1997
- **Details**: Complex system of dams and barriers to protect low-lying land.
- **Impact**: Saved thousands during 2013 storm surge events.

💡 5. Climate Mitigation – Solutions & Technology

Sleipner CCS Project – Norway

- **Date**: Launched in 1996 – Ongoing
- **Details**: Stores over **1 million tonnes of CO_2 annually** under the North Sea.
- **Impact**: Over **20 million tonnes stored**; pioneering carbon capture tech.

Climeworks Orca DAC Plant – Iceland

- **Date**: Operational since September 2021
- **Details**: Direct air capture of **4,000 tonnes CO_2/year**, stored in basalt.
- **Impact**: Scalable solution for carbon dioxide removal.

Germany's Energiewende

- **Date**: Launched in 2000 – Ongoing
- **Details**: Transition from fossil fuels/nuclear to **renewables**.
- **Milestone**: By **2020**, renewables generated over **40% of electricity**.

📈 6. GIS in Climate Action

Copernicus Programme – EU

- **Date**: Started in 2014
- **Details**: GIS-enabled Earth monitoring via satellites.
- **Use**: Climate tracking, land use, disaster response.

Global Forest Watch (WRI)

- **Date**: Launched in 2014
- **Details**: Real-time deforestation alerts using satellite GIS.
- **Use**: Forest policy enforcement, carbon tracking.

FEMA's GIS Resource Hub – USA

- **Date**: Officially launched on June 23, 2022
- **Details**: Maps disaster zones to plan for hurricanes, floods, wildfires.
- **Use**: National-level emergency preparedness and climate resilience.

🧭 7. Climate Change & Social Disparities

Lake Turkana Wind Farm – Kenya

- **Date**: Construction 2014–2017; inaugurated July 19, 2019
- **Details**: Africa's largest wind farm; built on indigenous land.
- **Disparity**: Lack of consultation; displacement of **El Molo, Turkana, Samburu, Rendille** communities.

Sami Reindeer Herders – Norway

- **Date**: Conflict escalated 2019–2025
- **Key Events**:
  - **Oct 2021**: Supreme Court ruled wind farms violated Sami rights
  - **2023**: Youth protests in Oslo escalated issue nationally
- **Disparity**: Wind farms disrupt grazing routes; threatens cultural survival.

Yurok Tribe vs Offshore Wind – California, USA

- **Date**: Resolution passed on **March 6, 2024**
- **Details**: Opposed offshore wind farms near sacred sites and marine habitats.
- **Disparity**: Cultural sovereignty concerns and exclusion from planning.

Little Haiti – Miami

- **Date**: Gentrification trend since 2015 – Present
- **Details**: Higher land values due to elevation (climate-safe zone).
- **Effect**: Displacement of Haitian-American communities due to rising rents.

📉 8. Climate Change: Economic & Ecosystem Impacts

Overfishing – Atlantic Cod Collapse (Canada)

- **Date**: Moratorium declared July 2, 1992

- **Details**: Stocks dropped to 1% → 40,000 job losses.
- **Impact**: Ecosystem shift; cod recovery still uncertain.

Coral Reef Loss – Global

- **Date**: Ongoing; intensified since the 1998 bleaching event
- **Details**: $42 billion/year in lost services (fisheries, tourism, protection).
- **Effect**: Worsened by warming seas and acidification.

Wetland Restoration – New York City, USA

- **Date**: Major investments since 2012 (post-Hurricane Sandy)
- **Details**: $1.5 billion into nature-based defenses like **wetland buffers**.
- **Impact**: Reduced flood risks, enhanced biodiversity.

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1. Successful Agreement: The Montreal Protocol (1987)

Overview

- **Name**: Montreal Protocol on Substances that Deplete the Ozone Layer
- **Adopted**: September 16, 1987 (came into force January 1, 1989)
- **Parties**: 198 (universal ratification—the only treaty to achieve this)
- **Objective**: Phase out ozone-depleting substances (ODS), particularly **CFCs**, **halons**, and **HCFCs**, which were widely used in refrigeration, air conditioning, and aerosols.

Why It Was Effective

- **Binding Commitments**: Unlike many climate agreements, it imposed **mandatory targets and deadlines** for ODS phase-out.
- **Strong Scientific Basis**: The 1985 discovery of the ozone hole over Antarctica drove urgency, supported by clear scientific consensus.
- **Adaptive Structure**: It included an **amendment mechanism**, allowing new chemicals (e.g., HFCs) to be added later through the **Kigali Amendment (2016)**.

- **Funding and Technology Transfer**: The **Multilateral Fund** supported developing nations in meeting targets by providing technology and financial assistance.
- **Measured Success**:
  - Ozone-depleting substances have been reduced by **over 98%** globally.
  - The ozone layer is **on track to recover by mid-to-late 21st century**.
  - Prevented an estimated **2 million cases of skin cancer per year** by 2030 (UNEP).

Lessons Learned

- **Clear deadlines**, **scientific evidence**, and **universal participation** created a model for successful environmental cooperation.
- It proves **international agreements can work** if they're targeted, enforceable, and paired with support for developing countries.

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2. Less Effective Agreement: The Kyoto Protocol (1997)

Overview

- **Adopted**: 1997 | **In force**: 2005
- **Target**: Legally binding emissions reduction (average 5% below 1990 levels for developed countries by 2012)
- **Structure**: Applied only to industrialized nations (Annex I countries); excluded developing countries like China and India from binding commitments.

Why It Failed

- **Lack of Inclusivity**: Developing nations, despite rising emissions, were not included in binding targets.
- **Major Power Withdrawal**: The United States signed but **never ratified** the agreement; Canada withdrew in 2011.
- **No Enforcement**: Even though legally binding, countries faced **no real penalties** for non-compliance.

- **Limited Emissions Coverage**: Accounted for only ~25% of global GHG emissions.

Outcome

- Most countries failed to meet their targets or did so through creative accounting and flexible mechanisms like **carbon trading**, without real structural change.
- Highlighted the **problem of fairness vs. effectiveness** in global agreements.

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3. Partially Effective Agreement: The Paris Agreement (2015)

Overview

- **Adopted**: December 2015 | **In force**: November 2016
- **Goal**: Keep global temperature rise well below 2°C, aiming for 1.5°C.

Strengths

- **Universal participation**, including both developed and developing countries.
- **Bottom-up structure**: Countries determine their own **Nationally Determined Contributions (NDCs)**.
- **Global stocktake**: Built-in mechanism for periodic review and strengthening of commitments.

Why It's Struggling

- **Non-binding**: Countries are **not legally required** to meet their NDCs.
- **Funding failures**: The promised **$100 billion per year** in climate finance (by 2020) has not been fully delivered.
- **US Withdrawal**: Under President Trump, the US exited the agreement in **2020**, rejoined under Biden in 2021, but political instability made commitments uncertain again.

Current Status

- Global emissions are **still rising**; the world is on track for **2.7–3°C warming** by 2100 based on current policies (IPCC 2023).
- Some nations (e.g., EU, UK) have passed net-zero laws, but many are falling short of even their 2030 goals.

Lessons

- Participation matters—but without binding enforcement and reliable finance, outcomes will fall short.
- The **Paris model relies on global goodwill**, which varies based on national politics.

Evaluation: To What Extent Are International Agreements Effective in Combating Climate Change?

Effective When:

1. **Targets are clear and measurable** (e.g., Montreal Protocol: phase-out of CFCs by specific dates).
2. **Enforcement exists**, or there's pressure through monitoring and naming non-compliant nations.
3. **Equity is addressed**—as seen with the Montreal Protocol's financial mechanisms.
4. **Global consensus exists**, supported by **science**, **media**, and **public demand**.

Ineffective When:

1. Commitments are **non-binding**, or **too vague**.
2. Major emitters **withdraw or fail to participate** (e.g., US leaving Kyoto and Paris).
3. **Funding gaps** and **technology inequality** exist, limiting action in the Global South.
4. Domestic **politics override global cooperation** (e.g., coal and oil lobbying, national elections).

Conclusion

International climate agreements have **varying degrees of effectiveness**. The **Montreal Protocol** stands out as a rare example of true success, thanks to its **binding framework**, **global cooperation**, and **scientific urgency**.

In contrast, the **Kyoto Protocol** failed due to exclusion and poor enforcement, and the **Paris Agreement**, while a step forward, remains **a work in progress**, threatened by **political instability**, **lack of enforcement**, and **weak financial follow-through**.

What Can Be Learned:

- Agreements **must be inclusive**, but also need **accountability**.
- **Equity and finance** are essential—developing nations must be supported.
- Long-term success depends not just on **diplomatic promises**, but on **domestic implementation**, **civil society engagement**, and **stable leadership** in key countries.

For global climate goals to be met, **future agreements must combine the binding discipline of the Montreal Protocol with the global inclusivity of the Paris Agreement**, backed by **real financing** and **transparency**.

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1. Little Haiti, Miami – Climate Gentrification

Location: Miami, Florida, USA

Timeframe: Mid-2010s – Present

Key Issue: Climate-driven gentrification

Background:

- Little Haiti is a historically Haitian-American neighborhood, located on higher ground (approx. 7–10 feet above sea level) compared to flood-prone areas like Miami Beach.
- As sea levels rise, developers began purchasing property in elevated areas like Little Haiti, initiating displacement and cultural disruption.

Climate Link:

- Miami experiences **chronic tidal flooding**, **saltwater intrusion**, and **insurance hikes** due to climate change.
- Higher-elevation areas are now seen as "climate-resilient real estate," triggering speculative investments.

Effects:

- **Displacement**: Rents and home prices rose steeply. Long-term residents, mostly working-class Haitian families, were priced out.
- **Cultural Loss**: Churches, Creole-speaking businesses, and cultural landmarks faced pressure from redevelopment.
- **Social Tensions**: Community pushback against gentrification led to protests, art activism, and legal challenges.

Response:

- **Grassroots campaigns**: Groups like “Little Haiti is Not for Sale” and “Haitian Voices Count” raised awareness and demanded policy protection.
- **City efforts**: Miami’s Resilient305 strategy (launched 2019) includes urban resilience planning, though affordable housing provisions remain limited.

Evaluation:

- Climate adaptation planning must incorporate social equity. Without protections, climate-safe zones become exclusion zones for vulnerable communities.

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2. Tuvalu Coastal Adaptation Project (TCAP)

Location: Tuvalu (South Pacific)

Launched: 2017

Partners: Tuvalu Government, UNDP, Green Climate Fund

Why It Was Implemented:

- Tuvalu is one of the most climate-vulnerable countries globally, with an average elevation of just 2 meters.

- Sea-level rise, salinization of water, land erosion, and storm surges threaten homes, agriculture, and sovereignty.

Project Goals:

- **Protect critical infrastructure** like schools and hospitals.
- **Enhance coastal resilience** through physical and ecological interventions.
- **Empower communities** with adaptation knowledge and planning roles.

Measures Taken:

- **Shoreline protection**: Construction of seawalls, berms, and breakwaters on the islands of Funafuti, Nanumea, and Nanumaga.
- **Land reclamation**: Elevation of land to protect homes and infrastructure.
- **Mangrove planting**: Used as a natural buffer against erosion and storm surges.
- **Community inclusion**: Public consultations and training for long-term maintenance.

Outcomes So Far:

- Reduced erosion along pilot sites.
- Strengthened national capacity for climate adaptation planning.
- Framework for regional Pacific island nations facing similar threats.

Challenges:

- Funding and material import costs are high due to remoteness.
- Rising sea levels continue to outpace adaptation in some areas.
- Long-term habitability remains uncertain, raising questions of **climate displacement and migration**.

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3. Indonesian Peatland Degradation – Palm Oil and Emissions

Location: Sumatra and Kalimantan, Indonesia

Timeframe: 2000 – Present

Key Issue: Drainage and burning of tropical peatlands

Background:

- Indonesia's peatlands are carbon-rich ecosystems that, when intact, store vast amounts of carbon.
- To make way for palm oil plantations, companies drain the peat, making it flammable and leading to **annual fires**.

Cause:

- Drainage canals and slash-and-burn practices by agribusiness, often in violation of local land tenure.
- Weak enforcement of environmental regulations.

Effects:

- Over **2.1 gigatons of CO_2** released from fires between 2000–2020.
- **Transboundary haze crises** affected Indonesia, Malaysia, and Singapore, causing respiratory illnesses and school closures.
- **Biodiversity loss**: Habitat destruction for endangered species like orangutans and Sumatran tigers.

Response:

- **Peatland Restoration Agency (BRG)** established in 2016 to restore 2.5 million hectares by 2020.
- **Moratorium on new peatland concessions** since 2011, extended multiple times.
- **GIS mapping and drones** used to track fire hotspots and illegal land clearing.
- Community-based rewetting programs and “paludiculture” (wetland farming of peat-safe crops) introduced.

Challenges:

- Limited enforcement, corruption, and illegal land deals persist.

- Restoration is complex; once dried, peatland ecosystems take decades to recover.
- International pressure through NGOs and palm oil buyers (e.g., RSPO certifications) has prompted modest improvements.

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4. Copernicus Programme – European Union (GIS-Based Climate Monitoring)

Launched: 2014

Administered by: European Commission and European Space Agency (ESA)

Purpose: Use Earth Observation satellites for real-time monitoring of climate, land, atmosphere, and oceans.

Why It Was Implemented:

- Addressed the need for reliable, near real-time data to support **climate mitigation, disaster response, urban planning**, and environmental conservation.
- Replaced older fragmented systems with a comprehensive European Earth-monitoring programme.

Features:

- **Sentinel satellite fleet** provides continuous Earth imagery.
- Monitors land cover, greenhouse gas emissions, deforestation, sea-level rise, air quality, and urban expansion.
- Supports policy decisions for the **European Green Deal** and **Paris Agreement**.

Use Cases:

- **Air quality mapping** in cities like Paris and Milan.
- **Tracking Arctic sea ice decline**, used in international IPCC assessments.
- Supports **early warning systems** for floods, wildfires, and droughts across Europe and Africa.

- Aids enforcement of **climate adaptation and sustainability goals** at the EU level.

Outcomes:

- Increased transparency and accountability in environmental governance.
- Supported national and international climate planning with standardized datasets.
- Inspired replication efforts like **Africa's AfriGEO** and **Asia's ASEAN Geoportal**.

Summary Points on These Case Studies:

Case Study	Focus	Success	Key Tools
Little Haiti	Urban displacement from sea-level rise	Partial – limited policy response	Elevation mapping, real estate data
Tuvalu (TCAP)	Small island climate adaptation	Effective pilot, still threatened long-term	Seawalls, land elevation, community engagement
Indonesia Peatlands	Emissions from land use change	Mixed – policy exists but enforcement weak	Fire mapping, drones, moratorium
Copernicus GIS	Monitoring for climate governance	Highly effective	Sentinel satellites, climate modeling