Lecture 9 (Climate change)

Air pollution

- If the air has some kind of bad smell or odour then air is polluted
- Air pollutants enter our deep into our lungs and causes problems (eg. sulphur dioxide) and airborne metals enters bloodstream

- Types of pollutants
    - There are 3 types of pollutants: primary, secondary and criteria pollutants
- Primary pollutant:
    - If emitted directly from the source
    - If source is natural eg. sandstorms, bushfires or volcanic erup.
    - If the source is anthropological industrial or vehicle emmis.
    - Eg are sulphur dioxide, carbon monoxide, nitrogen oxides(NOX), particulate matter (PM) and volatile organic compounds.
- Secondary pollutant:
    - Formed due to reaction among primary pollutants among themselves or primary pollutants with atmosphere.
    - Eg. photochemical oxidants and secondary particulate matter.
- Criteria pollutants:(The voice cracked too much here)
    - Pollutants that are benchmarks i.e to classify the pollutants.

- We basically focus more on pollutants which have anthropological sources i.e pollutants caused by humans.

TAs slide(About carbon modelling)

- Divided in two parts (vegetative and soil carbon modelling)
- Lithosphere has the most amount of carbon (other being ocean soil and plants)
- Vegetation carbon is carbon sequestered into soil.
- Deforestation is release of carbon (which is 9% of the 20% biomass plant have, other 80% being moisture)
- Carbon sinks is where the carbon gets sequestered.
- Carbon sources emit carbon back to the atmosphere. Which are divided into manmade and natural sources.
- Carbon sequestration means converting atmospheric carbon into sinks. Three types,
    - Photosynthesis, engineered tech., and chemical transformations.

- Carbon modelling is important for productivity of food and crops, climate and overall balance.
- Two components to focus in modelling:
    - The reservoirs and the flux(emission and sequestration rate, there should be balance)
- To model, we need variables like LAI, GPP, NDVI, FAPAR
    - Gpp=productivity due to actual input
    - npp=gpp-respiration
- Emission = gpp-npp
- Aim is to calculate the flux over tropical forests and make the emission rate=sequestration rate
- Light use efficiency (LUE) model use variables like fapar, apar and par.
- Compartment model uses
    - ΔC(Co2)=f(C(veg),C(ff),C(fire),C(resp)) i.e burning of fossil fuels, fossil fuels, forest fires and respiration.
- Soil carbon modelling:
    - Soil carbon exists in two types: organic and inorganic
    - Soil organic carbon=SOC and similarly there is SIC.
    - Organic carbon is affected by temperature, rainfall and other factors.
    - Inorganic carbon exists in carbonates and bicarbonates. The reactions are affected by Ph, electric conductivity and soil type.
    - Higher up in latitude soil organic carbon is high because temperature is low, so decomposition is also low
    - In tropic areas 0 deg latitude, soil organic carbon content is high because of the high rainfall
- Steps involved in soil sampling are:
    - Ecosystem division
    - Sampling algorithm
    - Collecting samples from the locations
- One of sampling method is known as “Conditional Latin hypercube sampling cLHS”
    - Given n spatial distribution variables, it combines them into unique combinations and selects k samples from them
    - It also minimizes the objective function to evaluate performance (IMP)
    - It is better than random sampling because it allows us to incorporate spatial distribution variables (IMP)
- For prediction of values of SOC and SIC (organic and inorganic) at unsampled location we use Interpolation and regression
    - Ordinary kriging is the most popular interpolation method.
        - $Z'(x0) = \sum_{i=1}^{n} \lambda i \, . \, Z(xi)$ where lambda are weights and z’ is unsampled location and z are sampled locations. It also minimizes the objective function.

- There is also regression kriging which uses regression residuals from kriging to model the SOC and SIC.
- There is also stacked regression which combines 2 or 3 models into one model, the combination is done by average of the prediction of all the models.