Introduction

- **National greenhouse gas inventory**
  - ✓ Key component of transparency framework under the Paris Agreement
  - ✓ Emission estimates based on "activity data" and "emission factors"
    - Associated with levels of human activities, therefore useful in considering portfolios for achieving mitigation targets
  - ✓ Basis for NDC setting
  - ✓ Essential data to track progress made in implementing and achieving NDC
- **Earth observations and national GHG inventory**
  - ✓ National inventory compilers – close to end-users of climate services value chain (= policy makers)
  - ✓ Utilizing earth observations (particularly in the domain of atmosphere, land and biosphere) is expected to enhance inventory quality.
    - 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories
    - Expert meeting on use of atmospheric observation data in emission inventories

Atmospheric observation and GHG inventory

- **Latest updates: Elaborated guidance on comparison of greenhouse gas emission estimates with atmospheric measurement in the 2019 Refinement**
  - ✓ Successful examples of comparison already exist
  - ✓ However, difficulties still exist (depending on gases, sectors, regions...)
    - Issue of natural vs anthropogenic, uncertainty in inverse modelling, distribution of measurement locations, lack of skills and resources to use observed data, etc
- **How can the utility of atmospheric measurements be enhanced**
  - ✓ Planning future development taking account of different available techniques for different scales and purposes, and also of strengths and weaknesses of atmospheric measurements for different gases
  - ✓ Enhancing and continuing dialogue between atmospheric observation researchers and inventory compilers to e.g. improve inverse modelling
- **Expected outcome**
  - ✓ Better use of atmospheric measurements for verification of inventories helps more accurate quantification of effects of mitigation action, leading to better mitigation planning and implementation

TABLE 6.2 (NEW)
STRENGTHS, PROBLEMS AND PROSPECTS OF USING ATMOSPHERIC MEASUREMENTS FOR VERIFICATION OF GHG EMISSIONS

Gas	Strengths/Successes[13]	Problems/Weaknesses	Future Development/Possibilities
CO_2	Large number of observations, although historically focusing on natural fluxes.	With sparse observing networks, uncertainties of models may be significantly higher than those of national anthropogenic CO_2 emission inventories.	Need more CO_2 observations targeting anthropogenic emissions, complemented by APO and radiocarbon observations.
CO_2 city-scale	City-scale studies show some degree of success. Inventory uncertainties are relatively larger than at national scale.	Even with dense observation networks, errors in emission estimates are large, due to interference from strong vegetation fluxes. Not used in national reporting.	Large efforts are ongoing to develop observation networks, pilot projects for tracking urban emissions, trends. Radiocarbon, APO, satellite observations also expected to contribute.
CH_4	Large anthropogenic emission fraction. National reporting[14]: UK, Switzerland. National-scale emission estimates[15]: EU-28, USA, India, China and others.	Few countries have observations, transport and inverse models have uncertainties, interference from natural emissions (wetlands) cited.	Regional observation networks and satellite observations are expanding.
N_2O	National reporting: UK National-scale emission estimates: EU-28, US, and others.	Observation sites are few, gridded inventories are simplified, large contribution from natural sources.	Expansion of surface networks will contribute to better model estimates.
HFCs, SF_6	Dominant anthropogenic emission fraction. National reporting: UK, Switzerland, Australia. National-scale emission estimates: China, US, EU. Revised EFs: Australia, UK.	Measurements are sophisticated and expensive. Observation sites are few, gridded inventories are simplified.	Expanding the monitoring network depends on funding.

Land/biosphere observation and GHG inventory

- **Latest updates: Elaborated guidance on use of remote sensing data for estimation of emissions/removals in AFOLU in the 2019 Refinement**
  - ✓ Examples of global land cover datasets exist. Steps to construct biomass density map are elaborated. However, consistent time series to quantify AD and EF –land cover/use change, biomass changes– are not yet achieved.
  - ✓ Data gaps – e.g. some areas of land may not be covered with data in every period, due to persistent cloud or haze, errors in the satellite etc
  - ✓ Lack of skills and resources to access and use data, particularly for developing countries
- **How can the utility of land/biosphere observations be enhanced**
  - ✓ Promoting cooperation with remote sensing community to improve capacities of inventory compilers to access and use remotely sensed data
- **Expected outcome**
  - ✓ Enhanced use of land/biosphere observations improve estimates of emissions/removals from AFOLU, leading to better land management for mitigation, though other aspects need to be considered

Conclusion

How can the provision of climate information, based on Earth observations, better inform decision making under the UNFCCC and Paris Agreement now and in the future to support understanding and implementation of mitigation action and national reporting?

- **Use of information from atmospheric observations and inverse models has potential for verification of national GHG inventories, which will help better quantification of effects of mitigation efforts. It will inform decision making on NDC planning, and will facilitate tracking progress made in implementation and achievement of NDC.**
- **Land cover information and biomass density map obtained from land/biosphere observations will improve estimates of emissions/removals from AFOLU in national GHG inventories. It will inform decision making on land management for mitigation**
- **To this end, enhanced dialogue and cooperative interaction between Earth observation researchers and inventory compilers is critical.**