Understanding of the global carbon cycle is essential for addressing global change through this century and beyond. Knowledge of the cycle comes from disparate observational systems and models whose results need to be integrated.

A systematic characterisation of the uncertainty is essential for assessing the consistency of various data sets, combining them in consistent ways and assessing the uncertainty in the composite budget. Consistency requirements include having each flux counted once and only once. Less obvious is the requirement to avoid having the same information implicitly included via different data streams while being treated as independent. To reduce the complexity, the analysis is factored using a 3-way classification of carbon fluxes by timescale, region and process.

Different classes of information, broadly described as inventories, models, data products and inversions, have uncertainties with very different statistical characteristics in space and time. For the regional carbon budgeting activity (RECCAP) of the Global Carbon Project, the long-term behaviour is analysed in order to demonstrate the requirements for producing a consistent carbon budget on regional scales. The relevant statistical characteristics of the various data streams are identified. The analysis exhibits the complementary role of top-down vs bottom up approaches in statistical terms: bottom-up estimates have the potential for highly correlated errors from methodological bias, while top down estimates tend to be negatively correlated in space.