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**Constraining carbon cycle dynamics using contemporary observations:
Achievements, challenges and opportunities**

Future climate predictions and societal responses (to climate change) require an in-depth understanding of carbon-climate feedbacks and changes to the natural carbon cycle. This in turn hinges on our understanding of the sources and sinks of carbon dioxide (CO₂), their variability and their future evolution. In this talk, I will present an overview of recent advances in modeling and observational strategies related to the carbon cycle with two contemporary examples: how did the global carbon cycle respond to the 2015-2016 El Niño event and what do space-based observations of atmospheric CO₂ tell us about global-to-regional source-sink distributions? Alongside I will highlight the potential for a coordinated carbon cycle and atmospheric composition observing system – such a system is becoming more and more necessary for providing new insights into atmospheric transport and biogeochemical models and helping refine imperfectly understood physical processes in these models. I will finally conclude with an outlook of carbon cycle research priorities, now and for the next several years. These emerging areas tackle a number of targets set forth by the carbon-climate community, such as observational (e.g., assess the scientific value and potential of future measurement constellations), methodological (e.g., reconcile top-down and bottom-up estimates of sources and sinks), and policy-related (e.g., verify CO₂ emissions for international legislative purposes).