The impact of improved satellite retrievals on estimates of biospheric carbon balance

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Background: The Orbiting Carbon Observatory 2 (OCO-2) is NASA's first satellite dedicated to monitoring CO2 from space. Launched in 2014, retrievals have undergone multiple updates, with the retrieval algorithm now on its ninth version.

Methods:

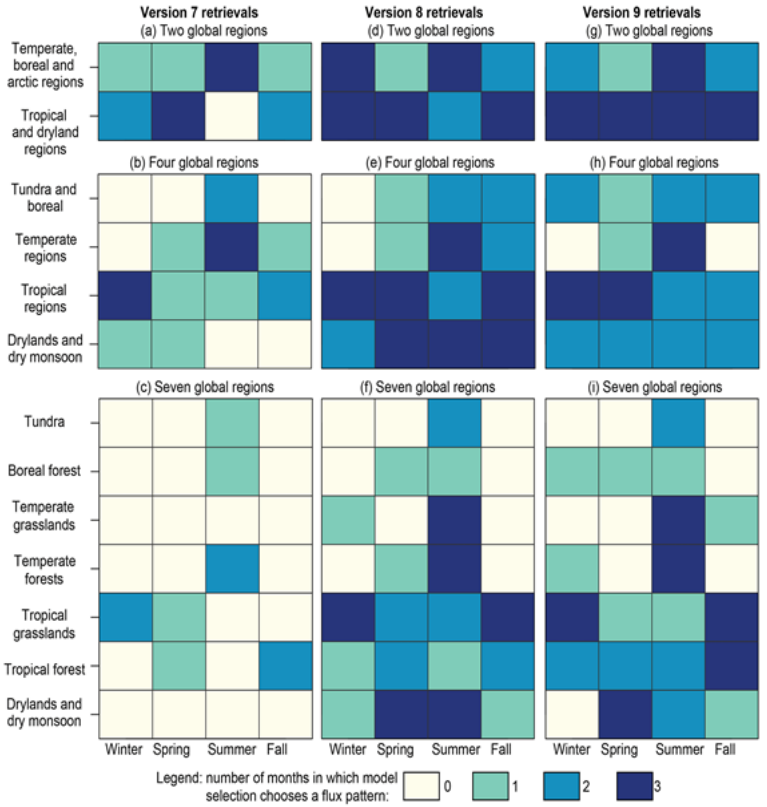
- This study uses a series of top-down experiments to evaluate the extent to which current OCO-2 observations can constrain monthly CO_2 sources and sinks within different regions of the globe and different months of the year.
- Identical experiments were conducted for each of the last three versions of the OCO-2 algorithms to examine how the results change with the retrieval version.
- The study used four and seven global regions in experiments, with the analysis performed for each month within the year 2015.

Results:

- New versions of the retrieval algorithm have improved CO_2 observations greatly, with new observations being more self-consistent (e.g., better agreement between glint and nadir data) and compare better against ground-based observations.
- The largest improvement was with version 8 (2017), which incorporated multiple changes to the quality control prescreening process, the forward spectroscopy model, the retrieval algorithm, and the bias correction. Changes in version 9 were smaller.
- Updated versions can be used to detect and constrain variations in monthly CO_2 fluxes from seven biome-based regions in about 2/3 of all months in the tropics and during the N. Hemisphere summer; there is also substantial improvement in other regions.

Significance:

- Improvements to space-based CO_2 observations are yielding large and lasting improvements in global monitoring of biospheric carbon fluxes, particularly with the launch of new CO_2 monitoring missions.
- In spite of these advances, many opportunities for further improving the retrievals exist.



Results of the model selection experiments using versions 7, 8, and 9 of the OCO-2 observations. Versions 8 and 9 provide a much stronger constraint on biospheric CO_2 fluxes than version 7. The top row **(a, d, g)** displays the results of the experiments with two global regions, the second row **(b, e, h)** with four global regions, and the third row **(c, f, i)** with seven global regions. Each box is color-coded based upon the number of months in which at least one biospheric flux model is chosen using model selection. Dark colors indicate a strong constraint on monthly CO_2 fluxes while light colors indicate a weak constraint. Note that these experiments include nadir-, target-, glint-mode observations. In addition, version 7 results are the same as those in Miller et al. (2018).