

# ***Interactive comment on “Design and evaluation of CO<sub>2</sub> observation network to optimize surface CO<sub>2</sub> fluxes in Asia using observation system simulation experiments” by Jun Park and Hyun Mee Kim***

## **Anonymous Referee #2**

Received and published: 14 September 2019

### General comments

This paper describes an impact of observation network against carbon cycle estimation by using CarbonTracker (CT). An important aspect is that the authors showed realistic solution this means that we have the potential to realize this observation network in the future. This viewpoint is very important, and I think it is necessary to advance research in this field in the future. I'd like to comment from a different perspective than Reviewer 1. I think authors need to do some additional experiments to take advantage of the excellent features of this paper. One important issue is that the authors show that root

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mean square error increases in many experiments in summer, but the reason is not well specified. Authors should consider this reason and suggest ways to reduce large summer uncertainty, if possible, without using ALL observations. The other issue is that authors should use observation sites registered in NOAA ObsPack but not assimilated in CT. This is because these stations are in operation and can be a precondition to be considered when considering future network expansion. The last issue is that this paper focuses on only ground observation network. Although it is considered unrealistic to use all observation points (ALL), the OSSE should be implemented in consideration of the observable area of satellite which can supply much more observation area than ground observation network even if the observation accuracy is inferior, if the authors want to evaluate the construction of a more realistic carbon cycle observation network.

Specific comments are described as below.

Page 3, line 20: As we can expect an increase in satellite observation data and quality improvement in the future, so it is necessary to consider the mixed use of ground observation data and satellite observation data.

Page 3, line 25: The authors should refer Patra et al., 2003 as this paper showed global CO<sub>2</sub> observation network design.

Page 9, Line 14 -15: The difference between hypothetical observations (TRUE) and real observation (OBS) is large in the summer, and this seems to be a cause of the increase in summer RMSD in each subsequent experiment. In order to analyze the cause of the increase in summer RMSD, another observation data that is close to actual observation should be used additionally.

Page 11, Line 24: In addition to the ALL observation network, XCO<sub>2</sub> observations of already operated satellites (ex. GOSAT, OCO-2) should be discussed as well as the expansion of the ground observation network.

Page 13, Line 16-17: Authors should clarify why RMSD grows in summer. Additional

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experiments using another hypothetical observation data closer to actual observation data may help. Other possible factors are meteorological conditions and rectifier effects.

Page 15, Section 3.2: As already mentioned, the authors should evaluate the observation sites that are included in ObsPack and not assimilated in CT, in the sense that they are most feasible.

Page 16, Section 3.3: As shown in general comments, authors should implement OSSE that assumes satellites in actual operation (data coverage, accuracy, etc.).

Page 18, Line 1-2: Authors should consider and show the reason (There are other similar examples).

Page 20, Section 3.5: Authors should show summer RMSD of surface CO<sub>2</sub> fluxes and discuss their features.

Table 3-6: Since Ecoregion Index is difficult to understand intuitively, authors should include the region number and vegetation type.

Figure 1: The authors should specify Transcom region boundaries in Asia. If the vegetation type can be illustrated, it is still preferable.

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