

Replies to referee comments:

The authors gratefully acknowledge the issues raised by the two referees. The detailed answers for each referee is given in the sections below in red.

Interactive comment on “Conceptual design of a measurement network of the global change” by P. Hari et al.

Anonymous Referee #2

Review of the manuscript “Conceptual design of a measurement network of the global change” by P. Hari et al. submitted for publication at ACP.

The manuscript describes a general approach of the design of a global monitoring network. Curiously, the proposed design is already in place in several global and regional networks, including WMO, NOAA, etc. All these global observation network follows the proposed scheme of “flagship stations” (proposed 50) with the application of results to the global level in denser network of the advanced/flux (500) and standard stations. I cannot find any really new concept of innovative idea behind this manuscript. Even smaller networks such as AERONET follow the same hierarchical principle for the last 15-20 years. The WMO proposal for a global change network also follows the same principle, and it was designed and proposed more than 5 years ago. Most of the manuscript describe this scheme, and which measurements should be taken under the concept. I cannot see any Scientific Significance in the proposed manuscript.

As I can not see in the manuscript any really new concept or useful innovative ideas, I recommend ACP to reject the manuscript.

The authors acknowledge the fact that the scientific novelty is not well enough underlined by the current manuscript. It is true that various national institutes and international organizations have presented versions of infrastructures, which are also implemented their activities well. Two mentioned by the referee (WMO and NOAA) have done excellent work in particular in improving global observational capacity (WMO, 2009, NOAA, 2015). The European counterpart here is Integrated Carbon Observation System (ICOS). These observation networks are without a doubt providing crucial, thematic data on the current status of the atmosphere and environment.

Although these networks provide high quality observations, their perspective is typically limited to only a certain type of observations, such as greenhouse gases, trace gases, atmospheric aerosols or ecosystem functions. However, there are interactions between the components and feedback loops that are associated with atmosphere, forests, soil, tundra, oceans etc. responses to the global change. These feedback loops play a very important role in the present global change. For example, increasing atmospheric CO₂ concentration increases air temperature that enhance decomposition of soil organic matter resulting increasing CO₂ flow into the atmosphere, or increasing atmospheric methane concentration increase air temperature that increase peat soil temperature and water temperature in the northern oceans resulting in increasing methane flow into the atmosphere. The number of known feedback loops is quite large (Kulmala et al. 2004, Arneth et al.2009, Paasonen et al. 2012, Kulmala et al. 2014, Petäjä et al. 2015) and it is evident that there are still important feedback loops that have not yet been identified. A proper study of the known and unknown feedback loops requires that we have coherent measurements of the processes generating the loops

and also on the fluxes they produce in the atmosphere and in all types of ecosystems on the globe. A more fundamental and thorough understanding on the global change can be achieved only with network of coherent and comprehensive measuring stations covering all relevant ecosystems and the atmosphere.

A true integration and interoperability is still work in progress and demands a comprehensive concept where all these domains are considered simultaneously. This activity should include not only atmosphere but also ecosystems and other relevant components, which is the innovative idea suggested in this work.

A practical example of such activities is Station for Measuring Ecosystem – Atmosphere Relations (SMEAR) network (Hari et al. 2009). Other relevant actions include Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS) as well as Global Atmospheric Watch (GAW) as well as the Global Earth Observation System of Systems (GEOSS), which aims at developing a comprehensive, coordinated and sustained Earth observation system of systems to understand and address global environmental and economic challenges.

One major challenge associated with global observations is the inclusion of challenging and less accessible observational areas, such as Russia and China with a clear concept of harmonized observations, which relies on existing infrastructures and gap-filling infrastructure development in target areas (Kulmala et al. 2011). High quality observations in these regions are of crucial importance for the predictions of future state of the Earth system. This is one of the main aims of Pan Eurasian Experiment, PEEEX (Kulmala et al. 2015). The two dimensional hierarchical station network comprising of coordinated operation of atmospheric and ecosystem observations is now suggested in Hari et al. (2015).

The concerns raised by the referee will be clarified in a revised version of the manuscript.

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