1. **What are the session key findings? What are the new Lesson(s) learned / Scientific progress (since AR5 release, if relevant)?**

There are two lines of key findings for this session, which correspond to the merging of Valérie Masson and Gilles Ramstein session’s proposals.

First, many talks demonstrated the relevance of deep time context to understand major climate and carbon cycle changes. Second, for quaternary climate, through talks and round tables, it has been shown that these periods are able to better constrain the sensitivity of model used in AR5 projections.

An important new feature is that climate of the Pliocene has been endorsed by IPCC as a relevant warm climate to be studied with regard to future climate. Moreover, the model inter-comparison for more recent climate: 6k, 21k, 125k allows to test the sensitivity of models at regional scale and including more and more feedbacks.

For Pliocene (PLIOMIP), Holocene and last Glacial Maximum, for instance, model data inter-comparisons are now able to depict the areas of agreement and disagreements at global scale between data and models, including error bars.

2. **What are the major knowledge Gaps and Research Needs identified in the session?**

Knowledge gaps in climate transition remain very important. For instance, in warm climate as interglacial or Pliocene, it is still very difficult to reproduce the sea-level drop inferred by the data or the large decrease of equator to pole thermal gradients. For cold climate, the transfer of heat and moisture allowing for the evolution of ice sheet and temperature at mid and high latitudes is still an open problem. In the tropics, the monsoon variation is now better simulated but still some discrepancies remain.
3. Did the session discuss/identify promising approaches in the fields of Adaptation and Mitigation, or both?

N/A.

4. Are there take-home messages from the session?

(When relevant, please specify targeted group of stakeholders. For example, policy-makers / COP21 negotiators, practitioners (experts, etc.), NGOs, private sector, citizens, media, etc.)

The main take-home message is that climate of the past remains key to investigate the sensitivity of models to climate change. The large number of data for the last glacial/interglacial cycle provides a unique target for comparison with model simulations. On the other hand, deep time climate provide situations where carbon and climate are deeply modified and are therefore worth to be studied in regards with present day large perturbation. This targeted messages is devoted to the funding agencies so that not all the fundings go to impact studies. There is still need for funding in fundamental research.

5. Are there Important Quotes from the session?

6. Please include any other remark that you might have.

The fact that a large community of data and model experts exists thanks to the international program PMIP allows a more and more robust quantification of IPCC models in the context of past climate change.