**Reconstructing internal and forced centennial variability in the Southern Ocean using data assimilation**

Goosse Hugues1\*, Quentin Dalaiden, Zhiqiang Lyu

1Earth and Life Institute, UCLouvain, Louvain-la-Neuve, Belgium

The agreement between simulated and reconstructed multidecadal to centennial climate variability has considerably improved over the past decades. However, significant disagreements still exist, especially at regional scale. In the Southern Ocean, both reconstructions and climate models display large variability at those timescales but models fail in reproducing some key elements such as the centennial variability in the strength of the westerly winds inferred from various types of data. Data assimilation can help in identifying the cause of such model-data mismatch by improving the reconstructions and by testing the consistency between different types of data as well as by analyzing the compatibility of those reconstructions with model physics and the simulated response to forcing changes. This will be illustrated here by analyzing the shift in the westerly winds between the 14th and 16th century, showing that it is clear in reconstructions based on classical statistical methods and on data assimilation but it is not simulated in models without data assimilation.