EAG-GS 2014 Outreach Program to Africa

Lecture Abstract:
Sea-level variations: past, present and future

Pierre Deschamps, CEREGE, UMR AMU-CNRS-IRD-Collège de France, France. deschamps@cerege.fr

One of the greatest potential threats from climate change is the future sea-level rise in response to global warming. Global mean sea-level change has increased from a few centimetres per century over recent millennia to a few tens of centimetres per century in recent decades. Reconstruction of global sea level using tide-gauge measured a significant sea level rise of about 1.7 mm/a during the twentieth century. For more than 15 years now, high-precision satellite altimetry and tide-gauge observations consistently indicates a global mean sea level rise of up to 3 mm/yr. This tenfold increase in the rate of rise observed since the beginning of the industrial era is attributed to climate change through the melting of land ice and the thermal expansion of ocean water. As the present warming trend is expected to continue, global mean sea level will continue to rise. However, the magnitude of the eustatic sea-level (ESL) rise predicted for the 21st century remains a subject of considerable debate with worst-case scenarios varying between 0.98 m and 1.4 m. In general, the basis for this debate revolves around the uncertainties in the nonlinear behaviour of ice sheets to the post-industrial global temperature perturbation.

Different approaches for addressing this issue have been attempted, including paleao studies that provide insights into past sea-level changes on decadal to millennial timescales. Palaeo studies may indeed be helpful in this debate by placing limits on projections of future sea-level rise. This will be the objective of this lecture to expose how paleoclimatic archives allow reconstruction of sea-level variations and how they may help to constrain future changes.

First, we will review the evidences of the present-day climatic change and its impact on sea level. The state-of-the-art of future sea-level rise projections will be then presented and the source of their uncertainties discussed. Principles of paleoclimatic archives (coral reef, ice cores,…) of past sea-level changes as well as the geochemical and geochronological tools used to decipher them will be presented. Afterwards, we will consider sea-level variations during some key climatic periods, i.e., the Holocene, the last deglaciation (21 ka to 6 ka) and the Last Interglacial Period (LIG; around 125 ka). Although these periods are not exact analogues to present-day situation, they are useful case study to understand the behaviour of ice sheets and the evolution of sea level in warmer climates (LIG), transitional climates (last deglaciation) or broadly similar climates (Holocene).