The variability in the Pacific has both oceanic and atmospheric components which show different temporal behaviors. In particular they span from inter-annual variability, in the case of ENSO, to decadal and inter-decadal occurrence as with PDO and IPO respectively. Interestingly, their spatial structure is quite similar, showing high SSTa in the Eastern Pacific both along the Equator and along the continental coasts with a symmetric extra-tropical signature. These processes have been characterized for their impacts on weather and ecosystems, but their dynamics is still under investigation.

Di Lorenzo et al. (2015) advanced and tested what they call a “red noise null hypothesis for Pacific decadal and multidecadal variability”. They argue that the primal origin of this variability can be traced back to random atmospheric processes that, captured by meridional modes, get injected in the tropical region. Here, they resonate thanks to the forcing of zonal modes and then return to the extra-tropics through teleconnections. In order to test the hypothesis, they first identify what they refer to as “ENSO-like patterns” as the first spatial PC of monthly SSTa in the Pacific. Then, they identify its growth and decay by constructing the correlation maps of the state of the Pacific 1.5 years before and 1.5 years after the peak phase. This progression is investigated in three conditions. First, they use observation data. Second, they run what they call the “zonal mode experiment” where all variance outside the Tropics is removed from the analysis that focuses only on the 12S-12N band. Third they run the “meridional mode experiment” where they use an AGCM slab coupled model, removing the dynamic response of the ocean and thus the impact of zonal modes. The comparison of growth, peak and decay shows that meridional and zonal modes, on their own, are not able to capture the full evolution of the Pacific variability. Furthermore, the MM experiment captures the growth fairly well and the ZM one captures decay and teleconnections, suggesting that they are active in different phases of the PDV evolution and are necessary for different passages, as suggested in the original hypothesis.

This first paper left space for further investigation, in particular with regard to future changes in the relationship between meridional modes and PDV in future forcing scenarios. This is the focus of Liguori and Di Lorenzo (2018). First of all, they construct a progression (PROG) index which captures the evolution (growth, peak and decay phases) of PDV. It is built as the 1st EOF of a combination of SSTa from different stages (both in time and space) of the PDV progression. This PROG index is then regressed against SST and SLP observations and CESM Large Ensemble simulation (LENS), the first shows the progression now, and the second simulates future changes under the RCP8.5 scenario. This analysis shows that the PROG index, in both observations and LENS data, is able to capture the evolution of PDV, validating its use. Then, it is shown that the standard deviation of the index, both in observation and LENS, is growing with time. This same growth in variability is then found in ENSO simulation and in the PMM signature on both temperature and winds. Since the same trend is also found in the behavior of the parametrization of the WES feedback, the conclusion of the paper is then that the growth of ENSO and PMM variability and the strengthening of their coupling (as a consequence of the increasing anthropogenic forcing in RCP8.5) can be explained as a result of the intensification of the WES feedback.