Evaluating the effect of tropical and extratropical Pacific initial errors on two types of El Niño prediction using particle filter approach

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Different types of El Niño-Southern Oscillation (ENSO) predictions are sensitive to the initial errors in different key areas in the Pacific Ocean. And it is known that the prediction can be improved by removing the initial errors by using assimilation methods. However yet, few studies have quantified to what extent can different types of ENSO predictions be improved by assimilating variable in different key areas. In Hou et.al (2019), 4 types of ocean temperature initial error patterns were classified for two types of El Niño prediction. It was indicated that initial errors in the north Pacific, covering the Victoria Mode region, along with south Pacific, covering the South Pacific Meridional Mode region, and subsurface layer of western equatorial Pacific have strong influence on the ENSO prediction. Following the data analysis method and the initial error patterns they proposed, we assimilate ocean temperature in these three key areas of Pacific Ocean by using CMIP5 pi-control dataset and particle filter method. Most EP- and CP-El Niño predictions in December are improved after assimilating the ocean temperature in southeast Pacific, north Pacific and western equatorial Pacific from January to March. Specially, for the prediction ensemble which contains EP(CP)-type-1 initial errors, the EP(CP)-El Niño prediction skill raises the most after assimilating the Tropical Pacific temperature, comparing with the result of assimilating the south Pacific and north Pacific. As for the prediction ensemble which contains EP-type-2 initial errors, which present similar pattern to EP-type-1 but with opposite sign, the EP-El Niño prediction skill increases the most by assimilating the north Pacific temperature. The results verify that the initial errors in the north Pacific exert contrary influences on the ENSO prediction with that in the southeast Pacific and western tropical Pacific. In addition, the initial errors in the north Pacific is more of concern for the SST prediction in the central tropical Pacific in December, while those in the southeast Pacific and tropical western Pacific is more related to the SST prediction in the central-eastern tropical Pacific. In conclusion, to better predict the types of El Niño, attentions should be paid to the initial ocean temperature accuracy not only in the tropical Pacific but also in the north and south Pacific.