Novel data-driven approach for ENSO prediction

*Dmitri Kondrashov[1], Evgeniy Loskutov[2], Andrei Gavrilov[2], Dmitry Mukhin[2], Alexander Feigin[2]

1. University of California, Los Angeles, United States, 2. Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russian Federation

We have developed novel data-driven technique for ENSO prediction that combines two existing approaches: linear dynamical mode (LDM) decomposition of spatially distributed data, and multilevel empirical model reduction (EMR) stochastic modeling approach. The nonlinear EMR model that utilizes dynamical variables obtained by empirical orthogonal function (EOF) decomposition of tropical Pacific SST’ s (Kondrashov et al. 2005), had already achieved a very competitive skill in International Research Institute for Climate and Society (IRI) ENSO real-time multi-model plume (Barnston et al. 2012). On the other hand, Gavrilov et al. (2018) have shown that LDM decomposition provides better modes for ENSO forecast than EOFs.

In the presented results we have used LDM modes as dynamical variables at the main level of multilevel linear EMR model. The model was trained on monthly 1960 -- 2014 sea surface temperatures (30S to 30N, 2x2 deg). The results of comparing skill of the retrospective predictions of the SST-based ENSO indices obtained by EMR model with LDM and EOF modes, will be discussed.

1. Kondrashov, D., Kravtsov, S., Robertson, A. W., & Ghil, M. (2005). A Hierarchy of Data-Based ENSO Models. Journal of Climate, 18(21), 4425–4444. doi:10.1175/JCLI3567.1

2. Gavrilov, A., Seleznev, A., Mukhin, D., Loskutov, E., Feigin, A., & Kurths, J. (2018). Linear dynamical modes as new variables for data-driven ENSO forecast. Climate Dynamics, 1–18. http://doi.org/10.1007/s00382-018-4255-7.

3. Barnston, A. G., M. K. Tippett, M. L. Heureux, S. Li, and D. G. DeWitt, 2012: Skill of real-time seasonal ENSO model predictions during 2002–2011 —is our capability improving? *Bulletin of the American Meteorological Society*, **93 (5)**, 631–651, doi:10.1175/BAMS-D-11-00111.1.

Keywords: ENSO, stochastic modeling, prediction

