# Dynamics and predictability of 2016 extreme Indian Ocean Dipole event

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A strong negative Indian Ocean Dipole (IOD) event occurred during 2016 boreal summer and fall, which led to large climate impacts such as the drought over East Africa. In this study, efforts are made to understand the dynamics of this IOD event and to evaluate real-time IOD predictions from current operational seasonal forecast systems. We show that both the wind-evaporation-SST and thermocline feedback lead to fast IOD growth in boreal summer 2016. Anomalous westerlies over the tropical Indian Ocean warmed the sea surface temperature (SST) over the tropical southeastern Indian Ocean (TSEIO) by reducing local evaporation; and wind induced thermocline deepening increased TSEIO SST by vertical advection. The intraseasonal disturbances in May induced the early subsurface warming and initiated the 2016 IOD. Due to negative cloud-radiation-SST feedback, the 2016 IOD event decayed quickly after October. We also demonstrate the successful real-time IOD predictions by the operational Hadley Center Global seasonal forecasting system version 5 (GloSea5) and the Beijing Climate Center Climate System Model (BCC-CSM1.1m). Resulting from the realistic representation of observed air-sea interactions, both models successfully predicted the evolution of the 2016 IOD up to 2 seasons ahead. The skillful prediction is also due to the precursor of the early subsurface warming in the eastern Indian Ocean, which increases intrinsic predictability of the 2016 IOD event. It is also demonstrated that IOD amplitude biases can be reduced by the joint-model prediction. The successful prediction of the 2016 IOD event allowed the East African drought to be predicted 4-6 months ahead. Our study reveals that current operational climate models can give useful warning of impending IOD events and impending climate extremes.

Key words: Indian Ocean Dipole, air-sea interaction, East African drought, seasonal prediction