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Progress towards improving climate prediction by mathematical methods.

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In this talk, we will present some progresses in improving seasonal climate predictions by using more advanced mathematical methods. The first example is to rely on the basic properties of stochastic theory to develop an efficient technique for the extraction of climatically relevant singular vectors (CSV) in the presence of weather noise. Emphasis is placed on the applications of the CSV in seasonal climate predictions and to construct optimal ensemble climate predictions. The results indicates that the CSVs can well characterize the optimal error growth of the climate predictions and lead to better ensemble predictions than traditional time lag (TLE) method. The second example is to apply for the information theory to quantify the potential climate predictability. It is found that the information-based measures such as relative entropy and multiple information can better characterize the real predictability than the traditional methods of signal-to-noise ratio. At last, our recent progress in the state estimate of state-space models isdiscussedwithapplicationsofBayesian-based algorithms. A simplified algorithm of Sigma-point Kalman filter is develop to deal with the state estimation of high-dimensional systems like atmospheric and oceanic general circulation models.