# KOOPMAN OPERATORS AND CLIMATE VARIABILITY


**Tuesday 16 June 2020**
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**Speaker**
Antonio Navarra - President CMCC Foundation

**Moderator**
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In the last years ensemble methods have been widely popular in atmospheric, climate and ocean dynamics investigations and forecasts as convenient methods to obtain statistical information on these systems. In many cases, ensembles have been used as an approximation to the probability distribution that has acquired more and more a central role, as the importance of a single trajectory, or member, became less stringent. This paper shows that using results from the dynamical systems and more recent results from the machine learning and AI communities, we can arrive at a direct estimation of the probability distribution evolution and also at the formulation of predictor systems based on a nonlinear formulation. The paper introduces the theory and demonstrates its application to two examples. The first is a one-dimensional system based on the NINO3 index, the second is a multidimensional case based on time series of monthly mean SST in the Pacific. We show that we can construct the probability distribution and we can set up a system to forecast its evolution and derive various quantities from it. The objective of the paper is not strict realism, but the introduction of these methods and the demonstration that they can be used also in the complex, multidimensional environment typical of atmosphere and ocean applications.

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