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Predictive Flow-Field Estimation For Atmospheric Dispersion Problems MOKHASI PARITOSH, DIETMAR REMPFER, IIT — In order to address the direct and inverse problems of contaminant dispersion, the need for complete three-dimensional flow-fields at previous and future time steps is very important. The method of Proper Orthogonal Decomposition (POD) allows us to decompose a 3D flow field into a set of basis functions and temporal coefficients. Recently it was shown that it is also possible to reconstruct flow-fields based on the POD and velocity sensor information at a few optimized locations in the domain. Through the use of POD and reduced sensor analysis, it is possible to reconstruct the flow-field at the specific instant of time when the velocity measurements were made. However, the method gives no information about the past or the future behavior of the flow. A new method has been developed that enables one to introduce a pseudo time scale into the POD basis function. This is accomplished by grouping the initial ensemble into subsets of snapshots which we call episodes. When conventional POD analysis is applied to the new ensemble, the resulting basis functions contain the temporal information associated with the flow field also, with the coefficients then varying only in episodes. When coupled with reduced sensor analysis, we obtain a method that enables us to compute the episodic coefficients based on velocity sensors. Once the episodic coefficients are computed, then the velocity field at past, present and future times are known instantly. Numerical experiments conducted on various cases show that the method retains the advantage of POD compression, while still producing accurate results.

Dietmar Rempfer
Illinois Institute of Technology

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