Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Topological Flow Data Analysis Part 1- Theory and Applications[1]
TAKASHI SAKAJO, Kyoto University, TOMOKI UDA, Tohoku University, TOMOO YOKOYAMA, Kyoto University of Education — We have investigated a mathematical theory classifying the topological structures of streamline patterns for 2D incompressible (Hamiltonian) vector fields on surfaces such as a plane and a spherical surface, in which a unique combinatorial structure, called partially Cyclically Ordered rooted Tree (COT), and its associated graph (Reeb graph) are assigned to every streamline topology. With the COT representations, one can identify the topological streamline structures without ambiguity and predict the possible transition of streamline patterns with a mathematical rigor. In addition, Uda has recently developed a software converting the values of stream function on structured/non-structured grid points in the plane into the COT representation automatically. It enables us to conduct the classification of streamline topologies for a large amount of flow datasets and the snapshots of time-series of flow evolutions obtained by measurements and numerical simulations, which we call Topological Flow Data Analysis (TFDA). In the three consecutive talks Part1-Part3, we introduce the recent developments of TFDA. In the first part followed by two talks, we will present an overview of basic theory and its applications to atmospheric data.

[1]This work is supported by Japan Science and Technology.

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Date submitted: 16 Jul 2019 Electronic form version 1.4