Research BRIEFS

NCAP-COALESCE

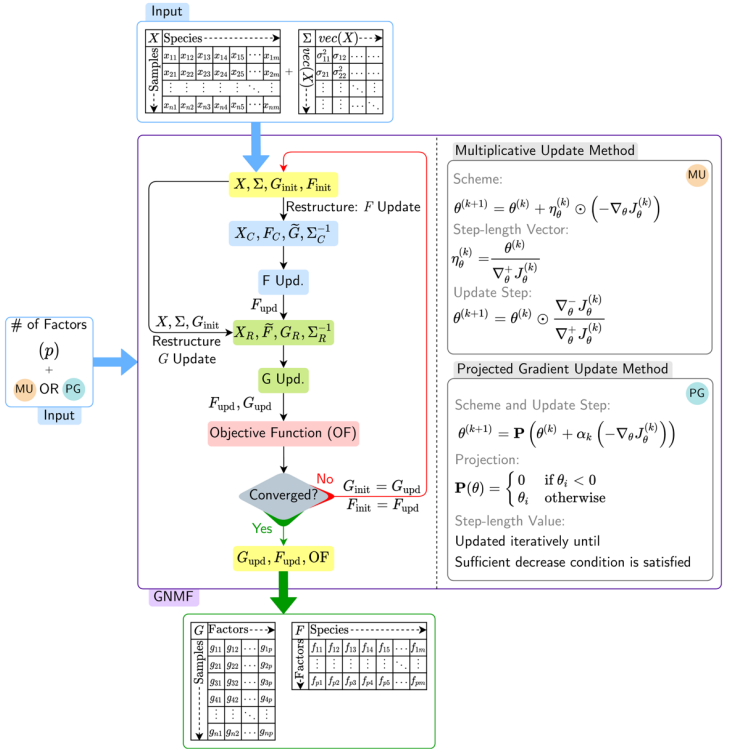
CarbOnaceous AerosoL Emissions, Source apportionment & ClimatE impacts

Understanding scientific complexities related to carbonaceous aerosols focussing on issues underlying their origin and fate, and their role as drivers of regional climate change over India.

Generalised non-negative matrix factorisation for air pollution source apportionment

Author List: Nirav L. Lekinwala[1] and Mani Bhushan[1,2,*]

[1]*Department of Chemical Engineering,* [2]*Interdisciplinary programme in Climate Studies, Indian Institute of Technology, Bombay*



Summary of your Research:

EPA-PMF is widely used for source apportionment application in the literature. EPA-PMF makes an implicit assumption that all the samples and species are uncorrelated. However, that may not be the case in reality. Filters are often subjected to similar storage and transportation conditions, the chemical analysis instruments used may use the same calibration equation over several samples introducing cross-correlation in same species across different samples and same species in am sample.

To account for the covariance information ignored in normal source apportionment methods, GNMF method is developed. Unlike other methods in the literature which only incorporate partial information, GNMF method incorporates fill covariance information to minimise the objective function.

Key highlights:

- GNMF approach proposed for source apportionment (SA) application.
- GNMF uses error covariance between different elements of concentration matrix.
- Multiplicative & projected gradient based rules to iteratively update G & F matrices.
- GNMF method subsumes existing NMF methods as special cases.
- Utility demonstrated on a field dataset derived simulated SA problem.

GNMF method has two update methods namely, multiplicative (similar to NMF updates) and projected gradient based update. GNMF method with projected gradient based updates ensures sufficient decrease at each step. On a simulated dataset obtained from real field measurements, the GNMF method performs better in obtaining the G and F matrices as compared to EPA-PMF and other NMF methods in the literature.

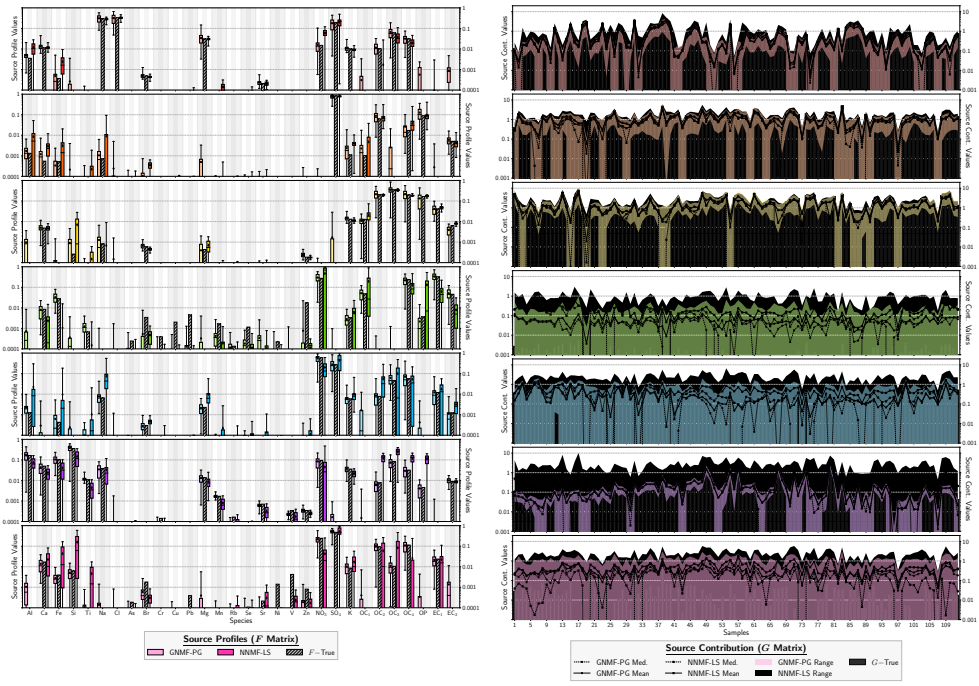


Fig: Source profile & source contribution plots shown for GNMF & NNMF-LS method.

Take away/conclusion :

This study forms the mathematical basis for GNMF method. The GNMF method overcomes the issue of NMF method not incorporating complete error variance-covariance information. For a typical source apportionment application using data obtained from field measurements, GNMF method is shown to perform better in recovering the true values of G and F matrices as compared to other methods in the literature. GNMF method also performed better when the errors are non-normal (heavy-tailed) which is typical in environmental datasets.

Research Article citation

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Contact:

National Co-ordinator

(NCAP-COALESCE Project)
Interdisciplinary Programme in Climate Studies

Indian Institute of Technology, Bombay
Powai, Mumbai-400076, India

Phone: 91-22-2576-5141

http://www.climate.iitb.ac.in/en/r-d-project-0