Environment modeling for the prediction of air and water pollution

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Pollution now-a-days has been a world issue from last few decades. From Air to Land to Soil to Noise, pollution is degrading the biodiversity. It is causing mass extinction, rise and fall in temperature in many areas, inhabiting environment in few regions and many more dangerous things around the globe. And still it is kept on increasing due to the actions by human that is directly or indirectly affecting the environment. In recent times, people are being aware of this environment degradation and are trying to preserve the environment. One of the practise that is efficient in preserving biodiversity was launched by USEPA (United States Environmental Protection Agency) to look after this issue and save the environment.

WASP Model - USEPA

The Water Quality Analysis Simulation Program (WASP) is a model that can predict the water pollution to a natural phenomenon like floods, algae formation and manmade pollution like acid rain, releasing untreated sewage water (Di Toro et al., 1983; Connolly and Winfield, 1984; Ambrose, R.B. et al., 1988). WASP is an advanced model which allows us to look at the pollution effects in 1D, 2D, 3D systems. 1D here refers to the model of pollution flowing along a straight river. 2D refers to the pollution spreading out in a lake (both length and width). Similarly, 3D refers to look at the height aspect too. WASP handles many types of pollutants like chemicals, waste particles and many more. It happens by handling the state variables which are the main characteristics of water, these variables includes dissolved Oxygen level an temperature too. This WASP releases its latest version a sediment diagnosis

model linked with Advanced Eutrophication model. This sediment diagnosis model predicts that how a particular sediments release or absorbs nutrients.

WASP Preprocessor

This preprocessing model basically deals with the input data for the model. Here users can easily import and organize data for the model by simply pasting or directly drag and drop the query database. It provides a detailed report and description of all parameters with accurate prediction in a very user friendly manner. One more good feature of it is when being linked with hydrodynamic model, the connection is simple as pointing to linkage file.

WASP Postprocessor

It does an in-depth time-to-time review. The WASP post-processor, WRDB, further provides measures of the model predictions against actual field data constituting ground truth. It does data visualization for all models of WASP by processing output data from other models. It has two functional display formats: Spatial Grids It generates a color-shaded two-dimensional map of the model network according to pollutant concentrations. x/y Plots Line graphs of the observed and predicted results are generated. By means of the post-processor the user may develop unlimited quantities of spatial grids, x/y plots and model result files.

WASP MODEL INFORMATION

Current Version	8.32
Release Date	April 2, 2019
Operating System	Windows 64-bit Windows 7 or higher, Macintosh, OSX, Linux, Ubuntu
Intended Audience	Scientist, Agencies and Environmental Engineers
Key Words	aquatic biology, assessment, compliance, discharge, environmental effects, hydrology, metals, NPS related, NPDES, point source(s), surface water, test/analysis, TMDL related
Media	Surface Water
Pollutant Types	Conventional Pollutants (Nitrogen, Phosphorus, Dissolved Oxygen, BOD, Sediment Oxygen Demand, Algae, Periphyton), Organic Chemicals, Metals, Mercury, Pathogens, Temperature

AERMOD Model - USEPA

AERMOD is a model system that studies on the air dispersion based on planetary bodies layer turbulence structure and scaling concept. AERMOD was developed by AERMIC as a collaborative group of scientists from AMS and the EPA.

This is an integrated system that includes basic three modules: A steady-state model that detects dispersion of air pollution over an short range (upto 50km) and it is primarily sourced from industrial sources; Its preprocessor AERMET accepts data from the surface of meteorological data and upper air surroundings like atmospheric turbulence, mixing heights. One of its another preprocessor is terrain (AERMAP) whose main purpose is to provide a physical behavior between air pollution fumes and terrain features. It creates a location and height for each receptor location.

AERMOD also includes PRIME(Plume Rise Model Enhancements), it is like an algorithm for modeling which is use to create an effect on pollution plume flowing over buildings by downwash. AERMOD main principle is to know the pollution concentration. The AERMOD (AMS/EPA) regulatory Model is a steady state gaussian air dispersion model based on planetary boundary. The model integrates PRIME building algorithms, with advanced parameters, local terrain and urban heat effects, and advanced meteorological turbulence.

Comparison summary

Feature	WASP	AERMOD
Primary Domain	Water quality modeling in rivers, lakes, estuaries, etc.	Air quality modeling around emission sources
Key Application	Pollution transport, water quality management, eutrophication	Air quality assessment, regulatory compliance
Core Modules	Dissolved oxygen, nutrients, toxicants, sediment dynamics	AERMET (meteorological), AERMAP (terrain)
Terrain Handling	Handles stratification and depth-based interactions	Considers terrain impacts on pollutant dispersion
Data Requirements	Requires hydrodynamic, pollutant, and sediment data	Requires meteorological and terrain data
Advantages	Highly flexible and modular, detailed pollutant tracking	Proven accuracy, EPA-endorsed, handles complex terrain
Limitations	Data-intensive, challenging for some complex scenarios	Assumes steady-state, limited in long-range transport

References

AERMOD Implementation Guide, https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf. Accessed 14 November 2024.

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