Polaris II: Gamma Ray Visualization System and Risk Mitigation Through Real-Time Radionuclide Atmospheric Dispersion Modeling

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Radiation is a silent force that has and continues to affect the lives of those living around nuclear power. Calibrating previously developed custom imaging algorithms through Monte-Carlo N-Particle flux simulations provides an update to the existing radioisotope visualization system. Through photon flux tally at specific energies, adjustments to signal processing allowed for 625% increase in detection area while maintaining high angular resolution. While this update provides a solution to imaging the source of release, the nature of atmospheric transport makes surveys of affected areas impossible until the actual period of radioactive fallout, which is too late for exposure mitigation. Therefore, this research expands to integrate source terms via the visualization system with a novel dispersion model that enhances the accuracy of Gaussian simulations. The usage of real-time topographical and meteorological datasets (RTMA, SRTM90 & ALOS30) allows modeling with low computational profiles and instantaneous estimations through replacement of steady-state Gaussian solutions with environmentally responsive predictions that improves in accuracy as metrology updates in each timestep. Models are tested against existing radiation surveys of Fukushima by comparing local-scale data with calculations in the same domain, and accuracy determined through fractional bias (FB), correlation (CC) and quantity factors (FA). Results demonstrate good accuracy with CC of 0.68 compared to current lagrangian model WSPEEDI-II of 0.59 and 100% of conservative estimated results within a factor of 10 from deposited concentrations. This combination of lightweight open-source modeling with source-term detection can then be deployed to create a user-friendly application ecosystem for public access.

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