Long-Term Continuous Day-and-Night Analysis of Rail Temperature Using an All-Sphere Visible Element

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This paper proposes a method for long-term, continuous day-and-night analysis of rail temperature. The method is based on a weakly coupled framework that combines detailed thermal evaluation of solar and longwave radiation with heat conduction analysis, using an all-sphere visible element. Atmospheric attenuation of longwave radiation and reflected radiation from surrounding objects is modeled using the Lambert–Beer law, with absorption coefficients adjusted for seasonal water vapor conditions. Validation against field measurements showed that the RMSE of the analyzed rail temperature ranged from 1.4 °C to 2.5 °C in summer and 1.6 °C to 2.1 °C in winter.