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Thermal Constraint Violations as a Result of Ambient Adjusted Transmission Line Ratings

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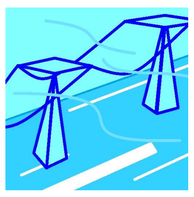

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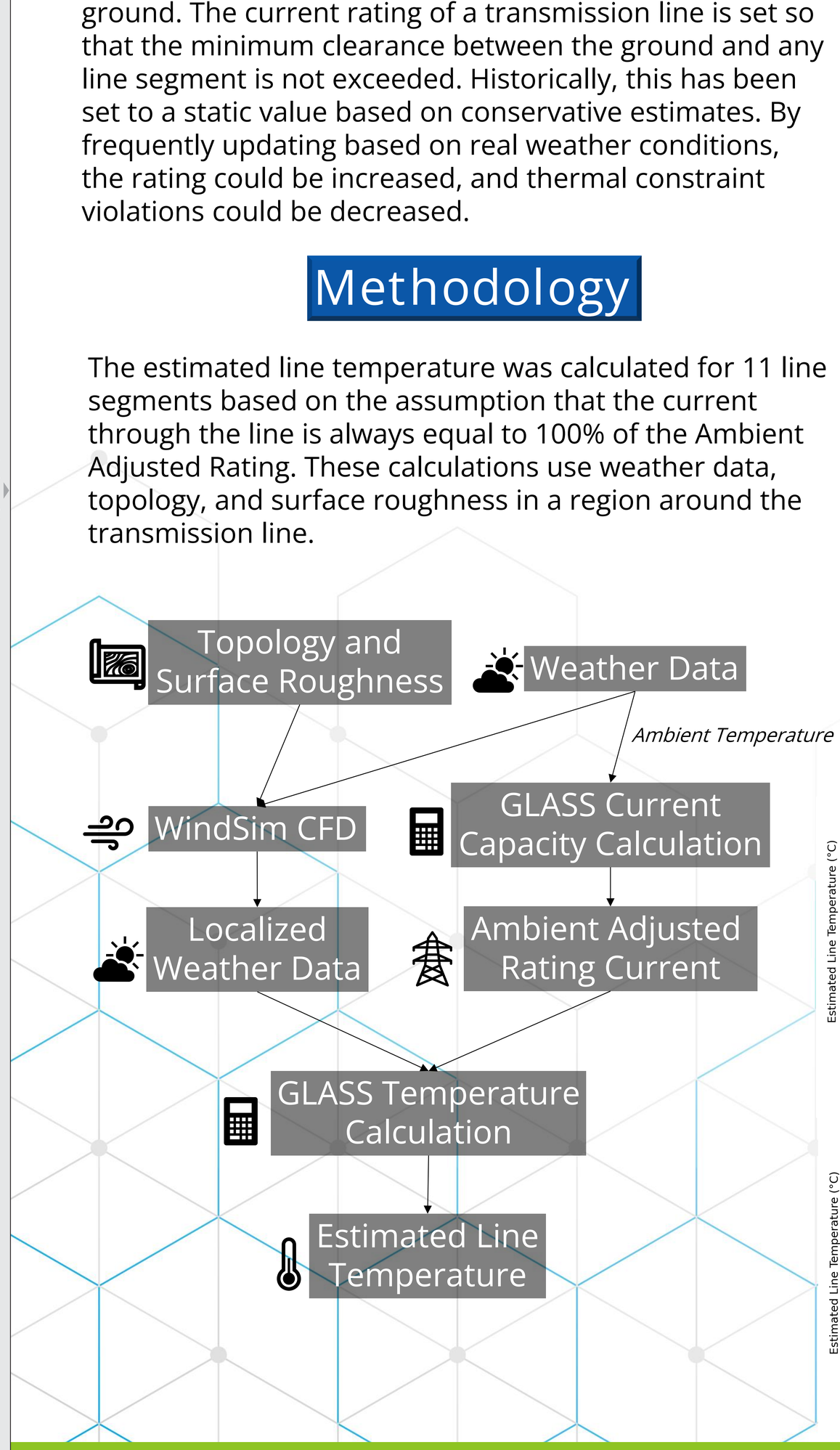
Transmission Line Ratings

The maximum current that can pass through an overhead transmission line is set by a thermal constraint on the line material. As the current through a transmission line increases, the temperature of the conductor material increases due to Joule heating, and as a result the material undergoes thermal expansion, and the midpoint of each line segment will sag and become closer to the ground. The current rating of a transmission line is set so that the minimum clearance between the ground and any line segment is not exceeded. Historically, this has been set to a static value based on conservative estimates. By frequently updating based on real weather conditions, the rating could be increased, and thermal constraint violations could be decreased.

Methodology

The estimated line temperature was calculated for 11 line segments based on the assumption that the current through the line is always equal to 100% of the Ambient Adjusted Rating. These calculations use weather data, topology, and surface roughness in a region around the transmission line.



Dynamic Line Ratings

Dynamic Line Ratings are derived completely from measured ambient temperature, solar irradiance, wind speed, and wind direction. Assuming ideal measurements, the Dynamic Line Rating will result in the transmission line being exactly at its thermal constraint.

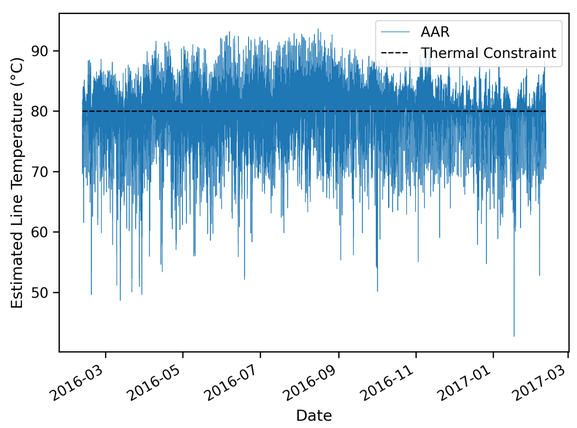
Ambient Adjusted Ratings

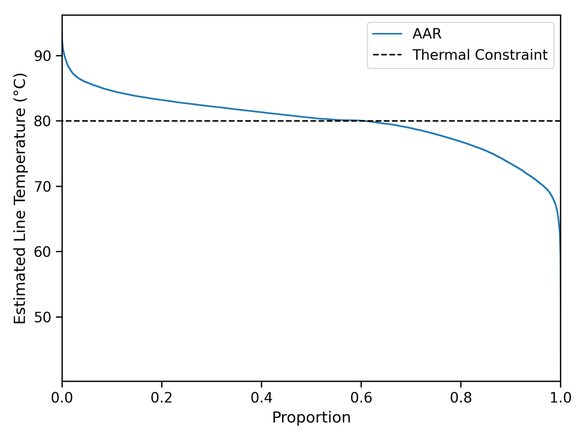
Ambient Adjusted Ratings use measured ambient air temperature but assume static values for all other parameters. If the actual conditions at the transmission line become more extreme than the static parameters, using the Ambient Adjusted Rating could result in the thermal constraint being exceeded.

Results

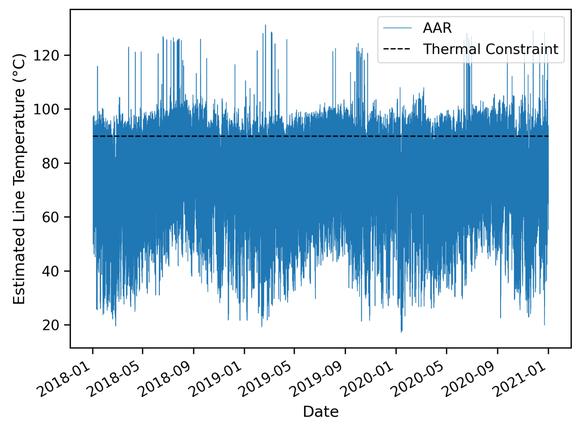
Over the 11 transmission lines studied the percent of time when the thermal constraint was violated ranged from 4.4% to 60.2%. The range of constraint violations correlates with wind speed. In areas with low average wind speed such as Hell's Canyon, OR, the frequency of thermal violations was much higher than in wind areas such as Idaho Falls, ID. These results illustrate that in all cases Dynamic ratings are preferable to Ambient Adjusted Ratings, but in areas with low wind speeds Dynamic Ratings are crucial to avoid excessive thermal constraint violations.

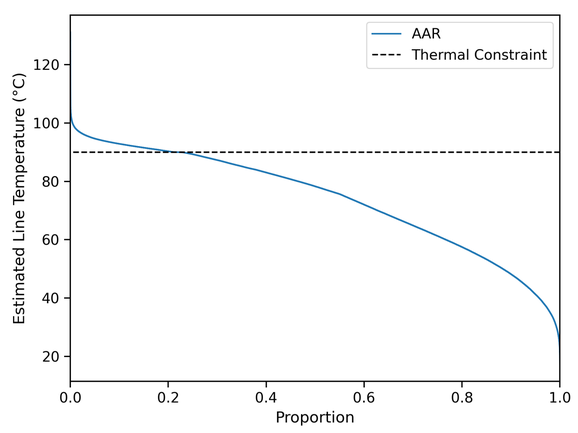
Hell's Canyon, OR
Temperature Distribution





Idaho Falls, ID
Temperature Distribution





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