The role of road networks in facilitating past and future invasions of *Aedes albopictus* mosquitoes in the contiguous United States
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### Introduction

*Aedes albopictus*
- Invasive, first established in US in mid-1980s
- Subsequent movement likely via road network
- Vector of multiple pathogens
- First established in United States in the mid-1980s; subsequent movement likely via road network

### Methods

Additive Cox models
- **Explanatory variables:**
  - Connectivity based on primary roads (Figure 3)
  - Climate and percent urban or built-up land cover
- **Response variable:**
  - Time from 1986 to year of first detection by county
  - 3,067 counties: 75% training; 25% testing

Future scenarios, starting in 2050
- Climate variables based on RCP 2.6, 4.5, 6.0, and 8.5 projections using CHELSA datasets\(^2\)
- Four urbanization projections based on the A1, A2, B1, and B2 scenarios modelled by USGS FORE-SCE\(^3\)

### Results

**Best model**
- Betweenness centrality
- Closeness centrality
- Eccentricity
- Percent urban land cover
- Coldest quarter temperature
- Warmest quarter precipitation

**Projected probability:**
- < 0.25
- 0.25 to 0.49
- 0.50 to 0.74
- 0.75 to 1.0
- Already present in 2020

**Table 1. Model evaluation**

<table>
<thead>
<tr>
<th></th>
<th>2020 prediction</th>
<th>2020 prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pres.</td>
<td>Abs.</td>
</tr>
<tr>
<td>Detected</td>
<td>294</td>
<td>60</td>
</tr>
<tr>
<td>Not Detected</td>
<td>64</td>
<td>348</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>Specificity</td>
<td>0.84</td>
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<tr>
<td>Overall accuracy</td>
<td>0.84</td>
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</tbody>
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### Discussion

- County-level road network connectivity measures improved model of *Aedes albopictus* expansion in the contiguous US
- Areas in Georgia and Louisiana likely undetected have *Ae. albopictus* populations, but mosquito surveillance is unequal
- The A1 urbanization / RCP 4.5 scenario resulted in the most counties with high (>0.5) predicted probabilities of *Ae. albopictus* presence by 2080
- Across future scenarios, upper Midwest has high probability of future expansion, Northwest has low probability

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\(^1\)Hahn et al. 2016, 2017; \(^2\)Karger et al. 2017, 2020; \(^3\)Sohl et al. 2014