

When color theory meets seismology: Principled visualization design for seismic hazard maps

Max Schneider^{1,2} and Fabrice Cotton^{2,3}

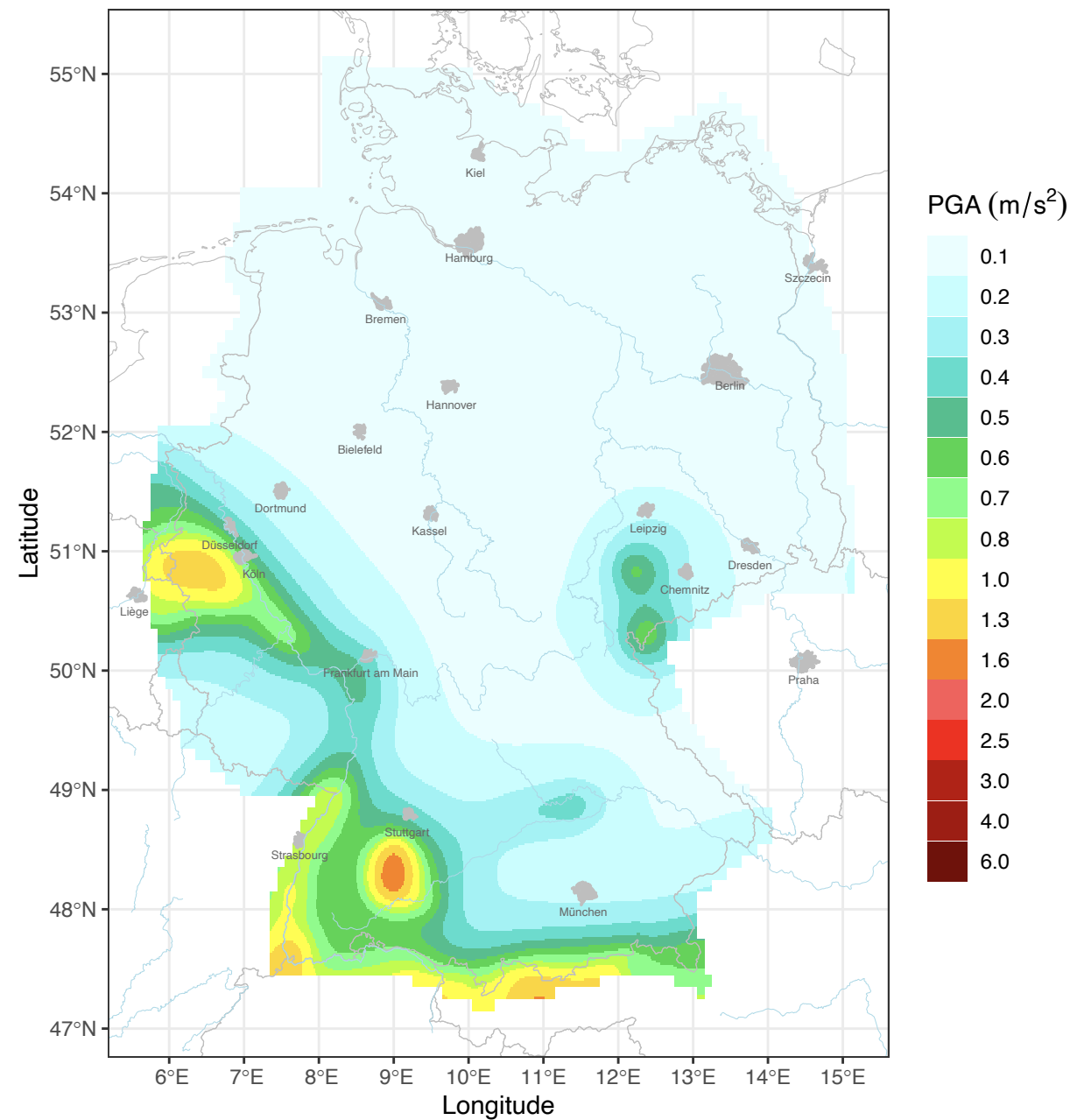
1  UNIVERSITY of WASHINGTON

2  HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES

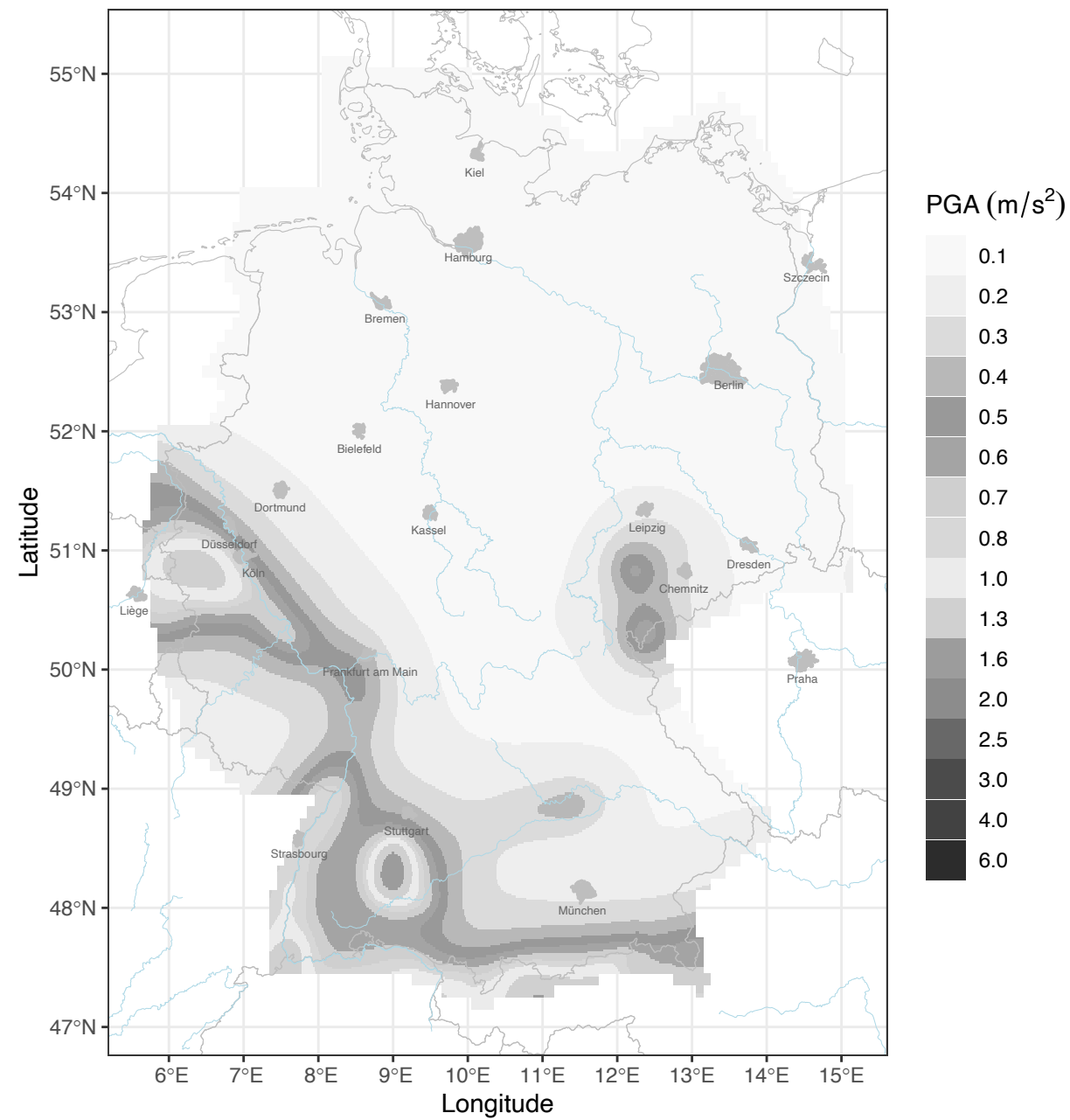
3  Universität
Potsdam
Universität Potsdam

Email me at maxs15@uw.edu with suggestions or questions!

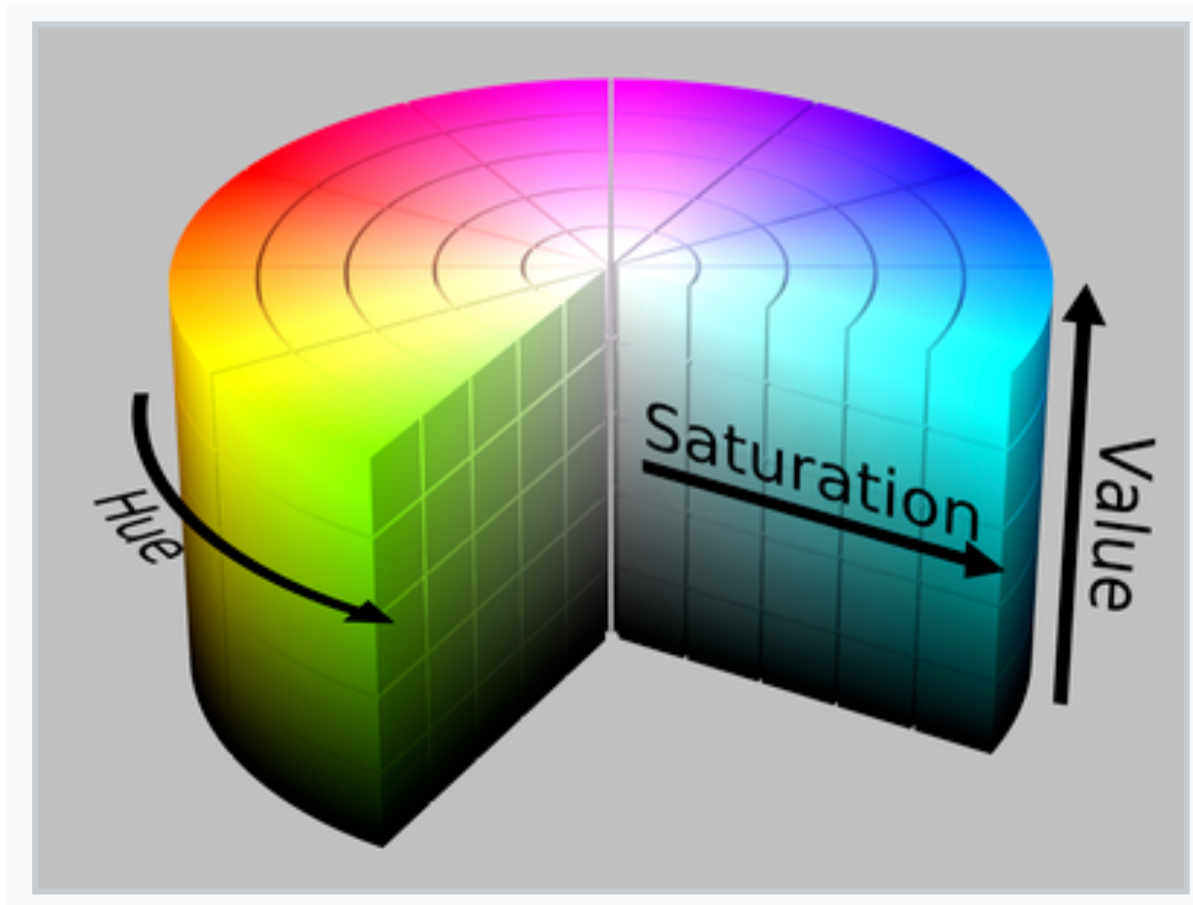
Mean Hazard (Peak Ground Acceleration), Baseline



Mean Hazard (Peak Ground Acceleration), Baseline in Grayscale

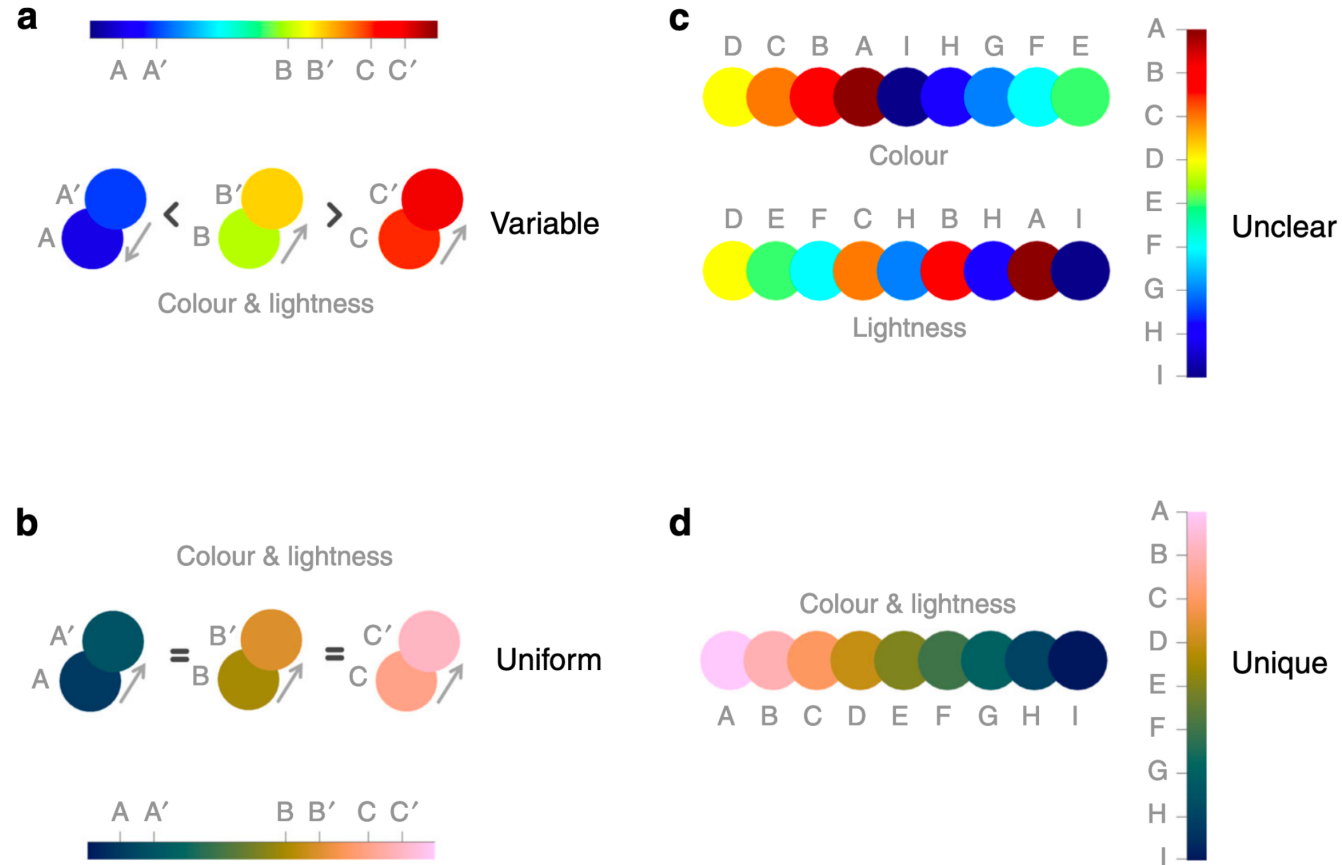


Hue-Saturation-Value Color Model



Rainbow color palette does not preserve....

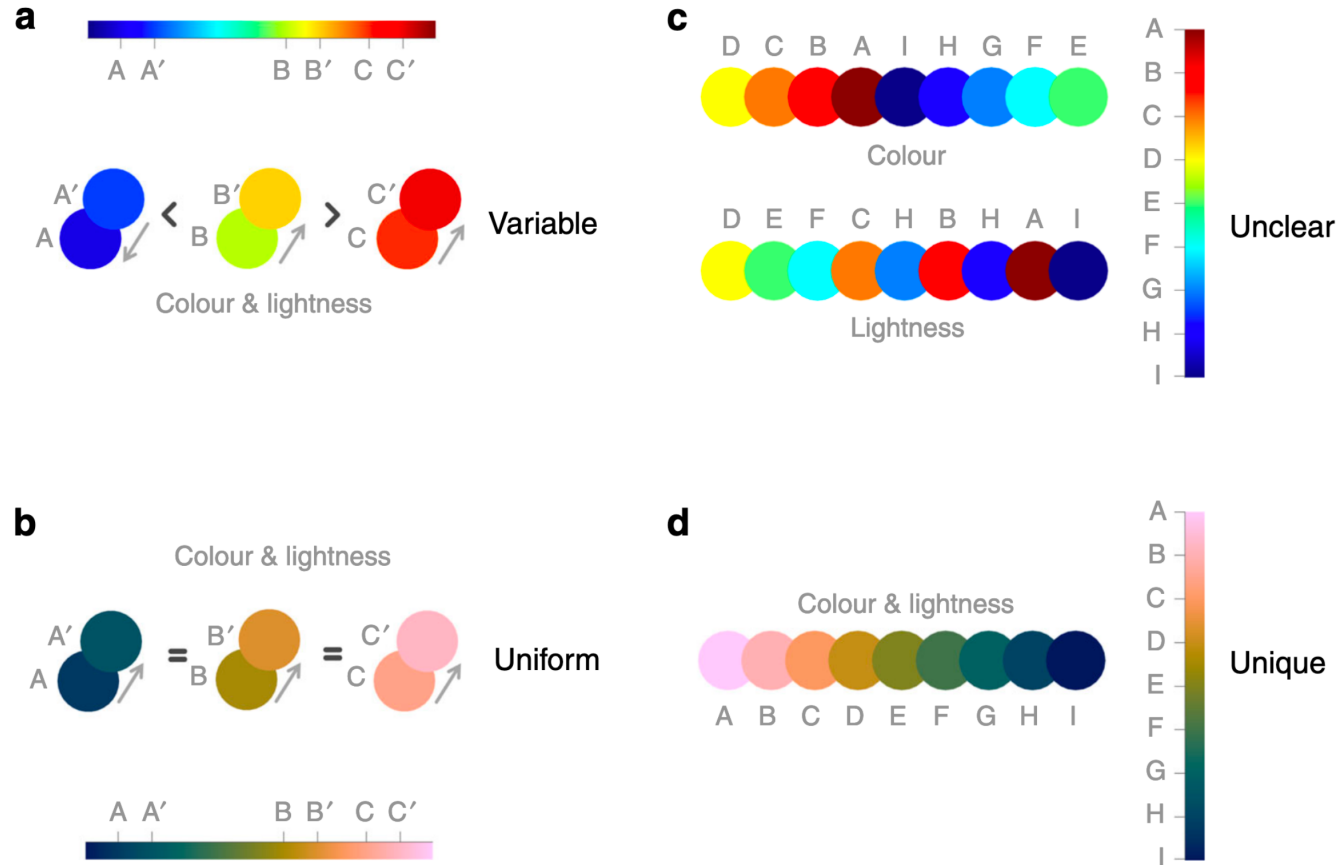
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Crameri et al. (2020), Nature, Figure 4

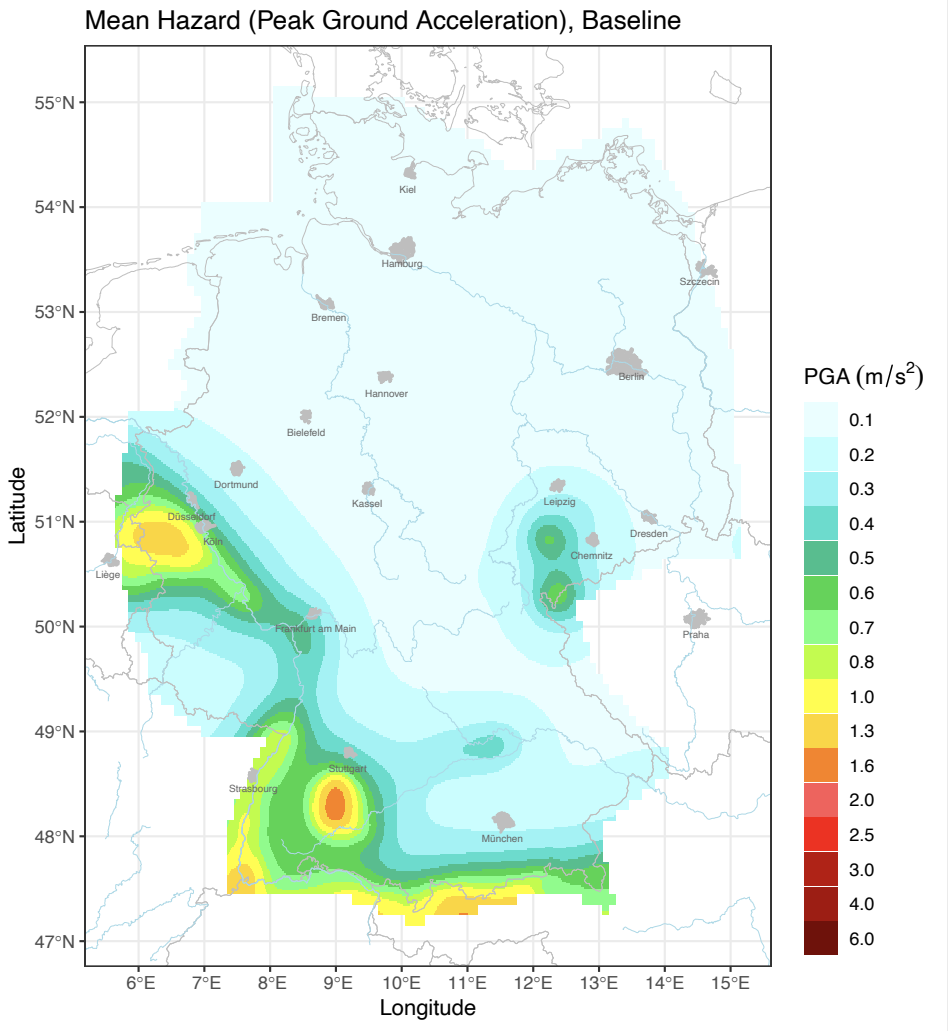
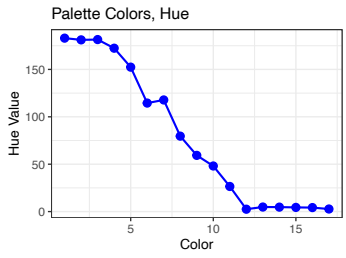
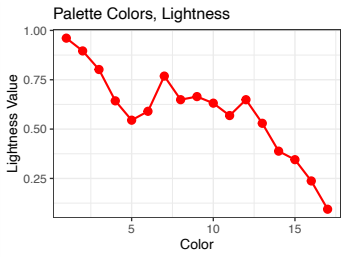
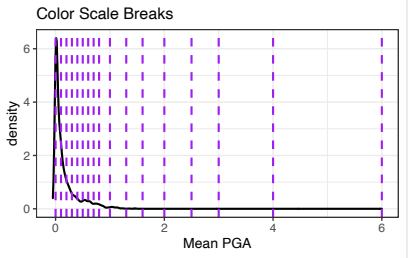
Rainbow color palette does not preserve....

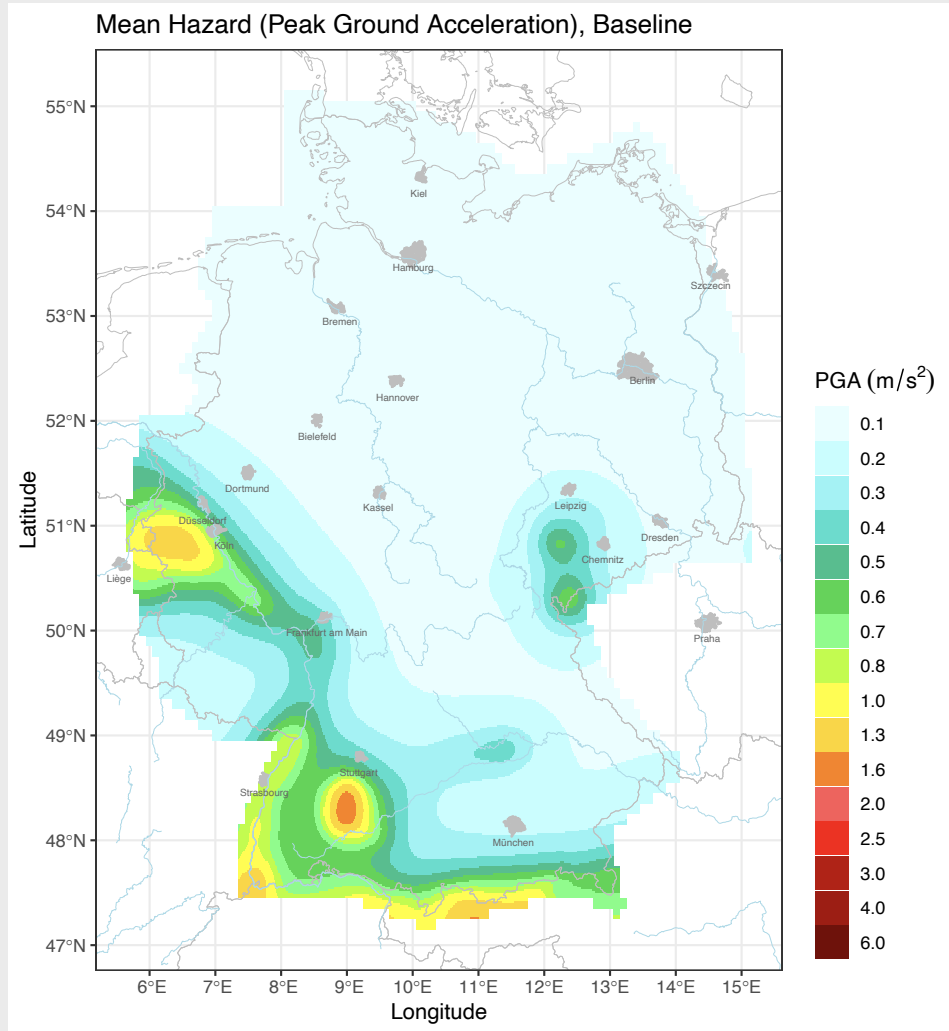
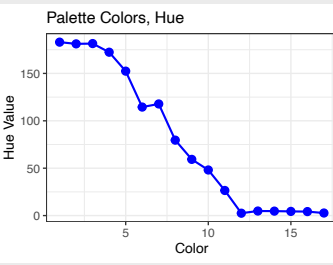
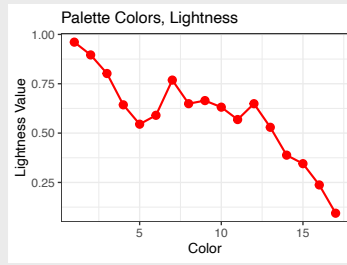
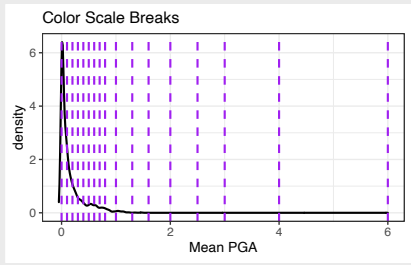
... **color perceptual uniformity**. This is (largely) determined by color's hue and lightness (value)



Crameri et al. (2020), Nature, Figure 4

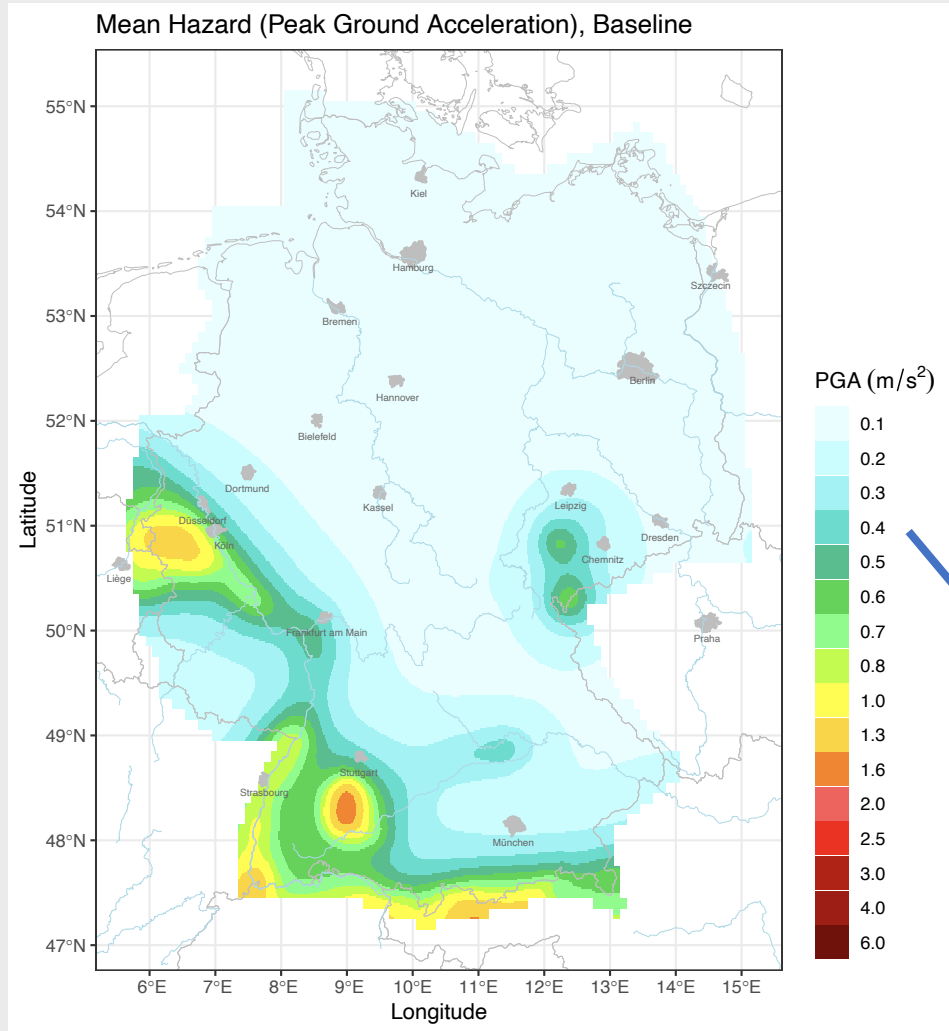
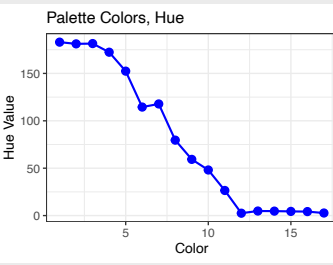
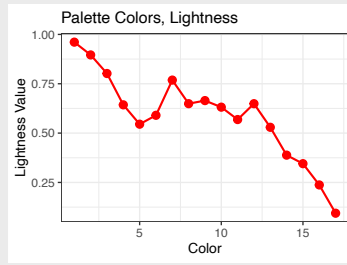
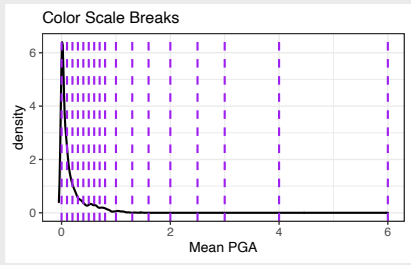
... **color order**. No single intuitive order as colors progress through palette





Key hazard principles to communicate:

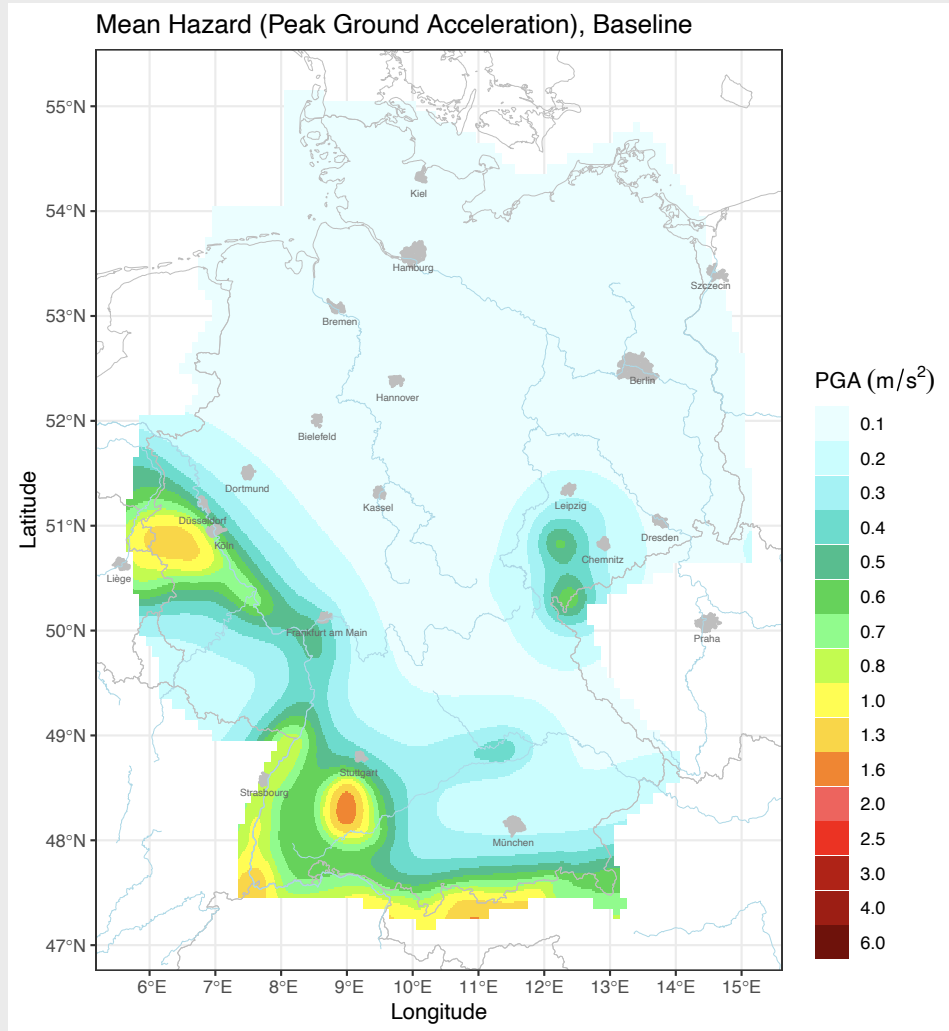
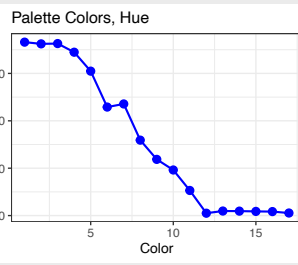
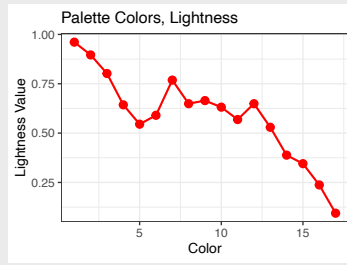
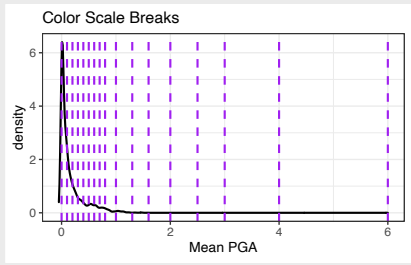
1. Seismic hazard (shaking) is not spotty but rather, changes continuously in space.
2. Seismic hazard areas are not limited to where earthquakes have occurred during time-limited earthquake catalogs.
3. The highest end of the hazard distribution has a large impact on expected losses and extreme hazard differs from high hazard.
4. Spatial patterns of hazard may be more important (for awareness) than the specific magnitude of the hazard.



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Also need to spotlight $PGA=0.4 \text{ m/s}^2$, hazard level where German seismic building codes must be applied



We contribute....

- New **scale breaks** to resolve
 - Consistent/meaningful breaks
 - Spotty/concentrated hazard

- New **color palette** to resolve
 - Color connotations and order
 - Perceptual non-uniformity
 - Discriminability

