

Blending with Intent: Color Design for Bivariate Thematic Maps

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Abstract:

Geographic phenomena are rarely shaped by a single factor, and yet thematic maps have traditionally displayed one variable at a time, leaving the relationships between variables to the reader's imagination. Bivariate maps offer a more expressive alternative by encoding two variables simultaneously through a blended color scheme, which allow viewers to immediately perceive spatial relationships, detect correlations, and identify anomalies that would remain hidden in separate maps. Despite their power, bivariate color schemes are frequently misunderstood or avoided by practitioners who find the design process intimidating. This presentation demystifies that process and provides a practical, teachable framework for constructing bivariate color schemes.

A bivariate color scheme is built on a grid — typically 3×3 or 4×4 cells — where tone encodes quantity (light for low values, dark for high) and hue encodes identity (one color per variable). The corners of the grid anchor the design: each represents a pure extreme of one variable, and the blended corner where both variables peak defines the most visually striking combination. Intermediate cells are then interpolated to create a perceptually smooth gradient across the surface. The number of grid steps reflects a practical trade-off: more steps add nuance but reduce the visual distinctiveness of individual classes, making legend interpretation harder for map readers. Knowing when to use a 3×3 versus a 4×4 grid is itself a meaningful design decision, one that should be driven by the complexity of the data and the needs of the intended audience.

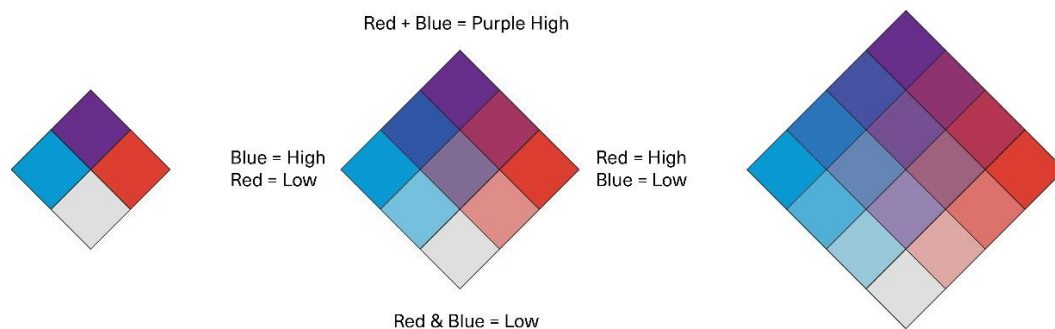


Figure 1. Examples of bivariate grids with simple color blends.

Crucially, the framework taught here is not about mechanical interpolation, it is about perceptual intent. Cartographers are encouraged to adjust blended colors so they appear visually coherent and carry meaning, even when they deviate slightly from mathematically exact mixtures. Color symbolism plays a central role: deliberately choosing hues that reinforce the narrative embedded in the data. For example, a blue-to-orange scheme for a map (see below top) about water demand and blue water availability is communicated through warm, dry tones and cooler, water-rich colors which make patterns of stress and balance easy to interpret. Another water related example (see below bottom) is a turquoise blue-to-purple palette which evokes flooding for a map of storm risk, which has the deepest colors naturally draw the eye to zones where storm frequency and intensity collide. Both examples illustrate how a well-chosen palette does more

than organize data, it shapes the reader's understanding of the map before a single legend entry has been consulted. When hue works with the data story rather than against it, cognitive load is reduced and map reading becomes more intuitive.

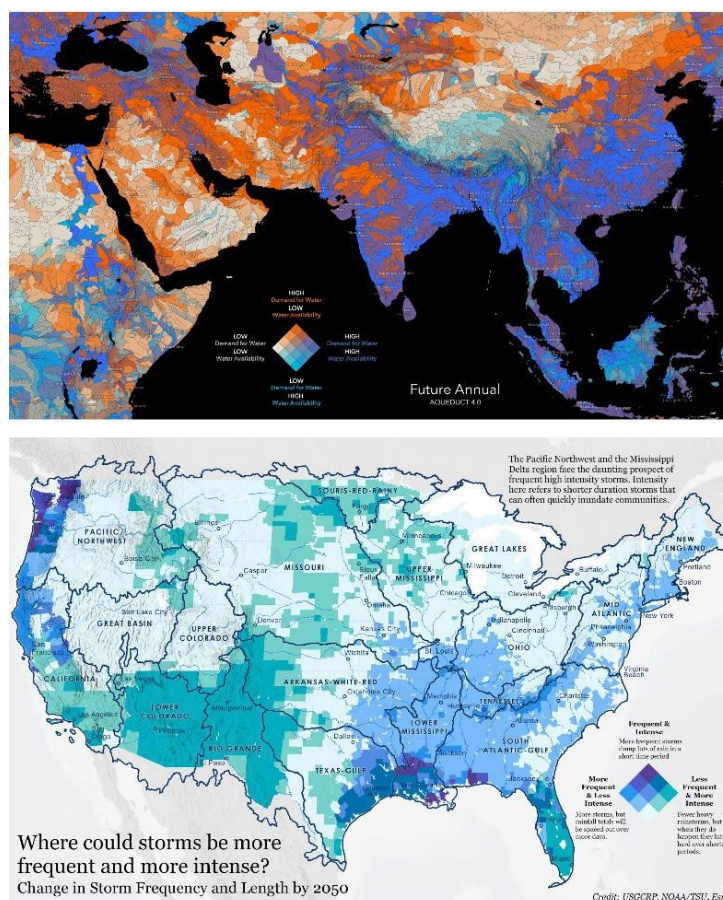


Figure 2. Two water themed bivariate map examples.

The presentation also addresses the workflow for implementing custom bivariate schemes in ArcGIS software and Adobe Illustrator. Working through layers from the ArcGIS Living Atlas of the World, participants will develop an understanding of how to iterate on color choices after seeing a scheme applied to real data. This is a step that almost always necessitates adjustments the cartographer could not anticipate during the initial design phase, and one that is central to building confidence and judgment in bivariate map design.

This presentation is designed to be accessible to cartographers and GIS practitioners at all levels. Whether participants are encountering bivariate mapping for the first time or looking to strengthen their color design instincts, the step-by-step design framework, grounded in real cartographic examples, provides an applicable and transferable skill set for producing maps that are both meaningful and effective. Participants will leave with practical techniques they can apply to their own data and design challenges.

Acknowledgement

Andrew Skinner; Esri ArcGIS Living Atlas

Reference

<https://www.esri.com/arcgis-blog/products/arcgis-living-atlas/mapping/building-a-bivariate-color-scheme>