



MINIMUM SPANNING TREE RANK HISTOGRAMS: AT WHAT SCALES ARE NWP ENSEMBLE FORECASTS RELIABLE?

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The minimum spanning tree (MST) rank histogram allows verification in high dimensional spaces, including those of the multi-dimensional verifications for numerical weather prediction (NWP) forecasts. Given a set of n points in an m -dimensional space, a spanning tree is a collection of $n - 1$ pairs of points (branches) such that all points are used at least once. Defining a metric on the space (the choice of this metric, or norm, is of critical importance) associates with each tree a length, specifically the sum of the distances of each branch in the tree. The spanning tree with the smallest length is the minimum spanning tree. We compare and contrast the traditional 1-d rank histogram with rank histograms based on the MST and on bounding boxes. In particular we ask the question "at what scales and for what norms are ensemble forecasts reliable?"