

Mapes, B., 2021: Toward form-function relationships for mesoscale structure in convection. *J. Meteor. Soc. Japan*, **99**, 847–878.

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**Plain Language Summary:** Mesoscale patterns are always observed in convective cloud fields. But there is a gap in theory and understanding about whether and how these patterns matter to the larger-scale weather in its entirety. This review essay spotlights that gap, and offers a formal framework for research to address it. Could patterns and textures, detected by imagery artificial intelligence, become a tangible and useful new form of semi-quantitative data? Perhaps, but only if we can better understand what the patterns signify.



Figure 1: This painting from the pre-satellite era imagined how the Earth would look from above. Cumulus and synoptic weather scales, prominent in theory, were well represented. I suggest that the lack of mesoscales is indicative of our lack of fundamental form-function knowledge about their importance. The painting was commissioned in 1954 by Dr. Henry Wexler, director of research for the US Weather Bureau.

- Form and function are defined, and form-function relationships are reviewed, with older science disciplines as models.
- Hypotheses from the literature about how mesoscale patterns affect convection’s impacts and interactions are reviewed.
- A framework for categorizing research approaches is staked out, and scientific gaps and opportunities are highlighted.