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Breaking down the contribution of different meteorological mechanisms

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Several mechanisms are held responsible for extreme atmospheric moisture into the Arctic - our case study - : extratropical cyclones, breaking Rossby waves, blocking events, etc. Based on composite analysis, all these phenomena have been associated with above average meridional moisture transport. These individual conclusions call for a synthesis in order to share the credit between the different mechanisms. However, it is impossible to break down the respective contributions by simply using their composites due to the risk of double counting. Indeed, the different phenomena may occur simultaneously and have overlapping regions of influence. As a result, building composites for one phenomenon will likely count in a portion of the others as well.

This ambiguity is raised within a probabilistic framework by viewing composites as conditional expectations. For a given event A, the composite is written as the sum of each event's contribution weighted by the event's conditional probability given A. The composites for a set of events can be interpreted as a linear system whose coefficents are conditional probabilities and whose solution is each event's individual contribution.

Using data from ERA Interim and cyclone tracks from the Shirshov Institute of Oceanology, we solve the linear system in the case of moisture transport through 70°N. The main result is to downgrade the collective influence of extratropical cyclones due to the predominance of weak inconsequential cyclones. Transient eddies are nonetheless responsible for more than 90 % of the transport : it undermines the common but untested assumption that transient eddies are identical to extratropical cyclones.