A New Climatology for Investigating Storminess Influences on the Extratropics

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**Overview**

**What is this MCMS?**

MCMS stands for the MAP Climatology of Mid-latitude Storminess dataset. Mid-latitude storminess in this case means the area confined to the sea level pressure (SLP) depression around a mid-latitude baroclinic cyclogenesis (or just cyclone). MCMS rests on two operations: 1) finding and tracking cyclones and 2) objectively delineating the area under each cyclone’s influence (storminess). These operations are elaborated below.

**Why make MCMS?**

Because cyclones are a primary weather-maker outside the tropics as well as a specific process that can be isolated in both observations and model results. Cyclone activity strongly shapes the distribution many quantities on both climatic and meteorological scales. Today’s climate models can in principle resolve basic cyclone features but they are unlikely to represent other key features such as fronts very well (Naud et al. 2010). Indeed, mid-latitude storm clouds are a key source of inter-model spread in climate sensitivity (Williams and Tselloulides 2007). Who might MCMS and for what?

The MCMS provides a detailed assessment of the areas under the influence of mid-latitude cyclones and those that are not. The temporal-spatial variability of storminess can be used to give phenomenological context or act as a screen for weather sensitive data. MCMS data will be made available for a variety of reanalysis products (e.g., NCEP/Reanalysis I and II, ERA-40, ERA-Interim, MERRA). The software for working with this MCMS data will also be made available, as will the source code to allow the creation of new MCMS datasets from climate model output or other numerical analyses.

**Our Approach**

**Center Finding**

MCMS uses the most popular method for locating cyclones: as depressions in the sea level pressure (SLP) field. All its most basic level means scanning the SLP field for local minima (an in time independent manner) and then refining the list of potential cyclones with additional criteria. This process ignores some open-wave cyclones which is why MCMS alters the conventional minima finding method to exclude only SLP maxima and then apply extra scrutiny to isolate likely cyclones. MCMS also employs a unique method for limiting the effects of SLP noise in over high or steep topography which allows for the retention of more cyclones over these areas that conventional methods allow.

**Center Tracking**

With the centers now identified we then attempt to associate them into cyclone tracks via nearest neighbor and other similarity arguments. For this MCMS defines a dissimilarity score for each potential connection. This score is based on a preference for connections with relatively small changes in track course, SLP and position. A connection is made for the connection with the lowest dissimilarity score. Multiple potential connections are rare events (~5% of cases), which mean that the primary tracking problem of MCMS is to determine whether to extend an existing track or terminate it and begin a new one. The last step of the tracking process ensures that retained tracks meet certain turntable criteria (e.g., minimum travel and duration).

MCMS retains a record all discarded centers, and the reason for their rejection, which is useful for refining the method as understanding how various criteria impact the final results.

Continue to “Defining Storminess.”

**Application/Examples**

**Example of MCMS Compositing:**

Composites a) shows the climatologically likely that a given point in the composite domain is enclosed by the outer most SLP contour of the cyclone being composited (i.e., storminess).

Composites b) shows the the climatological likelihood that a given point in the composite domain falls within the storminess area of a cyclone other than the one being composited.

Composites c) shows the climatological SLP composite collected in the conventional manner of centering the composited domain over each cyclone center.

Composites d) shows a hybrid SLP composite, which differs from a conventional composite in that the cyclone storminess from cyclones other than the one being composited are masked to reduce the contamination of multiple cyclones within the composited domain. Multiple cyclone centers are allowed in this case when they are linked by shared contours (e.g., ATTS).

**Example of MCMS Filtering:**

MCMS data can be used to contextualize or screen the presence of cyclone activity.

Here we show various views of recent cyclone activity near a fictitious ARM site in New York City (NYC) defined by the outermost SLP contour of the cyclone being composited. The final composites are centered over New York City for scale. The data comes from the NCEP/MC station (i.e., and then all points that are enclosed by multiple contours unique to a single center are composited).

**About the MCMS datasets and software:**

To encourage these works MCMS data from several reanalysis efforts will be made publicly available (e.g., NCEP/Reanalysis I and II, ERA-40, ERA-Interim, MERRA). MCMS data files come in the form of specially formatted plain text files.

Although this formatting is well documented and easily expressed in most programming languages, MCMS provides a number of tools for manipulating the datasets and source code. While MCMS is written the python programming language, MCMS provides a number of tools for manipulating the datasets and source code. Although this formatting is well documented and easily expressed in most programming languages, MCMS provides a number of tools for manipulating the datasets and source code. Although this formatting is well documented and easily expressed in most programming languages, MCMS provides a number of tools for manipulating the datasets and source code. Although this formatting is well documented and easily expressed in most programming languages, MCMS provides a number of tools for manipulating the datasets and source code. Although this formatting is well documented and easily expressed in most programming languages, MCMS provides a number of tools for manipulate.

**References**

