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1.0 Data Set Overview:

Enhanced Bragg Scattering Layer (EBSL) Analysis[1] is an automated technique for detecting the average tops and bases of layers of enhanced Bragg scatter from individual S-band radar Plan Position Indicator (PPI) scans. EBSL edges are identified by sharp gradients in radar reflectivity when analyzing data with values lower than 12 dBZ for this data set. Appropriate data will have alternating rings of higher and lower reflectivity values. Bragg scattering is inferred by virtue of reflectivity values, so independent confirmation from ancillary data is always advised (refer to references below for more detailed information about EBSLs and this process).

This data set consists of EBSL top and base altitude estimates for the NCAR S-Pol radar (5 km SW of McCracken, KS / 20 km W of La Crosse, KS: 38.5534706° Lat., -99.5361099° Long., 660 m Elev.) during the Plains Elevated Convection at Night (PECAN) field campaign (22 May 2015 - 16 July 2015). Real-time plot movies and quick-looks from the project are available online on the PECAN field catalog hosted by NCAR (http://catalog.eol.ucar.edu/pecan/radar). Date selection for these movies/plots can be made from the Choose Other Date link next to the calendar icons in the screen centers at either the top or bottom of the page. The corresponding data plots can be found by scrolling down to the appropriate radar and clicking on one of the Bragg Scattering Layer 24hr Plot links.

[1] The name of this technique in all past work is "Bragg Scattering Layer" (BSL) analysis. It has been changed to "Enhanced Bragg Scattering Layer" (EBSL) analysis to acknowledge the common occurrence of Bragg scattering throughout the lower atmosphere and to clarify that this technique targets the better-developed or "enhanced" layers.

2.0 Instrument Description:

Please refer to https://www.eol.ucar.edu/content/s-pol-users-guide-pecan for more information about the S-Pol radar and its operation during PECAN.

3.0 Data Collection and Processing:

An EBSL scan-mean top and base is found for each EBSL within all PPI scans with average elevation angles > 4.75 and < 12 deg. The EBSL tops are denoted by [*topsplus4*, *topsplus*] and the bases by [*topsminus4*, *topsminus*[2]], and elevations are given in [m above ground at the radar site]. A single scan generally has more than one EBSL, so multiple altitude estimates are common for a single scan. Convention is that the EBSL tops are plotted in red and the bases in blue. Because these estimates are scan averages, things like inhomogeneous layers, non-sharp transitions into and out of EBSLs, or false EBSL detections (etc.) can prevent the tops and bases from being perfectly partnered (ie., a base for every top or vice versa). Both the 4th [*topsplus4, topsminus4*] and 5th [*topsplus, topsminus*] level wavelet iteration processing were used, with the former being able to resolve thinner and/or weaker EBSLs and the latter being less noisy (refer to Davison et al. 2013 for details).

4.0 Data Format:

With the exceptions of data from 22 – 25 May (which have a single data file per day), there is one data file per radar volume. An example is: PECANlayerdata12dbz20150716185124.mat, where PECAN references the project, 12dbz references the maximum reflectivity value included in the analysis, the numbers are the yyyymmddHHMMSS start date and time of the radar volume, and the .mat indicates that the files are in Matlab data format.

There are seven variables in each file: *dateTimeStamp, radarDateNum, timeStamp, topsplus, topsplus4, topsminus,* and *topsminus4*. Each variable has [1 x *# of valid elevation angle scans in volume*] dimensions. For the 22 – 25 May, the variables are the

[2] Naming convention has to do with analysis choices and does not refer to the EBSLs themselves.

same as described below except they have [*# of volumes per day* x *# of valid elevation angle scans in volume*] dimensions. For the majority of the volumes on these days, there is only a single valid elevation angle. For these days, zeros are used for place-holder values for missing data / empty slots. The data for these days can best be plotted using the following (or similar) Matlab code:

```
figure
hold all
for n=1: size(timeStamp,1)
plot(timeStamp(n,1),topsminus{1}(n,:),'.b')
plot(timeStamp(n,1),topsminus4{1}(n,:),'.b')
plot(timeStamp(n,1),topsplus4{1}(n,:),'.r')
plot(timeStamp(n,1),topsplus{1}(n,:),'.r')
end
axis([0 24 0 8000])
```

dateTimeStamp is of type *double* and gives the same numeric sequence, yyyymmddHHMMSS, as the start date-time of the volume, given as the first date-time string in the original (field version) of the NCAR radar file names. *Note that *dateTimeStamp* contains multiple instances of the same value*. Times are given in UTC.

radarDateNum is of type *double* and is the serial date number of the start date-time of the radar volume (the same as in *dateTimeStamp*). It is generated using the *datenum* command in Matlab. **Note that it contains multiple instances of the same value, unlike the NWS versions of EBSL analysis for PECAN**. Using the command: *datestr(radarDateNum)* in Matlab will reverse this and produce a recognizable date and time string like *16-Jul-2015 07:18:29*. Refer to Matlab online help for more information about *datenum* and *datestr*. Times are given in UTC.

timeStamp is of type *double* and gives the scan time in hours UTC (with minutes and seconds in fractional form). Time is determined by taking the volume start time and adding the number of seconds since the volume start for the first beam of the new scan angle (from NCAR's variables *time* and *sweep_start_ray_index*). Since each scan has a unique scan time, elevation angle can be determined definitively by this time, but can also be inferred by elevation angle sequence order for all elevation angles in the volume > 4.75 and < 12 deg.

topsplus4, *topsplus*, *topsminus4* and *topsminus* are of type *cell*. This means that each column of data can house a different number of data points (which reflect the number of scan-mean EBSL edge detections for that variable and scan). Refer to Matlab's online documentation for more information on the *cell* data type.

5.0 Data Remarks:

All data files are in Matlab (.mat) format. **If using this data, please include proper acknowledgement by referencing:**

DOI: 10.5065/D6KD1W9H

Sample citation following ESIP guidelines:

Davison, J. 2017. S-Pol Enhanced Bragg Scattering Layer Data. Version 1.0. UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.5065/D6KD1W9H. Accessed 25 Jan 2017.

For additional citation styles see the bottom of the NCAR/EOL data set page:
https://doi.org/10.5065/D6KD1W9H

6.0 References:

https://www.eol.ucar.edu/projects/pecan/documents/UsingBSLdiagrams.pdf

https://www.eol.ucar.edu/content/s-pol-users-guide-pecan and page-listed references

Davison J. L., R. M. Rauber, and L. Di Girolamo, 2013: A revised conceptual model of the tropical marine boundary layer. Part II: Detecting relative humidity layers using Bragg scattering from S-band radar, J. Atmos. Sci., 70, 3025-3046.

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