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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 5 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 (Isle of Hithadu in the Addu Atoll, Maldives – also known as the Gan Site: -0.630447° Lat., 73.102766° Long., 10 m Elev.) during the Dynamics of the Madden Julian Oscillation (MJO), or DYNAMO, field campaign (01 October 2011 - 16 January 2012). New quality control practices for the finalized S-Pol dataset, namely the replacement of very low reflectivity values with placeholder values, was problematic for the EBSL algorithm. For this reason, the quality controlled field version of this data (NCAR's *DBZ_F* variable) was used for the EBSL analysis. Due to the intensity of sidelobe noise present in the original data, additional statistical filters were applied to the EBSL results to help eliminate false EBSL detections (Davison 2015).

[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/projects/dynamo/spol/SpolKa_DYNAMO_UsersGuide.toc.html
for more information about the S-Pol radar and its operation during DYNAMO.

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 between 3.5 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:

For this data set, there is a single data file per day. An example is: DYNAMOlayerdata5dbzfRHIfilt20111001.mat, where DYNAMO references the project, 5dbz references the maximum reflectivity value included in the analysis, RHIfilt indicates that statistsical filters based on the RHI EBSL analysis have been applied to the data (Davison 2015), the numbers are the data's date in yyyymmdd format, and the .mat indicates that the files are in Matlab data format.

There are ten variables in each file: *dateTimeStamp, spacingcomp, spacingcomp5, timeStamp, topsplus, topsplus4,*

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

topsminus, topsminus4, wavecompfast, and *wavecp5fast*. *topsplus, topsplus4, topsminus, topsminus4, wavecompfast,* and *wavecp5fast* each have [1 x *# of valid elevation angle scans in volume*] dimensions and are of type *cell*. *dateTimeStamp* and *timeStamp* have dimensions of [*# of volumes per day* x *# of valid elevation angle scans in volume*] dimensions. s*pacingcomp* and *spacingcomp5* have dimensions of [1 x *# of data points remaining after carrying out the modified wavelet portion of the EBSL analysis*] (Davison et al. 2013). ****Zeros are used for place-holder values for missing data / empty slots**.**

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

spacingcomp and *spacingcomp5* are of type *double*, and are for use with the 4^{th} and 5^{th} wavelet iteration processing, respectively. They denote the distance from the radar in an along beam sense and are given in [km]. They allow for matching the *wavecompfast* and *wavecp5fast* variables to projections of the original radar data. These variables are fixed constants, and were determined by the number of range gates chosen for use in the EBSL analysis and the range gate spacing (150 m) for S-Pol.

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 appropriate elevation angles

in the volume. ********Note: These times are currently ahead by ~ 5min*****.** Original start time in the algorithm was taken from the file name, but for the DYNAMO field version files, only the volume end time was given in the file name. Therefore, the seconds since the volume start were added to the wrong time. This will be corrected in a future version.

topsplus4, *topsplus*, *topsminus4* and *topsminus* are of type *cell*. Refer to Matlab's online documentation for more information on the *cell* data type. Each location in these variables houses a matrix of type *double* with dimensions [*# of volumes per day* x *# of valid EBSL edge estimates of that type for that wavelet iteration level for that elevation angle scan*].

wavecompfast and *wavecp5fast* are of type *cell*, with each location in these variables housing a matrix of type *double* with dimensions [*# of volumes per day* x *# of data points remaining after carrying out the modified wavelet portion of the EBSL analysis*]. These variables house individual scan-mean results—the maxima and minima of which are used to identify the along-beam location of the EBSL edges. They are given by $\bar{g}_4(r)$ and $\bar{g}_5(r)$ in Davison et al. (2013), which can be referred to for more detail.

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/D6FN14K5

Sample citation following ESIP guidelines:

Davison, J. 2017. S-Pol Enhanced Bragg Scattering Layer Data for Field QC'd PPI Data, with Statistical Filters Applied. Version 1.0. UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.5065/D6FN14K5. Accessed 31 Jan 2017.

For additional citation styles see the bottom of the NCAR/EOL data set page:
https://doi.org/10.5065/D6FN14K5

6.0 References:

https://www.eol.ucar.edu/projects/dynamo/spol/SpolKa_DYNAMO_UsersGuide.toc.html and page-listed references

Davison, J. L., 2015: A filter for removing sidelobe artifacts in Bragg Scattering Layer (BSL) analysis for S-Band radar. *J. Atmos. Oceanic Technol.*, **32,** 1289-1297.

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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