On Using the NOAA AVHRR "Experimental Calibrated Biweekly Global Vegetation Index"

Remote Sensing Brief

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Abstract

Several types of real and potential error in the current biweekly Experimental Global Vegetation Index (EGVI) distributed by the National Geophysical Data Center (NGDC) are described. The real errors are related to duplication of files among years. The potential errors arise from problems in resampling that are associated with transferring data between two types of projections. The failure to recognize and address these problems will lead to serious analytical error and false inferences.

Introduction

The National Oceanic and Atmospheric Administration (NOAA) Global Vegetation Index (GVI) product derived from visible and near-infrared Advanced Very High Resolution Radiometer (AVHRR) channel data is widely used in ecological and climatological research. This note concerns the biweekly Experimental Global Vegetation Index (EGVI) that is distributed by the National Geophysical Data Center (NGDC), NOAA on the CD-ROM labeled *Global Change Data Base, Volume 2. Experimental Calibrated Biweekly Global Vegetation Index from NOAA AVHRR, 1985-1991. Disk 1 of 1: Version 1.0; June 1992.* The EGVI was produced by the National Environmental Satellite, Data, and Information Service (NESDIS) of NOAA. This database was developed to improve the usefulness of NOAA GVI data by utilizing pre-launch calibrations and screening for low sun angle and cloud contamination (Gallo, 1992). While using the EGVI in our research, we have encountered significant errors in the database as well as inherent properties of the data that may also lead to error, both of which should be communicated to current and potential users of this dataset.

Errors in Image Files

The current NGDC version (1.0) of the EGVI dataset includes numerous duplications of biweekly image files among years. First, the image files for 1985 are a duplication of the first 19 biweekly image files from 1986. Specifically, the image files *bw8516.img* and *bw8602.img* are the same, *bw8518.img* and *bw8604.img* are the same, and so on for the remaining 17 biweekly periods. Second, three image files from 1988 are also incorrect, having been duplicated from image files in 1987. In this case, the image file pairs that are identical are *bw8726.img* and *bw8822.img*, *bw8728.img* and *bw8824.img*, and *bw8730.img* and *bw8826.img*. We have established that 1985 and 1988 are the duplicate years (NGDC, personal communication, 1994). The biweekly image files that contain erroneously duplicated data are shown in Table 1. Failing to recognize the duplication (and missing data) will lead to serious analytical errors and false inferences.

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TABLE 1. BIWEEKLY IMAGE FILES THAT CONTAIN ERRONEOUS DATA

Year			
1985			1988
bw8516.img	bw8530.img	bw8542.img	bw8822.img
bw8518.img	bw8532.img	bw8544.img	bw8824.img
bw8520.img	bw8534.img	bw8546.img	bw8826.img
bw8522.img	bw8536.img	bw8548.img	
bw8524.img	bw8538.img	bw8550.img	
bw8526.img	bw8540.img	bw8552.img	
bw8528.img			

Row Duplication Due to Resampling

We have also discovered that the method by which the EGVI was mapped and resampled using two map projections lends itself to errors in image processing. Moreover, the potential for this is not readily evident in the supporting documentation. The source data for the EGVI is the NOAA weekly GVI data. NOAA/NESDIS processes AVHRR sensor GVI daily data using the Plate Carreé projection for the base map. The Plate Carreé projection is a latitude/longitude projection where the east/west (here, designated as the x dimension) spatial resolution of the pixels decreases towards the poles (because lines of longitude are distorted), while the north/south (here, designated as the y dimension) spatial resolution remains the same. The daily images from the Plate Carreé projection are then composited into weekly maximum images and are remapped to the Mercator projection. The Mercator projection has the same longitudinal distortion as the Plate Carreé. Therefore, the x dimension in both projections decreases at a proportionally equal rate towards the poles. Unlike the Plate Carreé, however, the Mercator projection y dimension diminishes towards the poles, decreasing at the same rate as its x dimension (because the lines of latitude are also distorted in the Mercator, and at the same rate as the longitude distortion). In sum, the Mercator projection decreases in both the x and y dimensions towards the poles, whereas the Plate Carreé decreases in the x dimension but has a constant y dimension. To illustrate the change in pixel size towards the poles (Figure 1), the y dimension of a pixel in the Mercator projection, as established by NOAA/NESDIS, is 19.6 km at the equator, larger than the constant 16-km y dimension of the Plate Carreé projection. However, at higher latitudes, 55 degrees for example, the Mercator y dimension decreases to 11.3 km, and at 75 degrees of latitude it is 5.1 km.

NOAA/NESDIS resamples to the Mercator projection by

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0099-1112/96/6208–959$3.00/0

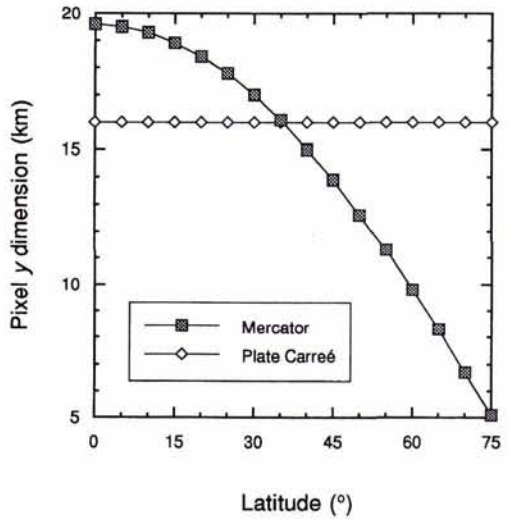

Figure 1. The variation of the pixel *y* dimension over latitude for Mercator and Plate Carreé projections. Plate Carreé pixels have a constant *y* dimension, whereas the Mercator pixels decrease in *y* dimension with increasing latitude.

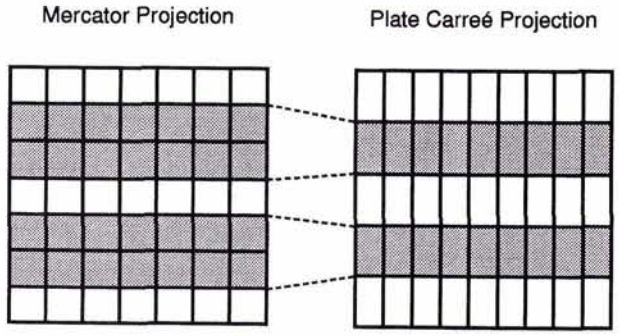

Figure 2. Illustration of resampling problem from Plate Carreé projection to Mercator projection. More than one row of Mercator pixels can be sampled from a single row of Plate Carreé pixels when the Mercator pixel *y* dimension is smaller than the Plate Carreé pixel *y* dimension.

calculating the location of each Mercator pixel on the Plate Carreé projection and transferring the corresponding pixel value to the Mercator projection (Kidwell, 1990). At higher latitudes, where the Mercator pixel *y* dimension has decreased to less than that of the Plate Carreé, more than one row of Mercator pixels can receive the same NDVI values from a single row of Plate Carreé pixels (Figure 2). In the EGVI Mercator images, successive rows with the same NDVI values occur at latitudes greater than approximately 37 degrees, where duplicate rows first appear. The frequency of duplicate rows increases as one advances towards the poles, and at latitudes greater than 67 degrees triplicate rows occur. One instance of four successive rows with the same pixel values occurs near the top rows of the EGVI images, at 74.5 degrees. In total, we found 163 instances of repetition (133 double, 29 triple, 1 quadruple) that occur at the same row locations in all 175 biweekly image files. In view of this problem, one must ensure that samples are taken from only one row of each group of successive repeating rows in the database.

Concerns for Monthly EGVI Product

Our research and this note are mainly concerned with the biweekly EGVI; however, a cursory examination indicated that image file duplication among years also existed in the monthly EGVI dataset. Each monthly EGVI image file is a monthly maxima derived from a pair of biweekly EGVI image files. The monthly image file *m8806.img*, derived from biweekly image files *bw8824.img* and *bw8826.img*, contains erroneous data. It is a duplicate of monthly image file *m8707.img*, derived from biweekly image files *bw8728.img* and *bw8730.img*. We also suspect that the monthly image file *m8805.img*, derived from biweekly image files *bw8820.img* and *bw8822.img*, is a partial duplicate of monthly image file *m8706.img*. However, this cannot be readily discerned as only the second of the two biweekly image files from which *m8805.img* is derived was duplicated in the biweekly database. The 1986 to 1985 image file duplications in the biweekly EGVI product do not appear to have been transferred to the monthly EGVI product.

We believe that there also exists the possibility for row and column duplication in the monthly EGVI. The monthly EGVI has been remapped to a latitude/longitude projection. The monthly remapped images contain 42 more rows and 112 more columns than in the biweekly images that they were derived from. The additional rows and columns in the monthly images suggests that there will be instances of duplicate columns and additional instances of duplicate rows in the monthly EGVI. Researchers working with the monthly EGVI data should further investigate these errors.

We have communicated our findings and concerns to the NGDC; they are planning a release of a corrected version of the Global Change Data Base, Volume 2 CD-ROM. Researchers using the NOAA GVI dataset or products derived from it, such as the EGVI, are directed to Goward *et al.* (1993) for a detailed assessment of problems associated with the NOAA GVI product itself, including properties of the base map projections.

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References

Kidwell, Katherine B., 1990. *Global Vegetation Index Users Guide*, Satellite Data Services Division, National Climatic Data Center, National Oceanic and Atmospheric Administration, Washington, D.C., 45 p.

Gallo, Kevin P., 1992. Experimental biweekly global normalized difference vegetation index from NOAA's AVHRR (April 1985-December 1991). Digital Data, *NOAA Global Change Data Base, Volume 2; Experimental Calibrated Global Vegetation Index from NOAA's Advanced Very High Resolution Radiometer, 1985-1991; Version 1.0*, National Geophysical Data Center, National Oceanic and Atmospheric Administration, Boulder, Colorado.

Goward, S.N., D.G. Dye, S. Turner, and J. Yang, 1993. Objective assessment of the NOAA global vegetation index data product, *International Journal of Remote Sensing*, 14(18):3365–3394.

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