# The Character of Discontinuities in MERRA Reanalysis and Some Preliminary Homogenization Results

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Discontinuities in time series commonly show in reanalysis datasets due to changes in observing system. The resulted temporal inhomogeneity is a major obstacle to apply reanalysis data in climate researches, especially trend researches. In this study, we aim to indentify the temporal discontinuities in NASA MERRA reanalysis, and to minimize the discontinuities caused by major changes in the observing system.

First, we quantitatively assess the discontinuities in MERRA reanalysis and reveal their connection with the changes in observing system. We use a sequential discontinuity detection method to indentify the discontinuities in the grid level time series of major state variables, thus obtaining a comprehensive picture and objective assessment of discontinuity in MERRA. By comparing the discontinuity information with detailed evolution history of the global observing system, the connections between the two are identified.

Then the MERRA data is augmented with several reanalysis segments each being performed for a period of a few months to two years when a major observing system change happens. Each of these reanalysis segments will be similar to the corresponding segment of original MERRA, except that the newly introduced observation data type is excluded. By comparing these Observing System Experiments (OSE) with original MERRA streams, impacts of the changes in observing system will be investigated and identified for many physical and dynamical parameters, and corrections to minimize the impacts will be produced. The corrections or patches could be constructed with variety methods, including simple offset method, more sophisticated statistical methods, for example, cumulative distribution function matching in one or more dimensions, and biases correction in model side. With the patches, the MERRA data before each ROSS run will be adjusted to offset the difference caused by the change of observing system. That is, MERRA data will be homogenized to match the latest MERRA data, which obtains the best quality with most recent advanced observations.

The preliminary homogenization result is encouraging, even with simple offset method. We will show how much the homogeneity of the reanalysis time series being improved after the initial homogenization and the corresponding change of the trend before and after the correction.

Future work and possible research topics based on homogenized MERRA will also be discussed.

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