

深層学習を用いたMGS/MOC画像における火星ダストストーム領域の自動抽出

Automated segmentation of Martian dust storms in MGS/MOC images using a deep learning technique

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The shape, texture, and size of dust storms and the climatology of these characteristics are important clues to understanding Martian dust storms. The relations between such characteristics and the phases of the variety of atmospheric waves as well as the frequency of textured/curvilinear dust storms and the spatial and seasonal variations of the cumulative area are also worth investigating (Wang 2007; Wang et al. 2011; Guzewich et al. 2015, 2017). However, it is time-consuming to detect all dust storms visually because of the vast number of images taken by just two instruments, the MGS/MOC and MRO/MARCI. It is also difficult to objectively define which features characterize dust storms. Even approximate categorization of dust events into textured dust storms, untextured yet discrete dust storms, and haze depends on the subjective experience of the human observer. For these reasons, visual detection and categorization of the three types of dust storm textures introduced by Kulowski et al. (2017) would not be exactly reproduced by another human viewing and characterizing the images. Furthermore, we perceive a need to update the criteria for detecting dust events, especially obscured ones such as untextured yet discrete dust storms and haze, via visual detection. Therefore, it would be useful to be able to automatically detect dust events, measure their shape, pattern, and size, and improve the objectivity and reproducibility of dust storm detection.

We have developed a novel algorithm for automated segmentation of Martian dust storms using an encoder-decoder type of Convolutional Neural Network. We can separate dust storm areas from the surface and cloud areas in subsets of the global swath images taken by MGS/MOC without any information from other instruments (e.g. MGS/TES). Assuming that segmentation based on authors' experience is the ground truth, 84% of the true dust storm areas in the Arabia Terra is recognized as dust storm. On the other hand, just 69% of the true dust storm areas in the Hellas Basin is correctly recognized as dust storm.

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