Effects of Hellas Basin on the meridional distribution of the Martian dust

Kazunori Ogohara[1]; Takehiko Satomura[2]

[1] Earth and Planetary Sci., Kyoto Univ; [2] Earth and Planetary Sci., Kyoto Univ.

1. Introduction

Dust exists to an extent in the atmosphere of Mars all year long and dust storms of various sizes occur on Mars. The largest dust storms that encircle the planet do not occur every year. It is observed that they tend to occur in between the southern spring equinox and the southern summer solstice in the region such as to the west of Hellas Basin, Isidis Planitia. Recently, the global dust storm in 2001 has been observed precisely over the whole of the lifetime by Mars Global Surveyor (MGS). According to MGS observation, the local storm which occurred at the southwest of Hellas moved northward for several sols along the west rim of Hellas with slow expansion and began to expand rapidly when dust clouds reached low latitudes [Strausberg et at., 2005]. Thus, it is suggested that the occurrence and expansion of global dust storms are depend heavily on the topography of the region where the dust storms occur and the season of the onset. However, the regionality and the seasonality are still hardly revealed and the interannual variation of Martian dust storms is not yet understand precisely. In this work, as the first step toward the comprehension of the regionality and the seasonality of global dust storms, we investigate the effects of the topography of Hellas on the expansion of dust with numerical experiments.

2. Experiments

Our model is GFD-Dennnou AGCM5.3 (the 3D primitive model on sphere) [SWAMP Project, 1998], which is changed to simulate the environment of Mars. But, the radiative process of AGCM5.3 is so simple that it is replaced by the radiative process of GFD-Dennou deepconv [Nakajima and Odaka, 2000].

We investigate the latitudinal distributions of mixing ratio of dust injected at the six different sources (P1-P6 in Fig 1.) both in case with the whole of topography (Fig 1.) and in case without the topography of Hellas. Calculation is performed for 20 sols from the southern spring equinox after spin up for one Mars year. The surface albedo is 0.6 (CO_2 ice cap) in 60S-90S and 0.25 in the other region.

3. Results

One of the results is that dust which arises at the middle and the south of Hellas does not expand vertically and latitudinally from Hellas. The dust mixing ratio in the atmosphere is smaller 16 sols after the injection of dust than in cases that dust is injected in lower latitudes and also than in cases without Hellas. Dust injected at the southwest of Hellas flowed northward along the rim of Hellas with southerly wind. This is consistent with Strausberg et al. [2005] and Newman et al. [2002]. It is confirmed in the meridional cross section at the longitude of the source that dust is not transported latitudinally as it piles up inside Hellas. In contrast, dust in lower latitudes ascends rapidly to expand into both hemisphere and much of it suspends in the atmosphere. However, while in cases without Hellas the shape of the dust mixing ratio curves are similar to them in cases with the topography of Hellas, the values are smaller than them in cases with the topography of Hellas. These results probably suggest that the topography of Hellas has the effect to prevent dust in the southwest of Hellas from spreading over other regions and the effect to encourage dust on the north of Hellas to expand.

Fig 1. The surface height used in this work. P1 to P6 indicate dust sources. Negative altitude is hatched. Contour interval is 1600 m.