Hindcast study of aerosol optical depth using retrieval of geostationary satellite over East Asia

S. LEE[1], C. H. SONG[1], M. E. PARK[1], R. S. PARK[1], J. LEE[2] AND J. KIM[3]

[1]School of Environmental Science and Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju, 500-712, Korea (noitul5@gist.ac.kr, *correspodence to chsong@gist.ac.kr)

[2]Aerosol and Cloud Group, NASA JPL, Pasadena, and JIFRESSE, UCLA, L.A., CA, USA

[3]Institute of Earth, Astronomy, and Atmosphere, Brain Korea 21 Program, Department of Atmospheric Sciences, Yonsei University, Seoul, Republic of Korea

Compared with the aerosol optical depth (AOD) retrievals from polar orbiting satellites, the AOD retrievals from geostationary satellites have a high temporal and spatial resolution. Because the number of AOD retrievals from geostationary satellites is increased, a better initial condition can be prepared for better aerosol forecast or hindcast. We carried out a hindcast study of AOD over East Asia to test the effects of the initial conditions prepared the AOD data from a geostationary satellite. The retrievals from the Geostationary Ocean Color Imager (GOCI) on board the Communication, Ocean, and Meteorological Satellite (COMS) were used in this study, and the retrieved AOD data were assimilated with the AOD values simulated by the Community Multiscale Air Quality Model (CMAQ). We assimilated the two data via an optimal interpolation (OI) technique, and the OI parameters of observation and modeling errors were calculated to minimize the variance of differences between assimilated and AERONET AODs. The AERONET AODs were selected within the period of Distributed Regional Aerosol Gridded Observation Networks DRAGON in Asia (DRAGON-ASIA) campaign, and were also used for comparison with the results of hindcast studies. The 6-hour hindcast result in selected days using the GOCI retrievals showed improved AOD distributions, compared with the AOD data from DRAGON-ASIA AERONET sites. Also, using GOCI and TERRA MODIS AOD retrievals, spatial coverage of satellite retrieval can be increased. 12-hour hindcast was also carried out using the combined GOCI-MODIS data sets.

Multi-component silicate glasses and melts under compression

SUNG KEUN LEE[1]

[1]School of Earth and Environmental Sciences, Seoul, 151742, Korea, sungklee@snu.ac.kr

Probing the pressure-induced structural changes and the extent of disorder in multi-component aluminosilicate glasses and melts at high pressure relevant to earth's inteiror remains challenge in mineral phsyics and high temperature geochemistry. Most of the previous studies focused on the pressure-induced bonding transition in rather simple model melts (e.g., from single-component, to ternary). Recent advances in element-specific experimental probe of local structures including non-resonant synchrotron inelastic x-ray scattering (IXS) and solid-state NMR unveil previously unknown structural details of the structural changes in the diverse multi-component silicate glasses under static and dynamic compression. This progress allows us to establish a systematic relationship between pressure, temperature, composition, and melt (and glass) structures. Here, we presnet an overview of the recent progress and insights by IXS and NMR into electronic structures of multi-component silicate glasses at high pressure. IXS study using shock compressed basaltic glasses allowed us to constrain topology-driven densification upon dynmaic compression. Contrary to an expected complexity in densification for multi-component silicate glasses, high-resolution O-17 NMR spectra for quaternary Ca-Mg- and Ca-Na aluminosilicate glasses quencehed from melts at high pressure demonstrate that the pressure-induced changes in melt structures show a simple densification trend where all the experimental non-bridging oxygen (NBO) fractions at high pressure converge into a single decaying function, regardless of composition. Additonally, detailed Al-27 NMR studies of aluminosilicate glasses showed that the fraction of $^{[5,6]}Al$ at a given pressure vary nonlinearly with variations of NBO/T. $^{[5,6]}Al$ fraction increases with decreasing degree of melt polymerization from NBO/T=0 to partially depolymerized melts. Then it gradually decreases with further increase in NBO/T. A new scheme of pressure-induced structural transitions in silicate melts involving $^{[4]}Al$-O-$^{[4]}Al$ also includes the formation of $^{[4]}Al$-O-$^{[5]}Al$. We finally show how these new structural information can be utilized to help elucidate connections between the microscopic signatures of anomalous and non-linear changes in the macroscopic properties of the corresponding liquids as well as natural magmatic processes in the Earth's interior.

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