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Hemispheric asymmetry in aerosol optical thickness and cloud fraction over the tropical Atlantic Ocean

Pavel Kishcha (1), Boris Starobinets (1), Arlindo da Silva (2), Charles Long (3), Olga Kalashnikova (4), and Pinhas Alpert (1)

(1) Tel Aviv University, Department of Geoscience, Tel Aviv, Israel (pavel@cyclone.tau.ac.il, 972-3 640-9282), (2) Global Modeling and Assimilation Office, NASA/GSFC, Greenbelt, Maryland, USA, (3) Pacific Northwest National Laboratory, Richland, Washington, USA, (4) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA

Hemispheric asymmetry in cloud fraction and aerosols could lead to hemispheric imbalance in solar radiation reaching the surface and, consequently, could affect the Earth radiation budget. Previous studies showed that, over the global ocean, there is no noticeable hemispheric asymmetry in cloud fraction (CF). This contributes to the balance in solar radiation reaching the sea surface in the Northern and Southern hemispheres. In the current study, we focus on the tropical Atlantic (30oN – 30oS) which is characterized by significant amounts of Saharan dust dominating other aerosol species over the North Atlantic. Our main point is that, over the tropical Atlantic, not only is Saharan dust responsible for the pronounced hemispheric aerosol asymmetry, but it also contributes to significant cloud cover along the Saharan Air Layer. This could lead to the hemispheric imbalance in strong solar radiation reaching the sea surface in the tropical Atlantic. During the 10-year study period (July 2002 – June 2012), NASA Aerosol Reanalysis (aka MERRAero) showed that, when the hemispheric asymmetry in dust aerosol optical thickness (AOT) was the most pronounced (particularly in July), dust AOT averaged separately over the tropical North Atlantic was one order of magnitude higher than that averaged over the tropical South Atlantic. In the presence of such strong hemispheric asymmetry in dust AOT in July, CF averaged separately over the tropical North Atlantic exceeded that over the tropical South Atlantic by 20%. In July, along the Saharan Air Layer, Moderate Resolution Imaging Spectroradiometer (MODIS) CF data showed significant cloud cover (up to 0.8 – 0.9). This significant cloud fraction along SAL together with clouds over the Atlantic Inter-tropical Convergence Zone contributes to the above-mentioned hemispheric CF asymmetry. Both Multi-Angle Imaging SpectroRadiometer (MISR) measurements and MERRAero data were in agreement on seasonal variations in hemispheric aerosol asymmetry. Hemispheric asymmetry in total AOT over the Atlantic was the most pronounced between March and July, when dust presence over the North Atlantic was maximal. In September and October, there was no noticeable hemispheric asymmetry in total AOT over the tropical Atlantic.