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Remote Sensing Based Estimates of the Fundamental Global Water Cycle and its Interannual Variability

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The average annual cycle of the atmospheric branch of the fundamental global water cycle (FGWC) was studied with remote sensing-based precipitation estimates from the Global Precipitation Climatology Project (GPCP; blended microwave-infrared-rain gauge) Version 2 and the Goddard PROFiling algorithm (GPROF; passive microwave) Version 6 data sets, and over-ocean evaporation estimates from the Goddard Satellite Surface Turbulent Fluxes Version 2 (passive microwave) data set from 1988 to 2000. Over-land evaporation was estimated from the remote sensing-based precipitation estimates combined with a global evaporation minus precipitation (EmP) data set produced by the Climate Analysis Section of the National Center for Atmospheric Research.

Results show that 75% to 85% of the total global evaporation and approximately 70% of the total global precipitation occur over the oceans in each season. In the GPCP-based FGWC estimate, there is a remarkable balance in the interhemispheric import-export of atmospheric moisture in December-January-February and June-July-August. The dominant cross-equatorial atmospheric moisture transports in the atmospheric branch of the FGWC supply a significant amount of moisture to precipitation regions and are from the Northern Hemisphere to the Southern Hemisphere in December-January-February and the Southern Hemisphere to the Northern Hemisphere in June-July-August, with approximately $3x10^6$ m^3/s net annual transport from the Southern Hemisphere to the Northern Hemisphere in the GPCP-based FGWC estimate. In the

GPROF-based FGWC estimate, there are substantial imbalances in interhemispheric moisture transports which may be attributable to missing data over snow/ice covered surfaces, inadequate diurnal sampling, and uncertainties in precipitation estimates especially over land. A quantitative evaluation of these results and comparisons with previous FGWC estimates is not possible without quantitative error estimates on precipitation, evaporation, and EmP estimates.

These results about the annual cycle of FGWC and its interannual variability will be described and discussed in this presentation. Relationships between interannual variability of the FGWC and interannual variability of the tropical climate, such as those associated with the monsoons, the El Niño-Southern Oscillation phenomenon, and the cross-equatorial gradient of sea-surface temperature in the tropical Atlantic, will also be described and discussed.