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Demonstrating next generation high-altitude, long endurance aircraft for earth science

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This paper will address NASA activities to monitor and study Earth processes from long-duration unmanned aircraft systems (UAS). NASA is currently supporting both large and small UAS development and demonstration. In a follow-on to previous work, NASA Armstrong Flight Research Center is hosting test flights of a large AeroVironment solar-powered aircraft, while NASA Ames Research Center is supporting the demonstration of a light-weight solar powered aircraft by Swift Engineering. Both are designed for long duration, multi-day flight. NASA Earth Science and Aeronautics researchers have been involved in the development and use of High Altitude Long Endurance (HALE) UAS since the 1990's. The NASA Environmental Research Aircraft Sensor and Technology Program (ERAST) demonstrated the promise of HALE aircraft for providing observations while also proving the importance of triple-redundant avionics to improve system reliability for large unmanned aircraft. Early efforts to develop an operational HALE capability for earth observations languished for nearly two decades owing to insufficient solar panel efficiency, battery power density, and light-weight, yet strong, materials. During this time NASA researchers focused on using the Global Hawk to demonstrate the utility of providing diurnal measurements over severe storms (i.e. HS3) and to track stratospheric water vapor transport (ATTREX). Recent significant commercial investments are now leading to the realization of a long-held goal of week- to month-long sustained observations and measurements from the stratosphere. In addition to a historical review of NASA use and interest in HALE aircraft, this paper will present current concepts for exploiting current and planned HALE aircraft capabilities including in situ characterization of atmospheric composition and dynamics as well as imagery collection and internet connectivity. NASA researchers anticipate HALE will also provide a useful means to test smallsat instruments and components. Observations from HALE-based instruments might also provide useful gap-filler observations to flagship satellite missions where the repeat time doesn't allow for measurements of quickly changing phenomenon. HALE will likely also provide measurements and communications relay to facilitate other aircraft in multi-aircraft campaigns. We will also report on progress towards a NASA-supported flight tests solar electric vehicles planned for 2019. One is the Swift Engineering UAS designed to carry 7kg (15lbs) for 30 days at 20km altitude. The other is the AeroVironment Hawk 30, also designed for multi-day flight.