Figure 2.– Time-lapse image of Florida and the southeastern United States at night (ISS030-E-6082, 11/24/2011, 19 mm), which is part of the video entitled "Mexico and the Eastern United States."

CEO Sites Mission Management System (SMMS)

Mike Trenchard

Late in fiscal year 2011, the Crew Earth Observations (CEO) team was tasked to upgrade its science site database management tool, which at the time was integrated with the Automated Mission Planning System (AMPS) originally developed for Earth Observations mission planning in the 1980s. Although AMPS had been adapted and was reliably used by CEO for International Space Station (ISS) payload operations support, the database structure was dated, and the compiler required for modifications would not be supported in the Windows 7 64-bit operating system scheduled for implementation the following year.

The Sites Mission Management System (SMMS) is now the tool used by CEO to manage a heritage Structured Query Language (SQL) database of more than 2,000 records for Earth science sites. SMMS is a carefully designed and crafted in-house software package with complete and detailed help files available for the user and meticulous internal documentation for future modifications. It was delivered in February 2012 for test and evaluation. Following acceptance, it was implemented for CEO mission operations support in April 2012. The database spans the period from the earliest systematic requests for astronaut photography during the shuttle era to current ISS mission support of the CEO science payload. Besides logging basic image information (site names, locations, broad application categories, and mission requests), the upgraded database management tool now tracks dates of creation, modification, and activation; imagery acquired in response to requests; the status

and location of ancillary site information; and affiliations with studies, their sponsors, and collaborators. SMMS was designed to facilitate overall mission planning in terms of site selection and activation and provide the necessary site parameters for the Satellite Tool Kit (STK) Integrated Message Production List Editor (SIMPLE), which is used by CEO operations to perform daily ISS mission planning.

The CEO team uses the SMMS for three general functions – database queries of content and status, individual site creation and updates, and mission planning (see figures 1 and 2).

Figure 1.– Panel of the SMMS interface displaying site name, location, and date information. The CEO sponsors (owners) of science sites can query the database and generate reports from the database through a system of filters and report detail options (see figure 2).

Figure 2.– Panel of the SMMS interface displaying filters for site selections and report detail options.

The CEO administrator of the science site database is able to create or modify the content of sites and activate or deactivate them based on the requirements of the sponsors. The administrator supports and implements ISS mission planning by assembling, reporting, and activating mission-specific site selections for management; deactivating sites as requirements are met; and creating new sites, such as International Charter sites for disasters, as circumstances warrant. In addition to the above CEO internal uses, when site planning for a specific ISS mission is complete and approved,

the SMMS can produce and export those essential site database elements for the mission into XML format for use by onboard Earth-location systems, such as Worldmap.

The design, development, and implementation of the SMMS resulted in a superior database management system for CEO science sites by focusing on the functions and applications of the database alone instead of integrating the database with the multipurpose configuration of the AMPS. Unlike the AMPS, it can function and be modified within the existing Windows 7 environment. The functions and applications of the SMMS were expanded to accommodate more database elements, report products, and a streamlined interface for data entry and review. A particularly elegant enhancement in data entry was the integration of the Google Earth application for the visual display and definition of site coordinates for site areas defined by multiple coordinates. Transfer between the SMMS and Google Earth is accomplished with a Keyhole Markup Language (KML) expression of geographic data (see figures 3 and 4). Site coordinates may be entered into the SMMS panel directly for display in Google Earth, or the coordinates may be defined on the Google Earth display as a mouse-controlled polygonal definition and transferred back into the SMMS as KML input. This significantly reduces the possibility of errors in coordinate entries and provides visualization of the scale of the site being defined.
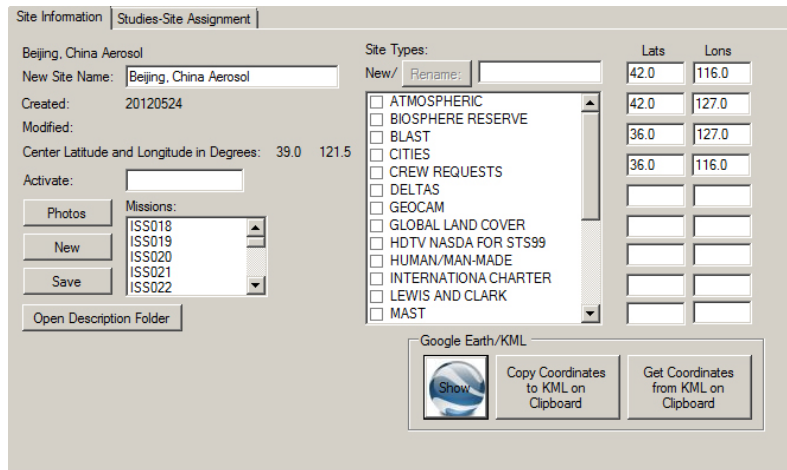

Figure 3.– Panel of the SMMS interface displaying a site's multiple coordinates and the interface with Google Earth for their definition and display via a KML expression of geographic information.
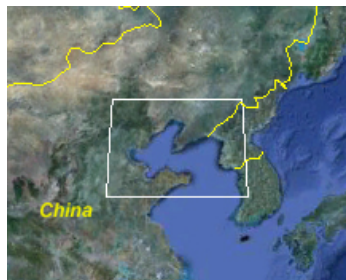

Figure 4.– Section of a Google Earth display of the Beijing, China, aerosol site coordinates.

CEO now has a powerful tool for managing and defining sites on the Earth's surface for both targets of astronaut photography or other onboard remote sensing systems. It can also record and track results by sponsor, collaborator, or type of study.

STK Integrated Message Production List Editor (SIMPLE) for CEO Operations

Mike Trenchard, James Heydorn

Late in fiscal year 2011, the Crew Earth Observations (CEO) team was tasked to upgrade and replace its mission planning and mission operations software systems, which were developed in the Space Shuttle era of the 1980s and 1990s. The impetuses for this change were the planned transition of all workstations to the Windows 7 64-bit operating system and the desire for more efficient and effective use of Satellite Tool Kit (STK) software required for reliable International Space Station (ISS) Earth location tracking. An additional requirement of this new system was the use of the same SQL database of CEO science sites from the SMMS, which was also being developed.

STK Integrated Message Production List Editor (SIMPLE) is the essential, all-in-one tool now used by CEO staff to perform daily ISS mission planning to meet its requirement to acquire astronaut photography of specific sites on Earth. The sites are part of a managed, long-term database that has been defined and developed for scientific, educational, and public interest. SIMPLE's end product is a set of basic time and location data computed for an operator-selected set of targets that the ISS crew will be asked to photograph (photography is typically planned 12 to 36 hours out).

The CEO operator uses SIMPLE to (a) specify a payload operations planning period; (b) acquire and validate the best available ephemeris data (vectors) for the ISS during the planning period; (c) ingest and display mission-specific site information from the CEO database; (d) identify and display potential current dynamic event targets as map features; (e) compute and display time and location information for each target; (f) screen and select targets based on known crew availability constraints, obliquity constraints, and real-time evaluated constraints to target visibility due to illumination (sun elevation) and atmospheric conditions (weather); and finally (g) incorporate basic, computed time and location information for each selected target into the daily CEO Target List product (message) for submission to ISS payload planning and integration teams for their review and approval prior to uplink. See figure 1.