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

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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.

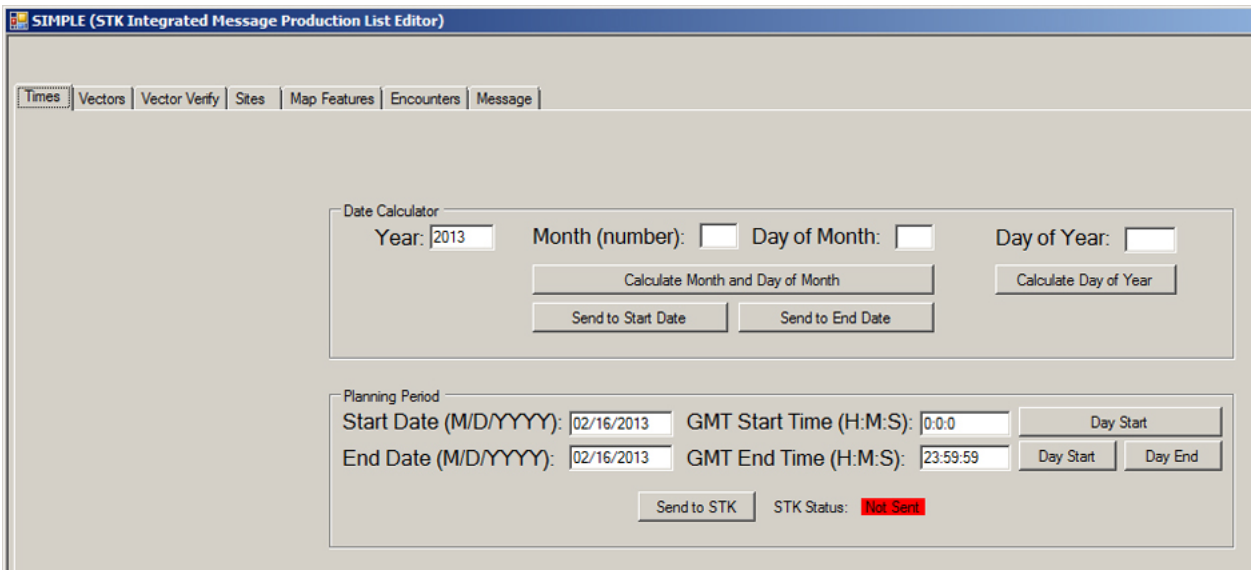

Figure 1.– Section of the SIMPLE user interface illustrating the functional tabs available to the CEO operator for daily target list production.

SIMPLE requires and uses the following resources: an ISS mission planning period Greenwich Mean Time start date/time and end date/time), the best available ISS mission ephemeris data (vectors) for that planning period, the STK software package configured for the ISS, and an ISS mission-specific subset of the CEO sites database (see figure 2).

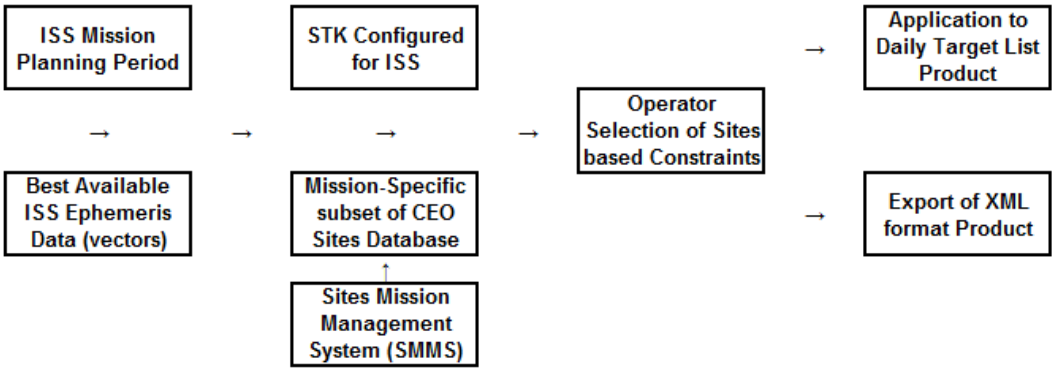

Figure 2.– Basic input and operations process flow for SIMPLE products.

The primary advantages realized by the development and implementation of SIMPLE into the CEO payload operations support activity are a smooth transition to the Windows 7 operating system upon scheduled workstation refresh; streamlining of the input and verification of the current ISS ephemeris (vector data); seamless incorporation of selected contents of the SQL database of science sites; the ability to tag and display potential dynamic event opportunities on orbit track maps; simplification of the display and selection of encountered sites based on crew availability, illumination, obliquity, and weather constraints; the incorporation of high-quality mapping of the

Earth with various satellite-based datasets for use in describing targets; and the ability to encapsulate and export the essential selected target elements in XML format for use by onboard Earth-location systems, such as Worldmap. See figure 3.

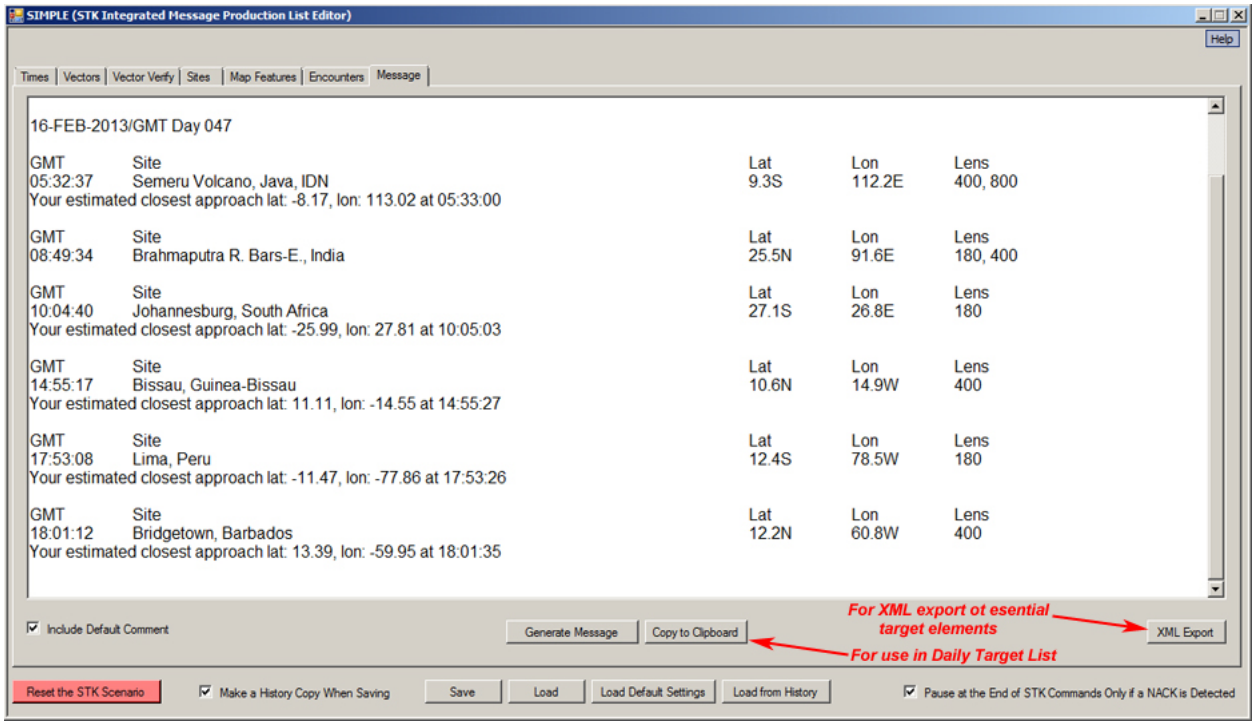

Figure 3.– Example of the SIMPLE Message tab with screened and selected target elements ready for incorporation in the daily target list product or for export as an XML-format product.

SIMPLE is a carefully designed and crafted in-house software package that includes detailed help files 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 May 2012.