

# CEOS Land Surface Imaging Constellation

## 2007 Work Plan

### I. Introduction

The primary objective of the CEOS Land Surface Imaging (LSI) Constellation is to define *standards* that describe optimal future LSI Constellation capabilities, characteristics, and policies. These standards will not all be defined by a single study. Rather, many studies, each focusing on a spatial-resolution-based and/or spectral-based subset of the full scope of land surface imaging sensor systems will be needed. Complete definition of the CEOS Land Surface Imaging Constellation may be a lengthy process, possibly requiring several years to fully complete. However, Constellation studies and activities also will address current and shorter-term problems and issues facing the land remote sensing community today, such as seeking ways to work more cooperatively in the operation of existing land surface imaging systems and helping to accomplish tangible benefits to society through application of land surface image data.

Consistent with guidance provided by the CEOS Constellations Process Paper and to aid in the accomplishment of LSI Constellation goals and objectives, the LSI Constellation Study Team will prepare an Annual Work Plan to guide its activities for each year. The Work Plan will identify goals for the year and describe the work to be accomplished to achieve those goals, including the objectives, approach, and personnel resources needed. The Work Plan also will identify deliverables expected from the work, and it will present a timeline with milestones for the year's activities. This **2007 Work Plan** is the first Annual Work Plan prepared by the LSI Imaging Constellation Study Team.

### II. 2007 Goals

Recognizing that definition, development, and implementation a CEOS Land Surface Imaging Constellation will not be a trivial undertaking and is one that must be accomplished over time with a phased approach, the LSI Constellation Study Team has established three main goals for 2007, which address both near-term and longer-term LSI Constellation goals. The three primary goals are:

- 1) establish agreement(s), among space agencies currently operating mid-resolution land surfacing imaging satellite systems, to cooperate more closely together to operate those assets as a real prototype Land Surface Imaging Constellation;
- 2) develop preliminary standards for a mid-resolution Land Surface Imaging Constellation; and
- 3) meaningfully contribute to the production of a fundamental climate data record (FCDR).

In addition to these goals, it is an objective of the LSI Constellation Study Team, to be accomplished in early 2007, to increase its membership by adding 4-6 new study team members from the diverse land remote sensing user community for the purpose of enhancing the study team's scientific and interdisciplinary applications expertise.

### III. Increase Study Team Membership

**Need.** Scientific and practical applications of remotely sense data are the fundamental reasons why systems exist to acquire, process, archive, retrieve, and distribute space-based land surface imaging data. Consequently, it is imperative that interdisciplinary users of such data play key roles in studies that seek to define requirements and standards for future land surface imaging systems. The first objective addressed by the LSI Constellation Study Team will be to add 4-6 (or more) members who represent various different disciplinary segments of the land remote sensing user community.

**Approach.** Current members of the Study Team will nominate candidates for consideration for membership, and they will provide supporting background information about the qualifications and expertise of the candidates they nominate. This information will be reviewed by a subcommittee of the study team, and recommendations will be made by the subcommittee for consideration by the full study team. Invitations will be issued accordingly. If this approach fails to identify the needed number of new study team members from the land remote sensing user community, the study team co-leads will consult appropriate land remote sensing user organizations and make invitations based on the results of those consultations.

In addition, the LSI Constellation Study Team could benefit from additional expertise in the areas of land surface imaging sensor calibration and ground data systems. Therefore, CEOS Working Groups on Calibration and Validation (WGCV) and on Information Systems and Services (WGISS) each will be invited to name a member from their working groups to serve on the LSI Constellation Study Team.

**Responsibilities.** New Study Team members will contribute to accomplishing each of the three main goals for 2007. However, they primarily will be responsible for defining discipline-oriented information requirements that will serve as the basis for establishing initial standards for a mid-resolution land surface imaging constellation. They also will play key roles, along with members from the CEOS WGCV and WGISS, in translating those information requirements into preliminary constellations standards.

#### Tasks & Timelines.

2007 Work Task	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Obtain Nominations for New Study Team Members from Current Study Team Members		■										
Circulate Member Nominations and Collect Input from Study Team to Determine Invitees			■									
Invite New Members to Study Team				■								

### IV. Establish Agreement to Operate Current Mid-Resolution Systems as a Real Prototype LSI Constellation

**Background.** Currently, approximately eight CEOS member space agencies independently operate a dozen or more mid-resolution (10m-30m) land surface imaging satellite systems that routinely acquire, archive, and distribute image data to segments of the land remote sensing user community. That user community could more efficiently and effectively

address many key societal problems and issues if the space agencies were to operate their mid-resolution land surface imaging systems in more coordinated ways.

In addition, the fundamental concept of the CEOS Constellations is to try to get the world's space agencies to design, build, and operate their future earth observation satellite systems according to "community-defined" standards. If this concept is to prove viable, a logical place to begin is with those agencies agreeing to cooperate more fully in operating the systems they already have in space. If they are not able to take that step, then the viability of the entire CEOS Constellations concept must be questioned.

**Objectives.** The primary objective of this 2007 goal is get CEOS member space agencies that currently operate mid-resolution land surface imaging satellite systems to agree to cooperate more closely in the operation of those systems. That is, the objective is to get those member agencies to agree to begin to operate their existing mid-resolution land surface imaging assets like a *real* prototype LSI Constellation.

It is also an objective of this goal to begin to add specificity to the higher-level agreement to cooperate more fully in operating existing assets by establishing up to three multilateral agreements that define specific cooperation in the areas of 1) improved or expanded data access; 2) operation of ground system assets; and 3) development of coordinated data acquisition and data management strategies.

**Approach.** A draft of the higher-level agreement described in the section will be prepared by the LSI Constellation Lead and reviewed by all Study Team members. A final draft, based on the collective input of Study Team members, will be sent to Study Team members for final review and approval. Following approval by the Study Team, agency members of the LSI Constellation Study Team will be responsible for securing the signature of their agencies approving official by no later than August 15, 2007.

Concurrent with the review and approval process implemented for the higher-level agency agreement, a series of activities will be undertaken to develop and approve up to three multilateral agreements, or annexes to the higher-level agreement, designed to add specificity and meaning to the higher-level agreement. First, the Study Team will develop an effective, concise user survey that provides brief background information on the CEOS LSI Constellation and asks users to state what they believe to be the most significant ways the space agencies can cooperate better together to improve the efficiency and effectiveness with which their collective mid-resolution land surface imaging assets can be brought to bear on pressing societal problems and issues. The LSI Constellation Study Team will ask each CEOS member space agency with mid-resolution land surface imaging systems to advertise and post the survey on their websites for one month.

The Study Team will form three sub-groups (*data access, ground systems operations, and data acquisition/data management strategies*) who will review user input provided by the posted survey and otherwise gather relevant information. Using this input and information, each sub-group will draft a multilateral agreement (annexes to the higher-level agreement) that outlines specific collaborative activities or strategies that the CEOS agencies who sign the agreement will undertake or strive to adopt. Those annexes will be provided to each CEOS agency that currently has one or more mid-resolution land surface imaging system in space for review and (hopefully) signature. In drafting the annexes, sub-groups will seek a balance between what users may desire and what agencies may be willing to agree to so as

to present agreements to the agencies that likely will be signed by at least some of those agencies. One area of focus for the sub-group that addresses *data acquisition and data management strategies* will be to develop a strategy to meet requirements for land surface imaging data in the event of failure of one or more existing mid-resolution satellite systems.

**Deliverables.** There are two fundamental deliverables from achieving this goal: 1) a formal agreement signed by CEOS agencies with mid-resolution land surface imaging satellite systems currently in space to cooperate more fully in the operation of those assets so that they may function like a *real*, prototype land surface imaging constellation; and 2) up to three annexes to the higher-level agreement, signed by two or more signatories to that higher-level agreement, agreeing to cooperate in the performance of specific activities or agreeing to adopt specific common strategies related to data access, ground systems operations, and data acquisition/data management of their existing mid-resolution LSI systems. These deliverables are due prior to the 21<sup>st</sup> CEOS Plenary Meeting in November.

**Tasks & Timelines.**

2007 Work Task	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Draft high-level agreement for increased cooperation in operating existing mid-resolution LSI systems.			—									
High-level agreement reviewed by LSI Constellation Study Team members who provide input for revision.			—									
Final draft of higher-level agreement completed, reviewed, and approved by LSI Study Team.				—								
CEOS space agency (w/mid-res. LSI systems) Study Team members secure agency signatures on higher-level agreement.					—	—	—	—				
Develop user survey seeking suggestions for specific cooperation among agencies in operating current LSI systems.				—								
User survey posted by CEOS space agencies with current mid-res. LSI systems.					—							
Three sub-groups established to develop annexes to higher-level agreement.				—	—							
Sub-groups review user input and develop annexes to higher-level agreement.						—	—					
Three annexes sent to CEOS agencies with mid-res LSI systems for review and signature.								—	—			

**V. Define Initial Standards for a Mid-Resolution LSI Constellation**

**Background.** The definition of *standards* that describe optimal characteristics of earth observation satellite systems, which can guide the definition, development, and operation of such systems in the future, is the fundamental objective of the CEOS Constellations concept. This goal ensures that 2007 LSI Constellation activities address this fundamental objective by defining initial standards for mid-resolution land surface imaging systems. Mid-resolution systems were selected because of their importance in addressing a broad range of important societal problems and issues, as well as because of concerns over potential continuity and data gap issues.

**Objectives.** The primary objective of this 2007 goal is to define an initial set of standards that describe optimal characteristics for the space and ground segments of a mid-resolution

LSI Constellation, as well as policy and operational considerations associated with such a constellation. In the process of meeting this first and primary objective, it also is an objective of this goal to fully engage the diverse land remote sensing user community to define a representative cross-section of their information requirements and to fully use those requirements in the definition of constellation standards.

**Approach.** Accomplishment of this goal will draw heavily upon the experience and expertise of the new user community and CEOS working group members of the LSI Constellation Study Team, as well as upon the expertise and resources provided by the CEOS Constellations Systems Engineering Office (SEO) established and supported by NASA. Drawing fully upon previous compilations of land remote sensing user requirements and the collective experience and expertise of LSI Constellation Study Team members and selected colleagues, a representative cross-section of land remote sensing user information requirements and technical requirements will be compiled and documented by a subcommittee established by the LSI Constellation Study Team.

Definition of standards for the space segments and ground segments of mid-resolution LSI Constellation systems will be accomplished separately, led by two subcommittees established by the LSI Constellation Study Team and working closely with the CEOS Constellations SEO. A third subcommittee will define standards (or perhaps more accurately, guidelines) associated with certain policies and operational considerations, particularly those that affect data access. Standards and guidelines defined by the subcommittee will be vetted and discussed by the full LSI Constellation Study Team, who will prepare the final compilation of proposed standards and guidelines for submission to the CEOS SIT for endorsement.

**Deliverables.** Two primary deliverables are planned for this goal: 1) a compilation of a representative cross-section of interdisciplinary user requirements associated with land remotely sensed data; and 2) an initial compilation of standards and guidelines that describe optimal characteristics for a future mid-resolution LSI Constellation.

**Tasks & Timelines.**

2007 Work Task	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Est. LSI Constellation Study Team Subcommittee to compile and document user requirements.				—								
Compile representative cross-section of land surface imaging interdisciplinary user requirement.					—————							
Est. three subcommittees for standards development: space segments; ground segments; policies/operations.					—————							
Develop initial standards and guidelines for a mid-res. LSI Constellation (three subcommittees w/SEO).						—————						
Standards and guidelines vetted and discussed by LSI Constellation Study Team; final compilation proposed to CEOS SIT for endorsement.									—			

**VI. Data for a Fundamental Climate Data Record**

**Background.** Since 1972, spaceborne sensors have provided scientists with a wealth of data that have been meaningfully applied in countless important land surface-related

scientific and practical endeavors. Yet, the premise of the CEOS Constellations Concept is that we can do better...and more. The potential benefits offered by a constellation of satellites that routinely and frequently image the Earth's land surface in consistently calibrated wavelengths from the visible through the microwave and in spatial detail that ranges from sub-meter to hundreds of meters are enormous. This 2007 goal seeks to demonstrate and illustrate the value of the Constellations Concept by cooperating in the provision of data for the development of a fundamental climate data record (FCDR).

**Objective.** The objective of this goal is to facilitate and expedite the completion of the United Nations Food and Agriculture Organization's (UN FAO) Forest Resource Assessment 2010 (FRA2010) by providing coordinated access to the global land surface imaging data needed to complete the assessment.

**Approach.** The LSI Constellations Study Team will establish a subcommittee to work closely with FRA2010 scientists to define the precise satellite land surface imaging data requirements for the assessment. The subcommittee will describe those data requirements in a report that will describe the data needed in terms of time epoch, geographic coverage, and optimal sensor. The report also will describe the role and importance of the identified land surface imaging data for the FRA2010 assessment.

Once the subcommittee has defined the data requirements, they will work closely with the Data Access sub-group established under Goal 1 for 2007 to work out the mechanisms and necessary agreements with the appropriate CEOS member space agencies to provide access to the data needed for the FRA2010 assessment. Such agreement may or may not be achieved within the primary annex on data access to be developed as part of addressing Goal 1.

**Deliverables.** The most important deliverable from this goal will be the data provided to the FRA2010 for use in performing a global forest assessment. However, two other important deliverables are needed in the process of providing access to the data. They are: 1) a report that describes the land surface image data requirements, including time epoch, geographic coverage, and optimal sensor, associated with the FRA2010 assessment, and 2) an agreement among the contributing CEOS space agencies that describes the terms and conditions under which the data will be provided and, in general terms at least, what data will be provided.

**Tasks & Timelines.**

2007 Work Task	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Est. LSI Constellation Study Team subcommittee to work with FRA2010 scientists to define the data requirements for the FRA2010 assessment.				—								
Define land surface imaging data requirements and document them in a report to Study Team.				—	—	—						
Data Requirements subcommittee and Data Access sub-group (Goal 1) develop necessary agreement(s) with CEOS space agencies with land surface data.						—	—	—				
Provide FRA2010 with access to needed data									—	—		

## VII. Summary of 2007 Tasks and Timelines

2007 Work Task	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
<b><u>Expand Study Team Membership</u></b>												
Obtain Nominations for New Study Team Members from Current Study Team Members		■										
Circulate Member Nominations and Collect Input from Study Team to Determine Invitees			■									
Invite New Members to Study Team				■								
<b><u>Establish Agreements for Expanded Cooperation</u></b>												
Draft high-level agreement for increased cooperation in operating existing mid-resolution LSI systems.			■									
High-level agreement reviewed by LSI Constellation Study Team members who provide input for revision.				■								
Final draft of higher-level agreement completed, reviewed, and approved by LSI Study Team.					■							
CEOS space agency (w/mid-res. LSI systems) Study Team members secure agency signatures on higher-level agreement.						■	■	■	■			
Develop user survey seeking suggestions for specific cooperation among agencies in operating current LSI systems.				■								
User survey posted by CEOS space agencies with current mid-res. LSI systems.					■							
Three sub-groups established to develop annexes to higher-level agreement.				■	■							
Sub-groups review user input and develop annexes to higher-level agreement.						■	■					
Three annexes sent to CEOS agencies with mid-res LSI systems for review and signature.								■	■			
<b><u>Define Standards for Mid-Res LSI Constellation</u></b>												
Est. LSI Constellation Study Team Subcommittee to compile and document user requirements.				■								
Compile representative cross-section of land surface imaging interdisciplinary user requirement.					■	■						
Est. three subcommittees for standards development: space segments; ground segments; policies/operations.					■	■						
Develop initial standards and guidelines for a mid-res. LSI Constellation (three subcommittees w/SEO).						■	■	■				
Standards and guidelines vetted and discussed by LSI Constellation Study Team; final compilation proposed to CEOS SIT for endorsement.									■			
<b><u>Provide Access to LSI Data for FCDR</u></b>												
Est. LSI Constellation Study Team subcommittee to work with FRA2010 scientists to define the data requirements for the FRA2010 assessment.				■								
Define land surface imaging data requirements and document them in a report to Study Team.					■	■						
Data Requirements subcommittee and Data Access sub-group (Goal 1) develop necessary agreement(s) with CEOS space agencies with land surface data.							■	■				
Provide FRA2010 with access to needed data.									■	■		
<b>Prepare 2007 LSI Constellation Study Report for presentation at 21<sup>st</sup> CEOS Plenary &amp; GEO Summit</b>										■	■	▲

## VIII. Summary of 2007 Deliverables

- 1) a **formal agreement** signed by CEOS agencies with mid-resolution land surface imaging satellite systems currently in space to cooperate more fully in the operation of those assets so that they may function like a *real*, prototype land surface imaging constellation;
- 2) up to **three annexes** to the higher-level agreement, signed by two or more signatories to that higher-level agreement, agreeing to cooperate in the performance of specific activities or agreeing to adopt specific common strategies related to data access, ground systems operations, and data acquisition/data management of their existing mid-resolution LSI systems;
- 3) a **compilation of requirements** associated with land remotely sensed data;
- 4) initial **compilation of standards and guidelines** that describe optimal characteristics for a future mid-resolution LSI Constellation;
- 5) a report that describes the land surface image **data requirements**, including time epoch, geographic coverage, and optimal sensor, associated with the FRA2010 assessment;
- 6) an **agreement** among the contributing CEOS space agencies that describes the terms and conditions under which the data will be provided and, in general terms at least, what data will be provided;
- 7) **data** provided to the FRA2010 for use in performing a global forest assessment.