Sub-task Number: DA-09-03d
Sub-task Title: Global DEM

Overarching Task: Global Data Sets
Area: DATA MANAGEMENT
Relevant Committee: *ADC*
Related Targets: *(to be included in 2009)*

Sub-task Definition *(as given in the 2009-2011 Work Plan):*

Facilitate interoperability among Digital Elevation Model (DEM) data sets with the goal of producing a global, coordinated and integrated DEM. This DEM database should be embedded into a consistent, high accuracy, and long term stable geodetic reference frame for Earth observation.

Leads *(GEO Member or PO, Entity carrying out the work, Contact: e-mail)*:

CEOS (BNSC), *Point of Contact*: Professor Jan-Peter Muller, Chair CEOS-WGCV-TMSG, ISPRS IV/6, University College London, UK, jpm@mssl.ucl.ac.uk

CEOS (ASTER DEM), G. Bryan Bailey, gbbailey@usgs.gov

CEOS (UNOOSA), Lorant Czaran, UN-SPIDER, lorant.czaran@unoosa.org

CEOS (USGS), Dean Gesch, EDC, gesch@usgs.gov;

Japan (JAXA), Takeo Tadono, tadono.takeo@jaxa.jp

USA (NOAA), Christopher Fox, Christopher.G.Fox@noaa.gov

Motivation/Background *(Why should this Task or sub-task be implemented? What relevance to society? What is the state of the art? 3-5 lines)*

A Global DEM is required by 6 of the 9 SBAs (Societal-Benefit Areas) described in the GEO 10 year Implementation Plan. Above all, it is critically required for Natural Hazards, both monitoring (for downstream georadiometric processing of EO data such as SAR), prediction (e.g. landslide slope dependency) and mitigation (e.g. how to reach remote areas using ground assets). In DA-07-01, a report entitled "Guidelines for Global DEM Interoperability" (authored by the DA-07-01 lead, Prof. Muller) described the state of the art. This report included a set of 30 recommendations. These were peer reviewed and extensively re-written by an international workshop held at IRSA in Beijing on 2 July 2008. These were tabled and subsequently agreed by CEOS-WGISS and CEOS-WGCV plenaries and by the CEOS and GEO plenaries held in November 2008. METI/NASA through the US Geological Survey will release a global 30m land surface topographic dataset covering all longitudes and ±83º of latitude in April 2009. These data will contain holes/voids, data resolution smearing due to the averaging process and pixel-level mis-registration between ASTER DEMs during stacking and possible artefacts due to clouds and/or issues with the DEM retrieval from stereo processing. These issues need to be identified and, where feasible, replaced from other data sources whilst ensuring the datasets' open source and public domain nature. Validation is also required of these data in addition to that being performed prior to launch. For continental shelf bathymetry (depth down to 30m), methods need to be developed for spaceborne depth retrieval on a comparable grid to land topography (1 arc-second, ≈30m) as sonar techniques used on the ocean surface are usually proprietary or subject to national security concerns. Geodetic issues are also of concern as land topography and bathymetry rarely join up seamlessly. Finally there is a need to ensure that the data released is available in a suitable format for users to be able to visualise the quality easily as well as to report online to a moderated "Known Product Issues" web resource to ensure that the data product can be improved by the relevant agency.

Outputs *(e.g. products and services which result from the activities of the Task/sub-task; outlined in the form of deliverables with timelines)*

Planned: co-ordination of ASTER GDEM post-release validation and assessment including organisation and reporting of workshops (IGARSS 2009 [Cape Town, S. Africa], ISPRS 2010 [Georgia, AT, US] and 2011

[London]). Workshops will also include reports on gap-filling, inter-operability issues, continental shelf bathymmetry. An extension of the CEOS-WGISS ICEDS website is planned to include WMS of ASTER GDEM showing gaps and data from different sources, co-registered to SRTM, to allow easy inter-comparison of heights and coastlines (3/10). A workshop on "Continental bathymetry and coastal zone mapping" to launch a global bathymetry project is due at ISPRS 2010. Promotion of open continental shelf bathymetry and coastal zone mapping in appropriate Ocean mapping fora (2010/2011). Establishment of "Known Product Issues" moderated web service to allow users worldwide to report errors (3/11). Second report on "Global DEM Interoperability" including further recommendations at or following ISPRS 2011 in UK for tabling at CEOS and GEO Plenaries in November 2011. Regular reports will be provided to CEOS-WGCV, CEOS-WGISS and via the task sheet to the GEO task group.

Produced (current status): SRTM 3" DEMs have been edited and distributed. The UCL ICEDS (http://iceds.net) web-GIS (a CEOS-WGISS EO Data portal) system displays the location of gaps/voids of unedited and edited DEMs. 22,895 1º x 1º cells have been completed of 30m DEMs generated from ASTER. These data were released on 29/6/09 and are accessible via the URLs reported on http://www.ersdac.or.jp/GDEM/E/4.html The conterminous US (CONUS) have been validated by USGS against NED and other USGS assets. NGA has performed an assessment worldwide of the ASTER GDEM. 200 cells of non-US and Alaska were offered through an open call via DA-07-01, CEOS-WGCV-TMSG and other communication channels on 2/12/08. Responses were received on 7/1/09, report released by USGS on 29/6/09 includes a summary of all of these results. This is available at http://www.ersdac.or.jp/GDEM/E/image/ASTER%20GDEM%20Readme_Ev1.0.pdf Detailed results from 10 of the participants are to be shown at the IGARSS 2009 special joint GEO-CEOS-ISPRS sessions on 17/7/09.

Activities *(operations or work processes through which resources are mobilized to produce specific outputs; outlined in the form of milestones including timelines)*

Planned: Successive open calls for validation of ASTER GDEM quality (12/08, 7/09, 6/10) and presentation of results through online proceedings of workshops, subsequent peer review journals. Open display of ASTER GDEM quality through ICEDS (3/10). Open display of errors and artefacts through Known Product Issues web service (3/11). Promotion of continental shelf bathymetry acquisition starting in north polar region through ESA/CSA MORSE programme (6/10).

Progress (current status): Some or all of the 200 cells were provided by USGS and were distributed for validation using end user "ground truth" datasets. In some cases these "truth" datasets were provided by end users to USGS. In other cases, copyright or other restrictions prevent these from being disseminated. All validation results were returned by the due date of 28/2/09 to USGS. IGARSS 2009 – there will be 10 talks on some of the validation results.

[Note: Updates on outputs and activities will be formally provided twice a year, according to the GEO schedule for 2009]

Resources *(indication of resources – e.g. financial, human – contributed by GEO Members or Participating Organizations to produce outputs)*

UCL are contributing the ICEDS system as well as sufficient disk-space to hold the ASTER GDEM once released. BNSC have been asked to provide support initially for populating these disks with ASTER GDEM data as well as meeting attendence in 2009-2011; ICEDS development in FY 09/10 and later on for establishing the "Known Issues" web service. EU-FP7 will be approached for funding a GMES service for global topography in the next available call to support bathymmetry activities. ESA/BNSC/NERC will be approached for support of the development of a space-based coastal zone bathymmetry sensor.

Architecture and Data Component

1) Please briefly describe any task-related Earth observation resources (data set, system, website/portal) and any related Web Service interfaces that are contributed to GEOSS. State whether these items are or will be registered with the GEOSS Component and Service Registry for access via the GEO Web Portals, and

whether any associated standards or other interoperability arrangements will be registered in the Standards and Interoperability Registry.

2) Please also describe what data and information your activity/system needs that you would request to be accessible through the GEOSS Common Infrastructure.

Capacity Building Component

(capacity building is defined to include the development of capacity related to: (i) Infrastructure and technology transfer (Hardware, Software and other technology required to develop, access and use EO); (ii) Individuals (education and training of individuals to be aware of, access, use and develop EO) and (iii) Institutions – building policies, programs & organizational structures to enhance the value of EO data and products).

1) In accordance with the above definition does this Task have a capacity-building component? If so, please provide a short description of this component including a description of end users.

(i) Capacity being developed for infrastructure to support display of ASTER GDEM through ICEDS and any updated DEM which may be developed during the 2009-2011 timescale.

(ii) promotion of global DEM through numerous fora by members of the task team.

(iii) encouragement of individual space agencies to provide their data free of charge and without any restrictions to fill in gaps in the ASTER GDEM.

2) Have any additional CB needs for this Task been identified? Please provide a short description.

User Engagement Component

(please briefly describe to what extent end users are engaged in this Task and influence the nature of the outputs produced)

So far there is no direct engagement by end users in the process described for this task. This task is in response to end users identifying the end product as of high priority in the 10 year GEOSS Implementation Plan. If the GEO Secretariat could provide the PoC with PoC from relevant SBAs, the PoC would be happy to start engagement.

Science and Technology (S&T) Component

1) Please briefly describe the elements of scientific research or technological development contained in this Task.

2) In relation to the S&T component(s) of this task, please describe gaps, priorities, continuity needs, barriers, scientific expertise and additional resource needs (this information will be used for developing a gaps and needs assessment in Task ST-09-01)

Members and POs' Contributions to Outputs and Activities above:

(Input is optional. This section gives the chance to Members and POs to provide more details (3-5 lines) on their individual activities, making a clear connection with the Outputs and Activities outlined above).

NASA Goddard (ICESat-GLAS) plan to process and release the majority of the ICESat-GLAS echo waveforms into top, bottom and centre of canopy as well as the ground return by acquisition period. Some assessments have been performed with five 1º x 1º ASTER GDEM data. which is being presented at the special joint GEO-CEOS-ISPRS-IEEE session

Two joint GEO-CEOS-ISPRS-IEEE sessions are being held at IGARSS 2009 in Cape Town, South Africa on Friday, 17 July 2009. Ten papers are being presented on different evaluations of five 1º x 1º cells of ASTER GDEM data. Some of these reports will appear in the online version of IGARSS 2009 web-site hosted by the US IEEE.

CGIAR is processing a v4.2 using GDEM data, mostly for desert areas and other areas which have not yet been filled by higher resolution auxiliary data. A list of the auxilliary sources can be found at http://srtm.csi.cgiar.org/ CGIAR continue to work on new methods for DEM merging.

The next generation Global multi-resolution (250m, 500m, 1000m) DEM is being completed at USGS EDC and is due to be completed by the end of December 2009. Release is due in 2010.

SPOT Image / IGN : On-going Reference3D project running which extracts a DTED level 2 DEM from stereoscopic SPOT5 HRS data. Reference3D is a dual project which was funded through a PPP (±50% military – 50% civilian).

Current output (June 2009) : more than 38 million sq km DTED level 2 DEM, including a full set of quality layers, and a 2.5m colour (RGB) orthoimage.

Expected output : 85+ M km² DTED 2 DEM for 2014, with a commitment to a 10m@90% horizontal location or better. From Q3 2009, a new layer will be included into the Reference3D product, which will provide a local estimation of the the horizontal accuracy throughout the geocell.

Q4 2008, SPOT Image / IGN contributed the whole available Ref3D coverage for the production, and control of the new version of GTOPO DEM being built by USGS.

NGA are engaged in producing a V3 of the SRTM v2 dataset filling in voids from different sources. This has already been employed to fill in voids in the ASTER GDEM. This dataset is due for release in the next few months.

Meanwhile JPL are engaged in a separate NASA funded activity to fill in voids in SRTM V2 using the ASTER GDEM. Timescales for this process are currently unknown.

NGDC Outputs

Produced

NGDC developed and publicly released the ETOPO1 Global Relief Model (1 arc-minute) in 'Ice Surface' and 'Bedrock' versions (http://www.ngdc.noaa.gov/mgg/global/global.html), as well as the 24 arc-second Southern Alaska Coastal Relief Model (http://www.ngdc.noaa.gov/mgg/coastal/s_alaska.html). NGDC has also developed and released high-resolution (1/3 to 8 arc-seconds), integrated bathymetric-topographic DEMs of numerous US coastal communities in either MHW or MHHW vertical datum to support tsunami preparedness (http://www.ngdc.noaa.gov/mgg/coastal/coastal.html).

Planned

In 2009 NGDC will build high-resolution DEMs of 11 US coastal communities in either MHW or MHHW vertical datum to support tsunami inundation modeling. NGDC will build DEMs of between 23 and 25 US coastal communities in 2010, in NAVD88, MHW or MHHW vertical datum, to support tsunami inundation and storm surge modeling. In 2010 NGDC will also build the first next-generation, 1 arc-second US CRM that integrates bathymetry and topography on a common vertical datum (NAVD88 and MHW versions). The NOAA 'VDatum' tool (http://vdatum.noaa.gov/) will be used to convert bathymetric data to common vertical datum. These DEM efforts will continue from 2011–2014.

NGDC Activities

Ongoing

NGDC is continually expanding its global multibeam bathymetric sonar (http://www.ngdc.noaa.gov/mgg/bathymetry/multibeam.html) and marine trackline geophysics (http://www.ngdc.noaa.gov/mgg/geodas/trackline.html) databases through acquisition of academic and international data, and acquiring, archiving and disseminating new US coastal hydrographic surveys and products (http://www.ngdc.noaa.gov/mgg/bathymetry/hydro.html). NGDC is also evaluating and editing US coastal hydrographic and topographic data sets for select US communities, converting those data to common horizontal and vertical datums and file formats, and integrating them into seamless, high-resolution DEMs of those communities. NGDC collaborates with other NOAA offices, the US NTHMP (National Tsunami Hazard Mitigation Program), and other Federal and State partners to support tsunami and hurricane preparedness.

GEBCO Outputs

Produced

GEBCO (http://www.gebco.net/) developed and released a 30 arc-second global bathymetric grid (GEBCO_08) in 2009, and released the latest 'GEBCO Digital Atlas' software interface, which now includes the option to display and access data from both the GEBCO One Minute and GEBCO_08 grids along with the existing bathymetric contour, coastline and feature name data sets contained within the GDA.

Germany

Bundesamt für Kartographie und Geodäsie (BKG): local validation of DEM.
DLR DFD-US: Science access to SRTM database, future TanDEM-X data.

Japan

AIST: Satellite-based DEM service implementation on GEO Grid.
GSI: To contribute to the GEO framework by promoting Global Mapping Project which develops fundamental geographic information of the whole land of the globe.
JAXA: To contribute to develop the R & D DEM product derived from ALOS/PRISM and PALSAR.

USA

NOAA: Facilitate interoperability among Digital Elevation Model (DEM) data sets with the goal of producing a global, coordinated and integrated DEM.

CEOS

BNSC/UCL, WGCV: Update ICEDS information server to provide OGC-compliant access to ASTER 30m DEM data (when it becomes available), together with localized validation DEM data and associated quality information (e.g. gap locations; number of ASTER observations per pixel, etc.).
JAXA: Develop the sample DEM datasets derived from ALOS PALSAR and PRISM.

Participation :

Type	Member or PO	Representing	Contact Name	EmailAddress
Lead(PoC)	CEOS	BNSC	Jan-Peter Muller	jpm@mssl.ucl.ac.uk
Lead	CEOS	ASTER DEM	G. Bryan Bailey	gbbailey@usgs.gov
Lead	CEOS	UN-SPIDER, UNOOSA	Lorant Czaran	lorant.czaran@unoosa.org
Lead	CEOS	USGS EDC	Dean Gesch	gesch@usgs.gov
Lead	Japan	JAXA:Japan Aerospace Exploration Agency	Takeo Tadono	tadono.takeo@jaxa.jp
Lead	USA	NOAA - NGDC and GEBCO	Christopher Fox	Christopher.G.Fox@noaa.gov
Contributor	Canada	Intermap Technologies	Bryan Mercer	bmercer@intermap.ca
Contributor	EC	JRC Ispra	Hannes Reuter	gisxperts@web.de
Contributor	ESA	ESRIN	Frank Martin Seifert	Frank.Martin.Seifert@esa.int
Contributor	France	SPOT Image	Marc Bernard	Marc.Bernard@spotimage.fr
Contributor	Germany	Bundesamt für Kartographie und Geodäsie - BKG	Michael Hovenbitzer	Michael.Hovenbitzer@bkg.bund.de
Contributor	Germany	DLR (ERS Tandem)	Richard Bamler	richard.bamler@dlr.de
Contributor	Germany	DLR (SRTM-X)	Achim Roth	Achim.Roth@dlr.de
Contributor	Germany	DLR (TANDEM-X)	Alberto Moreira	Alberto.Moreira@dlr.de
Contributor	Germany	DLR DFD (DEM distribution)	Pablo Angelo	Pablo.angelo@dlr.de
Contributor	Germany	EUROMAP, a GAF company	Frithjof Barner	barner@euromap.de
Contributor	Germany	Infoterra GmbH	Gertrud Riegler	gertrud.riegler@infoterra-global.com
Contributor	IGOS-P	Geohazards Theme	Gonéri Le Cozannet	G.LeCozannet@brgm.fr
Contributor	India	ISRO CartoSat DEM	Pradeep Srivastava	pradeep@sac.isro.gov.in
Contributor	ISCGM	International Steering Committee for Global Mapping	Toru Nagayama	nagayama@gsi.go.jp
Contributor	ISPRS	National Geomatics Center of China	Jiang Jie	jjie@nsdi.gov.cn
Contributor	ISPRS	University of Georgia (ISPRS Com. IV President)	Marguerite Madden	mmadden@uga.edu

Type	Member or PO	Representing	Contact Name	EmailAddress
Contributor	Italy	Italian Space Agency (ASI)	Ettore Lopinto	ettore.lopinto@asi.it
Contributor	Italy	Telespazio (It+CH DEM)	Mario Costantini	Mario_Costantini@telespazio.it
Contributor	Japan	ADC interface	Ryosuke Shibasaki	shiba@csis.u-tokyo.ac.jp
Contributor	Japan	AIST:National Institute of Advanced Industrial Science and Technology	Eikichi Tsukuda	e-tsukuda@aist.go.jp
Contributor	Japan	GSI/MLIT(Geographical Survey Institute/Ministry of Land,Infrastructure and Transport)	Akifumi ANDO	aando@gsi.go.jp
Contributor	Korea, Republic of	National Geographic Information Institute of KOREA	Myung-Ho Kim	hokim@moct.go.kr
Contributor	OGC		George Percivall	gpercivall@opengeospatial.org
Contributor	Spain	INTA	Severino Fernandez	fdezas@inta.es
Contributor	Taiwan	National Chengchi University	Shih-Yuan Lin	lintuyuan@googlemail.com
Contributor	Thailand	Kasetsart University	Deebun Mathakulachart	eengdbm@ku.ac.th
Contributor	Thailand	Land Development Department	Director, Mapping Division	boonrak@hotmail.com
Contributor	Thailand	Land Development Department	Phanumat Amphat	osm_7@ldd.go.th
Contributor	UK	University of Nottingham/ICEDS	Jeremy Morley	jmorley@gchannel.u-net.com
Contributor	UK	Viewfinder project	Jonathan de Ferranti	viewfinder@ferranti.sol.co.uk
Contributor	UNITAR	UNOSAT, CERN	Einar Bjorgo	einar.bjorgo@unitar.org
Contributor	USA	NASA - GSFC (ICESat topo lead)	David Harding	harding@denali.gsfc.nasa.gov
Contributor	USA	NASA - GSFC/Raytheon (EOS topo lead)	Robert Wolfe	rwolfe@pop900.gsfc.nasa.gov
Contributor	USA	NASA - JPL (Cartography Laboratory)	Nevin Bryant	Nevin.A.Bryant@jpl.nasa.gov
Contributor	USA	NASA - JPL (SRTM Project Scientist)	Michael Kobrick	mkobrick@jpl.nasa.gov
Contributor	USA	NASA - Vexel/Microsoft	John Curlander	jcc@vexcel.com
Contributor	USA	NGA (SRTM Project Lead)	James Slater	James.A.Slater@nga.mil
Contributor	WMO	WMO	Eliot Christian	echristian@usgs.gov