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THE ESSENTIAL CLIMATE VARIABLES (ECV) DATA ACCESS MATRIX A Quick and Convenient Method to Access Global Climate Datasets

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1. INTRODUCTION

The Global Observing Systems Information Center (GOSIC) [see <http://gosic.org>] was established by the Global Climate Observing System (GCOS) as a way to provide better and more centralized access to an extremely diverse array of climate related datasets that cross atmospheric, oceanic, and terrestrial domains that are collected from non-satellite, *in-situ* and satellite observing platforms. To aid in improving access to climate observing datasets, the GOSIC staff located at NOAA's National Climatic Data Center (NCDC) has developed an Essential Climate Variables (ECV) Data Access Matrix. The basic intent of the ECV matrix is to provide users with a centralized resource to access climate observing datasets from trusted sources for each of the defined atmospheric, oceanic and terrestrial variables as well as metadata and reference documentation. The GOSIC staff is constantly adding new climate datasets identified by the global observing systems and the world data centers as the best available collection of data for a particular variable. Information on spatial and temporal coverage, data gaps, quality control and additional data needs is also available in the matrix. The ECV Matrix is meant to be a 'one-stop-shop' to access trusted ECV datasets and information and can be accessed online at: <http://gosic.org/ios/MATRICES/ECV/ECV-matrix.htm>

2. MISSION AND BACKGROUND OF THE GOSIC

The GOSIC's mission is to provide a broad spectrum of users with a centralized resource to aid in finding worldwide climate observing system datasets and related information from the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS). However, the GOSIC

does not limit itself to these three systems, and also incorporates access to climate data from other partner programs such as the Global Atmosphere Watch (GAW) and the Atmospheric Circulation Reconstructions over the Earth (ACRE), and does so in a consistent fashion across a diverse array of international data centers.

The GOSIC was established in 1997 by the GCOS Steering Committee to develop methods for easy on-line access to the comprehensive base of Global Observing Systems data and information. Under an initial joint National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) grant, the GOSIC was developed at the University of Delaware, College of Marine Studies, building on experience with information systems for international climate research programs. Guidance and evaluation of the GOSIC is provided by the various scientific and steering committees of the three observing systems. The GOSIC reports at these meetings and receives directions for further development. Formal performance reviews were conducted in 2001 and 2003 by groups appointed by each observing system, and the results of these were extremely helpful in shaping the form and function of the GOSIC. Since 2007 the GOSIC has become operational and is a facility operated under the auspices of the U.S. Global Climate Observing System (USGCOS) program based at NOAA's NCDC, and is run on behalf of the international observing community (Diamond, 2009).¹ In addition, the GOSIC has become a key part of the infrastructure in helping to serve data via the World Data Center for Meteorology, Asheville.¹

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¹ See <http://wdca-meteorology.org>

3. THE ESSENTIAL CLIMATE VARIABLES (ECV) DATA ACCESS MATRIX

The ECV Matrix was developed by the GOSIC staff to provide users with a centralized 'one-stop-shop' resource to access climate observing datasets from trusted sources for each of the defined atmospheric, oceanic and terrestrial essential climate variables.

GCOS first defined a list of the ECVs in 2003 that were identified as "feasible for global implementation and have a high impact" on the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). Originally there were 44 ECVs that included such variables as air temperature, precipitation, sea surface temperature, salinity, snow cover, and albedo. By the end of August 2010, GCOS published an updated set of ECVs that built on the original set by adding variables such as soil moisture, soil carbon, ocean oxygen content, and also recognizing the role of precursors in forming ozone and aerosols¹. The updated list of 50 ECVs is as follows:

- **Atmospheric (over Land, Sea & Ice):**
 - **Surface:** Pressure, Air Temperature, Precipitation, Surface Radiation Budget, Water Vapor, Wind Speed and Direction.
 - **Upper-Air:** Cloud properties, Earth Radiation Budget, Temperature, Water Vapor, Wind Speed and Direction.
 - **Composition:** Composition: Carbon Dioxide, Methane and other Long-Lived Green House Gases (Nitrous Oxide (N₂O), Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), Hydrofluorocarbons (HFCs), Sulphur Hexafluoride (SF₆), and Perfluorocarbons (PFCs)), Ozone, Aerosol Properties, Precursors supporting the Aerosols and Ozone ECVs (NO₂, SO₂, HCHO, CO).

- **Oceanic:**
 - **Surface:** Carbon Dioxide Partial Pressure, Current, Ocean Color (for Biological Activity), Sea Ice, Sea Level, Sea State, Sea Surface Salinity (SSS), Sea Surface Temperature (SST), Ocean Acidity, Phytoplankton.
 - **Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon, Ocean Tracers, Phytoplankton, Ocean Acidity, Oxygen.

- **Terrestrial:** River Discharge (T1), Water Use (T2), Ground Water (T3), Lakes Levels (EVC T4), Snow Cover (T5), Glaciers and Ice Caps (T6), Permafrost and Seasonally-Frozen Ground (T7), Albedo (T8), Land Cover (including Vegetation Type) (T9), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) (T10), Leaf Area Index (LAI) (T11), Above Ground Biomass (T12), Fire disturbance (T13), Soil moisture, Ice Sheets, Soil Carbon.

The design of the ECV Matrix provides users with a quick overview of the ECVs identified by domain and easy access to data download, metadata and other information with a minimal amount of clicks. See figure 1 below for a view of the ECV Matrix main page on the GOSIC Portal.

GCOS Essential Climate Variables (ECV) Data Access Matrix

The ECV Data Access Matrix provides easy access to data download, metadata and information for each of the ECVs. Data access has been divided into 2 categories: 1) In-situ and Non-Satellite and 2) Satellite. The selection of the data sets are based on information from Scientific Steering committees and scientific expert advisory groups and the supporting documentation they provide and publish such as the recent WMO/IOC release: 'Implementation Plan for the Global Observing Systems for Climate in Support of the UNFCCC (August Update) (GCOS-138/GCOS-184/GTOS-76)'. The content of the matrix is presently being updated with information from this publication. Look for daily updates. Contact: gosic@noaa.gov

The Essential Climate Variables (ECV) are required to support the work of the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). All ECVs are technically and economically feasible for systematic observation. It is these variables for which international exchange is required for both current and historical observations. It is emphasized that the ordering within the table is simply for convenience and is not an indicator of relative priority. Currently, there are 50 ECVs. [More About the ECV Matrix](#)

[\[About the ECV Matrix\]](#) [\[Reference Documents & Web Sites\]](#) [\[Contact\]](#) [Lastest update December 20, 2010]

ATMOSPHERIC (over Land, Sea & Ice)	OCEANIC	TERRESTRIAL (2)
Surface (4)	Surface (6)	River Discharge (ECV T1)
Pressure	Carbon Dioxide Partial Pressure	Water Use (ECV T2)
Air Temperature	Current	Ground Water (ECV T3)
Precipitation	Ocean Acidity *	Lakes (ECV T4) *
Surface Radiation Budget	Ocean Color (for Biological Activity)	Snow Cover (ECV T5)
Water Vapor	Phytoplankton *	Glacier and Ice Caps (ECV T6) *
Wind Speed and Direction	Sea Ice	Permafrost (ECV T7)
Upper Air (3)	Sea Level	Albedo (ECV T8) *
Cloud Properties	Sea State	Land Cover (including Vegetation Type) (ECV T9)
Earth Radiation Budget (including Solar Irradiance) *	Sea Surface Salinity (SSS)	Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) (ECV T10)
Temperature	Sea Surface Temperature (SST)	Leaf Area Index (LAI) (ECV T11)
Water Vapor	Sub-Surface	Above Ground Biomass (ECV T12) *
Wind Speed and Direction	Carbon	Fire Disturbance (ECV T13)
Composition	Current	Soil Moisture *
Aerosol Properties	Nutrients	Soil Carbon *
Carbon Dioxide	Ocean Acidity *	Ice Sheets *
Methane and other Long-Lived Green House Gases (1)	Oxygen *	
Ozone	Salinity	
Precursors (supporting the Aerosols and Ozone ECVs) (3) *	Temperature	
	Tracers	

* Added or modified per Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC - August 2010, GCOS-138 (GCOS-184, GTOS-76, WMO-TD/No. 1523) (page 19) (pdf)

(1) The 'Other long-lived greenhouse gases' ECV includes Nitrous Oxide (N₂O), Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), Hydrofluorocarbons (HFCs), Sulphur hexafluoride (SF₆), and Perfluorocarbons (PFCs).

(2) Includes Runoff (m³ s⁻¹), Ground Water Extraction Rates (kg m⁻² yr⁻¹) and Location, Snow Cover Extent (km²) and Duration, Snow Depth (cm), Glacier/Ice Cap Inventory and Mass Balance (kg m⁻² yr⁻¹), Glacier Length (m), Ice Sheet Mass Balance (kg m⁻² yr⁻¹) and Extent (km²), Permafrost Extent (km²), Temperature Profiles and Active Layer Thickness, above ground Biomass (t/ha), Burnt Area (ha), Date and Location of Active Fire, Burn Efficiency (% Vegetation Burned/Unit Area)

Figure 1: Main view of the ECV Matrix

Each of the 50 ECVs has a dedicated web page that provides a list of trusted data sets identified by the global observing systems and world data centers and divided into two categories: 1) Non-Satellite or *in-situ* 2) Satellite. See example in Figure 2. The data sets for each of the ECVs are identified

based on documentation such as the 'Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (Update 2010) August 2010, GCOS-138, GTOS-184, GTOS-76, WMO-TD/No.1523 publication¹ and the GTOS Assessments of the Status of the Development of Standards for the Terrestrial Essential Climate Variables.¹¹ Each data set has a description of content, data download link, metadata, data documentation, list of variables, program information, and more. These web pages also include additional information such as definitions, spatial and temporal coverage, data gaps, quality control, contributing and status of networks, additional data needs, and reference documentation.

Observations (GEO)², the World Meteorological Organization Information System (WIS)³, as well as the NOAA Climate Portal⁴, to ensure that work already undertaken by the GOSIC does not have to be duplicated by these systems. As such, the consistent look and feel of the GOSIC that many users have become accustomed to can also now be found as powering the climate data search engines of these major systems. NCDC has been nominated by the U.S. to be a formal WIS Data Collection and Production Center (DCPC)⁵ and the GOSIC will form a key part of that DCPC function for NCDC; this nomination will be decided by the 16th WMO Congress at its next session in May 2011.

5. CONCLUSION

The unique value that the GOSIC offers its users is the ability to search, using a variety of tools, and quickly link users to a wide range of downloadable data sets that reside at multiple data centers around the world via a consistent and user friendly interface. The goal of the GOSIC Portal is to provide access to global observing system data with the fewest number of clicks as well as provide tailored search capabilities through a variety of search tools such as matrices, registries and search by key word, global observing system, data center, program and joint programs, theme, variable, and more.

The newly developed ECV Matrix provides another data access tool that allows users to search for data sets based on the 50 ECVs. Using this tool, the users can efficiently view all of the ECVs by domain (atmosphere, ocean and land), and with the fewest number of clicks access individual web pages for each of the ECVs listing trusted data sets with links to data download, metadata, and other relevant information. The GOSIC staff is constantly adding new climate datasets identified by the global observing systems and the world data centers as the best available collection of data for the ECVs. The GOSIC staff invites persons to become actively involved in the site by providing us feedback at <gosic@noaa.gov>; the staff is quite responsive and their goal is to provide

Figure 2: Example of individual ECV web page on the ECV Matrix - Partial view of the Atmospheric Surface Pressure ECV page

Since its inception, the success of the GOSIC has been in its ability to incorporate new search methodologies as well as to work in a synergistic way with other facilities to ensure maximum exposure of the GOSIC to as wide an audience as possible. The GOSIC has worked with the Group on Earth

² See <http://www.geowebportal.org/>

³ See <http://gis.ncdc.noaa.gov/geoport/catalog/main/home.page>

⁴ See <http://climate.gov>

⁵ See http://www.wmo.int/pages/prog/www/WIS/centres_en.html

the easiest and most convenient access to global climate observing datasets from the atmospheric, oceanic, and terrestrial observing domains. Finally, the GOSIC has a very small staff and depends on users to help us identify datasets for inclusion. The staff is quite flexible and looks forward to input and suggestion from users to assist us. Therefore, people should feel welcome to provide feedback and rest assured that it will be addressed in a timely fashion.

References

ⁱ Diamond, H.J. and C. J. Lief (2009). A Comprehensive Data Portal for Global Climate Information, *EOS Trans. AGU*, 90(39), doi:10.1029/2009EO390001.

ⁱⁱ Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (Update 2010) August 2010, GCOS-138, GTOS-184, GTOS-76, WMO-TD/No. 1523, United Nations Environment Programme, International Council For Science
<<http://www.wmo.int/pages/prog/gcos/Publications/gcos-138.pdf>>

ⁱⁱⁱ ECV T1 River Discharge - Assessment of the Status of the Development of Standards for the Terrestrial Essential Climate Variables - Draft version 9, 11 May 2009, GTOS-56
<<http://www.fao.org/gtos/doc/ECVs/T01/T01.pdf>>

ECV T4 Water Level - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 8, 11 May 2009, GTOS-59
<<http://www.fao.org/gtos/doc/ECVs/T04/T04.pdf>>

ECV T5 Snow Cover - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 8, 21 May 2009, GTOS-60
<<http://www.fao.org/gtos/doc/ECVs/T05/T05.pdf>>

ECV T6 Glaciers and Ice Caps - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables (ECV), Version 10, 21 May 2009, GTOS-61
<<http://www.fao.org/gtos/doc/ECVs/T06/T06.pdf>>

ECV T7 Permafrost - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 13, 8 May 2009,

GTOS-62
<<http://www.fao.org/gtos/doc/ECVs/T07/T07.pdf>>

ECV T8 Albedo and Reflectance Anisotropy - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 12, 7 May 2009, GTOS-63
<<http://www.fao.org/gtos/doc/ECVs/T08/T08.pdf>>

ECV T9 Land cover - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 16, 21 May 2009, GTOS-64
<<http://www.fao.org/gtos/doc/ECVs/T09/T09.pdf>>

ECV T10 FAPAR: Fraction of Absorbed Photosynthetically Active Radiation - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 8, 11 May 2009, GTOS-65
<<http://www.fao.org/gtos/doc/ECVs/T10/T10.pdf>>

ECV T11 LAI: Leaf Area Index - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 10, 25 May 2009, GTOS-66
<<http://www.fao.org/gtos/doc/ECVs/T11/T11.pdf>>

ECV T12 Biomass - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 10, 25 May 2009, GTOS-67
<<http://www.fao.org/gtos/doc/ECVs/T12/T12.pdf>>

ECV T13 Fire Disturbance - Assessment of the Status of the Development of the Standards for the Terrestrial Essential Climate Variables, Version 27, 6 May 2009, GTOS-68
<<http://www.fao.org/gtos/doc/ECVs/T13/T13.pdf>>