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Abstract	

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DOCUMENT REVISION HISTORY

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1.0	25.03.2022	Final version	Ester Prat

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TABLE OF CONTENTS

1. SUMMARY

As a virtual training, different unit materials have been prepared within each of the 4 topics covered in the Standard Course and they are available through the virtual learning platform. Each course and unit will be freely programmed so the CBK PAN staff is able to follow the course at their own availability rhythm. Please note that the Moodle Platform and its courses are planned to be managed and maintained by CBK PAN beyond the end of the project, thus any CBK PAN researcher or student will be able to enrol in the courses after the project ends.

Each unit is composed of different educational resources: presentations, video-tutorials, unit reports and scientific bibliography, practical exercises, a Questions and Answers section and a Self-Evaluation Quiz so that students can evaluate the level of their knowledge acquisition.

2. COURSE DESCRIPTION, CONTENT DETAILS AND LEARNING OUTCOMES

The Standard course is formed by 4 courses based on 4 main topics related to Ecosystem research: Remote Sensing (SR), Ecosystem Research (SE), Modelling (SM), Computer Science (SC). Each course includes different sections: several theoretical subjects, a practical exercise part and a Questions and Answers and Self Evaluation Quiz part. The outline is the following:

TOPIC	CODE	UNIT TITLE	RESPONSIBLE PARTNER
Remote Sensing	SR1	Principles and concepts spatial, time and spectral properties	CREAF
	SR2	Main data sources and types	CERTH-CREAF
	SR3	Basic environmental applications	CREAF
	SR4	Basic derived products: spectral indices	CREAF
Ecosystem Research	SE1	Principles and main open issues in Ecosystem Services	CREAF
	SE2	Essential Biodiversity Variables	CERTH-CREAF
	SE3	Other Essential Variables related to Ecosystems	CERTH-CREAF
	SE4	Ecosystem functional type approach	CREAF
Modelling	SM1	Principles and concepts on ecosystem modelling: how to write an ecological model	CNR
	SM2	Principles and concepts on ecosystem modelling: how to build a data-driven model	CNR
	SM3	Ecosystem modelling	CNR
Computer Science	SC1	Massive geoprocessing: procedures and tools	CERTH-CREAF
	SC2	Metadata roles	CREAF
	SC3	Introduction to Web Services (OGC standards), preservation issues and solutions	CREAF

SR REMOTE SENSING

SR1 PRINCIPLES AND CONCEPTS: SPATIAL, TIME AND SPECTRAL PROPERTIES

SR1 Principles and concepts: spatial, time and spectral properties				**CREAF**	
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SR1.1	What is Remote Sensing? Fundamentals	CREAF	5’	MOODLE PDF	SRO1.1 SRO1.4 SRO1.5
SR1.2	Spectral signatures	CREAF	20’	MODDLE PDF	SRO1.2
SR1.3	Platforms overview	CREAF	10’	MOODLE PDF	SRO1.3
SR1.4	Pixel and resolutions	CREAF	15’	MOODLE PDF	SRO1.3
SR1.5	Practical exercise	CREAF	20’	SNAP/ MiraMon	SR1.1
SR1.7	Self-Evaluation Test	CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SRO1.1	Understand the physical fundamentals of Remote Sensing and be able to apply them in the analysis and treatment of the data.	SR1.1
SRO1.2	Understand what is an spectral signature and learn how to identify them	SR1.2
SRO1.3	Learn about platforms characteristics and remote sensing resolutions	SR1.3, SR1.4, SR2.1
SRO1.4	Understand the concept of reflectivity and learn the factors that affect the reflectivity of natural surfaces	SR1.1
SRO1.5	Understand and assimilate the different ways in which electromagnetic radiation interacts with matter.	SR1.1

SR2 MAIN DATA SOURCES AND TYPES

SR2 Main data sources and types				**CREAF - CERTH**	
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SR2.1	Types of platforms and sensors	CREAF	5’	MOODLE PDF	SRO2.8 SRO1.3

SR2.2	Data types a) File Formats b) File Formats of the future	CERTH	20’	MOODLE PDF	SRO2.1, SRO2.2, SRO2.3
SR2.3	Data Sources a) Distribution policies b) Organizations/Data hubs	CERTH	20’	MOODLE PDF	SRO2.4, SRO2.5
SR2.4	Practical exercise	CREAF	25’		SRO2.6, SRO2.7
SR2.5	Questions and answers	CERTH, CREAF	20’	MOODLE FORUM	All
SR2.6	Self-Evaluation Test	CERTH, CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SRO2.1	Learn about the File formats, their scope and their limitations	SR2.2
SRO2.2	Gain insight in the upcoming remote sensing file formats	SR2.2
SRO2.3	Acquire knowledge about the different data acquisition modes	SR2.2
SRO2.4	Understand the need for interoperability	SR2.3
SRO2.5	Familiarize with the open platforms providing open access to remote sensing data	SR2.3
SRO2.6	Learn how to visualize data using SNAP	SR2.4
SRO2.7	Understand advantages and disadvantages of visualizing remote sensing data in the 2D domain	SR2.4
SRO2.8	Learn about the main platforms, sensors and space missions	SR2.1

SR3 BASIC ENVIRONMENTAL APPLICATIONS

SR3 Basic environmental applications	**CREAF**

COURSE CONTENT

Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SR3.1	Land use Planning	CREAF	20’		SRO3.1, SRO3.2
SR3.2	Water applications	CREAF	20’		SRO3.1, SRO3.3
SR3.3	Natural and man-made hazards	CREAF	15’		SRO3.1, SRO3.4
SR3.4	Meteorological/Climate applications	CREAF	15’		SRO3.1, SRO3.5

SR3.5	Questions and answers	CREAF	10’	MOODLE FORUM	SRO3.2, SRO3.3, SRO3.4 SRO3.5
SR3.6	Self-Evaluation Test	CREAF	15’	MOODLE TEST	SRO3.2, SRO3.3, SRO3.4 SRO3.5

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SRO3.1	Familiarize with many types of Remote Sensing applications for several purposes, at different scopes and sectors	SR3.1, SR3.2, SR3.3, SR3.4
SRO3.2	Understand the contribution of times series of Remote Sensing for obtaining land use and land cover maps and their applications in agriculture, forestry, urban planning..	SR3.1, SR3.5, SR3.6
SRO3.3	Learn about the main water domain applications.	SR3.2, SR3.5, SR3.6
SRO3.4	Understand the contribution of Remote Sensing to prevent, monitor and analyze the impacts of the natural and man-made hazards.	SR3.3, SR3.5, SR3.6
SRO3.5	Acquire basic knowledge about the main climate and meteorological Remote Sensing applications	SR3.4, SR3.5, SR3.6

SR4 BASIC DERIVED PRODUCTS: SPECTRAL INDICES

SR4 Basic derived products: spectral indices	**CREAF**

COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SR4.1	What is a spectral index?	CREAF	7’	MOODLE PDF	SRO4.1
SR4.2	Vegetation condition indices	CREAF	34’	MOODLE PDF	SRO4.2
	a) Simple Ratio	CREAF	3’	MOODLE PDF	SRO4.2
	b) NDVI	CREAF	5’	MOODLE PDF	SRO4.2; SRO4.3
	c) SAVI	CREAF	5’	MOODLE PDF	SRO4.2; SRO4.3
	d) EVI	CREAF	5’	MOODLE PDF	SRO4.2; SRO4.3
	e) NBR	CREAF	5’	MOODLE PDF	SRO4.2; SRO4.4
	f) NBR+	CREAF	2’	MOODLE PDF	SRO4.2; SRO4.4
	g) BAI	CREAF	5’	MOODLE PDF	SRO4.2; SRO4.4

	h) BAIS2	CREAF	2’	MOODLE PDF	SRO4.2; SRO4.4
	~~i)~~ NDWI	CREAF	2’	MOODLE PDF	SRO4.2; SRO4.5
SR4.3	Hydrology related indices	CREAF	5’	MOODLE PDF	SRO4.6
	a) NDSI	CREAF	3’	MOODLE PDF	SRO4.6
	b) NDSI Sentinel-2 Algorithm	CREAF	2’	MOODLE PDF	SRO4.6
SR4.4	Data transformation	CREAF	20’	MOODLE PDF	SRO4.7
	a) Tasseled Cap	CREAF	10’	MOODLE PDF	SRO4.7
	b) Principal Components Analysis	CREAF	10’	MOODLE PDF	SRO4.7
SR4.5	Urban area indices	CREAF	5’	MOODLE PDF	SRO4.8
	a) NDBI	CREAF	3’	MOODLE PDF	SRO4.8
	b) Other indices	CREAF	2’	MOODLE PDF	SRO4.8
SR4.6	Practical exercise	CREAF	45’	MOODLE PDF	SRO4.9
SR4.7	Questions and answers	CREAF	-	MOODLE FORUM	All
SR4.8	Self-Evaluation Test	CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES

Code	Title	Course Content (Code)
SRO4.1	Learn the principle of the spectral index calculation	SR4.1
SRO4.2	Familiarize with the most commonly used vegetation indices	SR4.2
SRO4.3	Examine how the vegetation indices relates to the vegetation dynamics and health	SR4.2
SRO4.4	Understand how fires are characterized using remote sensing data	SR4.2
SRO4.5	Examine how the water-related spectral indices relates to changes in the vegetation and soil water content	SR4.2
SRO4.6	Learn about the most commonly used hydrologic indices	SR4.3
SRO4.7	Learn about the most commonly used data transformations. Understand tasseled cap transformations and principal components analysis	SR4.4
SRO4.8	Learn about the most commonly used urban indices	SR4.5
SRO4.9	Calculate spectral indices on remote sensing images	SR4.7

SE ECOSYSTEM RESEARCH

SE1 PRINCIPLES AND MAIN OPEN ISSUES IN ECOSYSTEM SERVICES

SE1 Principles and main open issues in Ecosystem Services					**CREAF**
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SE1.1	What are Ecosystem services?	CREAF	2’	MOODLE PDF	SEO1.1
SE1.2	Why are Ecosystem Services important?	CREAF	5’	MOODLE PDF	SEO1.1
SE1.3	Types of Ecosystem services	CREAF	15’	MOODLE PDF	SEO1.2; SEO1.3
SE1.4	Remote sensing and EESS	CREAF	20’	MOODLE PDF	SEO1.4
SE1.5	Ecosystem Services Initiatives	CREAF	3’	MOODLE PDF	SEO1.5
SE1.6	Self-Evaluation Test	CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SEO1.1	Familiarize with the concept Ecosystem service and why are they important	SE1.1; SE1.2
SEO1.2	Identify ecosystem services in various ecosystems	SE1.3
SEO1.3	Classify those services according to one of the four categories as described in the Millennium Ecosystem Assessment (MA).	SE1.3
SEO1.4	Learn about the role of remote sensing on the monitoring of ecosystem services	SE1.4
SEO1.5	Familiarize with Ecosystem Services initiatives	SE1.5

SE2 ESSENTIAL BIODIVERSITY VARIABLES

SE2 Essential Biodiversity Variables					**CREAF - CERTH**
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SE2.1	What are Essential Biodiversity Variables	CREAF	10’	MOODLE PDF	SEO2.1 SEO2.2

					SEO2.3
SE2.2	Ecosystem Biodiversity Variables review		20’	MOODLE PDF	SEO2.2 SEO2.3
SE2.3	Satellite Remote Sensing EBV (SRS-EBV)	CREAF	10’	MOODLE PDF	SEO2.4
SE2.4	Practical exercise	CREAF	30’	PDF/SNAP	SE02.5
SE2.5	Self-Evaluation Test	CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SEO2.1	Understand Essential Biodiversity variables in the Essential variables framework	SE2.1
SEO2.2	Know about the requirements of the variables to be considered EBV	SE2.1 SE2.2
SEO2.3	Learn the different EBV, the different sources and their applications	SE2.1 SE2.2
SEO2.4	Understand the role of remote sensing in the EBV generation	SE2.3
SEO2.5	Download and process EBV datasets from source, management and information production	SE2.4

SE3 OTHER ESSENTIAL VARIABLES RELATED TO ECOSYSTEMS

SE3 Other Essential Variables related to Ecosystems					**CERTH**
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SE3.1	Types of essential variables	CERTH	10’	MOODLE PDF	SEO3.1
SE3.2	Essential Climate Variables (ECVs)	CERTH	14’	MOODLE PDF	SEO3.2, SEO3.3
SE3.3	Essential Ocean Variables (EOVs)	CERTH	5’	MOODLE PDF	SEO3.2, SEO3.3
SE3.4	Essential Agricultural Variables (EAVs)	CREAF	12’	MOODLE PDF	SEO3.2, SEO3.3, SEO3.4
SE3.5	Practical exercise	CERTH	25’	MOODLE PDF	SEO3.5, SEO3.6, SEO3.7

SE3.6	Questions and answers	CERTH	-	MOODLE FORUM	All
SE3.7	Self-Evaluation Test	CERTH	15’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SEO3.1	Learn about the types of essential variables related to ecosystems.	SE3.1
SEO3.2	Comprehend how each variable contributes in the ecosystem function as well as its importance.	SE3.2, SE3.3, SE3.4
SEO3.3	Familiarize with the available remote sensing products and datasets for the estimation of each variable.	SE3.2, SE3.3, SE3.4
SEO3.4	Learn about the open-source software tools for the estimation of a variable.	SE3.4
SEO3.5	Learn how to access and download Sentinel-2 images.	SE3.5
SEO3.6	Become acquainted with the preprocessing of Sentinel-2 images in QGIS.	SE3.5
SEO3.7	Acquire knowledge about the water mask and hydroperiod map generation.	SE3.5

SE4 ECOSYSTEMS FUNCTIONAL TYPE APPROACH

SE4 Ecosystems Functional Type approach	**CREAF**

COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SE4.1	What are Ecosystem functional types	CREAF	5’	MOODLE PDF	SEO4.1
SE4.2	Ecosystem Functional Types calculation	CREAF	20’	MOODLE PDF	SEO4.2
SE4.3	Ecosystem Functional Types applications	CREAF	15’	MOODLE PDF	SEO4.3
SE4.4	Practical exercise	CREAF	20’	PDF/QGIS	SEO4.2 SEO4.3 SEO4.4
SE4.5	Self-Evaluation Test	CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**

SEO4.1	Learn about the phenological basis of the Ecosystem Functional Type approach	SE4.1
SEO4.2	Know how to calculate EFT	SE4.2 SE4.4
SEO4.3	Distinguish phenological traits of ecosystems based on EFT maps	SE4.3 SE4.4
SEO4.4	Become aware of the EFT applications in ecosystem research	SE4.4

SM MODELLING

SM1 PRINCIPLES AND CONCEPTS ON ECOSYSTEM MODELLING: HOW TO WRITE AN ECOLOGICAL MODEL

SM1 principles and concepts on ecosystem modelling: how to write an ecological model				**CNR**	
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SM1.1	How to write an ecological model	CNR	60’	MOODLE PDF	SMO1.1
SM1.2	How to write an ecological model - exercises	CNR	80’	MOODLE PDF	SMO1.1
SM1.3	Questions and answers	CNR	-	MOODLE FORUM	All
SM1.4	Self-Evaluation Test	CNR	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SMO1.1	Learning how to write an ecological model starting from the ecological problem	SM1.1, SM1.2, SM1.3, SM1.4

SM2 PRINCIPLES AND CONCEPTS ON ECOSYSTEM MODELLING: HOW TO BUILD A DATA-DRIVEN MODEL

SM2 Principles and concepts on ecosystem modelling: how to build a data-driven model				**CNR**	
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**

SM2.1	How to build a data-driven model	CNR	50’	MOODLE PDF	SMO2.1
SM2.2	How to build a data-driven model - exercises	CNR	80’	MOODLE PDF	SMO2.1
SM2.3	Questions and answers	CNR	-	MOODLE FORUM	All
SM2.4	Self-Evaluation Test	CNR	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SMO2.1	Learning how to write an ecological model starting from the ecological problem	SM2.1, SM2.2, SM2.3, SM2.4

SM3 ECOSYSTEM MODELLING

SM3 Ecosystem modelling					**CNR**
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SM3.1	Ecosystem modelling	CNR	90’	MOODLE PDF	SMO3.1
SM3.2	Ecosystem modelling - exercises	CNR	30’	MOODLE PDF	SMO3.1
SM3.3	Questions and answers	CNR	-	MOODLE FORUM	All
SM3.4	Self-Evaluation Test	CNR	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SMO3.1	Learning how to simulate the dynamics of ecosystems	SM3.1, SM3.2, SM3.3, SM3.4

SC COMPUTER SCIENCE

SC1 MASSIVE GEOPROCESSING: PROCEDURES AND TOOLS

SC1 Massive geoprocessing: procedures and tools					CREAF - CERTH
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SC1.1	Introduction and concepts	CREAF		MOODLE PDF	SCO1.1, SCO1.2
SC1.2	Scripts and BATCH processing	CREAF		MOODLE PDF	SCO1.2
SC1.3	High Performance Computing	CERTH	10’	MOODLE PDF	SCO1.3
SC1.4	Geospatial information processing	CERTH	5’	MOODLE PDF	SCO1.4
SC1.5	Datacubes	CERTH	5’	MOODLE PDF	SCO1.5
SC1.6	Geoprocessing Business Models	CEERTH	5’	MOODLE PDF	SCO1.6, SCO1.7
SC1.6	Practical exercise	CREAF	20’	SNAP/ GDAL/ MiraMon	SCO1.2
SC1.7	Questions and answers	CREAF CERTH		MOODLE PDF	All
SC1.8	Self-Evaluation Test	CREAF CERTH	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SCO1.1	Learn about Computer Science concepts	SC1.1
SCO1.2	Understand the usefulness of the geoprocessing methods and tools	SC1.1, SC1.2, SC1.8
SCO1.3	Gain insight into the different HPC Platform Architectures and understand the advantages and disadvantages of each one.	SC1.3
SCO1.4	Learn about the standards for On-line Geospatial Information Processing	SC1.4
SCO1.5	Get acquainted with some of the most advanced Open Data Cube platforms.	SC1.5
SCO1.5	Understand the need for interoperability	SC1.5
SCO1.5	Understand the importance of open-source massive geoprocessing platforms	SC1.5
SCO1.6	Learn about the different business models	SC1.6
SCO1.7	Understand the advantages and the disadvantages of each business model	SC1.6

SC2 METADATA ROLES

SC2 Metadata roles				CREAF	
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SC2.1	What is metadata?	CREAF	5’	MOODLE PDF	SCO2.1
SC2.2	Importance of metadata		10’	MOODLE PDF	SCO2.1
SC2.3	Main geospatial metadata standards	CREAF	10’	MOODLE PDF	SCO2.2, SCO2.3, SCO2.4
SC2.4	What is an SDI?	CREAF	5’	MOODLE PDF	SCO2.5
SC2.5	INSPIRE international framework	CREAF	10’	MOODLE PDF/Video	SCO2.6
SC2.6	Creation and edition of metadata	CREAF	15’	MOODLE PDF	SCO2.3, SCO2.7, SCO2.8
SC2.7	Practical exercise	CREAF	20’	GeM+ GeoNetwork	SCO2.3, SCO2.7, SCO2.8, SCO2.9
SC2.9	Self-Evaluation Test	CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SCO2.1	Learn about metadata and its importance	SC2.1, SC2.2
SCO2.2	Get familiar with the main geospatial metadata standards	SC2.3
SCO2.3	Know the ISO 19115 Metadata Core minimum metadata	SC2.3, SC2.7,
SCO2.4	Learn the differences between ISO 19115 and ISO 19139	SC2.3
SCO2.5	Learn the purpose and functions of an SDI	SC2.4
SCO2.6	Get familiar with the INSPIRE Directive 2007/2/CE	SC2.5
SCO2.7	Introduce to the creation and edition of metadata with different tools	SC2.6, SC2.7
SCO2.8	Know the metadata quality elements according to ISO	SC2.6, SC2.7
SCO2.9	Learn how to create ISO metadata with GeM+ in XML	SC2.7

SC3 INTRODUCTION TO WEB SERVICES (OGC STANDARDS), PRESERVATION ISSUES AND SOLUTIONS

SC3 Introduction to Web Services (OGC standards), preservation issues and solutions				**CREAF**	
COURSE CONTENT					
Code	**Title**	**Resp.Team**	**Time**	**Format / Software**	**Learn.Out (Code)**
SC3.1	Introduction to Geospatial Web Services	CREAF	25’	MOODLE PDF	SCO3.1, SCO3.2, SCO3.3
SC3.2	Intro to OGC main web services	CREAF	35’	MOODLE PDF	SCO3.4
SC3.3	ISO 19165-1:2018 Geographic information — Preservation of digital data and metadata	CREAF	15’	MOODLE PDF	SCO3.5
SC3.4	MMZx preservation package	CREAF	5’	MOODLE PDF	SCO3.6
SC3.5	Practical exercise	CREAF	20’	MiraMon/QGIS	SCO3.7
SC3.7	Self-Evaluation Test	CREAF	10’	MOODLE QUIZ	All

LEARNING OUTCOMES		
Code	**Title**	**Course Content (Code)**
SCO3.1	Learn about the client-server architecture	SC3.1
SCO3.2	Get familiar with the communication protocols	SC3.1
SCO3.3	Know the technological evolution of distributed GIS	SC3.1
SCO3.4	Get familiar with the OGC main web services	SC3.2
SCO3.5	Know the ISO 19165-1:2018 Geographic information —Preservation of digital data and metadata	SC3.3
SCO3.6	Learn about the MMZx preservation package for data preservation	SC3.4
SCO3.7	Visualize a WMS service from a desktop GIS	SC3.5