



UNIVERSIDAD  
**COMPLUTENSE**  
MADRID

Facultad de Geografía e Historia  
Universidad Complutense de Madrid

## **Cursos de Formación Nuevas Tecnologías 2018-2019**

Vicedecanato de Innovación, Nuevas Tecnologías y Comunicación

# **FOTO-RECONSTRUCCIÓN 3D: MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS**

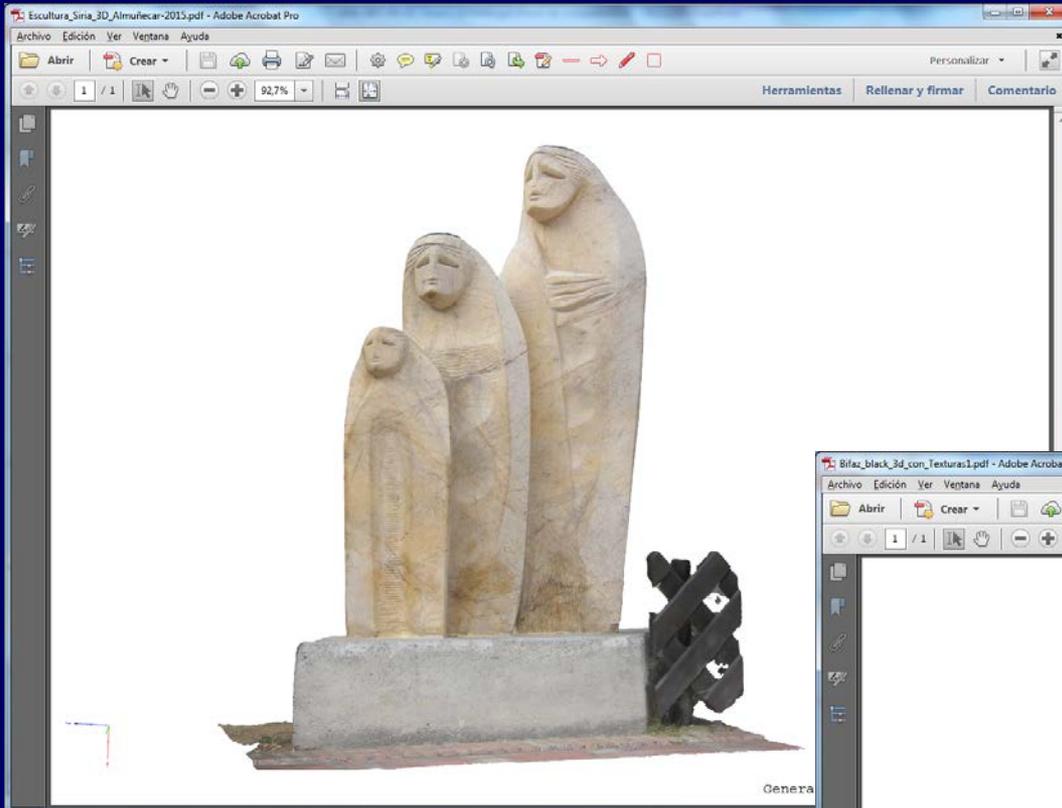
Miércoles y jueves 21-22/NOV/2018 (11:30-14:30; Aula 24i)

**Luis Miguel Tanarro García**

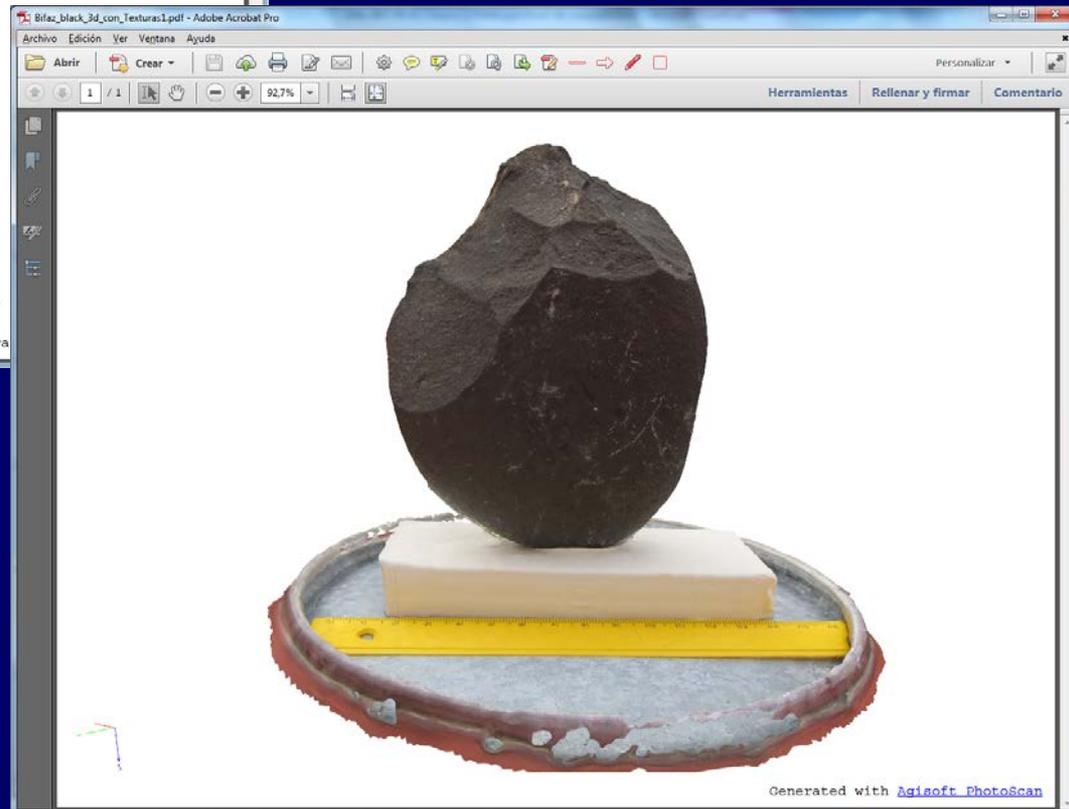
Departamento de Geografía. Universidad Complutense de Madrid  
Grupo de Investigación en Geografía Física de Alta Montaña (GFAM)

<https://www.ucm.es/gfam/>

# MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS



Escultura. Parque El Majuelo.  
Almuñécar (Granada)



Bifaz

¿Cómo podemos modelizar un objeto en 3 dimensiones?



**TÉCNICAS Y HERRAMIENTAS  
(FOTOGRAMETRÍA DIGITAL)**

# TÉCNICAS RECIENTES PARA EL LEVANTAMIENTO TRIDIMENSIONAL (3D)

SUPERFICIE TOPOGRÁFICA

Sistemas LiDAR basados en tecnologías láser

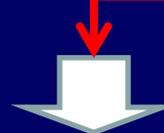
*Laser Imaging Detection and Ranging*

**LIDAR-ALS**  
(*Airborne Laser Scanner*)

**ESCANEO LÁSER TERRESTRE**  
(*Terrestrial Laser Scanning -TLS-*)

**PROCESAMIENTO DE FOTOGRAFÍAS**

**FOTO-RECONSTRUCCIÓN**  
(*Structure from Motion -SfM-*)



**NUBES DE PUNTOS**

Conjunto de vértices, identificados con coordenadas XYZ, en un sistema de coordenadas tridimensional

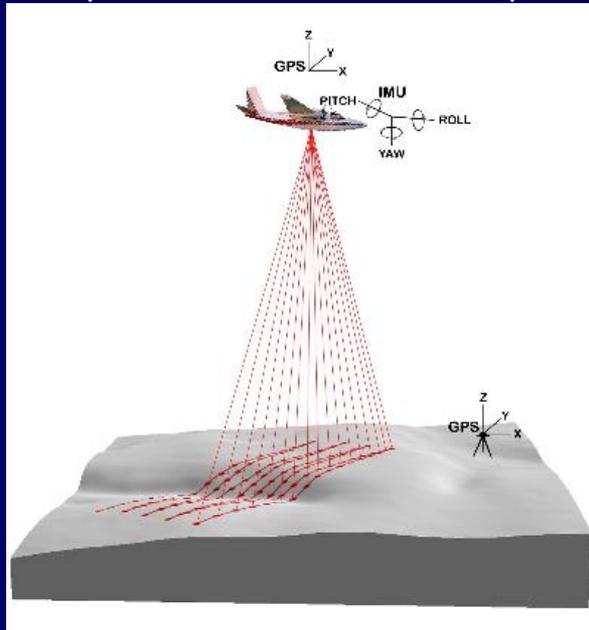


**MAIN OUTPUTS**

- Mesh 3D/Foto-escenas 3D
- Ortofotografías
- MDS/MDE

# HERRAMIENTAS PARA EL LEVANTAMIENTO TRIDIMENSIONAL (3D)

## LIDAR-ALS (Airborne Laser Scanner)



[http://forsys.cfr.washington.edu/JFSP06/lidar\\_technology.htm](http://forsys.cfr.washington.edu/JFSP06/lidar_technology.htm)

## ESCANEADO LÁSER TERRESTRE (Terrestrial Laser Scanning - TLS-)



## Fotografías FOTO-RECONSTRUCCIÓN (Structure from Motion - SfM-)



<https://www.propelleraero.com/blog/better-faster-topographic-surveys-drones-aeropoints/>



# FOTO-RECONSTRUCCIÓN 3D

(*Structure from Motion - SfM*)



Técnica fotogramétrica fundamentada en la reconstrucción tridimensional automática de un objeto o una escena a partir de varias o múltiples fotografías oblicuas convencionales, las cuales se toman desde distintos ángulos por una cámara fotográfica



GPS Garmin Monterra

<https://buy.garmin.com/es-ES/ES/p/113522>

*Structure from Motion*  
(*SfM*)

*Multi-View Stereo (MVS)*

algoritmos "visión estereográfica de vistas múltiples o multivista" (MVS), fundamentado en los principios de la visión estereoscópica

# MAIN OUTPUTS

**3D Point Cloud** Laser scanner (LiDAR) quality 3D points

**3D Textured Model** Full 3D triangle mesh with photo-realistic texturing

**True Orthomosaic** High resolution georeferenced aerial map with corrected perspective

**Digital Surface Model** Accurate georeferenced elevation map

**NDVI Map** Vegetation index map from multispectral cameras provides vital information on plant health

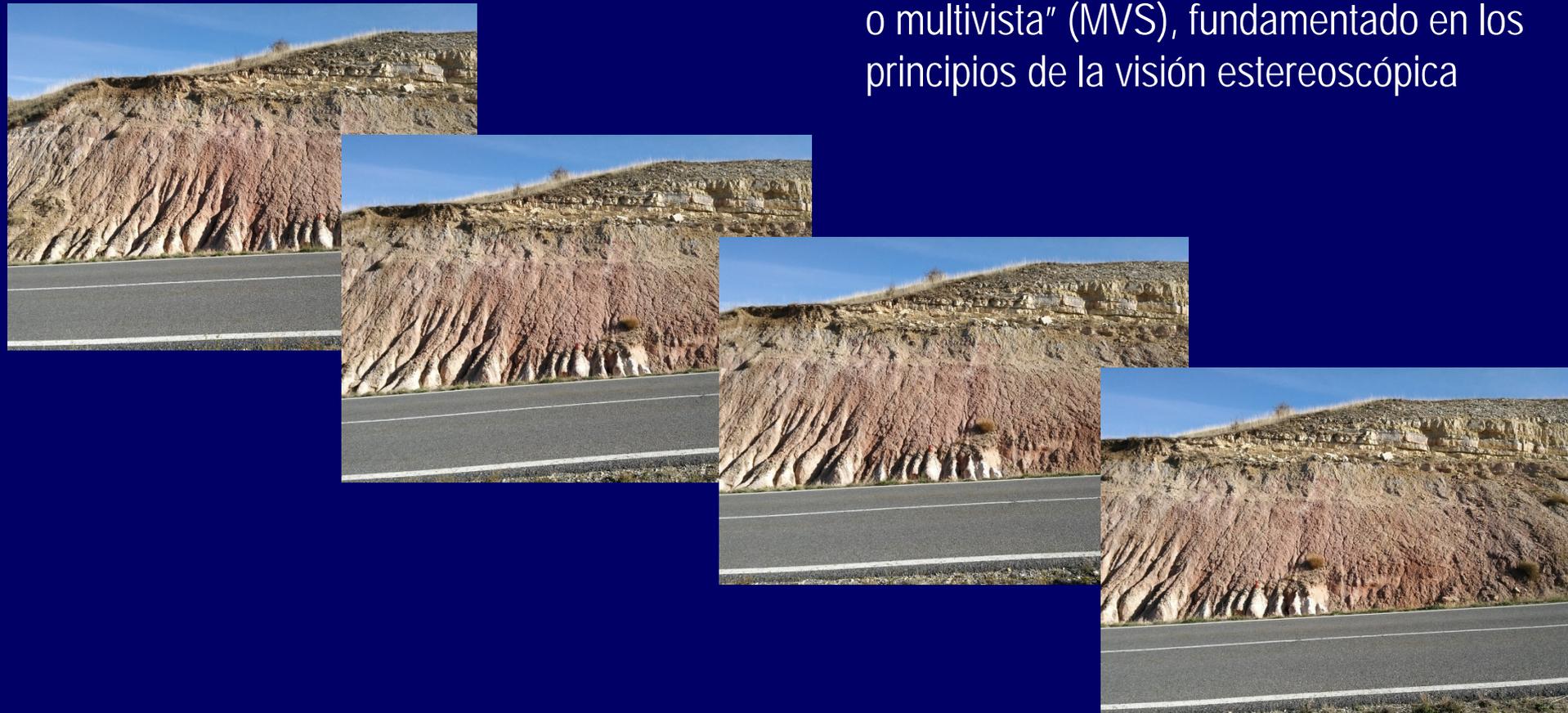
# SOFTWARE ESPECIFICO DENTRO DE LAS TECNOLOGÍAS DE LA INFORMACIÓN GEOGRÁFICA

*Structure from Motion (SfM)*

algoritmos

*Multi-View Stereo (MVS)*

“visión estereográfica de vistas múltiples o multivista” (MVS), fundamentado en los principios de la visión estereoscópica



# SOFTWARE ESPECIFICO DENTRO DE LAS TECNOLOGÍAS DE LA INFORMACIÓN GEOGRÁFICA

## TECNOLOGÍAS DE LA INFORMACIÓN GEOGRÁFICA (TIGs)

### Sistemas Cartográficos

#### Cartography Systems

Cartografía Asistida por Ordenador  
Computer Aided Cartography (CAC)

#### Programas de diseño gráfico

#### Programas de Diseño Asistido por Ordenador (CAD)

#### Desktop Publishing Programs (DTP)

#### Computer Aided Design Programs (CADs)

Adobe Illustrator  
Corel Draw  
Free Hand  
Inkscape

AutoCAD  
Bentley MicroStation  
ZWcad  
FreeCAD  
Tinkercad  
Solidworks  
Blender  
SketchUp  
DesingCAD 3D Max

### Sistemas de Información Geográfica (SIG)

#### Geographic Information System (GIS)

ArcGIS/ArcMap  
ArcView  
GeoMedia  
Bentley Map/GeoGraphics  
AutoCAD Map  
Idrisi  
Ilwis  
MiraMon  
Global Mapper  
GRASS SIG  
gvSIG  
Kosmos  
QGIS  
SAGA GIS

### Teledetección y Fotogrametría

#### Remote Sensing and Photogrammetry

Erdas Imagine  
Envi  
ER Mapper  
LPS  
LEOWorks

#### Photogrammetry

PhotoMod  
Digi3D  
Efoto  
Agisoft PhotoScan  
PhotoModeler  
123D Catch  
Bentley ContextCapture  
VisualSFM

**DPWS**

©Luis M. Tanarro

# "SOFTWARE" DE FOTO-RECONSTRUCCIÓN 3D

**VisualSFM : A Visual Structure from Motion System**  
Changchang Wu

VisualSFM is a GUI application for 3D reconstruction using structure from motion (SfM). The reconstruction system integrates several of my previous projects: [SfM on GPU \(SfM-GPU\)](#), [Multi-cores Bundle Adjustment](#), and [Towards Real-time Incremental Structure from Motion](#). VisualSFM runs fast by exploiting multicore parallelism for feature detection, feature matching, and bundle adjustment.

For dense reconstruction, this program integrates the execution of Yasutaka Furukawa's [PMVS/PMVS2](#) tool chain. The SfM output of VisualSFM works with several additional tools, including [CNE-MVS](#) by Michal Janosek, [MVE](#) by Michael Gosele's research group, [SURE](#) by Mathias Rothermel and Konrad Menzel, and [MeshBeacon](#) by Zhuoliang Kang.

**Structure from Motion - A Visual Interface**  
Reconstruct 3D with a few button clicks, and [watch the dynamic reconstruction process!](#)

3 Sparse Reconstruction



1 Add some images 2 Match the images 4 Dense Reconstruction

You still have the option to run from command line without a GUI!  
`VisualSFM Sfmparams ./images ./result.nvm`

**Download v0.5.26** ([changelog](#) with new feature documentation)

Windows\* ([64-bit](#), [32-bit](#), [installation guide](#)), \*for nVidia CUDA or [CUDA Simulation](#).  
Windows ([64-bit](#), [32-bit](#), [installation guide](#))  
Linux ([64-bit](#), [32-bit](#), [installation guide](#)), see the tutorials for [Ubuntu](#) or [Fedora](#).  
Mac OSX ([64-bit](#), [32-bit](#), [installation guide](#)), see the installer by [Dan Monaghan](#).

- VisualSFM is free for personal, non-profit or academic use. See [README](#) for more details.
- Please cite VisualSFM according to [README](#) in your publication.

**Documentation (FAQs)**  
[Basic usage](#), [image size](#), [customized matching](#), [controls](#), [parameters](#), [nvm file](#), [demo](#).  
Introductory videos (1, 2) and [tutorial](#) by Eugene Liscio. [French Tutorial](#) by Mathis Fassin.

• The [changelog](#) page offers limited documentations for recently added features.  
• Post questions and see discussions & tutorials at the [Google Group](#), or email me privately.

<http://ccwu.me/vsfm/>

Experience the new Photosynth 3D

Photosynth | Tech Preview | Explore | About | My Synths

TellusWorld Riggle  
Mantle 1/27/2013 65770 Views

Capture your world in 3D  
Shoot responsive panoramas or full synths and share them with friends.

Get up by checking out some of the best:

- Budgets
- Towers
- Collections
- Museums
- National Parks
- Markets
- Events
- Forests
- Architecture
- Aerial Views
- Beaches

**Featured**

- Rich Angles 1/27/2013 102794 Views
- The Treasury Photo Architecture 1/26/2013 102794 Views
- Experience the new dazstudio Photosynth 3D

**Recommended**

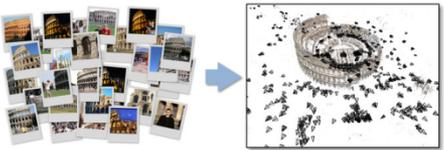
- COFFEE BEAN - Jan 2013 1/27/2013 102794 Views
- WORMS/COCKROACH WHATEVER! 1/27/2013 102794 Views

Create your Synth | About Photosynth | Explore Synths | Latest Synth News | Discussion Forum

Latest Blog Post: Photosynth mobile apps being retired

<https://photosynth.net/default.aspx>

**Bundler: Structure from Motion (SfM) for Unordered Image Collections**



Software written by [Noah Snavely](#)  
Download Bundler from the [bundler\\_sfm repository on GitHub](#)

[What is Bundler?](#) | [Downloading Bundler](#) | [Documentation](#) | [References](#) | [Links](#)

**What is Bundler?**

Bundler is a structure-from-motion (SfM) system for unordered image collections (for instance, images from the Internet) written in C and C++. An earlier version of this SfM system was used in the [Photo Tourism](#) project. For structure-from-motion datasets, please see the [BigSfM](#) page.

Bundler takes a set of images, image features, and image matches as input, and produces a 3D reconstruction of camera and (sparse) scene geometry as output. The system reconstructs the scene incrementally, a few images at a time, using a modified version of the [Sparse Bundle Adjustment](#) package of Lourakis and Argyros as the underlying optimization engine. Bundler has been successfully run on many Internet photo collections, as well as more structured collections.

The Bundler source distribution also contains potentially useful implementations of several computer vision algorithms, including:

- F-matrix estimation
- Calibrated 5-point relative pose
- Triangulation of multiple rays

Bundler produces sparse point clouds. For denser points, Dr. Yasutaka Furukawa has written a beautiful software package called [PMVS2](#) for running dense multi-view stereo. A typical pipeline is to run Bundler to get camera parameters, use the provided [Bundle2PMVS](#) program to convert the results into PMVS2 input, then run PMVS2. You might also be interested in Dr. Furukawa's [CMVS](#) view clustering software, which is a helpful preprocess to running PMVS2.

**Downloading Bundler**

The Bundler source code is now hosted at the [bundler\\_sfm repository on GitHub](#).

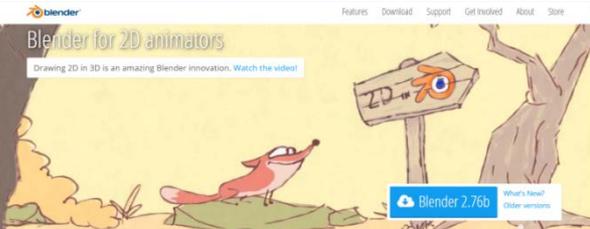
Before we began hosting [Bundler on GitHub](#), the latest released version of Bundler was 0.4. Bundler has been distributed in both Linux/Windows binary and source formats. Both distributions contains a number of scripts and utility programs that simplify the reconstruction pipeline.

- Bundler Version 0.4 (released April 10, 2010) ([Changelog](#))

<http://www.cs.cornell.edu/~snavely/bundler/>

Blender for 2D animators

Drawing 2D in 3D is an amazing Blender innovation. Watch the video!



Blender 2.76b [What's New!](#)  
Other versions

Blender is Free and Open Source Software. Free to use for any purpose, forever.

**Blender 2.76b**  
The binaries for the updated Blender 2.76b release are now ready for download.

**Blender 2.77 test**  
The 2nd test build for the new release is available now. [Download](#) it now!

**The Art of Open Source**  
A great introduction to Blender for a wider audience. Written for Linux Format magazine by Jim Thacker.

**Get Involved**  
Blender is being made by 100s of people from around the world: by students and individual artists, professionals and hobbyists, scientists, students, with experts, animators, game artists, modders, and the list goes on.

**Latest News**

- Blender Institute Postcard #014 - Zoo
- Blender Cloud - February 2013
- More Legs Fluid Simulations
- Before and after: paint over 3d render
- Blender Institute Postcard #013 - Pup
- Blender Cloud - February 18th
- The Art of Open Source
- Blender in News - January 2013
- Blender branches to watch in 2013
- Blender in News - January 8th

Blender 2016 Workflow project

More news >

<https://www.blender.org/>

# "SOFTWARE" DE FOTO-RECONSTRUCCIÓN 3D



**Accurate and Affordable**  
3D Modeling - Measuring - Scanning  
The PhotoModeler Software extracts 3D Measurements and Models from photographs taken with an ordinary camera. A cost-effective way for accurate 3D scanning, measurement, surveying and reality capture.



Why Use PhotoModeler



How PhotoModeler Works



Read our eBook

## Blog & News

Tue, 16 Feb

### PhotoModeler 2016.0.5 Release

2016.0 PhotoModeler 2016.0.5 was released Feb. 16th, 2016. The main reason for this release was to improve stability and fix user reported crashes and problems. There were 10 crash fixes, 4 fixes to non-crash items and 4 small improvements. Getting the New Release if you are a current customer and have an active maintenance

[read more >](#)

Wed, 27 Jan

### PhotoModeler 2016.0.4 Release

2016.0 PhotoModeler 2016.0.4 was released Jan. 27th, 2016 after a year of intense development and a couple of months of beta testing. One of the main focuses of this release is improved results with drone / UAS / UAV projects. The software is much faster processing larger numbers of photographs, handles control points with more

[read more >](#)

Wed, 30 Sep

### Tip #6: Reusing camera positions with replaced images

When two or more cameras, affixed in un-moving positions, are used in a project, the images taken by these cameras can be replaced in the project without having to re-orient them. Doing this can save time and effort for project setups or camera rigs that are reused repeatedly. This procedure of swapping images on fixed

[read more >](#)

<http://www.photomodeler.com/index.html>

## 123D Catch



123D Catch is a free app that lets you create 3D scans of virtually any object.



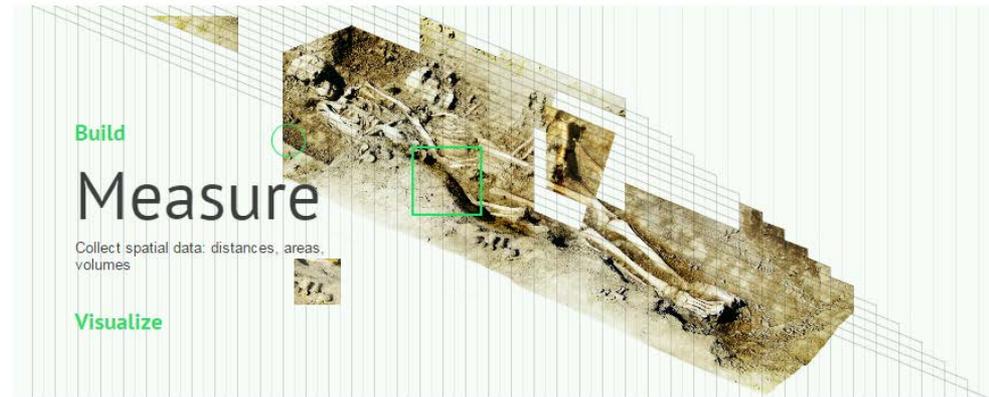
Turn ordinary photos into extraordinary 3D models.

<http://www.123dapp.com/catch>

# "SOFTWARE" DE FOTO-RECONSTRUCCIÓN 3D

Agisoft

FEATURES SUPPORT COMMUNITY DOWNLOADS BUY ABOUT



Take a look at  
showcase



30-day trial  
try it now!



Support  
service

## Agisoft PhotoScan

Agisoft PhotoScan is a stand-alone software product that performs photogrammetric processing of digital images and generates 3D spatial data

to be used in GIS applications, cultural heritage documentation, and visual effects production as well as for indirect measurements of objects of various scales.

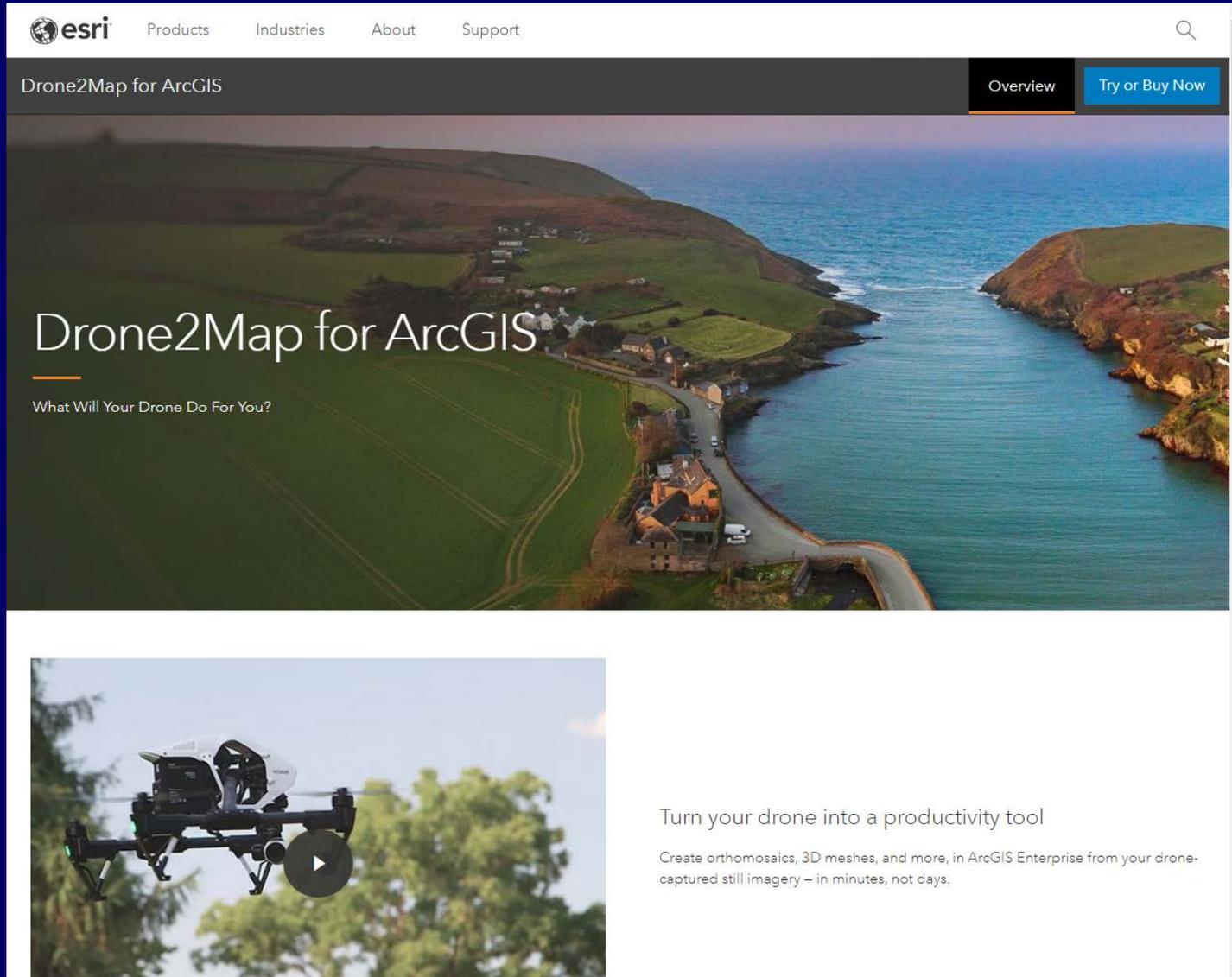
Wisely implemented digital photogrammetry technique enforced with computer vision methods

results in smart automated processing system that, on the one hand, can be managed by a new-comer in the field of photogrammetry, yet, on the other hand, has a lot to offer to a specialist who can adjust the workflow to numerous specific tasks and different types of data.

Throughout various case studies PhotoScan proves to produce quality and accurate results.

<http://www.agisoft.com/>

# "SOFTWARE" DE FOTO-RECONSTRUCCIÓN 3D



esri Products Industries About Support

Drone2Map for ArcGIS Overview Try or Buy Now

## Drone2Map for ArcGIS

What Will Your Drone Do For You?

Turn your drone into a productivity tool

Create orthomosaics, 3D meshes, and more, in ArcGIS Enterprise from your drone-captured still imagery – in minutes, not days.

<https://www.esri.com/en-us/arcgis/products/drone2map/overview>

# "SOFTWARE" DE FOTO-RECONSTRUCCIÓN 3D

## Bentley ContextCapture

ContextCapture  
Create 3D models from simple photographs

Home » Products

### Reality Modeling Software

With ContextCapture, you can produce even the largest and most challenging 3D models of existing real-world conditions, including scales as large as entire cities, from simple photographs, in order to easily and quickly provide context for design, construction, and operations decisions for all types of infrastructure projects throughout the world.

READ MORE +

PRODUCTS

<https://www.bentley.com/en/products/brands/contextcapture>

acute3D capturing reality

ContextCapture Showcase About us Customer area Contact us

Bentley Systems has acquired Acute3D  
Read the official press release

### Capturing reality with automatic 3D photogrammetry software

Turn photos into 3D models automatically with ContextCapture

Acute3D develops and sells ContextCapture, a software solution allowing to produce high resolution 3D models from simple photographs, without any human intervention.

READ MORE +

Why choose ContextCapture

- ✓ Unlimited scalability
- ✓ Superior precision
- ✓ CAD & GIS Interoperability
- ✓ High performance
- ✓ Free viewer & Web publishing

Read more >

See ContextCapture in action

Discover the stunning 3D models produced by ContextCapture by navigating our online 3D demos with our free viewer, or by watching our videos.

Read more >

Achieve your challenges

ContextCapture can dramatically enhance productivity in many applications. As examples, read our challenging

Trusted by industry leaders

ContextCapture has already been adopted by Airbus Group, Autodesk, Nokia, PASCO, Tencent...

Read more >

Learn more and try it yourself

Read more news >

News

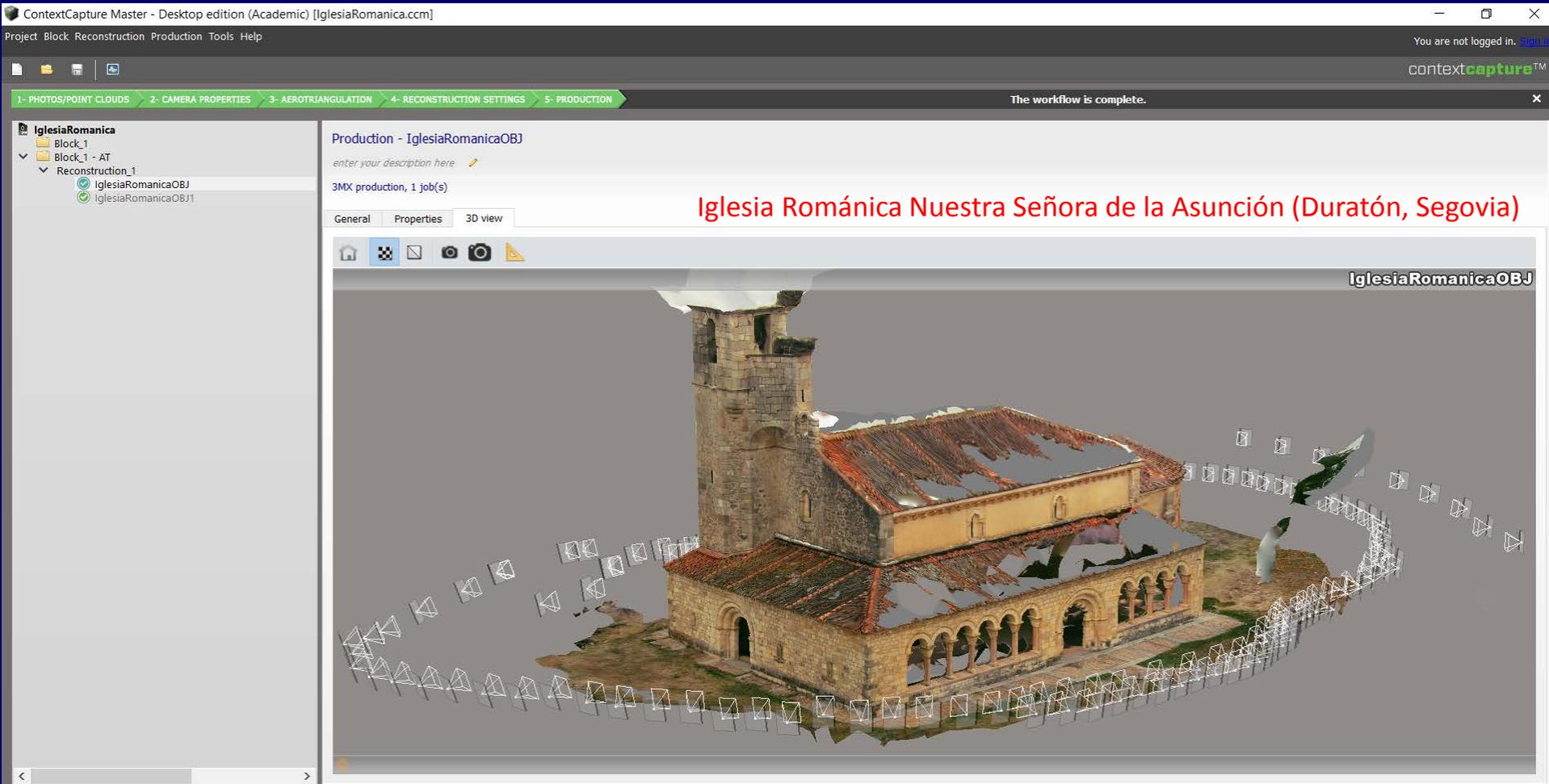
- ACUTE3D-BENTLEY SYSTEMS TO LAUNCH THE NEW CONTEXTCAPTURE SOLUTION FOR REALITY MODELING FROM PHOTOS  
September 8th, 2015
- BENTLEY SYSTEMS HAS ACQUIRED ACUTE3D  
February 10th, 2015
- SMART3DCAPTURE V3.2 IS RELEASED  
December 23rd, 2014
- TECHNIDRONE TO TRAIN ALL PILOTS ON SMART3DCAPTURE  
November 28th, 2014
- ACUTE3D PARTNERSHIP WITH ALTIGATOR  
November 28th, 2014
- ACUTE3D RECRUITS  
October 22nd, 2014

<https://www.acute3d.com/>

# MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS

## APLICACIONES DE LA TÉCNICA FOTO- RECONSTRUCCIÓN 3D

*Arqueología/Arte/Historia*

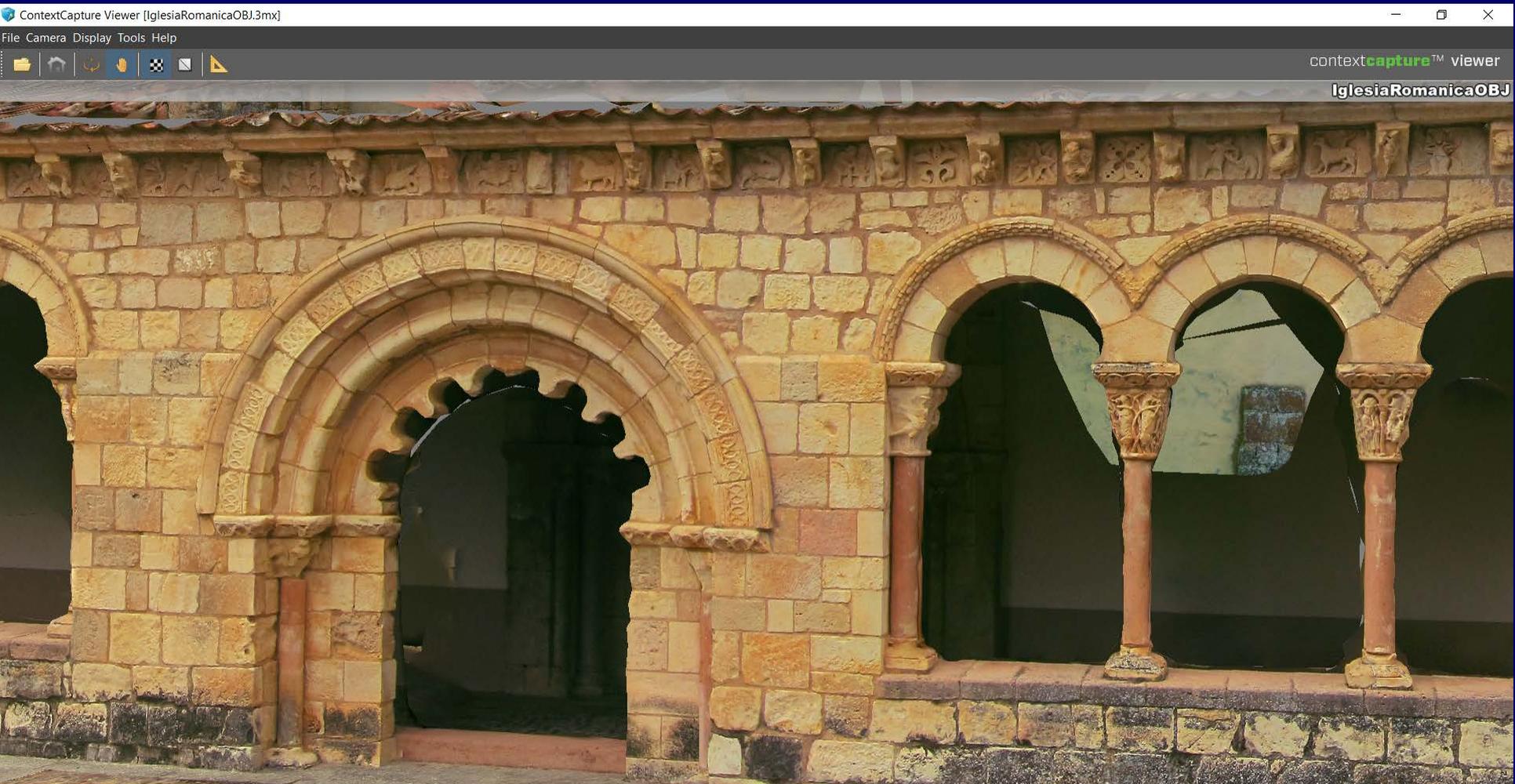


# MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS

## APLICACIONES DE LA TÉCNICA FOTO- RECONSTRUCCIÓN 3D

## *Arqueología/Arte/Historia*

Iglesia Románica Nuestra Señora de la Asunción (Duratón, Segovia)

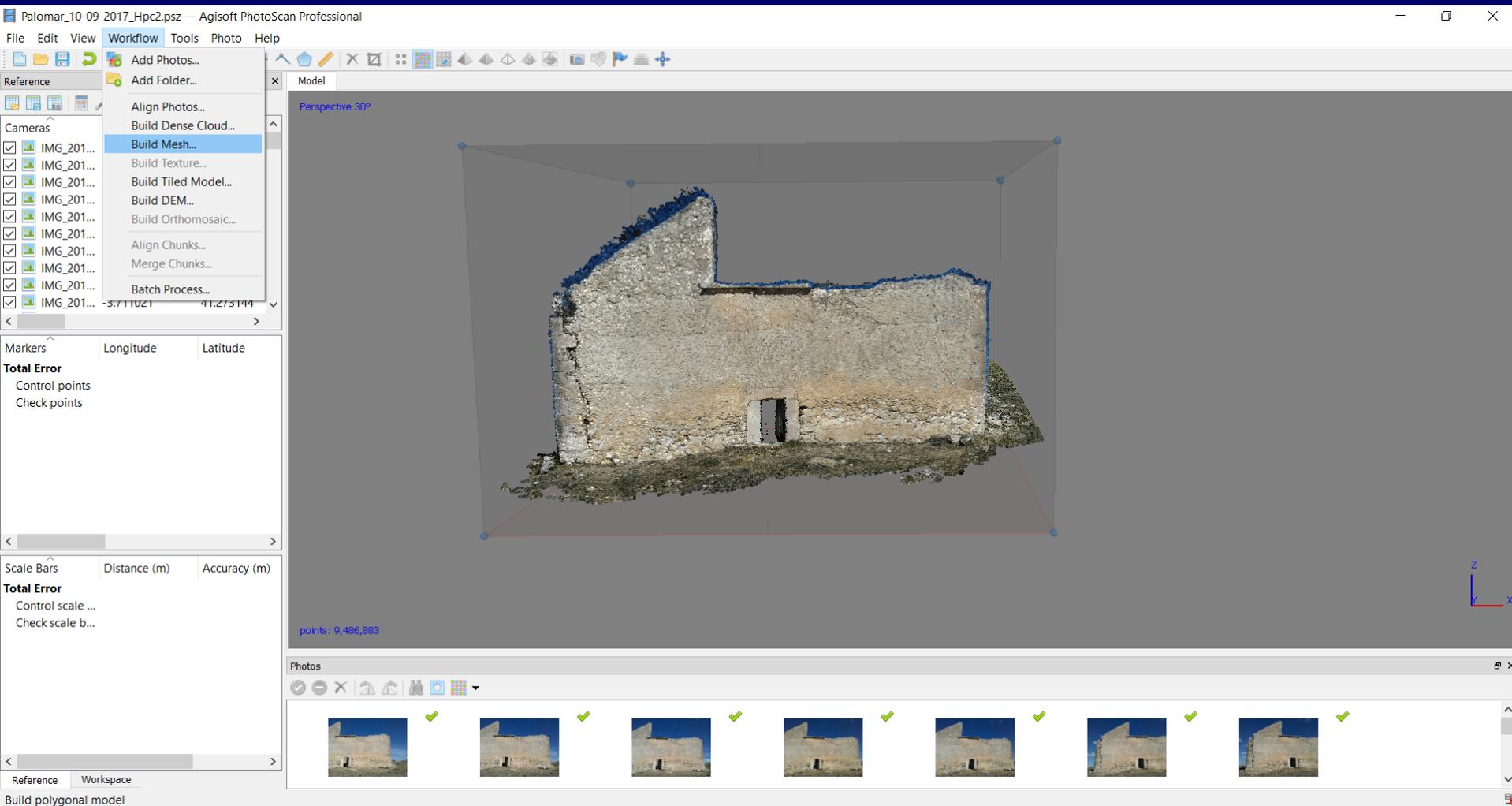


# MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS

*Arqueología/Arte/Historia*

*Patrimonio  
histórico-Artístico*

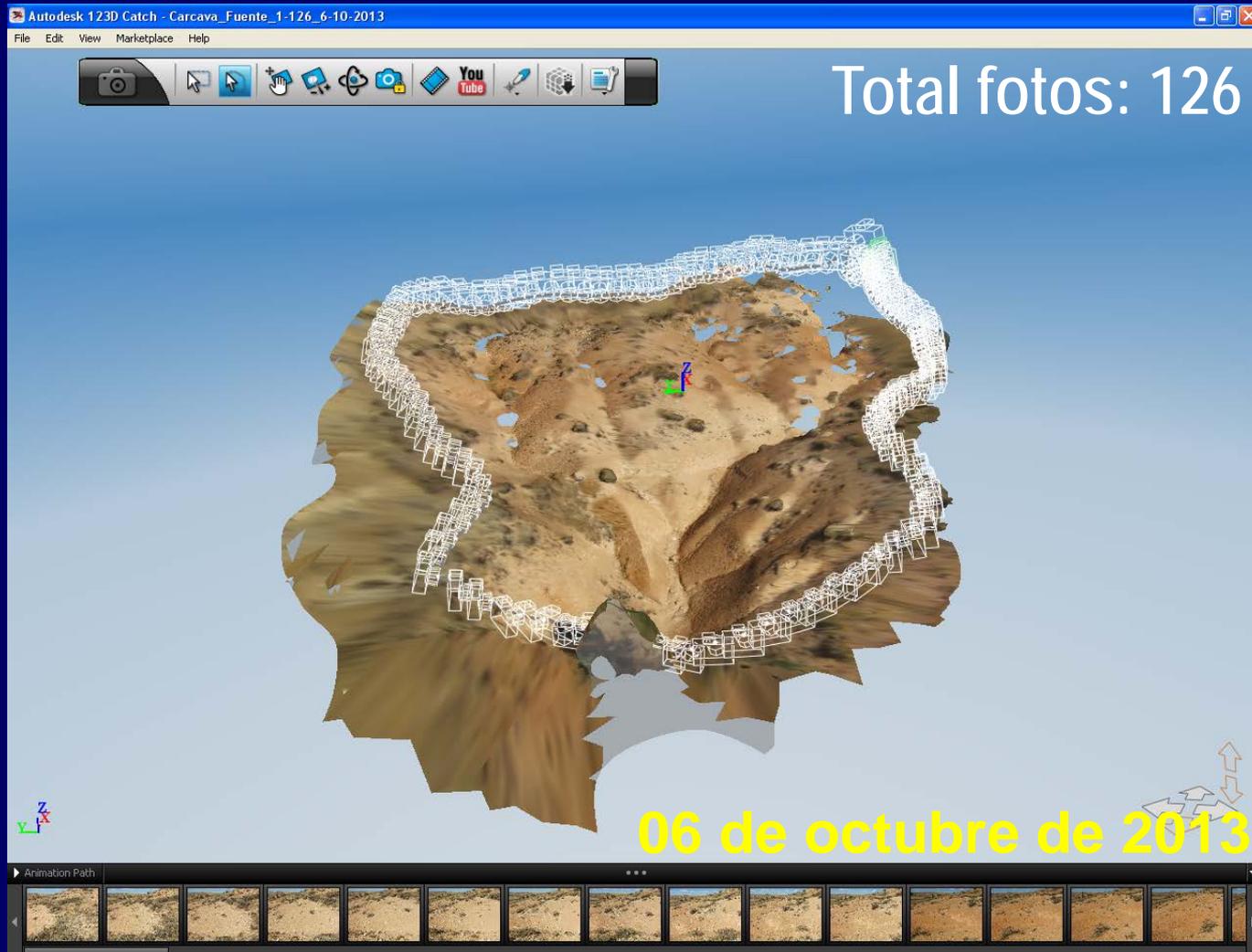
“Conservación de la arqueología rural”



# MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS

APLICACIONES DE LA  
TÉCNICA FOTO-  
RECONSTRUCCIÓN 3D

*Geografía - Geomorfología*



# MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS

## Geografía - Geomorfología

XIII Reunión Nacional de Geomorfología, Cáceres 2014

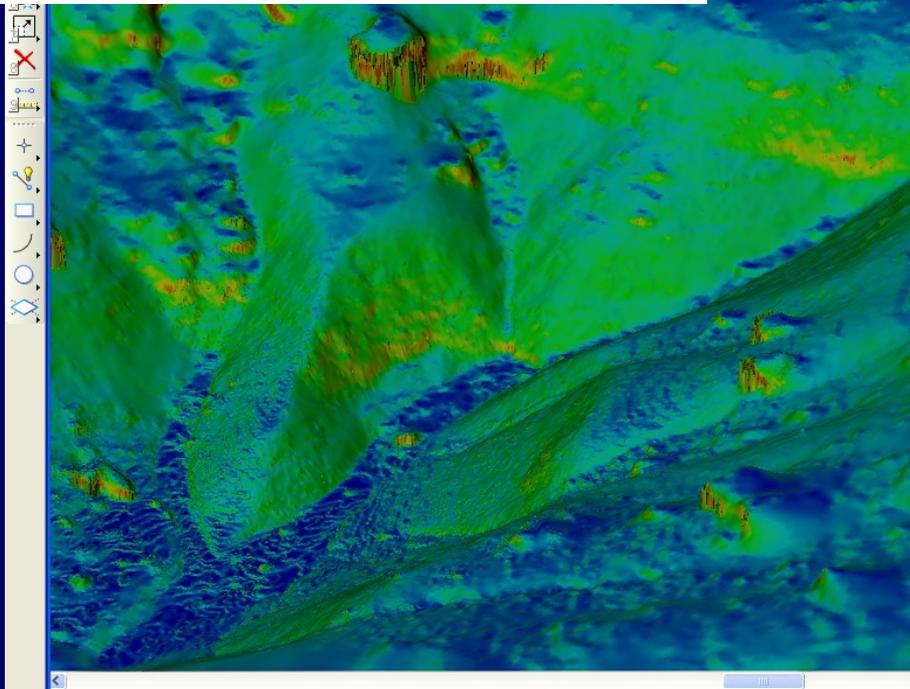
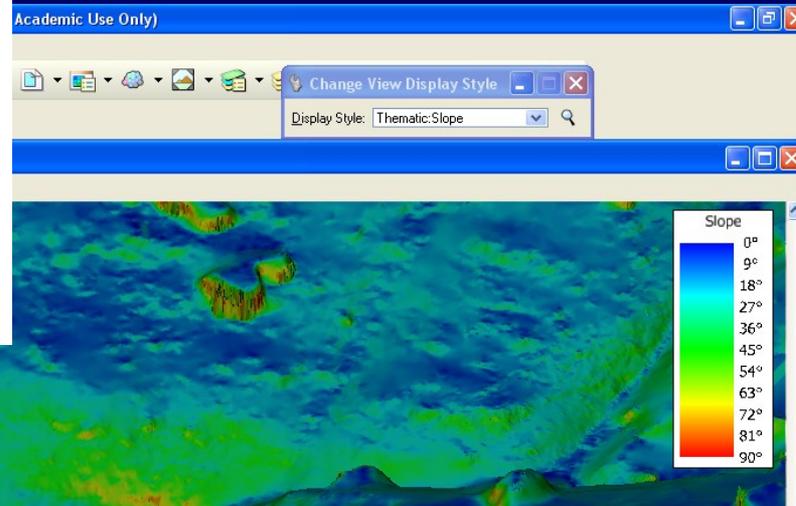
### LA APLICACIÓN DE TÉCNICAS DE FOTO-RECONSTRUCCIÓN 3D AL ESTUDIO DE LA DINÁMICA EROSIVA EN LAS LADERAS ACARCAVADAS DE VALLE DEL CASLILLA (SEGOVIA) Y DE UNA CÁRCAVA PERMANENTE EN MONROY (CÁCERES)

*Application of 3D photo-reconstruction techniques to the study of erosion in badland slopes of Castilla river (Segovia) and a permanent gully in Monroy (Cáceres)*

L. M. Tanarro García<sup>1</sup> y Á. Gómez Gutiérrez<sup>2</sup>

<sup>1</sup> Grupo de Investigación en Geografía Física de Alta Montaña. Universidad Complutense de Madrid, Madrid, España. pace@ghis.ucm.es.

<sup>2</sup> Grupo de Investigación GeoAmbiental. Universidad de Extremadura, Cáceres, España. alvgo@unex.es



Screen Cap... Z: -6.82

Capture Screen... [1] [2] [3] [4] [5] [6] [7] [8] A A B ABC C ? ABC A A A A1 A2 A1 A1 A2 A1 A1 A1 A2

Change View Capture Rectangle Screen image captured successfully



Duratón, 05-10-2013



Duratón, 06-02-2016

Geophysical Research Abstracts  
Vol. 17, EGU2015-1270, 2015  
EGU General Assembly 2015  
© Author(s) 2014. CC Attribution 3.0 License.



## Is SfM photogrammetry really the tool we've waited 30 years for?

Jim Chandler (1), Natan Micheletti (), and Stuart Lane ()

(1) Loughborough University, School of Civil and Building Engineering, Loughborough, United Kingdom (j.h.chandler@lboro.ac.uk), (2) Université de Lausanne, (3) Université de Lausanne

SfM photogrammetry has evolved rapidly in the last few years, to the point where it is beginning to surpass terrestrial laser scanning for capturing 3-D models of natural surfaces. The ability to generate high resolution digital terrain models using just a consumer grade digital camera, or even a smart phone, is an important advance. The fact that this can be achieved at a range of scales and resolutions and from a variety of platforms, whilst using software which is freely available, appears almost incredible.

This invited presentation seeks to place SfM photogrammetry in its proper historical context, by demonstrating just how rapidly techniques have evolved over the last 30 years. However, it is important to look forward and help ensure that future use is effective, even if spatial measurement expertise is limited. Consequently, the presentation will also demonstrate just how well-established lessons learnt in the past continue to remain important, particularly if accurate spatial data is desired. The application of SfM to a range of case studies will help to demonstrate the importance of scene geometry and accurate camera calibration and modelling. In addition, the establishment of external control remains critical for determining true change and the provision of independent checkpoints provides important verification of accuracies actually achieved. Recognition of these traditional photogrammetric principles and well-established practices should help ensure that expectations are both realistic and can be fulfilled, even for a new generation of non-expert users.

# MODELADO EN TRES DIMENSIONES A PARTIR DE FOTOGRAFÍAS

## Proceso metodológico

→ La captura de las fotografías.

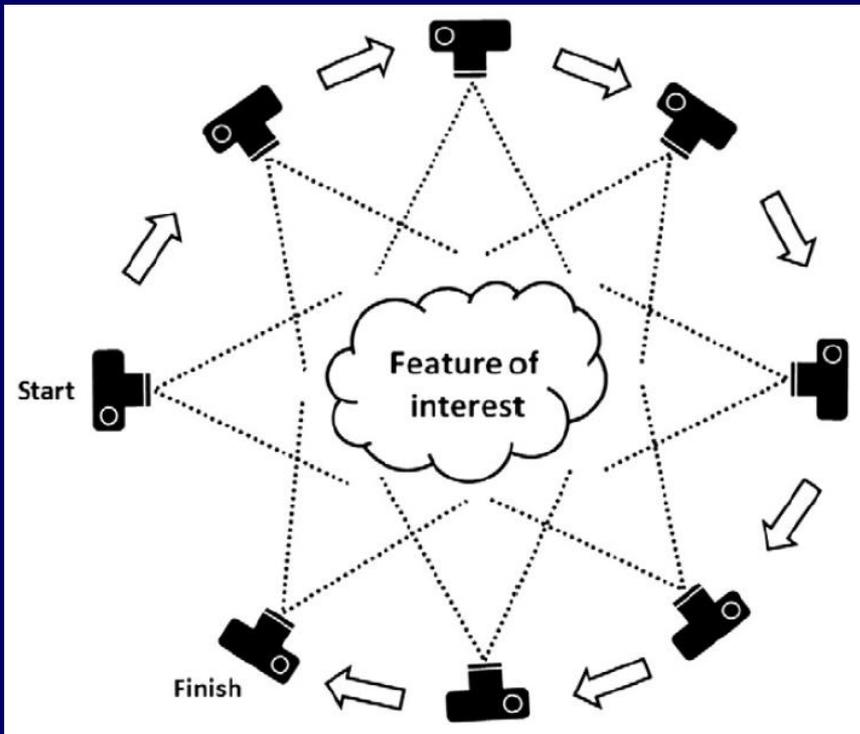
¡En la captura de las fotografías  
no se debe utilizar el zoom!



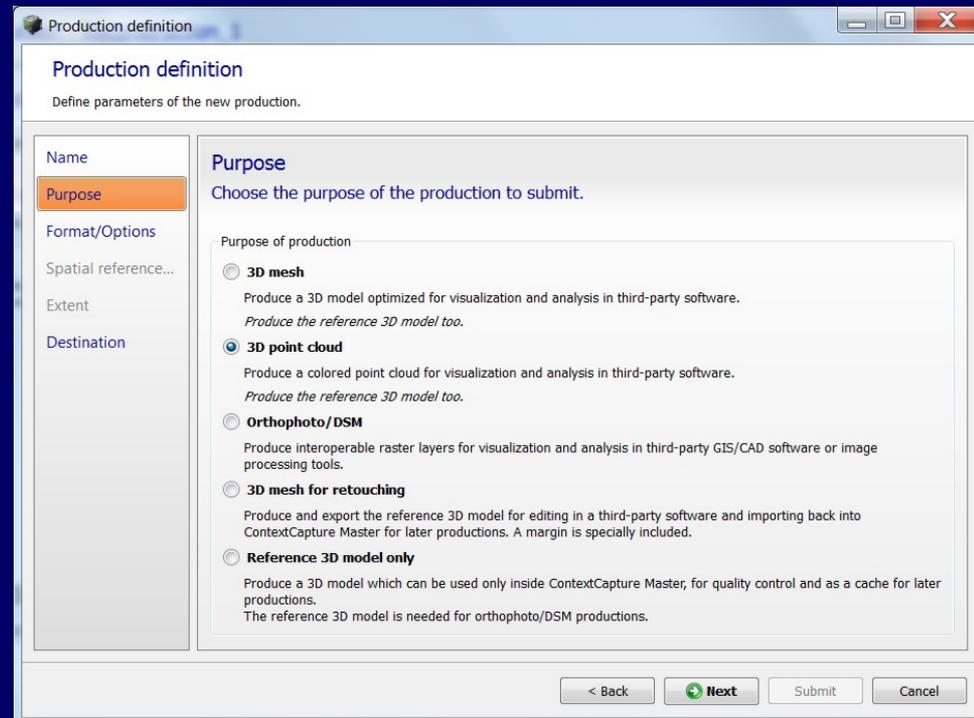
→ Procesamiento de las fotografías

→ Obtención de productos cartográficos

## La captura de las fotografías



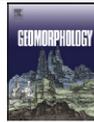
## Procesamiento de las fotografías y obtención de productos cartográficos



Contents lists available at SciVerse ScienceDirect

Geomorphology

journal homepage: [www.elsevier.com/locate/geomorph](http://www.elsevier.com/locate/geomorph)



'Structure-from-Motion' photogrammetry: A low-cost, effective tool for geoscience applications

M.J. Westoby <sup>a,\*</sup>, J. Brasington <sup>b</sup>, N.F. Glasser <sup>a</sup>, M.J. Hambrey <sup>a</sup>, J.M. Reynolds <sup>c</sup>

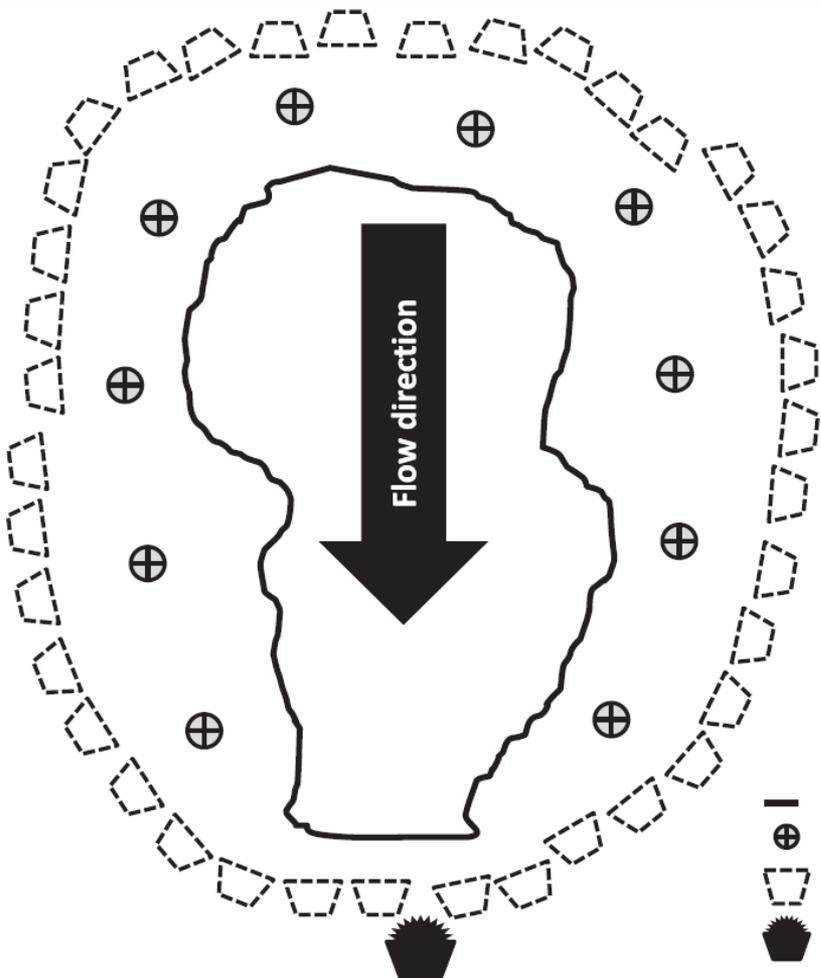
<sup>a</sup> Institute of Geography and Earth Sciences, Penllyn Campus, Aberystwyth University, UK

<sup>b</sup> School of Geography, Queen Mary, University of London, London, UK

<sup>c</sup> Reynolds International Ltd., Unit 17, Mold Business Park, Mold, UK

# ➔ La captura de las fotografías

Do not use digital zoom



- Headcut borders
- ⊕ Control points
- ▭ Camera locations
- 🔦 Laser scanner location

Catena 120 (2014) 91-101

Contents lists available at ScienceDirect

**Catena**

ELSEVIER

journal homepage: [www.elsevier.com/locate/catena](http://www.elsevier.com/locate/catena)



Using 3D photo-reconstruction methods to estimate gully headcut erosion

Álvaro Gómez-Gutiérrez<sup>a,\*</sup>, Susanne Schnabel<sup>a</sup>, Fernando Berenguer-Sempere<sup>b</sup>, Francisco Lavado-Contador<sup>a</sup>, Judit Rubio-Delgado<sup>a</sup>

<sup>a</sup> GeoEnvironmental Research Group, University of Extremadura, 10071 Cáceres, Spain  
<sup>b</sup> Technical College, University of Extremadura, 10071 Cáceres, Spain



Canon EOS 550D (18 MP)

# PRODUCTOS CARTOGRÁFICOS

Production definition

Production definition

Define parameters of the new production.

Name

Purpose

Format/Options

Spatial reference sy...

Extent

Destination

Purpose

## Bentley Context Capture

Choose the purpose of the production to submit.

Purpose of production

3D mesh

Produce a 3D model optimized for visualization and analysis in third-party software.  
*Produce the reference 3D model too.*

3D point cloud

Produce a colored point cloud for visualization and analysis in third-party software.  
*Produce the reference 3D model too.*

Orthophoto/DSM

Produce interoperable raster layers for visualization and analysis in third-party GIS/CAD software or image processing tools.

3D mesh for retouching

Produce and export the reference 3D model for editing in a third-party software and importing back into ContextCapture Master for later productions. A margin is specially included.

Reference 3D model only

Produce a 3D model which can be used only inside ContextCapture Master, for quality control and as a cache for later productions.  
The reference 3D model is needed for orthophoto/DSM productions.

Agisoft PhotoScan

Workflow Model Photo

Add Photos...

Add Folder...

Align Photos...

Build Dense Cloud...

Build Mesh...

Build Texture...

Build Tiled Model...

Build DEM...

Build Orthomosaic...

Align Chunks...

Merge Chunks...

Batch Process...

< Back

Next >

Submit

Cancel

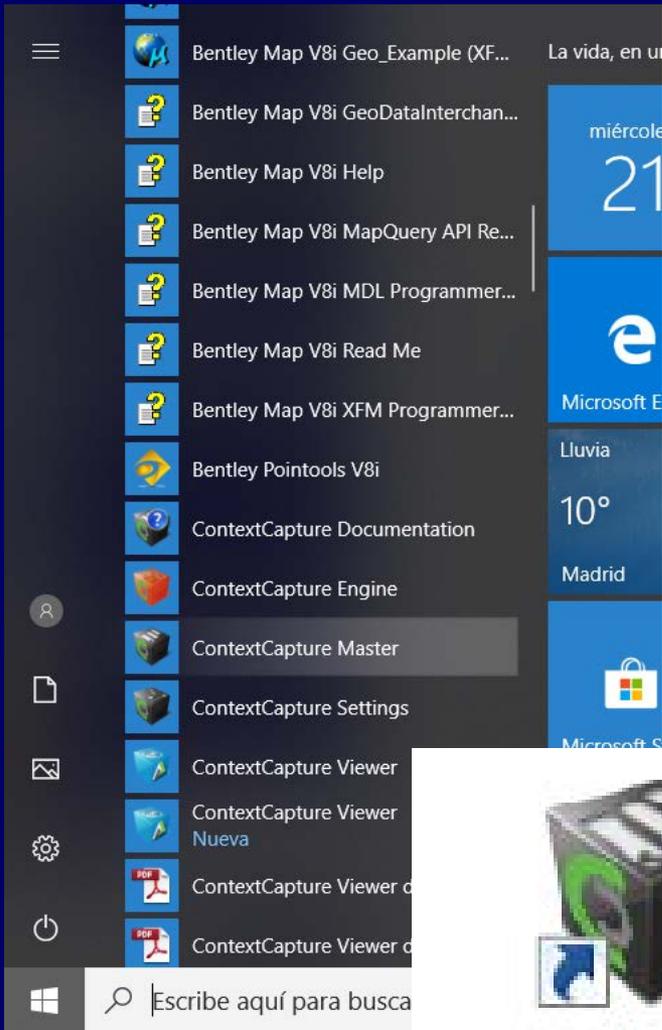


# MODELADO EN TRES DIMENSIONES DE UN BIFAZ

## Foto-reconstrucción 3D a partir de fotografías

- 1.- Captura de las fotografías
- 2.- Parámetros de la cámara y alineación de las fotografías
3. Generación de productos cartográficos (malla 3D -3D mesh-).
- 4.- Visualización del modelo 3D (bifaz) en un CAD.
- 5.- Impresión del modelo en 2D y 3D en formato \*pdf.
- 6.- Visualización y funcionalidades del formato \*pdf en 3D.

# El programa Bentley ContextCapture Master



**ContextCapture  
Master**



**ContextCapture  
Engine**

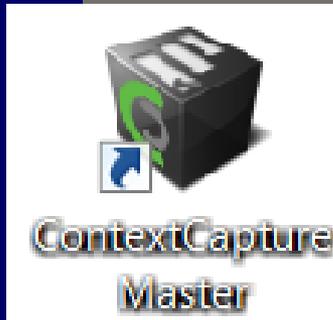
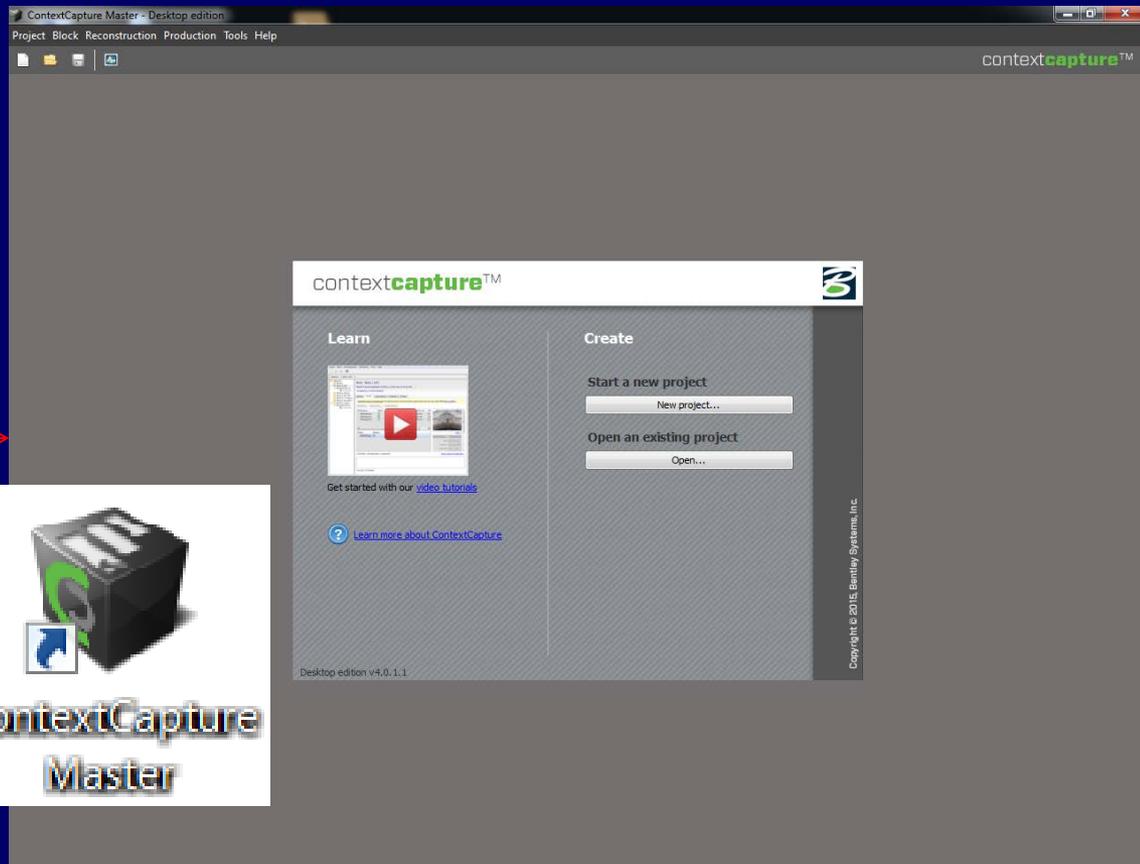
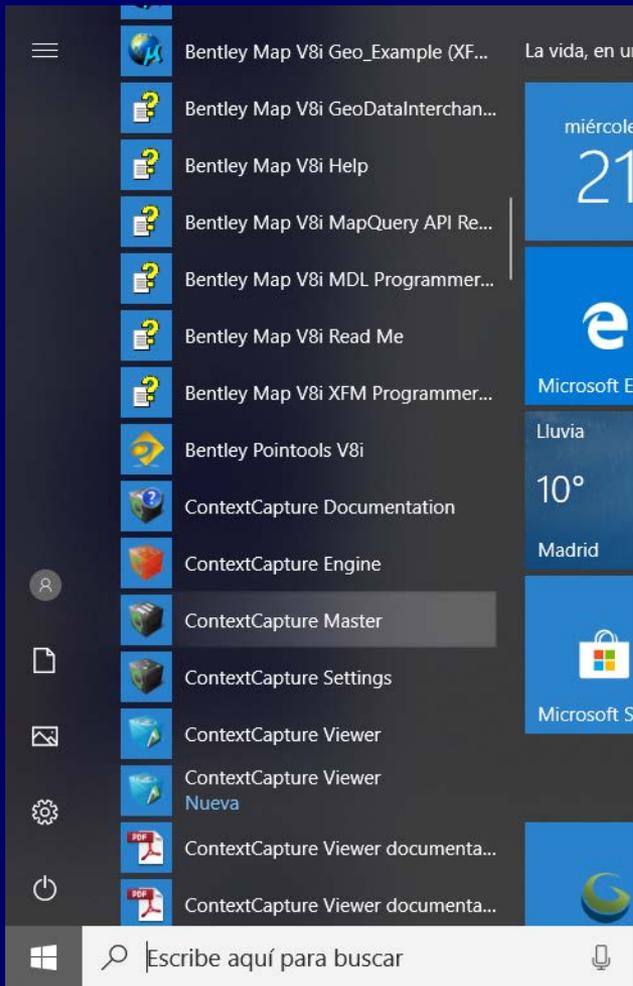


**Acute3D Viewer  
ContextCapture Viewer**

# Abrir el programa

## Acceder a Programas / Bentley / ContextCapture Master

- Especificar proyecto
- Seleccionar ruta donde se guardara el proyecto

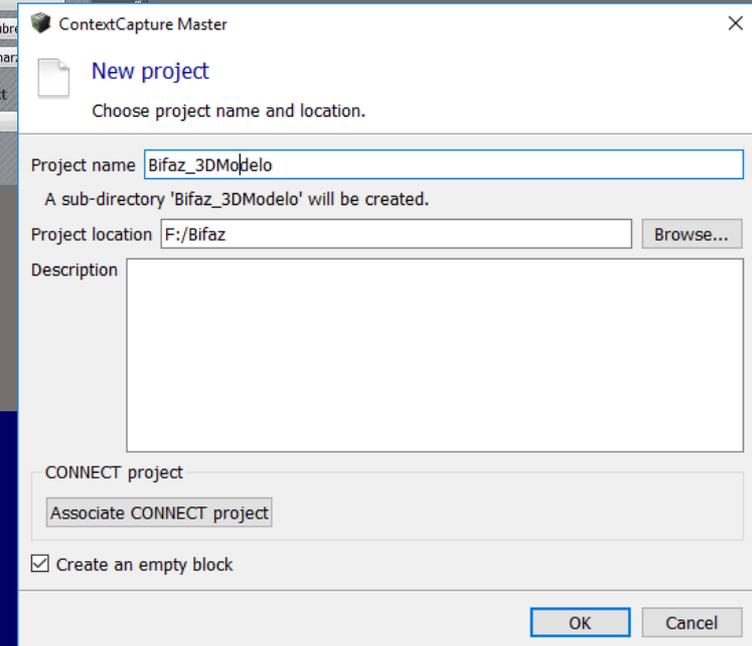
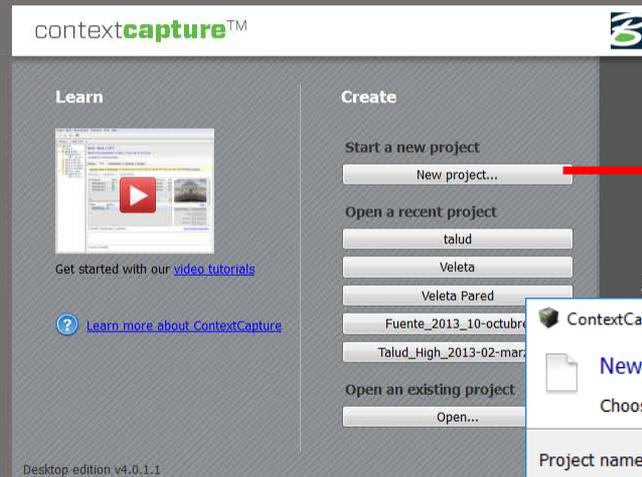


# Abrir el programa y crear un nuevo proyecto

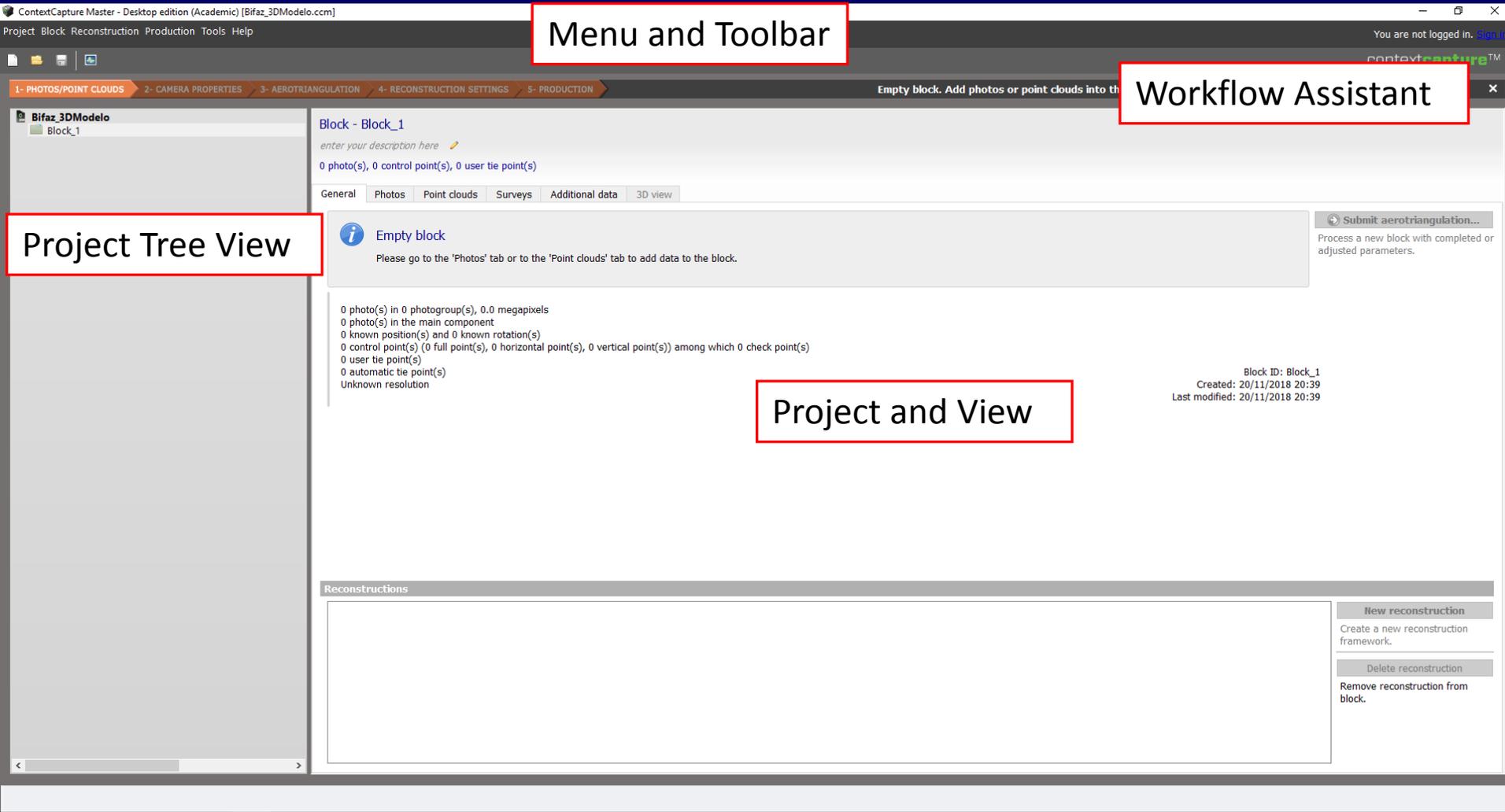
ContextCapture Master - Desktop edition

Project Block Reconstruction Production Tools Help

contextcapture™



# ContextCapture Master



Menu and Toolbar

Workflow Assistant

Project Tree View

Project and View

# ContextCapture Master

1- PHOTOS

2- CAMERA PROPERTIES

3- AEROTRIANGULATION

4- RECONSTRUCTION SETTINGS

5- PRODUCTION

3- AEROTRIANGULATION

4- RECONSTRUCTION SETTINGS

5- PRODUCTION

# ContextCapture Master

ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

Empty block. Add photos or point clouds into the block to proceed.

**Bifaz\_3DModelo**

- Block\_1

Block - Block\_1

enter your description here

0 photo(s), 0 control point(s), 0 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

Important notice on photogroups: For optimal precision and performance, please check that your input data fulfill [these conditions](#).

Add photos... Import videos... Remove photos Set downsampling... Check image files... Import positions...

Add photo selection... Add entire directory...

No. of photos Main compon Camera Sensor size Focal lengtl 35 mm eq.

Photogroup

Name Directory

Photo Pose Pose meta

0 photo(s), 0 photogroup(s), 0.0 megapixels

No photos added. Use the commands 'Add photos' or 'Add e

0 error(s), 0 warning(s)

Bifaz

Archivo Inicio Compartir Vista

FLASH DRIVE (F:) Bifaz

Nombre	Fecha de modifica...	Tipo	Tamaño
Bifaz_25-11-2014 022	25/11/2014 18:23	Archivo JPG	1.459 KB
Bifaz_25-11-2014 023	25/11/2014 18:23	Archivo JPG	1.664 KB
Bifaz_25-11-2014 024	25/11/2014 18:23	Archivo JPG	1.640 KB
Bifaz_25-11-2014 025	25/11/2014 18:23	Archivo JPG	1.599 KB
Bifaz_25-11-2014 026	25/11/2014 18:23	Archivo JPG	1.535 KB
Bifaz_25-11-2014 027	25/11/2014 18:23	Archivo JPG	1.671 KB
Bifaz_25-11-2014 028	25/11/2014 18:23	Archivo JPG	1.750 KB
Bifaz_25-11-2014 029	25/11/2014 18:23	Archivo JPG	1.616 KB
Bifaz_25-11-2014 030	25/11/2014 18:23	Archivo JPG	1.640 KB
Bifaz_25-11-2014 031	25/11/2014 18:23	Archivo JPG	1.683 KB
Bifaz_25-11-2014 032	25/11/2014 18:23	Archivo JPG	1.841 KB
Bifaz_25-11-2014 033	25/11/2014 18:23	Archivo JPG	1.739 KB
Bifaz_25-11-2014 034	25/11/2014 18:23	Archivo JPG	1.782 KB
Bifaz_25-11-2014 035	25/11/2014 18:23	Archivo JPG	1.708 KB
Bifaz_25-11-2014 036	25/11/2014 18:23	Archivo JPG	1.629 KB
Bifaz_25-11-2014 037	25/11/2014 18:23	Archivo JPG	1.641 KB
Bifaz_25-11-2014 038	25/11/2014 18:23	Archivo JPG	1.619 KB
Bifaz_25-11-2014 039	25/11/2014 18:23	Archivo JPG	1.598 KB
Bifaz_25-11-2014 040	25/11/2014 18:23	Archivo JPG	1.798 KB
Bifaz_25-11-2014 041	25/11/2014 18:23	Archivo JPG	1.818 KB
Bifaz_25-11-2014 042	25/11/2014 18:23	Archivo JPG	1.640 KB
Bifaz_25-11-2014 043	25/11/2014 18:23	Archivo JPG	1.620 KB
Bifaz_25-11-2014 044	25/11/2014 18:23	Archivo JPG	1.612 KB

37 elementos

# ContextCapture Master

ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

Submit block aerotriangulation to estimate missing photo information.

Bifaz\_3DModelo  
Block\_1

Block - Block\_1  
enter your description here

35 photo(s), 0 control point(s), 0 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

Important notice on photogroups: For optimal precision and performance, please check that your input data fulfill [these conditions](#).

Add photos... Import videos... Remove photos Set downsampling... Check image files... Import positions...

Photogroup	Status	No. of photos	Main compon	Camera	Sensor size	Focal length	35 mm eq.
Photogroup 1	⚠	35 photo(s)	0/35 photo(s)	Canon Powe...	undefined	6 mm	

**Sensor's largest dimension in mm**

Photo	Pose	Pose metadata	Component
Bifaz_25-11-2014 022.jpg	Unknown	None	None
Bifaz_25-11-2014 023.jpg	Unknown	None	None
Bifaz_25-11-2014 024.jpg	Unknown	None	None
Bifaz_25-11-2014 025.jpg	Unknown	None	None
Bifaz_25-11-2014 026.jpg	Unknown	None	None
Bifaz_25-11-2014 027.jpg	Unknown	None	None
Bifaz_25-11-2014 028.jpg	Unknown	None	None
Bifaz_25-11-2014 029.jpg	Unknown	None	None
Bifaz_25-11-2014 030.jpg	Unknown	None	None
Bifaz_25-11-2014 031.jpg	Unknown	None	None
Bifaz_25-11-2014 032.jpg	Unknown	None	None
Bifaz_25-11-2014 033.ico	Unknown	None	None

35 photo(s), 1 photogroup(s), 349.3 megapixels

⚠ Warning in Photogroup 1: Sensor size (sensor's largest dimension) and/or focal length are missing. We recommend to specify these properties.  
ℹ The sensor size of the camera 'Canon/Canon PowerShot S90' is not in the database. [Send a request to Bentley technical support.](#)  
⚠ Incomplete photos. You can estimate missing photo information by aerotriangulation. Go to the 'General' tab to proceed.

0 error(s), 1 warning(s)

Preview [View](#) | [Open](#)

Photo

Name: Bifaz\_25-11-2014 054.jpg

Directory: F:/Bifaz

Date taken: miércoles, 26 de noviembre de 2014 0:44:57

Size: 1 MB

Mask file:

Component: None

Pose

Spatial reference system:

Position X: unknown

Y: unknown

Z: unknown

# ContextCapture Master

Nombre	Fecha de modifica...	Tipo	Tamaño
Bifaz_25-11-2014 022.jpg	25/11/2014 18:23	Archivo JPG	1.459 KB
Bifaz_25-11-2014 023.jpg	25/11/2014 18:23	Archivo JPG	1.664 KB
Bifaz_25-11-2014 024.jpg	25/11/2014 18:23	Archivo JPG	1.640 KB
Bifaz_25-11-2014 025.jpg	25/11/2014 18:23	Archivo JPG	1.599 KB
Bifaz_25-11-2014 026.jpg	25/11/2014 18:23	Archivo JPG	1.535 KB
Bifaz_25-11-2014 027.jpg	25/11/2014 18:23	Archivo JPG	1.671 KB
Bifaz_25-11-2014 028.jpg	25/11/2014 18:23	Archivo JPG	1.750 KB
Bifaz_25-11-2014 029.jpg	25/11/2014 18:23	Archivo JPG	1.616 KB
Bifaz_25-11-2014 030.jpg	25/11/2014 18:23	Archivo JPG	1.640 KB
Bifaz_25-11-2014 031.jpg	25/11/2014 18:23	Archivo JPG	1.683 KB
Bifaz_25-11-2014 032.jpg	25/11/2014 18:23	Archivo JPG	1.841 KB
Bifaz_25-11-2014 033.jpg	25/11/2014 18:23	Archivo JPG	1.739 KB
Bifaz_25-11-2014 034.jpg	25/11/2014 18:23	Archivo JPG	1.782 KB
Bifaz_25-11-2014 035.jpg	25/11/2014 18:23	Archivo JPG	1.708 KB
Bifaz_25-11-2014 036.jpg	25/11/2014 18:23	Archivo JPG	1.629 KB
Bifaz_25-11-2014 037.jpg	25/11/2014 18:23	Archivo JPG	1.641 KB
Bifaz_25-11-2014 038.jpg	25/11/2014 18:23	Archivo JPG	1.619 KB
Bifaz_25-11-2014 039.jpg	25/11/2014 18:23	Archivo JPG	1.598 KB
Bifaz_25-11-2014 040.jpg	25/11/2014 18:23	Archivo JPG	1.798 KB
Bifaz_25-11-2014 041.jpg	25/11/2014 18:23	Archivo JPG	1.818 KB
Bifaz_25-11-2014 042.jpg	25/11/2014 18:23	Archivo JPG	1.640 KB
Bifaz_25-11-2014 043.jpg	25/11/2014 18:23	Archivo JPG	1.620 KB
Bifaz_25-11-2014 044.jpg	25/11/2014 18:23	Archivo JPG	1.612 KB
Bifaz_25-11-2014 045.jpg	25/11/2014 18:23	Archivo JPG	1.845 KB
Bifaz_25-11-2014 046.jpg	25/11/2014 18:23	Archivo JPG	1.895 KB
Bifaz_25-11-2014 047.jpg	25/11/2014 18:23	Archivo JPG	1.683 KB
Bifaz_25-11-2014 048.jpg	25/11/2014 18:23	Archivo JPG	1.626 KB
Bifaz_25-11-2014 049.jpg	25/11/2014 18:23	Archivo JPG	1.633 KB
Bifaz_25-11-2014 050.jpg	25/11/2014 18:23	Archivo JPG	1.530 KB
Bifaz_25-11-2014 051.jpg	25/11/2014 18:23	Archivo JPG	1.607 KB
Bifaz_25-11-2014 052.jpg	25/11/2014 18:23	Archivo JPG	1.761 KB
Bifaz_25-11-2014 053.jpg	25/11/2014 18:23	Archivo JPG	1.783 KB
Bifaz_25-11-2014 054.jpg	25/11/2014 18:23	Archivo JPG	1.713 KB
Bifaz_25-11-2014 055.jpg	25/11/2014 18:23	Archivo JPG	1.664 KB
Bifaz_25-11-2014 056.jpg	25/11/2014 18:23	Archivo JPG	1.825 KB

Propiedades: Bifaz\_25-11-2014 024.jpg

General Detalles

Propiedad	Valor
Unidad de resolución	2
Representación del color	sRGB
Bits comprimidos/píxel	3
<b>Cámara</b>	
Fabricante de cámara	Canon
Modelo de cámara	Canon PowerShot S90
Punto F	f/4
Tiempo de exposición	1/160 s
Velocidad ISO	ISO-160
Compensación de exposición	0 paso
Distancia focal	6 mm
Apertura máxima	2
Modo de medición	Diseño
Distancia al objeto	
Modo de flash	Sin flash, obligatorio
Intensidad de flash	
Longitud focal de 35 mm	
<b>Fotografía avanzada</b>	

[Quitar propiedades e información personal](#)

Aceptar Cancelar Aplicar

# ContextCapture Master

Si el tamaño del sensor de la cámara no aparece en la base de datos del programa, se puede buscar en páginas de fotografía o en la web del modelo de cámara



Bifaz\_25-11-2014 024.jpg



Digital Photography Review (DPPREVIEW)  
[http://www.dpreview.com/products/canon/compacts/canon\\_s90](http://www.dpreview.com/products/canon/compacts/canon_s90)

Max resolution: 3648 x 2736

Effective pixels: 10 megapixels

Sensor size: 1/1.7" (7.44 x 5.58 mm)

Focal length (equiv.): 28–105 mm

# ContextCapture Master

ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

Submit block aerotriangulation to estimate missing photo information.

Block - Block\_1

enter your description here

35 photo(s), 0 control point(s), 0 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

**Important notice on photogroups:** For optimal precision and performance, please check that your input data fulfill [these conditions](#).

Add photos... Import videos... Remove photos Set downsampling... Check image files... Import positions...

Photogroup	Status	No. of photos	Main compon	Camera	Sensor size	Focal length	35 mm eq.
Photogroup 1	✔	35 photo(s)	0/35 photo(s)	Canon Powe...	7.44 mm	6 mm	29.0323 mm

  
7.44 mm

Photo	Pose	Pose metadata	Component
-------	------	---------------	-----------

35 photo(s), 1 photogroup(s), 349.3 megapixels

**i** The sensor size of the camera 'Canon/Canon PowerShot S90' is not in the database. [Send a request to Bentley technical support](#).

**w** Incomplete photos. You can estimate missing photo information by aerotriangulation. Go to the 'General' tab to proceed.

0 error(s), 0 warning(s)

**Photogroup**

Name: Photogroup 1

Directory: F:/Bifaz

Description:

Multi-camera rig: None

Camera: Canon PowerShot S90

Lens:

Number of photos: 35

Image dimensions: 3648 x 2736

Camera model type: Perspective

Camera model band: Visible

Sensor size: 7.44 mm

Focal length: 6 mm

35 mm eq.: 29.0323 mm

+ More...

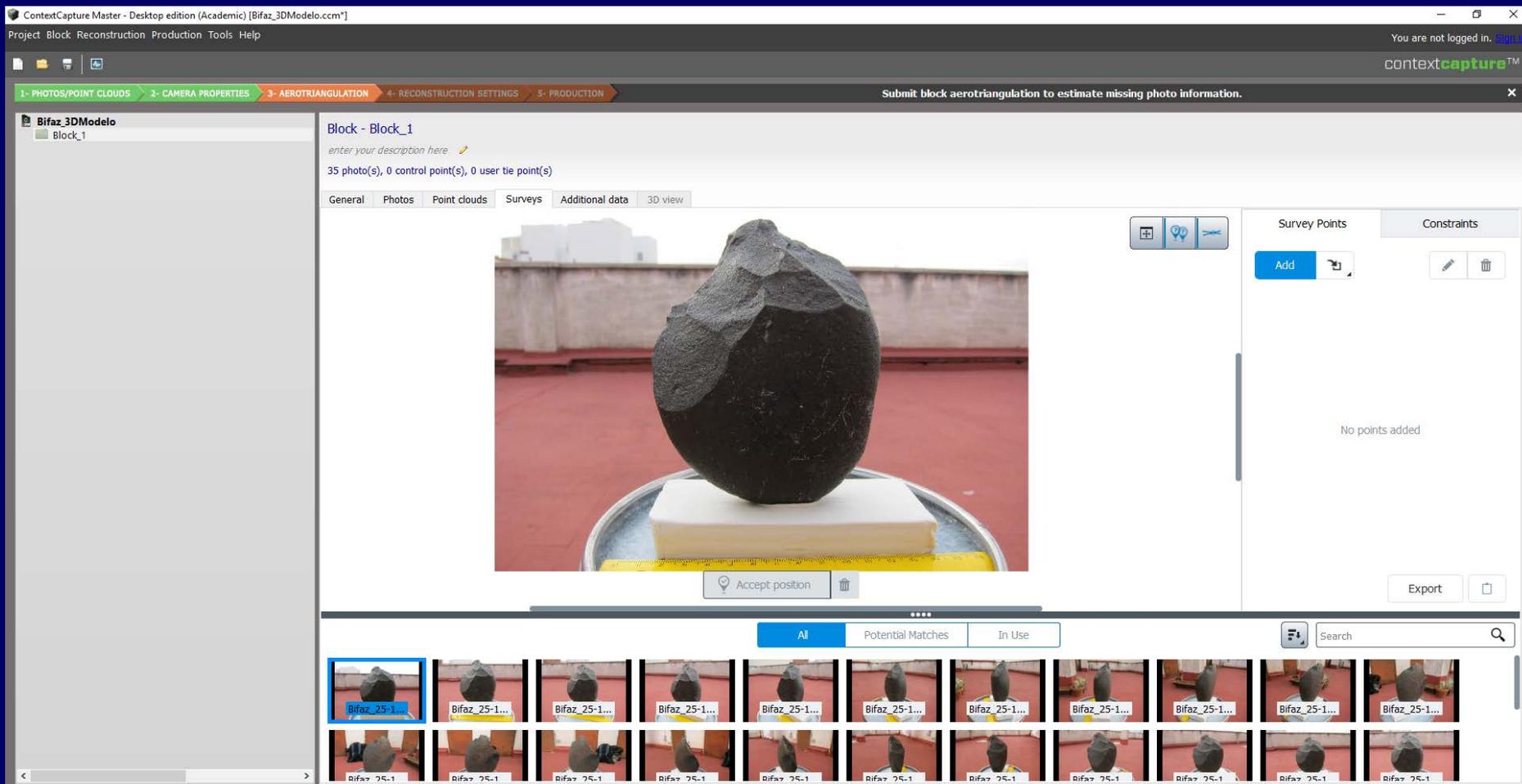
# ContextCapture Master

## 3- AEROTRIANGULATION

Antes de alinear las fotos, se puede escalar el modelo

### Surveys

Add Survey Points  
Specify type of Constraints



# ContextCapture Master → Surveys

## Add Survey Points: Tie Point 1

The screenshot displays the ContextCapture Master interface. The main window shows a photo of a yellow ruler with a blue object. The 'Survey Points' panel on the right has an 'Add' button. A 'Survey Point' dialog box is open in the foreground, showing the following details:

- Name:** Tie Point 1
- Type:** Tie Point
- Description:** Identify one point on photos. Used to create positioning/scaling constraint, or to stitch photos.
- Buttons:** Create, Cancel

The background interface includes a top menu bar with 'Project', 'Block', 'Reconstruction', 'Production', 'Tools', and 'Help'. The main toolbar shows steps: 1- PHOTOS/POINT CLOUDS, 2- CAMERA PROPERTIES, 3- AEROTRIANGULATION, 4- RECONSTRUCTION SETTINGS, and 5- PRODUCTION. The current block is 'Block - Block\_1' with 35 photos, 0 control points, and 0 user tie points. The 'Survey Points' panel also shows 'Add a new survey point' and 'No points added'.

# ContextCapture Master → Surveys

## Add Survey Points: Tie Point 1

The screenshot displays the ContextCapture Master software interface. The top navigation bar includes tabs for '1- PHOTOS/POINT CLOUDS', '2- CAMERA PROPERTIES', '3- AEROTRIANGULATION', '4- RECONSTRUCTION SETTINGS', and '5- PRODUCTION'. The current view is 'Block - Block\_1', which contains 35 photos, 0 control points, and 1 user tie point. The main workspace shows a close-up of a yellow ruler with a yellow crosshair marker placed on it. A toolbar above the ruler includes an 'Accept position' button. To the right, the 'Survey Points' panel shows a list with 'Tie Point 1' selected. Below the main workspace, a grid of photo thumbnails is visible, with a search bar and tabs for 'All', 'Potential Matches', and 'In Use'. A warning message at the bottom reads: 'Please select a survey point in the right panel before setting a position on the photo.'

# ContextCapture Master → Surveys

## Add Survey Points: Tie Point 2

The screenshot displays the ContextCapture Master software interface. The main window title is "ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]". The top menu bar includes "Project", "Block", "Reconstruction", "Production", "Tools", and "Help". The top status bar shows the current workflow step: "1- PHOTOS/POINT CLOUDS", "2- CAMERA PROPERTIES", "3- AEROTRIANGULATION", "4- RECONSTRUCTION SETTINGS", and "5- PRODUCTION". A message at the top right states "Submit block aerotriangulation to estimate missing photo information." and "You are not logged in. Sign in".

The main workspace shows a 3D view of a block named "Block - Block\_1" with a description field "enter your description here" and statistics "35 photo(s), 0 control point(s), 1 user tie point(s)". The "Surveys" tab is active, displaying a photo of a dark, textured object on a red surface. A "Survey Point" dialog box is open, with the "Name" field set to "Tie Point 2" and the "Type" set to "Tie Point". The dialog includes a "Create" button and a "Cancel" button. A small thumbnail of the photo with a green square and a blue crosshair is visible in the bottom left of the main workspace.

The right sidebar contains the "Survey Points" panel, which lists the current tie point: "Tie Point 1" with the file name "Bifaz\_25-11-2014 022.jpg". The "Constraints" panel is also visible. The bottom of the interface shows a photo gallery with a search bar and tabs for "All", "Potential Matches", and "In Use".

# ContextCapture Master → Surveys

## Add Survey Points: Tie Point 2

The screenshot displays the ContextCapture Master software interface. The main window title is "ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]". The top menu bar includes "Project", "Block", "Reconstruction", "Production", "Tools", and "Help". The top status bar shows the current step: "1- PHOTOS/POINT CLOUDS" (highlighted in green), "2- CAMERA PROPERTIES", "3- AEROTRIANGULATION", "4- RECONSTRUCTION SETTINGS", and "5- PRODUCTION". A notification bar at the top right says "Submit block aerotriangulation to estimate missing photo information." The left sidebar shows the project structure: "Bifaz\_3DModelo" and "Block\_1". The main workspace is titled "Block - Block\_1" and contains a description field "enter your description here" and statistics: "35 photo(s), 0 control point(s), 2 user tie point(s)". Below the statistics are tabs for "General", "Photos", "Point clouds", "Surveys" (selected), "Additional data", and "3D view". The central view shows a close-up of a yellow surface with a yellow crosshair marker. A smaller inset view shows a wider perspective of the same marker. Below the main view is an "Accept position" button. The right sidebar has two sections: "Survey Points" and "Constraints". Under "Survey Points", there is an "Add" button and a list of points: "Tie Point 1" (with a location pin icon and "1" next to it) and "Tie Point 2" (highlighted in blue). Below the list is an "Export" button. The bottom of the interface features a "Photo Grid" with tabs for "All", "Potential Matches", and "In Use". A search bar is located to the right of the tabs. The grid contains two rows of photo thumbnails, each labeled with a filename like "Bifaz\_25-11-2014 022.jpg" or "Bifaz\_25-11-2014 023.jpg".



# ContextCapture Master → Surveys

## Constraints: Scale constraint

The screenshot displays the ContextCapture Master software interface. At the top, the title bar reads "ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]". Below it, a menu bar includes "Project", "Block", "Reconstruction", "Production", "Tools", and "Help". A progress bar at the top indicates the current stage: "3- AEROTRIANGULATION".

The main workspace is titled "Block - Block\_1" and shows a 3D view of a dark, irregularly shaped object (a rock) on a white base. Two tie points are marked on the object: "Tie Point 1" and "Tie Point 2". A small inset image shows a zoomed-in view of the tie points. Below the 3D view, there are buttons for "Accept position" and a trash icon.

On the right side, the "Survey Points" panel is open, showing the "Constraints" tab. The configuration is as follows:

- Type: Scale constraint
- Point A: Tie Point 1
- Point B: Tie Point 2
- Value: 0.16
- Units: (empty)

At the bottom of the interface, there is a photo gallery with tabs for "All", "Potential Matches", and "In Use". The gallery shows a grid of 30 small images of the rock, with the first image highlighted in blue and marked with a green checkmark. A search bar is located at the bottom right of the gallery.

# ContextCapture Master



# Additional data

The screenshot shows the ContextCapture Master software interface. The title bar reads "ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]". The menu bar includes "Project", "Block", "Reconstruction", "Production", "Tools", and "Help". The main window has a navigation bar with five tabs: "1- PHOTOS/POINT CLOUDS", "2- CAMERA PROPERTIES", "3- AEROTRIANGULATION" (which is active), "4- RECONSTRUCTION SETTINGS", and "5- PRODUCTION". A notification bar at the top right says "Submit block aerotriangulation to estimate missing photo information." The left sidebar shows a tree view with "Bifaz\_3DModelo" and "Block\_1". The main content area is titled "Block - Block\_1" and contains the following information:

- enter your description here
- 35 photo(s), 0 control point(s), 2 user tie point(s)
- Navigation tabs: General, Photos, Point clouds, Surveys, **Additional data**, 3D view
- Text: "You can specify here additional knowledge on the acquisition in order to help the aerotriangulation."
- Block type:  Generic block type.
- Minimum viewing distance:  units Leave this field empty if unknown.
- Maximum viewing distance:  units Leave this field empty if unknown.

# ContextCapture Master

## 3- AEROTRIANGULATION

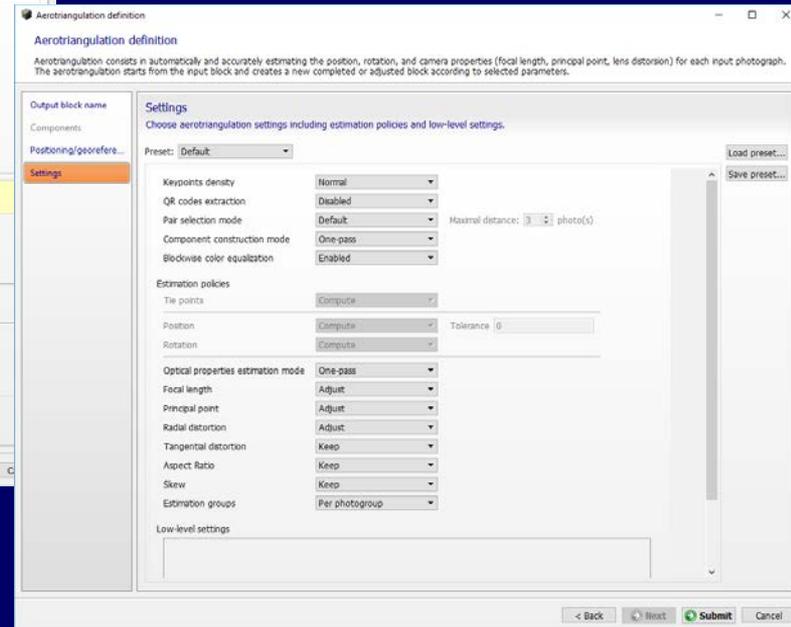
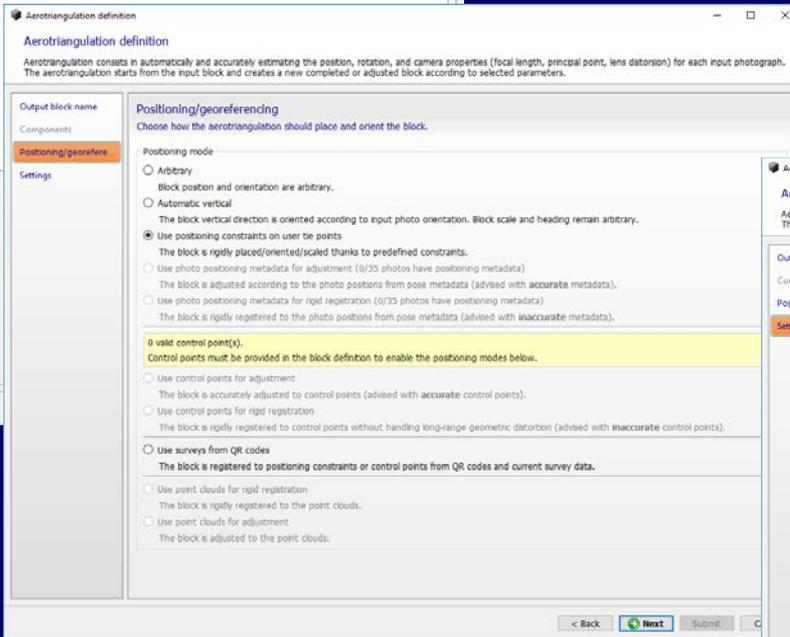
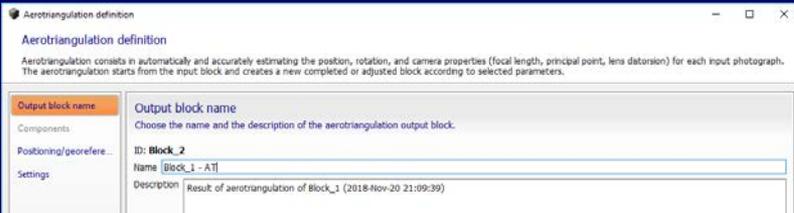
Situarse en la pestaña “General” y pulsar “Submit aerotriangulation”

The screenshot shows the ContextCapture Master software interface. The top navigation bar includes tabs for '1- PHOTOS/POINT CLOUDS', '2- CAMERA PROPERTIES', '3- AEROTRIANGULATION', '4- RECONSTRUCTION SETTINGS', and '5- PRODUCTION'. The '3- AEROTRIANGULATION' tab is selected, and a message at the top reads 'Submit block aerotriangulation to estimate missing photo information.' The main workspace shows a block named 'Block - Block\_1' with a description field and statistics: '35 photo(s), 0 control point(s), 2 user tie point(s)'. The 'General' tab is active, displaying a warning icon and the text 'Incomplete photos. You can estimate missing photo information by aerotriangulation.' Below this, a list of statistics is shown: '35 photo(s) in 1 photogroup(s), 349.3 megapixels', '0 photo(s) in the main component', '0 known position(s) and 0 known rotation(s)', '0 control point(s) (0 full point(s), 0 horizontal point(s), 0 vertical point(s)) among which 0 check point(s)', '2 user tie point(s)', '0 automatic tie point(s)', and 'Unknown resolution'. In the bottom right corner, there is a 'Submit aerotriangulation...' button with a green arrow icon, which is highlighted with a red box and a red arrow pointing to it from the text above. Other buttons in the bottom right include 'New reconstruction' and 'Delete reconstruction'. The 'Reconstructions' section at the bottom is currently empty.

### Definir las características de la Aerotriangulation

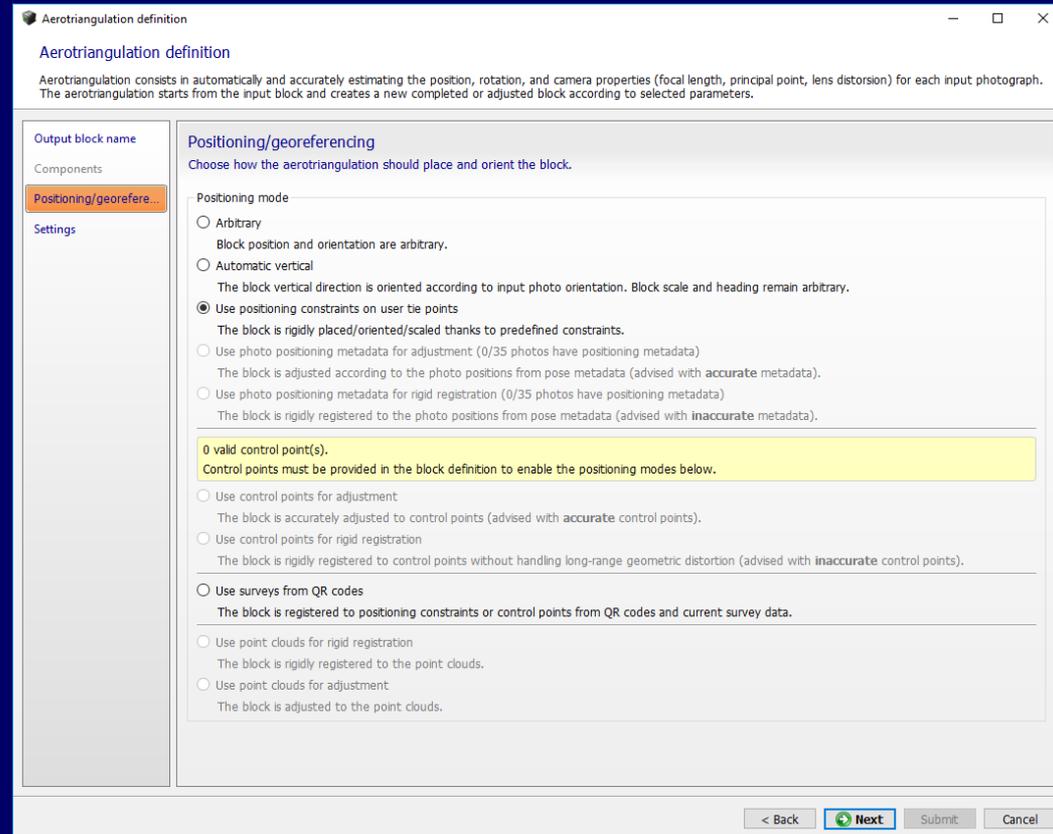
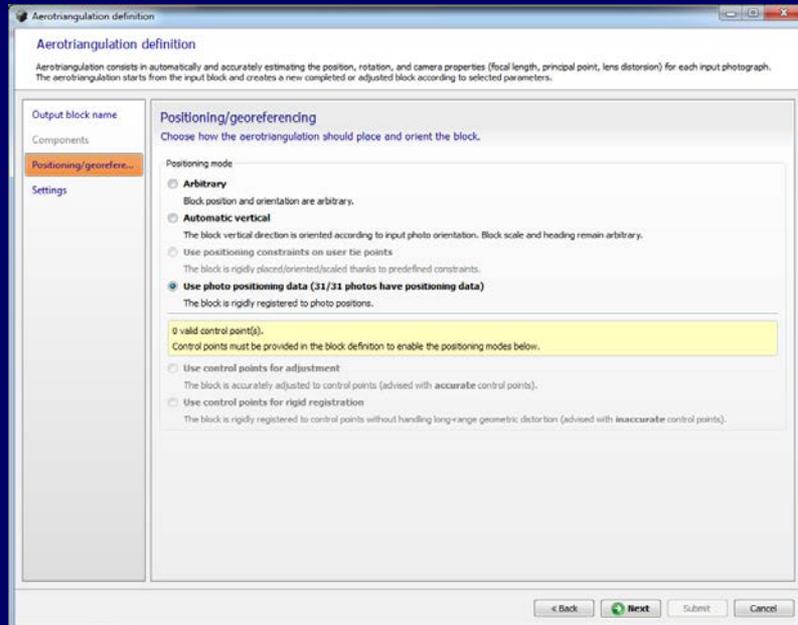
#### Aerotriangulation definition

Aerotriangulation consists in automatically and accurately estimating the position, rotation, and camera properties (focal length, principal point, lens distortion) for each input photograph. The aerotriangulation starts from the input block and creates a new completed or adjusted block according to selected parameters.



### Definir las características de la Aerotriangulation

Pantalla en versiones iniciales del programa



# ContextCapture Master

## 3- AEROTRIANGULATION

### Arrancar el proceso de Aerotriangulation

ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

Block aerotriangulation is being processed.

Bifaz\_3DModelo

- Block\_1
- Block\_1 - AT

Block - Block\_1 - AT

Result of aerotriangulation of Block\_1 (2018-Nov-20 21:09:39) ✎

35 photo(s), 0 control point(s), 2 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

**Aerotriangulation pending...**  
The aerotriangulation job has been submitted and is waiting to be processed.

**Warning: There is no engine currently listening to the job queue. You must run an engine now or later to process this aerotriangulation.**

[View aerotriangulation settings](#) | [Monitor job queue](#)

Block ID: Block\_2  
Created: 20/11/2018 21:09  
Last modified: 20/11/2018 21:11

Cancel aerotriangulation.

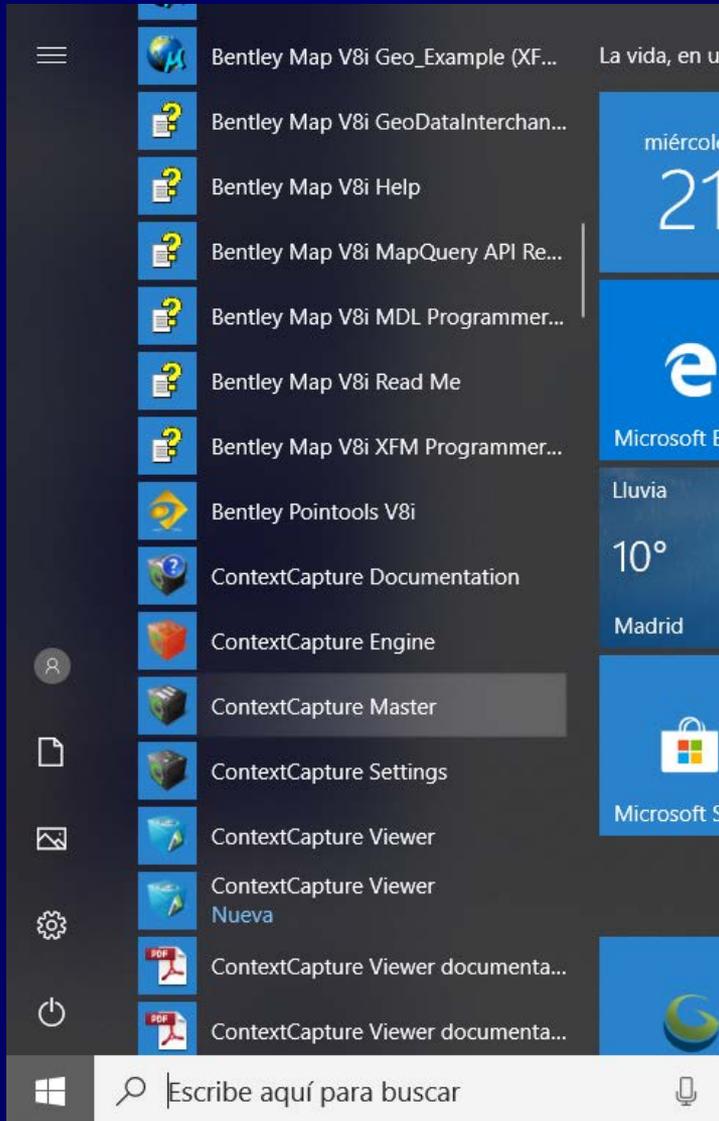
**Job queue monitor**

Job queue: C:\Users\ghia06usu23\Documents\Bentley\ContextCapture Desktop\Jobs

- 0 engine(s)
- 1 pending job(s)
- 0 running job(s)
- 0 failed job(s)

[Open job queue directory...](#)

### Arrancar el proceso de Aerotriangulation



Acceder a Programas /  
Bentley / ContextCapture  
Engine

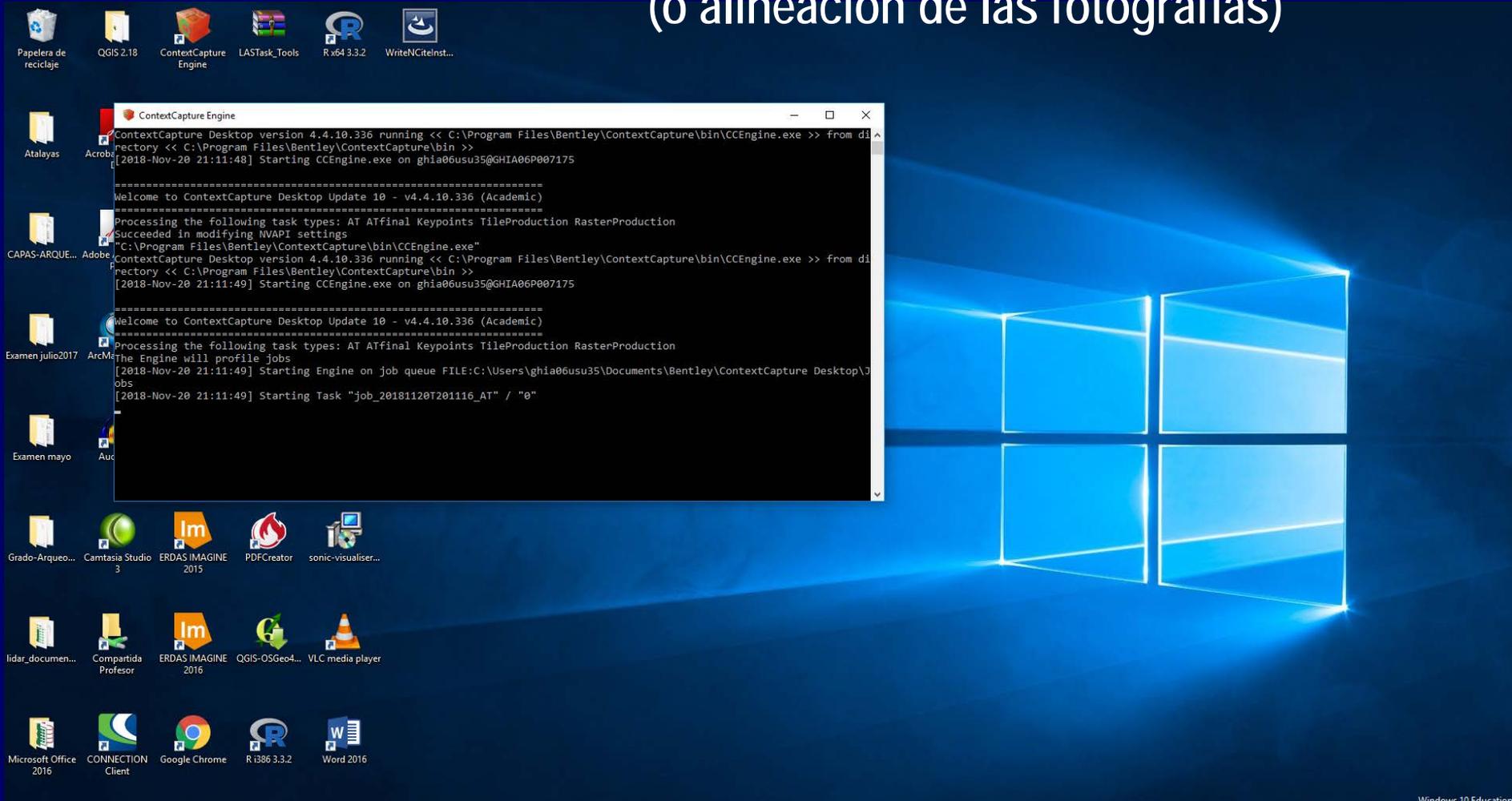


# ContextCapture Master

## 3- AEROTRIANGULATION

Al pulsar  ContextCapture Engine

Se inicia el proceso de Aerotriangulation  
(o alineación de las fotografías)

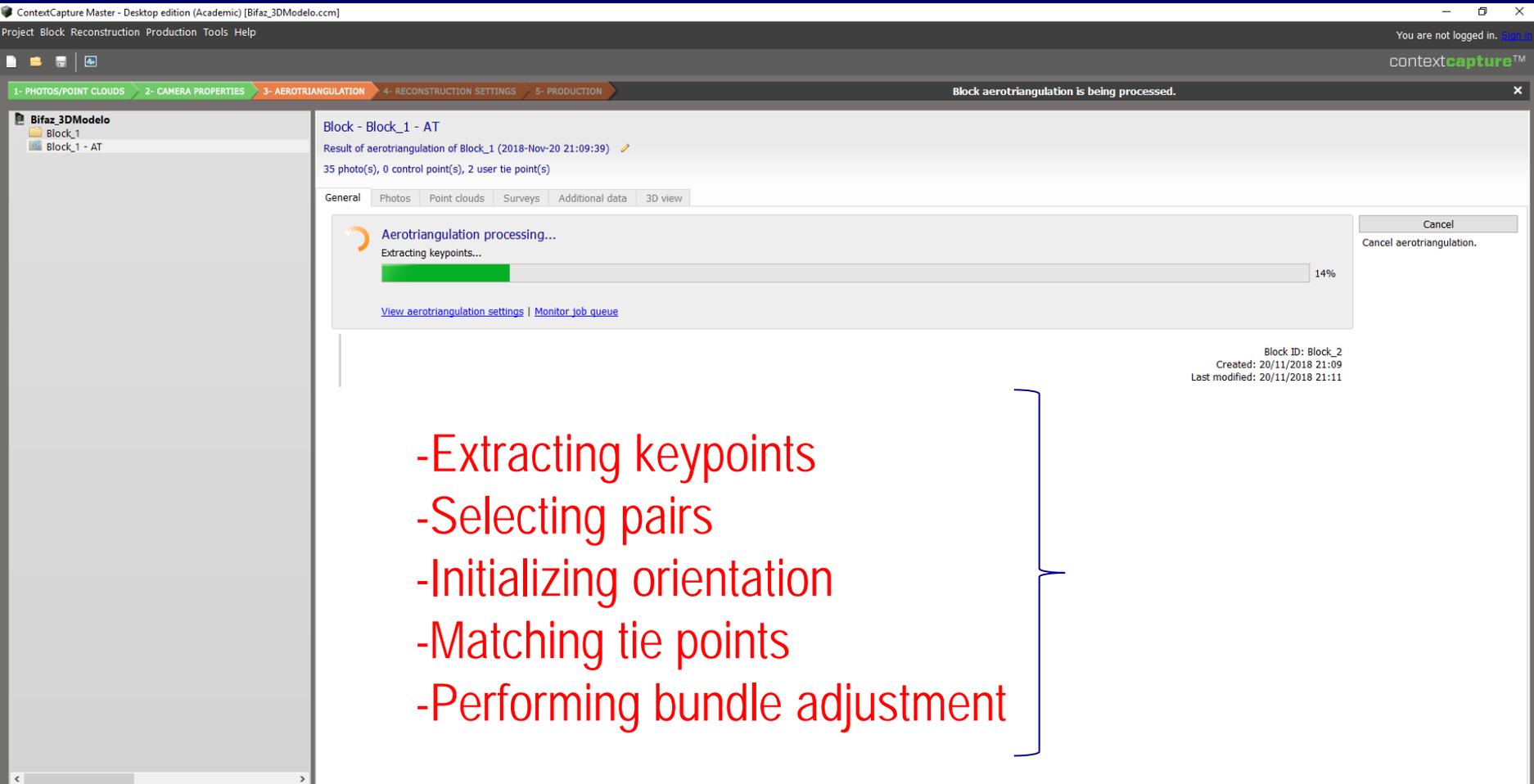


# ContextCapture Master

## 3- AEROTRIANGULATION

Al pulsar  ContextCapture Engine

 Se inicia el proceso de Aerotriangulation



Block - Block\_1 - AT  
Result of aerotriangulation of Block\_1 (2018-Nov-20 21:09:39)   
35 photo(s), 0 control point(s), 2 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

 Aerotriangulation processing...  
Extracting keypoints...  
14%

[View aerotriangulation settings](#) | [Monitor job queue](#)

Block ID: Block\_2  
Created: 20/11/2018 21:09  
Last modified: 20/11/2018 21:11

Cancel  
Cancel aerotriangulation.

- Extracting keypoints
- Selecting pairs
- Initializing orientation
- Matching tie points
- Performing bundle adjustment

# ContextCapture Master

## 3- AEROTRIANGULATION

“Aerotriangulation” finalizada : Visualizar los distintos informes y resultado provisional

The screenshot displays the ContextCapture Master software interface. The top navigation bar shows the current step as '3- AEROTRIANGULATION'. The main workspace is titled 'Block - Block\_1 - AT' and shows the 'Result of aerotriangulation of Block\_1 (2018-Nov-20 21:09:39)'. A red box highlights the 'General' tab in the top navigation of the main workspace. Below this, a green checkmark indicates 'Complete photos' with the message 'The block is ready for reconstruction.' Another red box highlights the 'Aerotriangulation' section, which includes links for 'View settings', 'View acquisition report', and 'View quality report'. A blue arrow points to the 'Reconstructions' section at the bottom of the main workspace, which is currently empty. On the right side, there is a 'Submit aerotriangulation...' button and a 'New reconstruction' button. The bottom right corner shows the 'Block ID: Block\_2', 'Created: 20/11/2018 21:09', and 'Last modified: 20/11/2018 21:13'.

ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]  
Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

You can create a new reconstruction.

Bifaz\_3DModelo  
Block\_1  
Block\_1 - AT

Block - Block\_1 - AT  
Result of aerotriangulation of Block\_1 (2018-Nov-20 21:09:39)

35 photo(s), 0 control point(s), 2 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

Complete photos  
The block is ready for reconstruction.  
Photos positioning level: absolute  
Aerotriangulation: [View settings](#) | [View acquisition report](#) | [View quality report](#)

35 photo(s) in 1 photogroup(s), 349.3 megapixels  
35 photo(s) in the main component  
35 known position(s) and 35 known rotation(s)  
0 control point(s) (0 full point(s), 0 horizontal point(s), 0 vertical point(s)) among which 0 check point(s)  
2 user tie point(s)  
8342 automatic tie point(s) [View](#)  
Resolution ranges from 4.4e-05 units to 8.8e-05 units  
Block has blockwise color equalization

Block ID: Block\_2  
Created: 20/11/2018 21:09  
Last modified: 20/11/2018 21:13

Submit aerotriangulation...  
Process a new block with completed or adjusted parameters.

Reconstructions

New reconstruction  
Create a new reconstruction framework.

Delete reconstruction  
Remove reconstruction from block.



# ContextCapture Master

## 3- AEROTRIANGULATION

“Aerotriangulation” finalizada : Visualizar los distintos informes y resultado provisional

The screenshot displays the ContextCapture Master software interface during the 'Aerotriangulation' phase. The main workspace shows a 3D model of a sphere covered in green and yellow points, representing the reconstructed geometry. The interface is divided into several panels:

- Project Tree (Left):** Shows the project structure with 'Block\_1' and 'Block\_1 - AT'.
- Navigation (Top):** Shows the workflow steps: 1- PHOTOS/POINT CLOUDS, 2- CAMERA PROPERTIES, 3- AEROTRIANGULATION (highlighted), 4- RECONSTRUCTION SETTINGS, and 5- PRODUCTION.
- Block Properties (Top Right):** Displays 'Block - Block\_1 - AT' with a 'Result of aerotriangulation of Block\_1 (2018-Nov-20 21:09:39)'. A red box highlights the 'General' tab and the text '25 photo(s), 0 control point(s), 2 usable point(s)'. A 'Submit aerotriangulation...' button is also visible.
- Automatic tie points (Middle):** A table showing the results of automatic tie point detection. A blue arrow points to the 'Automatic tie points' section.
- Photos (Bottom Left):** A grid of photo thumbnails with a 'Reconstruct' button.
- Measurements (Bottom Right):** A table showing measurements for the current photo.
- Statistics (Bottom Right):** A summary of automatic tie points and current photo statistics.

**Automatic tie points table:**

Name	X	Y	Z	RMS of reproj. error [px]	RMS of dist. to rays [u]
#995	-1.373	4.054	-11.059	0.26	0.000

**Measurements table:**

Image	x	y
.../Bifaz_25-11-2014	1488.50	126
.../Bifaz_25-11-2014	1279.48	106
.../Bifaz_25-11-2014	1342.72	115
.../Bifaz_25-11-2014	1198.80	105

**Statistics:**

**All automatic tie points:**

- number of points: 8342
- RMS of reproj. error: 0.55 px
- RMS of dist. to rays: 0.000 u

**Current photo:**

- number of usable measurements: 1464
- RMS of reproj. error: 0.55 px
- RMS of dist. to rays: 0.000 u

**Zoom:** wheel ; ctrl ; + ; - ; 0 | **Move viewing area:** click and drag | **Hide hints/points:** shift | **Quality:**=original

### Visualizar resultados de la "Aerotriangulation"

The screenshot shows the ContextCapture Master software interface. The main window displays the results of an aerotriangulation process for a block named "Block\_1 - AT". The central 3D view shows a point cloud of the block, surrounded by camera positions and tie points. The interface includes a project tree on the left, a top navigation bar, and a right-hand panel with photo details.

**Project:** Bifaz\_3DModelo

- Block\_1
- Block\_1 - AT

**Block - Block\_1 - AT**

Result of aerotriangulation of Block\_1 (2018-Nov-20 21:09:39)

35 photo(s), 0 control point(s), 2 user tie point(s)

**General** | Photos | Point clouds | Surveys | Additional data | 3D view

Show photos | In main component | Camera size

**Selected photos (1/35)**

Bifaz\_25-11-2014 022.jpg

Preview [View](#) | [Open](#)

**Photo**

Name	Bifaz_25-11-2014 022.jpg
Directory	F:/Bifaz
Date taken	lércoles, 26 de noviembre de 2014 0:41:06
Size	1 MB
Mask file	
Component	Main

**Pose**

Spatial reference system: **Not georeferenced**

Position X	-1.352970
Y	3.861788
Z	-11.038060

# ContextCapture Master

## 4- RECONSTRUCTION SETTINGS

ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

Warning: your license works in offline mode. If the license server cannot be contacted, your license will expire in 6 day(s).

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

You can create a new reconstruction.

Bifaz\_3DModelo

- Block\_1
- Block\_1 - AT

Block - Block\_1 - AT

Result of aerotriangulation of Block\_1 (2018-Nov-20 21:09:39)

35 photo(s), 0 control point(s), 2 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

 **Complete photos**  
The block is ready for reconstruction.  
Photos positioning level: **absolute**  
Aerotriangulation: [View settings](#) | [View acquisition report](#) | [View quality report](#)

Submit aerotriangulation...  
Process a new block with completed or adjusted parameters.

35 photo(s) in 1 photogroup(s), 349.3 megapixels  
35 photo(s) in the main component  
35 known position(s) and 35 known rotation(s)  
0 control point(s) (0 full point(s), 0 horizontal point(s), 0 vertical point(s)) among which 0 check point(s)  
2 user tie point(s)  
8342 automatic tie point(s) [View](#)  
Resolution ranges from 4.4e-05 units to 8.8e-05 units  
Block has blockwise color equalization

Block ID: Block\_2  
Created: 20/11/2018 21:09  
Last modified: 20/11/2018 21:13

Reconstructions

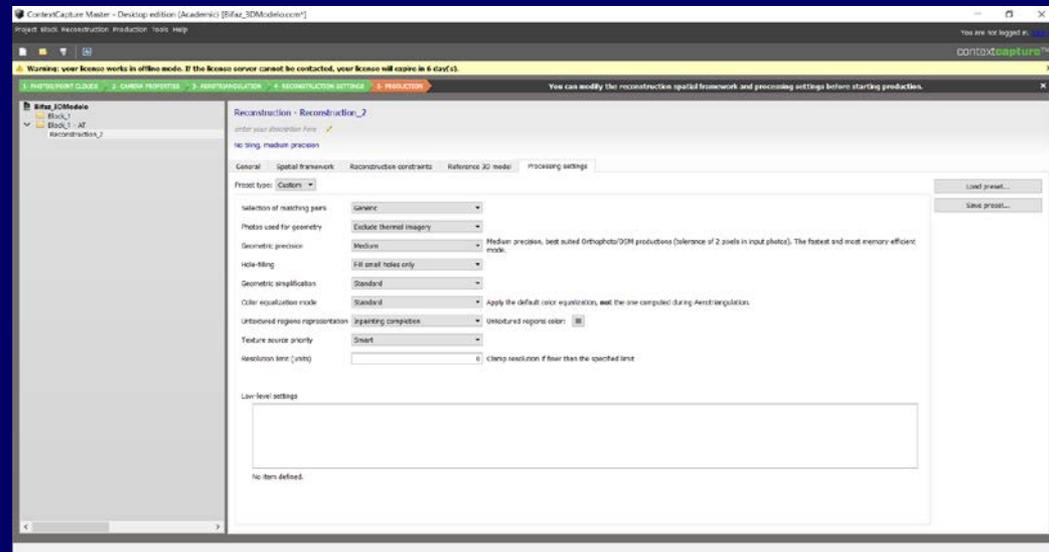
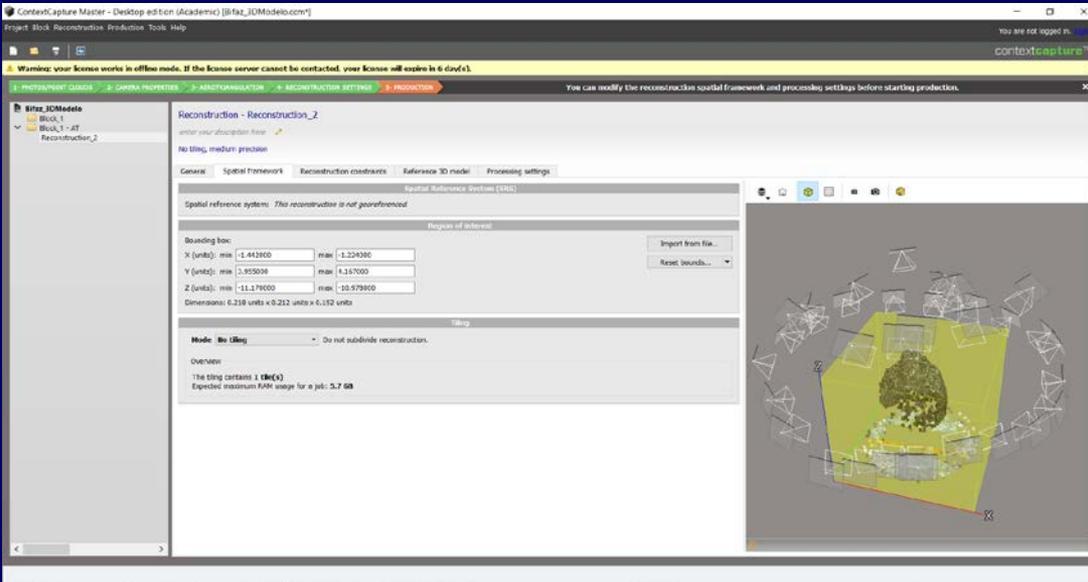


 **New reconstruction**  
Create a new reconstruction framework.

 Delete reconstruction  
Remove reconstruction from block.

### Definir los parámetros de la reconstrucción

- General
- Spatial framework
- Reconstruction constraints
- Reference 3D model
- Processing settings



ContextCapture Master - Desktop edition (Academic) [Bifaz\_3DModelo.ccm\*]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign In](#)

contextcapture™

**Warning: your license works in offline mode. If the license server cannot be contacted, your license will expire in 6 day(s).**

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

You can modify the reconstruction spatial framework and processing settings before starting production.

**Bifaz\_3DModelo**

- Block\_1
- Block\_1 - AT
  - Reconstruction\_2

### Reconstruction - Reconstruction\_2

enter your description here

No tiling, medium precision

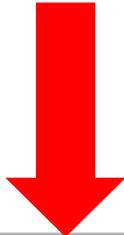
General Spatial framework Reconstruction constraints Reference 3D model Processing settings

**Ready for production**  
You can modify the spatial framework and processing settings before starting production.

No tiling  
Incomplete reference 3D model  
Medium precision

Reconstruction ID: Reconstruction\_2  
Created: 21/11/2018 1:20  
Last modified: 21/11/2018 1:22

# Submit new production



Production	Format	Status	Progress	Last submitted
------------	--------	--------	----------	----------------

**Submit new production...**  
Define and submit new production.

Delete production  
Remove production from the list.

The screenshot displays the ContextCapture Master software interface. The window title is 'ContextCapture Master - Desktop edition [Talud\_08-10-2016.ccm\*]'. The menu bar includes 'Project', 'Block', 'Reconstruction', 'Production', 'Tools', and 'Help'. The breadcrumb navigation shows 'Talud\_08-10-2016 > Block\_1 - AT > Reconstruction\_1'. The main content area is titled 'Reconstruction - Reconstruction\_1' and includes a description field, a status indicator 'Ready for production', and a 'Productions' table. The 'Ready for production' status is accompanied by a green checkmark icon and the text 'You can modify the spatial framework and processing settings before starting production.' The 'Productions' table is currently empty. On the right side, there are buttons for 'Submit new production...', 'Delete production', and 'Remove production from the list.' The bottom right corner of the interface contains the text 'Remove production from the list.'

ContextCapture Master - Desktop edition [Talud\_08-10-2016.ccm\*]

Project Block Reconstruction Production Tools Help

1- PHOTOS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION You can modify the reconstruction spatial framework and processing settings before starting production. X

Talud\_08-10-2016 > Block\_1 - AT > Reconstruction\_1

Talud\_08-10-2016  
Block\_1  
Block\_1 - AT  
Reconstruction\_1

### Reconstruction - Reconstruction\_1

enter your description here

No tiling, medium precision

General Spatial framework Reconstruction constraints Reference 3D model Processing settings

**Ready for production**  
You can modify the spatial framework and processing settings before starting production.

No tiling  
Incomplete reference 3D model  
Medium precision

Reconstruction ID: Reconstruction\_1  
Created: 02/03/2017 17:58:54  
Last modified: 02/03/2017 18:10:57

#### Productions

Production	Format	Status	Progress	Last submitted
------------	--------	--------	----------	----------------

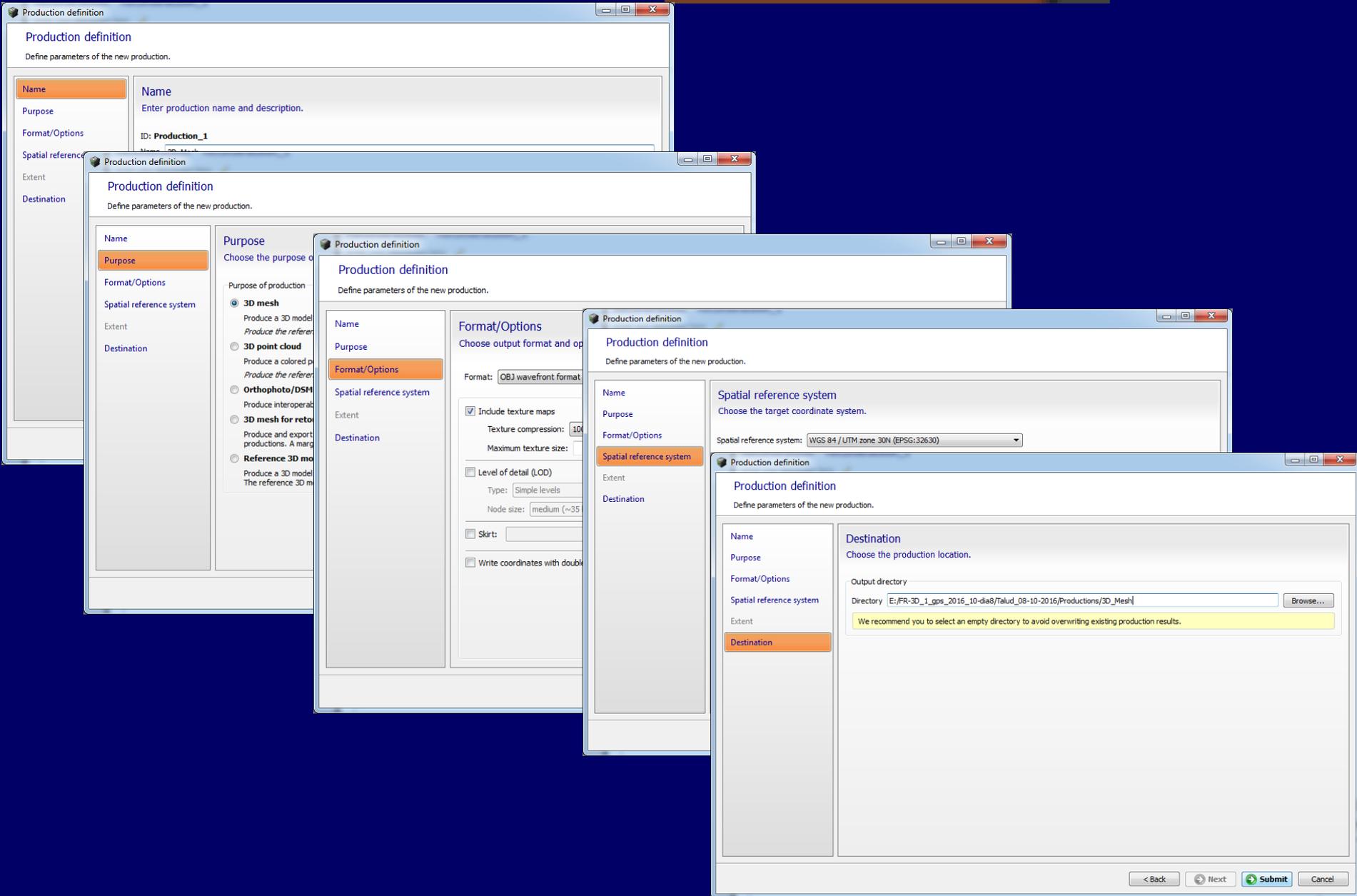
**Submit new production...**  
Define and submit new production.

**Delete production**  
Remove production from the list.

Remove production from the list.

# ContextCapture Master

5- PRODUCTION



Productos cartográficos que se pueden obtener de la reconstrucción

**Production definition**

Define parameters of the new production.

**Name**

**Purpose**

Choose the purpose of the production to submit.

Purpose of production

- 3D mesh**  
Produce a 3D model optimized for visualization and analysis in third-party software.  
*Produce the reference 3D model too.*
- 3D point cloud**  
Produce a colored point cloud for visualization and analysis in third-party software.  
*Produce the reference 3D model too.*
- Orthophoto/DSM**  
Produce interoperable raster layers for visualization and analysis in third-party GIS/CAD software or image processing tools.
- 3D mesh for retouching**  
Produce and export the reference 3D model for editing in a third-party software and importing back into ContextCapture Master for later productions. A margin is specially included.
- Reference 3D model only**  
Produce a 3D model which can be used only inside ContextCapture Master, for quality control and as a cache for later productions. The reference 3D model is needed for orthophoto/DSM productions.

< Back   Next >   Submit   Cancel

# ContextCapture Master

5- PRODUCTION

## Obtención de un objeto o modelo 3D (3D Mesh)

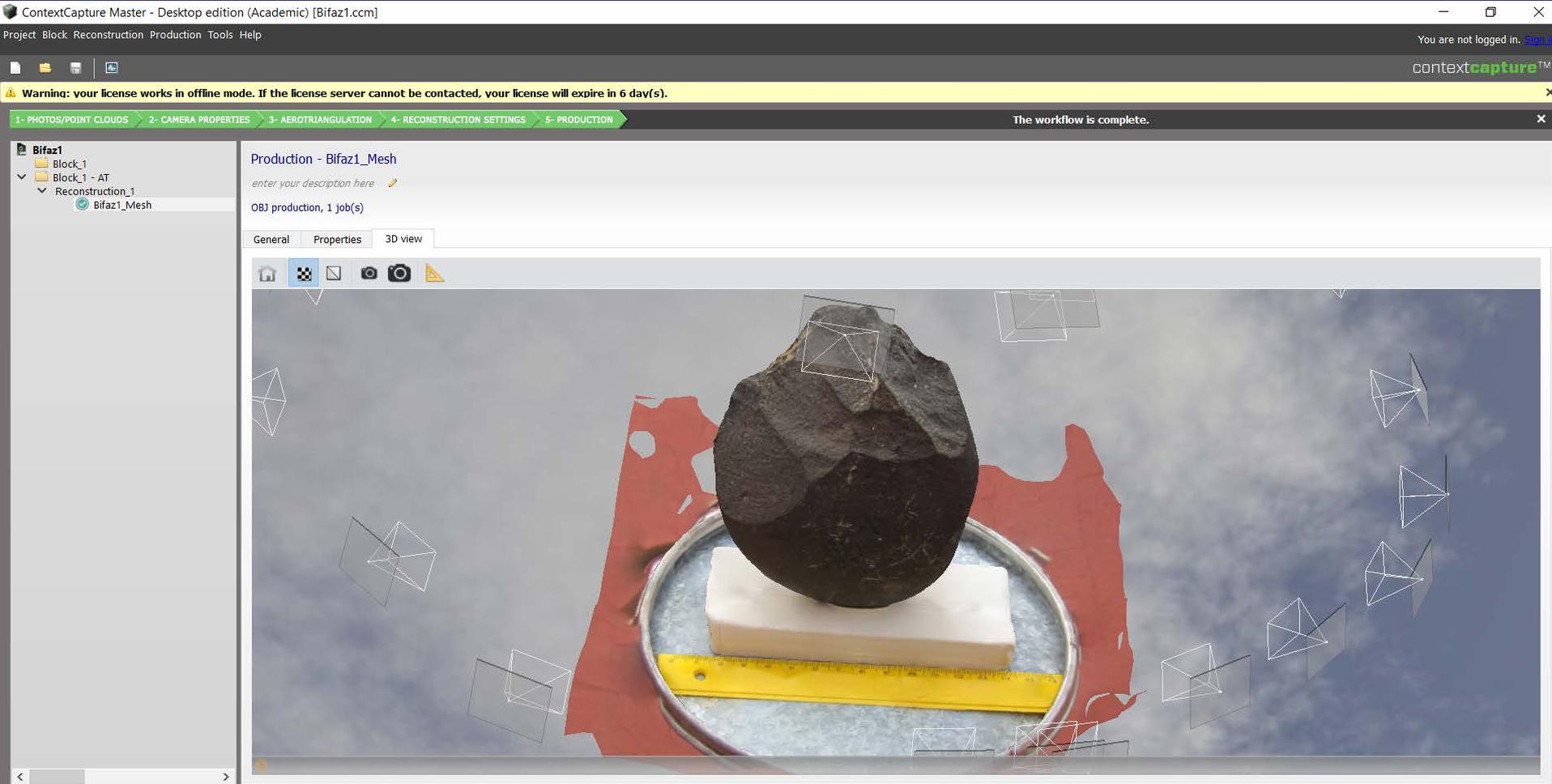
The screenshot displays the ContextCapture Master software interface. The title bar reads "ContextCapture Master - Desktop edition (Academic) [Bifaz1.ccm]". The menu bar includes "Project", "Block", "Reconstruction", "Production", "Tools", and "Help". A yellow warning banner at the top states: "Warning: your license works in offline mode. If the license server cannot be contacted, your license will expire in 6 day(s).". The main interface is divided into several sections:

- Navigation Bar:** Shows five steps: 1- PHOTOS/POINT CLOUDS, 2- CAMERA PROPERTIES, 3- AEROTRIANGULATION, 4- RECONSTRUCTION SETTINGS, and 5- PRODUCTION (highlighted).
- Project Tree (Left):** Shows a hierarchy: Bifaz1 > Block\_1 > Block\_1 - AT > Reconstruction\_1 > Bifaz1\_Mesh.
- Reconstruction - Reconstruction\_1:** The main workspace. It includes a description field, a "No tiling, high precision" setting, and tabs for "General", "Spatial framework", "Reconstruction constraints", "Reference 3D model", and "Processing settings". A green checkmark icon indicates "In production" with the message "Spatial framework and processing settings are fixed." Below this, it lists "No tiling", "Completed reference 3D model", and "High precision". On the right, it shows "Reconstruction ID: Reconstruction\_1", "Created: 05/11/2018 22:52", and "Last modified: 05/11/2018 22:55".
- Productions Table:** A table listing the production status.

Production	Format	Status	Progress	Last submitted
Bifaz1_Mesh	OBJ	Completed	100%	05/11/2018 22:57

On the right side of the interface, there are two buttons: "Submit new production..." (with a green plus icon) and "Delete production" (with a grey minus icon). Below the "Delete production" button, it says "Remove production from the list."

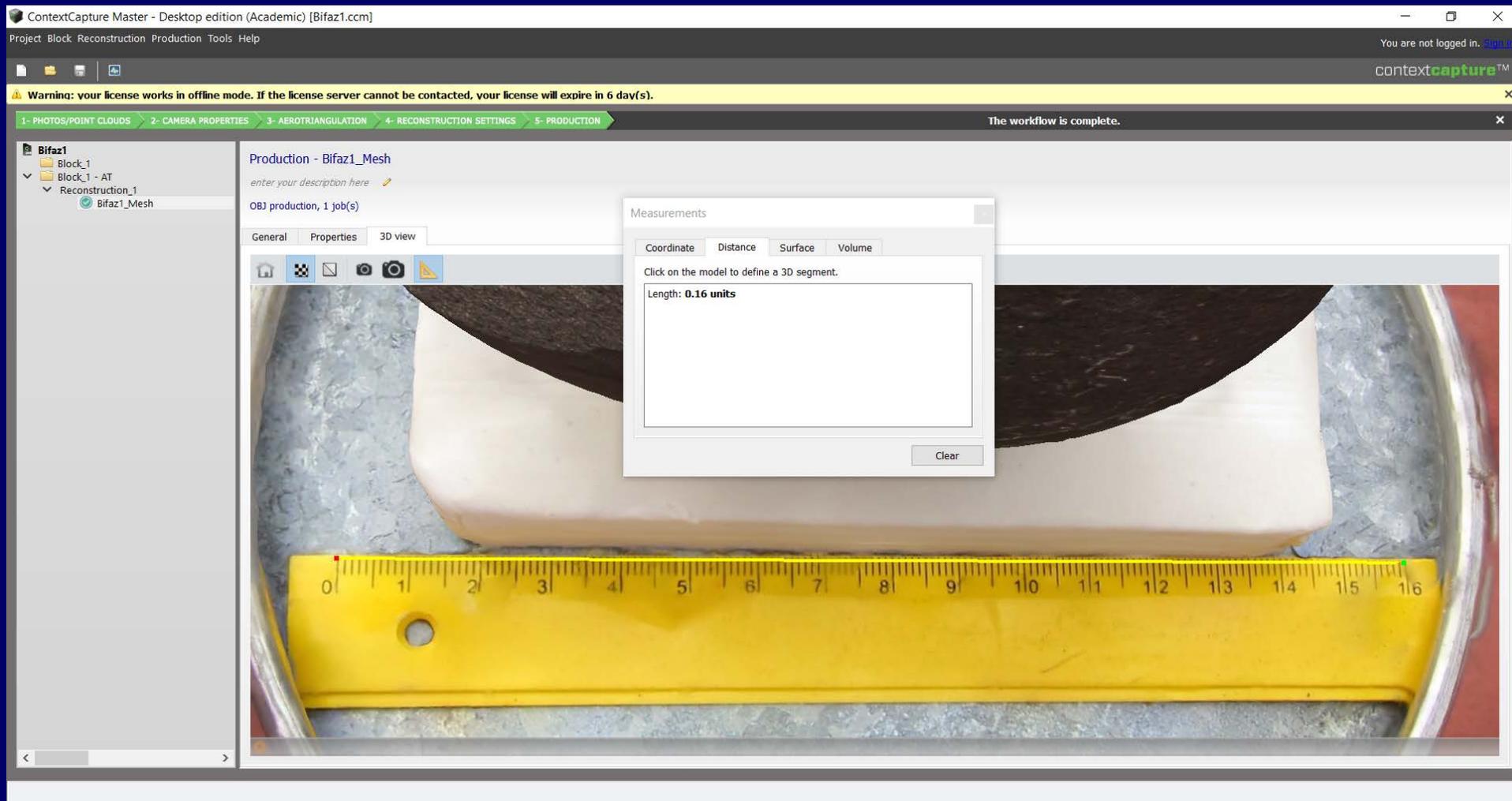
### Visualización de objeto o modelo 3D (3D Mesh)



# ContextCapture Master

5- PRODUCTION

## Mediciones sobre el objeto o modelo 3D (3D Mesh)



# ContextCapture Master

## Visualización del modelo 3D con ContextCapture Viewer

The screenshot displays the ContextCapture Master software interface. The title bar reads "ContextCapture Master - Desktop edition (Academic) [Bifaz1.ccm]". The menu bar includes "Project", "Block", "Reconstruction", "Production", "Tools", and "Help". A yellow warning banner states: "Warning: your license works in offline mode. If the license server cannot be contacted, your license will expire in 6 day(s).". The main workspace shows a progress bar with five steps: "1- PHOTOS/POINT CLOUDS", "2- CAMERA PROPERTIES", "3- AEROTRIANGULATION", "4- RECONSTRUCTION SETTINGS", and "5- PRODUCTION". The "5- PRODUCTION" step is active, and a message says "The workflow is complete.".

On the left, a tree view shows the project structure: "Bifaz1" containing "Block\_1", "Block\_1 - AT", and "Reconstruction\_1", which in turn contains "Bifaz1\_Mesh".

The main panel displays "Production - Bifaz1\_Mesh" with a description field "enter your description here" and "OBJ production, 1 job(s)". Below this, there are tabs for "General", "Properties", and "3D view". The "General" tab is selected, showing a green checkmark and the text "Completed". Below this, it says "The production is completed." and "1/1 job(s) completed.".

A red box highlights the link "Open with ContextCapture Viewer". Other links include "Open output directory" and "Publish to Sketchfab".

On the right side, there are three buttons: "Resubmit production", "Submit update", and "Cancel production". Below these buttons, there is text: "Restart processing of cancelled or failed jobs.", "Restart processing of jobs requiring update.", and "Cancel processing of running or pending jobs.".

At the bottom right, production details are listed: "Production ID: Production\_1", "Created: 05/11/2018 22:56", and "Last submitted: 05/11/2018 22:57".

At the bottom left, it says "Format: OBJ wavefront format" and "1 job(s)". A "More details" button is also present.

# ContextCapture Master

Visualización del modelo 3D con ContextCapture Viewer

ContextCapture Viewer [Model.obj]

File Camera Display Tools Help



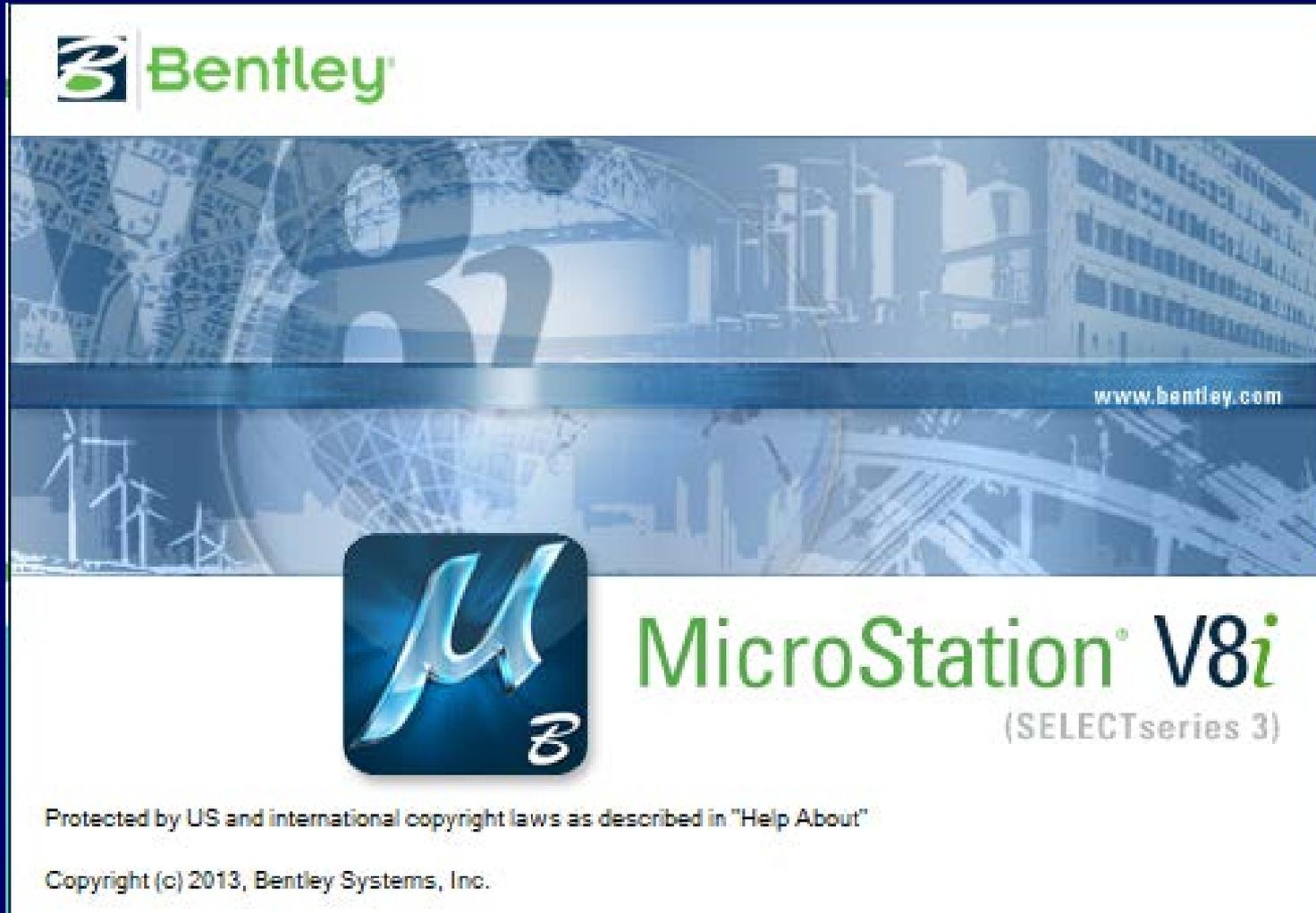
contextcapture™ viewer



# Bentley CAD MicroStation

## Visualización del modelo 3D y la nube de puntos 3D en el CAD

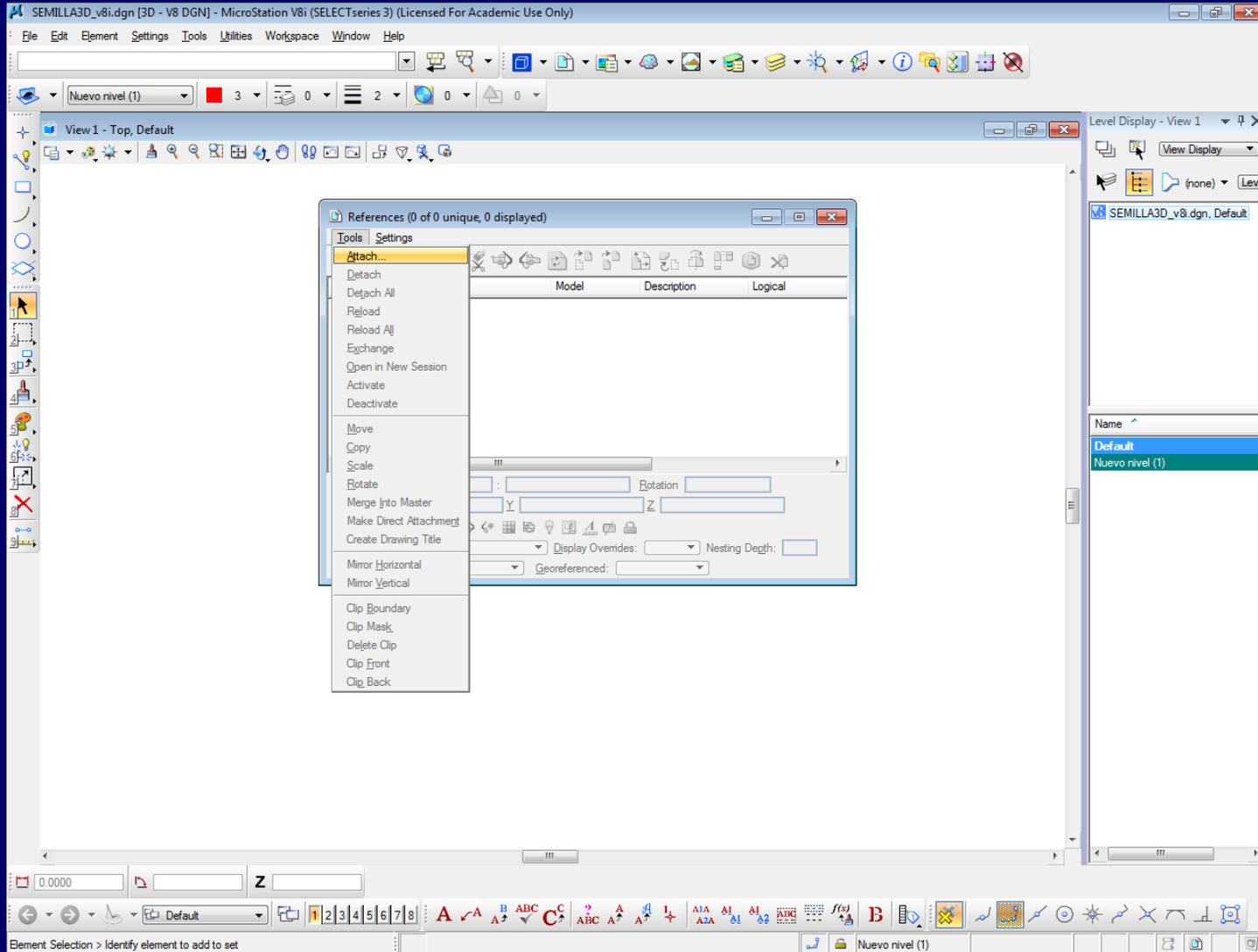
→ Abrir el CAD, desde Todas Aplicaciones/Bentley/MicroStation v8i



# Bentley CAD MicroStation

## Visualización del modelo 3D

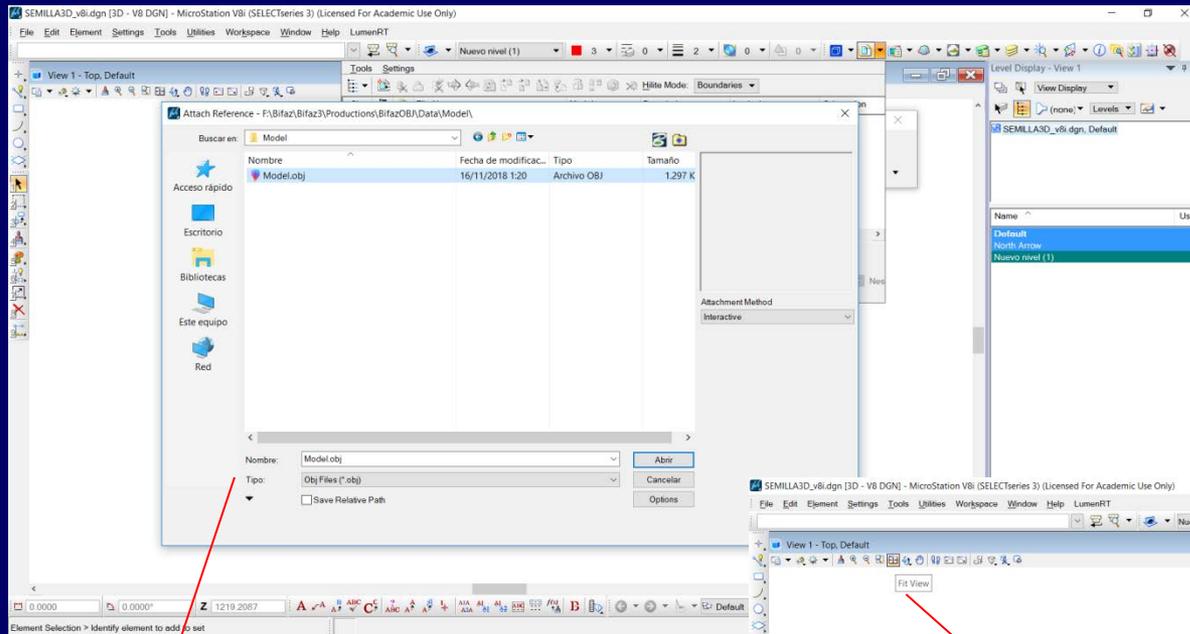
➤ Abrir el fichero "SEMILLA3D.dgn". Vincular el modelo 3D \*obj, desde File/References/Attach



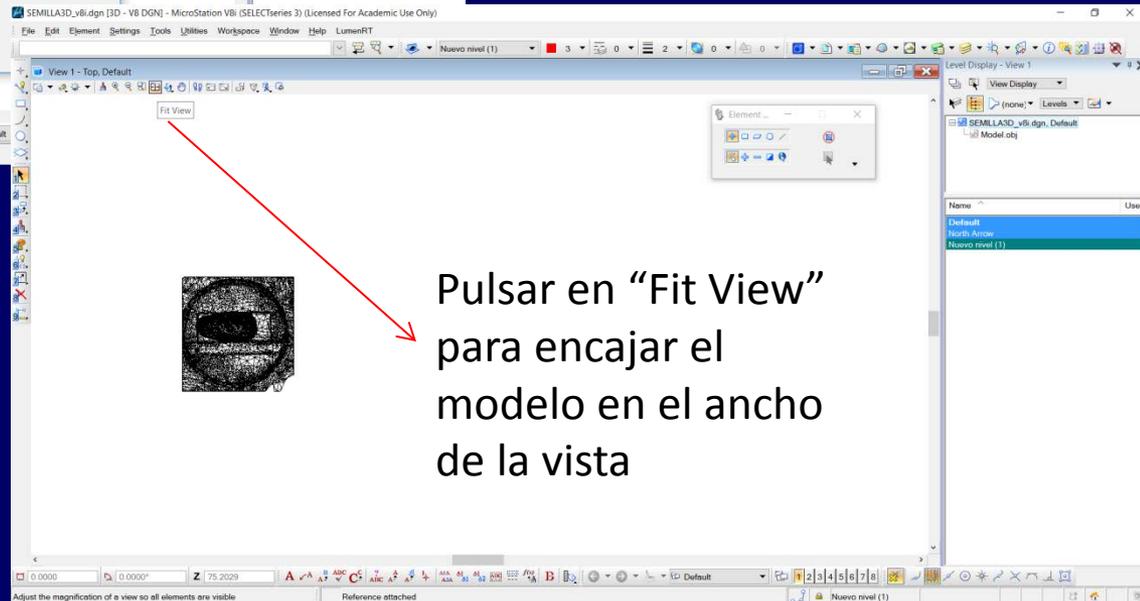
# Bentley CAD MicroStation

## Visualización del modelo 3D

➤ Abrir el fichero "SEMILLA3D.dgn". Vincular el modelo 3D \*obj, desde File/References/Attach



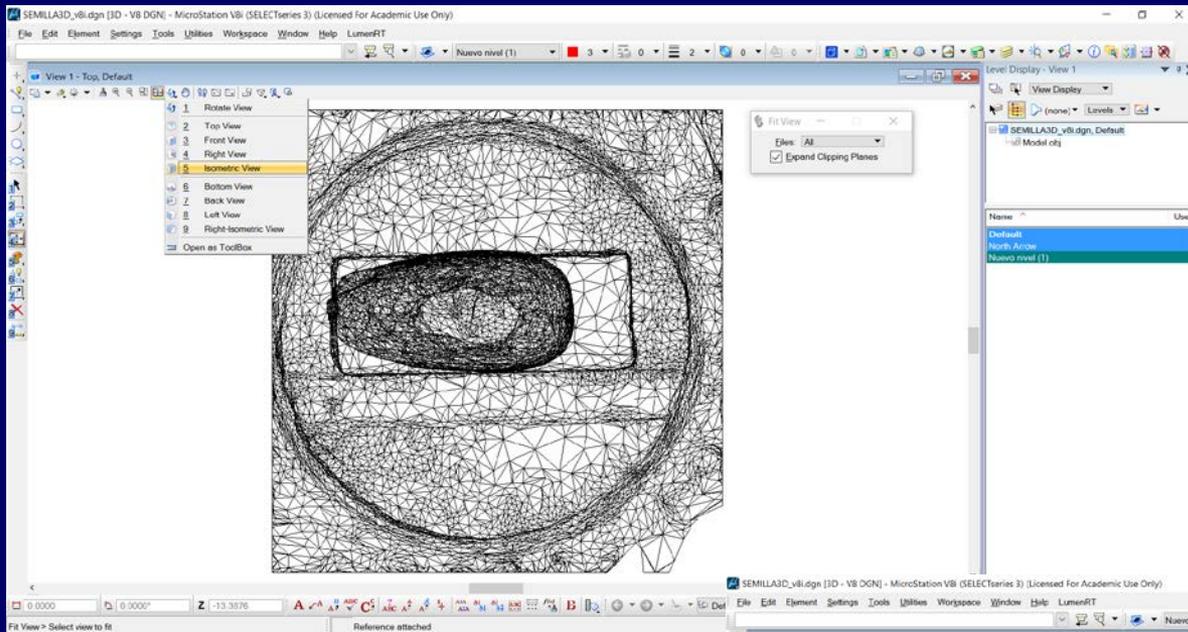
Recordar seleccionar el tipo de formato



Pulsar en "Fit View" para encajar el modelo en el ancho de la vista

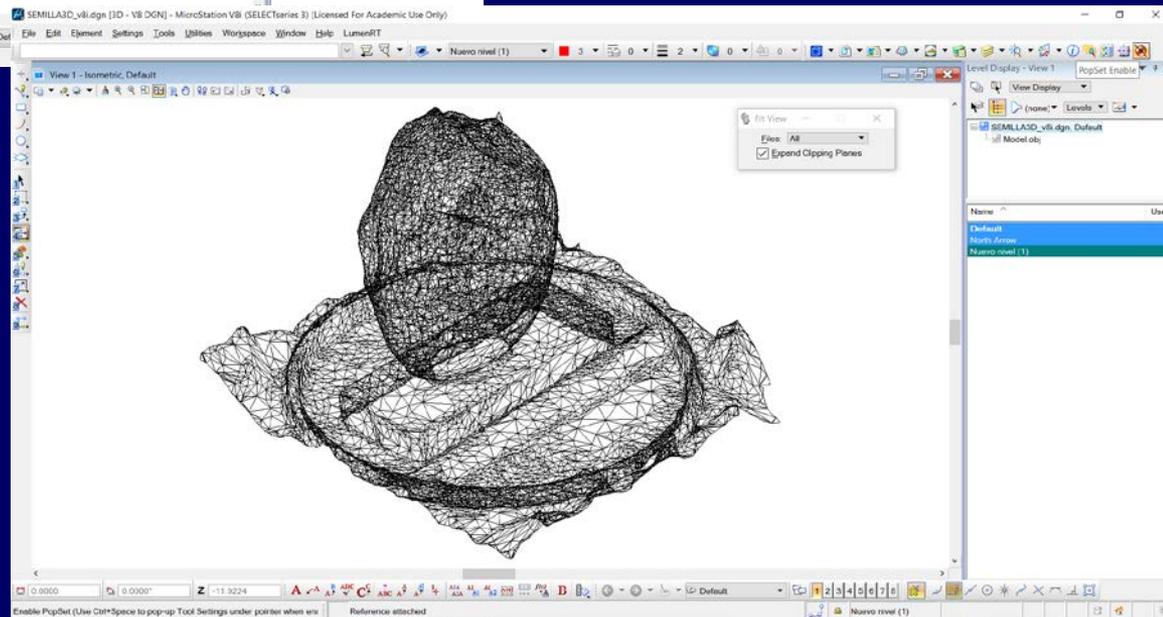
# Bentley CAD MicroStation

## Visualización del modelo 3D



Top View

Definir el modo de visualización del objeto con las herramientas “rotación de vistas”)



Isometric View

# Bentley CAD MicroStation

## Visualización del modelo 3D

The screenshot displays the Bentley CAD MicroStation interface for a 3D model. The main window shows a wireframe model of a seedling in an isometric view. The 'View' menu is open, with 'View Rotation' and 'Rotate View' highlighted. A 'Fit View' dialog box is also visible, showing 'Files: All' and 'Expand Clipping Planes' checked. The interface includes a top menu bar (File, Edit, Element, Settings, Tools), a left-hand navigation pane with categories like Animation, Base Geometry, Cells, etc., and a right-hand 'Level Display' pane. The status bar at the bottom shows 'Reference attached' and 'Nuevo nivel (1)'.

SEMILLA3D\_v8i.dgn [3D - V8 DGN] - MicroStation V8i (SFI ECTseries 3) / Licensed For Academic Use Only

File Edit Element Settings Tools

Attributes  
Primary  
Standard

Main  
Tasks

Animation  
Base Geometry  
Cells  
Change Tracking  
Clash Detection  
Coordinate Systems  
Curves  
Custom Linestyles  
Database  
Detailing Symbols  
Dimensions  
Feature Solids  
Geographic  
Groups  
Levels  
Manipulate  
Measure  
Mesh  
Multi-lines  
Parametrics  
Patterning  
Point Cloud  
Project Navigation  
Properties  
Raster  
Redline  
Reference  
Security  
Selection  
Sheet Composition  
Solids  
Surfaces  
Terrain Model  
Text  
View  
Visualization

Help LumenRT

Nuevo nivel (1)

Fit View

Files: All  
Expand Clipping Planes

Level Display - View 1

View Display

SEMILLA3D\_v8i.dgn, Default  
Model.obj

Name Used

Default  
North Arrow  
Nuevo nivel (1)

1 View Attributes  
2 Display Style List  
3 Adjust View Brightness  
4 Update View  
5 Zoom In  
6 Zoom Out  
7 Window Area  
8 Fit View  
9 View Rotation  
1 Rotate View  
2 Top View  
3 Front View  
4 Right View  
5 Isometric View  
6 Bottom View  
7 Back View  
8 Left View  
9 Right-Isometric View  
Open as ToolBox

1 View Control  
2 View Groups  
3 Saved View  
Open as ToolBox

0.0000 0.0000°

Fit View > Select view to fit

Tool Boxes... Ctrl+T  
Close Tool Boxes...

Reference attached

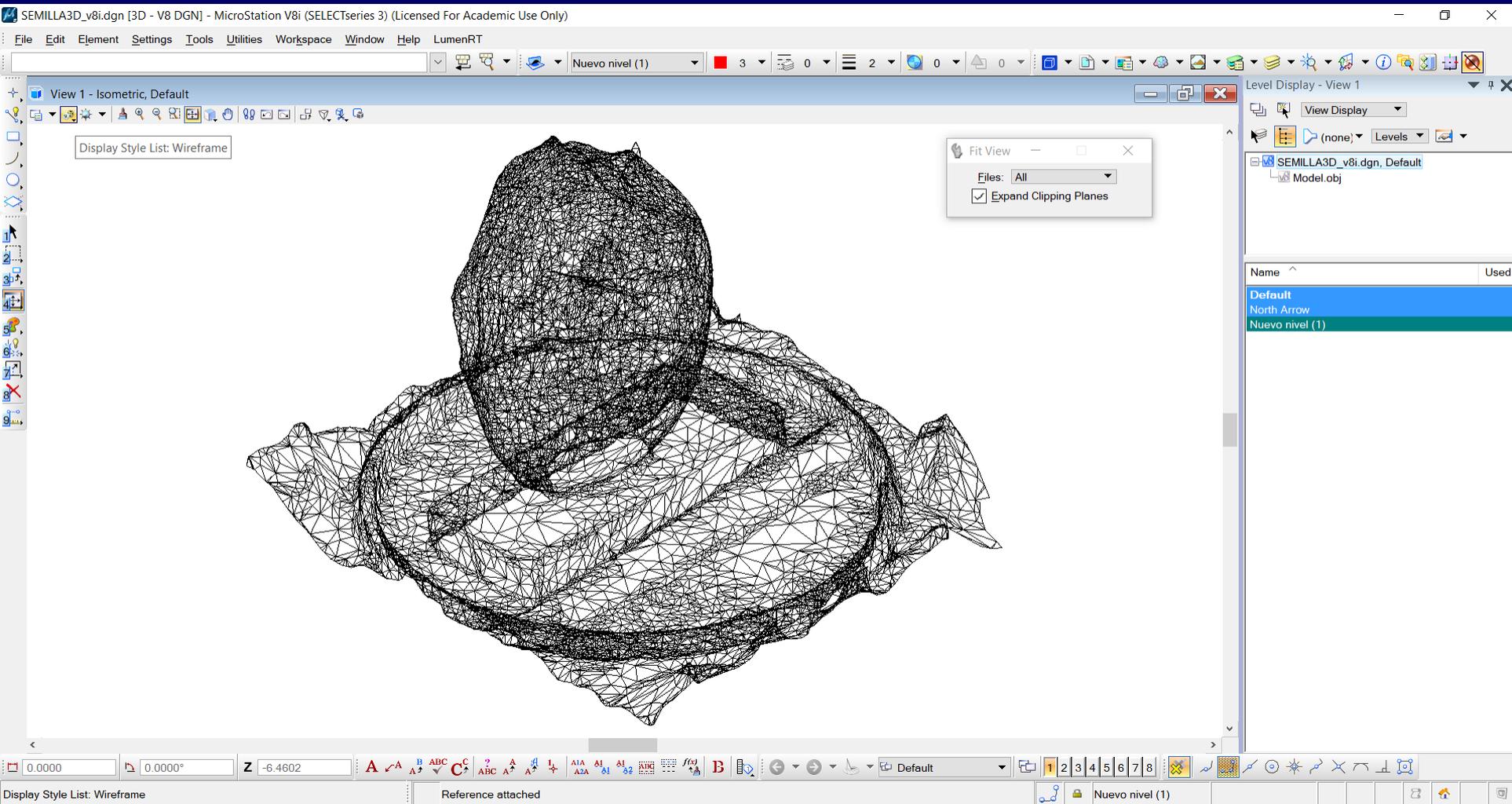
Default

Nuevo nivel (1)

# Bentley CAD MicroStation

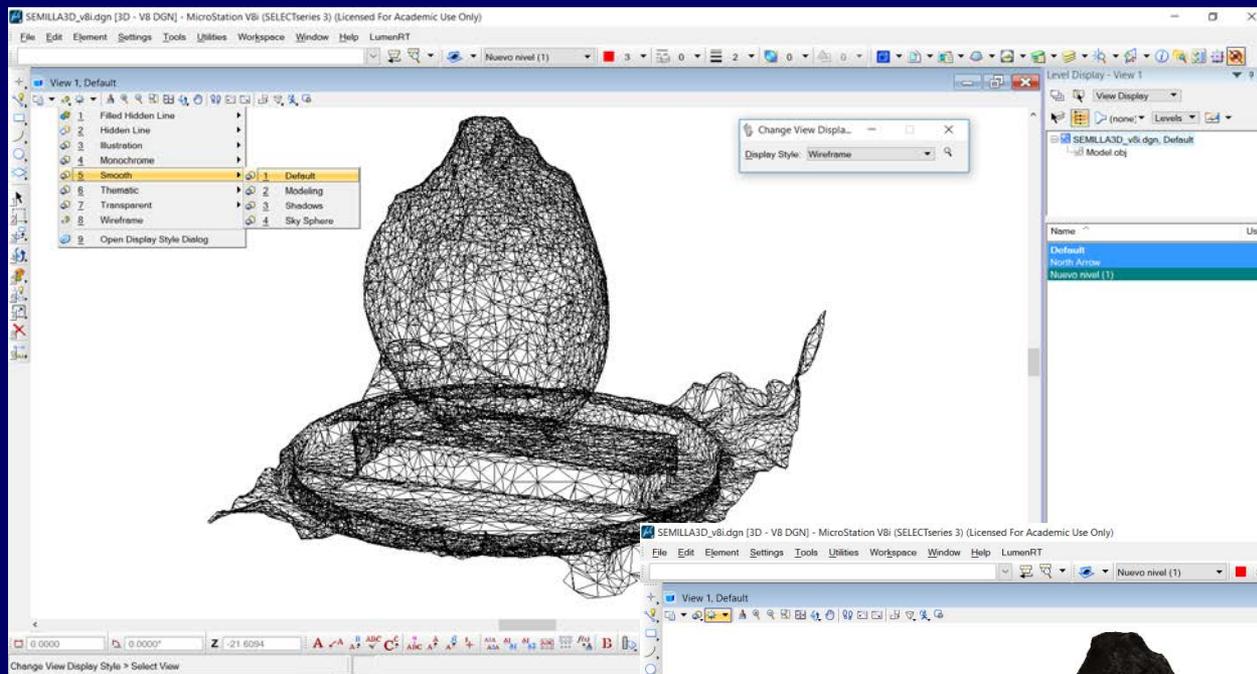
## Visualización del modelo 3D

### Definir el estilo de visualización

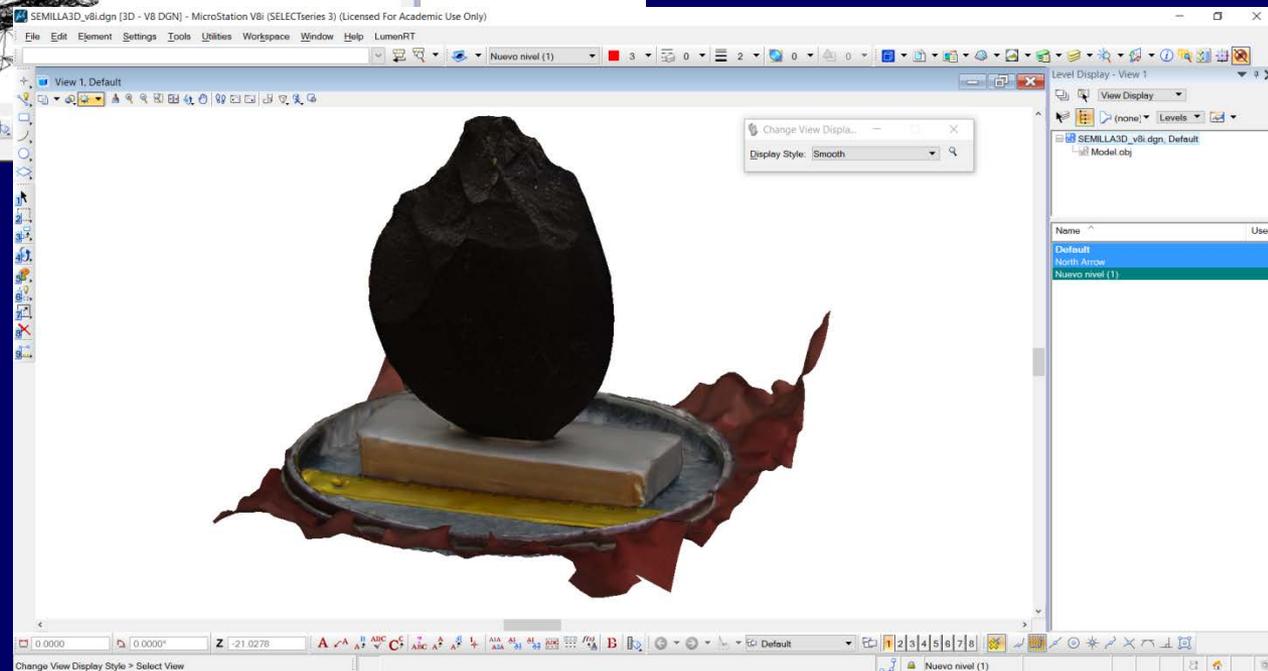


# Bentley CAD MicroStation

## Visualización del modelo 3D



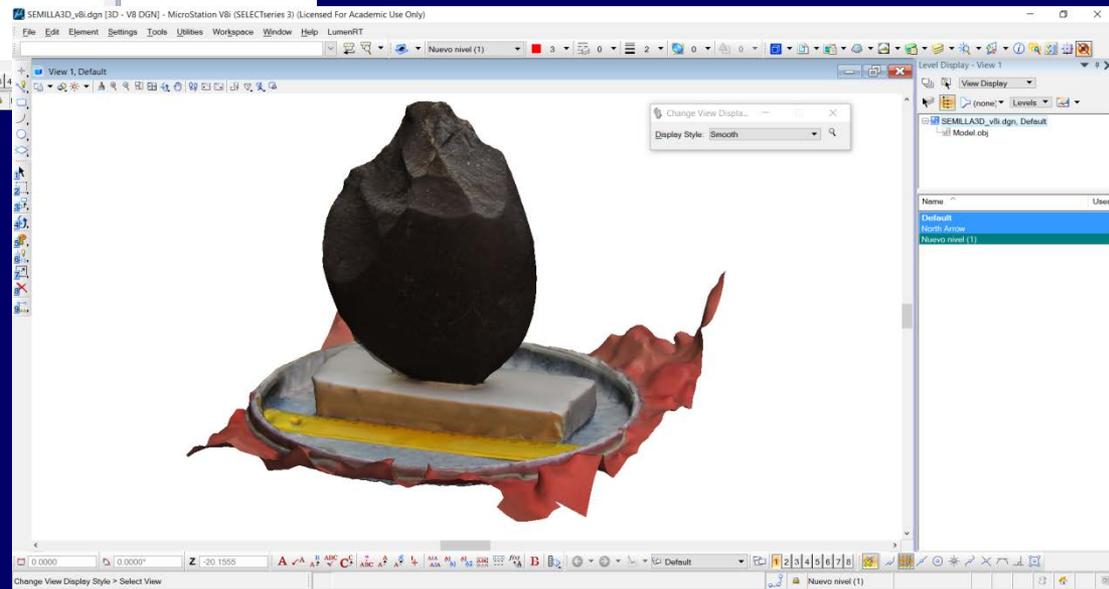
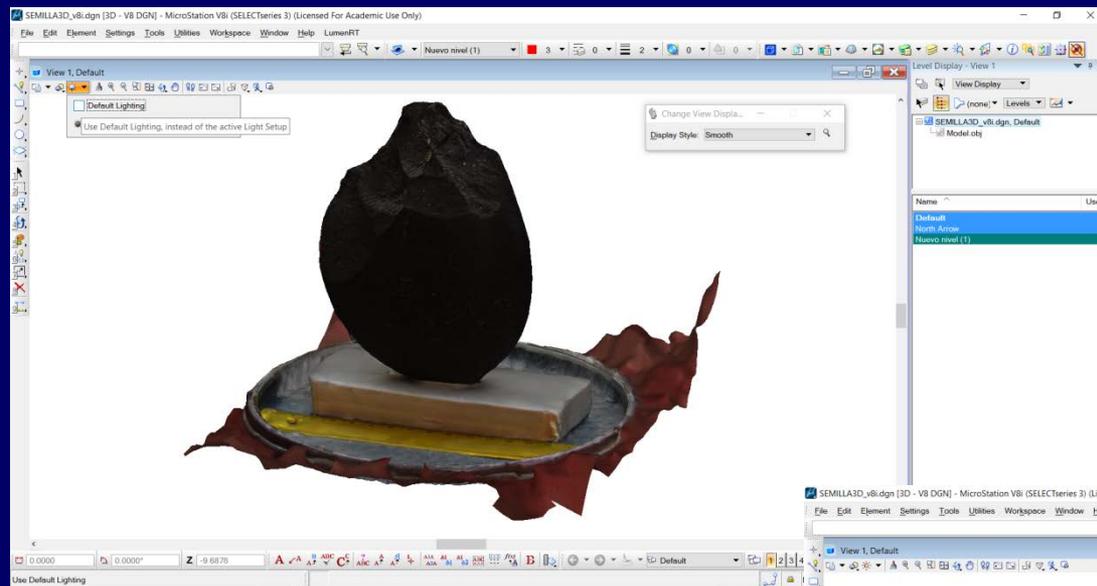
Seleccionar, por ejemplo, Smooth/Default



# Bentley CAD MicroStation

## Visualización del modelo 3D

Activar y ajustar, si se desea, el “brillo” de la vista



# Bentley CAD MicroStation

## Imprimir el modelo en 3D

## File/Print

SEMILLA3D\_v8i.dgn [3D - V8 DGN] - MicroStation V8i (SELECTseries 3) (Licensed For Academic Use Only)

File Edit Element Settings Tools Utilities Workspace Window Help LumenRT

Ctrl+N Ctrl+O Ctrl+W Ctrl+S

Level Display - View 1 View Display (none) Levels

### Print (pdf.pltcfg)

File Settings Resymbolization

General Settings

Area: View View: View 1 Color: True Color Print to 3D  Copies: 1

Printer and Paper Size

Bentley driver Paper: ISO A4 Usable area: 297 x 210 mm Landscape Create plot file

Show design in preview

Print Scale and Position

Scale: 0.1683 1 mm (paper) to 0.1683 m (design)

Size: 279.400 145.332 mm Maximize Rotation: None

Origin: 8.800 32.334 mm Auto-center

Print Resymbolization

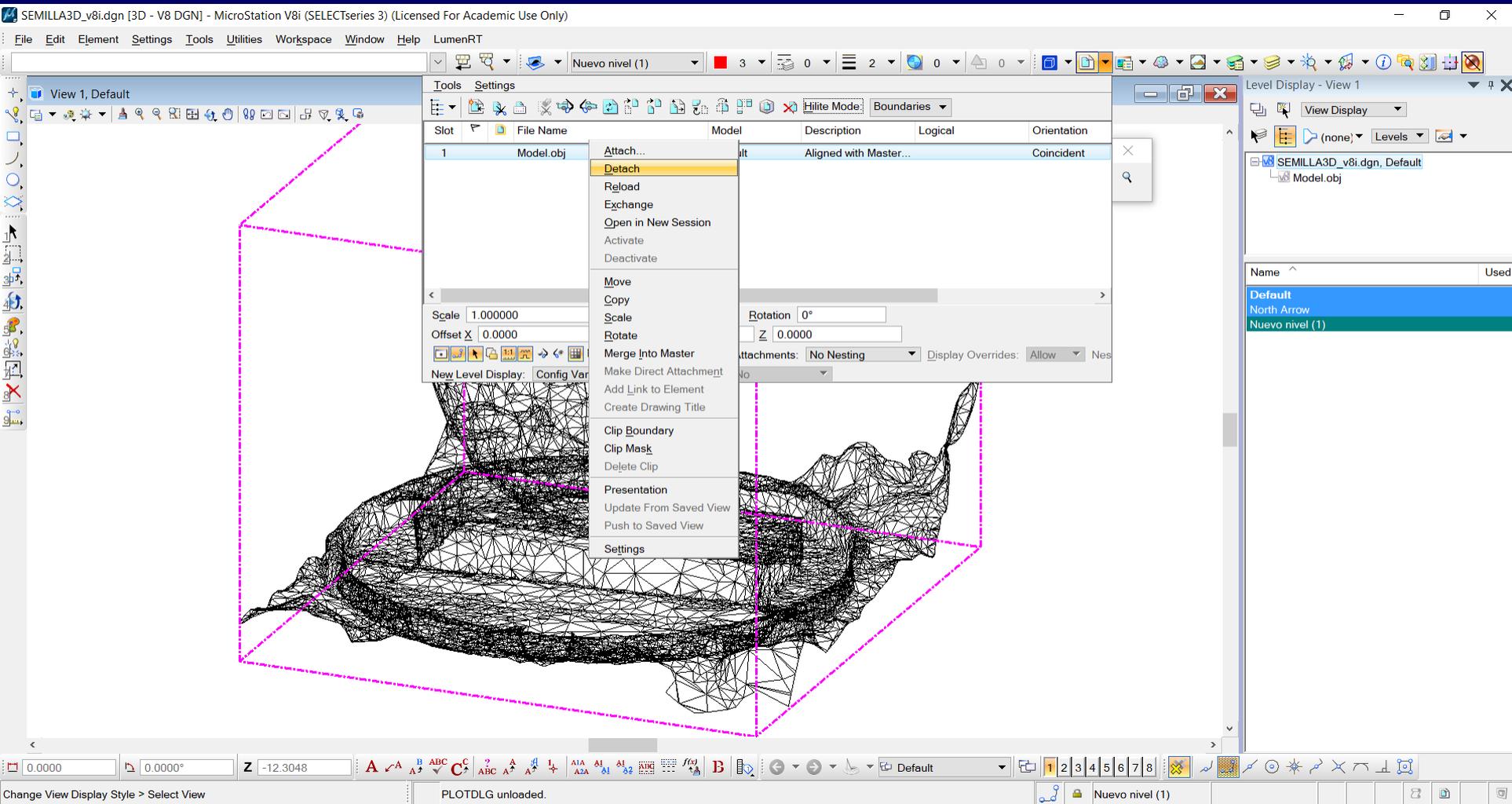
Pen table: Design script:



# Bentley CAD MicroStation

## Visualización de la nube de puntos 3D en el CAD

Desvincular el modelo 3D \*obj, desde File/References/Detach



# Bentley CAD MicroStation

## Visualización de la nube de puntos 3D en el CAD

→ Vincular la nube de puntos 3D \*pod, desde File/PointClouds/Attach

The screenshot displays the Bentley CAD MicroStation V8i interface. The main window shows a 3D view of a point cloud. The 'Point Clouds' menu is open, showing options: Attach..., Detach, Convert..., and Export... The 'Attach...' option is highlighted. A dialog box titled 'Element ...' is visible in the center of the 3D view. The 'Level Display - View 1' panel on the right shows the current level as 'Default'. The 'Point Clouds (0 of 0 listed)' dialog box is also visible, showing a table with a 'Description' column and a 'Used' column. The 'Attach...' option is highlighted in the menu.

SEMILLA3D\_v8i.dgn [3D - V8 DGN] - MicroStation V8i (SELECTseries 3) (Licensed For Academic Use Only)

File Edit Element Settings Tools Utilities Workspace Window Help LumenRT

New... Ctrl+N  
Open... Ctrl+O  
Close Ctrl+W  
Save Ctrl+S  
Save As...  
Compress  
Save Settings Ctrl+F

Item Browser  
Project Explorer  
References  
Raster Manager  
Point Clouds  
Models  
Publish i-model...  
Import  
Export

Print Preview  
Print...  
Print Organizer

Associate...  
Properties

Protection  
Send...

1 F:\Curso\_UCM\_2018-2019\Seminario\_Photos-to-3DModels\SEMILLA3D\_v8i.dgn  
2 F:\Chozo\_Prueba\_borra\Chozo.dgn  
3 F:\Carcava2016\UTM-Estacas\_carcava\_fuente.dgn  
4 G:\varios\coordenadas\_carcava\_fuente.dgn  
5 F:\carcava\coordenadas\_carcava\_fuente.dgn  
6 F:\Foto3D\_Reconstructions\ContextCapture\Pradena\_Cantera\SEMILLA3D\_v8i.dgn  
7 F:\Foto3D\_Reconstructions\ContextCapture\Pradena\_Cantera\Cantera\_Pradena.dgn  
8 F:\Curso\_UCM\_2018-2019\CARTOGRAFIA-I\PROF\_Ejercicios\_Pruebas\Prof\_C...  
9 F:\Articulos\Holar\_Iceland\_Timing\_RockGlaciers\Bloques\_Restitui...3D\_Samp...  
10 F:\Articulos\Holar\_Iceland\_Timing\_RockGlaciers\3D\_Blocks-Dating-Samples...

0.0000 0.0000° Z -12.3048 A ✓ A A

Element Selection > Identify element to add to set

Point Clouds (0 of 0 listed)

File Edit View Settings Utilities

Attach...  
Detach  
Convert...  
Export...

Description

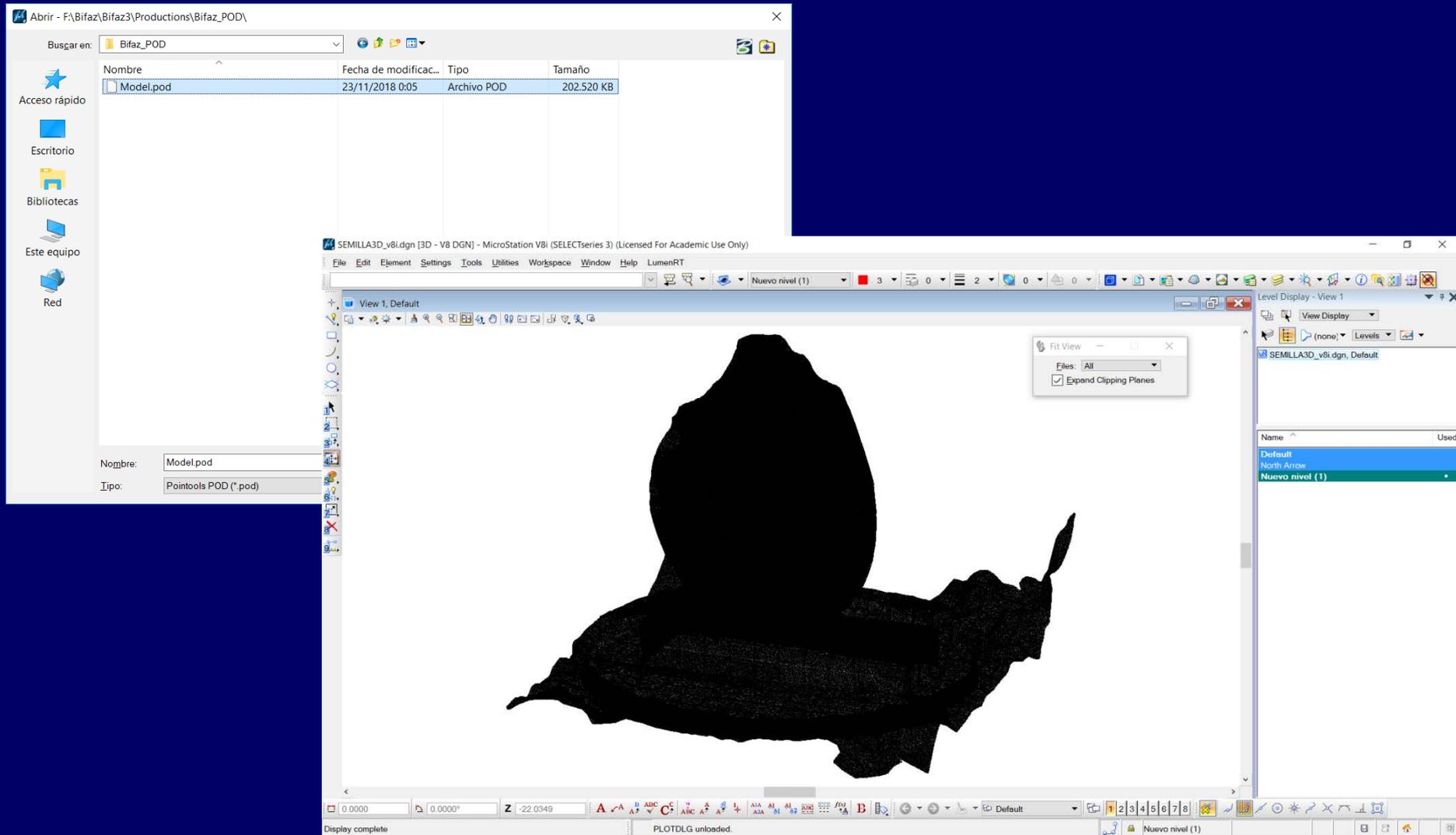
Name	Used
Default	
North Arrow	
Nuevo nivel (1)	

1 2 3 4 5 6 7 8

# Bentley CAD MicroStation

## Visualización de la nube de puntos 3D en el CAD

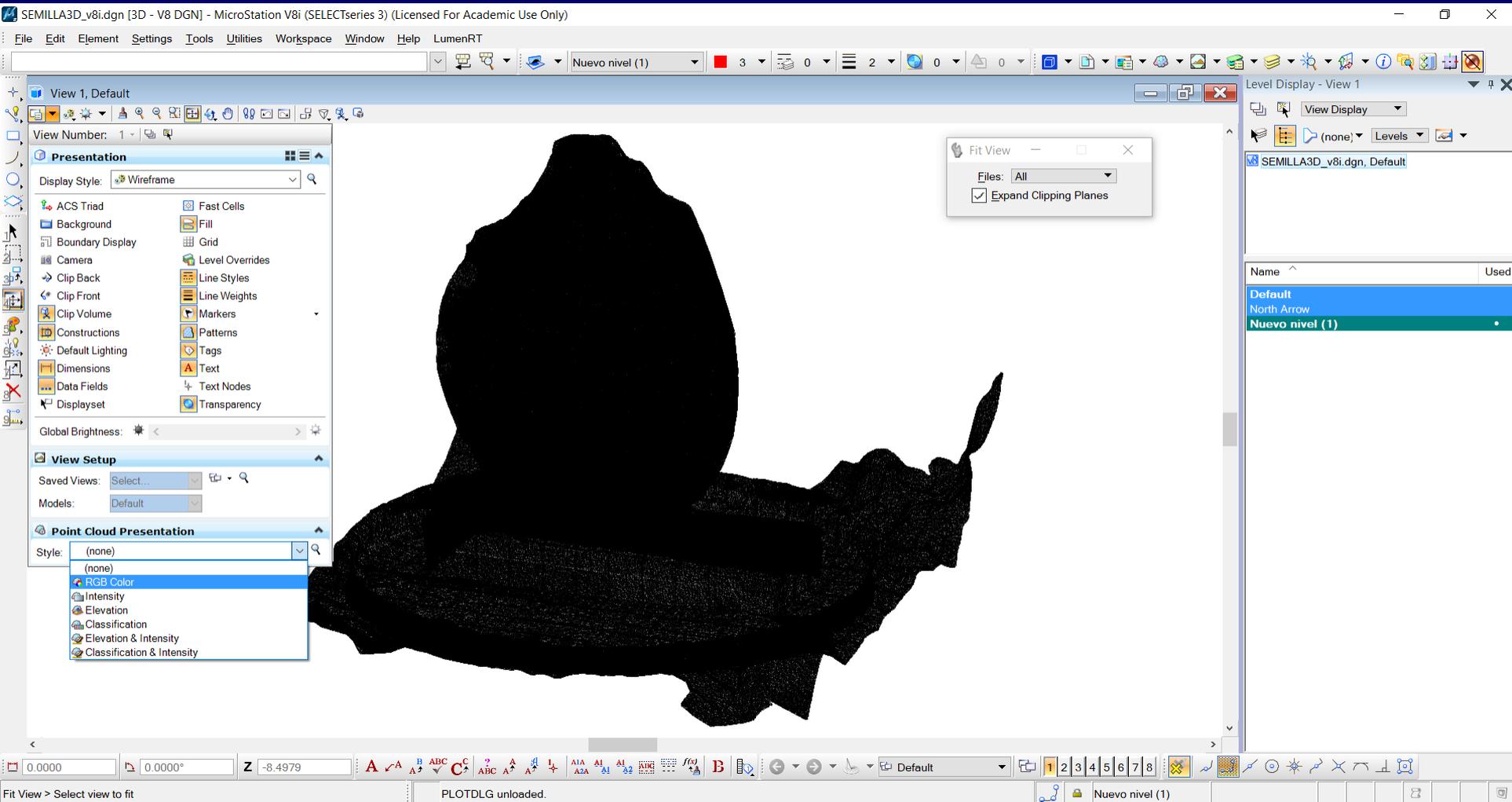
→ Vincular la nube de puntos 3D \*.pod, desde File/PointClouds/Attach



# Bentley CAD MicroStation

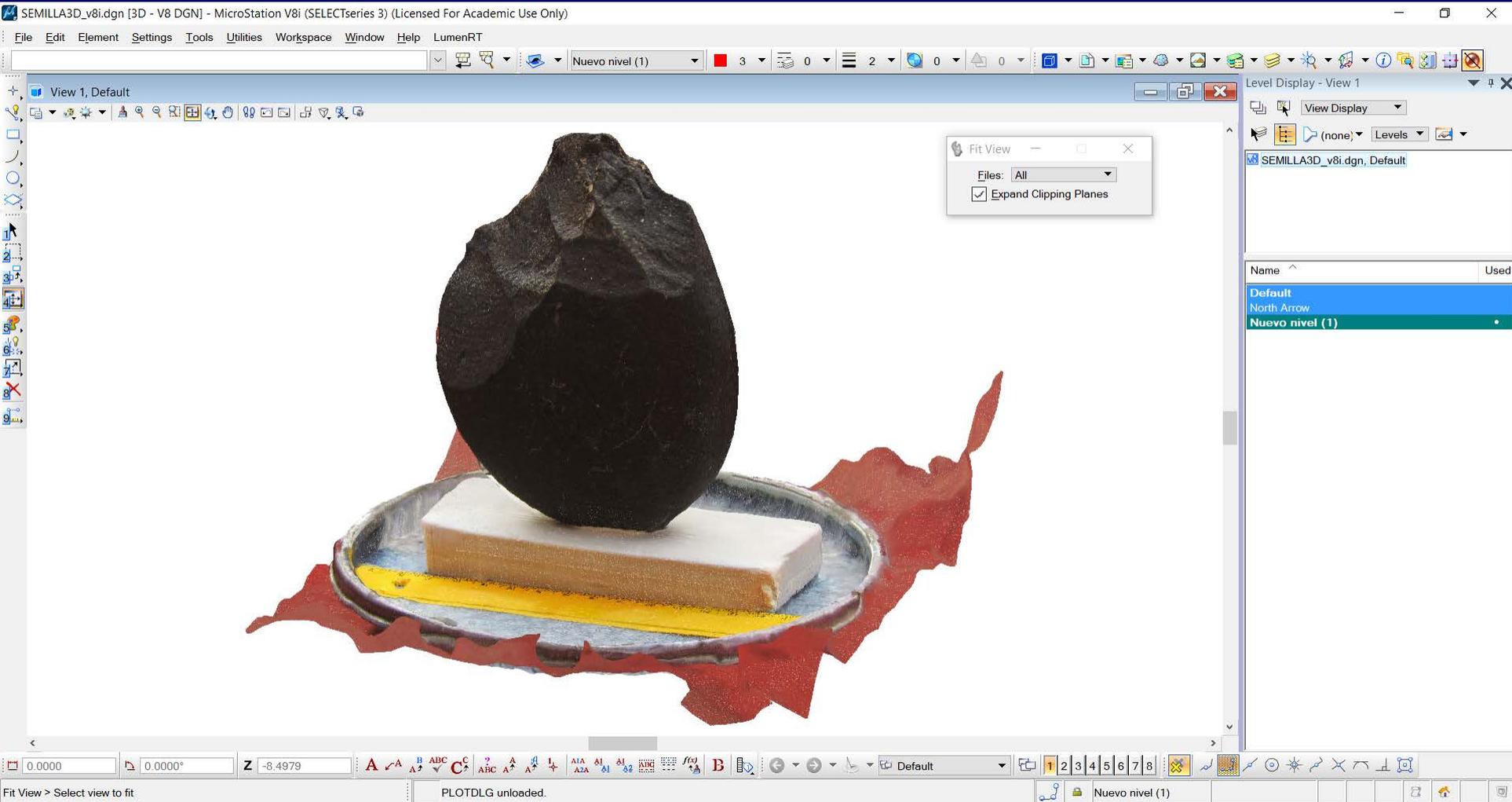
## Visualización de la nube de puntos 3D en el CAD

View Attributes/Point Cloud Presentation/ y seleccionar, por ejemplo, RGB color



# Bentley CAD MicroStation

## Visualización de la nube de puntos 3D en el CAD



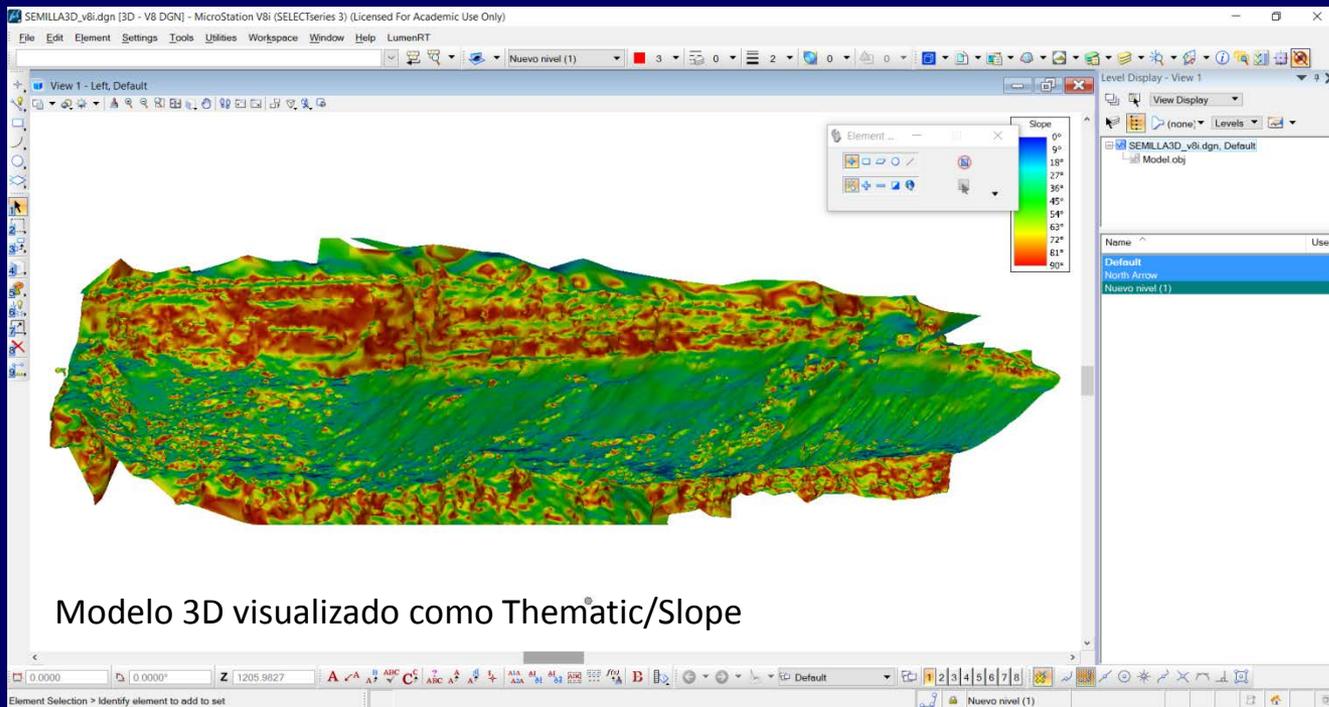


# PRÁCTICA 2. MODELADO EN TRES DIMENSIONES DE UNA CANTERA

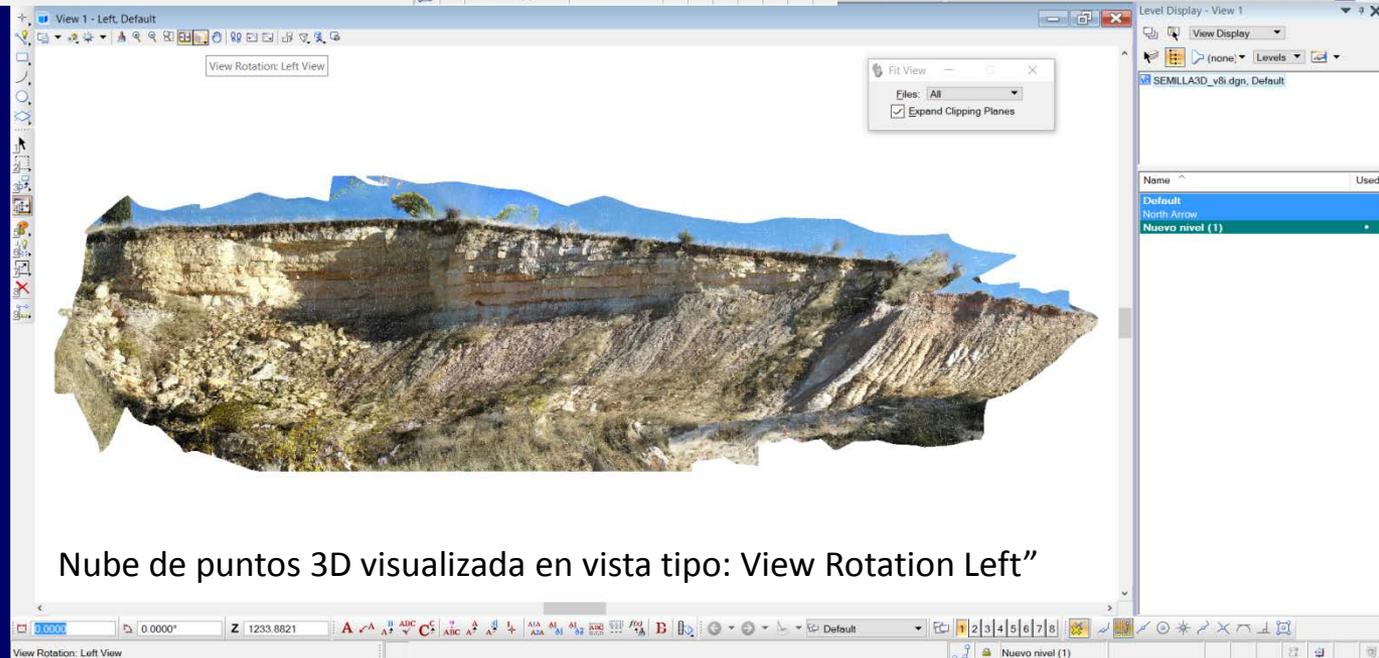
(Fotografías tomadas con GPS Garmin Monterra)

## Foto-reconstrucción 3D a partir de fotografías

- 1.- Captura de las fotografías
- 2.- Alineación de las fotografías
3. Generación de productos cartográficos (malla 3D, nubes de puntos, modelos digitales de superficie y ortofotos en diferentes formatos).
- 4.- Visualización de la malla 3D, del modelo digital de superficies y de la nube de puntos en CAD.
5. Visualización del modelo 3D en formato \*kml en Google Earth
- 6.- Obtención \*pdf 2D/3D.



Modelo 3D visualizado como Thematic/Slope

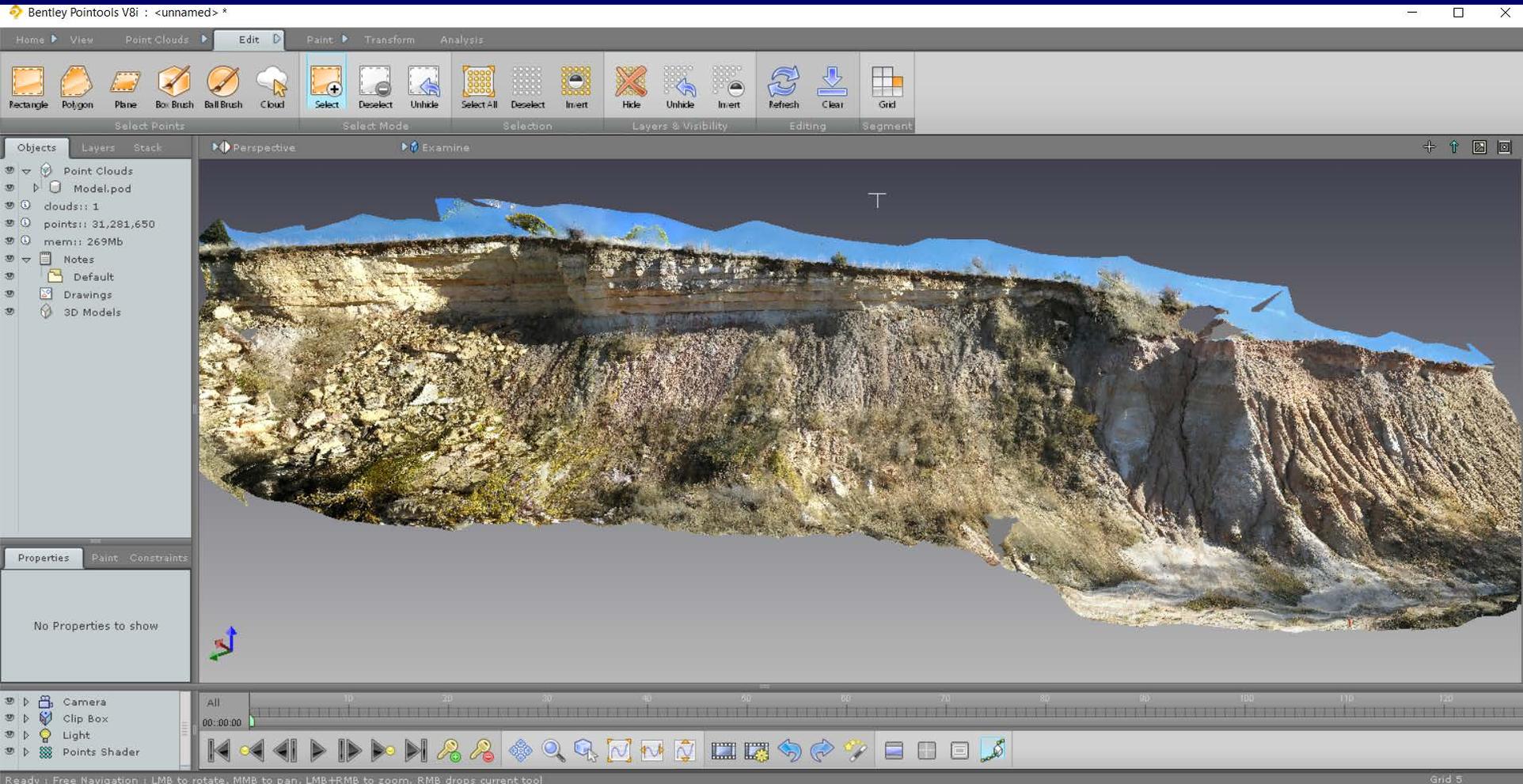


Nube de puntos 3D visualizada en vista tipo: View Rotation Left”

# Software específico para editar nubes de puntos



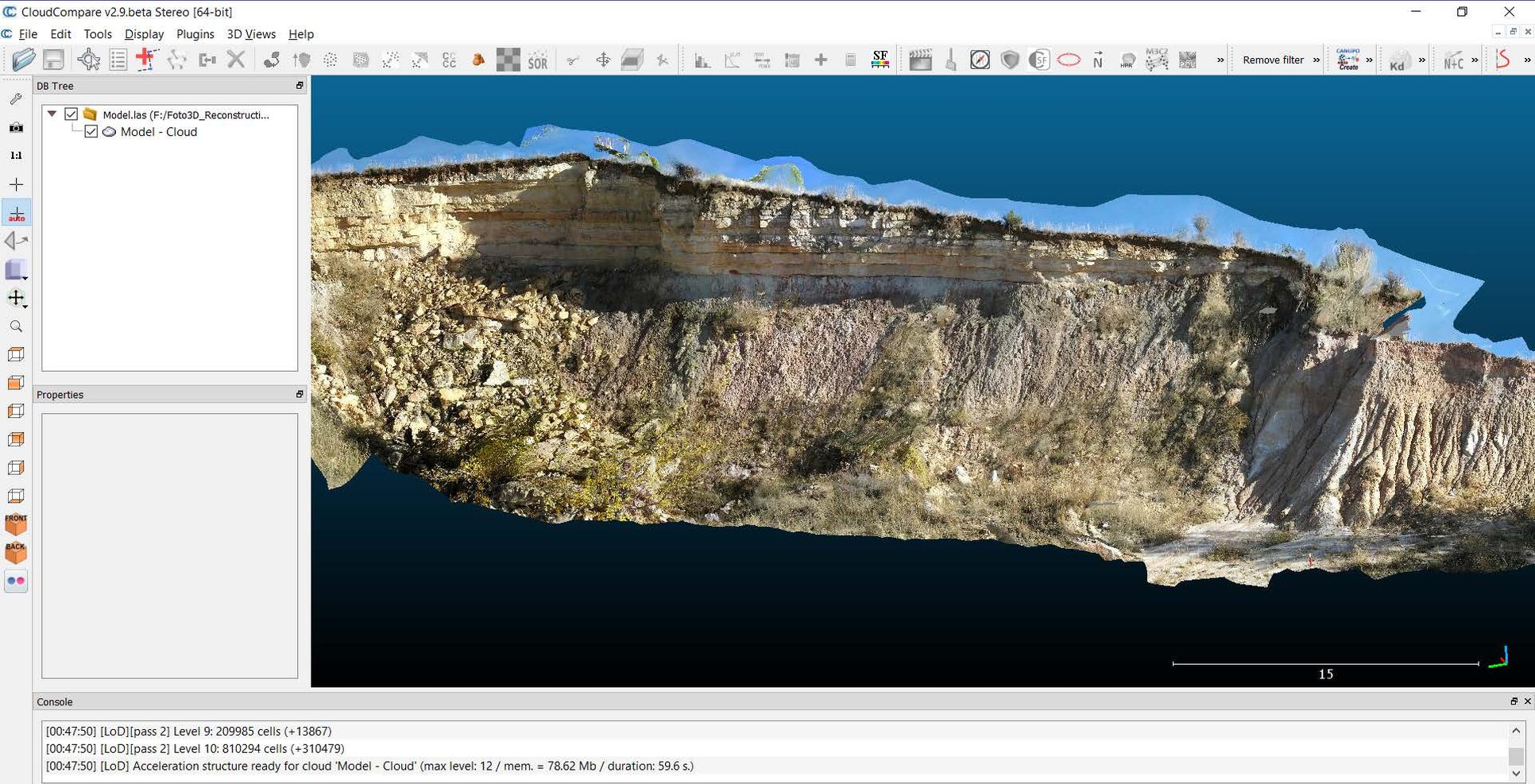
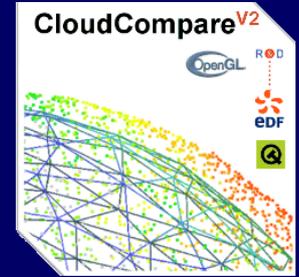
## Bentley Pointools



# Software específico para editar nubes de puntos



## CloudCompare





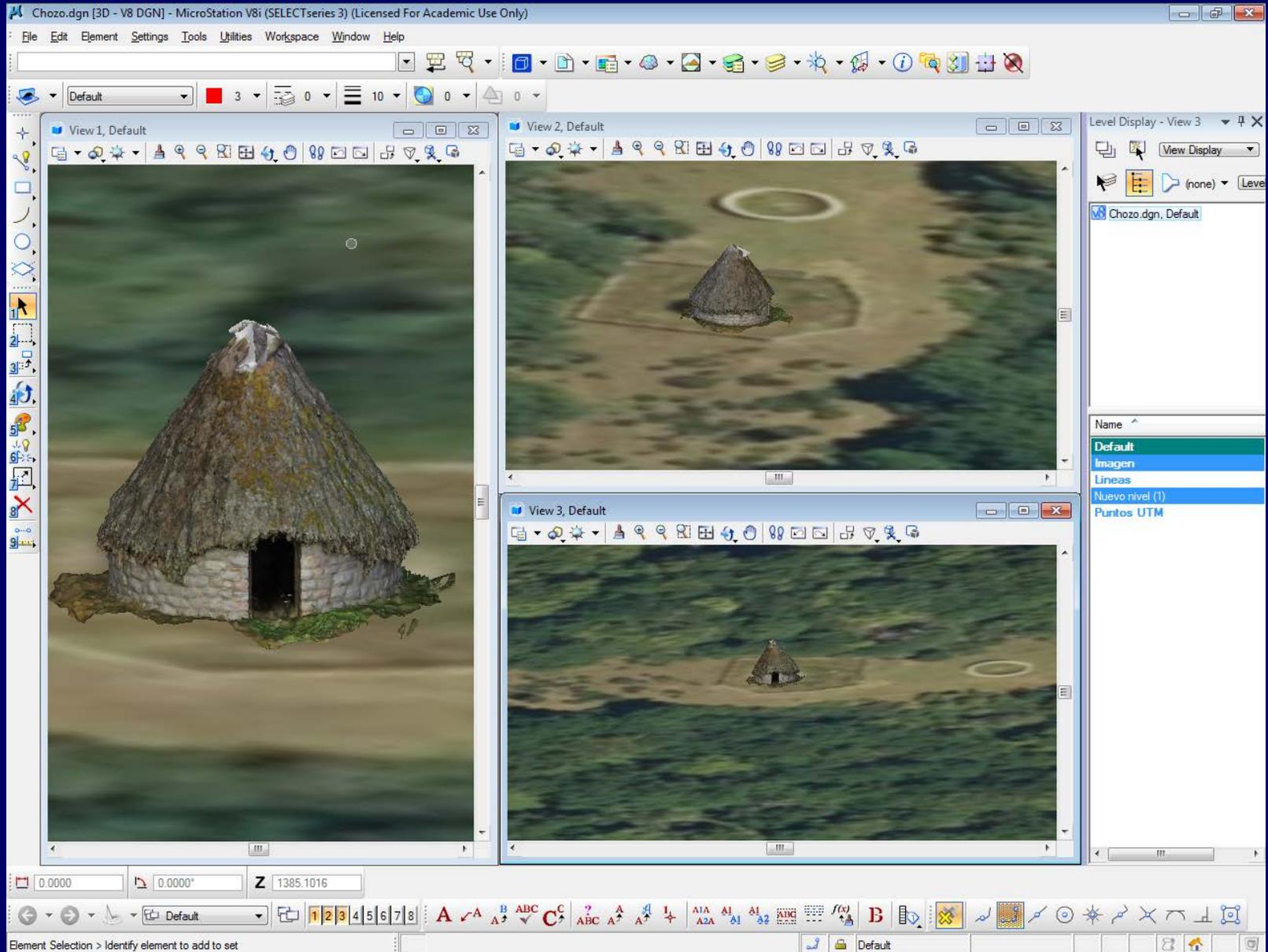
# PRÁCTICA 3. MODELADO EN TRES DIMENSIONES DE UN CHOZO DE PASTOR

## Foto-reconstrucción 3D a partir de fotografías

- 1.- Captura de las fotografías
- 2.- Alineación de las fotografías
3. Georreferenciar el modelo, desde "Surveys", Add Control Points.
4. Generación de productos cartográficos (malla 3D, nubes de puntos)
- 5.- Visualización del modelo y de la nube de puntos en CAD
6. Colocar el modelo sobre una ortofoto en la plataforma CAD.
- 7.- Obtención del modelo en \*pdf 3D.
8. Interactuar con Google Earth



# Colocación del modelo sobre una ortofoto georreferenciada en la plataforma CAD MicroStation, y visualización en diferentes vistas





# PRÁCTICA 4. MODELADO EN TRES DIMENSIONES DE UNA CÁRCAVA

## Foto-reconstrucción 3D a partir de fotografías

1. Captura y propiedades de las fotografías
2. Añadir puntos de control
- 3.- Aerotriangulación (alineación de las fotografías)
4. Generación de productos cartográficos (malla 3D, nubes de puntos, modelos digitales de superficie y ortofotos).
- 5.- Visualización de la malla 3D, del modelo digital de superficies y de la nube de puntos en CAD (y en GIS).
- 6.- Obtención \*pdf 3d.

# Captura y propiedades de las fotografías

Propiedades: IMG\_4039.JPG

General Detalles

Propiedad	Valor
Representación del color	sRGB
Bits comprimidos/píxel	3
<b>Cámara</b>	
Fabricante de cámara	Canon
Modelo de cámara	Canon PowerShot G9 X
Punto F	f/5
Tiempo de exposición	1/1250 s
Velocidad ISO	ISO-125
Compensación de exposición	0 paso
<u>Distancia focal</u>	<u>10 mm</u>
Apertura máxima	2
Modo de medición	Diseño
Distancia al objeto	
Modo de flash	Sin flash, obligatorio
Intensidad de flash	
Longitud focal de 35 mm	
<b>Fotografía avanzada</b>	
Creador de objetivo	
Modelo de objetivo	

[Quitar propiedades e información personal](#)

Aceptar Cancelar Aplicar

21/11/2018 Canon PowerShot G9 X: Digital Photography Review

## Canon PowerShot G9 X

Announced Oct 13, 2015 • 20 megapixels | 3" screen | 28 – 84 mm (3×)

Home Specs Review Samples User reviews (7) Q&As (52) Amazon reviews (189) Buy

Price

MSRP	\$529
------	-------

Body type

Body type	Compact
-----------	---------

Sensor

Max resolution	5472 x 3648
Other resolutions	5472 x 3080, 4864 x 3648, 4320 x 2880, 4320 x 2432, 3840 x 2880, 2304 x 1536, 2048 x 1536, 1920 x 1080, 720 x 480, 720 x 408, 640 x 480
Image ratio w:h	4:3, 3:2, 16:9
Effective pixels	20 megapixels
Sensor photo detectors	21 megapixels
Sensor size	1" (13.2 x 8.8 mm)
Sensor type	BSI-CMOS
Processor	DIGIC 6

Image

ISO	Auto, 125-12800
White balance presets	7
Custom white balance	Yes
Image stabilization	Optical
Uncompressed format	RAW
JPEG quality levels	Super fine, fine

Optics & Focus

Focal length (equiv.)	28–84 mm
Optical zoom	3×
Maximum aperture	F2–4.9

Autofocus

- Contrast Detect (sensor)
- Multi-area
- Center
- Selective single-point
- Tracking
- Single
- Continuous
- Touch
- Face Detection
- Live View

[https://www.dpreview.com/products/canon/compacts/canon\\_g9x/specifications](https://www.dpreview.com/products/canon/compacts/canon_g9x/specifications)

# 1. Captura y propiedades de las fotografías

ContextCapture Master - Desktop edition (Academic) [Carcava2016.ccm\*]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

Submit block aerotriangulation to estimate missing photo information.

Carcava2016  
Block\_1

Block - Block\_1  
enter your description here

176 photo(s), 0 control point(s), 0 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

**Important notice on photogroups:** For optimal precision and performance, please check that your input data fulfill [these conditions](#).

Add photos... Import videos... Remove photos Set downsampling... Check image files... Import positions...

Photogroup	Status	No. of photos	Main compon	Camera	Sensor size	Focal length	35 mm eq.
Photogroup 1		176 photo(s)	0/176 photo...	Canon Powe...	13.2 mm	10.2 mm	27.8182 mm

Photo Pose Pose metadata Component

176 photo(s), 1 photogroup(s), 3.5 gigapixels

**!** The sensor size of the camera 'Canon/Canon PowerShot G9 X' is not in the database. [Send a request to Bentley technical support](#).

**!** Incomplete photos. You can estimate missing photo information by aerotriangulation. Go to the 'General' tab to proceed.

0 error(s), 0 warning(s)

**Photogroup**

Name: Photogroup 1

Directory: F:/carcava\_2016

Description:

Multi-camera rig: None

Camera: Canon PowerShot G9 X

Lens:

Number of photos: 176

Image dimensions: 5472 x 3648

Camera model type: Perspective

Camera model band: Visible

Sensor size: 13.2 mm

Focal length: 10.2 mm

35 mm eq.: 27.8182 mm

+ More...

## 2. Añadir puntos de control

Utilizar las estacas (o tubos de color rojo) para georreferenciar el modelo

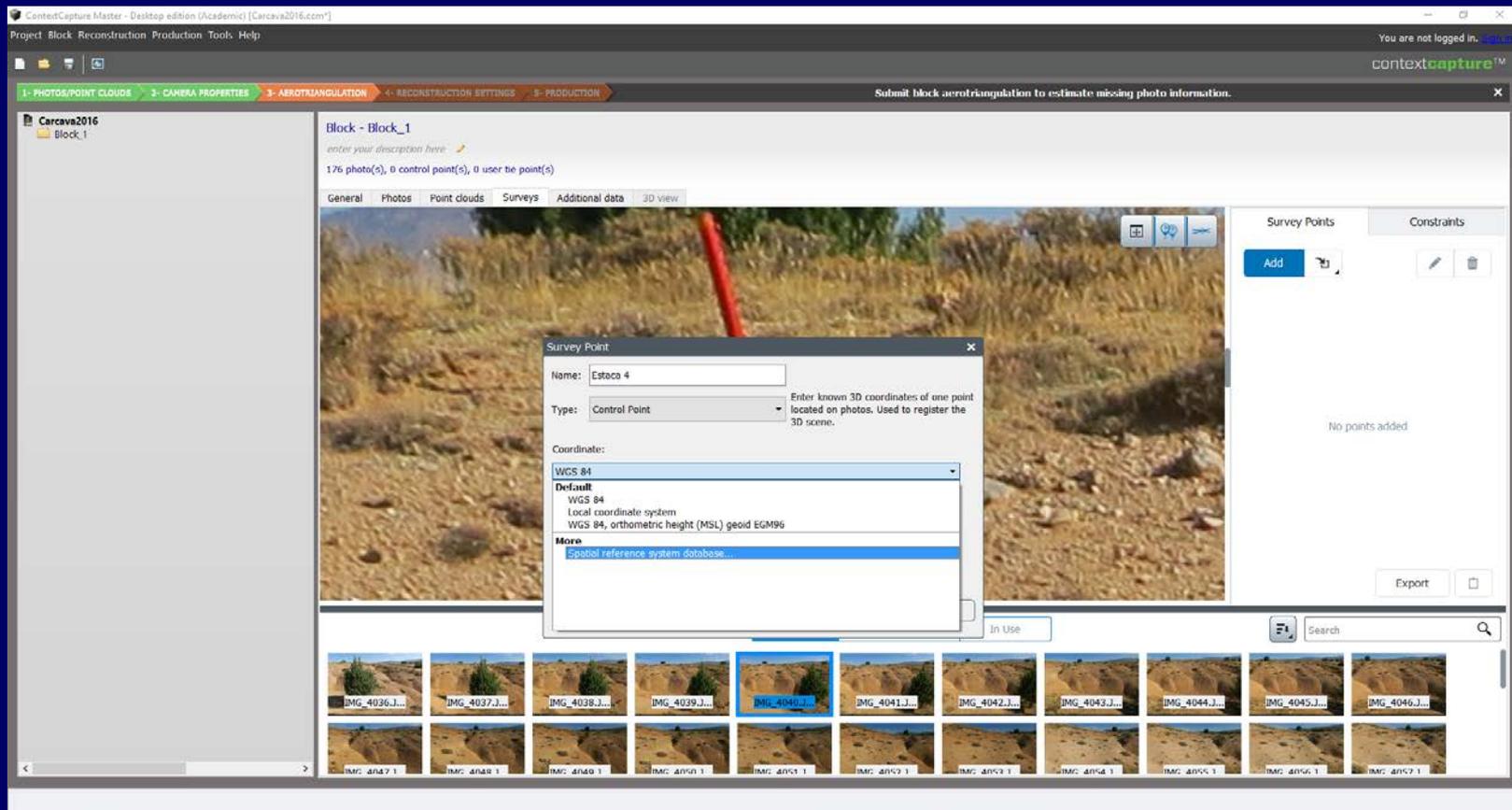
### Surveys

Añadir Survey Point y especificar

Nombre: Estaca 1

Type: Control Point

Coordinate: Definir Proyección



NOTA: Las coordenadas de la posición de los tubos se han tomado con un GPS Garmin Monterra. Para una precisión mayor sería necesario utilizar un GPS diferencial

# 2. Añadir puntos de control

Utilizar las estacas (o tubos de color rojo) para georreferenciar el modelo

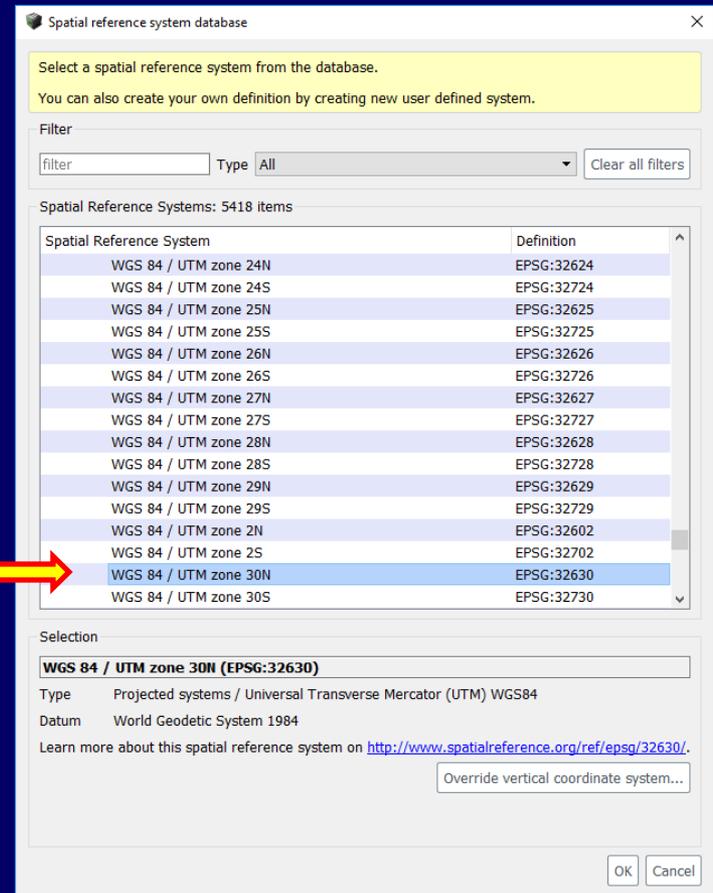
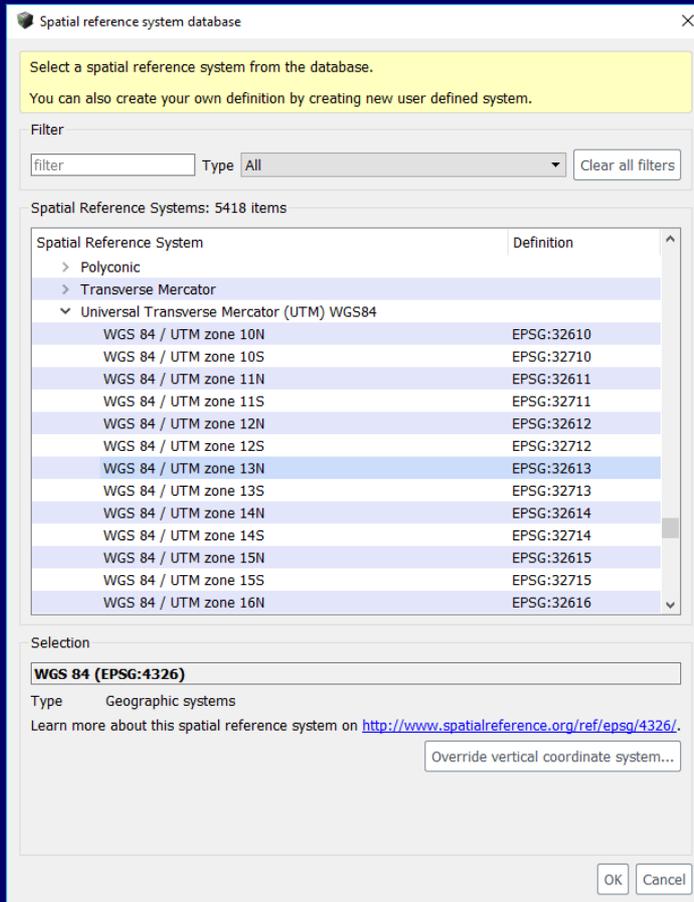
## Surveys

Añadir Survey Point y especificar

Nombre: Estaca 1

Type: Control Point

Coordinate: Definir Proyección



## 2. Añadir puntos de control

Utilizar las estacas (o tubos de color rojo) para georreferenciar el modelo

### Surveys

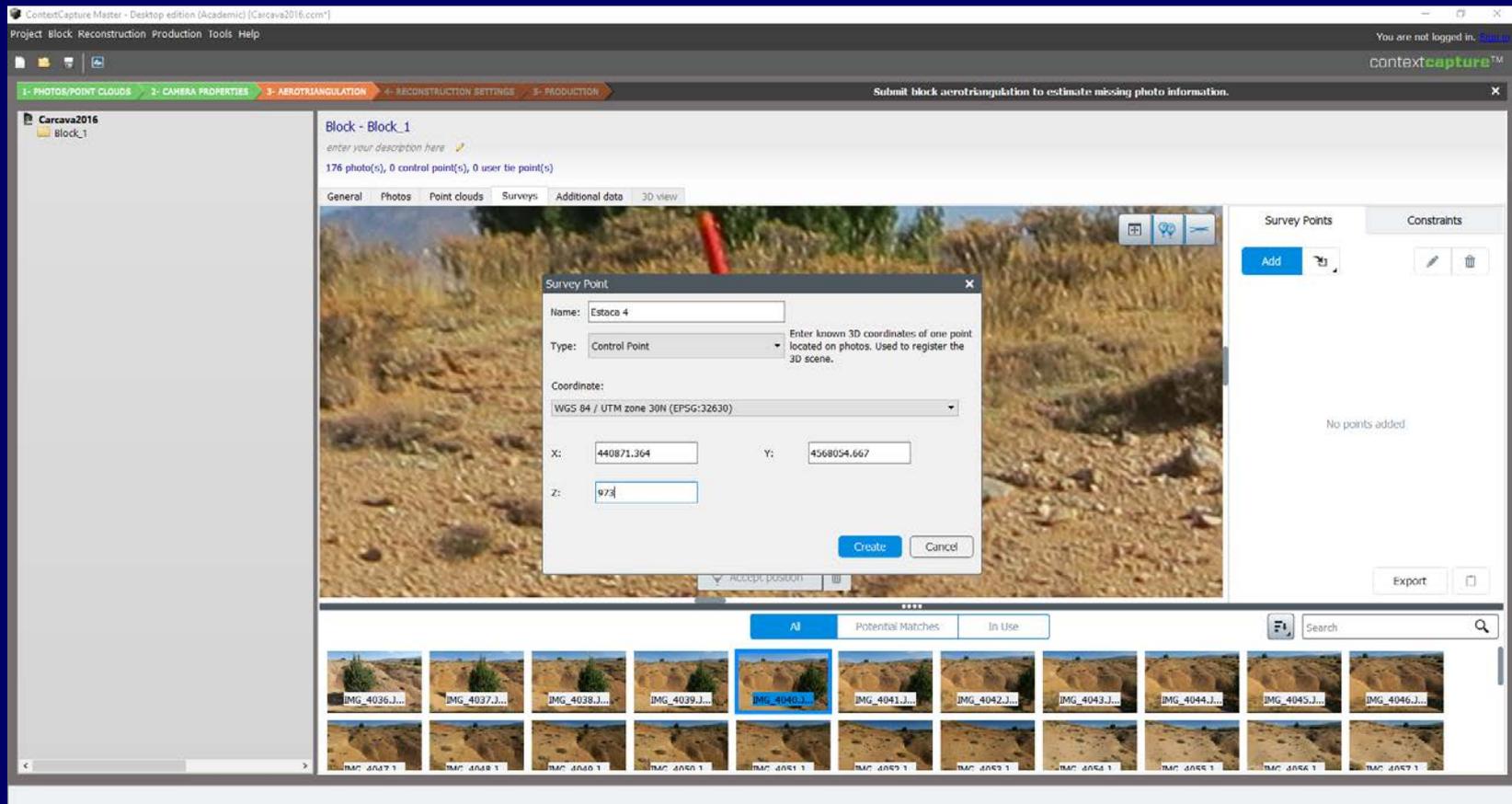
Añadir Survey Point y especificar

Nombre: Estaca 1

Type: Control Point

Coordinate: Definir Proyección

Una vez definido el Sistema de Proyección, indicar las coordenadas X, Y y Z del punto de control



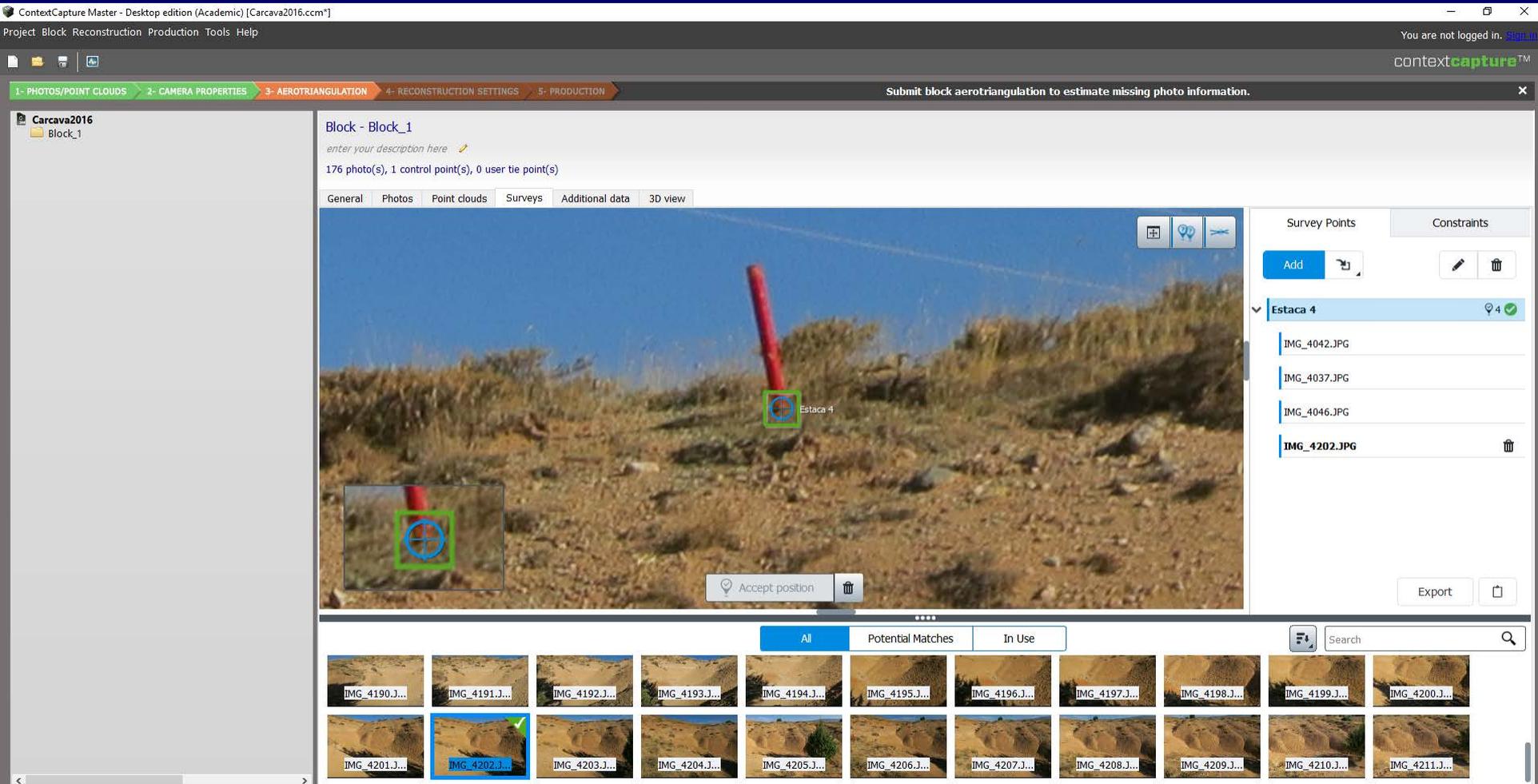
# 2. Añadir puntos de control

Utilizar las estacas (o tubos de color rojo) para georreferenciar el modelo

## Surveys

Situar el punto en la estaca, y pulsar en "Accept position". Introducir el punto en al menos tres fotografías

Less than three positions placed. To have a valid survey point, place at least three positions on different photos.

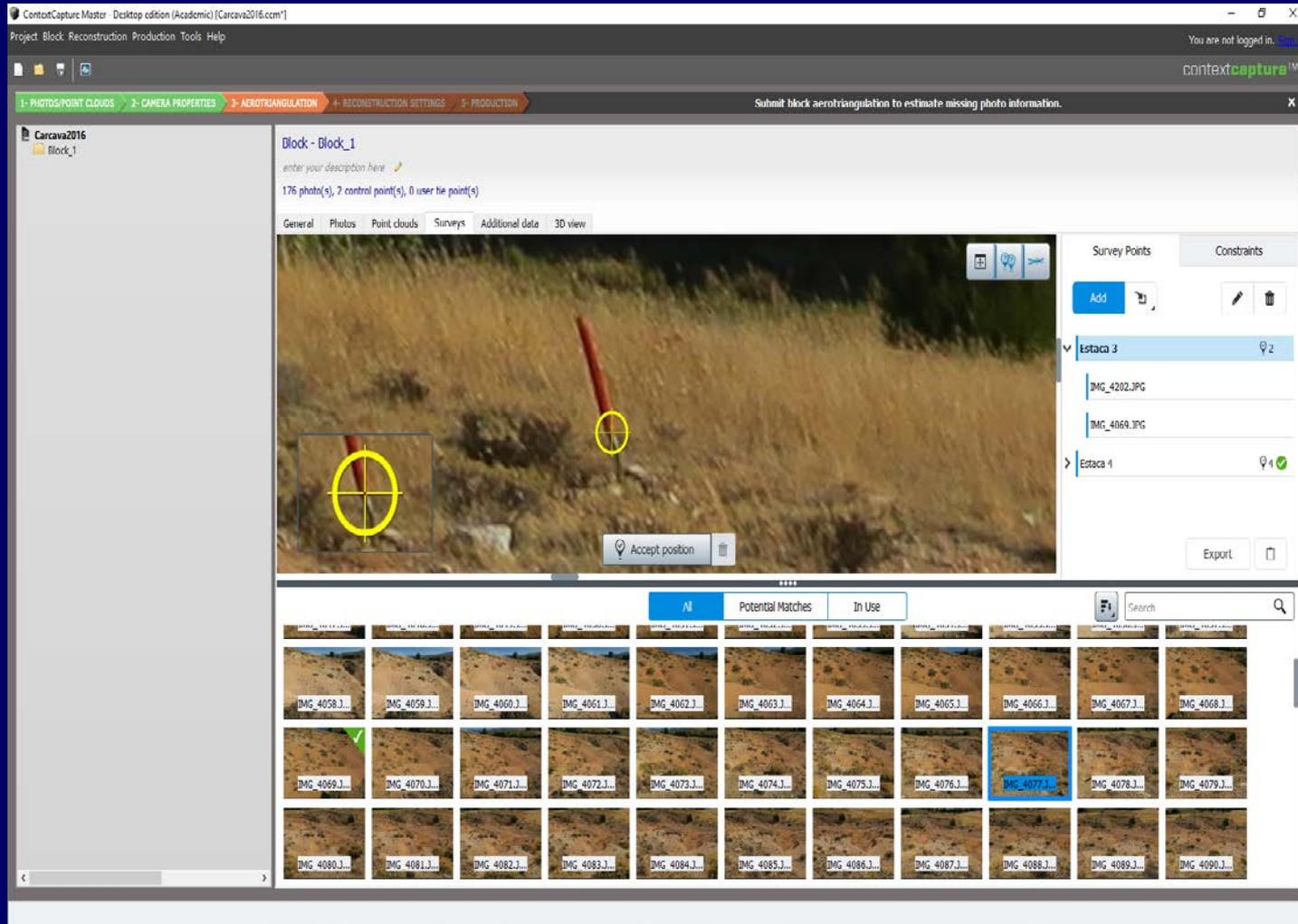


# 2. Añadir puntos de control

Utilizar las estacas (o tubos de color rojo) para georreferenciar el modelo

**Surveys** Repetir el proceso para las otras tres estacas

Less than three positions placed. To have a valid survey point, place at least three positions on different photos.



# 2. Añadir puntos de control

## 3D View

Visualización de los 4 puntos de control. Cada punto de control se ha situado en 4 fotografías

The screenshot displays the ContextCapture Master software interface. The main window shows a 3D view of a block with four control points marked with yellow circles. The axes are labeled X, Y, and Z. The interface includes a top menu bar with options like Project, Block, Reconstruction, Production, Tools, and Help. A navigation bar at the top indicates the current step is '3- AEROTRIANGULATION'. The main workspace shows 'Block - Block\_1' with 176 photos and 4 control points. The right sidebar contains a 'Photo' section with fields for Name, Directory, Date taken, Size, Mask file, and Component, and a 'Pose' section with fields for Spatial reference system, Position X, Y, Z, and Rotation. The bottom status bar shows 'Altitude: 1137m'.

ContextCapture Master - Desktop edition (Academic) [Carcava2016.ccm\*]  
Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)  
contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION

Submit block aerotriangulation to estimate missing photo information.

Carcava2016  
Block\_1

Block - Block\_1  
enter your description here  
176 photo(s), 4 control point(s), 0 user tie point(s)

General Photos Point clouds Surveys Additional data 3D view

Show photos All Camera size

Selected photos (0/176)

Photo

Name   
Directory   
Date taken   
Size   
Mask file   
Component

Pose

Spatial reference system:  
Position X   
Y   
Z   
Rotation

Altitude: 1137m

Windows taskbar: 21:04 21/11/2018

# 3. Aerotriangulación

ContextCapture Master - Desktop edition (Academic) [Carcava2016.ccm\*]

Project Block Reconstruction Production Tools Help

You are not logged in. [Sign In](#)

contextcapture™

1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULACIÓN

Carcava2016

Block\_1

Aerotriangulation definition

## Aerotriangulation definition

Aerotriangulation consists in automatically and accurately estimating the position, rotation, and camera properties (focal length, principal point, lens distortion) for each input photograph. The aerotriangulation starts from the input block and creates a new completed or adjusted block according to selected parameters.

Output block name

Components

Positioning/georeferenc...

Settings

### Positioning/georeferencing

Choose how the aerotriangulation should place and orient the block.

#### Positioning mode

- Arbitrary  
Block position and orientation are arbitrary.
- Automatic vertical  
The block vertical direction is oriented according to input photo orientation. Block scale and heading remain arbitrary.
- Use positioning constraints on user tie points  
The block is rigidly placed/oriented/scaled thanks to predefined constraints.
- Use photo positioning metadata for adjustment (0/176 photos have positioning metadata)  
The block is adjusted according to the photo positions from pose metadata (advised with **accurate** metadata).
- Use photo positioning metadata for rigid registration (0/176 photos have positioning metadata)  
The block is rigidly registered to the photo positions from pose metadata (advised with **inaccurate** metadata).
- Use control points for adjustment  
The block is accurately adjusted to control points (advised with **accurate** control points).
- Use control points for rigid registration  
The block is rigidly registered to control points without handling long-range geometric distortion (advised with **inaccurate** control points).
- Use surveys from QR codes  
The block is registered to positioning constraints or control points from QR codes and current survey data.
- Use point clouds for rigid registration  
The block is rigidly registered to the point clouds.
- Use point clouds for adjustment  
The block is adjusted to the point clouds.

< Back

Next >

Submit

Cancel

Submit aerotriangulation...

Process a new block with completed or adjusted parameters.

Block ID: Block\_1  
Created: 21/11/2018 20:18  
Last modified: 21/11/2018 21:04

New reconstruction

Create a new reconstruction framework.

Delete reconstruction

Remove reconstruction from block.



21:05  
21/11/2018

# 3. Aerotriangulación

# Resultado de la aerotriangulación

ContextCapture Master - Desktop edition (Academic) [carcava2-2016.ccm\*]  
Project Block Reconstruction Production Tools Help

You are not logged in. [Sign in](#)

contextcapture™

Warning: your license works in offline mode. If the license server cannot be contacted, your license will expire in 6 day(s).

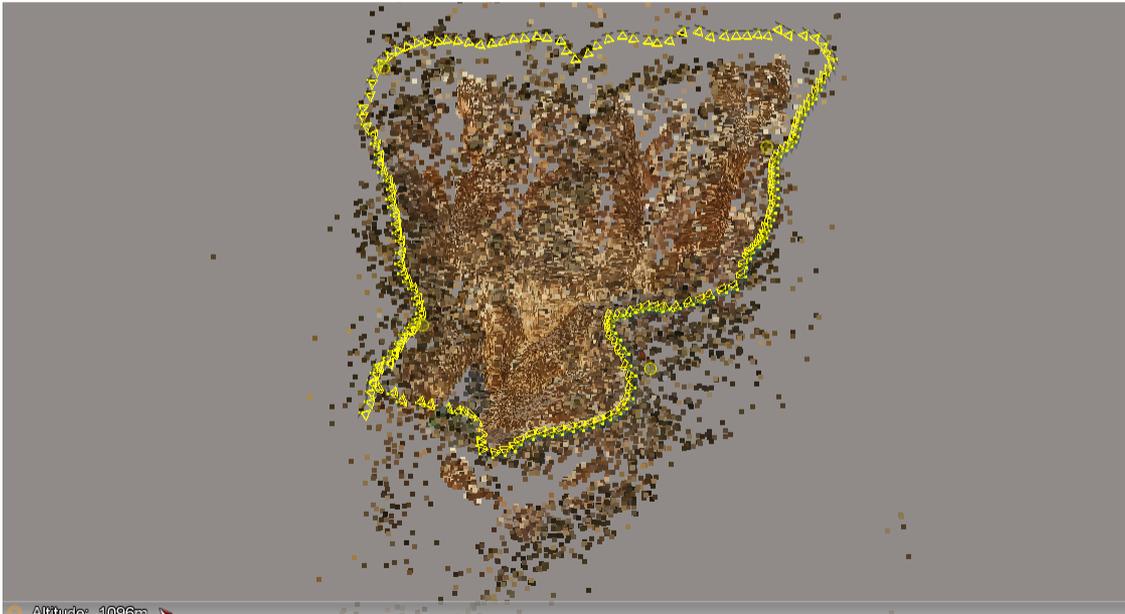
1- PHOTOS/POINT CLOUDS 2- CAMERA PROPERTIES 3- AEROTRIANGULATION 4- RECONSTRUCTION SETTINGS 5- PRODUCTION You can create a new reconstruction.

carcava2-2016  
Block\_1  
Block\_1 - AT

Block - Block\_1 - AT  
Result of aerotriangulation of Block\_1 (2018-Nov-21 23:22:16)  
176 photo(s), 4 control point(s), 0 user tie point(s), georeferenced

General Photos Point clouds Surveys Additional data 3D view

Show photos In main component Camera size



Selected photos (0/176)

**Photo**

Name   
Directory   
Date taken   
Size   
Mask file   
Component

**Pose**

Spatial reference system: **WGS 84**  
Position Longitude   
Latitude

Altitude: 1096m

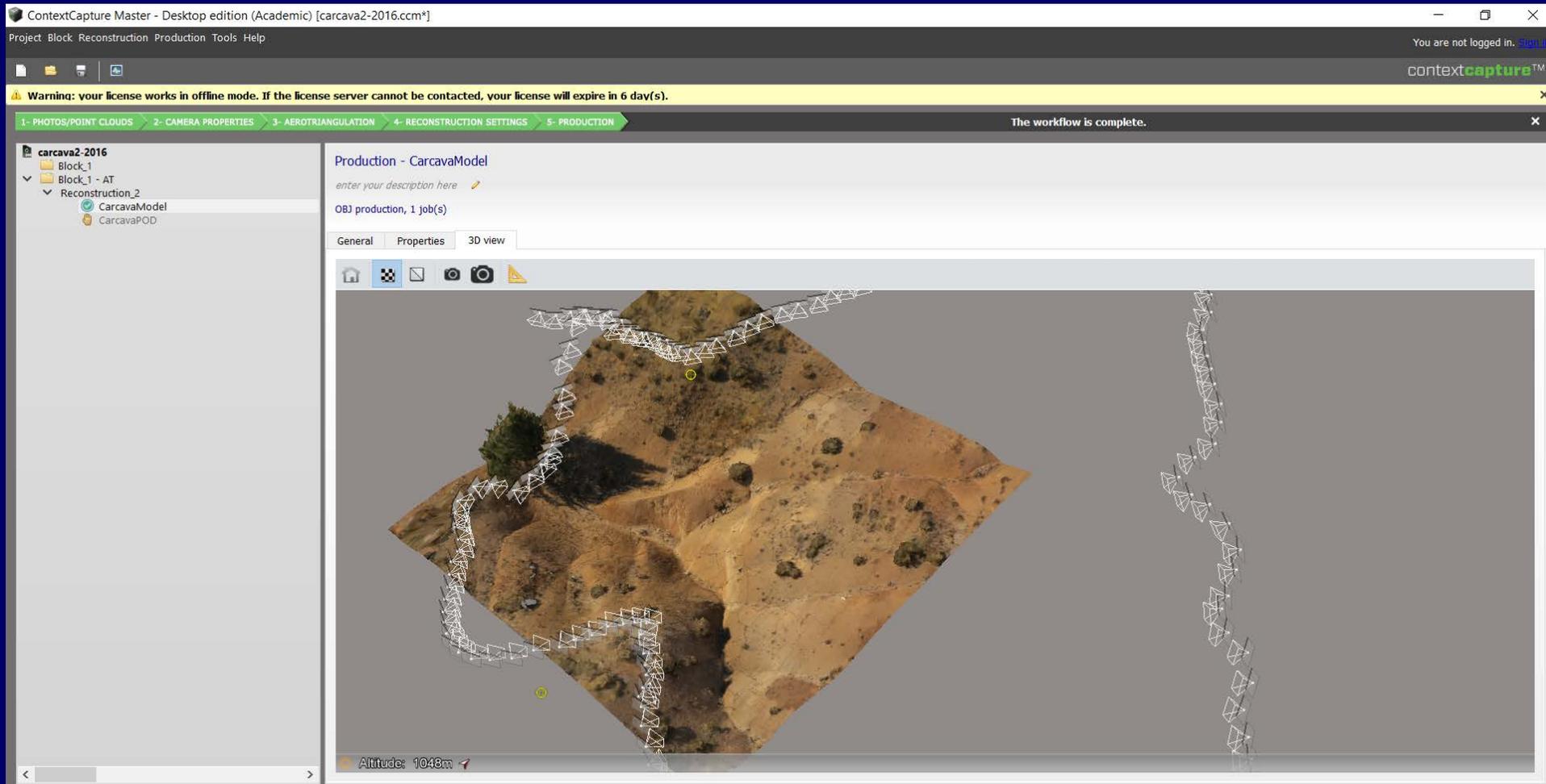
# 4. Ajustes de la reconstrucción

## Definir el área de interés

The screenshot displays the ContextCapture Master software interface. The main window is titled "Reconstruction - Reconstruction\_2". The interface is divided into several sections:

- Project Browser:** Located on the left, it shows a tree view with "carcava2-2016" as the root, containing sub-items "Block\_1", "Block\_1 - AT", and "Reconstruction\_2".
- Navigation and Status:** At the top, there are navigation buttons for "1- PHOTOS/POINT CLOUDS", "2- CAMERA PROPERTIES", "3- AEROTRIANGULATION", "4- RECONSTRUCTION SETTINGS", and "5- PRODUCTION". A warning banner states: "Warning: your license works in offline mode. If the license server cannot be contacted, your license will expire in 6 day(s)."
- Reconstruction Settings Panel:** This panel is divided into tabs: "General", "Spatial framework", "Reconstruction constraints", "Reference 3D model", and "Processing settings".
  - Spatial Reference System (SRS):** The "Spatial reference system" is set to "WGS 84 / UTM zone 30N (EPSG:32630)".
  - Region of interest:** This section contains a "Bounding box" with input fields for X, Y, and Z coordinates in meters. The X values are min: 440853.957301, max: 440881.371184. The Y values are min: 4568056.257210, max: 4568081.728877. The Z values are min: 964.900000, max: 981.694083. Dimensions are listed as 27.4139 meters x 25.4717 meters x 16.7941 meters. There are buttons for "Import from file..." and "Reset bounds...".
  - Tiling:** The "Mode" is set to "No tiling" with the description "Do not subdivide reconstruction." An overview section states: "The tiling contains 1 tile(s)" and "Expected maximum RAM usage for a job: 19 GB".
- 3D Viewport:** On the right, a 3D view shows a point cloud of a terrain with a green wireframe bounding box overlaid on it. The axes X, Y, and Z are visible. The altitude is shown as 1069m.

# 5. Producción cartográfica: Modelo 3D (3D Mesh) en formato \*obj



# 5. Producción cartográfica: Orthophoto y DSM

Production definition

Production definition

Define parameters of the new production.

Name

Purpose

**Format/Options**

Spatial reference sy...

Extent

Destination

**Format/Options**

Choose output format and options for the production.

Sampling distance (meters):

Maximum image part dimension (px):

Projection mode:

---

**Orthophoto**

Color source:

Format:

No data:

---

**DSM**

Format:

No data:

**i** Reference 3D model textured geometry (visible colors) is needed for this production. Please ensure the availability of data before submitting.

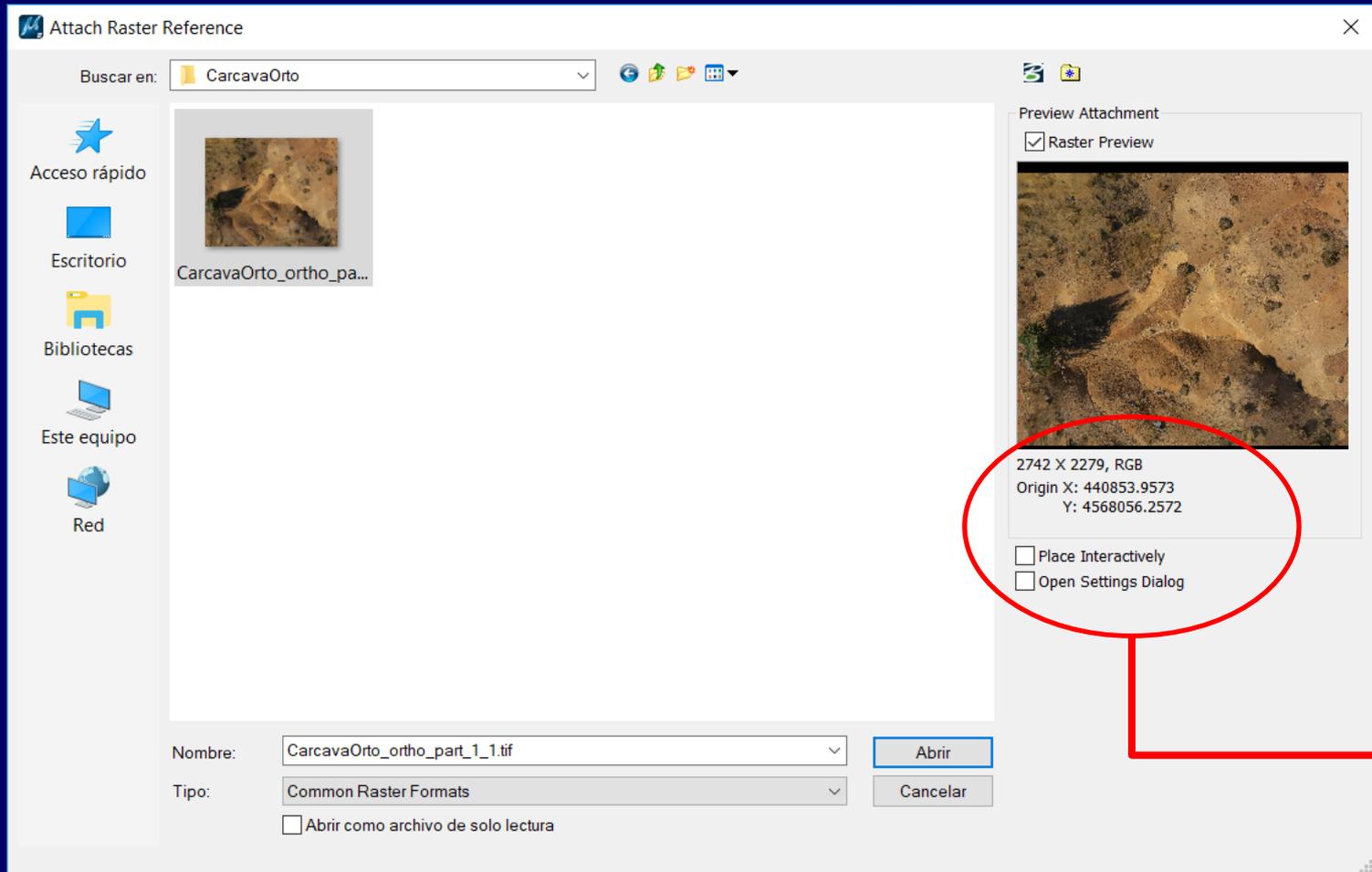
< Back **Next** Submit Cancel



# Bentley CAD MicroStation

## Visualización de la ortofoto en el CAD

→ Vincular la ortofoto, desde File/Raster Manager/Attach

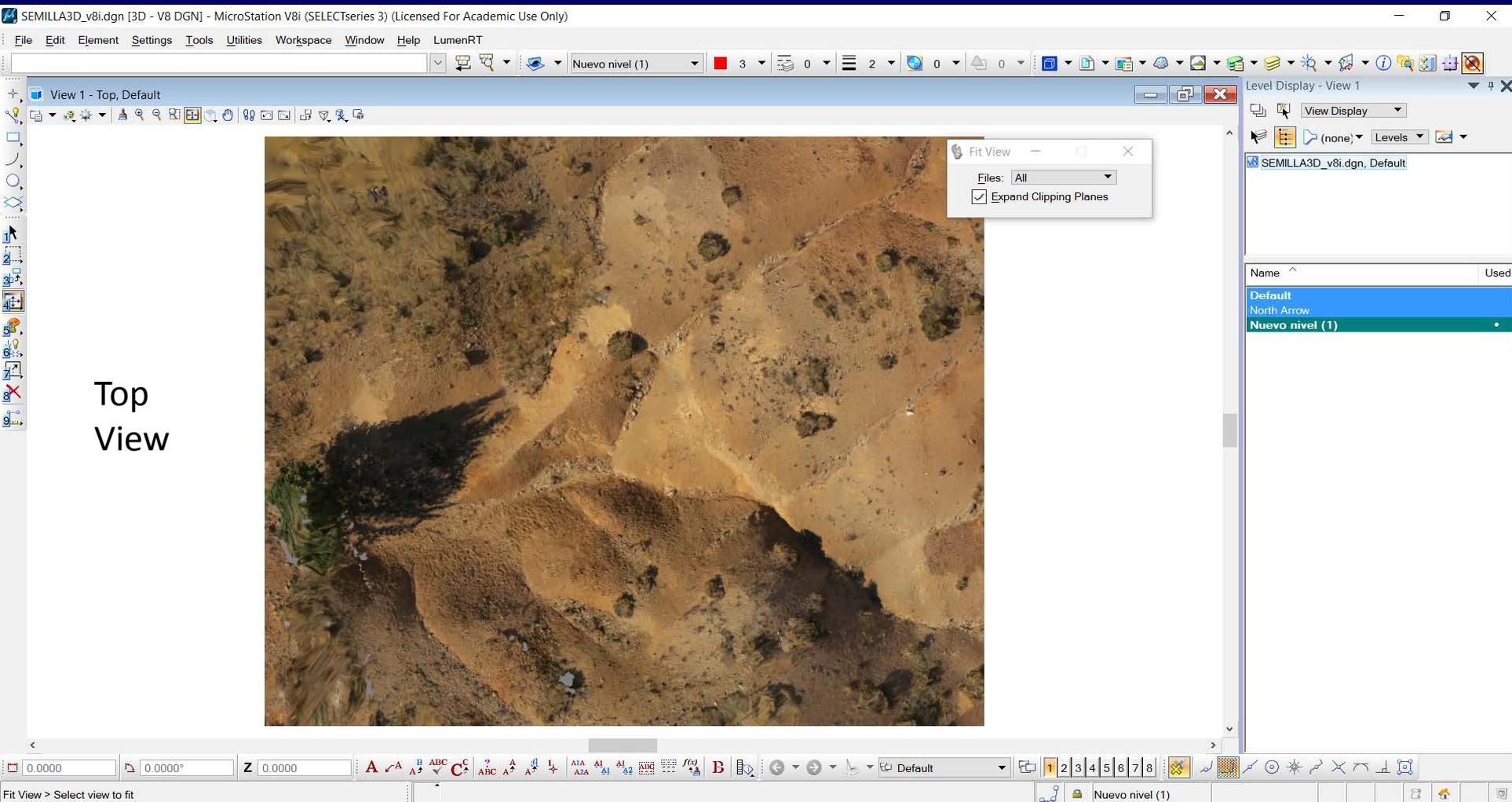


El programa reconoce que la ortofoto está georreferenciada. En ese caso no es necesario colocarla de manera interactiva (desactivar la opción "Place Interactively")

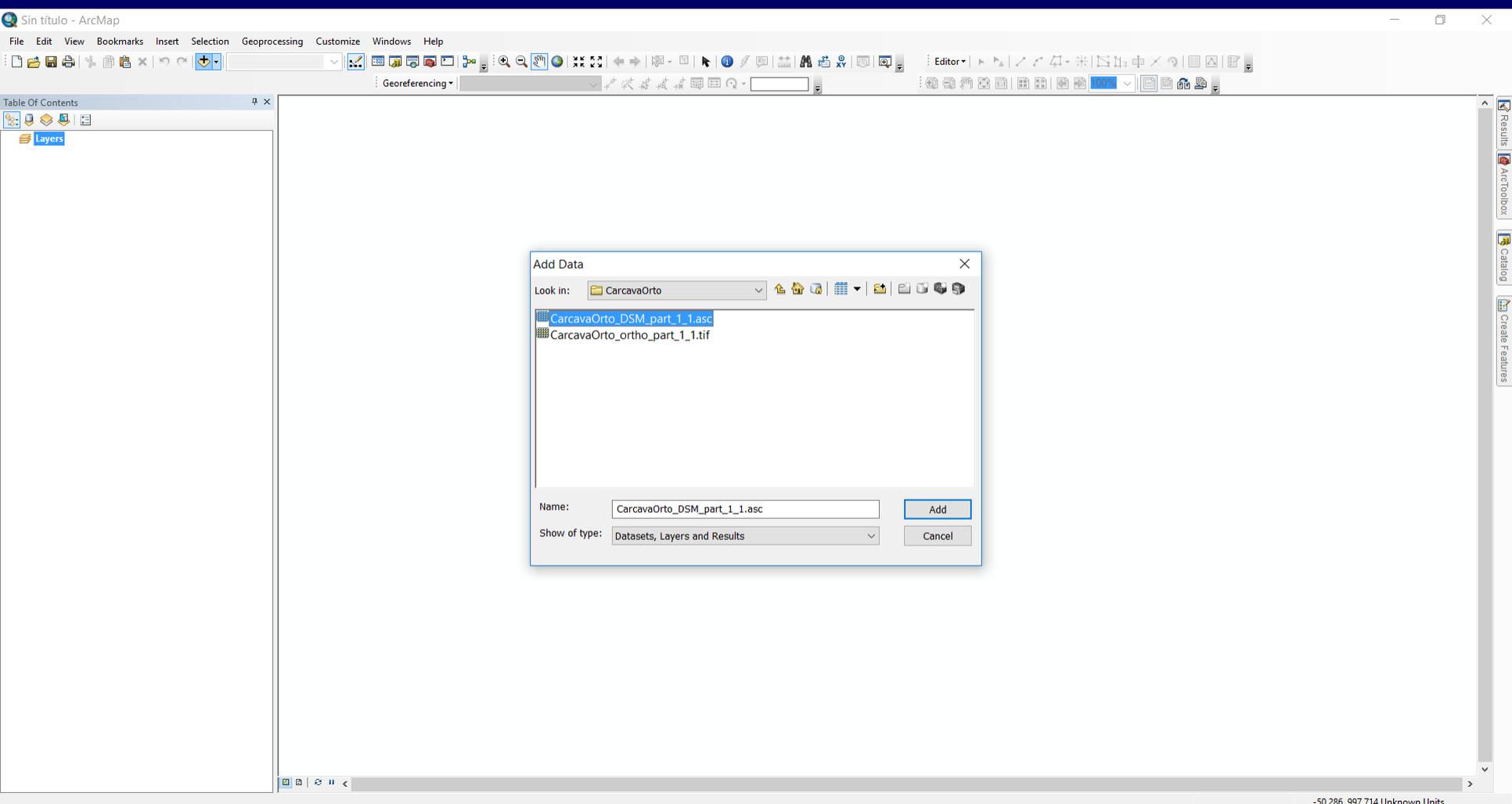
# Bentley CAD MicroStation

## Visualización de la ortofoto en el CAD

→ Vincular la ortofoto, desde File/Raster Manager/Attach



## Visualización de la ortofoto en un GIS

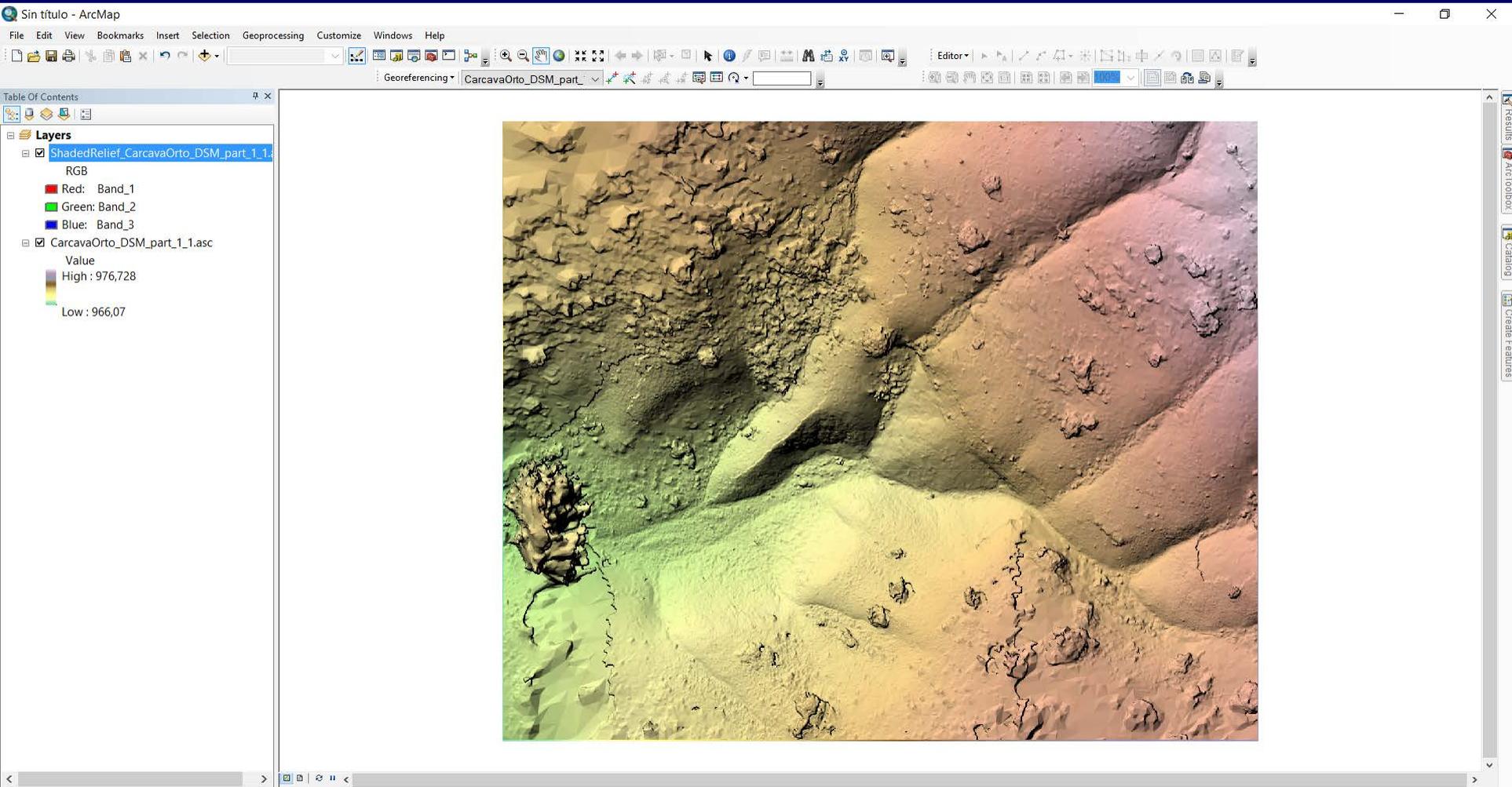


## Visualización de la ortofoto en un GIS

The screenshot displays the Esri ArcMap interface. The main window shows a visualization of a Digital Surface Model (DSM) derived from an orthophoto. The terrain is color-coded by elevation, with a color scale ranging from green (low elevation) to yellow and brown (high elevation). A prominent feature is a large, irregularly shaped area of high elevation (yellow/brown) in the center-right, which appears to be a hill or a large structure. To the left, there is a smaller, circular feature with a distinct peak, possibly a small hill or a building. The background is a blurred orthophoto of the same area.

The interface includes a menu bar at the top with options: File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, and Help. Below the menu bar is a toolbar with various GIS tools. The Table Of Contents (TOC) on the left shows a single layer named "CarcavaOrto\_DSM\_part\_1\_1.asc" with a value range from 966,07 (Low) to 976,728 (High). The status bar at the bottom right indicates the coordinates "440853,07 4568062,681" and "Unknown Units".

## Visualización de la ortofoto en un GIS



## Visualización de la ortofoto en un GIS

The screenshot displays the Esri ArcMap interface. The main window shows a 3D visualization of a terrain, likely a Digital Surface Model (DSM), with a color gradient from brown to red. The interface includes a menu bar (File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, Help), a toolbar, and a Table of Contents on the left. The Table of Contents lists the following layers:

- ShadedRelief\_CarcavaOrto\_DSM\_part\_1\_1.asc
  - RGB
    - Red: Band\_1
    - Green: Band\_2
    - Blue: Band\_3
- CarcavaOrto\_DSM\_part\_1\_1.asc
  - Value
    - High: 976,728
    - Low: 966,07

An 'Add Data' dialog box is open in the foreground, showing the current directory 'CarcavaOrto'. The dialog lists two files:

- CarcavaOrto\_DSM\_part\_1\_1.asc
- CarcavaOrto\_ortho\_part\_1\_1.tif

The 'Name' field at the bottom of the dialog is set to 'CarcavaOrto\_ortho\_part\_1\_1.tif'. The 'Show of type' dropdown is set to 'Datasets, Layers and Results'. The 'Add' button is highlighted in blue.

## Visualización de la ortofoto en un GIS

