



# Drone2Map: an Introduction

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576 / 1191 Tue 7/11/2017

576 / 1815 Wed 7/12/2017

576 / 1667 Fri 7/14/2017

Ballroom 06 C

Sapphire Ballroom I/J

Room 03

01:30 PM - 02:45 PM

08:30 AM - 09:45 AM

09:00 AM - 10:15 AM

As a courtesy to your colleagues...

- Please silence cell phones
- Please no flash photography
- Please take phone calls outside



# Presenters

About us....



- Senior Developer
- Esri Professional Services (18 Years)
- Focus Areas:
  - Drone Content Processing Workflows
  - Desktop Software Development
  - Imagery & Image Processing
  - LIDAR processing



- Senior Consultant Imagery Services
- Esri Professional Services (8 Years)
- Focus Areas:
  - Photogrammetric Workflows
  - Imagery Processing & Analysis
  - LIDAR Collection, Processing
  - Geodesy





# Drone2Map: An Introduction

- Topics:

- Introduction to Drone Mapping
- Coordinate Systems
- Overview of Drone2Map
- Basic Drone2Map Workflow
- 2D Data Processing
- 3D Data Processing
- Inspection Workflow
- Summary & Close

- Demonstrations:

- Rapid Processing
- 2D Processing
- 3D Processing
- Data Publishing
- Batch Processing
- Inspection Processing



# Who should be attending?

## Goals and Outcomes

- Target Audience
  - Those new to drones & drone mapping
  - Curiosity in applying drone technology to an application
  - Little or no prior experience in collecting & processing aerial imagery
  - Introductory knowledge of ArcGIS software stack
- Goals:
  - Introduce product & placement
  - Provide high level overview of software use
  - Generate ideas for applications
  - Identify additional training opportunities & resources



# Complete Drone Startup Kit

- Airframe
  - Platform (Fixed Wing, Copters)
- Sensors
  - Imaging Sensor (Digital, Multispectral)
    - Lens Types (Perspective, Fisheye, Wide Angle)
    - Resolution (Sensor Resolution, GSD)
  - Positioning Sensor (GPS, IMU)
- Software
  - Vendor, Platform Specific
    - Flight planning, device management, data collection, data exchange
  - ArcGIS technology stack:
    - Drone2Map, ArcGIS Desktop, ArcGIS Enterprise



# Drone Imagery Processing

Drone2Map

- Turn Drones into Enterprise Productivity Tools
- Run on Desktop or Amazon Cloud



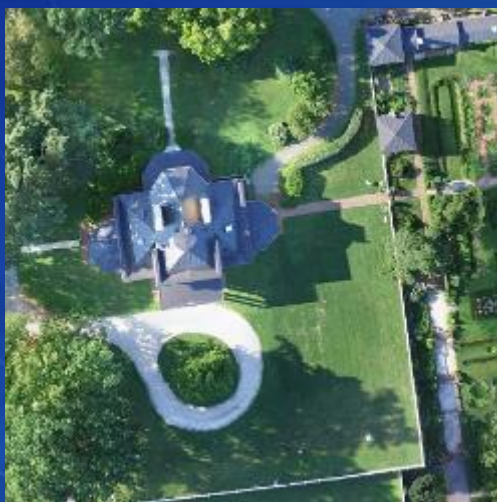
<http://www.esri.com/products/drone2map>



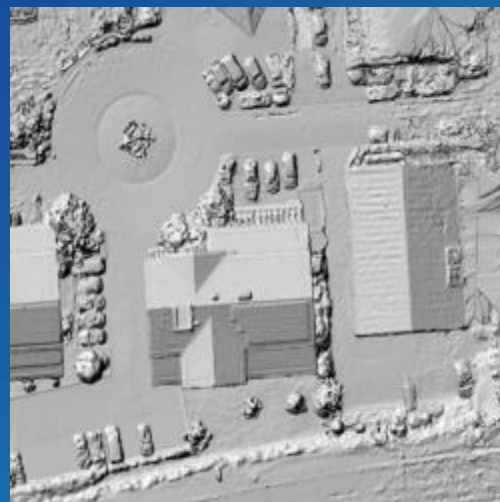
# Drone2Map for ArcGIS

Create 2D and 3D products from raw drone imagery

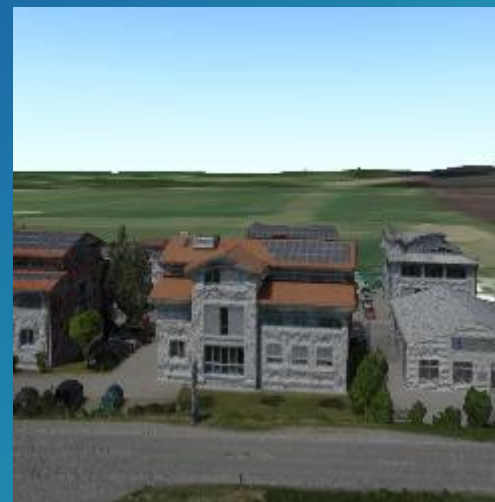
Drone2Map for ArcGIS is a desktop application that turns raw, still imagery from drones into orthorectified mosaics, terrain models, point clouds, 3D meshes, & more.



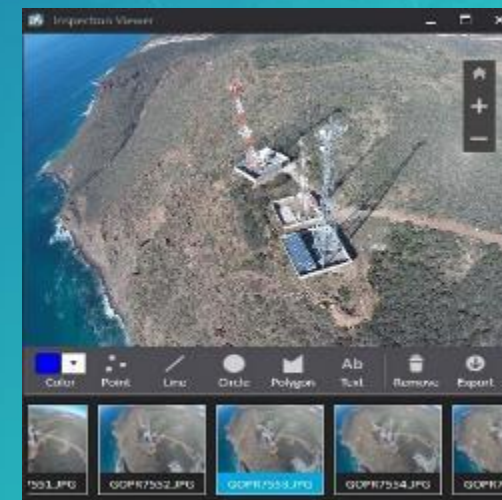
Orthomosaics



Digital Surface Models  
DSM & DTM



Point Clouds  
&  
3D Meshes



Smart Inspection  
&  
3D PDF

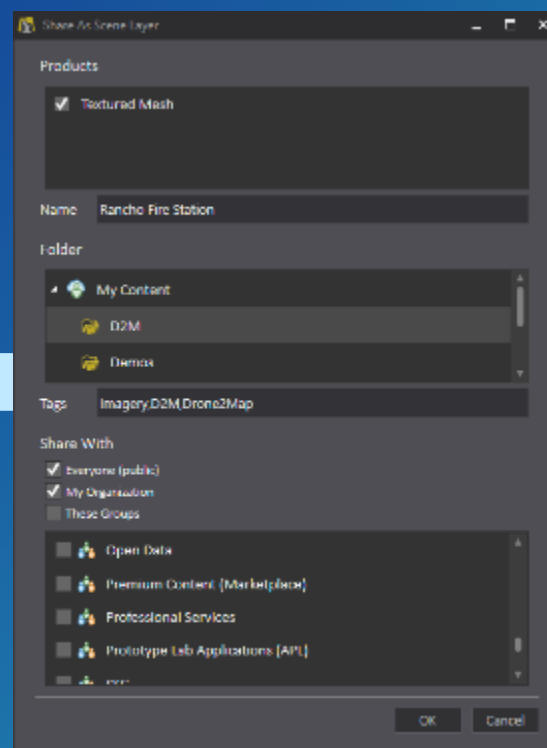


# Share Drone Imagery Fast

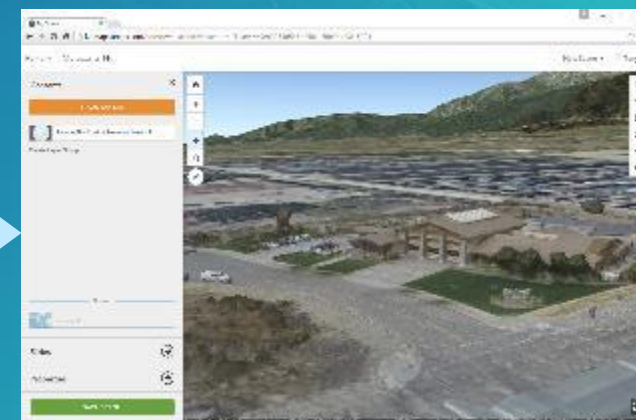
Get Imagery Products To Your Users When They Need It



3D products



Share as ...



Scene layers

# Drone Data Management

ArcGIS Platform



- Multiple -
  - Business Units
  - Operators / Field Crews
  - Sensors
  - Flights
  - Times
  - Geographies
- Products -
  - Orthomosaic
  - Mesh and Point Cloud
  - Elevation Surfaces: DTM, DSM
  - Contours



# Introduction to Drone2Map Application

- Current Release is Version 1.2
- Separate Install from ArcGIS Desktop, ArcGIS Pro
- Requires ArcGIS Online Subscription (or Trial)
- Licensed using ArcGIS Organizational or Portal for ArcGIS Accounts
  - Requires Level 2 Named User





# What's New in Drone2Map Release 1.2?

- Open Projects In ArcGIS Pro
- Batch Processing
- Share Project As Web Map
- New Image Carousel Integrated With Map Clicks
- Draw Tool
- Mesh Support For LOD's
- Support For Output Spatial Reference
- Updated 3D Textured Mesh Settings
- Additional Calibration Parameters
- Updated Ribbon
- Selection Of Image Centers (Camera Stations)
- Allow Layer Symbology Color Change:
  - Image Centers
  - Flight Lines
  - Contours
  - GCP's
  - Project Area
- Application Quality Improvements

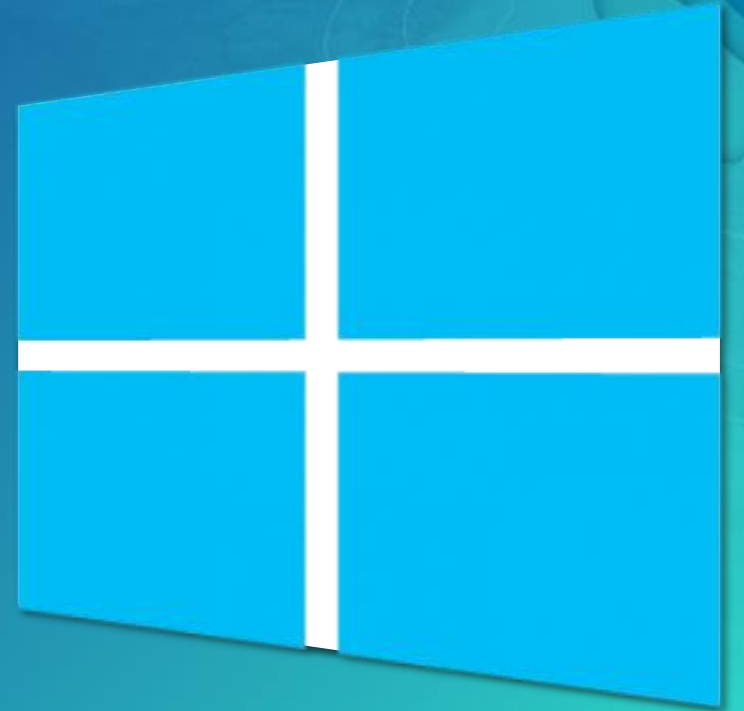
# Drone2Map Use Cases

- Ortho Mapping
- 3D Modeling
- Inspection (Oblique)
- Visualization



# Supported Platforms

- Windows 7 SP1 Ultimate, Enterprise, Professional, and Home Premium (64 bit)
  - NET Framework 4.5 installation required if not previously installed
- Windows 8.1 Basic, Pro, and Enterprise (64 bit)
- Windows 10 Home, Pro, and Enterprise (64 bit)





# Recommended Hardware Specifications...

- Windows 7, 8, 10 64 bit
- CPU: quad core or hexa-core Intel i7/Xeon
- Graphics: GeForce GPU compatible with OpenGL 3.2 and 2 GB RAM
- Hard disk: SSD

# Project Images (14 MP)	System Memory (GB)	SSD Free Disk Space (GB)
< 100	8	15
101-500	16	30
501-2000	16	60
> 2000	32	120

# Earth Models



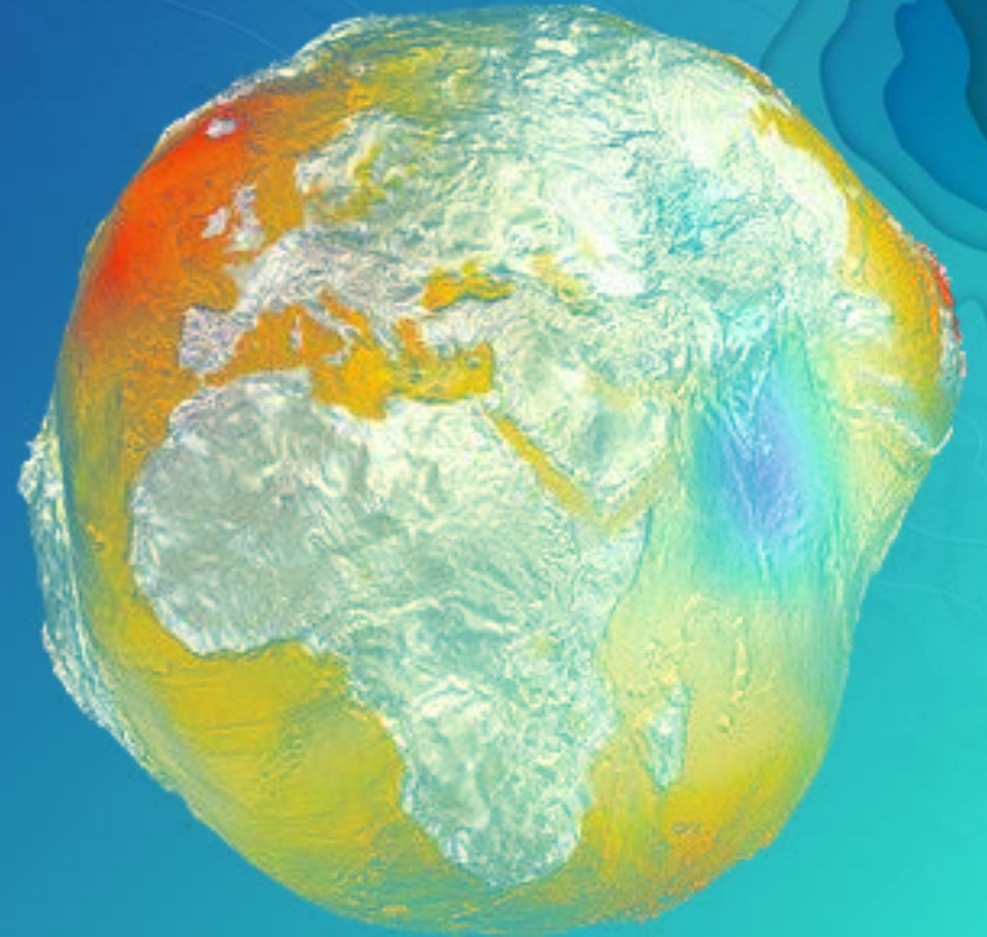
Spherical Earth



Ellipsoidal Earth

# Role of Gravity in Drone Mapping

- Global Gravity “Potato” (Geoid)
- Used to Define Vertical Coordinates
- Equipotential Models with names like EGM-96, EGM-2008, GEOID-12
- Vertical Coordinates Must Be Consistent with Observable Reality “Where water flows”
- Reason for Separate Horizontal and Vertical Systems
  - Horizontal Position Defined wrt Ellipsoid
  - Vertical Position (Height) Defined wrt Ellipsoid or Geoid
- MSL Elevation defined as perpendicular distance from geoid (not ellipsoid!)
- Ellipsoid & Geoid Heights can Differ by > 30m

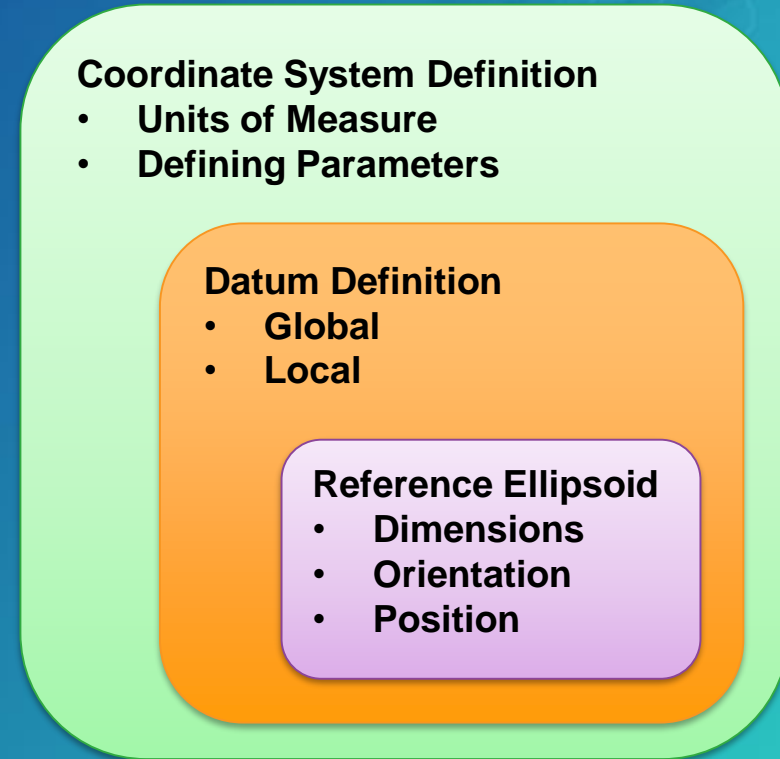


*Image Courtesy of <http://www.scinexx.de/>*



# Coordinate Systems Important to Drone Mapping

- Horizontal Coordinate System
  - Coordinate System Defining Parameters
    - Geographic Coordinates
    - Projected Coordinates
  - Datum
  - Reference Ellipsoid
- Vertical Coordinate Systems
  - Datum
  - Reference Ellipsoid
  - Geoid Model

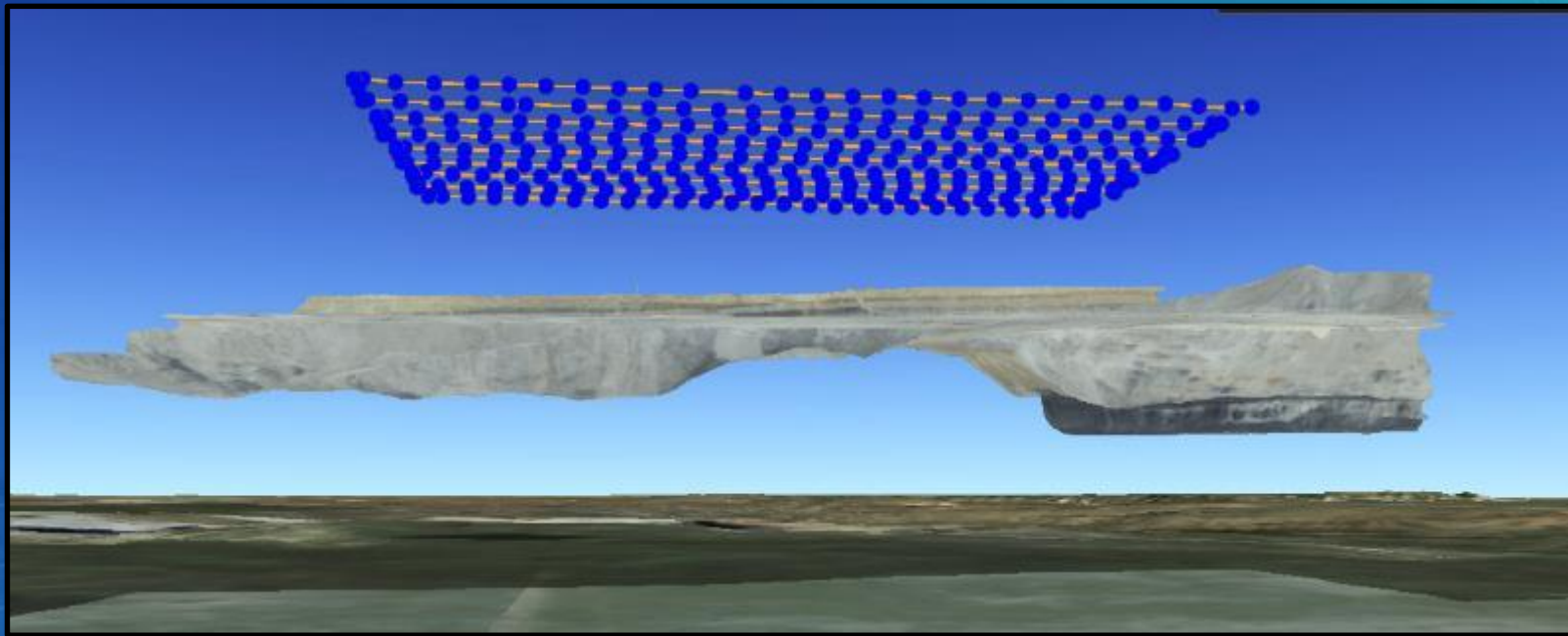


# Coordinate Systems in Drone2Map

- Image Coordinate System
  - Coordinate Data Recorded in Image Metadata (EXIF) Tags
    - Default Horizontal (XY) usually WGS 84 Longitude, Latitude (In Degrees)
    - Default Vertical (Z) usually EGM 96 MSL Height wrt WGS Reference Ellipsoid (In Meters)
  - What Is Actually Recorded Is Dependent On Your Flight Control Software
- Ground Control Coordinate System
  - Coordinate Reference In Which Control Points Are Defined
  - Is usually different From Image Coordinate System
- Output Coordinate System
  - Coordinate System In Which Drone2map Output Products are Defined
  - If Using Ground Control, Output Will default to Ground Control Coordinate System
  - If No Ground Control, default is UTM or User Can Specify

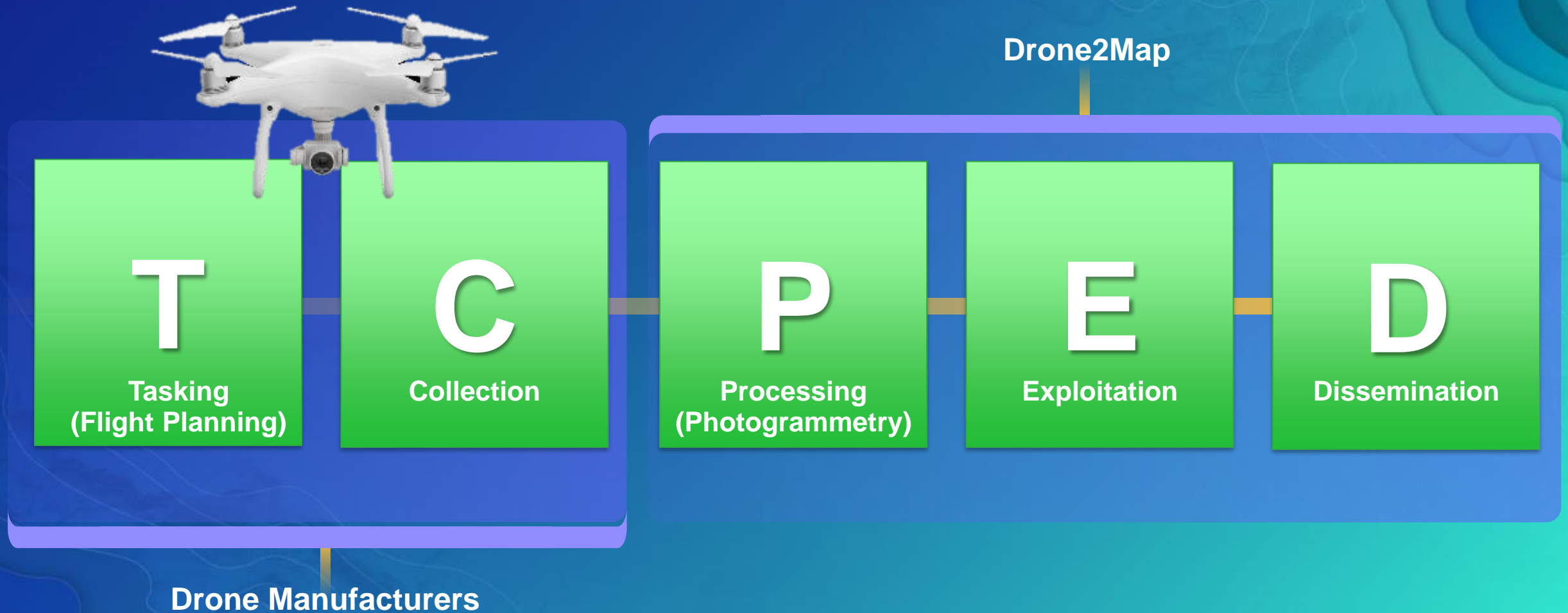
# Impacts of Incorrect Specification

- Products could be misaligned wrt to Base Map (Horizontal Reference Error)
- Computed Surfaces Above or Below Terrain. Products could be invisible due to being obscured by terrain layer (Vertical Reference Error)



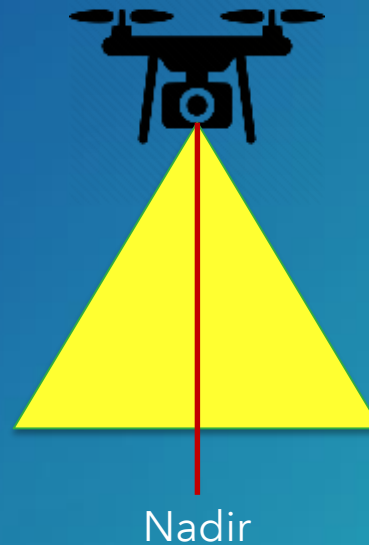


# Drone Mapping Workflow



# Flight Planning/Data Collection

- Use Case Driven
- Overlap Configuration
  - Sidelap, Endlap, Altitude
- Collection Angle
  - Nadir, Low Oblique, High Oblique
- Metadata (Exif)
  - Camera Calibration
  - Position & Orientation
  - Exposure Information
- Coordinate Systems (H, V)

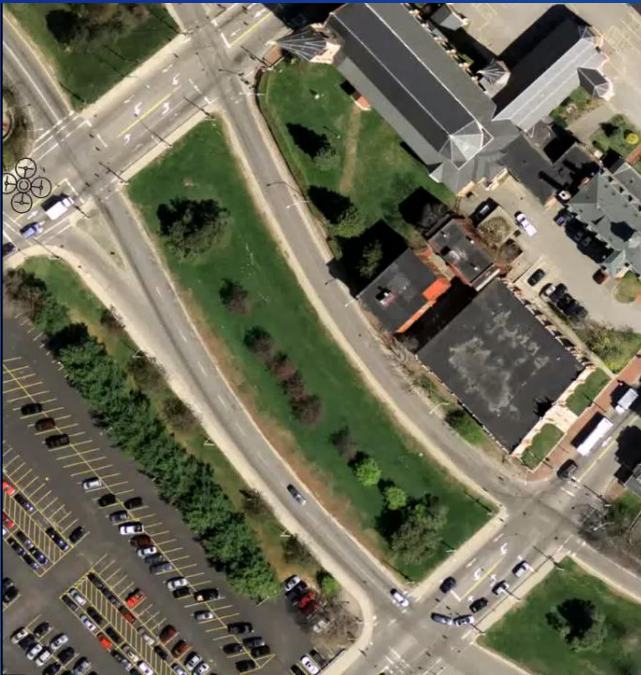




# Drone2Map Templates

## *2D Mapping*

Overlapping, nadir  
Orthomosaic, DEM, DSM  
3D point cloud, mesh



 Nadir (Vertical) Images

## *3D Mapping*

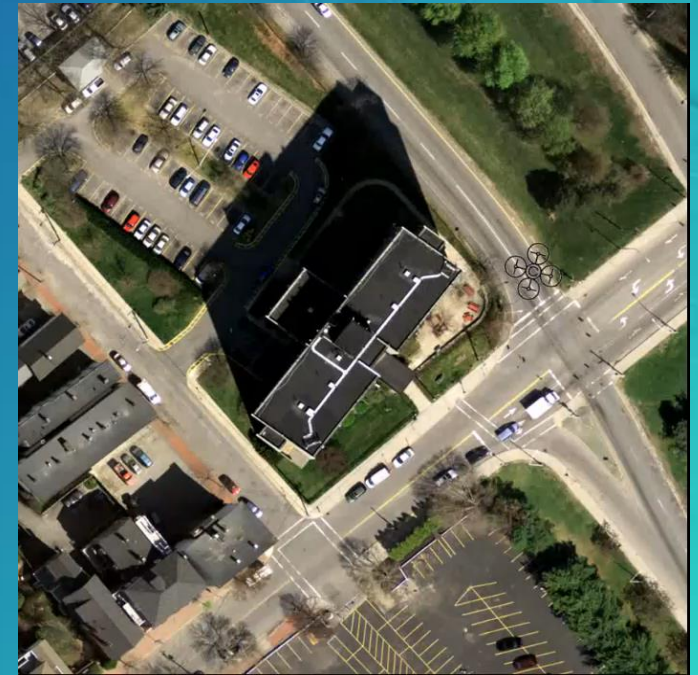
Overlapping, nadir & oblique  
Orthomosaic, DEM, DSM  
3D point cloud, mesh




 Nadir (Vertical) and Oblique  
(in direction of arrow) Images

## *Inspection Mapping*

Overlapping, high oblique images  
Annotation, attribution, visualization



 Concentric High Oblique  
Images (different altitudes)



# Demonstration Project

- Data Provided by
  - USACE, Wilmington, NC
  - McKim & Creed Engineers, Wilmington, NC
- Wrightsville Beach, North Carolina
  - Post-hurricane Beach Restoration Project
  - Independently Established Ground Control Points for Accuracy Assessment
  - Demonstrate Alternative To Terrestrial LIDAR
  - Platform Specifications DJI / ILCE QX1
  - 195 Images @ 3 cm GSD
  - **<2 Hours** Hour of Field Collection
  - **~4 Hours** for Final Product Generation

## RMS Error [ft]

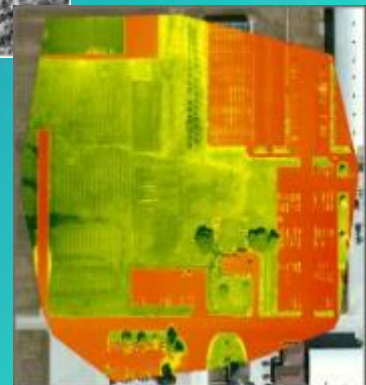
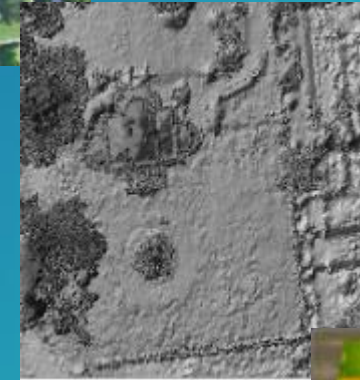
- X 0.053
- Y 0.034
- Z 0.118

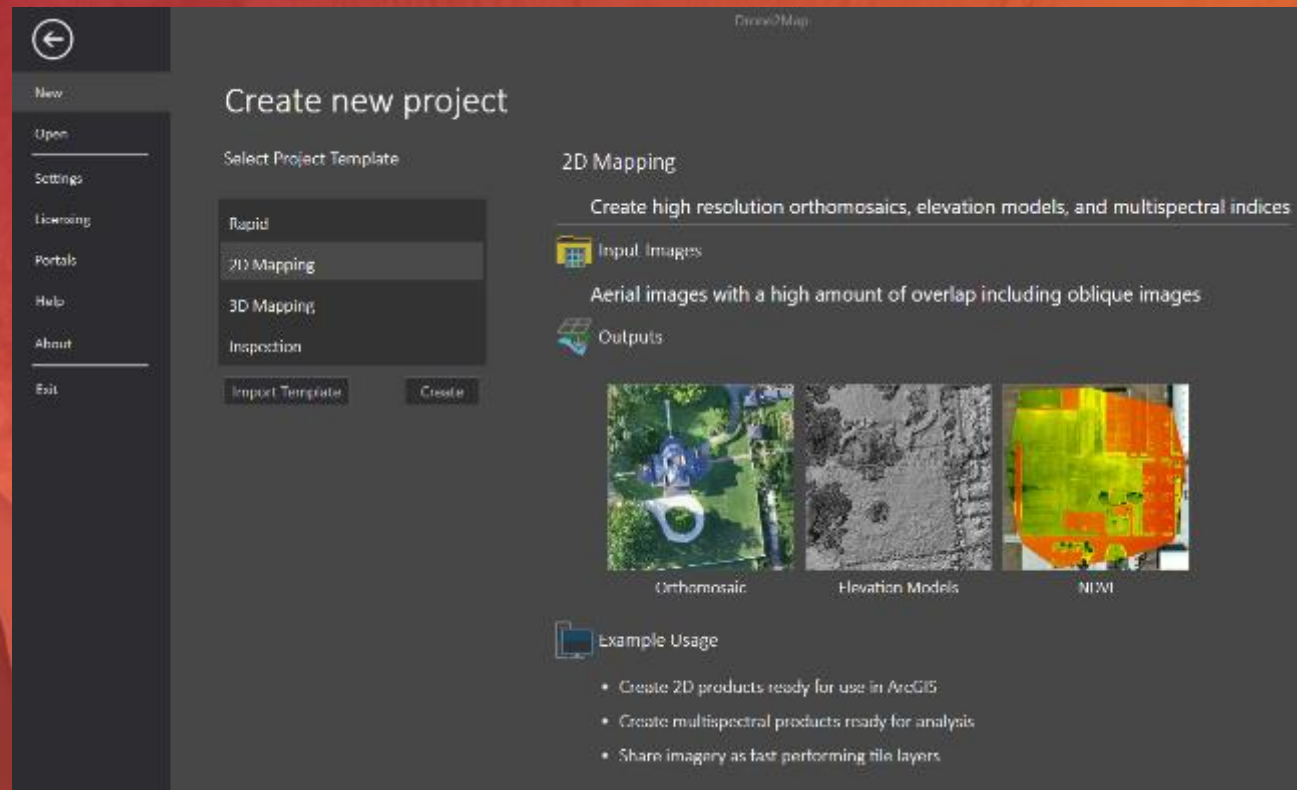
Point Cloud - 450 Million+ Points  
Average Point Density 30 Pt/m<sup>2</sup>



# Basic Workflow – Rapid & 2D Processing

- Rapid Processing
  - Ingest Source Data
  - Create low res products
  - Perform quick assessment of collection
- 2D Processing
  - Used to process flights with Nadir (vertical) images
  - Ingest Source Data
  - Define Processing Options & Process Image Collection
  - Generate Output Products
    - Create detailed Orthomosaic from the overlapping images
    - Extract a detailed DSM, DTM using auto correlation
    - Create Contours
    - Create 3D point cloud and textured mesh
    - Create derived products by applying standard function chains to images





# Rapid & 2D Processing Drone2Map

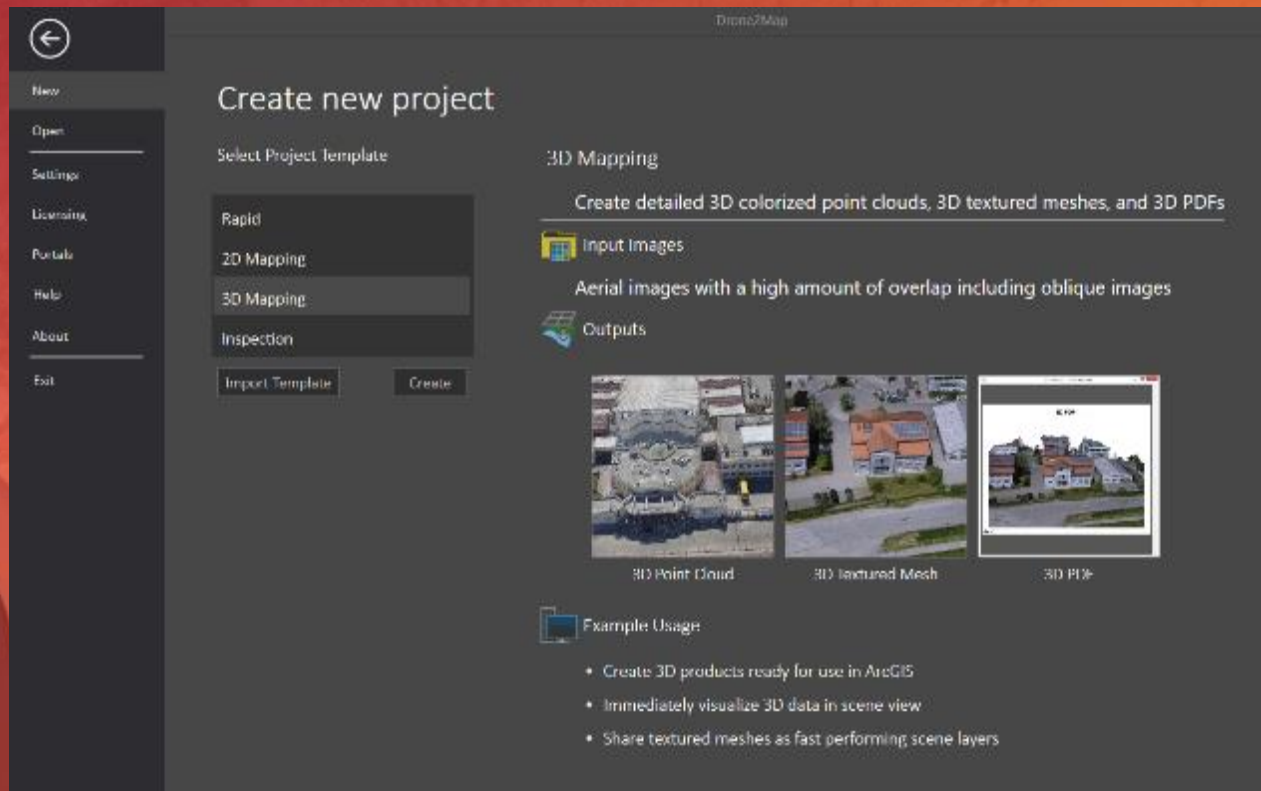
Roslyn Dunn



# Basic Workflow – 3D Processing

- Used to process flights with a *combination* of Nadir & Oblique Images
- Ingest Source Data
- Perform a Rapid Processing to Validate Collection
- Define Processing Options
- Process Image Collection
- Generate Output Products
  - 3D Point Cloud
  - 3D Textured Mesh
  - Orthomosaic
  - DSM, DTM
  - Contours



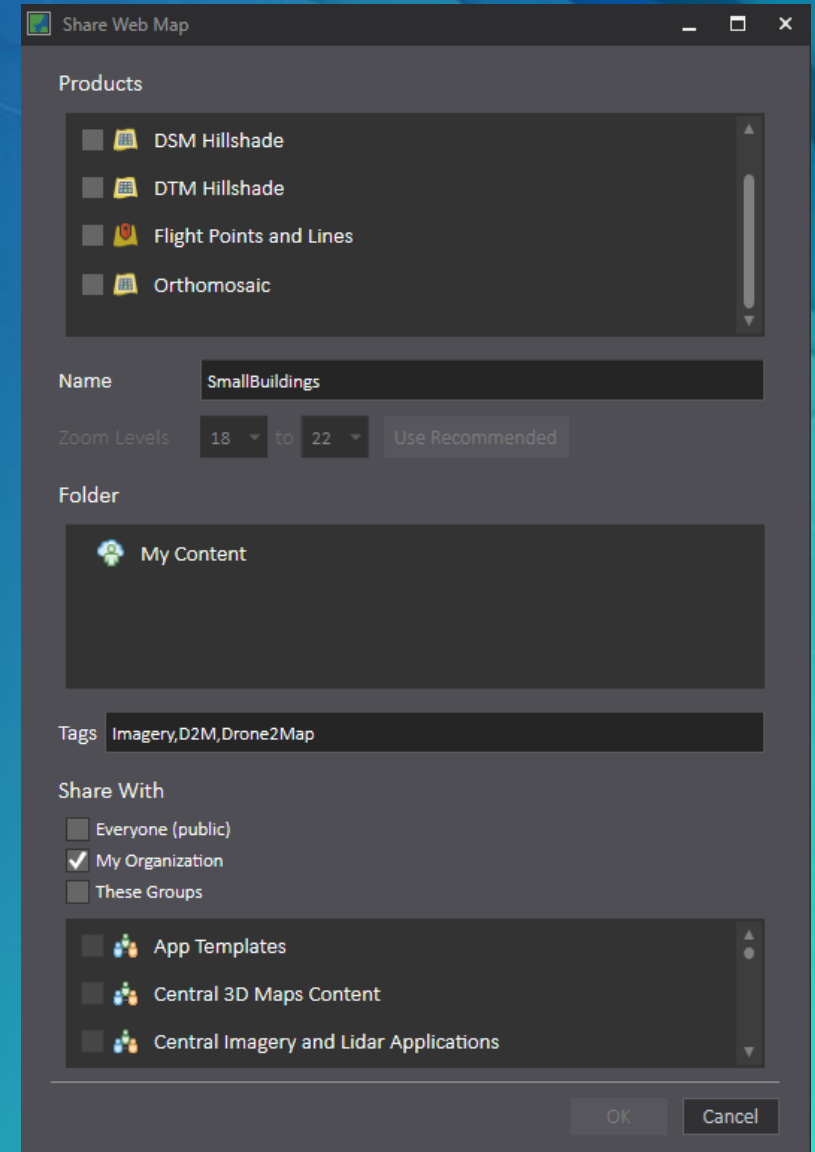


# 3D Processing Drone2Map

Roslyn Dunn

# Drone2Map Publishing

- Publish Products to ArcGIS Online or Portal for ArcGIS
- Share Contours, Flight Points & Lines as Feature Layer
- Share DSM, DTM, Orthomosaic as a Tile Layer
  - Tiling is performed locally, then uploaded
- Share 3D Textured Mesh as 3D Scene Layer
- Share 2D products in a Web Map
  - DSM, DTM
  - Orthomosaic
  - Flight Points & Lines
  - Contours
  - Markups (using the Draw tool)



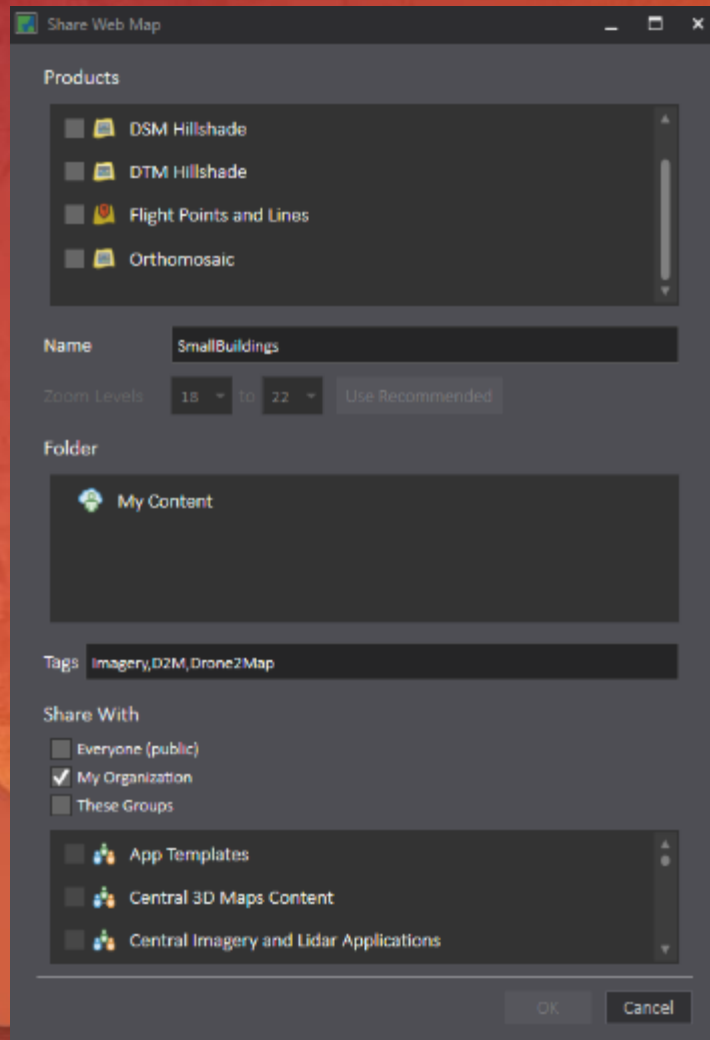


# Batch Processing

- Process *multiple* Drone2Map projects in succession
- Batch job consists of one or more projects
- Open existing Batch job or Create new
- For any Drone2Map Project in the Batch job:
  - Modify Processing Options
  - Change order of Project processing
  - Remove Project from Batch job
  - Open the Project in the Drone2Map UI

# Basic Workflow – Inspection Processing

- Different Use Cases From 2D & 3D
- Goal Is To Create A High Resolution Georeferenced Image Collection To Support Visual Inspection, Mensuration, Annotation Processes
- Increasing Demand Because Of Safety, Feature Access Issues
- Non-contact, Non-invasive Collection & Annotation
- Content Collection Can Support Work Order Generation, QC Inspections, etc.



# Publishing with Drone2Map

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## Batch Processing

Open

Open an existing batch processing job

### Create New Batch Processing Job



Select where to store your batch job

A new batch processing folder will be created

C:\Users\rosly2669\Documents\Drone2Map Proje

Browse



Give your batch processing job a name

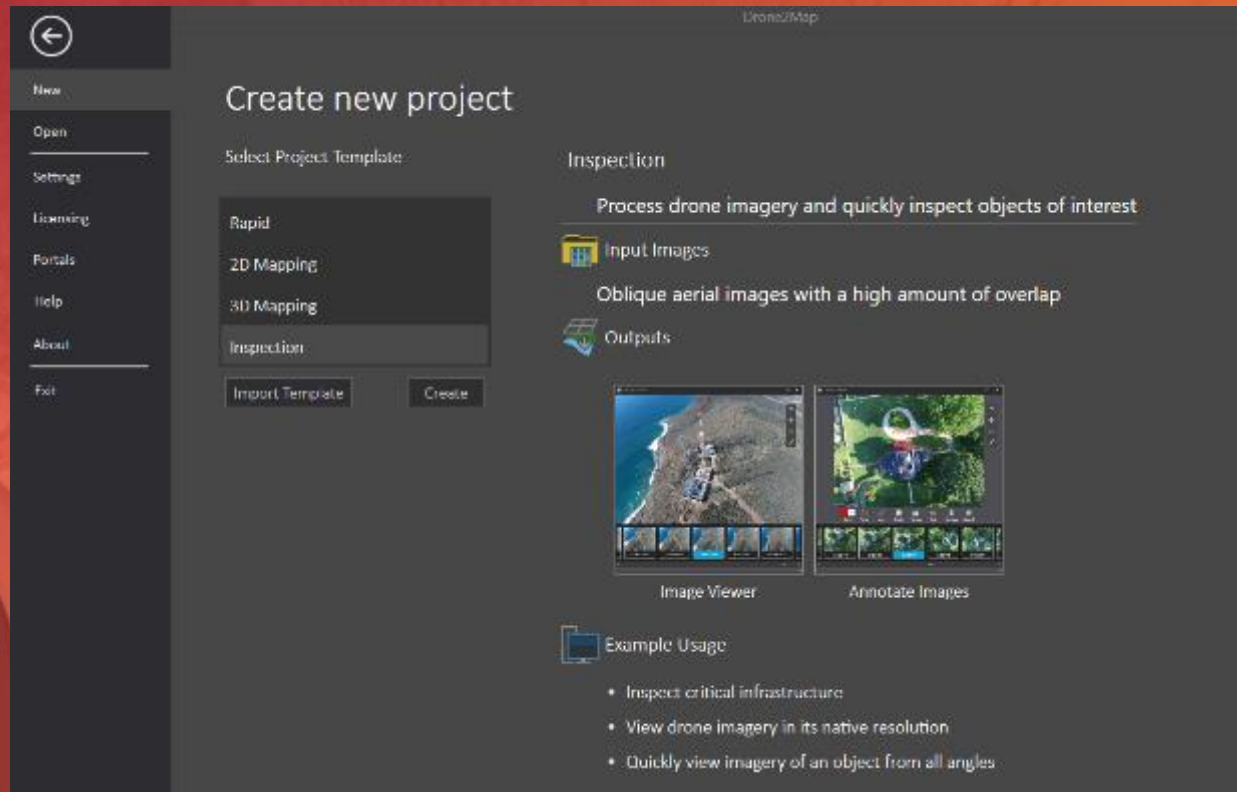
Create

# Batch Processing in Drone2Map

Roslyn Dunn

# Inspection Processing Drone2Map

Roslyn Dunn



# Summary

- Drone2Map is a complete drone data processing platform for field and office use
- Provides an intuitive, user friendly experience
- Supports a wide array of platforms and sensors
- Integrates seamlessly with the ArcGIS technology stack
- Permits processing of large collections of imagery supporting complex use cases
- Drone2Map product:
  - <http://www.esri.com/products/drone2map>
- Drone2Map Documentation:
  - <http://doc.arcgis.com/en/drone2map>
- Visit the Drone2Map team at the Imagery Island

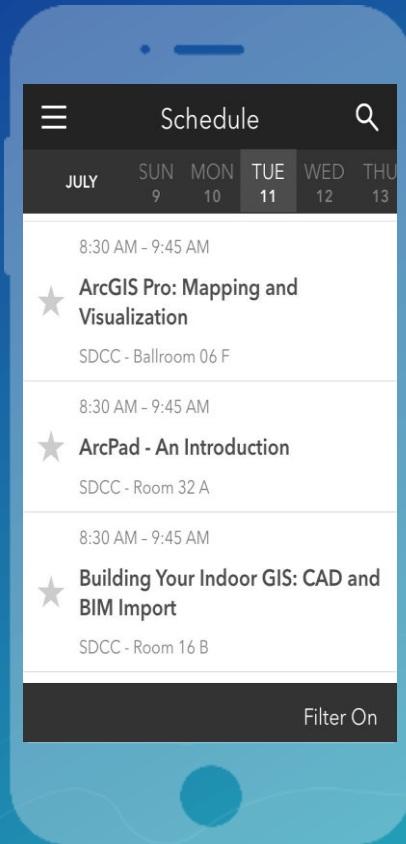


# Please Take Our Survey on the **Esri Events App**!

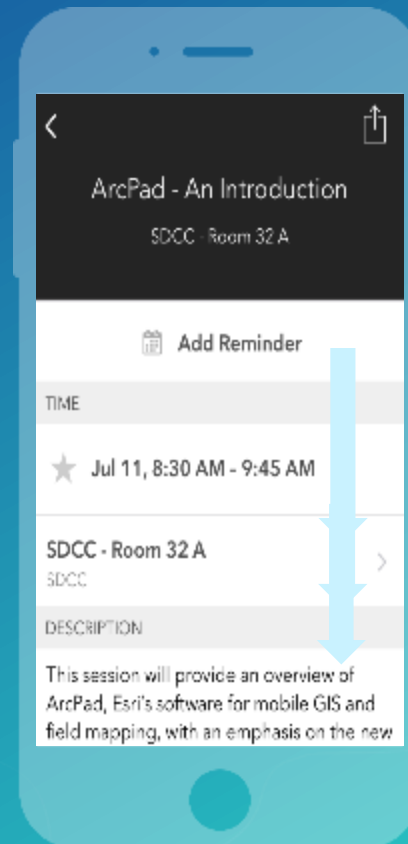
Download the Esri Events app and find your event



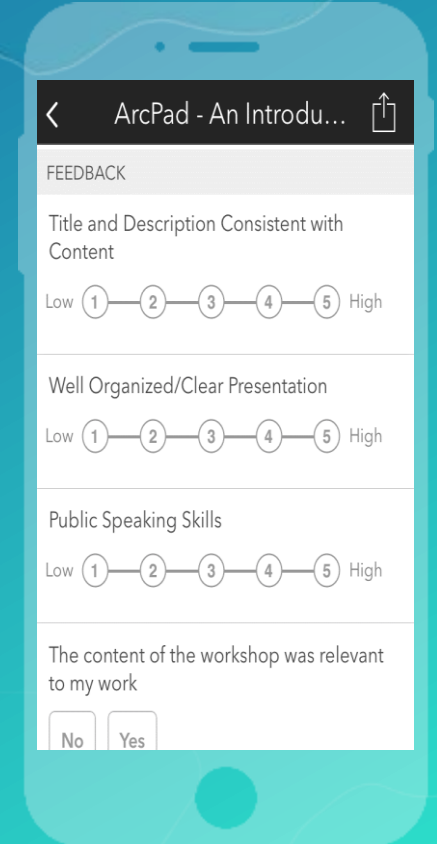
Select the session you attended



Scroll down to find the survey



Complete Answers and Select "Submit"





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SCIENCE  
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WHERE