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

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<th>System Memory (GB)</th>
<th>SSD Free Disk Space (GB)</th>
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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**
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

T - Tasking (Flight Planning)
C - Collection
P - Processing (Photogrammetry)
E - Exploitation
D - Dissemination

Drone Manufacturers

Drone2Map
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

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

Inspection Mapping
Overlapping, high oblique images
Annotation, attribution, visualization

- Nadir (Vertical) Images
- Nadir (Vertical) and Oblique (in direction of arrow) Images
- 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/m²
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
Create new project

Select Project Template

2D Mapping:
- Create high resolution orthomosaics, elevation models, and multispectral indices

Input Images:
- Aerial images with a high amount of overlap including oblique images

Outputs:
- Orthomosaic
- Height Models
- NEM

Usage:
- Create 2D products ready for use in ArcGIS
- Create multispectral products ready for analysis
- Share imagery as live performing data layers
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
Roslyn Dunn
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:
- Visit the Drone2Map team at the Imagery Island
Please Take Our Survey on the **Esri Events App**!

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2. **Select the session you attended**
3. **Scroll down to find the survey**
4. **Complete Answers and Select “Submit”**