IMAGING AND VISUALIZATION TECHNOLOGIES FOR ENVIRONMENTAL MONITORING AND ASSESSMENT

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SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT

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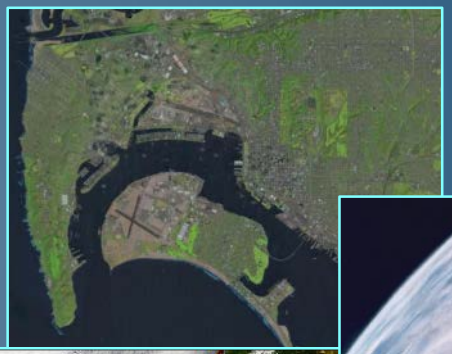
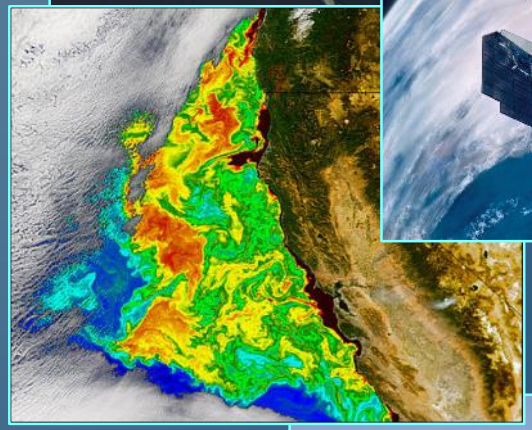
FIELD DATA COLLECTION

- Traditionally field data is collected by:
  - Sending a crew out to sample in the field
  - Deploy and later retrieve data loggers or cameras
  - Contract with an aerial survey company for imagery
- The problem with these approaches:
  - Time consuming
  - Expensive
  - Inconsistent
  - Inaccessible
  - Incomplete

WHY IMAGERY?





- Imagery may serve as a surrogate for field data.
- Multiple sensor options (RGB, multispectral, video, LiDAR)
- A complete, permanent record of the site.

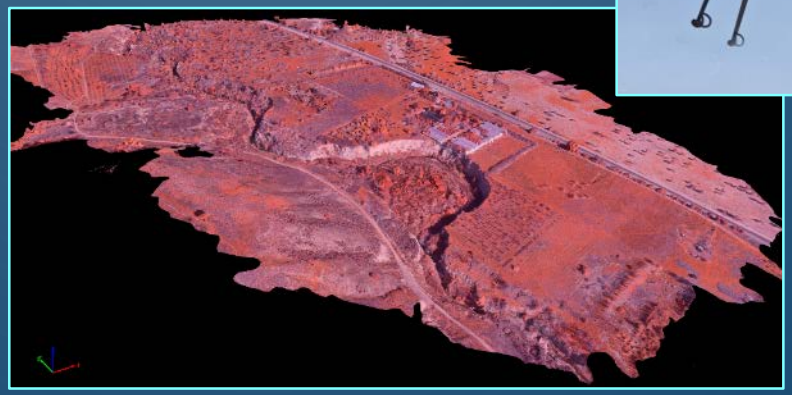


IMAGE ANALYSIS‡

- Acquisition using a variety of platforms
  - Match needs re: location, time scale and sensor
- Analysis can be automated to accomplish specific (pre-determined) objectives:
  - Presence of specific "targets of interest"
  - Identify change between image acquisition dates

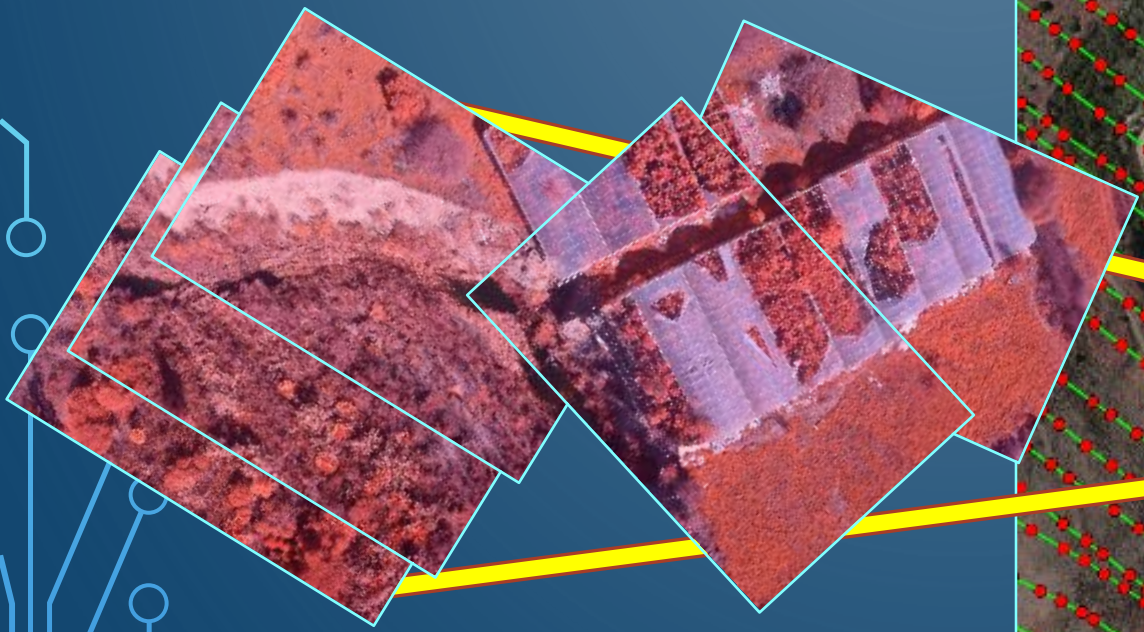
‡ These techniques work with all image types (sUAS, aerial, satellite and fixed station)

DRONES (sUAS)

- Benefits:
  - Flights on-demand
  - Repeatable flight coverage
  - Larger coverage areas (complete vs. sampled site)
  - Faster than field based mapping
  - Mapping quality results (metrically correct)

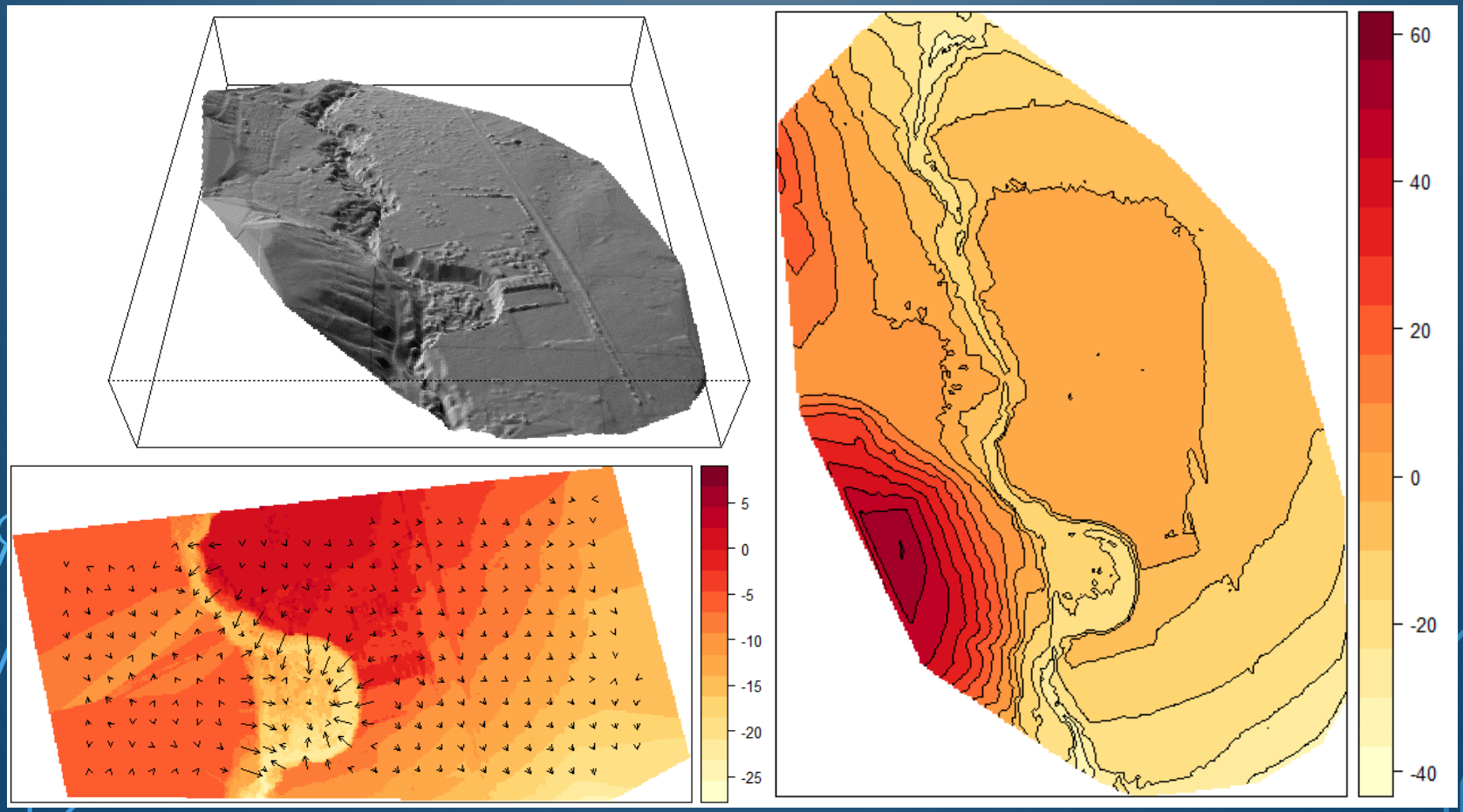
sUAS IMAGERY EXAMPLE

- Data from a fixed-wing sUAS with multispectral (RGB-NIR) sensor

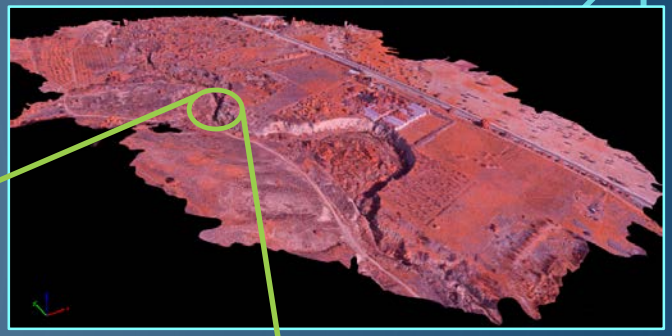


RESULTS (TERRAIN MODELING)

Computation of slope and aspect

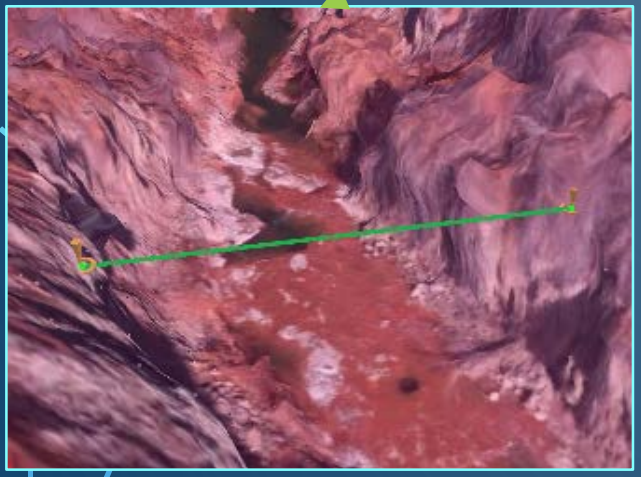


RESULTS (MEASUREMENTS)



Distances

Projected 2D Length: 20.60 m
Terrain 3D Length: 20.81 m



Surfaces

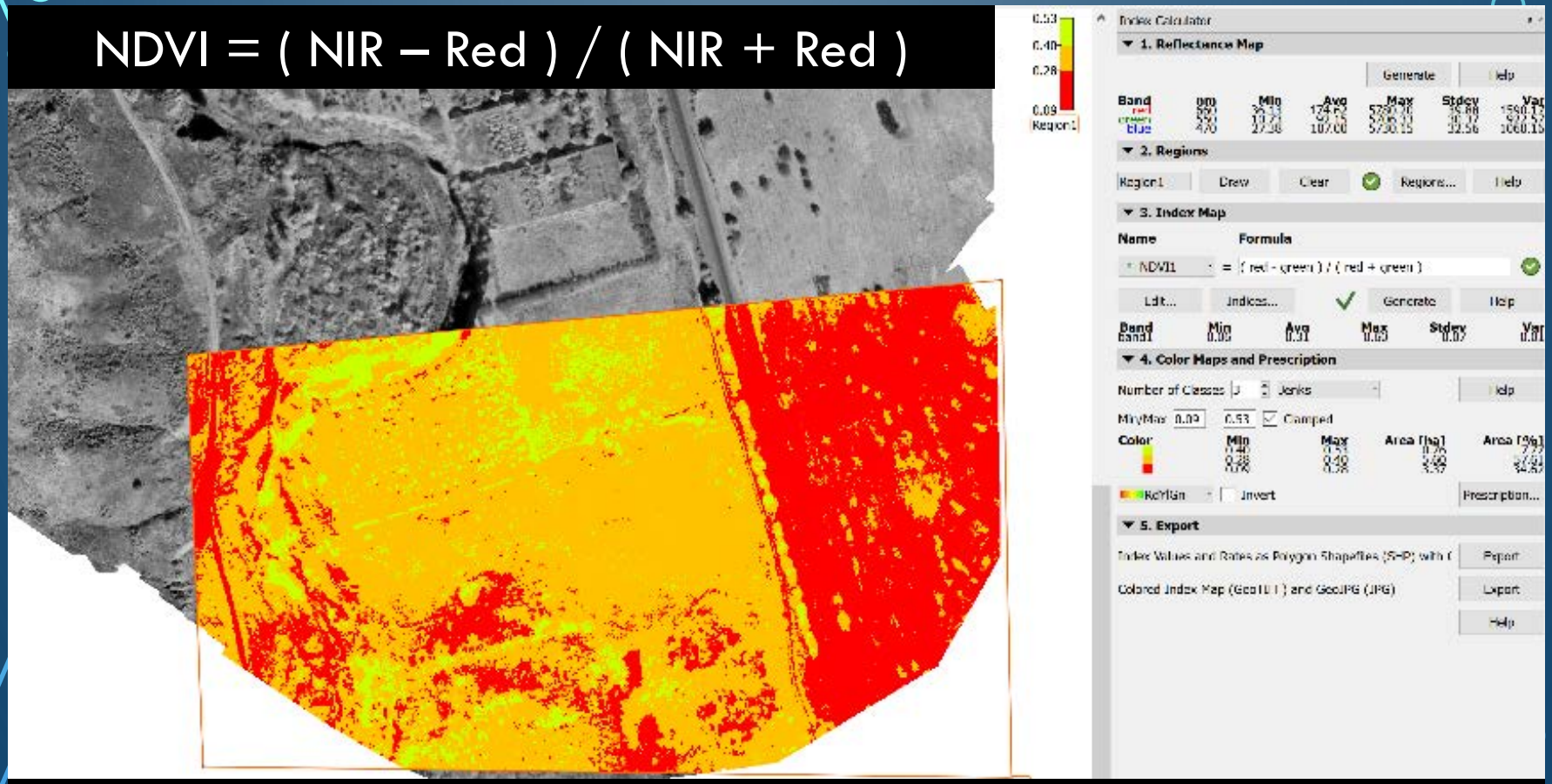
Projected 2D Length: 49.92 m
Terrain 3D Length: 59.14 m
Enclosed 3D Area: 174.62 m²

Volumes

Terrain 3D Area: 2069.57 m²
Cut Volume: 11.20 m³
Cut Volume Error: 0.27 m³
Fill Volume: -5019.87 m³
Fill Volume Error: 11.59 m³
Total Volume: -5008.68 m³
Total Volume Error: 11.86 m³

RESULTS (INDICES)‡

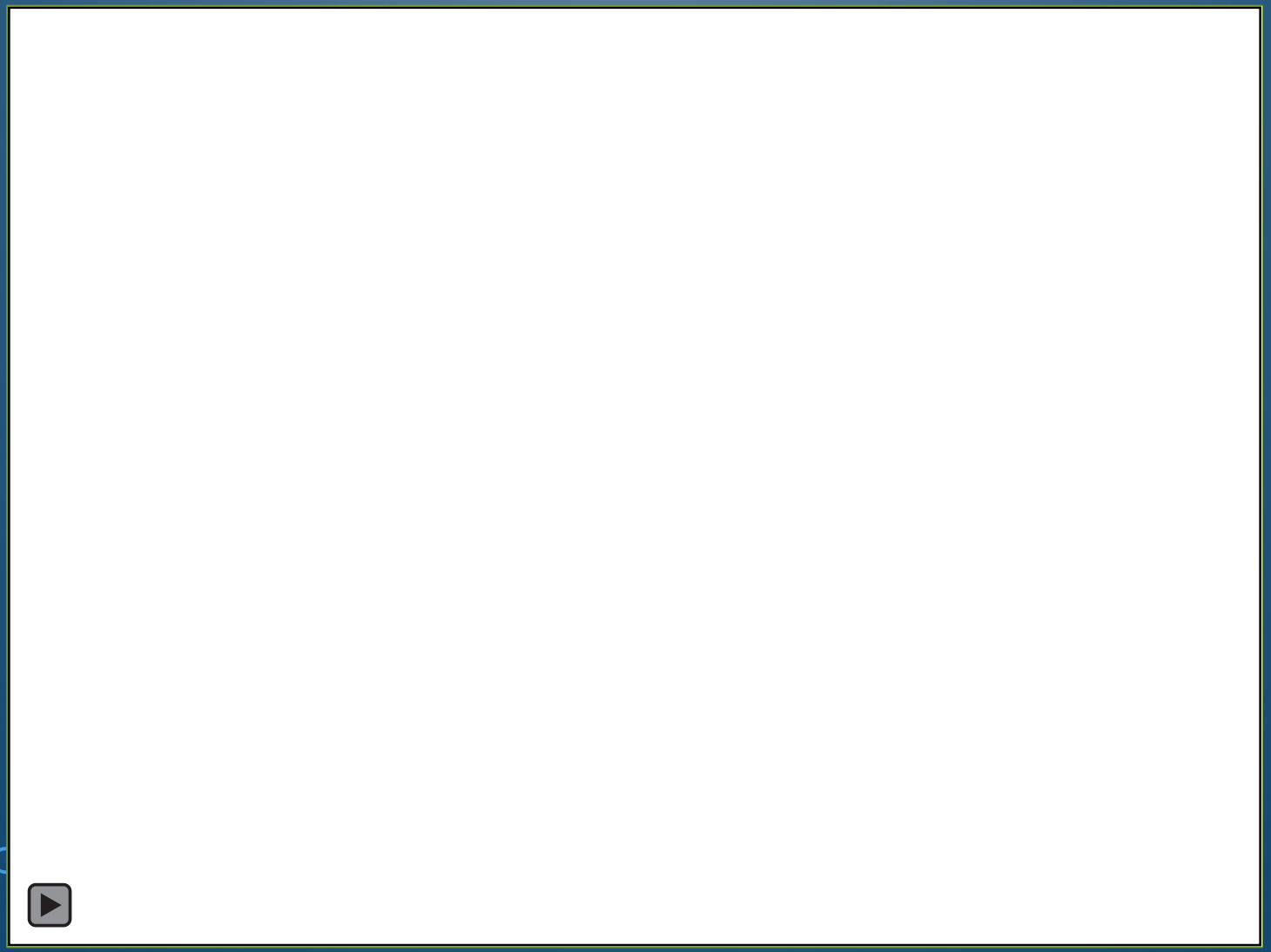
NDVI = (NIR – Red) / (NIR + Red)



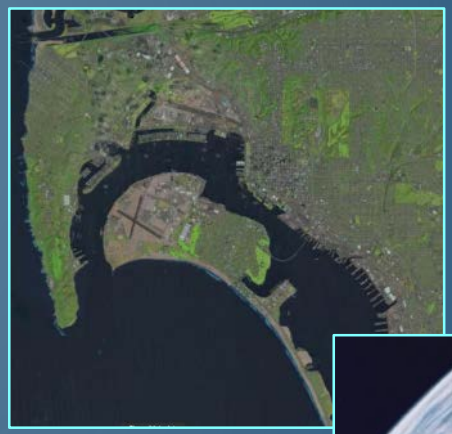
High values (yellows → greens) indicate vegetation; red values (red) indicate bare surface)

‡ These techniques work with all image types (sUAS, aerial, satellite and fixed station)

RESULTS (VISUALIZATION)



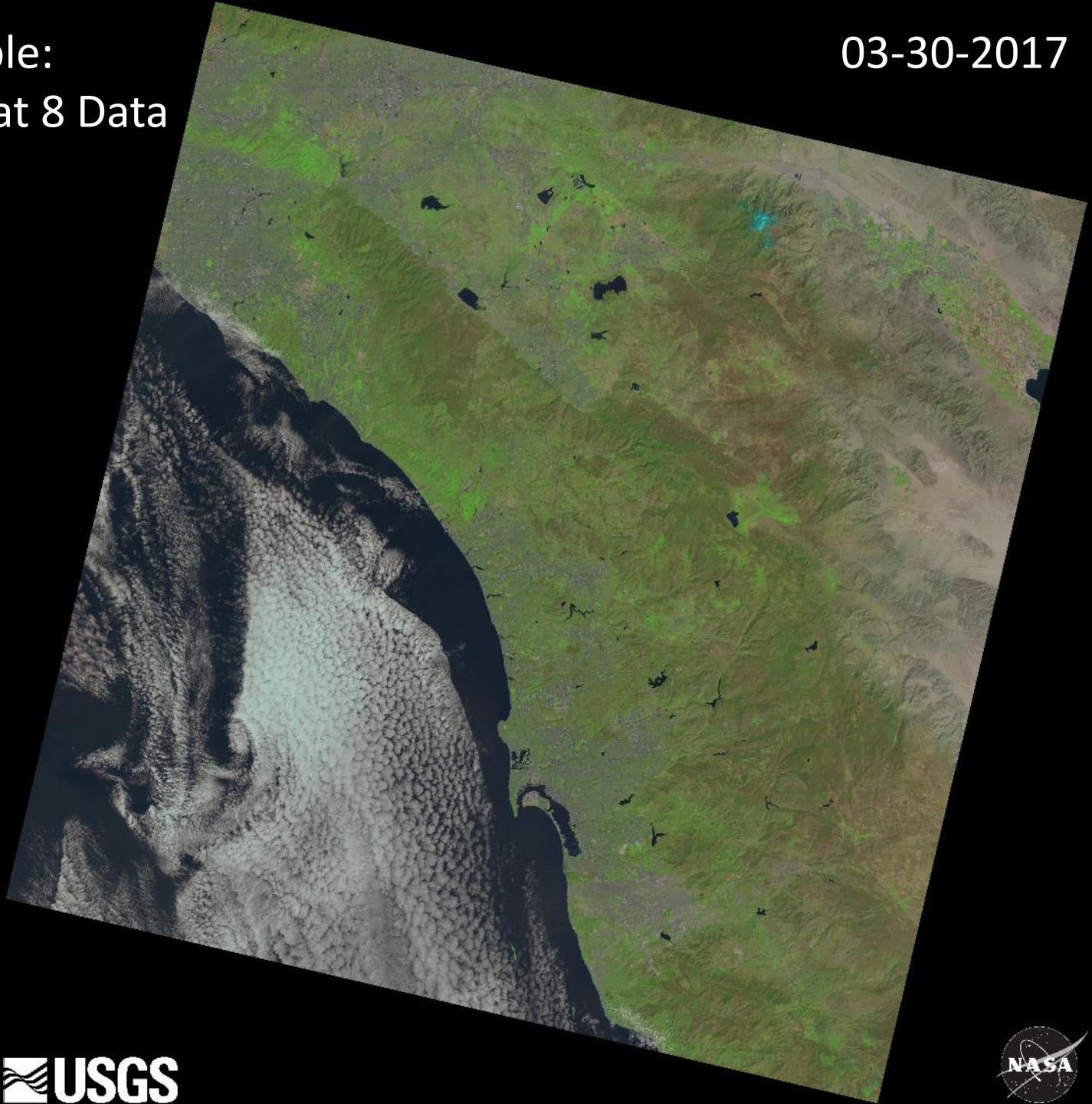
SATELLITE IMAGING



- Benefits
  - Regular, repeat visits (days to weeks)
  - Spatial resolutions: ~0.3 meters to kms
  - A variety of sensors
  - Both free (government) and commercial options
  - Provide consistent data over long periods of time

Example:
LandSat 8 Data

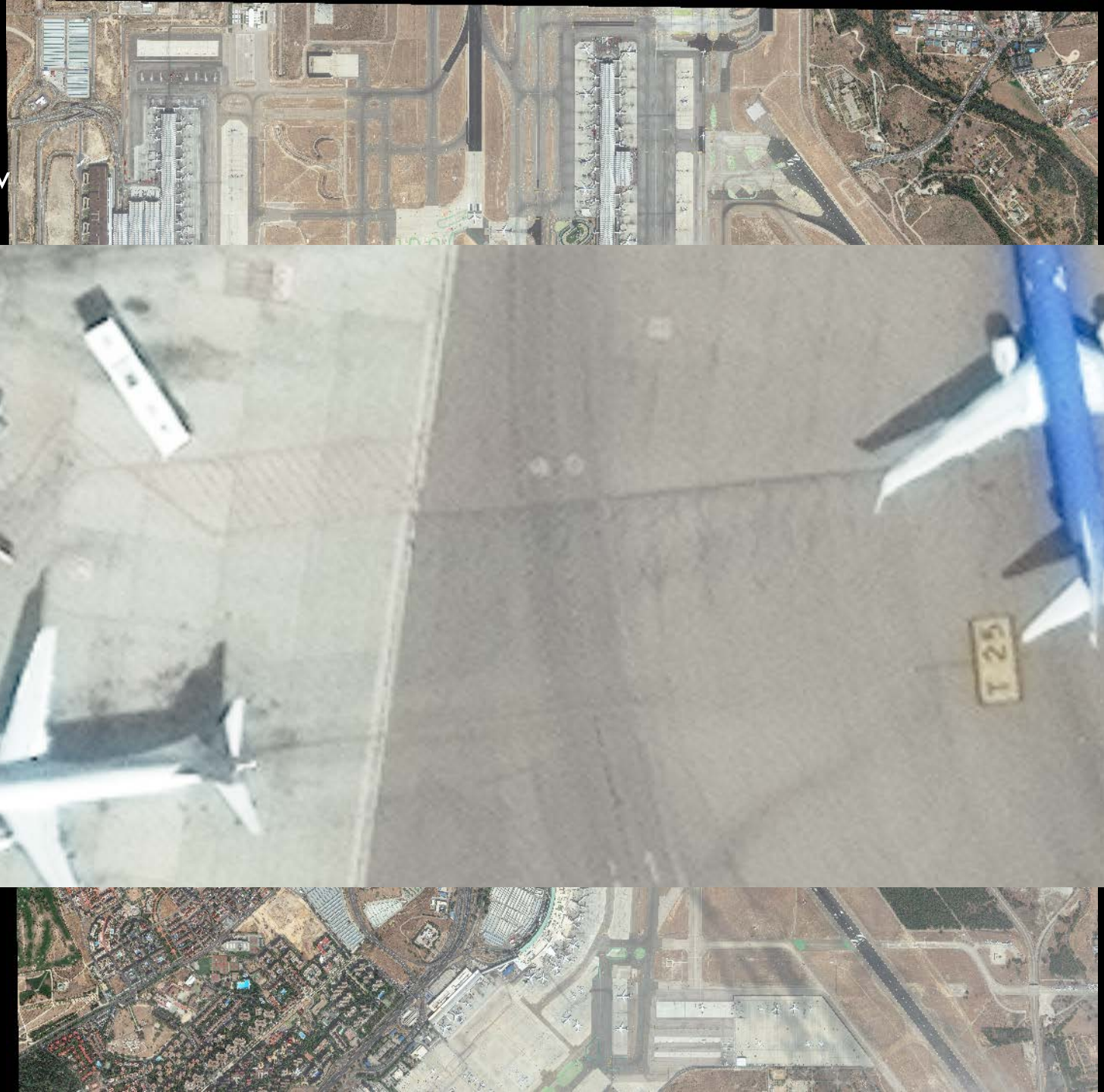
03-30-2017



USGS

NASA

Example: Digital Globe WorldView



SATELLITE IMAGING

- Limitations
  - Pixel resolution
  - Limited to cloud-free days*
  - Image timing (relative to need) may not match orbit
  - Acquisition cost (Sub-meter image cost example)
    - Archival (90+ days old) $14-19/sq km
      [25 sq km minimum]
    - New tasking $24-29/sq km
      [100 sq km minimum]

IMAGE ACQUISITION TECHNOLOGY AND ANALYSIS IS AVAILABLE NOW

- Environmental image analysis methods are well developed
  - Addressing specific targets/applications takes some effort to set-up and validate processes
- Wide array of platforms, scales and sensors to match with specific objectives
- sUAS is here today! (Site level, "on demand")
- Satellite imagery (regional level)
  - Including a substantial archival record available

VISIT US AT THE DEMOS

SCCWRP Information Management and Analysis

- Steve Steinberg: Image Analysis (sUAS, satellite and fixed stations)

- Paul Smith: Data workflow (mobile apps, QA/QC, data access)
- Shelly Moore: (Virtual and Augmented Reality)