OVERVIEW AND BACKGROUND GEOGRAPHICAL INFORMATIONS SYSTEMS

at the

Missouri University of Science & Technology

U.S. Geological Survey Mid-Continent Mapping Center and
National Imaging and Mapping Agency-St Louis
September 30, 2003

The Beginnings of GIS at Missouri S&T

- **The first generation of computers for digital image processing were obtained in 1975 with grant monies from:**
  - **National Science Foundation**
  - **NASA Cooperative on Remote Sensing Research**
- **UMR Research Involved:**
  - **LULC (Land Use/Land Cover)**
  - **Water Body Identification**
  - **Mineral Exploration**
  - **UMR teamed with UM-Columbia on many of the early research projects**

The Beginnings of GIS at Missouri S&T

- Dr. David Barr's background was in aerial photo interpretation. He graduated from Purdue, where Prof. Donald Belcher organized the nation's first Center for Aerial Photography Research in 1943, during World War II
- With the launching of Lansat-1 in 1972, multiple layers of geospatial information acquired from multiple wavelength bands gave birth to the idea that layers could be electronically overlaid or combined to create hybrid map products
- UMR was at the cutting edge of these early developments, establishing a Remote Sensing Laboratory (UMR-RSL) in 1975
- In the early 1980's Dr. Barr hired a GIS/computer technician, using additional research funds provided by NASA
- During its first decade, the UMR-RSL manipulated imagery using ERDAS Imagine and IDRISIS software
- In the early 1990s, NASA provided additional funding for a Mini-Mainframe to accommodate the NASA-funded image data processing

The Beginnings of GIS at Missouri S&T

Computer-Aided Mapping and Remote Sensing

The department of geological engineering has operated and maintained a digital image processing laboratory in the School of Mines and Metallurgy since 1975. This lab has hardware and software for analyzing all types of multispectral digital images as well as traditional topographic and geographic maps. Activities in the lab have encompassed a variety of applications leading to the creation of map products for such purposes as mineral and petroleum exploration, land use planning, site characterization for construction, location of geological hazards, evaluation of environmental hazards and stream and flood assessment.

The Philosophy of GIS at Missouri S&T

- Gaining practical knowledge in the application of GIS as an engineering tool to better serve the profession
- The GE department believed that students needed familiarity with GIS tools because these are rapidly becoming the primary database management tool for all forms of geoinformation
- All GE students are required to take an introductory GIS course which enables them to become proficient in writing basic scripts (code)

Courses Presently Offered in GIS Related Topics at Missouri S&T

- Geological Engineering – 248, 249, 344, 346, 349
- Geology – 254, 286, 338
- GeoPhysics – 285, 286
- Civil Engineering – 302

Geological Engineering Courses

- **GE 248 -** Fundamentals of Geographic Information Systems **[Lect 2.0 and Lab 1.0]**
- **GE 249 -** Fundamentals of Computer Applications in Geological Engineering **[Lect 2.0 and Lab 1.0]**
- **GE 344 -** Remote Sensing Technology **[Lect 2.0 and Lab 1.0]**
- **GE 346 -** Applications of Geographic Information Systems **[Lect 2.0 and Lab 1.0]**
- **GE 349 -** Computer Applications in Geological Engineering **[Lect 3.0]**

Geology and GeoPhysics GIS-related courses

- **Geo 254 -** Map and Airphoto Interpretation **[Lect 1.0 and Lab 1.0]**
- **Geo/GeoP 286 -** Introduction to Geophysical Data Analysis **[Lect 3.0]**
- **Geo 338 -** Computer Mapping in Geology **[Lect 1.0 and Lab 1.0]**
- **GeoP 285 -** Geophysical Imaging **[Lect 2.0 and Lab 1.0]**

Civil Engineering Course

- **CE 302 -** Geomatics **(Lect 3.0)**

Geospatial Image Processing Laboratory

- **Equipment includes digital image and data processing systems, light tables, stereoscopes, and spatial and spectral mensuration equipment.**
- **Lab Computers (12): 1GHz Processors, 256MB RAM, 19” Monitors**
- **Research Computers:**

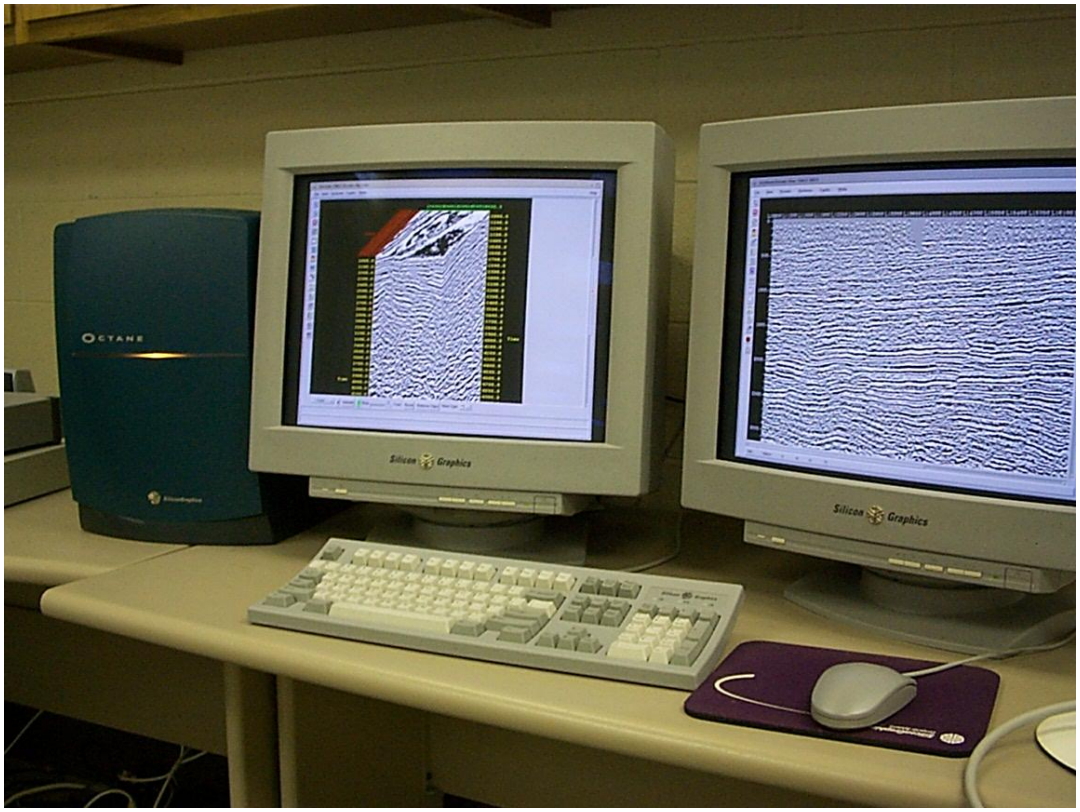
  - (1) 1.4GHz Processor, 1GB RAM

  - (1) 3.2GHz Processor, 2GB RAM

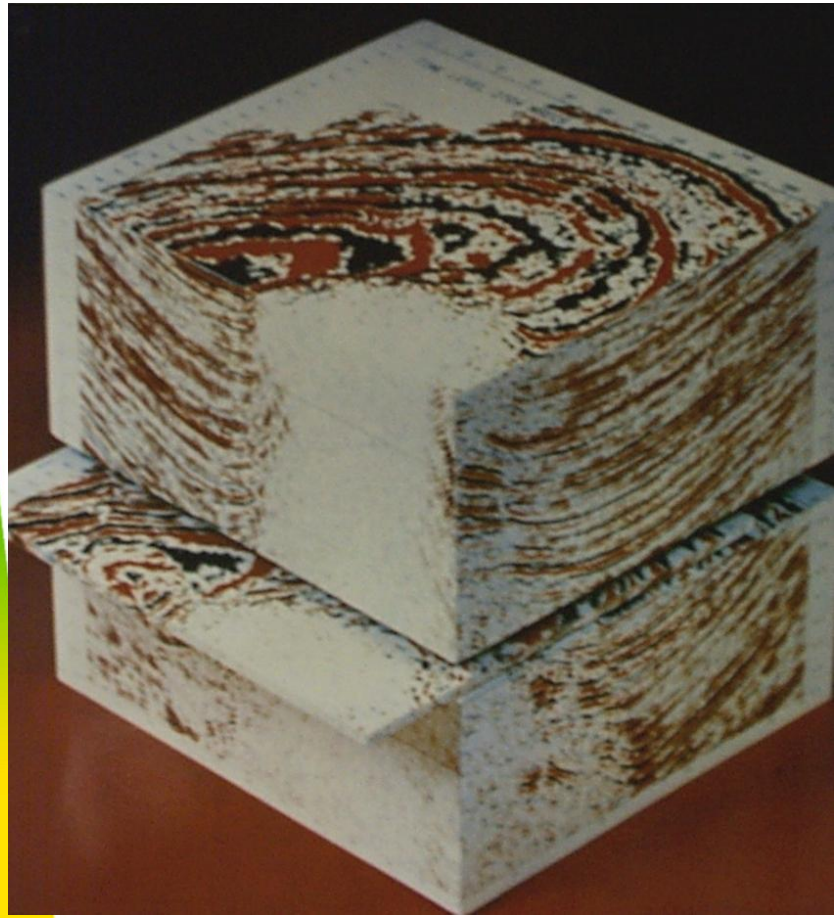
  - (1) 833MHz Processor, 512MB RAM

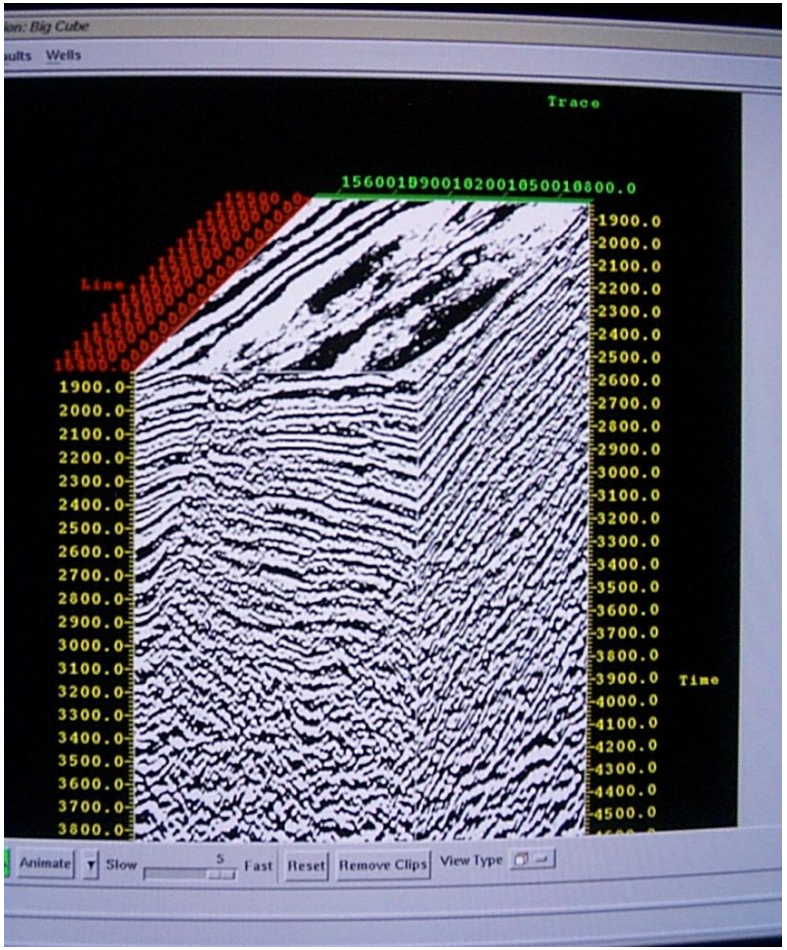
Digital Image Processing Stations in Geology and Geophysics

- Silicon Graphics MXE and SE Octane Workstations with Landmark Release 98 software
- Used for 3D Seismic and Geophysical Interpretation and Mapping Software



Geology and Geophysics GIS Facilities focus on 3D portrayal of the underground





GIS Software Currently Used at Missouri S&T

- ArcGIS 9.2
- Global Mapper
- MicroDem/Terrabase II
- Geosoft Oasis Montaj
- Fledermaus
- Visual Modflow
- ENVI
- Surfer
- ERDAS Imagine
- 3D Seismic
- Terragen
- Delta 3D
- 3DEM

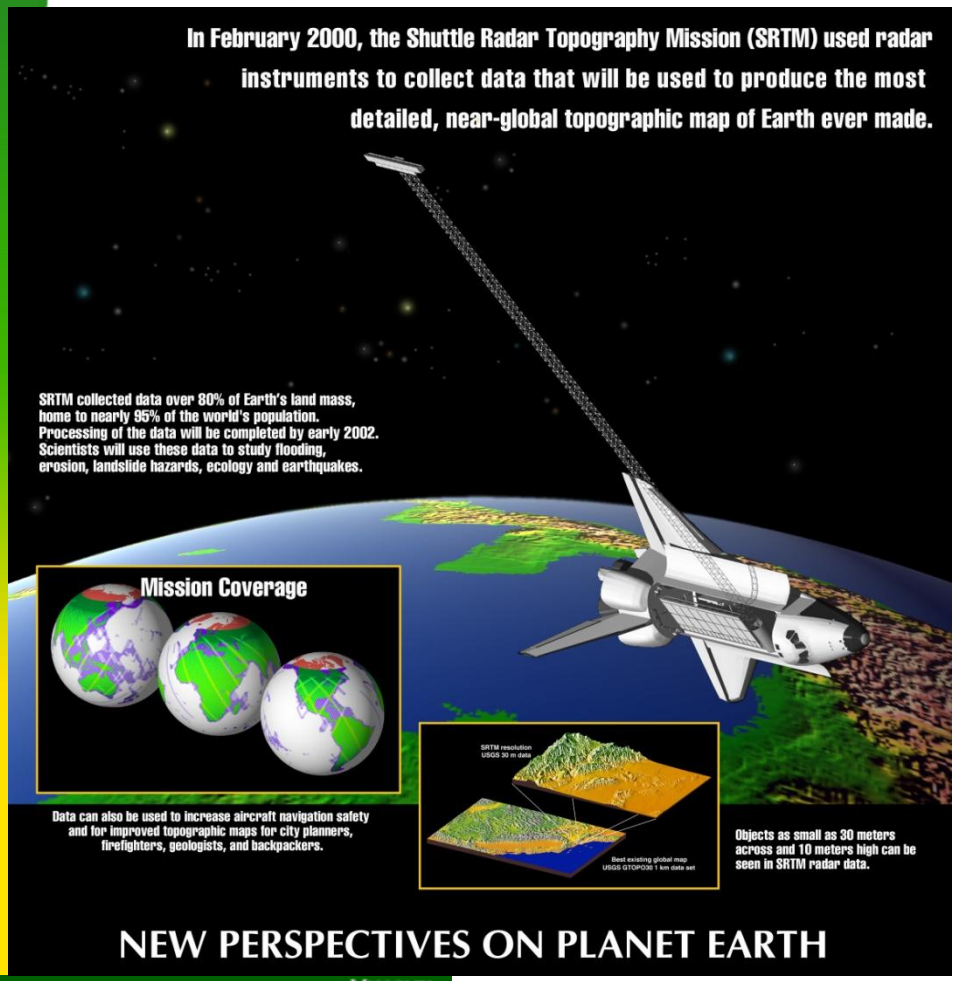
Student Cooperative with USGS - MCMC

- Program initiated by Prof. Rogers in Fall 2001. Prof. Rogers is former military intelligence officer
- Students volunteer time in exchange for on-the-job-training in new GIS applications
- Students work hand-in-hand with ongoing projects at the MCMC
- Students are able to gain advanced training in Photogrammetry, Spectral Analysis and Spectral Library Creation, DEM creation, and other state-of-the-art mapping techniques

GIS Courses Taught for Army Officers at Fort Leonard Wood

- MS degree program established in 1999
- Army officers attend classes in GIS and Remote Sensing
- Classes normally taken include GIS courses GE 248, 249, 344, 346, and 349
- Most courses are offered in late afternoons and evenings

An example of a customized course offering is Military Geology



- Military Geology was introduced as an experimental course for FLW officers in January 2002
- Established as GE 342 in Jan 2003, after two offerings
- Presently taught each semester
- Enrollment steadily growing
- Nationally recognized website established with pull-down PowerPoint lectures

Missouri University of Science and Technology

What is Needed to Create a Distance Education Relationship?

- Video Teaching
- Computer Station Laboratory
  - Both ends of communication
- Students must have access to computers that contain the proper software from a close proximity off-campus source.

Natural Hazards Mitigation Institute

- Established in 2001
- FHWA grant to identify EQ hazards in critical transportation corridors
- Development of mitigation schemes using retrofit or improved construction
- Access to a wide variety of research projects, including:
  - Seismic hazards
  - Flood hazards
  - Infrastructure disruption
  - Homeland Security issues
  - Mass movement hazards
  - Impacts of weathering and aging

Possible Course Offerings for USGS and/or NIMA:

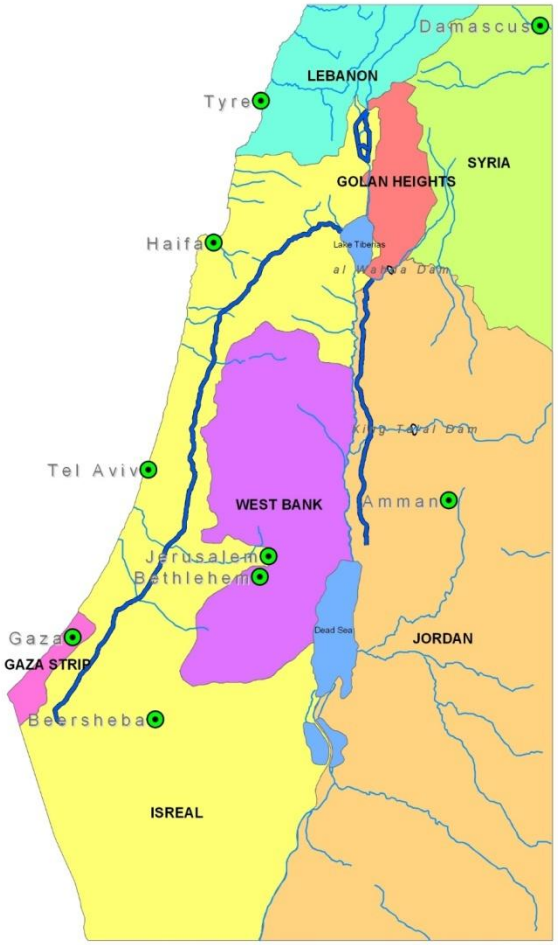
- GIS File Characteristics and Management
- Remote Sensing Fundamentals
- Advanced Applications of GIS and Remote Sensing
- Military/Homeland Security Applications of GIS
- History of GIS

Course #1

GIS File Characteristics and Management

BASIC PRODUCTS:

- **DRGs**
- **DOQQs**
- **DEMs/DTEDs**
- **DLGs**
- **Hyperspectral and Multispectral (IKONOS)**
- **Geologic maps**
- **Census tracts**
- **Hydrologic data**
- **Seismic information**
- **Climatologic data**
- **Geophysics data**
- **Land Use/Land Cover (LULC)**
- **Cadastral boundary maps, Political districts**
- **Transportation infrastructure layers, Administrative units, Major Arteries of Commerce**



GIS File Characteristics and Management

- Limitations on resolution of different types of data
- Subsurface management (below ground surface information; geology and hydrology)
- How to Create Specific Databases
- How to create multi-layer geopolitical map products for planning purposes
- Management of Workspace (the arrangement of all the potential files and how you work with these, modifying and controlling data streams within a given GIS)
- Management of Suites of information (information layers; sublayers)
- Attain Abilities in how to manipulate data; extract and combine different kinds of geospatial data
- Importance of Metadata

Course # 2

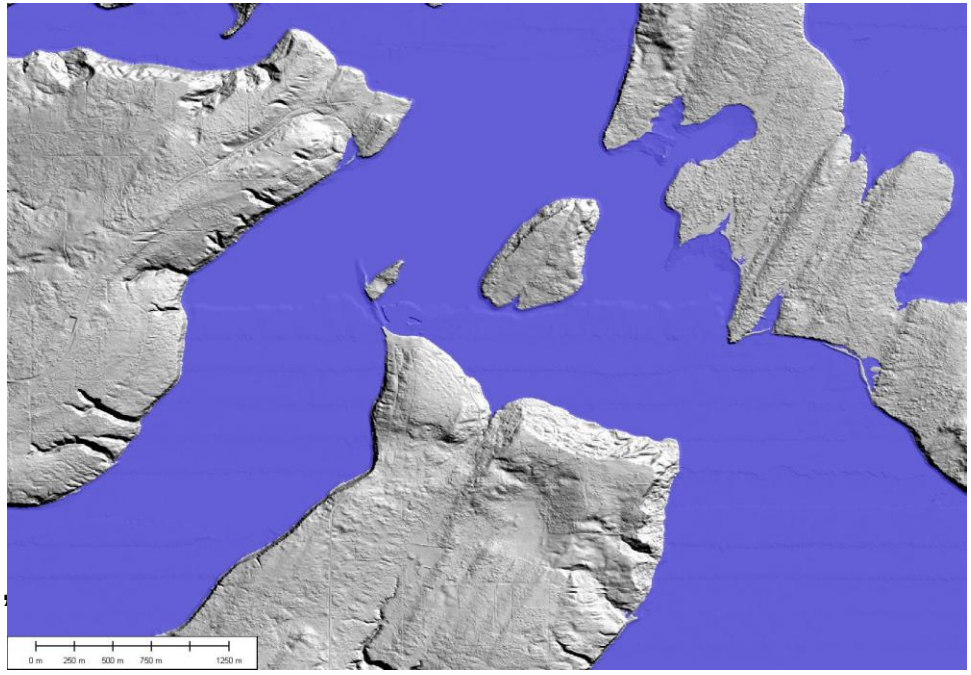
Remote Sensing Fundamentals

- **Stereopair Imagery – Fundamentals and Advanced**
- **Attain abilities on how to create spectral libraries**
- **0btaining hyperspectral and multispectral data**
- **Attain abilities on how to filter, manipulate, georeference/orthorectification**
- **Complexities how you get reflectance and transmittance information upwelling and downwelling atmospheric corrections**
- **Differences in resolution of data; then capabilities of various resolution data**

Course #3

Advanced Applications of GIS and Remote Sensing

- Creating surface maps and possibility of using lab equipment
- Familiarization with following systems:
- Radiometers,
- LiDAR,
- Terrestrial-based and Airborne LiDAR surveying systems,
- SAR systems,
- INSAR/IfSAR systems,
- LaDAR,
- Advanced DEM creation programs,
- Advanced remote sensing programs like ERDAS and ENVI



Course #4

Military Applications of GIS

- Terrestrial photogrammetry as an espionage and intelligence tool
- Prof. Lowe aerial photos from balloons during Civil War
- Kite photos between 1880-1916
- Beginnings in World War I
- Commercialization in 1920s in USA
- Wartime expansion in WW2; improvement of cameras and photo resolution
- Past failures of aerial imaging systems; such as Chinese troop concentrations near Fusin and Chosin Reservoir in fall of 1950;
- U-2 flights 1960s;
- Satellite-born expendable film canisters (1961-70);
- Tactical recee airborne systems (Cuban Missile Crisis Oct 1962 and Ho Chi Ming Trail 1965-73);
- Development of remotely piloted vehicles (RPVs);
- ABM treaty verification remote sensing methods (post 1972);
- Space-based remote sensing platforms, including Skylab and classified DoD low orbit sensor systems;
- Introduction of non-visible EMS sensor platforms in late 1970s through late 1980s;
- Unmanned Aerial Reconnaissance Vehicles (UARVs)

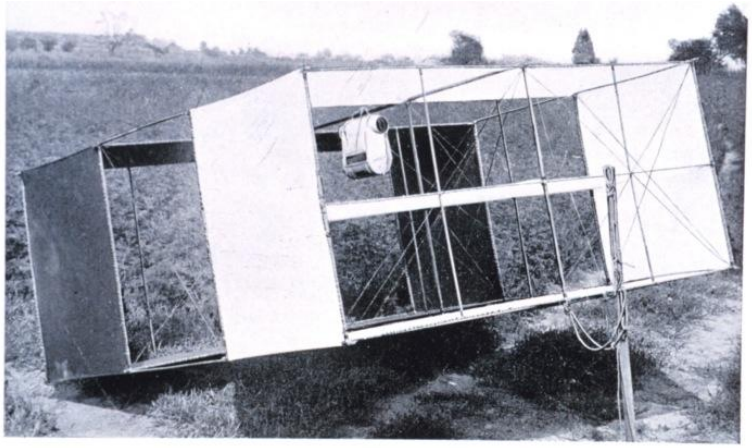


FIG. 2.—KITE AND MARVIN METEOROGRAPH.

Course #5

History of GIS

(Possible Humanities Course)

- Beginnings of cartography to present-day mapping methods
- Beginning with cadastral maps
- How surveying principles were applied to the evolution of mapping techniques.
- Development and evolution of aerial sensing platforms, beginning in First World War.
- Vertical stereopairs and oblique imagery;
- Then larger focal length cameras,
- Then gradual use of satellite-based platforms, using the entire electromagnetic spectrum.
- Near IR, ISAR and SAR (Band P and X) imagery