



# GIS

*The Geographic Approach for the Nation*



## ESRI Federal User Conference

Washington, D.C. • February 17-19, 2010



# Using ArcGIS and the Cloud

Ismael Chivite, Marwa Mabrouk



# What is the Cloud?



# ~~What is the Cloud?~~





# How can the Cloud Help me do my job?



# A practical Approach



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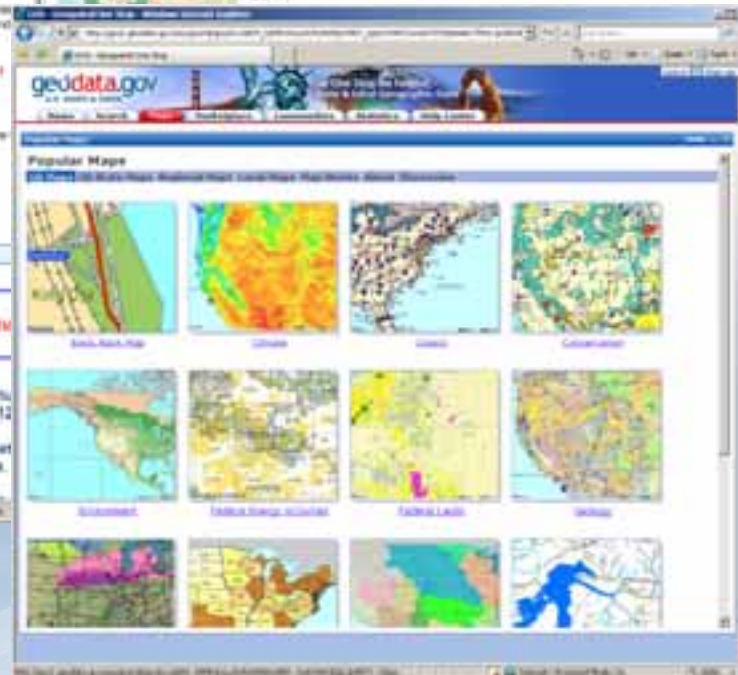
**Challenge: Accessing GIS resources**

- Massive amounts of data (imagery, vector...)
- Frequent data updates
- Sophisticated GIS functionality

**•Solution:**

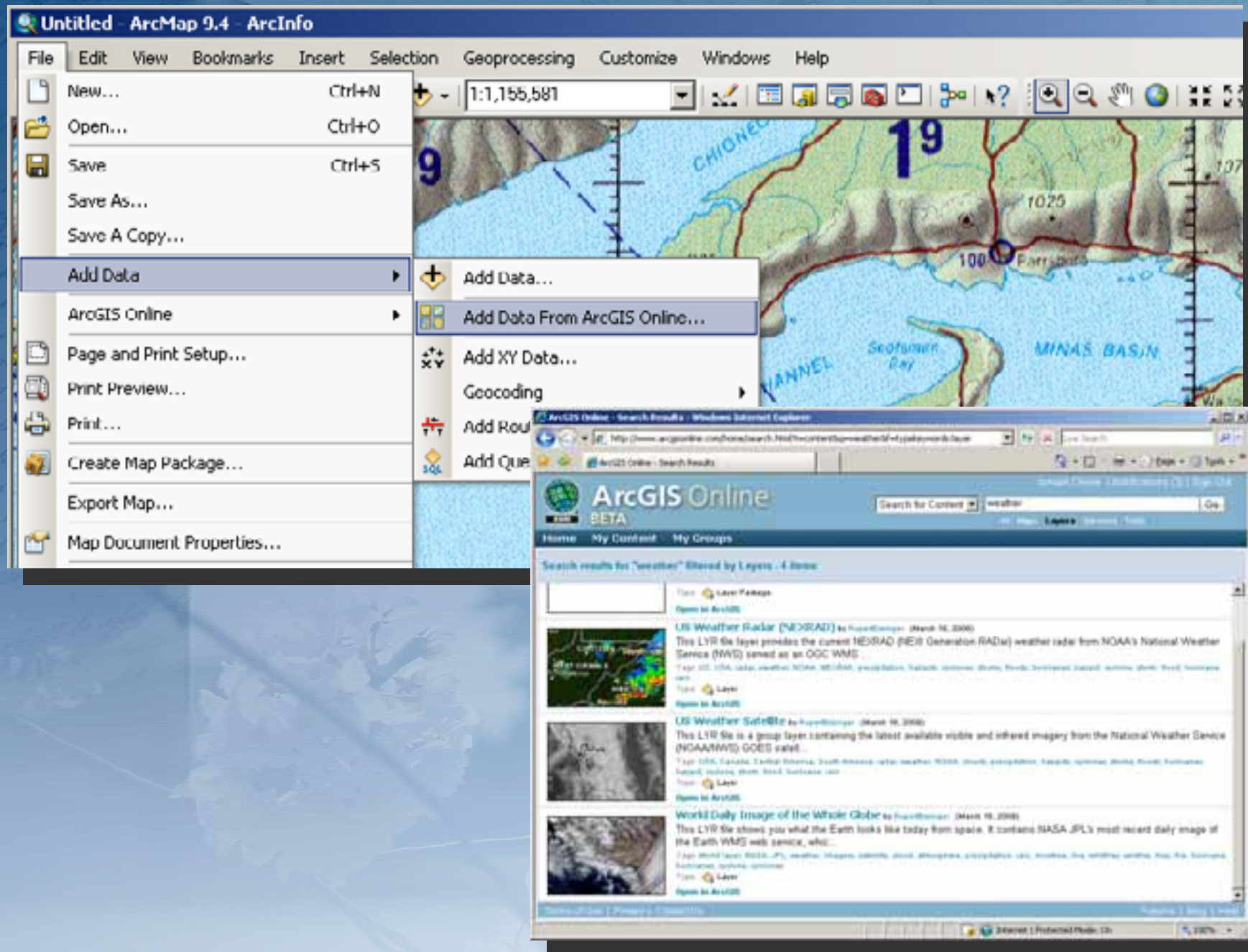
- Use on-demand GIS services from the cloud

# Not a new challenge



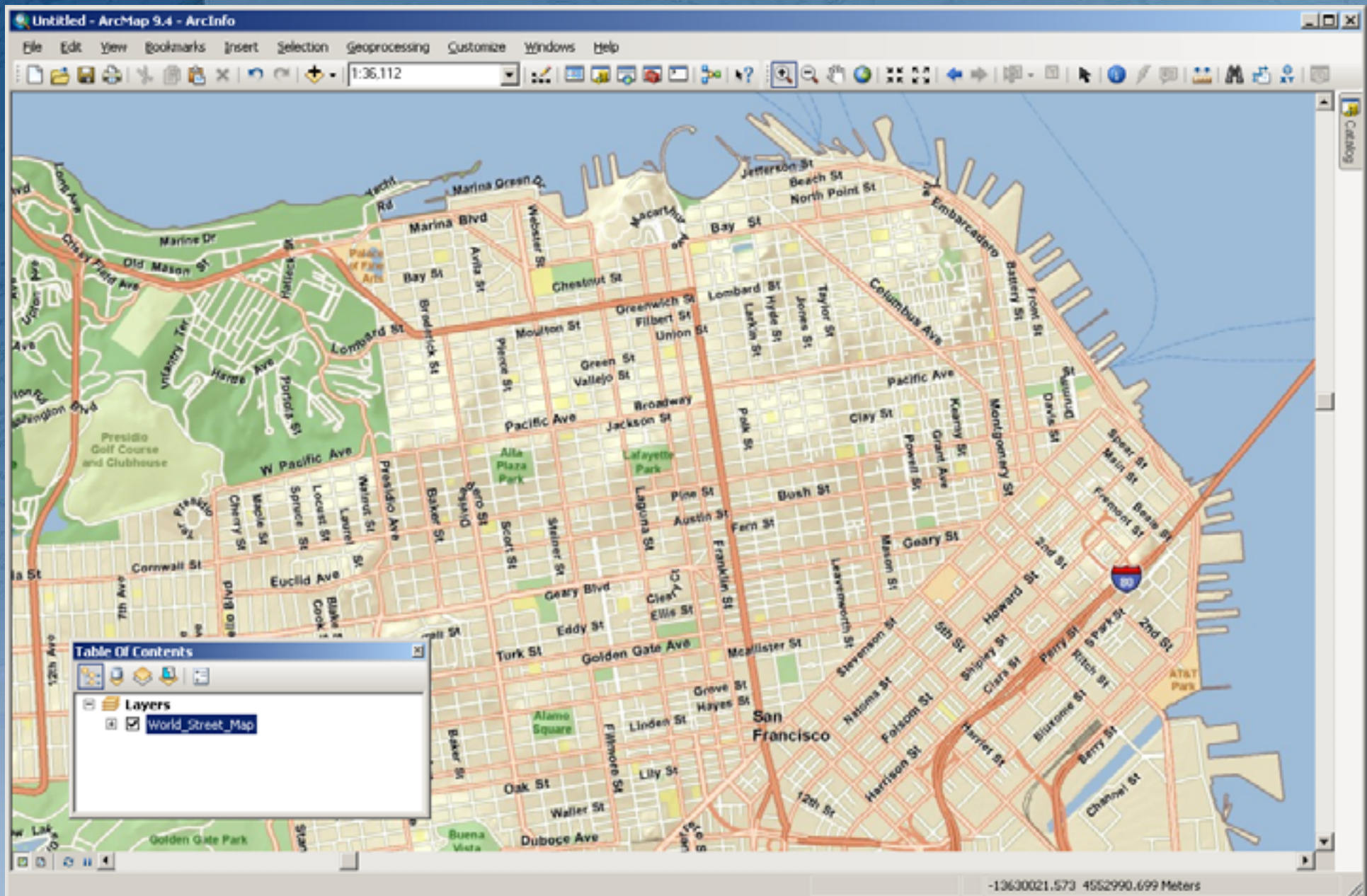


# Accessing cloud content from ArcMap



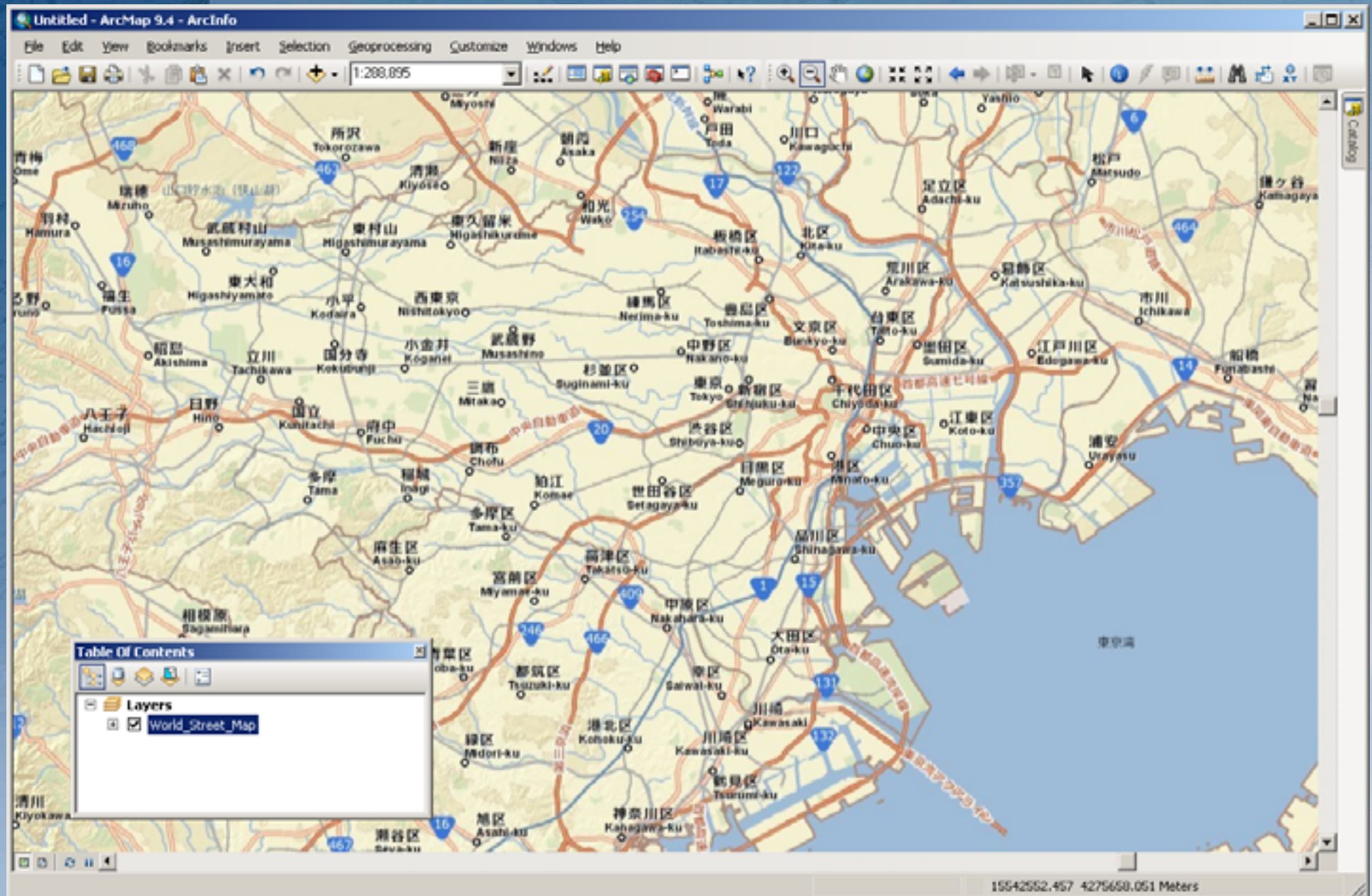


# World Street Map



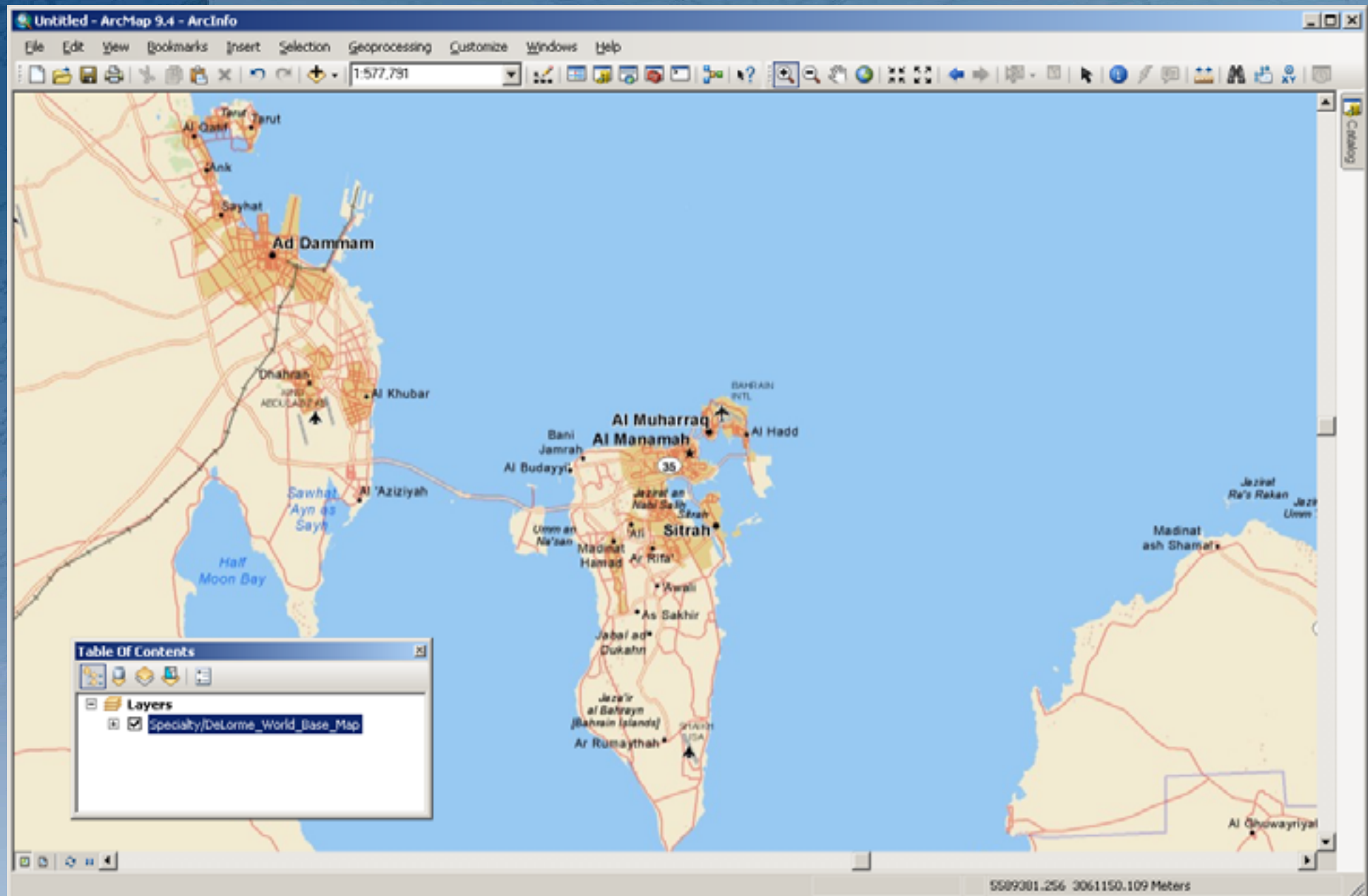


# World Street Map

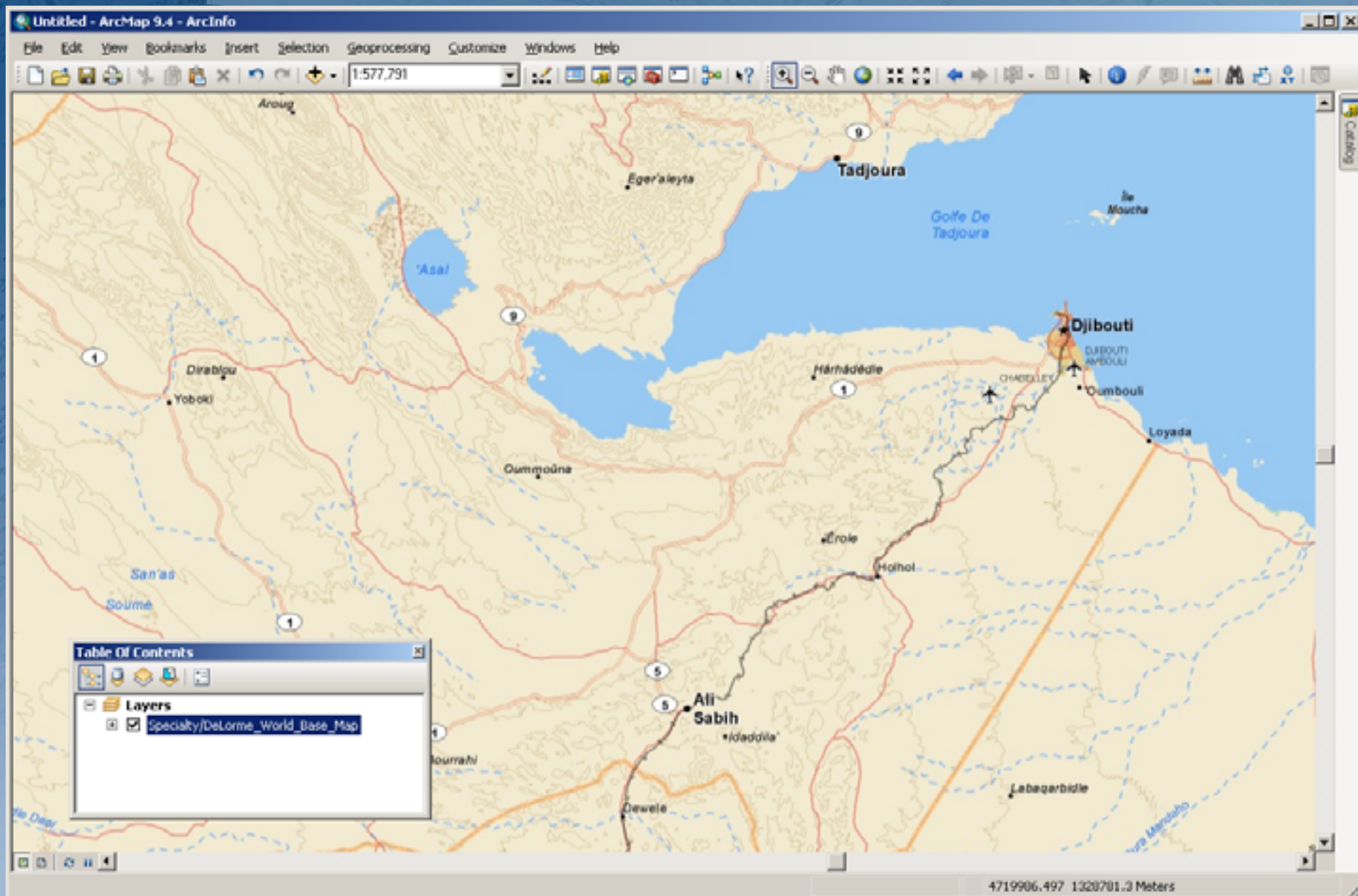




# DeLorme World Basemap

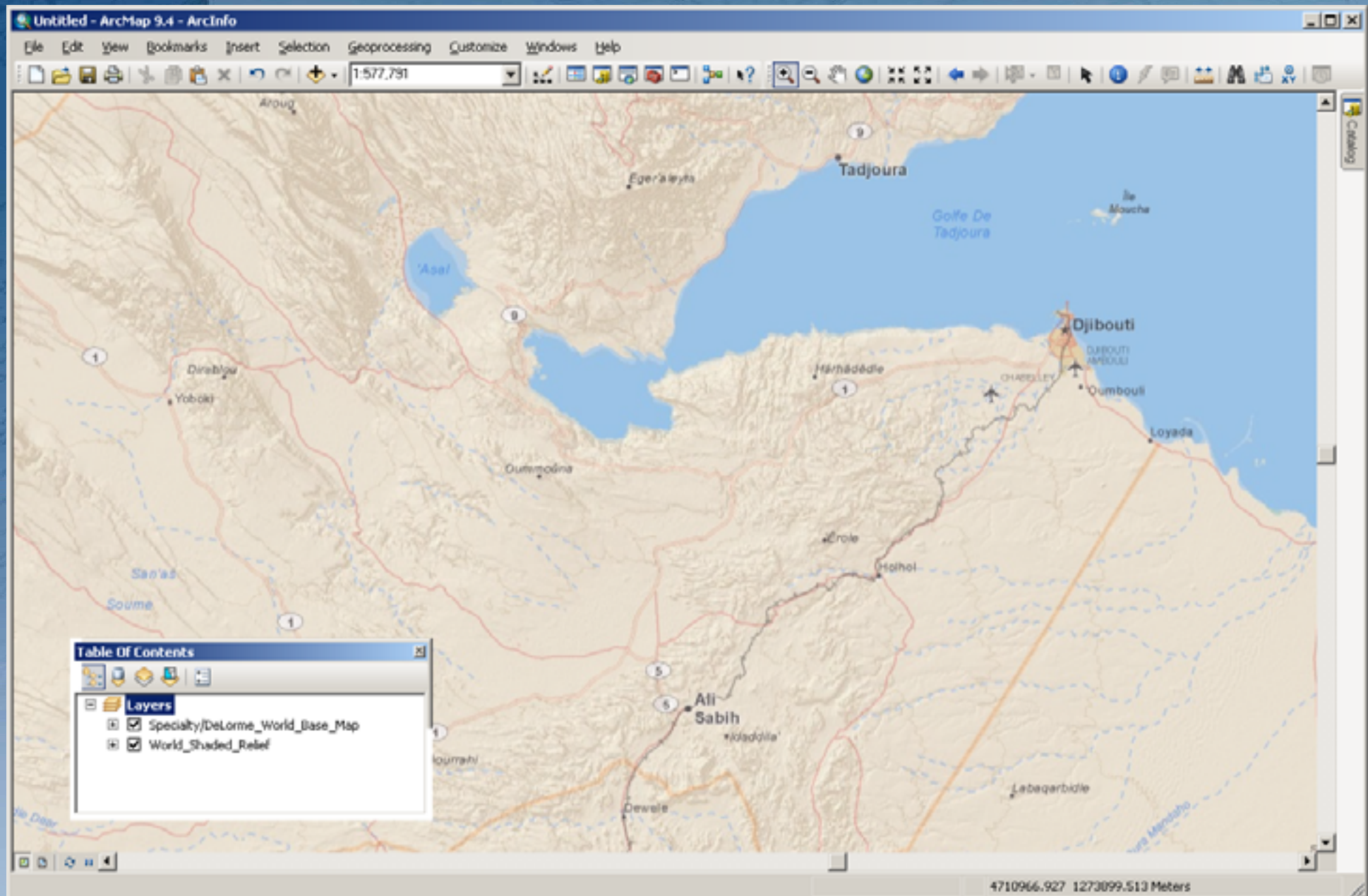


# DeLorme World Basemap

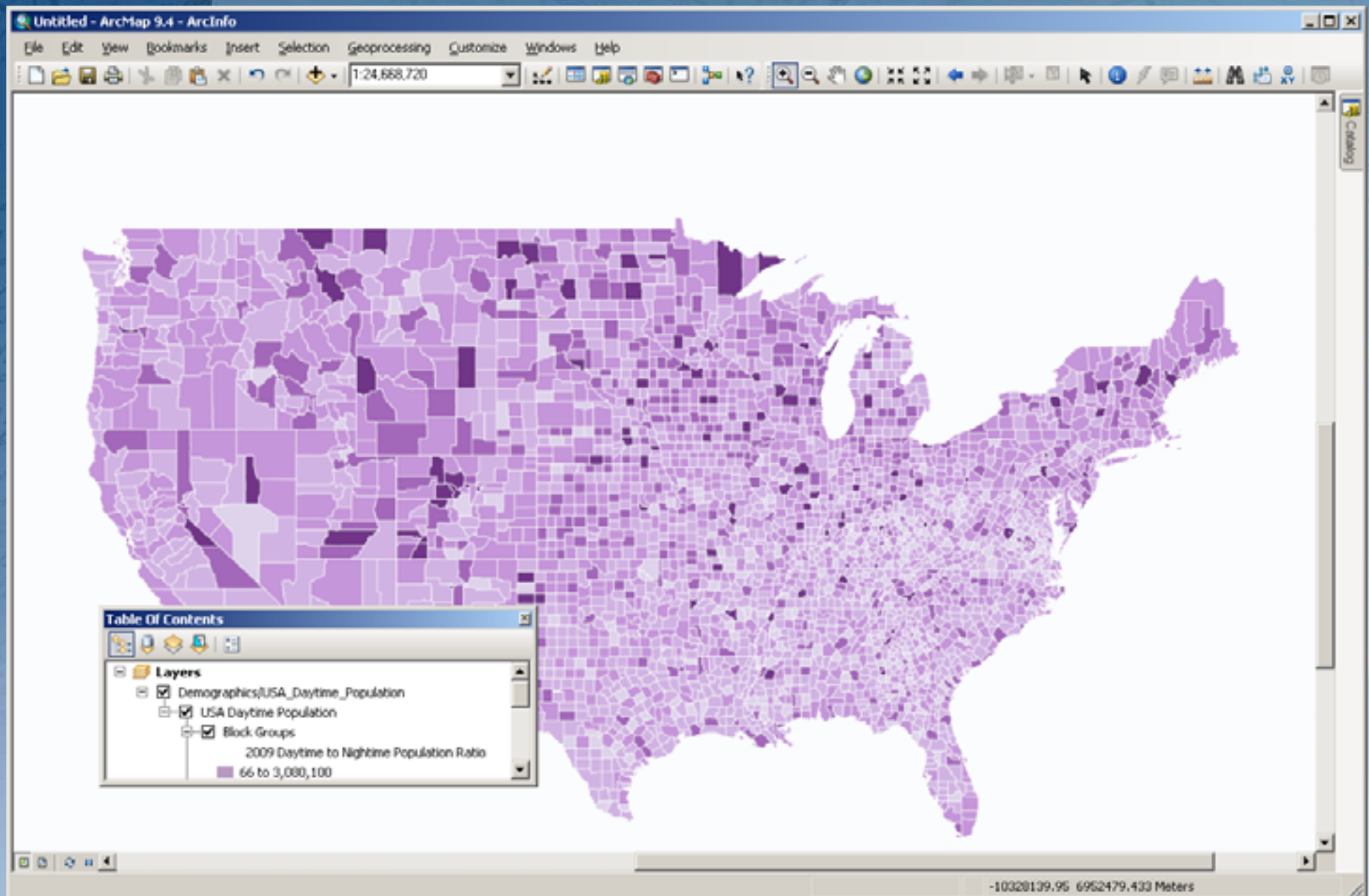




# DeLorme World Basemap

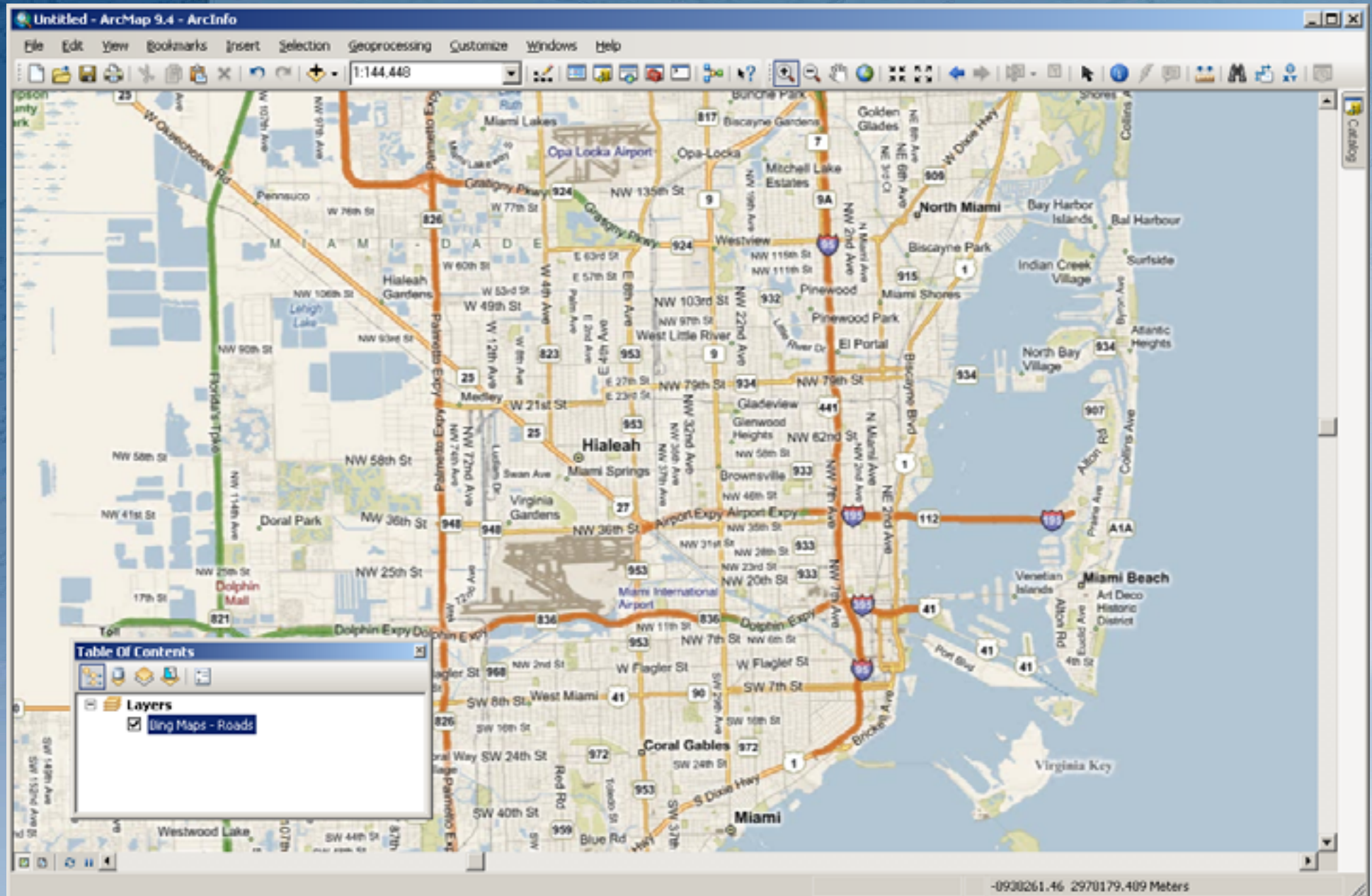


# ESRI Demographics Data



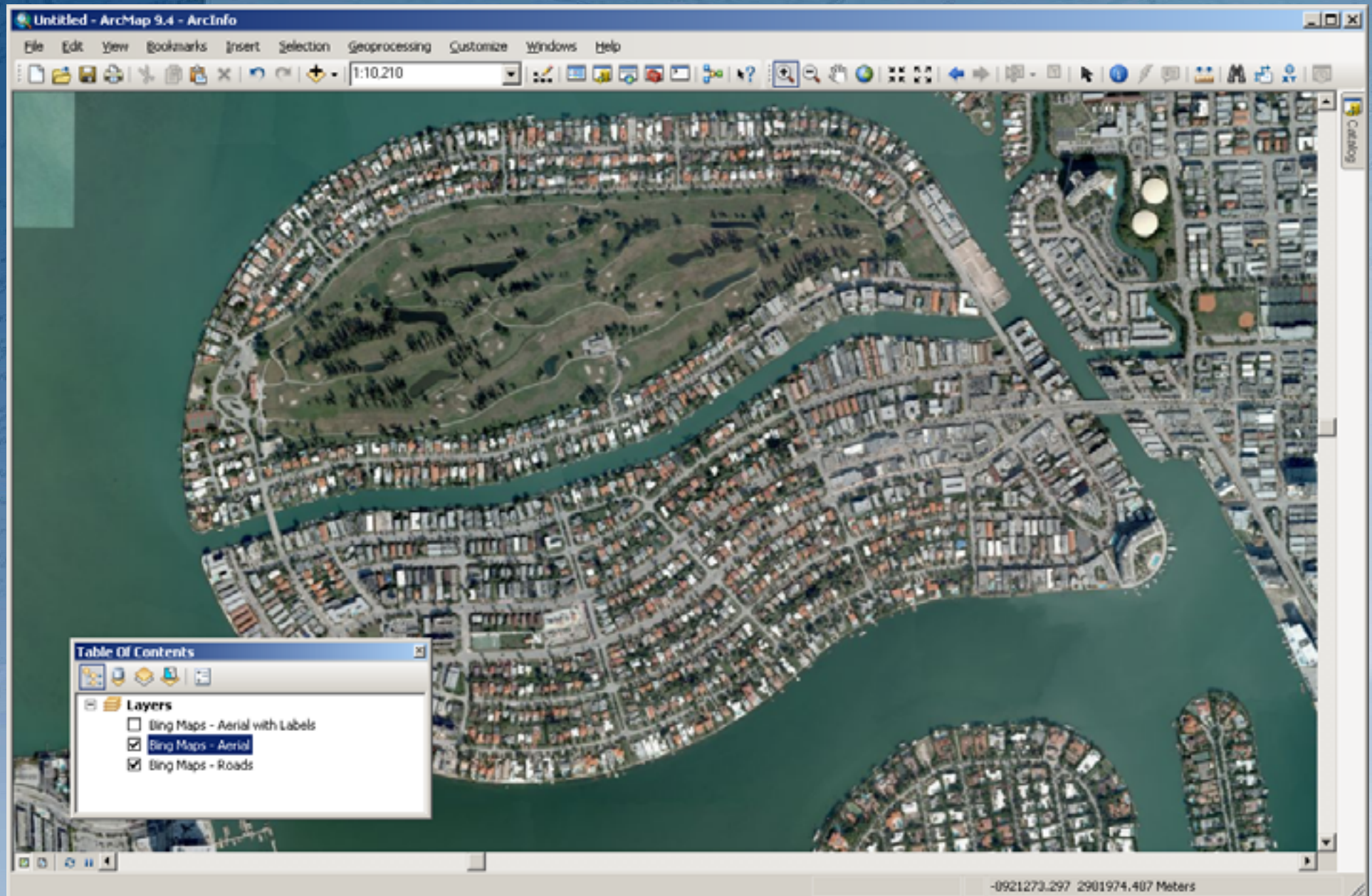


# Bing Maps (Roads)



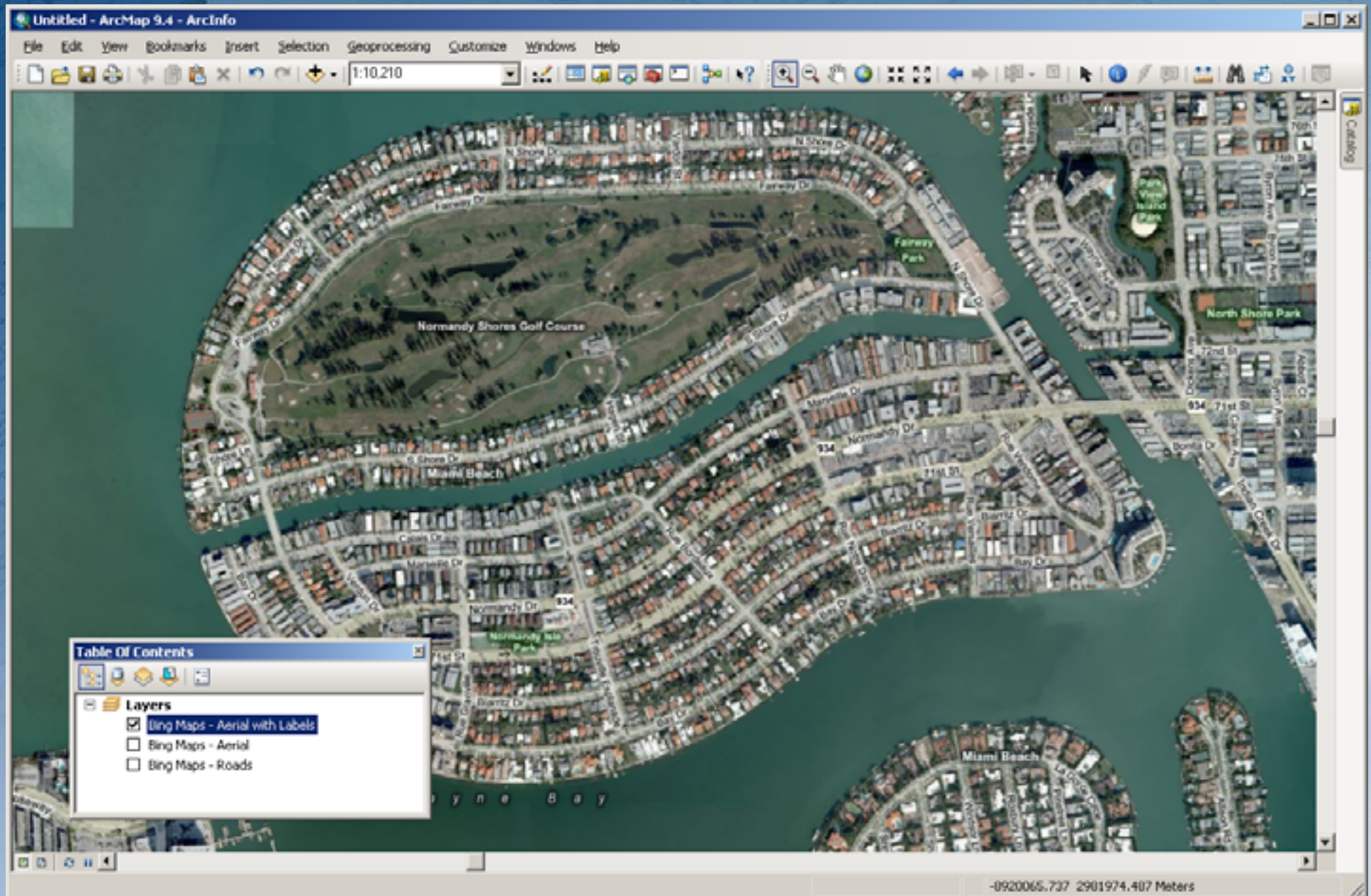


# Bing Maps (Imagery)



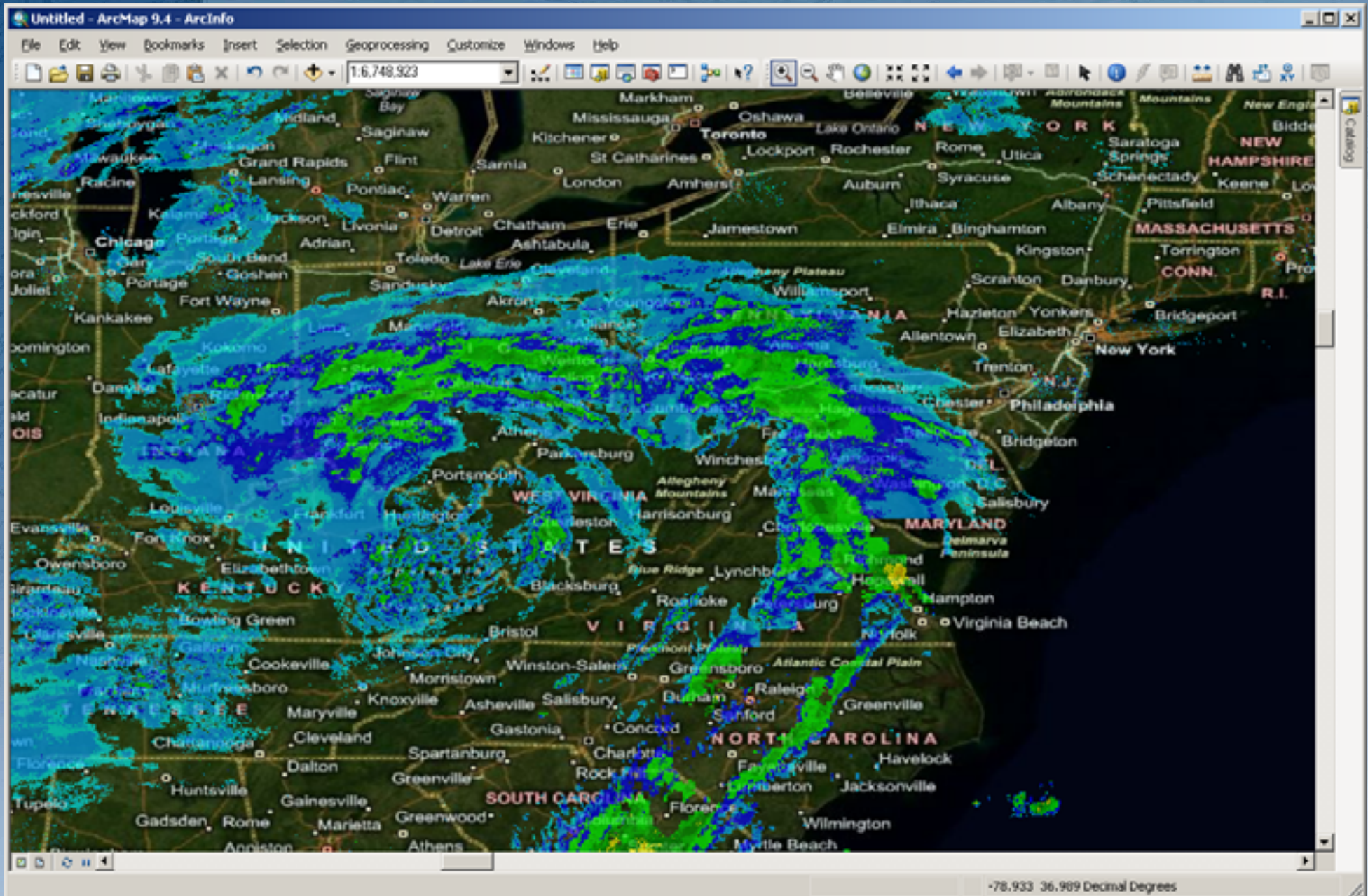


# Bing Maps (Imagery + Labels)





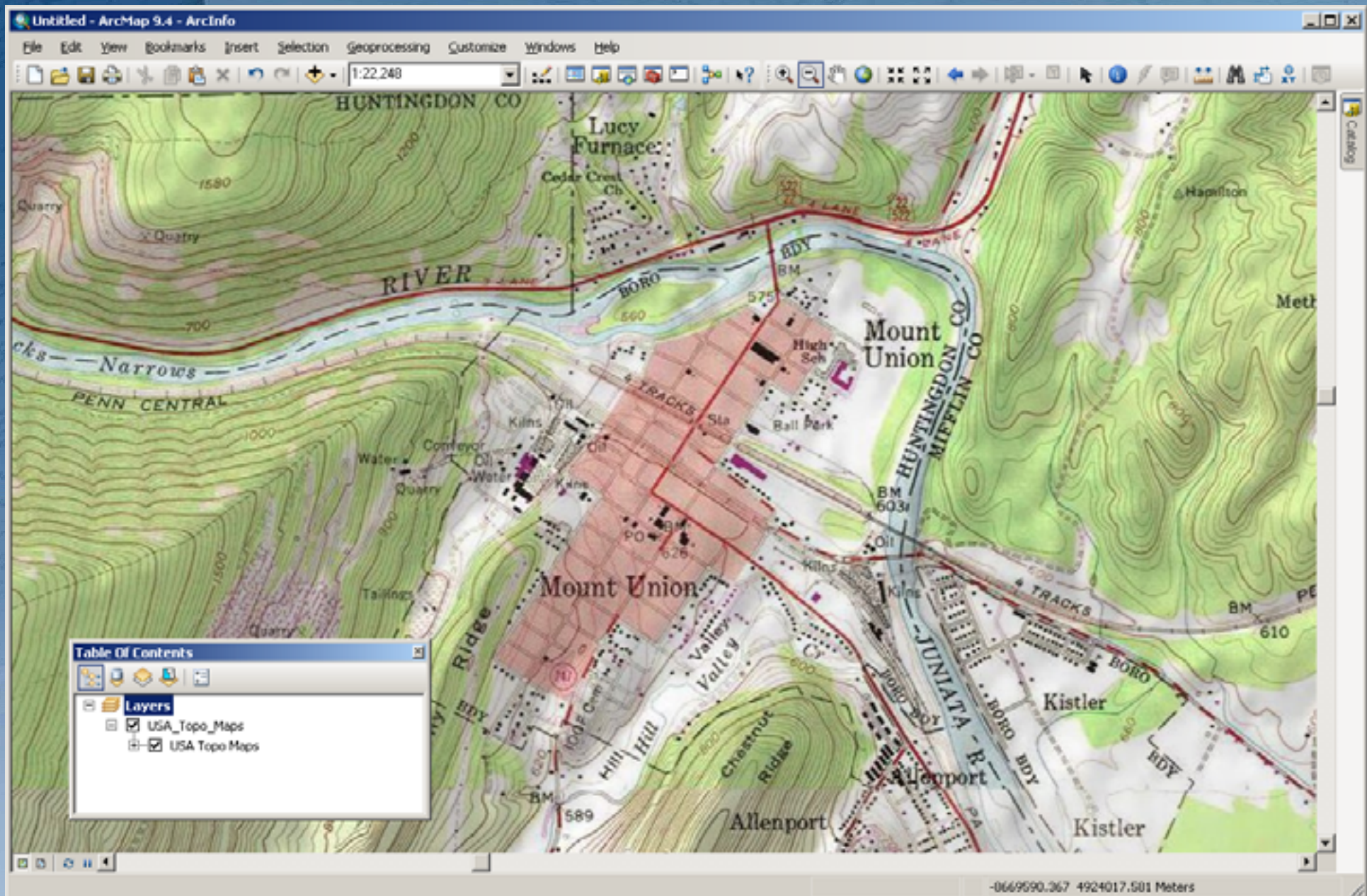
# NOAA NEXRAD





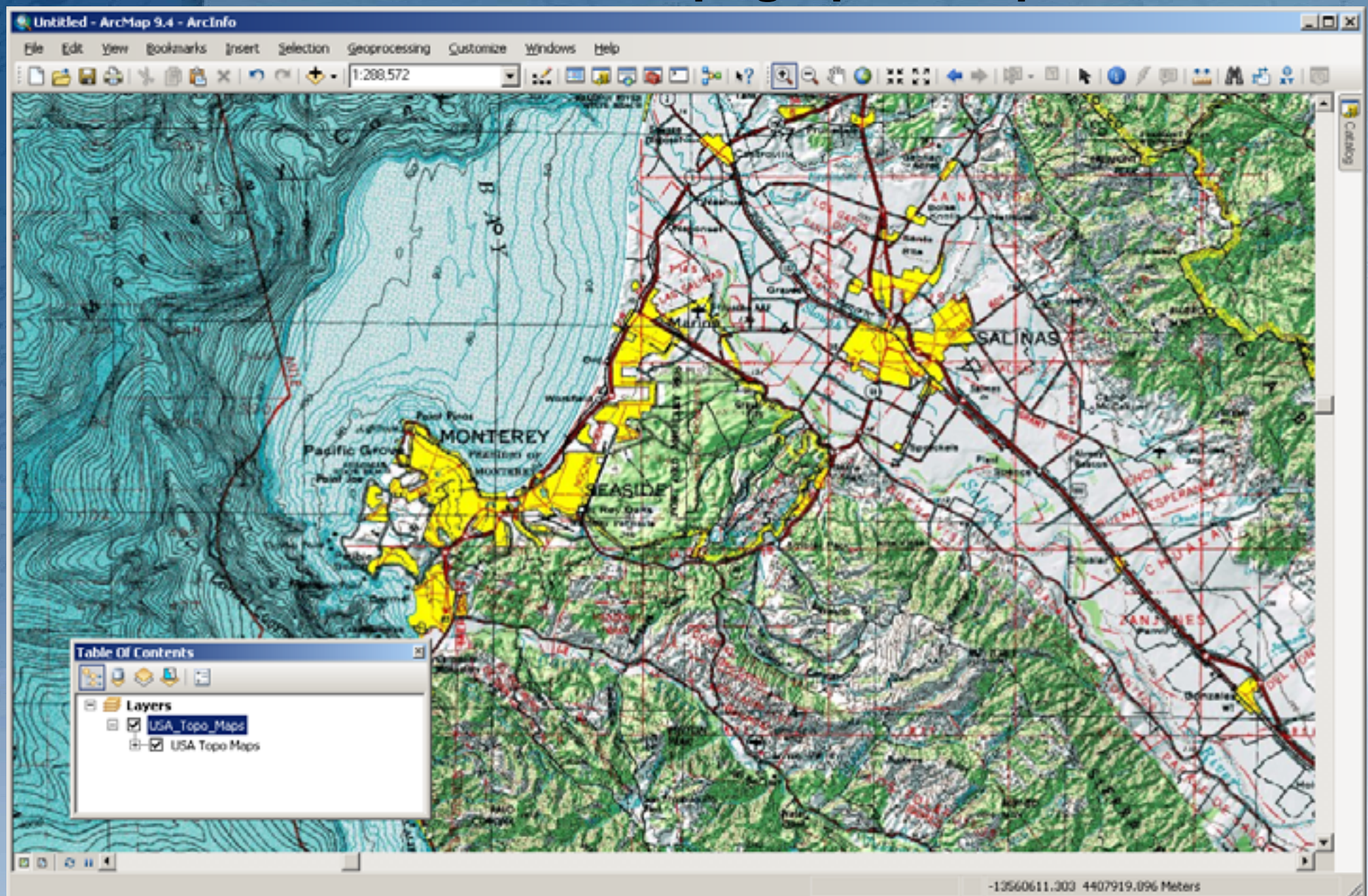
# US Topographic Maps

The screenshot shows the ArcMap 9.4 interface with a US Topographic Map of Mount Union, PA. The map displays contour lines, roads, and railroads. A 'Table Of Contents' window is open in the bottom left, showing the 'Layers' list with 'USA\_Topo\_Maps' and 'USA Topo Maps'. The map is titled 'Untitled - ArcMap 9.4 - ArcInfo' and the scale is 1:22,240. The map shows the town of Mount Union, PA, with the Juniata River and the Pennsylvania Central Railroad. The map is divided into sections by the Juniata River and the Pennsylvania Central Railroad. The map shows the town of Mount Union, PA, with the Juniata River and the Pennsylvania Central Railroad. The map is divided into sections by the Juniata River and the Pennsylvania Central Railroad. The map shows the town of Mount Union, PA, with the Juniata River and the Pennsylvania Central Railroad.



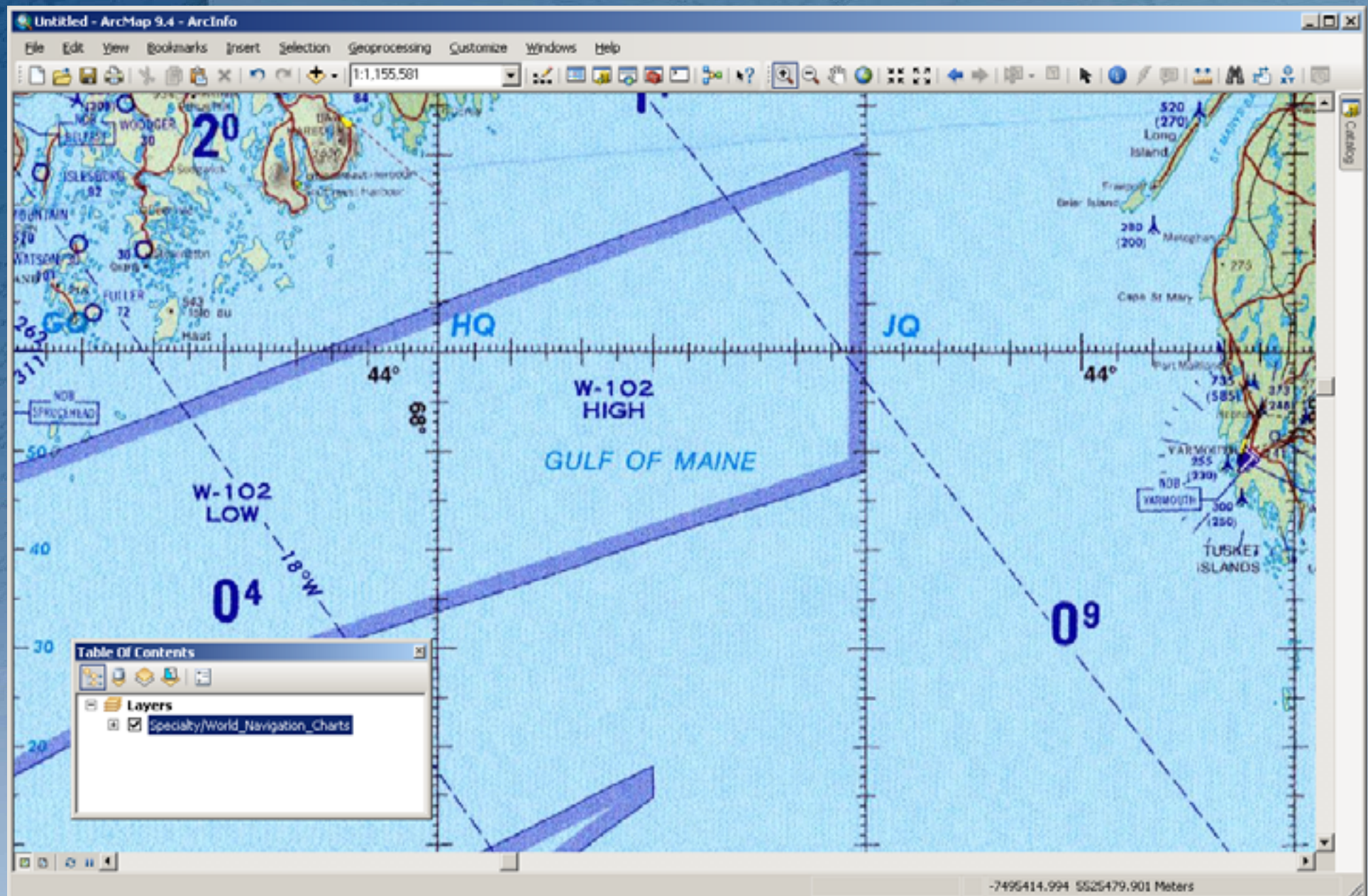


# US Topographic Maps



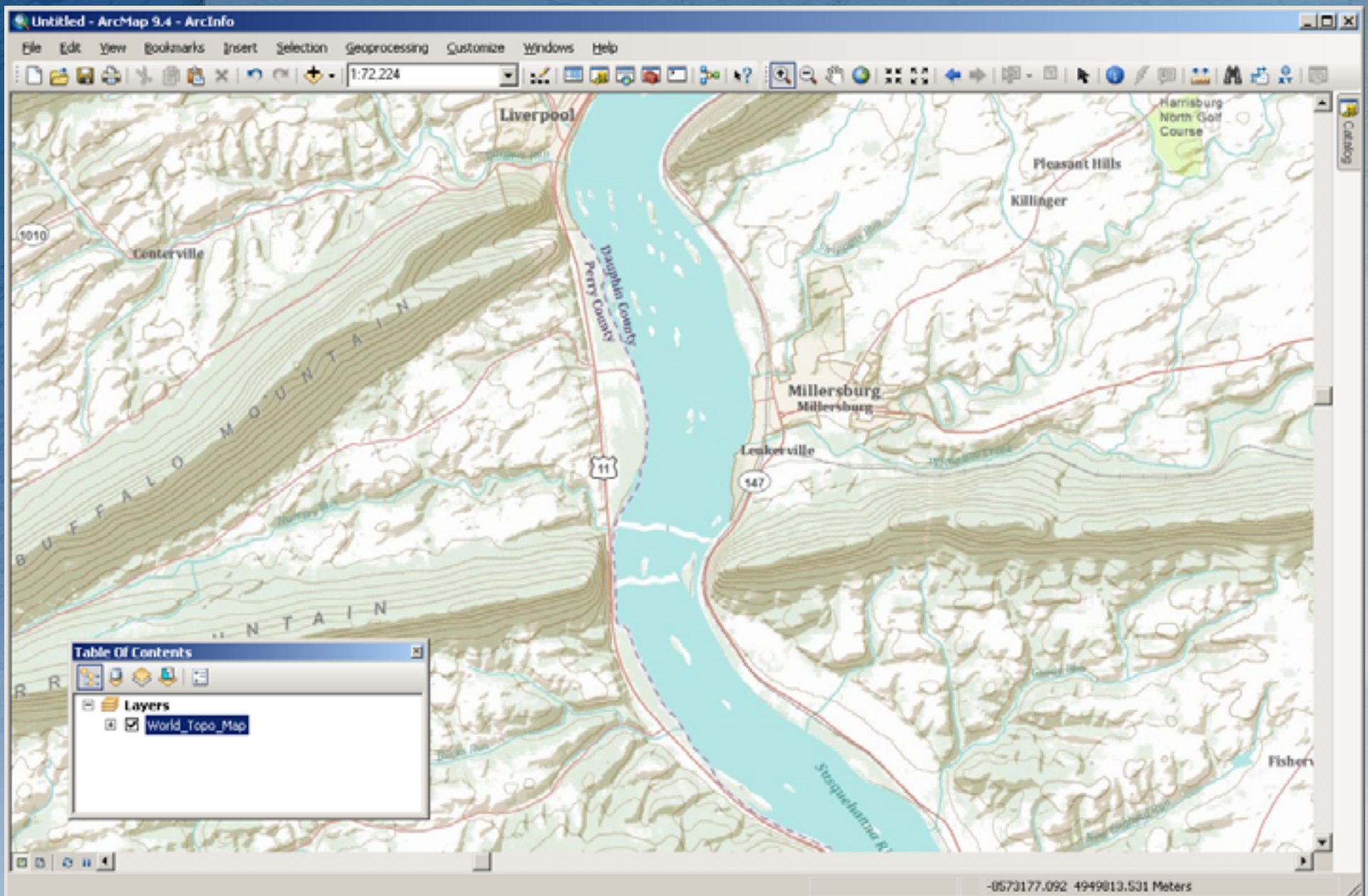


# World Navigation Charts (ONC)



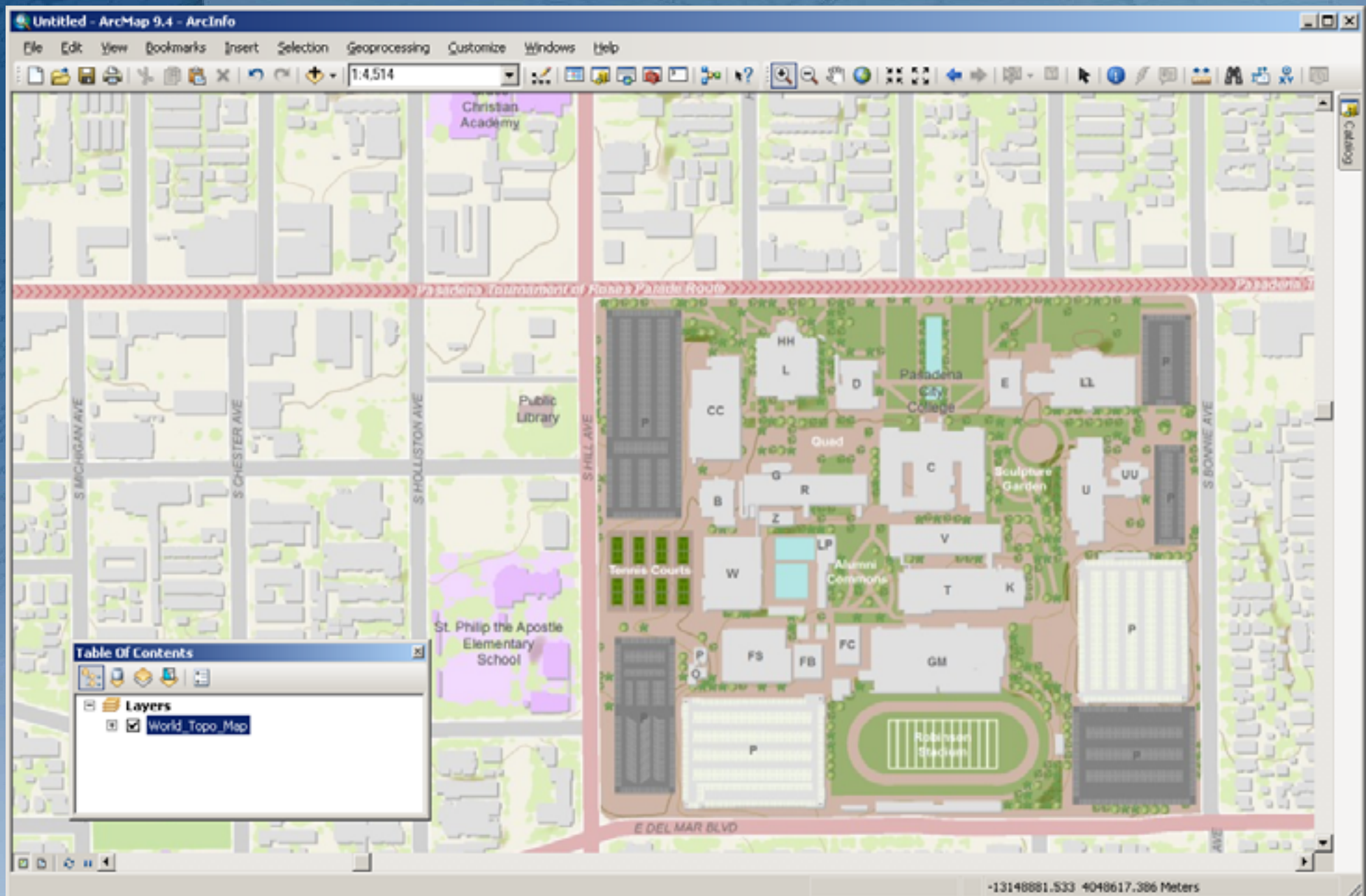


# World Topographic Map (Community Base Map)





# World Topographic Map (Community Base Map)





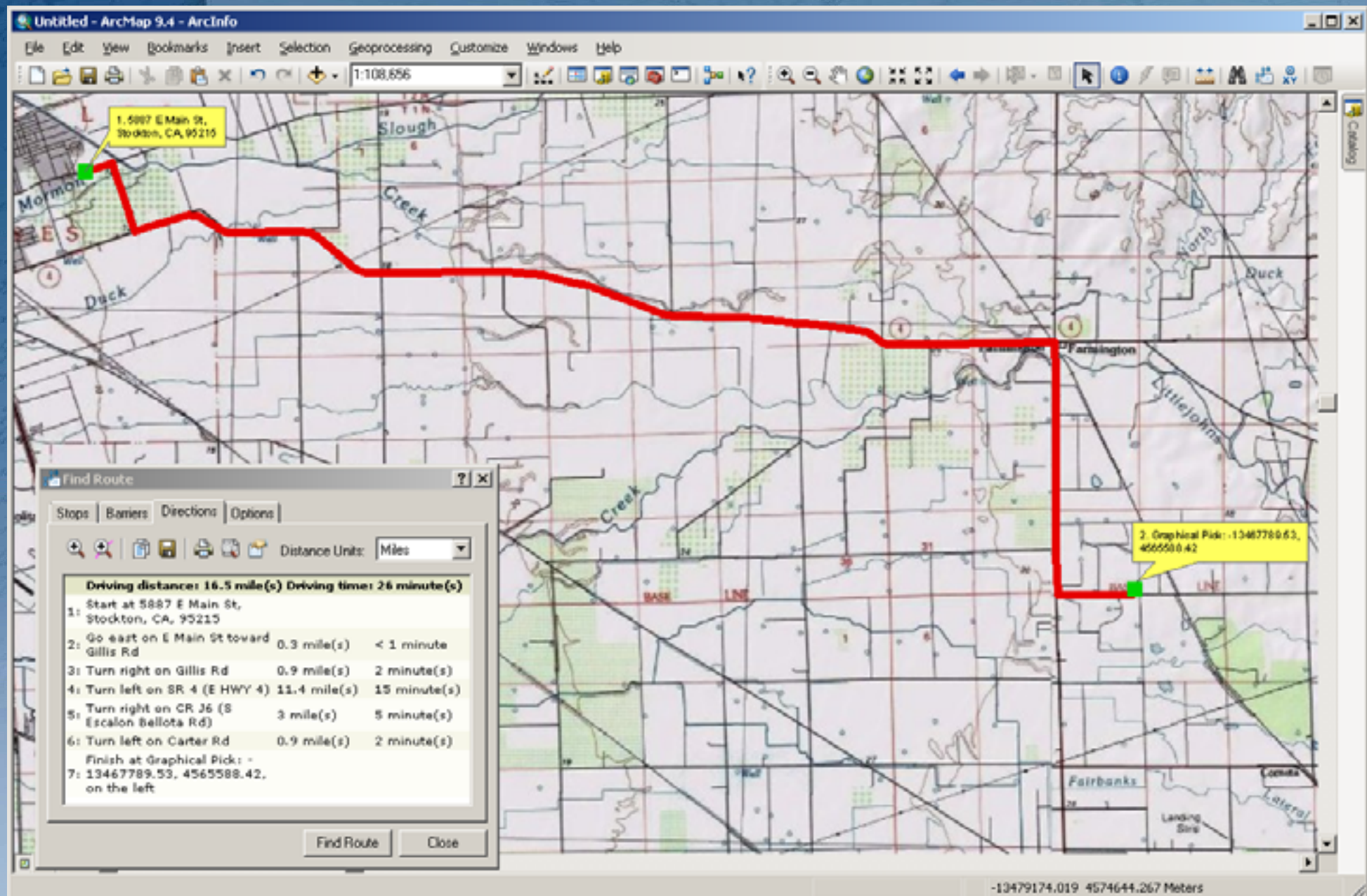
**Quick Demo!**



**Not just map content...  
GIS Services too**

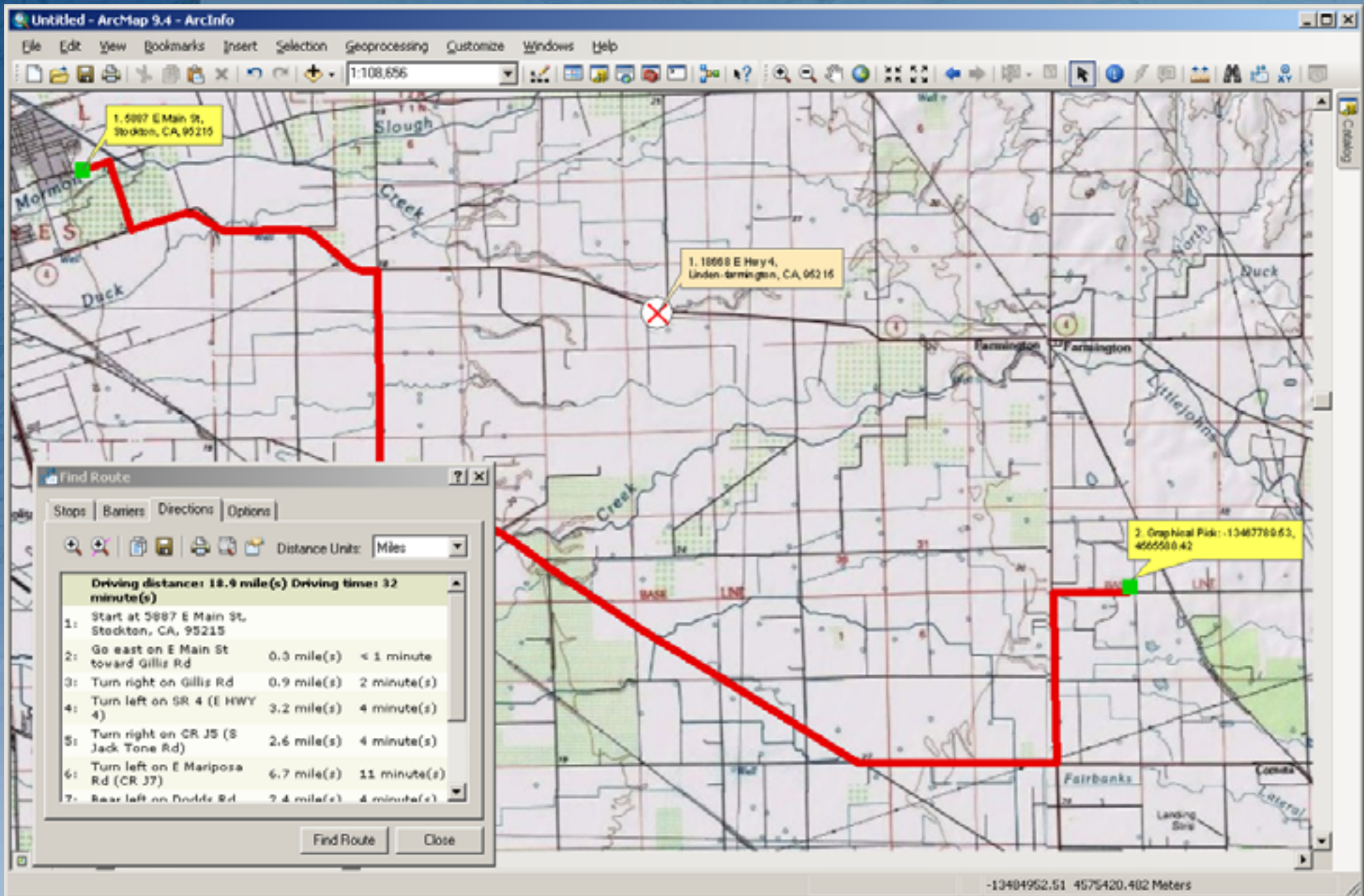


# ArcGIS Routing and Geocoding Cloud Services



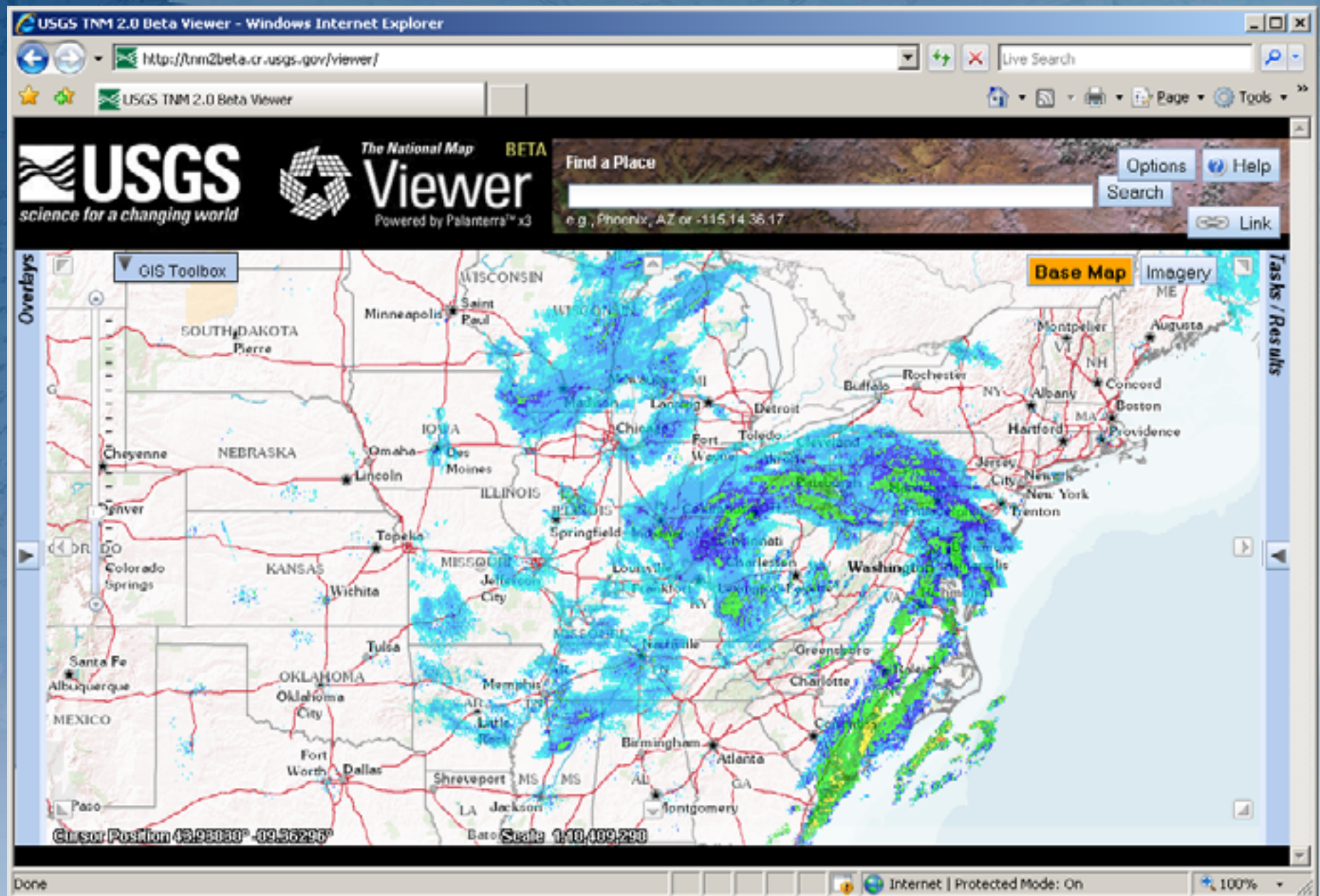


# ArcGIS Routing and Geocoding Cloud Services





# Accessing Cloud Services from Web apps





GeoMine System for  
Easement Recording & Search  
*USDOI Office of Surface & Mining*



Climate Change & Strategic Habitat  
Conservation Mapper  
*Fish & Wildlife Service*



Easement Recording & Search  
*USDA NRCS*





## Tracking Stimulus Dollars *U.S. Department of Transportation*



## Common Operational Picture *Louisiana National Guard*



## Flood Inundation Modeling *DHS/NPPD/IP/IICD*



## Collecting Storm Damage Information *National Weather Service*



# You, as a service provider

Mapping Services - Windows Internet Explorer

http://www.epa.gov/waters/geoservices/docs/waters\_mapping\_services.html

U.S. ENVIRONMENTAL PROTECTION AGENCY

## Watershed Assessment, Tracking & Environmental Results

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### Mapping Services

- [Description](#)
- [Environment](#)
- [ArcGIS Server](#)
- [ArcIMS Server](#)
- [Service Formats](#)
- [Metadata](#)
- [Changelog](#)

#### Description

WATERS exposes several mapping services that provide access to numerous datasets. This web page describes the content and purpose of each mapping service.

Each service is provided in [ESRI proprietary formats](#) EXIT Disclaimer and [Open Geospatial Consortium](#) EXIT Disclaimer open standards formats to enable the display and query of spatial WATERS data. Non-developers can utilize these services using a variety of mapping and GIS applications. Using such tools, the WATERS mapping services can be used as a data source, transparently integrated with other data sources such as shapefiles or geodatabase layers. For developers, custom html-based web applications can be created that use standard web and mapping service syntax to make requests for data in order to display maps or tabular information.

#### Environment

[Example Consumers](#)

File Geodatabase

Internet | Protected Mode: On 100%



# Software + Cloud Services



- Accessing massive amounts of information without hassle
  - No need to copy, load, maintain data
  - No need to update data (it just happens)
- Easy access via ArcGIS Online (and other portals)
- Works in private clouds via the ArcGIS Data Appliance
- For the Desktop and Web Map Application builder
- Other features in ArcGIS Online: Sharing and Layer Packages



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# On-Line GIS



ArcGIS.com

- Search / Sharing /Storage
- Caching
- Feature Services
- Web Map hosting
- And more...



Desktop 10.next



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# Dilemma: Time to service



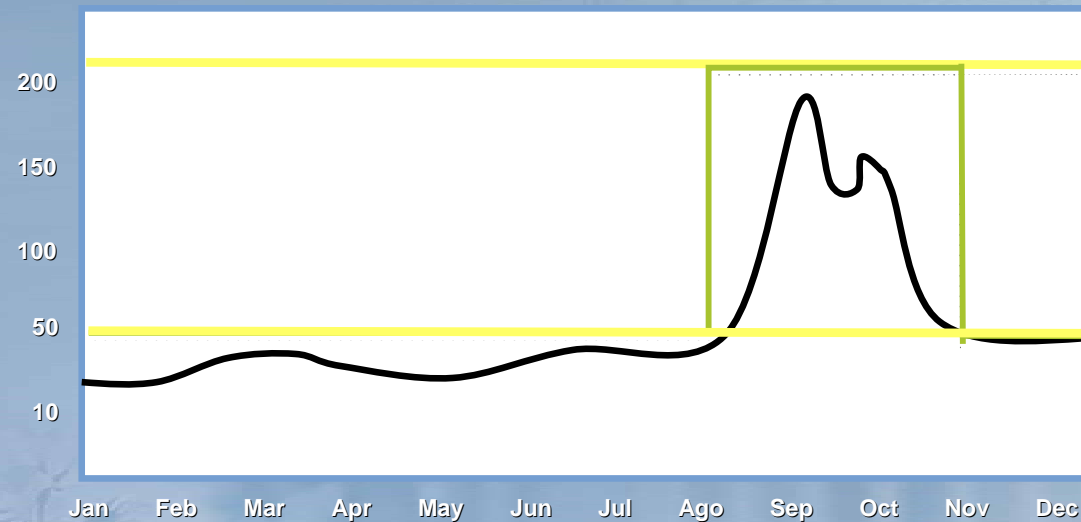
**Procure Hardware**

**Setup Application/Database Server**

**Load Data and Applications**

**Make available**

# Dilemma: Capacity vs Demand





# Elastic Cloud Computing with Amazon

Amazon Web Services - Windows Internet Explorer

http://aws.amazon.com/

Live Search

Amazon Web Services

Sign in to the AWS Management Console | Create an AWS Account

aws Products Developers Community Support Account

**Build even more resilient Web apps**  
New monitoring, auto scaling, and elastic load balancing features for Amazon EC2 now available.  
[Learn more](#)

Sign up for a free Amazon Web Services Account  
[Sign Up Now](#)

**Get Started**

**Business Managers**  
Learn how Amazon Web Services enables you to reach business goals faster:

- Solutions & Use Cases
- Security Center
- Economics Center
- Case Studies
- Service Health Dashboard
- Solution Providers

**News & Events**

What's New? Media Coverage Upcoming Events

Feb 09, 2010	Announcing Consolidated Billing for AWS Accounts	Feb 01, 2010	AWS Announces Lower Pricing for Outbound Data Transfer
Feb 08, 2010	Versioning Feature for Amazon S3 Now Available	Dec 18, 2009	AWS Management Console Adds Support for Elastic Load Balancing
Feb 02, 2010	Amazon Elastic MapReduce Now Supports Job Flow Debugging via the AWS Management Console	Dec 15, 2009	Announcing Amazon CloudFront Streaming

Done Internet | Protected Mode: On 100%

# Ready to use ArcGIS Server 10 AMIs



## ArcGIS Server Advanced Enterprise 10

- On Windows 2008 R2
- Image Extension (optional)



## ArcGIS Enterprise Geodatabase 10

- On PostgreSQL





**Quick Demo!**



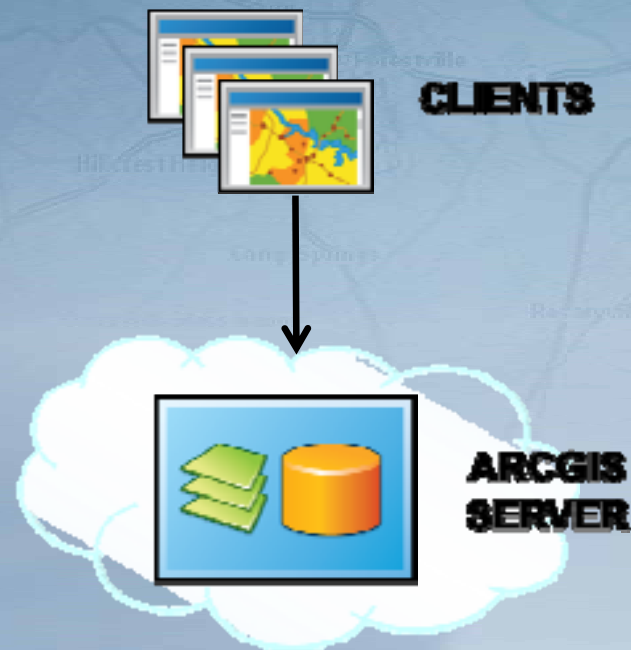
# Typical deployment Patterns for ArcGIS Server in the Amazon Cloud



# Workgroup deployment



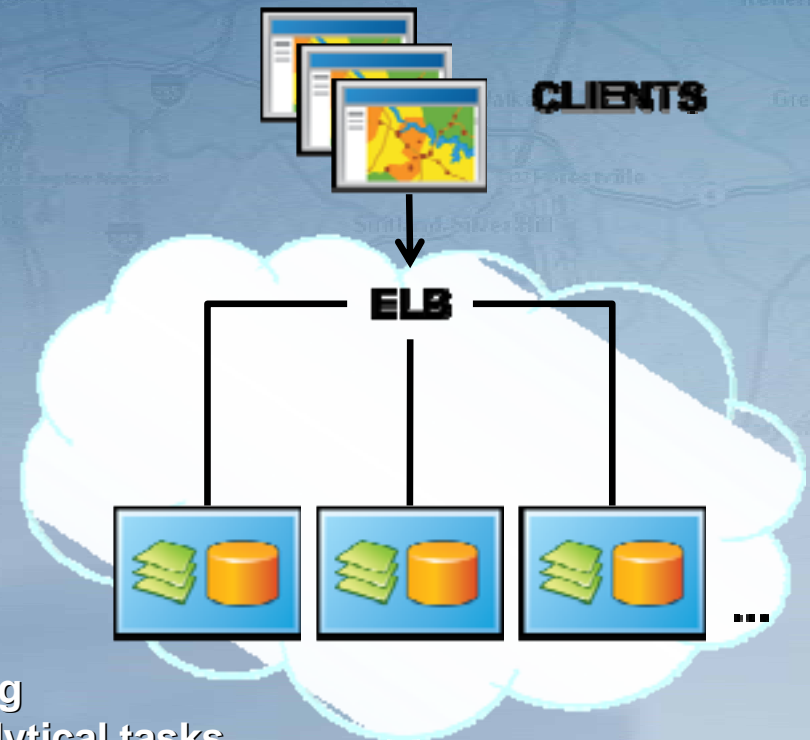
- Sandbox
  - Deployment on-premise
  - Deployment on cloud
- One server
- Static data
- Non HA: Single point of failure



# Elastic Cluster of Workgroups



- ELB clustering Workgroups
- Scheduled or demand-based sizing
- For apps and ad-hoc massive analytical tasks
- HA: No single point of failure
- Variation: Clone across regions

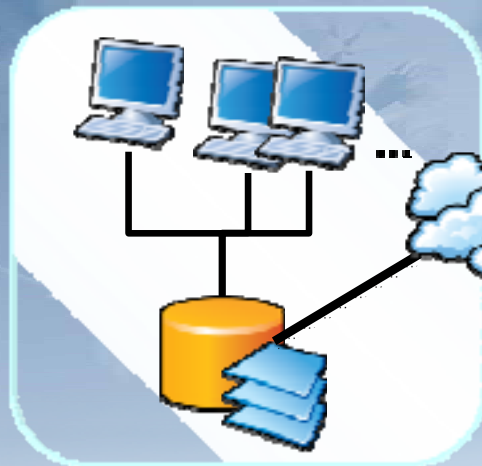




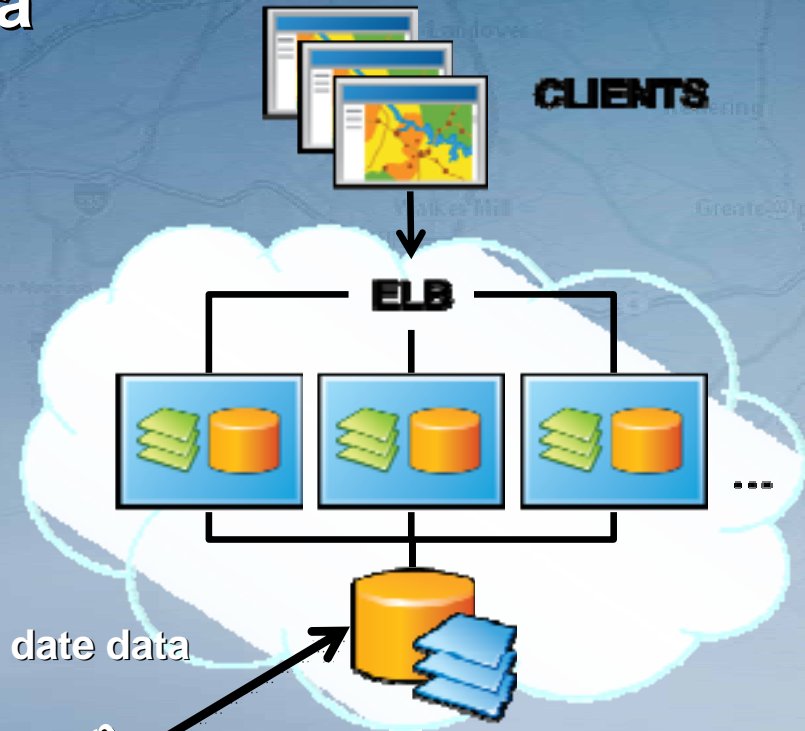
# Cloud replica



- Complements on-premise deployment
- Transactional database in-house
- Public facing services on the cloud
- Replicated Geodatabase for most up to date data
- One way vs Two Way



Geodatabase replication  
Over http/s



# Software in the Cloud



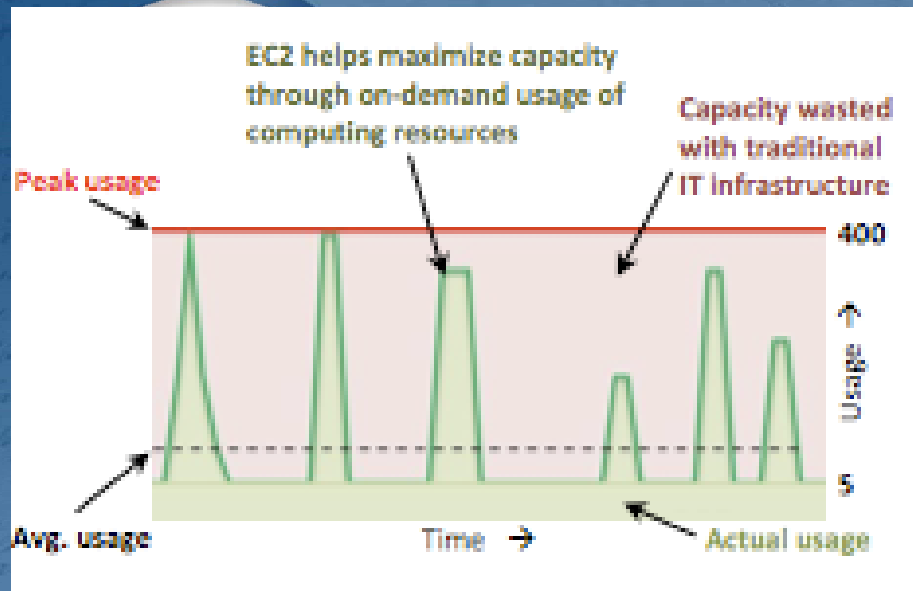
- Quick deployment of ArcGIS Server in the Amazon Cloud
- Transparently Leveraging Amazon services
  - Elastic Computing Cloud
  - Cloud Watch
  - Cloud Front
  - S3 storage
  - Etc





## Understanding the costs and benefit of cloud computing

# Amazon Use Case High-Performance Computing



## Assumptions

- » 5 servers running constantly at 100% full capacity
- » 400 servers utilized as needed for compute intensive projects, with average annual utilization of only 10%
- » 5 GB average monthly data transfer "in" and 15 GB average monthly data transfer "out" per instance
- » Region: US East (Northern Virginia)
- » Operating System: Linux/Unix

*Note: These assumptions are used for demonstration purposes only. You may input your own assumptions in the Amazon EC2 Cost Comparison Calculator for an accurate cost comparison based on your own use case and computing needs.*

## Co-Located Data Center

	<u>Annual Cost</u>
Server Hardware	\$49,005
Network Hardware	\$9,801
Hardware Maintenance	\$17,642
Co-Location Expense	\$504,187
Remote Hands Support	\$6,075
Data Transfer	\$2,686
<b>Total</b>	<b>\$589,395</b>

## Amazon EC2\*

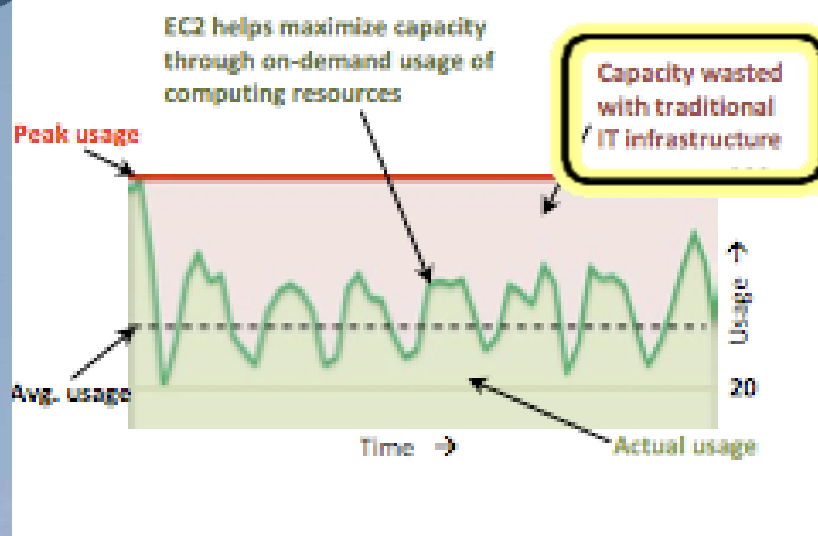
	<u>Annual Cost</u>
Instance Hours	\$33,415
Data Transfer	\$1,215
<b>Total</b>	<b>\$35,061</b>

Other Costs?



# Amazon Use Case

## Web Hosting with Occasional Traffic Spikes



### Assumptions

- » 20 servers running constantly at 100% full capacity
- » 200 servers needed during occasional traffic spikes, with average annual utilization of only 20%
- » 10 GB average monthly data transfer "in" and 50 GB average monthly data transfer "out" per instance
- » Region: US East (Northern Virginia)
- » Operating System: Linux/Unix

*Note: These assumptions are used for demonstration purposes only. You may input your own assumptions in the Amazon EC2 Cost Comparison Calculator for an accurate cost comparison based on your own use case and computing needs.*

### Co-Located Data Center

	<u>Annual Cost</u>
Server Hardware	\$26,620
Network Hardware	\$5,324
Hardware Maintenance	\$9,583
Co-Location Expense	\$274,293
Remote Hands Support	\$3,300
Data Transfer	\$9,401
<b>Total</b>	<b>\$328,521</b>

### Amazon EC2\*

	<u>Annual Cost</u>
Instance Hours	\$44,554
Data Transfer	\$5,400
<b>Total</b>	<b>\$49,954</b>

Other Costs?



# Different types of Costs

Setup

Maintenance

Operations





## Setup Costs

- Before the system is considered up and running for use.
- Configuration and Verification
  - Software
  - Data
- Software testing and trials
- Data upload
  - Time Vs Cost
  - EC2 Vs S3



## Operations costs

- Staging Environment
- Testing
  - Functional
  - Load testing
- Monitoring
- Troubleshooting





# Maintenance Costs

- Data updates
  - Data upload costs
  - Data Testing and Verification
- Configuration Changes
  - System capacity
  - System features
- Managing load changes

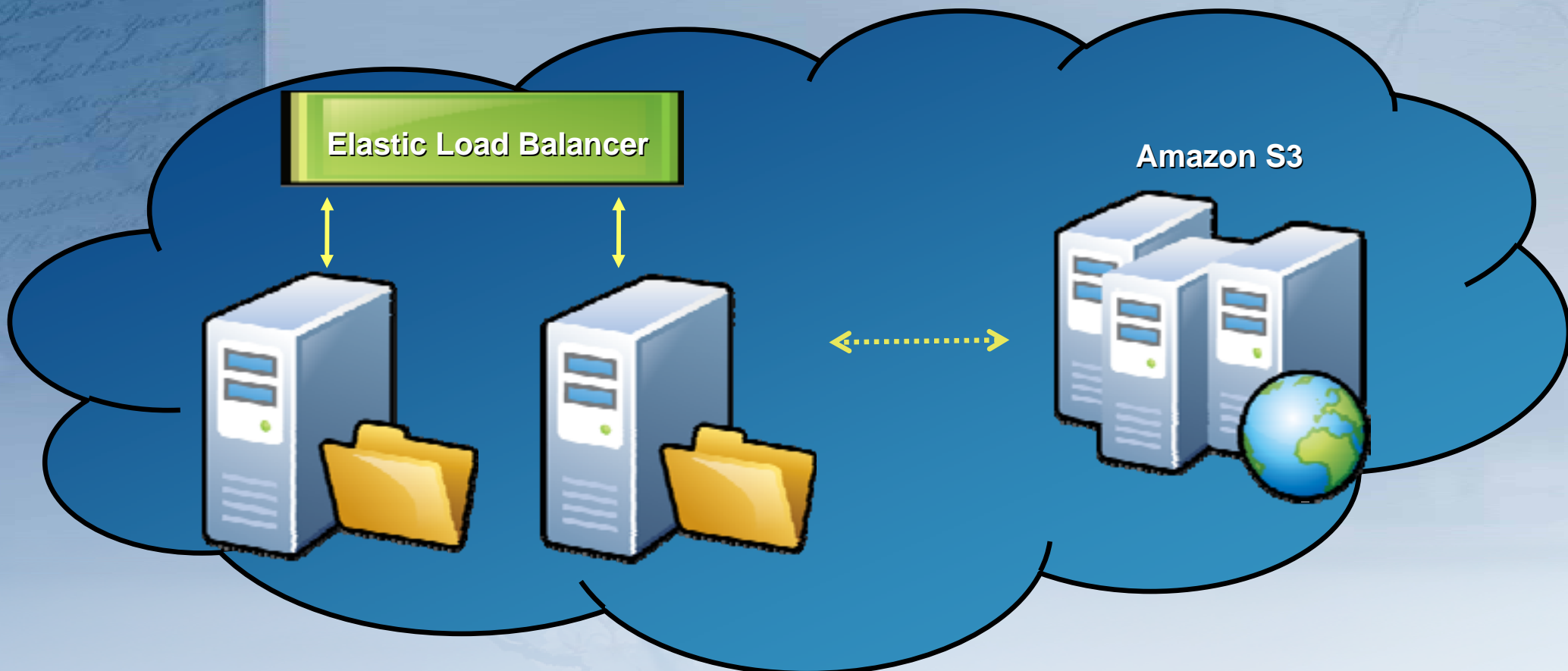


## Example Application Deployment in the Amazon Cloud

- Hosted components
  - AGS Server w/ 3 services
  - Web Application
- Hosting requirements
  - High Availability
  - Data updates



## Example Application Deployment Architecture





# Example Application Deployment Cost List



Amazon Service	Cost model
3 Instances 2 production 1 staging	Hourly rate / instance Data In - out / GB
Elastic Load Balancer	Data In – out / GB
2 EBS drives	Hourly rate / GB Data In – out / GB
S3 account	Hourly rate / GB In - out / GB



# Real World Implementation DataBasin

Data Basin is an online system that connects scientists and practitioners with spatial datasets and tools.



Explore and download datasets  
Connect to external data sources  
Upload and publish your datasets  
Connect to experts  
Create working groups  
Produce customized maps that  
can be easily shared

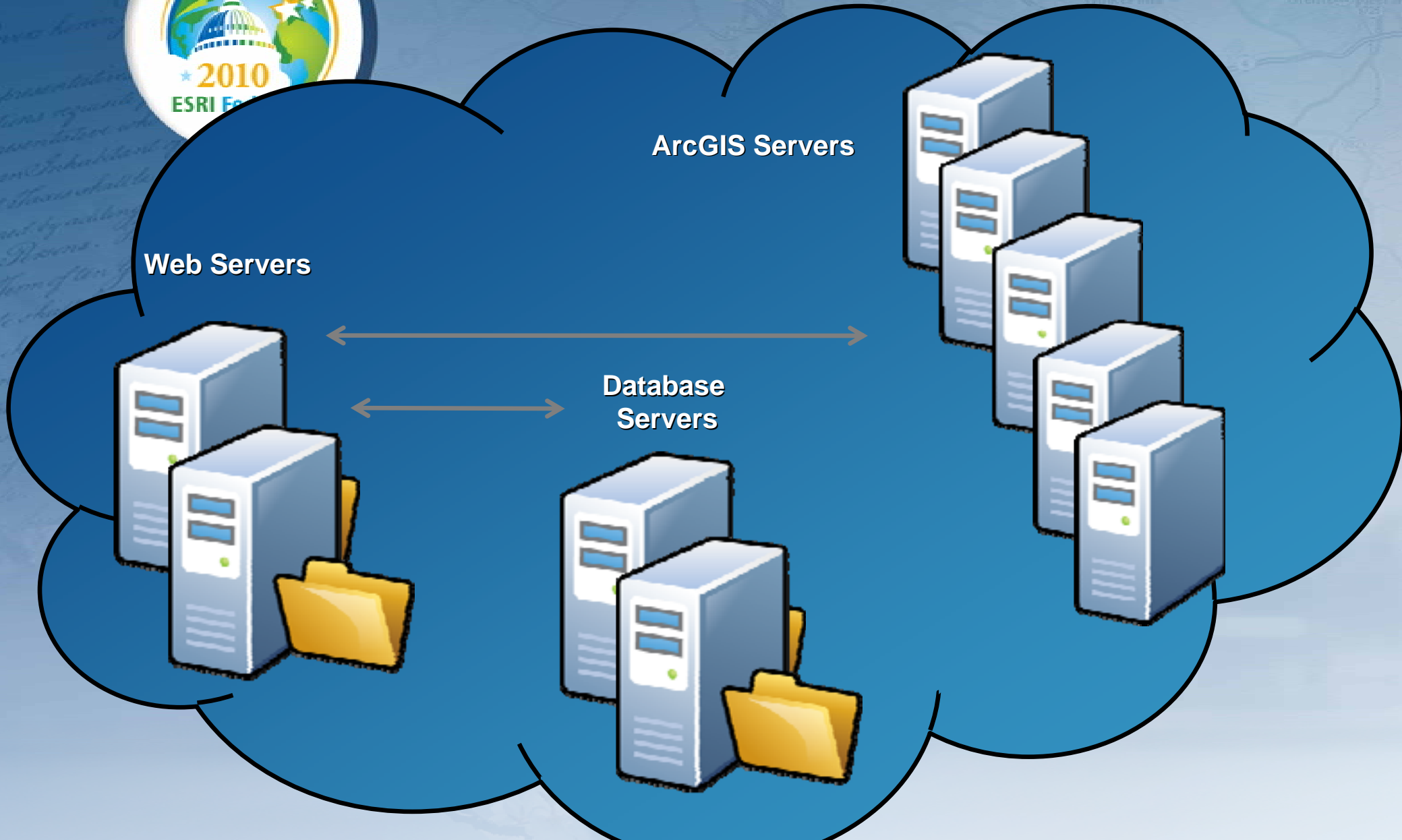
# DataBasin Cloud Deployment Architecture



Web Servers

ArcGIS Servers

Database Servers





# Real World Example

## USDA

**Your Food Environment Atlas**

Get a spatial overview of a community's ability to access healthy food and its success in doing so.

Assemble county-level statistics on:

- ✓ Food choices
- ✓ Health and well-being
- ✓ Community characteristics

[Enter Atlas](#)

U.S. Department of Agriculture  
Economic Research Service

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Wed 01...  
February 06, 2010 12:00 PM EST

**The First Lady Unveils Nationwide Campaign to Combat Childhood Obesity**  
The White House

February 06, 2010 1:30 PM EST

**Briefing by Press Secretary Robert Gibbs**  
The White House

50:36

There is a live discussion about this event at Facebook.  
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# Summary