

Use of Knowledge Modeling to Characterize the NOAA Observing System Architecture

***Presentation to The Open Group
Architecture Practitioner's Conference***

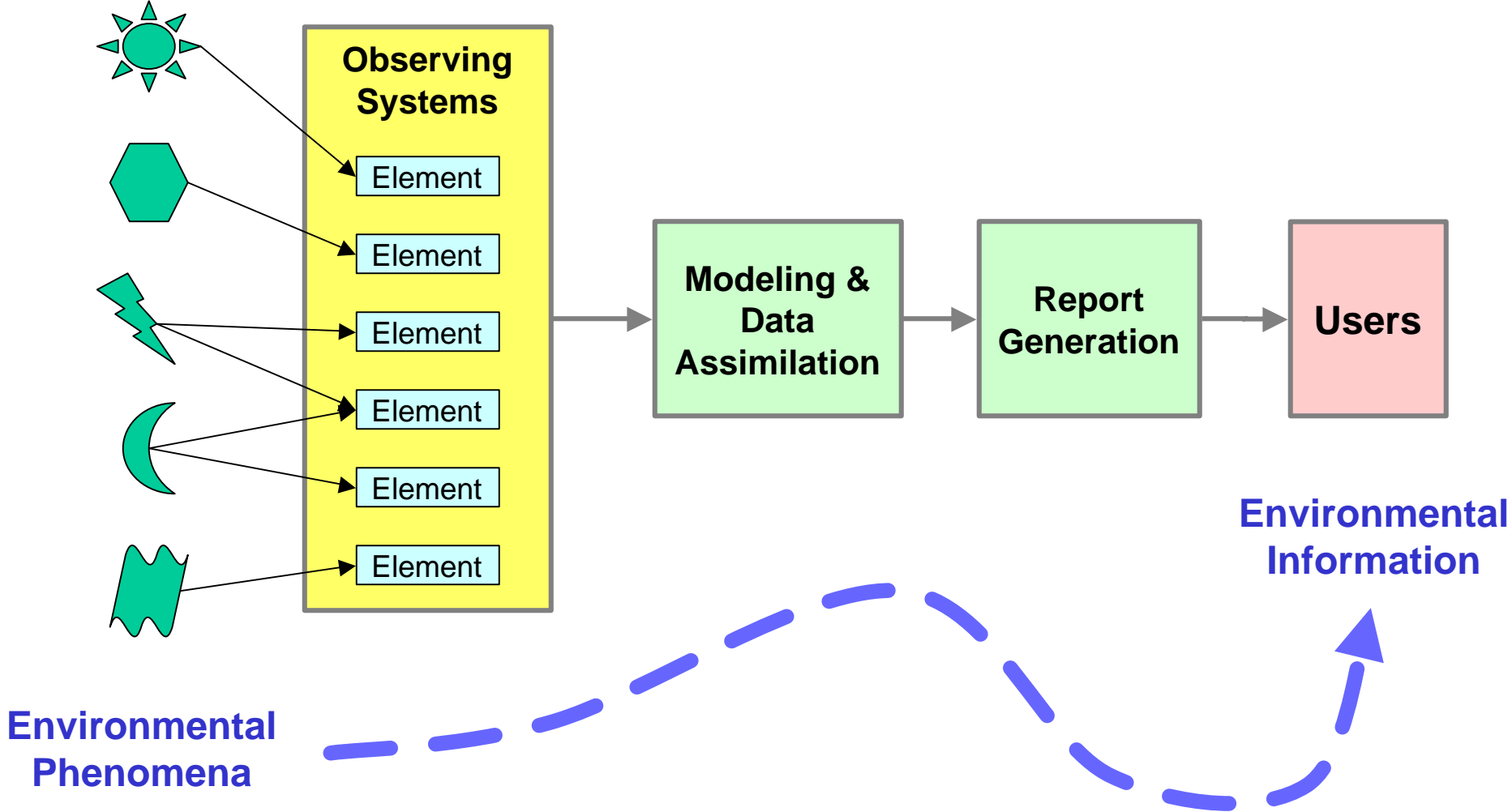
23 October 2003

***James N Martin
The Aerospace Corporation***

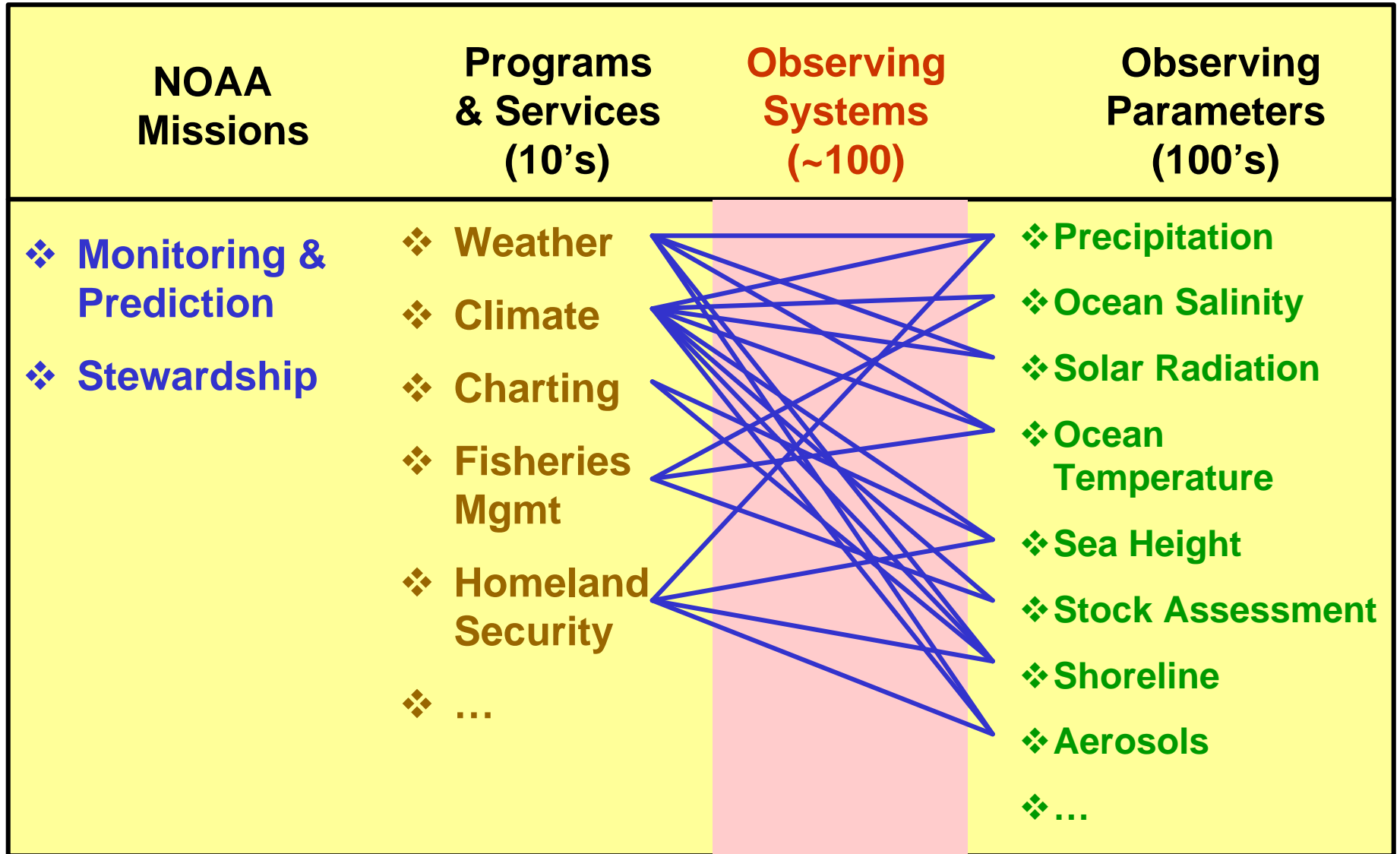
Topics

- **Need for an Architecture**
- **Modeling Approach**
 - Business Analysis
 - Knowledge Modeling
- **Architecture Models**
 - Observing Systems
 - NOAA Enterprise
- **Metis**
 - Uses and Benefits
 - Visualizing the Enterprise

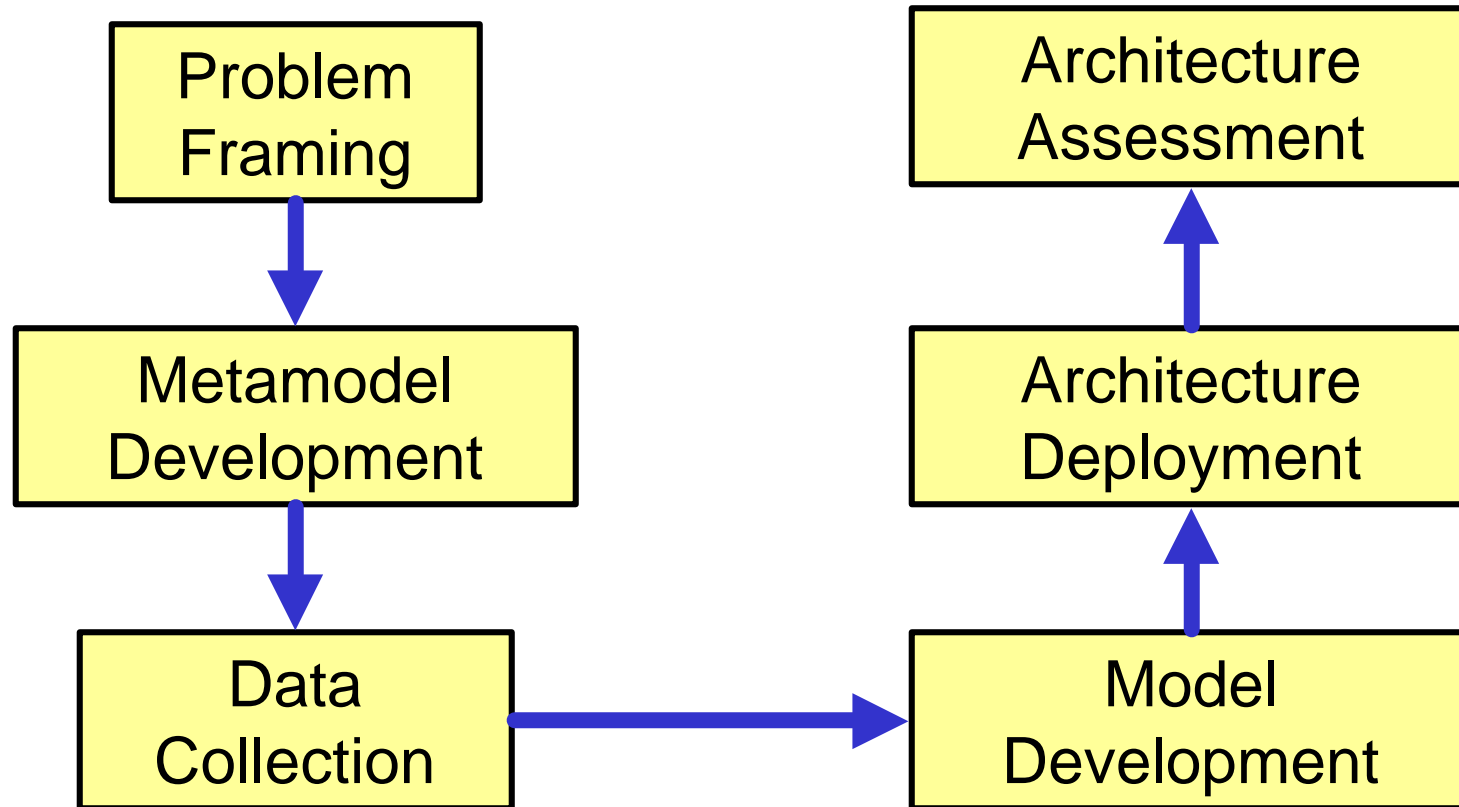
Context for NOAA's Observing Systems



Observing System Challenges



Six-Step Process for Developing the Baseline Architecture



Step 1 – Problem Framing

- **Business Analysis**
 - Identify Purpose of the Architecture
 - Identify “Business Questions” to be addressed by the Architecture
 - Establish business Priorities
- **Conceptual Framework**
 - Identify relevant business “Objects”
 - Identify “Facts” about these Objects
 - Define how Questions can be answered using these “Facts”
 - Develop Conceptual Framework for the Architecture

Business Analysis

Purpose of the Architecture (Business Queries)

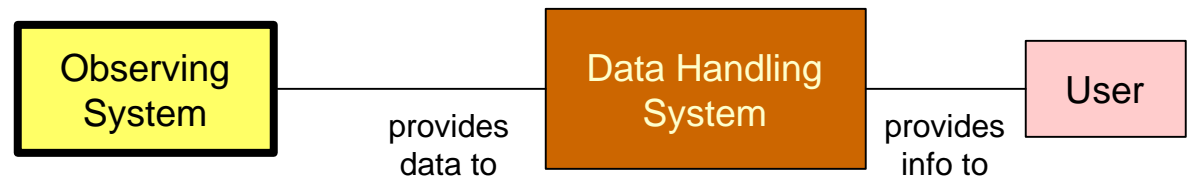
- Display all observing systems Owned By a particular line office.
- Display all Climate Requirements that are not being met by current observing systems.
- What observing systems are supporting our ability to measure the heat content of the ocean? (or other Scientific Query)
- Display all organizations that Own buoys.
- What observing systems are associated with each NOAA Strategic Goal?

Business Queries (continued)

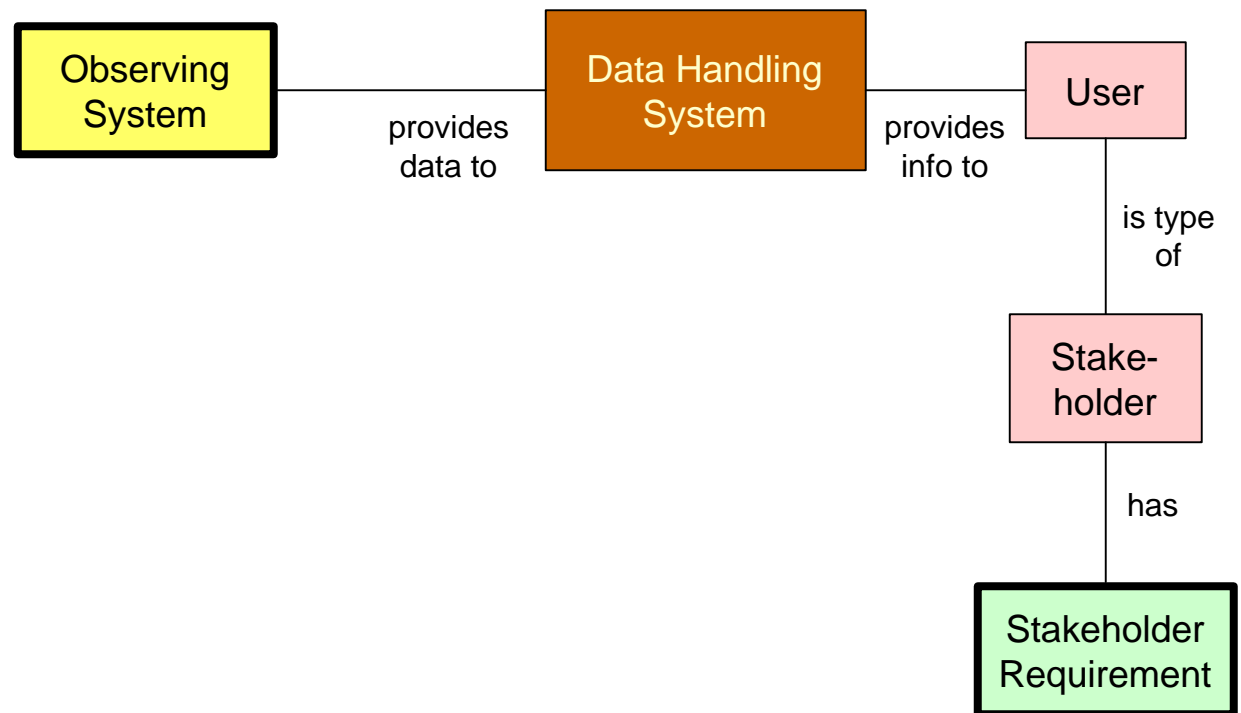
- Display all observing systems that a certain Stakeholder deems important.
- Display all observing systems that Measure a particular environmental parameter.
- Display the Acquisition Costs of all observing systems associated with a certain strategic goal.
- Display the Geographic Coverage of a particular observing system.

The architecture model is
based on these business queries

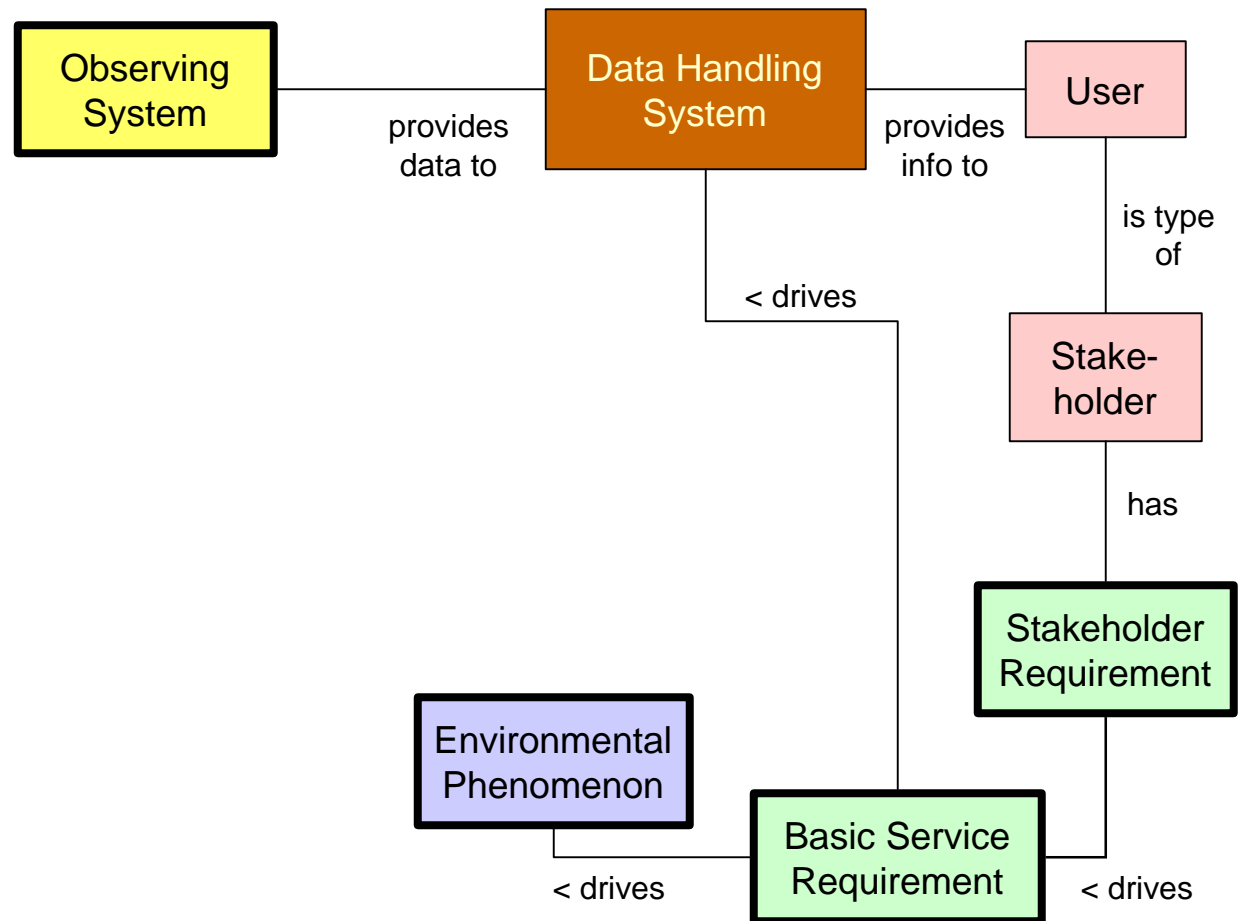
The NOSA Conceptual Framework



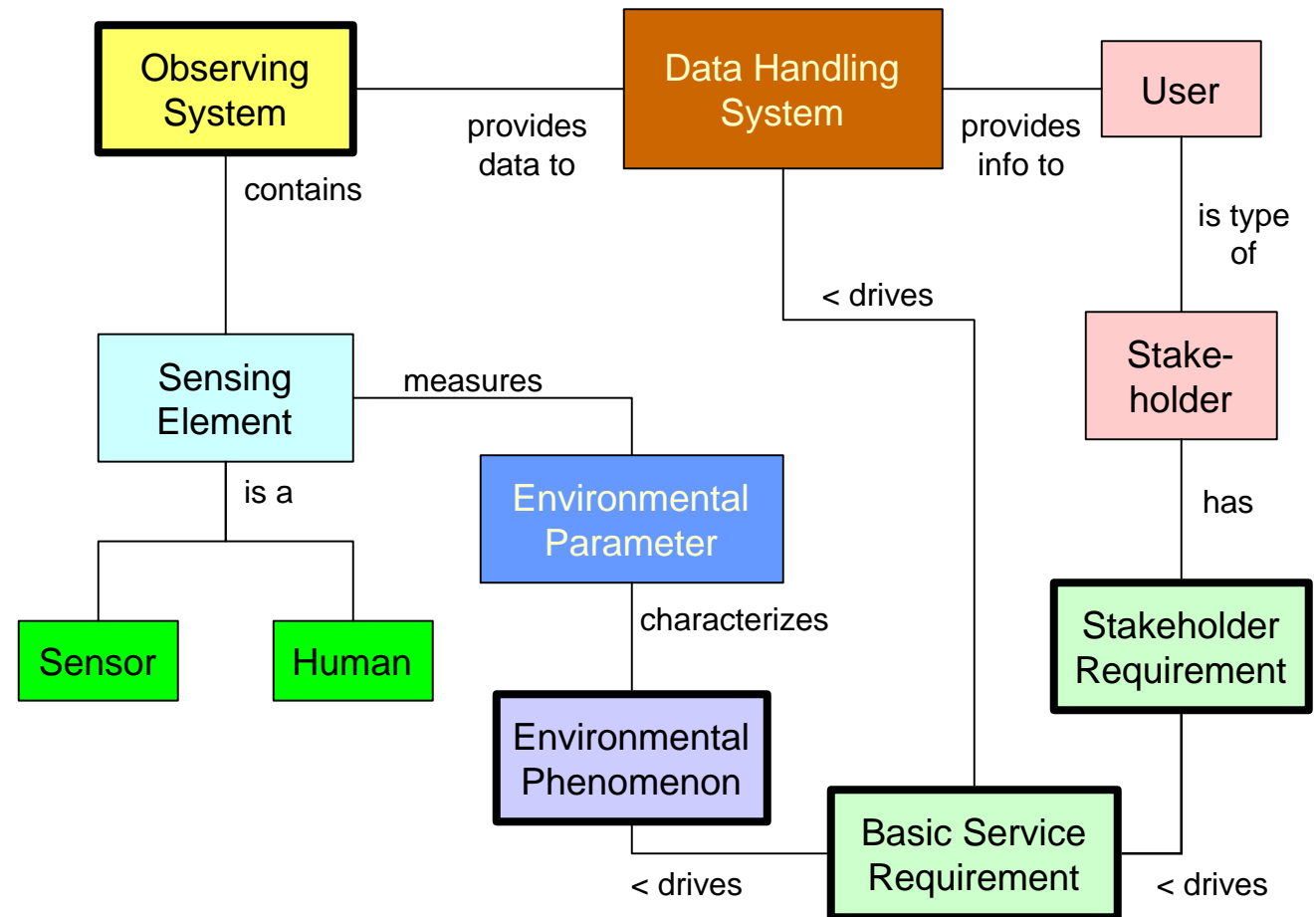
The NOSA Conceptual Framework



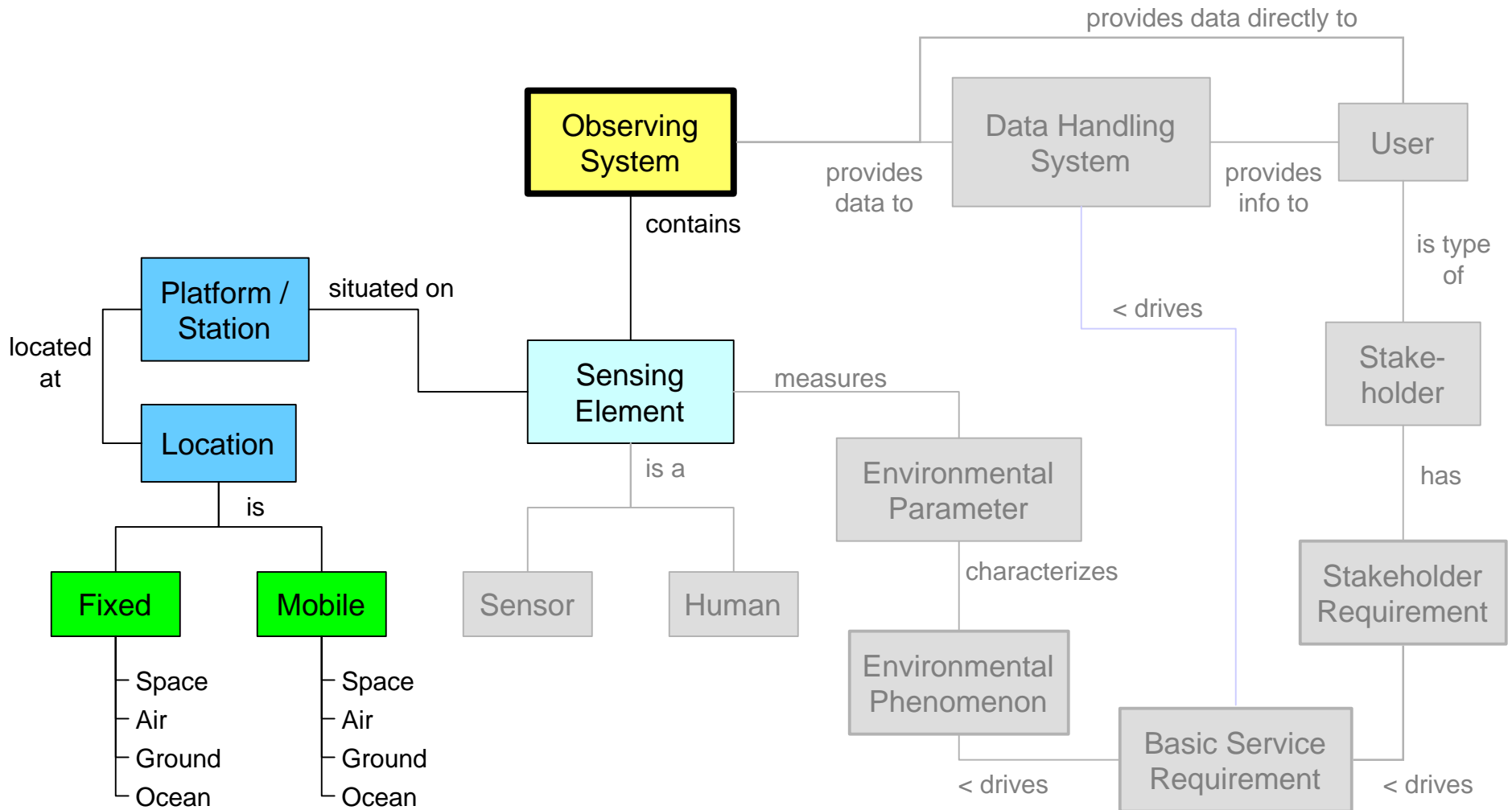
The NOSA Conceptual Framework



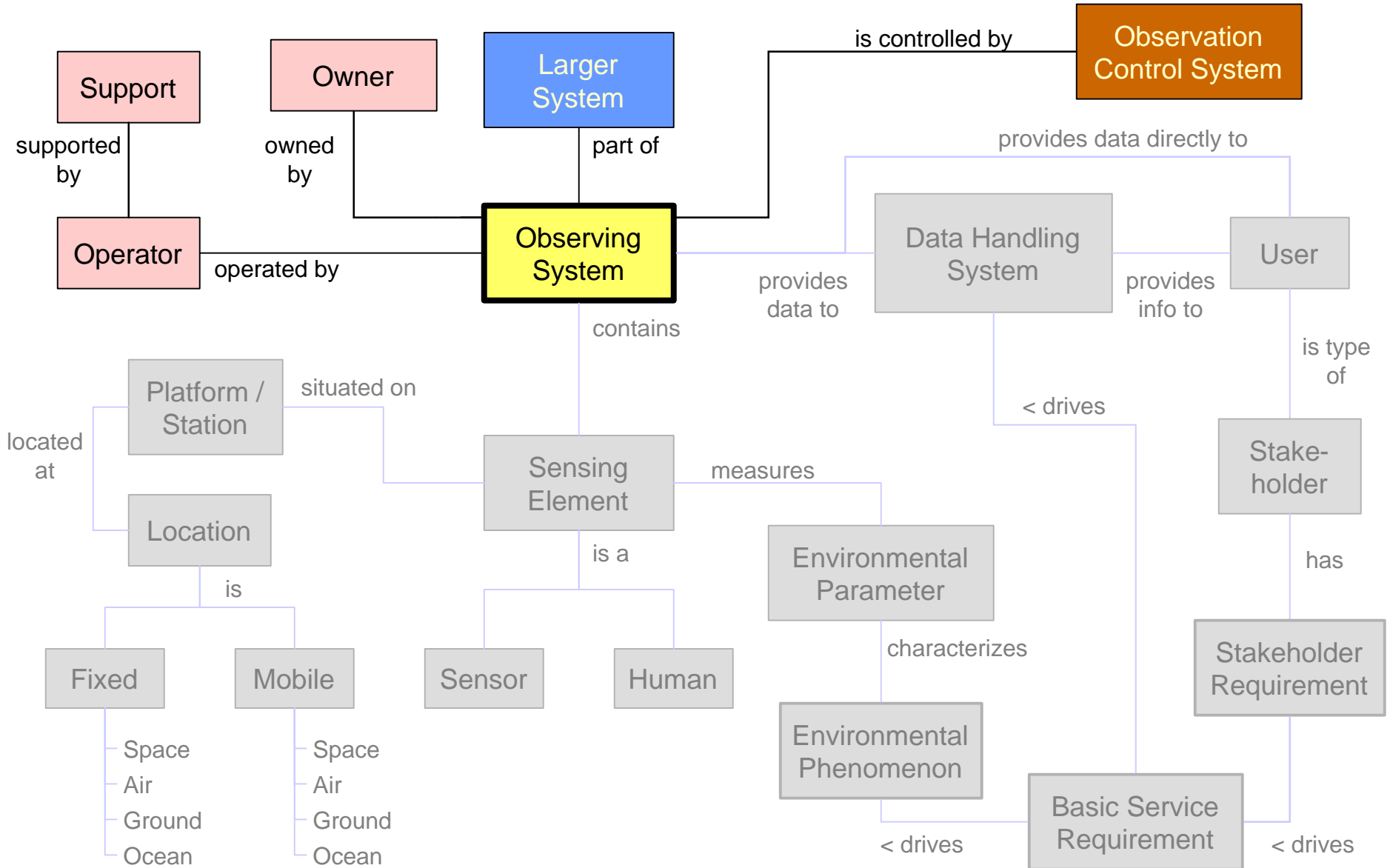
The NOSA Conceptual Framework



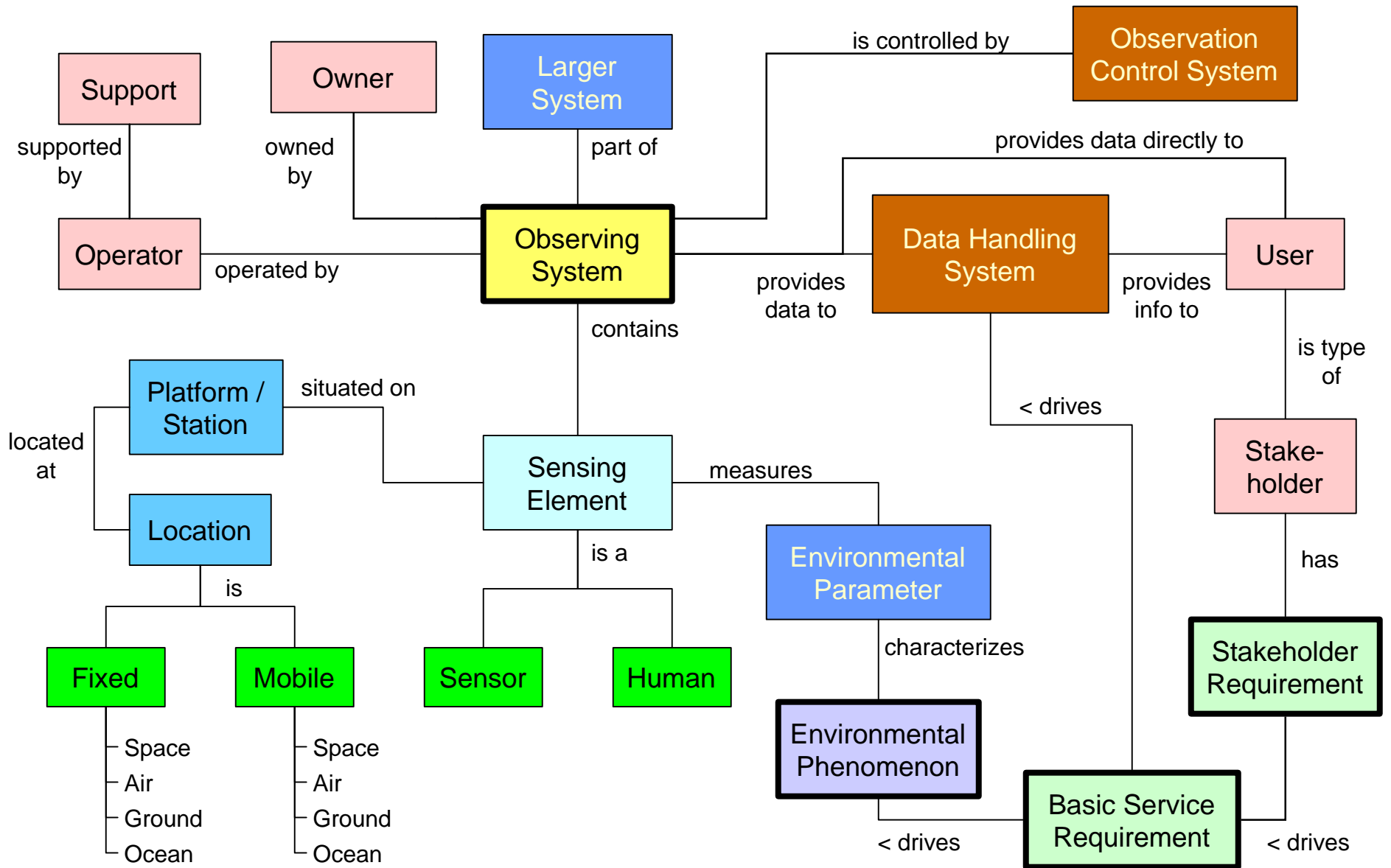
The NOSA Conceptual Framework



The NOSA Conceptual Framework

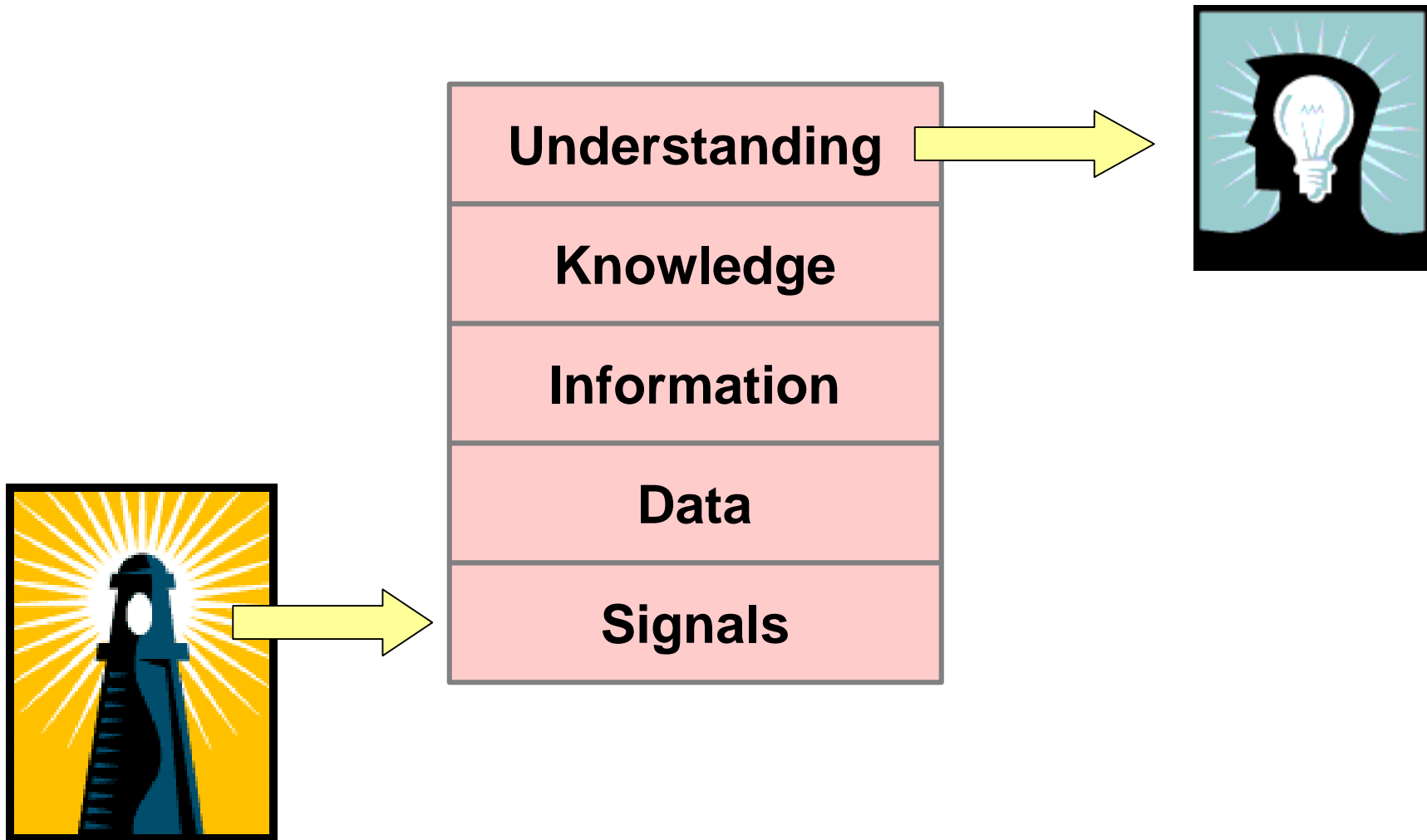


The NOSA Conceptual Framework

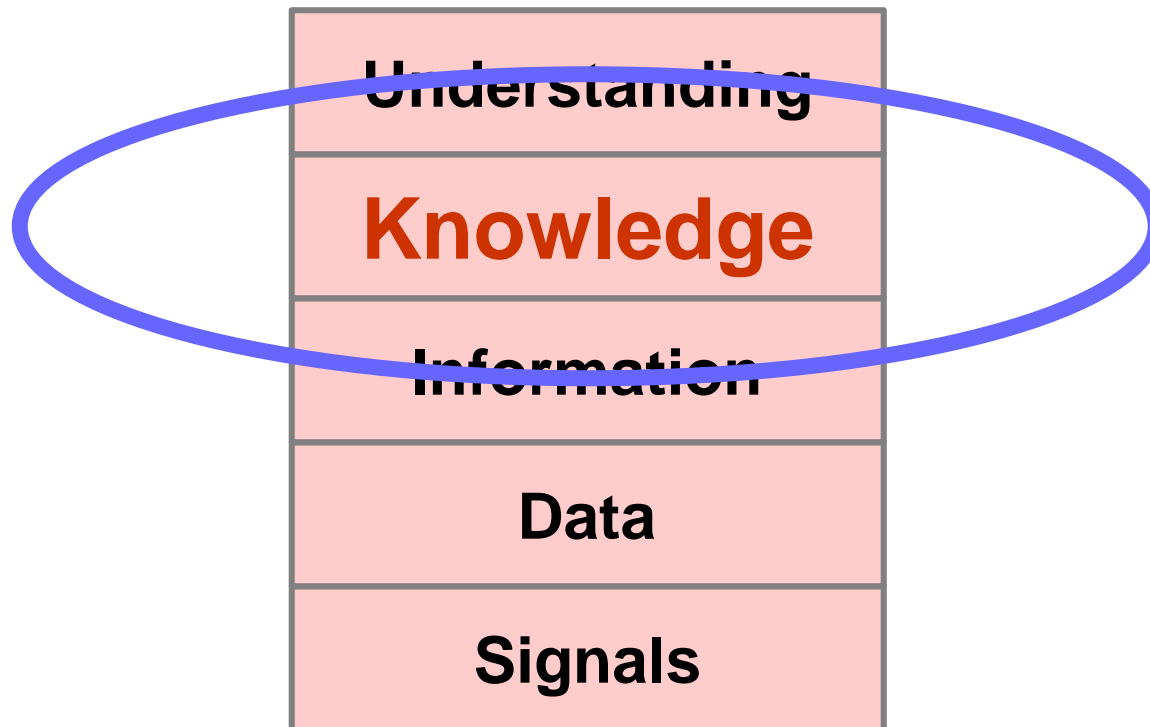


Knowledge Modeling

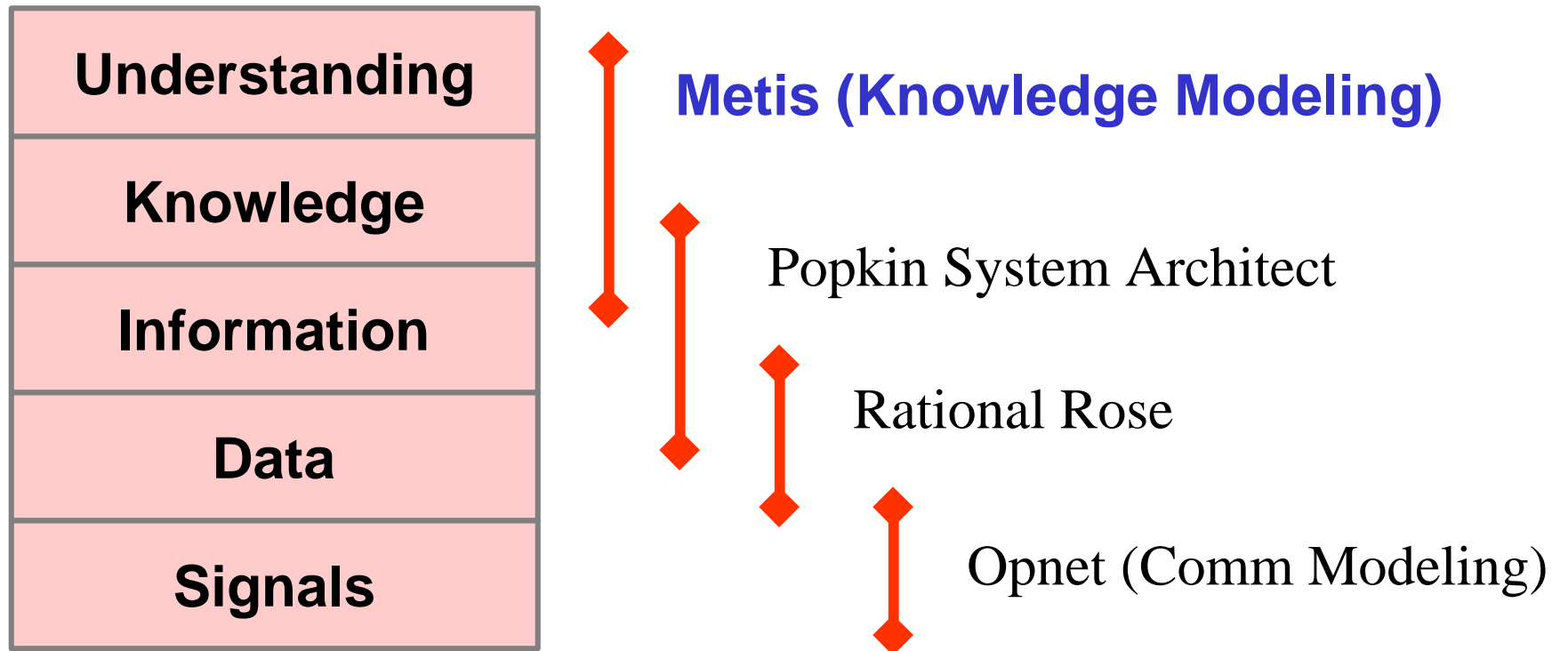
The Knowledge Modeling Paradigm



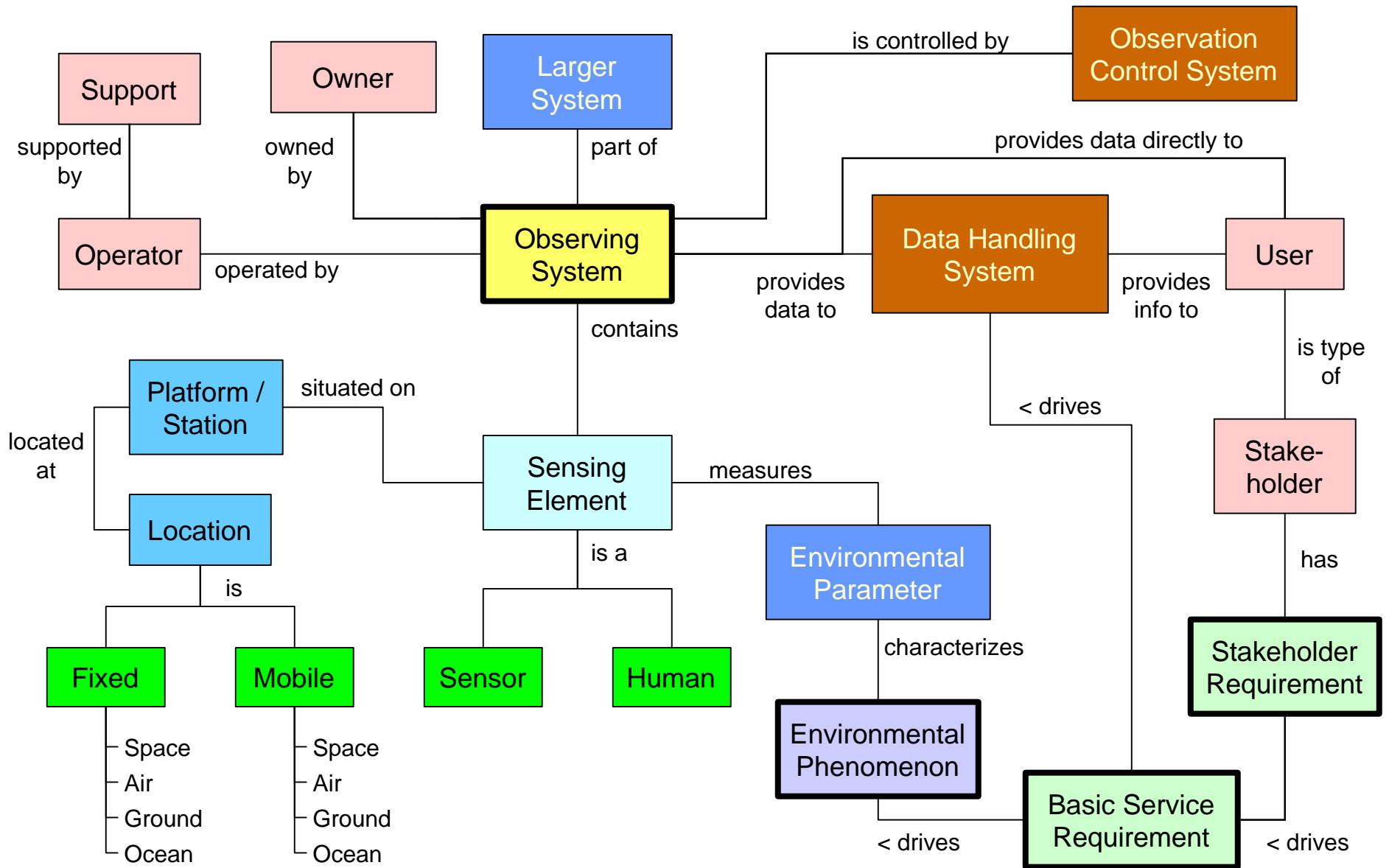
The NOAA Observing System Architecture Domain



Different Models Need Different Tools

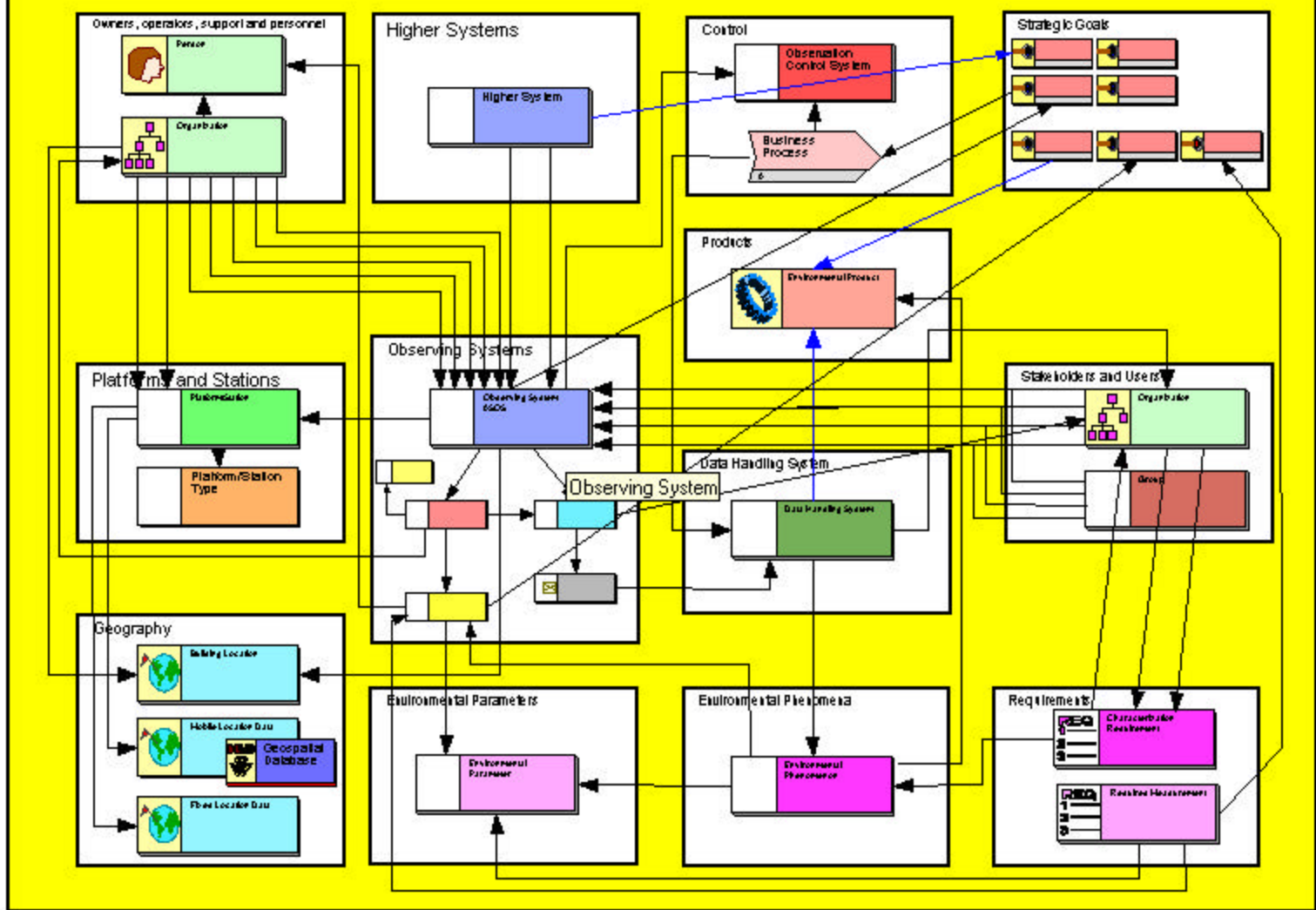


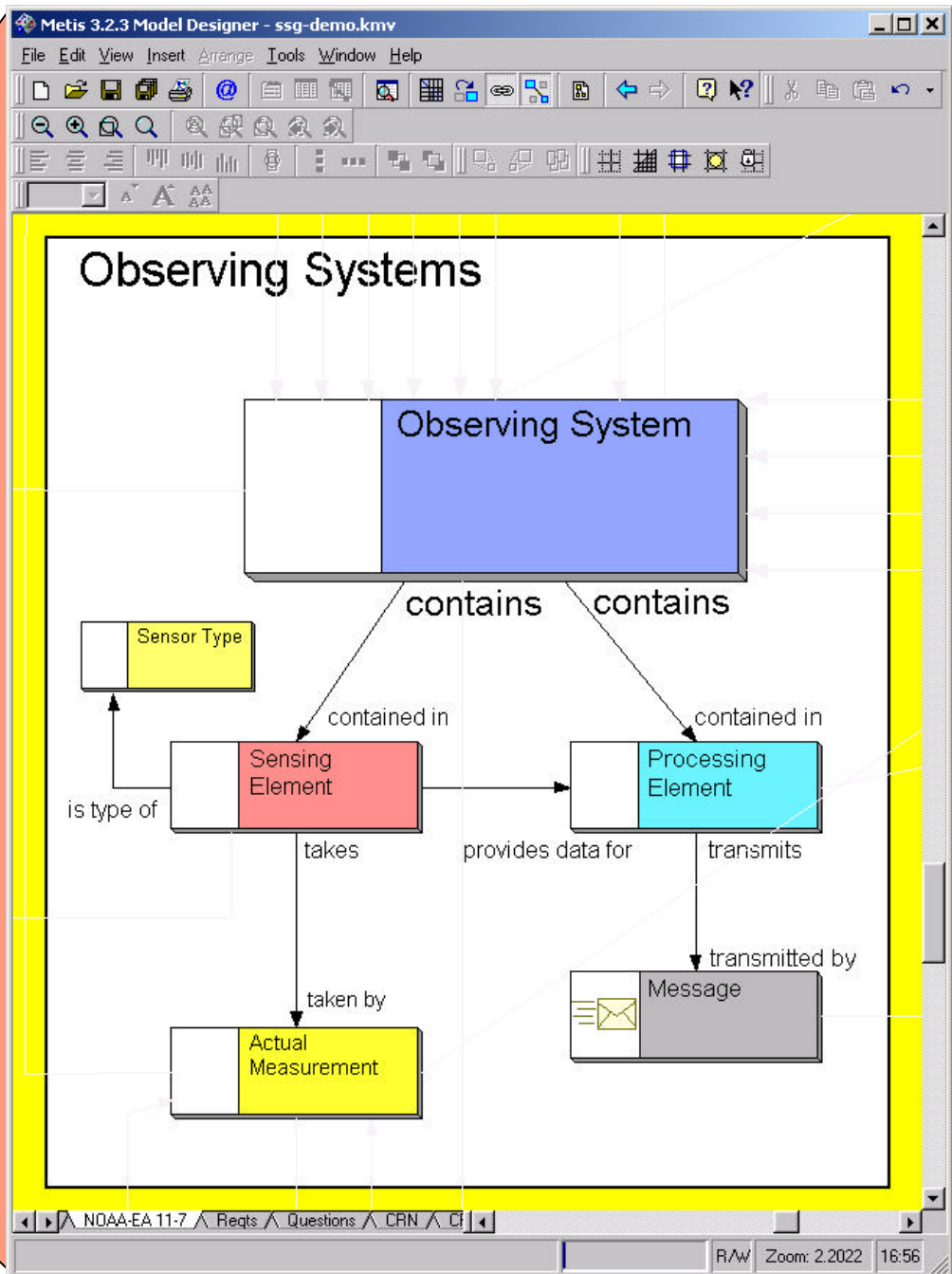
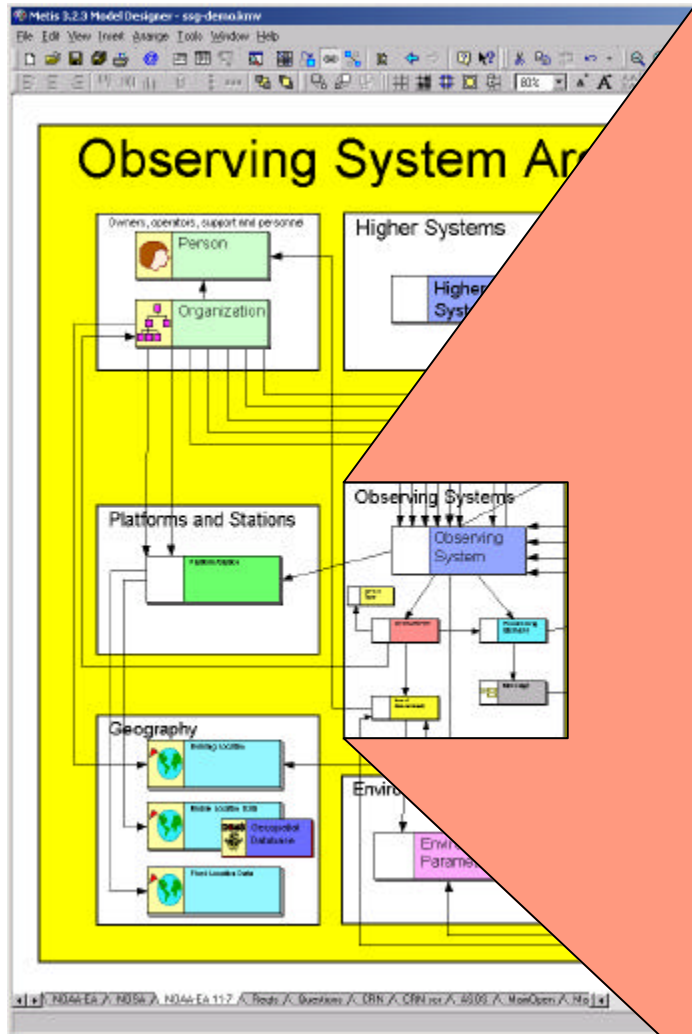
The NOSA Conceptual Framework

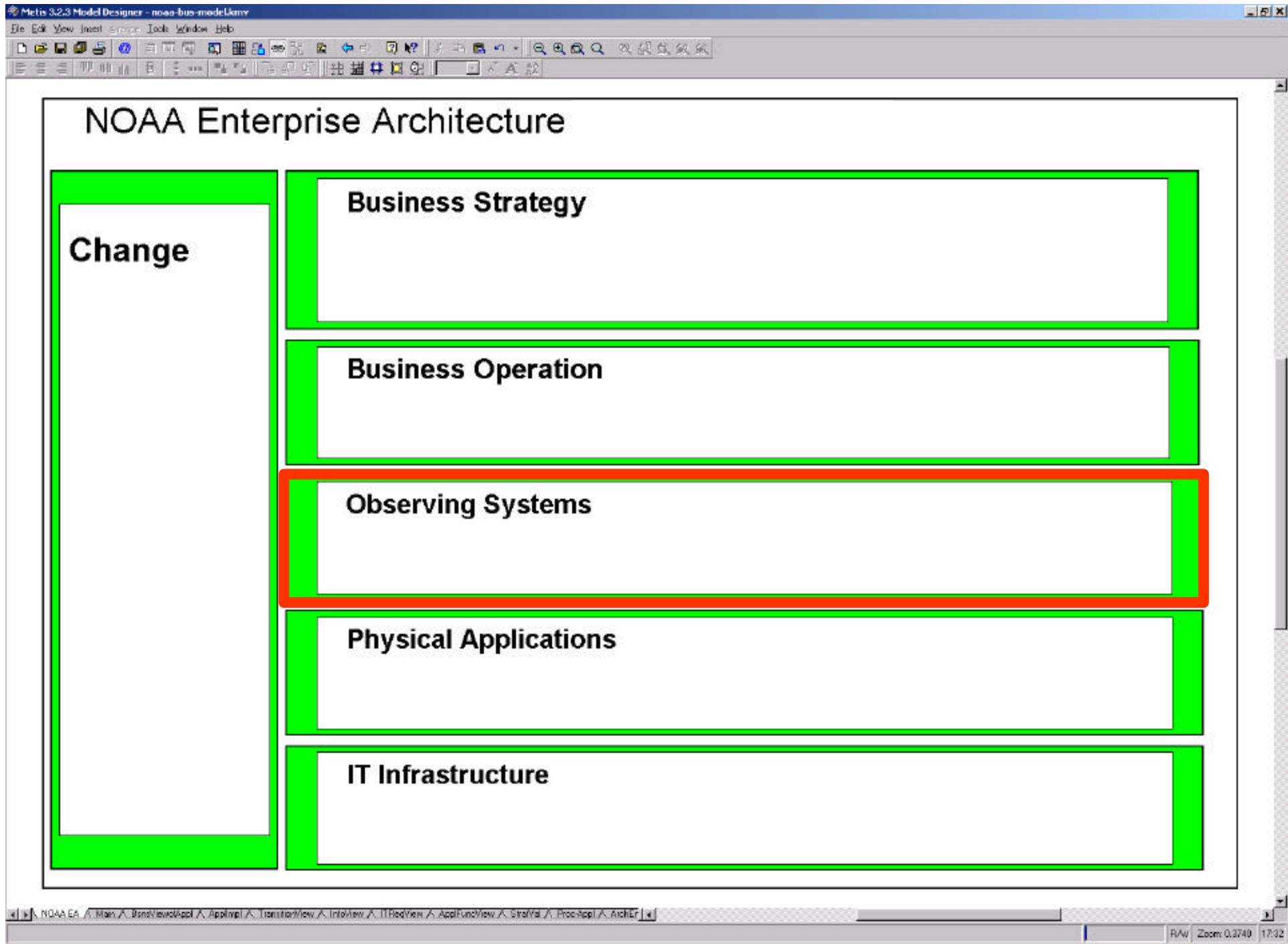


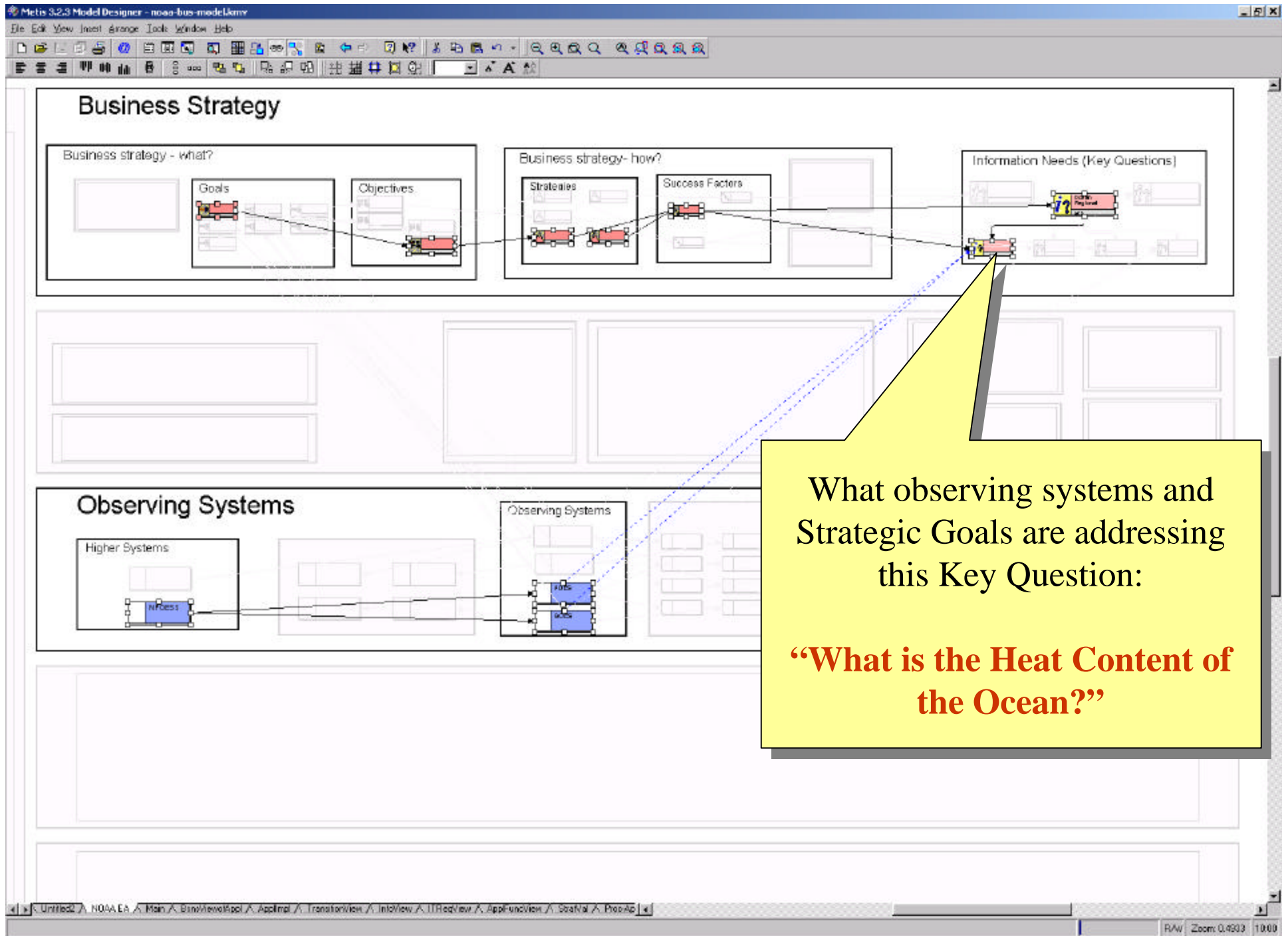


Observing System Architecture










NOAA Observing System Architecture - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: <http://mapdevel.ngdc.noaa.gov/website/naa/nosa/viewer.htm?layers=010000000000000001&ActiveLayer=1>

Instant Message Internet Lookup New&Cool Current Stuff Markets NOAAForge NOAA jnm email NOSA help

 **NOAA Satellites and Information**
NOAA's National Environmental, Satellite, Data, & Information Service

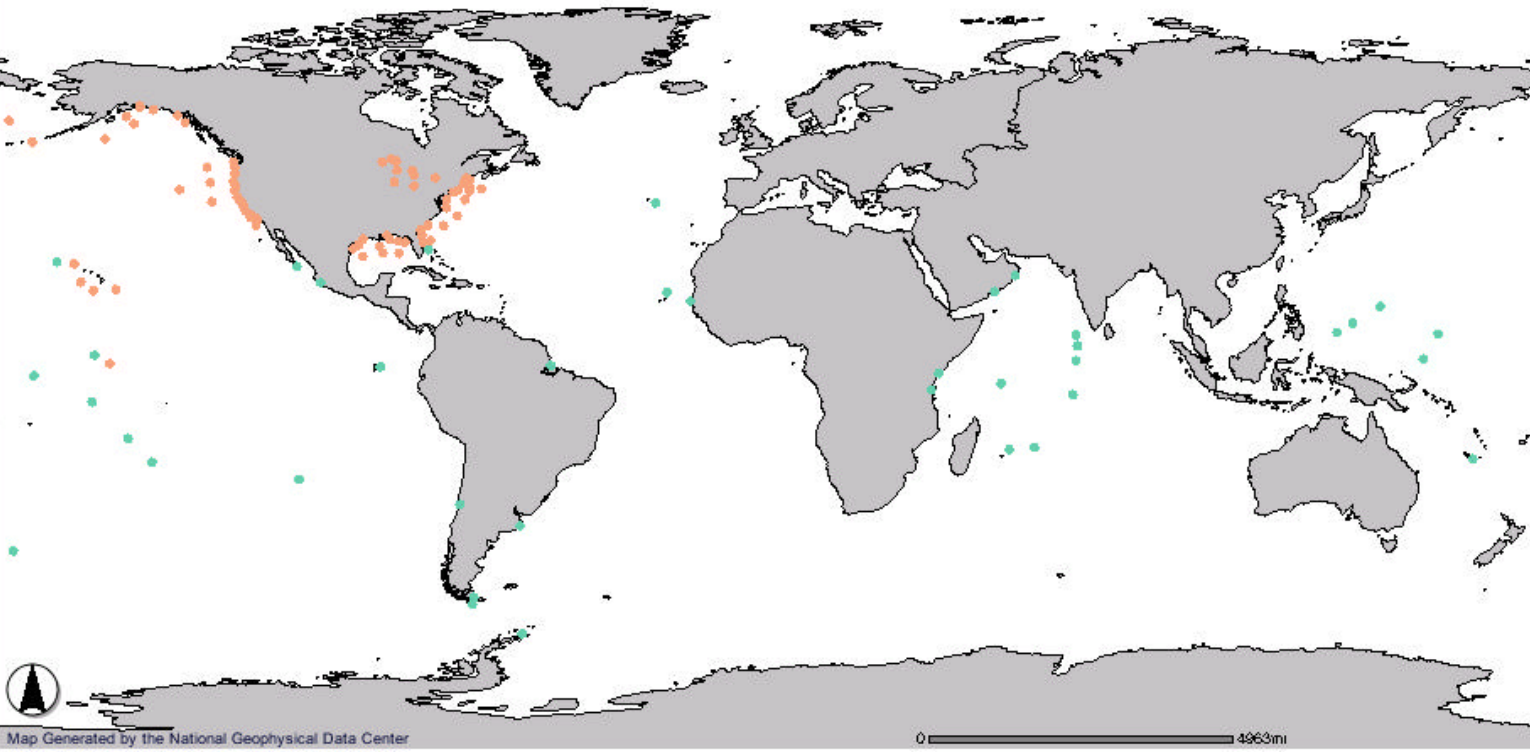
NOAA Observing System Architecture
(NOSA)

[privacy statement](#)

[legend](#) [layers](#)

Legend

- NWS BOY
- OAR GSLN



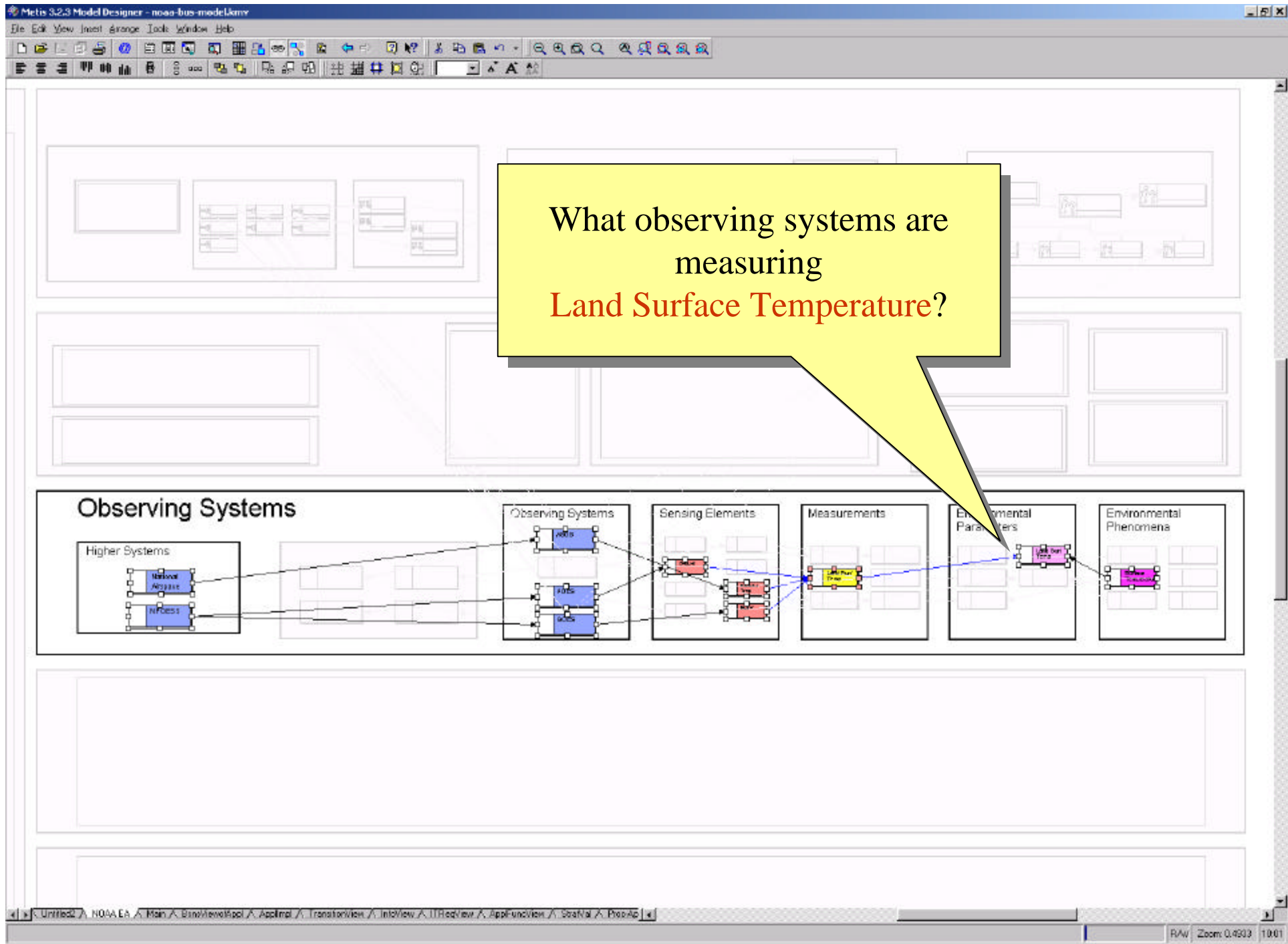
Map Generated by the National Geophysical Data Center

0 4963mi

[Refresh Map Now](#)

[Zoom Out](#) [About the Database](#) [help](#)

Document: Done




NOAA Observing System Architecture - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: <http://mapdev.ngdc.noaa.gov/website/naa/nosa/viewer.htm?layers=010000000000000001&ActiveLayer=1>

Instant Message Internet Lookup New&Cool Current Stuff Markets NOAAForge NOAA jnm email NOSA help




NOAA Satellites and Information
NOAA's National Environmental, Satellite, Data, & Information Service

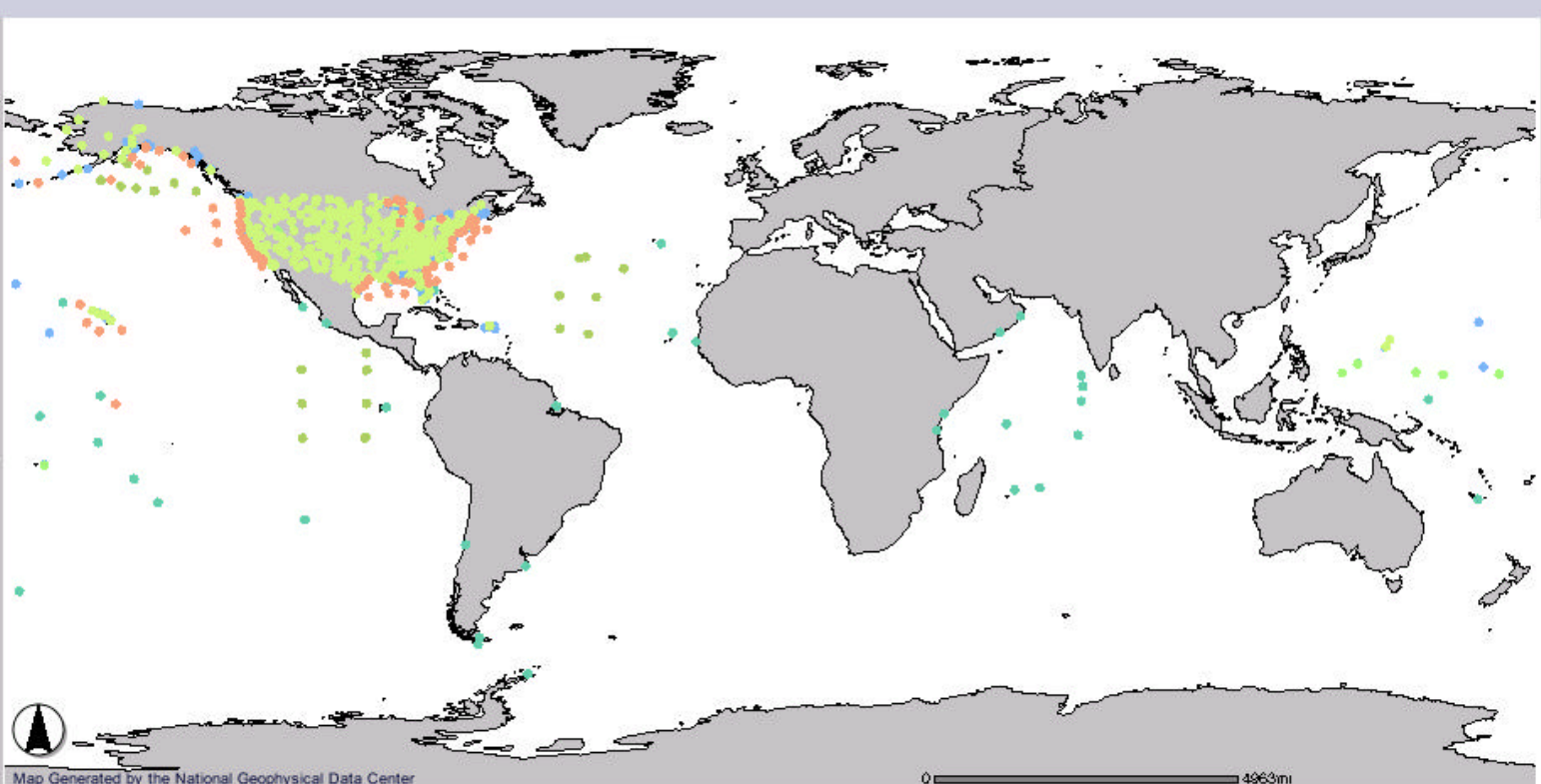
NOAA Observing System Architecture
(NOSA)

[privacy statement](#)

NOAA




toolbar help



Map Generated by the National Geophysical Data Center

0 4963mi



[legend](#) [layers](#)

Legend

- NWS BOY
- NWS ASOS
- NWS RAWINSONDE
- NOS NWLON
- OAR HYDROPHONE
- OAR GSLN

[Zoom In](#)

[About the Database](#)

[? help](#)

Document: Done



NOAA Satellites and Information

NOAA's National Environmental, Satellite, Data, & Information Service

NOAA Observing System Architecture

(NOSA)

[privacy statement](#)

NOAA

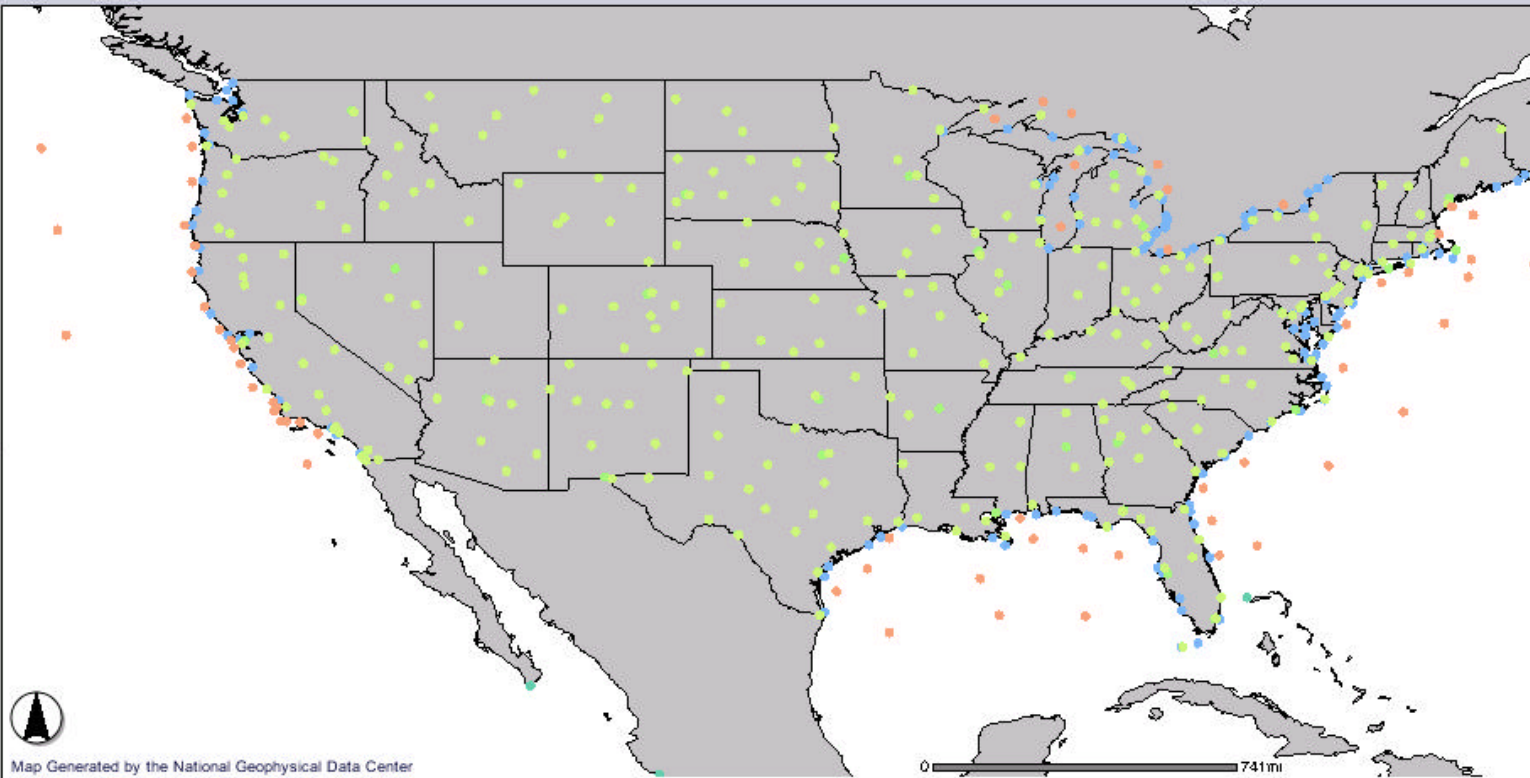


legend layers

Layers

Visible	Active	Name
<input type="checkbox"/>	<input type="radio"/>	NFS 109 Surface
<input checked="" type="checkbox"/>	<input checked="" type="radio"/>	NWS BOY
<input type="checkbox"/>	<input type="radio"/>	NWS LARC Stations
<input type="checkbox"/>	<input type="radio"/>	NWS MAN ALSN6
<input checked="" type="checkbox"/>	<input type="radio"/>	NWS ASOS
<input checked="" type="checkbox"/>	<input type="radio"/>	NWS RAWINSONDE
<input type="checkbox"/>	<input type="radio"/>	OAR ETL LIDAR GB MOBILE
<input checked="" type="checkbox"/>	<input type="radio"/>	NOS NWLON
<input type="checkbox"/>	<input type="radio"/>	NWS ARC Stations
<input type="checkbox"/>	<input type="radio"/>	NWS FNP Stations
<input type="checkbox"/>	<input type="radio"/>	NWS HMISC Stations

Refresh Map Now



Zoom In

[About the Database](#)

[help](#)

Metis 3.2.3 Model Designer - noaa-bus-model.kmrv

File Edit View Insert Arrange Tools Window Help

Business Strategy

Business strategy - what?

Goals

Observing Systems

AGOS
POES
GOES

What observing systems address the Strategic Goal:
Implement seasonal to interannual climate forecasts?

The screenshot shows a software interface for modeling business strategy and observing systems. The top section, titled 'Business Strategy', contains a diagram with a 'Goals' box. A yellow callout box points to a goal in this diagram, asking 'What observing systems address the Strategic Goal: Implement seasonal to interannual climate forecasts?'. The bottom section, titled 'Observing Systems', contains a diagram with three boxes labeled 'AGOS', 'POES', and 'GOES'. Blue lines connect the callout box to these three boxes, indicating that they are the observing systems that address the strategic goal.

The NOSA Knowledge Model

**Example Screen Shots from the
Metis Architecture Tool**

Metis 3.2.3 Model Designer - populated_from_proxy.kov

File Edit View Insert Layout Tools Window Help

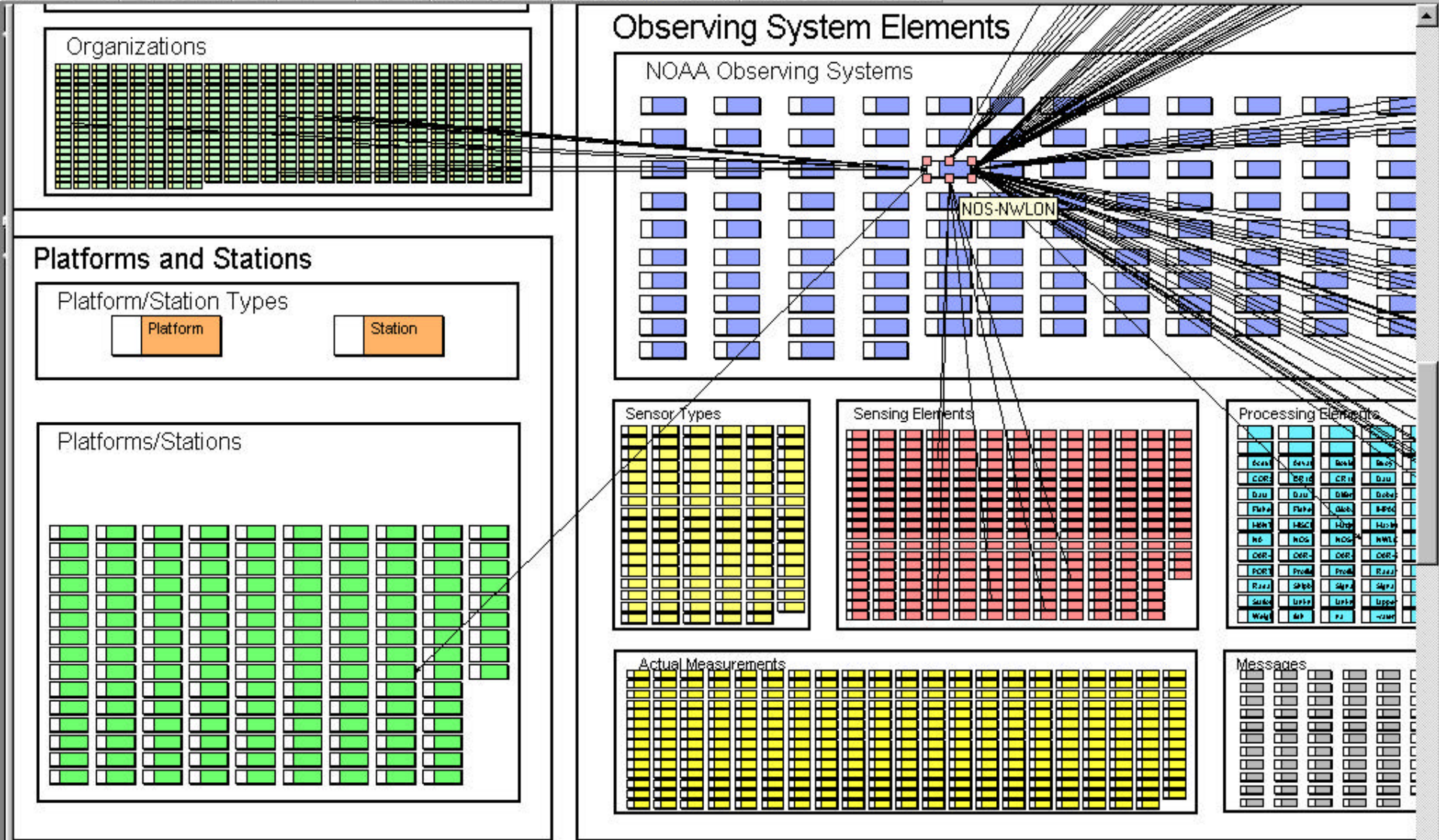
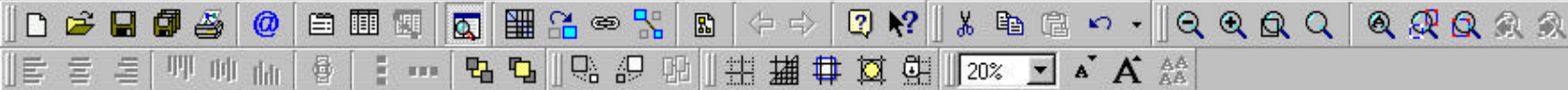
Browse Mode: Show Background: HD:R44220001

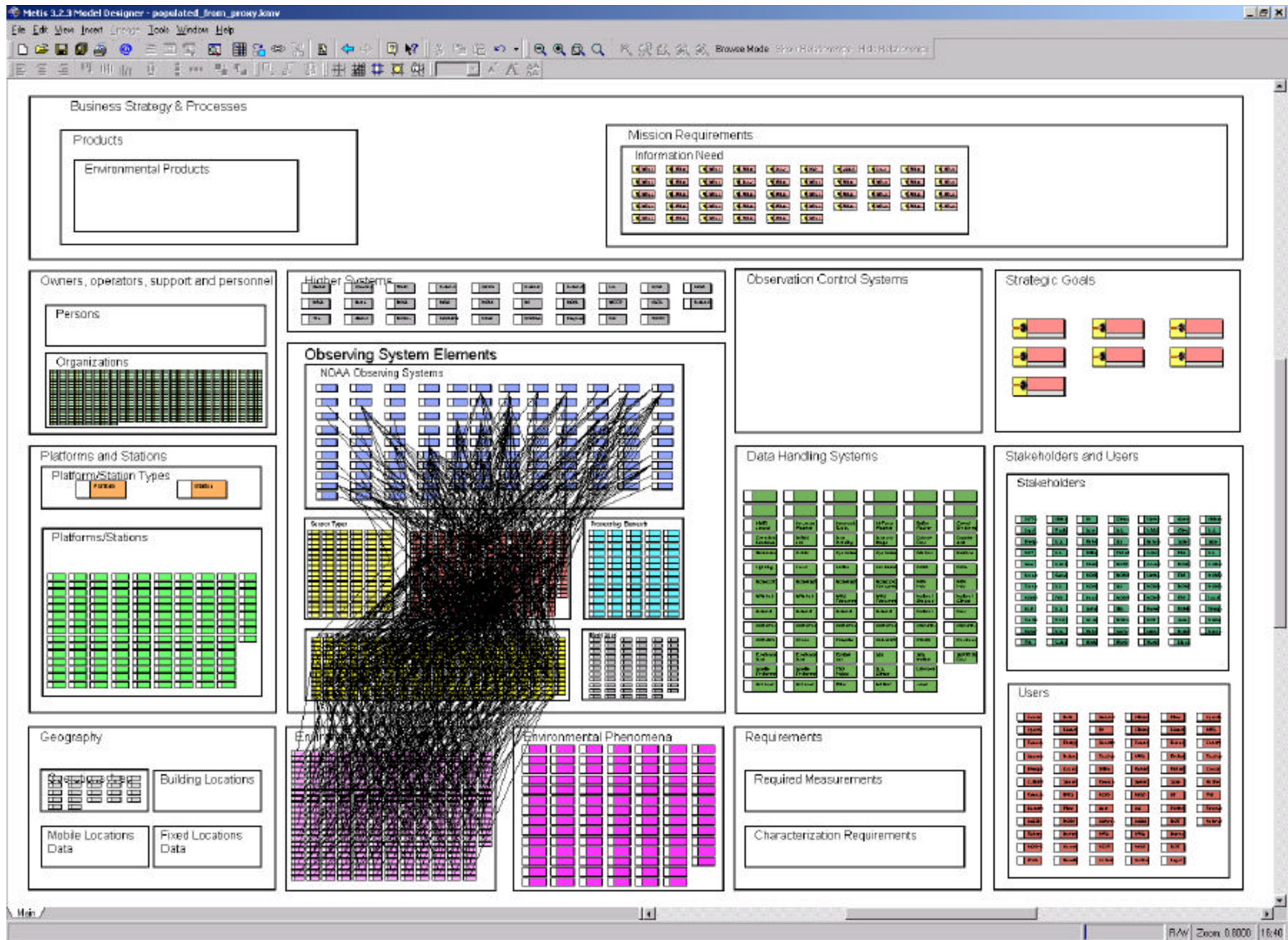
The interface is divided into several main sections:

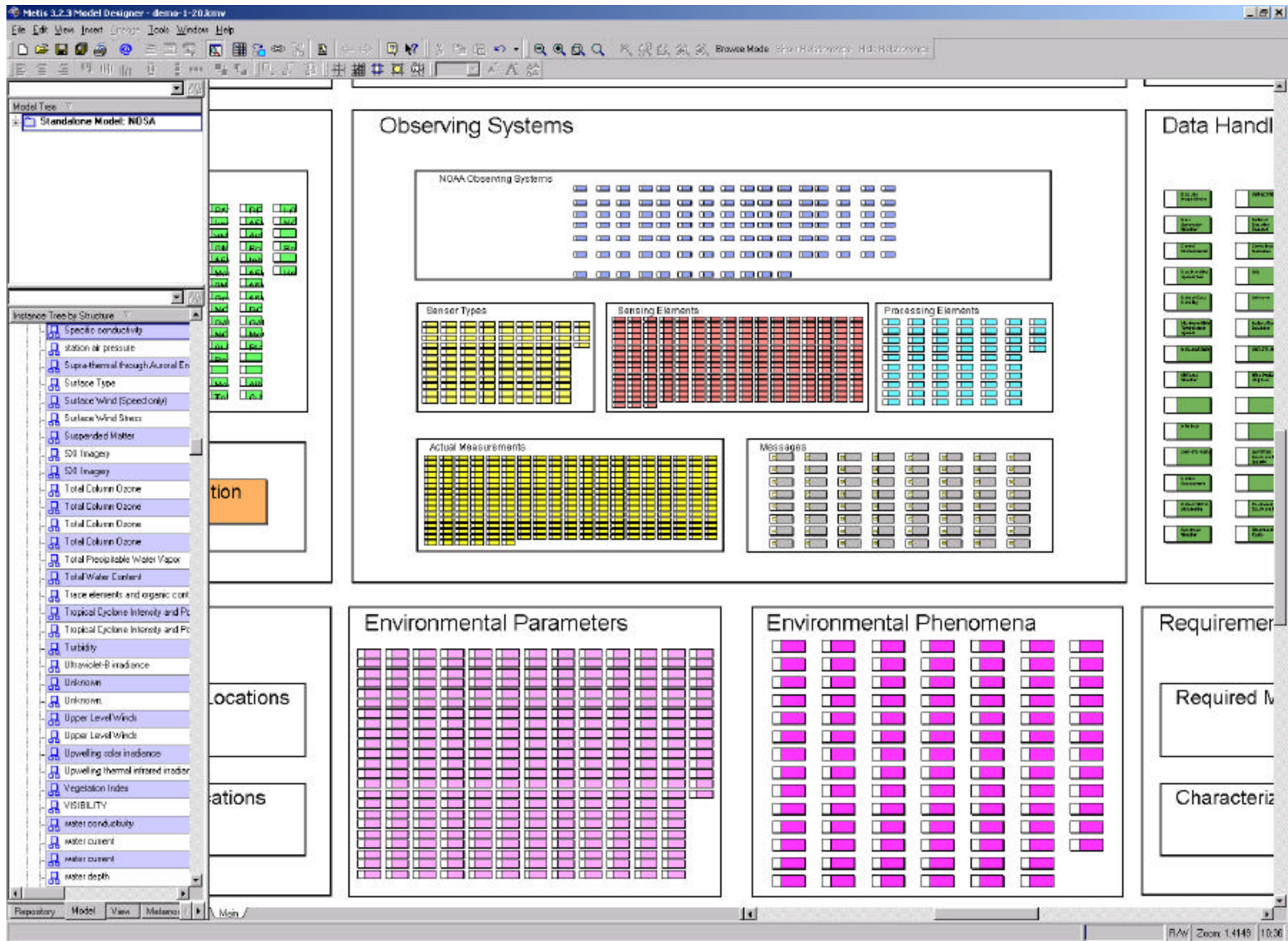
- Business Strategy & Processes:**
 - Products: Environmental Products
 - Mission Requirements: Information Need (table of 10x10 small colored boxes)
- Owners, operators, support and personnel:**
 - Persons
 - Organizations (table of 10x10 small colored boxes)
- Higher Systems:** (table of 10x10 small colored boxes)
- Observing System Elements:**
 - NCAA Observing Systems (table of 10x10 small colored boxes)
 - Station Types (table of 10x10 small colored boxes)
 - Scaling Factors (table of 10x10 small colored boxes)
 - Forecasting Methods (table of 10x10 small colored boxes)
 - NCAA Background (table of 10x10 small colored boxes)
 - Real Time (table of 10x10 small colored boxes)
- Observation Control Systems:** (empty panel)
- Strategic Goals:** (table of 10x10 small colored boxes)
- Platforms and Stations:**
 - Platform/Station Types (table of 10x10 small colored boxes)
 - Platforms/Stations (table of 10x10 small colored boxes)
- Data Handling Systems:** (table of 10x10 small colored boxes)
- Stakeholders and Users:**
 - Stakeholders (table of 10x10 small colored boxes)
 - Users (table of 10x10 small colored boxes)
- Geography:**
 - Building Locations (table of 10x10 small colored boxes)
 - Mobile Locations Data
 - Fixed Locations Data
- Environmental Parameters:** (table of 10x10 small colored boxes)
- Environmental Phenomena:** (table of 10x10 small colored boxes)
- Requirements:**
 - Required Measurements
 - Characterization Requirements

Map /

RAW Zoom: 0.6000 16:54







Metis 3.2.3 Model Designer - demo-1-20.kmiv

File Edit View Insert Arrange Tools Windows Help

Model Tree

- Standalone Model: N05A

Instance Tree by Structure

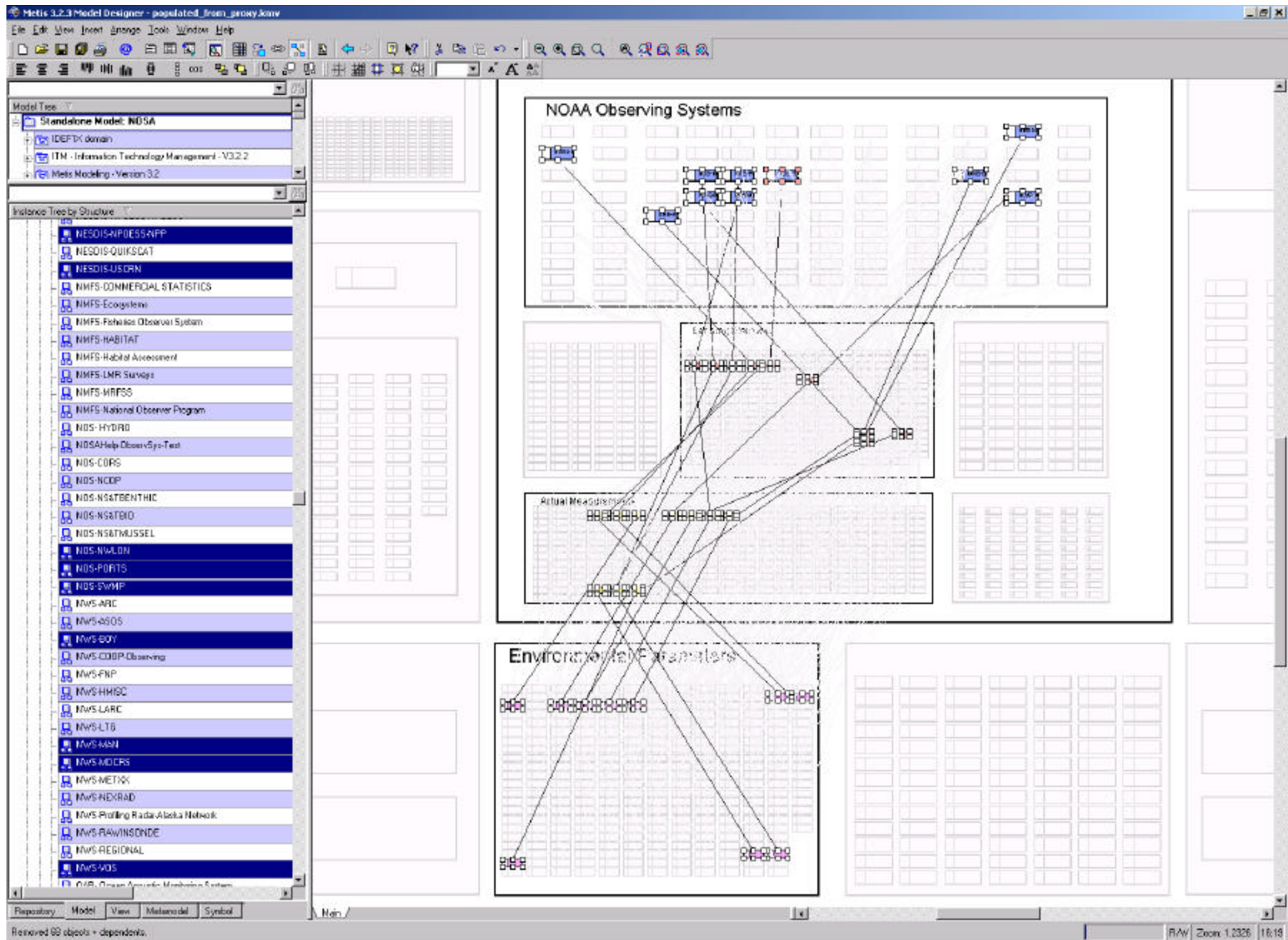
- Snow Cover
- Snow Cover
- Snow Cover and Sea Ice
- Snow Cover/Depth
- Soil Moisture
- Solar Irradiance
- Solar radiation
- Solar Radiation
- Space Environment
- Space Environment
- Space Environment
- Specific name
- Specific conductivity
- Station air pressure
- Supra-thermal through Auroral En
- Surface Type
- Surface Wind (Speed only)
- Surface Wind Stress
- Suspended Matter
- SW Imager
- SW Imager
- Total Column Ozone
- Total Column Ozone
- Total Column Ozone
- Total Column Ozone
- Total Precipitable Water Vapor
- Total Water Content
- Trace elements and organic con
- Tropical Cyclone Intensity and Pt
- Tropical Cyclone Intensity and Pt
- Turbidity

Environmental Parameters

									Active Fires	Aerosol Optical
Aerosol Particle Size	Aerosol Refractive	Aerosol Smoke	Aerosol Smoke	Aerosol profile (dilat)	Age Structures	Air Temperature	Air Temperature	Air Temperature	Air Temperature	Air Temporal
Air temperature	Air temperature	Albedo (Surface)	Ambient Air Temperature	Anthropogenic Interference	Atmospheric pressure	Atmospheric pressure	Atmospheric Electric Field	Atmospheric Humidity	Atmospheric Moisture	Atmospheric Moisture
Atmospheric Temperature	Atmospheric Temperature	Atmospheric Temperature	Atmospheric Temperature	Atmospheric Vehicle	Atmospheric pressure	Auroral Boundary	Auroral Energy	Auroral Imagery	Background Intensity	
Barometric pressure	Beta and Gamma	Biomass Burning	Biomass Burning	Cloud Amount	Cloud Amount	Cloud Base Height	Cloud Base Temperature	Cloud Cover/Layers	Cloud Effects	
Cloud Ice Water Path	Cloud Liquid Water	Cloud Optical Thickness	Cloud Particle Size Distribution	Cloud Top Height	Cloud Top Height	Cloud Top Height	Cloud Top Pressure	Cloud Top Temperature	Cloud Top Height	
Dew Point	Dew Point	Dew point	Dew point	Diffuse solar irradiance	Direct normal solar	Dissolved Oxygen	Dominant Wave period	Downward Longwave	Downward Shortwave	
Electron Density	Energetic Ions	Environmental Parameter	Fire Detection	Fire Detection	Fisher Parameter	GPS - positioning	Geomagnetic Field	Global Vegetation	Habitat	
Imagery	Imagery GOES	Imagery GOES	Imagery GOES Visible	Imagery GOES Visible	In Situ Plasma Fluctuations	In Situ Plasma Temperature	Ionospheric Scintillation	Land Surface Temperature	Land Surface Temperature	
Lightning	Low Level Winds	Low Level Winds	Maximum Altitude	Medium Energy	Miscellaneous	Net Heat Flux	Net Solar Radiation at	Neutral Density	Nighttime And Long	
OMI-CTL-4B Radi	OMI-CTL-Liquid	OMI-CTL-Radi	OMI-CTL-Radi	Ocean Color	Ocean Surface	Ocean Surface	Ocean Temperature	Ocean Wave Characteristic	Ocean current	
Ozone Vertical	Photosynthetic active	Precipitable Water	Precipitable Water	Precipitable Water	Precipitation	Precipitation	Precipitation	Precipitation	Precipitation	
Precipitation Profiles	Precipitation Type/rate	Present Weather	Pressure	Pyrrometer	Radiol wind speed	Radiol wind speed	Radiol wind speed	Radiation Budget	Radiation Budget	
Refractive Index	Refractive Temperature	Recreational Fishing Catch	Relative Humidity	Relative humidity	Relative humidity	Relative humidity	River Stage	SKImagery	SKImagery	
Sea Surface Height/Topogra	Sea Surface Temperature	Sea Surface Temperature	Sea Surface Temperature	Sea Surface Temperature	Sea Surface Winds	Sea level pressure	Sea level pressure	Sea surface temperature	Sea surface temperature	
Snow Cover	Snow Cover	Snow Cover and Sea Ice	Snow Cover/Depth	Soil Moisture	Solar Irradiance	Solar Radiation	Solar radiation	Space Environment	Space Environment	
Specific conductivity	Supra-thermal through	Surface Type	Surface Wind (Speed only)	Surface Wind Stress	Suspended Matter	Total Column Ozone	Total Column Ozone	Total Column Ozone	Total Column Ozone	
Trace elements and	Tropical Cyclone	Tropical Cyclone	Turbidity	Ultraviolet-B Irradiance	Unknown	Unknown	Upper Level Winds	Upper Level Winds	Upper Level solar	

Repository Model View Metadata

RAW Zoom 5.2530 10.56

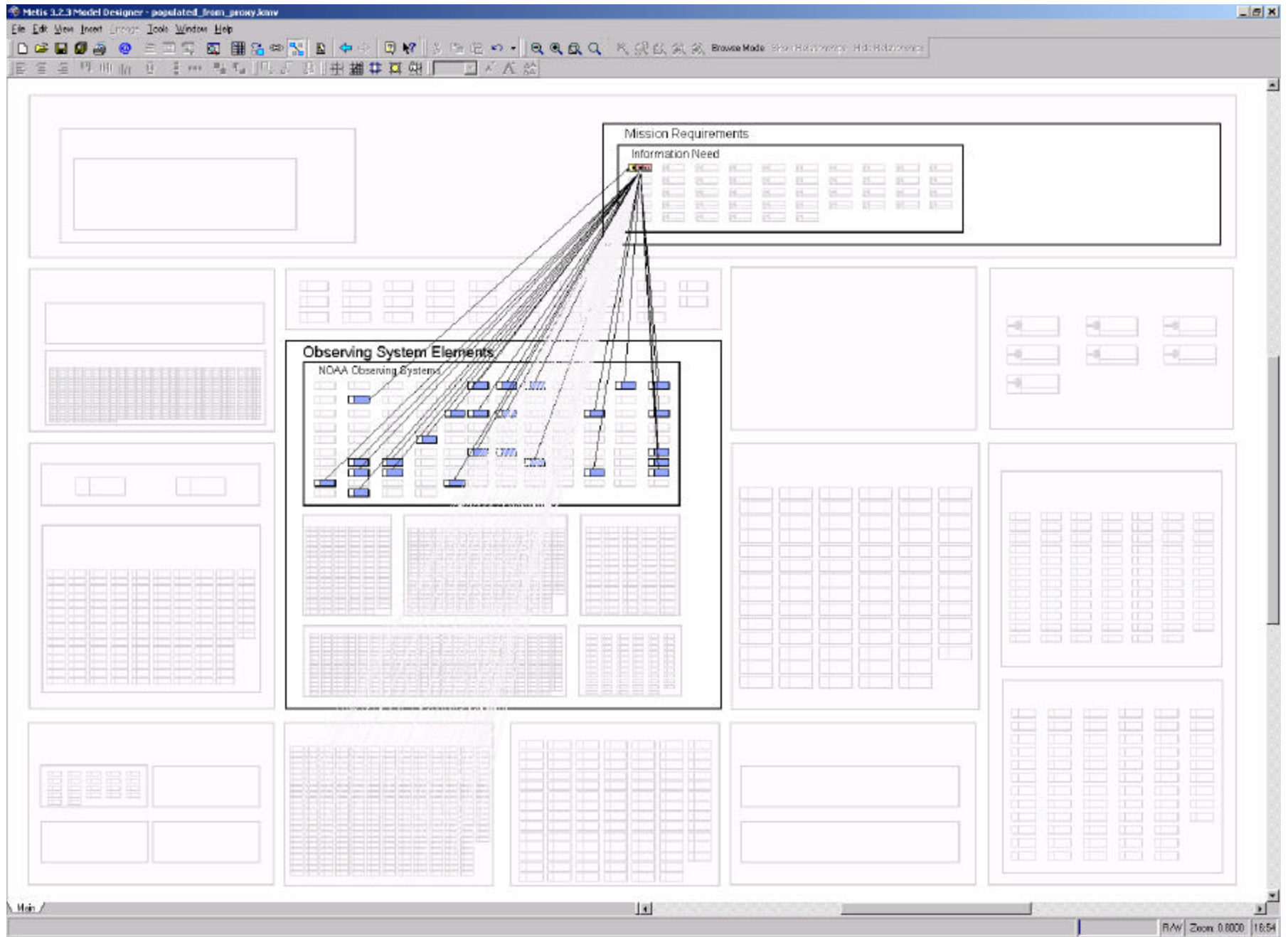


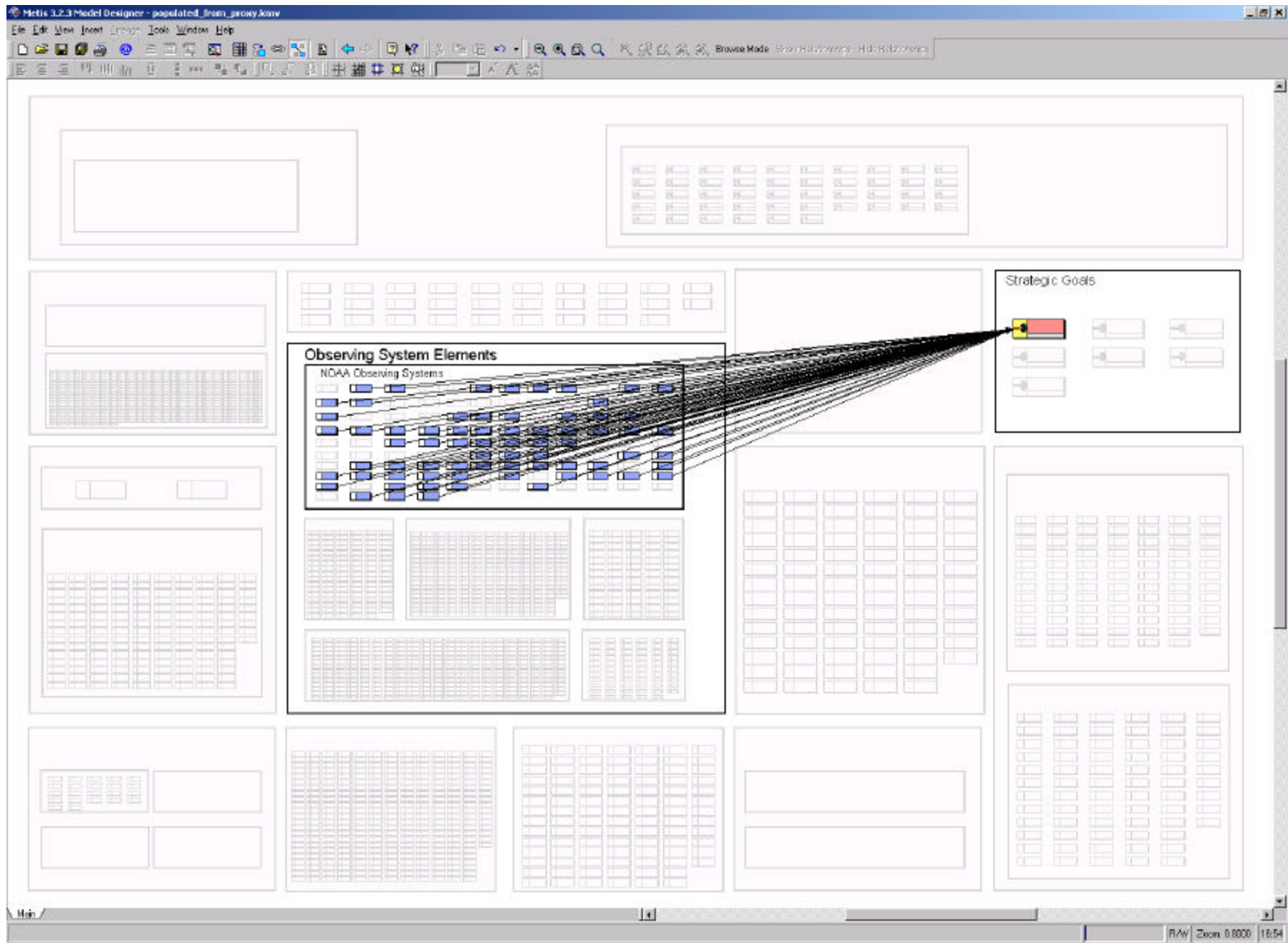
Property List [?] [X]

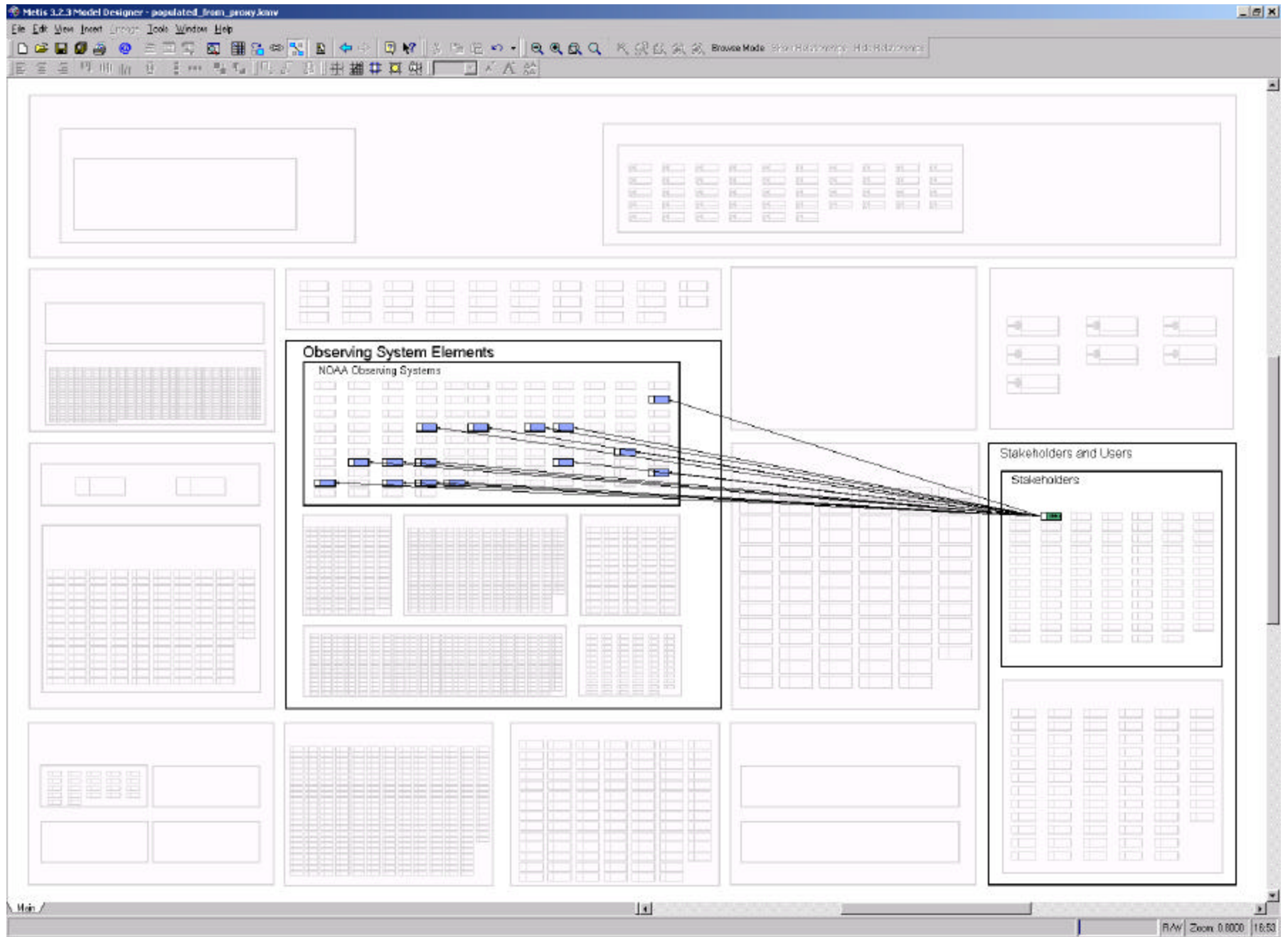
CSV [Print Icon]

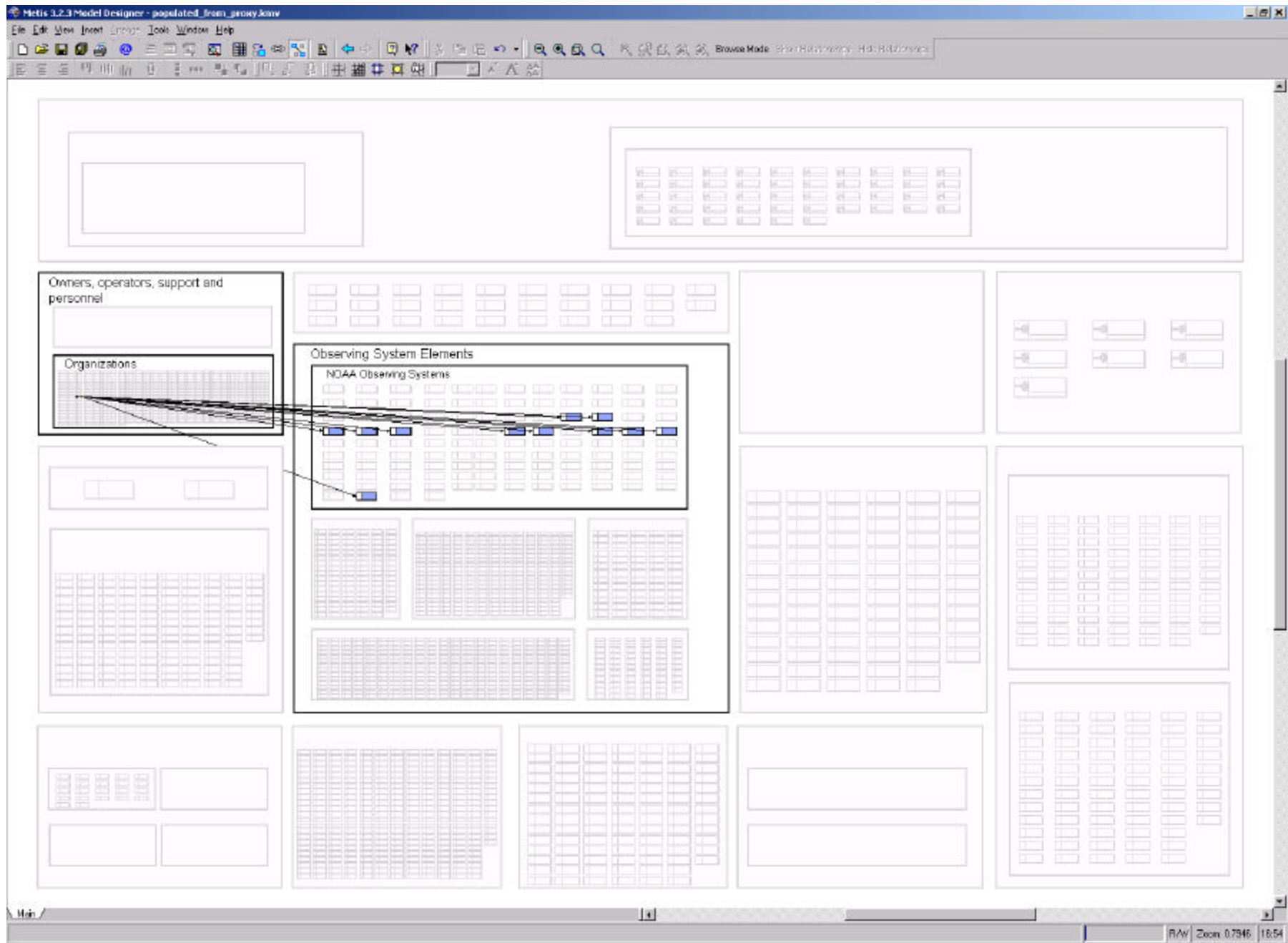
Type ▾	Origin	Target
Contains	NESDIS-NPOESS-NPP	Vaisala Temperature and RH probe
Contains	NESDIS-USCRN	Air Temperature
Contains	NOS-NWLON	Air Temperature
Contains	NOS-PORTS	Air Temperature
Contains	NOS-SWMP	Air temperature
Contains	NWS-BDY	Thermistor
Contains	NWS-MAN	Thermistor
Contains	NWS-MDCRS	Air Data Total Air Temperature Sensors
Contains	NWS-VOS	Hygrometer
Contains	OAR-ARL-SURFRAD	Vaisala Temperature and RH probe
Measures	air temperature	air temperature
Measures	air temperature	air temperature
Measures	air temperature	air temperature
Measures	Air temperature	Air temperature
Measures	Air temperature	Air temperature
Measures	Air temperature	Air temperature
Measures	Air temperature	Air temperature
Measures	Air Temperature	Air Temperature
Measures	Air Temperature	Air Temperature
Measures	Air Temperature	Air Temperature
Takes	Air Data Total Air Temperature Sensors	Air temperature
Takes	Air temperature	Air Temperature
Takes	Air Temperature	air temperature
Takes	Air Temperature	air temperature
Takes	Air Temperature	Air Temperature
Takes	Hygrometer	Air temperature
Takes	Thermistor	Air temperature
Takes	Thermistor	Air temperature
Takes	Vaisala Temperature and RH probe	air temperature

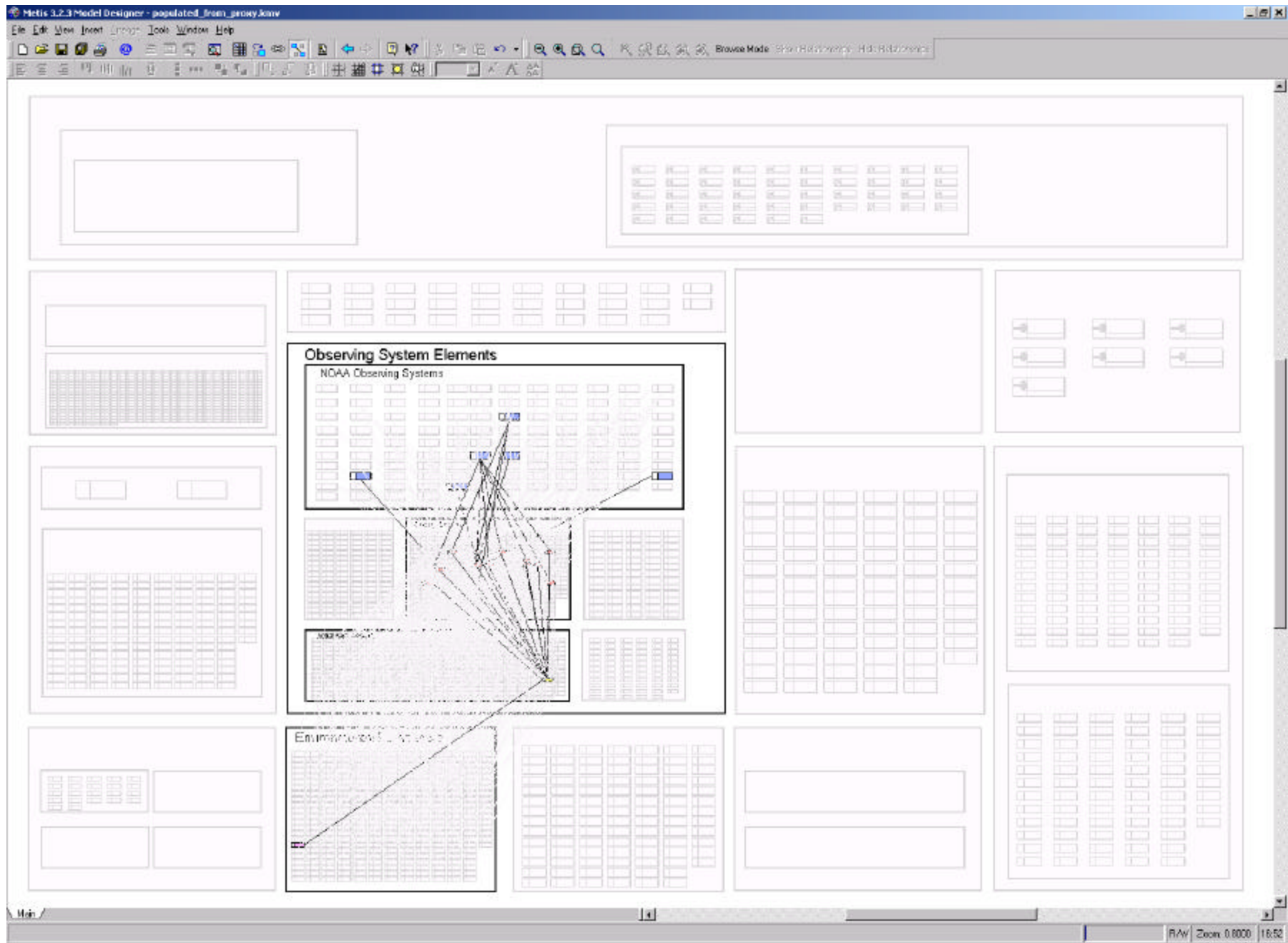
OK Apply Revert Cancel



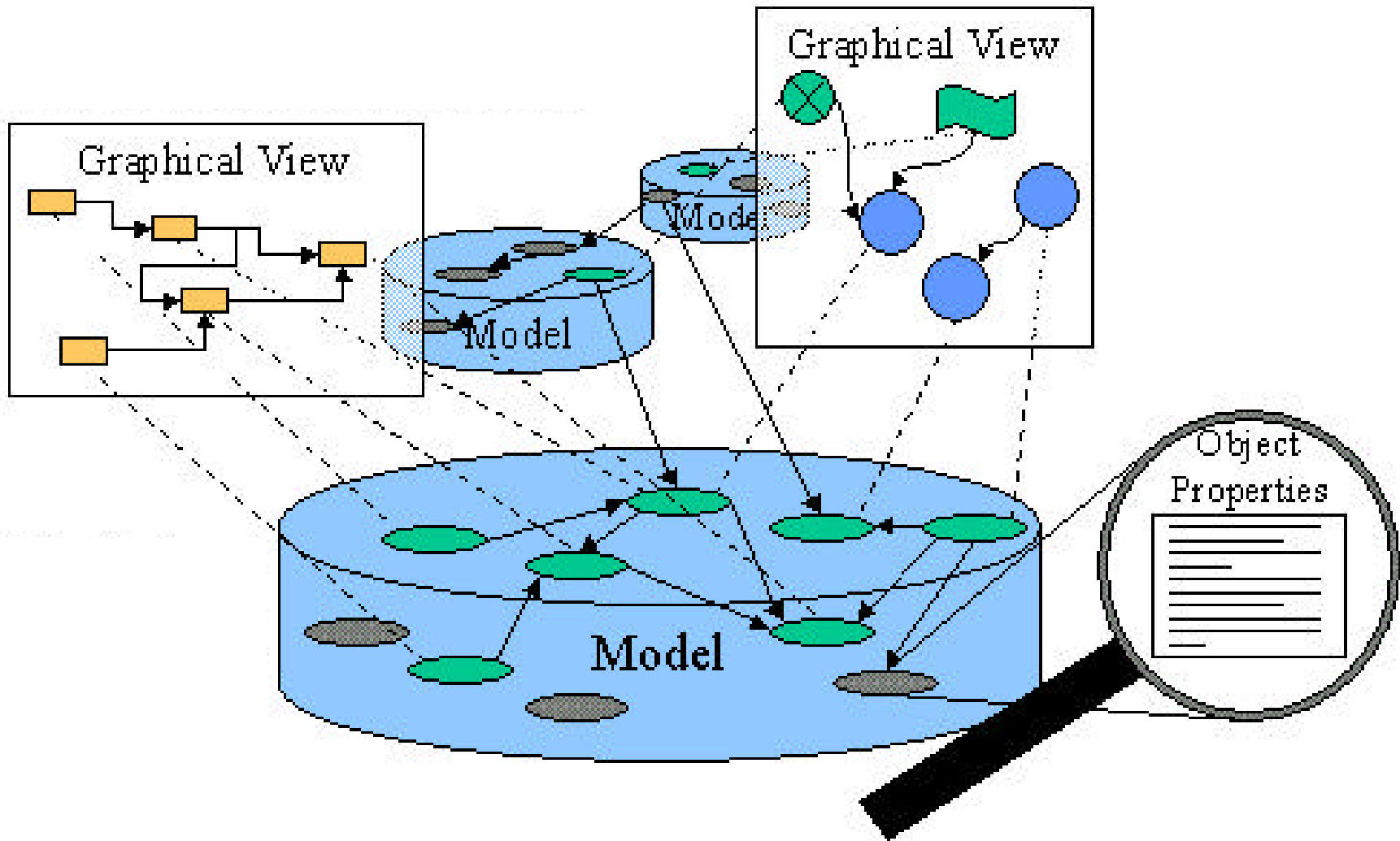








Metis Architecture Tool



Results

- ❖ **Architecture modeled using Metis provides a framework for:**
 - Examining future requirements and cost goals
 - Discovery of gaps and duplications
 - Identifying research opportunities
 - Planning evolutionary improvement

- ❖ **Metis provides an integrated view of NOAA's observing systems linked to missions**

- ❖ **Leads to a more cost-effective portfolio of systems, products & services**