

SOX

Sensor-web Operations Explorer

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ESTO-Sensor Web NRA

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Research Team

Co Investigators

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Richard Weidner, PhD (JPL)
Adrian Sandu, PhD (VT)
Kumarech Singh, (VT)

Infusion Teams

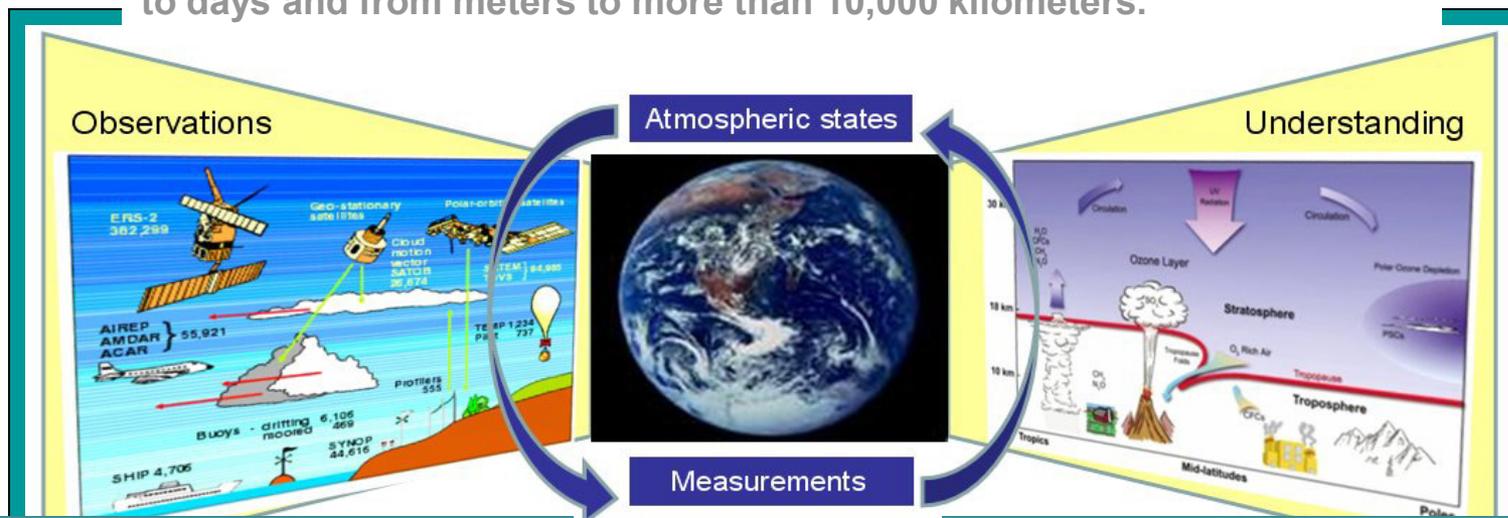
GEOCAPE (Geostationary Coastal and Air Pollution Events)
Concept Study Team

GEOS-Chem (Goddard Earth Observation System- Chemistry)
Adjoint Working group

CLARREO (Climate Absolute Radiance and Refractivity Observatory)
Concept Study Team

Science Problem

Understanding the atmospheric state and its impact on air quality requires **observations of trace gases, aerosols, clouds, and physical parameters** across temporal and spatial scales that range from minutes to days and from meters to more than 10,000 kilometers.



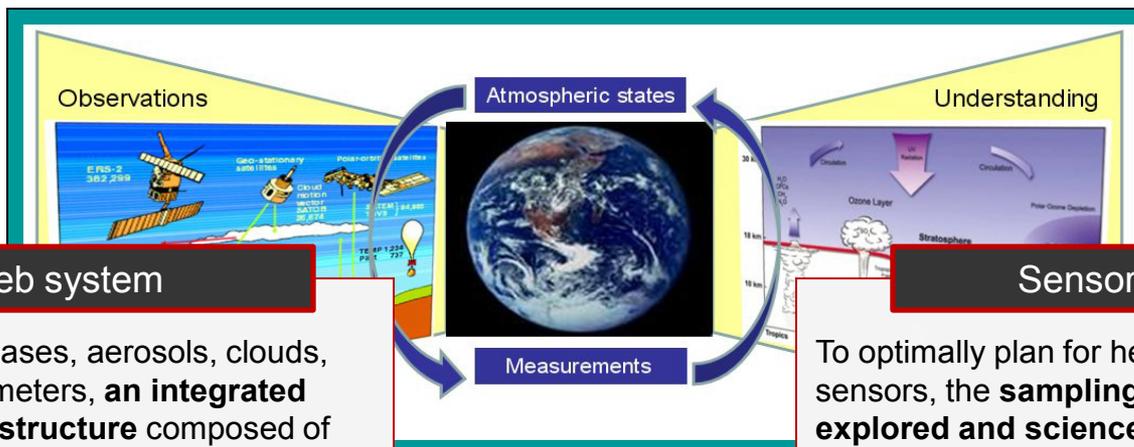
Observations

- Continuous local monitoring for particle formation
- Field campaigns for emissions, local transport, and chemistry
- Periodic global measurements for continental transport and chemistry

Understanding

- Global data assimilation framework capable of hierarchical coupling
- Dynamic integration of chemical data and atmospheric models
- Feedback loops between models and observations

Objectives

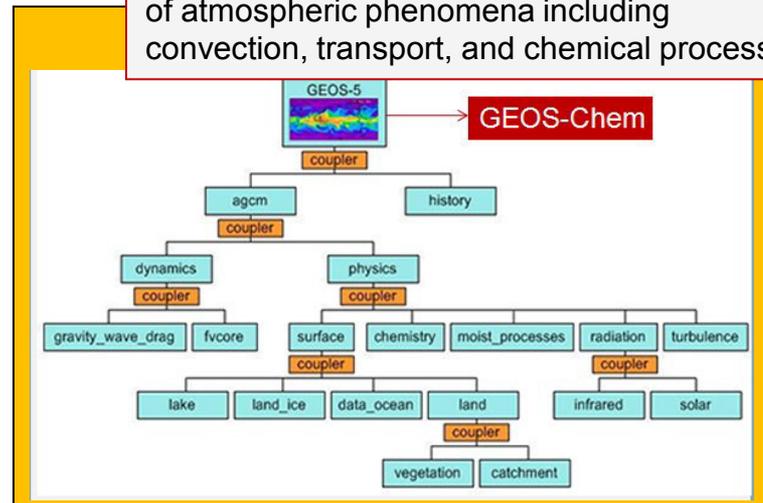
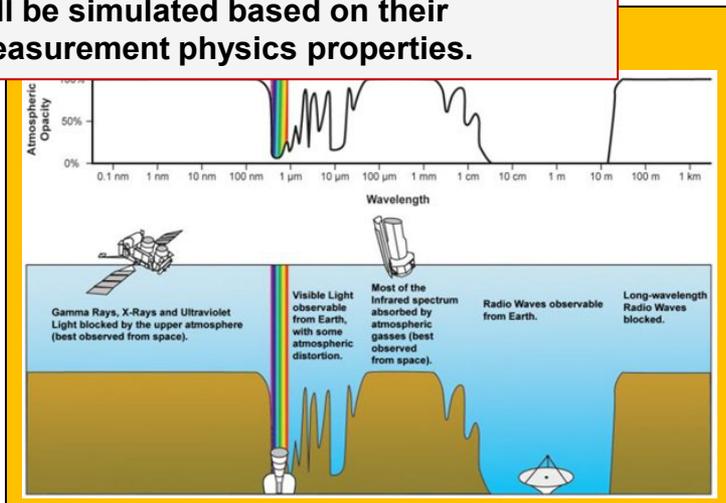


Sensor-web system

To observe trace gases, aerosols, clouds, and physical parameters, **an integrated observation infrastructure** composed of space-borne, air-borne, and in-situ sensors **will be simulated based on their measurement physics properties.**

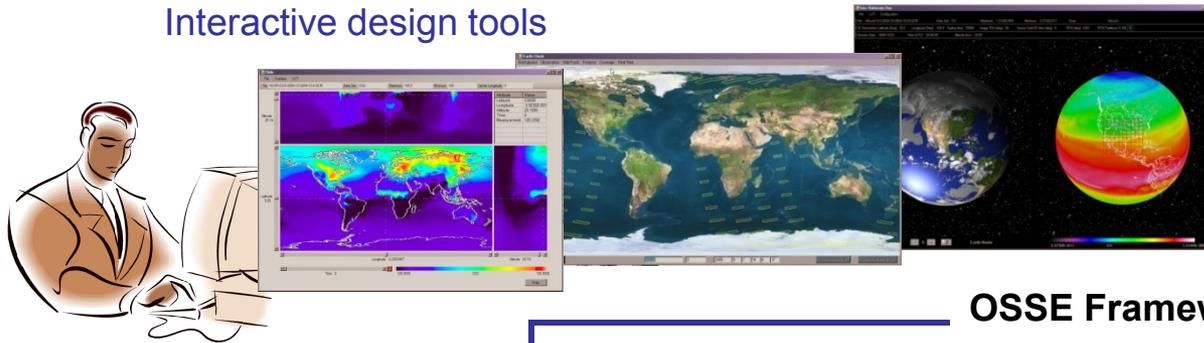
Sensor -web operation

To optimally plan for heterogeneous multiple sensors, the **sampling strategies will be explored and science impact will be analyzed** based on comprehensive modeling of atmospheric phenomena including convection, transport, and chemical process.



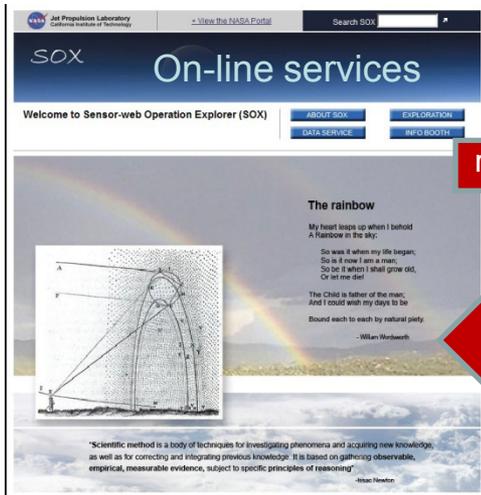
Exploration Framework

Interactive design tools



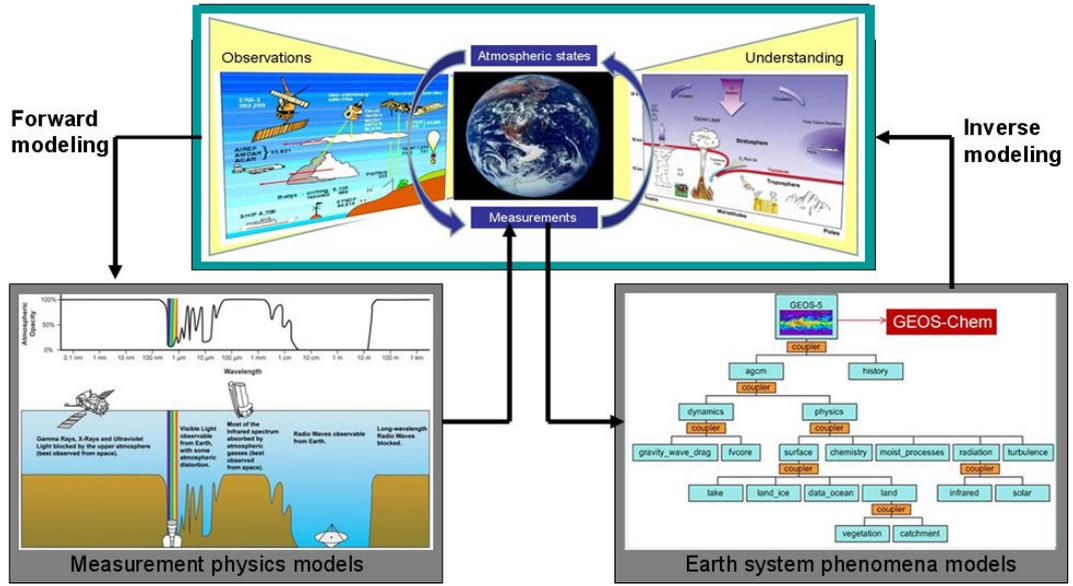
OSSE:
Observation
System
Simulation
Experiment

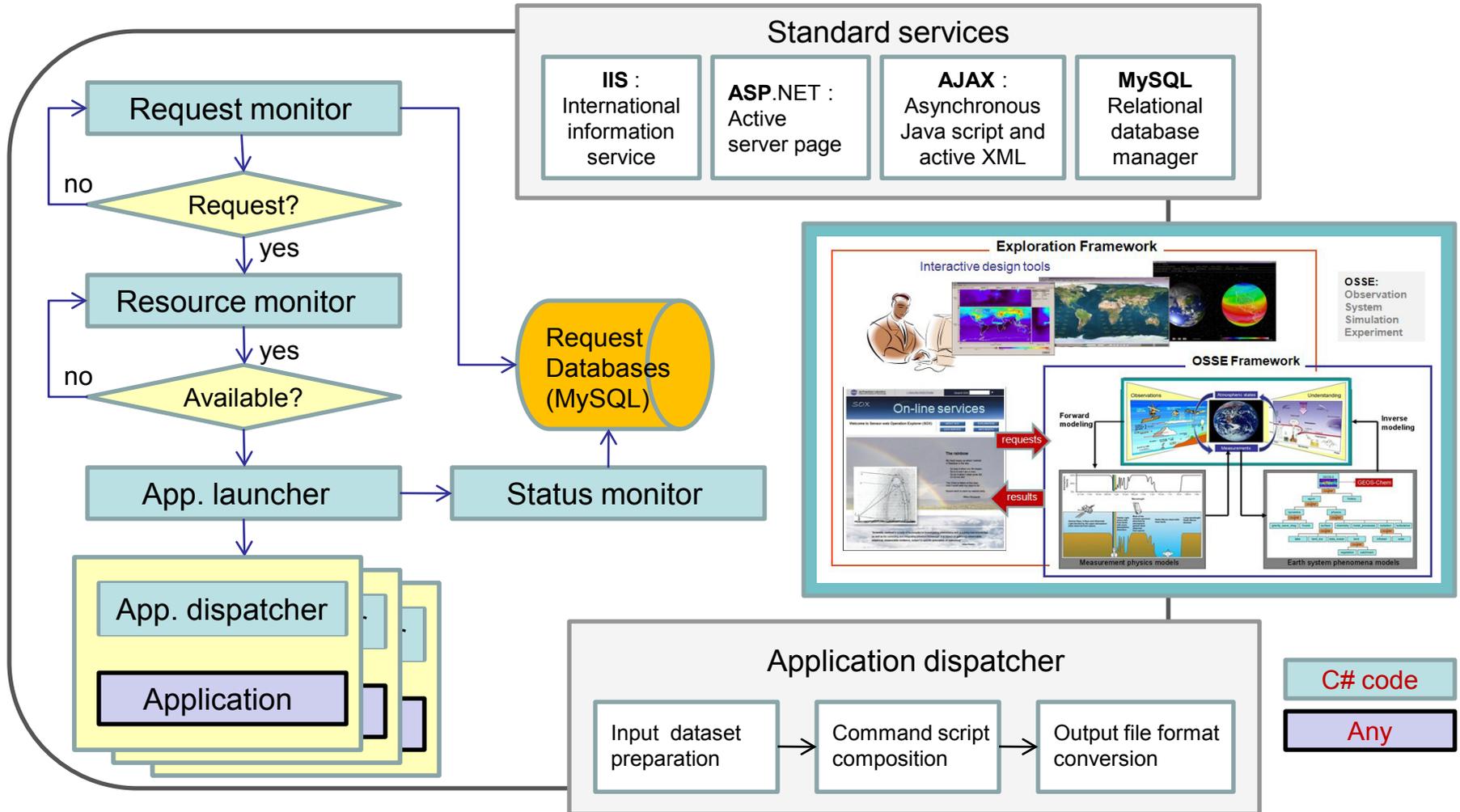
OSSE Framework

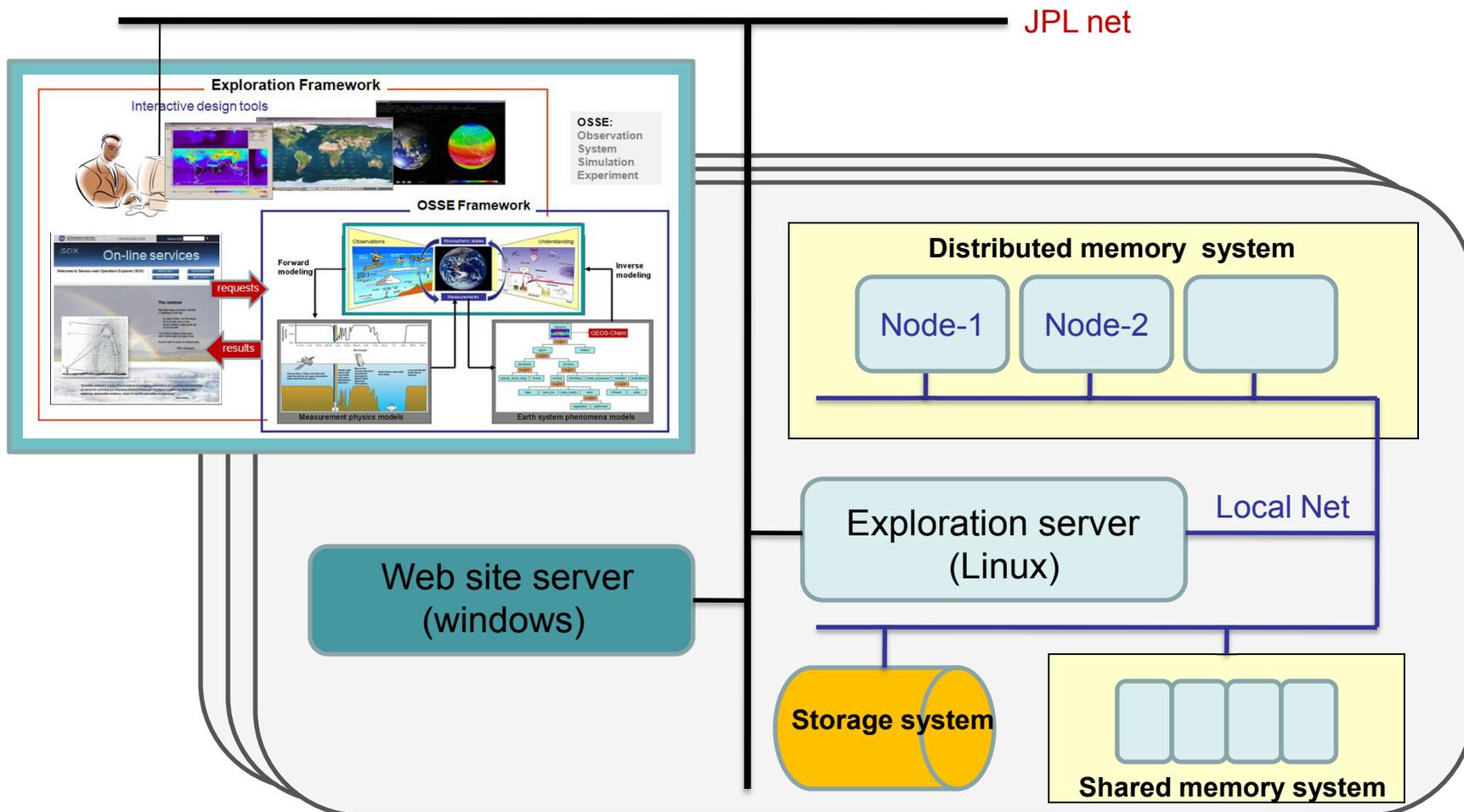


requests

results



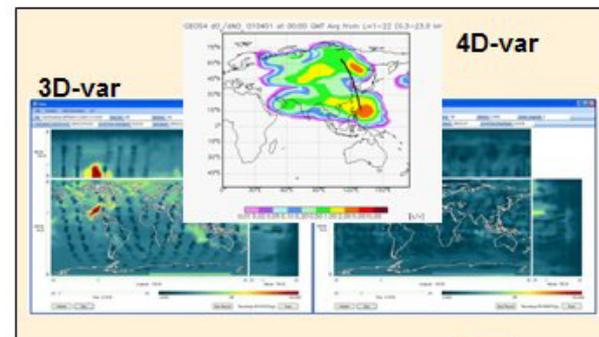
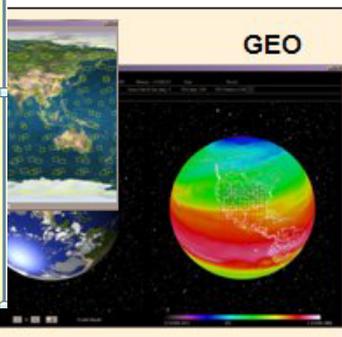




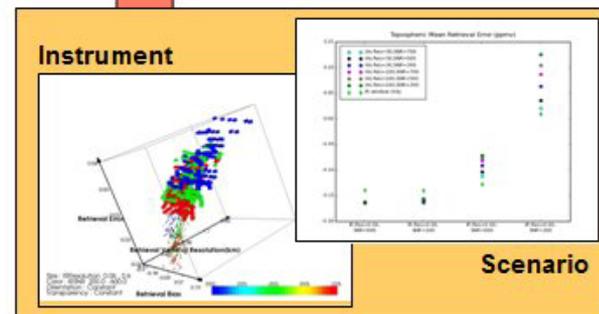
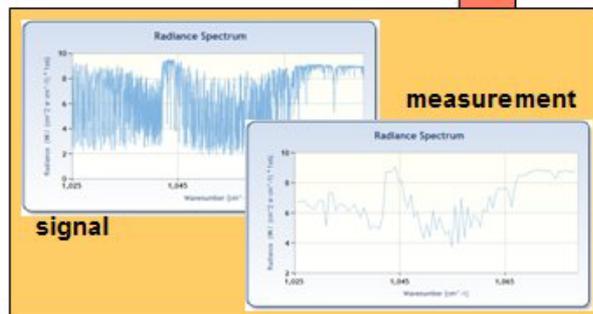
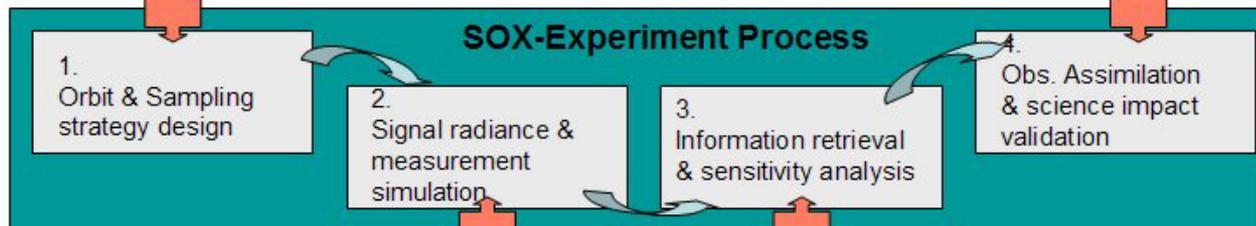
Process Flow

Property	Phenomena databases	Phenomena component
Altitude	Physical parameters	Temperature, Humidity, Pressure
Altitude	Trace gases	CO _x , O ₃ , NO _x , CH ₄
Wavelength	Aerosols	Organic material, Black carbon, Haze, Dust, Sea salt
Wavelength	Surface reflectance	Land, Ocean

MOZART	GEOCHEM	IMPACT	MODIS	Parametric
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For each experiment, a phenomena database is prepared that represents the global atmospheric state during the experiment period. The phenomena database is organized w.r.t. physical parameters, trace gases, aerosols, and surface properties.



Towards the Construction of a Standard Adjoint GEOS-Chem Model

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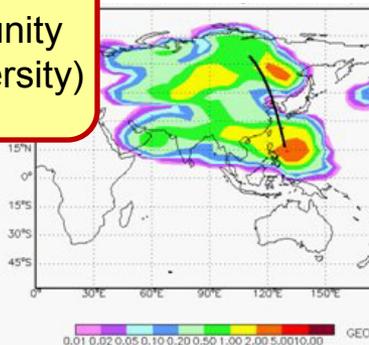
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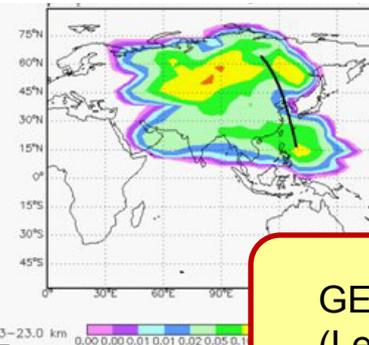
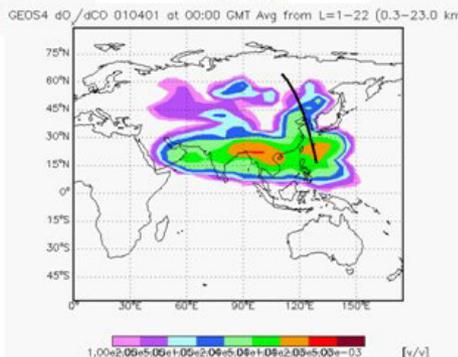
GEOS-Chem community
(Lead : Havard University)



GEOS-4 chemistry, transport and convection adjoint influence functions (48 hours simulation from 2001/04/01)

4D-Variational Assimilation Framework for Targeted Observation

dO_3/dCO



GEOS-Chem Adjoint
(Lead : Caltech/JPL)

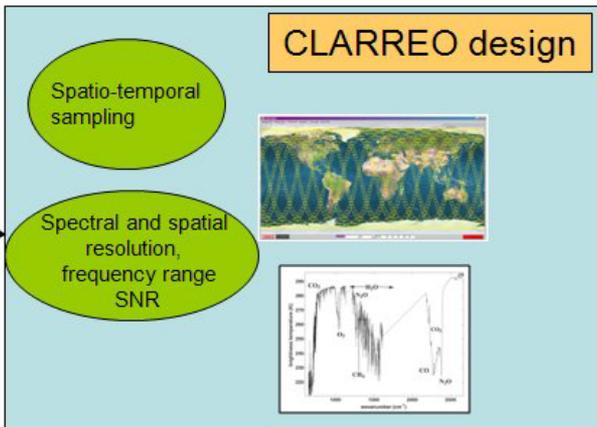
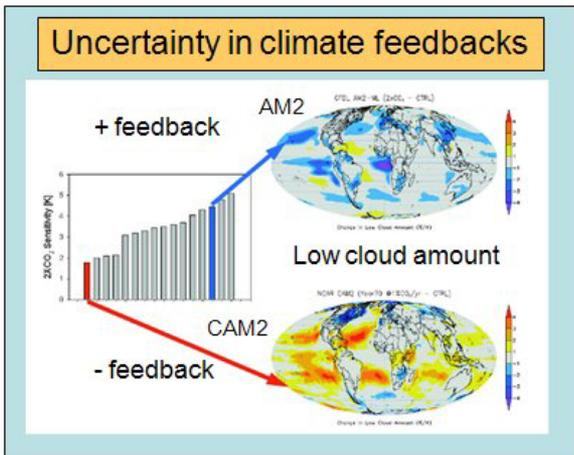
O_3 : Ozone
 CO : Carbon monoxide
 NO_x : Nitrogen oxides (NO , NO_2)

dO_3/dNO_x implies the changes in ozone at a given space and time to the changes in Nitrogen oxides at any other space and time.

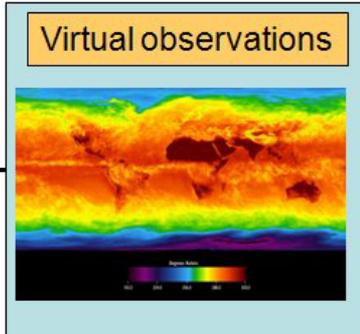
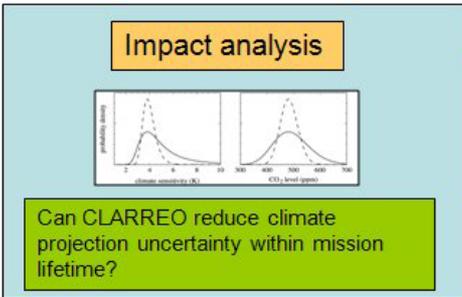


National Aeronautics and Space Administration
 Jet Propulsion Laboratory
 California Institute of Technology
 Pasadena, California

Science Requirements to Measurement Requirements.



CLARREO OSSE
 (Lead : Kevin Bowman)



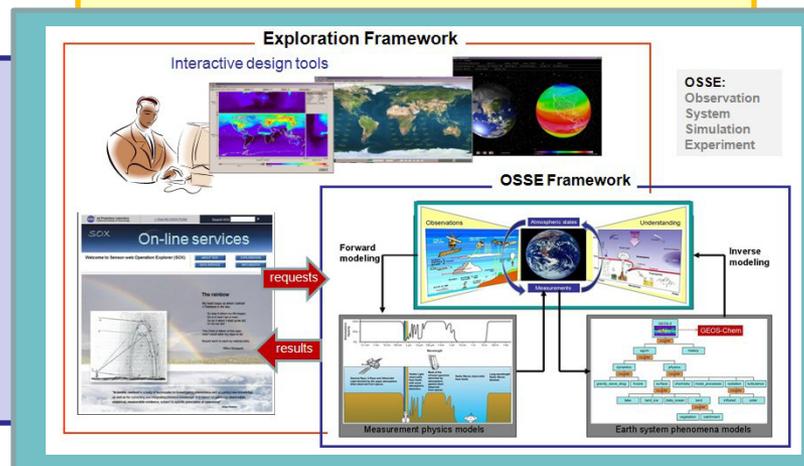
Challenges

Phenomena database

Unified atmospheric state representation integrating heterogeneous temporal and spatial resolution datasets.

Exploration space

Parameterization of sampling strategy, measurement quality, instrument control, & science impact.



Community models

Handling dependencies on programming languages, operating systems, ancillary datasets, and file formats.

Heterogeneous infrastructure design for integrating multiple processor types and storage systems in a scalable manner.

Computational facility

TechnicalDesign exploration

Parameterization of sampling strategy, measurement quality, instrument control, & science impact.

Community models

Handling dependencies on programming languages, operating systems, ancillary datasets, and file formats.

Computation

Heterogeneous infrastructure design for integrating multiple processor types and storage systems in a scalable manner.

OperationalPhenomena database

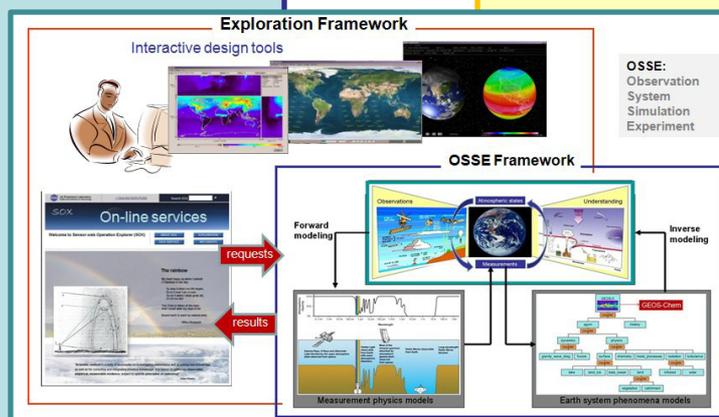
Unified atmospheric state representation integrating heterogeneous temporal and spatial resolution datasets.

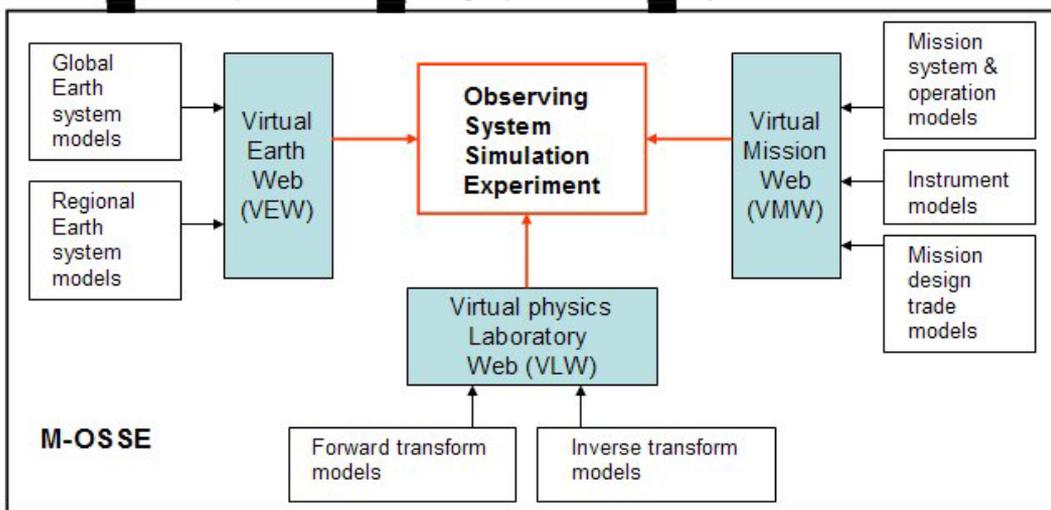
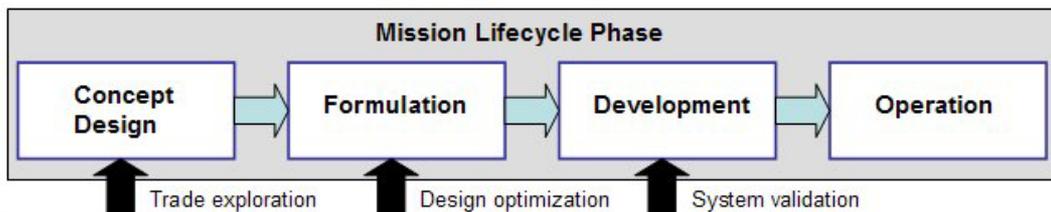
Facility

Heterogeneous infrastructure design for integrating multiple processor types and storage systems in a scalable manner.

Maintenance

Tracking new versions of community models and commercial products in software & hardware.





Project-lifecycle-phase sensitive decision support infrastructure

Model-web for OSSE (M-OSSE)

Collaboration between global and regional Earth system models

