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An Atmospheric Science Observing System Simulation Experiment (OSSE) Environment

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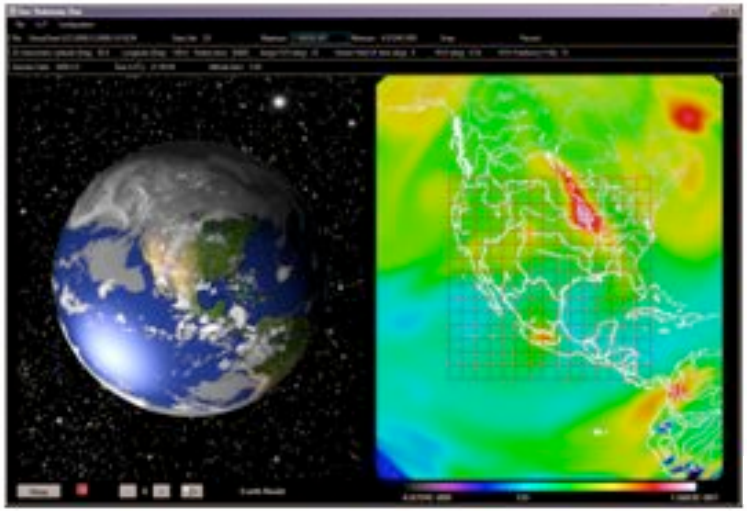
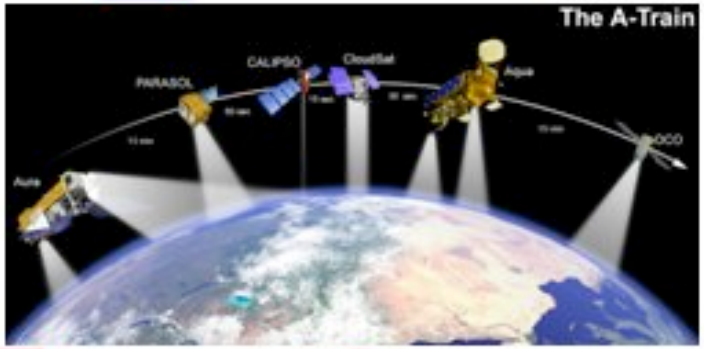
Background

Data assimilation
Model evaluation

Earth system models



Observing systems



Mission planning
Data acquisition

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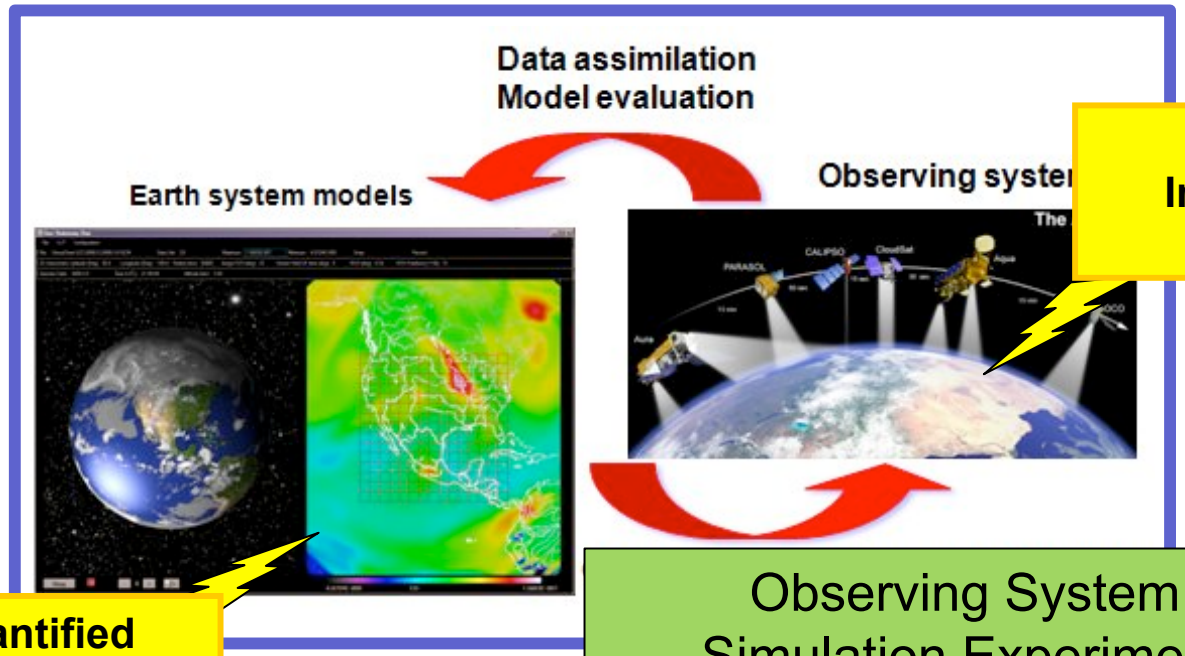
New Paradigm



Mission/ Instrument Concept

Quantified Science Impact

Observing System Simulation Experiment (OSSE)

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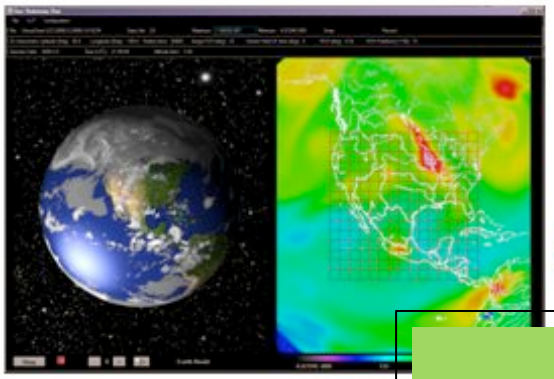
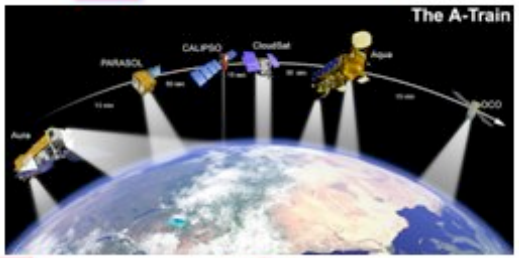
OSSE Process

Inverse Modeling
(from measurement to atmospheric state)

Earth system models



Observing systems



Forward Modeling
(from atmospheric state to measurement)

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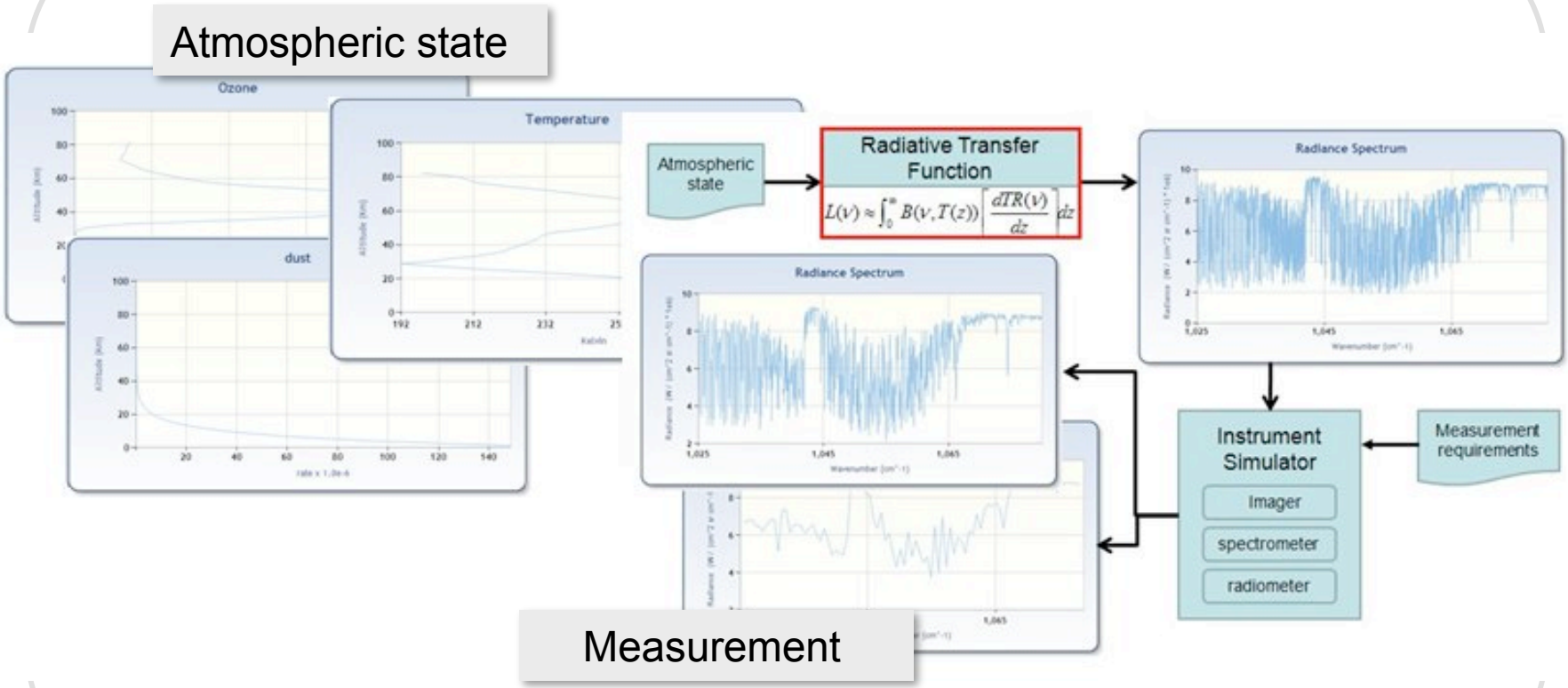
Forward Modeling



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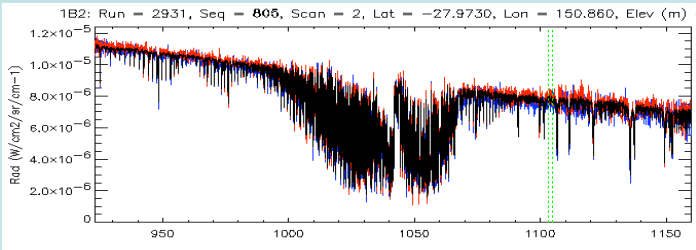
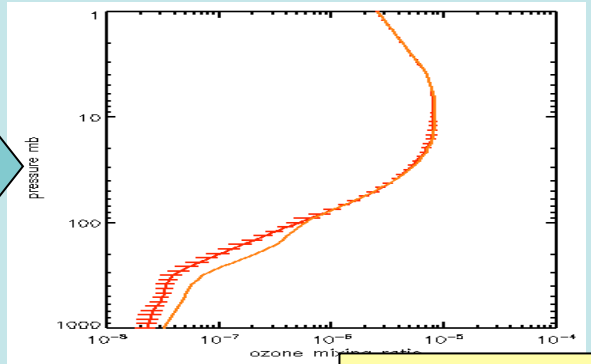
Inverse Modeling

Retrieval analysis

$$\hat{\mathbf{x}} = \mathbf{x}_a + \mathbf{A}(\mathbf{x} - \mathbf{x}_a) + \mathbf{G}\mathbf{n}$$



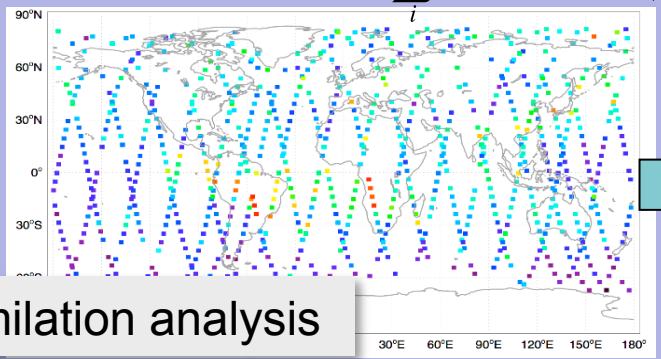


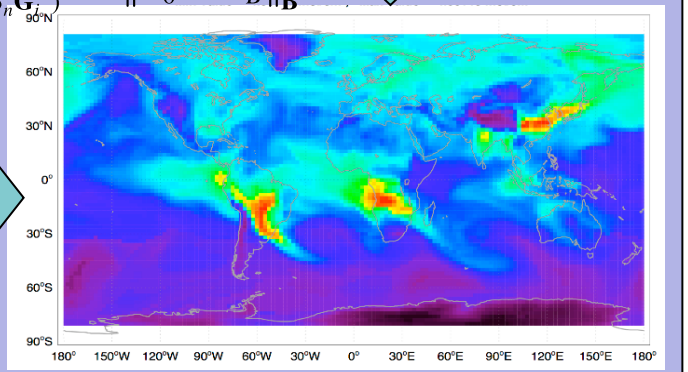
$$\|\mathbf{y} - \mathbf{F}(\mathbf{x}_a)\|^2_{\mathbf{S}_n^{-1}} + \|\mathbf{x} - \mathbf{x}_a\|^2_{\mathbf{S}_a^{-1}}$$

$$\mathbf{H}_i(\bullet) = \mathbf{x}_a + \mathbf{A}_i(\bullet - \mathbf{x}_a)$$

Assimilation analysis

$$\sum_i \|\hat{\mathbf{x}}_i - \mathbf{H}_i(\mathbf{x})\|^2_{(\mathbf{G}_i\mathbf{S}_n^i\mathbf{G}_i^T)^{-1}} + \|\mathbf{x}_0 - \mathbf{x}_B\|^2_{\mathbf{B}^{-1}}$$





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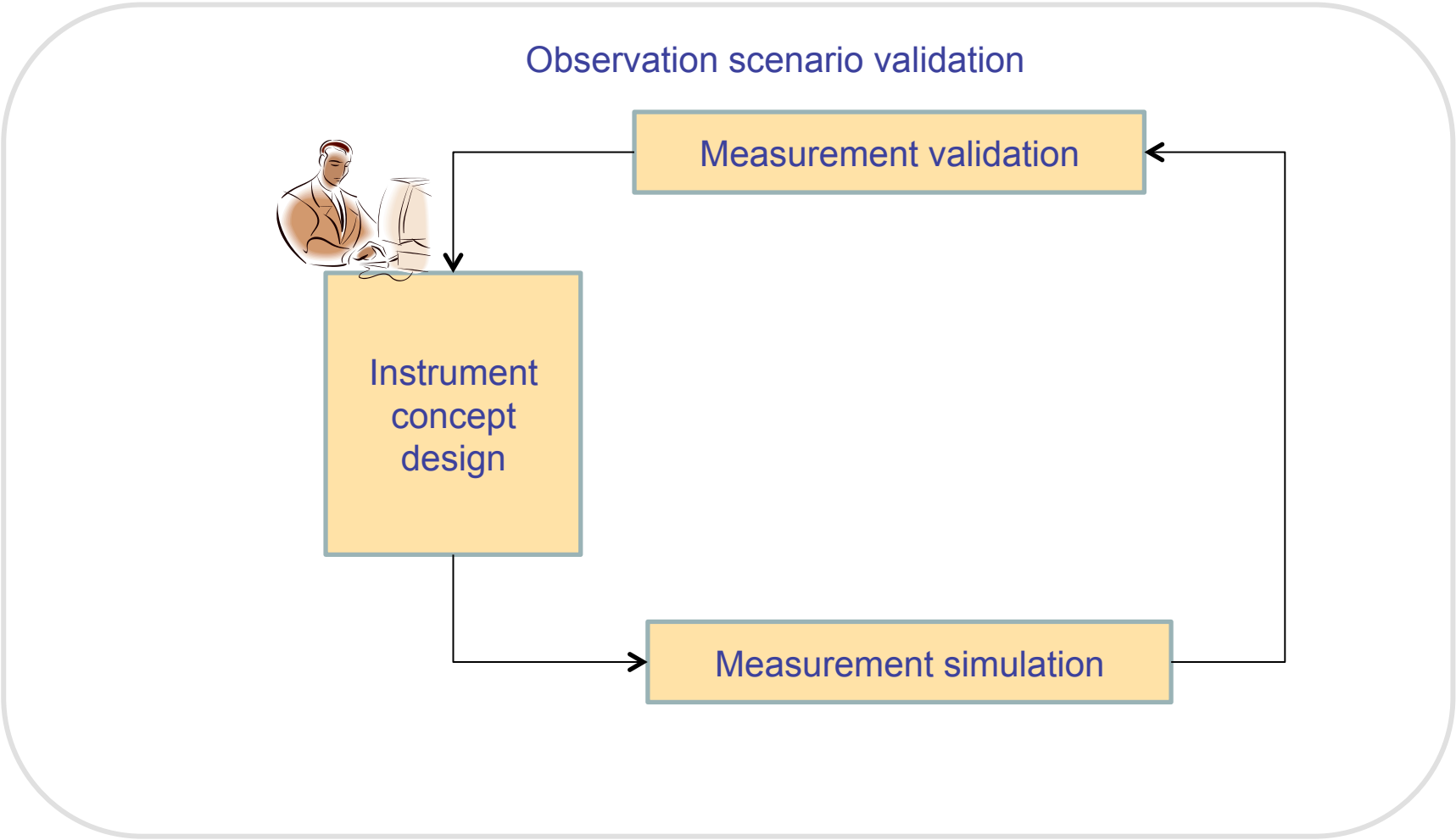
Exploration Framework



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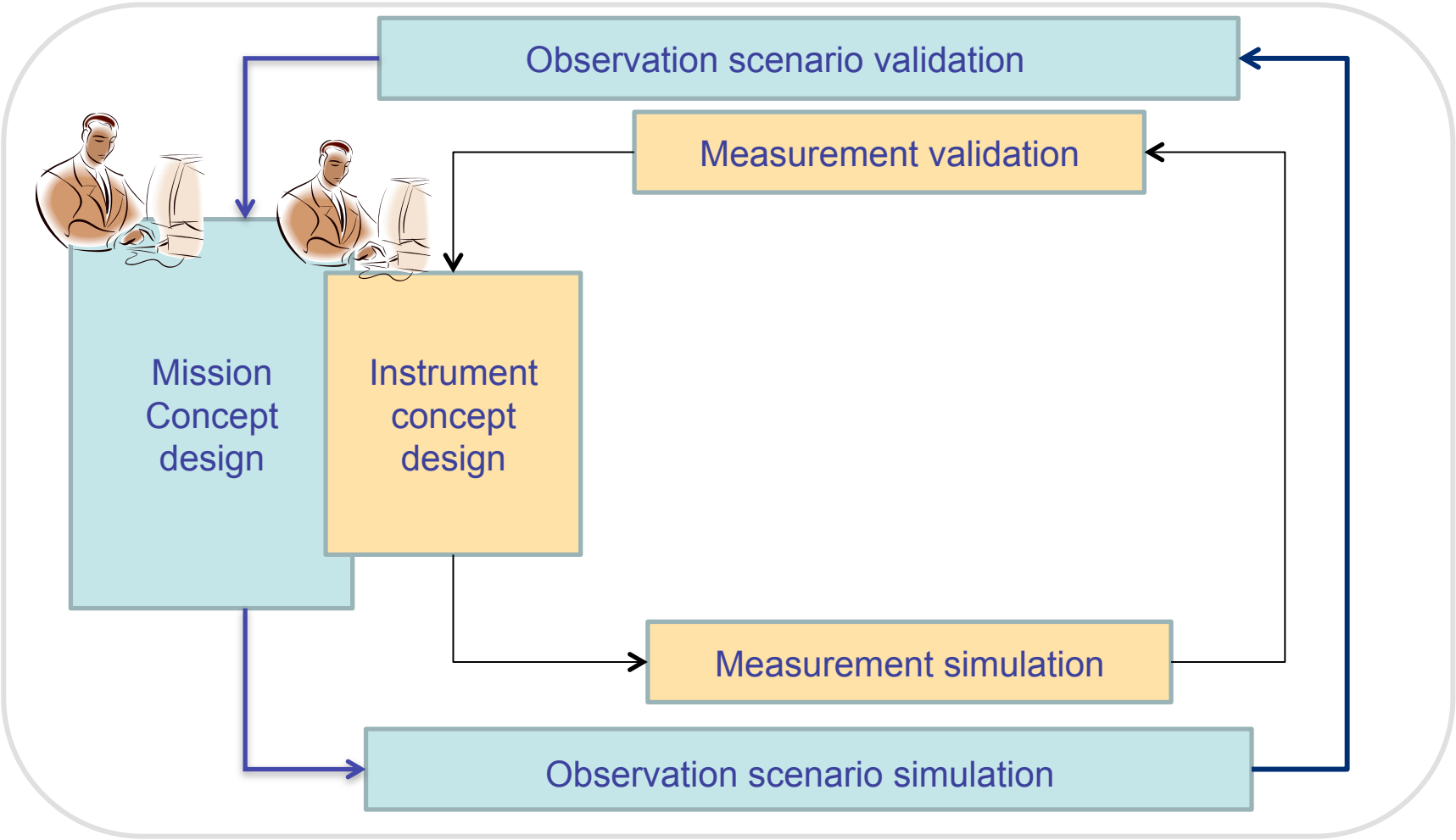
Exploration Framework



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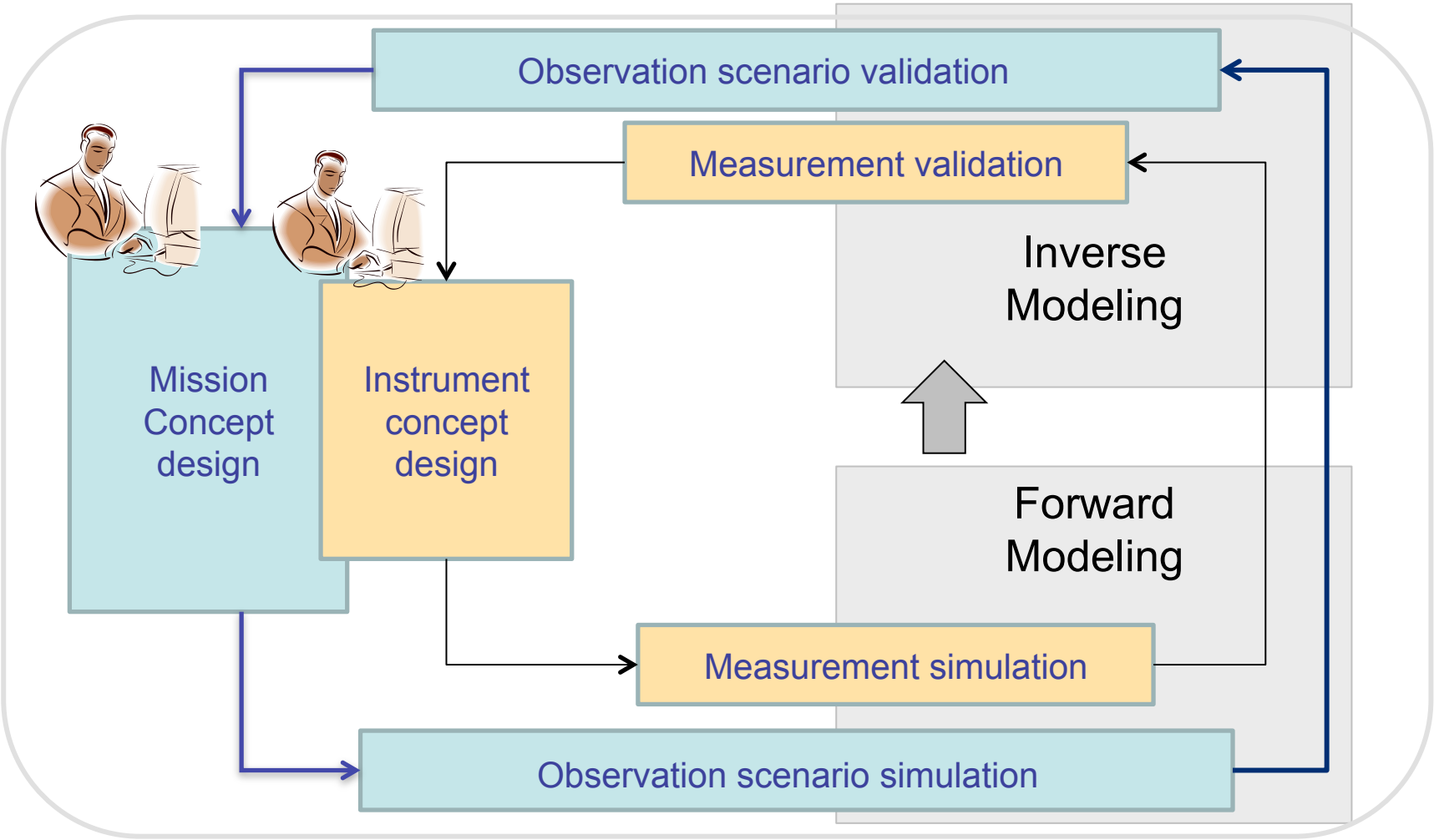
Exploration Framework



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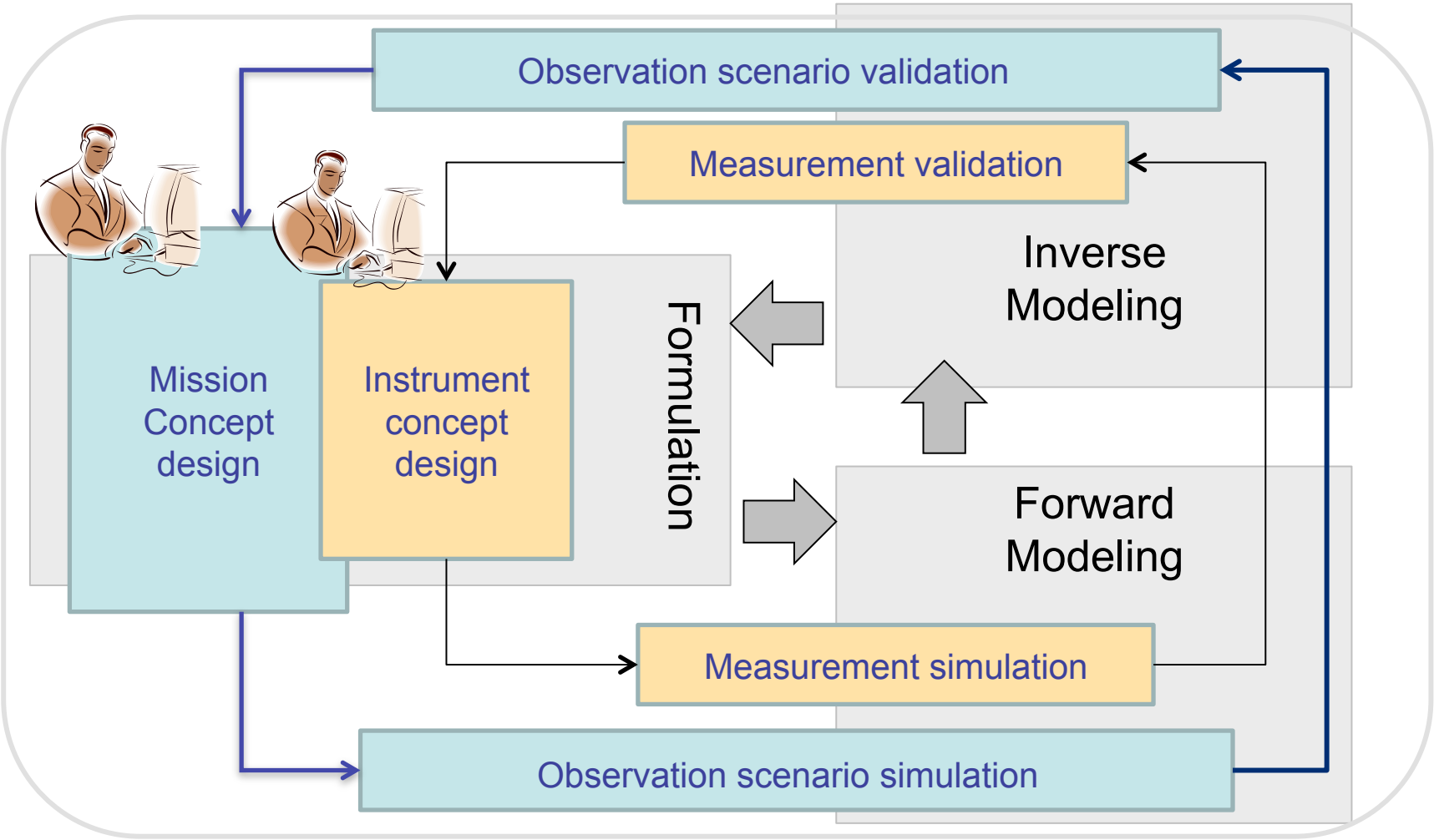
Exploration Framework



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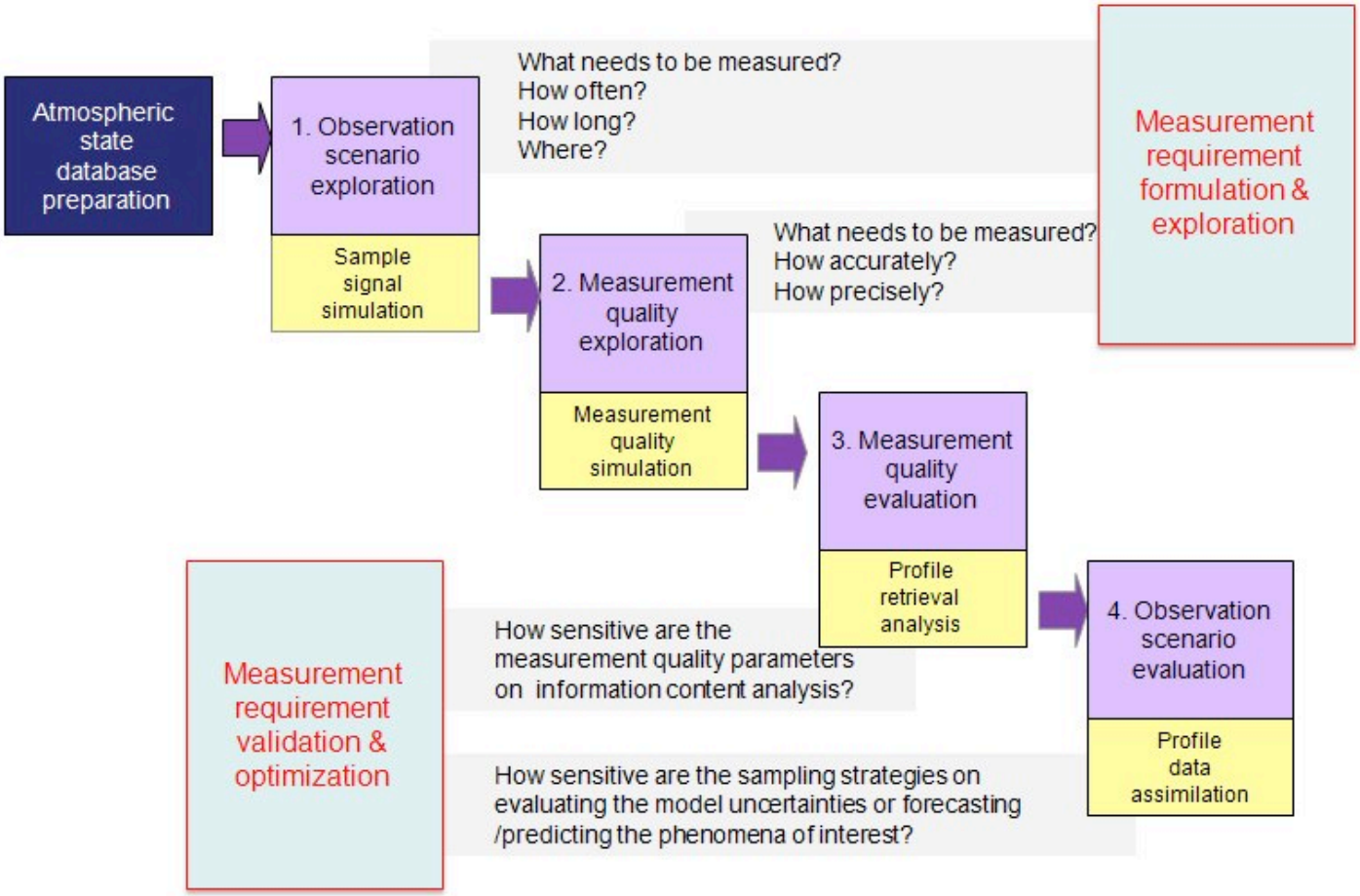
Mission concept exploration process



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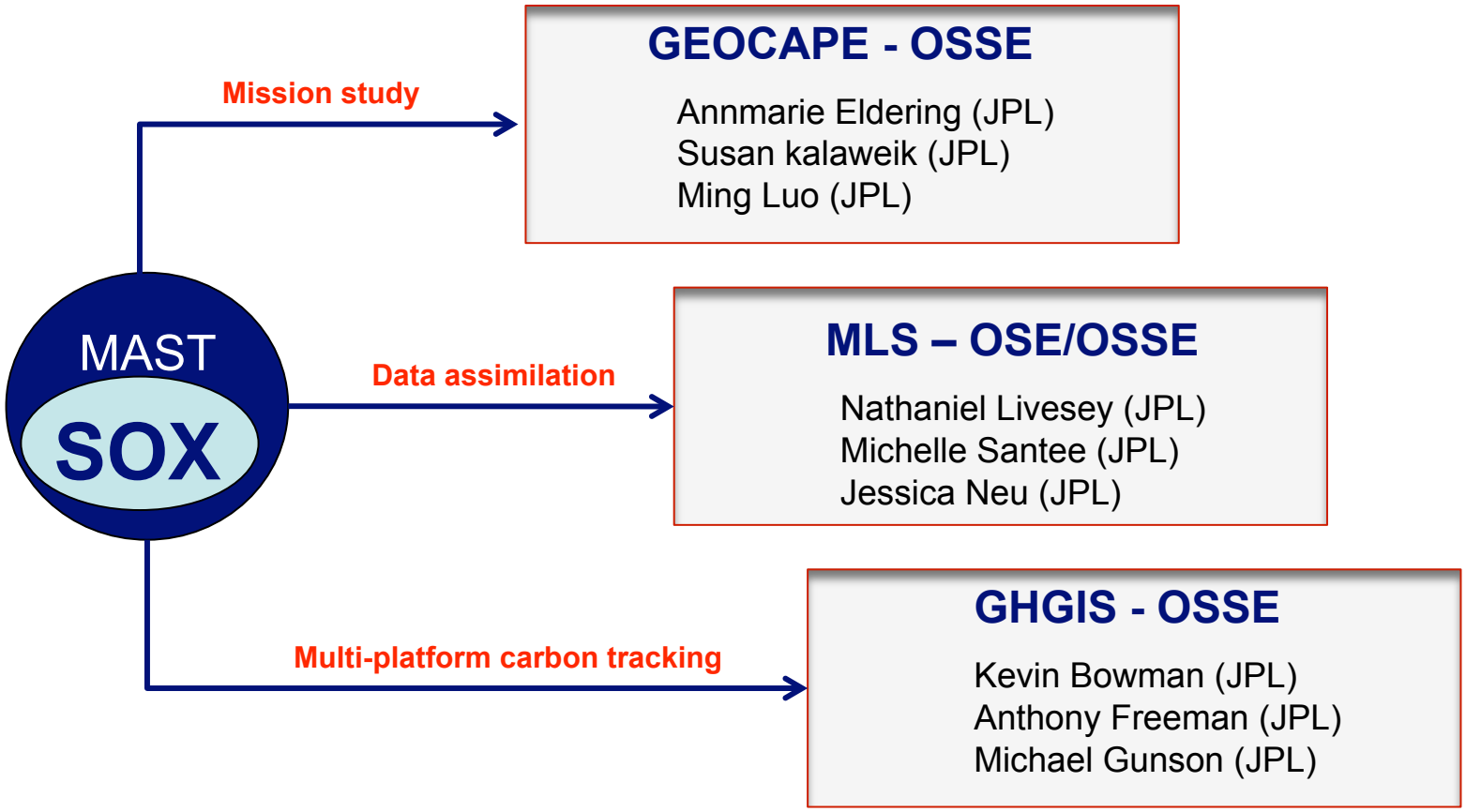
Technology Infusion



MAST: Multi-platform Atmospheric Science Testbed

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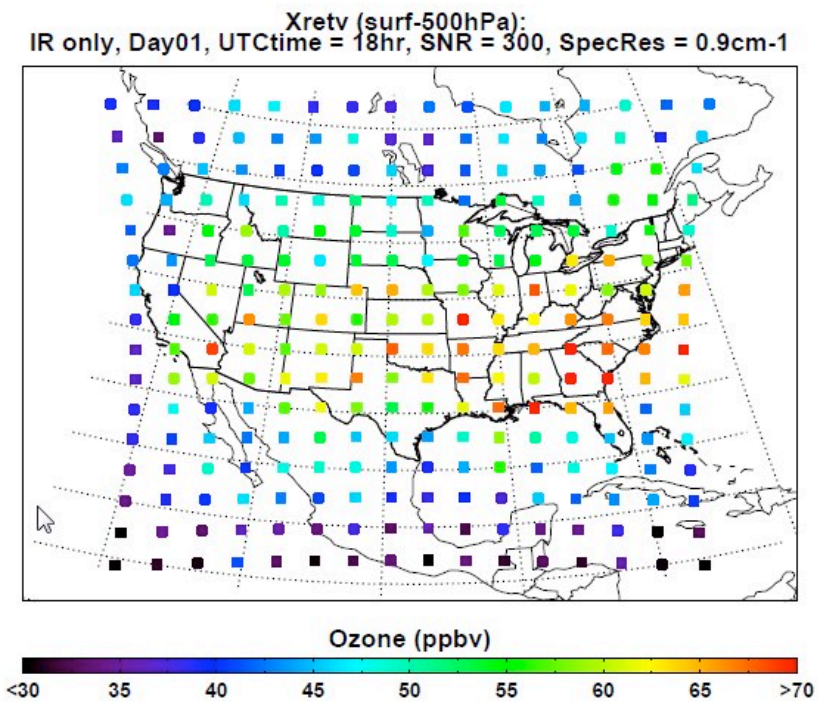
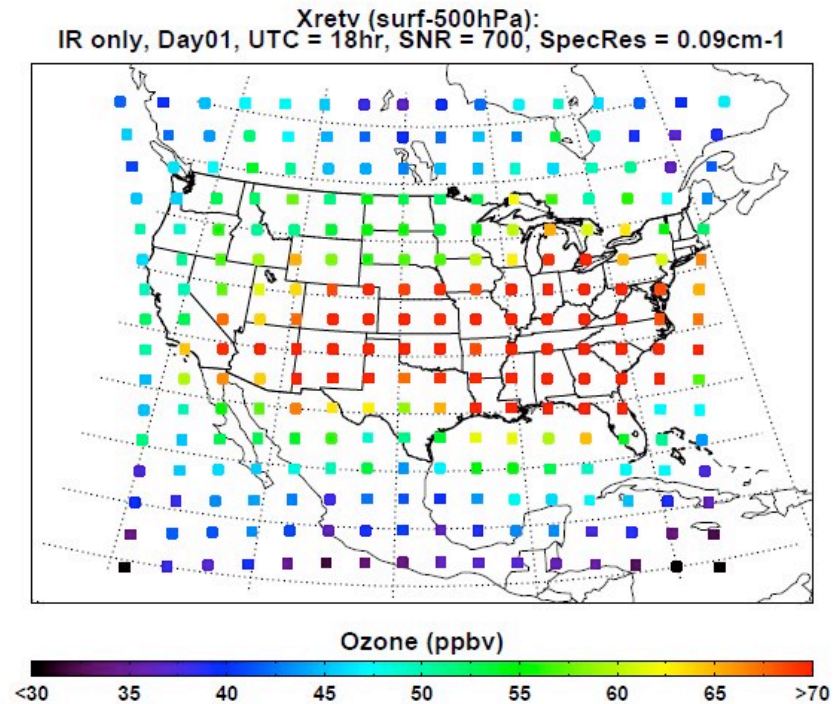
GEOCAPE-OSSE





PDF link-IR

PDF link-UV

PDF link-UV+IR

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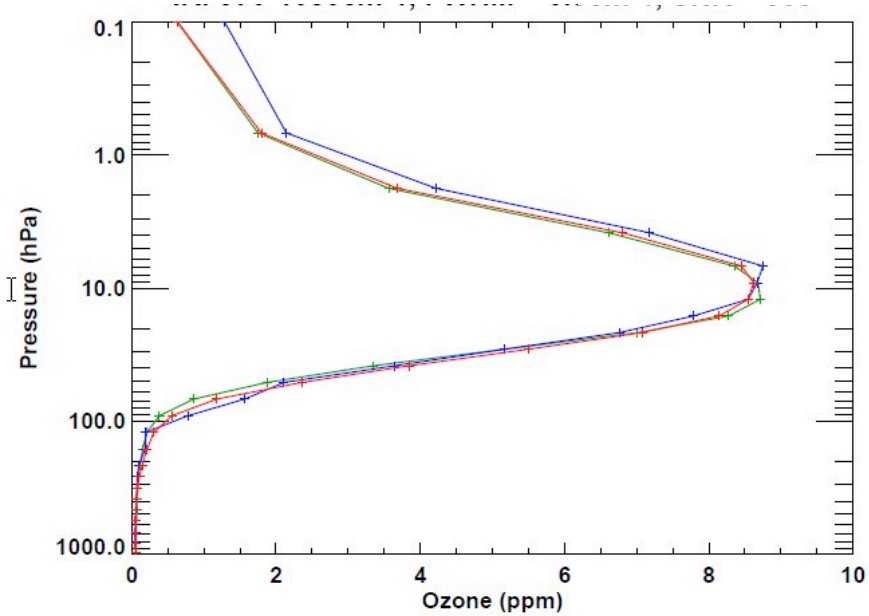
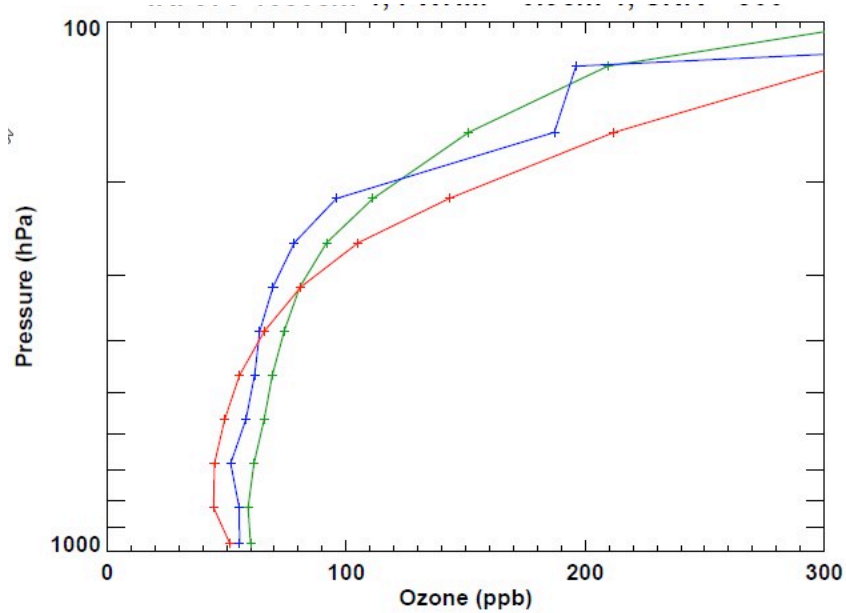
GEOCAPE-OSSE

IR: 970-1080 cm-1, FWHM = 0.9 cm-1, SNR = 300

Latitude = 36.38, Longitude = 240.56





retrieved, a priori, truth

PDF link-IR

PDF link-UV

PDF link-IR+UV

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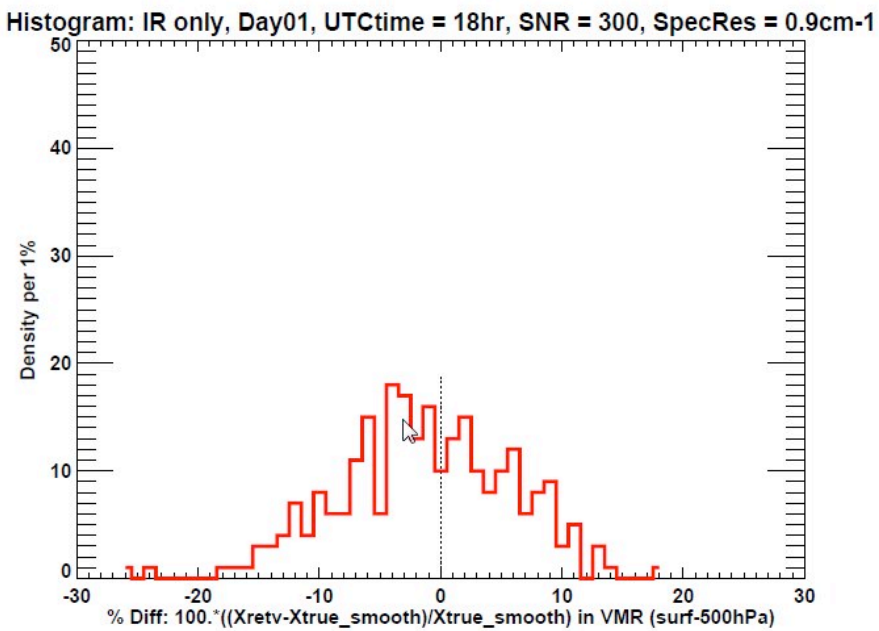
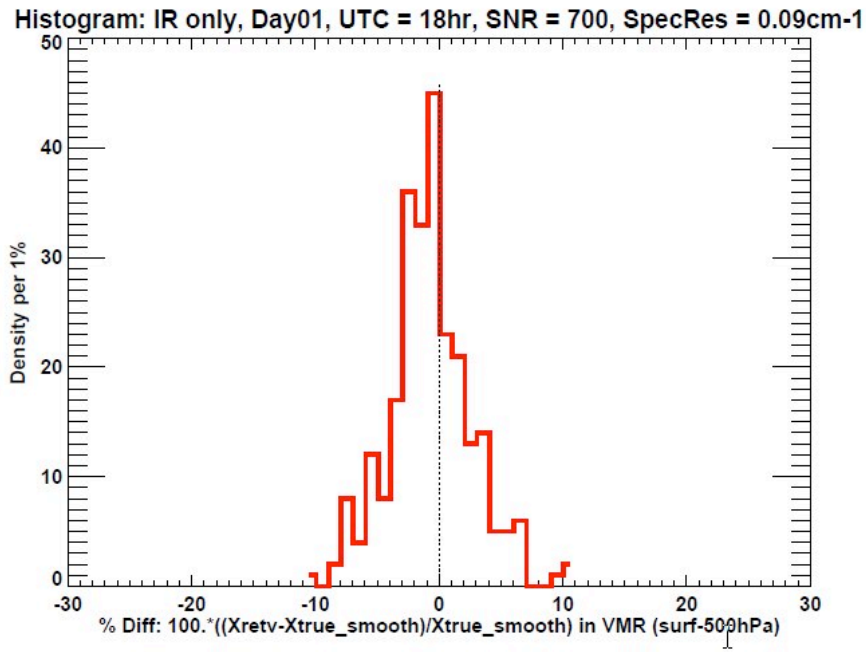
GEOCAPE-OSSE





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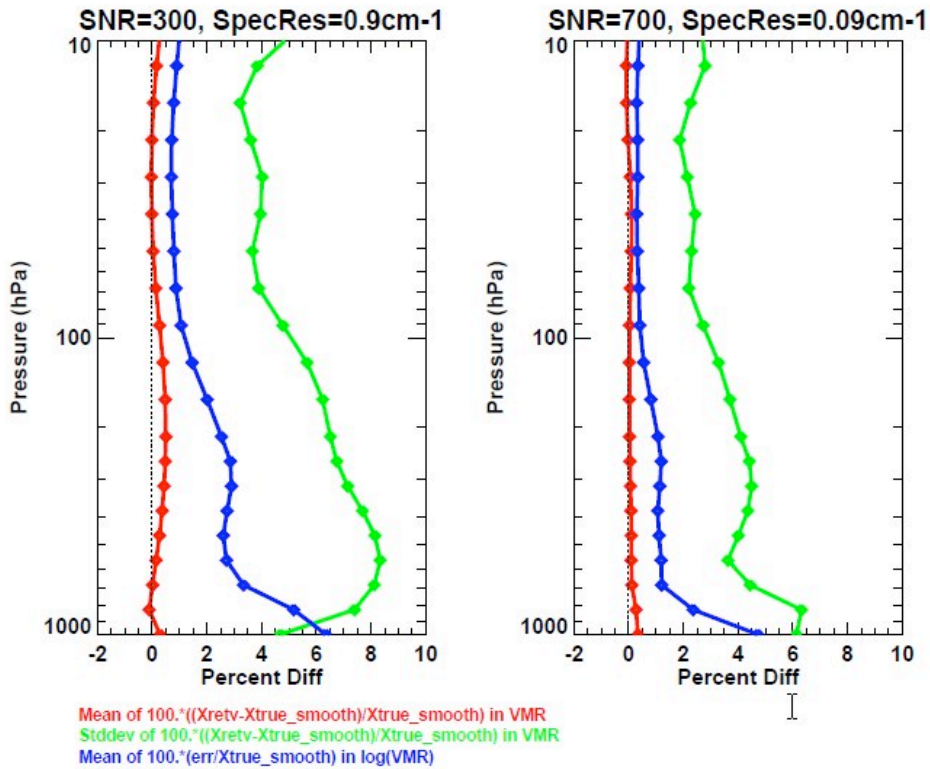
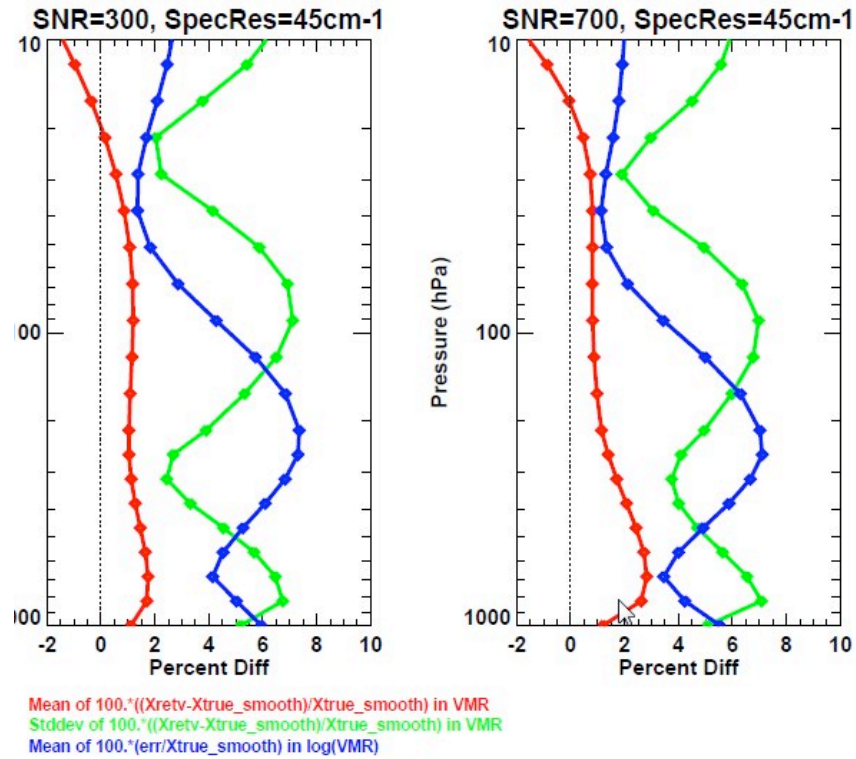
GEOCAPE-OSSE

IR: 970-1080 cm-1



UV: 29000-37200 cm-1



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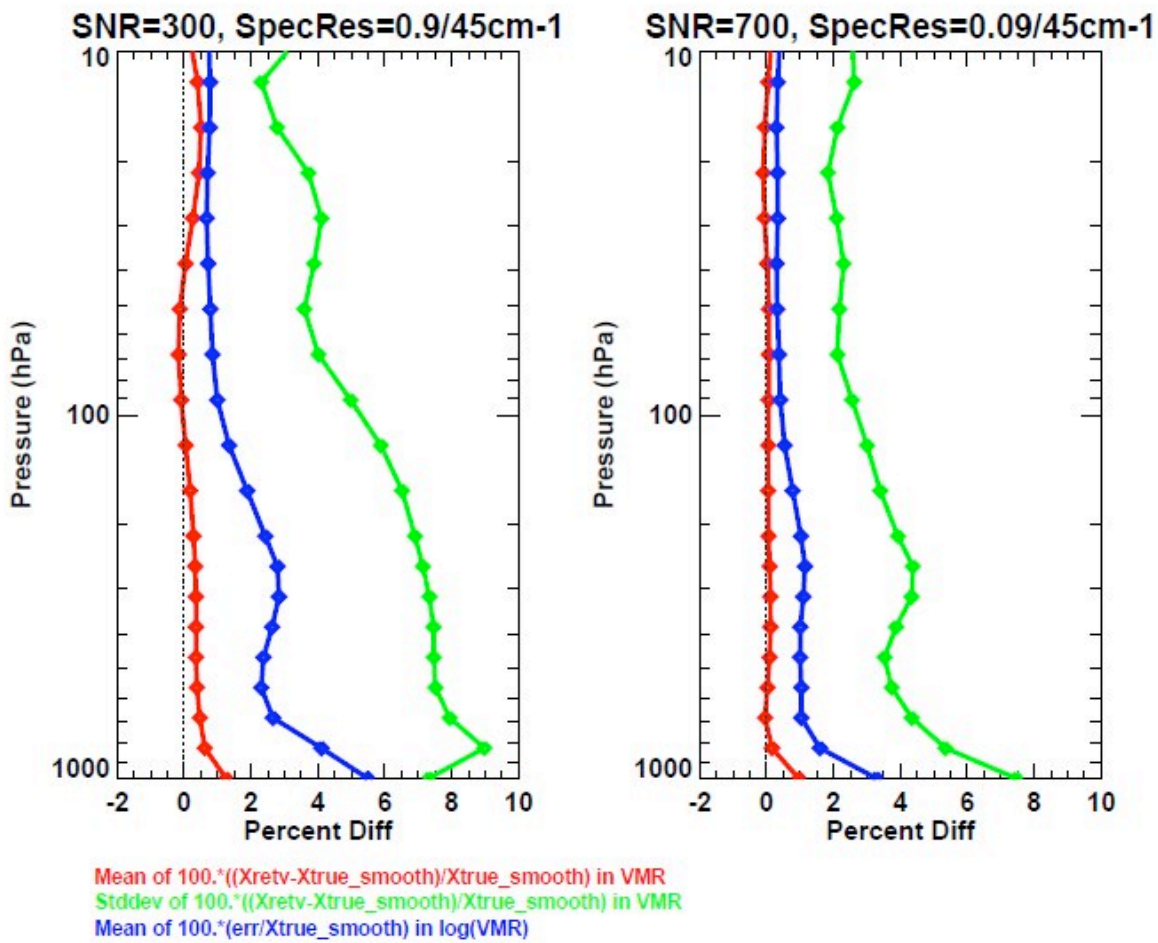
GEOCAPE-OSSE

IR+UV case

IR: 970-1080 cm-1

UV: 29000-37200 cm-1



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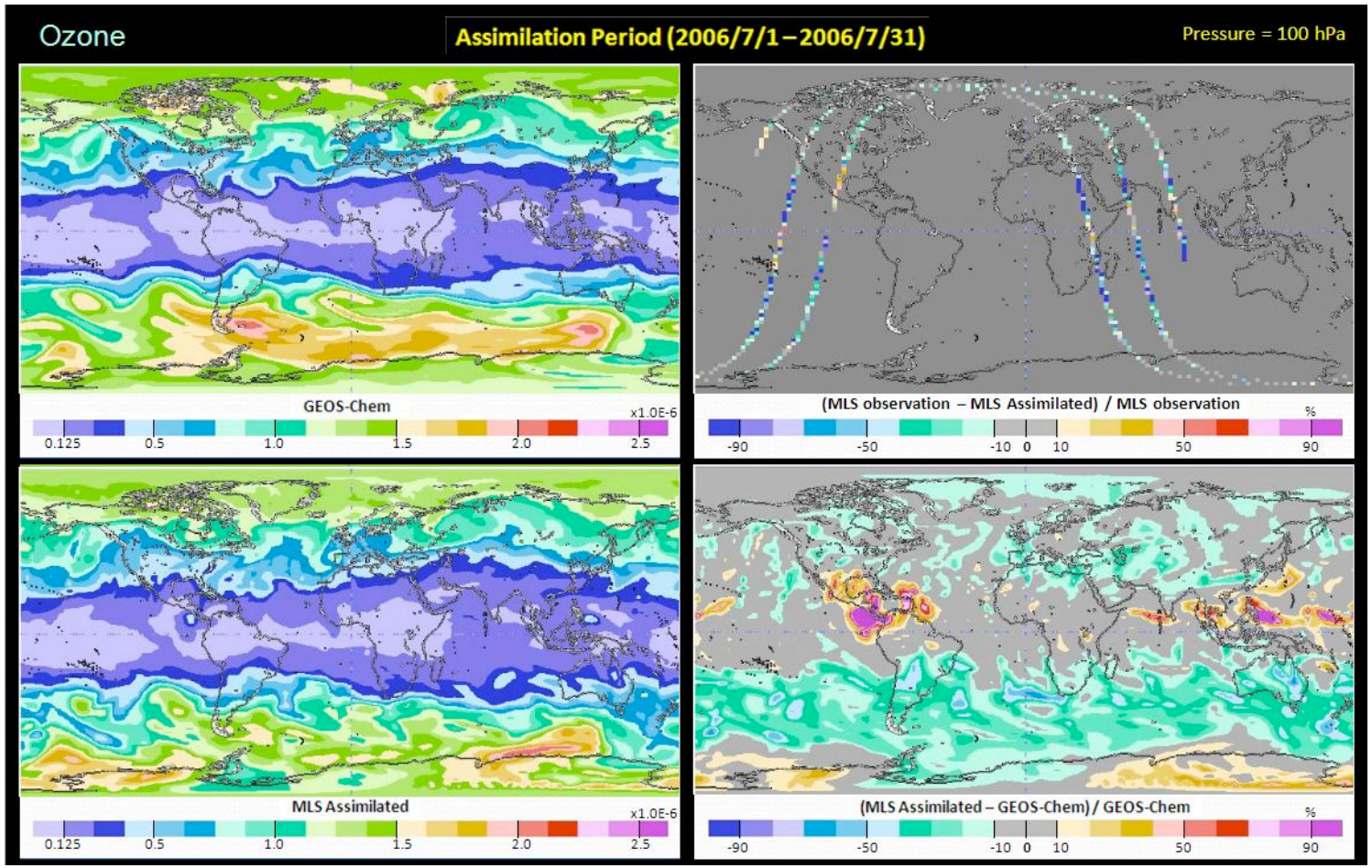
MLS-OSE/OSSE



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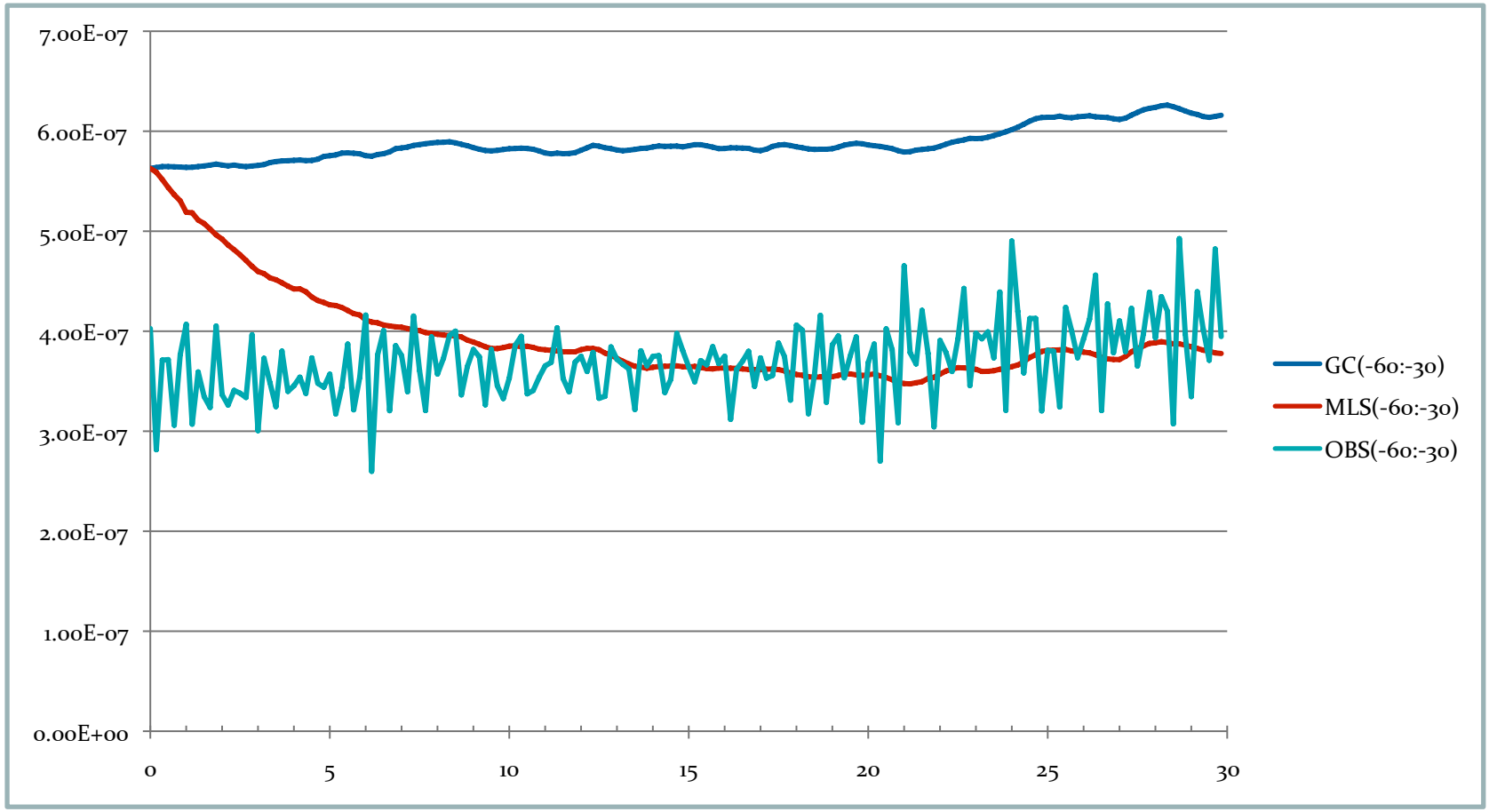
MLS-OSE/OSSE



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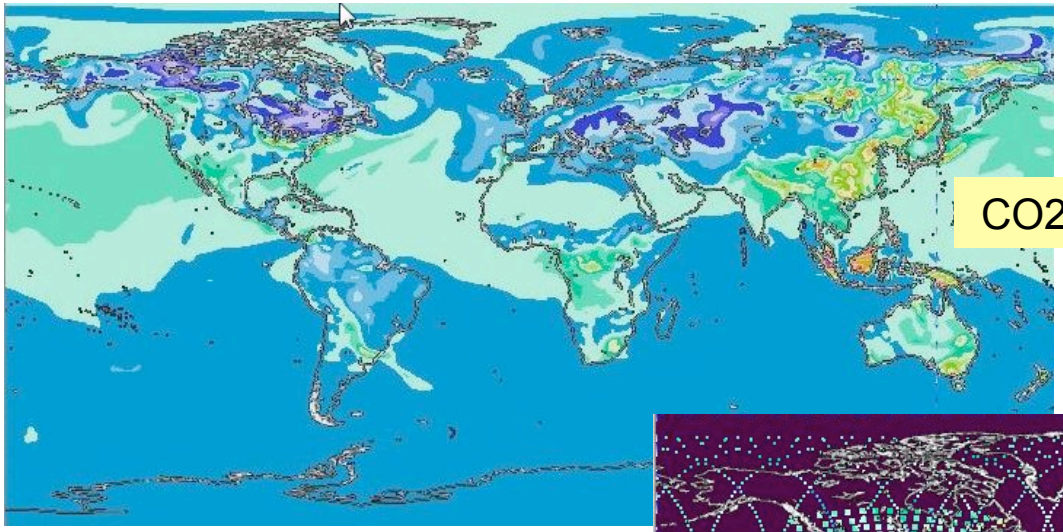
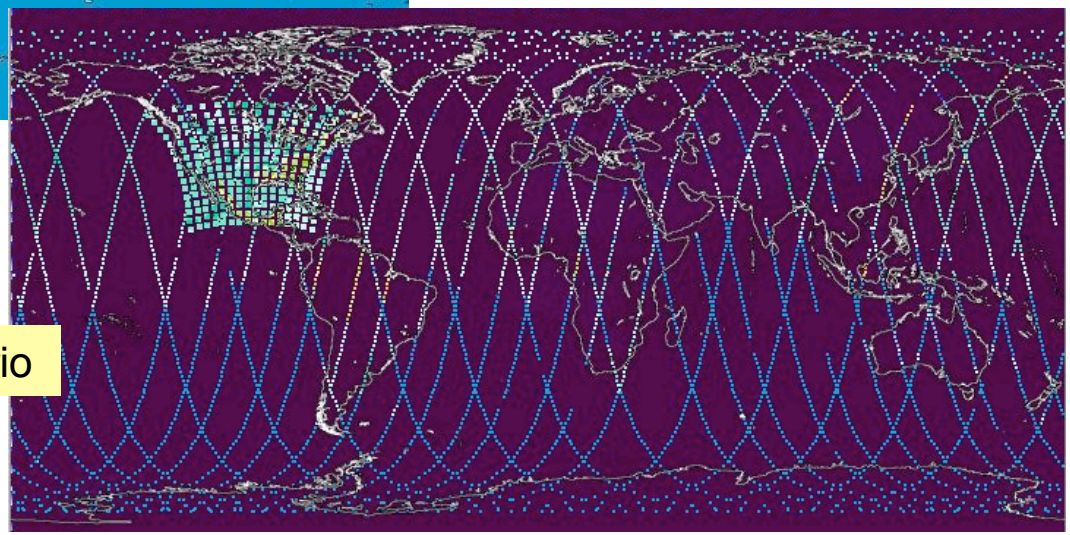
GHGIS-OSSE



CO2 concentration model



CO2 observation scenario

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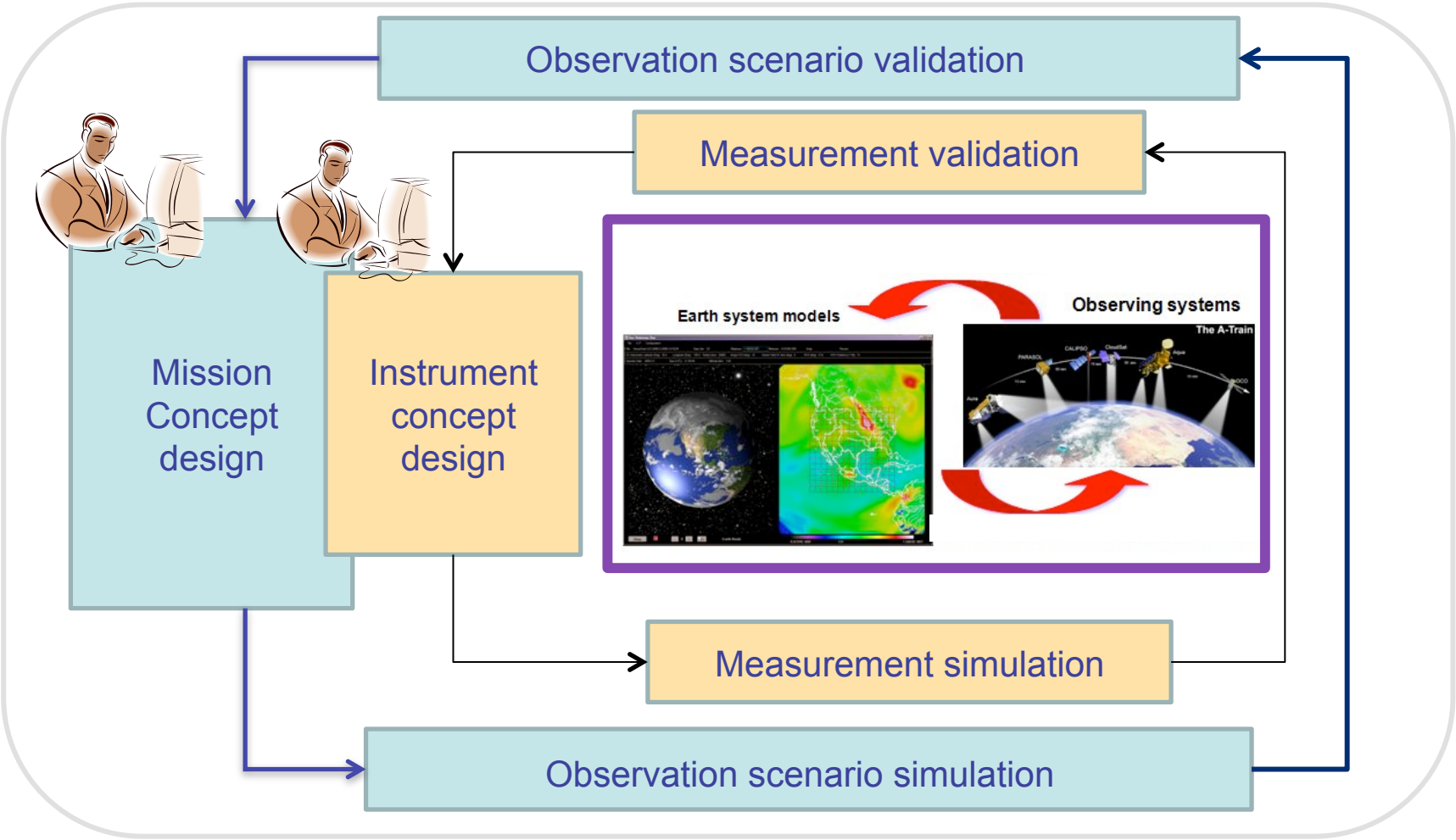
Conclusion