ESRL Theme Presentation on the Carbon Cycle
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Looking Ahead: Toward Development of an Integrated Earth System Analysis

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Goal

To provide a scientifically-based, internally consistent description of the state of the Earth system and how it is evolving over time.

Two primary components:

Ongoing Earth System Analysis

To provide the national foundation for assessing in near real-time and on an ongoing basis the current state of the global Earth system.

Earth System Reanalyses

To define a baseline "Earth System Analysis of Record" to serve as the nation's best assessment of how the Earth system has varied over the recent historical period.

What is an analysis?

For present purposes:

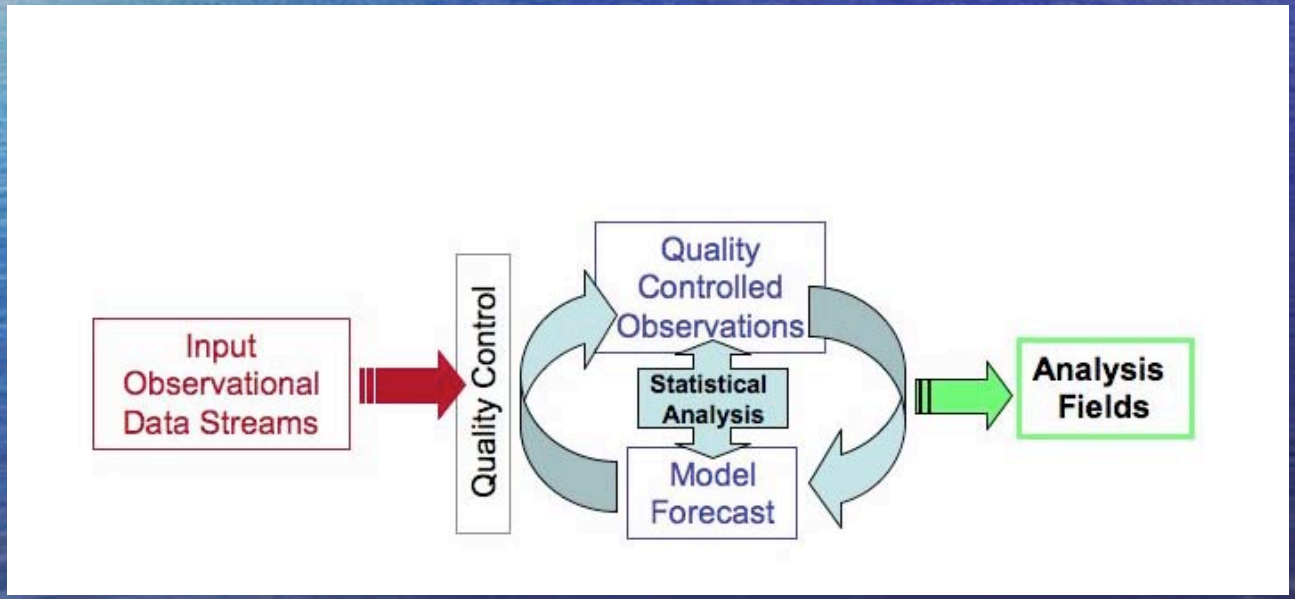
$$X_a = X_f + W\,(X_o - X_f)$$

Analysis: "What we want"

Prior or "First guess"

Weight Factor

Observations - first guess



A good analysis is fundamentally an optimization problem.

Some key points

- Observations and models are both crucial.
- High quality observations are gold; sustained high quality observations are diamonds.
- A good model is also extremely valuable, especially when observations are limited or observed variables differ from those desired in the analysis (e.g., radiances vs. temps.)
- The use of a model provides a basis for constructing a complete representation of the system in space and time.
- Models are more than simply sophisticated interpolators. They can transport information from data rich to data poor regions, and ensure a physically consistent depiction of the full system.

Earth System Analysis

Terrestrial & Marine Ecosystems

Land Surface

Cryosphere

Ocean

Atmosphere

Biogeochemical

Hydrologic

Glacier and Sea Ice

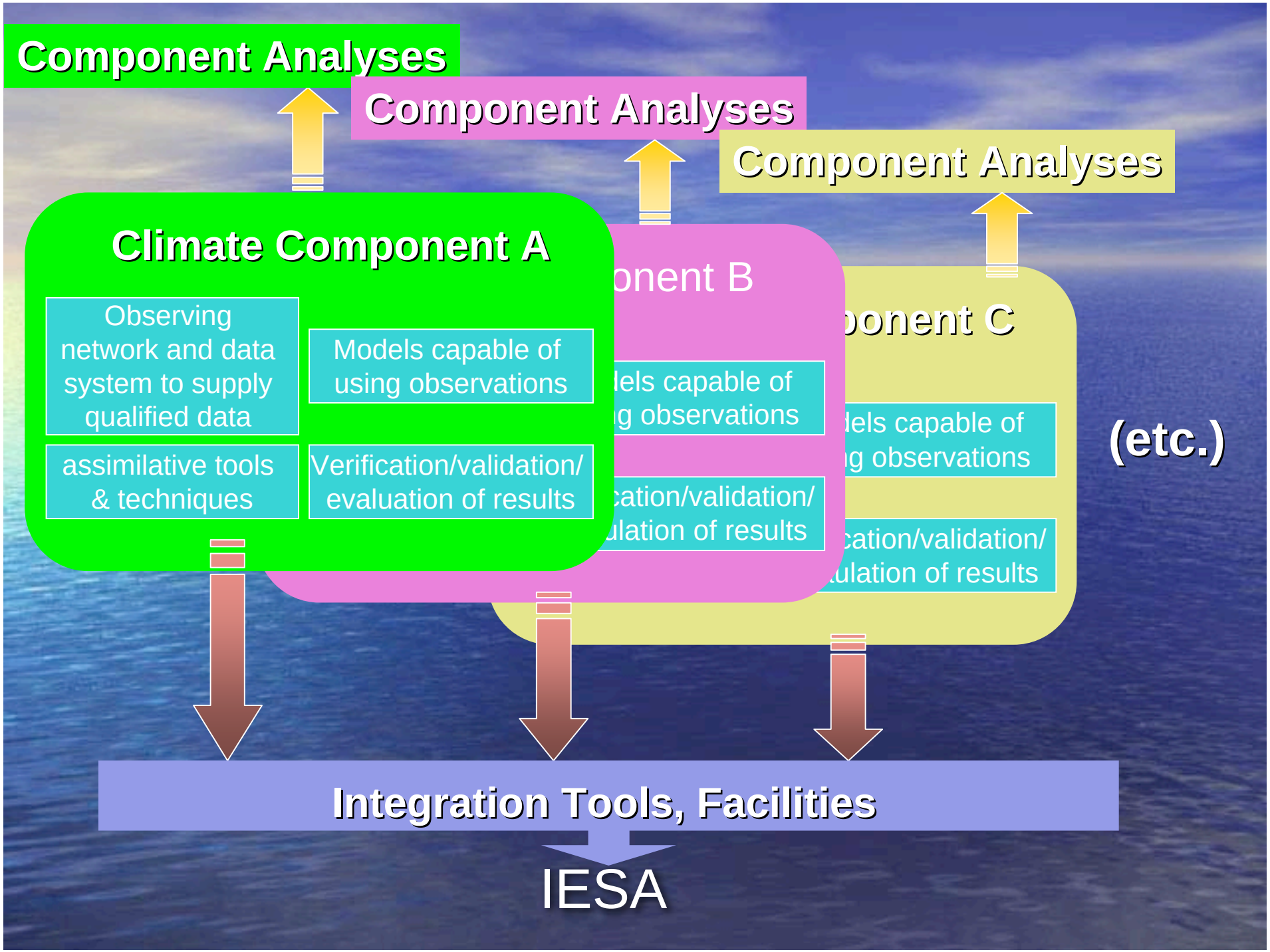
OGCM

AGCM

Observations

Analysis

Models


Component Analyses
Component Analyses
Component Analyses
Climate Component A
onent B
oonent C
Observing network and data system to supply qualified data
Models capable of using observations
assimilative tools & techniques
Verification/validation/ evaluation of results
lels capable of g observations
cation/validation/ ulation of results
lels capable of g observations
cation/validation/ ulation of results
(etc.)
Integration Tools, Facilities
IESA

Relationship to Carbon Cycle

- First generation climate analyses and reanalyses were built from weather prediction models. They focused exclusively on the atmosphere and on variables of specific interest to weather prediction.

- Second generation reanalyses now in development will be a major step forward. Atmosphere-ocean -land-sea ice models will generate the "first guess", but analyses for the components will still be developed separately. This is called loose or "soft" coupling. However, these second generation reanalyses will not incorporate key components for many climate purposes, including the carbon cycle.

- The Climate Change Science Program (CCSP) has identified development of an IESA as a high program priority. Within NOAA, we are also working to develop an IESA capability as part of the climate goal.

- **Development of a carbon data assimilation capability is identified as a high near-term priority in both the CCSP and NOAA IESA plans.**

ESRL Opportunities

Within ESRL, we are beginning to identify and develop collaborative opportunities related to IESA, based on laboratory strengths, scientific interests, and CCSP and NOAA priorities and plans (carbon cycle, other trace gas constituents and aerosols, land surface, ocean-atmosphere coupling, and sea ice). If there is sufficient interest, we may develop a new cross-Divisional theme in this area.

Based on initial meetings and the above considerations, we are planning to develop a cross-Divisional collaboration on carbon data assimilation. We hope that at a minimum this will involve GMD, PSD, and GSD, taking advantage of observational, modeling and data assimilation strengths across the lab.


Thanks!