NOS Workshop
AIST '18 Project Presentation

A Science-Focused, Scalable, Flexible
Instrument Simulation (OSSE) Toolkit
for Mission Design

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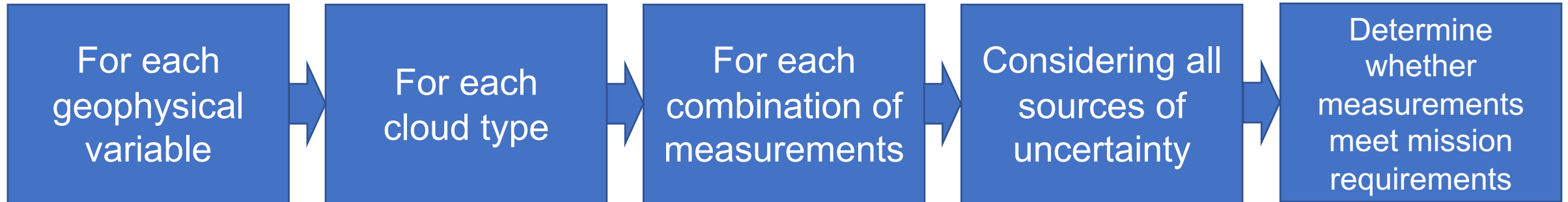
Parallel OSSE Toolkit / Posselt / JPL

- Missions are driven by science requirements

- Mission formulation and success are codified an a science and applications traceability matrix (SATM)

- Defines a set of geophysical variables (with desired uncertainty) required to address specific science goals and objectives

- Which (combinations of) measurements meet mission objectives?

- Observing system simulation experiments (OSSEs) provide an answer

Project Objective: Challenges

- <u>Goal</u>: Assess candidate observing systems for atmospheric convection using an OSSE that considers:
    - Multiple different geophysical scenarios (different cloud types)
    - Diversity of measurement types (active, passive, single-point, distributed)
    - Multiple sources of uncertainty (instrument noise, forward models)
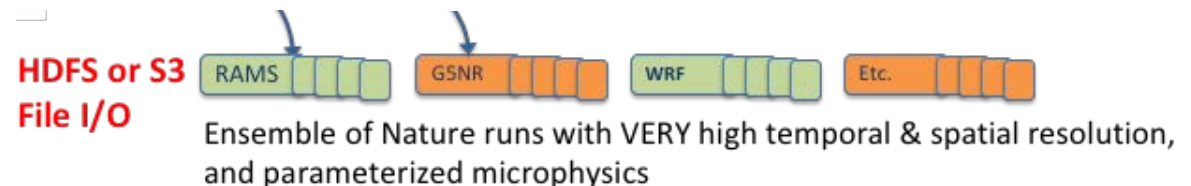
- <u>Computational challenge</u>:

For each geophysical variable	For each cloud type	For each combination of measurements	Considering all sources of uncertainty	Determine whether measurements meet mission requirements

- Library of nature runs

- Containers for pluggable measurement simulators

- Bayesian retrieval algorithms to quantify information gain

- Flexible knowledge database: tags and metadata to search and group experiment outputs

- Map-Reduce framework and cluster/GPU computing to:
  - Generate large database of simulations – geophysical variable (retrieval) pairs
  - Compute analytics to determine whether measurements satisfy mission requirements
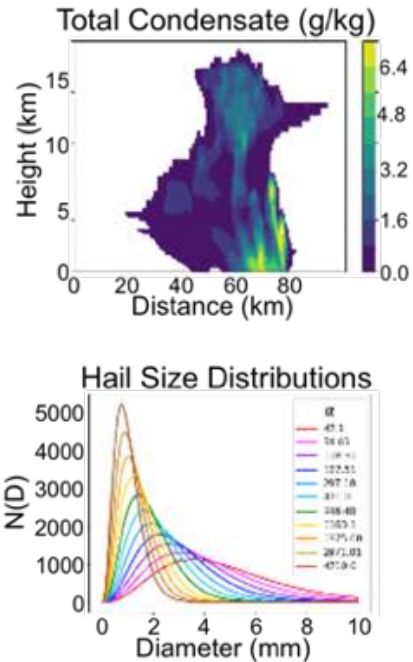
Architecture of the Parallel OSSE Framework

HDFS or S3 File I/O | RAMS | G5NR | WRF | Etc.

Ensemble of Nature runs with VERY high temporal & spatial resolution, and parameterized microphysics

Deploy using on-premise hardware cluster AND at Amazon.

Example: Radar Observations of Convection

User Input

Total Condensate (g/kg)

Hail Size Distributions

- Produce a large ensemble of radar profiles with quantified uncertainty
- Analyze statistics to assess measurements vs requirements

Project Relation to NOS Concept

- "Technology advances have created an opportunity to make new measurements to augment and complement current measurements in a less costly or more productive manner. Future science measurements will include capabilities such as smallsats equipped with science-quality instruments, distributed spacecraft missions and generalized sensor-webs, machine learning techniques enabling processing of large data volumes and real-time, onboard decision making."

- This project provides a framework for quantitatively evaluating the extent to which

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