Observing System Simulation Experiments (OSSE) for Geostationary Microwave Sounders

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INTRODUCTION AND MOTIVATION

•Microwave Sounders have been flying g on NOAA's Polar-orbiting Operational Environmental Satellites (POES) since 1978

•AMSU observations have contributed to improvement of weather and severe storm prediction.

•However, limited refresh rate of AMSU and IR-only capability of GOES leaves a gap to improve the accuracy of severe storm forecasts, especially over the data-sparse oceans.

•Therefore, a geostationary microwave capability was recommended

The Geostationary Synthetic Thinned Aperture Radiometer (GeoSTAR) is a microwave atmospheric sounder, with capabilities similar to those of the AMSU-A/B system, and is intended for deployment in geostationary orbit – where it will complement future infrared sounders to enable all-weather temperature and humidity soundings.

It also has the capability of mapping rain rates, and it can be deployed in medium earth orbits as well.

•To study the impact of the sensor OSSE was proposed

•Observing System Simulation Experiments (OSSEs) provide a rigorous, cost-effective approach to evaluate the potential impact of new observing systems and alternate deployments of existing systems, and to optimize observing strategies.

•They are also used to prepare for the assimilation of new types of data to accelerate their application to operational prediction, as well as to optimize the assimilation of existing data.

The objective of this project is to study the expected impact of The Geostationary Synthetic Thinned Aperture Radiometer (GeoSTAR), Geo-Microwave sounder, on weather forecast accuracy through OSSE

GEO-MICROWAVE OVERVIEW AND SPECIFICATION

• A microwave atmospheric sounder intended for geostationary satellites

• Able to make observations under clear as well as cloudy conditions, every 15-30 minutes.

• Improve Regional forecast and severe storm prediction

• A quintessential hurricane sensor; measures the scattering signal from hurricanes and large-scale convection.

• Improving precipitation measurements by looking at the full hemisphere with 50/25km pixels every 15 minutes continuously

• Stable & continuous microwave observations to observe long term trends in temperature & water vapor and storm stats.

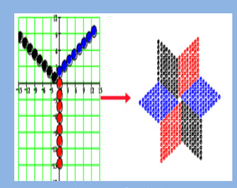
•Geo-Microwave is to act as a Geostationary AMSU,

•Based on spatial interferometric principles and uses a stationary array of a large number of individual receivers t o synthesize a large aperture and achieve the required spatial resolution,

• The symmetric Y configuration results in a symmetric hexagonal

•24 receiving elements - 8 per Y-arm

•Proposed frequencies:



Courtesy of NASA/JPL

Channel	1	2	3	4	5	6	7	8	9	10
Freq(GHz)	124.25	120.80	120.35	119.95	119.50	119.20	166.31	176.31	180.31	182.32

GEO-MICROWAVE SIMULATION AND CONSTELLATION EXPERIMENT SET-UP

OSSE Overview

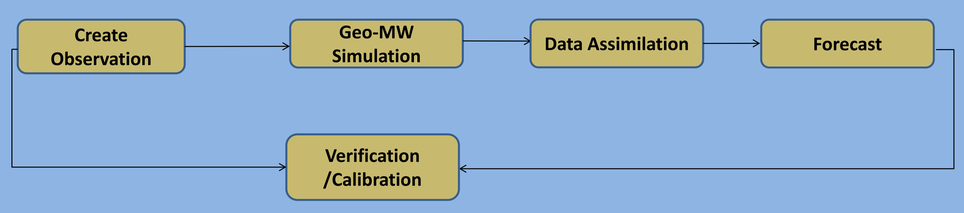
•A long atmospheric model integration using a very high resolution "state-of-the-art" numerical model to provide a complete record of the assumed "true" state of the atmosphere referred to as the "nature run" or "reference atmosphere

•Simulated conventional and remotely-sensed observations from the NR.

•Control and experimental data assimilation cycles. These are identical to the assimilation cycles in an OSE except that only simulated data are assimilated.

•Forecasts produced from the control (CTRL) and experimental assimilations.

•The analyses and forecasts are then verified against the NR to obtain a quantitative estimate of the impact of proposed observing systems and the expected accuracies of the analysis and forecast products that incorporate the new data.



Test Simulation

•A test experiment was run using a nature run file "goes13_sndrd1_2006080100.dbl72".

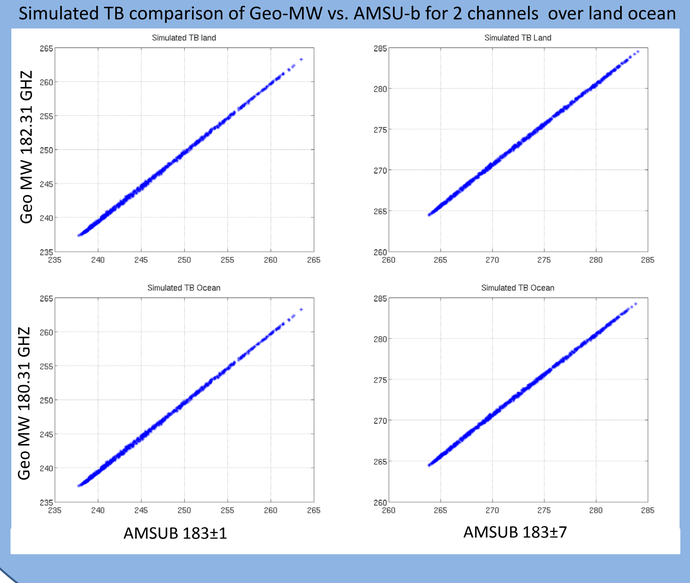
•The file has the pressure, temperature, humidity, and ozone profile for 72 layers for 878 different profiles over the globe.

•The information was generated for the day August 1, 2006 using Aug 1, 2014 observation.

•The surface information was just assumed all land or all oceans.

• The satellite sensor information, geostorm_proposed.gaussian.SpcCoeff.bin and geostorm_proposed.gaussian.TauCoeff.bin, were provided by CRTM team

Simulated TB comparison of Geo-MW vs. AMSU-b for 2 channels over land ocean

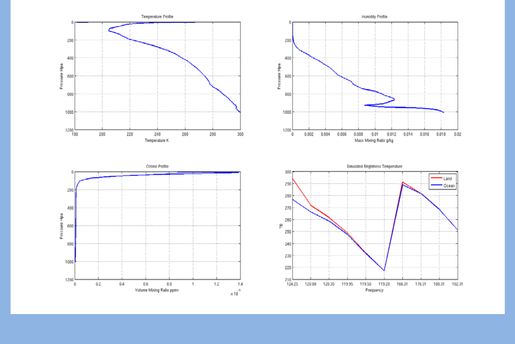


•CRTM was used to simulate the geo-microwave and AMSU-B brightness temperature for all the profiles in the nature run.

•The brightness temperatures of those frequencies that were similar to AMSUB N17 were compared with each other.

•Little discrepancies in higher brightness temperature are due to difference of frequency channel in geo microwave and AMSU-B.

Geo-MW test simulation for 1 profile over land and ocean



Calibration and Assimilation Experiments

•The random noise to be added to simulation will be the same as the AMSU noise.

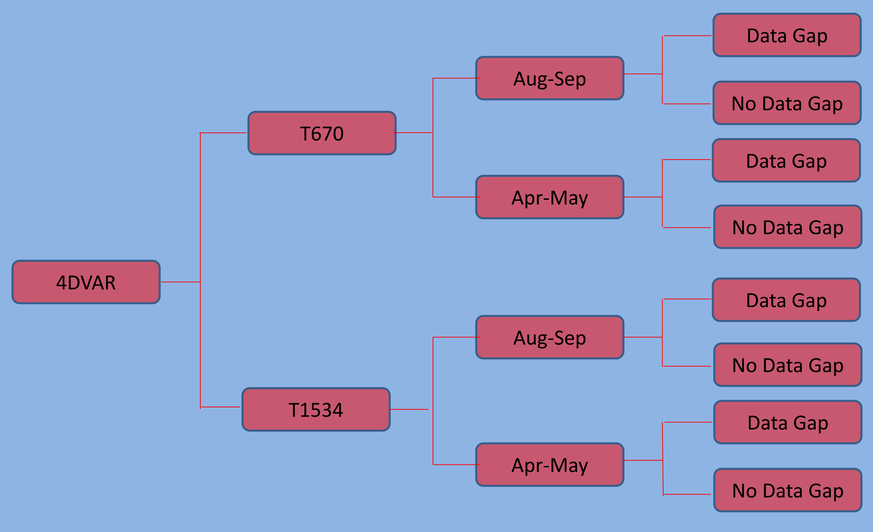
Calibrate Observations steps
Create observation base files
Simulate AS06 control observations
Run DA for control observation
Add random error/bias to control observations
Run DA with added errors
Simulate Geo-MW observations
Adjust random error/bias for control observations
Add random error/bias Geo-MW observations

•The proposed spatial resolution is 63 Km. This would match a 3x3 to 1 relationship seen between IR and MW instruments on Aqua and SNPP, with 9 IR fields-of-view to one MW field-of-regard)

•The first set of experiment will done with clear sky and precipitation will be QCed

•Cloudy-sky radiance will be added

T670 and T1534 4DVAR experiment will be run for two seasons for both data gap and no data gap scenario

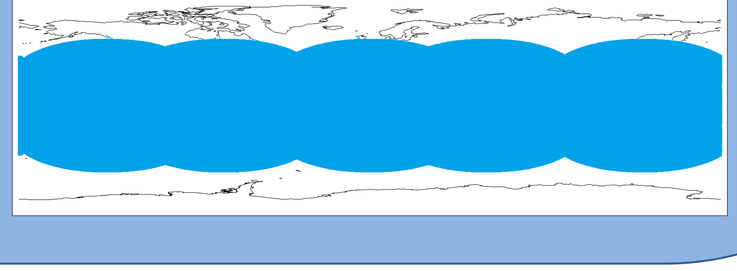


The analysis will be done for 4 different experiments

Experiments
CNTRL (No Geo-MW)
GMW5(Full constellation)
GMW1(GOES-EAST)
GMW2(GOES-EAST &GOES-WEST)

Satellite	Longitude
M10	0°E
ISAT	60°E
JMA	140°E
GOES-WEST	225°E
GOES-EAST	285°E

Full Constellation (GMW5)



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