MASDA
MODAS Adaptive Sampling Decision Aid

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OBJECTIVE

Build a decision aid to select AXBT measurement locations which improve the accuracy of MODAS analyses while minimizing the number of required measurements.

APPROACH

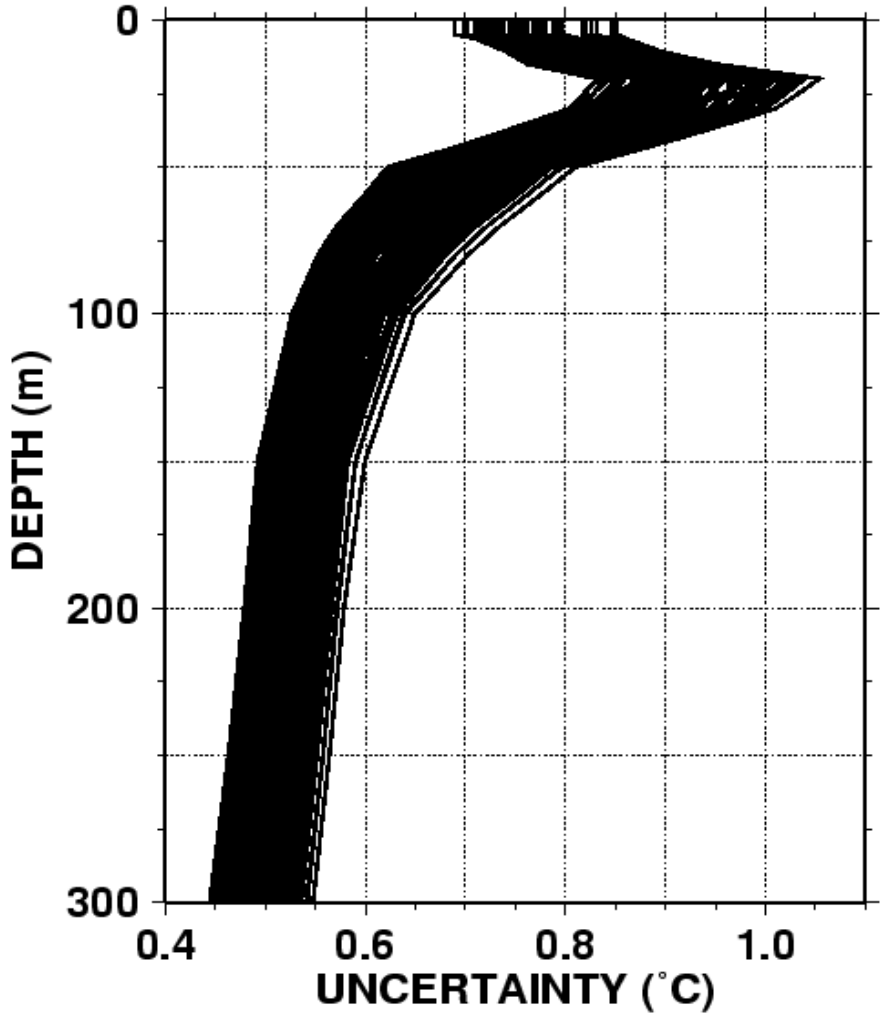
Use MODAS temperature uncertainty to predict optimum measurement locations that will minimize uncertainty over the entire operational region.

<u>Hypothesis:</u> Measurements that minimize uncertainty also tend to minimize error.

Uncertainty

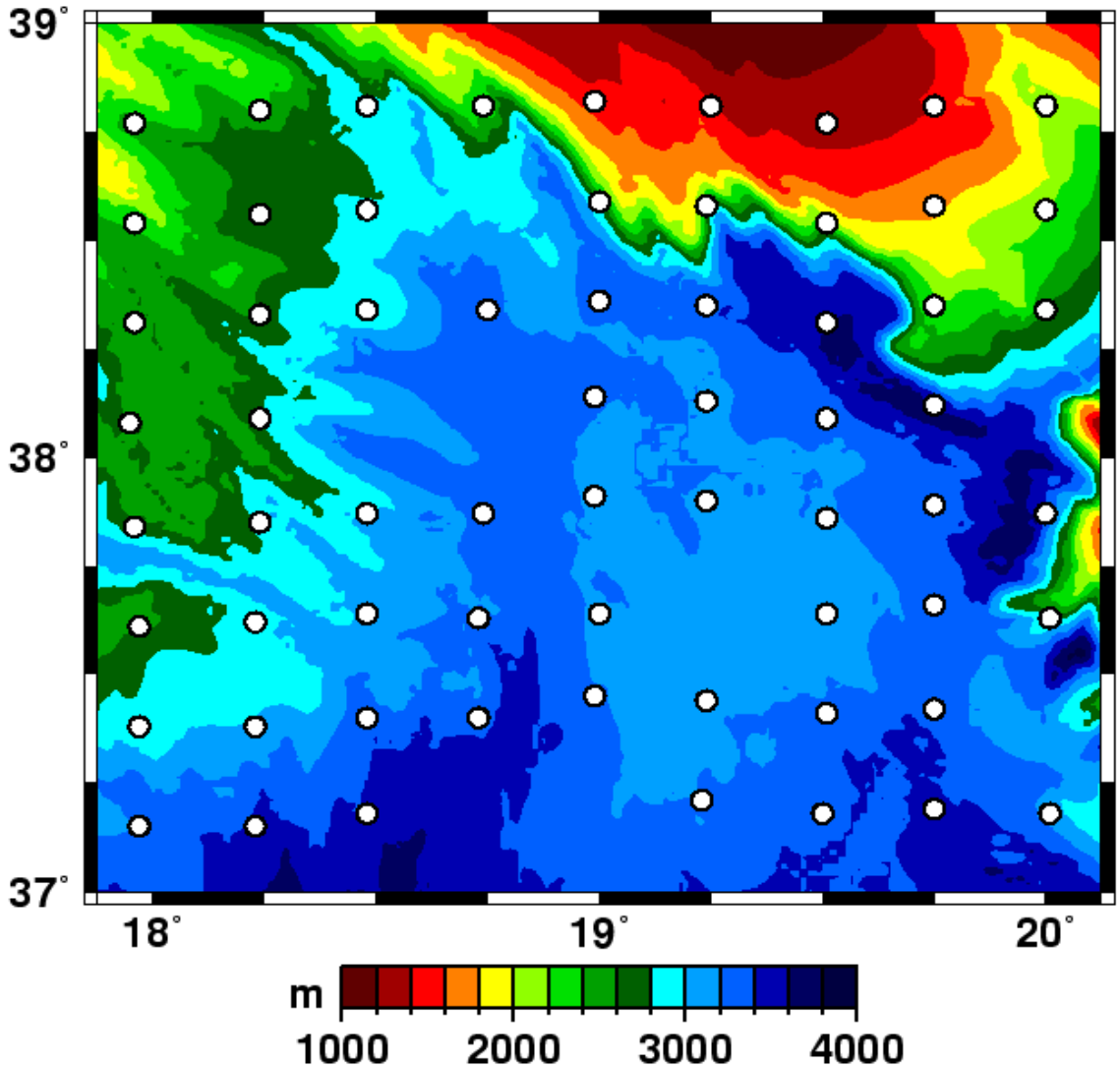
Uncertainty based on:

- **climatological standard deviations**
- **uncertainties in sea surface temperature and height**
- **errors associated with measurements**



Sample profiles every 0.25º. Highest at 20 m depth.

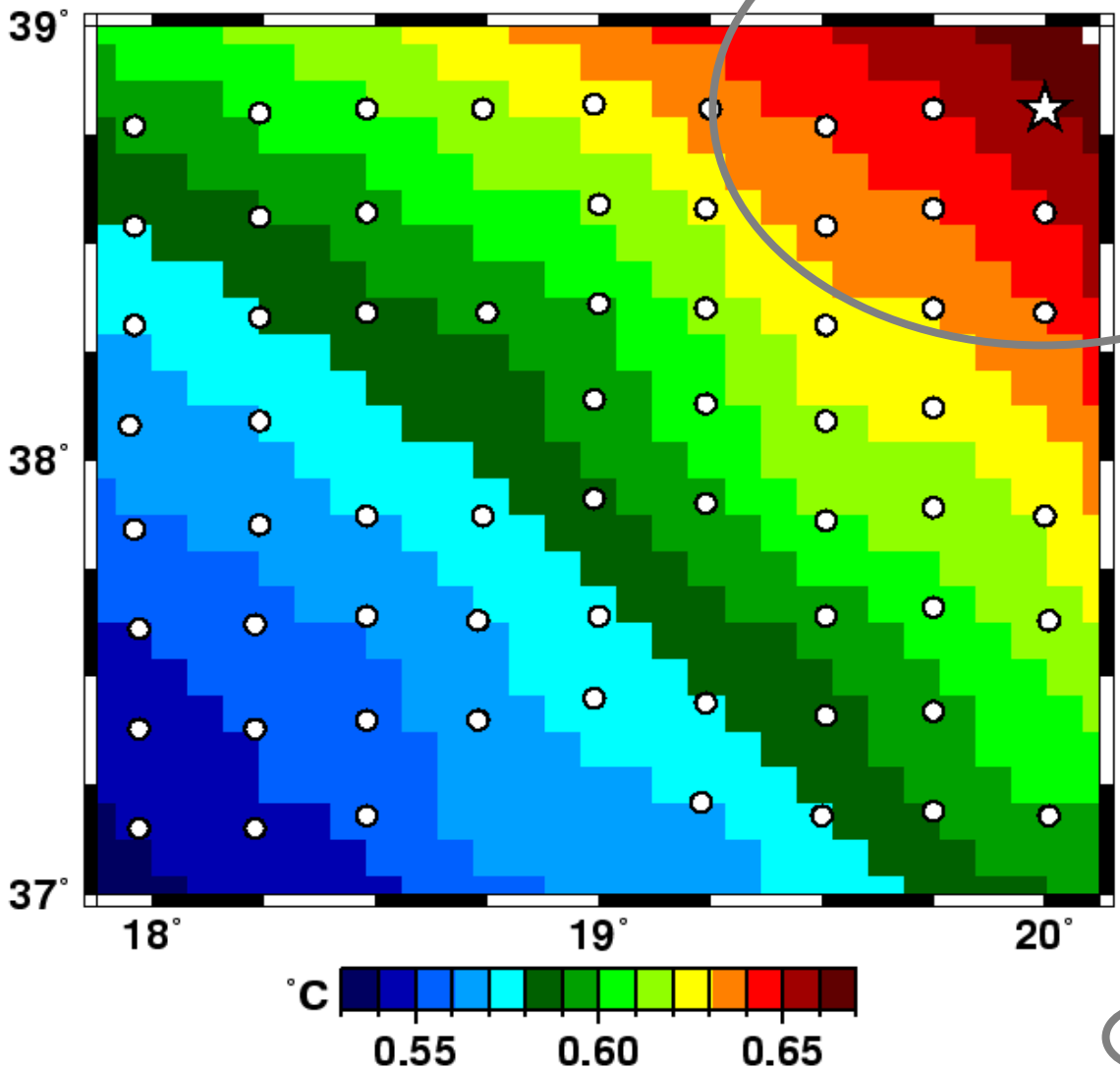
Mediterranean Bathymetry



Deep water.

Well-sampled region.

Uncertainty



Summer.

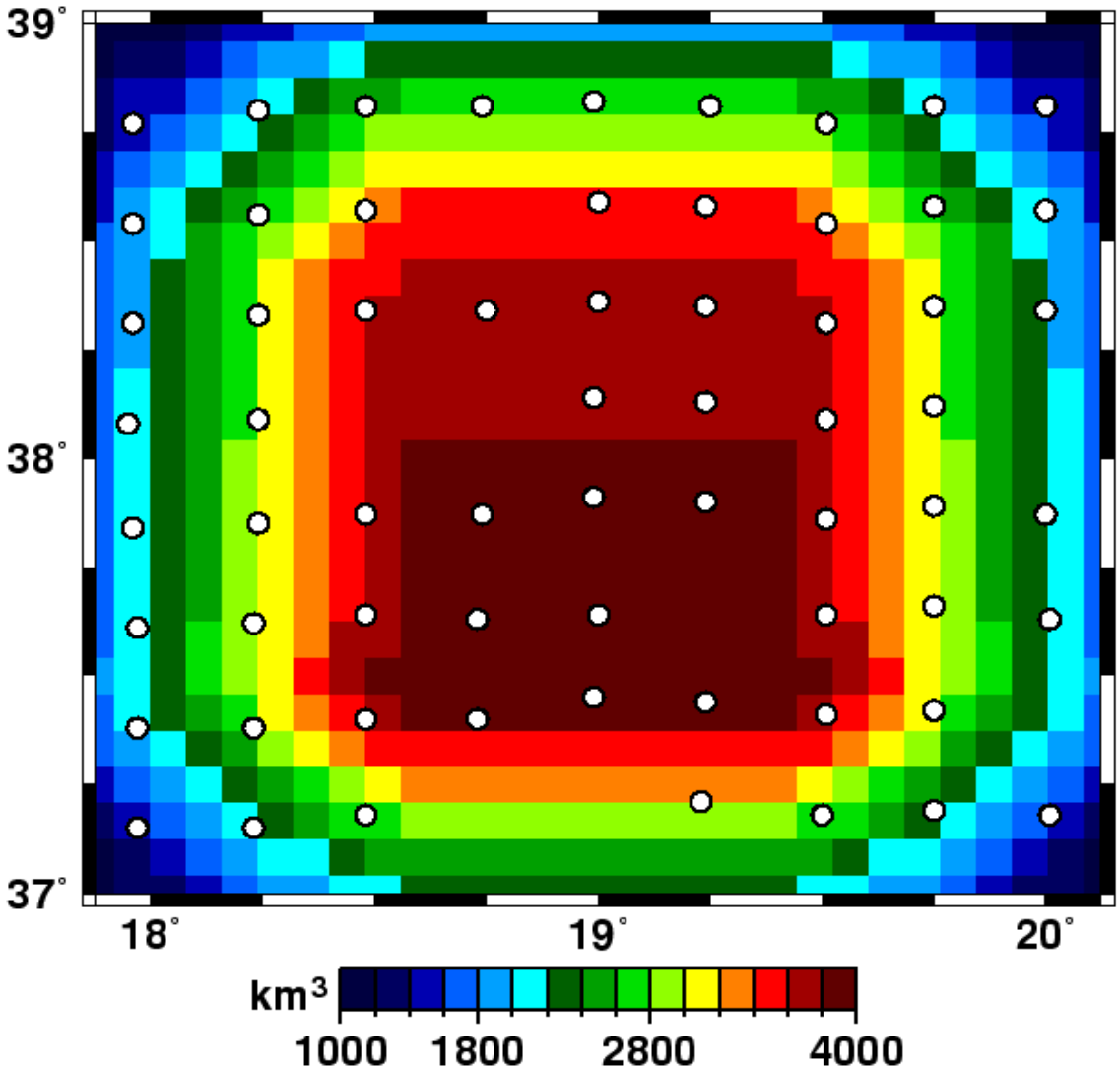
Averaged over 300 m depth.

Highest value in NE corner.

Limited impact.

Approximate Impact Area

Volume of Impact

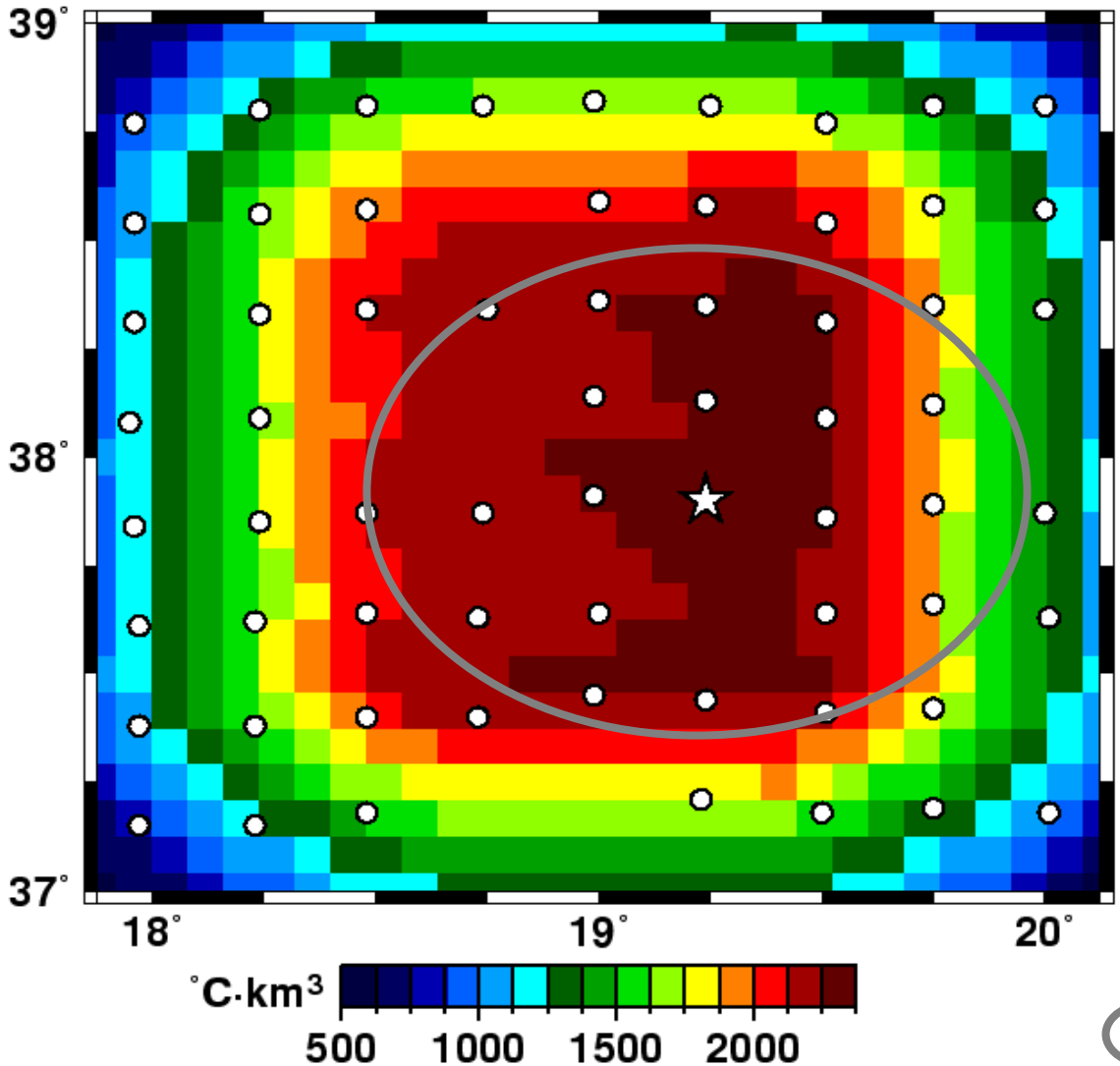


Limited to study area.

Function of:

- **water depth (≤ 300 m)**
- **Covariance scale (about 60 km).**

Volume-Weighted Uncertainty



Highest in deep water away from coast and measurement boundaries.

More impact.

Approximate Impact Area

Location Selection Method

Choose N measurement locations from the list of potential measurement locations.

- **Sequential – Select one location at a time until all N locations are selected.**
- **Combinatorial – Select a combination of N locations. Can be computationally expensive.**

Uncertainty Evaluation Type

- **Explicit – Select location(s) of maximum volume-weighted uncertainty based on pre-existing field.**
- **Implicit – Determine impact on uncertainty of measurement(s) at potential location(s). Choose location(s) which minimizes average uncertainty.**

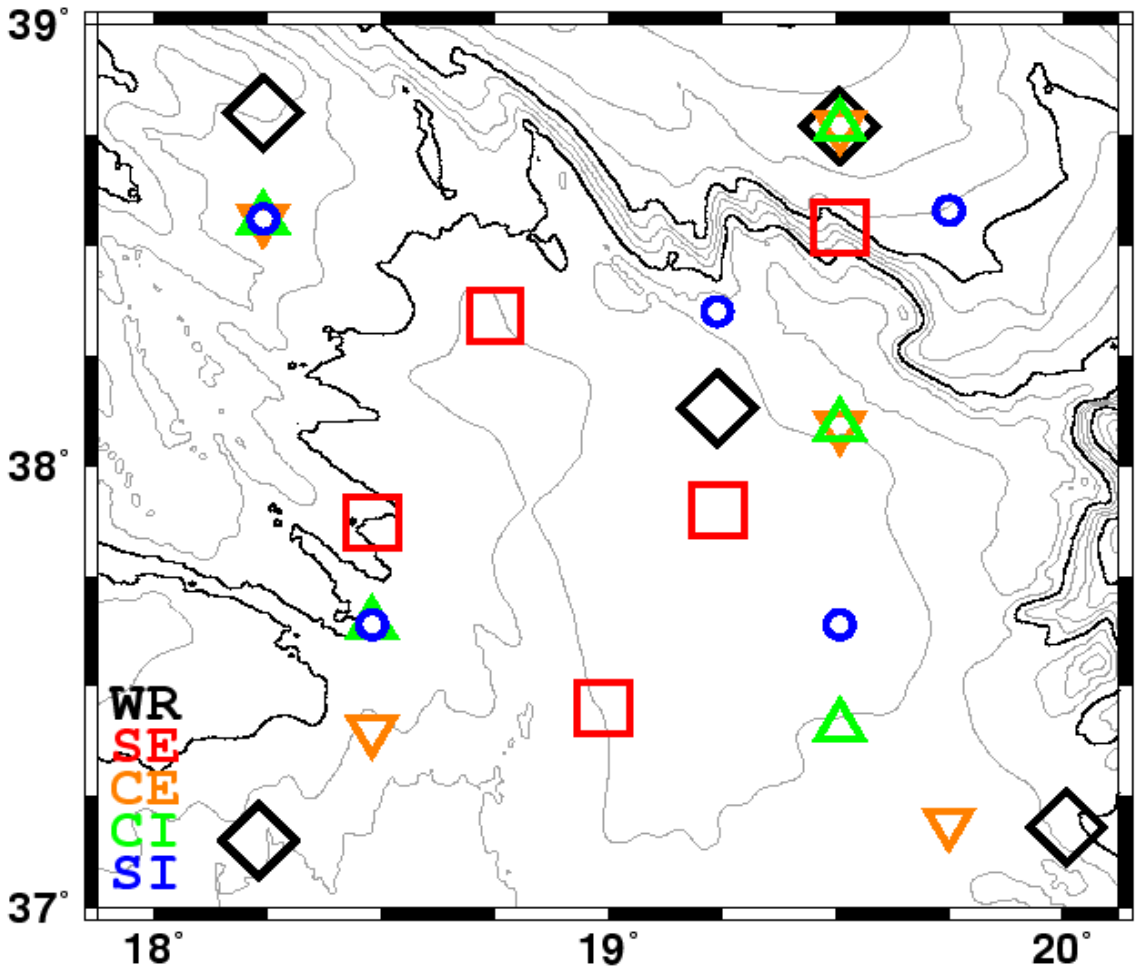
MASDA Options

Combination of location selection method and uncertainty evaluation type.

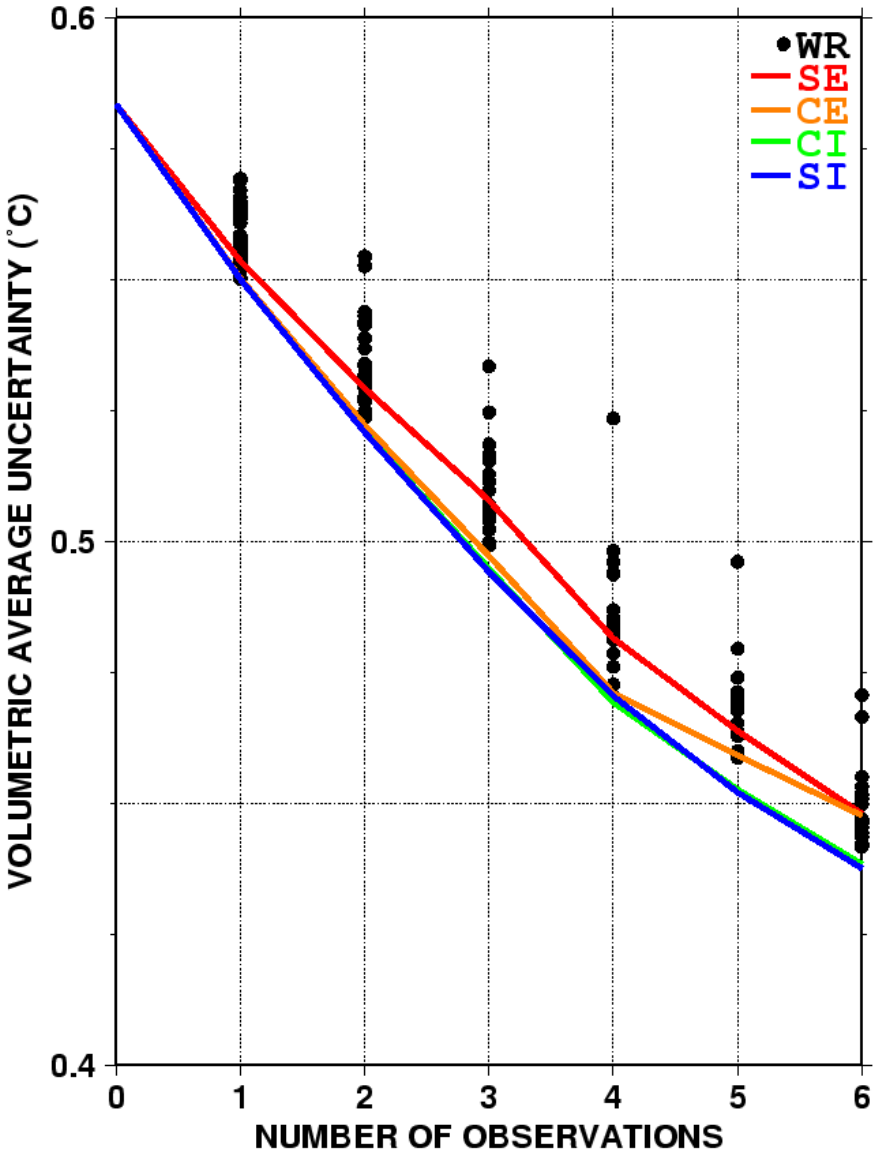
Sequential Explicit (SE)
Sequential Implicit (SI)
Combinatorial Explicit (CE)
Combinatorial Implicit (CI)

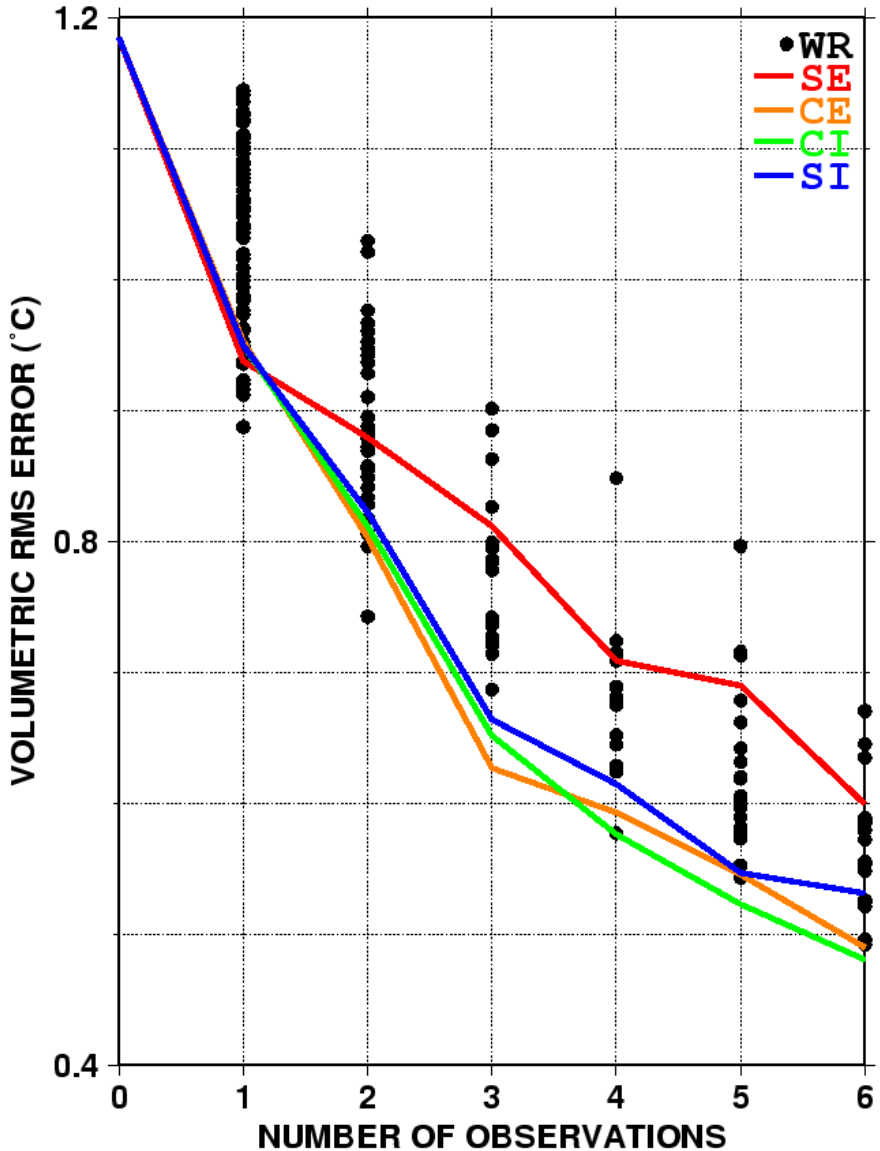
Measurement Locations

5 Observations

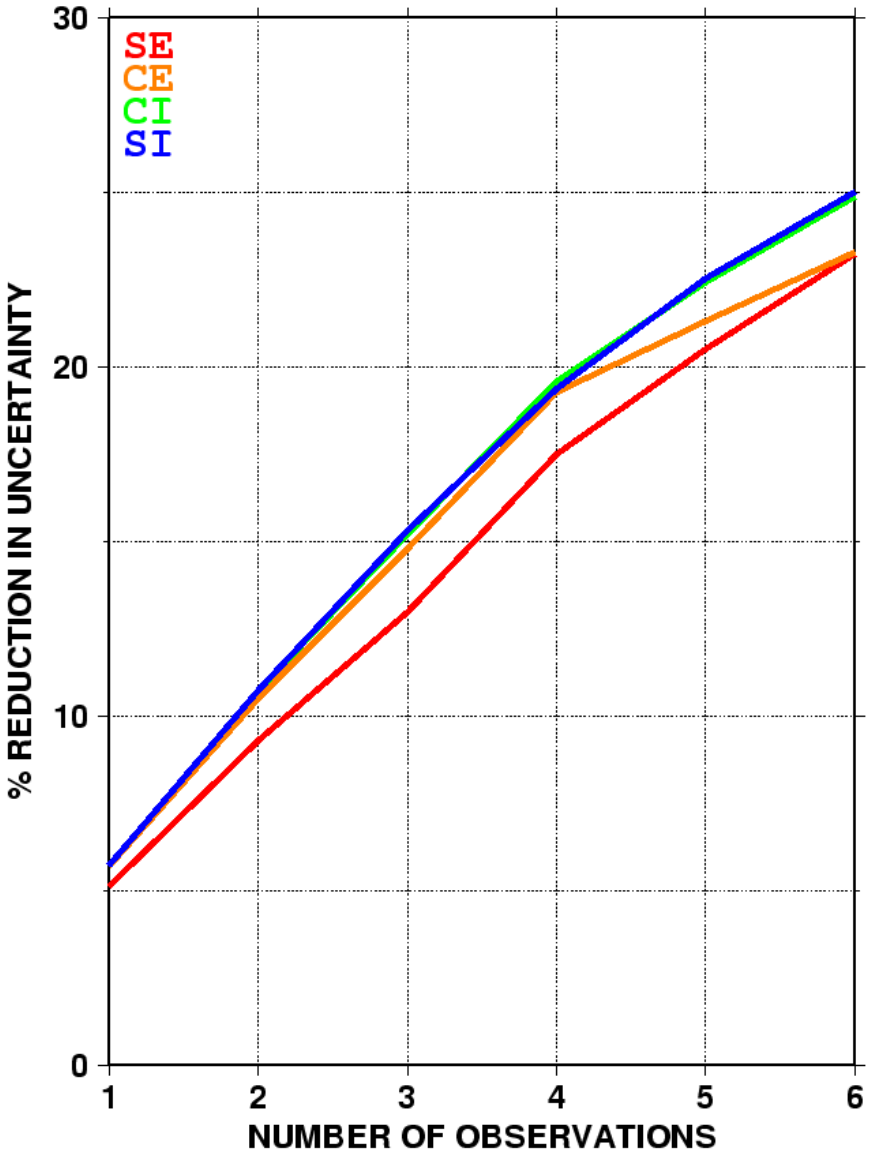


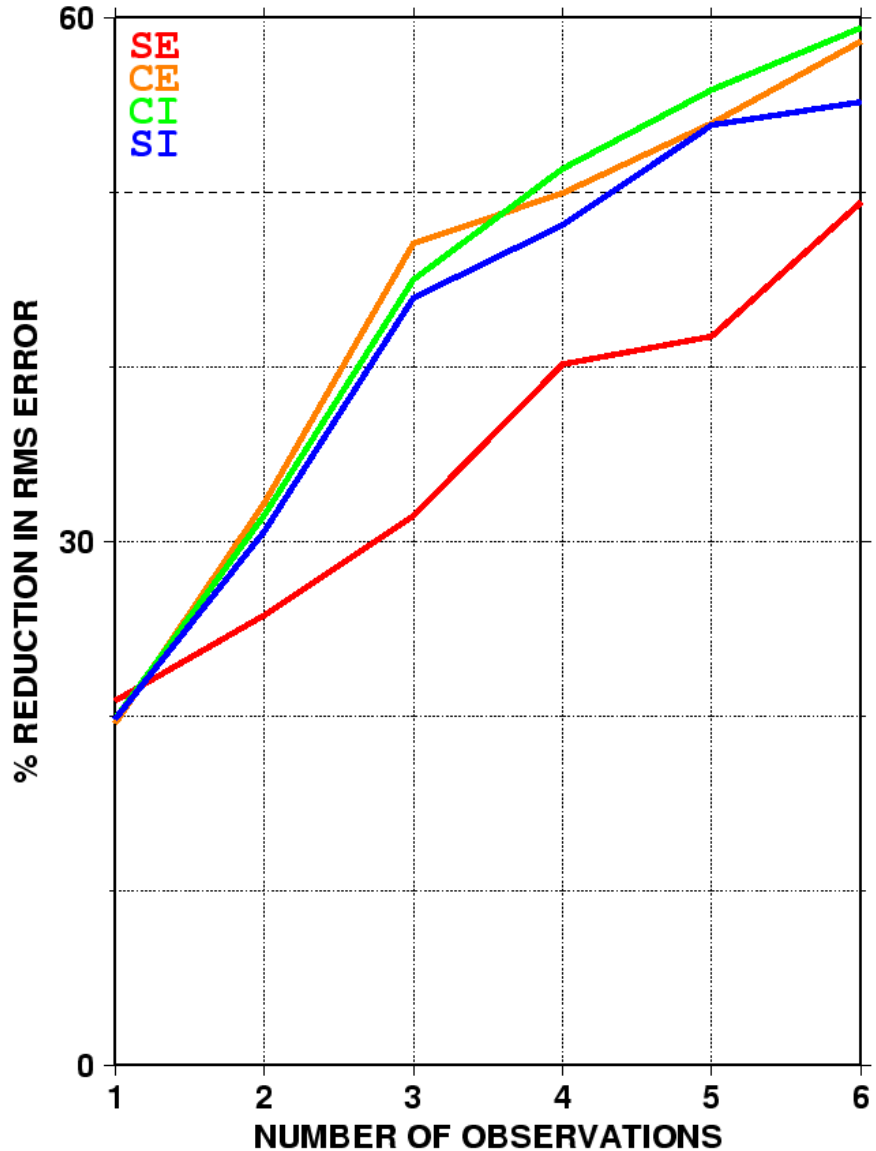
Uncertainty and RMS Error





Percent Reductions





CONCLUSIONS

- **MASDA efficiently reduces uncertainty and error.**
- **Combinatorial generally better than sequential but can be computationally more expensive.**
- **Implicit generally better than explicit.**

FUTURE ISSUES

- **Immediate: Build prototype MASDA.**
- **Investigate:**
  - **Total/partial measurement failure impact.**
  - **Better metric (uncertainty, SST, SSH, vertical gradient, horizontal gradient).**
  - **Geographical and seasonal dependence of covariance model.**