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## Using Data Assimilation to Understand the Systematic Errors of CHAMP Accelerometer-Derived Neutral Mass Density Data

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# Neutral mass density can be derived from accelerometer measurements onboard CHAMP



# The uncertainties of accelerometer-derived NMD are not fully understood



Using Data Assimilation to Understand the Systematic Errors of CHAMP Accelerometer-Derived Neutral Mass Density Data, Kodikara et al., AGU Fall Meeting 2021

### Some discrepancies exist in the published CHAMP height



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# Assimilate observations along CHAMP to understand the impact on NMD



### Assimilation of HWMo7 neutral winds greatly improves TIE-GCM's agreement with CHAMP neutral mass density



### Estimating the Error Variance using the Grubbs' method

Grubbs (1948) "On Estimating Precision of Measuring Instruments and Product Variability", Journal of the American Statistical Association

Four instruments A, B, C, D measuring the same physical qty

 $A = T + E_A$   $B = T + E_B$   $C = T + E_C$   $Var(A - B) = \frac{1}{n} \sum_{i=1}^{n} (A_i - B_i)^2 - \langle A - B \rangle^2,$   $D = T + E_D$ Error variance can be estimated independent of true value T  $\sigma(E_A) = \sqrt{Var(E_A)} = \begin{cases} \frac{1}{n} (Var(A - B) + Var(A - C) + Var(A - D)) \end{cases}$ 

$$-\frac{1}{6} \left( \operatorname{Var}(\mathbf{B} - \mathbf{C}) + \operatorname{Var}(\mathbf{B} - \mathbf{D}) + \operatorname{Var}(\mathbf{C} - \mathbf{D}) \right) \right\}^{\frac{1}{2}}.$$

### Estimating the Error Variance using the Grubbs' method



### Grubbs' method provide reliable estimates of the error





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