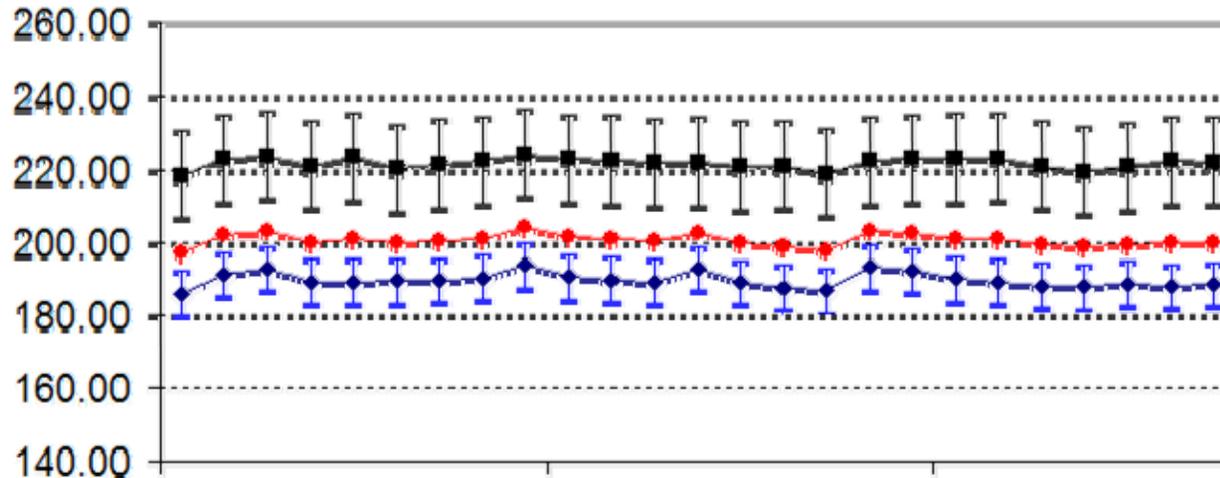
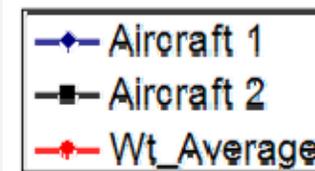


# Example of Intercomparison Discrepancy



PI uncertainties

$$u_{PI_1} = \pm 6 \quad u_{PI_2} = \pm 12$$



**Both measurements have been verified and validated  
and the difference cannot be reconciled**

$$wavg = \frac{\left(\frac{1}{u_{PI_1}^2}\right)(Air_1) + \left(\frac{1}{u_{PI_2}^2}\right)(Air_2)}{\left(\frac{1}{u_{PI_1}^2} + \frac{1}{u_{PI_2}^2}\right)}$$

$$E[Air_1] = \mu_{species} + \delta_{cal} + \delta_{IntComp}$$

$$\text{Total Intercomparison Unc}_1 = \frac{\sum_n |(Air1 - wavg)|}{n}$$

$$\text{Total Intercomparison Unc}_1 = 10.6$$

$$\text{Additional IntComp Bias} = \hat{\delta}_{IntComp} = 10.6 - 6 = 4.6$$

if Total IntComp Unc < PI Unc.  
then no adjustment is required  
(could occur with more than 2 aircraft)

# Uncertainty Estimates

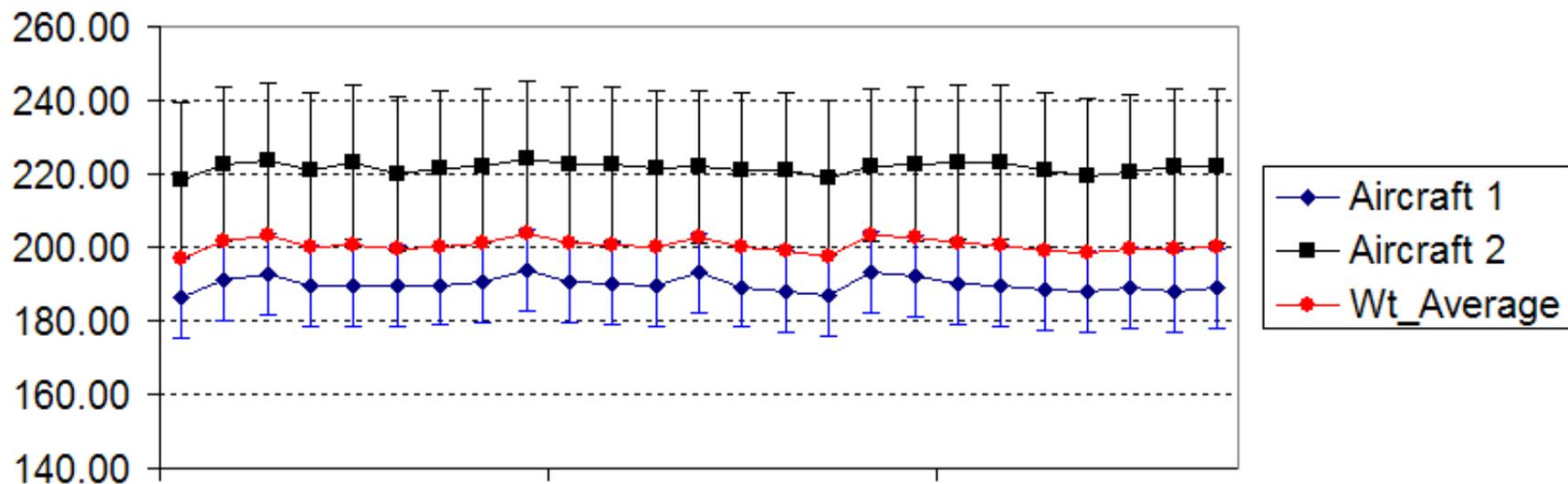


- **Within-instrument uncertainty (bias + precision)**
  - Source: PI, calibration data
  - Form: % of reading or constant value, 2-sigma interval
    - internal estimate of random uncertainty from intercomparison (Chen)
- **Between-instrument uncertainty (potential additional bias)**
  - Source: Panel, intercomparison data
  - Form: additional bias component estimated for each instrument
    - average abs(difference between measurement and weighted mean)
      - similar to the two aircraft difference plot (Parrish)
    - internal estimate from distribution of differences of time averaged means (new plot)
  - Result: Each instrument receives a proportional allocation of unexplained instrument-to-instrument difference based on PI uncertainties (or internal random estimates if PI uncertainty is not available)
- **Unified Data Base Total Measurement Uncertainty (bias + precision)**
  - Source: Panel, intercomparison data
  - Form: RMS combination of bias and precision for each instrument, 2-sigma
$$u_{TMU} = \sqrt{(\delta_{cal} + \delta_{IntComp})^2 + \sigma_{\varepsilon}^2}$$
  - Apply TMU error bars to regression plot to confirm coverage of the 1:1 expected line (Chen)

# Adjusted Error Bars Result



	Air1	Air2
PI uncertainty	6	12
Est. Additional Bias	4.6	9.3
Total IntComp Uncertainty	10.6	21.3



**Approach is equitable, objective, data-driven and conceptually satisfies the panel's deliberations**

**Need to test on actual data and verify statistical properties**

# Example with 3 Aircraft



	Air1	Air2	Air3
PI uncertainty	6	12	6
Est. Additional Bias	0	17.8	6.7
Total IntComp Uncertainty	6	29.8	12.7

