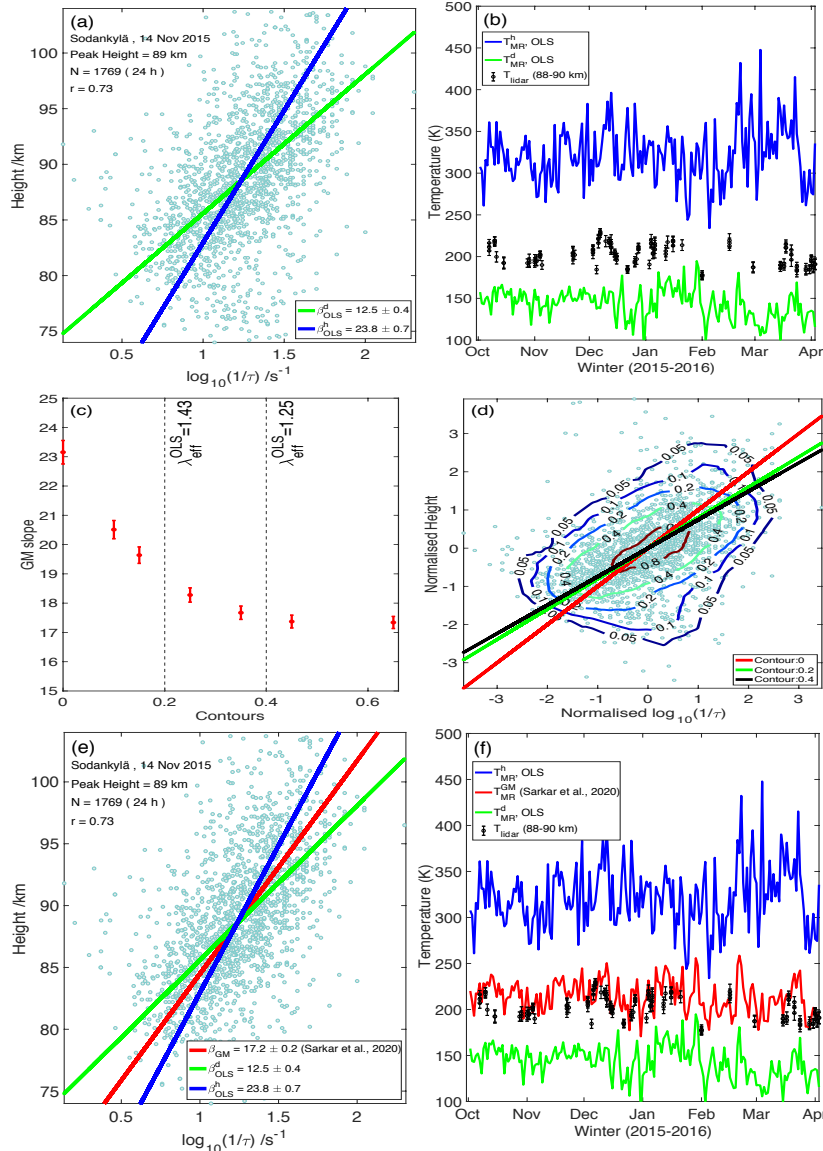


EGU21-14760: Solving the long-standing problem of estimating the atmospheric temperature at 90 km using meteor radar

(Sarkar et al., 2020)

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The linear dependence (β) of meteor decay time on height is a measure of the atmospheric temperature (T) at 90 km altitude [Hocking, 1997,1999] : (Fig. a)

$$\tau = \beta \left(\frac{mg}{k} + 2 \frac{dT}{dh} \right) \log_{10} e$$

Traditional method (Hocking, 1999,2007; Holdsworth et al., 2006; Kim et al., 2012):

- Classical regression analysis (Fig. a) to estimate the slope (β).
- Ignore measurement errors in the variables and the persistent effect of geophysical variability.
- Results depends on the assumption that one of the variable is independent and free of errors.
- Estimated temperature is biased when compared with colocated optical or satellite measurements (Fig. b).
- Requires subsequent calibration with other colocated measurements for bias-correction.
- Location dependent temperature gradient model ($\frac{dT}{dh}$) requires additional data and difficult to reproduce in a coherent way.

Improved method (Sarkar et al., 2020):

- Errors-in-variables (EIV) regression analysis (Smith, 2009) is implemented.
- Both measurement errors and the dominant effect of geophysical variability included in the 'model error'. This is referred to as geometric mean (GM) solution.
- The asymptotic properties of GM solution is utilised based on contour selection in a normalised coordinate system (Fig. c and Fig. d). This ensures stability of the solution.
- The geometric mean (GM) solution guarantees the results are scale-invariant and symmetric in the variables (Fig. e).
- MSIS model (Hedin, 1991) for temperature gradient is used. This data is publicly available and reproducible in a coherent way.
- This improved temperature estimate is self-consistent, unbiased and stable (Fig. f). No subsequent calibration is necessary.