A Site Atmospheric State Best Estimate of Temperature for Lauder, New Zealand

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April 25, 2018

Site Atmospheric State Best Estimates

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- Include an estimate of the uncertainty on every value

Temperature SASBE for Lauder

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[1] ground, 925 hPa, 850 hPa, 700 hPa, 500 hPa, 400 hPa, 300 hPa, 200 hPa, 150 hPa, 100 hPa, 70 hPa, 50 hPa, 30 hPa, 20 hPa, 10 hPa

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- Hourly temporal resolution

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- Vertically resolved on standard pressure levels[1]

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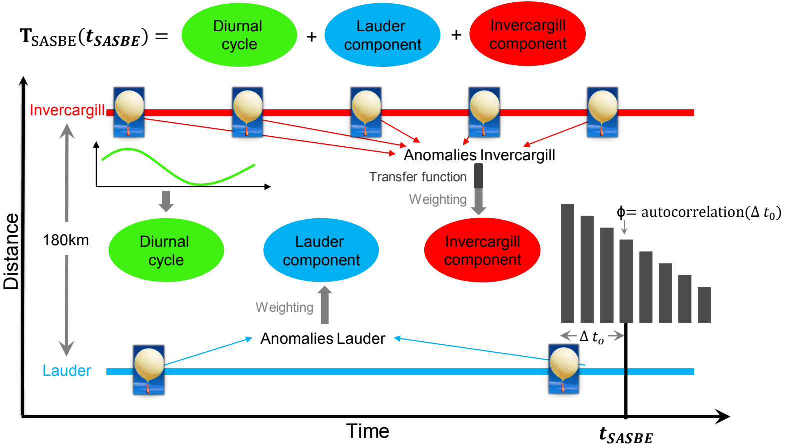
Schematic explanation of temperature SASBE for Lauder



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- Representativeness of diurnal cycle for measured temperatures is estimated as the standard deviation of the differences between T_{RS} and T_{Diur}

Diurnal Cycle

- Uncertainty on the diurnal cycle is estimated as:

$$\sigma_{T_{Diur}} = \sqrt{\sigma_{fit}^2 + \sigma_{representativeness}^2} \tag{2}$$

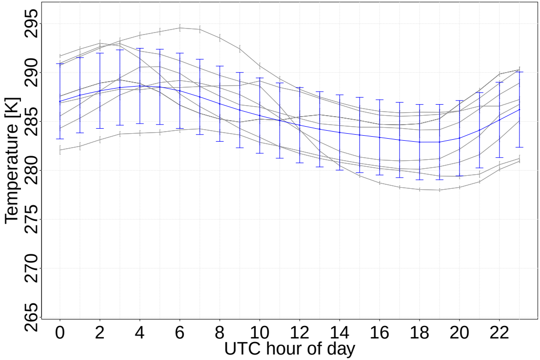

Figure 1: Diurnal cycle 925 hPa above Lauder at the 1st of January.

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- RS80: 1-σ=0.5 K, RS92: 1-σ=0.25 K

Invercargill component

- Temperature anomalies from Invercargill are *transferred* to Lauder with a regression model

$$\widehat{T}'_{Lau} = \underbrace{\gamma}_{\text{Offset}} + \underbrace{\beta \cdot T'_{Inv}}_{\text{T anomaly}} + \underbrace{\eta \cdot \Delta SP}_{\Delta\text{ surface P}} + \underbrace{\kappa \cdot \Delta ST'}_{\Delta\text{ surface T}} + \underbrace{\epsilon}_{\text{Residual}} \tag{3}$$

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- Temperature anomaly term is expanded in a Fourier series of the wind direction

Combining the SASBE components

The SASBE combines the diurnal cycle, the Lauder component and the Invercargill component.

$$T_{SASBE}(t) = \underbrace{T_{Diur}(t)}_{\text{Diurnal cycle}} + \underbrace{\sum_{i=1}^{N} \phi \cdot w_i \cdot T^*_{i_{Lau}}(t)}_{\text{Lauder component}} + \underbrace{\sum_{j=1}^{M} (1-\phi) \cdot w_j \cdot \widehat{T}^*_{j_{Lau}}(t)}_{\text{Invercargill component}} \quad (4)$$

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Using the attenuated temperature anomaly T^*:

$$T^*_{i_{Lau}}(t) = T'_{Lau}(t_i) \cdot acf(\Delta t_i) \quad (5)$$

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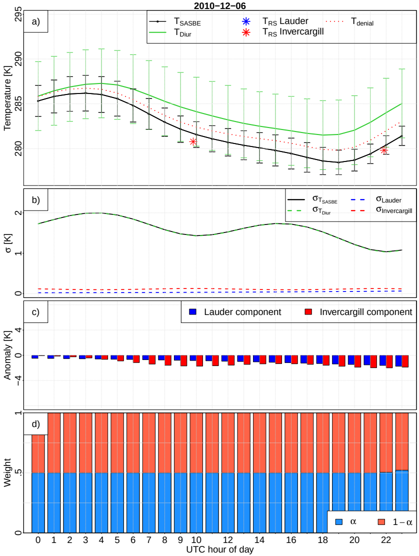
The uncertainties are propagated through Eq. (4).

$$\sigma_{T_{SASBE}(t)} = \sqrt{\sigma^2_{T_{Diur}} \left(\frac{\partial T_{SASBE}}{\partial T_{Diur}}\right)^2 + \sigma^2_{T_{RS_{Lau}}} \left(\frac{\partial T_{SASBE}}{\partial T_{RS_{Lau}}}\right)^2 + \sigma^2_{\widehat{T}_{RS_{Lau}}} \left(\frac{\partial T_{SASBE}}{\partial \widehat{T}_{RS_{Lau}}}\right)^2} \quad (6)$$

Example of the temperature SASBE



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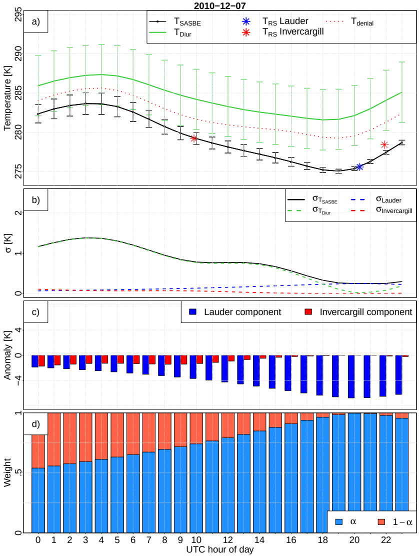

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- Outlook: Funding dependent: SASBEs for West Antarctic Ice Sheet → radiative transfer calculation using SASBE → study the sensitivity of the radiation balance to changes in the surface emissivity. For the motivation please see Feldman et al. (2014).

References I

Feldman, D., Collins, W., Pincus, R., Huang, X., and Chen, X. (2014). Far-infrared surface emissivity and climate. *Proc. Natl. Acad. Sci. U. S. A.*, 111.

Tradowsky, J., Bodeker, G., Querel, R., Builtjes, P., and Fischer, J. (2018). Combining data from the distributed gruan site lauder-invercargill, new zealand, to provide a site atmospheric state best estimate of temperature. *Earth System Science Data Discussions*.

Thank you for your attention!