Update on RS92 -> RS41 transition
Statistical analysis

Alessandro Fassò - University of Bergamo, Italy

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At ICM-9 I addressed the following question:

Do we have an universal formula

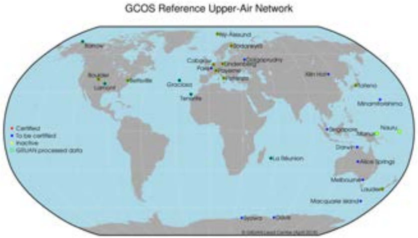
for harmonizing Vaisala transition ?

and I discussed the following points:

1. Use of GDP measurement uncertainty
2. Role of vertical correlation
3. Bias assessment using heteroskedastic local polynomial least squares.
4. Bias adjustment and harmonization

Dataset of dual soundings

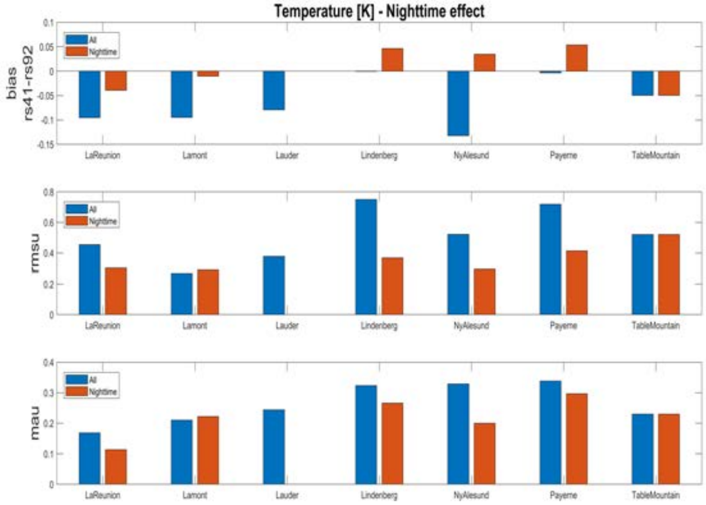
RS41-EDT.1 vs RS92-GDP.2



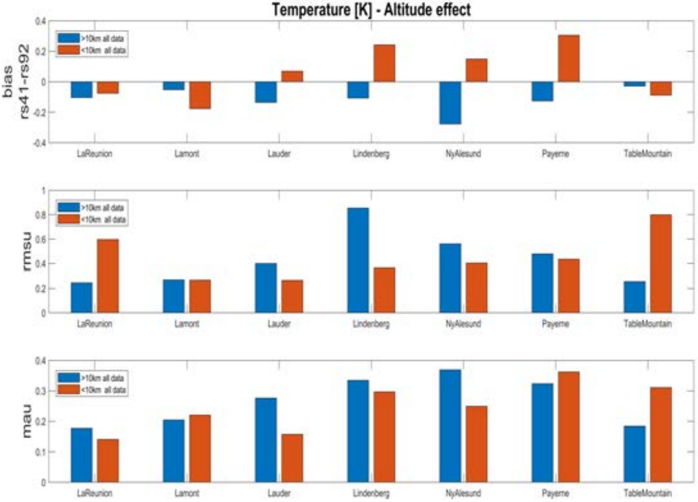
Site	Num of colocations	
	24 h	Nighttime
LAU	49	
LIN	186	77
NYA	114	17
PAY	110	49
REU	18	9
SGP	16	6
TMF	17	17
	510	175

Nighttime: $SEA < -10^\circ$

Temperature - Nighttime effect



Temperature - Altitude effect (alldata)



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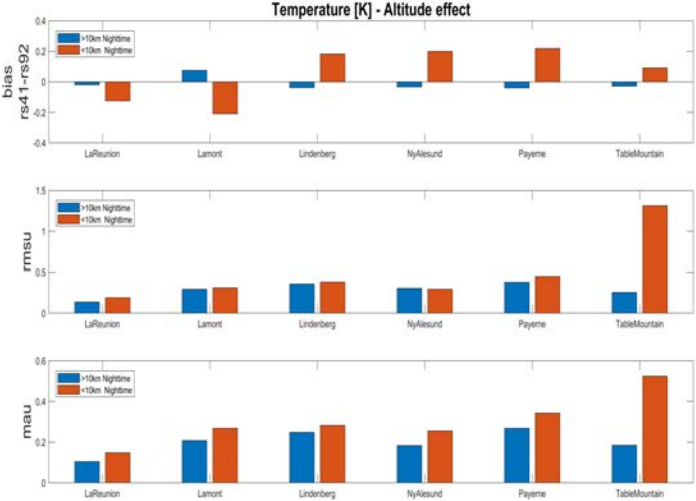
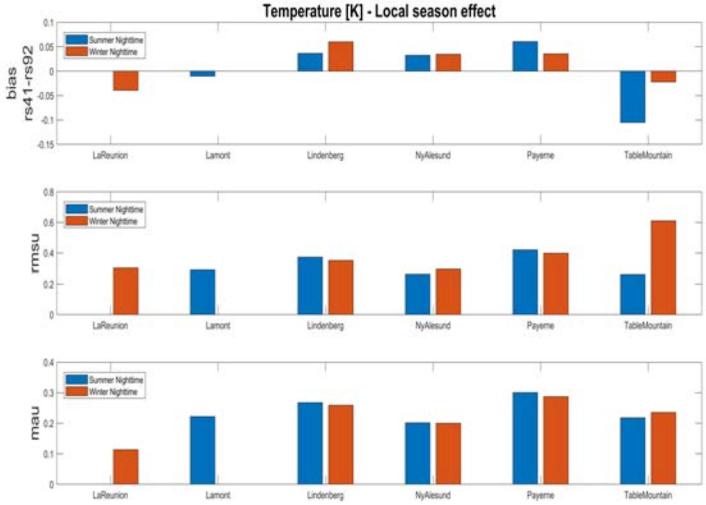
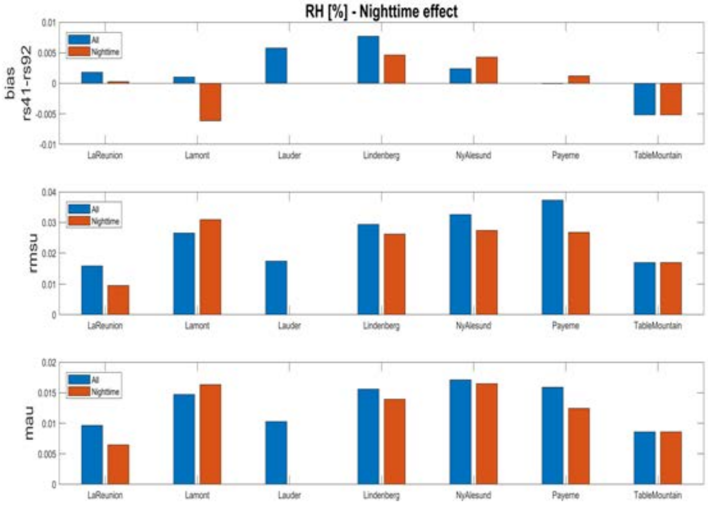


Temperature - Season effect



Humidity - Nighttime effect



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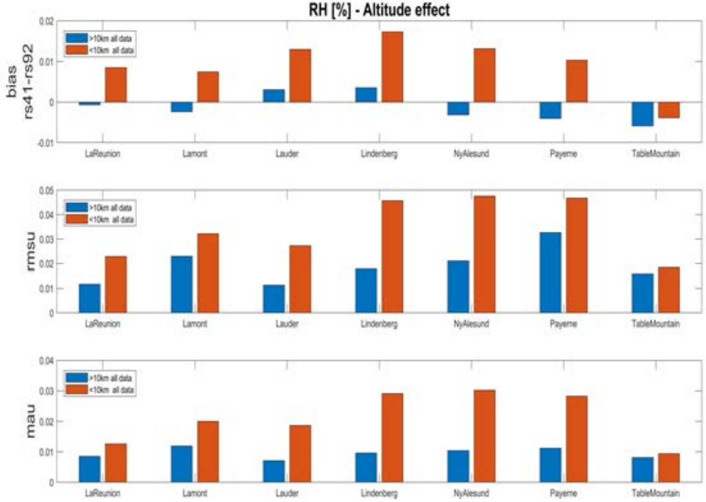

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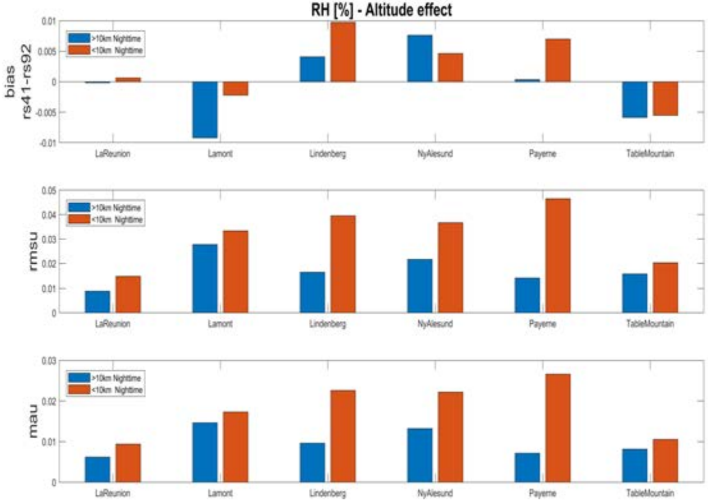

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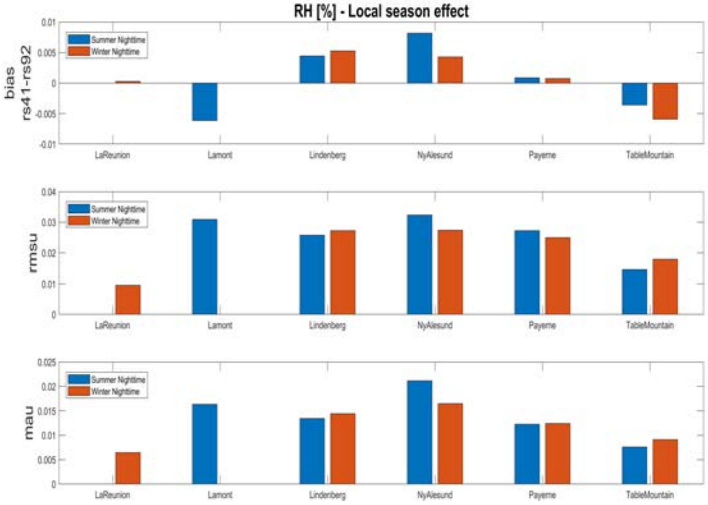

Modelling of bias (T&q)

We assume that RS41-RS92 difference at altitude (h) is such that

$$bias\,(h) = E\,(\text{measurement difference}|\text{local conditions})$$

$=>$ a smooth function of altitude (h) and,
$=>$ a locally-linear function of solar elevation angle (SEA) :

$$b\,(h) = \alpha\,(h) + \beta\,(h)\,SEA^*\,(h)$$

where

$$SEA^* = \begin{cases} SEA + 10 & Day : SEA > -10^\circ \\ 0 & Night : SEA < -10^\circ \end{cases}$$

$=>$ No assumptions about smoothness of measurements are made.

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- Some results in the following pictures ...

Methods

For each site, bias at altitude h is denoted by $b\left(h\right)$ and is obtained by minimizing

$$\sum_{i,j}\left(y_{i,j}-b\left(h\right)\right)^2 K_\lambda\left(h_i-h\right)\omega_{ij}$$

where

$j = 1, \ldots, N$ (# of co-locations)

$i = 1, \ldots, n_j$ (# of measurements of co-location j)

h_i = altitude of measurement $y_{i,j}$

K = Gaussian kernel with bandwidth λ ($\lambda = 100m$)

$\omega \propto uncertainty^{-1}$

Vertical correlation taken into account in IC's of α and β

Vertical correlation not taken into account in averaging and/or estimation

About vertical correlation

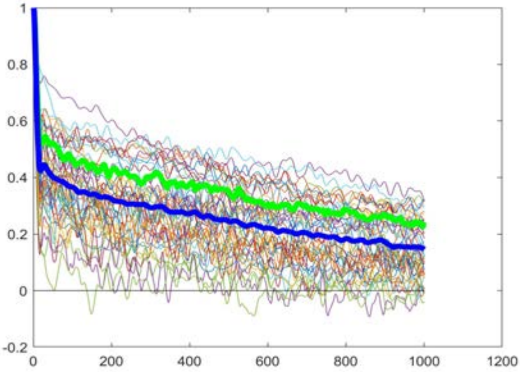
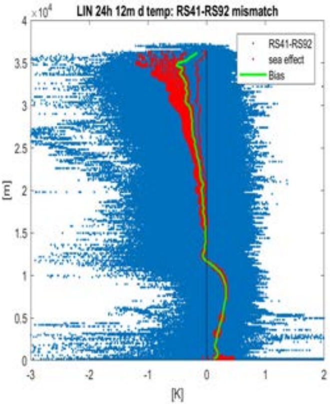
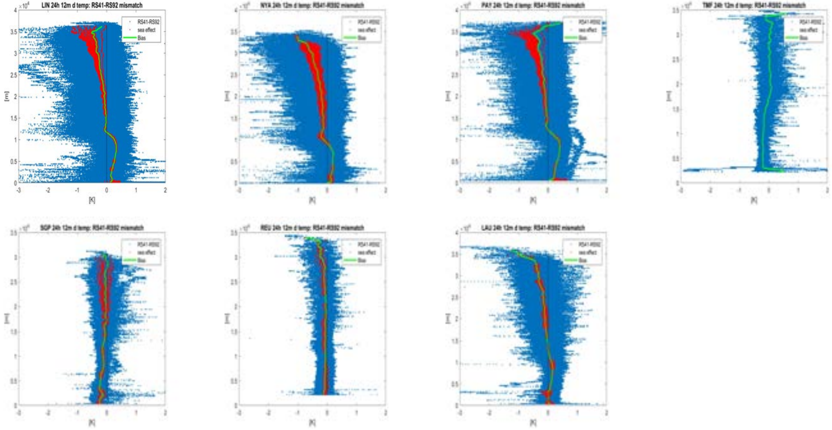


Figure: Lauder temperature-difference vertical correlation.

Temperature SEA & Nighttime (1/3)



Temperature SEA & Nighttime (2/3)



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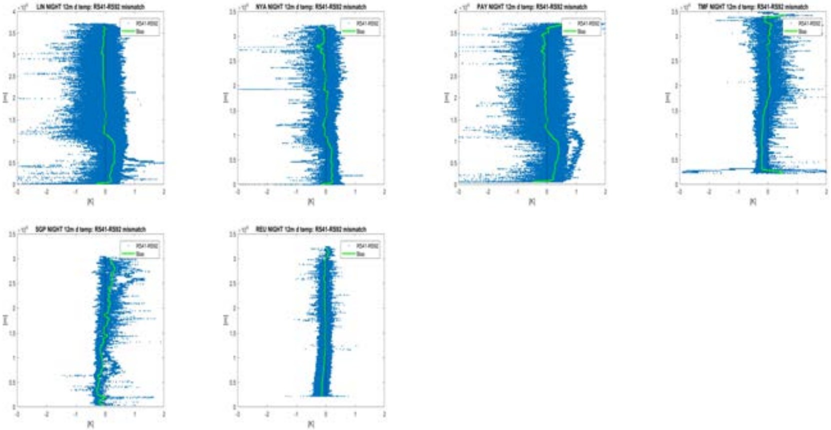
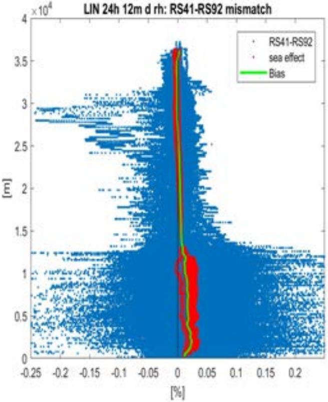
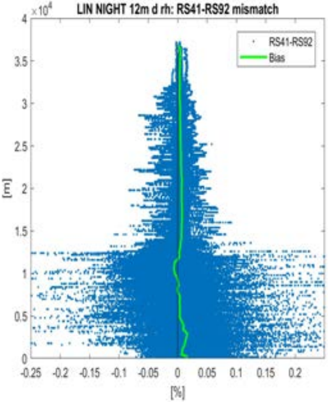


Humidity SEA & Nighttime (1/3)





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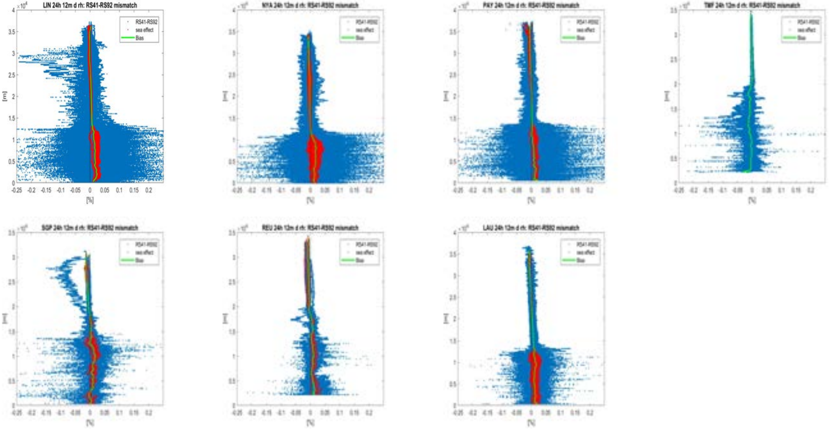

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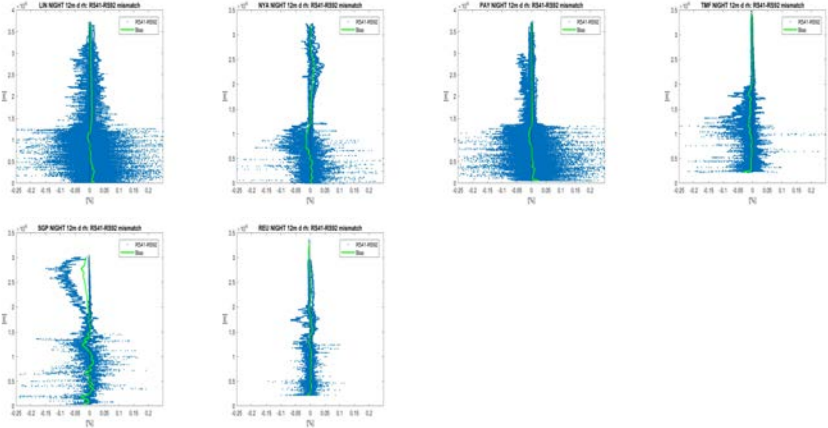

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- Local "out of situ" bias reduction ?

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- The dataset for each single site is randomly divided in two parts:
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- The above SEA model is estimated on the first and applied to the second one

Temperature Harmonization
Lindenberg valid. data

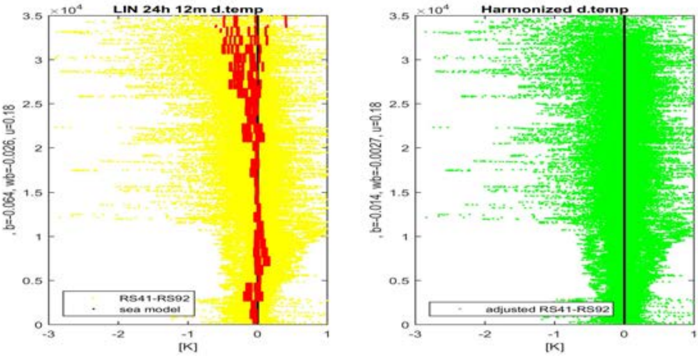
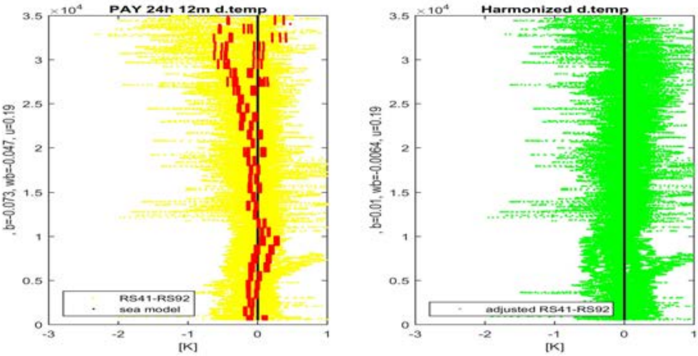


Figure: Left: differences and SEA effect in red. Right: differences after harmonization.

Temperature Harmonization
Payerne valid. data



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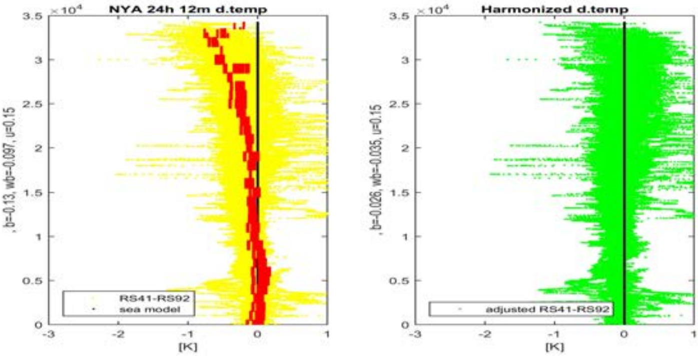
Temperature Harmonization
Ny Alesund valid. data



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RH Harmonization

LIMITED VALUE of RH CORRECTION

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  5. Harmonization (bias reduction) is possible in-situ provided a representative network of DS is available.

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THANKS FOR YOUR ATTENTION