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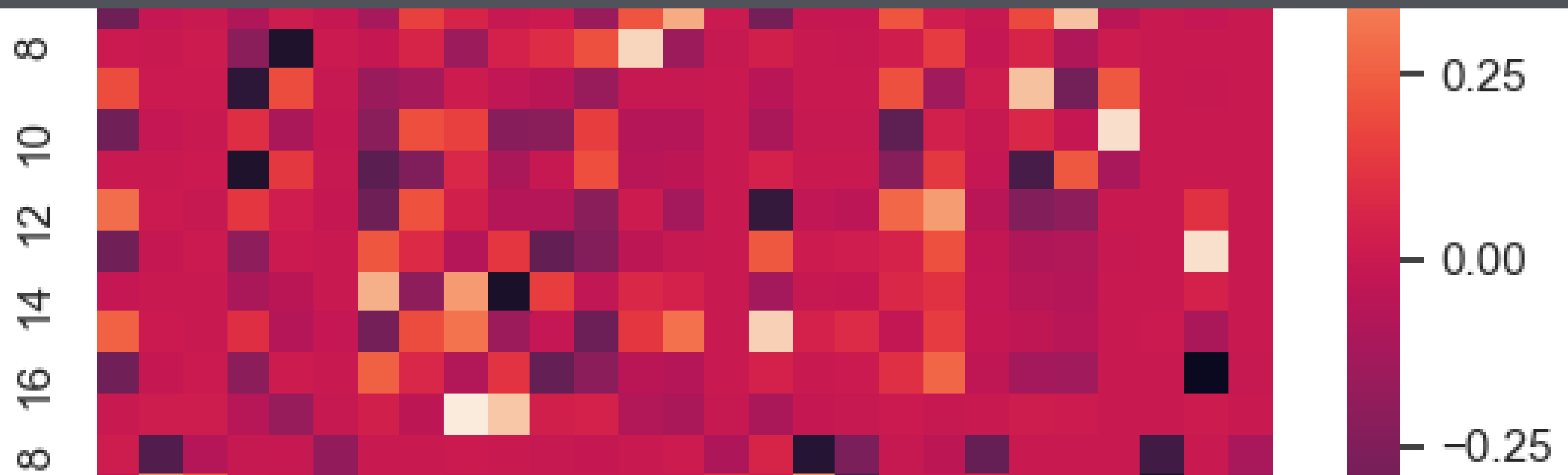
L1C ENSEMBLE FCDR



Progress update

LIMITLESS **POTENTIAL** | LIMITLESS **OPPORTUNITIES** | LIMITLESS **IMPACT**

HARMONISE → ENSEMBLE

- **9 harmonised AVHRR Easy FCDRs** (MetOp-A → NOAA-11)
- **3 IR channels** (**3.7 μm**, **11 & 12 μm**)
- **3 (or 4) harmonisation coefficients** (without WV) **per channel per sensor → 27 (or 36) coefficients per channel**
- **We know the uncertainty on each coefficient**
- **We know their correlation matrices [27 x 27] or [36 x 36]**

} 'best-case' **harmonised** AVHRR Easy FCDR

Measurement Equation for Ch3B (3.7 μm)

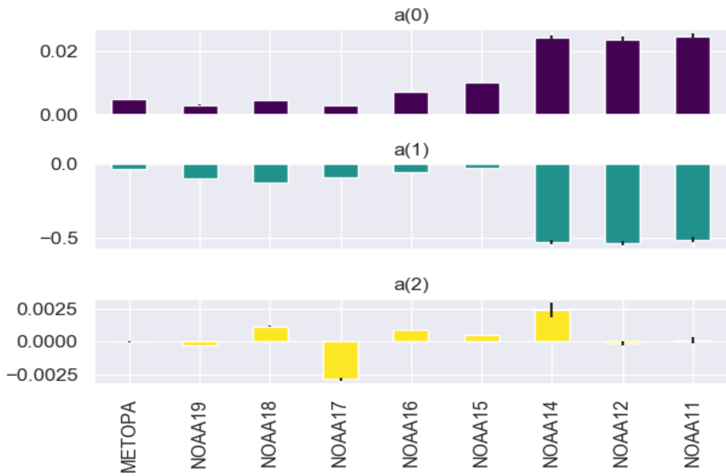
L = a0 + ((Lict * (0.985140 + a1)) / (Cict - Cs)) * (Ce - Cs) + a2 * Tinst + a3 * f(WV)
L = a0 + ((Lict * (0.985140 + a1)) / (Cict - Cs) + a2 * (Ce - Cict)) * (Ce - Cs) + a3 * Tinst +a4 * f(WV)

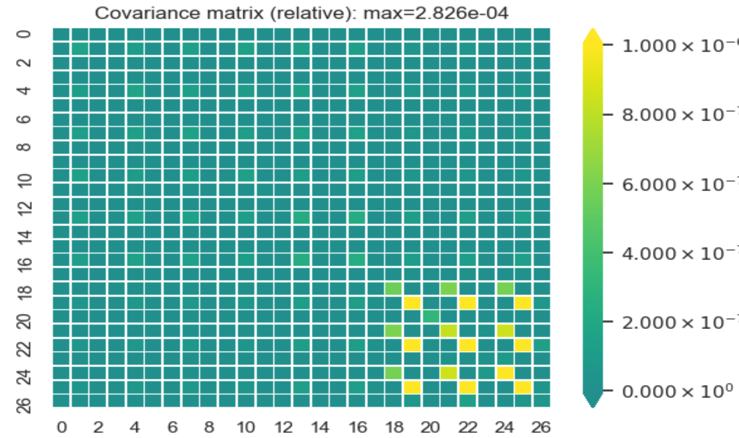
Measurement Equation for Ch4 (11 μm) & Ch5 (12 μm)

Q1: Can we generate another 10 FCDRs within the range of uncertainty but having a similar inter-sensor correlation structure to the best-case?
Q2: Why bother?

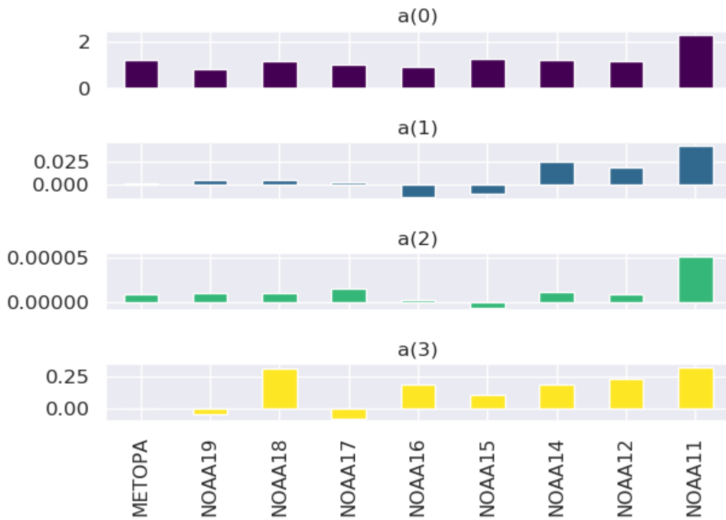
THE BEST CASE

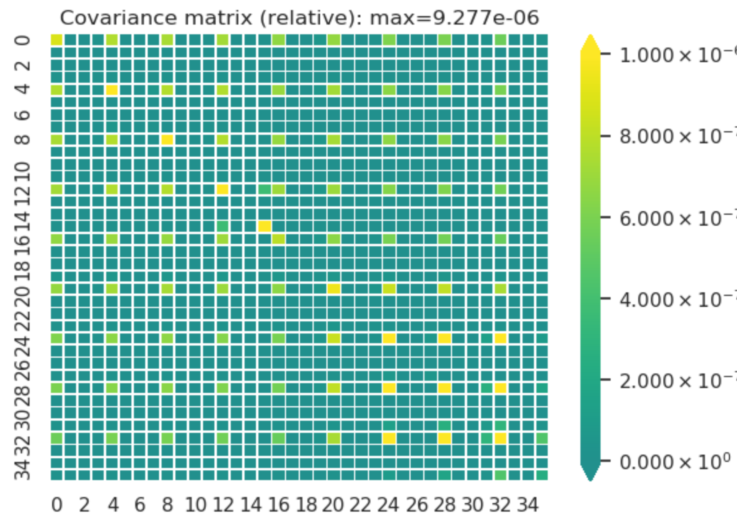
3.7 µm





11 µm

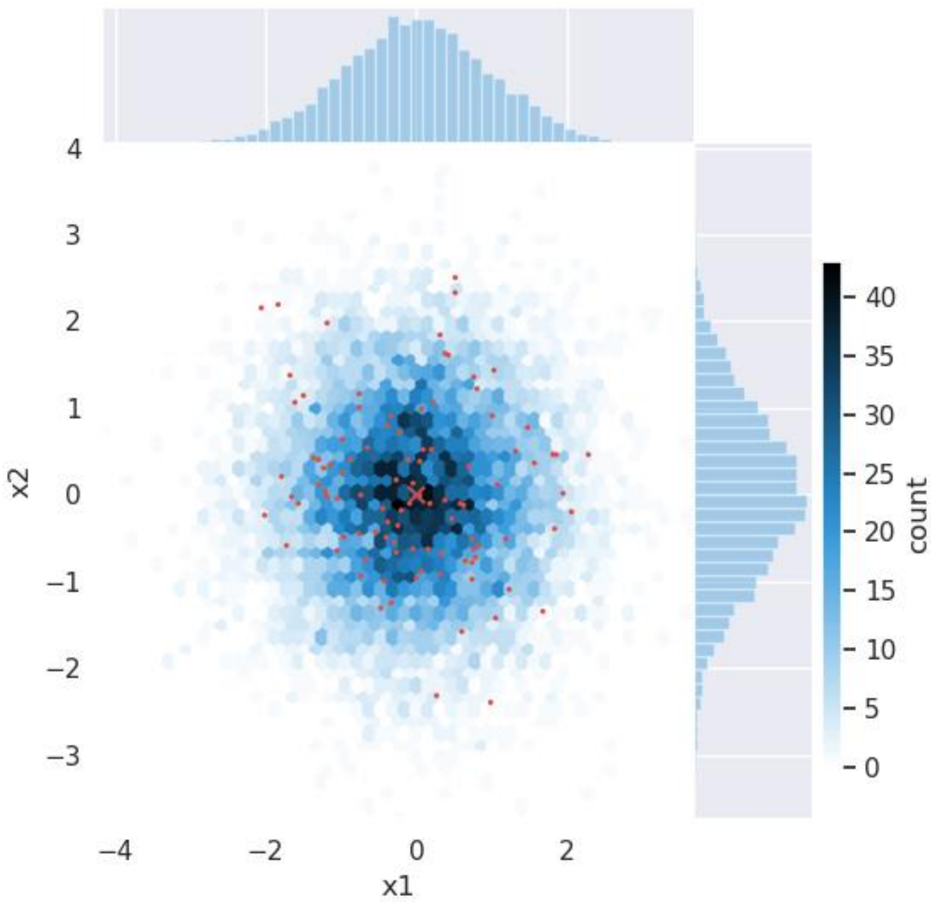




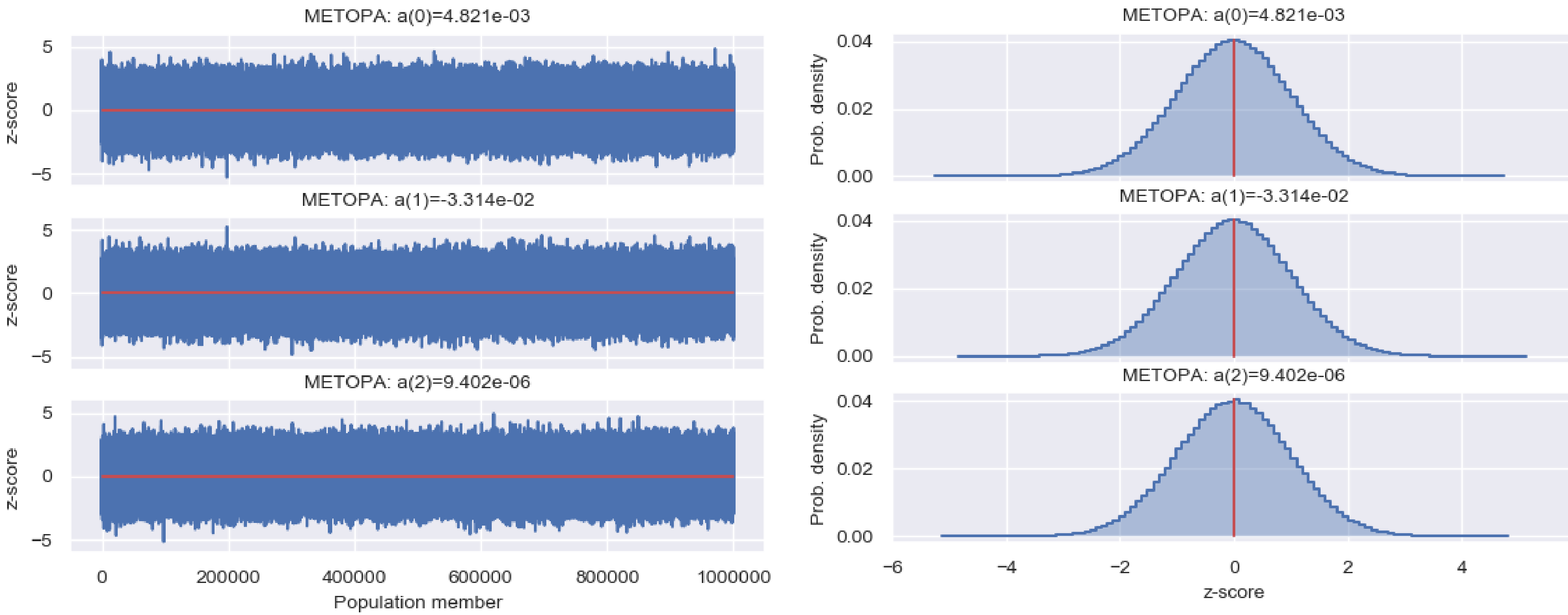
MONTE CARLO: 2D CHECK

Blue = 10000 draws from bi-normal X~N(μ=[0,0], σ=[1,1])

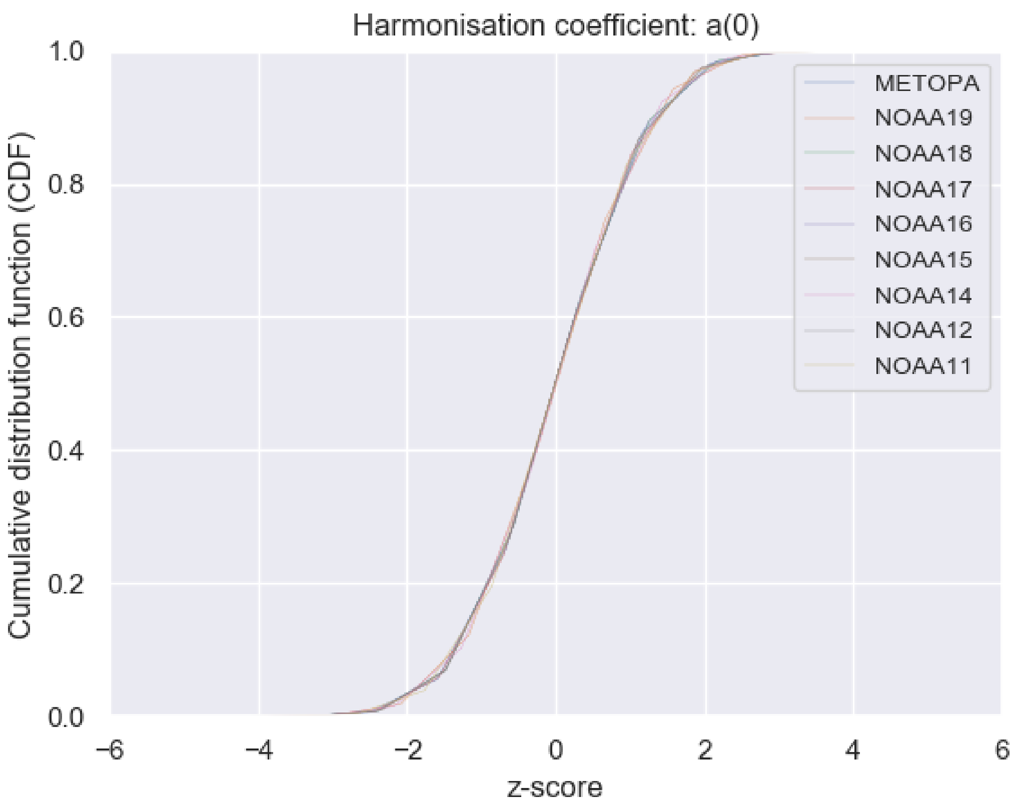
Red = 100 random draws with numpy.random.multinormal_normal(mean(X), cov(X), 100))



MONTE CARLO: 27D (& 36D)



METHOD #1: CDF NORM

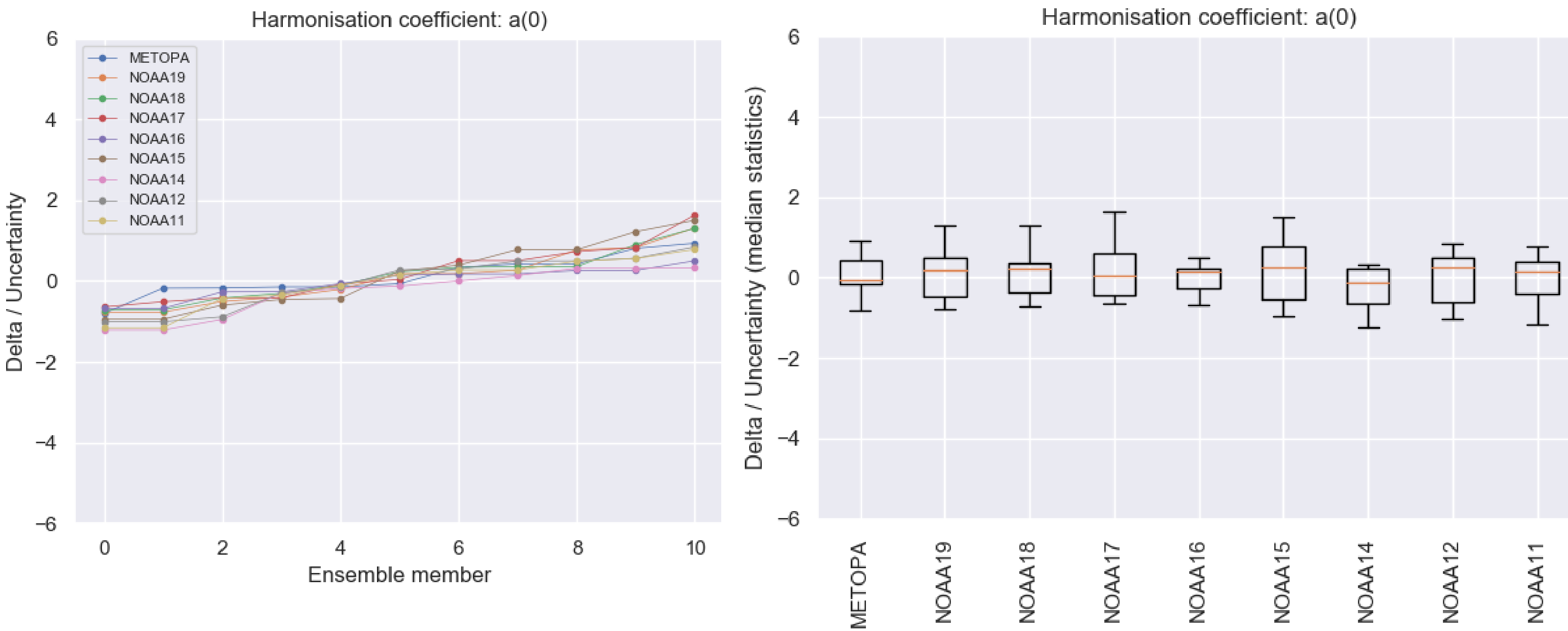


Use sorted draw CDFs to find deciles (& store indices)

Loop over all draw vectors & calculate norm for each decile

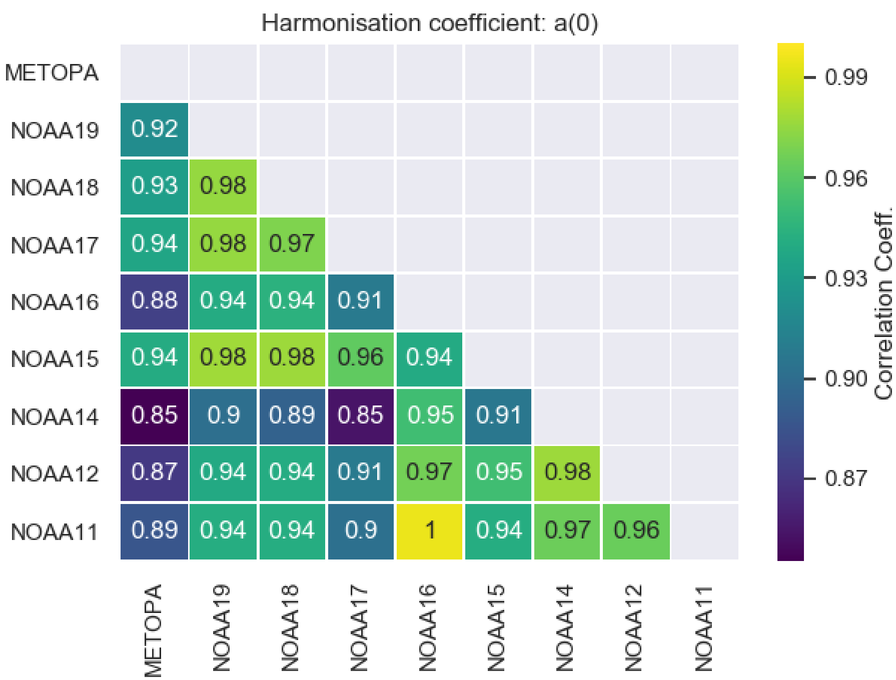
Index [min(Norm)] → ensemble

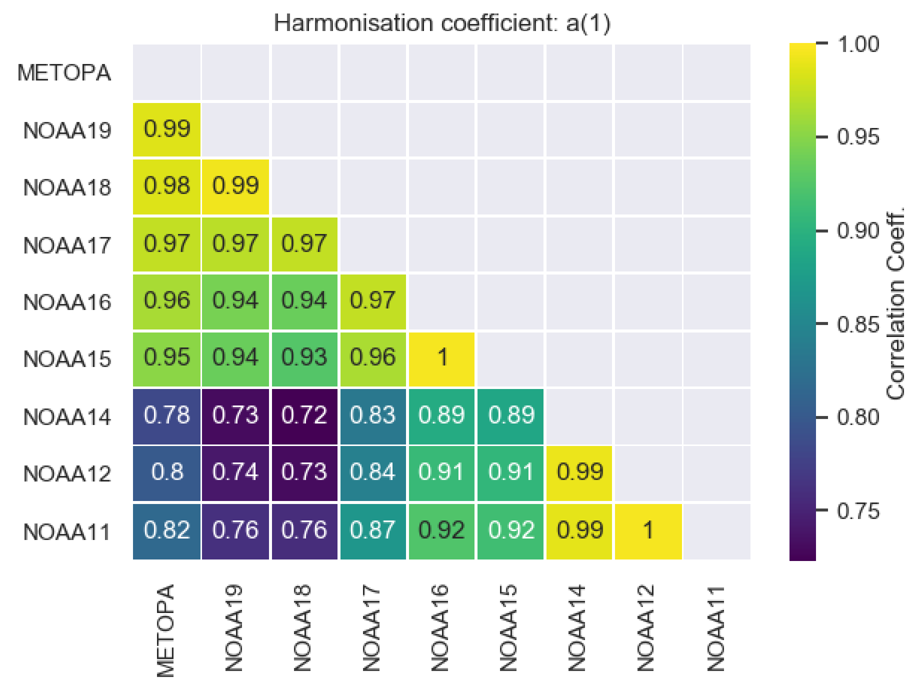
ENSEMBLE STATS



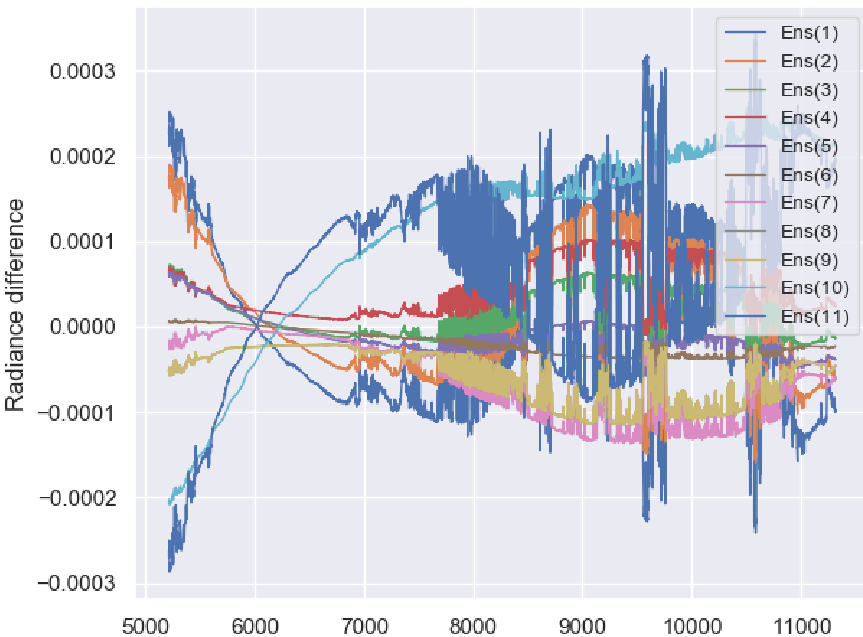
We would like the sorted ensemble to pass through (5,0) and present a CDF-shaped spread – it more or less does

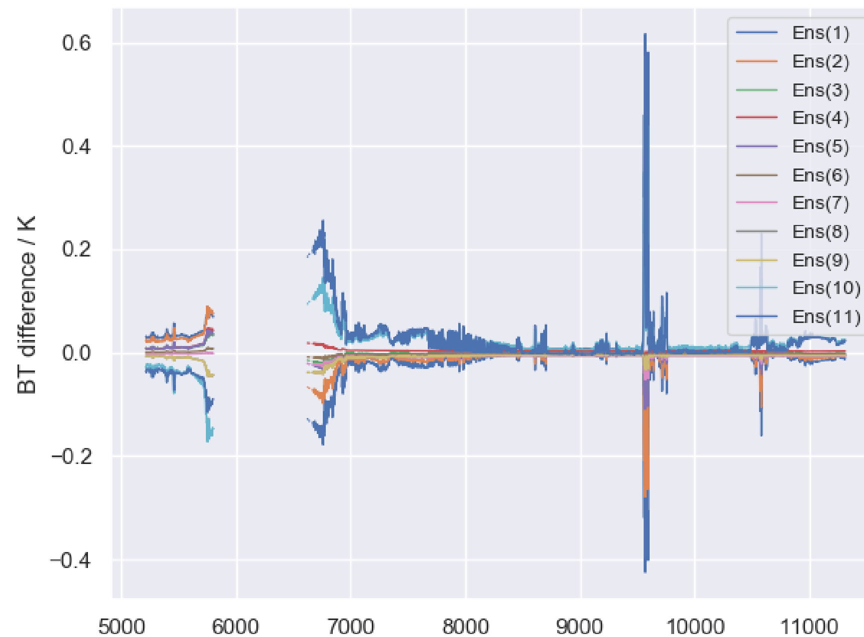
ENSEMBLE CORRELATIONS





ENSEMBLE RADIANCE

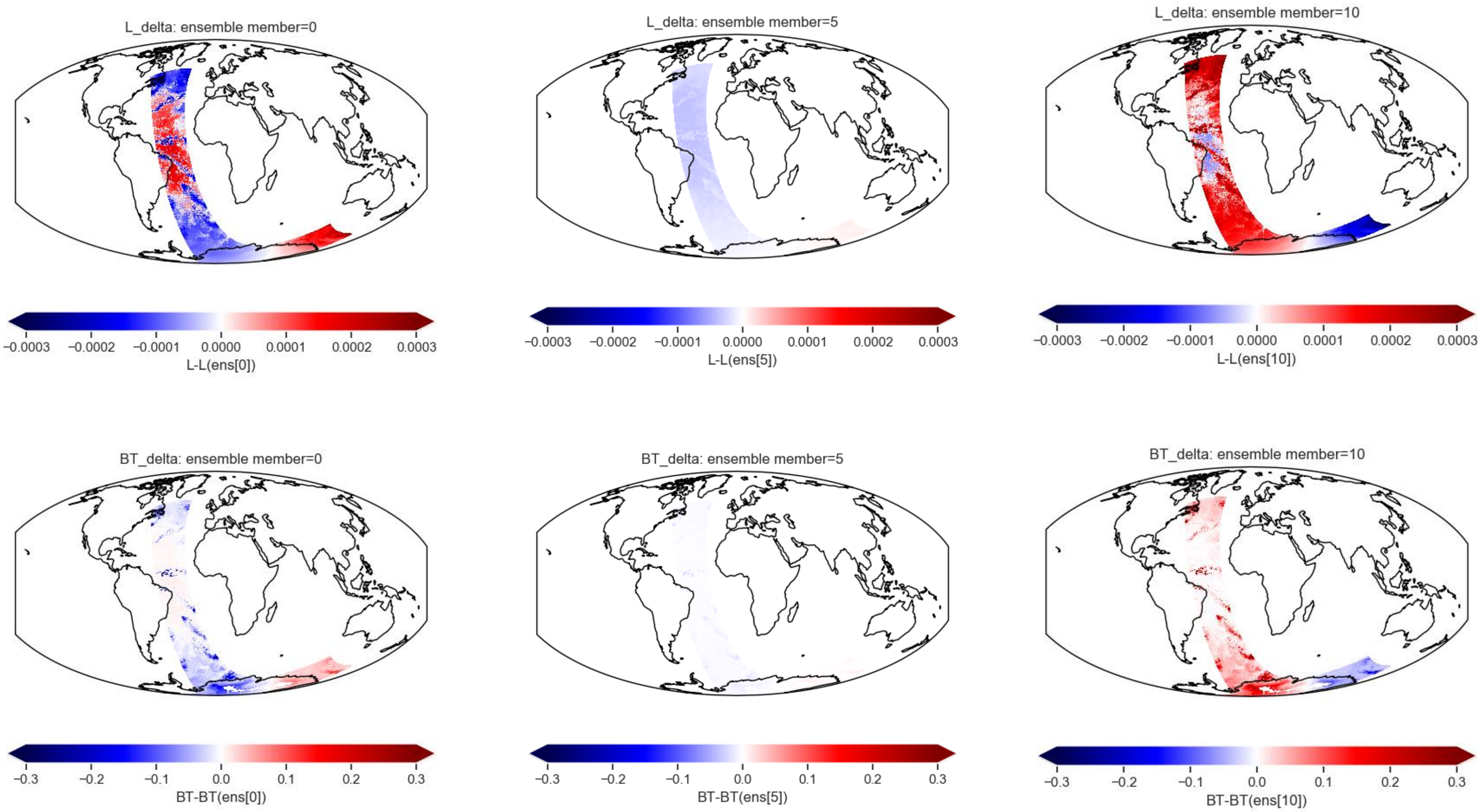




Using L1B counts and temperatures from an orbit from MetOp-A, I calculated the radiance for each ensemble member and then used LUTs from the L1C Easy FCDR (thanks James!) to convert to BTs:

https://github.com/FIDUCEO/MMD_HARM

ORBITAL ENSEMBLE DELTAS



METHOD #2: PCA-MC CHECK

Suppose there are n-samples of p-variables → [n × p] matrix

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{np} \end{bmatrix}$$

PCA →

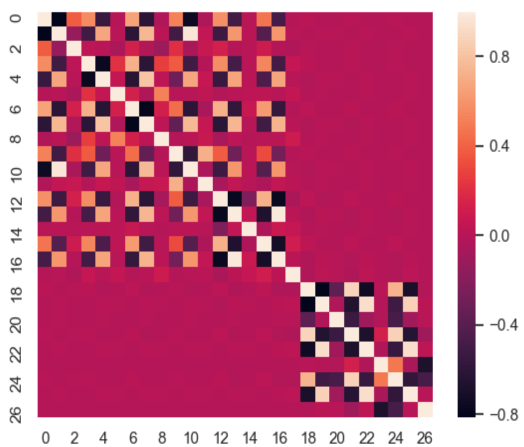
$$\begin{cases} z_1 = l_{11}x_1 + l_{12}x_2 + \cdots + l_{1p}x_p \\ z_2 = l_{21}x_1 + l_{22}x_2 + \cdots + l_{2p}x_p \\ \cdots\cdots\cdots\cdots \\ z_m = l_{m1}x_1 + l_{m2}x_2 + \cdots + l_{mp}x_p \end{cases}$$

$$l_{i1}^2 + \cdots + l_{ip}^2 = 1$$

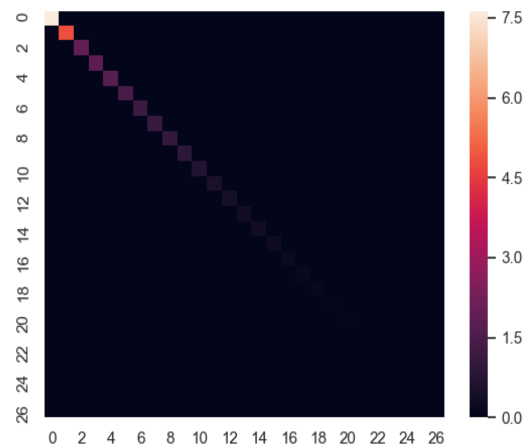
z_m = PCs

x_p = vectors in X

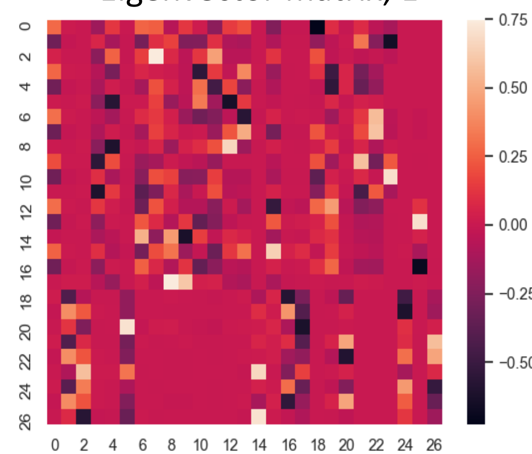
Correlation matrix, R



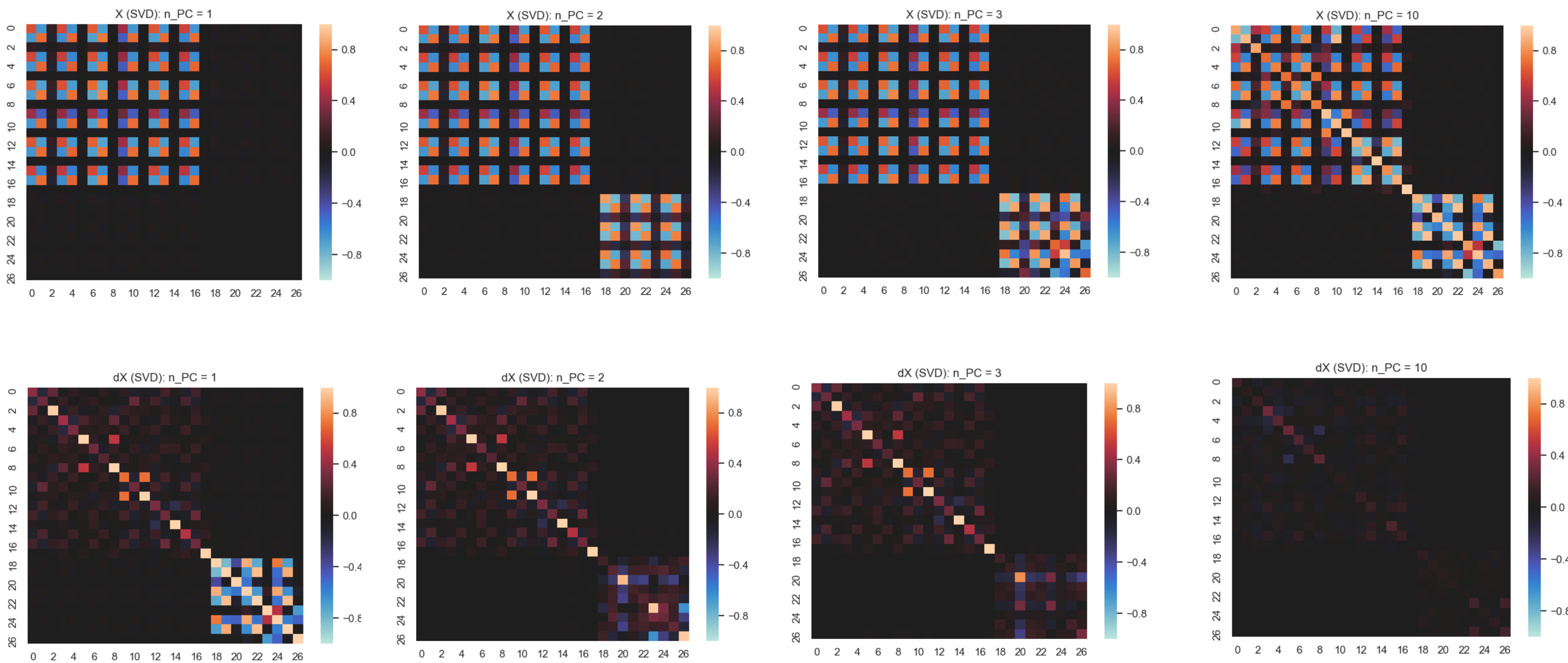
Singular value matrix, S



Eigenvector matrix, E



PCA



Q: Can we sample from the eigenvectors to generate the ensemble directly (rather than looping over all draws and then using the norm with respect to CDF deciles)?

THANKS!

I’ve put the python code here for re-use / revision:
https://github.com/patternizer/ENSEMBLE_SST