A new way of making a composite

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Principle of the composite making of

- Pre-treatment and homogeneously assessment of uncertainties at different scales.
- Decompose in scales all datasets
- Recombine scale by scale by weighting dataset following their uncertainty (at the given scale)

Step by step

- Homogeneous estimate of uncertainty of each dataset
 - short tem (precision) : Scholl et al., 2015
 - Long term (stability): see later.
 - in between: kind of weighted average of the two.
- Temporal extension of datasets (needed for multi scale decomposition)
 - Data gaps are filled by expectation-maximization [Dudok de Wit, 2011] (multiscale iterative proxy fitting).
 - Largest uncertainties are given to extrapolated data.

Step by step (2)

- Scale decomposition by wavelet transform
- Averaging in the wavelet domain:

$$\bar{d}_{j} = \sum_{i \in \mathbf{I}} d_{i,j} w_{i,j}$$
$$\bar{\epsilon}_{j} = \left(\sum_{i \in \mathbf{I}} \epsilon_{i,j}^{2} w_{i,j}^{2}\right)^{1/2}$$
where $w_{i,j} = \frac{\epsilon_{i,j}^{-2}}{\sum_{k \in \mathbf{I}} \epsilon_{k,j}^{-2}}$

- Recombine
- set absolute scale by matching ATLAS3 spectrum and TSI level (Dudok de Wit 2017) for 1 day.













Pre-treatment and precision (scholl et al., 2015)

- regridded all data onto a regular time and wavelength grid
- removed huge outliers (above 16σ and checked they are not outliers elsewhere)
- interpolate missing data.
- removed or modified datapoint are flagged and uncertainty is computed.

Pre-treatment and precision (scholl et al., 2015)

Noise computed from a modified Donoho noise estimator.





Each spectral time series of each datasets is fitted with a two time scale linear component model

Estimating stability UARS/SOLSTICE @ 180nm









The stability is defined as

$$\mathbf{s} \left[s(\lambda, t) = \mid a_{obs}(\lambda, t) - a_{bestfit}(\lambda, t) \mid \right]$$



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$$s(\lambda,t) = |a_{obs}(\lambda,t) - a_{bestfit}(\lambda,t)|$$



Proxy?

DSA, Mg II, radio flux at 3.2cm, 10.7cm, 15cm, and 30cm

Hypothesis behind

What can not be reproduced by a two time scales and six proxies model is more uncertain !

Cons: this multi parameters model can reproduce trends and non solar behavior to a certain degree. It is permissive.

UARS/ SOLSTICE

•In % / yr



 In % of solar cycle variation / yr

UARS Overview



Stabilities are averaged over the mission lifetime