The Humidity Composite Product (HCP) of EUMETSAT’s Satellite Application Facility on Climate Monitoring (CM-SAF) will integrate data from several existing and upcoming satellites, e.g., microwave imagers like SSMI as well as water vapour profiling instruments on the Meteorological Operational polar platform (MetOp) and ATOVS data from NOAA platforms. CM-SAF will provide single sensor estimates as well as some merged estimates, e.g., from SSMI and AMSSU-A. The production of this thematic climate record relies on calibrated and inter-calibrated input data to be provided by the satellite operators.

Two pilot studies on the creation of daily mean fields have been undertaken. The first provided a merged result from total precipitable water (TPW) observations from AMSSU-A aboard the NOAA-15 and NOAA-16 satellites and from SSMI on DMSP-F13, F14, and F15 satellites. The second study considered the merging of ATOVS estimates from NOAA-15 and NOAA-16. In both studies the merging is performed by Kriging, an optimal interpolation technique that provides not only fully covered fields but also a corresponding error map. The obtained errors reflect mostly the actual sampling situation and should not be mixed up with retrieval errors that have to be determined by external comparisons to other data. The technique has been chosen because of its potential to merge data from several completely different sources if they have no bias errors. It also holds the potential to include spatially resolved retrieval information on the retrieval error itself.

Within this poster the Kriging technique is presented and an exemplary application to ATOVS data from April 2004 is shown.

Kriging can be regarded as a prediction of a value $x_i$ at a location $P_i$, where no measurement is available employing information from measurements at the surrounding locations $P_j$. A solution is not possible for one single case. However, if a time series of $n$ measurements at each location $P_i$ is available it is reasonable to minimise the expression:

$$\sum_{i=1}^{n} \Delta^2 x_i + \sum_{i=1}^{n} \sum_{j \neq i}^{n} \lambda_i \Delta x_{ij} + \sum_{i=1}^{n} \lambda_i \Delta x_i$$

with $\lambda_i$ the weights, $\Delta x_i$ their errors, and $\Delta x_{ij}$ their spatial correlation. The minimised expression of this equation is equal to the error of the predicted value $\Delta x_i$ and reads:

$$\sum_{i=1}^{n} \Delta^2 x_i + \sum_{i=1}^{n} \sum_{j \neq i}^{n} \lambda_i \Delta x_{ij} + \sum_{i=1}^{n} \lambda_i \frac{\Delta x_i}{\sigma_i}$$

where $\sigma_i$ denotes temporal averaging. The first term denotes the variance at $P_i$ and is equal to unity if anomalies are considered. The second term contains the covariance between data points, the so-called spatial correlation. The third term contains the so-called redundancy because information from points $P_j$ may not be independent. The last term describes the individual errors at the points $P_i$. To determine the weights $\lambda_i$ information on the spatial covariance and the individual error $\sigma_i$ is needed. Note that the spatial covariance is spuriously modified by error covariance between the points. Although not explicitly mentioned the average effect of the spatial error covariance is implicitly included within the information and redundancy terms.

The correlation is calculated for daily averages, which are based on the maximal four independent observations available at each location, two from each platform and two from the morning and evening overpass, respectively. The distances are measured in units of the grid lengths of 150 km. For zero distance, no direct observation is available, but the fit of an exponential function allows a rough estimate of the average error variance, which can be read at the ordinate of 0.0969, meaning that a fraction of 0.031 of the total variance can be assigned to the error variance. The correlation length (the distance, where the correlation is decreased by a factor of $\frac{1}{e}$ compared to the correlation found for zero distance) is determined to be 4.3, corresponding to 645 km.

The standard Kriging output comprises of the daily mean fields and the corresponding error maps. The two upper maps show the normalised TPW anomaly (upper left) and the renormalised daily mean TPW anomaly (upper right) from ATOVS on NOAA-15, in April of 2004. The values are renormalised by subtracting the monthly mean and dividing by the extra daily standard deviation shown above. The lower left map shows the corresponding normalised error of the TPW anomaly. Due to the normalisation the maximum error is set to 1, corresponding to the extra daily standard deviation, which would be obtained if all daily values were set to the monthly mean. The renormalised field is shown in the lower right figure.