133736 OBJECTIVE ANALYSIS Using Modelled Correlation Structure

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(Retired)

Introduction

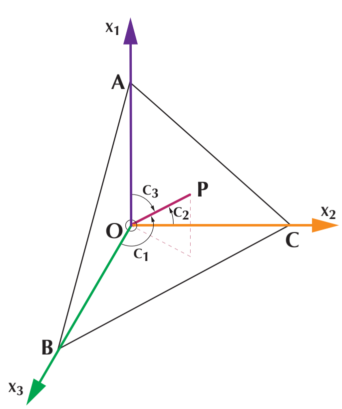
Objective analysis uses fixed rules, algorithms
To produce estimates of a variable everywhere in a domain given measurements only in arbitrary locations. Here we will only consider estimates on a regular grid since common methods e.g. Bilinear interpolation are available to further analyze grided estimates.

Plus a grid is desired input for most NWP predictions If the correlation is known between ob sites and grid sites, Multiple Linear regression cab calculate values on the gridX correlation can be empirically calculated between ob sites but in general is not available from ob to grid. Thus a model must be used.

Many simple models suffer from the fact that their resulting predictor correlation matrix is non singular which precludes the use of multiple linear regression. However Wave generation simulators Gringorten and Boehm (1967) Produce simple correlation formulas Boehm (1987) that have non singular predictor matrixes and thus are suitable for objective analysis

Wave Generators

A wave is defined as a periodic function in one or more dimensions. The superposition of waves can be used to generate a Gaussian field which in turn can be transformed into a metrological field via its cumulative climatological frequency. This simulation has been done with great success for clouds and related elements-ceiling and visibility.



CORRELATION OF RANDOMLY ORIENTED WAVES

First the correlation must be calculated along the direction of wave variation. This process is termed convolution. Next to get the anisotropic (without regard for direction) correlation, the effective distance when waves are randomly oriented i.e. The one dimensional correlation is weighted by the density of the N dimensional direction cosine distribution for random directions

Results are:

$$r_{2tri}(\delta\backslash\delta\leq 1/2)=1-12\delta^2+\frac{128}{3\pi}\delta^3$$

$$r_{3tri}(\delta\backslash\delta\leq 1/2)=1-8\delta^2+8\delta^3$$

$$r_{4tri}(\delta\backslash\delta\leq 1/2)=1-6\delta^2+\frac{256}{15\pi}\delta^3$$

TURNINGBAND SIMULATION Jean-Paul (1998)

SIMILARITIES

BOTH GENERATE A Gaussian field

Both start with a one dimensional result

Both concerned with simulating geophysical fields

DIFFERENCES

Turning Band emphasis on 2 dimensional results

Wave generators from the start produced higher dimensions

Allowing simultaneous simulation of several variables

The difficult integrations were done with DOD Macsyma which produced dozens of pages which were then reduced to the above simple results by hand.

Thus given only the distance between ob sites, correlation is calculated and put into a predictor matrix, R. In effect this matrix is inverted to find values at grid locations. If R is non singular it can not be inverted. In practice R inverse is not actually needed. Westlake (1968) but Linear equation algorithms will fail with a non singular R. For example the Cholesky Square root method will stop with trying to take the square root of a negative number.

STRONG POINTS OF MODELLED CORRELATION OBJECTIVE ANALYSIS

1 No initial guess is required

2 Analysis is done in a finite nuber of operations

3 Effect of closing a site or changing a configuration of sites can be directly calculated

4 Linear regression provides inherent error estimates

ADDITIONAL POSSIBILITIES

Correlation between levels and in time, allow obs at other levels and times to ne used in an analysis

FURTHER DESIRED TESTING

Warning! The author regrets unavailability of obs prevented testing on independent data. Thus above results were obtained only with simulated data.

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