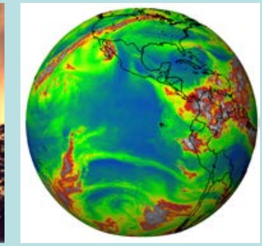
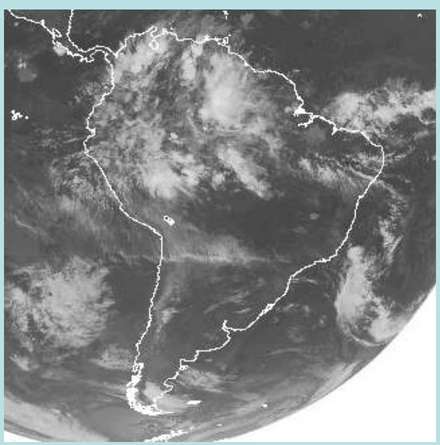


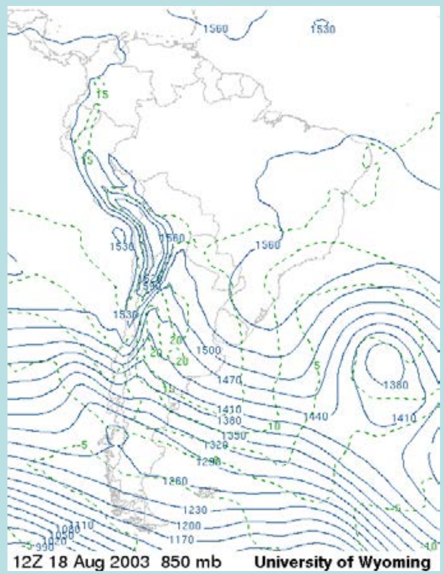
Tema 1c

Asimilación de Datos
Reanálisis

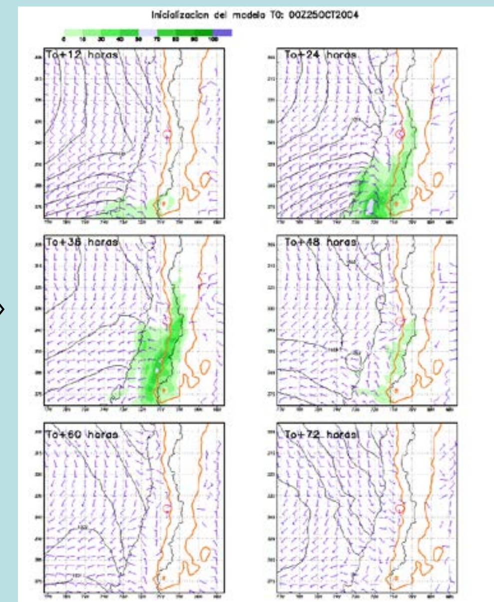
Observaciones



Análisis
(Grilla regular)

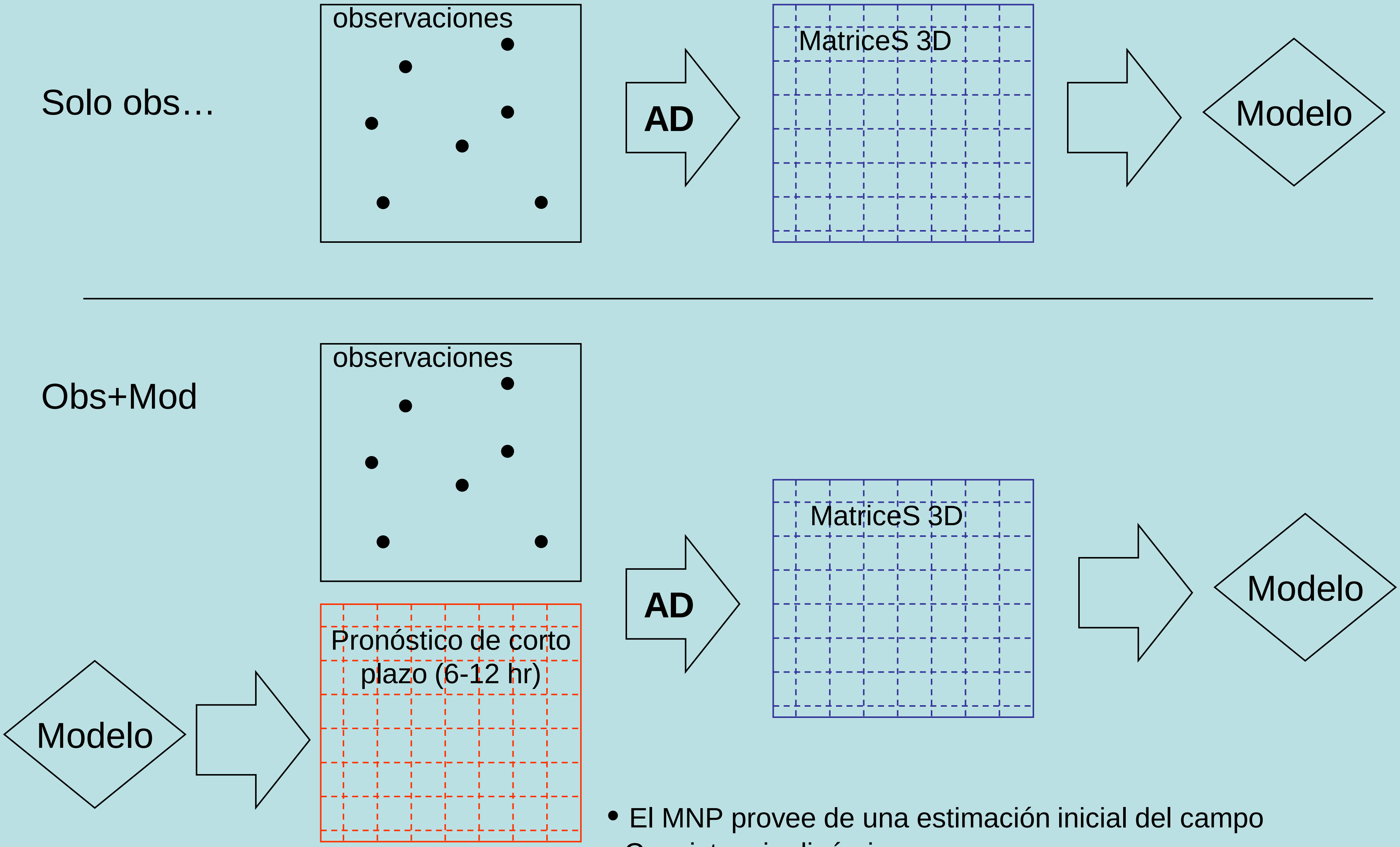


Pronósticos
(numéricos / subjetivos)



Asimilación de datos

Análisis objetivo requiere de una técnica de Asimilación de Datos (AD)



- El MNP provee de una estimación inicial del campo
- Consistencia dinámica
- Advección de información a zonas pobres en datos
- Continuidad temporal

Metodos de ajuste de superficies

$\phi(x,y) = a_0 + a_1x + a_2x^2 + b_1y + b_2y^2 + \ldots$

Los coeficientes a_i y b_i se obtiene de un ajuste de mínimos cuadrados.

12.2.1.4 ADVANTAGES AND DISADVANTAGES OF SURFACE FITTING

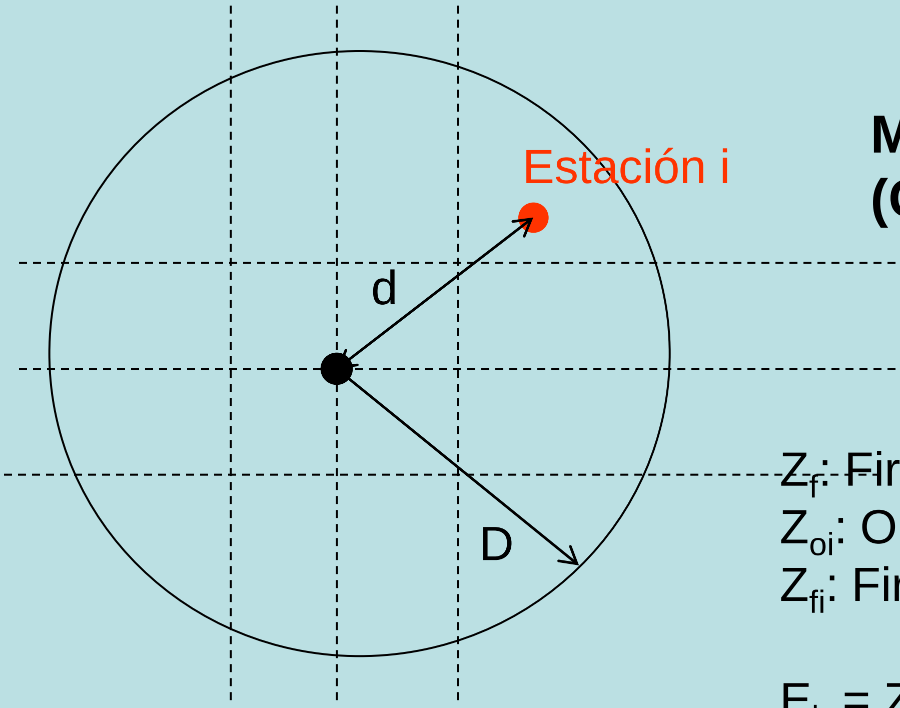
Surface fitting is an attractive method for small numbers of observations, especially when the observing network is fixed. No background (first guess) field is required. It is possible to account for observational error. There are several disadvantages:

•No incorporation of information from a background field is possible. Thus, the meteorological knowledge about the situation is ignored.

•One must be wary of underfitting, overfitting, or using the wrong set of functions. If the data are underfit (not enough functions in the polynomial expansion), important details resolved by the data may be lost in the analysis. If the data are overfit (too many functions), variability in the analysis may have no meteorological significance. Gradients between observing sites may be completely unrealistic.

•In data sparse areas or outside the domain of observations, surface fitting can lead to implausible functional values.

•Surface fitting is computationally expensive when large numbers of observations are considered. In some cases, the problem is ill-conditioned (numerically unstable).



Método de las Correcciones (Cressman)

Z_f: First guess en el punto de grilla
Z_{oi}: Observación en la estación i
Z_{fi}: First Guess interpolado a estación i

$E_h = Z_{fi} - Z_{oi}$

Corrección requerida en el punto de grilla:

$C_h = -W*E_h$, …. $Z_{final} = Z_f + C_h$

Donde $W = (D^2-d^2) / (D^2 + d^2)$ si $d<D$
y $W=0$ si $d>D$

El método se aplica sucesivamente, partiendo con D grande y luego reduciendolo

The advantages of the Cressman scheme:

•The method is simple and computationally fast. (The speed depends upon the number of scans.)

•The method incorporates forecast information in the background field. (The forecast is the source of the first guess.)

The disadvantages are:

•The Cressman scheme is not well-suited for diverse observations because observational error is not accounted for.

•It does not account for the distribution of observations relative to each other.

•The scale (detail) of the result varies with observation density.

•There is no obvious way to analyze the wind field based upon height observations.

•Optimum scan radii have to be determined by trial and error.

Interpolación Optima

(De amplio uso en la actualidad)

Similar al esquema de Cressman, la IO emplea observaciones y First Guess. La grilla inicial es interpolada a las estaciones en forma lineal, y luego se minimizan los errores mediante un ajuste de mínimos cuadrados:

$$\phi = \phi_{fg} + A*[O^i - FG^i]$$

La matriz A de determina en forma estadística (sustituye a W en el caso de Cressman)

The advantages of optimal interpolation include several shared by other techniques. For example:

•differentiation among observing systems and incorporation of error information specific to each

•ability to estimate one variable from observation of another

•use of the analysis method for quality control of the observations

The disadvantages of this method are:

•more expensive computationally than other commonly used methods

•Scale-dependent correlation models require a long history of numerical forecasts for accurate determination of empirical coefficients.

•not designed for best performance during extreme events.

Recently Developed Analysis Techniques

This section discusses three recent trends in four dimensional data assimilation:

1. Adaptive filtering (Kalman Filter) - The Kalman filter is a generalization of optimum interpolation. In optimum interpolation, the statistics of forecast error are fixed; in the Kalman filter, the error statistics evolve with time.

2. Bayesian approach to data assimilation - finding the most probable atmospheric state by maximizing the probability density function

3. Nudging - A prediction model is "pushed" gently either toward observations or an analysis of observations by including an extra term in the dynamical equations.

Nudging

(De amplio uso para inicialización de modelos de mesoescala)

$$Da/Dt = F(a,t) + G(t)*\Sigma w_i*(a_i-a)$$

Donde *a* es una variable pronósticada, F(a,t) es el forzamiento del modelo, G(t) es un coeficiente de nudging, w_i es un factor de peso, a_i es un valor observado y *a* es el valor interpolado del modelo.

The nudging term is time dependent; it forces the model every time step-more when the observations are current and less at earlier and later times. The advantages of nudging are:

•Approximate balance is maintained in the model.
•Physical processes are easily accommodated in the model.
•Asynoptic data are incorporated at the appropriate times.

The main disadvantage of nudging is that it lacks a solid theoretical foundation