

Quantifying the value of SOO routes

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Quantifying Observing Network Value

Although observing systems are a big investment...
...they are not always well thought out beforehand.

Can we assess the value of potential observing network designs prior to deployment?

Can we quantify the value of observations a posteriori?

Observing System Design and Assessment

obviously depends upon what exactly we want to study
(formulate an observation value metric)

it is commonly addressed with data assimilating models

observation value may be determined by withholding from the
DAS

for planning of future networks can use synthetic observations

variational DA techniques can characterise sensitivity directly

Without a DAS

Alternative approach: try to estimate system sensitivities directly from (pseudo-) observations

Proyecto FOCA

SOO scheme on the west coast of South America

to date funded through various small grants, each with a clear science objective

we now have a number of new sensors to deploy and a number of candidate routes

carbon fluxes: to the north or increased frequency to the south?

DO: how much do we need in the fjords?

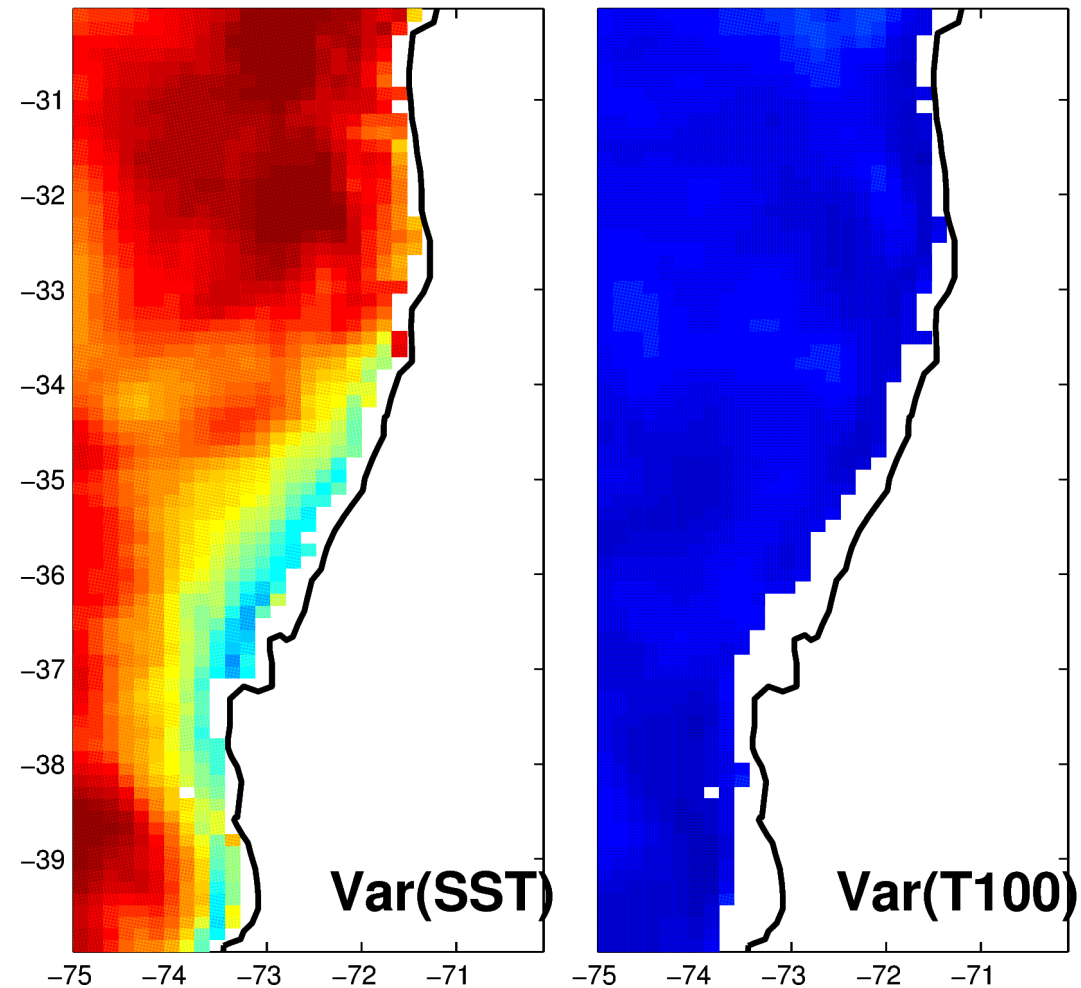
velocity profiles: north, west or more to south?

Consider the problem of selecting a future XBT line to improve SST forecasting in central Chile

SST Forecasting Network - Variance

our “observations”
come from the
HYCOM reanalysis

one approach would
simply be to
concentrate
observational effort in
the region with most
variance



SST Forecasting Network - LIM

but variance does not indicate sensitivity of the system

estimate SST dynamics as a *Linear Inverse Model*, ie

$$d\mathbf{T}/dt = \mathbf{A} \mathbf{T} + \text{noise}$$

where the vector \mathbf{T} contains ocean temp at the surface and 100 m depth

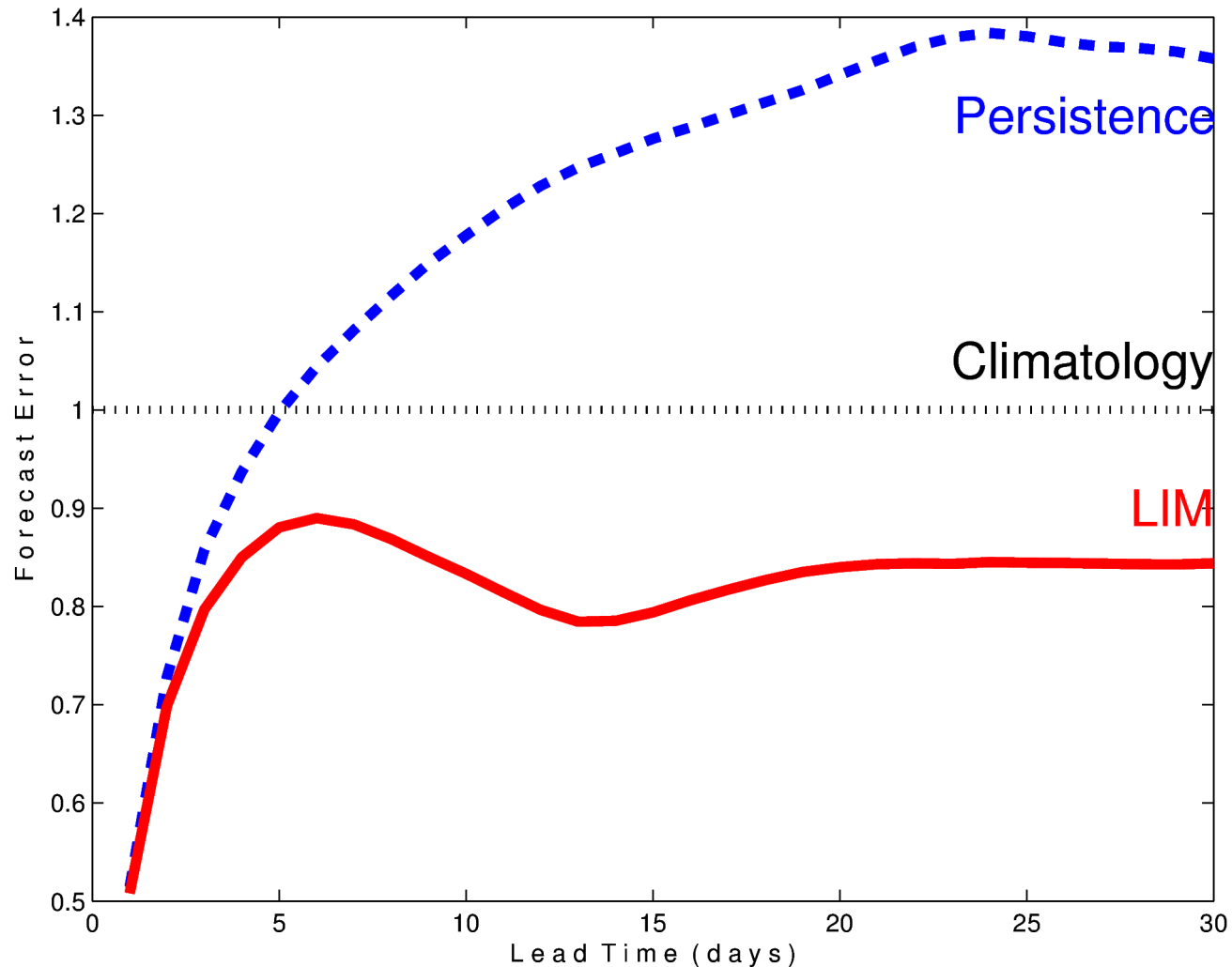
to solve for \mathbf{A} we project \mathbf{T} onto the first n EOFs

the LIM is low order but contains much of the variability

SST Forecasting Network - LIM

the linear model **A** preserves the covariance properties of the obs, and can often make decent forecasts

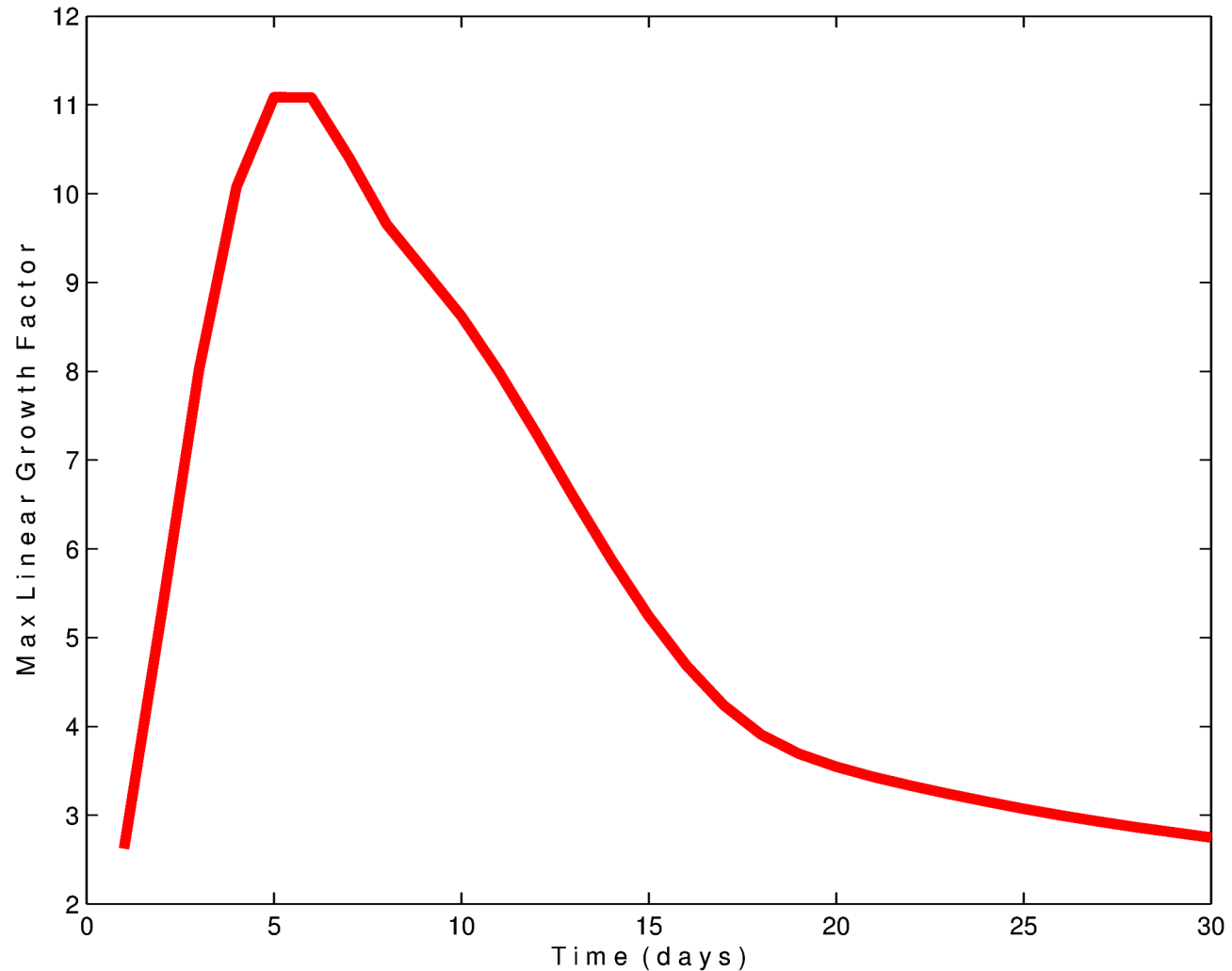
in this case it has (some) forecast skill out to 1 month



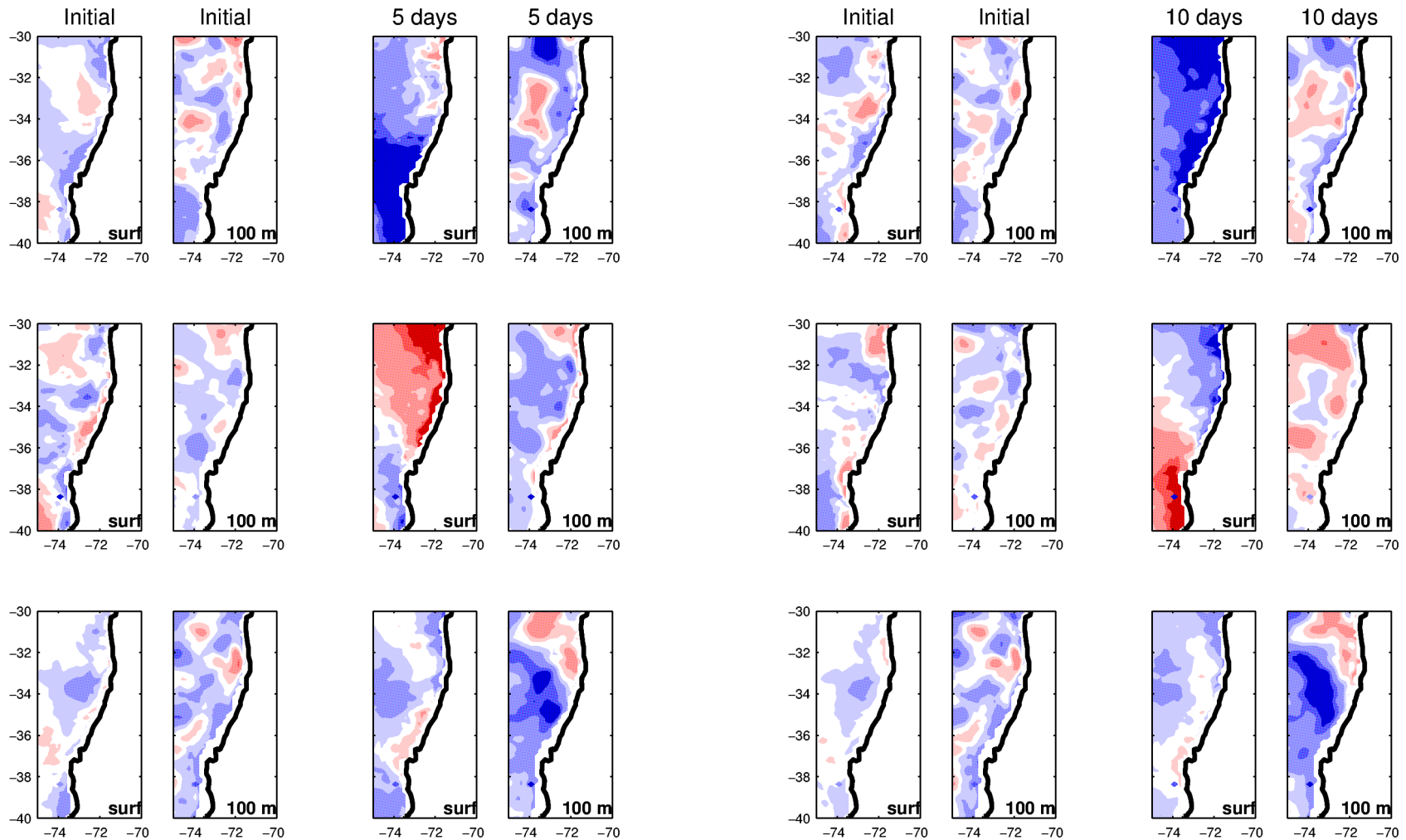
SST Forecasting Network - Sensitivity

armed with the LIM, it is straightforward to calculate the structures that control predictability

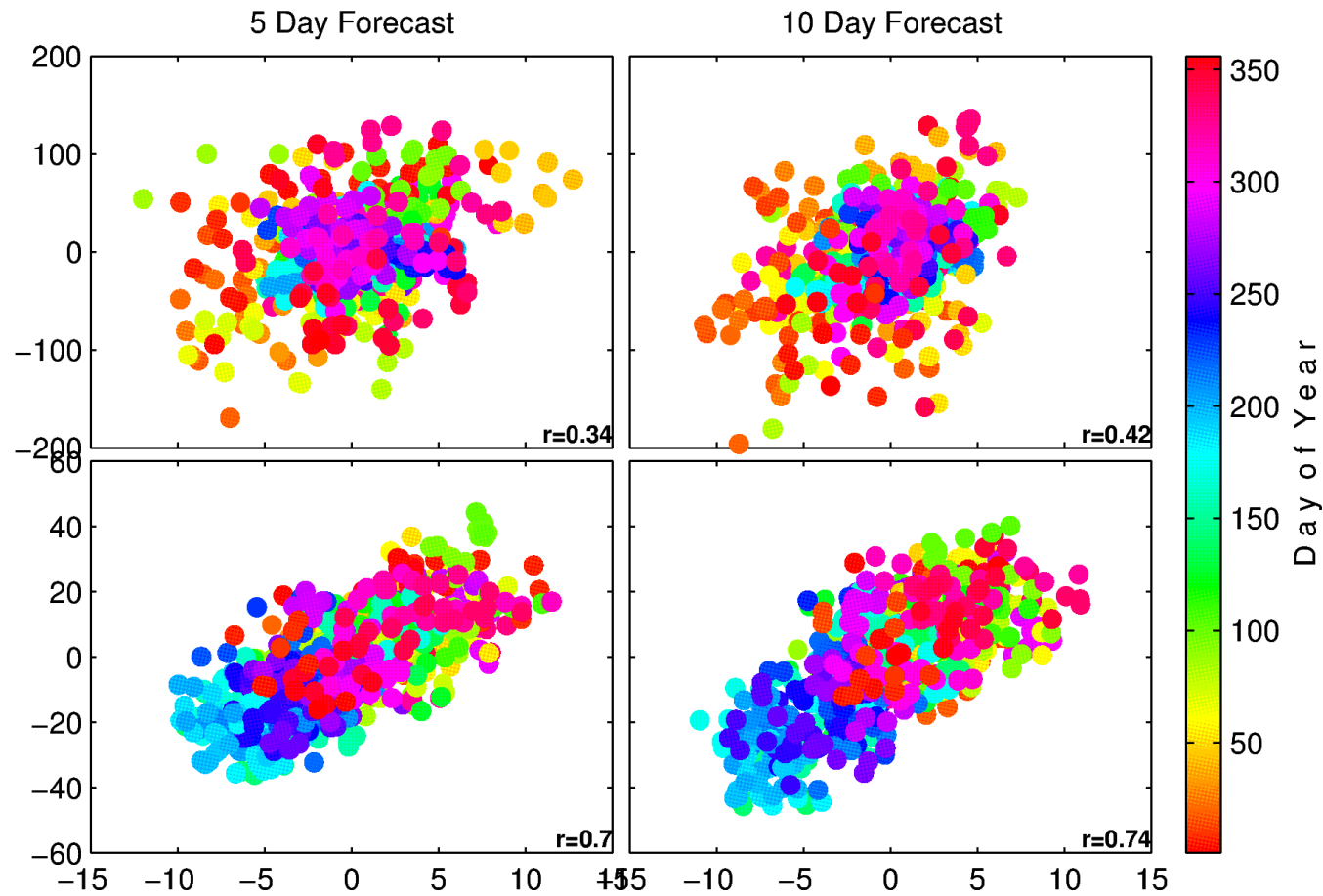
a SVD of the propagator $\exp(\mathbf{A}t)$ gives us the fastest growing perturbation at time t



SST Forecasting Network – Optimal Perturbations



SST Forecasting Network – Skill of Optimals

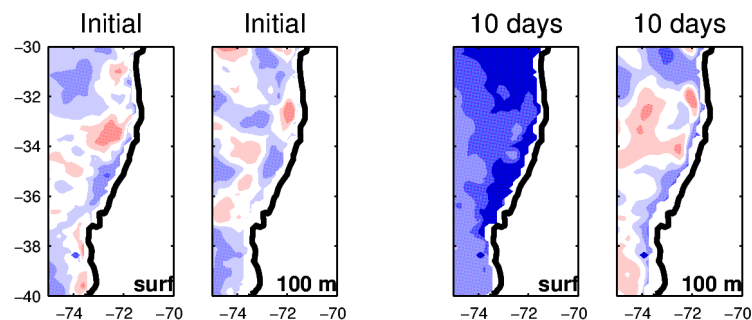


SST Forecasting Network – so, where then?

the optimal perturbations can be good predictors of future changes in the ocean temp field

especially for subsurface, because is less noisy

but what does this mean for the observing network???



Conclusion

the LIM technique shows some promise for a quick and dirty assessment of possible observation sensitivity

subsurface temp improves SST predictability in central Chile

would need to adapt the EOF basis to facilitate assessment of possible XBT lines

using ROMS 4DVAR to address this in a more sophisticated way, will allow a more detailed assessment of observation impact in different metrics