



"Estimating the spatial distribution of daily air temperature by Time Series Analysis of MODIS Land Surface Temperature"

*S. M. Alfieri*¹, *F. De Lorenzi*¹, *A. Bonfante*¹, *A. Basile*¹, *M. Menenti*²

1. Institute for Agricultural and Forest Systems in the Mediterranean, Ercolano, Italy. Silvia.alfieri@isafom-cnr.it

2. University of Technology, Department of Geoscience and Remote Sensing, Delft, The Netherlands

OBJECTIVES

Increase spatial resolution of available air temperature (Ta) data using Land Surface Temperature (LST) time series observed by satellite.



Case study: Telesina Valley, Italy (200 km²)

Research questions:

- Are spatial and temporal patterns in LST stable?
- Can we use time series of LST spatial data to capture and characterize such patterns?
- Can we characterize the coupling of Ta with LST using a limited areal density of meteorological stations?

* Method applied to downscale climate scenario on maximum air temperature at 35 x35 Km



Cloud removal and gap-filling of LST time series



RECONSTRUCTED LST TIME SERIES





Characterization of LST spatio-temporal patterns

Temporal series of pixel-wise ratio \mathbf{r} of LST(x,y) to LST at the reference point show a periodical trend due to seasonality of the allocation of net radiation to sensible and latent heat flux.







Evaluate temporal stability of LST ratios

Harmonic analysis of pixel wise ratio yearly time series has been performed considering three harmonic components (365,180,120 days).



Evaluate temporal stability of LST ratios

The interannual variability of pixel-wise ratio has been evaluated by the calculation of **coefficient of variation (cv)** of the amplitudes.



cv_A1*A1	0.00186
<i>cv_</i> A2*A2	0.001428
cv_A3*A3	0.001408
Mean r	0.991

Interannual variability of amplitude is not negligible but much smaller than mean **r**

We reconstruct r(x,y,t) taking into account the periodic components but we neglect the interannual variability of the amplitude



Air Temperature calculation





Relationship Tair/LST



Validation

SAME PERIOD OF LST OBSERVATIONS



		RMSE 5 days	RMSE 10
	RMSE	moving	days moving
	daily	average	average
Solopaca	3.9	1.7	1.5
Castelvenere	3.6	2.0	1.7
Guardia S.	3.6	2.1	2.0
Telese	3.2	1.9	1.9
Validation: Valle Telesina stations (2000-2005)			

PRE – MODIS



Stazione	anno	RMSE daily
Benevento	1984-1988	2.8 K
Bucciano	1984	2.5 K
Montesarc hio	1984	2.9 К

Conclusions

•A procedure to downscale maximum air temperature using satellite land surface temperature has been developed.

•The spatial pattern of LST has a periodic component with limited interannual variability.

•The procedure has been evaluated against observations of air temperature data for the same period as the MODIS LST observations and for few stations in earlier years.

•The RMSE on estimated daily air temperatures was about 3 K and about 2 K for five days moving averages.

•The procedure should be extended to a longer record of LST observations.