



A validation procedure to assess the precision and accuracy of satellite-derived land surface temperature



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MOTIVATION

Satellite LST products differ in **spatial resolution, viewing geometry, acquisition time and retrieval characteristics**.

Downscaling provides finer spatial detail but may introduce additional uncertainties.

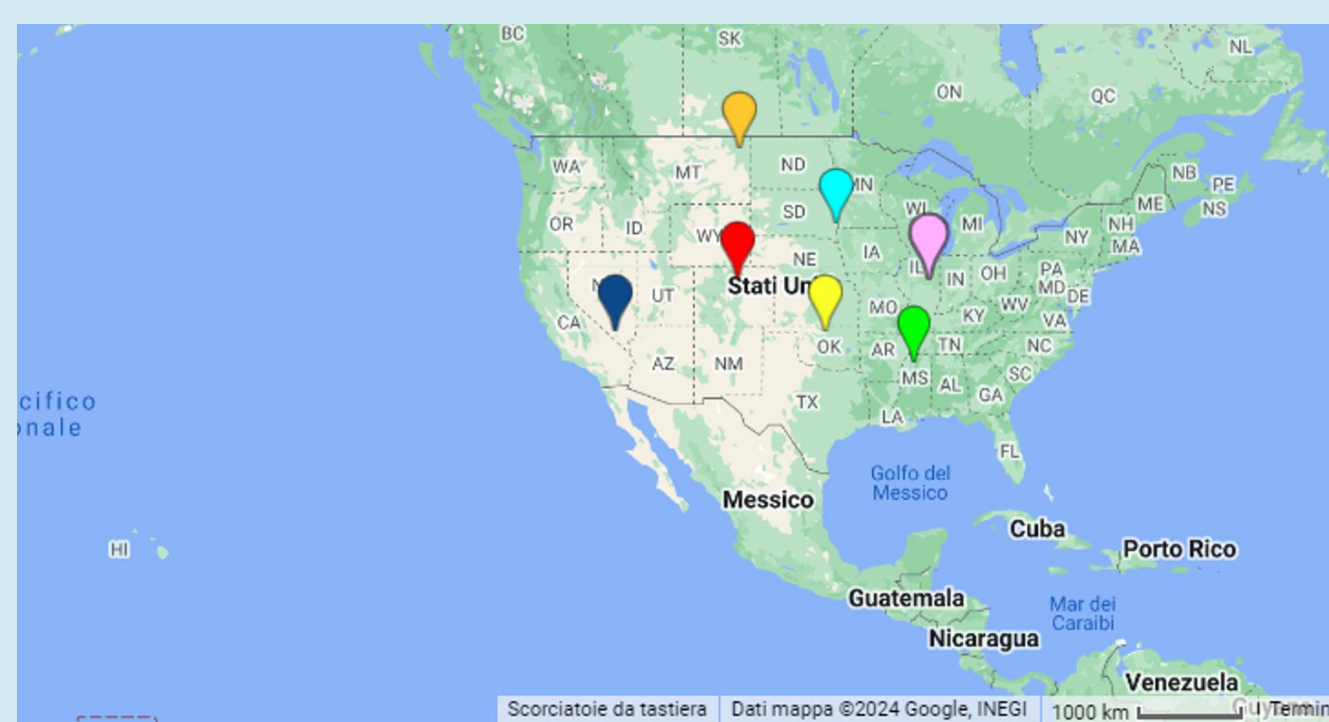
Research gap: How can we verify that higher-resolution LST products preserve the quality and thermal information of the original satellite observations?

OBJECTIVE

To develop and assess a validation framework we ask:

1. How accurate and precise are MODIS and Landsat LST products?
2. Do satellite products remain consistent across sensors, seasons and environmental conditions?
3. Does ML downscaling preserve the information contained in the original LST while providing enhanced spatial detail?

DATA & STUDY AREAS



GROUND REFERENCE:
SURFRAD & ARM stations
USA | 2013 – 2022 | GBOV
MODIS Terra-Aqua
Landsat 8-9



URBAN VALIDATION:
Italy | 2023 – 2025
Milan – Florence – Naples
MODIS Terra-Aqua Nighttime LST
Landsat 8-9 Daytime LST
Regional weather stations
Original & Downscaled products

VALIDATION FRAMEWORK

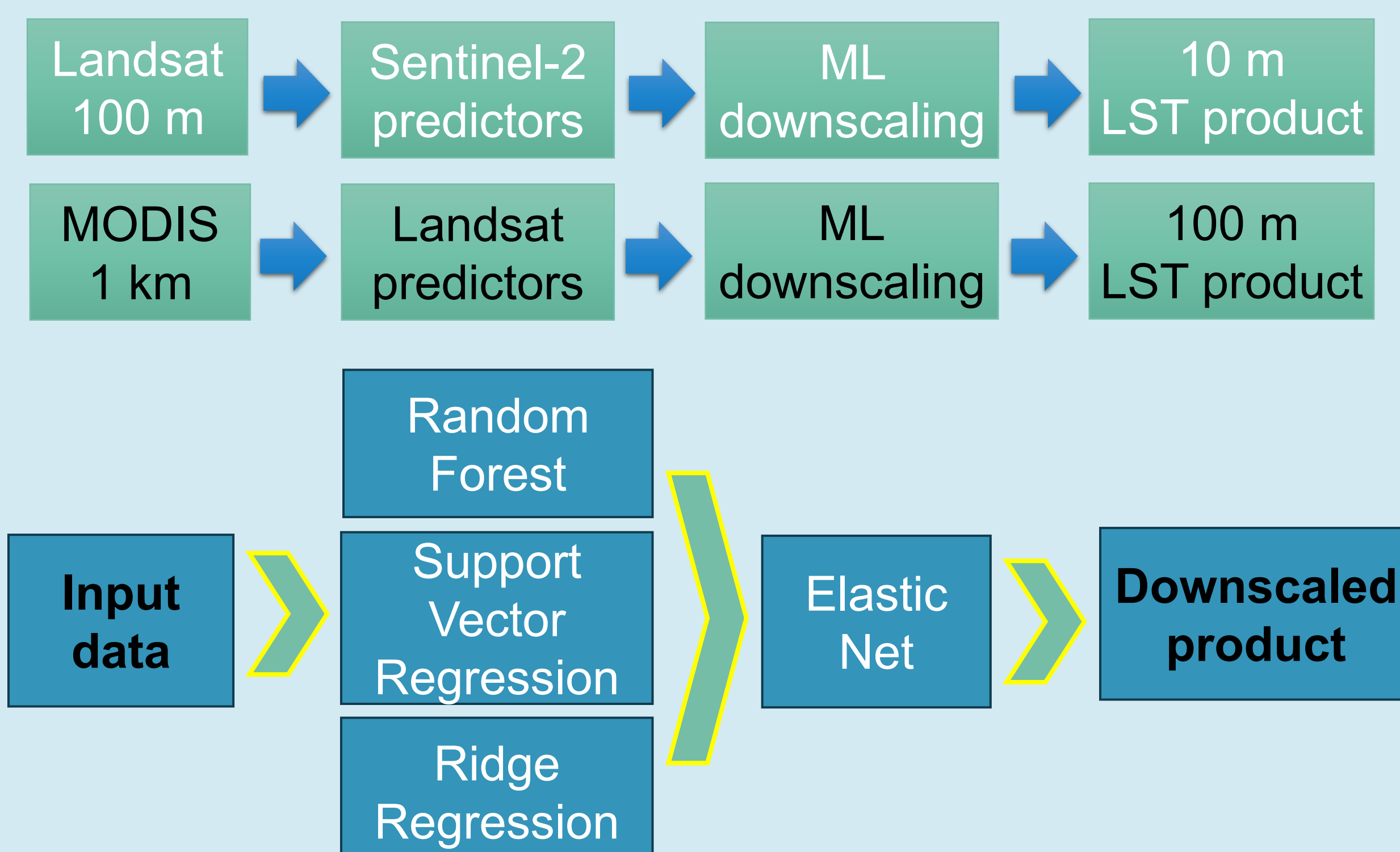
Phase 1 – original satellite-derived LST evaluation



Phase 2 – downscaled satellite-derived LST validation



DOWNSCALING



KEY FINDINGS

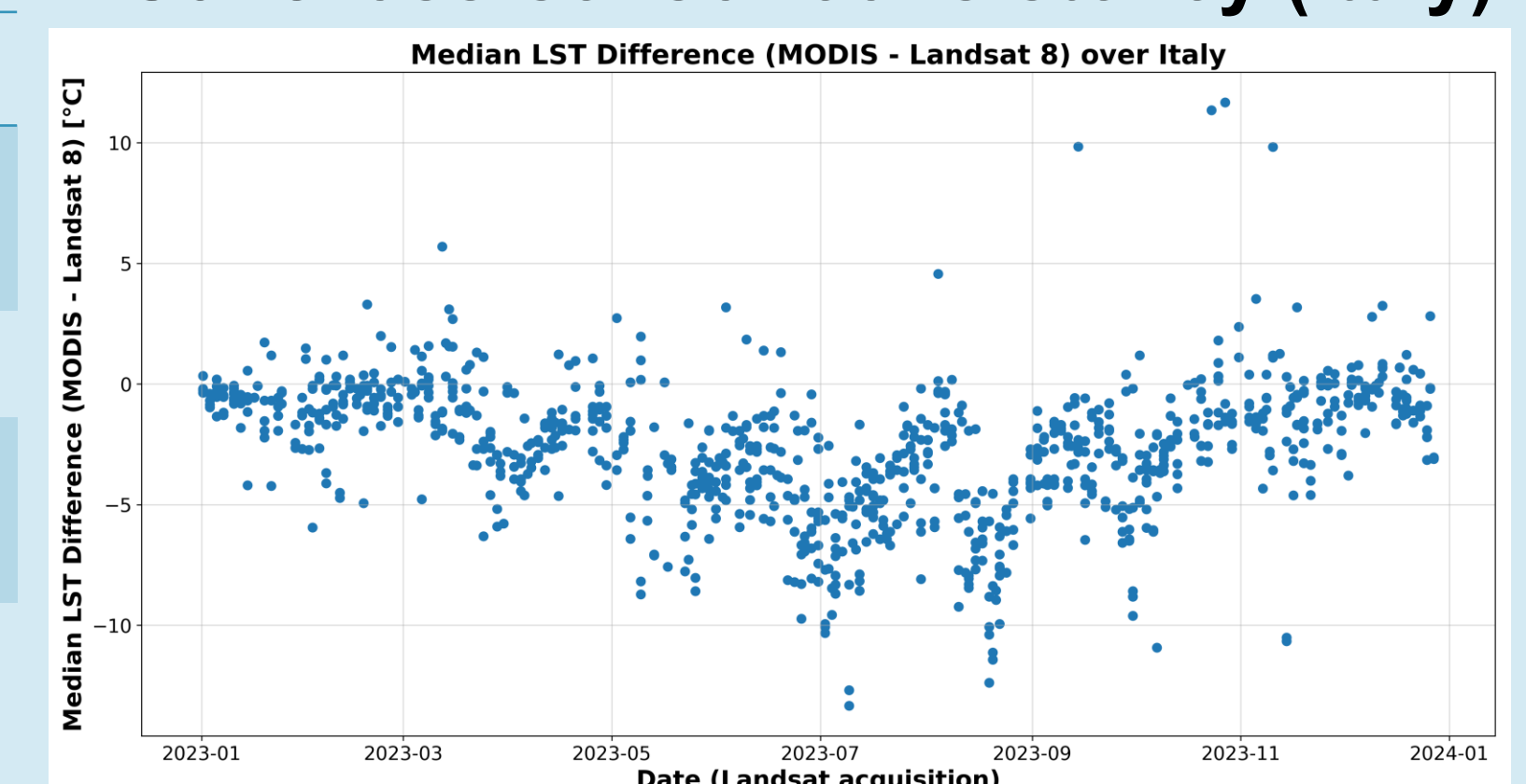
Step	Dataset	Period	Main result
S1	MODIS/Landsat vs GRD	2013-2022	Seasonal & site dependent performance
S2	MODIS vs Landsat	2013-2022	$R^2 = 0.94-0.99$
S3	MODIS vs Landsat	2023	~5 °C warm-season difference
S4	Original vs Downscaled	2023-2025	Generally high agreement
S5	LST vs Air temperature	2023-2025	Strong day/night asymmetry
S6	Milan multi-year	2023-2025	MODIS more temporally stable

RESULTS

S1. Satellite vs In-situ (USA)

Finding	Evidence
Seasonal Dependence	Winter more stable
MODIS Night	Lower NMAD
Land Cover / Climate	Site-dependent bias
Desert / Shrubland	MODIS underestimation
Grassland	Landsat summer overestimation

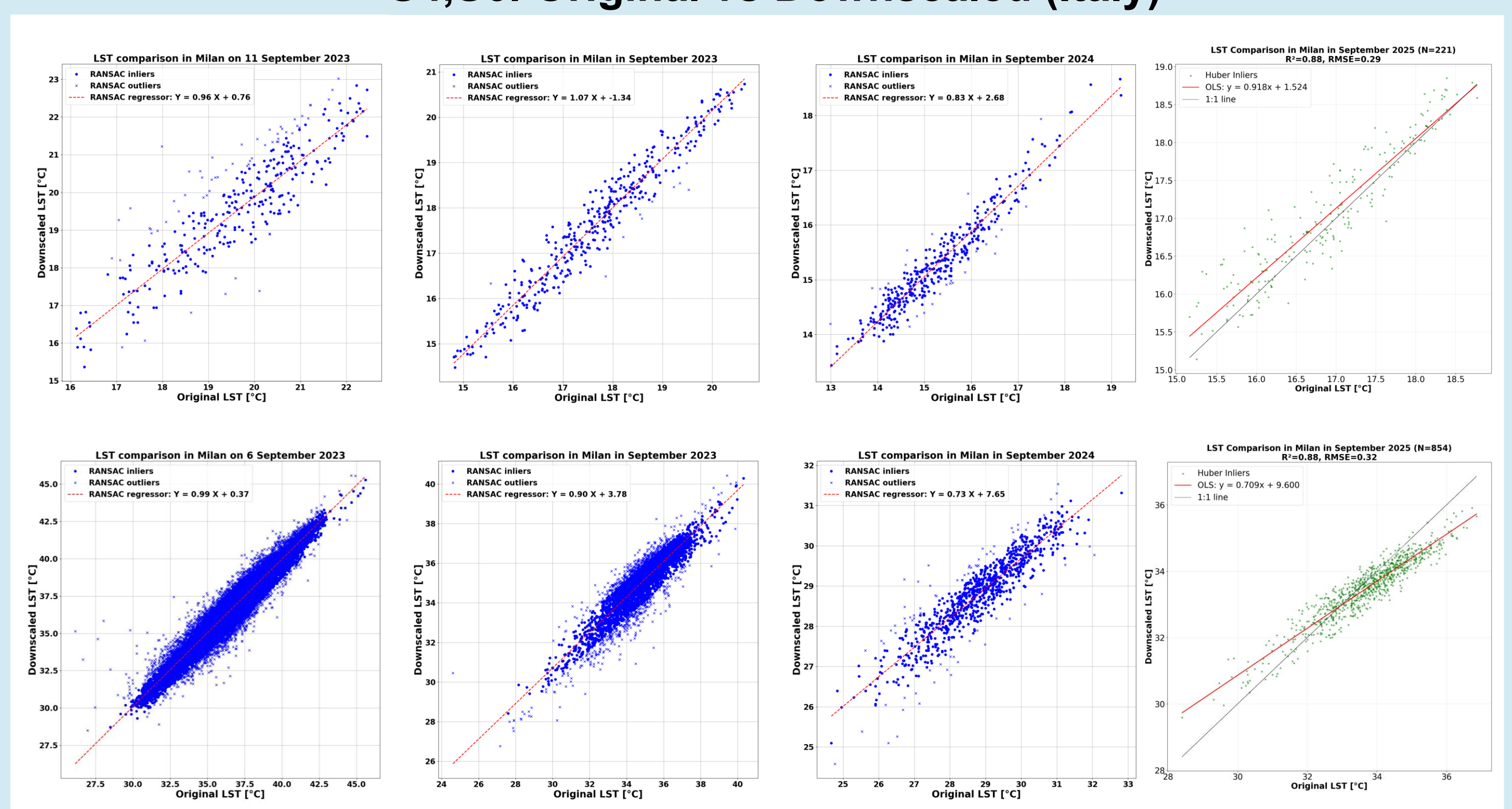
S3. Cross-sensor consistency (Italy)



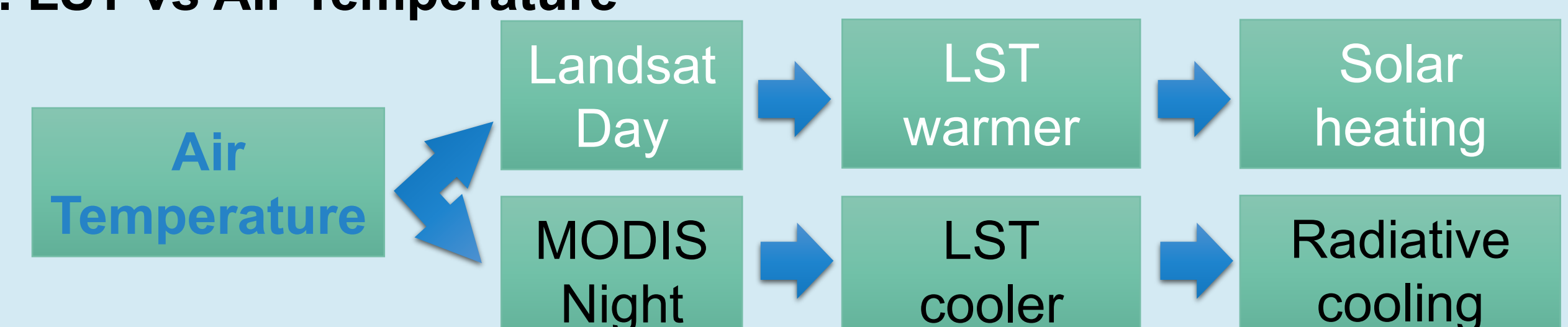
MODIS LST was approximately 5 °C lower than Landsat during warmer months.

S2. Cross-sensor (USA): $R^2 = 0.94-0.99$, Slope ≈ 1 , Intercept ≈ 0

S4,S6. Original vs Downscaled (Italy)



S5. LST vs Air Temperature



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