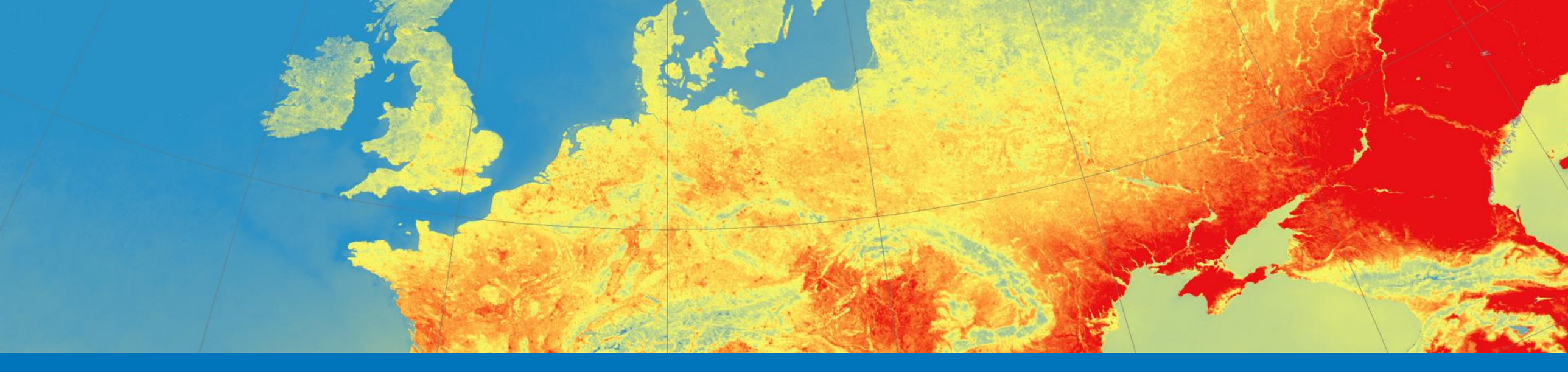

German Remote Sensing Data Center

Long-term dynamics of Land Surface Temperature (LST) over Europe

Philipp Reiners, Stefanie Holzwarth, Sarah Asam and Claudia Kuenzer

MOTIVATION

LST is recognized as one of the Essential Climate Variables by the World Meteorological Organization. It is a key parameter for climate models and a direct indicator of global warming. The Advanced Very High-Resolution Radiometer (**AVHRR**) is the only sensor that has been providing spatially and temporally continuous daily measurements for 40 years. In the TIMELINE project, consistent LST products were developed from AVHRR over Europe [1,2]. However, the different overpass times and the **orbital drift effect** hide actual trends and anomalies in LST. In this study TIMELINE LST from NOAA 9, 11, 14, 16, 17, 18 and 19 for the years 1984-2017 over four regions in Western and Central Europe was analyzed. A physical **daily temperature cycle (DTC) model** was applied to normalize the LST to a consistent observation time and then monthly anomalies and a linear trend was calculated.

[1] Dech S, Holzwarth S, Asam S, Andresen T, Bachmann M, Boettcher M, u. a. Potential and Challenges of Harmonizing 40 Years of AVHRR Data: The TIMELINE Experience. Remote Sensing. 10. September 2021;13(18):3618.

[2] Reiners P, Asam S, Frey C, Holzwarth S, Bachmann M, Sobrino J, u. a. Validation of AVHRR Land Surface Temperature with MODIS and In Situ LST—A TIMELINE Thematic Processor. Remote Sensing. 1. September 2021;13(17):3473.

APPRPOACH

DTC Parameter Derivation

DTC parameters were derived from a diurnal and annual LST cycle model in 1-km resolution based on geostationary SEVIRI measurements [3].

The cycle parameters were derived at 4 sites of the BEnchmark Land Multisite ANalysis and Intercomparison of Products
(BELMANIP) network located in Spain, Germany, Ireland and France.

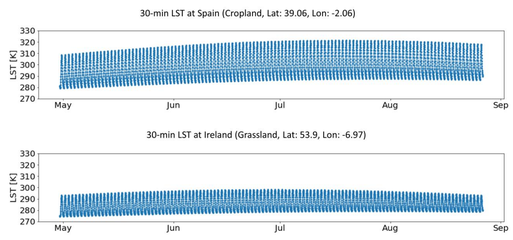

Figure 1: Four months of continuous LST in 30 minute resolution at two sites derived from the diurnal and annual LST model by []

DTC Model Validation

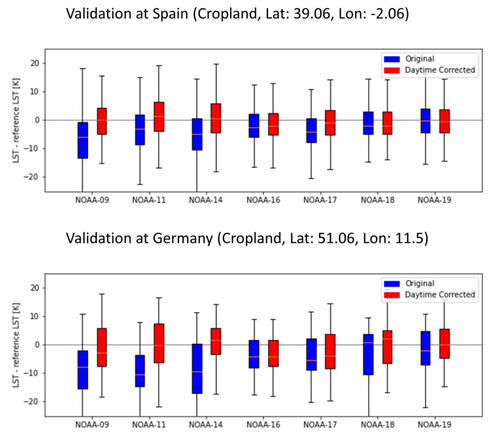

Figure 2: Comparison between orignal and DTC modelled TIMELINE LST with SEVIRI measurements at 13.30h solar time at two sites

TIMELINE daily LST was modelled to 13:30h solar time with the DTC parameters and a daytime normalization model based on [4].

The original and modelled TIMELINE LST was then compared to SEVIRI measurements at 13:30h solar time for the respective site provided by [5].

LST Time Series Analysis

The DTC model was applied to the monthly maximum TIMELINE LST for all pixel within a radius of 1° around the respective site matching following conditions:

- Same landcover as the site
- No landcover change between 1992 and 2018

The time series was analyzed by calculating monthly anomalies based on the whole reference period (1984-2017). A linear trend was derived to observe the LST warming for the areas around the sites.

[3] Panagiotis Sismanidis, Benjamin Bechtel, Iphigenia Keramitsoglou, Frank Göttsche, Chris T. Kiranoudis, Satellite-derived quantification of the diurnal and annual dynamics of land surface temperature, Remote Sensing of Environment, Volume 265, 2021, 112642, https://doi.org/10.1016/j.rse.2021.112642.

[4] Göttsche, F.M.; Olesen, F.-S. Modeling of diurnal cycles of brightness temperature extracted from METEOSAT data. Remote. 1029
Sens. Environ. 2001, 337–348.

[5] Julien, Y.; Sobrino, J.A. NOAA-AVHRR Orbital Drift Correction: Validating Methods Using MSG-SEVIRI Data as a Benchmark Dataset. Remote Sens. 2021, 13, 925. https://doi.org/10.3390/rs13050925

RESULTS

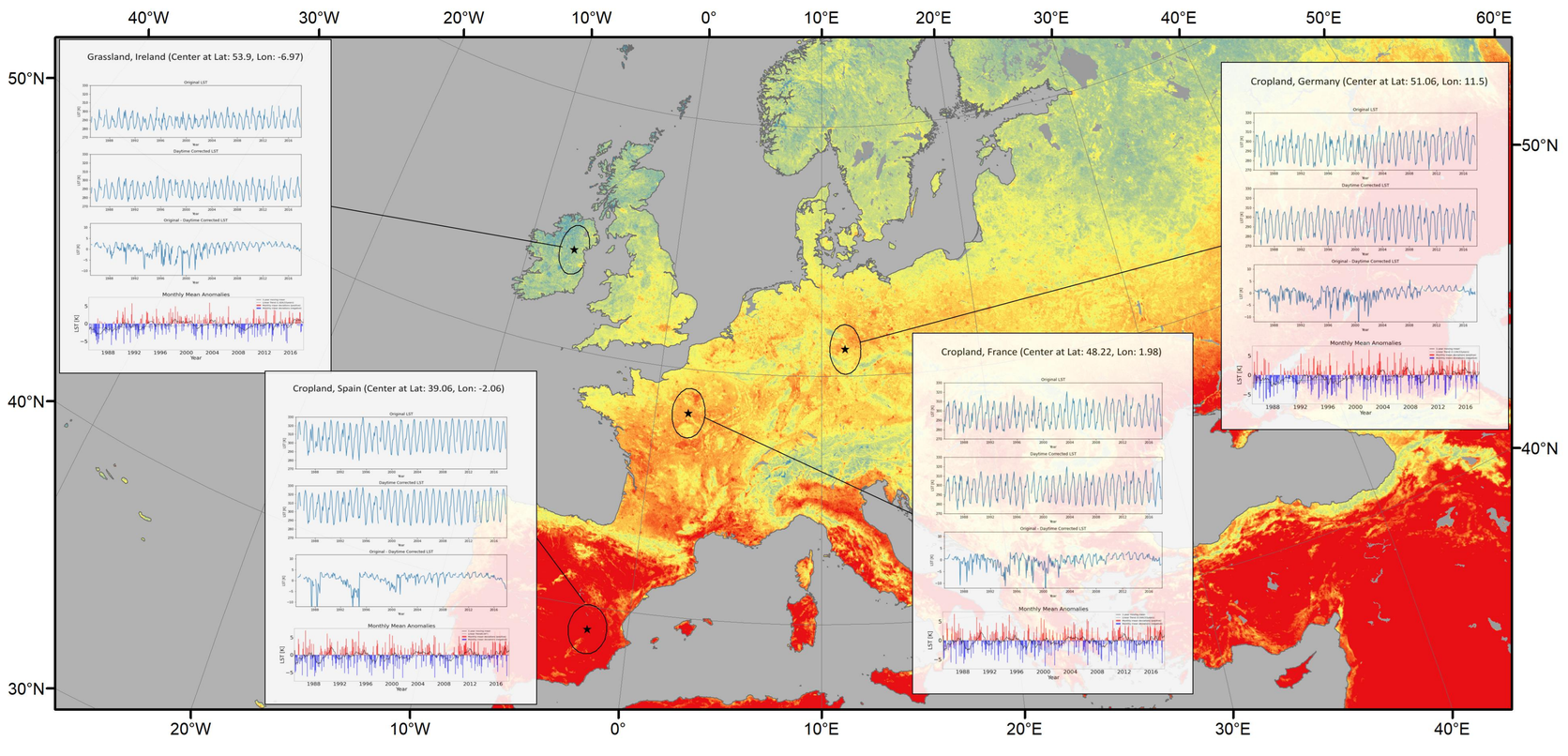

Figure 3 : Original and daytime normalized LST and the difference between both time series within a 1° circle of the BELMANIP sites. The monthly anomalies are based on the daytime time series as described in 6). The background map shows the average TIMELINE LST in July for the period 1984-2017.

TIMELINE

Deutsches Zentrum für Luft- und Raumfahrt