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Land Surface Temperature- Comparing Data from Polar Orbiting and Geostationary Satellites

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Land Surface Temperature (LST) is a vital parameter in Earth climate science, driving long-wave radiation exchanges that control the surface energy budget and carbon fluxes, which are important factors in Numerical Weather Prediction (NWP) and the monitoring of climate change. Satellites offer a convenient way to observe LST consistently and regularly over large areas. A comparison between LST retrieved from a Geostationary Instrument, the Spinning Enhanced Visible and InfraRed Imager (SEVIRI), and a Polar Orbiting Instrument, the Advanced Along Track Scanning Radiometer (AATSR) is presented. Both sensors offer differing benefits. AATSR offers superior precision and spatial resolution with global coverage but given its sun-synchronous platform only observes at two local times, ∼10am and ∼10pm. SEVIRI provides the high-temporal resolution (every 15 minutes) required for observing diurnal variability of surface temperatures but given its geostationary platform has a poorer resolution, 3km at nadir, which declines at higher latitudes.

A number of retrieval methods are applied to the raw satellite data: First order coefficient based algorithms provided on an operational basis by the LandSAF (for SEVIRI) and the University of Leicester (for AATSR); Second order coefficient based algorithms put forward by the University of Valencia; and an optimal estimation method using the 1DVar software provided by the NWP SAF. Optimal estimation is an iterative technique based upon inverse theory, thus is very useful for expanding into data assimilation systems. The retrievals are assessed and compared on both a fine scale using in-situ data from recognised validation sites and on a broad scale using two 100x100 regions such that biases can be better understood.

Overall, the importance of LST lies in monitoring daily temperature extremes, e.g. for estimating permafrost thawing depth or risk of crop damage due to frost, hence the ideal dataset would use a combination of observations. Results show that there is a strong agreement for night-time matchups and understandable biases for the daytime matchups, owing to the differing viewing geometry and relative sun position. This comparison gives promise to the possibility of constructing a combined retrieval mechanism which draws the best characteristics from each instrument with possible courses of action identified.