climate change initiative

→ LAND SURFACE TEMPERATURE

Cloud detection stability for Land Surface Temperature Climate Data Records

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Introduction

Cloud detection is a necessary pre-processing step in the retrieval of land surface temperature (LST) from instruments measuring in the infrared. Given imperfect cloud detection methods, cloud contamination will to some degree affect the retrieved LST. To ensure that changes in the quality of the cloud detection are not mistaken for climate signals in the data, cloud clearing performance must be stable over the length of the climate data record (CDR). This can be particularly challenging where a CDR is comprised of data from a series of satellite sensors or makes use of more than one cloud detection algorithm.

Assessing cloud mask stability

1) We assess cloud masking stability for the single-sensor LST CDR product comprised of retrievals from ATSR-2, AATSR, MODIS Terra and SLSTR-A (Fig. 1).

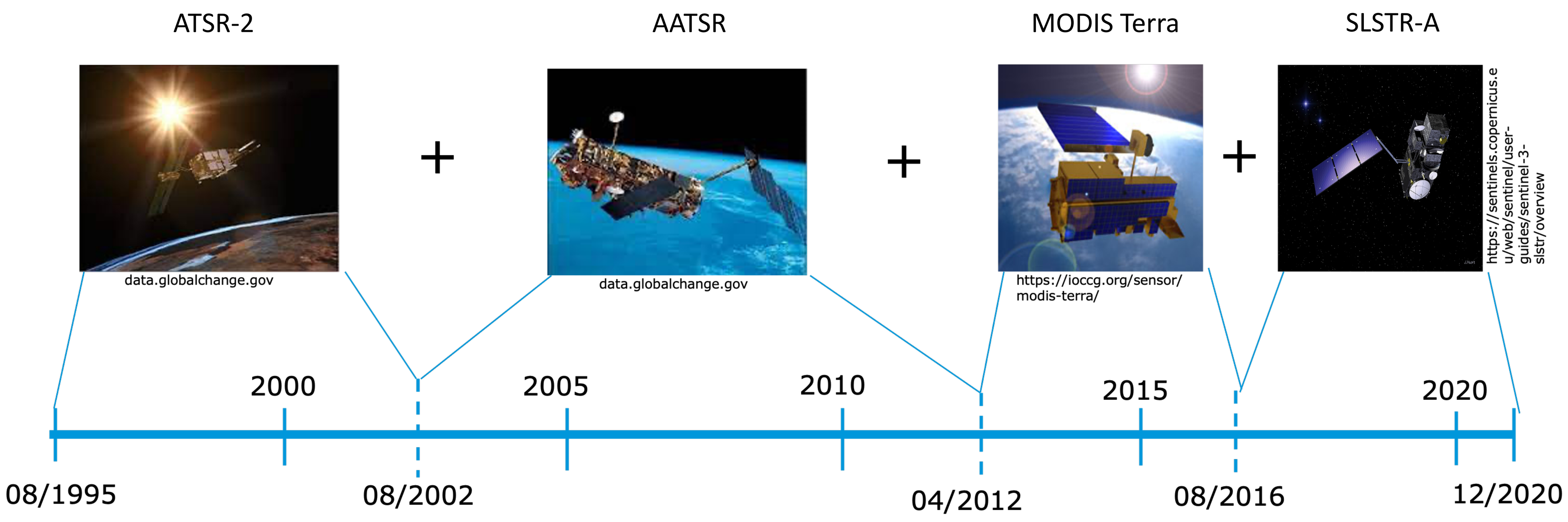

Figure 1: Single-sensor LST CDR instrument series

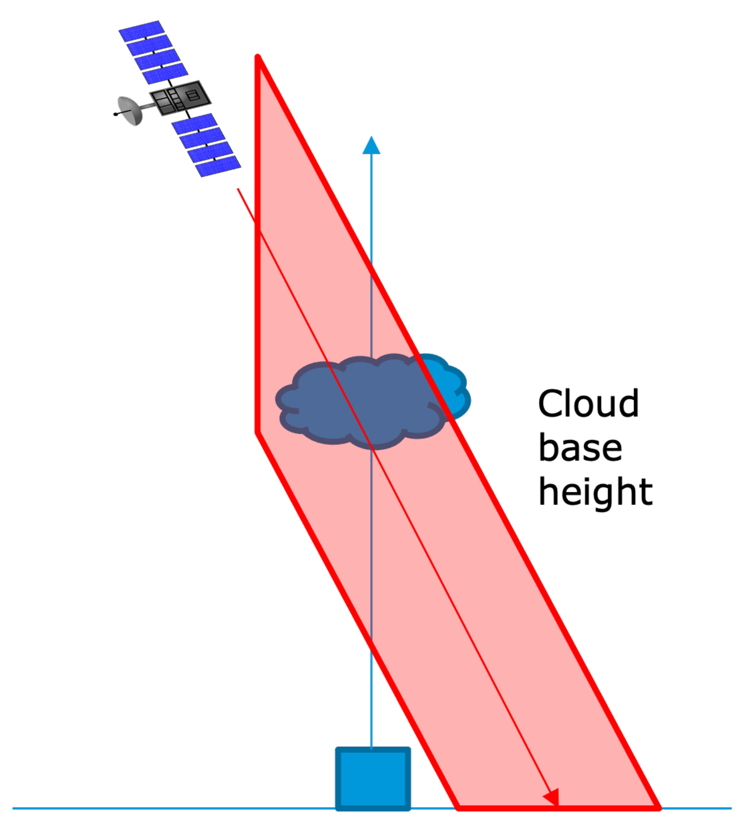

Figure 2: Matching process for satellite and ceilometer data. The satellite pixel location on the ground may be offset from the ceilometer due to the viewing geometry of the satellite and height of the cloud.

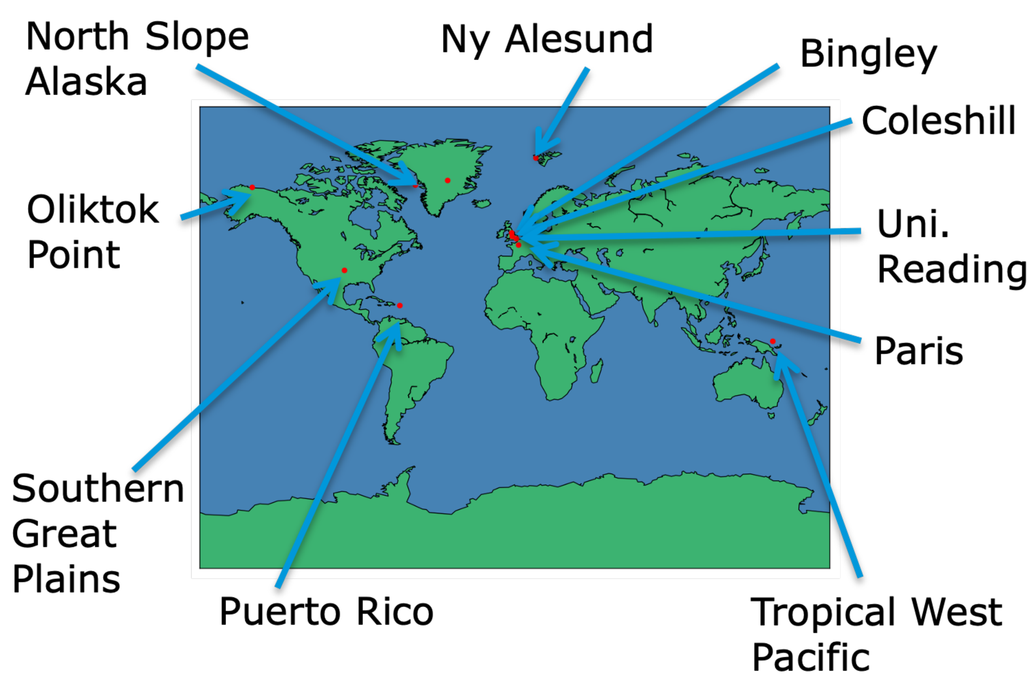

Figure 3: Locations where satellite and ceilometer matches have been made. Matches have a maximum temporal separation of 5 minutes and maximum spatial separation of 1 km.

2) Satellite data are matched to co-incident ceilometer observations of cloud-base height (Fig. 2) for 10 different sites across the globe (Fig. 3).

3) Three different series of cloud masks are assessed:

a) Operational cloud masks (threshold based)
b) Bayesian cloud detection (University of Reading)
c) Probabilistic cloud detection (University of Leicester, used in LST CCI products).

Results

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1) Each of the sequential sensor pairs in the satellite series have a period of overlapping data, within which we assess the difference in hit rate (percentage of clouds correctly identified) between the operational cloud detection algorithms (Fig. 4, blue) and the Bayesian cloud detection algorithm applied to all sensors (pink). Using a consistent cloud mask improves cloud detection stability.

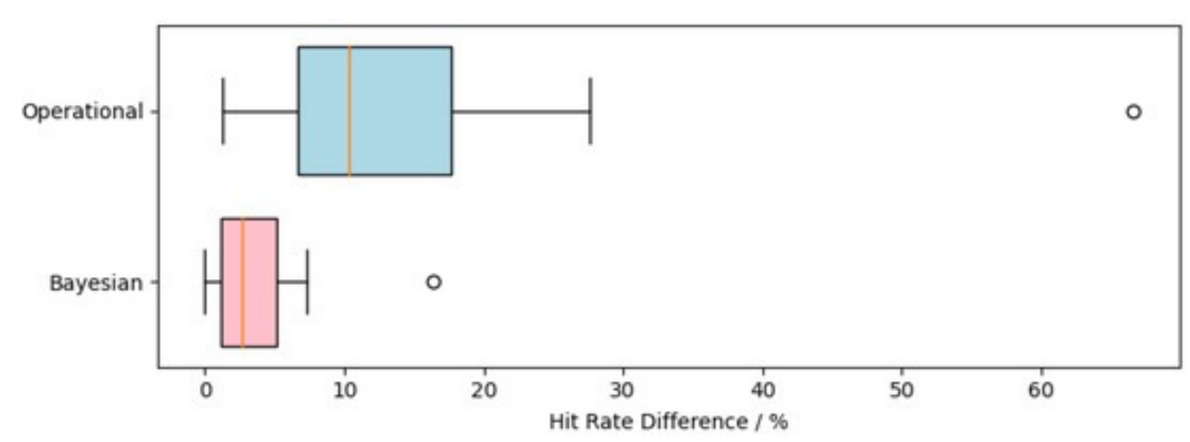

Figure 4: : Percentage difference in cloud mask hit-rate in overlaps between sensors for the operational and Bayesian cloud masks.

2) An early assessment of cloud masking stability between sensors across the entire data record shows location-specific differences with some within-sensor performance changes and performance jumps between sensors (Fig. 5).

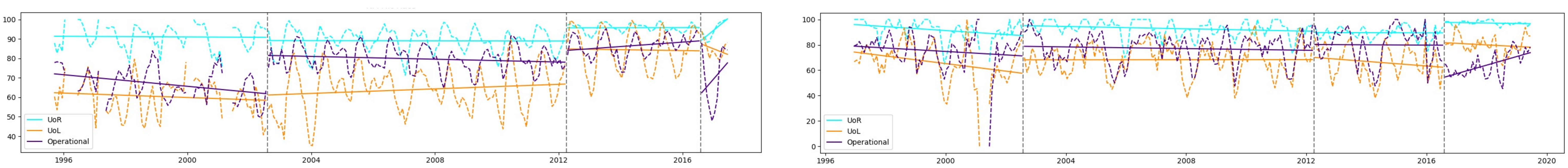

Figure 5: Cloud detection hit rate over time at Ny Alesund (left) and Southern Great Plains (right). Plots show the operational algorithms (purple), Bayesian (blue) and probabilistic (orange).

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