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The diurnal cycle of cloud profiles over land and ocean between 51° S and 51° N, seen by the CATS spaceborne lidar from the International Space Station

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S1 - CATS sampling compared to CALIPSO

Figure S1 shows the number of profiles sampled by CATS divided by the number of profiles sampled by CALIOP in the same 2° latitude band, when aggregated over two successive JJA seasons (2015-2016). The red line considers all CATS profiles, while the green line only considers CATS profiles sampled roughly around the local time sampled by CALIOP -- i.e. the green line shows CATS measurements made at the same local time as CALIOP. These results are based on CALIOP's v4.10 level 2, 5-km cloud layer product and CATS's v2.05 level 2, 5-km cloud layer product.

The orbital differences between the CALIPSO satellite and the ISS mean that CATS samples generally less profiles than CALIOP, with a 0.4 minimum ratio near 20°N during the JJA period. At that latitude, CALIOP samples more than double the number of profiles sampled by CATS, when considering all local times. When considering only profiles sampled by CATS at the same local time as CALIOP, the ratio drops to 0.1, meaning CALIOP's sampling is ten times better the one from CATS. This ratio means that CATS data need to be aggregated over long periods for any comparison between both instruments to be meaningful.

When considering high latitudes (50° and above), CATS sampling improves significantly, up to the point where it gets better than CALIOP's: the CATS to CALIOP sampling ratio reaches 1.4 for latitudes above 50°S.

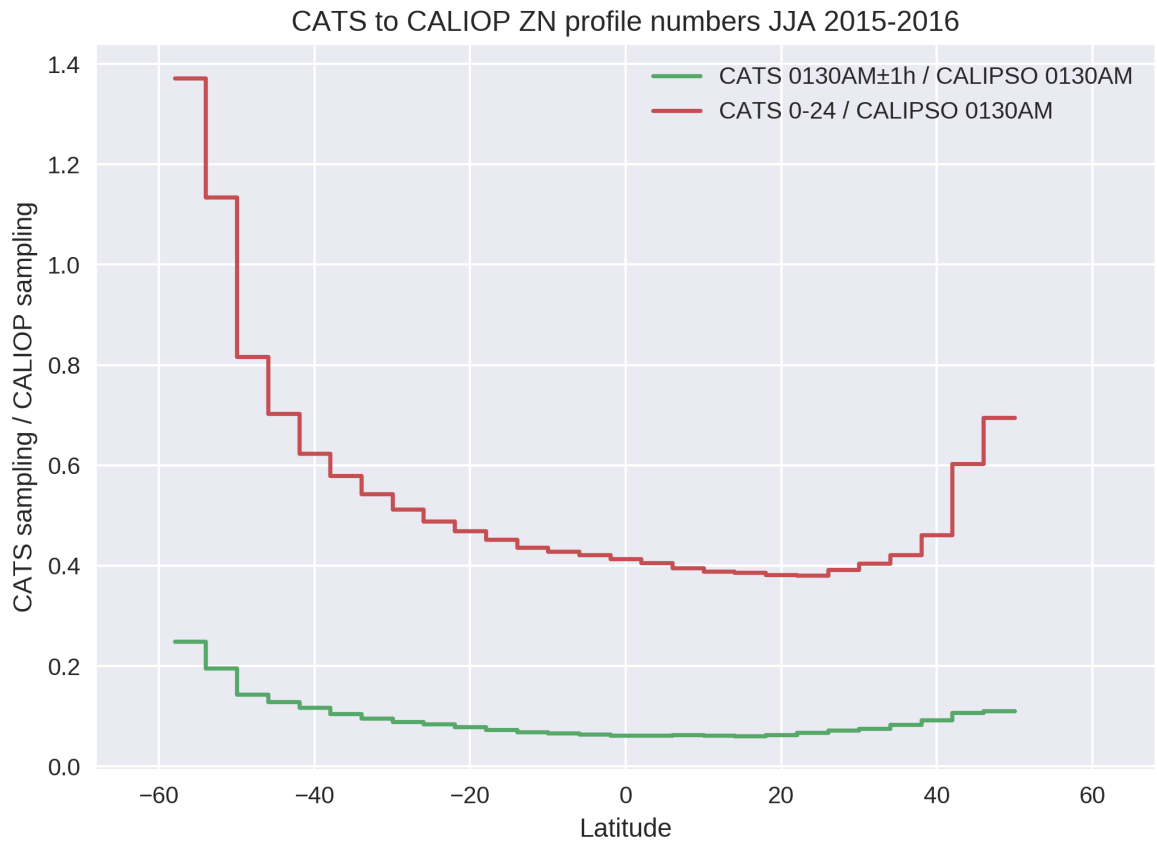

Fig. S1: ratio of the number of profiles seen by CATS and CALIOP in 2° latitude bands over the JJA periods of 2015 and 2016.

S2 - Continuity of CATS cloud detections according to solar pollution

Fig. S2 shows Cloud Fraction profiles observed by CATS over land (left) and ocean (right) between 5 and 8 AM local time in nighttime (orange) and daytime (blue) conditions. Here we show that cloud detections made using data acquired by CATS either in daytime (sunlit) conditions (blue) or nighttime conditions (orange) leads to similar cloud fraction profiles. This suggests that CATS cloud detections are consistent in both conditions and that the instrument can provide a continuously stable record of cloud detections throughout the day.

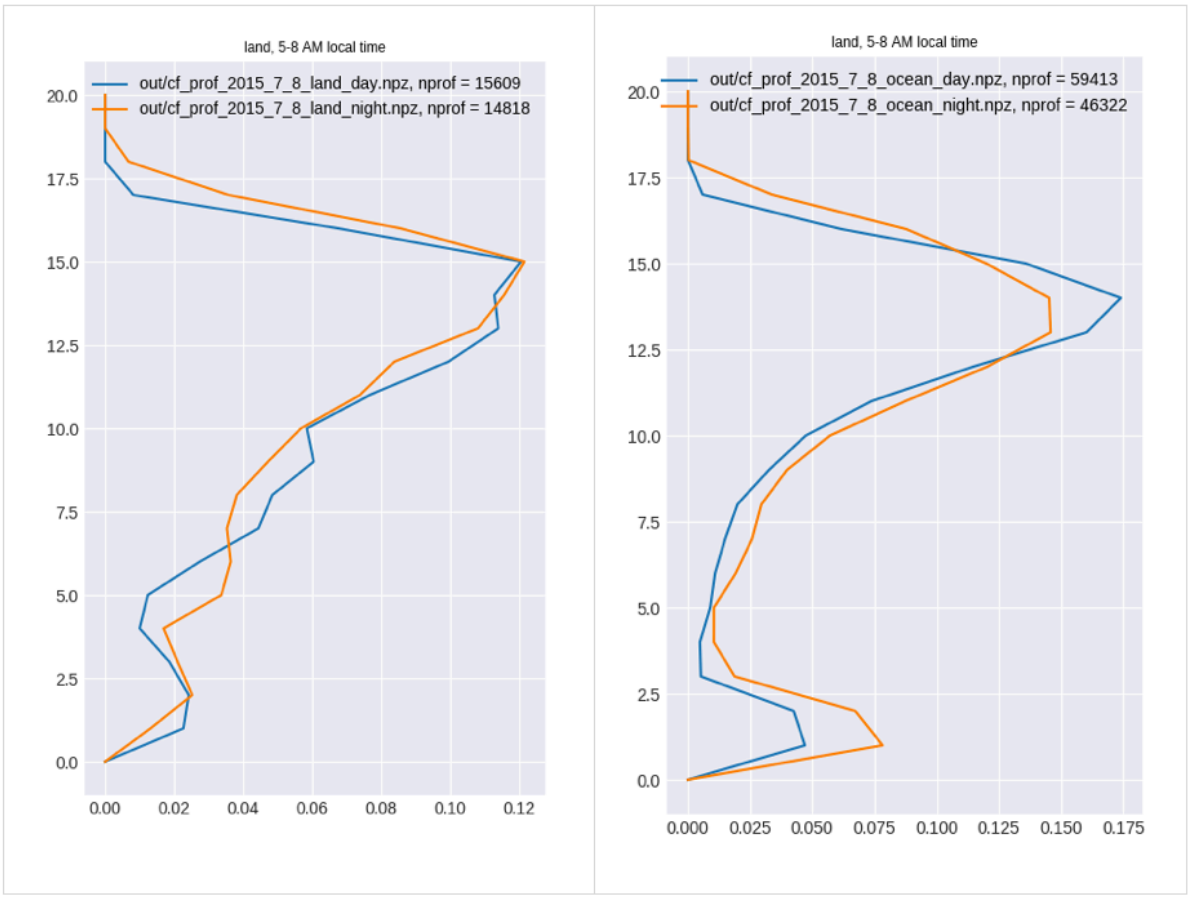

Fig. S2. Profiles of Cloud Fraction observed by CATS over land (left) and ocean (right) between 5 and 8AM local time (JJA 2015-2016) in nighttime (orange) and daytime (blue) conditions.

S3 - Sampling bias due to CATS lidar attenuation, by region

Figures S3 to S7 below document how the CATS sampling gets relatively degraded from high to low altitudes due to the attenuation of the laser light as it gets progressively scattered by atmospheric components, for the various regions described in the main article. Sampling is reported relative to its initial value of 100% at high altitudes, where no attenuation has yet occurred.

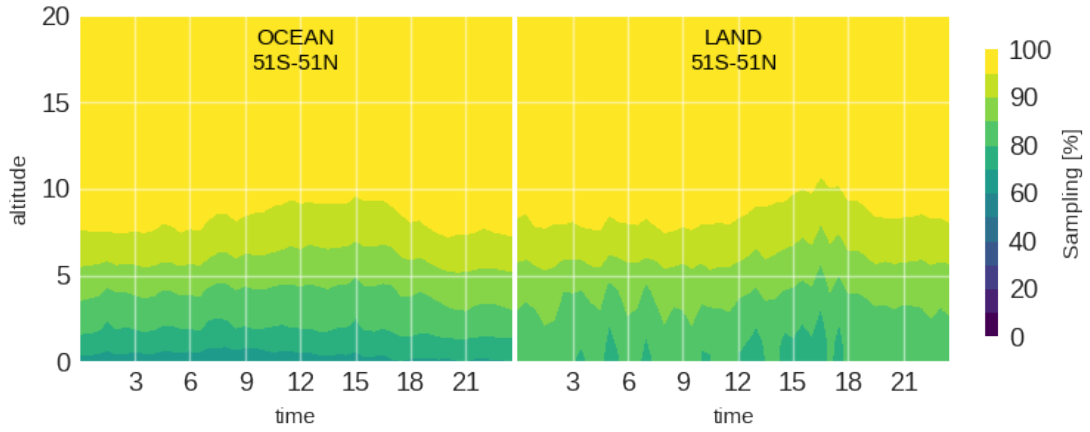

Fig. S3 - Vertical sampling over ocean (left) and land (right) between 51°S and 51°N (same data as in Fig. 1 in the main article)

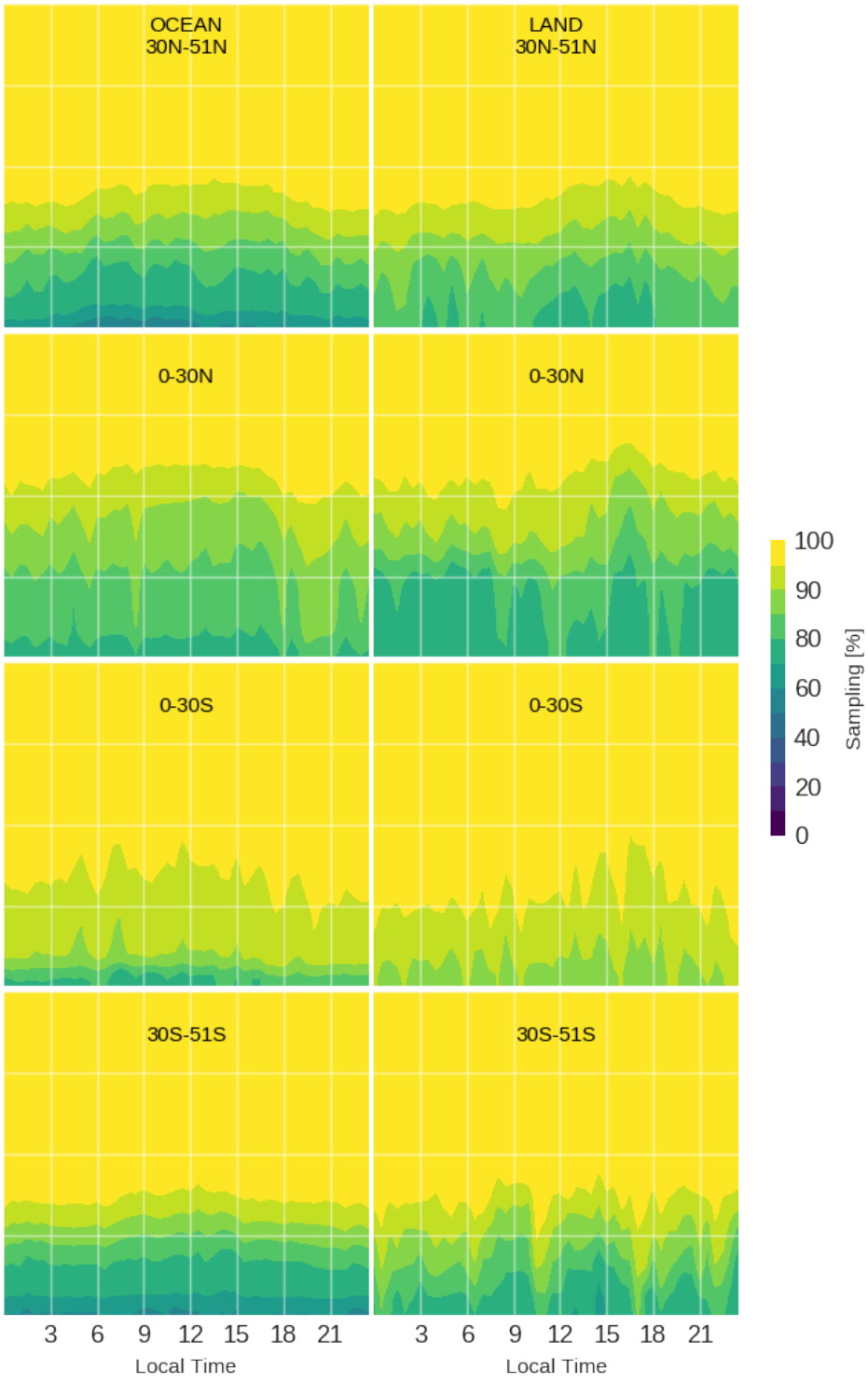

Fig. S4 - Vertical sampling over ocean (left) and land (right) in latitude bands during JJA (same data as in Fig. 2 in the main article)

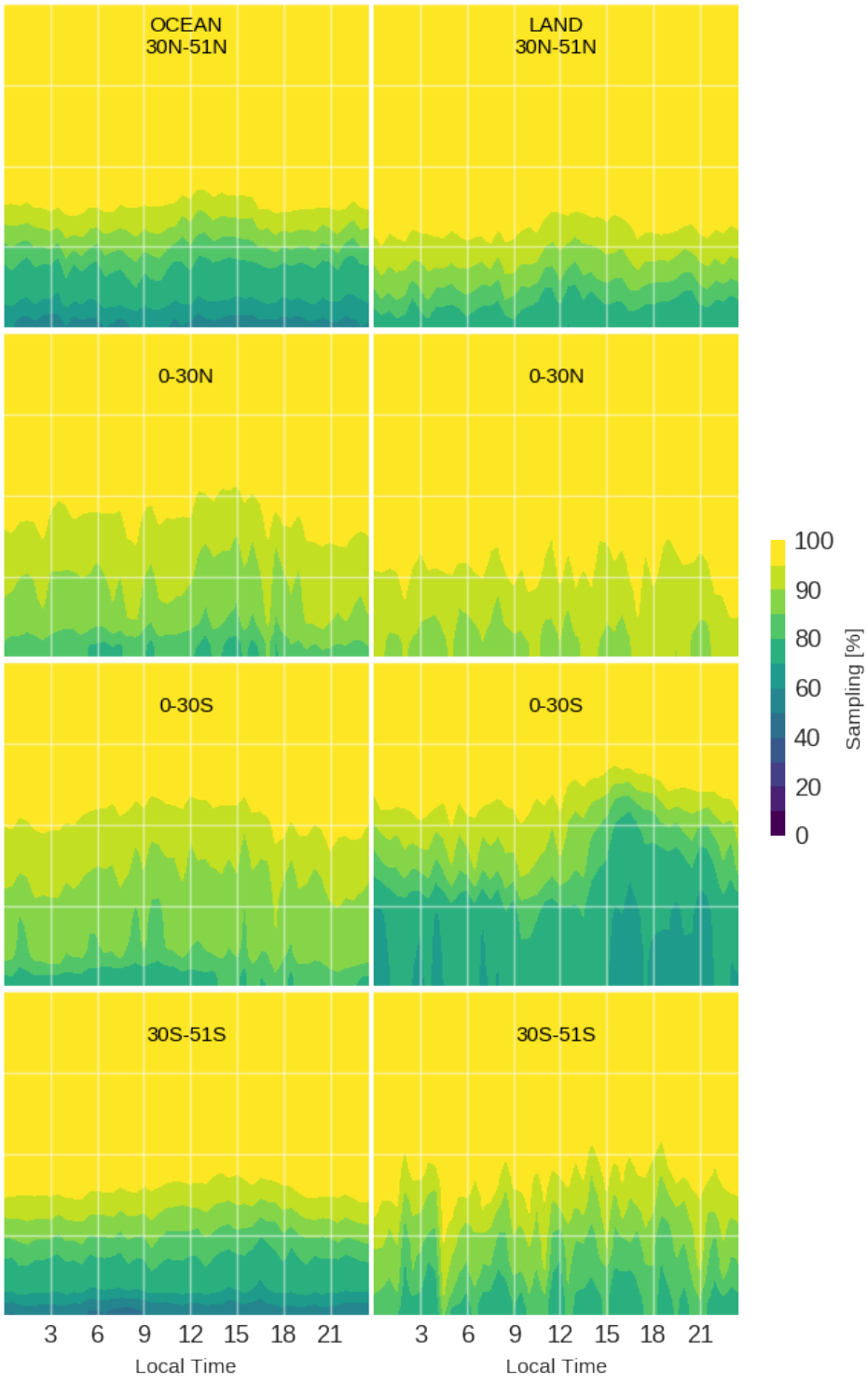

Fig. S5 - Vertical sampling over ocean (left) and land (right) in latitude bands during DJF (same data as in Fig. 3 in the main article)

Fig S6 - Vertical sampling of the CATS lidar over the SIRTA ground-based site (top) and over the ARM SGP site (bottom), same data as in Fig. 4 in the main article

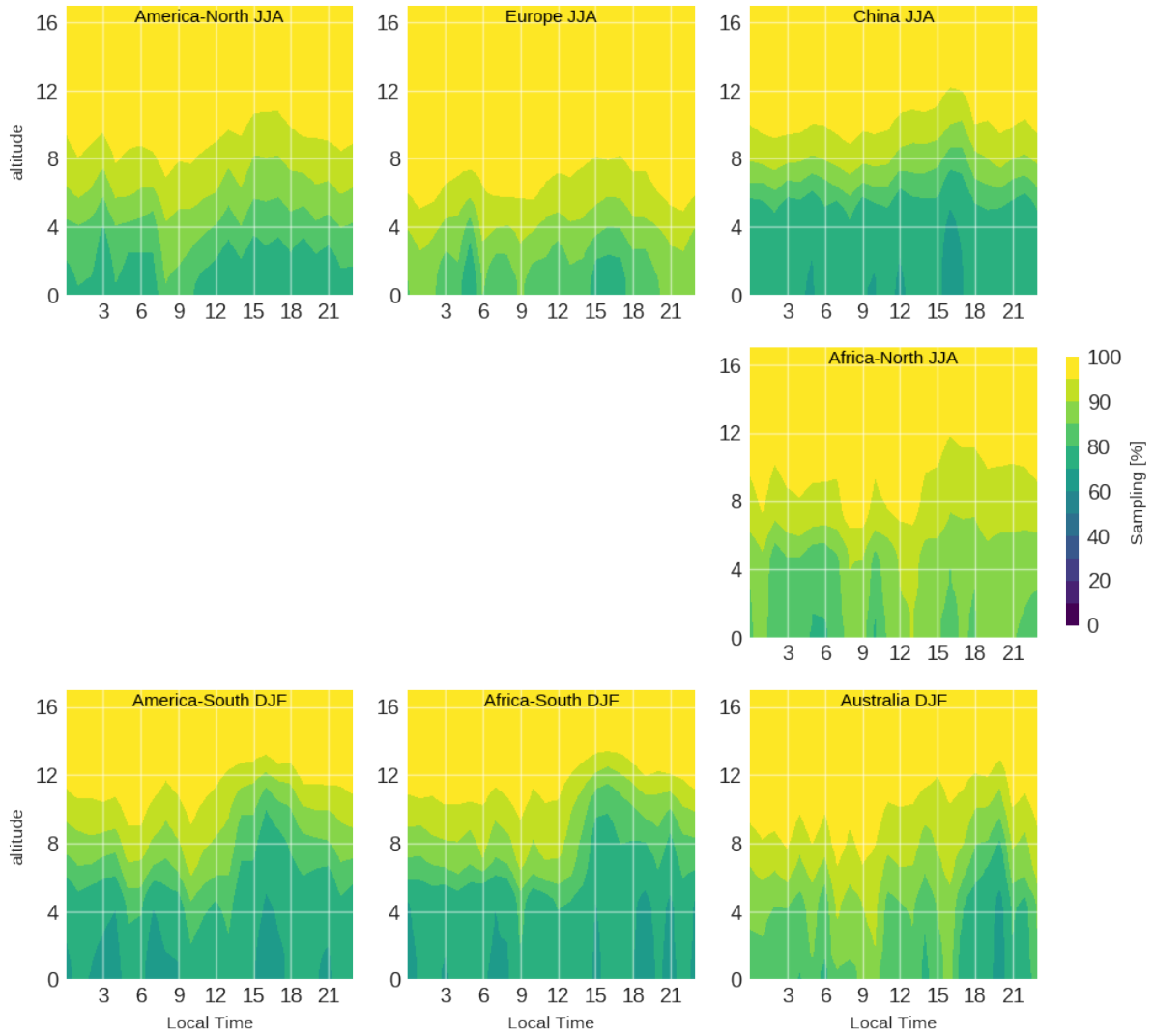

Fig. S7 - Vertical sampling over the regions considered in Fig. 5 from the main paper, during JJA.