Data quality assessment of HIRAS-2 on FY-3E

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Introduction

The Chinese satellite Feng-Yun 3E (FY-3E) was launched in July 2021 and carries the hyperspectral infrared instrument HIRAS-2. Unlike its predecessor, HIRAS, this instrument measures a continuous spectrum from 650-2550cm^{-1} with spectral sampling of 0.625cm^{-1}.

A unique feature of FY-3E is its orbital plane. The equator crossing time is 05:40, so complements the orbits of existing polar orbiting satellites.

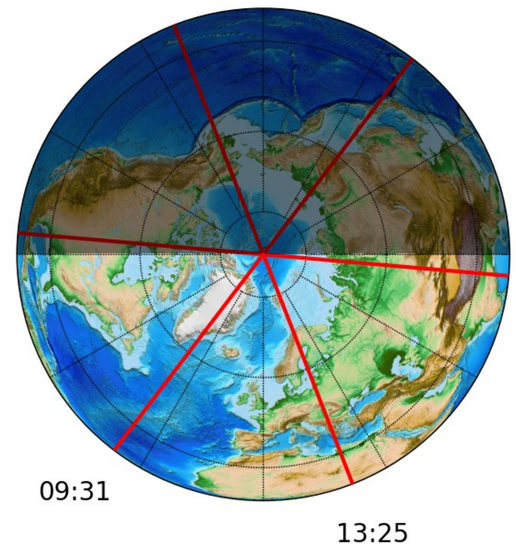
Orbital plane

In general:

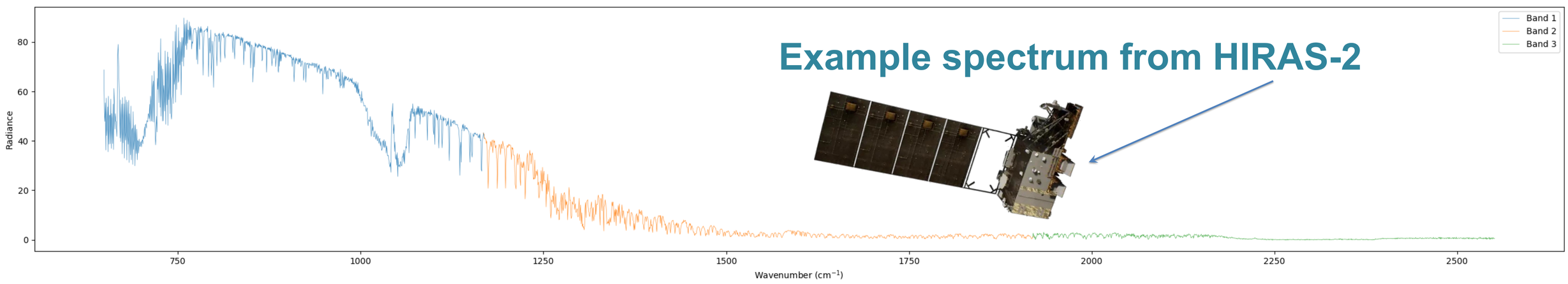
- The European polar orbiters cross the equator at around 9:30.
- The American polar orbiters cross the equator at around 1:30.

With these observations alone, only a small portion of the local times are measured, and hence the full diurnal cycle cannot be constrained by these observations alone in an assimilation system.

So, FY-3E's orbital plane has potential to be beneficial at improving the diurnal sampling.



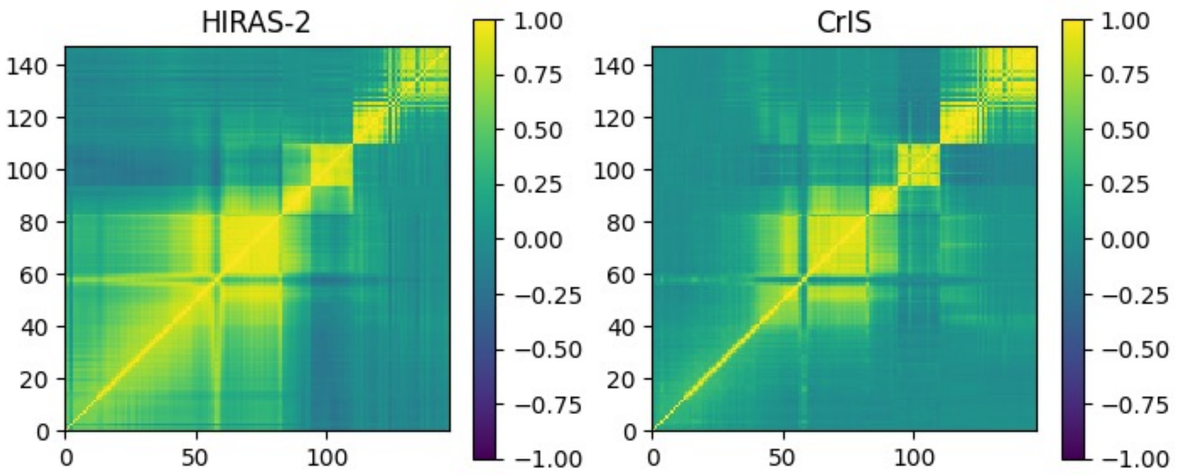
Example spectrum from HIRAS-2

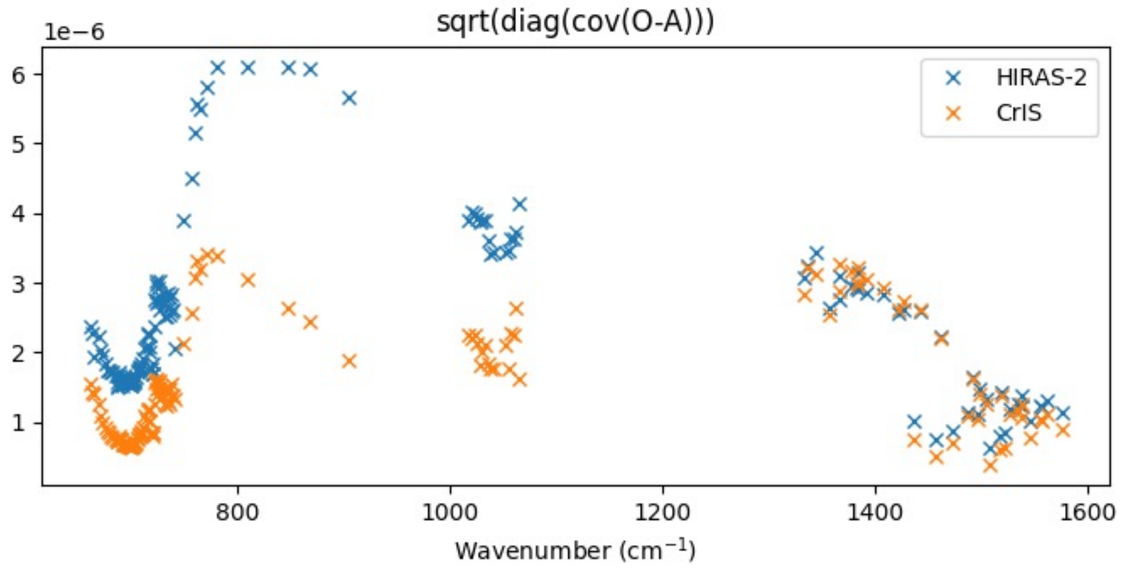


Observation error estimates

To assimilate radiance data from FY-3E, observation uncertainties need to be estimated. This is done by computing the covariance of O-A (i.e. observations minus simulated equivalents from analyses). This approach makes several approximations, but the simplicity and numerical stability make this an attractive alternative to the Desroziers approach.

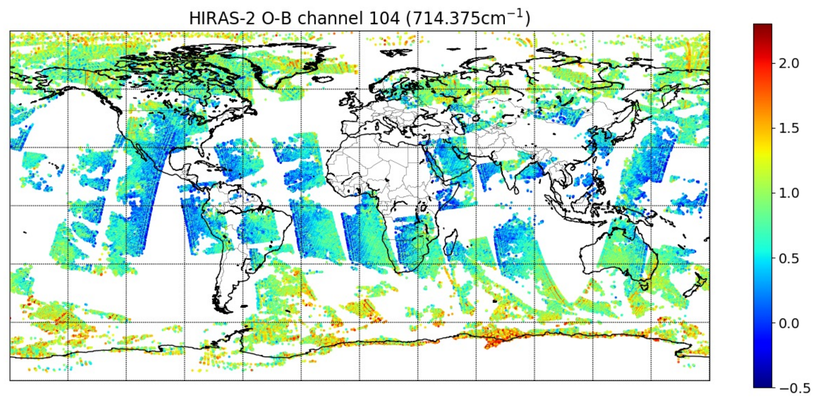
Comparing HIRAS-2 with CrIS, we see that the standard deviation of the O-As are larger for HIRAS-2, as are the inter-channel correlations between the used channels.





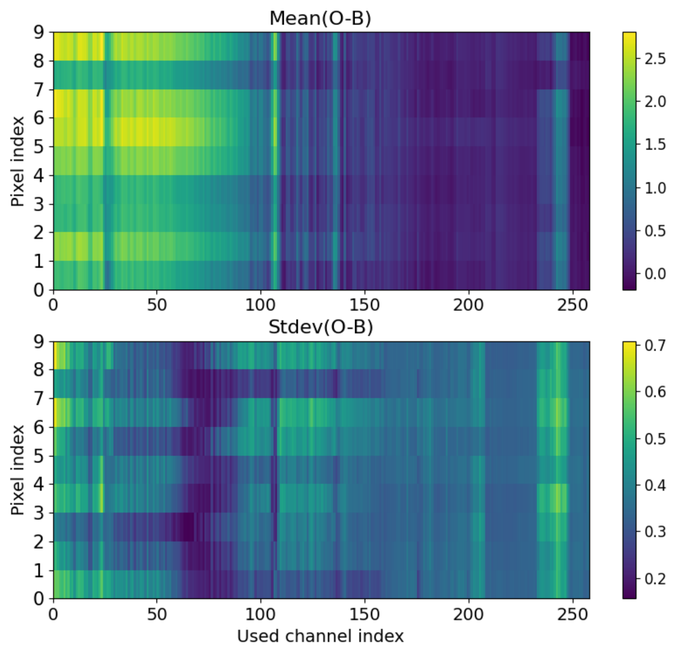
Cross-scan bias pattern

There is a strong cross-scan bias pattern in some of the LWIR channels. This seems to be worst in the tropics. Identifying suitable bias predictors is not straightforward.



Variation across pixels after QC

The mean and standard deviation of O-B show significant variation across the pixels. For NWP, we will consider using only one pixel per FoR. Although pixel 2 shows larger noise than others, the sample of observations passing QC and cloud detection are higher than some others, so this has been selected for assimilation experiments.



Future work

HIRAS-2 will be passively monitored in the ECMWF system soon, along with FY-4B GIIRS. This requires in-house BUFR encoding. Care will be needed due to the large increase in the total number of observations in the ECMWF system. Assimilation experiments are in progress.

Acknowledgements

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