# Intercomparison of stratospheric gravity wave observations with AIRS and IASI

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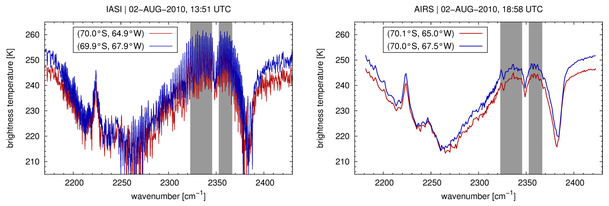
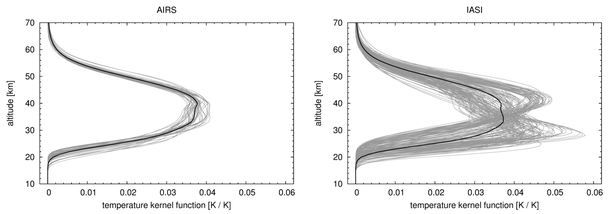
## Characteristics of AIRS and IASI gravity wave observations

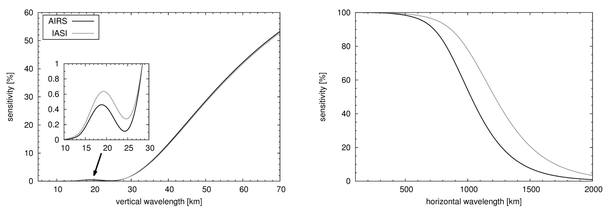
- Gravity wave observations from the AIRS/Aqua and IASI/MetOp infrared nadir sounders are based on 4.3 $\mu$m radiance measurements in the $CO_2$ fundamental band:



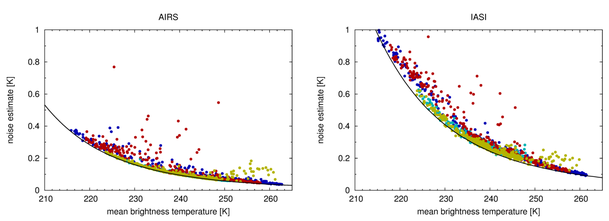

- Kernel functions from radiative transfer calculations indicate that gravity wave observations are most sensitive to temperature perturbations at 30 – 40 km altitude:




- 4.3 $\mu$m brightness temperature variances from AIRS and IASI are most sensitive to gravity waves with long vertical and short horizontal wavelengths:



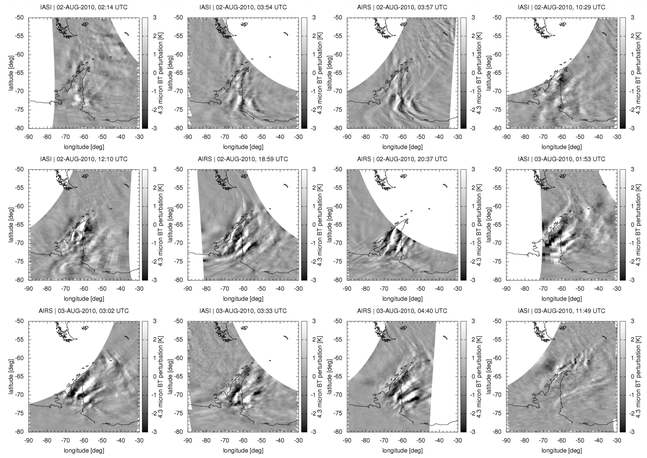

- IASI noise at 4.3 $\mu$m about 2 – 3 times larger than AIRS noise, which makes observations more difficult for weak gravity wave events:



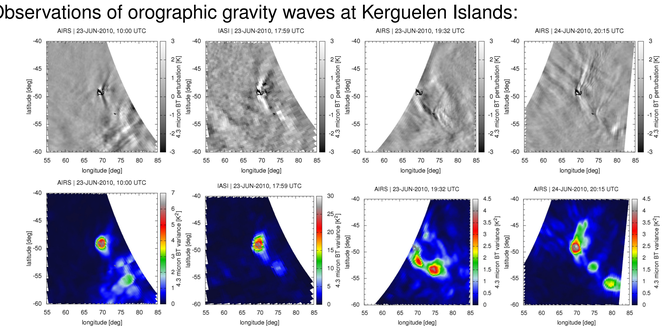

- AIRS and IASI measure at different local time (01:30 and 09:30 LT, resp.), which allows us to study the temporal development of individual gravity wave events.
- Combined AIRS and IASI observations (since 2002 and 2006, resp.) may lead to a long-term climatology of stratospheric gravity wave activity.

## Case studies of individual gravity wave events

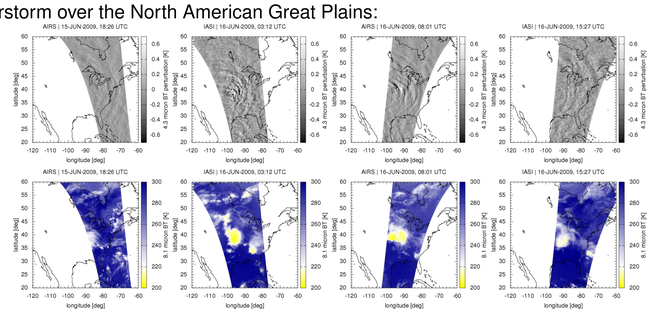
- AIRS and IASI observations of a mountain wave event at the Antarctic Peninsula:




- Observations of orographic gravity waves at Kerguelen Islands:



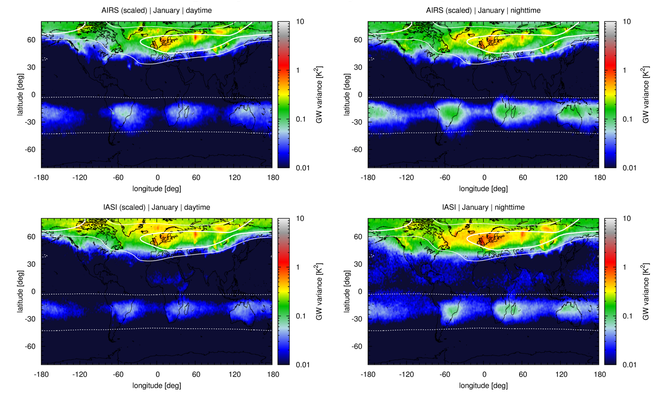

- Simultaneous observations of gravity waves and their convective source during a thunderstorm over the North American Great Plains:



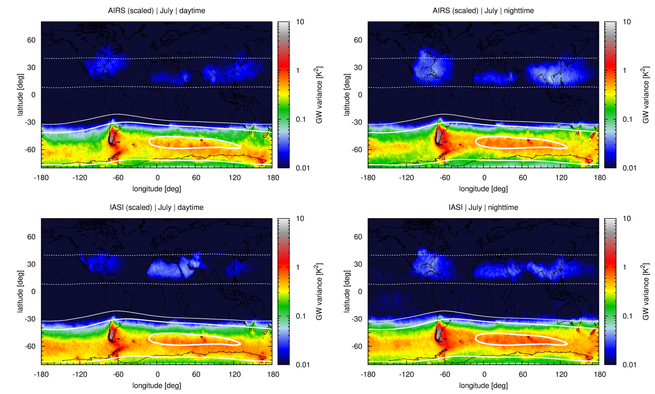

- Case studies reveal that both AIRS and IASI generally provide a consistent picture of the temporal development of individual gravity wave events. AIRS has more regular and better horizontal sampling, providing "clearer" wave patterns. IASI has better horizontal resolution, giving more sensitivity to short horizontal wavelengths.

## Statistical comparisons of stratospheric gravity wave activity

- Statistical comparisons of a five-year record (2008 – 2012) of 4.3 $\mu$m brightness temperature variances revealed systematic differences between AIRS and IASI observations: IASI variances are about 45% larger than AIRS variances, possibly due to better sensitivity to longer horizontal wavelengths (broader measurement track) and better horizontal resolution (smaller footprint size).
- Patterns of stratospheric gravity wave activity in January:




- Patterns of stratospheric gravity wave activity in July:




- AIRS and IASI reproduce climatological features seen by other instruments and models, including strong winter-time maxima at mid and high latitudes, convective wave activity at summer-time low latitudes, and local hotspots (e. g., Scandinavian Mountains, Urals, Andes, Antarctic Peninsula, remote islands of the southern oceans).

## References

Hoffmann, L., Xue, X., and Alexander, M. J.: A global view of stratospheric gravity wave hotspots located with Atmospheric Infrared Sounder observations, J. Geophys. Res., 118, 416–434, 2013.

Hoffmann, L., Alexander, M. J., Clerbaux, C., Grimsdell, A. W., Meyer, C. I., Rößler, T., and Tournier, B.: Intercomparison of stratospheric gravity wave observations with AIRS and IASI, Atmos. Meas. Tech., 7, 4517–4537, 2014.