Previous work by this team (Reale et al. 2018) has found that the current assimilation of AIRS radiances on a regularly spaced thinning grid is suboptimal, probably because of horizontal error correlation over meteorologically inactive areas. Moreover, cloud-cleared radiances appear to be a better product than clear-sky radiances, but need to be assimilated at a much lower density globally, because of the higher information content. Specifically:

1. Assimilation of AIRS clear-sky radiances at a density of about one quarter of the clear-sky radiances improves global forecast skill.
2. An adaptive thinning strategy assimilating cloud-cleared radiances at reduced density globally except around tropical cyclones (TCs), leads to substantial improvements in the structure and intensity foreseen TCs without damaging global skill.

**Model and Experiment Setup**

All experiments are performed with the NASA Goddard Earth Observing System Data Assimilation and Forecast system, version 5 (GEOS-5 DFS version 5-13.0.1) at approximately quarter degree resolution. RAD: Control with all observations assimilated optimally without vortex relocation. Assimilation of AIRS clear-sky radiances at 145 km thinning density, as done operationally at NCEP. ODS: as RAD, but with vortex relocation (operational ODSM version in 2014). CLD: Observation System Experiment (OSE) with assimilation of AIRS cloud-cleared radiances at 145 km thinning density (same as RAD). CLD3: OSE with assimilation of AIRS cloud-cleared radiances at 300 km thinning density (one-quarter coverage as RAD). SThin2_CLD: OSE with adaptive thinning, assimilating AIRS cloud-cleared radiances at 145 km inside a 15 x 15 box centered around TCs, and at 300 km globally.

**Plots**

- Global anomaly correlation and forecast skill as a function of time, showing improved global skill for CLD3 experiment. Forecasts initialized from 29 Sep to 31 Oct 2014 at 06 UTC (14 7-day forecasts, 500 hPa height). Figures from Reale et al. (2016).
- Cross-section: Polar cross-section of analyzed windspeed (m s\(^{-1}\), shaded), temperature (°C, black), and temperature anomaly (°C, red) showing improved structure of Hurricane Gonzalo (194 UTC, 1 Oct 2014) in SThin2_CLD experiment. Map: 850 hPa windspeed (m s\(^{-1}\), shaded) and SLP (hPa, black). Figures from Reale et al. (2016).
- Map: Coverage of AIRS radiances for each experiment showing locations of observations at the time of assimilation (30 Sep 2014). Shading represents "observation minus forecast" brightness temperature differences (K) for channel 215 (approximately 900 nm).