Detecting Climate Variability and Cloudiness by Legacy Satellites

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Cloudiness, Climate Variability and Satellite Observations

- We are interested in how the climate variability is associated with large-scale cloudiness in the midlatitude southern oceans. Currently this cannot be directly measured by any instruments with both accuracy and time span required by climate studies.

- Polar orbiting satellites launched by NOAA have been observing and recording the Earth since 1980s. They do not only provide a relatively long data record with real observations, but also measure with a fairly good accuracy for imageries (e.g. AVHRR) and soundings (e.g. HIRS).

- Climate data records require a spectrally resolved dataset. We developed a unique method that combine the cloud type data from AVHRR and vertically resolved sounding profiles from HIRS to create this spectrally resolved dataset.

- Climate patterns are characterized as modes of variability and measured via empirical orthogonal function analysis. The times series of these indices can tell us about the changing phases of sea surface temperatures (SOI/MEI), the changing positions of the zonal mean winds (driven by barotropic processes) in the midlatitudes (SAM/NAM/AAO/AO), the changing amplitudes of the baroclinic wave propagations (BAMs), etc.

- We correlate the modes of the variability and cloud type statistics to identify the signature of how climate variabilities are associated with cloudiness.

Combine Imagery and Sounding Data

- We used AVHRR/HIRS data acquired from 3 satellites for this study. They are
  NP - NOAA 19, 2009 - 2016
  NN - NOAA 18, 2006 - 2016

- AVHRR data are sampled at 1 km but the global area coverage (GAC) data are provided at 4x4 km. AVHRR GAC data are processed with CLAVR-x software for cloud-types. HIRS/4 on-board these satellites are sampled at 10 km.

- AVHRR cloud type data are interpolated onto HIRS footprints by conic SRFs with a radius of ~8km [Staten et al., 2016].

- Cloud statistics - cloud fraction (CF), mean and variance - are deseasonalized to remove their seasonal cycle.

Future Work

- Correlate the cloud statistics with climate variabilities by season.

- Extend data records by using more satellites. This may lead the way back to 1998, when NOAA 15 (NK) started to work.

- Identify the vertical structure in the cloud statistics with climate variability.