Motivation

- Heat and moisture exchange between ocean surface and atmosphere plays integral role in short-term, regional NWP
- Current SST products lack both spatial and temporal resolution to accurately capture small-scale features that affect heat and moisture flux
- NASA satellite used to produce high spatial and temporal resolution SST analysis using an OI technique

Background

- NASA SPoRT has developed compositing techniques for producing four-times daily, 1 km SST products
- Techniques include only temporal weighting, leading to pixel-to-pixel variations in composites, often appearing as unrealistic or false gradients
- Data assimilation is promising technique because of ability to spatially spread information

Methods

- OI technique with Gaussian covariance function implemented for simplicity (Cummings, 2006)

\[ Cov = (1 + s_h) e^{-s_h} \]

\[ x_{obs} = x_{an} + P_b H^T (H P_b H^T + R)^{-1} (y - H x_{an}) \]

- \( s_h \) is distance between points, normalized by correlation length scale, \( x \) is the analysis field, \( P_b \) is the background error covariance, \( R \) is the observation error, \( y - H x_{an} \) is the observation increment, and \( H \) is an operator to transform model space to observation space
- MODIS and AMSR-E data used as observations
- Objective is to create a spatially consistent, 1 km regional SST map for the August 2008-September 2008 period over tropical Atlantic
- Period presents challenge because of multiple hurricanes and tropical storms moving through domain
- RTG analysis used as initial background and previous day’s analysis subsequently in lieu of
- Background variance inflated each day by an empirically determined constant
- Observations assimilated sequentially
- Correlation length scale varies based on number of available observations in surrounding 70km x 70km box

Results

- Validation against both drifting and fixed buoys to compare analysis to in situ observations
  - OI technique compared favorably with SST products that use a compositing technique in both bias and RMSE
  - Validation against drifting buoys (not shown) show slightly higher bias (~0.12 K) and RMSE (~0.17 K) than compositing techniques, but still compares favorably because of uncertainties in validation due to sparse in situ data
  - OI reduces small scale “artifacts” in areas with higher data latency
  - Tuning length scale to longer lengths produces consistently smoother analysis product, but has yet to be validated
  - OI schemes with shorter correlation length scales struggle in large cumulus fields due to lower number of observations, often producing a speckled appearance

Summary

- OI analysis used to produce high spatial and temporal resolution SST analysis
- Variable length scale used based on number of available observations in predetermined radius
- Technique reduces artifacts in areas of high latency and validates favorably against SST compositing techniques
- Future work will include continued tuning of parameters and extension of technique to other domains and seasons