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)

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

\[ x_{s} = x_{i} + P_{b}(H_{b}H_{b}^T + R)^{-1}(y_{o} - H_{b}x_{i}) \]

• \( s \) is distance between points, normalized by correlation length scale, \( x \) is the analysis field, \( P \) is the background error covariance, \( R \) is the observation error, \( y \) 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