



Blending Methods: A Brief Overview

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Outline

- What's blending and why do it?
- Some common methods & products
- Product stability & Improvements
- Addressing public wants and needs
- Summary and Conclusions

What's Blending and Why do it?

- Combining data from multiple sources and instruments for a better measure of a physical property
- Care needed to ensure that the product is suitable for its intended purpose
 - Climate needs differ from weather needs
 - Blending requires compromises to best suit a particular need
 - Compromise means that no product is best for all applications
- Done right, blending reduces uncertainty and yields more useful products

Some Common Blended Products

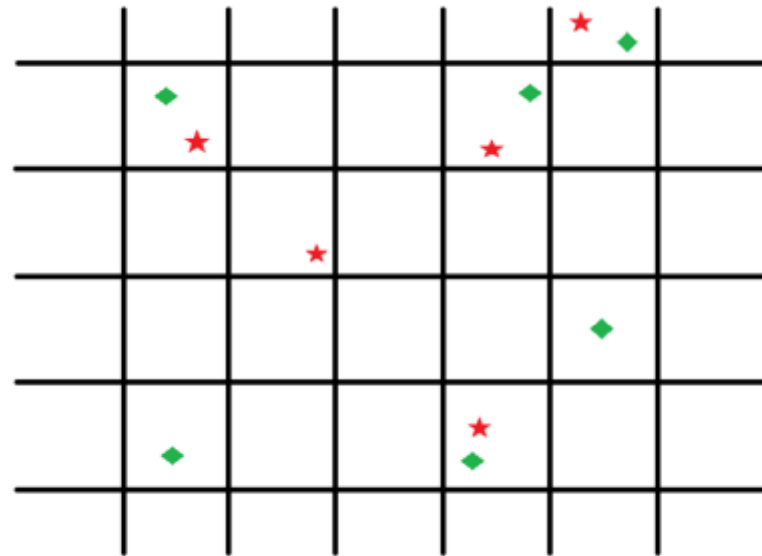
- Hydrometeorology products
 - Rain, snow, TPW
 - CMORPH, GPCP, etc.
 - Tropical cyclone properties
- SST
 - Different time and space scales, different lengths of analyses
 - OI-like methods good with dense data, EOF-like methods better for sparse data
- Winds, Ozone, Soil moisture, Biomass burning, etc.
- All instruments can have biases that should be addressed

Data and Blending

- Combining measurements
 - Consider instruments noise & bias errors, and sampling density
 - Best method depends on measurement properties and product requirements
 - Record length needed, resolution needed, etc.
- Merging & interpolation
 - High resolution real time for weather, may have more bias
 - Minimizing bias may lower resolution and delay analysis
 - A balance of needs should guide analysis development

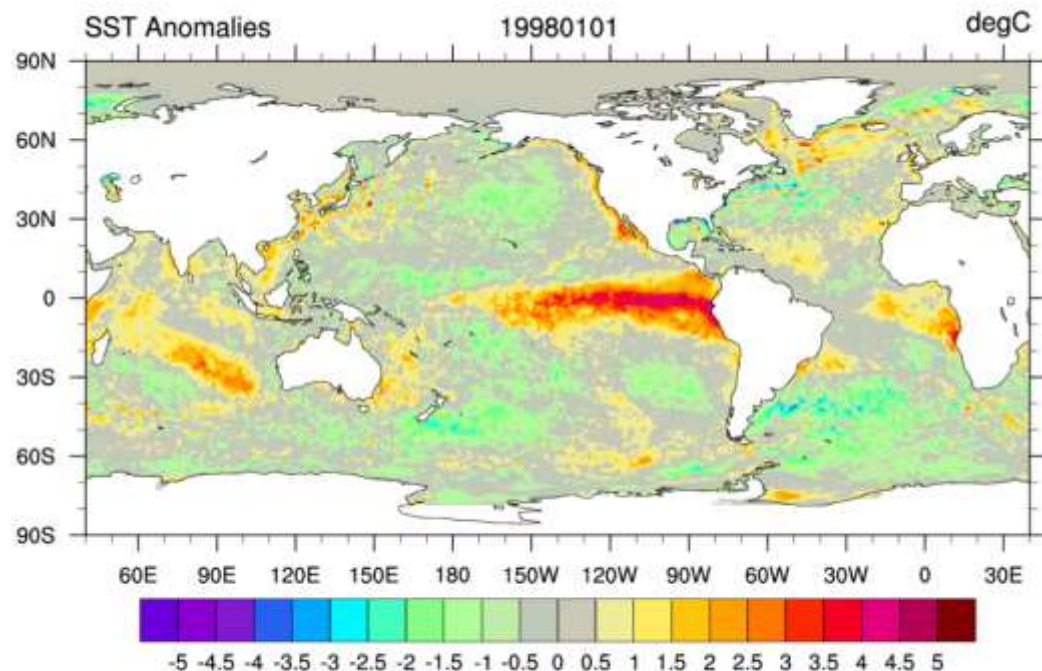
Analysis Methods

- Merging: combining data within a grid square
- Interpolation: filling gaps between data
 - Linear good when data dense & all have comparable quality
 - Optimum Interpolation (OI) uses statistics for better analysis with sparser data of different quality
 - Variation Methods (nD-Var, for assimilation) simplifies OI statistics, faster when data are dense
 - Morphing Methods, morph between high-quality observations using supplemental data
 - Machine Learning does tuning and adjusting on the fly



Example: OISST

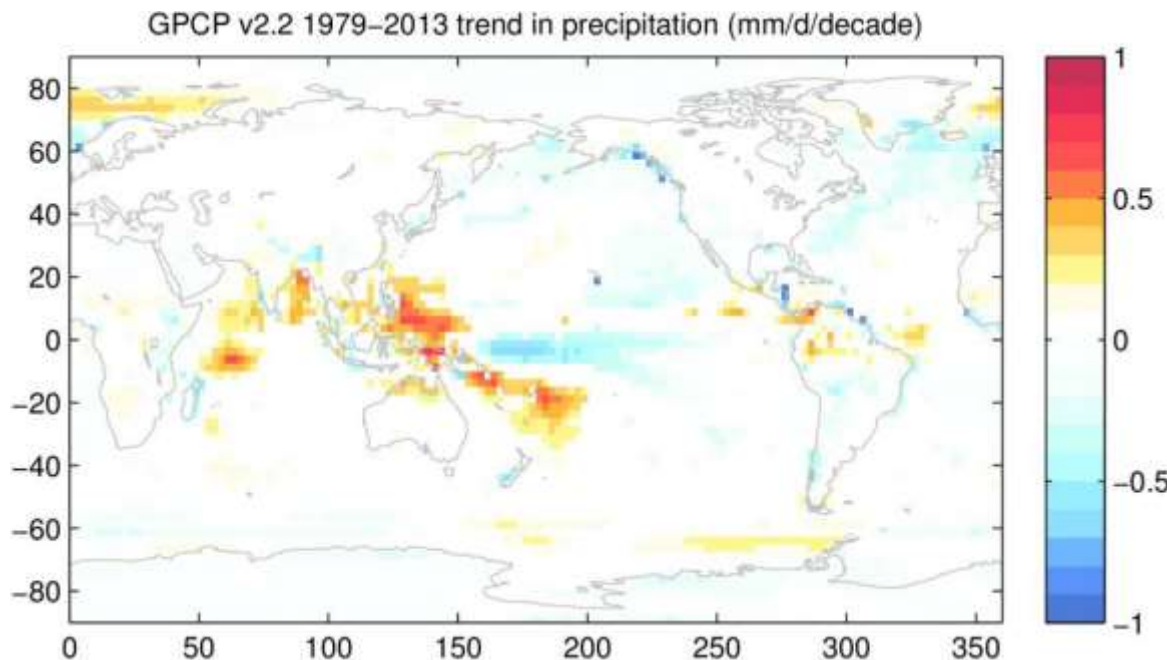
- 0.25-deg daily v2 analysis of sea-surface temperature (SST) using optimal interpolation (OI)
- For data need:
 - Bias estimates
 - Noise/signal variance
 - Spatial scales
- Different inputs:
 - AVHRR (changing to VIIRS)
 - MW for part of period
 - Ships more important early
 - Buoys more important later
- High-latitude ice adjustments



Banzon, Viva, Reynolds, Richard & National Center for Atmospheric Research Staff (Eds). Last modified 21 Apr 2018. "The Climate Data Guide: SST data: NOAA High-resolution (0.25x0.25) Blended Analysis of Daily SST and Ice, OISSTv2." Retrieved from <https://climatedataguide.ucar.edu/climate-data/sst-data-noaa-high-resolution-025x025-blended-analysis-daily-sst-and-ice-oisstv2>.

Example: GPCP

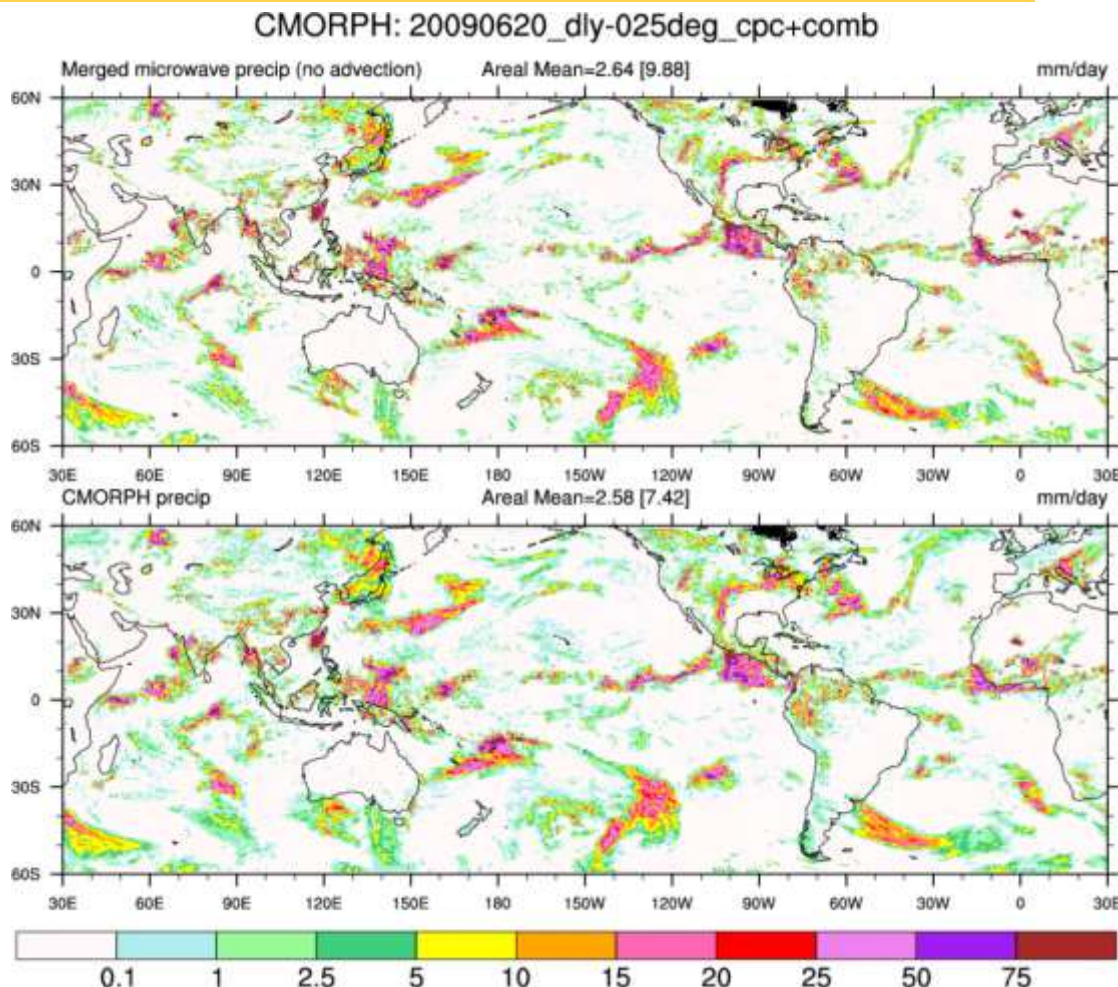
- Global Precipitation Climatology Project (GPCP), monthly 2.5-deg from 1979
- Multiple satellite and *in situ* estimates
 - Relative satellite bias removed
- Coarser but much longer record for climate studies
 - Can be used to show long-term changes, like trends
 - A 1-deg daily available from Oct 1996



Rainfall trend (1979-2013) in GPCP v 2.2. Only trends significantly different from zero at 95% are shown in color. The pattern in the Pacific largely resembles what is expected in response to ENSO, and may be related to decadal variability (Dai 2013). (Fig. from A. Pendergrass)

Example: CMORPH

- Climate Prediction Center MORPHing technique (CMORPH), hourly 0.25-deg since December 2002
 - MW for rain rate, IR for advection
- Most skill from MW estimates
 - Sample without (top) and with (bottom) advection for June 20, 2009. [Climate Data Guide; D.Shea]
- Advection important for hourly estimates
- New CMORPH2: Incorporates more satellite inputs & model inputs for 0.05-deg, 30 min, pole-to-pole analysis



National Center for Atmospheric Research Staff (Eds). Last modified 06 Oct 2017. "The Climate Data Guide: CMORPH (CPC MORPHing technique): High resolution precipitation (60S-60N)." Retrieved from <https://climatedataguide.ucar.edu/climate-data/cmorph-cpc-morphing-technique-high-resolution-precipitation-60s-60n>.

Product Stability & Improvements

- Stability depends on:
 - Stable inputs from satellites or *in situ* sources
 - A continued need for the product
 - Community support for maintenance and upgrades
- Improvements:
 - Products require upgrades to maintain usefulness
 - Some are obsolete but still used (*i.e.*, weekly 1-degree OI SST)
 - Improvements require support (no free lunch)

Public Wants and Needs

- Needs: for physical or economic safety
- Wants: for perceived need or convenience
- Communication of product value
 - Useful to have partners in universities and weather-reporting centers
 - Communicate trade offs: what's it cost, what's its value
- Knowing public needs and wants
 - Listen and consider what the general public says
 - Evaluate events that cause social disruptions
 - Develop products that can minimize future disruptions

Summary and Conclusions

- Blending can refer to a number of different methods for combining and interpolating data
- Different methods are needed to best meet different needs
- Continued support is needed to maintain product value
- Outreach efforts can help gauge what products will be most useful