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Training AHI SST using ACSPO VIIRS L2P

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Motivation

- ABoM requires an operational real-time SST from H08 (Himawari-8) Geostationary Satellite.
- Regression based retrieval was chosen because of speed and ease of implementation. (~45 seconds on a standard VM including I/O)
- Tuning to *in situ* requires a relatively long time series of *in situ* measurements, since the coverage is not global.
- *In situ* measurements do not necessarily reflect skin SST.
- Mature, good quality SST retrievals with global coverage and skin sensitivity are readily available from VIIRS.
- Large number of temporal and spatial matches allows relatively short time frames to be used for tuning.
- We do not want to rely on our H08 cloud detection for tuning.

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Method

- Determine matches between H08 and VIIRS
  - VIIRS SST quality 5
  - Close in space and time

    (0.5km, 10min, geo zenith angle<50, closest pixel for every given geo measurement, randomly sampled to thin the data)

    O(10^4) to O(10^5) matches per day
  - VIIRS SST, matched with H08 Brightness temperatures (H08 Channels 7,9,13,14,15)
  - Implicitly relies on the ACSPO cloud detection for VIIRS which is more mature
- Consider density of matches so that suitability for tuning and biases can be assessed, and compensated if required

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Method

- Tune with Weighted Ordinary Least Squares over a variety of models linear in Brightness Temperatures (H08 Channels 7,9,13,14,15)
- Assess residuals of all models
  - Choose those that seem a good compromise between simplicity (same model for day and night, linear, decoupled from first guess fields) and accuracy.
- Estimate Sensor Error Statistics based on the residuals of the fit binned based on the measurement properties and geometry (location, satellite, sun angles and local variation of observations).
  - Generally beyond the scope of this talk

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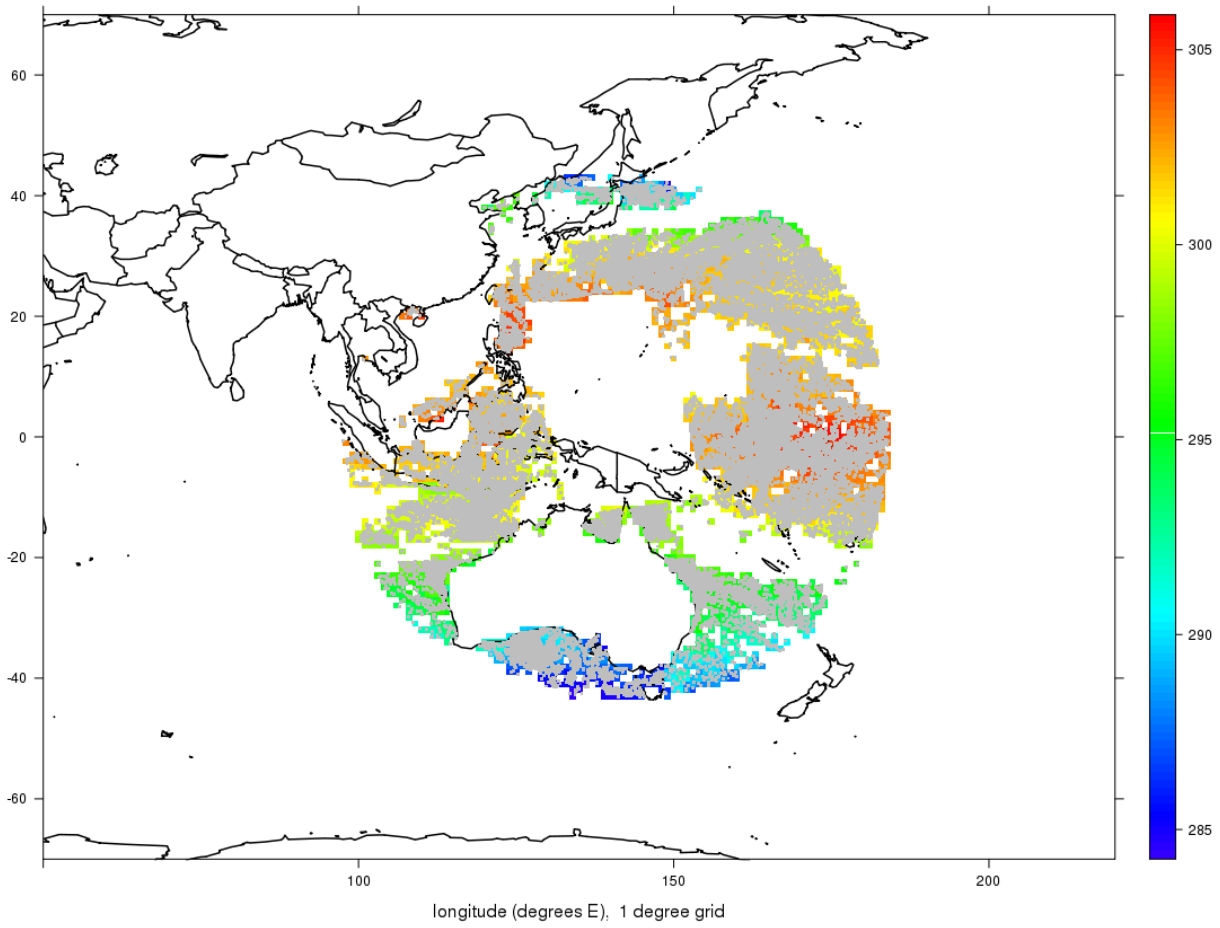
Coverage



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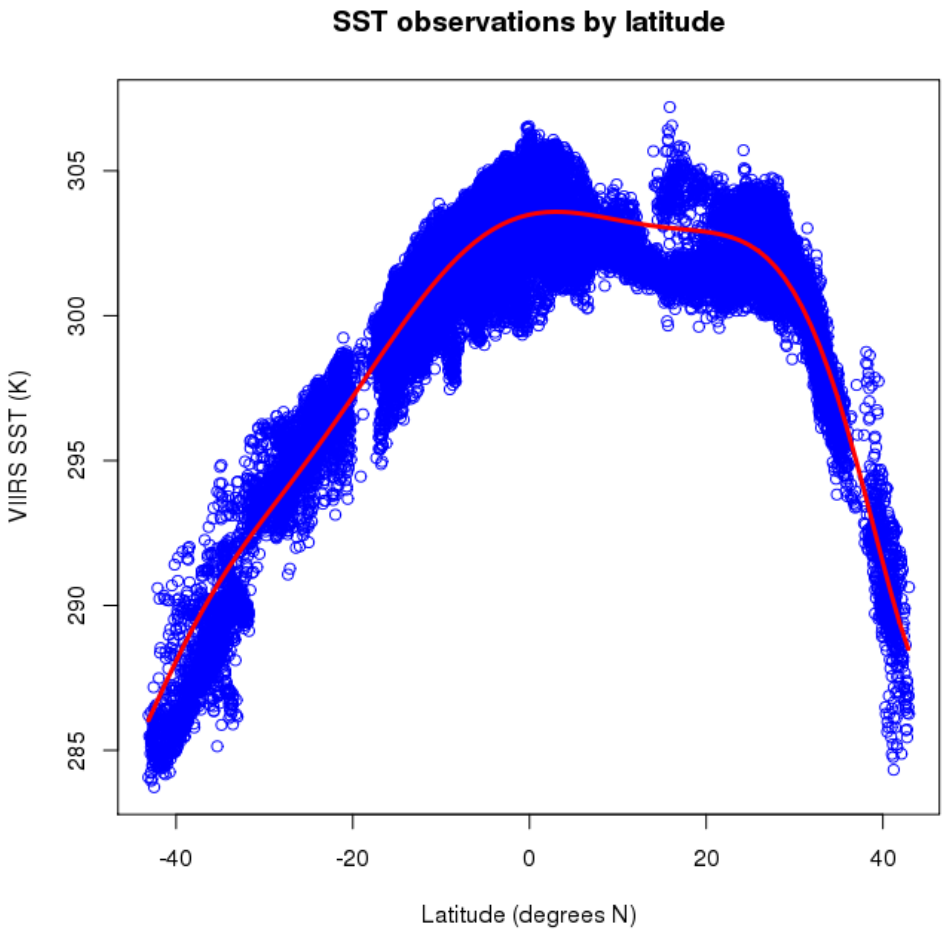
A few results

- Observations can be fitted on latitude with a single function. Used as a "First Guess"
- Variation is not erratic.
- No need to quality control VIIRS observations.
- Distribution over latitude is non-Gaussian.
- Ordinary least squares may be problematic.



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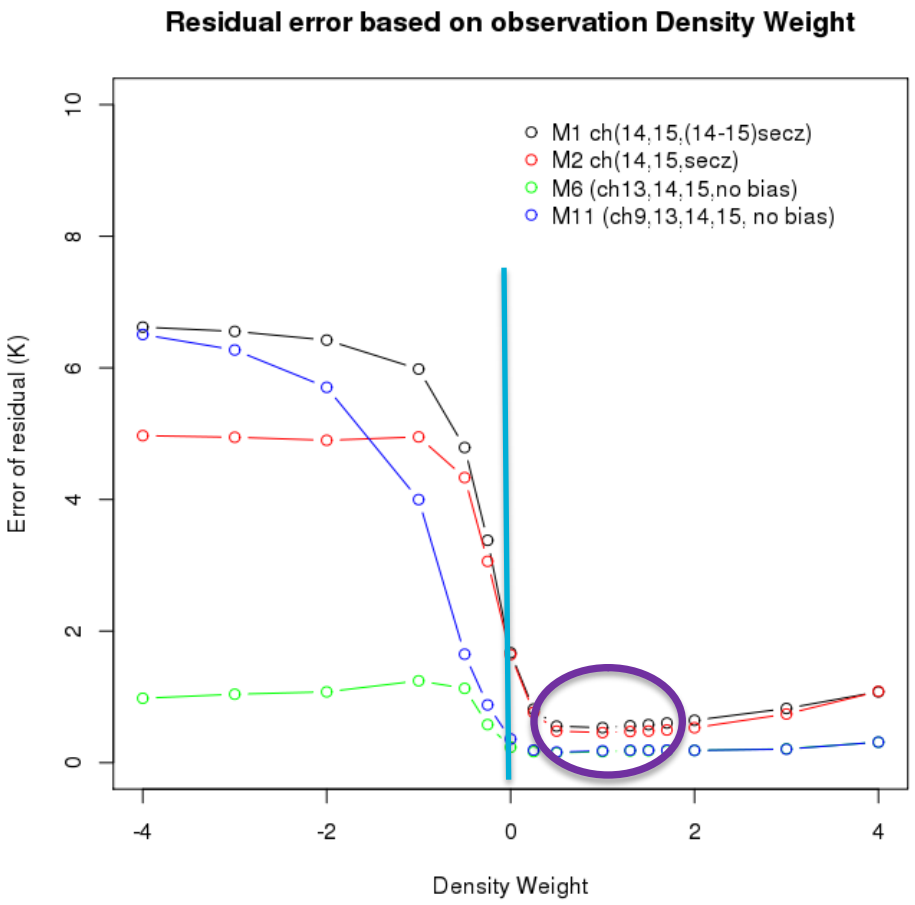
A few results

- Best fits require some Density Weighting, which gives consistently good results (Purple Ellipse).
- Not weighing (DW=0) gives inferior results in some cases (intercept with Blue line).



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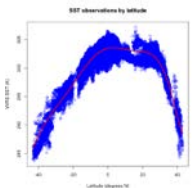
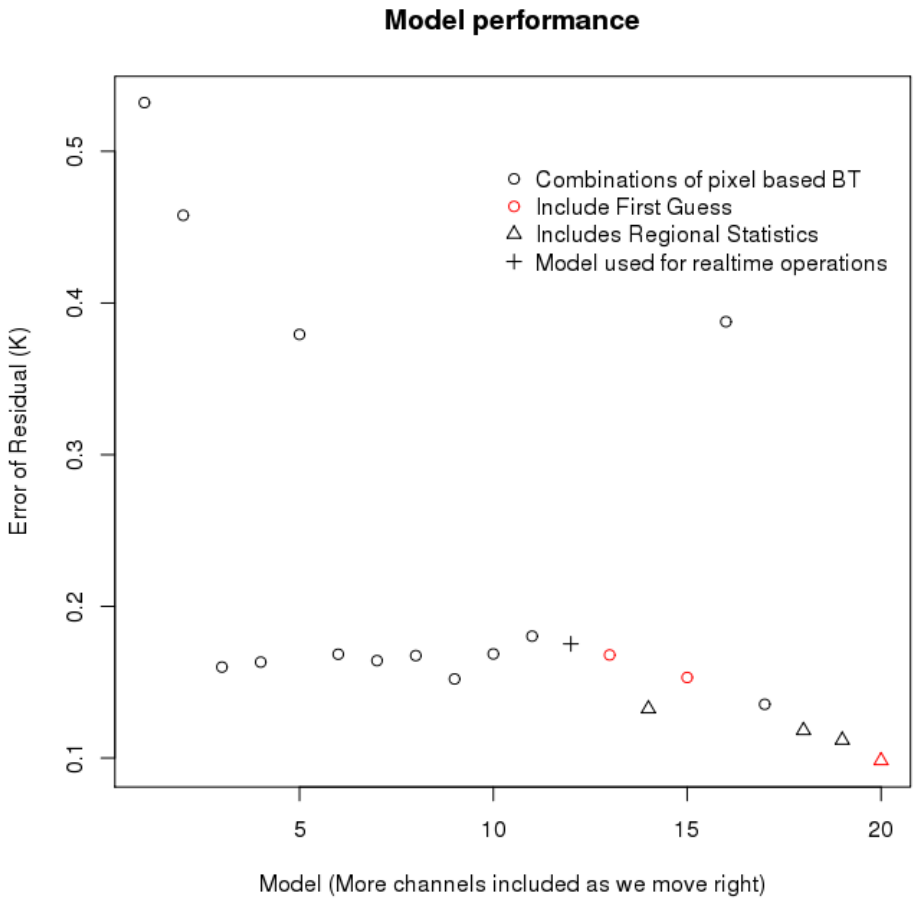
A few results

- Fit performance is qualitatively similar for any sensible model.
- As it should be.
- (Models were chosen based on Principal Component Analysis).
- ("First Guess" is the 1-d latitude model ).



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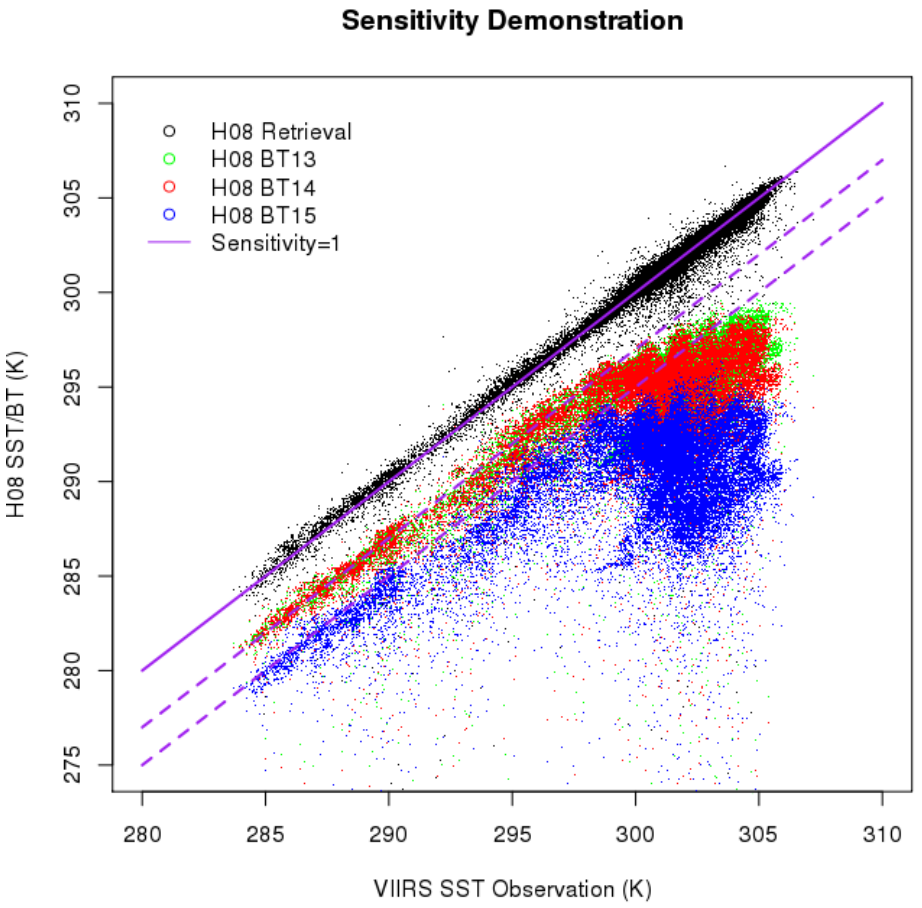
A few results

- Sensitivity is reasonable. (slightly worse @cold ?)
- For H08 BT vs VIIRS observations.
- For H08 retrieval vs VIIRS observations.
- As it should be.

$$
\begin{aligned}
SST \quad = \quad & BT_9 \left(a_9 + g_9 \left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{13} \left(a_{13} + g_{13} \left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{14} \left(a_{14} + g_{14} \left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{15} \left(a_{15} + g_{15} \left(\sec(\theta_z) - 1\right)\right) + \\
& T_0
\end{aligned}
$$



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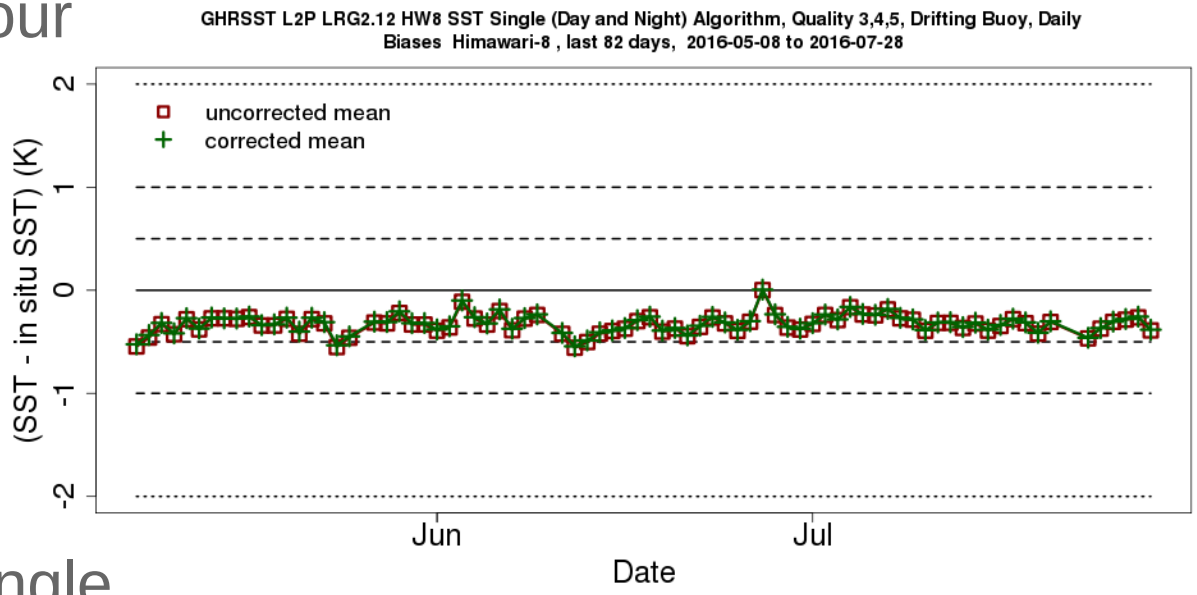
Performance of H08

- Validation of tuned H08 with *in situ* measurements shows consistent behaviour over time.
- As it should be.



Tuned based on a single day: 7th July 2015

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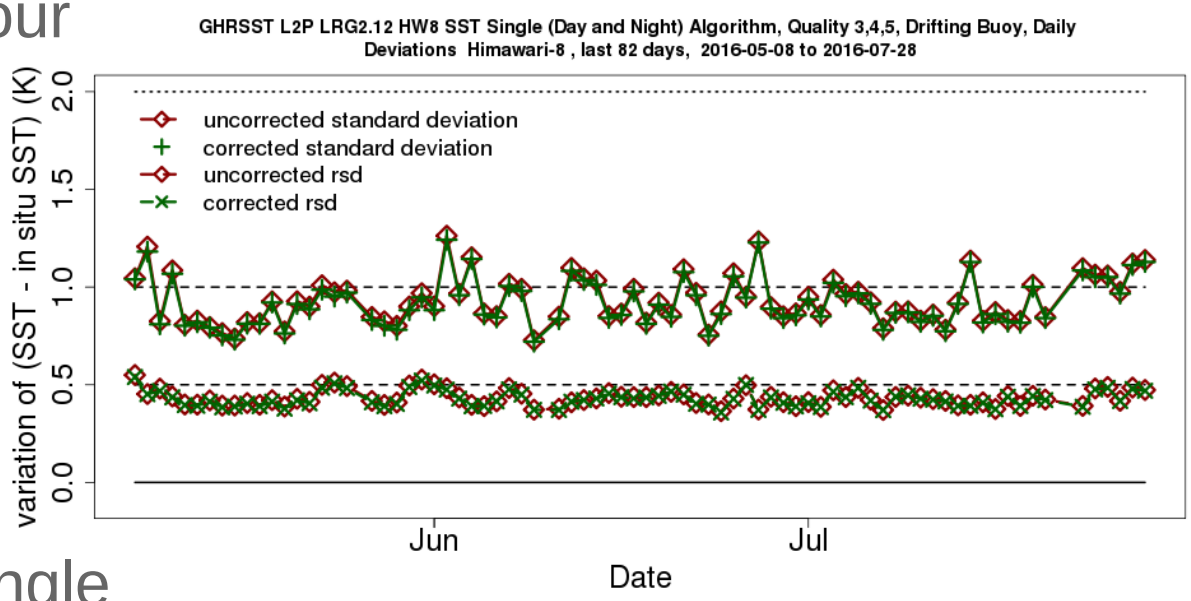

Tuned based on a single day: 7th July 2015

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Concluding remarks

- Using a similar procedure on other geostationary satellites allows the same tuning standard to be employed for all geostationary platforms.
  - Keep the geo's SST *cross calibrated*
- Dependence on *in situ* is less direct, allowing greater scope for validation and verification.
- The method used also avoids L4 *First Guess* fields, but allows a 1-d latitude model First Guess to be employed.
- Short time scale of tuning parameters might allow on satellite sensor performance and short time scale geophysics to be better characterized and tuned for.
- Regional performance uniformity of bias and sensitivity of VIIRS SST are keys to success, however having large numbers of coincident measurements permits greater robustness.

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Questions / Comments

Would be much appreciated

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