Progress in using ground-based GPS-met total precipitable water for cal/val of both product data and satellite retrievals

and other activities

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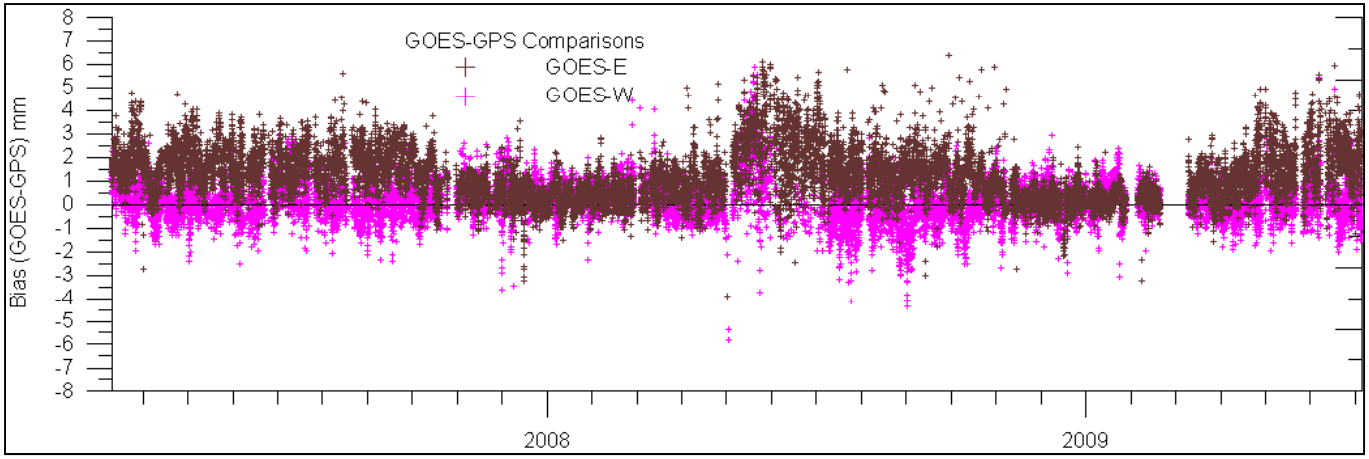
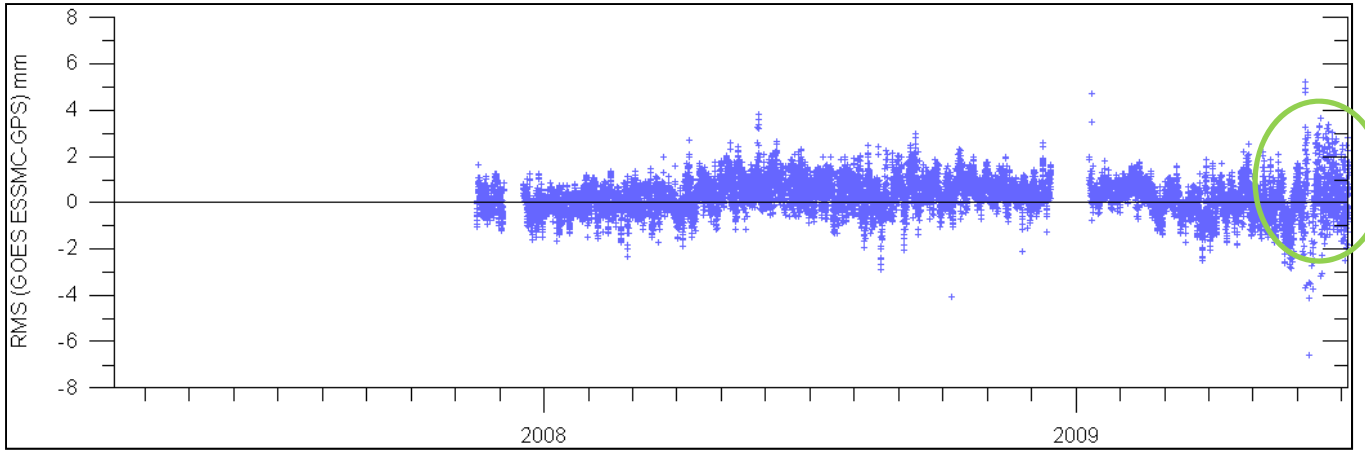
Overview

- Operational Products
  - Validation of current products (stems back to prior talks and presentations on performance of GOES TPW since 2002.
  - Detection of GOES sensor problems
  - Model first guess assessment
- Model interface
  - New metrics for microphysics assessment in models
  - Pathway for direct (including cloudy) radiance assimilation
- CRTM Applications

Operational Products - validation



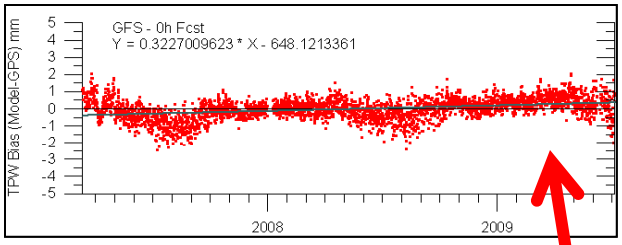
Current operational moisture product comparison

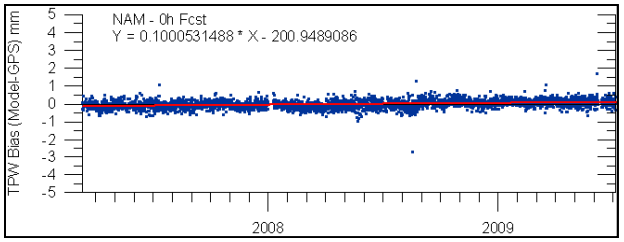


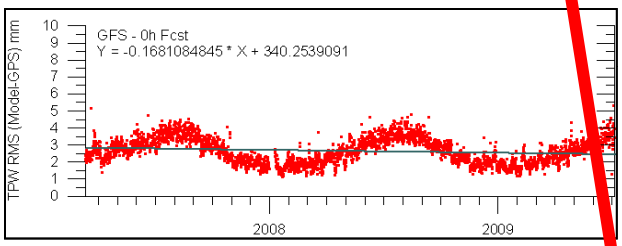
New CIMSS algorithm compares better to GPS

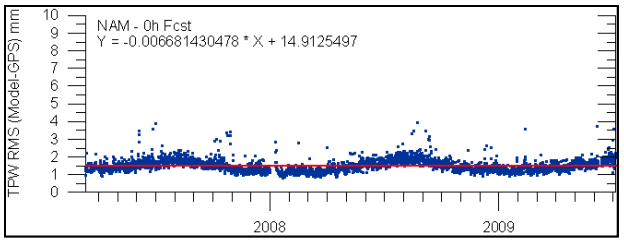
Detected problems with satellite sensor

Operational Products – first guess









GFS time zero

NAM time zero

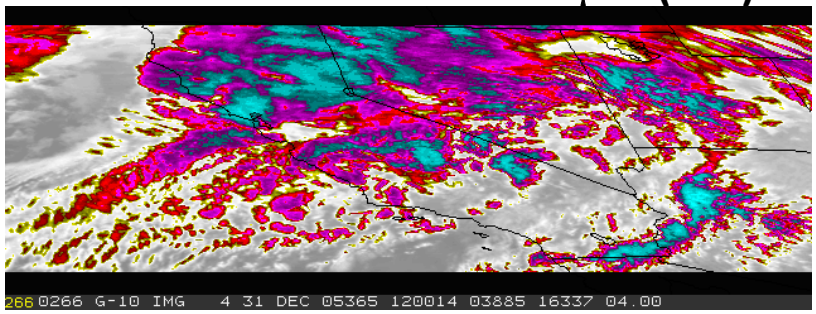
Recommend fixing GFS or using different model for background like the NAM for CONUS retrievals.

Also consider using GPS data in retrieval processing as a constraint

GFS used for satellite retrieval initialization

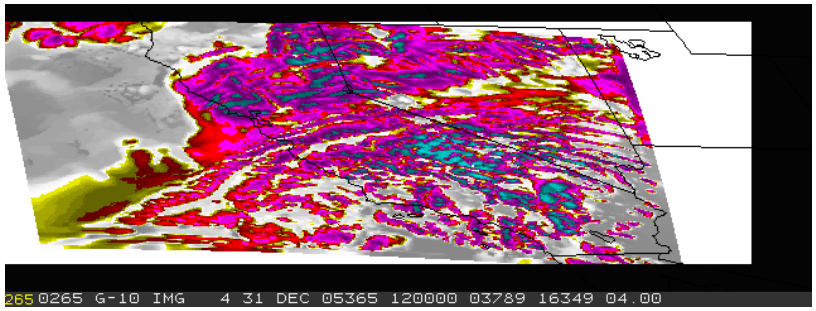
Model Interface – metrics for microphysics

Observation-GOES-10 10.7μm (ch4)

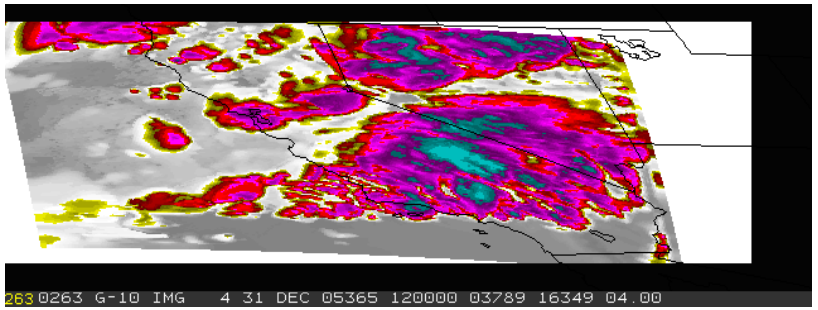


24-hr forecasts valid at 31 Dec. 2005 at 12 UTC

WSM6

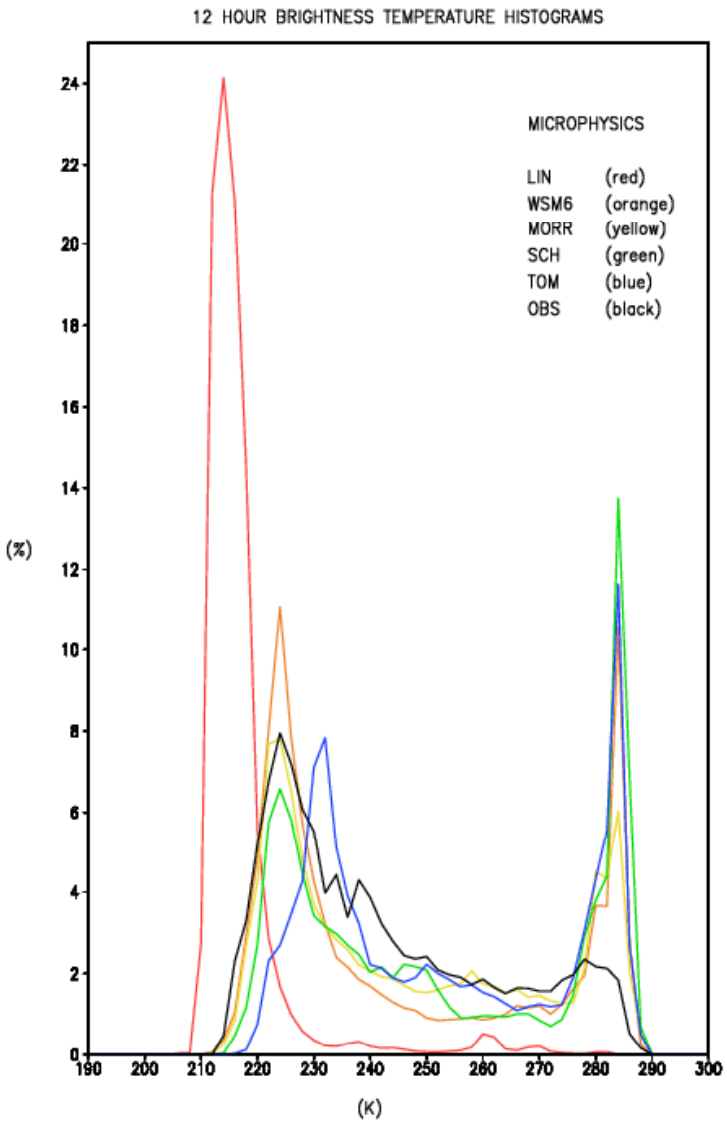


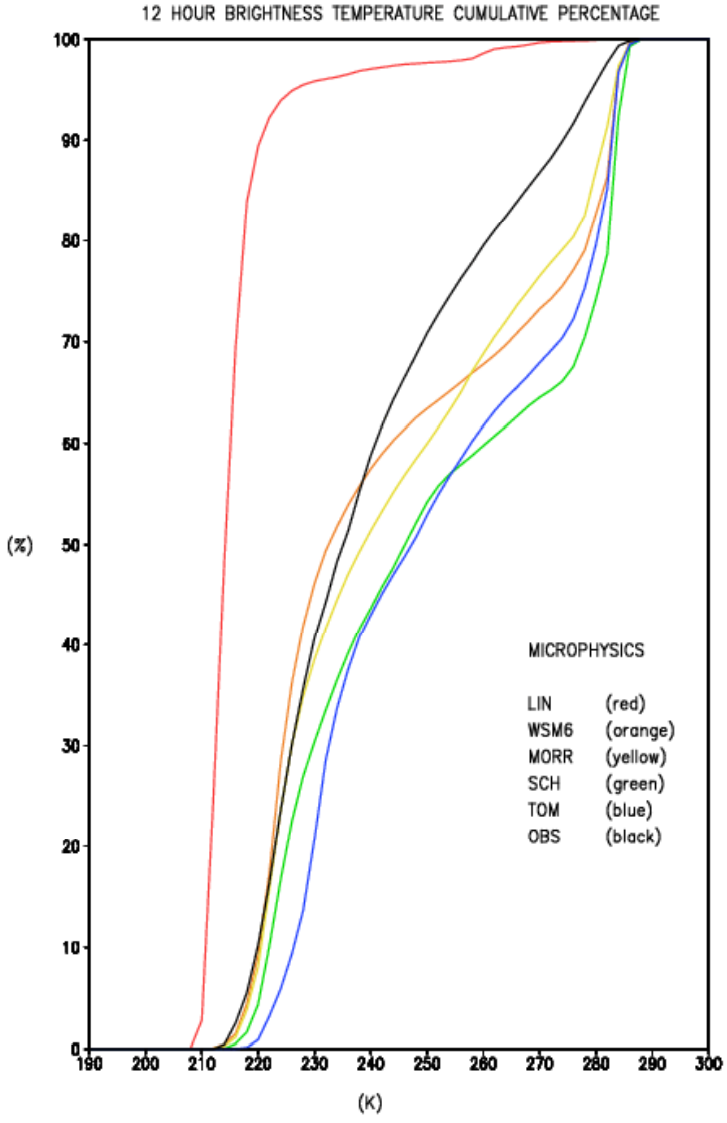
Schultz



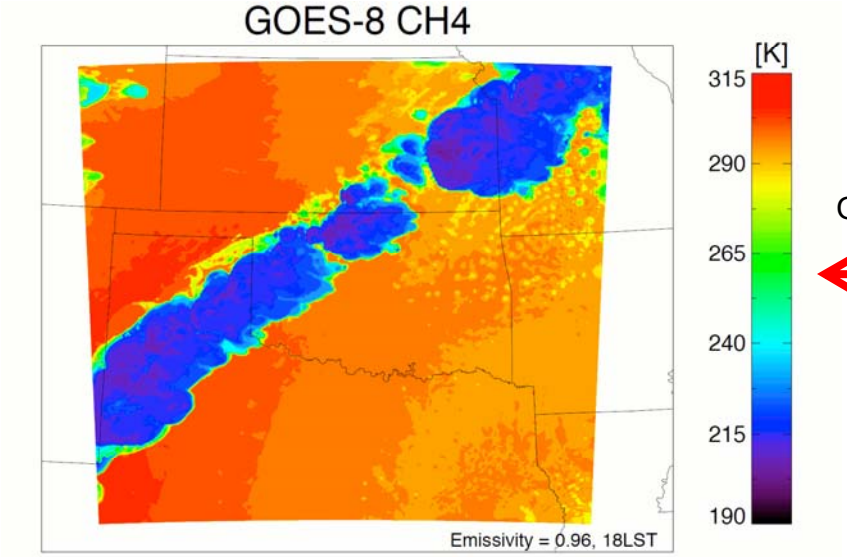
Jankov, I. L. D. Grasso, M. Sengupta, P. J. Neiman, D. Zupanski, M. Zupanski, D. Lindsey, D. W. Hillger, D. L. Birkenheuer , R. Brummer and H. Yuan, 2010: An Evaluation of Five WRF-ARW Microphysics Schemes Using Synthetic GOES Imagery for an Atmospheric River Event Affecting the California Coast. Submitted to JHM.

Microphysics metrics from simulated imagery

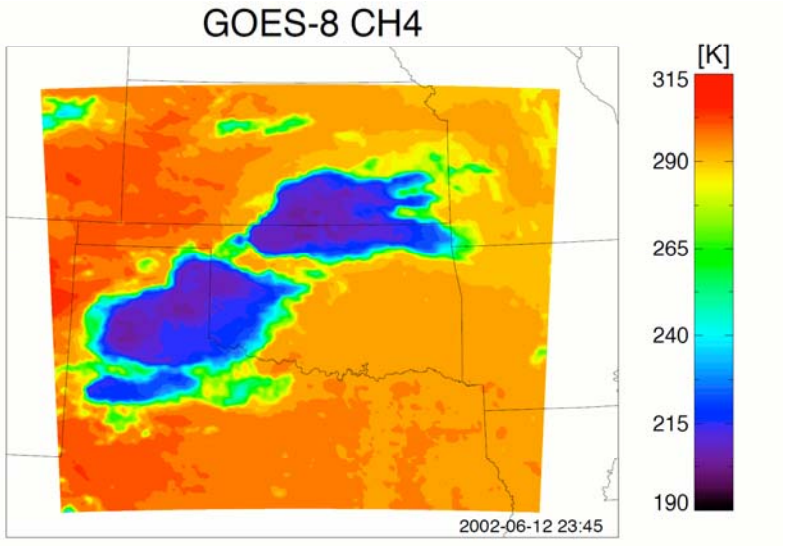




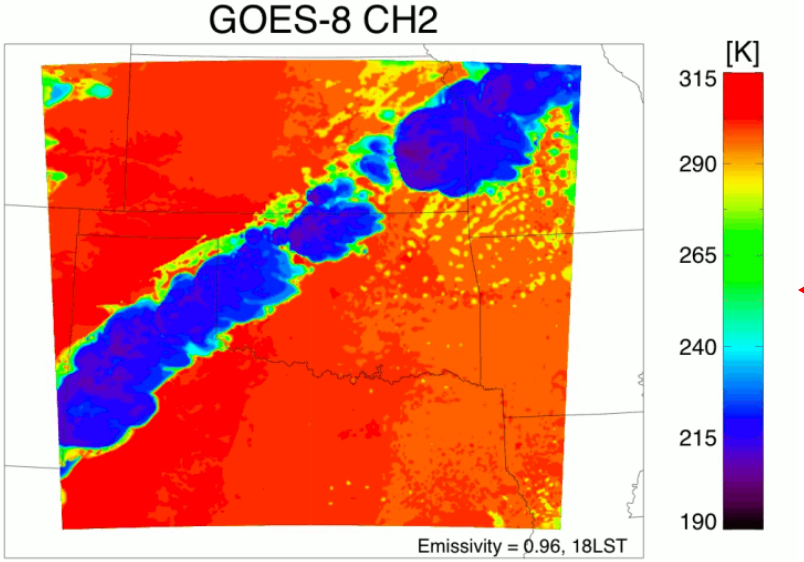
Model Interface – pathway for DA



Good

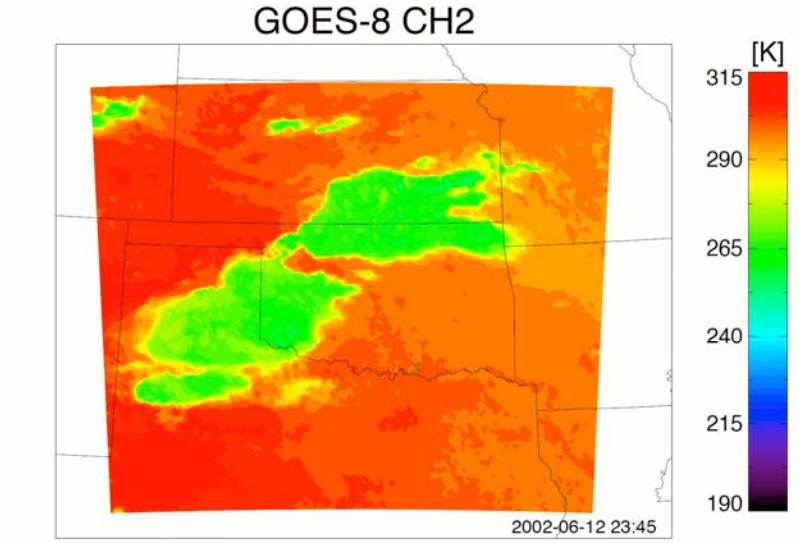


Modeled



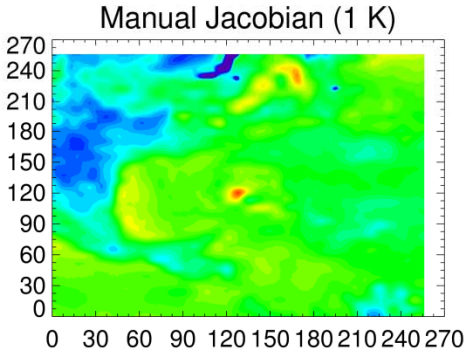
Not so Good

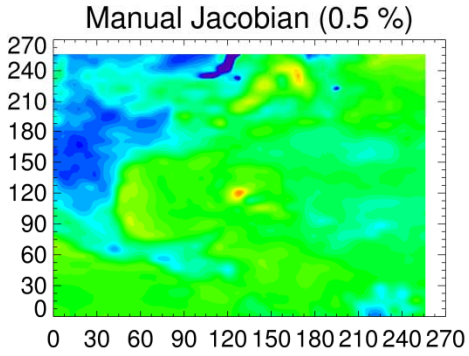
Observed



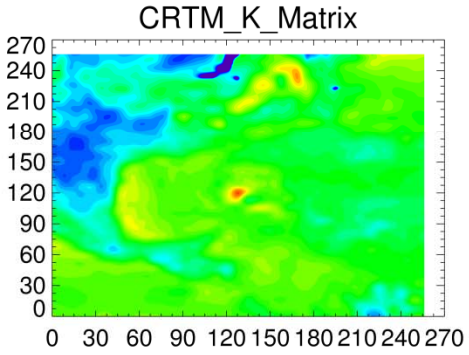
CRTM checkout – K-Matrix

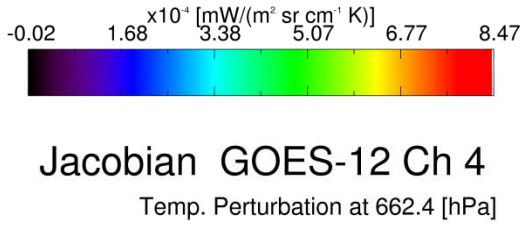
Manual partial derivative computed Jacobian for temperature @ 662 hPa





CRTM Version 2 K-Matrix result





For the low-levels the thermal Jacobians and K-matrix **results look very reasonable**. We are seeing some **differences at the 100 hPa level** where the standard atmosphere is spliced into the lower-level, model produced profile. Water and ozone gas concentration perturbations are under study.

Soon will be working with CRTM v.2 visible

- Currently, DA work with CRTM version 2 IR/MW.
- IR (GOES channels) and AVHRR microwave channels working well.
- Plans to begin examining visible data (GOES) since these are actively used in our cloud analysis (has been since 1990).
- Hope to have more of this at the AMS satellite conference.

Enhanced use of mesoscale satellite cloud image data in DA

- Probably one of the most under-utilized data sets in current GOES
- Current variational minimization has been disabled since HMT last spring due to over-humidification of LAPS moisture.
- Modification of the functional to use only in stratus cloud-typed areas, convective clouds caused problems

Modification of DA functional to revisit cloud humidity enhancement – emphasis on scale, and cloud type

$$J = S_{SAT}\sum_{k=1}^{7}\frac{\mathrm{GT}(g_i)[\mathrm{R}(T,cq,o_3)_i - R_i^o]^2}{E_{SAT}^2} + \sum_{i=1}^{N}\frac{(1-c_i)^2}{E_{BACK}^2}$$

$$+ S_{GPS}\frac{\left(\sum_{i=1}^{N} c_i q_i - Q^{GPS}\right)^2}{E_{GPS}^2 L_{GPS}} + S_{sonde}\frac{\sum_{i=1}^{N}\left[\mathrm{RH}\left(T,p,cq\right)_i - RH_i^o\right]^2}{E_{sonde}^2 L_{sonde}}$$

$$+ S_d S_{GVAP}\sum_{j=1}^{3}\frac{\mathrm{G}(g)[\sum_{i=1}^{N}\frac{\Delta}{\Delta x}\mathrm{P}_{ji}(c_i q_i) - \frac{\Delta}{\Delta x}Q_j^{GVAP}]^2}{E_{xGVAP_j}^2 L_{GVAP}}$$

$$+ S_d S_{GVAP}\sum_{j=1}^{3}\frac{\mathrm{G}(g)[\sum_{i=1}^{N}\frac{\Delta}{\Delta y}\mathrm{P}_{ji}(c_i q_i) - \frac{\Delta}{\Delta y}Q_j^{GVAP}]^2}{E_{yGVAP_j}^2 L_{GVAP}}$$

$$+ S_{CLD}\sum_{i=1}^{N}\frac{\mathrm{g}_i[c_i q_i - q_s(t_i)]^2}{E_{CLD}^2}$$

Cloud utilization enhancement

- LAPS system is now at 1km running 15min cycles
- Will be able to utilize full potential of satellite imagery (including visible)
- Being incorporated into STMAS and the GSI component within STMAS
- Wish to share with NCEP and others when complete (GSI elements)

Summary – areas of desired interaction

- Cloudy data assimilation
- CRTM validation with case studies
- Model microphysics validation and improvements to either the physics or CRTM
- Share strategic approaches on cloudy DA with GSI developers
- Utilize visible cloud data in analysis to a greater degree than we currently do