

Ceiling and Visibility

NextGen Workshop

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Szoke

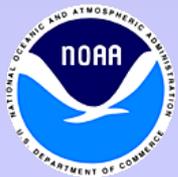
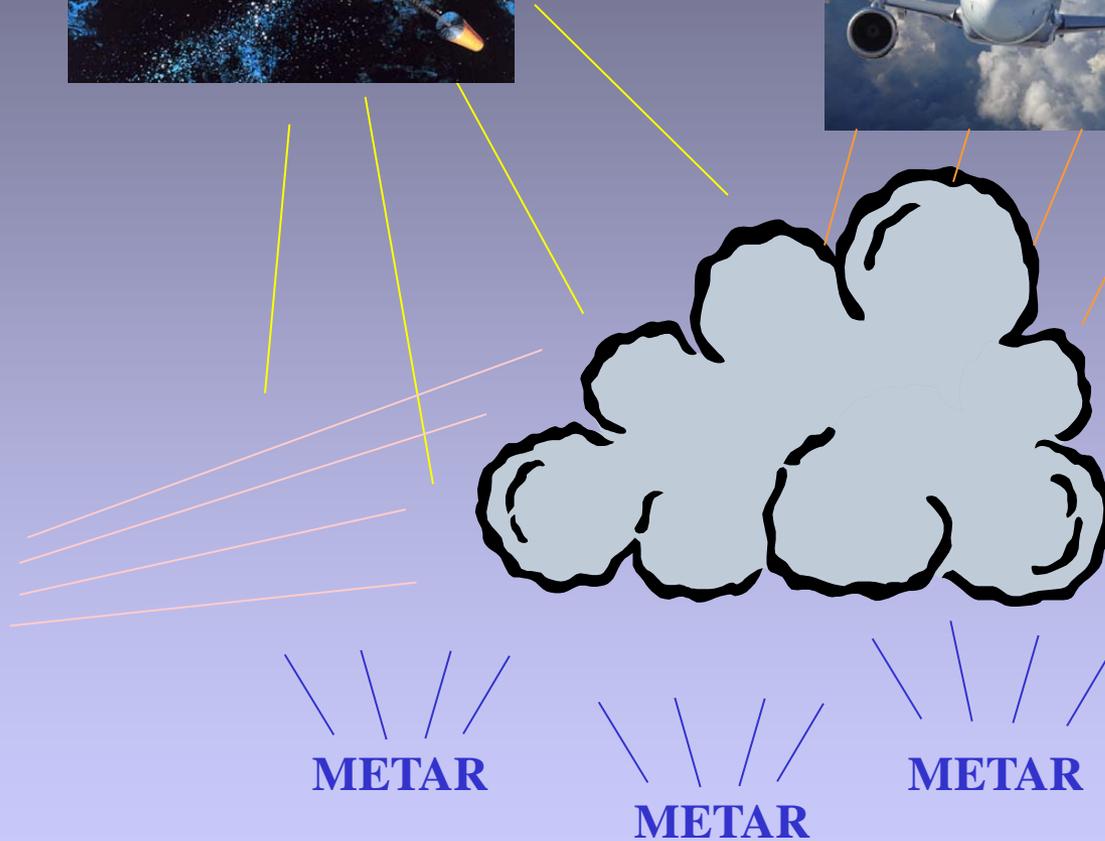
OAR/ESRL/GSD/FAB

March 22-24, 2010

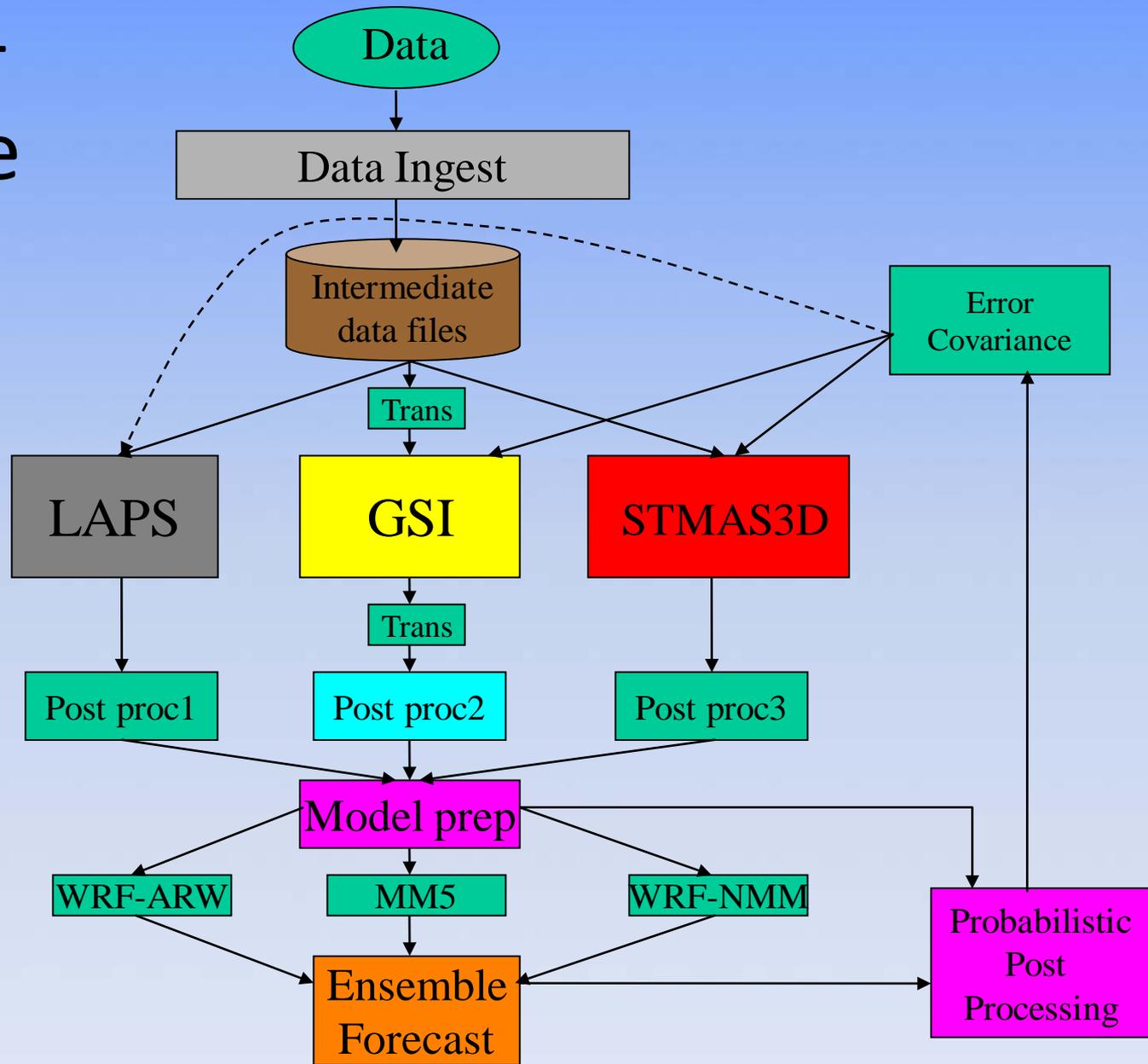


LAPS Cloud analysis

C&V / Icing



LAPS DA-Ensemble System



Some LAPS History

1989 - Wind Analysis Developed, Radar remapping of V,Z

1991 - Cloud Analysis / hot start developed and tested in the WISP experiment (with NCAR)

1992 - T-LAPS installed at 40 ITWS sites using Doppler Winds

2-km resolution every 5-min by 1998

Compare with national 2-km by ~2013

2000s - Cloud analysis / hot start elements incorporated into RUC running at NCEP

2006 - STMAS surface analysis developed & tested at MIT/LL for CoSPA

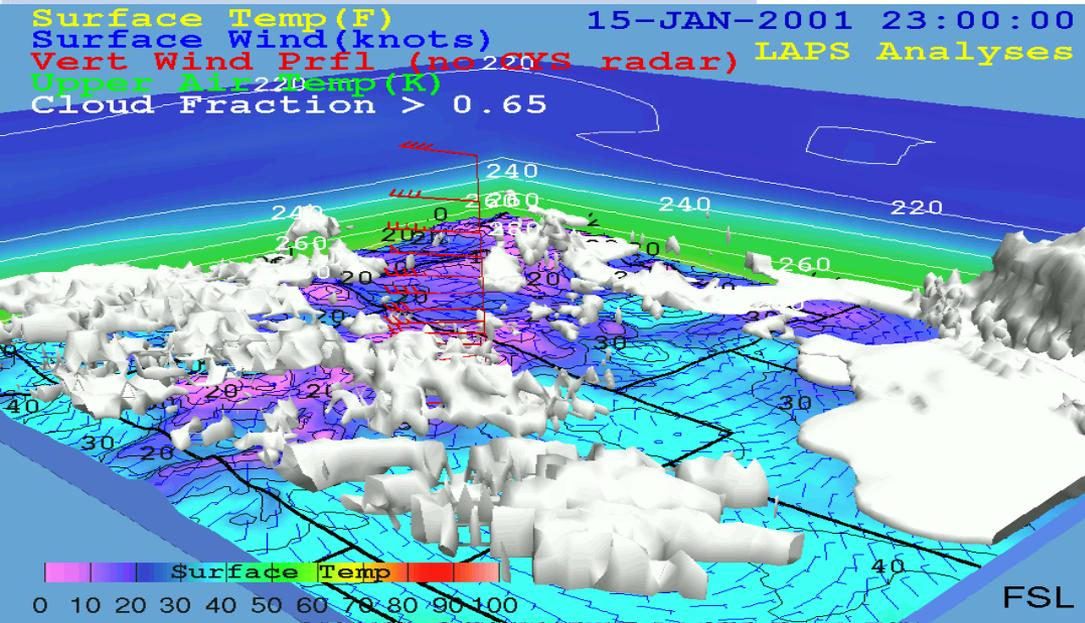
2009 - STMAS 3-D analysis developed

STMAS (state vars + clouds) → GSI → HRRR in future?

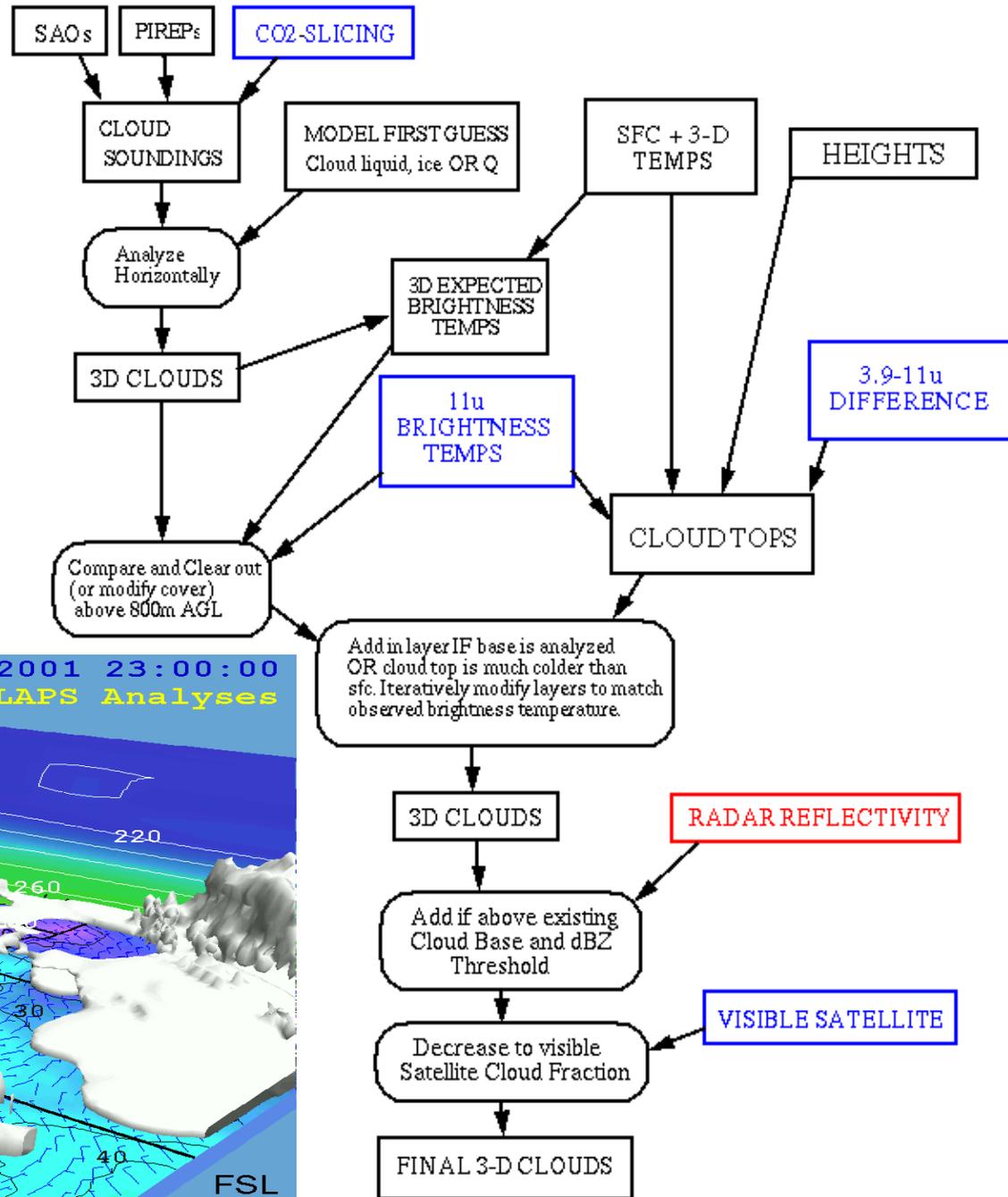


Cloud Analysis Flow Chart

Cloud Fraction 3-D Isosurface



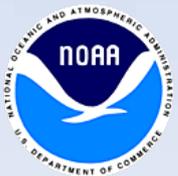
LAPS CLOUD ANALYSIS



Satellite use in Cloud Analysis

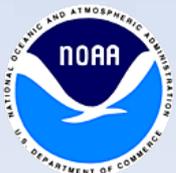
(GOES / SEVIRI)

- 11 micron IR
- 3.9 micron data
- Visible (with terrain albedo database)
- CO2-Slicing method (Cloud-top pressure)

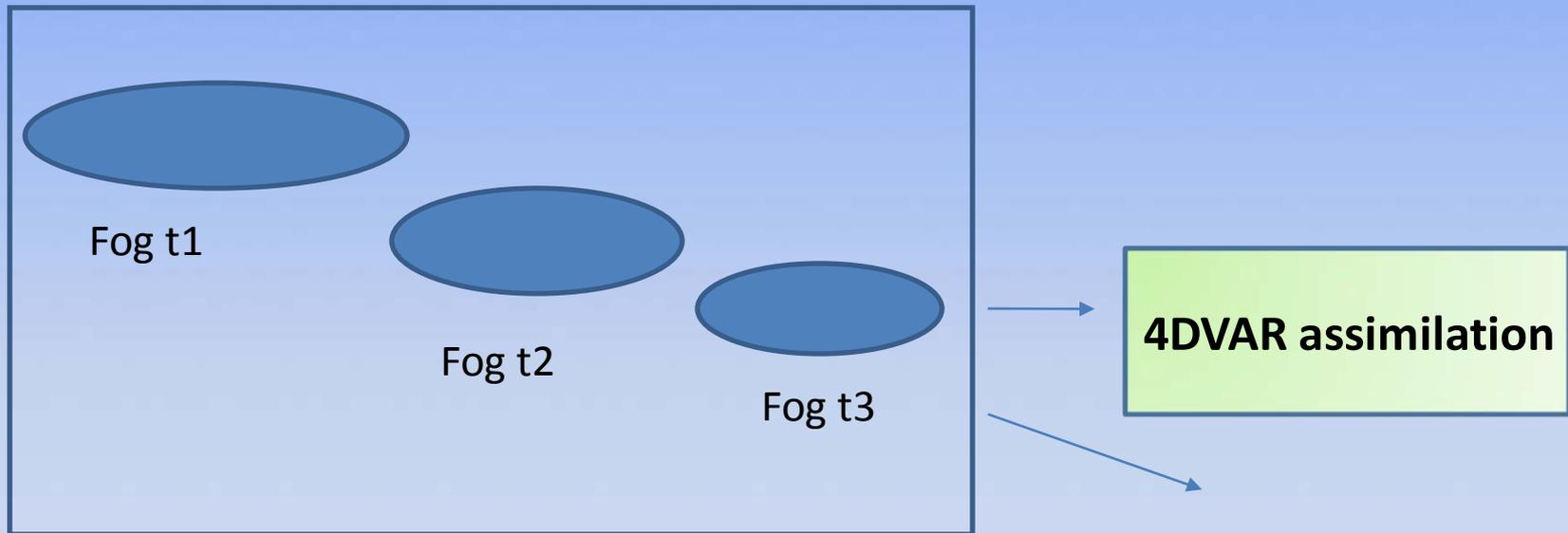


Satellite Fog Dissipation

- Relies on satellite visible imagery input to 4DVAR assimilation system
- Useful for daylight determination of early morning “burnoff” of fog
- IFR to VFR forecast timing
- Can interface with the **new** CRTM visible channel satellite forward radiance model



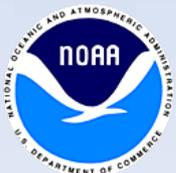
Temporal gradient assimilation with 4DVAR



Prior observations

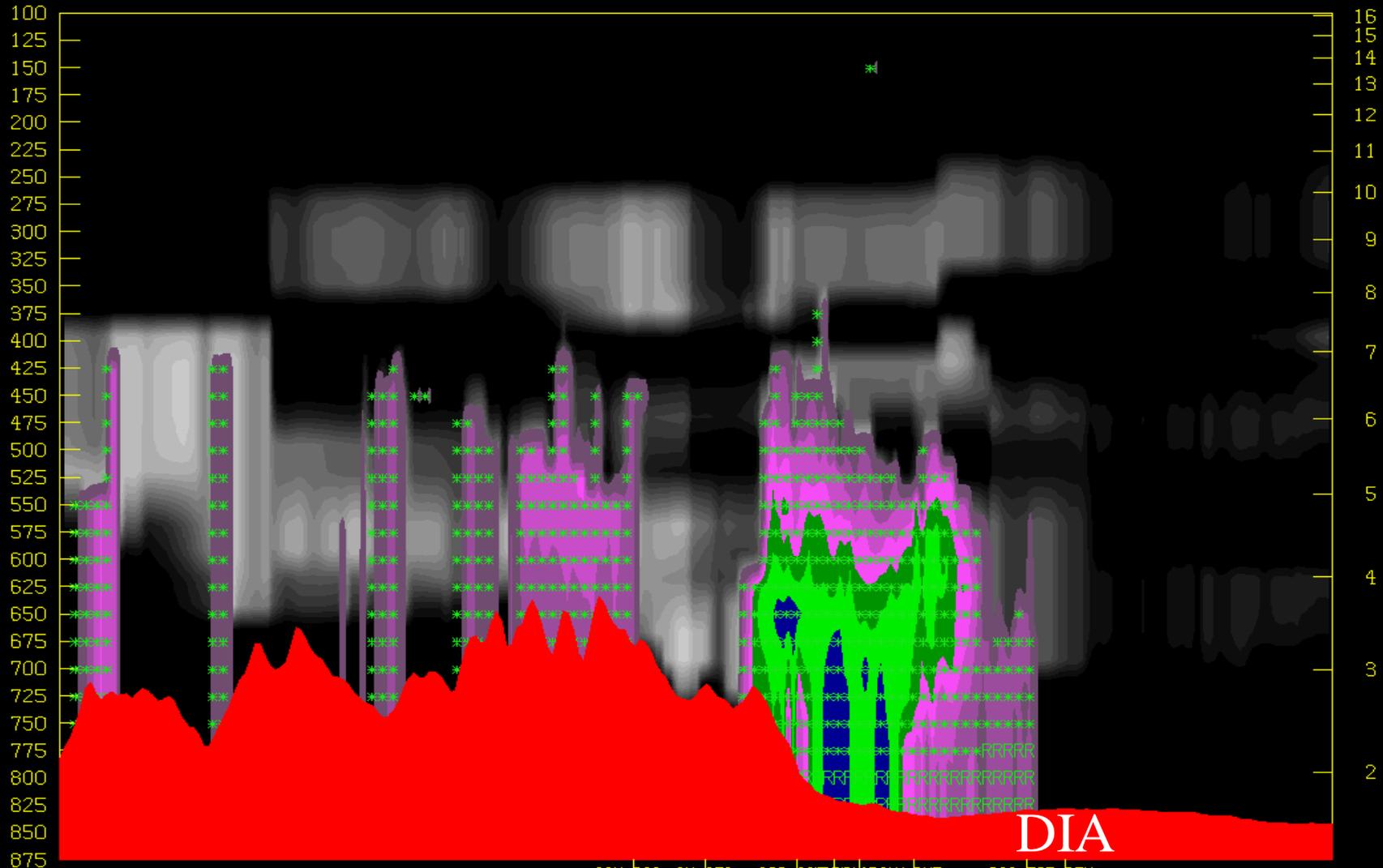
Fog t4

Forecast



Cloud / Reflectivity / Precip Type (1km analysis)

NOAA/ESRL LAPS 



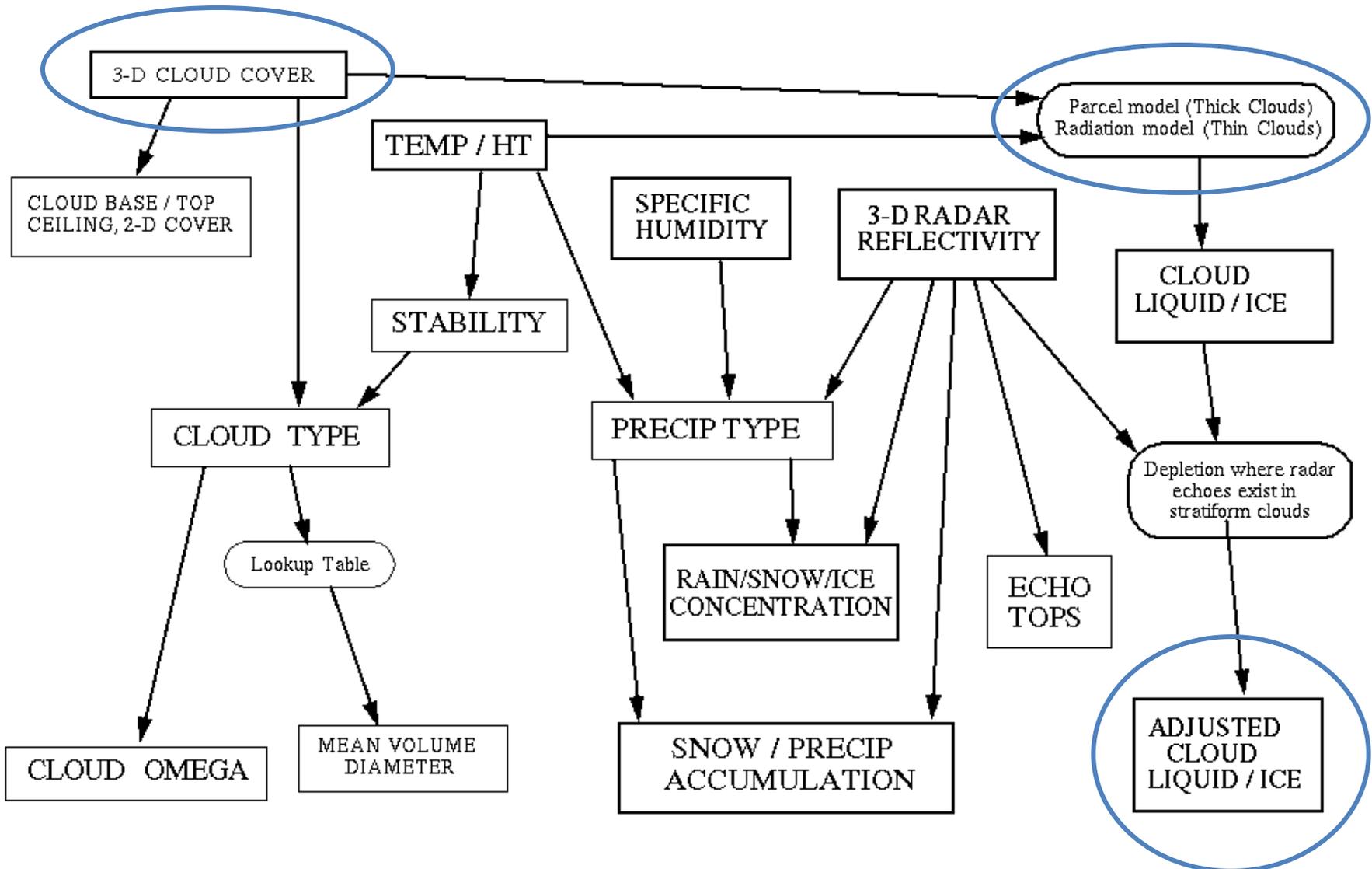
DIA



39.82
-106.95 Gridded Cloud Cover X-Sect VT 23-Mar-2010 2000 UTC -104.05
LAPS Reflectivity Vert X-Sect VT 23-Mar-2010 2000 UTC
LAPS Precip Type VT 23-Mar-2010 2000 UTC

Cloud Liquid Analysis

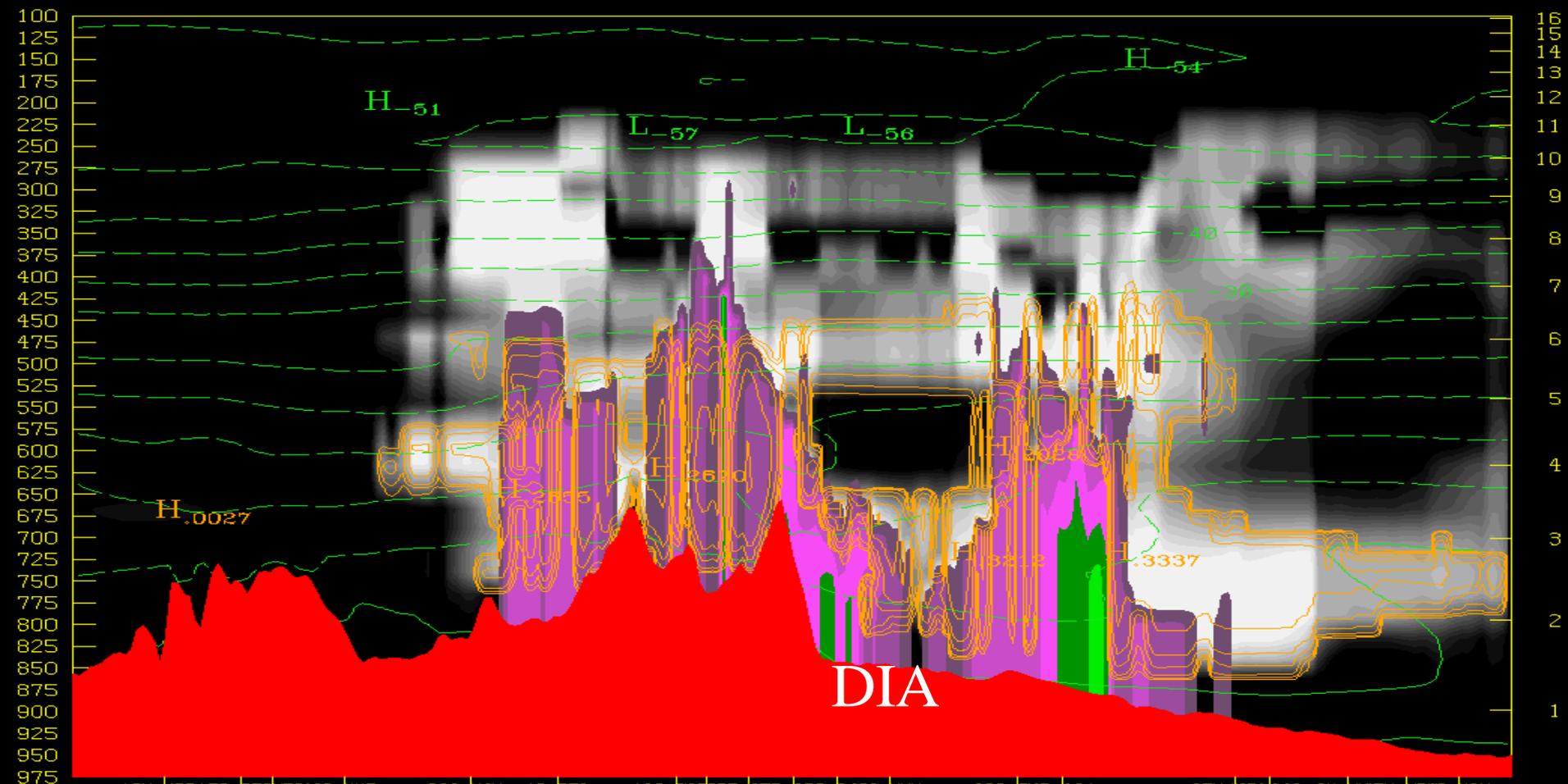
LAPS DERIVED CLOUD / HYDROMETEOR FIELDS



Cloud liquid / Temperature (5km analysis)

Cloud Ice / Precipitating Ice also analyzed (not shown)

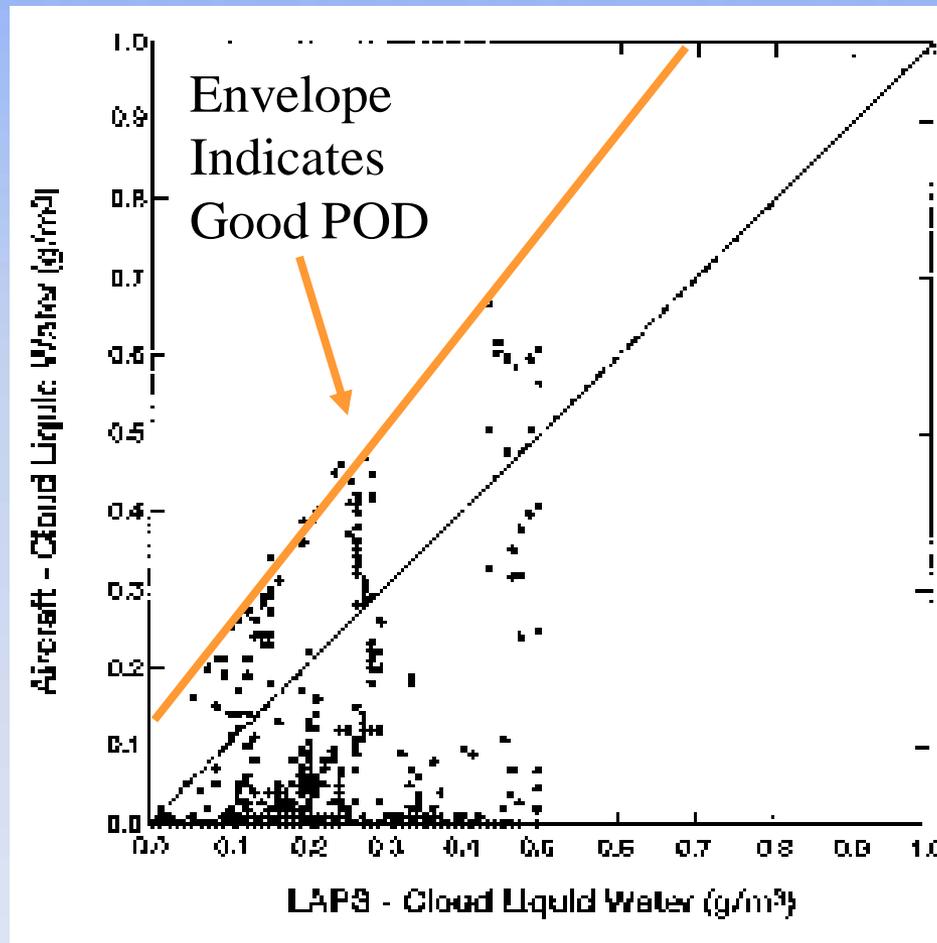
NOAA/ESRL LAPS



DIA

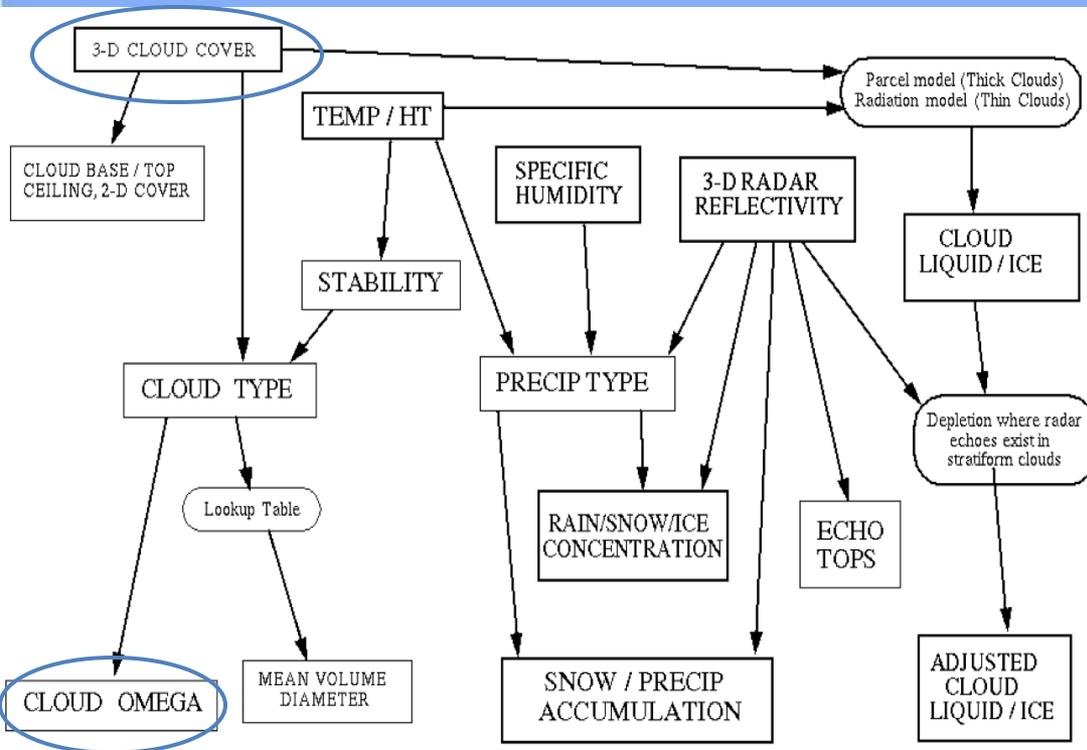
39.71 18N NEP17S 65SUT140S MYT 23S K4V 6S EEO 10S 100203 65S 650 64AS KNY 32S 640S 634 27N 108A 649 3N KN15N KP16S KSM 39.71 -98.25
Gridded Cloud Cover X-Sect VT 19-Mar-2010 1100 UTC
LAPS Reflectivity Vert X-Sect VT 19-Mar-2010 1100 UTC
LAPS Temp Vert X-Sect Deg C VT 19-Mar-2010 1100 UTC

Analyzed Cloud Liquid vs WISP Aircraft measurements



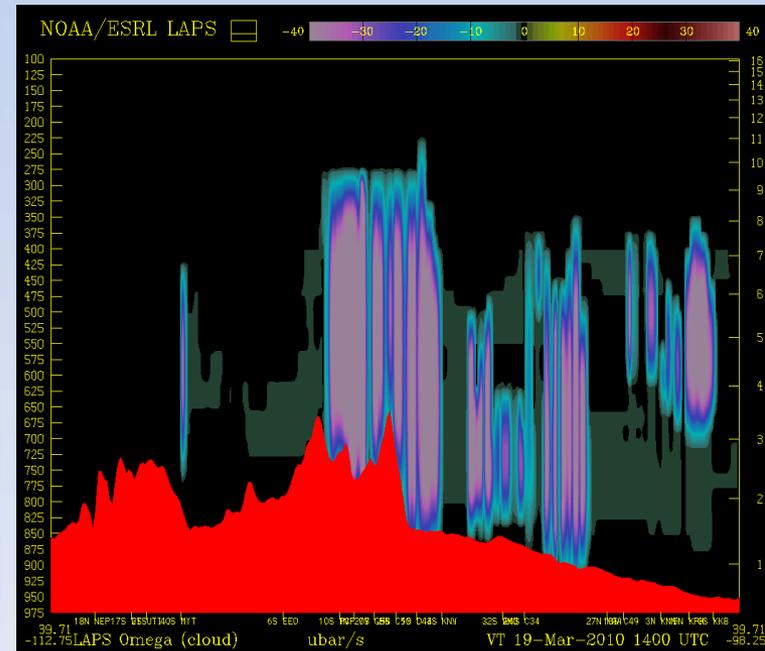
Scatter (FAR) due to unresolved small-scale LWC variability, otherwise good analysis of icing potential

Vertical motion and Hot-Start

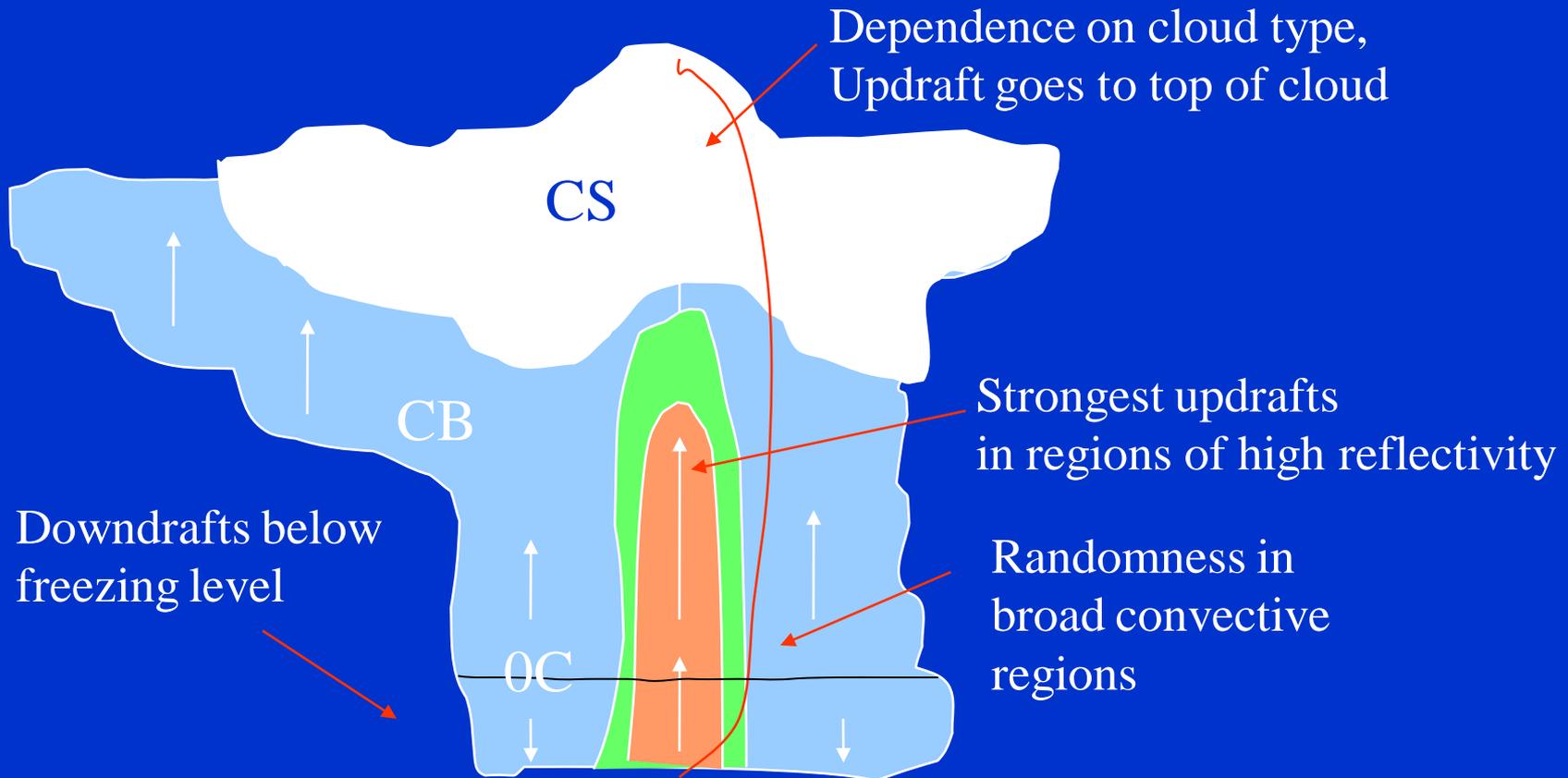


LAPS hot-start scheme
Dramatically improves
Very short-range forecast,
Importance to terminal
Scale forecasts

The hot-start scheme will be adapted into STMAS, a multi-grid variational data assimilation system with satellite, radar, conventional obs and model dynamic constraint applied simultaneously.



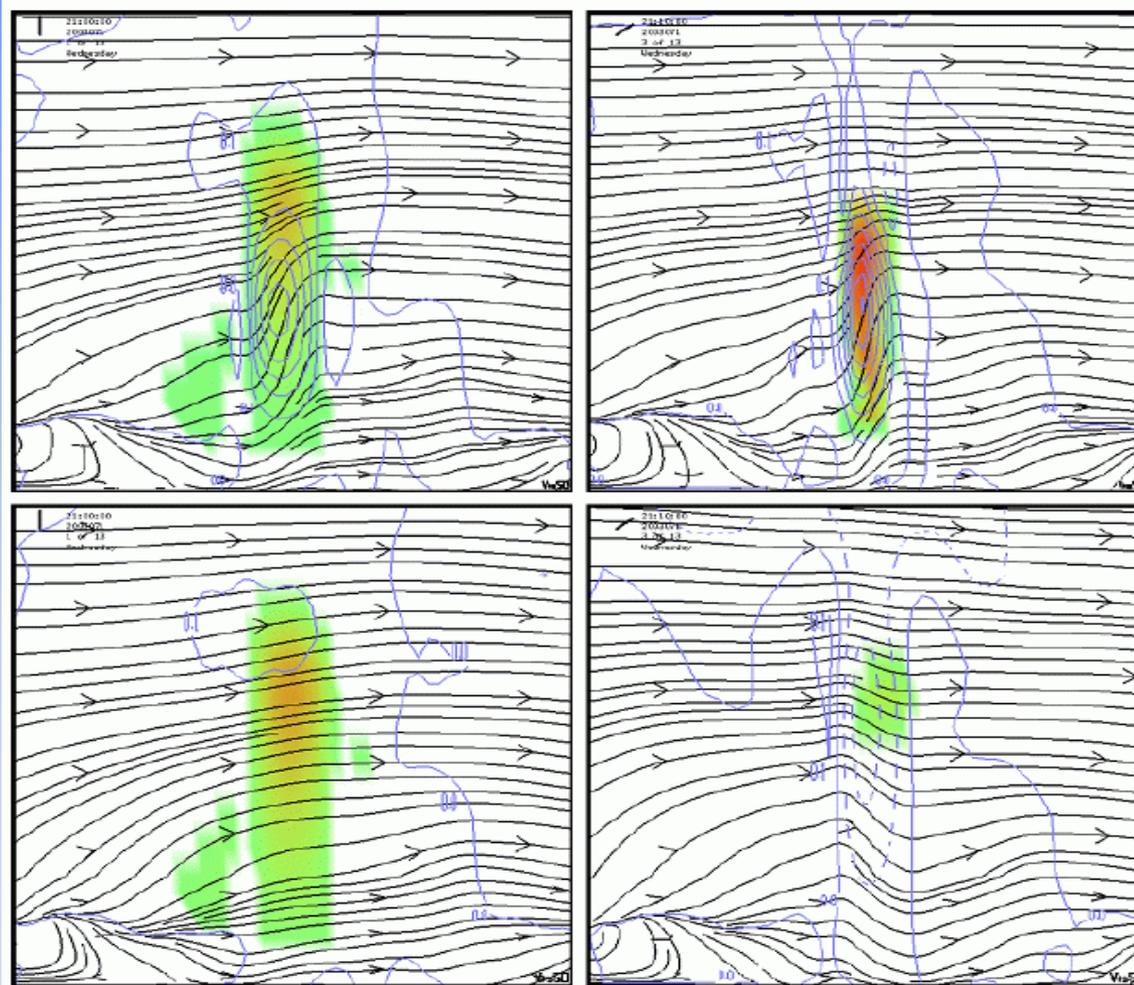
Cloud vertical motion for LAPS developed at FAB and Taiwan CWB



Initialization

5 min forecast

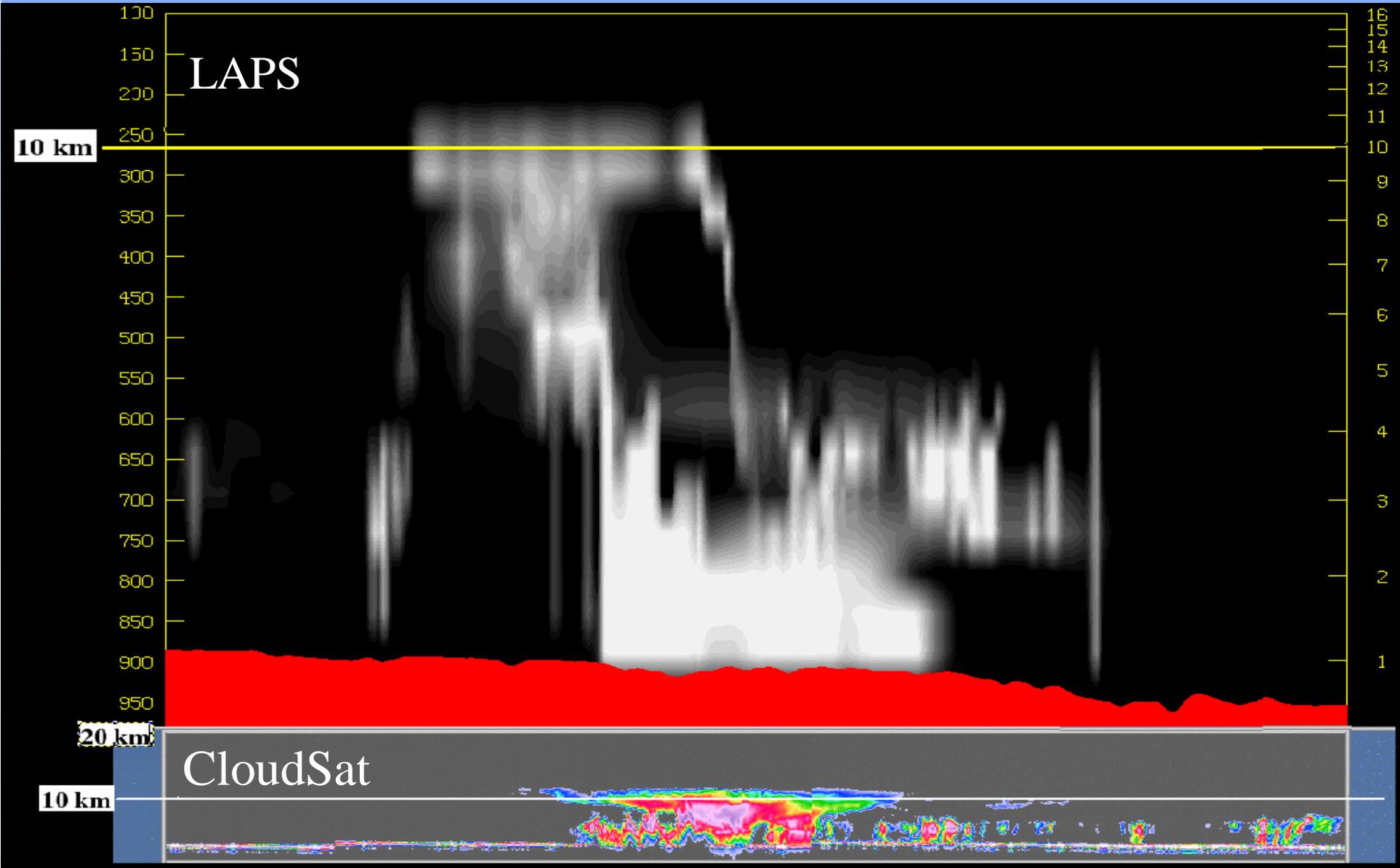
Hot Start



Cloud insertion

Cloud liquid (shaded), vertical velocity (contours) and cross-section streamlines for analyses (right) and 5-min forecasts (left). The top pair shows LAPS hot-start DI with upward vertical motions where clouds are diagnosed and properly sustained cloud and vertical motions in the forecast; the bottom pair demonstrates the artificial downdraft that usually results from simply injecting cloud liquid into a model initialization without supporting updrafts or saturation. Note that cloud liquid at the top of the updraft shown in the hot-started forecast (above right) has converted to cloud ice.

CloudSat Verification of LAPS Cloud Analysis



Future Cloud Analysis Development

- Higher Resolution Time/Space
- Develop forward models for all data sources being used to more fully implement a variational approach
- Incorporate into STMAS & GSI
- Consider new data sources

