Assimilation of Level-1D ATOVS Radiances in the Australian Region LAPS System

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The Domains of the Operational Suite of
Numerical Weather Analysis and Prediction Systems

GASP
- Global Analysis and Prediction System
- T255 assimilation half wave length resolved (~71 km)
- 24 levels
- Prediction to 8 days

LAPS
- Limited Area Prediction System
- Australian Region
- 0.375° horizontal grid spacing
- 26 levels
- Prediction to 72 hours

TLAPS
- Tropical Limited Area Prediction System
- 0.375° horizontal grid spacing
- 26 levels
- Special features for tropical analysis
- Prediction to 48 hours

MESO-LAPS
- Smaller scale versions of LAPS
- 0.125° - 0.375° horizontal grid spacing
- 21 levels
- Prediction to 36 hours
- Special version for tropical cyclone prediction
LAPS 0.375° grid

MESOLAPS 0.125° grid

TXLAPS 0.375° grid

CITY-CENTRED DOMAINS 0.05° grids
LAPS Configuration

- Hydrostatic
- Miller-Pearce explicit time-stepping scheme
- Third order upwinding advection scheme
- ECMWF land surface and vertical diffusion scheme
- Radiation: Fels-Schwartzkopf (SW) Lacis-Hansen (LW) 
  ==> Sun-Edwards-Slingo
- Convection: Tiedtke’s, early ECMWF mass flux scheme with MC trigger and closure. ==> CAPE closure
- Large Scale Rain : Bulk Explicit Microphysics
BOUNDARY CONDITIONS

First guess

GASP

ANAL INIT

ANAL

FORC

FORC

FORC

FORC

LAPS

ANAL INIT

ANAL INIT

ANAL INIT

24 Hr FORC

48 Hr FORC

DATA

1DVAR BIAS CORRECTION

1DVAR BIAS CORRECTION

T = −12hr

T = −6hr

BASETIME

T = 0

Cutoff at basetime + 50 min
1DVAR in the Bureau of Meteorology

\[ \min J = (x - x_b)^T B^{-1} (x - x_b) + (y_0 + y(x))^T [E + F]^{-1} (y_0 - y(x)) \]

- \( x_b \): background field
- \( y_0 \): observed radiances
- \( x \): control vector
- \( B \): background error covariance matrix
- \( E + F \): Observation and Forward model error covariance
- \( y(x) \): Forward operator

- Purser type dynamic error scaling
- Air mass dependent radiance bias predictors & bias monitoring
- Latitudinally varying scan correction
- Implemented operationally in GASP July 2000, LAPS Sept 2002
Local HRPT reception
Comparison of locally received and processed (AAPP) NOAA-17 1D radiances with corresponding NESDIS values.
LAPS 60-level Trials

1. All Met Office 1D radiance data available to final (base date-time) analysis
2. Restricted set of Met Office 1D radiances available to final analysis – simulates impact of early cut-off
3. NESDIS radiances (as used by operational LAPS system) used for all analyses
4. Locally received and processed 1D radiances used in final analysis

• All experiments nested in same GASP L60 trial
• All other data types as per operational model
FORECAST SKILL - MSLP

S1.MSLP.0.mdl 2005010112-2005022012

RMS.MSLP.0.mdl 2005010112-2005022012

BIAS.MSLP.0.mdl 2005010112-2005022012
FORECAST SKILL - Z

S1.HGHT.24.mdl 2005010112-2005022012

RMS.HGHT.24.mdl 2005010112-2005022012

- LAPS_RTO
- L60L60
- L60L60nes
LAPS  GASP

Radiance Bias Monitoring
Melbourne floods Feb 3rd 2005
Conclusions

- Significant improvement in forecast quality from transition to 60 vertical levels in LAPS
- Additional improvement from use of AAPP derived 1D radiances
- Early cut-off may be a less significant issue for final (base date-time) analysis
- Successful assimilation of locally received and processed radiances
Further work

- AMSU-B
- Rainfall forecast verification
- Aqua
- GenSI/3D-VAR
- Mesoscale (10 km) assimilation
  - more frequent (3 hourly) insertions
  - earlier data extraction cut-offs
    ⇒ local radiances essential