Generating Model Time Series

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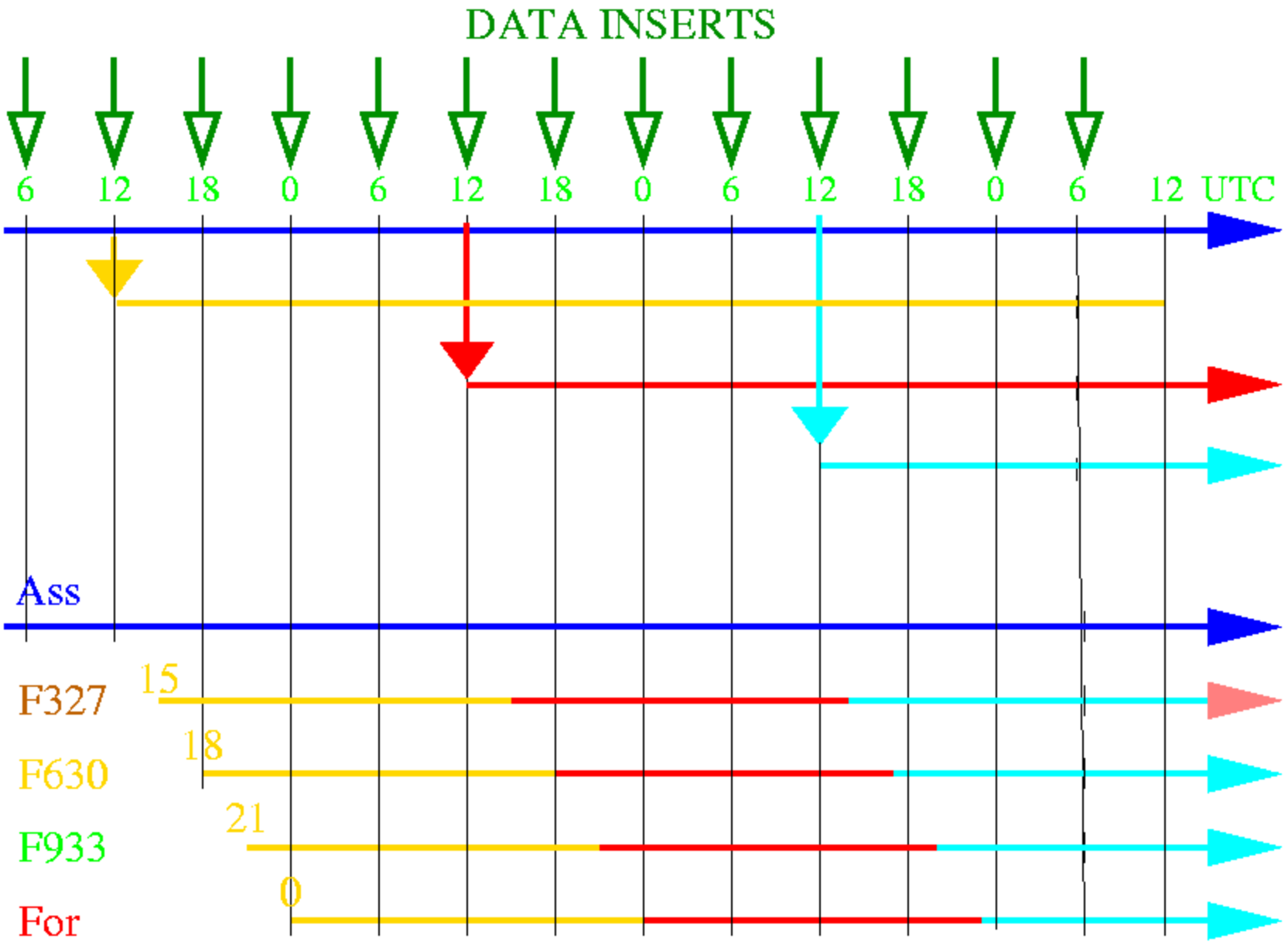
Abstract:

CEOP NWP MOLTS is generally available in two forms; a time series from the assimilation cycle and a series of longer forecasts initiated from 12UTC each day during the observing period. In-situ data consists of contiguous series of (generally) hourly data. In comparing the model and in-situ data the first decision therefore is which model data to actually use. This paper discusses this problem in the context of a simple investigation of the diurnal behavior of the Bureau of Meteorology's MOLTS data .

The time sequence of assimilation and forecasts



Concatenating MOLTS series

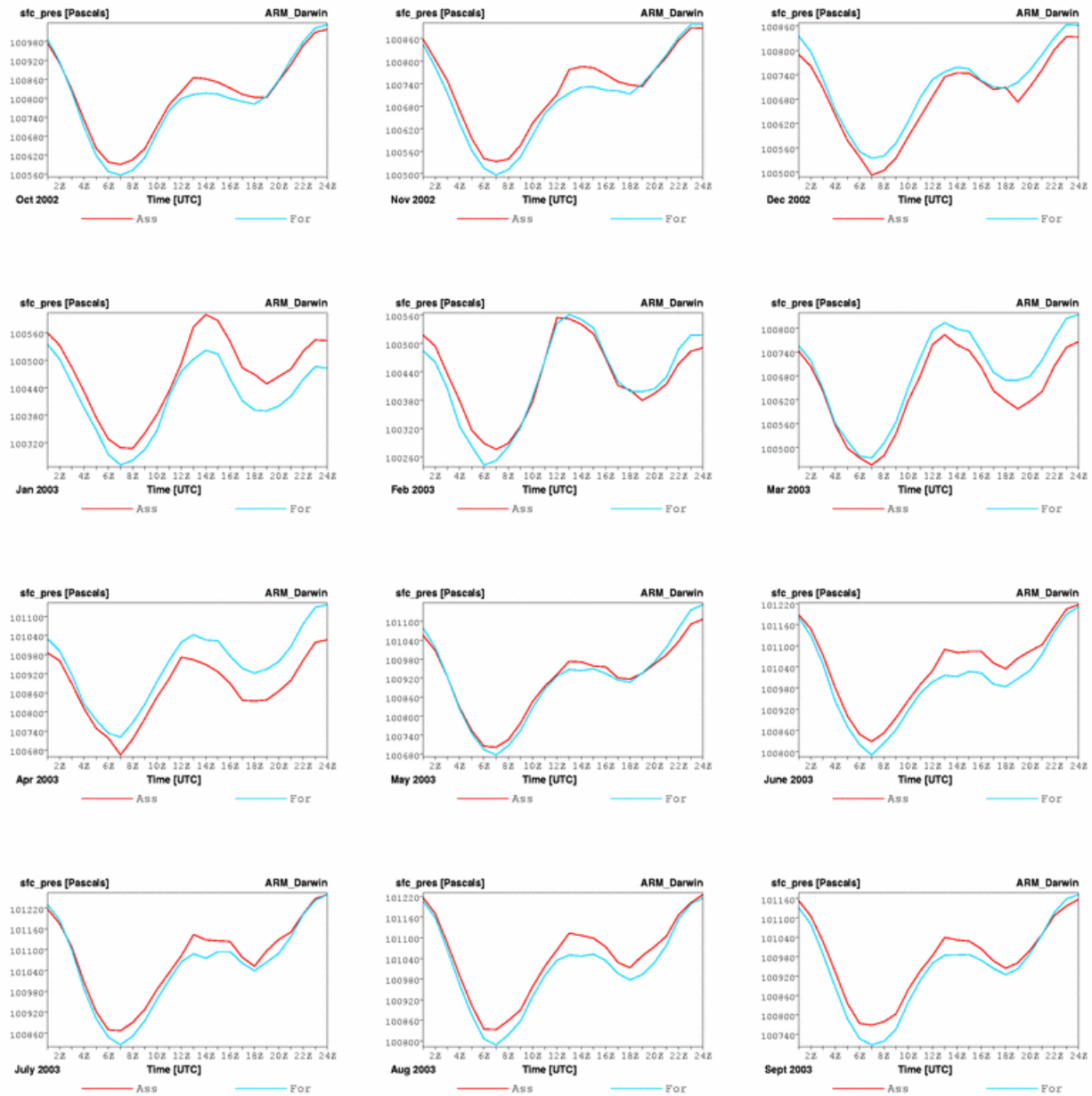
- Possible MOLTS netCDF time series
  - pure analysis
    - 6 hourly
      - best model guess for 'reality'?
  - assimilation cycle
    - add in hourly output from model first guess forecast
      - close to 'reality'
  - forecast series
    - concatenate a 24 hour segment from each day
      - **which 24 hours?**
        - starting later in forecast – further from 'reality'
        - different choices sample different phases of model spin-up

An example: diurnal behavior

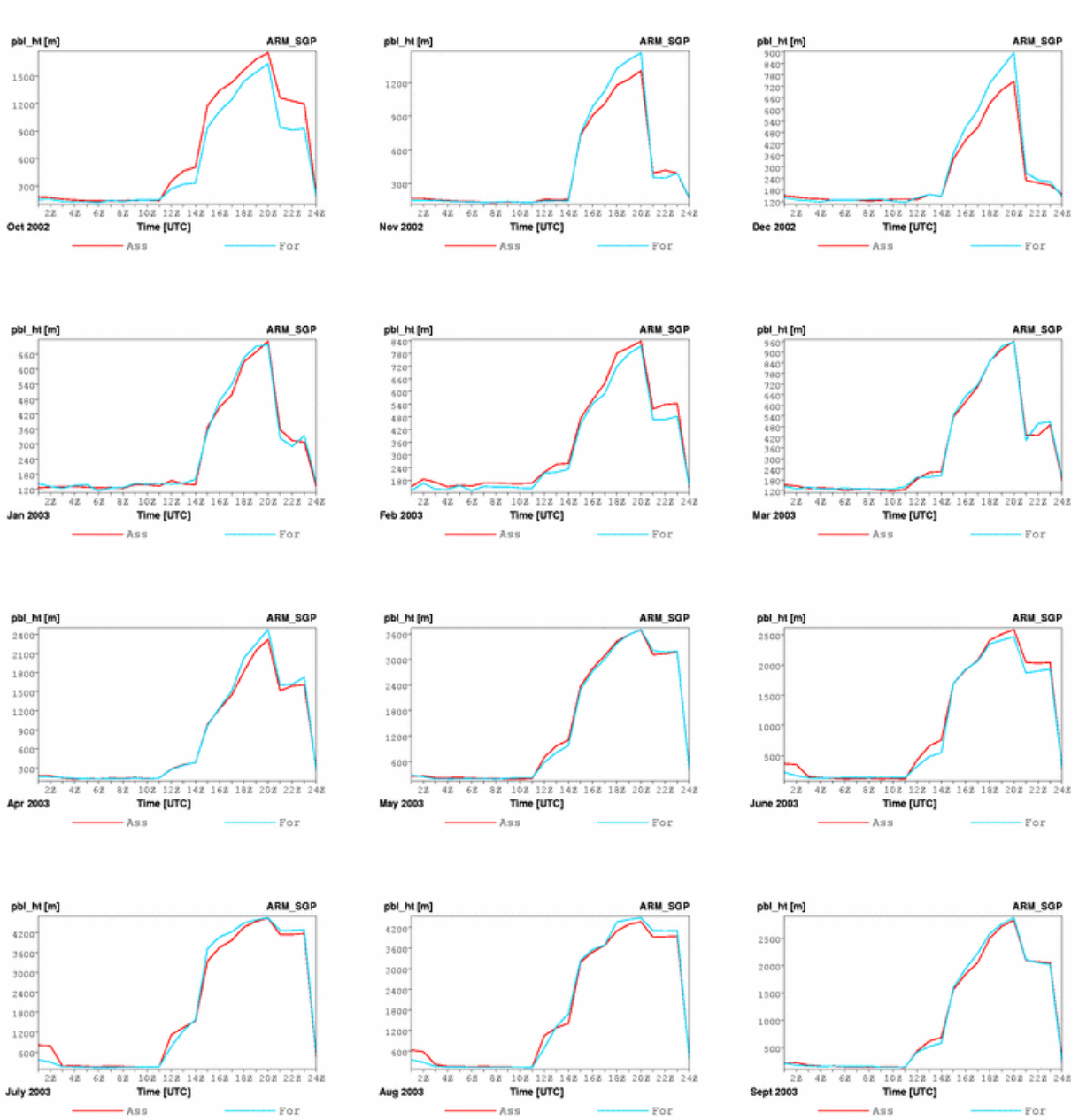
Locations

- The ARM Southern Great Plains Site (SGP)
  - data rich region with a full suite of in-situ data.
- The ARM Darwin site
  - tropical environment with attendant seasonality and reliance on convection.
- The Western Pacific site
  - nominally an oceanic surface in a data sparse region, dominated by satellite data.
- Caxiuna
  - land site in data sparse region where model has assimilation 'issues'

Darwin surface pressure



PBL Height for the ARM SGP site



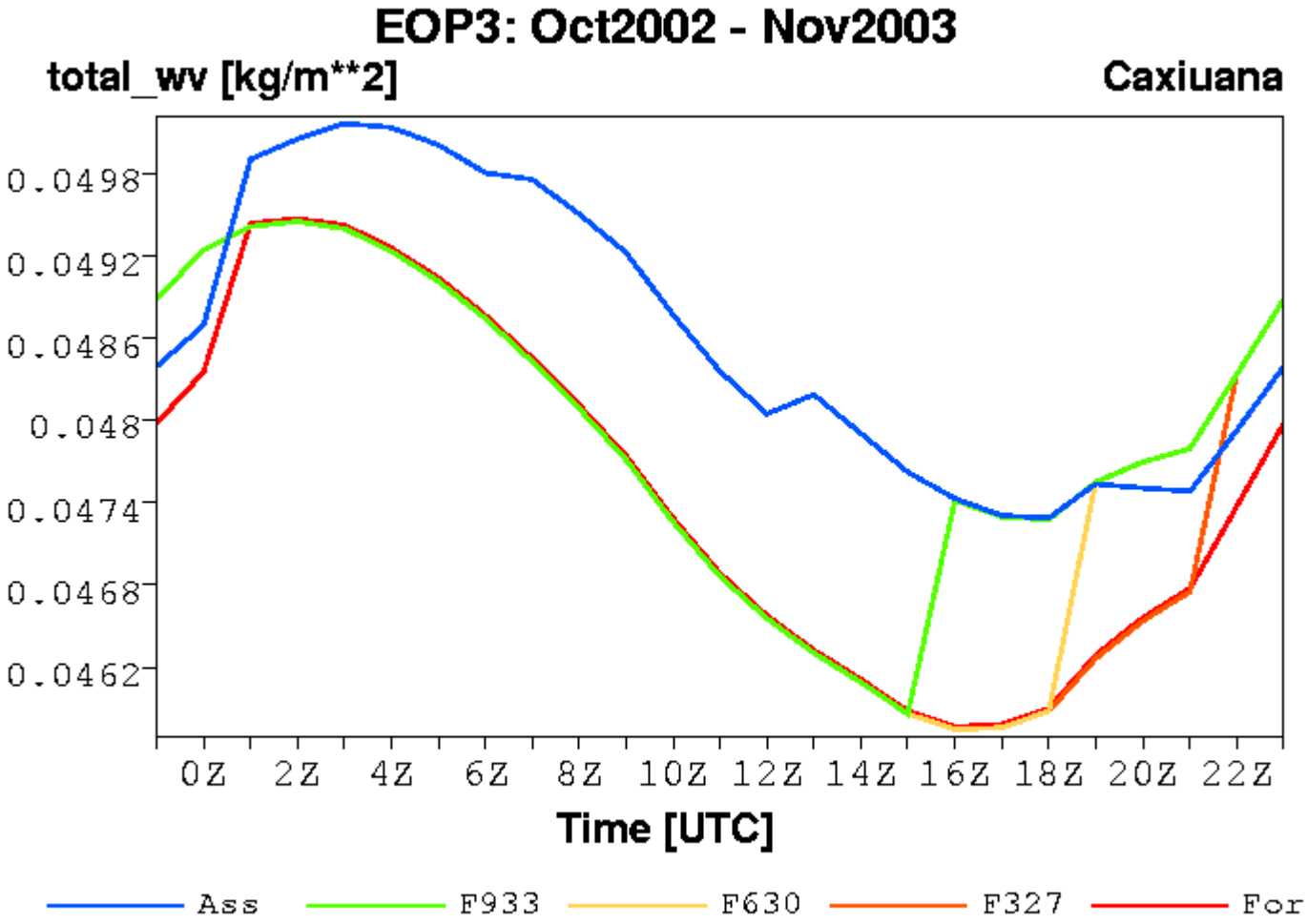
Remarks on the assimilation

- Discontinuities around insertion times
  - basically result of difference between data and first guess.
  - fields dependent on moisture most obvious
- These could be due to:
  - imbalances in analysis not allowed by model
    - result of independent moisture insertion
  - long intervals between data
    - e.g. 12 hourly satellite passes in data sparse regions
- Symptomatic of GASP assimilation method
  - minimized in 4DDA type schemes?

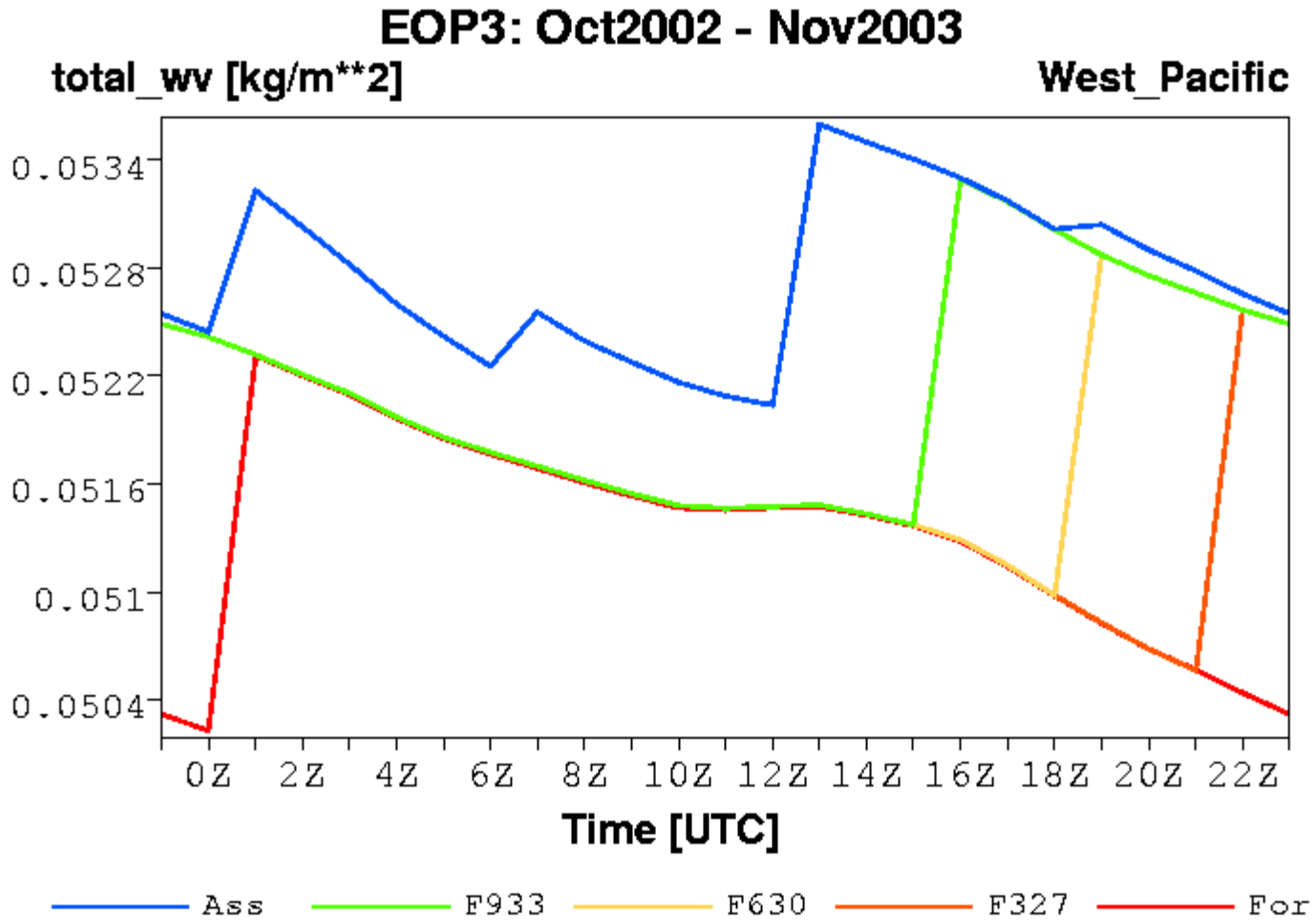
Annual Mean Diurnal Series

- Mean taken over entire EOP3 year
  - ignores intra-seasonal variability
    - most fields don't show much monthly variation anyway
      - except PRECIPITATION
  - emphasizes systematic problems
- Note that forecast series are identical for 1 – 15UTC
- Beginning of each series is closest to assimilation series
  - less time for model drift
- End of series 'jumps' back to assimilation
  - jump size depends on drift and **phase of diurnal cycle**

Caxiuana total water vapour



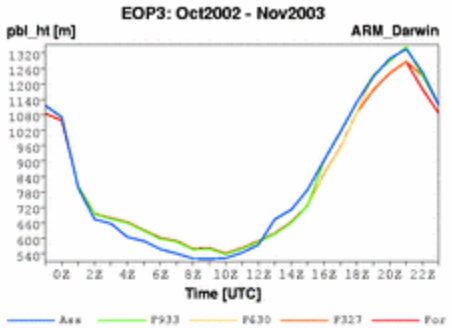
West Pacific total water vapour

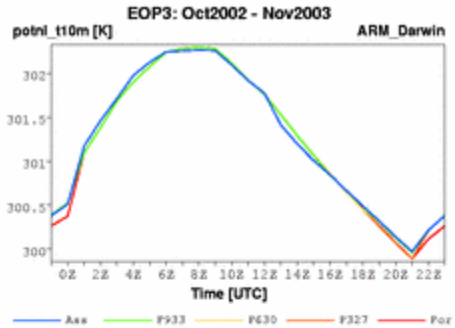


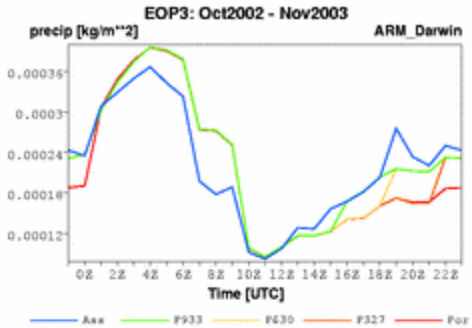
List of variables

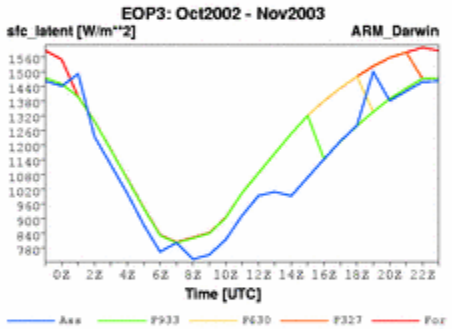
- **PBL Height**
  - diagnostic variable not assimilated
- **Surface Pressure**
  - prognostic variable - not assimilated but dependent on T and Φ
- **Surface Latent Heating**
  - diagnostic variable - not assimilated
- **Surface Sensible Heating**
  - diagnostic variable - not assimilated
- **Potential Temperature at 10m**
  - diagnostic variable with strong dependence on assimilated T.
- **Total water vapour**
  - based on a prognostic variable strongly modified by assimilation.
- **Precipitation**
  - strongly dependent on model fields, imbalances due to data insertion and **numerics**

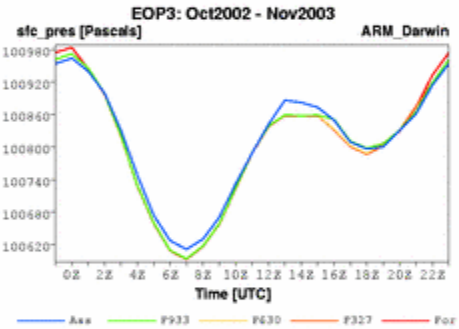
Summary for Darwin

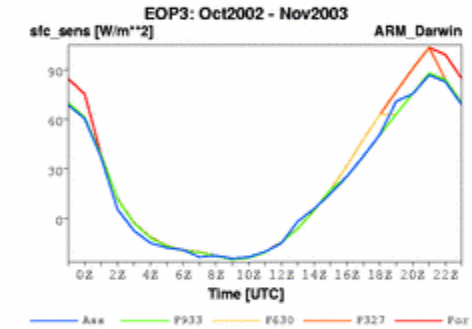


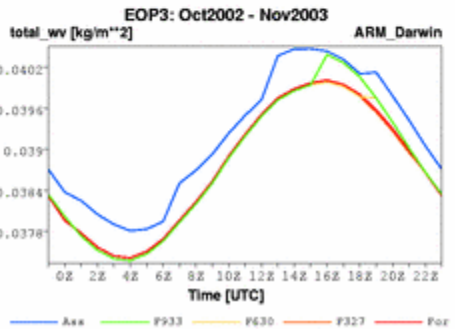


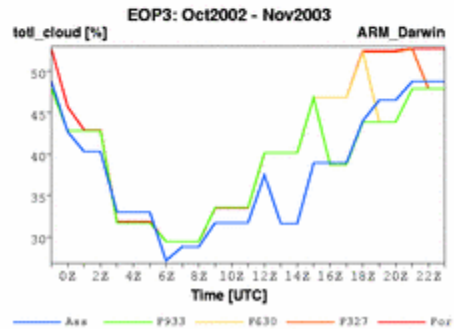




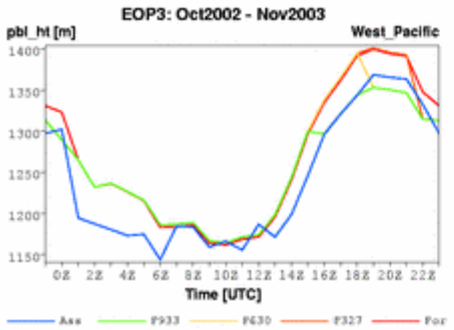


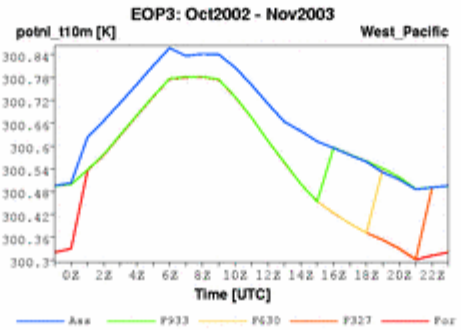


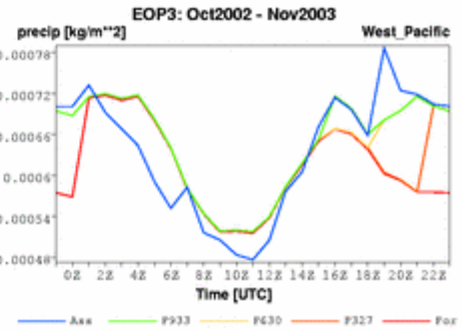


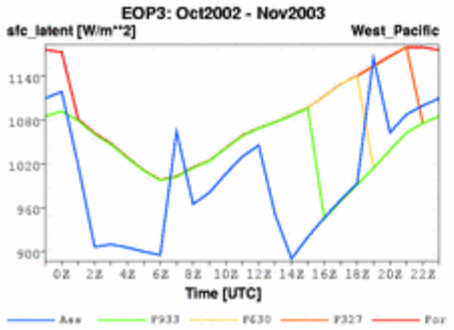


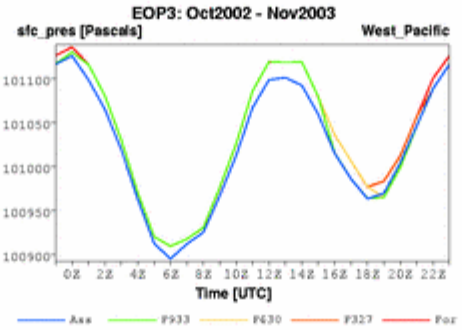
Summary for Western Pacific site

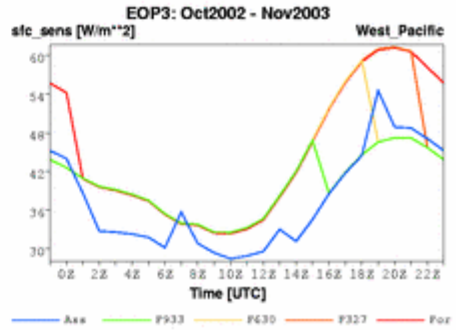


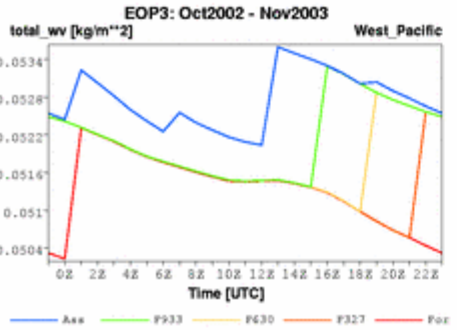


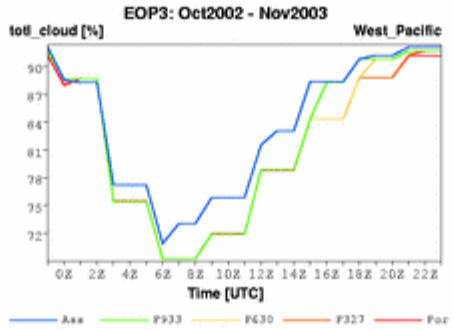












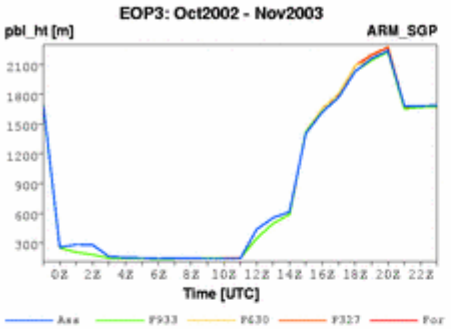
Conclusions (1)

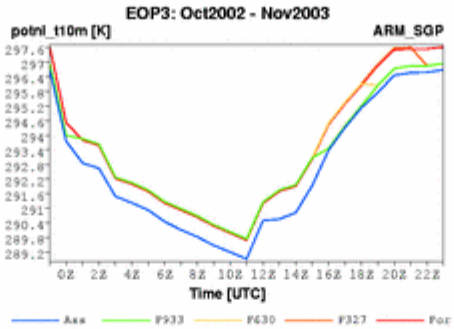
- Model drift needs to be taken into account when comparing MOLTS and in-situ data.
  - even 'straight' assimilation data has potential problems
    - first guess forecast can have drift
    - systematic diurnal variations in data quality and quantity
  - series based on forecasts **could be worse**
    - (long lead time series might be better but further from analysis)
- Different time series based on different parts of the forecasts are a useful diagnostic

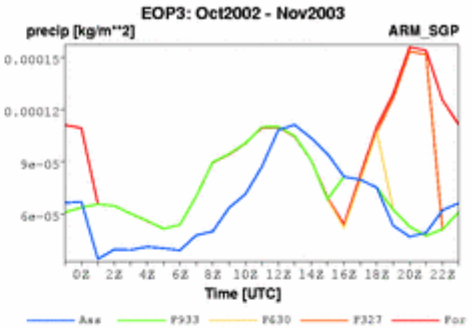
Conclusions (2)

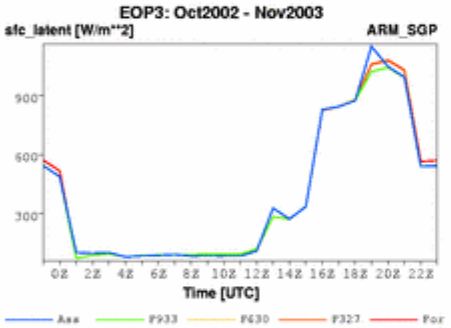
- Users of the data should have access to a number of different time series.
  - need more than assimilation and 12 – 36 hour series on archive.
- These results probably specific to GASP
  - water vapour assimilation not done well
  - 4DDA might not show same problems
    - but don't bet on it!
    - problems with variation in data quantity etc still there
    - models always have drift

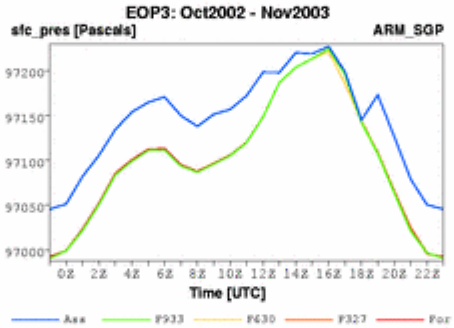
Summary for SGP site

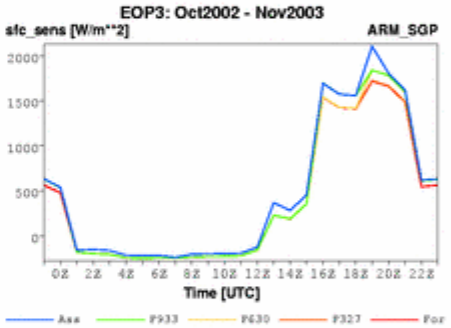


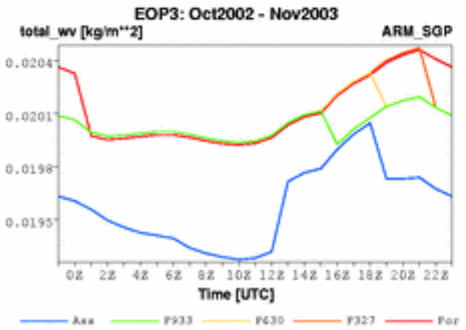


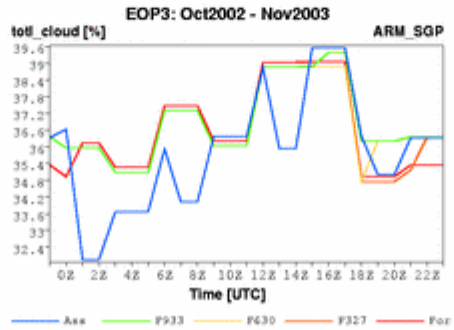












Summary for Caxiuana