Evaluation of Space Based Doppler Wind Lidar in Joint OSSEs

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http://www.emc.ncep.noaa.gov/research/JointOSSEs

Full OSSEs

There are many types of simulation experiments. Sometimes, we have to call our OSSE a 'Full OSSE' to avoid confusion.

- A Nature Run (NR, proxy true atmosphere) is produced from a free forecast run using the highest resolution operational model which is significantly different from NWP model used in DAS.

- For Full OSSE, all major existing observation have to be simulated and observational error have to be calibrated.

- Calibrations will be performed to provide quantitative data impact assessment.

In OSSE calibrations, real and simulated data impacts are compared. The results are used to evaluate data impacts in simulation experiments.

Advantage of Full OSSE

- Data impact on analysis and forecast will be evaluated.

- A Full OSSE can provide detailed quantitative evaluations of the configuration of observing systems.

- A Full OSSE can use an existing operational system and help the development of an operational system

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Existing Data assimilation system and vilification method are used for Full OSSEs. This will help development of DAS and verification tools.

Why International Joint OSSE capability!!

- Full OSSEs are expensive
  - Nature Run, entire reference observing system, additional observations must be simulated. Sharing one Nature Run **save the cost**
  - Calibration experiments, perturbation experiments must be assessed according to standard operational practice and using operational metrics and tools
- OSSE-based decisions have **international stakeholders**
  - Decisions on major space systems have important scientific, technical, financial and political ramifications
  - Community ownership and oversight of OSSE capability is important for maintaining credibility
- Independent but related data assimilation systems allow us to test **robustness** of answers

New Nature Run by ECMWF

Produced by Erik Andersson(ECMWF)

Based on discussion with

JCSDA, NCEP, GMAO, GLA, SIVO, SWA, NESDIS, ESRL, and ECMWF

Low Resolution Nature Run

Spectral resolution : T511 , Vertical levels: L91, 3 hourly dump

Initial conditions: 12Z May 1st, 2005 , Ends at: 0Z Jun 1,2006

Daily SST and ICE: provided by NCEP

Model: Version cy31r1

Two High Resolution Nature Runs

35 days long

Hurricane season: Starting at 12z September 27,2005,

Convective precipitation over US: starting at 12Z April 10, 2006

T799 resolution, 91 levels, one hourly dump

Get initial conditions from T511 NR

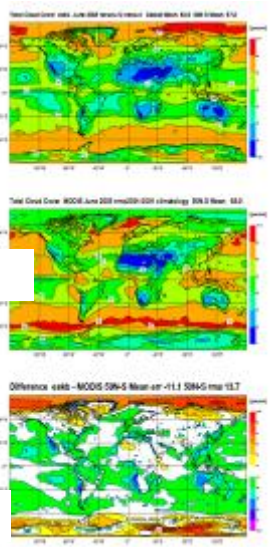
Note: This data must not be used for commercial purposes and re-distribution rights are not given. User lists are maintained by Michiko Masutani and ECMWF.

Evaluation of the Nature run

Comparison betwee NR the ECMWF T511 Nature Run against climatology

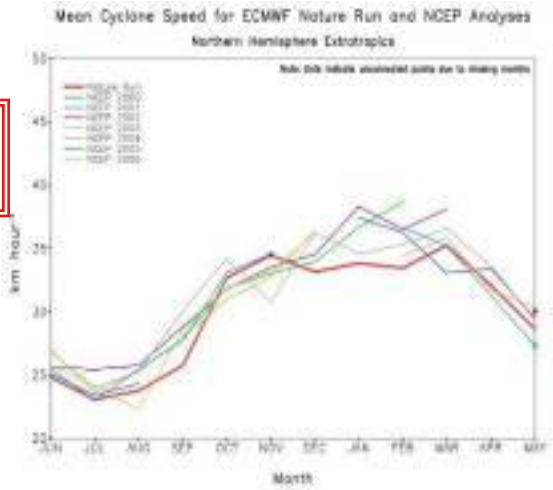
20050601-20060531, exp=e MODIS cycle=31r1

Adrian Tompkins, ECMWF

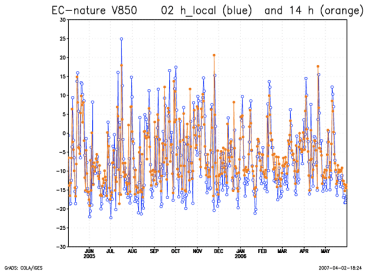


NR-MODIS

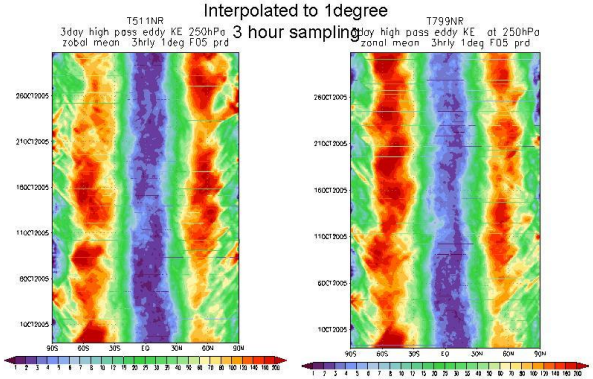
Utilize Goddard's cyclone tracking software. - By J. Terry(NASA/GSFC)



THE SOUTH AMERICAN LOW LEVEL JET
Juan Carlos Jusem (NASA/GSFC)



Time series showing the night intensification of the LLJ at the lee of the Andes in the simulation.
Gridpoint at 18 S / 63 W

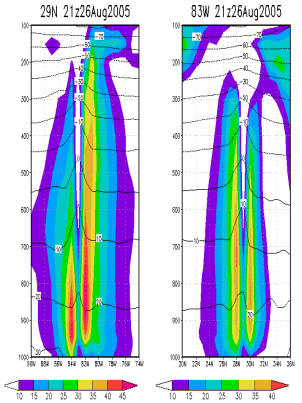


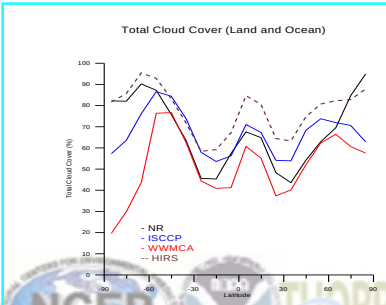
Toward end of October, SH become erroneously active in T799 NR.

M.Masutani (NOAA/NCEP)

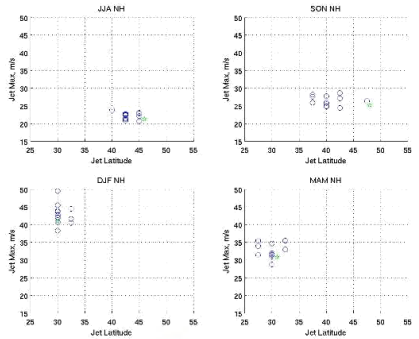
Tropics by Oreste Reale (NASA/GSFC/GLA)

Vertical structure of a HL vortex shows, even at the degraded resolution of 1 deg, a distinct eye-like feature and a very prominent warm core. Structure even more impressive than the system observed in August. Low-level wind speed exceeds 55 m/s.





Evaluation of T511(1°) clouds by SWA



Seasonal mean zonal mean zonal wind jet maximum strength and latitude of the jet maxima for the ECMWF reanalysis (1989-2001, blue circles) and the Nature Run (⊗), northern hemisphere. (N. Prive.)

Data Sharing in Joint OSSEs

Simulated observation and other useful data will be shared among Joint OSSE teams.

NASA/NCCS provided dis space for Joint OSSE data sharering
There is a entry created for Joint OSSE
http://portal-dev.nccs.nasa.gov/josse/index.pl

Make entry to each data set and generating institute, and contact person.

People use these data must contact generating institutes.

OSSE Calibration

- In order to conduct calibration all major existing observation have to be simulated.
- The calibration includes adjusting observational error.
- If the difference is explained, we will be able to interpret the OSSE results as to real data impact.
- The results from calibration experiments provide guidelines for interpreting OSSE results on data impact in the real world.
- Without calibration, quantitative evaluation data impact using OSSE could mislead the meteorological community. In this OSSE, calibration was performed and presented.

Simulation of control data for calibration

- Simulation of control data are difficult to be funded for specific OSSEs
- GMAO and NCEP are simulating control data

Data Simulation strategies at NCEP-NESDIS

Progress and current plan :

- Ozone data from SBUV
- Conventional data based on NCEP reanalysis quality controlled distribution. (More complete data set compared to operational data)
- Satellite radiance data in 2005 distribution. AMSUA, AMSUB, GOES, HIRS2, HIRS3, AIRS,MSU are being generated at foot print used by NCEP operational analysis.
- Observational error is random error based on error table.
- Limited calibration and validation will be conducted by NCEP and NESDIS for their own use. However, users are expected to perform their own calibrations and validation.

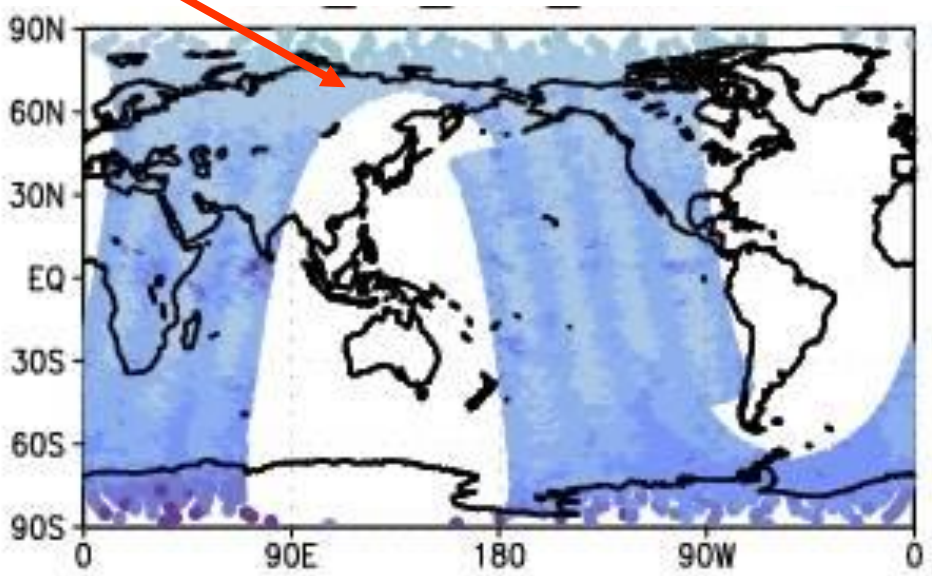
Future plan:

- Observational error based on correlated noize
- Simulation and assimilation of of cloudy radiance and let sampling done by assimilation. Cloudy radiance is still under development.

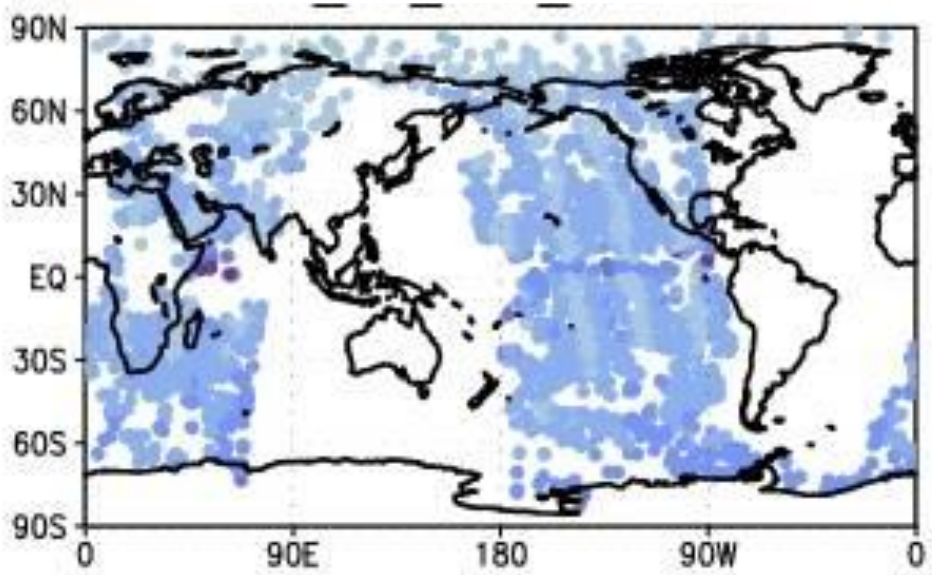
HIRS3 NOAA 16 Ch=4 May 2nd 00z (f12)

Template data

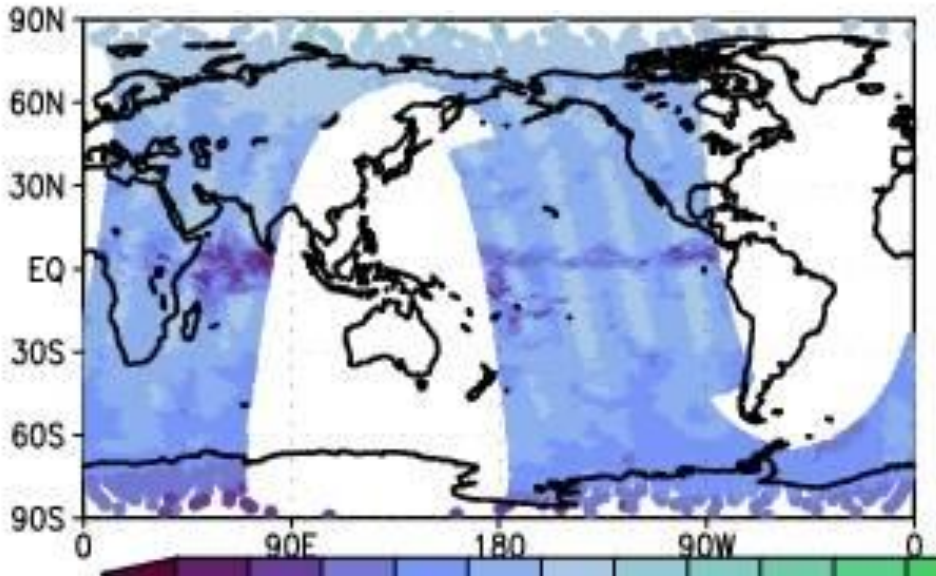
Observed radiance with horizontal thinning



Horizontal and vertical thinning



Horizontal thinning



Simulation of HIRS3 radiance from NOAA16

Latest version of CRTM (1.2.2) is used for simulation

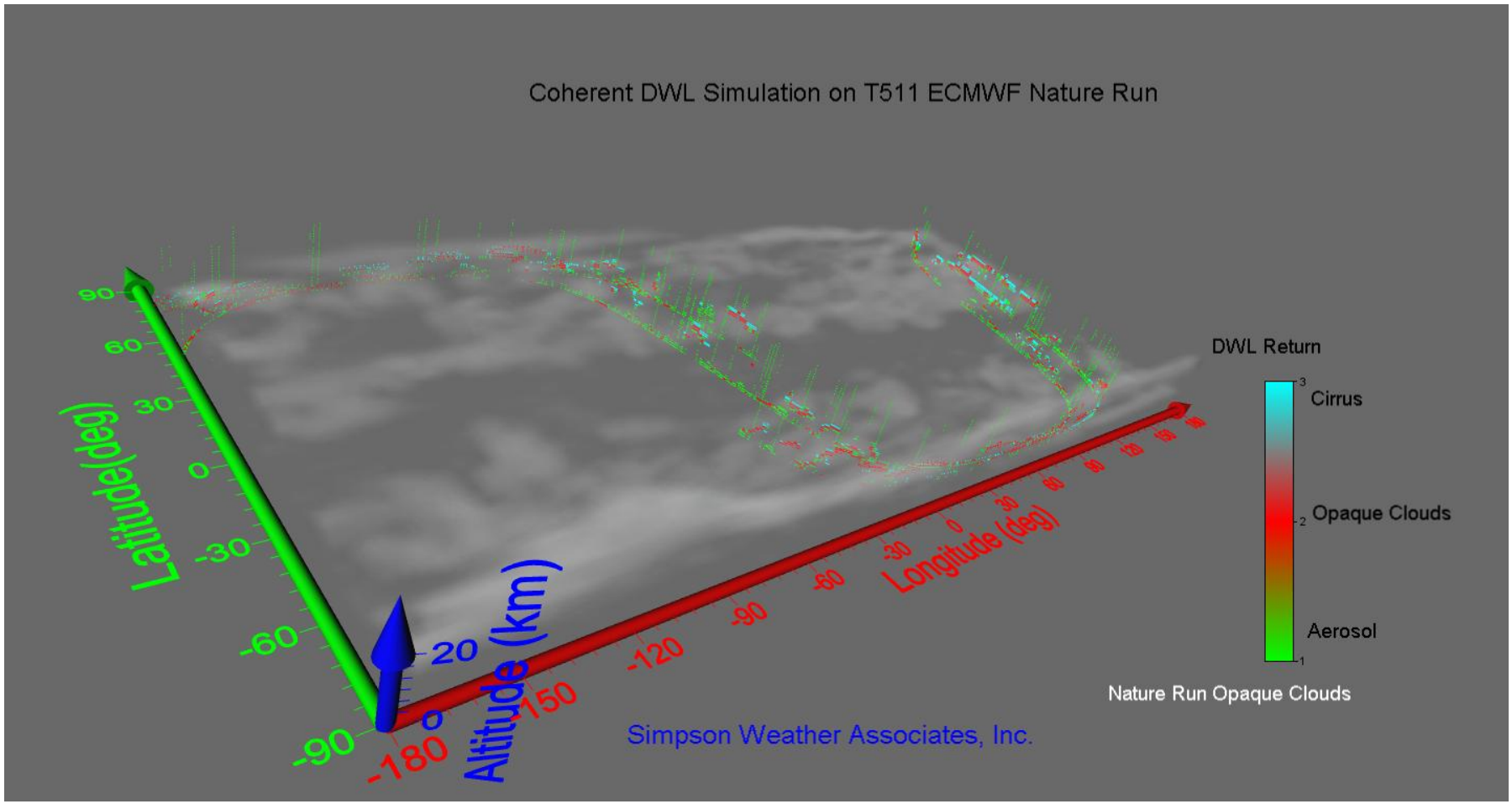
DBL 91 was generated at foot print used by NCEP GDAS

All information in GDAS bufr files are copied to simulated radiance file.

Channel which are not used by GDAS was marked in diag file. Masked out to generate masked radiance data.

Simulation of GWOS data

Simpson Weather associates

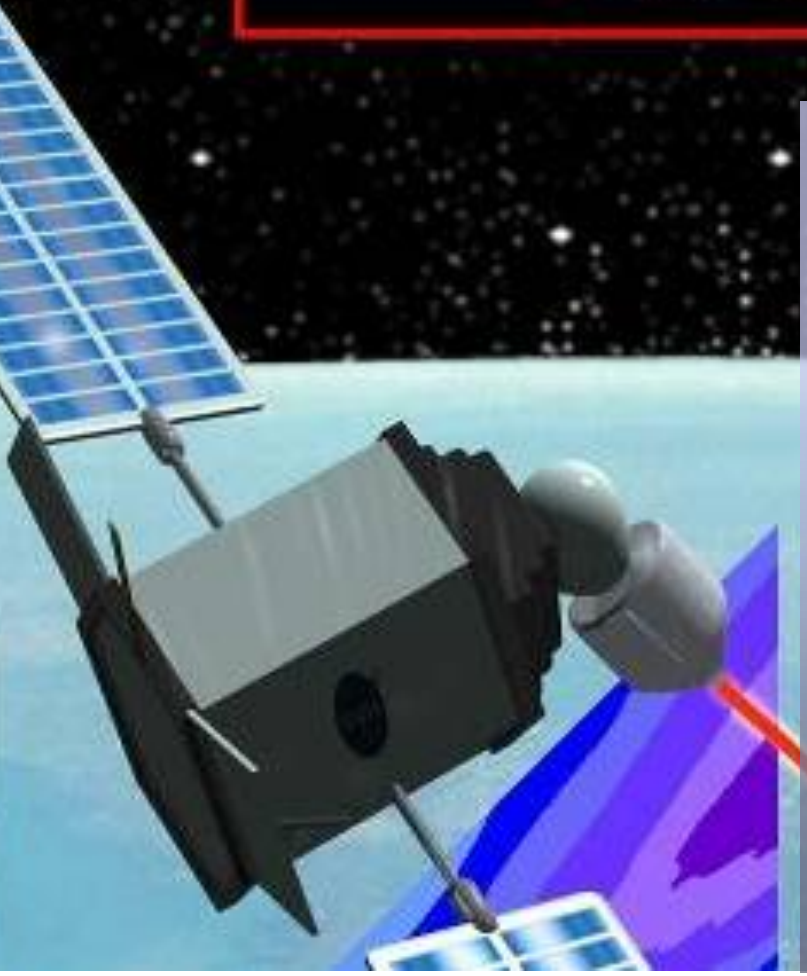


DOPPLER LIDAR SIMULATION MODEL

VERSION 4.2

Online Web-based User's Guide

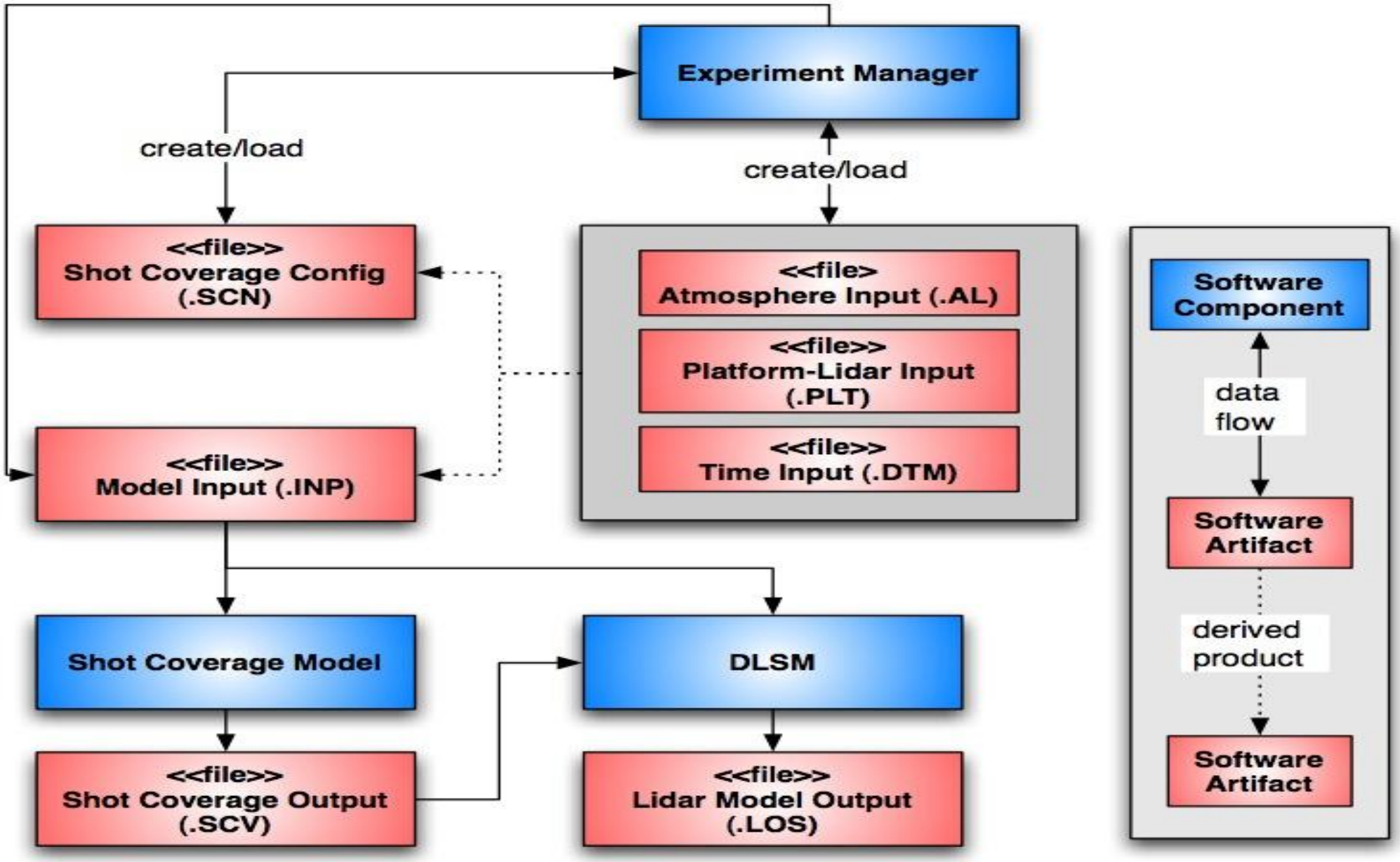
S. A. Wood G. D. Emmitt L. S. Wood S. Greco



In Spring, 2008 Simpson Weather Associates, Inc. established the Doppler Lidar Simulation Model version 4.2 on an Apple dual quad processor computer for the SensorWeb project. SSH, the network protocol that allows data to be exchanged over a secure channel between two computers, was installed and tested. SWA and SIVO were able to test the push/pull and communications functionality successfully. SIVO was able to push DLSM inputs to SWA and request model simulations. The DLSM was successfully executed and SIVO was able to retrieve DWL coverage and DWL line-of-sight wind products for a six hour simulation in less than 2 minutes.

Doppler Wind Lidar Simulation Model

Simpson Weather Associates



Progress

1) Acquired the ECMWF T511 Nature Run (NR) model level data in GRIB format
2) Developed software to read and unpack the T511 NR model level GRIB data
3) Unpacked the T511 NR model level GRIB data for July 1 - Aug 10, 2005
4) Created global atmospheric data sets for July 1 - Aug 10, 2005 to be used by the Lidar Simulation Model (LSM)
5) Modified the LSM to work with the variables, levels and resolutions/grids of the T511 NR model level data
6) Conducted a test run of a coherent DWL simulation using the T511 NR
7) Will continue the DWL simulations for July 1 - August 10, 2005 upon final quality check

Simmulation of ESA DWL KNMI

- Spring 2008: ADM Mission Advisory Group (ADMAG) advices ESA to participate in Joint OSSE
- KNMI writes TOGETHER proposal to ESA

TOGETHER

Towards a Global observing system through collaborative simulation experiments

ADM simulation

- ADM OSSE heritage, for details see Stoffelen et al., 2006
  http://www.knmi.nl/~marseill/publications/fulltexts/osse.pdf
- Tools for retrieving nature run fields from ECMWF archive
- Orbit simulator
- Interpolation of model fields to ADM location
  - ➢ “True” (HLOS) wind
- Instrument error: LIPAS (Lidar Performance Analysis Simulator)
  - For details see Marseille and Stoffelen, 2003
    http://www.knmi.nl/~marseill/publications/fulltexts/dwlsimul.pdf
  - LIPAS is updated and compatible with L2B processor performance

DWL OSSE Progress and Plans at NCEP

NCEP data assimilation system (GSI) has been upgraded to handle DWL data more efficiently. The code was successfully tested for idealized data. The system is being upgraded for 2010 operational version.

Extensive calibration experiments have been conducted by ESRL for July-August 2005 using control data produced by GMAO with 2007 GSI system. NCEP will repeat calibration experiment for selected wind data with new GSI system.

GWOS DWL data provided by SWA will be tested for July-August 2005.

NCEP will produce further control data.

GWOS OSSE will be extended to hurricane period and winter storm period.

Data impact of SWA and KNMI product for ADM will be compared.

Coordinate with GMAO OSSE to gain the confidence in results.

End

Summary

- OSSEs are a cost-effective way to optimize investment in future observing systems
- OSSE capability should be broadly based (multi-agency)
  - Credibility
  - Cost savings
- Timing

  All OSSEs are funded unrialistic time scale. People are forced to do shortcut.

  Simulation of basic data will should be funded for OSSEs.

If we do not assist other OSSEs they will produce damaging results