EGU2007-A-10961

Progress in Observing System Simulation Experiments

- A New Nature run International Collaboration -

http://www.emc.ncep.noaa.gov/research/osse/NR

EGU April 2007

NOAA-NASA and International OSSEs Team

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KNMI: Ad Stoffelen, Gert-Jan Marseille

OSSEs: Observing Systems Simulation Experiments
JCSDA: Joint Center for Satellite Data Assimilation
SWA: Simpson Weather Associates
ESRL: Earth System Research Laboratory (formerly FSL, CDC, ETL)

Extended international collaboration Meteorological community is essential for timely and reliable OSSEs

Effective collaboration and effective distribution of resources will significantly reduce the cost.

This will also speed up the performance and enhance the credibility of the results.

Why do we need OSSEs

Quantitatively–based decisions on the design and implementation of future observing systems

Evaluate possible future instruments without the cost of developing, maintaining & using observing systems.

There are significant time lags between instrument deployment and eventual operational NWP use.

The current NCEP/JCSDA system has shown that OSSEs can provide critical information for assessing observational data impacts

The results also showed that theoretical explanations will not be satisfactory when designing future observing systems.

OSSEs will help the data assimilation system with the new data

However:
OSSEs are expensive
DA system will be different when the actual data become available

If we cannot simulate observations, how could we assimilate observations?

New Nature Run by ECMWF

Based on Recommendations by

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

Nature Run: Serves as a true atmosphere for OSSEs

Preparation of the Nature Run and simulation of basic observations consume a significant amount of resources.

If different NRs are used by various DAs, it is hard to compare the results.

Need one good new Nature Run which will be used by many OSSEs.

Share the simulated data to compare the OSSE results from various DA systems to gain confidence in results.

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
Completed in July 2006, rerun October 2006

Data Format: Grib1
Model level data: Reduced Gaussian in model resolution
Surface data: Reduced Gaussian in model resolution
Modification done for OSSEs:
Geopotential height for model level Increased pressure level data (31 levels)
Potential temperature level. Precipitation and radiance (change the units)

High Resolution Nature Run

for a selected period
Hurricane season is recommended
T799 resolution, 91 levels,
one hourly dump
Get initial conditions from low resolution-NR

Supplemental 1degx1deg data

Pressure level data: 31 levels

Potential temperature level data: 315,330,350,370,530K

Selected time series for surface data: Convective precip, Large scale precip, MSLP,T2m,TD2m, U10,V10, HCC, LCC, MCC, TCC, Sfc Skin Temp

Other time series:
All variables for potential temperature levels
Variables: T,U,V,VO,D,Z, W, Q at 1000,850,700,500,300,250,200,100,50,10 hPa

Forecast run is used for the Nature Run

Because the real atmosphere is a chaotic system governed mainly by conditions at its lower boundary, it does not matter that the Nature Run diverges from the real atmosphere.

The Nature Run should be a separate universe, ultimately independent from but parallel to the real atmosphere.

The Nature Run must have the same statistical behavior as the real atmosphere in every aspect relevant to the observing system under scrutiny.

A succession of analyses is a collection of snapshots of the real atmosphere. Each analysis marks a discontinuity in model trajectory. Considering a succession of analyses as truth seems to be a serious compromise in the attempt to conduct a "clean" experiment.

I favor a long, free-running forecast as the basis for defining "truth" in an OSSE.

-- from Tom Schlatter

Discussions forums

Representativeness error
Strategies of simulation of observation
Evaluation of nature run cloud
Diurnal cycle in Nature run

Archive and Distribution

To be archived in the MARS system on the THORPEX server at ECMWF
Accessed by external users
expver=etwu

Copies for US are available to designated users & users known to ECMWF

Currently available from NCEP ftp server.
(Contact Michiko Masutani michiko.masutani@noaa.gov)

To be available from NASA/GSFC/SIVO and THORPEX server at NCAR

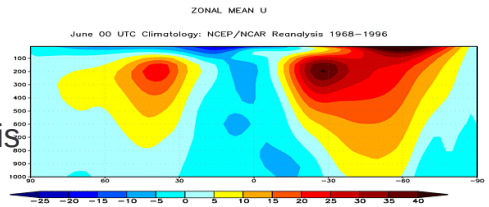
Proposed subset of the data:
The complete surface data in reduced Gaussian (N256),
Complete 1x1 pressure level data (0.16TB), Complete 1x1 isentropic data (0.018TB),
A few days worth model level data to be posted for online access,
The complete model level data (2.4TB) must be sent using hard disks.
Simulated observations. Some OSSE results

Initial Diagnostics of the Nature run

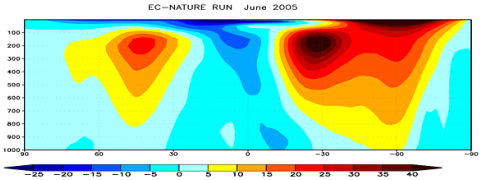
Zonal wind June 2006

By Juan Carlos Jusem (NASA/GSFC)

NCEP reanalysis

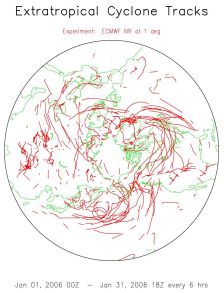


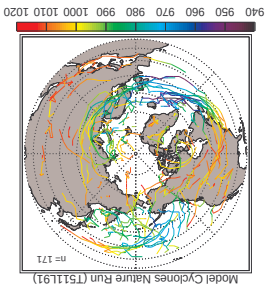
Nature Run



NH Cyclones Track

Joe Terry NASA/GSFC and Thomas Jung (ECMWF)





Study of drift in NR

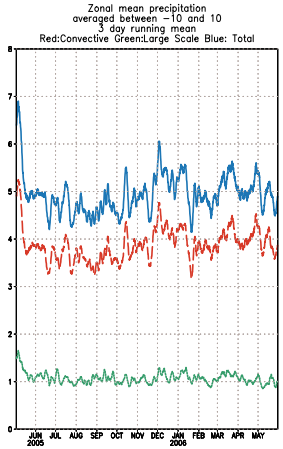
Michiko Masutani (NCEP)

Area averaged precipitation

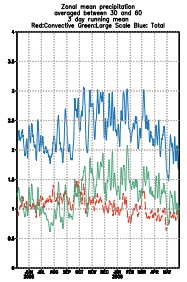
It takes about two to three weeks to settle tropical precipitation.
- Michiko Masutani (NCEP/EMC)

Convective precipitation
Large Scale precipitation
Total precipitation

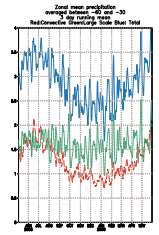
Tropics



NH mid-latitudes

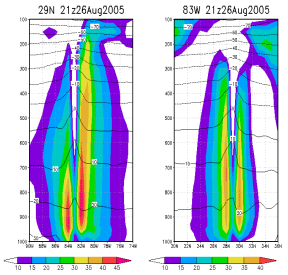


SH mid-latitudes



The African Monsoon Region and the Tropical Atlantic

Oreste Reale NASA/GSFC



HL vortices: vertical structure

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.
-- Oreste Reale (NASA/GSFC/GLA)

Extratropical Cyclone Statistics

Joe Terry
NASA/GSFC

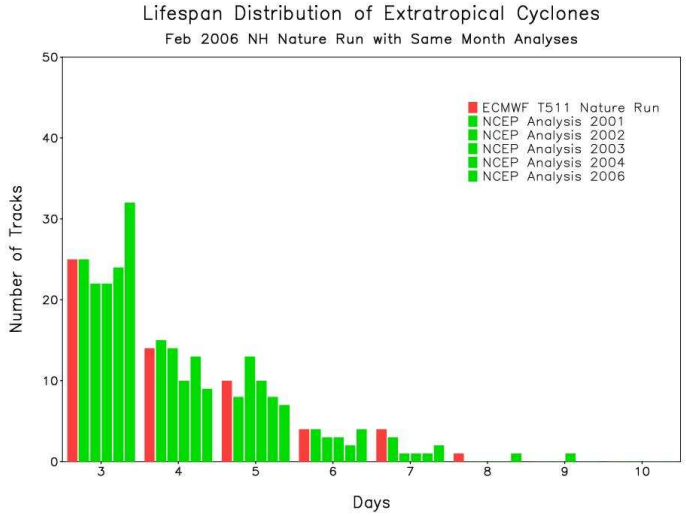
1) Extract cyclone information using Goddard's objective cyclone tracker

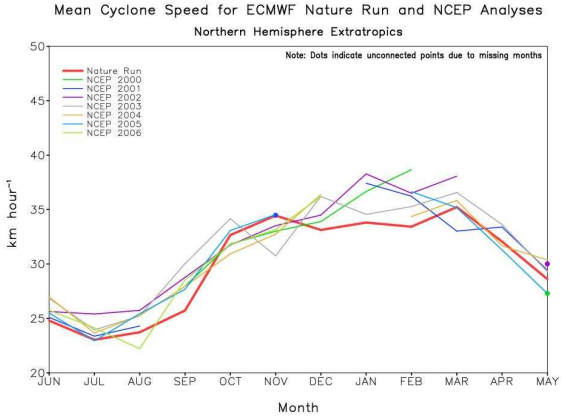
- Nature Run
- One degree operational NCEP analyses (from several surrounding years)
- NCEP reanalysis for specific years (La Nina, El Nino, FGGE)

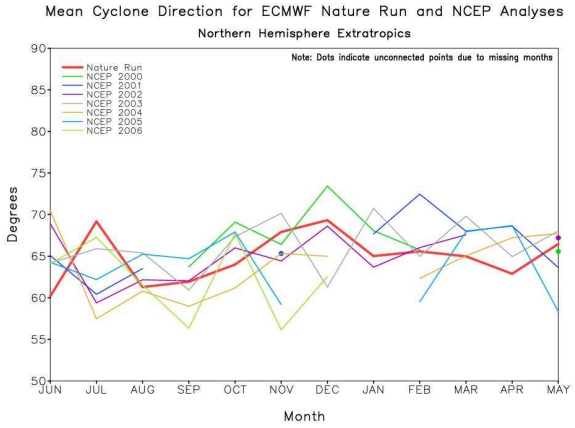
2) Produce diagnostics using the cyclone track information

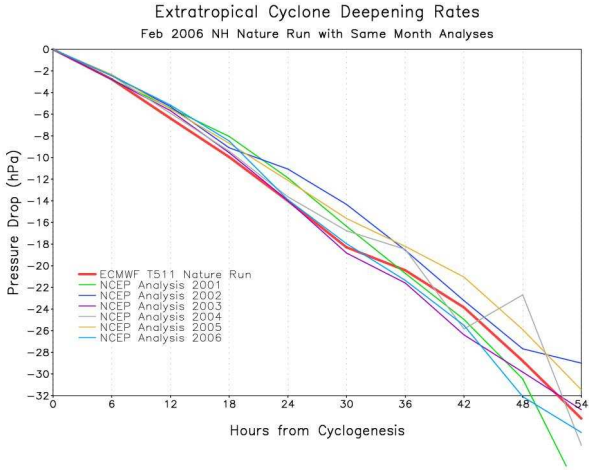
(comparisons between Nature Run and NCEP analyses for same month)

- Distribution of cyclone strength across pressure spectrum
- Cyclone lifespan
- Cyclone deepening
- Regions of cyclogenesis and cyclolysis
- Distributions of cyclone speed and direction









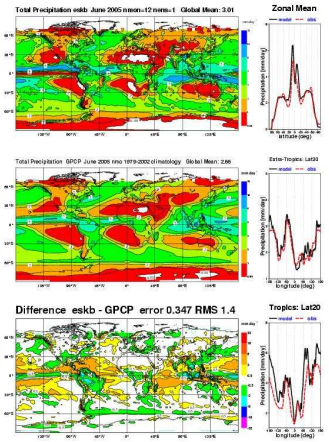
Comparison between the ECMWF T511 Nature Run against climatology

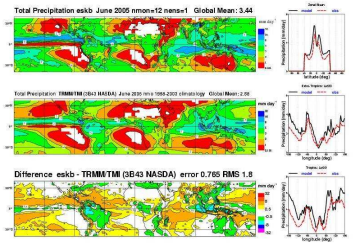
20050601-20060531, exp=eskb, cycle=31r1

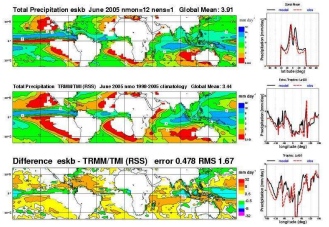
Adrian Tompkins, ECMWF

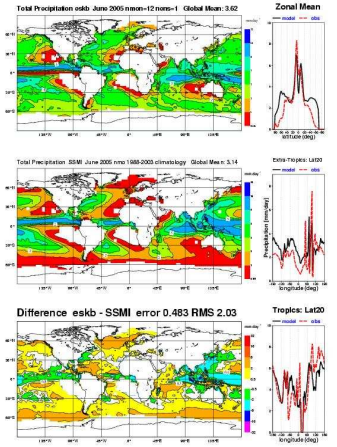
TechMemo 452 Tompkins et al. (2004)
http://www.emc.ncep.noaa.gov/research/osse/NR/ECMWF_T511_diag/ tm452.pdf
Jung et al. (2005) TechMemo 471
http://www.emc.ncep.noaa.gov/research/osse/NR/ECMWF_T511_diag/tm471.pdf
Plot files are also posted at
http://www.emc.ncep.noaa.gov/research/osse/NR/ECMWF_NR_Diag/ECMWF_T511_diag
The description of the data
http://www.emc.ncep.noaa.gov/research/osse/NR/ECMWF_T511_diag/climplot_README.html

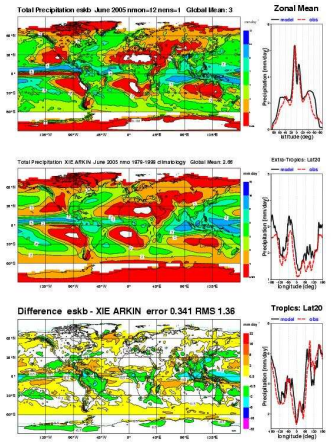
Nature run **Total precipitation, against GPCP, SSMI, and XieArkin











- These comparisons confirm the lack of rainfall over the tropical land masses.

- We have an overestimation of precip over the high-SST regions in the tropics.

- There is a tendency for deep convection to become locked in with the highest SSTs, which in the east Pacific results in a narrow ITCZ.

- The TRMM NASDA-3b43 algorithm is presumed to be the most accurate of the two TRMM retrieval products.

Simulation of Observation

August 2005 is selected as the period for initial simulation

20-30 August

(1) A hurricane that makes landfall in Florida and then dissipates in the southeastern United States. As you will see, this hurricane is suggested in my skewness plot.
(2) A very intense extratropical cyclone in the Southern Hemisphere that reaches a pressure minimum of less than 925 hPa. It can be observed between 60S and 65S and between 105E and 115E.

(Juan Carlos Jusem, NASA/GLA)

Simulation of Conventional Observations

Jack Woollen (NCEP/EMC) and Joe Terry (NASA/SIVO)

Considerations

Data distribution depends on atmospheric conditions
Cloud and Jet location, Surface orography, RAOB drift

Initial simulation

Simulation for August 2005 completed and posted from NCEP ftp site

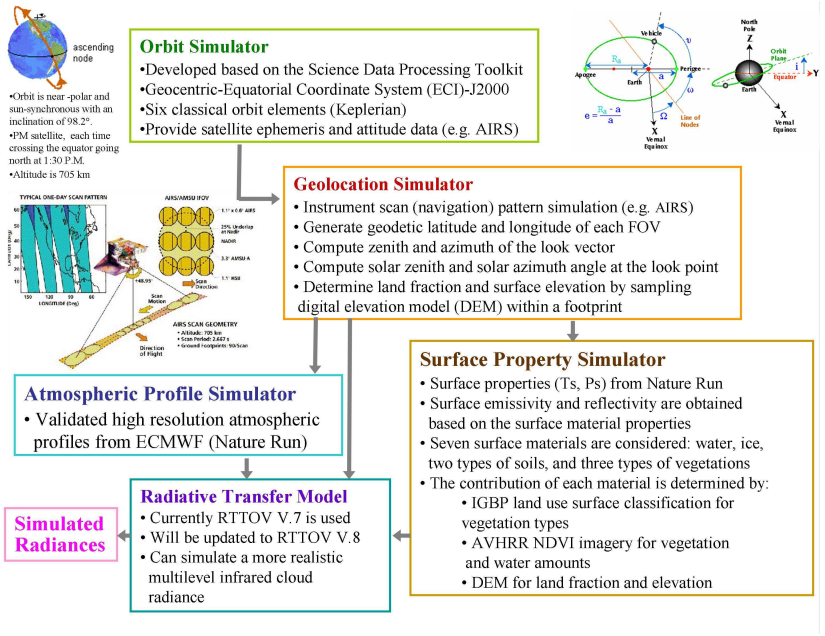
SWA will simulate Cloud Motion Vectors
- Advised by Chris Velden

Uniform Raob for testing
Michiko Masutani(NCEP)

Radiance Simulation System for OSSE

Lars-Peter Riigeojgaard, Emily Liu, NASA/GSFC/GMAO and Haibing Sun (NOAA/NESDIS)

Other resources and/or advisors*Tom Kleespies, Paul Van Delst, Yong Han (JCSDA);Erik Andersson (ECMWF); Roger Saunders (Met Office)*



Simulation of DWL

SWA simulates DWL planned by NASA
KNMI simulates DWL from ESA
Use common BUFR table and definitions

KNMI will simulate ASCAT

UAS by Nikki Prive and Yuanfu Xie (NOAA/ESRL)

In US, Data assimilation will be conducted at NCEP/EMC, NASA/GMAO, and NOAA/ESRL

Data assimilation: Gridpoint Statistical Interpolation (GSI)
Various Forecast model

Calibration

coordinator: Michiko Masutani (NCEP/EMC)

In calibrations of the OSSE, similarity in the amount of impact from existing data in the real and simulated atmosphere needs to be achieved.

The difference needs to be explained based on the characteristics of the Nature Run.

Need to select sets of experiments to be used for calibration and standard verification.

Selected calibration experiments to be performed every time the DA system is changed.

Evaluation of the results

Initial verification will be performed by the institutes where data assimilation is performed.

The selected results will be posted through NASA/SIVO.

Other institute including Universities will be able to participate in verification.

The results from data impact depend on variables and verification methods.

The date impact depends on how the data is handled in the DA system.

Discussion for calibration and verification strategies to be scheduled.