Seasonal climate prediction
With GEOS-5

Yury Vikhliaev, Yoo-Geun Ham, Guillaume Vernieres
Bin Zhao, Andrea Molod
Zhao Li, Siegfried Schubert, Michele Rienecker, Max Suarez

Global Modeling and Assimilation Office
NASA/Goddard Space Flight Center
The GMAO’s Mission

To develop and maintain global assimilation and modeling systems to support NASA’s Earth Science Mission. This includes supporting instrument teams and field campaigns, generating comprehensive climate-relevant data sets to support studies of variability and change, as well as addressing the weather and climate research questions identified in NASA's mission.

Our long-term goal is the development of an Integrated Earth System Analysis (IESA) capability.
GEOS-5 in NWP – April 2011

NHE 500 hPa

SHE 500 hPa

ANOMALY CORRELATION

ANOMALY CORRELATION

DIFFERENCE

DIFFERENCE

Forecast Day

Forecast Day
The GMAO AOGCM for S-I and decadal

<table>
<thead>
<tr>
<th>GEOS-5(6) AGCM</th>
<th>1° lat. X 1.25° lon. X 72L (0.5x91L) surface to 0.01hPa (~80 km) Finite Volume Lat-Lon Dynamical Core (cubed, non-hydro) RAS convection scheme with stochastic Tokioka Bacmeister et al. prognostic clouds (M-G-B Microphysics) Chou-Suarez radiation (RRTMG option) Louis-Lock PBL schemes (??) Catchment Land Surface Model (v1) (v2+Thornton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OGCM: MOM4</td>
<td>MOM4p1 1/2° lat. x 1/2° lon. with 1/4° equatorial refinement 40 vertical levels Tripolar grid z coord; conservative temp., KPP+tidal mixing</td>
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<tr>
<td>CICE v4.1</td>
<td>Sea-ice thermodynamics (Exchange) Sea-ice dynamics and advection(Tripolar)</td>
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<tr>
<td>Coupling Scheme</td>
<td>Exchange grid based Diurnal interface layer 30 minute interval</td>
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<tr>
<td>ANALYSIS</td>
<td>Atmosphere: GSI Ocean: EnOI</td>
</tr>
</tbody>
</table>
Annual Mean Model Bias

- **GEOS-5 – Reynolds SST**
  - mean: -0.54
  - std: 2.00

- **GEOS-5 – Levitus SSS**
  - mean: -0.07
  - std: 1.30

- **GEOS-5 – Annual Mean Precip**
  - mean: 2.98
  - std: 2.62

- **GPCP – Annual Mean Precip**
  - mean: 2.62
  - std: 1.82
Annual Mean Equatorial Temperature

Levitus

GEOS-5

Δ
Equatorial Wind Stress, $x10 \text{ N/m}^2$
SST Forecast Bias 1981-2009
Based on 3 ensemble members close to 1 Sept (Aug 24, Aug 29, Sept 3)
**Coupled A-L-O-S initialization of seasonal predictions**

**Atmosphere constrained by MERRA every 6 hours**
- Precipitation rescaled to GPCP for LSM

**Ocean: daily assimilation**
- Ensemble Optimal Interpolation (EnOI)
- State dependent localization based on density
- 1960 to present

Sea-ice: daily assimilation of sea-ice concentration
Next: Generation of Ensemble Perturbations

- Method: **Two-sided breeding**
- Norm variable: **SST**
- Norm Region: **Equatorial Pacific (5S-5N)**
- Initial BV magnitude: **Reduced to 10% of natural variability**
- Rescaling Interval: **2-month**
Tav 300m Basin averages, 5S-5N

Equatorial Pacific

Equatorial Atlantic

Equatorial Indian Ocean

EN3 data and analyses courtesy of Simon Good, UKMO
Nino3 SST Anomaly – Forecast (from August i.c.) c.f. Observed
SST Anomaly Correlation 1993-2009
Based on 3 ensemble members close to 1 Sept (Aug 24, Aug 29, Sept 3)

GEOS-5

CGCMv1
T2m Forecast Anomaly Correlation

GEOS-5 AC for T2m for Oct from Aug IC

ACove=0.06

GEOS-5 AC for T2m for Nov from Aug IC

ACove=0.22