Intraseasonal Hindcasts at CMCC.

Outline:
- CMCC-INGV Prediction system
- Preliminary ISO results
- ISM onset prediction

A. Alessandri, A. Borrelli and A. Navarra

CLIVAR/AAMP 10 – Eusar, South Korea, 18-19 June 2010
The coupled Model components

**Radiative forcings**
- GHGs & SO4

**Land Surface**
- SILVA (Alessandri, 2006, 2007)

**Atmosphere**
- ECHAM5 (T63) ( Roecker et al. 1995, 2003)

**Coupling daily**
- No Flux Adjustment

**Coupler**
- OASIS 3 (Valcke et al. 2000)

**Sea Ice**
- LIM (ORCA2) (Timmerman et al. 2005)

**Ocean**
- OPA 8.2 (ORCA2) (Madec et al. 1998)

**Atmosphere**: Echam-5 - Spectral T63 (1.8°x1.8°) & 19 vertical levels

**Land Surface**: SILVA (Surface Interactive Land VegetAtion)

**Ocean**: OPA8.2 – 2° longitude - 0.5° - 2° latitude - 31 Vertical Levels

**Coupler**: OASIS3 (Ocean Atmosphere Sea Ice Soil)

**Sea Ice Dynamics**: LIM (Louven laneuve sea-Ice systeM)

Radiative boundary forcing: GHGs, direct and indirect effects of anthropogenic sulphate aerosols

http://www.ecmwf.int/research/ECMWF/research/EMPS/ensemble/ensemble/boundaryforcings.html
The coupled Model components

- Radiative forcings
  GHGs & SO4

- Land Surface
  SILVA
  (Alessandri, 2006, 2007)

- Atmosphere
  ECHAM5 (T63)
  (Roecker et al. 1996, 2003)

- Coupling daily
  No Flux
  Adjustment

- Coupler
  OASIS 3
  (Valcke et al. 2000)

- Sea Ice
  LIM (ORCA2)
  (Timmerman et al. 2005)

- Ocean
  OPA 8.2 (ORCA2)
  (Madec et al. 1998)

Off line Initialization Tools
CMCC-INGV Global Ocean Data
Assimilation System (CIGODAS)

Assimilated Ocean initial condition production:

- T & S - OI assimilation
  SOFA 3.0
  (De Mey and Benkiran 2002)

  Bellucci, Masina, Di Pietro
  & Navarra, 2007
  - Di Pietro & Masina, 2009
Retrospective forecasts performed

Hindcasts have been performed for the period 1989-2009
3 start dates each month for each year
Ensembles of 5 forecasts, each integration 2 months long

5 Atmospheric IC from lagged days (-2:0:+2)

5 perturbed i.c. for each start date, each year

OFF LINE interpolated Atmosphere IC from reanalysis

SYSTEM INITIALIZATION SCHEME

days lag
-2 +2
-2 +2
-2 +2

INITIALIZED COUPLED RUNS

1st start date 11th start date 21st start date

OFF LINE assimilated OCEAN ANALYSIS
Climatologies - Boreal Summer (MJJASON, 1989-2008)

Era Interim

Model (lead-time 6-15 days)

Boreal Summer - MJJASON
Climatologies – Boreal Winter (NDJFMA, 1989-2008)

Era Interim

Model (lead-time 6-15 days)

Boreal Winter - NDJFMA
Total variance (1989-2008) & Filtered (20-100d) vs unfiltered

Contour: Total Variance -- Shaded: Filtered (20-100d)/Total Variance ratio

Era Interim

Boreal Summer - MJJASO

Model ensemble means (lead-time 6-15d)

Boreal Summer - MJJASO

Boreal Winter - NDJFMA

Boreal Winter - NDJFMA
Multivariate CEOF technique applied on filtered (20-100d) data

Era-Interim

Model (lead-times 6-15 days)

Multivariate EOF 15N-15N 1989-2008

44.2% 38%
Multivariate CEOF technique applied on filtered (20-100d) data

Era-Interim
MJO amplitude index (PC1^2 + PC2^2) 15S-15N: 1989-2008

Model (lead-times 6-15 days)

Cross Correlation: PC1 vs PC2 - 1989-2008
Anomalous MJO amplitude ($PC_1^2 + PC_2^2$) prediction: above normal (upper tercile) & below normal (lower tercile)

Skill as a function of lead time (Model vs persistence)

MJO amplitude > upper tercile

MJO amplitude < lower tercile

Averaged lead Time (lead-4 to lead+5)

Averaged lead Time (lead-4 to lead+5)
Predictability of the Indian Summer Monsoon onset
Sensitivity to realistic atmospheric initial conditions

See also Poster at the Monsoon Intraseasonal Variability Workshop

Alessandri et al., 2010, In preparation
Sensitivity to Atmosphere ICs

Atmosphere ICs from ERA-Interim (ERAINI)

- Atm T63 (1.87°x1.87°)
- Same ocean model & oceanic ICs
- Retrospective forecasts have been performed for the period 1989–2005
- Start dates May

Experiment ICs from AMIP-Type runs (AMIPINI)
Sensitivity to Atmosphere ICs: Monsoon onset predictability

- **ERAINI**
- **AMIPINI**

![Graph showing Brier Skill Score for Early and Late Onset]

**OCI**: Onset Circulation Index (Wang et al., 2009)

**HOWI**: Hydrological Onset & Withdrawal Index (Fasullo and Webster, 2003)

* Significance of the difference at 5% level (bootstrap method)
Sensitivity to Atmosphere ICs: Intraseasonal Variability
(20-100d filtered zonal wind; 65-85E average)
Summary

- CMCC-INGV contributes to the ongoing CLIPAS ISO hindcast experiment with the latest development of its short term climate prediction system.

- Preliminary analysis shows that the system is able to reproduce eastward propagating intraseasonal wind and precipitation anomalies in good agreement with observations.

- The system shows a considerable skill in predicting above normal (upper tercile) & below normal (lower tercile) MJO amplitude ($PC_1^2 + PC_2^2$).
  
  ➤ It always performs better than persistence
  
  ➤ It display a positive skill till leads 11-20 (8-17) for above (below) normal MJO amplitude

- Realistic initialization of the atmospheric component is shown to significantly contribute to the predictability of early than normal monsoon onsets.
  
  ➤ In three out of the 5 earliest monsoon years, northward propagating ISV modes appear to trigger onset. Phase initialization of this modes contribute to predictability.

... analysis just started ...