National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

Some current and proposed UK activities in Asian-Australian monsoon research

Andy Turner

NCAS-Climate, University of Reading, UK

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Outline

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- Some current work at UoR
- Activities in the Met Office
- Upcoming research programmes

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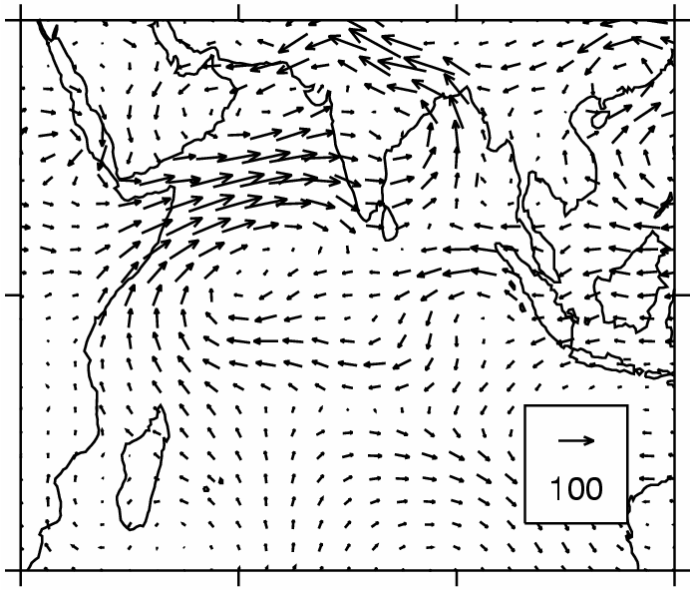
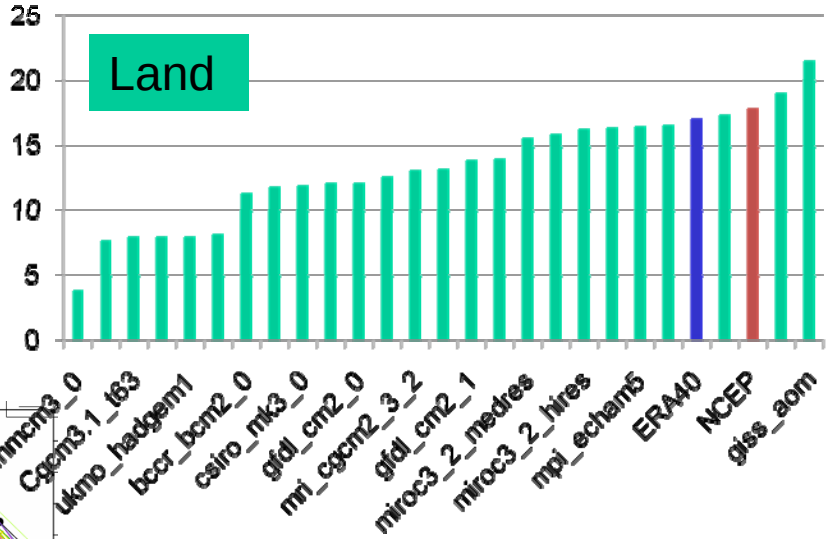
Arabian Sea as a source of moisture and error...

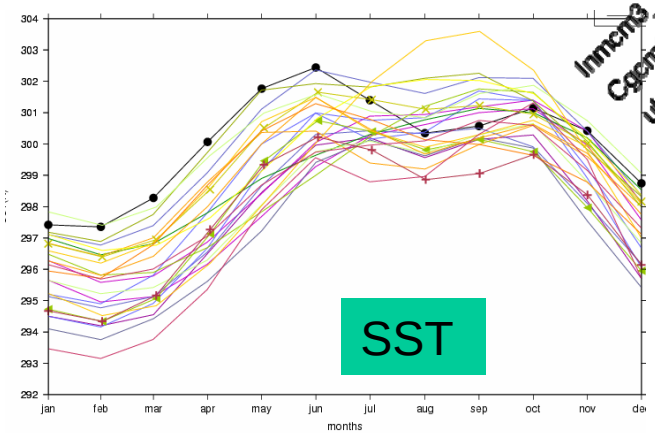


From Levine &Turner (2010) *in preparation.*

Additional vertically integrated moisture flux from the Arabian Sea during strong monsoon years (ERA40 & AIR index)…

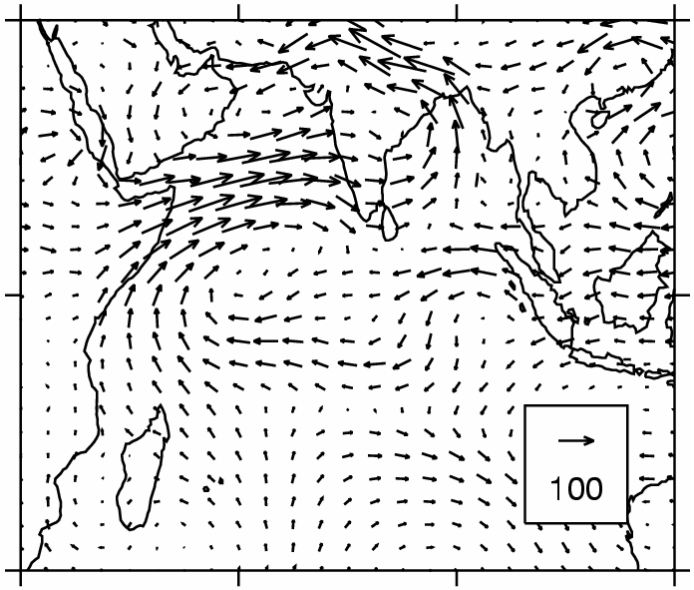


...but most CMIP3 models have cold temperature biases in Arabian Sea SST, and north India land surface temps during winter and spring.



From Marathayil, Shaffrey, Turner (2010) *in preparation.*

Arabian Sea as a source of moisture and error...

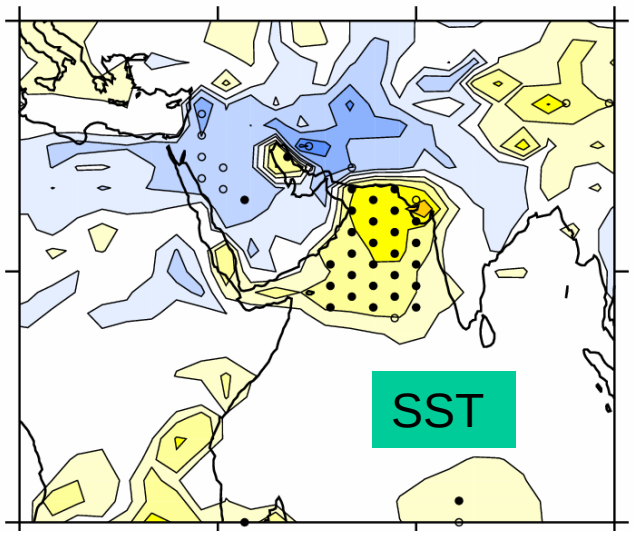


From Levine &Turner (2010) *in preparation.*

Additional vertically integrated moisture flux from the Arabian Sea during good monsoon years...

...but most CMIP3 models have cold temperature biases in Arabian Sea SST, and north India land surface temps during winter and spring.

By incorporating simple effects of ocean biology, can warm SST and reduce bias.



From Joshi & Turner (2010) *in preparation.*

Role of anthropogenic aerosol emissions over China on EASM rainfall

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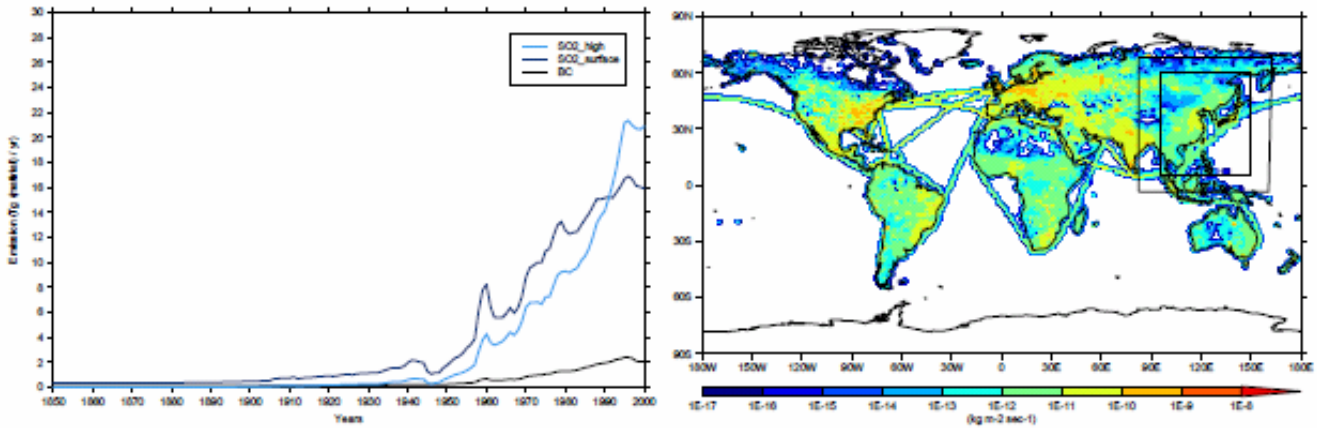

(a) (b)

Figure 5: (a) Historical emissions of SO_2 and black carbon from 1850 to 2000 averaged over East Asia $(15-54°N,\ 90-136°E)$. (b) SO_2 emission used in the experiment, emission inside the inner rectangle is 1950's level, emission outside the outer rectangle is 2000's level, and emission is linearly decreased from outer rectangle to inner rectangle. (units: $Tg\ SO_2\ /\ yr$)

- Using Edwards-Slingo offline radiation code and HiGEM coupled model to test impact of aerosol trends.
- Current experiments test sulphates scaled back to 1950 levels in East Asia only (before rapid industrialisation) in HiGEM.

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Liang Guo, Ellie Highwood, Len Shaffrey, Andy Turner

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Crop-climate modelling for India

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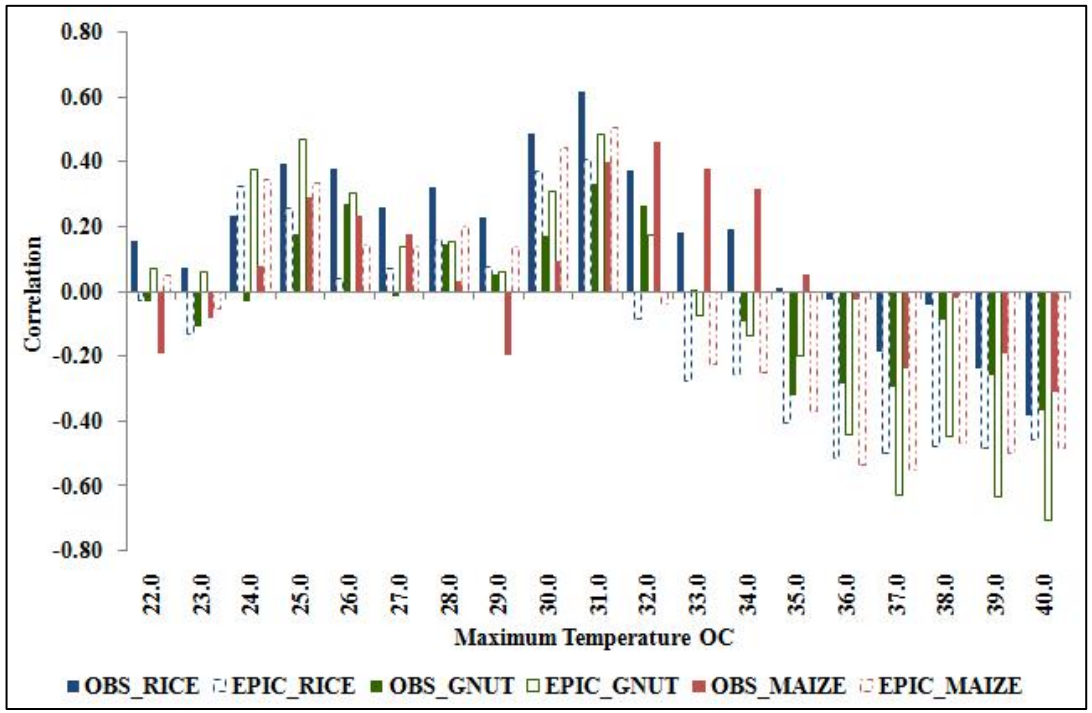
Modelling crop-climate interactions at different spatial scales, using diverse CMIP3 GCM input data and testing RCM/statistical downscaling methods.



Correlation between T_{max} and crop yields at Andhra Pradesh. Showing observed and EPIC modelled paddy rice, groundnut and maize yields.

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Sridhar Gummadi, Tom Osborne, Andy Turner, Tim Wheeler

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Importance of well-resolved ocean thermodynamics coupling to MISV

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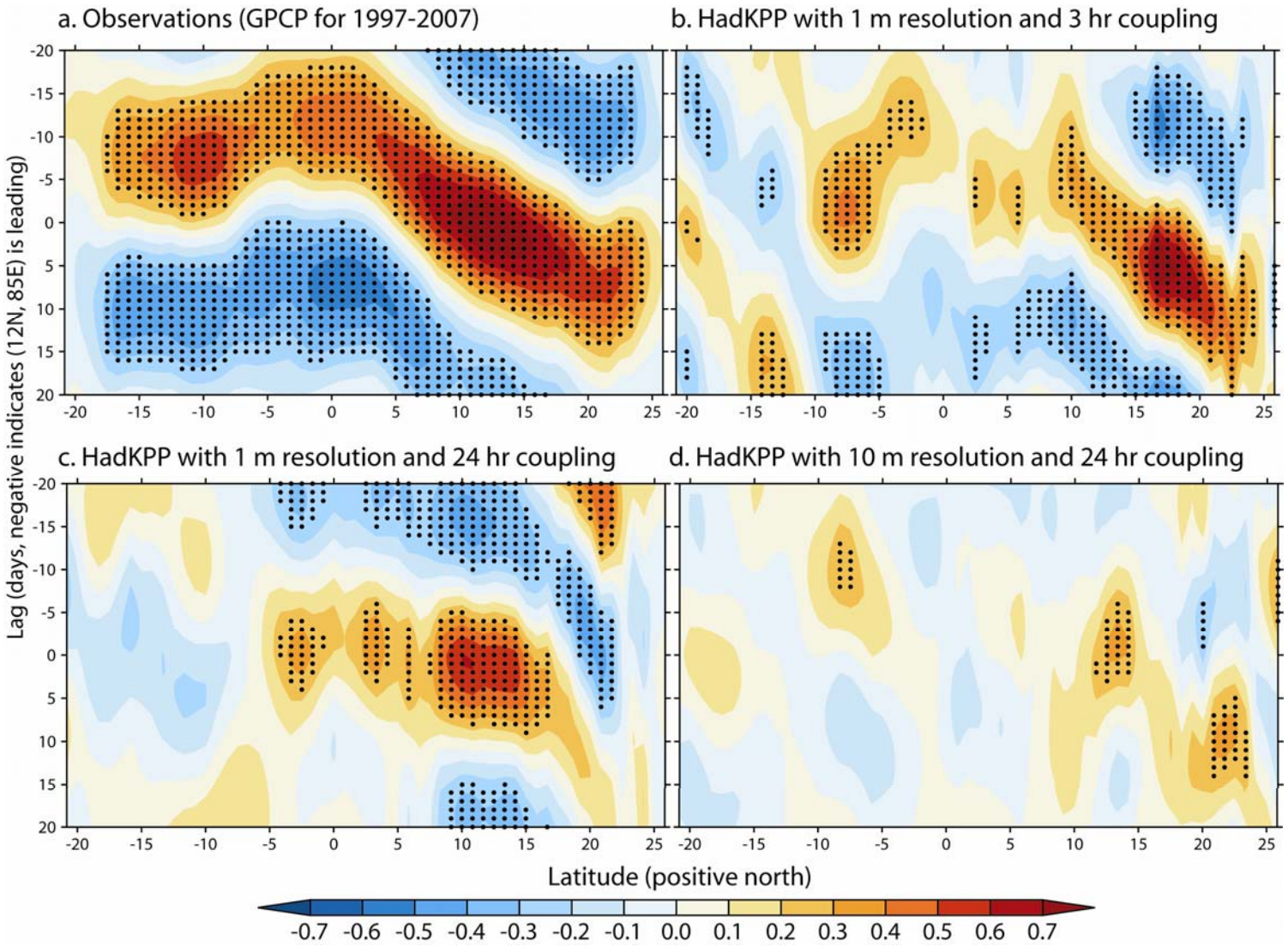
- Lag correlations of 30–50 day filtered July and August rainfall.
- 30 member ensembles of HadKPP with varying upper-ocean vertical resolution and air-sea coupling frequency.
- To capture the ISV requires a 1m near-surface ocean vertical resolution **and** 3hr coupling frequency.



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Courtesy: Nick Klingaman

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Met Office: MORPH3 assessment

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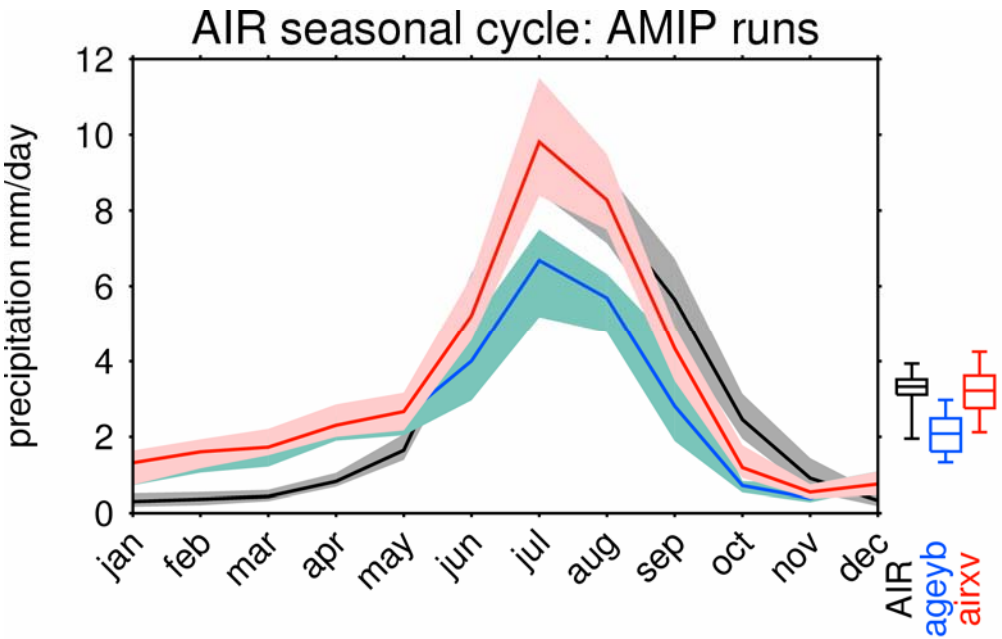
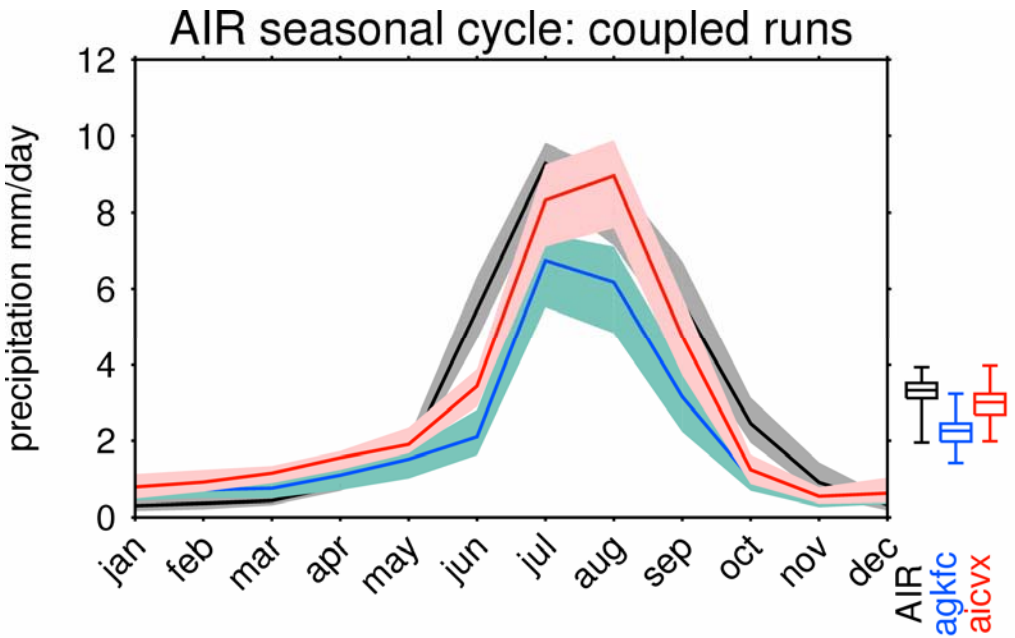
- UKMO assessment with expert support to determine progress in simulating various global features in HadGEM3 model vs. HadGEM2.





India Summary Tables:
atmosphere-only

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airxv: HadGEM3-A N96L85 atmosphere only model (baseline: HadGEM2-A N96L38)

see detailed results of submetrics here

CLIM	*Summer monsoon precipitation (8)*	*Summer monsoon winds (17)*	*Seasonal cycle (7)*	*Monsoon onset and retreat (2)*	*Land Surface temperature (3)*	*Soil moisture*	*Winter monsoon*
VAR	*Interannual variability of summer monsoon precipitation (2)*	*Interannual variability of dynamical monsoon indices (9)*	*Intra-seasonal variability of summer monsoon (6)*	*Monsoon depressions (3)*	*Tropical cyclones (8)*	*Extremes (8)*	*Interannual variability of Winter Monsoon*
TELE	*ENSO-monsoon teleconnection (3)*	*Arabian Sea-monsoon teleconnection (2)*	*Indian Ocean Dipole-monsoon teleconnection (6)*	*European/Tibetan/Asian winter/spring snow-monsoon teleconnection*	*MJO and monsoon onset*		

xemjo: HadGEM3-A N216L85 atmosphere only model (baseline: HadGEM2-A N96L38)

see detailed results of submetrics here

CLIM	*Summer monsoon precipitation (8)*	*Summer monsoon winds (17)*	*Seasonal cycle (7)*	*Monsoon onset and retreat (2)*	*Land Surface temperature (3)*	*Soil moisture*	*Winter monsoon*
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Monsoon precipitation: errors across resolution and timescale

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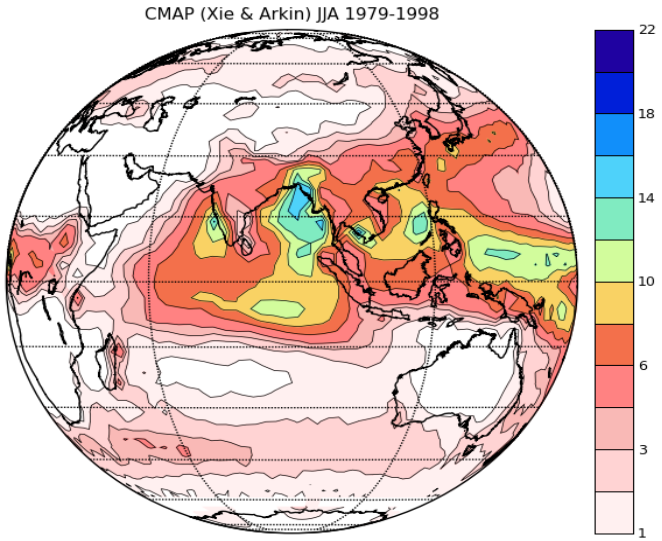
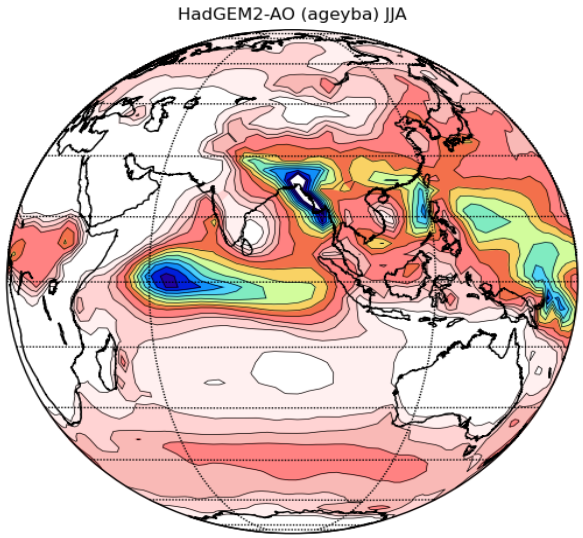
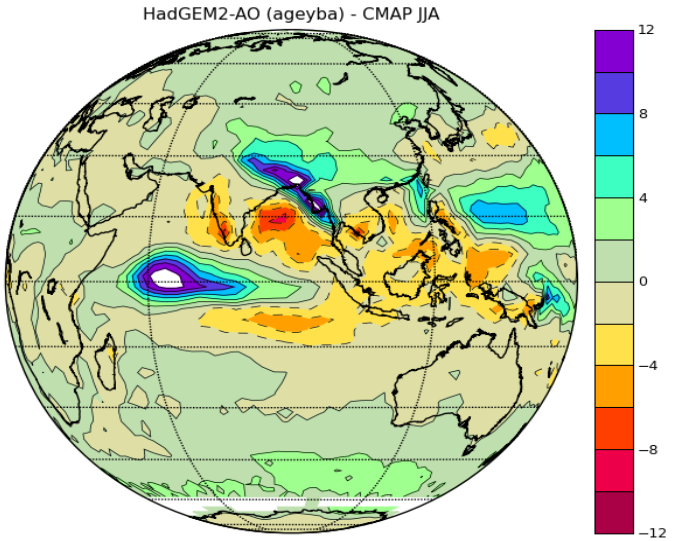
N96 – 135km

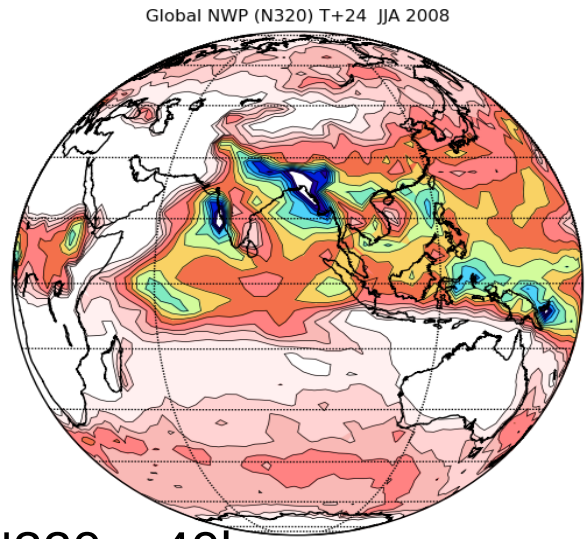
Multi-Decade error

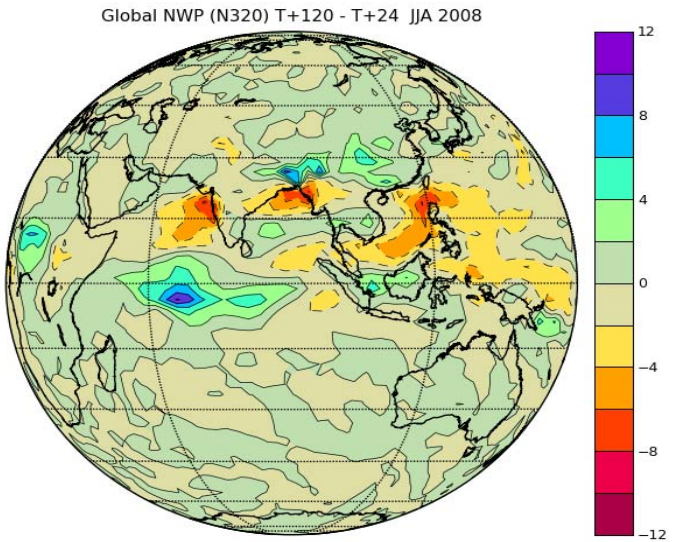






NWP Techniques





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N320 – 40km

5day – 1 day tendency

Coupled model SST biases implicated in detrimental Indian precipitation

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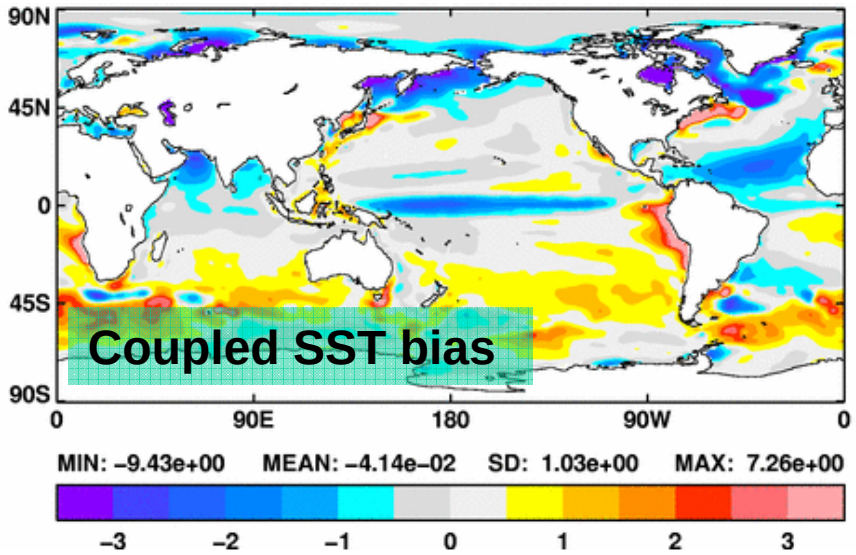
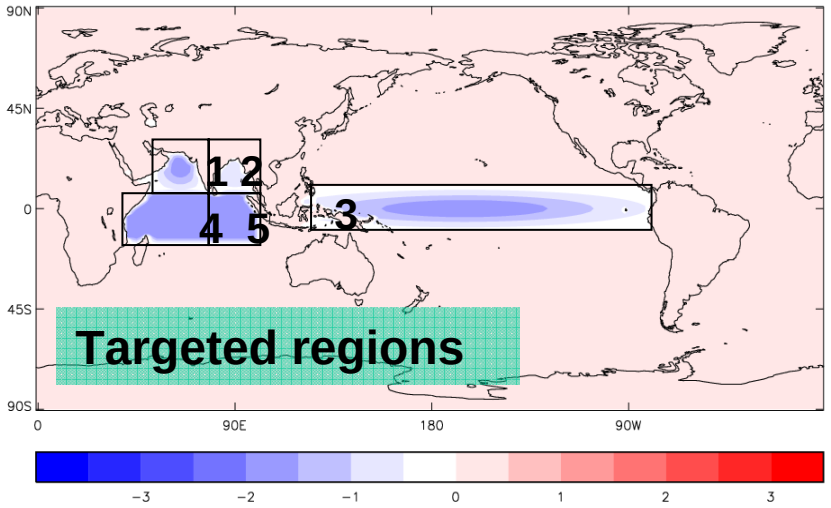
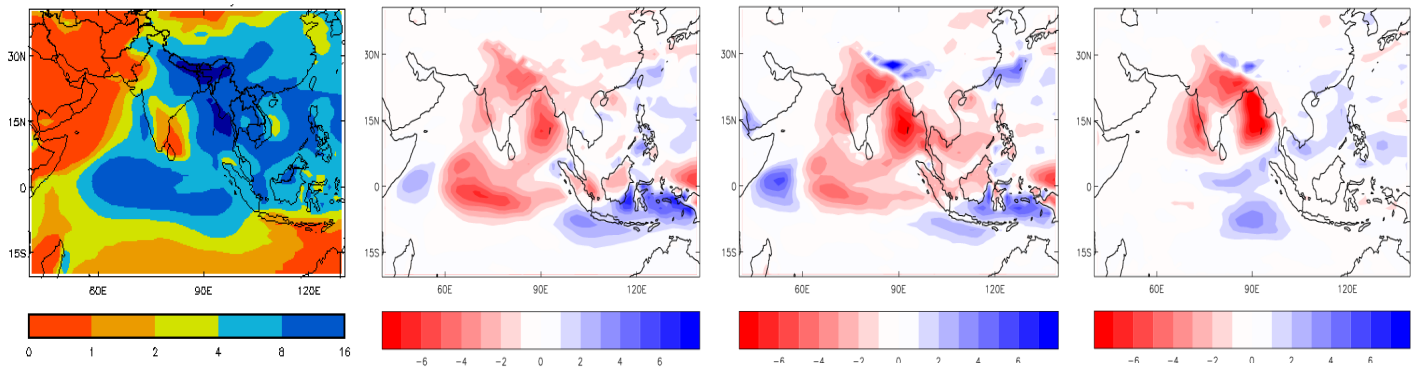


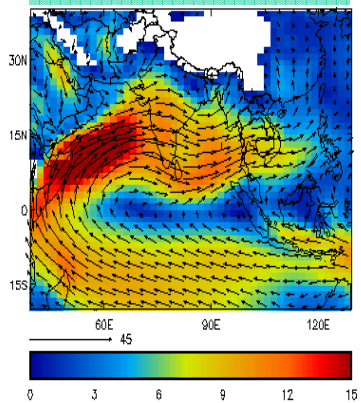


JJAS precip

JJAS precipitation anomalies

JJAS uv850





AGCM

COUPLED

AGCM+ COUPLED SST

ARABIAN SEA+BoB BIAS

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Richard Levine (UKMO) & AndyTurner

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Met Office: CAPTIVATE

Follow on project from MORPH3 is CAPTIVATE (18 months).

- assess and develop HadGEM3 with more emphasis on comparison with other modelling groups.
- prioritize work based on hypotheses as to the sources of systematic error.
- Will examine latest physics developments.

UKMO now has a collaboration with NCMRWF, Noida, Delhi, who are installing HadGEM3.

NERC-Met Office JWCRP

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- Since 2006 NCAS-Met Office Monsoon Working Group; bimonthly meetings on model analysis.
- New Joint Weather & Climate Research Programme.
- Major new collaboration and knowledge exchange between academia and UKMO:
  - six new 3-year posts initially, working across universities and UKMO.
  - Shared computing resource and access (!).
- Includes posts based at UoR to be filled soon on:
  - high resolution modelling
  - Modelling monsoon systems (improving representation of monsoons in HadGEM3)

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NERC Ecosystem Services for Poverty Alleviation (ESPA)

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- NERC, DFID, ESRC: 7year interdisciplinary research programme, total £40.5millions. Part of Living with Environmental Change (LWEC) partnership.
- Various funding streams for long and short duration projects:
  - Programme Framework Grants: to kick-start new innovative concepts/methods/models; up to 2 years/£250,000.
  - Partnership & project development grants: catalyst funding to support south-south and north-south consortia and proposal writing; up to 6 months/£50,000.
  - Research consortium grants.
- Geographical scope: South Asia, China, Sub-Saharan Africa, Amazonia

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ESPA Objectives

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- Create strong research/evidence base on interface of ecosystem services, dynamics & management, human use and pathways to sustainable poverty reduction.
- Develop innovative, interdisciplinary research and methodologies, delivering tools and approaches enabling simulation/prediction of socio-ecological response to multiple drivers.
- High uptake of research outputs; engagement with end-users, decision makers.
- Enhanced capability of southern researchers to conduct, lead, use ESPA research through partnerships.

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ESPA research themes

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- Water: impacts of climate variability and change on the water cycle, ecosystem services and water security.
- Health: ecosystem services, disease ecology & human well-being.
- Forest theme: forests, land-use change & ecosystems services.
- Biodiversity: biodiversity & ecosystems services- ensuring a sustainable flow of goods and services to enhance human well-being.
- Coasts: strengthening management of coastal ecosystems to support sustained ecosystem service delivery for reduced poverty and vulnerability.

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Example projects in submission

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Seasonal forecasting and use of ecosystem indicators for poverty alleviation in South Asia

- gather user profiles of forecast products more meaningful to poverty reduction at community/national/international levels.
- Showcase effective dissemination of climate risk information at different decision-making scales.
- Protection plans for the poor against uncertain forecast outcomes.

Developing a novel approach to integrating scientific and local valuations from the benefits of forest ecosystems

- How the poor derive enhanced livelihoods from forest ecosystem services.
- Systematic comparisons of land management change and climate change on forests (sequestration).

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NERC-MOES Changing Water Cycle

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- Relates to several aspects of NERC strategy (climate system; sustainable use natural resources; natural hazards) and UK government strategic goals.
- 2009-2014: £10.1 million, contributes to LWEC.
- Part of this call (£2.5millions plus matched funding from MOES) is available as a regional focus on South Asia.

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CWC Goals

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- Integrated, quantitative understanding of changes in global WC, involving all earth system components.
- Improve predictions for next few decades of regional precip, evapotranspiration, soil moisture, hydrological storage and fluxes. Must quantify and narrow uncertainty in predictions.
- Understand how local-regional scale hydrological and biogeochemical processes are responding to changing climate and land use, together with impact on sustainable use of soil and water.
- Understand consequences of CWC for water-related natural hazards, including floods & droughts, improve prediction and mitigation of these.

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CWC Themes

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LAO Interactions and Feedbacks

- Impacts of land surface on rainfall anomaly persistence
- Impacts of changing ocean surface state, WV and rainfall patterns
- Feedbacks between atmosphere & natural/anthropogenic changes

Precipitation

- Sources of precip, Precip forming processes
- Role of large-scale circulation, Changes in extreme precipitation

Detection & Attribution of water cycle changes

- Development of techniques/quantification of change/application to other systems

Consequences of CWC

- New and innovative ways to assess consequences

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UKIERI programme

UKIERI
UK-India Education and Research Initiative

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UK India Education and Research Initiative (www.ukieri.org)

Addressing Climate Change through Collaborative Partnerships

Launched in Delhi, November 2007

one Indian national PhD student currently at UoR

Another scheduled to start at UEA/UoR or Exeter University October 2010 depending on interviews

UK-India Downscaling linking to applications workshop held January 2009 at UEA.

Other workshops planned including high resolution modelling, possibly at ECMWF.

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MJO implicated in monsoon 2009: onset to August

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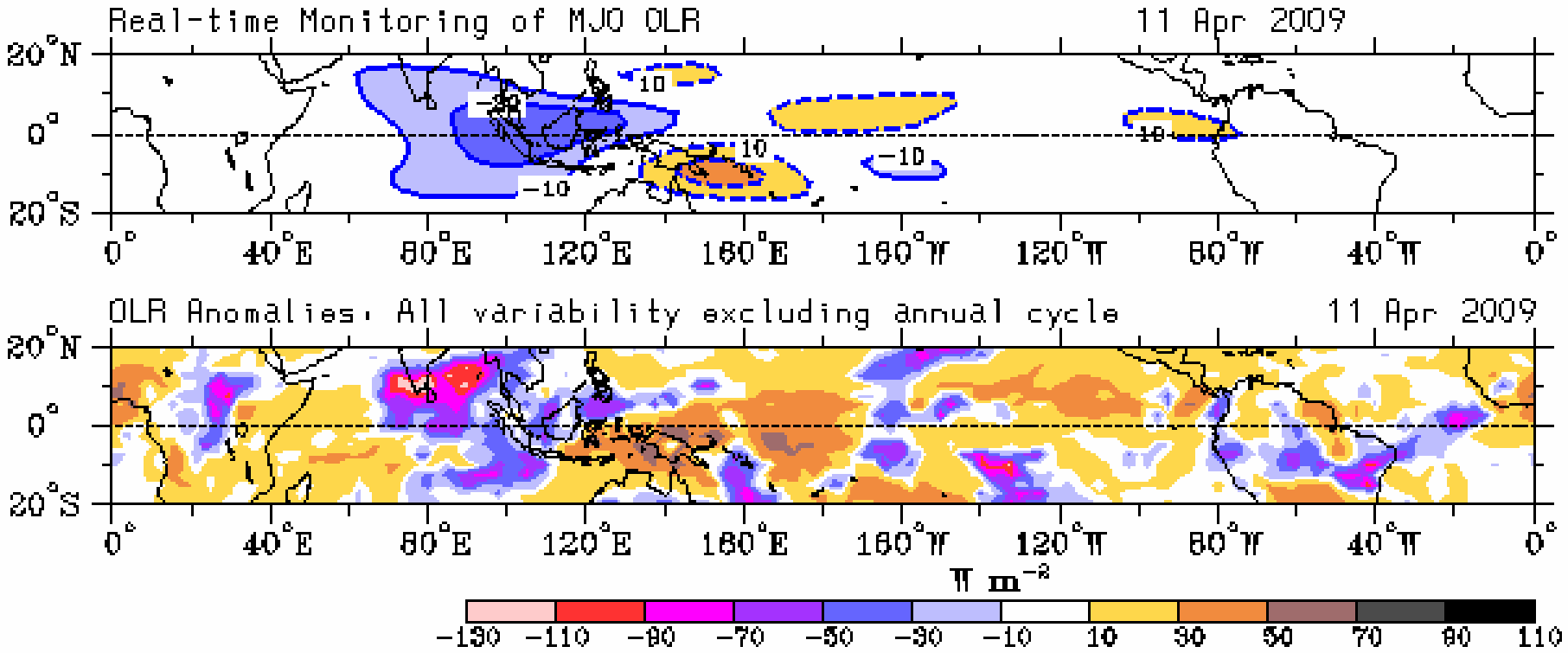
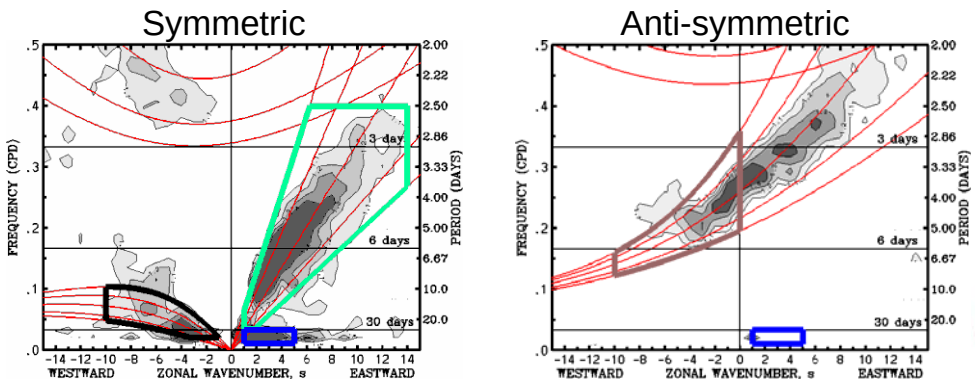
Daily OLR anomalies + 'MJO' modal projection (Mat Wheeler, BMRC)



'MJO' mode by filtering in the zonal wavenumber / frequency domain, Wheeler & Weickmann (2001)



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MJO implicated in monsoon 2009: July to September

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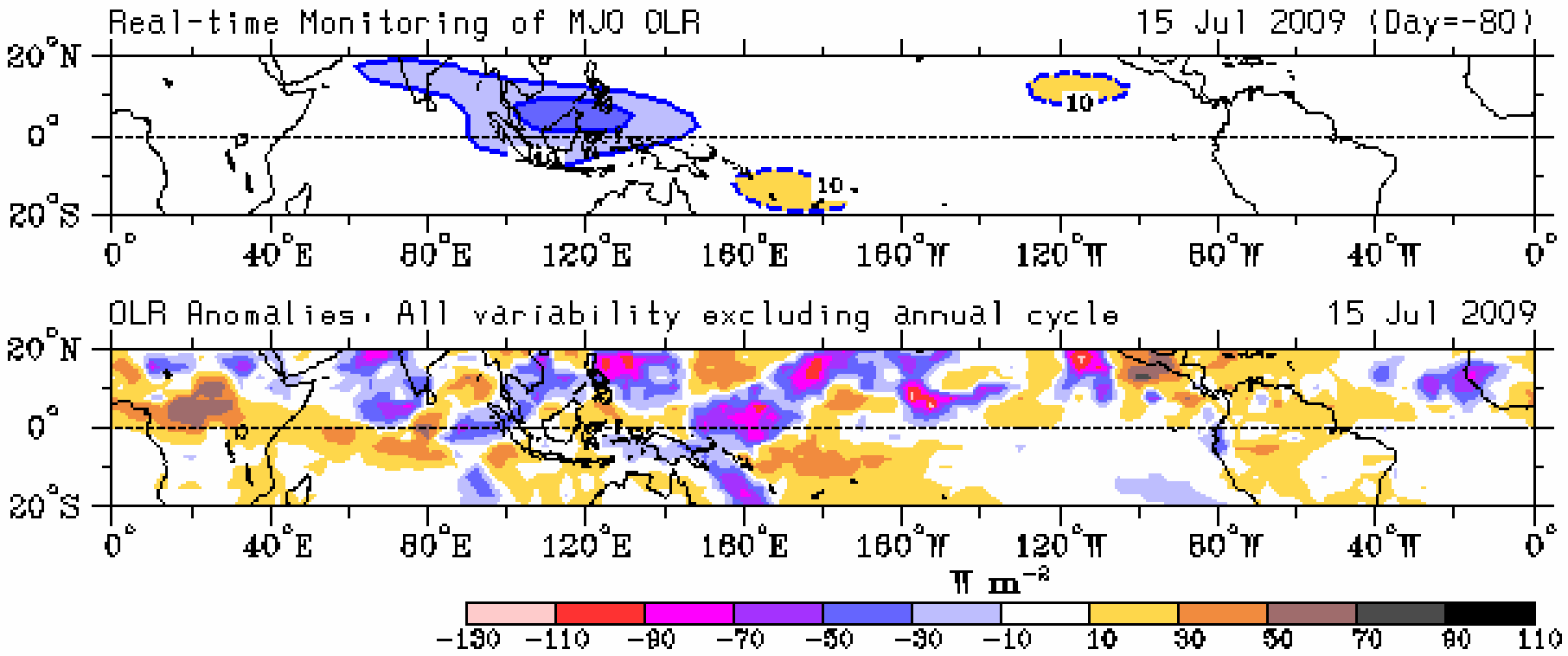
Daily OLR anomalies + 'MJO' modal projection (Mat Wheeler, BMRC)



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