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Influence of El Nino on the upper-ocean circulation in the tropical Atlantic in different ocean estimates

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Influence of El Nino on the upper-ocean circulation in the Tropical Atlantic in different ocean state estimates

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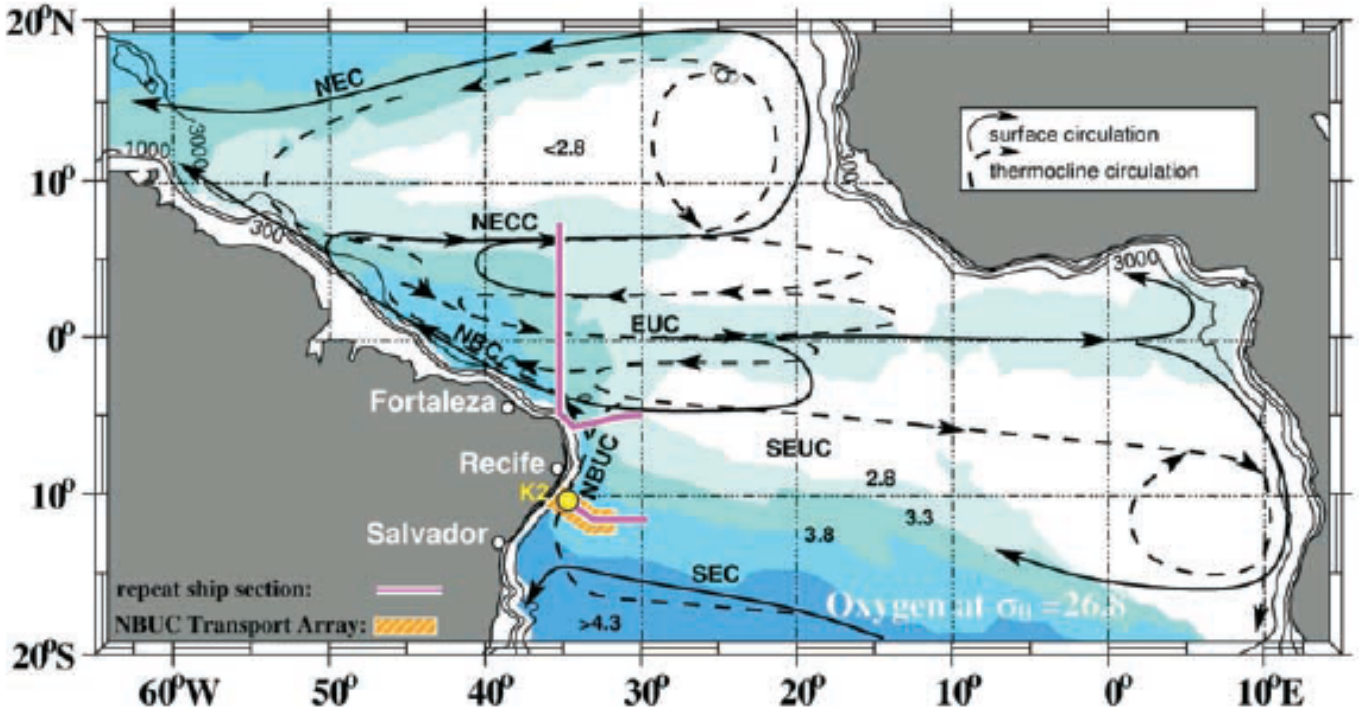
Influence of El Nino on the upper-ocean circulation in the Tropical Atlantic in different ocean state estimates

- **NCEP – GODAS**
- **UMD - SODA**
- **ECMWF - ORA-S3**
- **Gent & Cane**

(1981 – 2005, monthly data, climatology out)

Circulation in the upper subtropical and tropical Atlantic

Wind-driven zonal flow system superimposed on western boundary current regime

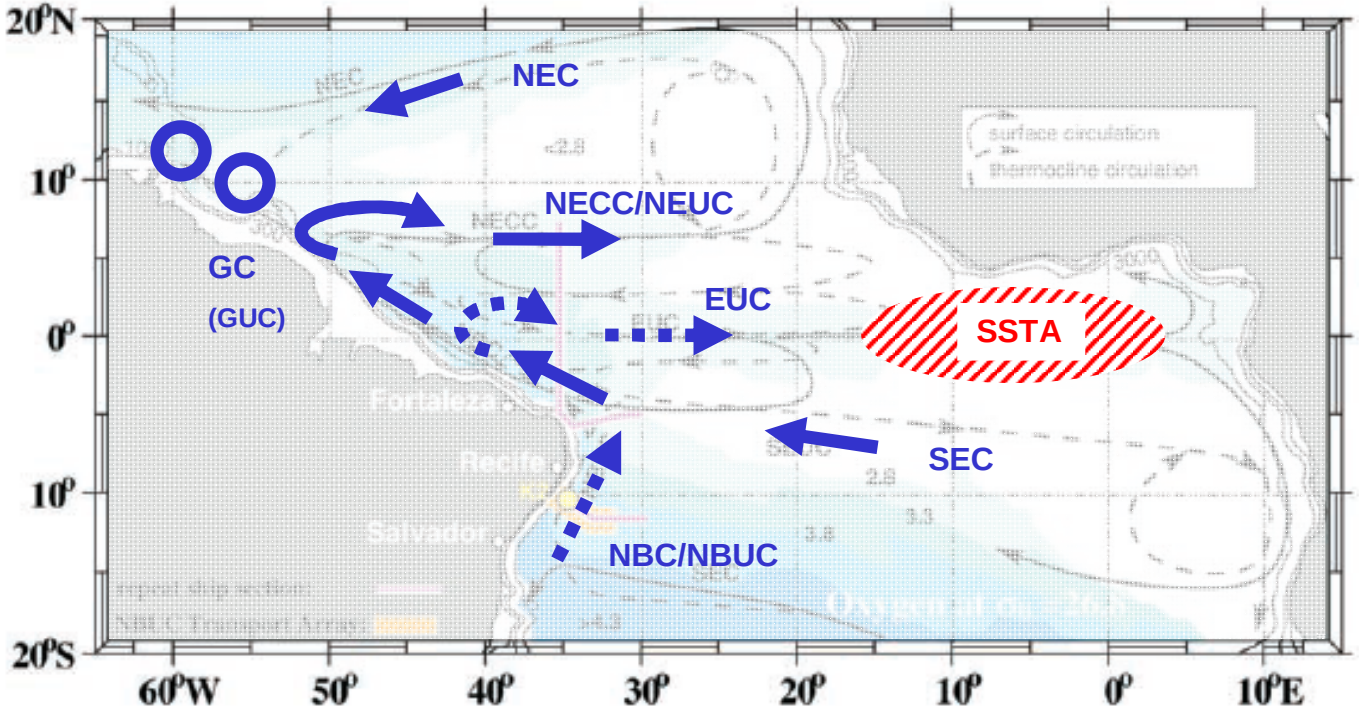


Schematic diagram of the surface and thermocline flow field in the subtropical and tropical Atlantic; Schott et al. (2002)

Circulation in the upper subtropical and tropical Atlantic

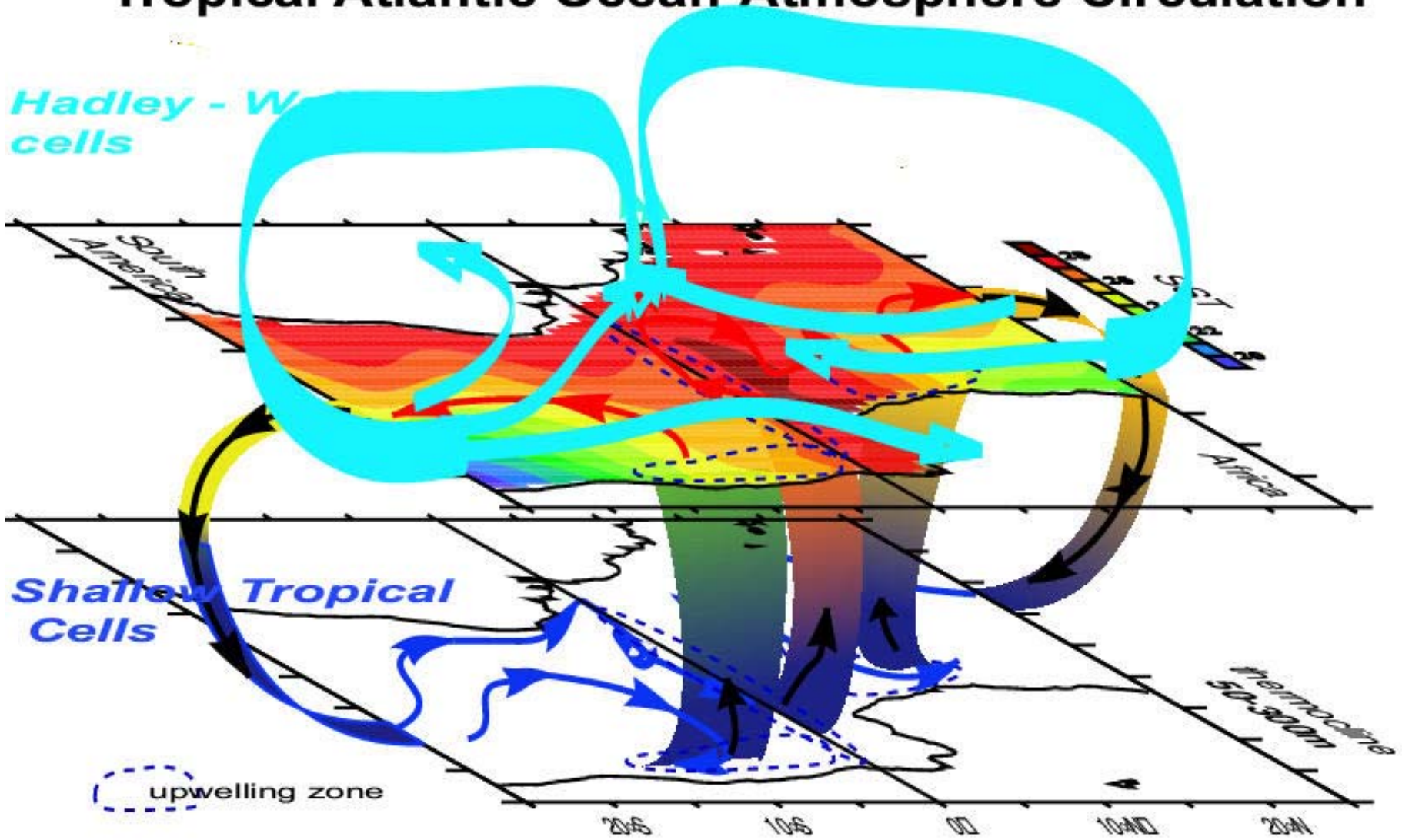
this complex flow field forms 3-dim shallow cells …

… involved in modulating eq. SST



Schematic diagram of the surface and thermocline flow field in the subtropical and tropical Atlantic; Schott et al. (2002)

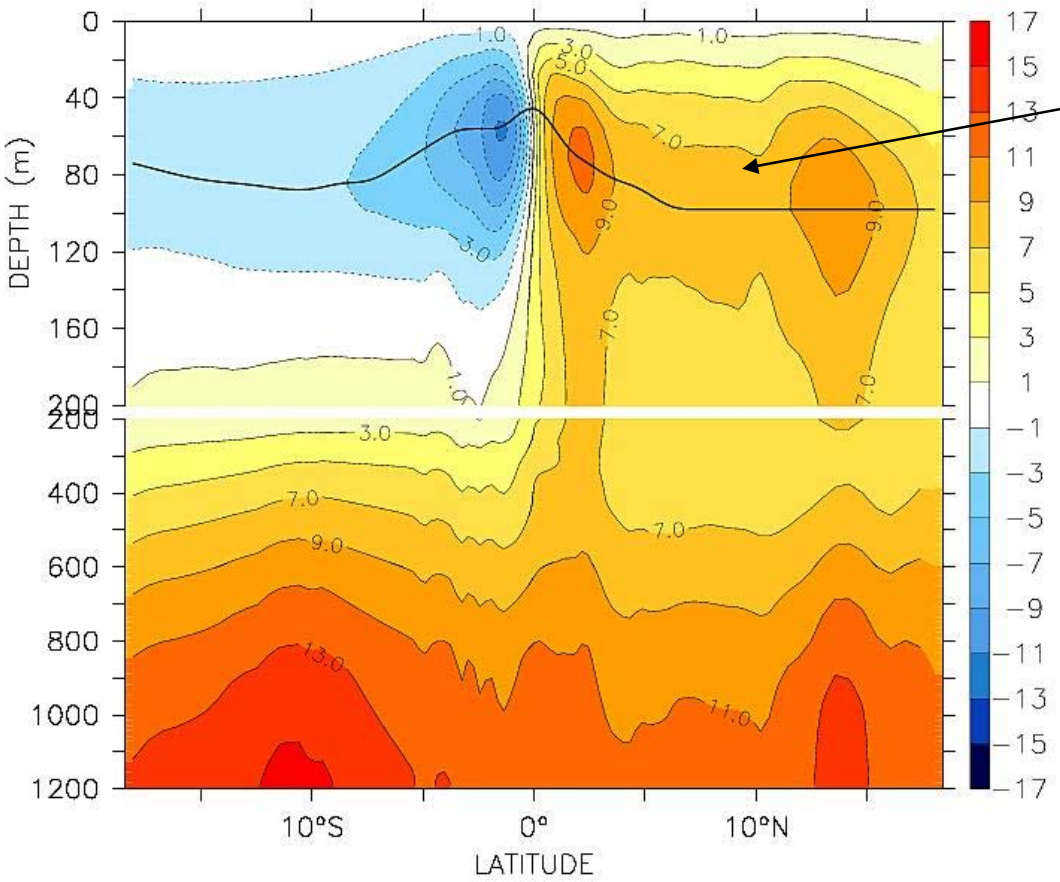
Tropical Atlantic Ocean-Atmosphere Circulation



(courtesy A. Lazar)

Zonally integrated flow field & shallow cell strength index in an OGCM

Common means to give insight into net meridional transports



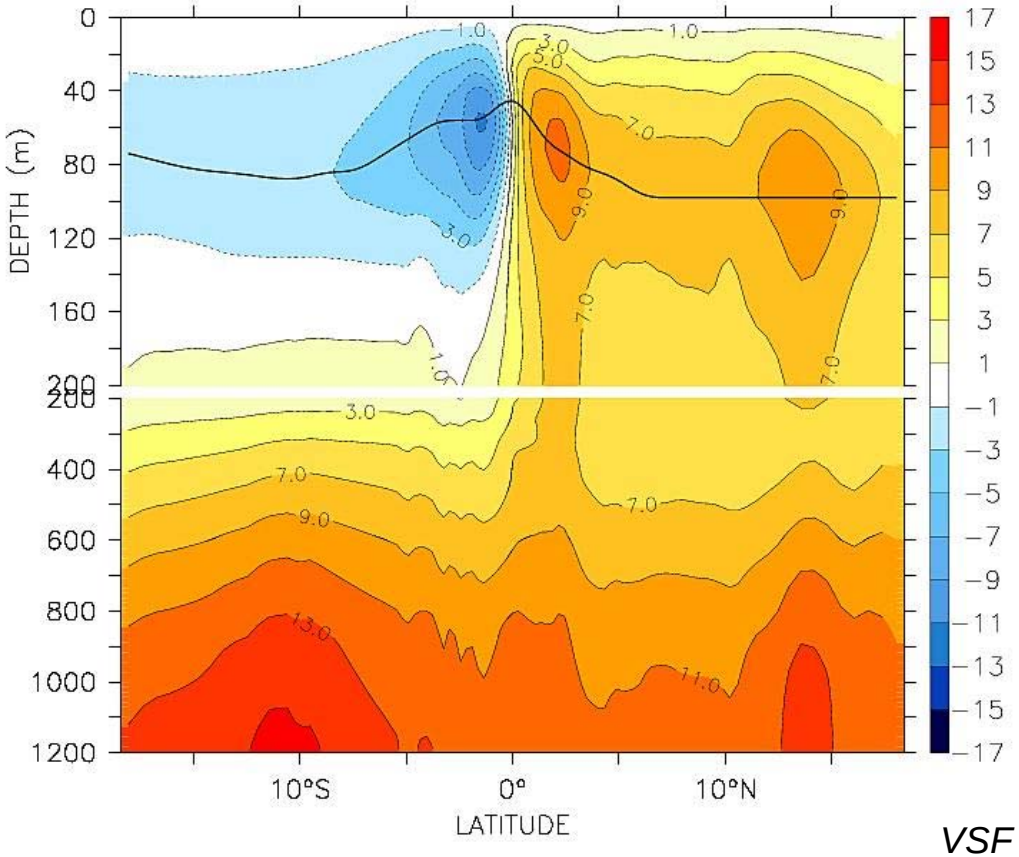
VSF index (φ, t)

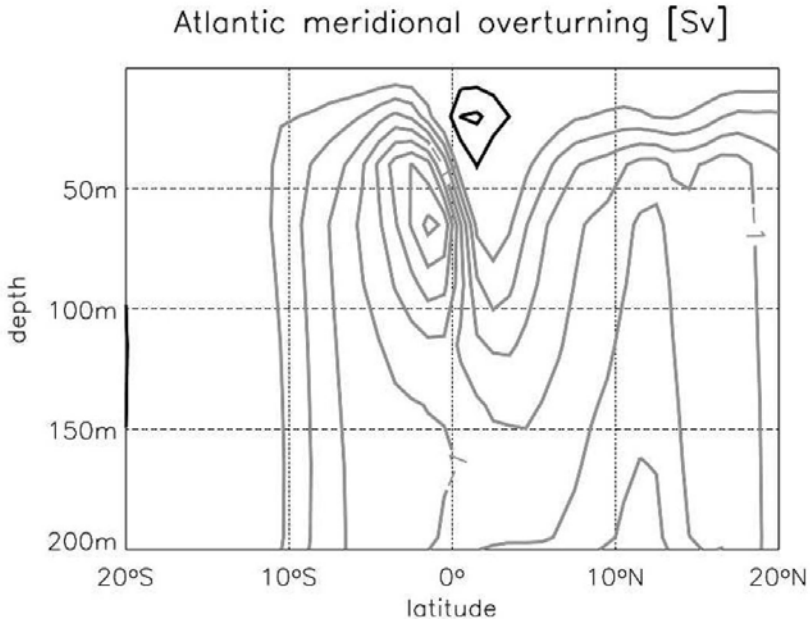
low-pass filtered vertical stream function (VSF) [Sv] in 1984 in Gent & Cane, with the local extreme value (between surface and 100 m) indicated by the thick black line;

Kröger et al. (2005)

Zonally integrated flow field & shallow cell strength index in an OGCM

Influence of El Nino on the Atlantic shallow cell variability



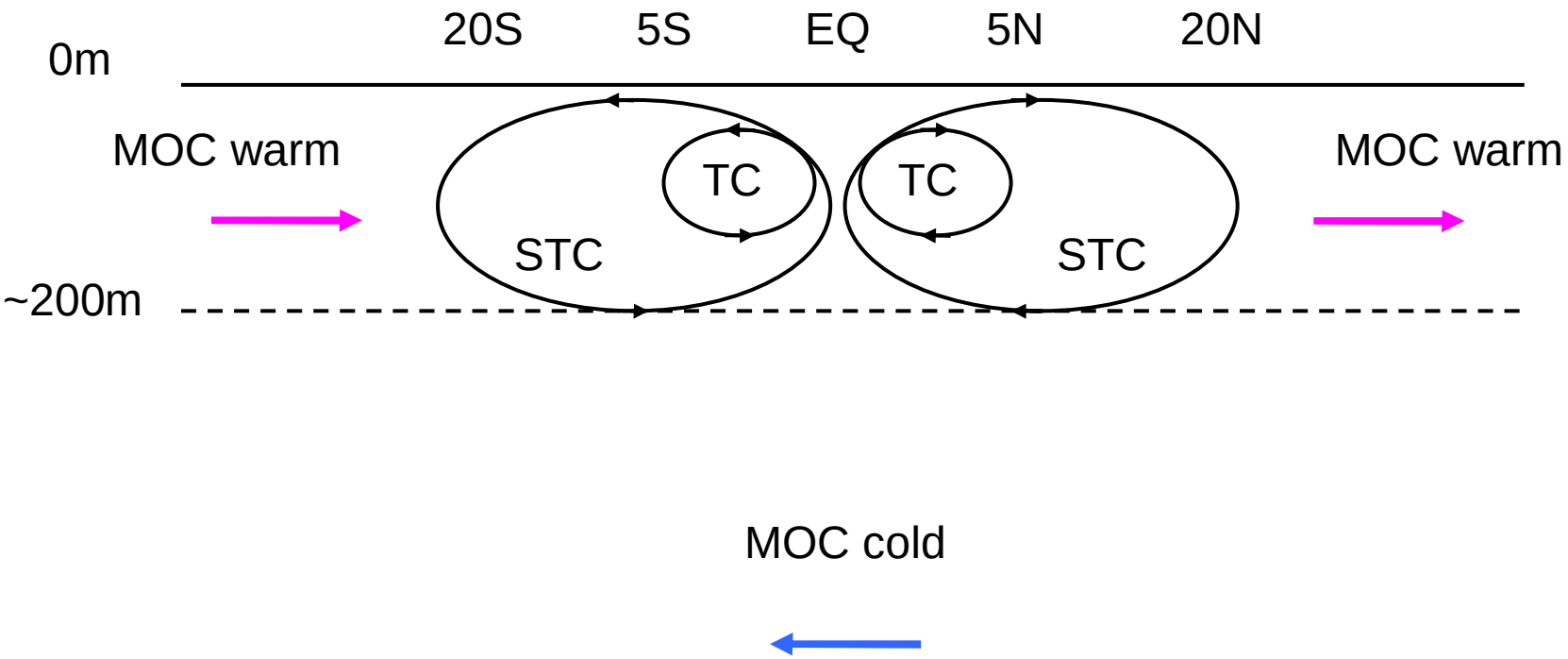


VSF anomaly composite based on Pacific Nino3 (4 months lead) in MPI-OM (NCEP forcing, all months, no phase locking with the seasonal cycle);

Lohmann & Latif (2007)

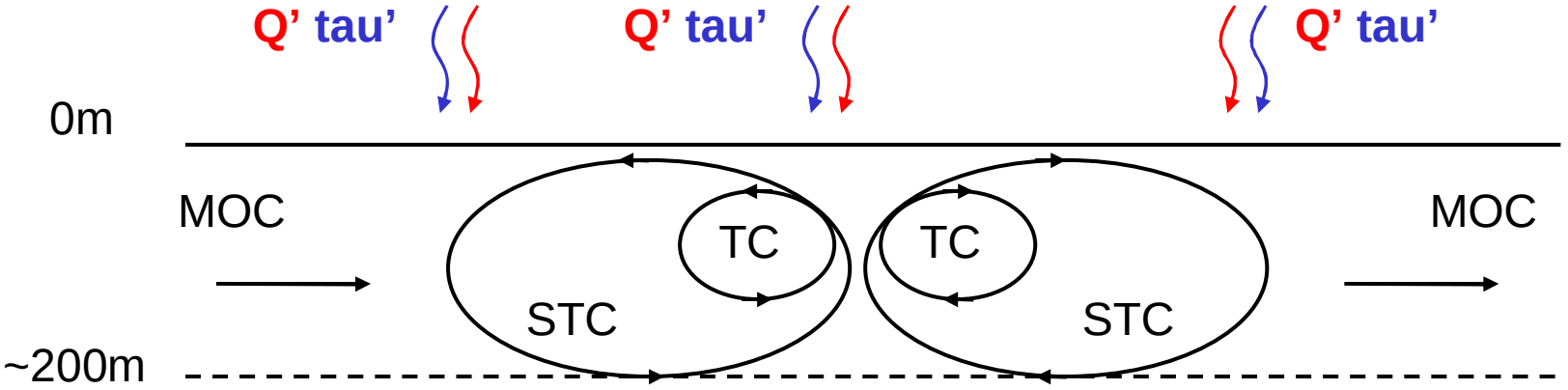
Sketch of the zonally integrated flow field in the Atlantic

Subtropical and Tropical Cells (STC,TC) superimposed on the MOC



OGCM exps. elucidate the role of shallow cells in modulating eq. SST

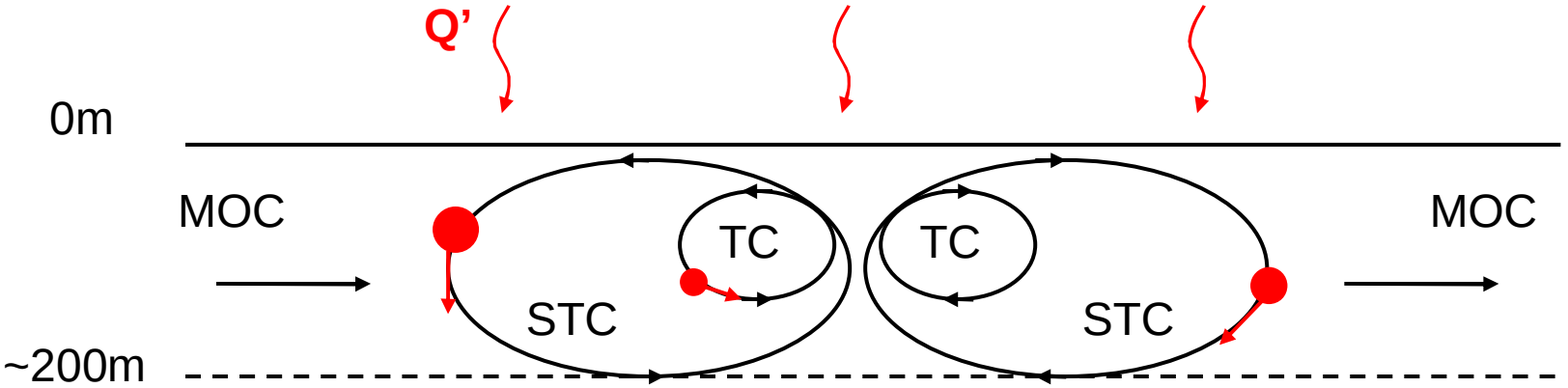
(i) remote vs. local forcing



Kröger et al. (2005)

OGCM exps. elucidate the role of shallow cells in modulating eq. SST

(ii) dynamical vs. thermo-dynamical forcing

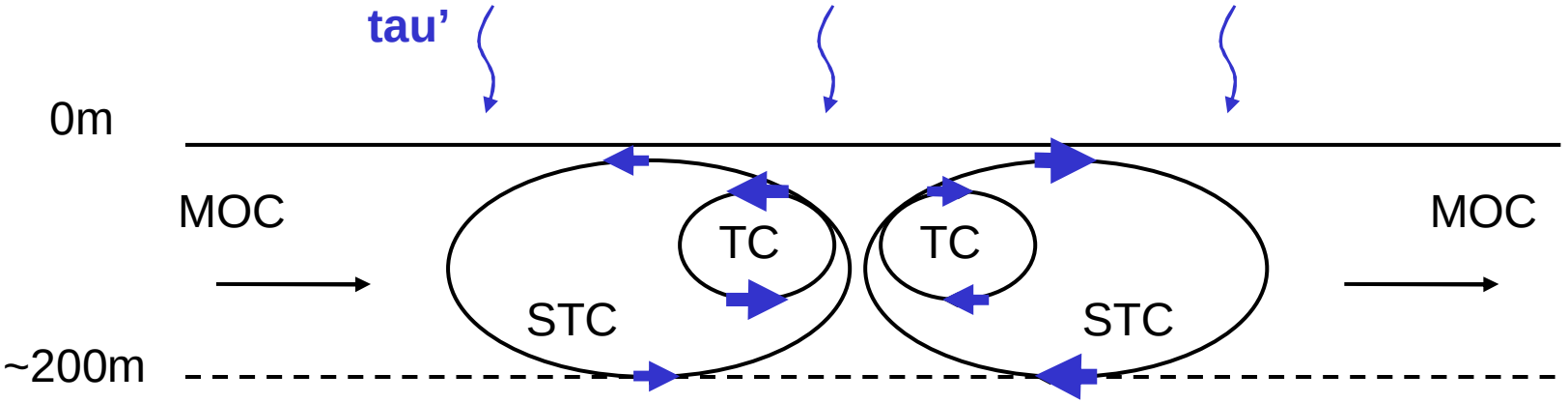


(1) $\bar{v}$ T'

Kröger et al. (2005)

OGCM exps. elucidate the role of shallow cells in modulating eq. SST

(ii) dynamical vs. thermo-dynamical forcing



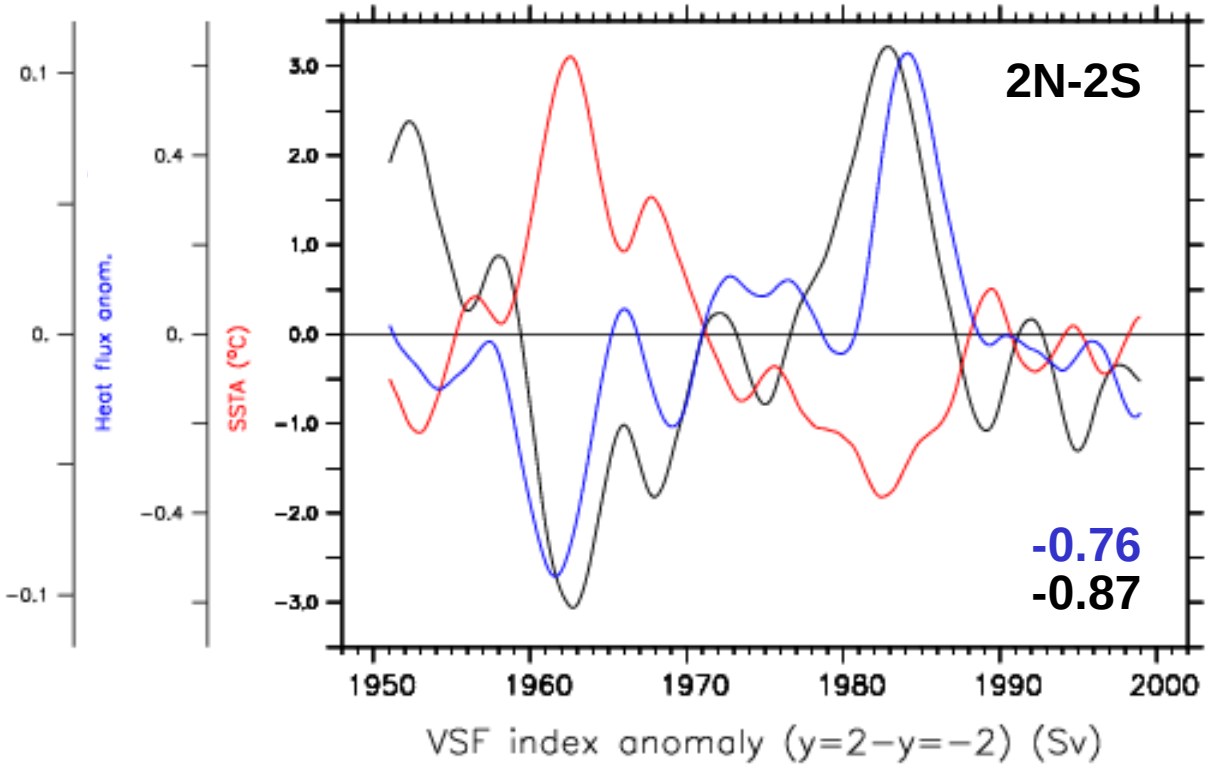
(1) $\bar{v}\,T'$

(2) $v'\bar{T}$

Kröger et al. (2005)

Relation between VSF index, heat transport and equatorial SSTA

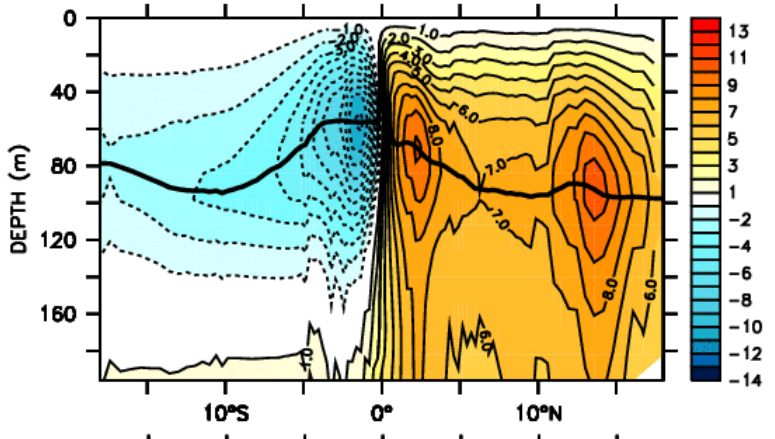
SST variability in Atl. Nino region is dominated by local, dynamical forcing

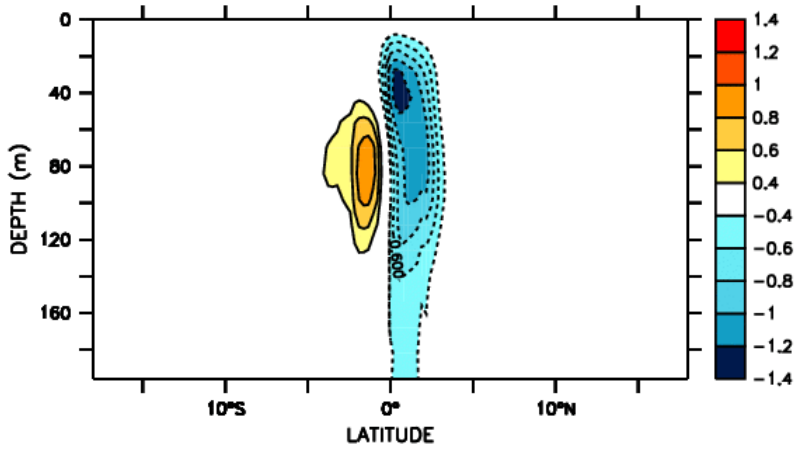


Low-pass filtered *(6-year-running mean) time series of VSF index anomaly (black), heat transport anomaly (blue), and equatorial SSTA (red, mean over 1S-1N, 25W-Africa) in Gent & Cane with observed momentum and climatological heat flux forcing (NCEP)*

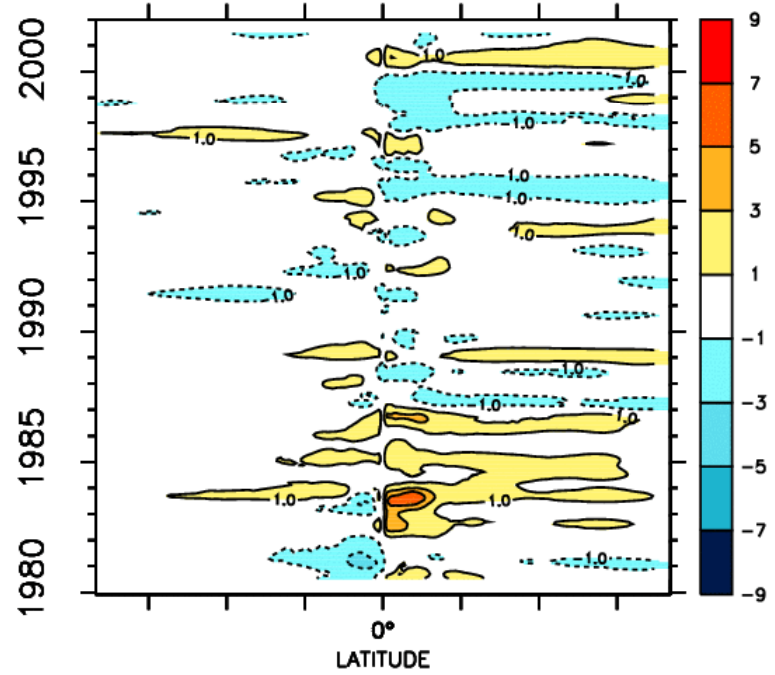
Zonally integrated flow field: regression on the Atl. Nino in Gent & Cane

warm eq. SST related to spin-down of TCs and vice versa

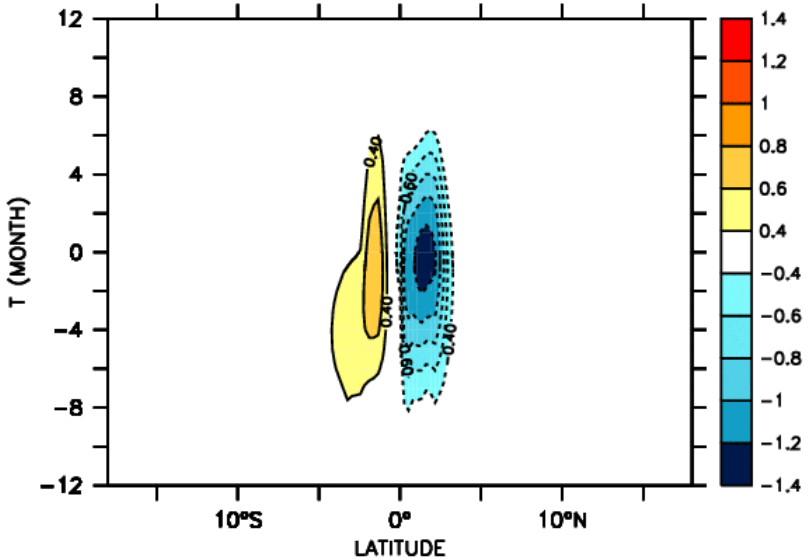




Reg[eastatl, vsfa] in exp8.1.1, eastatl lags by 0 ts, mon of yr: 0



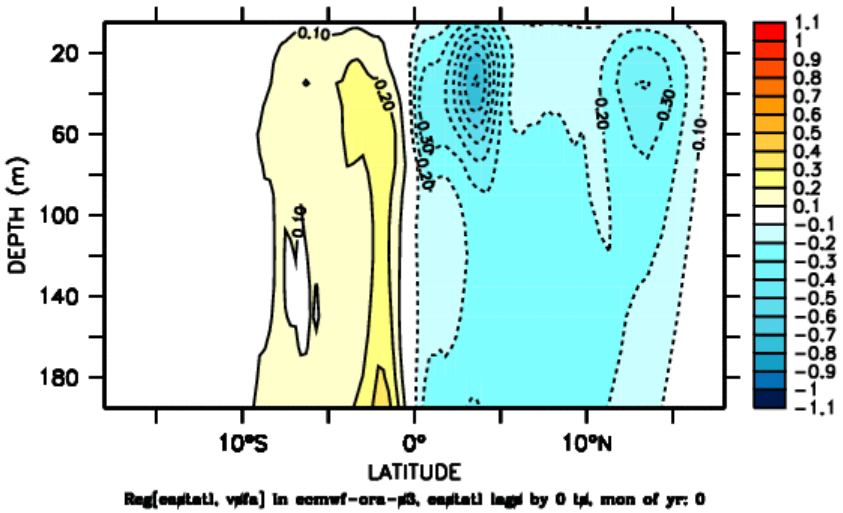
exp8.1.1: VSF index − mean and anomalies

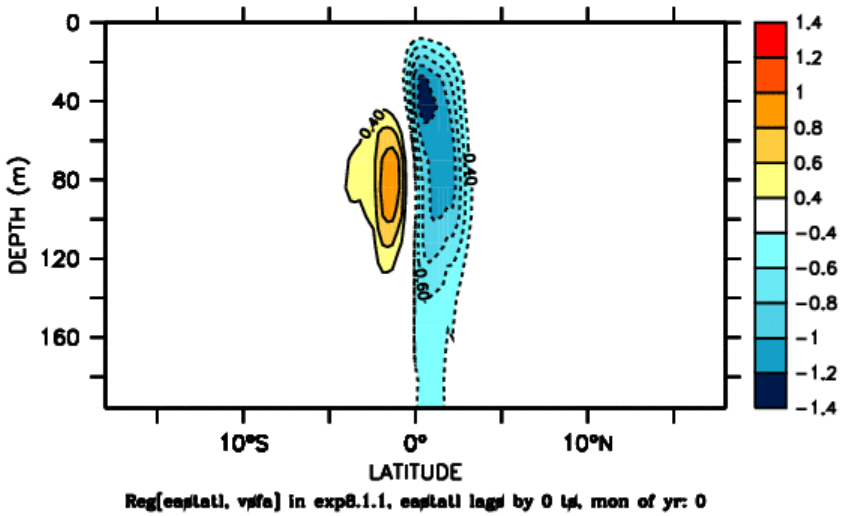


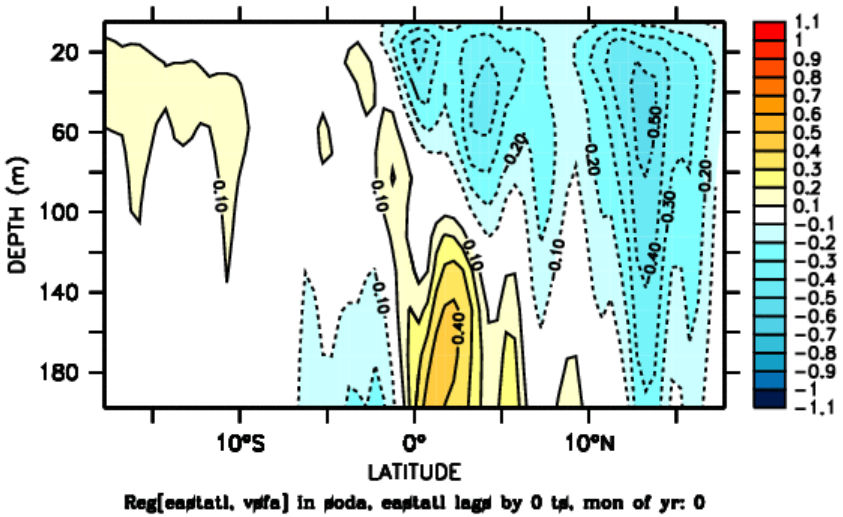
Reg[eastatl, vsf_index] in exp8.1.1 with shn:13, lead/lag in months

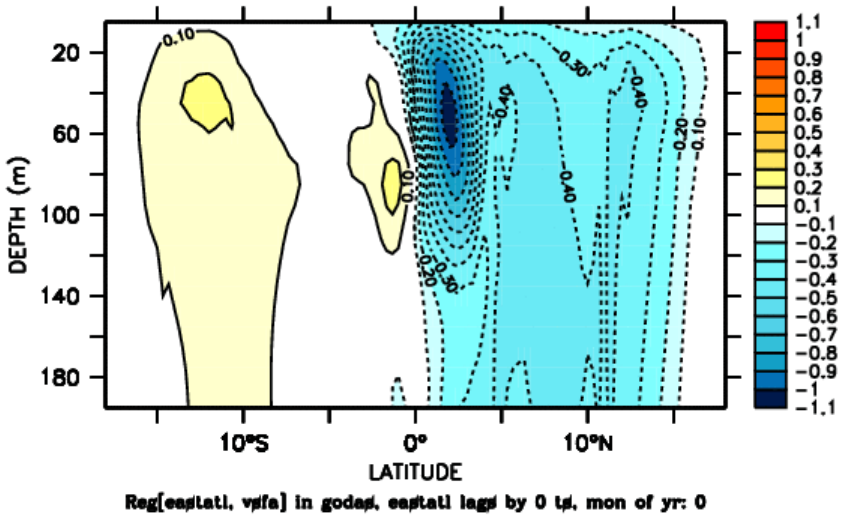
Zonally integrated flow field: regression on the Atl. Nino in the ODAs

eq. SSTA related to spin-up and spin-down of TCs, especially in the north



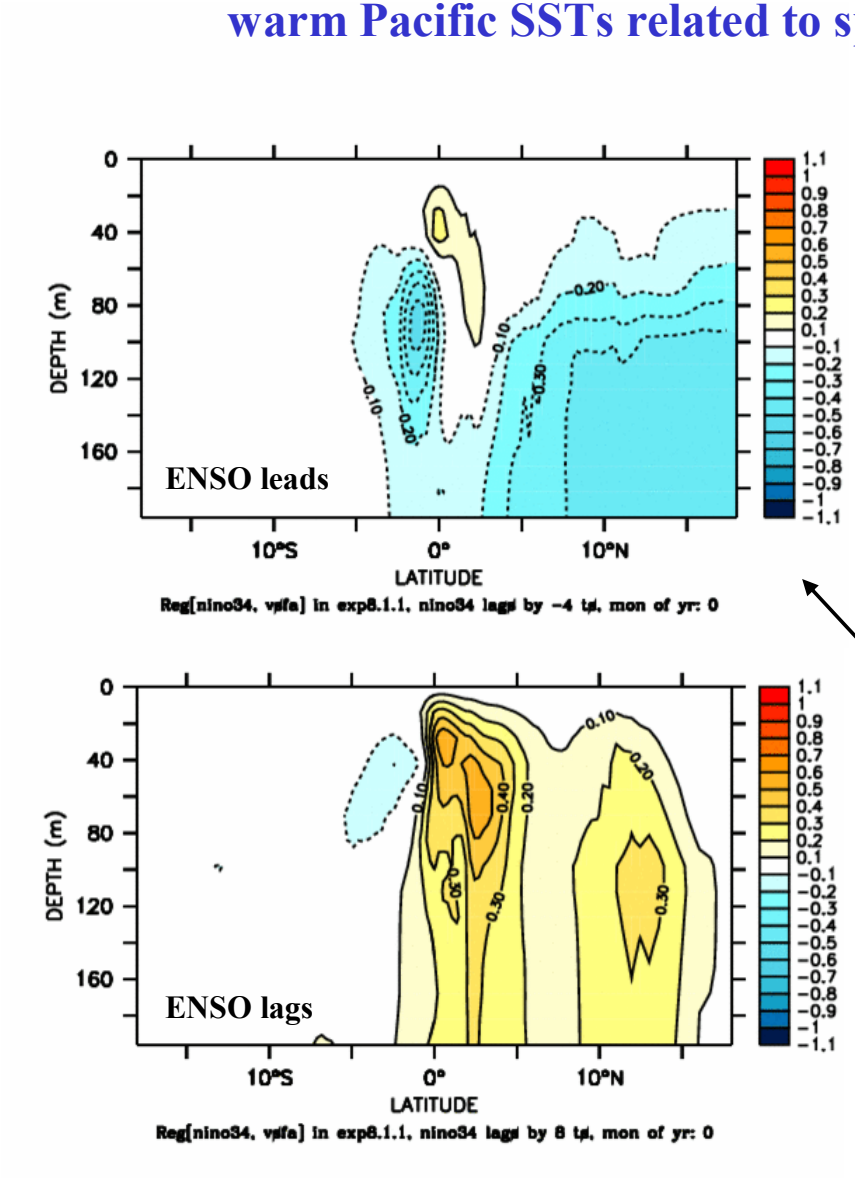






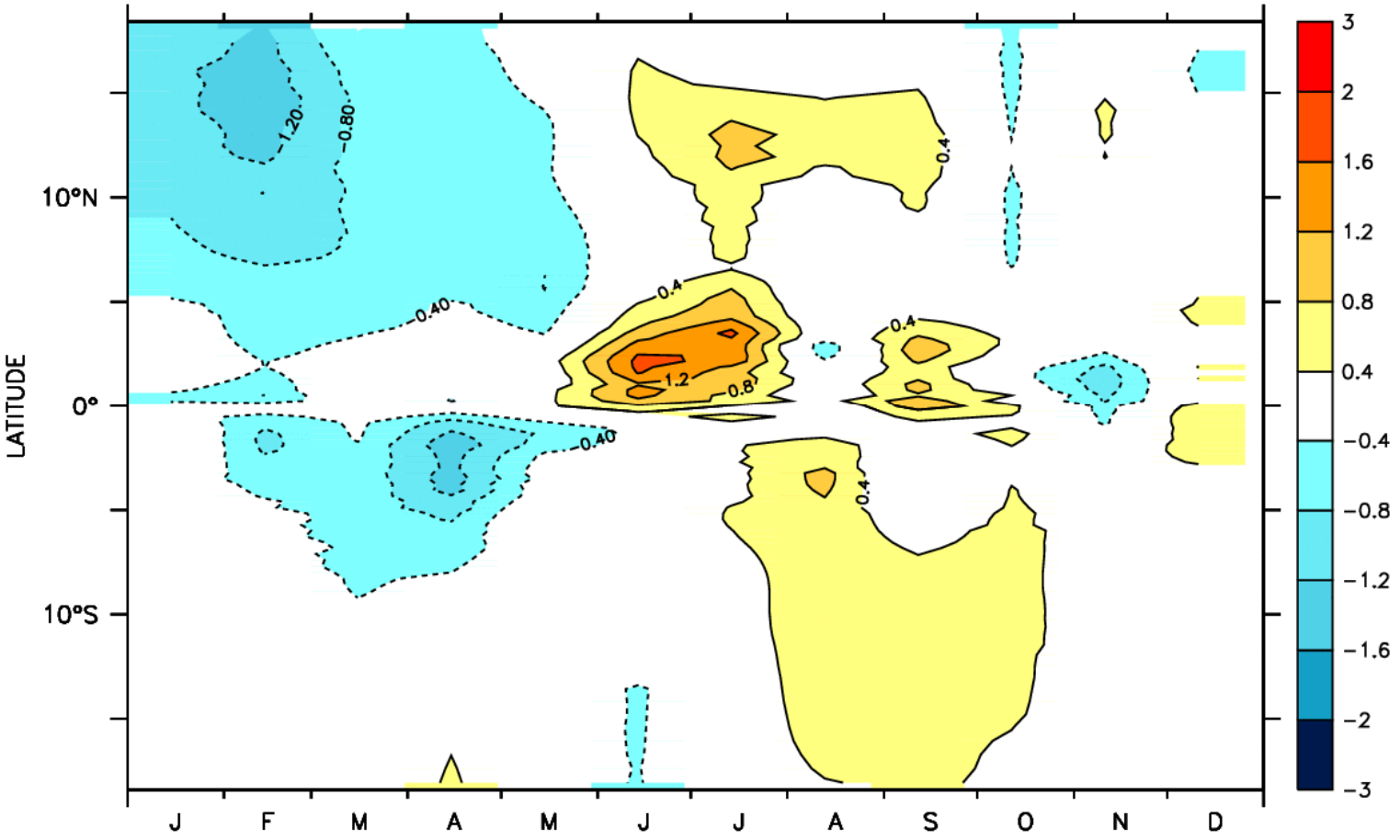
Zonally integrated flow field: regression on Pacific Nino34 in Gent & Cane

warm Pacific SSTs related to spin-up of Atlantic TCs and vice versa



Zonally integrated flow field: regression on Pacific Nino34 in Gent & Cane

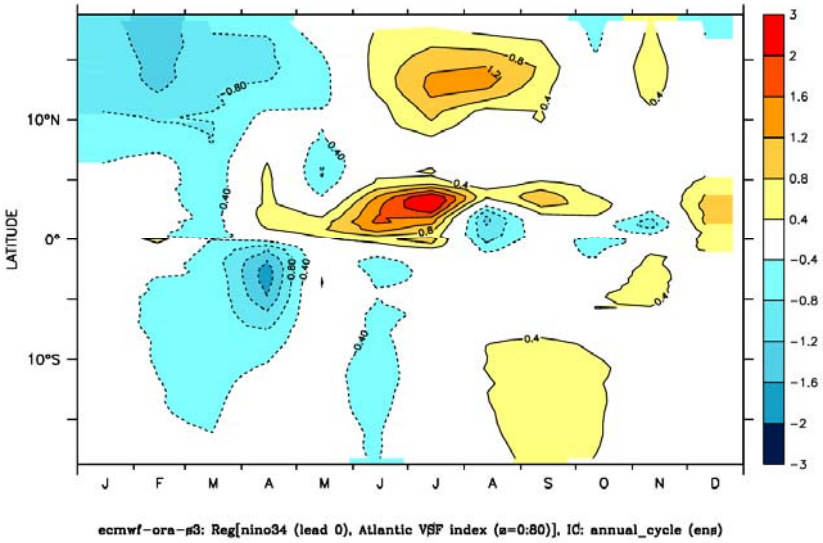
regressions for all individual months reveal phase locking with seasonal cycle



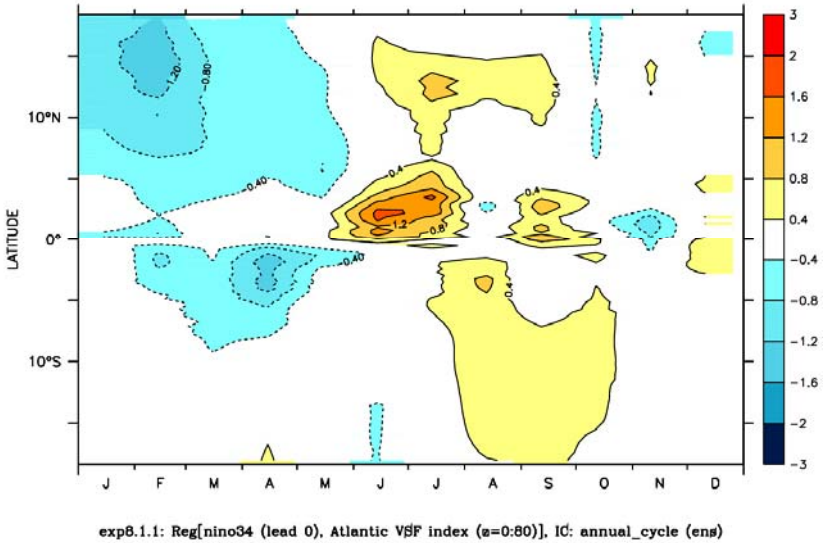
exp8.1.1: Reg[nino34 (lead 0), Atlantic VSF index (ø=0:80)], IC: annual_cycle (ens)

Zonally integrated flow field: regression on Pacific Nino34 in the ODAs

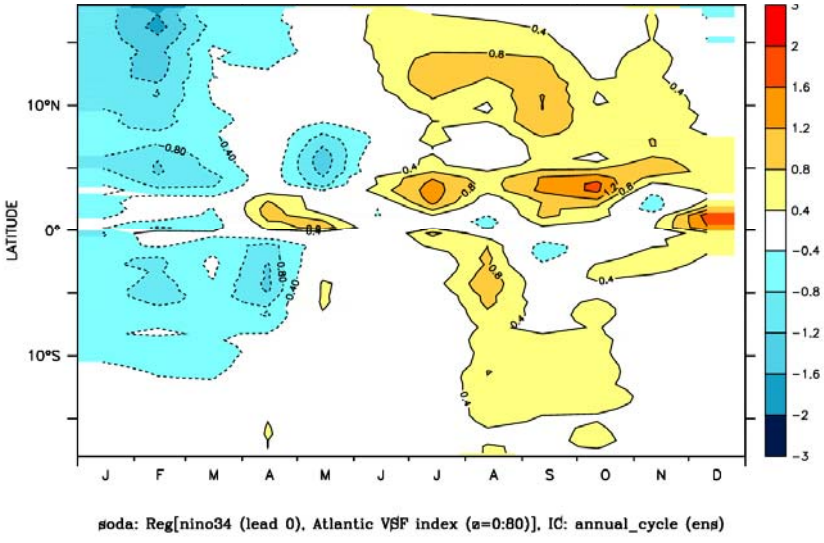
regressions for all individual months reveal phase locking with seasonal cycle



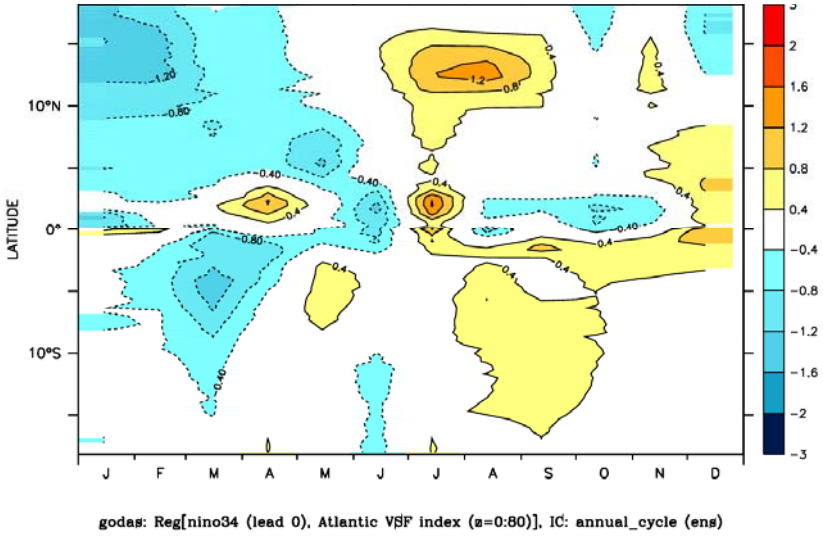
ecmwf-ora-s3: Reg[nino34 (lead 0), Atlantic VSF index (a=0:80)], IC: annual_cycle (ens)



exp8.1.1: Reg[nino34 (lead 0), Atlantic VSF index (a=0:80)], IC: annual_cycle (ens)



soda: Reg[nino34 (lead 0), Atlantic VSF index (a=0:80)], IC: annual_cycle (ens)



godas: Reg[nino34 (lead 0), Atlantic VSF index (a=0:80)], IC: annual_cycle (ens)

Influence of El Nino on the upper-ocean circulation in the Tropical Atlantic in different ocean state estimates

- El Nino (La Nina) leads to spin-up (spin-down) of TCs
- TC response reveals phase locking with the seasonal cycle
- southern TC dominates in spring, northern TC in summer

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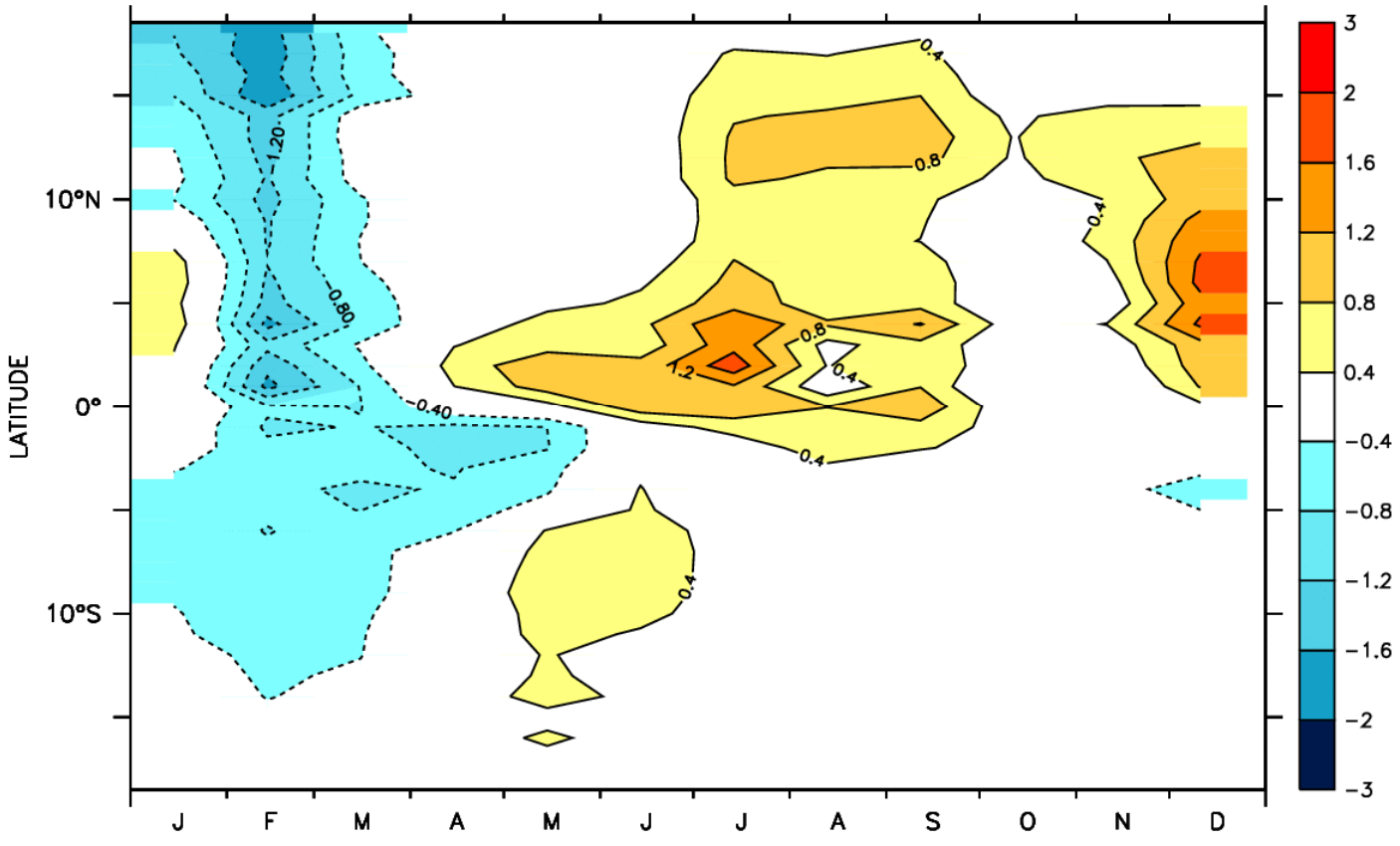
Zonally integrated flow field: regression on Pacific Nino34 in CFS

regressions for all individual months reveal phase locking with seasonal cycle



Zonally integrated flow field: regression on Pacific Nino3 in Gent & Cane

warm Pacific SSTs related to spin-up of Atlantic TCs and vice versa