An ECMWF IFS with SuperParameterization

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ECMWF

Super-Parameterized IFS (SP-IFS)

- **GCM: OpenIFS (IFS 38R1), which is free-running IFS without data assimilation system;**

- **SP: 32 x 74; Δx=4 km; Δt=20s;**

- **All IFS cloud and convective parameterizations are off;**

- **PBL/mixing parameterizations are allowed;**

- **Radiation coupling through SP's *mean* profiles (not on CRM grid as done in SP-CAM);**

- **T159 (~1.125° x 1.125°)   T42 (~2.8° x 2.8°)**
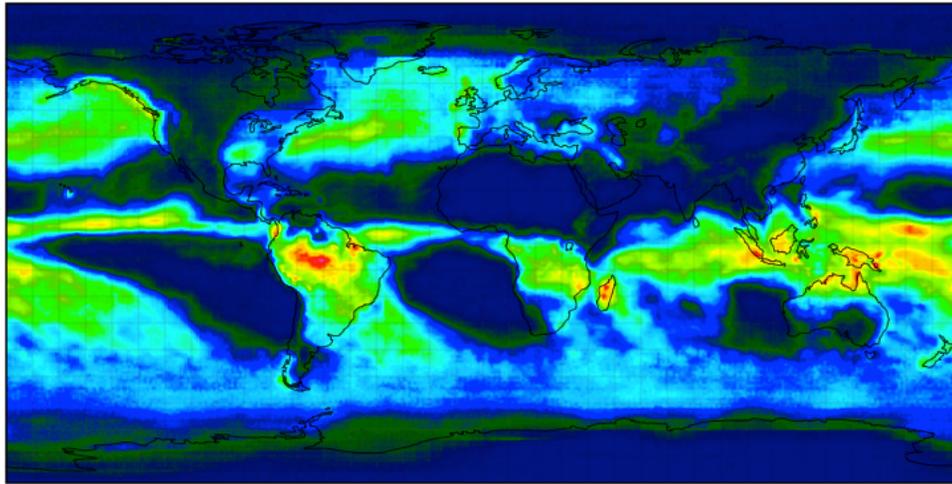
- **3 year runs starting Aug 2000, and ending Sep 2003.**

SP-IFS T159

Precipitation (LOG mm/h)
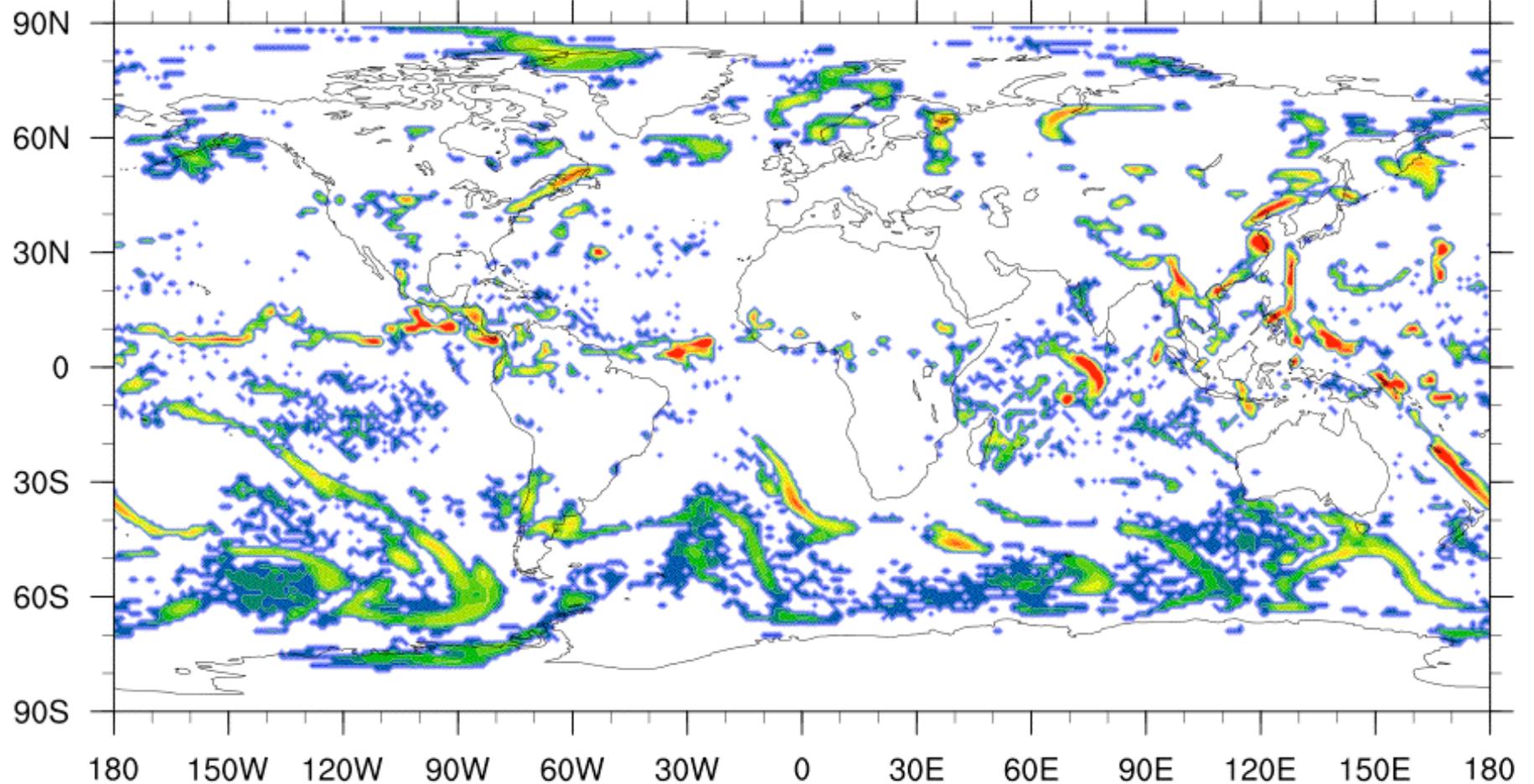
DJF Precipitation

GPCP
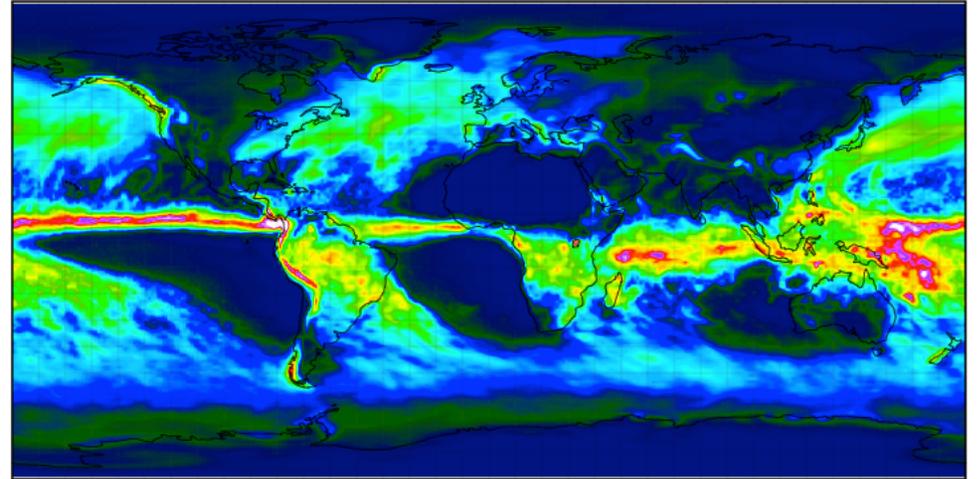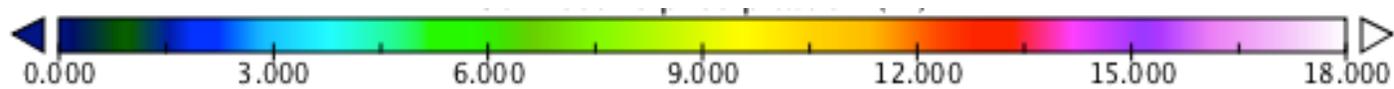
SP-IFS

IFS

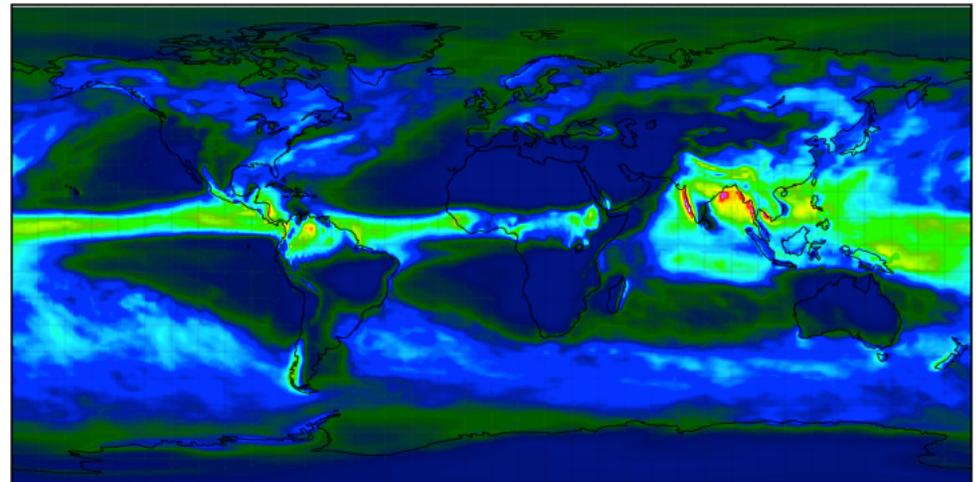| 0.000 | 3.000 | 6.000 | 9.000 | 12.000 | 15.000 | 18.000 |
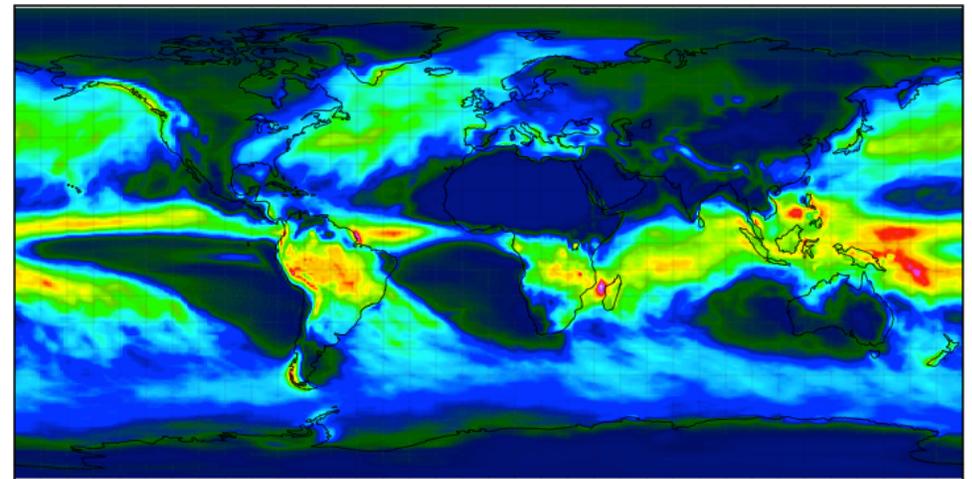
JJA Precipitation
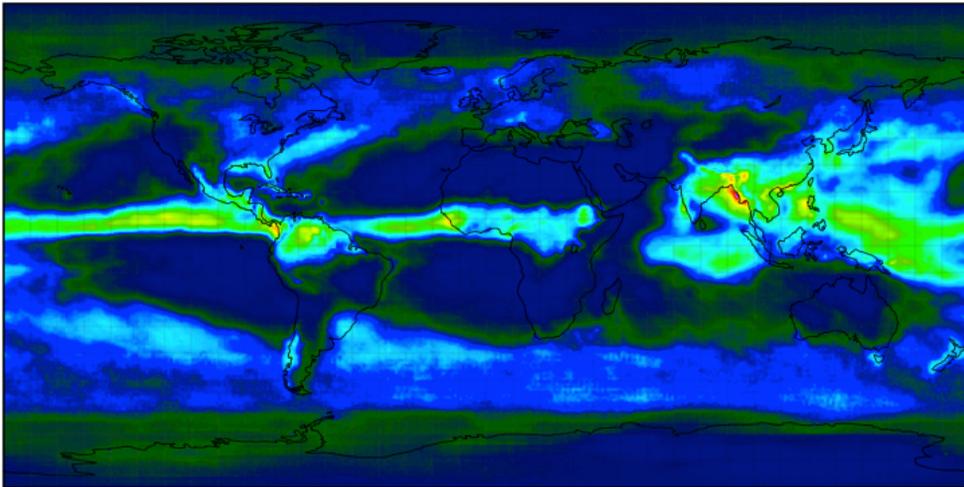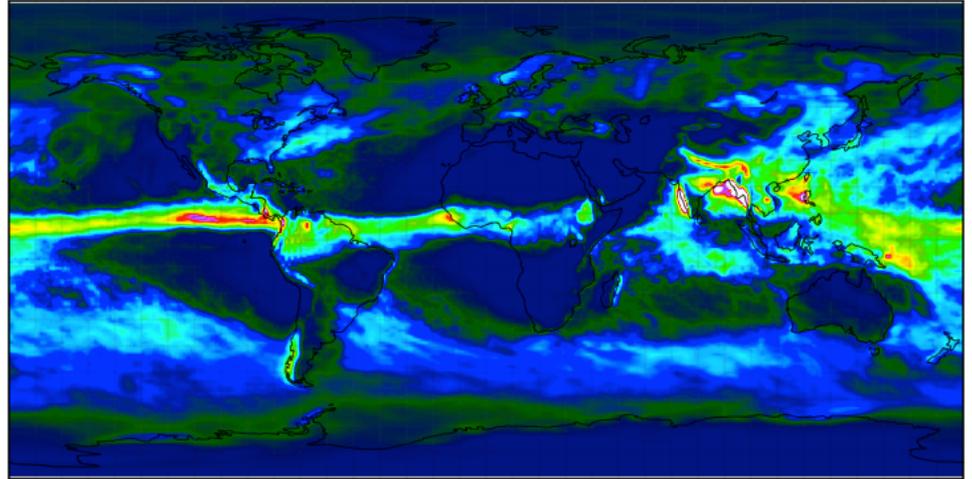
GPCP

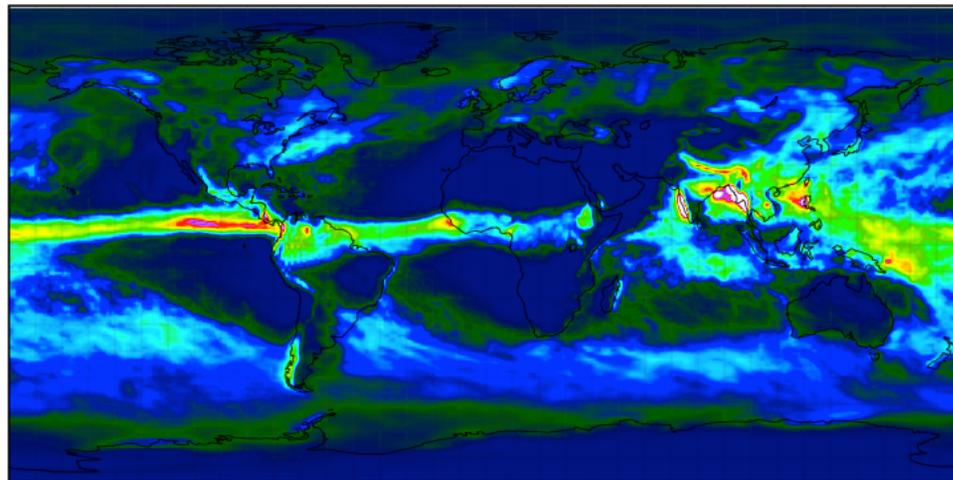**SP-IFS T159**

IFS T159

There is no Great Red Spot at T159!

0.000   3.000   6.000   9.000   12.000   15.000   18.000
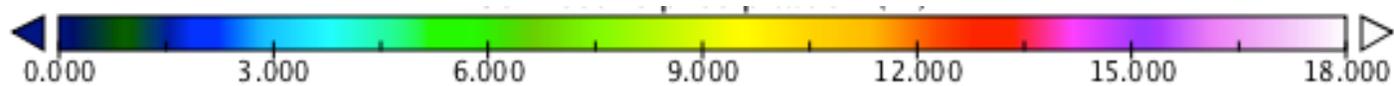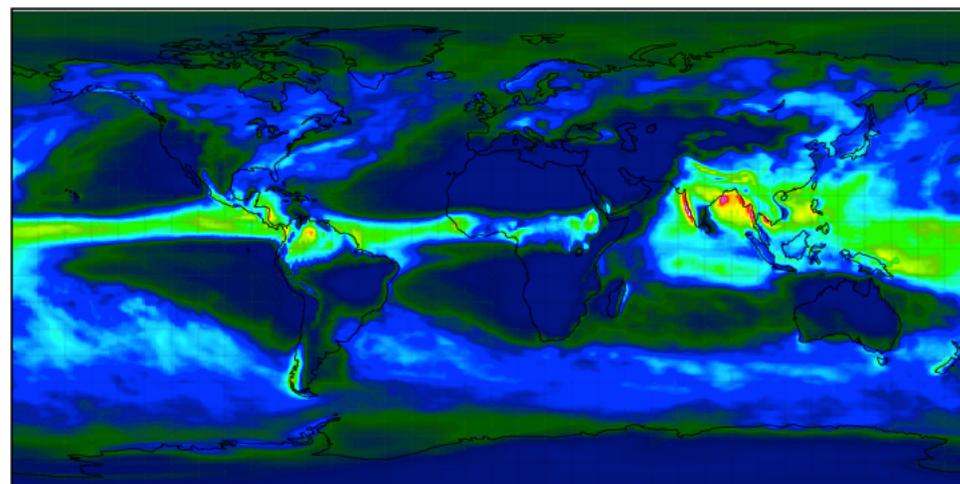
JJA Precipitation

GPCP

SP-IFS

SP-IFS **T42**   2.9041

IFS

180 150W 120W 90W 60W 30W 0 30E 60E 90E 120E 150E 180

0.000   3.000   6.000   9.000   12.000   15.000   18.000
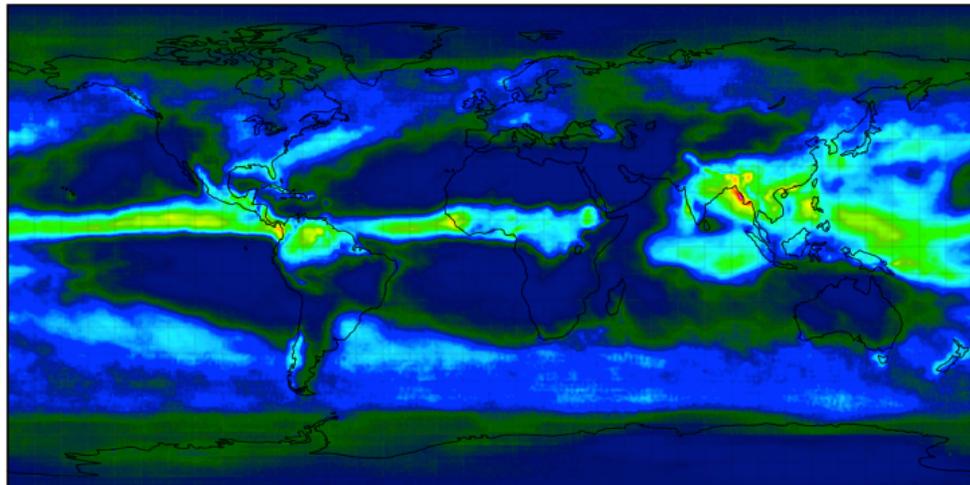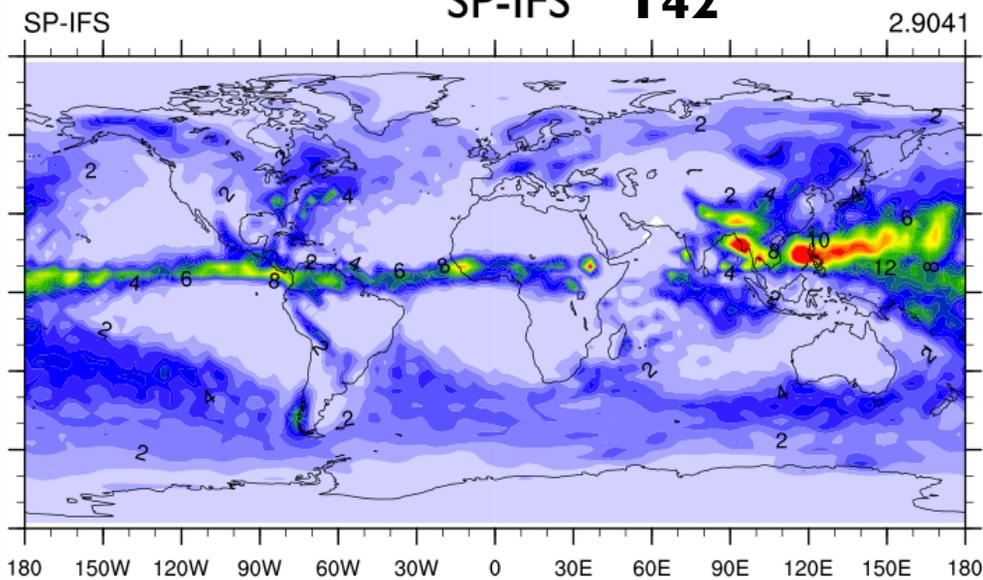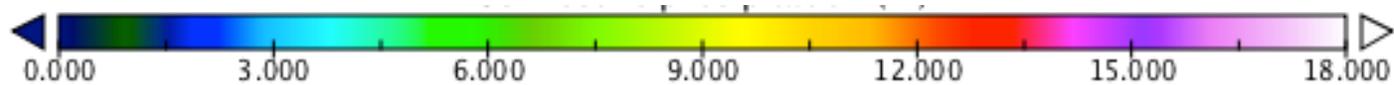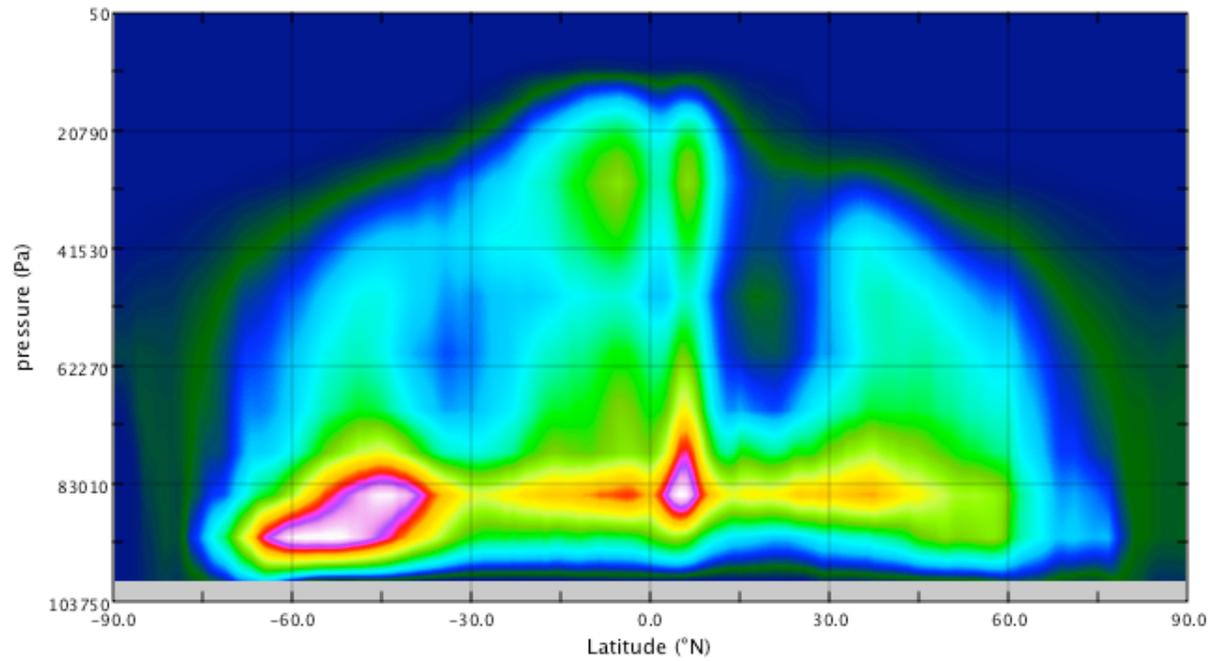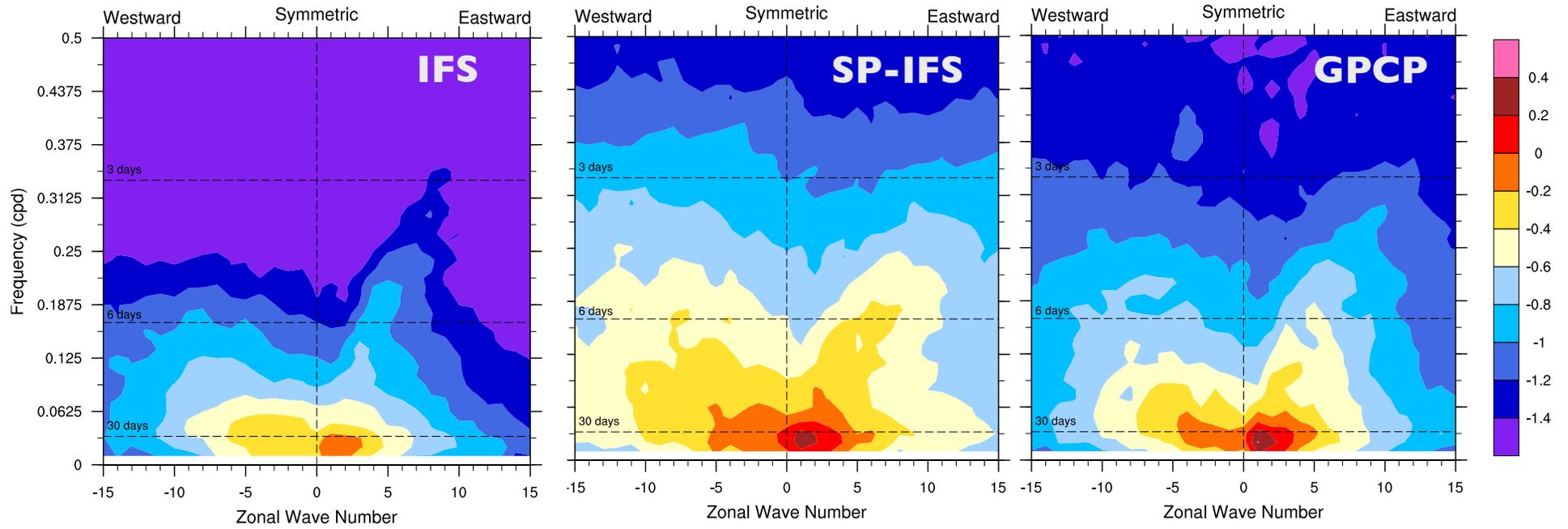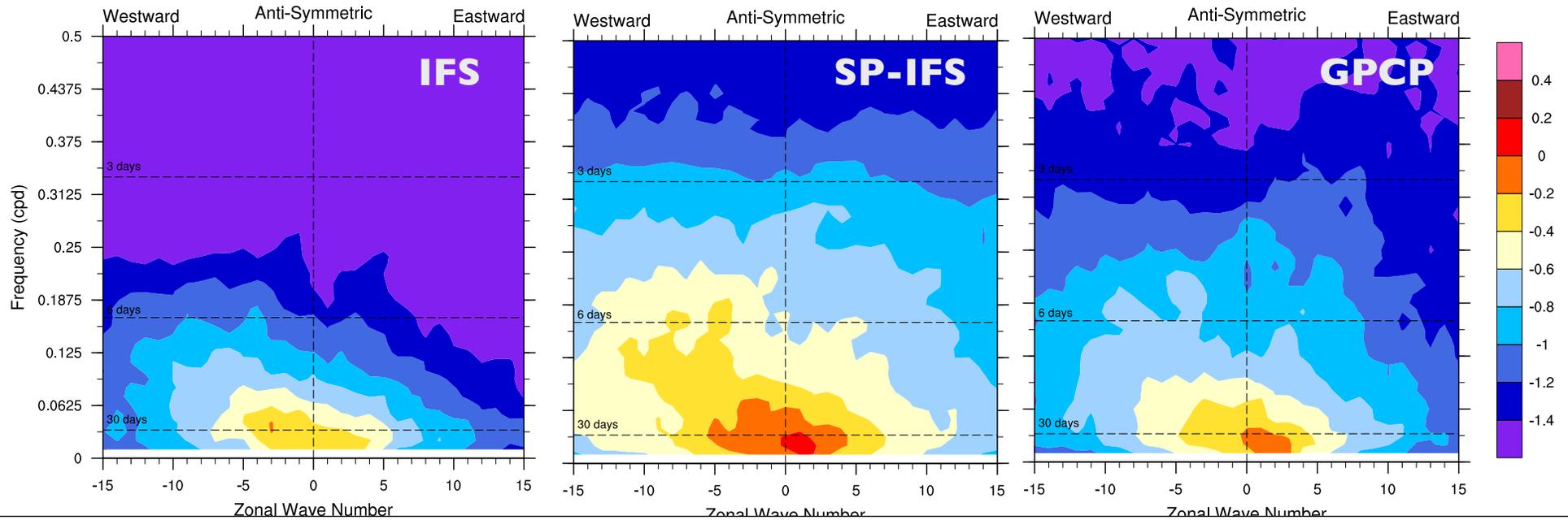
DJF Zonal-mean cloud water/ice

SP-IFS

IFS
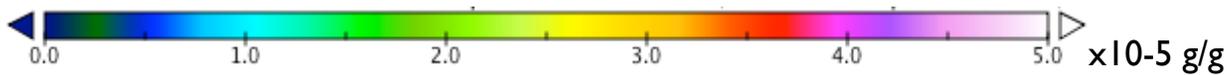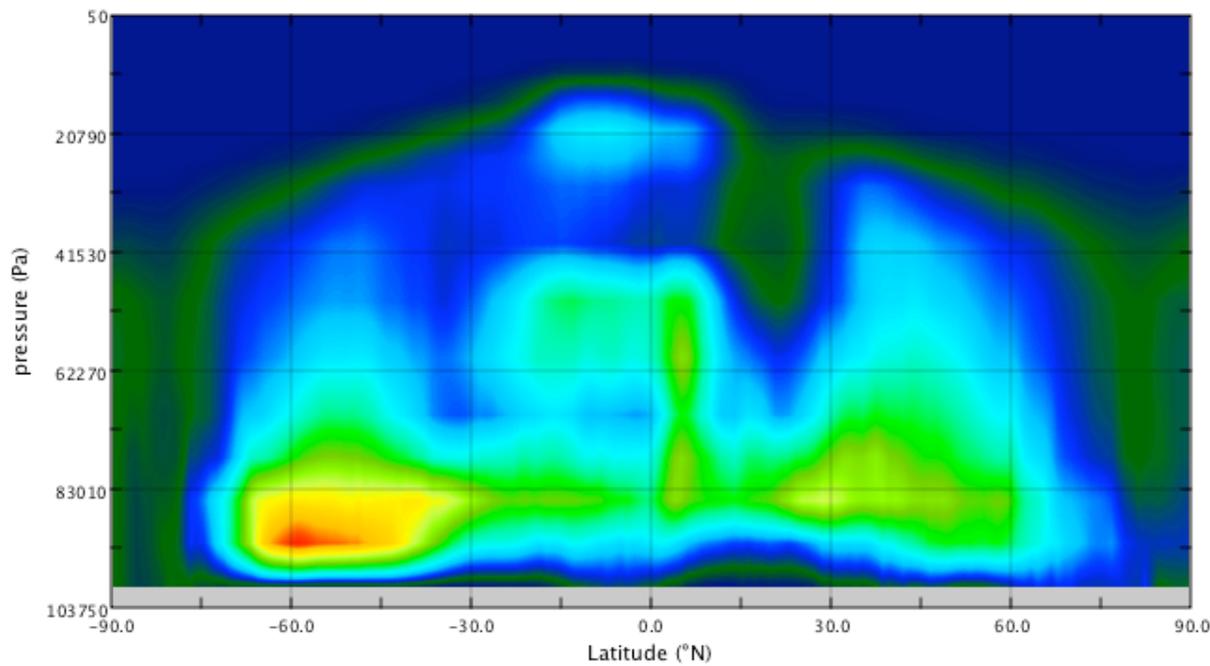
Frequency Spectrum (Intraseasonal):
Precipitation in Tropics (15°S-15°N)
Symmetric

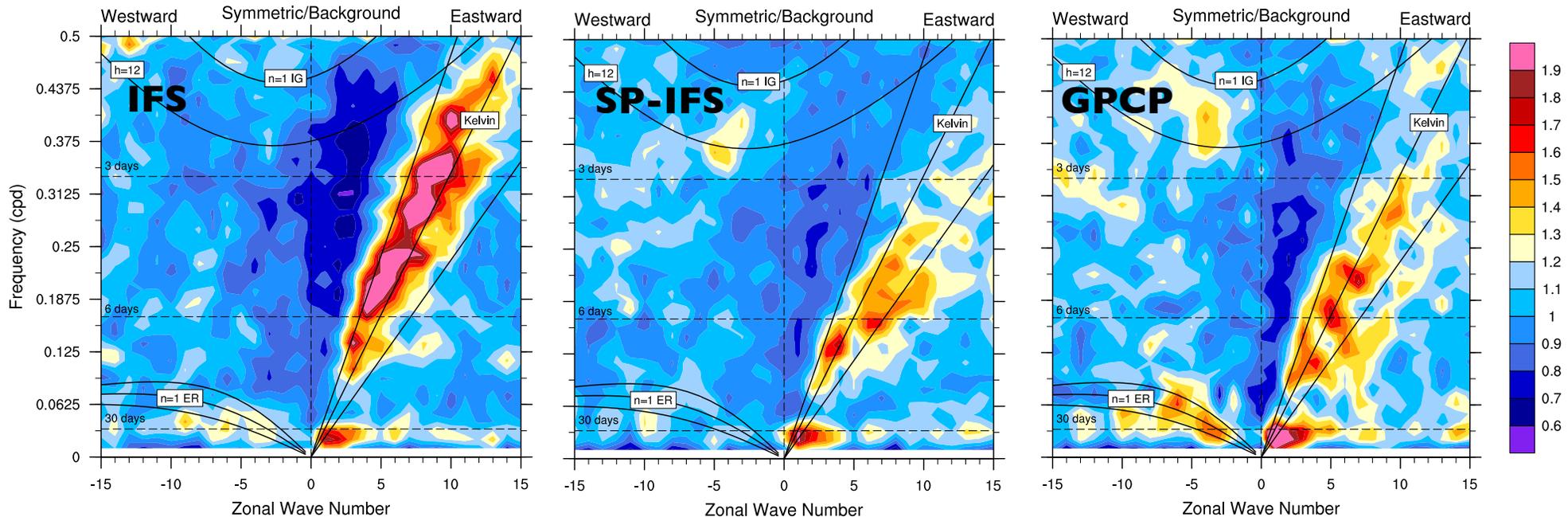## Anti-Symmetric
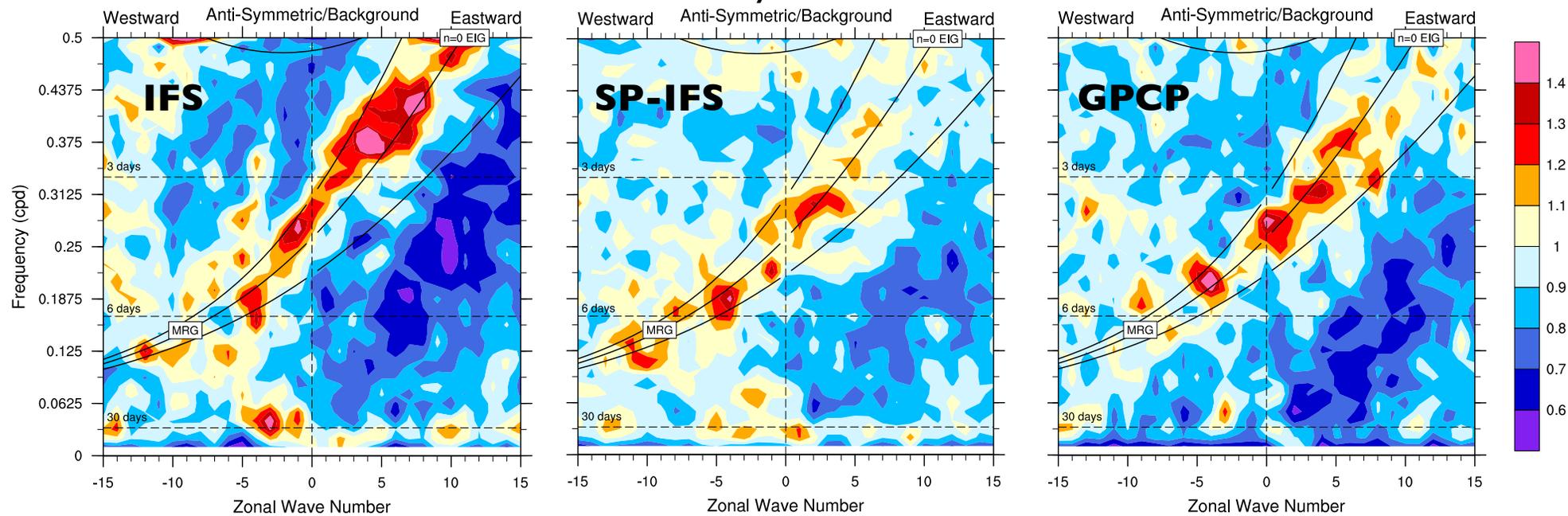
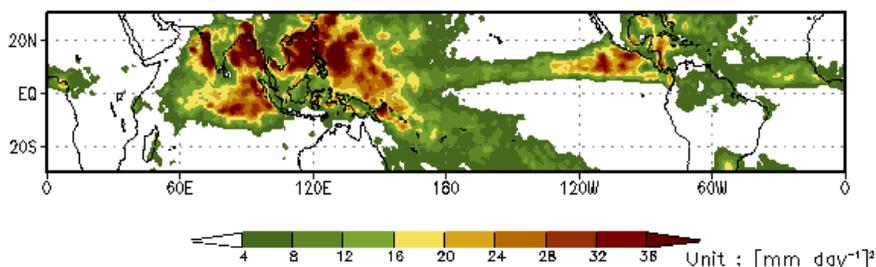Frequency Spectrum (S/N): Precipitation in Tropics (15°S-15°N)

Variance: 20-100 day filtered precipitation

Summer (May-Oct)

Winter (Nov-Apr)
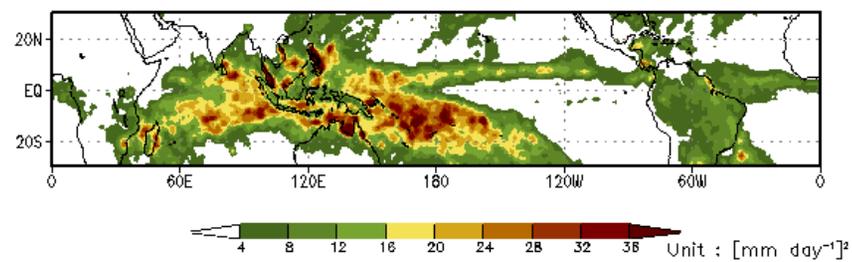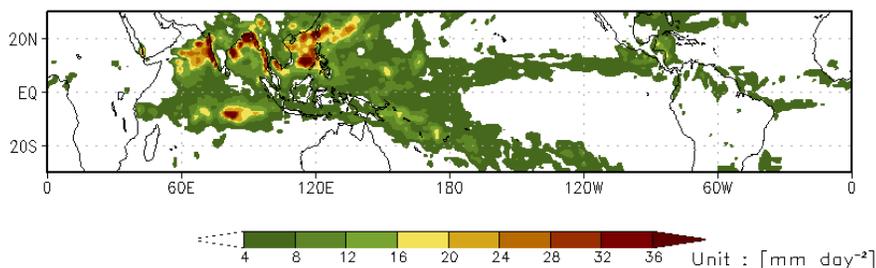

(b) 20−100 day variance, PRCP, TRMM, Summer

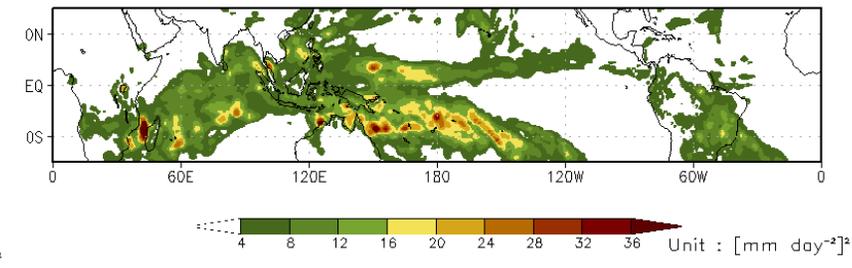(b) 20−100 day variance, PRCP, TRMM, Winter

TRMM

Unit : [mm day⁻¹]²

(b) 20−100 day variance, PRCP, CTRL, Summer(May−Oct)

(b) 20−100 day variance, PRCP, CTRL, Winter(Nov−Apr)

IFS

Unit : [mm day⁻²]²

(b) 20−100 day variance, PRCP, SP32, Summer(May−Oct)
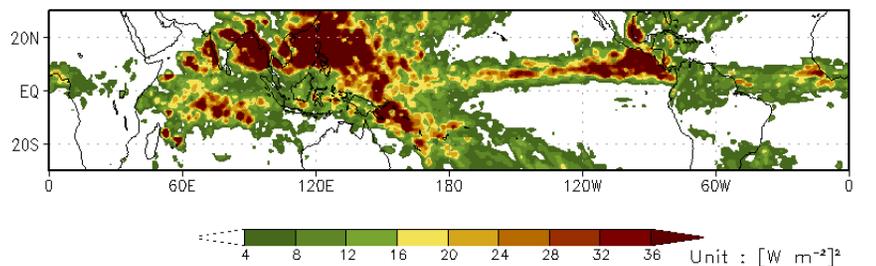
(b) 20−100 day variance, PRCP, SP32, Winter(Nov−Apr)
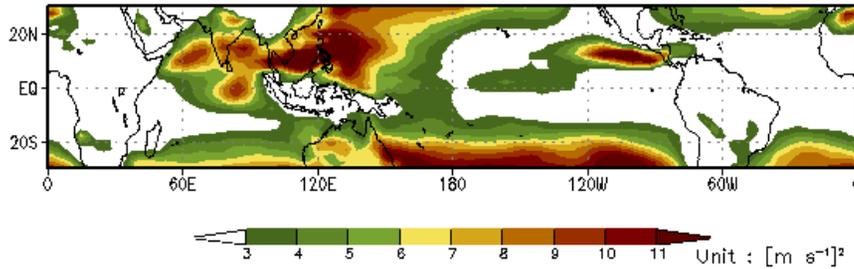
SP-IFS

Unit : [W m⁻²]²
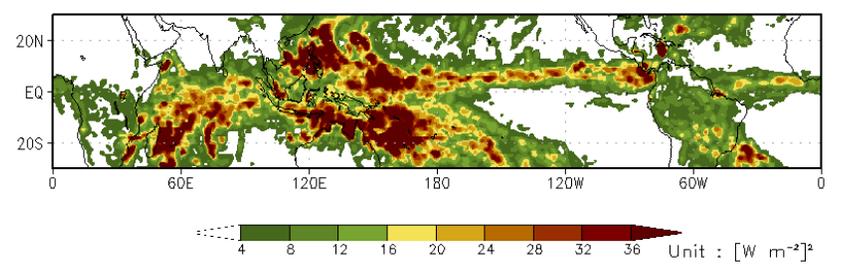
Variance: 20-100 day filtered U850

	Summer (May-Oct)	Winter (Nov-Apr)
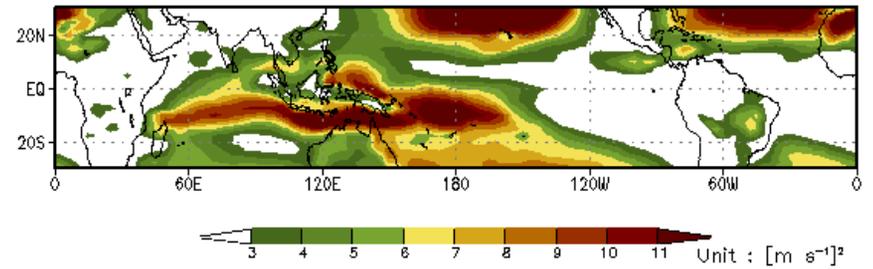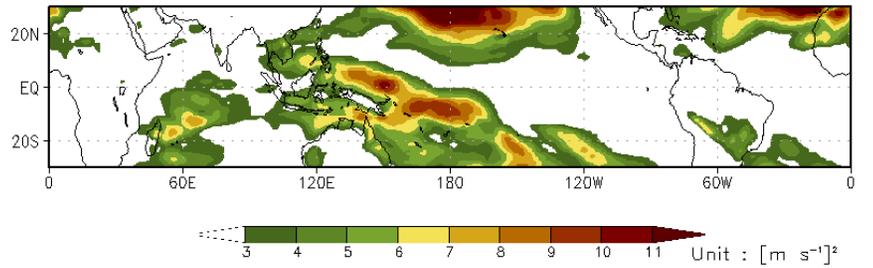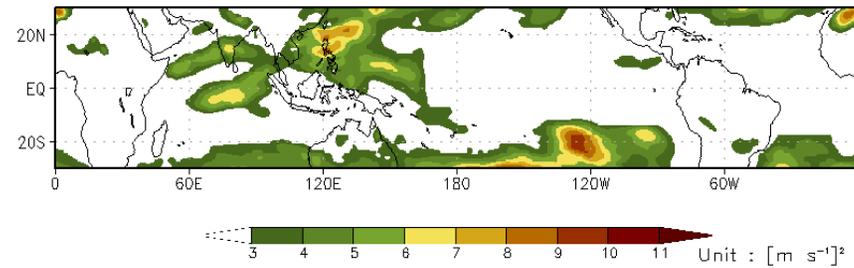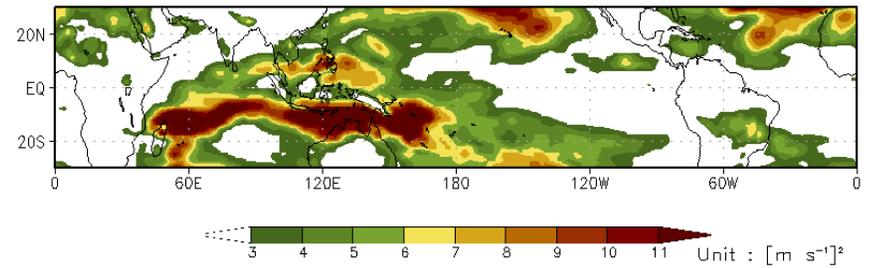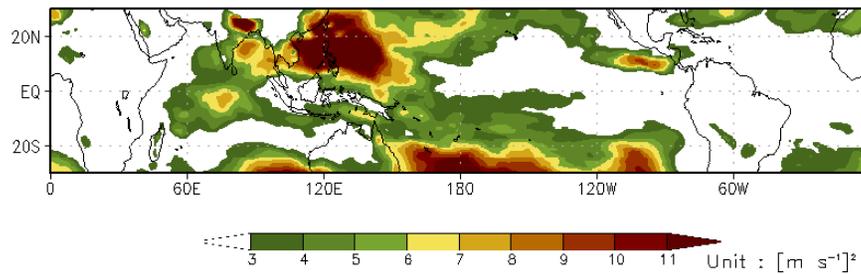
MJO eastward propagation

Lag correlation (U850, Winter)

ERA40
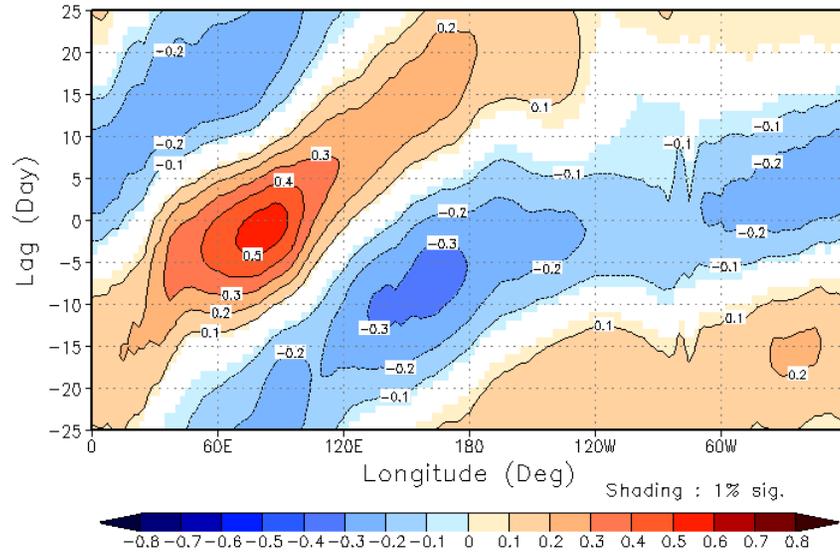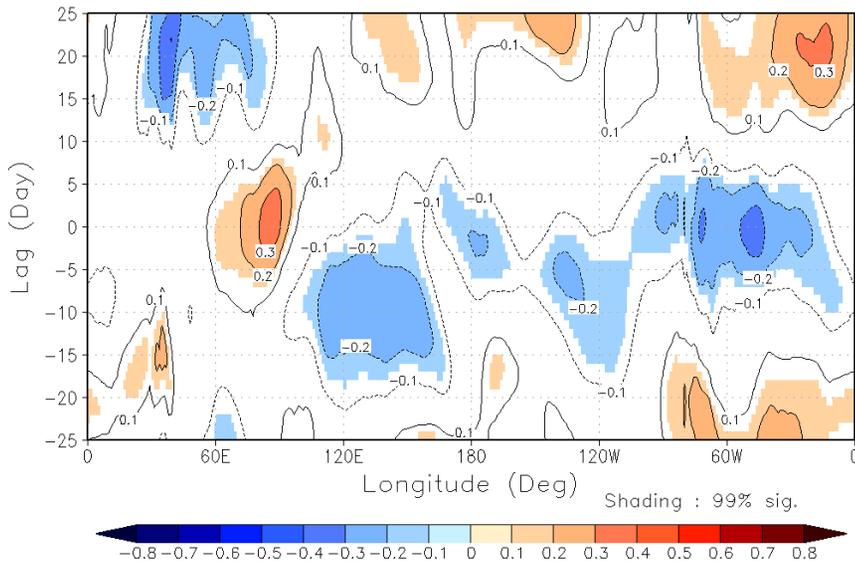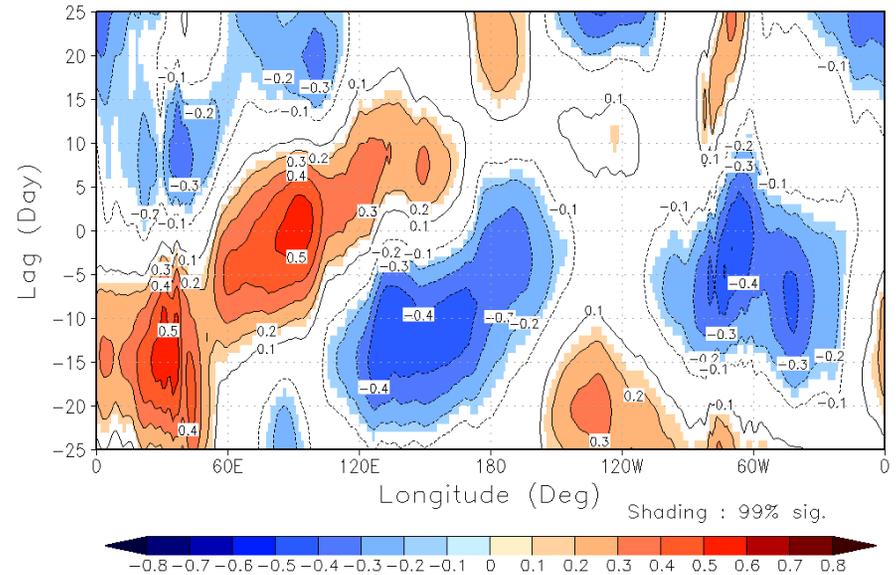

**Reference domain:
1.25S-16.25N, 68E-96E**
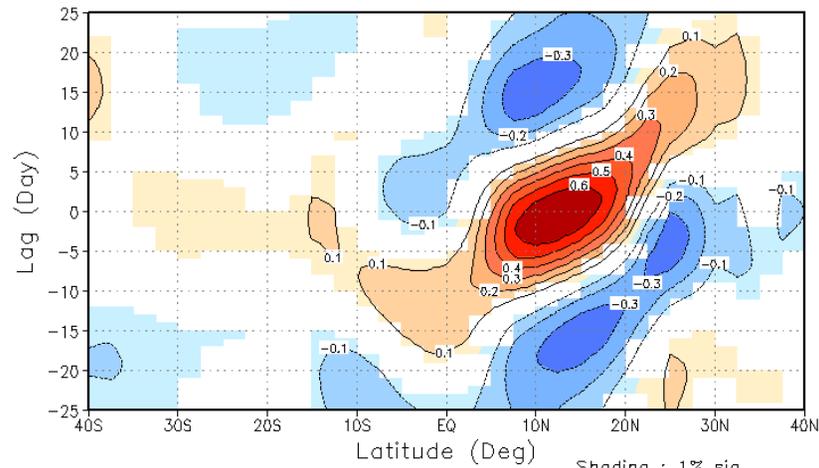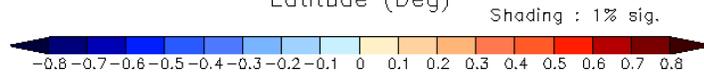
* US CLIVAR MJO Diagnostic metrics

IFS

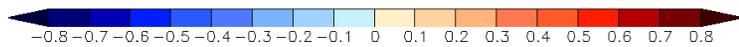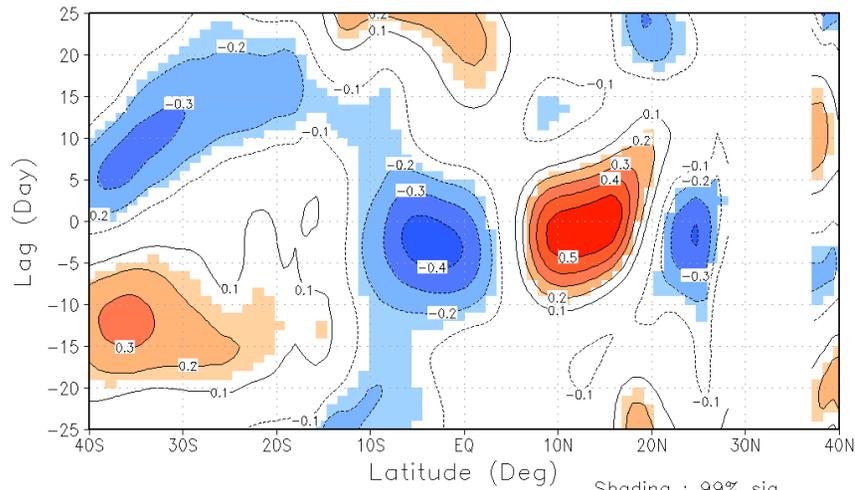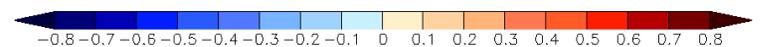### SP-IFS

Summer ISO northward propagation

Lag correlation (U850, Summer)

ERA40
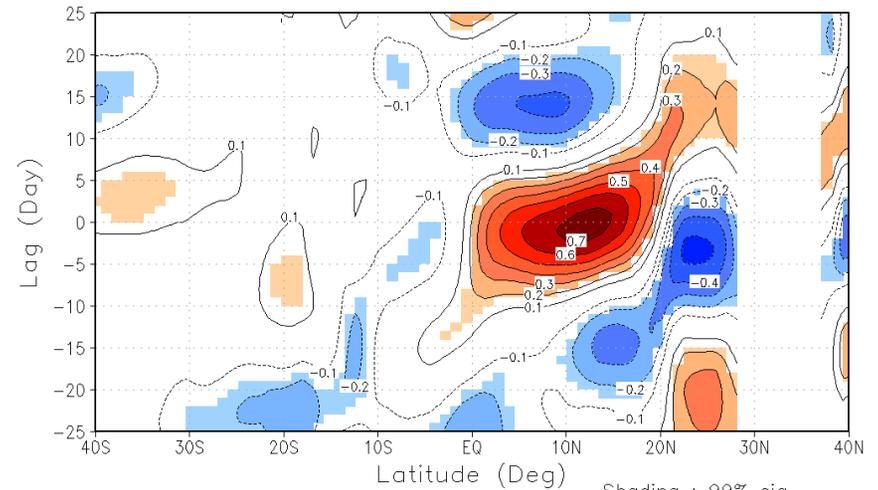

Reference domain: 3.75N-21.25N, 68E-96E
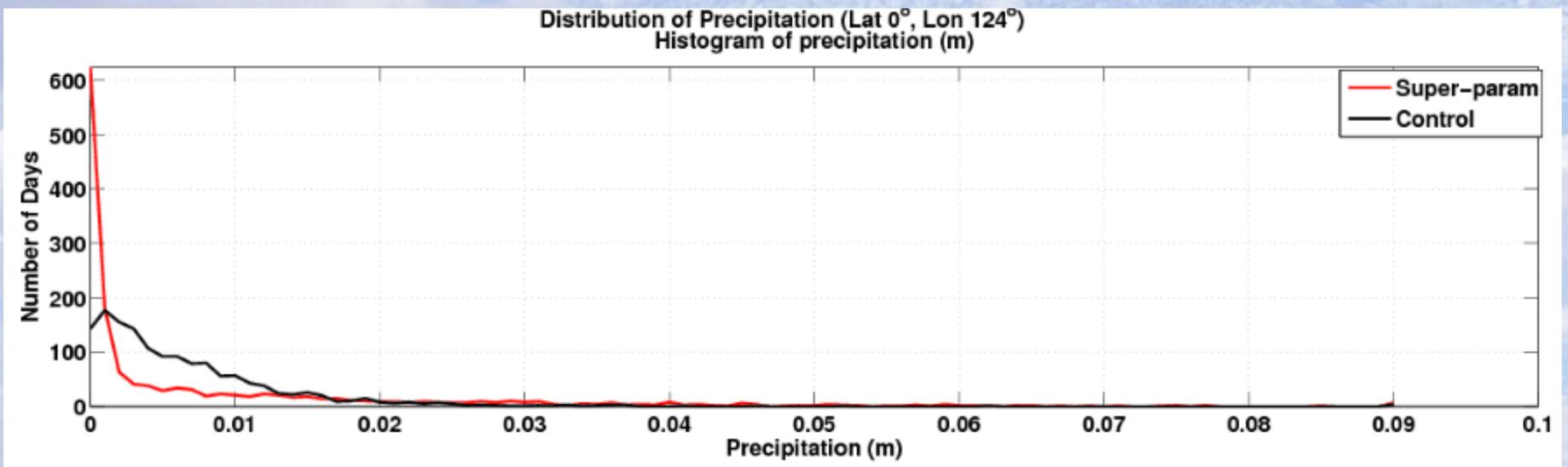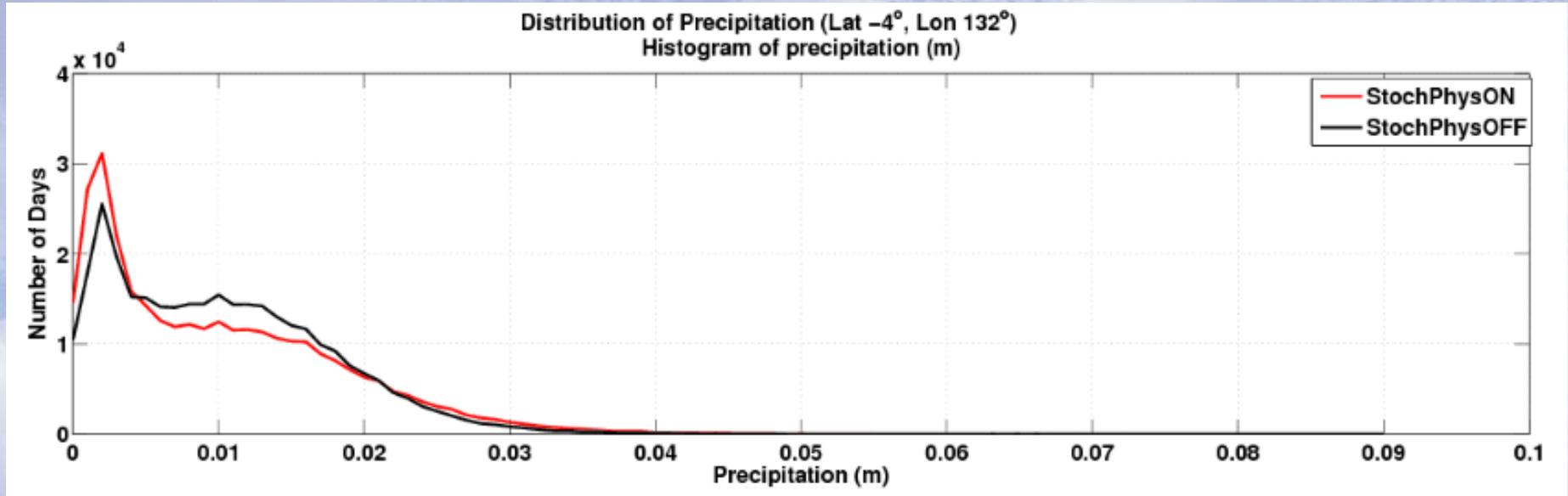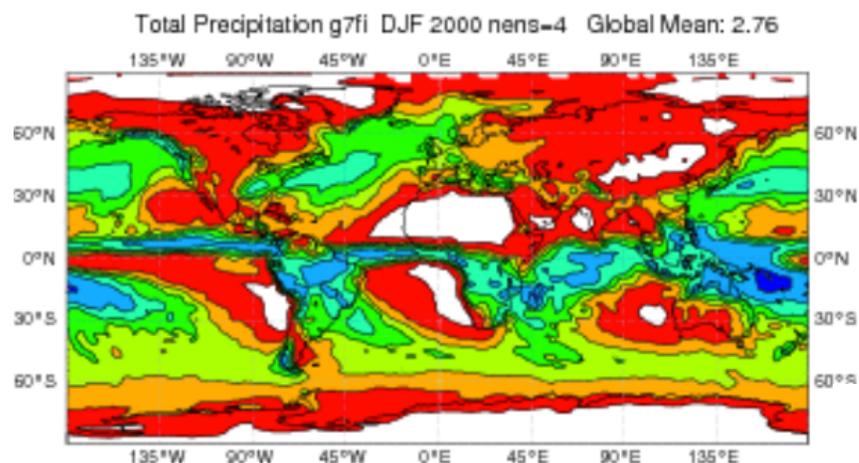
IFS

SP-IFS

Recent developments

- **SP has been ported to CY40R3, and new SP-IFS is run at ECMWF without my explicit involvement**

- **SP-IFS is used by Tim Palmer group (results will be reported at EGU 2015)**

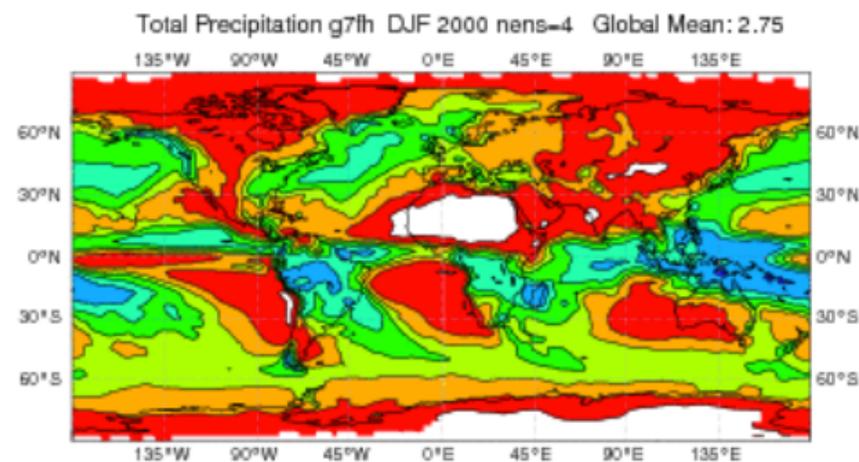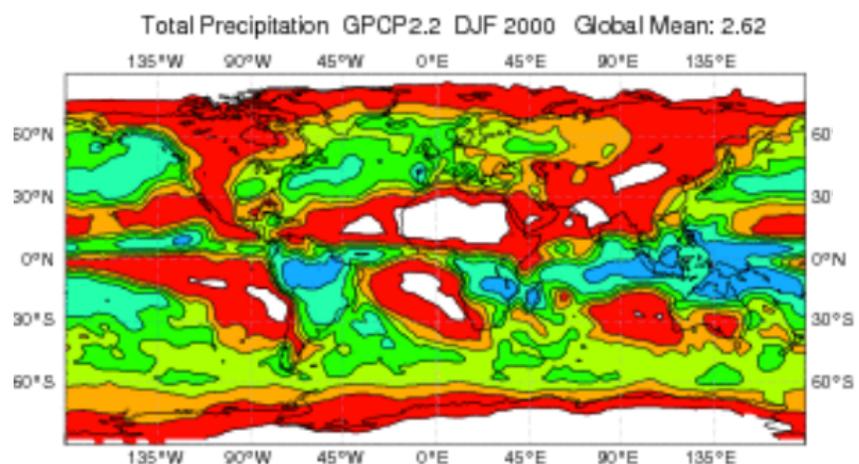- **SP is implemented in IFS' Single-Column Model CY40R1**

Distribution of Precipitation (Lat −4°, Lon 132°)
Histogram of precipitation (m)

Distribution of Precipitation (Lat 0°, Lon 124°)
Histogram of precipitation (m)

Curtesy of Aneesh Subramanian

Total Precipitation g7fi DJF 2000 nens=4 Global Mean: 2.76

Total Precipitation g7fh DJF 2000 nens=4 Global Mean: 2.75

Total Precipitation GPCP2.2 DJF 2000 Global Mean: 2.62

SP-IFS

IFS

Obs

DJF

SP-IFS   IFS

Zonal
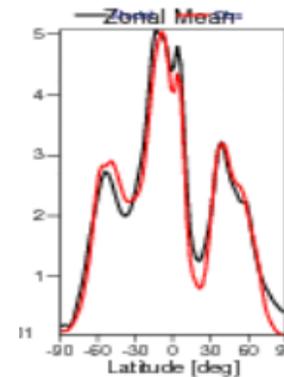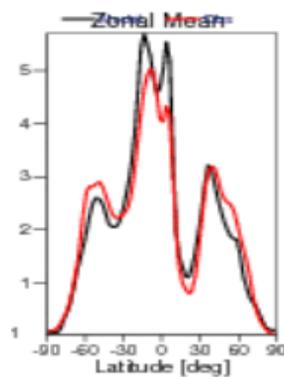
Extra-
Tropics
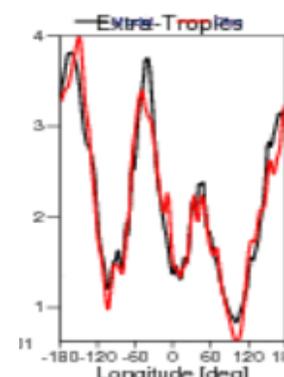
Tropics
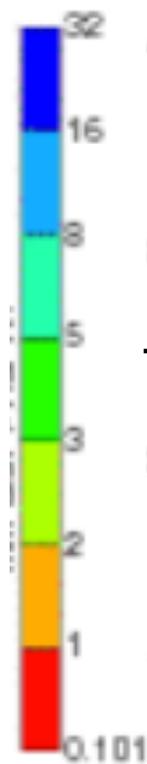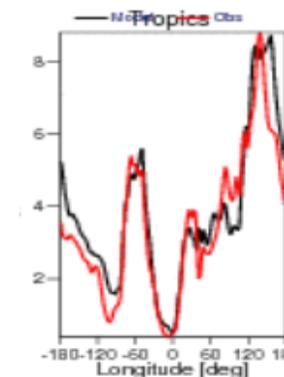
Water vapor path

IFS

SP-IFS

- Global mean about the same (difference = 1.7)
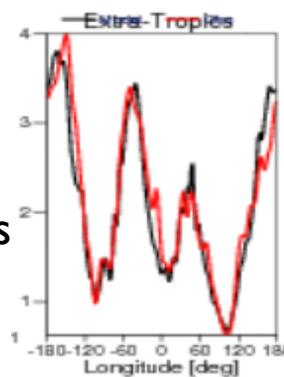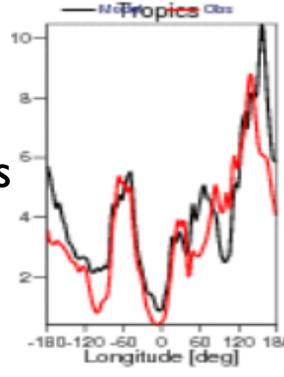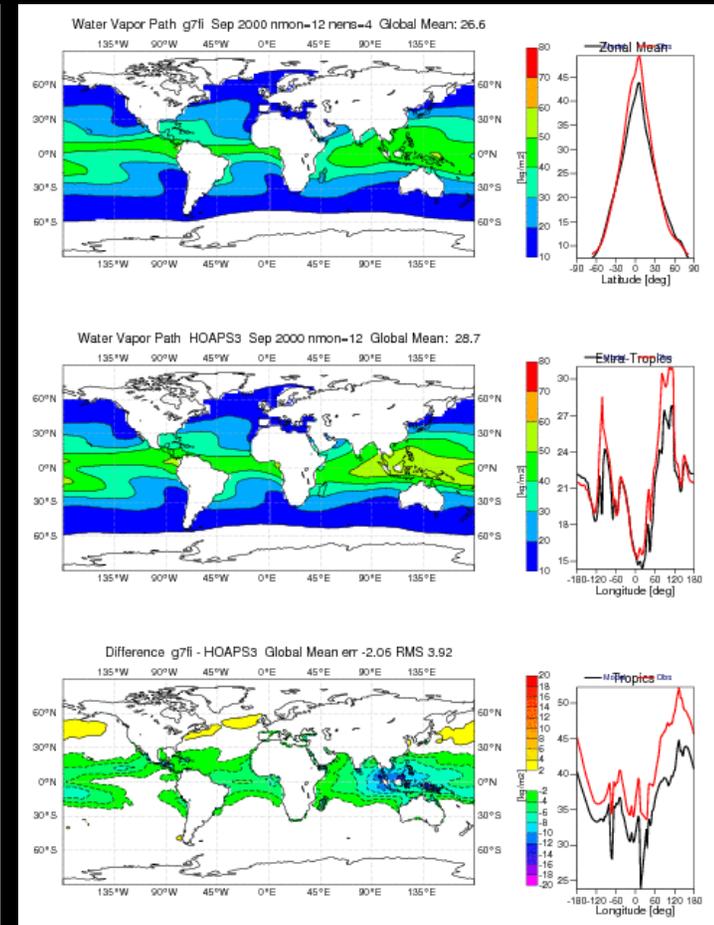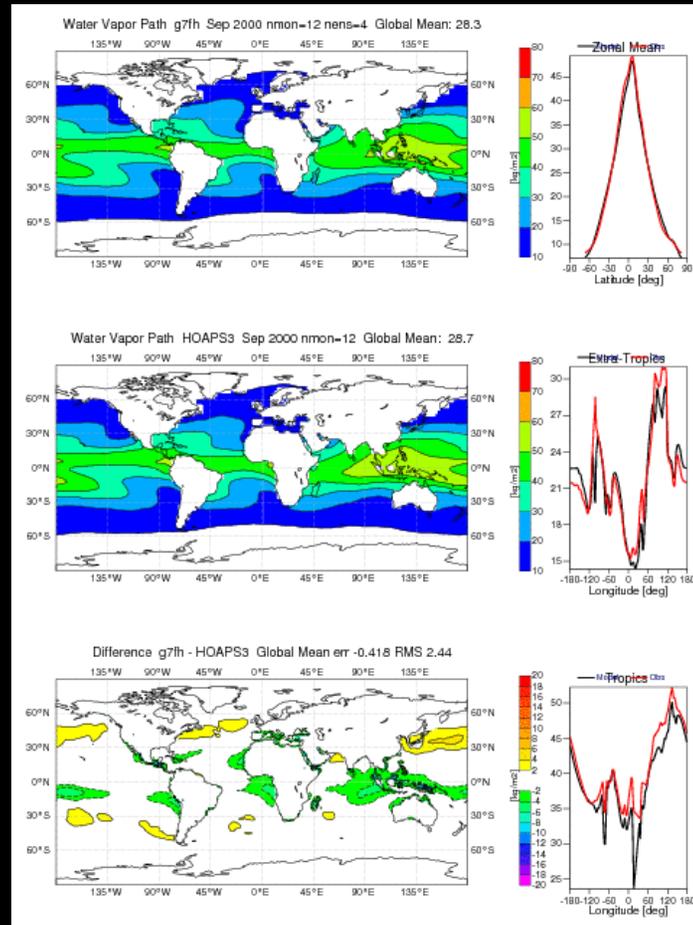- Less water vapor in the tropics
- Less WV in W. Pac. and maritime continent
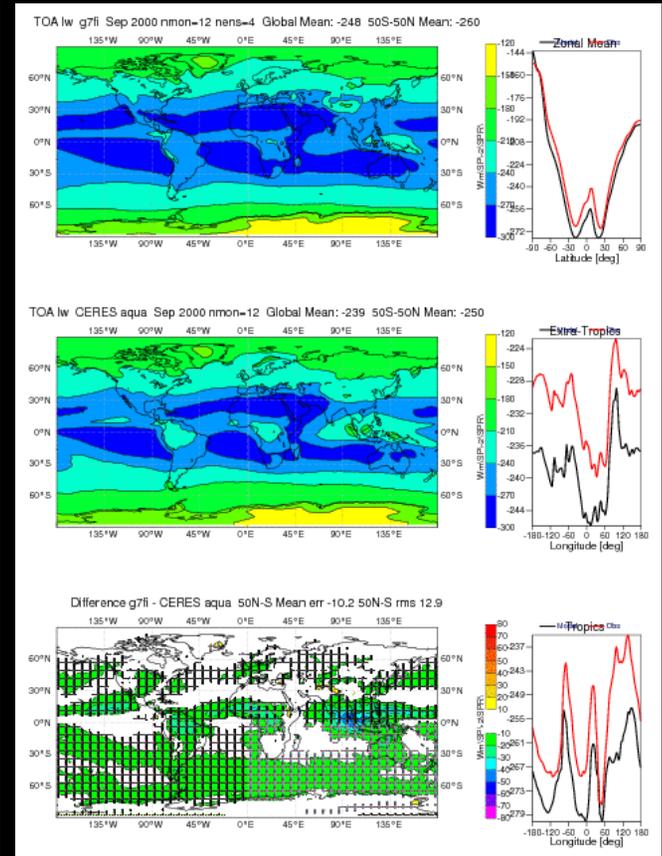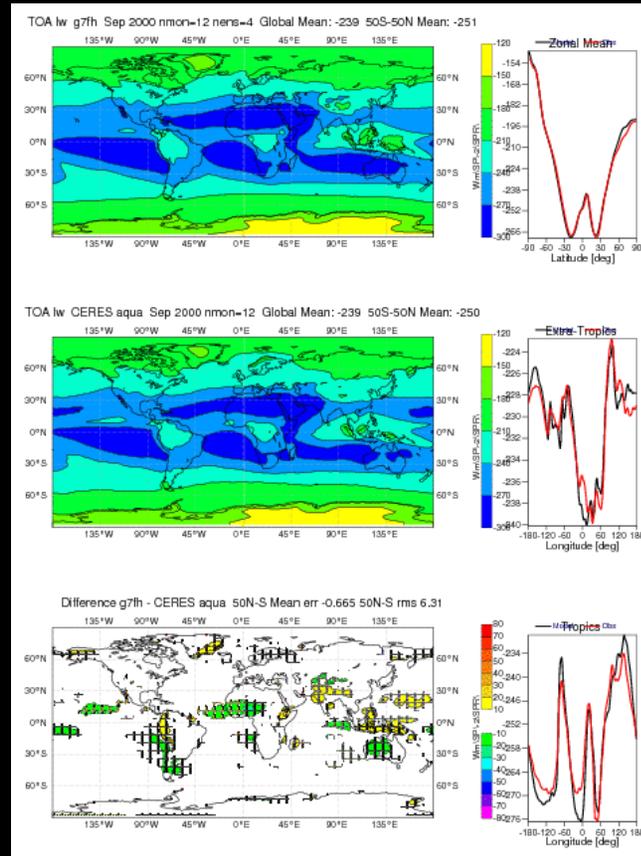- Precip is high in ITCZ region and WV is lesser.

Curtesy of Aneesh Subramanian

TOA Longwave

IFS

SP-IFS

- Global mean about the same (difference 9)
- Negative bias in OLR in SP all over the globe
- Biggest difference is in the Extra-tropics.
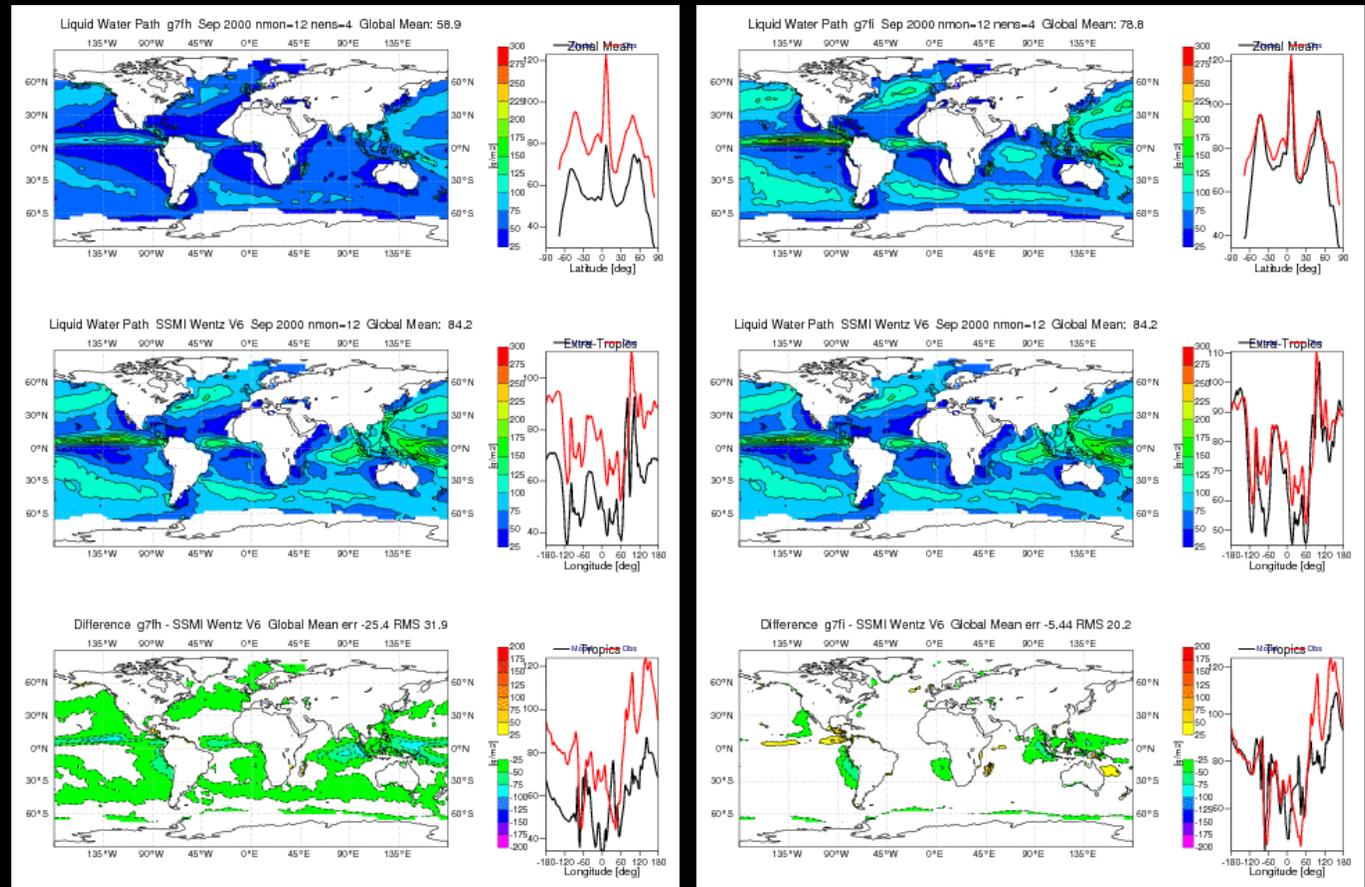- Significantly lower OLR in the zonal mean in the Tropics too

Curtesy of Aneesh Subramanian

Cloud Liquid Path

IFS   SP-IFS

- Global mean is different (difference 19.1)
- Tropical CLW compares better in SP vs Obs
- Many CLW biases are removed in SP.
- Eastern boundary regions (stratus deck regions) are still a problem.
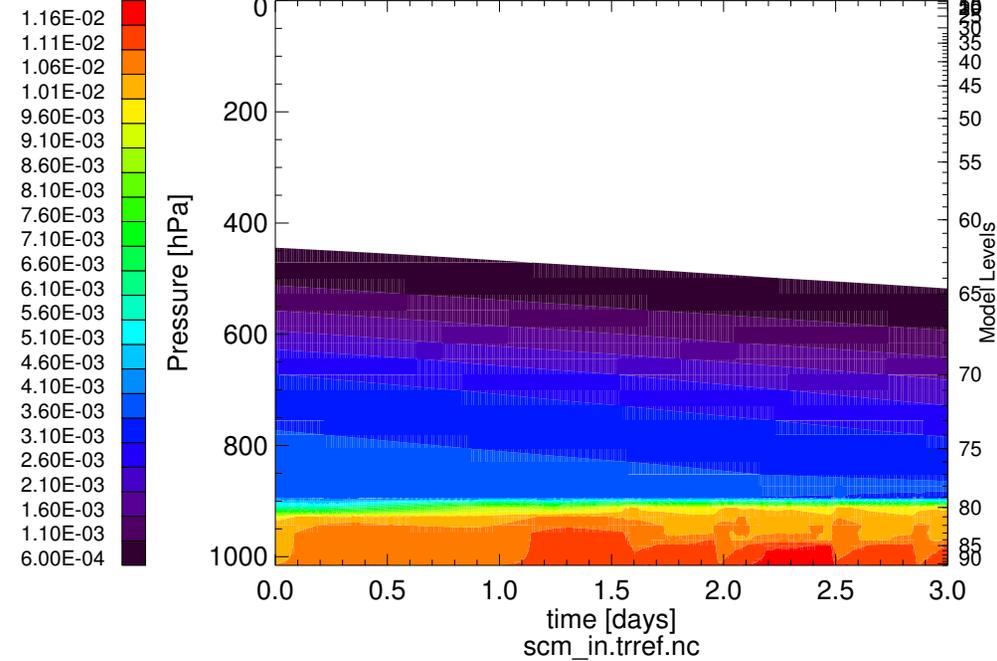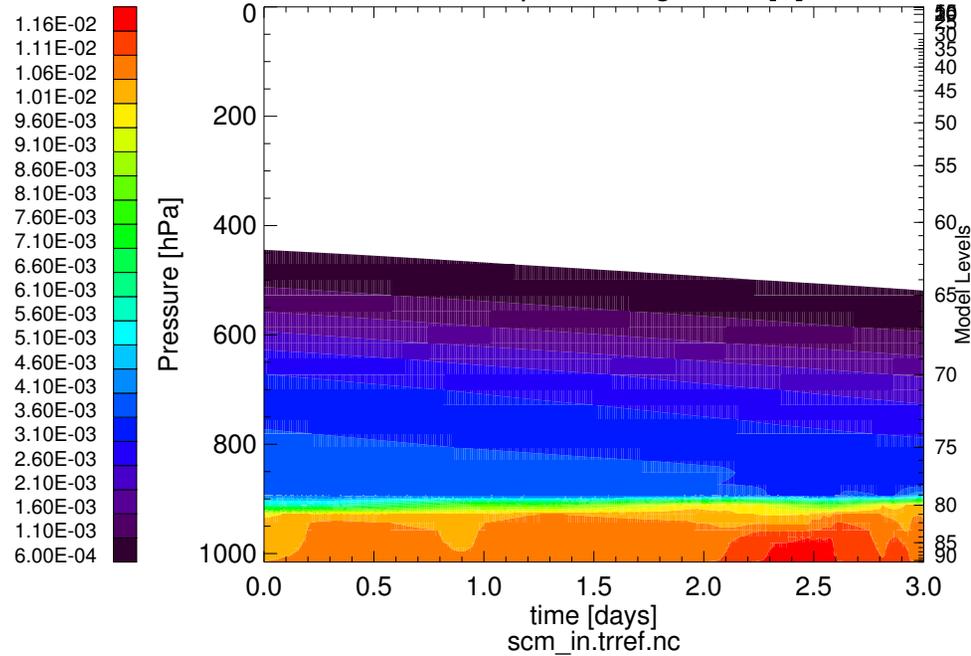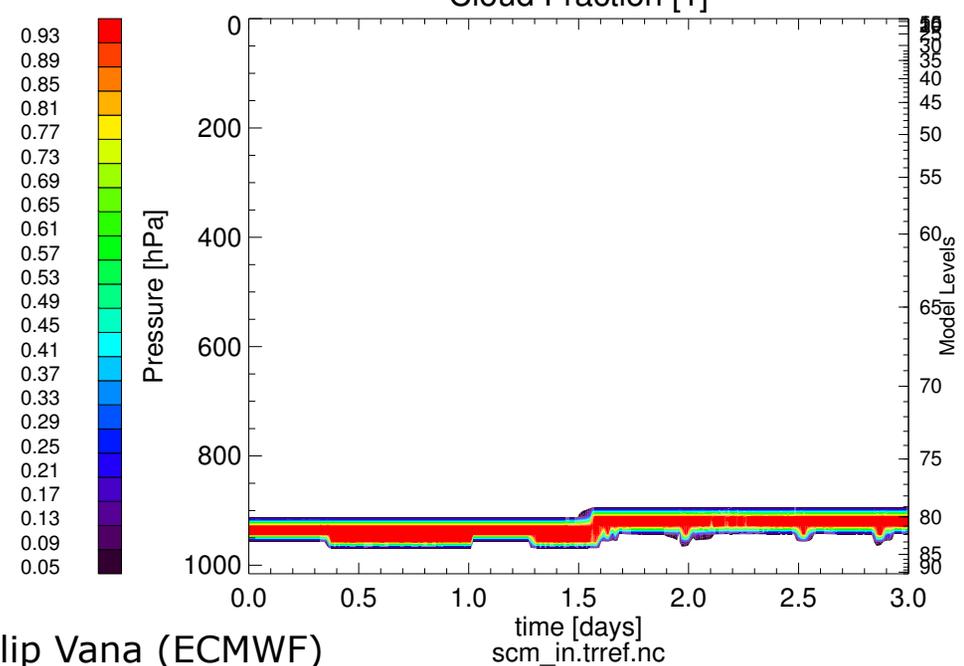

Curtesy of Aneesh Subramanian

Single-Column Model

SP-IFS

Water Vapor Mixing Ratio [1]

scm_in.trref.nc

Cloud Fraction [1]

scm_in.trref.nc

IFS

Water Vapor Mixing Ratio [1]

scm_in.trref.nc

Cloud Fraction [1]
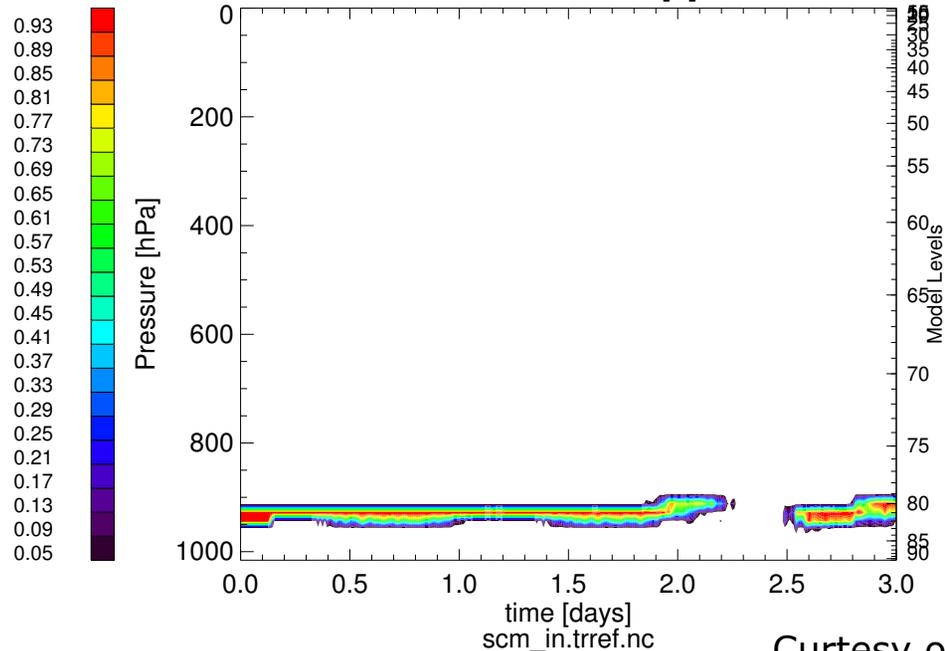
Curtesy of Filip Vana (ECMWF)

scm_in.trref.nc