# Preliminary results from SP-IFS (ECMWF) model

**Marat Khairoutdinov**

**School of Marine and Atmospheric Sciences
Stony Brook University
Long Island, New York**

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# Chronology of the events

- **November 2012 - Workshop at ECMWF on parameterization of clouds; 'half-jokingly' offer is made to Anton Beljaars to implement SP in IFS;**

- **November 2012 - OpenIFS, which has all the forecast capabilities of IFS, but no data assimilation, is sufficiently advanced;**

- **November 2012 - email from Anton;**

- **December 2012: IFS license is obtained (and signed), code is downloaded;**

- **January 2013: IFS is built and run on Mac Pro server and Yellowstone;**

- **March 2013: Memory management for SP prognostics is implemented with great help from ECMWF;**

- **September-October 2013: SP-IFS finally works; preliminary runs are done;**

- **November 2013: Visit to ECMWF; many issues addressed and solved;**

- **December 2013: Account on ECMWF supercomputers approved;**

# How can SP-IFS help IFS?
## ("brainstorm" at ECMWF)

- **Application to stochastic physics: how to perturb input or output tendencies (but do not introduce biases)**

- **Check Pdfs, is temporal coherence important?**

- **Can heating profiles in CRM (SP-IFS) be obtained by neural network**

- **Establish Kelvin-wave composites using Kelvin wave diagnostic suite**

- **Establish effects are currently not or not sufficiently taken into account in IFS: e.g. (i) Wind-shear effects (exclude wind-shear in CRM), (ii) sensitivity to environmental moisture: top-heavy versus bottom-heavy heating profiles**

- **Diagnose gravity momentum fluxes (from deep convection)**

# Tests of Super-Parameterization in Open-IFS

**ECMWF Collaborators:**

Anton Beljaars

Peter Bechtold

Glenn Carver

Filip Vana

- **Based on OpenIFS (CY38R1, circa June 2012);**

- **SP: 32 x 74; $\Delta x$=4 km; $\Delta t$=20s; IFS: 90 levels**

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

- **PBL parameterization still operates;**

- **Radiation is computed using SP's mean profiles (on IFS grid);**

- **T42**

- **2 year runs starting Aug 2000, and ending Sep 2002.**

- **Throughput: 18 wall-clock hours per simulated year on 420 cores of Cray XC30 (@NERSC).**

# DJF Precipitation Rate
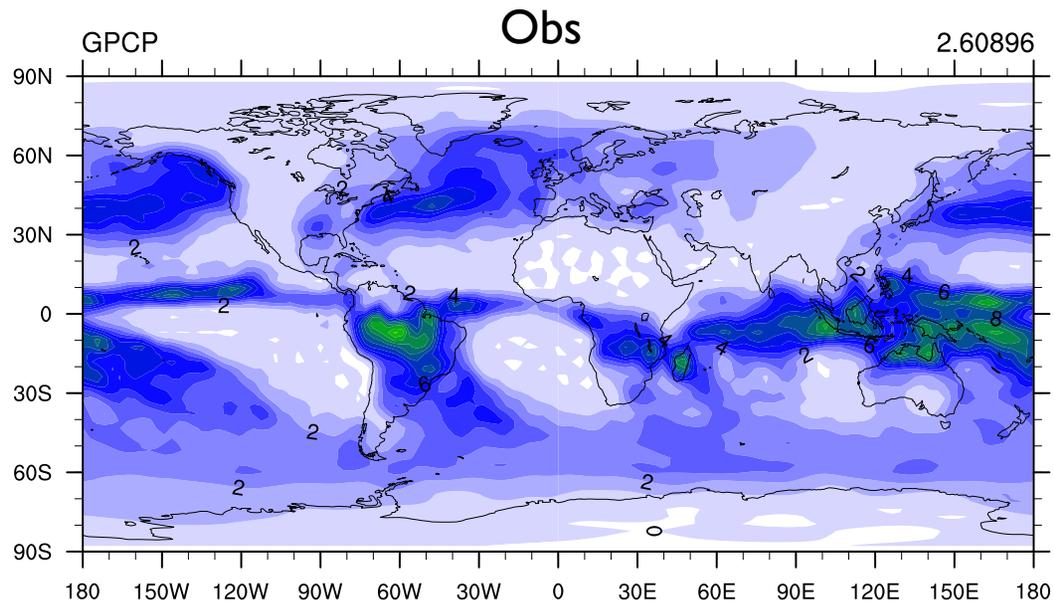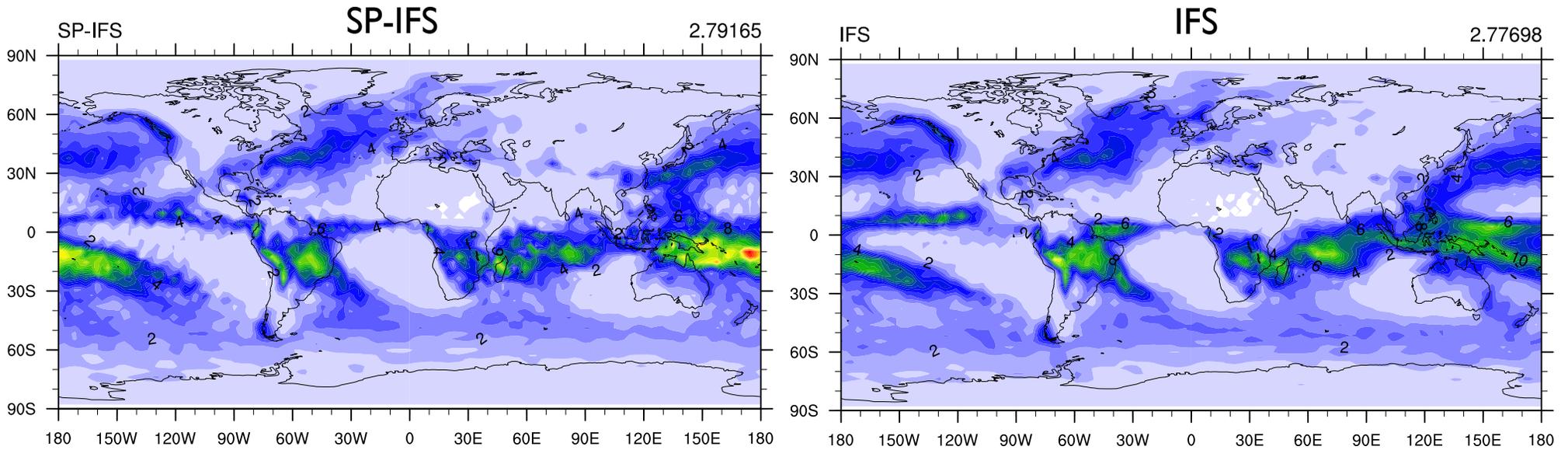


SP-IFS 2.79165

IFS 2.77698

Obs — GPCP 2.60896

# DJF Precipitable Water

# DJF OLR

**SP-IFS**

SP-IFS    244.369

**IFS**

IFS    236.612

# DJF ASR

**SP-IFS**

SP-IFS    256.032

**IFS**

IFS    248.481
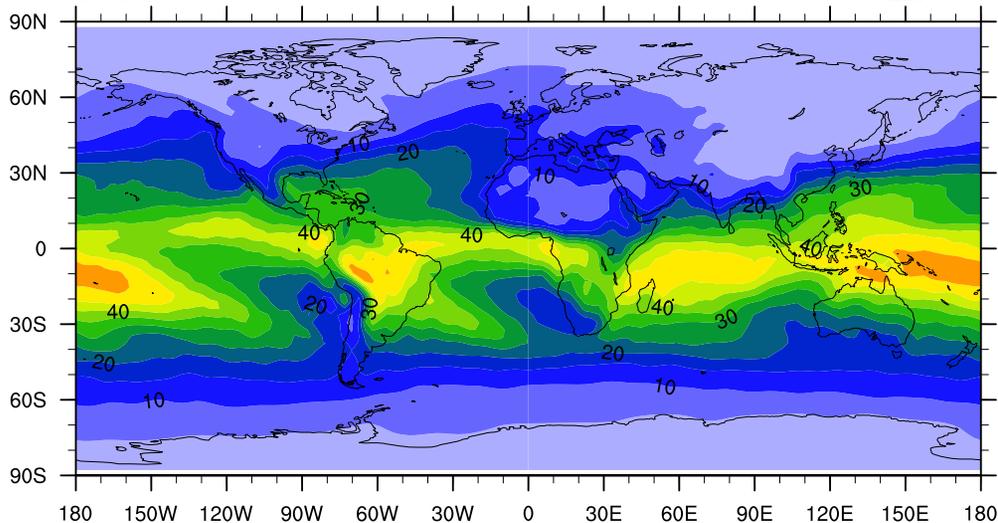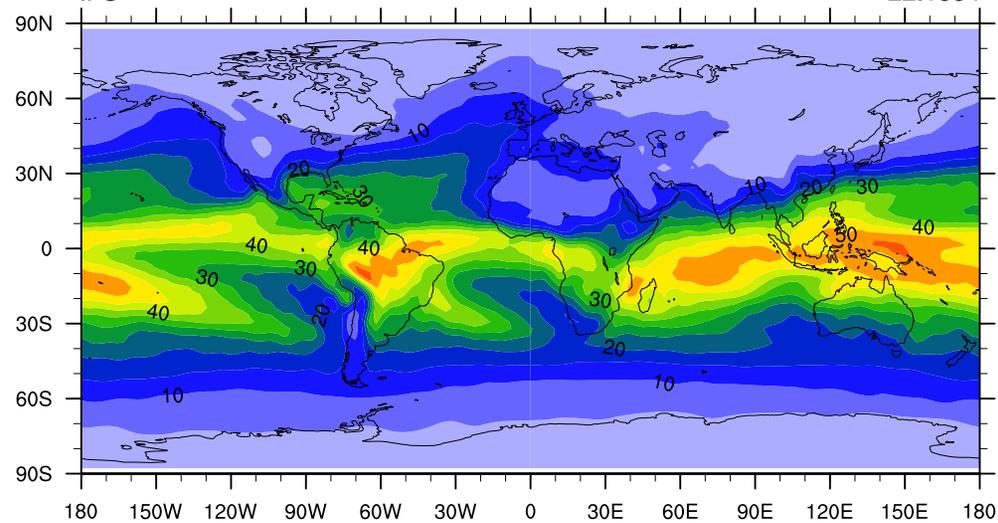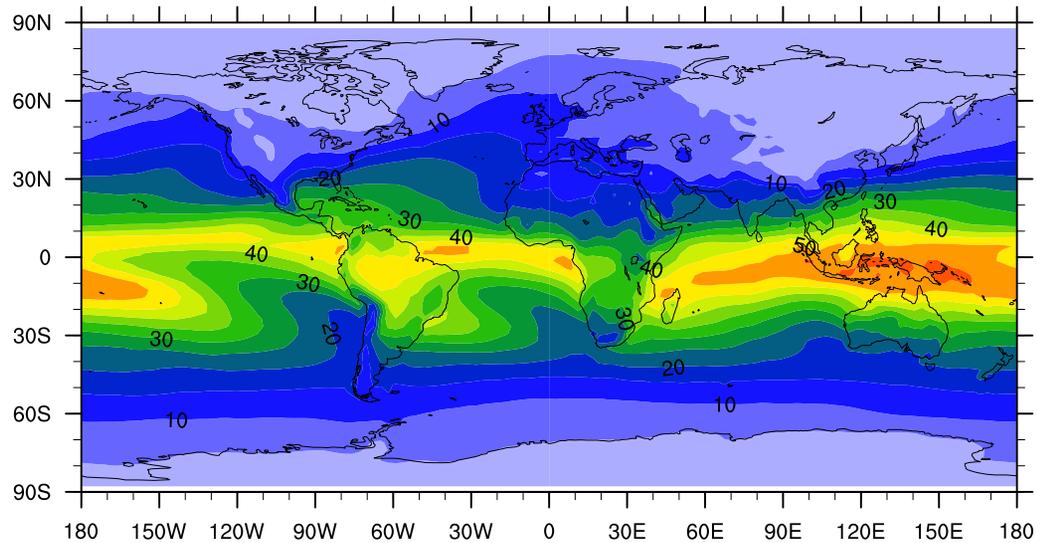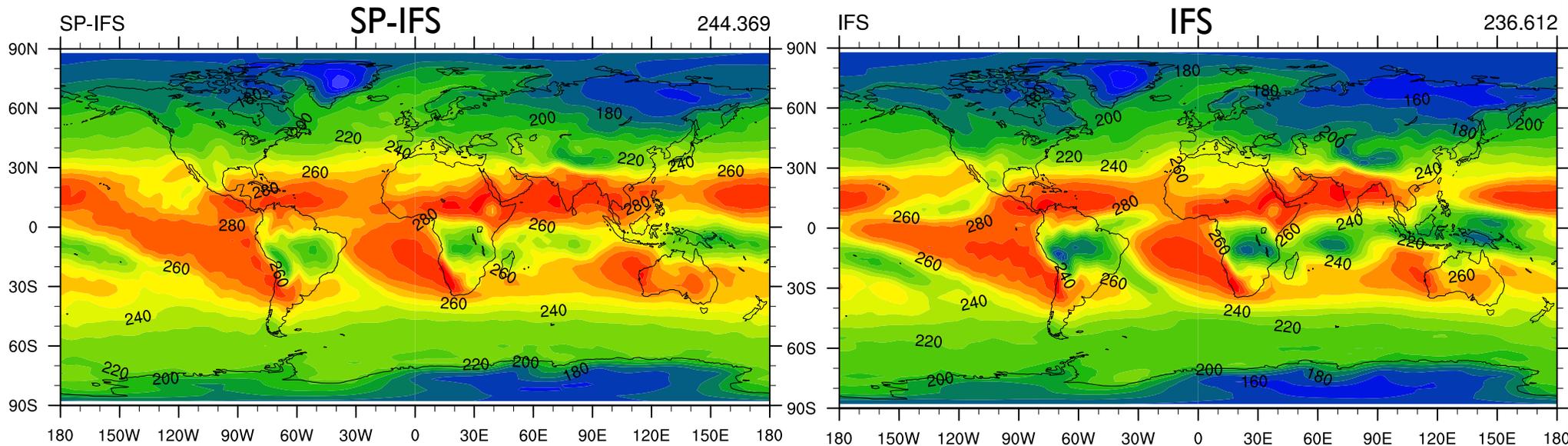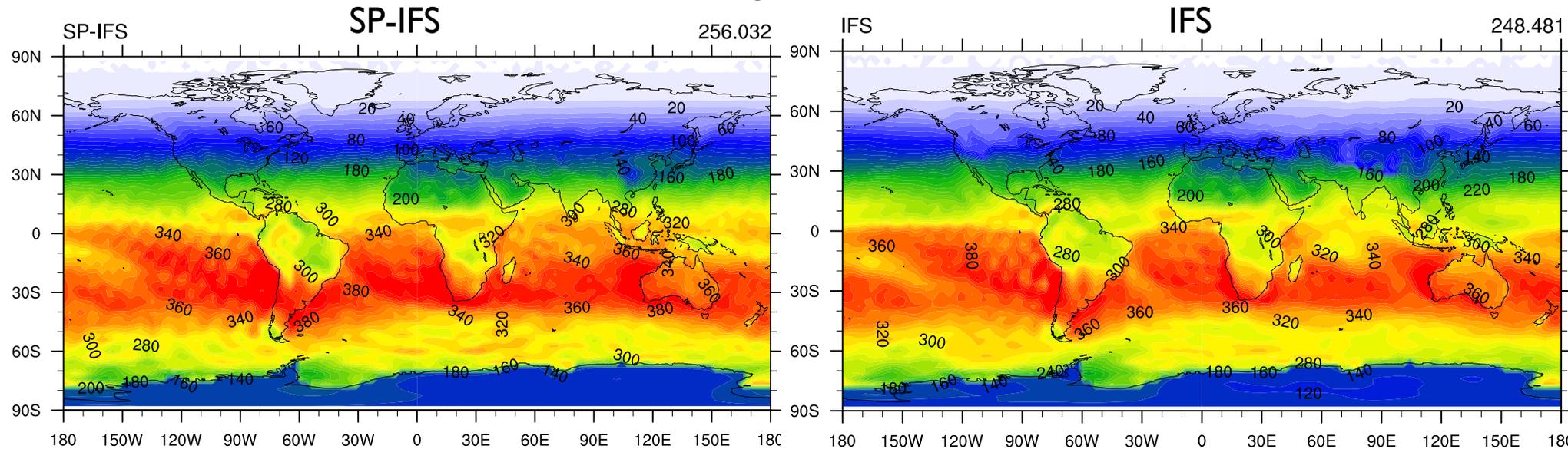
# JJA Precipitation Rate



SP-IFS — 2.9041

IFS — 2.87845

GPCP — Obs — 2.63502
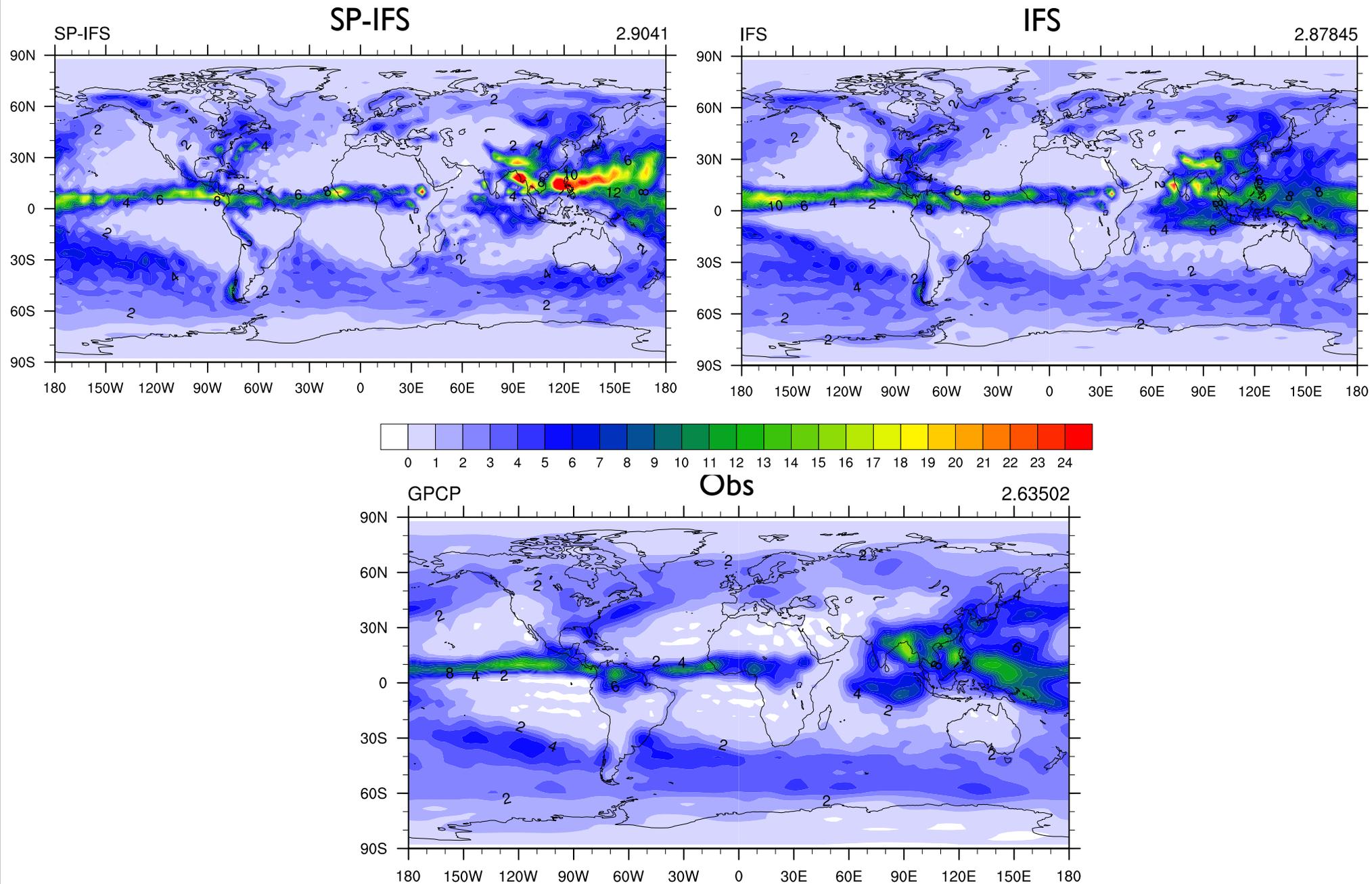
# JJA Precipitation Bias - 'Great Red Spot'

## SP-IFS
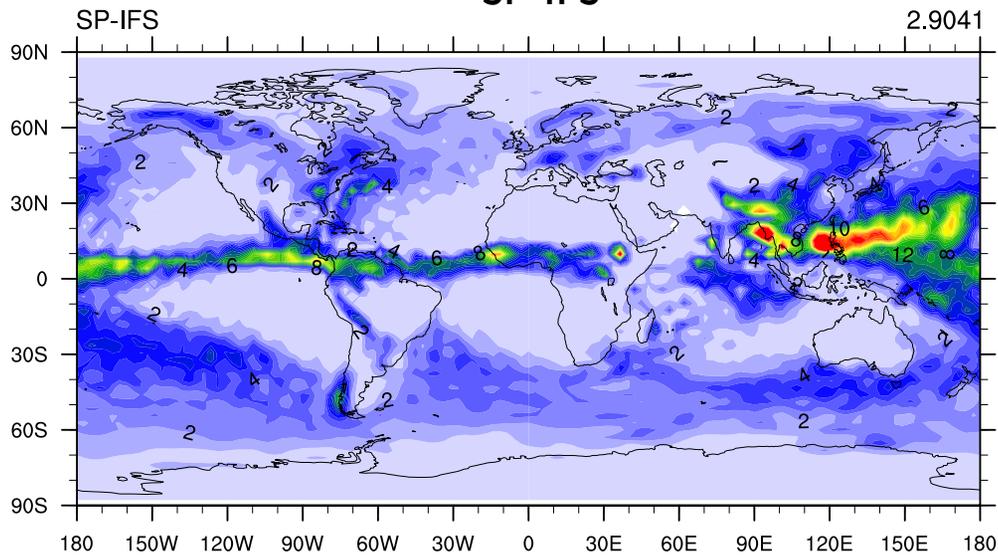


## SP-CAM

E-W orientation of CRM          S-N orientation of CRM
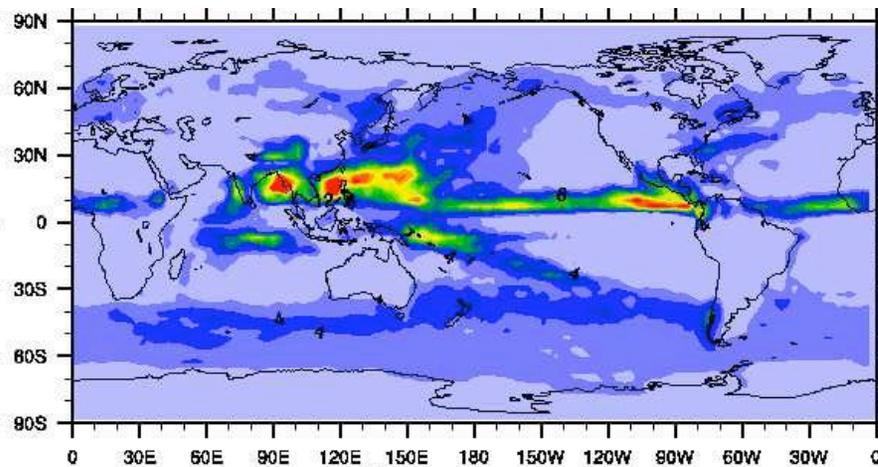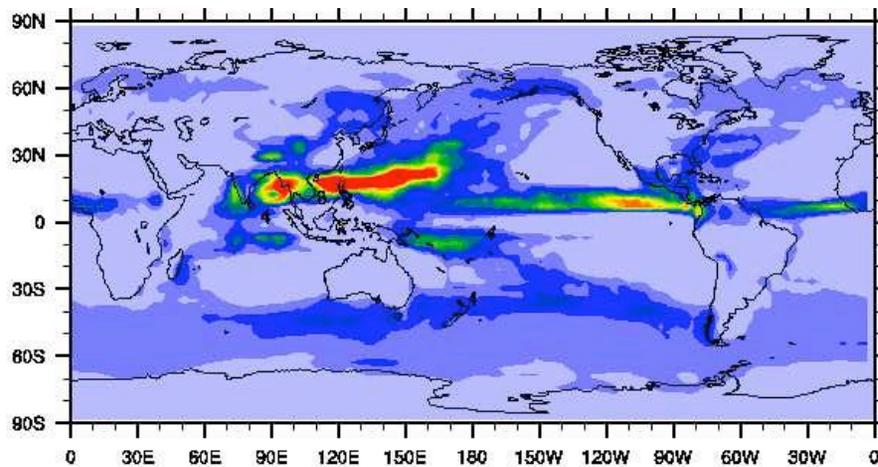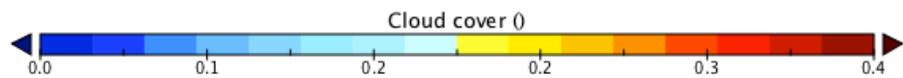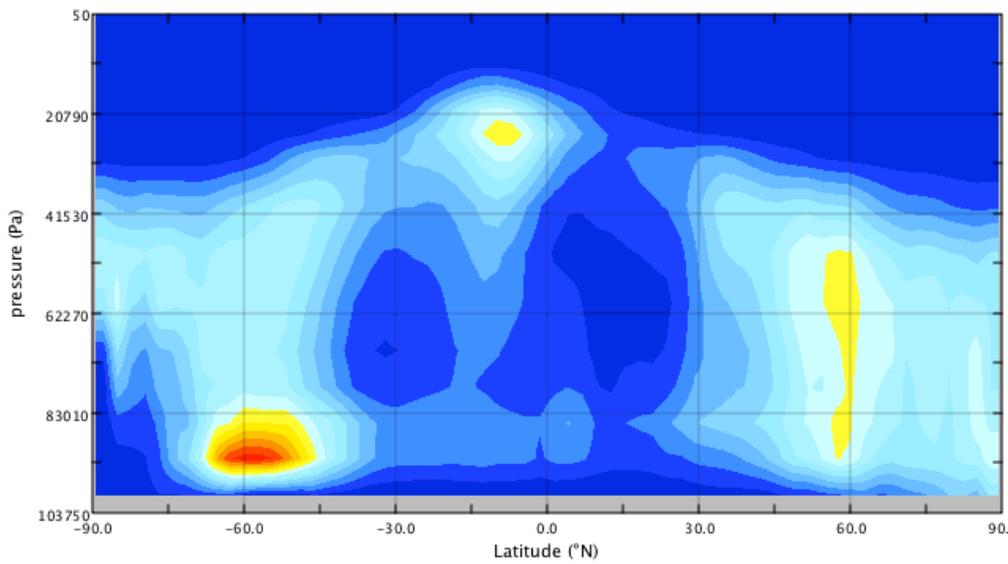
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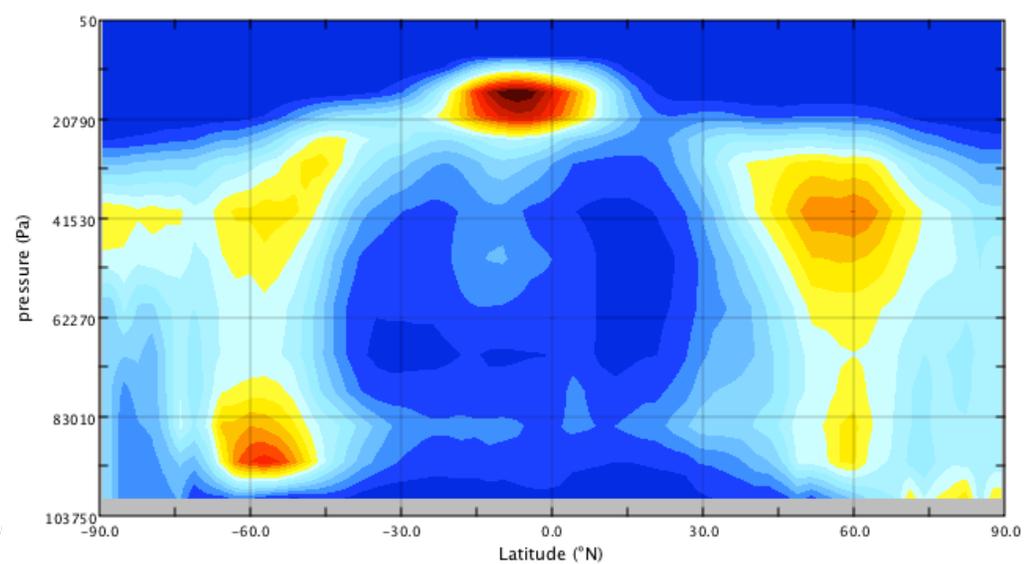
SP-IFS

IFS

Cloud cover ()

## JJA Cloud Fraction
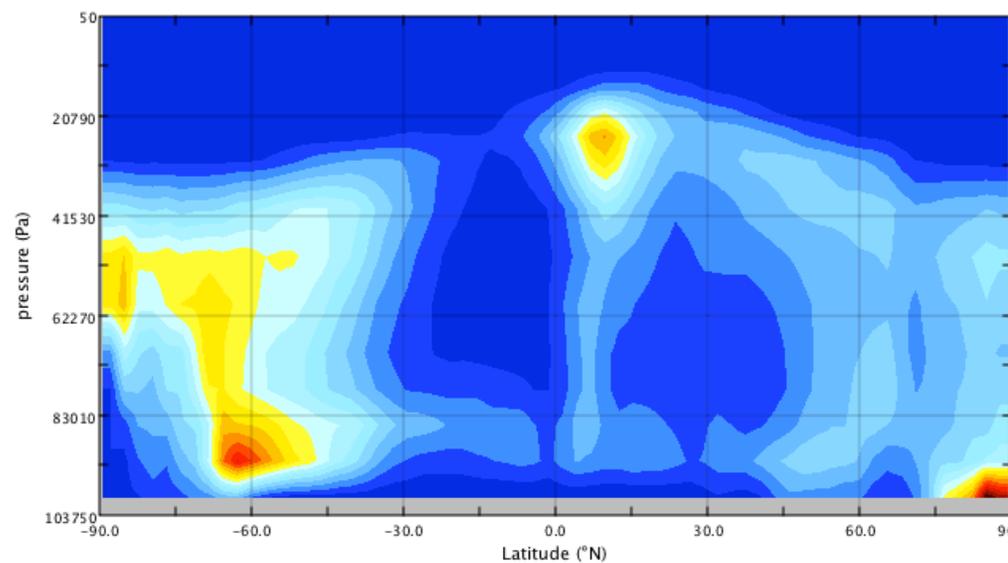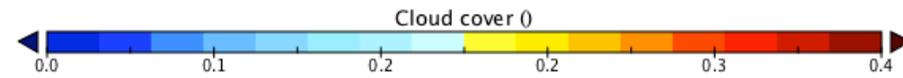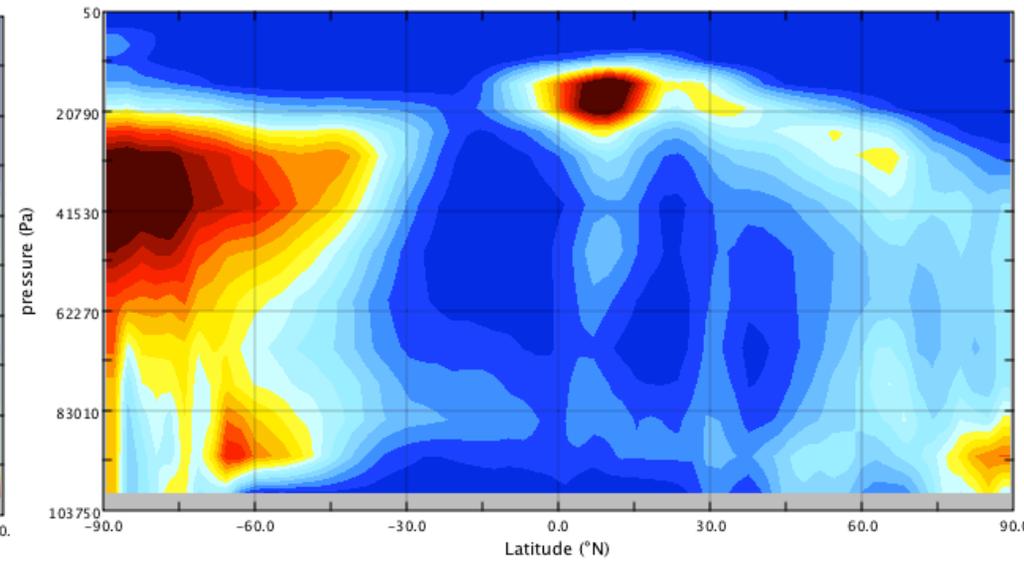
SP-IFS

IFS

Cloud cover ()

DJF Cloud Water/Ice
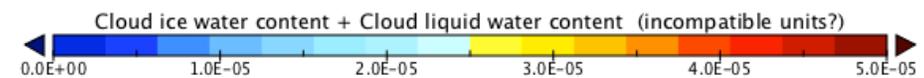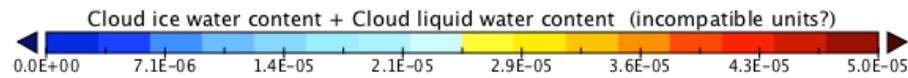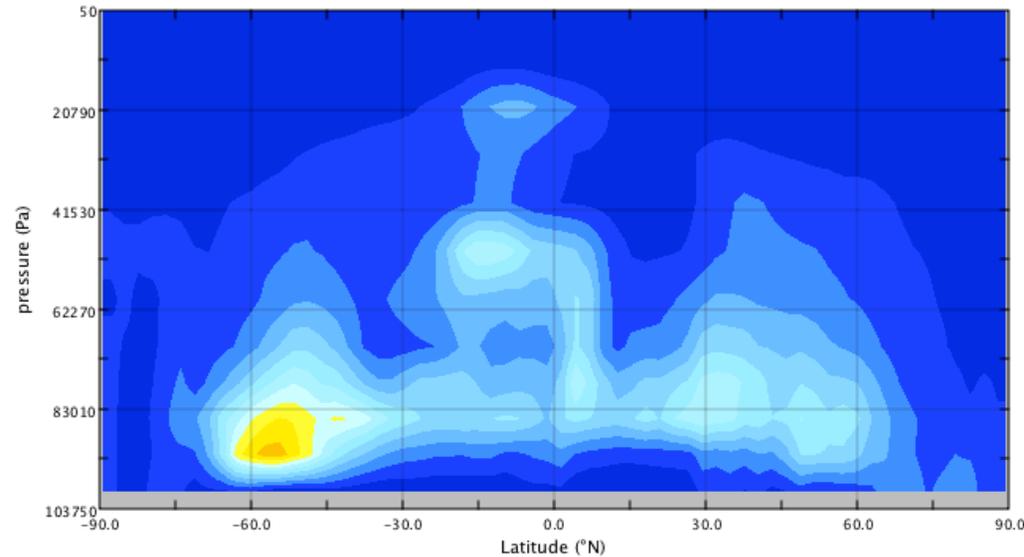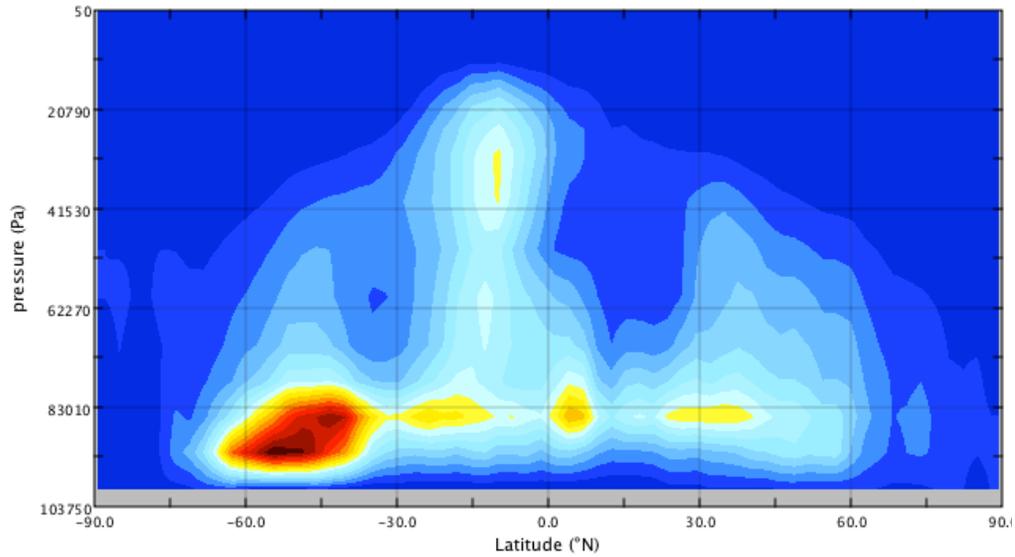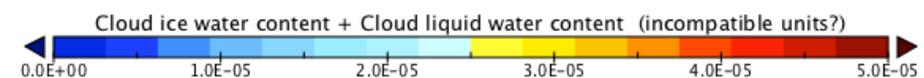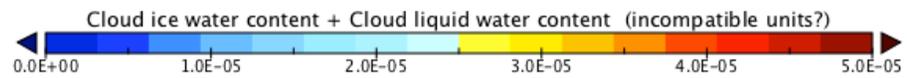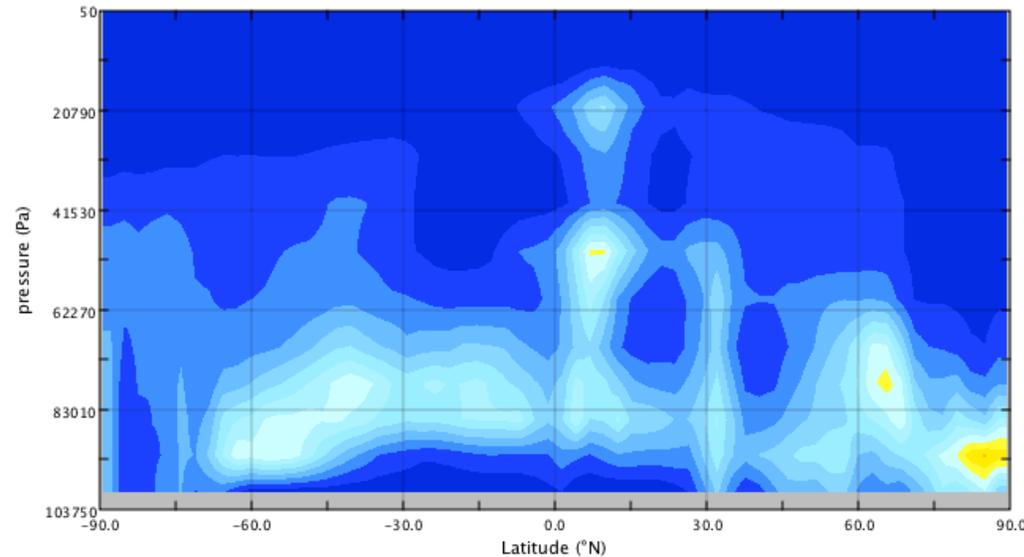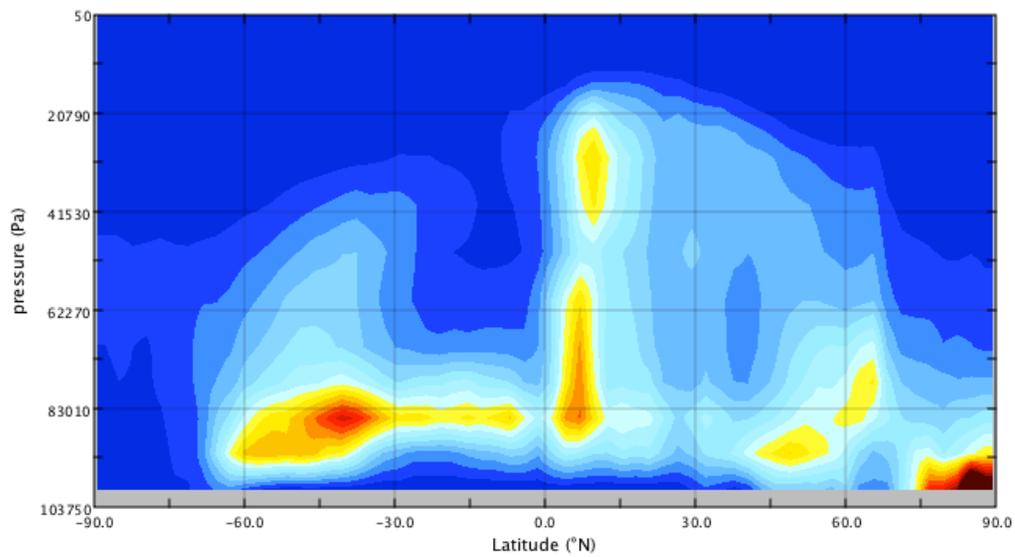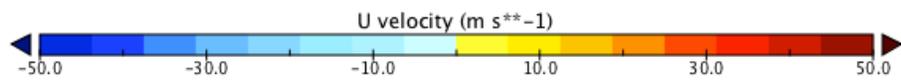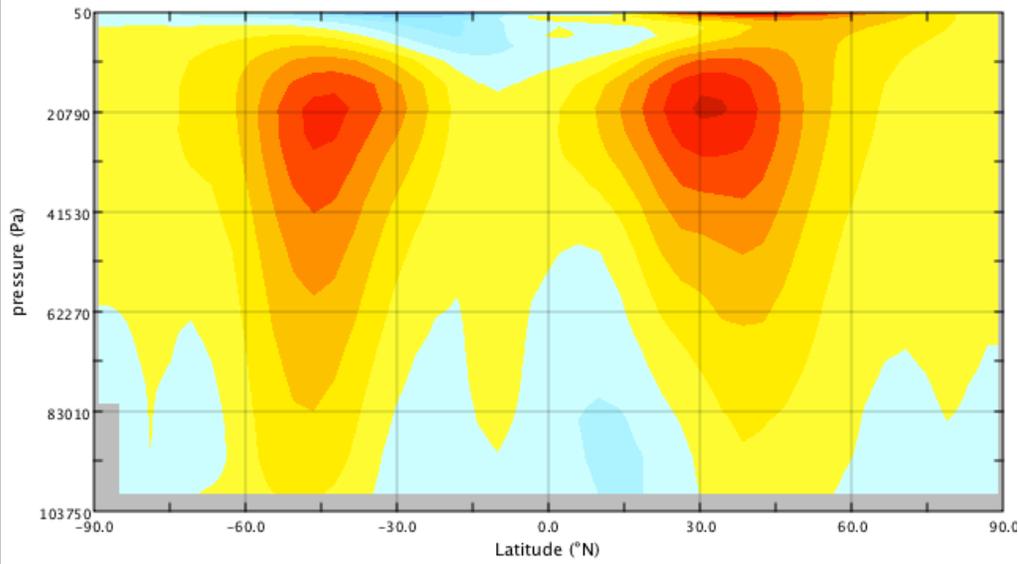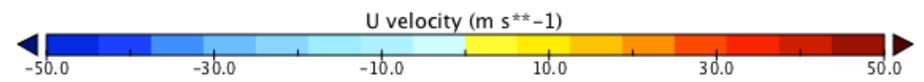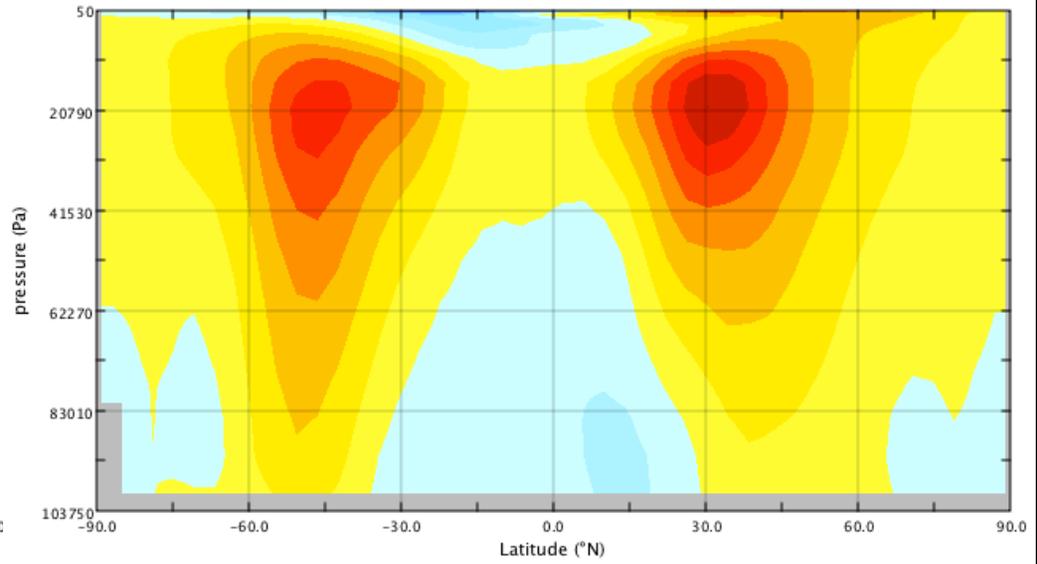
SP-IFS

IFS

Cloud ice water content + Cloud liquid water content (incompatible units?)

JJA Cloud Water/Ice
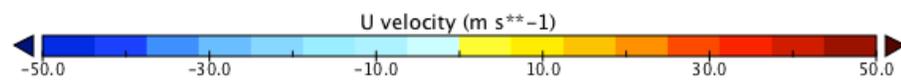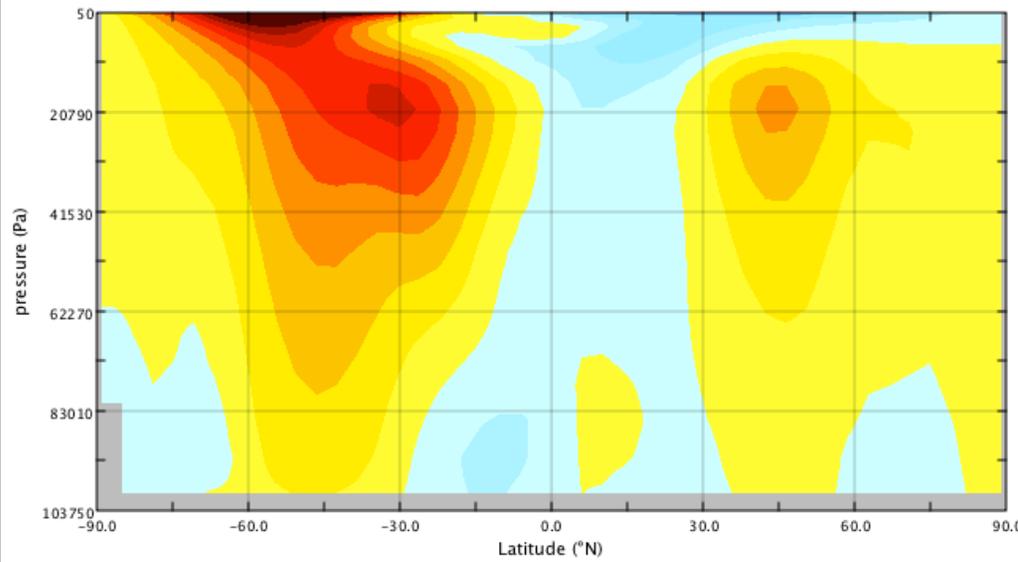
SP-IFS

IFS

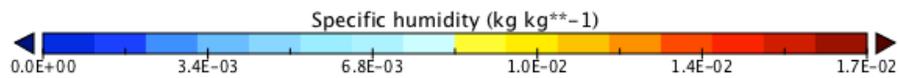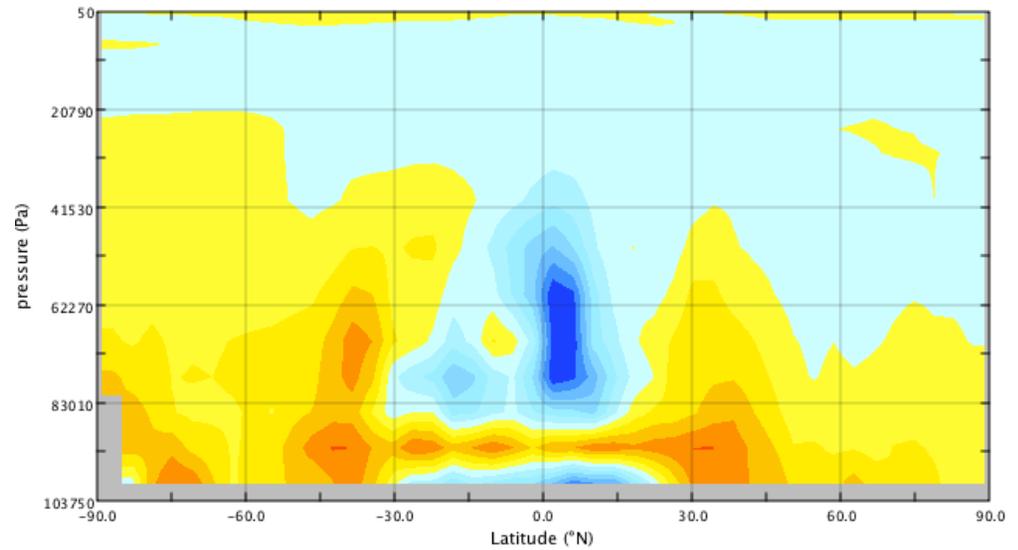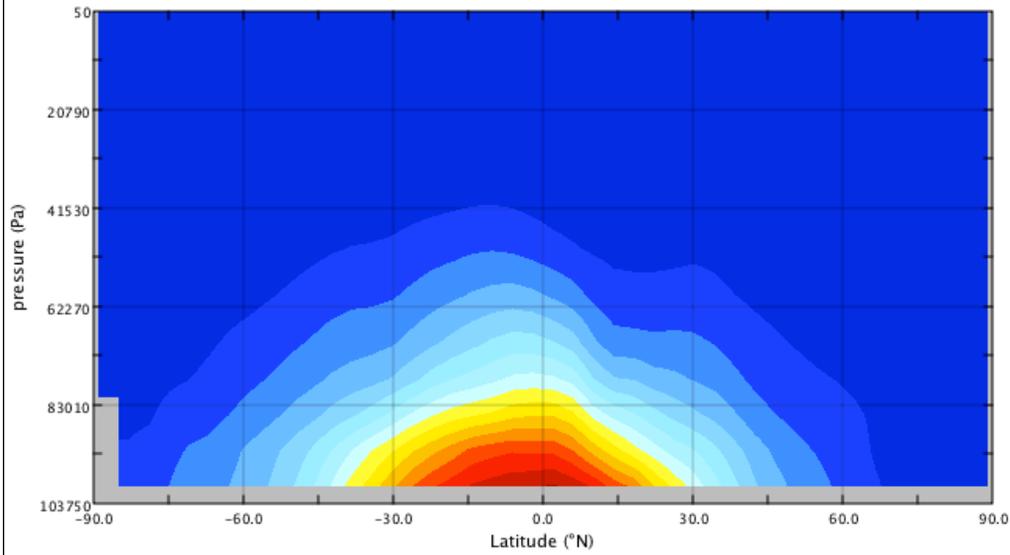Cloud ice water content + Cloud liquid water content (incompatible units?)

**DJF Zonal Wind**

SP-IFS

IFS

**JJA Zonal Wind**

SP-IFS

IFS

DJF Specific Himidity

SP-IFS
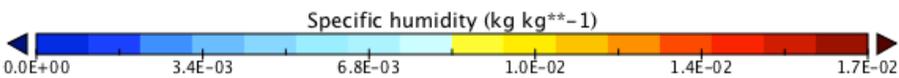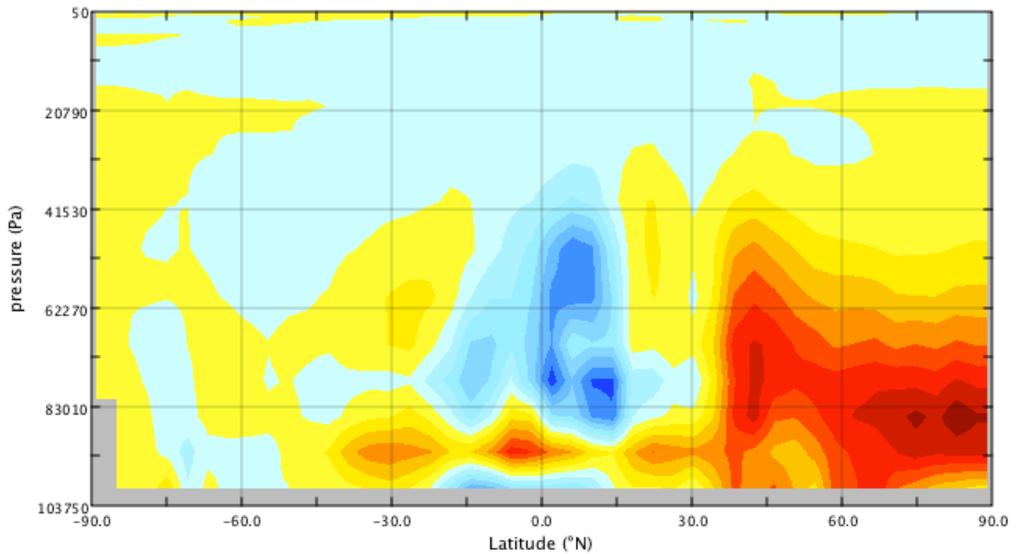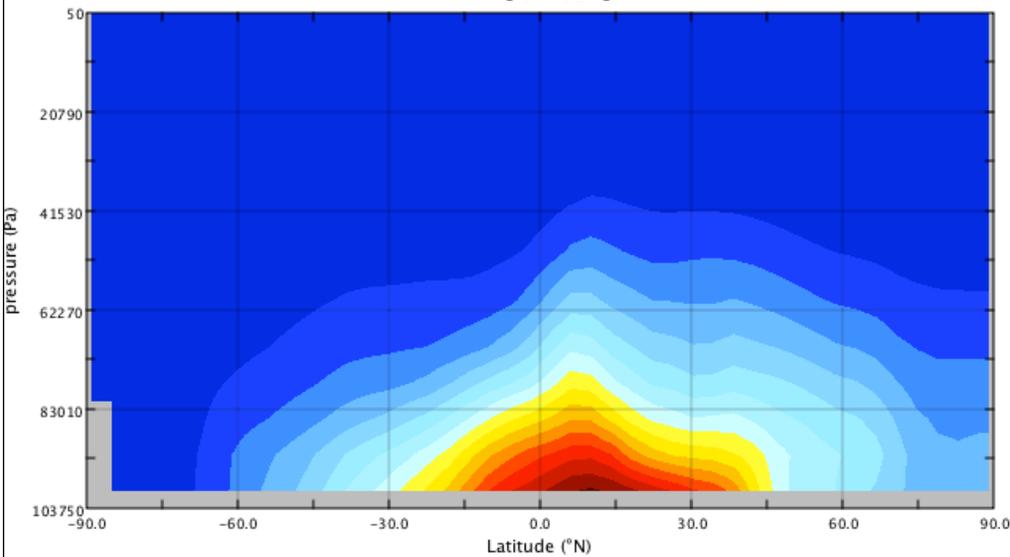
SP-IFS minus IFS

Specific humidity (kg kg**−1)

0.0E+00    3.4E−03    6.8E−03    1.0E−02    1.4E−02    1.7E−02

Specific humidity – Specific humidity  (incompatible units?)

−1.0E−03    −6.0E−04    −2.0E−04    2.0E−04    6.0E−04    1.0E−03
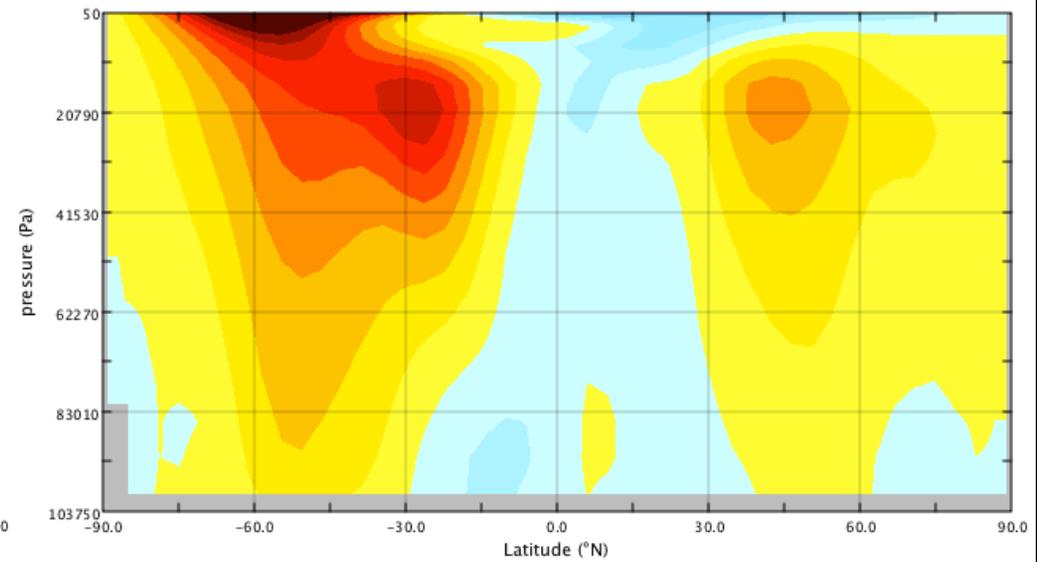
JJA Specific Humidity

SP-IFS

SP-IFS minus IFS

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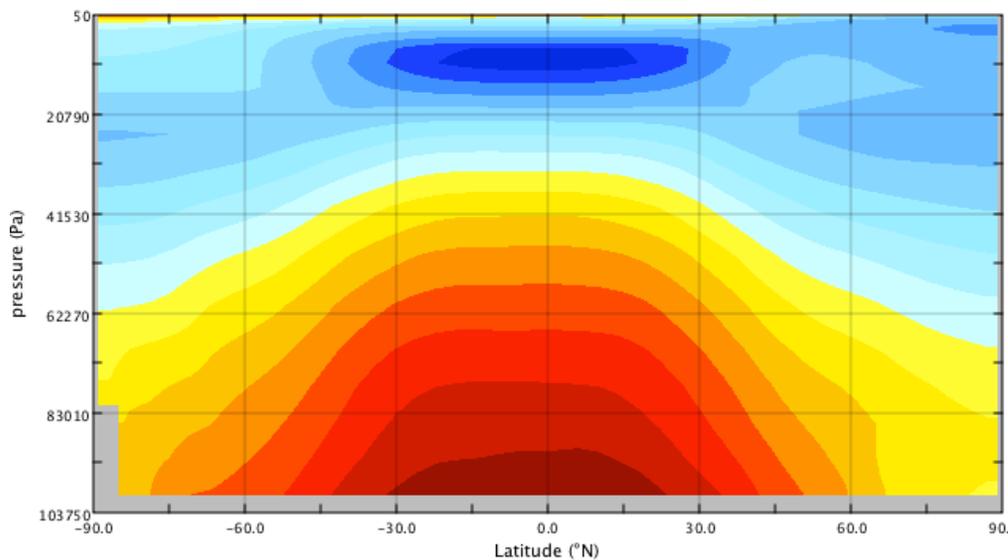
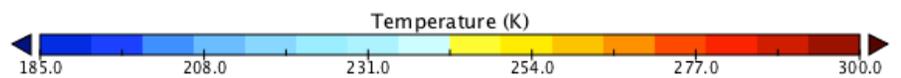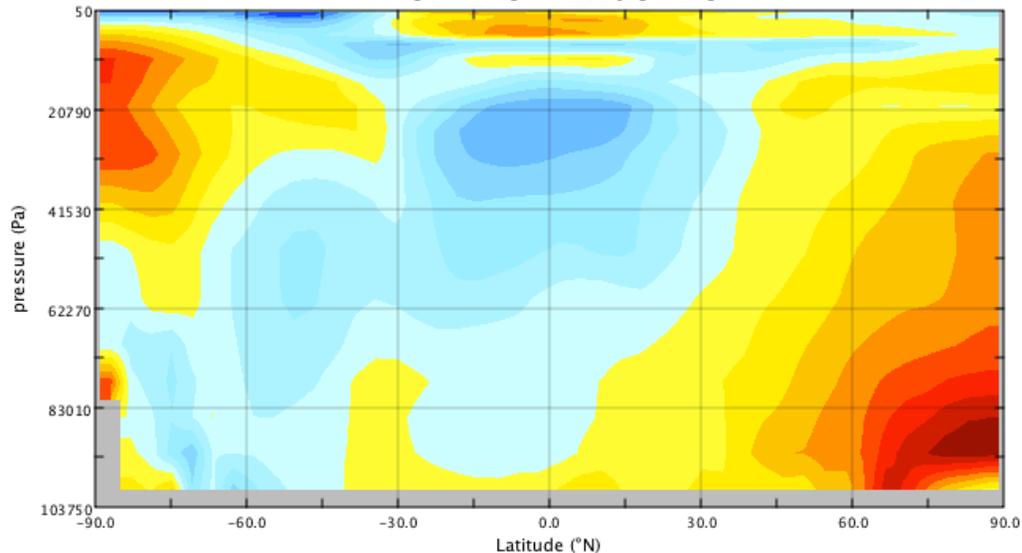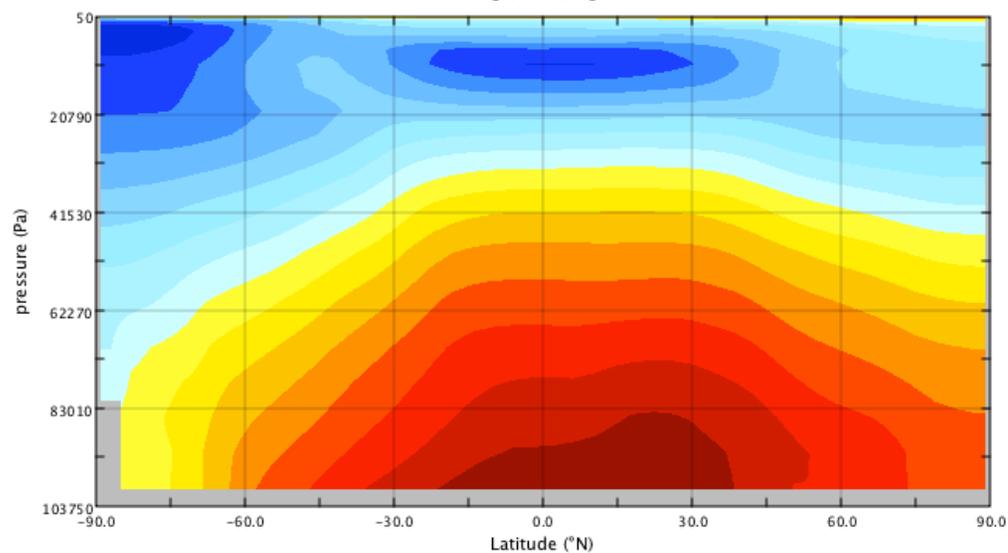−1.0E−03    −6.0E−04    −2.0E−04    2.0E−04    6.0E−04    1.0E−03
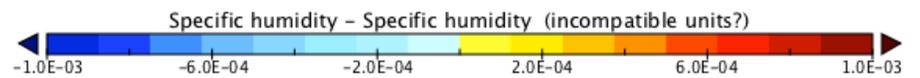
DJF Temperature
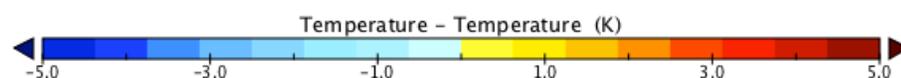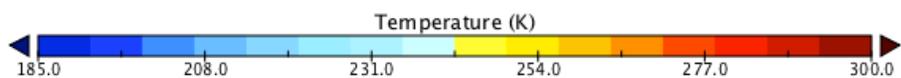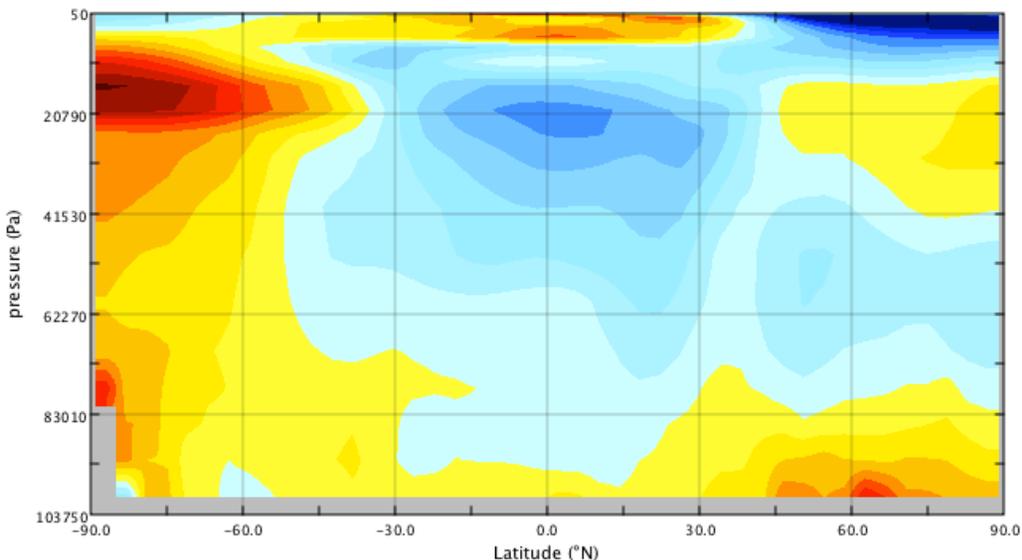
SP-IFS    SP-IFS minus IFS

JJA Temperature

SP-IFS    SP-IFS minus IFS

Intraseasonal Variability
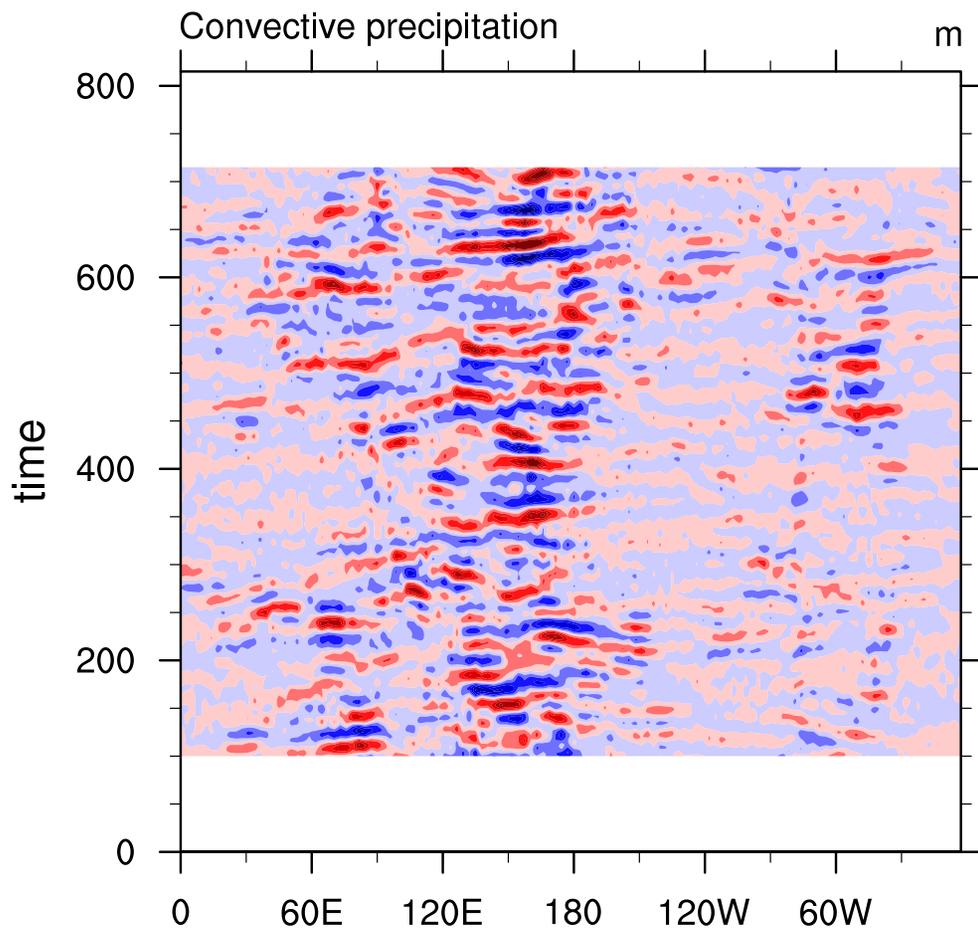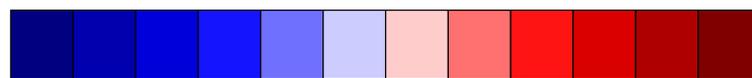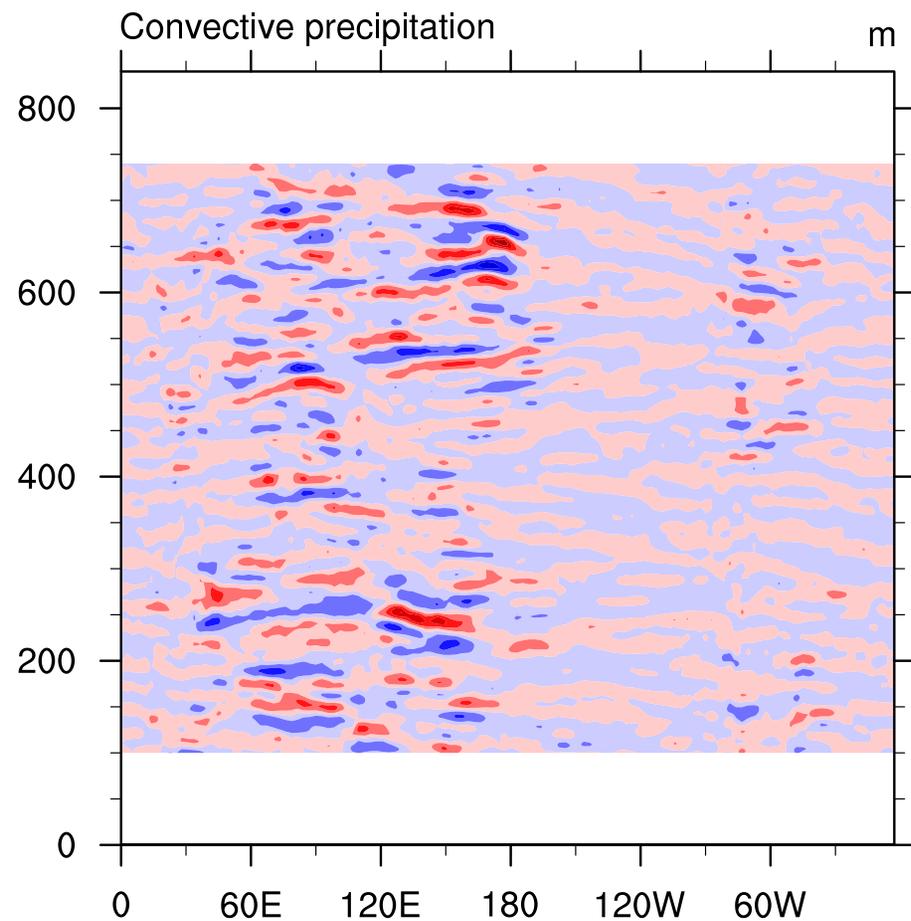Tropics (15S-15N)
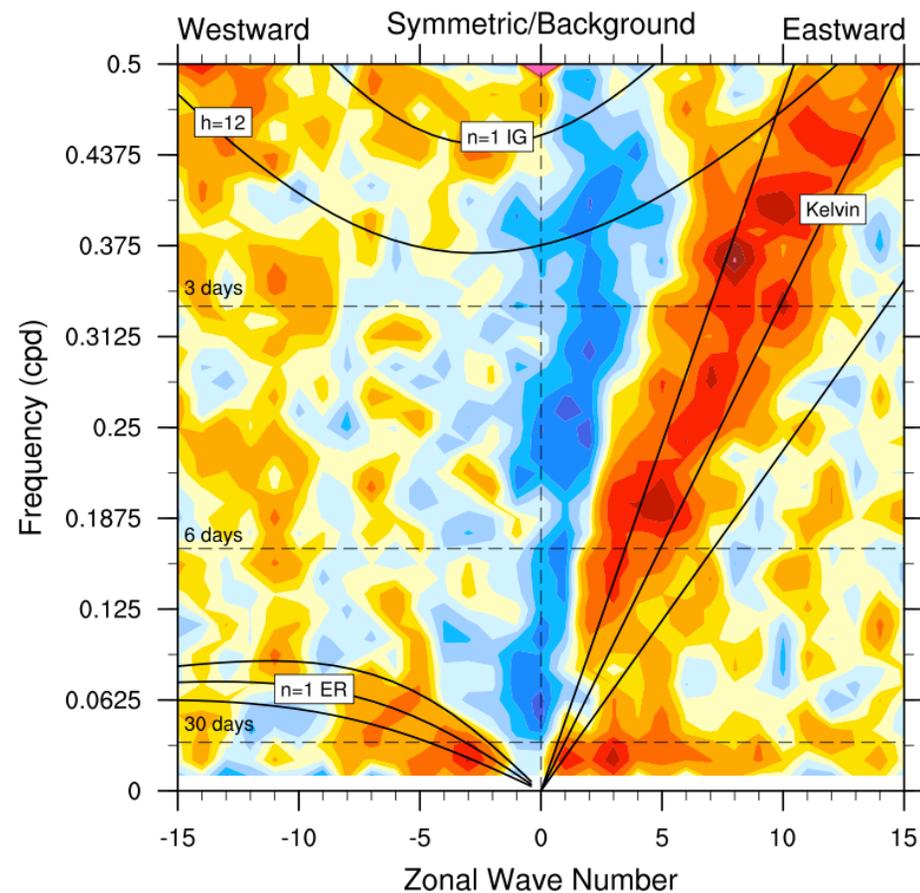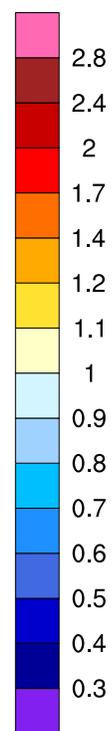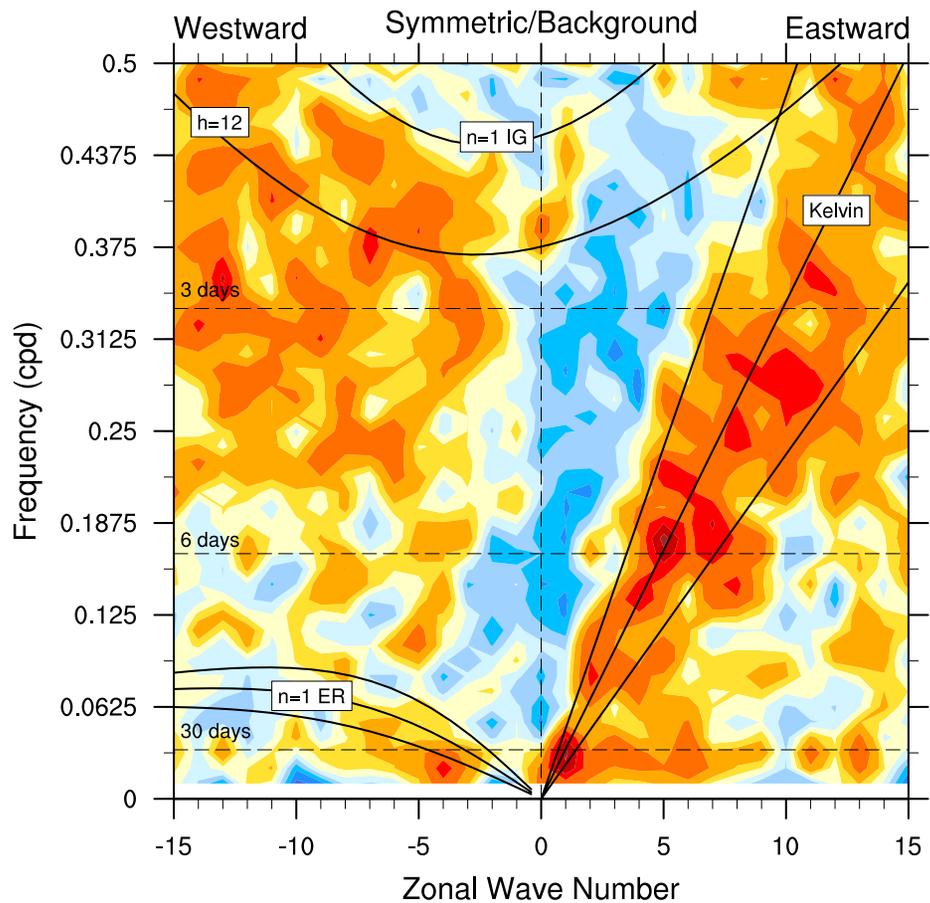
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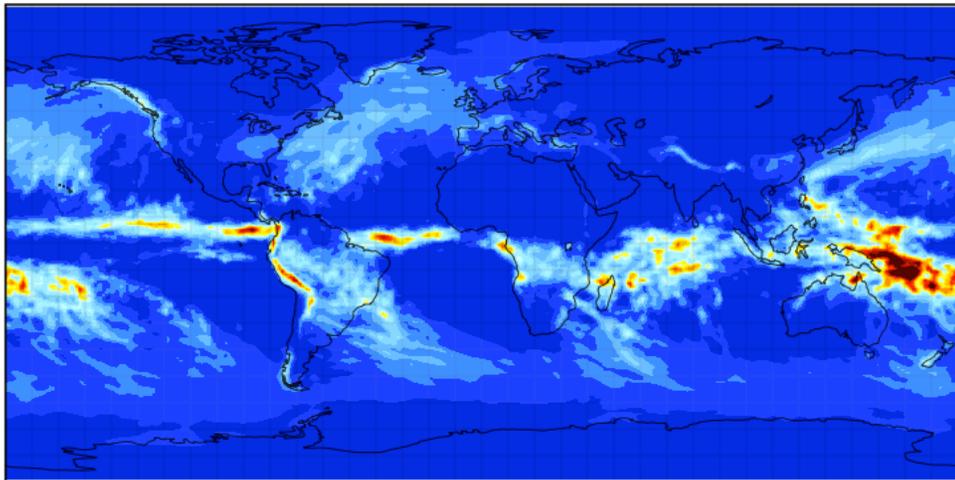
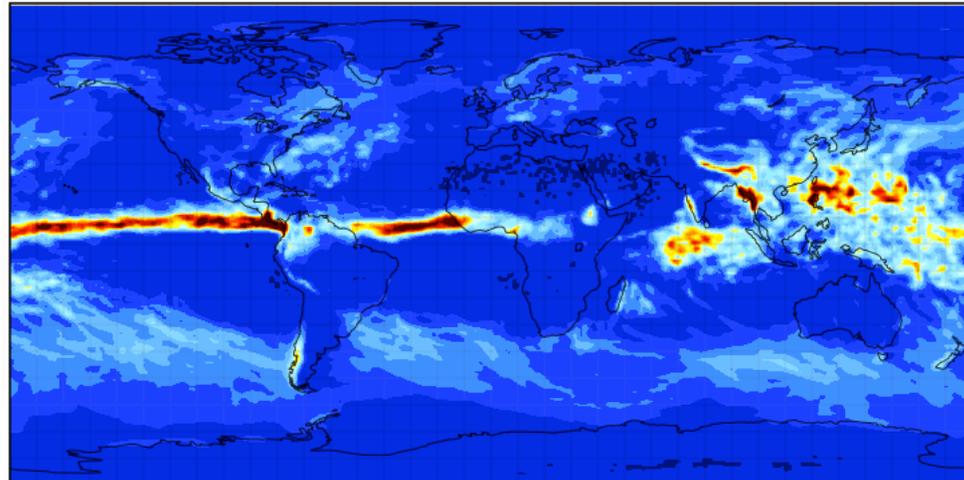SP-IFS
Precipitation
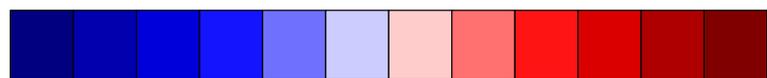
IFS
Precipitation

# Future work with SP-IFS

- **T95 and T159 production runs**

- **Radiation on CRM grid**

- **Short-term hindcasts of interesting events**

- **Ensembles**

- **Intraseasonal variability in Tropics and Mid-latitudes**

- **Mini-LES for PBL and shallow clouds**

- **Convective Momentum Transport**

- **Gravity wave sources due to deep convection**

**SP-IFS T159**

DJF

JJA

# SP-IFS T159

Precipitation (LOG mm/h)

801 3