

IPSL VENUS GCM

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IPSL TITAN GCM

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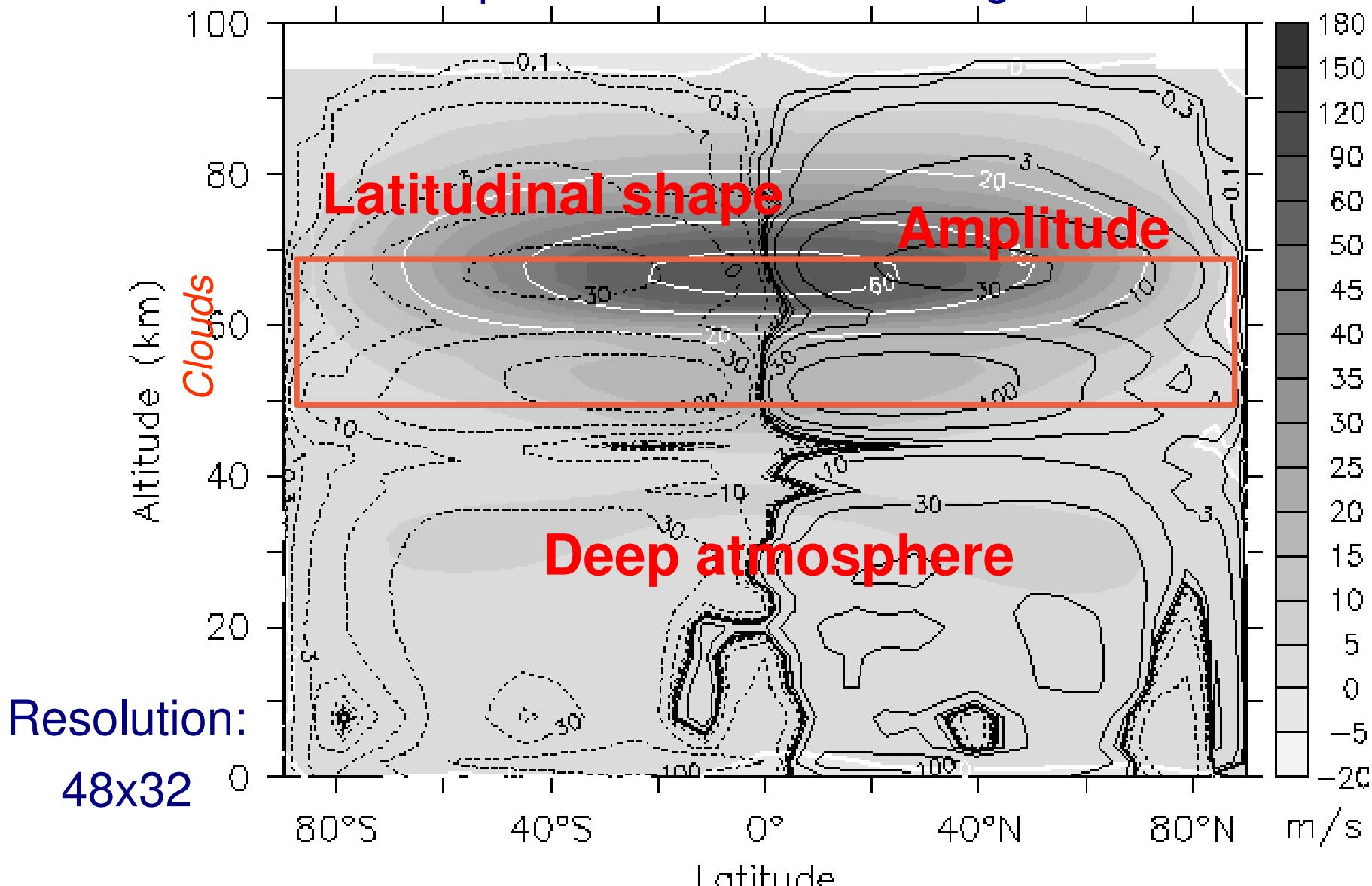
Pascal Rannou, Jérémie Burgalat (GSMA)

IPSL VENUS GCM

- Three-dimensional: 48x32x50 (0~95 km)
 Current goal: 96x96x78 (0~150 km)
- Vertical coordinates: hybrid (sigma/pressure)
- Dynamical core, transport of tracers
- Specific physics:
 - ◆ radiative transfer: Net Exchange Rates matrix
 - ◆ parameterizations (sub-grid processes: boundary layer, convection, turbulence)
 - ◆ topography
 - ◆ no clouds microphysics yet (work ongoing at Latmos)
- Photochemistry : PhD of Aurélien Stolzenbach

Venus Superrotation

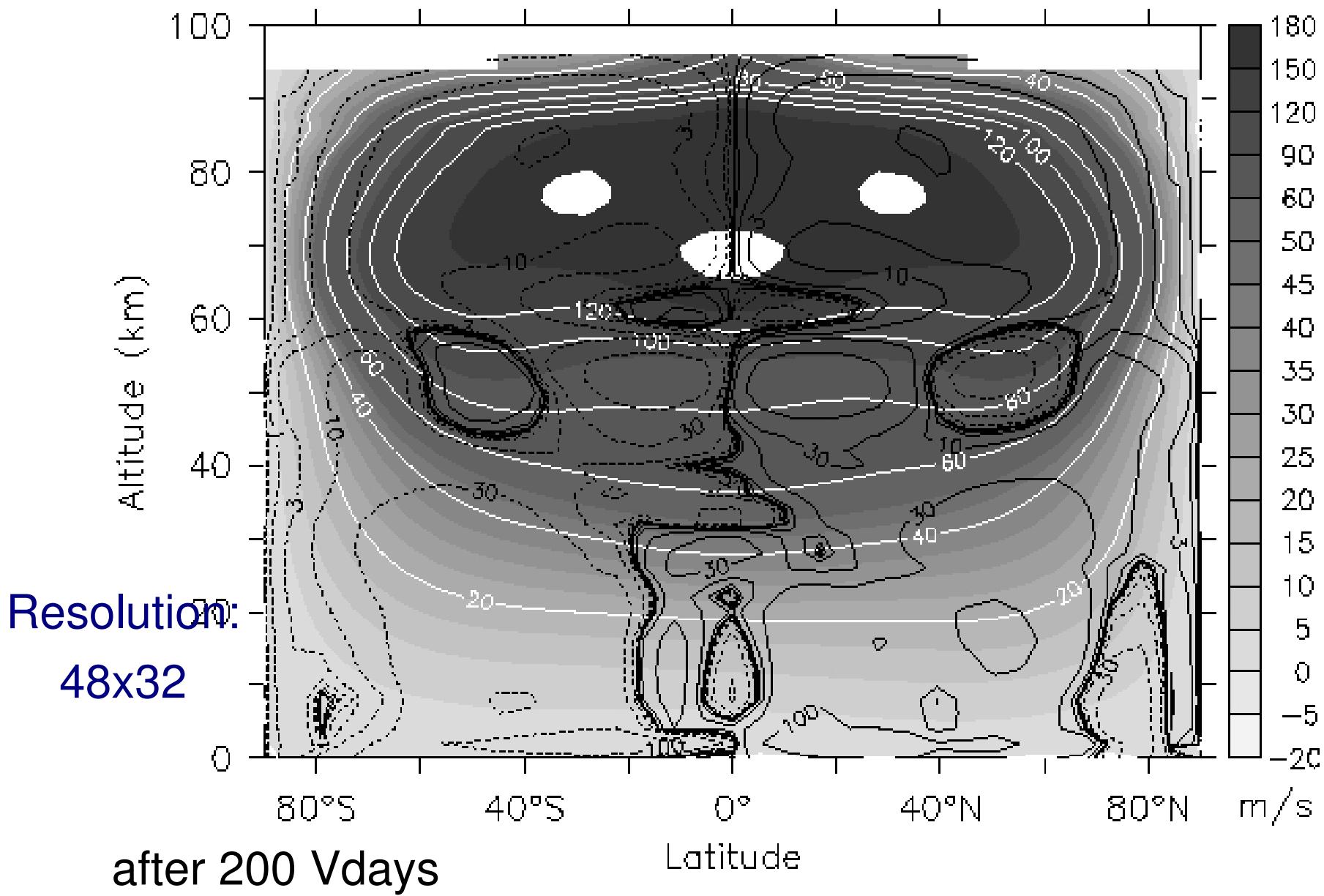
atmospheric circulation starting from rest



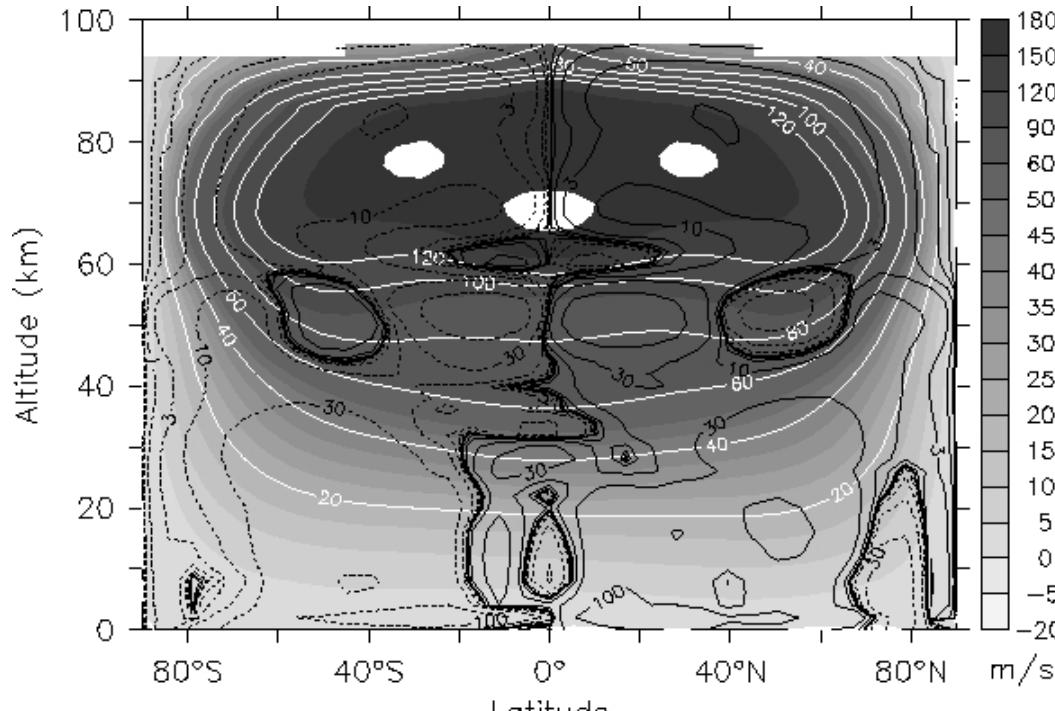
Mean zonal wind and stream function after 350 Vdays
(Topography, diurnal cycle)

Initial conditions

Starting from a zonal wind profile close to observations



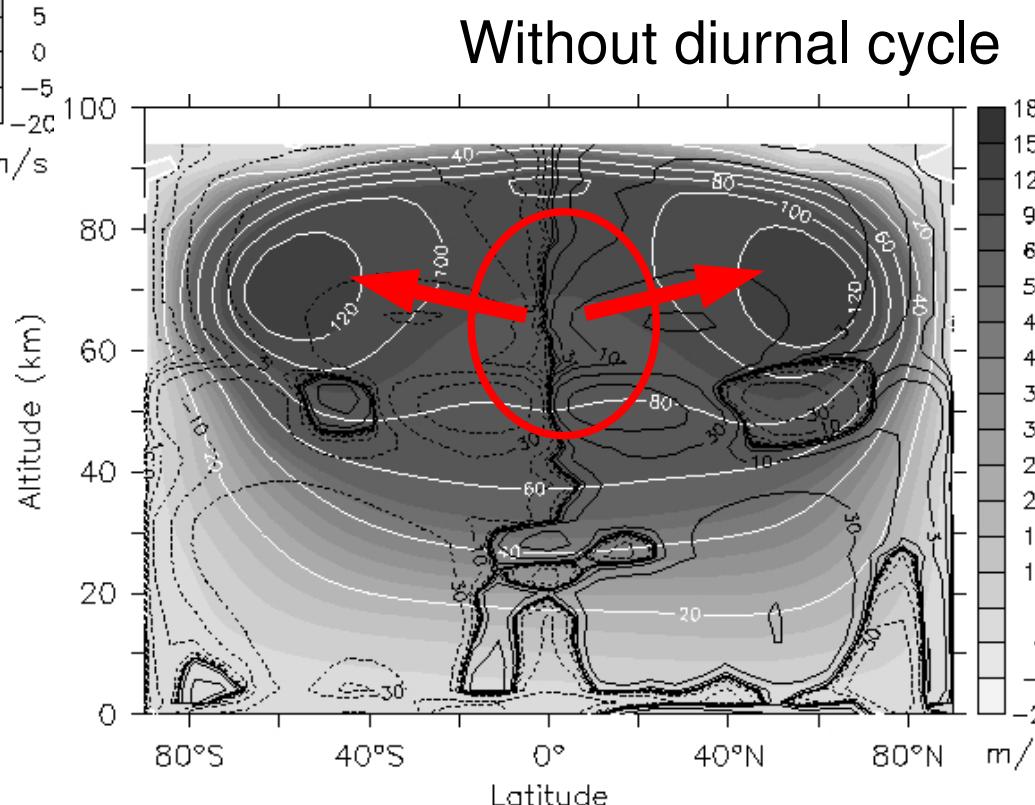
Role of the diurnal cycle



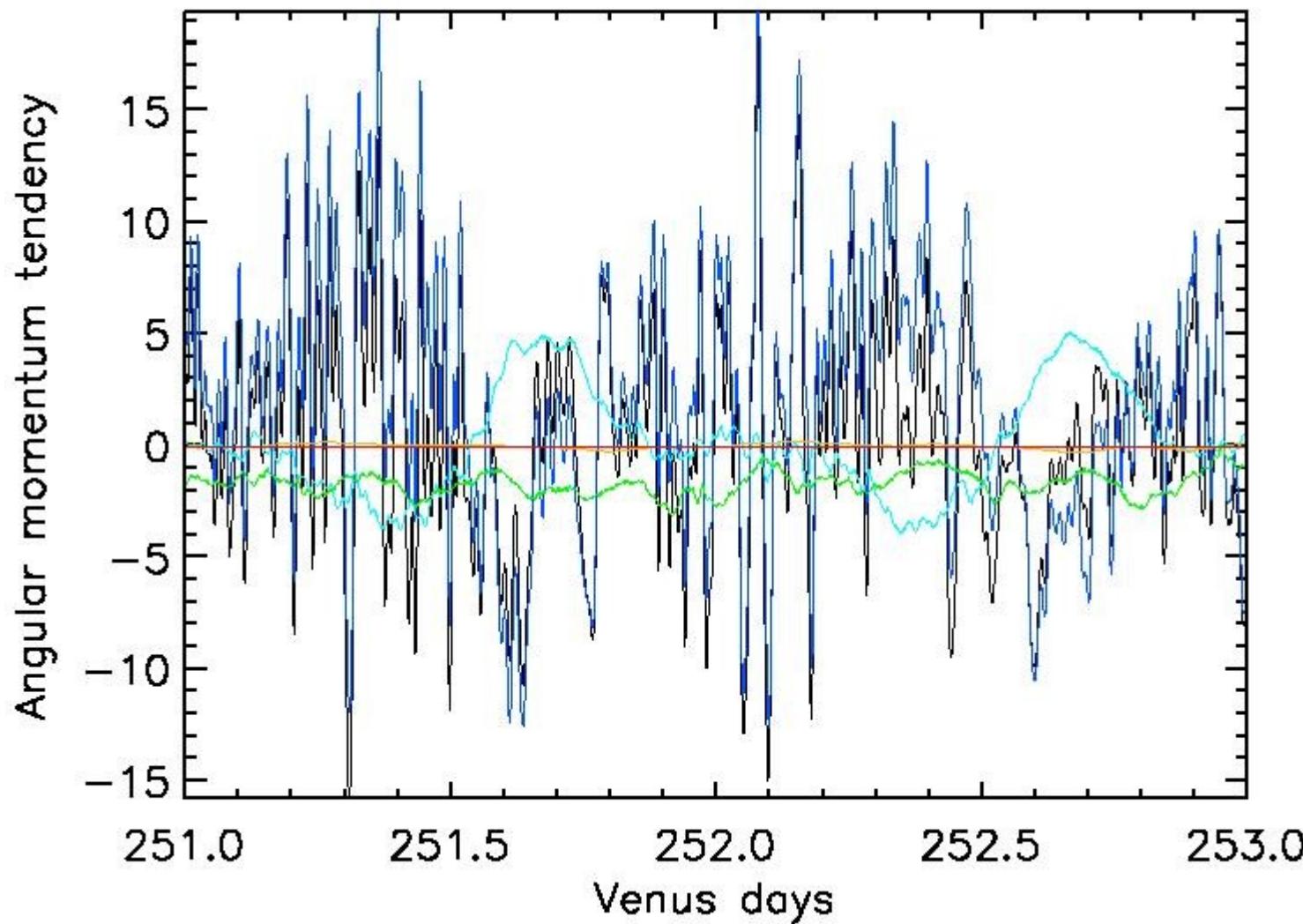
With diurnal cycle

Influence of thermal tides in angular momentum transport:

downward transport in the equatorial 64-90 km region.



Angular momentum budget



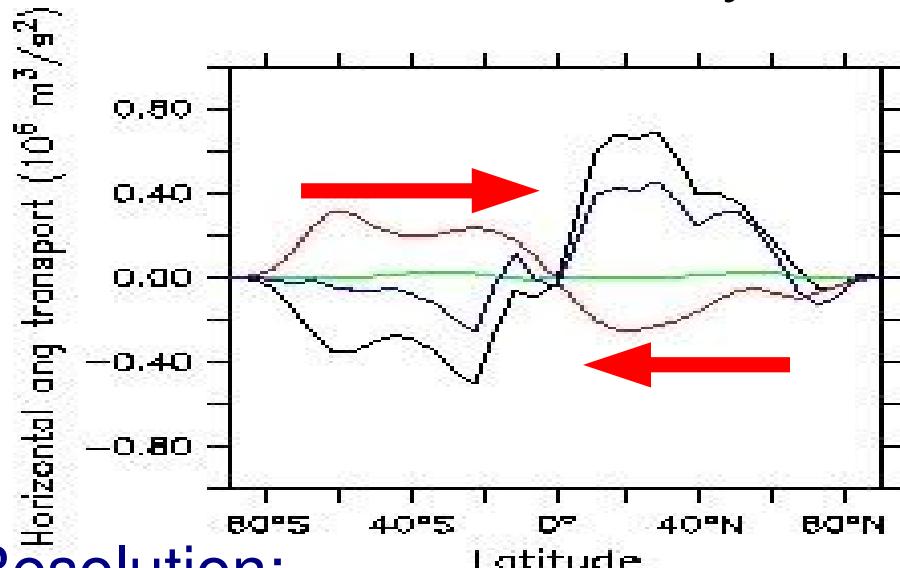
Resolution:
48x32

$$\frac{dM}{dt} = T + F + S + D + \epsilon$$

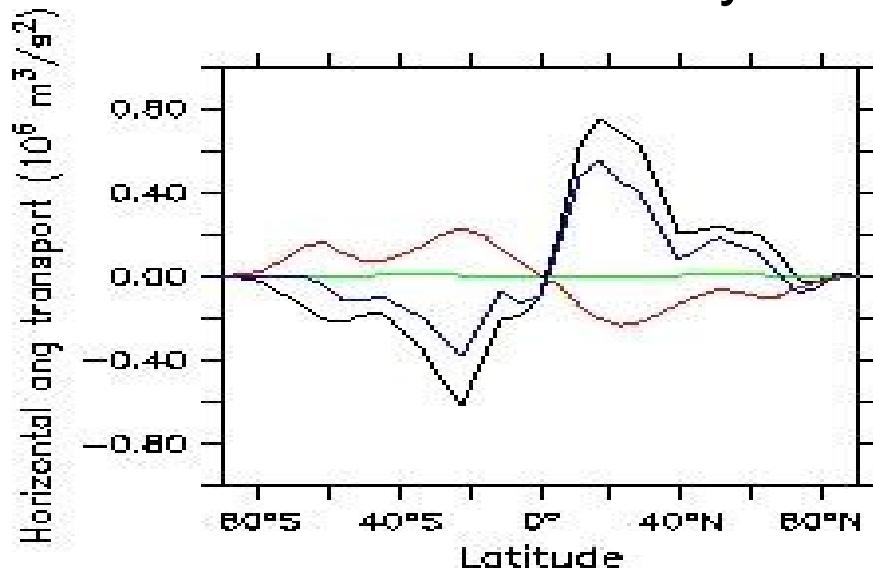
Angular momentum transport

Role of waves

Without diurnal cycle



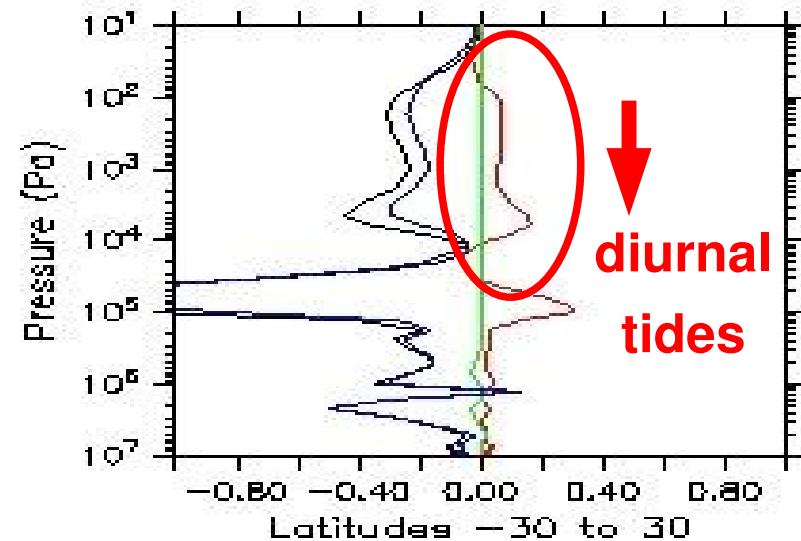
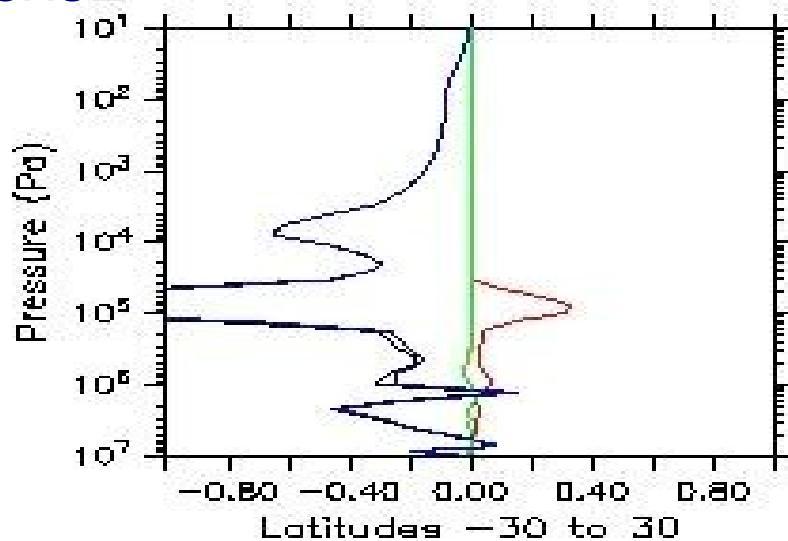
With diurnal cycle



Resolution:

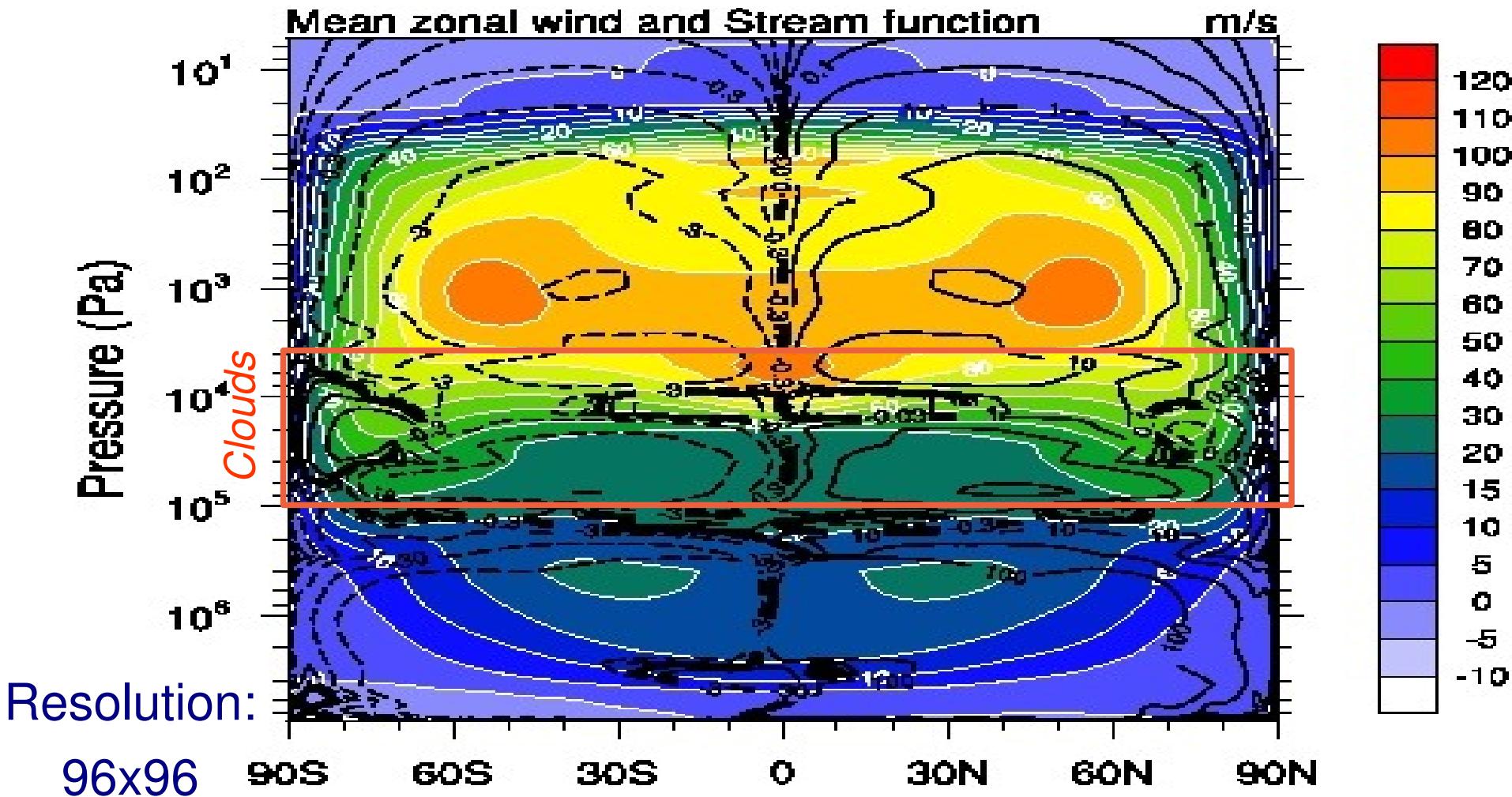
48x32

Vertical transport between 30°N and 30°S



Impact of resolution

atmospheric circulation starting from rest OR superrotation

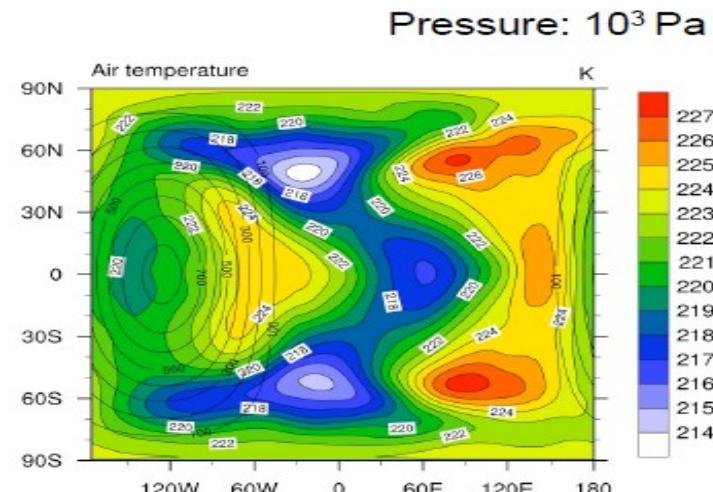
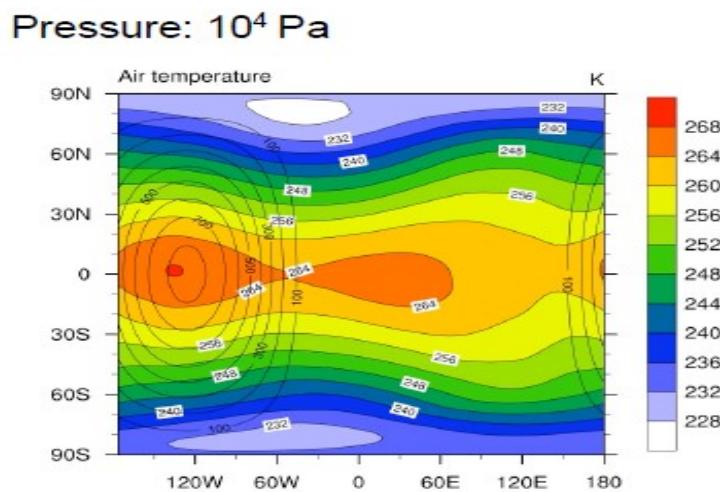
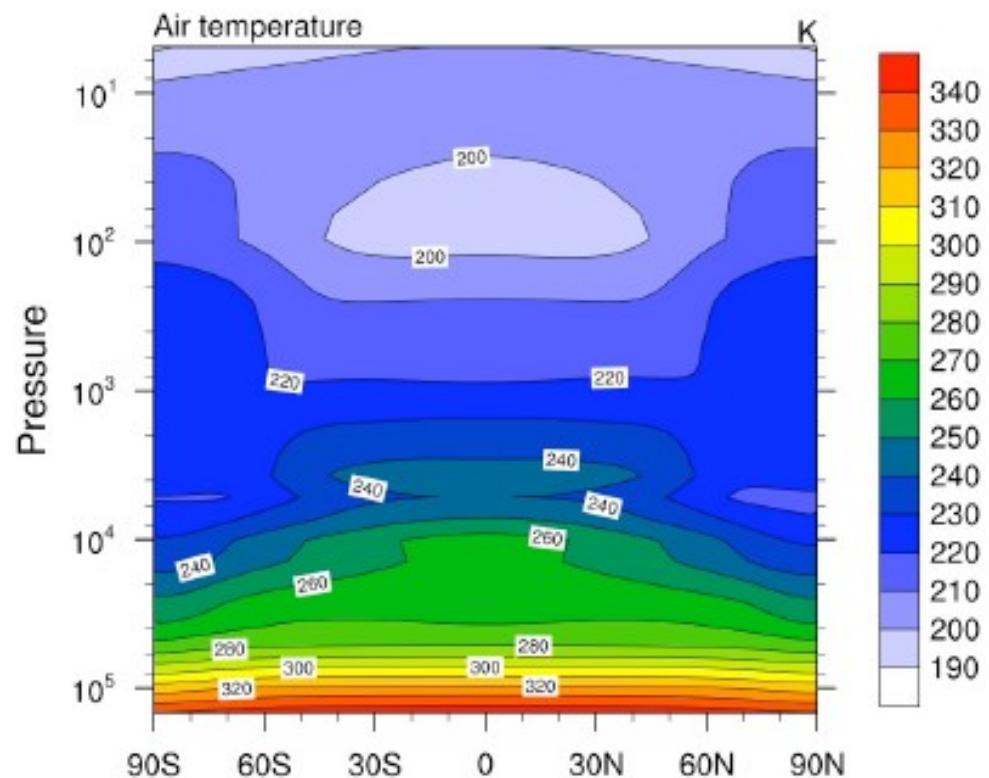


Mean zonal wind and stream function after 180 Vdays
(Topography, diurnal cycle)

Temperature fields (cloud region)

Horizontal resolution 96x96,
after 60 Vd simulation

Temperatures 10-30 K
higher than observed



Current work in progress

Impact of GW

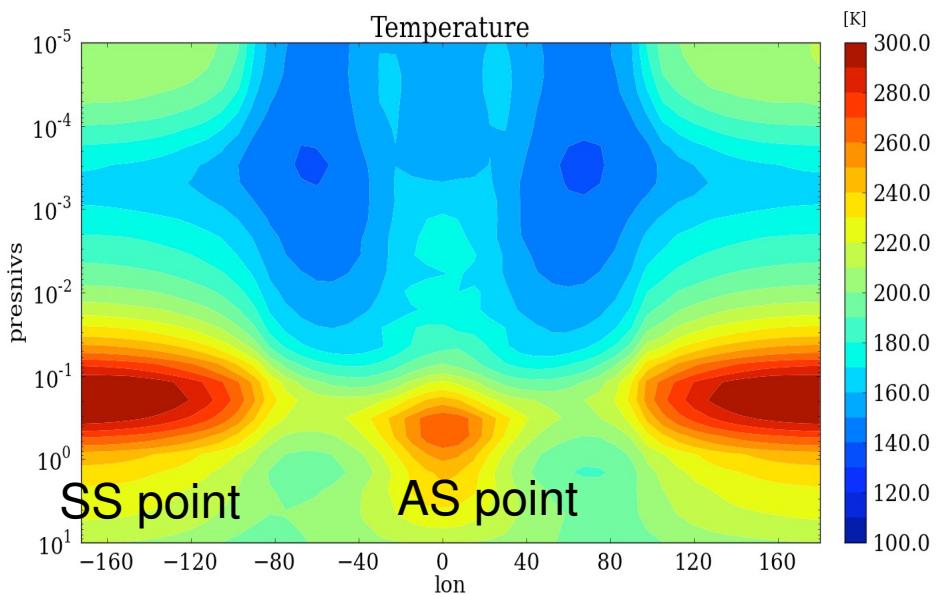
implementation of orographic and non-orographic (convection)
gravity wave parameterisations
=> mesoscale model in project

Upper atmosphere

extending the GCM up to
 μPa levels / 150 km

Radiative transfer

computation of solar heating rates
with a new 3D tool



Photochemistry and microphysics

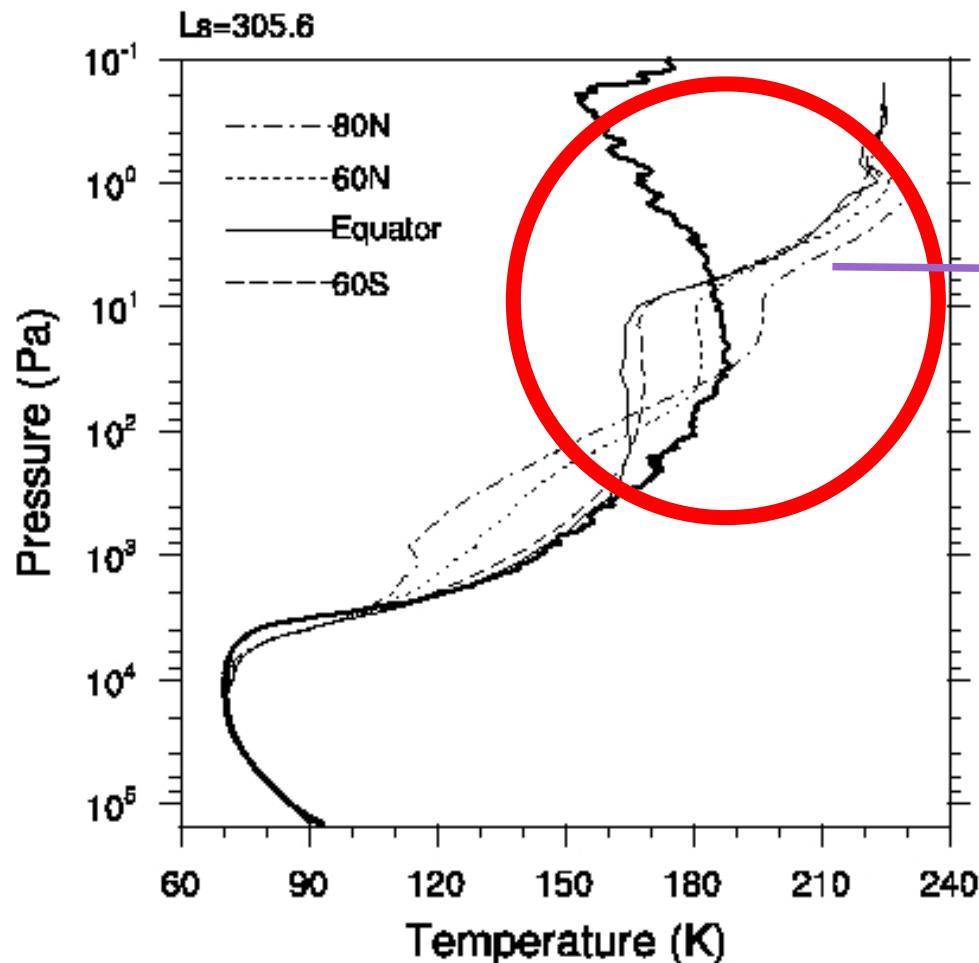
=> modules under development at LATMOS

IPSL TITAN GCM

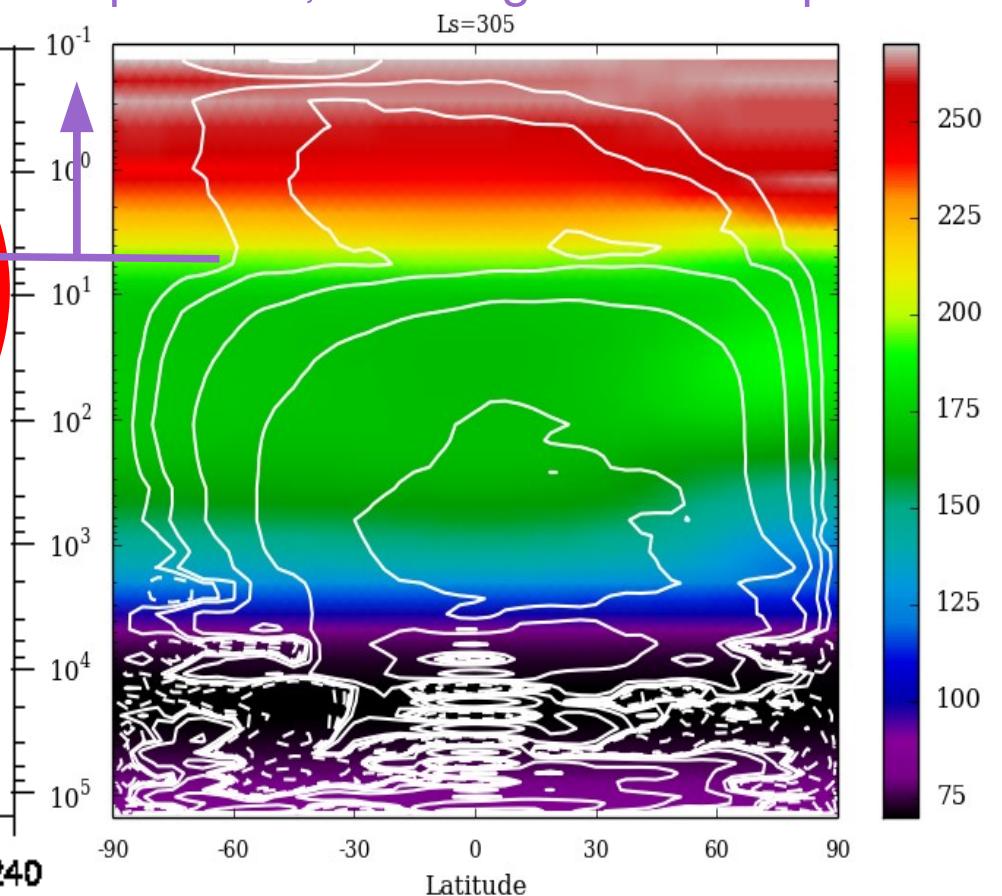
- Three-dimensional: 32x48x55 (0~500 km)
=> The thickness of the atmosphere is a problem for the dycore
- Vertical coordinates: hybrid (sigma/pressure)
- Dynamical core, transport of tracers
- Specific physics:
 - ◆ parameterizations (sub-grid processes, boundary layer, convection, turbulence)
 - ◆ Interactive haze and clouds microphysics
 - ◆ Topography: to be implemented soon
- Photochemistry:
44 species (H,C,N), 377 reactions (54 photodissociations)
Extension above GCM up to 1300 km (no latitudinal transport)

Vertical structure

Northern winter



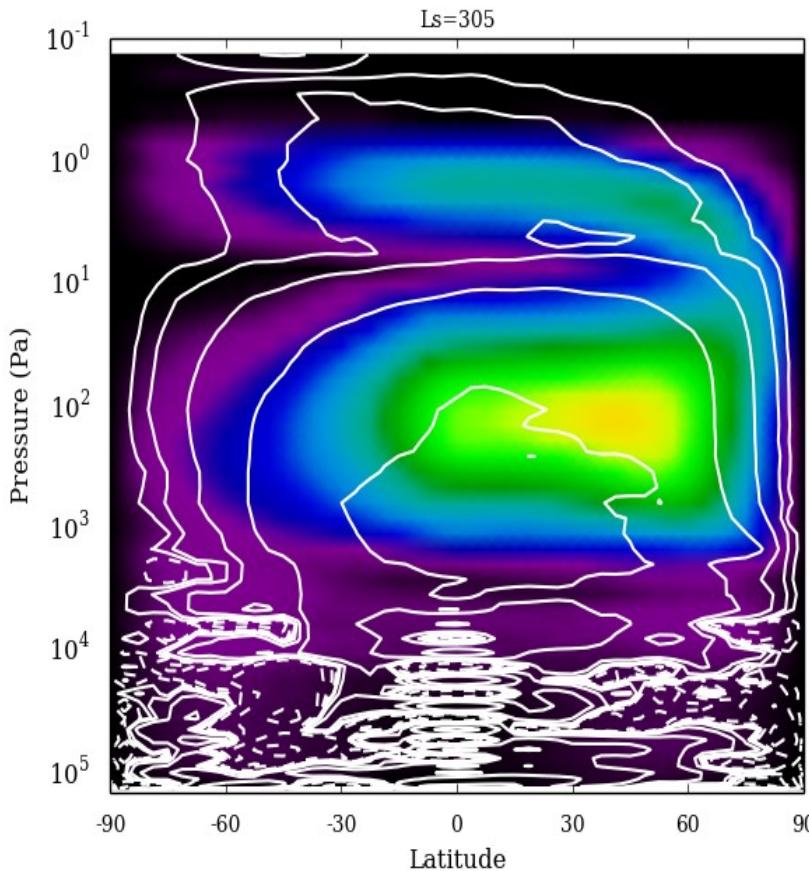
T problem, inducing circulation problem...



Main problem of the GCM for the moment...

Vertical structure

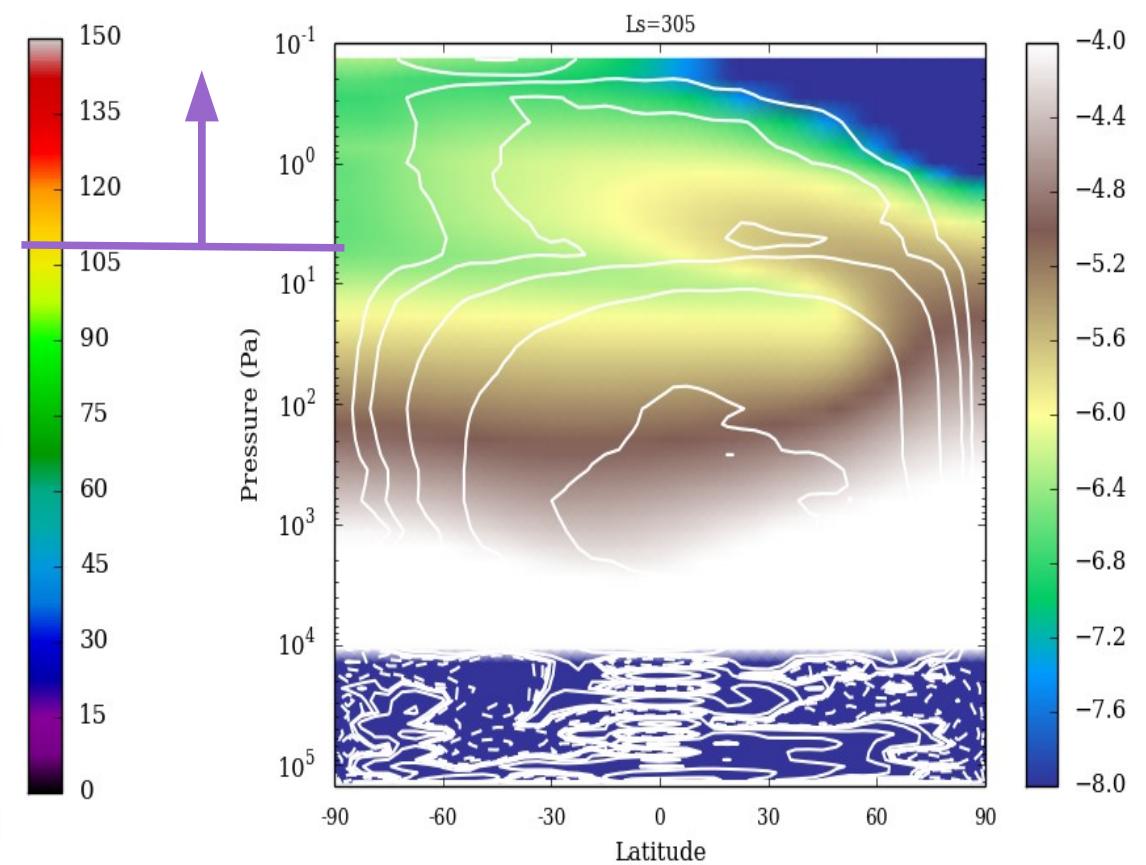
Northern winter



Zonal wind

Lower than observations

T problem, inducing circulation problem...

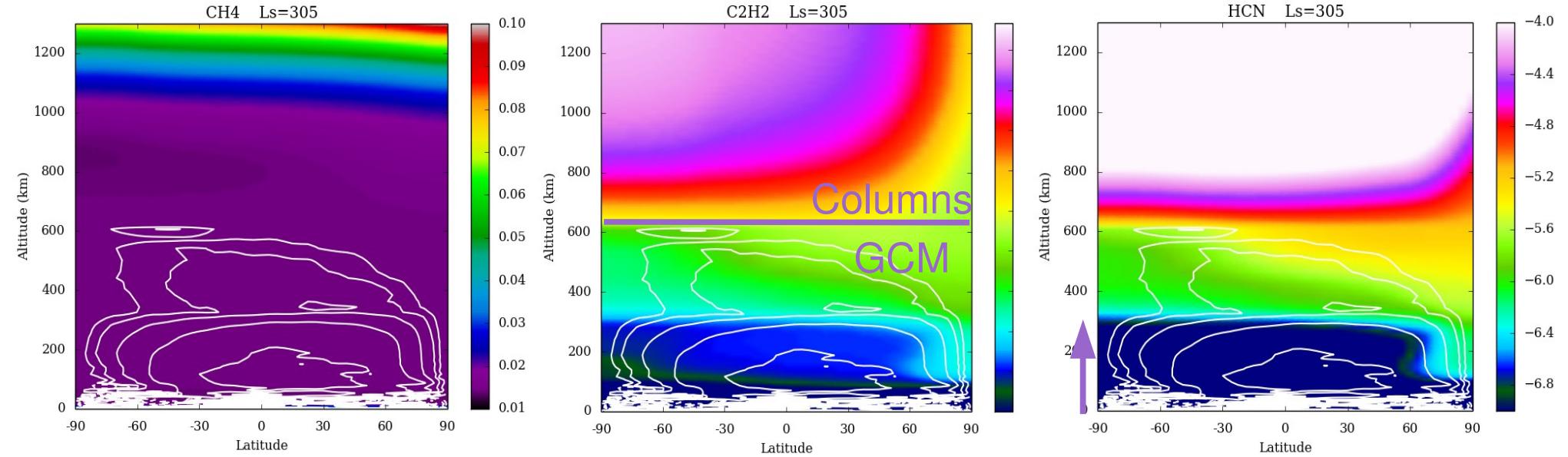


640 nm aerosol extinction

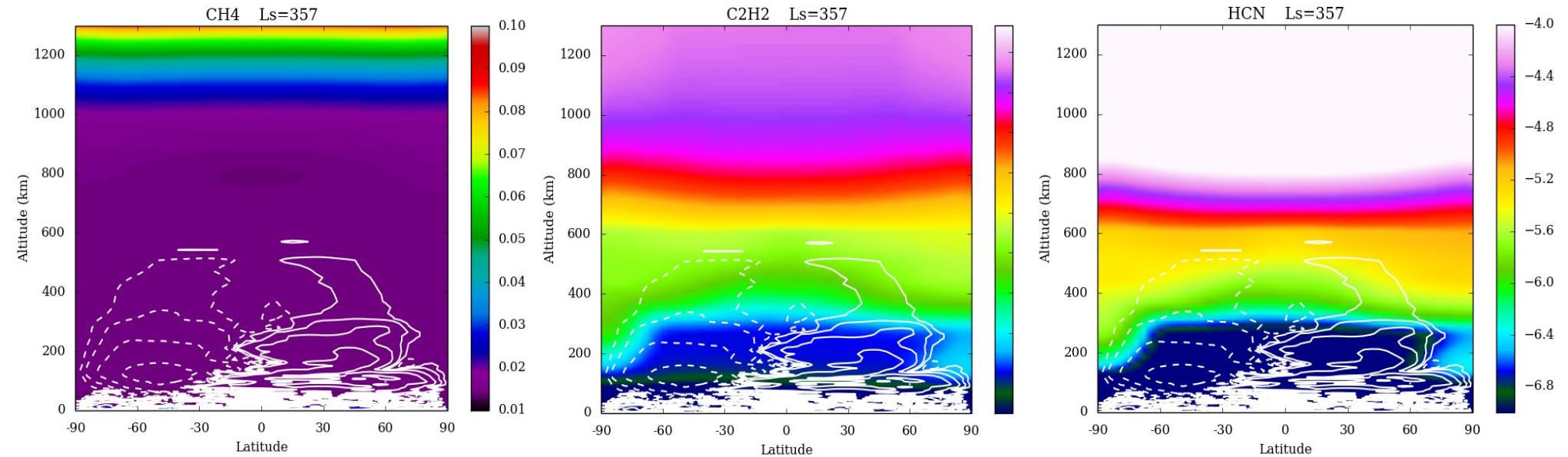
Detached layer too low

Composition / Seasonal variations

Northern winter

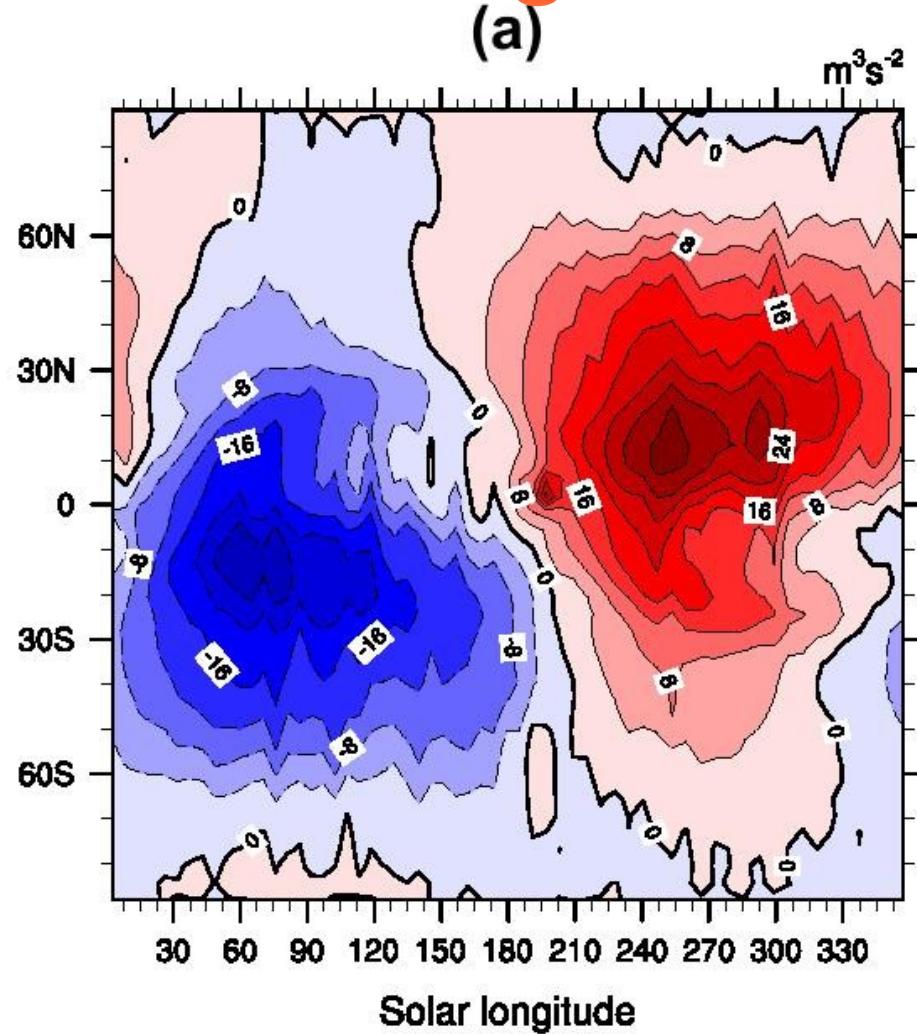


Northern spring equinox

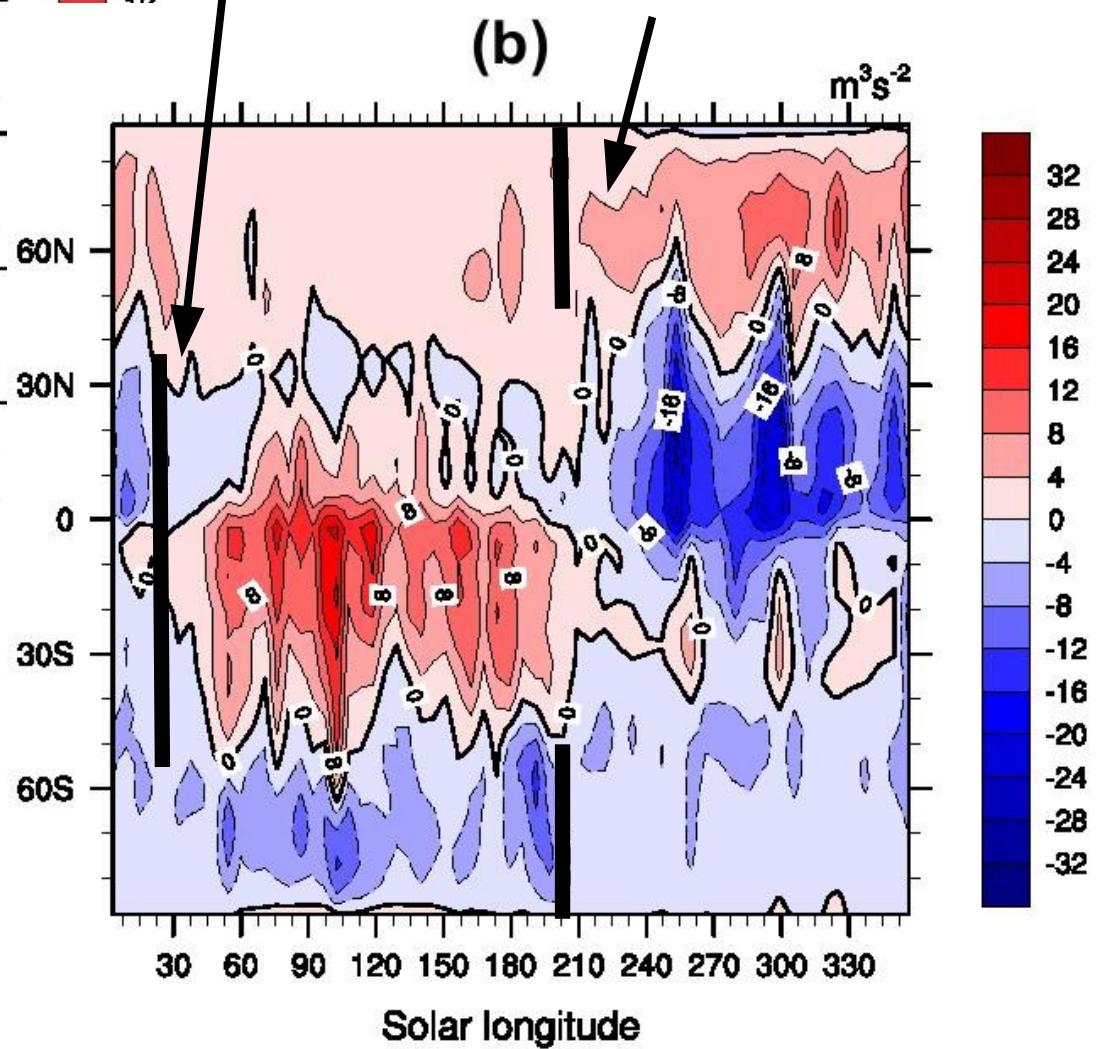


Limited vertical mixing...

Angular momentum transport



Eddies:
Barotropic waves (stratosphere)
Baroclinic waves ? (troposphere)



Interaction with the surface

Boundary layer

Potential temperature

