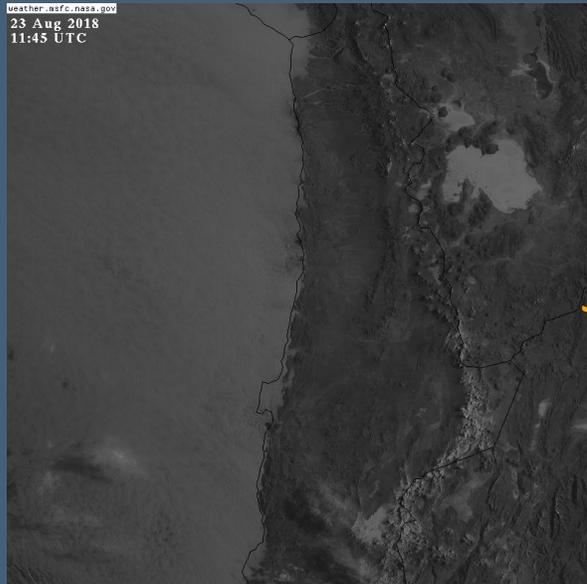


# Water vapor transport into the Atacama desert simulated with a high resolution atmospheric model



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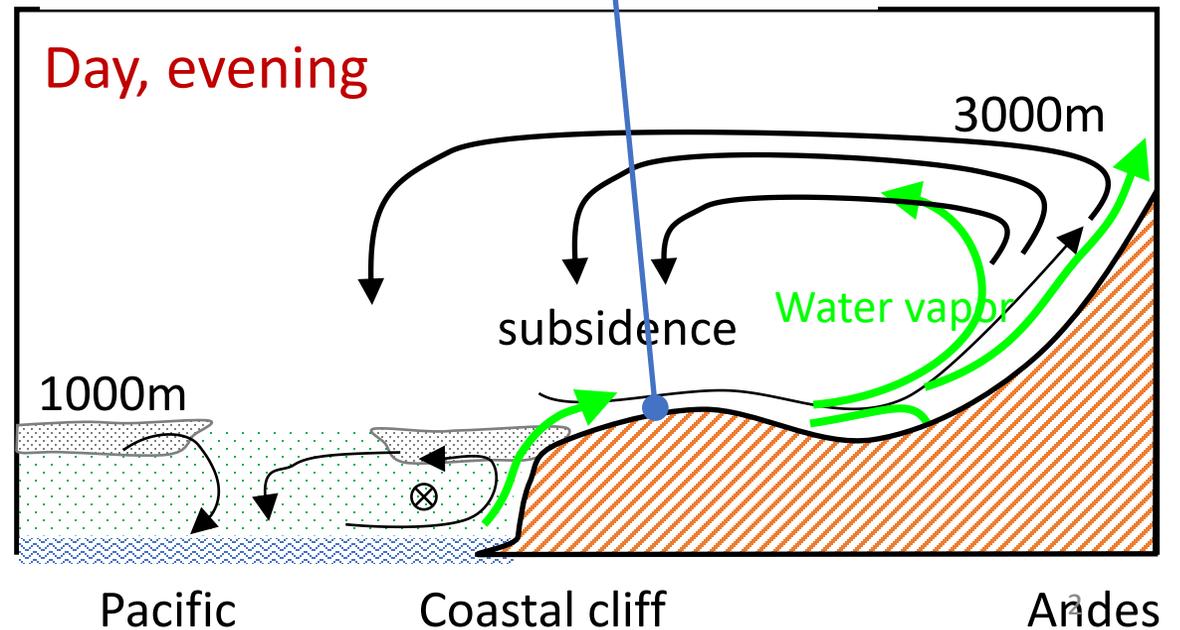
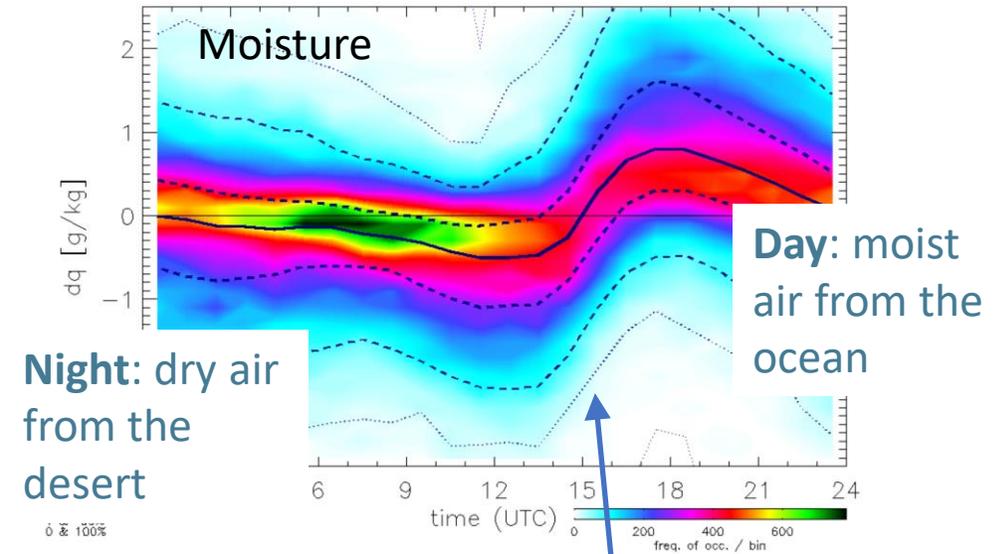
# Water vapor transport by the „Rutllant Cell“?

## Observations

- During daytime strong inland wind at surface, moisture input Atacama
- During night, weak outflow → dry desert air towards the ocean

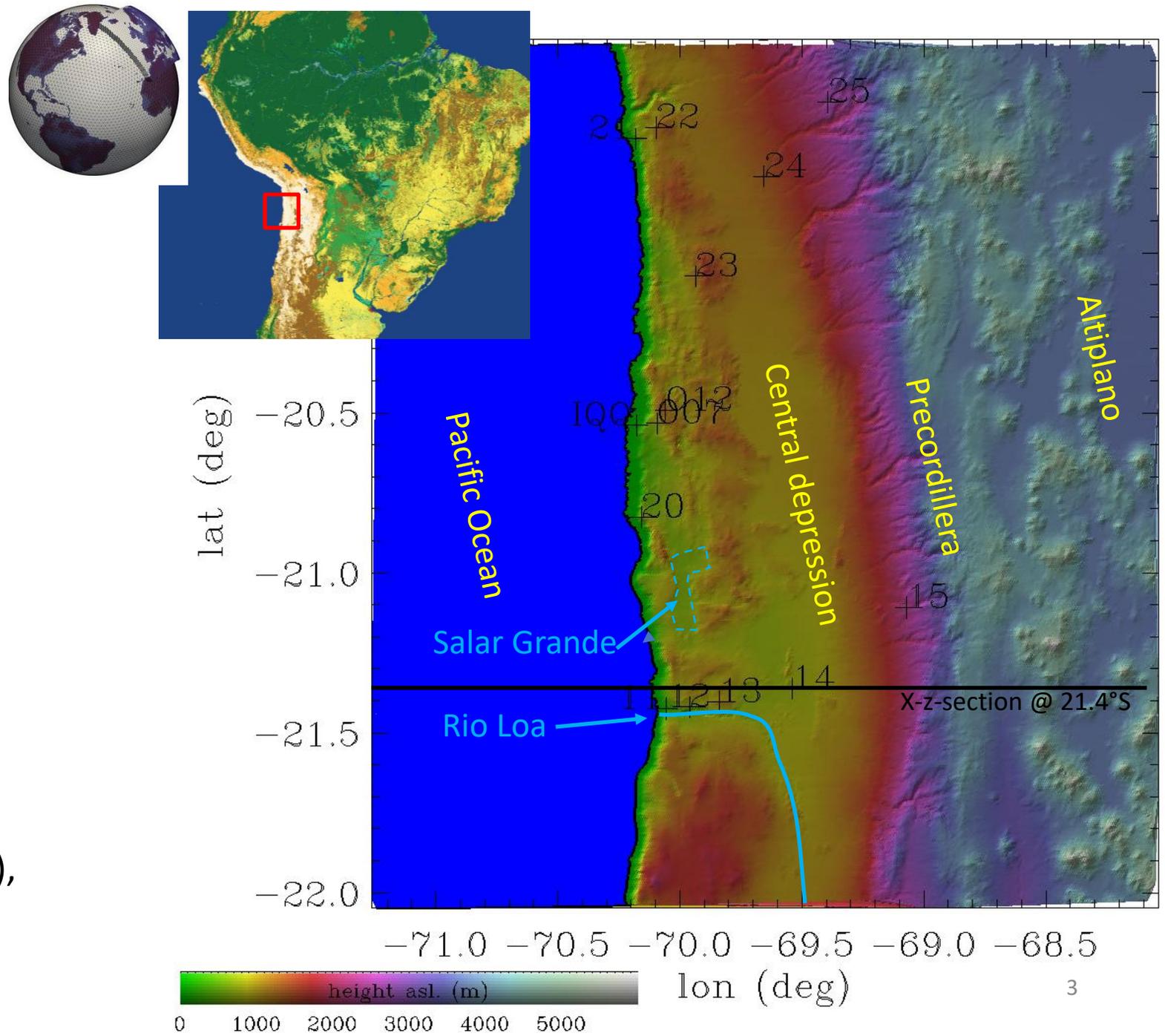
## Issues

- How far does moisture propagate land-inward?
  - Dew or fog deposition: potential 0.2 mm/day to the central depression (not observed)
- Where does the moisture go?



# Model run

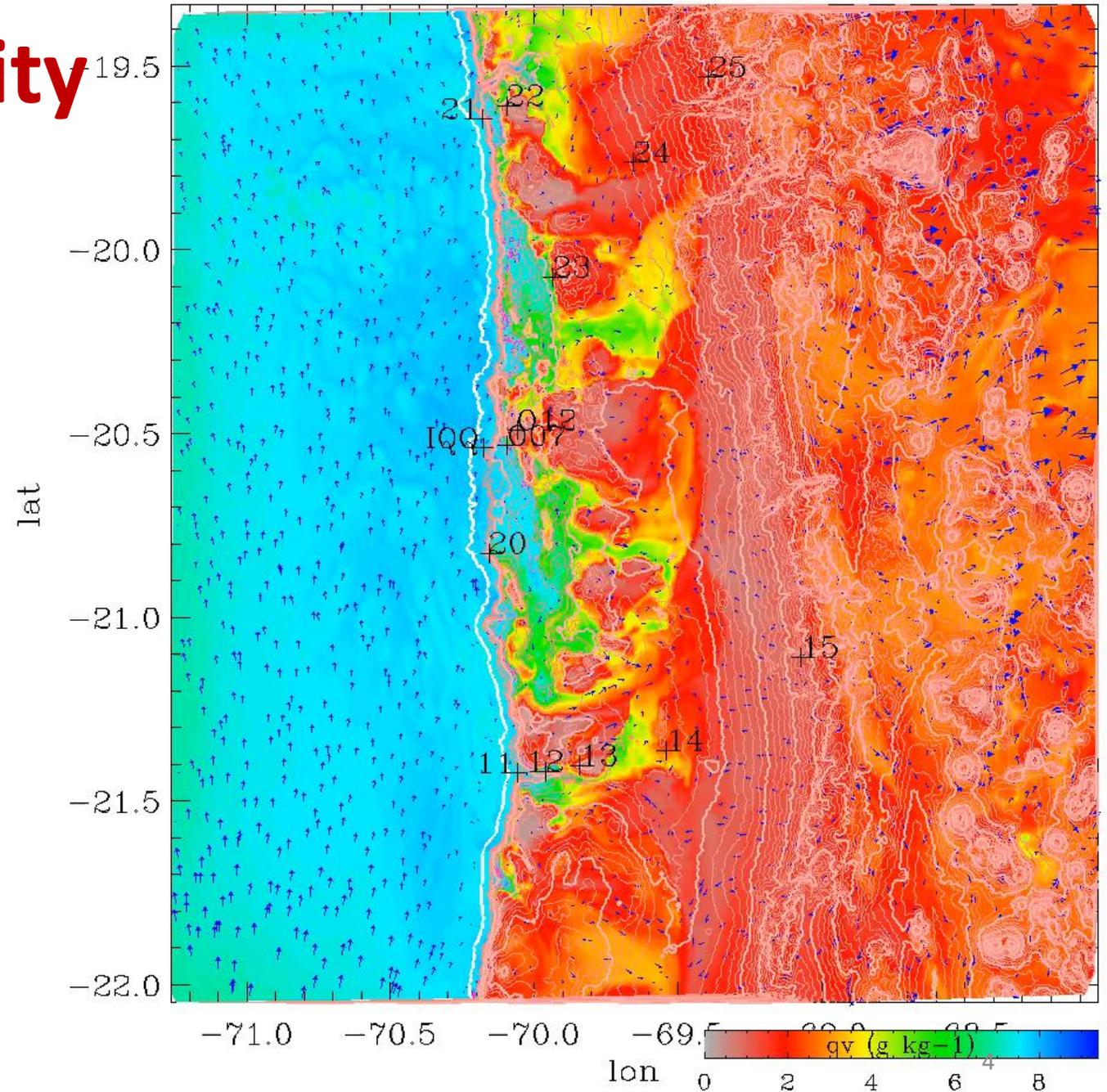
- ICON-LEM of the DWD  
ICOsahedral Nonhydrostatic Modell  
permitting Large scale turbulence
- Two days in winter  
no large scale disturbances  
22+23. Aug. 2018
- ~300x300km
- ~624m horizontal resolution
- 200Lev. up to 20km
- Forcing by ICON-Global
- Domain covers
  - Pacific Ocean
  - coastal mountain range (~1400m asl.),
  - Central depression (~900m),
  - ‚Precordillera‘ (~2000-5800m),
  - Altiplano (~3800m)



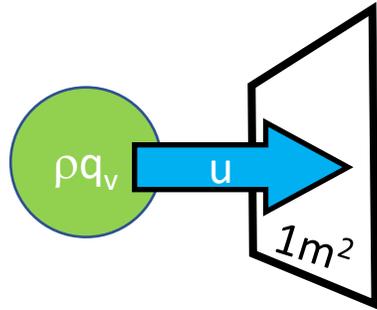
22.08.2018 / 00:00:00

# Surface specific humidity

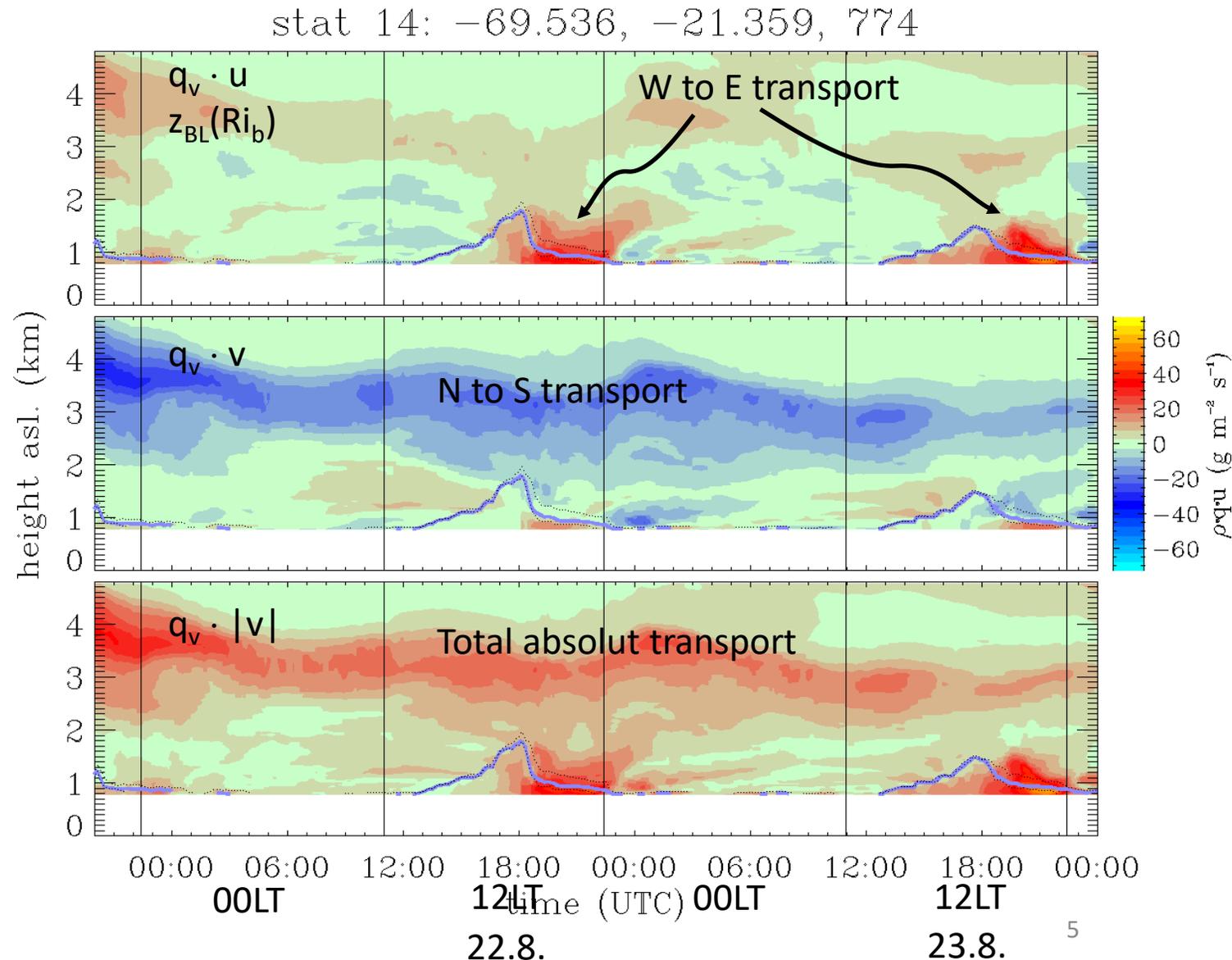
- Moist air from ocean is channelled through valleys in the coastal mountains
- It reaches to the Precordillera but not higher
- It flows back in the evening / night.
- It remains in valleys and basins during night, eventually forms fog.



# moisture transport above station 14

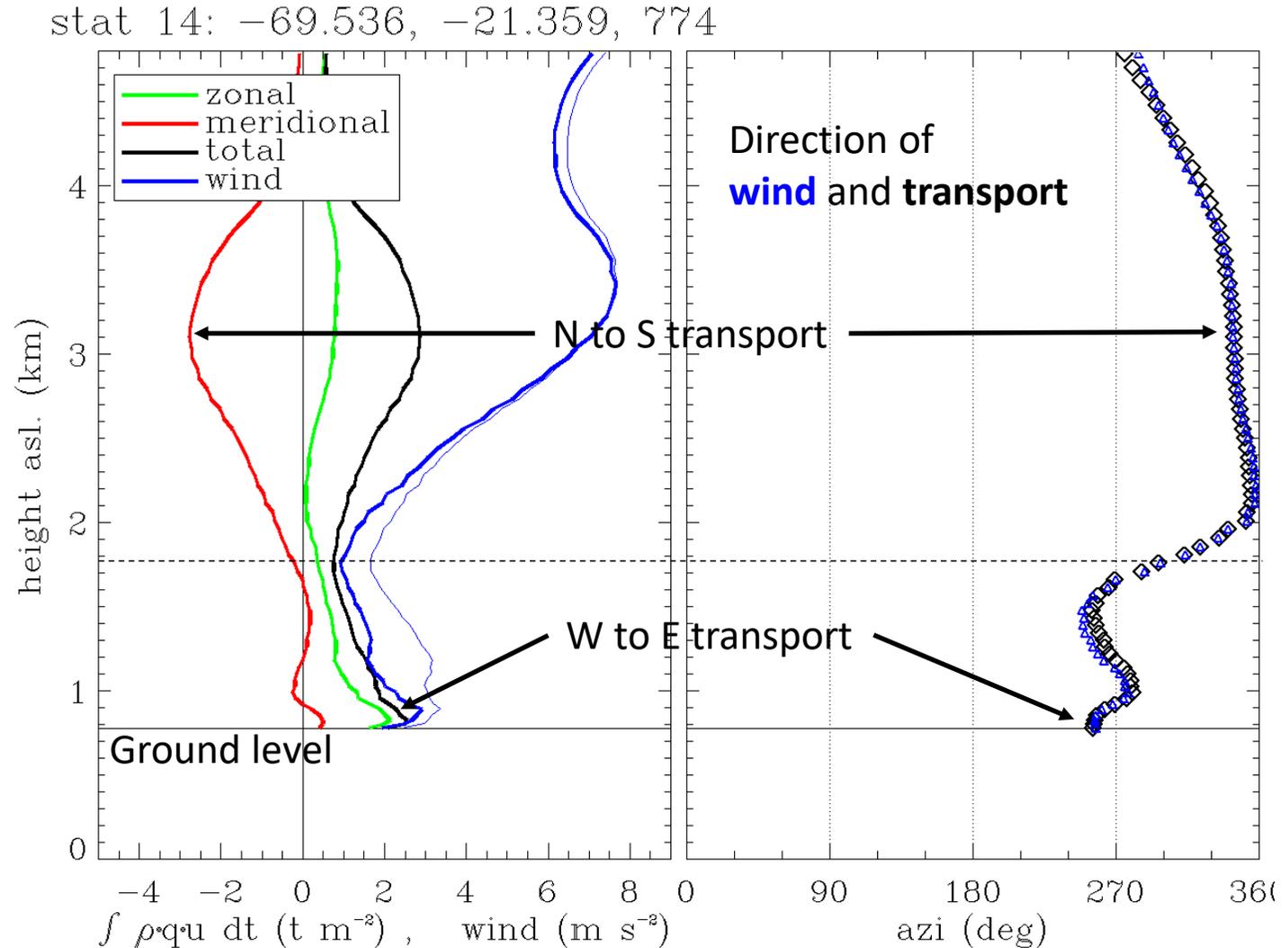


- Product  $\rho \cdot q_v \cdot u$  gives vapor transport in  $\text{g}/(\text{m}^2 \text{ s})$
- W-wind during daytime ( $\sim 9\text{h}$  17-02UTC) below 2km asl is main W-E transport
- N-S transport of moist air at 3-4km asl. is larger (same absolutum but layer thicker and whole time present)

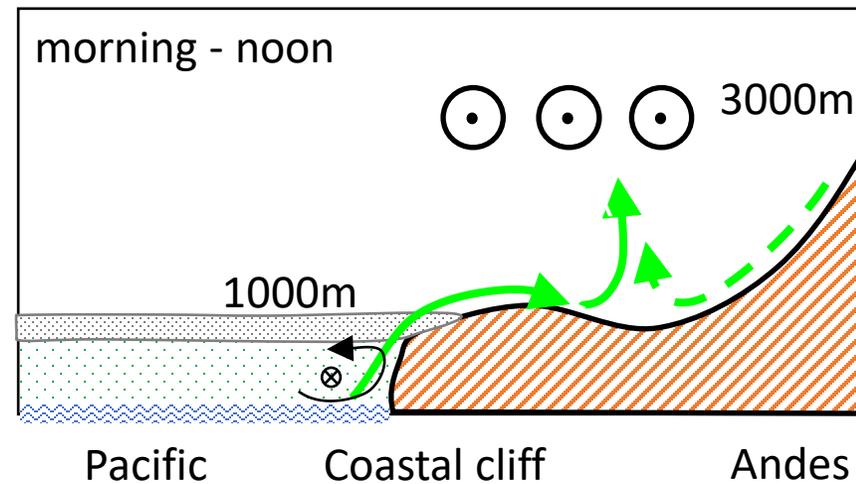
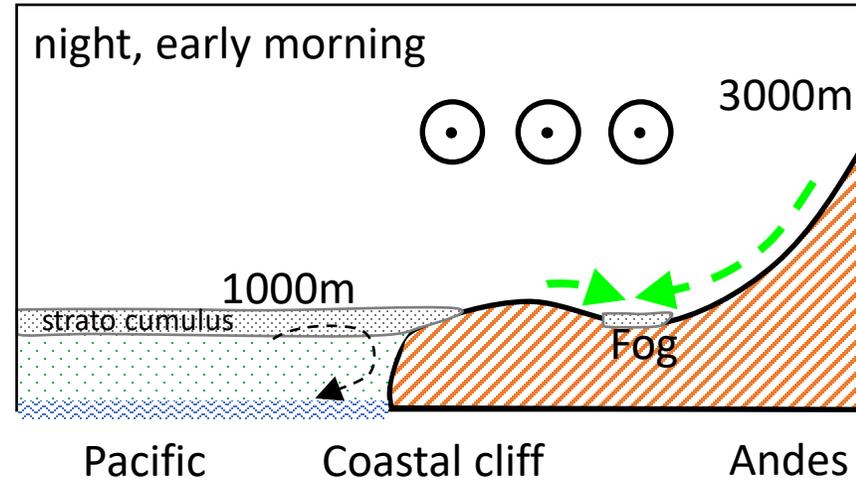
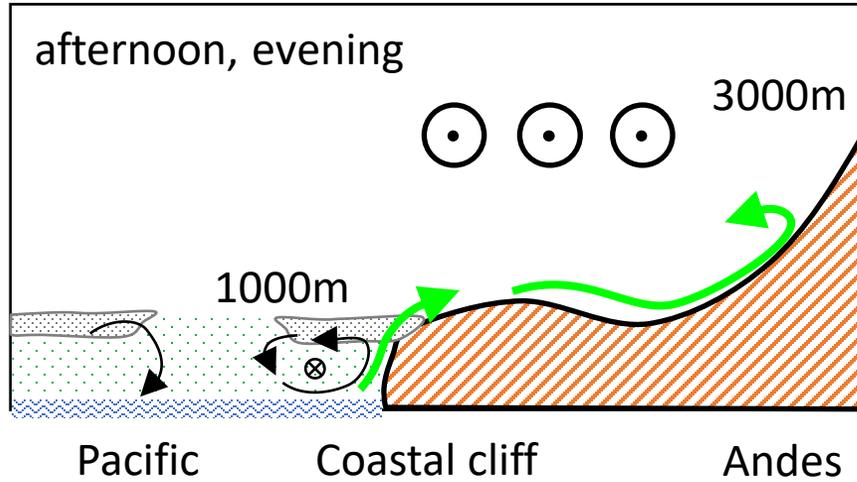


# Total vapor transport over both days

- Transport in  $t/m^2$  as function of height
- Transport from W to E up to 1km agnd.
- Above 1km transport from N to S with maximum in 3.2km asl.
- More moisture transport to the south in upper layer than to east in lower layer (area under curves is larger)
- => not a continuous transport

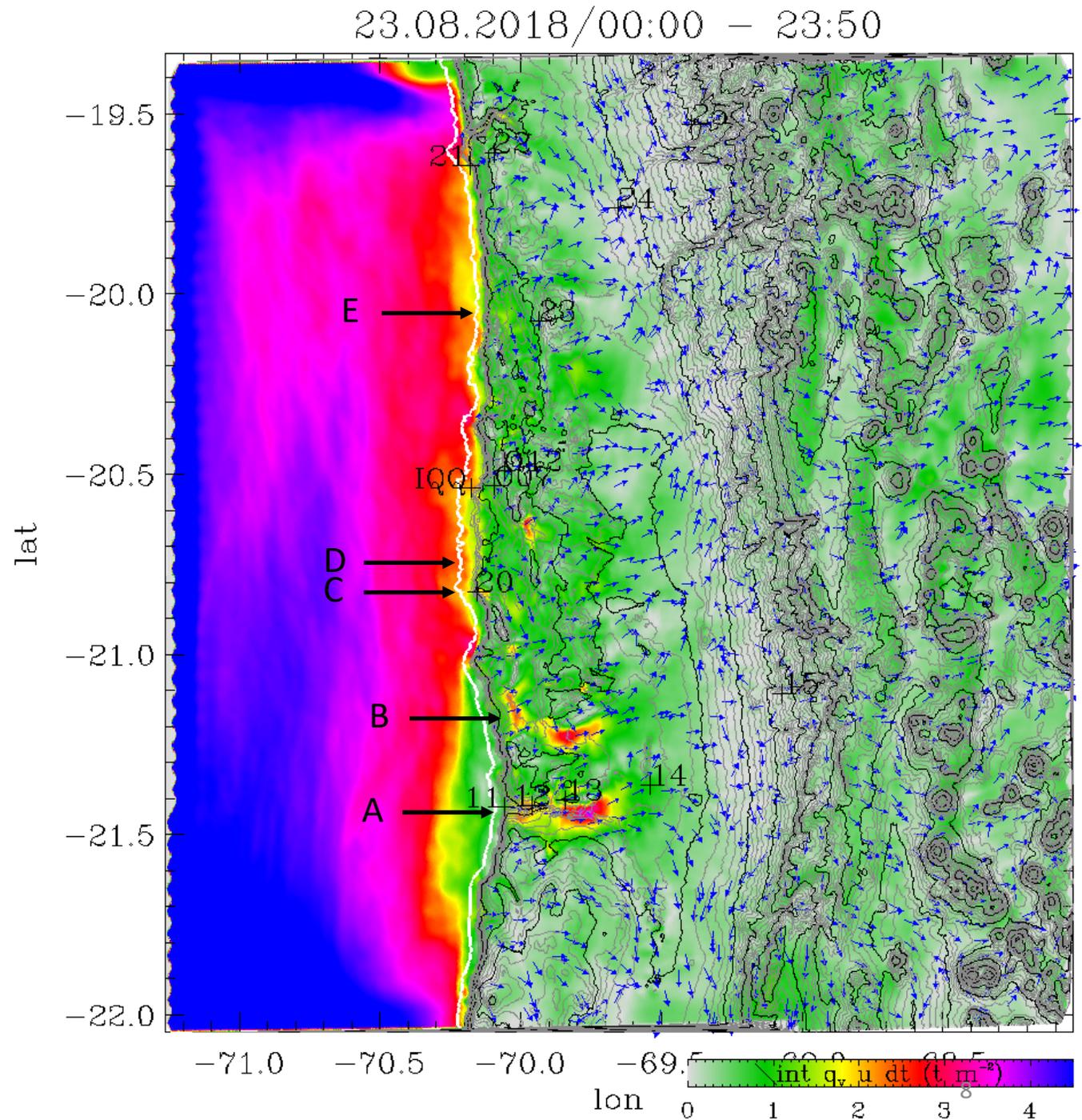


# Circulation scheme



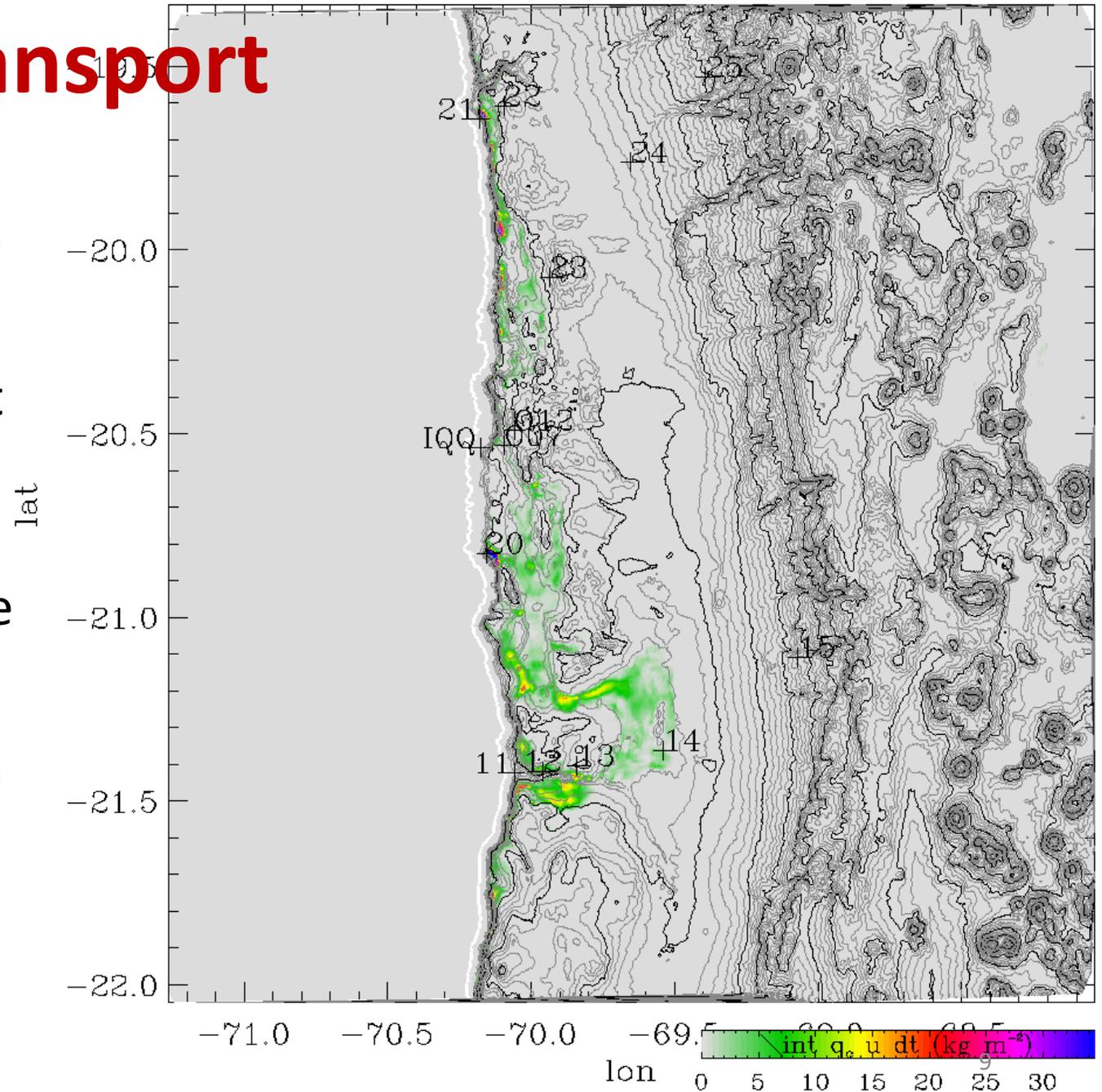
# water vapor pathways

- Total transport of water vapor in  $t/m^2$  over one day (color shading)
- Direction of transport (arrows)
- Valleys and basins provide pathways through the coastal mountains connecting the central depression to ocean air, e.g.:
  - a. Rio Loa mound – Central depression
  - b. Punta Chomache – Salar Grande – Salar de Llamara
  - c. Alto Patache – Salar Grande – Salar de Llamara – Central depression
  - d. Alto-Patache – Oficina Victoria – Central depression
  - e. Caleta Buena – Pampa de la Perdiz – Pozo Almonte – Central depression...



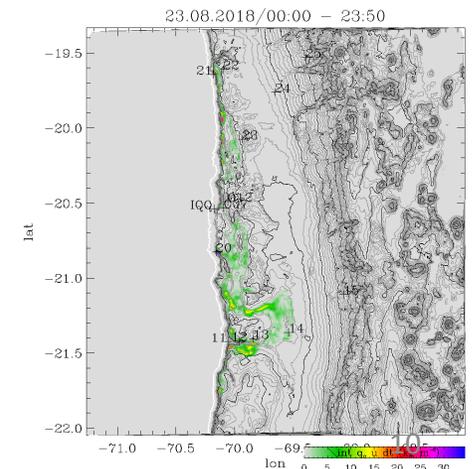
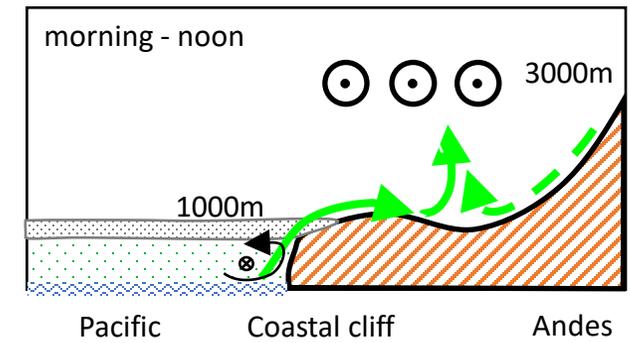
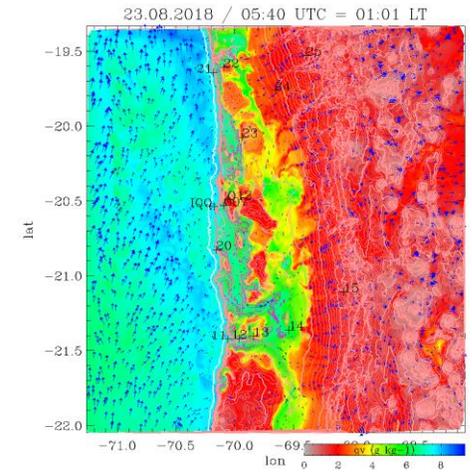
# Fog => Liquid Water Transport

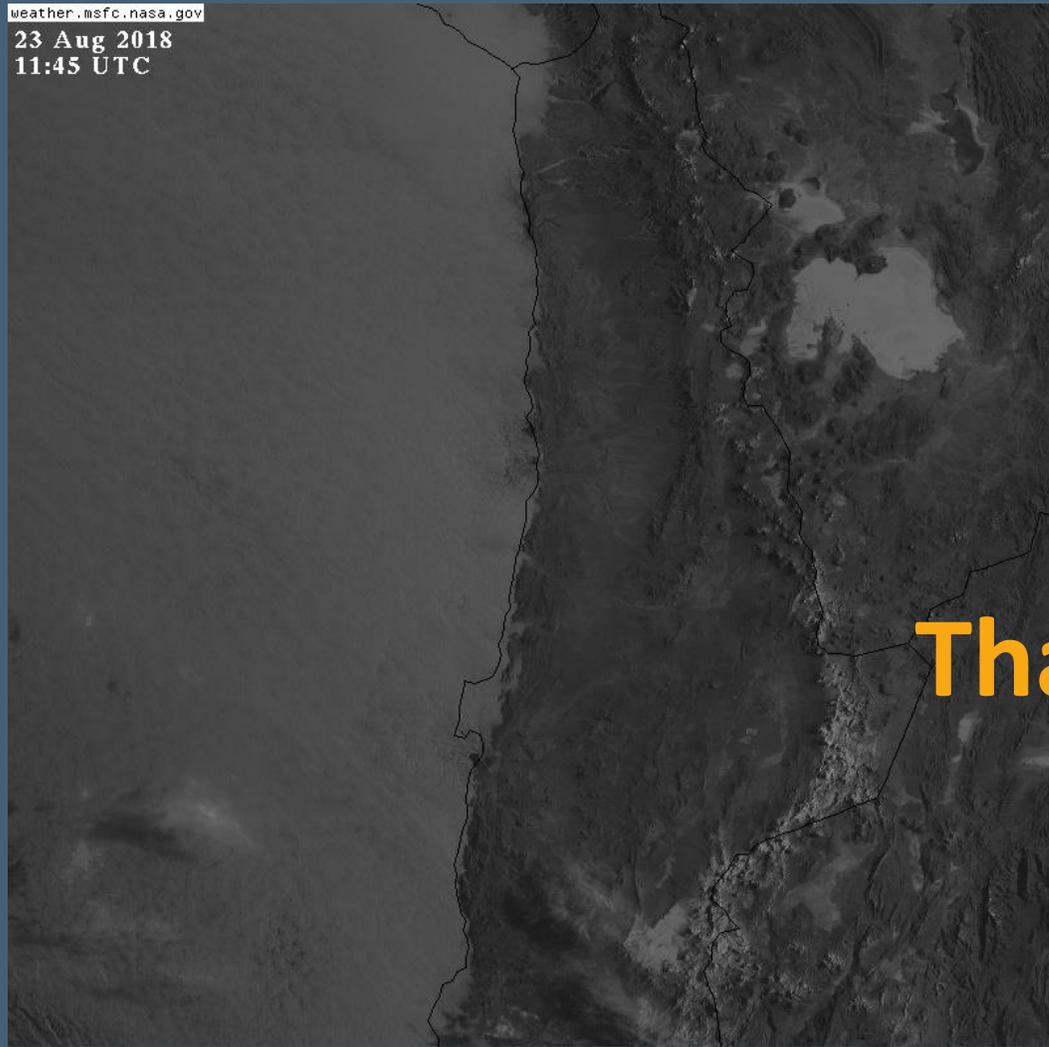
- During fog the air transports droplets of liquid water.
- When the flow encompasses an obstacle the air can move around but not all droplets can follow and would deposit on that surface.
- A theoretical fog collector with 100% efficiency, would have collected these amounts of water.
- Additionally turbulence can deposit a part ( $\sim 1/100$ ) of this water directly to the surface => in the order of 0.15mm for this (model) day (estimate based on Taylor (et al.) 2021 a,b)



# Summary and conclusions:

- Water vapor transport into the Atacama is a rather complex interplay of back and forth movements and not a continuous flow.
- Water vapor is injected into the free troposphere (FT) at ,sea breeze front' and ,slope wind front.'
- Vapor transport at the W-side of the Andes at 3km persistent over whole year.
- During night form pools of moist air in basins and valleys. They may eventually lead to formation of fog.
- A rough estimate of fog deposition by turbulence gives in maximum values in the order of 0.15mm/fog event





Thank you!

