

# OH in the tropical upper troposphere and its relationships to solar radiation and reactive nitrogen

Ru-Shan Gao, Karen Rosenlof, David Fahey,  
Paul Wennberg, Eric Hintsa, and Tom Hanisco

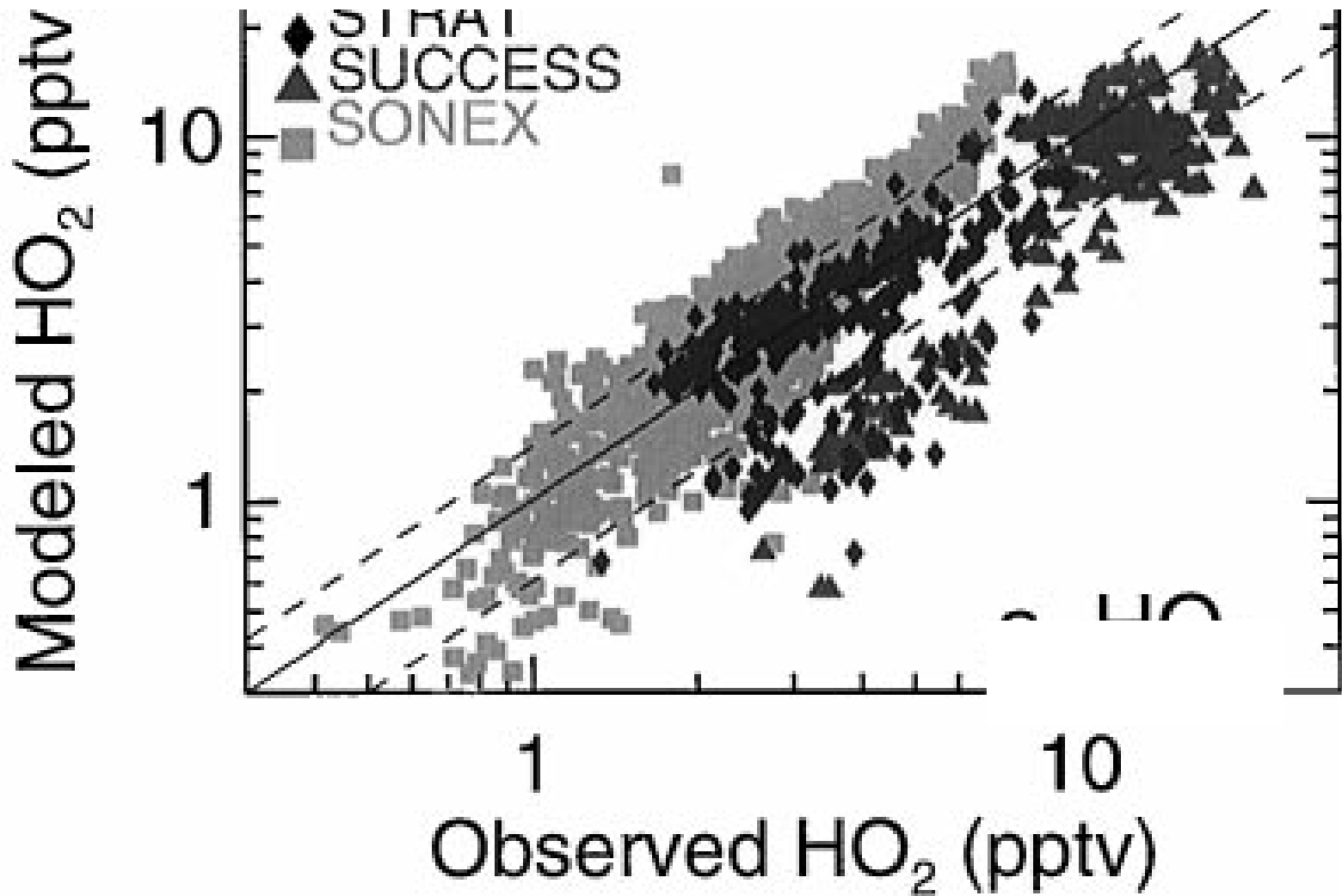
and

the STRAT team

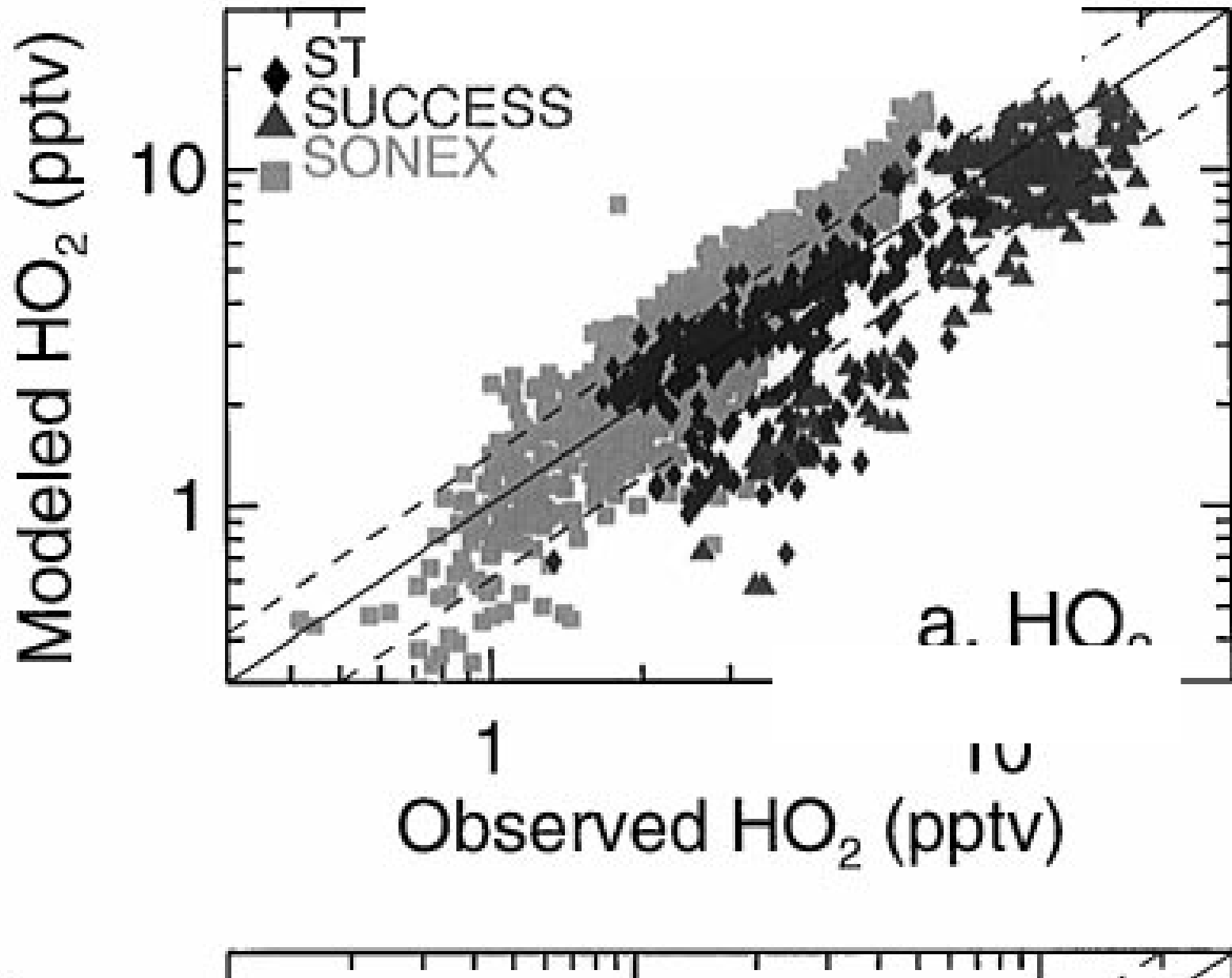
# OH in the tropical upper troposphere (TUT)

- Low concentration but important for pollutant degradation
- Direct source:  $O_3 + h\nu \rightarrow O_2 + O(^1D)$  (R1)  
 $O(^1D) + H_2O \rightarrow 2OH$  (R2)
- $O_3$ , low  $H_2O$  conditions in the TUT  $\rightarrow$  Low OH?
  - Kley et al., Science 1996
- Tightly coupled to  $HO_2$ 
  - Easier to model  $HO_2/OH$  than OH

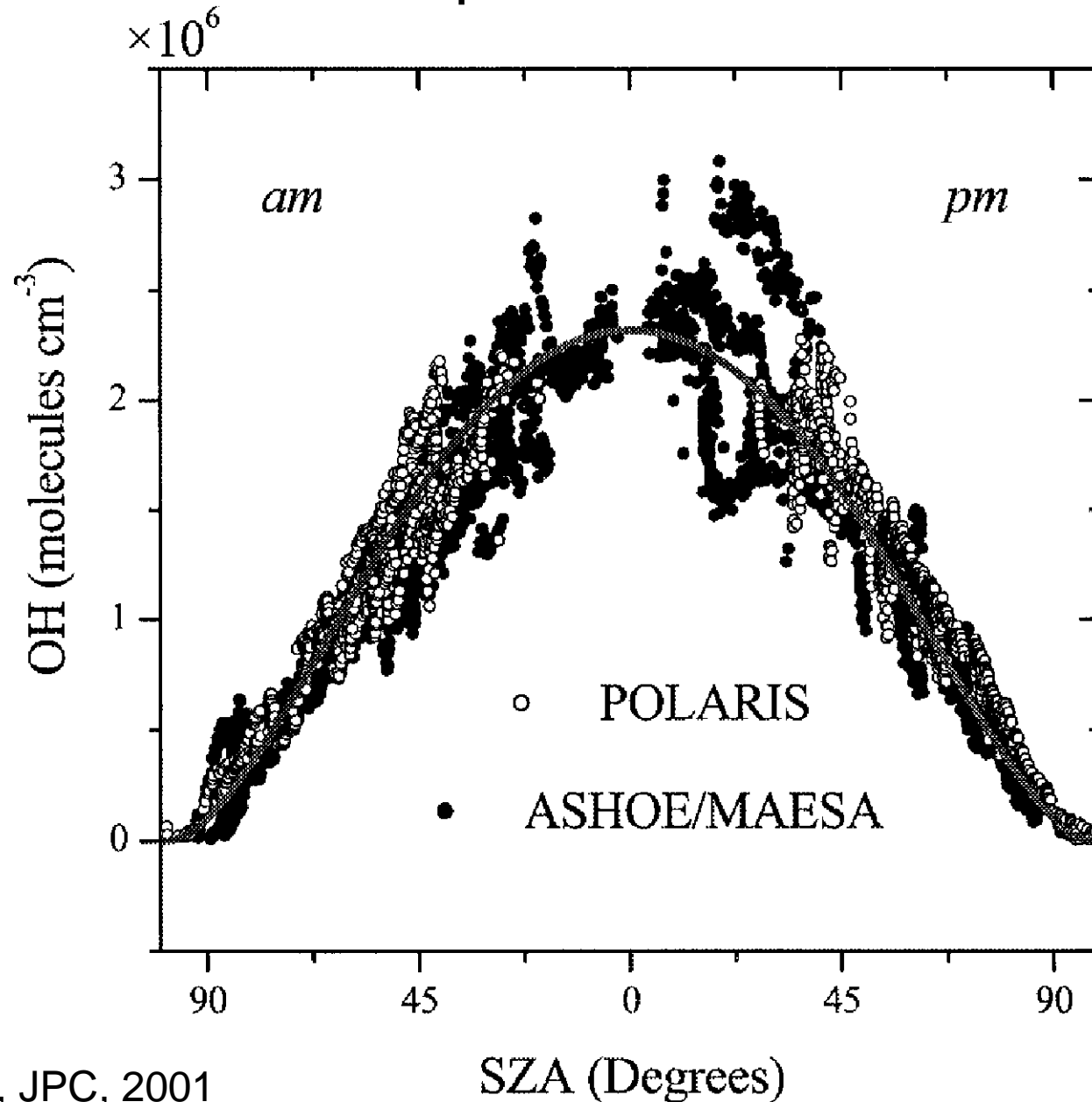
# Box model results, Jaeglé et al., AE 2000



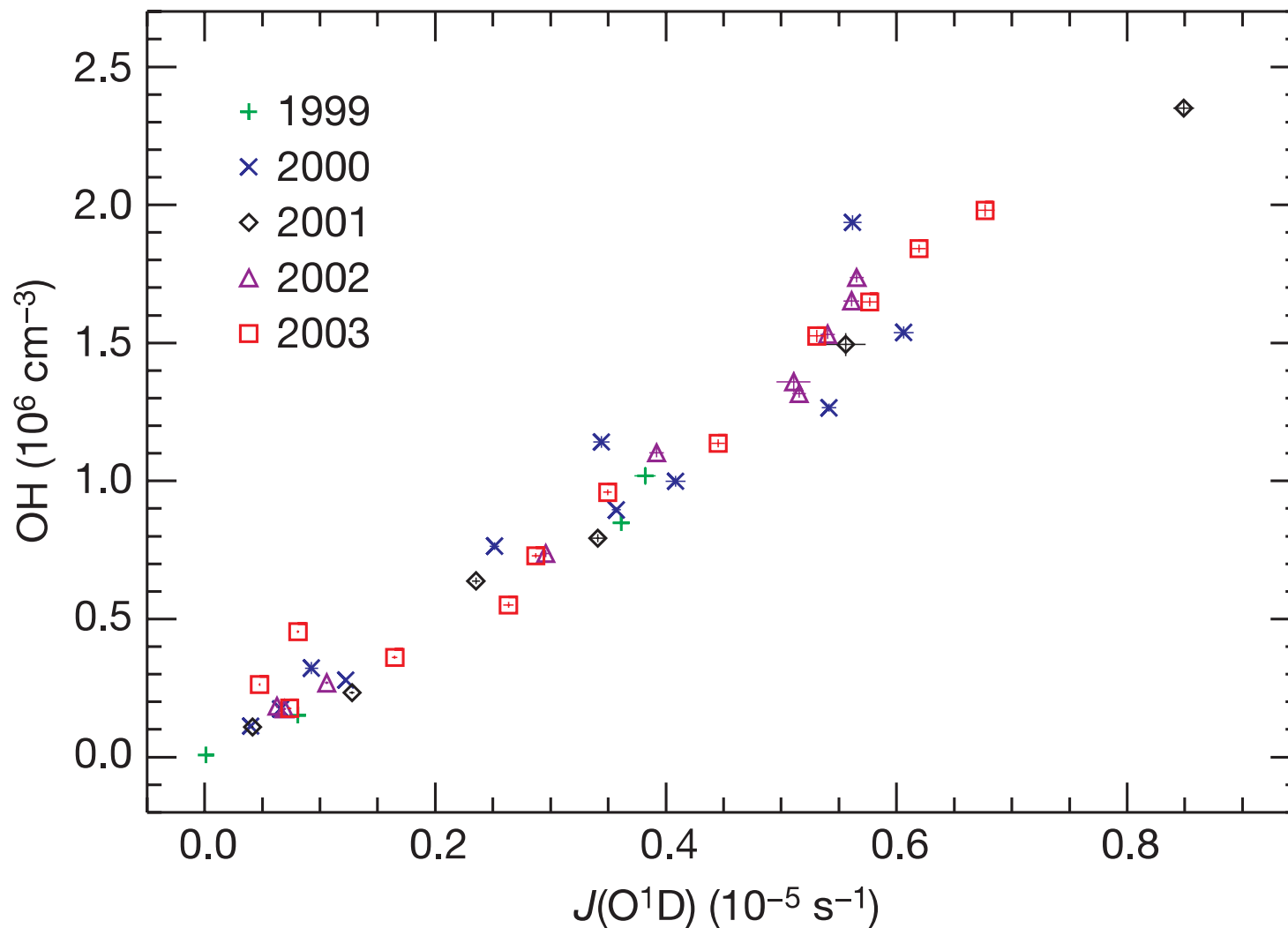
# Box model results, Jaeglé et al., AE 2000



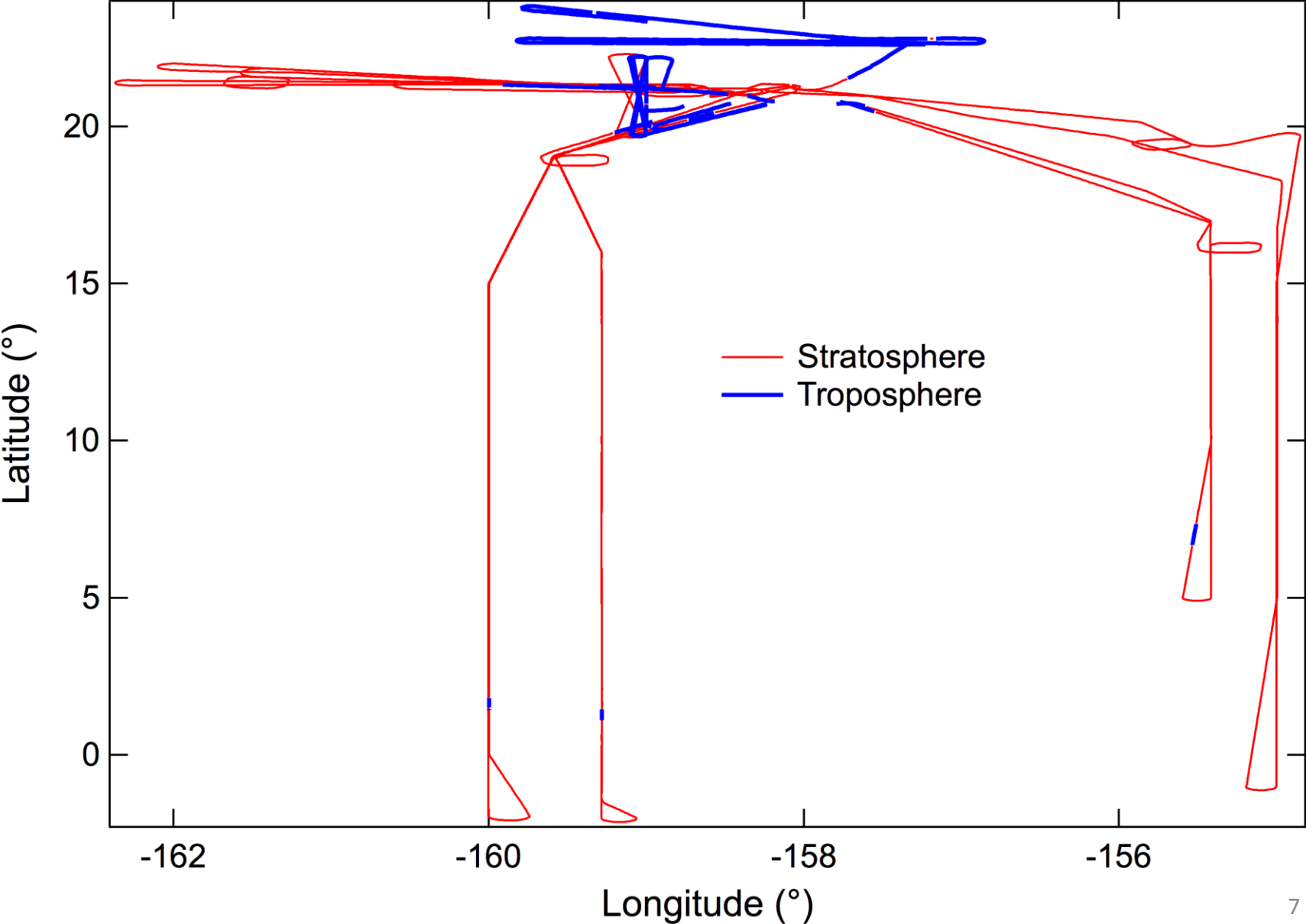
# OH in the lower stratosphere correlates with SZA

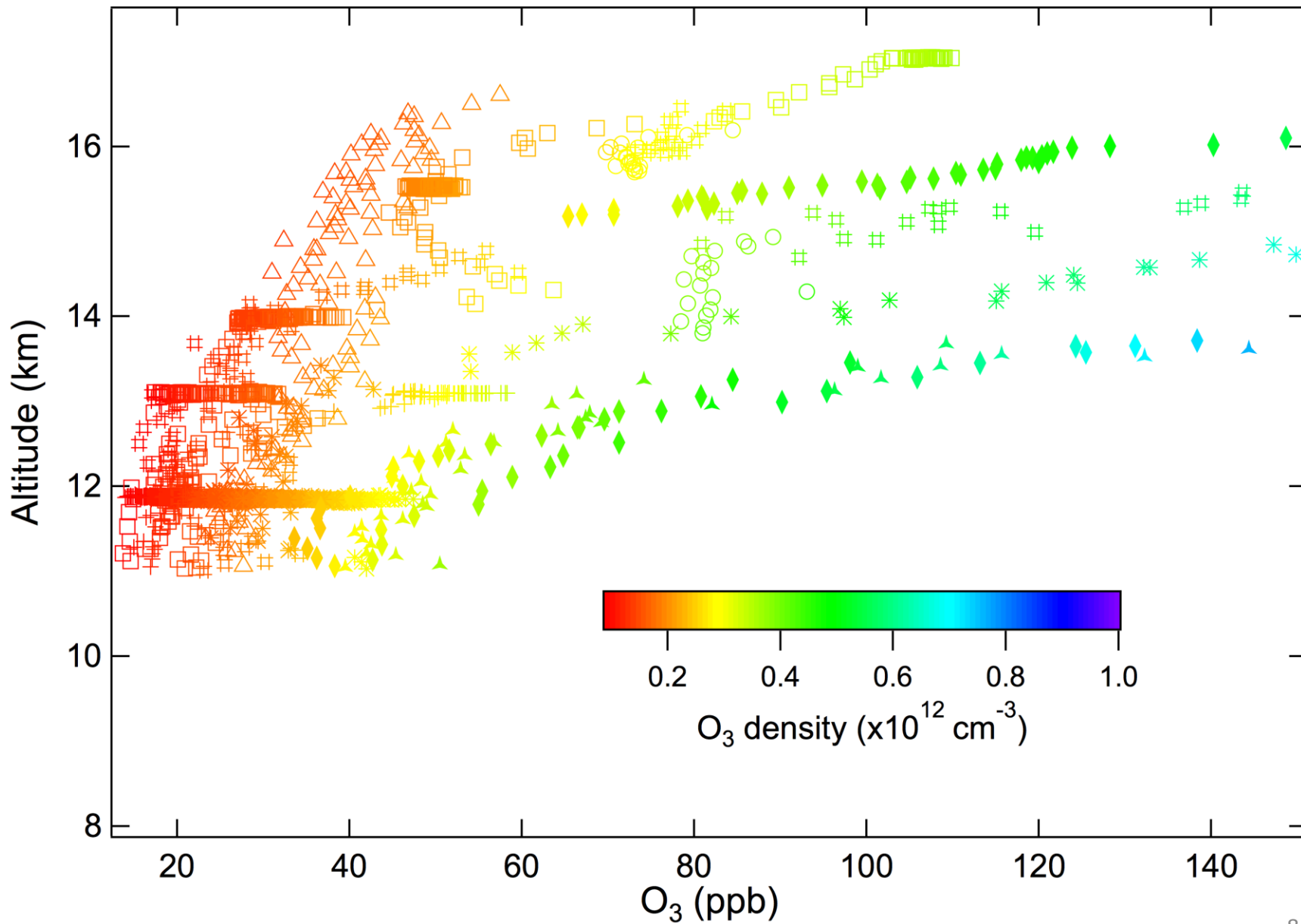


# OH in the lower troposphere correlates with $J(^1D)$

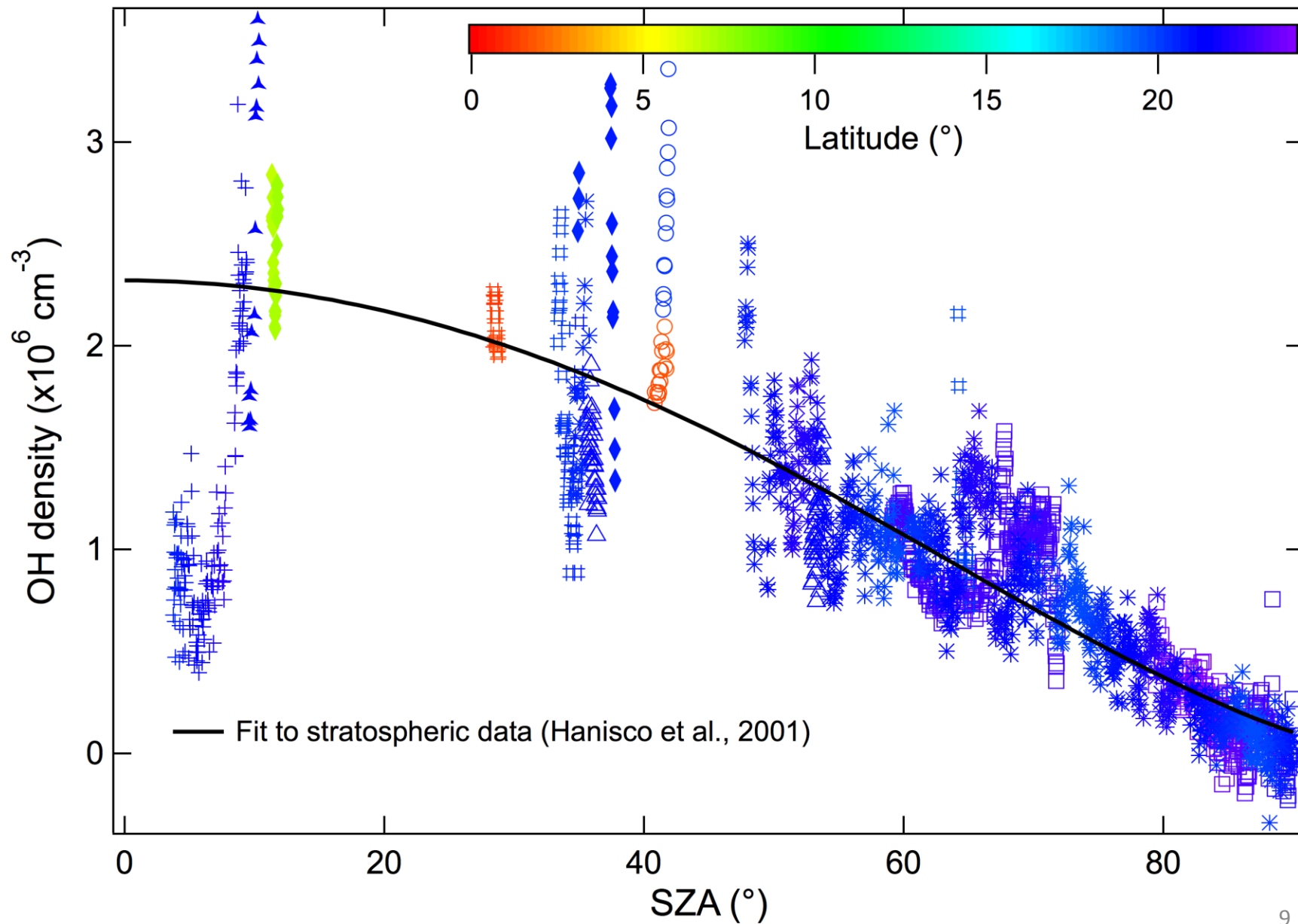


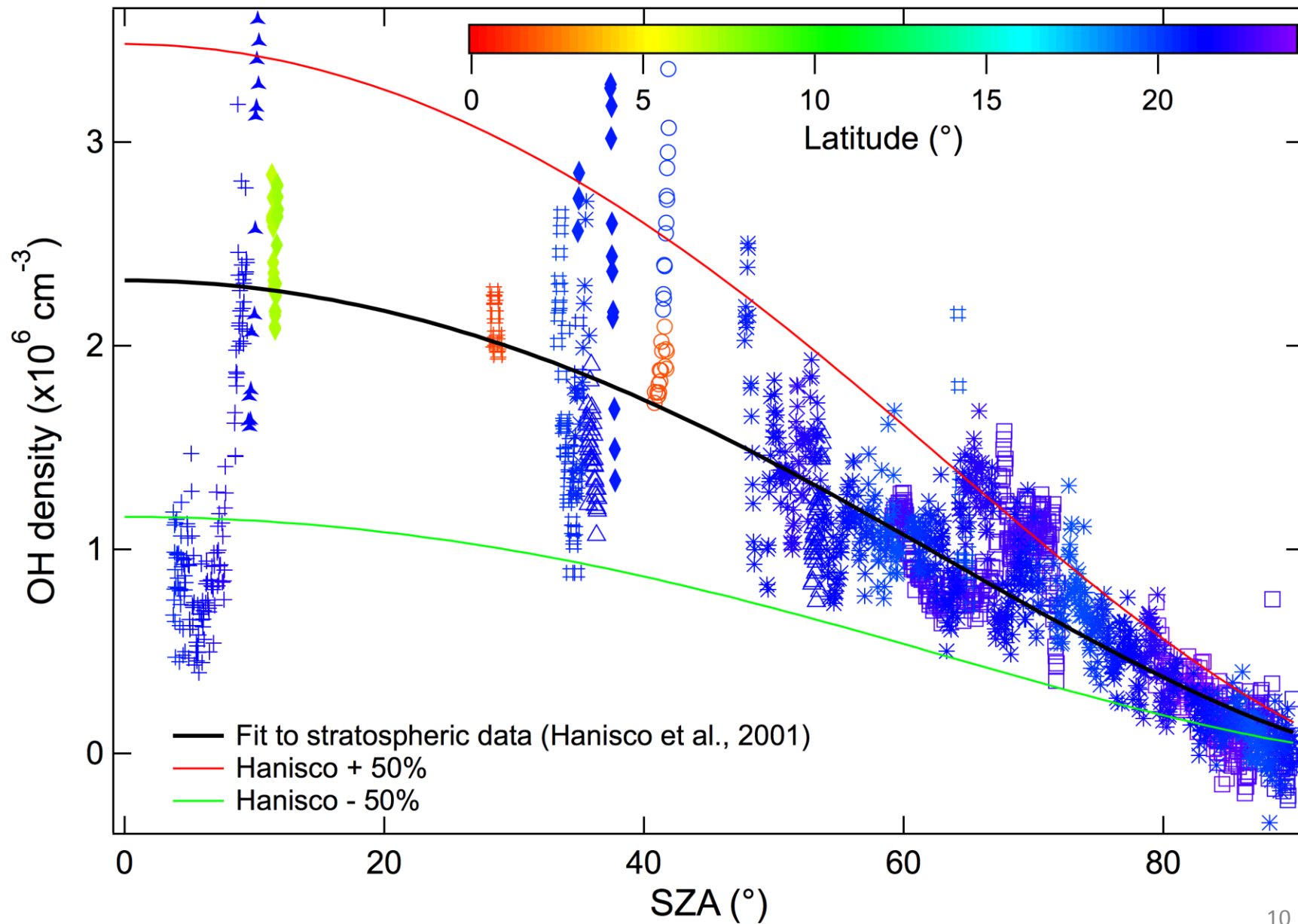
# Measurements in TUT during STRAT

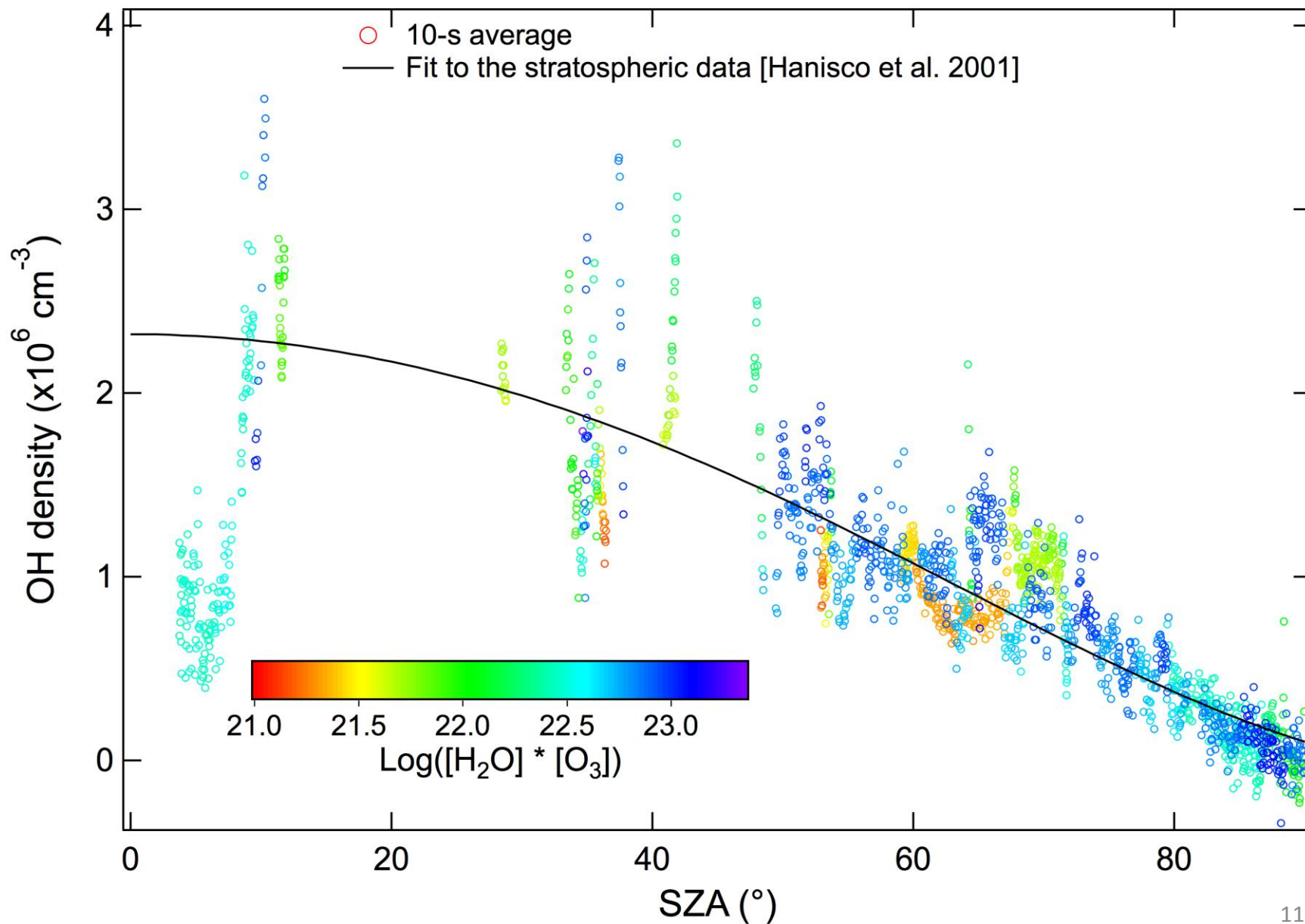
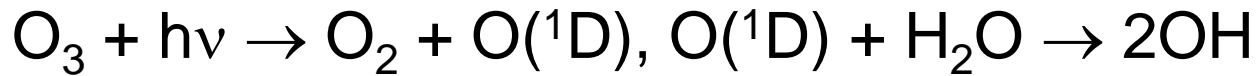


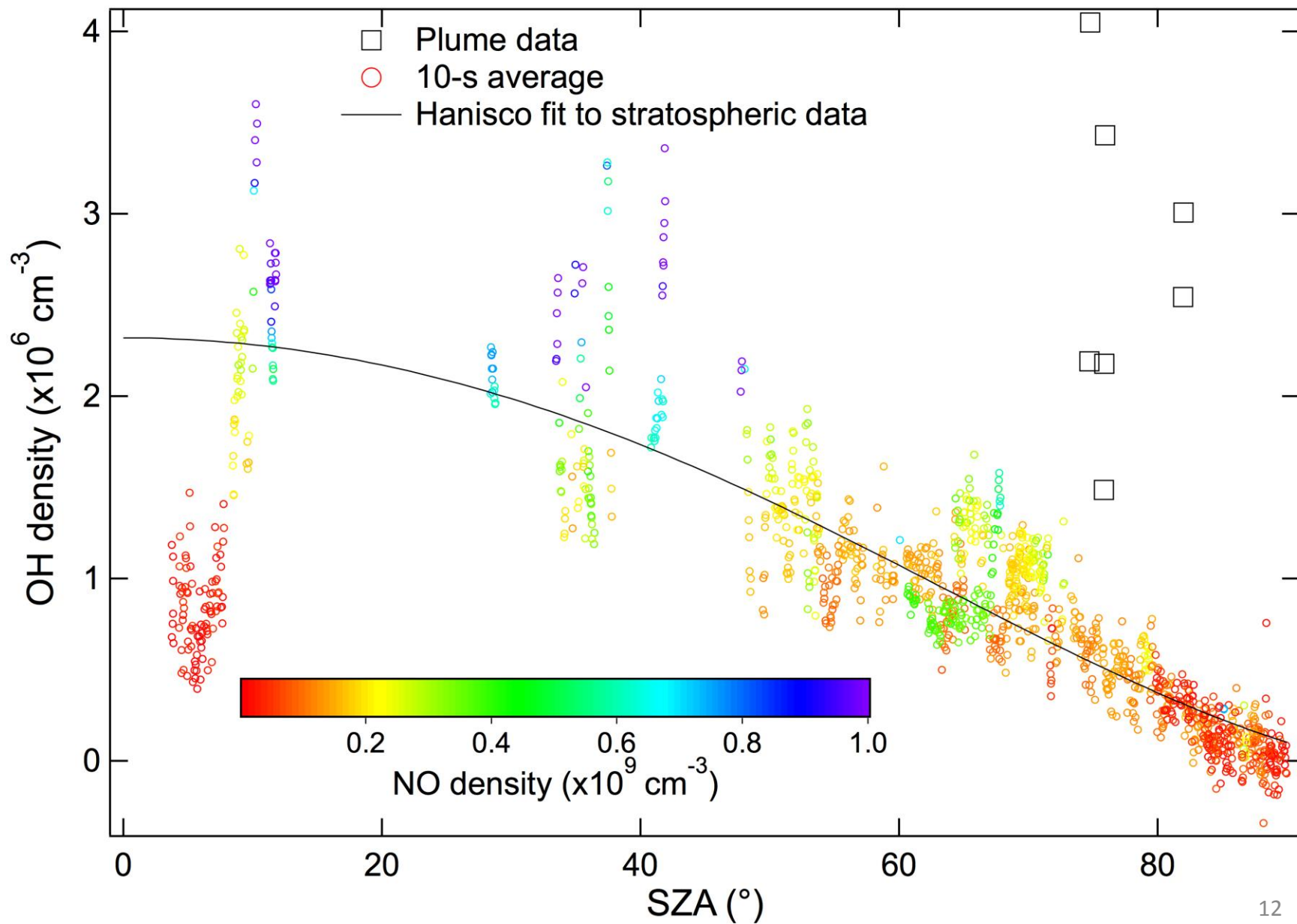






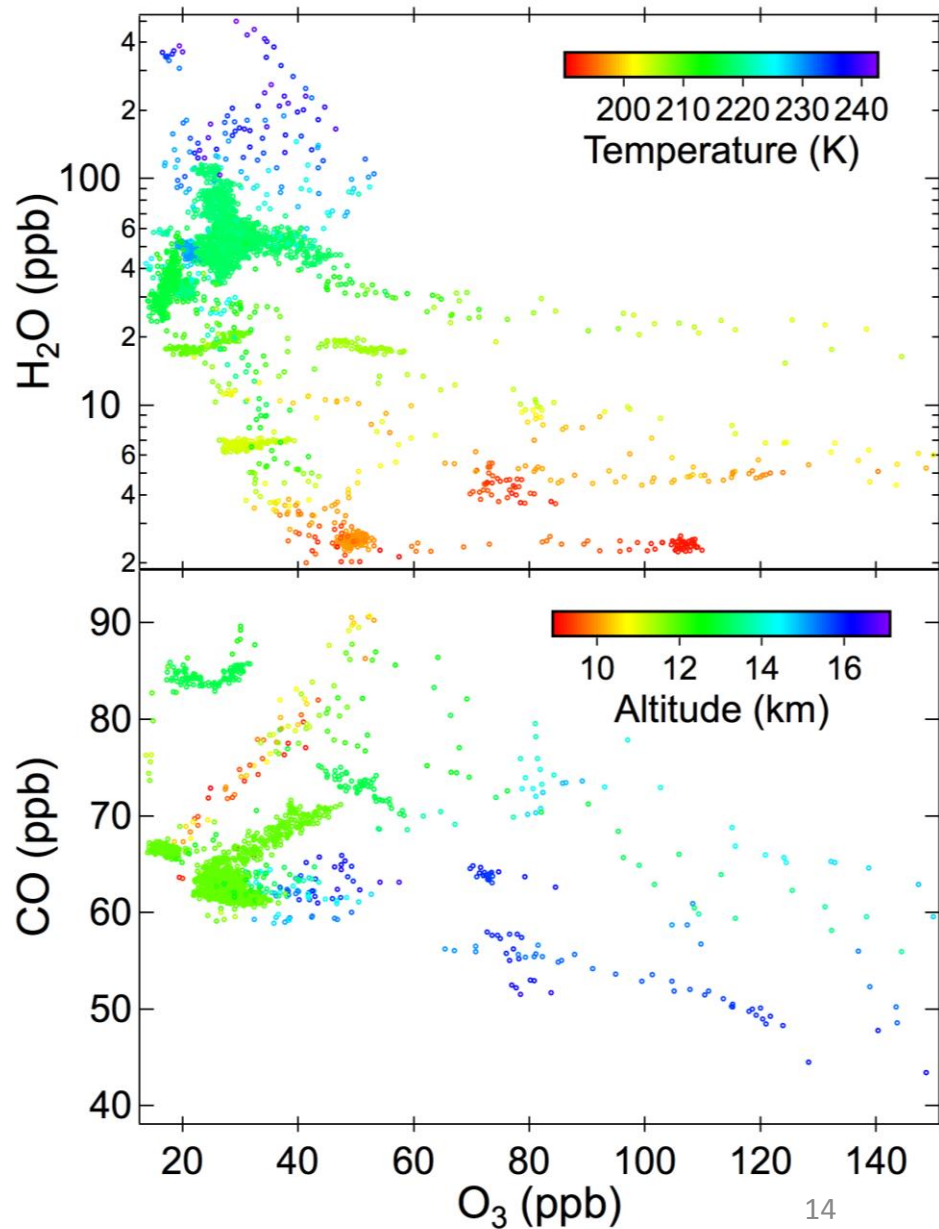
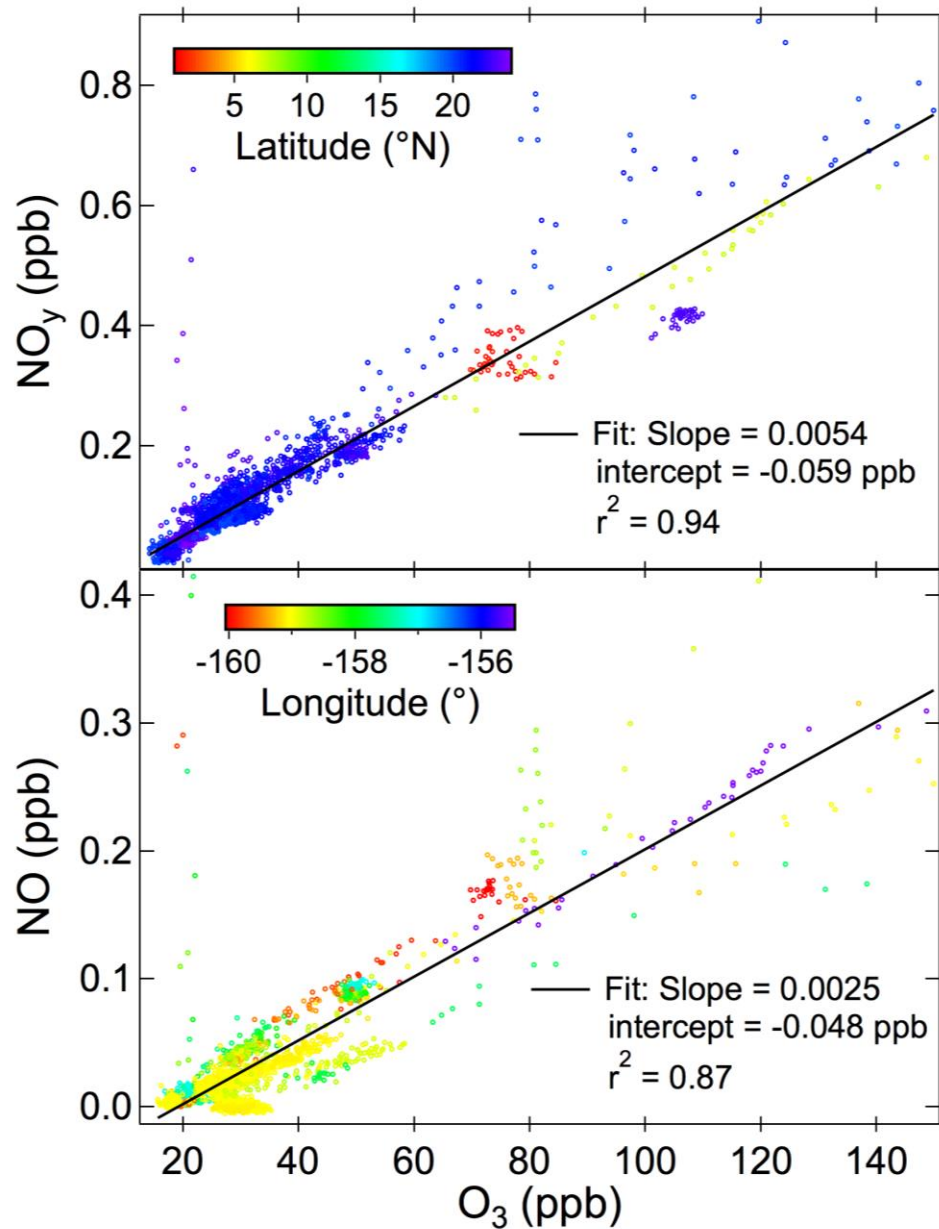




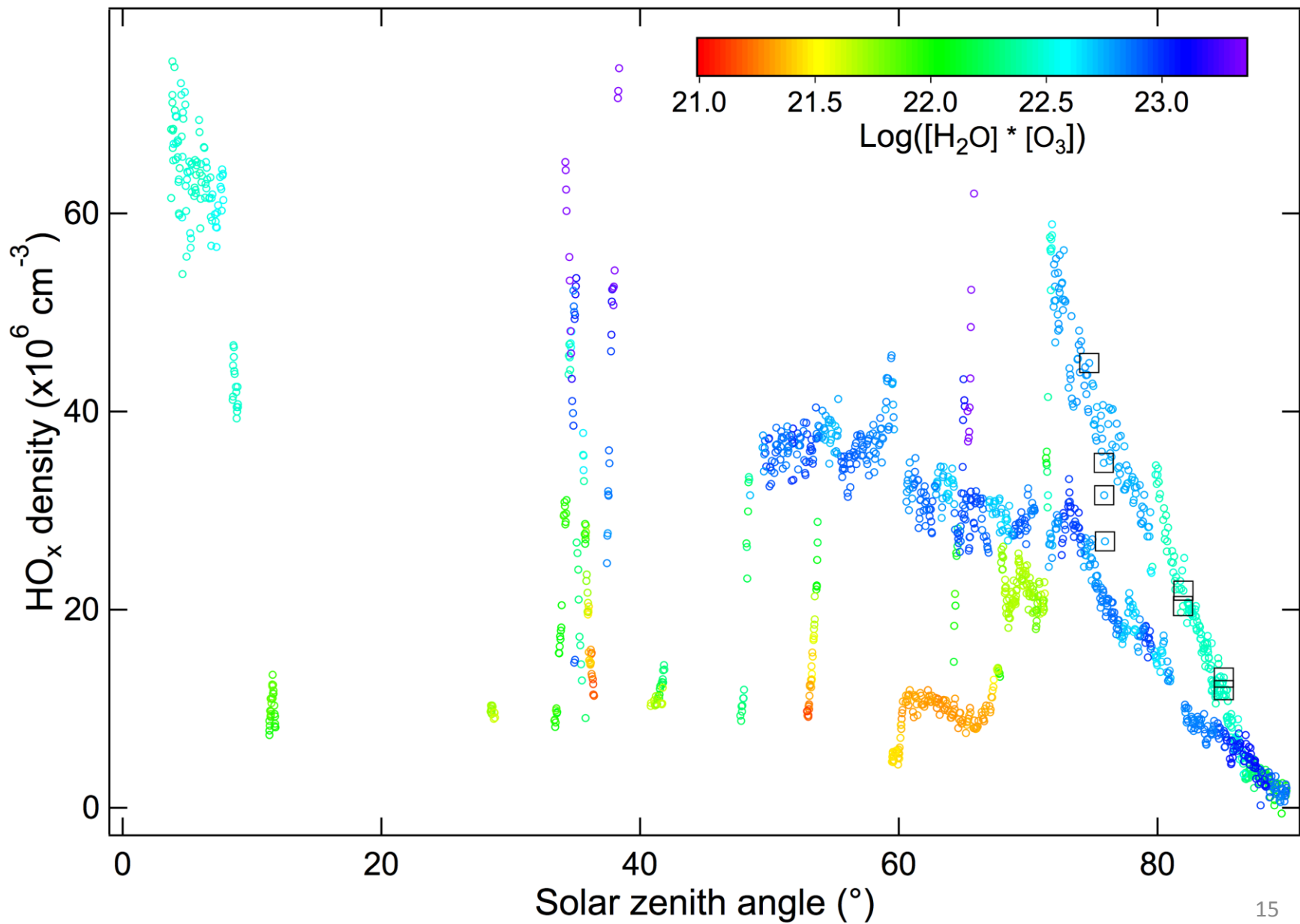


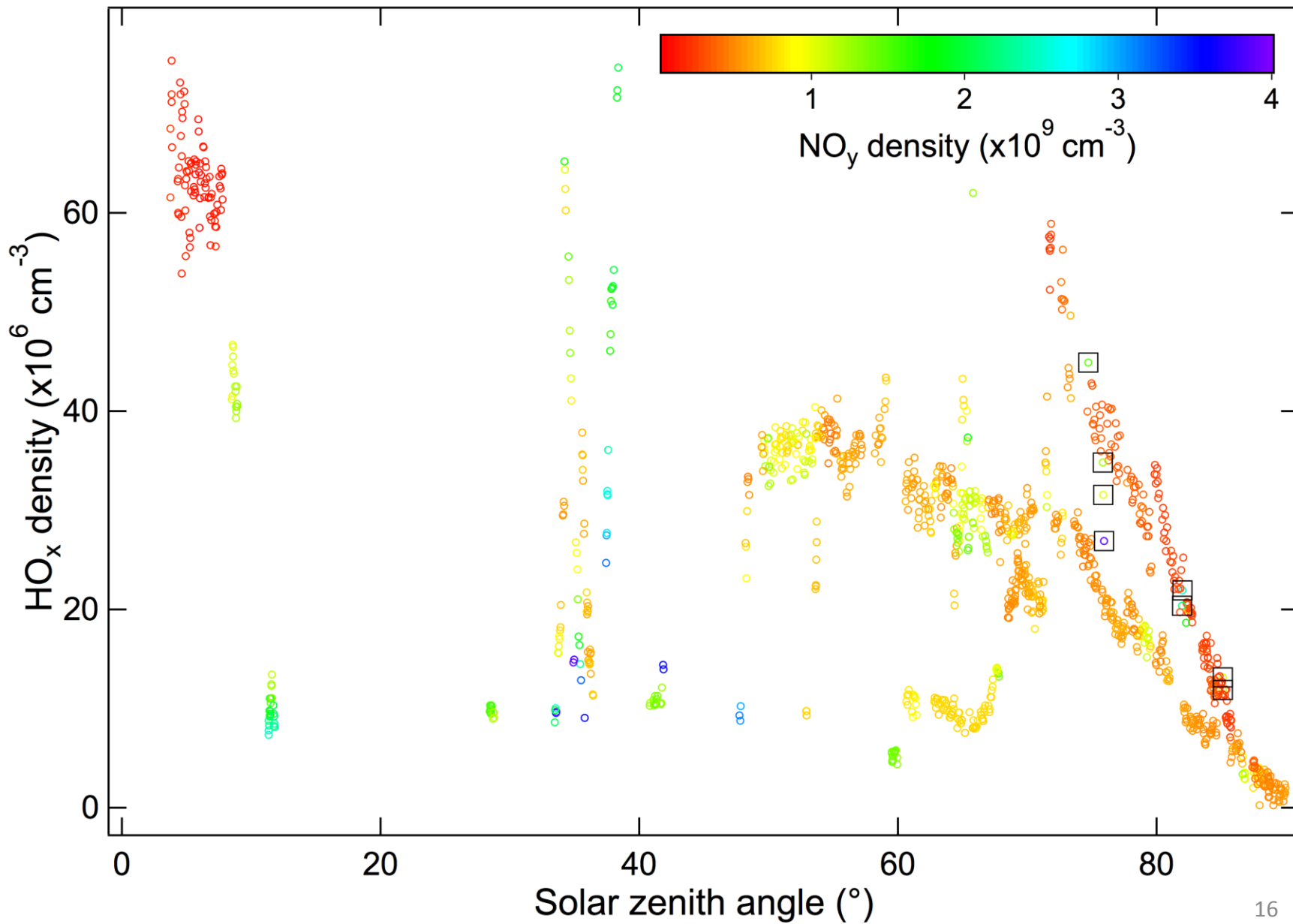
- The cycling time between OH and HO<sub>2</sub> is much shorter than the lifetime of HO<sub>x</sub>
- OH  $\leftrightarrow$  HO<sub>2</sub>:
  - OH + CO (+ O<sub>2</sub>) → HO<sub>2</sub> + CO<sub>2</sub> (R3)
  - HO<sub>2</sub> + NO → OH + NO<sub>2</sub> (R4)
- OH is controlled by R3, R4, and HO<sub>x</sub> sources and sinks
- O<sub>3</sub>+H<sub>2</sub>O is not the dominant HO<sub>x</sub> source
- Main HO<sub>x</sub> sink:
  - NO<sub>y</sub> (high NO<sub>y</sub>) or HO<sub>x</sub> self reactions (low NO<sub>y</sub>)

# Measurements in TUT during STRAT











## Concluding remarks:

- 1) A simple functional description for OH in the tropical upper troposphere (TUT) is accurate to  $\pm 50\%$ 
  - Except for air parcels with very low NO  $\rightarrow$  low OH
- 2) It appears that the TUT OH has no dependence on  $O_3$  and  $H_2O$
- 3)  $HO_x$  does show some dependence on  $[O_3]^*[H_2O]$  ( $HO_x$  source) and  $NO_y$  ( $HO_x$  sink)
- 4) Source of very low NO air parcels:
  - Low NO – marine boundary air (low  $O_3$  and  $NO_y$  as well)
  - Strong convection without lightning – marine convection
  - Most likely place – the west Pacific warm pool
  - Low  $O_3$  can be an indicator of low NO and low OH!



