

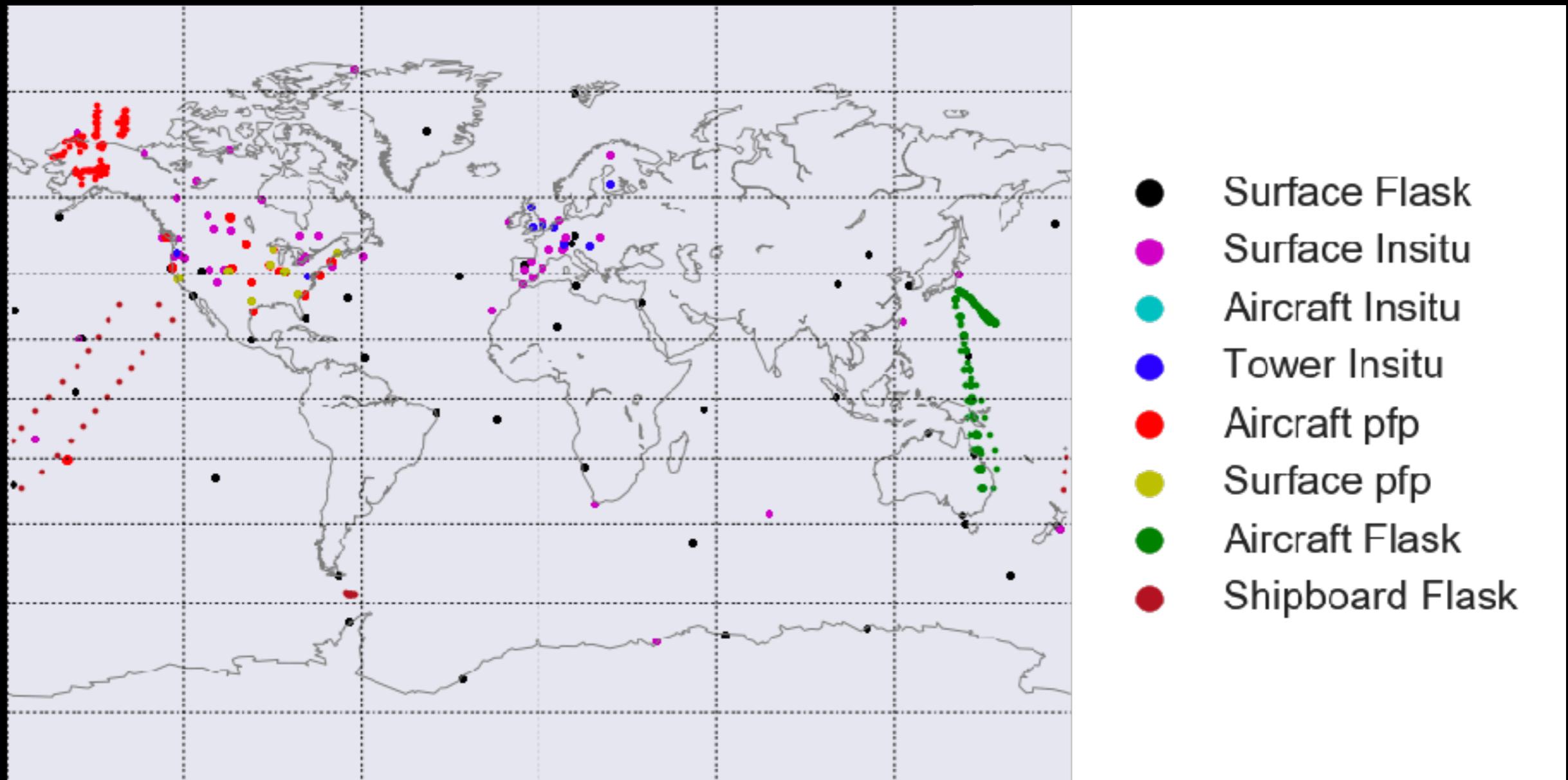
# Evaluation of the coupled TM5/IFS model

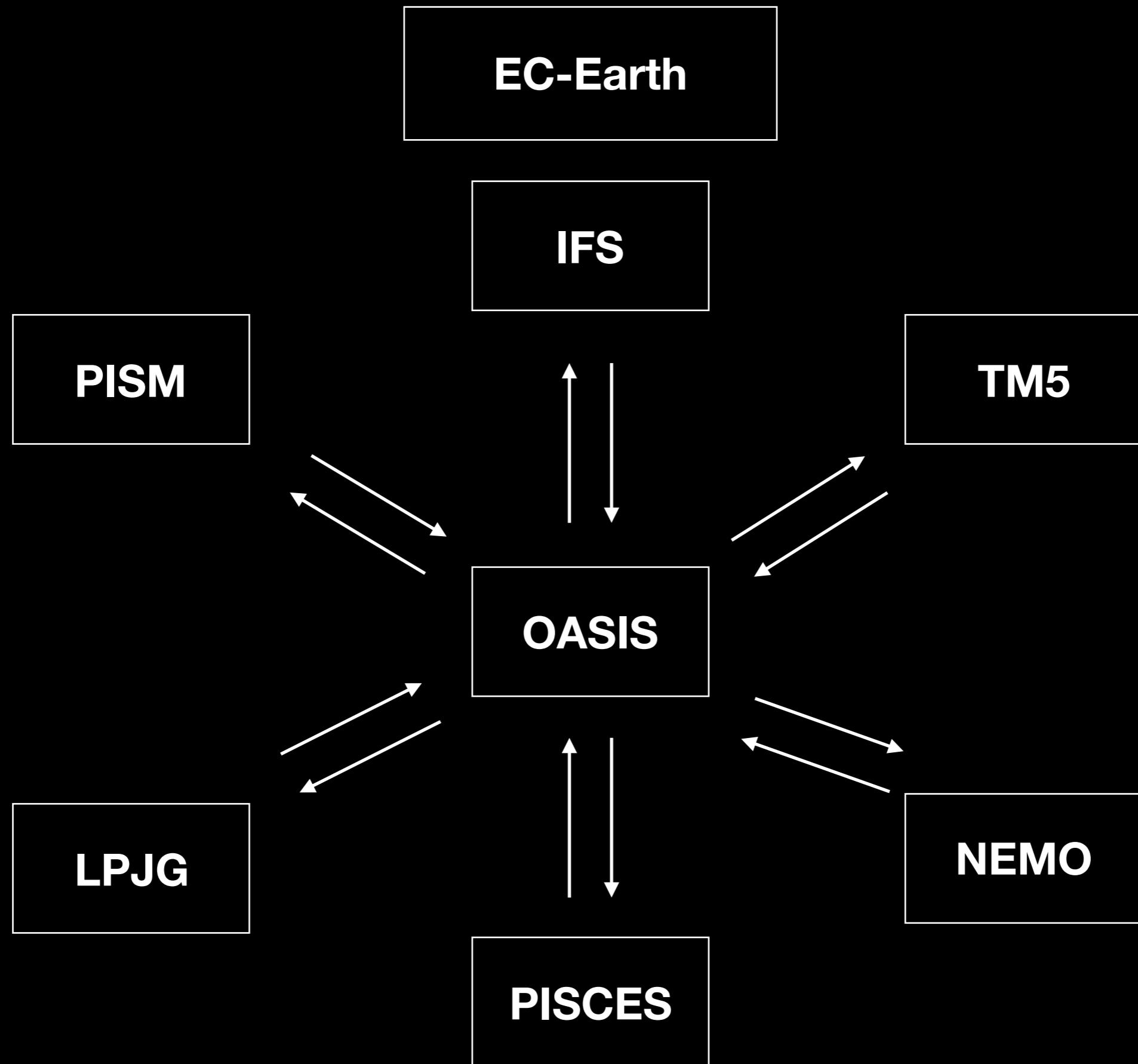
*Comparison to CO<sub>2</sub> observations, TM5-offline and  
different configurations*

**TM5-meeting November 2017**

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# Introduction

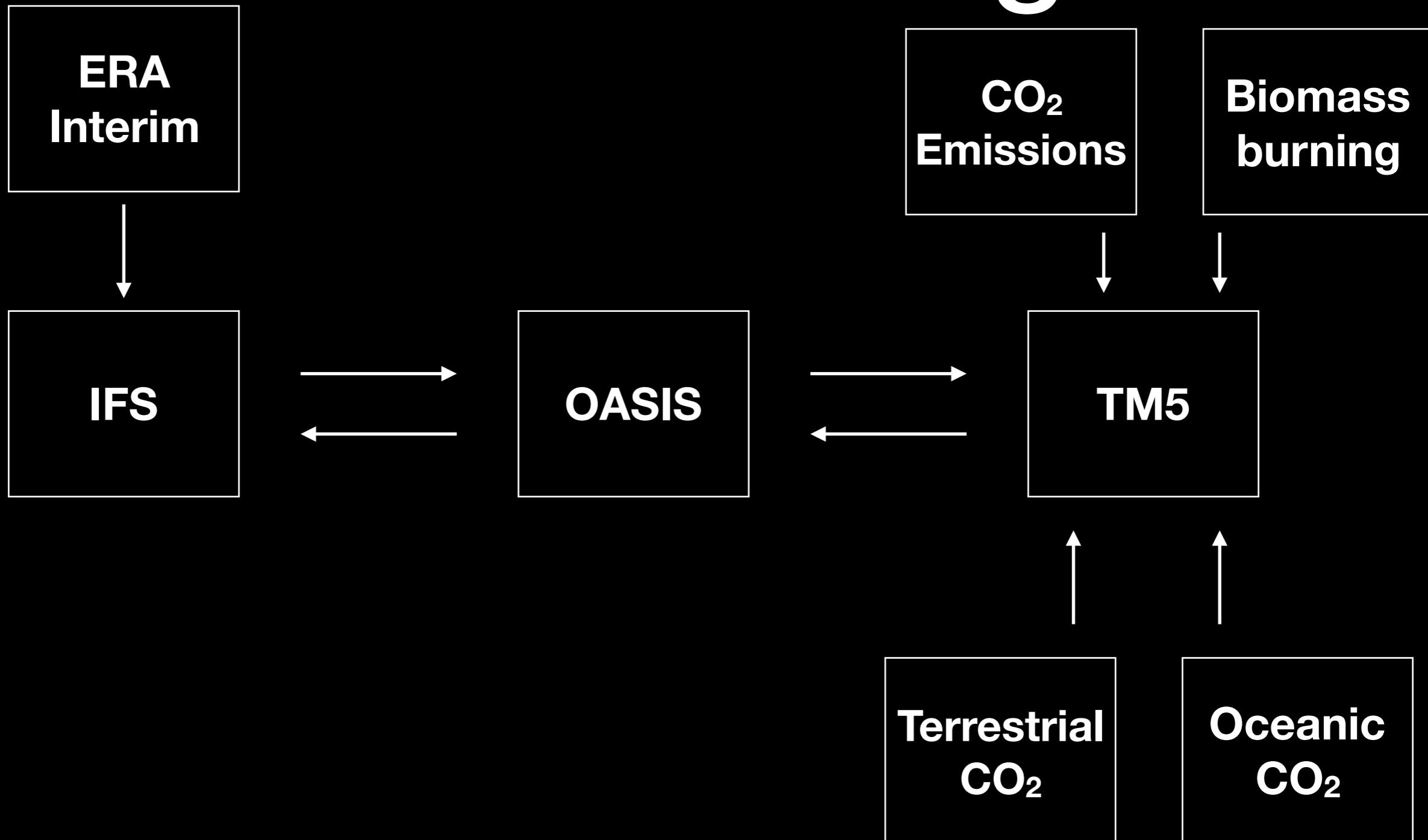




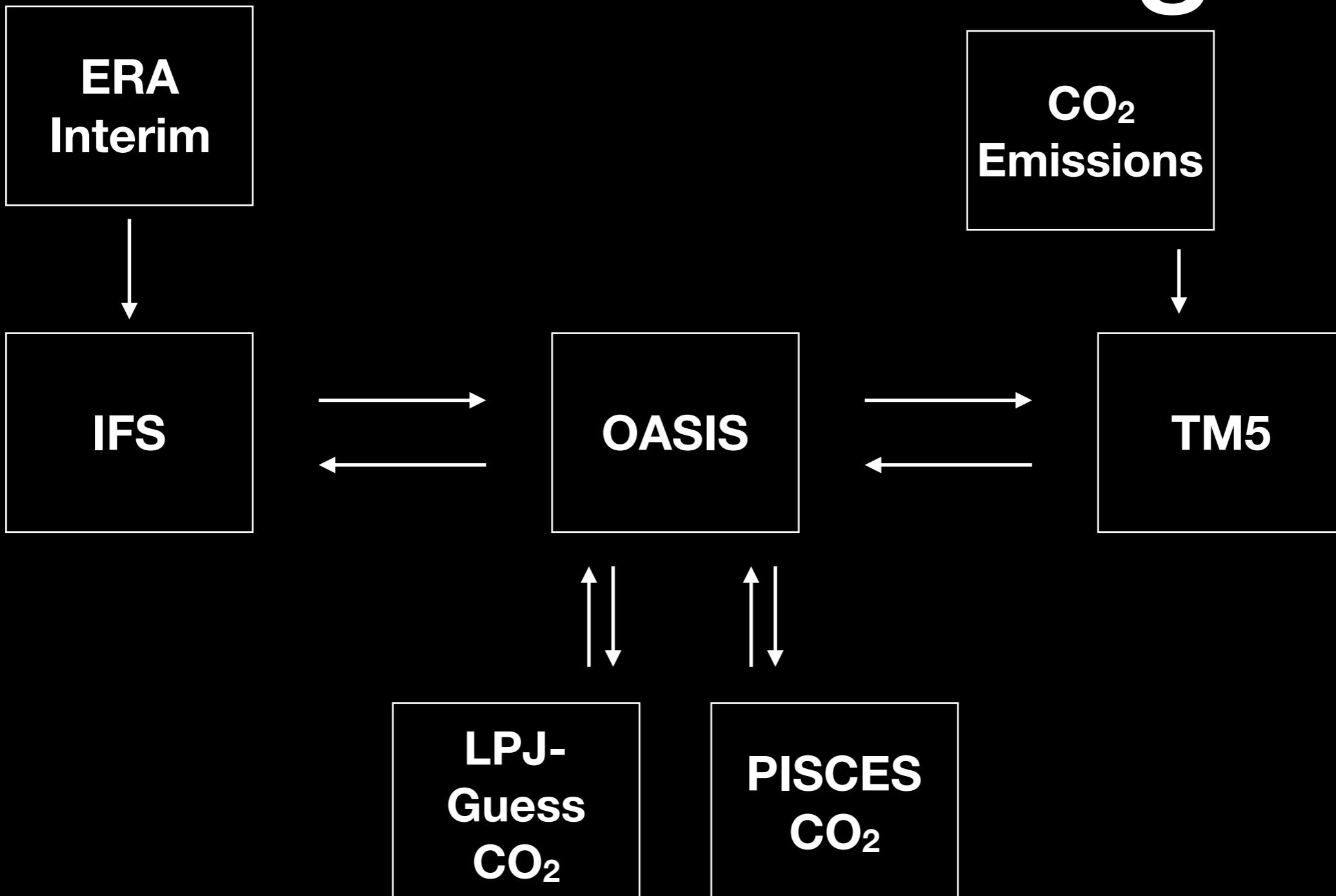
# TM5 Online



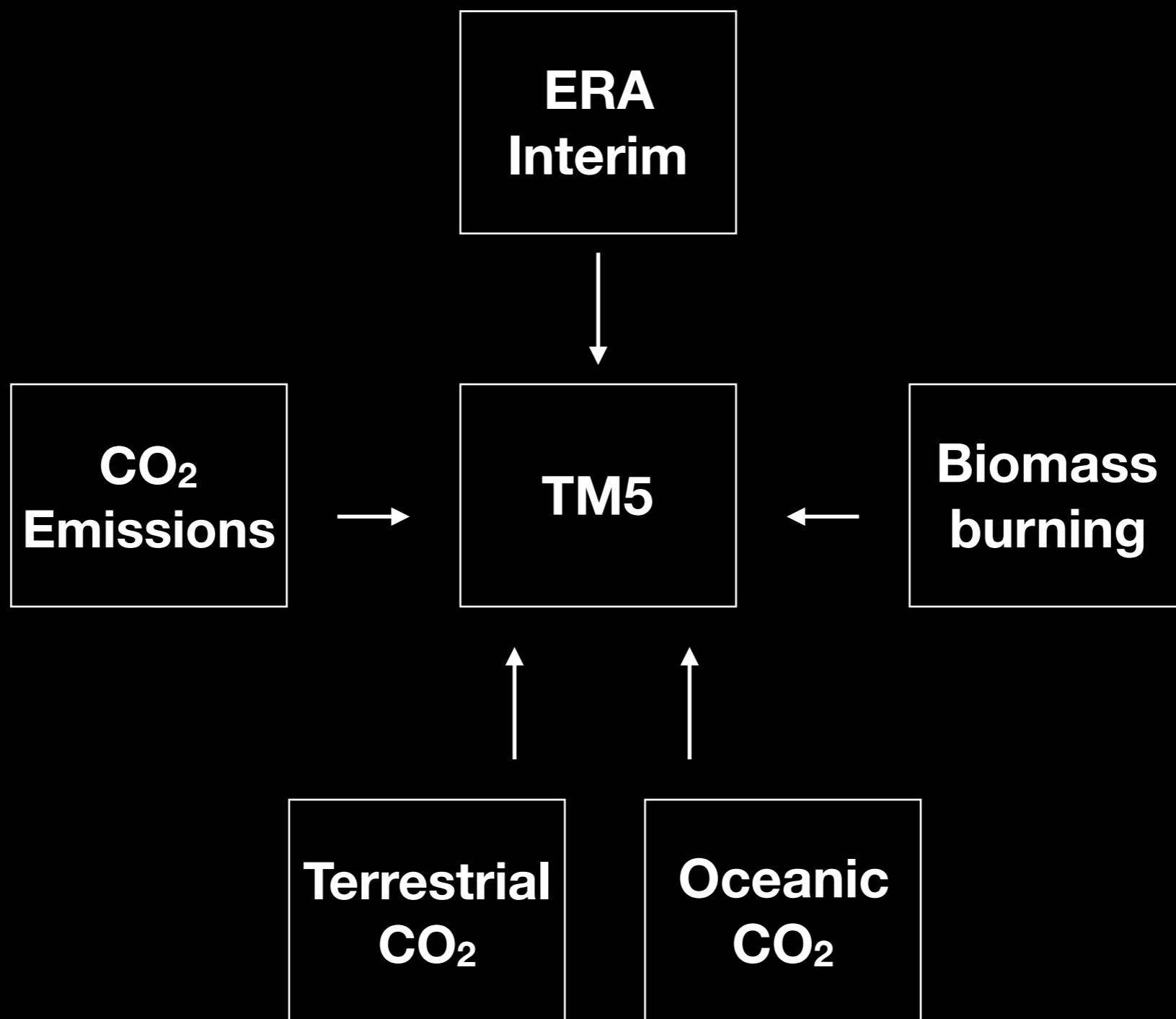
# TM5 Online nudged



# EC-Earth CO<sub>2</sub> Nudged



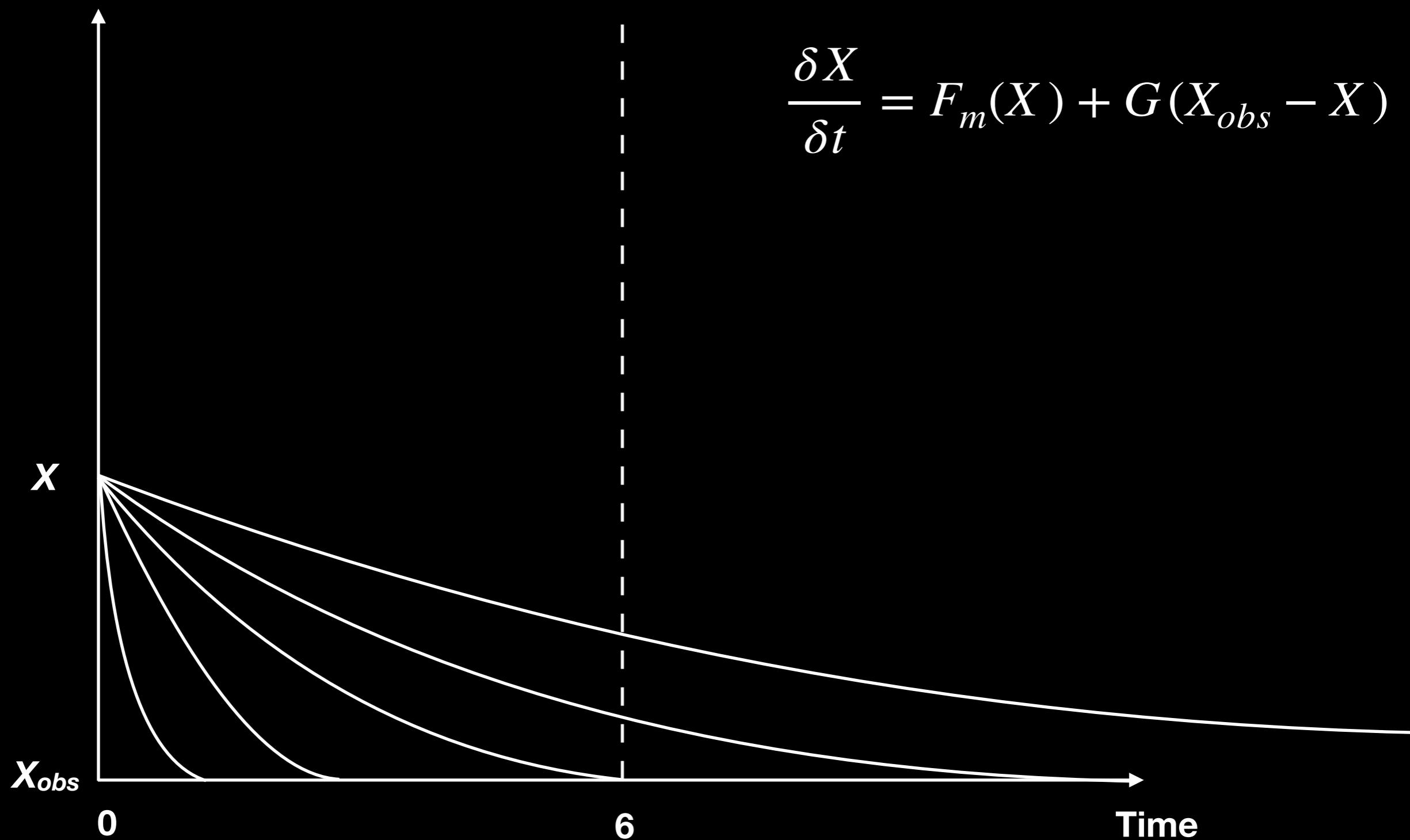
# TM5-Offline



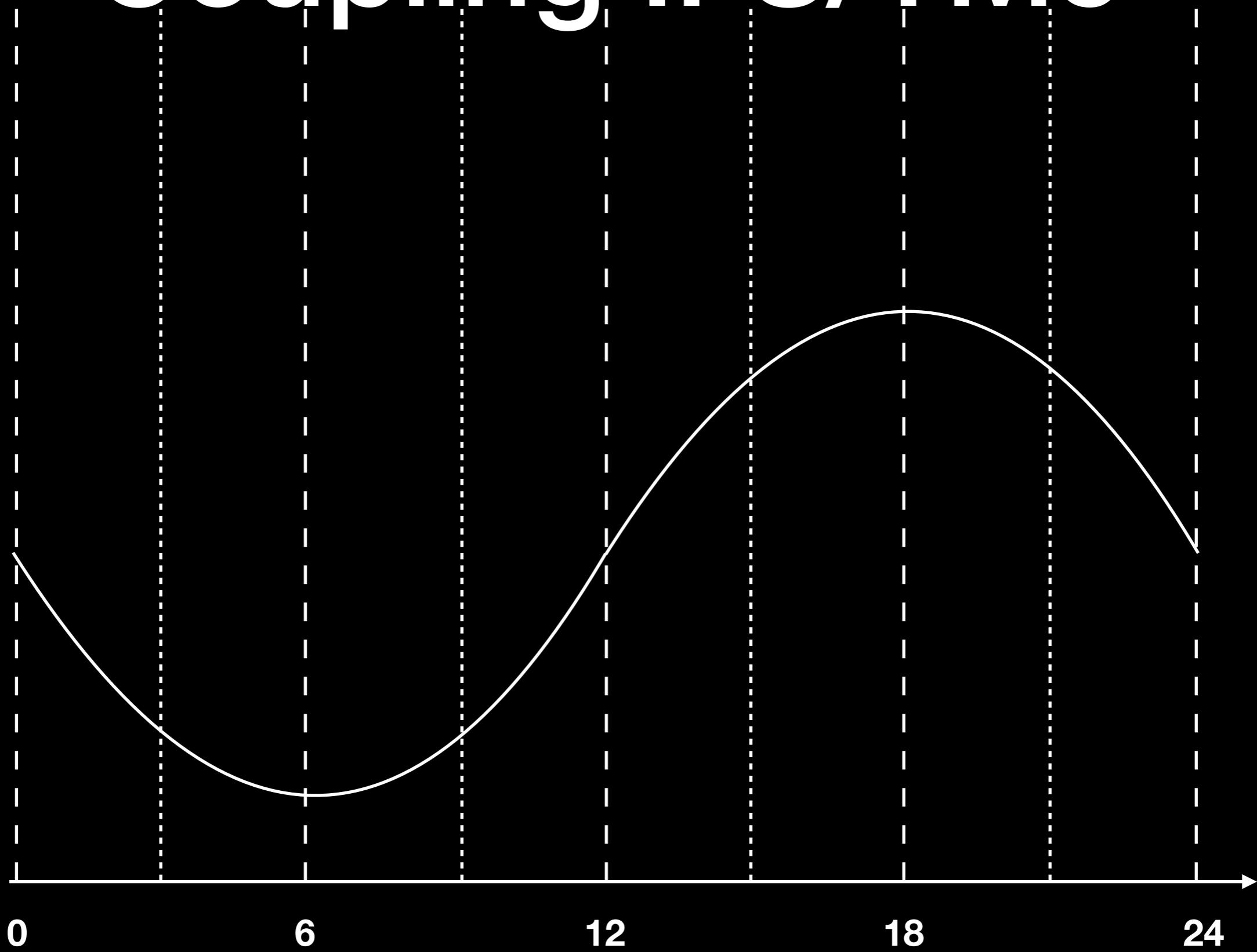
# Casestudy

- Simulated one year (2014)
- Comparison of TM5-Online and TM5-Offline with over 600.000 CO<sub>2</sub> observations
- Multiple TM5-Online configurations
  - Varied the nudging strength
  - Coupling frequency between IFS and TM5

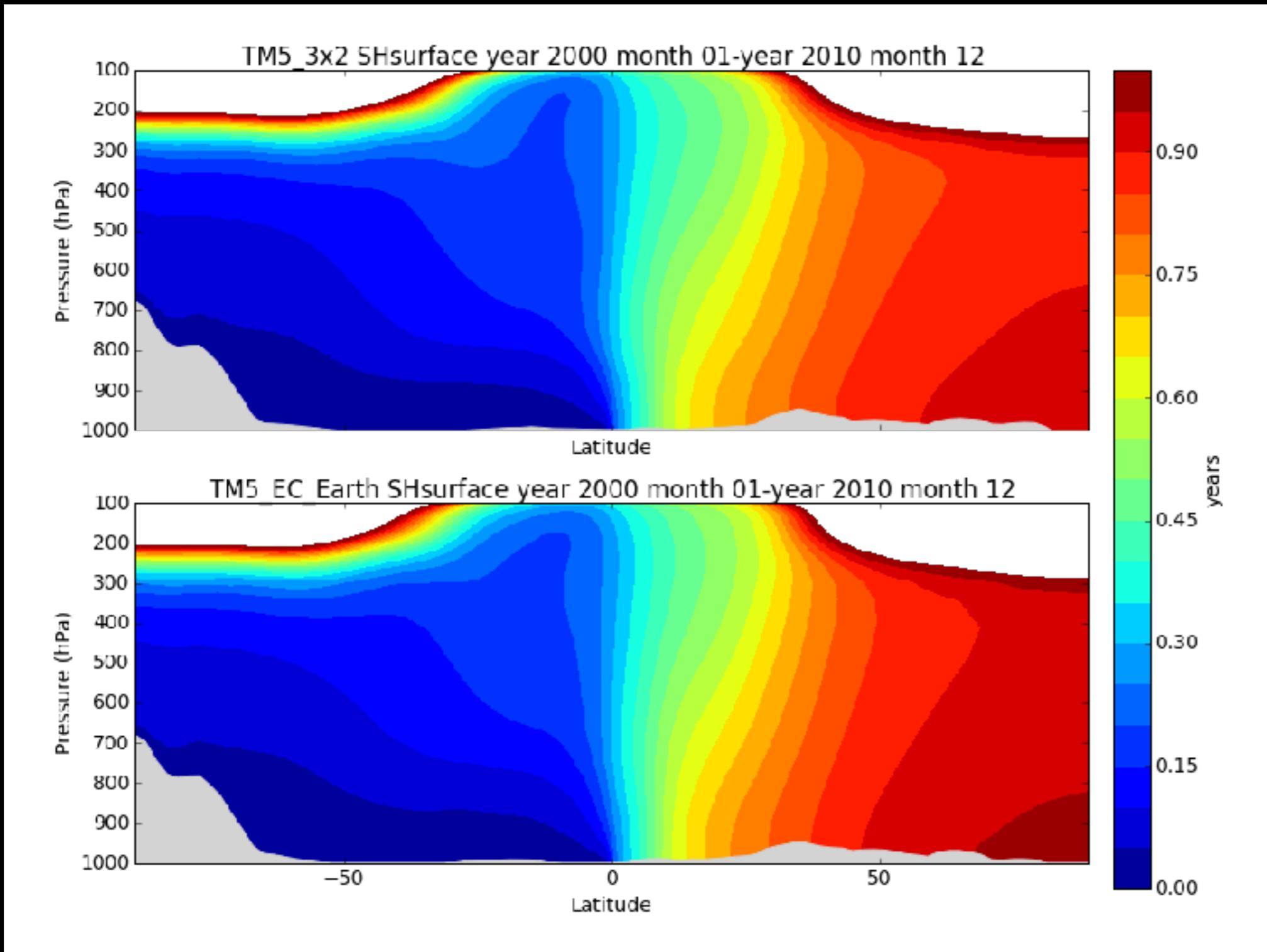
# Atmospheric nudging

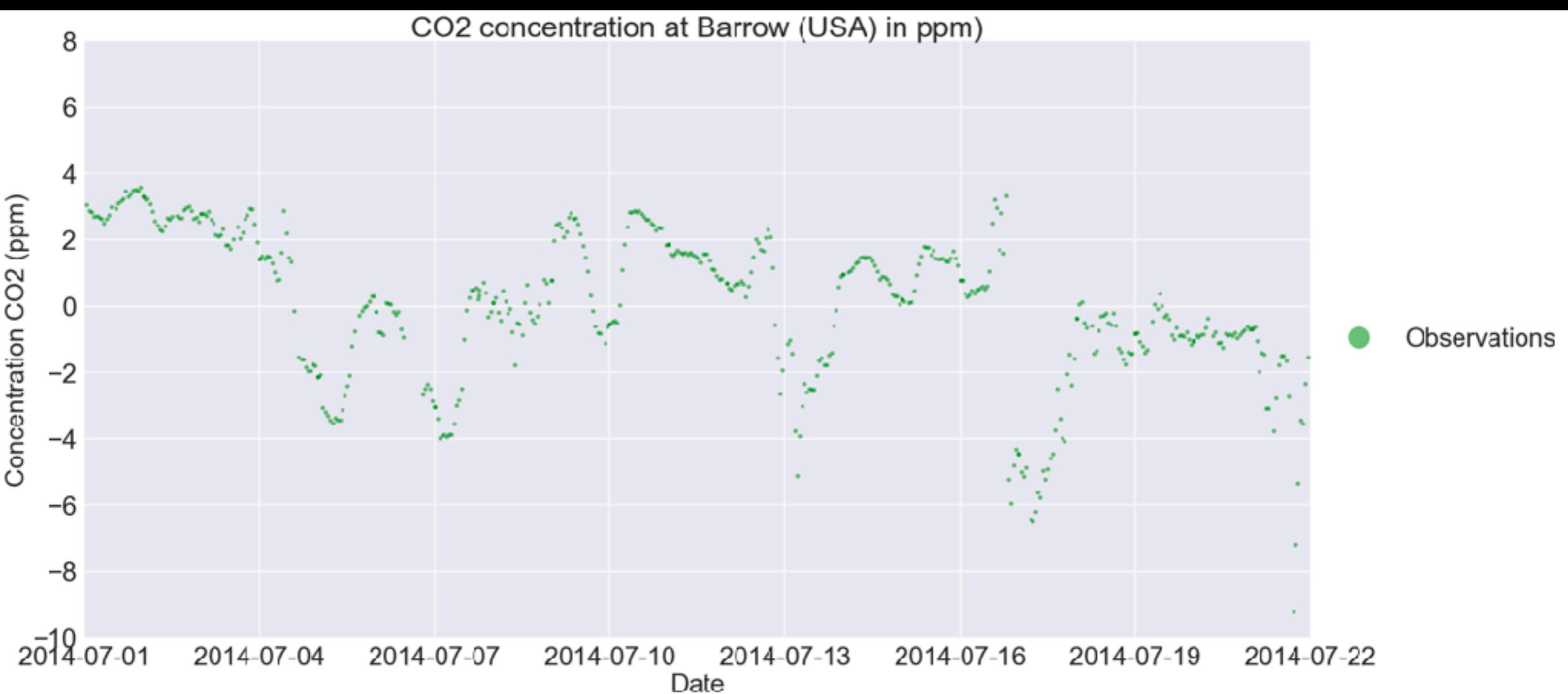


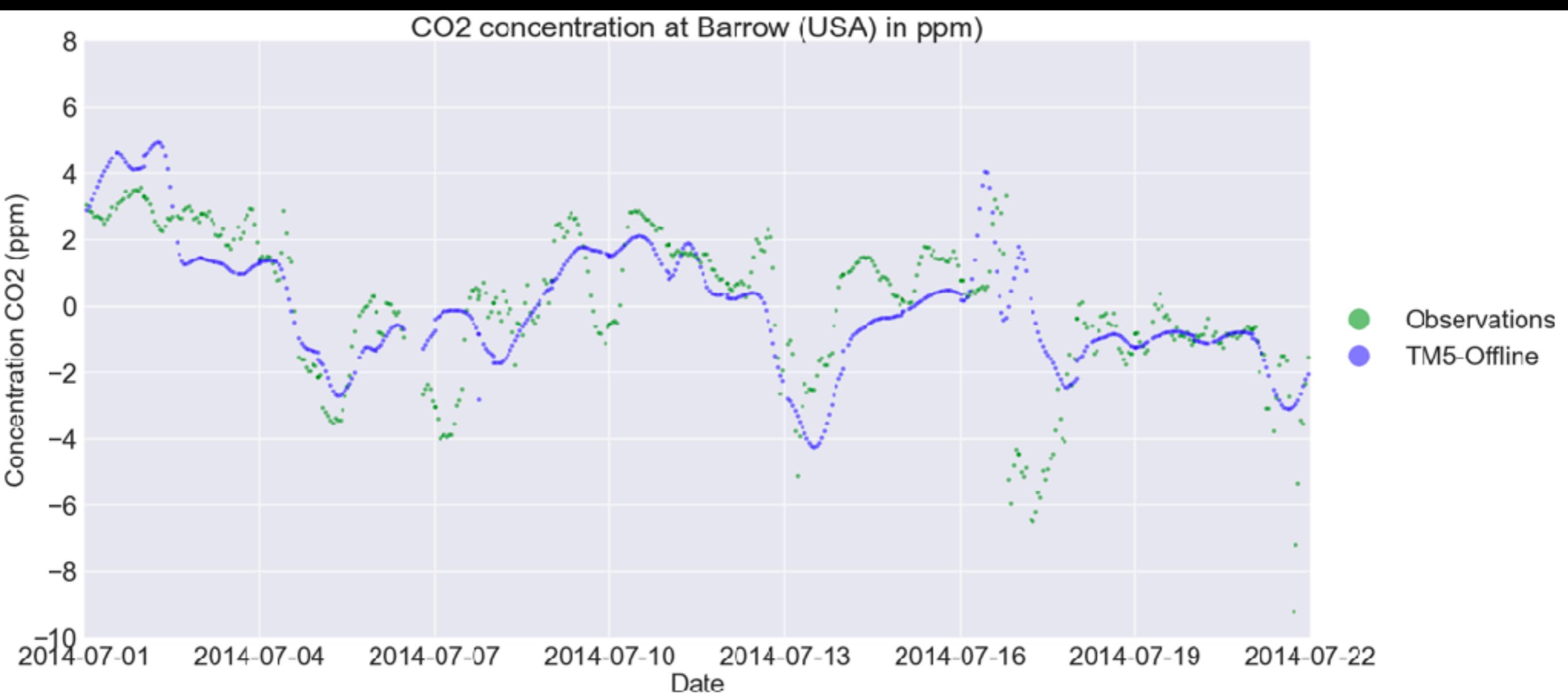
# Coupling IFS/TM5

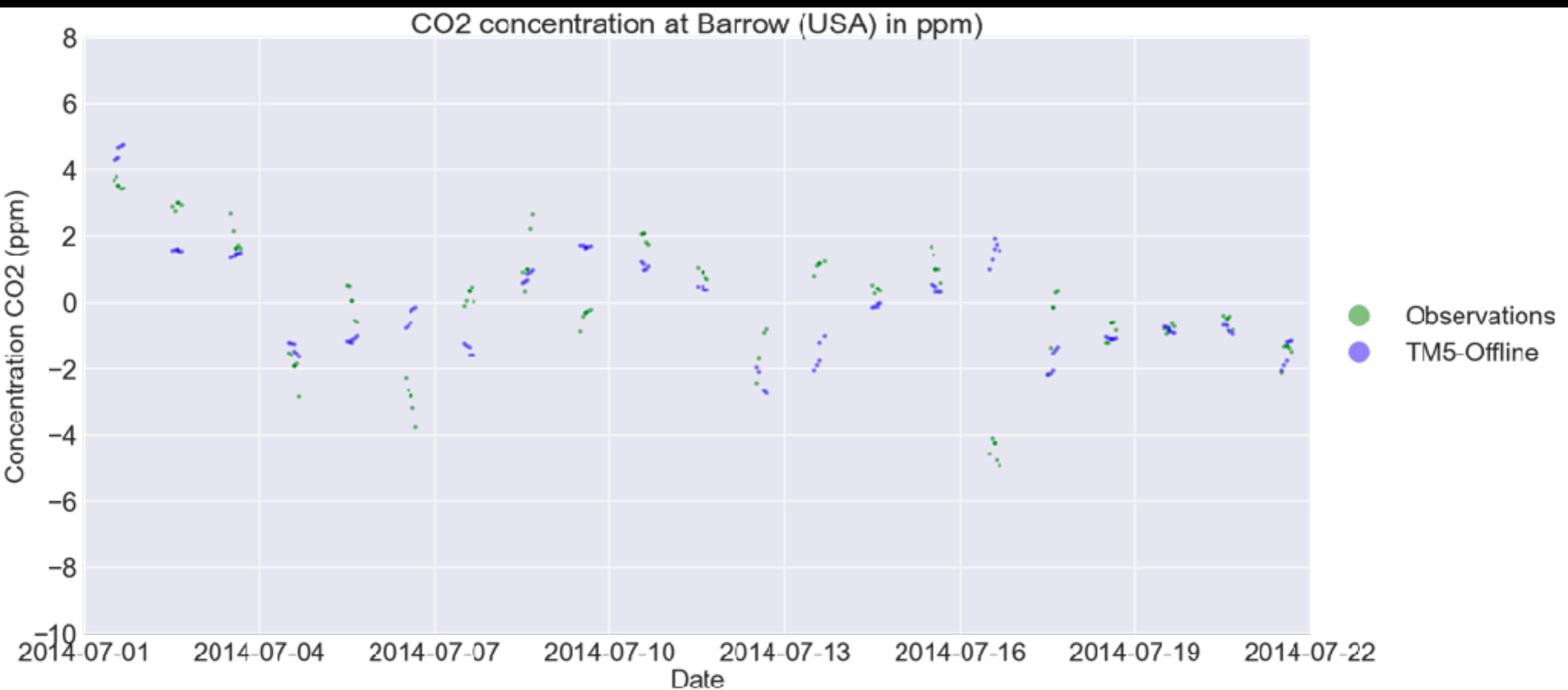


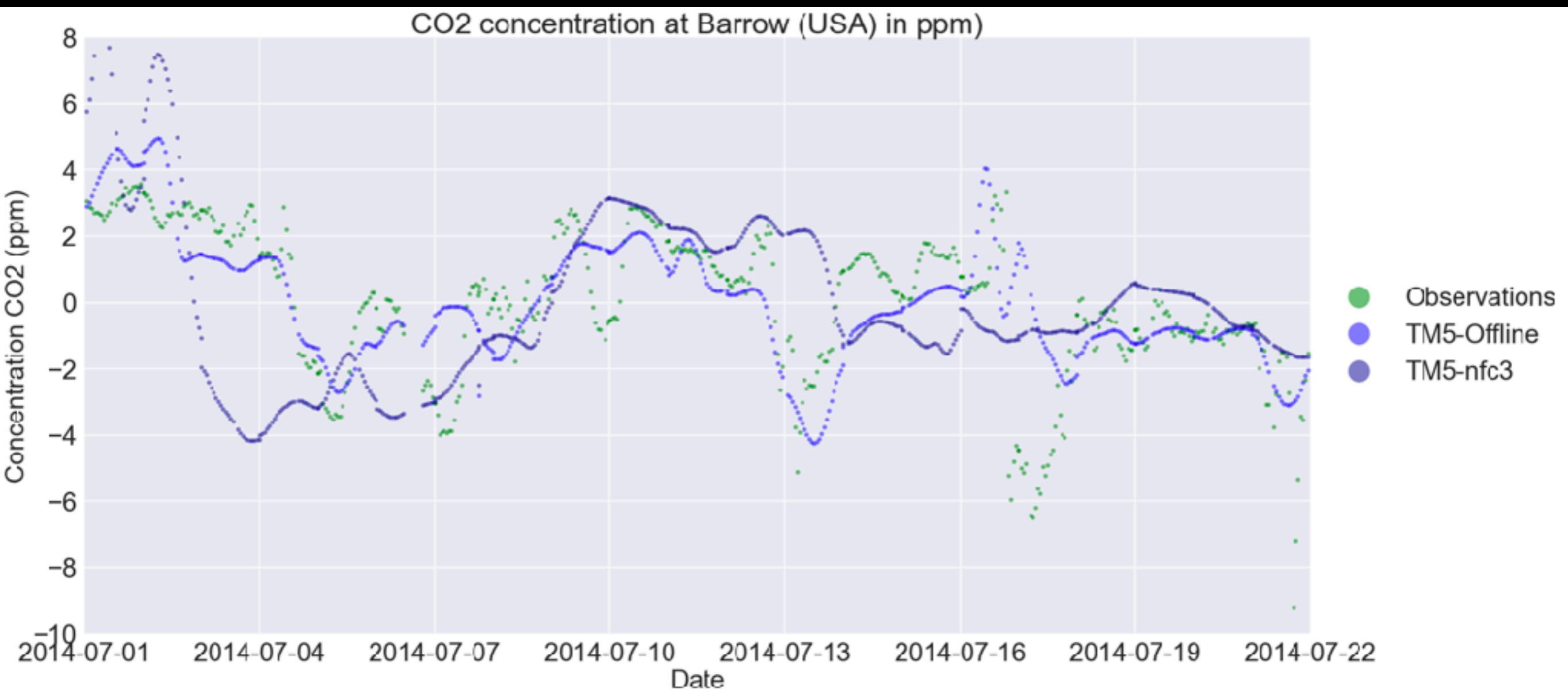
# Age of Air

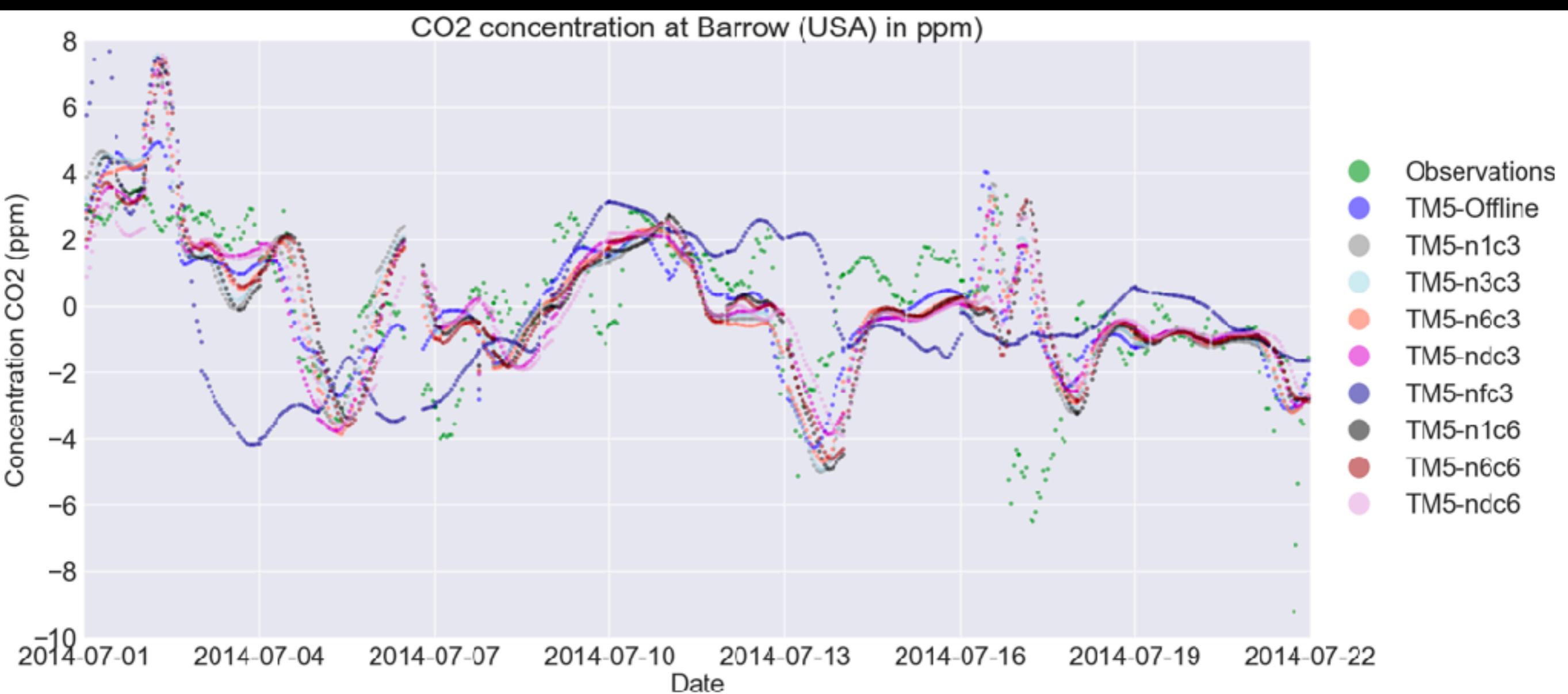


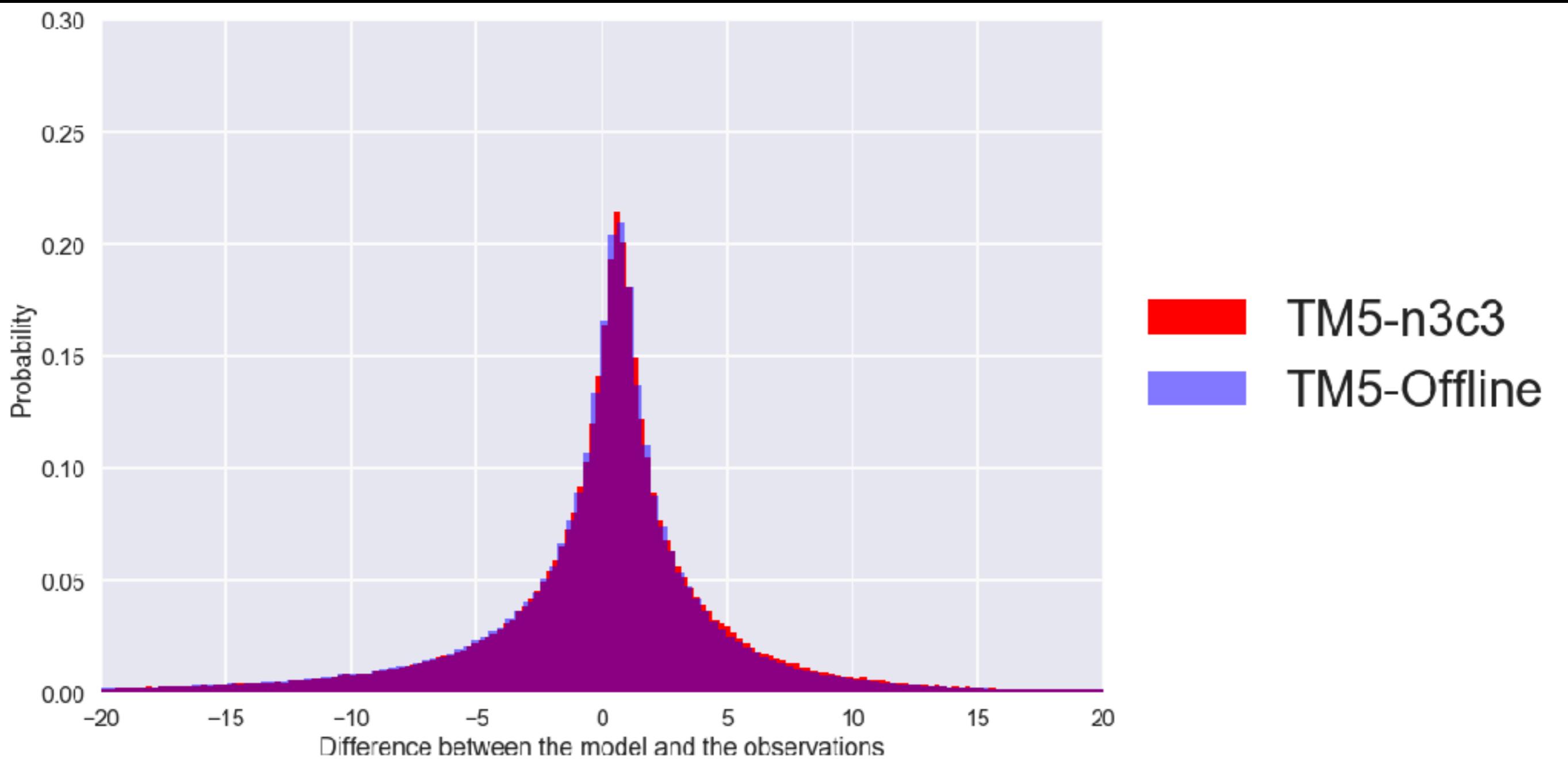


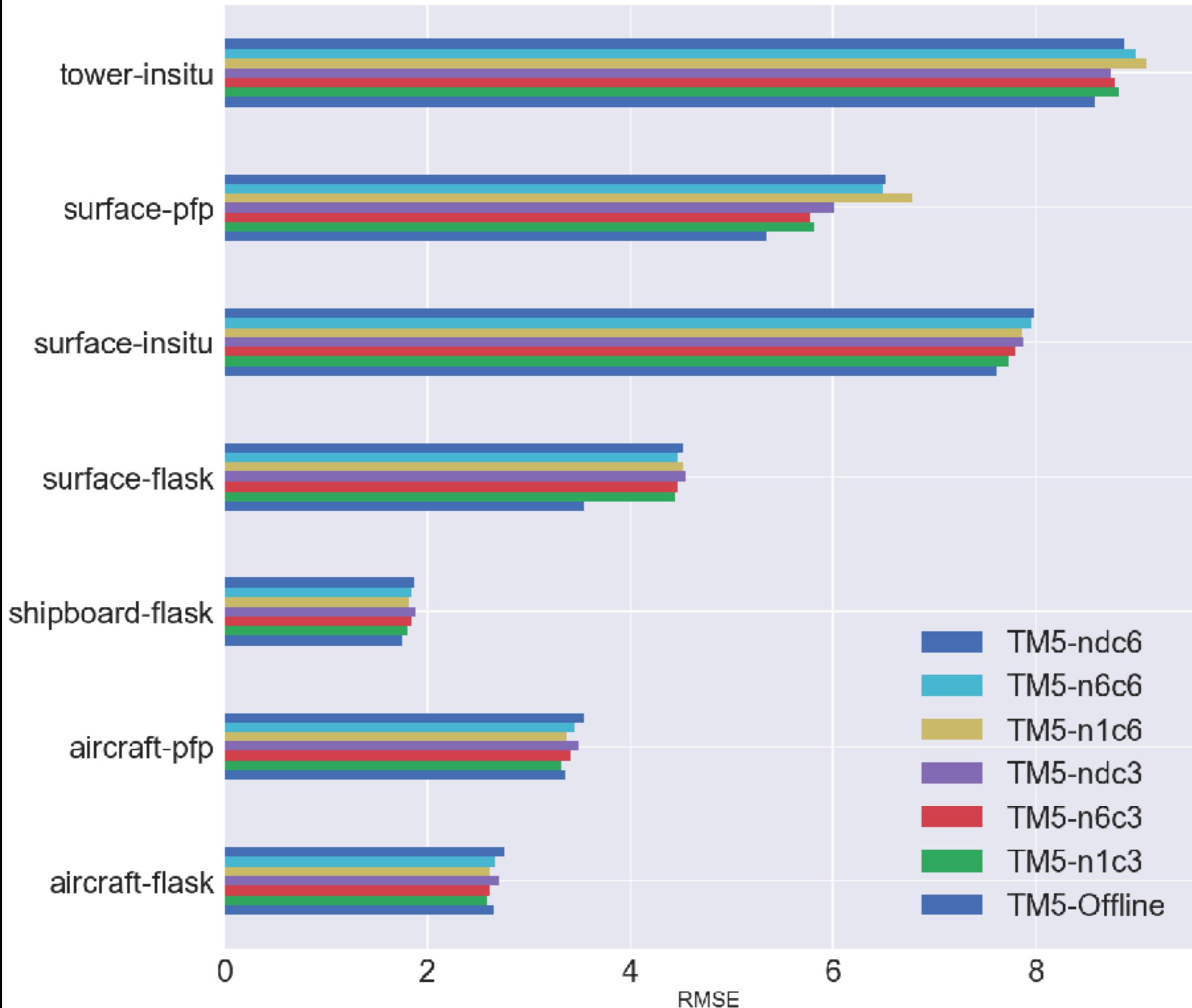








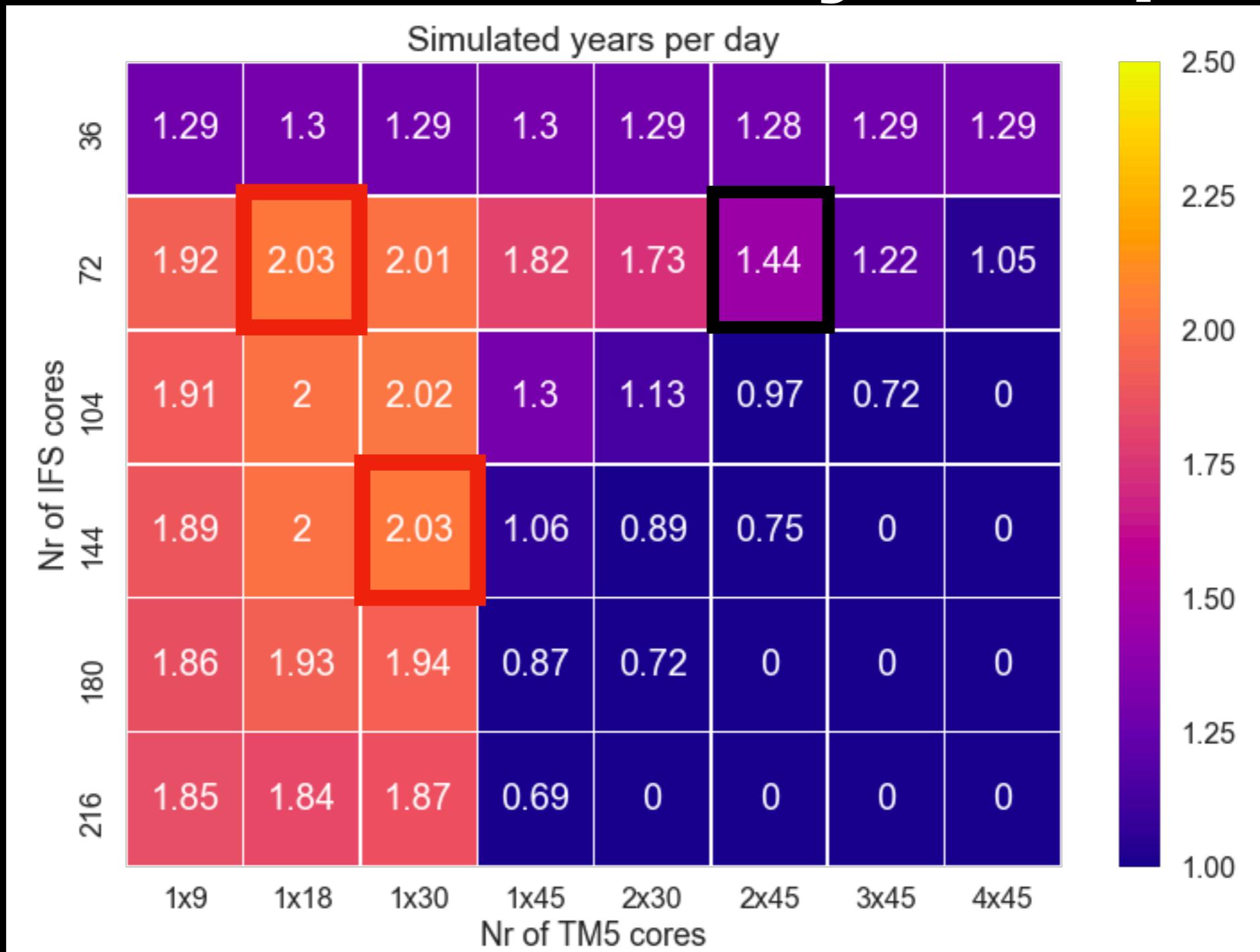




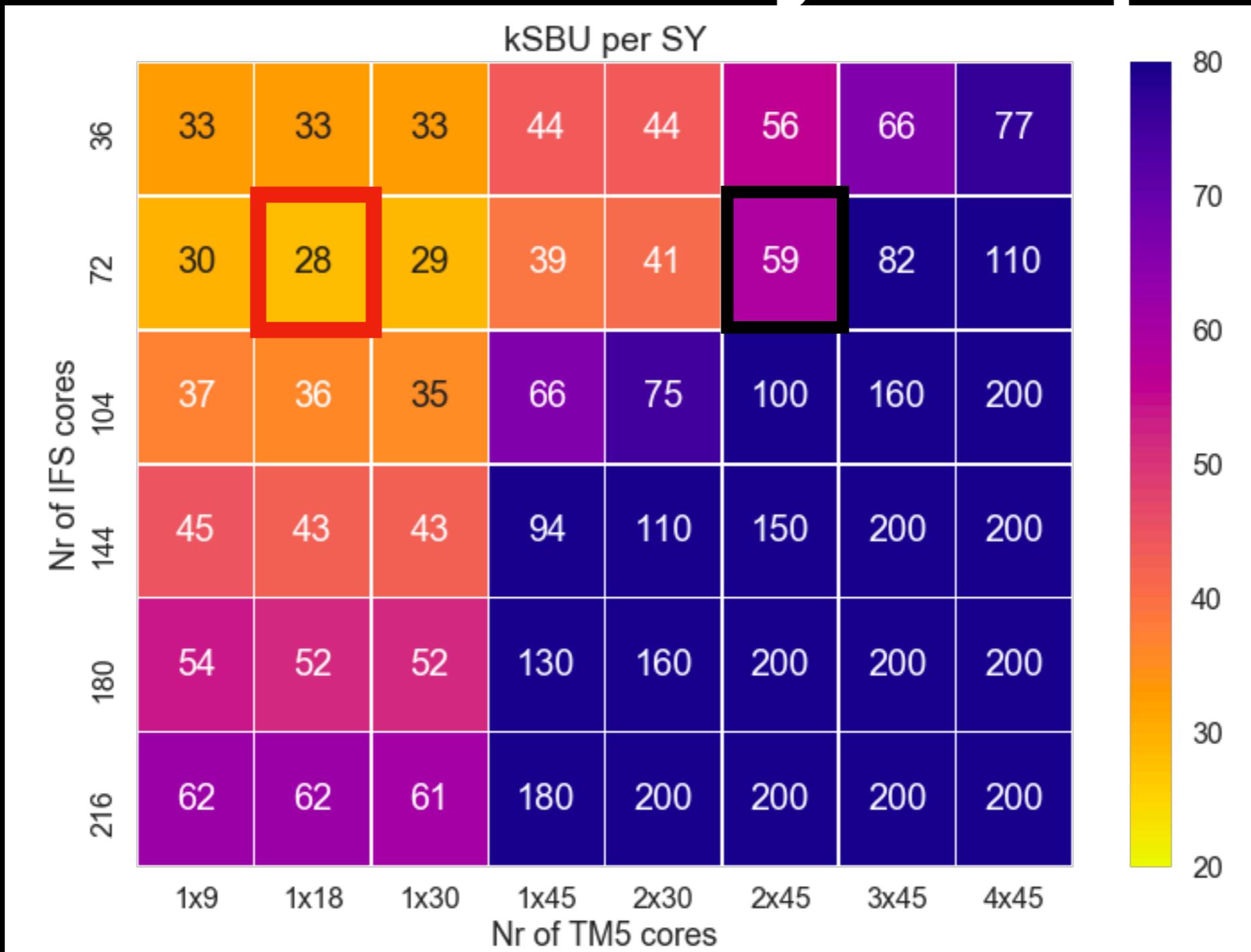
# Costs and runtime

| Model       | Time per timestep, relative<br>to TM5-Offline | kSBU cost at ECMWF |
|-------------|---|--------------------|
| TM5-Offline | 1.00  | 6.27               |
| TM5-n1c3    | 2.49  | 110.28             |
| TM5-n1c6    | 1.51  | 80.52              |
| TM5-n6c3    | 2.81  | 101.75             |
| TM5-n6c6    | 1.66  | 86.79              |
| TM5-ndc3    | 2.82  | 110.22             |
| TM5-ndc6    | 1.66  | 80.61              |

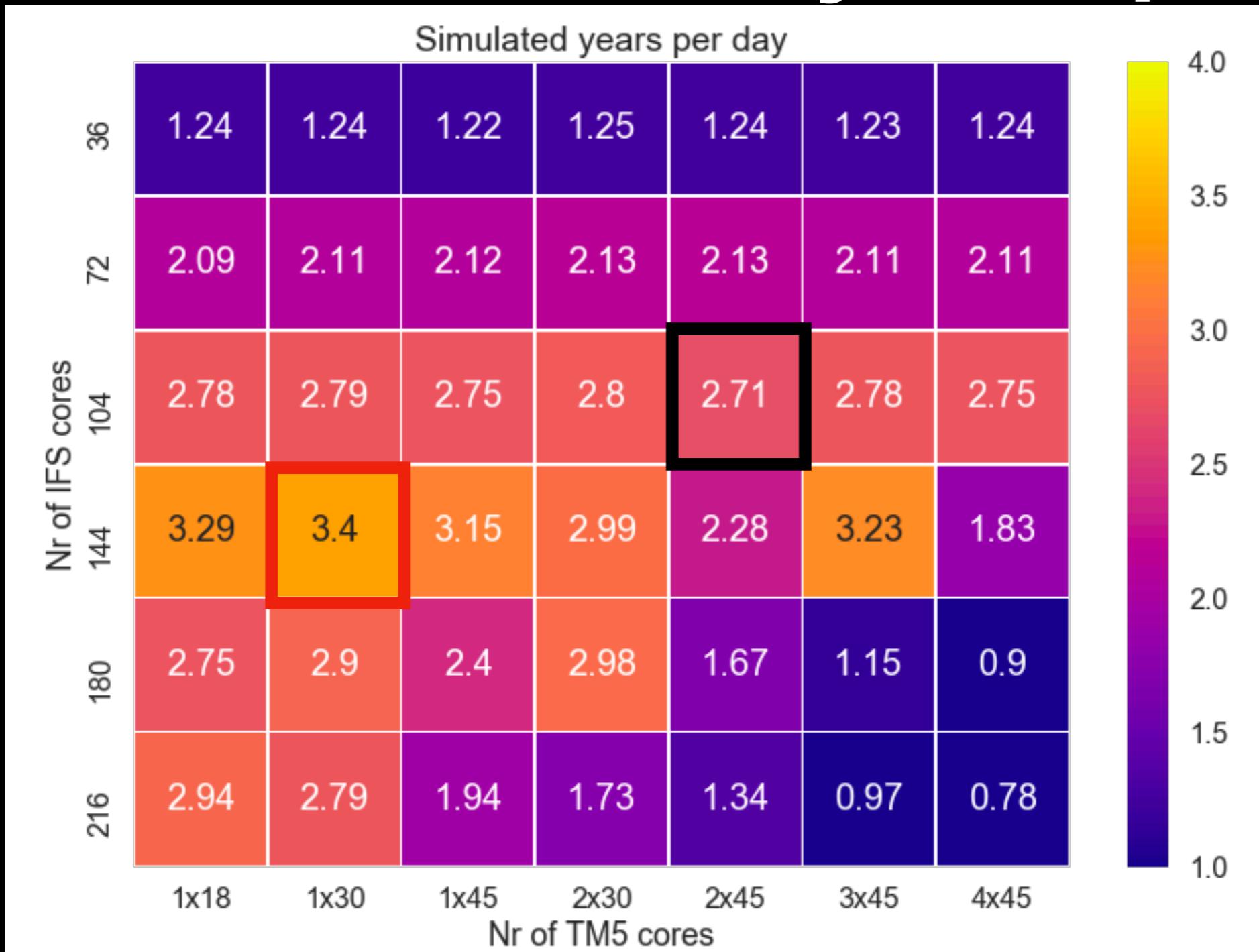
# Speed of 3 hourly coupling



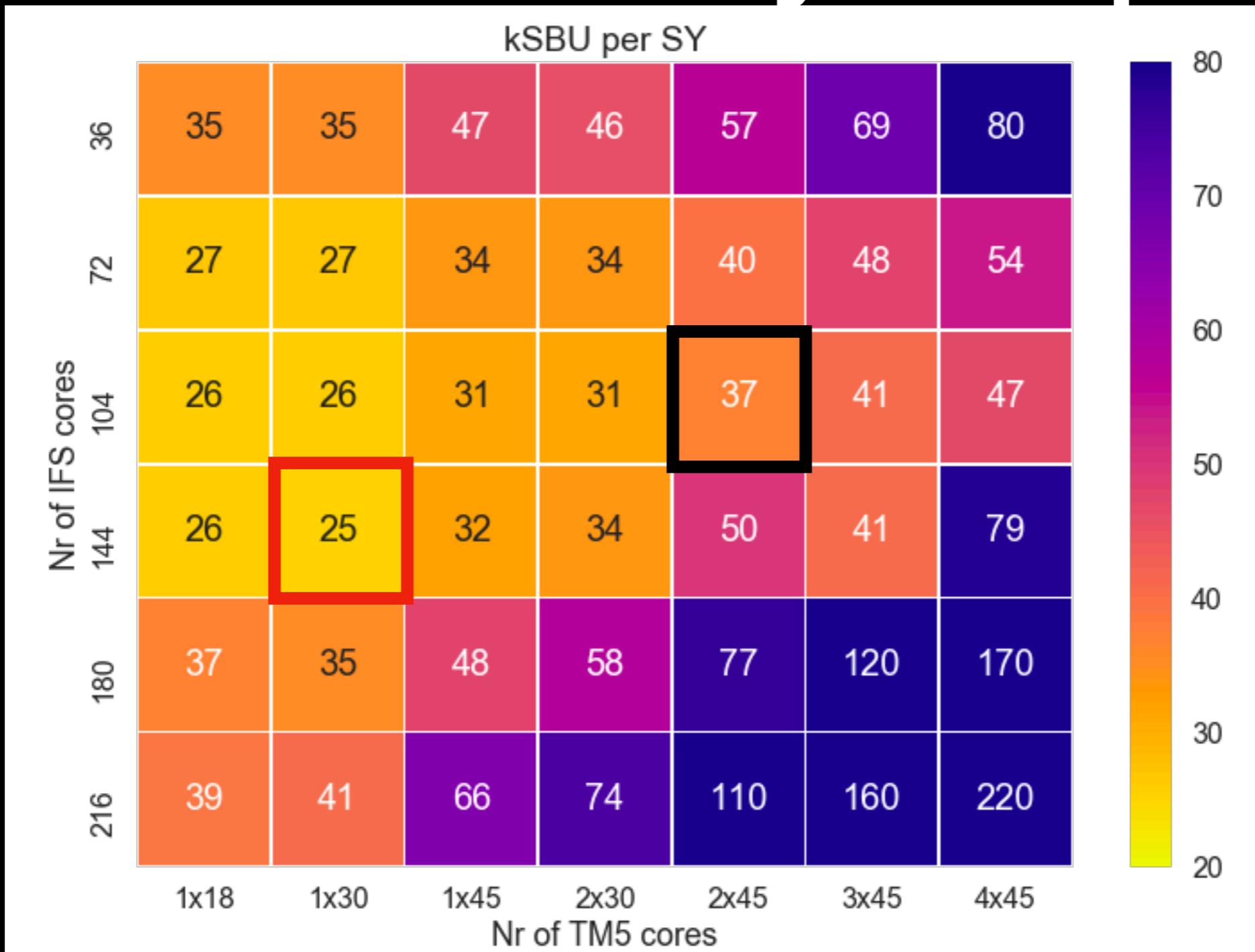
# Cost of 3 hourly coupling



# Speed of 6 hourly coupling



# Cost of 6 hourly coupling



| <b>Speedup and cost reduction</b> | <b>SYPD</b> | <b>kSBU per SY</b> |
|-----------------------------------|-------------|--------------------|
| <b>3 hourly coupling</b>          | 1.44 → 2.03 | 59 → 28            |
| <b>6 hourly coupling</b>          | 2.71 → 3.40 | 37 → 25            |

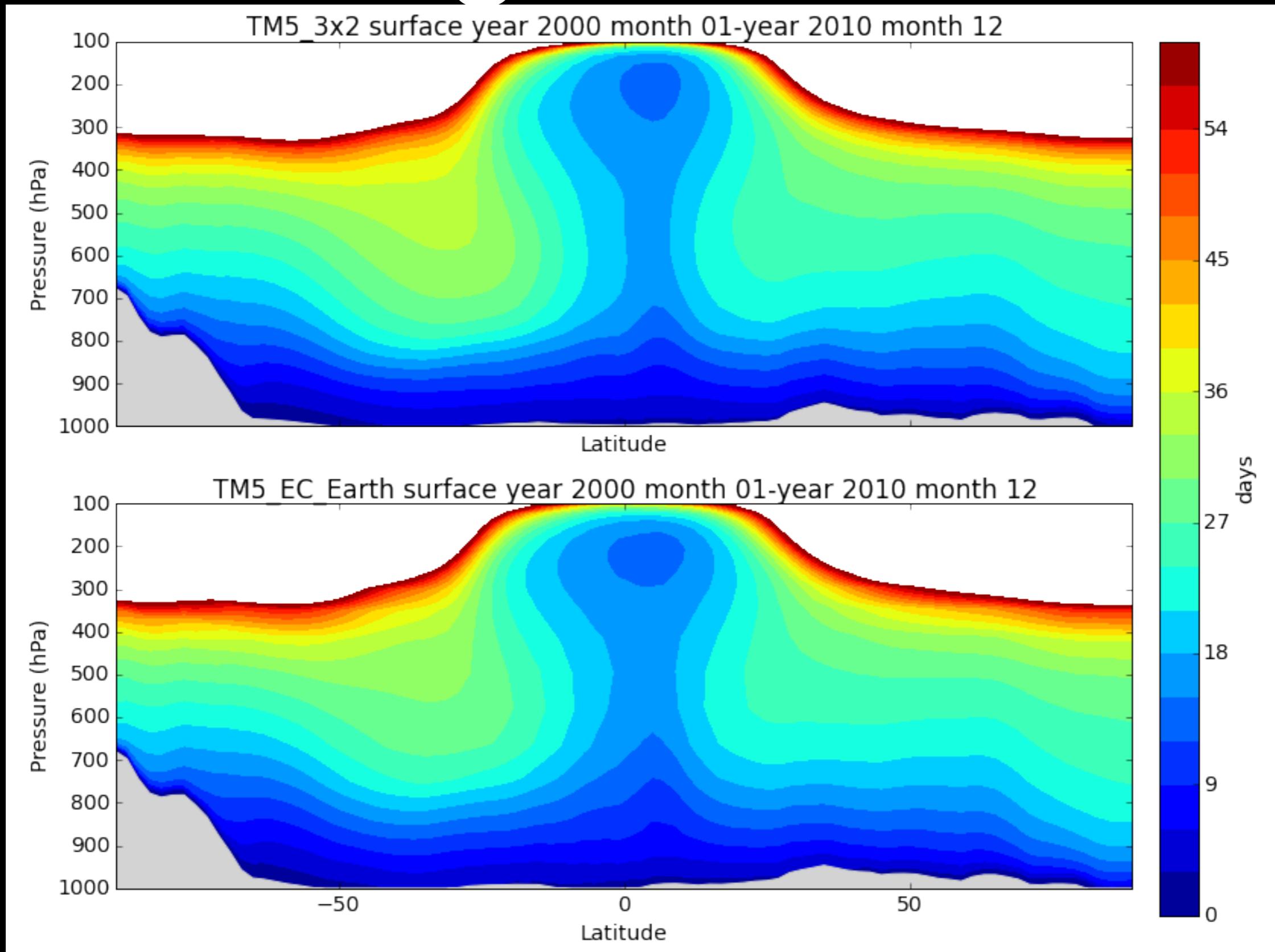
# Added value

- Possible to change resolution to suit your needs
  - T159, T255, T799
- Flexible in space and time
- Storage requirements
  - 870 GB p/y for TM5-offline 1x1
  - 17 or 23 GB p/y per variable for TM5-online T159 nudging data
- Model version of IFS (depends on ERA5)

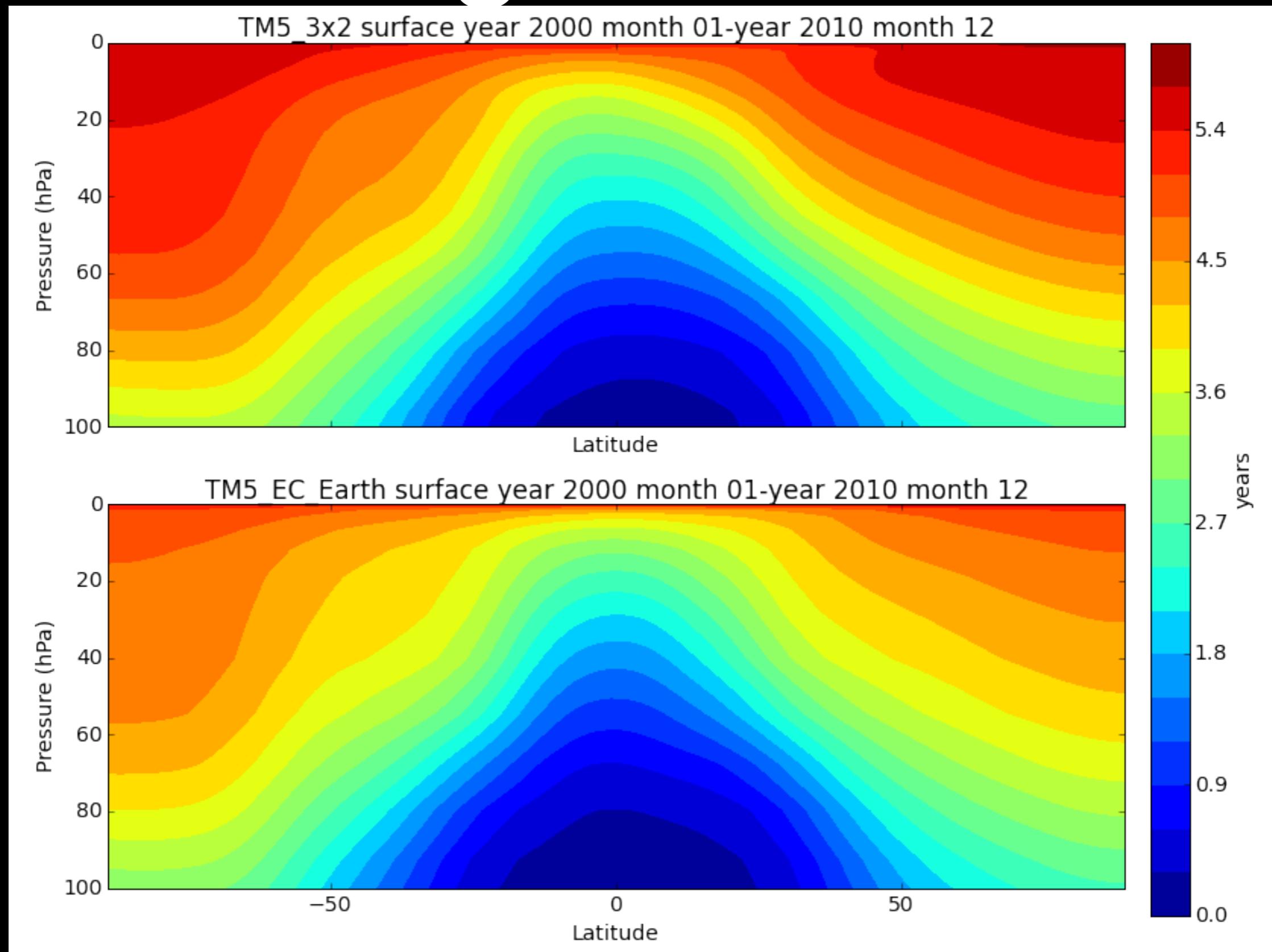
# Conclusions

- TM5-Online performs similar to TM5-Offline
- Nudging and coupling has effect for the non-background observation stations
- More coupling results in slower and more expensive model, but can make a large difference for some stations
- Balance your model, preferably before the experiments
  - Very important for model time and model costs

# Age of Air

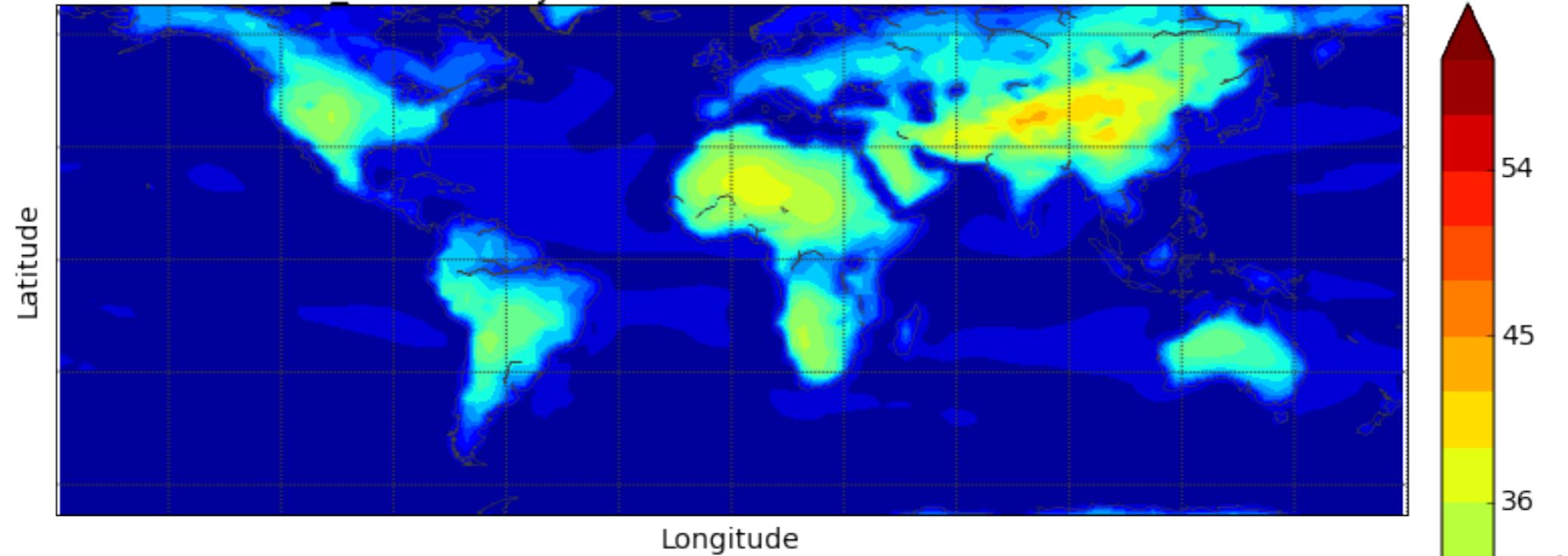


# Age of Air

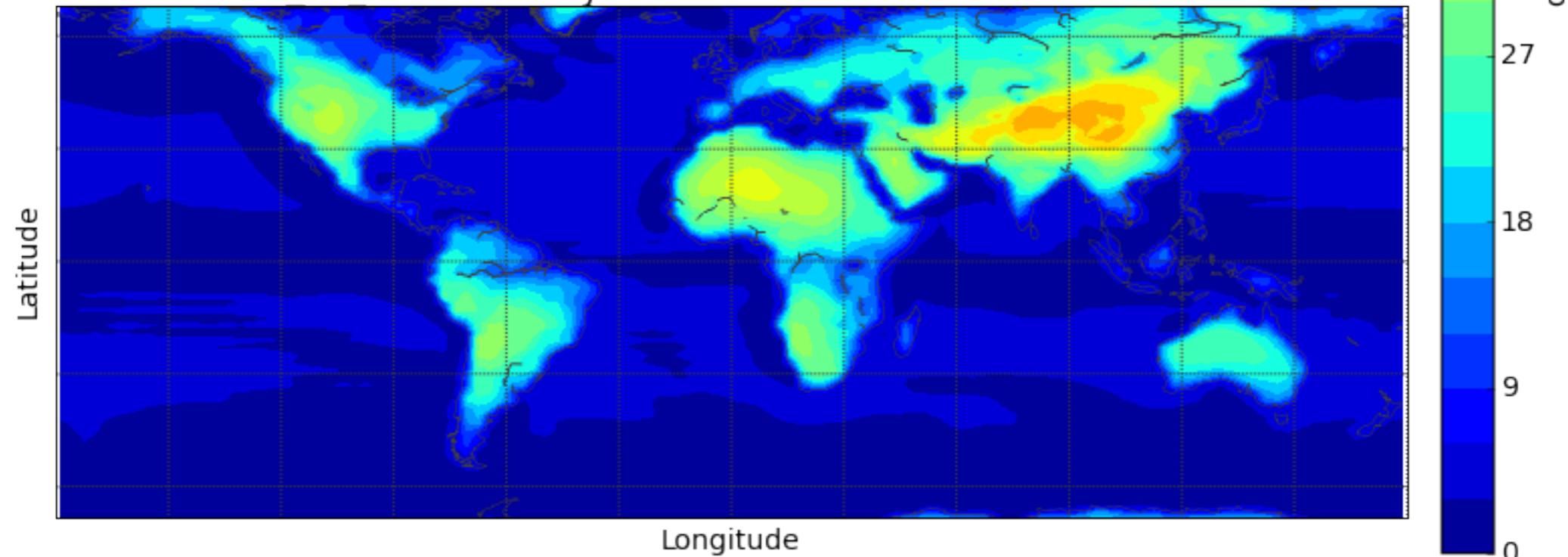


# Age of Air

TM5\_3x2 ocean year 2000 month 01 Pressure= surface

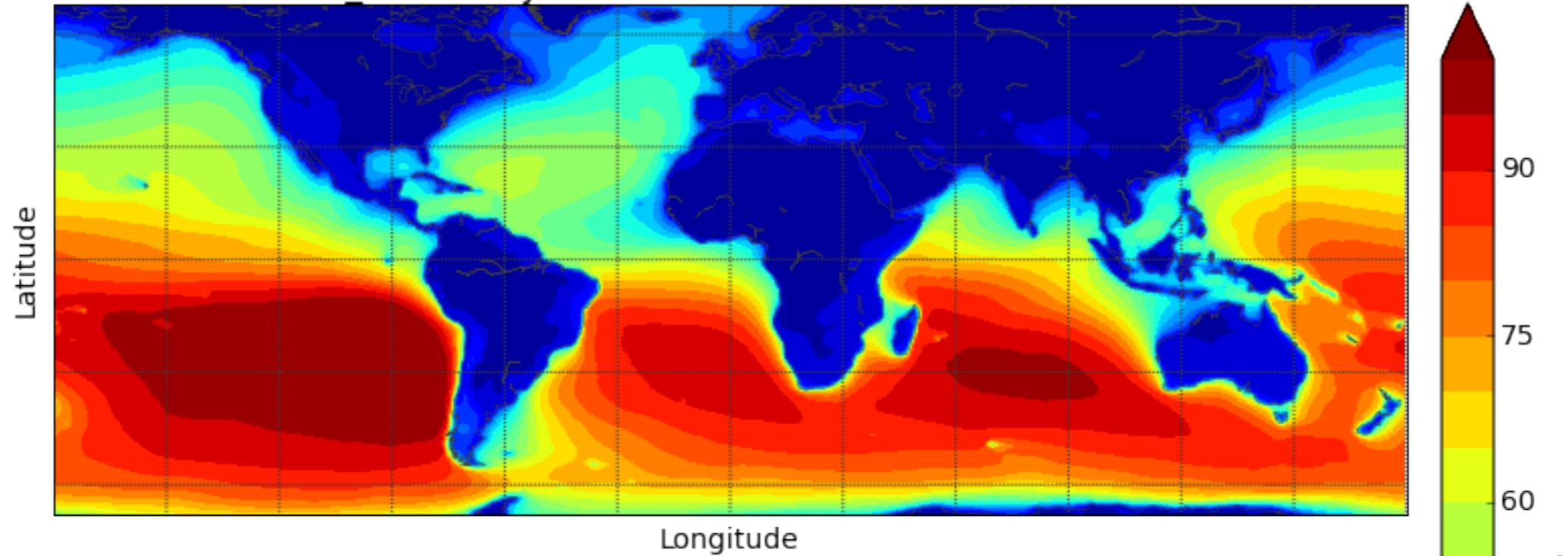


TM5 EC Earth ocean year 2000 month 01 Pressure= surface

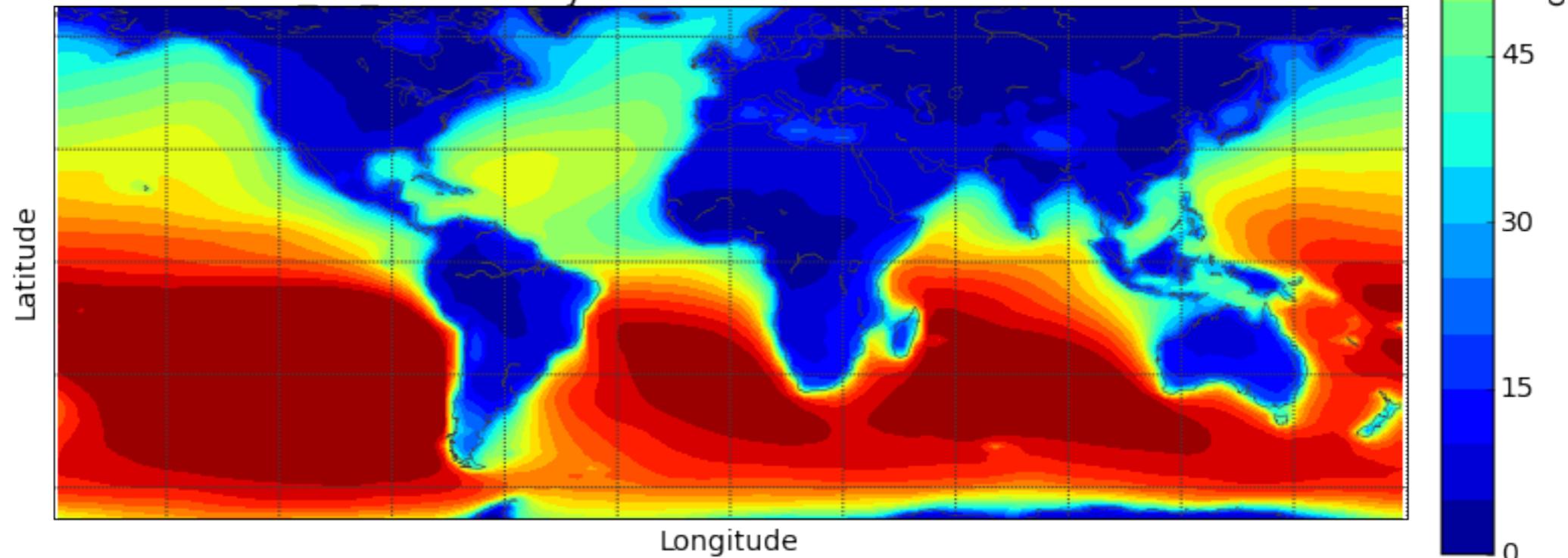


# Age of Air

TM5\_1x1 land year 2009 month 01 Pressure= surface



TM5 EC Earth land year 2009 month 01 Pressure= surface



# Age of Air

