

An Example High Ambient Temperature (HAT) Definition for the Montreal Protocol

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Why Discuss HAT?

- Robust AC and refrigeration are crucial in hot locations
- Some parties are concerned about using alternatives to HFCs in HAT countries
- The Dubai Pathway mandates work on a 'high ambient temperature exemption' to alleviate their concerns

But how do we define HAT?

What Do We Need?

- No clear definition exists for HAT, so we should choose a HAT definition that addresses key air conditioning issues like:
 - Energy efficiency
 - Cooling Capacity
 - Reliability
 - Safety

COP, Capacity, Reliability, Safety

Air Conditioning:

- Oak Ridge National Lab (ORNL) and US DOE tested alternative refrigerants in room ACs at HAT (52°C & 55°C), showing:

	R-410A	HFC-32	HC-290
Cooling Capacity	Low	High	Medium
Energy Efficiency	Low	High	High
GWP	High	Medium	Low
Flammability	Low	Medium	High

So COP and cooling capacity improve at HAT using alternatives to HFCs. Reliability and safety expected to be high.

The Role of an Exemption

- Technical evidence says alternatives to HFCs, once fully in the market, will have better performance than HFCs in HAT countries
- In the meantime, HAT countries will be reliant on R-410A equipment less efficient at high temperatures
- Manufacturers of R-410A equipment may not be eligible for MLF transition funds during HAT exemption

Possible HAT Definition Structure

1. Existing Standards Definition

a) e.g. ASHRAE Climate zones

2. New Definition

a) Average temperature

b) Cooling degree days

c) Peak temperature

Peak Temperature HAT Definition

- What temperature?
 - International Standards Organization (ISO) Standard 5151:2010 includes a “T3” test condition at 46°C
- For how long?
 - Frich et al. (2002) and others define a heat wave as 5 days

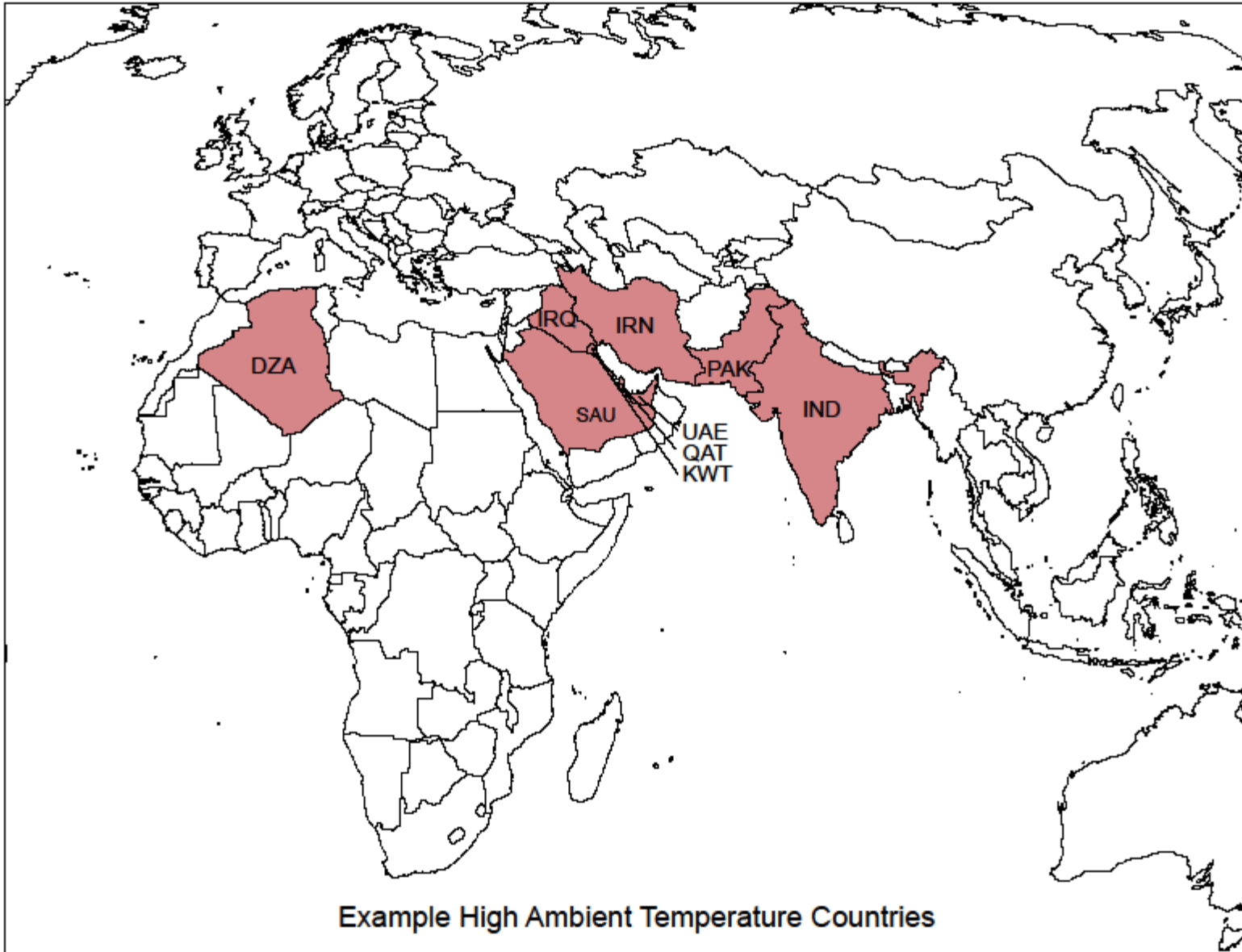
Peak Temperature HAT Definition

- In our example, a country experiences HAT if:
 - It contains a weather station that measures a temperature of at least
47°C
 - for at least
10 days per year
 - at least once over the last four years.

Methodology

1. Collected and processed Integrated Surface Database (ISD) data from 2011-2014
 - Includes hourly temperature measurements from over 14,000 weather stations worldwide
2. Checked each weather station to find number of days above 47°C each year
3. Matched weather stations with 10 or more days above 47°C to their home countries

Results - 47°C & 10 days



Results - 47°C & 10 days

Countries meeting this HAT definition are:

1. Iraq
2. Iran
3. Kuwait
4. Algeria
5. Pakistan
6. Saudi Arabia
7. Qatar
8. India
9. United Arab Emirates
10. United States of America (likely ineligible as an A2)

Conclusions

- Evidence emerging that alternatives to HFCs perform better than HFCs at HAT
- HAT can be defined for air conditioning applications, using objective metrics that result in a group of eligible countries

References

- Abdelaziz, Omar et al. *Alternative Refrigerant Evaluation for High-Ambient-Temperature-Environments*. Oak Ridge National Laboratory. October 2015.