

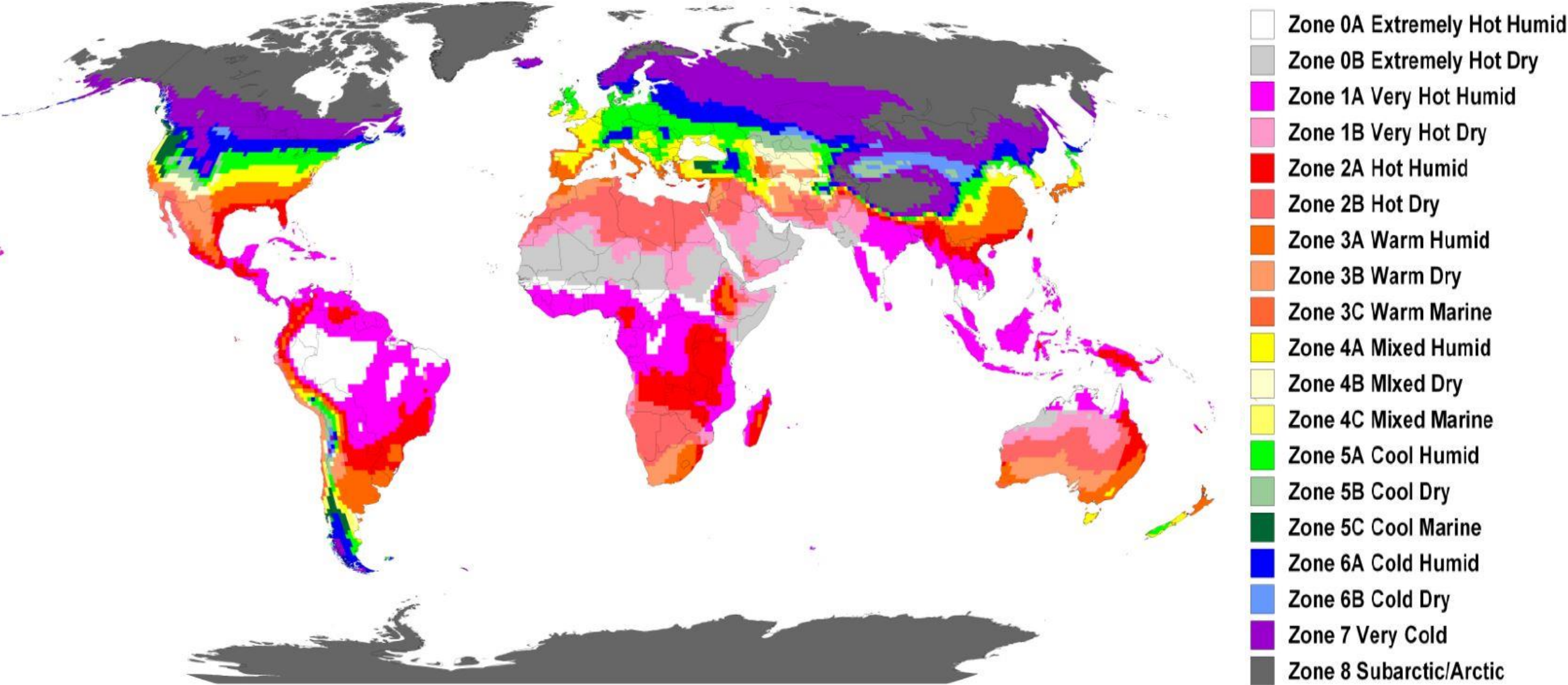
VISUALIZING CLIMATES AND HUMIDIFICATION TO FIGHT PANDEMICS

RELATIVE HUMIDITY PROFILES FOR MAJOR SOUTHERN HEMISPHERE CITIES

1. CLIMATE ZONE MAP
2. VISUALIZING CLIMATE OVERVIEW
3. ZONE 1A – JAKARTA, INDONESIA
4. ZONE 1A – SAO PAULO, BRAZIL
5. ZONE 3C – BUENOS AIRES, ARGENTINA
6. ZONE 1A – RIO DE JANEIRO, BRAZIL
7. ZONE 1A – KINSHASA, CONGO
8. ZONE 1A – LIMA, PERU
9. ZONE 4A – JOHANNESBURG, SOUTH AFRICA
10. ZONE 4A – SANTIAGO, CHILE
11. ZONE 3C – SYDNEY, AUSTRALIA

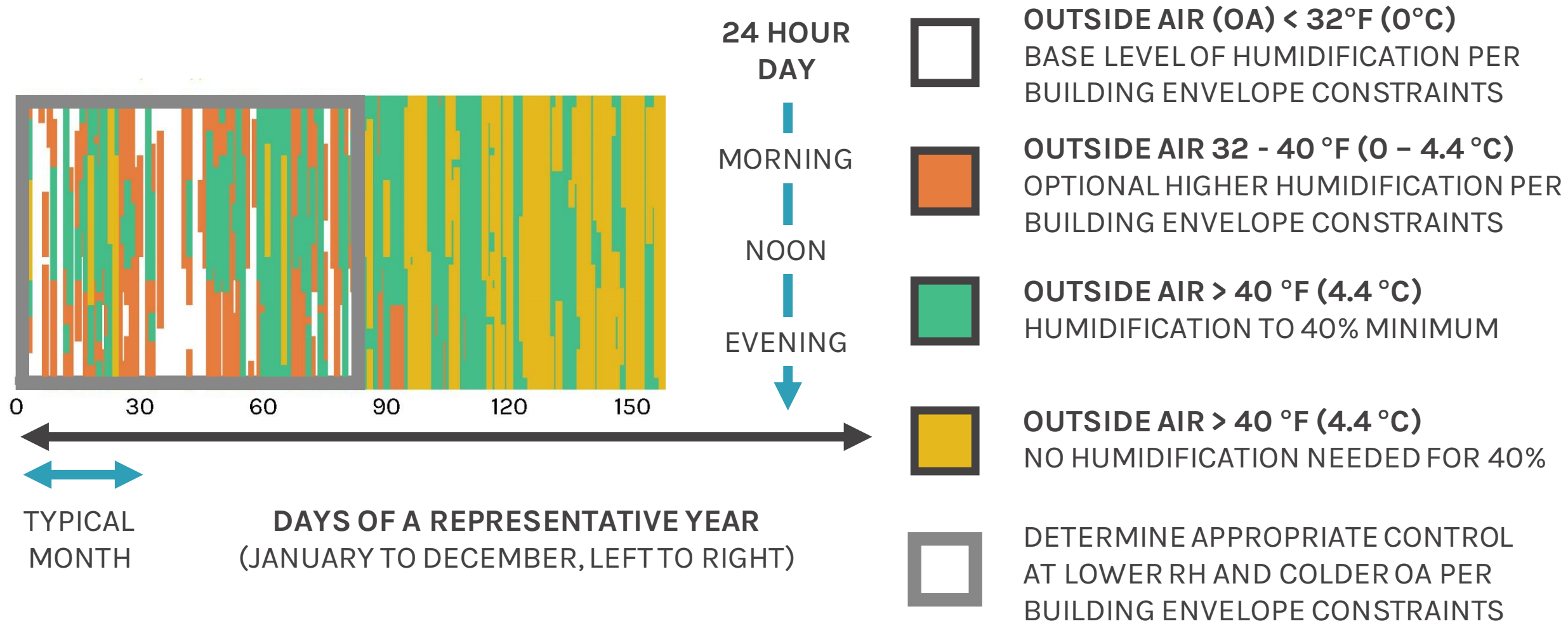
ASHRAE CLIMATE ZONES AND ASHRAE STANDARD 169-2013

CLIMATE ZONE VARIATION BY LOCATION IN THE WORLD



VISUALIZING RELATIVE HUMIDITY OPERATION BY LOCATION

RELATIVE HUMIDITY NEEDS VARY GREATLY BY LOCATION AND ELEVATION



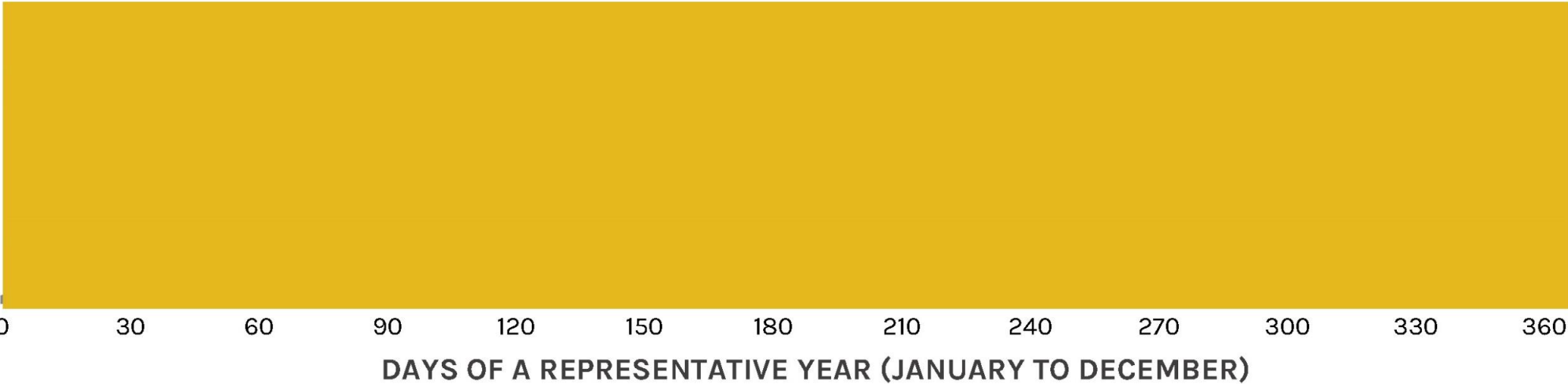
ASHRAE CLIMATE ZONE 1A

VERY HOT - HUMID

JAKARTA SOEKARNO HATTA INTL AP, IDN

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 100% OF DAYS PER YEAR

Jakarta Soekarno Hatta Intl AP, IDN
34 FEET ABOVE SEA LEVEL
LATITUDE: -6.126 / LONGITUDE: 106.656



* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- SUPPLEMENTAL HUMIDIFICATION TO MINIMUM 40% IS NOT REQUIRED
- NO POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS

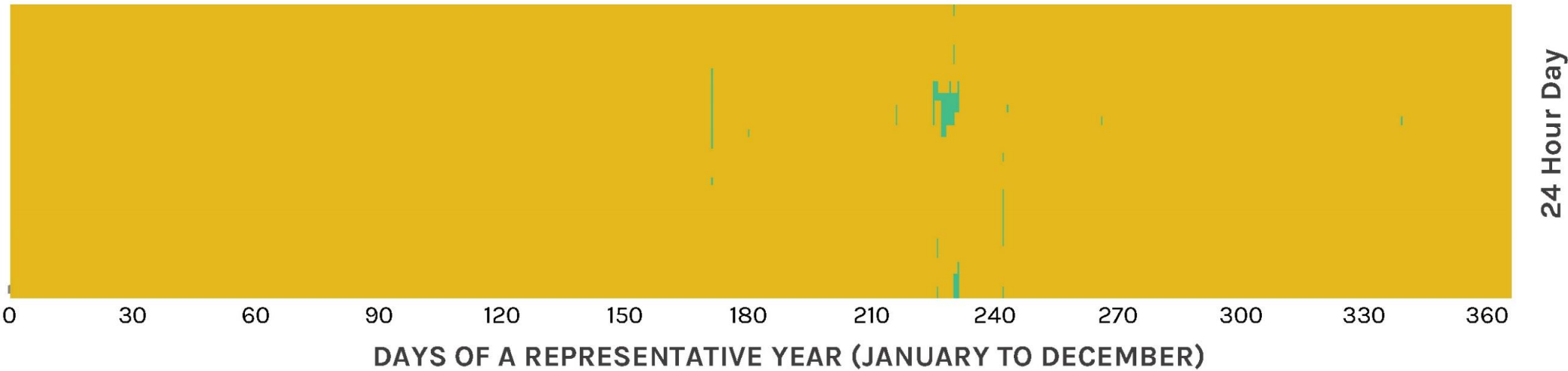
ASHRAE CLIMATE ZONE 1A

VERY HOT - HUMID

SAO PAULO-CONGONHAS AP, BRA

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 1% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 99% OF DAYS PER YEAR

Sao Paulo-Congonhas AP, BRA
2631 FEET ABOVE SEA LEVEL
LATITUDE: -23.62 / LONGITUDE: -46.65



* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- SUPPLEMENTAL HUMIDIFICATION TO MINIMUM 40% IS NOT REQUIRED
- NO POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS

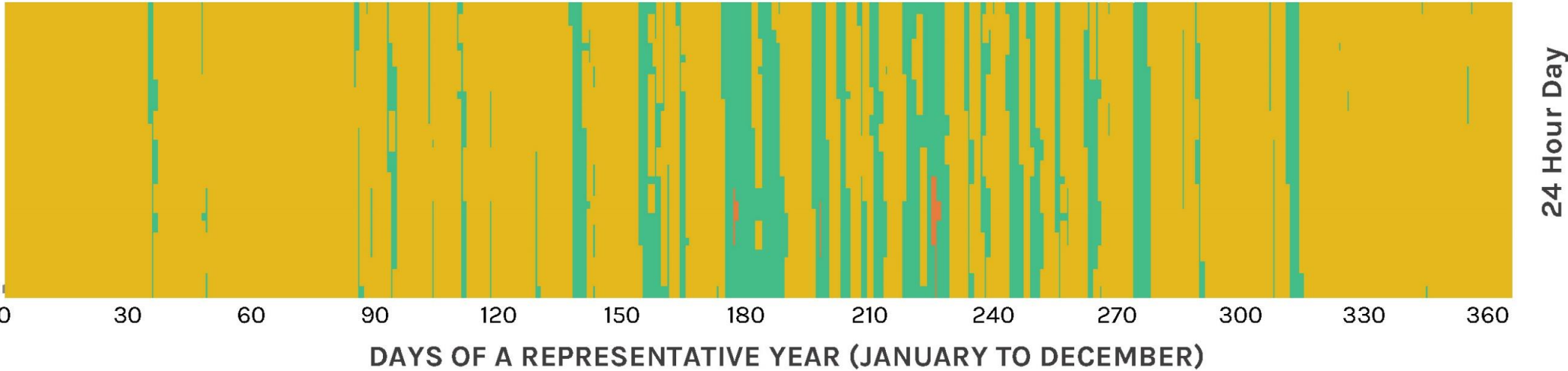
ASHRAE CLIMATE ZONE 3C

WARM - MARINE

BUENOS AIRES NEWBERY INTL AP, ARG

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 24% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 76% OF DAYS PER YEAR

Buenos Aires Newbery Intl AP, ARG
18 FEET ABOVE SEA LEVEL
LATITUDE: -34.559 / LONGITUDE: -58.416



* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- NEED FOR SUPPLEMENTAL HUMIDIFICATION TO 40% RH MINIMUM IS LIMITED TO LATE FALL THROUGH EARLY SPRING
- MINIMAL POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS
- CONSIDER SUPPLEMENTAL HUMIDIFICATION TO 40% MINIMUM FOR LATE FALL TO EARLY SPRING

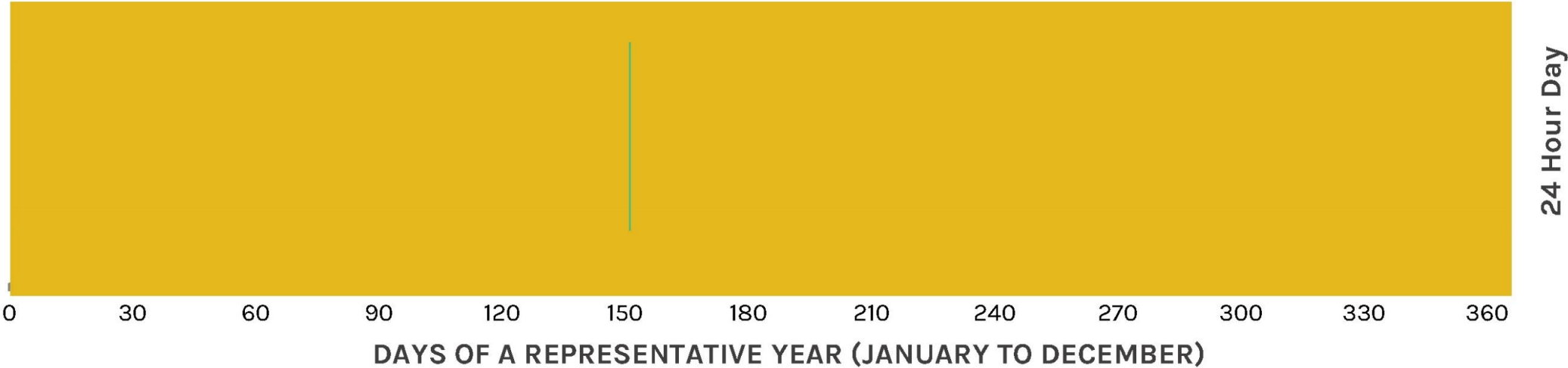
ASHRAE CLIMATE ZONE 1A

VERY HOT - HUMID

RIO DE JANEIRO GALEAO INTL AP, BRA

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 100% OF DAYS PER YEAR

Rio de Janeiro Galeao Jobim Intl AP, BRA
28 FEET ABOVE SEA LEVEL
LATITUDE: -22.809 / LONGITUDE: -43.244



* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- SUPPLEMENTAL HUMIDIFICATION TO MINIMUM 40% IS NOT REQUIRED
- NO POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS

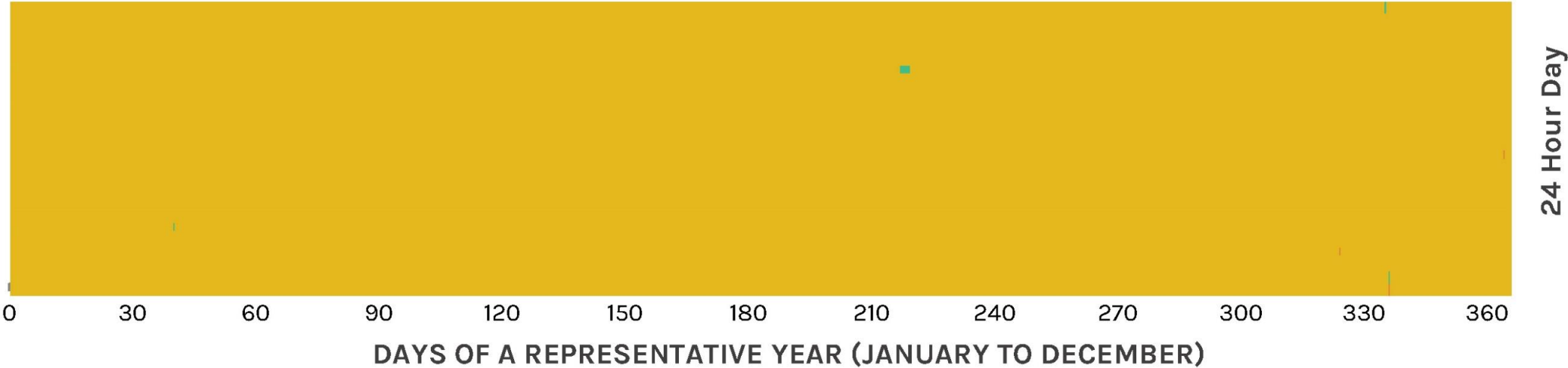
ASHRAE CLIMATE ZONE 1A

VERY HOT - HUMID

KINSHASA BRAZZAVILLE MAYA MAY INTL AP, COG

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 100% OF DAYS PER YEAR

Kinshasa Brazzaville Maya Maya Intl AP, COG
1048 FEET ABOVE SEA LEVEL
LATITUDE: -4.252 / LONGITUDE: 15.253



* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- SUPPLEMENTAL HUMIDIFICATION TO MINIMUM 40% IS NOT REQUIRED
- NO POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS

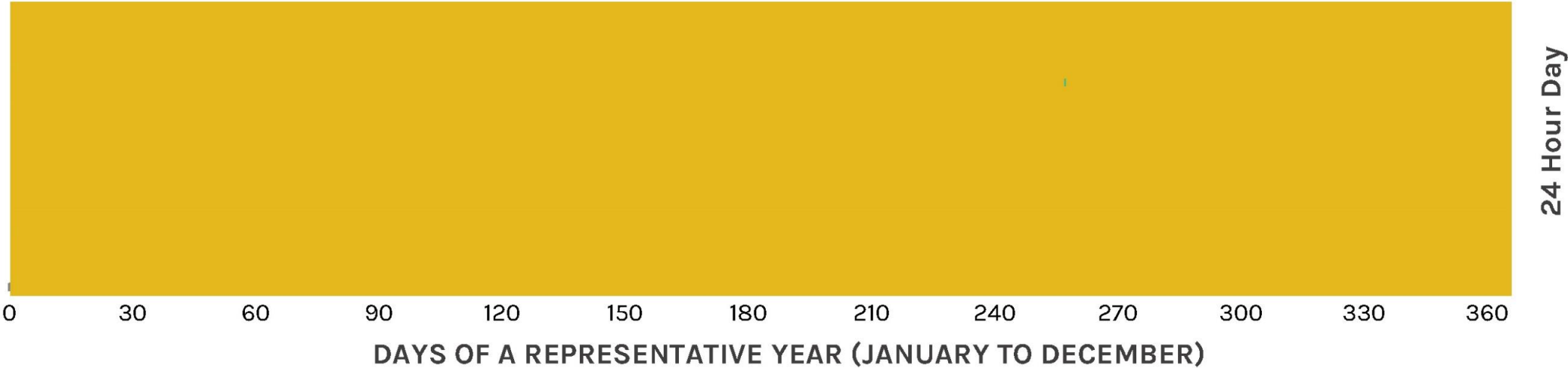
ASHRAE CLIMATE ZONE 1A

VERY HOT - HUMID

LIMA CHAVEZ INTL AP, PER

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 100% OF DAYS PER YEAR

Lima Chavez Intl AP, PER
113 FEET ABOVE SEA LEVEL
LATITUDE: -12.022 / LONGITUDE: -77.114



* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- SUPPLEMENTAL HUMIDIFICATION TO MINIMUM 40% IS NOT REQUIRED
- NO POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS

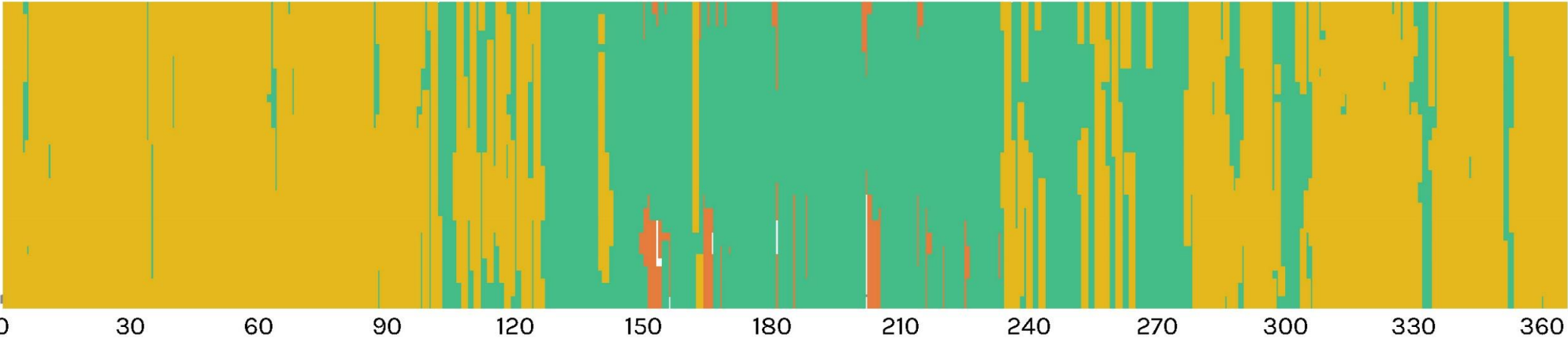
ASHRAE CLIMATE ZONE 4A

MIXED - HUMID

JOHANNESBURG, ZAF

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 3% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 46% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 51% OF DAYS PER YEAR

JOHANNESBURG, ZAF
5576 FEET ABOVE SEA LEVEL
LATITUDE: -26.13 / LONGITUDE: 28.23



DAYS OF A REPRESENTATIVE YEAR (JANUARY TO DECEMBER)

* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- ELEVATED OUTDOOR HUMIDITY IN SUMMER/FALL REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- NEED FOR SUPPLEMENTAL HUMIDIFICATION TO 40% RH MINIMUM IS LIMITED TO FALL THROUGH SPRING
- LOW POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS
- PROVIDE SUPPLEMENTAL HUMIDIFICATION TO 40% MINIMUM TOGETHER WITH ABILITY TO REDUCE WITH OA TEMPERATURES BELOW 40 °F (4.4 °C)

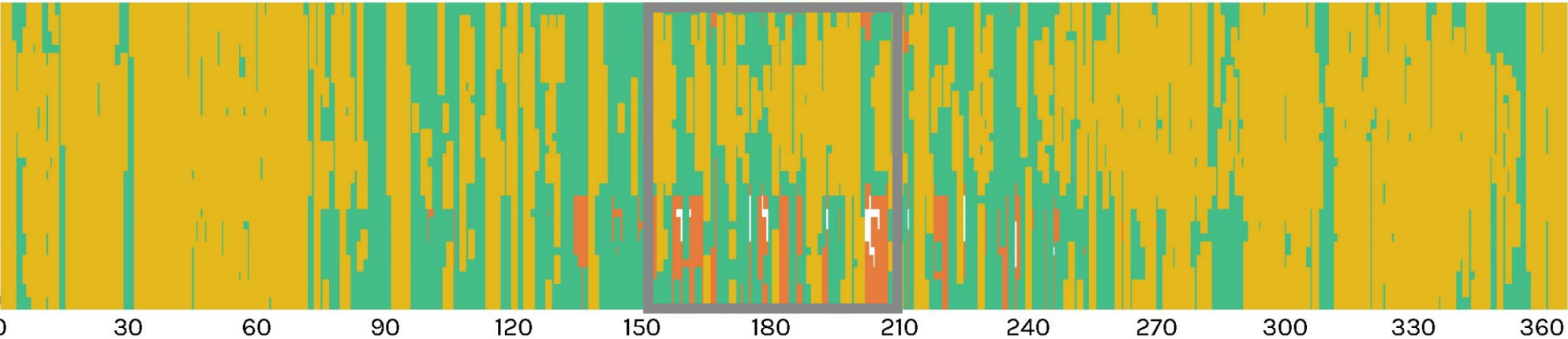
ASHRAE CLIMATE ZONE 4A

MIXED - HUMID

SANTIAGO BENITEZ INTL AP, CHL

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 1% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 5% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 42% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 52% OF DAYS PER YEAR

Santiago Benitez Intl AP, CHL
1555 FEET ABOVE SEA LEVEL
LATITUDE: -33.393 / LONGITUDE: -70.786



DETERMINE APPROPRIATE
CONTROL AT LOWER RH*

DAYS OF A REPRESENTATIVE YEAR (JANUARY TO DECEMBER)

* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- ELEVATED OUTDOOR HUMIDITY IN SUMMER/FALL REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- NEED FOR SUPPLEMENTAL HUMIDIFICATION TO 40% RH MINIMUM IS LIMITED TO FALL THROUGH SPRING
- LOW POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

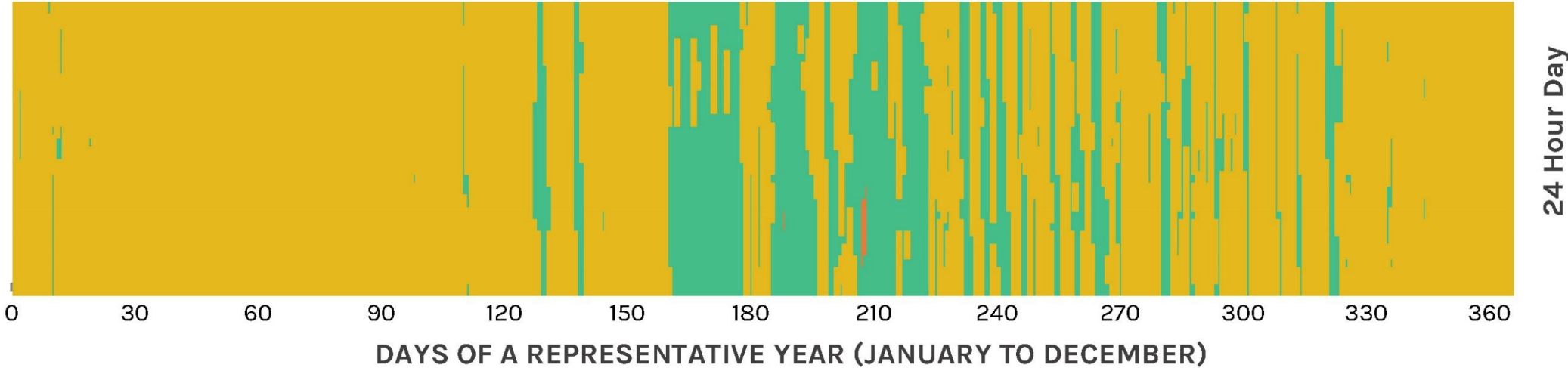
- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS
- PROVIDE SUPPLEMENTAL HUMIDIFICATION TO 40% MINIMUM TOGETHER WITH ABILITY TO REDUCE WITH OA TEMPERATURES BELOW 40 °F (4.4 °C)

ASHRAE CLIMATE ZONE 3C

WARM - MARINE SYDNEY, AUS

- OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 0% OF DAYS PER YEAR
- OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 27% OF DAYS PER YEAR
- OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 73% OF DAYS PER YEAR

SYDNEY, AUS
10 FEET ABOVE SEA LEVEL
LATITUDE: -33.95 / LONGITUDE: 151.18



* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- NEED FOR SUPPLEMENTAL HUMIDIFICATION TO 40% RH MINIMUM IS LIMITED TO LATE FALL THROUGH EARLY SPRING
- MINIMAL POTENTIAL FOR FREEZING IN THIS CLIMATE

RECOMMENDATIONS

- PROVIDE HVAC SYSTEMS THAT MAINTAIN UPPER LIMIT RELATIVE HUMIDITY OF 60% OR LESS
- CONSIDER SUPPLEMENTAL HUMIDIFICATION TO 40% MINIMUM FOR LATE FALL TO EARLY SPRING

Design a
Better Future

SMITHGROUP