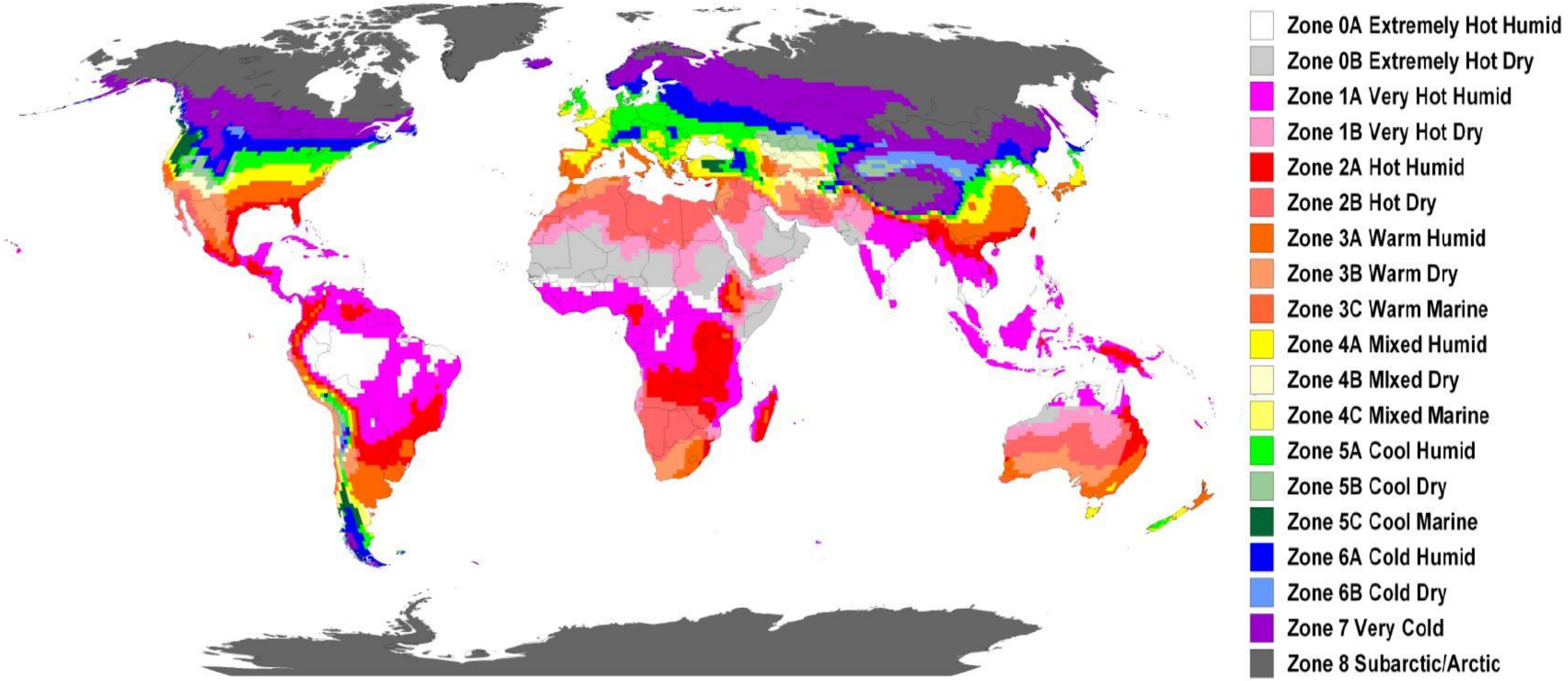
VISUALIZING CLIMATES AND HUMIDIFICATION TO FIGHT PANDEMICS

RELATIVE HUMIDITY PROFILES FOR NOTABLE NORTHERN HEMISPHERE CITIES

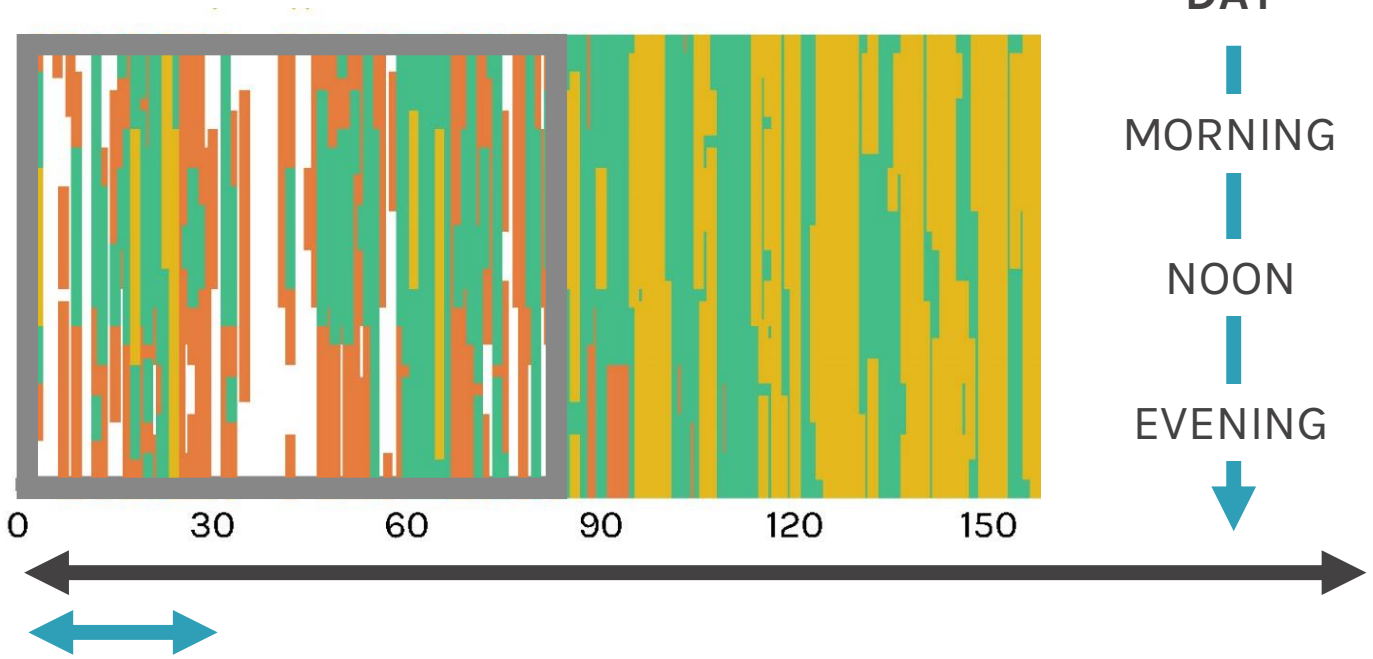
ASHRAE CLIMATE ZONES AND ASHRAE STANDARD 169-2013

CLIMATE ZONE VARIATION BY LOCATION IN THE WORLD



VISUALIZING RELATIVE HUMIDITY OPERATION BY LOCATION

RELATIVE HUMIDITY NEEDS VARY GREATLY BY LOCATION AND ELEVATION



OUTSIDE AIR (OA) < 32°F (0°C)
BASE LEVEL OF HUMIDIFICATION PER BUILDING ENVELOPE CONSTRAINTS

OUTSIDE AIR 32 - 40 °F (0 – 4.4 °C)
OPTIONAL HIGHER HUMIDIFICATION PER BUILDING ENVELOPE CONSTRAINTS

OUTSIDE AIR > 40 °F (4.4 °C)
HUMIDIFICATION TO 40% MINIMUM

OUTSIDE AIR > 40 °F (4.4 °C)
NO HUMIDIFICATION NEEDED FOR 40%

DETERMINE APPROPRIATE CONTROL AT LOWER RH AND COLDER OA PER BUILDING ENVELOPE CONSTRAINTS

ASHRAE CLIMATE ZONE 3A

WARM - HUMID

ROME, ITA

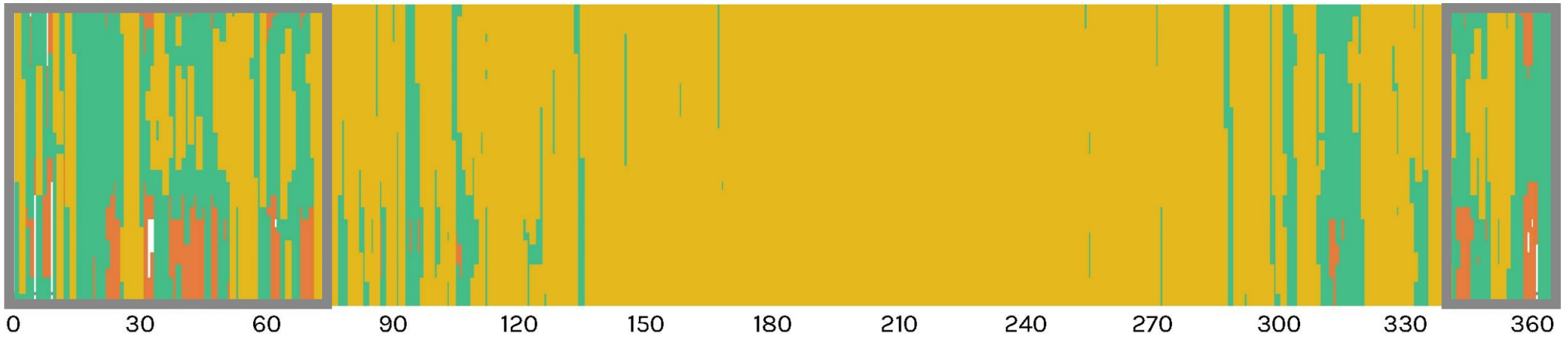
OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 1% OF DAYS PER YEAR

OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 5% OF DAYS PER YEAR

OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 25% OF DAYS PER YEAR

OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 69% OF DAYS PER YEAR

ROME, ITA
10 FEET ABOVE SEA LEVEL
LATTITUDE: 41.8 / LONGITUDE: 12.23



DETERMINE APPROPRIATE CONTROL AT LOWER RH*

* 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 FALL THROUGH SPRING
- LIMITED 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)

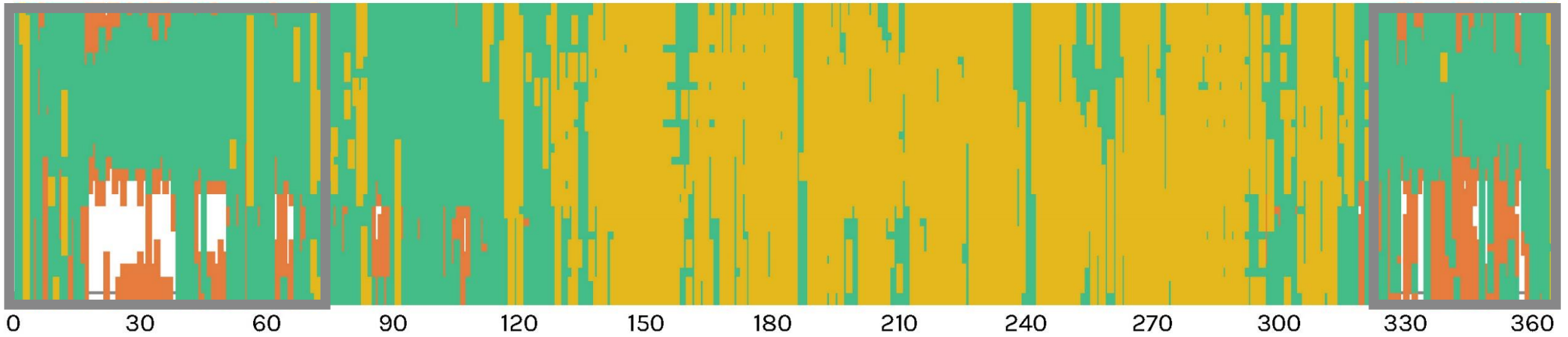
ASHRAE CLIMATE ZONE 4A

MIXED - HUMID

MADRID, ESP

OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 3% OF DAYS PER YEAR
OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 9% OF DAYS PER YEAR
OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 48% OF DAYS PER YEAR
OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 40% OF DAYS PER YEAR

MADRID, ESP
1909 FEET ABOVE SEA LEVEL
LATTITUDE: 40.45 / LONGITUDE: -3.55



DETERMINE APPROPRIATE CONTROL AT LOWER RH*

* 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
- POTENTIAL FOR FREEZING IN THIS CLIMATE

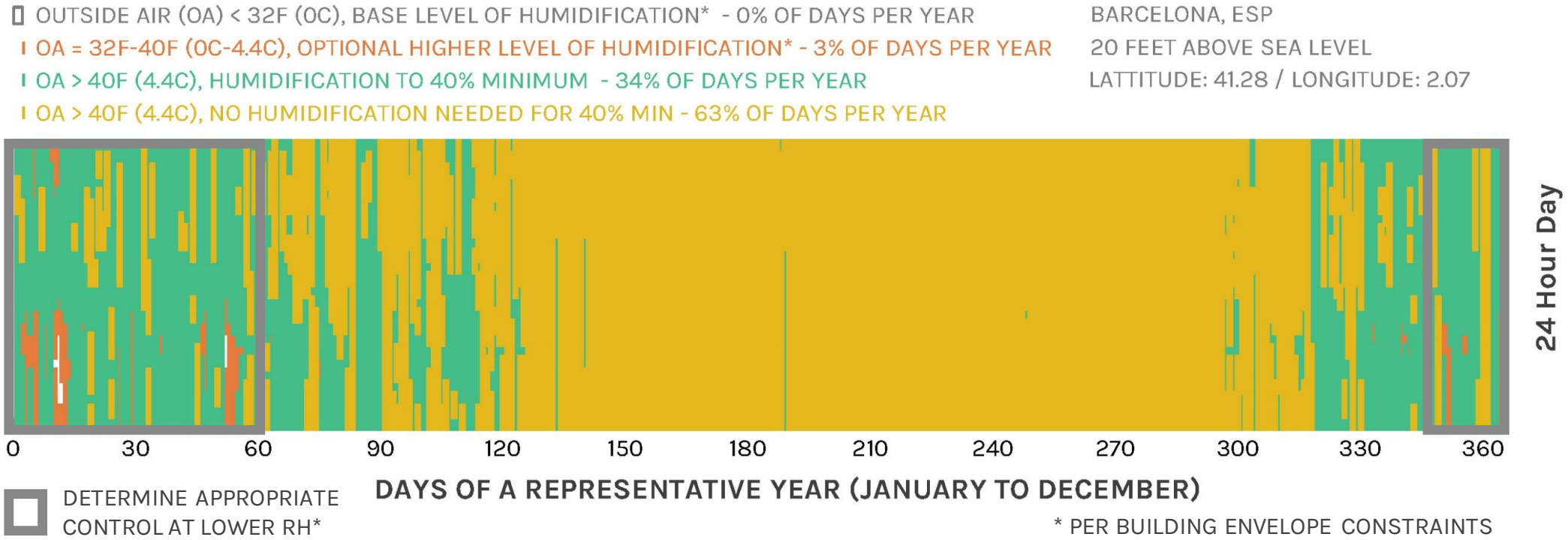
RECOMMENDATIONS

- 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 4C

MIXED - MARINE

BARCELONA, ESP



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
- PROVIDE SUPPLEMENTAL HUMIDIFICATION TO 40% MINIMUM FOR LATE FALL TO EARLY SPRING

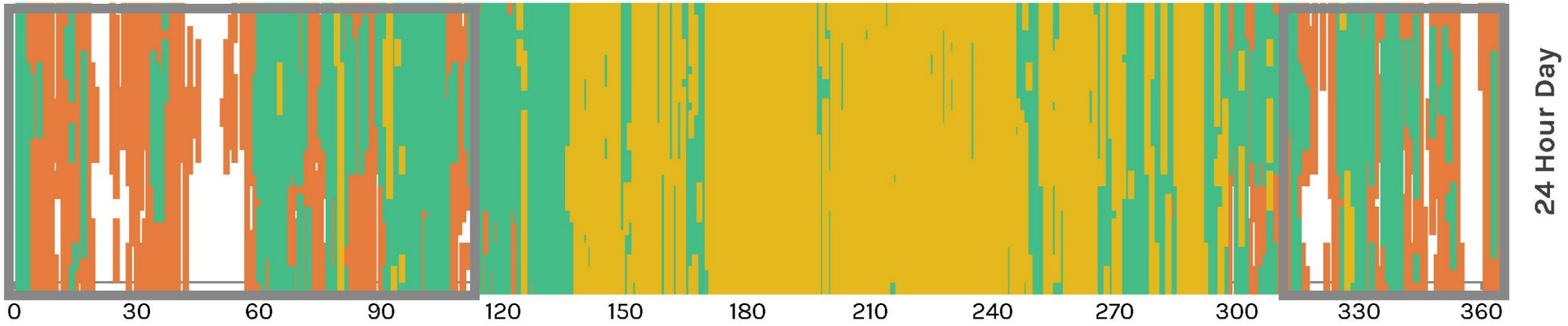
ASHRAE CLIMATE ZONE 5A

COOL - HUMID

BERLIN, DEU

OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 10% OF DAYS PER YEAR
OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 21% OF DAYS PER YEAR
OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 34% OF DAYS PER YEAR
OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 35% OF DAYS PER YEAR

BERLIN, DEU
161 FEET ABOVE SEA LEVEL
LATTITUDE: 52.47 / LONGITUDE: 13.4



DETERMINE APPROPRIATE CONTROL AT LOWER RH*

* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

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

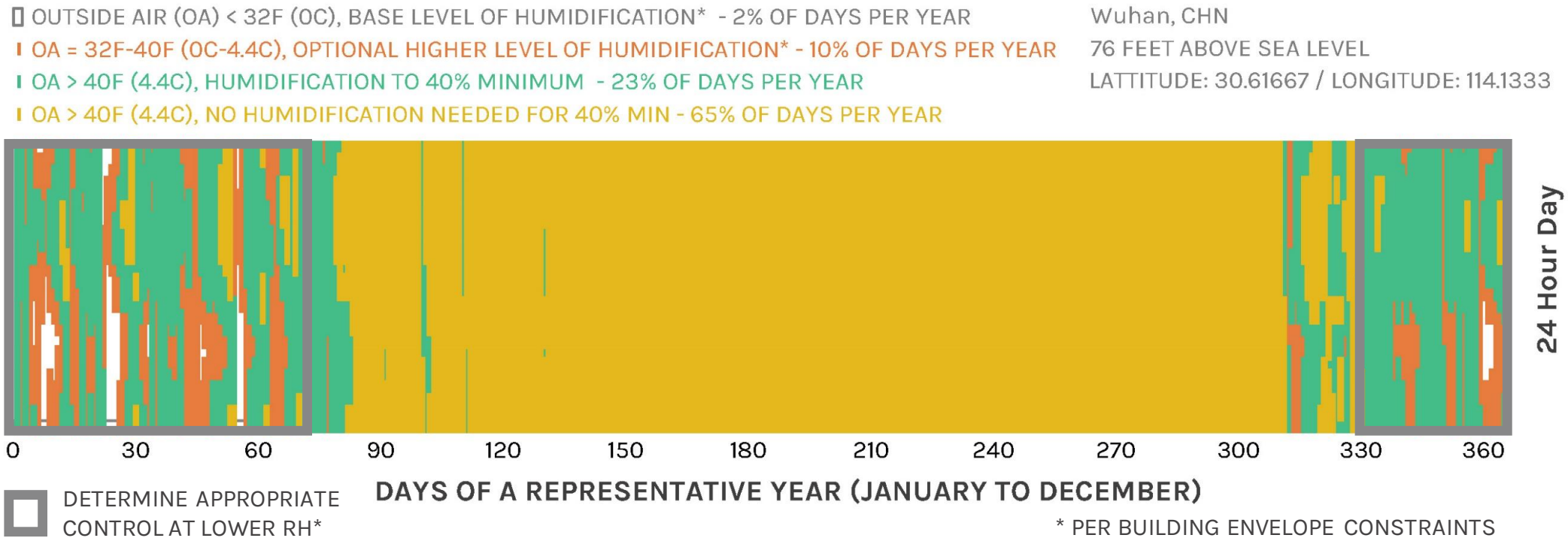
RECOMMENDATIONS

- 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 3A

WARM – HUMID

WUHAN, CHN



OBSERVATIONS

- CONSISTENTLY ELEVATED OUTDOOR HUMIDITY REQUIRES DEHUMIDIFICATION TO LOWER INDOOR RELATIVE HUMIDITY
- NEED FOR SUPPLEMENTAL HUMIDIFICATION TO 40% RH MINIMUM IS LIMITED TO FALL THROUGH SPRING
- SOME 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)

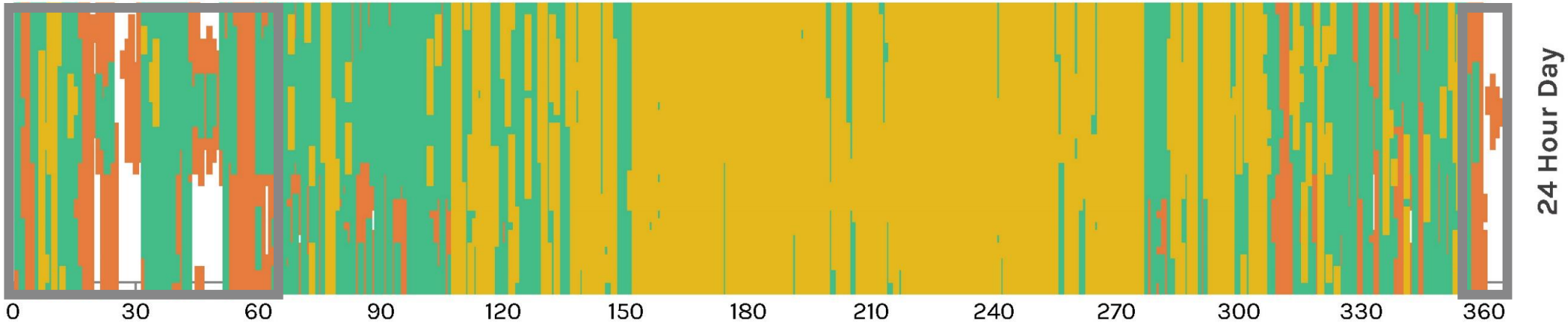
ASHRAE CLIMATE ZONE 4A

MIXED - HUMID

PARIS_ ORLY, FRA

OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 5% OF DAYS PER YEAR
OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 14% OF DAYS PER YEAR
OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 36% OF DAYS PER YEAR
OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 45% OF DAYS PER YEAR

PARIS_ ORLY, FRA
315 FEET ABOVE SEA LEVEL
LATTITUDE: 48.73 / LONGITUDE: 2.4



DETERMINE APPROPRIATE CONTROL AT LOWER RH*

* 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
- 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 3B

WARM – DRY

TEHRAN MEHRABAD INTL AP, IRN

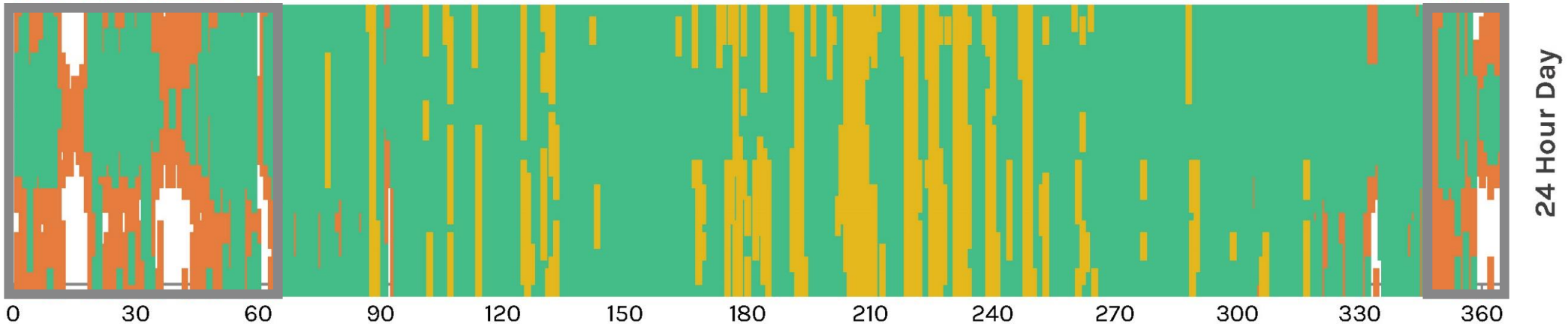
OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 4% OF DAYS PER YEAR

OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 12% OF DAYS PER YEAR

OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 73% OF DAYS PER YEAR

OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 11% OF DAYS PER YEAR

Tehran Mehrabad Intl AP, IRN
3903 FEET ABOVE SEA LEVEL
LATTITUDE: 35.68333 / LONGITUDE: 51.31667



DETERMINE APPROPRIATE CONTROL AT LOWER RH*

* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

- CONSISTENTLY DRY CONDITIONS WITH SHORTENED PERIODS OF ELEVATED HUMIDITY PRIMARILY IN SUMMER
- NEED FOR SUPPLEMENTAL HUMIDIFICATION TO 40% RH MINIMUM THROUGHOUT THE YEAR
- SOME POTENTIAL FOR FREEZING IN THIS CLIMATE

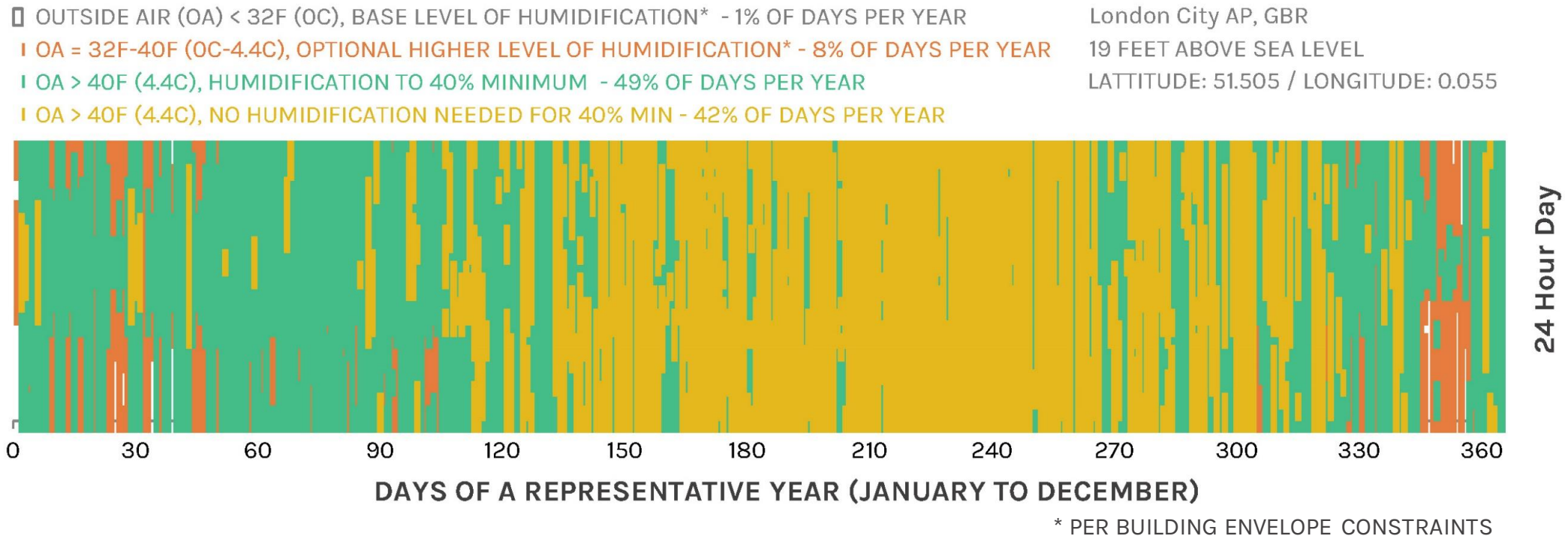
RECOMMENDATIONS

- 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 4C

MIXED – MARINE

LONDON CITY AP, GBR



* 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
- PROVIDE SUPPLEMENTAL HUMIDIFICATION TO 40% MINIMUM FOR LATE FALL TO EARLY SPRING

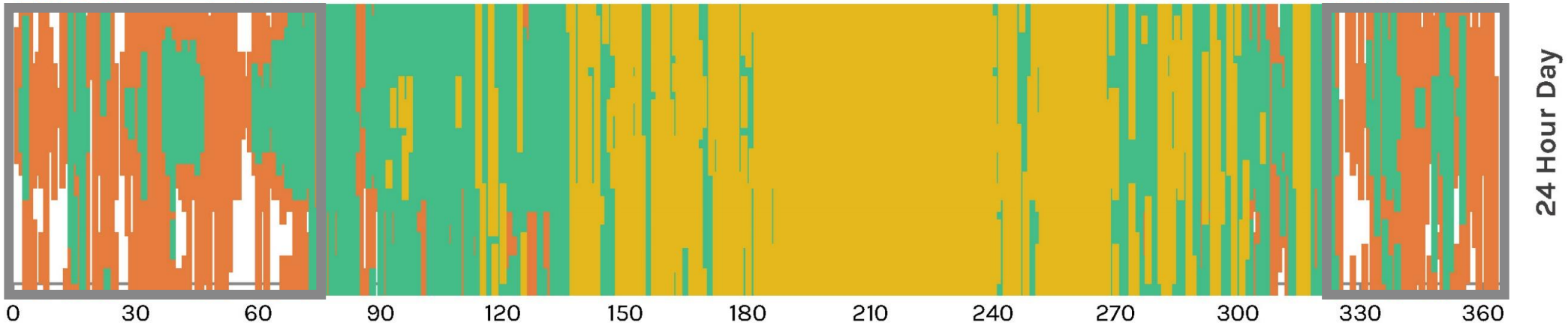
ASHRAE CLIMATE ZONE 5A

COOL - HUMID

GENEVA, CHE

OUTSIDE AIR (OA) < 32F (0C), BASE LEVEL OF HUMIDIFICATION* - 7% OF DAYS PER YEAR
OA = 32F-40F (0C-4.4C), OPTIONAL HIGHER LEVEL OF HUMIDIFICATION* - 22% OF DAYS PER YEAR
OA > 40F (4.4C), HUMIDIFICATION TO 40% MINIMUM - 34% OF DAYS PER YEAR
OA > 40F (4.4C), NO HUMIDIFICATION NEEDED FOR 40% MIN - 37% OF DAYS PER YEAR

GENEVA, CHE
1364 FEET ABOVE SEA LEVEL
LATTITUDE: 46.25 / LONGITUDE: 6.13



DETERMINE APPROPRIATE CONTROL AT LOWER RH*

* PER BUILDING ENVELOPE CONSTRAINTS

OBSERVATIONS

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

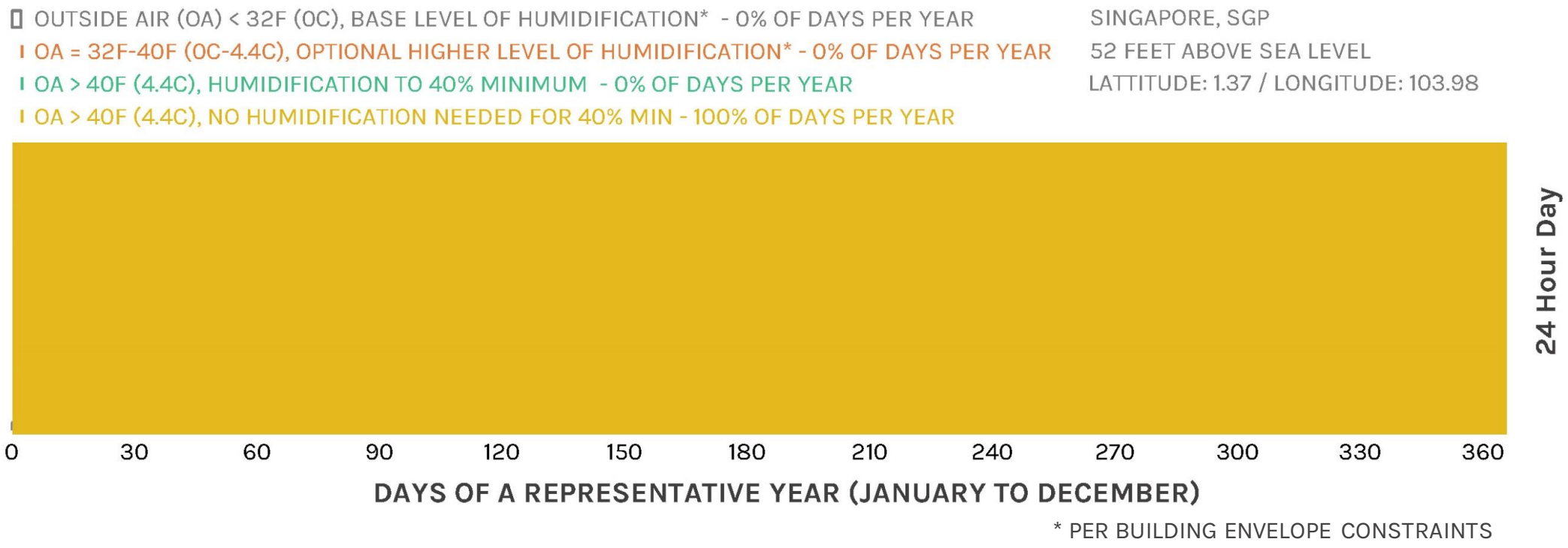
RECOMMENDATIONS

- 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 1A

VERY HOT - HUMID

SINGAPORE, SGP



* 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

Design a Better Future

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