METEOROLOGY PANEL

METP SWX User Workshop, 20 October 2025, Rome, Italy

Transition to Polygons

User Feedback

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Transitioning to Polygons

- Currently SWx advisories are issued in latitude bands

HNH	60˚ to 90˚	HSH	-60˚ to -90˚
MNH	30˚ to 60˚	MSH	-30˚ to -60˚
EQN	00˚ to 30˚	EQS	-00˚ to -30˚

- ICAO Annex 3 allows the SWx advisory to be issued using polygons to describe the geographic extent of the impacts of SWx events
- Transition will take part in 3 stages
  - Stage 1: November 2025
  - Stage 2: February 2026 (tentative)
  - Stage 3: May 2026 (tentative)

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Latitude Bands

HNH

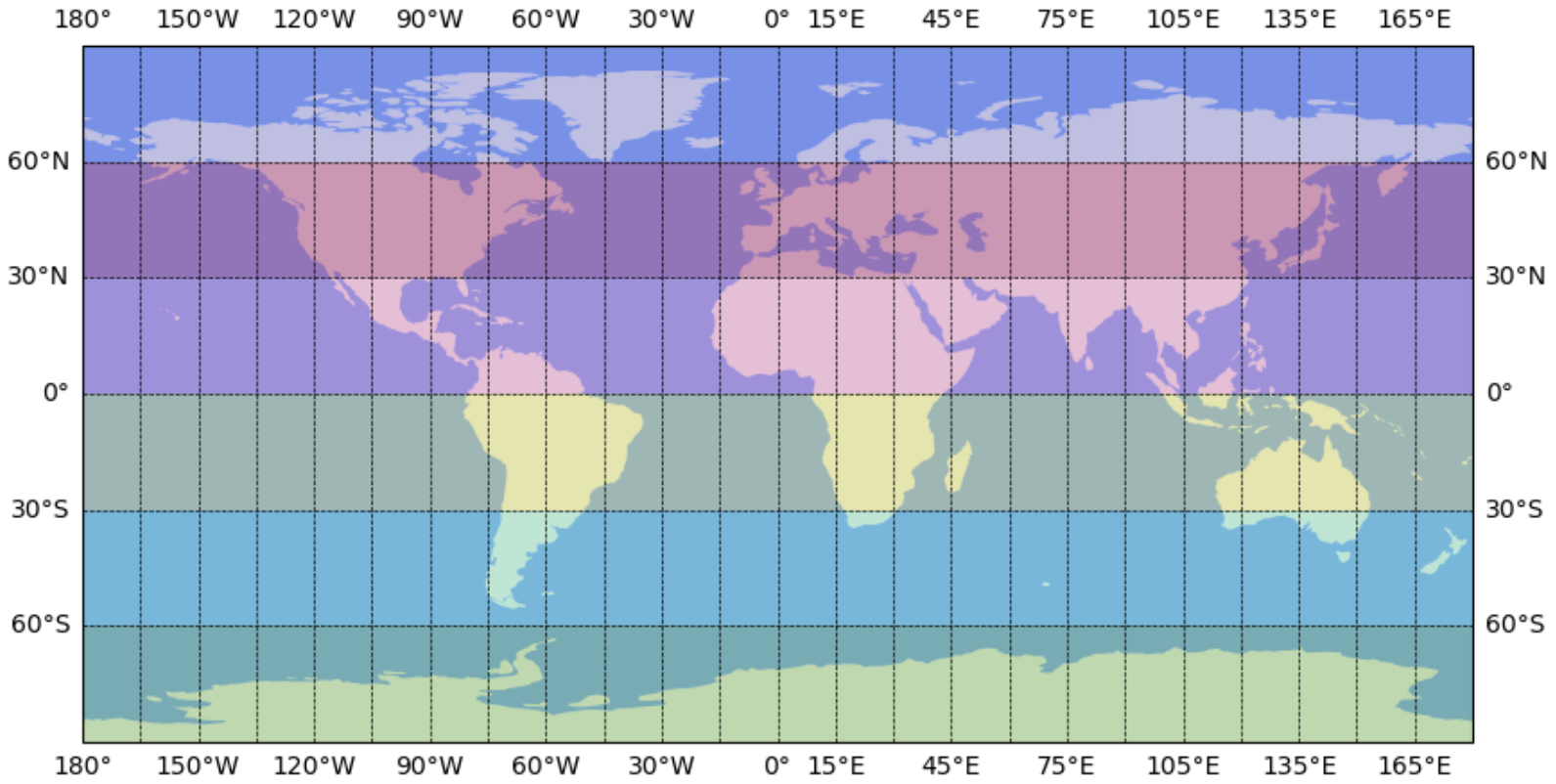
MNH

EQN

EQS

MSH

HSH



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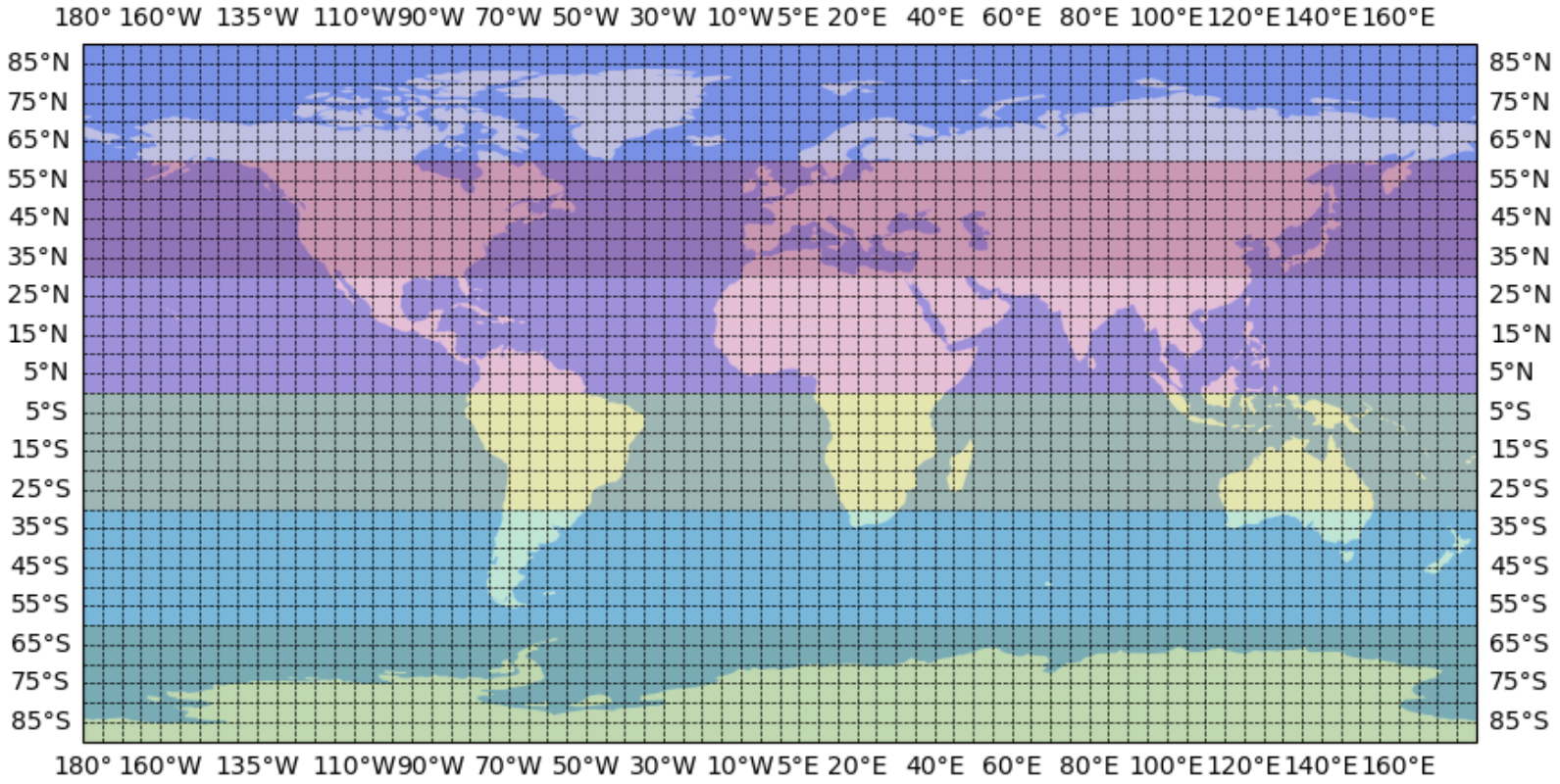
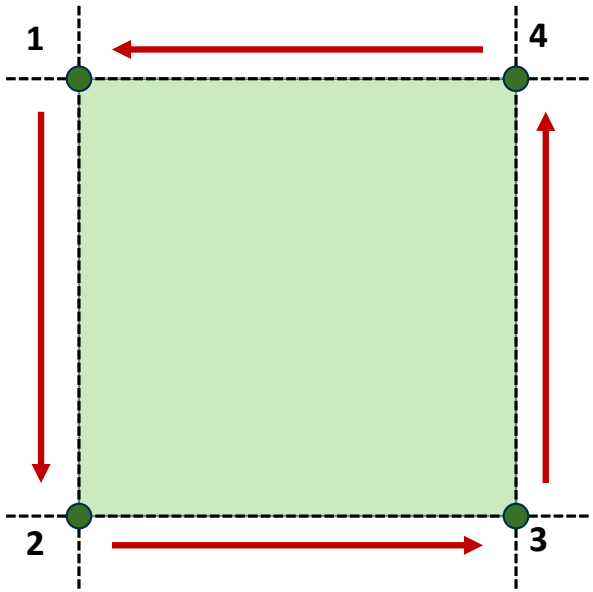
Polygons



5˚ resolution

Implementation

- Polygons are implemented gradually to ensure a smooth transition
  - 5 (moving to 7) vertices
  - First and last vertex are the same
  - Counterclockwise
  - Connecting lines follow lines of constant latitude and longitude
  - 5˚ x 5˚ resolution in latitude and longitude for the corner points



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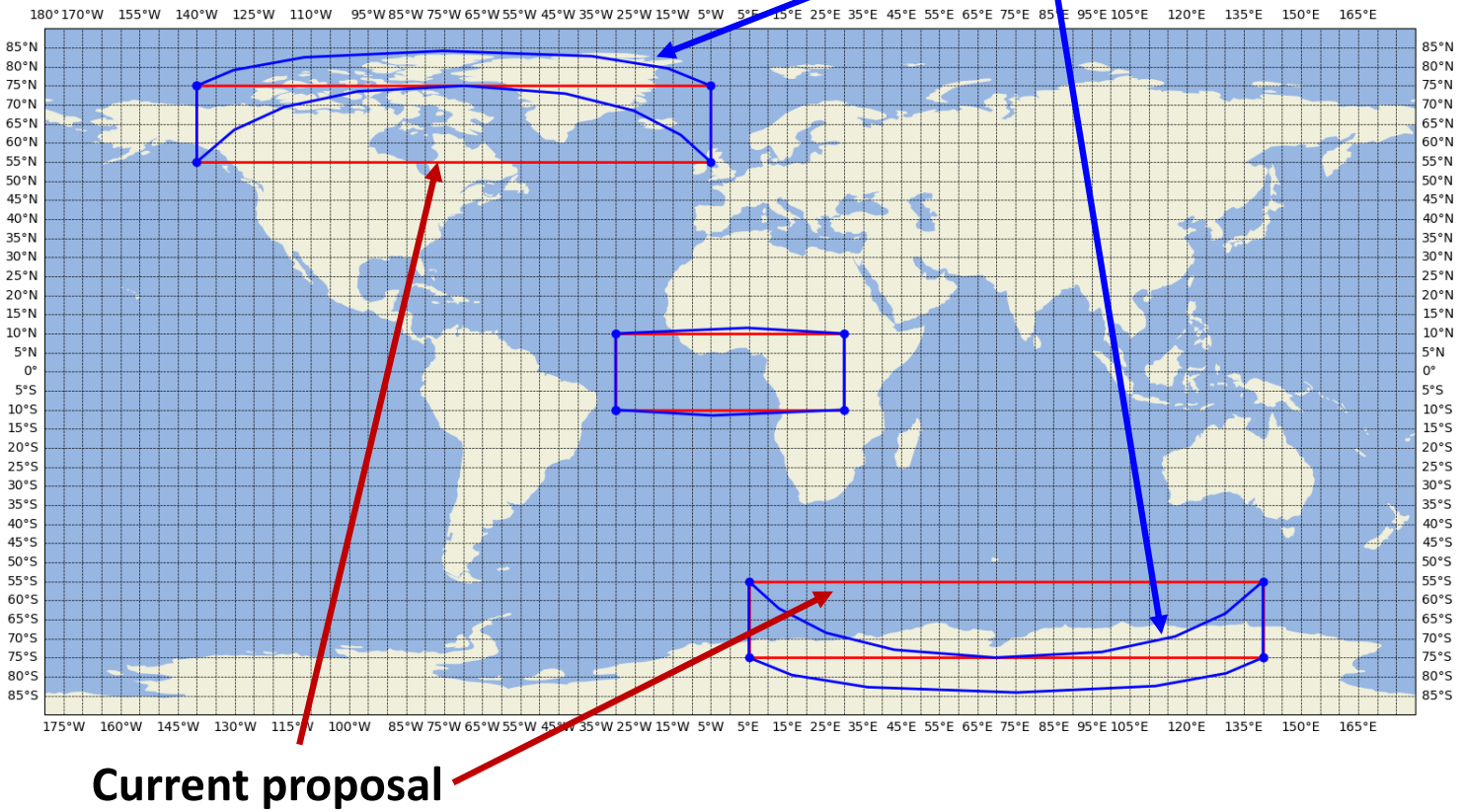
Connecting the dots

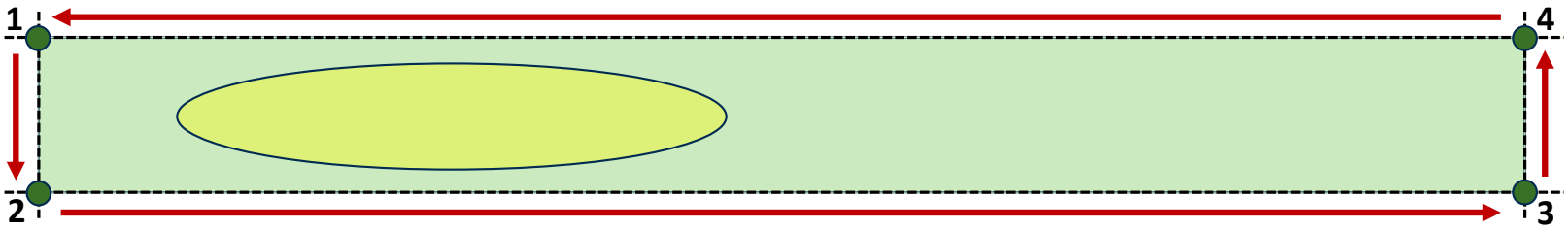


- Service providers and users must agree on how to connect polygon vertices
- Current proposal: connecting lines follow lines of constant latitude and longitude

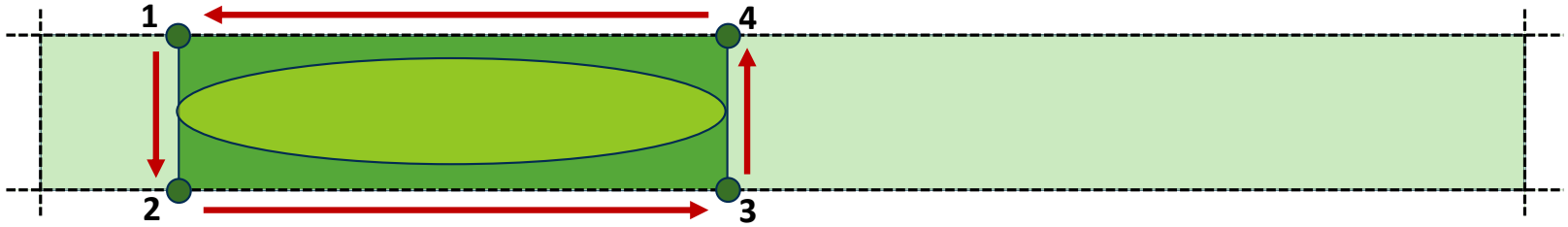
Does this agree with your visualization software?

Increased Precision

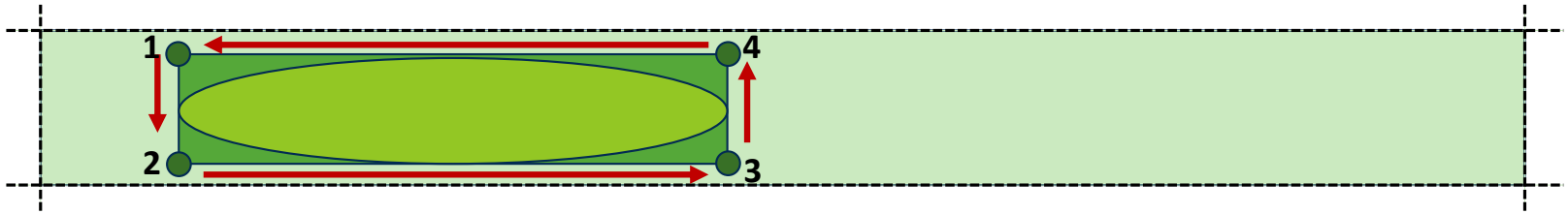
Latitude Bands with equivalent polygon



EQN EQS W180 – E180



N30 W150 – N00 W150 – N00 W015 – N30 W015 – N30 W150

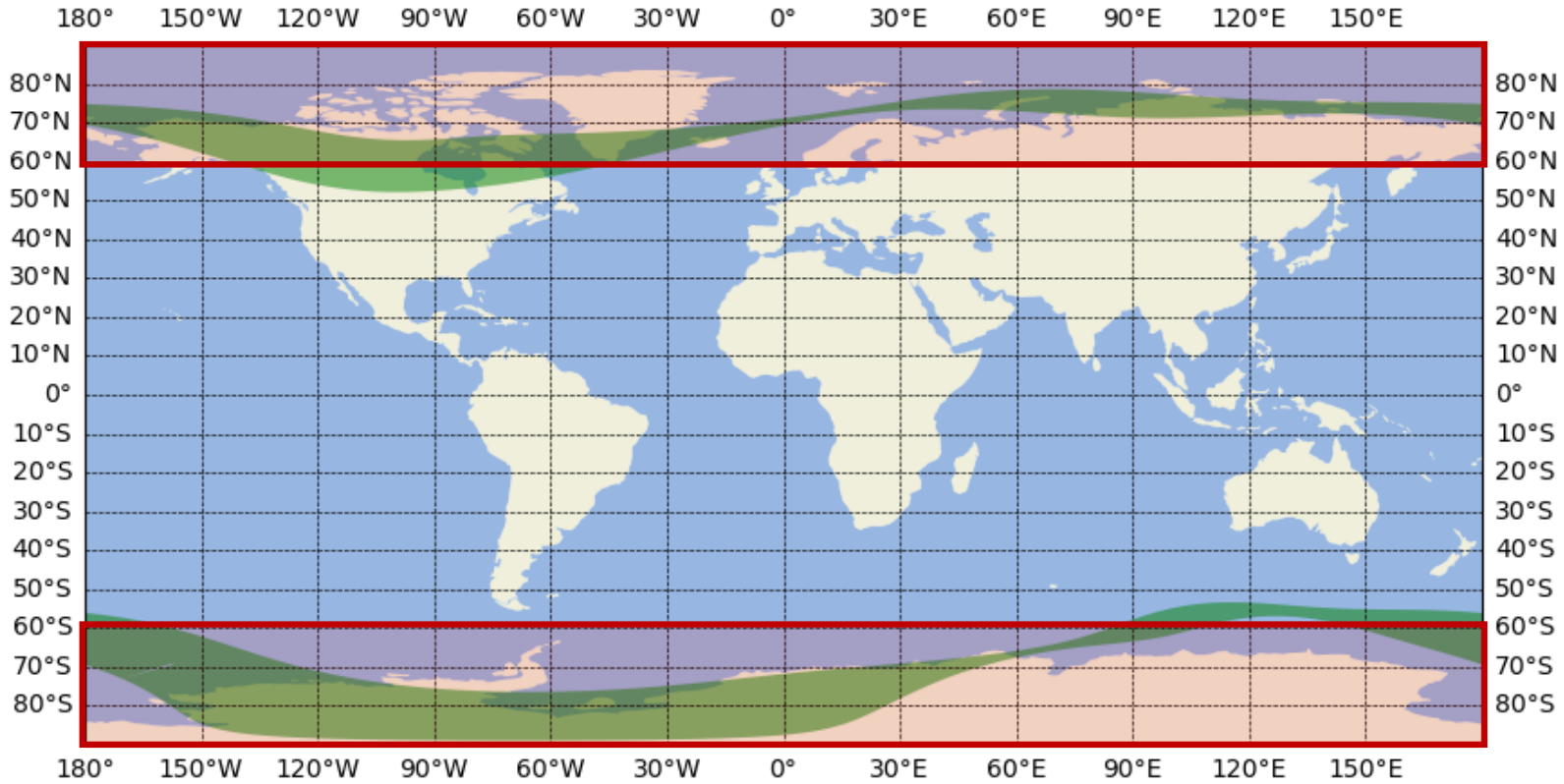


N20 W150 – N05 W150 – N05 W015 – N20 W015 – N20 W150

Increasing Precision

HF COM – Auroral Absorption

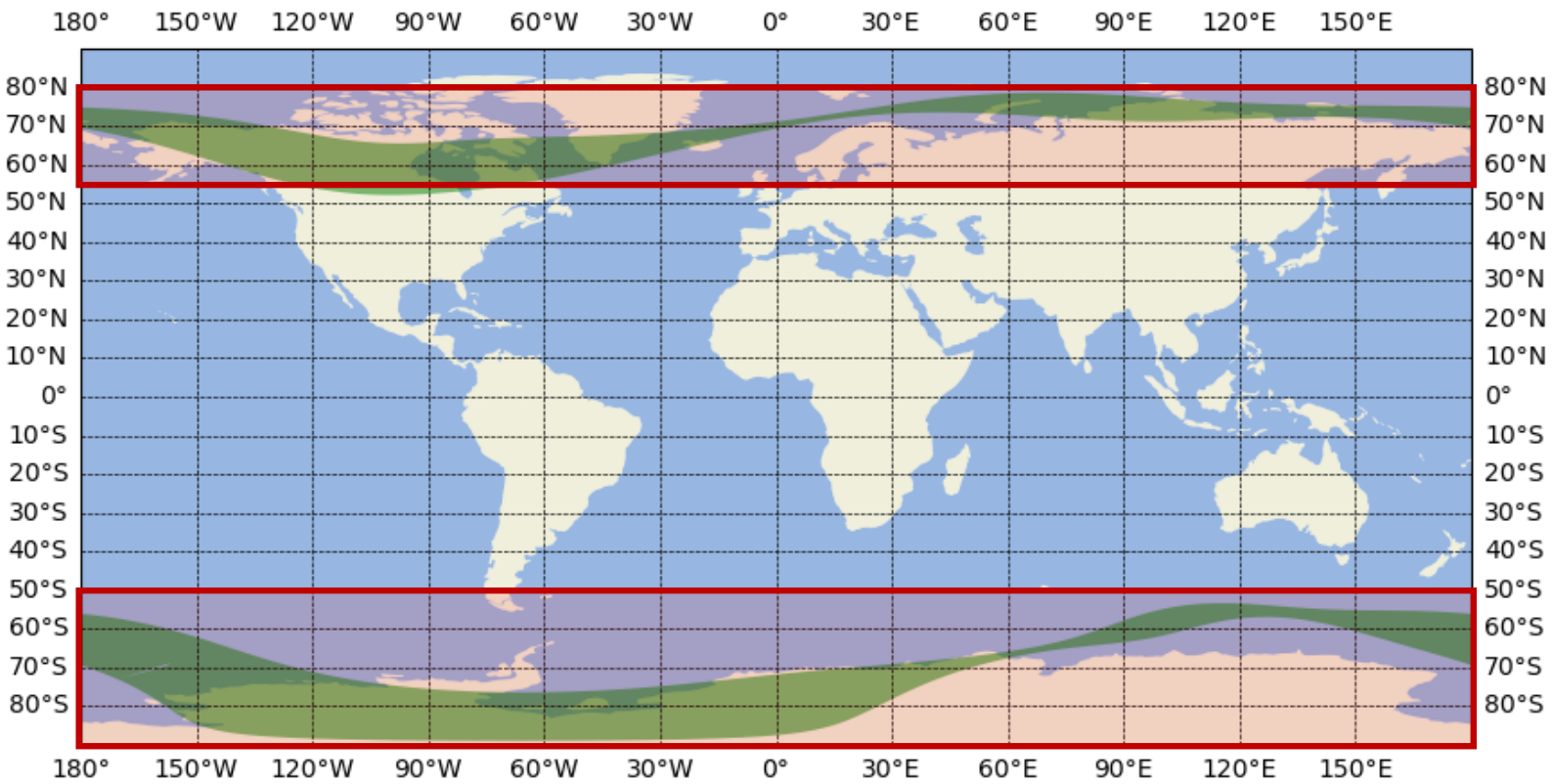
Latitude Bands



- Minimizes number of advisories
- Accounts for rotation of the Earth under the disturbance
- Exaggerates alerting region

HF COM – Auroral Absorption

Polygons – Stage 1



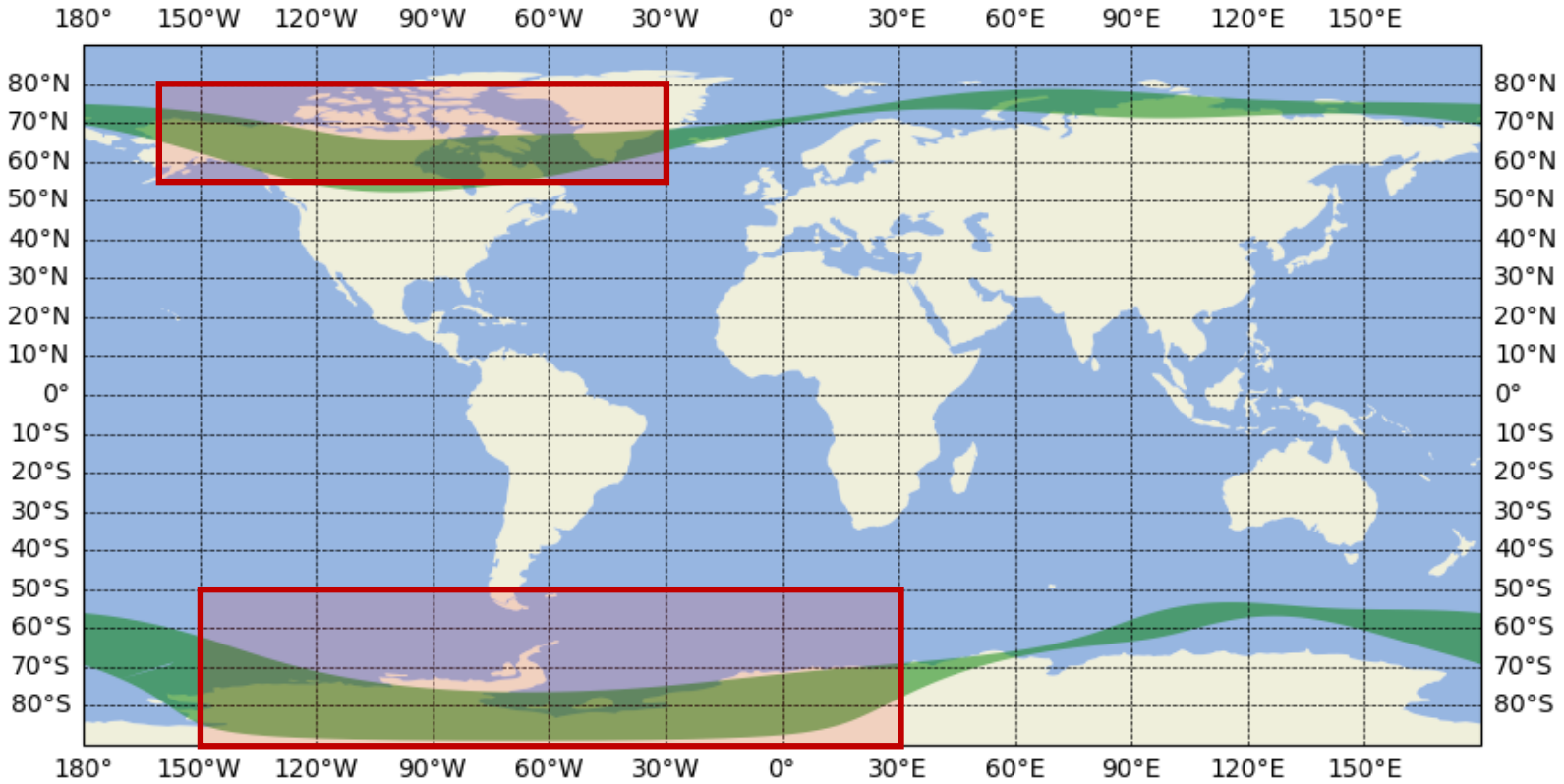
Northern	
80˚	100%
50˚	54%
55˚	38%
60˚	8%

Southern	
-90˚	92%
-85˚	8%
-45˚	59%
-50˚	39%
-55˚	2%

- More accurate alerting region
- Reflects lack of impact over the north pole

HF COM – Auroral Absorption

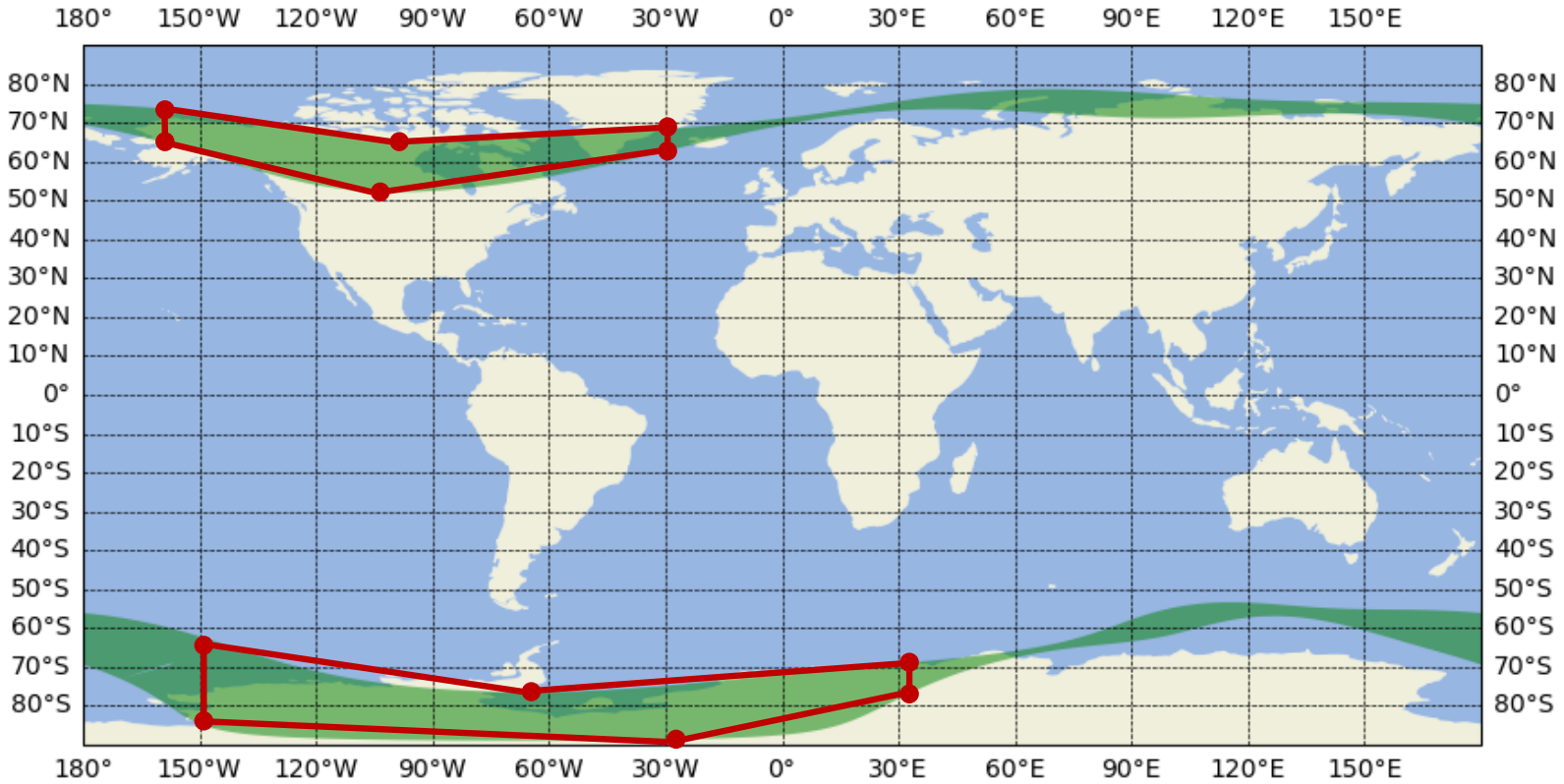
Polygons – Stage 2



- More accurate alerting region
- Relies on the forecast to propagate the alerting region with time

HF COM – Auroral Absorption

Polygons – Stage 3

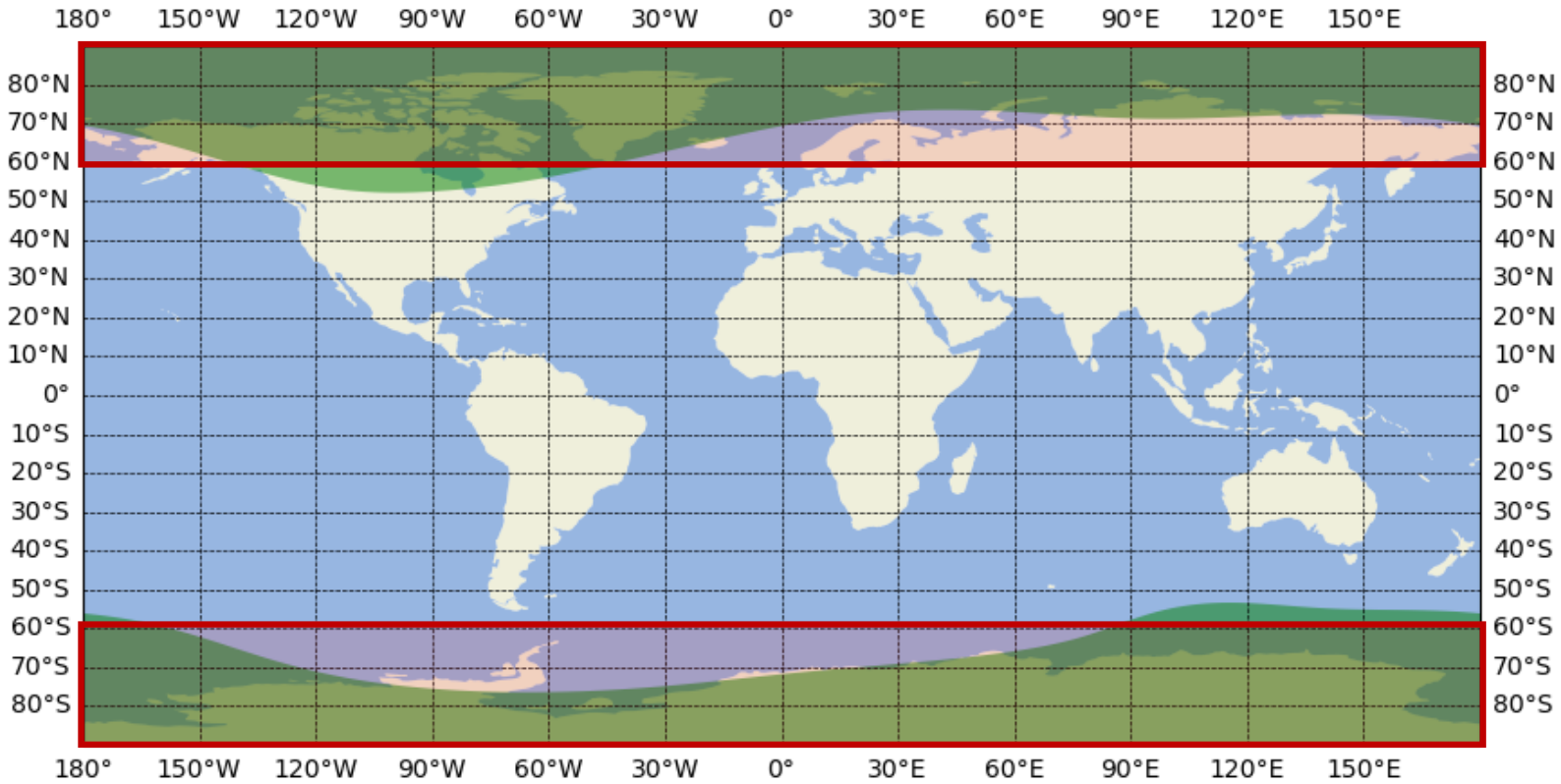


- Most accurate alerting region
- Relies on the forecast to propagate the alerting region with time

7-point polygons

HF COM PCA / Radiation

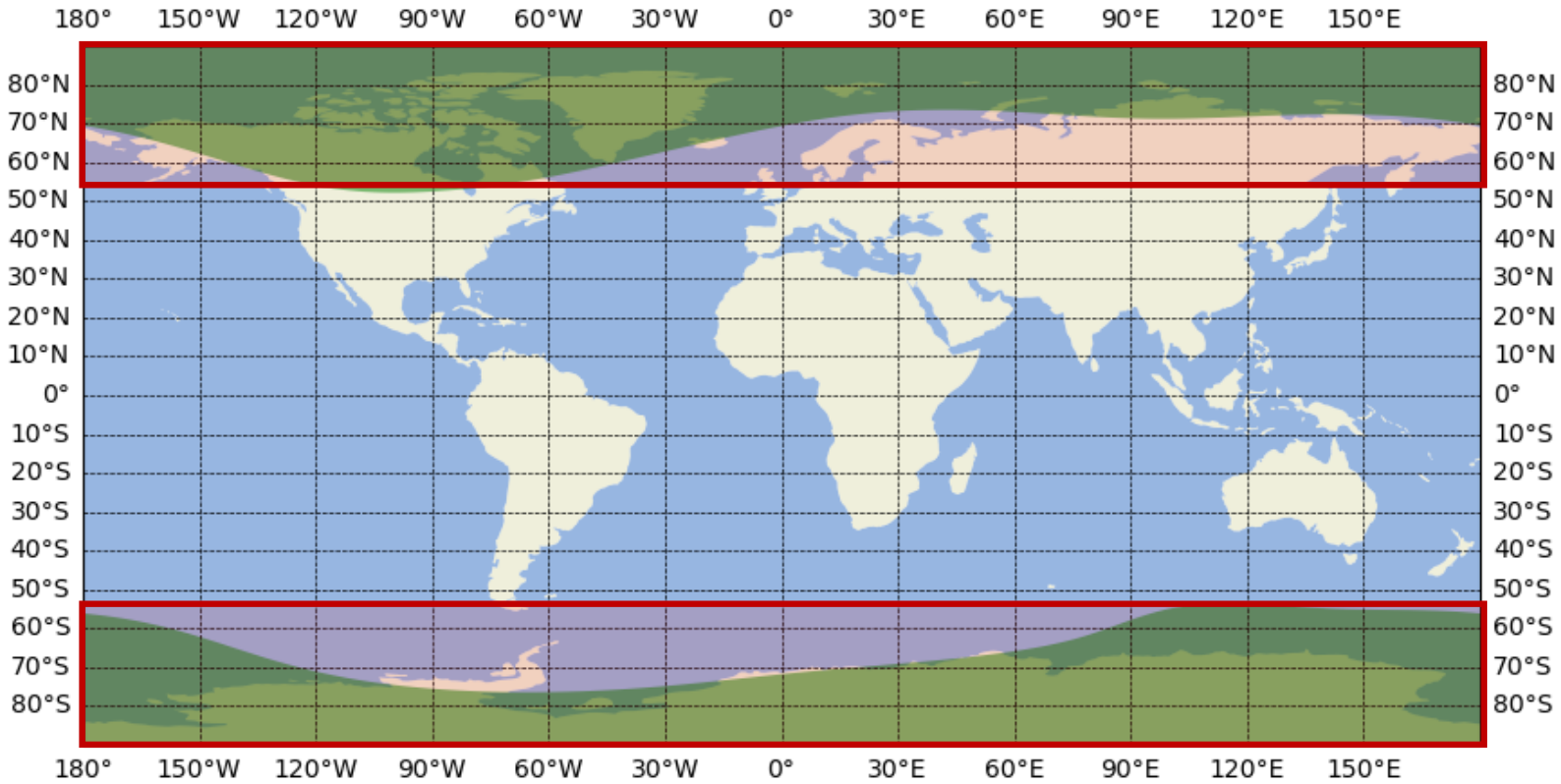
Latitude Bands



- Minimizes number of advisories
- Exaggerates and underexaggerates alerting region

HF COM PCA / Radiation

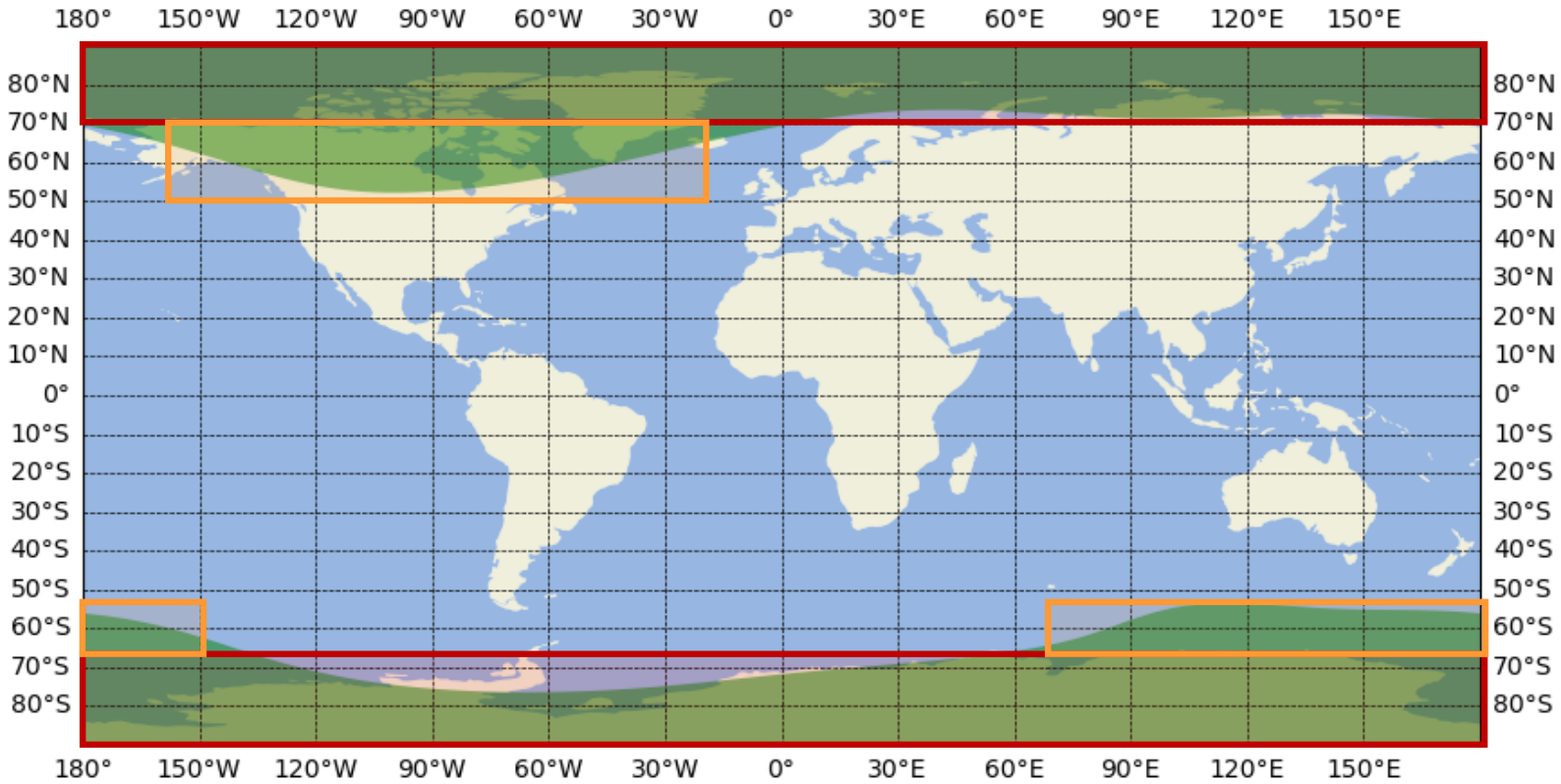
Polygons – Stage 1



- More accurate alerting region
- Exaggerates and underexaggerates alerting region

HF COM PCA / Radiation

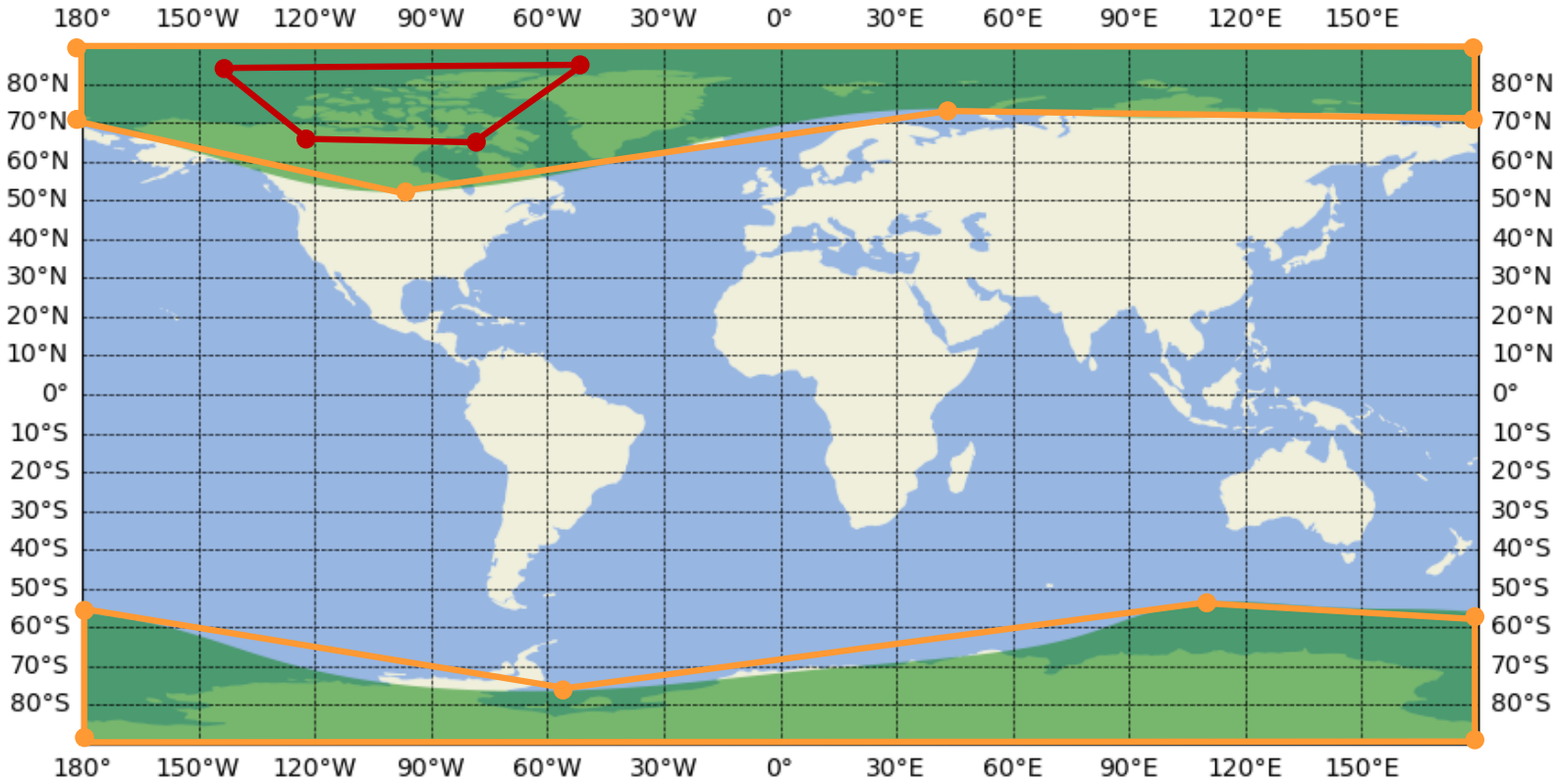
Polygons – Stage 2



- More accurate alerting region
- Relies on the forecast to propagate the alerting region with time.
- Separation of MOD and SEV regions

HF COM PCA / Radiation

Polygons – Stage 3



- Most accurate alerting region
- Relies on the forecast to propagate the alerting region with time.
- Separation of MOD and SEV regions

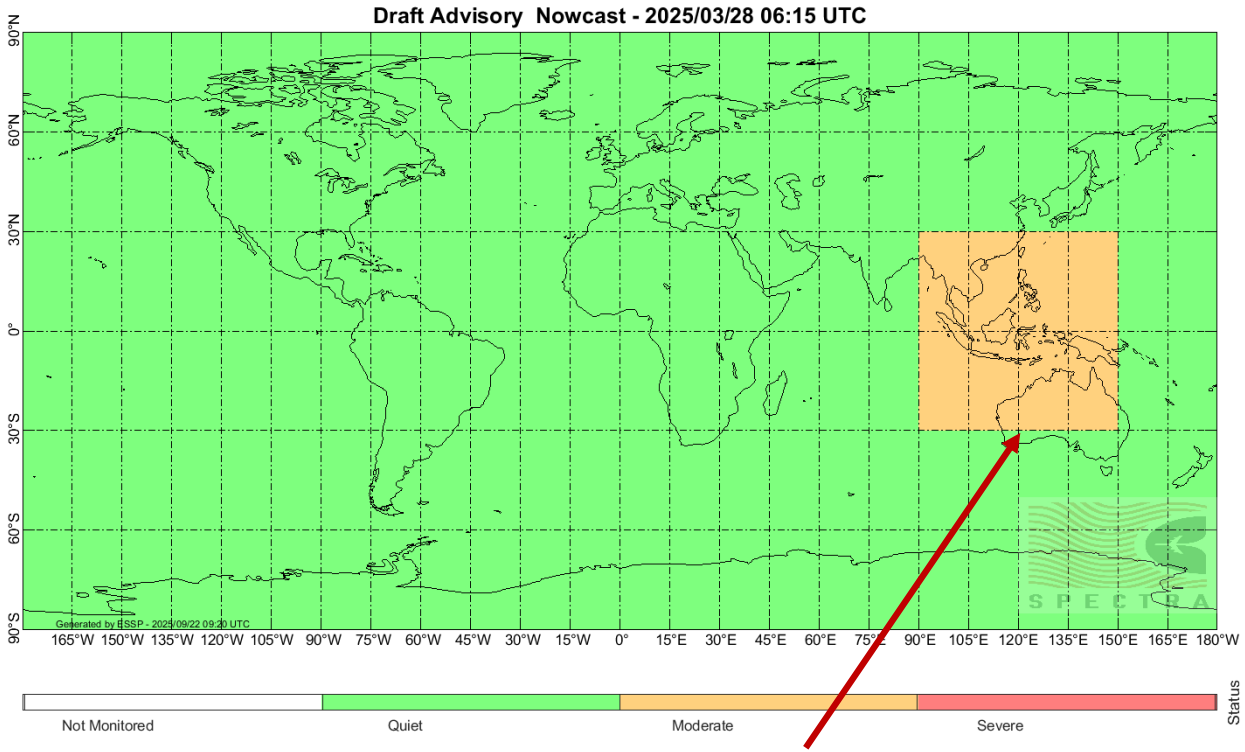
7-point polygons

HF COM - Absorption

- Auroral absorption (AA) and polar cap absorption (PCA) are independently evaluated, and the polygons are combined to create a joint PCA + AA = PAA advisory

	Time 1	Time 2	Time 3
AA	MOD alert for 55˚ - 80˚	MOD alert for 55˚ - 80˚	QUIET
PCA	QUIET	MOD alert for 55˚ - 90˚	MOD alert for 55˚ - 90˚
PAA	MOD alert for 55˚ - 80˚	MOD alert for 55˚ - 90˚	MOD alert for 55˚ - 90˚

Current Solution

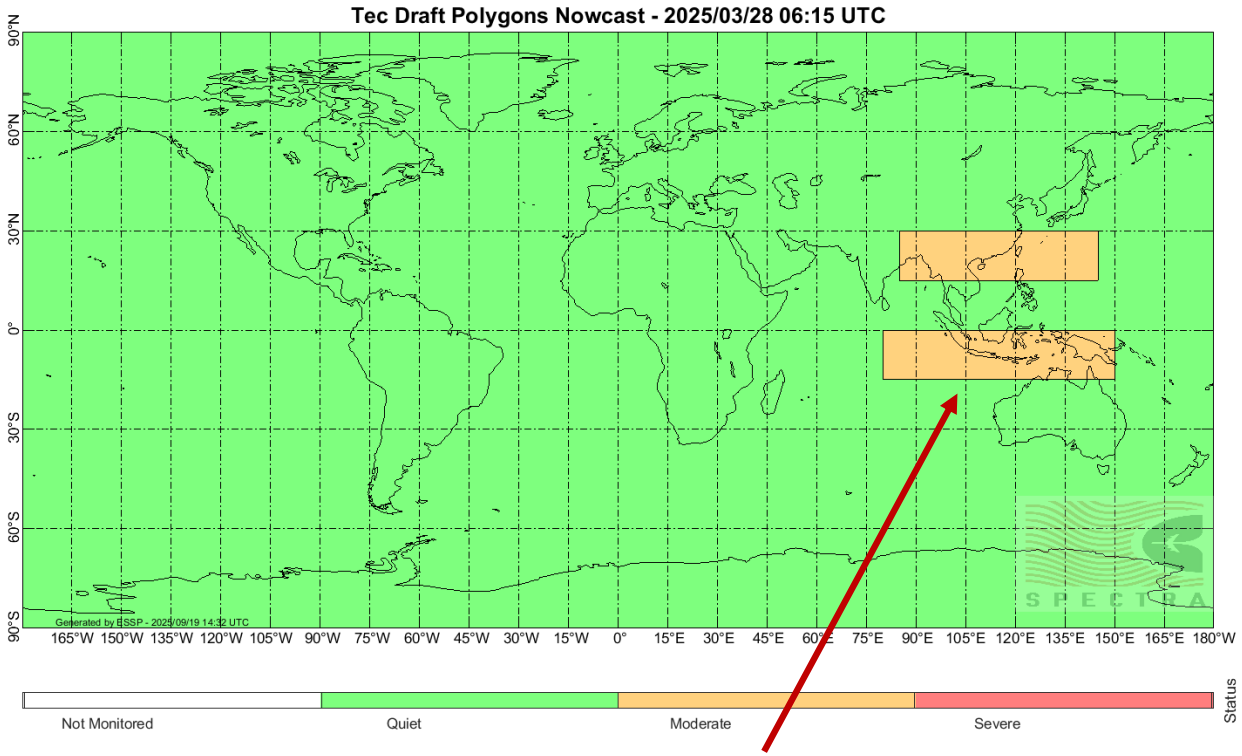


Large area of impact affecting an increased number of users.

Effect severity written in the SWX EFFECT line

FNXX40 LFPW 220920
SWX ADVISORY
STATUS: TEST
DTG: 20250328/0615Z
SWXC: ACFJ
ADVISORY NR: ESSP-SW3-TEST-2025/1
SWX EFFECT: GNSS MOD
OBS SWX: 28/0615Z EQN EQS E090 - E150
FCST SWX +6 HR: 28/1300Z NOT AVBL
FCST SWX +12 HR: 28/1900Z NOT AVBL
FCST SWX +18 HR: 29/0100Z NOT AVBL
FCST SWX +24 HR: 29/0700Z NOT AVBL
RMK: SWX EVENT (IONOSPHERIC DISTURBANCE) INPR POSSIBLY IMPACTING GNSS PER. COULD LEAD TO DEGRADATION OF TIMING AND POSITIONING PER. INTST MAY VARY ACROSS THE REGION AND WITH TIME BUT GENERALLY STRONGER ON THE DAYSIDE.
NXT ADVISORY: WILL BE ISSUED BY 20250328/0915Z=

Polygons



Severity is within the OBS SWX and FCST SWX lines.

FNXX40 LFPW 191432
SWX ADVISORY
STATUS: TEST
DTG: 20250328/0615Z
SWXC: ACFJ
SWX EFFECT: GNSS
ADVISORY NR: ESSP-SW3-TEST-2025/13
OBS SWX: 28/0615Z MOD S15 E080 - S15 E150 - N00 E150 - N00 E080 - S15 E080 MOD N15 E085 - N15 E145 - N30 E145 - N30 E085 - N15 E085
FCST SWX +6 HR: 28/1300Z NO SW EXP
FCST SWX +12 HR: 28/1900Z NO SW EXP
FCST SWX +18 HR: 29/0100Z NO SW EXP
FCST SWX +24 HR: 29/0700Z NO SW EXP
RMK: SWX EVENT (IONOSPHERIC DISTURBANCE) INPR POSSIBLY IMPACTING
GNSS PER. COULD LEAD TO DEGRADATION OF TIMING AND POSITIONING PER.
INTST MAY VARY ACROSS THE REGION AND WITH TIME BUT GENERALLY STRONGER ON THE DAYSIDE.
NXT ADVISORY: WILL BE ISSUED BY 20250328/0915Z=

increased resolution + multiple polygons in one advisory → **better precision + smaller area of impact**

Concerns

- Current ICAO implementation for GNSS has resulted in a high number of advisories. This is being addressed:
  - revising MOD and SEV thresholds
  - harmonization
  - user engagement
- Increased resolution for polygons makes finding the balance between over and under alerting even more challenging.
  - buffer zone (?)
  - merging polygons (?)
  - nesting polygons (?)
- Stages 2 and 3 will incorporate these, and additional improvements with a shift from 5 to 7 polygon vertices by Stage 3.

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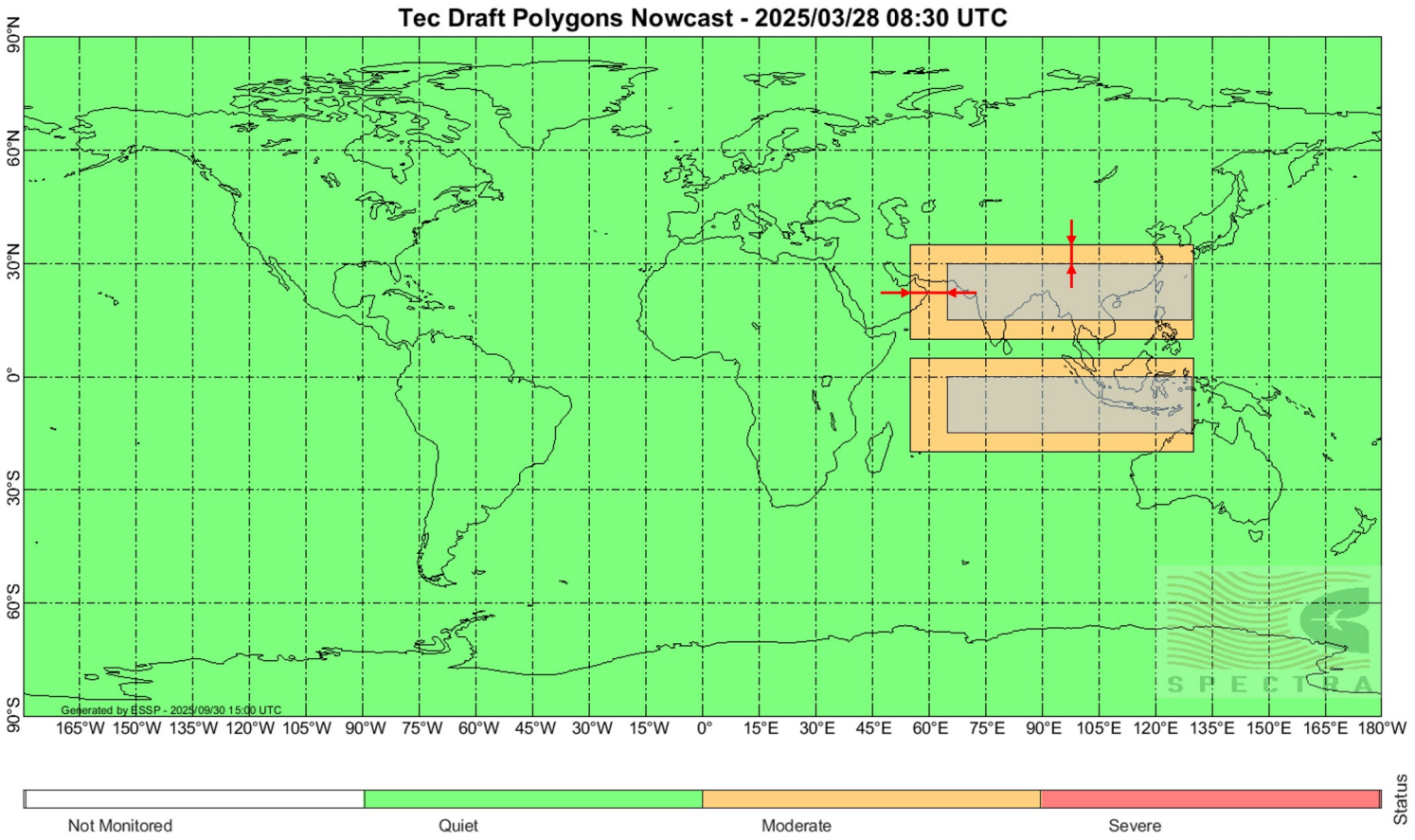
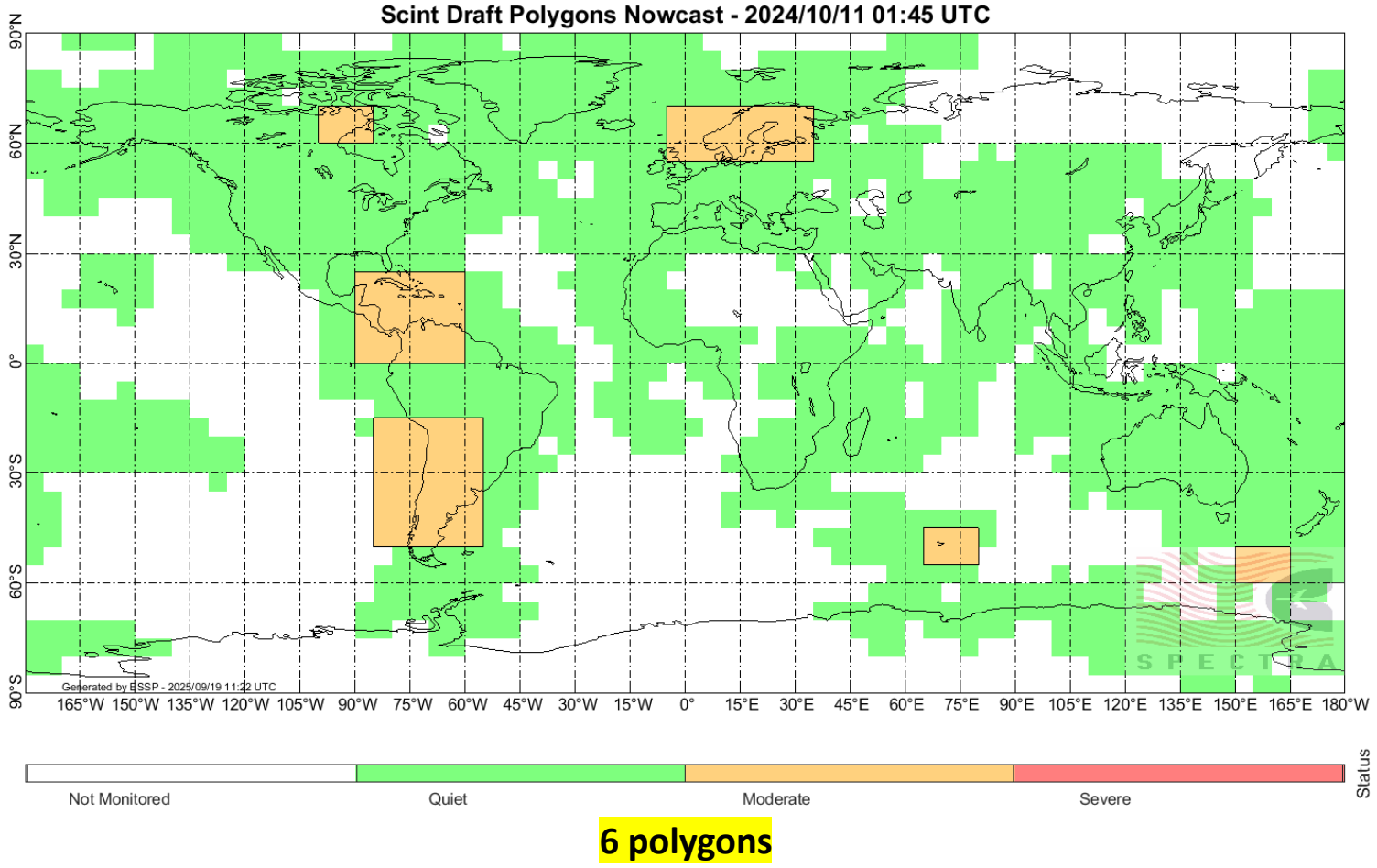
GNSS – Buffer Zone



- Increases precisions means increased sensitivity to changes in the size of an active region
- Buffer zones allow for the expected progression of an active zone
- Reduces number of advisories compared to approach with no buffers

Are buffers an acceptable solution? Would the information be preferred in the remarks?

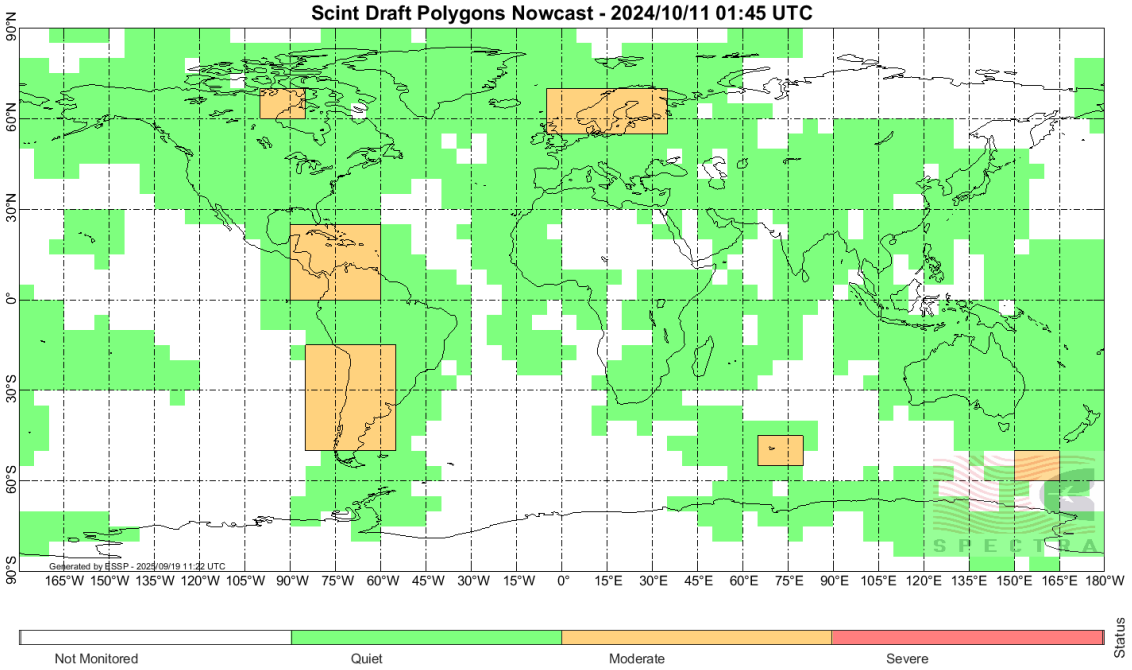
GNSS – Merging polygons



6 polygons

- Active conditions can produce many polygons and long advisories
- A limit of 4 polygons was proposed within the ICAO SWXC
- Polygons could be merged, which affects precision

GNSS – Merging polygons

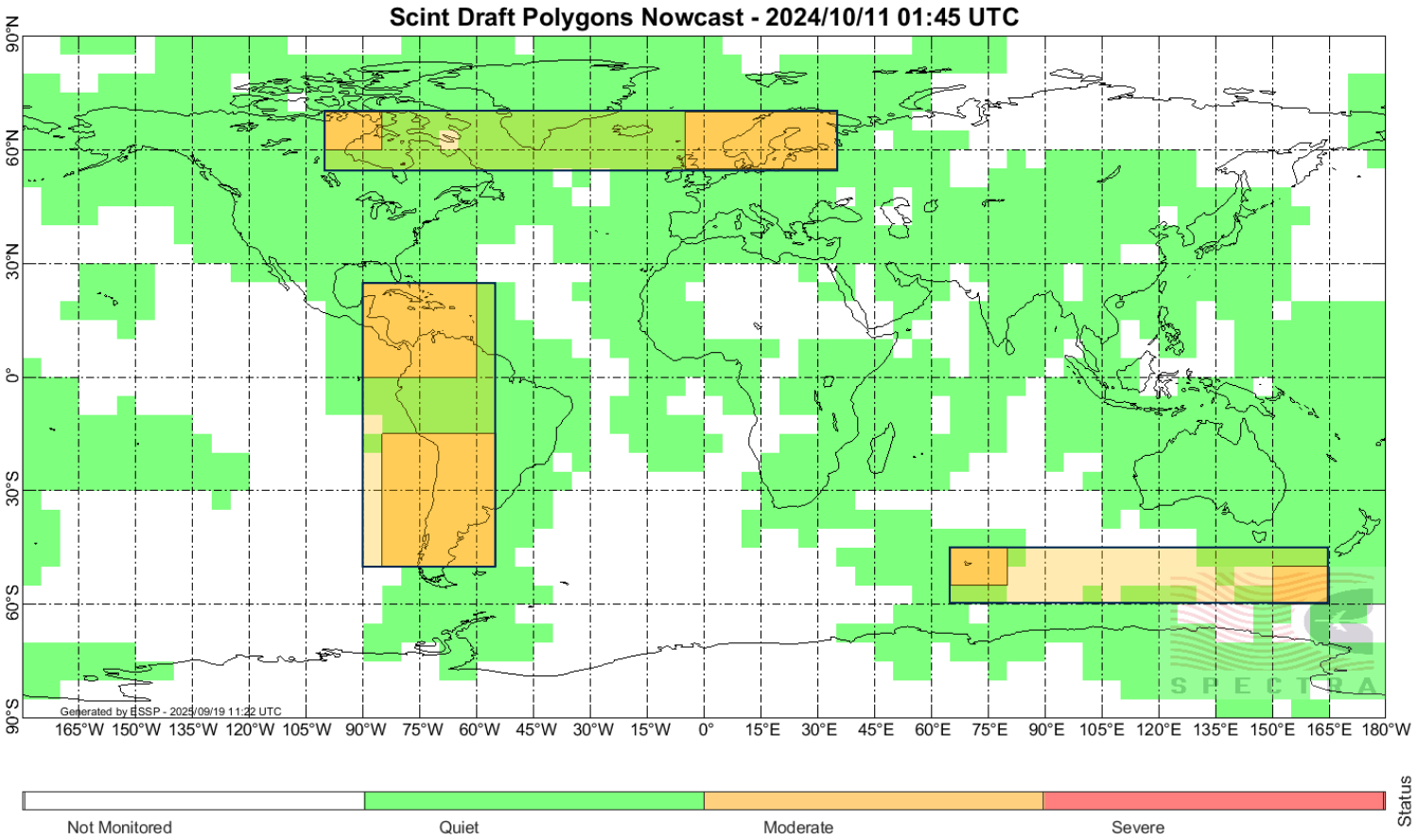


6 polygons

FNXX40 LFPW 191123
SWX ADVISORY
STATUS: TEST
DTG: 20241011/0145Z
SWXC: ACFJ
SWX EFFECT: GNSS
ADVISORY NR: ESSP-SW3-TEST-2024/72
OBS SWX: 11/0145Z MOD S60 E150 - S60 E165 - S50 E165 - S50 E150 - S60 E150 MOD S55 E065 - S55 E080 - S45 E080 - S45 E065 - S55 E065 MOD S50 W085 - S50 W055 - S15 W055 - S15 W085 - S50 W085 MOD N00 W090 - N00 W060 - N25 W060 - N25 W090 - N00 W090 MOD N55 W005 - N55
E035 - N70 E035 - N70 W005 - N55 W005 MOD N60 W100 - N60 W085 - N70 W085 - N70 W100 - N60 W100
FCST SWX +6 HR: 11/0800Z NO SW EXP
FCST SWX +12 HR: 11/1400Z NO SW EXP
FCST SWX +18 HR: 11/2000Z NO SW EXP
FCST SWX +24 HR: 12/0200Z NO SW EXP
RMK: SWX EVENT (SCINTILLATION) INPR POSSIBLY IMPACTING GNSS PER. COULD LEAD TO DEGRADATION OF TIMING AND POSITIONING PER. INTST GENERALLY STRONGER ON THE NIGHTSIDE. ISOL AREAS OF SEV SCINTILLATION POSS.
NXT ADVISORY: WILL BE ISSUED BY 20241011/0745Z=

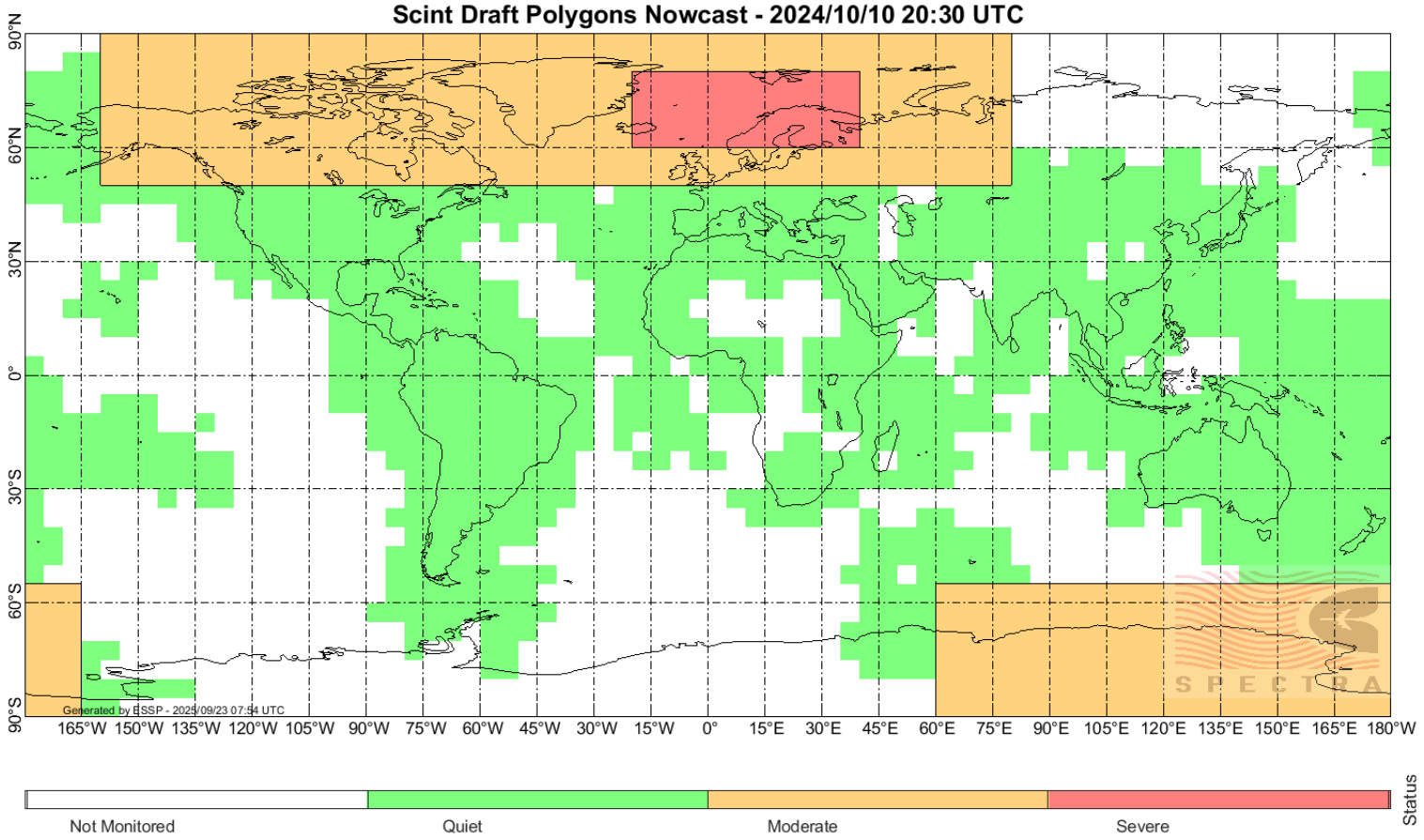
→ **883 characters**

GNSS – Merging polygons



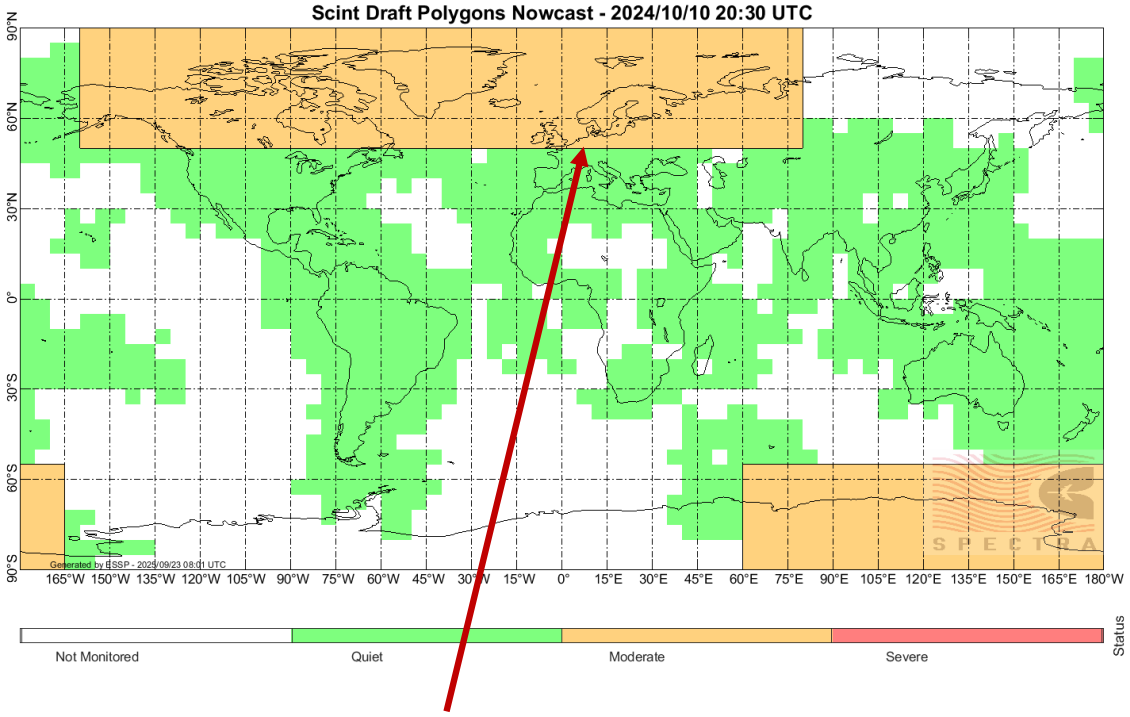
- Active conditions can produce many polygons and long advisories
- A limit of 4 polygons was proposed within the ICAO SWXC
- Polygons could be merged, which affects precision
- Merging should be based on proximity of nearby polygons and avoid creating large regions where there is no activity.

GNSS – Nested polygons



- Currently each alerting region is assigned a single severity
- In the case of MOD activity, remarks are used to indicate the potential for pockets of SEV activity
- Nested polygons could better communicate this

GNSS – Nested polygons

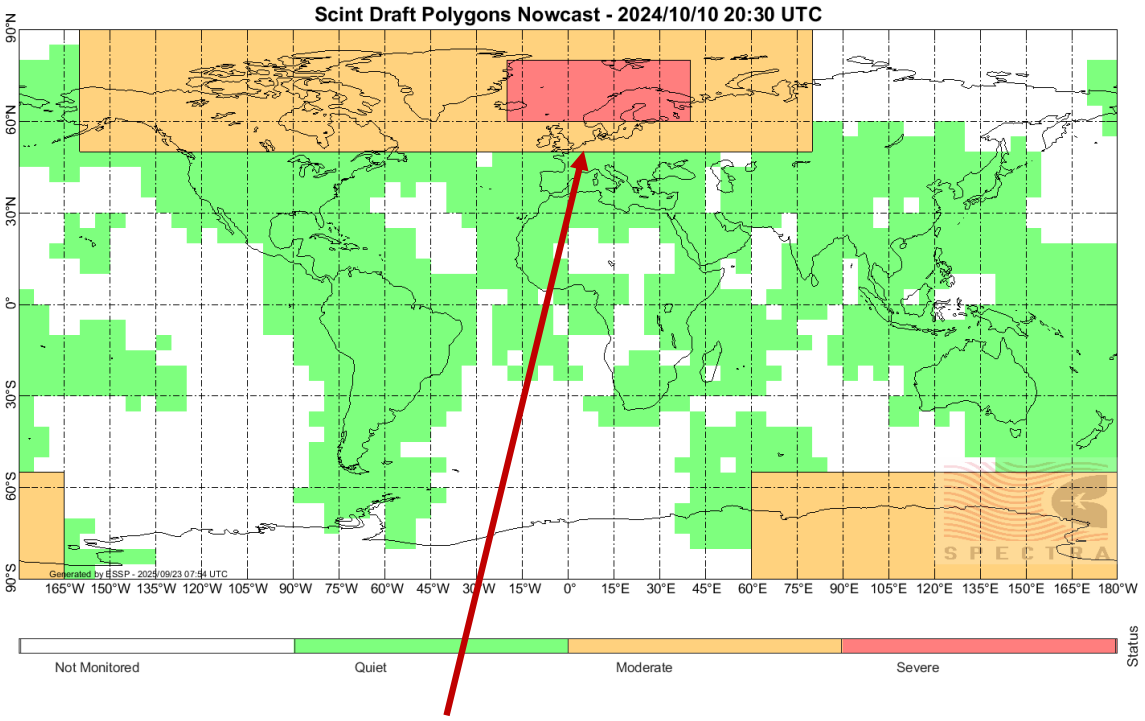


FNXX40 LFPW 230802
SWX ADVISORY
STATUS: TEST
DTG: 20241010/2030Z
SWXC: ACFJ
SWX EFFECT: GNSS
ADVISORY NR: ESSP-SW3-TEST-2024/2
OBS SWX: 10/2030Z MOD S90 E060 - S90 W165 - S55 W165 - S55 E060 - S90 E060 MOD N50 W160 - N50 E080 - N90 E080 - N90 W160 - N50 W160
FCST SWX +6 HR: 11/0300Z NO SW EXP
FCST SWX +12 HR: 11/0900Z NO SW EXP
FCST SWX +18 HR: 11/1500Z NO SW EXP
FCST SWX +24 HR: 11/2100Z NO SW EXP
RMK: SWX EVENT (SCINTILLATION) INPR POSSIBLY IMPACTING GNSS PER. COULD LEAD TO DEGRADATION OF TIMING AND POSITIONING PER. INTST GENERALLY STRONGER ON THE NIGHTSIDE. ISOL AREAS OF SEV SCINTILLATION POSS.
NXT ADVISORY: WILL BE ISSUED BY 20241011/0230Z=

Current guidelines result in the SEV activity only being noted in the remarks section, where it could easily be missed - this could have an impact for the users.

Is the remarks section an effective way of communicating to the user?

GNSS – Nested polygons



A nested SEV polygon within the larger MOD polygon prevents missed information and better informs the user.

FNXX40 LFPW 230755
SWX ADVISORY
STATUS: TEST
DTG: 20241010/2030Z
SWXC: ACFJ
SWX EFFECT: GNSS
ADVISORY NR: ESSP-SW3-TEST-2024/2
OBS SWX: 10/2030Z SEV N60 W020 - N60 E040 - N80 E040 - N80 W020 - N60 W020 MOD S90 E060 - S90 W165 - S55 W165 - S55 E060 - S90 E060 MOD N50 W160 - N50 E080 - N90 E080 - N90 W160 - N50 W160
FCST SWX +6 HR: 11/0300Z NO SW EXP
FCST SWX +12 HR: 11/0900Z NO SW EXP
FCST SWX +18 HR: 11/1500Z NO SW EXP
FCST SWX +24 HR: 11/2100Z NO SW EXP
RMK: SWX EVENT (SCINTILLATION) INPR POSSIBLY IMPACTING GNSS PER. COULD LEAD TO LOSS OF GNSS SIGNALS AND/OR DEGRADATION OF TIMING AND POSITIONING PER. INTST GENERALLY STRONGER ON THE NIGHTSIDE.
NXT ADVISORY: WILL BE ISSUED BY 20241011/0230Z=

Summary

- Polygons are being introduced to improve spatial precision.
- HF COM auroral absorption and polar cap absorption polygons will be implemented in a 3-stage approach to ensure a smooth transition and consistency. This addresses overexaggeration of impacted regions that currently exists and opens the northern hemisphere's polar cap in some instances.
- GNSS advisories have the potential to temporarily increase in number due to the increased resolution. However, efforts are being taken to minimize this effect. Several solutions are under investigation to reasonably balance the number and precision of advisories.

Thank you