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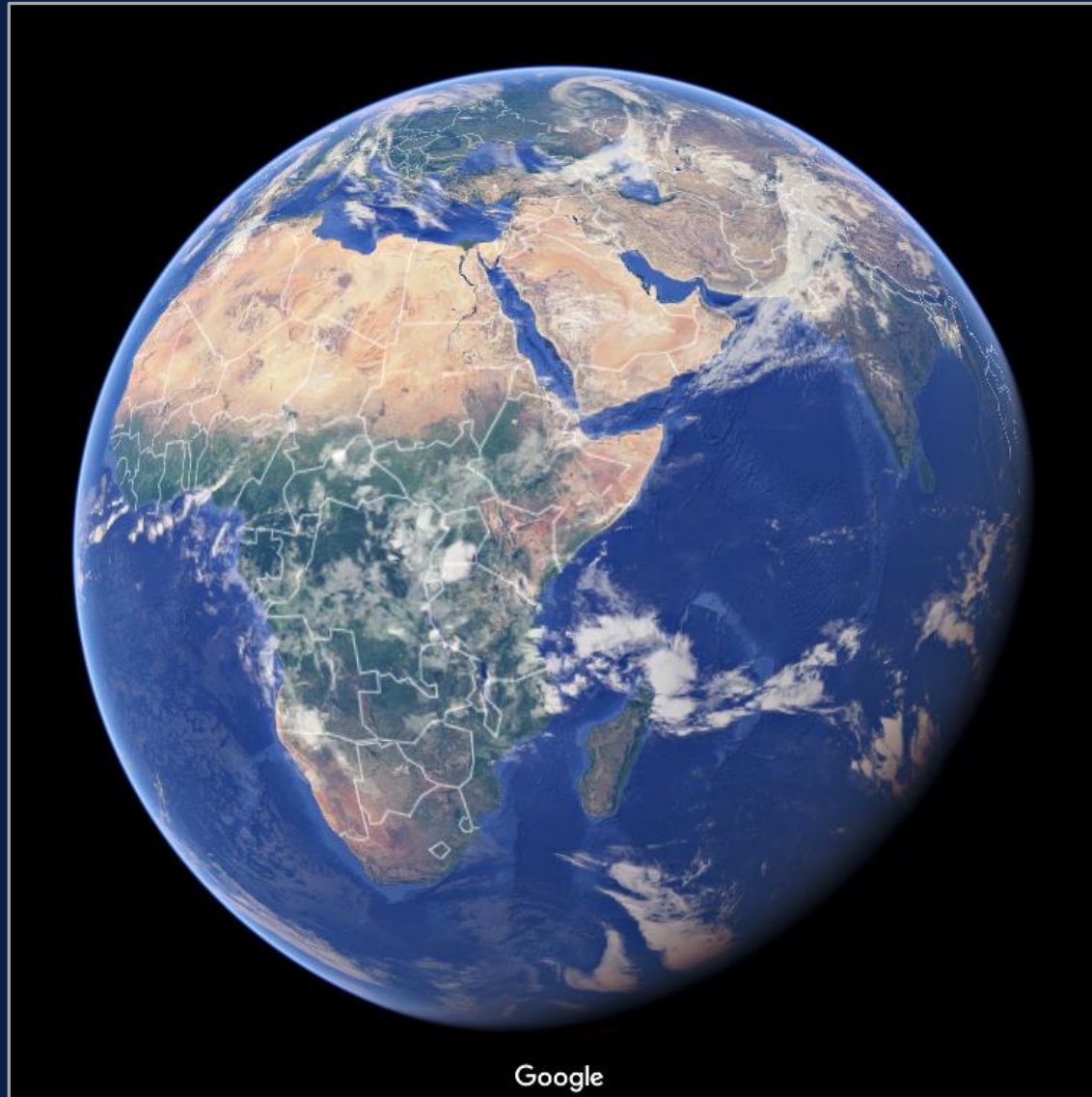


## ***Meteosat-8 IODC HRV***

### ***Discussion of the possible scenario(s)***

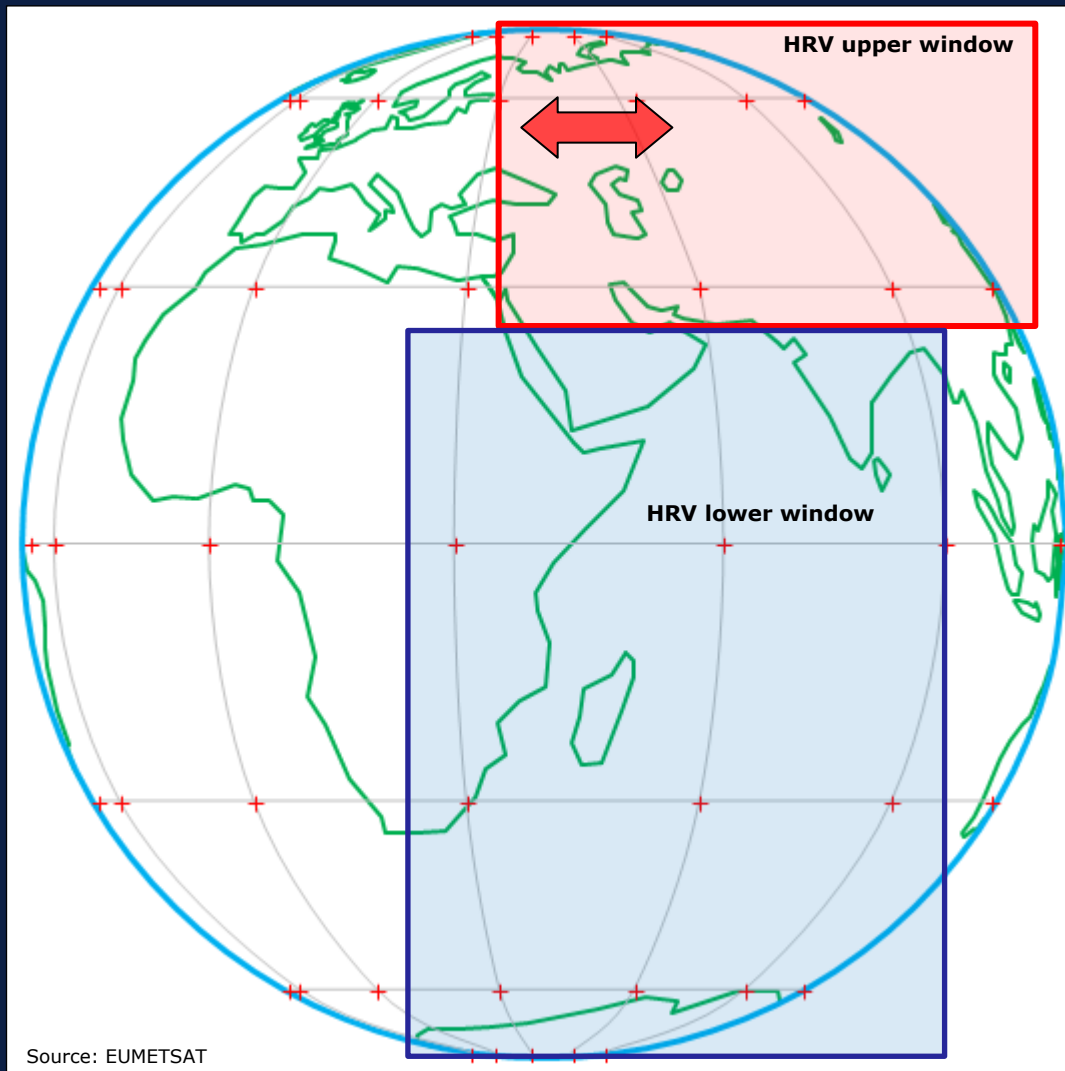
Prepared for a discussion at the CWG 2016 workshop, Florence, Italy (4–8 April 2016)

## Simulated view of the Earth from 41.5°E (MSG IODC position)



<https://www.google.com/maps/@0.00001,41.5,11480418m/data=!3m1!1e3>

## Simulated view of the Earth from 41.5°E (IODC) and HRV windows coverage:



The following discussion addresses various options ("scenarios") of the daily shift of the upper HRV window, to maximize the availability of daylight in HRV for various regions.

## 39th STG Operations Working Group Meeting, 10 – 11 March 2016

Minutes of the meeting (document EUM/STG-OPSWG/39/16/MIN),

5.2 Meteosat-8 IODC Service Specification including HRV Scan Configuration (p.11-12):

Czech Republic, re-iterating what they said at the STG-SWG, suggested that another option for the upper window, taking into account seasonal changes, could be considered - e.g. moving the upper window to the West sooner in the summer months than in winter.

The Netherlands liked the idea proposed by Czech Republic and suggested that the upper HRV window for the 0 deg mission could also be shifted earlier to cover the Azores earlier. The Secretariat advised that the shift of the upper window for the 0° mission and the IODC mission is planned to be synchronized.

Czech Republic informed the Group that the matter would be discussed within the Convection Working Group which will come up with recommendations.

Action 16/39/03: Relating to Meteosat-8 IODC HRV scan configuration option adopted by the STG-OPSWG (i.e. Option 3: Two HRV windows, with lower window maximizing Indian Ocean coverage then following Sun illumination, and upper window moving in synchronization with the 0 deg mission upper HRV window), STG-OPSWG to assess what would be the preferred time for the upper window shift, and to report back at the Spring 2017 meeting.

Recommendation 16/39/01: STG-OPSWG recommends to STG the Meteosat-8 IODC Service Specification and the HRV scan configuration, as proposed in EUM/STGOPSWG/39/16/DOC/04, noting that from the three HRV scan configuration options proposed, Option 3 is the preferred one.

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### **ONLY THE UPPER HRV WINDOW IS DISCUSSED NEXT**

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## Reasons to have maximum daylight HRV coverage from IODC for Europe:

- Backup for HRV coverage of Europe in cases of problems with the 0° MSG mission (to cover the data gaps while switching to a backup satellite).
- Possibility to use dual stereoscopic observations in HRV (from 0° and 41.5°E positions) to retrieve more accurate cloud top height products, utilizing different parallax shift from the two satellites. Similarly, the dual view in HRV might contribute to more accurate Atmospheric Motion Vectors products (???).
- Possibility of "3D" studies of various convective storm top phenomena (such as overshooting tops, above-anvil ice plumes, etc.), similar to those based on GOES-E (75W) and GOES-W (135W) satellites.
- Any other? ...

## One possible reason against modifying the IODC HRV in favor of Europe:

- As longest as possible IODC HRV coverage of central – southern parts of Asia, e.g. in support of observations of convective storms there.

## Facts to remember when considering various shift scenarios

- Given the annual changes of the astronomical declination of the Sun, the sunrise/sunset times and resulting length of daylight at a given location (other than in tropics) change significantly during the year, namely at higher latitudes.
- Thus, to utilize to a maximum the daylight HRV coverage, the upper HRV window shift should take into account these seasonal changes (of the sunrise/sunset times). This may require several regular changes of the daily shift scenarios throughout the year, depending on how much technically demanding such scenario change is.

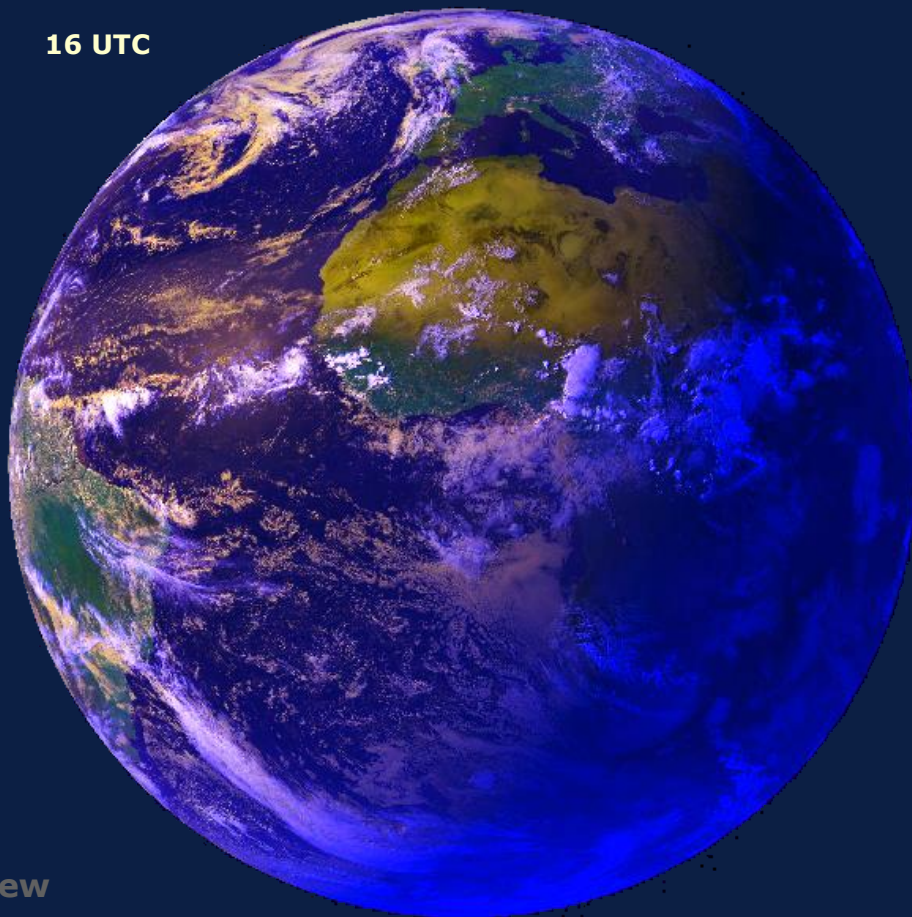
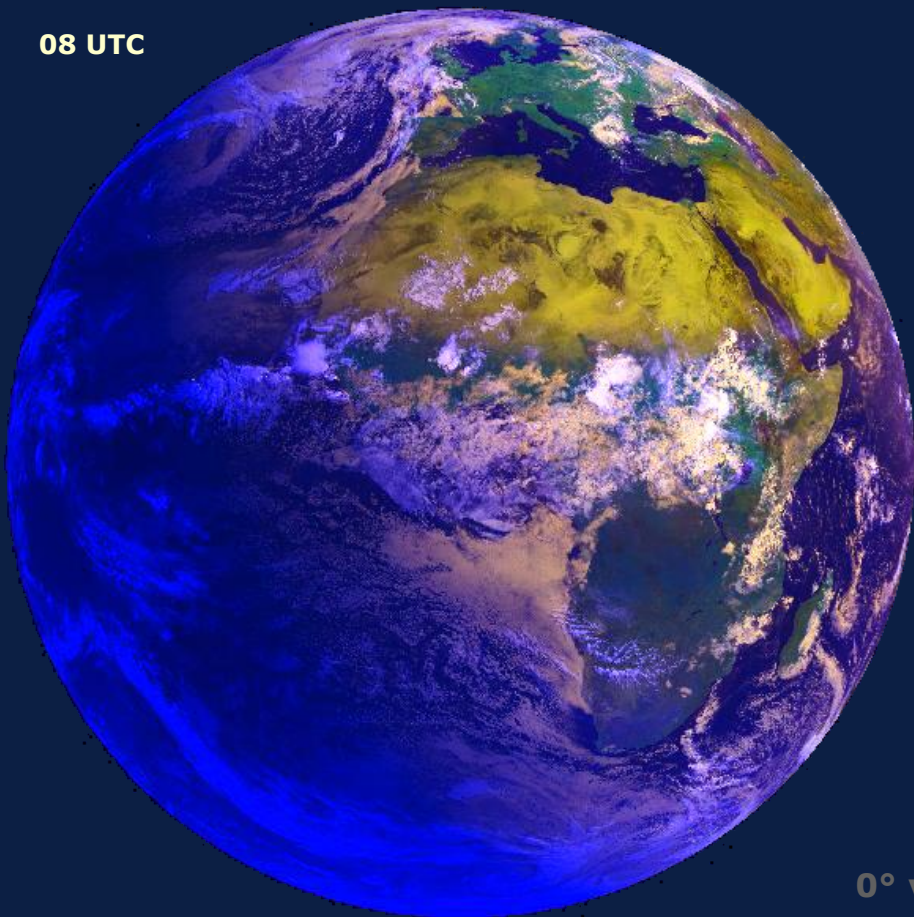


- **Basic demand**: the **westernmost (left) side** of the upper HRV window should follow the actual position of the **morning terminator** (provided that Europe has a higher priority than central-southern parts of Asia) throughout the year.
- However, if there is a higher demand to cover with HRV the central-southern parts of Asia, the **easternmost (right) side** of the upper window has to follow the **evening terminator** location.

## Seasonal changes of the daylight ... summer of the north hemisphere (01 July)

08 UTC

16 UTC

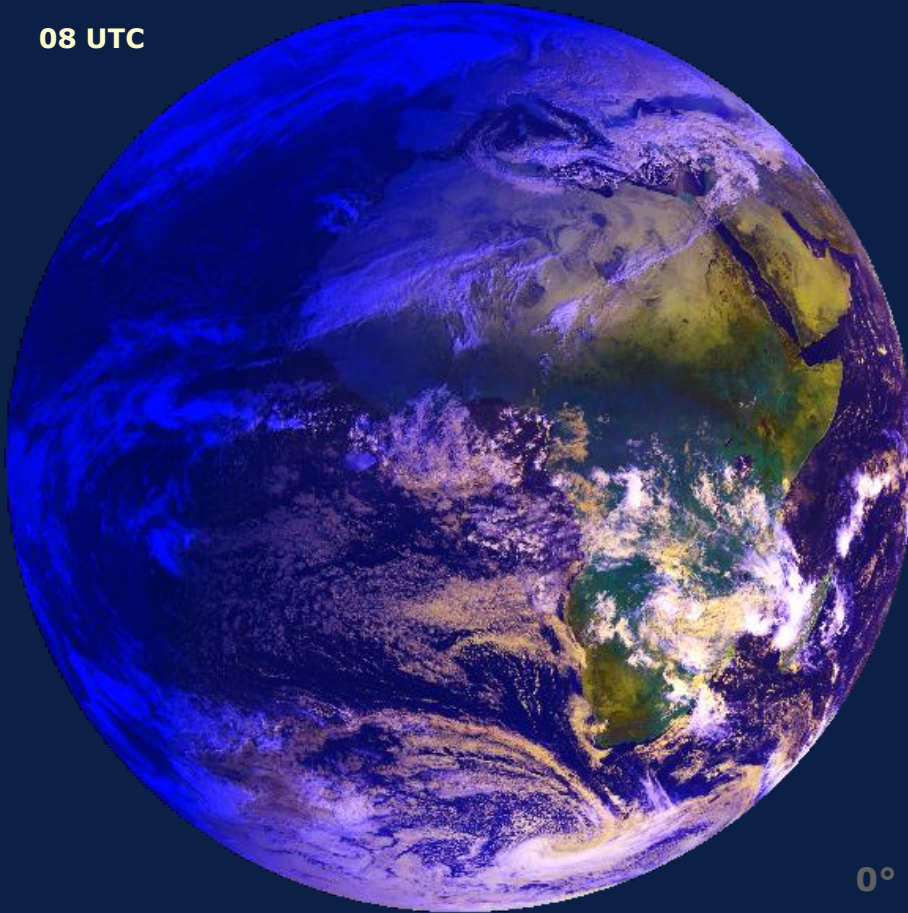


0° view

## Seasonal changes of the daylight ... winter of the north hemisphere (01 January)

08 UTC

16 UTC



0° view

## Seasonal changes of sunrise, sunset and daylight duration

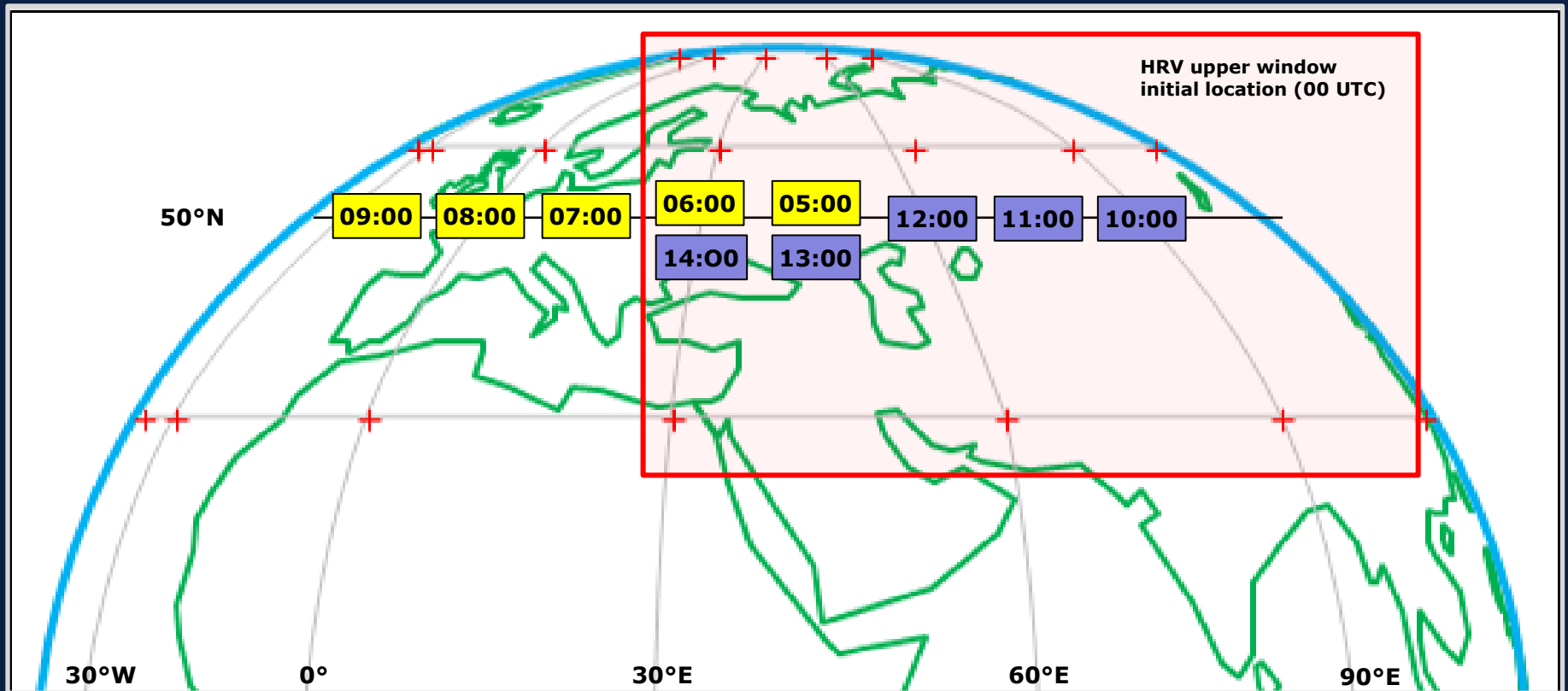
Sunrise time [UTC]												
LOCATION	DATE											
	01 Jan	01 Feb	01 Mar	01 Apr	01 May	01 Jun	01 Jul	01 Aug	01 Sep	01 Oct	01 Nov	01 Dec
60 N / 15 E	8:02	7:15	5:57	4:24	2:57	1:49	1:43	2:41	3:56	5:06	6:23	7:36
50 N / 15 E	6:59	6:34	5:43	4:36	3:36	2:56	2:55	3:30	4:15	5:00	5:50	6:37
40 N / 15 E	6:22	6:09	5:33	4:44	4:00	3:33	3:35	3:59	4:28	4:57	5:29	6:03

Sunset time [UTC]												
LOCATION	DATE											
	01 Jan	01 Feb	01 Mar	01 Apr	01 May	01 Jun	01 Jul	01 Aug	01 Sep	01 Oct	01 Nov	01 Dec
60 N / 15 E	14:04	15:13	16:28	17:45	18:59	20:08	20:25	19:29	18:02	16:32	15:03	14:02
50 N / 15 E	15:08	15:53	16:43	17:32	18:19	19:01	19:12	18:42	17:43	16:38	15:36	15:01
40 N / 15 E	15:45	16:18	16:52	17:25	17:55	18:23	18:33	18:13	17:31	16:42	15:57	15:35

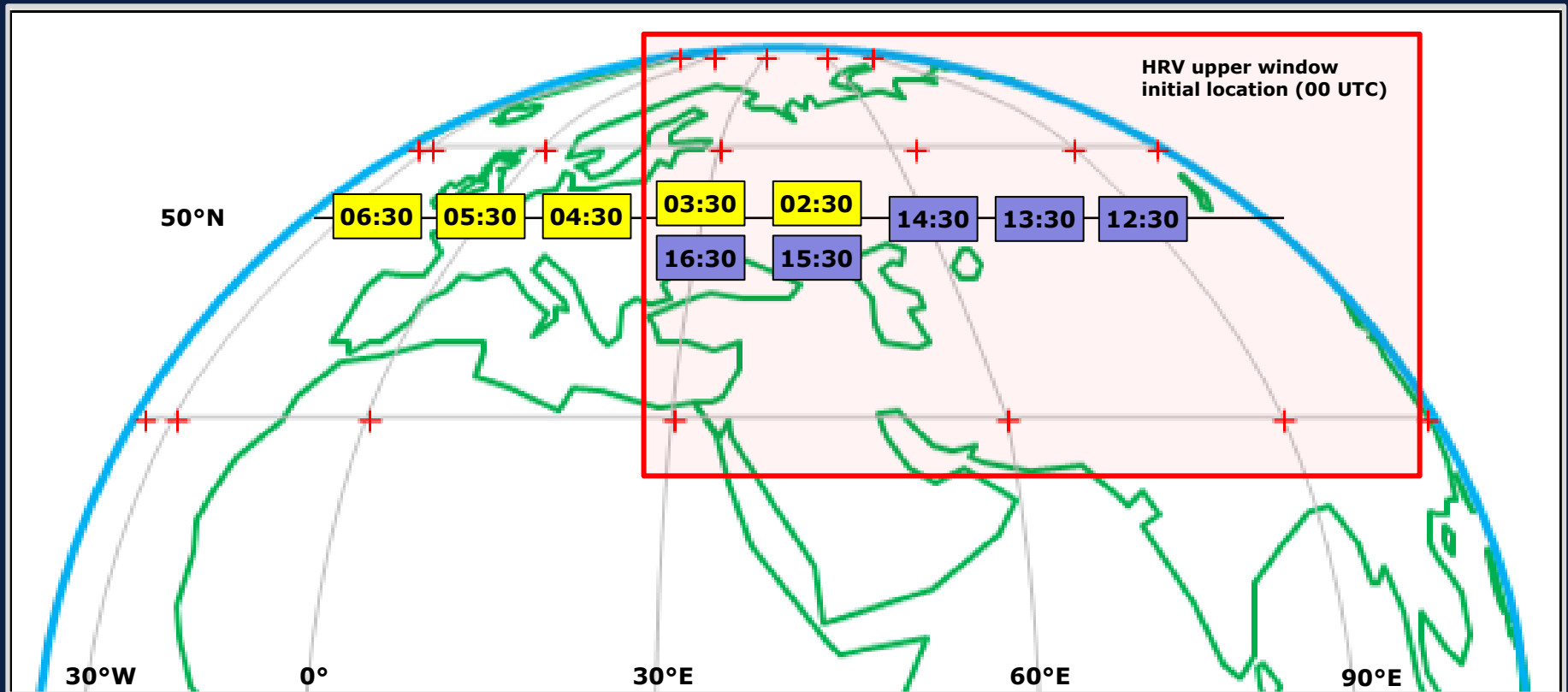
Total sunlight [hh:mm]												
LOCATION	DATE											
	01 Jan	01 Feb	01 Mar	01 Apr	01 May	01 Jun	01 Jul	01 Aug	01 Sep	01 Oct	01 Nov	01 Dec
60 N / 15 E	6:02	7:58	10:31	13:21	16:02	18:19	18:42	16:48	14:06	11:26	8:40	6:26
50 N / 15 E	8:09	9:19	11:00	12:56	14:43	16:05	16:17	15:12	13:28	11:38	9:46	8:24
40 N / 15 E	9:23	10:09	11:19	12:41	13:55	14:50	14:58	14:14	13:03	11:45	10:28	9:32

In this table LAT = 15°E was chosen as an example, but for any other longitude the local sunrise and sunset time can be calculated easily:  $\Delta_{\text{LON}} = 15^\circ \sim \Delta_T = 1\text{h}$

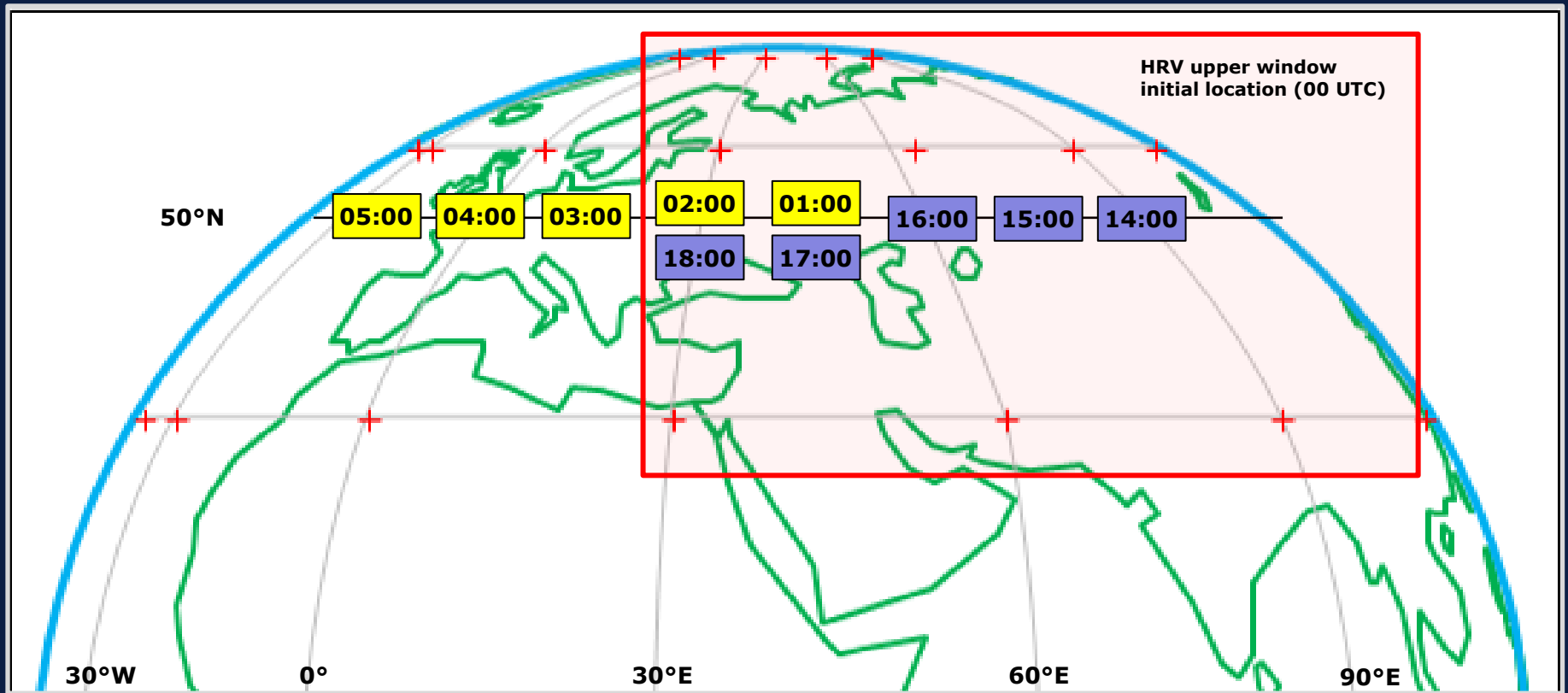
## Sunrise and sunset at 50°N for 01 January (~ winter solstice, shortest daylight)



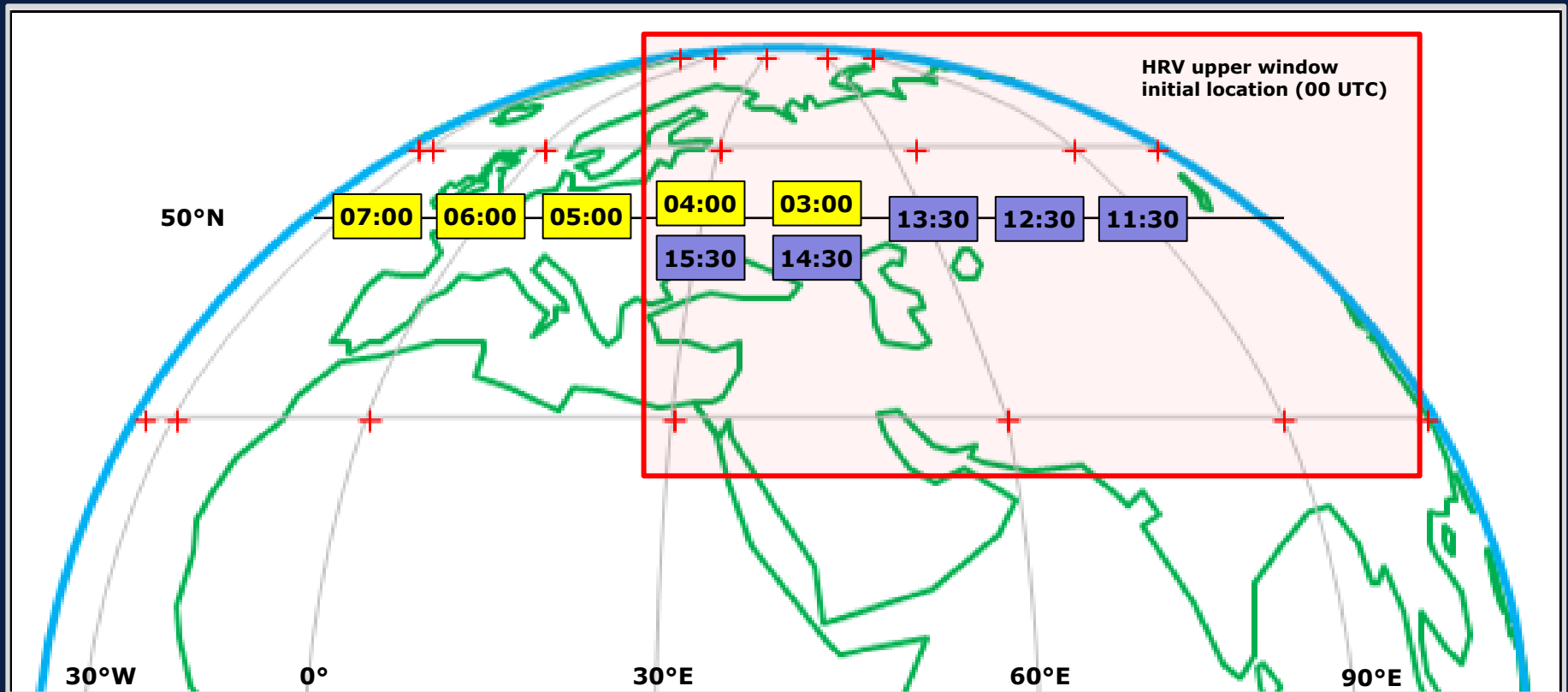
## Sunrise and sunset at 50°N for 01 April (~ spring equinox)



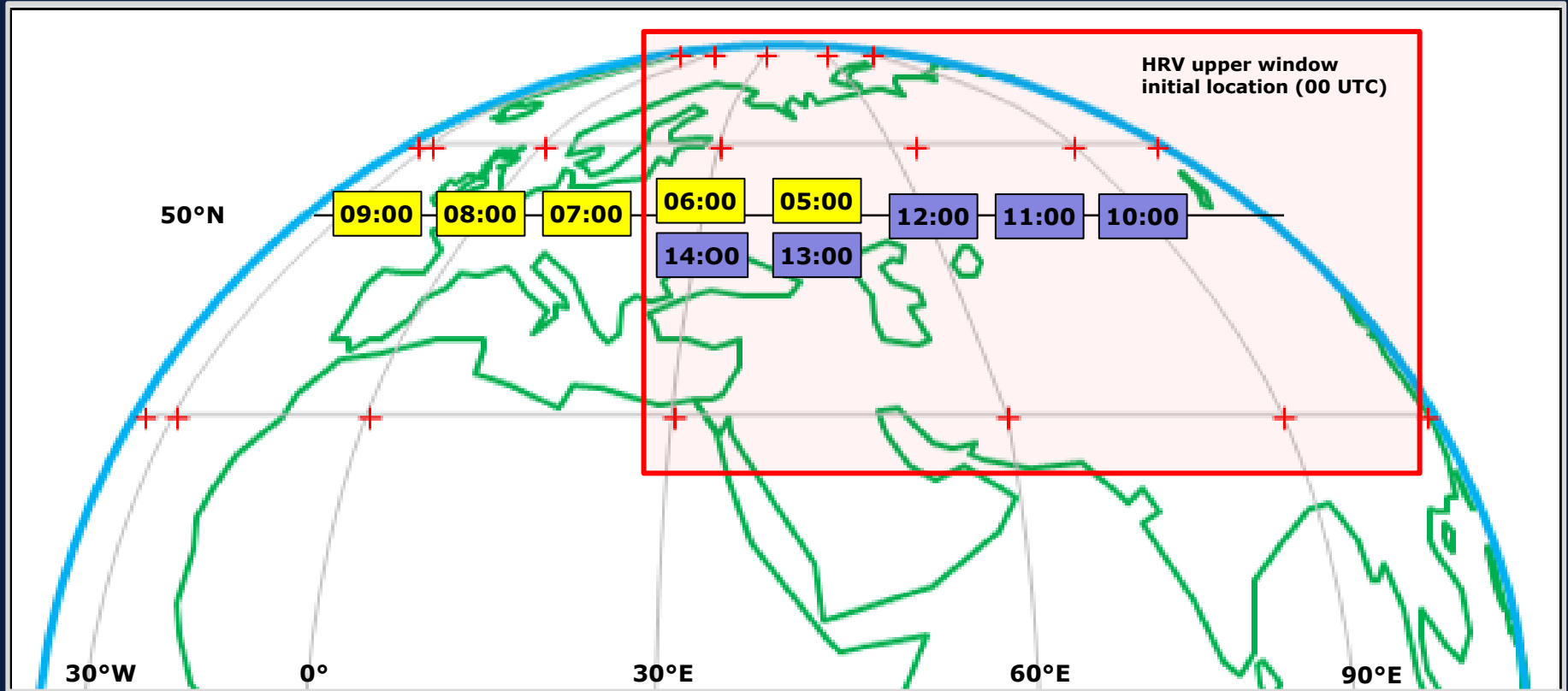
## Sunrise and sunset at 50°N for 01 July (~ summer solstice, longest daylight)



## Sunrise and sunset at 50°N for 01 October (~ autumn equinox)



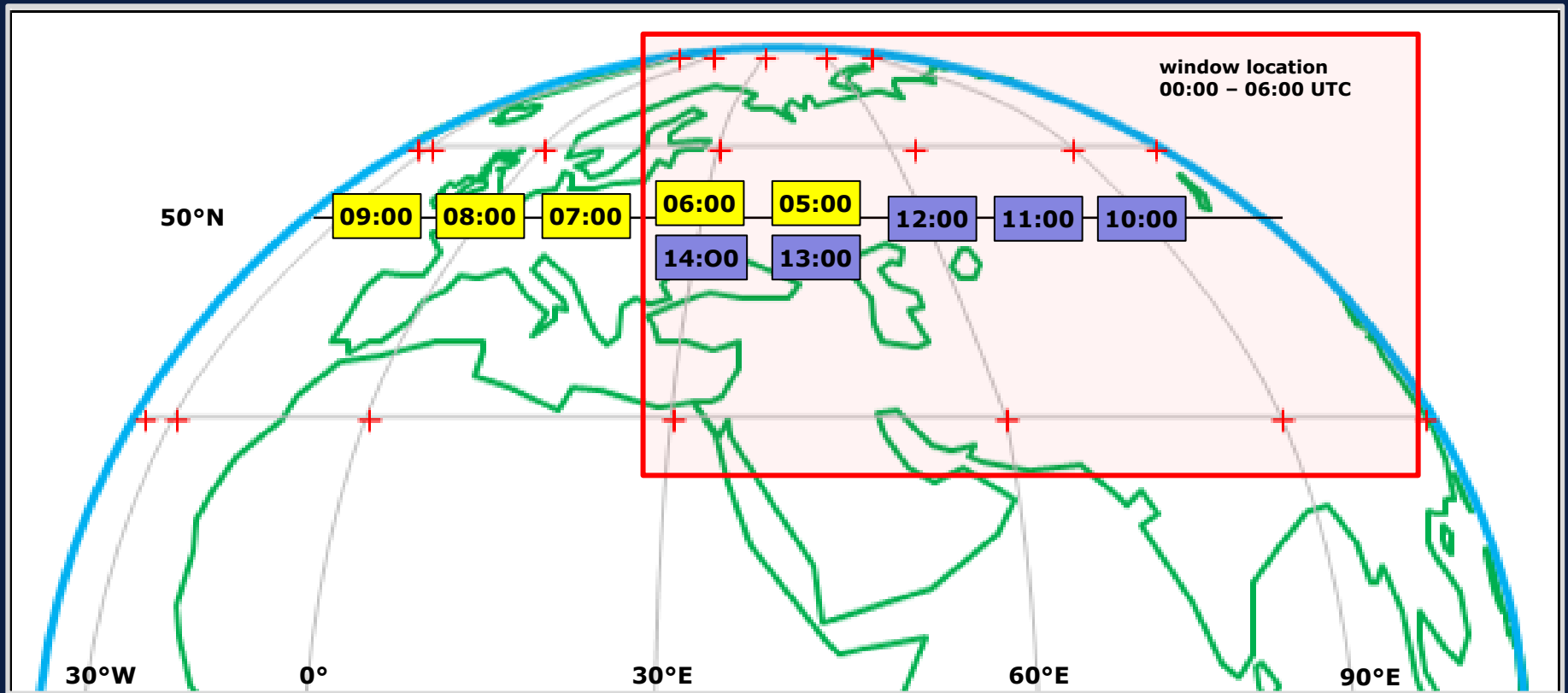
## Sunrise and sunset at 50°N for 01 January (~ winter solstice, shortest daylight)



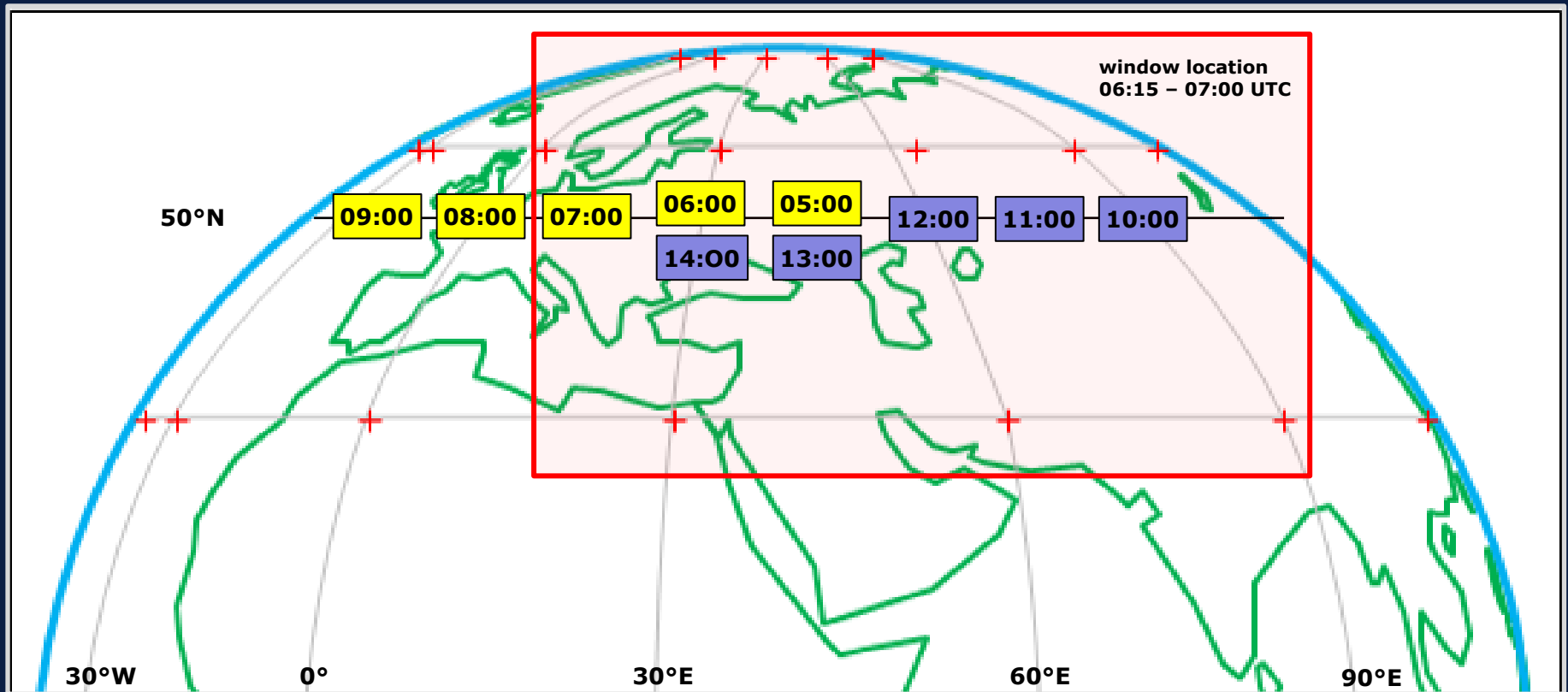
Seasonal changes of sunrise (and sunset) times are significant. If the goal is to gain maximum daylight coverage of the upper HRV window, the window shifts (4 westward, and 1 final to initial location) should follow the sunrise times (next slides).



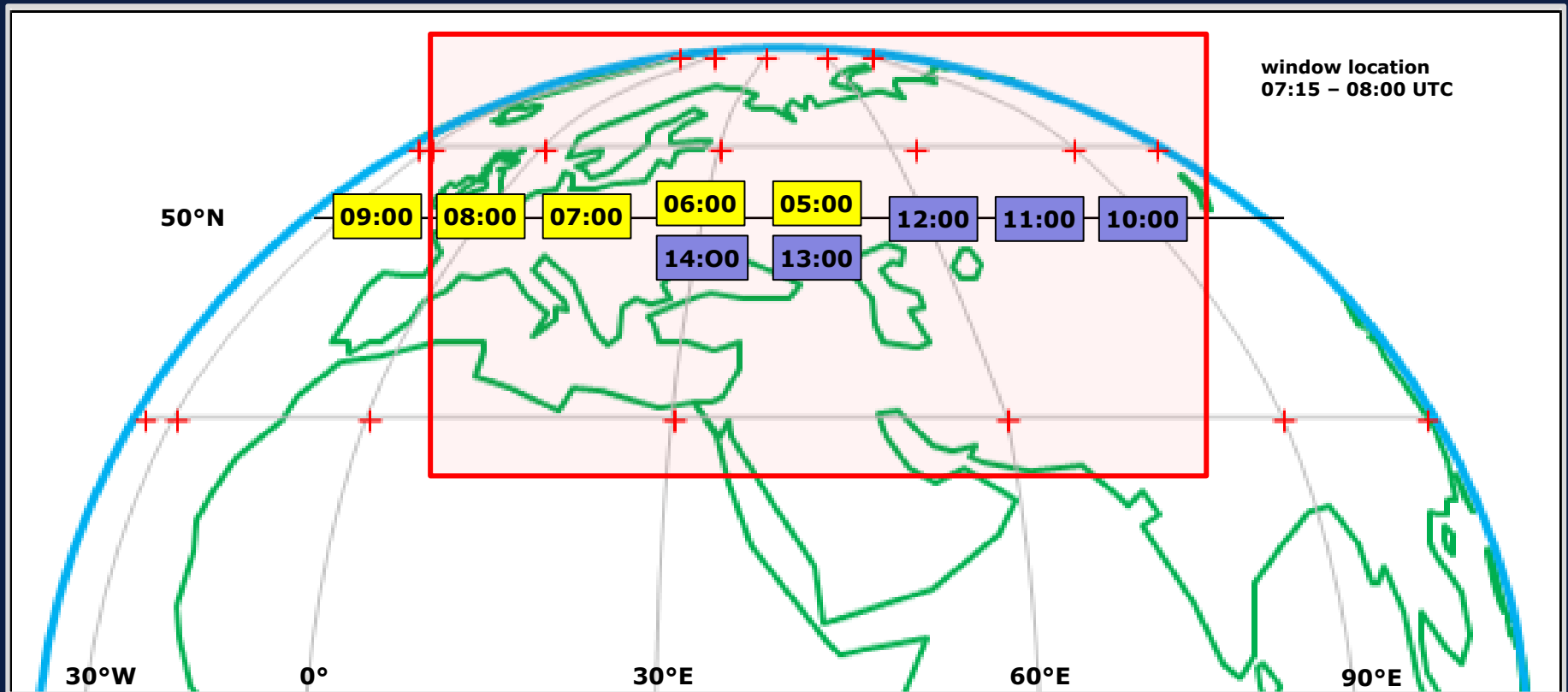
Example of possible scenario for the winter period (shortest daylight):



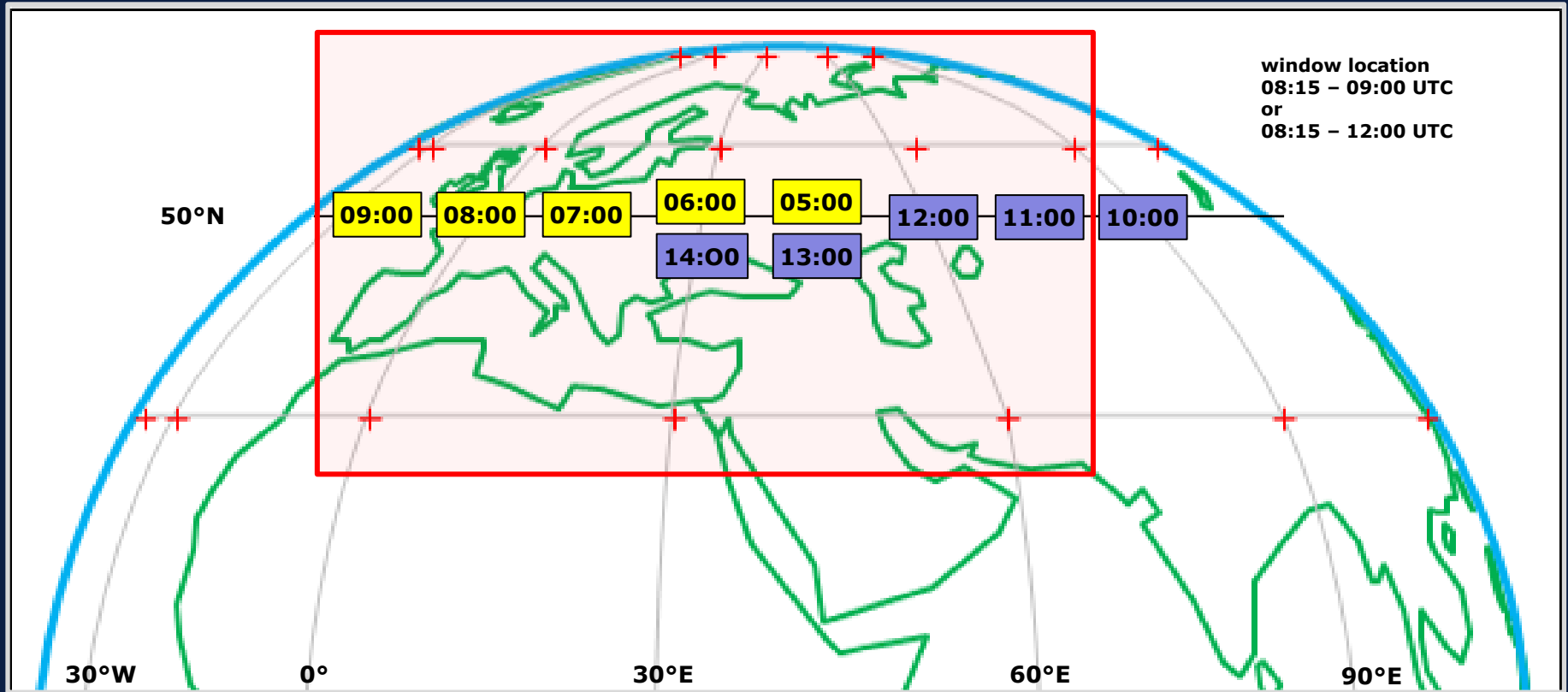
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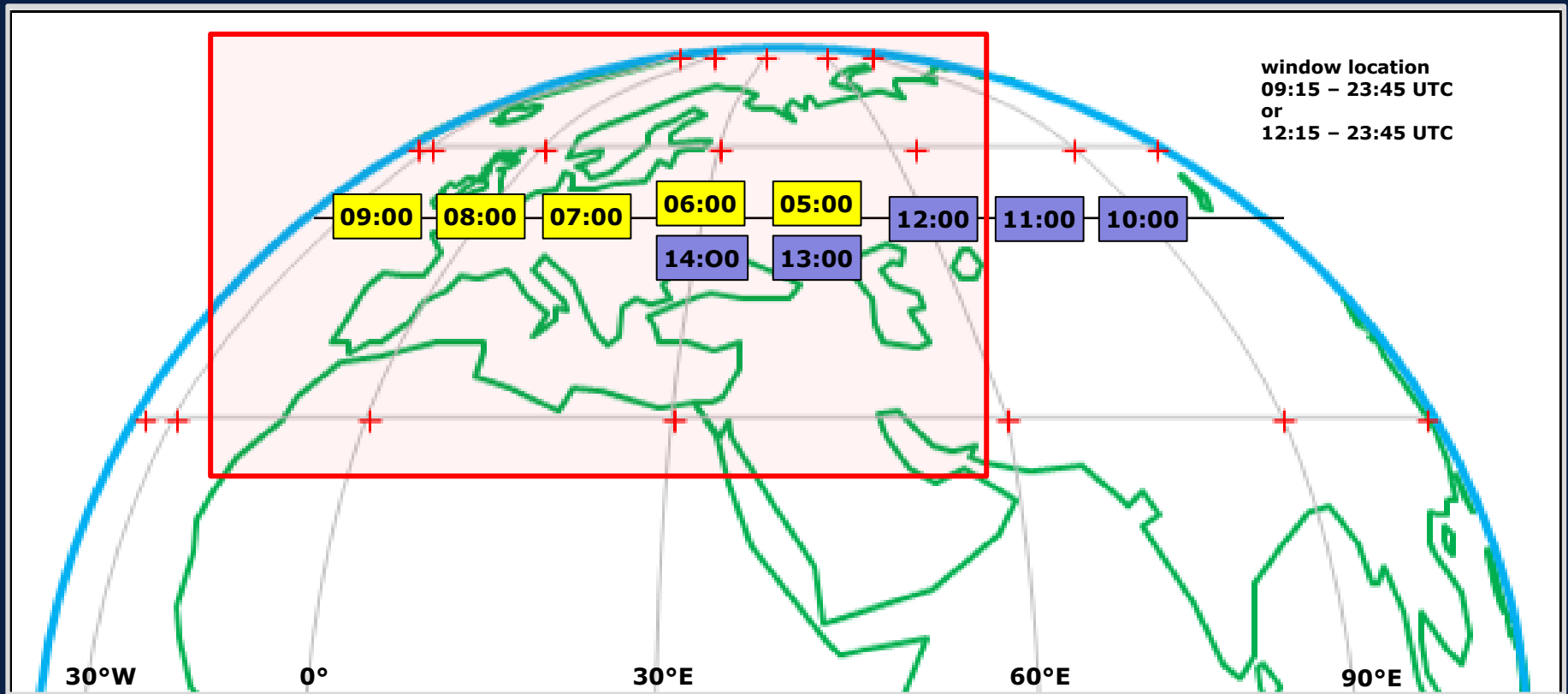


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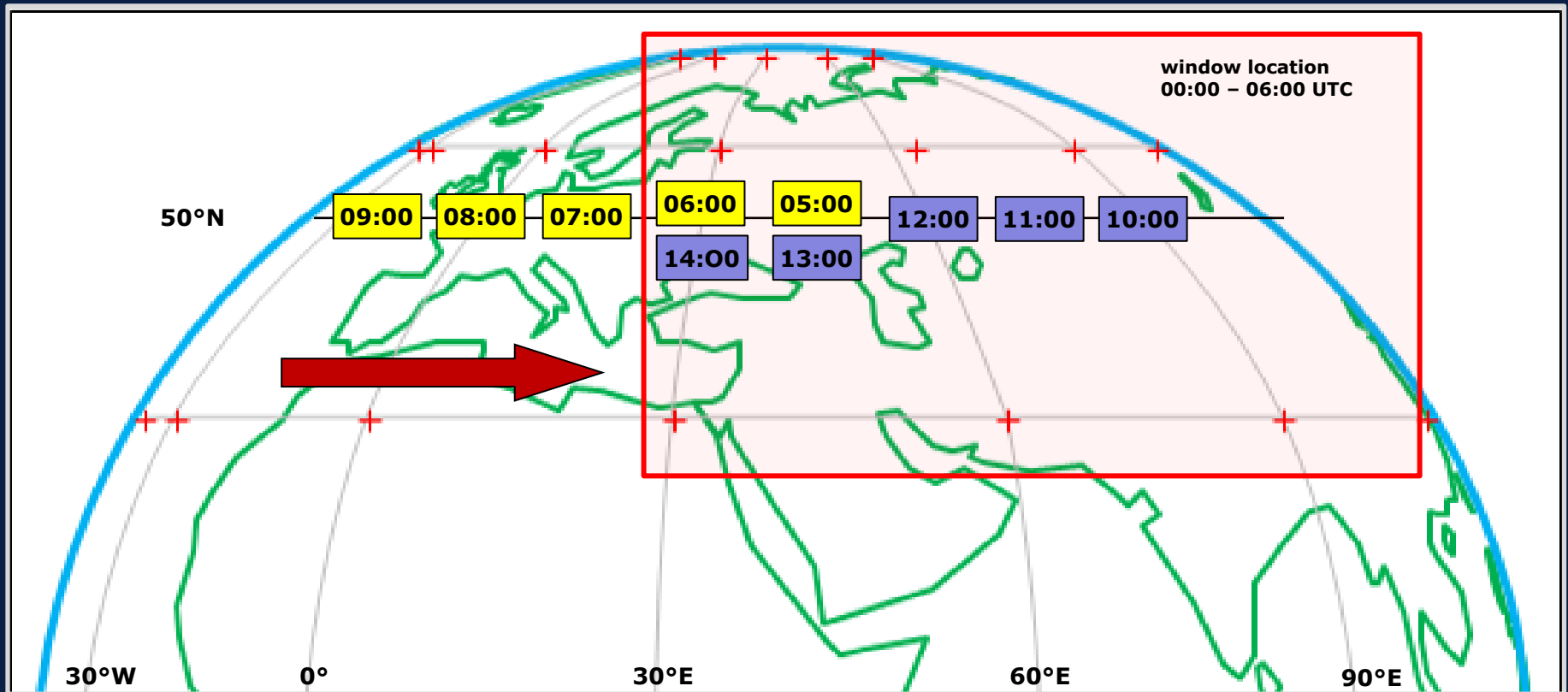
From now on, there are two options: either preserve the window here till 12 UTC (to enable maximum daylight coverage of the central-southern parts of Asia, till local sunset) and only afterwards perform one more, final shift to the west, or – if the central-southern parts of Asia coverage is not essential – perform the final shift to the west, where the window remains till midnight, when it moves back to the initial position.

## Example of possible scenario for the winter period (shortest daylight):



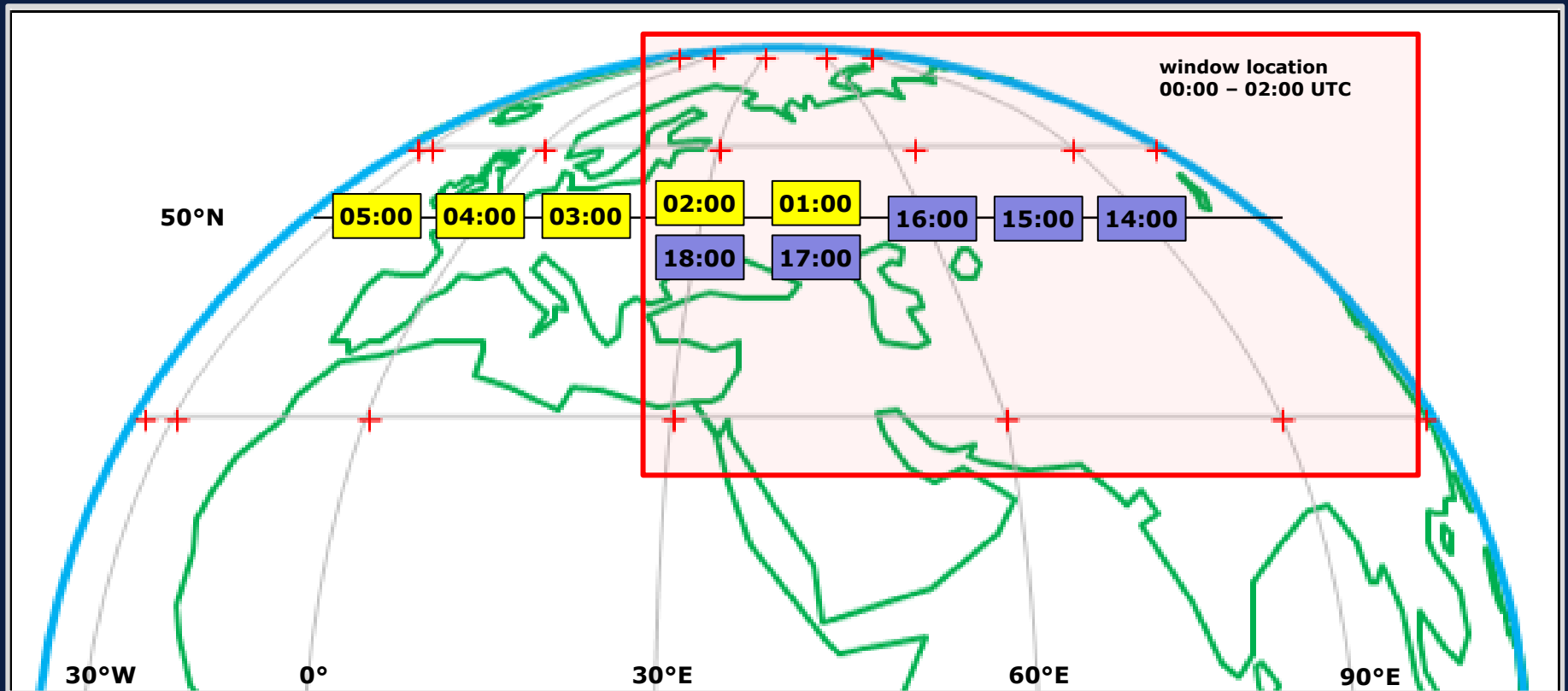
Here the window remains till the last scan of the day, and with midnight it moves back to the initial location at east.

## Example of possible scenario for the winter period (shortest daylight):



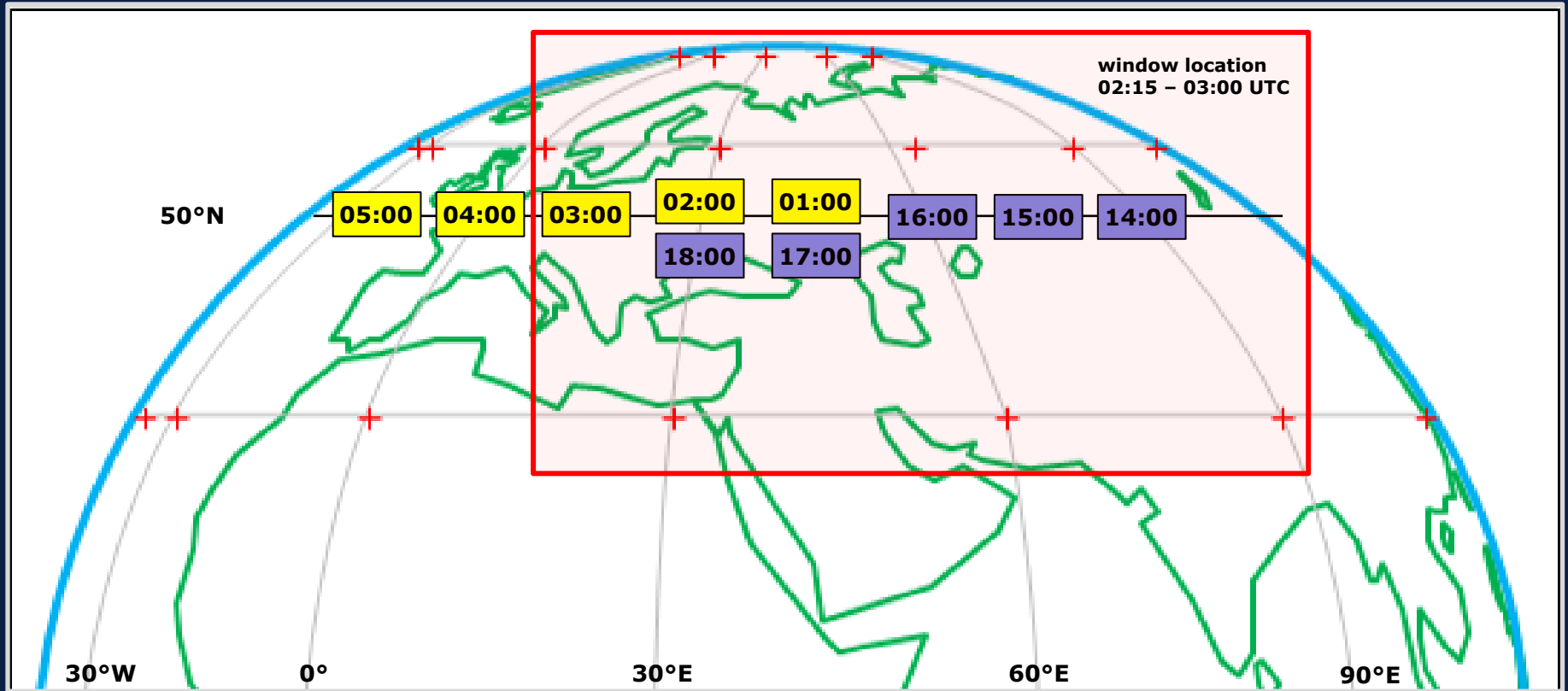


**Example of possible scenario for the summer period (longest daylight):**

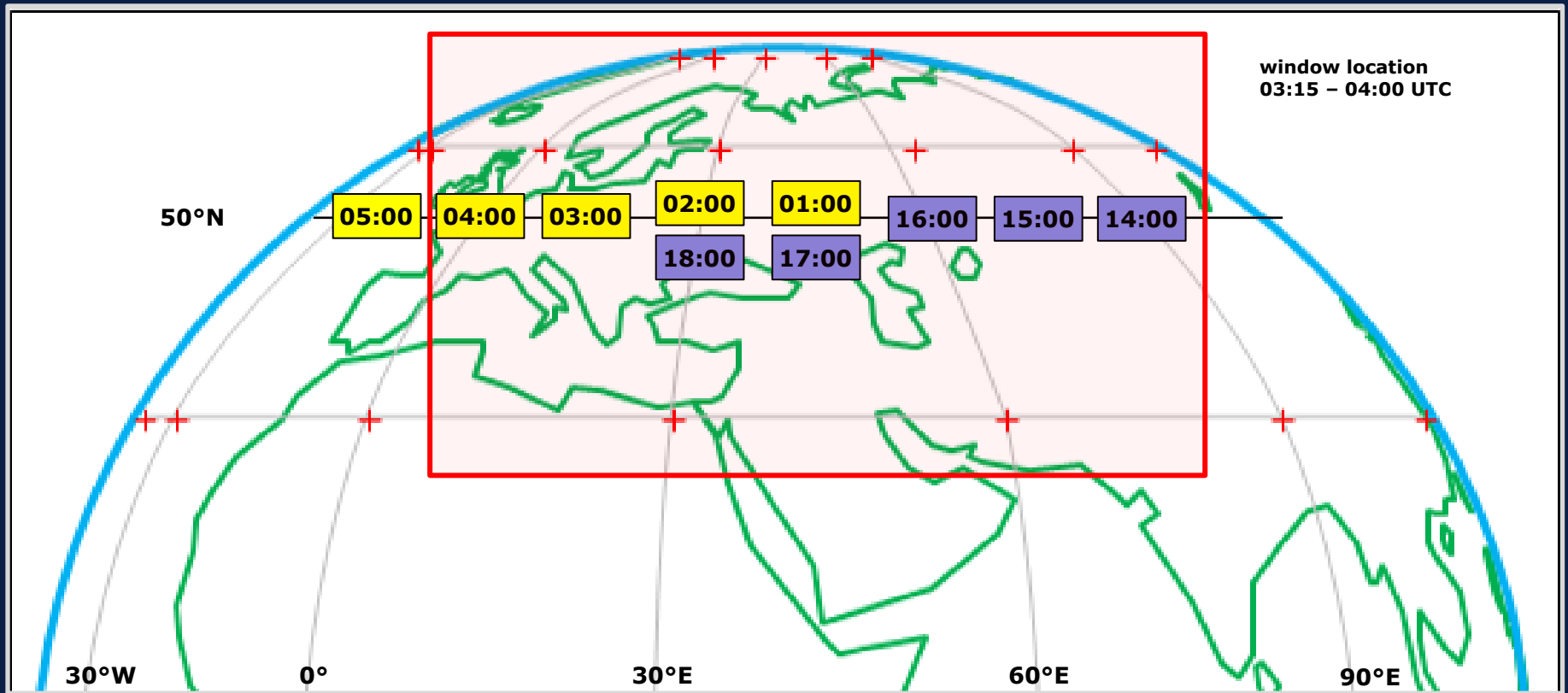


In summer, the westward window shift start 4 hours sooner than in winter.

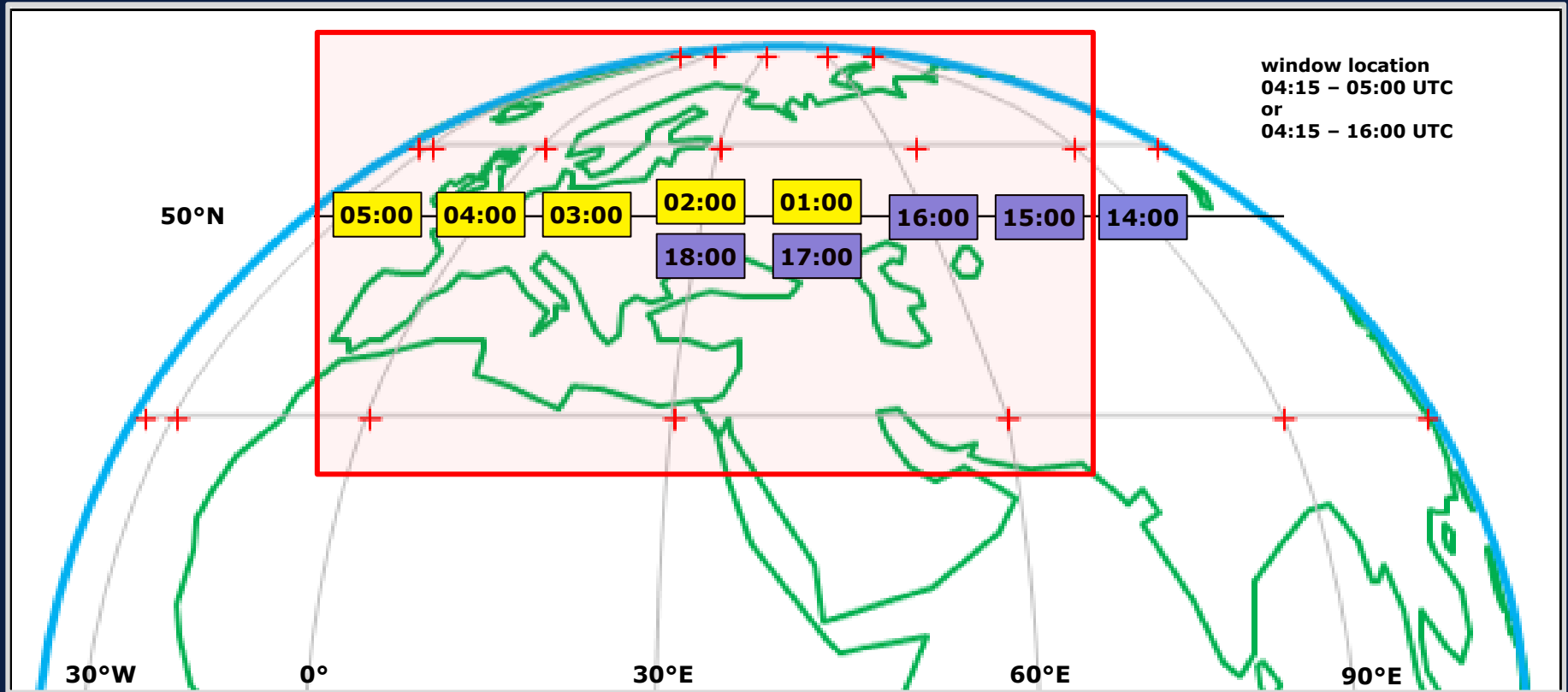
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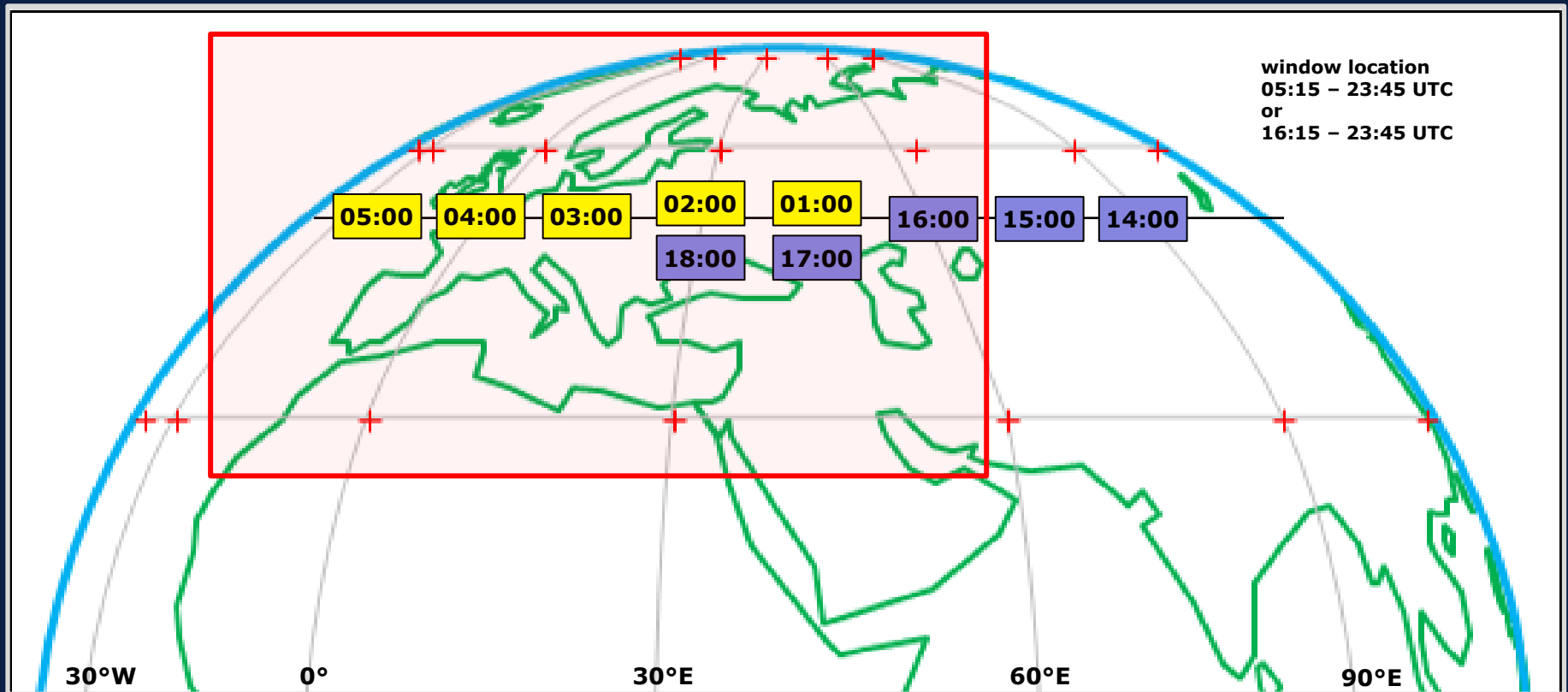


## Example of possible scenario for the summer period (longest daylight):



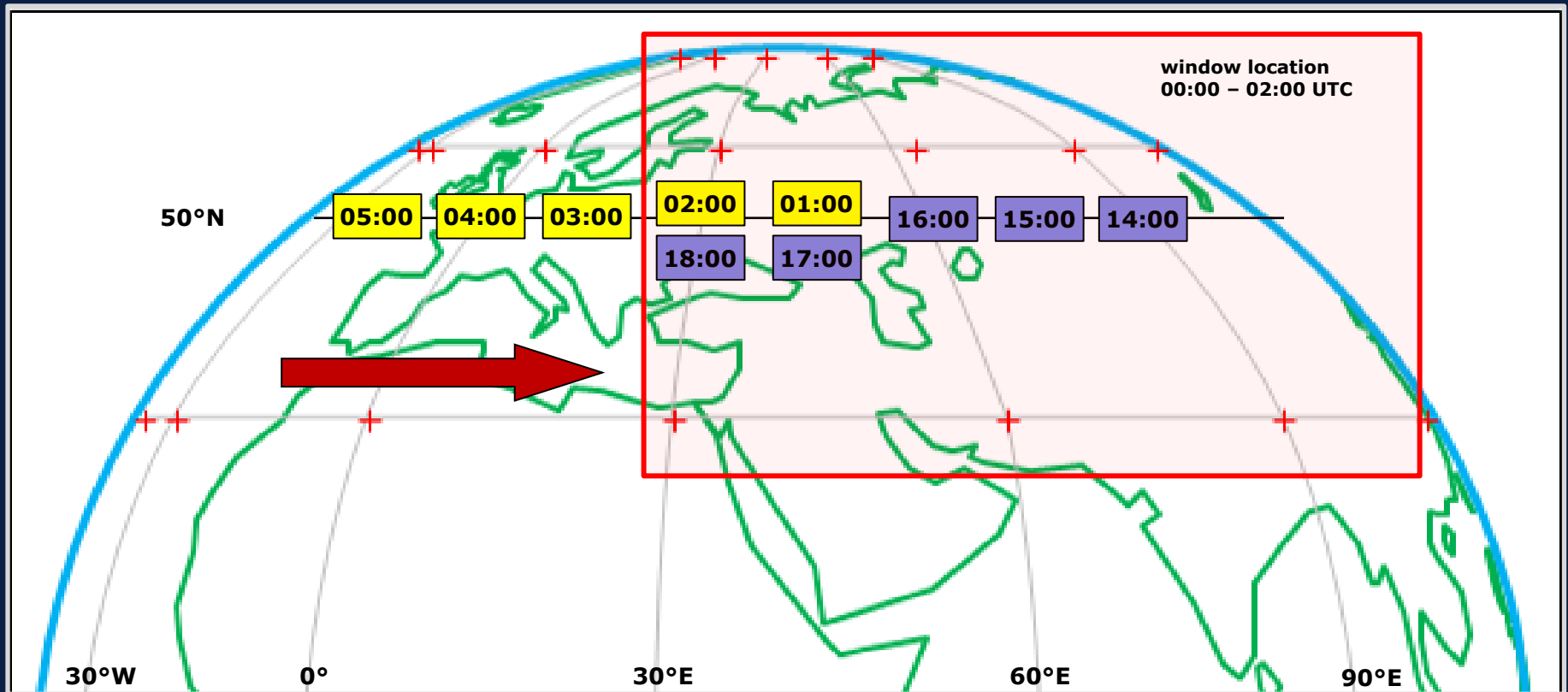
From now on, there are two options: either preserve the window here till 16 UTC (to enable maximum daylight coverage of the central-southern parts of Asia, till local sunset) and only afterwards perform one more, final shift to the west, or – if the central-southern parts of Asia coverage is not essential – perform the final shift to the west, where the window remains till midnight, when it moves back to the initial position.

## Example of possible scenario for the summer period (longest daylight):



Here the window remains till the last scan of the day, and with midnight it moves back to the initial location at east.

## Example of possible scenario for the summer period (longest daylight):



## Summary

- Several similar daily shift scenarios can be prepared for different seasons of the year, at least 3 total: 1 for winter months, 1 (common one) for spring and autumn, and 1 for summer months. The summer shift should start 4 hours sooner as compared to the winter shift.
- Alternatively, each month could have its own scenario, which would provide the most efficient use of daylight across the area of interest (this depends on how much technically difficult is the change of such scenarios).
- From the perspective of the Convection Working Group (CWG), data from MSG IODC can contribute to studies of storm tops, utilizing the dual-view from  $0^\circ$  and  $41.5^\circ$  locations.