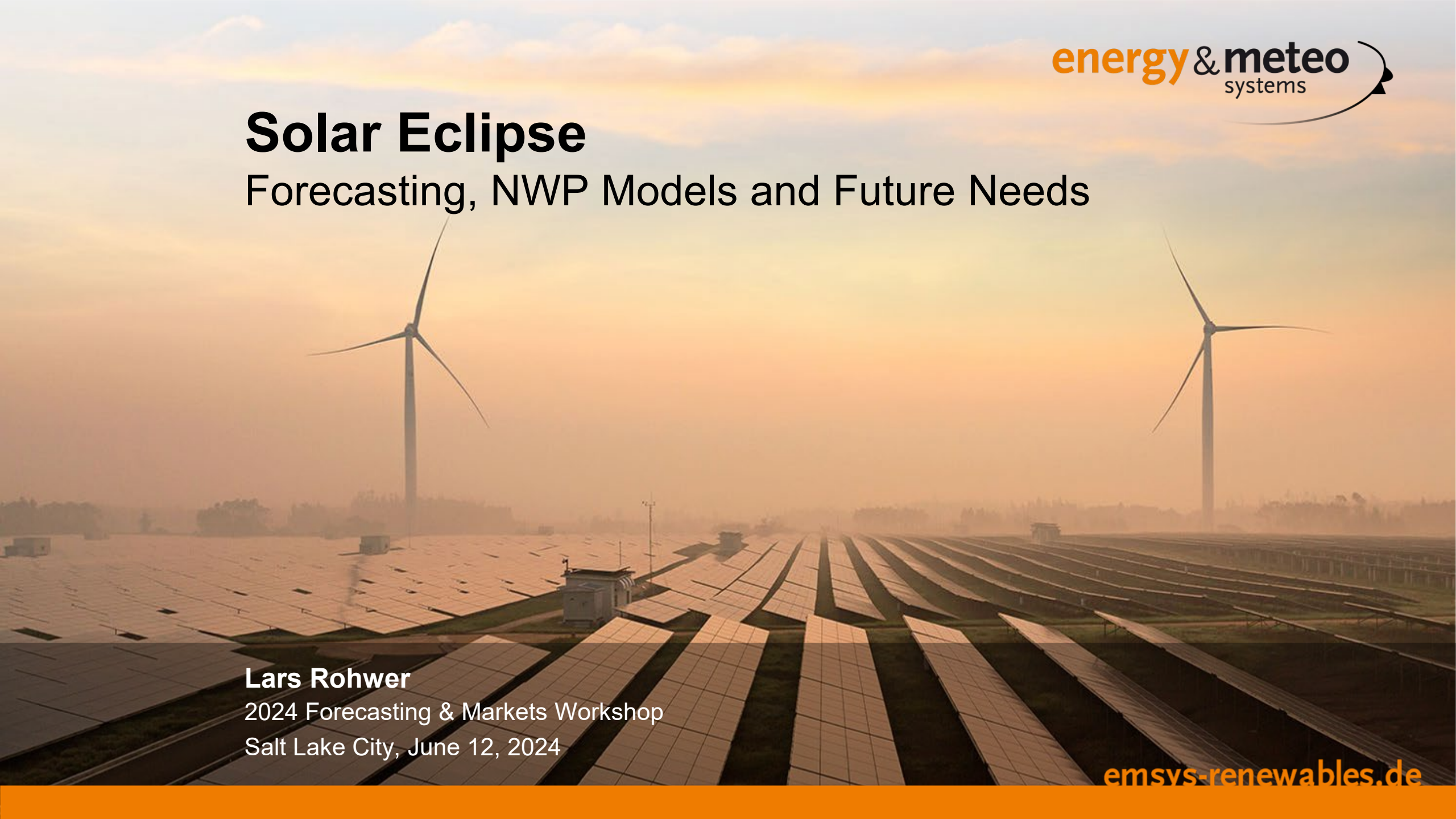


Solar Eclipse

Forecasting, NWP Models and Future Needs

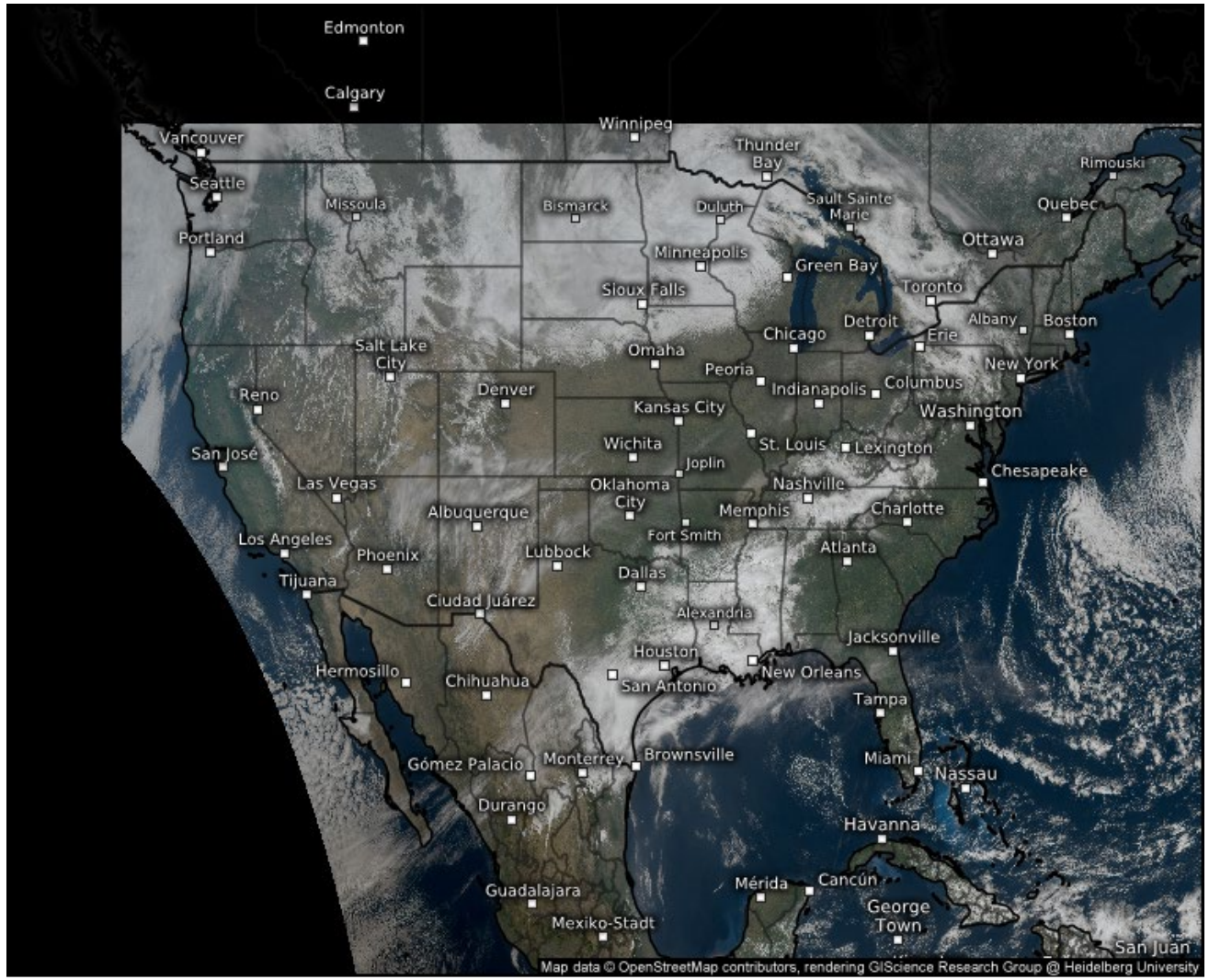
Lars Rohwer

2024 Forecasting & Markets Workshop

Salt Lake City, June 12, 2024

Solar Eclipse Post Event Analysis

Adam Simkowsk
ESIG Forecasting & Markets Workshop
June 2024



Satellit color Super HD

Mo. 08.04.2024, 19:15 Uhr MESZ

USA

kachelmannwetter.com
WETTER HD

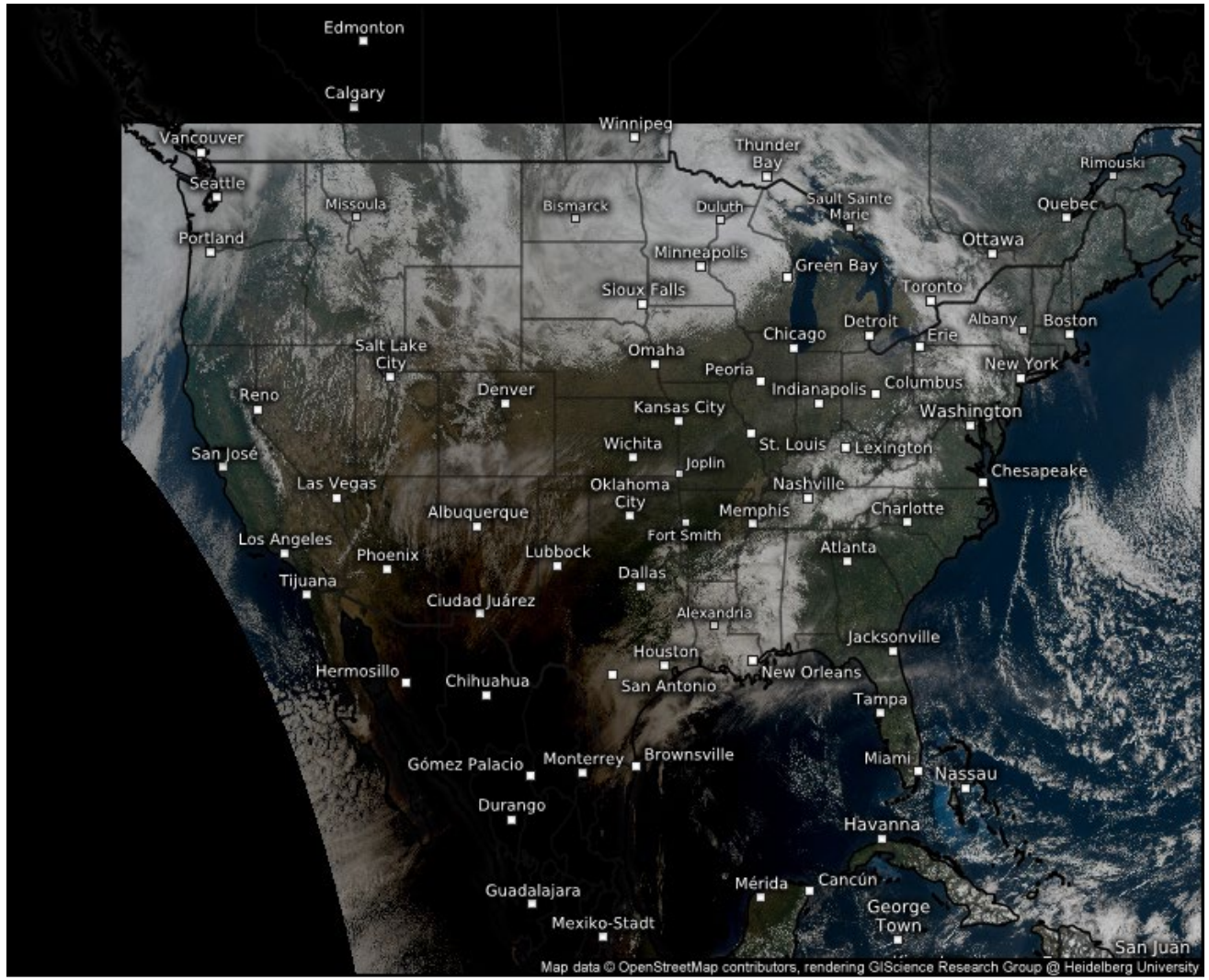
Satellitendaten: NOAA/GOES-16

Eclipse on April 08, 2024
Satellite images

01:15 pm EST

Eclipse on April 08, 2024
Satellite images

02:15 pm EST



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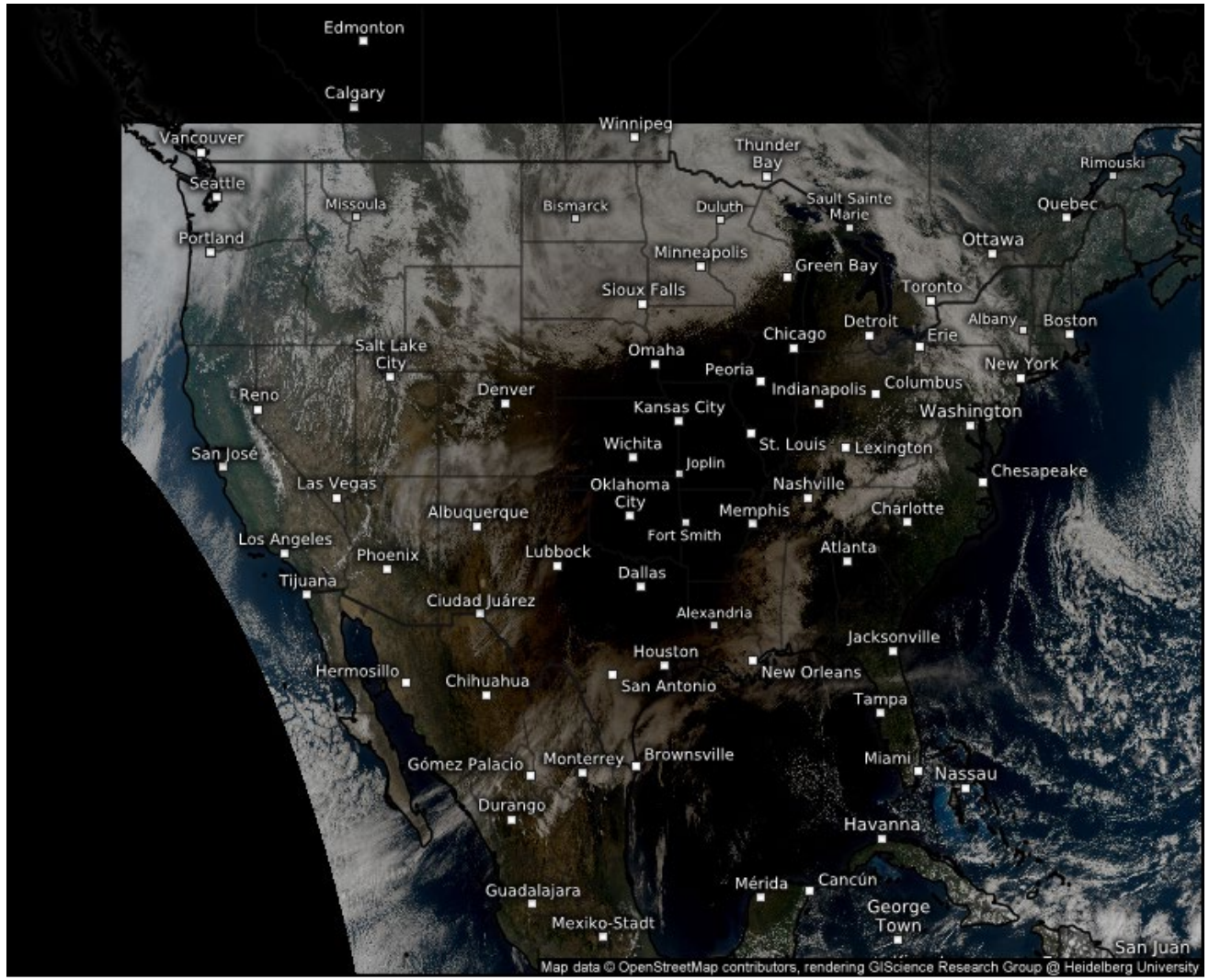

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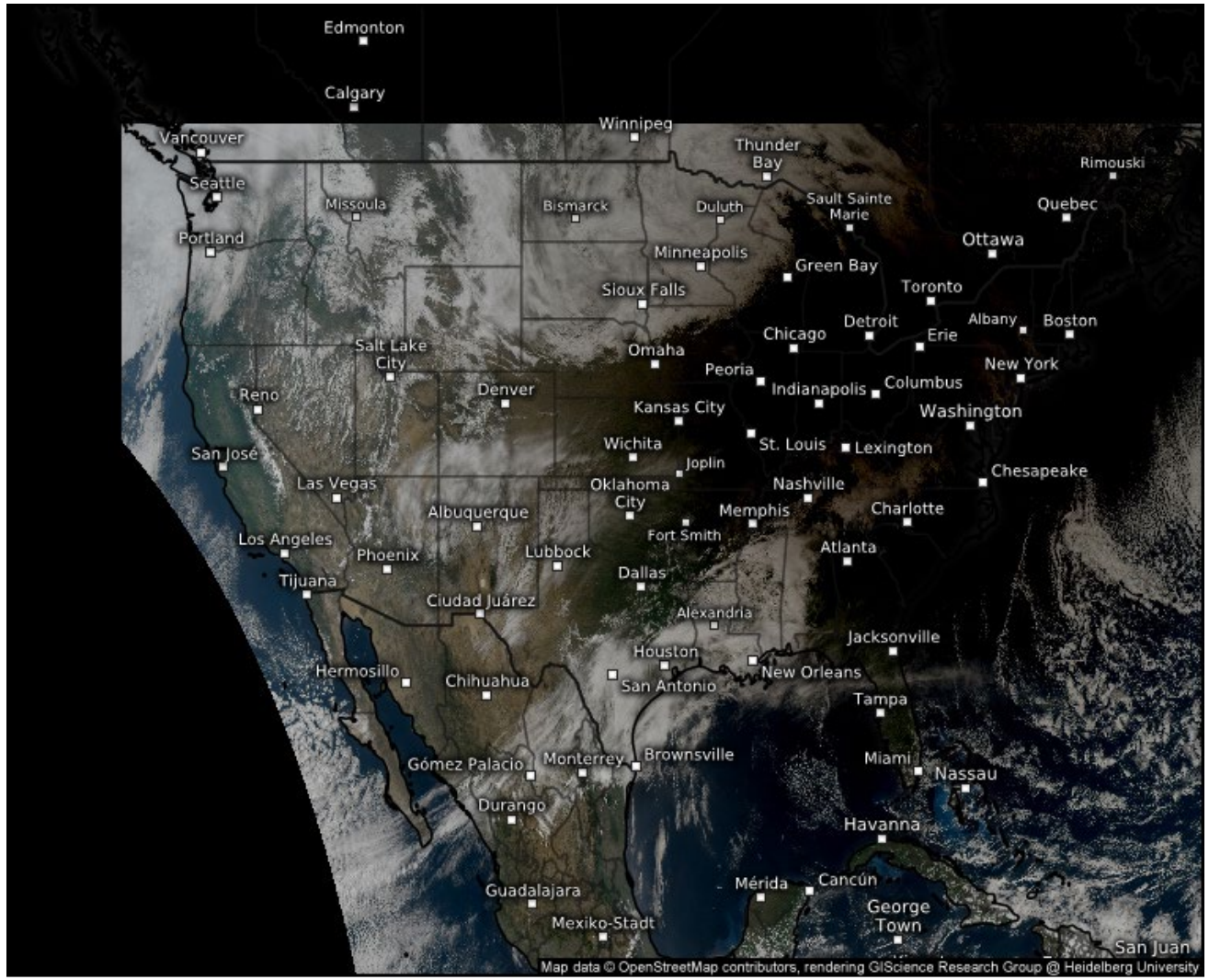
Eclipse on April 08, 2024
Satellite images

02:45 pm EST



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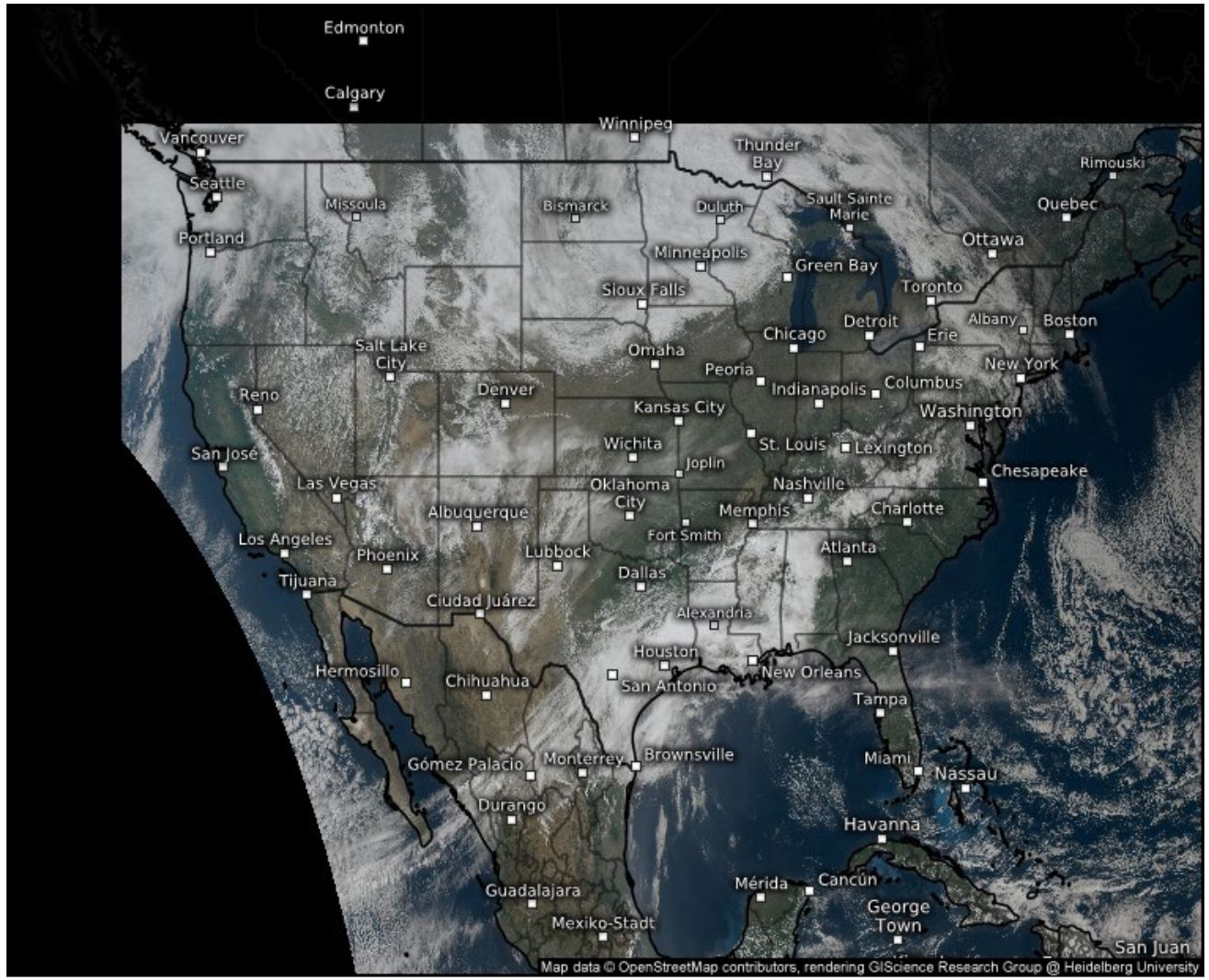
Satellitendaten: NOAA/GOES-16

Eclipse on April 08, 2024
Satellite images

03:15 pm EST



Satellit color Super HD

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USA

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WETTER HD

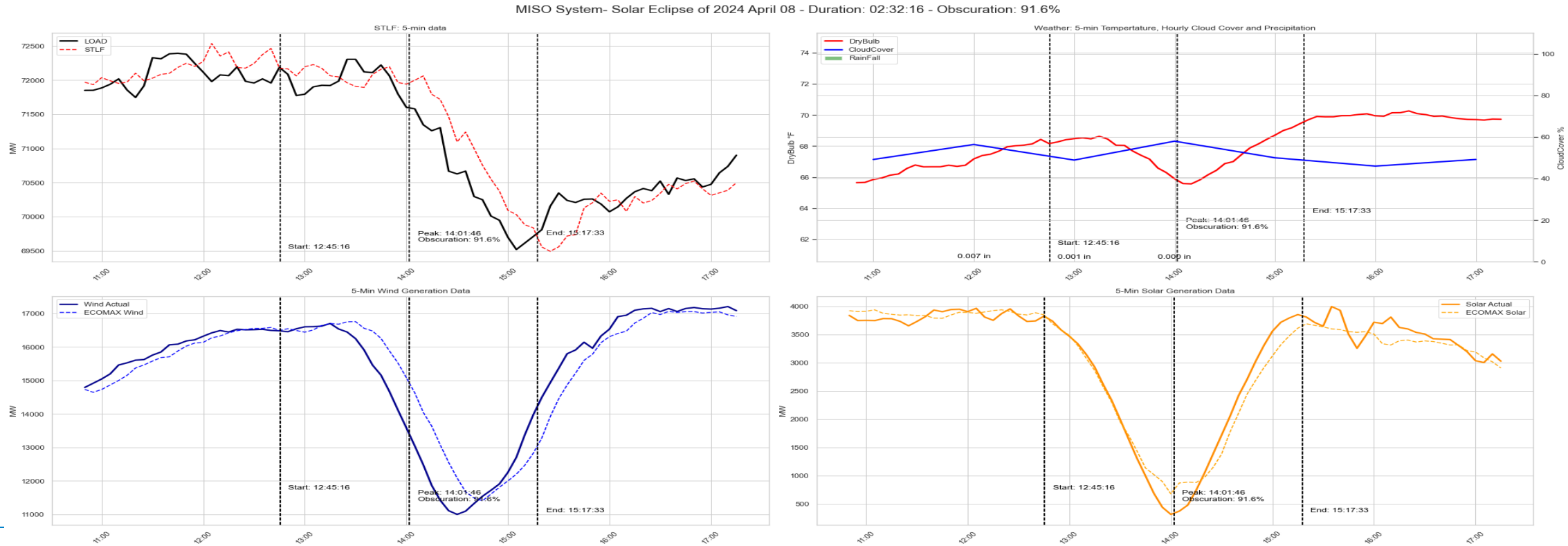
Satellitendaten: NOAA/GOES-16

Eclipse on April 08, 2024
Satellite images

04:15 pm EST

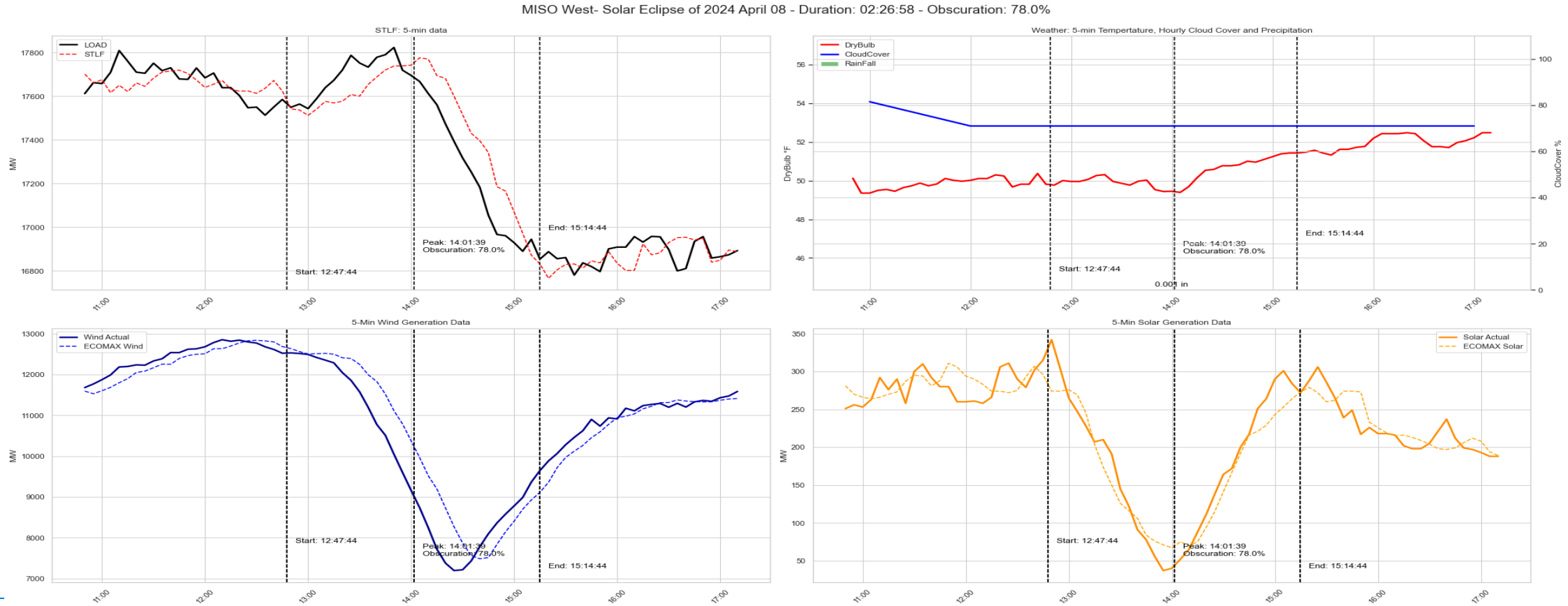
MISO Total Solar Eclipse Impacts
Load, Temperatures, Wind, and Solar

- Load began ramping down near peak obscuration in part due to the eclipse, but also in part due to daily load shape in April around the Great Lakes.
- Temperatures dipped during peak obscuration and rose as the eclipse exited MISO's footprint
- Wind ramped down considerably more than forecast although risk assessments and some NWP models warned of this behavior .
- Solar behaved mostly as expected but did bottom out more than forecast.



MISO North Solar Eclipse Impacts
Load, Temperatures, Wind, and Solar

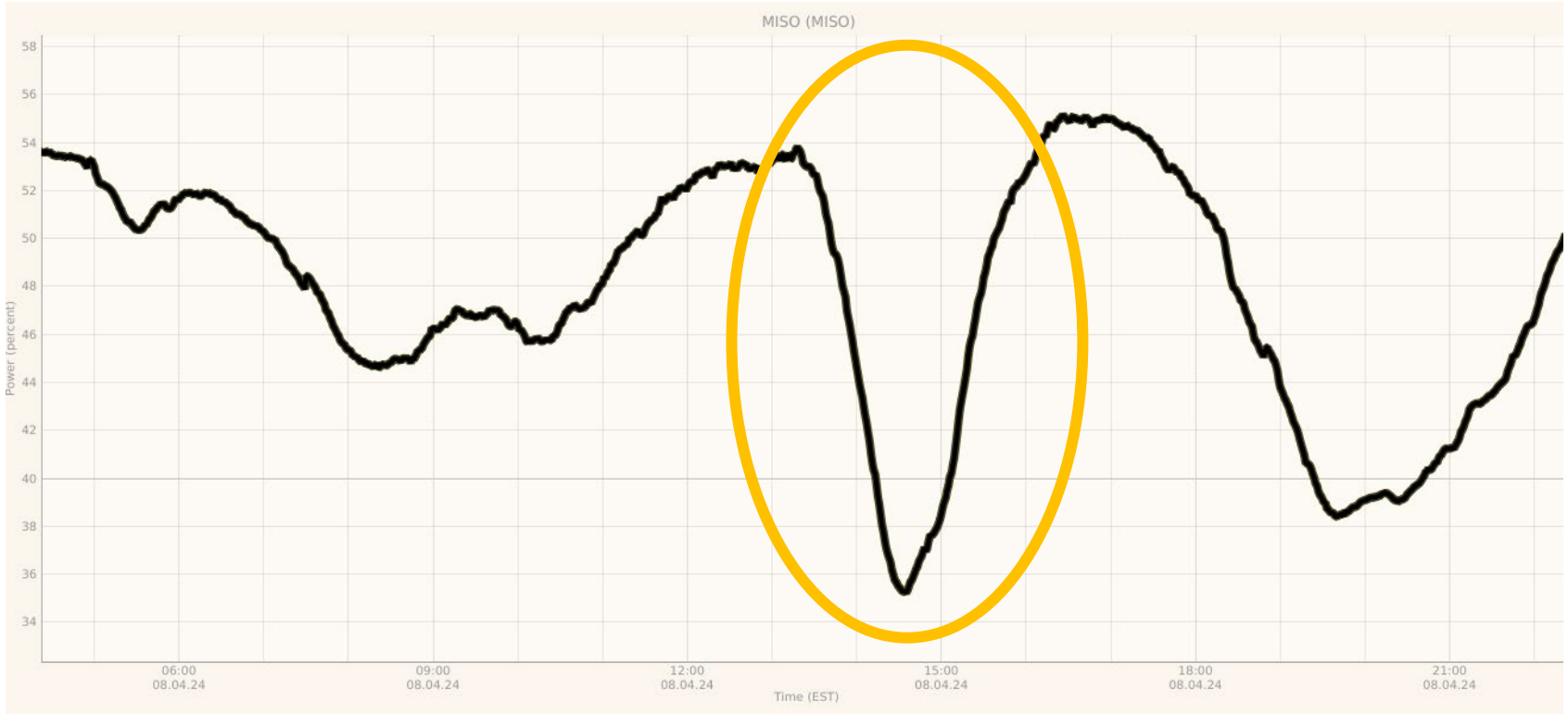
- Load began ramping down near peak obscuration but was in large part due to daily load shape in April around the Great Lakes.
- Temperatures barely responded to the eclipse in part due to max 78% obscuration, but also due to ample cloud cover
- Wind ramped down even with peak obscuration being south of the North region (majority of MISO wind)



MISO PV Measurement During Eclipse

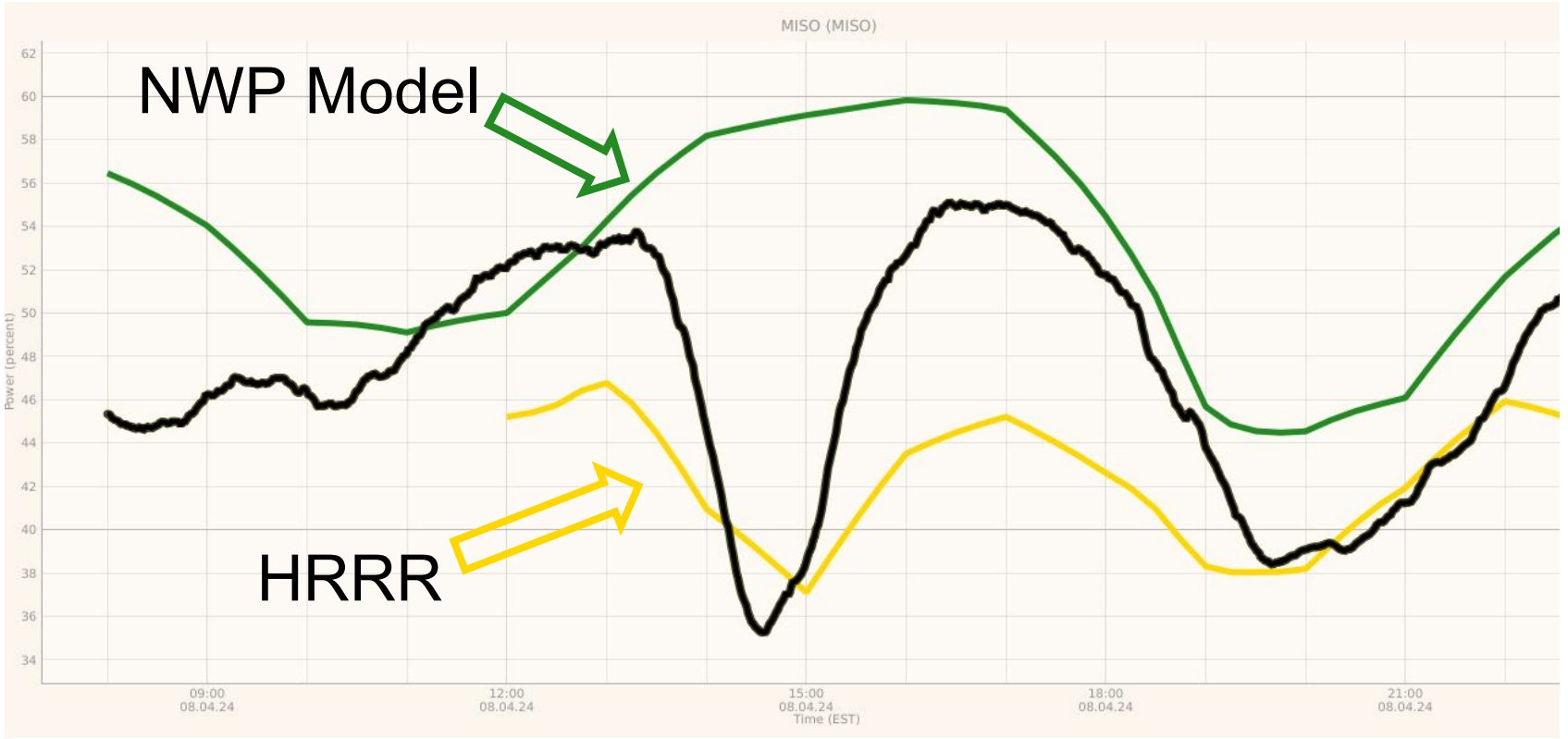
- direct correlation - effect can be integrated into the forecast
- weather prediction models do not normally take the eclipse into account
- NCEPS HRRR took the effect into account

MISO Wind Measurement During Eclipse



- indirect correlation - effect can hardly be integrated into the forecast
- severity and nature of the effect depends on the general weather situation

MISO Wind Measurement During Eclipse



- indirect correlation - effect can hardly be integrated into the forecast
- severity and nature of the effect depends on the general weather situation
- NCEPS HRRR considers the effect (in parts) - just as the spreads

How MISO managed uncertainty During The Total Solar Eclipse

Decision	Market	April 8, 2024
Regulation Reserve	Y	Increase Reg for the eclipse period
STR requirement	Y	Increase STR for the eclipse period
Ramp Capability Requirement	Y	Increase uncertainty component of Ramp Product for the eclipse period (RT only)
Monitor and preposition RDT	Y	YES
Txx Limit Control, Increase TCDC	Y	Be conservative on constraint limit control (suggested by IMM for Oct)
Cap Solar or MRD as needed		As Needed
Testing Solar		No testing solar during eclipse
MCS/OI Messages		To be sent out to members
Additional Operators and Supporting Staff		Subject to business function managers
Reschedule Planned Outages	Y	Outage Coordination Team worked to re-schedule multiple CT outages

Prior to the eclipse, MISO meteorologists raised the awareness around wind forecast risks particularly related to the April 8th weather setup, despite vendor forecasts.

From Adam Simkowski on 4/5 (Friday before eclipse):

- *"A low-pressure system traversing our region is inherently risky to the wind forecast as weather models can struggle more. Also, the weather models currently displaying the wind up ramp do not factor in the eclipse. Once we get closer to the 8th, the high-resolution weather models that do factor in the eclipse will be interesting to watch. Regardless,* ***this wind up ramp is risky and may be over-done****"*

From Adam Simkowski at 10:14 EST on April 8th to Control Room Operators on shift:

- *"We're watching the wind forecast closely this morning. Given the current weather pattern with a low-pressure system moving through the North region-* ***the forecast ramp up during eclipse time remains in low confidence****. The traditional global weather models (lower resolution) all anticipate the low-pressure system to strengthen slightly this afternoon- which is typical behavior with solar heating. However, solar heating will be much more absent today with the eclipse and these weather models do not factor in the eclipse. Enter the* ***high-resolution weather models*** *which do factor in the eclipse. Most of them are* ***showing a ramp down in wind*** *during the eclipse as they anticipate less solar heating and less strengthening of the low-pressure system- equating to low wind speeds. "*

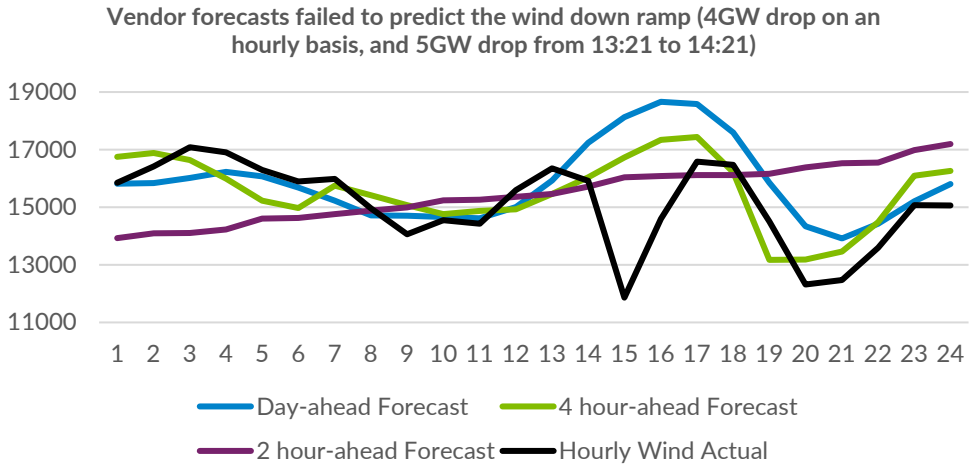
MISO's Risk Assessment Takeaways

- The risk assessments on the previous slides clearly demonstrates the **importance** of having *explicit eclipse behavior* in the NWP models, as only through the proper modeling of all the feedback pathways would such an effect on wind have been predicted at all.
  1. **With more extreme events being modeled with high-resolution NWP, better risk assessments can be made to manage challenging conditions on the grid. The more, the better.**
  2. **Without high-resolution NWP during the eclipse, its not likely the aforementioned risk assessments would have been communicated to the Control Room due to low confidence.**

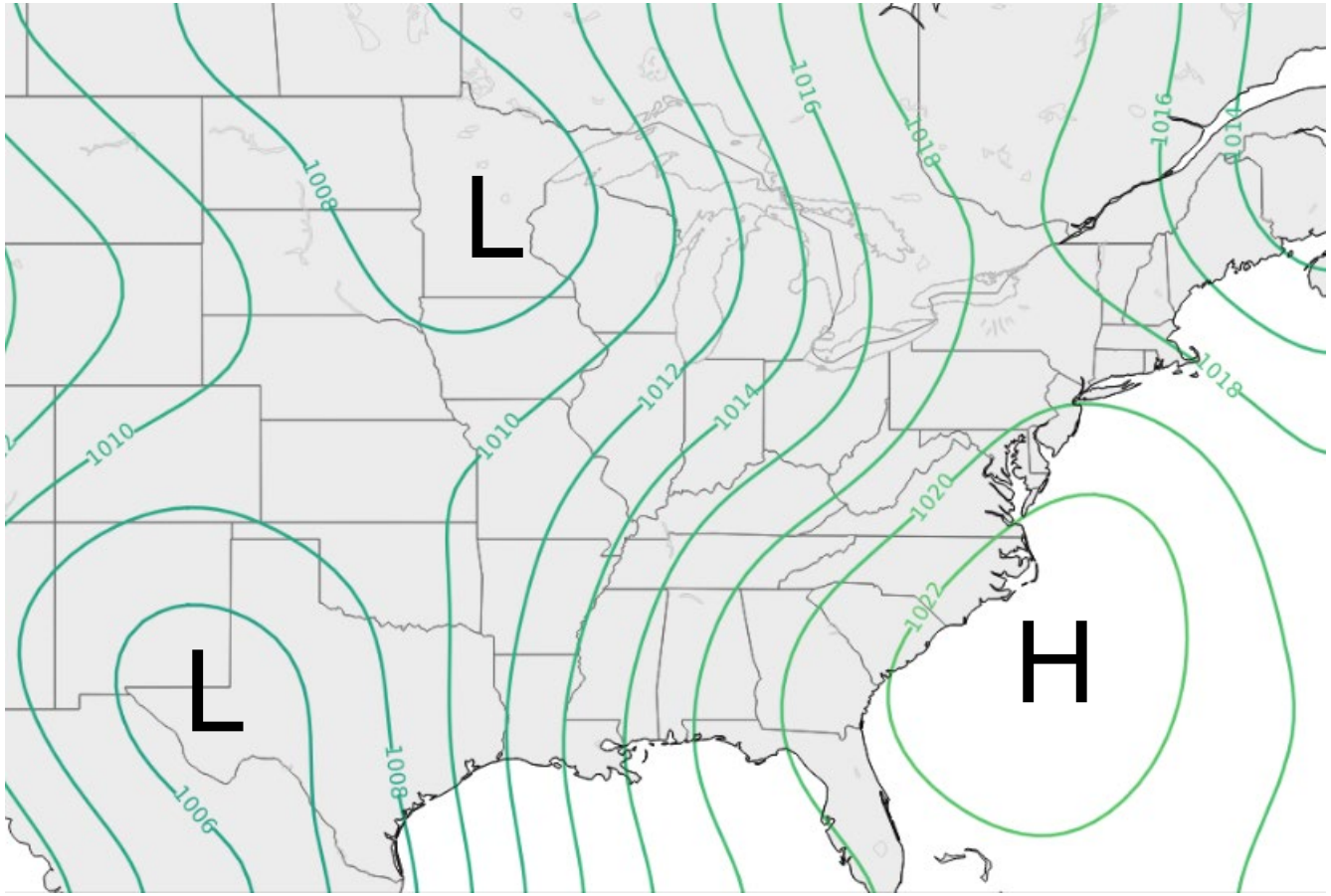
- Continue prioritizing **expert insights**, augmenting them with **quantified** risk assessments, even if they're estimated ranges, and **expanding our outreach** (for example, beyond Control Room) when applicable.

- Continue the efforts to build weather-scenario-based forecast analysis capability (NWP based), analytics, and automation. Vendors provide ample amounts of valuable data- keep determining the best ways to leverage it.

- Request vendors to apply manual adjustments, when applicable, on future extreme events instead of focusing on "all hours" metrics.



Weather Situation



- MISO was located between a high in the southeast and a low in the northwest
- due to the dry air and the sunshine, a low level jet forms
- the process was interrupted due to the eclipse
- a similar behavior as we see in corresponding weather conditions at sunset

Thank you for your attention!

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