

# **Overview of the TC4 Mission and Scientific Objectives**

**Brian Toon**

**Department of Atmospheric and  
Oceanic Sciences**

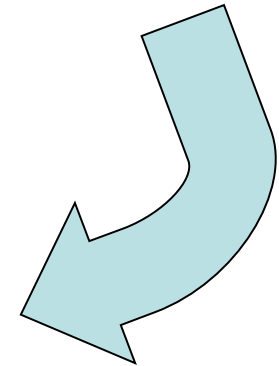
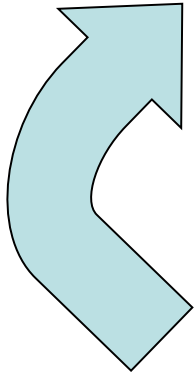
**University of Colorado**

**Boulder**

# Goals of the Meeting

Feedback

Logistics

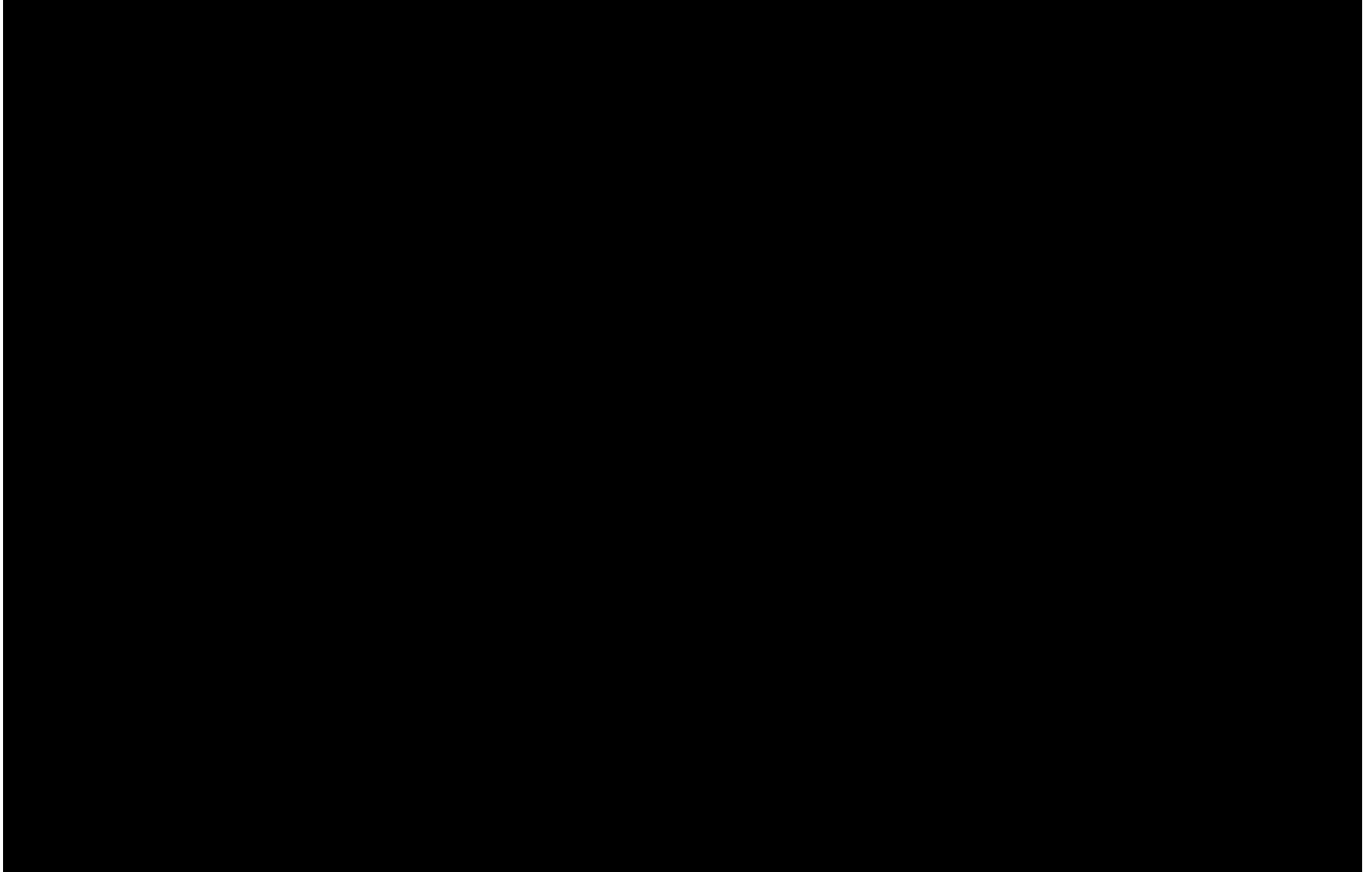


Science

# Mission management

- Program Scientists-Mike Kurylo/Hal Maring
- Mission Scientists-Brian Toon/Dave Starr
- ER-2 Flight Scientists-Paul Newman/Steve Platnick
- WB-57 Flight Scientists-Eric Jensen/Steve Wofsy
- DC-8 Flight Scientists-Mark Schoeberl/Paul Wennberg
- And many others

# Calendar-July -23 possible flight days



# Calendar-August 23 possible flight days

<b>Detailed Major questions</b>	<b>Primary Mission addressing ?</b>
<p>1. How can space-based measurements of geophysical parameters, particularly those known to possess strong variations on small spatial scales (e.g., H<sub>2</sub>O, cirrus), be validated in a meaningful fashion?</p>	<p>Costa Rica 07, Guam</p>
<p>2. How do convective intensity and aerosol properties affect cirrus anvil properties?</p>	<p>Costa Rica 07</p>
<p>3. How do cirrus anvils, and tropical cirrus in general, evolve over their life cycle? How do they impact the radiation budget and ultimately the circulation?</p>	<p>Costa Rica 07</p>
<p>4. What controls the formation and distribution of thin cirrus in the Tropical Tropopause layer, and what is the influence of thin cirrus on radiative heating and cooling rates, and on vertical transport?</p>	<p>Costa Rica 07</p>

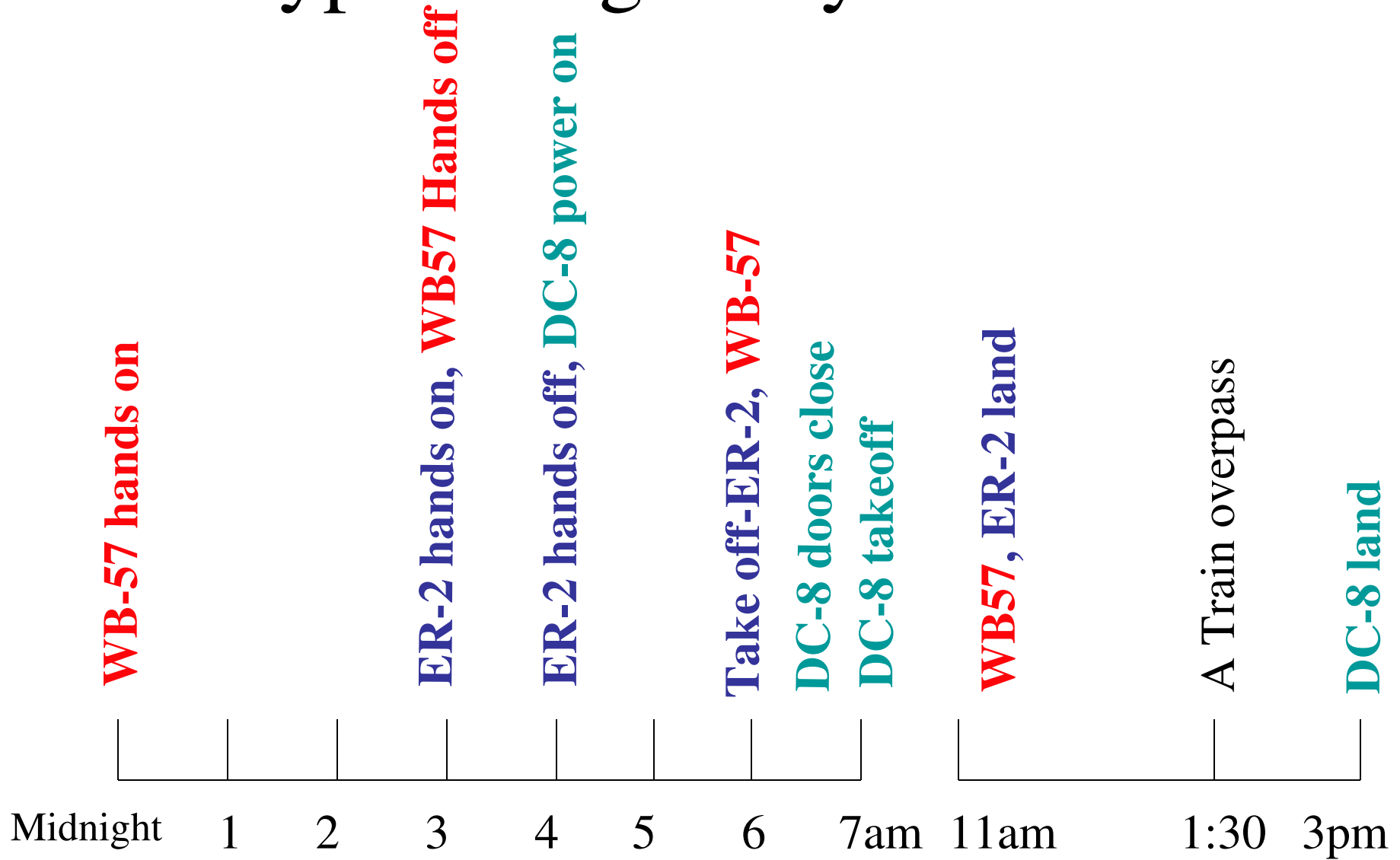
<b>Detailed Major questions (cont.)</b>	<b>Primary Mission addressing ?</b>
5. What are the physical mechanisms that control (and cause) long-term changes in the humidity of the upper troposphere in the tropics and subtropics?	Costa Rica 07, Guam
6. What are the chemical fates of short-lived compounds transported from the tropical boundary layer into the Tropical Tropopause layer. (i.e., what is the chemical boundary condition for the stratosphere?)	Guam , Costa Rica 07
7. What are the mechanisms that control ozone within and below the Tropical Tropopause Transition layer?	Guam, Costa Rica 07
8. What mechanisms maintain the humidity of the stratosphere? What are the relative roles of large-scale transport and convective transport and how are these processes coupled?	Guam

## Example of flights

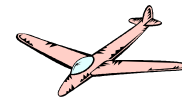
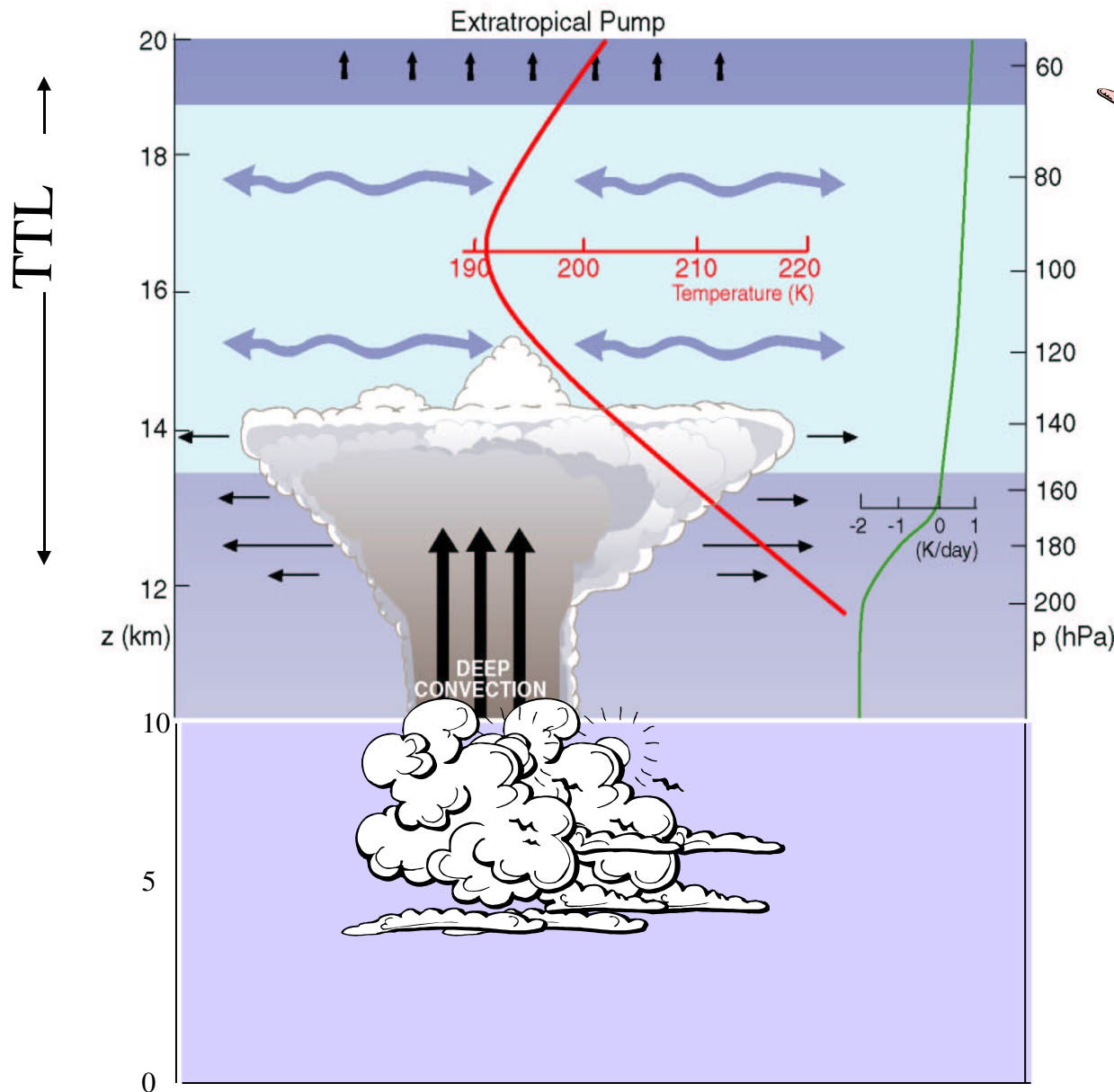
Number of multi-aircraft missions dedicated to goal	Goals All flights include satellite validation
5	Study anvils and outflow from deep convection
5	Examine TTL properties (Clear sky)



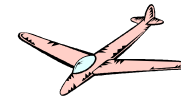
# Typical flight day timeline



# Sampling strategy-Costa Rica



**Remote Sensing-ER-2**



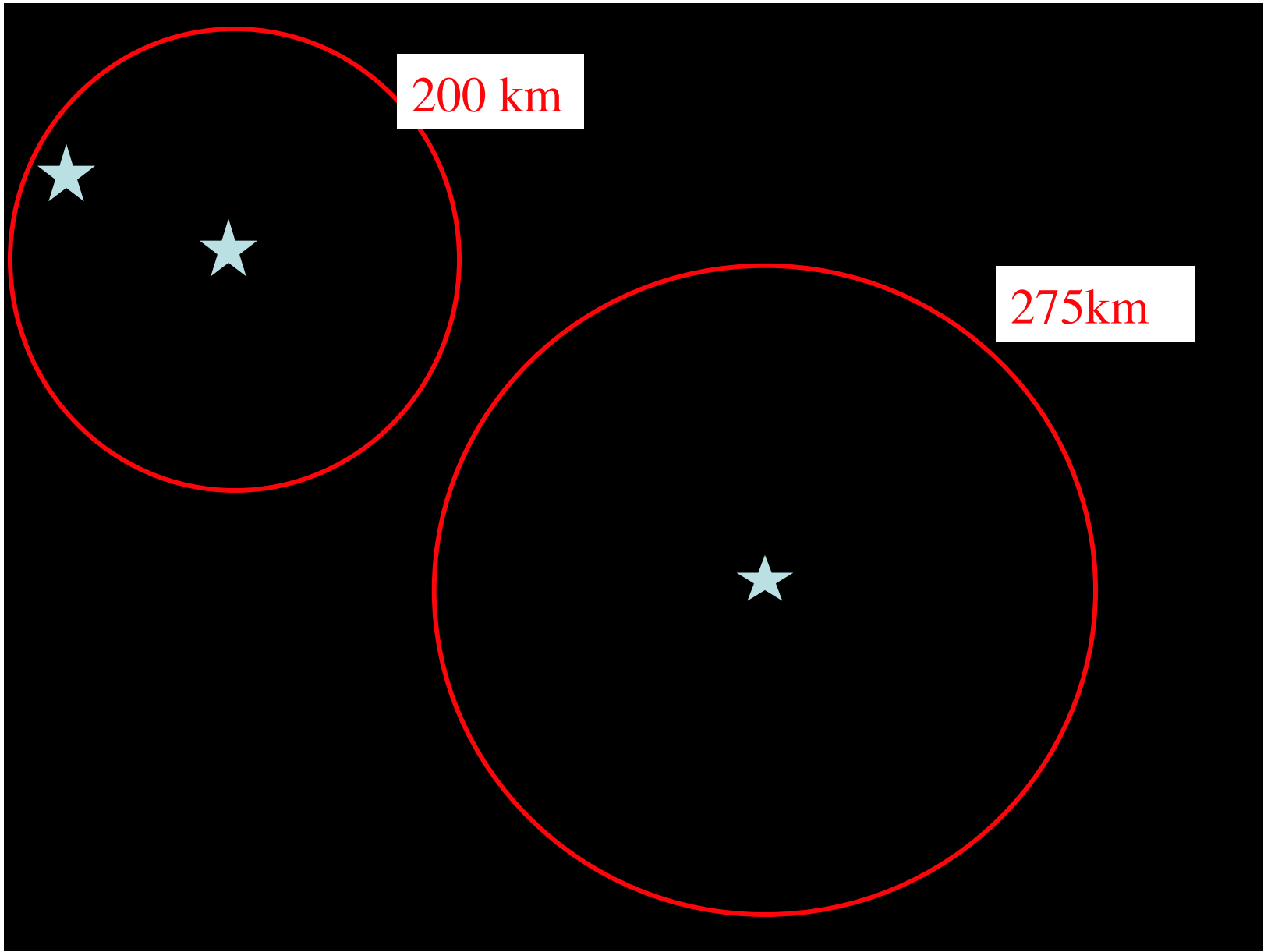
**Cloud physics,  
TTL chemistry  
WB57**



**Cloud physics,  
TTL chemistry,  
Remote sensing  
DC-8**

**Note: We plan  
coordinated flights  
with all 3 aircraft**

# Locations of Ground Sites & Radar Coverage



**CRYSTAL-FACE FLIGHT TRACKS**  
**JUL 23, 2002**

**FLT TIME (GMT)**  
**19: 24-19: 39**



**ER-2** **WB-57** **PROTEUS** **CITATION** **P3** **TW.DTTER**

# CRYSTAL-FACE FLIGHT TRACKS JUL 23, 2002

FLT TIME (GMT)  
19:31-19:44



ER-2 WB-57 PROTEUS CITATION P3 TW, OTTER

# CRYSTAL-FACE FLIGHT TRACKS JUL 23, 2002

FLT TIME (GMT)  
19:39-19:54



ER-2 WB-57 PROTEUS CITATION P3 TW, DTTT

2 GOES-8 VIS 23 JUL 02 19:45 Z NASA LARC ■ W/E SITES

**CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002**

**FLT TIME (GMT)  
19: 44-20: 01**



**ER-2 WB-57 PROTEUS CITATION P3 TW. OTTER**

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# CRYSTAL-FACE FLIGHT TRACKS JUL 23, 2002

FLT TIME (GMT)  
19: 54-20: 09



ER-2 WB-57 PROTEUS CITATION P3 TW. OTTER



# CRYSTAL-FACE FLIGHT TRACKS JUL 23, 2002

FLT TIME (GMT)  
20: 01-20: 14



ER-2 WB-57 PROTEUS CITATION P3 TW. OTTER

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# CRYSTAL-FACE FLIGHT TRACKS JUL 23, 2002

FLT TIME (GMT)  
20: 09-20: 24



ER-2 WB-57 PROTEUS CITATION P3 TW OTTER

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# CRYSTAL-FACE FLIGHT TRACKS JUL 23, 2002

FLT TIME (GMT)  
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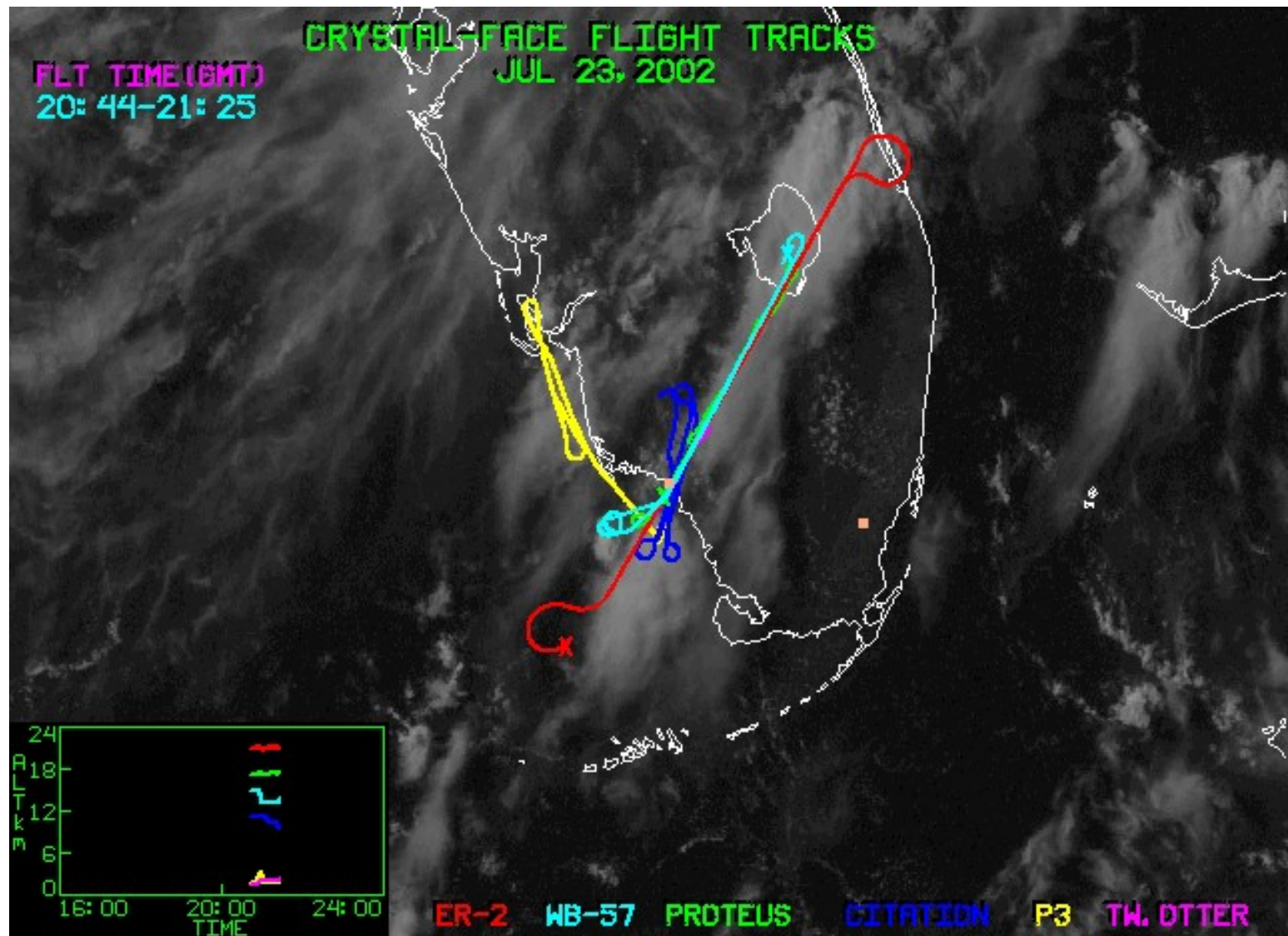


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CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

FLT TIME (GMT)  
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CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

FLT TIME (GMT)  
21: 14-21: 31



ER-2 WB-57 PROTEUS CITATION P3 TW. OTTER



CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

FLT TIME (GMT)  
21: 24-21: 39



ER-2 WB-57 PROTEUS CITATION P3 TW, OTTER

CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

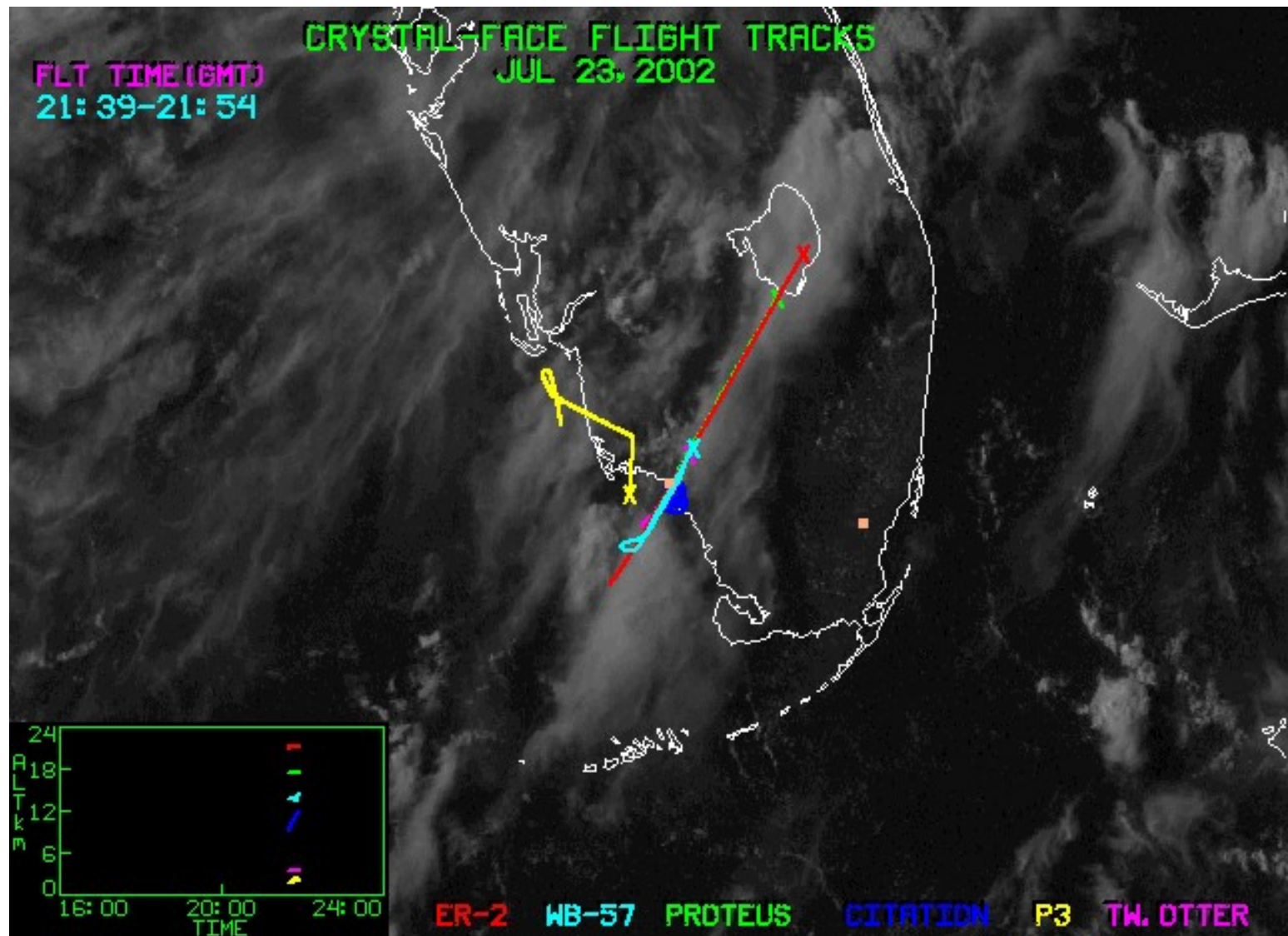
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CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

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ER-2 WB-57 PROTEUS CITATION P3 TW, OTTER

CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

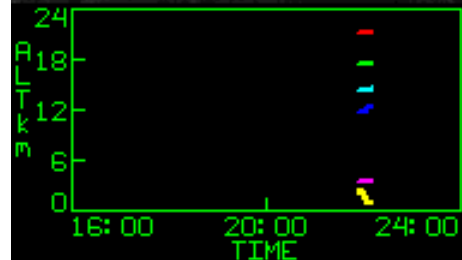
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CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

FLT TIME (GMT)  
21:54-22:09

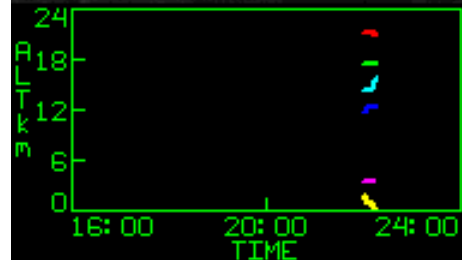


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JUL 23, 2002

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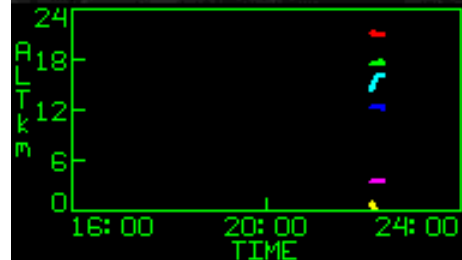


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CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

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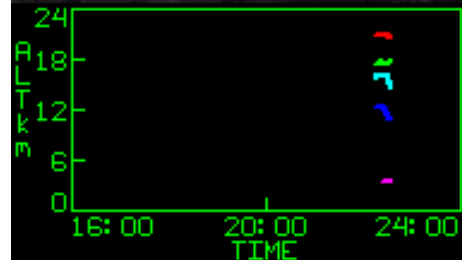


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CRYSTAL-FACE FLIGHT TRACKS  
JUL 23, 2002

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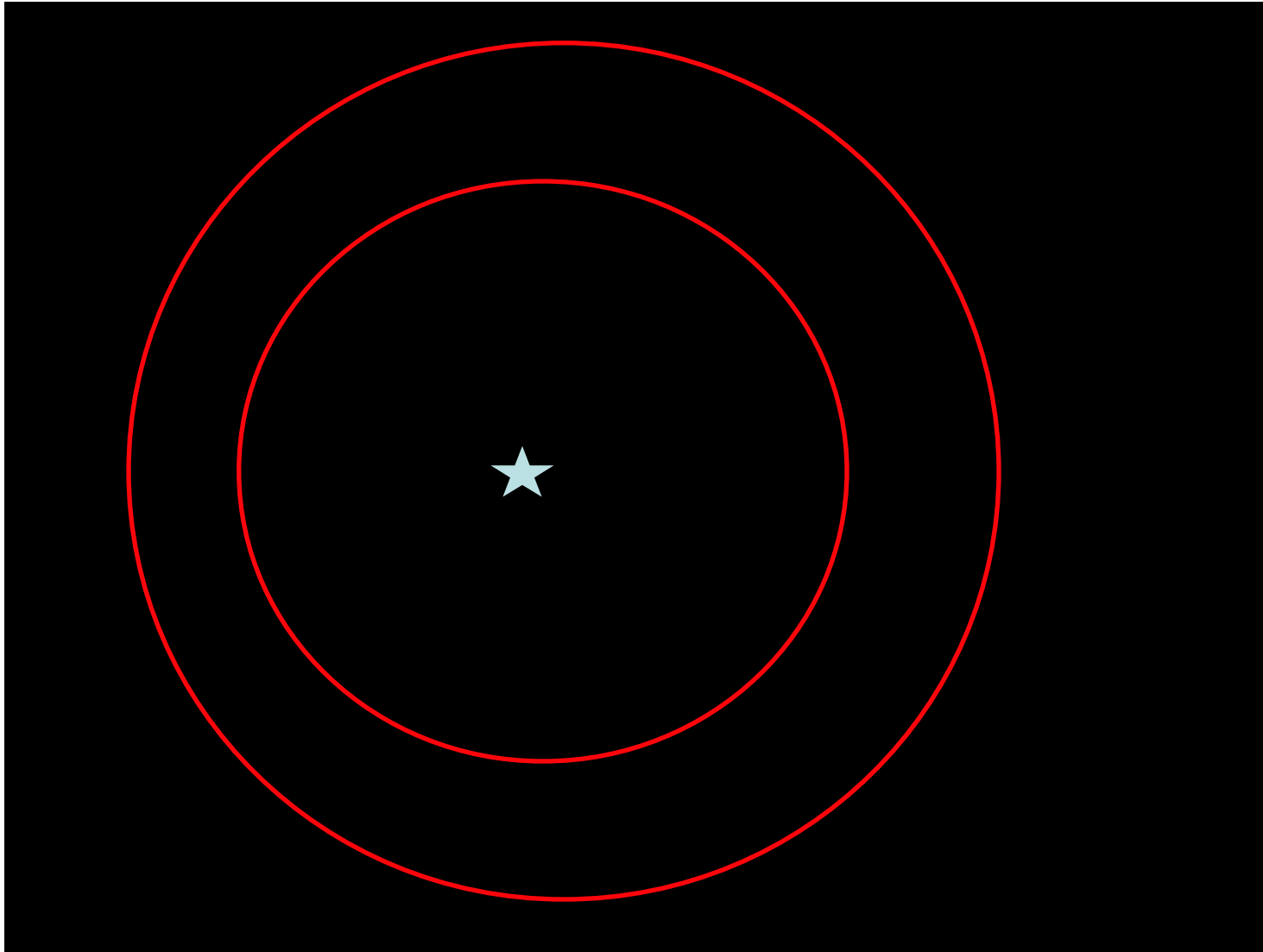


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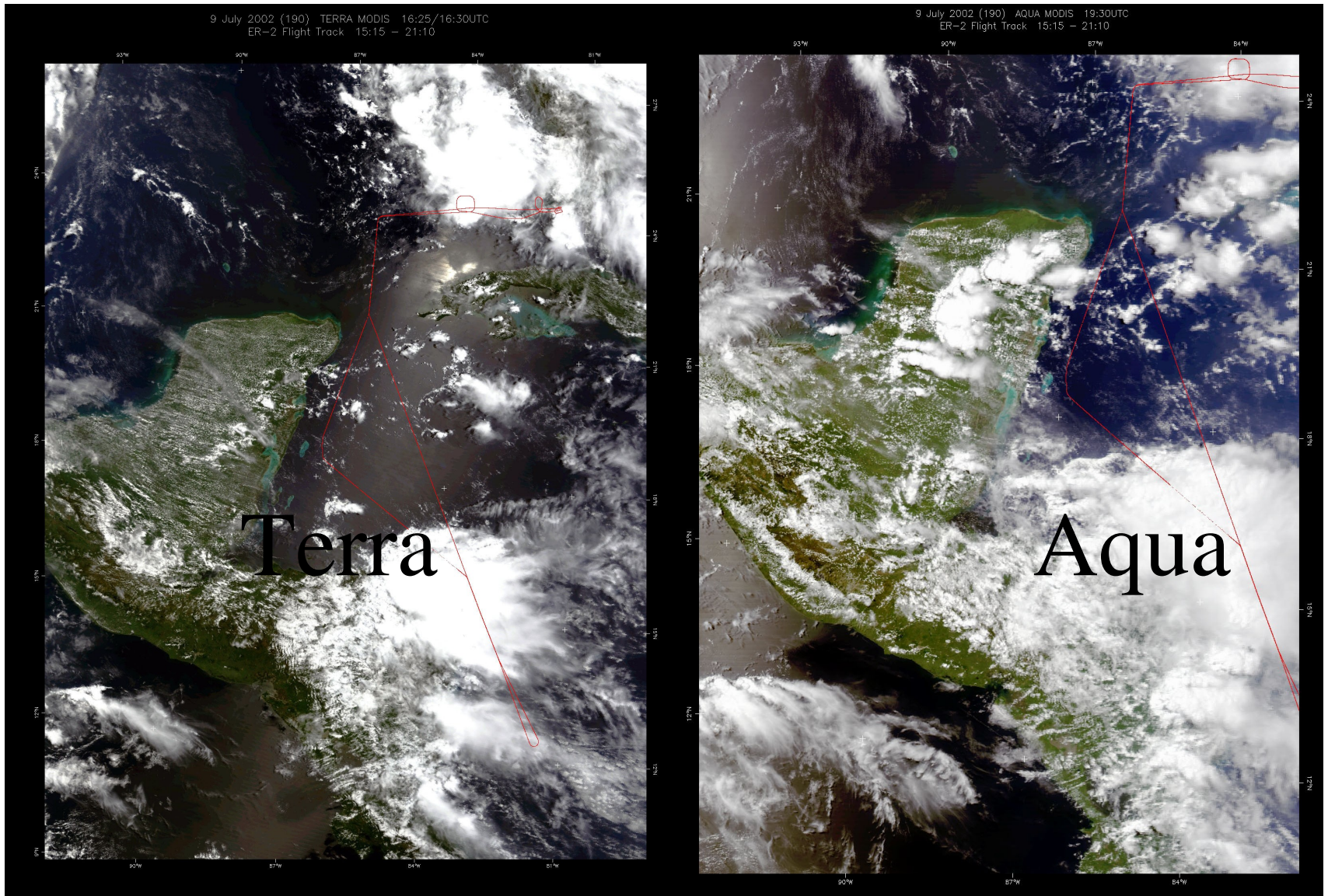
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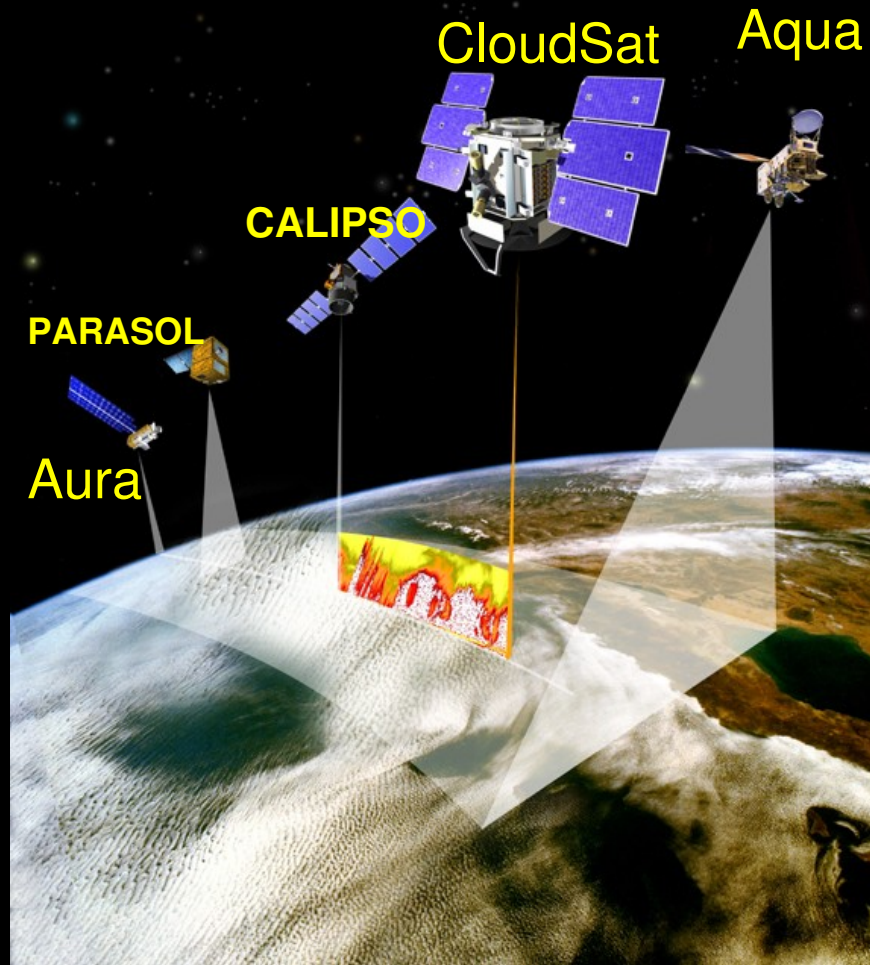
# 5 and 8 hour range rings (200m/s)



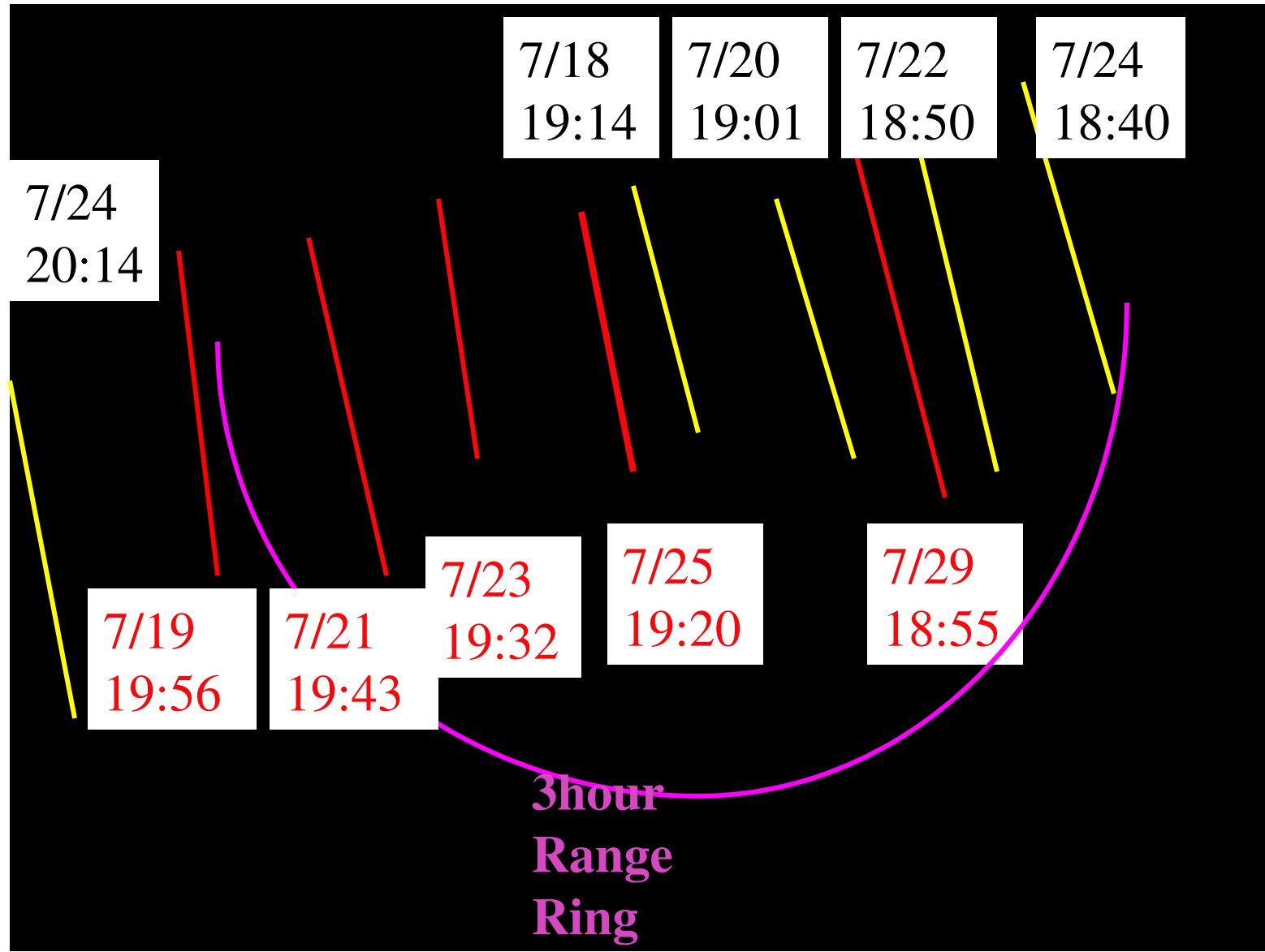
# Crystal Face example of TTL survey



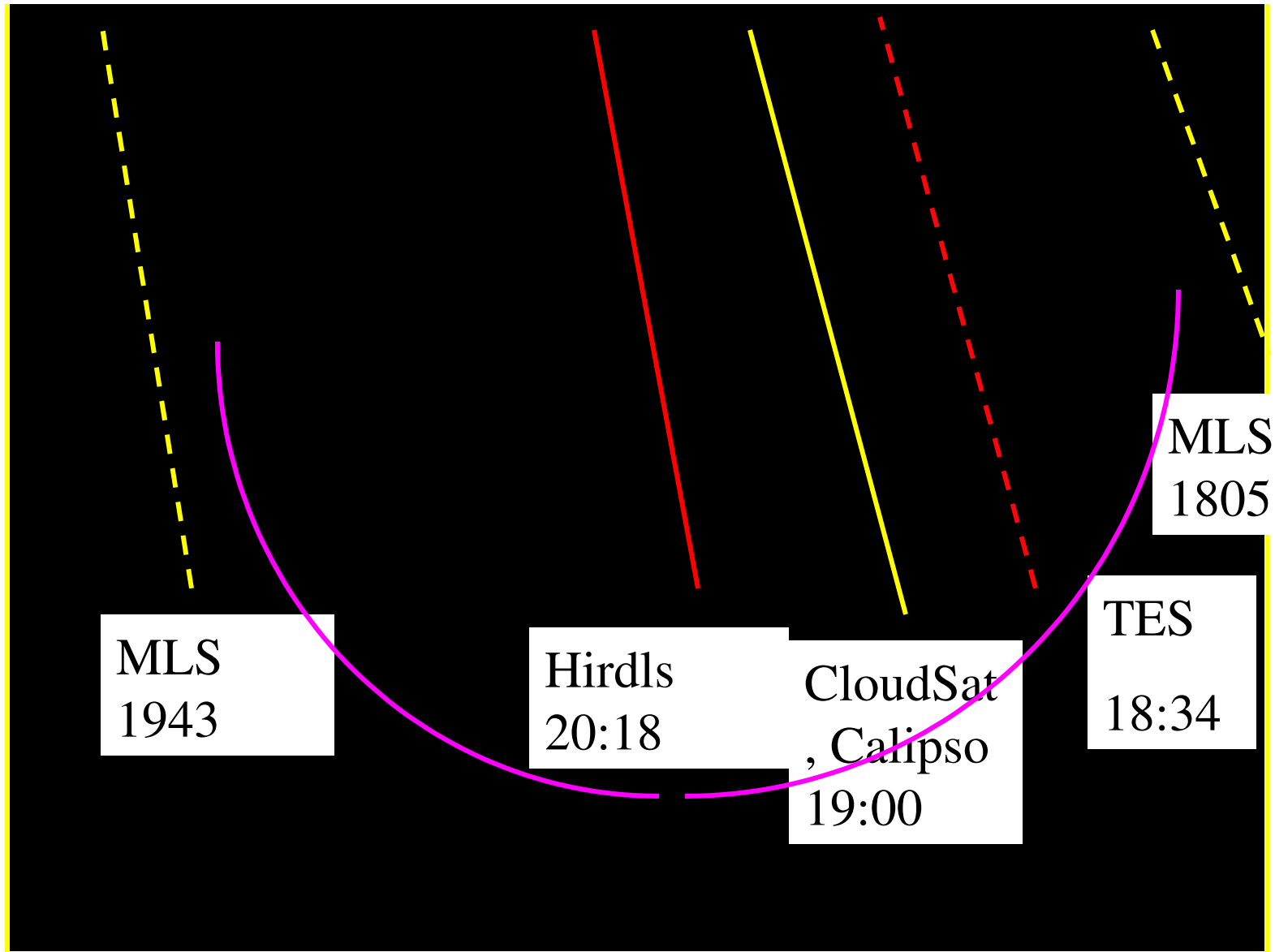
# A train



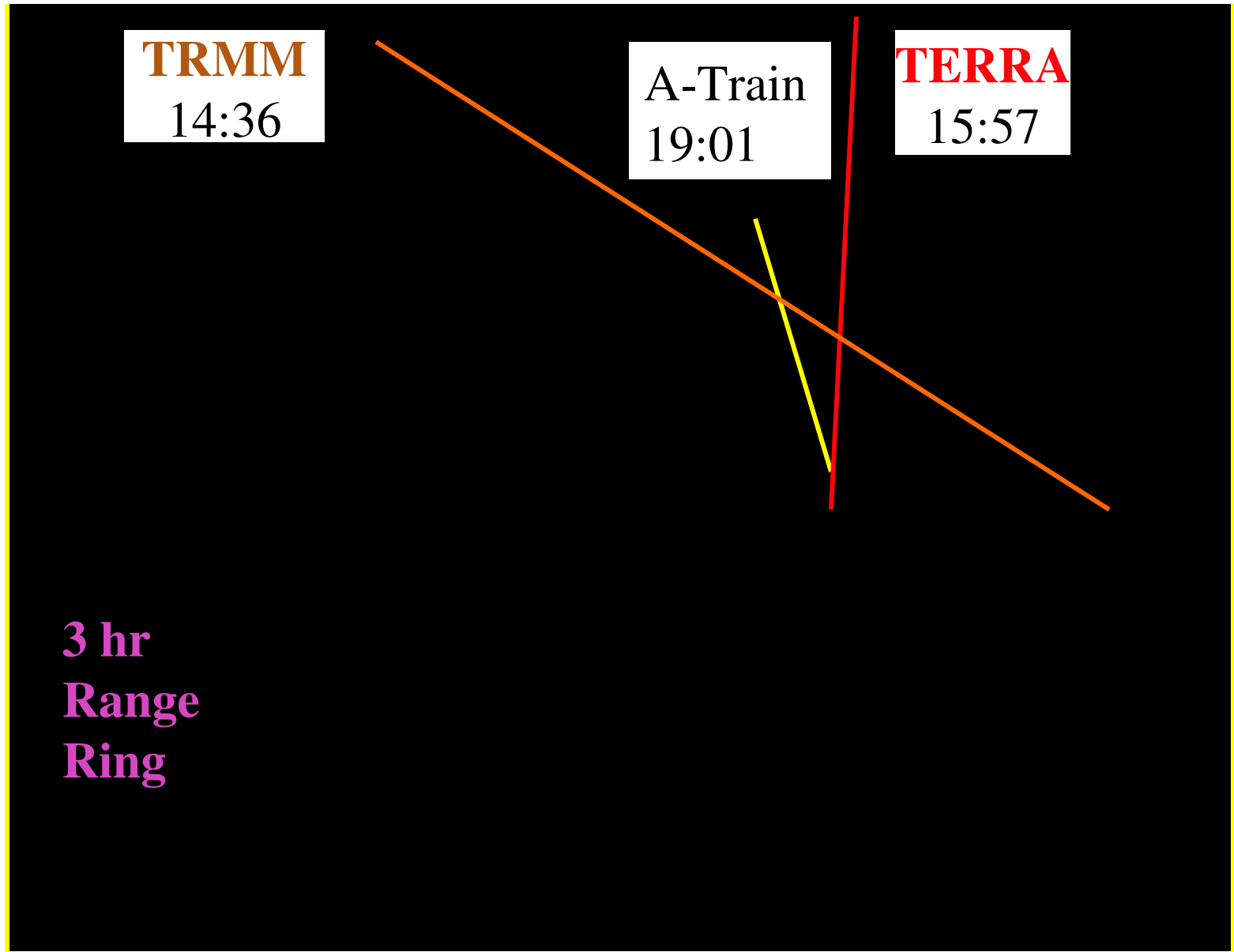
# CloudSat overpass times and locations



# Aura fields of view, 7/20/07



# Satellite Overpass times and locations, 7/20/07



# Summary

- We have a great opportunity to resolve some important scientific problems.
- TC4 has a short duration, it will be intense.
- Be prepared to operate soon after arrival, and for operating hours that will be challenging.
- We want your feedback. Send us your ideas.