Cloud System Evolution in the Trades--CSET

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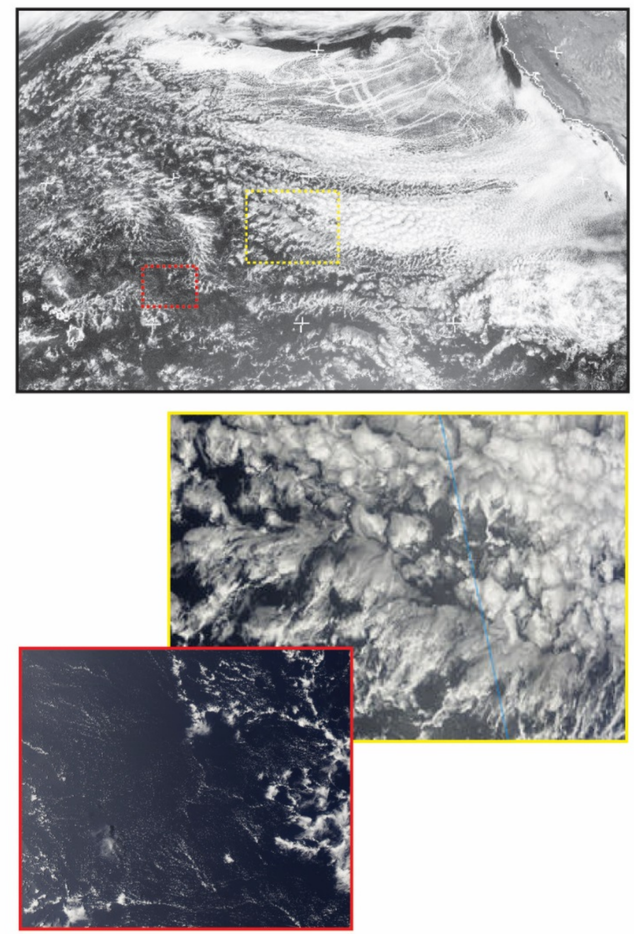
Purpose: To study cloud and boundary layer evolution along trajectories within the north-Pacific trade-winds using the NSF/NCAR Gulfstream G-V (HIAPER).

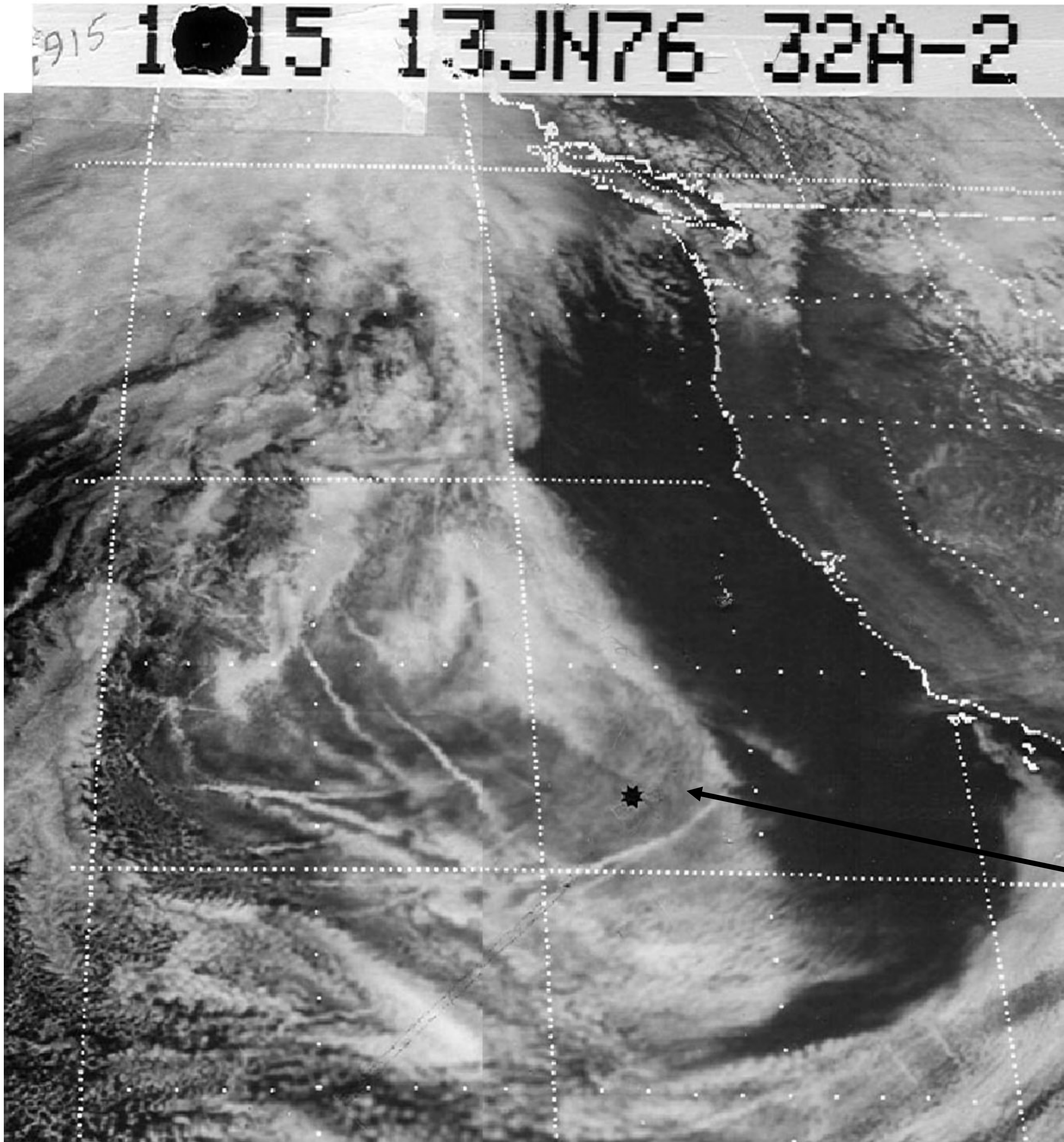
These characterizations along trajectories will be designed to aid in our understanding and simulation of the transitions between the two convective regimes.



Scientific Objectives:

- *Define the evolution of the cloud, precipitation and aerosol fields in stratocumulus clouds as they transition into the fair-weather cumulus regimes within the subtropical easterlies over the northern Pacific.*
- *Examine the cloud microphysical properties and processes as a function of boundary-layer depth, towards assessing the relative contributions of internal and external processes to boundary-layer decoupling.*
- *Assess the relative importance of boundary layer deepening and precipitation processes in driving boundary layer decoupling and cloud breakup.*
- *Develop integrated data sets and use them to evaluate LES model simulations of cloud system evolution relying on differing resolution and complexities.*

A Little (ancient) History



First Pacific Stratus Study

PIs: Wayne Schubert and Doug Lilly

5 Electra Flights –June 1976

Operations:
Moffet Field/Redwood City

13 June 1976
NCAR Electra
"Drizzle on the windshield flight"

Experiment Design-- Lagrangian Approach

•Sample aerosol, cloud, precipitation, and boundary layer properties upwind from the transition zone over the North Pacific and sample these areas two and four days later.

•Evaluate the moisture, dry static energy and mass budgets and estimate changes in these budgets between the upstream Sc region sampled and the downstream Cu region sampled on subsequent flights.

Lagrangian approach minimizes uncertainties in the large-scale forcing due to horizontal advection in the lower troposphere as air masses move from colder to warmer sea surface temperatures and thus facilitate model simulations and isolate critical physical processes.

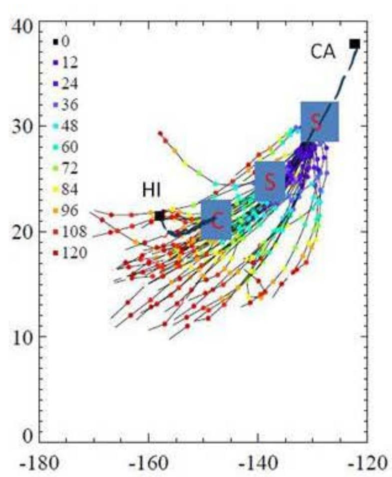
Approach enabled by GV capabilities (performance and remote sensing)

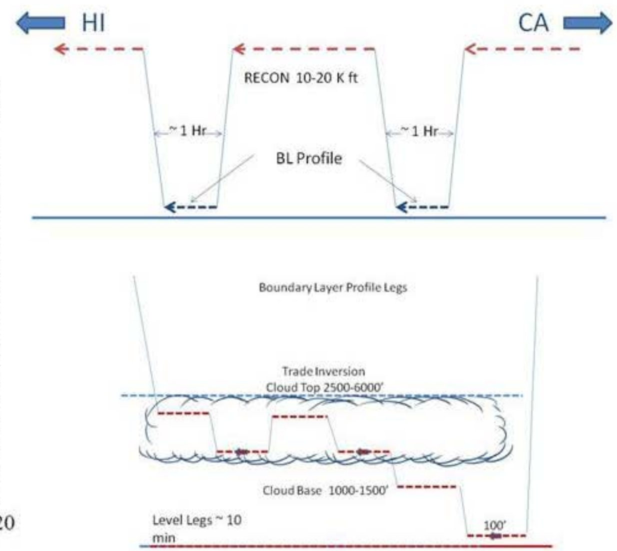
Instrumentation

- Remote sensing instruments will be used to define macroscopic and microscopic cloud properties as the G-V flies above, below, and in the clouds.
  - HIAPER Cloud Radar (HCR) developed by NCAR EOL for deployment on GV specially designed wing pod.
  - High Spectral Resolution Lidar (HSRL) that was developed under the NSF HIAPER Aircraft Instrumentation Solicitation (HIAS) (also for aerosol characterizations above the boundary layer)
  - Microwave Radiometer
- Meteorology and turbulence sensors
- Cloud microphysics, aerosol, and precipitation probes (HOLODEC)
- Radiation sensors (HIAPER Atmospheric Radiation Package; and Kipp &Zonen pyranometers and pygeometers)
- Dropsondes for thermodynamic and wind structure on flights above boundary layer

Proposed Observing Strategy

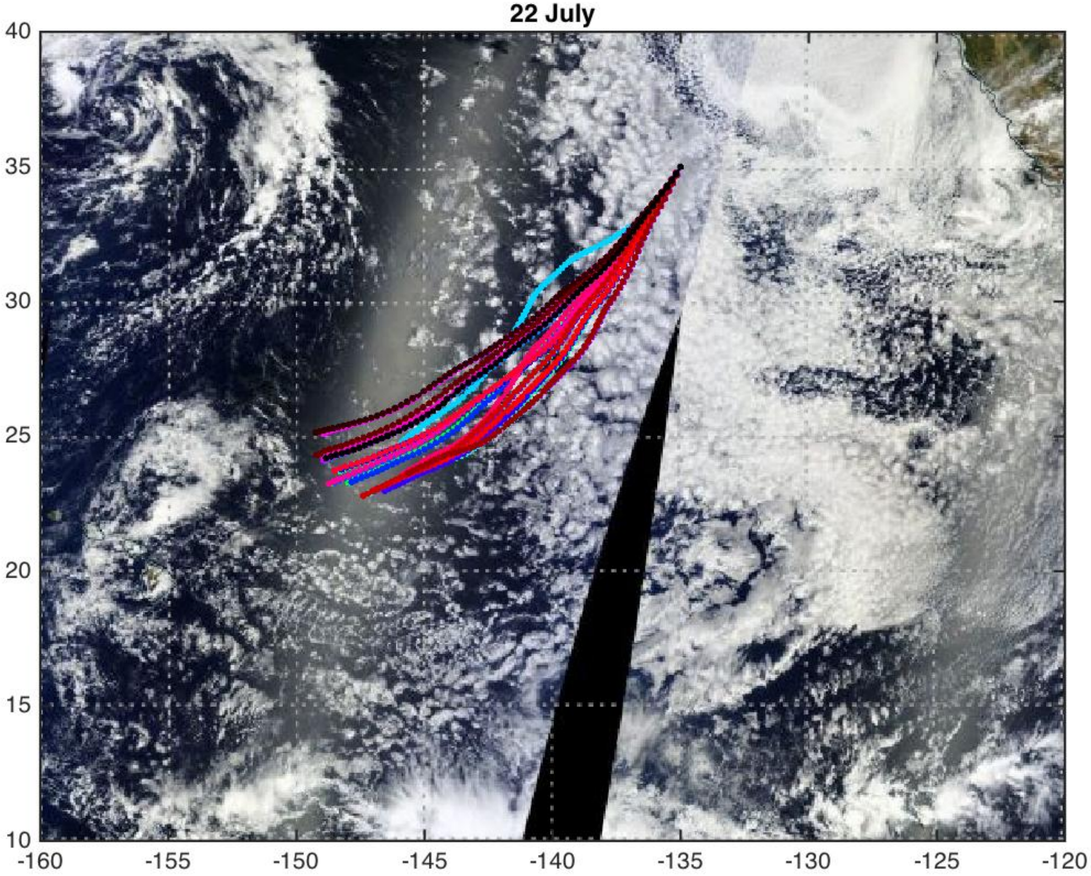
- Flight from west coast to Hawaii
  - Remote sensing and dropsonde sampling at altitude above boundary layer (surveillance mode)
  - Detailed boundary layer observations in 2-3 selected areas in stratocumulus and trade cumulus areas
- Return flight (after I day rest) sample same air masses sampled in detail on previous legs
- Repeat Sequence after 1- day rest



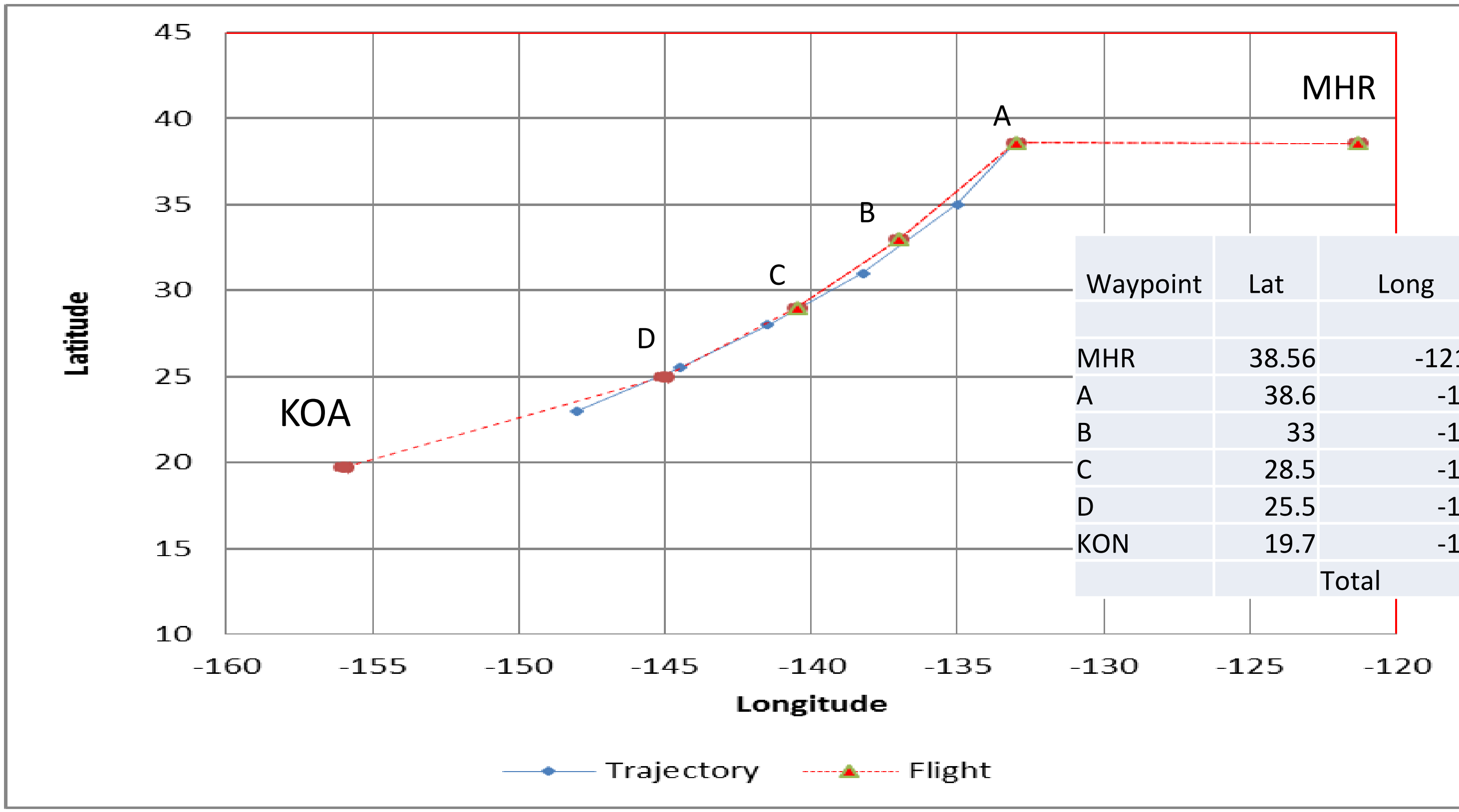


CSET Flight Plans--Simple

MODIS July 22, 2013
72 h Trajectories



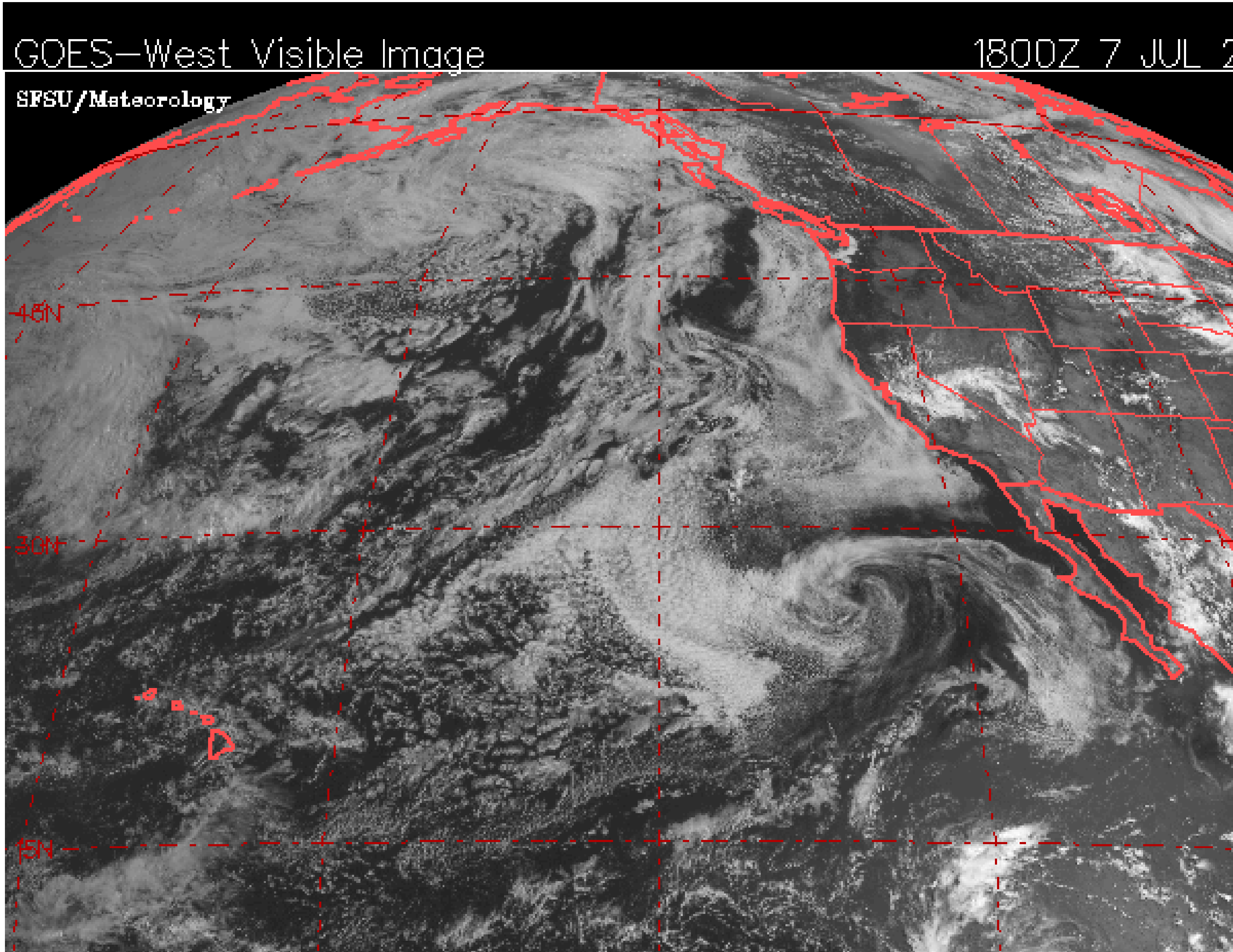
Sample CSET Flight Plan –WB—Two Low Profiles July 22, 2013)



Waypoint	Lat	Long	Distance (nm)
MHR	38.56	-121.3	
A	38.6	-133	549
B	33	-137	389
C	28.5	-141	340
D	25.5	-145	280
KON	19.7	-156	702
		Total	2261

1. TO (9 AM*[1] PST) -- From Mather (MHR)
2. MHR to A --Transit at Cruising Altitude (30 k ‘ ?)
3. A to B --Low-Level Profiling (500-10 k ‘)
4. B to C --Remote Sensing Leg (20 k ft)
5. C to D --Low Level Profiling (500-10 k’)
6. D to KOA --Transit at Cruising Altitude
7. LDG --At Kona (KOA)

Notes: *[1] Adjust TO time for ~10 LST at A


GOES-West Visible Image
1800Z 7 JUL 2
SFSU/Meteorology
45N
30N
15N