Comparison of PREDICT dropsonde missions to the PREDICT-mean profile and the Dunion (2008) non-SAL profile

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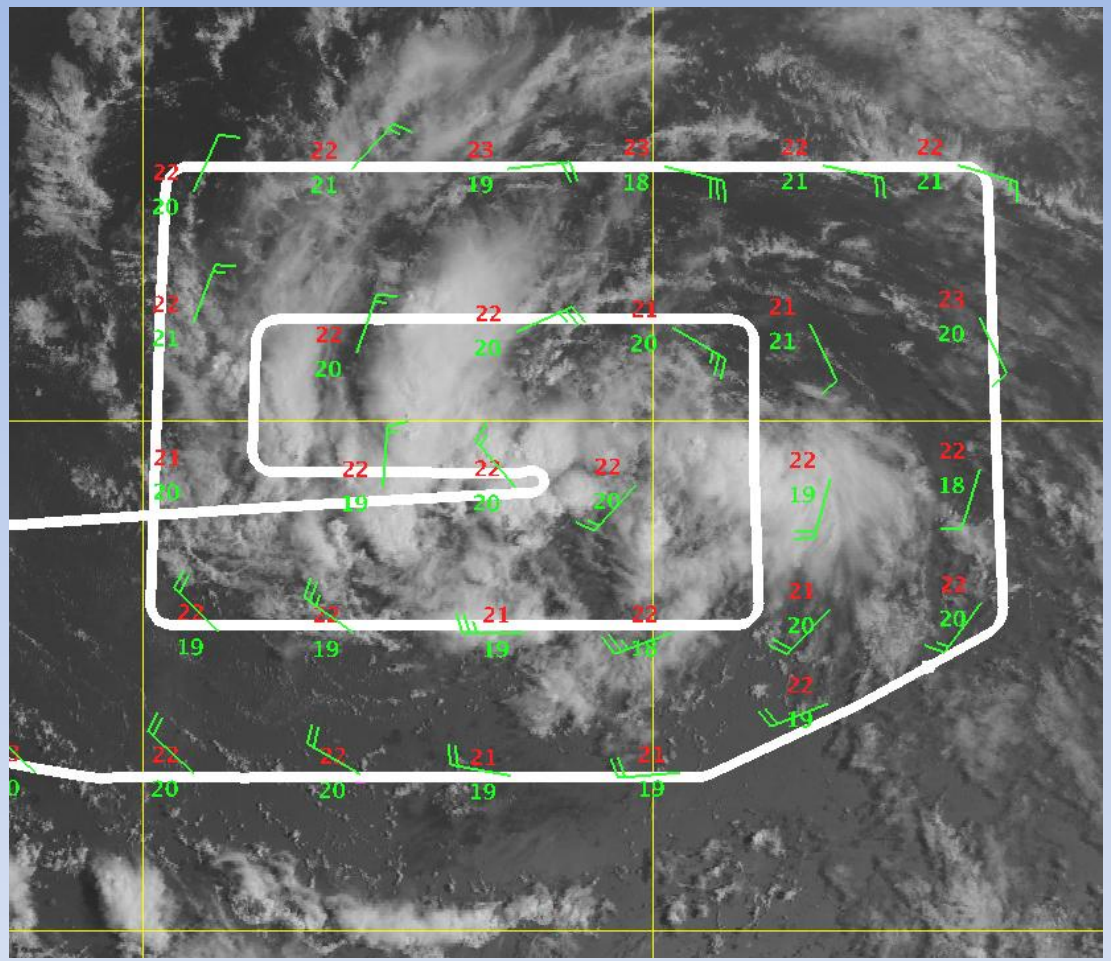
PREDICT Dropsonde Missions

Aug 15	Trop. Fntl. Conv.
Aug 17	PGI27L
Aug 18	PGI27L
Aug 21	PGI30L
Aug 23	PGI30L
Aug 30	pre- TS Fiona
Aug 31	TS Fiona
Sep 1	TS Fiona
Sep 2	TS Gaston
Sep 3	PGI38L *
Sep 5	PGI38L
Sep 6	PGI38L
Sep 7	PGI38L

Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

* post-Gaston, expected to re-develop but did not

Take a “mean” vertical profile of genesis vs non-genesis cases



Q: Can we do this?

A: Since PREDICT dropsondes are co-located with, and distributed (reasonably) evenly about, a center of circulation, comparison of mean profiles should have “meaning”

Genesis vs. non-genesis?... Or take it a step further?

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Aug 17	PGI27L
Aug 18	PGI27L
Aug 21	PGI30L
Aug 23	PGI30L
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Aug 31	TS Fiona
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Sep 5	PGI38L
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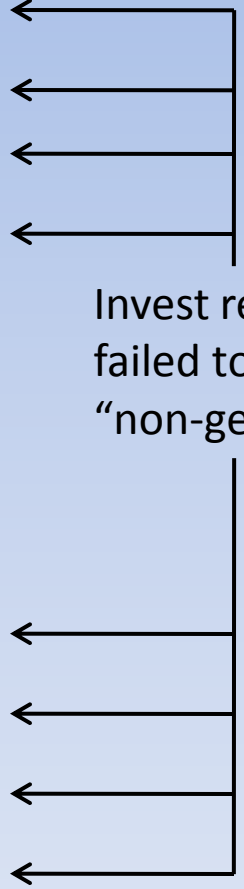
Sep 7	PGI38L



Invest regions that failed to develop: "non-genesis"

Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

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Sep 2	TS Gaston
Sep 3	PGI38L
Sep 5	PGI38L
Sep 6	PGI38L
Sep 7	PGI38L

Region of enhanced convection over Bahamas associated with old frontal system, also non-genesis but not a true invest either: “trop. fntl. conv.”

Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

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Sep 5	PGI38L
Sep 6	PGI38L
Sep 7	PGI38L

← Flights in which the invest becomes a TC within 24 h of investigation: "pre-gen. 0-24 h" →

Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

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Aug 23	PGI30L
Aug 30	pre- TS Fiona
Aug 31	TS Fiona
Sep 1	TS Fiona
Sep 2	TS Gaston
Sep 3	PGI38L
Sep 5	PGI38L
Sep 6	PGI38L
Sep 7	PGI38L

Flights in which the invest becomes a TC within 24-48 h of investigation: "pre-gen. 24-48 h"

Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

Aug 15	Trop. Fntl. Conv.
Aug 17	PGI27L
Aug 18	PGI27L
Aug 21	PGI30L
Aug 23	PGI30L
Aug 30	pre- TS Fiona
Aug 31	TS Fiona
Sep 1	TS Fiona
Sep 2	TS Gaston
Sep 3	PGI38L
Sep 5	PGI38L
Sep 6	PGI38L
Sep 7	PGI38L

Flights in which the invest becomes a TC within 48-72 h of investigation: "pre-gen. 48-72 h"

Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

Aug 15	Trop. Fntl. Conv.
Aug 17	PGI27L
Aug 18	PGI27L
Aug 21	PGI30L
Aug 23	PGI30L
Aug 30	pre- TS Fiona
Aug 31	TS Fiona
Sep 1	TS Fiona
Sep 2	TS Gaston
Sep 3	PGI38L
Sep 5	PGI38L
Sep 6	PGI38L
Sep 7	PGI38L

Flights in which the invest becomes a TC in 72+ h from investigation: "pre-gen. 72+ h"

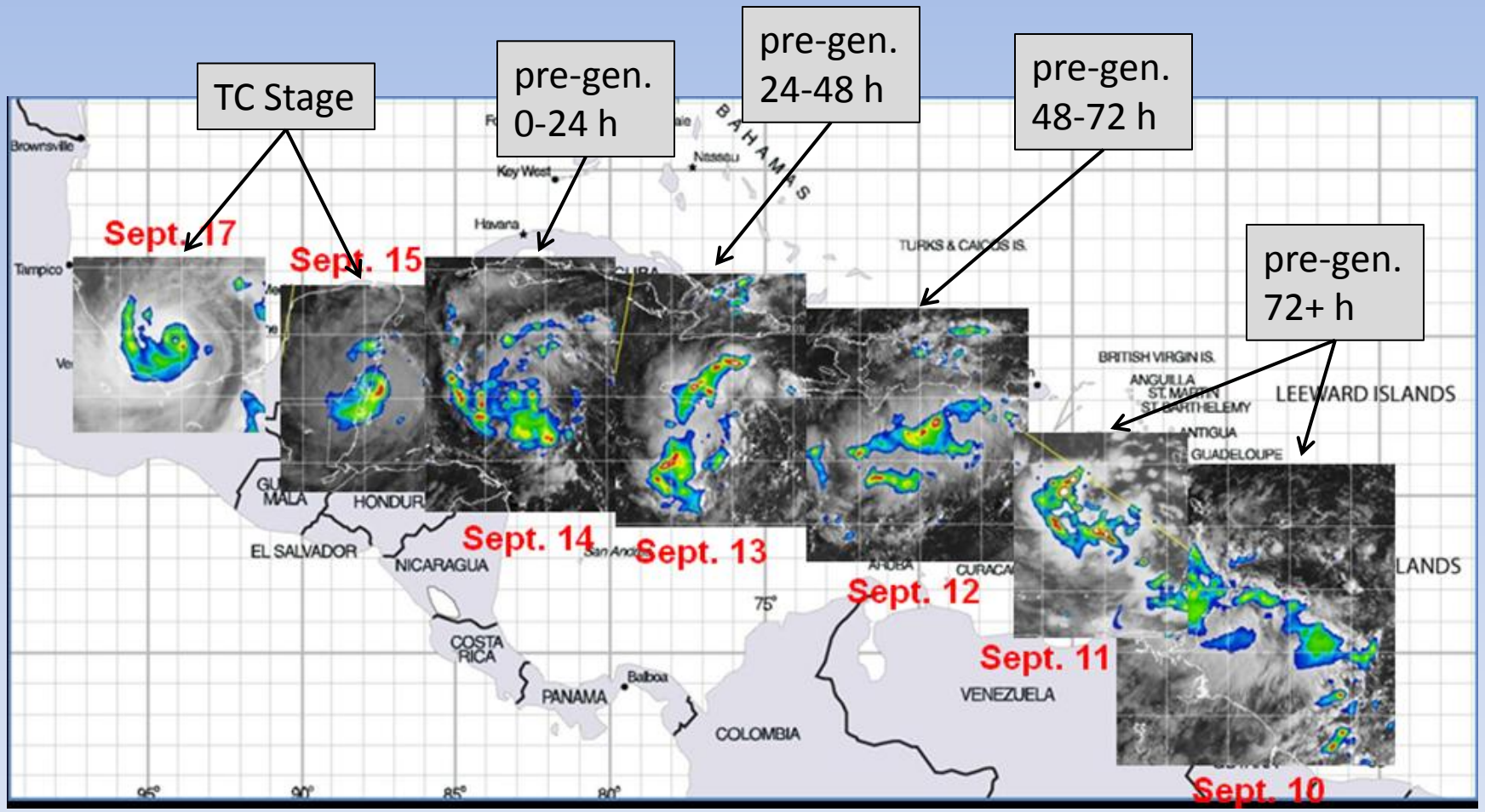
Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

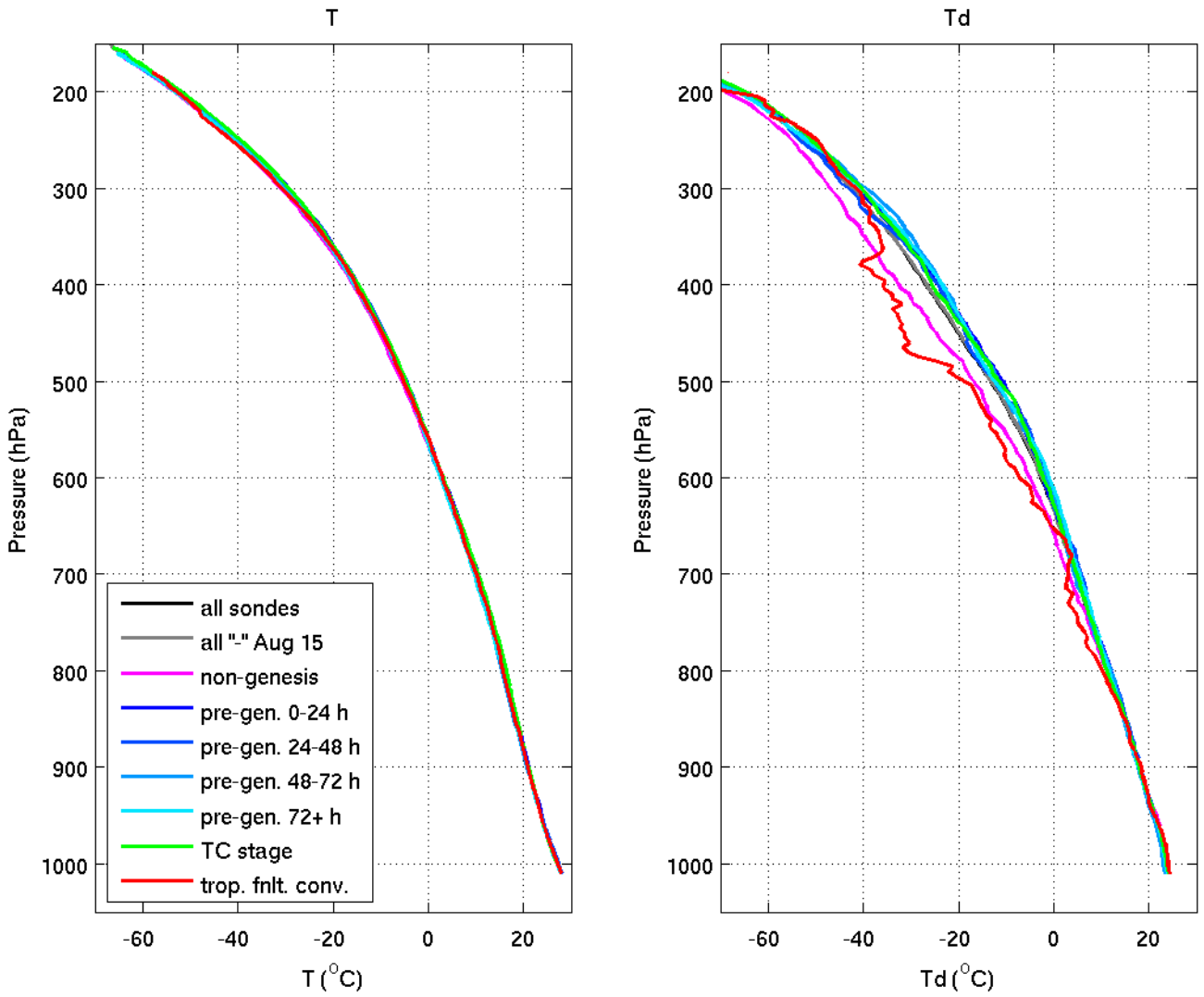
Aug 15	Trop. Fntl. Conv.
Aug 17	PGI27L
Aug 18	PGI27L
Aug 21	PGI30L
Aug 23	PGI30L
Aug 30	pre- TS Fiona
Aug 31	TS Fiona
Sep 1	TS Fiona
Sep 2	TS Gaston
Sep 3	PGI38L
Sep 5	PGI38L
Sep 6	PGI38L
Sep 7	PGI38L

Flights into named tropical cyclones / post-genesis: "TC Stage"

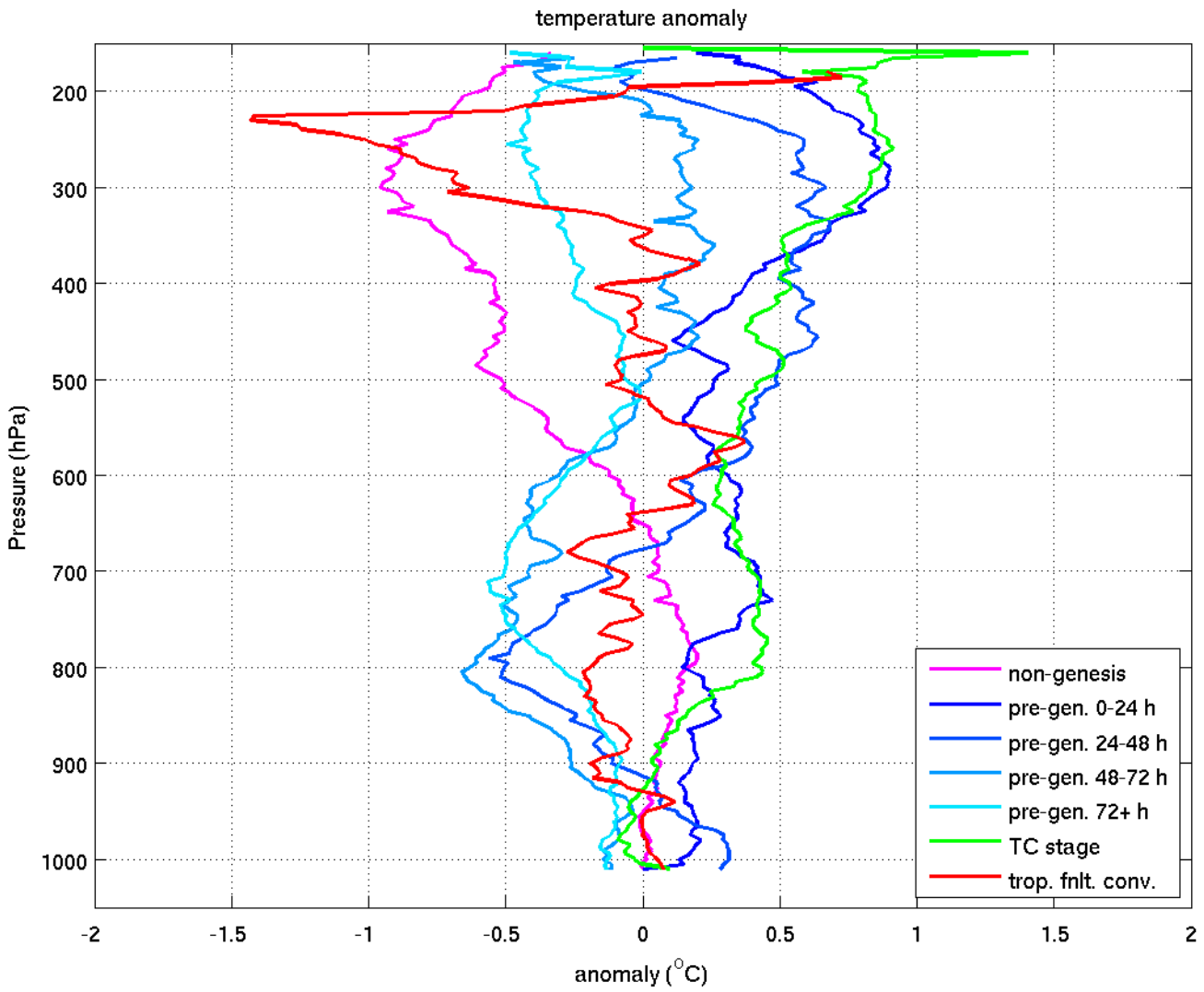
Sep 10a	pre- H Karl
Sep 10b	pre- H Karl
Sep 11	pre- H Karl
Sep 12	pre- H Karl
Sep 13	pre- H Karl
Sep 14	pre- H Karl
Sep 20	pre- TS Matthew
Sep 21	pre- TS Matthew
Sep 22	pre- TS Matthew
Sep 24	TS Matthew
Sep 27	pre- TS Nicole
Sep 28	TS Nicole
Sep 30	pre- H Otto

example: Hurricane Karl




T
Td
Pressure (hPa)
200
300
400
500
600
700
800
900
1000
-60
-40
-20
0
20
T (°C)
Td (°C)
all sondes
all "-" Aug 15
non-genesis
pre-gen. 0-24 h
pre-gen. 24-48 h
pre-gen. 48-72 h
pre-gen. 72+ h
TC stage
trop. fnlt. conv.

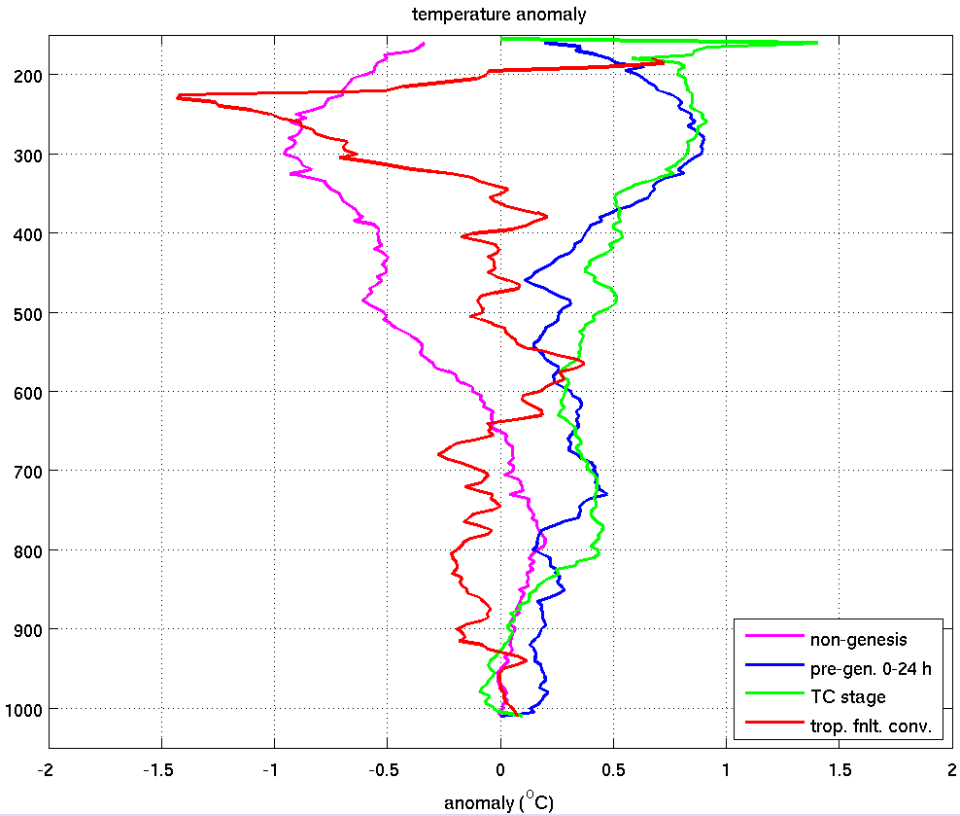
Take the difference between each set of dropsondes and the PREDICT mean sonde:

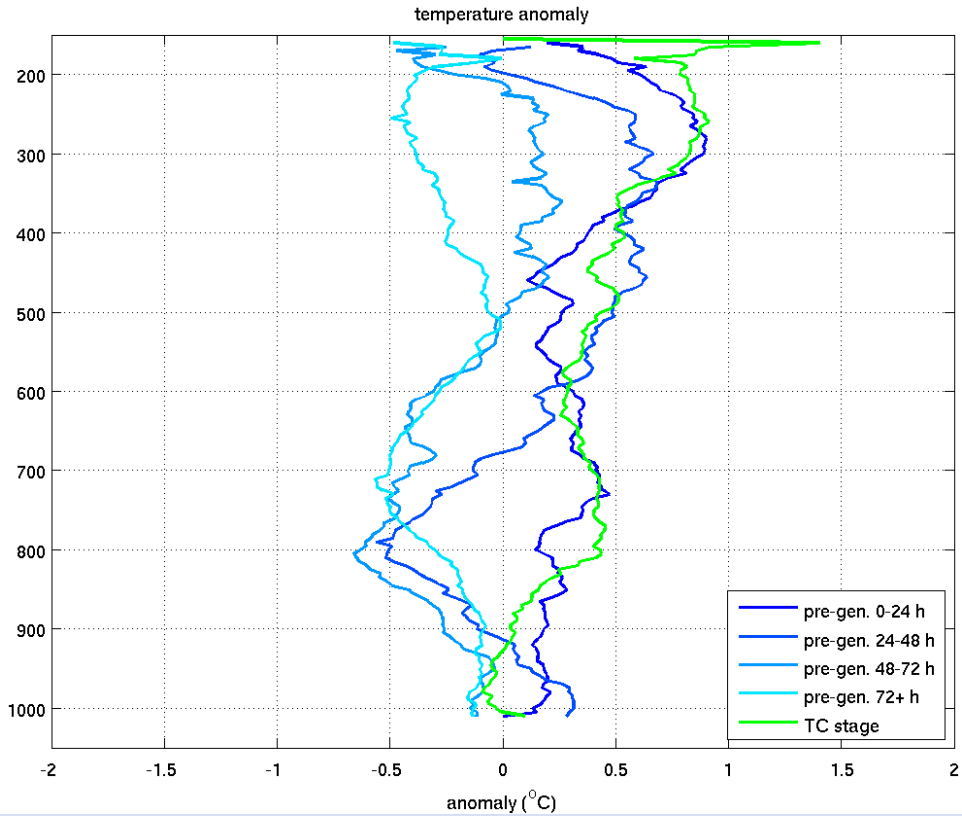


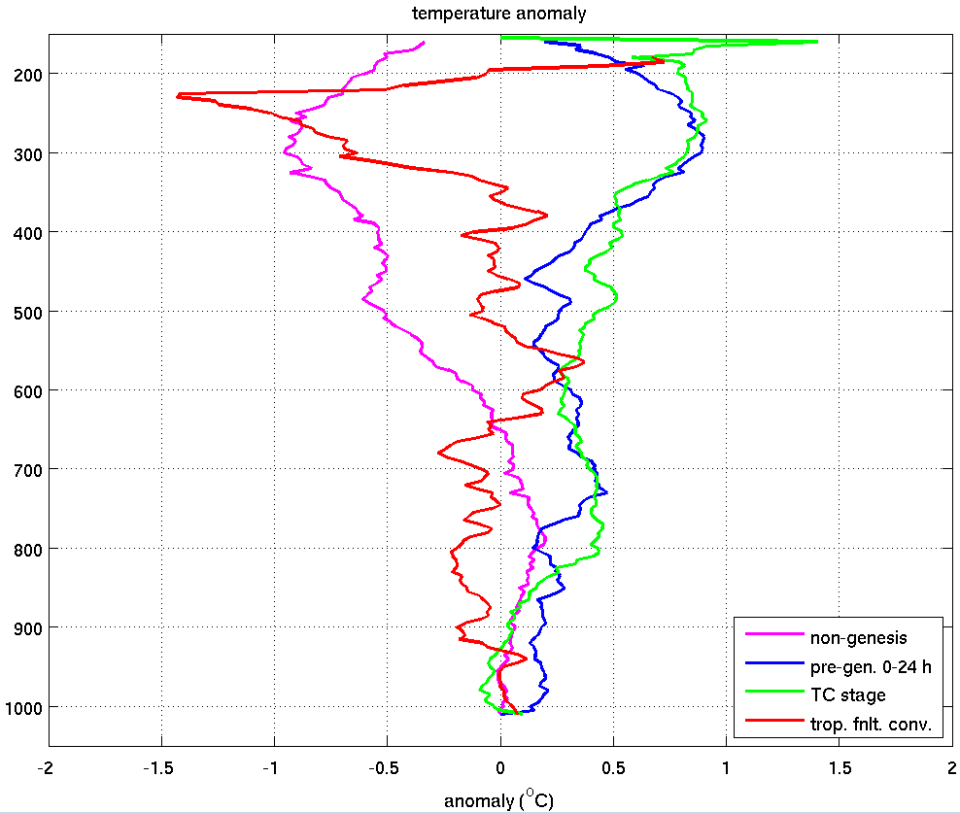
A bit noisy…

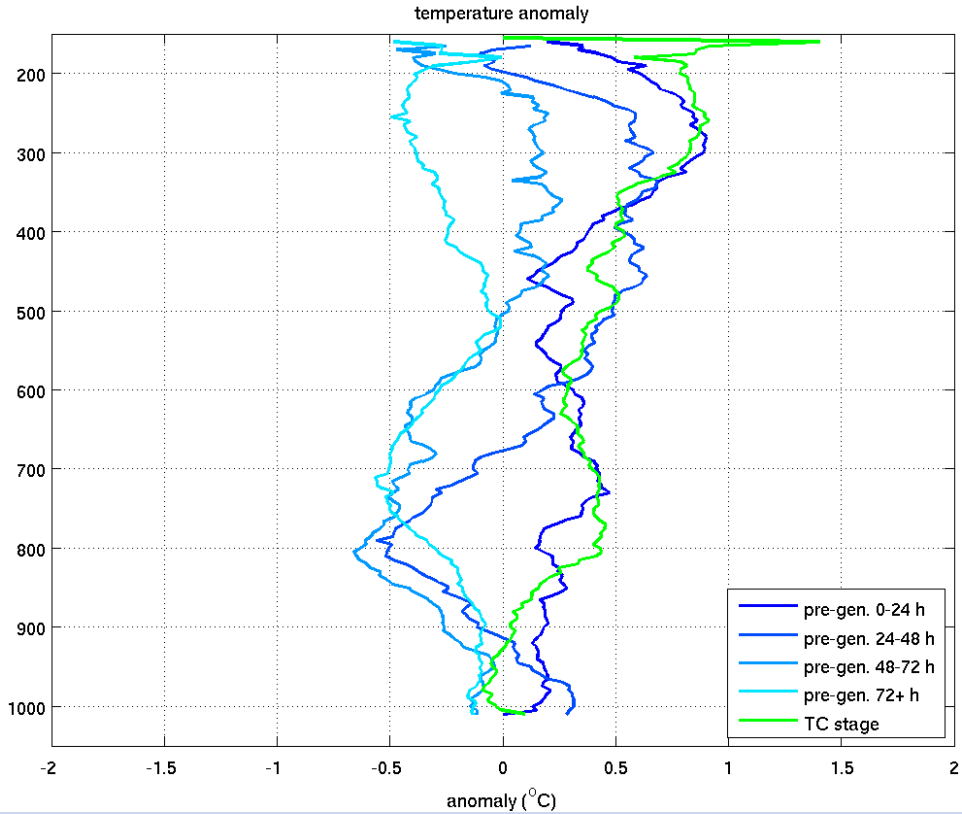
Immediately before/after genesis (blue/green) vs non-genesis pouches and non-genesis convective regions (pink/red)

Time-progression from t = 72+ h before genesis through named TC stage

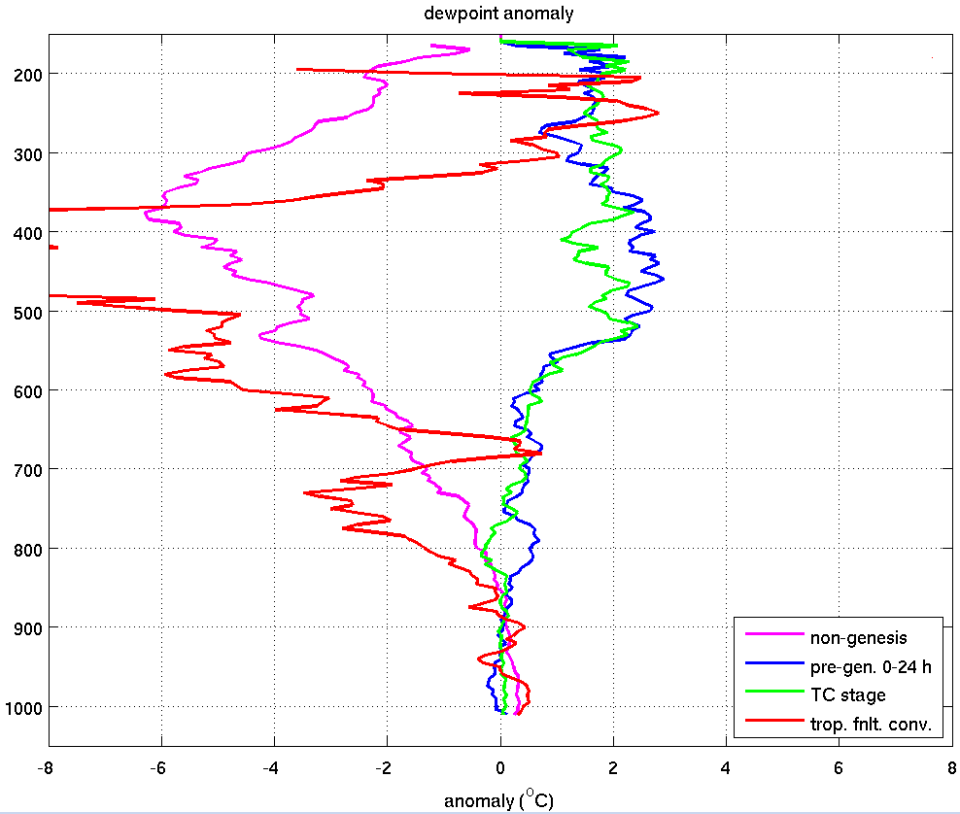


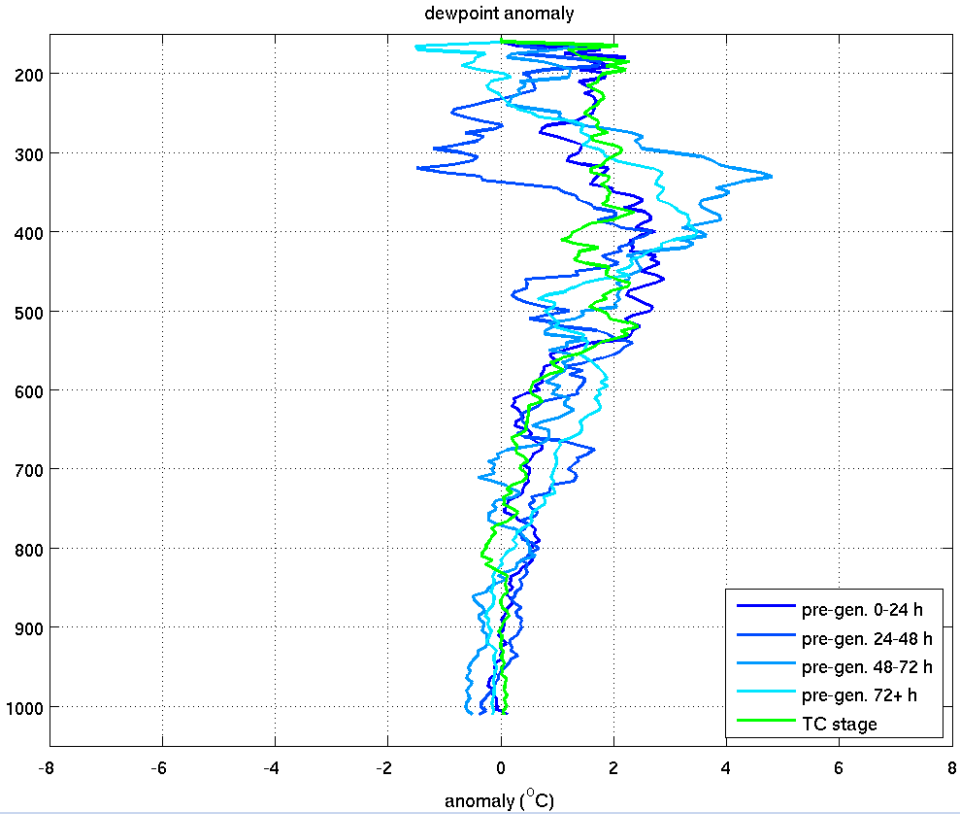




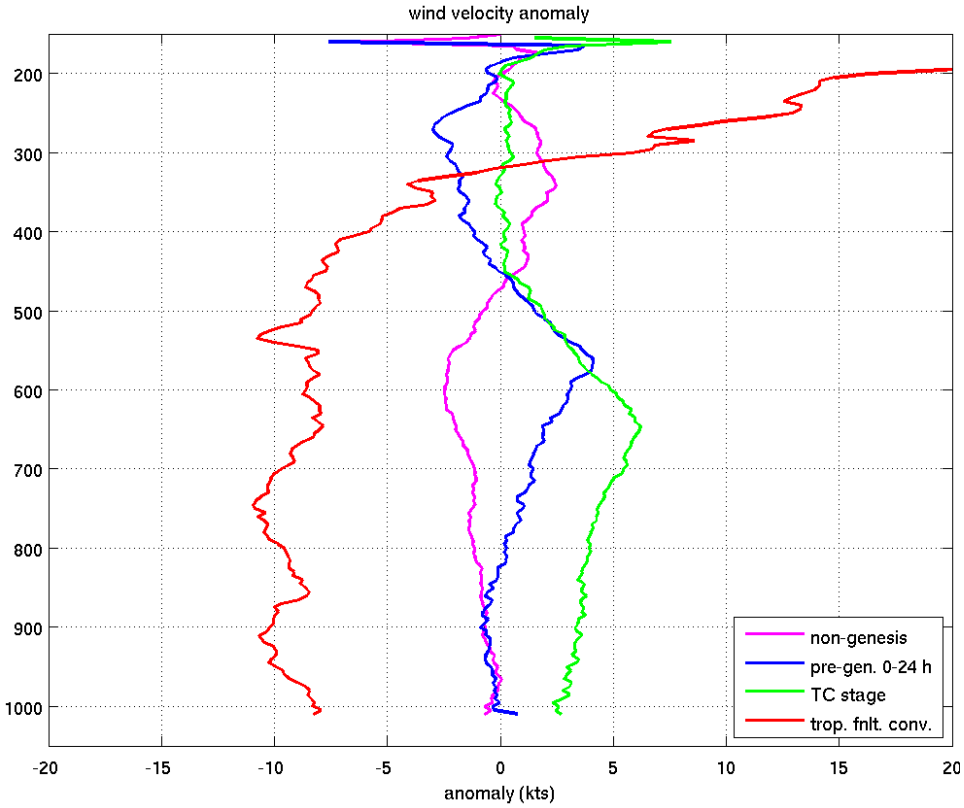


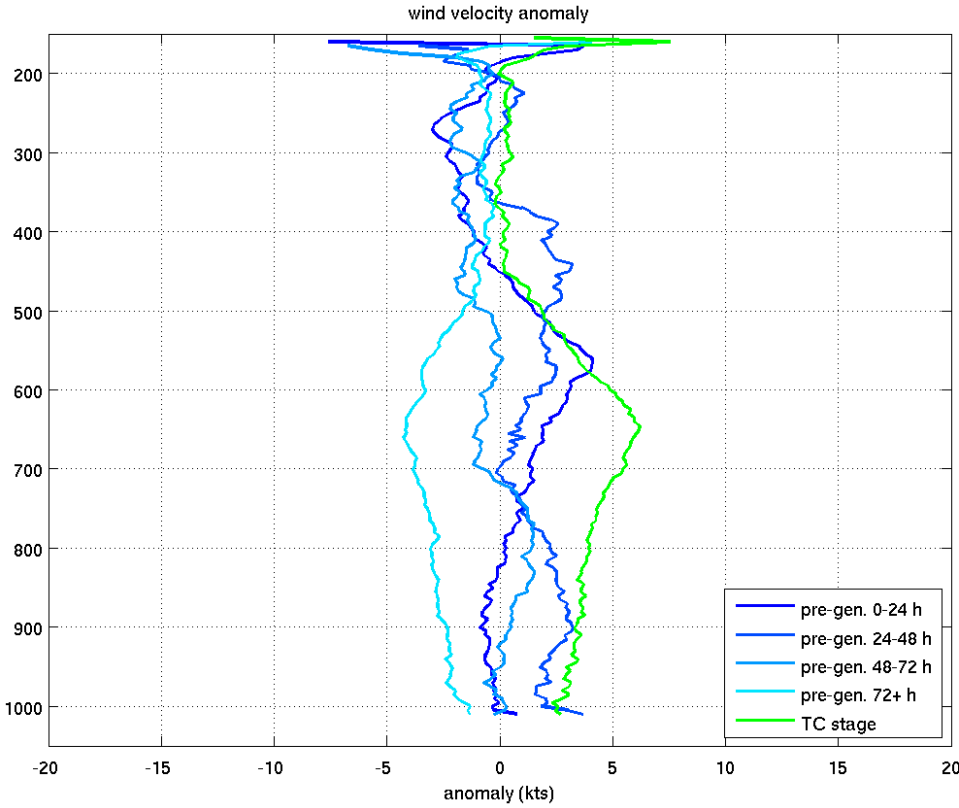
- Genesis much warmer than non-genesis, especially at upper levels
- Whole environment clearly progresses from cooler to warmer sounding at all levels of troposphere closer to genesis, consistent with building of the warm core



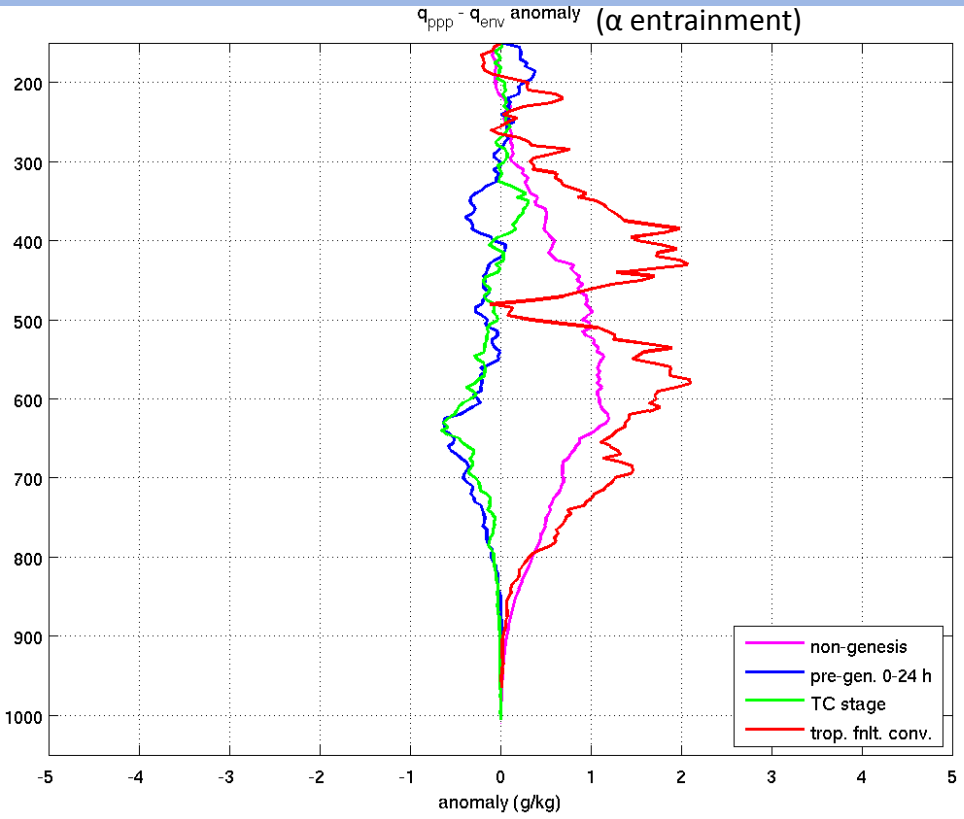


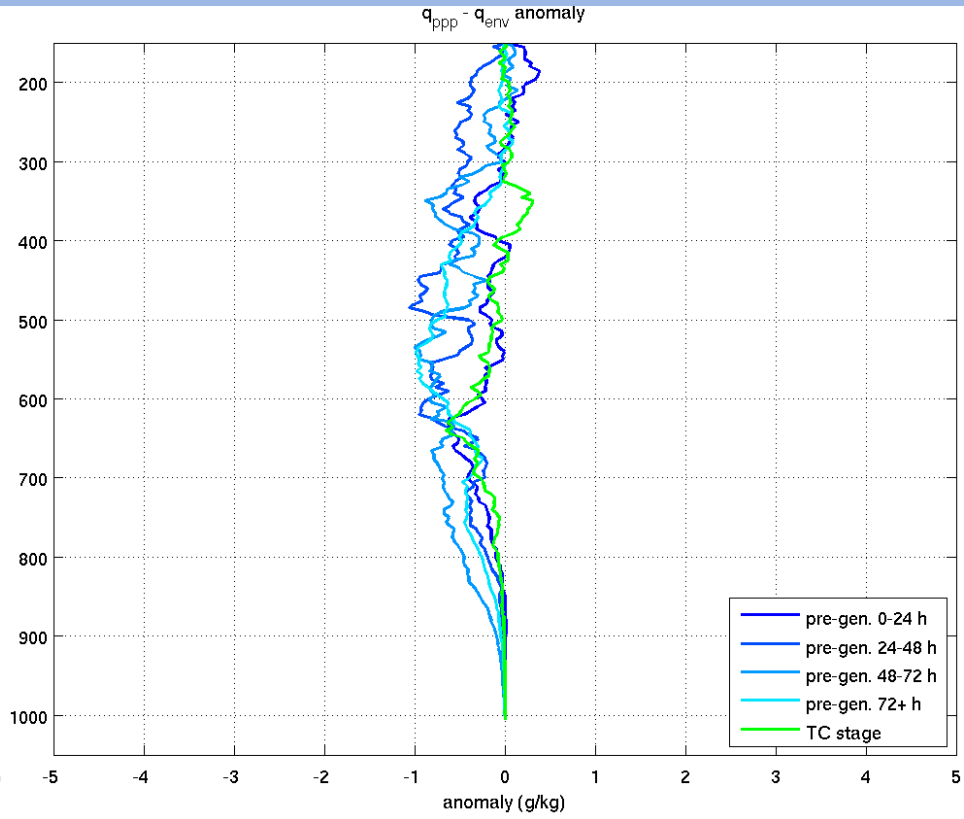
- Genesis much more moist than non-genesis at upper-levels, comparable at lower-levels
- Little progress in moisture leading up to genesis, genesis environment simply moist to begin with



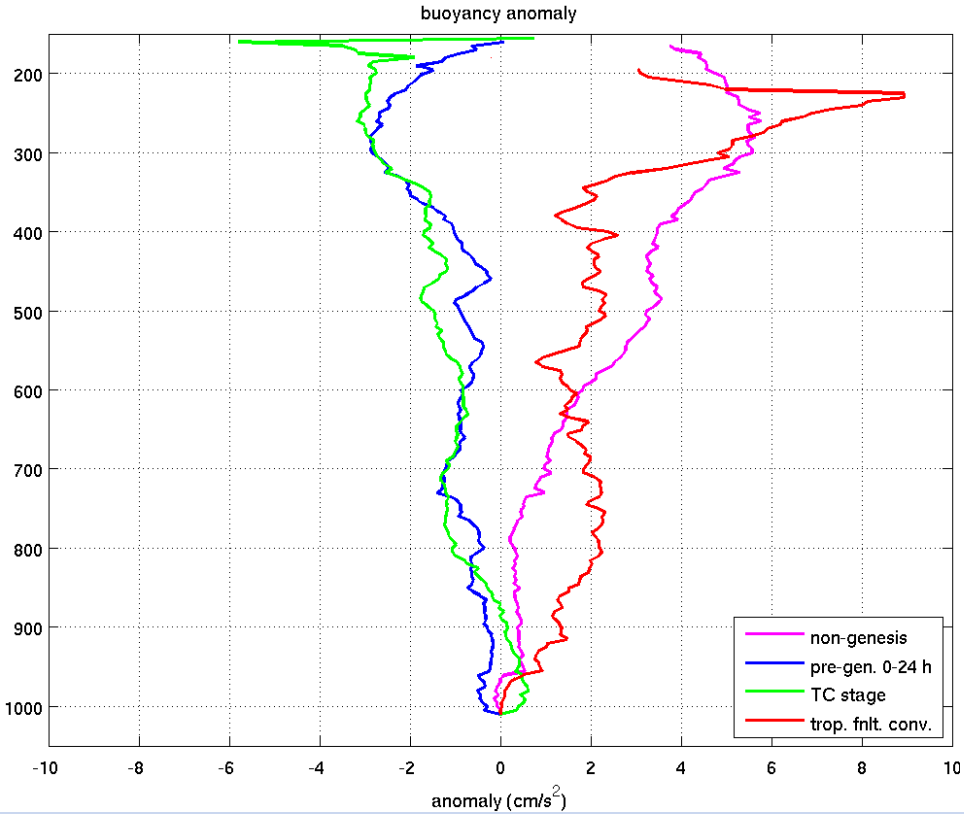


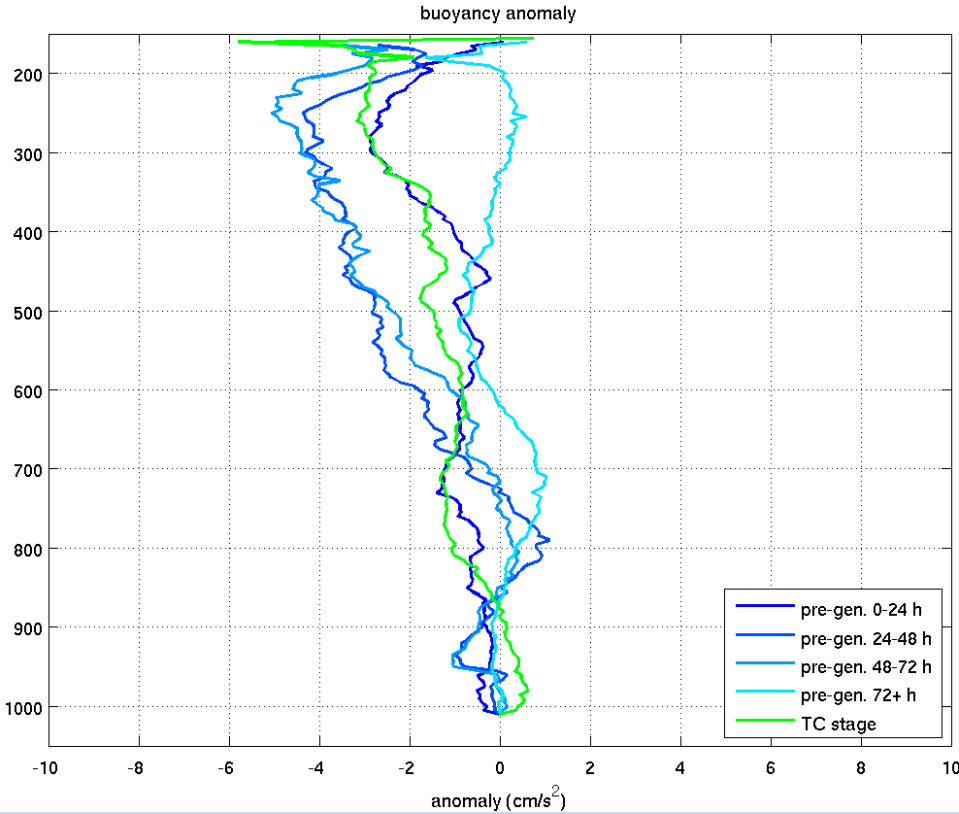
- TC winds much stronger than frontal winds, but no obvious separation between genesis and non-genesis
- Winds strengthen most at mid levels leading up to genesis… agrees with theory that steady convective warming (shown earlier) correlates well with steady strengthening of the mid-level vortex





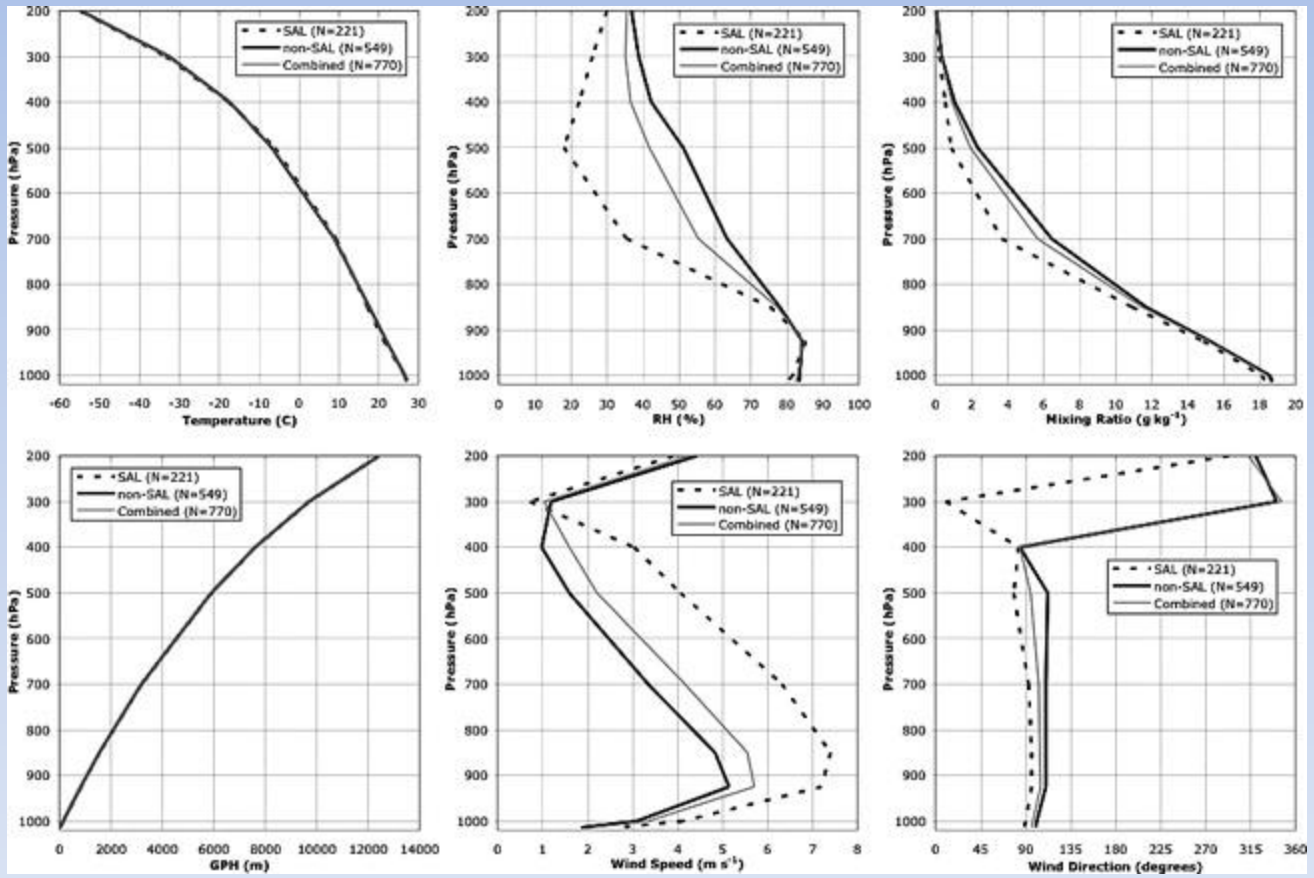
- A rising parcel for the non-genesis cases is much more moist than its environment at mid levels (often associated with downdrafts), while developing cases are not
- Signal not obvious for pre-genesis time series



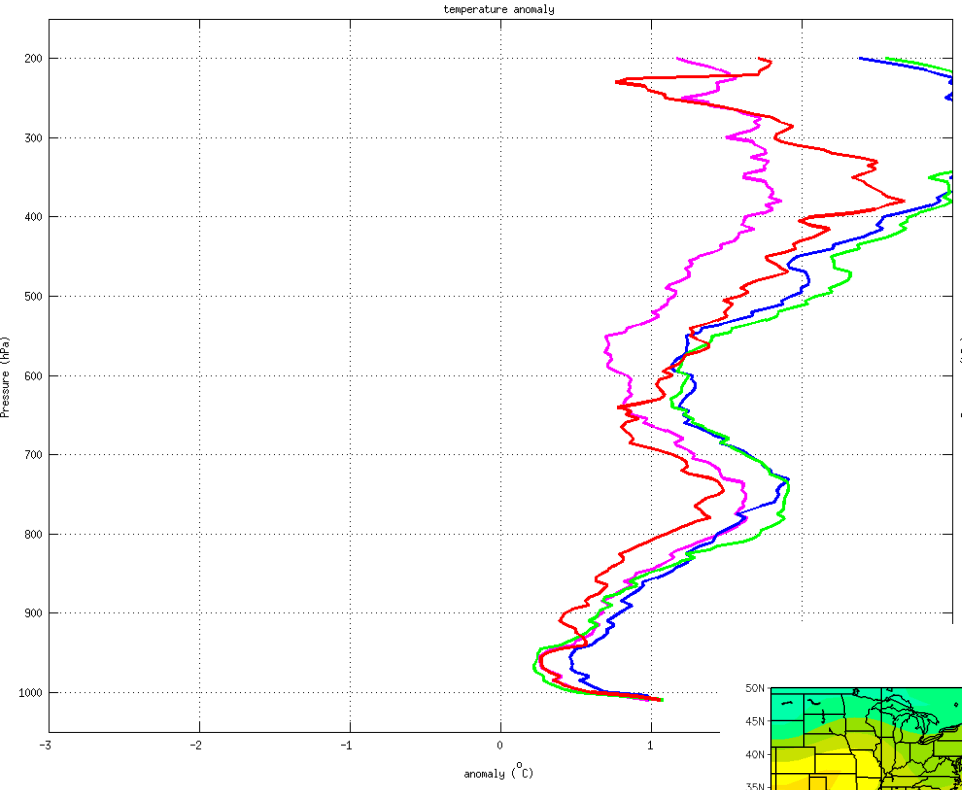


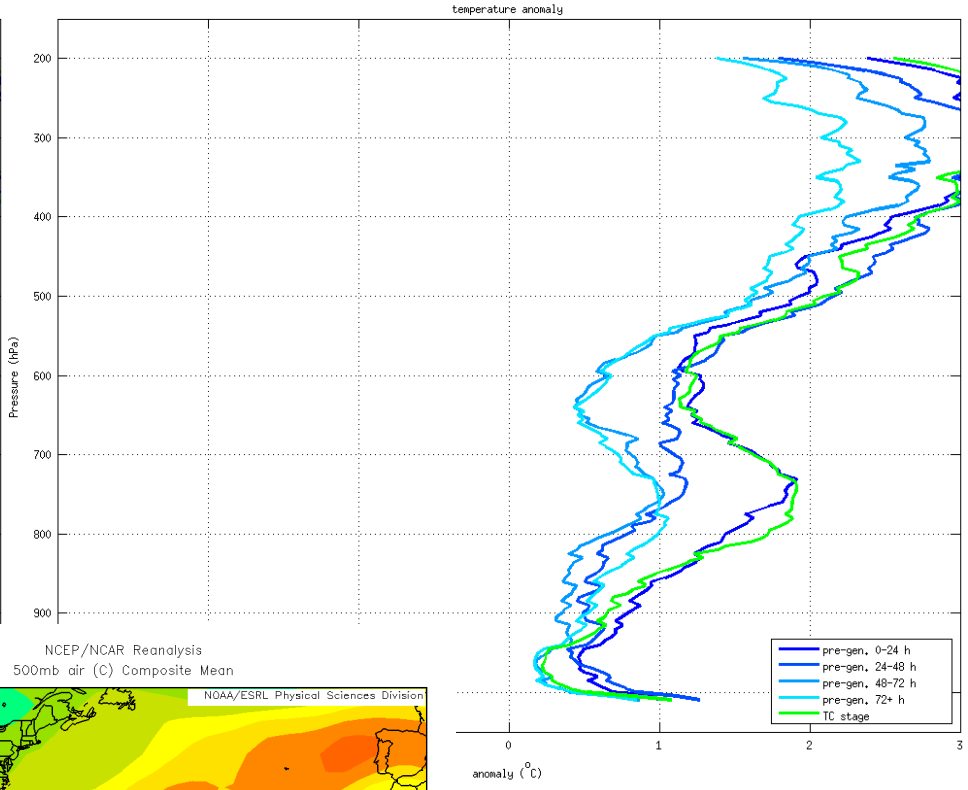
- Not surprisingly, cooler temperatures aloft in the non-developing cases generates greater instability / buoyancy. It appears that high instability and parcel buoyancy are not a necessary condition for tropical cyclogenesis
- Buoyancy anomaly profile for pre-genesis illustrates that warming at all levels as time progresses produces a fluctuating, but not trending, buoyancy profile

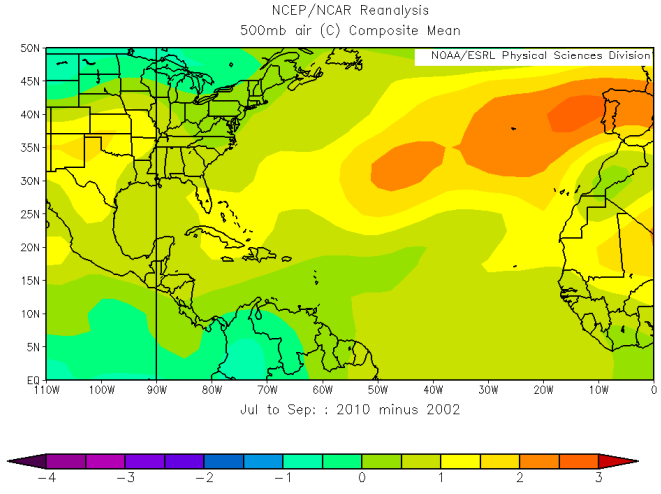
Differences between Predict dropsondes and Dunion and Marron (2008) non-SAL sounding



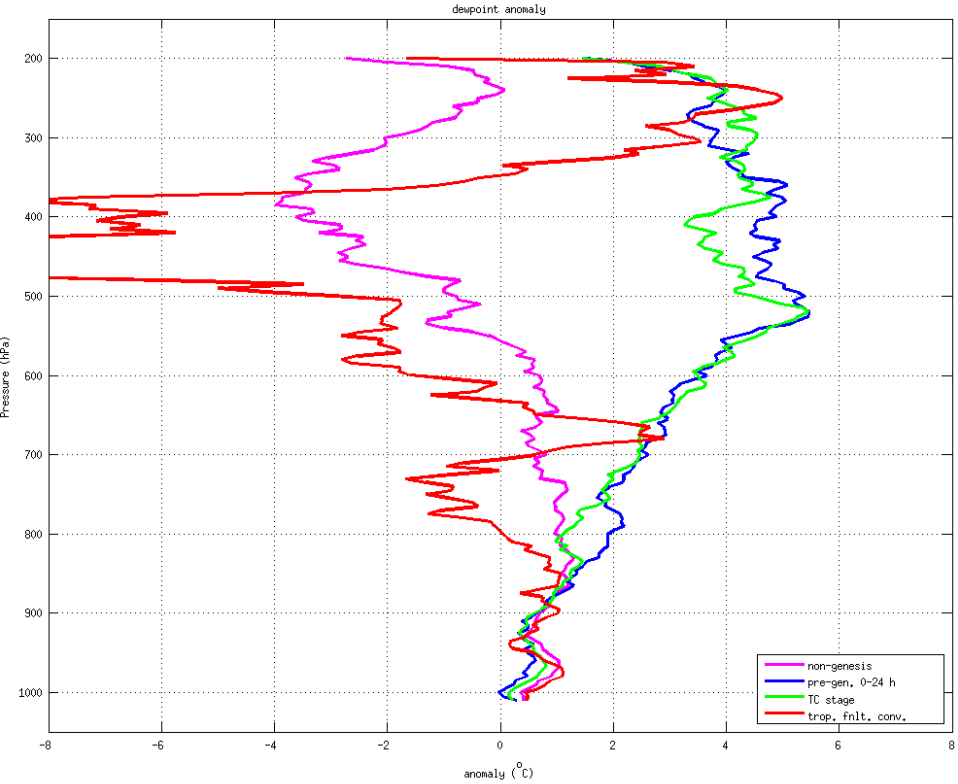
T anomaly

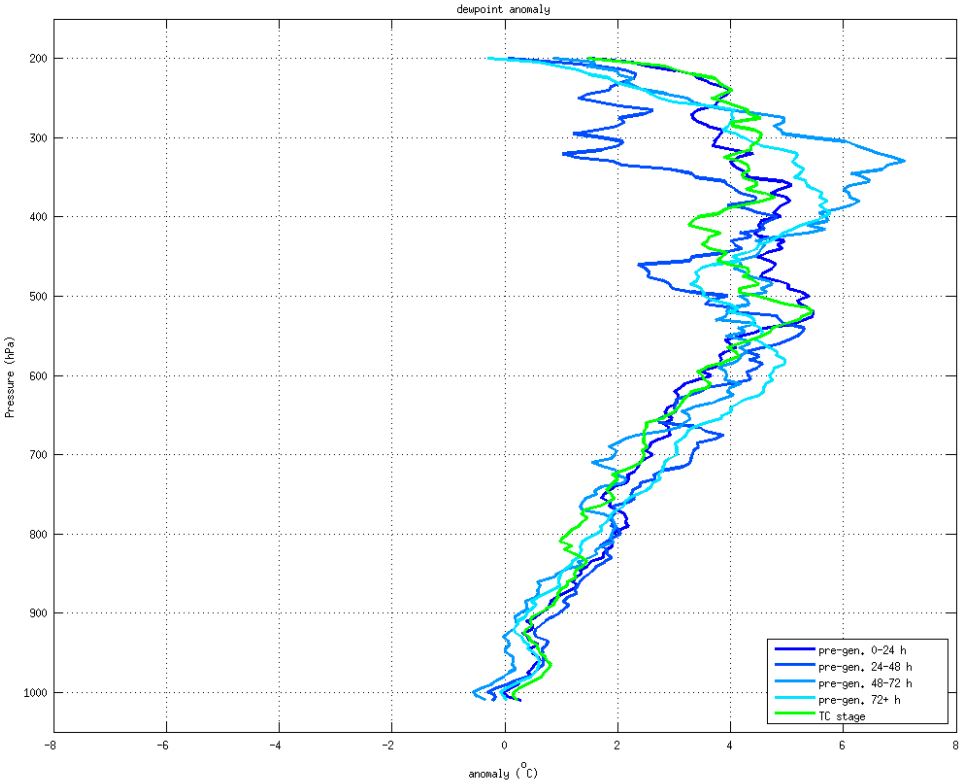

temperature anomaly
Pressure (hPa)
anomaly (°C)


temperature anomaly
Pressure (hPa)
anomaly (°C)
pre-gen. 0-24 h
pre-gen. 24-48 h
pre-gen. 48-72 h
pre-gen. 72+ h
TC stage

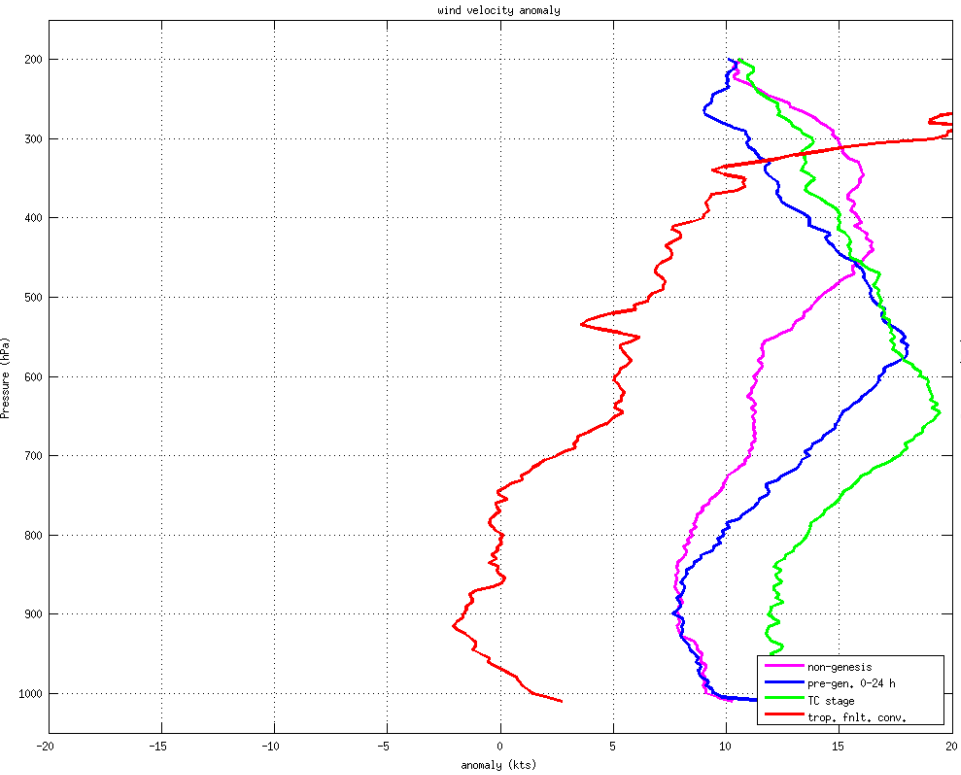

NCEP/NCAR Reanalysis
500mb air (C) Composite Mean
NOAA/ESRL Physical Sciences Division
Jul to Sep: : 2010 minus 2002

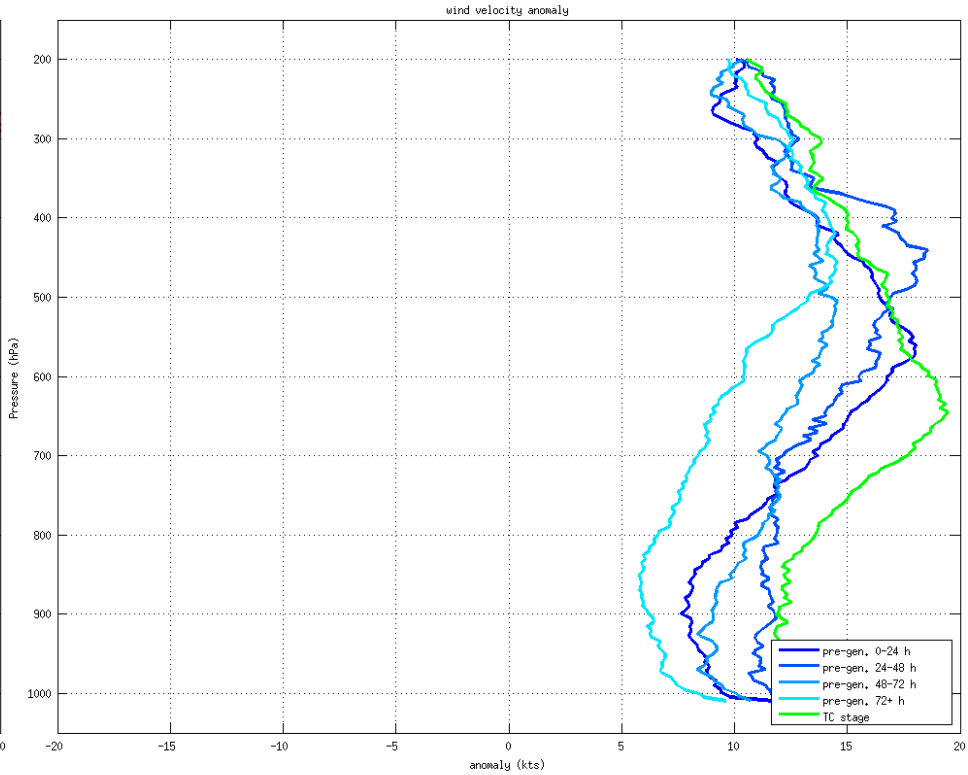
Td anomaly


dewpoint anomaly
Pressure (hPa)
anomaly (°C)
non-genesis
pre-gen. 0-24 h
TC stage
trop. fnlt. conv.

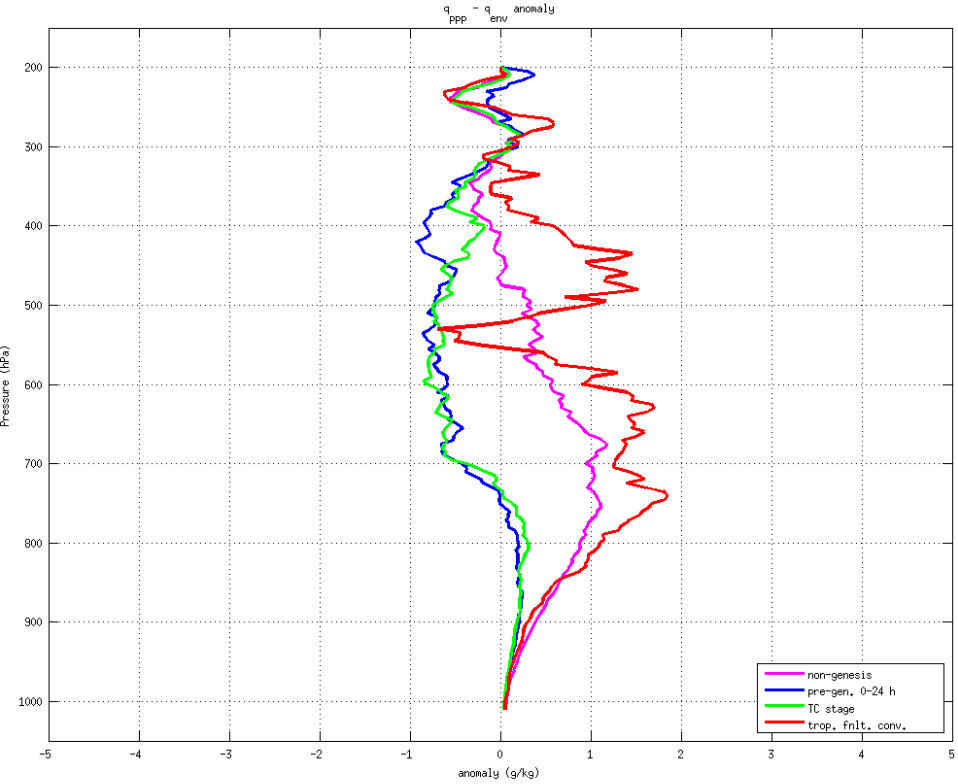

dewpoint anomaly
Pressure (hPa)
anomaly (°C)
pre-gen. 0-24 h
pre-gen. 24-48 h
pre-gen. 48-72 h
pre-gen. 72+ h
TC stage

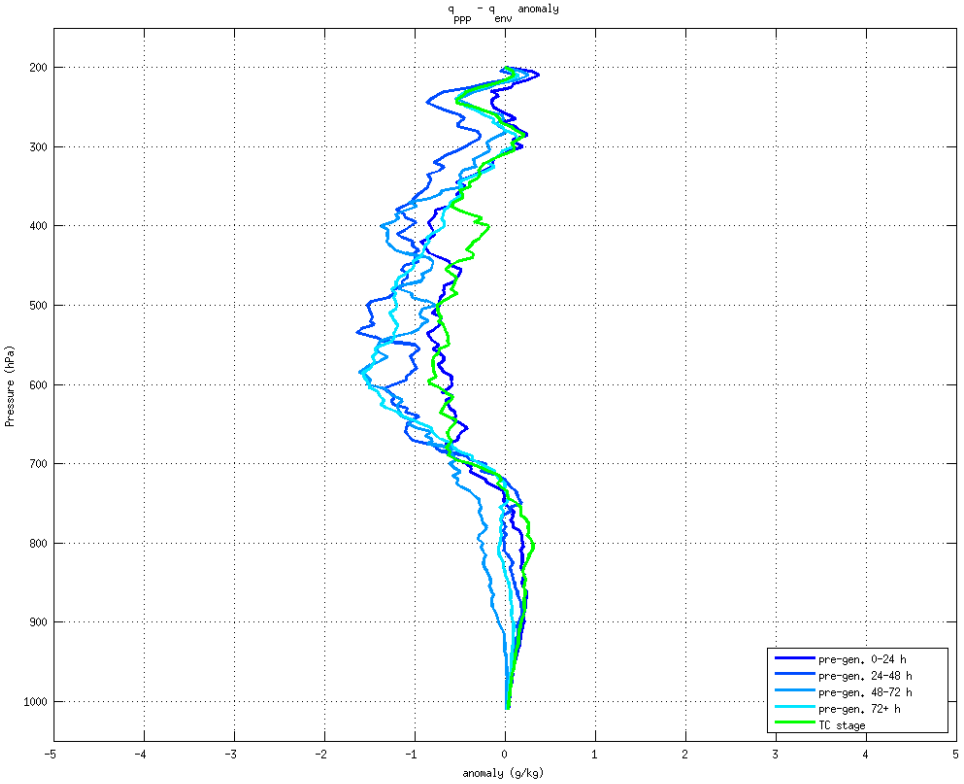
Wind Velocity anomaly





$q_{ppp} - q_{env}$ anomaly





bouyancy anomaly