Cloud Organization associated with frontal convection in Midlatitude Cyclones

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MAP Climatology of Midlatitude Storminess (MCMS) Project

Goal of this project

Provide a detailed 40 year climatology of the areas that come under cyclone influence at a given point in time

Most popular method

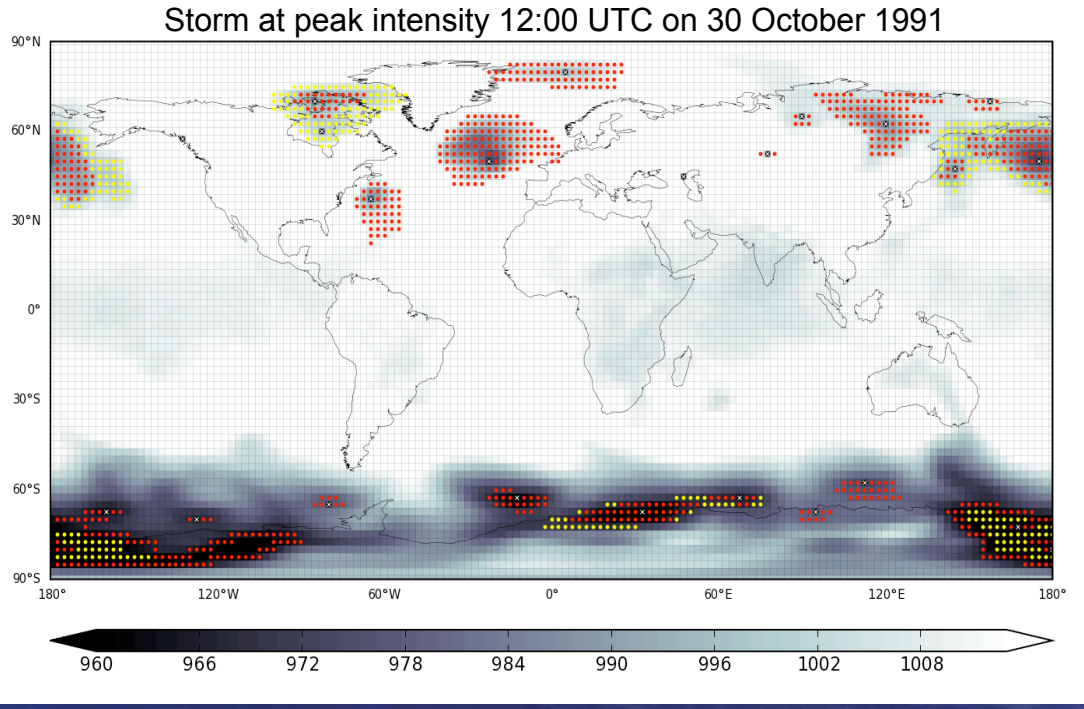
- Locating cyclones as depressions in the SLP field
- Find cyclones in space and time
- Demarcate the area of influence around them

- Bauer and Del Genio, *Journal of Climate*, 2006
- http://gcss-dime.giss.nasa.gov/mcms/mcms.html

Database

- NCEP/NCAR Reanalysis
- Midlatitude Cyclones

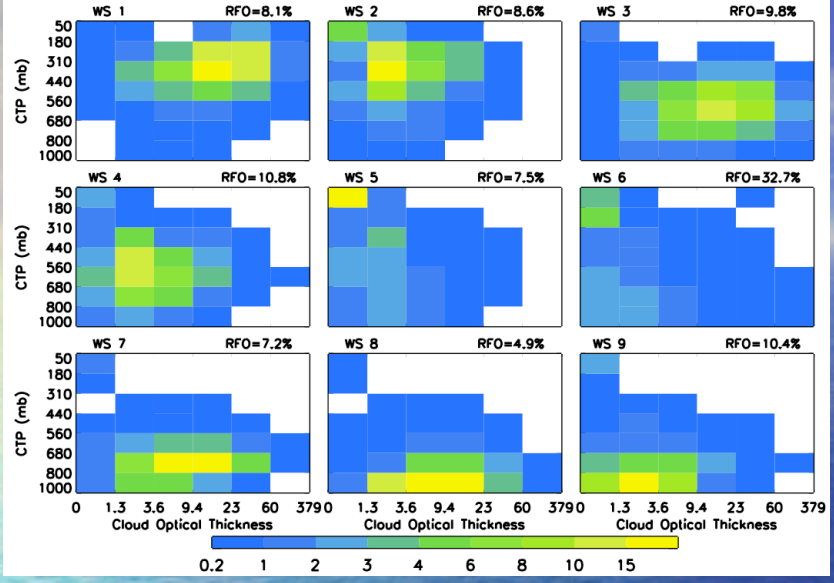
Triad of cyclones off the North American eastern seaboard from the NCEP/NCAR Reanalysis



- Attributed grids: closed SLP contours around a center that contain just that center
- Stormy grids: closed SLP contours that enclose multiple centers

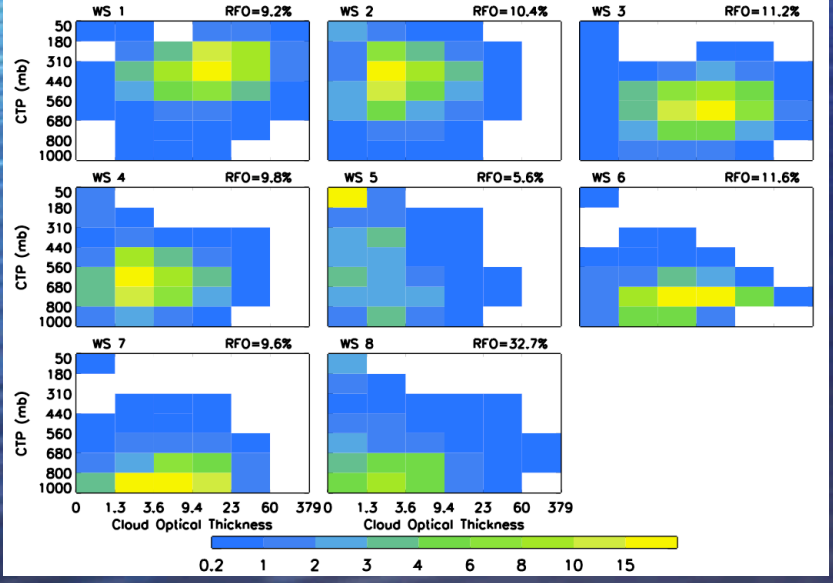
ISCCP Cluster Analysis

Northern Midlatitudes (30N - 65N)



Deep Cumulus Convective regime	Anvil Clouds Convective regime	Mid-level Clouds Convective regime
Mid-level Clouds Convective regime	Cirrus Clouds Cirrus regime	Cirrus Clouds Cirrus regime
Shallow Cumulus Suppressed regime	Stratocumulus Suppressed regime	Stratocumulus Suppressed regime

Southern Midlatitudes (30S - 65S)



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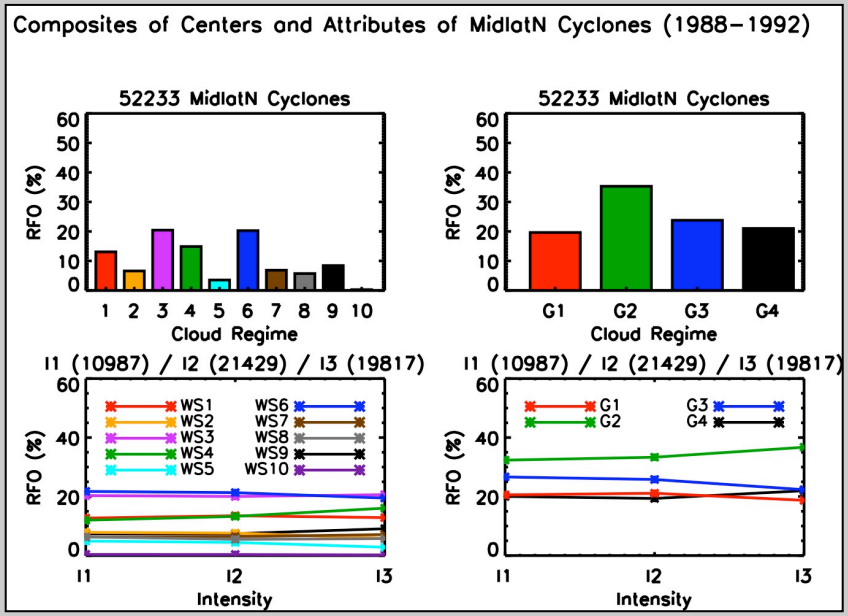
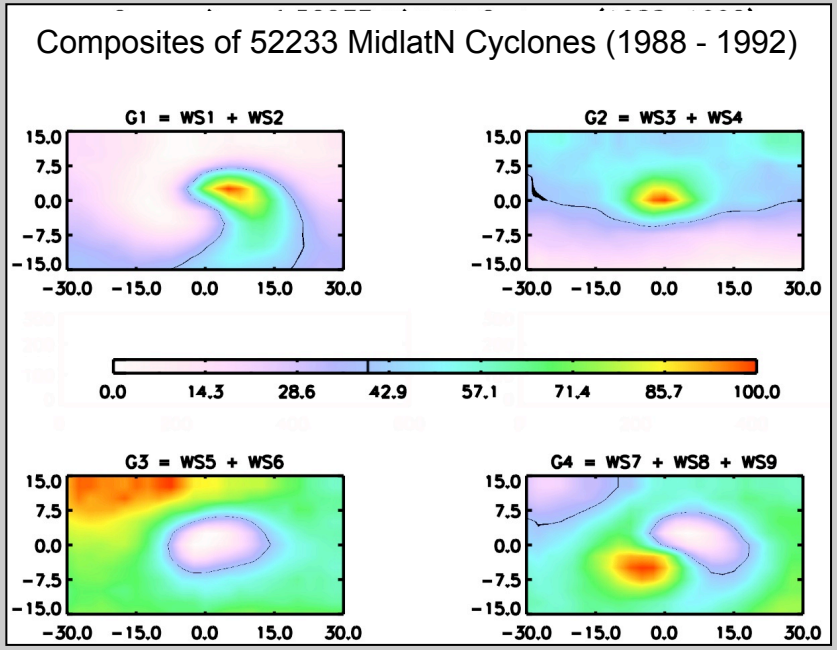
Outline

1. Northern and Southern Midlatitude Cyclones
2. Seasonal variations of cloud organization
3. Land / Water contrast
4. Tests for models

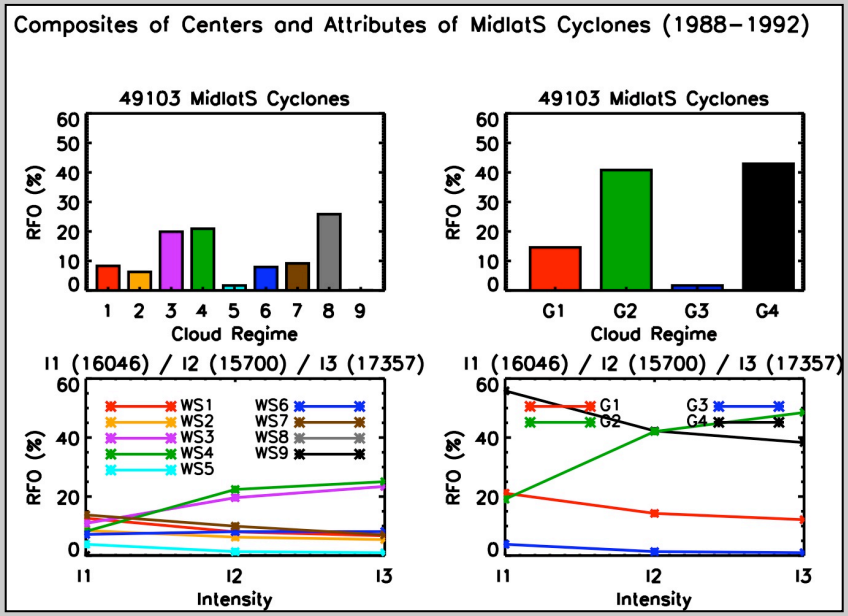
Midlatitude Cyclones (1988-1992)

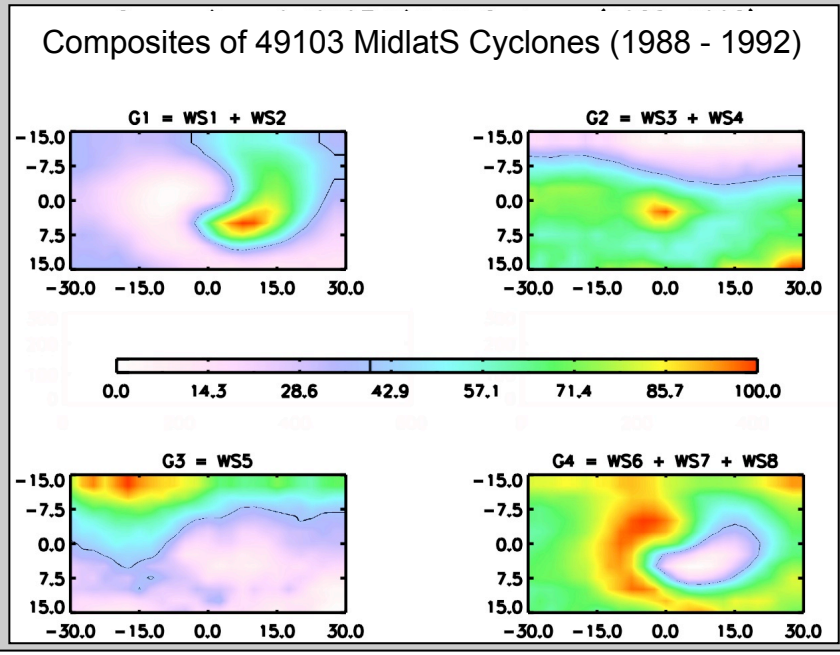
Northern Midlatitudes





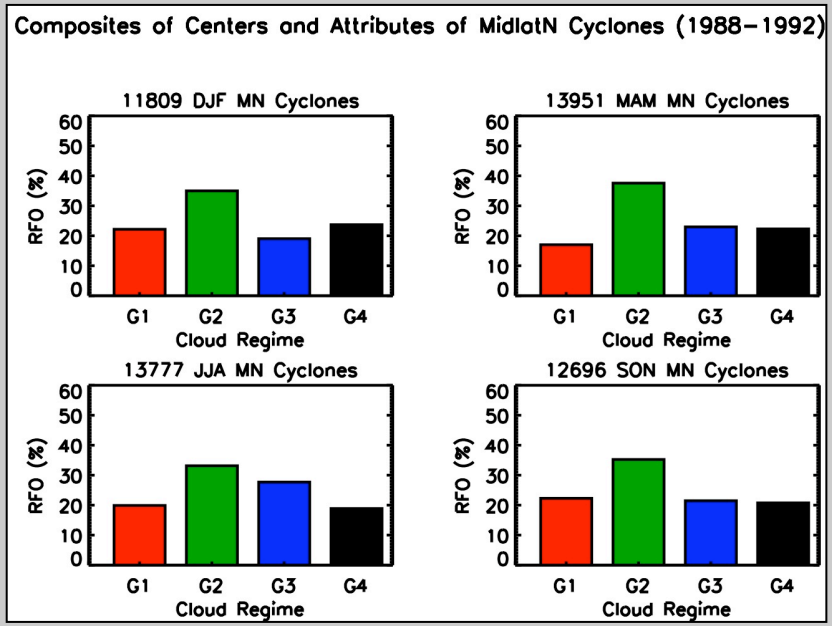
Southern Midlatitudes

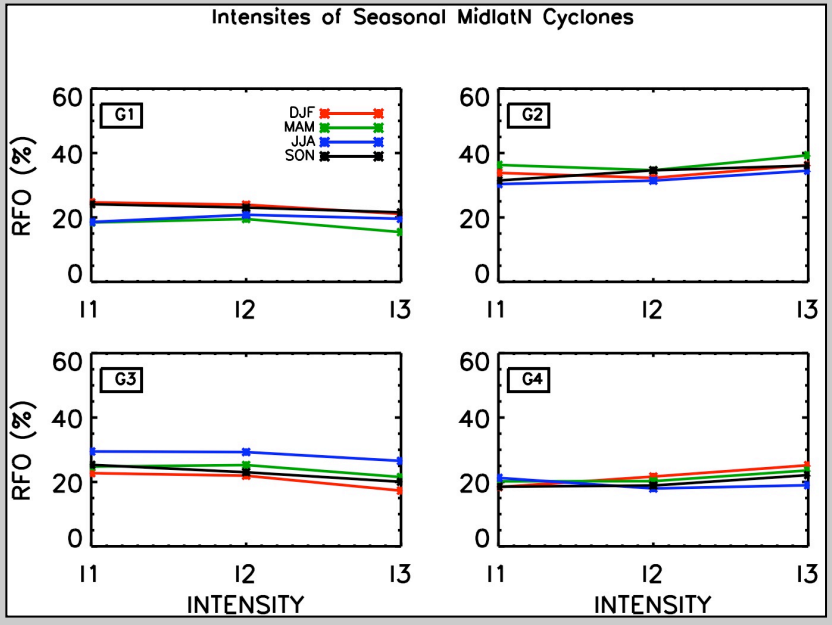




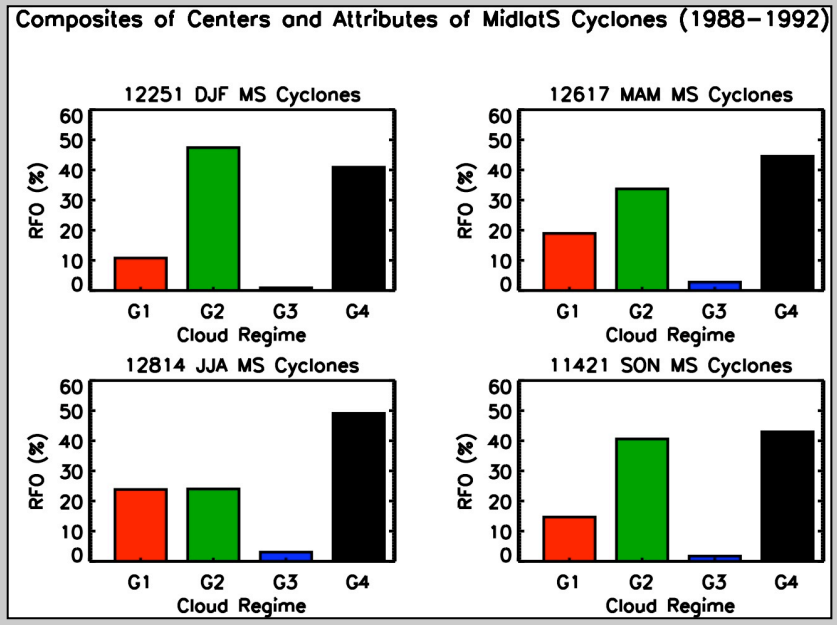
Seasonal Midlatitude Cyclones per WS Groups (1988-1992)

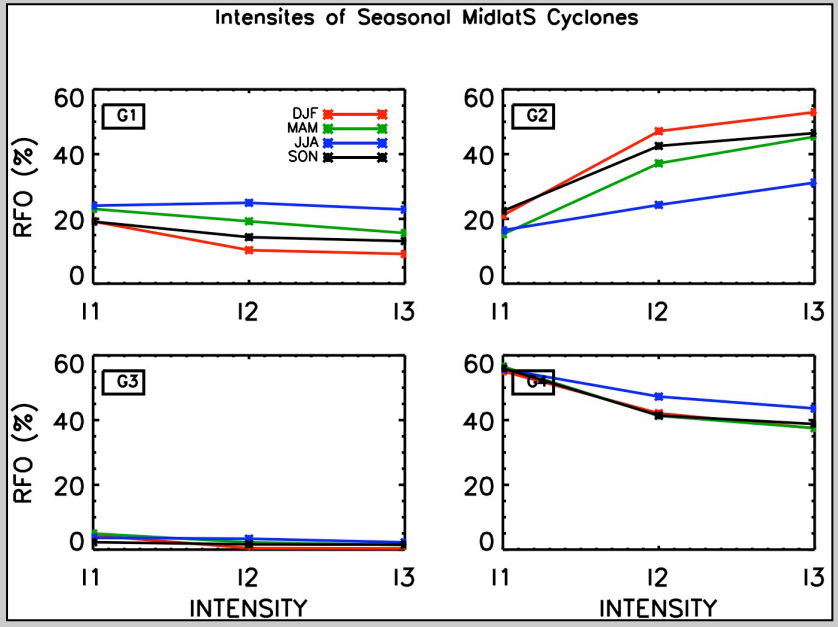
Northern Midlatitudes





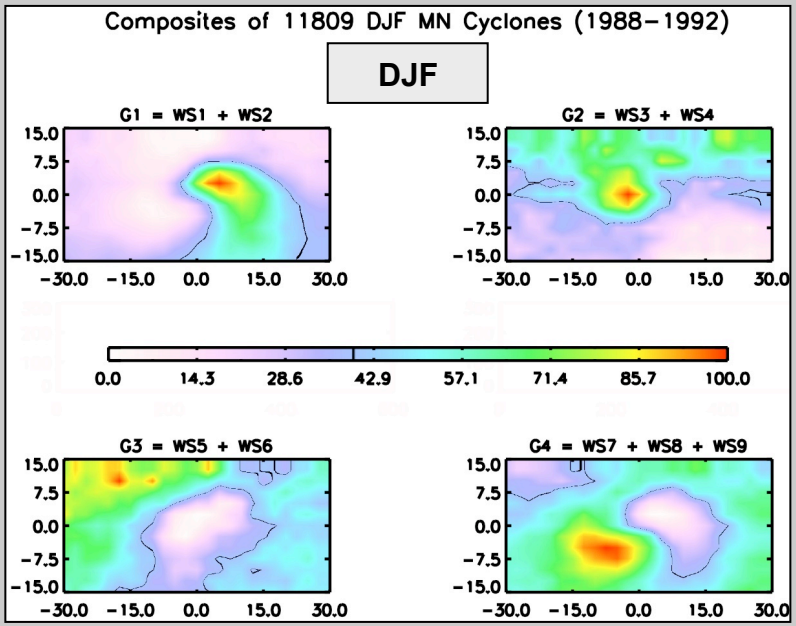
Southern Midlatitudes

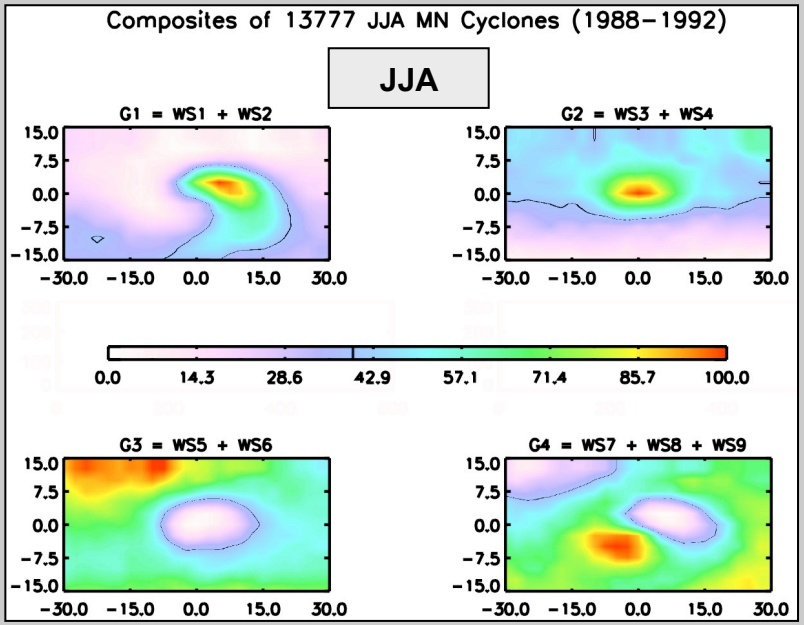




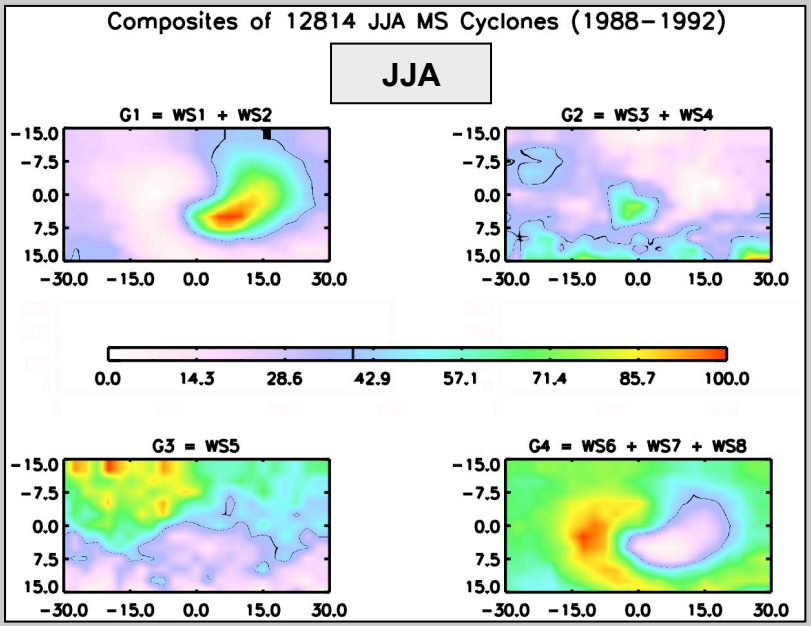
Seasonal Midlatitude Cyclone Composites per WS Groups (1988-1992)

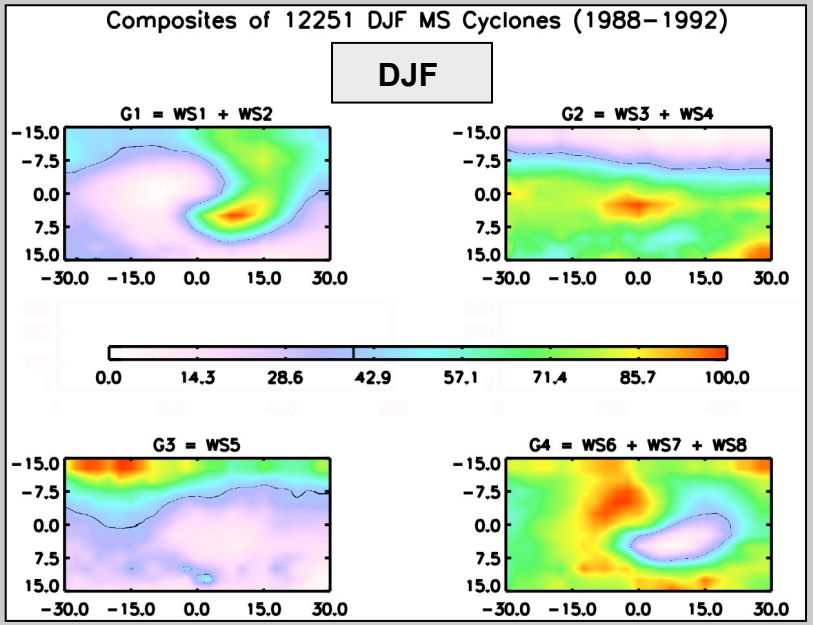
Northern Midlatitudes





Southern Midlatitudes





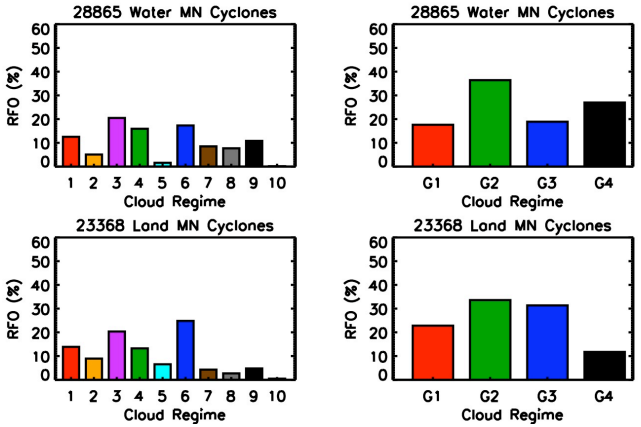
Water and Land Midlatitude Cyclones (1988-1992)

Northern Midlatitudes

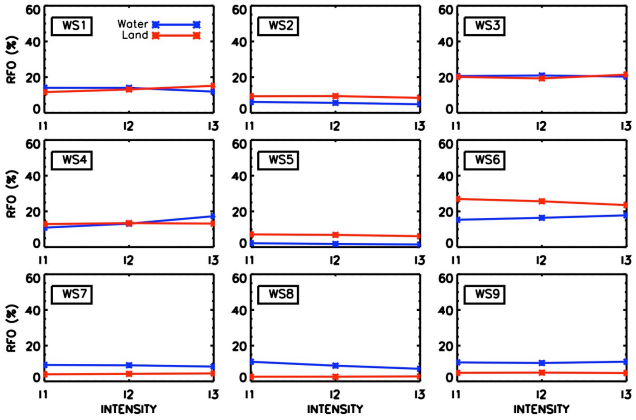
RFO of each WS

RFO of WS Groups

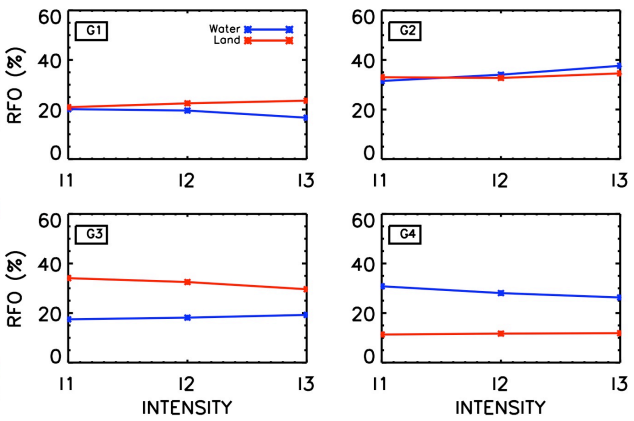
Composites of Centers and Attributes of MidlatN Cyclones (1988–1992)



Intensites of Water and Land MidlatN Cyclones



Intensites of Water and Land MidlatN Cyclones

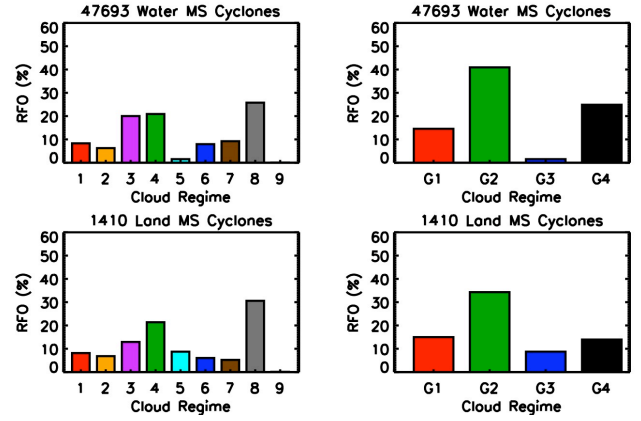


Southern Midlatitudes

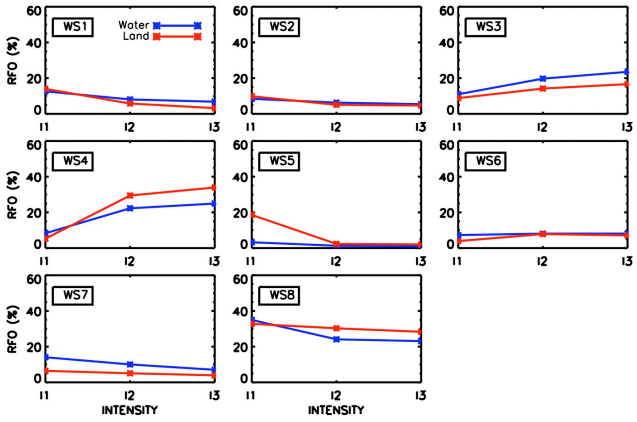
RFO of each WS

RFO of WS Groups

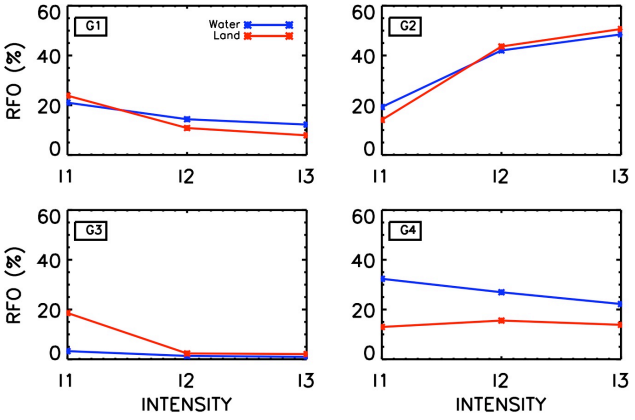
Composites of Centers and Attributes of MidlatS Cyclones (1988–1992)



Intensites of Water and Land MidlatS Cyclones

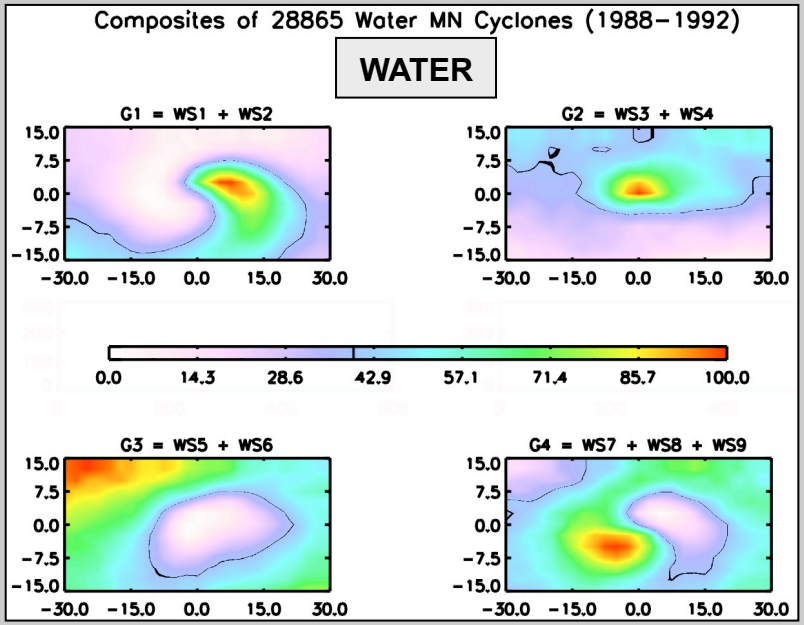


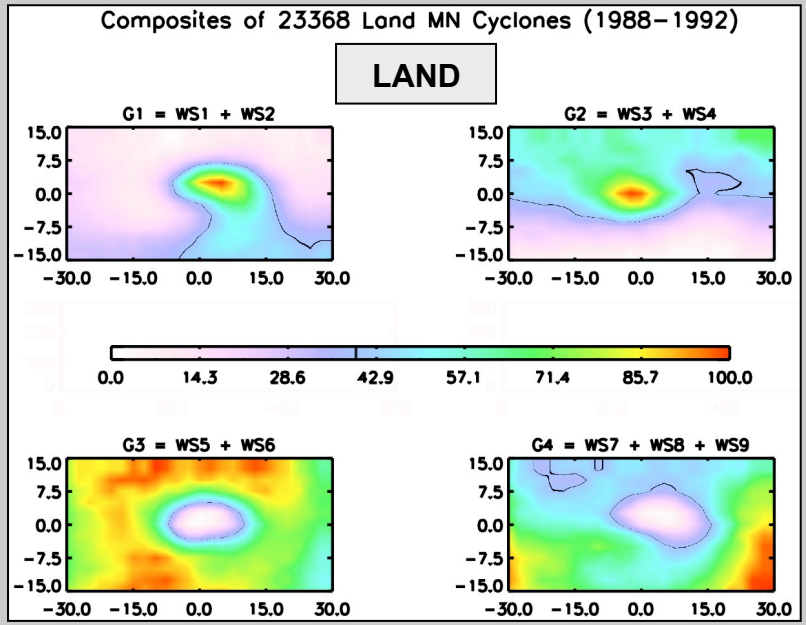
Intensites of Water and Land MidlatS Cyclones



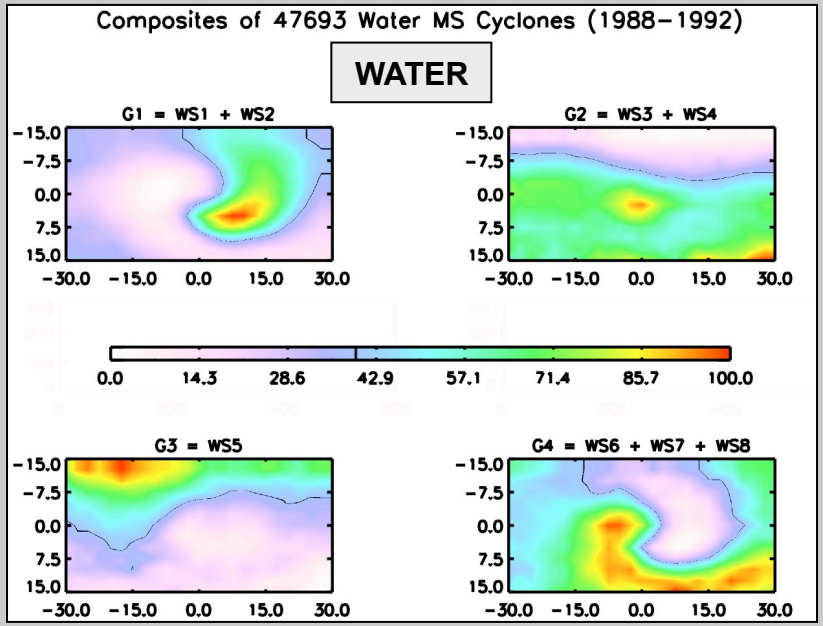
Land / Water Midlatitude Cyclone Composites per WS Groups (1988-1992)

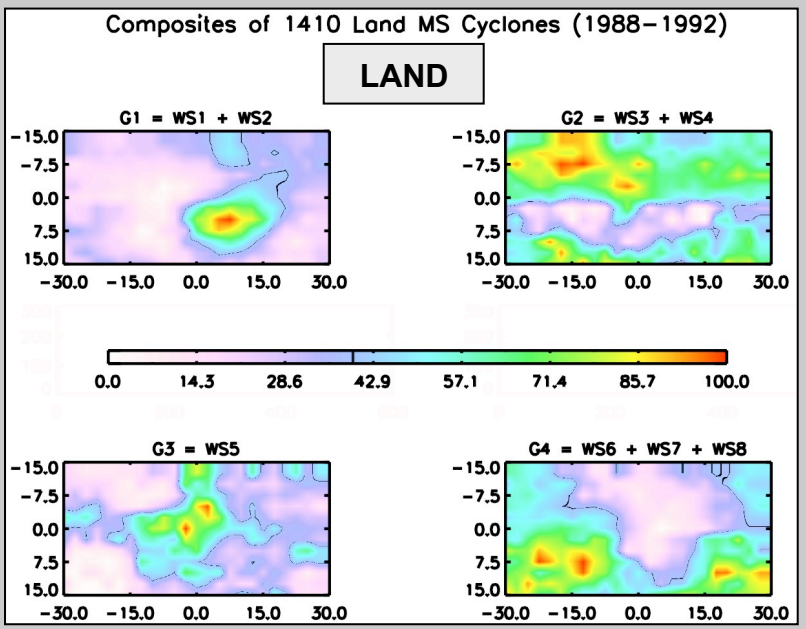
Northern Midlatitudes





Southern Midlatitudes





Tests for Models

Cloud organization in Midlatitude Cyclones

- Clouds are more shallower in the South than in the North
- Almost no Cirrus regime in the Southern Hemisphere
- RFO of Southern Mid-level Clouds increases with Intensity
- Southern Shallow cloud RFO decreases with Intensity
- Shallow clouds more frequent around the cold front in the South
- Seasonal variations: weak Summer / Winter contrast in the North
- Cloud RFO strongly dependent on Intensity of cyclones in the South

Hints for models

- Northern and Southern Midlatitude cyclones behave differently
- A step for models would be to look at the cloud organization

Things to do …

- Sort cyclones by size, location, …
- Construct lifecycle composites of midlatitude cyclones
- Examine how the atmosphere-to-surface and within-atmosphere exchanges of energy change
- Charaterize the structures of the clouds via vertical profiles from CloudSat / Calipso data
- Investigate influence of precipitation phase on cyclone development