Characterizing ocean winds near precipitation events in Mesoscale Convective Systems using ASCAT winds and MSG rain

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(progress report)

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Motivation

NWP resolution too coarse
- to resolve downbursts
- hence, convective storms are modelled less accurately

Project aim

Use collocated ASCAT-A, ASCAT-B and Meteosat MSG rain ...
- characterise ocean winds near precipitation events in Mesoscale Convective Systems
- focus on the Tropical Atlantic
Downburst
Gust Front
New Convection

When the cool air from the downdraft reaches the surface....

... it creates the outflow which pushes forward and provides lift for clouds to form (along the black line.)
Mesoscale Convective Systems

Africa (Classical)

Atlantic (Messy)

Schumacher and Houze (QJRMS 2006)
METEOSAT
Second Generation

- Data every 15 minutes (VIS and INFRA imager)
- MSG rain rate
  - derived from cloud optical thickness (COT) retrievals
  - does not discriminate between convective and stratiform
  - day time only

Liquid water equivalent of precipitation
COLLOCATIONS

ASCAT A + B
+ MSG Rain

2013–06–07–1200
Lat–time plot taken for mid–box longitude

2013–06–07–1115
Lat–time plot taken for mid–box longitude

2013–06–07–1030
Lat–time plot taken for mid–box longitude
Collocation near African coast

$$DIV = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}$$

50 mins later

DIV > 0
DIV < 0
RR > 1mm/hr
First Diff

Central Diff

Greens Thm

50 km x 50 km

\[ \text{DIV} = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \]
**MSG RR > 40 mm/hr**

**DIV > 0**

**DIV < 0**

|DIV| > $3 \times 10^{-4}$ s$^{-1}$

**divergence**

**convergence**
**COLLOCATIONS**

**DIV > 0**

**DIV < 0**

**RR > 1mm/hr**

ASCAT A + B + MSG Rain

**Scat 2 DIV (cd)**
2013–06–07–1115

**Scat 1 DIV (cd)**
2013–06–07–1115

**Scat 2 DIV (cd)**
2013–06–07–1030

**Scat 1 DIV (cd)**
2013–06–07–1030
Collocation near African coast

50 mins later
Mid-Atlantic Collocation

50 mins later

Rain and DIV patterns are similar, so they should correlate.
Regrid MSG RR to ASCAT WVCs

See the correlation?
Regrid MSG RR to ASCAT WVCs

How about now?

$\log(RR)$

$\log(|DIV|)$

DIV > 0
DIV < 0
Regrid MSG RR to ASCAT WVCs

Apply a strategy used in forecast verification

How well does RR predict DIV?
Set thresholds, partition the space, and count

\[ \log(\text{RR}) \]

\[ \log(|\text{DIV}|) \]

create “contingency tables”
heavy rain fails to predict large DIV

log(|DIV|)

log(RR)

large DIV not due to heavy rain
Heidke Skill Score (HSS)

- Use results from all collocations during month
- MSG RR every 15 minutes so...
  - compile contingency table vs time
- Construct skill score vs time

HSS

Forecast has skill when $$\text{HSS} > 0$$

$$T - T_0$$

$$T_0$$ is time of ASCAT pass
Mid-Atlantic Example

Plot Locations …

Latitude

Longitude

False Alarms

Hits

Misses
Summary

- MSG RR and large DIV are **well-correlated spatially**
- **Contingency Table** offers a useful framework
  (hits, false alarms, misses, correct nulls)
- **False Alarms** (heavy rain, small $|\text{DIV}|$): border the hits
- **Misses** (light or no rain, large $|\text{DIV}|$): need further investigation

- **TO DO:**
  investigate changes in (DIV, VORT, Rain) between the ASCAT-A and B passes.

Comments on the contingency table approach will be appreciated!!