Tracking and monitoring severe convection over the Mediterranean from onset over rapid development to mature phase using multi-channel Meteosat SEVERI data

Arnold Tafferner
Caroline Forster, Hermann Mannstein, Tobias Zinner

4th HyMeX Workshop, Bologna, 8 June 2010
Cb-TRAM  Thunderstorm tracking and monitoring
(Zinner, Mannstein, Tafferner, 2008; Zinner and Betz, 2009)

Three detection phases:
• Initiation of convection
• Rapid development
• Mature state

Use of four Meteosat SEVIRI channels:
• HRV
• IR 10.8µm
• IR 12.0µm
• WV 6.2µm

Pyramidal Matching for correlating Meteosat image pairs
• tracking
• Nowcasting

ECMWF forecast data used for cloud top height calculation
Cb-TRAM  Thunderstorm tracking and monitoring

- detected cloud cell
- extrapolated/first guess cell
- analysed track

Detection & Tracking  Nowcasting  Monitoring
1. **Initiation**: Detection of beginning convection

Criterion:
Development in HRV field with accompanying cooling in the IR 10.8 field

Areas of
- cloud growth - bright
- cloud dissolution - dark
2. Rapid development

Criterion:
cooling $> 1.5\text{K}/15\ \text{min}$
in WV field

Rapid cooling
3. Mature phase

Criteria:

$T(6.2\mu m) - T(10.8\mu m) > 0$

Cloud tops are suspected to reach or overshoot the tropospheric background which is a clear sign of strong convective activity

HRV texture:
Local standard deviation of HRV reflectivity as threshold for convective cells

$T_{10.8} - T_{12.0} > 0$
Thin ice clouds are filtered
Nowcasting detected cells

\[ W_t \]

\[ W_t + dt \]

displacement vectors
29 May 2010

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast
(thin red lines)

++ lightning obs
LINET (nowcast GmbH)
29 May 2010

Cb-TRAM contours:
- initiation
- rapid growth
- mature

60 min nowcast (thin red lines)

++ lightning obs
LINET (nowcast GmbH)
29 May 2010

Cb-TRAM contours:
- initiation
- rapid growth
- mature
- 60 min nowcast (thin red lines)

++ lightning obs
LINET (nowcast GmbH)
29 May 2010

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast (thin red lines)

++ lightning obs
LINET (nowcast GmbH)
29 May 2010

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast
(thin red lines)

++ lightning obs
LINET (nowcast GmbH)
29 May 2010

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast (thin red lines)

++ lightning obs
LINET (nowcast GmbH)
29 May 2010

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast
(thin red lines)

++ lightning obs
LINET (nowcast GmbH)
Lee cyclone
19 May 2010

Cb-TRAM contours:
- initiation
- rapid growth
- mature
- 60 min nowcast (thin red lines)

++ lightning obs
LINET (nowcast GmbH)
Mallorca storm
4 October 2007

Aqua Modis 1300 UTC
Mallorca storm
4 October 2007

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast
(thin red lines)
Mallorca storm 4 October 2007

Rapid Developing Thunderstorms: 4th October 2007: 1400 UTC

RDT (Meteo France)
- developing
- mature
- dissipating

Cb-TRAM
- initiation
- rapid growth
- mature
60 min nowcast for Mallorca
Mallorca storm
4 October 2007

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast
(thin red lines)
Mallorca storm
4 October 2007

Cb-TRAM contours:
initiation
rapid growth
mature
60 min nowcast
(thin red lines)
Summary

- Results suggest that Cb-TRAM is capable of detecting, tracking and nowcasting severe convective clouds over the Mediterranean.
- It runs in real time, also with Meteosat rapid scan data (5 min refresh).
- It is able to distinguish active cores in thunderstorm complexes.
- For the Mallorca storm, the devastating cell was tracked for 14 hours.
- It runs also with synthetic Meteosat data from numerical forecasts --> useful for choosing best forecast out of an ensemble (in real time).
- Could provide a valuable tool for heavy precipitation studies in HyMeX.

References:


Zinner, Mannstein, Tafferner, 2008:
Tracking and monitoring of severe convection (Cb) from onset over rapid development to mature phase using multi-channel Meteosat-8 SEVIRI data.