



UWERN SMA Presentation

Theme 1: Mesoscale Weather Systems

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- Leading role taken by Theme 1 PIs and PDRAs
- Developed with community consultation
 - *December 2000/April 2001/February 2004*
- Community support for UM
- Priority science issues identified
 - *New UWERN Themes for QPF, assimilation*
 - *Parameterisations/mesoscale aspects of extratropical storms*

Strategy for PDRA Work



- Overall aim:
 - *To test and enhance theoretical interpretations of mid-latitude storm development.*
- In particular, to focus on:
 - *Extreme events and forecasting of them.*
 - *Mesoscale structures within cyclones.*
 - *Role of “physics” processes in development.*
- Extensive use of Unified Model (UM).
- Research has spun-off new code for UM available for community use.

A Selected Highlight

- Classification of a **new type** of cyclone development...
 - ...with distinctive dynamics,
 - in which diabatic heating is crucial.
 - The type is fairly common
 - and potentially explosive.

Studied by funded PDRAs, UWERN PIs and others:
Plant (PDRA), Gray (PDRA/PI), Craig (PI), Browning
(PI), Hewson (MO), Deveson, Ahmadi-Givi (both PhD).

The A/ B Classification



- Petterssen and Smebye scheme...
 - Simple, qualitative description.
 - Labels which theoretical view of cyclogenesis is most applicable.

The Two Types

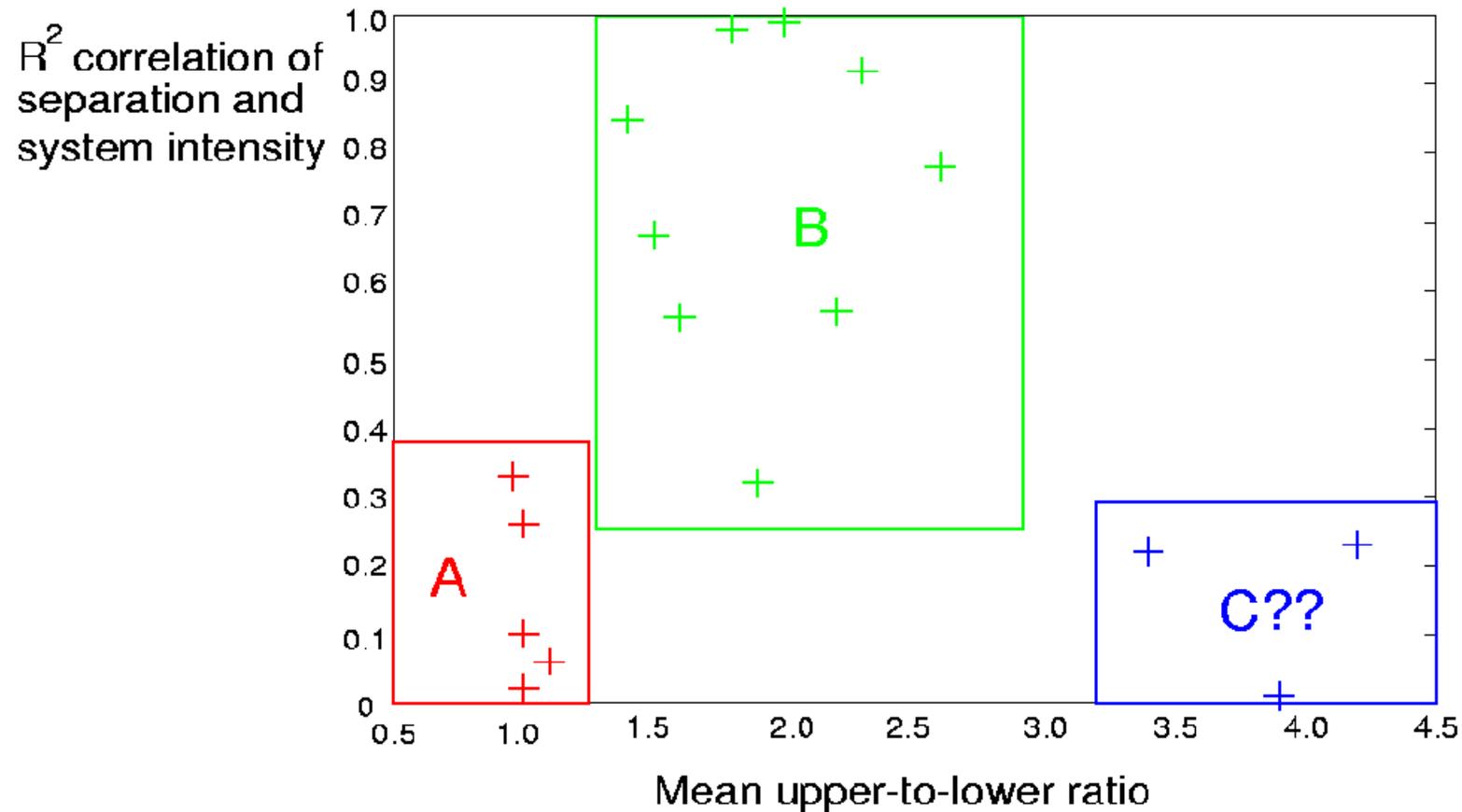
- Type A:
 - Strong thermal advection at low levels, with an upper level response.
 - Somewhat like a baroclinic wave.
- Type B:
 - Upper level feature provokes a reaction in a baroclinic region below.
 - "Non-modal" growth.

A/B Determination

- Objective identification (Deveson, Browning and Hewson 2000)...
- Determine adiabatic forcings from upper (U) and lower (L) levels.
- **For A:** $U \sim L$. Constant phase shift.
- **For B:** $U > L$. Decrease in shift with intensification.

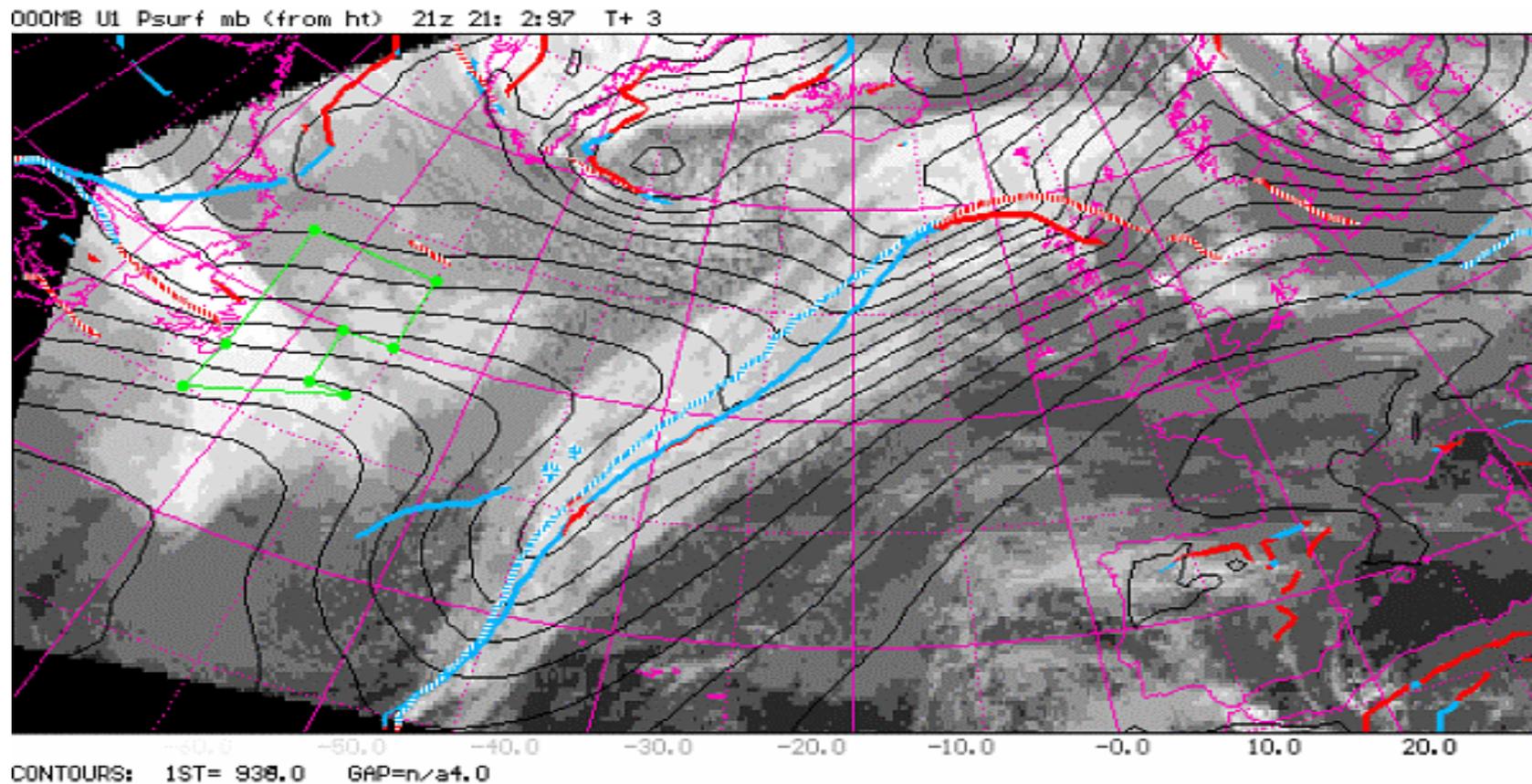
Some Exceptions!

- Analysis of FASTEX cyclones:



FASTEX IOP4/ 18

- Are Type C events driven by a different dynamical mechanism? (Ahmadi-Givi, Craig and Plant 2003; Plant, Craig and Gray 2004).



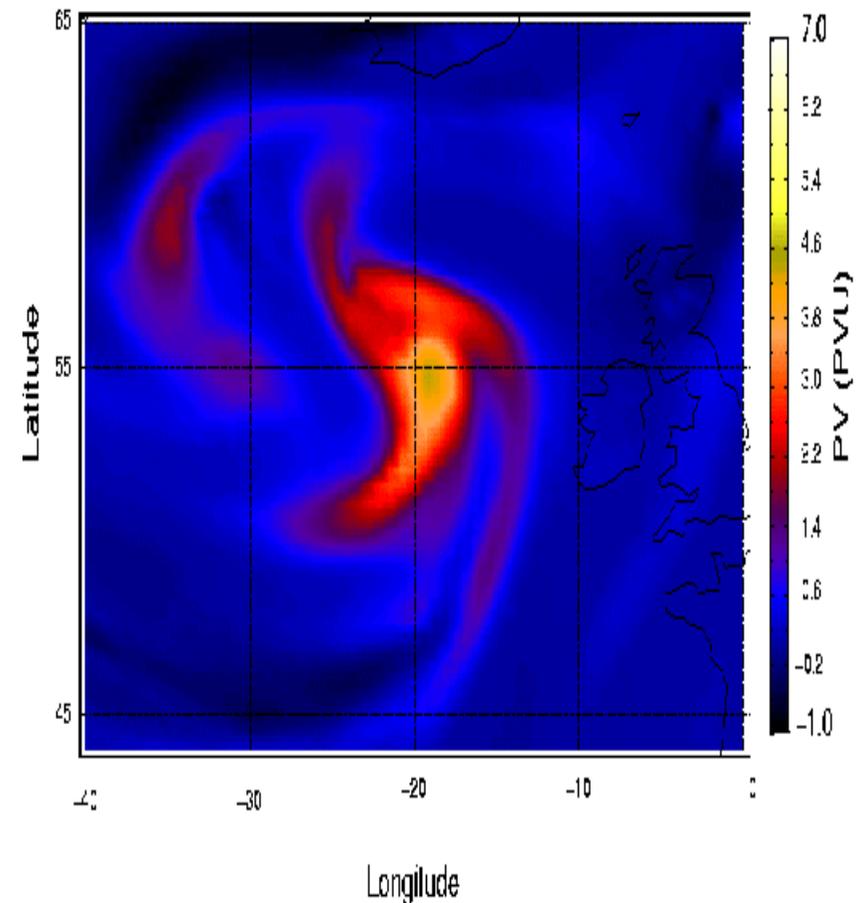
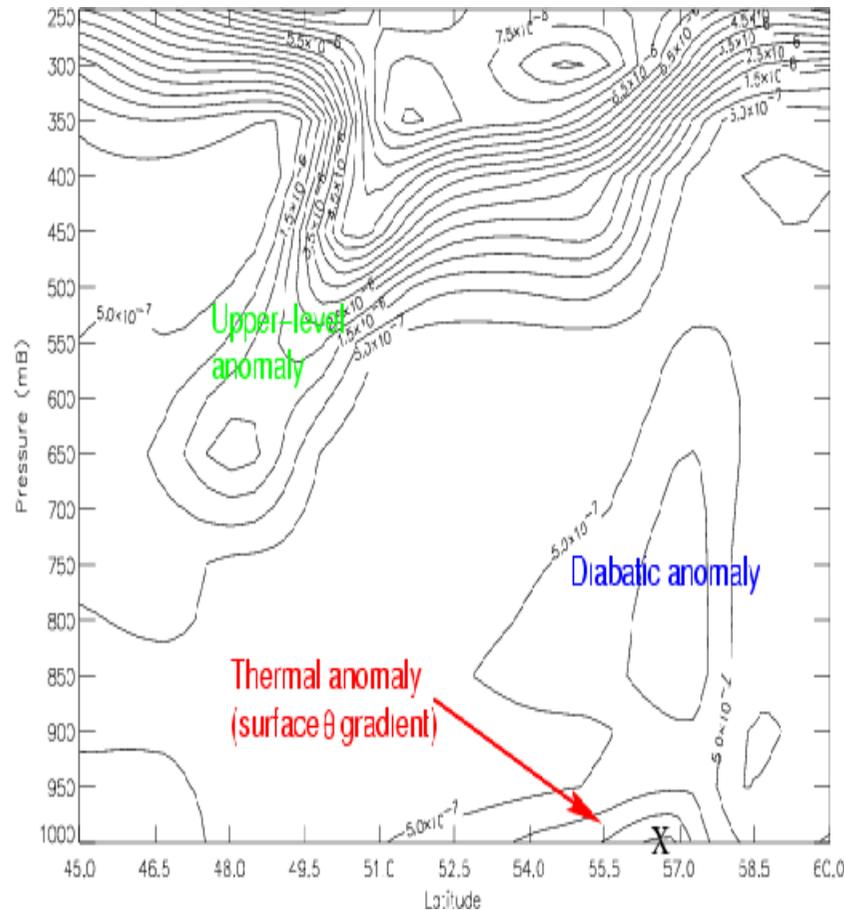
Potential Vorticity

$$PV = \frac{1}{\rho} \zeta \cdot \nabla \theta$$

- PV combines vorticity and temperature gradients.
- Conserved in a Lagrangian sense by adiabatic, inviscid dynamics.
- For region of anomalous PV, can derive associated circulation and thermal structure.

Identifying PV Features

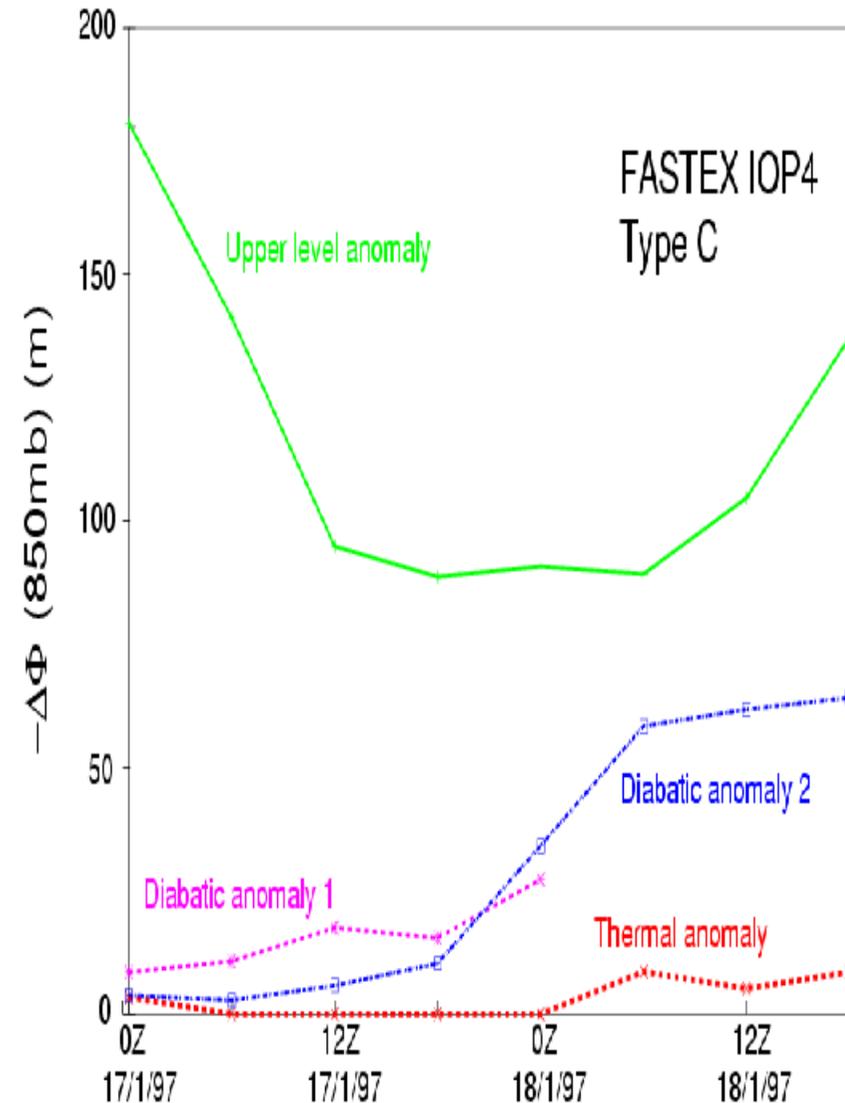
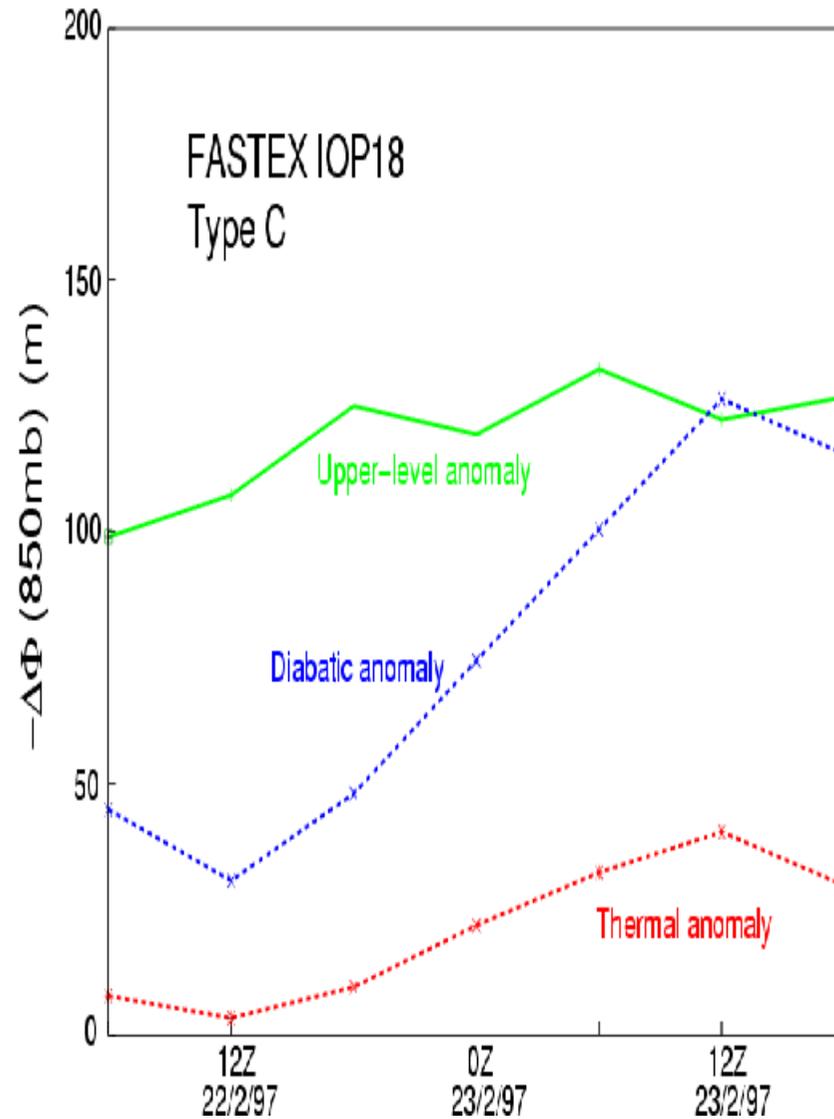
Sections through FASTEX IOP18:



EW section, 12Z on 23rd.

PV from convection, at 900mb.

Inversions of Type C

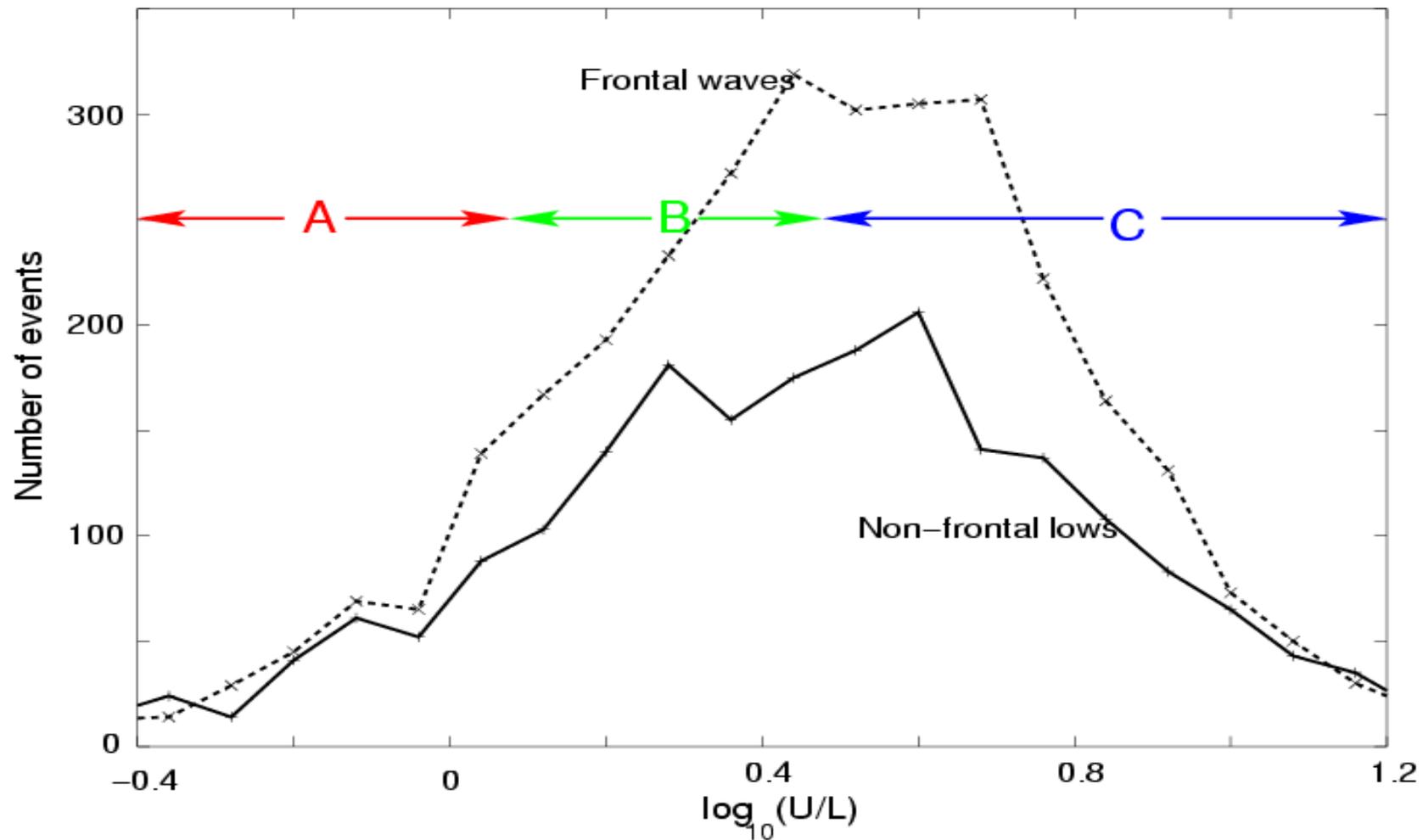


Type C Dynamics

- Initial stages dominated by upper-level precursor, as in type B.
- Little co-operative interaction with very weak thermal anomaly.
- Strong latent heat release crucial to intensification.
- Strong latent-heat release weakens the upper-level feature.

Prevalence of Type C

From analysis of a cyclone database:



Update on Type C

- Research continues by other investigators....
- Tracking analysis (Dacre and Gray) reveals that...
 - ~ 1/3 of all cyclone features are type C
 - ~ 1/6 of well-developed cyclones are type C
- Many polar lows can be categorized as type C (Bracegirdle and Gray)

although many C events are not polar lows

Theme 1 Achievements



- Convection can drive cyclogenesis
- Slantwise convection a **major contributor** to some intense storms
(Gray and Thorpe)
- Interactions of boundary-layer and baroclinic dynamics:
Ekman pumping is **not** the main effect of friction of cyclones
(Plant and Belcher)

...continued

- **Valuable new diagnostics** for
 - PV generation and redistribution
(Plant)
 - SCAPE
(Gray)
- **New parameterization scheme** for convection
 - Stochastic approach: recognizes statistical fluctuations
 - Inspired by results from Theme 2
(Plant, Craig and Cohen)

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